1968

OLDSMOBILE

Vista Cruiser

Cutlass

Delmont

Delta

Ninety Eight

Toronado

CHASSIS SERVICE MANUAL

1968 OLDSMOBILE

CHASSIS SERVICE MANUAL

FOREWORD

This Manual provides information on chassis service procedures, adjustments and specifications for 1968 Oldsmobiles. An understanding of the material contained herein and in monthly issues of the Oldsmobile Service Guild and Dealer Technical Information Bulletins, issued when necessary, will assist service personnel in properly maintaining the quality to which Oldsmobile cars are built.

A separate Manual, the 1968 Body Service Manual, contains body service information on all series and models used in 1968.

PRICE: FIVE DOLLARS

SERVICE DEPARTMENT
OLDSMOBILE DIVISION
GENERAL MOTORS CORPORATION
LANSING, MICHIGAN

© 1967 General Motors Corp.

Litho in U.S.A.

F85 Through 98 (3100—8600 SERIES)

SECTION	SUBJECT	PAGE
0	GENERAL INFORMATION PERIODIC MAINTENANCE	0-1
1	HEATER AND AIR CONDITIONER	1-1
2	FRAME AND BODY MOUNTINGS	2-1
3	FRONT SUSPENSION	3-1
4	REAR SUSPENSION, PROPELLER SHAFT AND DIFFERENTIAL	4-1
5	BRAKES	5-1
6	ENGINE	6-1
7	TRANSMISSION AND CLUTCH	7-1
8	FUEL TANK AND EXHAUST	8-1
9	STEERING	9-1
10	WHEELS AND TIRES	10-1
11	CHASSIS SHEET METAL	11-1
12	CHASSIS ELECTRICAL, INSTRUMENT PANEL AND WIPERS	12-1
13	RADIATOR AND GRILLE	13-1
14	BUMPERS	14-1
15	ACCESSORIES	15-1
	ALPHABETICAL INDEX YELLOW PAGES	
	TORONADO	1E-1

1968 OLDSMOBILE CUTLASS "S" COUPE

GENERAL INFORMATION & PERIODIC MAINTENANCE

ALL SERIES

CONTENTS OF SECTION 0

Subject	Page
GENERAL INFORMATION	
1968 MODEL IDENTIFICATION	0-1
BODY AND STYLE NUMBERS	0-1
1968 MODEL DESIGNATION CHART	0-2
VEHICLE IDENTIFICATION NUMBER PLATE	0-3
ENGINE UNIT NUMBER	0-3
ENGINE IDENTIFICATION CHART	0-4
MANUAL TRANSMISSION	0-5
JETAWAY TRANSMISSION	0-5
TURBO HYDRA-MATIC TRANSMISSION	0-5
DIFFERENTIAL RATIOS	0-6
FINAL DRIVE ASSEMBLY	0-6
GENERAL INFORMATION (Cont'd.)	
TIRE INFORMATION	0-7
TIRE ROTATION	0-7
GENERAL SPECIFICATIONS	0-8
TOWING DATA	0-8
SERVICE BRAKES	0-8
BATTERY	0-9
PAINT CHART	0-9
FACTORY OPTIONAL EQUIPMENT	0-10
GUARDIAN MAINTENANCE CHART	0-11
PERIODIC MAINTENACE CHART	0-12

1968 MODEL IDENTIFICATION

A five digit number, called the car series and body style designation number, identifies any car as to series and style. Reading from left to right, the digits represent the following:

The first digit indicates the General Motors Division.

The second and third digits are Fisher Body Shell Designation. The third digit also is used to designate the L-6 or V-8 engine (odd numbers indicate L-6 and even, V-8 engine).

The fourth and fifth digits are body style designation.

EXAMPLE: 3 3 1 77

- 77 — Club Coupe
- 31 — Standard F-85 Series With L-6 Engine
- 3 — GM Division (Oldsmobile)

BODY AND STYLE NUMBERS

The body and style numbers are stamped on a plate that is mounted on the left upper cowl. (Fig. 0-1)

Information on this plate shows:

1. Style Number
2. Body Number
3. Trim Number
4. Paint Number (Color Specification)
5. Accessories
6. Time Built Code

All Fisher Body numbers are prefixed by a letter or letters indicating the plant at which the body was assembled.

F-85 bodies are coded as follows:

LAN - Lansing	BF - Fremont
FRA - Framingham	OS - Oshawa (Ontario, Can.)

All 88 and 98 series are coded as follows:

LAN - Lansing	BL - Linden
BA - Doraville	BC - South Gate
BK - Kansas City	ATL - Atlanta

All 98 series will be assembled at Lansing.

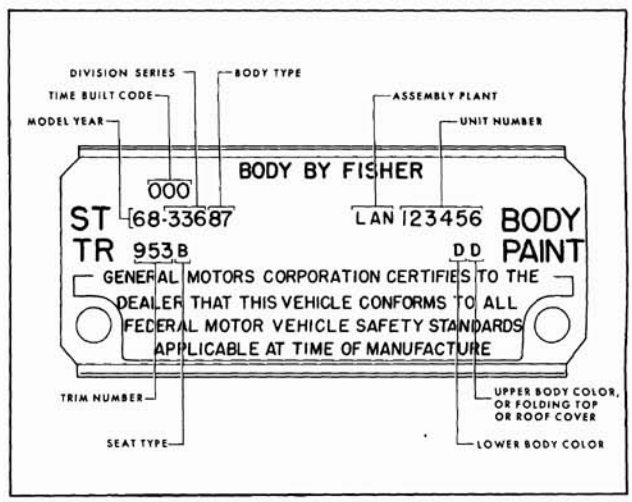


Fig. 0-1 Body and Style Number Plate (31-86 Series)

All 94 Series will be built at Lansing, Michigan and have code letters "EUC" for Body Unit Number(s) prefix. (Fig. 0-2)

1968 MODEL DESIGNATION

Series	Body Description or Name	Body Style	Body Type	Chassis Designation		Sales and Scheduling Code	
				L-6	V-8	L-6	V-8
F-85 33100 (L-6) 33200 (V-8)	Town Sedan Club Coupe	69 77	A	33169 33177	33269 33277	3169 3177	3269 3277
Cutlass 33500 (L-6) 33600 (V-8)	2-Seat Station Wagon Holiday Sedan Convertible Town Sedan Sports Coupe Holiday Coupe	35 39 67 69 77 87	A	33535 33539 33567 33569 33577 33587	33635 33639 33667 33669 33677 33687	3535 3539 3567 3569 3577 3587	3635 3639 3667 3669 3677 3687
Cutlass Supreme 34200 (V-8)	Holiday Sedan Town Sedan Holiday Coupe	39 69 87	A		34239 34269 34287		4239 4269 4287
442 34400 (V-8)	Convertible Sports Coupe Holiday Coupe	67 77 87	A		34467 34477 34487		4467 4477 4487
Vista-Cruiser 34800 (V-8)	Two-Seat Three-Seat	55 65	A		34855 34865		4855 4865
Delmont 88 35400	Holiday Sedan Convertible Town Sedan Holiday Coupe	39 67 69 87	B		35439 35467 35469 35487		5439 5467 5469 5487
Delta 88 36400	Holiday Sedan Town Sedan Holiday Coupe	39 69 87	B		36439 36469 36487		6439 6469 6487
Delta 88 Custom 36600	Holiday Sedan Holiday Coupe	39 87	B		36639 36687		6639 6687
Ninety-Eight 38400	Holiday Sedan Holiday Coupe Convertible Town Sedan	39 57 67 69	C		38439 38457 38467 38469		8439 8457 8467 8469
Ninety-Eight 38600	Luxury Sedan	69	C		38669		8669
Toronado 39400	Coupe	87	E		39487		9487

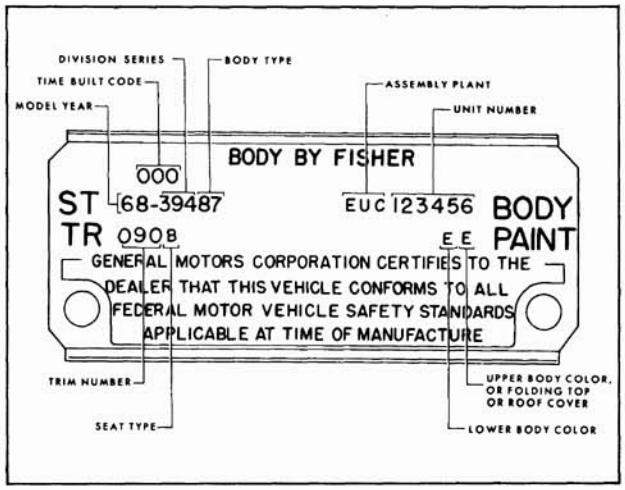


Fig. 0-2 Body and Style Numbers (9400 Series)

VEHICLE IDENTIFICATION NUMBER PLATE

The 1968 vehicle identification number plate is located in the left upper instrument panel. The numbers are visible from the outside of the car. (Fig. 0-3) Each unit number is prefixed by a letter and six numbers and have designations as shown in Fig. 0-4.

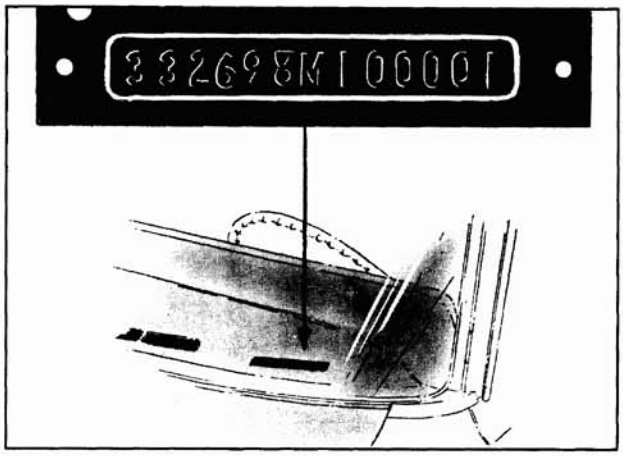
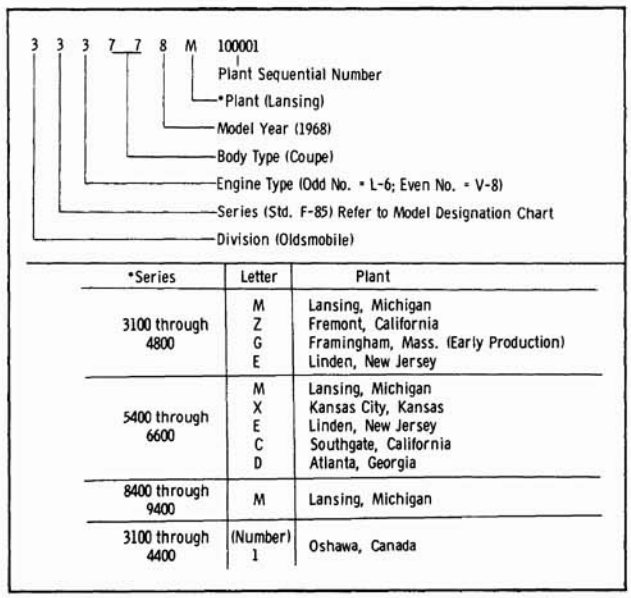


Fig. 0-3 Vehicle Identification Number Plate

Fig. 0-5 L-6 Engine Unit Number Location



*Series	Letter	Plant
3100 through 4800	M	Lansing, Michigan
	Z	Fremont, California
	G	Framingham, Mass. (Early Production)
	E	Linden, New Jersey
5400 through 6600	M	Lansing, Michigan
	X	Kansas City, Kansas
	E	Linden, New Jersey
	C	Southgate, California
	D	Atlanta, Georgia
8400 through 9400	M	Lansing, Michigan
3100 through 4400	(Number) 1	Oshawa, Canada

Fig. 0-4 Vehicle Identification Plate Data

ENGINE UNIT NUMBER (For Manufacturing and Service Use)

The L-6 Engine has a DATE-CODE stamped on the right side of the engine block, directly to the rear of the distributor. (Fig. 0-5)

The date code consists of a letter, four digits and two letters. The first letter stands for source identification. The first two digits show the month and the second two digits show the day the unit was built. The last two letters show transmission or option usage.

EX.: F 07 12 VE

- VE — Jetaway Equipped
- 12 - Day of Month
- 07 - July - Month
- F - Source Code (Flint)

V-8 engines have the code tape installed directly above the engine unit number which is stamped on the engine oil fill tube. (Fig. 0-6) The following chart shows engine usage and identification.

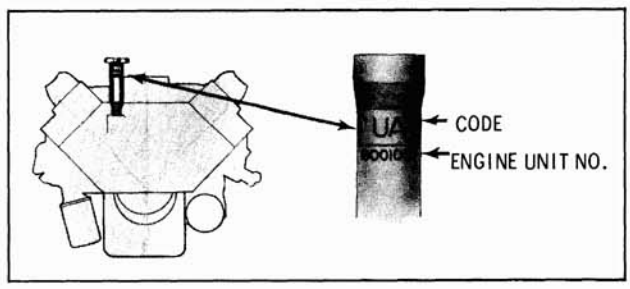


Fig. 0-6 V-8 Engine Unit Number and Code Location

ENGINE IDENTIFICATION CHART

Model	Trans.	ENGINE USAGE: 250 Cu. In. 8.50 C.R. 1-Barrel L6 Action Line 6	350 Cu. In. 9.00 C.R. 2-Barrel V8 Jetfire	350 Cu. In. 10.25 C.R. 4-Barrel V8 Jetfire	400 Cu. In. 9.00 C.R. 2-Barrel V8 Rocket 400	400 Cu. In. 10.50 C.R. 4-Barrel V8 4-4-2	455 Cu. In. 9.00 C.R. 2-Barrel V8 Super Rocket	455 Cu. In. 10.25 C.R. 2-Barrel V8 Super Rocket	455 Cu. In. 10.25 C.R. 4-Barrel V8 Super Rocket	*IDENTIFICATION: With C-60 Y-72	Without C-60 Y-72	Low Comp. 2 Barrel	High Comp. 4 Barrel	High Comp. 2 Barrel
Standard L6	SMT	S								VB	VA			
3100	AMT	S								VF	VE			
Standard V8	SMT		S	O								QI	QV	
3200	AMT		S	O								QA & QB	QN & QP	
Cutlass L6	SMT	S								VB	VA			
3500	AMT	S								VF	VE			
Cutlass V8	SMT		S	O								QI	QV	
3600	AMT		S	O								QA & QB	QN & QP	
Cutlass Supreme	SMT		O	S								QI	QV	
4200	AMT		O	S								QA & QB	QN & QP	
442	SMT					S							QW & QU	
4400	AMT				O	S						QL	QR, QS, QT	
Vista-Cruiser	SMT		S	O								QI	QV	
4800	AMT		S	O	O	O						QL	QR & QS	
Delmont 88 350 Cu. In.	SMT		S									TL		
5400	AMT		S	O								TB & TD	TN	
Delmont 88 455 Cu. In.	SMT						S					UJ		
5400	AMT						S	O	O			UC & UD	UN & UO	UA & UB
Delta 88	SMT						S					UJ		
6400	AMT						S	NCO	O			UC & UD	UN & UO	UA & UB
Delta 88 Custom	SMT						S					UJ		
6600	AMT						S	NCO	O			UC & UD	UN & UO	UA & UB
Ninety-Eight 8400-8600	ALL								S				UN & UO	
Toronado 9400	ALL								S				US, UT, UW & UV	

S - Standard
O - Option
NCO - No Charge Option
*Refer to Fig. 0-6.

EXPORT OPTION

L-6 Export Option (7.25) Compression Ratio (CR)
V-8 Export Option (8.3) Compression Ratio (CR) Available in 2 or 4 Barrel.

MANUAL TRANSMISSION

The three speed standard transmission has 1" high identification code letters on the right-hand side of case. The three speed heavy duty transmission has 2" high identification code letters on the right-hand side of extension housing. Fig. 0-7 shows manual transmission identification.

TYPE	SERIES	CODE R. H. SIDE OF CASE	OPTION CODE
3-Speed	3100, 3500 L-6 Engine 3200, 3600, 4200, 4800	QP RJ	
3-Speed Heavy Duty	5400, 6400 Column Shift 4400 Floor Shift 3200, 3600, 4200 Floor Shift (Except Station Wagons)	DA DB DB	 M-14
4-Speed	3200, 3600, 4200, 4400, 4800 (wide ratio) 3200, 3600, 4200, 4400 (close ratio)	HP HF	M-20 M-21

Fig. 0-7 Manual Transmission Code Numbers

JETAWAY TRANSMISSION

Transmission MODEL and CODE NUMBERS are stamped on the servo cover as shown in Fig. 0-9.

EXAMPLE: 68 LC 001

- 001 — First Day of Production
- LC — Model LC (L-6 Usage)
- 68 — 1968 Model Year

JETAWAY MODEL	USAGE
LC	All 6 Cyl.
MM	V-8 - 32, 36 and 4200 Series
MT	V-8 - 5400 Series (350 cu. in.)

Fig. 0-8 Jetaway Transmission Usage

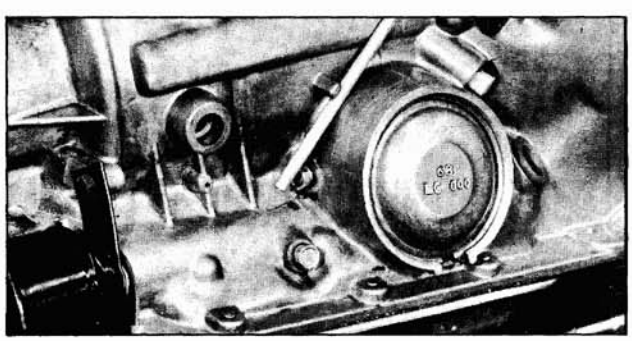


Fig. 0-9 Jetaway Model and Date Code Location

TURBO HYDRA-MATIC TRANSMISSION

The Turbo Hydra-Matic serial number for all series except 9400 is stamped on a plate located on the right side of the case. (Fig. 0-11). The Turbo Hydra-Matic serial number for 9400 series is stamped on a plate located on the left-hand side of the converter housing. (Fig. 0-12)

TURBO HYDRA-MATIC USAGE CHART

Turbo Hydra-Matic Model	Model	Engine
OA	Vista Cruiser	350 cu. in. - 2 Bbl. Low and 4 Bbl. High Compression
OB	Ninety-Eight*	455 cu. in. - 4 Bbl. High Compression
OC	Delta & Delmont	455 cu. in. - 2 Bbl. Low and High Compression
OF	Delmont	350 cu. in. - 2 Bbl. Low and 4 Bbl. High Compression
OG	F-85 Cutlass 442 and L77	400 cu. in. - 4 Bbl. High Compression
OG	4400 - L65	400 cu. in. - 4 Bbl. High Compression
OH	442	400 cu. in. - 2 Bbl. Low Compression
OJ	Toronado	455 cu. in. - 4 Bbl. High Compression
OL	Police Option & Heavy Duty	455 cu. in. - 4 Bbl. High Compression
OM	Toronado	455 cu. in. - 4 Bbl. High Compression (Performance Option)
OP	Vista Cruiser**	400 cu. in. - 2 Bbl. Low Compression 4 Bbl. High Compression

* Engine and Transmission Optional Delmont (455 cu. in.) and Delta Series
** Optional Engine

Fig. 0-10 Turbo Hydra-Matic Usage Chart

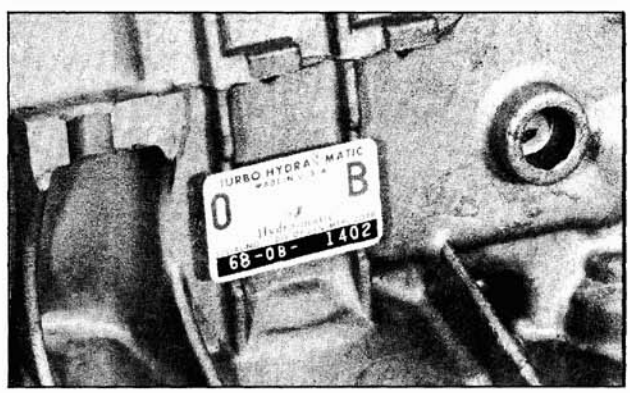


Fig. 0-11 Turbo Hydra-Matic Serial Number Plate Location (Except 9400)

Fig. 0-12 Turbo Hydra-Matic Serial Number Plate Location (9400)

DIFFERENTIAL RATIOS

The differential ratio code letters (1/4" high) are stamped on the right rear inboard side of the axle housing tube. (Fig. 0-13)

Fig. 0-13 Axle Ratio Codes (3100-8600 Series)

Letters, for standard, Anti-Spin and final drive differentials, indicating corresponding ratio for each series are shown in Fig. 0-14.

FINAL DRIVE ASSEMBLY (Differential)

The ratio and date code is stamped on the flange near the right hand spreader hole (Fig. 0-15).

RATIO CODE: T = 3.07

DATE CODE: The code letter for month and number(s) for actual date.

A - Jan.	D - April	H - July	L - Oct.
B - Feb.	E - May	J - Aug.	M - Nov.
C - March	G - June	K - Sept.	N - Dec.

EXAMPLE:

T = 3.07 Ratio Code
M10 = Built November 10

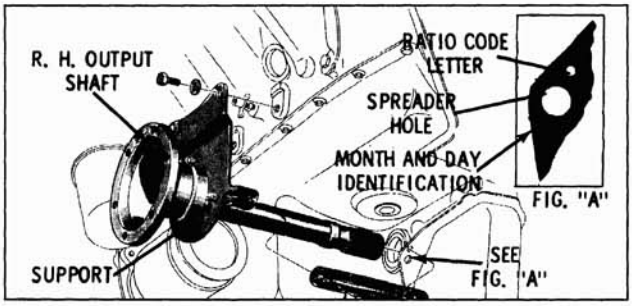


Fig. 0-15 Final Drive Ratio and Date Code

	GEAR RATIO	NO. GEAR TEETH	CODE LETTERS STD. TYPE DIFFERENTIAL STD. EQUIP.	WITH J-52, J-55	WITH Y-75	CODE LETTERS ANTI-SPIN DIFFERENTIAL STD. EQUIP.	WITH J-52, J-55	WITH Y-75	WITH W-30
3100 THRU 4400 (TYPE "O")	2:56	41:16	R2	R6		R3	R7		
	2:78	39:14	SA	S2		SB	S3		
	3:08	40:13	SC	S4		SD	S5		
	3:23	42:13	SE	S6		SF	S7		
	3:42	41:12	TL	S8		TM	S9		
	3:91	43:11	TN	T2		TO	T3		
400 CU. IN.	4:33	39:09				TW	TY		
3100 THRU 4400 (TYPE "C")	2:56	41:16	R8	TR		R9	TH		TW
	2:73	41:15	RA	TT		RB	TJ		
	3:07	43:14	RC	T4		RD	T5		
	3:31	43:13	RE	T6		RF	T7		
4800 SERIES (TYPE "O") ONLY	2:78	39:14	TA			TB			
	3:08	40:13	SM			SN			
	3:23	42:13	SO			SP			
5400 SERIES (350 CU. IN.)	2:78	39:14	RA			RB			
	3:08	40:13	RC			RD			
	3:23	42:13	RE			RF			
5400 (455 CU. IN.) 64-6600 SERIES *54 (455 CU. IN.) & 6400 ONLY	2:56	41:16	QC	#QQ		QD	#QR		
	2:73	41:15	QA	#QK	*QS	QB	#QL	*QT	
	3:08	40:13	QE	#QM	*QY	QF	#QN	*QZ	
84-8600 SERIES	2:56	41:16	QQ	QC		QR	QD		
	2:73	41:15	QK	QA		QL	QB		
	3:08	40:13	QM	QE		QN	QF		
TORONADO	3:07	43:14	T						

Fig. 0-14 Differential Usage and Codes

TIRE INFORMATION

RECOMMENDED COOL TIRE INFLATION PRESSURES - POUNDS PER SQUARE INCH

	All Loads	
	Front	Rear
All Models - Except Station Wagons, 442 and 94 Series	24	24
Station Wagons & V.C.	24	32
442	26	26
9400	24	22
8 Ply Tires 88-98	24	26

When the car is driven a few miles, tires warm up causing pressure increase. If tire pressures are checked when tires are warm, they may be up to 6 pounds higher than the pressures shown on the chart.

For continuous high speed operation (over 75 mph) increase tire pressure (cool) 4 pounds over the above recommended inflation pressures, up to a maximum of 32 pounds for 4-ply rating tires, or 40 pounds for 8-ply rating tires.

Over inflation at light loads will have an adverse effect on the car ride and tire tread wear pattern. Under inflation will promote heat and abnormal wear.

When towing trailers, the allowable passenger and cargo load must be reduced by an amount equivalent to the trailer tongue load on the trailer hitch.

Vehicles with luggage racks do not have a load limit greater than specified in the tire inflation pressure table.

VEHICLE LOAD CAPACITY AND DISTRIBUTION

	Full Load Capacity Is:
All Models - Except Station Wagons	1100 Lbs. Total: 3 Passengers front seat 3 Passengers rear seat 200 Lbs. luggage
Station Wagons 2 Seat	1200 Lbs. Total: 3 Passengers front seat 3 Passengers rear seat 300 Lbs. luggage
Station Wagons 3 Seat	1200 Lbs. Total: 3 Passengers front seat 3 Passengers second seat 2 Passengers third seat or 300 Lbs. luggage

TIRE ROTATION

To equalize wear, it is recommended that the four road tires be rotated every 6,000 miles, see Fig. 0-16. It is not necessary to rotate the spare. Upon rotation, tire pressures must be adjusted (front and rear) in accordance with the recommendations in the tire inflation pressure table. Also keep tires balanced, the front wheels aligned, and periodically examine tires for unusual wear.

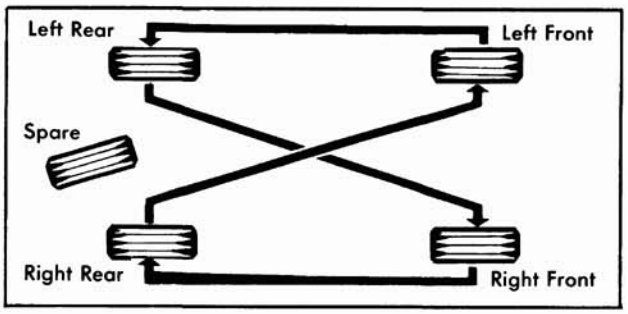


Fig. 0-16 Tire Rotation

TIRE SIZES

SERIES	TIRE SIZE
F-85 Exc. Vista-Cruiser & 442	
Std. Size & 8 Ply Option	7.75 x 14
Radial Ply Option	205R14
Vista-Cruiser	
Std. Size & 8 Ply Option	8.25 x 14
Radial Ply Option	205R14
442	
Std. Size (Nylon)	F70 x 14
4 Ply Option (Nylon)	7.75 x 14
Radial Ply Option Exc. with 4 Bbl. Engine	205R14
Delmont & Delta	
Without Disc Brakes	
Std. Size	8.55 x 14
Radial Ply Option	225R15
With Disc Brakes	
Std. Size & 8 Ply Option	8.45 x 15
Radial Ply Option	225R15
Ninety-Eight	
Without Disc Brakes	
Std. Size	8.85 x 14
Radial Ply Option	225R15
With Disc Brakes	
Std. Size & 8 Ply Option	8.85 x 15
Radial Ply Option	225R15
Toronado	
Std. Size	8.85 x 15
Radial Ply Option	235R15
All Std. Tires are 2-Ply - 4-Ply Rating.	

GENERAL SPECIFICATIONS

Series	F-85 Series 3100 Thru 4800 Series					Delmont 88 (5400)	All Other 88's 6400 6600	98's 8400 & 8600	9400
	Standard Station Wagons	Vista-Cruiser	442	Coupes	Sedan				
Wheelbase	116"	121"	112"	112"	116"	123"	123"	126"	119"
Tread Width									
Front	59"	59"	59"	59"	59"	62.5"	62.5"	62.5"	63.5"
Rear	59"	59"	59"	59"	59"	63"	63"	63"	63.0"
Overall Length	212.5"	217.5"	201.6"	201.6"	205.6"	217.8"	217.8"	223.7"	211.4"
Overall Width	75.9"	75.9"	76.6"	76.6"	75.9"	79.3"	79.3"	79.7"	76.4"
Overall Height	54.6"	56.8"	53.5"	53.5"	53.5"	55.5"	55.5"	55.8"	52.8"
Engine Displacement (Cu. In.) L-6	250	-	-	250	250				
V-8	350	350	400	350	350	350	455	455	455
Taxable Horsepower									
L-6	36			36	36				
V-8	52.7	52.7	47.9	52.7	52.7	52.7	54.4	54.4	54.4

TOWING DATA

Toronado

It is recommended that the car be towed with the front wheels off the ground. However, the car can be towed with the rear wheels off the ground if damage in the rear wheel area will not permit such towing. In this event, the car may be towed with the rear wheels off the ground by placing the selector lever in the "N" (neutral) position and driving at speeds not to exceed 45 mph for distances up to 50 miles. When towing with the front or, if necessary, the rear wheels off the ground, it is advisable that the lift sling be positioned approximately 8" to 10" from the outboard ends of the bumper (over the bumper jack lift points) to reduce the possibility of grille and bumper damage.

If it becomes necessary to pull or winch a Toronado from the rear, the chain should be fastened around the rear spring at the rear shackle with the chain load on the bottom of the leaf spring.

Depending on the severity of the pull, the rear axle could be damaged if the chain is fastened to the axle.

All Others

Except when the transmission, propeller shaft or rear axle has become damaged or when the transmission is low on fluid, the car may be towed with the selector lever in the "N" (Neutral) position at speeds up to 45 mph, for distances up to 50 miles. For higher speeds, longer distances, or if the transmission has become damaged or has lost fluid, it is recommended that the car be towed with the rear wheels off the ground or the propeller shaft disconnected at the differential and secured to the frame or exhaust pipe. If the car is towed with the rear wheels off the ground, the steering wheel should be centered and lashed to the window division channel or held in centered position with a steering clamp. The car should not be lifted more than six inches off the ground or towed at speeds above 45 mph. When towing with the wheels off the ground, it is recommended that a 4" x 4" timber be located beneath the lower edges of the bumper to prevent lift chains damaging the lower panel.

SERVICE BRAKES

The fluid level in the master cylinder located at the left rear side of the engine compartment should be checked at each engine oil change interval. If necessary to add fluid, use Brake Fluid equivalent to Supreme No. 11. On all standard and power brakes, the fluid level must be maintained at 1/4" below the top of both sections of the reservoir, at the rear. Prevent entry of dirt into the master cylinder. See Periodic Maintenance Chart Fig. 0-18 for checking brake warning light.

Brake linings should be periodically inspected for wear. The frequency of this inspection depends upon driving conditions such as traffic or terrain, and also the driving techniques of individual owners.

BATTERY

Check battery liquid level at each engine oil change interval or once a month or more often, when refueling in hot weather. Level should reach the bottom of the split ring in the vent well. DO NOT OVERFILL.

Clean top of battery and terminals every 12,000 miles and check tightness of battery hold-down bolt. To properly clean battery:

A. Make sure vent plugs are closed tight.

B. Remove battery cables from battery.

C. Clean battery with a diluted ammonia or soda solution. When the solution stops foaming, rinse with clear water.

D. Clean battery cable clamps with diluted ammonia or soda and rinse with clear water. Apply a thin coating of petrolatum to terminals and clamps, after installing clamps.

EXTERIOR COLORS AND STOCK NUMBERS

Color Code	Color Name	DuPont	Rinshed-Mason	Ditzler DDL
A	Ebony Black	88L	A946	9300
B	Twilight Teal	4911L	A2001	13515
C	Provincial White	4024L	A1199	8259
D	Sapphire Blue	4892L	A1985	13512
E	Nocturne Blue	4899L	A1992	13513
F	Teal Frost	4901L	A1994	13514
G	Willow Gold	4896L	A1988	22942
K	Ocean Turquoise	4900L	A1993	13517
L	Teal Blue	4893L	A1986	13516
M	Cinnamon Bronze	4903L	A1998	22967
N	Burgundy	4915LH	A1999	50775
P	Silver Green	4897L	A1989	43774
R	Scarlet	4948LH	A1997	71634
S	Jade Gold	4905L	A1991	43794
T	Ivory	4895L	A1987	81617
V	Juneau Gray	4898L	A1990	43773
W	Silver Beige	4912L	A2002	22962
X	Buckskin	4913L	A2003	22983
Y	Saffron	4620L	A1715	81500
Z	Peruvian Silver	4907L	A2000	8596

INTERIOR COLORS AND STOCK NUMBERS

Color Name	DuPont Low Gloss	DuPont Flat	Rinshed-Mason Low Gloss	Rinshed-Mason Flat	Ditzler DIA Low Gloss	Ditzler DIA Flat
Black	88L	4428L	A946	A946	9266	9317
Med. Blue Met.	9461LH		168B23		13563	
Dk. Blue	9464LH		168B26		13565	
Dk. Blue Met.	9463LH	9452LH	168B25	168B21	13564	13533
Med. Gold Met.	9478L		168B74		22988	
Dk. Gold	9481LH		168B77		22989	
Dk. Gold Met.	9480L	9456L	168B76	168B71	43805	43799
Midnight Gold Met.	9489L	9459L	168B78	168B72	43804	43800
Dk. Red	9385LH	9201LM	167B55R	165B55M	71589	71486
Med. Turquoise Met.	9469LH		168B32		13569	
Dk. Turquoise	9472LH		168B34		13571	
Dk. Turquoise Met.	9471L	9454L	168B35	168B31	13570	13557
Parchment	9482L		168B91		22985	
Med. Teal Met.	9465L		168B27		13566	
Dk. Teal	9468LH		168B20		13568	
Dk. Teal Met.	9467L	9453L	168B29	168B22	13567	13556
Med. Buckskin	9490L		168B83		22986	
Dk. Buckskin	9491L	9460L	168B88	168B84	22987	22975

PAINT STRIPE COLORS AND STOCK NUMBERS

Color Code	Color Name	DuPont	Rinshed-Mason	Ditzler DDL
A	Black	88L	A946	9000
C	White	4024L	A1199	8259
O	Orange	9546LH	168B51R	60511
R	Red	4822LH	A1907R	71583
G	Gold Metallic	9547LH	168B79	22991
W	Buckskin	4913L	A2003	22992

For PAINT Recommendations
For Textured Steel Moldings
Refer To Page 0-14

FACTORY INSTALLED OPTIONAL EQUIPMENT

The following list of factory installed options have been used in numerous sections of this Service Manual. This list does not cover all optional equipment but only the items which effect adjustments or service procedures covered in this manual.

OPTION CODE	DESCRIPTION
A-91	Vacuum Trunk Lid Latch
A-93	Vacuum Door Lock, All Doors
B-01	Police Apprehender - City Cruiser
B-07	Police Apprehender - Highway Patrol
C-24	Recessed Windshield Wiper (F-85)
C-50	Rear Window Defogger
C-60	Air Conditioning
C-61	Air Conditioning with Automatic Controls
G-51	Heavy Duty Rear Springs
G-66	Superlift Rear Shock Absorbers
G-80	Locking Type (Anti-Spin) Differential
J-50	Power Brakes
J-52	Front Disc Brakes - Power
J-55	Heavy Duty Brakes (Police Usage)
K-30	Automatic Throttle Control (Cruise Control)
K-66	Capacitor Discharge Ignition System (Ultra High Voltage)
L-65	L.C. 350 Cu. In. 2Bbl. (4200 Only) or L.C. 400 Cu. In. 2Bbl. (4400 & 4800)
L-66	H.C. 455 Cu. In. V-8 2Bbl.
L-74	H.C. 350 Cu. In. V-8 4Bbl.
L-76	H.C. V-8 Performance Engine (For B-01 or B-07) (Same as L-74 Except for Spark Plugs and Air Cleaner Label)
L-77	H.C. 400 Cu. In. V-8 Performance Engine (Police)
L-78	H.C. 400 Cu. In. V-8 Performance Engine
M-11	3 Speed Column Shift
M-14	3 Speed Fully Synchronized H.D., Floor Shift
M-20	4 Speed Fully Synchronized, Wide Ratio, Floor Shift
M-21	4 Speed Close Ratio Synchronized, Floor Shift
M-31	Jetaway Transmission
M-40	Turbo Hydra-Matic Transmission
M-55	Auxiliary Oil Cooler, Automatic Transmission
N-10	Dual Exhaust System with L-74 & L-76
N-33	Tilt Steering Column (F-85)
N-37	Tilt & Telescope Steering Wheel (All Exc. F-85)
N-40	Power Steering
T-87	Cornering Lamp
U-15	Safety Sentinel
U-21	Rally Pack
U-80	Rear Seat Speaker
U-89	Trailer Hauling Wire Harness
W-30	Air Induction System (442)
W-34	Air Induction System (Toronado)
Y-72	Heavy Duty Engine Cooling
Y-75	Heavy Duty 15" Wheels, Hubs & Drums (With B-01, B-07)

1968 OLDSMOBILE GUARDIAN MAINTENANCE SCHEDULE

MAINTENANCE SERVICE	MAINTENANCE INTERVAL (Whichever Occurs First)														
	MILEAGE	TIME (In Months)													
		4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
•ENGINE OIL - Change†	6,000	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
•FLUID LEVELS, ALL - Check and Add if Necessary	6,000	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
CRANKCASE VENTILATION FILTER - Clean†	6,000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LINKAGE (Trans., Throttle, Manual Shift & Clutch) - Lubricate	6,000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BODY HINGES and RUBBER PARTS - Lubricate	6,000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TIRE PRESSURES, All Including Spare - Check When Cold	6,000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TIRES, Except Spare - Rotate	6,000															
•ENGINE OIL FILTER - Replace†	—	•REPLACE AT FIRST OIL CHANGE AND EVERY SECOND OIL CHANGE THEREAFTER														
DRIVE BELTS - Check & Adjust if Necessary	12,000			X			X			X			X			X
•STEERING LINKAGE - Lubricate & Check for Lash & Wear & Seals for Damage	12,000			•			•			•			•			•
AIR CONDITIONER - Service System	—			X			X			X			X			X
CARBURETOR - Replace Fuel Inlet Filter	12,000			X			X			X			X			X
EMISSION CONTROL ADJUSTMENTS																
SPARK PLUGS - Clean & Gap or Replace (Not required at first interval)	First Time at 6,000 Second Time at 12,000 Then Every 12,000	X		X			X			X			X			X
DISTRIBUTOR POINTS - Adjust or Replace & Set Timing																
CARBURETOR - Adjust Idle Speeds and Mixture																
•P.C.V. SYSTEM (See Note)				•			•			•			•			•
ENERGIZER - Clean Terminals & Cables	12,000			X			X			X			X			X
COOLING SYSTEM - Pressure Test, Wash Radiator Cap & Add Coolant if Necessary	12,000			X			X			X			X			X
•AIR CLEANER ELEMENT (Disposable) - Replace†	24,000						•						•			
• AUTOMATIC TRANSMISSION - Change Fluid & Strainer* (Clean on Jetaway)	24,000						•						•			
•JETAWAY TRANSMISSION BAND - Adjust	24,000						•						•			
•ENGINE COOLANT - Service System & Install New Coolant	—						•						•			
BRAKE SYSTEM WARNING LIGHT - Check Operation	24,000						X						X			
•BALL JOINTS - Lubricate & Check for Lash & Wear and Inspect Seals for Damage	36,000 - then every 12,000									•			•			•
FRONT WHEEL BEARINGS (Rear on Toronado) - Repack	—	WHEN BRAKE MAINTENANCE REQUIRES DRUM REMOVAL														
APPEARANCE CONDITIONING	—	AS REQUIRED														

•Required services to assure full consideration under the 5-year/50,000-mile coverage of Oldsmobile's New Vehicle Warranty.
†May require more frequent service under dusty operating conditions.
* Under heavy duty operating conditions or extensive stop and go driving, replace fluid and strainer (clean strainer on Jetaway) at 12,000 mile interval.
NOTE: Check operation of PCV valve at first oil change. Replace valve, clean hoses at intervals indicated with a (•).

CHASSIS LUBRICATION POINTS

12 month or 12,000 mile interval	No. Fittings
Tie Rods	4
Relay Rod	*2
Idler Arm	*1
Upper Ball Joints	**2
Lower Ball Joints	**2

*Lubrication not required on Toronado.
**Remove plugs, install zerk fittings. Lubricate at 36 months or 36,000 miles then at every 12 months or 12,000 miles. Use multi-purpose lubricant. (31 through 48 Series have zerk fittings)

At each engine oil change interval, all friction and bearing surfaces in the linkage for the throttle, transmission, clutch and parking brake should be lubricated with SAE 10W-30 oil. Ball and socket in the throttle linkage should be lubricated with Seal Lubricant, No. 1050169 or equivalent whenever they are disassembled.

SPEEDOMETER & CRUISE CONTROL CABLE

Lubricate cables every 24,000 miles. Apply a coating of speedometer cable grease to the lower two-thirds of the cable only.

DISTRIBUTOR

The breaker cam should be lubricated with a thin film of ballbearing lubricant every 12,000 miles or whenever the contact assembly is replaced. No other lubrication is required.

POWER STEERING GEAR AND PUMP

Check lubricant level in pump at each oil change interval. Maintain lubricant level with power steering fluid such as No. 1050017, or if adding less than a pint, Dexron type automatic transmission fluid can be used.

Gear lubrication is provided by oil supplied by the pump.

MANUAL STEERING GEAR

Check lubricant at 36,000 miles or 36 months. Regular or seasonal changes are not required. Remove bolt in side cover at "Check Lube", lubricant should be visable. To add lubricant, remove upper bolt and fill gear through bolt hole at "Check Lube" until lubricant is forced from upper bolt hole. Replace bolts and torque to 30 ft. lbs. Use water resistant E.P. Chassis Lubricant.

AIR CLEANER (All Engines)

The air cleaner has a disposable air filter element. Soft plastic flanges on the element seal the air cleaner body and cover. All air will pass through the filter element.

Replace air filter element every 24,000 miles under normal conditions, and more frequently under dusty conditions. Do not attempt to service the element. The filter element should be replaced as follows:

A. Remove air cleaner assembly to prevent dirt from falling into carburetor.
B. Remove filter element from air cleaner.
C. Clean dust and dirt from metal surfaces of air cleaner body and install new filter element.
D. Install air cleaner assembly on carburetor.

CRANKCASE VENTILATION FILTER

At every oil change, more often under dusty conditions, remove filter, which is located inside air cleaner, wash in kerosene and re-oil with SAE 10W-30 oil. Also clean the connecting pipe.

CRANKCASE VENTILATION VALVE

Once a year or every 12,000 miles (or at the oil change period nearest to this interval) replace the ventilation valve. The rest of the system should be serviced at this interval by washing the parts in kerosene and blowing out the hoses and/or pipes with compressed air.

MANUAL TRANSMISSION

Periodic or seasonal changes of lubricant is not recommended.

The lubricant level should be checked at each engine oil change interval. Use multi-purpose gear lubricant meeting requirements of MIL-L-2105B. SAE 80 preferred, SAE 90 alternate.

Always clean dirt from around plug before removing.

AUTOMATIC TRANSMISSION

Check fluid level at each engine oil change. Change fluid and strainer every 24 months or 24,000 miles, whichever occurs first. (Wash screen and adjust low band on Jetaway.) Under heavy-duty operating conditions or excessive stop and go driving, change fluid and strainer (wash screen on Jetaway) every 12,000 miles.

Use only automatic transmission fluid identified with the mark DEXRON. This fluid has been especially formulated and tested for use in automatic transmissions. This automatic transmission fluid is also preferred for use in all pre 1968 automatic transmissions. Type A, Suffix A fluids identified by the mark "AQ-ATF" and a number followed by the suffix letter A (AQ-ATF- . . . A) are satisfactory for use in pre 1968 automatic transmissions.

For draining and refilling or checking and adding fluid, refer to the specific transmission, Section 7.

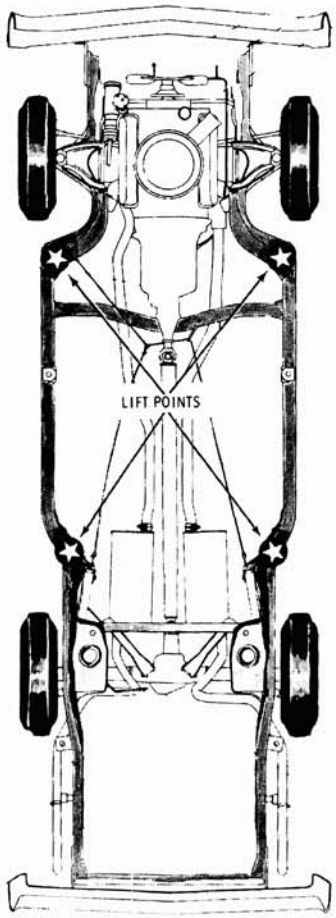
COOLING SYSTEM

ON ALL SERIES - Keep coolant level to "Fill Cold" mark on radiator. Check only when cool. The system should be periodically inspected for leaks. It is designed to use a highly inhibited "year around" Ethylene-Glycol solution both summer and winter.

Every 24 months, the system should be completely drained and flushed. When refilling, use enough "year around" Ethylene-Glycol, No. 389200 or equivalent Ethylene Glycol coolant labeled as meeting specification GM 1899, to insure at least -20°F. protection.

Alcohol base coolants or plain water will not provide adequate engine cooling.

The radiator cap should be thoroughly washed every 12,000 miles with clean water to remove any foreign matter, particularly from the vent valve.



CARBURETOR

Change fuel inlet filter every 12,000 miles.

DIFFERENTIAL AND FINAL DRIVE

Check lubricant level at each engine oil change period.

Conventional

Maintain lubricant level with SAE 90 Multi-Purpose Gear Lubricant, meeting requirements MIL-L-2105B or No. 1050081.

Anti-Spin & Final Drive

Maintain lubricant level with No. 1050081, or lubricant which meets GM specifications GM 4744 (OL134).

Use of other than the above mentioned type of lubricant in the Anti-Spin differential may cause chatter. If the wrong type of lubricant is used in the Anti-Spin, it will require draining the differential and installing the recommended lubricant. It may be necessary to drive Anti-Spin equipped cars for distances of 50 miles or more to allow the new lubricant to work through the units before the chatter will disappear.

Always clean dirt from around plug opening before removing the filler plug.

Trailer hauling and break-in period operations have been found to create excessive axle lubricant temperatures. This results in depletion of the axle lubricant additives.

To alleviate this condition, the following is recommended:

Lubrication

Anti Spin Differential - Periodic or seasonal changes are not recommended except under heavy duty operations such as trailer hauling. For heavy duty operations, lubricant replacement in the anti-spin differential is recommended every 12,000 miles.

Axle Break-In Period

In addition to the above, it is recommended the car be driven at least 500 miles prior to hauling a trailer below a gross weight of 2,000 lbs. and 1,000 miles for trailers in excess of 2,000 lbs. gross weight.

Final Drive - Toronado

For sustained high speed driving or trailor hauling it is recommended the fluid be changed every 24,000 miles.

ENGINE OIL CHANGE INTERVAL

Change engine oil every 4 months. If more than 6,000 miles are driven in a 4-month period, change oil every 6,000 miles. This interval applies to the initial change as well as subsequent oil changes. The oil change interval is based on the use of oils that meet the requirements indicated below, under "ENGINE OIL RECOMMENDATIONS." Excessive mileage or time between oil change intervals will result in serious reductions in engine life and will void the warranty.

For certain driving conditions including trailer hauling, extensive idling, and operation in dust storms or on dusty roads, oil change intervals should not exceed 2 months or 3,000 miles, whichever occurs first.

ENGINE OIL RECOMMENDATIONS

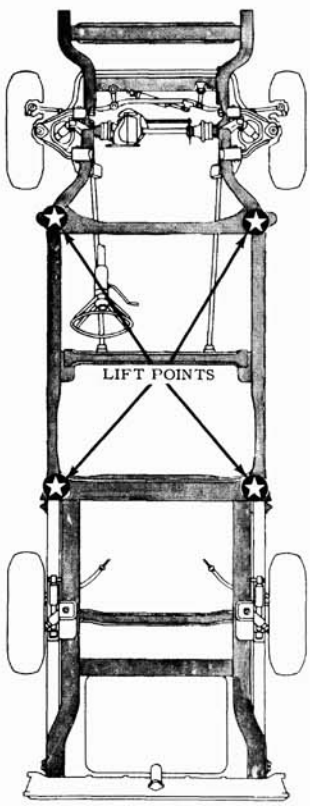
Use only "first line" oils which, according to the label on the can, are (1) intended for service MS, and (2) pass car makers' tests (including General Motors Standard GM 6041-M). The majority of the suitable oils currently available are multi-viscosity. Non-detergent and other low quality oils are specifically not recommended. The use of proper engine oils and oil change intervals are the best assurance of continued reliability and performance from the Oldsmobile engine.

The use of "break-in" oils, "tune-up" compounds, "friction-reducing" compounds, etc., are not recommended. However, there are additive supplements available that can be helpful under certain conditions. For example, if higher detergency is required to reduce varnish and sludge deposits, a thoroughly tested and approved concentrate--High Detergency Concentrate--is available.

RECOMMENDED VISCOSITY

The proper viscosity helps assure good cold and hot starting by reducing friction and thus increasing cranking speed.

ANTICIPATED TEMPERATURES	VISCOSITY NUMBER
Above Freezing (+32°F)	SAE 20W, SAE 10W-30
Below Freezing and Above 0°F	SAE 10W, SAE 10W-30
Below 0°F	SAE 5W, SAE 5W-20



TORONADO LIFT POINTS

NOTE: When changing oil, consider the anticipated temperatures for the next 4 months. SAE 5W and 5W-20 oils are not recommended for sustained high speed driving. SAE 30 and SAE 20W-40 oils may be used at temperatures above 70°F. SAE 5W-30 oils may be used at temperatures below 32°F. SAE 10W-40 oils may be used at temperatures between 0° and 90°F.

OIL LEVEL

The engine oil dip stick located on the left side of the engine, is marked "Full" and "Add". The oil level should be maintained neither going above the "Full" line nor under the "Add" line. The oil level should be checked at every refueling and oil added to maintain the proper level.

OIL FILTER

The full flow oil filter filters 100% of the oil delivered by the pump. Replace oil filter at first oil change and every second oil change thereafter. Operating conditions may require more frequent replacement. Replace oil filter as follows:

A. Loosen filter with wrench, then remove and discard filter.
B. Clean out filter body casting.
C. With new seal seated on face of new filter, install filter and tighten to 17 ft. lbs.
D. Add oil, start engine and check for leaks.

BRAKE LIGHT CHECK

Check bulb and switch at 24 months or 24,000 mile interval and at time of major brake work or any time pedal travel is excessive.

1. Determine if bulb is functioning by depressing parking brake.
2. Make sure both master cylinders are full (within 1/4" of top).
3. Open one rear wheel cylinder bleed screw.
4. Depress brake pedal and hold it down. Light should come on, if not, correct trouble (switch or wiring).
5. While holding pedal down, close bleed screw. Refill master cylinders.

CAPACITIES

COOLING SYSTEM	Units	U.S. Measure	Imperial Measure
31 THROUGH 48 SERIES			
L-6 (with or without A/C)	Qts.	12	10
For L-6 with Y-72, Add	Qts.	1/2	3/8
350 Cu. In.	Qts.	15	12 1/2
For 350 Cu. In. with A/C, Add	Qts.	1/2	3/8
For 350 Cu. In. with Y-72, Add	Qts.	1	3/4
400 Cu. In.	Qts.	16	13 1/4
For 400 Cu. In. with A/C or Y-72, Add	Qts.	1	3/4
54 THROUGH 86 SERIES			
350 Cu. In.	Qts.	16 1/2	13 3/4
455 Cu. In.	Qts.	17 1/2	14 1/2
With A/C, Add	Qts.	1/2	3/8
With Y-72, Add	Qts.	1	3/4
94 SERIES			
455 Cu. In.	Qts.	18	15
With A/C or Y-72, Add	Qts.	1/2	3/8
DIFFERENTIAL			
Type "O" 31-54 (54 with 350 Cu. In.)	Pts.	3 3/4	3
Type "O" 54-86 (455 Cu. In.)	Pts.	5 1/3	4 1/3
Type "C" 31-44	Pts.	4 1/2	3 3/4
Final Drive (9400)	Pts.	4 1/2	3 3/4
ENGINE CRANKCASE			
Drain and Refill (Except 9400)	Qts.	4	3 1/4
Drain and Refill (9400)	Qts.	5	4 1/4
When Changing Filter, Add	Qts.	1	3/4
FUEL TANK			
Station Wagons	Gals.	20	16 3/4
31 Through 44 Series	Gals.	20	16 3/4
54 Through 86 Series	Gals.	25	20 3/4
9400 Series	Gals.	24	20
*TRANSMISSION			
AUTOMATIC			
Jetaway	Qts.	8	7 1/2
Turbo Hyd-Matic (Except 94)	Qts.	10	7 1/2
Turbo Hyd-Matic (94 Series)	Qts.	12	8 3/4
MANUAL			
3-Speed Std.	Pts.	3 1/2	3
3-Speed H.D.	Pts.	4 1/2	3 3/4
4-Speed	Pts.	2 1/4	1 3/4
POWER STEERING (ALL SERIES)			
Pump Only	Qts.	1	3/4
Complete System	Qts.	1 3/4	1 1/2

*For Draining and Refilling Refer to the Specific Transmission - Section 7.

SPECIAL PAINT FOR TEXTURED STEEL MOLDINGS

When painting the air outlet grille (between deck lid and back glass) on Toronados, the rear door corner finishing molding on the F-85 four-door and the upper deck lid molding on F-85 two-door, it will be necessary to use special paint to match the fabric roof cover material. The paint manufacturers and part numbers are shown below. Standard painting techniques should be used when applying this paint.

PAINT COLOR CHART FOR EXTERIOR MOLDING

COLOR	DuPONT Plus Flattening Compound #4528	R-M	DITZLER NO.
Parchment	9569L - *1-1/2 oz.	168V87	DDL or DIA 23034
Dark Teal	9571L - *2 oz.	168V36	DDL or DIA 13628
Medium Gold	9568L - *1-1/2 oz.	168V74	DDL or DIA 23035
Buckskin	9570L - *1-1/2 oz.	168V75	DDL or DIA 23036
Black	9333L - *2 oz.	168C41	DDL or DIA 9358
Dark Blue	9567L - *2 oz.	168C20	DDL or DIA 13627

*The amount of flattening compound (DuPont #4528) indicated should be added to one pint of unreduced color to arrive at the correct gloss level.

HEATER AND AIR CONDITIONER

31 THROUGH 86 SERIES

CONTENTS OF SECTION 1

Subject	Page
HEATER 54 Through 86 Series	
GENERAL DESCRIPTION	1-1
VENTILATION SYSTEM	1-1
HEATER SYSTEM	1-1
ADJUSTMENTS	1-2
TEMPERATURE CONTROL	1-2
AIR INLET ASSEMBLY	1-2
BLOWER ASSEMBLY	1-2
HEATER CASE AND CORE	1-5
VENTILATION AND HEATER CONTROL	1-5
HEATER RESISTOR	1-5
VACUUM TANK	1-5
HEATER 31 Through 48 Series	
GENERAL DESCRIPTION	1-5
CONTROL ASSEMBLY	1-5
FAN SWITCH	1-5
RESISTOR	1-5
ADJUSTMENTS	1-6
BLOWER MOTOR AND AIR INLET	1-6
CORE ASSEMBLY	1-8
HEATER HOSE	1-8
AIR CONDITIONER	
GENERAL A.C. INFORMATION	1A-1
CUSTOM A.C. (54-86 Series)	1B-23
CUSTOM A.C. (31-48 Series)	1C-1
COMFORTRON A.C.	1D-16

HEATER

54 Through 86 Series

GENERAL DESCRIPTION (Fig. 1-1)

Air enters the ventilation and heater system at the cowl vent grille, travels through the plenum chamber and into the cowl air chamber. Air can now be directed into the passenger compartment by opening the right and left side cowl doors or by opening the heater inlet door. The doors are opened by vacuum operated diaphragms, actuated by pushbuttons, and closed by spring force.

The ventilation and heater control pushbuttons are in a single control unit located on the instrument panel on the right side of the steering column. The control also contains the blower speed switch and the temperature control slide lever.

A water valve is not used in the heater system. However, a calibrated nipple is used to reduce coolant pressure in the heater core.

VENTILATION AND HEATER (Figs. 1-2 and 1-3)

When the "Left" button is depressed, air flows into the passenger compartment through the left vent door.

When the "Right" button is depressed, air flows into the passenger compartment through the right vent door.

When the MAXIMUM button is depressed, both the right and left vent doors are opened.

For heating, the temperature control lever must be moved to the right, depending on the amount of heat desired.

Depressing the HEAT button opens the heater inlet air door and starts the blower motor.

Outside air is drawn through the cowl air intake grille into the ventilation duct and into the heater blower and air inlet assembly. The heater blower then forces a portion of the outside air through the heater core and into the ducting system. The remaining air is forced directly into the ducting system. To obtain the desired discharge air temperature, the heated air then mixes with the unheated air in the necessary proportions.

The temperature lever operates the temperature door which controls the temperature of the discharged air by regulating the mixing of heated and unheated air. In the COOL position, the air flow from the heater core is completely blocked. As the lever is moved to WARM, the temperature door opens, admitting heated air into the ducting and progressively decreases the amount of unheated air. In the MAX. WARM position, the flow of unheated air is completely blocked directing all the air through the heater core, for maximum heating.

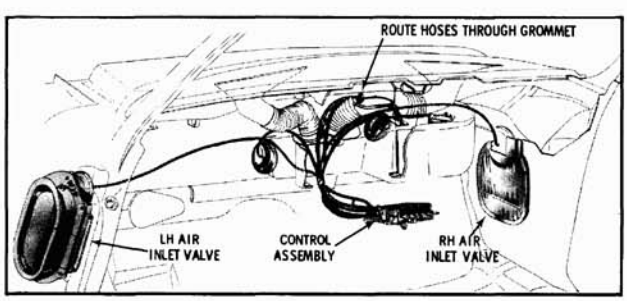


Fig. 1-1—Heater Control Layout

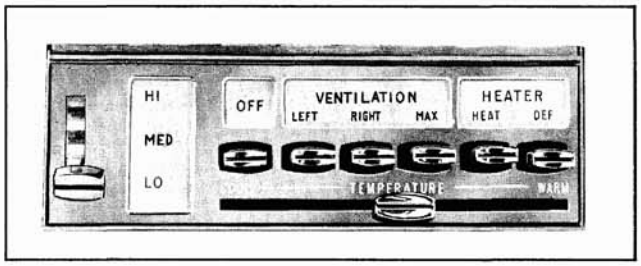


Fig. 1-2—Heater and Ventilation Control

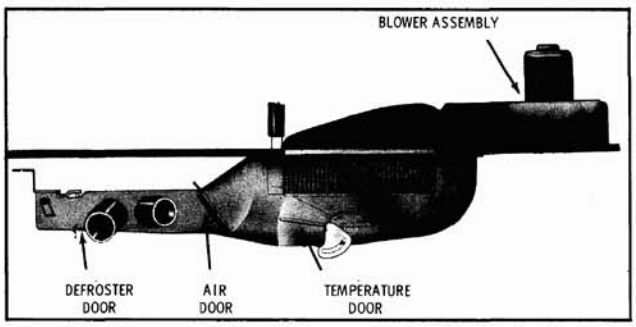


Fig. 1-3—Air Doors

Depressing the DEF button operates a vacuum operated diaphragm which opens the defroster door and air flows into the right and left defroster nozzles, diverting the air flow onto the windshield. Approximately 80% of the air flow is directed on the windshield. The balance of the air flow enters the passenger compartment through the heat outlet.

Rate of air flow on HEAT and DEF can be controlled by the blower speed switch.

ADJUSTMENTS

Temperature Control Cable

The cable is connected to a cam lock device that assures positive closing of the temperature door. The cable must be adjusted so there is 1/16" to 1/8" control lever spring back with the valve fully closed (Fig. 1-4).

Air Inlet Door

Adjustment of the air inlet door and diaphragm linkage is provided at the diaphragm. (Fig. 1-5)

1. With the air inlet body removed, loosen set screw.
2. Pull diaphragm lever to its extreme stop, then push back 1/16".
3. While holding door closed, tighten set screw.

AIR INLET VALVE ASSEMBLY

Remove and Install (Fig. 1-6)

1. Remove cowl vent grille and trim pad.
2. Disconnect vacuum line from diaphragm.

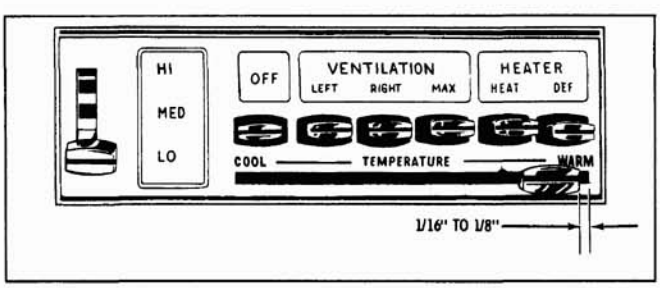


Fig. 1-4—Temperature Control Adjustment

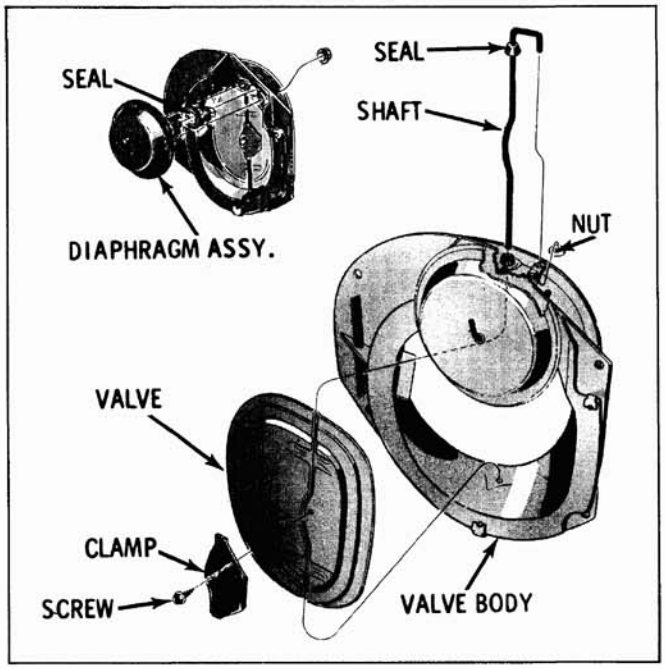


Fig. 1-5—Diaphragm Adjustment

3. Remove the air inlet valve assembly to cowl attaching screws and remove assembly.
4. If necessary the diaphragm can now be removed.

On installation, apply a 3/8" bead of caulking compound between the assembly and cowl. Make sure water seal tape is installed over actuating wire rod hole in door body, then reverse removal procedure.

BLOWER ASSEMBLY

Remove and Install (Fig. 1-7)

1. Disconnect blower feed wire.
2. Remove upper sheet metal screw holding the heater inlet to the dash by assembling approximately three feet of 3/8" extensions and a 7/16" socket through the opening

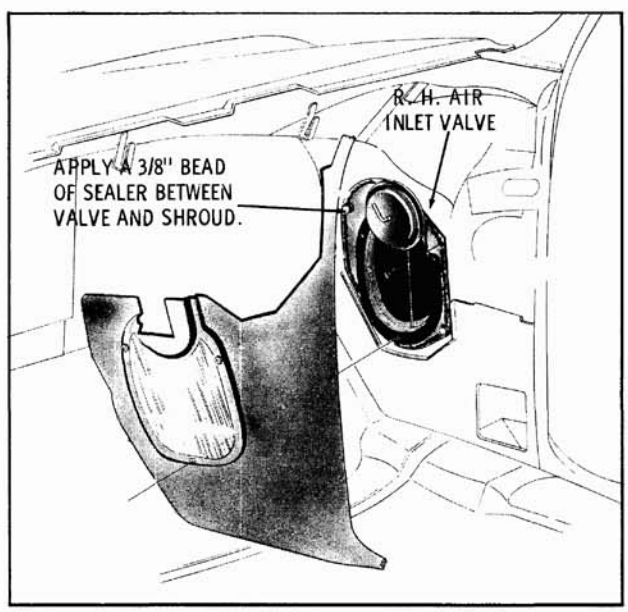


Fig. 1-6—Air Valve Installation

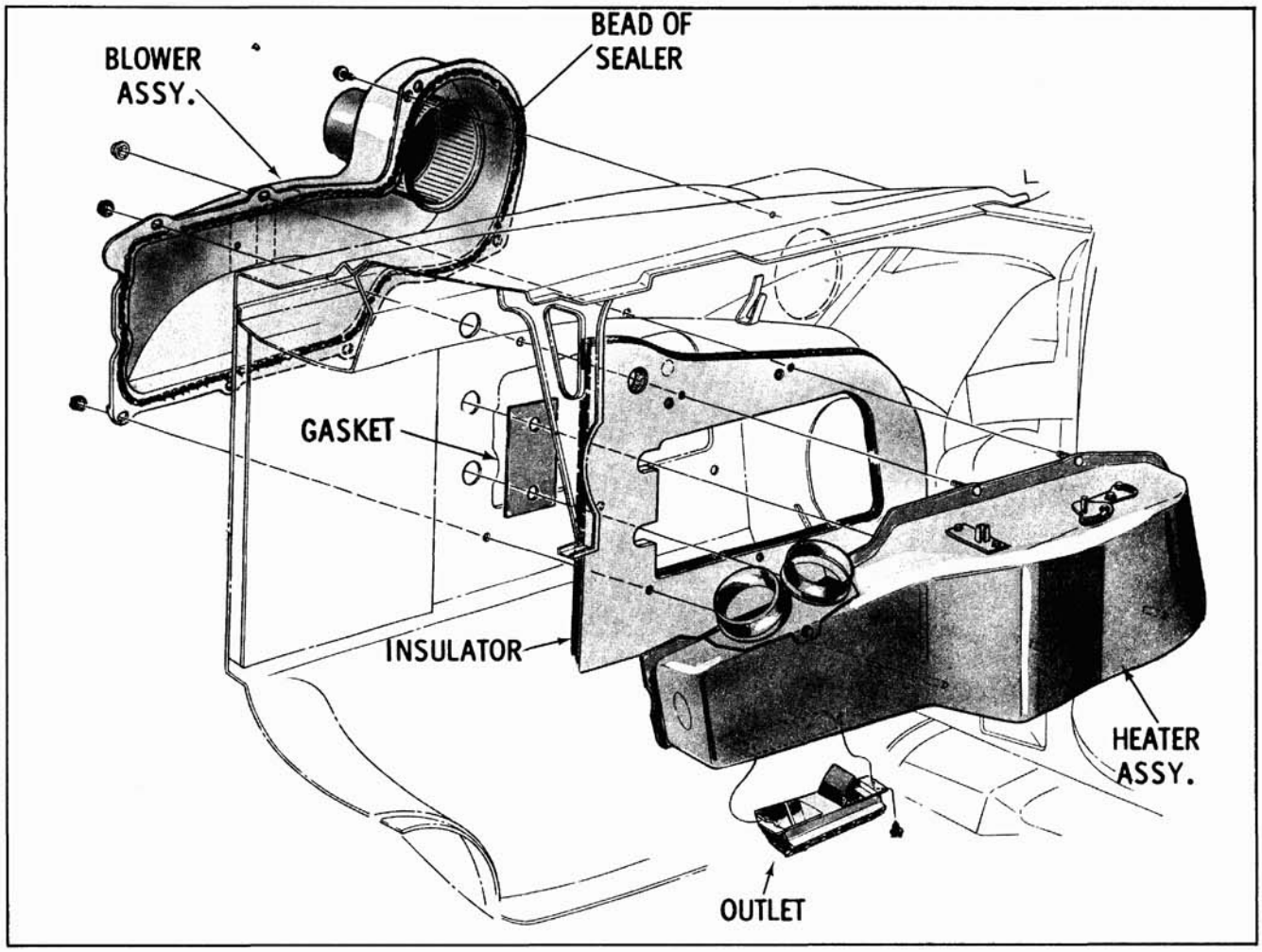


Fig. 1-7—Blower and Heater Case Installation

between the fender filler plate and the fender forward of the right front wheel. Guide the socket onto the sheet metal screw and remove screw.

Use body sealing compound on socket to hold screw while removing or installing.

3. Remove remaining attaching nuts and screws.

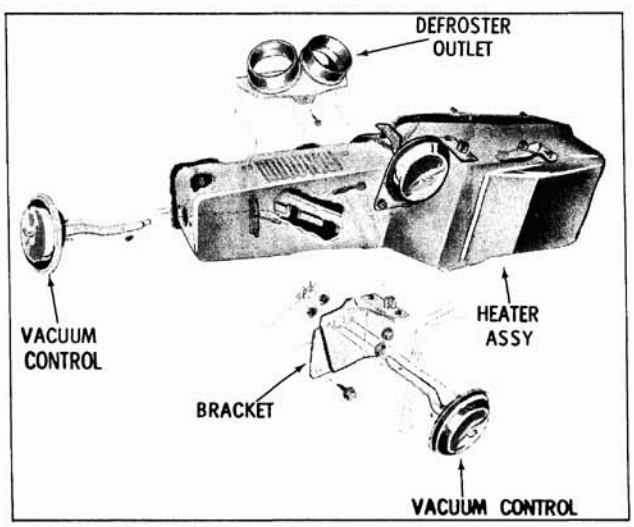


Fig. 1-8—Heater Assembly

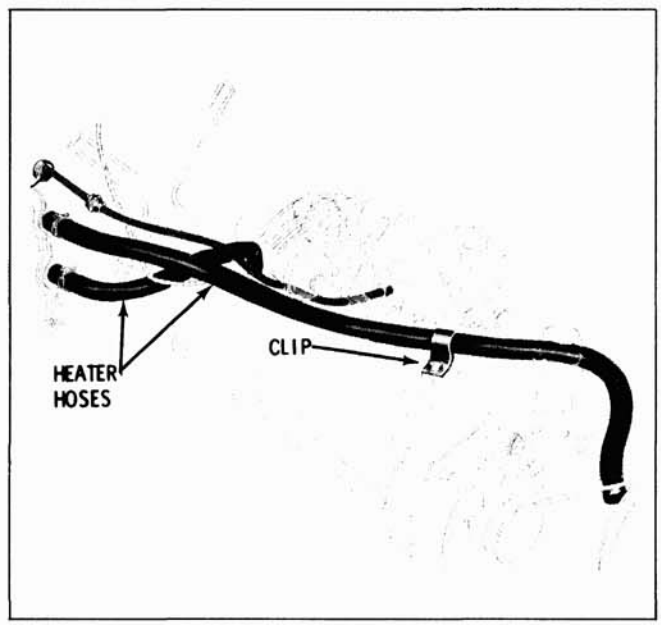


Fig. 1-9—Heater Hose Routing

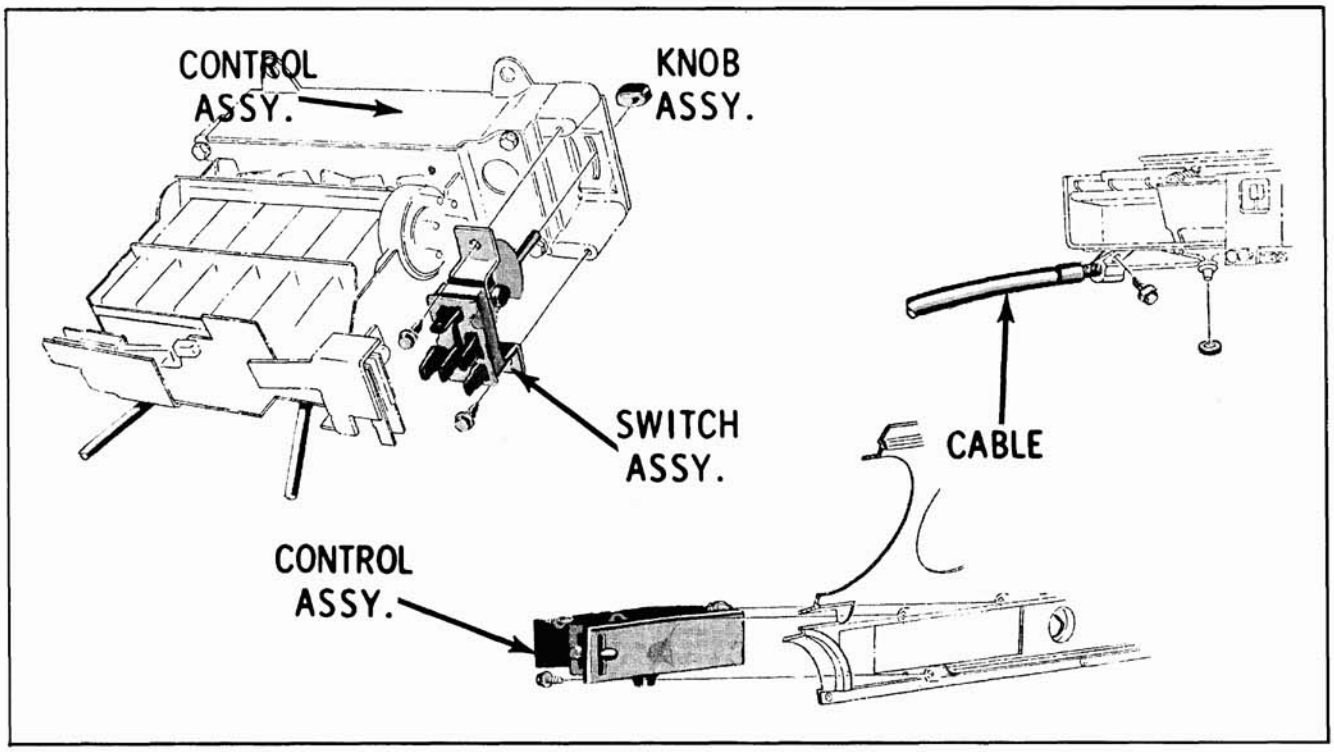


Fig. 1-10—Heater Control Attachment

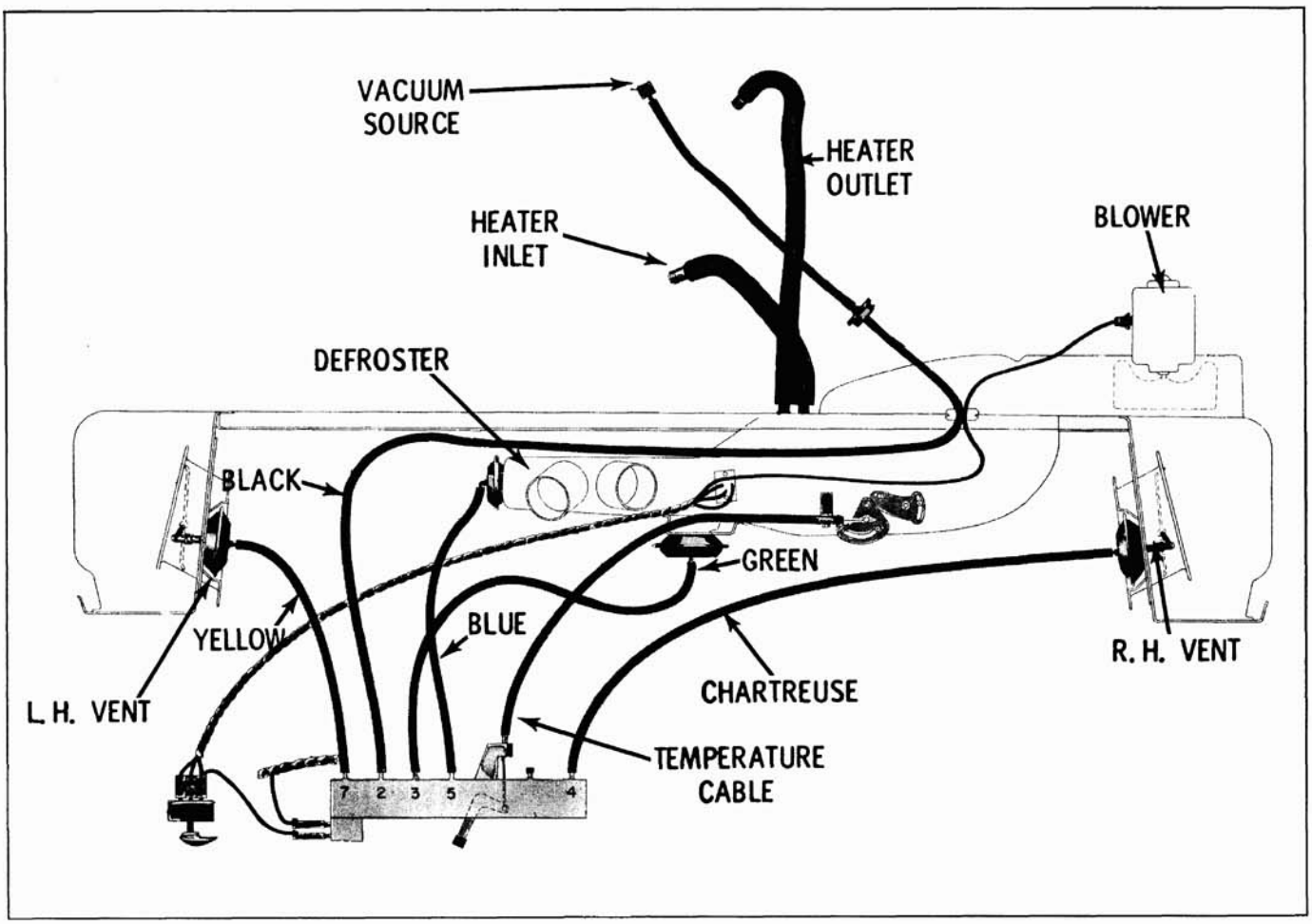


Fig. 1-11—Vacuum Hose Routing

4. Push heater case studs back until studs do not protrude through dash.
5. Remove one fender to dash panel attaching screw just over the blower assembly case.
6. Remove the two bolts from the bottom rear of fender.

Keep track of how many shims there are under each bolt.

7. Push down on inner fender panel and remove blower assembly.
8. Remove blower motor attaching screws and remove blower motor. (Fig. 1-7)

To install reverse the removal procedure. Be sure to position a bead of sealer on the heater inlet as shown in Fig. 1-7.

HEATER CASE AND CORE

Remove and Install (Figs. 1-7 and 1-8)

1. Remove glove box.
2. Disconnect wiring, vacuum lines and defroster hoses from heater case.
3. Drain radiator below heater level, disconnect heater hoses. (Fig. 1-9)
4. Remove the blower assembly attaching screws and nuts.
5. From inside the car, remove the heater case.
6. Remove the heater core from the case.

To install, reverse the removal procedure applying sealer as shown in Fig. 1-7.

VENTILATION AND HEATING CONTROL

Remove and Install (Fig. 1-10)

1. Disconnect all vacuum lines and wiring.
2. Disconnect temperature valve control cable.
3. Remove the attaching nuts and remove control from the rear of instrument panel.

To install, reverse removal procedure. Refer to schematic diagram (Fig. 1-11) for proper installation of hoses. Wiring and hoses must be properly routed and retained.

HEATER RESISTOR

Remove and Install (Fig. 1-7)

The heater resistor is mounted on the heater case with two sheet metal screws. To remove, disconnect wiring connector and remove attaching screws.

To install resistor, reverse removal procedure.

VACUUM CHECK VALVE

A vacuum check valve is located in the vacuum source line in the engine compartment, and retains a vacuum supply to operate the vacuum diaphragms. (Fig. 1-11)

HEATER

31 through 48 Series

DESCRIPTION (Figs. 1-12 and 1-13)

Air is supplied to the heater through the air intake grille and enters the air inlet assembly where air flow is controlled by three different doors.

The heater operates on outside air only and does not have a water valve to control water circulation. Air passing through the core receives maximum heat at all times.

Heater operation is controlled by the air control lever and the temperature control lever. The air control lever operates both the air door and defroster door by use of two bowden cables. The position of the air control lever will determine if the air will be directed to the heater outlet or defroster ducts. The temperature control lever operates the temperature door by the use of a bowden cable. The temperature control lever can be adjusted so that the desired amount of air can be directed through the heater core. The air control lever must be in either HEAT or DEFROST position when the heater is in operation.

CONTROL ASSEMBLY (Fig. 1-14)

Removal

1. Disconnect the wiring connectors and pull out lamp socket.
2. Remove the spring nuts retaining the cables to the control levers.
3. Remove the three screws securing the cables to the control.
4. Remove the three screws securing control to instrument panel and remove control assembly.

Install

1. Position control assembly to instrument panel and retain with the three screws.
2. Position the ends of the cables over the control levers and retain with the spring nuts.
3. Retain the cables to the control.
4. Install lamp socket and connect the two connectors.

If the control only is removed, it should not be necessary to adjust the cables. When the cables are properly adjusted, the levers should have 1/8" clearance when moved to the extreme left position. Cable adjustment is provided on the heater case end of the cable.

FAN SWITCH (Fig. 1-15)

Removal

1. Loosen the set screw retaining the switch knob and remove the knob.
2. Disconnect the two wiring connectors.
3. Remove the screw holding the switch to the heater control and remove the switch.

Install

1. Position the switch to the heater control assembly and install the retaining screw.
2. Connect the two wiring connectors.
3. Observe the flat on the switch shaft and install the knob so that the set screw contacts the flat.

Resistor

The resistor can be removed by disconnecting the harness and removing the two attaching screws. To install, position the resistor on the heater case as shown in Fig. 1-16 and retain with the two screws and connect wiring.

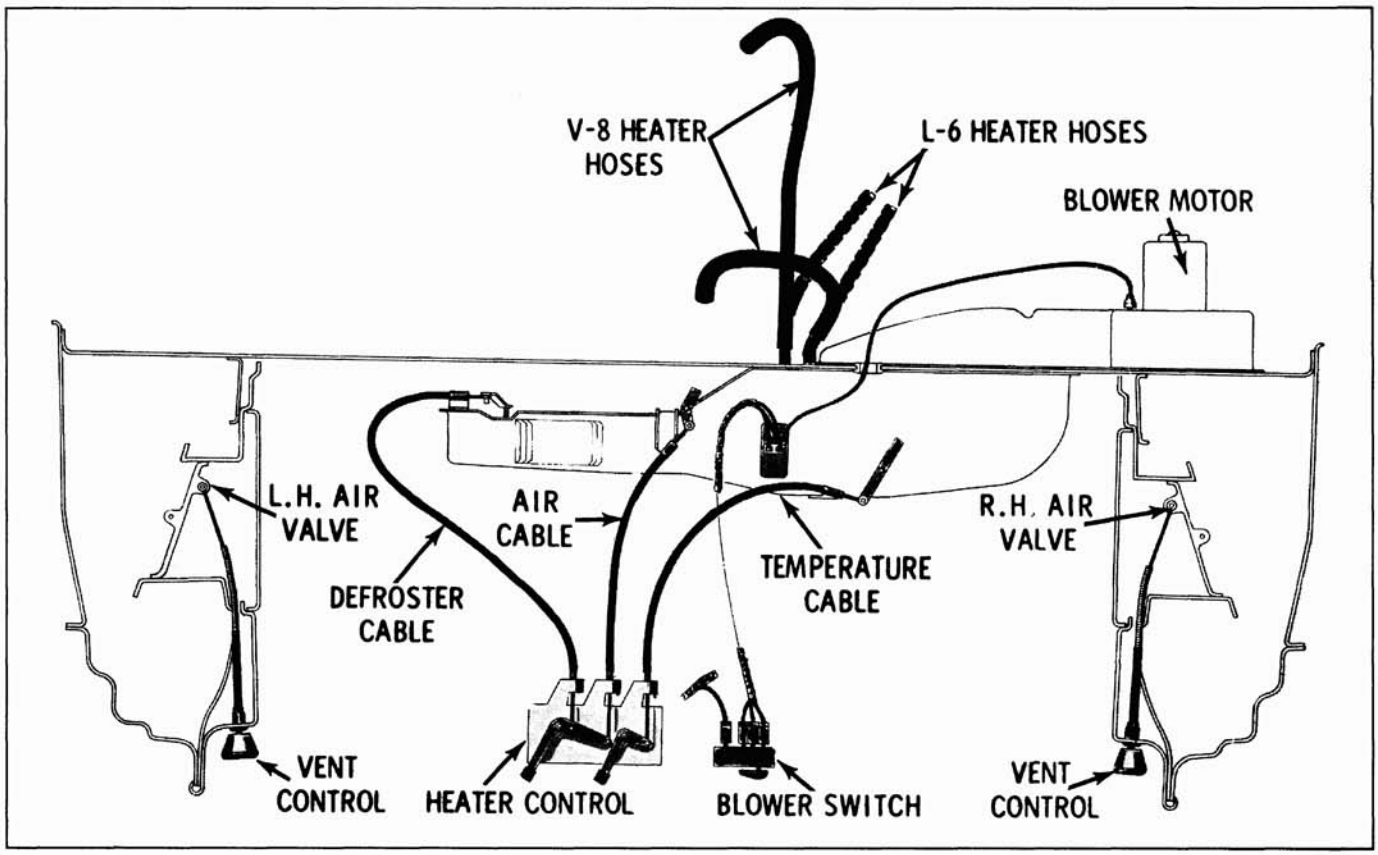


Fig. 1-12—Heater Control Cables

ADJUSTMENTS

The temperature cable and air cable assembly is provided with a turnbuckle on the heater end of the cables. To adjust either of the cables, it is only necessary to adjust the turnbuckle in the necessary direction to obtain 1/8" clearance between the levers and the control assembly. (Fig. 1-17)

Defroster Cable

The defroster cable is not adjustable.

Temperature Cable

With temperature door fully closed and the control in the "cool" position adjust cable turnbuckle for 1/8" clearance between lever and control assembly.

Air Cable

With air valve control cable installed and with air door fully closed in "off" position adjust cable turnbuckle for 1/8" clearance between lever and control assembly.

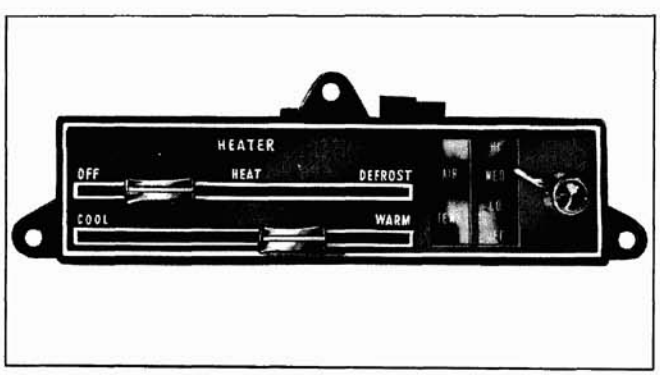


Fig. 1-13—Heater Control

Blower Motor and Air Inlet Assembly (Figs. 1-18 and 1-19)

1. Remove the right front fender filler panel. Refer to Sheet Metal Section 11.
2. Disconnect blower motor wiring.
3. Remove the five nuts and two screws securing inlet assembly to dash.

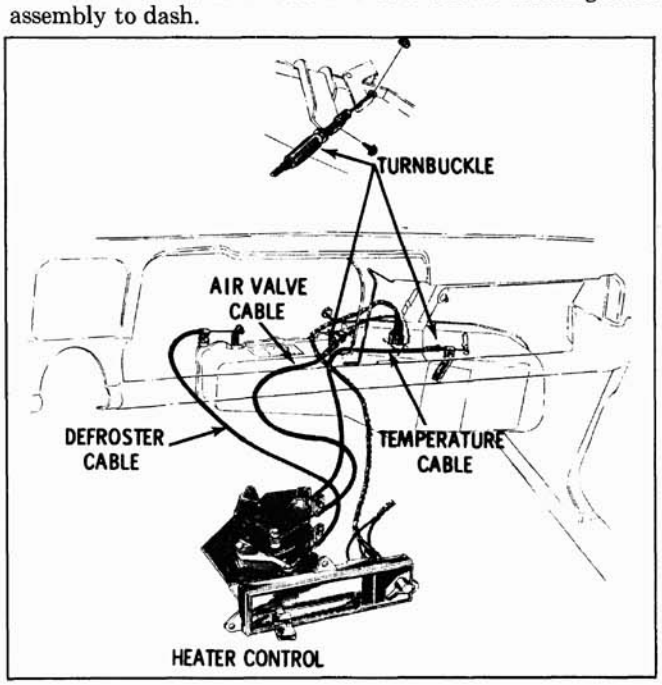


Fig. 1-14—Control Assembly

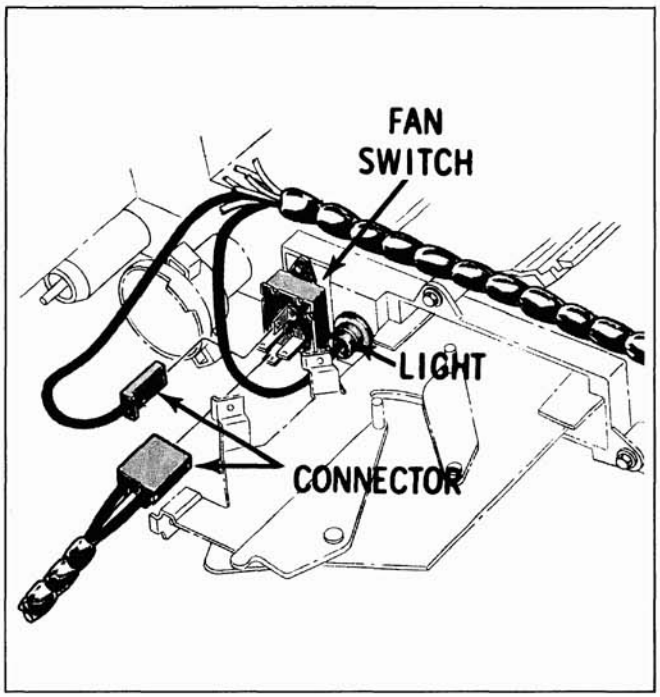


Fig. 1-15—Fan Switch

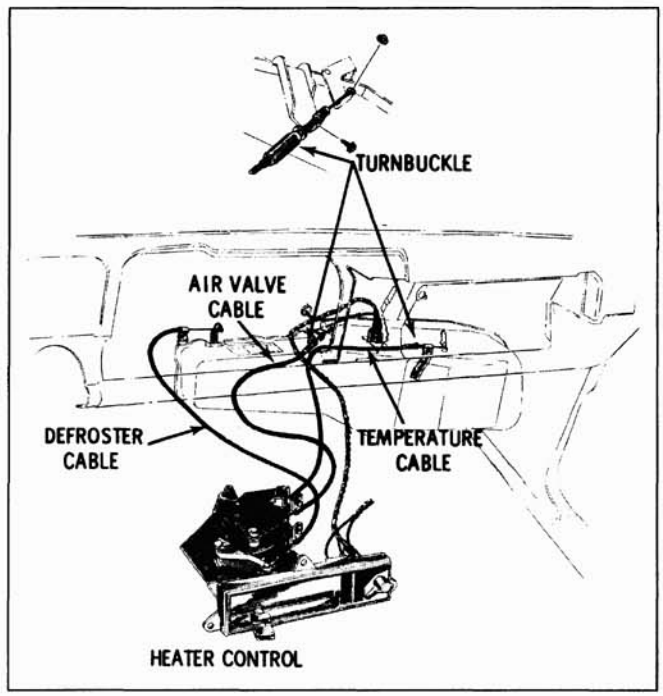


Fig. 1-17—Cable Routing

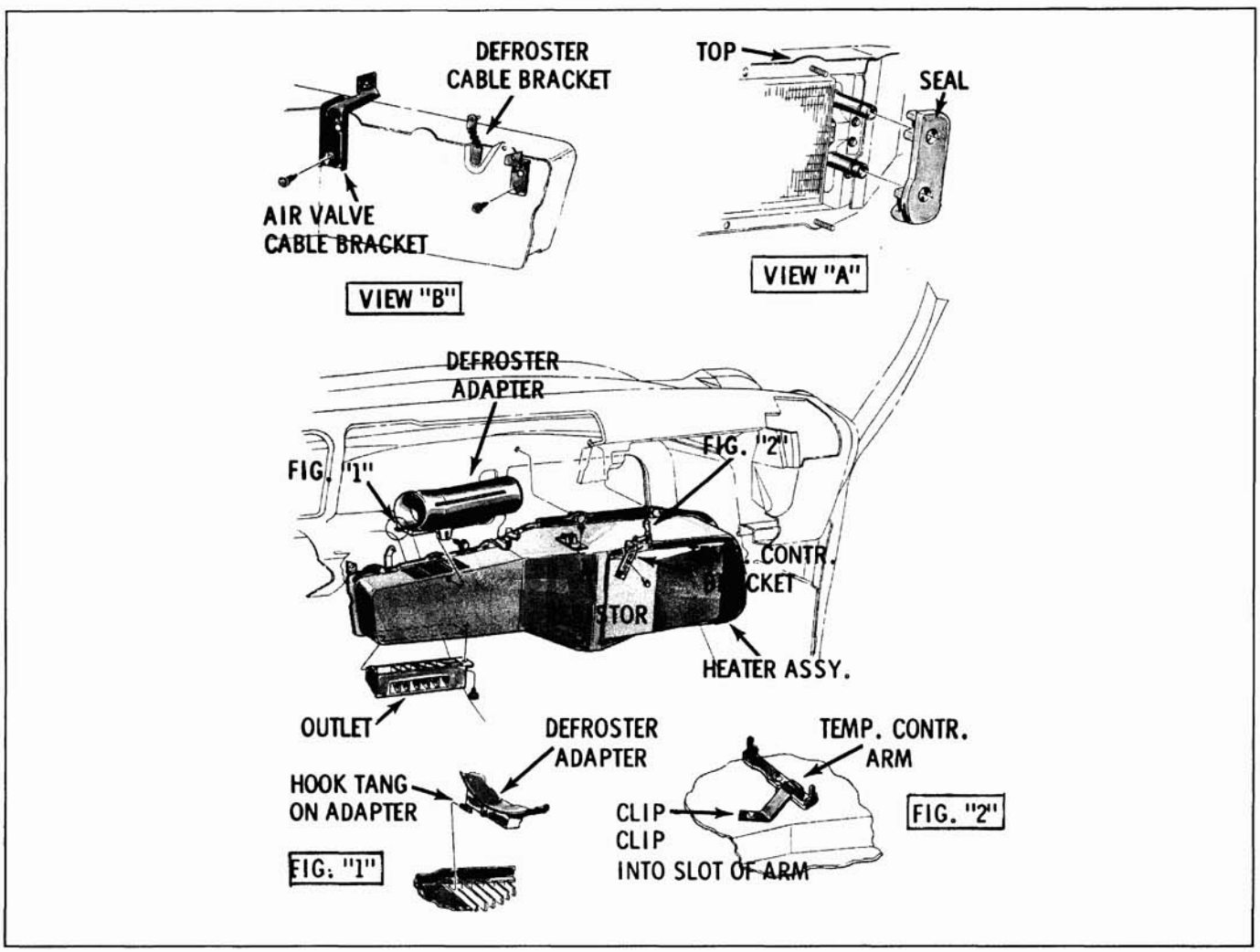


Fig. 1-16—Heater Assembly

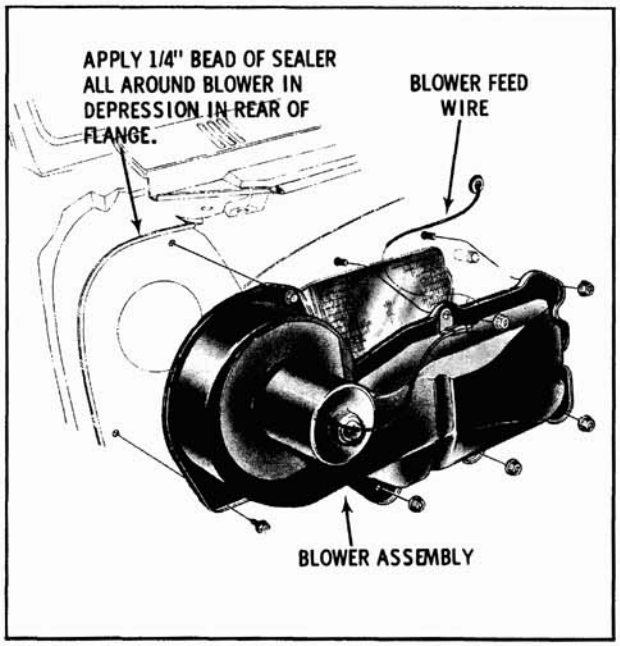


Fig. 1-18—Blower Installation

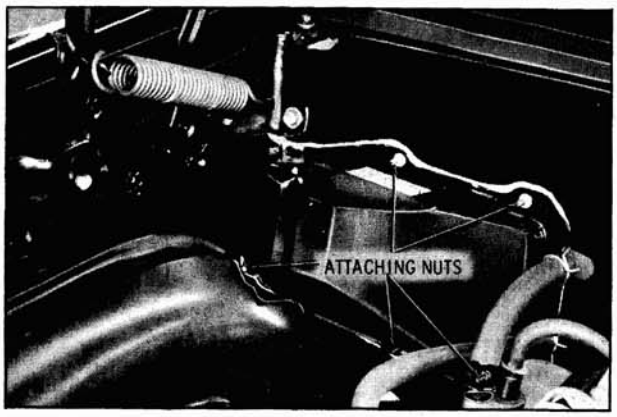


Fig. 1-19—Blower and Air Inlet Attachment

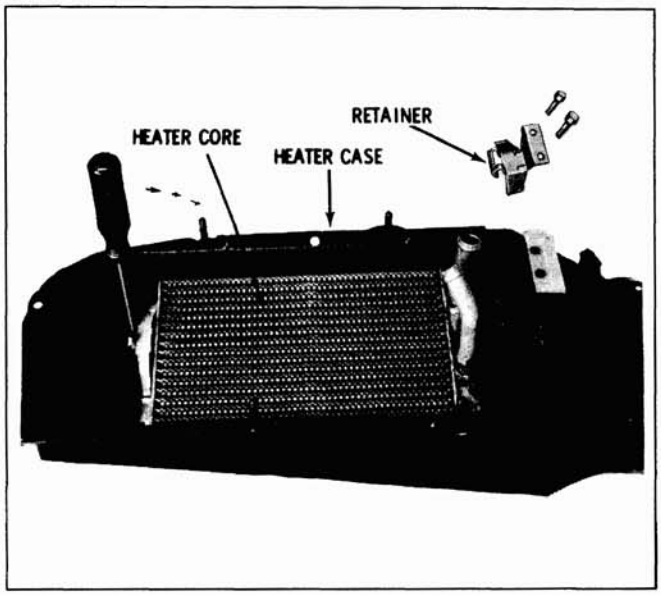


Fig. 1-20—Core to Case Attachment

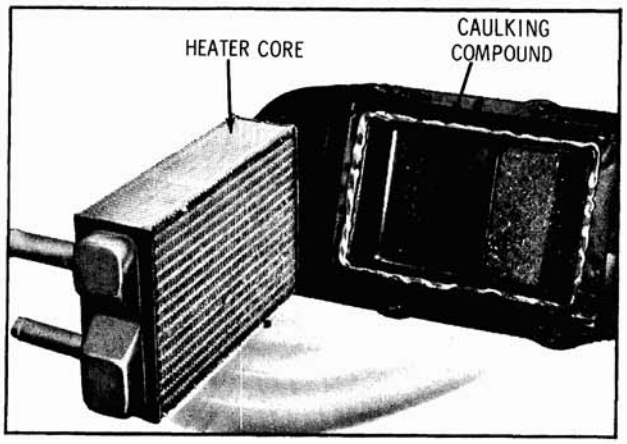


Fig. 1-21—Heater Core Sealing

4. Disengage the inlet assembly from the studs and remove from the car. The blower motor can be removed from the inlet assembly by removing the attaching screws. The fan is secured to the motor shaft by a nut and lockwasher.

To install reverse removal procedure.

Core Assembly

The heater core is located in and attached to the heater case. To remove the core, drain radiators, disconnect heater hoses and remove the five attaching nuts.

To remove the right lower attaching nut it will be necessary to disconnect the right fender at the bottom and block away from body then remove retaining nut through this opening.

Disconnect the resistor wiring, the three control cables and remove the case assembly from the dash panel. The core can be removed from the case as illustrated in Fig. 1-20. When replacing the core in the case, use body sealer or caulking compound as indicated in Fig. 1-21.

To install reverse removal procedure.

HEATER HOSE

The heater water hoses are routed and retained as shown in Fig. 1-22.

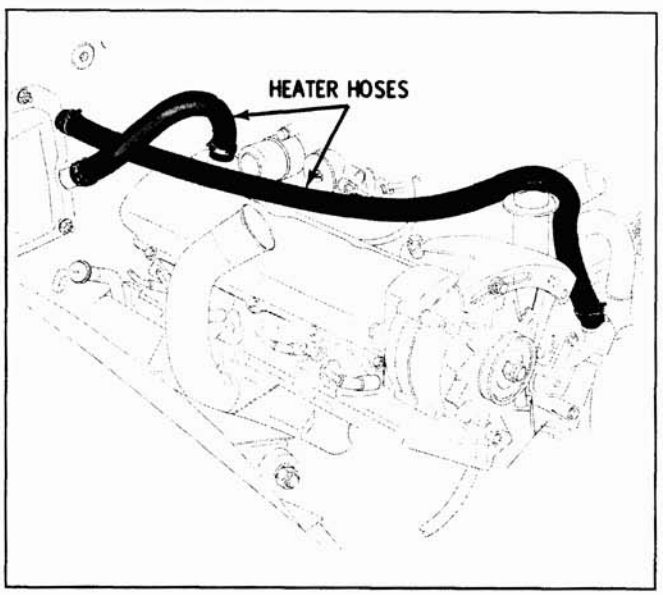


Fig. 1-22—Heater Hose Routing

AIR CONDITIONER

GENERAL DESCRIPTION

Three types of air conditioning systems are available:

Custom (Push-Button, Vacuum Control)
Used on 54-86 Series
Custom (Manual, Vacuum Control)
Used on 31-48 Series
Comfortron (Automatic Control)
Used on 54-86 Series
(Not available on 31-48 Series)

Service information on the Air Conditioner Systems will be covered in order as follows:

1A. General Air Conditioning Information
1B. Custom Air Conditioner (Push-Button, Vacuum Control)
1C. Custom Air Conditioner (Manual, Vacuum Control)
1D. Comfortron (Automatic Control)

GENERAL AIR CONDITIONING INFORMATION

CONTENTS OF SECTION 1A

Subject	Page
PERIODIC MAINTENANCE	1A-1
OPERATION OF SYSTEM	1A-1
REFRIGERATION CIRCUIT	1A-3
SAFETY PRECAUTIONS	1A-5
SPECIAL EQUIPMENT	1A-6
DRIVEN PLATE	
REMOVAL	1A-7
INSTALLATION	1A-7
DRIVE PLATE AND PULLEY	
REMOVAL	1A-8
INSTALLATION	1A-8
CLUTCH COIL AND HOUSING	
REMOVAL	1A-8
INSTALLATION	1A-9
SERVICING REFRIGERANT SYSTEM	
DISCHARGING	1A-10
EVACUATING	1A-10
CHARGING	1A-11
COMPRESSOR SHAFT SEAL	
REMOVAL	1A-12
INSTALLATION	1A-13
COMPRESSOR DISASSEMBLY	
REAR HEAD	1A-14
FRONT HEAD	1A-14
CYLINDER	1A-14
COMPRESSOR ASSEMBLY	1A-17
ADDING REFRIGERANT - PARTIAL CHARGE	1A-21
CHECKING AND ADDING OIL	1A-21
FLUSHING SYSTEM	1A-22

PERIODIC MAINTENANCE

Remove road accumulation from condenser at every engine oil change interval or as necessary.

Check and adjust compressor belt tension at each engine oil change interval.

Check refrigerant level and replenish as necessary at the start of every cooling season.

OPERATION OF SYSTEM

COMPRESSOR

The refrigeration system uses a recirculating axial type six cylinder compressor, with intake and discharge valve reeds for each cylinder. These valve reeds cause the compressor to have a definite separation between the discharge (high) side and the suction (low) side. Oil is picked up by the refrigerant in the compressor and is pumped through the refrigeration system. A magnetic clutch pulley disengages the compressor in OFF and VENT. The compressor is completely serviceable.

A serial number plate is attached to the top side of the compressor and includes the Serial Number, Model Number and refrigerant charge.

PRESSURE RELIEF VALVE

The compressor is equipped with a pressure relief valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed a safe operating pressure. To prevent damage, the valve is designed to open automatically at approximately 440 psi (470 psi on Toronado). Any condition that causes this valve to open should be corrected, and the refrigerant oil and refrigerant should be replenished as necessary.

MUFFLER

A muffler is used in the refrigerant system to reduce compressor noises and high pressure line vibrations. No repairs are to be made on the muffler. If a muffler is defective, it should be replaced. Install the muffler with the outlet side down to prevent trapping refrigerant oil.

CONDENSER

The condenser assembly in front of the radiator is made up of coils which carry the refrigerant, and cooling fins which provide rapid transfer of heat. The air passing through the condenser cools the high pressure refrigerant vapor, causing it to condense into a liquid.

EVAPORATOR

The evaporator is a device which cools and dehumidifies the air before it enters the car. High pressure liquid refrigerant flows through the expansion valve into the low pressure area of the evaporator. This regulated flow of refrigerant boils immediately. Heat from the evaporator core surface is lost to the boiling and vaporizing refrigerant, which is cooler than the core, thereby cooling the core. The heat in the air passing through the evaporator core, is lost to the cooler surface of the core, thereby cooling the air. As the process of heat loss from the air to the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside surface of the evaporator core and is drained off as water.

SIGHT GLASS

The sight glass (at the top of the dehydrator receiver) is provided to aid in diagnosis, by permitting the refrigerant to be observed. The appearance of a steady flow of bubbles or foam, after the compressor has run long enough to stabilize, indicates a shortage of refrigerant, when checking in temperatures above 75°F.

DEHYDRATOR RECEIVER ASSEMBLY

The functions of this unit are to absorb any moisture that may be present in the system after assembly, and to insure a solid charge of liquid refrigerant in the line feeding the expansion valve, providing the system is properly charged. This unit is not serviceable, and should be replaced when there has been a leak in the suction side of the system which permitted air and moisture to be drawn into the system.

EXPANSION VALVE (Fig. 1A-1)

The expansion valve, mounted outside the evaporator, is an externally equalized valve, controlling the flow of refrigerant into the evaporator.

It is important that the expansion valve capillary bulb be tightly clamped to the suction line at the evaporator. Both the suction line and the capillary tube should be clean at the points of contact.

Do not kink capillary tubes when removing or installing.

P.O.A. SUCTION THROTTLING VALVE

OPERATION (Fig. 1A-2)

The abbreviations P.O.A. stand for Pilot Operated Absolute.

The function of the P.O.A. Suction Throttling Valve is to

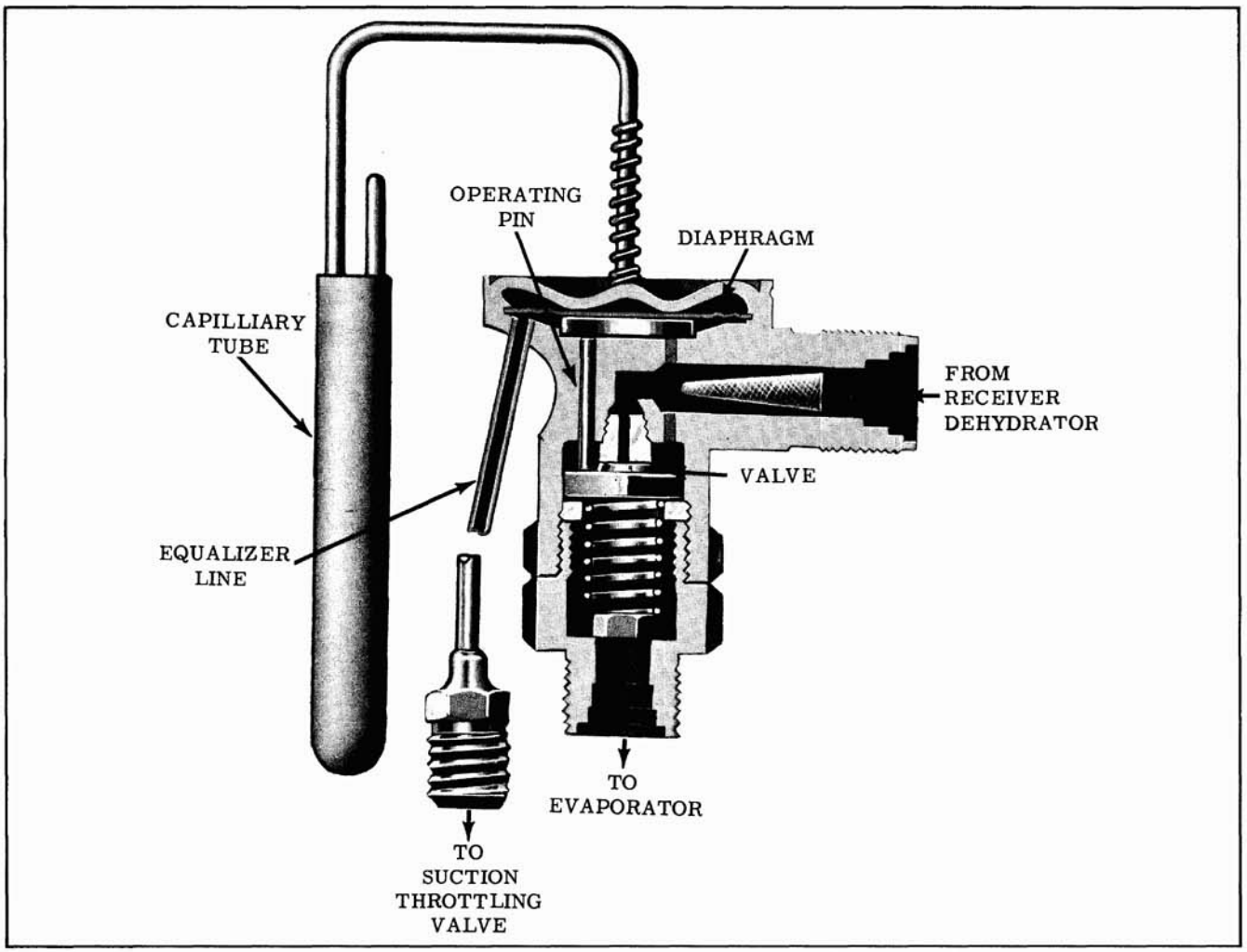


Fig. 1A-1—Expansion Valve

control the evaporator pressure. This is accomplished by throttling or restricting the outlet from the evaporator so that the pressure within the evaporator is maintained at a predetermined value to prevent the freezing of atmospheric moisture on the evaporator.

The valve cannot be repaired or adjusted and is to be replaced as an assembly once it has been determined that it is malfunctioning.

REFRIGERATION CIRCUIT
(Fig. 1A-3)

Heat laden, low pressure vapor refrigerant is drawn into the compressor and pumped from the compressor through the muffler to the condenser under high pressure. The vapor is heated as a result of the compression process. As it passes through the condenser, the high pressure - high temperature vapor is cooled, which causes the vapor to condense into liquid. The liquid refrigerant passes from the condenser into the dehydrator receiver which acts as a reservoir. The liquid in the receiver is still under high pressure.

Liquid refrigerant from the receiver now passes on to the expansion valve. The expansion valve meters refrigerant into the evaporator core. When the pressure in the evaporator is reduced, the liquid refrigerant immediately begins to boil at low temperature as it enters the evaporator. As the refrigerant passes through the evaporator, it continues to boil, absorbing heat from (and thereby cooling) the air passing

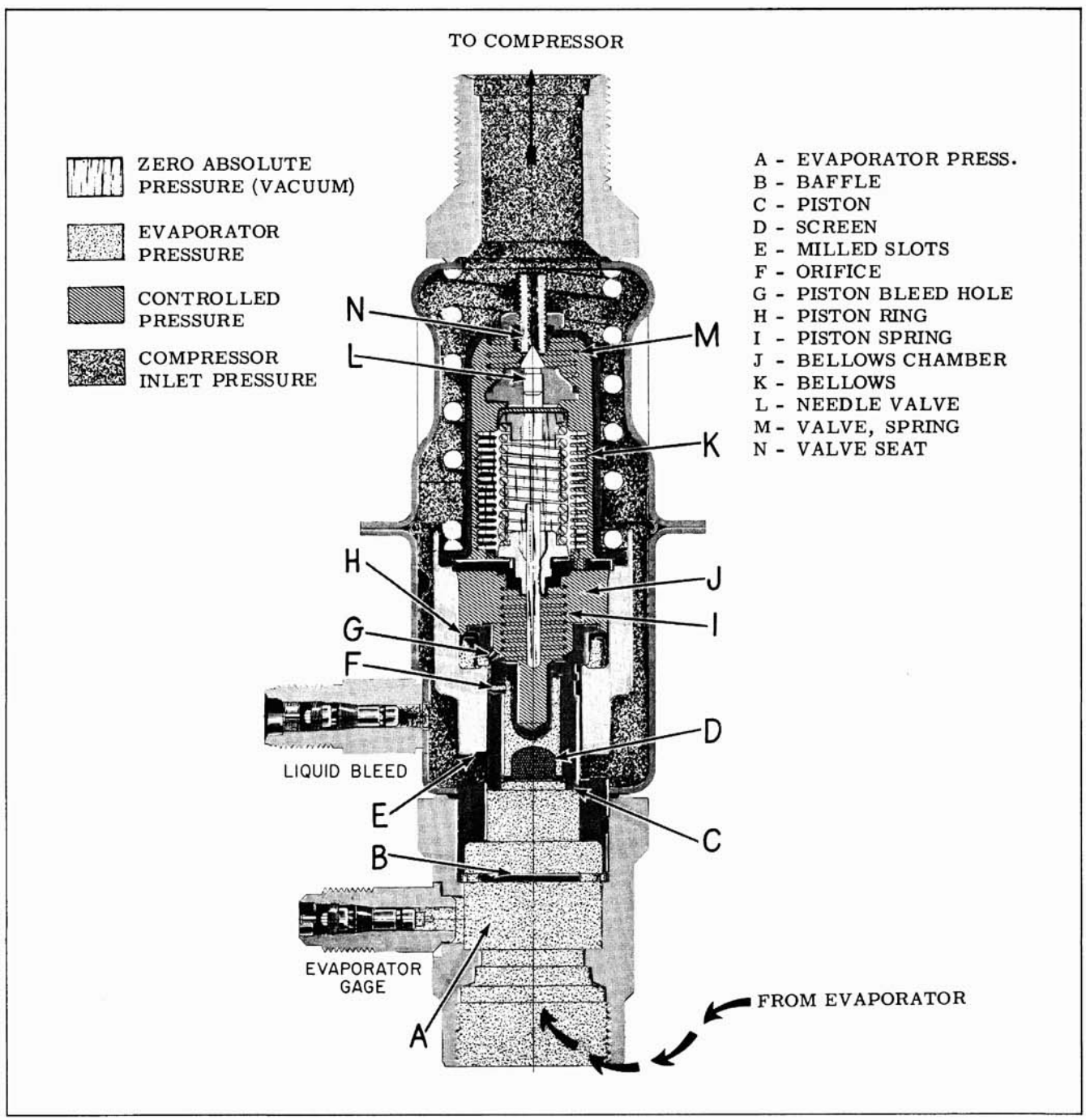


Fig. 1A-2—P.O.A. Suction Throttling Valve

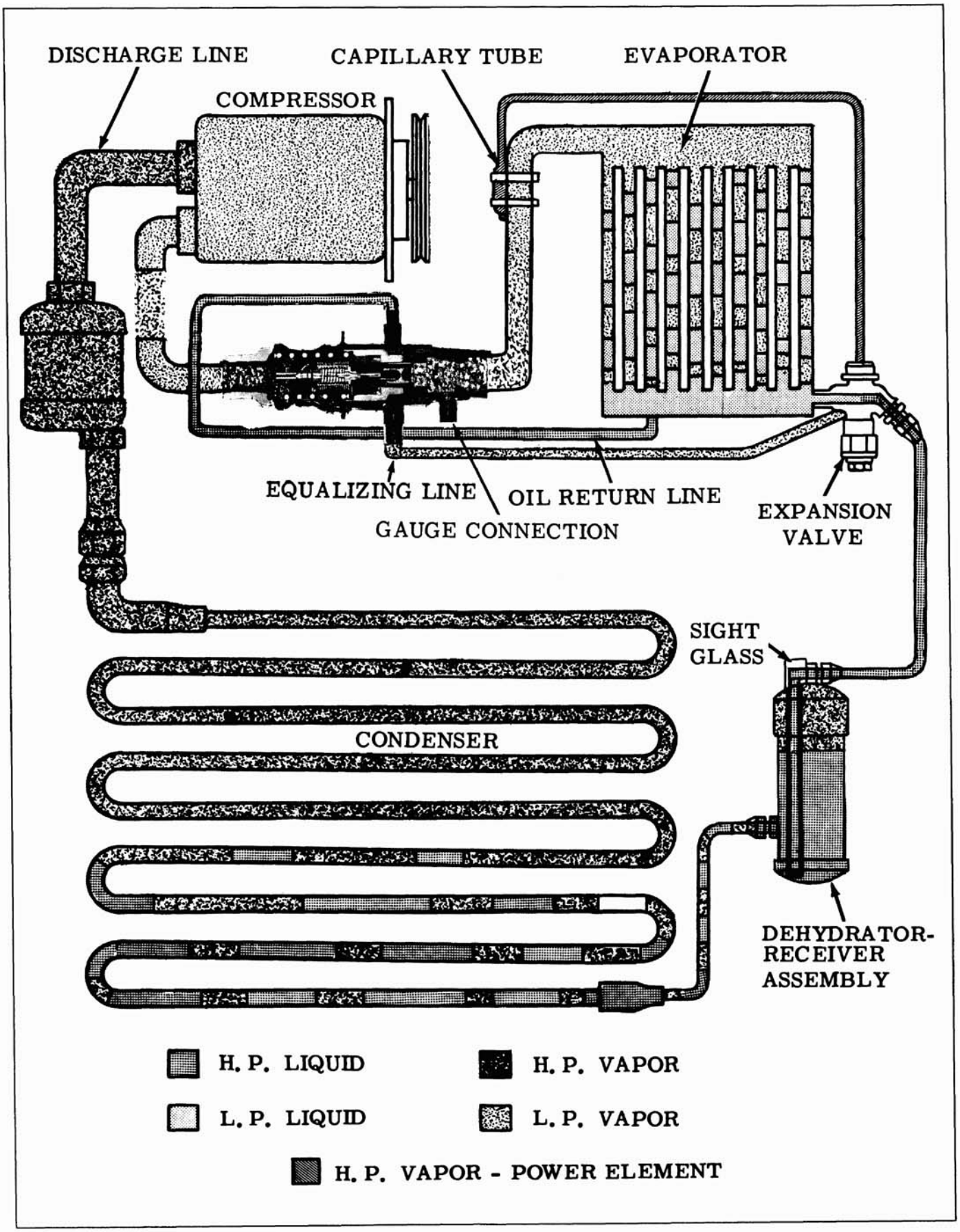


Fig. 1A-3—Refrigeration Circuit

through the evaporator core. By the time the refrigerant leaves the evaporator, it has completely vaporized and has warmed approximately 6°F.

Refrigerant returns from the evaporator through the suction pressure line to the compressor. When the evaporator pressure drops below 29.5 psi, the suction throttling valve restricts the flow of refrigerant to the compressor, thereby raising the evaporator pressure to prevent freezing of the core.

SAFETY PRECAUTIONS

DO NOT LEAVE REFRIGERANT DRUM UNCAPPED

All refrigerant drums have a metal screw cap. This cap protects the valve and safety plug from damage; therefore, the protective cap should always be replaced when the drum is not in use.

DO NOT SUBJECT DRUM TO HIGH TEMPERATURE

The drum should not be exposed to the radiant heat of the sun, for the resulting increase in pressure may cause the safety plug on the drum to burst.

The refrigerant drum should never be subjected to excessive temperature when charging a system. The drum should be heated for charging purposes by placing in 125°F. water. Never heat above 125°F. or use a blow torch, radiator, or stove to heat the drum.

DO NOT WELD OR STEAM CLEAN ON OR NEAR THE SYSTEM

Welding or steam cleaning of, or near, any of the refrigerant lines or components of the refrigerant system can build up dangerous pressures in the system.

DO NOT FILL THE DRUM COMPLETELY

When filling a small drum from the larger one, always allow space above the liquid for expansion. If the drum were completely filled and the temperature increased, tremendous hydraulic force would develop.

DO NOT DISCHARGE VAPOR INTO AREA HAVING EXPOSED FLAME

Large quantities of refrigerant 12 should not be discharged into a closed room. The refrigerant may displace the oxygen in the air. Also, heavy concentrations of refrigerant 12 in contact with a live flame, such as a gas heater, or drawn into the intake of a running engine will produce a poisonous gas. This gas will also tarnish all bright metal surfaces.

DO NOT EXPOSE EYES TO REFRIGERANT

One of the most important precautions is protection of the eyes when handling refrigerant. Any liquid refrigerant which may accidentally escape is approximately 21.7°F. below zero. If any refrigerant comes in contact with the eyes, serious injury could result. Always wear goggles to protect the eyes when handling refrigerant.

If refrigerant should come in contact with the eyes:

1. DO NOT rub the eyes. Splash the eyes with cold water to gradually get the temperature above the freezing point.
2. Apply a protective film of an antiseptic oil over the eye ball to reduce the possibility of infection.
3. Consult a doctor or an eye specialist immediately.

Should liquid refrigerant come in contact with the skin, the injury should be treated the same as though the skin had been frostbitten or frozen.

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation of the air conditioning refrigeration

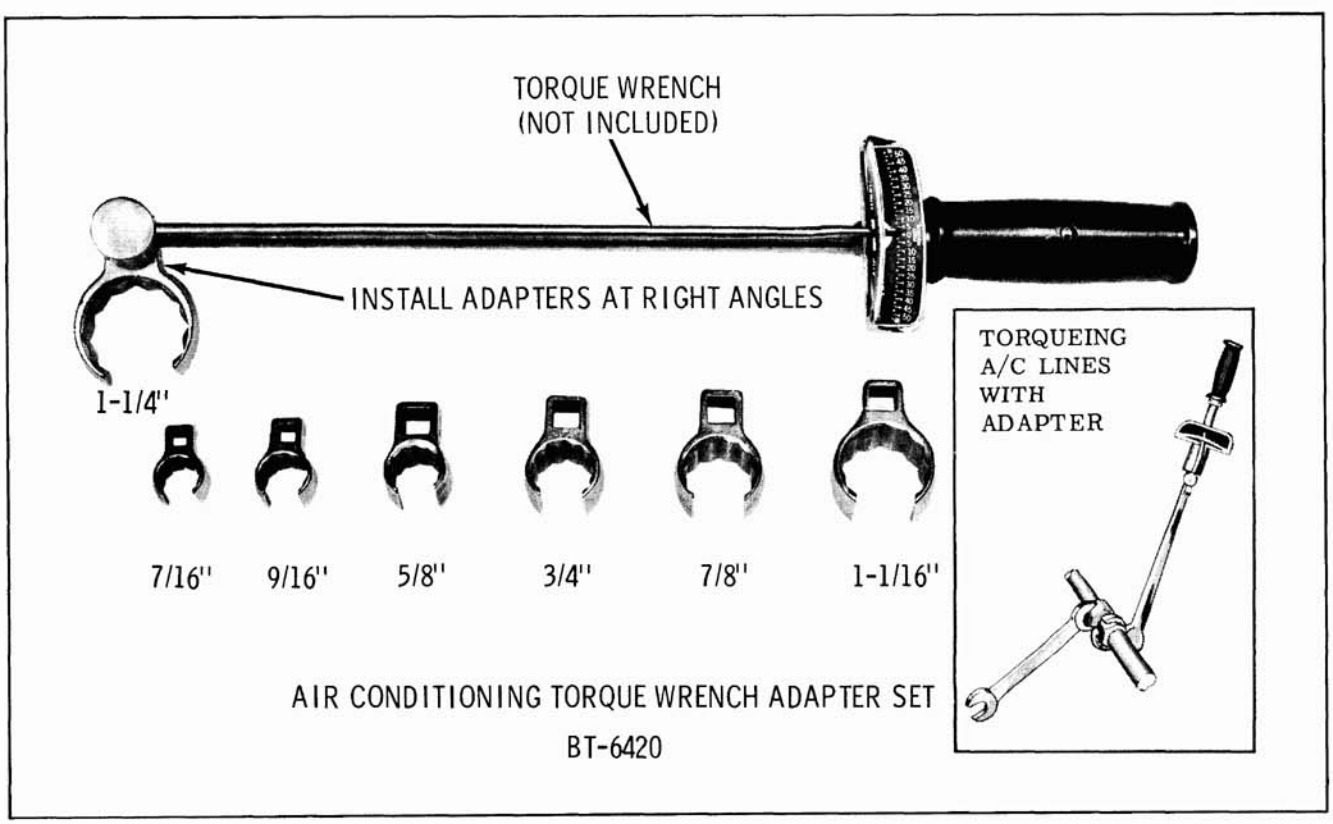


Fig. 1A-4—Torque Wrench Adapter Set

system is dependent on the pressure-temperature relationship of pure refrigerant. As long as the system contains only pure refrigerant (plus a specified amount of compressor oil which mixes with the refrigerant), it is considered to be chemically stable.

When foreign materials, such as dirt, air or moisture are allowed to get into the system, they will affect chemical stability, resulting in the formation of acids or sludge which could cause the expansion valve to freeze up, and change the pressure-temperature relationship of the refrigerant. Thus, the system will no longer operate at the proper pressures and temperatures, and the efficiency will decrease and parts deteriorate.

The following general practices should be observed to insure chemical stability in the system:

KEEP LINES SEALED

When disconnecting refrigerant lines, the lines should be at, near or above surrounding room temperature to prevent formation of condensation inside the lines. The lines should also be immediately capped to prevent entrance of dirt or foreign material.

KEEP TOOLS CLEAN

Tools should be kept clean and dry. This includes the gauge set and replacement parts. Keep gauge lines plugged when not in use.

USE CLEAN DRY OIL CONTAINER

When adding oil to compressor, the container should be exceptionally clean and dry due to the fact that refrigeration oil is as moisture-free as possible; therefore, it will quickly absorb any moisture with which it comes in contact.

KEEP OIL CONTAINER CAPPED

The oil container should not be opened until ready for use and should be capped immediately after use to reduce the possibility of the oil absorbing moisture and dirt entering the container.

DO NOT KEEP SYSTEM OPEN LONGER THAN FIVE MINUTES

PRECAUTION IN HANDLING LINES

Always wear safety goggles when opening refrigerant lines.

All line connections use "O" rings for sealing. Replacement lines must be checked to see that they are completely sealed and dehydrated. Refrigerant lines must be free of kinks which would restrict the flow of refrigerant and cause noise.

Insulated clamps are used to reduce vibration and it is important to reinstall all the clamps when a line is replaced. Tightening connections is very important and the proper size wrenches should be used. The opposing fitting should always be held with a wrench to prevent distortion of connecting lines or components. This is especially important in tightening a hose connection as twisting a hose stiffens it and permits it to transmit more vibration. ALWAYS USE TWO WRENCHES WHEN TIGHTENING OR LOOSENING LINE FITTINGS. "O" rings should be coated with refrigeration oil and installed on the line before the line is inserted into the fitting, to prevent damaging the "O" ring. If leaks are encountered at couplings or connectors, no attempt should be made to correct the leaks by tightening the connections beyond the recommended torque. The "O" rings are designed to seal at the specified torque and overtightening the connection does not result in a satisfactory permanently sealed connection. The connection must be disassembled and the cause of the leak (damaged "O" ring, defective pipes, etc.) corrected. Refer to Fig. 1A-4 for use of Tool BT-6420.

TORQUE IN FT. LBS.

TUBE OD	SWIVEL NUT ON STEEL TUBE	SWIVEL NUT ON ALUMINUM TUBE
1/4"	10 to 15	5 to 7
3/8"	30 to 35	11 to 13
1/2"	30 to 35	15 to 20
5/8"	30 to 35	21 to 27
3/4"	30 to 35	28 to 33
For steel to aluminum connections, use the aluminum torque specifications.		

In the event any line is opened to atmosphere, it should be IMMEDIATELY capped to prevent entrance of moisture and dirt.

SPECIAL EQUIPMENT

REFRIGERATION GAUGE SET (Fig. 1A-5)

The gauge set is used when discharging, evacuating, charging, or diagnosing trouble in the system. The low pressure gauge is graduated into pounds of pressure from 0 to 100 and in the opposite direction in inches of vacuum from 0 to 30. The high pressure gauge is graduated from 0 to 300 pounds pressure. The center connection is common to both and is for the purpose of attaching a line for adding refrigerant or evacuating the system. When this connection is not required, it should be capped with a flare nut and cap.

The shut-off valves close each opening to the connector and to each other. They DO NOT open or close off pressure to the gauges.

LEAK DETECTOR

The Leak Detector is a gas operated torch type detector using a replaceable cylinder. It can also be used as a blow-torch by replacing the leak detector burner unit with Utility Torch Unit.

Leak Detector J-6084

1. Open control valve until slight hiss of gas is heard, then light gas at opening in chimney.

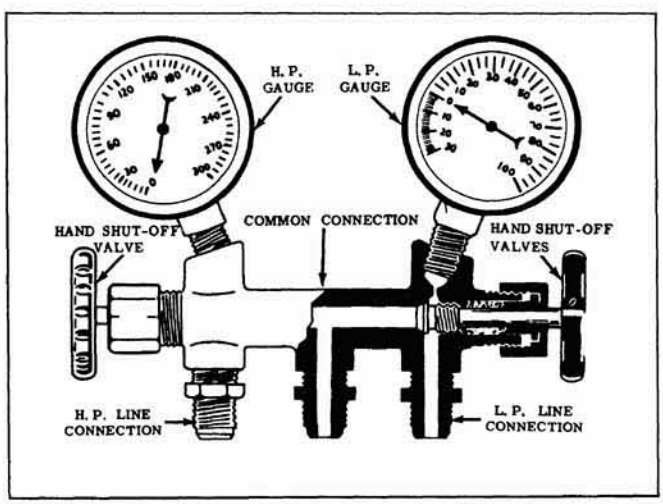


Fig. 1A-5—Gauge Set

Do not use lighted detector in any place where combustible or explosive gases, dusts or vapors may be present.

2. Adjust the flame until the desired volume is obtained. A pale blue flame approximately 3/8" above the reaction plate is best for detecting leaks.

The reaction plate will be heated to a cherry red.

Correction For Yellow Flame

If the flame is yellow, insufficient air is being inspirated or the reaction plate is dirty. Insufficient air may be caused by:

1. Obstructed or partially collapsed suction tube.
2. Dirt or foreign substance in burner tube.
3. Dirty or partially clogged orifice.

Blowing air through the suction tube and back through the detector will usually clear dirt or foreign matter. If a yellow flame is caused by dirty reaction plate, allow the flame to burn for several minutes. This will usually burn the plate clean. If an oxide film appears on the reaction plate from continued use, it will reduce the sensitivity of the detector. This may be remedied by removing the plate and scraping the surface gently with a knife.

To Clean Orifice

1. Never attempt to clean orifice by passing anything through the hole.
2. Unscrew burner assembly from burner tube by applying wrench to hexagon part located immediately below search hose connection. Turn to left. This will expose orifice block which is inserted into the end of the tube.
3. Remove orifice block from tube.
4. Reverse orifice block and replace against burner tube; screw burner head onto burner tube (hand tight), then open valve quickly, admitting several short blasts.
5. To reassemble; unscrew burner head, insert orifice block into burner tube, and screw burner head onto burner tube with a wrench to form a gas-tight joint.

CHECKING FOR REFRIGERANT LEAKS

After the leak detector flame is adjusted, check for refrigerant leaks in an area having a minimum amount of air flow in the following manner:

Do not breathe the fumes and black smoke that are produced if the leak is a big one. They are poisonous. Any time an open flame is used near a car there is a certain amount of danger. Although the torch flame is small and well protected, it is recommended that a fire extinguisher be close at hand for any emergency that might arise.

Explore for leaks by moving end of hose or sampling tube around all connections and points where a leak may be. Check around bottom of connections, since Refrigerant 12 is heavier than air and will, therefore, be more apparent at bottom of fitting. (Refer to compressor shaft seal for seal leak detection.)

The color of the flame will turn to a yellow-green when a small leak is detected. Large leaks will be indicated by a change in color to brilliant blue or purple. When the suction hose is moved away from the leak the flame will clear to an almost colorless pale blue again.

LEAK DETECTOR (LIQUID)

There are a number of fittings and places throughout the air conditioning unit where a leak detector solution may be used to pinpoint leaks.

Apply the solution to the suspected area. Bubbles will form within seconds if there is a large leak.

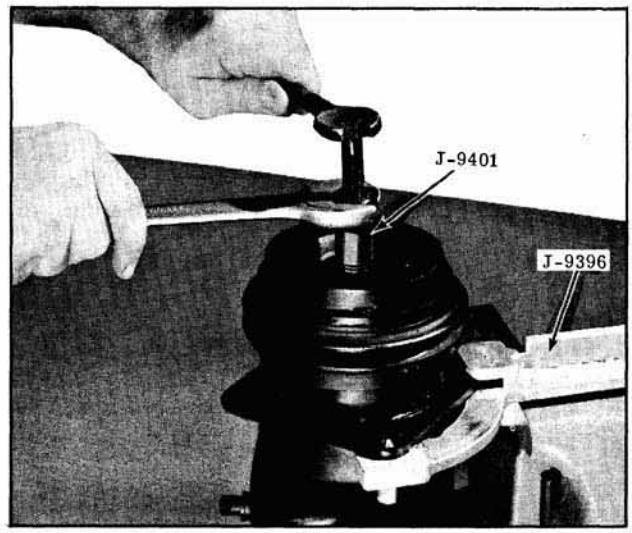


Fig. 1A-6—Removing Driven Plate

VACUUM PUMP

If a leaking system has been operated in a discharged condition, the receiver dehydrator assembly should be replaced and a vacuum pump used to thoroughly evacuate the system.

CLUTCH, PULLEY AND COIL

The following procedures can be performed with the compressor either on or off the car. When working with the compressor on the car, the compressor should be disconnected from the mounting bracket and tipped upward to provide adequate working clearance.

DRIVEN PLATE

Removal

1. Using a thin wall socket, remove the locknut from the compressor shaft. Use Tool J-972-A to hold driven plate.
2. Install Puller J-9401 into hub of driven plate. Hold main body of tool and turn forcing screw clockwise to remove driven plate. (Fig. 1A-6)
3. Remove tool from hub of driven plate.
4. Remove the retaining ring and spacer washer from inside the driven plate.
5. Remove key from either the compressor shaft or the driven plate.
6. Inspect driven plate for cracks or stresses in the resilient drive. Do not replace driven plate for a scoring condition. (Fig. 1A-7)

Installation

1. Insert the square drive key into the hub of driven plate; allow it to project approximately 3/16" out of the keyway.
2. Line up the key in the hub with keyway in the shaft. (Fig. 1A-8)
3. Position the Driven Plate Installing Tool J-9480 on the threaded end of the shaft. The "Free" Washer, J-9480-2, should be in place under the hex nut on the tool. This tool has a left hand thread on the body. (Fig. 1A-9)
4. Press the driven plate onto the shaft until there is approximately 3/32" space between the frictional faces of the clutch plates.
5. Remove installing tools.
6. Install hub spacer washer and snap ring.
7. Install the locknut, using a thin wall socket. Tighten to 15 ft. lbs. torque. The air gap between the friction faces should now be between .022" to .057" clearance. (Fig. 1A-10)

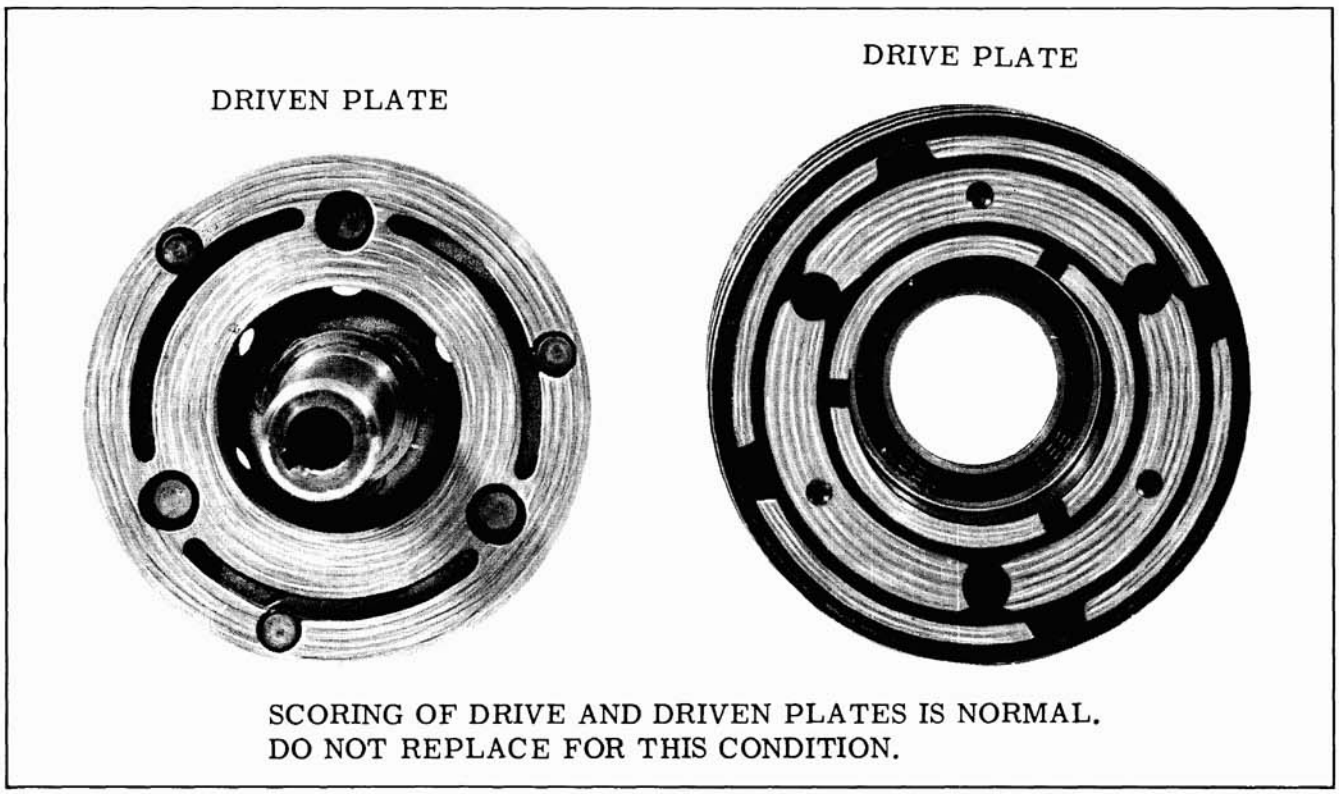


Fig. 1A-7—Driven Plate and Drive Plate

DRIVE PLATE AND PULLEY ASSEMBLY

Removal

1. With the driven plate removed, remove the pulley retaining ring with Pliers J-6435. (Fig. 1A-11)
2. Insert Pilot J-9395 over shaft then remove pulley with Puller J-8433. (Fig. 1A-12)
3. If necessary to remove the pulley bearing, proceed as follows:
   a. Remove the bearing retaining ring.
   b. Drive out bearing with brass drift. (Fig. 1A-13)
   c. Install new bearing as shown in Fig. 1A-14 then install retaining ring.

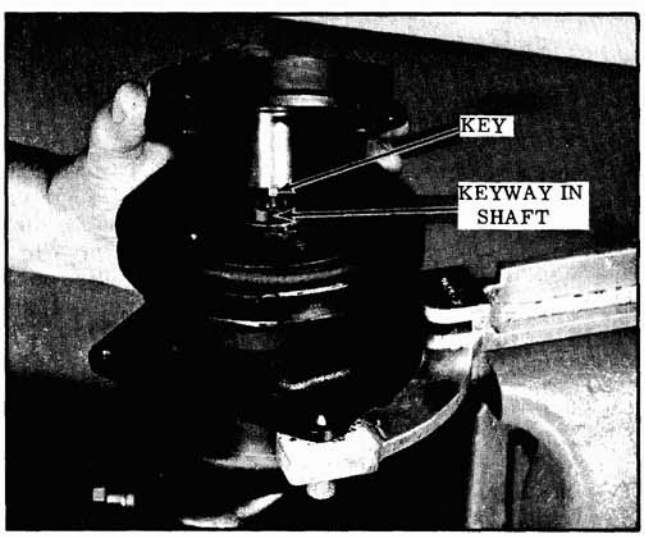


Fig. 1A-8—Aligning Driven Plate Key

Installation

1. Install the pulley and bearing assembly on the end of the compressor, with Tool J-9481. (Fig. 1A-15) The pulley should rotate freely.
2. Install the pulley retaining ring with Pliers J-6435.

CLUTCH COIL AND HOUSING

Removal

1. With the driven and drive plates removed, scribe the clutch coil housing and compressor housing.

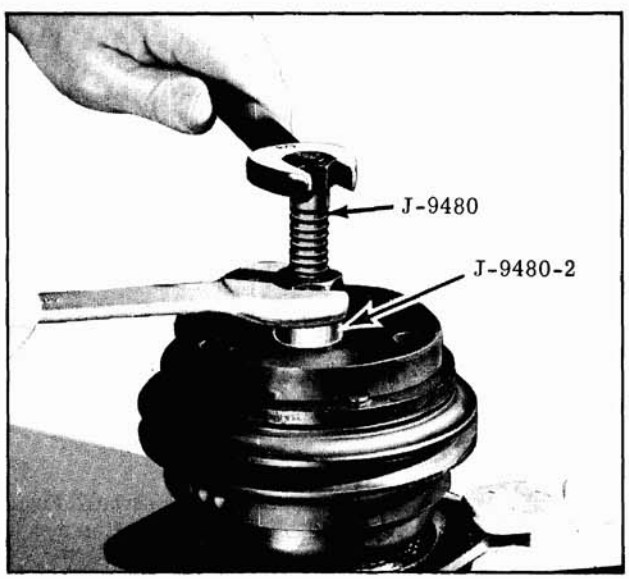


Fig. 1A-9—Installing Driven Plate

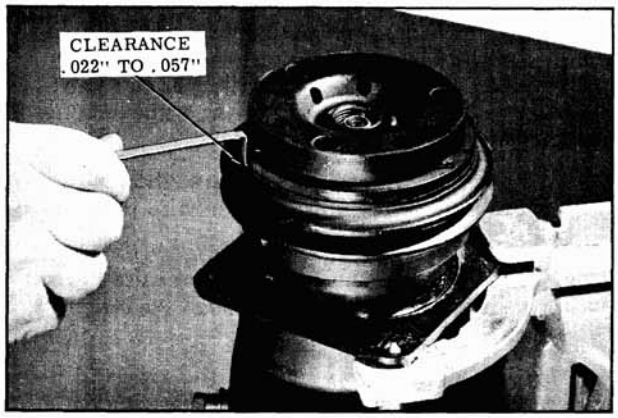


Fig. 1A-10—Checking Air Gap

Fig. 1A-11—Removing Pulley Retaining Ring

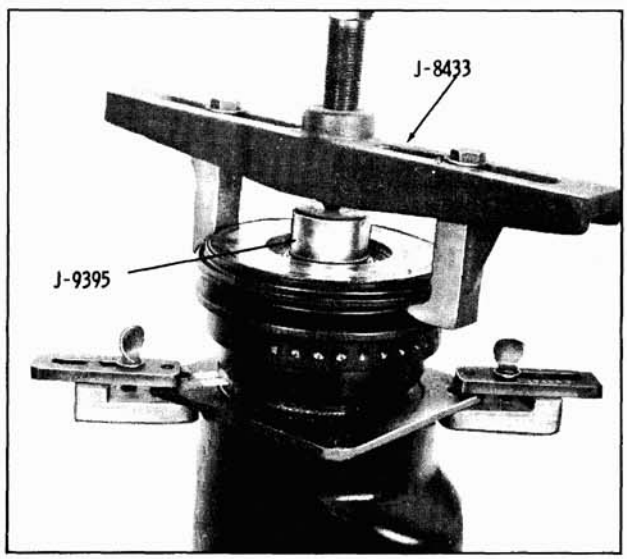


Fig. 1A-12—Removing Pulley and Drive Plate

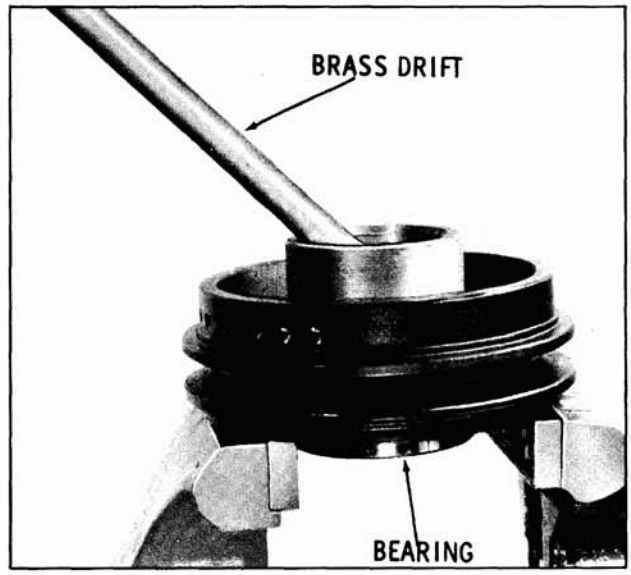


Fig. 1A-13—Removing Bearing

2. Remove the clutch coil housing retaining ring with Tool J-6435. (Fig. 1A-16)
3. Remove coil housing assembly.

Installation

1. With the scribe marks aligned, locate the extrusions on the coil housing with the holes in the front head.
2. Install the coil retainer ring with Tool J-6435.

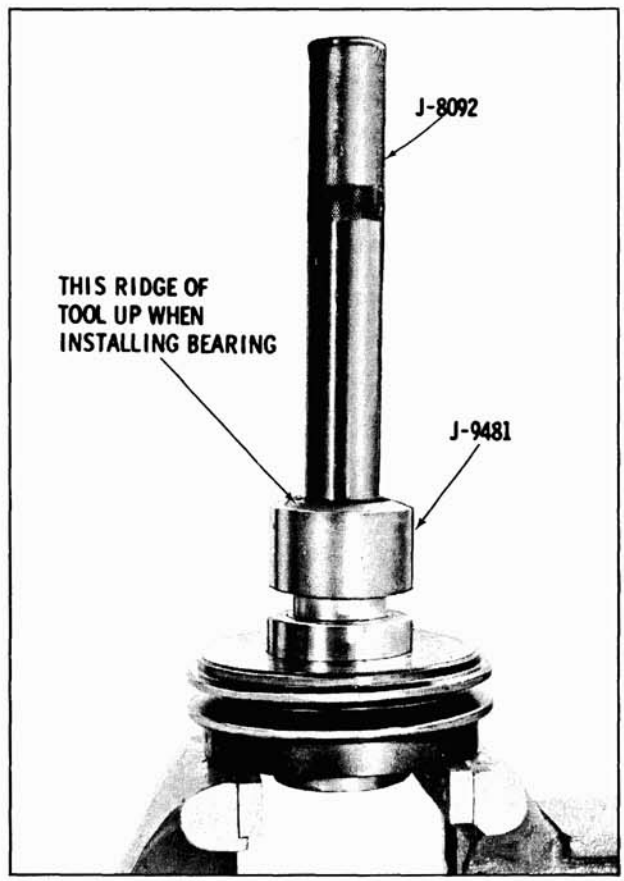


Fig. 1A-14—Installing Pulley and Drive Plate Bearing

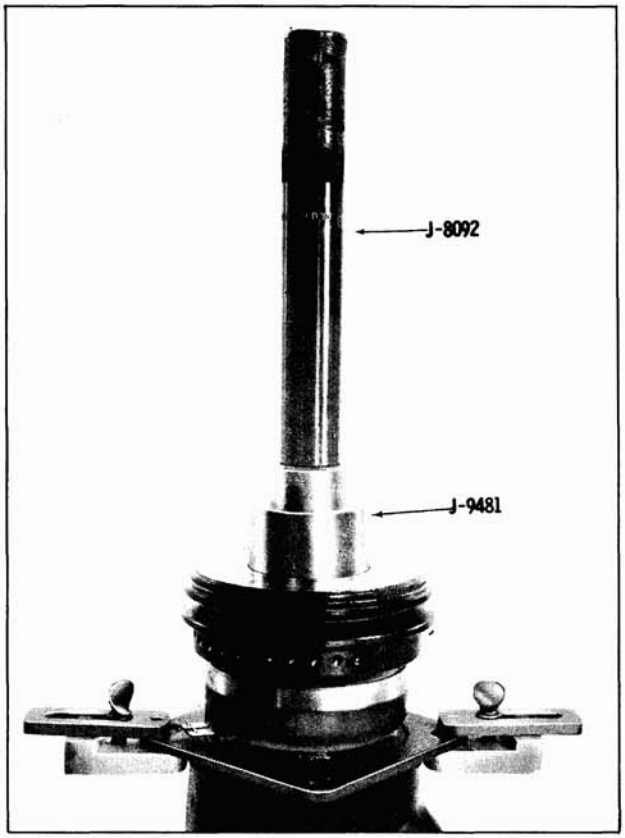


Fig. 1A-15—Installing Pulley and Drive Plate

SERVICING OF THE REFRIGERANT SYSTEM

In removing and replacing any part of the refrigerant system, the following operation must be performed.

1. Discharge the system by releasing the refrigerant to atmosphere.
2. Remove and replace the defective part.
3. Evacuate the system of air and moisture.
4. Charge the system with refrigerant 12.
5. Leak test connections which were disconnected.

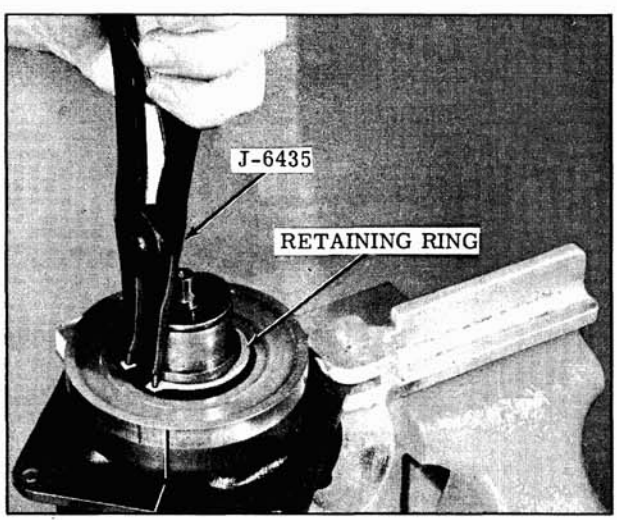


Fig. 1A-16—Removing Coil Housing Retaining Ring

DISCHARGING THE SYSTEM

1. With the engine stopped, remove protective caps from compressor discharge and suction Schrader valves.
2. Connect Gauge Set J-5725 with Schrader Valve Adapters J-5420 to the Schrader valve fitting at the compressor and suction throttling valve.

When connecting the gauge set to the Schrader valve adapters, use a cloth as a guard to divert escaping refrigerant.

3. Crack open both high and low pressure gauge valves and allow refrigerant to escape through the center outlet of the gauge set.

Do not open valves beyond the cracking point, or compressor oil may be discharged with the refrigerant.

After the complete system has been discharged of refrigerant, any part of the refrigeration system can be serviced.

EVACUATING THE SYSTEM

In the following procedure, the specification of 28 inches of vacuum is used. This figure is based on performing the operation at an elevation at or near sea level. For every 1000 ft. of elevation above sea level, the specification should be lowered one inch.

1. Connect the Gauge Set J-5725, vacuum pump and refrigerant charging drum as shown in Fig. 1A-17. Use J-5420 Schrader Valve adapters to connect gauge lines to the Schrader valve fittings at the compressor and suction throttling valve.
2. Open gauge set high and low pressure valves and start vacuum pump. Pull a vacuum of 28". Close gauge set valves and vacuum pump valve. Shut off vacuum pump. If loss of vacuum exceeds 2" in five minutes, the system leaks. Check

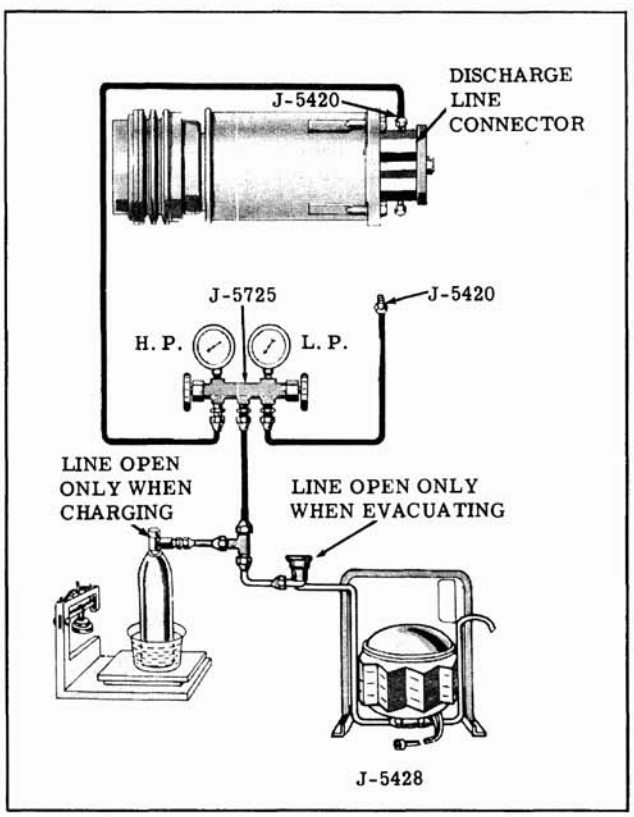


Fig. 1A-17—Evacuating The System

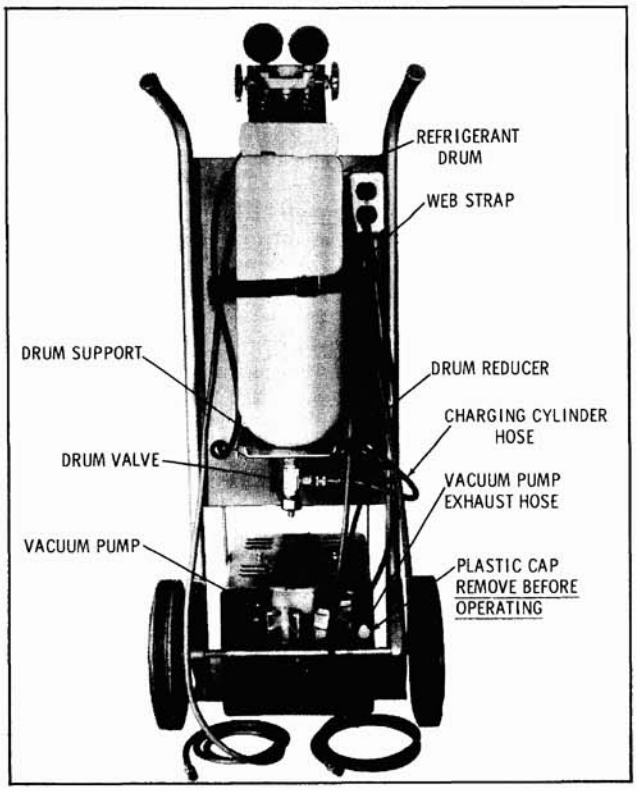


Fig. 1A-18—Charging Station

all system connections for proper tightness.

3. If system does leak, crack open refrigerant drum valve and the low pressure gauge valve and allow system to charge to drum pressure. Close drum valve. Using a refrigerant leak test torch, check system for leaks. Correct leaks and repeat procedure until leaks are eliminated.

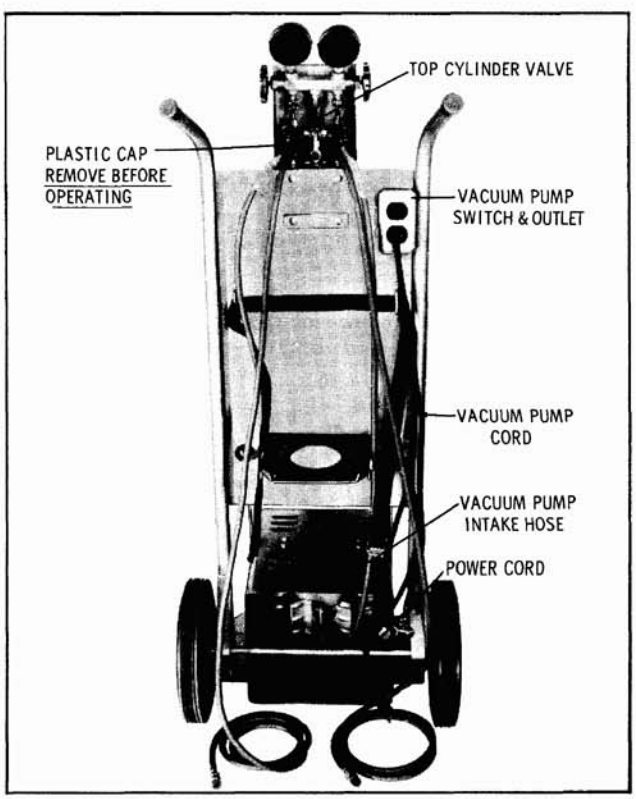


Fig. 1A-19—Charging Station

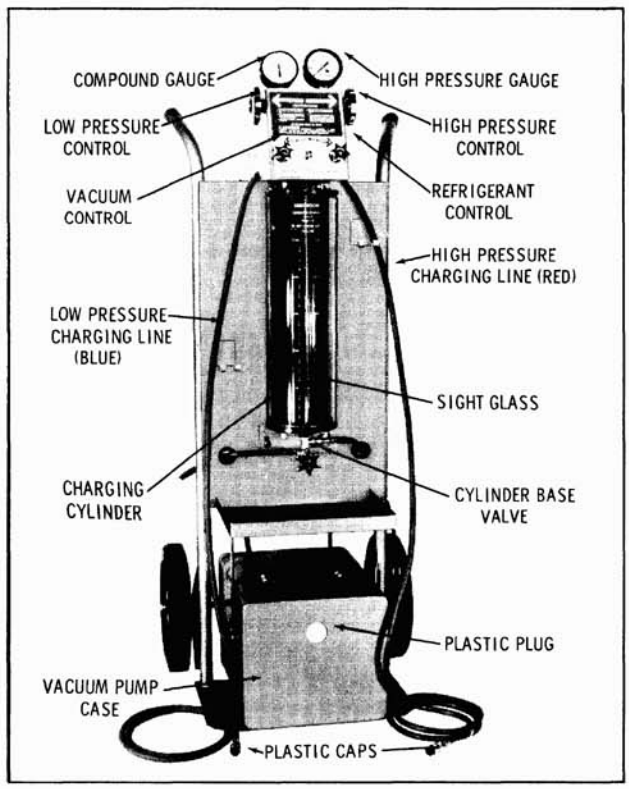


Fig. 1A-20—Charging Station

4. When system no longer leaks, proceed to evacuate system:

a. Discharge refrigerant from system, then open both gauge set valves and start vacuum pump, then open vacuum pump valve.

DO NOT discharge refrigerant through vacuum pump.

b. Allow pump to run for 15 minutes at a vacuum of 28". Close the high pressure gauge valve and vacuum pump valve, then stop vacuum pump. The system is now ready for charging.

CHARGING THE SYSTEM

REFRIGERANT DRUM METHOD

After the system is evacuated, leave the gauge set and refrigerant drum connected for the charging process. Also make sure the high pressure gauge valve is closed, the low pressure gauge valve is open, and the refrigerant drum valve is closed; then proceed as follows:

1. Place an auxiliary fan in front of condenser.
2. Place drum on scales and weigh accurately.

It may be necessary to place refrigerant drum in a pail of warm water to facilitate the charging process. Do not use water at a temperature in excess of 125°F. Weigh pail and water with refrigerant drum.

3. Open refrigerant drum valve and allow system to charge to drum pressure.
4. With transmission in "neutral" ("park" if car has Automatic) and the parking brake applied, start engine and set speed at 2000 rpm.
5. Position A/C control on NORMAL, slide the temperature control fully to the left and turn blower speed switch to the HIGH position.

6. Close low pressure valve in gauge set at frequent intervals to be certain pressure in low side of system is always maintained above 5 psi.

7. When 4 lbs. (31 through 48 Series) or 4-1/2 lbs. (54 through 86 Series) of refrigerant has entered the system, close the refrigerant drum valve and the low pressure gauge valve.

8. Remove the gauge set, install the protective caps on the Schrader valve and gauge fittings.

When disconnecting Schrader valve adapters from system use a cloth as a guard to divert escaping refrigerant.

9. After the system is charged, a performance check should be made. Observe particularly for excessive head pressures.

CHARGING STATION METHOD (Figs. 1A-18, 1A-19 and 1A-20)

Installing J-8393

1. Be certain all valves on charging station are closed.

2. Connect high pressure gauge line (with Adapters J-5420 attached) to the compressor discharge Schrader valve fitting.

3. Turn high pressure control (2) one turn counterclockwise (open). Crack open low pressure control (1) and allow refrigerant gas to hiss from low pressure gauge line for three seconds, then connect low pressure gauge line (with Adapters J-5420) to low pressure gauge fitting on suction throttling valve.

Filling Charging Cylinder

1. Open control valve on refrigerant container.

2. Open valve on bottom of charging cylinder, allowing refrigerant to enter cylinder.

3. Bleed charging cylinder top valve (behind control panel) only as required to allow refrigerant to enter cylinder. When refrigerant reaches desired charge level (4 lbs. for 31 through 48 Series or 4-1/2 lbs. for 54 through 86 Series), close valve at bottom of charging cylinder and be certain cylinder bleed valve is closed securely.

While filling the cylinder, it will be necessary to close the bleed valve periodically to allow boiling to subside so that refrigerant level in the charging cylinder can be accurately read.

Charging the System Using J-8393

1. With charging station installed as previously described, remove low pressure gauge line at the suction throttling valve.

2. Crack open high (No. 2) and low (No. 1) pressure control valves on station and allow refrigerant to discharge from system. Discharge slow enough so that oil does not escape from system along with refrigerant.

3. When refrigerant flow nearly stops, connect low pressure gauge line to suction throttling valve.

4. Turn on vacuum pump and open vacuum control valve (No. 3).

5. With system discharged as above, run pump until 26 to 28 inches of vacuum is obtained. Continue to run pump for 15 minutes after the system reaches 26 to 28 inches vacuum.

In all evacuating procedures, the specification of 26 to 28 inches of mercury, vacuum is used. These figures are only attainable at or near sea level. For each 1000 feet above sea level where this operation is being performed, the specifications should be lowered by one inch.

6. If 26 to 28 inches vacuum (corrected to sea level) cannot be obtained, close vacuum control valve (No. 3) and shut off vacuum pump. Open refrigerant control valve (No. 4) and allow some refrigerant to enter system. Locate and repair all leaks.

7. After evacuating for 15 minutes, add 1/2 pound of refrigerant to system as described in step 6 above. Discharge this 1/2 pound and re-evacuate for 15 minutes. This second evacuation is to make sure that as much contamination is removed from the system as possible.

8. Only after evacuating as above, the system is ready for charging. Note reading on sight glass of charging cylinder. If it does not contain a sufficient amount for a full charge, fill to the proper level.

9. Close low pressure valve on charging station. Fully open station refrigerant control valve (No. 4) and allow all liquid refrigerant to enter the system. When full charge of refrigerant has entered system (4 lbs. for 31 through 48 Series and 4-1/2 lbs. for 54 through 86 Series), turn off refrigerant control valve (No. 4).

10. If full charge of refrigerant will not enter system, close high pressure control and refrigerant control valves. Start engine and run at slow idle with compressor operating. Crack refrigerant control valve (No. 4) and low pressure control on station. Watch low side gauge and keep gauge below 50 psi by regulating refrigerant control valve. Closing valve will lower pressure. This is to prevent liquid refrigerant from reaching the compressor while the compressor is operating. When required charge has entered system, close refrigerant control valve and close low pressure control.

11. System is now charged and should be performance tested before removing gauges.

COMPRESSOR SHAFT SEAL (Fig. 1A-21)

Seal Leak Detection

A shaft seal should not be changed because of an oil line on the hood insulator. The seal is designed to seep some oil for lubrication purposes. Only change a shaft seal when a leak is detected by the following procedure:

1. Be sure there is refrigerant in the system. This can be determined by feeling the suction line (POA valve to compressor line) while operating the compressor. Cooling of the line indicates refrigerant in the system.

2. Turn off engine.

3. Blow off compressor clutch area with compressed air. Blow out clutch vent holes to completely remove all freon and oil accumulations.

4. Allow car to set for approximately 30 minutes without operating compressor.

5. Rotate the compressor clutch drive plate by hand until one of the vent holes is at the lower port of drive plate. Using leak detector J-6084, sense through vent hole at lower port of driven plate only.

Removal

1. Remove compressor from car. Refer to COMPRESSOR - Removal.

2. Remove clutch driven plate from compressor. Refer to DRIVEN PLATE - Removal.

3. Pry out sleeve retainer and remove absorbent sleeve, if present. Remove the seal seat retainer ring with Tool J-5403.

4. Thoroughly clean the inside of the compressor neck, the shaft, and the exposed portion of the seal seat of any dirt or foreign material. This is absolutely necessary to prevent any such material from getting into the compressor.

5. Remove the seal seat with Tool J-9393 as shown in Fig. 1A-22 and remove the seal seat "O" ring from inside the compressor neck with Tool J-9553.

6. Insert Tool J-9392 on top of seal. Rotate tool clockwise while forcing tool downward until tool engages tangs of seal.

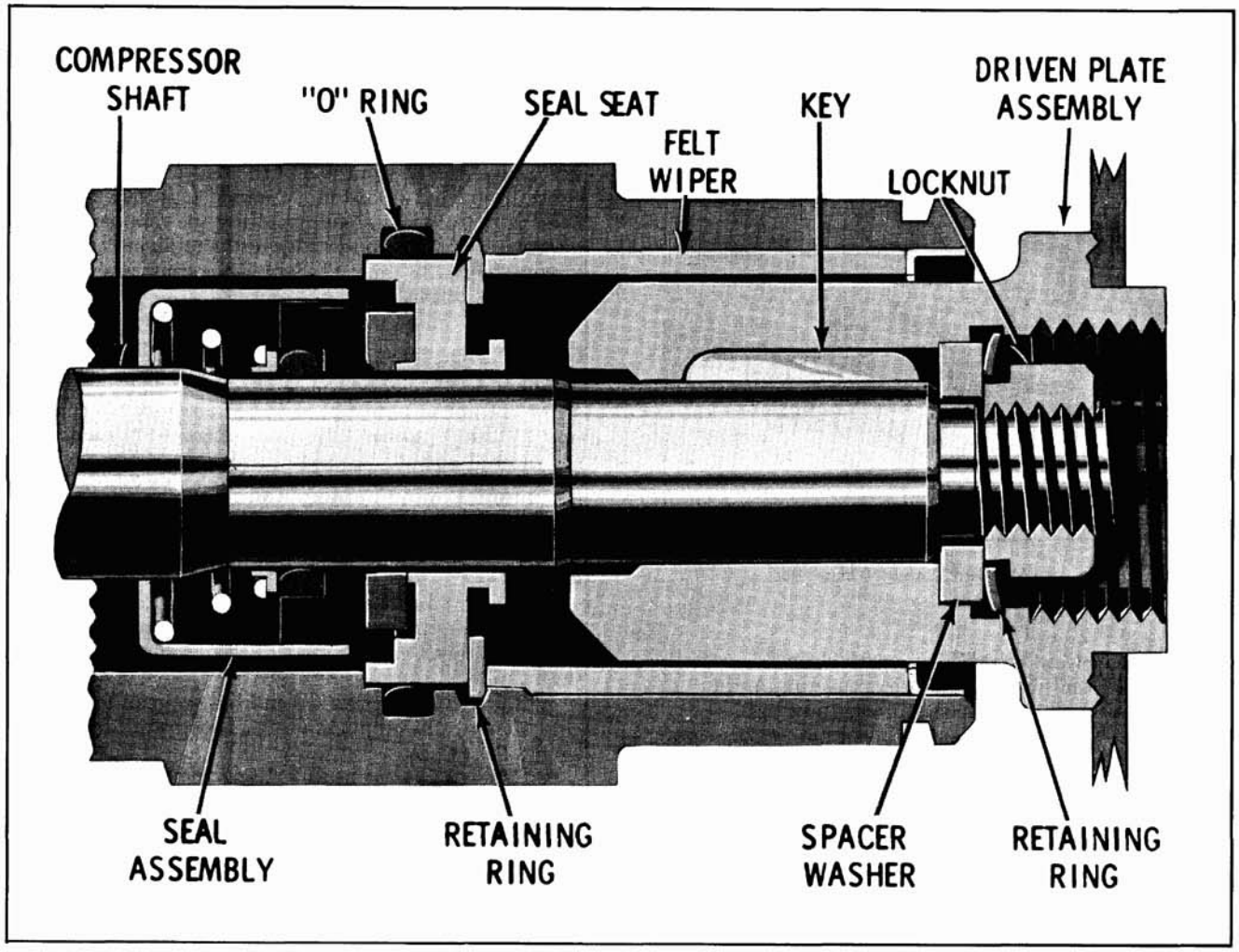


Fig. 1A-21—Compressor Shaft and Seal

Remove seal by lifting tool out of compressor neck. (Fig. 1A-23)

7. Recheck the shaft and inside of compressor neck and be sure that these areas are perfectly clean before installing the new parts.

Installation

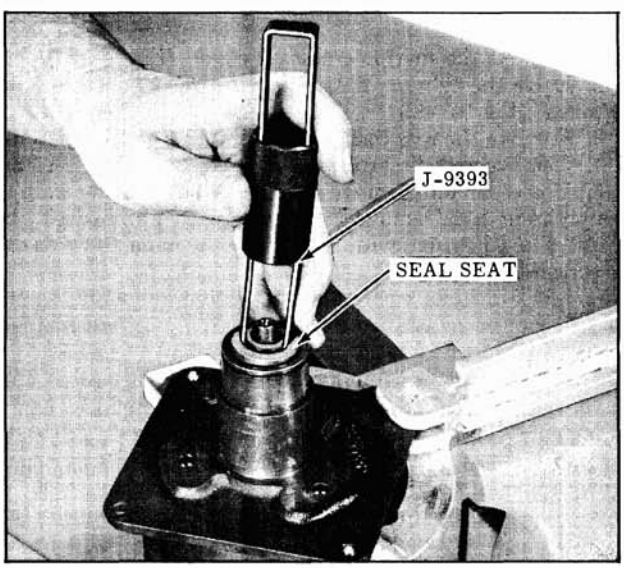


Fig. 1A-22—Removing Seal Seat

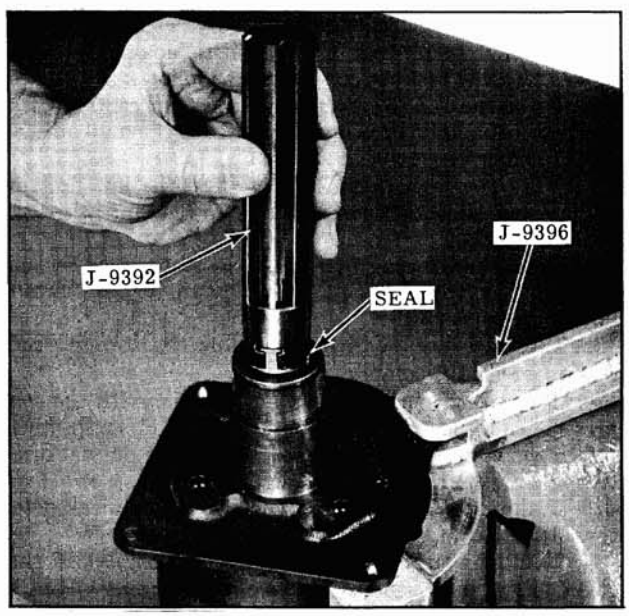


Fig. 1A-23—Removing Seal

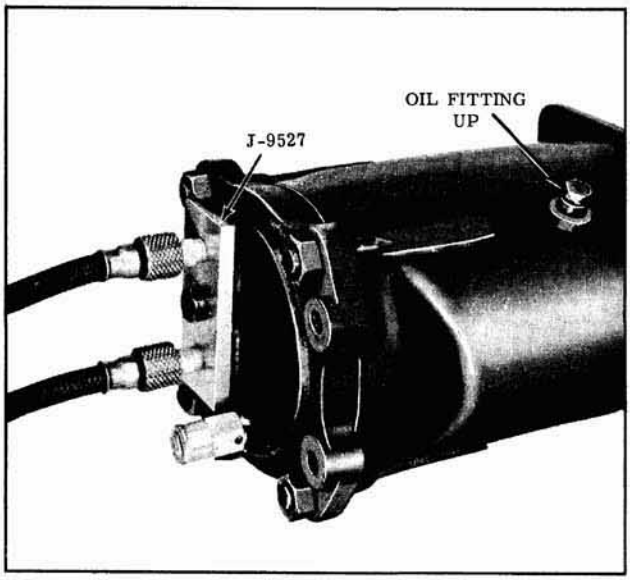


Fig. 1A-24—Leak Testing Compressor

1. Coat the new seal seat "O" ring with clean 525 viscosity refrigeration oil and install it in the groove inside the compressor neck, using Tool J-21508 ("O" ring installer).

2. Coat the "O" ring and seal face of the new seal assembly with clean refrigeration oil and carefully engage the seal assembly onto the locking tangs of Tool J-9392. Place Tool J-22974 (shaft seal protector) over the end of the shaft and slide the seal down the shaft, turning the tool clockwise and applying light pressure until the seal assembly engages the flats on the shaft and is seated in place. Rotate the tool counterclockwise slightly to release from the seal and remove tool.

3. Coat the seal face of the seal seat with clean 525 viscosity refrigeration oil. Grip the seal seat with Tool J-9393. Push it into place so as not to disturb the "O" ring and also to effect a seal with this "O" ring. Remove the tool.

4. Install the new seal seat retainer ring with Tool J-5403, with the flat face against the seal seat. The sleeve from Tool J-9393 may be used to press down on the retainer ring so that it snaps into place. Remove Tool J-22974 from the end of the shaft.

5. With Tool J-9527 and "O" rings installed on compressor (Fig. 1A-24), leak test the compressor as follows:

a. Using the J-5725 gauge set, connect the center hose to an R-12 drum and the other two hoses to the high and low pressure Schrader valves.

b. With the high pressure valve and the low pressure valve open, allow refrigerant vapor to flow into the compressor.

c. Open the oil plug fitting in the compressor housing and allow air to exhaust until refrigerant vapor starts to flow from the fitting.

d. Close the oil plug fitting and allow the drum pressure to stabilize in the compressor.

e. Temporarily install the shaft nut and with the compressor in horizontal operating position (oil sump down) rotate the compressor shaft several times in normal direction of rotation by hand.

f. Leak test seal with a propane halide torch leak detector. (J-6084) Correct any leak that may exist.

g. Remove gauge set, cap fittings on Tool J-9527 then check and add oil if necessary as outlined under CHECKING AND ADDING OIL.

6. Install the absorbent sleeve by rolling the material into a cylinder, overlapping the ends and slipping the sleeve into the compressor neck with the overlap toward the top of the compressor. With a small screwdriver or similar instrument carefully spread the sleeve to remove the overlap so that in the final position the ends of the sleeve will butt at the top vertical center line.

7. Position the metal sleeve retainer so that its flange face will be against the front end of the sleeve. Tool J-9395 or the sleeve from Tool J-9393 may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place, until the outer edge of the retainer is recessed approximately 1/32" from the face of the compressor neck.

8. Install driven plate on compressor.

9. Install compressor on car.

COMPRESSOR DISASSEMBLY (Fig. 1A-25)

Before disassembling the compressor, remove the oil drain screw and allow all of the oil to drain from the compressor into a clean container. This is to determine the amount and condition of the oil.

REAR HEAD

1. With compressor mounted in a vise or in Holding Fixture J-9396, rear head up, scribe rear head and compressor housing.

2. Remove the four rear head to housing attaching nuts.

3. Remove the rear head, inspect teflon gaskets on the casting. If teflon gaskets are damaged, replace the rear head. (Fig. 1A-26)

4. Remove the suction screen from the rear head.

5. Remove the oil pump gears. If gears are damaged, gears should be replaced.

6. Remove the rear head "O" ring and discard.

7. Remove the rear discharge valve plate and reed valve assembly. Separate the discharge valve plate and reed valve and inspect. (Fig. 1A-27)

8. Remove the oil inlet tube and "O" ring. Discard "O" ring. (Fig. 1A-28)

FRONT HEAD

1. Position compressor horizontally and slide the cylinder assembly out the rear of the compressor housing by pushing on the compressor shaft. (Fig. 1A-29)

2. Remove the front head by tapping it to the rear with a wood block. Discard "O" ring. Check sealing surfaces of head.

3. Remove the front discharge valve plate and reed valve assembly. Separate discharge plate from reed valve and inspect. (Fig. 1A-30)

CYLINDER

1. Remove the suction crossover cover. (Fig. 1A-31)

2. Drive the cylinder halves apart using a wood block and hammer. (Fig. 1A-32)

3. Remove the rear half of the cylinder from the pistons.

4. Remove and discard the discharge tube. (Fig. 1A-33)

5. If necessary to remove the drive shaft bearing from the rear cylinder half, remove the bearing with a brass drift, then install a new bearing, with manufacturers name towards tool, as shown in Fig. 1A-34.

6. Mark pistons with their respective cylinders, so that pistons can be reinstalled in their original position and location.

7. Rotate shaft until a piston is at its highest point. Push shaft away from head until the piston assembly can be removed. Separate the piston, piston drive balls, and piston rings and place in Tray J-9402, in compartments associated with proper end of piston. Discard all piston shoe discs.

8. Repeat procedure until all pistons are removed. (Fig. 1A-35)

9. Remove shaft and swash plate assembly. Separate thrust bearings and races and discard. Inspect bearing surfaces of shaft and swash plate assembly.

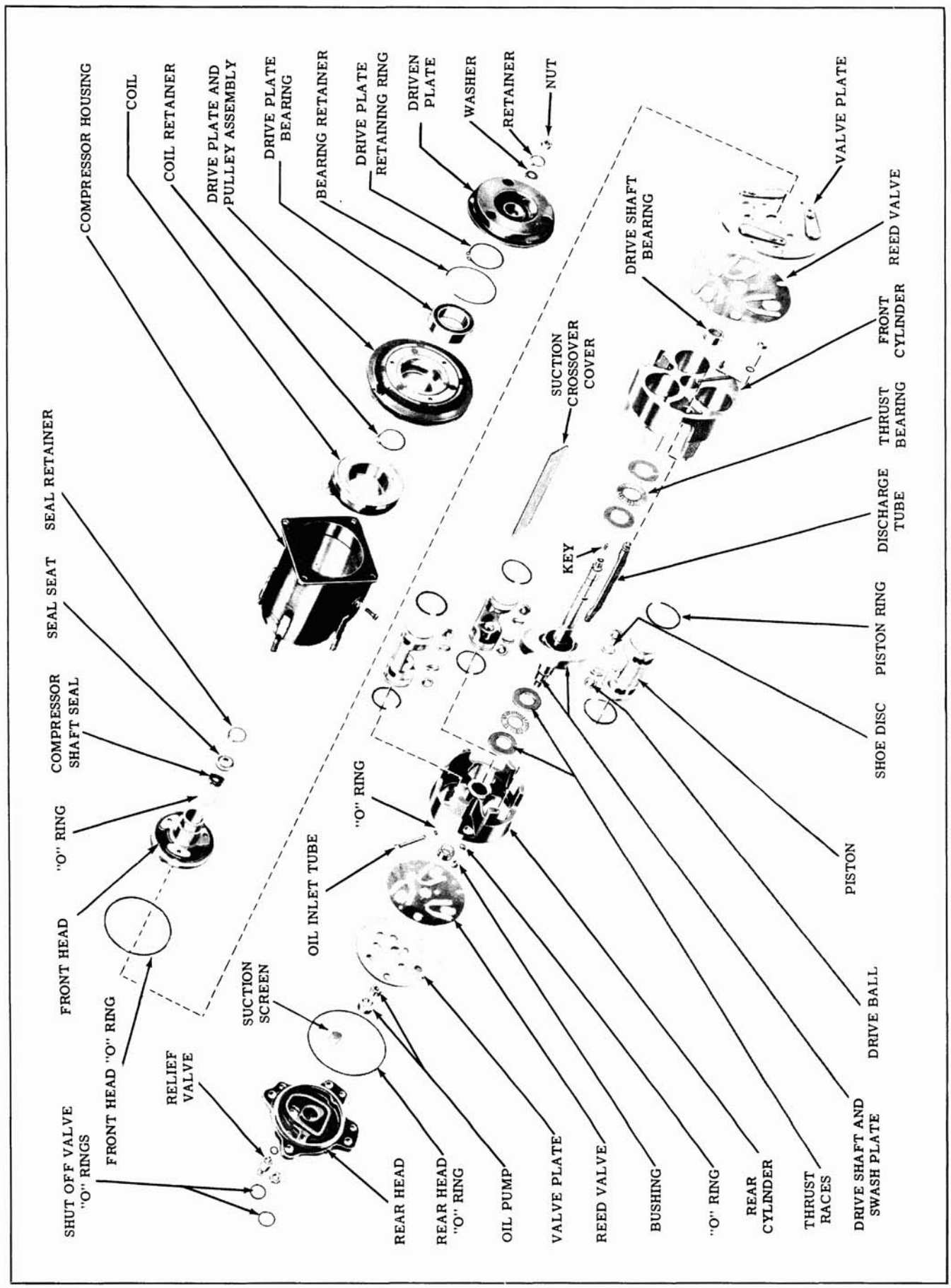


Fig. 1A-25—Compressor Disassembled

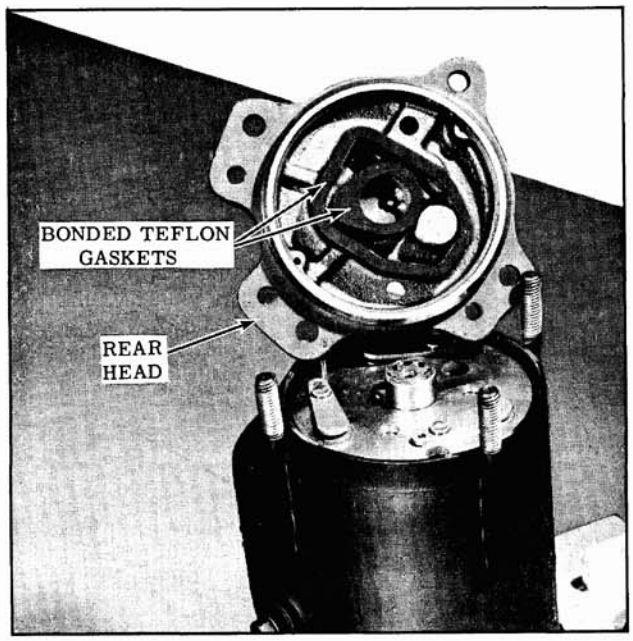


Fig. 1A-26—Rear Head Removed

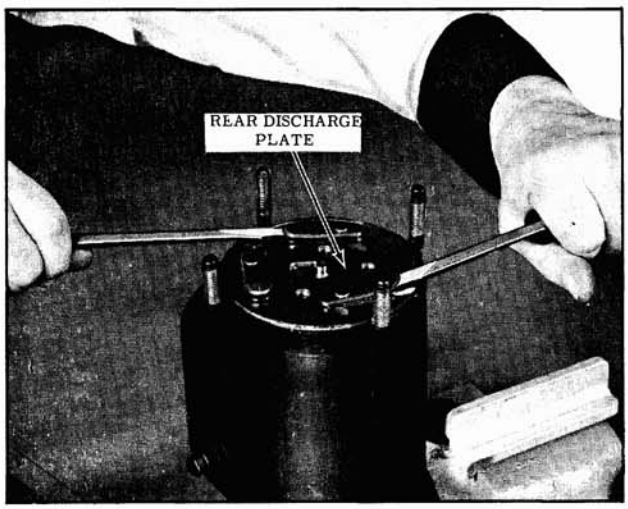


Fig. 1A-27—Removing Rear Discharge Plate

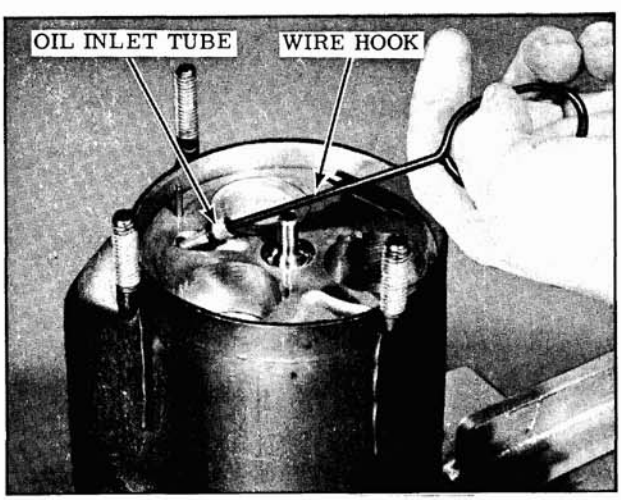


Fig. 1A-28—Removing Oil Inlet Tube

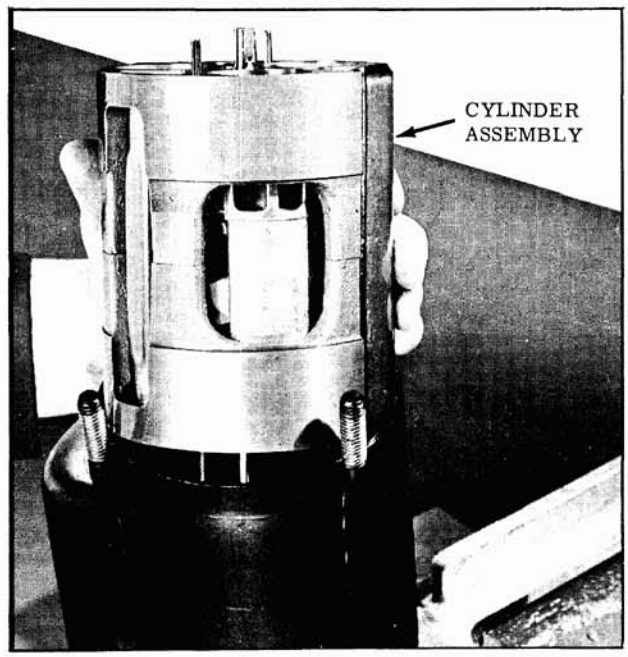


Fig. 1A-29—Removing Cylinder from Housing

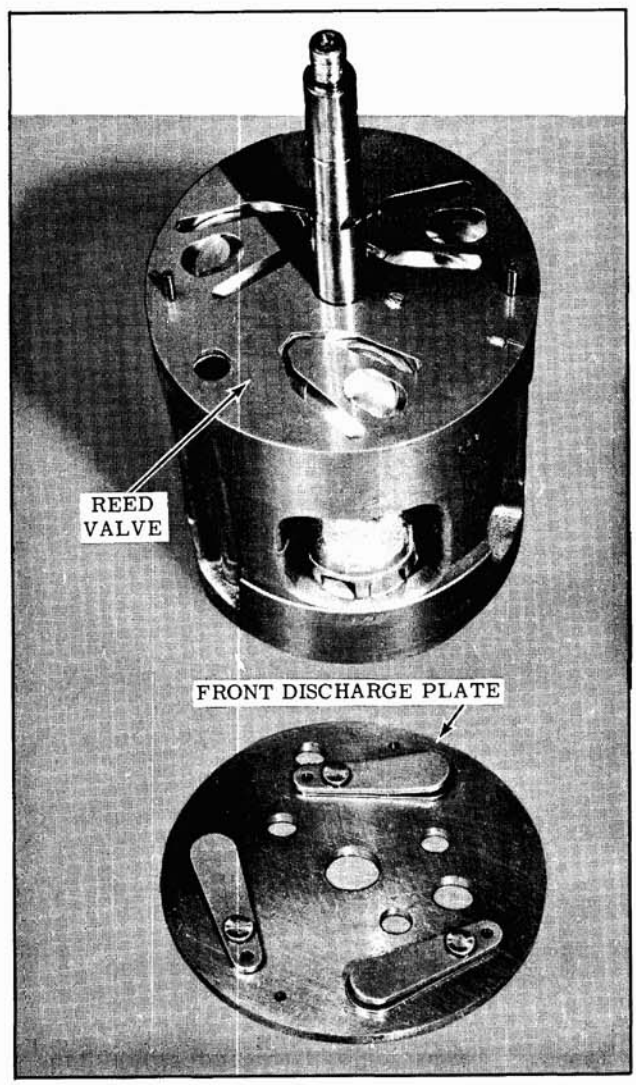


Fig. 1A-30—Front Head Discharge Plate and Reed Valve

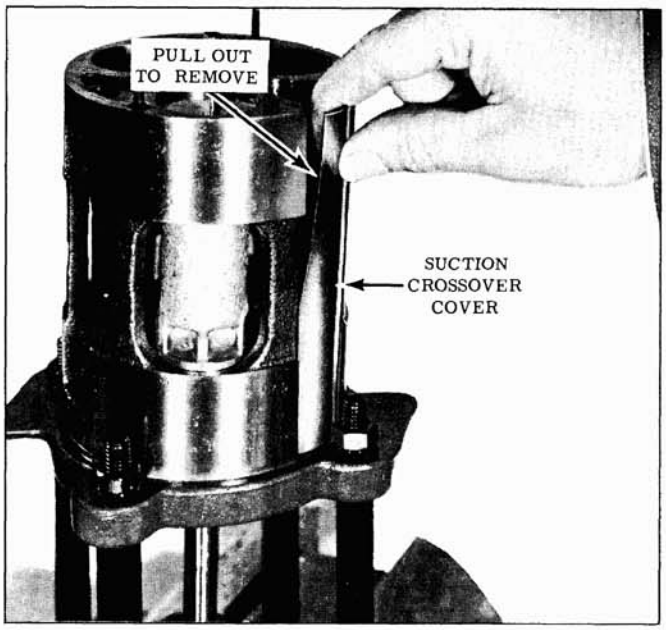


Fig. 1A-31—Removing Suction Crossover Cover

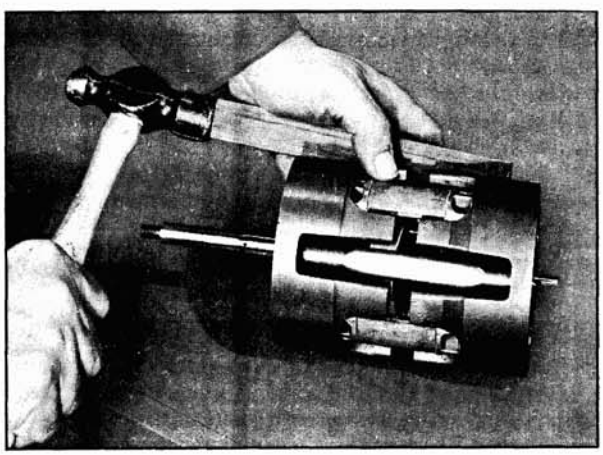


Fig. 1A-32—Separating Cylinder Halves

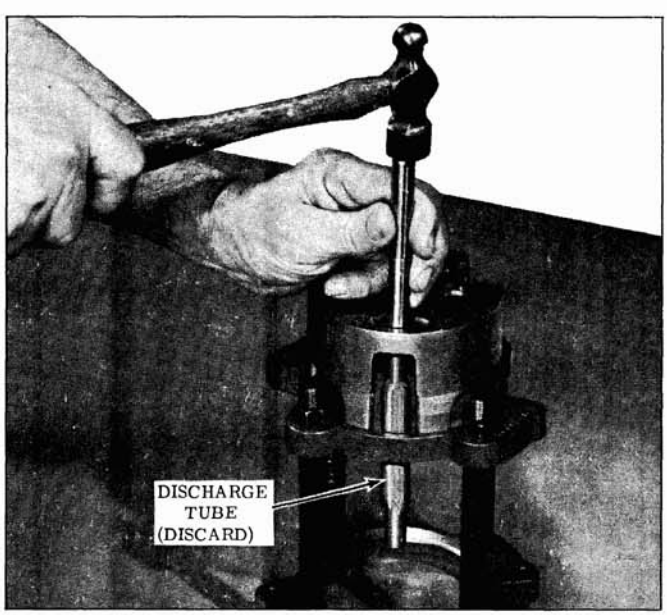


Fig. 1A-33—Removing Discharge Tube

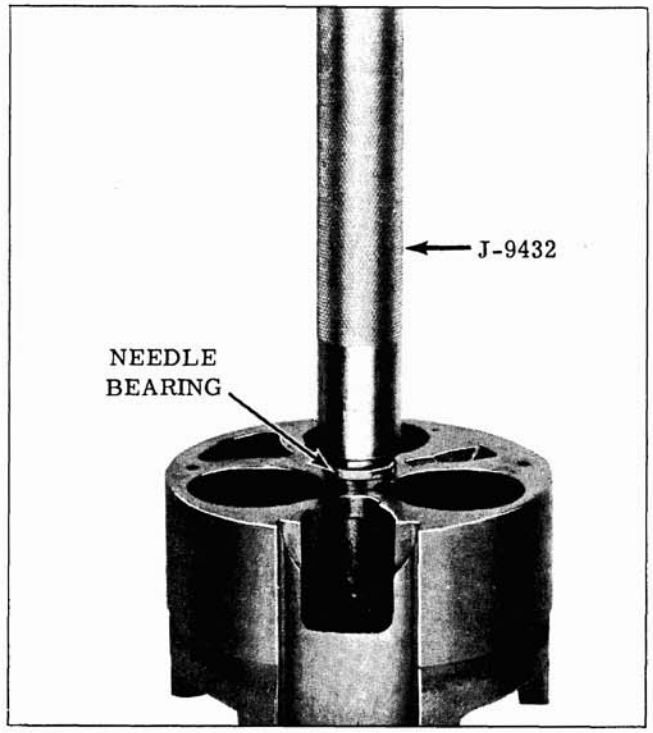


Fig. 1A-34—Installing Drive Shaft Bearing

10. If necessary to replace the front cylinder half drive shaft bearing, repeat Step 5.

11. Wash all parts to be reused in clean solvent (oleum). Dry with compressed air.

COMPRESSOR ASSEMBLY

CYLINDER

1. Position front half of cylinder on the Cylinder Assembly Fixture J-9558.

THRUST BEARING RACE CHART

Service *Part Number	Identification No. Stamped on Race
6556000	0
6556050	5
6556055	5-1/2
6556060	6
6556065	6-1/2
6556070	7
6556075	7-1/2
6556080	8
6556085	8-1/2
6556090	9
6556095	9-1/2
6556100	10
6556105	10-1/2
6556110	11
6556115	11-1/2
6556120	12

*The last three digits indicate identification number on race.

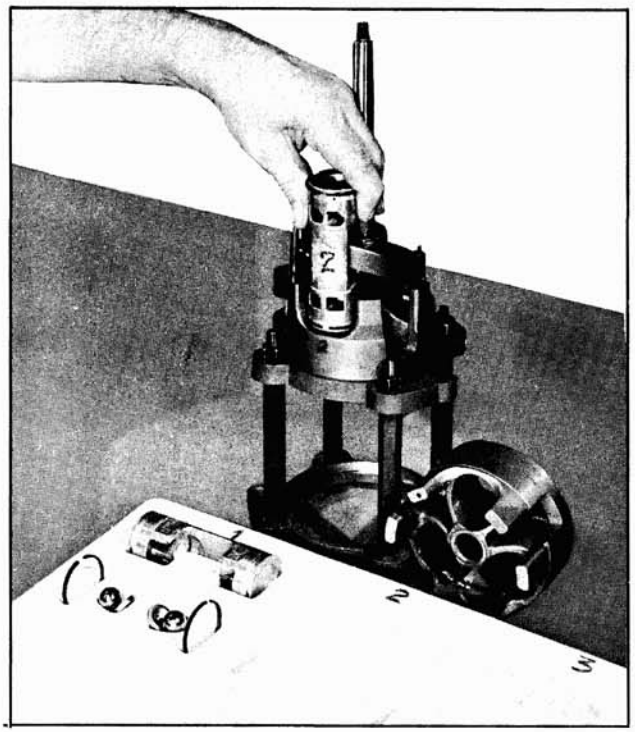


Fig. 1A-35—Removing Piston

2. Position a zero thrust race, a thrust bearing and another zero thrust race over the front and rear ends of the compressor shaft. Retain bearings and thrust washers with clean petrolatum. Install shaft into front cylinder, threaded end of shaft down. (Fig. 1A-36)

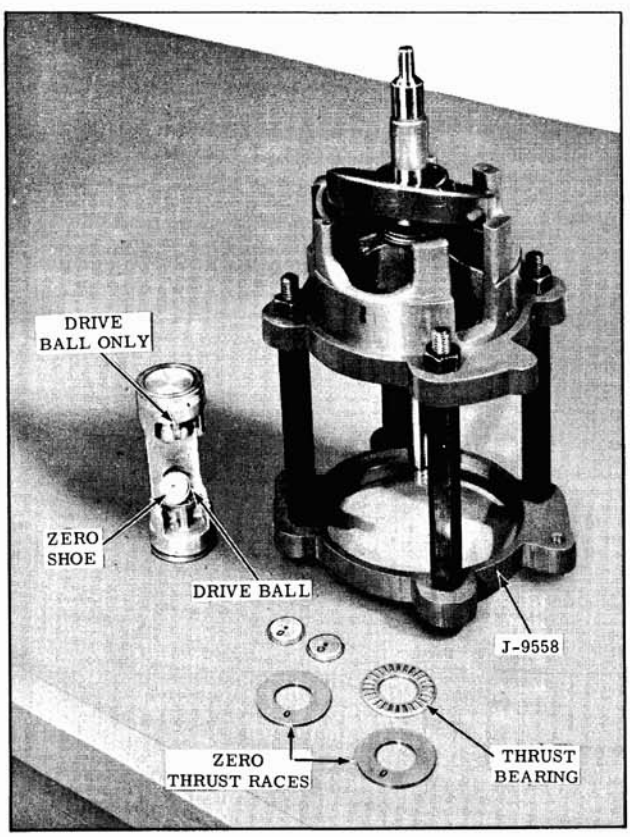


Fig. 1A-36—Assembling Parts for Clearance Check

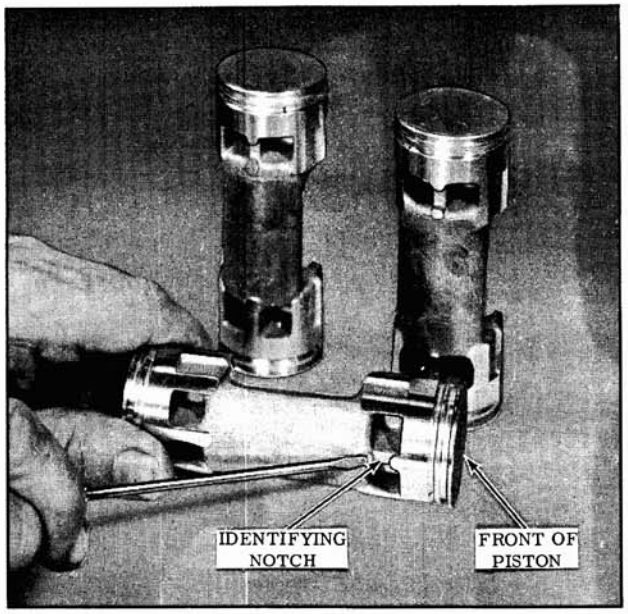


Fig. 1A-37—Piston Identification

3. Apply a light smear of clean petrolatum to the ball pockets of each of the three pistons.

4. Place the balls in the piston pockets.

5. Apply a light smear of clean petrolatum to the cavity of three new zero shoe discs.

6. Place a zero shoe over each ball in the front end of the piston. The front end of the piston has an identifying notch in the casting web. (Fig. 1A-37)

7. Place a ball only in the rear ball pocket of each of the three pistons.

Do not assemble any of the piston rings at this time.

8. Rotate the shaft and swash plate until the high point of the swash plate is over the piston cylinder bore, which has been identified as No. 1. Raise the shaft until the front end of the piston can be inserted in the cylinder bore, at the same

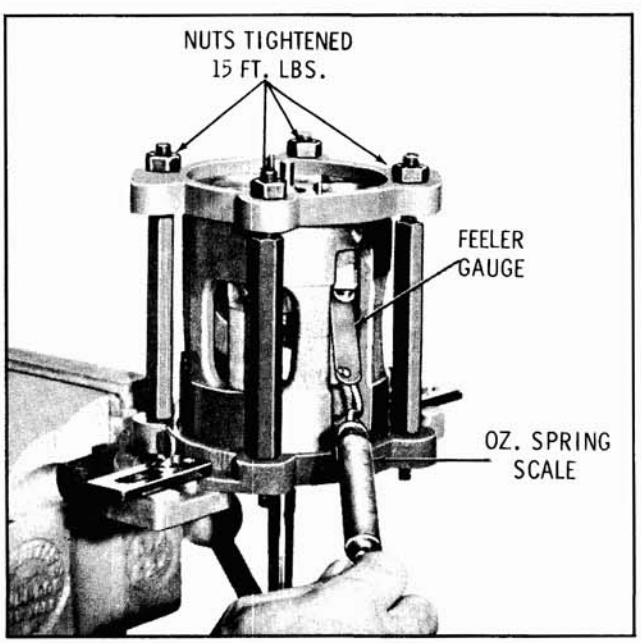


Fig. 1A-38—Checking Drive Ball to Swash Plate Clearance

time place the front ball and shoe and the rear ball only over the swash plate.

9. Repeat this operation for pistons No. 2 and No. 3.

The balls and shoes must adhere to the piston during this assembly.

10. Align the rear cylinder with the front cylinder. Tap into place, using a wood block and mallet.

11. Assemble the head ring of Tool J-9558 and nuts to the fixture, tighten the nuts to approximately 15 ft. lbs. torque.

12. Measure clearance between rear ball of No. 1 piston and swash plate, in following manner:

a. Select a suitable combination of well-oiled feeler gauge leaves to fit snugly between ball and swash plate.

b. Attach a spring scale reading in 1 ounce increments to the feeler gauge. Distributor point checking scale J-5184 may be used.

c. Pull on spring scale to slide feeler gauge stock out from between ball and swash plate, and note reading on spring scale as feeler gauge is removed, Fig. 1A-38. Reading should be between 4 and 8 ounces.

d. If reading in step (c) is under 4 or over 8 ounces, reduce or increase thickness of feeler gauge leaves and repeat steps (a) through (c) until a reading of 4 to 8 ounces is obtained. Record clearance between ball and swash plate that results in a 4 to 8 ounce pull on spring scale. Rotate the shaft approximately 120°, and make a second check with feeler gauge between the ball and plate. Rotate the shaft again approximately 120° and again check with a feeler gauge between the parts. Record the three readings.

EXAMPLE

	Position 1	Position 2	Position 3	Select and Use Shoe No.
Piston #1	.019"	.0195"	.019"	19
Piston #2	.020"	.020"	.020"	20
Piston #3	.021"	.021"	.022"	21

SHOE CHART

Service *Part Number	Identification No. Stamped on Shoe
6557000	0
6556175	17-1/2
6556180	18
6556185	18-1/2
6556190	19
6556195	19-1/2
6556200	20
6556205	20-1/2
6556210	21
6556215	21-1/2
6556220	22

*The last three digits indicate identification number on shoes.

From the three checks, select a numbered shoe to correspond to the minimum feeler gauge reading for No. 1 piston (refer to SHOE CHART). Mark piston number on the shoe package. The shoe may be put in the assembly tray in the compartment corresponding to the piston number and rear ball pocket position. Repeat checking procedure for the remaining two pistons.

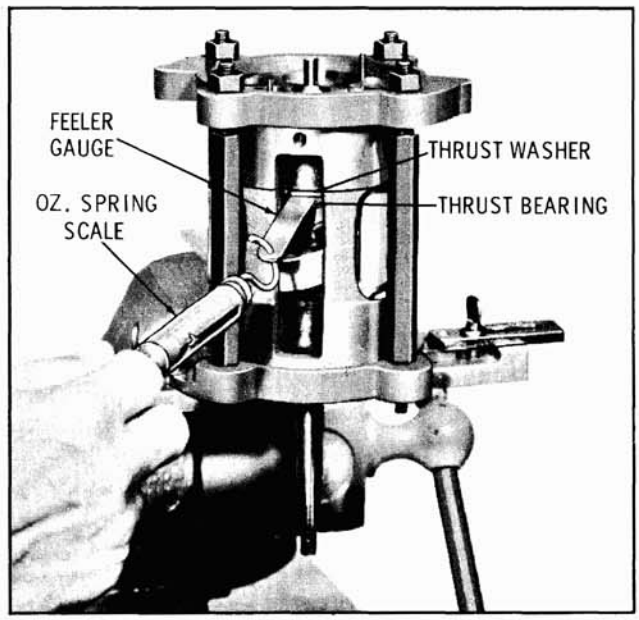


Fig. 1A-39—Checking Drive Shaft End Play Clearance

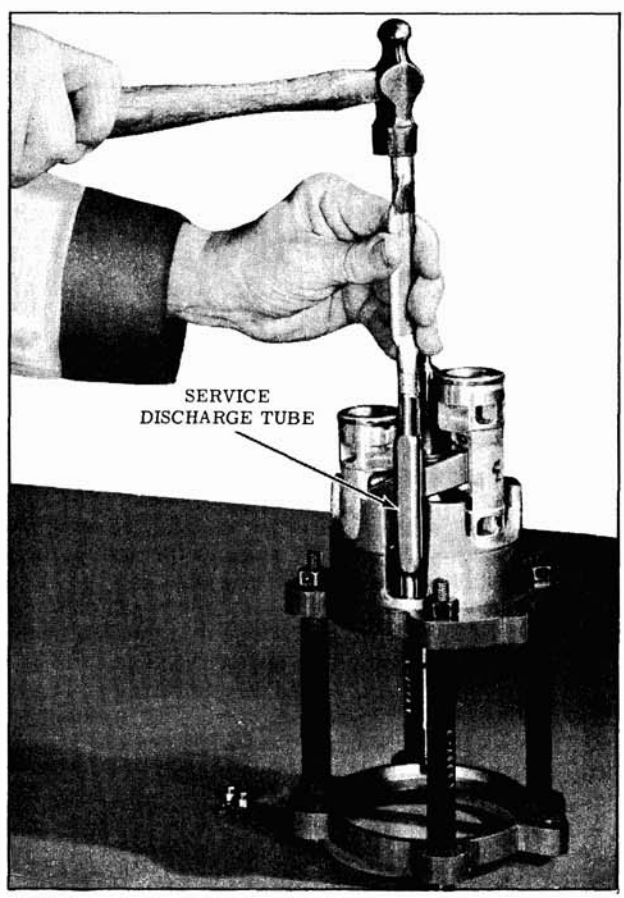


Fig. 1A-40—Installing Discharge Tube

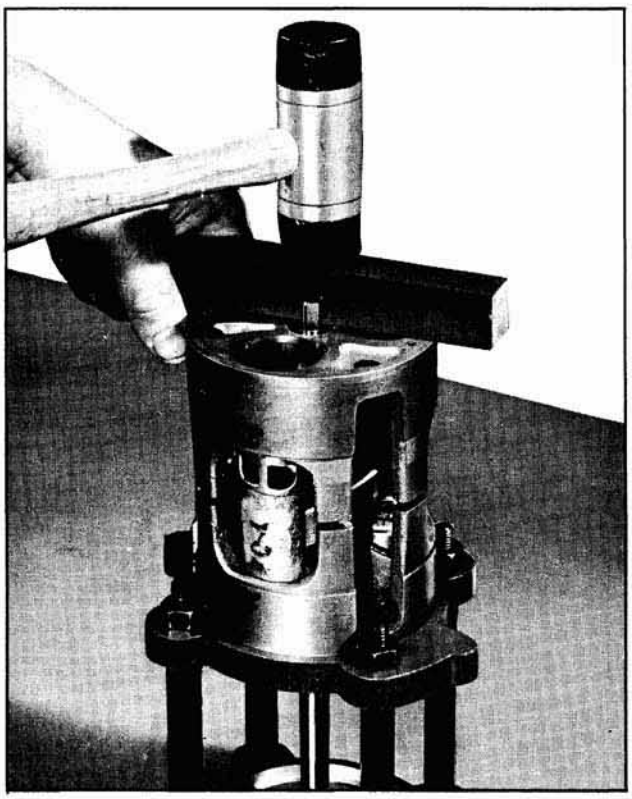


Fig. 1A-41—Assembling Cylinder Halves

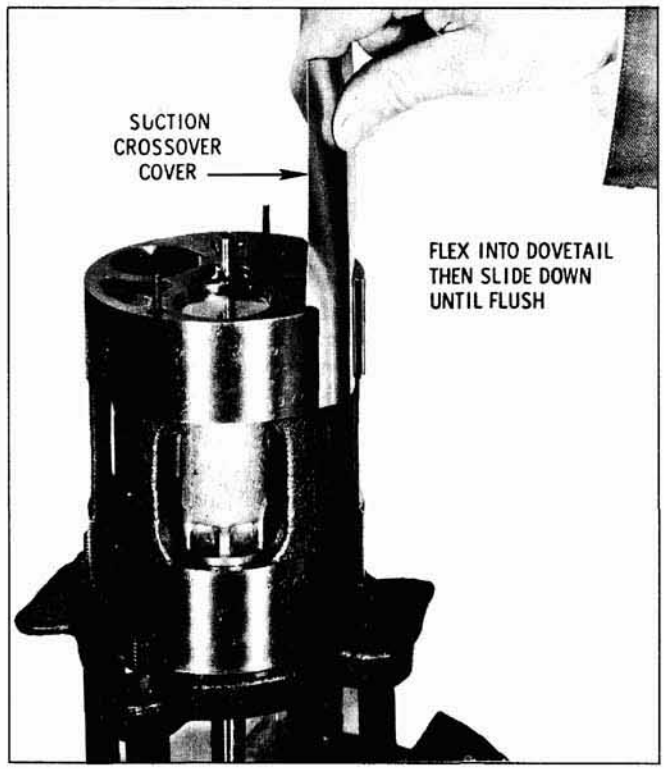


Fig. 1A-42—Installing Suction Crossover Cover

13. To determine the clearance between the rear thrust bearing and the upper or outer-rear thrust race use a combination of feeler gauge leaves, so that 4 to 8 oz. of force is required to pull gauge free. (Fig. 1A-39)

14. Select from stock a numbered thrust race that corresponds to the feeler gauge used. Mark the package "REAR", place it in the assembly tray corresponding to this position.

15. Loosen and remove the nuts and ring from the checking fixture. Remove the rear cylinder, pistons and rear outer thrust race.

16. Install the correct thrust race, determined in Step 14, over the compressor shaft. Apply a light smear of petrolatum to the thrust races to aid in holding them in place during assembly.

17. Assemble a piston ring, scraper groove toward the piston ball socket, to each end of the three pistons.

18. Apply a light smear of petrolatum to the numbered shoes and place them over the correct ball in the rear of the piston.

19. Rotate the swash plate so the high point is above cylinder bore No. 1. Carefully assemble piston No. 1, complete with ball and a zero shoe on the front end and ball and numbered shoe on the rear end, over the swash plate. Compress and enter the front piston ring into the front cylinder half. Repeat this operation for pistons No. 2 and No. 3.

20. Assemble one end of the service discharge crossover tube into the hole in the front cylinder. (Fig. 1A-40)

21. Rotate the shaft to position the pistons in a "stair step" arrangement. Place the rear half of the cylinder over the shaft and start the pistons and rings into the cylinder bores. When all parts are in proper alignment, tap rear cylinder with a wood block and mallet to seat the rear cylinder over the locating dowel pins. (Fig. 1A-41)

22. Generously lubricate all moving parts with 525 Viscosity Oil. Check for the free rotation of the mechanism.

23. Remove cylinder assembly from fixture.

24. Install the suction crossover cover by flexing the cover sufficiently to engage the groove in the end of the "dove tail" slot of the rear cylinder head; then slide the cover down until it is flush with the cylinder head. (Fig. 1A-42)

25. Install "O" ring and bushing over discharge tube. (Fig. 1A-43)

26. Assemble the suction reed valve and the front discharge valve plate to the front end of the cylinder. Align the dowel pin holes, suction ports and oil return slot.

The front discharge valve plate has a large diameter hole in the center.

27. Coat the machined surfaces on the webs of the front head with 525 Viscosity Oil. Examine the location of the dowel pins and contour of the webs. Rotate so as to position it properly over discharge reed retainers. Use care to avoid damaging the machined surfaces. When in proper alignment, seat with light mallet taps.

28. Apply an ample amount of 525 Viscosity Oil around the angle groove at the lower edge of the head and to the "O" ring. Assemble the "O" ring in the groove.

29. Mount the compressor housing on the holding fixture, attaching bolts up.

30. Coat the inside machined surfaces of the housing with 525 Viscosity Oil. Install the cylinder assembly into the housing. Line up the oil sump with the oil intake tube hole.

31. Position a new "O" ring on the oil intake tube, apply oil to the cavity and "O" ring. Insert the tube and "O" ring, rotating the cylinder assembly to align the tube with the hole in the housing baffle.

32. Install "O" ring and bushing over discharge tube.

33. Position the rear suction reed valve and discharge valve assembly to align with the dowel pins, then slide it into place over pins.

34. Assemble the inner oil pump gear over the "D" shaped

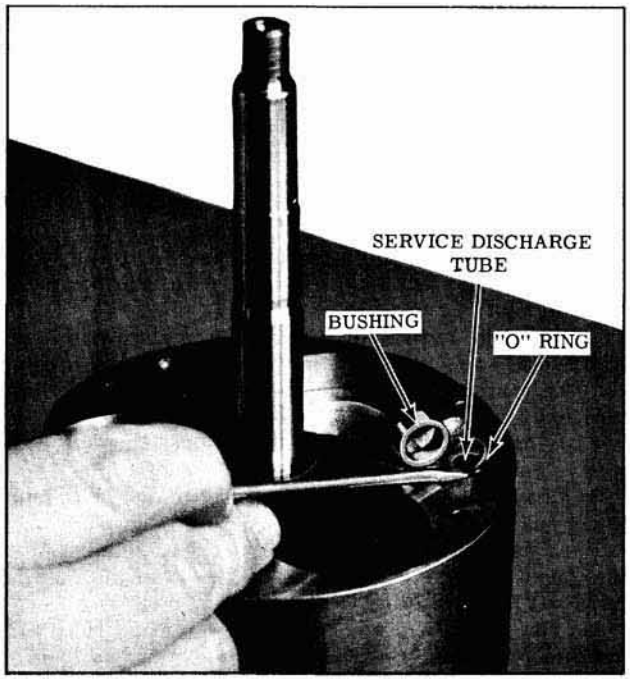


Fig. 1A-43—Installing "O" Ring and Bushing

flat on the shaft. Place the outer oil pump gear into oil pump gear cavity in the head. Retain with petrolatum. If original gears are being reused, be sure gear ends were kept matched and re-installed in original position.

35. Generously oil the valve plate around the outer ends where the large "O" ring will be placed. Oil the valve reeds, oil pump gears, and the area where the teflon gasket will contact the valve plate.

36. Coat the rear head to housing "O" ring with Frigidaire 525 Viscosity Oil and place it on the valve plate in contact with the housing.

37. Place the suction screen in the rear head.

38. Assemble the rear head to the compressor housing, using care not to damage the teflon gasket.

If oil pump gears do not mesh, a slight movement of the rear head or drive shaft will aid in meshing of the gears.

39. Assemble the nuts to the threaded housing studs. Tighten to 23 ft. lbs. torque.

40. Install new compressor shaft seal. Refer to compressor shaft seal installation.

41. Position two "O" rings in the cavity of the rear of the compressor.

42. Install Tool J-9527 on compressor (Fig. 1A-24), then leak test the compressor as follows:

a. Using the J-5725 Gauge Set, connect the center hose to the refrigerant drum and the high and low pressure hoses to the compressor.

b. With the high pressure valve and the low pressure valve open, allow refrigerant to flow into the compressor.

c. Open the oil plug fitting in the compressor housing and allow the air to exhaust until refrigerant starts to flow from the fitting.

d. Close the oil plug fitting and allow the drum pressure to stabilize in the compressor.

e. Check and correct any leaks that may exist.

f. Release the pressure and remove gauge set.

g. Install caps on fittings of Tool J-9527.

43. Add oil to compressor as outlined under CHECKING AND ADDING OIL.

ADDING REFRIGERANT—PARTIAL CHARGE

The proper charge of refrigerant to insure a clear sight glass under operating conditions at various ambient temperatures is 4-1/2 lbs. for 54 through 86 Series and 4 lbs. for 31 through 48 Series. Since less than the specified amount will result in a clear sight glass under some load conditions, it is necessary to consider load effects when checking and adding refrigerant to the system. The load can be varied by changing the blower speed as listed in the following chart. Be sure to operate the system for at least five minutes before checking sight glass.

On cars equipped with Comfortron, set the control on automatic high position.

Ambient Temp. (Outside of Car)	Blower Switch Position	Temperature Control Setting	Control Setting	Engine RPM
70° to 80°	High	Fully to Left	Normal	2000
80° to 90°	Medium	Fully to Left	Normal	2000
90° or above	Low	Fully to Left	Normal	2000

If the system is low on refrigerant, proceed as follows:

1. Turn off the ignition.
2. Remove protective caps from Schrader valve adapters.
3. Install gauge set.
4. Crack open both gauge valves to purge the gauge hoses through the center hose, and crack open the valve on the refrigerant drum or the "Fits-All" valve on a 15 oz. refrigerant can. While refrigerant is escaping from the center hose of the gauge set and the valve fitting on the refrigerant container, connect the center hose to the refrigerant container.
5. Close the refrigerant container valve and both gauge valves.
6. Start the engine and make settings according to the preceding chart.
7. Open valve on refrigerant container and the low pressure gauge valve to allow refrigerant to enter the system. When sight glass clears, close refrigerant container valve.
8. Wait two minutes, then check the sight glass. If vapor is still visible, open the refrigerant container valve and again allow refrigerant to enter the system. Add 1/4 lb. of refrigerant after sight glass clears.
9. Shut off engine, remove gauge set, and install all protective caps.

CHECKING AND ADDING OIL

The compressor was originally charged with 10.5 ounces of 525 Viscosity Oil. During normal operation, because of an affinity of refrigerant 12 for oil, a certain amount of oil will circulate throughout the system along with the liquid and vapor. If any major loss of oil has occurred, such as a severe compressor seal leak, line breakage, damaged condenser, etc. proceed as follows after making the necessary repairs.

1. Remove belt and compressor clutch lead.
2. Remove compressor.
3. Transfer compressor to bench and loosen the oil drain screw.
4. Allow all of the oil to drain from the compressor into a clean container. This is to determine the amount and condition of oil. If oil shows signs of contamination, refer to Flushing System.
5. If the condition of the oil indicates that the compressor is free of any contamination, position the compressor so that the oil test valve flange is on the top side and pour from a graduated bottle, new 525 Viscosity Oil into the compressor

in the amount required as follows:

a. If oil drained in Step 4 was more than 1-1/2 ounces, add to the compressor the amount drained in Step 4.

b. If oil drained in Step 4 was less than 1-1/2 ounces and a major oil loss has occurred, add 6 ounces of oil to the compressor.

c. If the compressor is overhauled, add 1 ounce in addition to the oil added in Steps 5a or 5b.

d. If a new service compressor is to be installed, drain service compressor and fill with oil as indicated in Steps 5a or 5b.

e. If refrigeration components are replaced, add oil as follows, in addition to the oil added in Steps 5a, 5b or 5c.

Evaporator	3 Fluid Ounces
Dehydrator Receiver	1 Fluid Ounce
Condensor-Dehydrator Receiver	3 Fluid Ounces

6. Tighten the oil drain screw.

7. Install compressor.

8. Evacuate the system to remove air and moisture, then charge the system with refrigerant.

FLUSHING SYSTEM

1. Install compressor on mounting brackets and tighten to 25 ft. lbs.

2. Install new "O" rings on the valve port opening and position the fitting connector on the compressor.

3. Connect compressor clutch wire.

4. Install belt and adjust tension using Tool 33-70M.

5. Install a charging line to the compressor discharge Schrader valve and to a drum of refrigerant 12.

6. Disconnect the liquid line from the dehydrator receiver assembly on the inlet side and cap the dehydrator receiver immediately.

7. Open the refrigerant drum valve and turn the drum upside down to allow liquid refrigerant to flush through the condenser and out the line. Use approximately 2 lbs. of refrigerant for this operation.

8. Close the drum valve and connect the dehydrator receiver assembly.

9. Remove the expansion valve screen and clean or replace as necessary.

10. Remove the charging line from the compressor, install the gauge set and evacuate the entire system as outlined under EVACUATING THE SYSTEM.

11. Recharge the system as outlined under CHARGING THE SYSTEM.

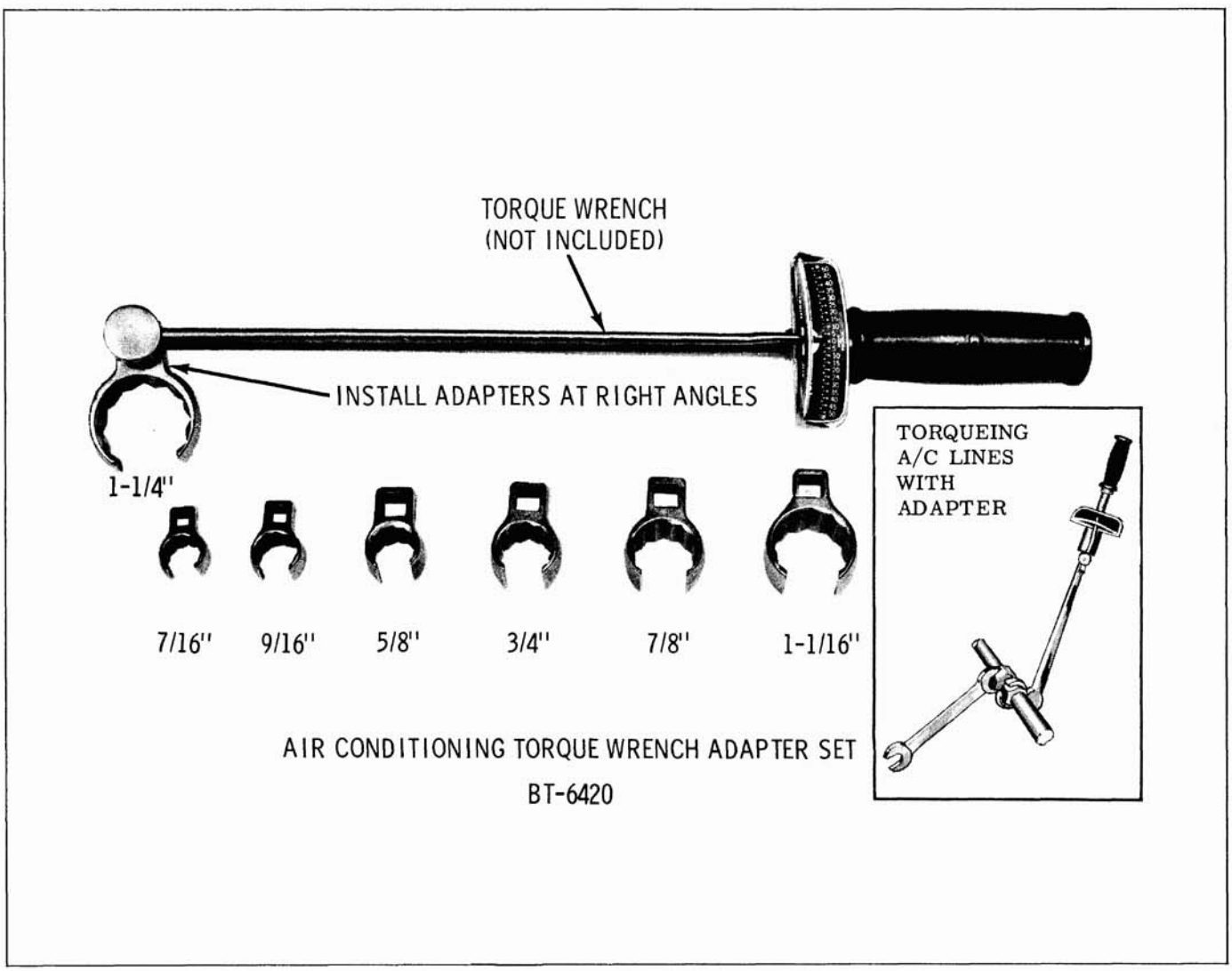


Fig. 1A-44—Torque Wrench Adapter Set

CUSTOM AIR CONDITIONER (MANUAL, VACUUM CONTROL)

54 THROUGH 86 SERIES

CONTENTS OF SECTION 1B

Subject	Page
PERIODIC MAINTENANCE	1B-23
GENERAL DESCRIPTION	1B-23
AIR OUTLETS	1B-23
FAST COOL DOWN	1B-23
DRIVING CONDITIONS	1B-23
OPERATION	1B-23
HEAT	1B-23
VENT	1B-24
NORMAL	1B-24
RECIR	1B-24
COMPRESSOR BELT ADJUSTMENT	1B-27
AIR OUTLETS	1B-27
SIDE OUTLET	1B-27
ADJUSTMENT	1B-27
CONTROL ASSEMBLY	1B-28
BLOWER MOTOR AND EVAPORATOR	1B-28
RESISTOR	1B-28
HEATER CASE	1B-28
VACUUM DIAPHRAGMS	1B-28
ADJUSTMENTS	1B-28
RECIRCULATING AIR DOOR	1B-28
MODE DOOR	1B-28
TEMPERATURE DOOR	1B-29
SIGHT GLASS R AND R	1B-29
EVAPORATOR	1B-29
REMOVAL	1B-29
DISASSEMBLY	1B-29
INSTALLATION	1B-29
CONDENSER AND RECEIVER	1B-31
REFRIGERANT LINES	1B-31
COMPRESSOR	1B-31
REMOVAL	1B-31
INSTALLATION	1B-32
WIRING AND HOSE ROUTING	1B-33
AIR CONDITIONING DIAGNOSIS	1B-33
VISUAL CHECKS	1B-34
OPERATIONAL TEST	1B-34
PERFORMANCE TEST	1B-34
PERFORMANCE CHART	1B-36
SPECIFICATIONS	1B-38

PERIODIC MAINTENANCE

Remove road accumulation from condenser at every engine oil change interval or as necessary.

Check and adjust compressor belt tension at each engine oil change interval.

Check refrigerant level and replenish as necessary at the start of every cooling season.

GENERAL DESCRIPTION

The air conditioning system provides refrigerated and dehumidified air to cool the car interior. The system uses both outside and recirculated air.

For normal cooling, A.C. control set for "NORMAL", 100% outside air passes through the evaporator core. For maximum cooling, A.C. control set for "RECIR", approximately 80% recirculated air and 20% outside air is directed through the evaporator core.

Air Outlets

Adjustable air outlets are located on either side of the instrument panel. The left and right air outlets may be adjusted to direct the air as desired. In addition, center outlets are provided to allow additional upper level cooling. All outlets are equipped with shut-off valves. Floor cooling is provided by discharging air directly to the floor from fixed openings in the air manifold located under the instrument panel.

The air conditioning control assembly is mounted in the instrument panel. A four-speed blower switch is located in the control assembly.

FAST COOL DOWN

To rapidly cool a car which has been standing for a period of time in the sun, open the center outlet, set A.C. control on "NORMAL", slide temperature lever to the extreme left position and turn blower speed switch on "HI". Open car windows just long enough to expel hot air. After car has cooled, adjust temperature control lever position to suit individual comfort. Air flow can be directed by adjusting the side outlets. The recommended position of the air outlets, for best over-all front and rear seat cooling, is when the side outlets are adjusted to direct the air flow along the inside roof line, and the auxiliary side and center outlets are open.

DRIVING CONDITIONS

For normal driving conditions, the driver may adjust the temperature of cool air by moving the control lever to suit individual comfort. Selection of blower speeds should be regulated according to the amount of air forced into the passenger compartment by the forward motion of the car.

When driving in heavy traffic, it may be desirable to set the blower speed switch on "HI". At higher speeds, air will be forced by the forward motion of the car into the passenger compartment in greater volume, lessening the speed requirements of the blower motor. It then may be desirable to set the blower speed switch to suit individual comfort.

OPERATION

Heat Button Depressed
(Fig. 1B-1)

When the "HEAT" button is depressed vacuum is applied to both parts of the outside air door (3) and to the mode door (5). This positions the mode door in the heat position and the outside air door to allow 100% outside air to enter the heater assembly.

When the temperature lever is moved toward the warm position, vacuum is directed to the water valve allowing engine coolant to flow through the heater core (1). Air flowing through the heater assembly is now warmed and flows out of the heater outlets. Temperature of heater outlet air is controlled by moving the temperature lever which is connected to the temperature door (4) with a cable. This mixes outside air with heated air to temper the discharge air.

Air velocity is controlled by a four-speed blower switch. When the "DEF" button is depressed the operation is identical to the "HEAT" except the defroster door is actuated to direct air flow to the windshield.

Vent Button Depressed
(Fig. 1B-2)

When the "VENT" button is depressed, vacuum is applied to both parts of the outside air door (3).This positions the outside air door to allow 100% outside air to enter the heater assembly. With no vacuum applied to the mode door (5), the mode door is in the A.C. position, allowing discharge air to flow out of the A.C. outlets. With the temperature lever moved to the full cool position 100% outside ambient air flows out of the A.C. outlets. When the temperature lever is moved toward the warm position, vacuum is directed to the water valve allowing engine coolant to flow through the heater core (1). Some of the air is now directed through the heater core by movement of the temperature door (4) where it is warmed and mixes with the outside air to temper the discharge air from the A.C. outlets.

Air velocity is controlled by a four speed blower switch.

Normal Button Depressed
(Fig. 1B-3)

When the "NORMAL" button is depressed an electrical switch is closed to start the compressor and vacuum is applied to both ports of the outside air door (3). This positions the outside air door to allow 100% outside air to enter the heater assembly. With no vacuum applied to the mode door (5) the mode door in the A.C. position.

Air flowing through the heater assembly is cooled by the evaporator (2).

With the temperature lever in the full cool position all the cooled air is directed out of the A.C. outlets.

As the temperature lever is moved toward the warm position, vacuum is directed to the water valve allowing engine coolant to flow through the heater core (1). Some of the air is now directed through the heater core by movement of the temperature door where it is warmed and mixes with the A.C. air to temper the discharge air from the A.C. outlets. If the temperature lever is moved to the full warm position all the air coming out of the A.C. outlets will be heated.

Air velocity is controlled by a four speed blower switch.

Recir Button Depressed
(Fig. 1B-4)

When the "RECIR" button is depressed, an electrical switch is closed to start the compressor and vacuum is applied to one port of the outside air door (3). This positions the outside air door to allow 20% outside air and 80% inside air to

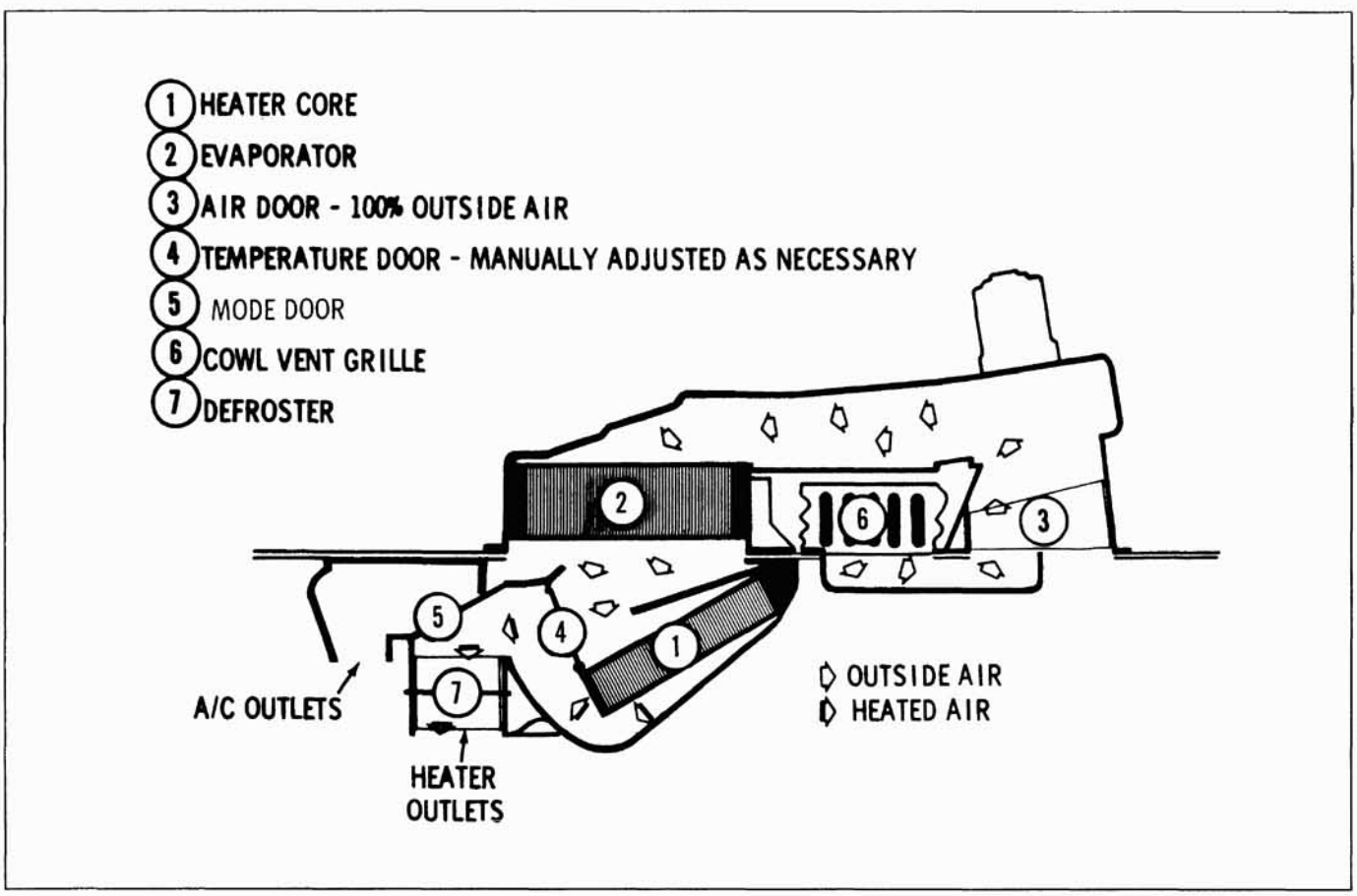


Fig. 1B-1—A.C. Off - Heater On

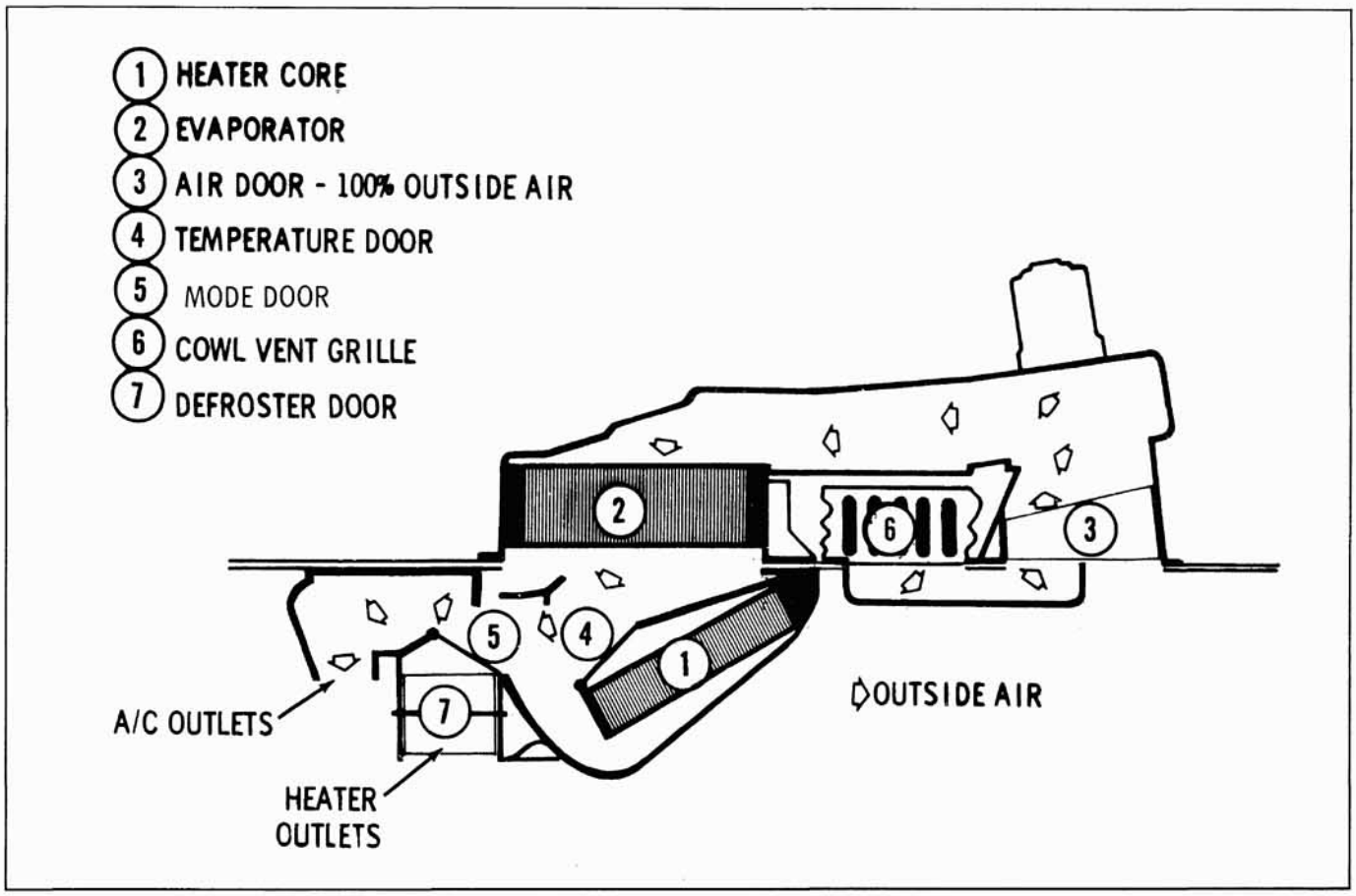


Fig. 1B-2—A.C. Off - Ventilation On

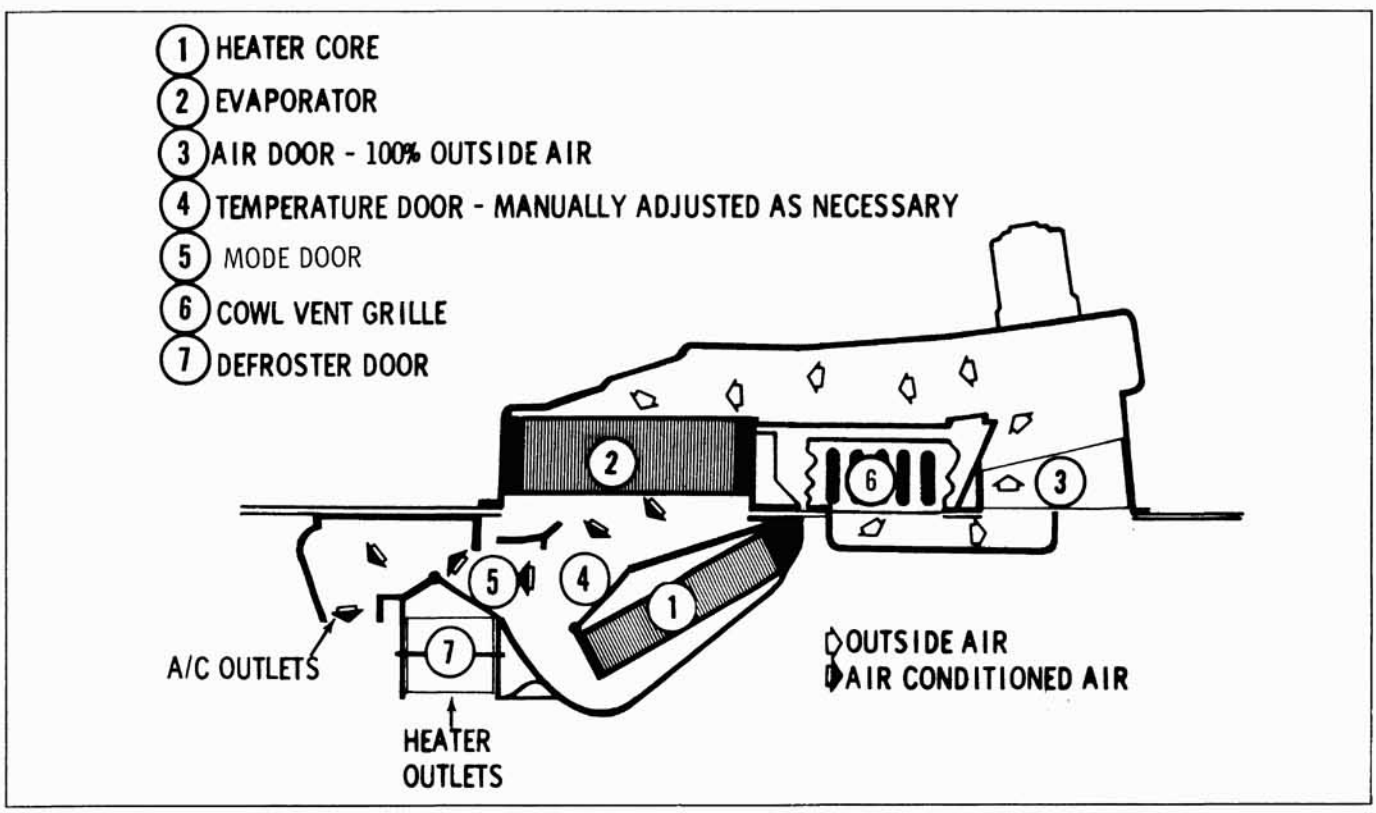


Fig. 1B-3—A.C. On - Normal Position

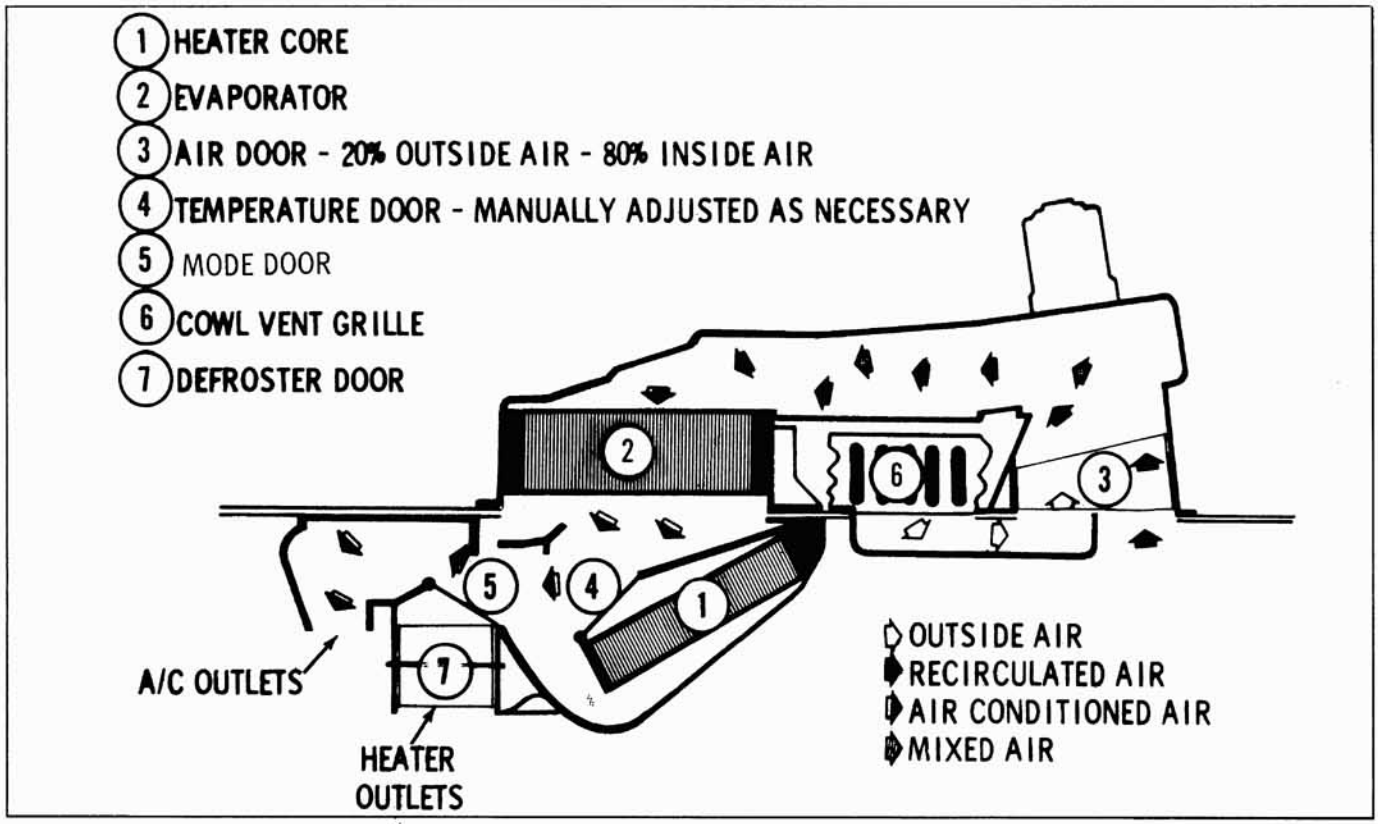


Fig. 1B-4—A.C. On - Recirc. Position

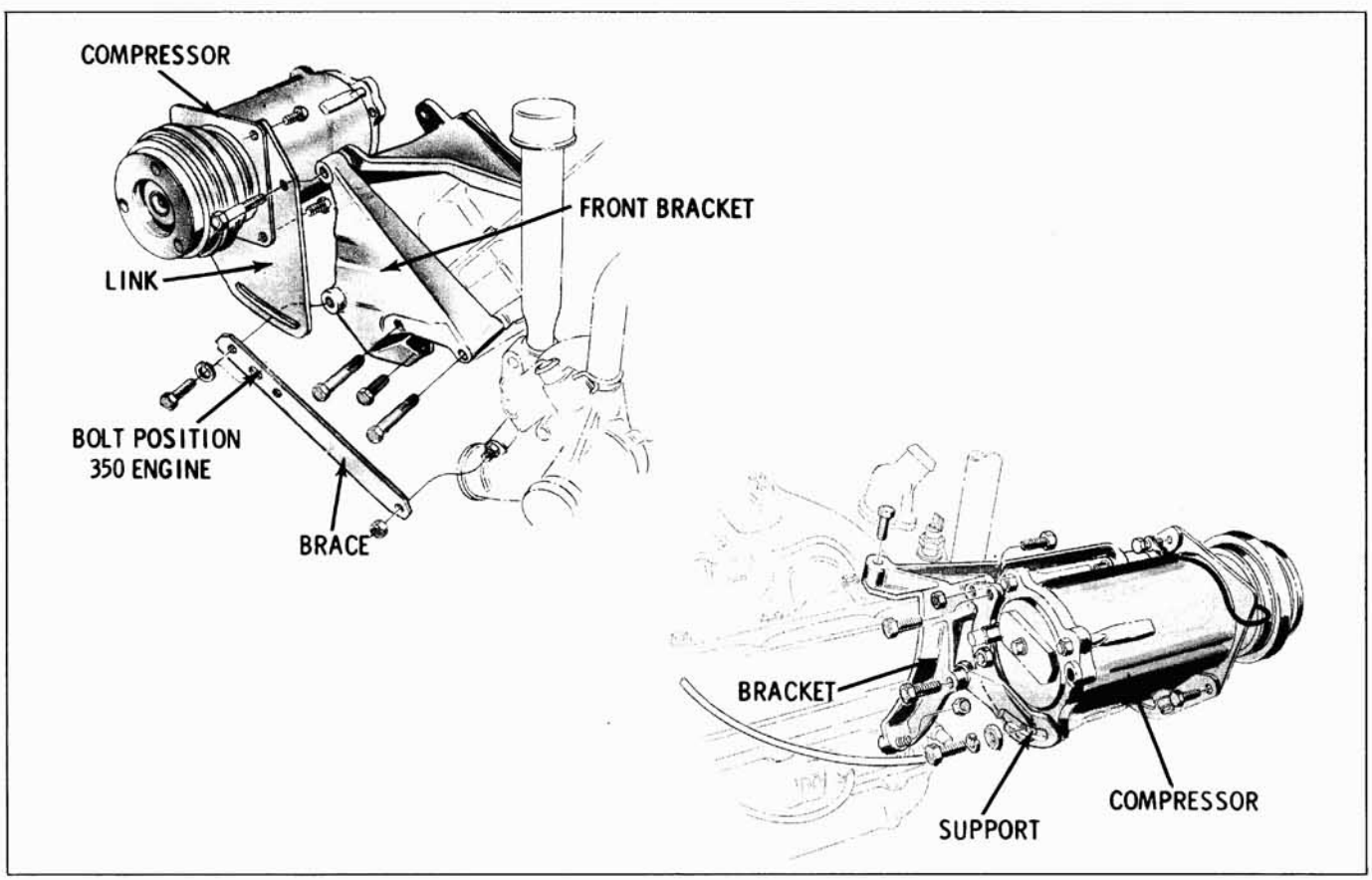


Fig. 1B-5—Compressor Installation

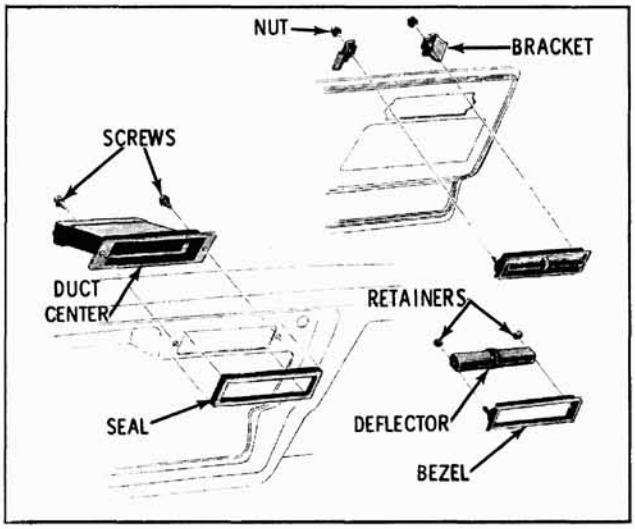


Fig. 1B-6—Center Outlet Installation

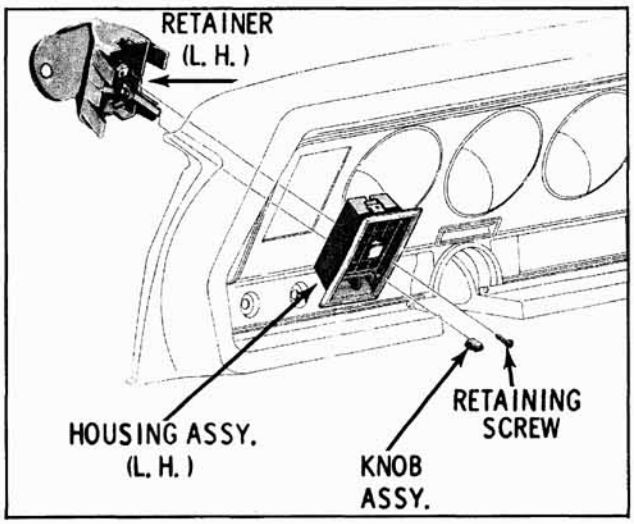


Fig. 1B-7—Left Side Outlet

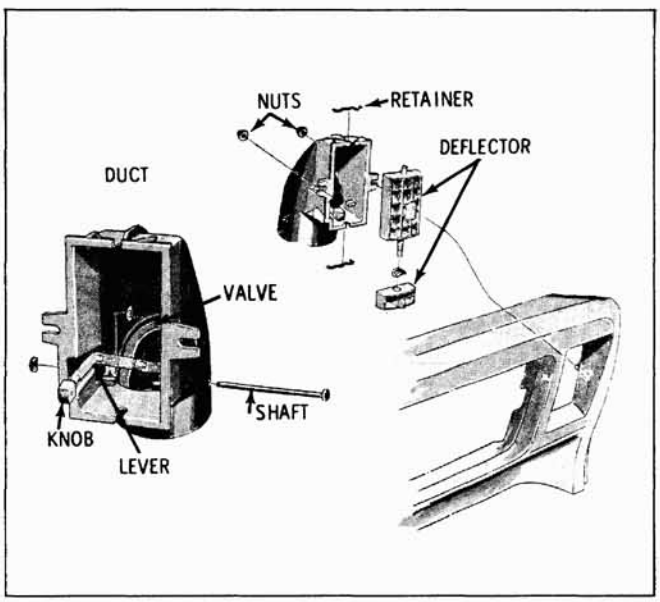


Fig. 1B-8—Right Side Outlet

enter the heater assembly. With no vacuum applied to the mode door (5) the mode door is in the A.C. position.

Air flowing through the heater assembly is cooled by the evaporator((2).

With the temperature lever in the full cool position all the cooled air is directed out of the A.C. outlets.

As the temperature lever is moved toward the warm position, vacuum is directed to the water valve allowing engine coolant to flow through the heater core (1). Some of the air is now directed through the heater core where it is warmed and mixes with the A.C. air to temper the discharge air from the A.C. outlets. If the temperature lever is moved to the full warm position all the air coming out of the A.C. outlets will be heated.

Air velocity is controlled by a four-speed blower switch.

COMPRESSOR BELT ADJUSTMENT
(Fig. 1B-5)

Tool BT-33-70M is used to check the compressor belt tension. IF belts require adjustment:

1. At rear of compressor, loosen bolt securing support to rear bracket.
2. At front of compressor, loosen bolt securing link to bracket.
3. Loosen bolt securing adjusting link to front bracket.
4. Pivot the compressor evenly at the front and rear until correct belt tension is obtained using belt tension gauge BT-33-70M.

Check belt alignment and torque all bolts loosened.

Bolt Size	Torque Ft. Lbs.
5/16"	25
3/8"	35
7/16"	50

CENTER OUTLET AND SIDE OUTLETS

The center outlet is installed as shown in Fig. 1B-6. The side outlets are installed as shown in Figs. 1B-7 and 1B-8.

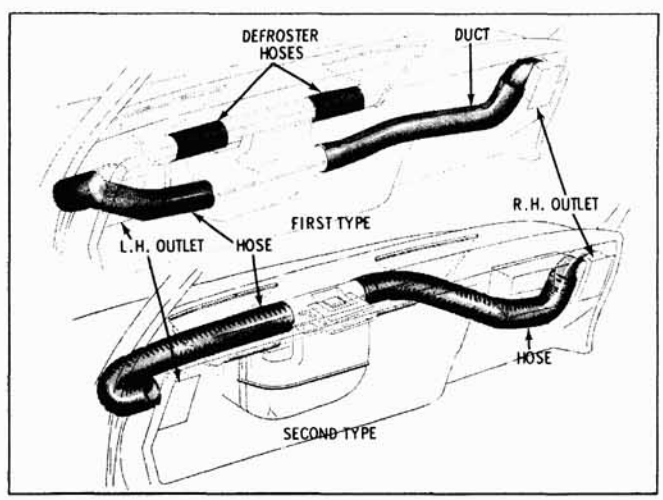


Fig. 1B-9—Air Distributing Hoses

AIR DISTRIBUTING HOSES

The air distributing hoses are installed as shown in Fig. 1B-9.

MANIFOLD

The manifold lower duct and seal are installed as shown in Fig. 1B-10.

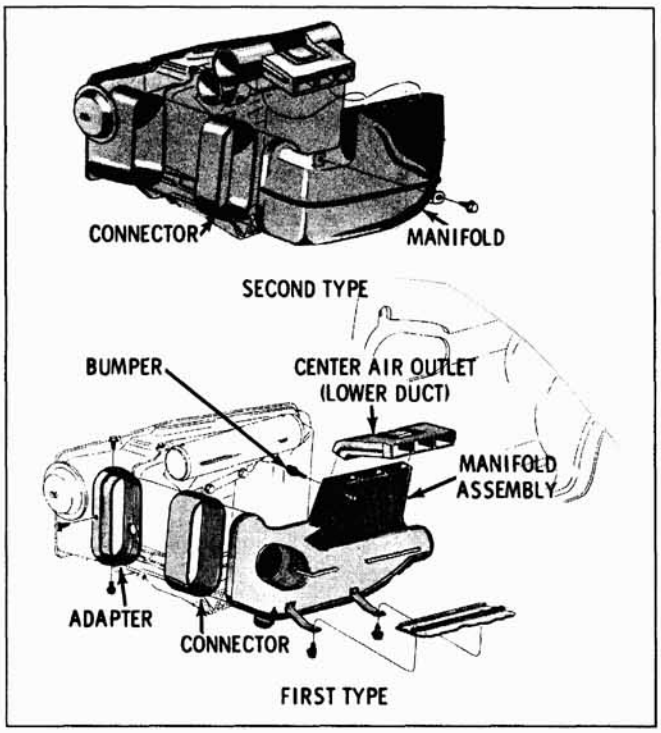


Fig. 1B-10—Manifold Installation

CONTROL ASSEMBLY

The control attachment and wiring connections are shown in Figs. 1B-11 and 1B-12.

BLOWER MOTOR AND EVAPORATOR

The blower motor, duct and evaporator is attached as shown in Fig. 1B-13. Fig. 1B-14 illustrates evaporator to case attachment.

BLOWER MOTOR RESISTOR

The blower motor resistor is mounted on the blower duct and can be removed by removing the two attaching screws. (Fig. 1B-14)

HEATER CASE ASSEMBLY

The heater case assembly is installed as shown in Fig. 1B-15. The heater core can be removed after removing the heater case assembly. Fig. 1B-16 illustrates the core location.

VACUUM DIAPHRAGMS

Vacuum diaphragms are used to operate the air inlet and recirculate door, the defroster door and the mode door. The air inlet and recirculate door diaphragm is a two-step diaphragm. When the A.C. control is set for "RECIR", vacuum is applied to the upper port and the door opens a predetermined distance allowing 20% outside air and 80% inside air to be drawn through the evaporator. When the A.C. control is set for "NORMAL", vacuum is applied to both ports and 100% outside air is drawn through the evaporator.

ADJUSTMENTS

Recirculating Air Door (Fig. 1B-17)

To adjust the recirculating air door the blower duct assembly must be removed from the car.

1. With vacuum applied to the upper port, the recirculating air door should open 11/32".
2. Adjustment can be made by loosening the diaphragm to link screw and moving link in or out.

Mode Door (Fig. 1B-18)

With vacuum applied to the mode door diaphragm, the mode door directs air flow out of the heater ducts. With no vacuum applied the mode door directs air flow out of the A.C. ducts.

The mode door adjustment is correct when no air flow can be felt at the A.C. outlets with the heat button depressed.

Adjustment is provided for at the diaphragm adjustment screw.

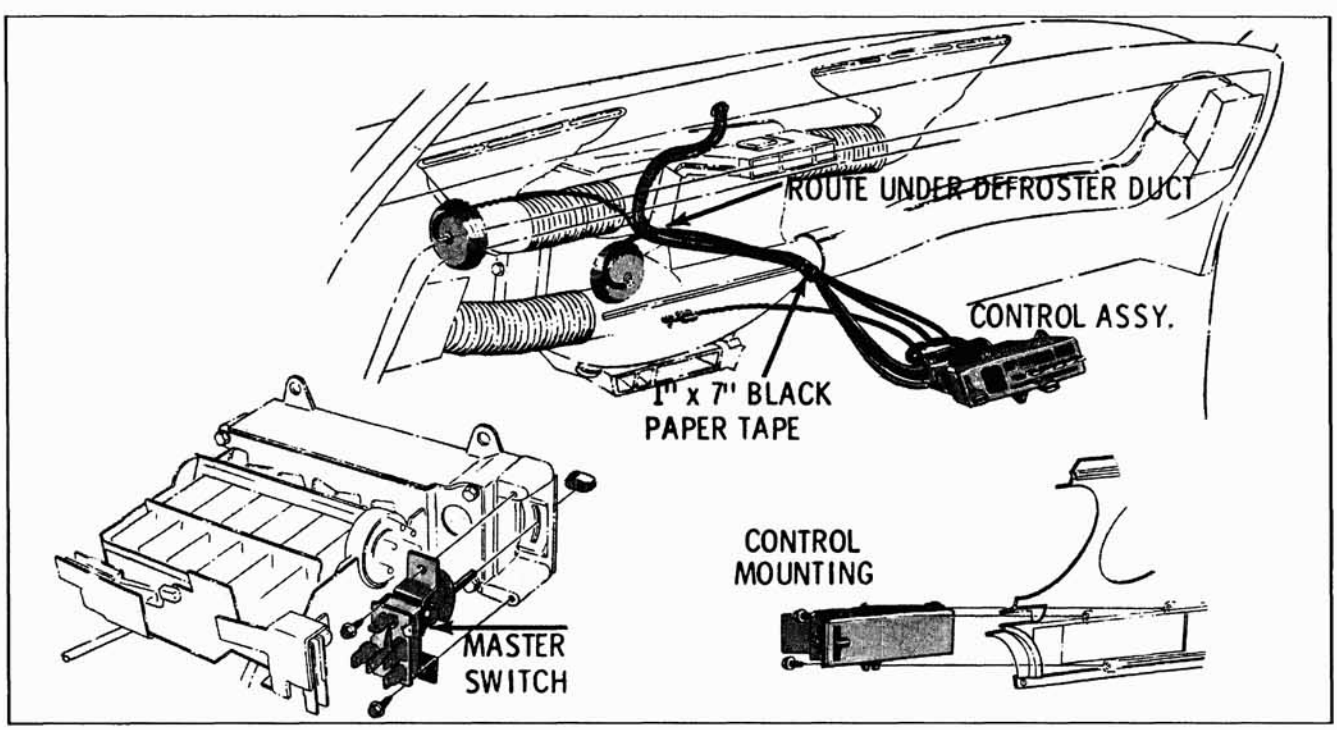


Fig. 1B-11—A.C. Control Installation

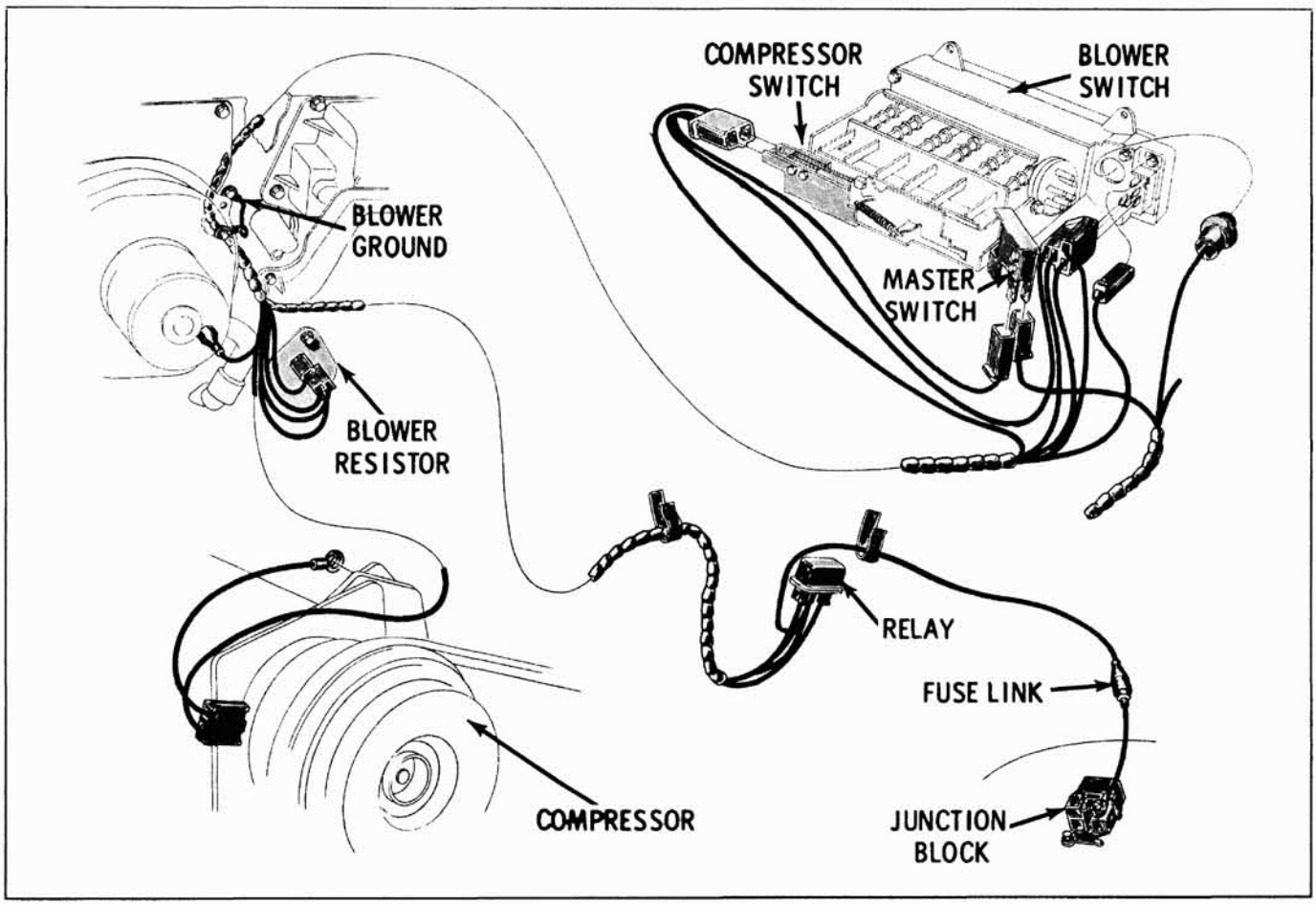


Fig. 1B-12—Wiring Connections

Temperature Control Cable

The cable is connected to a cam lock device that assures positive closing of the temperature door. The cable must be adjusted so there is 1/16" to 1/8" control lever spring back with the valve fully closed. Section 1 (Fig. 1-4)

SIGHT GLASS

Removal

1. Discharge the system as outlined under DISCHARGE THE SYSTEM. Section 1A.
2. Remove the sight glass retaining screw.
3. Lift out the sight glass with caulking compound.
4. Remove the "O" ring with a wire hook.

When performing this operation, the system should not be left open longer than absolutely necessary as the dehydrator will absorb an excess of moisture. Refer to SERVICING OF THE REFRIGERANT SYSTEM.

To install, reverse the removal procedure and evacuate and charge the system.

EVAPORATOR ASSEMBLY

Removal (Fig. 1B-13)

1. Disconnect the battery.
2. Discharge the system as outlined under DISCHARGING THE SYSTEM. Section 1A
3. Remove blower and housing assembly.

It is not necessary to remove the resistor from the duct or disconnect the wiring.

4. Disconnect refrigerant lines from suction throttling valve and expansion valve.

Cap fittings to prevent entrance of dirt and moisture.

5. Fold back front floor carpet and remove the three heater assembly attaching screws. From the engine compartment, remove the evaporator attaching screws and remove the evaporator.

Disassembly

1. Remove mounting gasket and grommets around the outlets.
2. On bench, remove expansion valve.

Capillary bulb is retained by two clamps which are accessible after peeling back the insulating material.

3. Remove clamps securing expansion valve and evaporator pipe.
4. Disconnect all lines and remove suction throttling valve.

Tape or cap all valve openings to prevent entrance of dirt and moisture.

5. Remove screws securing evaporator core to case. (Fig. 1B-14)

Installation

1. With gasket cemented to evaporator, position evaporator assembly to the dash and install retaining screws.
2. Install duct and blower assembly.

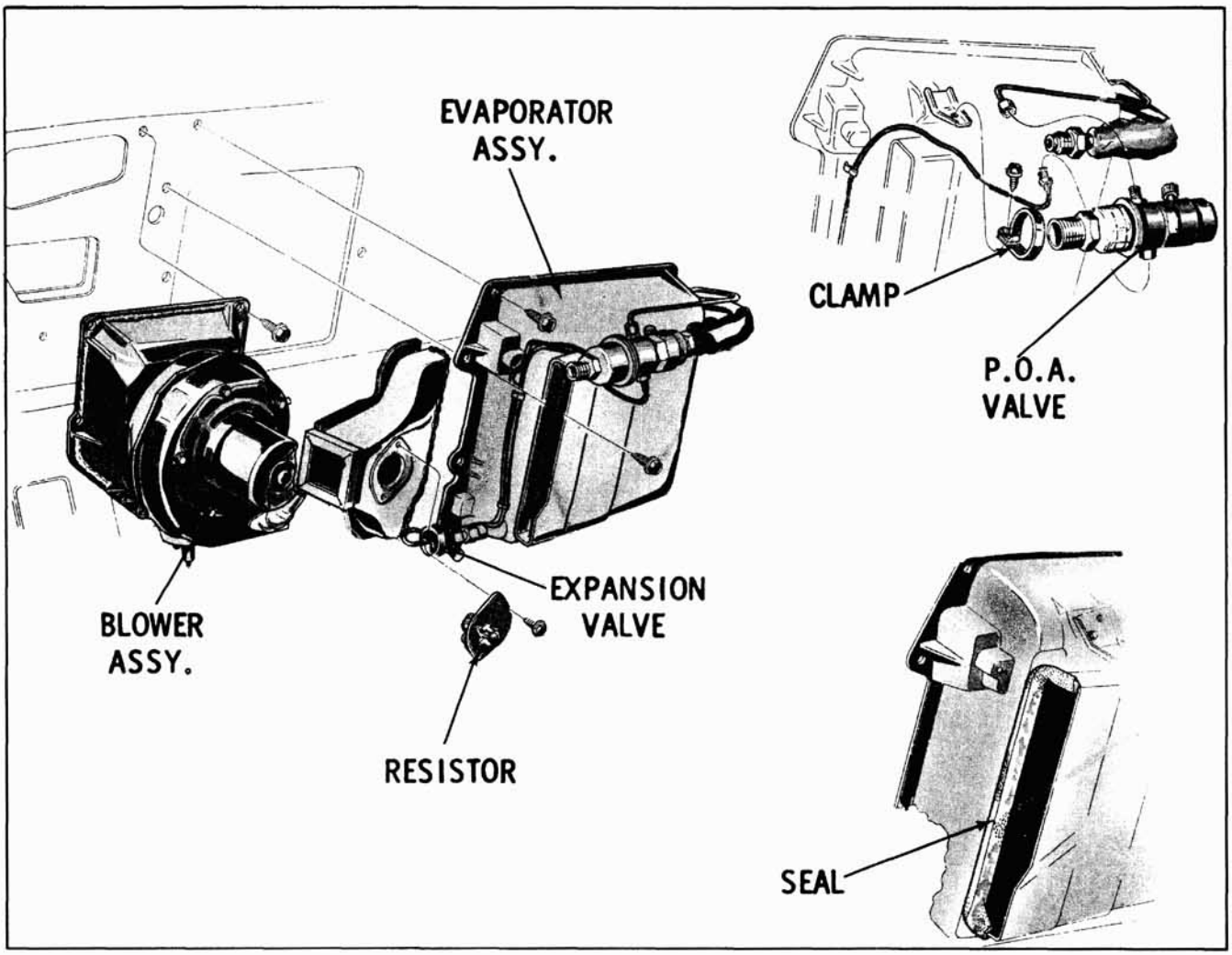


Fig. 1B-13—Blower and Evaporator Installation

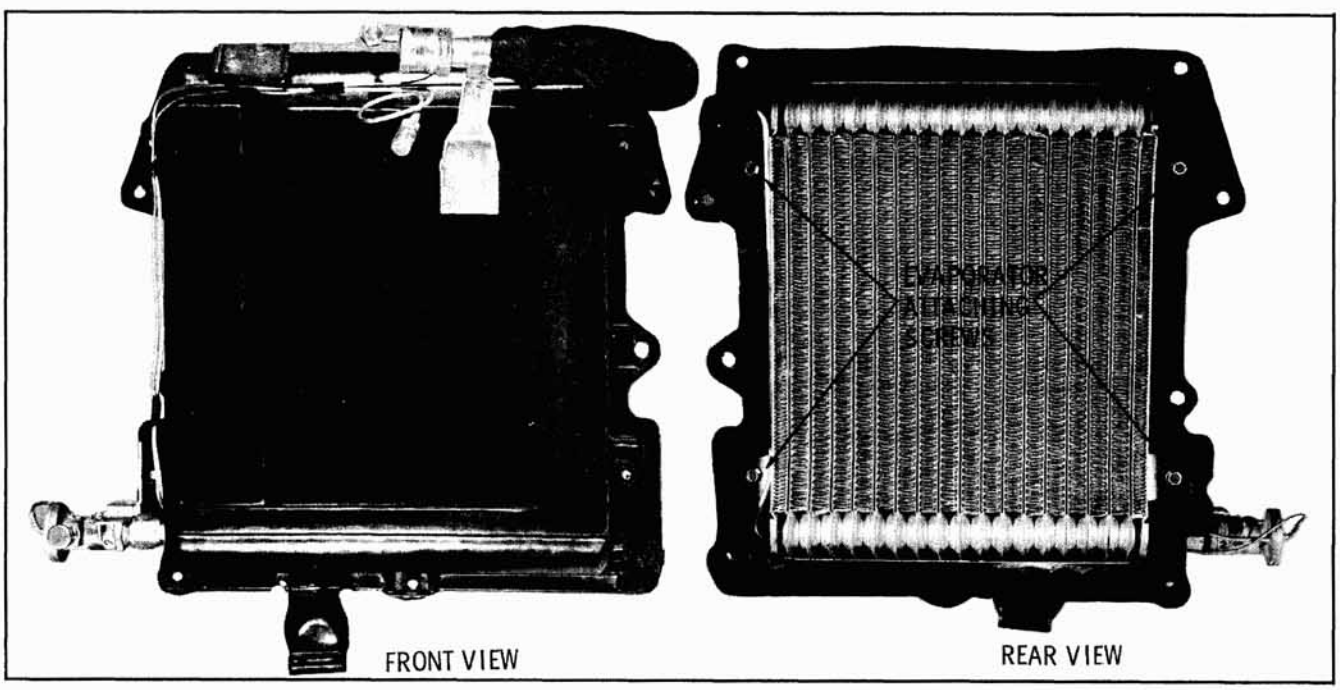


Fig. 1B-14—Evaporator to Case Attachment

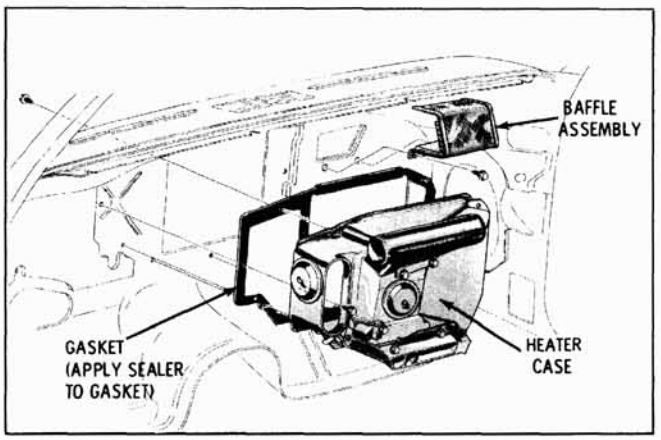


Fig. 1B-15—Heater Case Attachment

3. Remove caps from lines, oil the fitting with 525 viscosity refrigerant oil, then connect the lines.
4. Evacuate the system as outlined under EVACUATING THE SYSTEM, Section 1A.
5. Charge the system as outlined under CHARGING THE SYSTEM, Section 1A.
6. Leak test all line fittings that were disconnected.

It is important that the expansion valve capillary bulb be tightly clamped to the suction line at the evaporator. Both the suction line and the capillary tube should be clean at the points of contact.

Do not kink capillary tubes when removing or installing.

CONDENSER AND RECEIVER

The condenser and receiver are mounted in front of the radiator. After discharging the system, the condenser or receiver can be removed as illustrated in Fig. 1B-19.

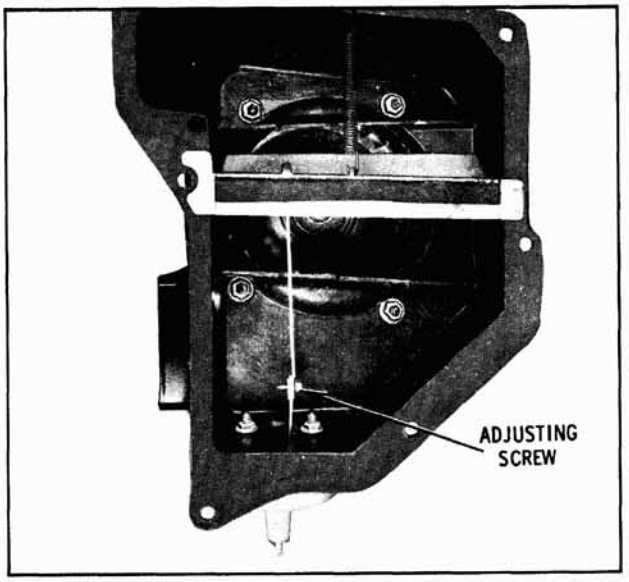


Fig. 1B-17—Recirculating Air Door Adjustment

REFRIGERANT LINES

The refrigerant lines and mufflers are attached as shown in Figs. 1B-20 and 1B-21.

When installing lines, always use new "O" rings. Torque lines as indicated in Fig. 1B-22.

COMPRESSOR (Fig. 1B-23)

Removal

1. Discharge the refrigerant system.
2. Disconnect compressor clutch wire at compressor connector.
3. Remove belt from compressor pulley.

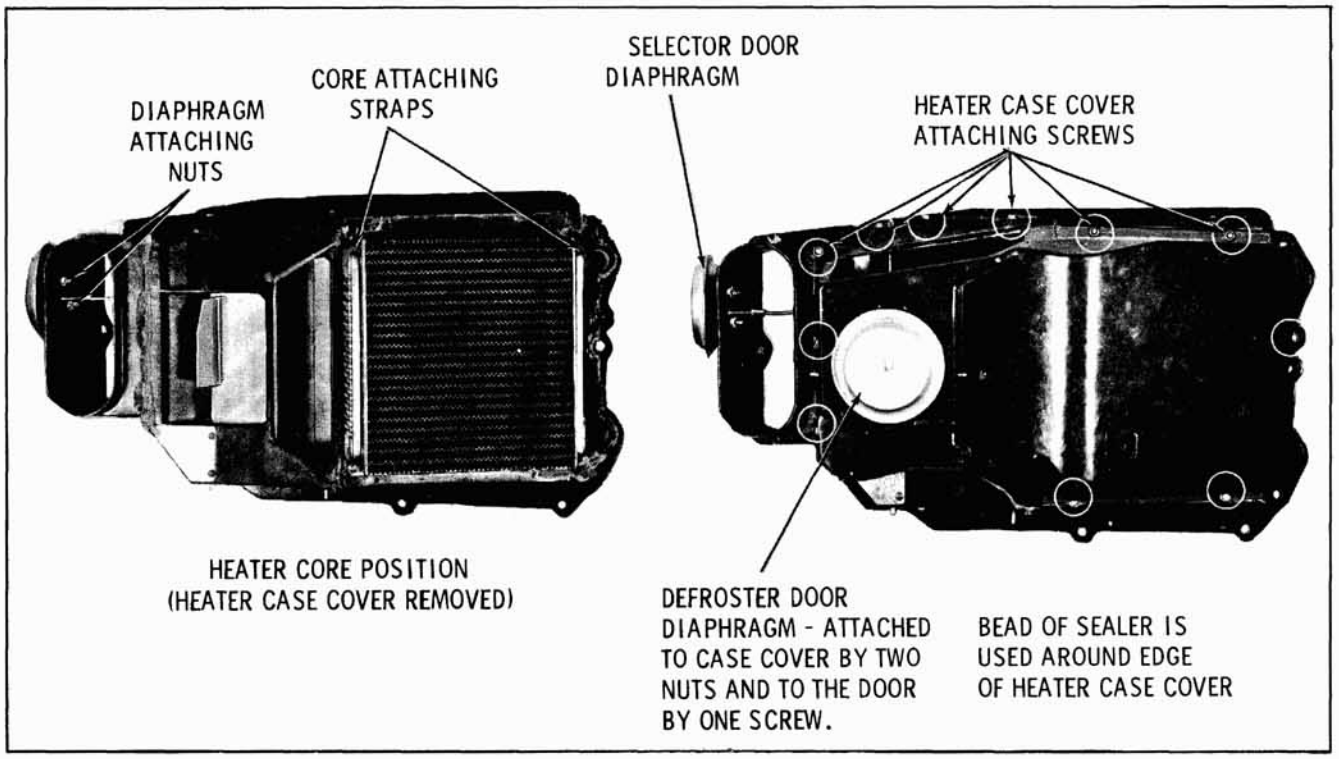


Fig. 1B-16—Heater Core Attachment

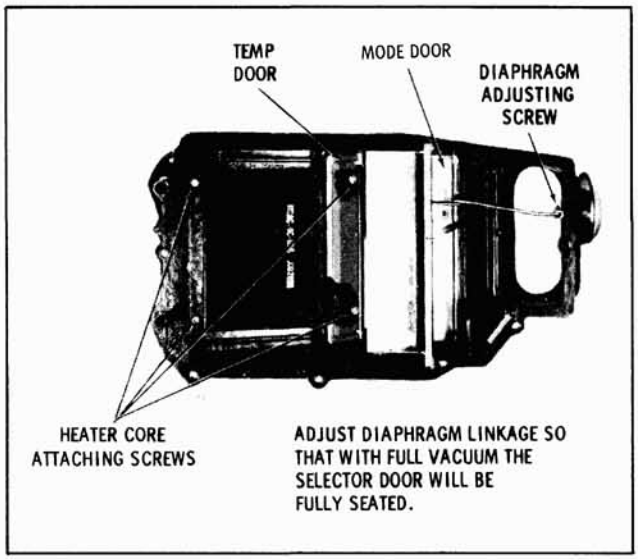


Fig. 1B-18—Mode Door Adjustment

4. Remove the bolt holding the fittings connector to the compressor, then remove the assembly from the compressor. Tape lines and fittings to prevent entry of dirt and moisture.

5. Remove the compressor to bracket bolts, then remove the compressor assembly.

Installation

1. Position the compressor on the mounting bracket, then install and tighten the compressor to bracket bolts.

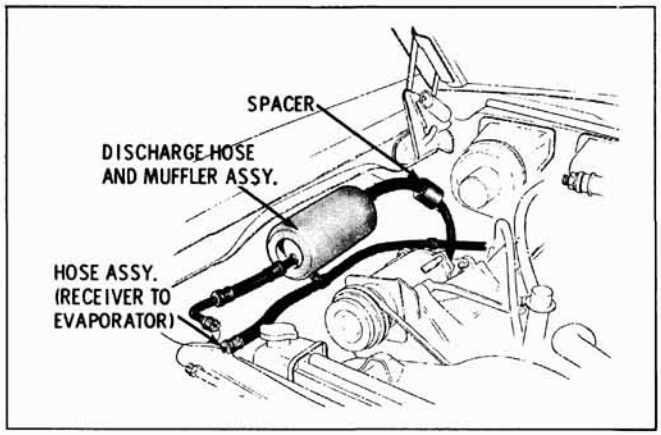


Fig. 1B-20—Refrigerant Lines

2. Connect compressor clutch wire.

3. Install two new "O" rings on the valve port openings and position the fittings connector on the compressor. Install the mounting bolt and tighten to 22 ft. lbs. torque.

4. Install belt and adjust tension using Tool BT-33-70M.

5. If compressor was removed for some internal malfunction and foreign material has circulated throughout the system, proceed as follows:

a. Install a charging line to the compressor discharge Schrader valve and to a drum of refrigerant 12.

b. Disconnect the liquid line from the dehydrator-receiver assembly on the inlet side, and cap the dehydra-

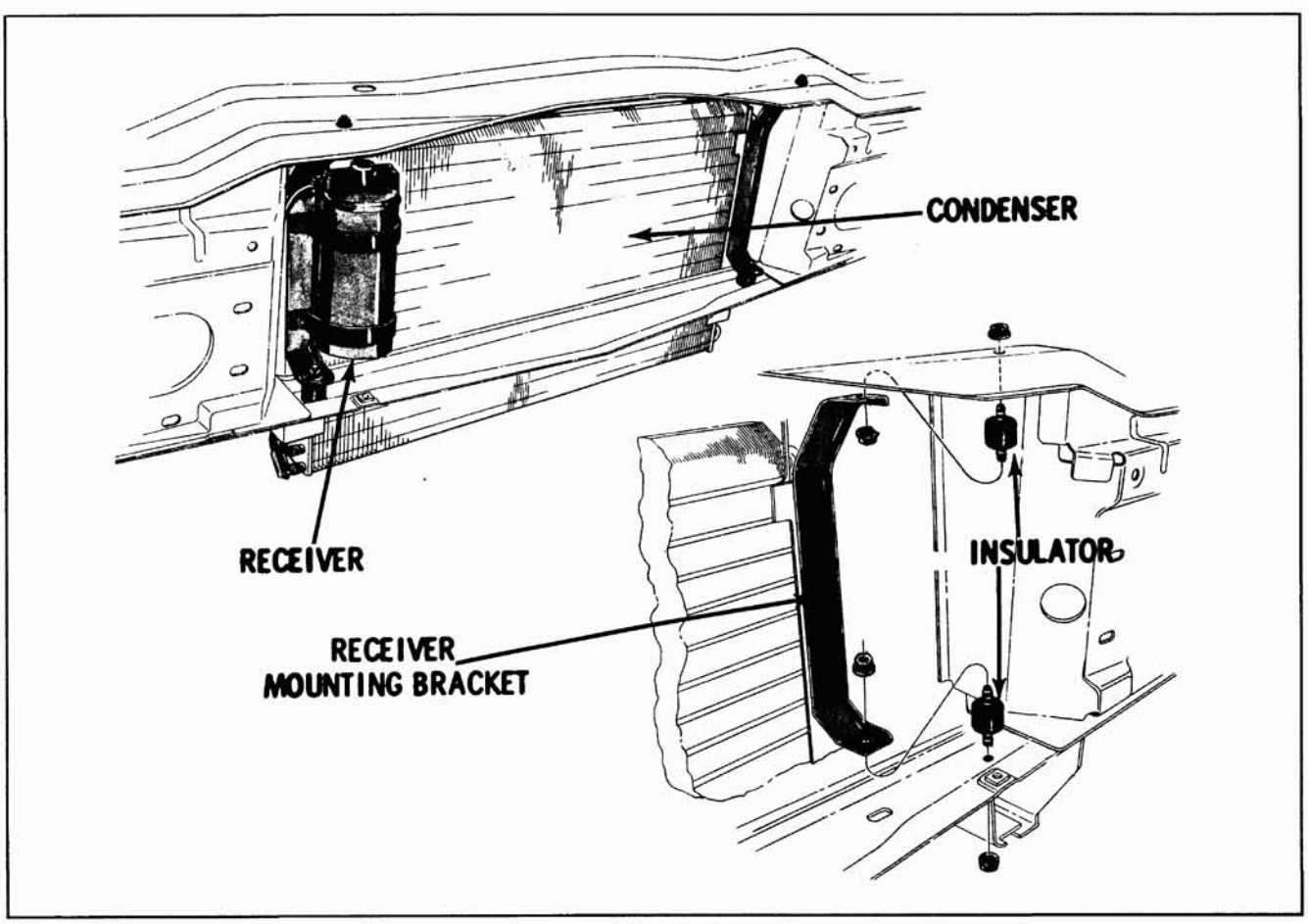


Fig. 1B-19—Condensor and Receiver Installation

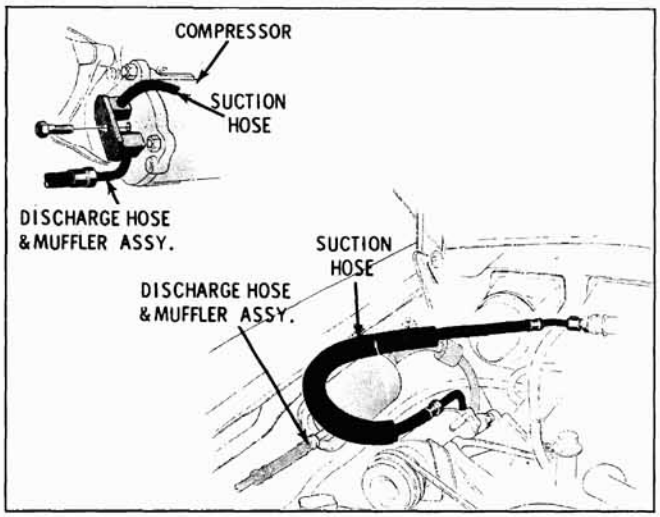


Fig. 1B-21—Refrigerant Lines

tor-receiver immediately.

c. Open the refrigerant drum valve and turn the drum upside down to allow liquid refrigerant to flush through the condenser and out the line. Use approximately 2 lbs. of refrigerant for this operation.

d. Close the drum valve and connect the dehydrator-receiver assembly.

e. Remove the expansion valve screen and clean or replace as necessary.

6. Remove the charging line from the compressor, install the gauge set, and evacuate the entire system.

7. Recharge the system.

WIRING AND HOSE ROUTING

For wire routing, refer to Fig. 1B-12. For heater hose routing, vacuum hose routing and water valve installation, refer to Figs. 1B-24,1B-25 and 1B-26.

AIR CONDITIONING DIAGNOSIS

If a car is in for service with a complaint of high outlet temperatures on the road but appears to operate normally during tests, a quick check to determine which unit is at fault can be

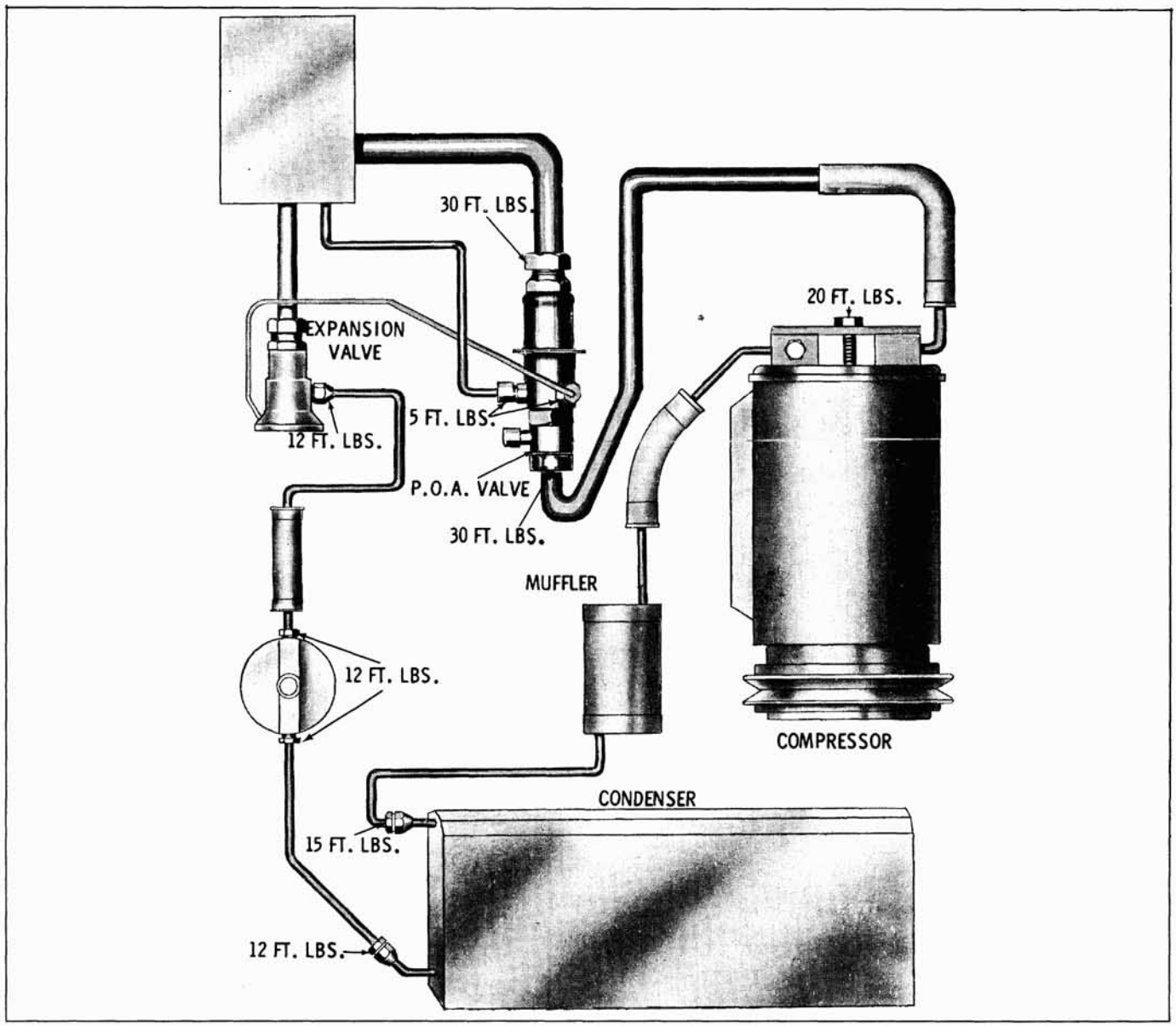


Fig. 1B-22—Refrigerant Line "O" Ring Torque

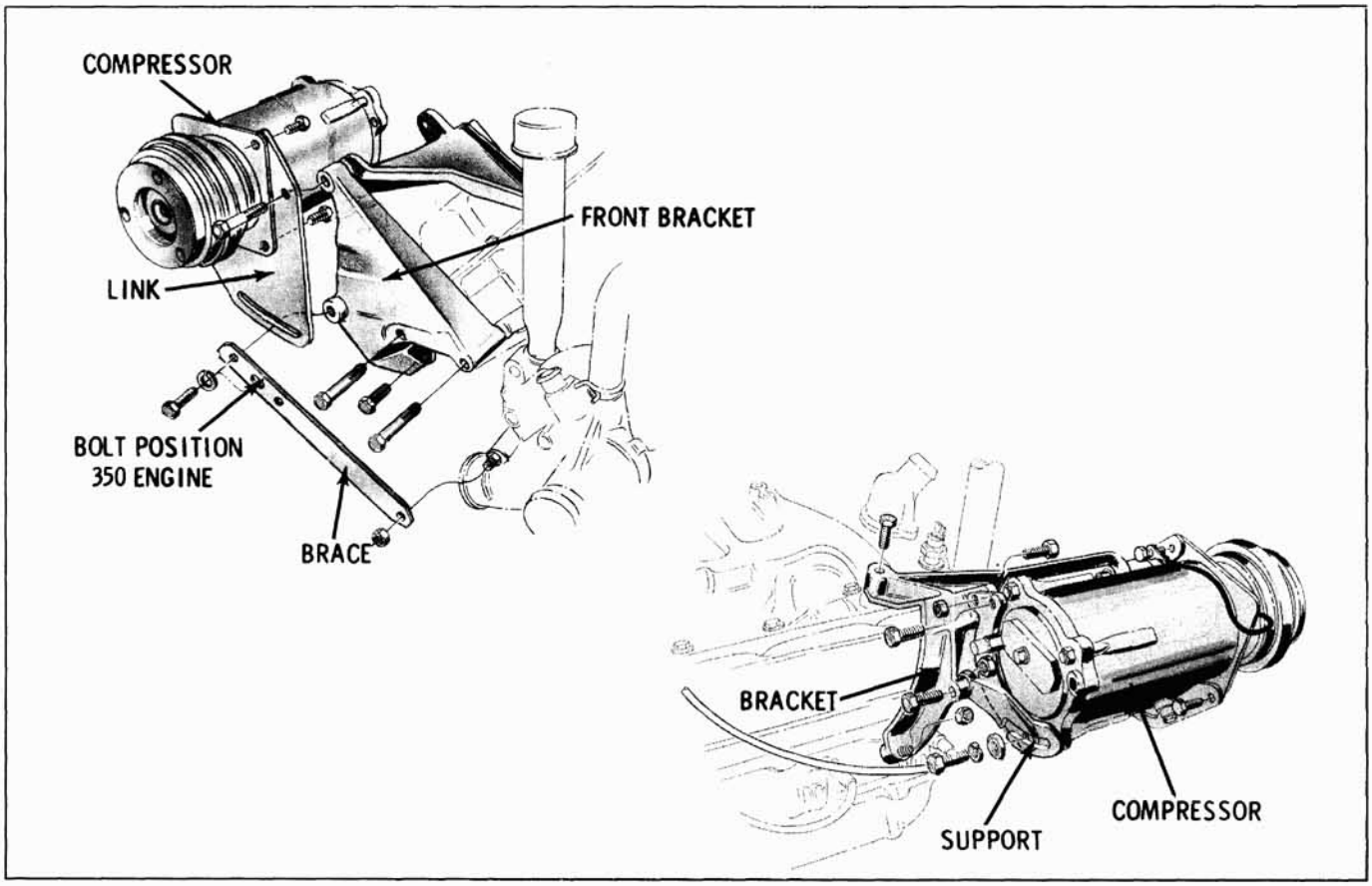


Fig. 1B-23—Compressor Installation

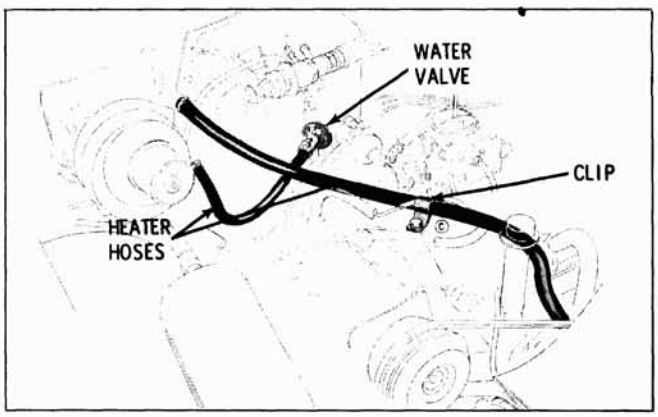


Fig. 1B-24—Heater Hose Routing

made using the following procedure.

VISUAL CHECKS

1. Check temperature door to make sure that it seals in the cool position. Adjust if necessary.
2. Check air hoses and ducts for proper connection.
3. Check vacuum hoses for correct routing and connection.

A leaking engine water valve could cause a slight rise in outlet temperature.

4. Check sight glass for "clear" condition.
5. Check compressor clutch to make sure that it engages.
6. Check compressor belt, adjust if necessary.

OPERATIONAL TEST

Install air conditioning gauge set, apply parking brake and operate the engine at 1500 rpm in Neutral. Set control on Recirculate with blower at low speed.

1. Check evaporator pressure. If pressure is 30 psi or less and outlet air temperature is too warm, check to see that the expansion valve is clamped tightly to the evaporator outlet pipe and that the insulation is in place.

If the feeler bulb installation and insulation are satisfactory, a leak in the bulb is indicated and the expansion valve should be replaced.

2. If the evaporator pressure is above 30 psi, even with blower motor wire disconnected, replace the P.O.A. valve.
3. If evaporator pressure is 29 psi $\pm$ 1 psi and the outlet air temperature is normal, partially cover the condenser to obtain head pressure of 300 psi. If evaporator pressure rises above 30 psi replace the expansion valve. If evaporator pressure remains at 29 psi during test, there is a possibility of water or moisture in the system which could freeze under certain conditions, and a new receiver-dehydrator may be required.

PERFORMANCE TEST

The Performance Test should be made with the car doors open, the temperature control lever fully to the left, A.C. control set at "NORMAL", blower speed switch on "HI", all air outlets open an auxiliary fan in front of the radiator, and the car hood lowered.

1. Remove Schrader valve fitting cap at the suction throttling valve.
2. Install Adapter J-5420 on the low pressure gauge hose, and connect the adapter to the Schrader valve fitting on the suction throttling valve, then momentarily open low pressure

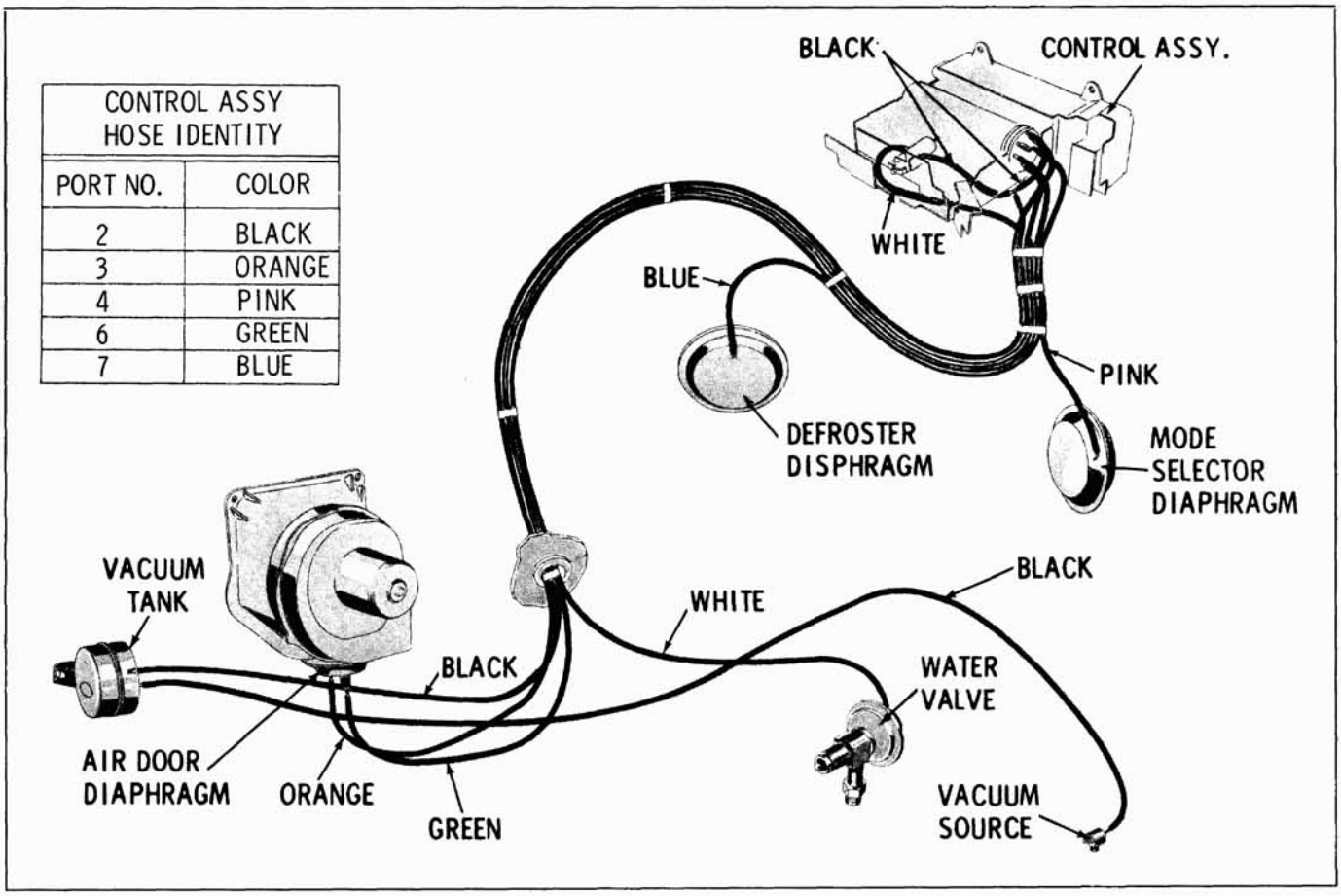


Fig. 1B-25—Vacuum Hose Routing

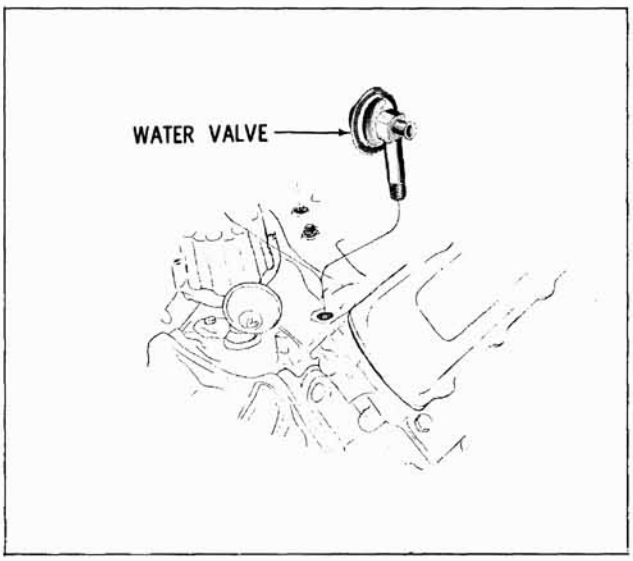


Fig. 1B-26—Water Valve Installation

gauge valve to purge gauge hose.

3. Remove the compressor high pressure Schrader valve protective cap and install high pressure gauge hose with Adapter J-5420. Be sure high pressure gauge valve is closed.

4. Momentarily open high pressure gauge to purge the gauge and hose.

5. With transmission in PARK or NEUTRAL and parking brake applied, adjust engine speed to 2000 rpm.

6. After temperature and humidity have been determined, compare test results with the PERFORMANCE CHART.

7. When test is completed, disconnect gauge hoses, and install protective caps.

8. Install Schrader valve fitting cap on suction throttling valve.

PERFORMANCE CHART
(54 THROUGH 86 SERIES)

In Front Of Condenser		Evaporator Pressure At Suction Throttling Valve psi ±1	Engine rpm	Discharge Air Temp. R.H. Nozzle ±2°F.	Pressure High (Discharge) ±20 psi
Relative Humidity	Air Temp. °F.				
20	70	29.0	2000	37.0	162
	80	29.0		37.0	170
	90	29.0		38.0	186
	100	34.0		40.0	246
	110	40.5		53.0	300
30	70	29.0	2000	37.0	162
	80	29.0		37.0	176
	90	30.5		40.0	202
	100	36.0		45.0	268
	110	43.0		56.0	319
40	70	29.0	2000	37.0	163
	80	29.0		37.5	183
	90	32.0		42.0	218
	100	38.0		49.0	288
	110	45.0		61.0	339
50	70	29.0	2000	37.5	164
	80	29.5		40.0	192
	90	33.5		44.0	231
	100	40.5		54.0	340
	110	48.0		66.0	355
60	70	29.0	2000	39.0	165
	80	30.0		42.0	200
	90	35.0		46.0	244
	100	43.0		60.0	330
70	70	29.0	2000	39.0	168
	80	30.0		44.0	206
	90	36.0		51.0	257
	100	45.0		65.0	345
80	70	29.0	2000	40.0	173
	80	31.0		46.0	212
	90	37.5		53.0	267
	100	49.0		67.0	362
90	70	29.0	2000	41.0	177
	80	32.0		48.0	219
	90	39.0		56.0	278
	100	50.0		72.0	368

DIAGNOSIS OF PERFORMANCE TEST RESULTS

CONDITION AND CAUSE	CORRECTION
EVAPORATOR PRESSURE TOO HIGH	
A. Defective suction throttling valve.	A. Replace
B. Restriction in suction line.	B. Remove, inspect, and clean or replace.
C. Loose compressor drive belt.	C. Adjust as outlined.
D. Defective clutch or coil.	D. Check or replace as necessary.
E. Defective expansion valve.	E. Replace as necessary.
F. Expansion valve capillary tube not tight to evaporator suction line.	F. Check clamp for tightness.
G. Clutch slipping.	G. Refer to CLUTCH SLIPPAGE.
HIGH PRESSURE SIDE OF SYSTEM TOO HIGH	
A. Engine overheated.	A. Check engine cooling system.
B. Restricted air flow through condenser.	B. Remove foreign material from engine radiator and condenser.
C. Air in system or overcharge of refrigerant.	C. Momentarily discharge system on discharge side with engine not running; then, operate system and recheck pressure. Repeat as necessary. Check sight glass with system under load.
D. Restriction in condenser, dehydrator-receiver assembly, or any discharge or liquid line.	D. Remove parts, inspect for restricted passage, and clean or replace.
E. Too much oil in compressor.	E. Drain oil and add correct amount.
NOZZLE DISCHARGE AIR TOO WARM (With Other Readings OK)	
A. Air hoses not properly connected.	A. Inspect air hoses and manifolds.
B. Defective or mispositioned evaporator drain hoses.	B. Replace or align as necessary.
C. Poor Seal-Evaporator to cowl.	C. Correct sealing.
CLUTCH SLIPPAGE	
A. Head pressure too high.	A. Discharge system until bubbles appear in sight glass and then add one pound of refrigerant.
B. Pulley wobbles.	B. Check and replace, if necessary, the pulley bearing. If pulley has been worn by bearing, replace pulley.
VELOCITY OF AIR AT DISCHARGE NOZZLES TOO LOW	
A. Restricted evaporator core in evaporator assembly.	A. Wash evaporator core. Restricted evaporator core caused by freezing.
B. Restricted air hoses.	B. Inspect and replace if necessary.
C. Defective blower motor.	C. Check and replace if necessary.
D. Defective switches.	D. Check and replace if necessary.
E. Poor wiring connection (Low voltage at blower.)	E. Correct wiring.
EVAPORATOR PRESSURE TOO LOW	
A. Insufficient Refrigerant charge.	A. Add refrigerant.
B. Restricted air flow through evaporator.	B. Check air flow.
WATER BLOWING OUT AIR DISCHARGE NOZZLE	
A. Plugged or kinked evaporator drain hose.	A. Clean or align as necessary.
INOPERATIVE CONTROLS	
A. Inadequate vacuum.	A. Check vacuum. All controls should move with 10" of vacuum. Check hoses.
B. Control cables improperly adjusted.	B. Adjust cables.

PRESSURE—TEMPERATURE RELATIONSHIP OF REFRIGERANT-12

Temp. °F	Pressure	Temp. °F	Pressure	Temp. °F	Pressure	Temp. °F	Pressure	Temp. °F	Pressure
- 8	5.4	22	22.4	52	49.0	82	87.0	112	140.1
- 6	6.3	24	23.9	54	51.0	84	90.1	114	144.2
- 4	7.2	26	25.4	56	53.0	86	93.2	116	148.4
- 2	8.2	28	27.0	58	55.4	88	96.4	118	153.0
0	9.2	30	28.5	60	58.0	90	99.6	120	157.1
2	10.2	32	30.1	62	60.0	92	103.0	122	161.5
4	11.3	34	32.0	64	62.5	94	106.3	124	166.1
6	12.3	36	33.4	66	65.0	96	110.0	126	171.0
8	13.5	38	35.2	68	67.5	98	113.3	128	175.4
10	14.6	40	37.0	70	70.0	100	117.0	130	180.2
12	15.9	42	39.0	72	73.0	102	121.0	132	185.1
14	17.1	44	41.0	74	75.5	104	124.0	134	190.1
16	18.4	46	43.0	76	78.3	106	128.1	136	195.2
18	19.7	48	45.0	78	81.1	108	132.1	138	200.3
20	21.0	50	47.0	80	84.1	110	136.0	140	205.5

GENERAL SPECIFICATIONS

Engine Idle Speed	(Refer to Engine Tune-Up and/or Carburetion Section)
Fuse (at Fuse Block)	AGC25 Amps.
Amount of Refrigerant 12 in System	4-1/2 Lbs.
Total Amount of Oil in Refrigerant System	10 1/2 Fluid Oz.
Type of Oil	525 Viscosity

TORQUE SPECIFICATIONS

Application	Ft. Lbs.
* (Refer to Chart for Power Steering Pump, Delcotron and Compressor Mounting Brackets)	
Schrader Valve Adapter Fittings to Compressor Bolt	10 to 15
Driven Plate to Compressor Shaft Nut	14 to 16
Rear Head to Compressor Housing Nuts	19 to 23

*TORQUE CHART

Bolt Size	Torque Ft. Lbs.
5/16"	25
3/8"	35
7/16"	50

CUSTOM AIR CONDITIONER (MANUAL, CABLE CONTROL)

31 THROUGH 48 SERIES

CONTENTS OF SECTION 1C

Subject	Page
PERIODIC MAINTENANCE	1C-1
GENERAL DESCRIPTION	1C-1
AIR OUTLETS	1C-1
FAST COOL DOWN	1C-1
DRIVING CONDITIONS	1C-4
OPERATION	1C-4
HEAT	1C-4
VENT	1C-4
NORMAL	1C-5
RECIRC	1C-5
COMPRESSOR BELT ADJUSTMENT	
L-6 ENGINE	1C-5
V-8 ENGINE	1C-5
SIDE OUTLETS	
ADJUSTMENT	1C-5
CENTER OUTLET	1C-5
CONTROL ASSEMBLY	1C-5
BLOWER MOTOR AND EVAPORATOR	1C-5
BLOWER MOTOR RESISTOR	1C-5
BLOWER RELAY	1C-5
HEATER CASE	1C-5
VACUUM DIAPHRAGM	1C-5
ADJUSTMENTS	
RECIRCULATING AIR DOOR	1C-5
SELECTOR DOOR	1C-5
TEMPERATURE CABLE	1C-6
DEFROSTER CABLE	1C-6
SIGHT GLASS R AND R	1C-6
EVAPORATOR	
REMOVAL	1C-7
DISASSEMBLY	1C-8
INSTALLATION	1C-8
CONDENSER AND RECEIVER	1C-8
REFRIGERANT LINES	1C-8
COMPRESSOR	1C-8
REMOVAL	1C-8
INSTALLATION	1C-8
WIRING AND HOSE ROUTING	1C-11
PERFORMANCE TEST	1C-12
SPECIFICATIONS	1C-13

PERIODIC MAINTENANCE

Remove road accumulation from condenser at every engine oil change interval or as necessary.

Check and adjust compressor belt tension at each engine oil change interval.

Check refrigerant level and replenish as necessary at the start of every cooling season.

GENERAL DESCRIPTION

The air conditioning system provides refrigerated and dehumidified air to cool the car interior. The system uses both outside and recirculated air.

For normal cooling, A.C. control set for "NORMAL", 100% outside air passes through the evaporator core. For maximum cooling, A.C. control set for "RECIRC", approximately 80% recirculated air and 20% outside air is directed through the evaporator core.

AIR OUTLETS (Fig. 1C-1)

Adjustable air outlets are located on either side of the instrument panel. The left and right air outlets may be adjusted to direct the air as desired. In addition, a center outlet is provided to allow additional upper level cooling. Floor cooling is provided by discharging air directly to the floor from fixed openings in the air manifold located under the instrument panel.

The air conditioning control assembly is mounted in the instrument panel. A four-speed blower switch is located in the control assembly.

FAST COOL DOWN

To rapidly cool a car which has been standing for a period of time in the sun, open the center outlet, set A.C. control on "NORMAL", slide temperature lever to the extreme left position and turn blower speed switch on "HI". Open car windows just long enough to expel hot air. After car has cooled, adjust temperature control lever position to suit

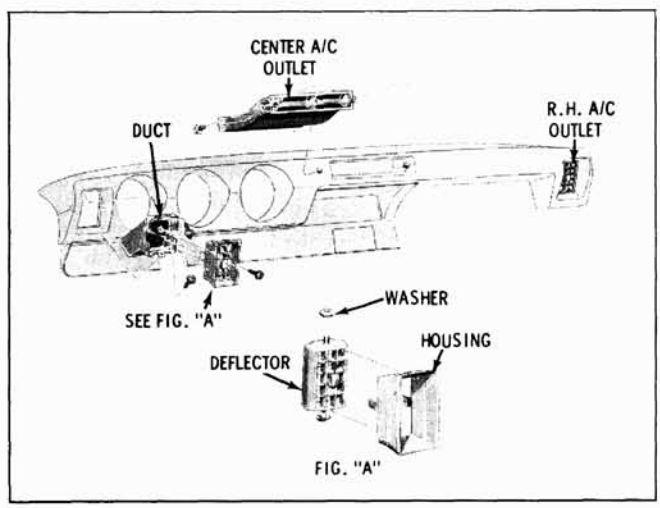


Fig. 1C-1—Air Outlets

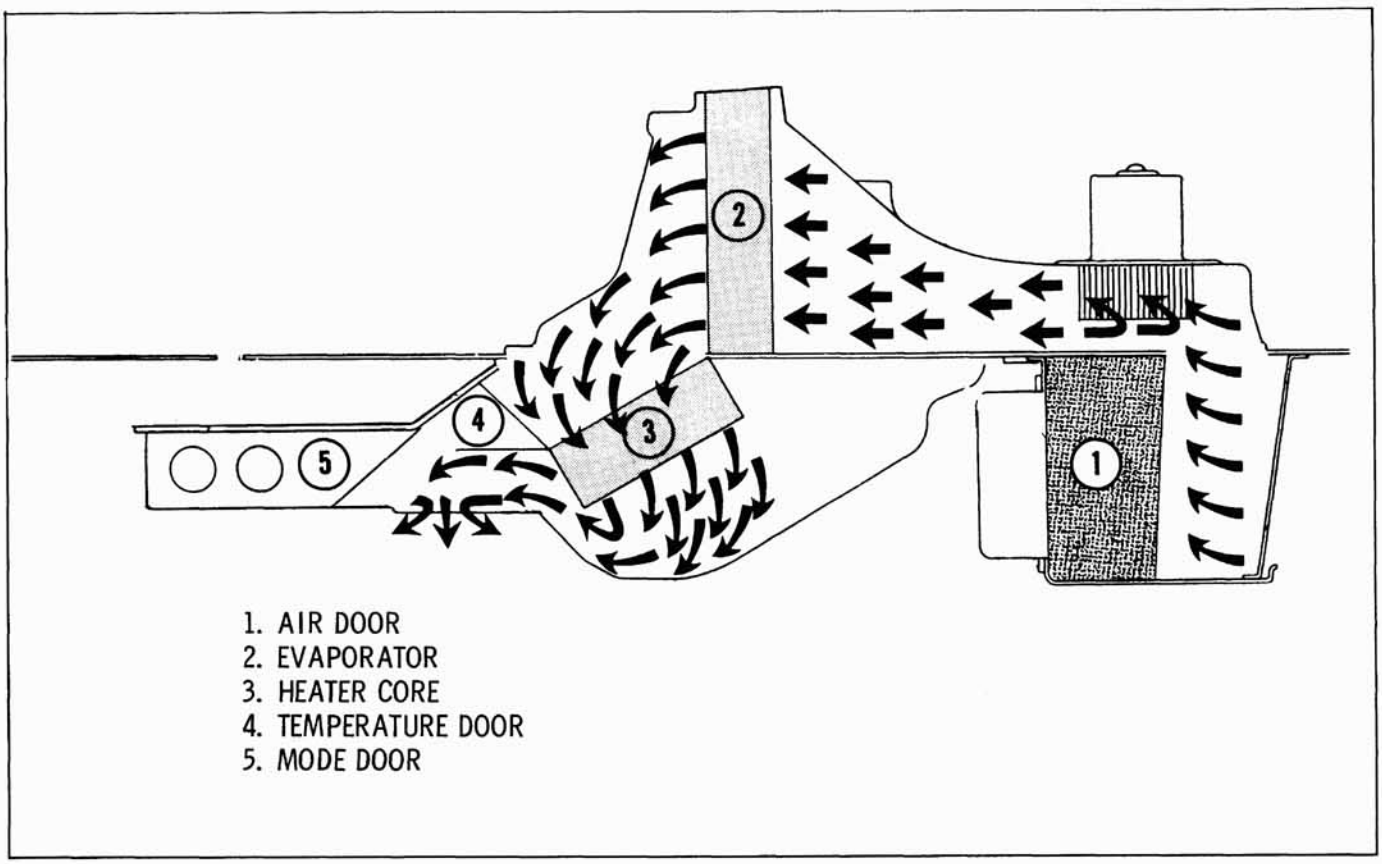


Fig. 1C-2—Heat Position

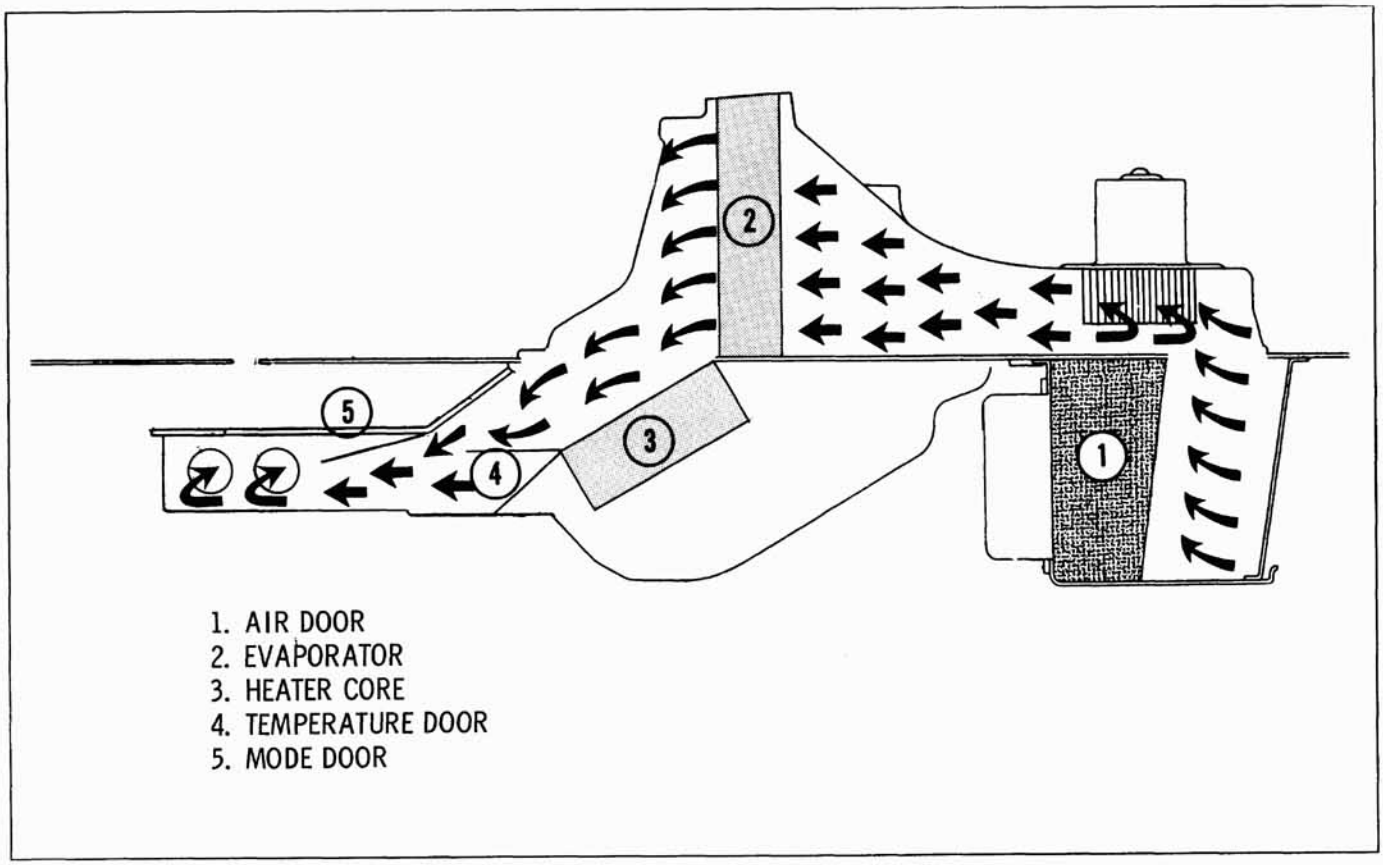


Fig. 1C-3—Vent Position

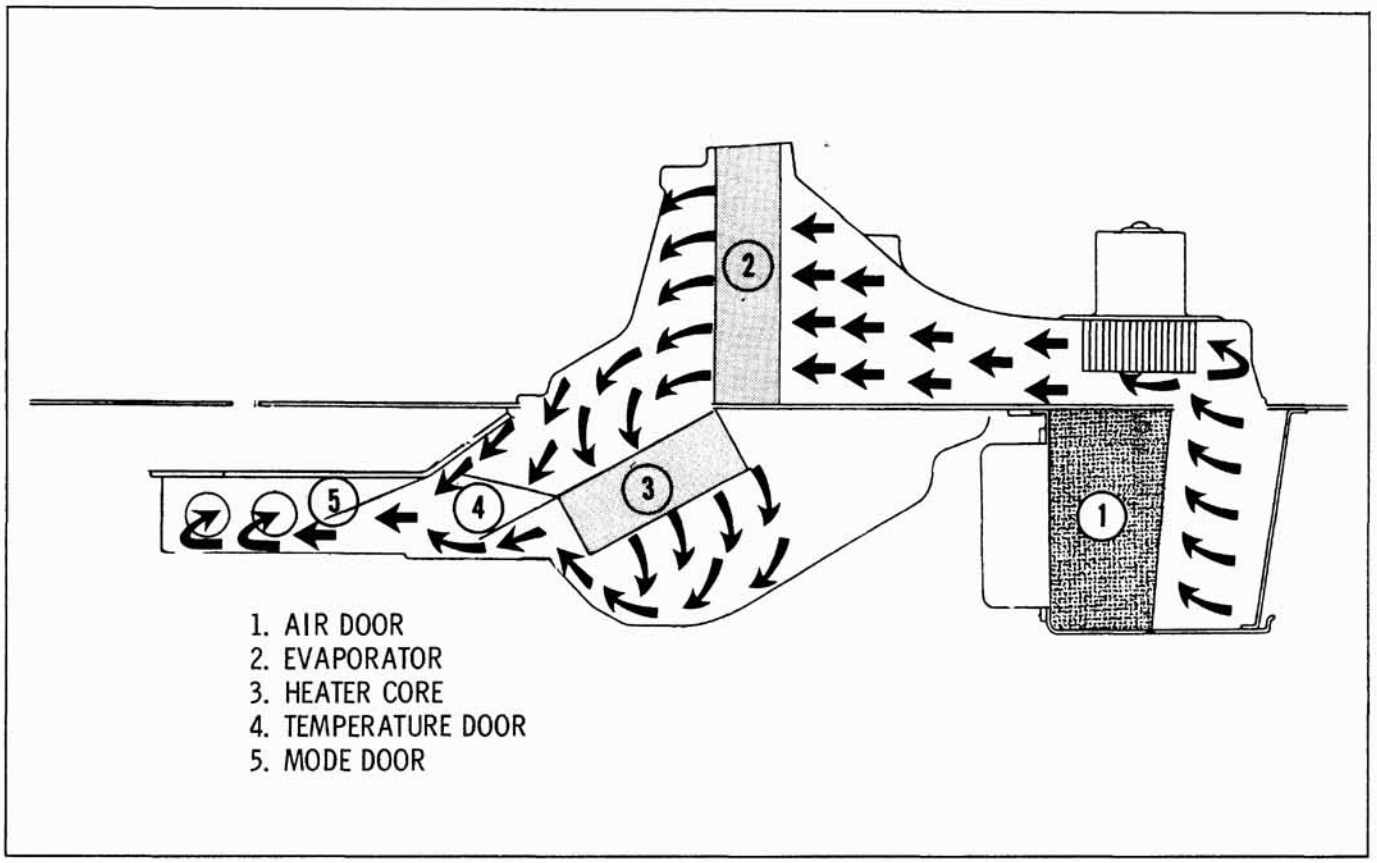


Fig. 1C-4—Normal Position

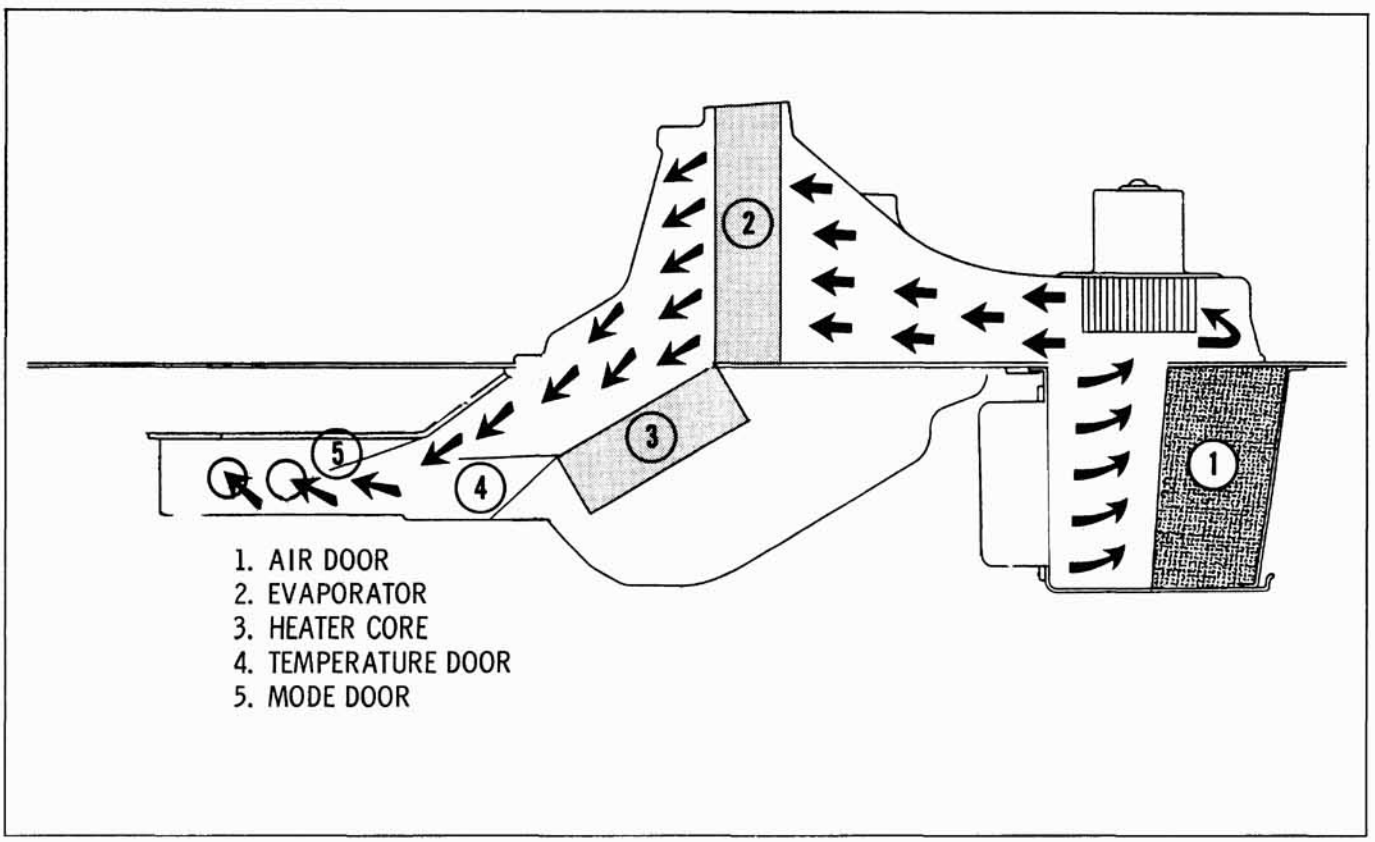


Fig. 1C-5—Recirc. Position

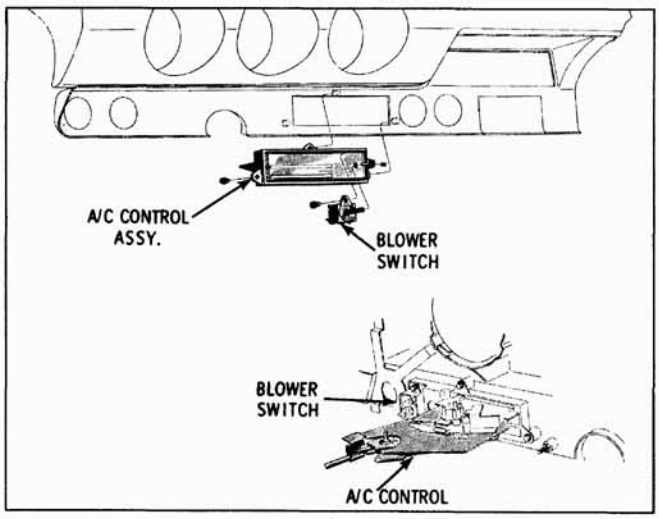


Fig. 1C-6—Control Installation

individual comfort. Air flow can be directed by adjusting the side outlets. The recommended position of the air outlets, for best over-all front and rear seat cooling, is when the side outlets are adjusted to direct the air flow along the inside roof line, with the center outlet open.

DRIVING CONDITIONS

For normal driving conditions, the driver may adjust the temperature of cool air by moving the control lever to suit individual comfort. Selection of blower speeds should be regulated according to the amount of air forced into the passenger compartment by the forward motion of the car.

When driving in heavy traffic, it may be desirable to set the blower speed switch on "HI". At higher speeds, air will be forced by the forward motion of the car into the passenger compartment in greater volume, lessening the speed requirements of the blower motor. It then may be desirable to set the blower speed switch to suit individual comfort.

OPERATION

Heat (Fig. 1C-2)

When the sliding lever is moved to heat, vacuum is applied to both ports of the outside air door. This allows 100% outside air to enter the heater assembly. With the A.C. sliding lever in the OFF position, the mode door is in the heat position, which will allow all air flowing through the heater assembly to be discharged out of the heater outlets.

When the temperature lever is moved toward the warm position, vacuum is directed to the water valve, V-8 engine only, allowing engine coolant to flow through the heater core. Air flowing through the heater assembly is now warmed and flows out of the heater outlets. Temperature of the heater outlet air is controlled by moving the TEMP lever, which is connected to the temperature door with a cable. This mixes outside air with heated air to temper the heater outlet discharge air. Air velocity is controlled by a four-speed blower switch.

When the lever is moved to DEF the operation is identical to heat except the defroster door is actuated to direct air flow to the windshield.

Vent (Fig. 1C-3)

When the AIR COND sliding lever is moved to the VENT position, vacuum is applied to both ports of the outside air door, allowing 100% outside air to enter the heater assembly. Movement of the sliding lever also moves the mode door to

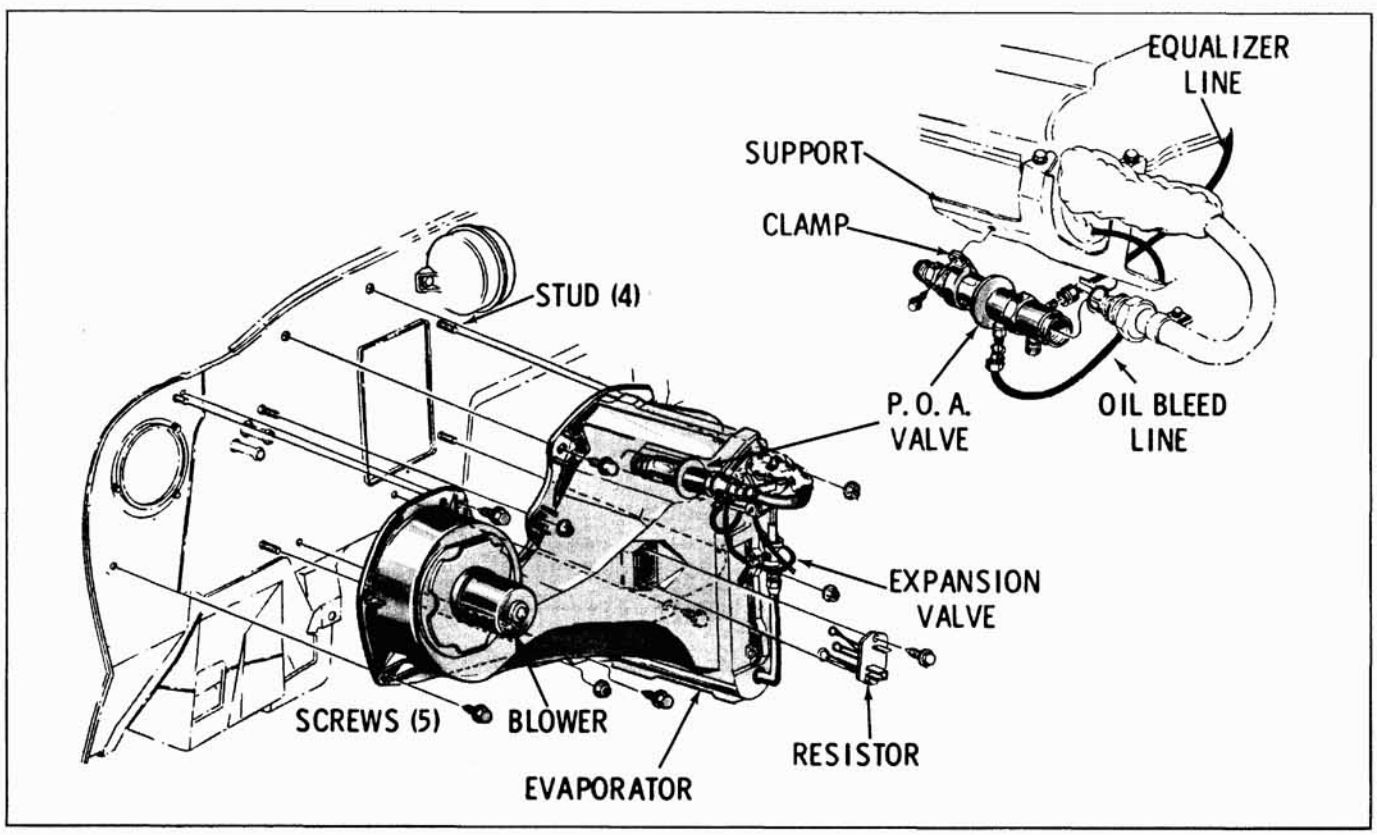


Fig. 1C-7—Evaporator Installation

the A.C. position allowing all the air to flow out of the A.C. outlets.

When the temperature lever is moved to the full cool position, 100% outside ambient air flows out of the A.C. outlets.

When the temperature lever is moved toward the warm position, the water valve, V-8 engine only, is actuated to allow engine coolant to flow through the heater core. Some of the air is now directed through the heater core by movement of the temperature door where it is warmed and mixes with the outside air to temper the discharge air from the A.C. outlets.

Air velocity is controlled by a four-speed blower switch.

A.C. Normal (Fig. 1C-4)

When the AIR COND sliding lever is moved to the NORMAL position an electrical switch is closed to start the compressor and vacuum is applied to both ports of the outside air door. This allows 100% outside air to enter the heater assembly. The mode door is in the A.C. position. Air flowing through the heater assembly is cooled by the evaporator and flows out of the A.C. outlets.

As the temperature lever is moved toward the warm position the water valve, V-8 engine only, is actuated to allow engine coolant to flow through the heater core. Some of the air now flows through the heater core where it is warmed and mixes with the A.C. air to temper the discharge air from the A.C. outlets. If the temperature lever is moved to the full WARM position all the air coming out of the A.C. outlets will be heated.

Air velocity is controlled by a four-speed blower switch.

A.C. Recirc (Fig. 1C-5)

When the AIR COND sliding lever is moved to the RECIRC position an electrical switch is closed to start the compressor and vacuum is applied to one port of the outside air door. This allows 20% outside air and 80% inside air to enter the heater assembly. The mode door is in the A.C. position.

Air flowing through the heater assembly is cooled by the evaporator and all the cooled air is directed out of the A.C. outlets.

As the temperature lever is moved toward the warm position the water valve, V-8 engine only, is actuated allowing engine coolant to flow through the heater core. Some of the air now flows through the heater core where it is warmed and mixes with the A.C. air to temper the discharge air from the A.C. outlets. If the temperature lever is moved to the full WARM position all the air coming out of the A.C. outlets will be heated.

Air velocity is controlled by a four-speed blower switch.

COMPRESSOR BELT ADJUSTMENT

Tool 33-70M is used to check the compressor belt tension. If belts require adjustment proceed as follows:

L-6 (31 and 35 Series)

1. Loosen bolt securing rear bracket to compressor support.
2. Loosen bolts securing front bracket to compressor support.
3. Pivot the compressor evenly at the front and rear until the correct belt tension is obtained.
4. Tighten and torque all loosened bolts.

V-8 (32, 36, 42, 44 and 48 Series)

1. Loosen bolt securing rear support to rear bracket.
2. Loosen bolt securing compressor to front and rear bracket.
3. Loosen bolt securing brace to link to front bracket.
4. Pivot the compressor evenly at the front and rear until correct belt tension is obtained.
5. Tighten and torque all bolts loosened to make belt adjustment.

Bolt Size	Torque Ft. Lbs.
5/16"	25
3/8"	35
7/16"	50

SIDE OUTLETS

Adjustment

Adjustable air outlets are located on either side of the instrument panel. The left and right air outlets may be adjusted to direct the air as desired, and are installed as shown in Fig. 1C-1.

CENTER OUTLET

The center outlet is installed as shown in Fig. 1C-1.

CONTROL ASSEMBLY

The control attachment and wiring connections are shown in Fig. 1C-6.

BLOWER MOTOR AND EVAPORATOR

The blower motor, duct and evaporator are attached as shown in Fig. 1C-7.

BLOWER MOTOR RESISTOR

The blower motor resistor is mounted on the blower duct and can be removed by removing the two attaching screws. (Fig. 1C-7)

BLOWER RELAY

The blower relay is mounted on the blower assembly as shown in Fig. 1C-8.

HEATER CASE ASSEMBLY

The heater case assembly is installed as shown in Figs. 1C-9 and 1C-10. The heater core can be removed after removing the heater case assembly.

VACUUM DIAPHRAGM

A vacuum diaphragm is used to operate the air inlet and recirculate door. The air inlet and recirculate door diaphragm is a two-step diaphragm. When the A.C. control is set for RECIRC., vacuum is applied to the upper port and the door opens a predetermined distance allowing 20% outside air and 80% inside air to be drawn through the evaporator. When the A.C. control is set for NORMAL, vacuum is applied to both ports and 100% outside air is drawn through the evaporator.

ADJUSTMENTS

Recirculating Air Door (Fig. 1C-11)

To adjust the recirculating air door, the blower duct assembly must be removed from the car.

1. With vacuum applied to the upper port, the recirculating air door should be opened 1/2".
2. If necessary to adjust, loosen the set screw on the diaphragm link and move link until proper adjustment is obtained.
3. Recheck adjustment.

Selector Door Cable

1. Set the A.C. control in the RECIRC or NORMAL position.
2. Loosen the cable attaching screw.

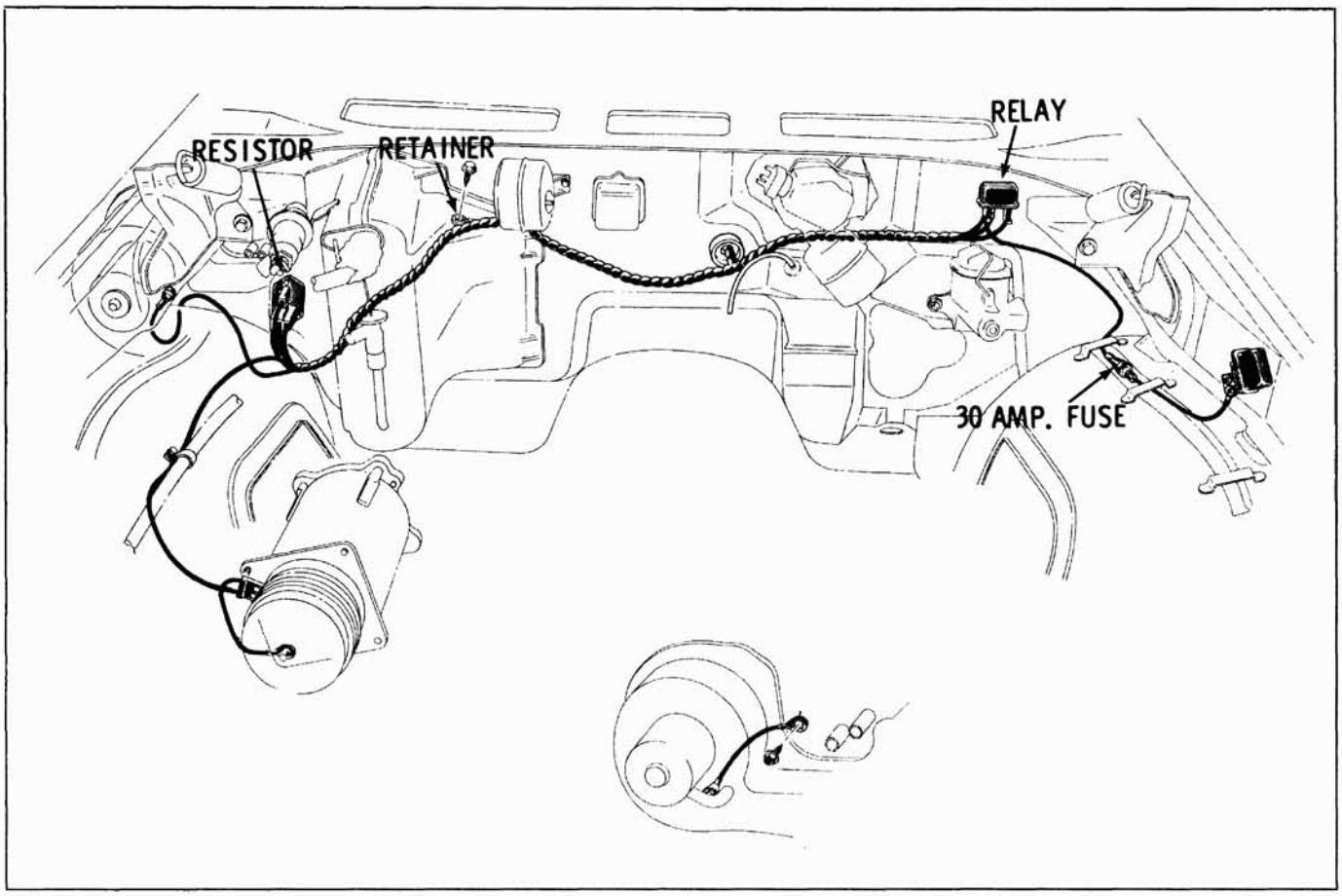


Fig. 1C-8—Blower Relay

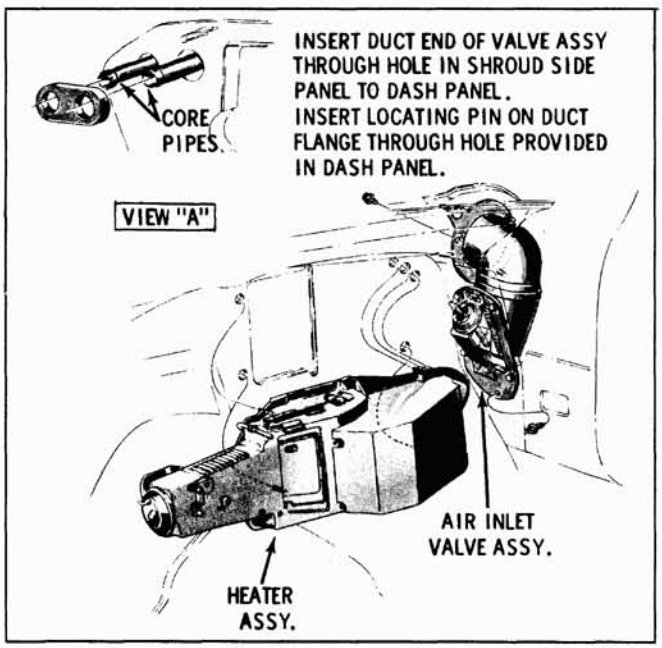


Fig. 1C-9—Heater Case Attachment

3. Hold the selector door fully open and tighten the cable attaching screw.

Temperature Cable

The cable is connected to a cam lock device that assures positive closing of the temperature door. To adjust close temperature door and adjust temperature cable, turnbuckle for 1/8" spring back of control lever with valve fully closed.

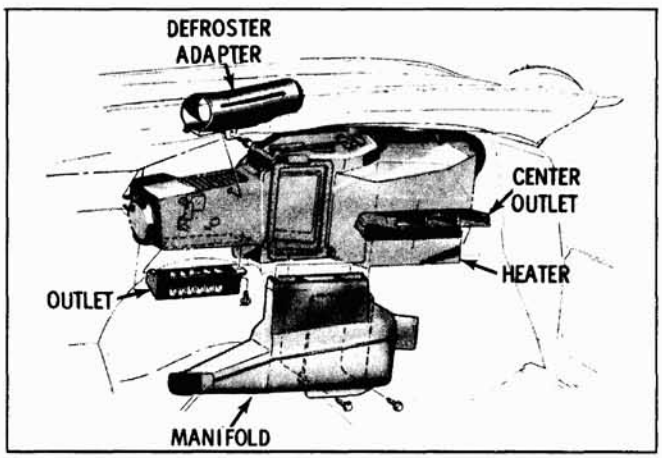


Fig. 1C-10—Manifold Installation

Defroster Door

The defroster door is actuated by a vacuum diaphragm assembly and is not adjustable. (Fig. 1C-12)

SIGHT GLASS

Removal

1. Discharge the system as outlined under DISCHARGING THE SYSTEM - Section 1A.

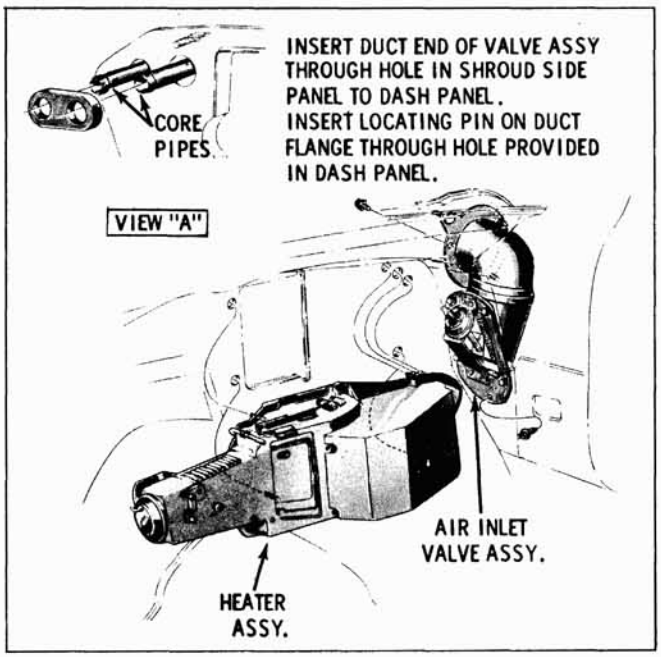


Fig. 1C-11—Recirculating Air Door

2. Remove the sight glass retaining screw.
3. Lift out the sight glass with caulking compound.
4. Remove the "O" ring with a wire hook.

When performing this operation, the system should not be left open longer than absolutely necessary as the dehydrator will absorb an excess of moisture. refer to SERVICING OF THE REFRIGERANT SYSTEM - Section 1A.

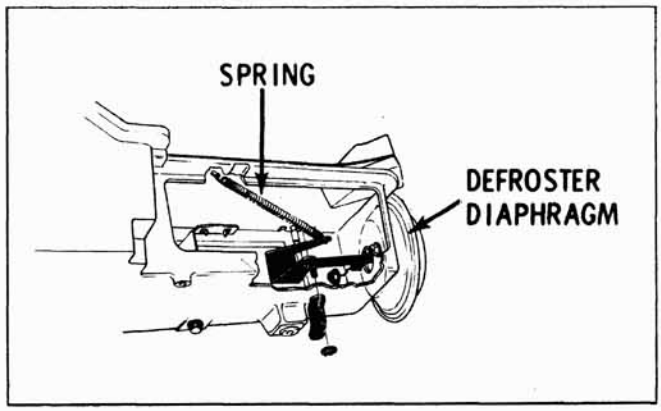


Fig. 1C-12—Defroster Diaphragm

To install, reverse the removal procedure and evacuate and charge the system.

EVAPORATOR ASSEMBLY

Removal (Fig. 1C-13)

1. Disconnect the battery.
2. Discharge the system as outlined under DISCHARGING THE SYSTEM.
3. Disconnect all parts that attach to the right-hand filler plate and remove the filler plate.
4. Disconnect refrigerant lines from suction throttling valve and expansion valve.

Cap fittings to prevent entrance of dirt and moisture.

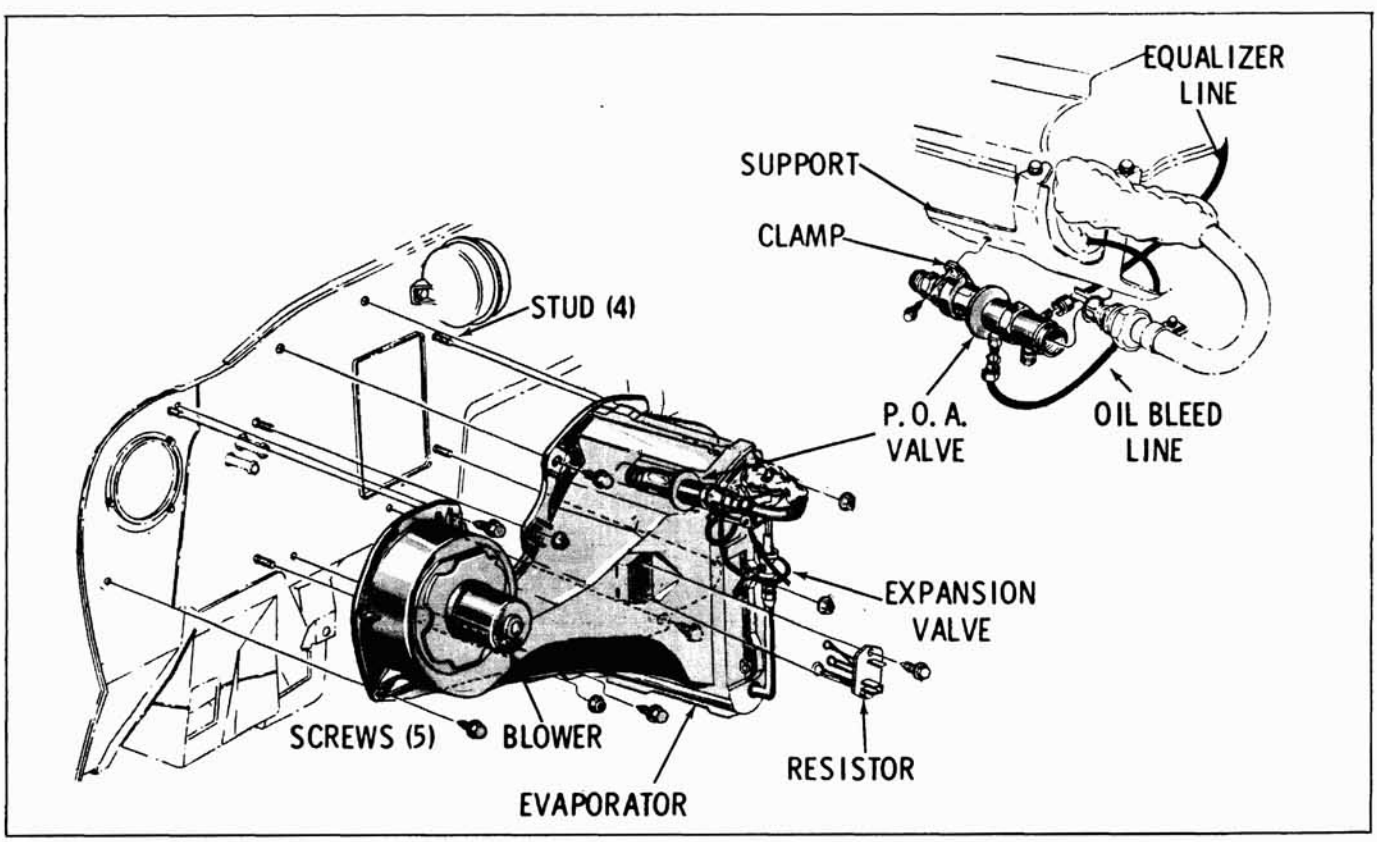


Fig. 1C-13—Evaporator Assembly

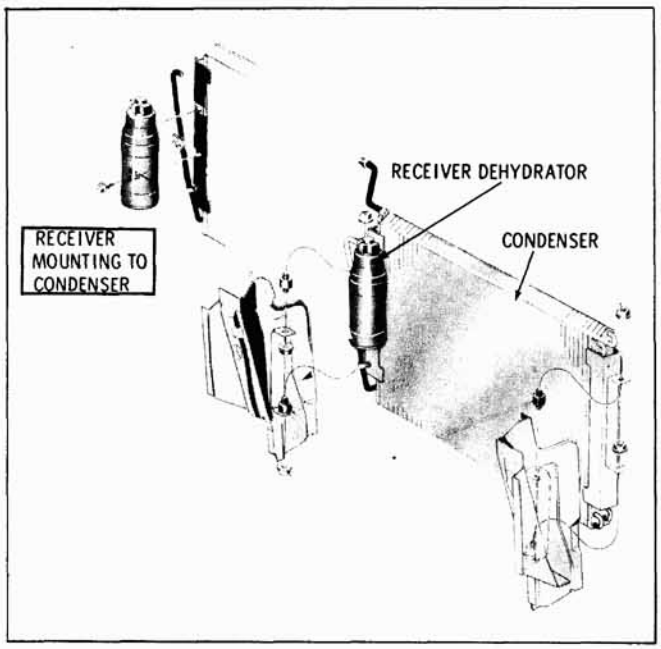


Fig. 1C-14—Condenser and Receiver Installation

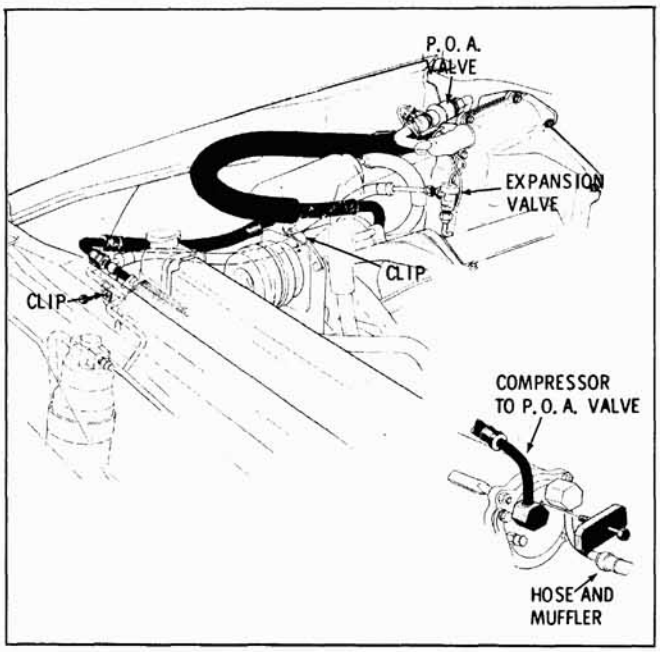


Fig. 1C-15—Refrigerant Line (V-8 Engine)

5. Remove screws securing evaporator to front of dash and remove evaporator and case.

Disassembly

1. Remove the screws securing the case and separate the case.
2. On bench, remove expansion valve.
3. Remove clamps securing expansion valve and evaporator pipe.
4. Disconnect all lines and remove suction throttling valve.

Tape or cap all valve openings to prevent entrance of dirt and moisture.

5. Remove screws securing evaporator core to case.
6. To assemble - Reverse disassembly procedure.

Installation

1. Apply 1/4" bead of sealer around case. Then position evaporator assembly to the dash and install retaining screws.
2. Install front and rear ducts.
3. Remove caps from lines, oil the fitting with 525 viscosity oil, then connect the lines.
4. Install the fender filler plate and all attaching parts.
5. Evacuate the system as outlined under EVACUATING THE SYSTEM - Section 1A.
6. Charge the system as outlined under CHARGING THE SYSTEM - Section 1A.
7. Leak test all line fittings that were disconnected. Refer to LEAK DETECTOR - Section 1A.

It is important that the expansion valve capillary bulb be tightly clamped to the suction line at the evaporator. Both the suction line and the capillary bulb should be clean at the points of contact. Do not kink capillary tubes when installing.

CONDENSER AND RECEIVER

The condenser is mounted in front of the radiator. After discharging the system, the condenser or receiver can be removed as illustrated in Fig. 1C-14.

REFRIGERANT LINES

The refrigerant lines and muffler are attached as shown in Fig. 1C-15. When installing lines, always use new "O" rings. Torque lines as indicated in Fig. 1C-16.

COMPRESSOR (Figs. 1C-17 and 1C-18)

Removal

1. Discharge the refrigerant system.
2. Disconnect compressor clutch wire at compressor connector.
3. Remove belt from compressor pulley.
4. Remove the bolt holding the fittings connector to the compressor, then remove the assembly from the compressor. Tape lines and fittings to prevent entry of dirt and moisture.
5. Remove the compressor to bracket bolts, then remove the compressor assembly.

Installation

1. Position the compressor on the mounting bracket, then install and tighten the compressor to bracket bolts.
2. Connect compressor clutch wire.
3. Install two new "O" rings on the valve port openings and position the fittings connector on the compressor. Install the mounting bolt and tighten to 22 ft. lbs. torque.
4. Install belt and adjust tension using Tool 33-70M.
5. If compressor was removed for some internal malfunction and foreign material has circulated throughout the system, proceed as follows:
   a. Install a charging line to the compressor discharge Schrader valve and to a drum of refrigerant 12.
   b. Disconnect the liquid line from the dehydrator-receiver assembly on the inlet side, and cap the dehydrator-receiver immediately.
   c. Open the refrigerant drum valve and turn the drum upside down to allow liquid refrigerant to flush through the condenser and out the line. Use approximately 2 lbs. of refrigerant for this operation.
   d. Close the drum valve and connect the dehydrator-receiver assembly.
   e. Remove the expansion valve screen and clean or replace as necessary.

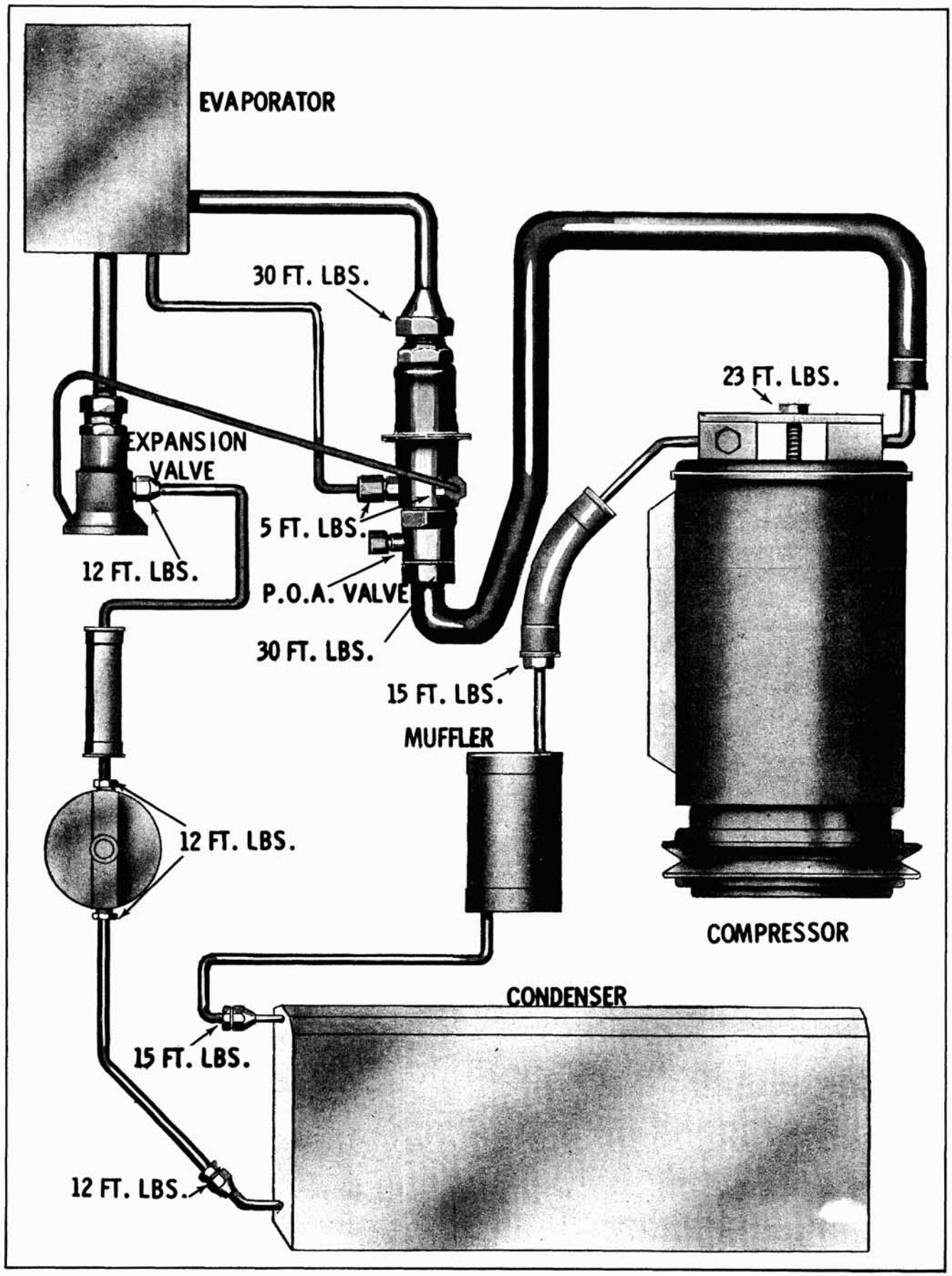


Fig. 1C-16—Refrigerant Line "O" Ring Torque

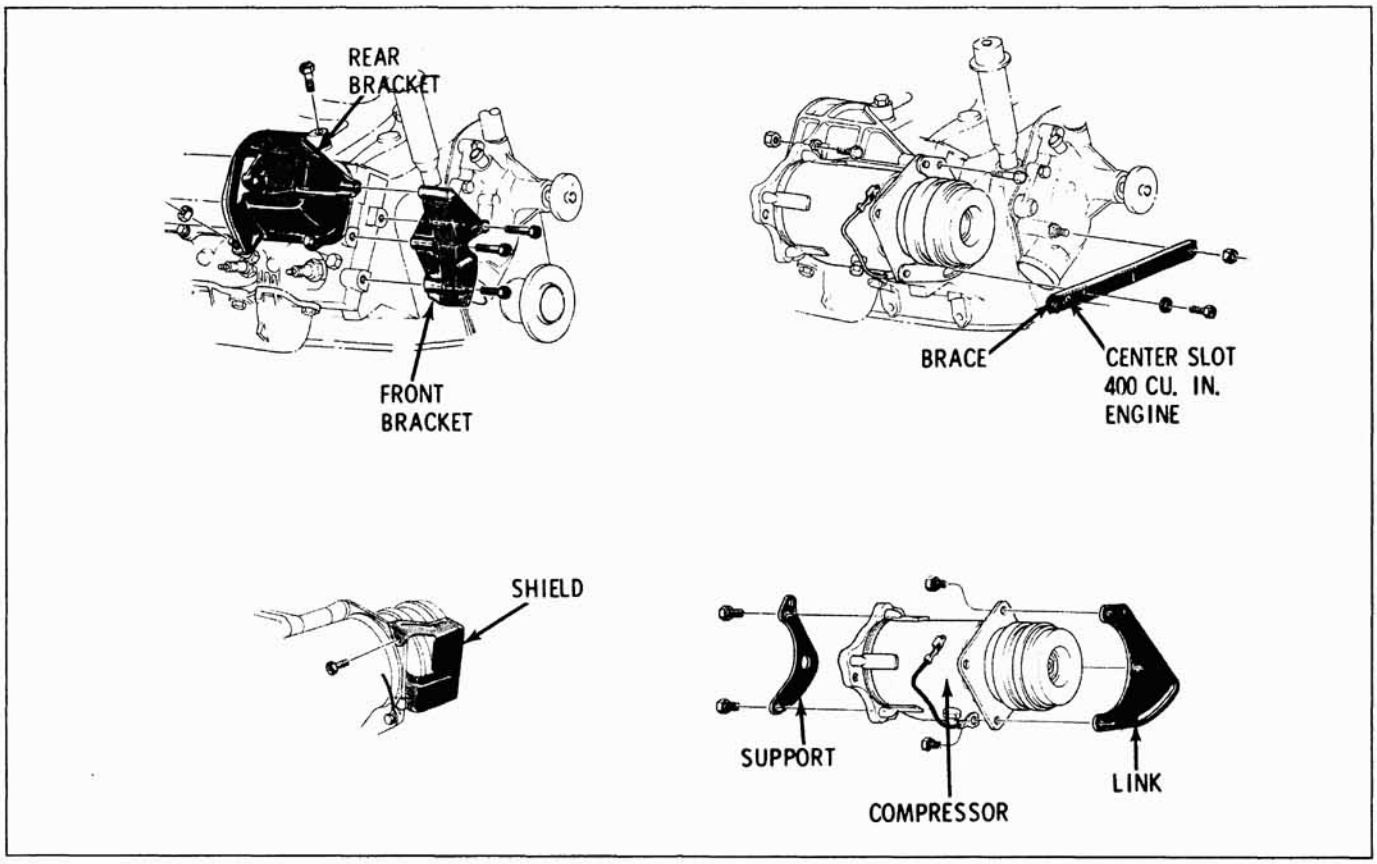


Fig. 1C-17—Compressor Mounting (V-8 Engine)

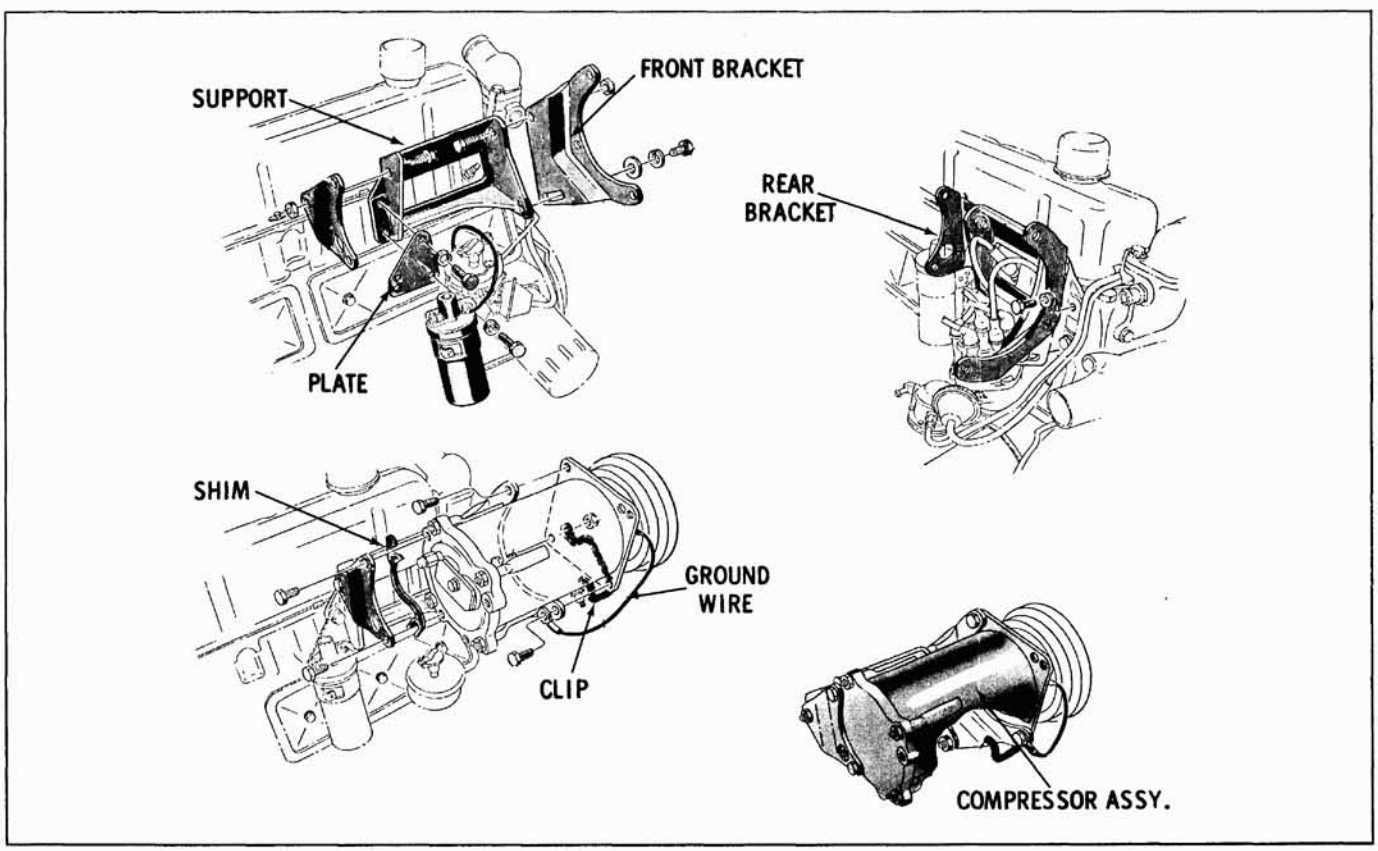


Fig. 1C-18—Compressor Mounting (L-6 Engine)

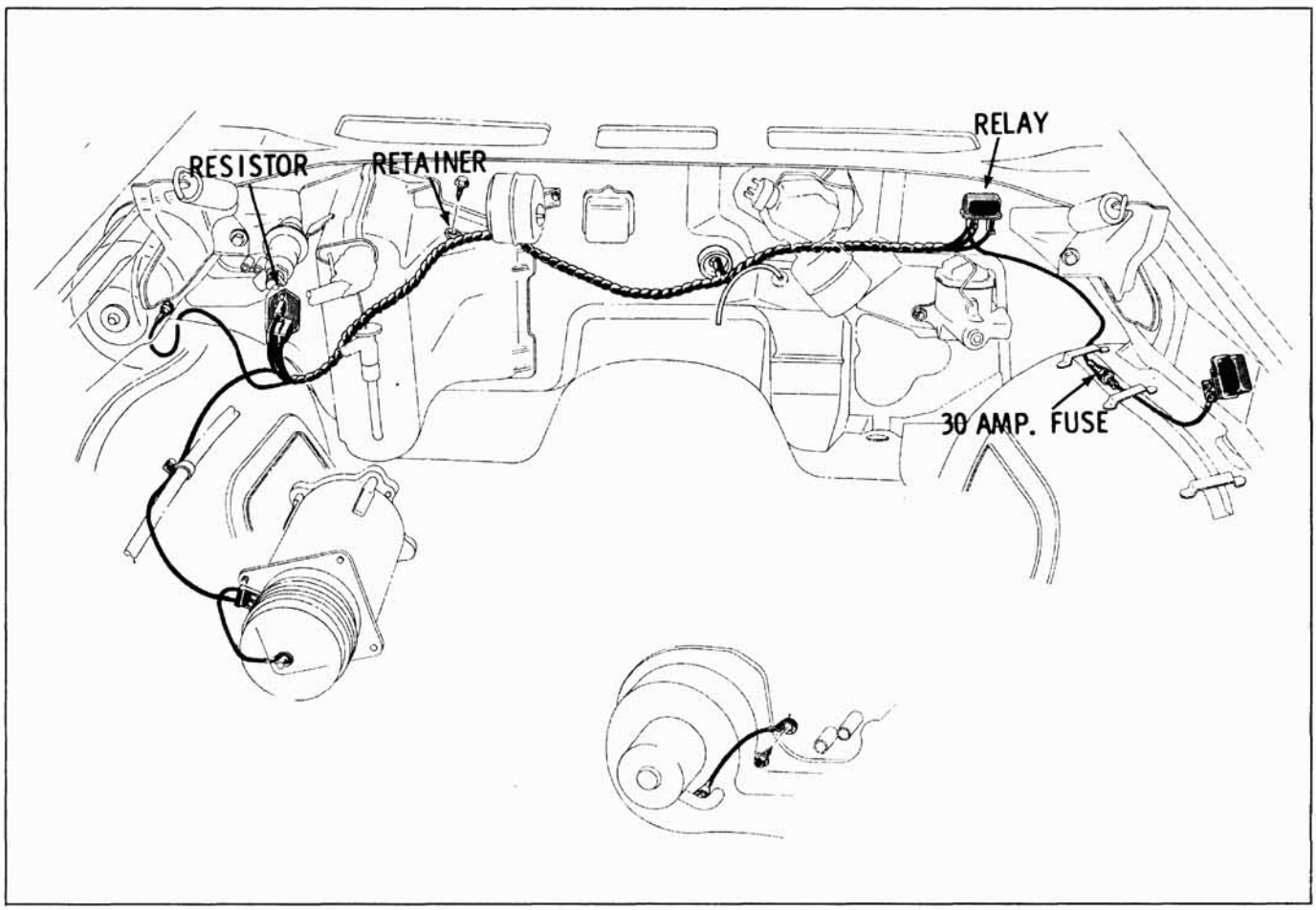


Fig. 1C-19—Wire Routing

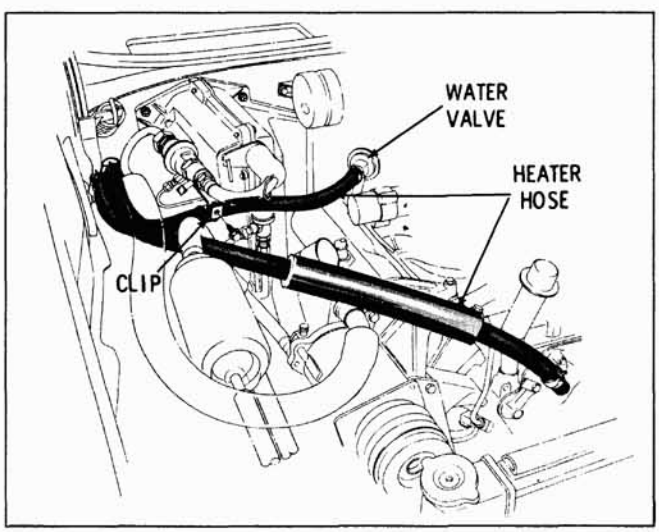


Fig. 1C-20—Heater Hose Routing (V-8 Engine)

f. Remove the charging line from the compressor, install the gauge set, and evacuate the entire system.

g. Recharge the system.

WIRING AND HOSE ROUTING

For wire routing, refer to Fig. 1C-19. For heater hose routing, vacuum hose routing and water valve installation, refer to Figs. 1C-20, 1C-21, 1C-22 and 1C-23.

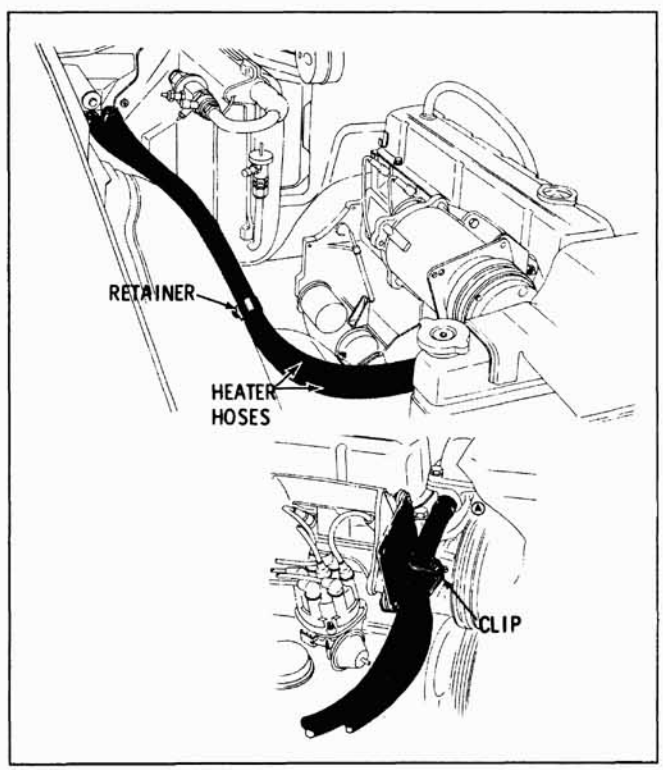


Fig. 1C-21—Heater Hose Routing (L-6 Engine)

The L-6 engine does not use a water valve.

AIR CONDITIONING DIAGNOSIS

If a car is in for service with a complaint of high outlet temperatures on the road but appears to operate normally during tests, a quick check to determine which unit is at fault can be made using the following procedure.

VISUAL CHECKS

1. Check temperature door to make sure that it seals in the cool position. Adjust if necessary.
2. Check air hoses and ducts for proper connection.
3. Check vacuum hoses for correct routing and connection.

A leaking engine water valve could cause a slight rise in outlet temperature.

4. Check sight glass for "clear" condition.
5. Check compressor clutch to make sure that it engages.
6. Check compressor belt, adjust if necessary.

OPERATIONAL TEST

Install air conditioning gauge set, operate the engine at 1500 rpm in neutral. Set control on RECIRC with blower at low speed.

1. Check evaporator pressure. If pressure is 30 psi or less and outlet air temperature is too warm, check to see that the capillary bulb is clamped tightly to the evaporator outlet pipe and that the insulation is in place.

If the capillary bulb installation and insulation are satisfactory, a leak in the bulb is indicated and the expansion valve should be replaced.

2. If the evaporator pressure is above 30 psi, even with blower motor wire disconnected, replace the P.O.A. valve.
3. If evaporator pressures is 29 psi ± 1 psi and the outlet air temperature is normal, partially cover the condenser to obtain head pressure of 300 psi. If evaporator pressure rises above 30 psi, replace the expansion valve. If evaporator pressure remains at 29 psi during test, there is a possibility of water or moisture in the system which could freeze under certain conditions, and a new receiver-dehydrator may be required.

PERFORMANCE TEST

The Performance Test should be made with the car doors open, the temperature control lever fully to the left, A.C. control set at NORMAL, blower speed switch on "HI", all air outlets open, an auxiliary fan in front of the radiator, and the car hood lowered.

1. Remove Schrader valve fitting cap at the suction throttling valve.
2. Install Adapter J-5420 on the low pressure gauge hose, and connect the adapter to the Schrader valve fitting on the suction throttling valve, then momentarily open low pressure gauge valve to purge gauge hose.

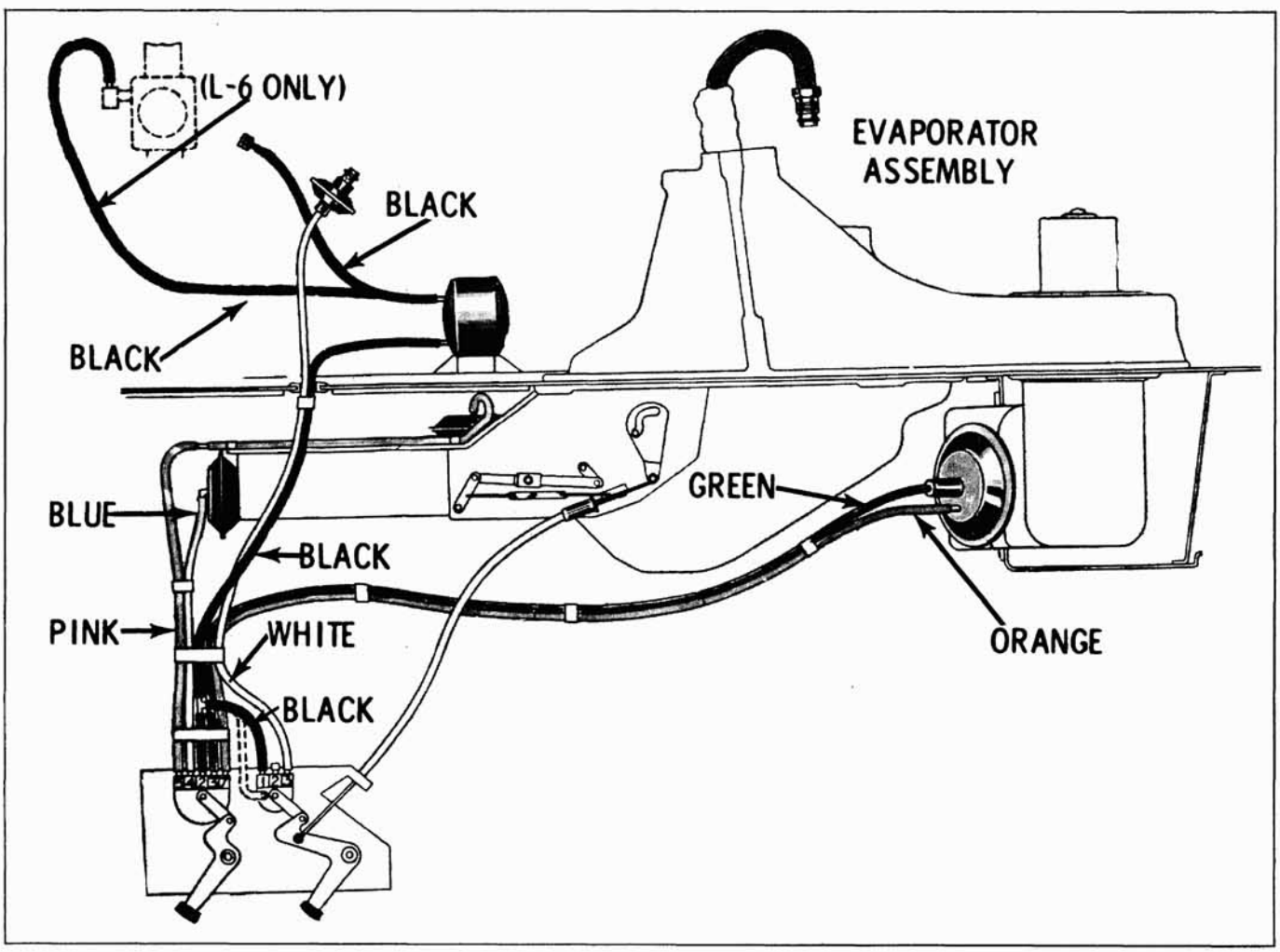


Fig. 1C-22—Vacuum Hose Routing

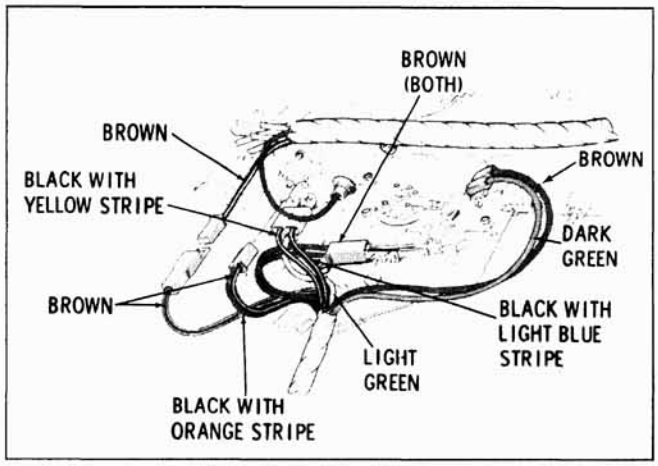


Fig. 1C-23—Electrical Wiring to Control

3. Remove the compressor high pressure Schrader valve protective cap and install high pressure gauge hose with Adapter J-5420. Be sure high pressure gauge valve is closed.
4. Momentarily open high pressure gauge to purge the gauge and hose.
5. With transmission in PARK or NEUTRAL and parking brake applied, adjust engine speed to 2000 rpm.
6. After temperature and humidity have been determined, compare test results with the PERFORMANCE CHART.
7. When test is completed, disconnect gauge hoses, and install protective caps.
8. Install Schrader valve fitting cap on suction throttling valve.

PRESSURE—TEMPERATURE RELATIONSHIP OF REFRIGERANT-12

Temp. °F	Pressure	Temp. °F	Pressure	Temp. °F	Pressure	Temp. °F	Pressure	Temp. °F	Pressure
- 8	5.4	22	22.4	52	49.0	82	87.0	112	140.1
- 6	6.3	24	23.9	54	51.0	84	90.1	114	144.2
- 4	7.2	26	25.4	56	53.0	86	93.2	116	148.4
- 2	8.2	28	27.0	58	55.4	88	96.4	118	153.0
0	9.2	30	28.5	60	58.0	90	99.6	120	157.1
2	10.2	32	30.1	62	60.0	92	103.0	122	161.5
4	11.3	34	32.0	64	62.5	94	106.3	124	166.1
6	12.3	36	33.4	66	65.0	96	110.0	126	171.0
8	13.5	38	35.2	68	67.5	98	113.3	128	175.4
10	14.6	40	37.0	70	70.0	100	117.0	130	180.2
12	15.9	42	39.0	72	73.0	102	121.0	132	185.1
14	17.1	44	41.0	74	75.5	104	124.0	134	190.1
16	18.4	46	43.0	76	78.3	106	128.1	136	195.2
18	19.7	48	45.0	78	81.1	108	132.1	138	200.3
20	21.0	50	47.0	80	84.1	110	136.0	140	205.5

GENERAL SPECIFICATIONS

Engine Idle Speed	(Refer to Carburetion Section)
Fuse (at Fuse Block)	AGC 25 Amps.
Amount of Refrigerant 12 in System	4 Lbs.
Total Amount of Oil in Refrigerant System	10.5 Fluid Oz.
Type of Oil	525 Viscosity

TORQUE SPECIFICATIONS

Application	Ft. Lbs.
*(Refer to Chart Page 1C-5 for Power Steering Pump, Delcotron and Compressor Mounting Brackets)	
Schrader Valve Adapter Fittings to Compressor Bolt	13
Driven Plate to Compressor Shaft Nut	15
Rear Head to Compressor Housing Nuts	20

PERFORMANCE CHART

31 THROUGH 48 SERIES

In Front of Condenser		Evaporator Pressure At Suction Throttling Valve ±1 psi	Engine rpm	Discharge Air Temp. R.H. Nozzle ±2°F.	Head Pressure (Discharge) ±20 psi
Relative Humidity	Air Temp. °F.				
20	60	29	2000	36.0	145
	70	29		38.5	165
	80	29		40.0	188
	90	29		42.5	215
	100	29		47.0	245
	110	31		62.0	295
30	60	29	2000	37.0	146
	70	29		39.0	167
	80	29		41.5	195
	90	29		46.0	225
	100	29		55.0	256
	110	34		66.0	317
40	60	29	2000	38.0	148
	70	29		40.0	170
	80	29		42.0	201
	90	29		46.0	229
	100	30		67.0	268
	110	37		72.0	335
50	60	29	2000	38.5	150
	70	29		41.0	175
	80	29		44.5	208
	90	29		54.0	234
	100	33.5		66.5	283
	110	39.5		77.0	355
60	60	29	2000	39.0	158
	70	29		42.0	182
	80	29		47.0	213
	90	29.5		57.5	240
	100	36.5		70.5	296
70	60	29	2000	39.5	168
	70	29		43.0	188
	80	29		50.0	219
	90	29.5		61.0	245
	100	39.0		75.0	308
80	60	29	2000	40.0	175
	70	29		43.0	192
	80	29.5		53.0	225
	90	31		64.5	251
	100	42		80.0	320
90	60	29	2000	40.0	183
	70	29		44.0	199
	80	30		55.5	231
	90	32.5		67.5	257
	100	44.5		85.0	330

DIAGNOSIS OF PERFORMANCE TEST RESULTS

CONDITION AND CAUSE	CORRECTION
EVAPORATOR PRESSURE TOO HIGH	
A. Defective suction throttling valve.	A. Replace.
B. Loose compressor drive belt.	B. Adjust as outlined.
C. Defective clutch or coil.	C. Check or replace as necessary.
D. Defective expansion valve.	D. Replace as necessary.
E. Expansion valve capillary bulb not tight to evaporator suction line.	E. Check clamp for tightness.
F. Clutch slipping.	F. Refer to CLUTCH SLIPPAGE.
HIGH PRESSURE SIDE OF SYSTEM TOO HIGH	
A. Restricted air flow through condenser.	A. Remove foreign material from engine radiator and condenser.
B. Air in system or overcharge of refrigerant.	B. Momentarily discharge system on discharge side with engine not running; then, operate system and recheck pressure. Repeat as necessary. Check sight glass with system under load.
C. Restriction in condenser, dehydrator-receiver assembly, discharge or liquid line.	C. Remove parts, inspect for restricted passage, and clean or replace.
NOZZLE DISCHARGE AIR TOO WARM (With Other Readings OK)	
A. Low refrigerant charge.	A. Check and add refrigerant as necessary.
B. Temperature door misadjusted.	B. Refer to temperature cable adjustment.
C. Poor seal - evaporator to cowl.	C. Correct sealing.
CLUTCH SLIPPAGE	
A. Head pressure too high	A. Discharge system until bubbles appear in sight glass and then add one pound of refrigerant.
B. Pulley wobbles.	B. Check and replace, if necessary, the pulley bearing. If pulley has been worn by bearing, replace pulley.
VELOCITY OF AIR AT DISCHARGE NOZZLES TOO LOW	
A. Restricted evaporator core in evaporator assembly.	A. Wash evaporator core. Restricted evaporator core caused by freezing.
B. Restricted air hoses.	B. Inspect and replace if necessary.
C. Defective blower motor, relay or resistor.	C. Check and replace if necessary.
D. Defective switches.	D. Check and replace if necessary.
E. Poor wiring connection (Low voltage at blower.)	E. Correct wiring.
EVAPORATOR PRESSURE TOO LOW	
A. Insufficient refrigerant charge.	A. Add refrigerant.
B. Defective expansion valve.	B. Replace.
C. Defective suction throttling valve.	C. Replace.
WATER BLOWING OUT AIR DISCHARGE NOZZLE	
A. Plugged or kinked evaporator drain hose.	A. Clean or align as necessary.
INOPERATIVE CONTROLS	
A. Inadequate vacuum.	A. Check vacuum. All controls should move with 10 in. vacuum. Check hoses.
B. Control cables improperly adjusted.	B. Adjust cables.

COMFORTRON AIR CONDITIONING

(AUTOMATIC CONTROL)

54 THROUGH 86 SERIES

CONTENTS OF SECTION 1D

Subject	Page
INTRODUCTION	1D-16
GENERAL DESCRIPTION	1D-16
SENSORS	1D-16
CONTROL PANEL	1D-16
TRANSDUCER	1D-18
POWER SERVO	1D-18
THERMOSTATIC VACUUM VALVE	1D-18
VACUUM MASTER SWITCH	1D-18
AMBIENT SWITCH	1D-18
RANGE RELAY	1D-18
VACUUM RELAY	1D-19
VACUUM TANK	1D-19
VACUUM CHECK VALVE	1D-19
ASPIRATOR	1D-19
MODE DOOR	1D-19
TEMPERATURE DOOR	1D-19
OPERATION	1D-19
SERVICE PROCEDURES	1D-19
POWER SERVO	1D-20
IN-CAR SENSOR	1D-20
POTENTIOMETER (ON SERVO)	1D-20
AMBIENT SENSOR	1D-21
MASTER SWITCH	1D-21
VACUUM TANK	1D-21
TRANSDUCER	1D-21
COMFORTRON CONTROL	1D-21
WATER VALVE	1D-22
VACUUM HOSES	1D-22
WIRING	1D-23
CHARGING THE SYSTEM	1D-24
CHECKING COMFORTRON SYSTEM	1D-24
CHECKING SENSOR CIRCUIT FOR OPEN	1D-24
AMPLIFIER AND TEMPERATURE DIAL TEST	1D-25
TEMPERATURE CONTROL DIAL ADJUSTMENT	1D-25
FUNCTION CHECK	1D-25
FUNCTIONAL TESTS	1D-26
TOOLS	1D-37

INTRODUCTION

The comfortron air conditioning uses an automatic temperature control system which allows the driver to preset a desired temperature, between 65 and 85 degrees, which is then automatically maintained regardless of changes in ambient air temperatures.

Outside of the automatic control system, which is covered in this section, the basic air conditioning components are similar to the procedures outlined in Custom Air Conditioning Section 1B. Service procedures pertaining only to the Comfortron system are covered in this section.

GENERAL DESCRIPTION

The Comfortron system consists of four major components:

1. Temperature Sensors
   a. In-car
   b. Ambient
   c. Potentiometer
2. Control Panel
3. Transducer
4. Power Servo

In addition to the four major components, an electrical and vacuum system is used to control the complete system.

Sensors

The sensors consist of a special type of resistor (Thermistor) which varies inversely to temperature change. As the temperature rises, the resistance decreases; as the temperature falls, the resistance increases. The two sensors and potentiometer are connected in series.

The in-car sensor, located in the control panel, Fig. 1D-1 is positioned so that it senses the temperature of the interior of the car.

The ambient sensor, Figure 1D-2, mounted in the blower inlet duct senses the temperature of the air entering the system.

The potentiometer mounted on the power servo replaces the duct sensor that was used in previous years. Fig. 1D-3 The potentiometer mechanically provides a resistance in the sensor circuit in relation to the discharge temperature.

Control Panel (Fig. 1D-4)

The control panel located in the instrument panel contains the Amplifier, Temperature Dial and the in-car sensor.

The amplifier is a two stage DC amplifier which provides a voltage output proportional to the input signal from the sensors to control the transducer.

The amplifier is serviced only as an assembly.

The temperature dial is graduated in 5° divisions between 65° and 85° allowing the driver to select any desired temperature within this range.

The temperature dial operates a rheostat. Setting the dial sets the resistance value of the rheostat. This resistance, in series with the resistance of the two sensors and potentiometer forms a voltage divider network supplying a voltage signal to the amplifier. If any of the sensors detect a change in temperature, or the driver changes the temperature dial rheostat setting, the resultant resistance change causes the voltage signal to the amplifier to vary accordingly.

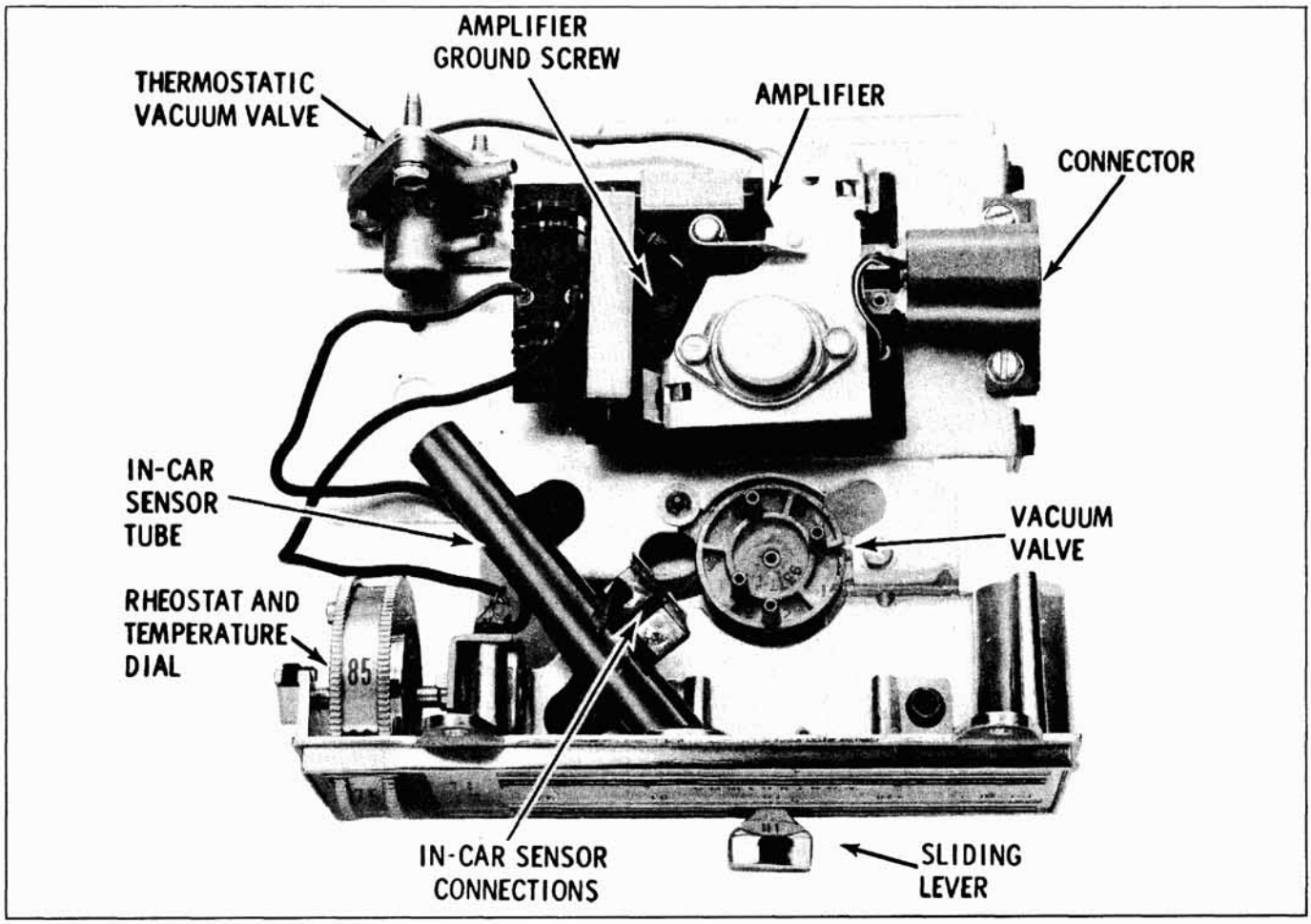


Fig. 1D-1—In Car Sensor

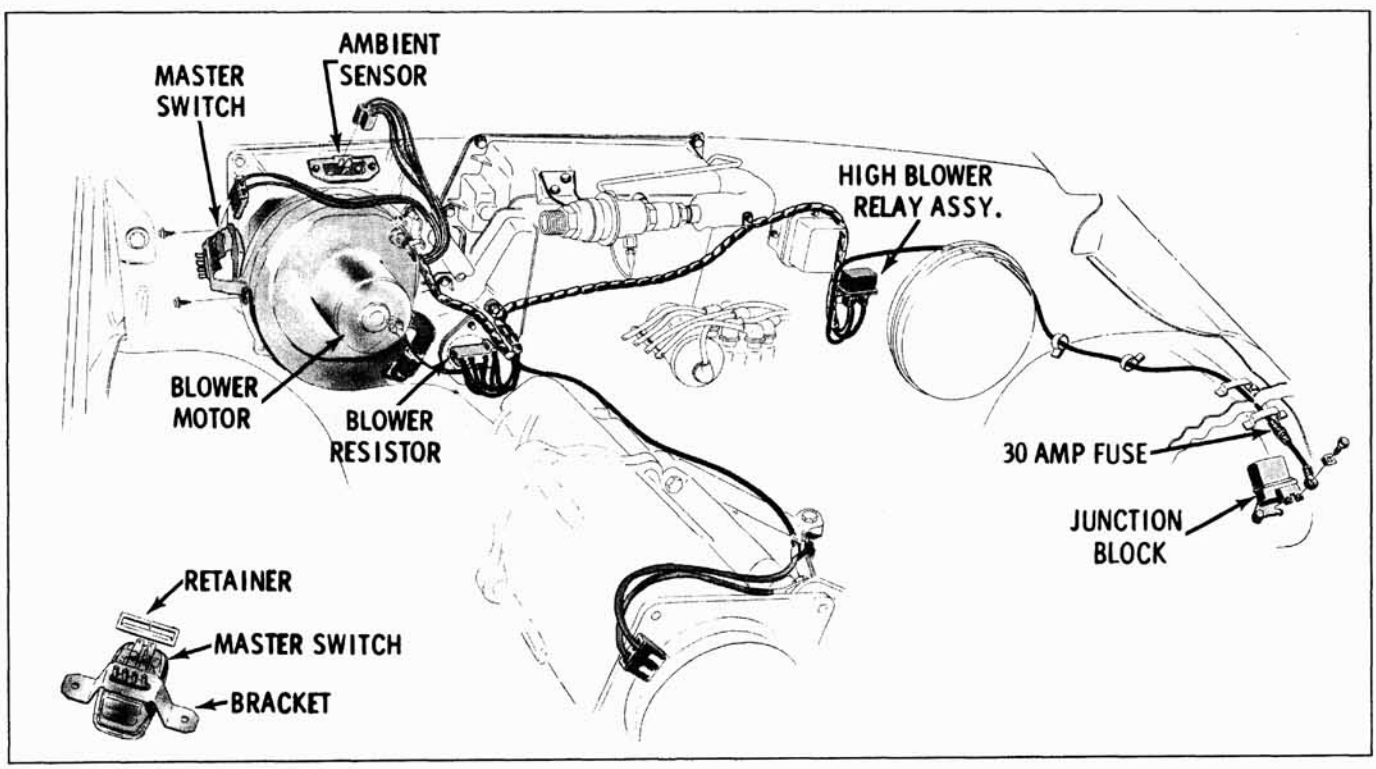


Fig. 1D-2—Ambient Sensor Location

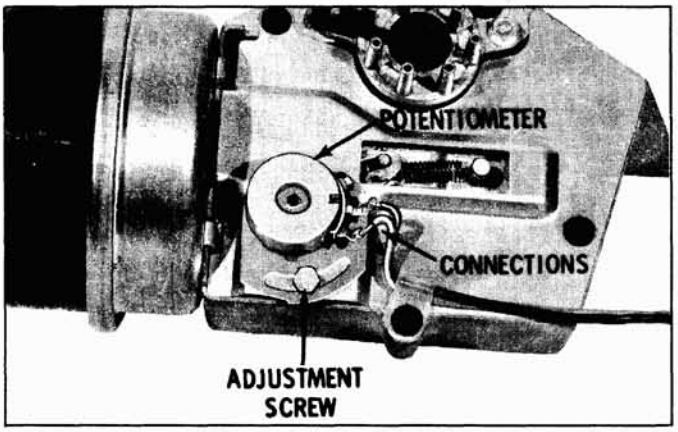


Fig. 1D-3—Potentiometer (On Servo)

Transducer (Fig. 1D-4)

The transducer is an electro-mechanical device that converts the DC voltage signal from the amplifier to a proportionate vacuum output that controls the power servo unit.

The transducer is constructed of four major parts; the vacuum regulator valve, wire element, production adjusting mechanism, and housing. The valve is a force actuated type where the output is proportioned to the force applied by the wire element. The wire element is enclosed in a steel tube housing that provides rigidity as well as protection from air currents.

During periods when the amplifier is supplying a weak, or no electrical signal, the wire element contracts, allowing a large amount of vacuum flow to the power servo unit. When the amplifier emits a stronger signal, the wire element is heated and expands, thereby diminishing the vacuum flow to the power servo unit. No attempt should be made to adjust the transducer during any service operation.

Power Servo (Fig. 1D-4)

The power servo is mounted on the right top side of the heater case assembly in the passenger compartment. It is composed of five basic parts; a vacuum diaphragm assembly, an electrical circuit board (blower speed switch), a rotary vacuum valve, a door link attached to the temperature door and potentiometer.

The vacuum diaphragm is connected to a pivot arm, and positions the pivot arm in response to the regulated vacuum output from the transducer. The pivot arm actuates the temperature door, the rotary vacuum valve, the blower speed switch and potentiometer.

The temperature door controls the proportions of cooled and heated air that are mixed to provide the proper discharge air temperature.

The rotary vacuum valve provides the necessary control for the operation of the mode door and the water valve.

The electrical circuit board controls the blower speeds through the use of resistors.

The following components are also used to operate the Comfortron system.

Thermostatic Vacuum Valve (Engine Compartment)

A valve mounted on the water valve which prevents the system from operating until the engine coolant reaches 120°F.

Thermostatic Vacuum Valve (Inside Car)

A valve mounted on the control panel which allows vacuum to pass through it whenever the in-car temperature is above 70°F.

Vacuum Master Switch

This switch located on the blower duct assembly turns on the blower motor whenever vacuum is applied to it.

Ambient Switch

The ambient switch located in the blower inlet duct energizes the compressor clutch whenever the ambient temperature rises above approximately 35°F. The ambient switch and the ambient sensor are assembled as one unit.

Range Relay

The range relay is located in the engine compartment next to the voltage regulator. When the sliding lever on the instrument panel control is moved to HI, a switch on the control is closed and energizes the range relay. The range relay allows voltage from the junction block to by-pass a fixed resistor permitting the blower to operate in one of the five high range speeds.

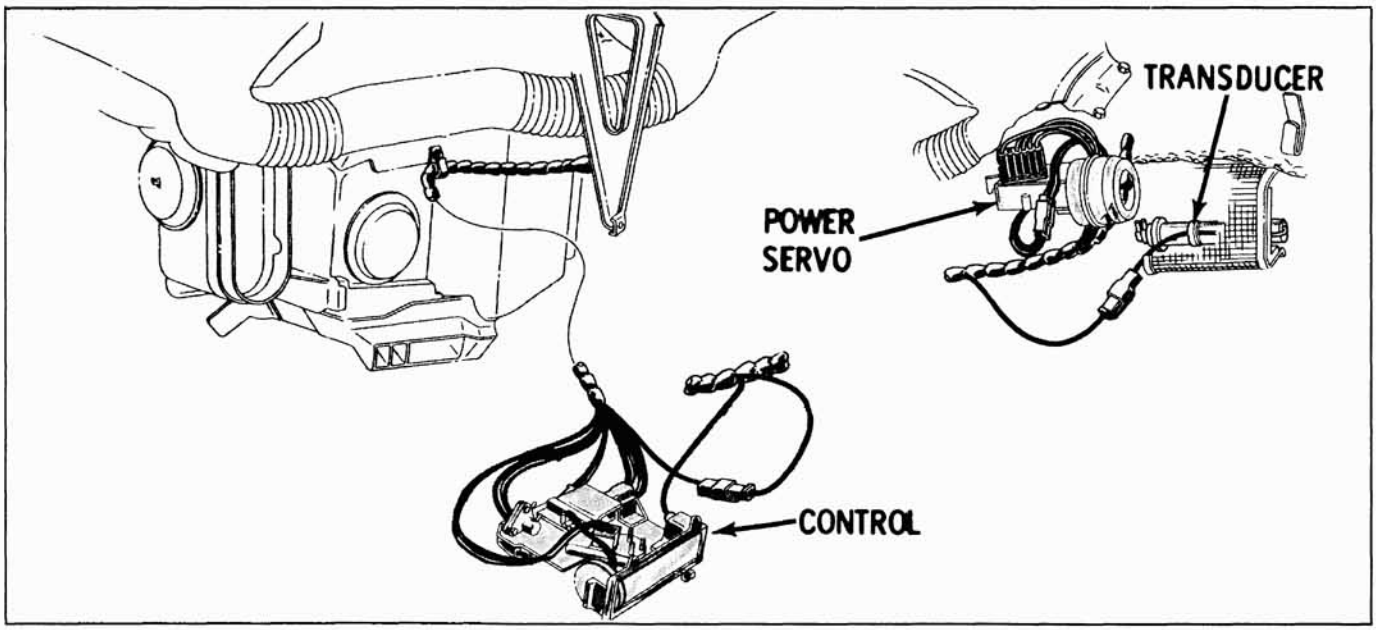


Fig. 1D-4—Control Panel

Vacuum Relay

The vacuum relay located in the passenger compartment, allows vacuum to pass from the transducer to the Power Servo as long as vacuum is present from the engine. If engine vacuum drops, the vacuum relay closes, sealing off the vacuum line to the Power Servo, locking it in position.

Vacuum Tank

The vacuum tank, located in the engine compartment on the right side of the cowl is used to store engine vacuum so that the system can continue to operate even though engine vacuum is low.

Vacuum Check Valve

The vacuum check valve is an integral part of the tank and prevents loss of vacuum stored in the vacuum tank whenever engine vacuum drops.

ASPIRATOR (Fig. 1D-6)

The aspirator is attached to the bottom of the heater case and is located just ahead of the mode door. Air is passing through the aspirator whenever the blower motor is operating. When air passes through the aspirator, it causes a vacuum on the inside tube of the aspirator. A hose connects the aspirator to the in-car sensor tube. Due to vacuum in the tube, the in-car air is drawn over the in-car sensor through the grille on the front of the control panel.

Mode Door

A door in the heater assembly that directs air flow either out of the air conditioning or heater ducts.

Temperature Door

A door in the heater assembly, controlled by the Power Servo, that controls the temperature of the air that comes out of the air outlets.

OPERATION

While Comfortron is regulating, warm air can come from the A/C outlets (approx. 95°). This will occur just before the system changes from A/C mode to heat mode.

The operation of the Comfortron A.C. system is controlled at the control panel. The sliding lever can be positioned in five positions.

Off-With the sliding lever in the OFF position, vacuum is shut off from the system and the system is inoperative.

Lo-With the sliding lever in the LO position, engine coolant above 120°F or inside car temperature above 70°F., vacuum is supplied to the system. Current to the blower motor must pass through a fixed resistor and the blower operates in one of the five speeds in low range. The system is on automatic control.

Hi-With sliding lever in the HI position, engine coolant about 120°F. or inside car temperature above 70°F., vacuum is supplied to the system. Movement of the sliding lever activates a switch on the control which energizes the range relay. With the range relay energized, the fixed resistor is by-passed and the blower operates in one of the five speeds in high range. The system is on automatic control.

Defrost

With the sliding lever in the DEFROST position, operation of the system is identical to the HI position except that approximately 80% of the air is directed to the windshield. The other 20% flows out of the heater outlets. The temperature of the air coming out of the defroster outlets can be either warm or cold as the system is on automatic control. The defroster air temperature is dependent on the temperature dial setting on the control, the temperature inside the car and outside temperature.

De-Ice

With the sliding lever in the DE-ICE position, the thermal and temperature vacuum valves are by-passed. Vacuum is supplied to the system regardless of in-car or engine coolant temperature. The sensors are by-passed so the system is no longer on automatic control. Movement of the temperature dial has no effect on the system.

In the DE-ICE position, the defroster door directs the air to the windshield. The system is in maximum heat and maximum blower speed position, however temperature of DE-ICE air will be dependent on engine coolant temperature.

Air flow through the Comfortron System is identical to the air flow in the custom air conditioning system, Section 1B.

SERVICE PROCEDURES

Service procedures listed in this section are peculiar to the Comfortron system. For procedures not listed refer to Sections 1A and 1B.

ASPIRATOR

Remove and Install

1. Remove aspirator hose from aspirator.
2. Remove rivets or screws from aspirator to case. (Fig. 1D-6)
3. Position aspirator on case and secure with two screws.

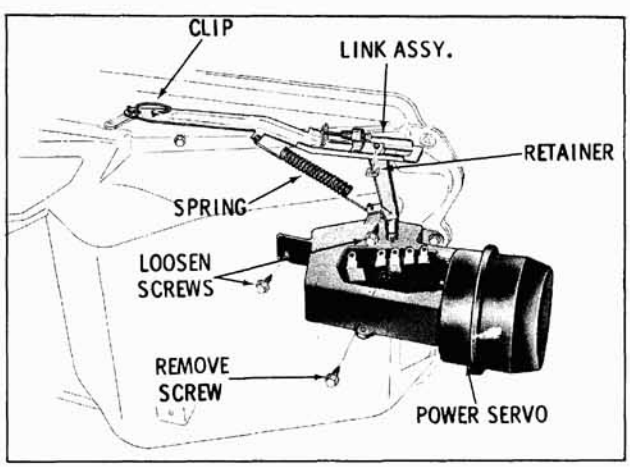


Fig. 1D-5—Power Servo Attachment

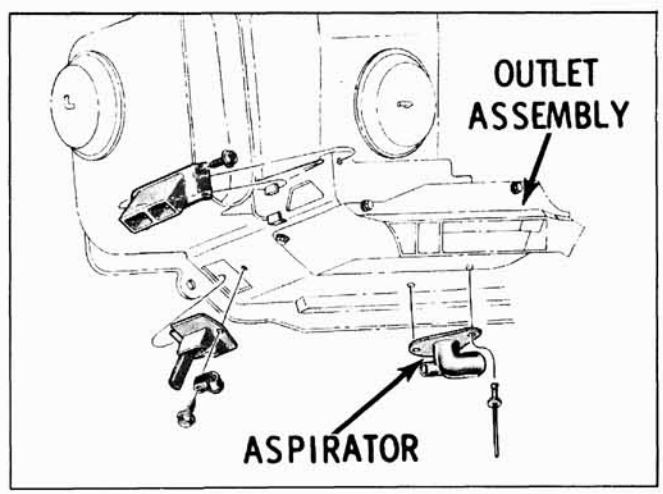


Fig. 1D-6—Aspirator

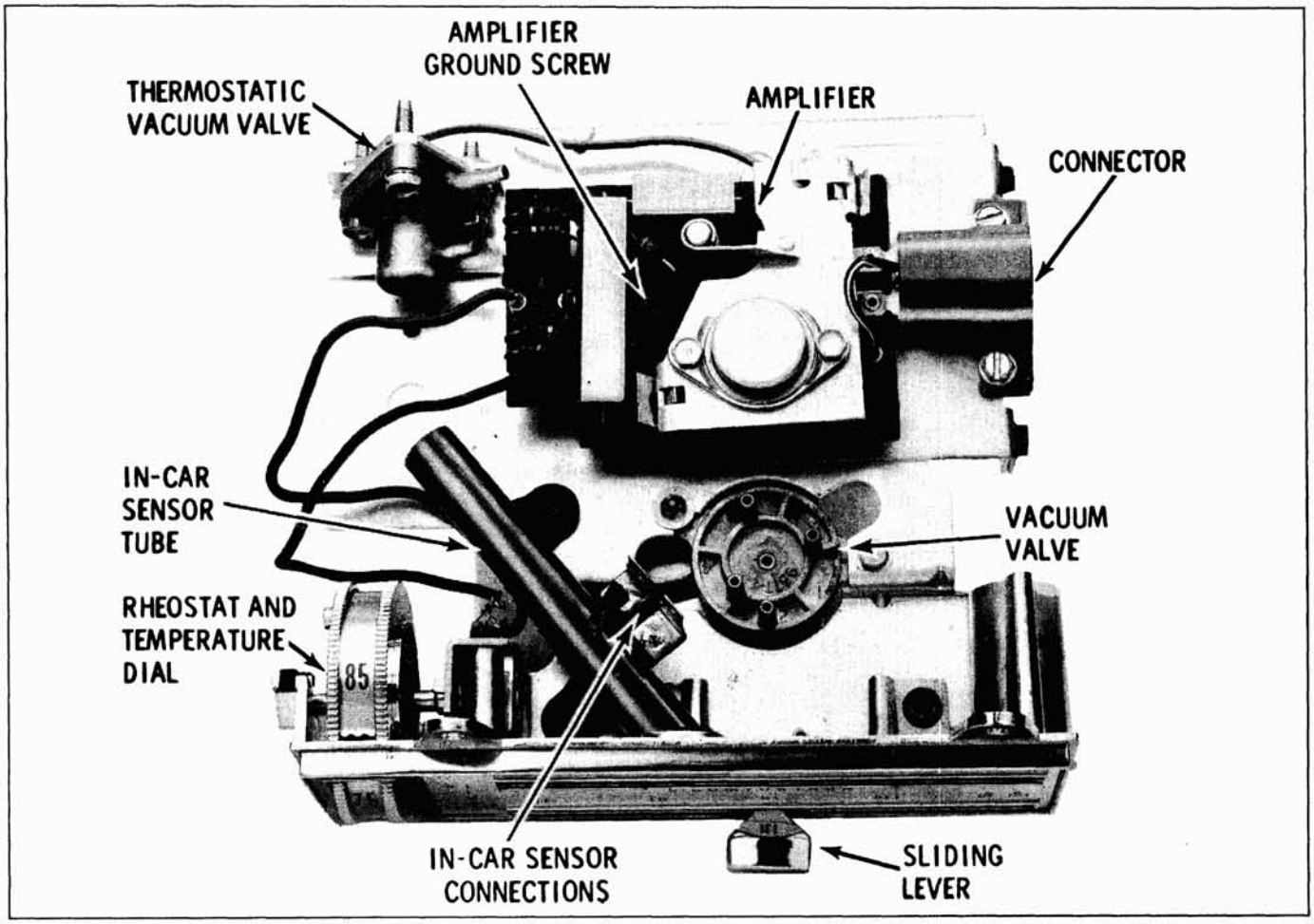


Fig. 1D-7—In Car Sensor

POWER SERVO

Removal

1. Disconnect battery.
2. Disconnect potentiometer connector.
3. Remove glove box.
4. Disconnect right defroster hose and remove right defroster duct if necessary.
5. Disconnect vacuum hose connector and electrical connector.
6. Remove the servo lower attaching screw. (Fig. 1D-5)
7. Loosen the two upper attaching screws and partially remove power servo from heater case.
8. Disconnect spring from servo arm.
9. Remove link to servo arm retainer. (Fig. 1D-5)
10. If necessary to remove and install the rotary vacuum valve proceed as follows:

a. Remove the three power servo cover attaching screws. Remove potentiometer spring through hole in cover and remove cover.

b. Remove the valve attaching spring nut and attaching screw.

c. Remove the valve from the power servo.

d. Remove the valve actuating arm and test spring from the servo arm.

e. Position the leaf spring on the servo arm.

f. Position the valve actuating arm on the vacuum valve, then install valve into the power servo with actuating arm over the servo arm stud and the valve mounting holes aligned with the alignment stud and the attaching screw hole.

g. Install the attaching screw and the spring nut. Press spring nut down securely.

h. Install the cover, making sure potentiometer link fits over power servo arm pin and install attaching screws. Install potentiometer spring.

Install

1. Position the link on servo arm. Install retainer.
2. Install spring on servo arm.
3. Position the servo over the two upper attaching screws. Install the lower attaching screw. Tighten all screws.
4. Install vacuum hose and electrical connectors.
5. Install defroster duct and hose if removed.
6. Install glove box.
7. Connect battery.

IN-CAR SENSOR

Remove and Install

1. Remove Comfortron control from instrument panel.
2. Remove two sensor to control attaching screws. (Fig. 1D-7)

To install, reverse removal procedure.

POTENTIOMETER

Removal

1. Disconnect potentiometer connector.
2. Disconnect vacuum connector from rotary vacuum valve.

3. Remove the three power servo cover attaching screws and remove cover. (Fig. 1D-8)

When replacing the potentiometer, the power servo cover and potentiometer will be serviced as a complete assembly. The potentiometer is factory adjusted and no attempt should be made to adjust it.

Install

1. Install the cover, making sure potentiometer link fits over the power servo arm pin and install attaching screws.
2. Install potentiometer spring.
3. Install vacuum connector.
4. Connect potentiometer connector.

AMBIENT SENSOR AND SWITCH

The ambient sensor and switch assembly, located on the blower duct can be removed by disconnecting the electrical connector, then removing the two attaching screws. (Fig. 1D-9)

MASTER SWITCH

Remove and Install

1. Disconnect vacuum hoses and electrical connector.
2. Remove the two master switch attaching screws and remove master switch from blower duct. (Fig. 1D-9)

To install, reverse removal procedure. Vacuum hoses can be reinstalled on any connector.

VACUUM TANK

Remove and Install

1. Remove two vacuum hoses from vacuum tank.
2. Remove two vacuum tank to cowl attaching screws.
3. Remove vacuum tank.

To install, reverse removal procedure.

TRANSDUCER

Remove (Fig. 1D-10)

1. Disconnect electrical connector.

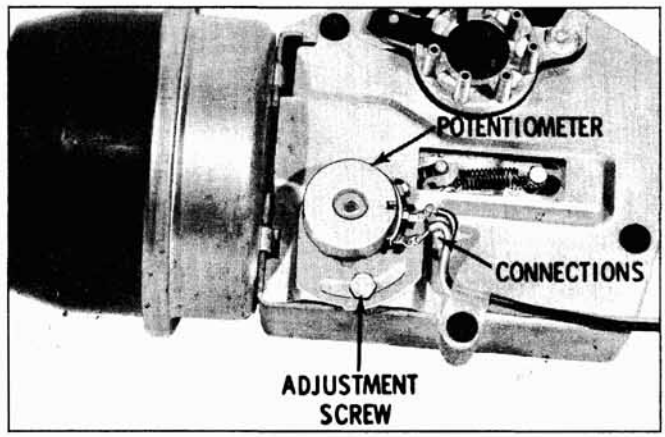


Fig. 1D-8—Potentiometer (On Servo)

2. Remove screen covering transducer.
3. Remove the transducer attaching screws.
4. Lower transducer and remove the two vacuum hoses.

Install

1. Install vacuum hoses on the transducer. Note that the hoses and connectors are of different size and must be installed in proper order.
2. Position the transducer over the two guide pins, then install the attaching screw.

The transducer attaching screw must be tightened securely as proper operation of the complete system is dependent on a good ground at the transducer.

3. Install screen covering transducer.
4. Reconnect the electrical connector.

COMFORTRON CONTROL (Fig. 1D-11)

The amplifier, range switch, compressor switch, thermostatic vacuum valve, vacuum control valve, rheostat and the

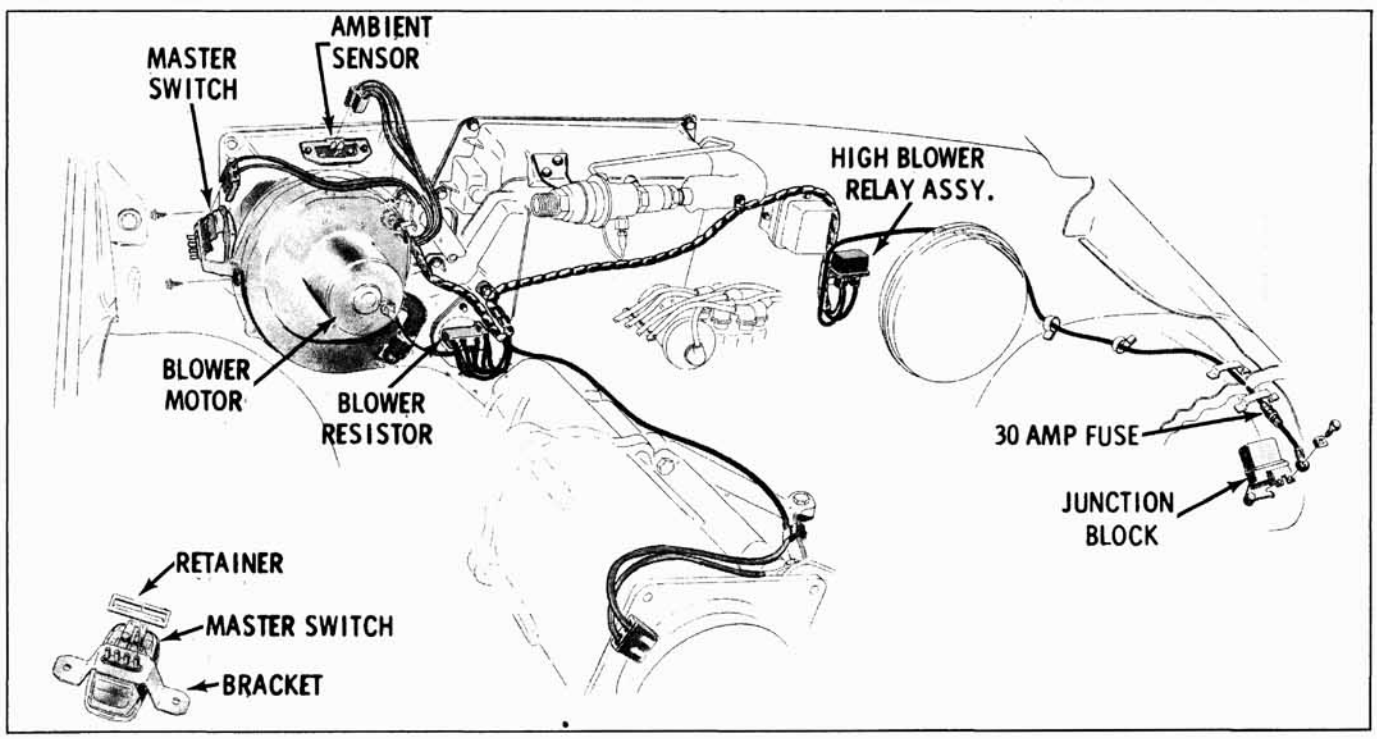


Fig. 1D-9—Ambient Sensor Attachment

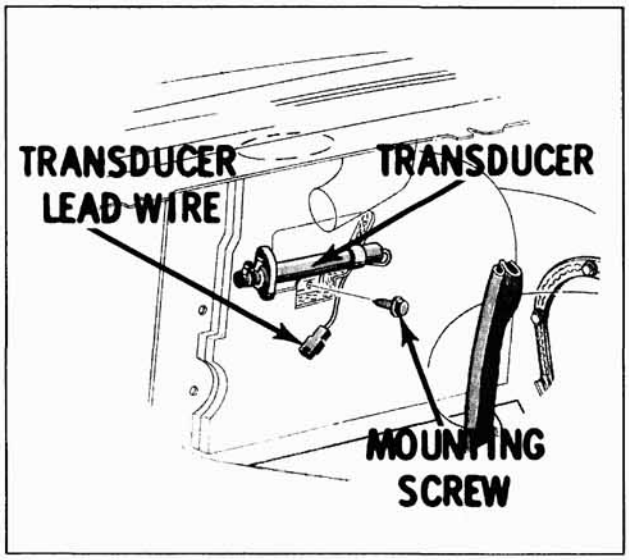


Fig. 1D-10—Transducer Attachment

in-car sensor can be serviced after removing the control from the instrument panel.

Remove

1. Disconnect battery.
2. Remove manifold.
3. Disconnect vacuum and electrical connectors from the control.
4. Remove the control attaching screws and remove control from beneath instrument panel.

If component parts of the control are to be serviced they can be removed as shown in Figs. 1D-11 and 1D-12.

AMPLIFIER

The amplifier is attached with one screw. Connections to the amplifier are of the plug-in type.

It will be necessary to loosen both connector screws.

RANGE SWITCH

The range switch can be removed by removing the attaching screw and disconnecting the actuating arm from the sliding lever.

TEMPERATURE VACUUM VALVE

The temperature vacuum valve is attached with two screws.

VACUUM CONTROL VALVE

The vacuum control valve can be removed by removing the attaching screw and the push-on spring nut, then disconnecting the valve from the sliding lever.

RHEOSTAT AND TEMPERATURE DIAL

The rheostat and temperature dial can be removed by disconnecting the electrical wires and removing the attaching screws.

To install the control reverse the removal procedure. Make sure that all vacuum and electrical connections are made securely.

WATER VALVE

The water valve and thermostatic vacuum switch is installed in the engine block. The valve installation and heater hose routing is shown in Fig. 1D-13.

VACUUM HOSES

Vacuum hoses used in the Comfortron system are color coded to assist in correct routing of the hoses.

Whenever any of the vacuum hoses or connectors are dis-

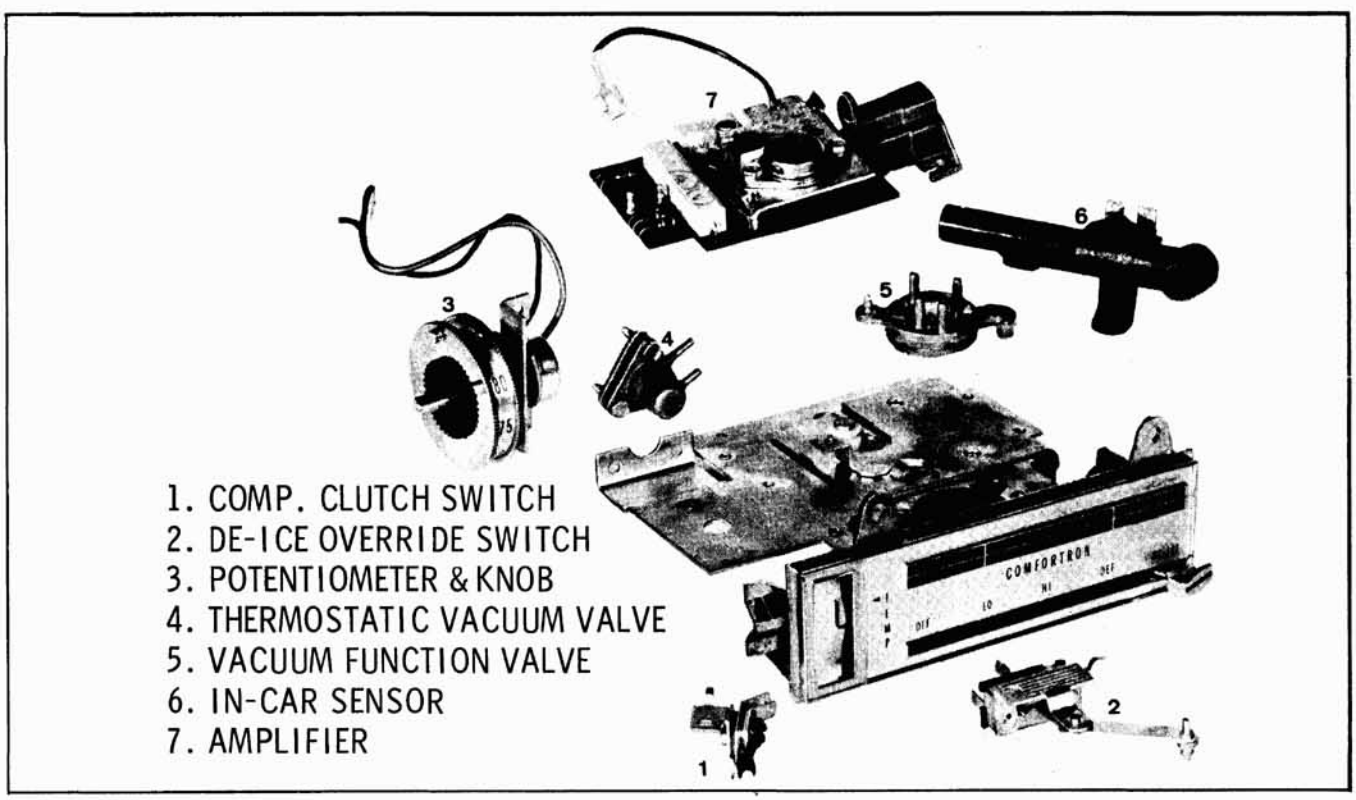


Fig. 1D-11—Control Components

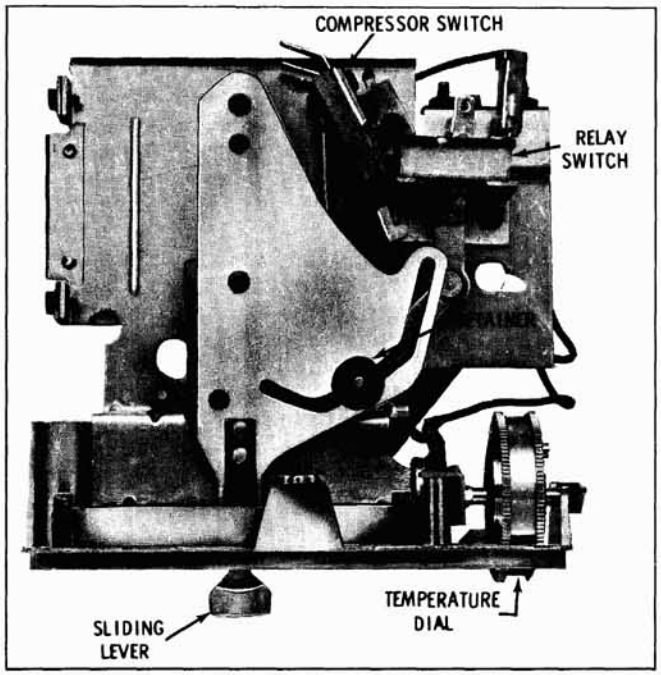


Fig. 1D-12—Control Components

connected be sure the hoses and connectors are installed securely. Vacuum hose routing is shown in Figs. 1D-14 and 1D-15.

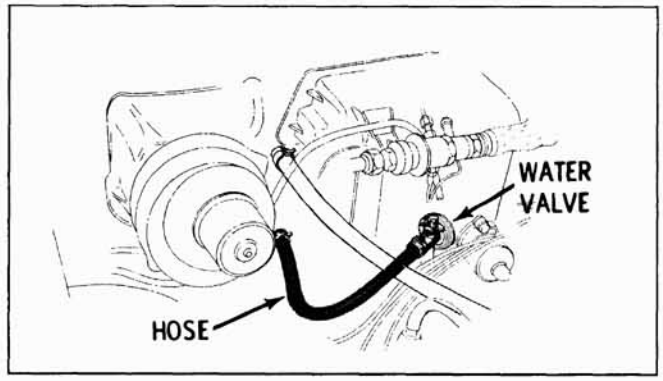


Fig. 1D-13—Water Valve Installation

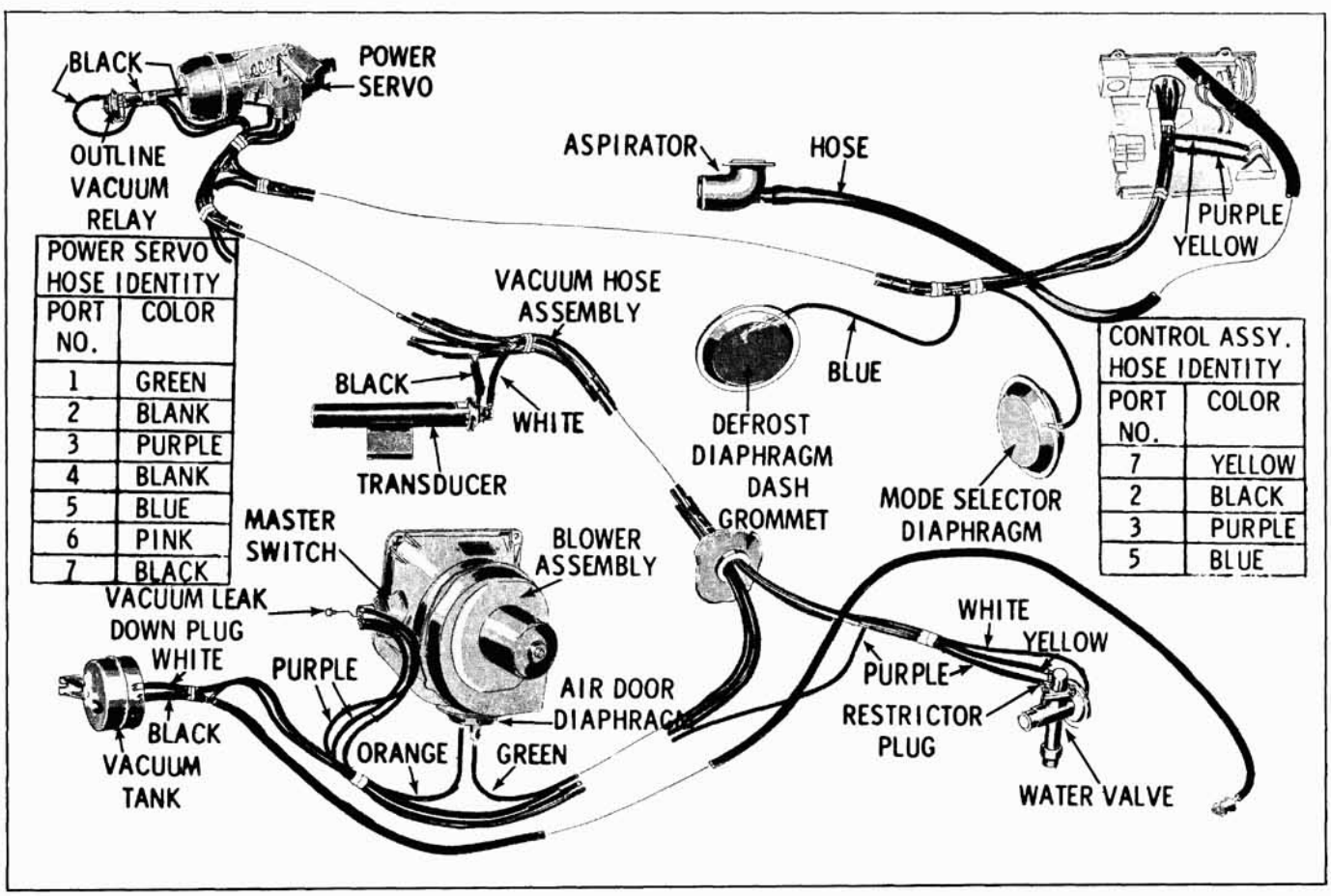
A restrictor is used in the end of the purple hose that attaches to the water valve. When replacing the vacuum hose harness, the restrictor must be removed from the old harness and placed in the new harness.

WIRING

Wiring used on the Comfortron system is shown in Fig. 1D-16. Whenever wiring connectors are removed, be sure that the connectors are fully seated on their terminals and that the terminals are clean and fit tightly. Due to the low current used in some of the circuits, a poor connection could cause a malfunction in the Comfortron system.

REFRIGERATION SYSTEM

The refrigeration system used with the Comfortron system



POWER SERVO HOSE IDENTITY	
PORT NO.	COLOR
1	GREEN
2	BLANK
3	PURPLE
4	BLANK
5	BLUE
6	PINK
7	BLACK

CONTROL ASSY. HOSE IDENTITY	
PORT NO.	COLOR
7	YELLOW
2	BLACK
3	PURPLE
5	BLUE

Fig. 1D-14—Vacuum Hose Routing

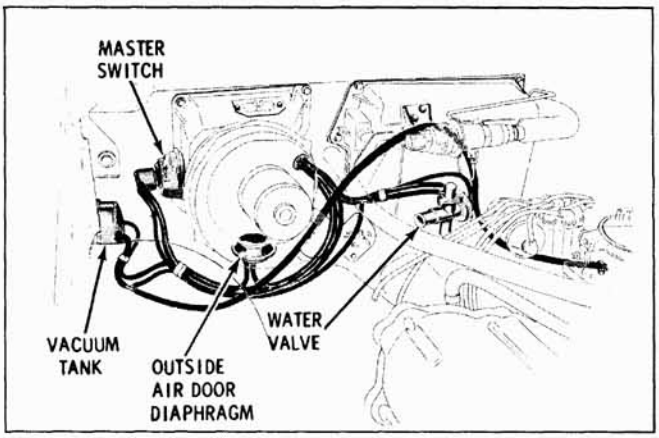


Fig. 1D-15—Vacuum Routing (Engine Compartment)

is basically the same as used on the custom air conditioning. For repairs to the refrigeration system or components, refer to Section 1A and 1B. When making a performance test on comfortron equipped cars, the sliding lever should be on high blower speed and the vacuum line must be disconnected from the power servo and plugged.

CHARGING THE SYSTEM

The system can be charged by the refrigerant drum, disposable can or charging station method only after being evacuated as outlined in 1A. When charging the Comfortron System, follow the procedures as outlined in Section 1A. However, the control must be set on automatic.

CHECKING COMFORTRON SYSTEM

Before checking the Comfortron system, it is essential that the function and operation of each unit in the system is understood and that the engine is running and the coolant is warm. It is important to remember that at the transducer, the lower the voltage, the higher the vacuum, the higher the voltage, the lower the vacuum. If Tester J-22368 is not available, refer to FUNCTION CHECK, at rear of this section. Many of the Function Checks can be performed without the use of the Tester. Tester J-22368 or J-22368-01 (Fig. 1D-17) is available to assist in locating malfunctions in the system. Operating instructions are attached to the back of the tester.

When using Tester J-22368, Step 2 of the operating instructions states, "Disconnect large vacuum hose from transducer and insert tester tee in vacuum line". However, on 54 through 86 Series cars, remove the vacuum hose from the power servo and insert tester tee in this vacuum line as it is more easily accessible. Under Step 4 of the tester instructions, the only correction listed is a defective transducer. If the diaphragm in the vacuum relay is ruptured, the same problem will be encountered as a defective transducer. To determine which unit is defective, pinch the vacuum hose between the tester and the vacuum relay. If tester still indicates a defective transducer, then replace it. If problem is now cured, then replace vacuum relay.

CHECKING SENSOR CIRCUIT FOR A SHORT

First indication of a shorted sensor or potentiometer in the Comfortron will be delivery of cold air (max. Air Conditioning) in the "Lo", "High" or "Defrost" position, regardless of temperature dial setting.

a. Check sensor or potentiometer visually for indication of a short.

b. Substitute known good sensor or potentiometer in wiring harness to check each individually.

CHECKING SENSOR CIRCUIT FOR AN OPEN

1. Use Tester J-22368 voltmeter probe. Position voltage knob in the probe position. Attach tester ground clip to car. Disconnect power plug from amplifier.

2. With ignition switch in the accessory position, test for battery voltage at both terminals on all three connectors.

a. Obtaining a voltage reading at both terminals indicates a good sensor or potentiometer.

b. Obtaining a voltage reading at one terminal only in-

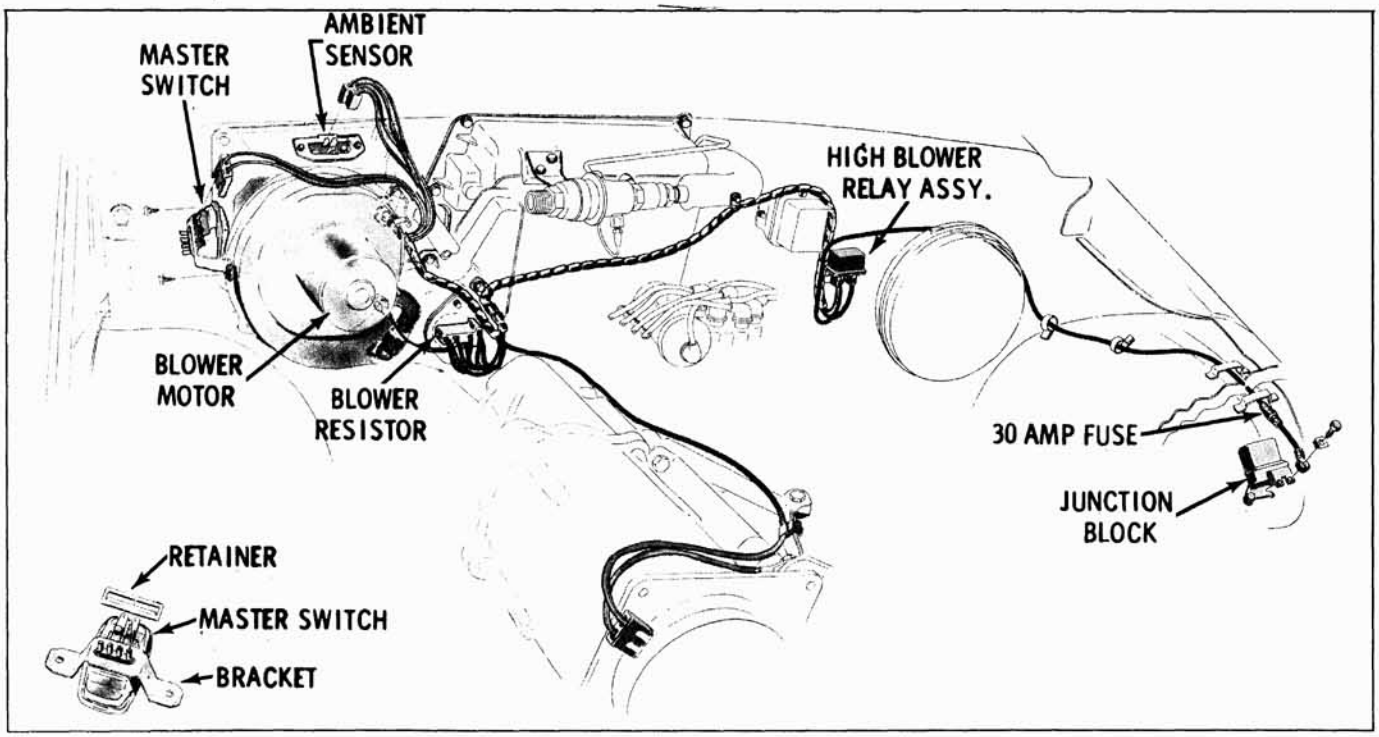


Fig. 1D-16—Wiring Diagram

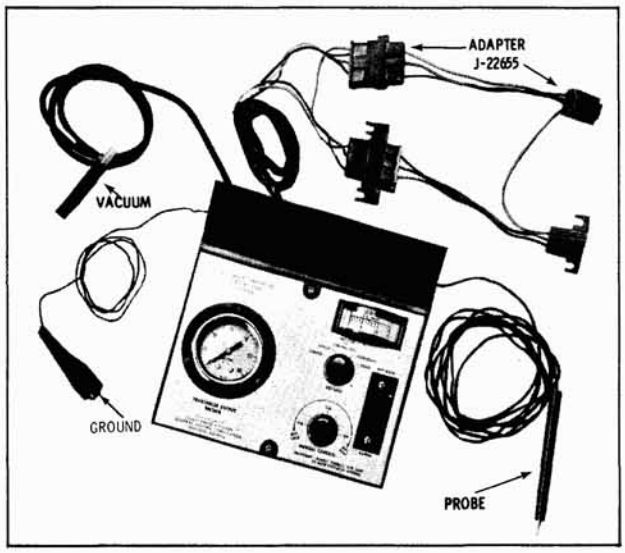


Fig. 1D-17—Comfortron Tester

dicates an open circuit in the sensor or potentiometer. Replace sensor or potentiometer.

c. No voltage at either terminal on a sensor or potentiometer indicates the open circuit is at one of the other sensors or the battery feed wire to the sensor circuit is open.

AMPLIFIER AND TEMPERATURE DIAL TEST

(Step 3 on Tester J-22368)

1. With tester connected and set as in Step 3, disconnect both wires from amplifier. Voltage should go to 8 to 9 volts minimum and should go to zero when connecting the two terminals on amplifier together with a jumper wire or screwdriver.
2. If voltage is as indicated in Step 1, replace temperature dial and rheostat assembly.
3. If voltage did not change in Step 1, replace amplifier.

TEMPERATURE CONTROL DIAL ADJUSTMENT

1. Connect Tester J-22368 to Comfortron amplifier as outlined by instructions on back of Tester.

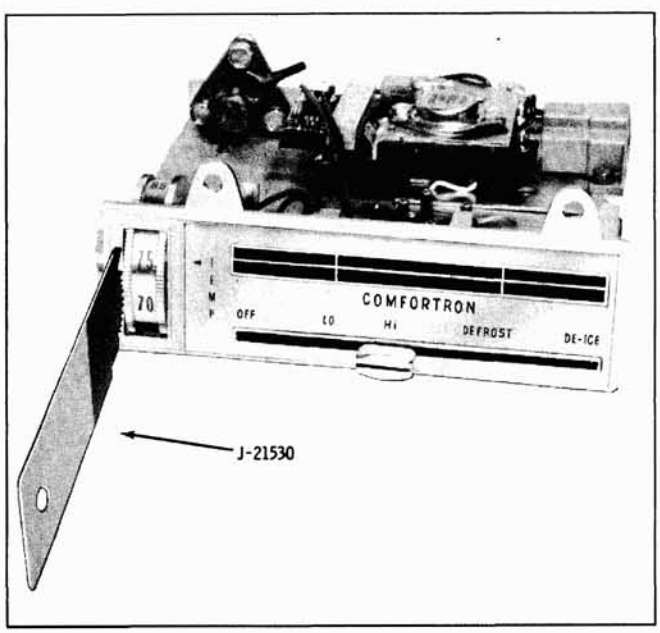


Fig. 1D-18—Adjusting Control Dial

2. Follow Step 5A of instructions, setting Manual Control on Tester to 157.
3. Insert available Tool J-21530 or a 6" steel scale to the left of temperature dial. (Fig. 1D-20)
4. While holding temperature dial on 75°, rotate Tool J-21530 or 6" steel scale until voltmeter on Tester J-22368 reads 6.5 volts.

Tool J-21530 must contact teeth on side of temperature dial.

FUNCTION CHECK

Normal Operation System

Check to be made with engine operating and coolant warm.

1. Set Control lever in OFF position. Rotate temperature dial to maximum heat position.
   a. No air flow from any outlets.
2. Move control lever to NORMAL LO position.
   a. Blower comes on high speed.
   b. Hot air comes chiefly from heater outlet with some air from defroster outlets.
3. Move control lever to NORMAL HI position.
   a. Blower speed and air flow increases.
4. Rotate temperature dial to maximum cold position. (65°)
   a. Cold air comes from air conditioning outlets.
   b. Blower speed goes from high down through low and up to high.
5. Move control lever to DEFROST position.
   a. Cold air comes chiefly from defroster outlets, with some air from heater outlets.
6. Move control lever to DE-ICE position.
   a. Hot air comes chiefly from defroster outlets, with some air from heater outlet.
   b. Blower operating on high speed.

If function check reveals that system is not operating normally, refer to the following specific functional tests. For example, step 1-A, air flows from outlets, refer to functional tests item 1A Fig. 1D-21 for further diagnosis.

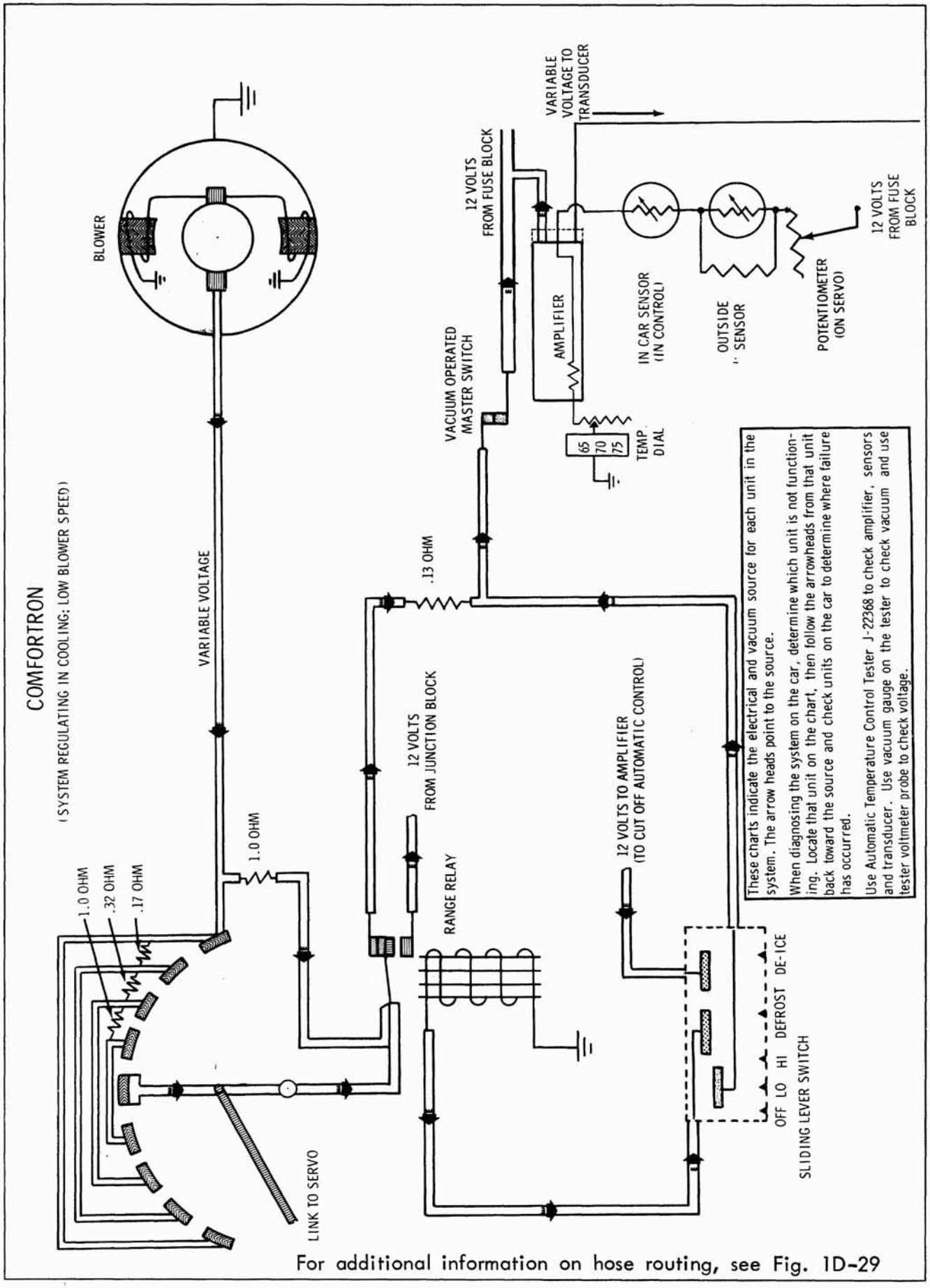


Fig. 1D-19—Comfortron Check Chart (Electrical)

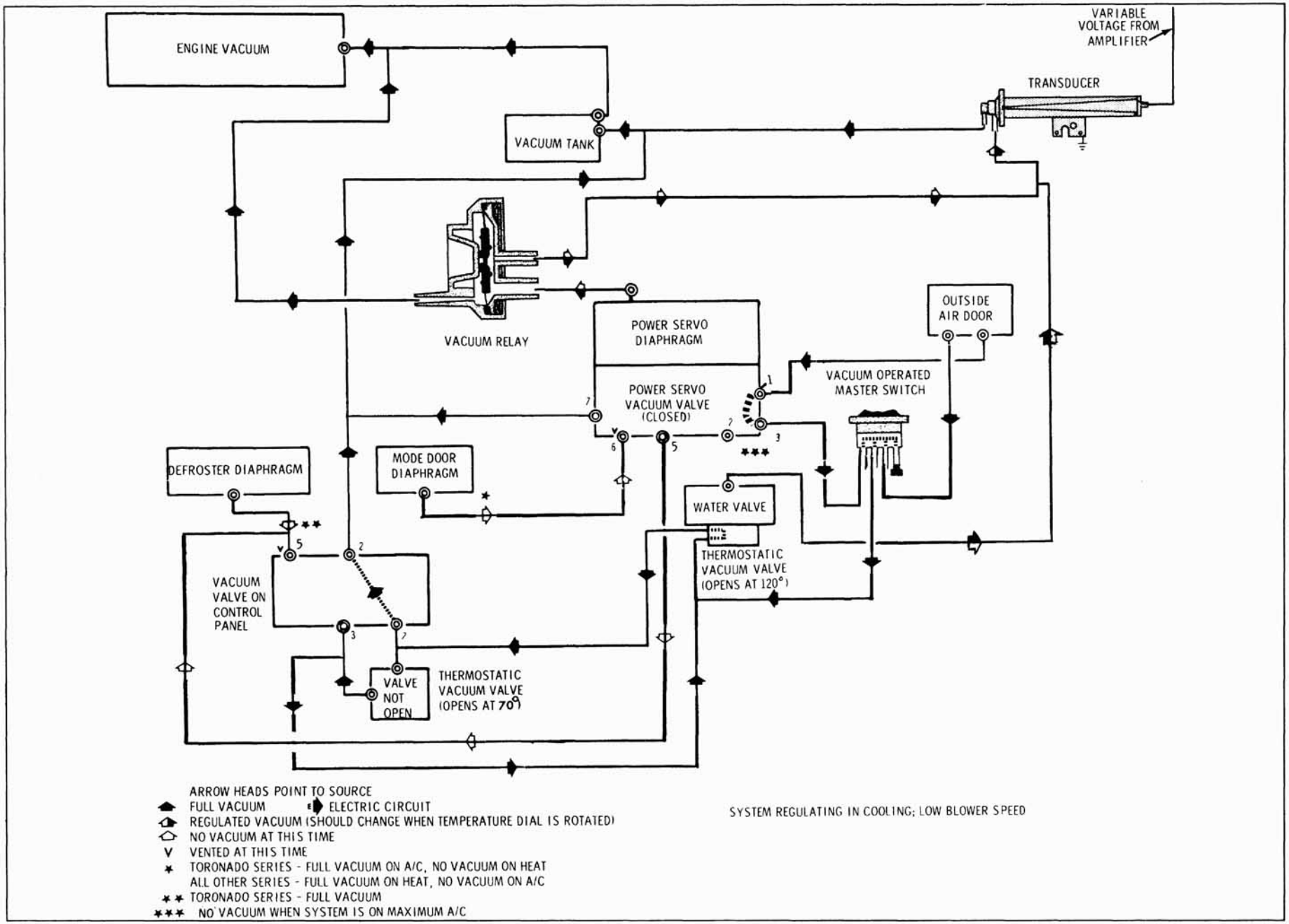


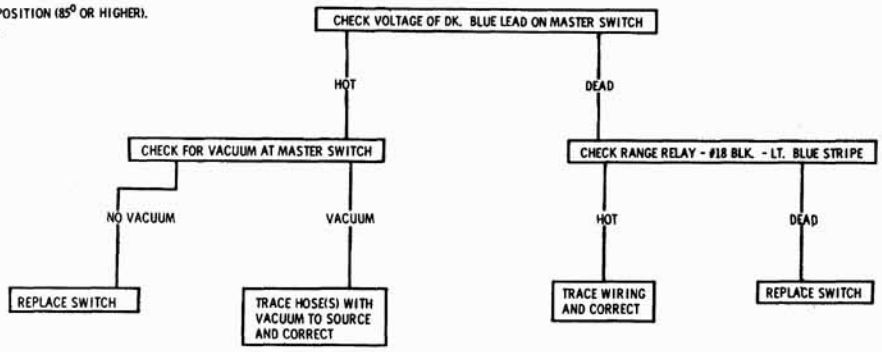
Fig. 1D-20—Comfortron Check Chart (Vacuum)

FUNCTIONAL TEST ITEM 1-A

AIR SHOULD NOT FLOW FROM ANY OUTLET
BUT
AIR DOES FLOW FROM OUTLETS

TEST CONDITIONS:

1. SET CONTROL LEVER IN "OFF" POSITION.
2. SET TEMPERATURE DIAL TO MAX. WARM POSITION (85° OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER IS USED AS A VOLTMETER.



FUNCTIONAL TEST ITEM 2-A

BLOWER SHOULD COME ON HIGH SPEED
BUT
BLOWER DOES NOT COME ON HIGH SPEED

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "LOW" POSITION.
2. ROTATE TEMPERATURE DIAL TO MAX. WARM POSITION (85° F. OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED AS VOLTMETER.

NOTE: IF AMBIENT TEMPERATURE IS HIGH OR THE IN-CAR TEMPERATURE IS HIGH (85° F. OR HIGHER), THE BLOWER WILL NOT STAY ON "HI". TO RUN THIS PROCEDURE UNDER HIGH TEMPERATURE CONDITIONS, REMOVE POWER CYLINDER HOSE FROM POWER SERVO AND SEAL THE HOSE. APPLY 12" HG. OF VACUUM ON THE POWER SERVO SO THAT THE POWER SERVO ARM GOES TO FULL WARM POSITION (DOOR LINK FULL LEFT).

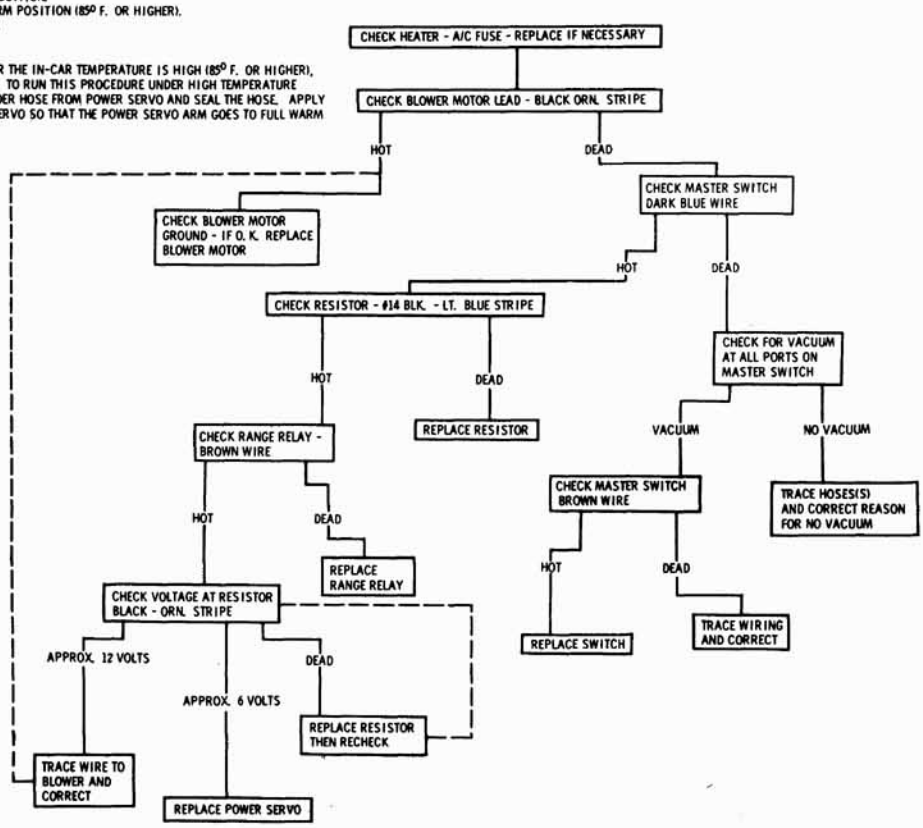


Fig. 1D-21—Function Chart

FUNCTIONAL TEST ITEM 2-B

HOT AIR SHOULD COME CHIEFLY FROM HEATER OUTLET
BUT
HOT AIR DOES NOT COME FROM HEATER OUTLET

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "LOW" POSITION.
2. ROTATE TEMPERATURE DIAL TO MAX. WARM POSITION (85° F. OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER TO BE USED AT THE AMPLIFIER CONNECTOR.

NOTE: IF AMBIENT TEMPERATURE IS HIGH OR IN-CAR TEMPERATURE IS HIGH (ABOVE 85° F.), SYSTEM WILL NOT PUT OUT MAXIMUM HEAT AND MAY EVEN GO INTO A/C BECAUSE SYSTEM WILL TRY TO MAINTAIN 85° F. INSIDE CAR. THE ONLY WAY TO CHECK THE SYSTEM AS A UNIT WOULD BE TO HAVE THE CAR AMBIENT AT 75° F. AND THE ENGINE SHOULD NOT BE SO HOT THAT EXTREMELY HOT AIR WOULD BE HITTING THE AMBIENT SENSOR.

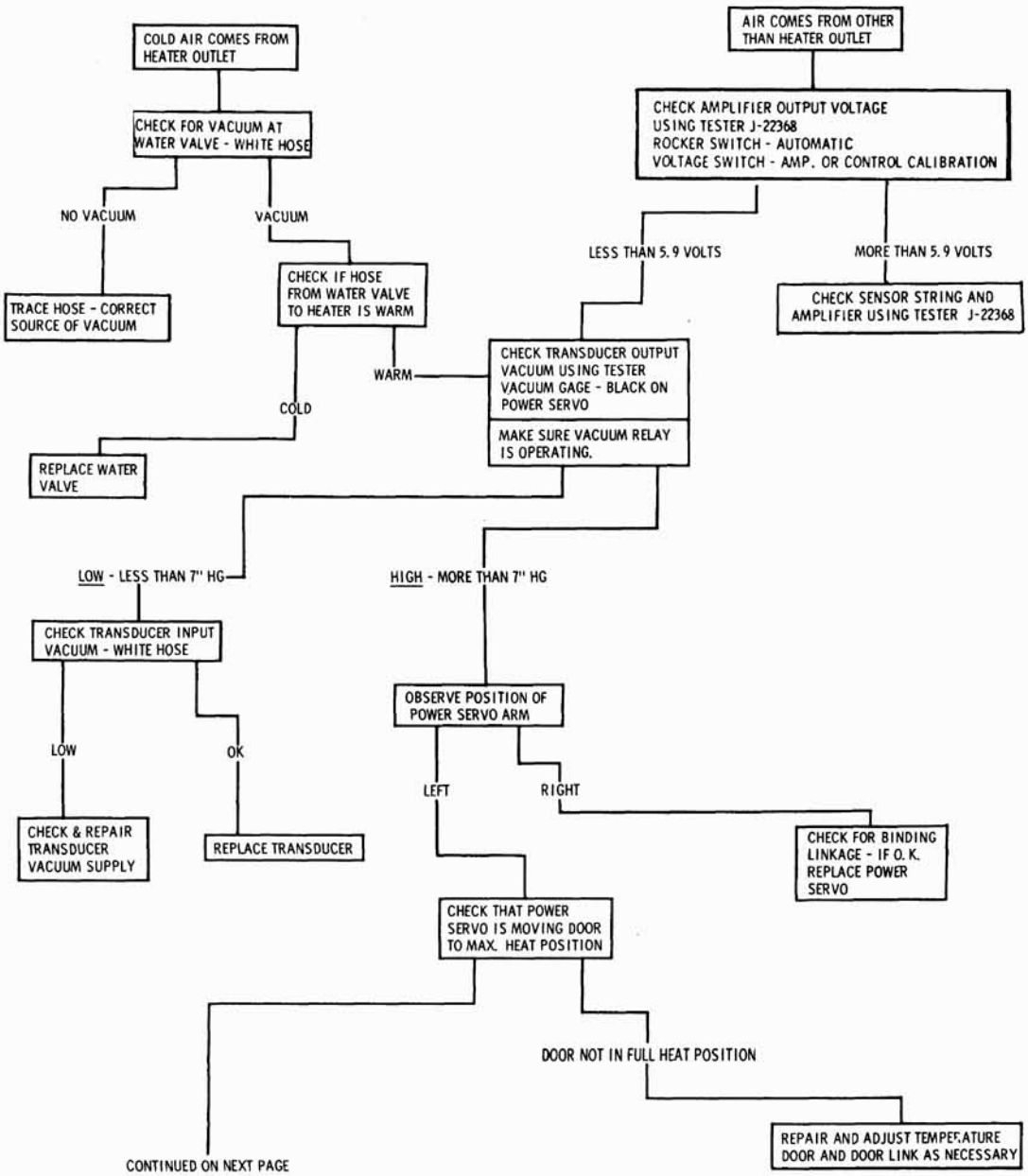


Fig. 1D-22—Function Chart

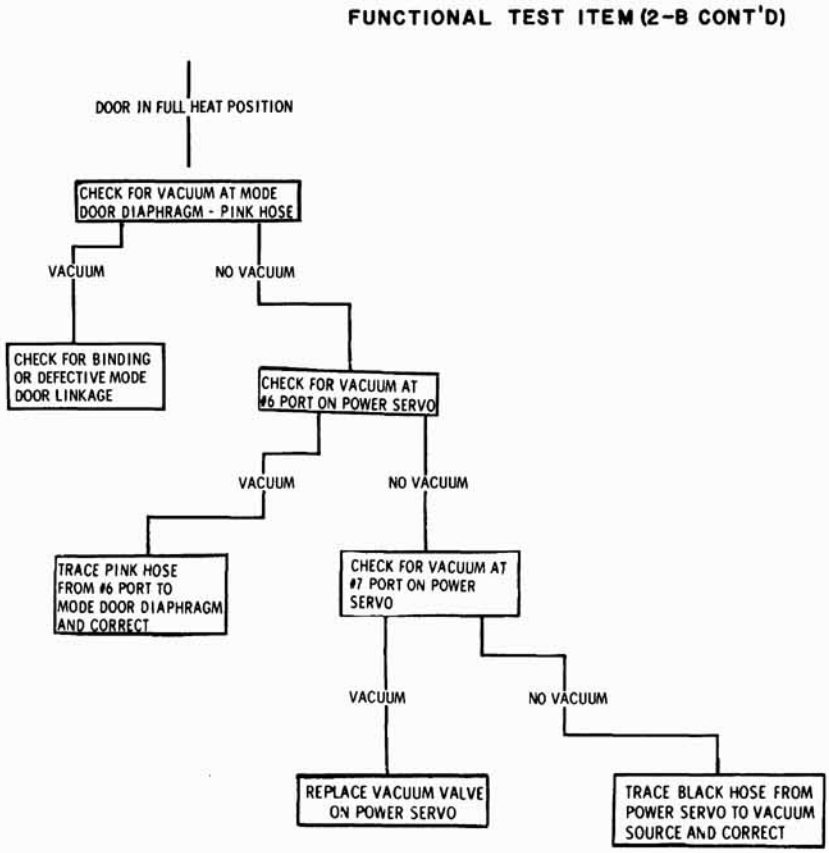


Fig. 1D-23—Function Chart

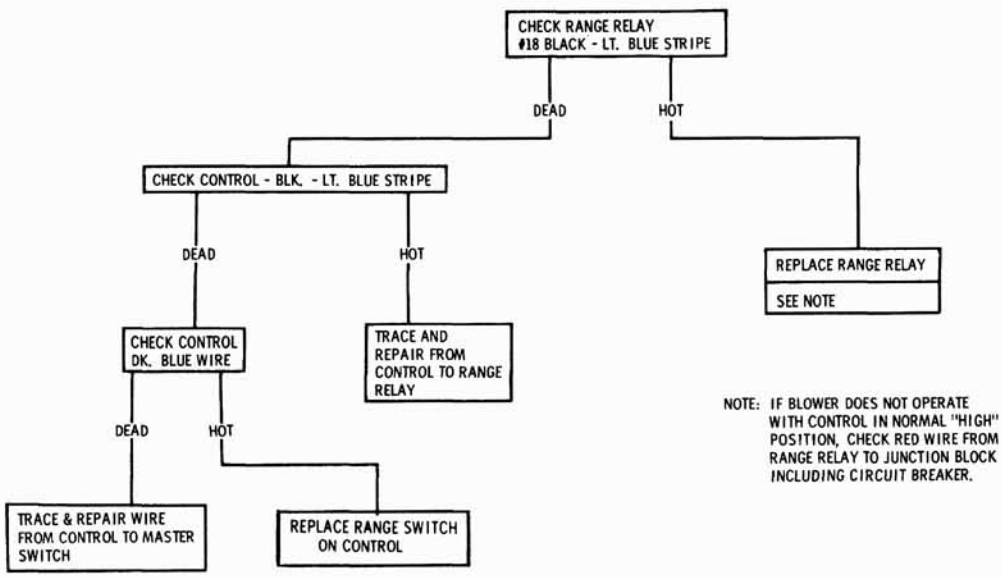
FUNCTIONAL TEST ITEM 3-A

BLOWER SPEED AND AIR FLOW SHOULD INCREASE
BUT
BLOWER SPEED AND AIR FLOW DOES NOT INCREASE

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "HIGH" POSITION.
2. ROTATE TEMPERATURE DIAL TO MAX. WARM POSITION (85° OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED AS A VOLTMETER.

NOTE: AT HIGH AMBIENT TEMPERATURES, IT MAY BE NECESSARY TO SET THE TEMPERATURE DIAL IN MAX. COLD POSITION (65° OR LESS) TO MAINTAIN HIGH SPEED BLOWER OPERATION.



NOTE: IF BLOWER DOES NOT OPERATE WITH CONTROL IN NORMAL "HIGH" POSITION, CHECK RED WIRE FROM RANGE RELAY TO JUNCTION BLOCK INCLUDING CIRCUIT BREAKER.

VACUUM OPERATION

CONTROL					
		FUNCTION			
PORT	CONNECTION	OFF	AUTOMATIC	DEFROST	DE-ICE
2	SUPPLY	SEAL	INPUT		
3	DE-ICE OVERRIDE	VENT	SEAL	SEAL	VAC
5	DEFROST	VENT	VENT	VAC	VAC
7	THERMO VAC. VALVES	VENT	VAC	VAC	VAC

	POWER SERVO		
		POSITION	
PORT	CONNECTION	MAX. A/C	MAX. HEAT
4	BLOCKED	--	--
3	MASTER SWITCH-VAC. INPUT	SEAL	CONNECT TO #1 & #2
1	OUTSIDE AIR DOOR 100%	REG. VAC./VENT	CONNECT TO #2 & #3
2	BLOCKED		
5	MODE OVERRIDE	CONNECT TO #6	SEAL
6	MODE DOOR	VENT	VAC.
7	MODE SUPPLY	SEAL	CONNECT TO #6

Fig. 1D-24—Function Chart

FUNCTIONAL TEST ITEM 4-A

COLD AIR SHOULD COME FROM A/C OUTLETS
BUT
COLD AIR DOES NOT COME FROM A/C OUTLETS

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "HIGH" POSITION.
2. ROTATE TEMPERATURE DIAL TO FULL COLD POSITION (65° F. OR LESS).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED TO CHECK AMPLIFIER OR AS A VOLTMETER AS REQUIRED.

NOTE: IF AMBIENT OR IN-CAR TEMPERATURE IS LOW (BELOW 65° F.), SYSTEM WILL TRY TO MAINTAIN 65° F. AND IT WOULD NOT BE UNUSUAL FOR THE SYSTEM NOT TO GO MAX. COLD, ALTHOUGH THE TEMPERATURE DIAL IS SET FULL COLD.

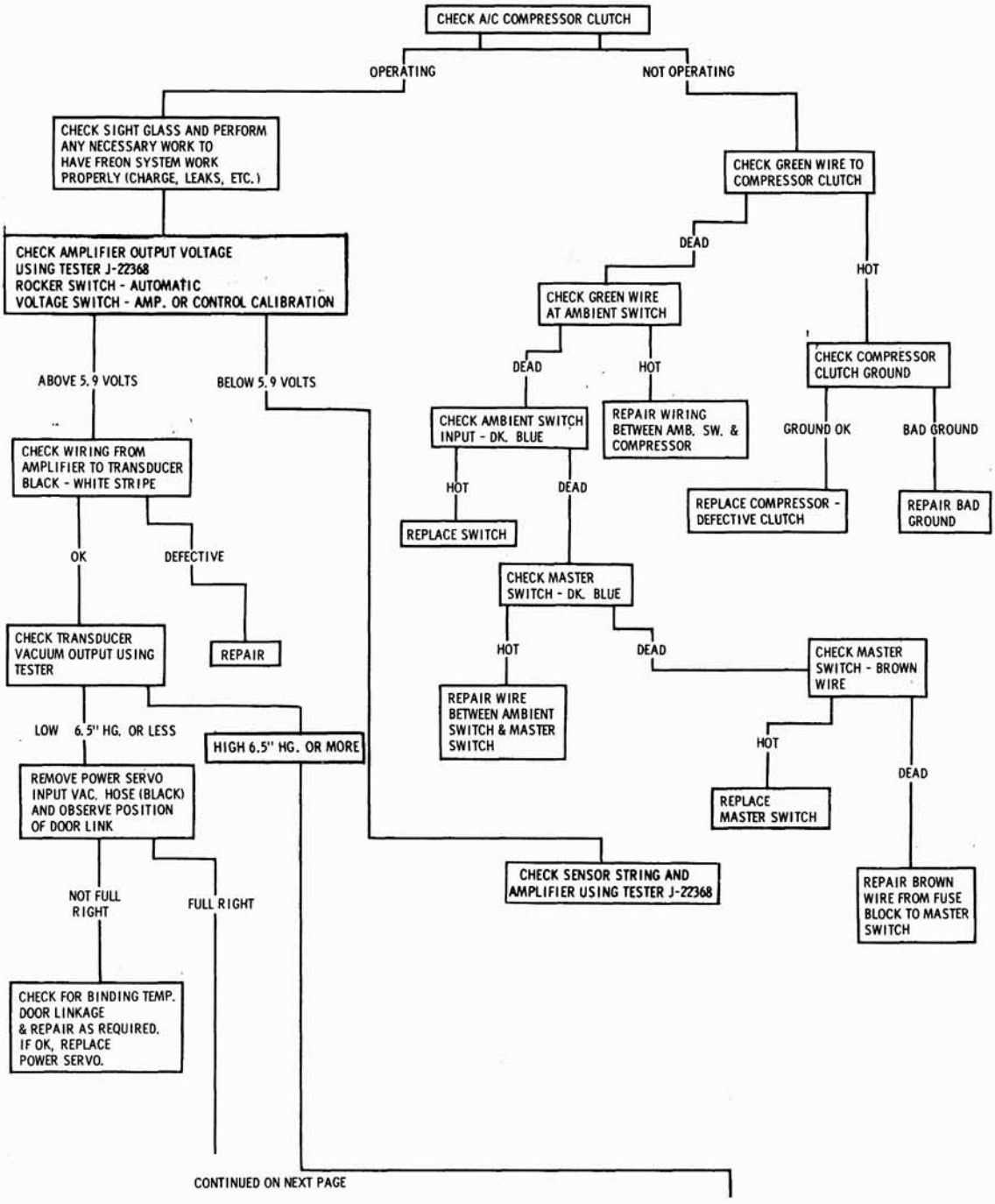
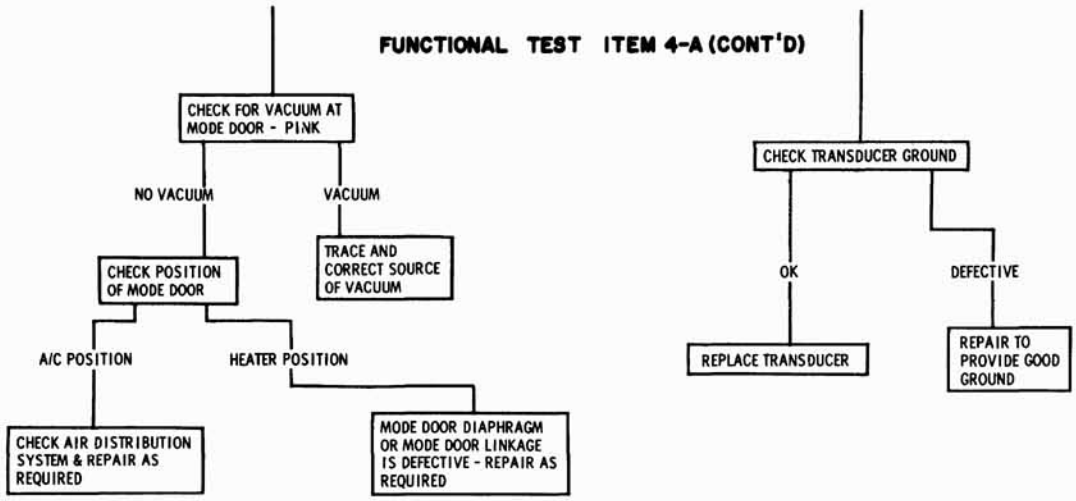


Fig. 1D-25—Function Chart



FUNCTIONAL TEST ITEM 4-B

BLOWER SPEED SHOULD GO FROM HIGH DOWN THROUGH LOW AND UP TO HIGH
BUT
BLOWER SPEED DOES NOT GO FROM HIGH DOWN THROUGH LOW AND UP TO HIGH

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "HIGH" POSITION.
2. SET TEMPERATURE DIAL IN MAX. WARM POSITION (85^{0} OR HIGHER) - FUNCTION TEST IS TO ROTATE DIAL FROM FULL WARM TO FULL COLD.
3. ENGINE OPERATING AND COOLANT WARM.

NOTE: HIGH-LOW-HIGH BLOWER CHANGES ARE ONLY TRANSIENT AS THE POWER SERVO GOES FROM MAXIMUM HEAT TO MAXIMUM COLD IN THE FUNCTION TEST.

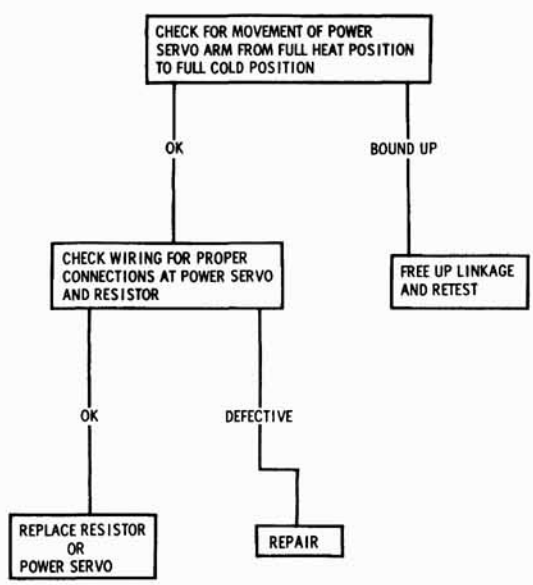


Fig. 1D-26—Function Chart

FUNCTIONAL TEST ITEM 6-B

BLOWER SHOULD OPERATE ON HIGH SPEED
BUT
BLOWER DOES NOT OPERATE ON HIGH SPEED

TEST CONDITIONS:

1. SET CONTROL LEVER IN DE-ICE POSITION.
2. ROTATE TEMPERATURE DIAL TO FULL COLD POSITION (65 OR LESS).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED AS A VOLTMETER, VACUUM GAGE AND AMPLIFIER CHECK.

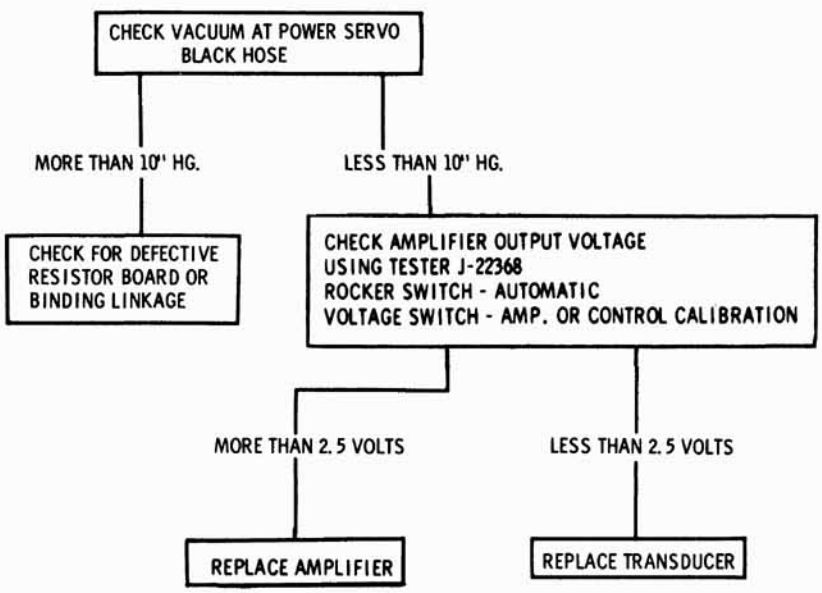


Fig. 1D-27—Function Chart

FUNCTIONAL TEST ITEM 6-B

BLOWER SHOULD OPERATE ON HIGH SPEED
BUT
BLOWER DOES NOT OPERATE ON HIGH SPEED

TEST CONDITIONS:

1. SET CONTROL LEVER IN DE-ICE POSITION.
2. ROTATE TEMPERATURE DIAL TO FULL COLD POSITION (65 OR LESS).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED AS A VOLTMETER, VACUUM GAGE AND AMPLIFIER CHECK.

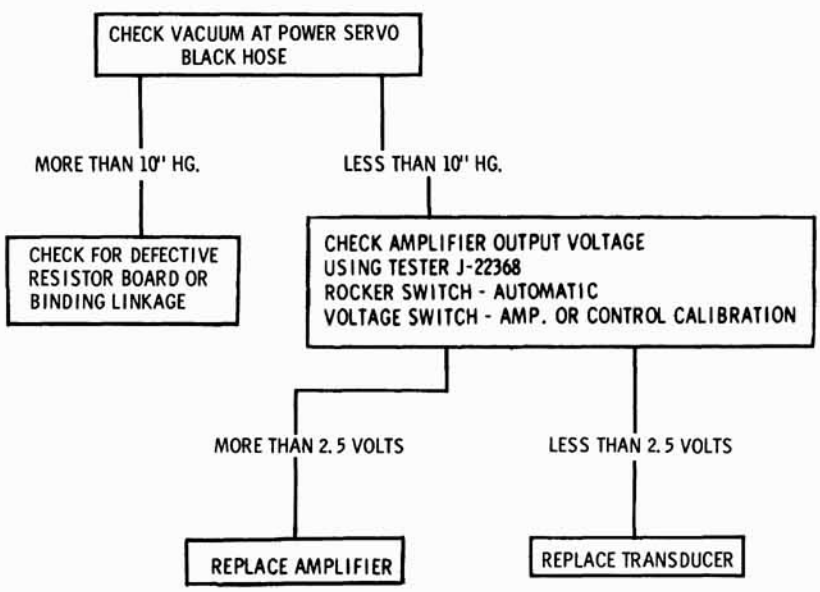


Fig. 1D-28—Function Chart

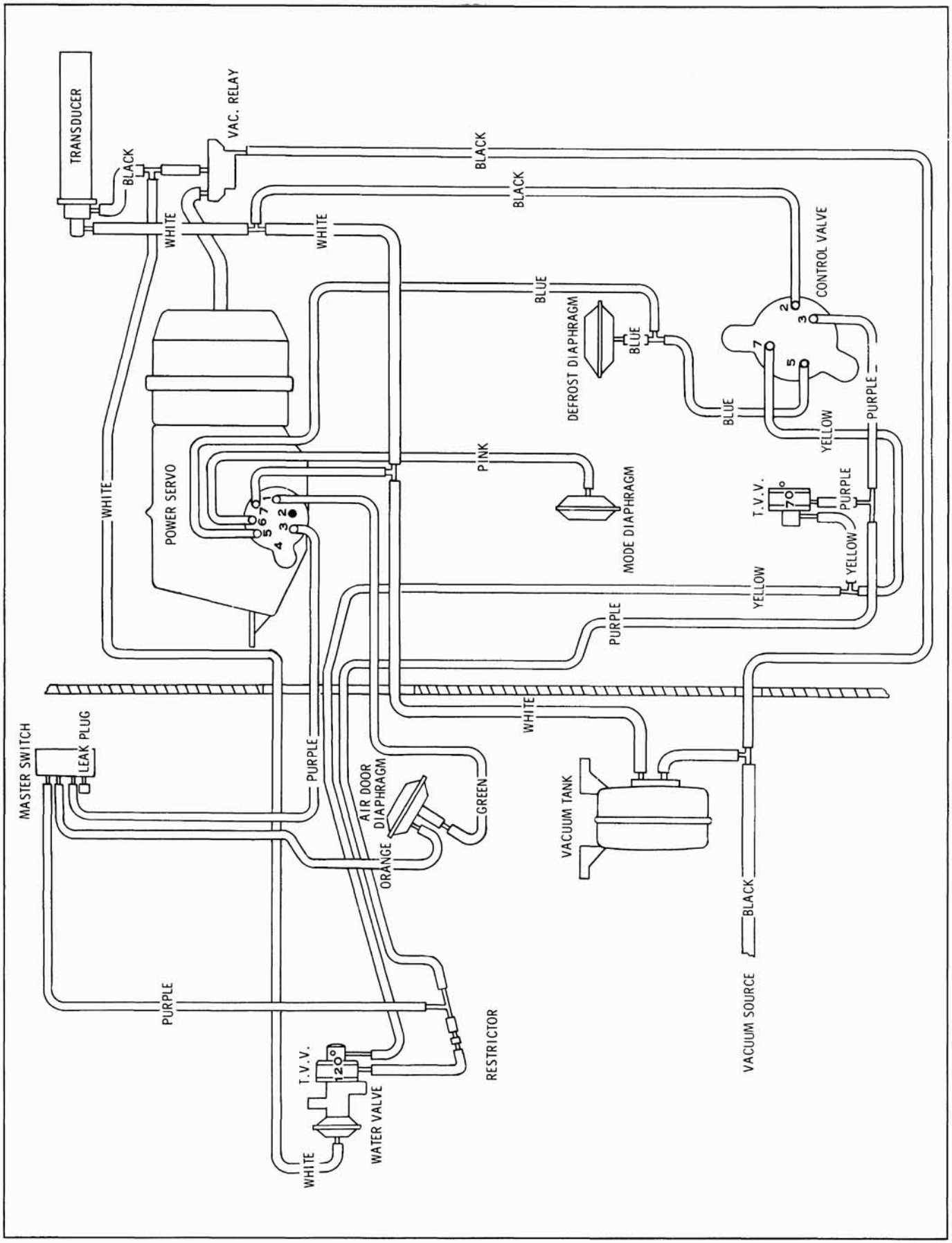
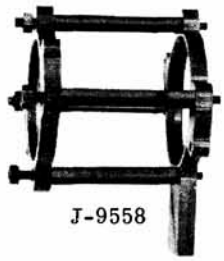


Fig. 1D-29—Vacuum Hose Routing

J-9402


J-9558

J-8433

J-9395

J-9401

J-9480-2

J-9480

J-6435

J-5403

J-9393

J-9392

J-9481

J-5453

J-9432

J-9527

J-5420

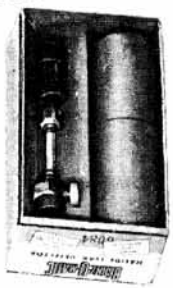
J-972

J-5725

J-5421

J-5462

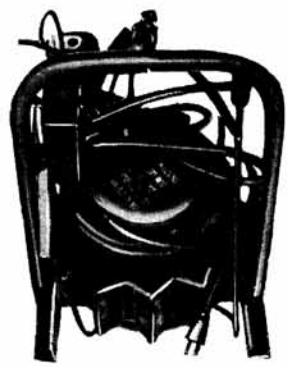
J-22974


J-6084

J-5418

J-6271

J-6272


J-5428

J-972-A	Spanner Wrench (Used for Holding Driven Plate)
J-5403	Snap Ring Pliers
J-5418	Gauge Charging Line
J-5420	Gauge Adapter
J-5421	Pocket Thermometer
J-5428	Vacuum Pump
J-5453	Goggles
J-5462	Refrigerant Drum Hook-Up Set
J-5725	Gauge Manifold Test Unit
J-6084	Leak Detector Kit
J-6271	Fits-All Valve
J-6272	#3 Multi-Opener
J-6435	Snap Ring Pliers
J-8433	Compressor Pulley Puller
J-9392	Seal Remover & Installer
J-9393	Seal Seat Remover & Installer
J-9395	Puller Pilot
J-9401	Hub & Drive Plate Assembly Remover
J-9402	Cylinder Assembly Tray
J-9432	Needle Bearing Remover & Installer
J-9480	Driven Plate Installer
J-9481	Pulley Bearing & Drive Plate Assembly Installer
J-9527	Leak Test Adapter
J-9558	Checking Fixture
J-22974	Seal Protector

Fig. 1D-30—Tools

FRAME AND BODY MOUNTING

31 THROUGH 86 SERIES

CONTENTS OF SECTION 2

Subject	Page	Subject	Page
FRAME	2-1	FRAME REPAIR	2-1
FRAME ALIGNMENT	2-1	BODY MOUNTS	2-3

FRAME

All extended station wagons, convertibles, 84 and 8600 series use the boxed type frame, meaning that the side rails are boxed or two sided through the center section of the frame. All heavy duty frames are the boxed type construction using the same steel stock as used in convertibles of the same series.

When supporting car on a floor jack or floor stands, the car should be supported at the suspension points only. Under no conditions should the car be supported at the extreme ends of frame or at the center of a frame side rail.

When using a frame contact hoist, the car should be lifted at the contact points as shown in Figs. 2-1 and 2-2.

FRAME ALIGNMENT

The diagram shown in Figs. 2-1 and 2-2 can be used to check the alignment of a car frame that has been distorted.

The reference points indicated in the illustration are to be checked with a tram gauge. The dimensions between the various reference points will show where straightening operations are necessary.

Corresponding measurements must be equal within 1/4".

1. Measure A-A. If not equal, rear end of frame is misaligned.
2. Measure B-B. If not equal, center portion of frame is misaligned.
3. Measure C-C. If not equal, then front suspension crossmember is misaligned.
4. Measure D-D. If not equal, then frame horn is misaligned.

In case of collision, frame members can often be satisfactorily straightened to the required limits. However, the front suspension crossmember is made to unusually close limits necessary for proper front wheel alignment; therefore, straightening of this unit may not be successful.

It is possible that the ordinary straightening methods will suffice for minor damage to the front suspension crossmember; however, in case of serious damage or fracture, the entire front suspension crossmember or the side rail extension suspension crossmember must be replaced. Before the member is

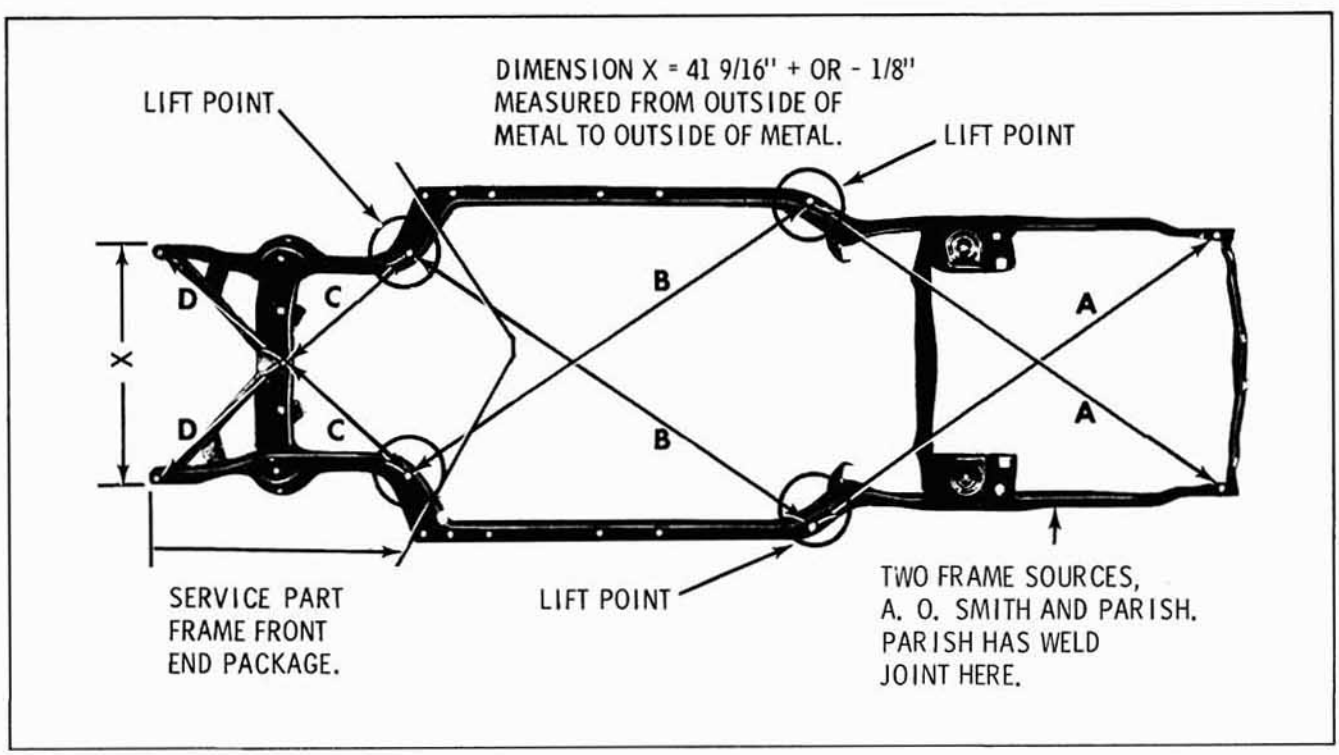


Fig 2-1—Frame - 54 through 86 Series

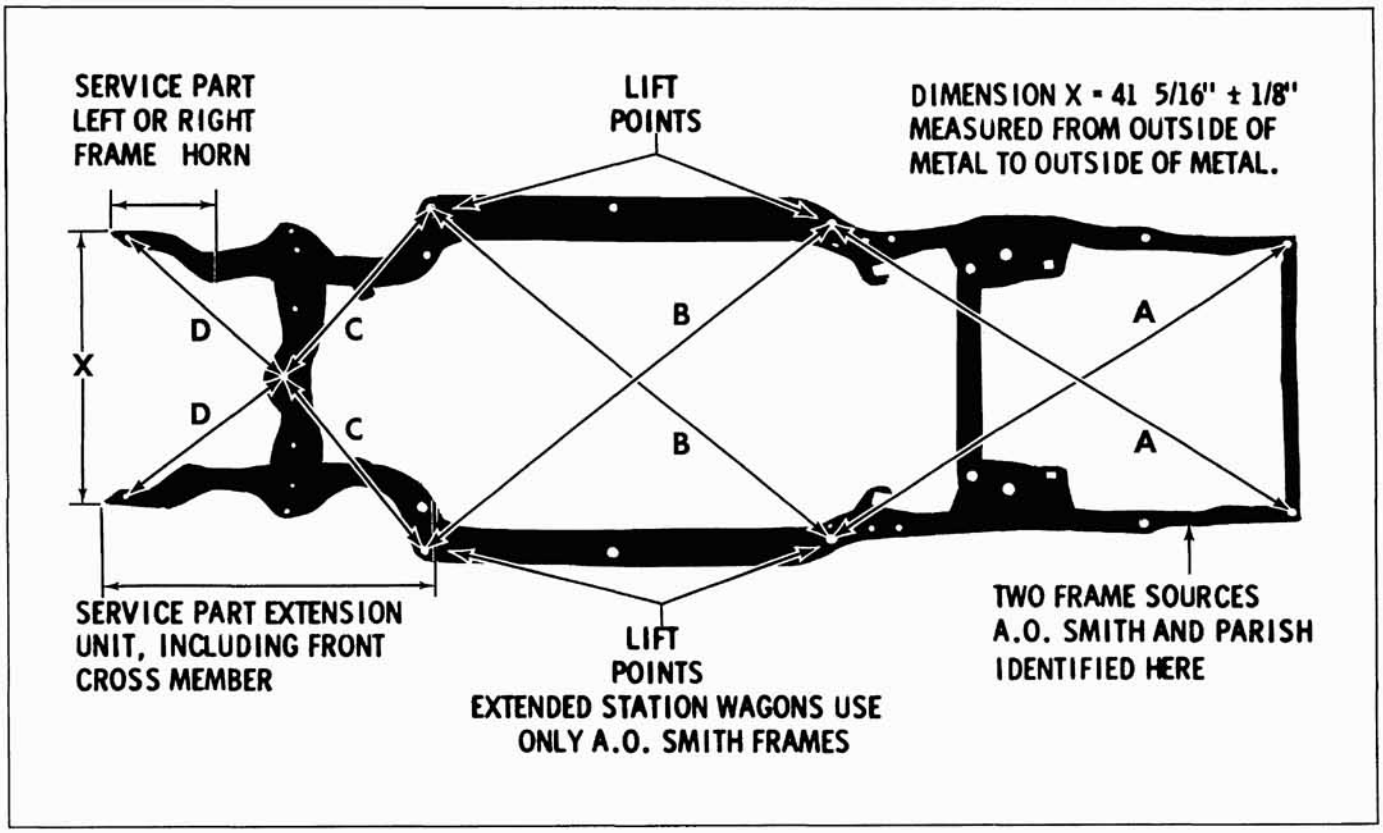


Fig 2-2—Frame - 31 through 48 Series

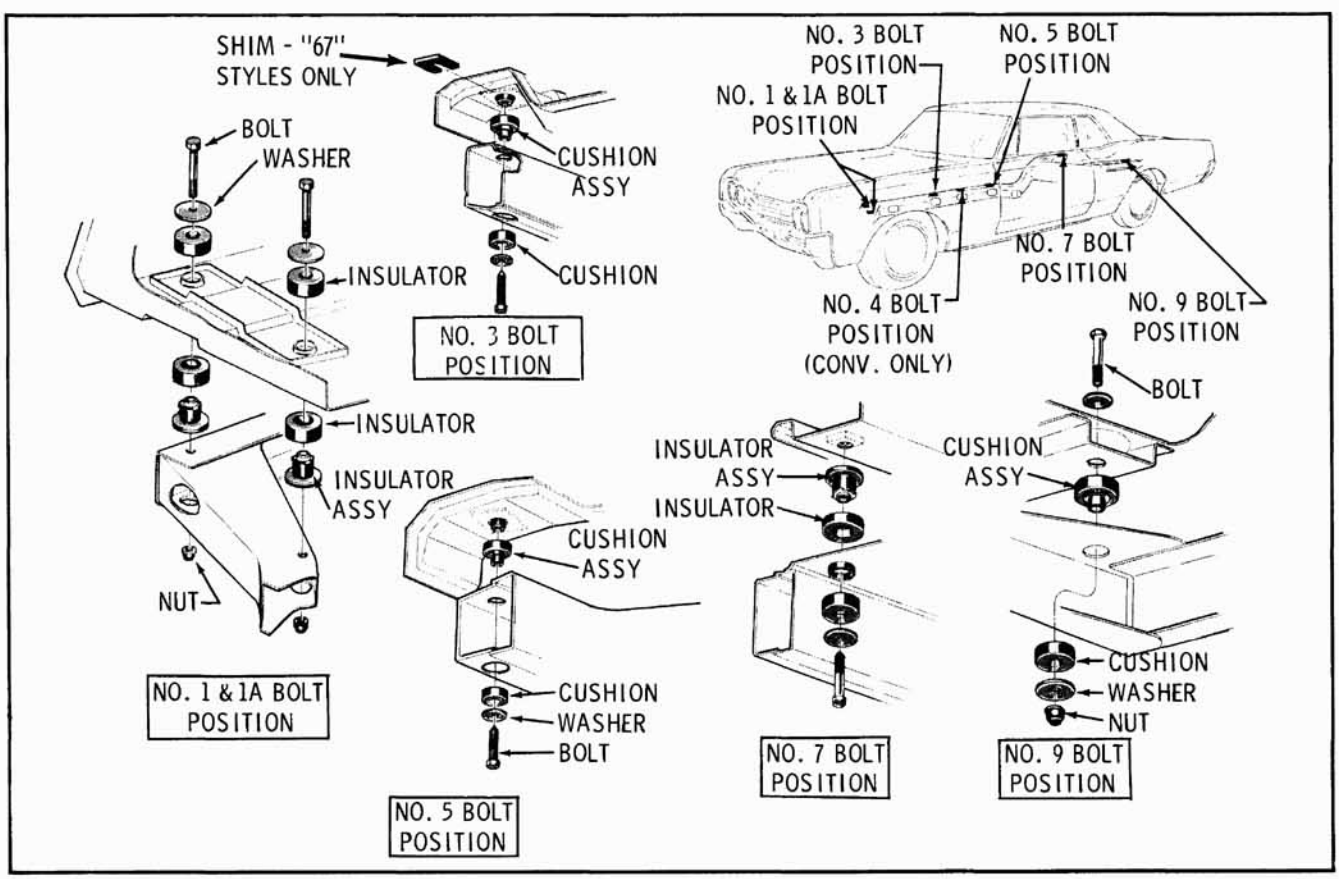


Fig 2-3—Body Mounting - 54 through 86 Series

replaced, it is essential that the frame alignment be checked, and corrected if necessary. The service parts package contains all necessary cutting, welding and alignment specifications.

Whenever possible, frame members should be securely fastened with hot rivets. In case riveting equipment is not available, finished bolts snugly fitted in reamed holes may be used. The nuts should be securely tightened and lockwashers used, care being taken that washers do not spread. (Cold driven rivets are not recommended unless the heavy power press equipment necessary to make secure fastening is available.)

After frame members are riveted or bolted securely, all welded joints and areas that were cut to permit removal of a frame member should be welded.

When the frame repair is completed and inspected, the various parts of the suspension may be assembled.

BODY MOUNTS

To minimize vibration and noise, the body mounts must be properly torqued. Body mounts which are not tightened sufficiently will cause body "chucking" and damage to the cushions. If body mounts are tightened excessively, the cushioning effect of the cushion is impaired, resulting in squeaks and body "drumming". Torque body mount bolts to 40 ft. lbs. for 31 through 86 Series.

Figure 2-3 illustrates the use of shims at No. 3 and 4 body mount locations on 54 and 84 Series convertibles. The shims are used to obtain correct door alignment, a maximum of two shims for each of the mount locations.

For installation of body mounts, refer to Figs. 2-3 and 2-4.

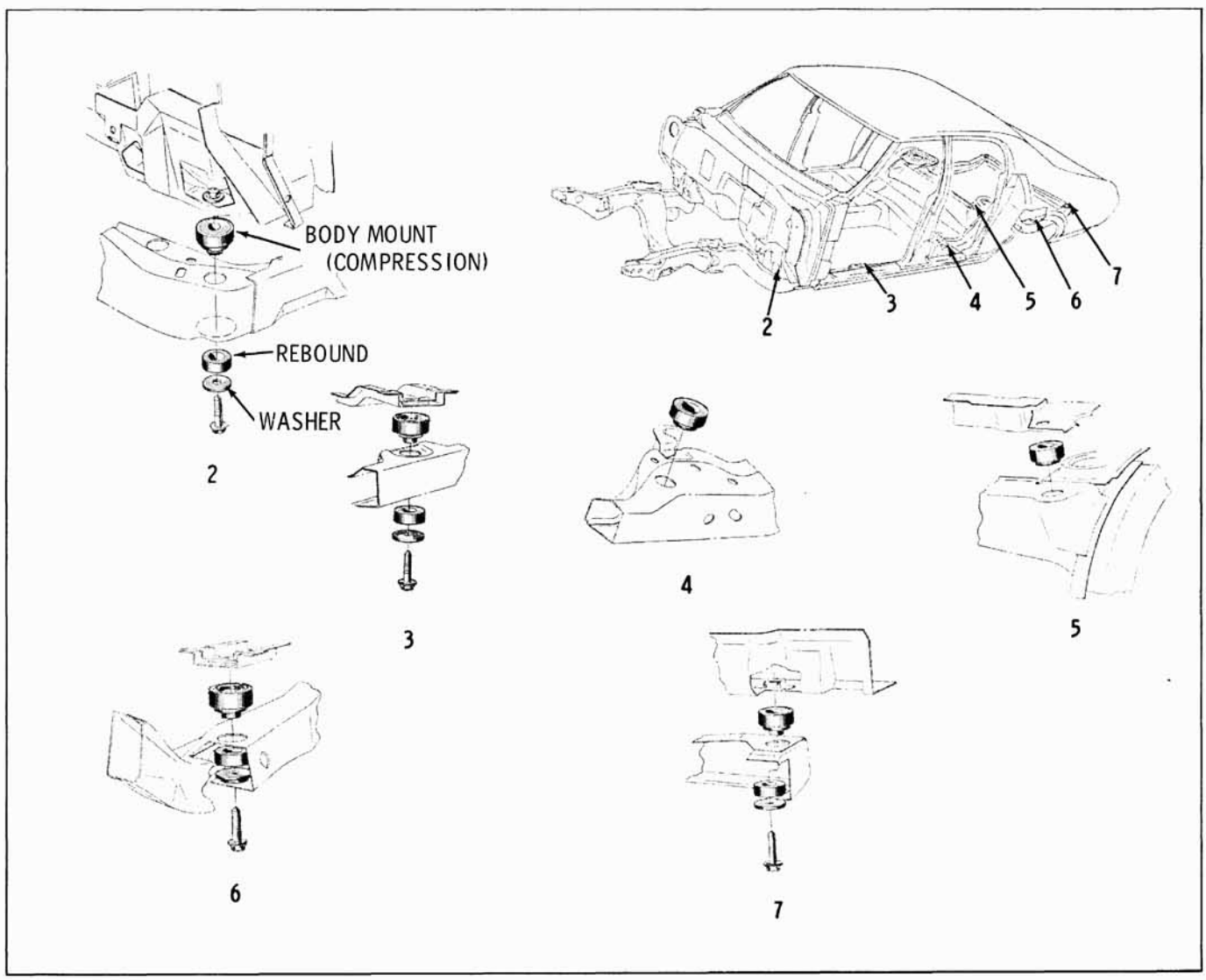


Fig 2-4—Body Mounting - 31 through 48 Series

FRONT SUSPENSION

31 THROUGH 86 SERIES

CONTENTS OF SECTION 3

If equipped with disc brakes, refer to BRAKE SECTION 5 for the removal of disc brake components in relation to front suspension.

Subject	Page	Subject	Page
PERIODIC MAINTENANCE	3-2	LOWER CONTROL ARM OR COIL SPRING	3-14
WHEEL BEARING ADJUSTMENT	3-2	LOWER CONTROL ARM BUSHINGS	3-15
HUB AND DRUM ASSEMBLY	3-2	STEERING KNUCKLE	3-16
SHOCK ABSORBER	3-5	STEERING ARM	3-17
STABILIZER	3-6	WHEEL ALIGNMENT	3-17
BALL JOINT LUBRICATION	3-7	SPRING CARRYING HEIGHT	3-19
BALL JOINT CHECKING	3-7	DIAGNOSIS	3-20
BALL JOINT REPLACEMENT	3-8	SPRING USAGE CHART	3-21
BALL JOINT SEALS	3-10	SPECIFICATIONS	3-22
UPPER CONTROL ARM	3-11	TORQUE SPECIFICATIONS	3-22
UPPER CONTROL ARM PIVOT SHAFT	3-13	TOOLS	3-23

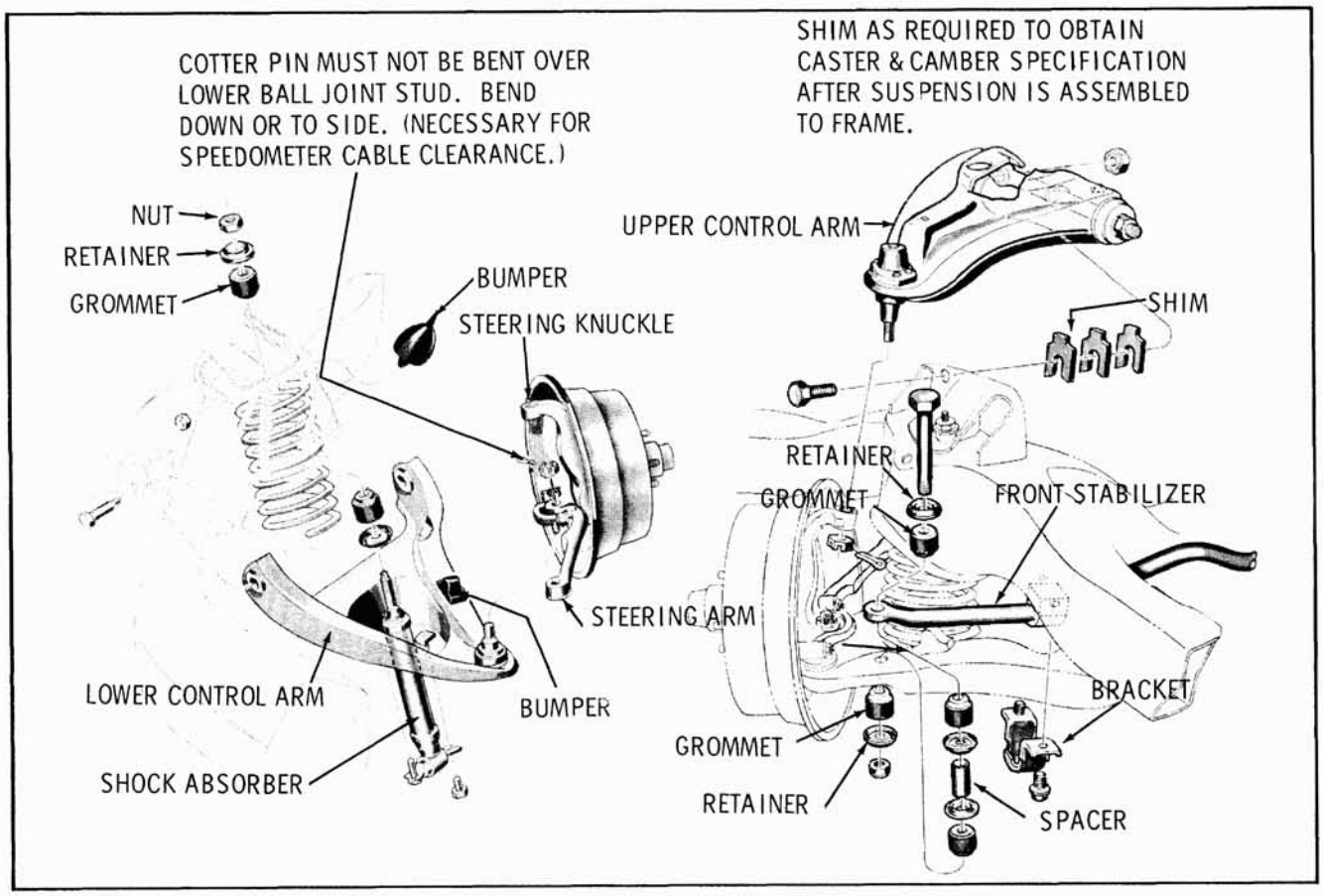


Fig. 3-1—Front Suspension 54-86 Series

	DIA.	SERIES
A	13/16"	31, 35
C	15/16"	32, 36, 42 EXC. 3667 3567, 77, 87 WITH HEAVY DUTY
B	31/32"	3667, 44 32, 36, 42 WITH A/C EXC. 3667 3667, 87 WITH HEAVY DUTY EXC. A/C
D	1"	48

E	31/32"	54 - 86
F	1"	54 WITH 350 CU. IN. HEAVY DUTY
G	1-1/32"	54 WITH 455 CU. IN. HEAVY DUTY

Fig. 3-2—Front Stabilizer Shaft Chart

FRONT SUSPENSION

PERIODIC MAINTENANCE

For ball joint seal inspection and lubrication interval, refer to PERIODIC MAINTENANCE, Section 0.

A periodic front wheel bearing repack is not required. However, when major brake service is being performed, it is recommended that the front wheel bearings be cleaned and repacked with a lithium soap, EP grease.

WHEEL BEARINGS

The proper functioning of the front suspension cannot be maintained unless the front wheel TAPER ROLLER BEARINGS are correctly adjusted. Cones must be a slip fit on the spindle and the inside diameter of cones should be lubricated to insure that the cones will creep. Spindle nut must be a free-running fit on threads.

Adjustment

1. While rotating hub and drum assembly, tighten nut to 30 ft. lbs.
2. Back off nut 1/2 turn.
3. Retighten nut finger tight and install retaining ring or cotter key if possible.

If unable to install retaining ring or cotter key, back off nut (not to exceed 1/24 of a turn) until tabs on clip align with serrations in nut.

HUB AND DRUM ASSEMBLY

Remove (Wheel Removed)

1. Remove grease cup from hub, using Tool BT-6507. Carefully remove left front cap to prevent distortion of speedometer drive coupling on 54-86 Series.
2. Remove cotter pin or retaining ring, nut and washer from spindle.
3. Carefully pull hub and drum assembly from spindle.

It may be necessary to back off the brake shoe adjustment before the hub and drum can be removed.

BEARING AND SEAL

Removal

1. Remove the roller and separator assembly from the hub.
2. Remove the outer bearing inner race from hub.
3. Pry seal from hub, then remove inner bearing, inner race and roller and separator assembly from hub.
4. If necessary to remove outer races, insert a brass drift into hub, indexing end of drift with notches in hub behind bearing outer race and tap with a hammer. (Fig. 3-6)

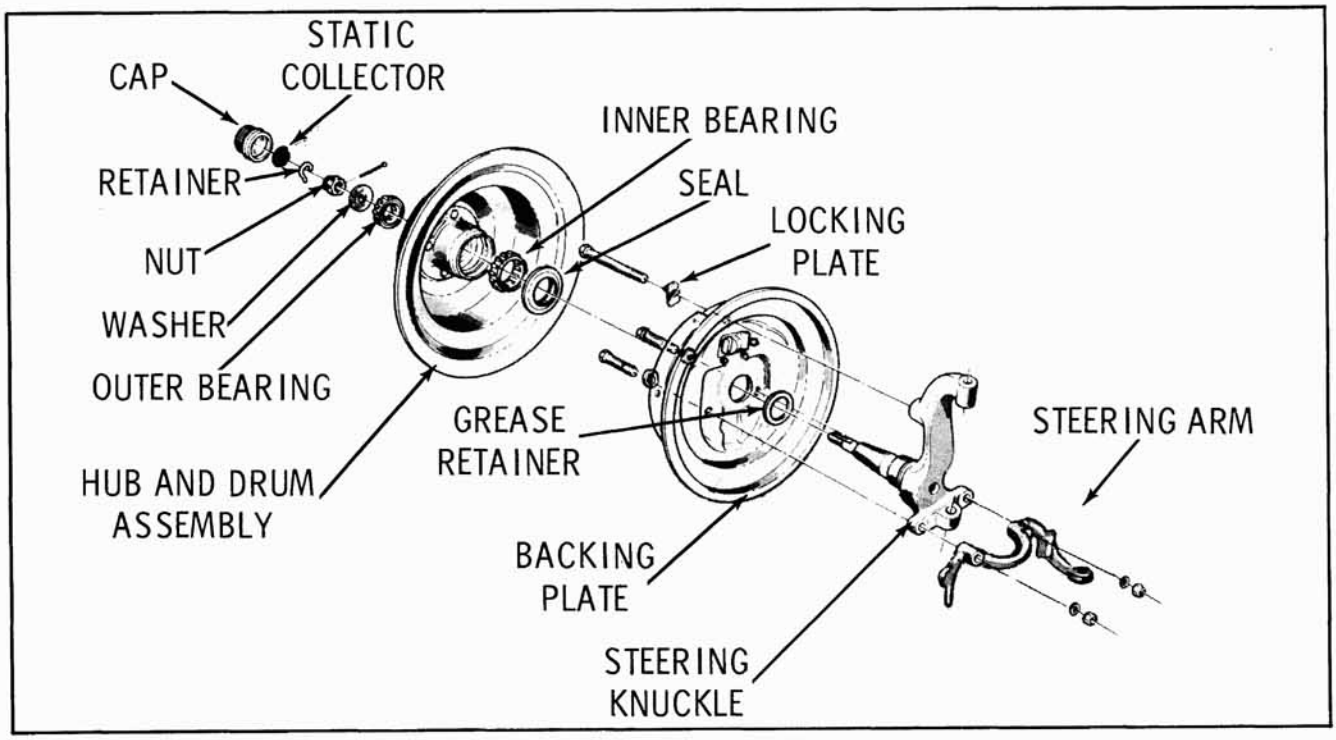


Fig. 3-3—Front Wheel Layout 54-86 Series

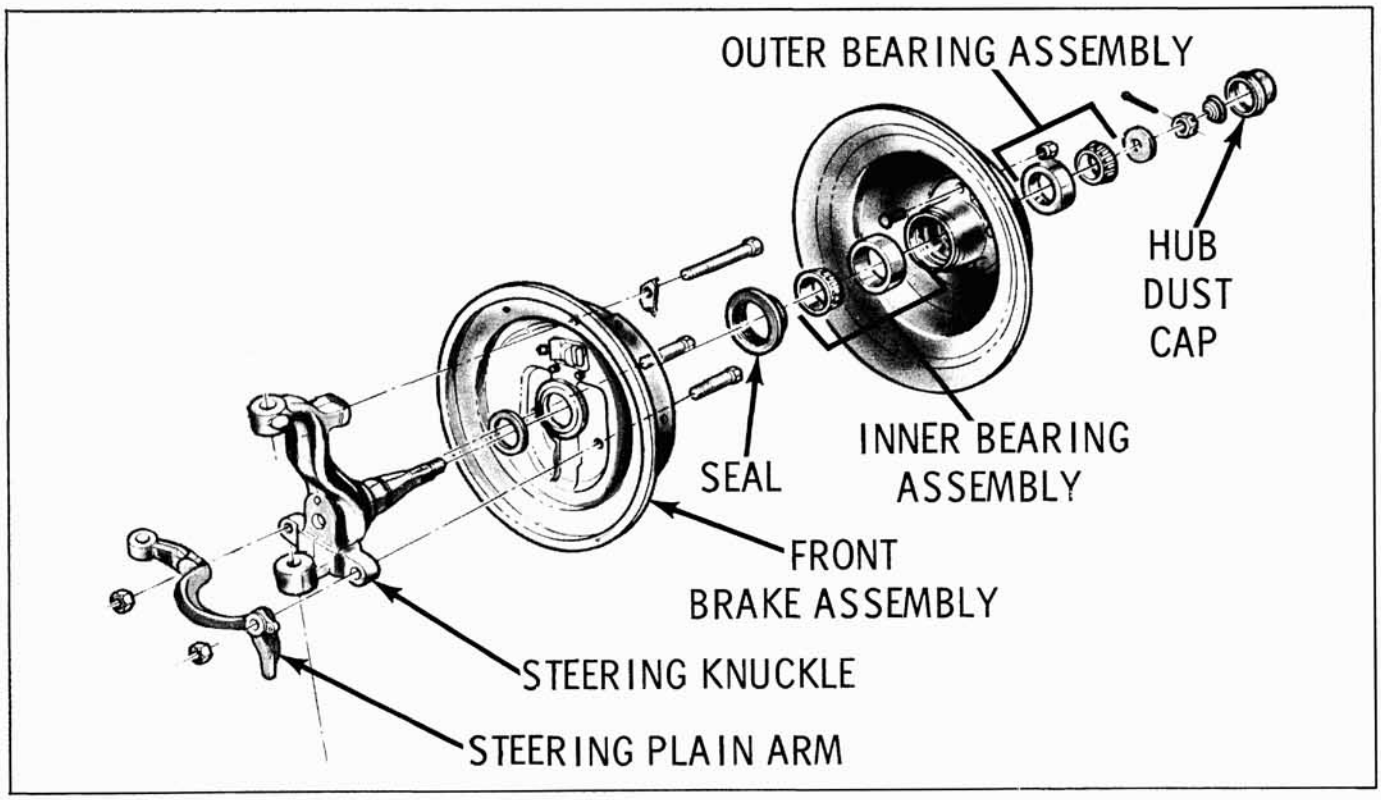


Fig. 3-4—Front Wheel Layout 31-48 Series

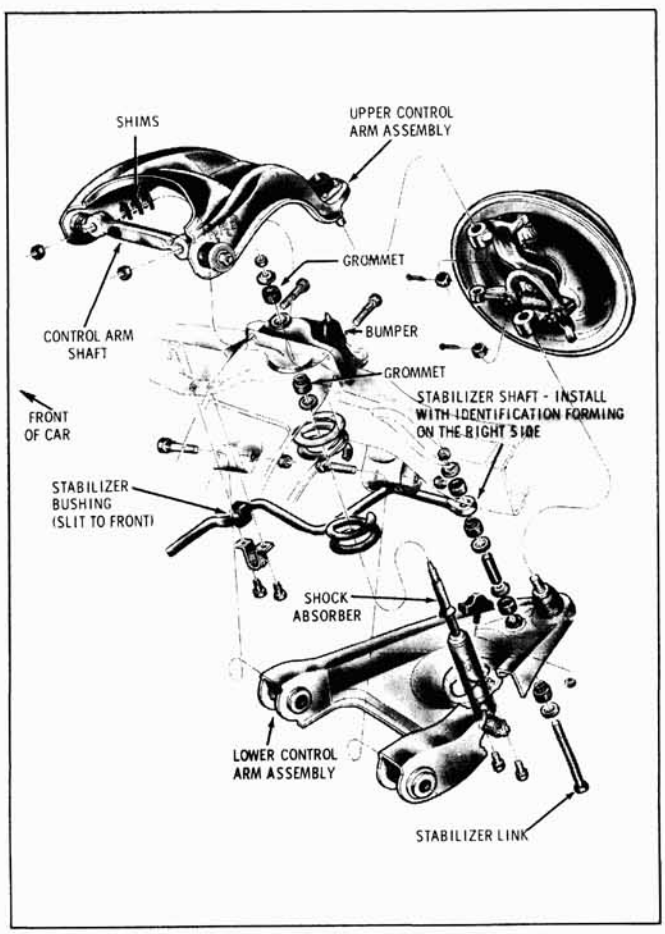


Fig. 3-5—Front Suspension 31-48 Series

Cleaning and Inspection

For inspection of front drum, refer to BRAKE DRUMS, Section 5.

1. Wash all parts in clean solvent with the exception of the roller and separator assemblies and race and air dry. Roller and separator assemblies should be washed in gasoline.
2. Check bearings for cracked separators and worn or pitted rollers.
3. Check bearing races for cracks, scores or a brinelled condition.

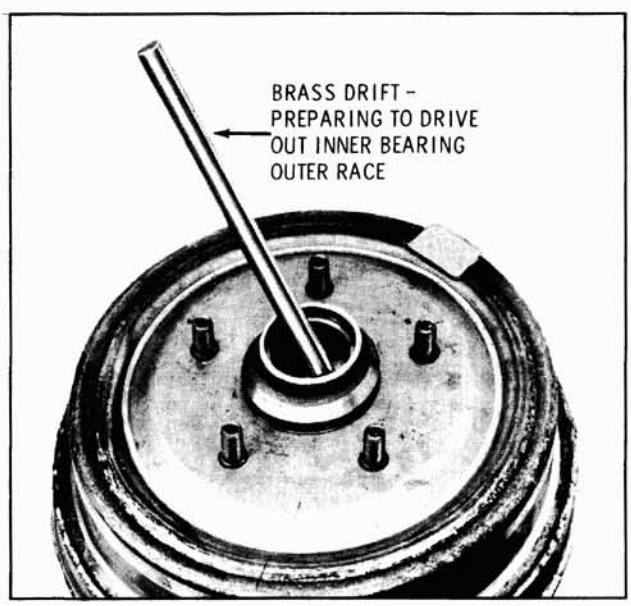


Fig. 3-6—Removing Inner Bearing Outer Race

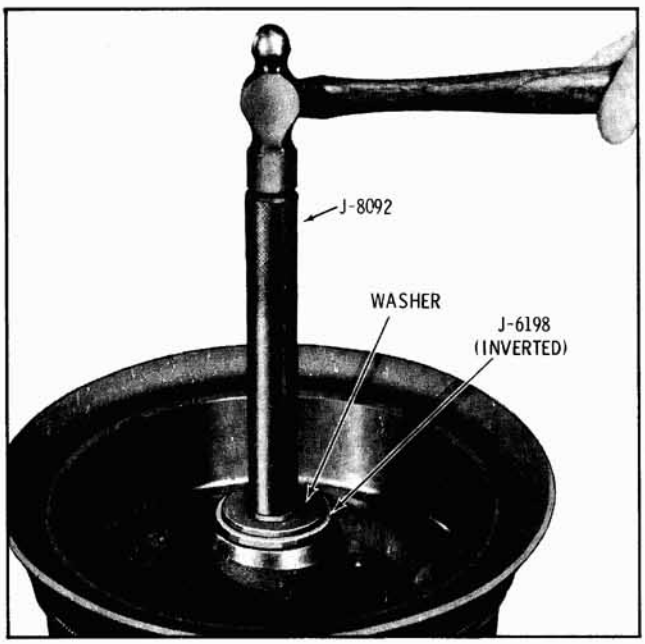


Fig. 3-7—Installing Inner Bearing Outer Race 31-48 Series

Installation

1. If the outer races were removed, drive or press the races into the hub as shown in Figs. 3-7, 3-8 and 3-9.
2. Lubricate the bores of the inner races and fully pack the roller and separator assemblies with a lithium soap, EP grease.
3. Install inner bearing roller and separator assembly into outer race, then install inner bearing inner race.
4. Carefully tap seal into hub.
5. Clean any traces of grease from brake linings and drum with fine sandpaper. If necessary to adjust brake shoes, refer to BRAKE SHOES - ADJUST, Section 5.
6. Position hub and drum assembly over spindle.
7. Install outer bearing roller and separator into hub.

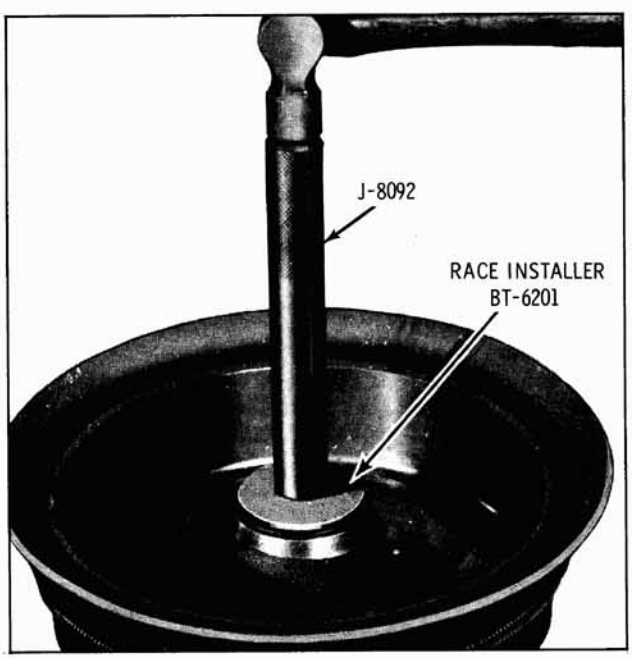


Fig. 3-8—Installing Inner Bearing Outer Race 54-86 Series

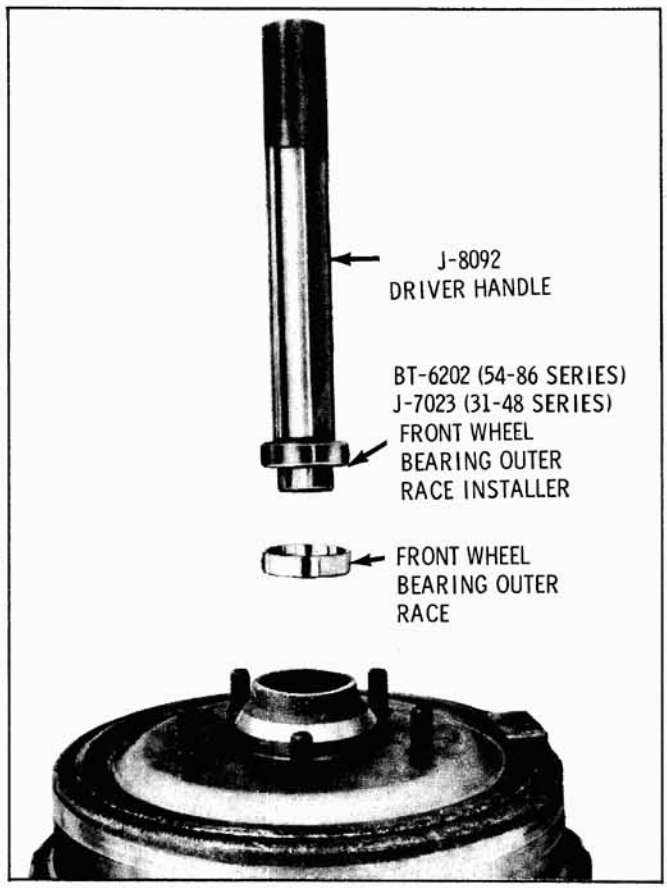


Fig. 3-9—Installing Outer Bearing Outer Race

8. Install outer bearing inner race over spindle, then install the washer and spindle nut. Draw spindle nut up snug and adjust bearings as outlined under WHEEL BEARING ADJUSTMENT.
9. Install dust cap. Tool BT-6507 can be used to install the dust cap without distortion.

HUB BOLT REPLACEMENT

1. With the hub and drum assembly removed, drill a 5/8" hole 1/4" deep into the head of the hub bolt.
2. Support hub and drum assembly and drive or press hub bolt out through the front of the hub and drum assembly.

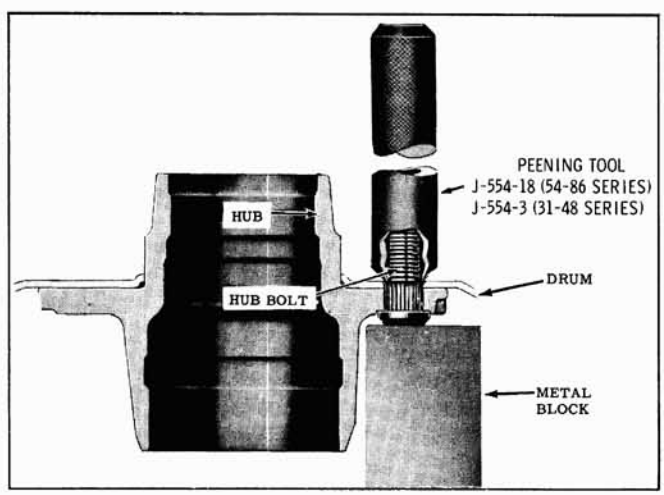


Fig. 3-10—Peening Hub Bolt

3. Press a new hub bolt into the hub.
4. While supporting hub bolt, peen hub bolt into the countersunk area of drum with the use of Peening Tool J-544-18 or -3 until the drum is secure to the hub. (Fig. 3-10)

FRONT SHOCK ABSORBER

SHOCK ABSORBER CODE AND USAGE				
SERIES OR STYLE	STD.		FEI	
	Front	Rear	Front	Rear
3100	RW	VW		
3200	VV	VW		
3539-69	RW	VW		
3567-77-87	RW	VW	RZ	KV
3535	RW	SB		
3639-69	VV	VW		
3667-77-87	VV	VW	RZ	KV
3635	VV	SB		
4200	VV	VW		
4400	RZ	KV		
4800	RY	SC		
5400-6600	RS	RT		
8400-8600	RM * RU	RN * RV		
Super Lifts Available on 3100-4200 and 4800 (Not Identified by Code Letter)				
*Second Type				

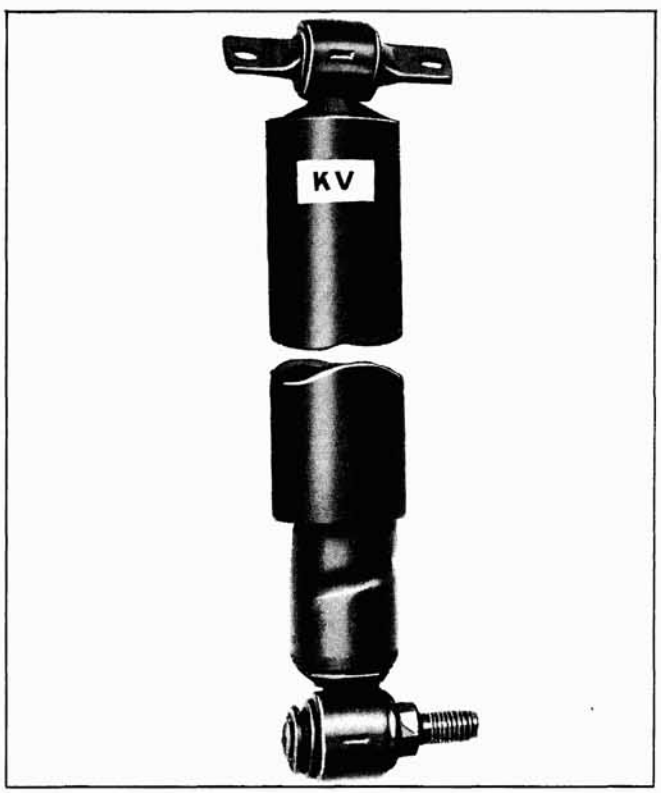


Fig. 3-11—Typical Shock Absorber Tag Location

A slight amount of fluid may bleed by the rod seal in cold weather and deposit a light film on the upper area of the shock absorber. This condition will not impair operation and should be considered normal. A shock absorber should never be checked horizontally or with the rod extension down.

For a complaint of a noisy or defective shock absorber, first check the mounting torque. If mounting is satisfactory, disconnect the lower mountings and pump the shock absorber by hand in a vertical position. Compare both shock absorbers. If both shock absorbers respond the same, it is unlikely that a defective shock absorber exists.

Thumping Noise

A thumping noise usually occurs when a shock absorber is changing its direction of stroke.

1. The shock absorber should be pumped with a rapid change of stroke. If lag is felt when changing stroke, this unit will be noisy.
2. Completely extend the shock absorber and pull hard. If spring tension is felt, the shock absorber will be noisy and should be replaced.

SQUEAKY OR REED TYPE NOISE

Hand pump the shock absorber at different rates of speed. If noise is heard that changes from a deep grunt to a high-pitched squeak, the shock absorber needs replacement.

A squeaking noise could be attributed to seals. This is particularly true if the shock absorber has not been operating for a period of time. This noise will disappear after a few strokes of the shock absorber and is not a cause for rejection.

Remove and Install

1. Remove the two bolts attaching shock absorber to the lower control arm.
2. Remove upper nut, retainer and grommet from shock absorber. (Fig. 3-12)

Use a special socket such as BT-6515 to aid in removal of the shock absorber upper nut. Hold the nut with a short box wrench, turn the shock absorber with the special socket and remove shock absorber from the car

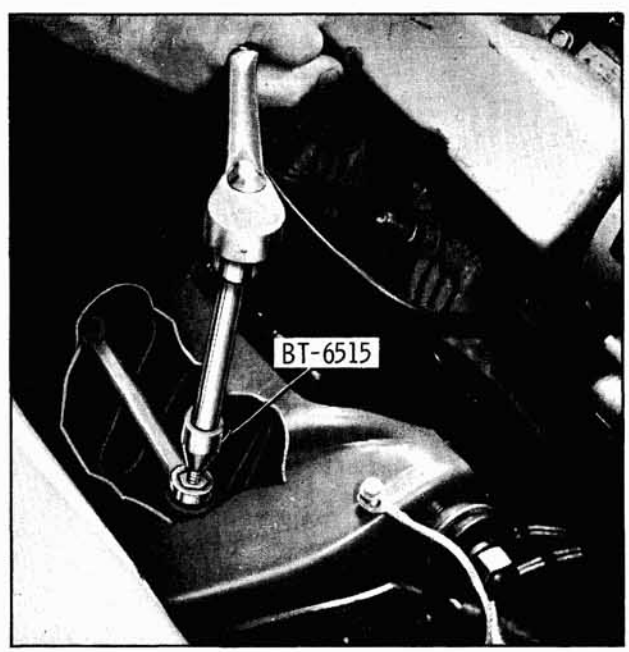


Fig. 3-12—Removing Shock Absorber Upper Attaching Nut

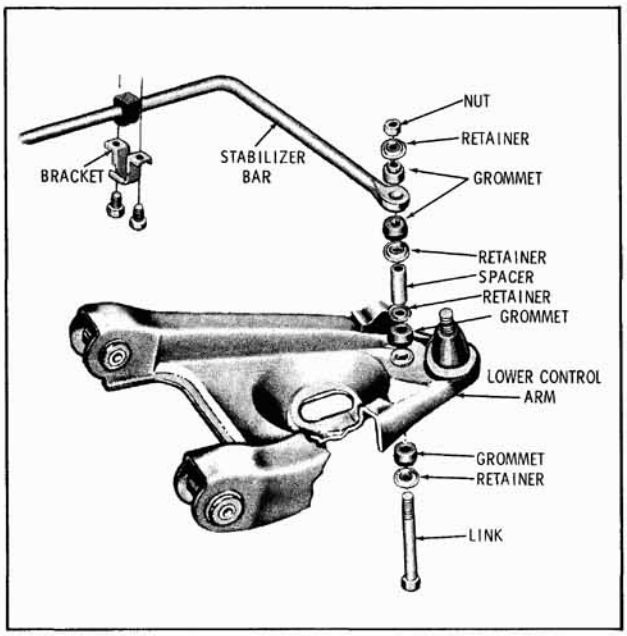


Fig. 3-13—Stabilizer Shaft and Linkage - 31-48 Series

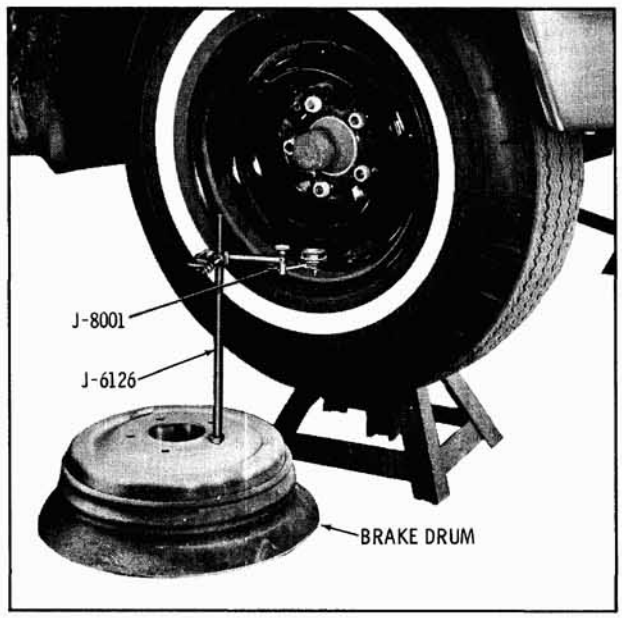


Fig. 3-15—Ball Joint Vertical Check

To install shock absorber, reverse sequence of operations. Torque the upper nut to 7 ft. lbs. and the lower bolts to 20 ft. lbs.

STABILIZER SHAFT—54-86 SERIES

Remove and Install (Fig. 3-14)

1. Disconnect each side of stabilizer linkage by removing nut from link bolt, pull bolt from linkage and remove retainer, grommets and spacer.
2. Remove crankshaft pulley and one wheel and tire assembly.
3. Remove bracket to frame bolts and remove stabilizer shaft, rubber bushings and brackets.
4. To install, reverse sequence of operations. The rubber bushings should be positioned squarely in the brackets with the slit in the bushings facing the front of the car. Torque stabilizer link nut and the bracket bolts to 10 ft. lbs. with weight of car on wheels. If 5/16" production bracket bolt strips, it can be replaced with a 3/8" service bolt.

STABILIZER SHAFT—31-48 SERIES

Remove and Install (Fig. 3-13)

1. Disconnect each side of stabilizer linkage by removing nut from link bolt, pull bolt from linkage and remove retainers, grommets and spacer.
2. Remove bracket to frame bolts and remove stabilizer shaft, rubber bushings and brackets.
3. To replace, reverse sequence of operations, being sure to install with the identification forming on the right side of the car. The rubber bushings should be positioned squarely in the brackets with the slit in the bushings facing the front of car. Torque stabilizer link nut and bracket bolts to 10 ft. lbs.

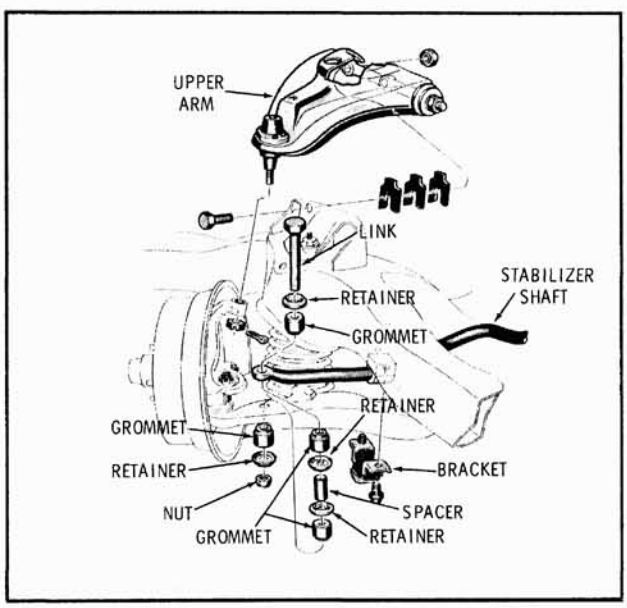


Fig. 3-14—Stabilizer Shaft and Linkage - 54-86 Series

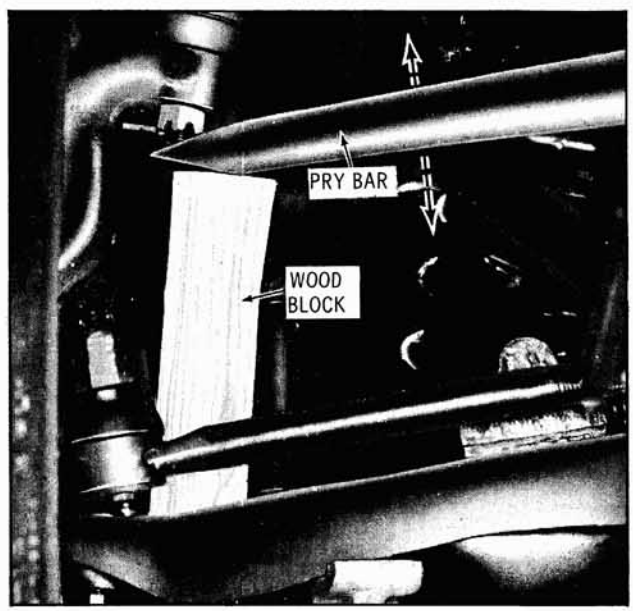


Fig. 3-16— Pry Bar Installation

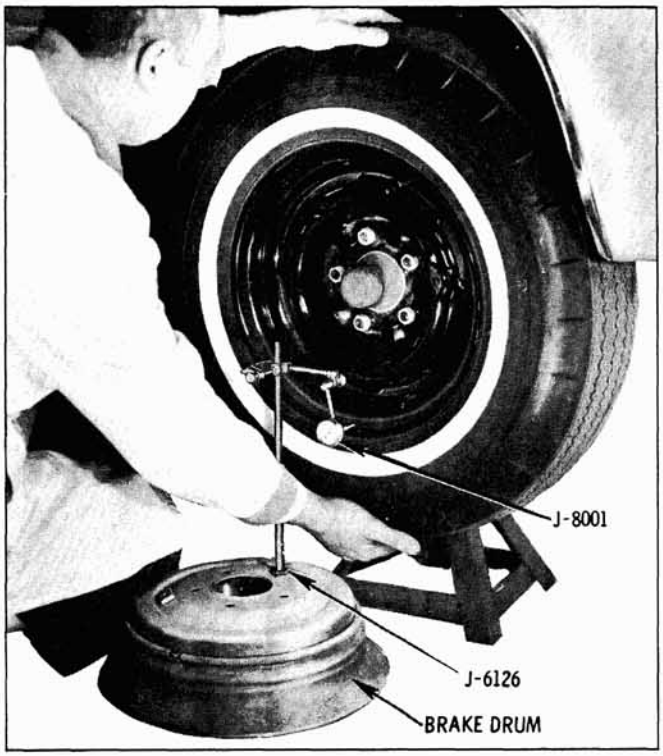


Fig. 3-17— Ball Joint Horizontal Check

If 5/16" production bracket bolt strips, it can be replaced with a 3/8" service bolt.

BALL JOINTS

Lubrication

For ball joint seal inspection and lubrication interval, refer to PERIODIC MAINTENANCE, Section 0.

Checks

Before checking ball joints, the wheel bearings must first be properly adjusted. To check the steering linkage and steering gearlash, refer to STEERING, Section 9.

Fig. 3-18—Disconnecting Lower Ball Joint

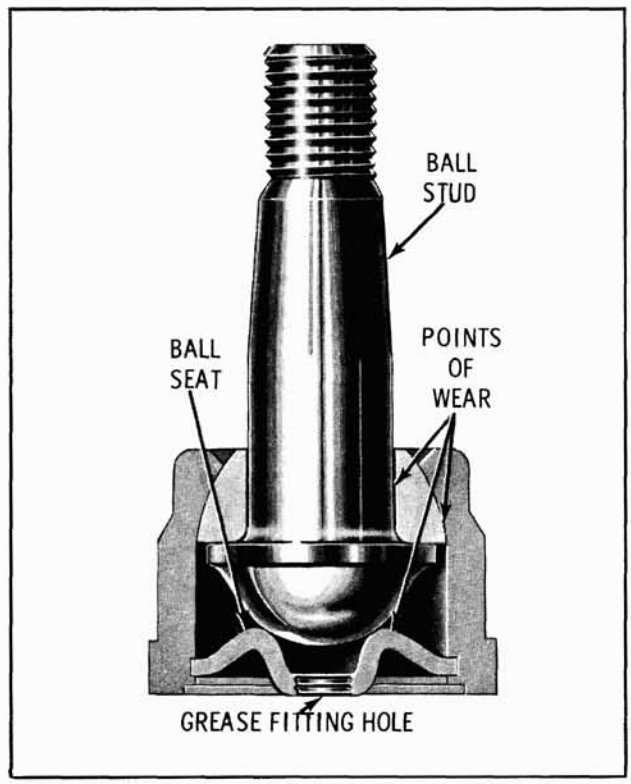


Fig. 3-19—Saginaw Lower Ball Joint

Vertical Check

1. Raise the car and position floor stands under the left and right lower control arm as near as possible to each lower ball joint. Car must be stable and should not rock on the floor stands.
2. Position dial indicator as shown in Fig. 3-15.
3. ALL SERIES - Place a 2 x 4 (approx. 6") vertically on the lower control arm and pry on the upper end of the steering knuckle as shown in Fig. 3-16.
4. Move pry bar gently up and down and observe vertical deflection on dial indicator. Reading must not exceed .125".
5. Repeat Steps 2, 3 and 4 on opposite ball joint.

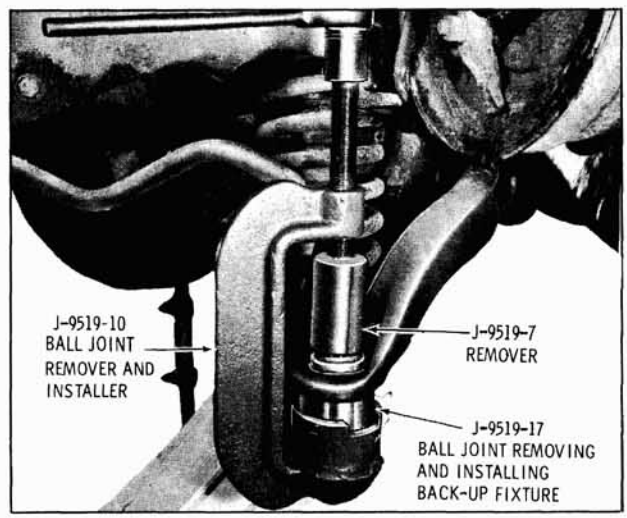


Fig. 3-20—Removing Lower Ball Joint - 31-48 Series

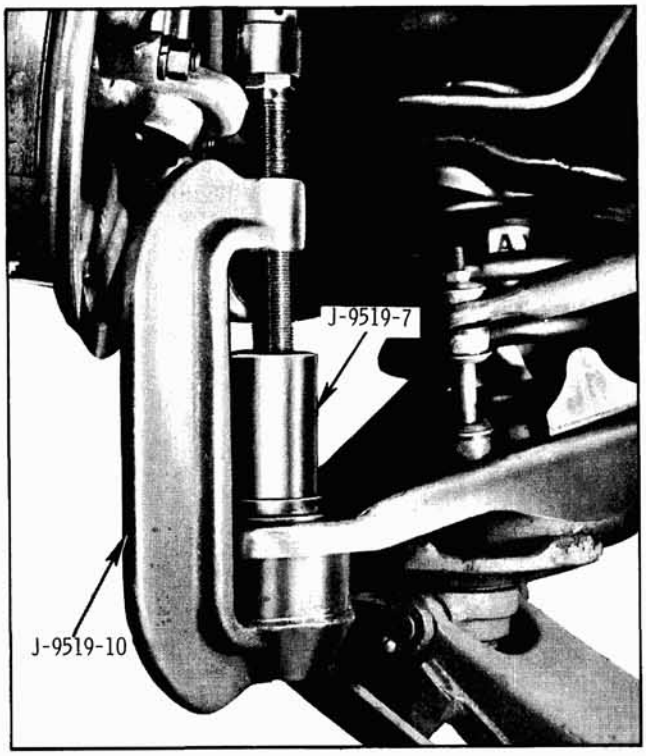


Fig. 3-21—Removing Lower Ball Joint - 54-86 Series

Horizontal Check

1. Place car on floor stands as outlined in Step 1 of the VERTICAL CHECK.
2. Position dial indicator as shown in Fig. 3-17.
3. Grasp front wheel as shown in Fig. 3-17 and push in on bottom of tire while pulling out at the top. Read gauge, then reverse the push-pull procedure. Horizontal deflection on gauge should not exceed .125" at the wheel rim. This procedure checks both the upper and lower ball joints.
4. Repeat Steps 2 and 3 on the opposite ball joint.

BALL JOINT

Removal—Lower

1. Raise car, support with floor stands under frame.

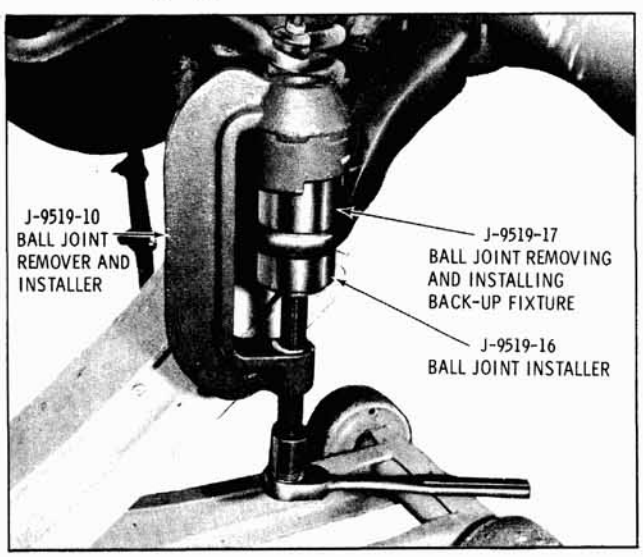


Fig. 3-22—Installing Lower Ball Joint - 31-48 Series

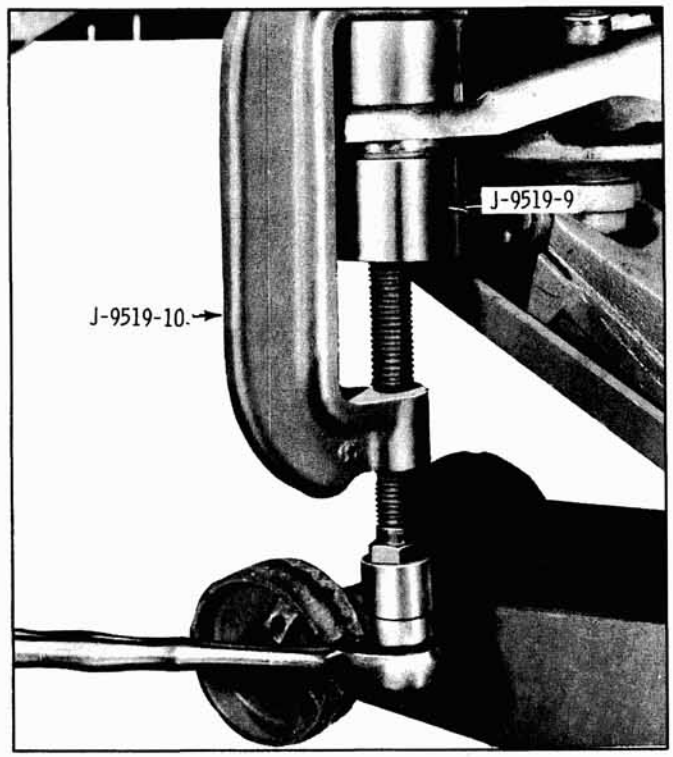


Fig. 3-23—Installing Lower Ball Joint - 54-86 Series

2. Remove tire and wheel assembly.
3. Place floor jack under control arm spring seat.
4. To disconnect the lower control arm ball joint from the steering knuckle:
   a. Remove the cotter pin from ball joint stud. Tool J-8806 can be used as shown in Fig. 3-18 to break the ball joint loose from knuckle.
5. After studs break loose, raise control arm to relieve spring tension, then remove stud nut.

If interference is encountered between the ball joint and the backing plate, it will be necessary to loosen

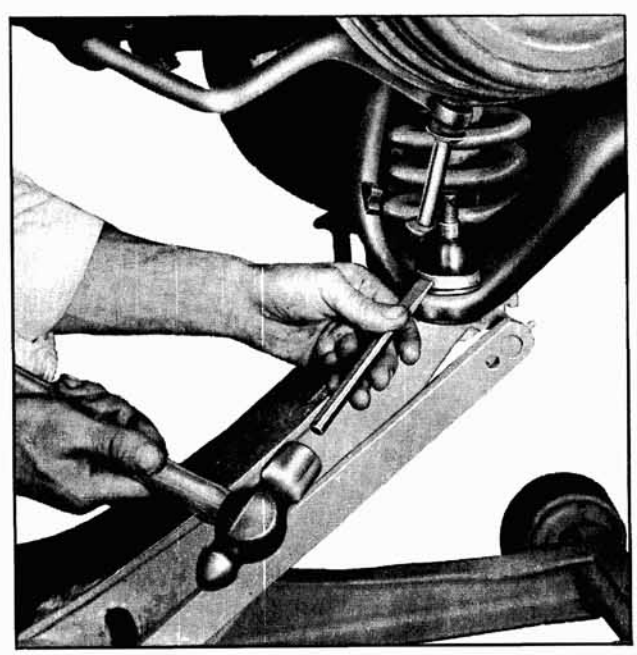


Fig. 3-24—Removing Saginaw Lower Ball Joint Seal

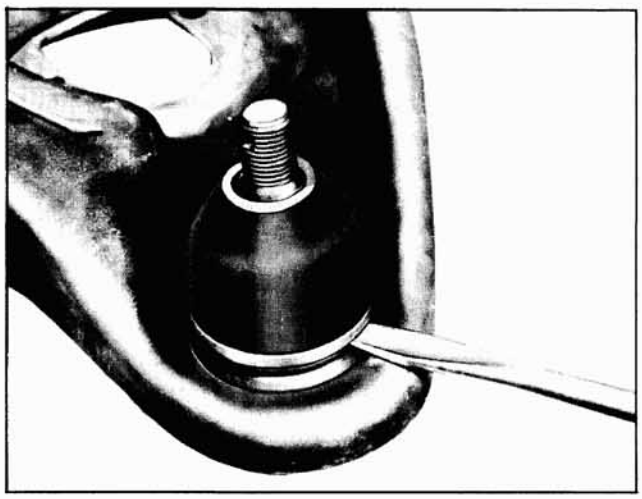


Fig. 3-25—Removing Inland Lower Ball Joint Seal

the backing plate bolts slightly to obtain the necessary clearance.

6. Block brake assy. out of the way by placing a wooden block between frame and upper control arm.

Remove ball joint seal by prying off retainer with a screwdriver or driving off with a chisel as shown in Fig. 3-24 or 3-25.

7. Remove grease fittings, if any, and install tools as shown in Figs. 3-20 and 3-21 and remove lower ball joint from lower control arm.

Installation—Lower

1. Position ball joint into lower control arm and press in until it bottoms on the control arm, using tools as illustrated in Figs. 3-22 and 3-23.

2. Install new ball joint seal and retainer as shown in Figs. 3-26 and 3-27.

Grease purge on seal must be located facing inboard on disk brake equipped cars.

3. 31 - 48 Series - Install ball joint stud into steering knuckle. Torque nut 40 ft. lbs. (min.) and install cotter pin.

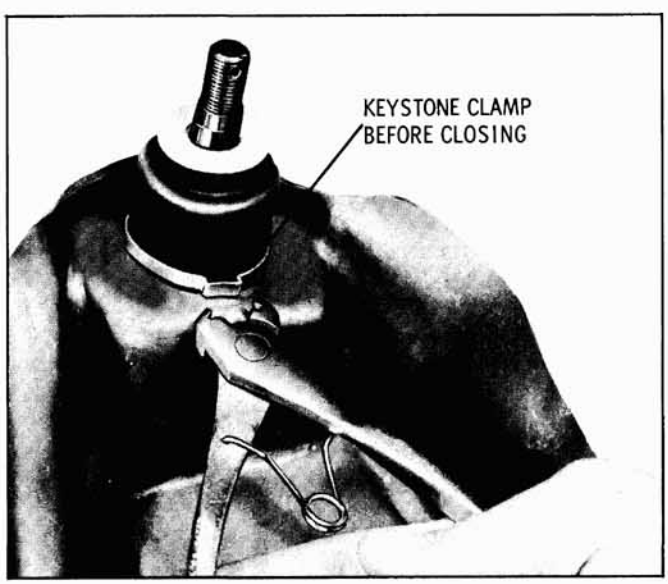


Fig. 3-26—Installing Saginaw Ball Joint Seal

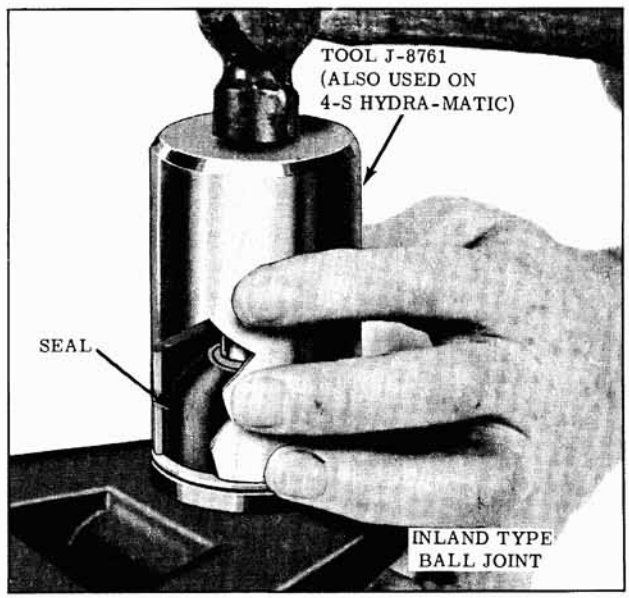


Fig. 3-27—Installing Inland Ball Joint Seal

4. 54 - 86 Series - Reassemble suspension and torque ball joint stud nut to 70 ft. lbs. (min.) and install cotter pin. Bend cotter pin to side of nut, not over top.

Tighten backing plate attaching bolts if necessary.

5. Install and lubricate ball joint fitting until grease appears at the seal.

6. Install tire and wheel assembly.

Removal—Upper

1. Refer to UPPER CONTROL ARM - Removal, and remove upper control arm.

2. Clamp control arm in a vise and drill four rivet heads 1/4" deep using an 1/8" diameter drill. (Fig. 3-28)

3. Drill off rivet heads using a 1/2" diameter drill. (Fig. 3-29)

4. Punch out rivets using a small punch, and remove ball joint. (Fig. 3-30)

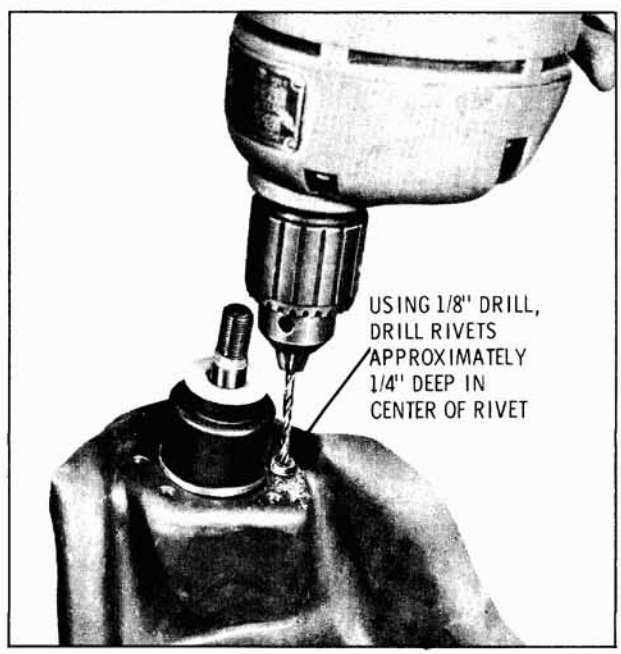


Fig. 3-28—Drilling Upper Ball Joint Attaching Rivets

Fig. 3-29—Drilling Upper Ball Joint Rivets

Installation—Upper (Fig. 3-31)

1. Position new ball joint in control arm and install the four attaching bolts. Torque nuts to 8 ft. lbs.
2. Refer to UPPER CONTROL ARM - Installation, and install upper control arm.

BALL JOINT SEALS (LOWER)

The ball joint seal can be installed with the control arm either on or off the car.

Removal

1. Raise car, support with floor stands under frame.
2. Remove tire and wheel assembly.
3. Place floor jack under control arm.

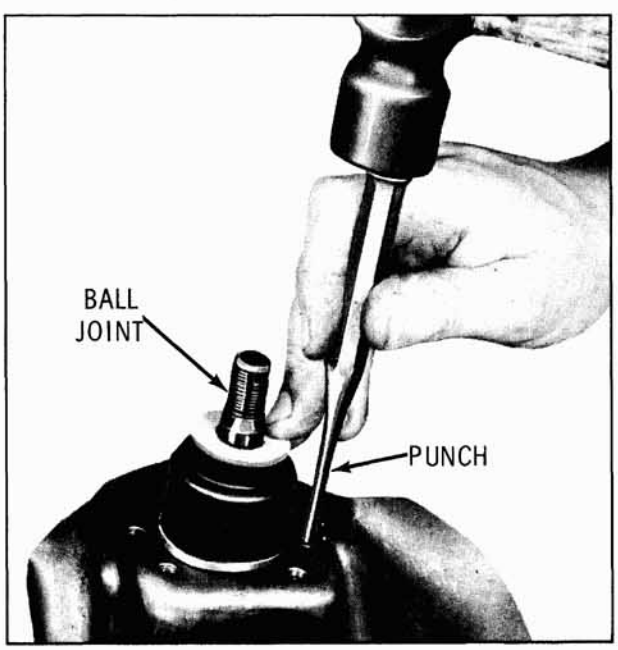


Fig. 3-30—Removing Upper Ball Joint

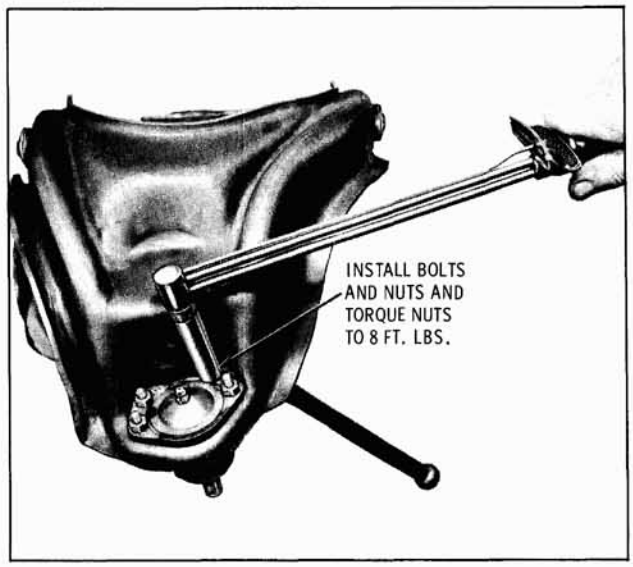


Fig. 3-31—Installing Upper Ball Joint

4. Remove cotter pin and remove the nut to clean the threads. (REINSTALL THE NUT, LEAVING IT APPROXIMATELY TWO TURNS LOOSE).
5. Remove ball joint stud from steering knuckle as shown in Fig. 3-18 and described under BALL JOINTS - Removal.
6. Remove the seal by prying off retainer with a screwdriver or driving it off with a chisel. (Figs. 3-24 and 3-25)
7. Wipe grease from ball joint and stud.

Installation

1. Position new seal and retainer squarely over the ball joint stud and install as shown in Figs. 3-26 and 3-27.

Grease purge on seal must face inboard on car.

2. 31 - 48 Series - Install the ball joint stud through the steering knuckle. Install ball joint nut. Torque nut 40 ft. lbs. (min.) and install cotter pin.
3. 54 - 86 Series - Torque lower stud nut to 70 ft. lbs. and install cotter pin. Tighten further, if necessary, to install cotter pin. Bend cotter pin to side of nut, not over top so it will not contact speedometer cable.
4. Lubricate the ball joint fitting until grease appears at the seal.
5. Install tire and wheel assembly.

BALL JOINT SEALS (UPPER)

Removal

1. Refer to "Upper Control Arm" - Removal and remove upper control arm.
2. Clamp control arm in a vise and drill four rivet heads 1/4" deep using an 1/8" diameter drill. (Fig. 3-28)
3. Drill off rivet heads using a 1/2" diameter drill. (Fig. 3-29)
4. Punch out rivets using a small punch and remove ball joint. (Fig. 3-30)
5. Bend retaining tangs from ball joint and remove seal.

Installation

1. Position new seal on ball joint and bend retaining tangs against joint securely.
2. Position ball joint in control arm and install the four attaching bolts and nuts. Torque to 8 ft. lbs.
3. Refer to "Upper Control Arm" - Installation and install upper control arm.

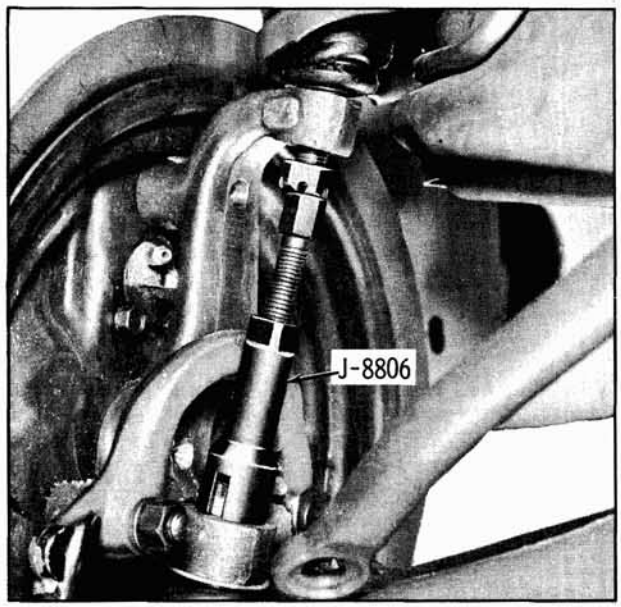


Fig. 3-32—Loosening Upper Ball Joint

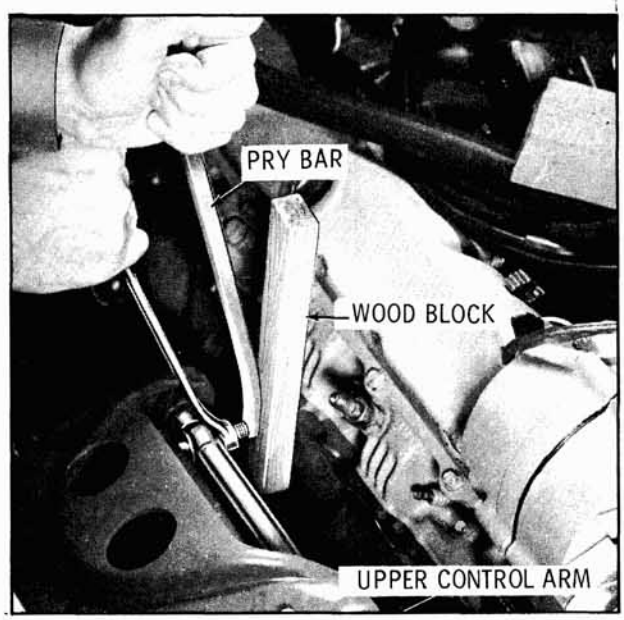


Fig. 3-34—Removing Upper Control Arm Bolts

UPPER CONTROL ARM—31-48 SERIES

The upper control arm is attached to the frame by a cross shaft and bushings on the inner end and a ball joint on the outer end which is attached to the steering knuckle.

Removal

1. Raise car and place floor stands under frame.
2. Remove tire and wheel assembly.
3. Place floor jack under lower control arm spring seat.
4. Remove ball joint stud from steering knuckle as shown in Fig. 3-32 and described under BALL JOINTS - Removal.
5. Support hub assembly.
6. Remove pivot shaft to frame attaching nuts and remove shims. Remove upper control arm assembly by sliding shaft off end of bolts in frame.

Alignment shims are to be installed in the same position from which they were removed.

Installation

1. Attach arm assembly to frame using original shims. Torque nuts to 55 ft. lbs.
2. Install ball joint stud into the steering knuckle. Torque nut 40 ft. lbs. (min.) and install cotter pin.
3. Lubricate ball joint fitting until grease appears at the ball joint seal.
4. Install hub and drum assembly and tire and wheel assembly.

Fig. 3-33—Loosening Upper Control Arm Bolts

UPPER CONTROL ARM—54-86 SERIES

Removal

1. Raise front of car and support lower control arm with floor stands.

Since the weight of the car is used to relieve spring tension on the upper control arm, the floor stands must be positioned between the spring seats and ball joints of the lower control arms for maximum leverage.

2. Remove wheel and front wheel speedometer cable from knuckle if so equipped, then loosen the upper ball joint from the steering knuckle as follows:

a. Remove the cotter pin from the upper ball joint stud and clean threads of stud.

b. Loosen the upper ball joint nut and install Tool J-8806 as shown in Fig. 3-32.

It may be necessary to grind about 3/32" off of Tool J-8806 where tool contacts the steering arm. It may be necessary to remove cotter pin so tool can be positioned correctly after grinding.

c. Apply pressure on stud by expanding the tool until the stud breaks loose.

d. Remove Tool J-8806 and upper ball joint nut, then pull stud free from knuckle. Support the hub and drum to prevent weight of the assembly from damaging the brake hose.

3. Disconnect ground strap from control arm.
4. Loosen pivot shaft to frame attaching nuts and remove alignment shims.

Alignment shims are to be installed in the same position from which they were removed.

It is necessary to remove the upper control arm attaching bolts to allow clearance to remove upper

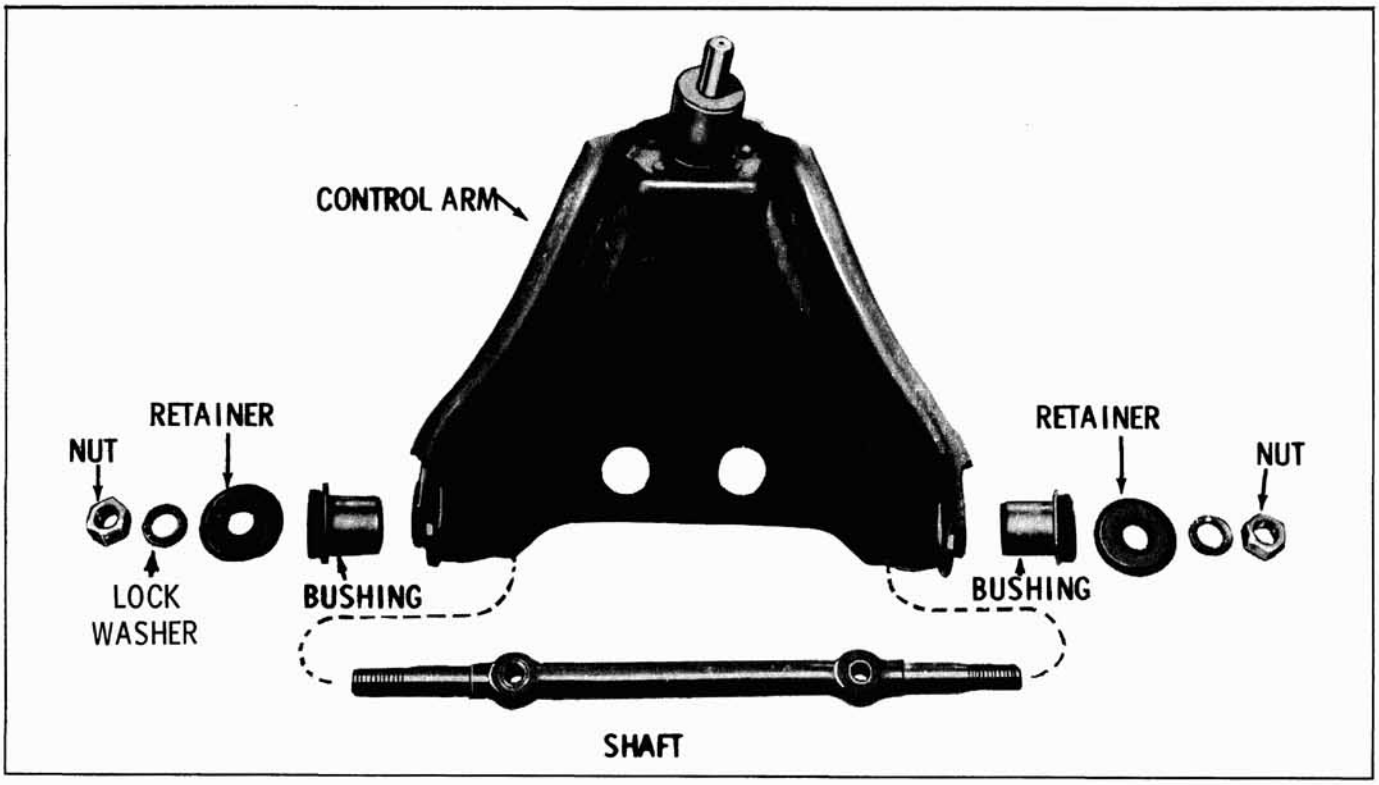


Fig. 3-35—Upper Control Arm Assembly - 54-86 Series

control arm assembly. The attaching bolts are splined into the frame, to remove, proceed as follows:

a. Tap bolt down as shown in Fig. 3-33.
b. Using a box wrench, pry bolt up.
c. Remove nut and using a suitable pry bar and block of wood, pry bolts from the frame as shown in Fig. 3-34.
5. Remove control arm from the car.

Install

1. Position attaching bolts loosely in the frame and install pivot shaft on the attaching bolts.
2. Using a free running nut instead of the regular locknut, tighten both nuts until serrated bolts are reseated.
3. Remove free running nuts and install the regular lock nuts.
4. Install alignment shims between the pivot shaft and frame on their respective bolts. Torque nuts to 75 ft. lbs.
5. Remove the temporary support from the hub and drum, then connect ball joint to steering knuckle. Torque nut to 40 ft. lbs. (min.) and install cotter pin. Attach ground strap to control arm.
6. Install speedometer cable and wheel, then check wheel alignment and adjust if necessary.

UPPER CONTROL ARM PIVOT SHAFT BUSHING REPLACEMENT—54-86 SERIES

1. Remove upper control arm assembly from the car.
2. Remove nuts from ends of pivot shaft. (Fig. 3-35)
3. Position control arm assembly and tools in a press as shown in Fig. 3-36 and press bushing out of control arm.
4. Repeat Step 3 on other bushing.
5. To install bushings, place pivot shaft in control arm and

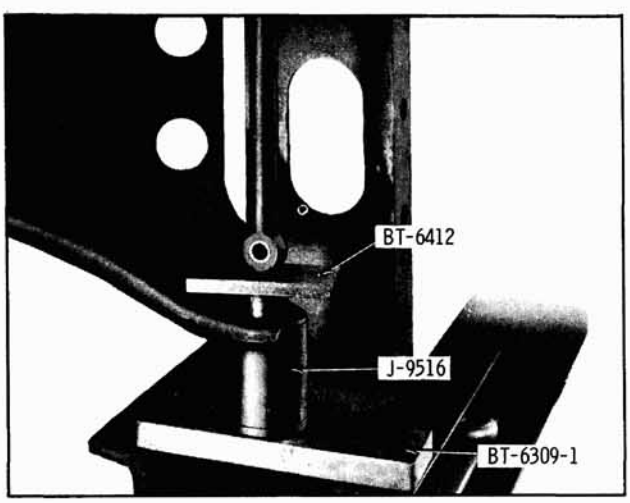


Fig. 3-36—Removing Upper Control Arm Bushings - 54-86 Series

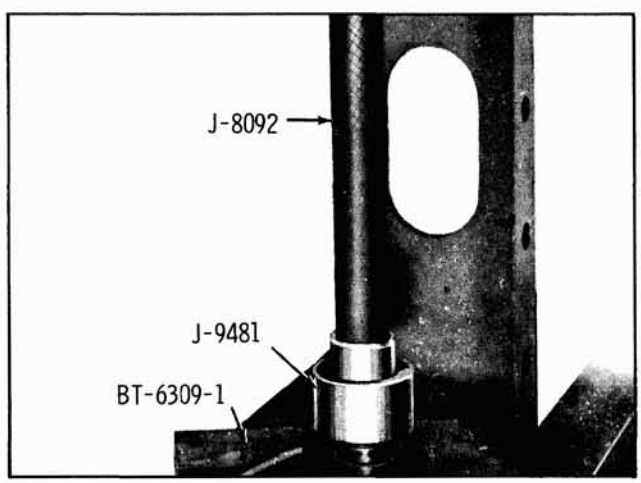


Fig. 3-37—Installing Upper Control Arm Bushing - 54-86 Series

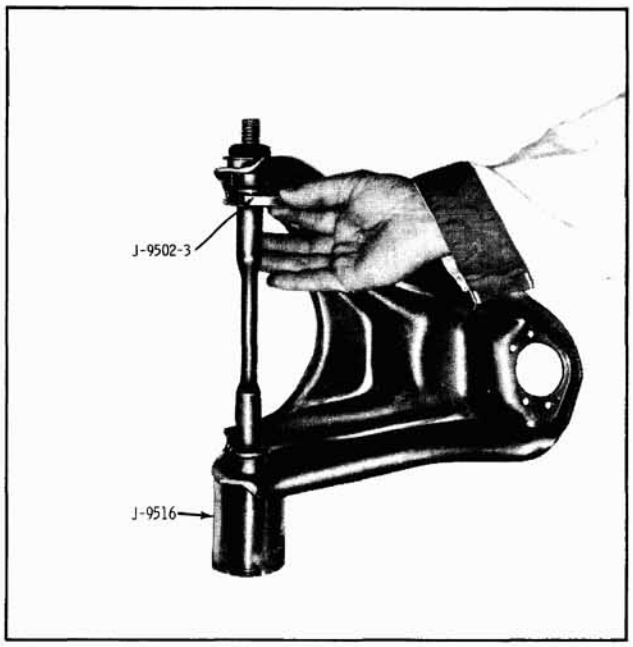


Fig. 3-38—Installing "C" Washer - 31-48 Series

press new bushing into control arm and over end of pivot shaft. (Fig. 3-37)

6. Repeat Step 5 on other bushing.
7. Assemble nuts to ends of pivot shaft.
8. Install the upper control arm assembly on the car. With weight of car on the wheels, torque pivot shaft nuts to 55 ft. lbs. Check front end alignment and adjust if necessary.

UPPER CONTROL ARM SHAFT AND BUSHING SERVICE—31-48 SERIES

The upper control arm bushings or shaft and bushings may be replaced. The shaft cannot be replaced without replacing the bushings.

Removal

1. Refer to UPPER CONTROL ARM - Removal, and remove upper control arm.
2. Remove bushing nuts. Set up arm in press as shown in Fig. 3-38. Press on shaft until "C" washer J-9502-3 can be inserted.
3. Remove arm from press and set up arm in press as shown in Fig. 3-39. The bushing can now be removed by pressing it into the Back-Up Tool J-9516.
4. To remove the other bushing, set up arms as shown in Fig. 3-40 and press bushing into the Back-Up Tool J-9516.

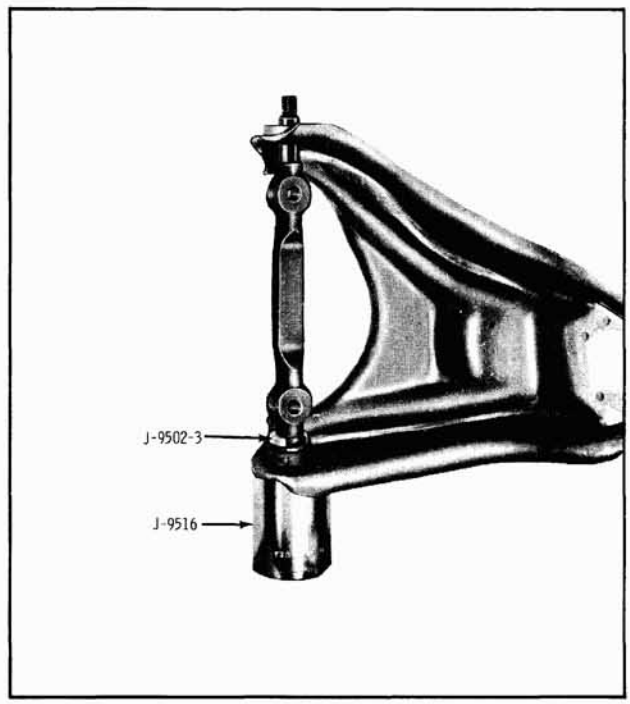


Fig. 3-40—Bushing Removal - 31-48 Series

Installation

1. Place arm in press as shown in Fig. 3-41, using J-21474-3 and 4 as a spreader to prevent distorting the control arm.

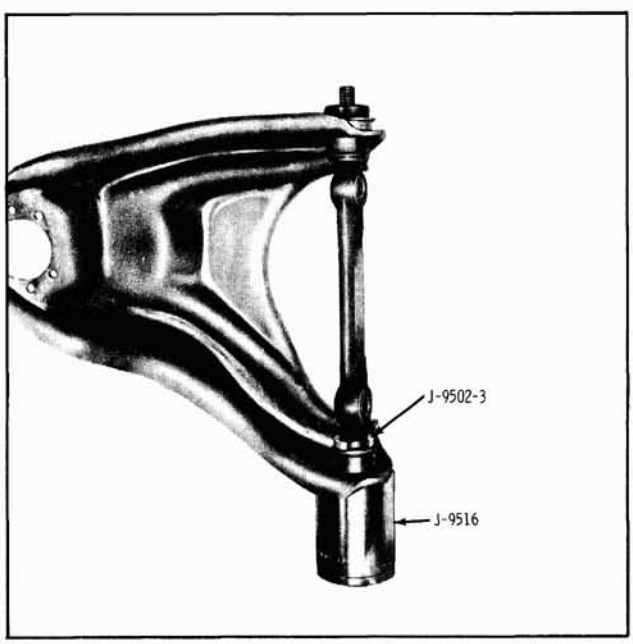


Fig. 3-39—Bushing Removal - 31-48 Series

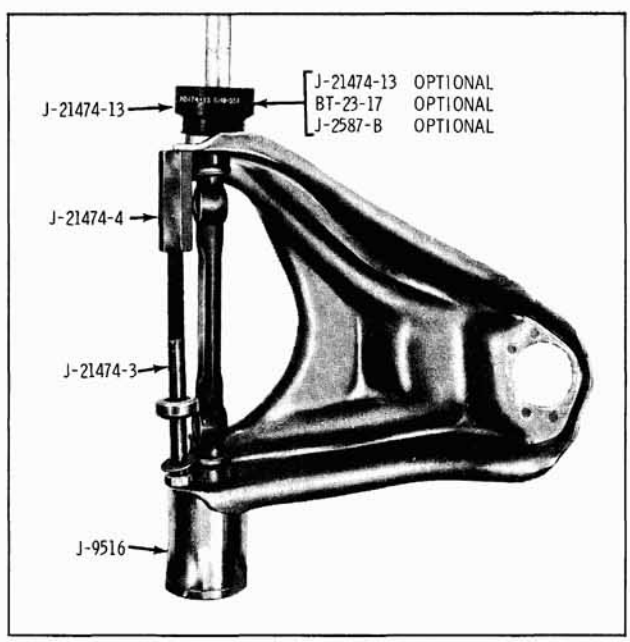


Fig. 3-41—Bushing Installation - 31-48 Series

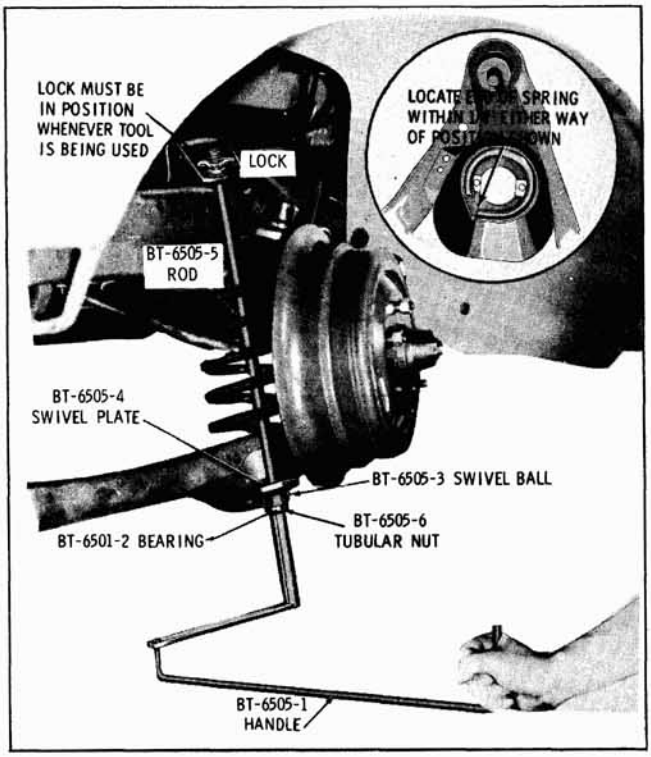


Fig. 3-42—Front Coil Spring Compressor - 54-86 Series

2. Press bushing in until it bottoms on control arm.
3. Turn arm over and install the other new bushing in the same manner.
4. Install the bushing loosely.
5. Refer to UPPER CONTROL ARM - Installation, and install control arm.

LOWER CONTROL ARM OR COIL SPRING—ALL SERIES

Removal

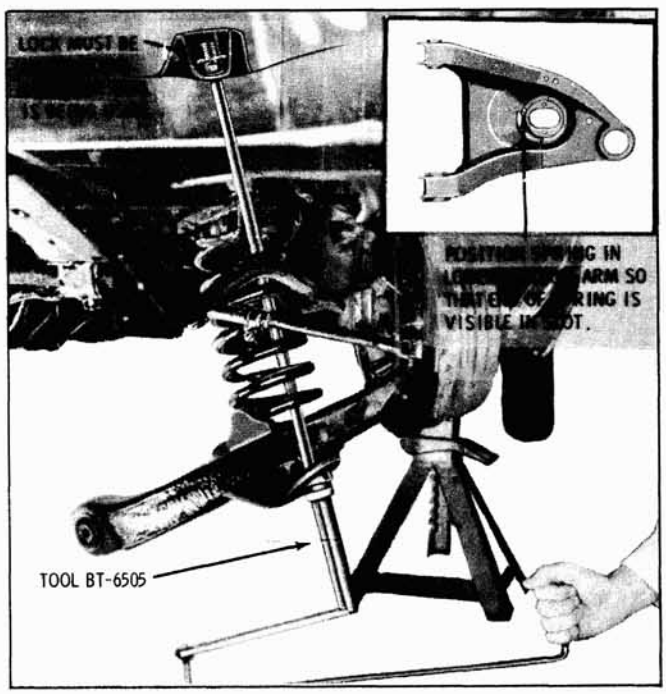


Fig. 3-43—Front Coil Spring Compressor - 31-48 Series

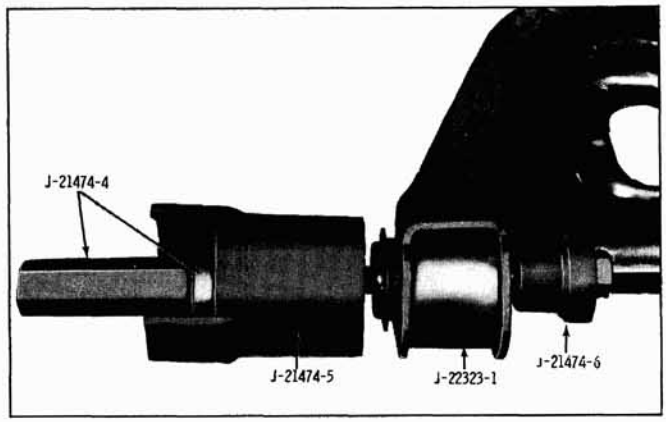


Fig. 3-44—Removing Front Bushing - 31-48 Series

1. Raise front of car and support at frame with floor stands.
2. Remove wheel and tire assembly.
3. Disconnect stabilizer link.
4. Remove shock absorber.
5. Install Tool BT-6505 as shown in Figs. 3-42 and 43 and compress spring slightly to permit removal of lower control arm bushing bolts. Leave ball joints connected to steering knuckle.

Clip must be installed in upper end of tool so that tool cannot come apart during usage.

6. Release spring tension by slowly unwinding tool. After tension is released, remove tool, then remove spring from control arm.
7. If lower control arm is to be removed, proceed as follows:
   a. Remove speedometer cable. (54-86 Series)
   b. Remove the cotter pin from the ball joint stud and clean the threads of the stud.
   c. Loosen the lower ball joint nut.
   d. Install Tool J-8806 as shown in Fig. 3-18 and expand tool until ball joint stud loosens from knuckle.
   e. Remove Tool J-8806.
   f. Remove nut from ball joint and remove lower control arm.

If interference is encountered between the ball joint and the backing plate, it will be necessary to loosen the backing plate slightly to obtain the necessary clearance.

Installation

If lower control arm was removed, install control arm ball joint stud in steering knuckle and torque to 70 ft. lbs. (54-86 Series), 40 ft. lbs. (31-48 Series) (min.)

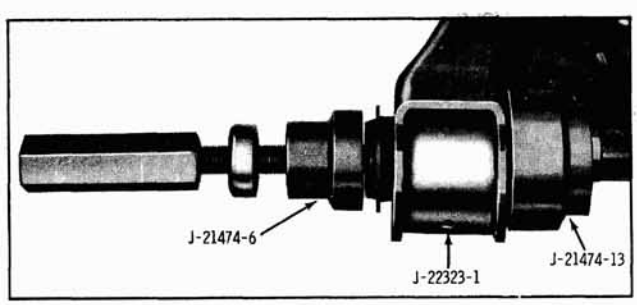


Fig. 3-45—Installing Front Bushing - 31-48 Series

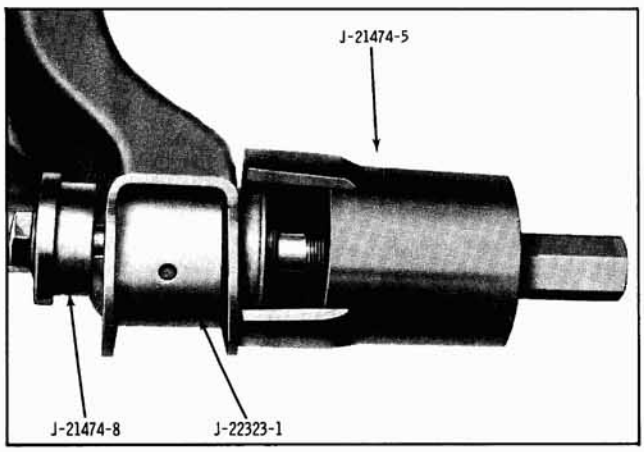


Fig. 3-46—Removing Rear Bushing - 31-48 Series

and install cotter pin. Tighten further if necessary to install cotter pin.

On 54-86 Series bend cotter pin to side of nut, not over top so it will not contact speedometer cable.

1. Position spring into pilot of frame and onto lower control arm as shown in insets of Figs. 3-42 and 3-43.
2. Install Tool BT-6505 and compress spring until lower control arm bushing bolts can be installed. (Fig. 3-42)

Do not torque bolts at this time. Bolts are to be torqued with weight of car on the wheels.

3. Remove tool and install shock absorber, stabilizer link and wheel and tire assembly.
4. Remove floor stands and lower car.
5. Torque lower control arm bushing bolts and nuts to 75 ft. lbs.

LOWER CONTROL ARM BUSHINGS

Use of Spring Compressor BT-6505 will allow the replacement of the lower control arm bushings without removing the control arm from the car. However, it may be desirable to remove the control arm and replace the bushings on the bench as illustrated.

Removal

1. Raise front of car and support at frame with floor stands.

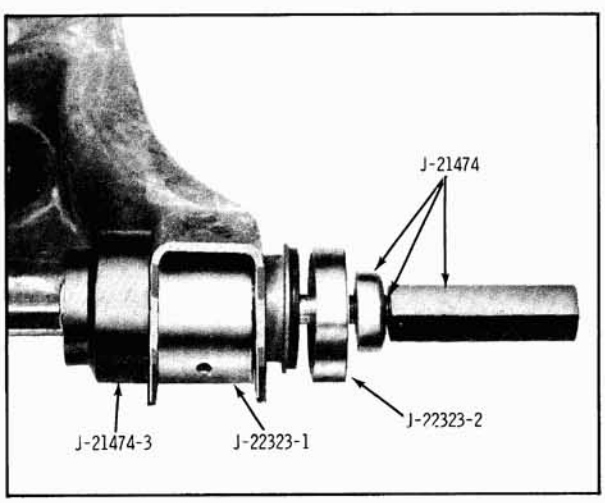


Fig. 3-47—Installing Rear Bushing - 31-48 Series

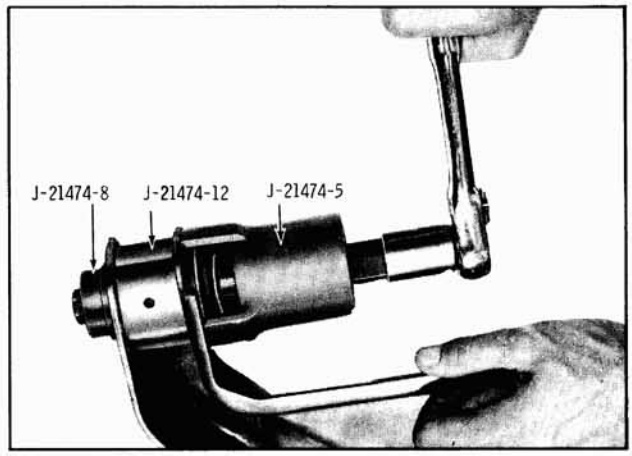


Fig. 3-48—Removing Bushings - 54-86 Series

2. Remove wheel and tire assembly.
3. Disconnect stabilizer link.
4. Remove shock absorber.
5. Install Tool BT-6505 as shown in Figs. 3-42 and 3-43 and compress spring slightly to permit removal of lower control arm bushing bolts. Leave ball joint connected to steering knuckle.
6. Relax spring tension by slowly removing Tool BT-6505 until lower control arm is low enough to install Bushing Removing Tools.

FRONT BUSHING—31-48 SERIES

Remove bushing as shown in Fig. 3-44.

REAR BUSHING—31-48 SERIES

Remove bushing as shown in Fig. 3-46.

LOWER BUSHINGS—54-86 SERIES

Remove bushings as shown in Fig. 3-48.

Installation

FRONT BUSHING—31-48 SERIES

Install bushing as shown in Fig. 3-45. Bushing should bottom against control arm.

REAR BUSHING—31-48 SERIES

Install bushing as shown in Fig. 3-47. Bushing should bottom against control arm.

LOWER BUSHINGS—54-86 SERIES

Install bushings as shown in Fig. 3-49. Bushings should bottom against control arm.

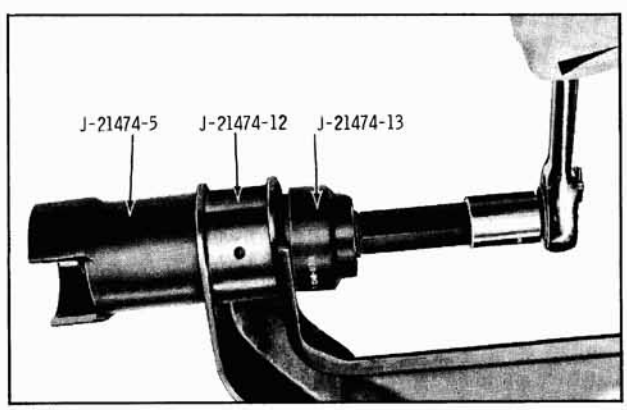


Fig. 3-49—Installing Bushings - 54-86 Series

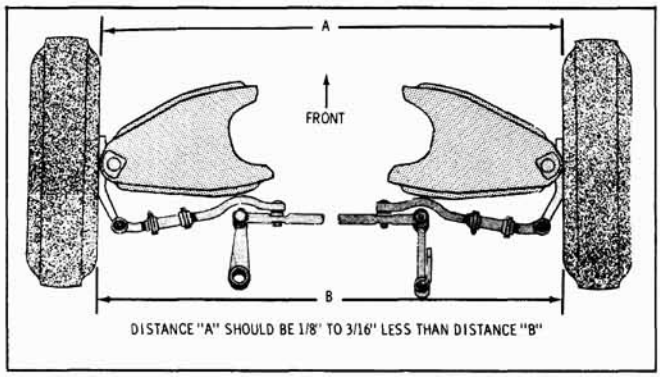


Fig. 3-50—Front Wheel Toe-In - 54-86 Series

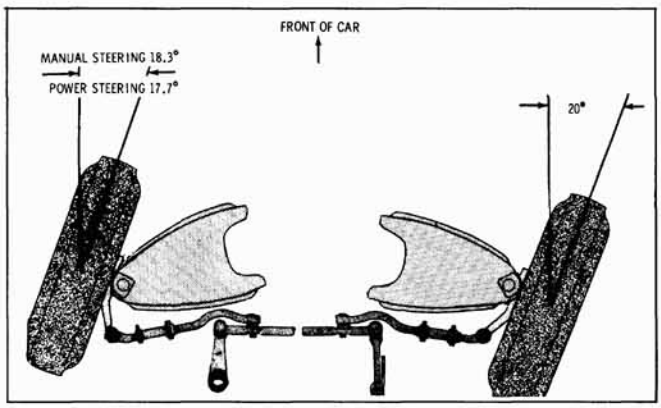


Fig. 3-51—Front Wheel Toe-Out - 54-86 Series

Reverse removal procedure to install lower control arm.

Lower control arm bushing bolts must be torqued with weight of car on wheels.

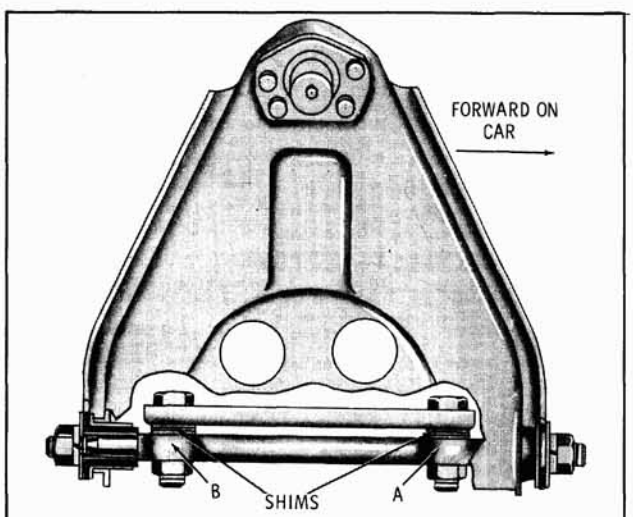


Fig. 3-52—Caster and Camber Adjustment - 54-86 Series

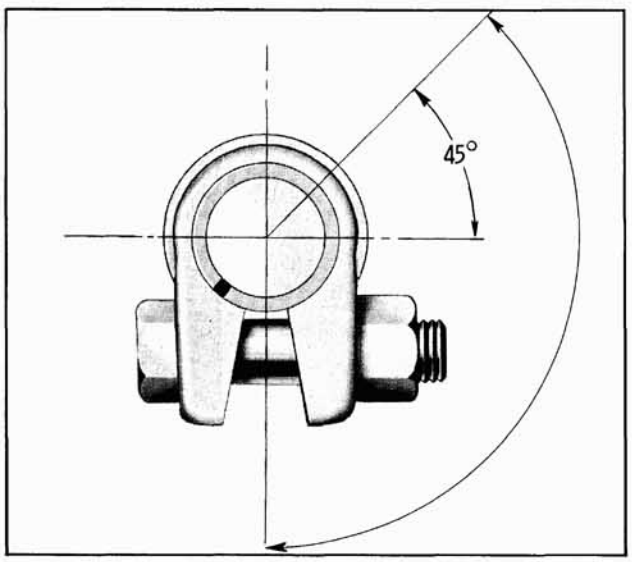


Fig. 3-53—Tie-Rod Clamp Positioning - 54-86 Series

STEERING KNUCKLE—31-86 SERIES

Removal

1. Raise front of car and support with floor stands under frame.

Spring tension is needed to assist in breaking ball joint studs loose from steering knuckle. Do not place stands under lower control arm.

2. Remove front wheel and hub and drum assembly.
3. Remove backing plate without disconnecting brake hose. Leave steering arm connected to tie-rod end.

Support the backing plate assembly out of the way to avoid any strain on brake hose.

4. Place floor jack under lower control arm.
5. Disconnect the control arm ball joints from the steering knuckle by:
   a. Removing cotter pins from ball joint studs.
   b. Remove the upper and lower joint nuts to clean the threads. REPLACE THE NUT, LEAVING IT AP-

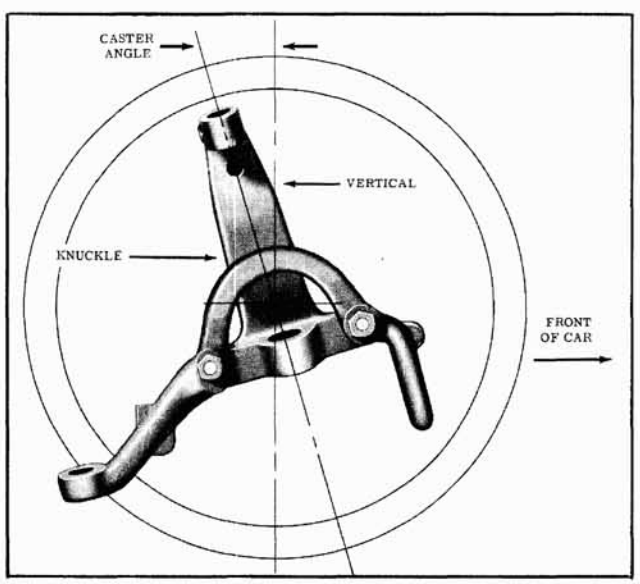


Fig. 3-54—Front Wheel Caster - 54-86 Series

PROXIMATELY TWO TURNS LOOSE. Lower floor jack slightly, then tap knuckle with a brass drift at ball joint stud. This will loosen stud from steering knuckle. Tool J-8806 can be used as shown in Figs. 3-18 and 3-32 to break ball joints loose from knuckle.

After stud breaks loose from steering knuckle, raise floor jack and relieve spring tension. This will permit removal of ball joint nuts.

6. Lift upper control arm and remove steering knuckle from car.

Lower control arm must be supported while knuckle is disconnected.

Installation

1. Connect the upper and lower ball joints to the steering knuckle.
2. Torque upper ball joint studs to 40 ft. lbs. min., lower ball joint studs to 40 ft. lbs. on 31-48 Series and 70 ft. lbs. on 54-86 Series. Install cotter pins, tighten further if necessary to install cotter pin.

Bend cotter pin to side of nut, not over top, so there is room for speedometer cable.

3. Install a new backing plate gasket on the steering knuckle.
4. Install backing plate and steering arm to steering knuckle. Use new locking plate and torque to specifications.
5. Connect speedometer cable to steering knuckle, if so equipped.
6. Install wheel and hub and drum assembly. Refer to WHEEL BEARING ADJUSTMENT for correct procedure.
7. Lower car.
8. Check camber, caster and toe-in and adjust if necessary.

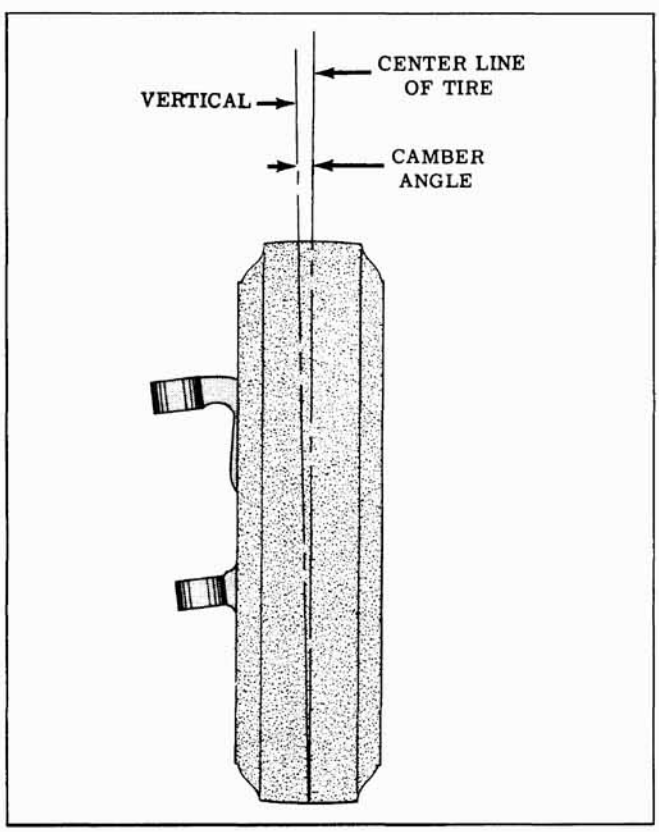


Fig. 3-55—Front Wheel Camber - 54-86 Series

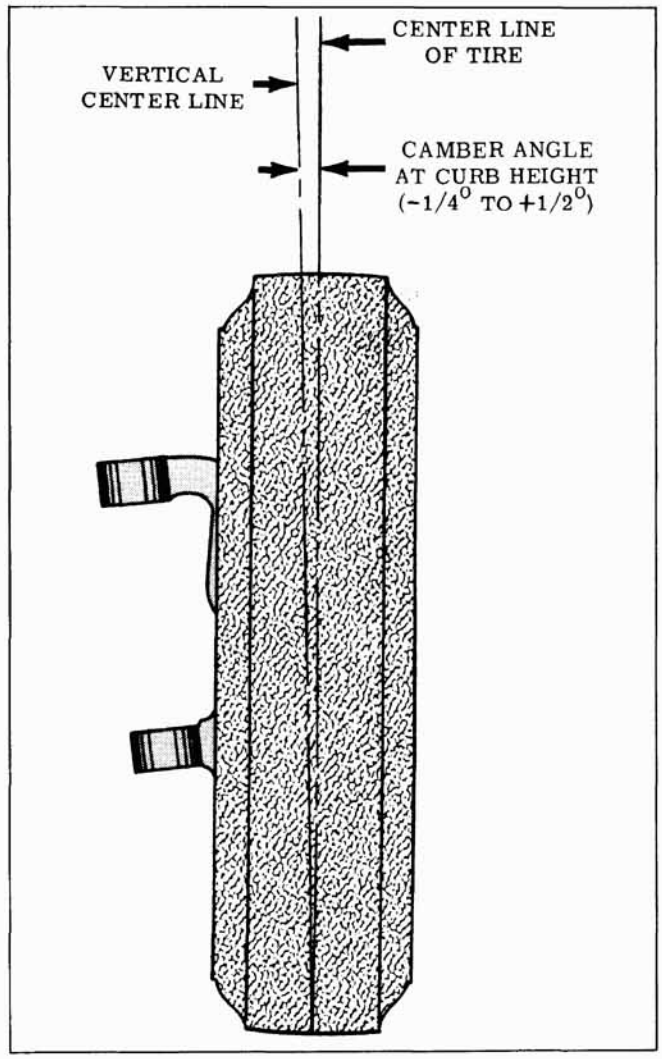


Fig. 3-56—Front Wheel Camber - 31-48 Series

STEERING ARM

Remove

1. Raise front of car on hoist.
2. Remove front wheel hub and drum assembly.
3. Remove cotter key and nut from tie-rod end.
4. Remove tie-rod end using Tool BT-6320.
5. Remove two attaching bolts (backing plate to steering knuckle to steering arm).

Install

1. Install two attaching bolts through backing plate to steering knuckle to steering arm and torque nuts to 120 ft. lbs. 31-48 Series; 140 ft. lbs., 54-86 Series.
2. Install tie-rod end and torque to 45 ft. lbs.
3. Install cotter key in tie-rod end.
4. Install front wheel hub and drum assembly. Refer to WHEEL BEARING ADJUSTMENT for correct procedure.
5. Lower car.
6. Check toe-in and correct as necessary.

WHEEL ALIGNMENT

The front wheel alignment factors are:

1. CASTER (Figs. 3-54 and 3-57)
2. CAMBER (Figs. 3-55 and 3-56)
3. TOE-IN (Figs. 3-50 and 3-58)

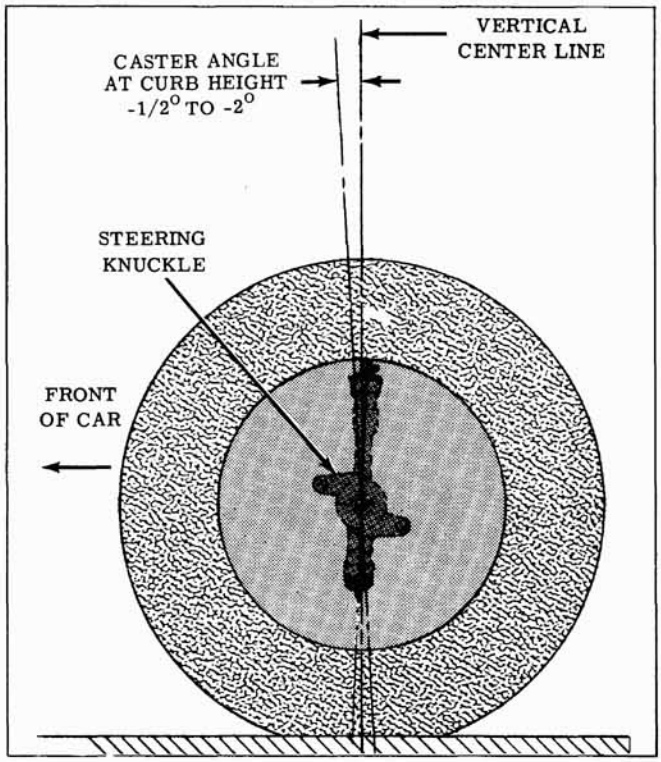


Fig. 3-57—Front Wheel Caster - 31-48 Series

4. TOE-OUT (STEERING GEOMETRY) (Figs. 3-51 and 3-59)

Before any attempt is made to check or correct caster, camber, toe-in or toe-out, the following preliminary checks and necessary corrections should be made on those parts which influence the steering of the car.

1. Inflate tires to recommended pressure.
2. Check front wheel bearings and steering gear for proper adjustments.
3. Check front wheel and tire assemblies for radial and lateral runout.
4. Grasp front bumper in center and raise and lower front end several times to allow car to come to its normal level. Check for erratic shock absorber action.

The method of checking alignment will vary depending on the type of equipment being used. The instructions furnished by the manufacturer of the equipment should be followed.

Check front wheel alignment without passengers or load in or on car and with car doors closed, as the addition of load or shifting of weight will result in incorrect alignment. Camber angle of the right and left wheels should be within 1/2° of each other for best handling characteristics.

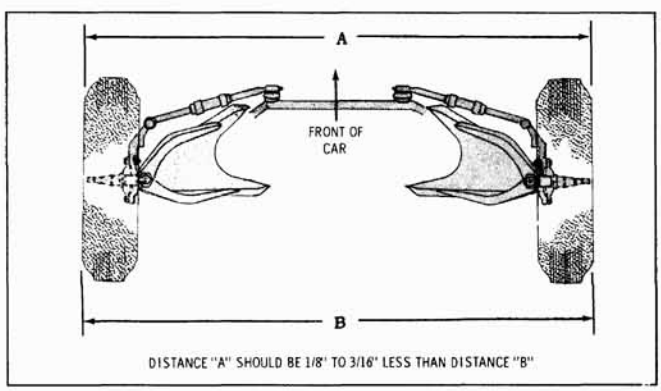


Fig. 3-58—Front Wheel Toe-In - 31-48 Series

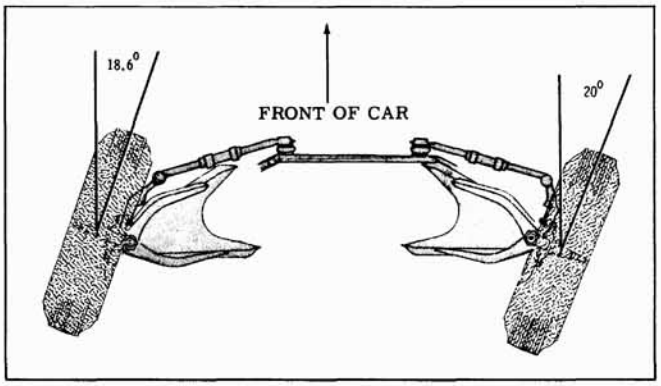


Fig. 3-59—Front Wheel Toe-Out - 31-48 Series

CASTER AND CAMBER ADJUSTMENT—54-86 SERIES

(Caster—1/2° to - 1 1/2°)
(Camber—1/4° to+1/2°)

Camber and caster are adjusted by shims placed between the upper pivot shafts and the frame. (Fig. 3-52) Both caster and camber adjustments can be made at the same time after the wheel alignment checks have been completed.

Shim Thickness	One shim added to or subtracted from Both Bolts will change Camber	One Shim added to or subtracted from Front Bolt Only will change Caster
.030"	1/8°	1/8°
.060"	5/16°	7/16°
.120"	5/8°	7/8°

Loosen the pivot shaft to frame nuts. In order to remove or install shims, do not remove weight from the front wheels. The attaching BOLTS are splined into the frame and should not be turned.

Refer to the shim chart to determine the thickness of shims necessary to correct the adjustment. After the correct number of shims have been installed, torque the pivot shaft mounting nuts to 105 ft. lbs. and recheck caster and camber.

TOE-IN ADJUSTMENT (1/8" to 3/16") 54-86 SERIES (Fig. 3-50)

1. Loosen the clamp bolts at each end of the steering tie-rod adjustable sleeves.
2. With steering wheel set in straight ahead position, turn tie-rod adjusting sleeves to obtain the proper toe-in adjustment.
3. When adjustment has been completed according to the recommended specification, and tie-rod and ball studs are riding squarely in their seats, position inner clamps as shown in Fig. 3-53.

TOE-OUT (STEERING GEOMETRY)—54-86 SERIES (Fig. 3-51)

To check, turn wheels to right until right wheel has been

turned 20° from straight ahead position. Left wheel setting should be 18.3° without power steering and 17.7° with power steering. Then follow same procedure with wheels turned to the left.

Errors found are usually due to bent steering arms or incorrect caster, camber or toe-in. If error is due to bent steering arm, replacement with new arm should be made. When replacements of this kind are made, it is important that other front end parts are checked and front wheels realigned.

CASTER AND CAMBER ADJUSTMENT— 31-48 SERIES

Caster—1/2° to – 2°
Camber—1/4° to +1/2°

Camber and caster are adjusted by shims placed between the upper pivot shafts and the frame. (Fig. 3-60) Both caster and camber adjustments can be made at the same time after the wheel alignment checks have been completed.

In order to remove or install shims, loosen the pivot shaft to frame nuts.

Refer to the shim chart to determine the thickness necessary to correct the adjustment. After the correct number of shims have been installed, torque the pivot shaft mounting nuts to 55 ft. lbs. and recheck caster and camber.

Shim Thickness	One shim added to or subtracted from Both Bolts will change Camber	One shim added to or subtracted from Front Bolt Only will change Caster
.030"	3/16°	1/4°
.060"	3/8°	1/2°
.120"	3/4°	1°

TOE-IN ADJUSTMENT (Fig. 3-58)— 31-48 SERIES

Toe-in spec. 1/8" to 3/16" In

1. Loosen the clamp bolts at each end of the steering tie-rod adjustable sleeves.
2. With steering wheel set in straight ahead position, turn tie-rod adjusting sleeves to obtain the proper toe-in adjustment at curb load. (Fig. 3-58)
3. When adjustment has been completed according to the recommended specification, position inner clamps so that entire bolt is below centerline of tie-rod. (Fig. 3-61) Torque nut to 15 ft. lbs.

TOE-OUT (STEERING GEOMETRY) (Fig. 3-59)

Toe-out is the mechanics of keeping the front wheels in proper relative alignment as the wheels are turned right or left. When turning, the wheels go into a toe-out position (further apart at the front of the tire than they are at the back). This condition increases with the increase of the turn.

To check, turn wheels to right until right wheel has been turned 20° from the straight ahead position. Left wheel setting should be 18.6° on all models. Follow the same procedure with wheels turned to left. Errors found are usually due to bent plain arms or incorrect caster, camber or toe-in. If error is due to bent plain arm, replacement with new arm should be made. When replacements of this kind are made, it is important that other front end parts are checked and front wheels aligned.

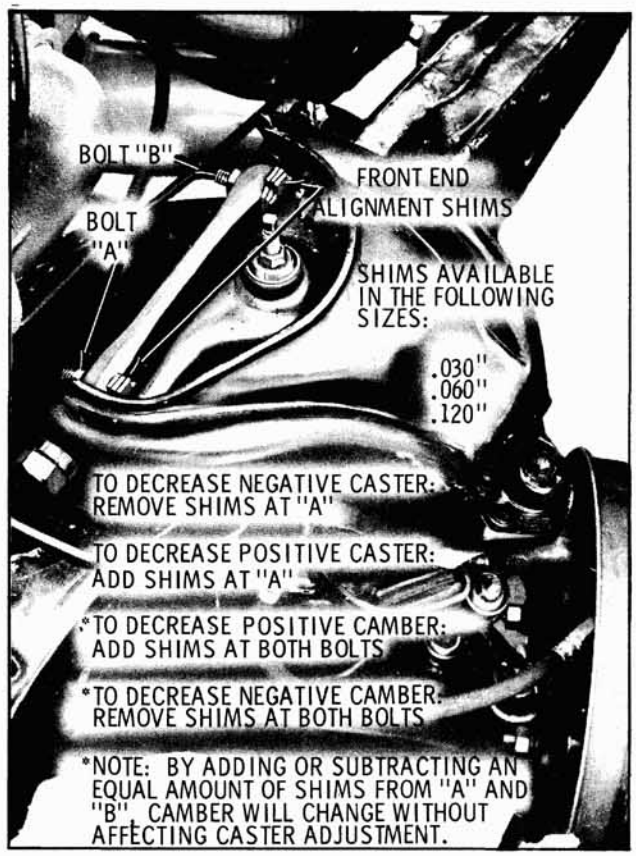


Fig. 3-60—Front Wheel Alignment Shims - 31-48 Series

SPRING CARRYING HEIGHT

Spring carrying height is controlled by the spring length and spring rate and may be checked as indicated in Figs. 3-62 and 3-63.

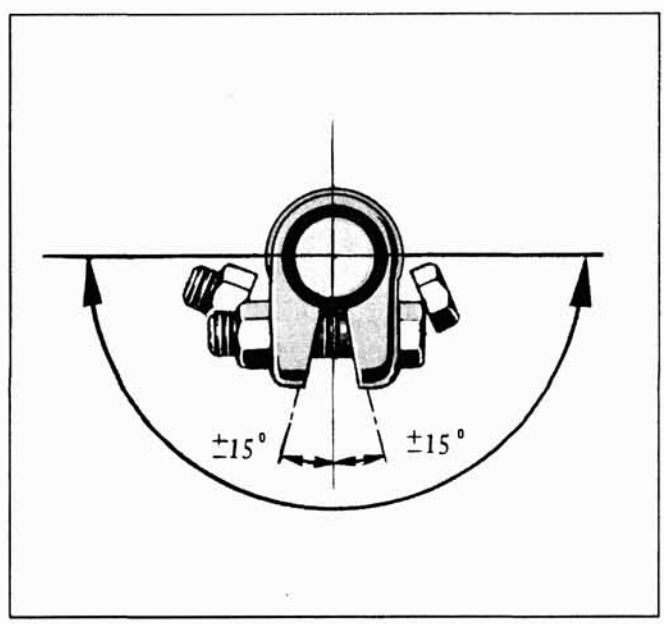


Fig. 3-61—Tie-Rod Clamp Positioning - 31-48 Series

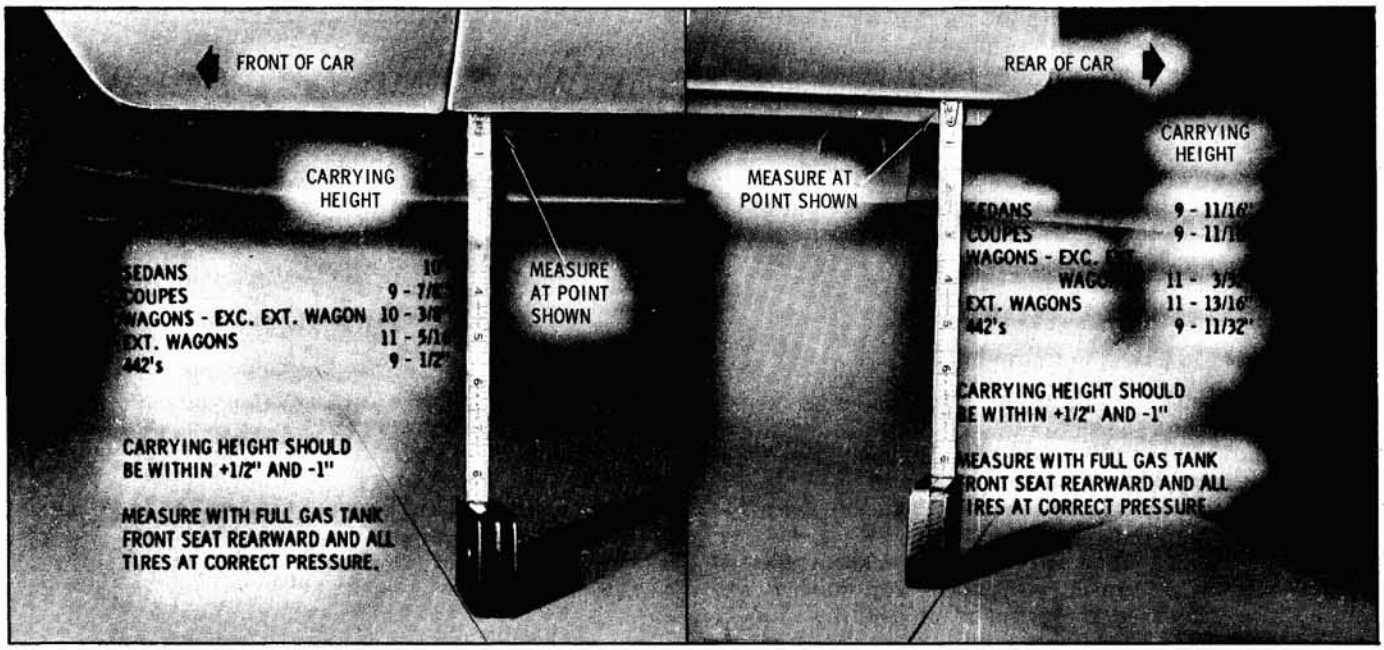
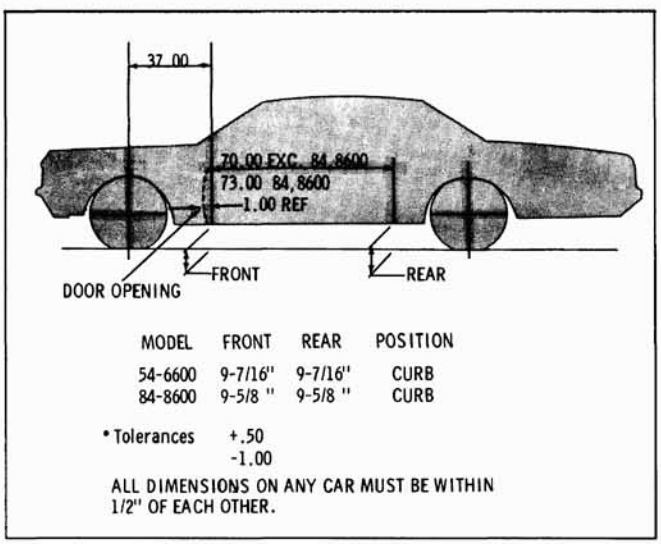


Fig. 3-62—Checking Spring Carrying Height - 31-48 Series



MODEL	FRONT	REAR	POSITION
54-6600	9-7/16"	9-7/16"	CURB
84-8600	9-5/8 "	9-5/8 "	CURB

* Tolerances +.50 -1.00

ALL DIMENSIONS ON ANY CAR MUST BE WITHIN 1/2" OF EACH OTHER.

Fig. 3-63—Checking Spring Carrying Height - 54-86 Series

DIAGNOSIS

HARD STEERING

Cause:

1. Low or uneven tire pressure.
2. Steering gear or linkage adjusted too tight.
3. Insufficient or incorrect lubricant used.
4. Improper caster.
5. Upper or lower control arms bent.
6. Frame bent or broken.
7. Steering knuckle bent.

EXCESSIVE PLAY OR LOOSENESS IN STEERING SYSTEM

Cause:

1. Steering gear or linkage worn.
2. Control ball joints worn.
3. Front wheel bearings worn or incorrectly adjusted.
4. Loose front stabilizer.

SCUFFED TIRES

Cause:

1. Tires improperly inflated.
2. Wheels or tires out-of-true.
3. Control arm ball joints worn.
4. Toe-in incorrect.
5. Uneven caster.
6. Incorrect toe-out on turns.
7. Steering gear incorrectly adjusted.
8. Eccentric or bulged tires.
9. Wheels, tires or brake drums out-of-balance.
10. Excessive runout on wheels or tires.

CAR PULLS TO ONE SIDE

Cause:

1. Uneven tire pressure.
2. Rear wheels not tracking with front wheels.
3. Brakes incorrectly or unevenly adjusted.
4. Shock absorbers worn or inoperative.
5. Toe-in incorrect.
6. Incorrect or uneven caster or camber.

WORN TIRE TREAD EDGES

Cause:

1. Improper front end alignment.
2. High speed driving on curves.
3. Steering knuckle bent.
4. Steering plain arm bent.
5. Low tire pressure.

ERRATIC STEERING ON APPLICATION OF BRAKE

Cause:

1. Low or uneven tire pressure.
2. Brakes incorrectly or unevenly adjusted.
3. Incorrect or uneven caster.
4. Steering knuckle bent.

5. Loose steering linkage or suspension.
6. Dirt or grease on brake lining.

FRONT WHEEL SHIMMY

Cause:

1. Uneven tire pressure.
2. Steering linkage worn or incorrectly adjusted. Loose adjusters on tie-rods.
3. Front wheel bearing worn or incorrectly adjusted.
4. Shock absorbers inoperative or leaking.
5. Control arm ball joints worn.
6. Toe-in incorrect.
7. Incorrect or uneven caster.
8. Steering knuckle bent.

FRONT OR REAR WHEEL TRAMP

Cause:

1. Wheels, tires or brake drums out-of-balance.
2. Shock absorbers inoperative.
3. Loose or worn front wheel bearings.

CAR WANDERS

Cause:

1. Low or uneven tire pressure.
2. Steering gear or linkage worn.

FRONT SUSPENSION SPRING USAGE

				L-65	L-78	FEI	
Series	Style	Std.	W/AC	Std.	W/AC	Std.	W/AC
3100	69	LD	LP				
	77	LN	LP				
3200	69, 77	LT	LY				
3500	35	R.H.-LN	LY				
		L.H.-#LD	#LP				
	39, 69	LD	LP				
	77	LN	LP			RW	RY
	67, 87	LD	LD			RW	RY
3600	35	R.H.-LT	SB				
		L.H.-LX	#SB				
	39, 69	LT	SB				
	67	LT	SB			RX	RI
	77, 87	LT	LY			RX	RI
4200	39, 69, 87	LT	SB				
4400	67, 77, 87	RX	RI	RX	RI		
4800	55	R.H.-SD	SN	RP	RV		
		L.H.-SN	SK	RV	L4		
	65	R.H.-SD	SN	RP	RV		
		L.H.-SN	SK	RV	L4		
5400 (With 350 Cu. In.)	39, 69	VA	VF				
	67	VB	VF				
	87	VA	VD				
5400 (With 455 Cu. In.)	39, 67	VF	VC				
	69, 87	VD	VC				
6400	39, 87	VF	VC				
	69	VD	VC				
6600	39	VF	VK				
	87	VF	VC				
8400	39, 67	VL	VK				
	57, 69	VF	VK				
8600	69	VL	VK				

#3535 and 3635 uses shim 400360

31-48 Series use high range spring on left side of car and low range spring on right side of car.

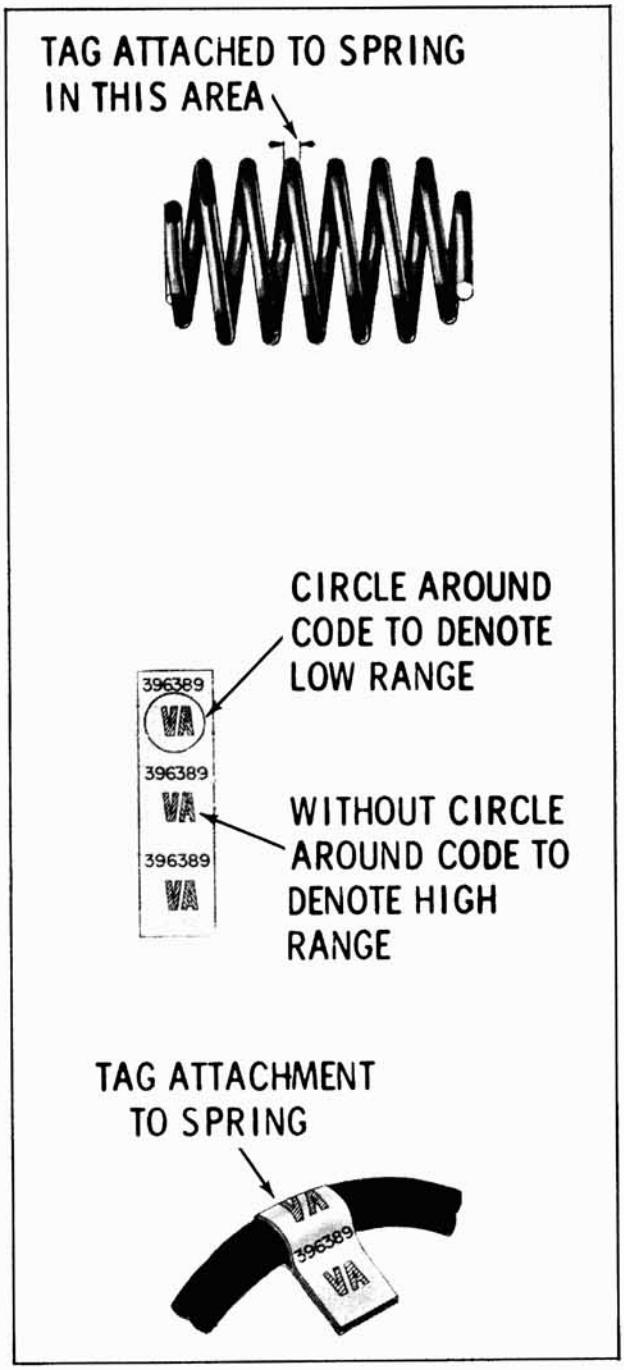


Fig. 3-64—Spring Code Identification

TORQUE SPECIFICATIONS

Series	31-48	54-86
Caster Angle (Degrees)	-1/2° to -2°	-1/2° to -1-1/2°
Camber (Degrees)*	-1/4° to +1/2°	-1/4° to 1/2°
Toe-In	1/8" to 3/16"	1/8" to 3/16"
Toe-Out On Turns		
Manual Steering	20° = 18.6°	20° = 18.3°
Power Steering	20° = 18.6°	20° = 17.7°
Ball Joint Inclination	9°	11°
Tread Width, Front Wheels**	59.00"	62.50"

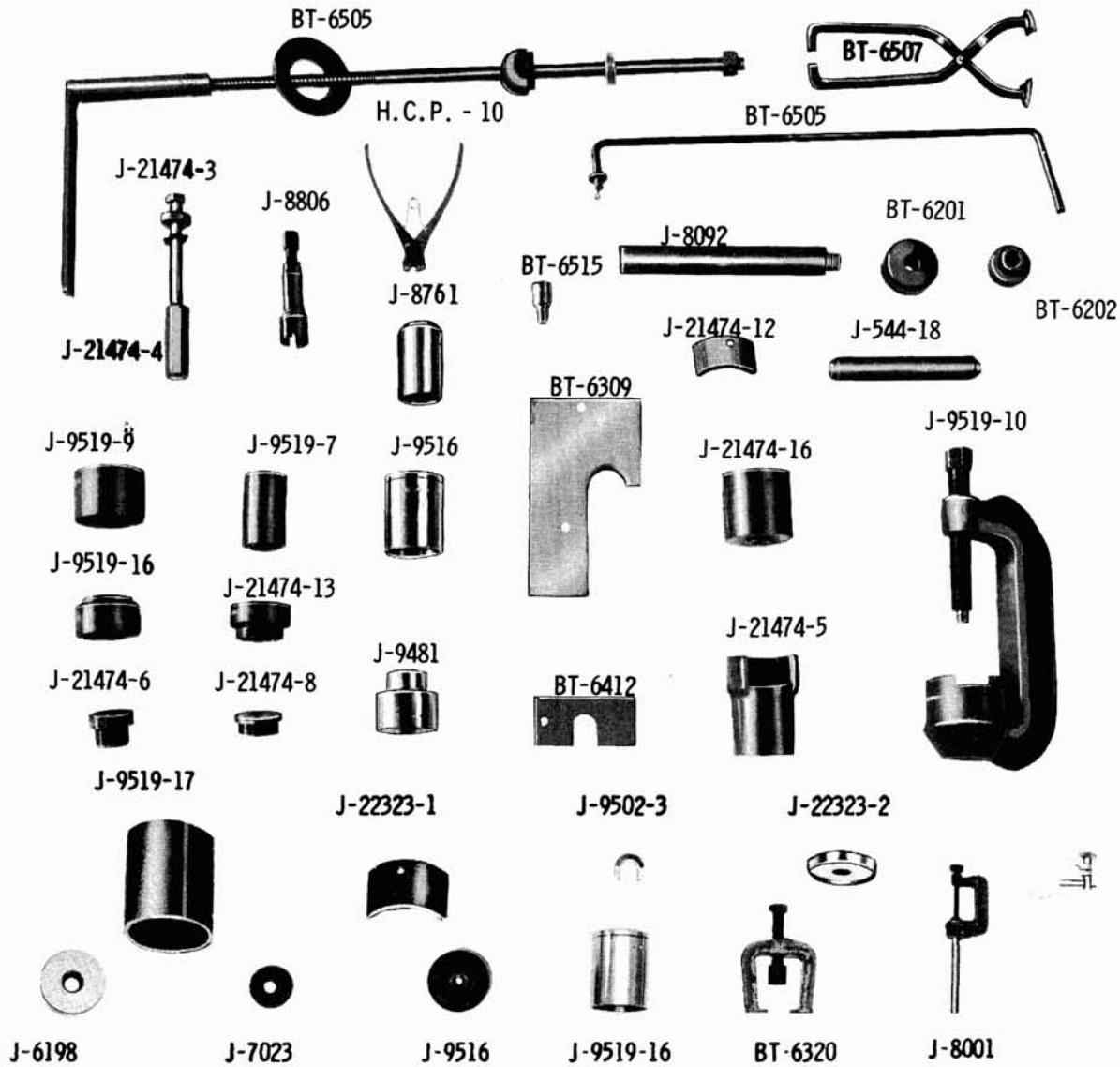
*Maximum camber variation between either side of the car should not exceed 1/2°.
**Measured from center of tires.

TORQUE SPECIFICATIONS

NOTE: Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

Series	31-48	54-86
	FT. LBS.	FT. LBS.
STABILIZER		
Stabilizer Link Nut	10	10
Stabilizer Bar Bracket to Frame Bolts and Nuts*	10	10
SHOCK ABSORBER		
Shock Absorber Upper Attaching Nut	7	7
Shock Absorber to Control Arm Bolts	20	20
CONTROL ARMS		
Upper Control Arm to Frame Attaching Nuts	55	75
Lower Control Arm to Frame Attaching Nuts*	75	75
Upper Arm Bushing Nuts*	55	55
BALL JOINTS		
Service Ball Joints to Upper Control Arm		8
Ball Joints to Steering Knuckle Nuts		
Lower	40 Min.	70 Min.
Upper	40 Min.	40 Min.
STEERING KNUCKLE		
Backing Plate to Steering Knuckle (Anchor Bolt)	95	135
Steering Arm to Steering Knuckle to Backing Plate Bolts	120	140
BUMPER		
Lower Control Arm	12	12
HUB TO DRUM		
Wheel Nuts	65	75

*Torque with weight of car on wheels.



H.C.P.-10	Keystone Clamp Pliers (Cornwell Tool)
J-544-18	Hub Bolt Peening Tool
J-6198	Inner Bearing Outer Race Installer
BT-6201	Front Pinion Bearing Cup Remover (Used to Install Inner Bearing Outer Race)
BT-6202	Pitman Shaft Oil Seal Installer (Used to Install Outer Bearing Inner Race)
BT-6309-1	Pivot Shaft Bushing Press Plate
BT-6320	Puller
BT-6412	Back-Up Plate
BT-6505	Front Suspension Coil Spring Compressor
BT-6507	Dust Cap Remover and Installer
BT-6515	Socket (Used for Front Shock Absorber Removal)
J-7023	Outer Bearing Outer Race Installer
J-8001	Dial Indicator
J-8092	Driver Handle
J-8761	Front Pump Seal Installer (Used to Install Inland Ball Joint Seal)
J-8806	Ball Joint Remover
J-9481	Pivot Shaft Bushing Installer
J-9502-3	Front Upper Control Bushing Remover
J-9516	Control Arm Bushing Installer
J-9519-7	Ball Joint Remover
J-9519-9	Ball Joint Installer
J-9519-10	Ball Joint Fixture
J-9519-16	Ball Joint Installer
J-9519-17	Ball Joint Remover Back-Up Tool
J-21474-3	Special Bolt and Thrust Bearing Assembly
J-21474-4	Special Nut
J-21474-5	Receiver Tool
J-21474-6	Axle Housing Bushing Remover & Installer
J-21474-8	Front and Rear Lower Control Arm Bushing Remover
J-21474-12	Front Lower Control Arm Bushing Installer Spacer
J-21474-13	Front and Rear Lower Control Arm Bushing Installer
J-21474-16	Rear Control Arm Bushing Receiver
J-22323-1	Front Lower Control Arm Bushing Installer
J-22323-2	Rear Lower Control Arm Bushing Installer

Fig. 3-65—Tools

REAR SUSPENSION PROPELLER SHAFT DIFFERENTIAL

31 THROUGH 86 SERIES

CONTENTS OF SECTION 4

Subject	Page
REAR SUSPENSION	4-1
DESCRIPTION	4-1
SHOCK ABSORBERS	4-1
UPPER SUSPENSION ARMS	4-1
LOWER SUSPENSION ARMS	4-2
BUSHINGS	4-2
COIL SPRINGS	4-3
AXLE HOUSING ALIGNMENT	4-4
BUMPERS (RUBBER)	4-4
REAR STABILIZER SHAFT	4-4
SERVICE DIAGNOSIS	4-5
TORQUE SPECIFICATIONS	4-5
SPRING USAGE CHART	4-5
PROPELLER SHAFT	4A
DIFFERENTIAL	4B

REAR SUSPENSION 31-86 SERIES

DESCRIPTION

The rear suspension is of the link-type with coil springs. It uses four suspension arms that attach the rear axle assembly to the frame. A bracket on the axle supports the coil spring, the top of which is positioned under the frame rail. The upper arms are attached to the top of the differential and extend forward to the frame. Two shock absorbers are attached to the frame and to brackets on the axle housing. (Fig. 4-1 and 4-2)

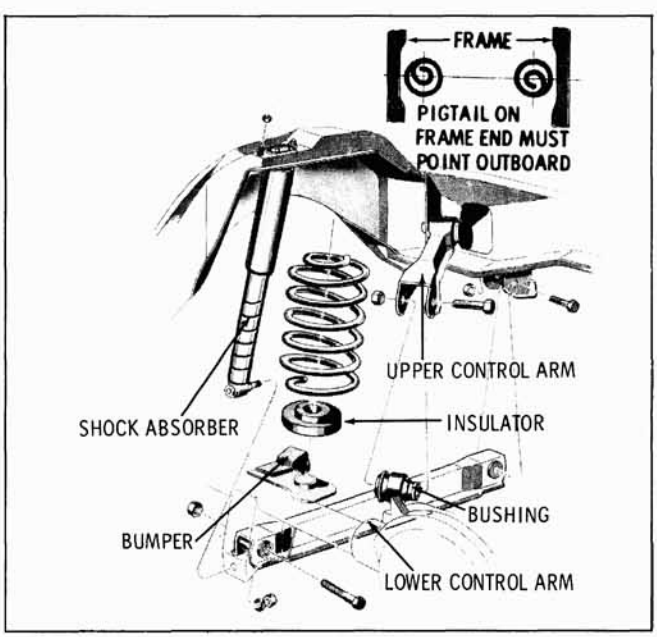


Fig. 4-1—Rear Suspension (54-86 Series)

SHOCK ABSORBERS

Refer to Front Suspension, Section 3, for code and usage.

The double action shock absorbers are mounted by bolts through the frame at the top and to a bracket welded on the axle housing. (Fig. 4-3 and 4-4)

If noisy rear shock absorbers are encountered, the attaching bolts should be retorqued. If this does not correct the noise, further checking will be necessary.

Removal

If necessary to replace, raise car and support rear axle to prevent stretching of brake hose. The lower end has a stud which is an integral part of the shock. Remove the nut and tap shock free from bracket. To disconnect the shock at the top, on all models except extended station wagons, remove the two bolts, nuts and lockwashers. On extended station wagons, remove the nut, retainer and grommet.

Installation

Loosely attach shock at both ends before tightening nuts. Torque lower stud nut to 45 ft. lbs. and on all models except extended station wagons torque upper mounting bolts to 20 ft. lbs. On extended station wagons, torque upper mounting nut to 10 ft. lbs. or until nut is to end of threads on stud.

UPPER SUSPENSION ARMS

Removal

1. Remove nut from rear arm to differential housing bolt and while rocking differential, remove the bolt. (Fig. 4-5)
2. Remove front rear arm attaching nut and bolt.
3. Remove suspension arm and inspect bushing for damage.

Installation

To install, reverse removal procedure. Torque nuts to 80 ft. lbs. with car resting at normal carrying height.

31-48 Series upper arms on cars equipped with manual transmission are to be installed in upper holes of frame crossbar on V-8 Sedans, Coupes and 67 Styles.

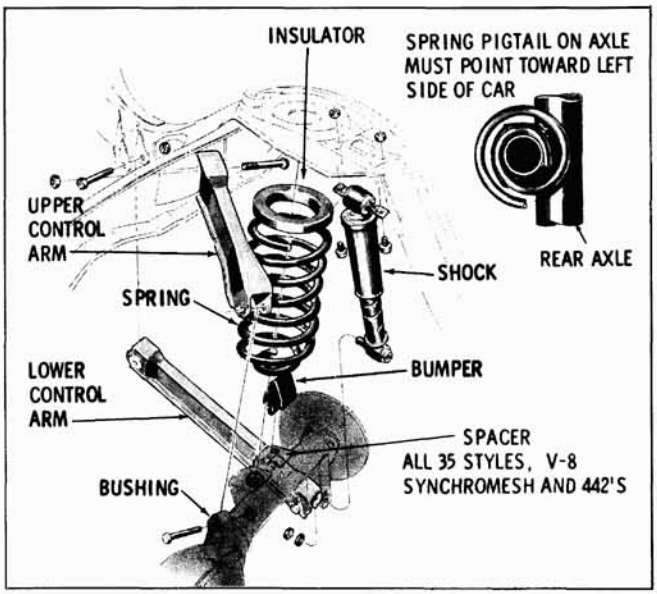


Fig. 4-2—Rear Suspension (31-48 Series)

LOWER SUSPENSION ARMS

Removal

1. Raise car and support under axle housing.
2. Remove rear arm to axle housing bracket bolt. (Fig. 4-6)
3. Remove front arm to bracket bolts and remove lower control arm.

Installation

To replace arm, reverse the removal sequence of operations. Torque arm attaching nuts to 80 ft. lbs. with the weight of the car on the rear springs.

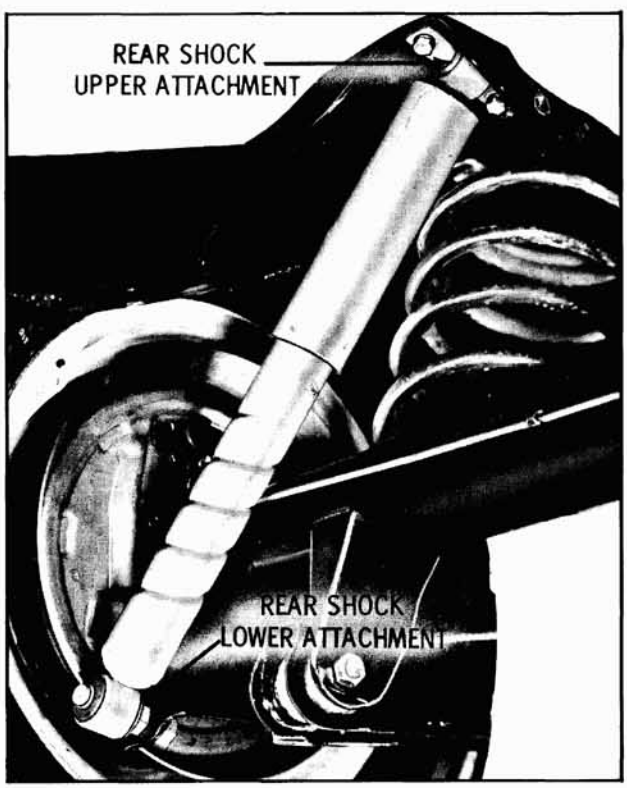


Fig. 4-3—Rear Shock Attachment (Exc. 48 Series)

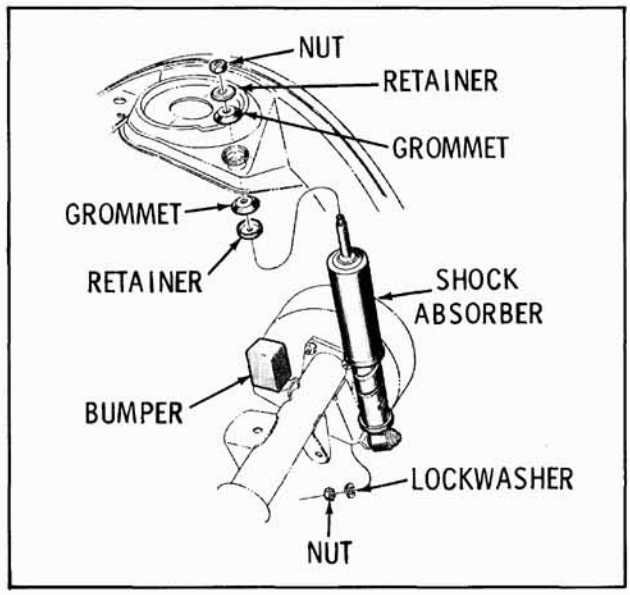


Fig. 4-4—Rear Shock Attachment (48 Series)

BUSHINGS

Differential identification will be necessary before bushing removal is attempted. (Fig. 4-7)

The bushings in the differential carrier are replaceable. The bushings in the suspension arms can only be serviced by replacing the complete arms.

Removal

The bushings in the differential carrier can be replaced as follows:

1. Raise car and support under frame, lower axle housing until proper clearance is obtained.
2. Disconnect upper arm at differential and hold it up and out of the way.
3. Position tools as shown in Figs. 4-8 or 4-9 and remove bushing.

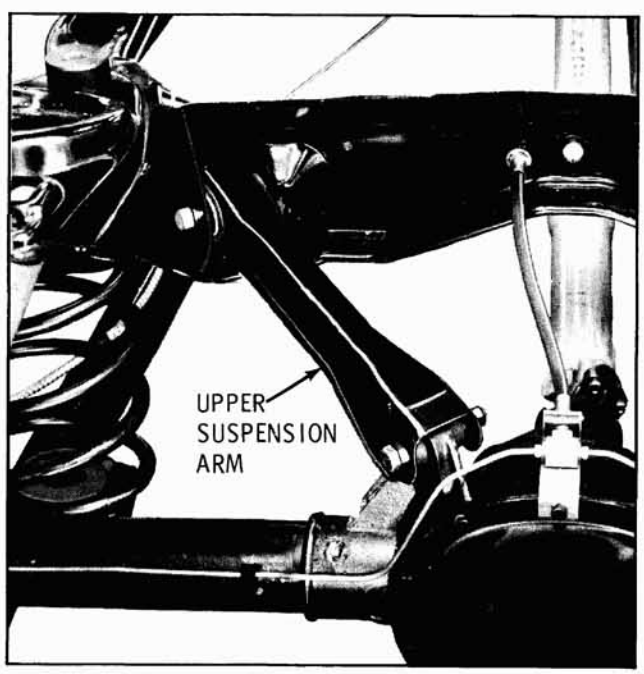


Fig. 4-5—Typical Upper Control Arm

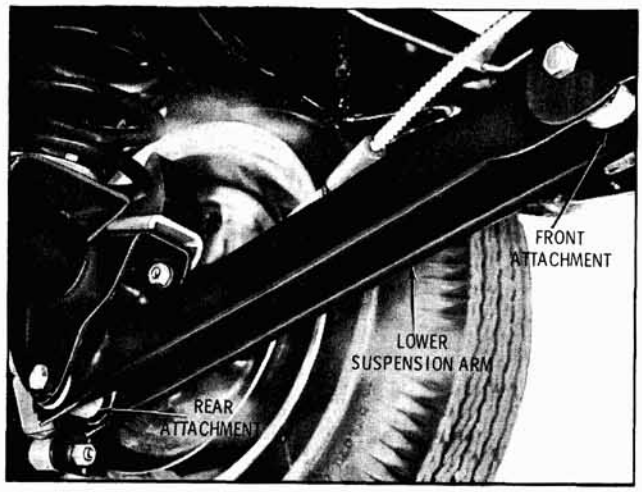


Fig. 4-6—Typical Lower Control Arm

Installation

To install the bushing, reverse the tool as shown in Figs. 4-9 or 4-10 and pull bushing into position. Connect the upper suspension arms. Install bolt and torque nut to 80 ft. lbs. with weight of car on wheels.

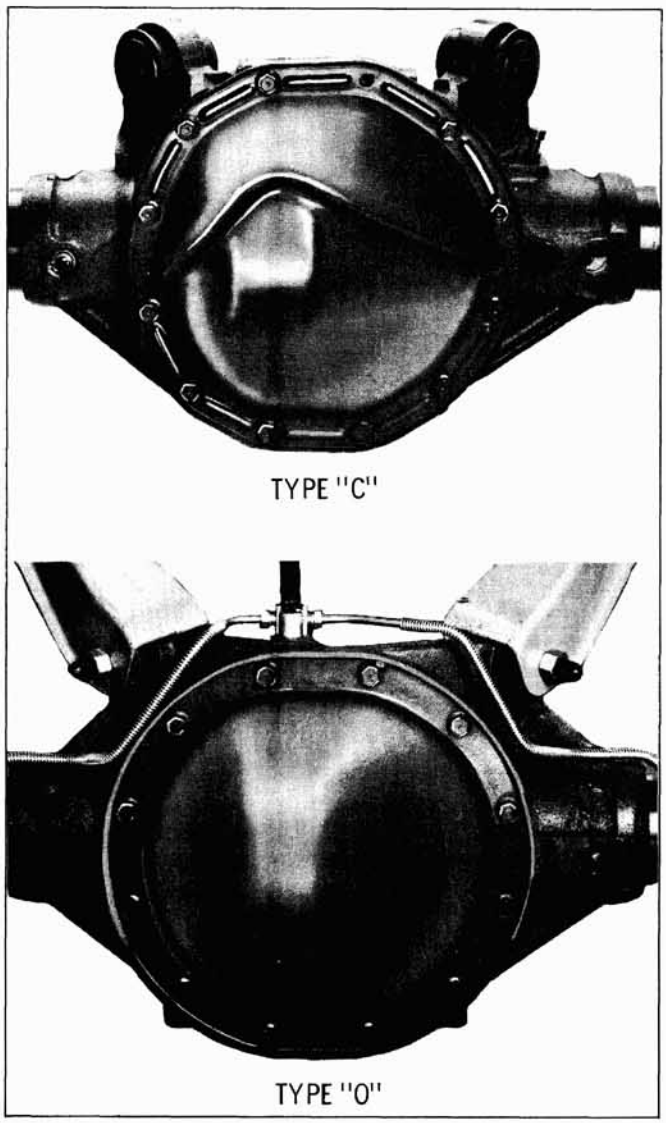


Fig. 4-7—Differential Identification

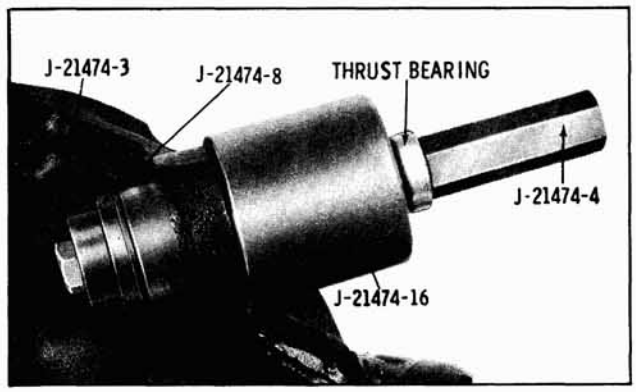


Fig. 4-8—Bushing Removal (31-86 Series) Type "O"

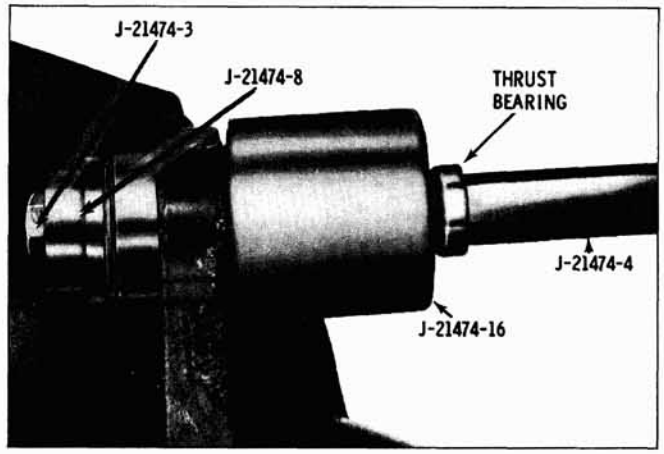


Fig. 4-9—Bushing Removal (31-44 Series) Type "C"

COIL SPRINGS

Removal

1. Disconnect shock from lower bracket.
2. Lift car at rear by frame rail. This will allow suspension to drop far enough to remove the spring (31 - 86 Series).

Installation

1. a. 31-48 Series, install spring in position so that spring pigtail on axle housing points toward left side of car.
   b. 54-86 Series, install spring in position so that spring pigtail on frame end points toward frame side rail.
   c. 31-48 Series, install spring insulator on top of spring. (Fig. 4-2)

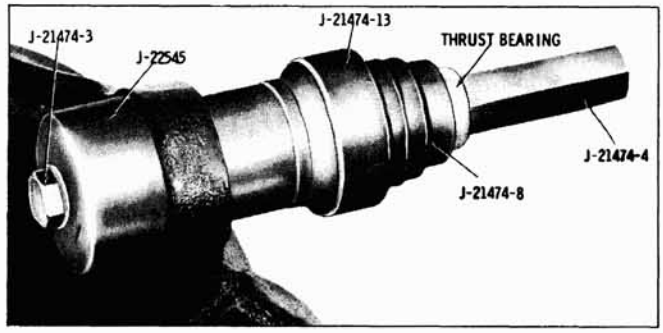


Fig. 4-10—Bushing Installation (31-86 Series) Type "O"

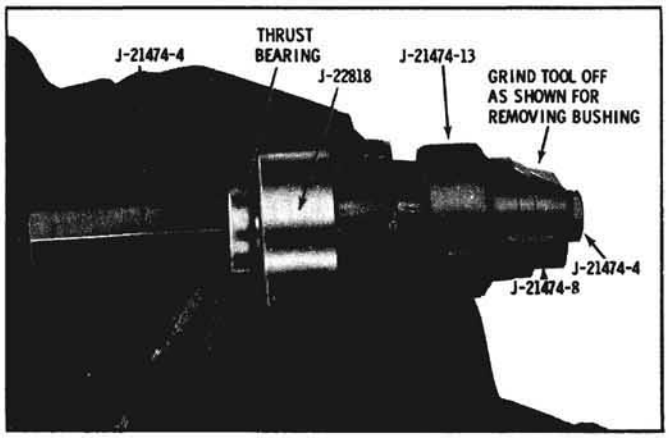


Fig. 4-11—Bushing Installation (31-44 Series) Type "C"

d. 54-86 Series, install spring insulator on axle housing spring seat.

2. Lower car sufficiently to attach shock to lower bracket. Torque shock nut to 45 ft. lbs.

AXLE HOUSING

For removal or installation of Axle Housing, Refer to Differential Section 4B.

BUMPER (RUBBER)

The rear axle bumper is located on the top of the axle housing and is attached by snapping into a bracket on the axle housing. If found deteriorated or damaged, it must be replaced.

AXLE HOUSING ALIGNMENT

If rear tire wear indicates that the axle housing may be bent, the alignment can be checked as follows:

1. Back the car squarely onto an alignment machine.
2. Compensate for wheel runout the same as for checking front wheel toe-in.
3. Check camber reading which should be 1/4° negative to 1/2° positive.
4. 54-86 Series, check the amount of toe-out which should be 0" to 1/16".
5. 31-48 Series, check the amount of toe-out which should be 3/64" to 5/32".

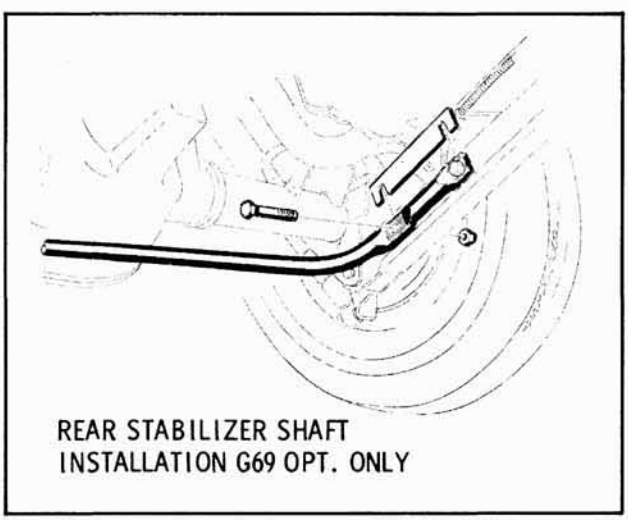


Fig. 4-12—Rear Stabilizer Installation

Due to the fact that the car is backed onto an alignment machine, the actual toe-out will be read on the scale as toe-in. However, if the toe-out is checked with a tram gauge, disregard the aforementioned.

6. If a tram is used for checking toe-out, it will still be necessary to perform Steps 1 and 2 in order to check camber.

The necessary straightening operations may be performed using frame straightening equipment without removing the axle housing from the car. This procedure will allow checks during the straightening operation to determine when the housing is within the prescribed limits.

REAR STABILIZER SHAFT

The rear stabilizer shaft is standard on 442 models and is available only on police options on other models. It is attached as shown in Fig. 4-12.

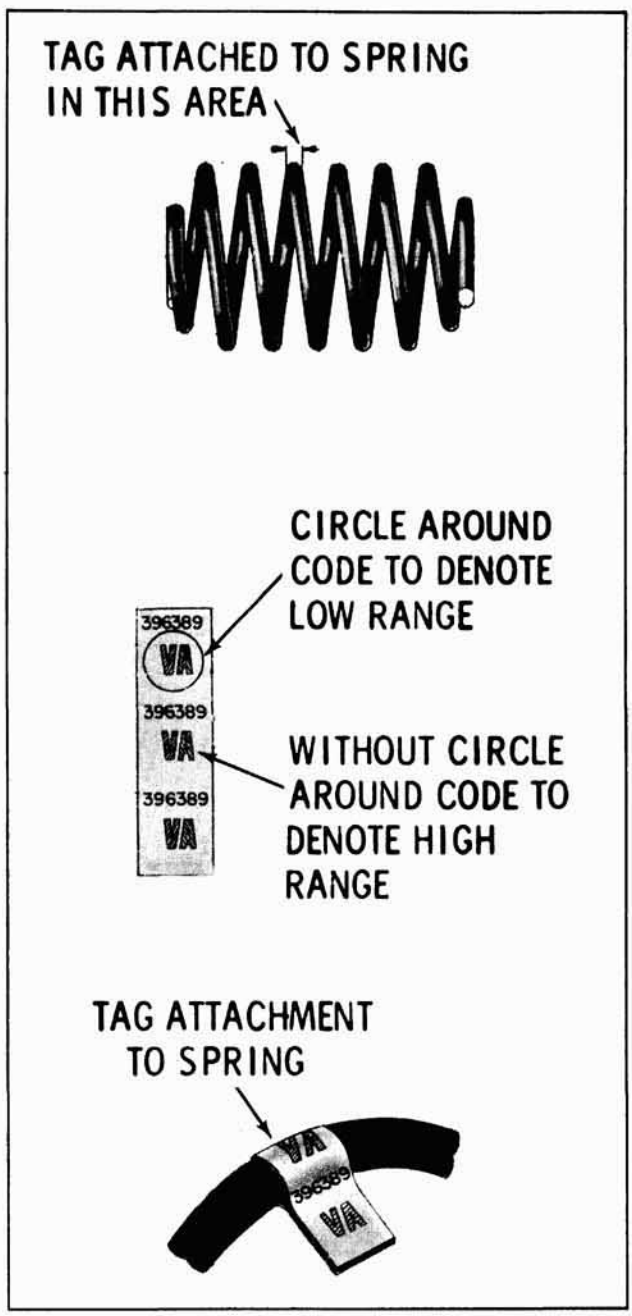


Fig. 4-13—Rear Suspension Spring Identification

SERVICE DIAGNOSIS

REAR SUSPENSION NOISE

Possible Causes:

1. Improperly torqued upper or lower control arm bolts.
2. Worn bushings.
3. Loose shock absorber bolts and nuts.
4. Spring out of position.
5. Broken welds.
6. Bent control arms.

TORQUE SPECIFICATIONS

Application	Ft. Lbs. 31-48	54-86
Shock Absorbers		
Upper Attaching Bolts and Nuts (Exc. Ext. S.W.)	20	20
Upper Attaching Nut (Ext. S.W.)	10	
Lower Stud Nut	45	45
**Suspension Arms		
*Upper Arm to Frame Nuts	80	80
*Upper Arm to Differential Nut	80	80
*Lower Arm to Frame Nut	80	80
*Lower Arm to Differential Nut	80	80
Stabilizer Shaft to Lower Control Arm Nut	50	50

*Torque with Weight of Car on Wheels
**If Necessary to Torque Bolts, Torque to 105 Ft. Lbs.

REAR SUSPENSION SPRING USAGE

Series	Model	Standard		Trailer Hauling	FEI
3100	69	PC		↑	↑
	77	PU		HG	PP
3200	69	PC		↓	↓
	77	NN			
3500	35	R.H.-NF		HB	PN
		L.H.-PE			
	39	NO		↑	↑
	67,69	PC		HG	PP
	77	PU		↓	↓
	87	NN			
3600	35	R.H.-NF		HB	PN
		L.H.-PE			
	39,69	NO		↑	PP
	67,77,87	NN			PP
4200	39	NB			PR
	69	NO		HG	PP
	87	NN		↓	PP
4400	67,77,87	NP			
4800	55	R.H.-PE		↑	↑
		L.H.-N6		HC	HA
4800	65	R.H.-PX		↓	↓
		L.H.-N7			
		Man. Trans.	Auto. Trans.		
54 With 350 Cu. In.	39	ID	ID	↑	
	67	IG	IG		
	69,87	LJ	IJ		
54 With 455 Cu. In.	39,69,87	IC	IJ		
	67	IC	IG	IP	
6400	39	IC	ID		
	69,87	IC	IJ		
6600	39	IC	ID		
	87	IC	IJ	↓	
84-8600	All		IH	IS	

31-44 Series, Exc. Wagons use High Range Springs on left side and Low Range on right side.
All Wagons and 4800 Series use the Same Range Spring on both sides of car.

PROPELLER SHAFT

31-86 SERIES

CONTENTS OF SECTION 4A

Subject	Page
31-54 (54 WITH 350 CU. IN.)	
PERIODIC MAINTENANCE	4A-1
DESCRIPTION	4A-1
REMOVE AND INSTALL	4A-2
BEARINGS	4A-2
REMOVAL	4A-2
INSTALLATION	4A-3
54-86 WITH 455 CU. IN.	
PERIODIC MAINTENANCE	4A-3
DESCRIPTION	4A-4
54-86 WITH 455 CU. IN. (CONT.)	
REMOVE AND INSTALL	4A-4
BEARINGS - REMOVE	4A-4
SAGINAW	4A-4
SPICER	4A-5
BEARINGS - INSTALL	4A-5
SAGINAW AND SPICER	4A-5
31 THROUGH 86 SERIES	
SERVICE DIAGNOSIS	4A-6
DRIVE LINE ALIGNMENT	4A-6
SPECIFICATIONS	4A-8

31-54 (54 WITH 350 CU. IN.)

PERIODIC MAINTENANCE

The propeller shaft slip yoke does not require a scheduled lubrication interval. However, if stickiness at the slip yoke develops in models with Turbo Hydra-Matic transmission, it should be lubricated with one ounce of lubricant, No. 1050169 or equivalent. Universal joints, under both hot and cold weather conditions, do not require a scheduled lubrication interval.

DESCRIPTION

The rear yoke shaft on all Automatic Transmission equipped cars, is bonded in rubber to the inside of the propeller shaft tube and cannot be removed for service. The shaft used on manual transmission equipped cars is one piece.

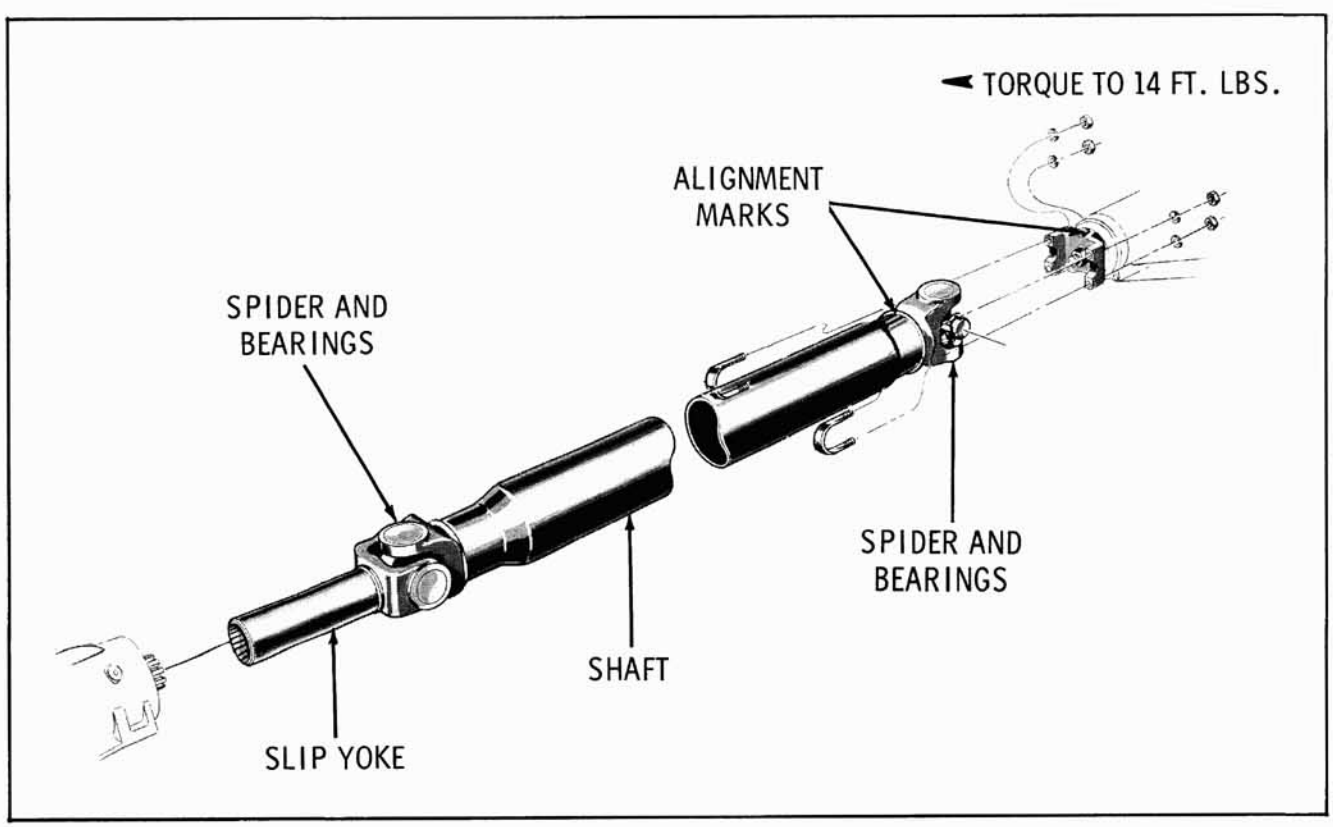


Fig. 4A-1—Propeller Shaft Installation

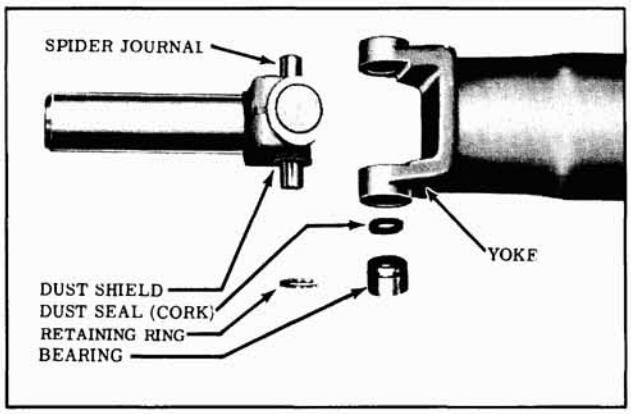


Fig. 4A-2—Universal Joint Bearings

The propeller shaft assembly is a balanced unit and should be kept free of undercoating or other material which could upset the balance.

Remove and Install (Fig. 4A-1)

1. Mark the companion flange and propeller shaft so they can be reinstalled in their original position.
2. Remove the four nuts and lockwashers from the U-bolt at the differential companion flange.
3. If the companion flange U-joint bearings are not retained with a metal retaining strap, use a piece of wire or tape to hold bearings on their spider journals.
4. Lower the rear of the shaft and slide rearward.

To install, reverse removal procedure. Torque U-bolt nuts to 14 ft. lbs.

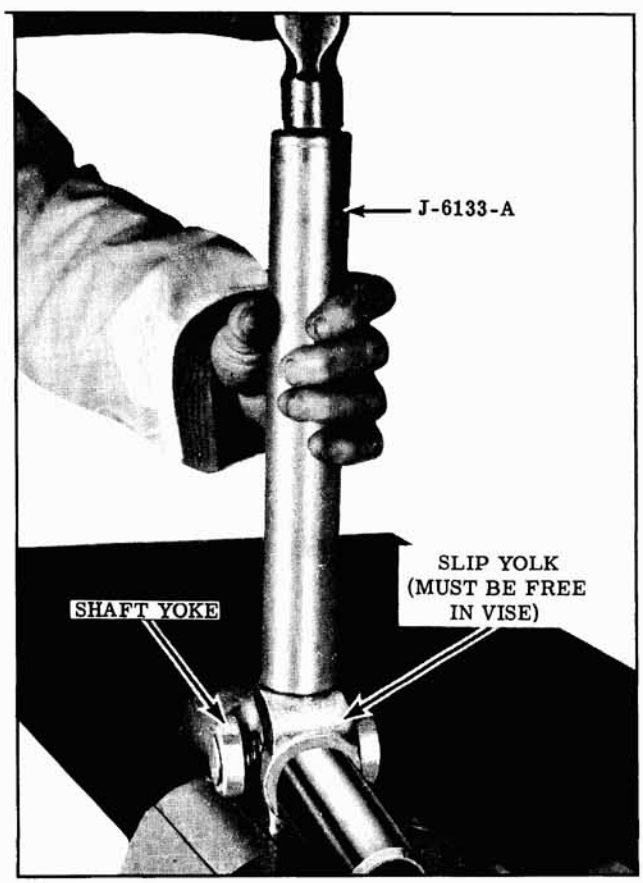


Fig. 4A-3—Partial Bearing Removal

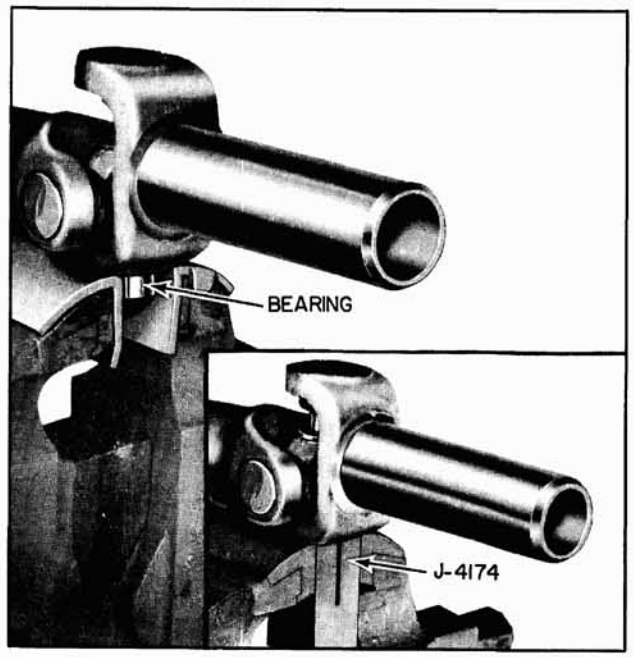


Fig. 4A-4—Bearing Removal

UNIVERSAL JOINT BEARINGS-REMOVAL (Fig. 4A-2)

1. With propeller shaft removed from the car, remove all bearing retaining rings.

Mark both yoke and shaft so that the units may be reassembled in their original position in order to maintain the original balance.

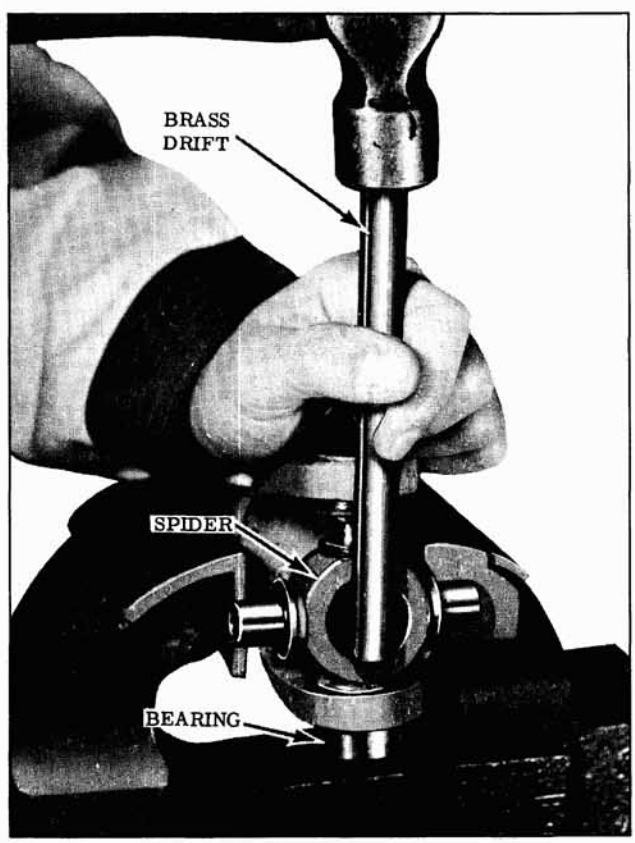


Fig. 4A-5—Partial Bearing Removal

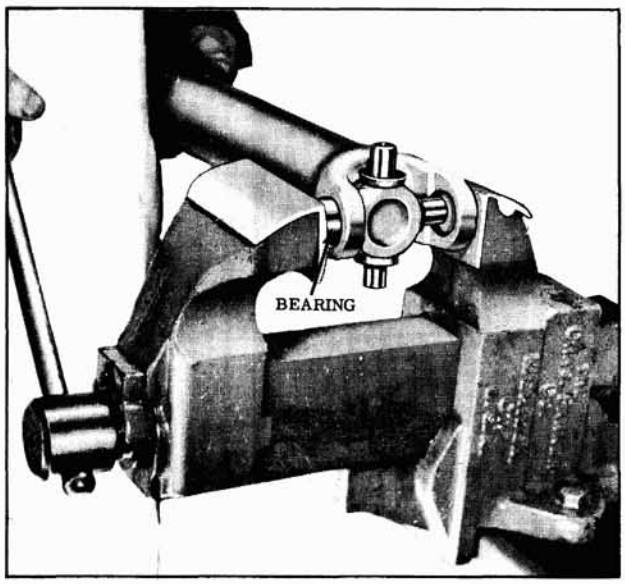


Fig. 4A-6—Installing Bearings

2. Position the slip yoke end of propeller shaft on a vise so that the shaft yoke rests on top of the vise jaws. The slip yoke must be free to move vertically between jaws of vise.

3. Apply force on yoke around bearing. (Fig. 4A-3) This will drive the slip yoke down, causing spider to force bearing partially out of yoke.

4. Clamp the partially exposed bearing in a brass jawed vise, then tap yoke until bearing is removed. (Fig. 4A-4) Remove bearing from vise.

The use of Tool J-4174 will facilitate removal of bearings. (Inset, Fig. 4A-4)

5. Remove slip yoke from spider.

6. Clamp shaft yoke in vise.

Do not clamp the propeller shaft tube in a vise.

7. Drive on spider until bearing is partially forced out of yoke. (Fig. 4A-5)

8. Clamp partially exposed bearing in a brass jawed vise and tap on yoke until bearing is removed.

9. To remove opposite bearing, repeat Steps 7, 8 and 9.

10. Remove spider from shaft yoke.

11. Remove spider and bearings.

Installation

1. Press dust seal into recess.

2. If new dust shields are to be installed, install at this time.

3. Position a spider journal in a shaft yoke.

4. Press a bearing into one side of yoke until retaining ring can be installed. (Fig. 4A-6)

5. Install retaining ring. Retaining rings must be installed with the gap toward the yoke.

6. Repeat Steps 4 and 5 on opposite bearing. As the bearing is installed, align spider journal with the bearing.

7. To install the slip yoke, position the yoke over the spider journal with scribe marks aligned and repeat Steps 4, 5 and 6.

8. Position bearings which attach to a companion flange onto the spider journals and retain with wire or tape.

54-86 WITH 455 CU. IN.

PERIODIC MAINTENANCE

The propeller shaft slip yoke does not require a scheduled lubrication interval. However, if at high mileage a tendency for stickiness should develop at the slip yoke, it should be lubricated with one ounce of Lubricant, No. 1050169 or equivalent. Universal joints, under both hot or cold weather conditions, do not require a scheduled lubrication interval.

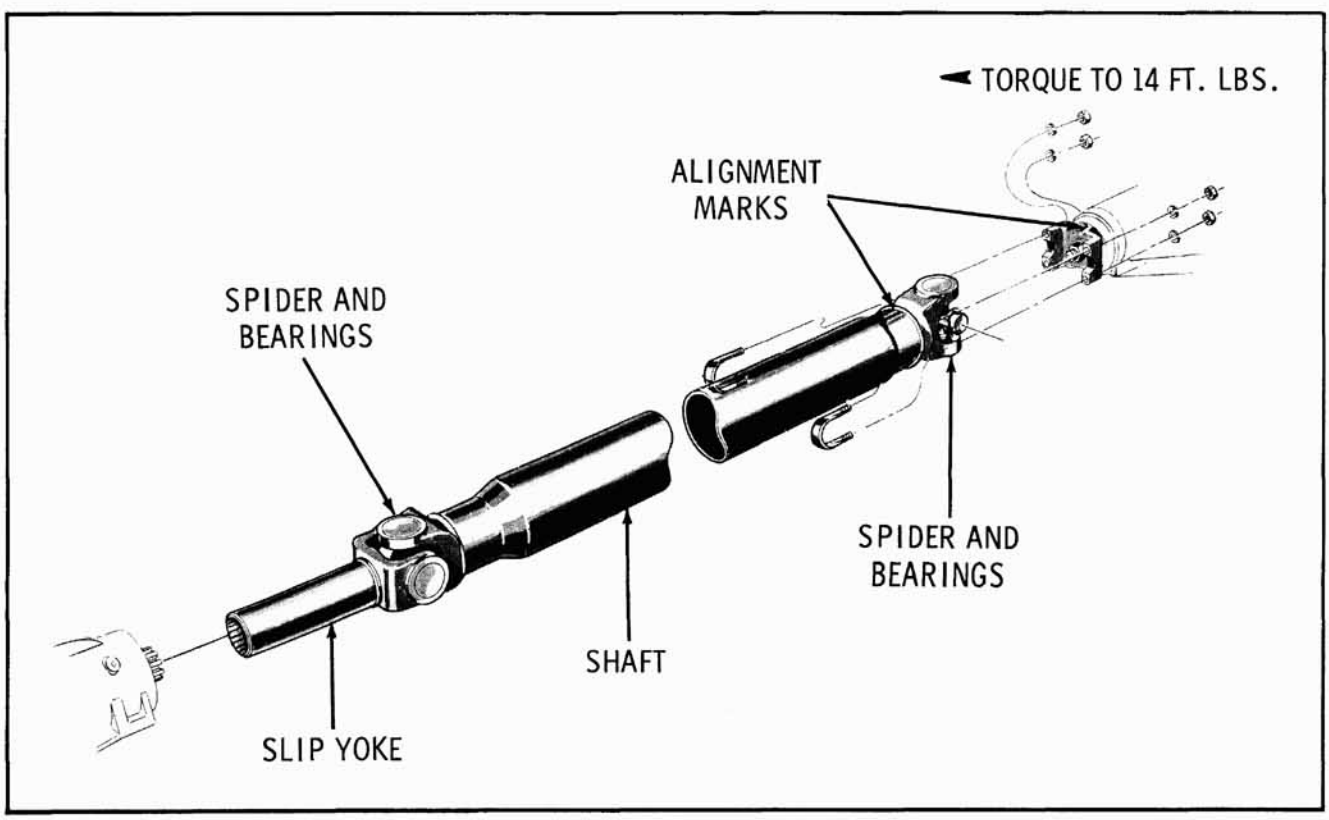


Fig. 4A-7—Propeller Shaft Installation

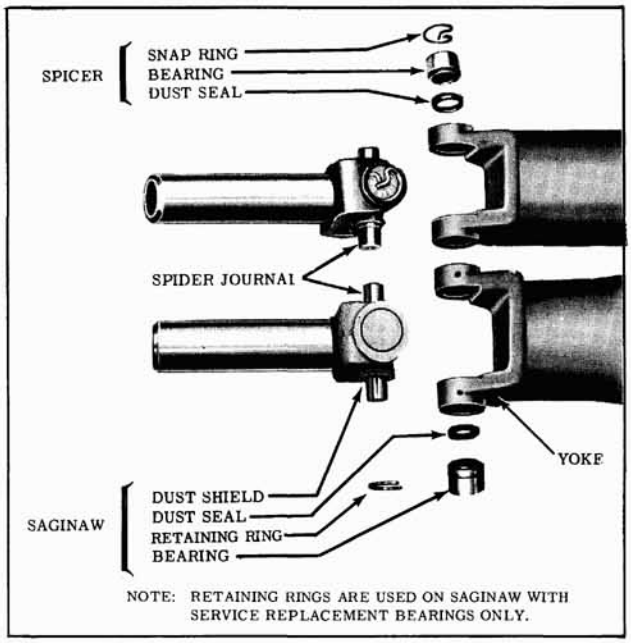


Fig. 4A-8—Propeller Shaft Identification

DESCRIPTION (Fig. 4A-7)

The rear yoke shaft is bonded in rubber to the inside of the propeller shaft tube and cannot be removed for service.

Both Saginaw and Spicer propeller shaft assemblies are used. Refer to Fig. 4A-8 for identification.

The propeller shaft assembly is a balanced unit and should be kept free of undercoating or other material which could upset the balance.

Remove and Install

1. Mark the companion flange and the propeller shaft so that they can be reinstalled in their original location.
2. Remove the nuts and lockwashers from the four U-bolts and remove the U-bolts from the differential companion flange.
3. If the companion flange U-joint bearings are not retained with a metal retaining strap, use a piece of wire or tape to hold bearings on their spider journals.

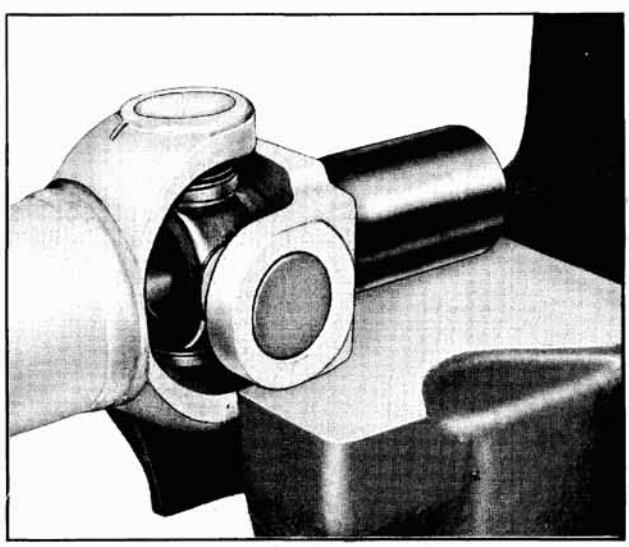


Fig. 4A-9—Supporting Propeller Shaft

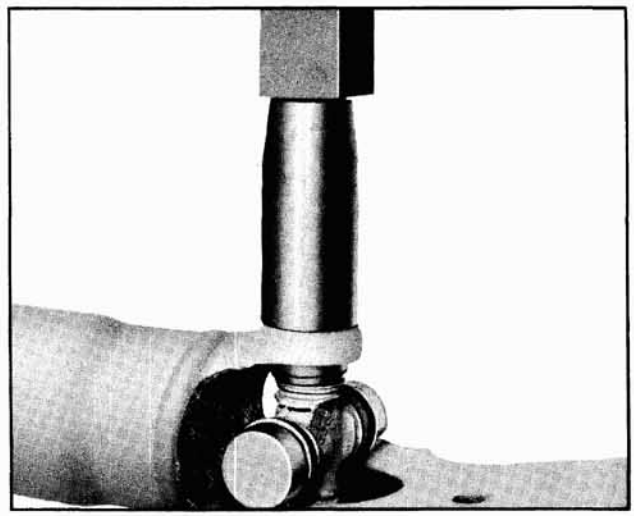


Fig. 4A-10—Pressing Out Bearings

4. Lower the rear of the shaft and slide rearward.

To install, apply one ounce of Lubricant, No. 1050169 or equivalent to the splines of the slip yoke (Automatic Transmission only) and reverse removal procedure. Torque U-bolt nuts to 14 ft. lbs.

UNIVERSAL JOINT BEARINGS—REMOVE

Saginaw Type (Fig. 4A-8)

Production Saginaw propeller shafts use an internally molded nylon retainer to retain the universal joint bearings to the yoke. When servicing this type of bearing, the molded nylon retainer is sheared when the bearing is disassembled and new bearings with metal retaining rings must be reinstalled.

1. With propeller shaft removed from the car, remove all bearing retaining rings if so equipped.

Mark both yoke and shaft so that the units may be reassembled in their original position in order to maintain the original balance.

2. Support splined yoke on a press bed with the rear of the propeller shaft on a stand so shaft is horizontal. Be sure the weight is evenly distributed on each side of the splined yoke

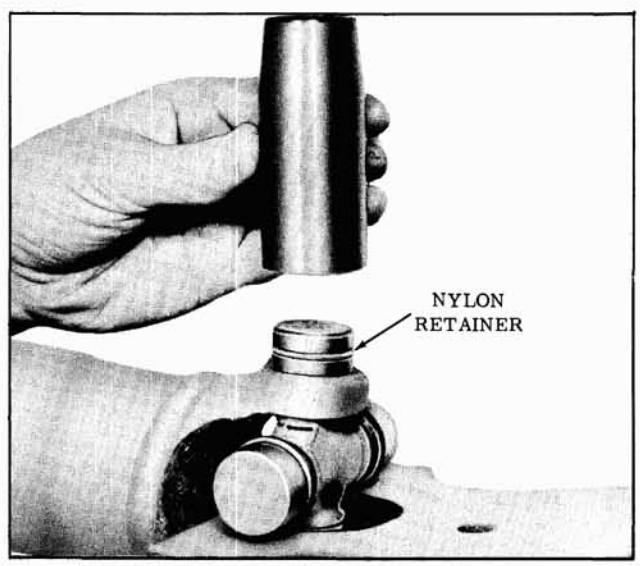


Fig. 4A-11—Partial Bearing Removal

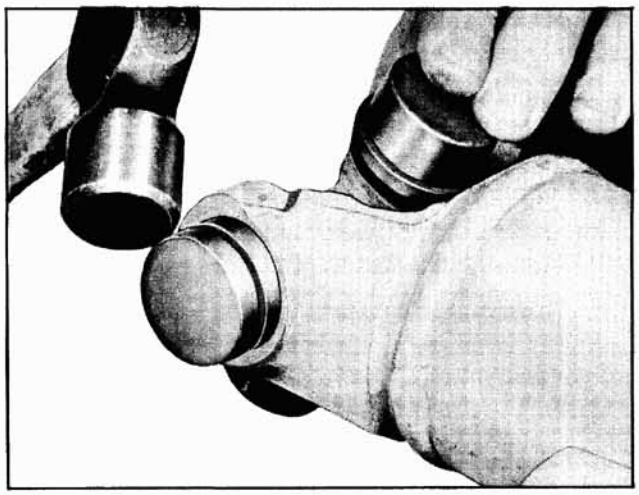


Fig. 4A-12—Removing Bearing

and that the fixed yoke half of the U-joint is free to move downward. (Fig. 4A-9)

3. Using a piece of pipe or similar tool with a diameter sufficiently large to encircle bearing (slightly larger than 1-1/8 inches), apply force on fixed yoke until nylon retainer breaks. (Fig. 4A-10) Continue to apply force until the downward movement of the yoke and the stationary position of the journal forces the bearing almost completely out of yoke. (Fig. 4A-11)

4. Rotate the propeller shaft 180° and repeat Step 3 to partially remove opposite bearing.

5. Completely remove bearings by tapping around circumference of exposed portion with a hammer. (Fig. 4A-12)

6. Remove splined yoke and journal from fixed yoke.

7. Remove bearings and journal from splined yoke.

8. Remove bearings and journal from fixed yoke in a similar manner.

Spicer Type (Fig. 4A-8)

1. With propeller shaft removed, remove all retaining rings that retain bearings in the yoke.

Mark the slip yoke and fixed yoke, so that the units may be reassembled in their original position to maintain original balance.

2. Press the bearings from the yoke as shown in Fig. 4A-13.

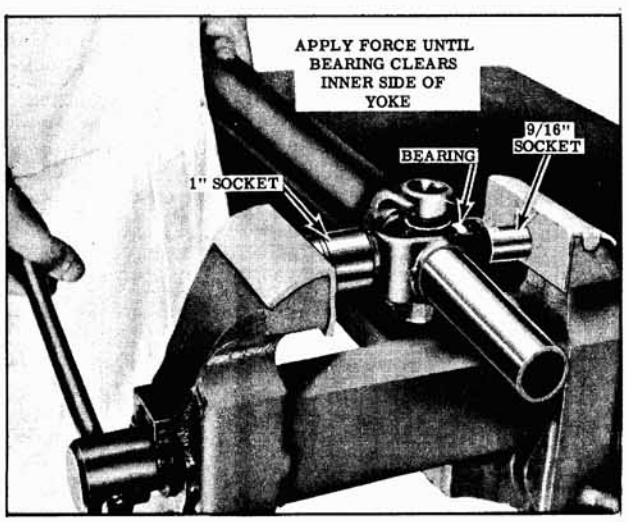


Fig. 4A-13—Pressing Bearing From Yoke (Spicer)

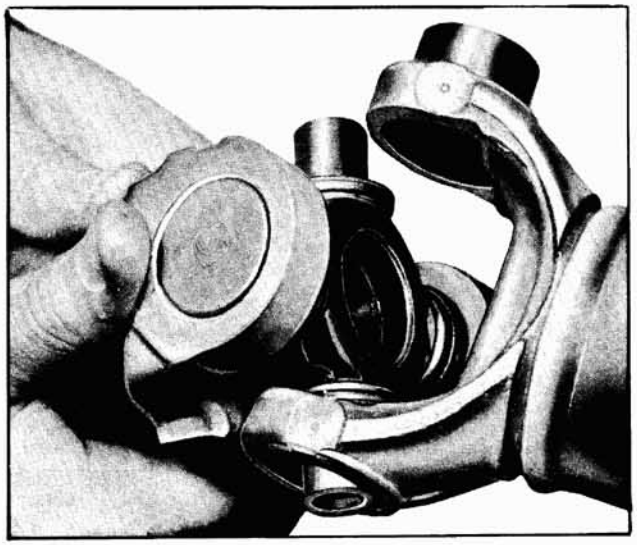


Fig. 4A-14—Installing Spider Journal

Continue pressing until bearing which is pushed by the 9/16" socket clears inner side of yoke.

3. Remove propeller shaft and sockets from vise.

4. If exposed bearing on the outer side of yoke is still tight, clamp bearing in a brass jawed vise and tap yoke until bearing is free.

5. Remove slip yoke from spider. Remove bearing from spider journal.

6. To remove bearings from the fixed yoke, repeat Step 2.

7. Clamp exposed bearing in a brass jawed vise and tap yoke until bearing is free.

8. Remove spider from the fixed yoke.

9. The bearings can be removed from the rear fixed yoke in a similar manner.

UNIVERSAL JOINT BEARINGS—INSTALL

Saginaw and Spicer

1. Install neoprene dust seals on the bearings.
2. Install dust shields on Saginaw spiders.
3. Position a spider journal in a shaft yoke. (Fig. 4A-14)

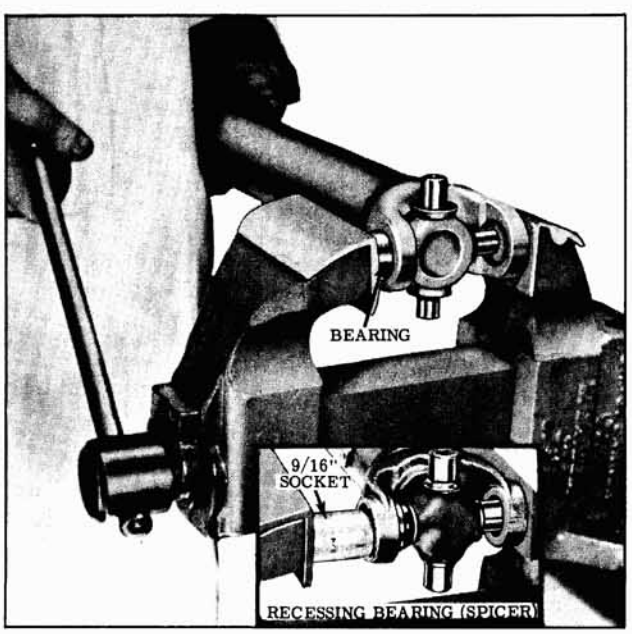


Fig. 4A-15—Installing Bearings

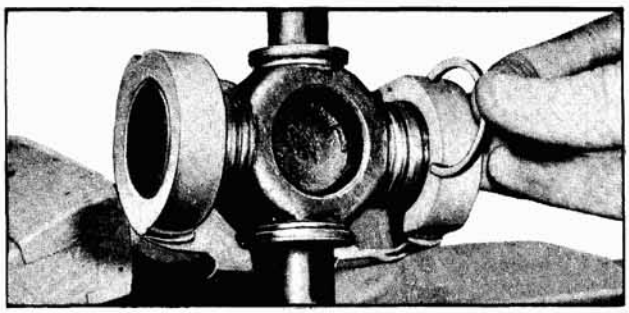


Fig. 4A-16—Installing Retaining Rings (Saginaw)

4. Press a bearing into one side of yoke until retaining ring can be installed. (Fig. 4A-15)

On Spicer units, the bearing must be recessed into the yoke so that the retaining ring can be installed. The bearing can be recessed with a 9/16" socket and vise. (Inset, Fig. 4A-15).

5. Install retaining rings. Retaining rings on Saginaw units must be installed with the gap toward the yoke. (Fig. 4A-16)

6. Repeat Steps 4 and 5 on opposite bearing. As the bearing is installed, align spider journal with the bearing.

7. To install the slip yoke, position the yoke over the spider journal with scribe marks aligned and repeat Steps 4, 5 and 6.

8. Position bearings which attach to a companion flange, onto the spider journals and retain with wire or tape.

31 THROUGH 86 SERIES

SERVICE DIAGNOSIS

PROPELLER SHAFT VIBRATION

Possible Causes:

1. Worn spider.
2. Worn universal bearings or needle bearings missing.
3. Propeller shaft sprung or out-of-balance.
4. Undercoating on shaft.
5. Loose companion flange nut.
6. Shifted springs.
7. Weak springs.
8. Joint not seated in companion flanges.
9. Excessive companion flange radial runout.
10. Excessive propeller shaft runout.
11. Spring pads not welded at the same angle.
12. Bent transmission or pinion flanges (check with dial indicator).
13. Sprung transmission output shaft and/or rear axle pinion (check with dial indicator).
14. Rear springs not matched.
15. Bent rear axle housing.
16. Rear frame section at kickup may be humped due to the car being hit in the car.
17. Drive shaft and iniversal joints 180° out of phase.
18. Over torqued U-bolts.
19. Tight U-joints.

UNIVERSAL JOINT NOISE

Possible Causes:

1. Improper lubrication.
2. Worn universal joint bearings.
3. Propeller shaft flange bolts loose.
4. Brinnelled spider.

DRIVE LINE ALIGNMENT

Proper alignment of the drive line components is necessary to provide vibration free operation through all speed ranges and driving conditions.

Shudder on acceleration and/or vibration while driving or during braking can be the result of misalignment of the drive line.

The available Drive Shaft Alignment Kit, BT-6511 can be used to check drive line alignment.

CHECKING (31-86 SERIES)

Use only "Drive-on "or" Twin Post Hoist".

Remove rear stabilizer bar if so equipped before lifting car to check propeller shaft alignment.

1. Install Differential Guide Plate on differential. (Fig. 4A-18) Special spacers and bolts are provided with the guide plate to space it away from the cover plate flange.

2. Install Cable BT-6511-5A. Fasten the cable hook over center of bumper at license support. Assemble the ring end of the cable over the guide plate pulley and attach a 20 lb. weight to the ring as shown. Do not drop weight to tighten cable.

3. a. Except L-6 - Install Spacer BT-6511-10 so that it rests against the machined surface of the crankshaft pulley and contacts the timing cover and the spacer locator on the cable.

b. L-6: Install Spacer BT-6724 so that it is positioned in front of oil pan bolt and against oil pan, also against spacer locator on the cable.

4. Select the correct wood blocks for the series car being checked and install between the rear axle housing and frame. Blocks must rest solidly on axle housing. Not on casting flash, dirt, etc.

5. Install Hold-Down Clamps BT-6511-17 as shown in Fig. 4A-18. Install upper hook through hole in frame and lower hook around shock mount. Adjust turnbuckles on clamps until wood blocks fit snugly between axle housing and frame. Hold down on rear bumper while adjusting turnbuckle.

The above adjustment is very critical for accurate measurement of transmission angle and should be performed carefully.

6. To check alignment, place a steel scale against the machined surface of the splined yoke immediately next to the rear transmission seal, exc. 442 with THM. Refer to Fig. 4A-18, read measurement to top of cable. Record measurement.

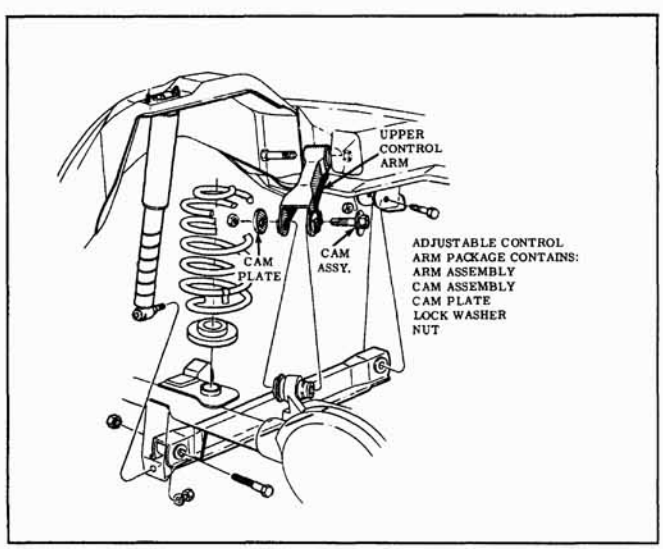
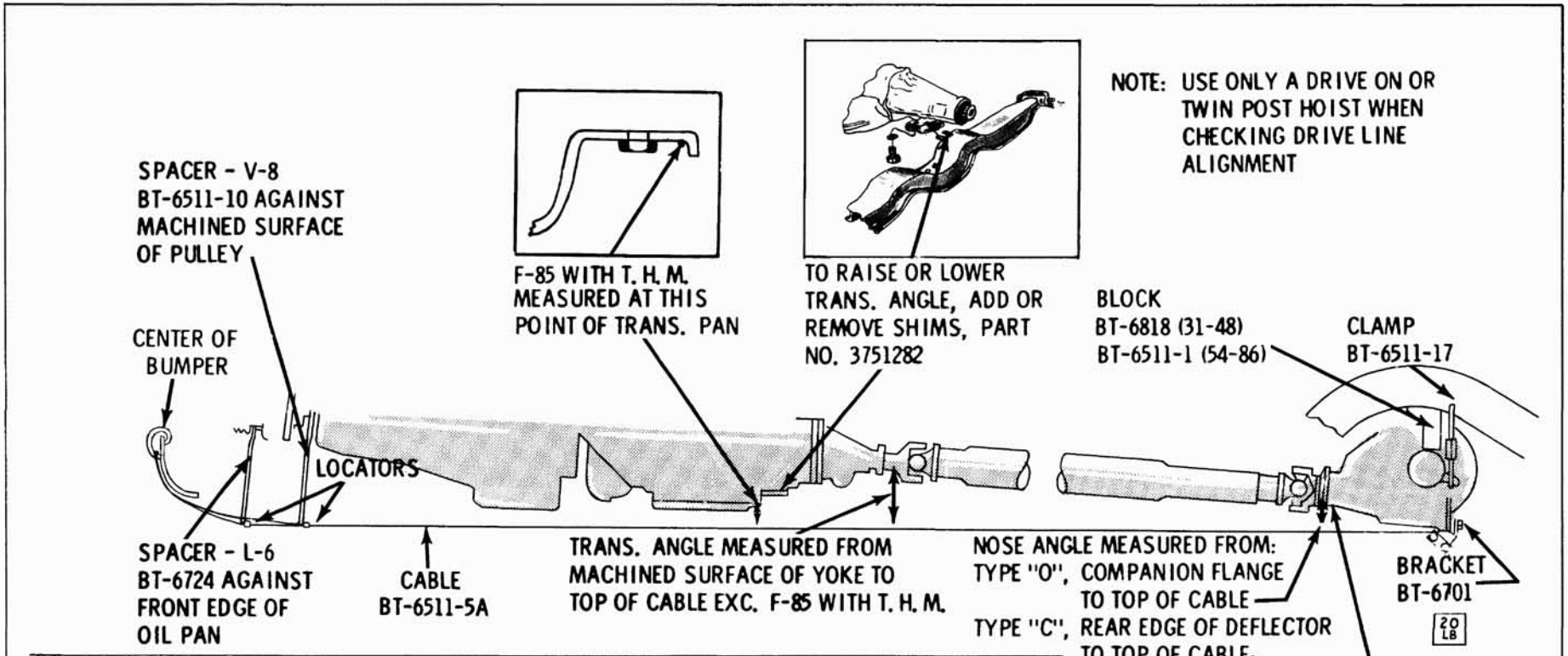


Fig. 4A-17—Adjustable Control Arm Installation



MODEL	TYPE "O"		TYPE "C"	
	TRANS. ANGLE	NOSE ANGLE	TRANS. ANGLE	NOSE ANGLE
F-85				
L-6	5-17/32"	2-9/16"	5-19/32"	2-5/16"
ALL V-8 WITH J. T.	5-3/8"	2-9/16"	5-7/16"	2-5/16"
ALL V-8 WITH T. H. M. EXC. EXT. S. W.	3-1/4"	2-9/16"	3-9/32"	2-5/16"
ALL V-8 WITH M. T. EXC. EXT. S. W.	5-7/16"	2-9/16"	5-1/2"	2-5/16"
EXT. S. W. WITH T. H. M.	4-11/16"	2-1/2"		
EXT. S. W. WITH M. T.	5-31/32"	2-1/2"		
54-86 SERIES				
M. T. EXC. 5400 WITH 350 CU. IN.	5-11/16"	2-15/16"		
T. H. M. EXC. 5400 WITH 350 CU. IN.	5-15/32"	2-15/16"		
M. T. 5400 WITH 350 CU. IN.	5-13/16"	2-5/8"		
J. T. 5400 WITH 350 CU. IN.	5-13/16"	2-5/8"		
T. H. M. 5400 WITH 350 CU. IN.	5-11/32"	2-19/32"		

ALL SPECIFICATIONS LISTED HAVE AN ALLOWABLE TOLERANCE OF ± 3/32"

Fig. 4A-18—Drive Line Alignment

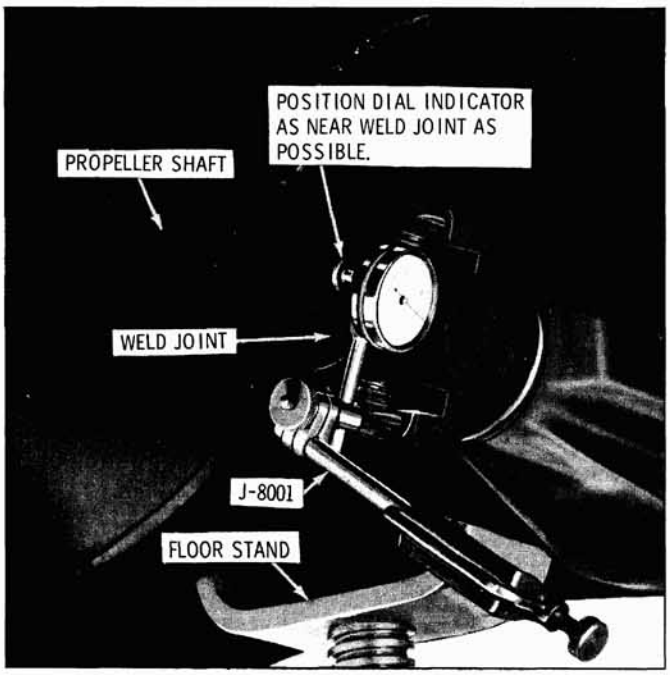


Fig. 4A-19—Checking Propeller Shaft Runout

7. Type "O" place steel scale against differential companion flange and measure to top of cable. Record measurement and compare measurements with chart shown in Fig. 4A-18.

Type "C" measured from bottom rear edge of deflector to the top of cable as shown in Fig. 4A-18.

8. If not within specifications, make corrections as follows.

DRIVE LINE CORRECTIONS

1. To lower transmission angle on 54 through 86 Series, remove shims from beneath transmission mount as necessary to obtain specified dimension.

31 through 48 Series do not have a provision for lowering the transmission since the transmission is mounted directly to the support.

2. To raise transmission angle, add shims as necessary to obtain the correct angle.

Use care when installing shims on 31 through 48 Series to avoid contact between transmission and floor pan.

3. To adjust differential nose angle, remove upper control arms and replace with Adjustable Control Arm Package (two required per car). The adjustable arm package includes an adjustable cam assembly that is used to obtain correct nose angle.

4. Install arms, (Fig. 4A-17) assemble cam so that alignment marks are centered and tighten cam assembly nuts finger tight.

5 Adjust nose angle by rotating either cam bolt until correct measurement is obtained.

6. Tighten nut and note alignment marks on cam and arm. Rotate opposite cam so that alignment marks are identical, tighten nut and recheck nose angle. If necessary, loosen nuts and readjust.

PROPELLER SHAFT RUNOUT

1. Mark propeller shaft and companion flange with chalk so that original positioning can be determined.

2. Install dial indicator as shown in Fig. 4A-19.

3. Check runout of the propeller shaft just ahead of the weld joint as shown in Fig. 4A-19. If balance weights are welded close to weld joint, move just forward of weights and check runout.

Do not check runout on large rubber insulated portion of propeller shaft.

4. Record runout.

5. Disconnect propeller shaft from companion flange, rotate shaft 180° and reinstall. Torque nuts to 14 ft. lbs.

When propeller shaft is disconnected from companion flange, check bearing surfaces and mating surfaces of companion flange for nicks or foreign material. If nicks or foreign material are found, then clean up and reinstall propeller shaft in original position and perform Steps 2, 3 and 4. Then continue with Step 5.

6. Check runout and record.

If .015" or less runout was recorded on either check (Steps 4 or 6), leave propeller shaft in the position where the least runout was recorded.

If .016" or more runout was recorded on both checks (Steps 4 and 6), discard shaft and install new propeller shaft and recheck new shaft for runout as described above.

SPECIFICATIONS

PROPELLER SHAFT

Length (From Centerline of Front U-Joint to Centerline of Rear U-Joint).

F-85	
Sedans or Wagon-T.H.M.	59.10"
Sedans or Wagon-M.T. or J.T.	60."
Coupes-T.H.M.	55.10"
Coupes-M.T. or J.T.	56."
Vista Cruiser-M.T.	65.04"
Vista Cruiser-T.H.M.	58.26"
54-86 Series	
54 With 350 Cu. In.-M.T.	59.50"
54 With 350 Cu. In.-J.T.	59.69"
54 With 350 Cu. In.-T.H.M.	59.23"
54-64-66 With 455 Cu. In.-S.M.	58.56"
54-64-66 With 455 Cu. In.-T.H.M.	58.37"
84-86 With T.H.M.	61.37"

TORQUE

Propeller Shaft to Companion Flange Nuts	14 Ft. Lbs.

DIFFERENTIAL

31 THROUGH 86 SERIES TYPE "O"
31 THROUGH 44 SERIES TYPE "C"

Oldsmobile Chevrolet dual dealers use Chevrolet tools and procedure for the "C" type differential. Positive identification of differential is required before any repairs are made. (Fig. 4B-1) Type "O" differential is basically the same as used in previous years. Type "C" differential is NEW and requires removal of "C" lock from axle shaft inside of case assembly before axle shafts can be removed and repair performed. Refer to appropriate procedures listed below.

CONTENTS OF SECTION

Subject	Page
PERIODIC MAINTENANCE	4B-2
MINOR SERVICE OPERATIONS	4B-2
PINION OIL SEAL REPLACEMENT	4B-2
COMPANION FLANGE REPLACEMENT	4B-3
AXLE SHAFT - TYPE "O"	4B-4
DESCRIPTION	4B-4
REMOVAL	4B-4
AXLE SHAFT BEARING - TYPE "O"	4B-4
REMOVE AND INSTALL	4B-4
AXLE SHAFT FLANGE BOLT - TYPE "O"	4B-4
REMOVE AND INSTALL	4B-4
AXLE SHAFT SEAL - TYPE "O"	4B-5
REMOVE AND INSTALL	4B-5
AXLE SHAFT - TYPE "O"	4B-5
INSTALLATION	4B-5
AXLE SHAFT - TYPE "C"	4B-6
REMOVAL	4B-6
WHEEL BOLT REPLACEMENT - TYPE "C"	4B-6
OIL SEAL AND/OR BEARING - TYPE "C"	4B-6
BRAKE BACKING PLATE - TYPE "C"	4B-6
INSTALLATION	4B-7
REAR AXLE HOUSING - TYPE "O" AND "C"	4B-7
REMOVAL	4B-7
INSTALLATION	4B-7
DISASSEMBLY OF DIFFERENTIAL ASSEMBLY - TYPE "O"	4B-9
DIFFERENTIAL CASE - TYPE "O"	4B-9
REMOVE	4B-9
DISASSEMBLY	4B-10
DRIVE PINION - TYPE "O"	4B-10
REMOVE	4B-10
DISASSEMBLY	4B-11
CLEANING AND INSPECTION	4B-11
DRIVE PINION - TYPE "O"	4B-12
ASSEMBLY	4B-12
ADJUSTING PINION DEPTH	4B-12
DIFFERENTIAL CASE - TYPE "O"	4B-14
ASSEMBLY	4B-14
SIDE BEARING PRE-LOAD ADJUSTMENTS	4B-15
DRIVE PINION - TYPE "O"	4B-16
INSTALLATION	4B-16
DIFFERENTIAL BACKLASH ADJUSTMENT- TYPE "O"	4B-17
DISASSEMBLY OF DIFFERENTIAL ASSEMBLY - TYPE "C"	4B-19
DIFFERENTIAL CASE - TYPE "C"	4B-19
REMOVAL	4B-19
DRIVE PINION - TYPE"C"	4B-20
REMOVE	4B-20
DISASSEMBLY	4B-21
CLEANING AND INSPECTION	4B-21
DRIVE PINION - TYPE "C"	4B-21
ASSEMBLY	4B-21
ADJUSTING PINION DEPTH - TYPE "C"	4B-22
RING GEAR - TYPE "C"	4B-23
INSTALLATION	4B-23
SIDE BEARING - TYPE "C"	4B-23
INSTALLATION	4B-23
SIDE BEARING PRE-LOAD ADJUSTMENT - TYPE "C"	4B-23
DRIVE PINION - TYPE "C" INSTALLATION	4B-25
DIFFERENTIAL BACKLASH ADJUSTMENT - TYPE "C"	4B-25
ANTI-SPIN DIFFERENTIAL - TYPE "O"	4B-27
DESCRIPTION	4B-27
OPERATION	4B-27
ANTI-SPIN CONVERSION INFORMATION	4B-27
DIFFERENTIAL CASE - TYPE "O"	4B-27
DISASSEMBLY	4B-27
CLEANING AND INSPECTION	4B-27
DIFFERENTIAL CASE - TYPE "O"	4B-28
ASSEMBLY	4B-28
ANTI-SPIN DIFFERENTIAL - TYPE "C"	4B-30
DESCRIPTION	4B-30
OPERATION	4B-30
ANTI-SPIN CONVERSION INFORMATION	4B-31
DIFFERENTIAL CASE AND DRIVE PINION - TYPE "C"	4B-31
DISASSEMBLY	4B-31
INSPECTION	4B-31
ASSEMBLY	4B-32
DIAGNOSIS	4B-33
ANTI-SPIN OPERATION	4B-33
DIFFERENTIAL NOISE	4B-33
TIRE NOISE	4B-33
WHEEL BEARING NOISE	4B-33
ENGINE AND TRANSMISSION NOISE	4B-33
DIFFERENTIAL SIDE AND PINION GEAR NOISE	4B-33
RING GEAR AND PINION GEAR NOISE	4B-33
DRIVE PINION AND SIDE BEARING NOISE	4B-33
DIFFERENTIAL CLUTCH CHATTER ANTI-SPIN ONLY	4B-33
TORQUE SPECIFICATIONS	4B-33
SPECIFICATIONS	4B-34
SPEEDOMETER GEAR INFORMATION	4B-34
DIFFERENTIAL IDENTIFICATION CODE	4B-36
TOOLS TYPE "O"	4B-37
TOOLS TYPE "O"	4B-38
TOOLS TYPE "C"	4B-39

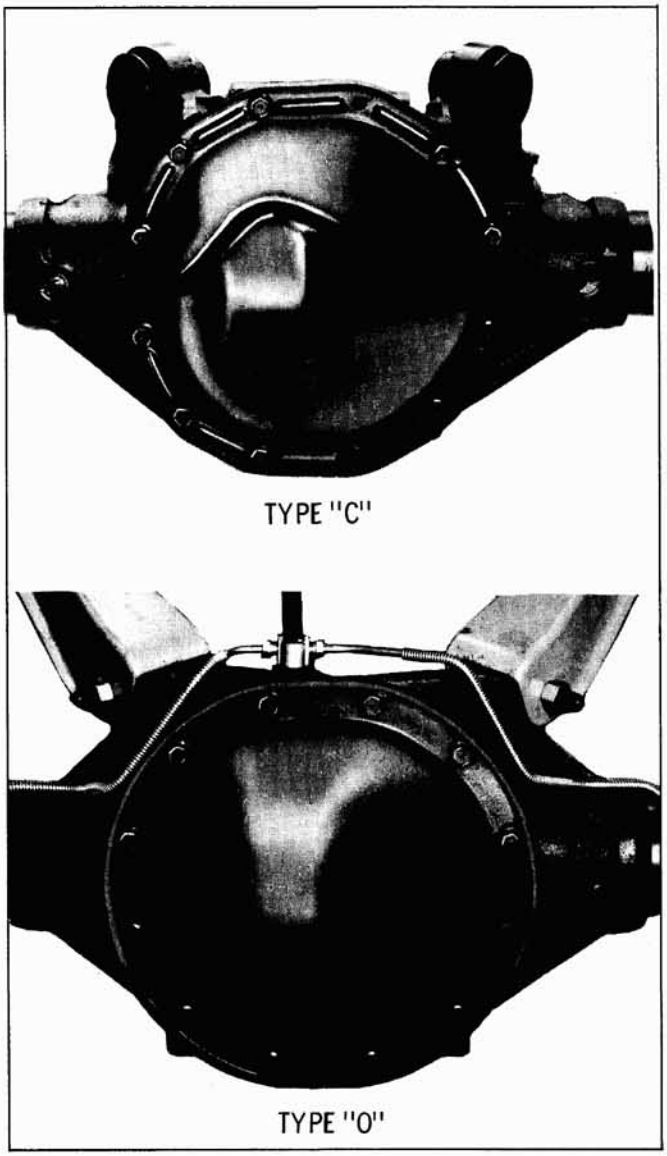


Fig. 4B-1—Differential Identification

PERIODIC MAINTENANCE

Periodic or seasonal lubricant changes are not recommended. The lubricant level should be checked at each oil change interval. If lubricant addition is required, add:

Conventional Differential: Special Lubricant, No. 1050081, or S.A.E. 90 Hypoid Gear Lubricant meeting the requirements of military specifications MIL-L-2105B.

Anti-Spin Differential: Only Special Lubricant, No. 1050081 or Lubricant which meets GM Specifications - GM 4744-M (OL134).

Use of other than the above mentioned type of lubricant in the Anti-Spin Differential will cause chatter. If the wrong type of lubricant is used in the Anti-Spin, it will require draining the differential and installing the recommended lubricant. It may be necessary to drive Anti-Spin equipped cars for distances of 50 miles or more to allow the new lubricant to work through the unit before the chatter will disappear.

MINOR SERVICE OPERATIONS

PINION OIL SEAL REPLACEMENT

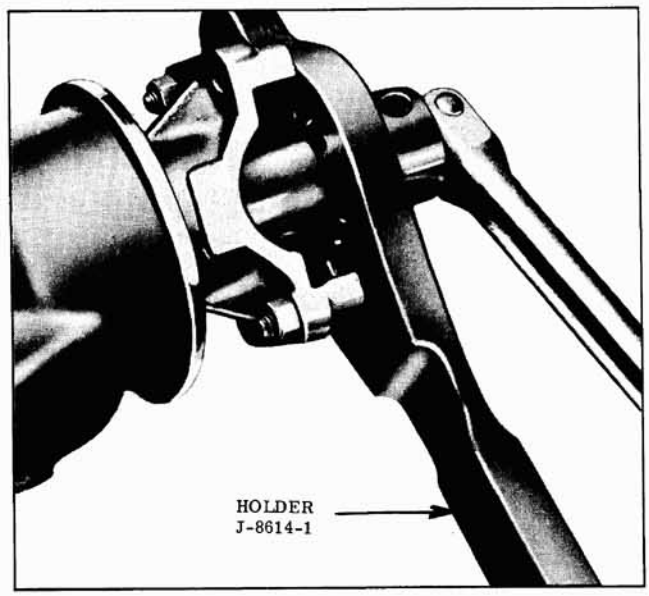


Fig. 4B-2—Removing Companion Flange Nut

1. Mark the propeller shaft and companion flange so they can be reassembled in the same position.
2. Disconnect propeller shaft from differential companion flange and support shaft up in body tunnel by wiring propeller shaft to the exhaust pipe. If U-joint bearings are not retained by a retainer strap, use a piece of wire to hold bearings on their journals.
3. Mark the position of the companion flange, pinion shaft and nut so the proper pinion bearing pre-load can be maintained.
4. Remove companion flange nut and washer. (Fig. 4B-2)
5. Remove companion flange. (Fig. 4B-3)
6. Remove oil seal by driving it out of carrier with a blunt chisel. (Fig. 4B-4)
7. Examine seal surface of companion flange for tool marks, nicks, or damage, such as a groove worn by the seal. If damaged, replace flange as outlined under COMPANION FLANGE REPLACEMENT.
8. Examine carrier bore and remove any burrs that might cause leaks around the O.D. of the seal.
9. Coat outside diameter of new seal sparingly with sealer,

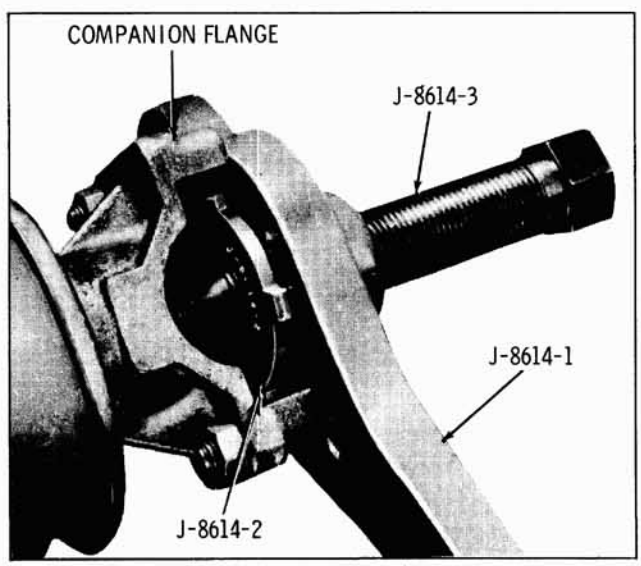


Fig. 4B-3—Removing Companion Flange

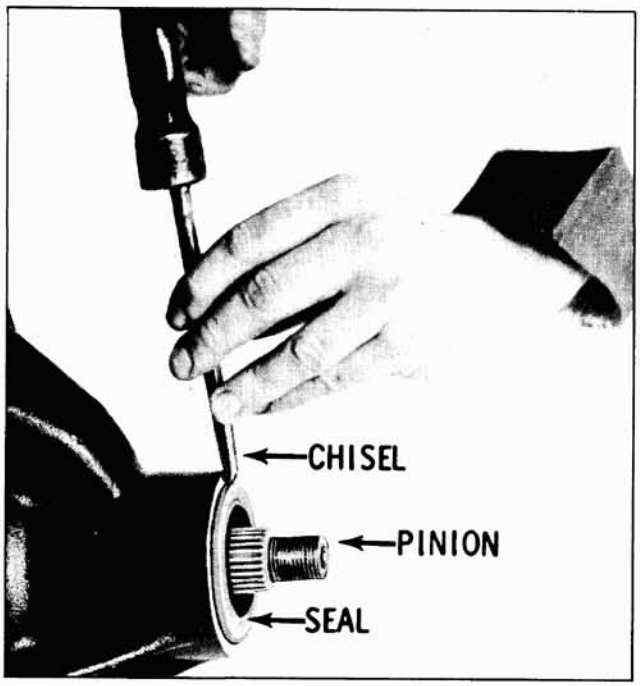


Fig. 4B-4—Removing Pinion Oil Seal

No. 1050026 or equivalent, and install seal. (Fig. 4B-5 Type "O") (Fig. 4B-6 Type "C")

10. Apply Special Seal Lubricant, No. 1050169 or equivalent, to the O.D. of the companion flange and sealing lip of new seal.

11. Install companion flange and tighten nut to the same position as marked in Step 2. While holding companion flange with Tool J-8614-1, tighten nut 1/16" beyond alignment marks.

COMPANION FLANGE REPLACEMENT

1. Raise car and remove both rear wheels and drums.
2. Remove both axle shafts.

Refer to Axle Shaft Removal: Type "O" or Type "C".

3. Mark propeller shaft and companion flange, then disconnect rear universal joint and support propeller shaft by tying propeller shaft to exhaust pipe. If U-joint bearings are not retained by a retainer strap, use a piece of wire to hold bearings on their journals.

4. Check pre-load with an inch pound torque wrench and record. This will give combined pinion bearing and carrier bearing pre-load. (Fig. 4B-7)

5. Remove companion flange nut and washer. (Fig. 4B-2)

6. Remove companion flange. (Fig. 4B-3)

7. Apply Special Seal Lubricant, No. 1050169 or equivalent, to the O.D. of the new companion flange then install companion flange, washer and companion flange nut finger tight.

8. While holding companion flange with Tool J-8614-1, tighten the nut a little at a time and turn drive pinion several revolutions after each tightening to set the rollers. Check the

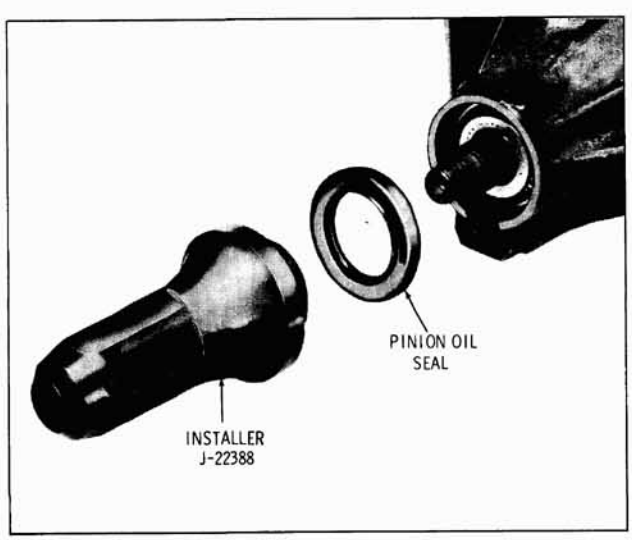


Fig. 4B-5—Installing Pinion Oil Seal (Type "O")

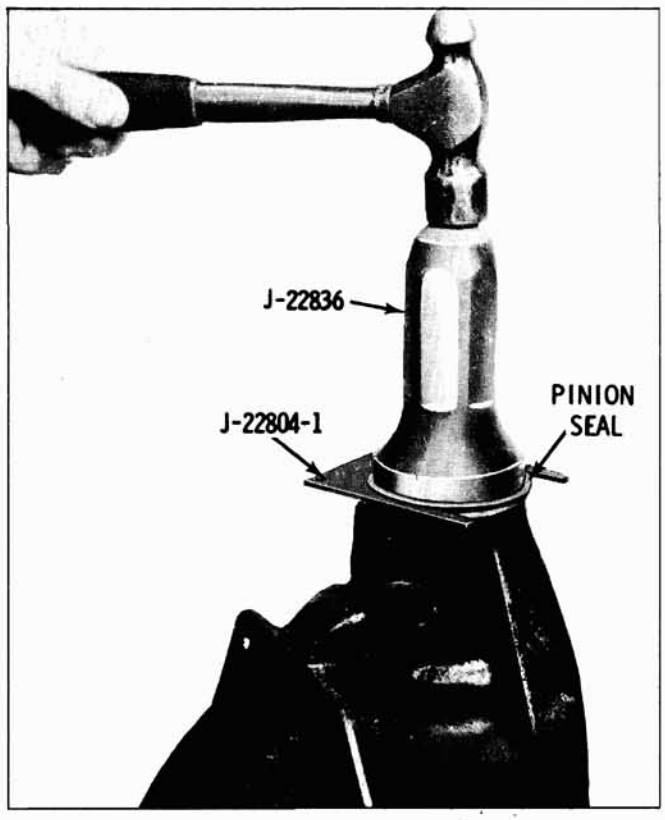


Fig. 4B-6—Installing Pinion Oil Seal (Type "C")

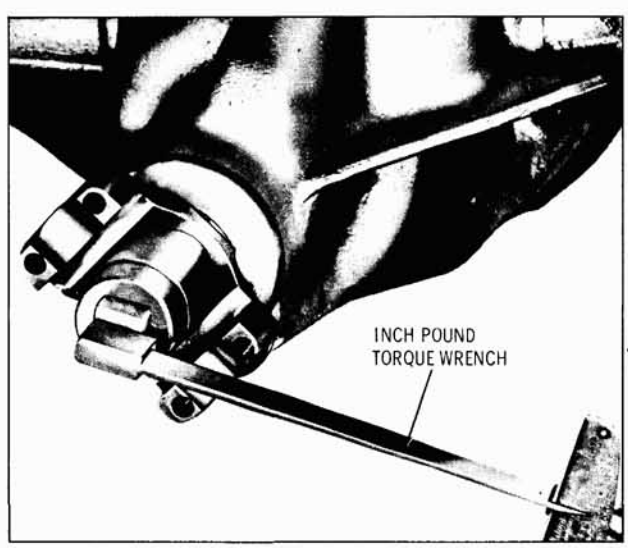


Fig. 4B-7—Checking Combined Bearing Preload

pre-load of bearings each time with an inch pound torque wrench until pre-load is 3-5 inch pounds more than reading obtained in Step 4.

9. Connect rear universal joint to differential companion flange.

10. Install axle shafts.

Refer to Axle Shaft Installation Type "O" or Type "C".

11. Install drums and wheels.

AXLE SHAFT—TYPE "O"

DESCRIPTION

Design allows for axle shaft end play up to .035" loose. This end play can be checked with the wheel and brake drum removed by measuring the distance between the end of the housing and the axle shaft flange while moving the axle shaft in and out by hand.

End play over .035" is excessive. Compensating for all of the end play by inserting a shim inboard of the bearing in the housing is not recommended, since it ignores the end play of the bearing itself and may result in improper seating of the gasket or backing plate against the housing. If the end play is excessive, the axle shaft and bearing assembly should be removed and the cause of the excessive end play determined and corrected.

Removal

1. Remove wheels and brake drums.

2. Remove nuts holding retainer plates to brake backing plates. Pull retainers clear of bolts and reinstall two lower nuts finger tight to hold brake backing plate in position.

3. Pull out axle shaft assemblies as shown in Figure 4B-8.

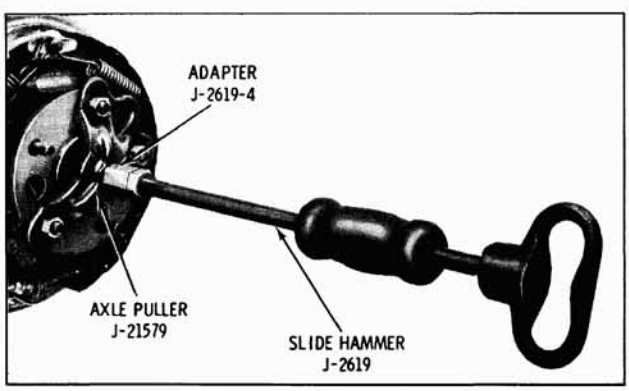


Fig. 4B-8—Removing Axle Shaft (Type "O")

While pulling axle shaft out through oil seal, support shaft carefully to avoid cutting seal lip.

AXLE SHAFT BEARING - TYPE "O"

Do not heat or cut bearing with a torch to remove as damage to axle shaft will result.

Remove and Install

1. Nick bearing retainer (inner) in three or four places with a chisel, deep enough to spread ring. Retainer will then slip off. (Fig. 4B-9)

2. Press axle shaft bearing from the axle shaft as shown in Figs. 4B-10 and 4B-11.

3. Retainer (outer) which retains bearing in the axle housing must be installed on the axle shaft before the bearing is installed. Press new axle shaft bearing and retainer (inner) against shoulder on axle shaft as shown in Figs. 4B-12 or 4B-13.

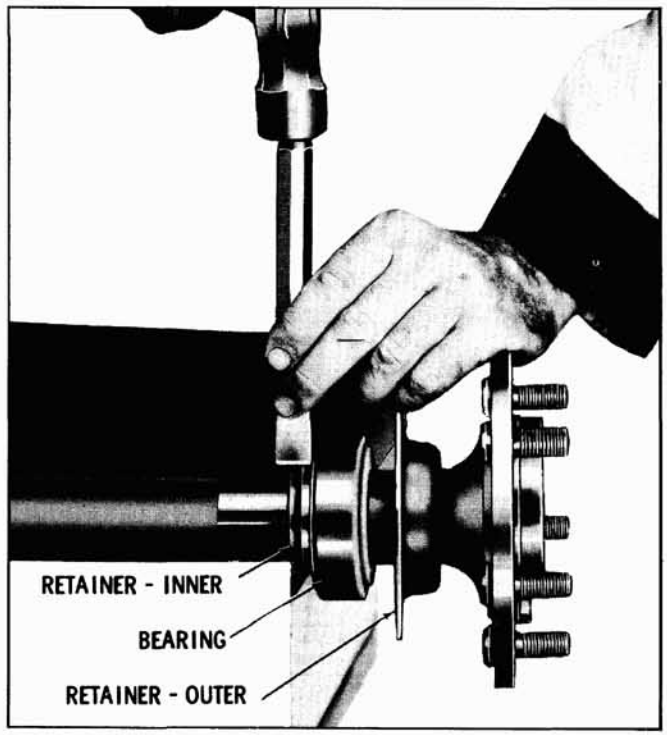


Fig. 4B-9—Removing Bearing Retainer (Inner) (Type "O")

AXLE SHAFT FLANGE BOLT - TYPE "O"

Remove and Install

1. To remove and install an axle shaft flange bolt, the axle shaft assembly must be out of car. Remove bolt by pressing from axle flange.

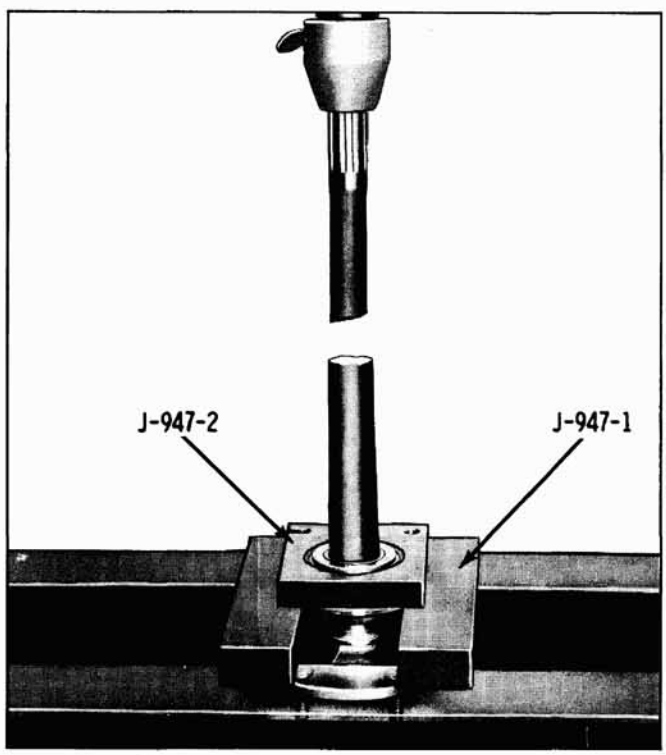


Fig. 4B-10—Removing Axle Bearing - 54-86 (Type "O") With 455 Cu. In.

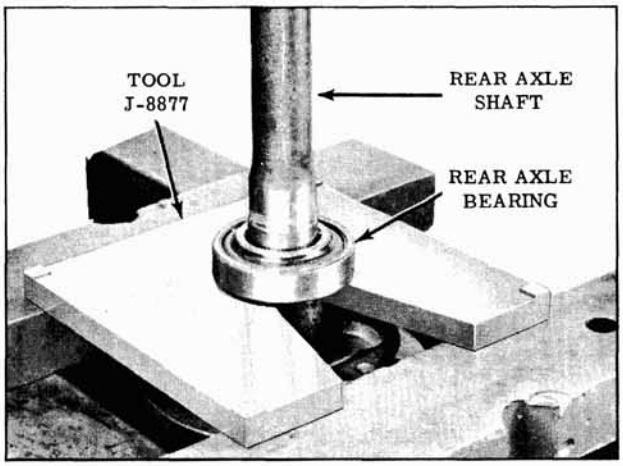


Fig. 4B-11—Removing Axle Bearing - 31-54 (Type "O")
54 With 350 Cu. In.

2. Install new bolt by pressing through axle flange. Support bolt head and peen bolt with Peening Tool J-554-18 (54 (455 cu. in.) through 86 series) and Peening Tool J-554-3 (for 31 through 54 (350 cu. in.) series).

AXLE SHAFT SEAL - TYPE "O"

Remove and Install

1. Remove the axle shaft.
2. Remove the axle shaft seal as shown in Fig. 4B-14.
3. Apply Sealer No. 1050026 or equivalent, to the O.D. of the new seal.
4. Install seal as shown in Fig. 4B-15. Make sure seal is fully seated.

AXLE SHAFT - TYPE "O"

Installation

1. Apply a coat of wheel bearing grease in bearing recesses of housing. To help prevent damage to the lip of the axle shaft seal when installing axle shaft and to insure lubricant on the seal lip during the first few miles of operation, the axle shaft should be lightly lubricated with axle lubricant from the sealing surface to approximately six inches inboard of the shaft. Insert axle shaft assemblies carefully until shaft splines

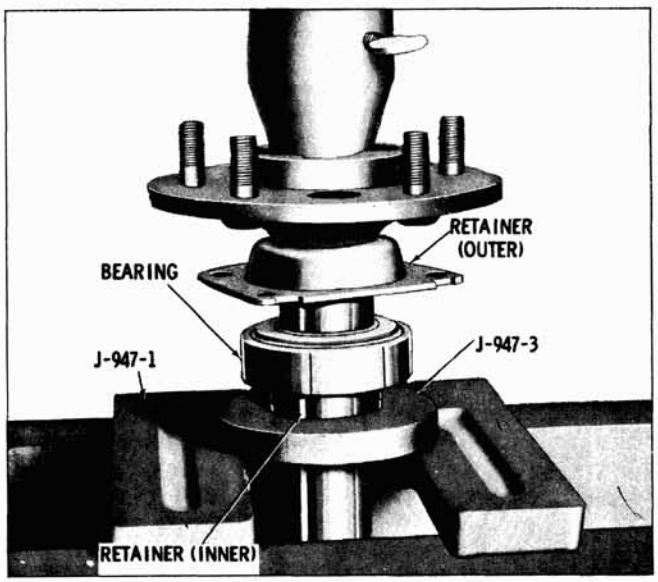


Fig. 4B-12—Installing Axle Bearing - 54-86 (Type "O")
With 455 Cu. In.

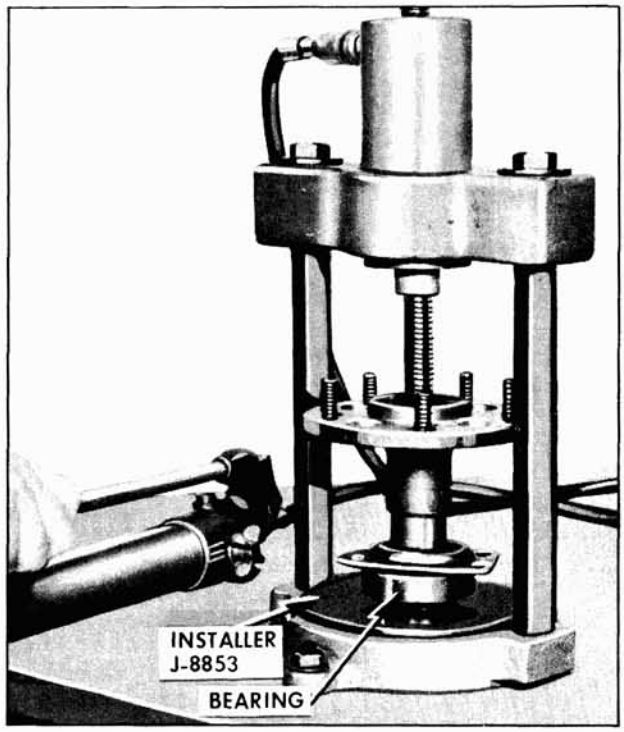


Fig. 4B-13—Installing Axle Bearing - 31-54 (Type "O")
54 With 350 Cu. In.

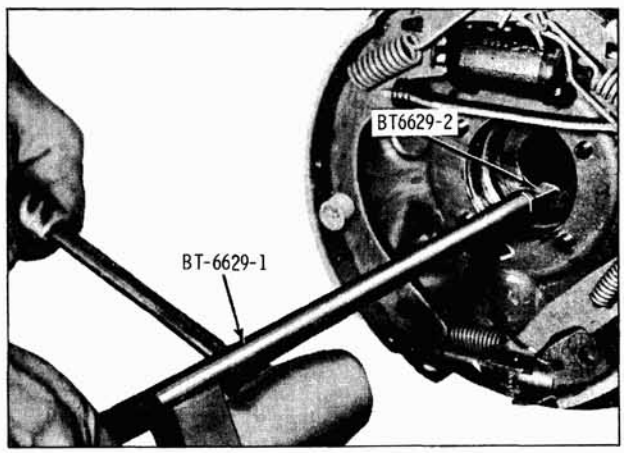


Fig. 4B-14—Removing Axle Shaft Seal (Type "O")

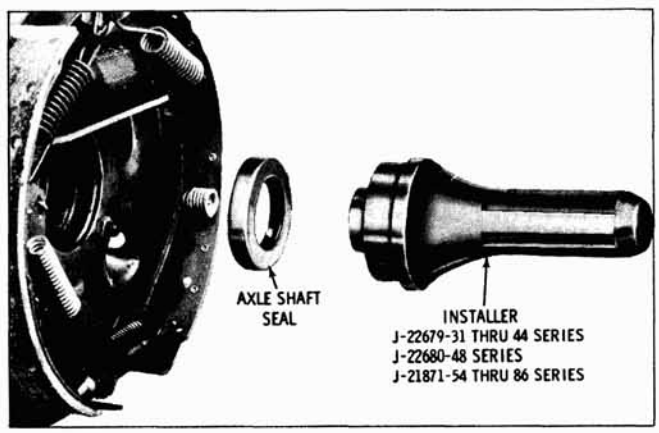


Fig. 4B-15—Installing Axle Shaft Seal (Type "O")

engage in differential to avoid damage to seals.

2. Drive axle shaft assemblies into position.

3. Place gasket and retainer over studs and install nuts. Torque nuts to 40 ft. lbs.

4. Install brake drums and wheels.

AXLE SHAFT—TYPE "C"

Removal

1. Raise vehicle and remove wheel and brake drum.
2. Clean all dirt from area of carrier cover.
3. Drain lubricant from carrier by removing cover.
4. Remove the differential pinion shaft lock screw and the differential pinion shaft (Fig. 4B-16).
5. Push flanged end of axle shaft toward center of vehicle and remove "C" lock from button end of shaft.
6. Remove axle shaft from housing, being careful not to damage oil seal.

WHEEL BOLT REPLACEMENT - TYPE "C" (WITH AXLE SHAFT REMOVED)

Press bolts out of axle shaft flange (Fig. 4B-17) and press new bolts into place, making sure that they are tight and square with flange.

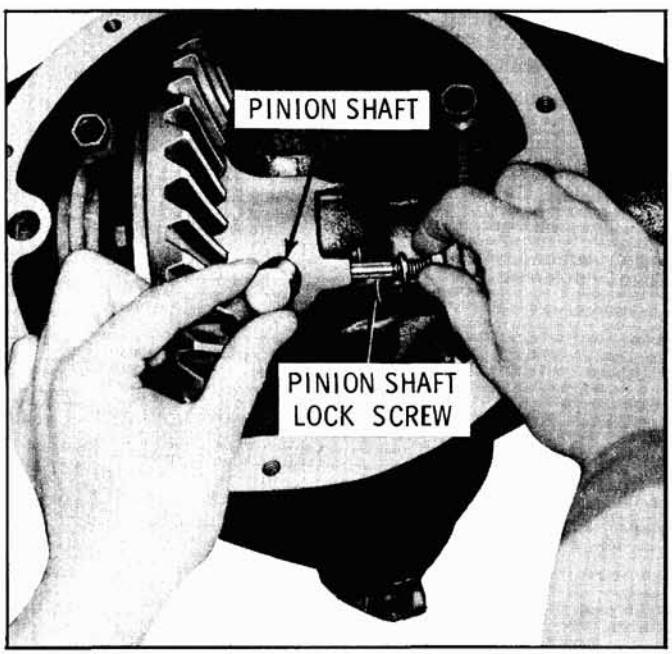


Fig. 4B-16—Differential Pinion Shaft Removal (Type "C")

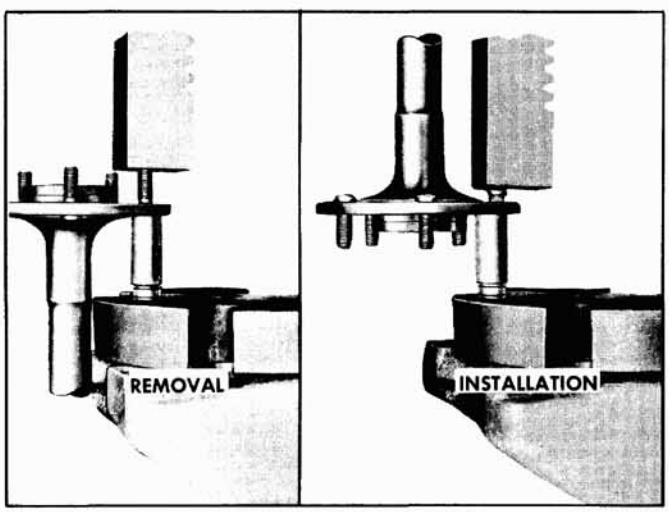


Fig. 4B-17—Wheel Bolt Replacement (Type "C")

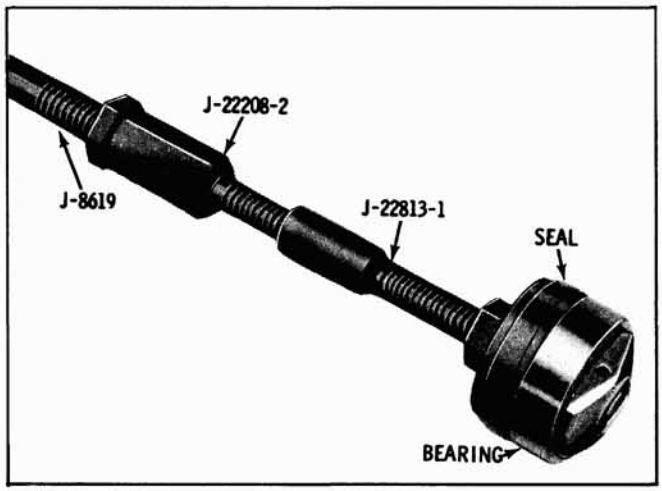


Fig. 4B-18—Positioning of Tool J-21491

OIL SEAL AND/OR BEARING REPLACEMENT - TYPE "C" (WITH AXLE SHAFT REMOVED)

1. Remove seal from housing with a pry bar behind steel case of seal, being careful not to damage housing.
2. Insert Tool into bore and position it behind bearing, Fig. 4B-18 so that tangs on tool engage bearing outer race. Remove bearing, using slide hammer as shown in Fig. 4B-19.
3. Lubricate new bearing with wheel bearing lubricant, and install bearing so that it bottoms against shoulder in housing, using Tool J-21491. (Fig. 4B-20)
4. Pack cavity between the seal lips wth wheel bearing lubricant; position seal on Tool J-21491 and position seal in axle housing bore. Tap seal into place so that it bottoms against bearing (Fig. 4B-20).

BRAKE BACKING PLATE REPLACEMENT - TYPE "C" (WITH AXLE SHAFT REMOVED)

1. Remove brake line at wheel cylinder inlet and disassemble brake components from backing plate. Refer to Section 5 for brake disassembly procedure.

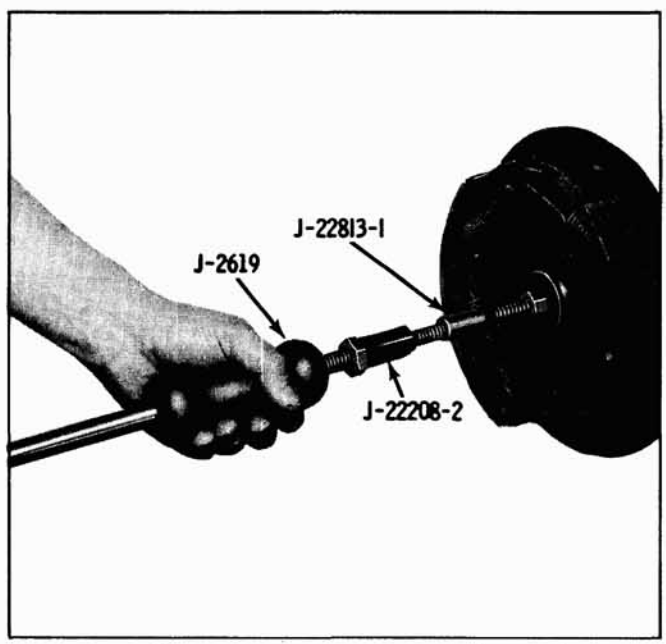


Fig. 4B-19—Removing Wheel Bearing (Type "C")

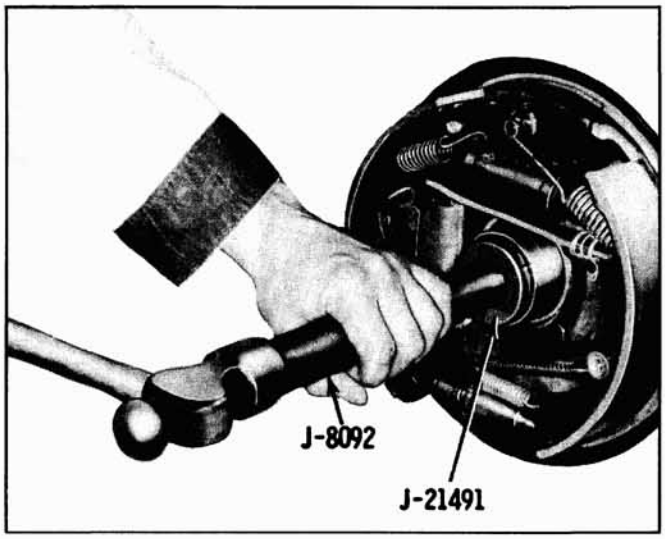


Fig. 4B-20—Installing Axle Shaft Bearing and Seal (Type "C")

2. Remove 4 nuts securing backing plate to axle housing.
3. Install new backing plate to axle housing and torque nuts to 40 ft. lbs.
4. Install brake components on backing plate and connect hydraulic line to wheel cylinder inlet. See Section 5 for brake assembly procedure.
5. Install axle shaft, refer to Axle Shaft - Type "C", Installation, brake drum and wheel.
6. Bleed and adjust brakes as outlined in Section 5.

AXLE SHAFT - TYPE "C"

Installation

1. Slide axle shaft into place.

Exercise care that splines on end of shaft do not damage oil seal and that they engage with splines of differential side gear.

2. Install axle shaft "C" lock on button end of axle shaft and push shaft outward so that shaft lock seats in counterbore of differential side gear.
3. Position differential pinion shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw and torque to 20 ft. lbs.
4. Using a new gasket, install carrier cover and torque bolts to 20 ft. lbs.

Make sure both gasket surfaces on carrier and cover are clean before installing new gasket. Torque carrier cover bolts in a crosswise pattern to ensure uniform draw on cover gasket.

5. Fill axle with lubricant to a level even with bottom of filler hole. See Specifications for proper lubricant.
6. Install brake drum and wheel.
7. Lower car and test operation of axle.

REAR AXLE HOUSING— TYPE "O" AND TYPE "C"

It is not necessary to remove the rear axle housing for differential repairs. However, if the housing is damaged, it may be removed and installed following procedure given.

Removal

1. Hoist car and remove rear wheels, drums and axle shafts.

Determine type of differential before attempting to remove axle shafts. Type "C" will require removing "C" lock from axle shaft inside of differential case. Refer to Axle Shaft - Type "C", Removal.

2. a. Type "O" - disconnect brake lines from clips on axle housing. Do not disconnect brake lines from junction block or wheel cylinders.
b. Type "C" - disconnect brake line from wheel cylinders.
3. a. Type "O" - support backing plate assemblies in their normal position by using wire hooks at the frame kickup and attaching them to the backing plates.
b. Type "C" - remove backing plate to housing attaching bolts. Remove backing plates and support with wire hooks at frame kickup.
4. Disconnect shock absorbers at the axle housing.
5. Support rear of car by positioning stands under frame rear torque boxes, then lower axle housing assembly to limit of travel.
6. Pry springs from axle housing pads and remove springs.
7. Remove propeller shaft and support front of axle housing assembly at companion flange to prevent assembly from rotating when the control arms are disconnected.
8. Remove control arm bolts at axle housing.
9. Remove support at companion flange and lower axle housing assembly.
10. Move assembly to the bench and transfer parts to new axle housing.

Refer to procedures for removing and installing case and pinion assemblies Type "O" or Type "C".

Installation

1. Place axle housing under car and raise into position. Support axle housing at companion flange to prevent rotating.
2. Install bolts through upper and lower control arms at axle housing but do not tighten. Remove support at companion flange.
3. Install propeller shaft. Torque U-bolt to 14 ft. lbs.
4. Install Springs.

31 through 48 series: Install insulators on top of springs and position springs into place with pigtails at axle housing toward left side of car.

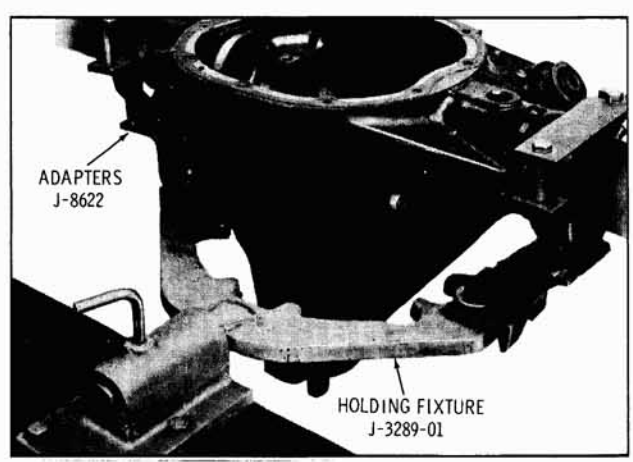


Fig. 4B-20A—Differential Holding Fixture

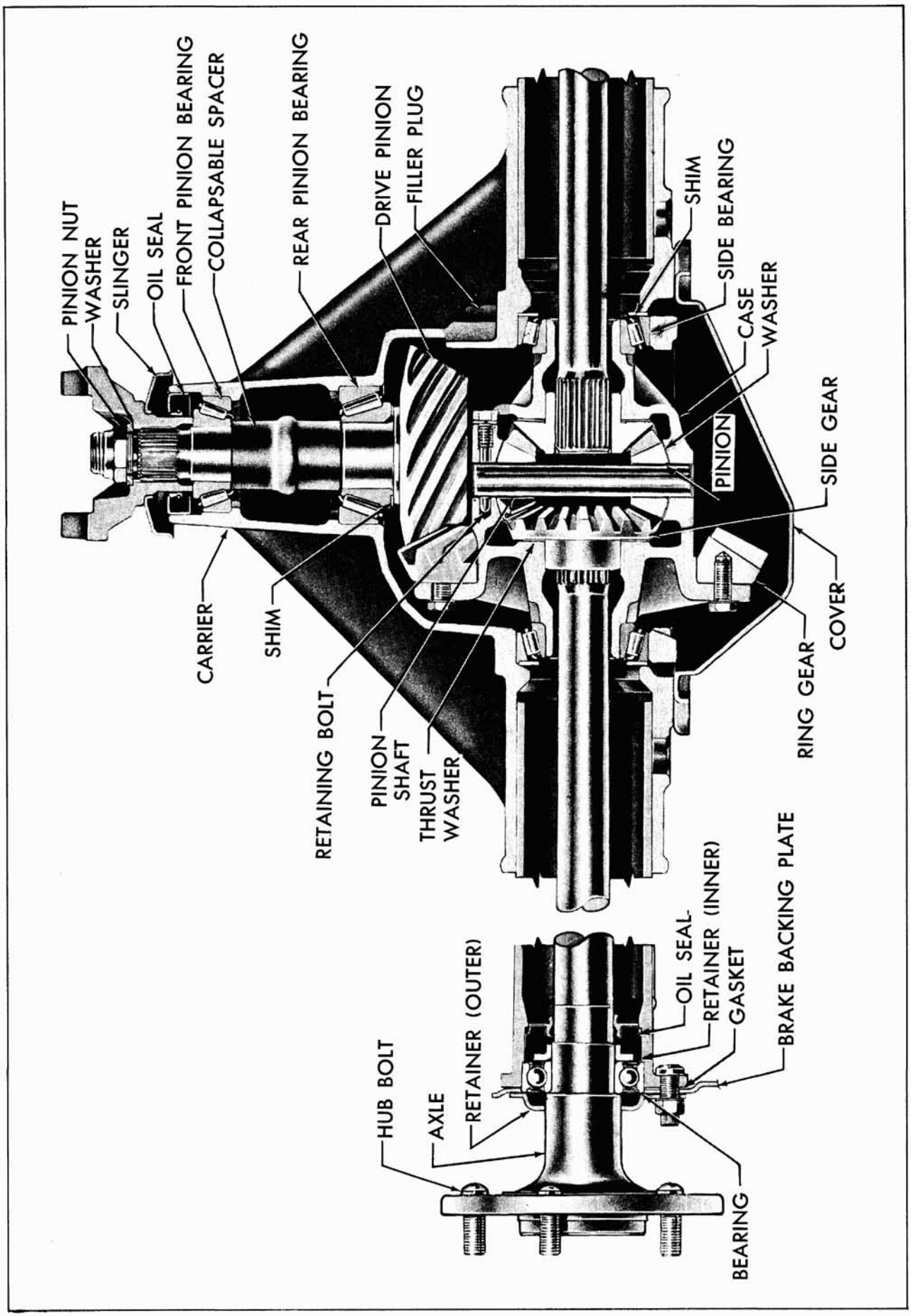


Fig. 4B-21—Differential Case Assembly (Type "O")

54 through 86 series: Install insulators on axle housing spring pads and position springs into place with pigtails at frame end toward outboard side of car.

5. Raise axle housing until shock absorbers can be connected. Torque nuts to 45 ft. lbs.

6. Position backing plate assemblies in their normal position, Type "C" will require installing attaching bolts and nuts and torque to 40 ft. lbs.

7. a. Type "O" - connect brake lines into clips on axle housing.

b. Type "C" - connect brake lines to wheel cylinders.

8. Install axle shafts. Refer to axle shaft installation. Type "O" or type "C".

9. Torque control arm attaching bolts and nuts with weight of car on springs to 75 ft. lbs.

10. Type "C" - bleed rear wheel cylinders and check for leaks.

DISASSEMBLY OF DIFFERENTIAL ASSEMBLY TYPE "O"

Most differential service repairs can be made with the assembly in the car by disconnecting the rear axle assemblies, shock absorbers and supporting the car by the frame with the axle housing supported and lowered to its lowest maximum travel.

Do not allow the rear brake hose to become kinked or stretched.

Lubricant may be drained by backing out all cover bolts and breaking cover loose at the bottom.

If the differential housing is removed for any reason, differential service can be performed on the bench by using the fixtures shown in Fig. 4B-20A

When a new ring gear and pinion is installed, the owner should be advised not to accelerate rapidly or exceed 50 mph for the first 50 miles of driving.

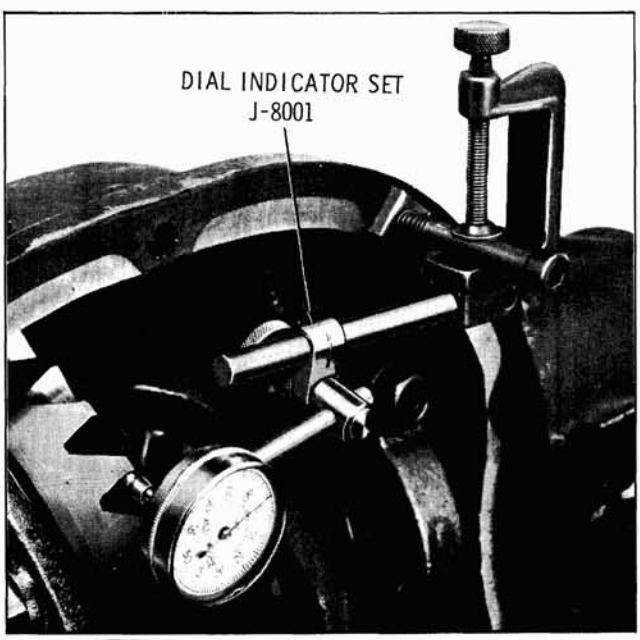


Fig. 4B-22—Checking Ring Gear to Pinion Backlash (Type "O")

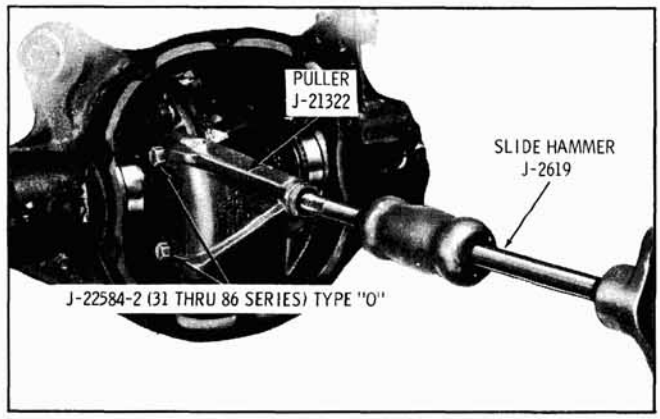


Fig. 4B-23—Removing Case Assembly (Type "O")

DIFFERENTIAL CASE (Fig. 4B-21) TYPE "O"

Remove

1. Before removing the differential from the housing, ring gear to pinion backlash should be checked. This will indicate gear or bearing wear or an error in backlash or pre-load setting which will help in determining cause of axle noise. (Fig. 4B-22)

2. Remove differential bearing cap bolts. Bearing caps should be marked "R" and "L" to make sure they will be reassembled in their original location.

3. Remove two ring gear retaining bolts from differential case and install Ring Gear and Case Remover J-21322 with slide hammer as shown in Fig. 4B-23. Remove the case assembly and place right and left bearing outer races and shims in sets with marked bearing caps so that they can be

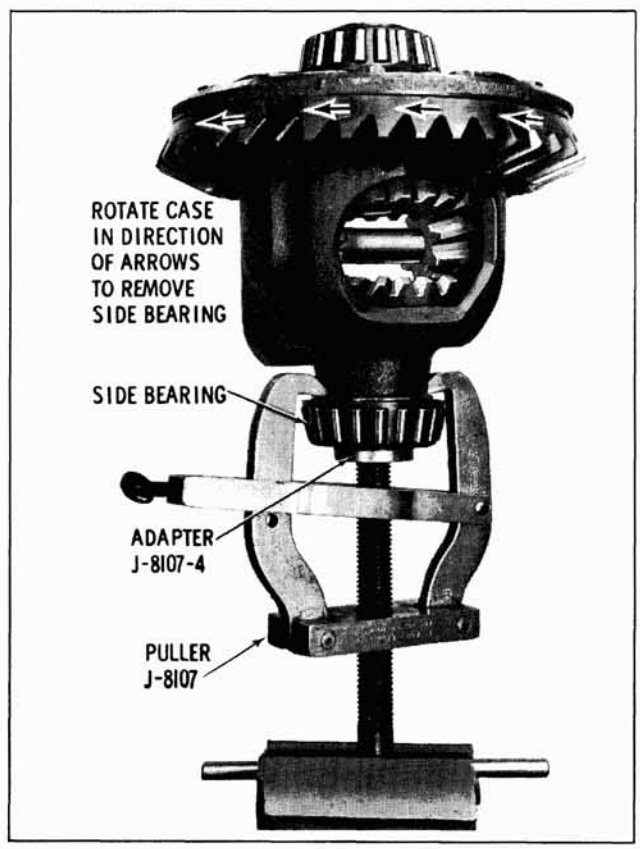


Fig. 4B-24—Removing Side Bearings (Type "O")

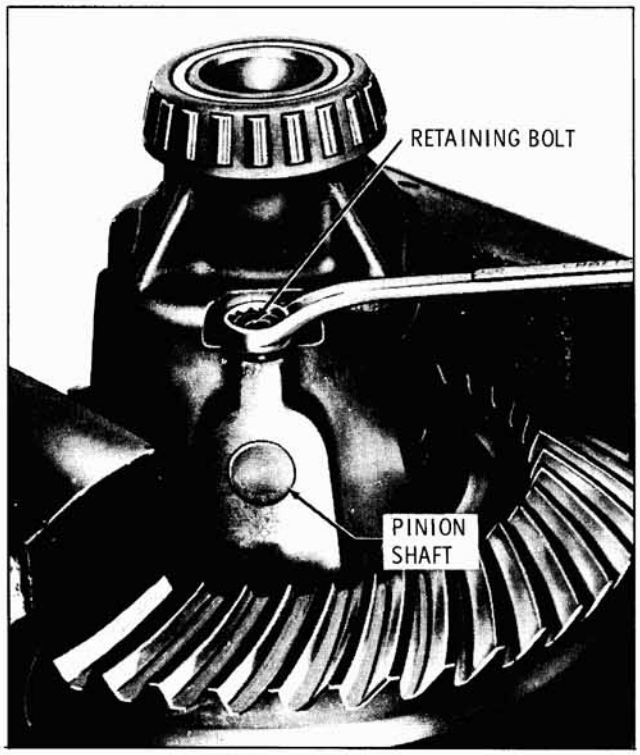


Fig. 4B-25—Removing Pinion Shaft Retaining Bolt (Type "O")

reinstalled in their original positions.

Disassembly

1. If differential side bearings are to be replaced, they can be removed as shown in Fig. 4B-24.
2. Remove bolt that retains differential pinion shaft. (Fig. 4B-25) Remove differential pinions, side gears and thrust washers from case.

Mark side gears and case so they can be installed in their original location.

3. If ring gear is to be replaced and it is tight on case after removing bolts, drive it off using a brass drift and hammer. Do not pry between ring gear and case.

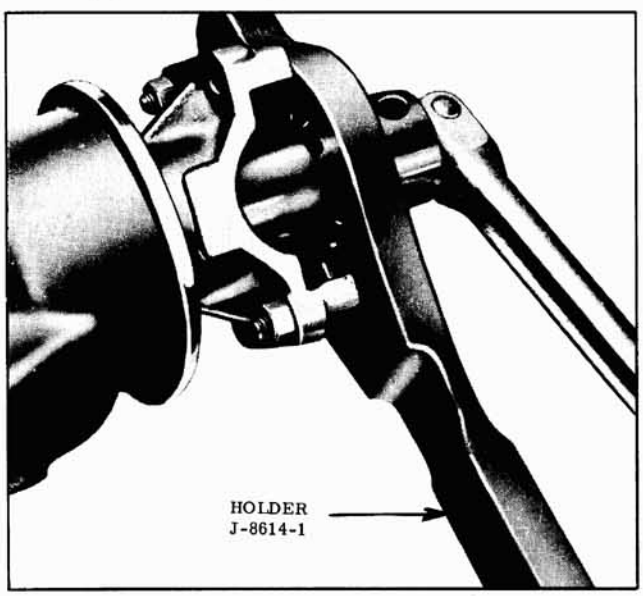


Fig. 4B-26—Removing Companion Flange Nut

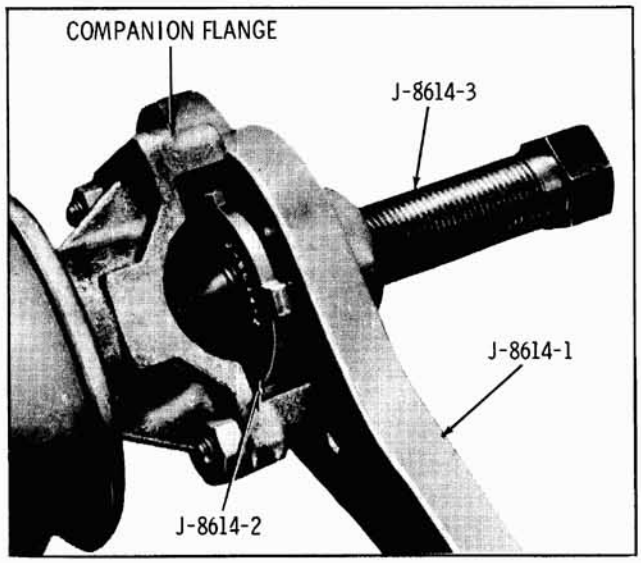


Fig. 4B-27—Removing Companion Flange

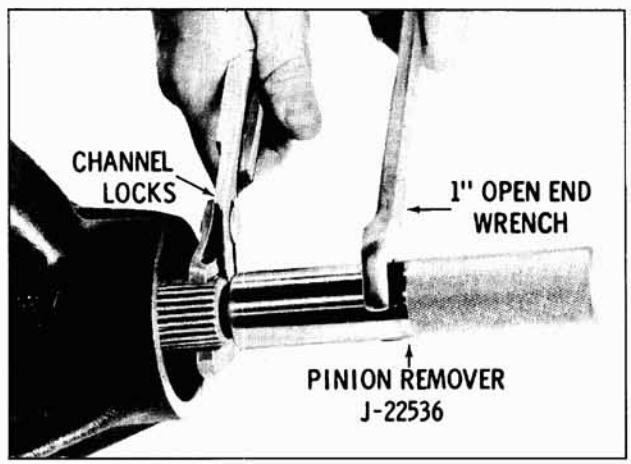


Fig. 4B-28—Installing Remover (Type "O")

DRIVE PINION - TYPE "O"

Remove

Before removing drive pinion, check ring gear to pinion back-lash as outlined under DIFFERENTIAL CASE - REMOVE.

1. Check drive pinion bearing pre-load. If there is no pre-load reading, check for looseness of pinion assembly by shak-

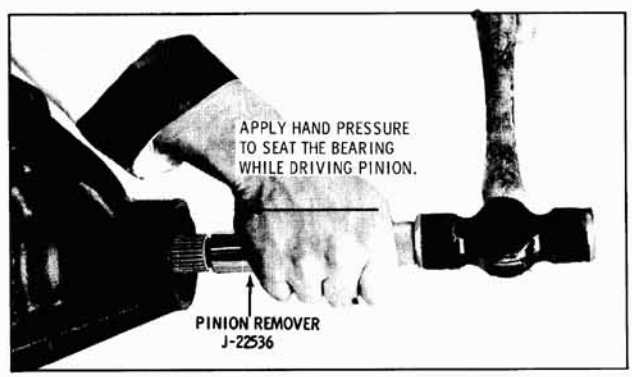


Fig. 4B-29—Removing Pinion Assembly (Type "O")

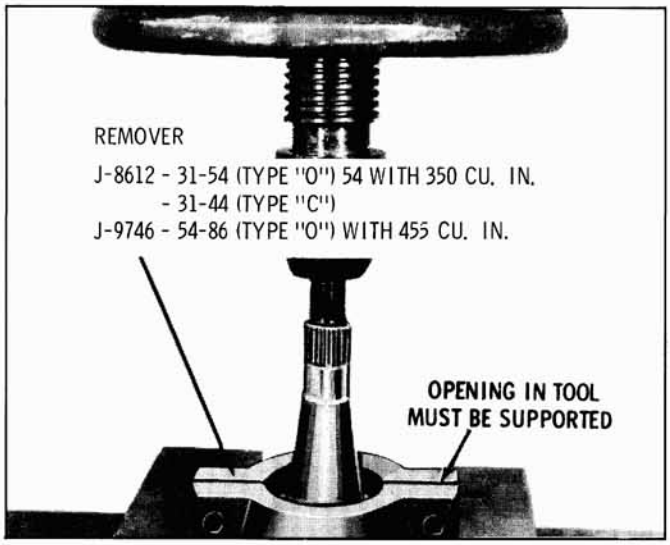


Fig. 4B-30—Removing Rear Pinion Bearing (Type "O")

ing. Looseness could be caused by defective bearings or worn companion flange. If differential was operated for an extended period with very loose bearings, the ring gear and pinion will also require replacement.

2. Remove companion flange nut and washer. (Fig. 4B-26)
3. Remove companion flange. (Fig. 4B-27)
4. Install Pinion Remover J-22536 and drive out pinion (Figs. 4B-28 and 4B-29). Apply heavy hand pressure on pinion remover toward differential housing to keep front bearing seated to avoid damage to outer race.

Disassembly

The rear pinion bearing must be removed when it becomes necessary to change the pinion depth adjustment.

1. With drive pinion removed from carrier, press bearing from the pinion gear as shown in Fig. 4B-30.
2. Drive pinion oil seal from carrier (Fig. 4B-31) and remove front pinion bearing. If this bearing is to be replaced, remove outer race from carrier as shown in Fig. 4B-32.

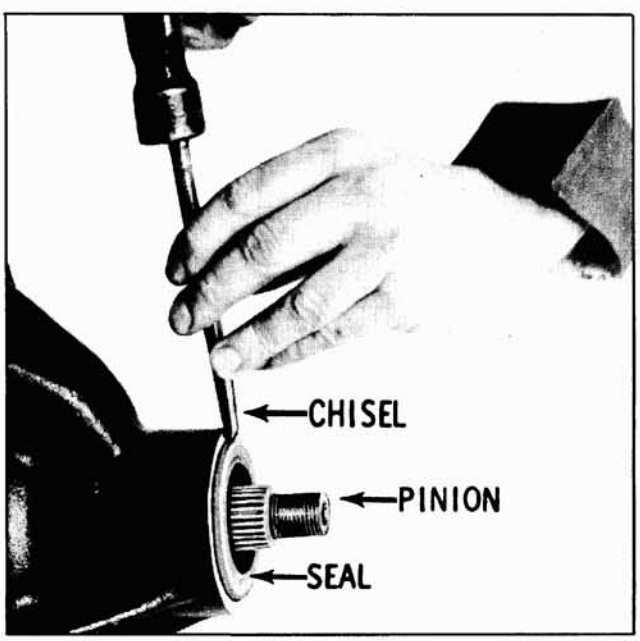


Fig. 4B-31—Removing Pinion Oil Seal

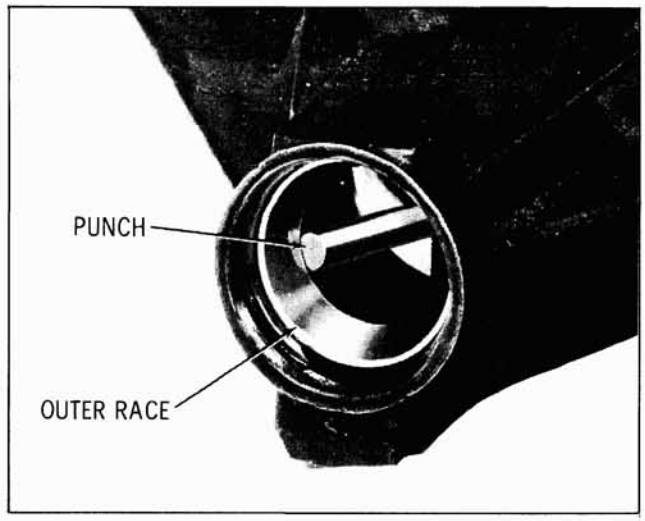


Fig. 4B-32—Removing Front Pinion Bearing Outer Race

3. If rear pinion bearing is to be replaced remove outer race from carrier using a punch in slots provided for this purpose as shown in Fig. 4B-33.

CLEANING AND INSPECTION

1. Clean all differential bearings thoroughly in clean solvent (do not use a brush). Examine bearings visually and by feel. All bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.

Minute scratches and pits that appear on rollers and races at low mileage are due to the initial pre-load, and bearings having these marks should not be rejected.

2. Examine sealing surface of companion flange for nicks, burrs, or rough tool marks which would cause damage to the seal and result in an oil leak. Replace if damaged.
3. Examine carrier bore and remove any burrs that might cause leaks around the O.D. of the pinion seal.
4. Examine the differential ring gear and drive pinion teeth for excessive wear and scoring. If any of these conditions exist, replacement of the gear set will be required.
5. Inspect the differential pinion gear shaft for unusual wear; also check the pinion and side gears and thrust washers.

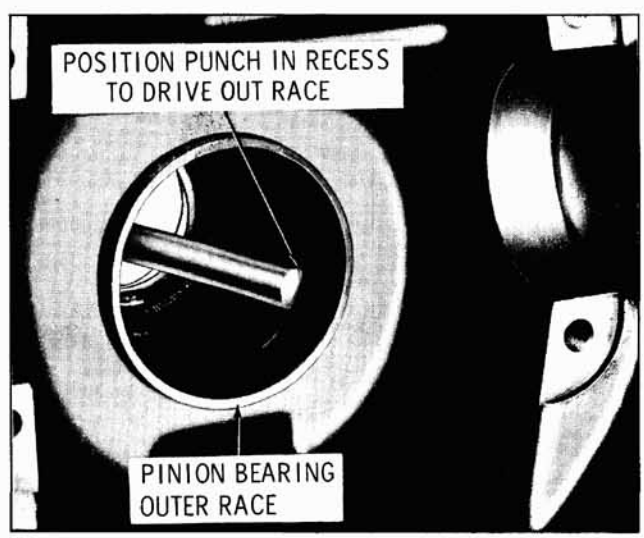


Fig. 4B-33—Removing Rear Pinion Bearing Outer Race

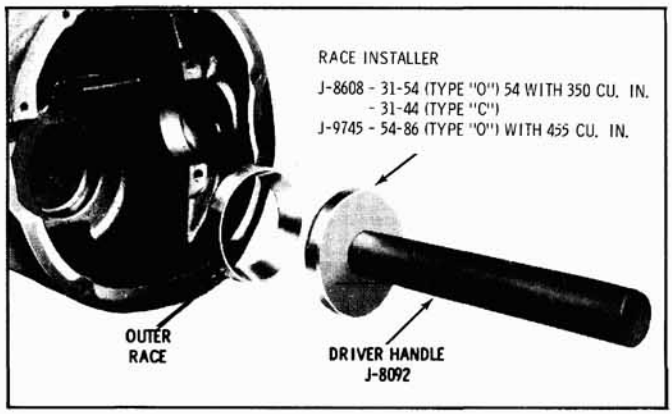


Fig. 4B-34—Installing Rear Pinion Bearing Outer Race

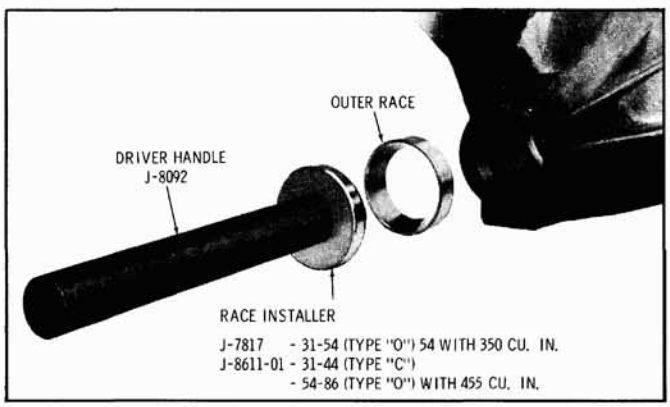


Fig. 4B-35—Installing Front Pinion Bearing Outer Race

6. Check the press fit of the side bearing inner race on the differential case hub by prying against the shoulder at the puller recess in the case. Side bearings must be a tight press fit on the hub.

7. Diagnosis of a differential failure such as: chipped bearings, loose (lapped-in) bearings, chipped gears, etc., is a warning that some foreign material is present; therefore, the axle

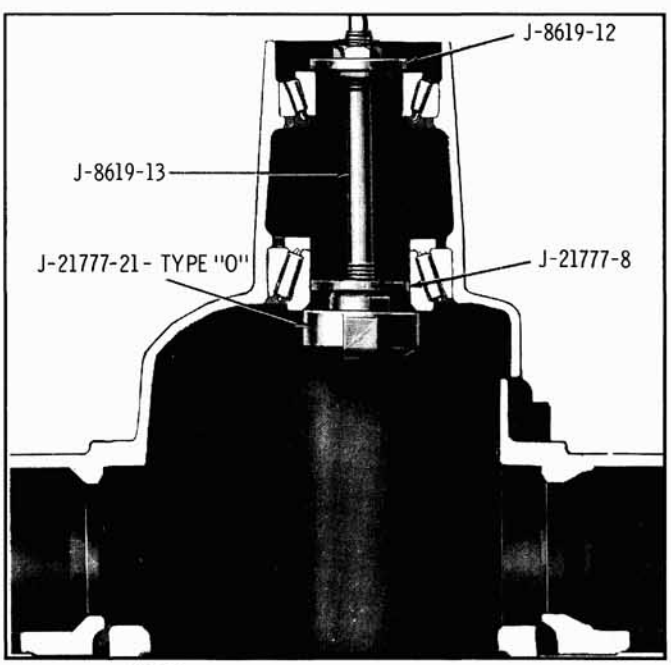


Fig. 4B-36—Installing Pinion Depth Gauge Plate - 54-86 (Type "O") With 455 Cu. In.

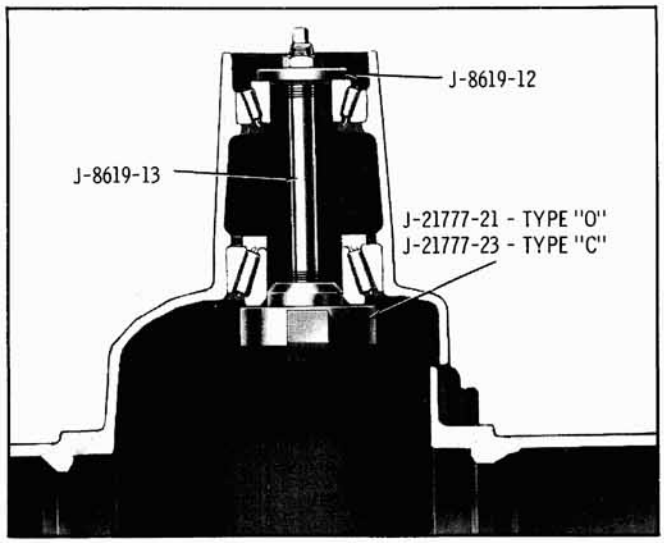


Fig. 4B-37—Installing Pinion Depth Gauge Plate - 31-54 (Type "O") 54 With 350 Cu. In.

housing must be cleaned.

DRIVE PINION - TYPE "O

Assembly

1. If a new rear pinion bearing is to be installed, install new outer race as shown in Fig. 4B-34

2. If a new front pinion bearing is to be installed, install new outer race as shown in Fig. 4B-35.

ADJUSTING PINION DEPTH

Pinion depth is set with Pinion Setting Gauge J-21777. The pinion setting gauge provides in effect, a "nominal" or "zero" pinion as a gauging reference.

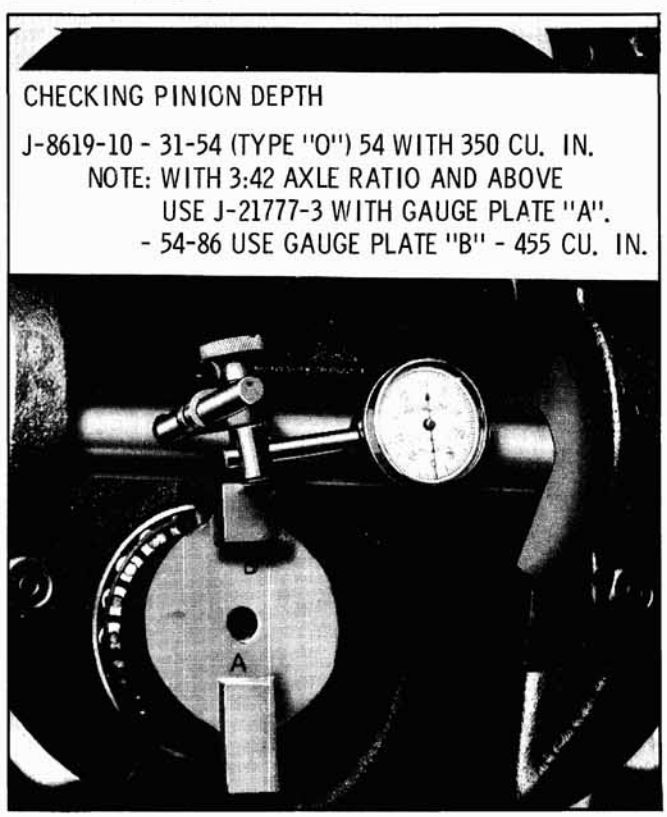


Fig. 4B-38—Pinion Depth Checking Gauge (Type "O")

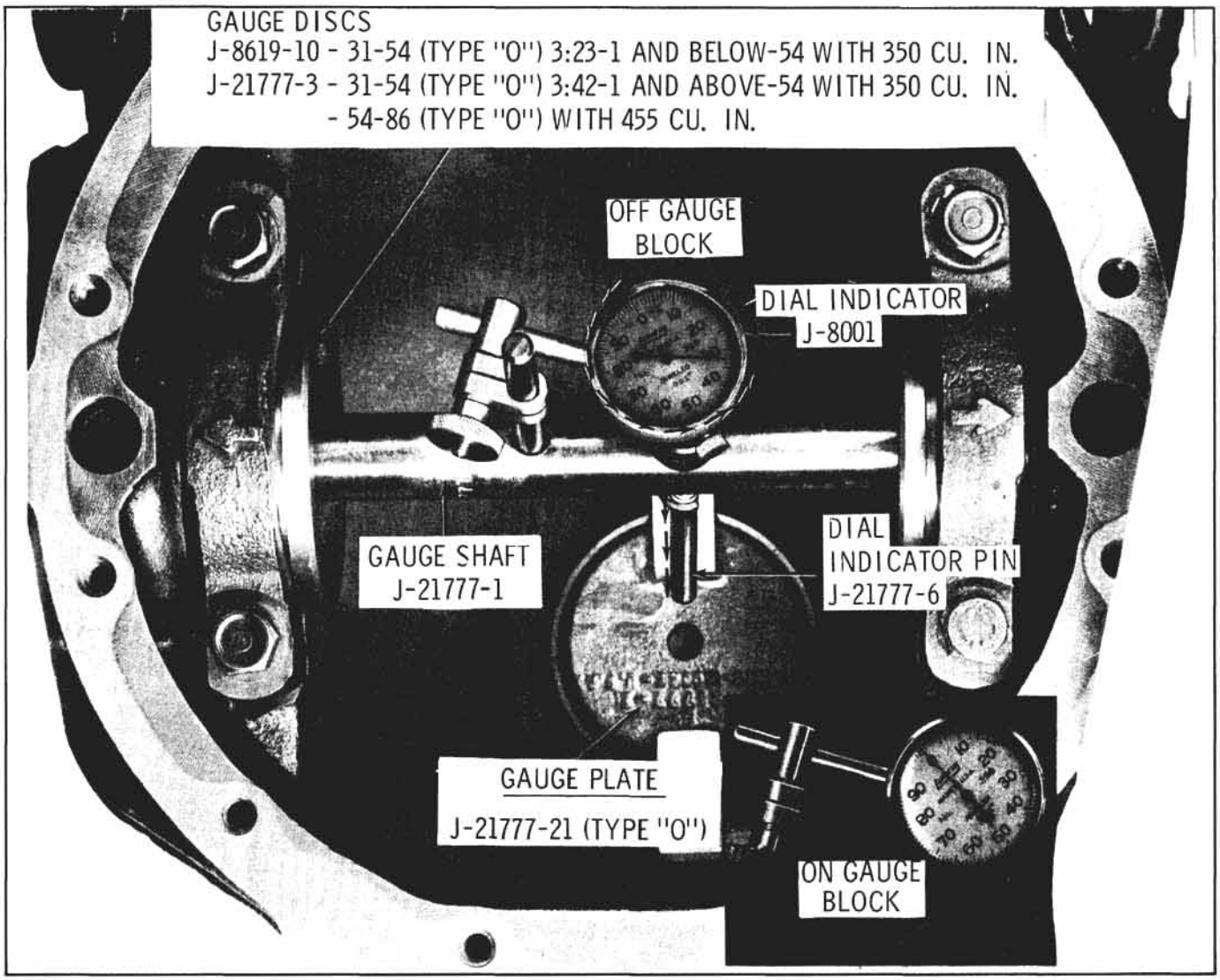


Fig. 4B-39—Checking Pinion Depth (Type "O")

1. Make certain all of the gauge parts are clean.
2. Lubricate front and rear pinion bearings liberally with differential lubricant, No. 1050081 or equivalent.
3. While holding pinion bearings in position, install depth setting gauge assembly as shown in Figs. 4B-36 or 4B-37.
4. Hold stud stationary with a wrench positioned over the flats on the ends of stud and tighten nut to 20 in. lbs. torque. Rotate gauge plate assembly several complete revolutions to seat the bearings. Then tighten nut until a torque between 15 and 25 in. lbs. is required to keep the gauge plate in rotation.
5. Rotate the gauge plate until the gauging areas are parallel with the discs.

The gauging area marked "B" is used with discs J-21777-3 on 54 (with 455 cu. in.) thru 86 Series. The gauging area marked "A" is used with discs J-8619-10 or J-21777-3, depending on axle ratio and size of side bearings on 31 thru 54 Series. (54 with 350 cu. in.)

6. Make certain differential side bearing support bores are clean and free of burrs.
7. Install the correct discs on the gauge shaft. (Fig. 4B-38)
8. Position the gauge shaft assembly in the carrier so that the dial indicator rod is centered on the gauging area of the gauge block, and the discs seated fully in the side bearing bores. Install side bearing caps and torque bolts to 65 ft. lbs. (Fig. 4B-38)
9. Set dial indicator at ZERO. Then position on mounting post of the gauge shaft with the contact button touching the indicator pad. Push dial indicator downward until the needle rotates approximately 3/4 turn clockwise. Tighten the dial indicator in this position and recheck.

Use dial indicator J-8001 or an equivalent indicator reading from 0 to 100.

10. Rotate gauge shaft slowly back and forth until the dial indicator reads the greatest deflection. At the point of greatest deflection, set the dial indicator to ZERO. Repeat rock action of gauge shaft to verify the ZERO setting.
11. After the ZERO setting is obtained, rotate gauge shaft until the dial indicator rod does not touch the gauge block.
12. Record dial reading at pointer position. Example: If pointer moved counterclockwise .067" to a dial reading of .033" (as shown in Fig. 4B-39), this indicates a shim thickness of .033" except as follows:

Dial indicator reading should be within the range of .020" to .050".

13. Select the correct pinion shim to be used during pinion reassembly on the following basis:

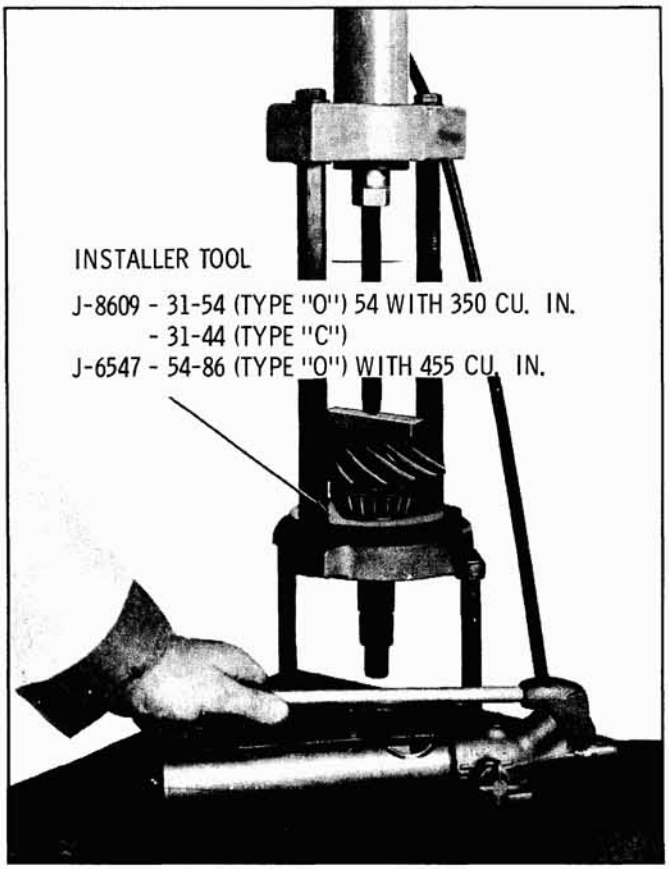


Fig. 4B-40—Installing Rear Pinion Bearing (Type "O")

a. If a pinion with no marking is being used, the correct shim will have a thickness EQUAL to the indicator gauge reading found in Step 12.

Service and production pinions will be marked with white ink on the pinion head, all stamping on metal should be ignored.

Pinions that are marked "+" (plus), the shim thickness indicated by the dial indicator on the pinion setting gauge must be INCREASED by the amount marked on the pinion.

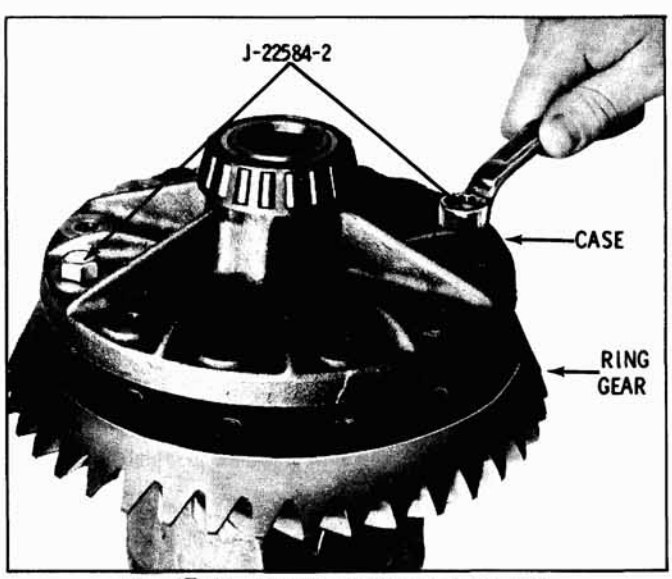


Fig. 4B-41—Installing Ring Gear (Type "O")

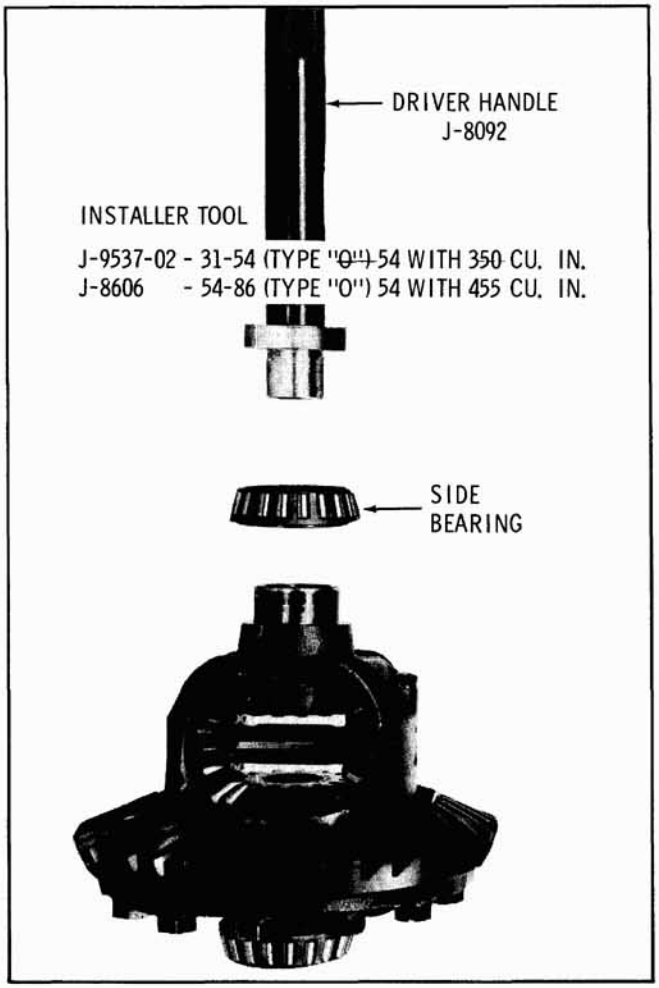


Fig. 4B-42—Installing Side Bearings (Type "O")

If the pinion is marked "-" (minus) the shim thickness indicated by the dial indicator on the pinion setting gauge must be DECREASED by the amount marked on the pinion.

14. Loosen Stud J-8619-13 and remove Gauge Plate Washer and both bearings from carrier.

15. Position correct shim on drive pinion and install the drive pinion rear bearing as shown in Fig. 4B-40.

DIFFERENTIAL CASE - TYPE "O"

Assembly

Before assembling the differential case, lubricate all parts with Lubricant No. 1050081 or equivalent.

1. Place side gear thrust washers over side gear hubs and install side gears in case. If same parts are reused, install in original sides.

2. Position one pinion (without washer) between side gears and rotate gears until pinion is directly opposite from loading opening in case. Place other pinion between side gears so that pinion shaft holes are in line; then rotate gears to make sure holes in pinions will line up with holes in case.

3. If holes line up, rotate pinions back toward loading opening just enough to permit sliding in pinion thrust washers.

4. Install pinion shaft. Install pinion shaft retaining bolt. Torque to 15 ft. lbs.

5. After making certain that mating surfaces of case and ring gear are clean and free of burrs, thread two bolts into opposite sides of ring gear; then install ring gear on case. (Fig.

4B-41) install NEW ring gear attaching bolts just snug. NEVER REUSE OLD BOLTS. Torque bolts alternately in progressive stages to 85 ft. lbs.

6. If differential side bearings were removed, install bearings as shown in Fig. 4B-42.

SIDE BEARING PRE-LOAD ADJUSTMENT - TYPE "O"

The side bearing pre-load adjustment is to be made before installing the pinion. If the pinion is installed, remove ring gear.

Differential side bearing pre-load is adjusted by changing the thickness of both the right and left shims by an equal amount. By changing the thickness of both shims equally, the original backlash will be maintained.

Production shims are cast iron and vary in thickness from .180" to .272" in increments of .002".

Standard service spacers are .170" thick and steel service shims are available from .040" to .082" in increments of .002".

Do not attempt to reinstall the production shims as they may break when tapped into place. If service shims were previously installed, they can be reused, but (whether using new or old bearings) adhere to the following procedure in all cases.

1. Before installation of the case assembly, make sure that side bearing surfaces in the carrier are clean and free of burrs. side bearings must be oiled with Lubricant No. 1050081 or equivalent and if the same bearings are being reused, they must have the original outer races in place.

2. Determine the approximate thickness of shims needed by measuring each production shim or each service spacer and shim pack as shown in Fig. 4B-43.

3. In addition to the service spacer, a service shim will be needed. To select a starting point in service shim thickness, use the following chart:

.170" Service Spacer	
Total Thickness of Both Prod. Shims Removed	Total Thickness of Service Shims to be used as a Starting Point
.420"	.060"
.430"	.070"
.440"	.080"
.450"	.090"
.460"	.100"
.470"	.110"
.480"	.120"
.490"	.130"
.500"	.140"
.510"	.150"
.520"	.160"
.530"	.170"
.540"	.180"
.550"	.190"

4. Place differential case with bearing outer races in position in carrier. Slip the service spacer between each bearing race and carrier housing with chamfered edge against housing. (Fig. 4B-44)

Install the left bearing cap loose so that the case may be moved while checking adjustments. Another bearing cap bolt can be added in the lower right bearing cap hole. This will prevent case from dropping while making shim adjustments.

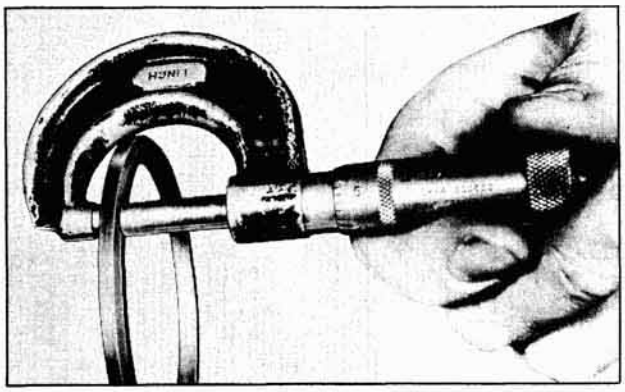


Fig. 4B-43—Measuring Production Shim

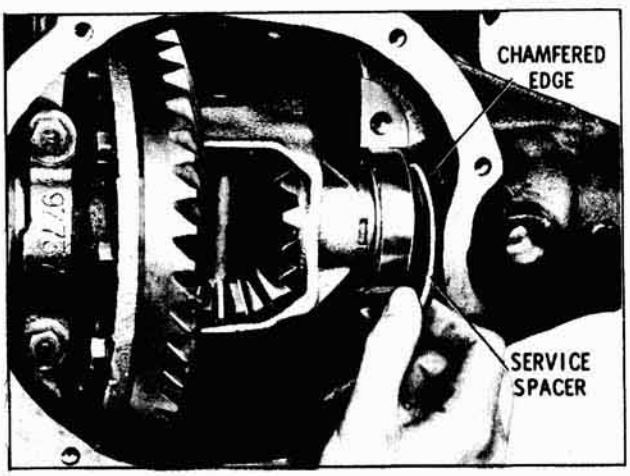


Fig. 4B-44—Installing Service Spacer (Type "O")

Select one or two shims totalling the amount shown in the right-hand column and position between the right bearing race and the service spacer. Be sure left bearing race and spacer are against left side of housing. (Fig. 4B-45)

5. Insert progressively larger feeler gauge sizes (.010", .012", .014", etc.) between the right shim and service spacer until there is noticeable increased drag. Push the feeler gauge downward until the end of the gauge makes contact with the carrier bore so as to obtain a correct reading. The point just before additional drag begins is correct feeler gauge thickness. Rotate case while using feeler gauge to assure an even reading. (Fig. 4B-46)

The original light drag is caused by weight of the case against the carrier while aditional drag is caused by side bearing pre-load. By starting with a thin feeler gauge, a sense of "feel" is obtained so that the beginning of pre-load can be recognized to obtain Zero clearance.

It will be necessary to work case in and out and to the left in order to insert the feeler gauge. Be sure to locate the feeler gauge as shown in Fig. 4B-46.

6. Remove left bearing cap and all shims from carrier. The total shim pack needed (with no pre-load on side bearings) is the feeler gauge reading found in Step 5 plus thickness of shims installed in Step 4.

7. Select two shims of approximately equal size whose total thickness is equal to the value obtained in Step 5. These shims will be installed between each side bearing race and service spacer when the case is installed in the carrier.

The object of Step 7 is to obtain the equivalent of a

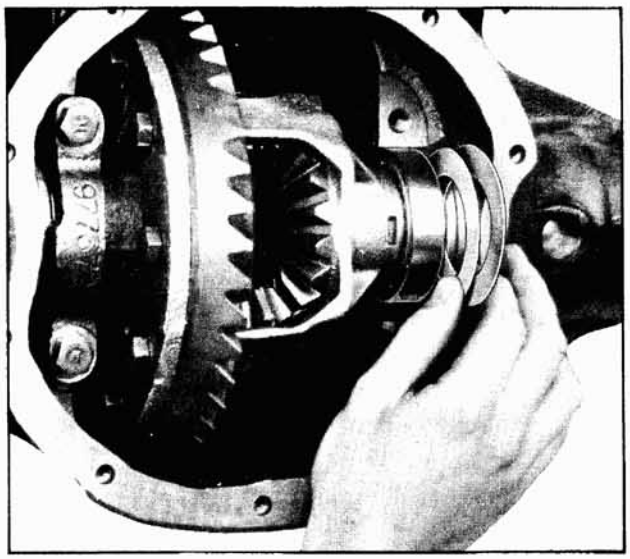


Fig. 4B-45—Installing Service Shims (Type "O")

"slip fit" of the case in the carrier. For convenience in setting backlash, the pre-load will not be added until the final step.

8. If the pinion is in position, install the ring gear, then proceed to DIFFERENTIAL BACKLASH ADJUSTMENT.

DRIVE PINION INSTALLATION - TYPE "O"

Lubricate pinion bearings with Lubricant No. 1050081 or equivalent before installing pinion.

1. Install new collapsible spacer on pinion and position assembly in carrier. (Fig. 4B-47)

Collapsible spacer must be put on pinion shaft and pinion assembly installed into carrier together. Spacer will not fit through front pinion bearing outer race.

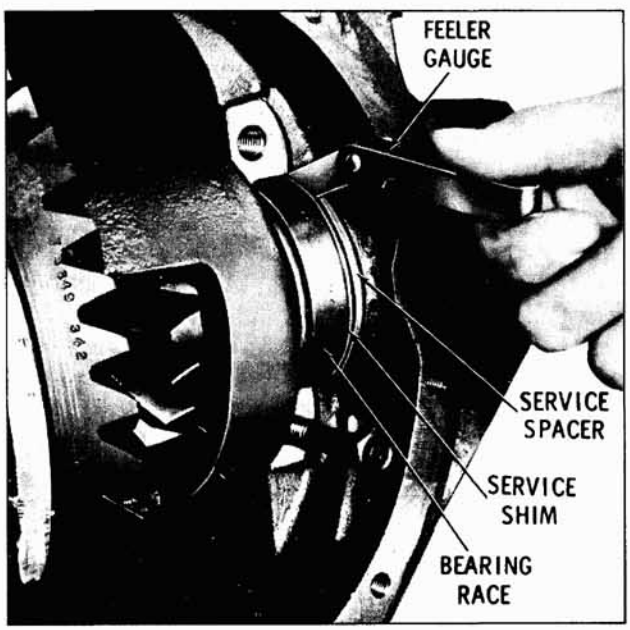


Fig. 4B-46—Inserting Feeler Gauge (Type "O")

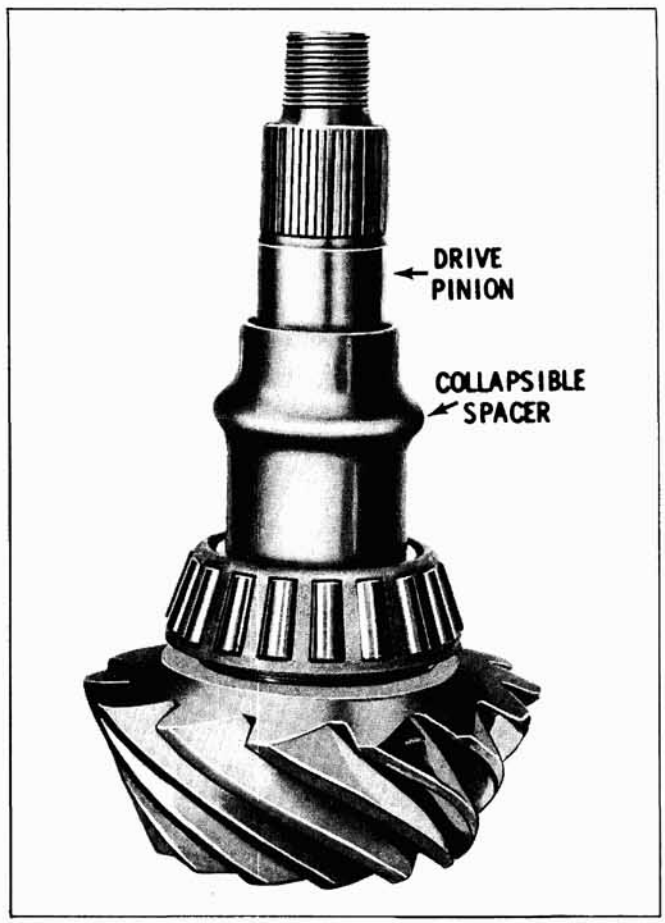


Fig. 4B-47—Collapsible Spacer on Pinion (Type "O")

2. While holding forward, install pinion blocking fixture, (J-22535) and tighten screw to hold rear pinion bearing tight against race. (Fig. 4B-48)

3. Install front bearing on pinion and drive bearing on pinion shaft until seated in race, using Tool J-6133-A. (Fig. 4B-49)

4. Position pinion oil seal in carrier. Install seal as shown in Fig. 4B-50.

5. Coat lips of pinion oil seal and seal surface of pinion flange with Lubricant, No. 1050169 or equivalent. Install companion flange on pinion by tapping with a soft hammer until a few pinion threads project through flange.

6. Install pinion washer and nut. Hold companion flange with Holder J-8614-1. While intermittently rotating pinion to seat bearings, tighten companion flange nut until end play begins to be taken up. (Fig. 4B-51)

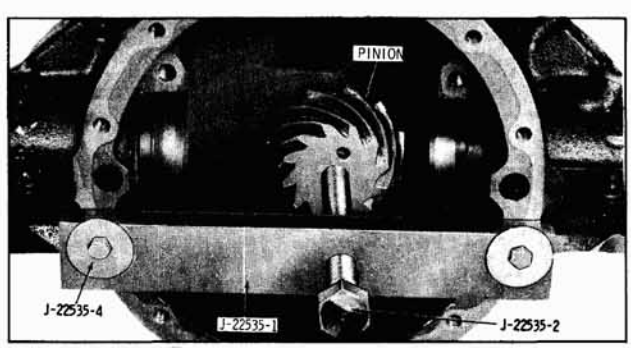


Fig. 4B-48—Pinion Holding Tool

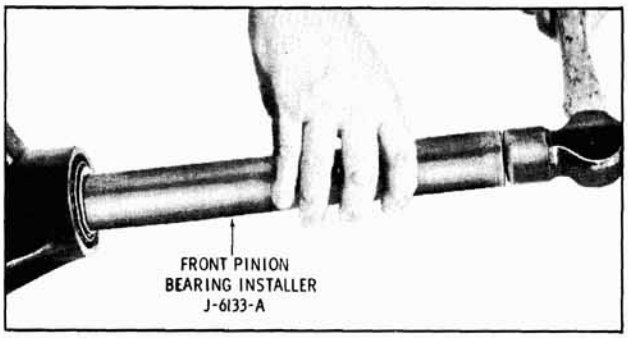


Fig. 4B-49—Installing Front Pinion Bearing

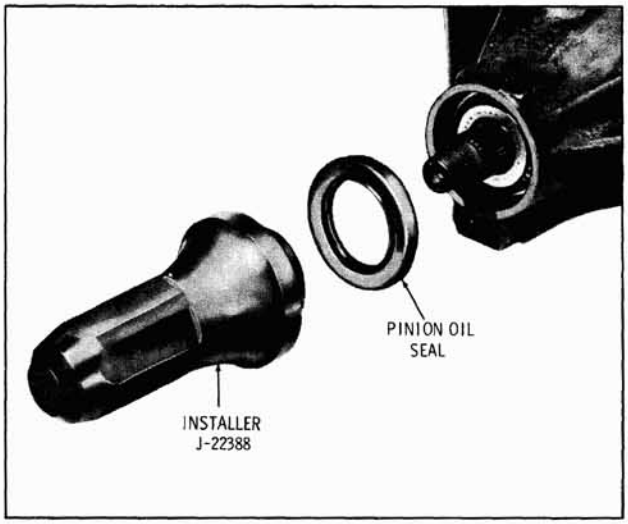


Fig. 4B-50—Installing Pinion Oil Seal (Type "O")

When no further end play is detectable and when Holder J-8614-1 will no longer pivot freely as pinion is rotated, pre-load specifications are being approached. No further tightening should be attempted until the pre-load has been checked.

7. Check pre-load by using an inch pound torque wrench as shown in Fig. 4B-52.

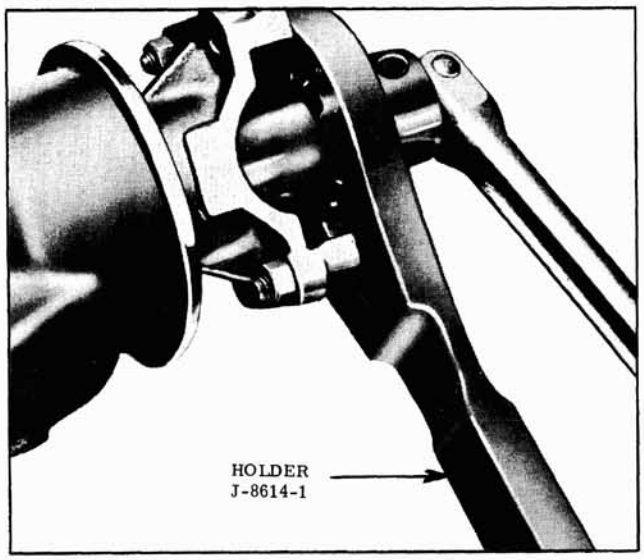


Fig. 4B-51—Installing Companion Flange Nut

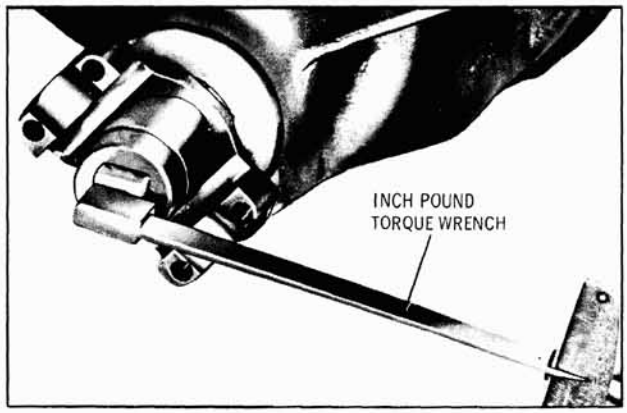


Fig. 4B-52—Checking Pinion Bearing Pre-load

After pre-load has been checked, final tightening should be done very carefully. For example, if when checking pre-load was found to be 5 in. lbs., any additional tightening of the pinion nut can add many additional inch pounds of torque. Therefore, the pinion nut should be further tightened only a little at a time and the pre-load should be checked after each slight amount of tightening. Exceeding pre-load specifications will compress the collapsible spacer too far and require the installation of a new collapsible spacer or the addition of a shim.

Only one shim may be used. Then the spacer must be replaced.

While observing the preceding note, carefully set pre-load at 24 to 32 in. lbs. on new bearings or 8 to 12 in. lbs. on used bearings.

8. Rotate pinion several times to assure that bearings have been seated. Check pre-load again. If pre-load has been reduced by rotating pinion, reset pre-load to specifications.

DIFFERENTIAL BACKLASH ADJUSTMENT - TYPE "O"

1. Install differential case into carrier, using shims as determined by the side bearing pre-load adjustment.

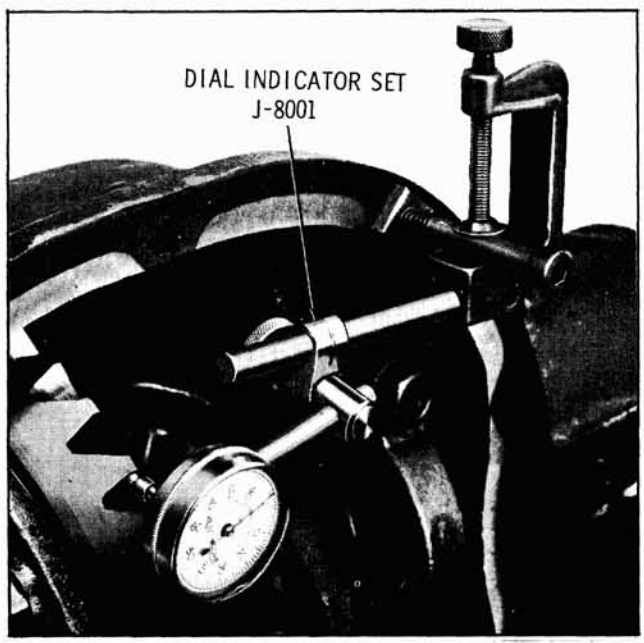


Fig. 4B-53—Checking Ring Gear to Pinion Backlash

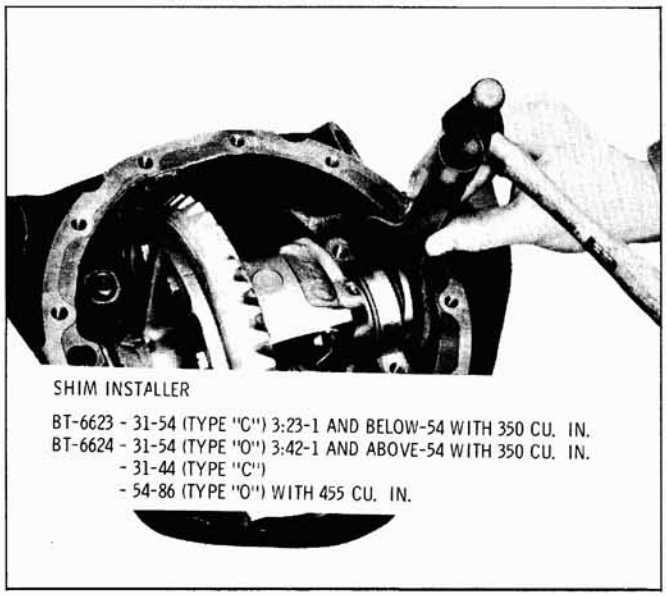


Fig. 4B-54—Driving Shim into Position (Type "O")

2. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Fig. 4B-53. Use a small button on the indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is in line as nearly as possible with gear rotation and perpendicular to tooth angle for accurate backlash reading.

3. Check backlash at three or four points around ring gear. Lash must not vary over .002" around ring gear.

Pinion must be held stationary when checking backlash.

If variation is over .002" check for burrs, uneven bolting conditions or distorted case flange and make corrections as necessary.

4. Backlash at the point of minimum lash should be between .005" and .009" for all new gears.

5. If backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. This will maintain correct differential side bearing pre-load.

For each .001" change in backlash desired, transfer .002" in shim thickness. To decrease backlash .001", decrease thickness of right shim .002" and increase thickness of left shim .002". To increase backlash .002" increase thickness of right shim .004" and decrease thickness of left shim .004".

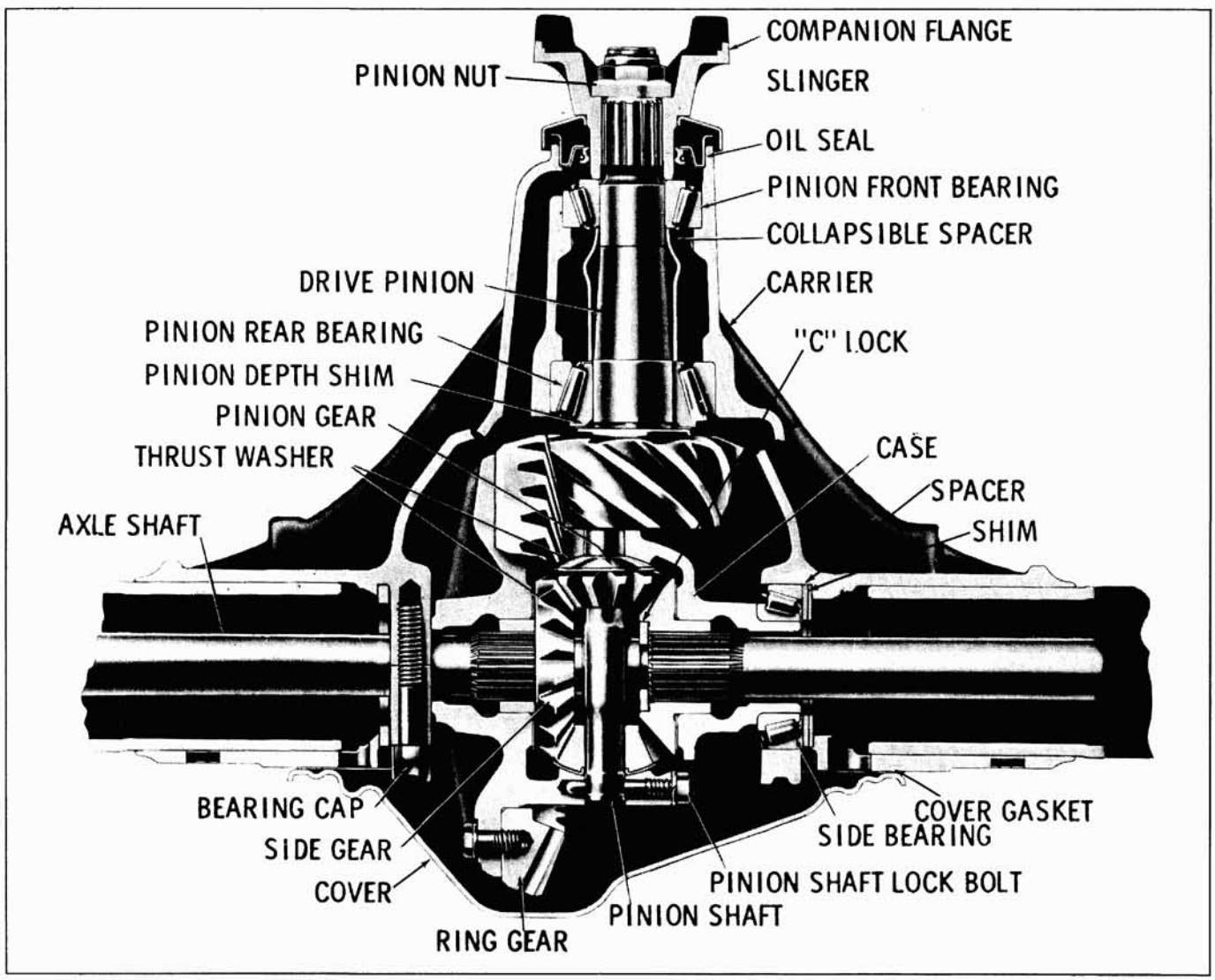


Fig. 4B-55—Differential Case Assembly (Type "C")

6. When backlash is correctly adjusted, loosen bearing cap bolts. Remove left bearing cap and left shim pack. Select a shim .004" thicker than the one removed, and insert between the spacer and the left bearing race. Loosely install bearing cap.

7. Remove right bearing cap and right shim pack. Select a shim .004" thicker than the one removed and insert between the spacer and the right bearing race. It will be necessary to drive the right shim into position. (Fig. 4B-54)

8. Torque bearing cap bolts to 65 ft. lbs.

9. Recheck backlash and correct if necessary.

10. Install new gasket on housing. Install cover. Torque cover bolts to 25 ft. lbs.

11. Fill differential to proper level with the specified lubricant.

DISASSEMBLY OF DIFFERENTIAL ASSEMBLY

TYPE "C"

(31 Through 44 Series)

DIFFERENTIAL CASE (Fig. 4B-55)

Removal

1. Raise vehicle and remove wheels and brake drums.
2. Clean all dirt from area of carrier cover.
3. Drain lubricant from carrier by removing cover.
4. Remove the differential pinion shaft lock screw and the differential pinion shaft (Fig. 4B-56).
5. Push flanged end of axle shafts toward center of car and remove "C" locks from button ends of shafts.
6. Remove axle shafts from housing, being careful not to damage oil seals.
7. Roll out the differential pinions and thrust washers, then remove side gears and thrust washers. Mark pinions and side gears so that they can be reassembled in original position.

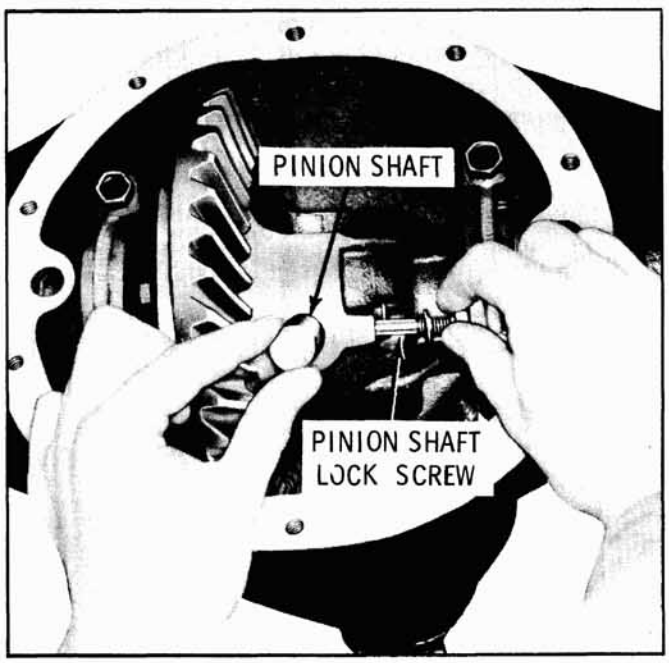


Fig. 4B-56—Removing Pinion Shaft Lock Screw and Shaft (Type "C")

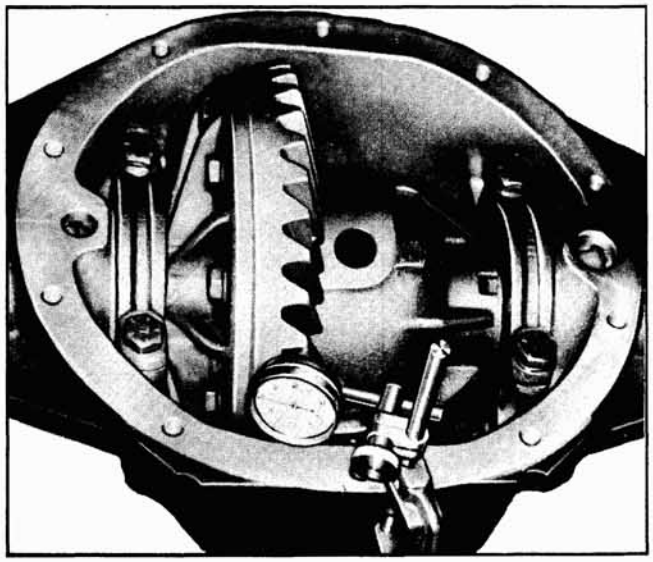


Fig. 4B-57—Checking Ring Gear Backlash (Type "C")

Before removing the differential case from the housing, ring gear to pinion backlash should be checked. This will indicate gear or bearing wear or an error in backlash or pre-load setting which will help in determining cause of failure or of axle noise. (Fig. 4B-57)

8. Mark one bearing cap and housing for reassembly in same position. Remove bearing cap bolts and bearing caps.

Do not attempt to pry caps off as they may damage machined face of cap.

9. Using a pry bar as shown in Fig. 4B-58. Pry differential case out of carrier. Exercise care in prying on carrier so that gasket sealing surface is not damaged.

If the bearings are pre-loaded, the case will suddenly fall free when it is pried past a certain point; therefore, make sure case is properly supported to prevent damage. The bearing caps may be loosely installed to prevent case from falling.

10. Place left and right bearing races with bearing caps so

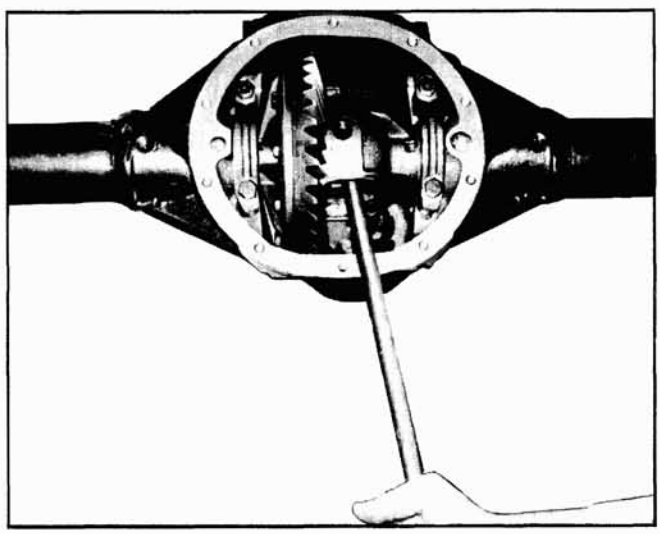


Fig. 4B-58—Differential Case Removal (Type "C")

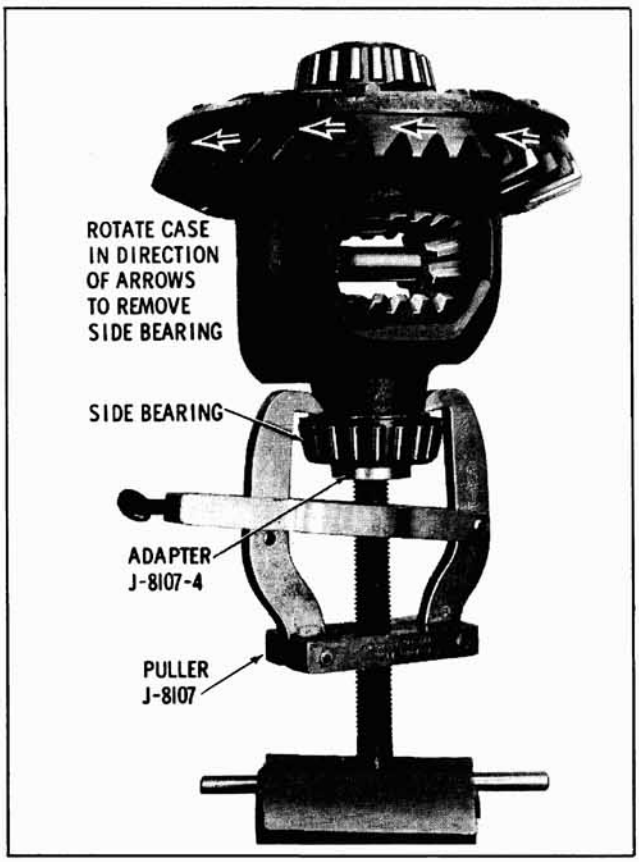


Fig. 4B-59—Side Bearing Removal (Type "C")

that they may be reinstalled in original positions. Place shims with appropriate races.

11. If differential side bearings are to be replaced, they can be removed as shown in Fig. 4B-59.

12. If ring gear is to be replaced and it is tight on case after removing bolts, drive it off using a brass drift and hammer. Do not pry between ring gear and case.

Ring gear attaching bolts on all type "C" differentials have right hand threads.

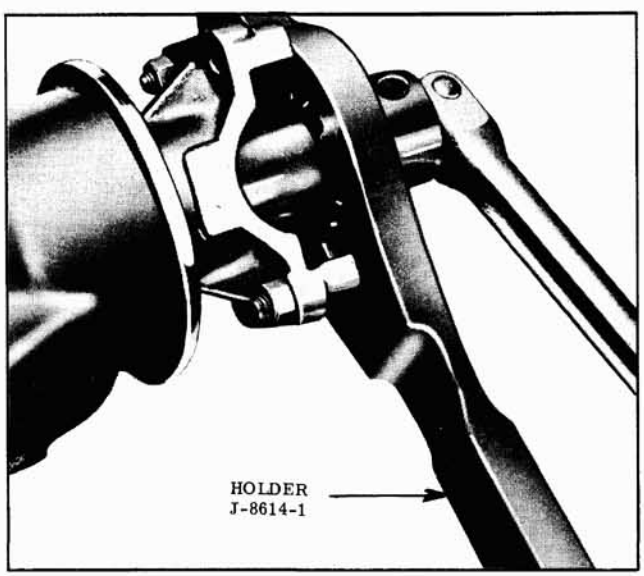


Fig. 4B-60—Removing Companion Flange Nut

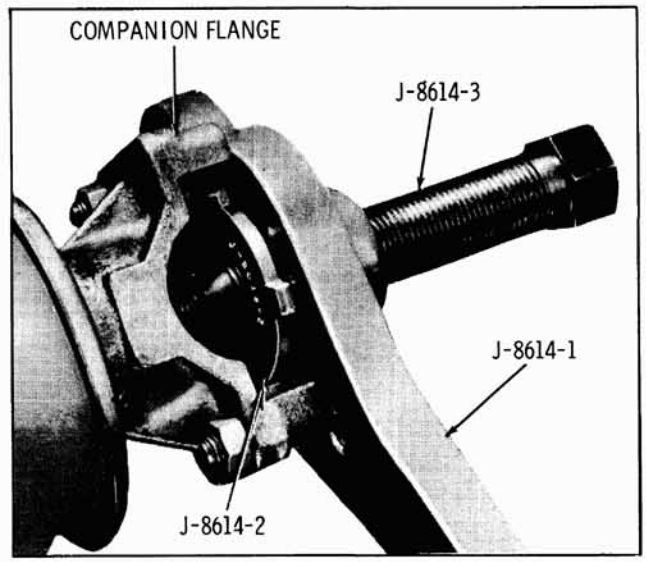


Fig. 4B-61—Removing Companion Flange

DRIVE PINION - TYPE "C"

Remove

Before removing drive pinion, check ring gear to pinion back-lash as outlined under DIFFERENTIAL CASE - REMOVE.

1. Check drive pinion bearing pre-load. If there is no pre-load reading, check for looseness of pinion assembly by shaking. Looseness could be caused by defective bearings or a worn companion flange. If differential was operated for an extended period with very loose bearings, the ring gear and pinion will also require replacement.
2. Remove companion flange nut and washer. (Fig. 4B-60)
3. Remove companion flange. (Fig. 4B-61)
4. Remove drive pinion by tapping on front end with a soft faced hammer.

Hold pinion with one hand while tapping to prevent pinion from falling inside of carrier and being damaged.

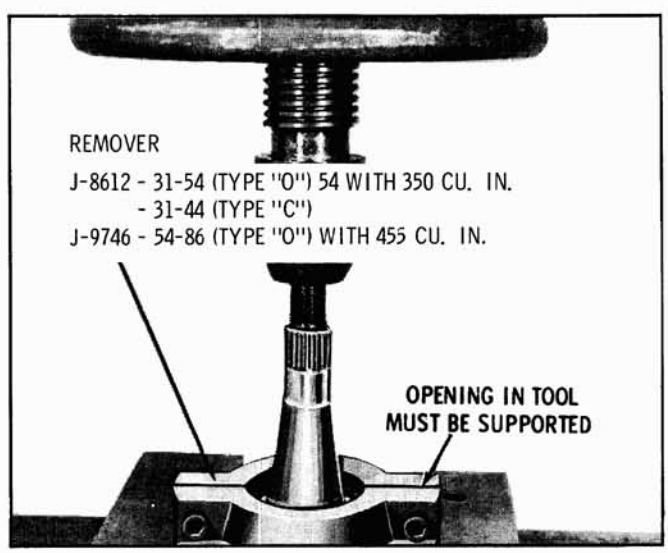


Fig. 4B-62—Removing Rear Pinion Bearing (Type "C")

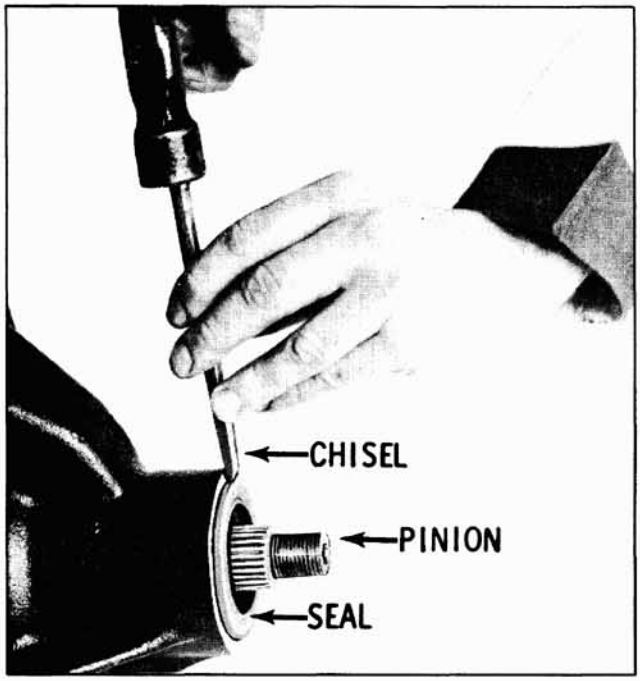


Fig. 4B-63—Removing Pinion Oil Seal

Disassembly

The rear pinion bearing must be removed when it becomes necessary to change the pinion depth adjustment.

1. With drive pinion removed from carrier, press bearing from the pinion gear as shown in Fig. 4B-62.
2. Drive pinion oil seal from carrier (Fig. 4B-63) and remove front pinion bearing. If this bearing is to be replaced, remove outer race from carrier as shown in Fig. 4B-64.
3. If rear pinion bearing is to be replaced remove outer race from carrier using a punch in slots provided for this purpose as shown in Fig. 4B-65.

CLEANING AND INSPECTION

1. Clean all differential bearings thoroughly in clean solvent (do not use a brush). Examine bearings visually and by feel. All bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.

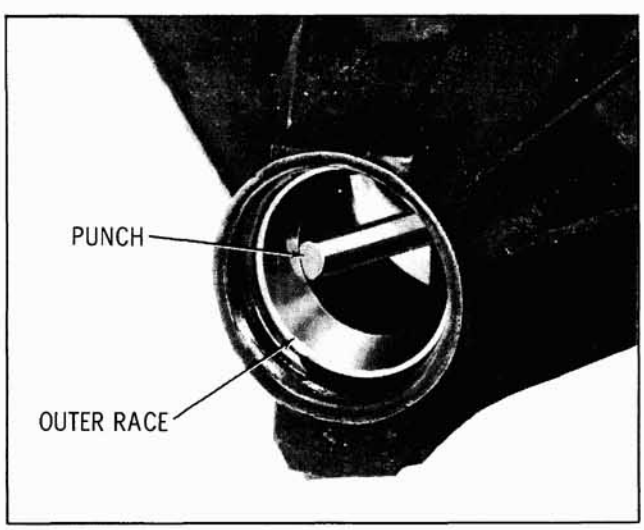


Fig. 4B-64—Removing Front Pinion Bearing Outer Race

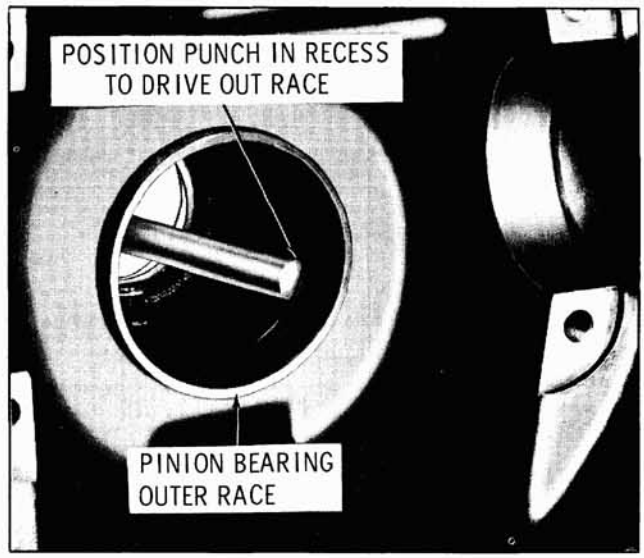


Fig. 4B-65—Removing Rear Pinion Bearing Outer Race

Minute scratches and pits that appear on rollers and races at low mileage are due to the initial pre-load, and bearings having these marks should not be rejected.

2. Examine sealing surface of companion flange for nicks, burrs, or rough tool marks which would cause damage to the seal and result in an oil leak. Replace if damaged.
3. Examine carrier bore and remove any burrs that might cause leaks around the O.D. of the pinion seal.
4. Examine the differential ring gear and drive pinion teeth for excessive wear and scoring. If any of these conditions exist, replacement of the gear set will be required.
5. Inspect the differential pinion gear shaft for unusual wear; also check the pinion and side gears and thrust washers.
6. Check the press fit of the side bearing inner race on the differential case hub by prying against the shoulder at the puller recess in the case. Side bearings must be a tight press fit on the hub.
7. Diagnosis of a differential failure such as: chipped bearings, loose (lapped-in) bearings, chipped gears, etc., is a warning that some foreign material is present; therefore, the axle housing must be cleaned.

DRIVE PINION - TYPE "C"

Assembly

1. If a new rear pinion bearing is to be installed, install new outer race as shown in Fig. 4B-66.

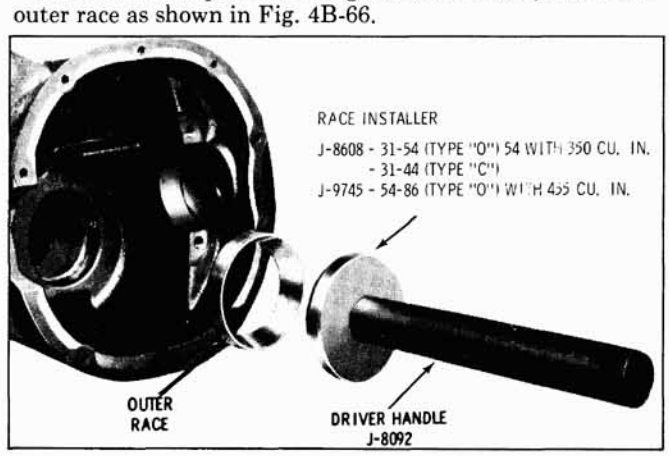


Fig. 4B-66—Installing Rear Pinion Bearing Outer Race

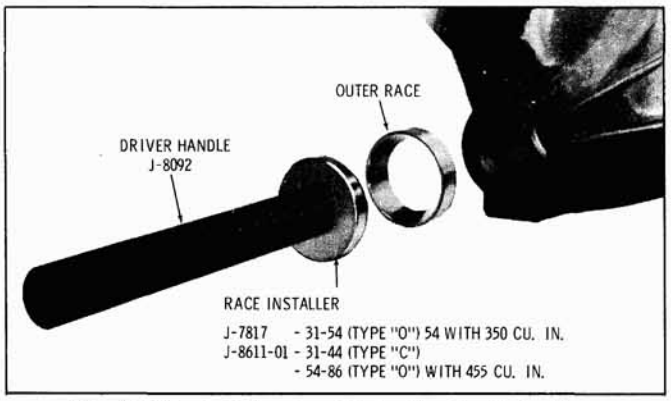


Fig. 4B-67—Installing Front Pinion Bearing Outer Race

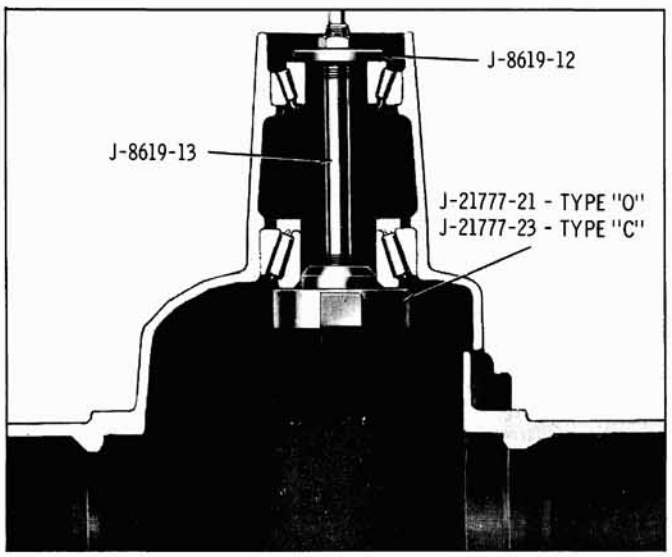


Fig. 4B-68—Installing Pinion Depth Gauge Plate (Type "C")

2. If a new front pinion bearing is to be installed, install new outer race as shown in Fig. 4B-67.

ADJUSTING PINION DEPTH - TYPE "C"

Pinion depth is set with Pinion Setting Gauge J-21777. The pinion setting gauge provides in effect, a "nominal" or "zero" pinion as a gauging reference.

1. Make certain all of the gauge parts are clean.
2. Lubricate front and rear pinion bearings liberally with differential lubricant, No. 1050081 or equivalent.
3. While holding pinion bearings in position, install depth setting gauge assembly as shown in Fig. 4B-68.

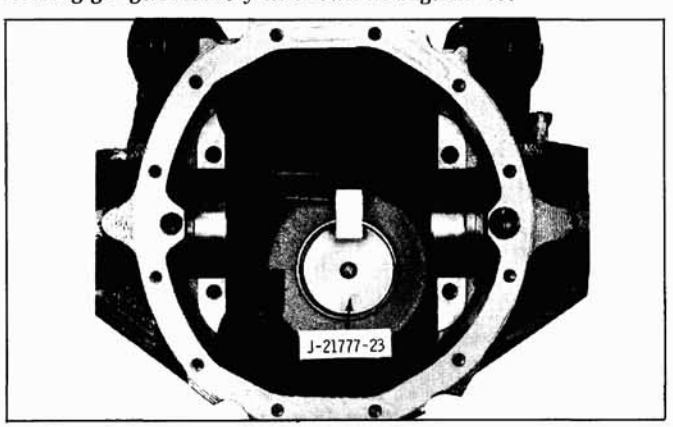


Fig. 4B-69—Pinion Depth Checking Gauge (Type "C")

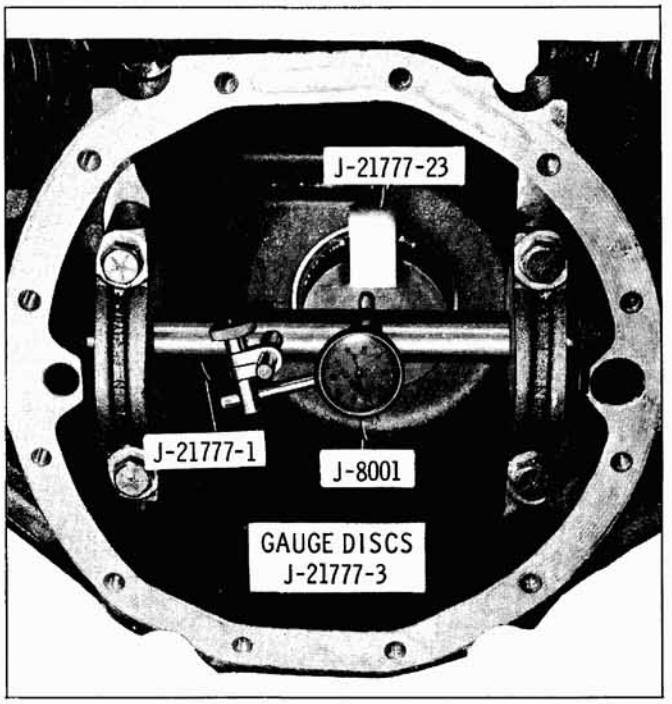


Fig. 4B-70—Checking Pinion Depth (Type "C")

4. Hold stud stationary with a wrench positioned over the flats on the ends of stud and tighten nut to 20 in. lbs. torque. Rotate gauge plate assembly several complete revolutions to seat the bearings. Then tighten nut until a torque between 20 and 30 in. lbs. is required to keep the gauge plate in rotation.

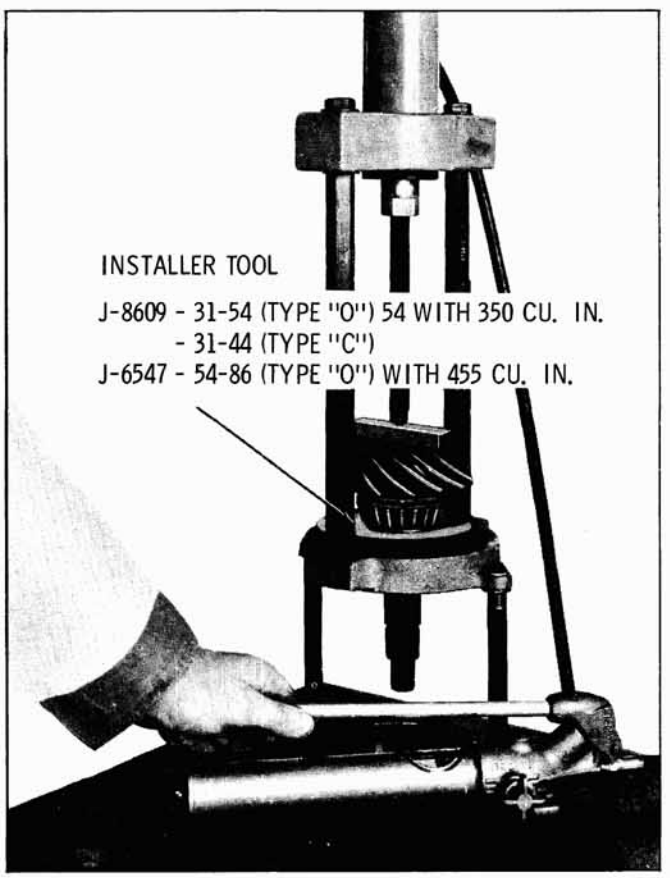


Fig. 4B-71—Installing Rear Pinion Bearing (Type "C")

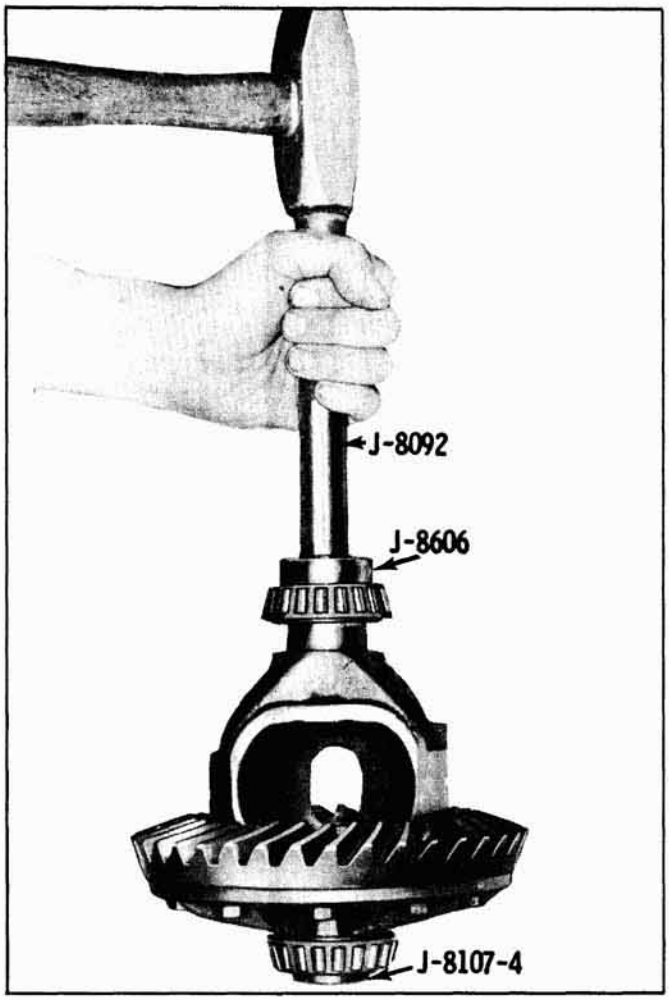


Fig. 4B-71A—Installing Side Bearings (Type "C")

5. Make certain differential side bearing support bores are clean and free of burrs.
6. Install the correct discs on the gauge shaft. (Fig. 4B-70)
7. Rotate the gauge plate until the gauging areas are parallel with the discs. (Fig. 4B-69)
8. Position the gauge shaft assembly in the carrier so that the dial indicator rod is centered on the gauging area of the gauge block, and the discs seated fully in the side bearing bores. Install side bearing caps and torque bolts to 55 ft. lbs.
9. Set dial indicator at ZERO. Then position on mounting post of the gauge shaft with the contact button touching the indicator pad. Push dial indicator downward until the needle

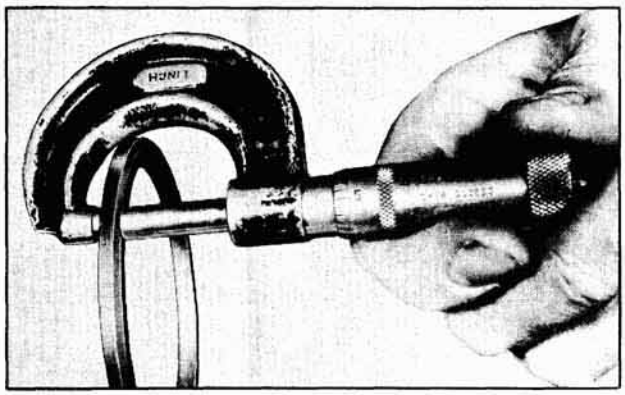


Fig. 4B-72—Measuring Production Shim

rotates approximately 3/4 turn clockwise. Tighten the dial indicator in this position and recheck.

Use dial indicator J-8001 or an equivalent indicator reading from 0 to 100.

10. Rotate gauge shaft slowly back and forth until the dial indicator reads the greatest deflection. At the point of greatest deflection, set the dial indicator to ZERO. Repeat rocking action of gauge shaft to verify the ZERO setting.
11. After the ZERO setting is obtained, rotate gauge shaft until the dial indicator rod does not touch the gauge block.
12. Record dial reading at pointer position. Example: If pointer moved counterclockwise .067" to a dial reading of .033" (as shown in Fig. 4B-70), record the reading of .033".
13. All drive pinions are painted with a code number on the large end of the pinion drive gear. The code number in the chart below indicates the amount to be added or subtracted from gauge reading obtained in Step 12.

DRIVE PINION CODE

40 = .005" Minus	46 = .001" Plus
41 = .004" Minus	47 = .002" Plus
42 = .003" Minus	48 = .003" Plus
43 = .002" Minus	49 = .004" Plus
44 = .001" Minus	50 = .005" Plus
45 = .000"	

Example: Dial Indicator Reading Step 12 was .033".
Pinion Code is 47.
Pinion Shim required. = .033" (Dial Indicator Reading) plus .002" (Pinion Code + .002") = .035" Shim Required.

Shims are available in .001" to .037". Each shim has the thickness etched on flat surface for easy identification.

14. Remove side bearing caps and gauge shaft and discs.
15. Loosen Stud J-8619-13 and remove Gauge Plate Washer and both bearings from carrier.
16. Position correct shim on drive pinion and install the drive pinion rear bearing as shown in Fig. 4B-71.

RING GEAR-TYPE "C"

Installation

1. Install guide pins, made from 3/8" - 24 x 1-1/2" long cap screws with heads cut off and ends slotted, to ring gear.
2. Position ring gear over pilot diameter of the case. Install every other ring gear bolt and lock washer, then draw them up evenly and snugly so that gear face is flush with face of case.
3. Remove guide pins and install remaining bolts - torque all bolts to 50 ft. lbs.

SIDE BEARING TYPE "C"

Installation

1. If side bearings were removed, install bearings with tools shown in (Fig. 4B-71A).

SIDE BEARING PRE-LOAD ADJUSTMENT - TYPE "C"

The side bearing pre-load adjustment is to be made before installing the pinion. If the pinion is installed, remove ring gear.

Differential side bearing pre-load is adjusted by changing the thickness of both the right and left shims by an equal amount. By changing the thickness of both shims equally,

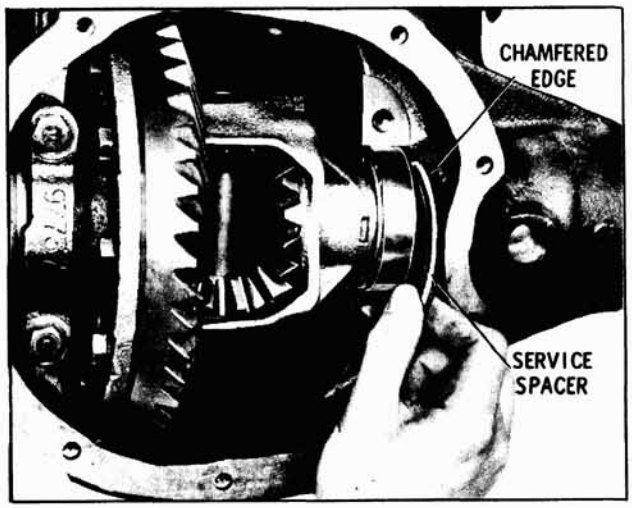


Fig. 4B-73—Installing Service Spacer (Type "C")

the original backlash will be maintained.

Poduction shims are cast iron and vary in thickness.

Standard service spacers are .160" thick and steel service shims are available from .064" to .100" in increments of .002"

Do not attempt to reinstall the production shims as they may break when tapped into place. If service shims were previously installed, they can be reused, but (whether using new or old bearings) adhere to the following procedure in all cases.

1. Before installation of the case assembly, make sure that side bearing surfaces in the carrier are clean and free of burrs. Side bearings must be oiled with Lubricant No. 1050081 or equivalent and if the same bearings are being reused, they must have the original outer races in place.

2. Determine the approximate thickness of shims needed by measuring each production shim or each service spacer and shim pack as shown in Fig. 4B-72.

3. In addition to the service spacer (.160"), a service shim will be needed.

4. Place differential case with bearing outer races in position in carrier. Slip the service spacer between each bearing race and carrier housing with chamfered edge against housing. (Fig. 4B-73) See Example for determining shims to each side of differential.

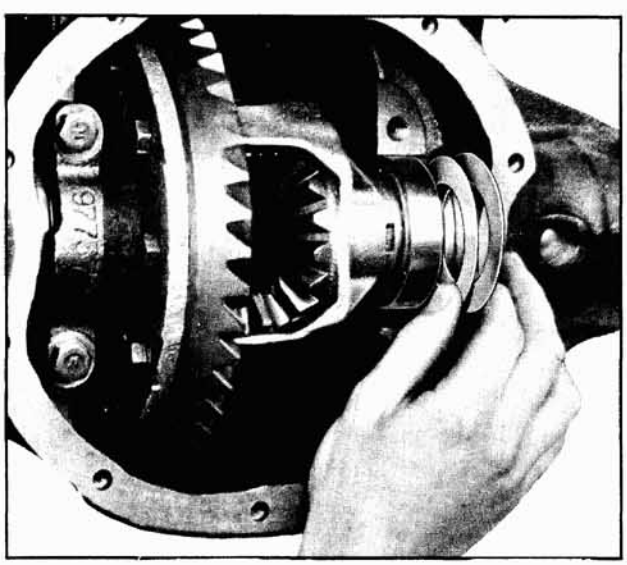


Fig. 4B-74—Installing Service Shims (Type "C")

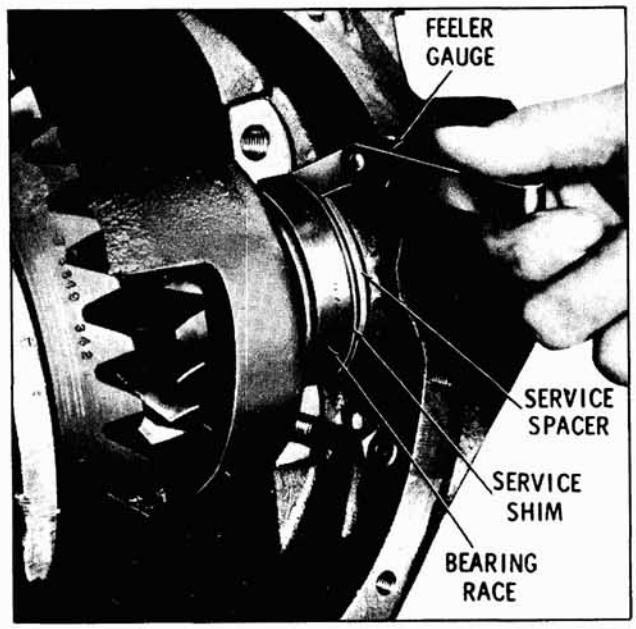


Fig. 4B-75—Inserting Feeler Gauge (Type "C")

Example - (One Side)

	.242"	Total Production Shim Removed.
Less	.160"	Service Spacer (Steel)
	.082"	
Less	.010"	For Feeler Gauging
	.072"	Starting Shim Required

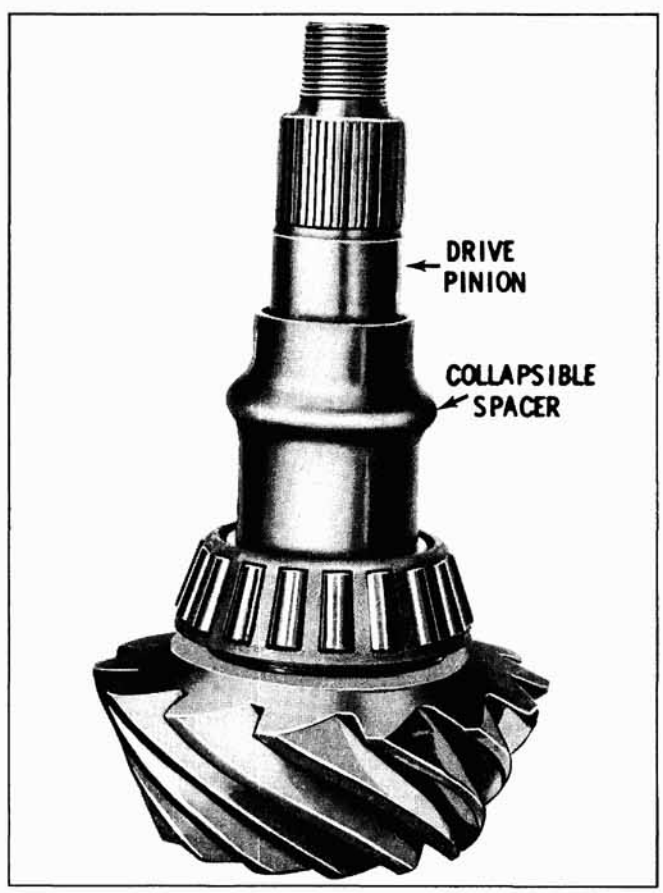


Fig. 4B-76—Collapsible Spacer on Pinion (Type "C")

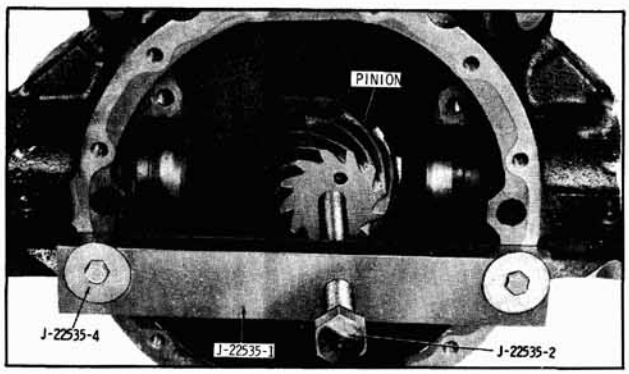


Fig. 4B-77—Pinion Holding Tool

Install the left bearing cap loose so that the case may be moved while checking adjustments. Another bearing cap bolt can be added in the lower right bearing cap hole. This will prevent case from dropping while making shim adjustments.

Select shim as shown in the Example (Step 4) and position between the right bearing race and the service spacer. Be sure left bearing race and spacer are against left side of carrier. (Fig. 4B-74)

5. Insert progressively larger feeler gauge sizes (.006", .008", .010", etc.) between the right shim and service spacer until there is noticeable increased drag. Push the feeler gauge downward until the end of the gauge makes contact with the carrier bore so as to obtain a correct reading. The point just before additional drag begins is correct feeler gauge thickness. Rotate case while using feeler gauge to assure an even reading. (Fig. 4B-75)

The original light drag is caused by weight of the case against the carrier while additional drag is caused by side bearing pre-load. By starting with a thin feeler gauge, a sense of "feel" is obtained so that the beginning of pre-load can be recognized to obtain Zero clearance.

It will be necessary to work case in and out and to the left in order to insert the feeler gauge. Be sure to locate the feeler gauge as shown in Fig. 4B-75.

6. Remove left bearing cap and all shims from carrier. The total shim pack needed (with no pre-load on side bearings) is the feeler gauge reading found in Step 5 equally divided and added to the thickness of shims installed in Step 4.

7. These shims will be installed between each side bearing race and service spacer when the case is installed in the carrier.

The object of Step 6 is to obtain the equivalent of a "slip fit" of the case in the carrier. For convenience in setting backlash, the pre-load will not be added until the final step.

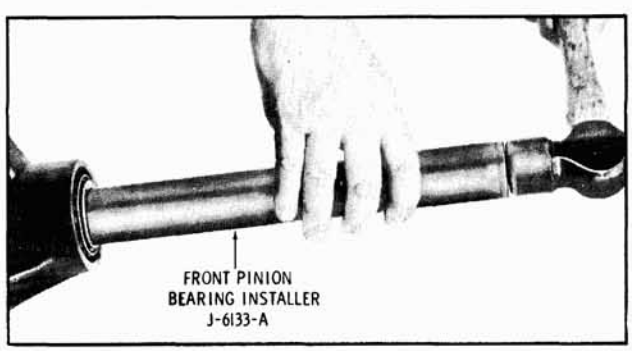


Fig. 4B-78—Installing Front Pinion Bearing

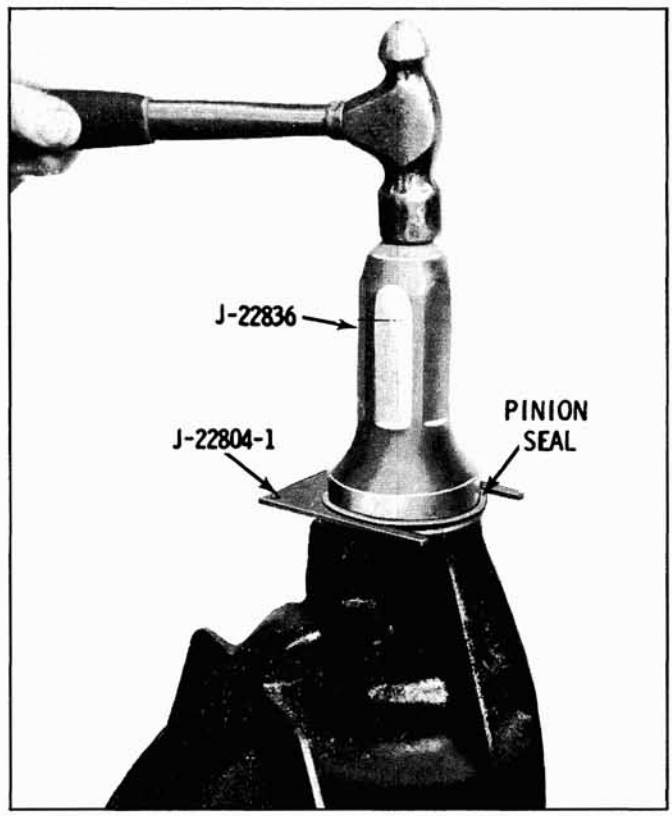


Fig. 4B-79—Installing Pinion Oil Seal (Type "C")

8. If the pinion is in position, install the ring gear, then proceed to DIFFERENTIAL BACKLASH ADJUSTMENT.

DRIVE PINION INSTALLATION - TYPE "C"

Lubricate pinion bearings with Lubricant No. 1050081 or equivalent before installing pinion.

1. Install collapsible spacer on pinion and position assembly in carrier. (Fig. 4B-76)

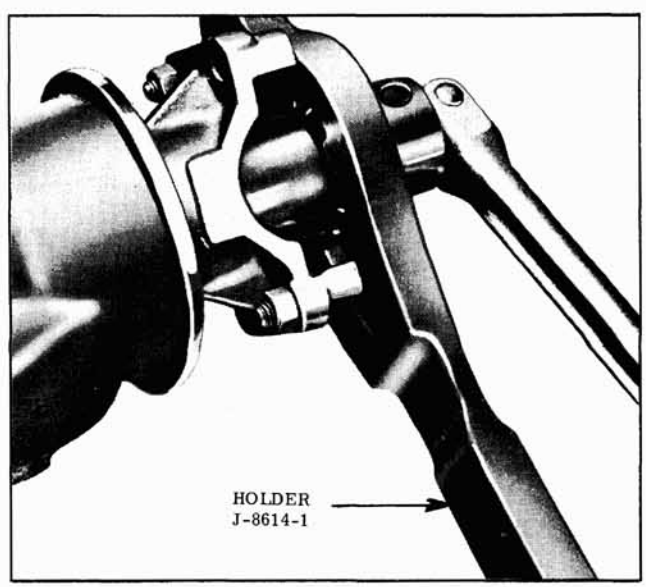


Fig. 4B-80—Installing Companion Flange Nut

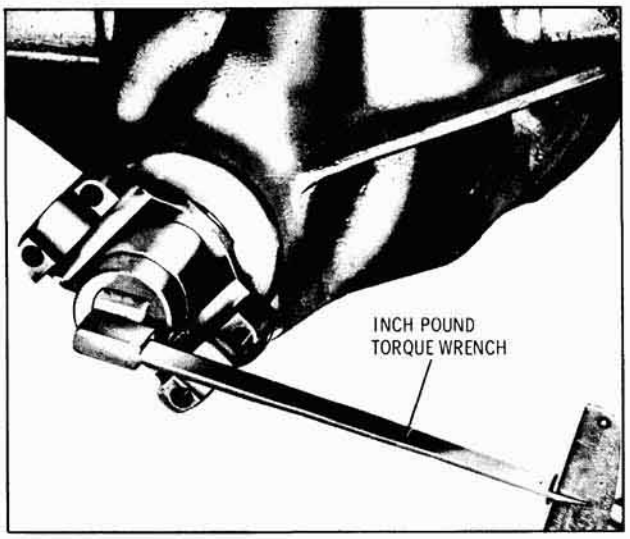


Fig. 4B-81—Checking Pinion Bearing Preload

Collapsible spacer must be put on pinion shaft and pinion assembly installed into carrier together. Spacer will not fit through front pinion bearing outer race.

2. While holding pinion forward, install pinion blocking fixture (J-22535) and tighten screw to hold rear pinion bearing tight against race. (Fig. 4B-77)

3. Install front bearing on pinion and drive bearing on pinion shaft until seated in race, using Tool J-6133-A. (Fig. 4B-78)

4. Position pinion oil seal in carrier. Install seal as shown in Fig. 4B-79.

5. Coat lips of pinion oil seal and seal surface of pinion flange with Lubricant, No. 1050169 or equivalent. Install companion flange on pinion by tapping with a soft hammer until a few pinion threads project through flange.

6. Install pinion washer and nut. Hold companion flange with Holder J-8614-1. While intermittently rotating pinion to seat bearings, tighten companion flange nut until end play begins to be taken up. (Fig. 4B-80)

When no further end play is detectable and when Holder J-8614-1 will no longer pivot freely as pinion is rotated, pre-load specifications are being approached. No further tightening should be attempted until the pre-load has been checked.

7. Check pre-load by using an inch pound torque wrench as shown in Fig. 4B-81.

After pre-load has been checked, final tightening should be done very carefully. For example, if when checking pre-load was found to be 5 in. lbs., and additional tightening of the pinion nut can add many additional inch pounds of torque. Therefore, the pinion nut should be further tightened only a little at a time and the pre-load should be checked after each slight amount of tightening. Exceeding pre-load specifications will compress the collapsible spacer too far and require the installation of a new collapsible spacer or the addition of a shim.

Only one shim may be used, then the spacer must be replaced.

While observing the preceding note, carefully set pre-load at 20 to 30 in. lbs. on new bearings or 5 to 15 in. lbs. on used bearings.

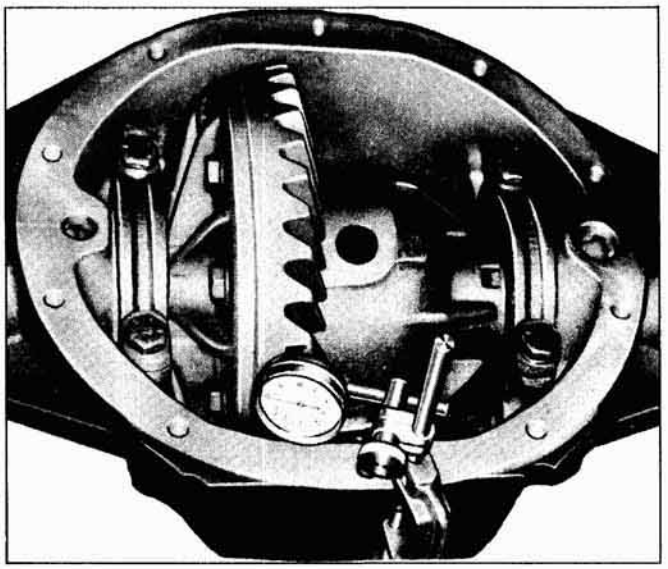


Fig. 4B-82—Checking Ring Gear to Pinion Backlash (Type "C")

8. Rotate pinion several times to assure that bearings have been seated. Check pre-load again. If pre-load has been reduced by rotating pinion, reset pre-load to specifications.

DIFFERENTIAL BACKLASH ADJUSTMENT - TYPE "C"

1. Install differential case into carrier, using shims as determined by the side bearing pre-load adjustment.

2. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Fig. 4B-82. Use a small button on the indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is in line as nearly as possible with gear rotation and perpendicular to tooth angle for accurate backlash reading.

3. Check backlash at three or four points around ring gear. Lash must not vary over .002" around ring gear.

Pinion must be held stationary when checking backlash.

If variation is over .002" check for burrs, uneven bolting conditions or distorted case flange and make corrections as

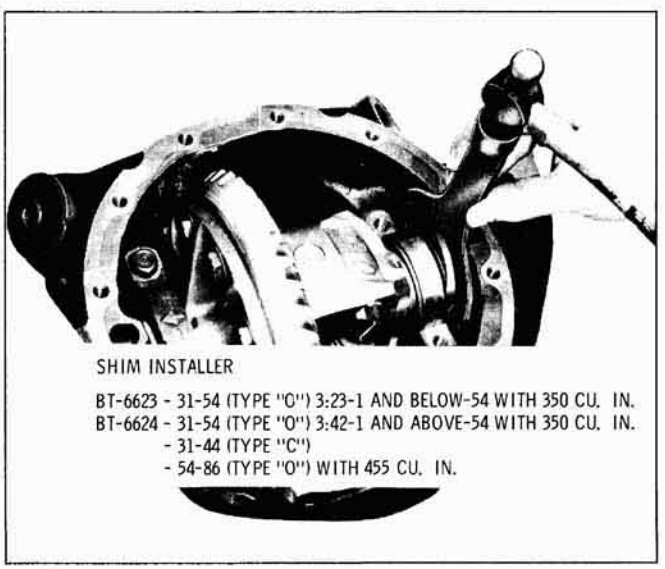


Fig. 4B-83—Driving Shim into Position (Type "C")

necessary.

4. Backlash at the point of minimum lash should be between .005" and .008" for all new gears.

5. If backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. This will maintain correct differential side bearing pre-load.

For each .001" change in backlash desired, transfer .002" in shim thickness. To decrease backlash .001", decrease thickness of right shim .002" and increase thickness of left shim .002". To increase backlash .002" increase thickness of right shim .004" and decrease thickness of left shim .004".

6. When backlash is correctly adjusted, loosen bearing cap bolts. Remove left bearing cap and left shim pack. Select a shim .004" thicker than the one removed, and insert between the spacer and the left bearing race. Loosely install bearing cap.

7. Remove right bearing cap and right shim pack. Select a shim .004" thicker than the one removed and insert between the spacer and the right bearing race. It will be necessary to drive the right shim into position. (Fig. 4B-83)

8. Torque bearing cap bolts to 55 ft. lbs.

9. Recheck backlash and correct if necessary.

10. Install thrust washers and side gears in case, if same parts are used, replace in original sides. Position pinions and thrust washers through loading holes in case 180 degrees apart so that they engage side gears. Rotate gears until pinion shaft holes are aligned.

11. Slide axle shafts into place.

Exercise care that splines on end of shaft do not damage oil seal and that they engage with splines of differential side gear.

12. Install axle shaft "C" lock on button end of axle shaft and push shaft outward so that shaft lock seats in counterbore of differential side gear.

13. Position differential pinion shaft through case and pinions, aligning hole in shaft with lock screw hole.

14. Install lock screw and torque to 20 ft. lbs.

15. Using a new gasket, install carrier cover and torque bolts to 20 ft. lbs.

Make sure both gasket surfaces on carrier and cover are clean before installing new gasket. Torque carrier cover bolts in a crosswise pattern to ensure uniform draw on cover gasket.

16. Fill axle with Lubricant Part No. 1050081 or equivalent to a level even with bottom of filler hole.

17. Install brake drums and wheels.

18. Lower car and test operation of axle.

ANTI-SPIN DIFFERENTIAL

31 THROUGH 86 SERIES

TYPE "O"

DESCRIPTION

The conventional differential divides the driving force equally to both rear wheels. The driving force is limited by the wheel which has the least amount of traction; therefore, if one wheel is on snow or mud, the wheel will spin and the driving force is lost.

The Anti-Spin differential (optional on all Series) through the use of clutch plates directs the driving force to the wheel with the best traction thus improving the ability of the car to pull out of mud or snow.

For Anti-Spin identification, refer to the GENERAL INFORMATION SECTION.

ON CARS EQUIPPED WITH ANTI-SPIN DIFFERENTIALS, DO NOT RUN ENGINE WITH ONE REAR WHEEL OFF THE GROUND AND TRANSMISSION IN GEAR. Also, "on the car" type wheel balancers should not be used on the rear wheels unless both rear wheels are off the floor.

OPERATION

The Anti-Spin differential transmits torque from the drive pinion gear to the ring gear and to the case in the same manner as the conventional differential. In addition, the Anti-Spin differential incorporates the use of clutch plates which tend to lock the axle shafts to the case, or in effect, to each other.

When driving force is applied at the differential case, the pinion shaft, pinion gears and side gears (splined to the axle shafts) begin to rotate as an assembly in the same direction as the case. Although traction at the rear wheels may not be equal, their resistance to turning allows the pinion gears to bear against the side gears (splined to the axle shaft and the clutch plates) to apply the clutches, and to lock the axle shafts to the case. This allows both rear wheels to turn at an equal speed and the driving force is not lost by the wheel with poor traction.

When turning a corner, the action is essentially that of a conventional differential.

ANTI-SPIN CONVERSION INFORMATION

The case assembly (less ring gear and side bearings) is available for converting a conventional differential to Anti-Spin. The ring gear and side bearings of the conventional differential, if in good condition, can be used with the Anti-Spin case assembly.

DIFFERENTIAL CASE-TYPE "O"

Disassembly (Fig. 4B-84)

1. If side bearings are to be removed, they can be removed as outlined in the CONVENTIONAL DIFFERENTIAL Section.

2. If the ring gear or differential case is to be replaced, remove ring gear from case.

3. Remove pinion shaft lock screw and then remove pinion shaft from case.

4. Drive the pre-load spring from the case. (Fig. 4B-85)

5. Rotate side gears until the pinions are in the open area of the case. Remove the pinions and thrust washers. (Fig. 4B-86)

6. Remove a side gear, clutch pack and shims from the case, noting its location in the case to aid in reassembly. Remove the side gear clutch pack and shims from the opposite side.

7. Remove the shims and clutch plates from the side gears.

Keep the clutch plates in their original location in the clutch pack.

CLEANING AND INSPECTION OF CASE

1. Clean side bearings thoroughly in clean solvent (do not use a brush). Examine bearings visually and by feel. Bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.

Minute scratches and pits that appear on rollers and races at low mileage are due to the initial pre-load, and bearings having these marks should not be rejected.

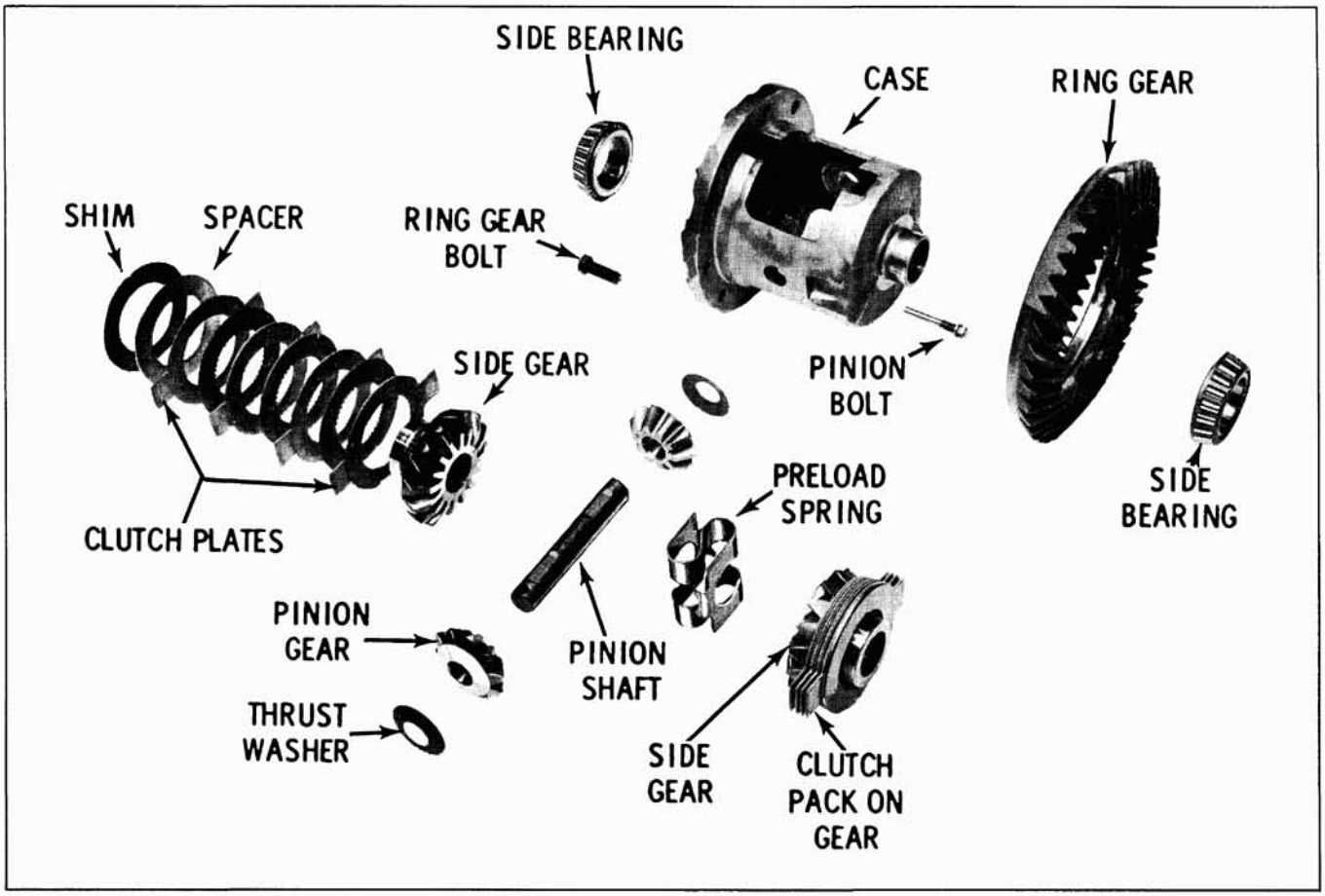


Fig. 4B-84—Anti-Spin Differential (Type "O")

2. Examine the ring gear and drive pinion teeth for nicks, burrs, or scoring. Any of these conditions will require replacement of the gear set.

3. Inspect pinion shaft, pinions and side gears. Replace if parts are excessively scored, pitted or worn.

4. Check the press fit of the side bearing inner race on the differential case. Side bearings must be a tight press fit on the hub.

5. Inspect clutch plates for scored, worn, cracked or a distorted condition. If any of these conditions exist, new clutch plates must be installed.

DIFFERENTIAL CASE - TYPE "O

Assembly

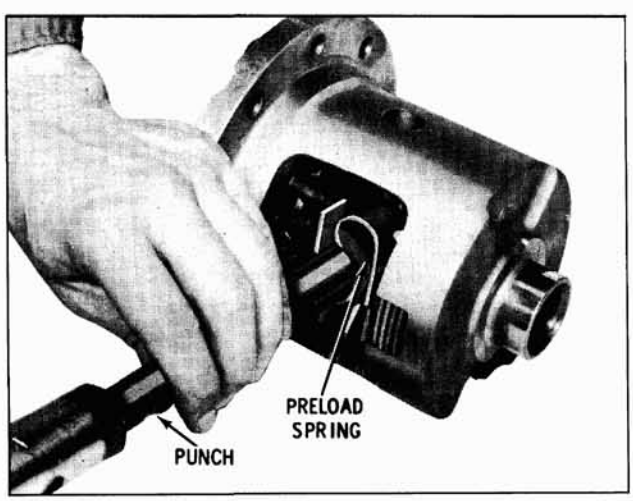


Fig. 4B-85—Removing Pre-load Spring (Type "O")

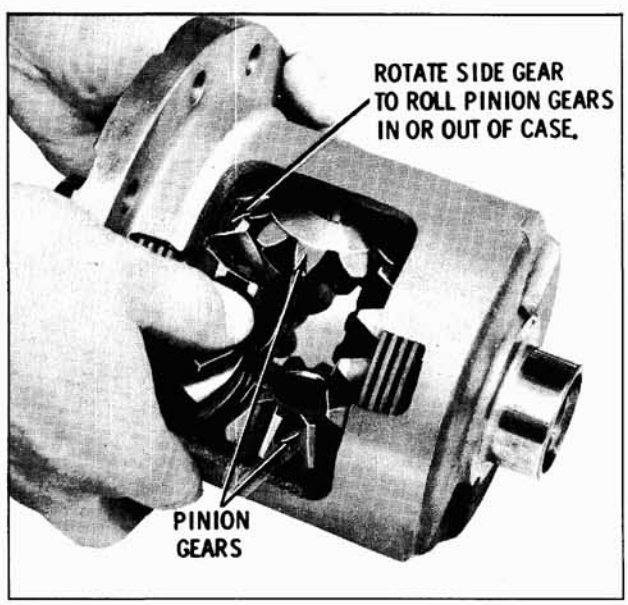


Fig. 4B-86—Removing or Installing Pinions and Thrust Washers

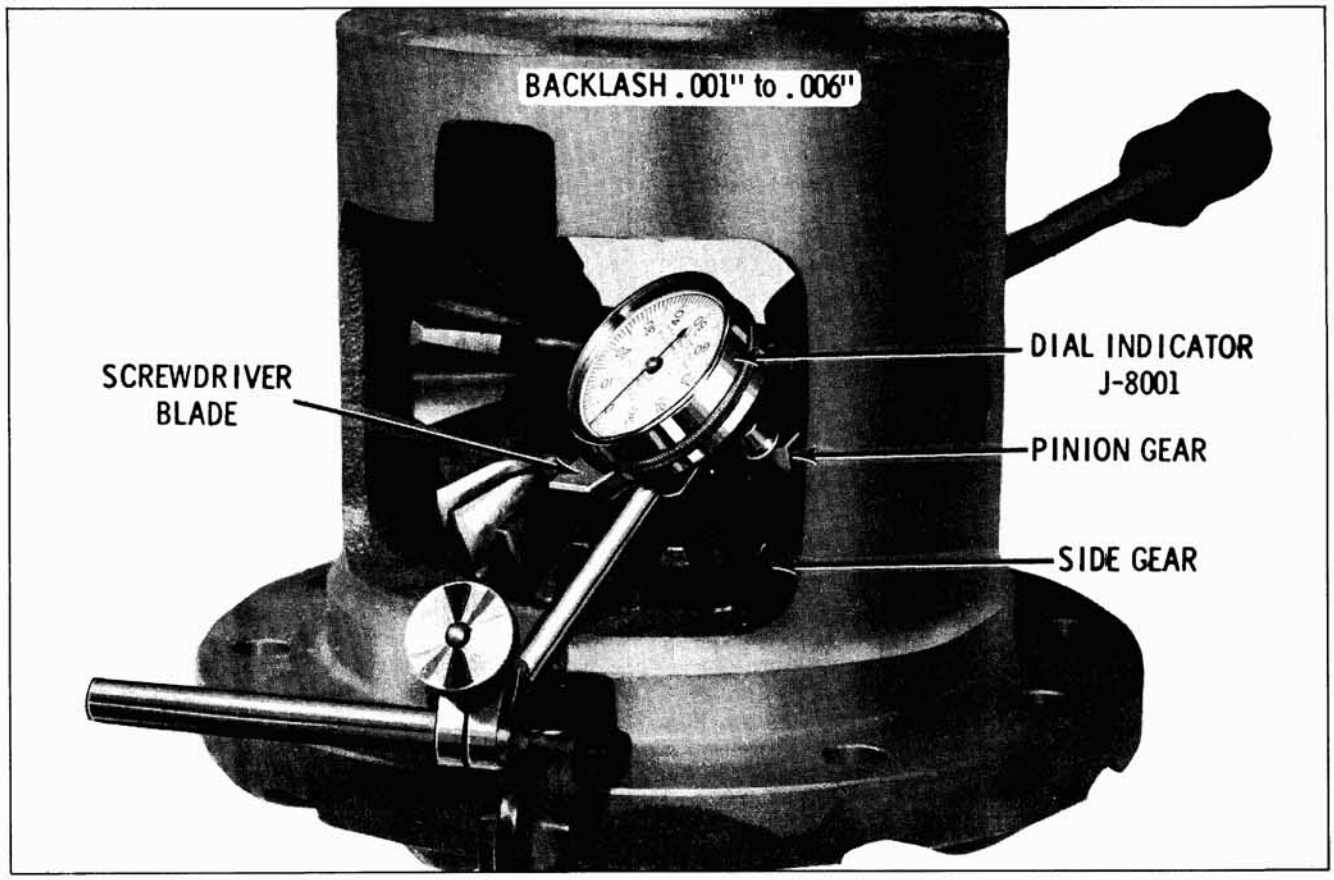


Fig. 4B-87—Checking Side Gear to Pinion Backlash

1. If side bearings were removed, lubricate the bearings and install on case hubs as outlined in the CONVENTIONAL DIFFERENTIAL Section

2. Apply Special Lubricant, No. 1050081 or lubricant meeting GM Specifications—GM4744-M (OL 134) to the clutch plates.

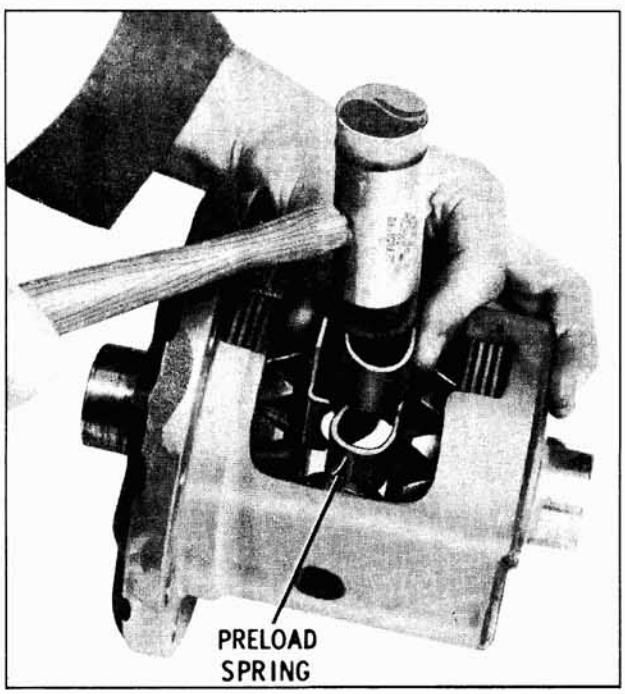


Fig. 4B-88—Installing Preload Spring

3. Assemble the clutch pack as follows:

a. Alternately position 7 clutch plates on the side gear, STARTING and ENDING with a clutch plate having external lugs.

b. Next, place the spacer against the plate having external lugs then the shims on last.

Be careful to install the same spacer and shims or an equal amount on the clutch pack for a starting point.

c. Repeat Steps a and b on the other clutch pack.

4. Check the pinion to side gear clearance as follows:

a. Install one side gear with clutch pack and shims in the case.

b. Position the two pinion gears and thrust washers on the side gear and install the pinion shaft.

c. Compress the clutch stack by inserting a screwdriver or wedge between the side gear and the pinion shaft.

d. Install dial indicator J-8001 with the contact button against the pinion gear. (Fig. 4B-87)

e. Rotate pinion gear. Clearance should be .001" to .006".

f. If clearance is more than .006", add shims between clutch pack and case. If clearance is less than .001", remove shims. A .002" shim will change clearance approximately .001". Recheck clearance after adding or subtracting shims.

g. Remove side gear and repeat procedure with opposite clutch pack, on opposite side of case.

5. Remove pinion shaft, pinions and thrust washers.

6. Install the remaining side gear and clutch pack with correct shims in the case.

7. Place the pinion gears on the side gears and rotate into correct position (Fig. 4B-86)

8. Install the thrust washers behind the pinion gears and align.

9. Insert the pinion shaft into the case, through the thrust washer and part way into the pinion gear. This will keep the pinion gears aligned while driving the pre-load spring into place.

10. Position pre-load spring as shown in Fig. 4B-88 next to the side gears and drive into place.

11. Push the pinion shaft into position and align the lock screw hole in the shaft with the hole in the case. Install the pinion shaft lock screw and torque to 15 ft. lbs.

12. If the ring gear was removed, position the gear on the case flange and install new attching bolts. Tighten the attaching bolts evenly and alternately across the diameter in progressive stages. Torque to 85 ft. lbs.

ANTI-SPIN DIFFERENTIAL

(31 Through 44 Series)

TYPE "C"

DESCRIPTION

The conventional differential divides the driving force equally to both rear wheels. The driving force is limited by the wheel which has the least amount of traction; therefore, if one wheel is on snow or mud, the wheel will spin and the driving force is lost.

The Anti-Spin differential (optional on all Series) through the use of clutch plates directs the driving force to the wheel with the best traction thus improving the ability of the car to pull out of mud or snow.

For Anti-Spin identification, refer to the GENERAL INFORMATION SECTION.

ON CARS EQUIPPED WITH ANTI-SPIN DIFFERENTIALS, DO NOT RUN ENGINE WITH ONE REAR WHEEL OFF THE GROUND AND TRANSMISSION IN GEAR. Also, "on the car" type wheel balancers should not be used on the rear wheels unless both rear wheels are off the floor.

OPERATION

The Anti-Spin differential transmits torque from the drive pinion gear to the ring gear and to the case in the same manner as the conventional differential. In addition, the Anti-Spin differential incorporates the use of clutch plates which tend to lock the axle shafts to the case, or in effect, to each other.

When driving force is applied at the differential case, the pinion shaft, pinion gears and side gears (splined to the axle shafts) begin to rotate as an assembly in the same direction as the case. Although traction at the rear wheels may not be equal, their resistance to turning allows the pinion gears to bear against the side gears (splined to the axle shaft and the clutch plates) to apply the clutches, and to lock the axle shafts to the case. This allows both rear wheels to turn at an equal speed and the driving force is not lost by the wheel with poor traction.

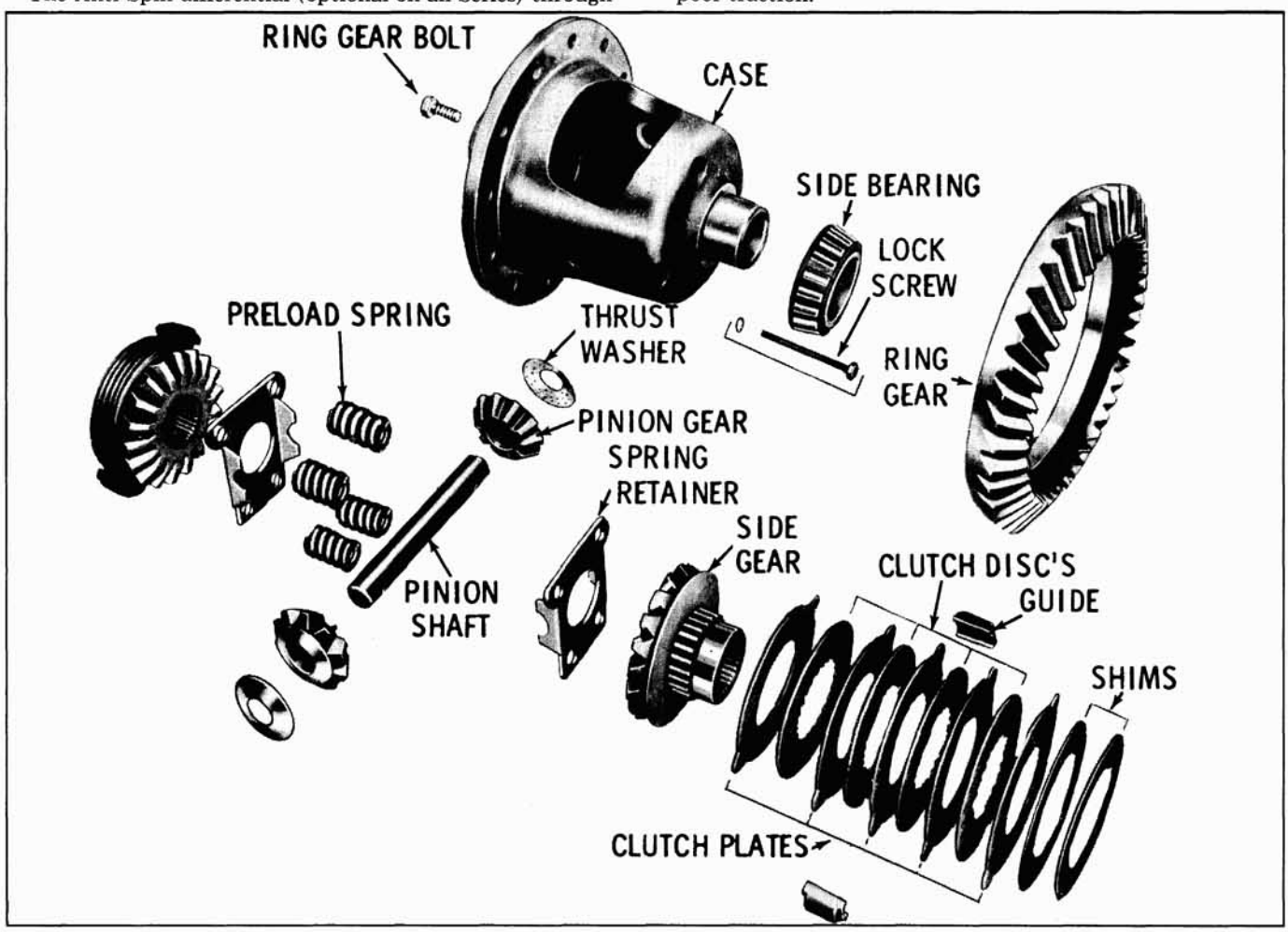


Fig. 4B-89—Anti-Spin Differential (Type "C")

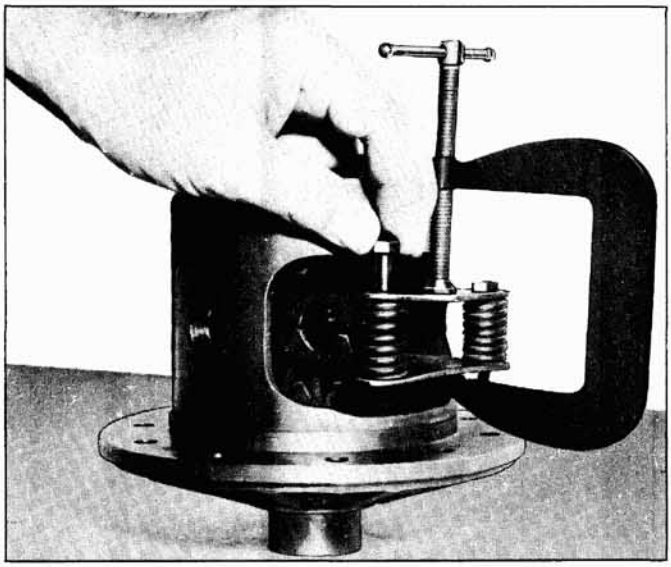


Fig. 4B-90—Installing Bolts to Retain Springs

When turning a corner, the action is essentially that of a conventional differential.

ANTI-SPIN CONVERSION INFORMATION

The case assembly (less ring gear and side bearings) is available for converting a conventional differential to Anti-Spin. The ring gear and side bearings of the conventional differential, if in good condition, can be used with the Anti-Spin case assembly.

DIFFERENTIAL CASE AND DRIVE PINION - TYPE "C"

Disassembly (Fig. 4B-89)

1. If necessary to remove ring gear and side bearings, follow the procedures established for the conventional differential unit type "C".
2. Drive the pre-load spring retainer and springs through the observation hole in case only far enough to secure a "C" clamp. (Fig. 4B-90). Then install 1/4" bolts through retainers and secure enough to remove retainer and spring pack.
3. If necessary to disassemble retainer and spring, position in a vise and remove 1/4" bolts and "C" clamp and loosen vise until spring compression is relieved.
4. Remove the pinion thrust washers from behind the pinion gears.

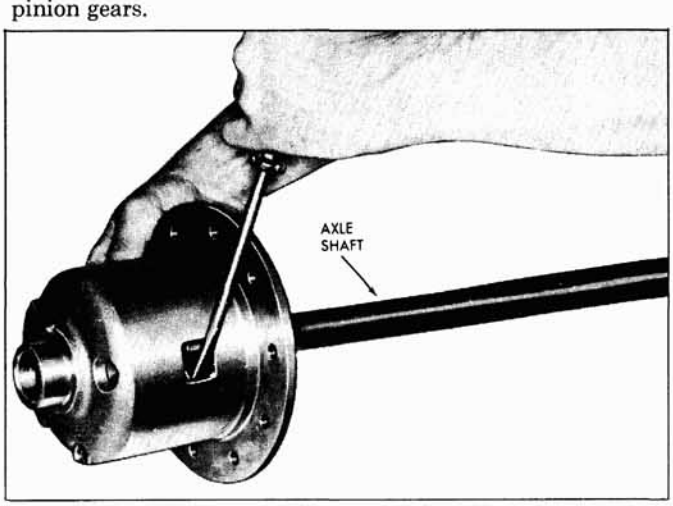


Fig. 4B-91—Removing Pinion Gears

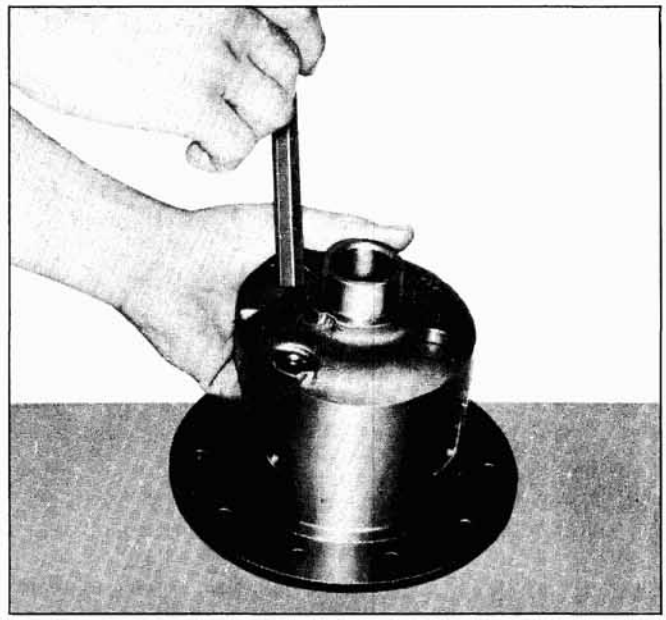


Fig. 4B-92—Removing Clutch Pack

5. Remove pinion gears from the case - pinion gears can be removed by rotating them in one direction only. Using Fig. 4B-91 as a reference, rotate differential case clockwise to remove the first gear, then rotate case counterclockwise to remove the second gear. To remove second gear, it may be necessary to assist pinion gear upon its seat by prying on gear through observation hole in case. (Fig. 4B-91)
6. Remove side gear, clutch pack, shims and guides from case. Tap the assembly from the case, using a brass drift as shown in Fig. 4B-92. Repeat removal on opposite gear.
7. Separate clutch pack assembly from side gear. Retain clutch pack assembly with original side gear.

Inspection

1. Check clutch plates and discs for excessive wear and signs of overheating.

Clutch plates or discs are not serviced separately, if replacement is required, clutch pack must be replaced as an assembly.

2. Inspect pre-load springs for distortion and other defects.
3. Compress springs and determine if they are capable of properly pre-loading the clutch pack, replace springs that are weak or questionable.

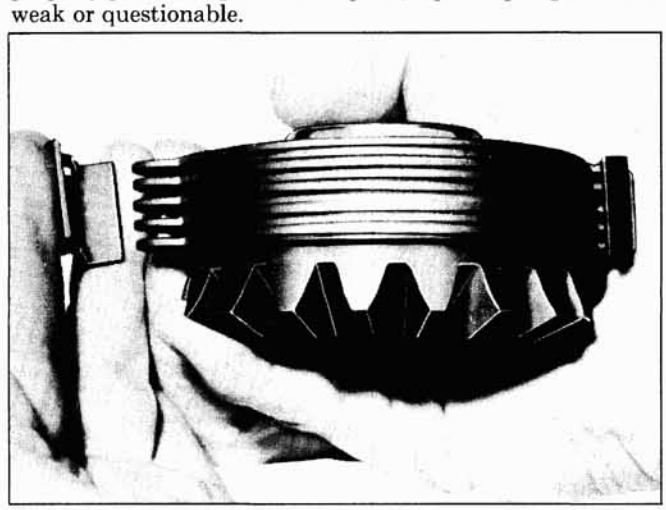


Fig. 4B-93—Assembling Clutch Pack

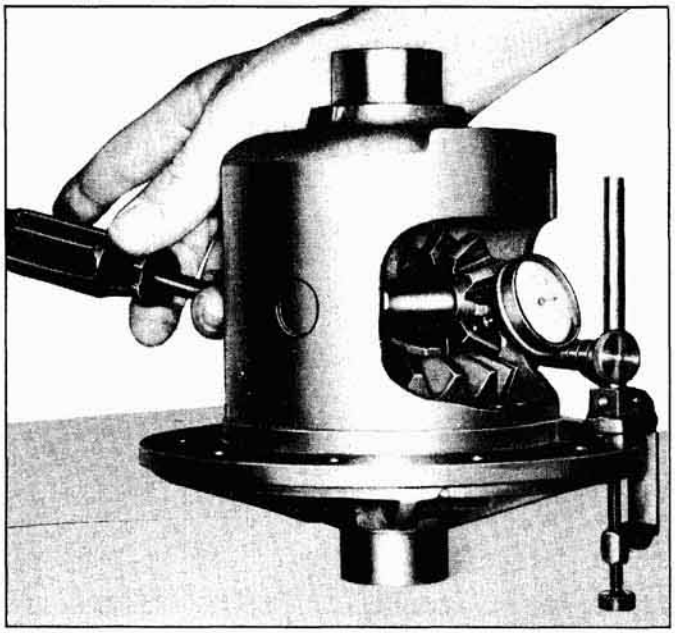


Fig. 4B-94—Measuring Pinion Gear Tooth Clearance

4. Examine spring retainer for alignment between the retainer halves and for excessive wear at spring seats.

5. Clean side bearings thoroughly in clean solvent (do not use a brush). Examine bearings visually and by feel. Bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.

Minute scratches and pit that appear on rollers and races at low mileage are due to the initial pre-load, and bearings having these marks should not be rejected.

6. Examine the ring gear and drive pinion teeth for nicks, burrs, or scoring. Any of these conditions will require replacement of the gear set.

7. Inspect pinion shaft, pinions and side gears. Replace if parts are excessively scored, pitted or worn.

8. Check the press fit of the side bearing inner race on the differential case. Side bearings must be a tight press fit on the hub.

Assembly

1. Lubricate clutch plates and discs with lubricant No. 1050081 or lubricant that meets GM Specifications - GM 4744-M (OL 134).

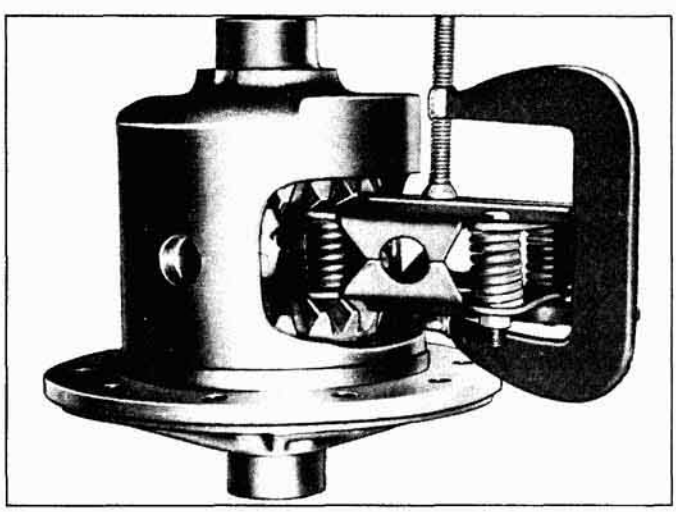


Fig. 4B-95—Clutch Pack Compressed for Installation

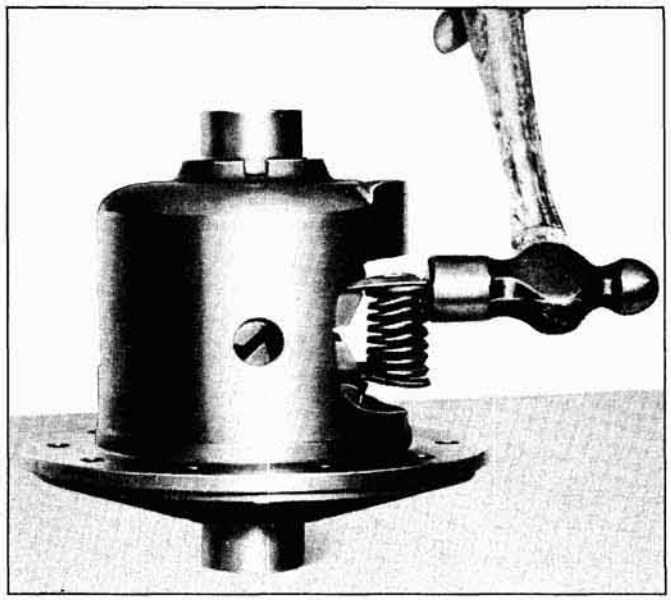


Fig. 4B-96—Installing Clutch Pack

2. Alternately position clutch plate and clutch disc on side gear, beginning and ending with clutch plate, until assembly of clutch pack is complete. (Fig. 4B-93)

3. Install clutch pack guides on the clutch plate lugs. Make sure that the clutch disc lugs engage with side gear teeth.

4. Select shims of equal thickness as those removed from the case, or if old shims are suitable, reinstall them over the side gear hub.

5. Lubricate and assemble opposite side gear as above.

6. Install one side gear, clutch pack assembly and shim(s) in the differential case.

7. Position pinion gears and thrust washers on side gears, install pinion shaft through case and gears.

8. Install dial indicator on case so that contact button rests against pinion gear. (Fig. 4B-94)

9. Compress clutch pack, using a screwdriver as shown in Fig. 4B-94. Move the pinion gear to obtain tooth clearance.

10. Tooth clearance should be .001" to .006", if required change shims to obtain proper tooth clearance.

11. Remove side gear assembly and repeat tooth clearance procedure for gear on opposite side of case.

12. Remove pinion shaft, gears and thrust washers.

13. Install remaining side gear, clutch pack assembly and shims in case.

14. Install pinion gears and thrust washers. Installation of pinion gears can be performed by reversing the pinion gear removal procedure.

15. Assemble springs in spring retainer and clamp assembly in vise. Install "C" clamp and bar stock on spring retainer then install a 1/4" bolt and nut in each front spring. (Fig. 4B-95)

16. Position spring pack between side gears and remove bar stock and "C" clamp.

17. Drive spring pack into side gears sufficiently to retain front springs, then retain front springs, then remove 1/4" bolts from springs. Drive spring pack into position. (Fig. 4B-96)

18. Check alignment of spring retainer with side gears. Slight movement of the spring pack can be made if necessary.

19. Install side bearings and ring gear to case, if removed, using procedure outlined for the conventional differential.

DIAGNOSIS (ALL SERIES)

ANTI-SPIN OPERATION

If an Anti-Spin differential is suspected of not providing positive traction to the non-slipping wheel, the condition can be checked as follows:

1. Place the transmission in neutral.
2. Raise one wheel off the floor and place a block at the front and rear of the opposite wheel.
3. Remove hub cap or wheel disc and apply a torque wrench as shown in Fig. 4B-97.
4. Disregard breakaway torque and observe only the torque required to continuously turn the wheel smoothly.

If the torque reading is less than 15 ft. lbs., the unit should be disassembled and the case assembly repaired as necessary.

DIFFERENTIAL NOISE

When a differential assembly is suspected of being noisy, a thorough road test should be made to make sure that the noise is not being caused by tires, road surface, wheel bearings, engine, transmission, muffler, body or propeller shaft.

TIRE NOISE

Different types of road surfaces will affect tire noise but will not affect differential noise. For road testing, select a level tarvia or asphalt road, as this type road surface practically eliminates tire noise. For test purposes only, inflating all tires to approximately 50 lbs. pressure will materially alter noise caused by tires, but will not affect noise caused by the differential. Differential noise usually ceases when coasting with transmission in neutral at speeds under 30 mph, however, tire noise continues with lower tone as car speed is reduced. Differential noise always changes when comparing "pull" and "coast", but tire noise remains about the same.

WHEEL BEARING NOISE

Wheel bearing noise may be confused with differential noise; however, a rough rear axle bearing produces a vibration or growl which continues with car coasting with transmission in neutral. A bad bearing may cause a knock or click approximately every two revoluations of the wheel since the bearings do not travel at the same speed as the rear axle shaft. To determine which front wheel bearing is noisy, hoist the car and spin each wheel while listening at the hub cap. To determine which rear axle bearing is noisy, hoist car and start engine. With transmission in gear, use a piece of rubber hose or stethoscope BT-37 at the axle housing to locate the noise.

ENGINE AND TRANSMISSION NOISE

Note speed at which noise occurs, and with car standing

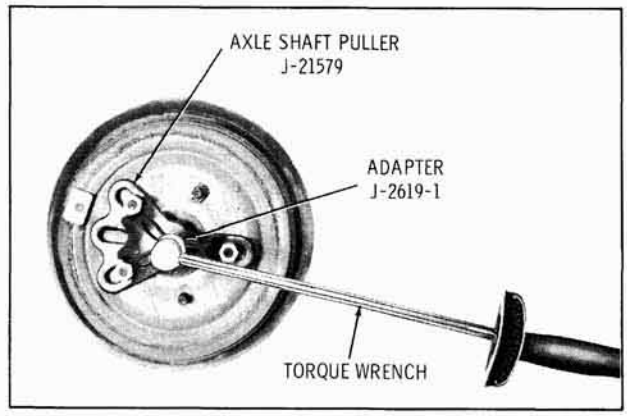


Fig. 4B-97—Checking Anti-Spin

and transmission in neutral, accelerate the engine to approximate speed where noise was noticed. If a similar noise is produced with the car standing, it cannot be due to the differential.

DIFFERENTIAL SIDE AND PINION GEAR NOISE

Differential side gears and pinions seldom cause noise because their movement is negligible on straight ahead driving.

RING GEAR AND PINION GEAR NOISE

These generally show up as drive noise, coast noise, or float noise. Drive noise is most pronounced on constant acceleration through the speed range. Coast noise is most pronounced when the car is allowed to coast through the speed range while in gear. Float noise is most pronounced while holding the car speed constant at various speeds.

DRIVE PINION BEARING AND SIDE BEARING NOISE

Rough or brinnelled bearings produce a continuous whine starting at a relatively low speed. The noise is most noticeable with a light pull between 18 to 25 miles per hour.

DIFFERENTIAL CLUTCH CHATTER ANTI-SPIN ONLY

Improper lubricant can cause the clutch plates to grab and release intermittently resulting in chatter when the car is turning a corner slowly. If this condition is encountered, remove the lubricant and refill with Special Lubricant, No. 1050081 or lubricant which meets GM Specifications GM 4744-M (OL 134).

Special Lubricant No. 1050081, MUST be used for initial fill of the differential and for any additions.

TORQUE SPECIFICATIONS

Application	Type "O"	Type "C"
Differential	Ft. Lbs.	Ft. Lbs.
Filler Plug	30	20
Axle Housing to Cover	25	20
Ring Gear Bolts	85	50
Side Bearing Cap Bolts	65	55
Pinion Gear Shaft Retaining Bolt	15	20

SPECIFICATIONS

Differential		
Lubrication		
Capacity		
31-54 (54 with 350 Cu. In.)	Type "O"	3-3/4 Pts. approx.
31-44	Type "C"	4-1/2 Pts. approx.
54-86 (with 455 Cu. In.)	Type "O"	5-1/3 Pts. approx.
Replenish (Conventional)	Special Lubricant No. 1050081 or S.A.E. 90 Multi Purpose Gear Lubricant Meeting Military Specifications MIL-L-2105B.	
(Anti-Spin)	Special Lubricant No. 1050081 or Lubricant Meeting GM Specification GM 4744 - M (OL 134)	

Adjustments	Type "O"	Type "C"
Backlash	.005 - .009	.005 - .008
Drive Pinion Bearing Pre-Load		
New Bearings	24 to 32 in. lbs.	20 to 30 in. lbs.
Old Bearings	8 to 12 in. lbs.	5 to 15 in. lbs.

SPEEDOMETER GEAR REFERENCE CHART

31 THROUGH 48 SERIES

Locate differential code number, read across under tire size to find correct number of teeth for speedometer drive gear - driven gear.

NOTE: Number of teeth on drive gear is related to type of transmission.

Number of Drive Gear Teeth	Type of Transmission
8	3 & 4 Speed Manual
17	Jetaway
18	Turbo Hydra-Matic

EXAMPLE: Differential code RE, 7.75-14 tires and 3 speed manual transmission. From chart this takes an 8 tooth drive gear, 23 tooth driven gear with adapter (C) 1.125:1 ratio.

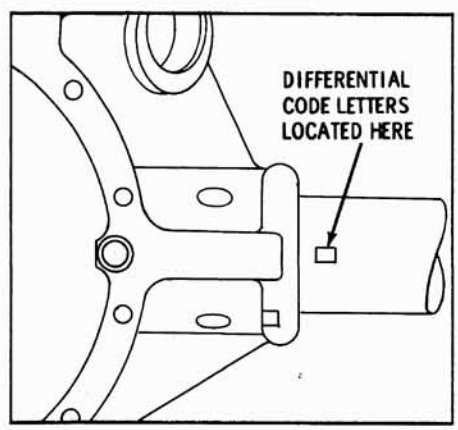


Fig. 4B-98—Location of Code Identification

	Tire Sizes				
Differential Codes	7.75-14	7.75-15	8.25-14	205R-14	F70-14
R2, R3, R6 & R7	17-34 18-40 (A)	17-36 (A) 18-34		17-37 (A) 18-35	
R8, R9, TH. & TR	18-35	18-34		18-35	
RA, RB, TJ & TT	8-17 17-36 18-38	8-18 (A) 17-34 18-36		8-19 (A) 17-35 18-38	

SPEEDOMETER GEAR REFERENCE CHART (CONT'D.)

Differential Codes	Tire Sizes				
	7.75-14	7.75-15	8.25-14	205R-14	F70-14
SA, SB, S2, S3, TA & TB	8-17 17-36 18-39	8-20 (B) 17-35 18-37	18-38	8-17 17-36 18-38	
RC, RD, SC, SD, S4, S5, SM, SN, T4 & T5	8-19 8-22 (Q) 17-40 18-43	8-18 8-22 (Q) 17-38 18-41	17-39 18-42	8-19 8-22 (Q) 17-40 18-42	8-19 8-22 (C) 18-43 17-41
SE, SF, SO, SP, S6 & S7	8-20 8-22 (Q) 17-42 18-45	8-19 8-22 (Q) 17-40 18-43	8-17 (E) 17-41 8-22 (C) 18-43	8-20 8-22 (Q) 17-42 18-44	8-20 8-22 (C) 18-45 17-43
RE, RF, T6 & T7	8-20 8-23 (C) 17-43 18-40 (E)	8-17 (K) 8-22 (C) 17-41 18-43		8-20 8-23 (C) 17-43 18-45	8-21 8-23 (C) 18-34 (D) 17-44
TL & TM S8, S9	8-21 8-24 (C) 17-45 18-41 (E)	8-20 8-23 (C) 17-43 18-45		8-21 8-24 (C) 17-44 18-36 (G)	8-21 8-24 (C) 17-45 18-37 (G)
TN, TO, T2 & T3	8-21 (K) 8-24 17-39 (G) 18-40 (D)	8-20 (K) 8-23 17-34 (J) 18-38 (D)		8-21 (K) 8-24 17-39 (G) 18-41 (G)	8-21 (K) 8-24 17-40 (G) 18-34 (M)
TW & TY	8-20 (G) 8-23 (K) 17-35 (M) 18-37 (M)	8-19 (D) 8-22 (K) 17-40 (D) 18-42 (D)		8-19 (P) 8-23 (K) 17-39 (J) 18-37 (M)	8-20 (D) 8-23 (K) 17-40 (J) 18-45 (D)
Dealer Installed Only 4.66:1 Ratio	8-21 (D) 8-25 (N) 17-45 (D) 18-40 (M)	8-17 (M) 8-24 (N) 17-45 (G) 18-43 (J)		8-21 (D) 8-25 (H) 17-42 (J) 18-40 (M)	8-18 (M) 8-25 (N) 17-43 (J) 18-41 (M)

ADAPTER RATIO INFORMATION

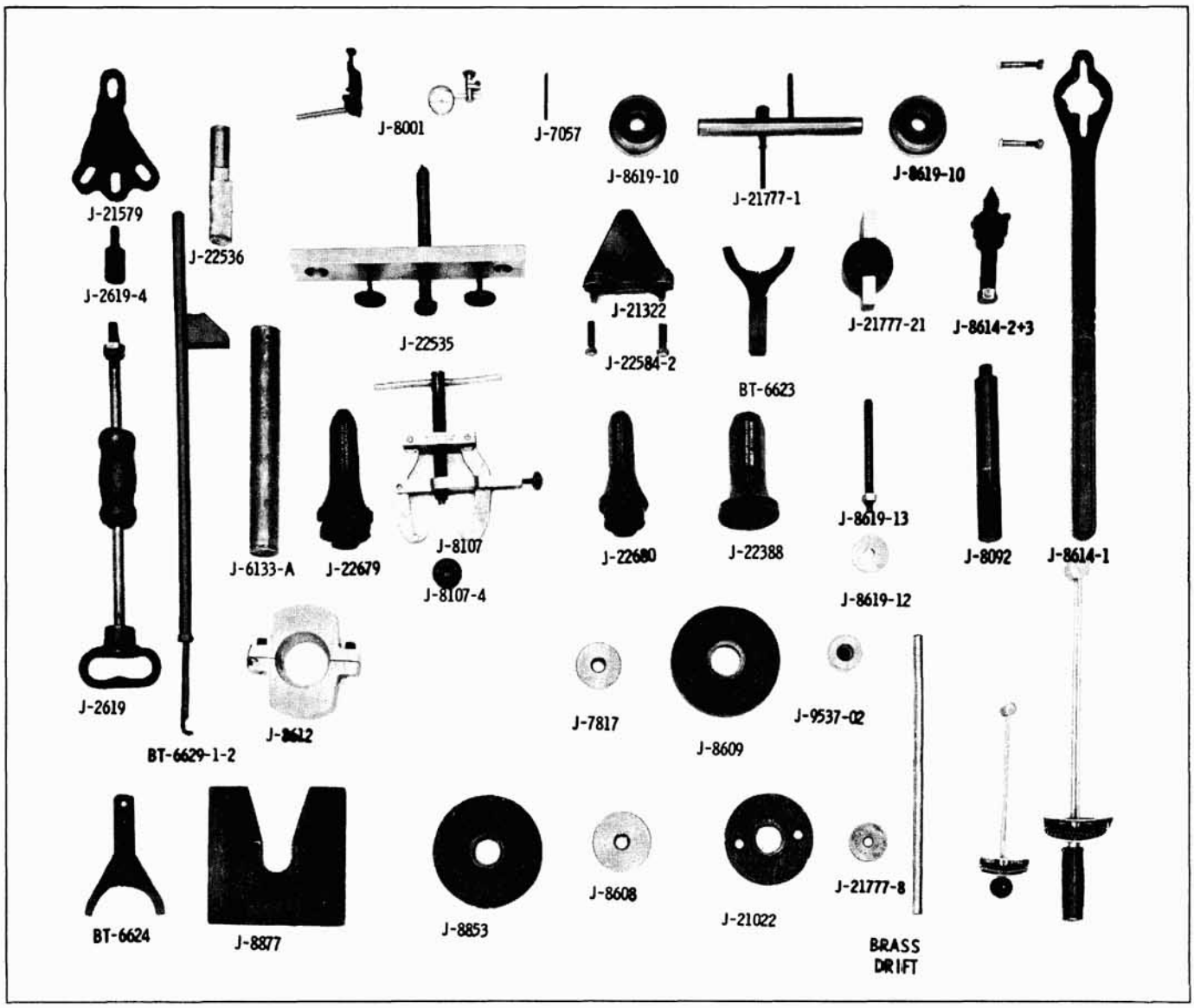
ADAPTER RATIO	ADAPTER RATIO	ADAPTER RATIO
(A) 1.125:1 (B) 1.202:1 (C) 1.125:1 with 3 Speed Manual; 1.132:1 with 4 Speed Manual (D) .7333:1 (E) .8653:1	(F) 1.132:1 with 4 Speed Manual; No Adaptor with 3 Speed Manual (G) .7692:1 (H) .6944:1 with 3 Speed Manual in cars built in Oshawa (J) .6944:1	(K) .8653:1 with 3 Speed Manual; .8660:1 with 4 Speed Manual (L) .7850:1 (M) .6190:1 (N) .8660:1 (P) .7222:1 (Q) .1.272:1

NOTE: Adaptors used on 4 Speed Manual are right angle adaptors only.

1968 DIFFERENTIAL IDENTIFICATION CODE

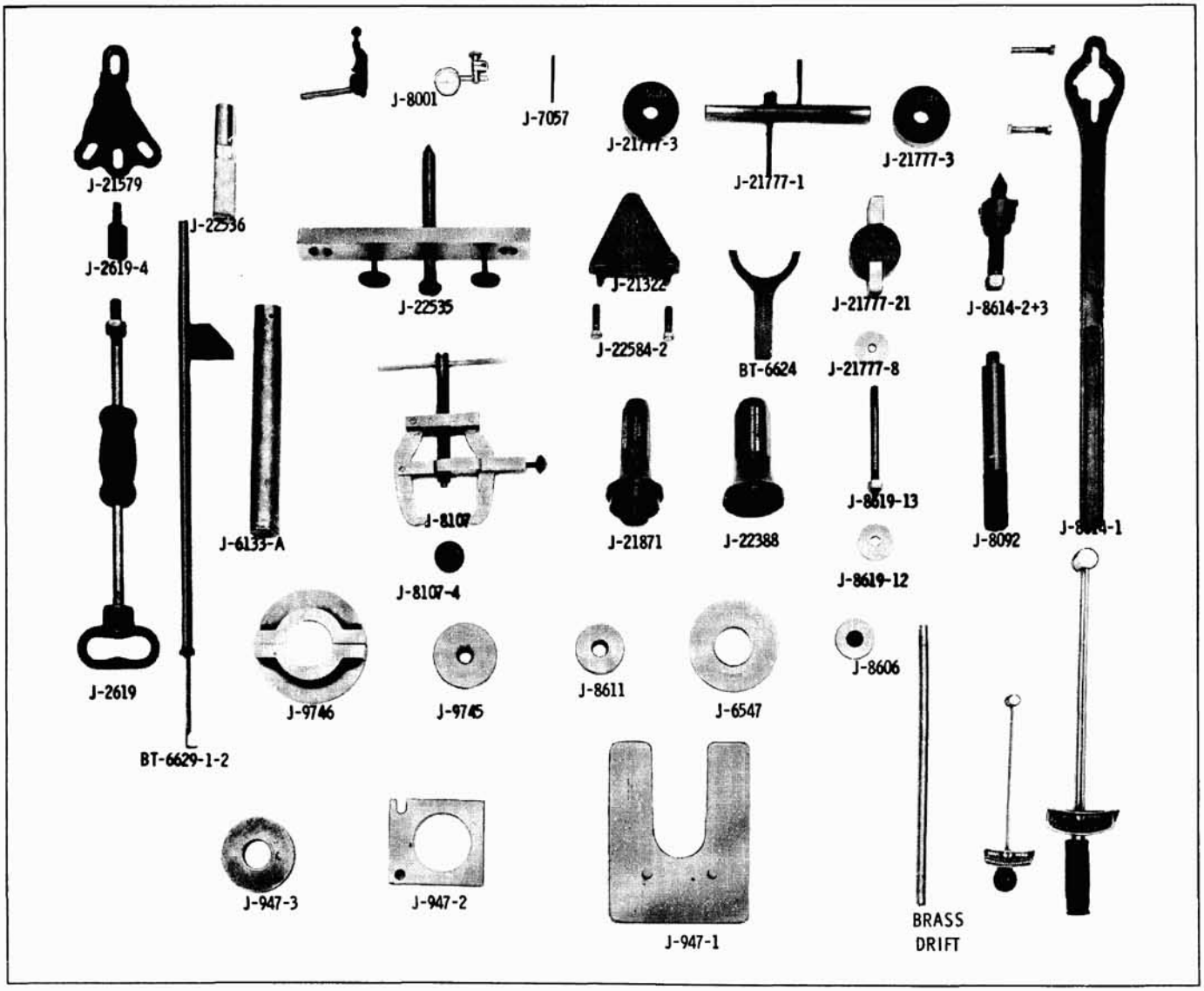
	Gear Ratio	No. Gear Teeth	Code Letters Std. Differential			Code Letters Anti-Spin Differential			
			Std. Equip.	With J-52 J-55	With Y-75	Std. Equip.	With J-52, J-55	With Y-75	With W-30
3100 Thru 4400 (Type "O")	2:56	41:16	R2	R6		R3	R7		
	2:78	39:14	SA	S2		SB	S3		
	3:08	40:13	SC	S4		SD	S5		
	3:23	42:13	SE	S6		SF	S7		
	3:42	41:12	TL	S8		TM	S9		
	3:91	43:11	TN	T2		TO	T3		
400 Cu. In.	4:33	39:09				TW	TY		TW
3100 Thru 4400 (Type "C")	2:56	41:16	R8	TR		R9	TH		
	2:73	41:15	RA	TT		RB	TJ		
	3:07	43:14	RC	T4		RD	T5		
	3:31	43:13	RE	T6		RF	T7		
4800 Series (Type "O") Only	2:78	39:14	TA			TB			
	3:08	40:13	SM			SN			
	3:23	42:13	SO			SP			
5400 Series (350 Cu. In.)	2:78	39:14	RA			RB			
	3:08	40:13	RC			RD			
	3:23	42:13	RE			RF			
5400 (455 Cu. In.) 64-6600 Series *54 (455 Cu. In.) & 6400 Only	2:56	41:16	QC	#QQ		QD	#QR		
	2:73	41:15	QA	#QK	*QS	QB	#QL	*QT	
	3:08	40:13	QE	#QM	*QY	QF	#QN	*QZ	
84-8600 Series	2:56	41:16	QQ	QC		QR	QD		
	2:73	41:15	QK	QA		QL	QB		
	3:08	40:13	QM	QE		QN	QF		

#54 (455 Cu. In.) 64 and 66 with J-55



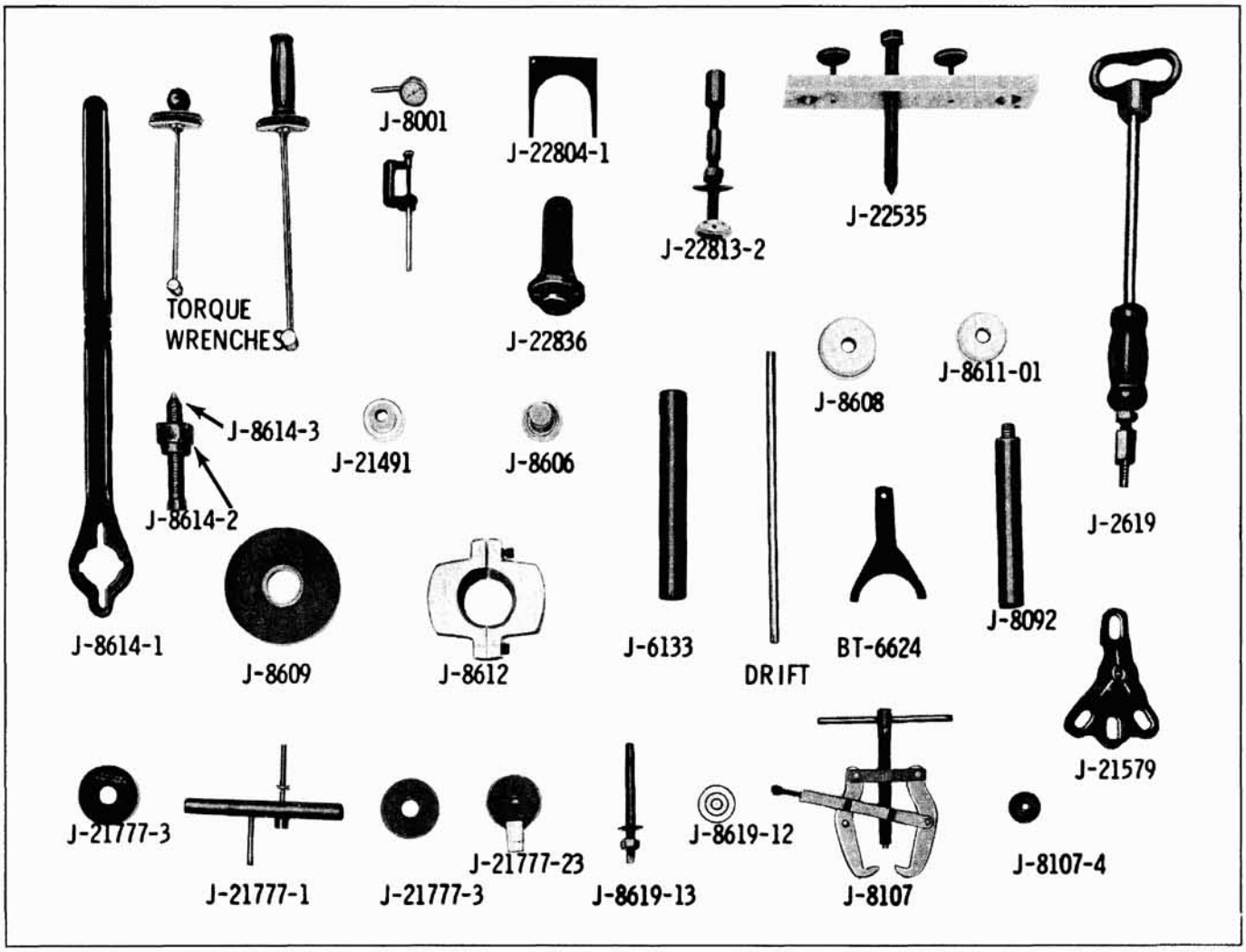
J-2619	SLIDE HAMMER ASSEMBLY
J-2619-4	SLIDE HAMMER ADAPTER
J-6133-A	FRONT PINION BEARING INSTALLER
BT-6623	SIDE BEARING SHIM INSTALLER
BT-6624	SIDE BEARING SHIM INSTALLER
BT-6629-1	OIL SEAL REMOVER (UNIVERSAL)
BT-6629-2	OIL SEAL REMOVER ADAPTER
J-7057	DIAL INDICATOR PLUNGER EXTENSION
J-7817	FRONT PINION BEARING RACE INSTALLER
J-8001	DIAL INDICATOR ASSEMBLY
J-8092	DRIVER HANDLE
J-8107	DIFFERENTIAL SIDE BEARING PULLER
J-8107-4	SIDE BEARING PULLER ADAPTER
J-8608	REAR PINION BEARING RACE INSTALLER
J-8609	REAR PINION BEARING INSTALLER
J-8612	REAR PINION BEARING REMOVER
J-8614-1	COMPANION FLANGE HOLDER
J-8614-2	COMPANION FLANGE REMOVER
J-8614-3	COMPANION FLANGE REMOVER SCREW
J-8619-10	PINION SETTING GAUGE SHAFT DISCS
J-8619-12	PINION SETTING GAUGE STUD WASHER
J-8619-13	PINION SETTING GAUGE STUD ASSEMBLY
J-8853	REAR AXLE BEARING INSTALLER
J-8877	REAR AXLE BEARING REMOVER
J-9537-02	SIDE BEARING INSTALLER
J-21322	RING GEAR AND CASE REMOVER
J-21579	AXLE SHAFT REMOVER
J-21777-1	GAUGE SHAFT AND PIN ASSEMBLY
J-21777-8	PILOT WASHER FOR GAUGE PLATE
J-21777-21	PINION GAUGE PLATE
J-22388	PINION SEAL INSTALLER
J-22535	PINION HOLDING TOOL
J-22536	PINION DRIVER
J-22584-2	CASE REMOVER ATTACHING BOLTS
J-22679	AXLE SHAFT OIL SEAL INSTALLER F-85
J-22680	AXLE SHAFT OIL SEAL INSTALLER VISTA CRUISER

Fig. 4B-99—Tools - 31-54 Series (54 with 350 Cu. In.)



J-947-1	REAR AXLE BEARING REMOVER
J-947-2	REAR AXLE BEARING PROTECTOR
J-947-3	REAR AXLE BEARING INSTALLER
J-2619	SLIDE HAMMER ASSEMBLY
J-2619-4	SLIDE HAMMER ADAPTER
J-6133-A	FRONT PINION BEARING INSTALLER
J-6547	REAR PINION BEARING INSTALLER
BT-6624	SIDE BEARING SHIM INSTALLER
BT-6629-1	OIL SEAL REMOVER
BT-6629-2	OIL SEAL REMOVER ADAPTER
J-7057	DIAL INDICATOR PLUNGER EXTENSION
J-8001	DIAL INDICATOR ASSEMBLY
J-8092	DRIVER HANDLE
J-8107	DIFFERENTIAL SIDE BEARING PULLER
J-8107-4	SIDE BEARING PULLER ADAPTER
J-8606	SIDE BEARING INSTALLER
J-8611	FRONT BEARING RACE INSTALLER
J-8614-1	COMPANION FLANGE HOLDER
J-8614-2	COMPANION FLANGE REMOVER
J-8614-3	COMPANION FLANGE REMOVER SCREW
J-8619-12	PINION SETTING GAUGE STUD WASHER
J-8619-13	PINION SETTING GAUGE STUD ASSEMBLY
J-9745	REAR PINION BEARING RACE INSTALLER
J-9746	REAR PINION BEARING REMOVER
J-21322	RING GEAR AND CASE REMOVER
J-21579	AXLE SHAFT REMOVER
J-21777-1	GAUGE SHAFT AND PIN ASSEMBLY
J-21777-3	PINION SETTING GAUGE SHAFT DISCS
J-21777-8	PINION GAUGE PLATE ADAPTER DISC
J-21777-21	PINION GAUGE PLATE
J-21871	AXLE SHAFT OIL SEAL INSTALLER
J-22388	PINION SEAL INSTALLER
J-22535	PINION HOLDING TOOL
J-22536	PINION DRIVER
J-22584-2	CASE REMOVER ATTACHING BOLTS

Fig. 4B-100—Tools - 54-86 Series (54 with 455 Cu. In.)



J-2619	SLIDE HAMMER
J-6133	FRONT PINION BEARING INSTALLER
BT-6624	SIDE BEARING SHIM INSTALLER
J-8001	DIAL INDICATOR ASSEMBLY
J-8092	DRIVER HANDLE
J-8107	BEARING REMOVER
J-8107-4	ADAPTER
J-8606	SIDE BEARING INSTALLER
J-8608	REAR PINION BEARING RACE INSTALLER
J-8609	REAR PINION BEARING INSTALLER
J-8611-01	FRONT BEARING RACE INSTALLER
J-8612	REAR PINION BEARING REMOVER
J-8614-1	COMPANION FLANGE HOLDER
J-8614-2	COMPANION FLANGE REMOVER
J-8614-3	COMPANION FLANGE REMOVER SCREW
J-8619-12	PINION SETTING GAUGE STUD WASHER
J-8619-13	PINION SETTING GAUGE STUD ASSEMBLY
J-21491	AXLE BEARING AND SEAL INSTALLER
J-21579	AXLE SHAFT REMOVER
J-21777-1	GAUGE SHAFT AND PIN ASSEMBLY
J-21777-3	PINION GAUGE PLATE ADAPTER DISCS
J-21777-23	PINION GAUGE PLATE
J-22535	PINION HOLDING TOOL ASSEMBLY
J-22804-1	PINION OIL SEAL SPACER
J-22813-2	AXLE BEARING AND SEAL REMOVER
J-22836	PINION OIL SEAL INSTALLER

Fig. 4B-101—Tools - 31-48 Series (Type "C")

BRAKES

(ALL SERIES)

CONTENTS OF SECTION 5

Subject	Page
PERIODIC MAINTENANCE	5-1
DESCRIPTION AND OPERATION	5-1
DRUM BRAKES	5-1
DISC BRAKES	5-1
PARKING BRAKE	5-2
SELF ADJUSTING BRAKE	5-2
ADJUSTMENTS	5-4
PARKING BRAKE LAMP	5-4
STOP LAMP SWITCH	5-4
BRAKE SHOES	5-4
PARKING BRAKE	5-6
HYDRAULIC SYSTEM	5-6
MASTER CYLINDER	5-7
REMOVAL	5-7
DISASSEMBLY	5-7
ASSEMBLY	5-8
INSTALLATION	5-9
WHEEL CYLINDERS (DRUM TYPE)	5-10
DRUMS AND BRAKE ASSEMBLIES	5-12
INSPECTION	5-12
TURNING DRUMS	5-13
BRAKE LINES	5-13
BRAKE LINING	5-13
PARKING BRAKE CABLE	5-13
FRONT SHOES	5-14
REAR SHOES	5-15
DISC BRAKE ASSEMBLIES	5-16
INSPECTION	5-16
SERVICING THE DISC	5-16
DISC REMOVAL	5-17
DISC INSTALLATION	5-17
TESTING WARNING LIGHT	5-17
LINING INSPECTION	5-17
SHOE REMOVAL	5-18
CALIPER DISASSEMBLY	5-19
CALIPER ASSEMBLY	5-19
INSTALLING DUST BOOT	5-20
POWER BRAKES	5-21
DESCRIPTION	5-21
MINOR SERVICE OPERATIONS	5-21
REMOVE AND INSTALL	5-21
MORAINE POWER BRAKE	5-21
OPERATION	5-21
DISASSEMBLY	5-26
ASSEMBLY	5-27
BENDIX POWER BRAKE	5-29
OPERATION	5-29
DISASSEMBLY (SINGLE DIAPHRAGM)	5-32
ASSEMBLY (SINGLE DIAPHRAGM)	5-33
DISASSEMBLY (DUAL DIAPHRAGM)	5-34
ASSEMBLY (DUAL DIAPHRAGM)	5-36
POWER BRAKE TESTING	5-38
DIAGNOSIS	5-38
SPECIFICATIONS	5-39
TOOLS	5-42

PERIODIC MAINTENANCE

Each time the car is in the service department, the brake pedal height should be observed. If the brake pedal travel from the released to the fully applied position (engine running, power brakes) exceeds 1-7/8" on power brakes or 4" on standard brakes, the car should be driven alternately forward and backward and the brakes applied moderately each time to operate the self-adjuster until the proper pedal height is obtained. If brake pedal travel cannot be reduced in this manner the drums should be removed and the self-adjusting mechanism inspected for the cause of inoperation.

The adjusting screws should be cleaned and lubricated with brake lubricant such as No. 1050110 or equivalent.

The fluid in the master cylinder reservoir should be checked at every engine oil change interval. Fluid level should be no more than 1/4" below the reservoir opening at the rear. Replenish as necessary with Brake Fluid Delco Supreme No. 11 or equivalent.

Brake hoses and pipes should be inspected for chafing, deterioration or other damage.

Brake linings should be periodically inspected for wear. The frequency of this inspection depends upon driving conditions such as traffic or terrain, and also the driving techniques of individual owners.

DESCRIPTION AND OPERATION

DRUM BRAKE ASSEMBLIES

When the hydraulic brake pedal is depressed, the piston in the master cylinder forces fluid under pressure to a wheel cylinder at each wheel, which in turn, pushes the brake shoes against the brake drum. As the shoes contact the drum, the friction between the shoes and the rotating drum moves the primary shoe downward against the adjusting screw which acts as a link to transmit the force of the primary shoe to the lower end of the secondary shoe. With the upper end of the secondary shoe being held by the stationary anchor pin, the secondary shoe is wedged against the drum. This wedging action, due to frictional force, imparts the self-energizing action to the braking effort and thereby decreases the effort required by the driver to stop the car.

DISC BRAKE ASSEMBLIES

The disc brakes, available with power brakes, are composed of a fixed caliper containing four opposed pistons that contact a cast iron ventilated disc which rotates with the front wheel.

The disc brake system also includes the power brake vacuum cylinder and dual master cylinder with individual brake lines for front and rear brake systems.

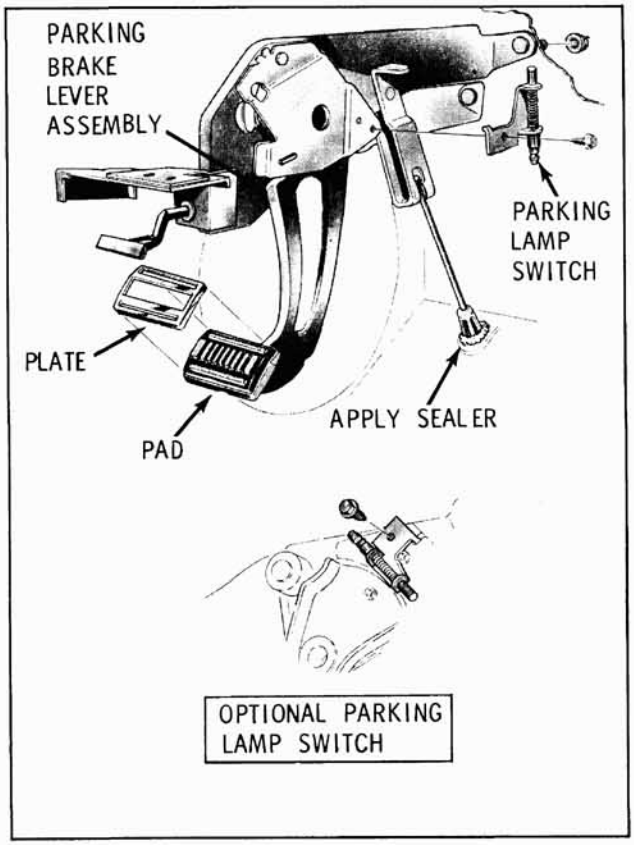


Fig. 5-1—Parking Brake (54 thru 86 Series)

A fixed caliper assembly is mounted to a special adapter on the steering knuckle with two bolts and made up of a pair of castings machined to accomodate four brake cylinder (two for each brake shoe) and connections for brake lines and a bleeder valve.

There are two brake shoes per wheel, composed of curved lining segments riveted to steel backing plates. Each shoe is actuated by two wheel cylinders (4 per wheel) composed of spring loaded pistons which squeeze the linings against the braking disc by hydraulic pressure. The brake shoes are prevented from rotating by machined stops in the caliper. The wheel cylinders are interconnected by internal drilled passages or external brake lines.

The disc is protected from road dirt by a splash shield on the inner side and the wheel on the outer side. The cast iron disc incorporates ventilated ribs that use the rotation of the disc to cool the braking surfaces. The braking of an automobile requires the same amount of heat transfer regardless of how fast it is stopped or of the type of braking system used. The faster the heat is dissipated, the more efficient the brake.

Since the disc brake shoes are smaller than drum brake shoes, they are in contact with a smaller portion of the disc. This means that over two-thirds of the disc is being cooled at all times resulting in more rapid heat dissipation.

The valving system is composed of a metering valve for the front brakes, a distributor and switch assembly which operates a warning signal to the driver and a balance valve for the rear brakes.

The metering valve is to prevent application of the front disc brakes until approximately 100 psi have built up in the hydraulic system. This pressure overcomes the tension of the shoe return springs on the rear drum brakes and moves the rear brake shoes outward to contact the drum at the same time the linings in the front disc brakes contact the discs. This prevents the disc brakes from doing all the braking during light brake applications.

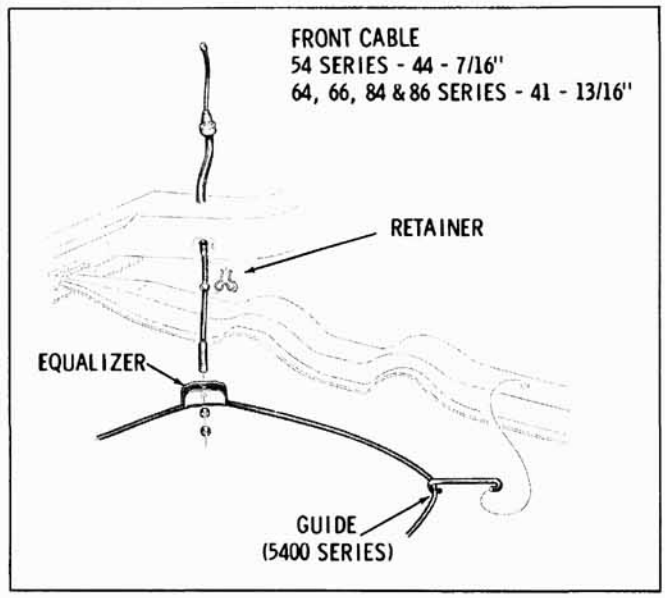


Fig. 5-2—Parking Brake (54 thru 86 Series)

Whenever the front brakes are bled, it is necessary to keep the piston rod depressed with Tool BT-6710 to permit free flow of the fluid.

Fluid from the metering valve and from the rear brake port of the master cylinder is routed to a distributor and switch assembly. In the distributor block, the fluid from the two systems is separated by sealed spring loaded pistons that are spaced away from a central electrical contact. If a leak in either front or rear system should occur, the pressure differential (150 to 200 lbs.) during brake application will cause the piston to compress the springs and move in the bore until it touches the electrical contact which causes the parking brake lamp on the instrument panel to come on.

Fluid from the distributor to the rear brakes passes through a balance valve. The balance valve is designed to proportion the hydraulic pressure to the rear wheels when more than 400 psi is required at the front wheels.

As the brake pedal is depressed hydraulic pressure from the master cylinder forces the wheel cylinder pistons out of the caliper bores against respective shoe assemblies. The force of the pistons against the plates (shoes) presses the linings against both sides of the revolving disc to provide braking action. When the brake pedal is released, the hydraulic pressure decreases and the pistons relax. The compressed piston springs or the flexible seals in the cylinder bores position the linings lightly against the disc continually wiping the disc clean. Each lining has a groove in the center to provide an escape path for the dirt particles that are wiped off. There is a .020" shim between each brake shoe and piston to prevent vibration with the brakes released.

PARKING BRAKE (Figs. 5-1, 5-2 and 5-3)

The parking brake applies the rear brakes through cable and linkage by means of a foot operated parking brake pedal mounted below the instrument panel. The parking brake is released by pulling the release handle.

SELF-ADJUSTING BRAKE

General Description

All cars are equipped with self-adjusting brakes. The self-adjusting brake mechanism consists of an actuating link, adjuster lever, adjuster lever return spring, override spring and override pivot.

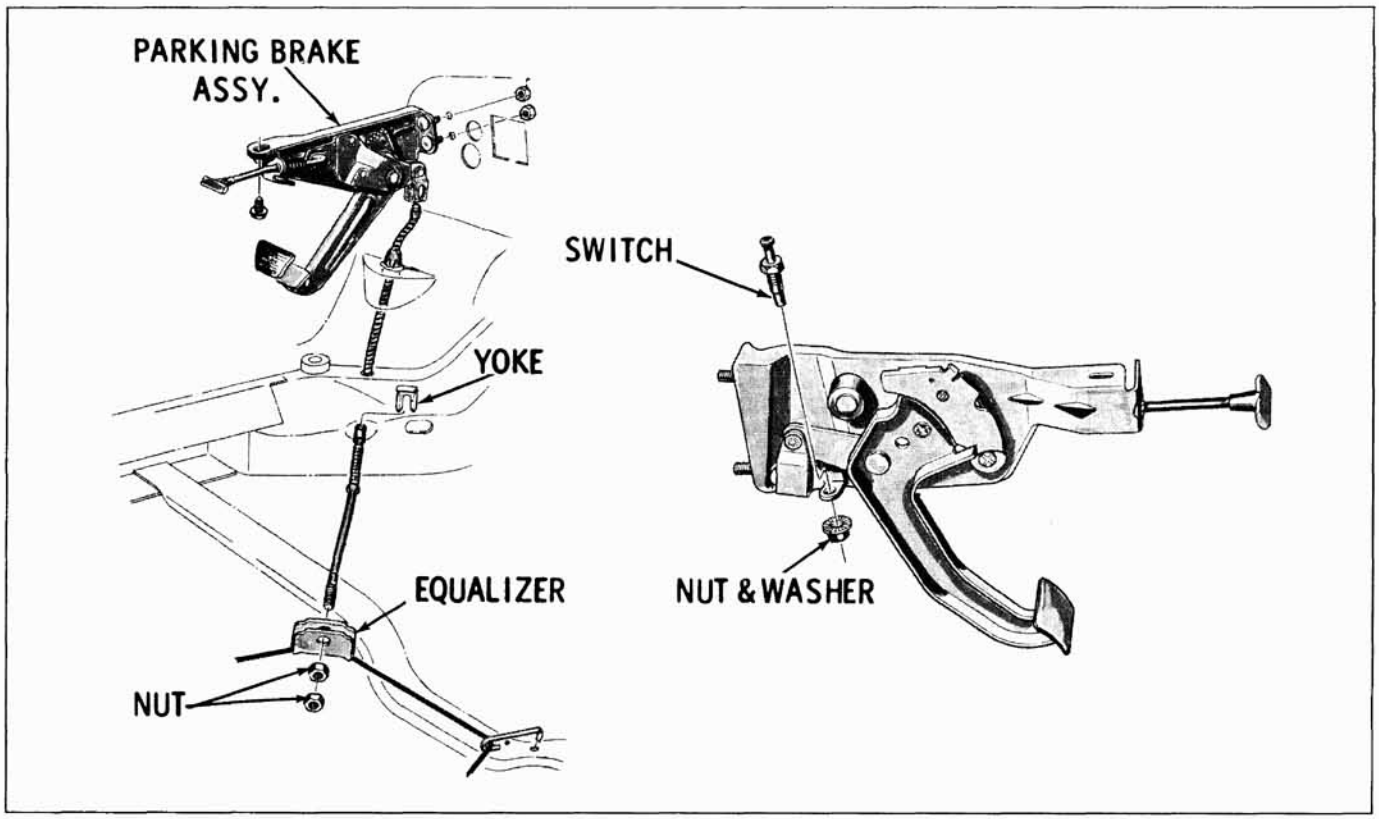


Fig. 5-3—Parking Brake (31 thru 48 Series)

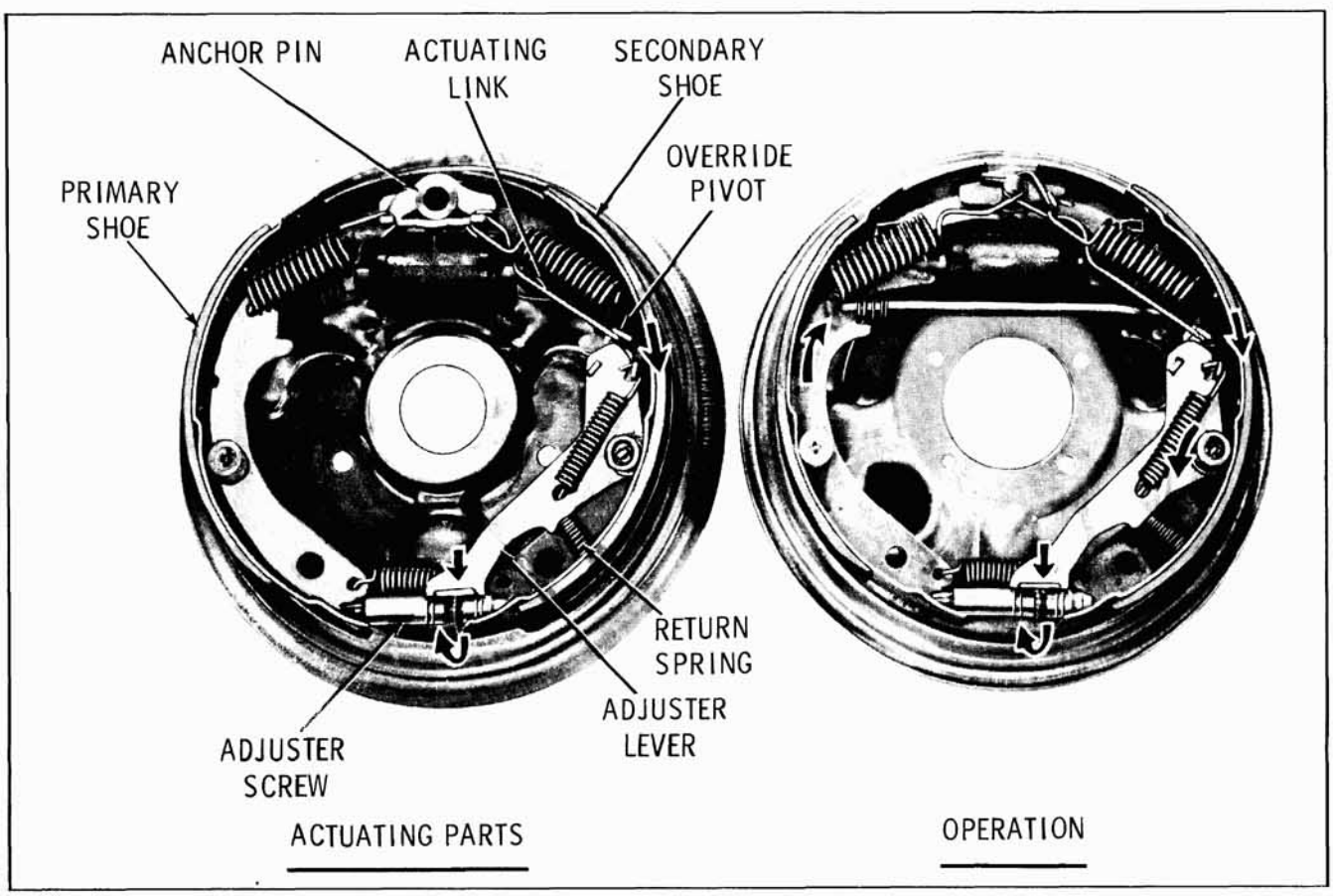


Fig. 5-4—Typical Self Adjusting Brake

Operation (Fig. 5-4) (Drum Type)

The self-adjusting brake mechanism operates only when the brakes are applied while the car is moving rearward and only when the secondary shoe moves a predetermined distance toward the brake drum.

As the car moves rearward and the brakes are applied, friction between the primary shoe and the drum forces the primary shoe against the anchor pin. Hydraulic pressure in the wheel cylinder forces the upper end of the secondary shoe away from the anchor pin. As the secondary shoe moves away from the anchor pin, the upper end of the adjuster lever is prevented from moving by the actuating link. This causes the adjuster lever to pivot on the secondary shoe forcing the adjuster lever against the adjusting screw sprocket. If the brake linings are worn enough to allow the secondary shoe to move the predetermined distance, the adjuster lever will turn the adjusting screw sprocket one or two teeth, depending on lining wear. If the secondary shoe does not move the predetermined distance, movement of the adjuster lever will not be great enough to rotate the adjusting screw sprocket.

When the brakes are released, the adjusting lever return spring will move the adjuster lever into the adjusting position on the sprocket.

An override feature is built into the self adjusting brake which allows the secondary shoe to be applied in reverse in the event the adjusting screw becomes "frozen" preventing the self-adjuster from operating.

When the car is moving forward and the brakes are applied, the upper end of the secondary shoe is forced against the anchor pin due to the self-energizing action of the brakes and the self-adjuster does not operate.

ADJUSTMENTS

PARKING BRAKE LAMP SWITCH

The parking brake lamp switch is bolted to the pedal mounting bracket and is actuated by the parking brake pedal arm.

The parking brake lamp switch is non-adjustable on all models. Refer to Figs. 5-1, 5-2, and 5-3 for installation.

STOP LAMP SWITCH (Fig. 5-5)

The stop lamp switch is attached to the brake pedal bracket and is actuated by the brake pedal arm.

Adjustment (All Series)

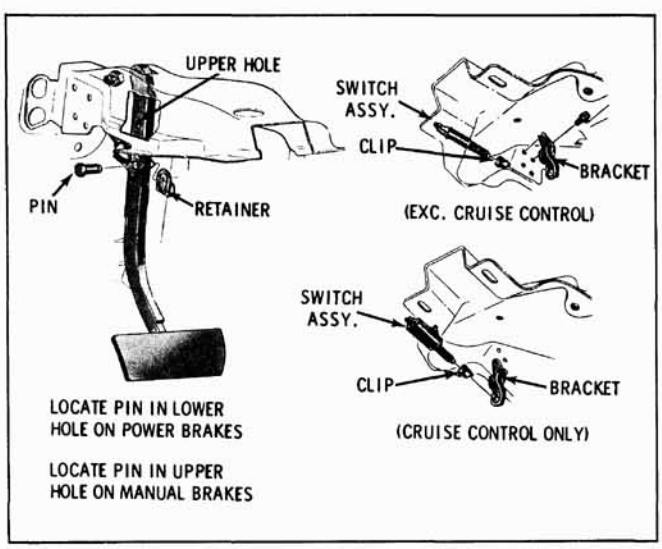


Fig. 5-5—Brake Switch Installation

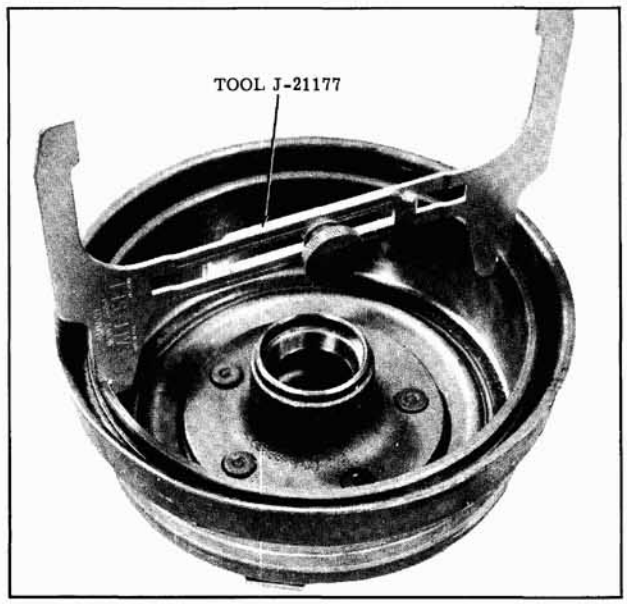


Fig. 5-6—Checking Brake Drum

1. Insert switch into tubular clip until switch body seats on tube clip.
2. Pull brake pedal rearward until it contacts the brake pedal stop. This moves the switch in the tubular clip providing proper adjustment.
3. Check stop lamp switch operation by applying and releasing the brake, making certain that the stop lamps go off when the brake pedal is in the fully released position.

BRAKE SHOE

A brake shoe adjustment is required only when new linings are installed or whenever the length of the brake shoe adjusting screw has been manually changed.

1. With the brake drums removed, position the drum end (inside diameter measuring caliper) of the Brake Drum and Shoe Gauge Tool J-21177, to the inside diameter of the drum and tighten clamp screw. (Fig. 5-6).
2. Position the brake shoe end (outside diameter measuring caliper) of Tool J-21177 over the brake shoes as shown in Fig. 5-7. Rotate gauge slightly around shoes to insure that

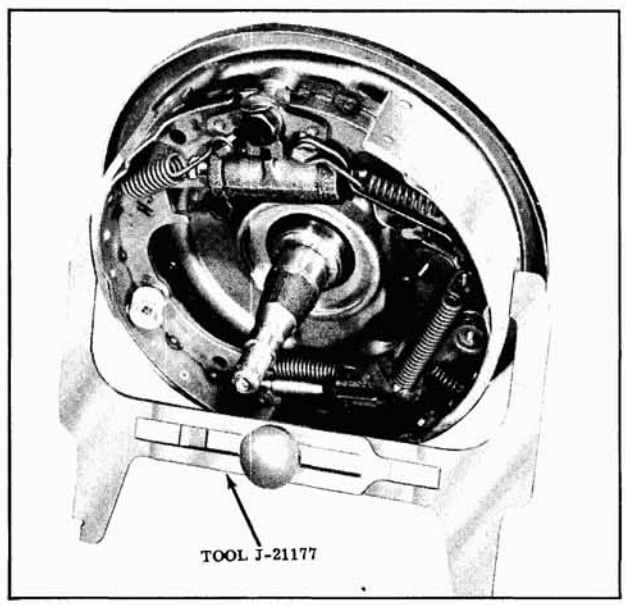


Fig. 5-7—Checking Lining

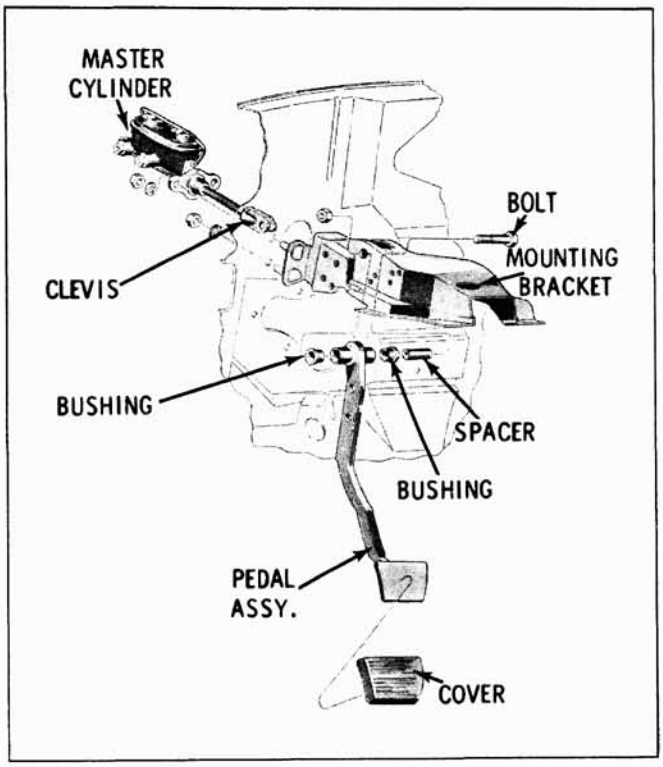


Fig. 5-8—Brake Pedal (Standard Brake) (31 thru 48 Series)

gauge contacts the linings at the largest diameter. Adjust brake shoes until gauge is a snug fit on linings at the point of largest lining diameter.

If it is necessary to back off the brake shoe adjustment, it will be necessary to hold the adjuster lever away from the sprocket.

3. Remove the gauge.

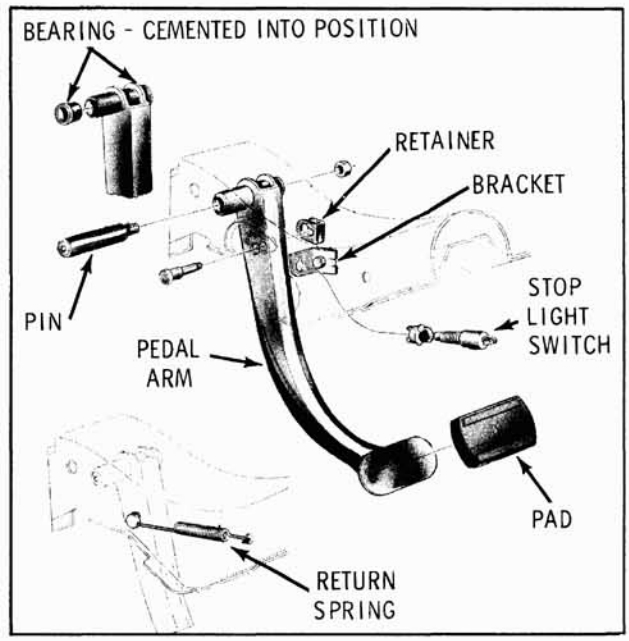


Fig. 5-9—Brake Pedal (Standard Brake) (54 thru 66 Series)

STANDARD BRAKE PEDAL ADJUSTMENT (31 Through 66 Series)

The brake pedal height is not adjustable.

BRAKE CONTROL PEDAL (Refer to Figs. 5-8 and 5-9)

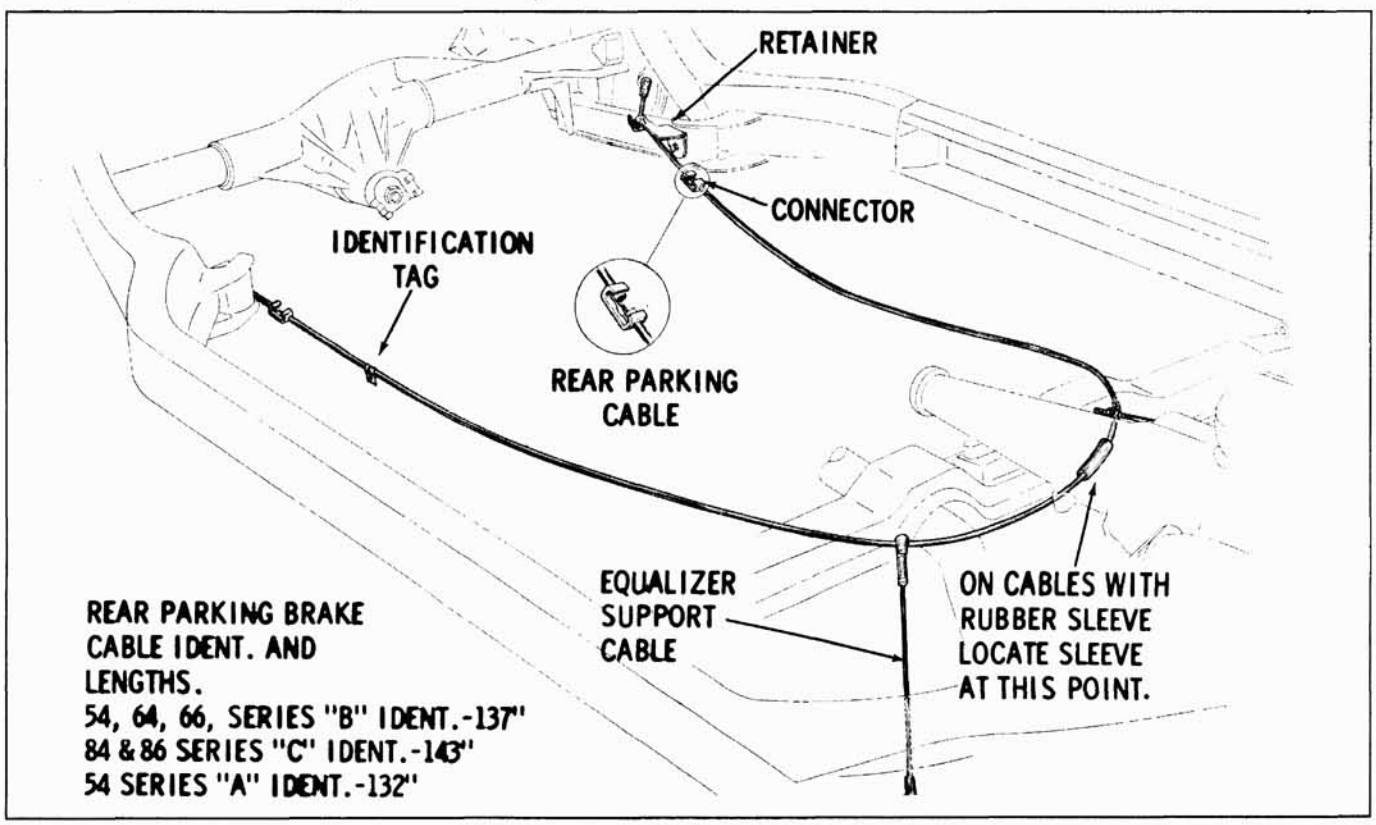


Fig. 5-10—Parking Brake Control (54 thru 86 Series)

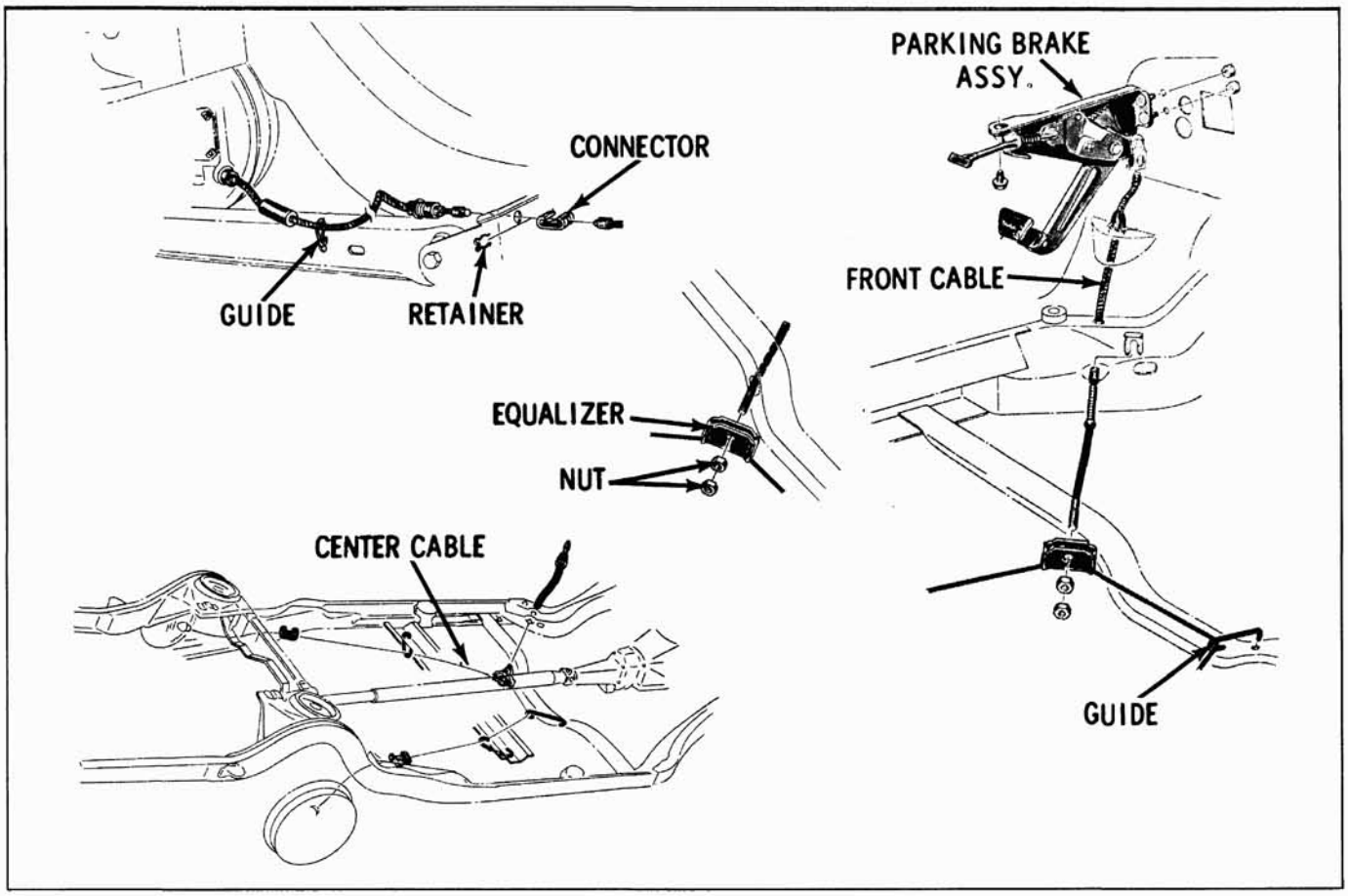


Fig. 5-11—Parking Brake Control (31 thru 48 Series)

PARKING BRAKE ADJUSTMENT
(All Series)

1. Release parking brake.
2. Be sure the hydraulic brake pedal travel is within specifications before adjusting parking brake.
3. Adjust cables by first tightening equalizer adjusting nut until a heavy resistance is felt when rotating rear wheels forward, then loosen equalizer adjusting nut seven full turns. (Figs. 5-10 and 5-11)

HYDRAULIC SYSTEM

BLEEDING OF LINES

Whenever a line is disconnected from any wheel, it is necessary that the wheel cylinder be bled. If the hydraulic line is disconnected from the master cylinder or the brake pedal has a spongy feeling, each wheel cylinder must be bled to expel air from the system.

Power brakes can be bled in the same manner as a standard brake system. If pressure bleeding equipment is not available, do not use the vacuum assist. With the engine shut off, the vacuum reserve should be depleted by applying the brakes several times before starting the bleeding procedure.

The system can be bled manually or by using pressure bleeding equipment.

To bleed the system, the following procedure is recommended.

The correct sequence for bleeding is left front, right front, left rear, right rear. On 31-48 Series equipped with a bleeder valve, bleed the master cylinder last.

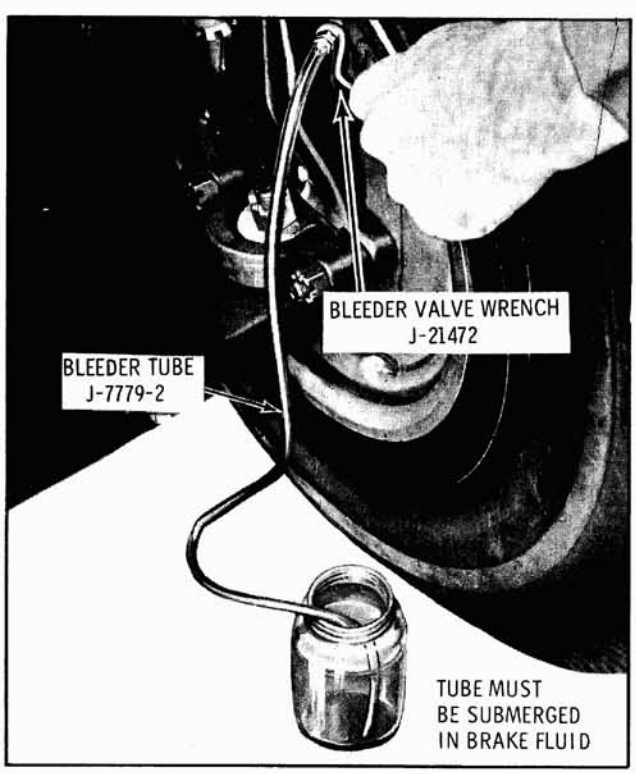


Fig. 5-12—Bleeding Brakes

1. If brakes are to be bled manually, fill the brake reservoir with Brake Fluid Delco Supreme No. 11 or equivalent and KEEP AT LEAST ONE-HALF FULL OF FLUID DURING THE BLEEDING OPERATION.
2. If brakes are to be bled with pressure equipment, connect the tank to the brake reservoir and raise the pressure in the brake system to 20 to 30 psi.
3. Disc Brakes Only: Attach BT-6710 to the metering valve to hold the push rod in and allow the pressure in the line to flow through the valve at a 1 to 1 ratio, requiring less pressure to bleed the front cylinders.

Due to the larger fluid capacity in the wheel cylinders, the fluid level in the reservoir should be checked more frequently during the bleeding procedure.

4. Attach Bleeder Tube J-7779-2 to bleeder valve. (Fig. 5-12) THE TUBE MUST HANG SUBMERGED IN A CLEAN CONTAINER PARTIALLY FILLED WITH BRAKE FLUID, DELCO SUPREME NO. 11 OR EQUIVALENT DURING THE BLEEDING OPERATION.
5. Unscrew bleeder valve three-quarters of a turn with a wrench such as J-21472 and watch flow of fluid from bleeder tube. When all air bubbles cease to appear and fluid is clear, close bleeder valve.

If brakes are bled without the aid of pressure equipment, the brake pedal must be operated during this operation to force the fluid from the bleeder hose. To do this, open the bleeder valve, fully depress the brake pedal, then slowly release pedal until it is in the fully released position. Continue operating pedal until fluid, containing no air bubbles, emerges from bleeder tube. Close bleeder valve.

6. Remove bleeder tube.
7. Repeat steps on the remaining wheel cylinders if the entire system is to be bled.
8. If the brakes were bled manually, check fluid in the reservoir and replenish if necessary, after the bleeding operation has been completed.

FLUSHING HYDRAULIC SYSTEM

Whenever mineral oil has been introduced into the hydraulic system, the entire system must be thoroughly flushed with brake fluid and all rubber parts must be replaced. The brake fluid is introduced into the master cylinder reservoir and expelled at each wheel cylinder in the same manner as the bleeding operation (see BLEEDING OF LINES).

When flushing is completed, bleed the hydraulic system with Brake Fluid Delco Supreme No. 11, or equivalent until all flushing fluid and air is expelled from the lines.

MASTER CYLINDER

STANDARD AND POWER

Description

The dual master cylinder is designed so that the front and rear brakes have separate hydraulic systems. The hydraulic pressure developed in both systems is equal at all times since the front piston is balanced between the hydraulic pressure in each system.

Malfunction in either system has no effect on the other system but is immediately evident to the driver because of the additional pedal travel required to actuate the remaining half of the dual brake system. Also, a pressure differential sensing switch in the system actuates a warning light (parking brake light) on the instrument panel.

Operation

Two brake fluid reservoirs are cast integrally with the master cylinder and supply fluid to the areas ahead of the primary seals through the compensating ports and between the primary and secondary piston seals through by-pass ports in the casting.

Within the bore of the master cylinder is the rear piston assembly, which is composed of the piston, return spring, retainer, spacer and screw. Also in the bore is the front piston with a primary and two secondary piston seals, front piston return spring and retainer.

Fluid is directed to the wheel cylinders through two hydraulic outlets, one for the front brakes and one for the rear brakes. In the two outlet bosses are located residual check valves and check valve springs.

A check valve is not used in the front brake outlet with disc brakes.

These valves act to retain approximately 6 psi of hydraulic fluid in the brake lines and wheel cylinders when the brakes are in the released position.

In the event the engine stalls, the vacuum chambers within the power brake provide adequate vacuum reserve for two or three brake applications. If the vacuum check valve is defective or braking has depleted the vacuum reserve, the driver can still operate the brakes in a conventional manner but more effort is required due to the loss of power assist.

Removal

The hydraulic master cylinder, on all series equipped with power brakes, can be removed and serviced without removing the vacuum cylinder from the car.

1. Be sure the area around master cylinder is clean, then disconnect the hydraulic lines at the master cylinder. Plug or tape end of line to prevent entrance of dirt, or loss of brake fluid.
2. On 31 through 48 series, with standard brakes, remove the push-rod to brake pedal clevis pin.
3. Remove the master cylinder attaching nuts and remove master cylinder. (Figs. 5-13 and 5-14)
4. Drain master cylinder.

MASTER CYLINDER

Disassembly (Figs. 5-15 and 5-16)

1. Remove cover and diaphragm and drain brake fluid. Actuate push rod to empty fluid from bore.
2. Mount master cylinder in vise and remove seal from cavity in master cylinder hub.

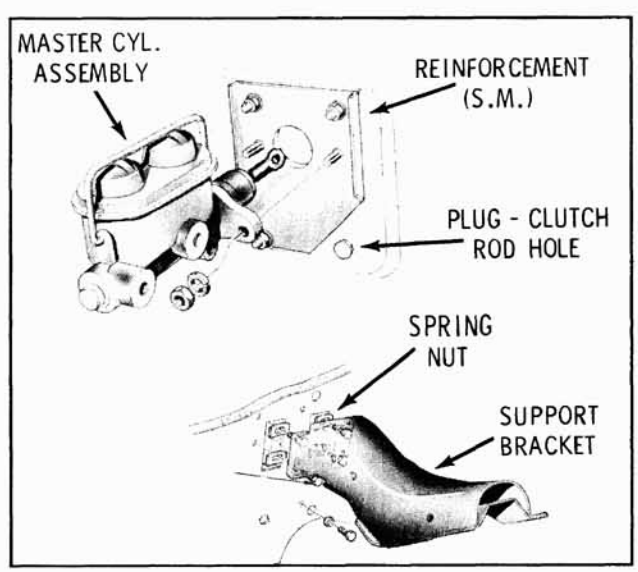


Fig. 5-13—Master Cylinder Removal (54 thru 86 Series)

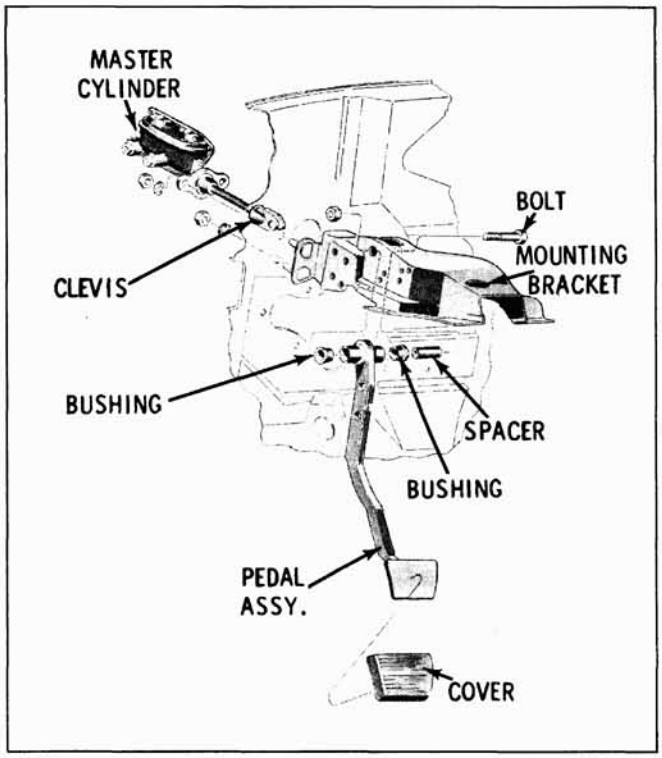


Fig. 5-14—Master Cylinder Removal (31 thru 48 Series)

3. Press in against rear piston with round-end rod to relieve spring load on piston stop screw under master cylinder bore. Use a 3/8" wrench to remove stop screw and "O"-ring seal from the bottom of the front reservoir on Moraine cylinders; or remove the stop bolt from the bottom (external) of the master cylinder on the Bendix cylinders. Maintain pressure on rear piston and use Tru-Arc pliers to remove snap ring from groove in master cylinder bore.

4. Remove rear piston assembly from bore.

5. Remove the front piston assembly by blowing compressed air through the front reservoir compensating port hole.

Cover bore opening with a shop cloth to prevent piston from falling on floor.

6. Position master cylinder in vise so that outlets are up.

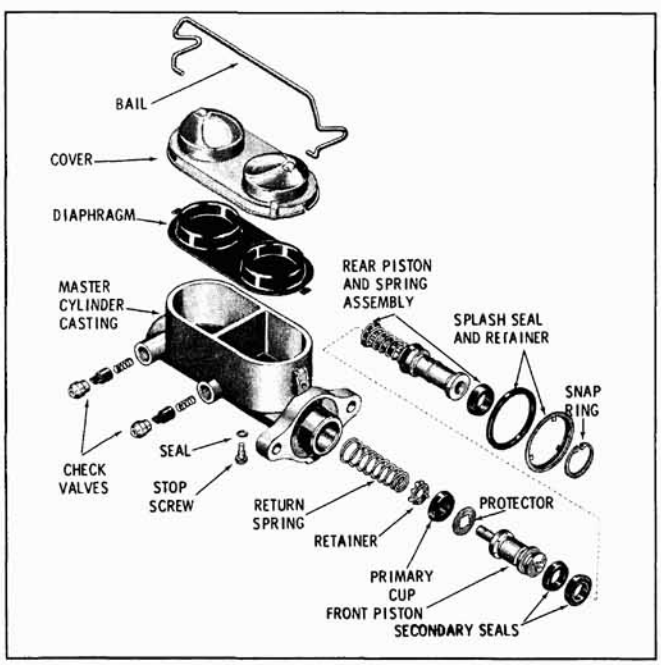


Fig. 5-15—Master Cylinder (Bendix)

Check Valve Removal (Fig. 5-17)

If necessary to remove check valve use the following procedure.

1. Position master cylinder in a vise so that brake pipe outlet holes are up.
2. Carefully enlarge hole in tube fitting insert using a 13/64" drill.
3. Tap a 1/4"-20 thread in the insert.
4. Place a heavy washer over outlet on master cylinder and thread a 1/4"-20 x 3/4" screw into the insert. Tighten screw until insert is unseated.
5. Remove insert, screw and washer. Blow out all chips resulting from drilling and removal operations.

Cleaning and Inspection

Clean metal parts in Declene or clean brake fluid. Place cleaned parts on clean paper or lint free cloth. Inspect cylinder bore for cracks, structural damage, corrosion pits and foreign material. Be sure outlet ports are clean. Inspect reservoirs for foreign material. Check the bypass and supply ports in the master cylinder bore to see that they are not restricted. Inspect threads for damage. Inspect check valves and springs for distortion or damage. Discard check valve retainers. Blow out and air dry all passages. Inspect cover diaphragm for hardness, holes, cuts or abrasions. Examine rubber seals for damage. Inspect both pistons for nicks, cracks or corrosion. Check for fit in bore. Fit should be free but not sloppy. When a new secondary piston is installed refer to secondary piston identification chart.

If any evidence of corrosion or contamination exists in the system, completely flush the hydraulic system and refill with clean brake fluid.

DELCO MORAINE IDENTIFICATION OF SECONDARY PISTON

SERIES	* MASTER CYLINDER IDENT.	SECONDARY PISTON IDENT.
54-8600	HU	No Rings or Grooves
31-6600	CT	1 Ring or 1 Groove
31-4800 With Disc Brakes	DW	6 Rings or 6 Grooves

* Stamped on the top front end of master cylinder.

ASSEMBLY OF MASTER CYLINDER (Figs. 5-15 and 5-16)

1. With master cylinder in a vise so that brake pipe outlet holes are up, position check valve spring in outlet hole so that spring seats in depression in bottom of hole.

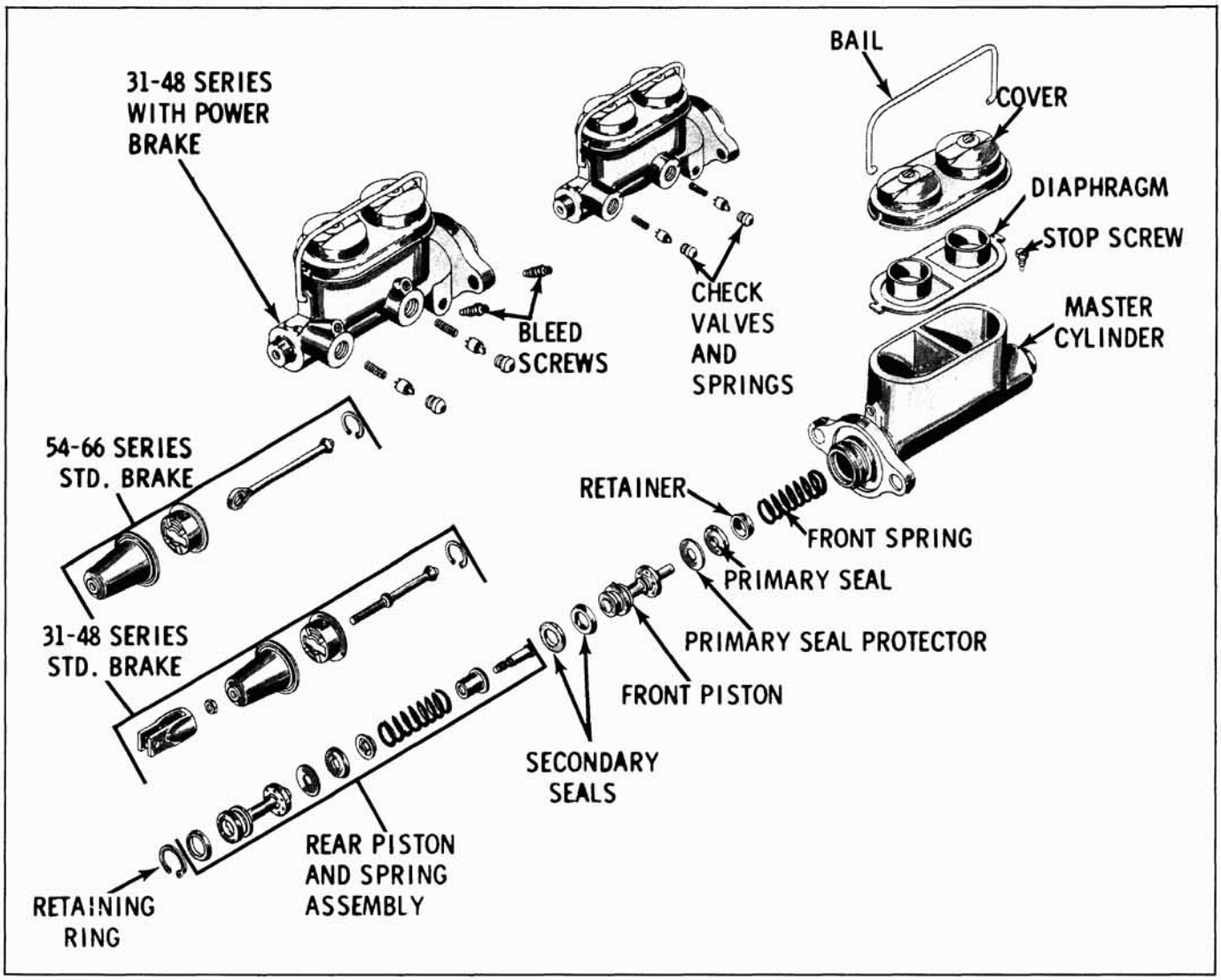


Fig. 5-16—Master Cylinder (Moraine)

2. Place new check valve over spring being careful not to displace spring from its seat.

3. Place new tube fitting insert in outlet hole so that it is in a position to be pressed into outlet hole. Be sure that insert is not cocked as this would cause burrs to be turned up when insert is pressed into place.

4. Use "L" shaped piece of flared tubing with spare tube nut to avoid scoring seat surface on new insert during installation.

5. Tighten nut until insert bottoms. Remove tubing and nut assembly and check outlet hole for loose burrs which might have been turned up when tube fitting insert was pressed down.

6. Install new secondary seals in the two grooves in the flat end of the front piston. The lips of seals will be facing away from each other.

7. Install a new primary seal and the seal protector on opposite end of front piston with lips of seal facing outward.

8. Coat bore of master cylinder with clean brake fluid. Coat seals on front piston with clean brake fluid. Install piston spring on front piston with the spring retainer in the primary seal.

9. Holding master cylinder with open end of bore down, insert front piston assembly, spring end first, use wooden rod to seat assembly.

10. Clamp master cylinder in vise with bore facing up.

11. Coat rear piston seals with clean brake fluid and insert assembly into bore, stop first.

12. Hold piston assembly in place and install retaining ring in master cylinder groove with Tru-Arc pliers.

13. Hold piston train at bottom of bore and install stop screw and "O"-ring in cylinder. Torque to 35 in. lbs.

14. Install filter in master cylinder hub.

Installation

1. To install the standard brake master cylinder on 31 through 66 series:

a. Position the master cylinder against dash and install the attaching nuts. Torque nuts to 28 ft. lbs.

b. Install the push-rod to brake pedal clevis pin.

2. To install the power brake master cylinder on 31 through 86 series:

a. Position master cylinder so that push-rod enters cavity in master cylinder piston.

If a new push-rod was installed, adjust push-rod as outlined under PUSH-ROD ADJUSTMENT.

b. Install master cylinder attaching nuts and lockwashers. Torque to 24 ft. lbs.

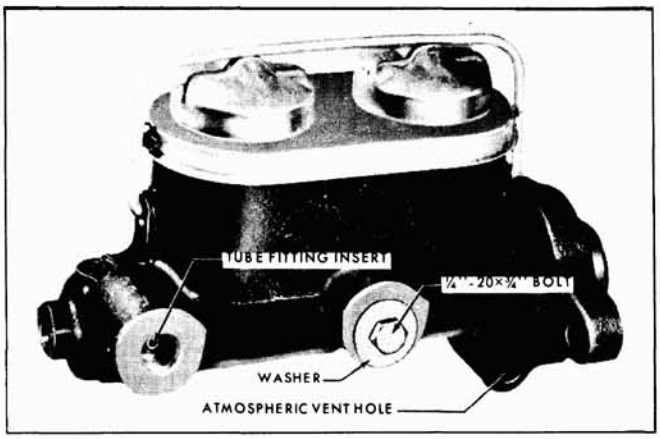


Fig. 5-17—Check Valve Removal

3. Install hydraulic lines to master cylinder and tighten securely to prevent leaks.

4. Fill master cylinder reservoir with Brake Fluid, Delco Supreme No. 11 or equivalent and bleed all wheel cylinders as outlined under BLEEDING OF LINES.

WHEEL CYLINDERS (DRUM TYPE)

REMOVE AND INSTALL

1. Remove brake drums and shoes as outlined under DRUM AND BRAKE ASSEMBLIES, REMOVE.

2. Front wheel cylinder:

a. Disconnect brake line from brake hose.

b. Remove the brake hose retainer clip at the frame bracket.

c. Remove brake hose from wheel cylinder.

3. Rear wheel cylinder - disconnect the brake line from the wheel cylinder.

4. Remove the wheel cylinder to backing plate attaching bolts and remove wheel cylinder.

To install, reverse the removal procedure, torque wheel cylinder to backing plate bolts to 6 ft. lbs. and bleed the lines. (See BLEEDING OF LINES)

DISASSEMBLY (Fig. 5-18) (31 through 48 Series)

The internal wheel cylinder boots should be disassembled only when they are visibly damaged or leaking fluid.

Wheel cylinders having torn, cut, or heat cracked boots should be completely overhauled.

Inspection for leakage may be accomplished at the boot center hole after removal of the link pin. Fluid coatings on the piston within the cylinder and on the end of the link pin are normal, as the cylinder contains a porous piston which is impregnated with a corrosion inhibiting fluid. Fluid spilling from the boot center hole, after the link pin is removed, indicates cup leakage and the necessity of completely overhauling the cylinder.

1. Pull boots from cylinder ends with pliers and discard boots.

2. Remove and discard pistons and cups.

CLEANING AND INSPECTION

1. Inspect cylinder bore. Check for staining or corrosion. It is best to discard a corroded cylinder.

Staining is not to be confused with corrosion. Corrosion can be identified as pits or excessive bore roughness.

2. Polish any discolored or stained area with crocus cloth by revolving the cylinder on the cloth supported by a finger. Do not slide the cloth in a lengthwise manner under pressure. Do not use any other form of abrasive or abrasive cloth.

3. Rinse the cylinder in Declene or brake fluid.

4. Shake excess cleaning fluid from the cylinder. Do not use a rag to dry the cylinder as lint from the rag cannot be kept from the cylinder bore surfaces.

ASSEMBLY

1. Lubricate the cylinder bore and counterbore with brake fluid and insert spring expander assembly.

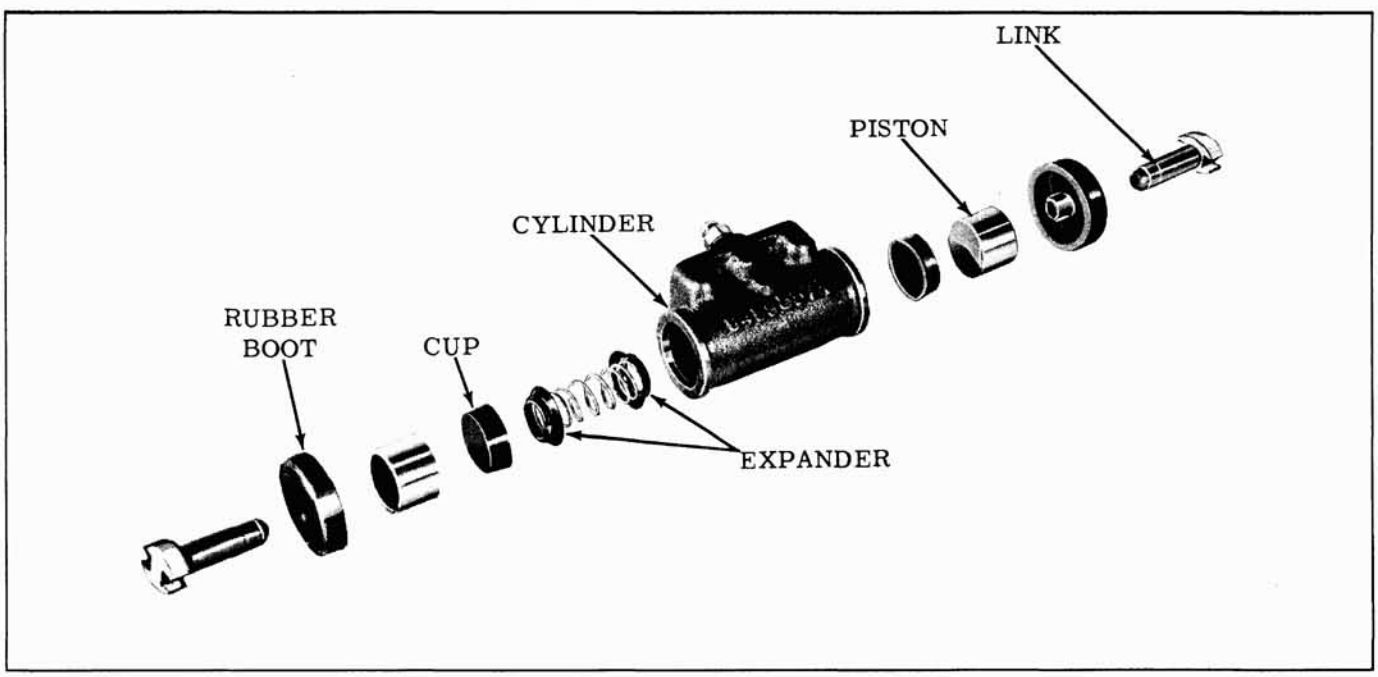


Fig. 5-18—Wheel Cylinder (31 thru 48 Series)

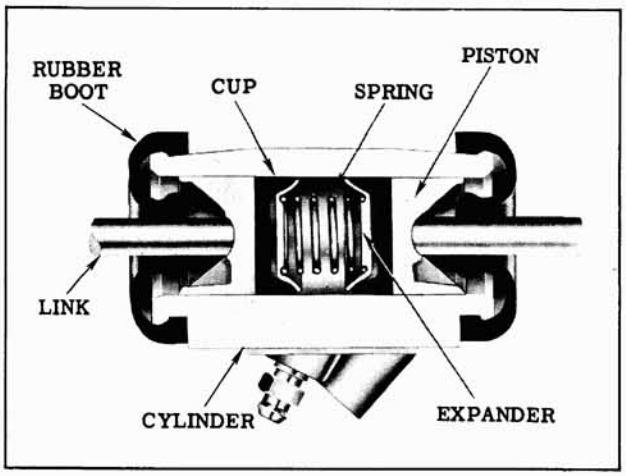


Fig. 5-19—Wheel Cylinder (54 thru 86 Series)

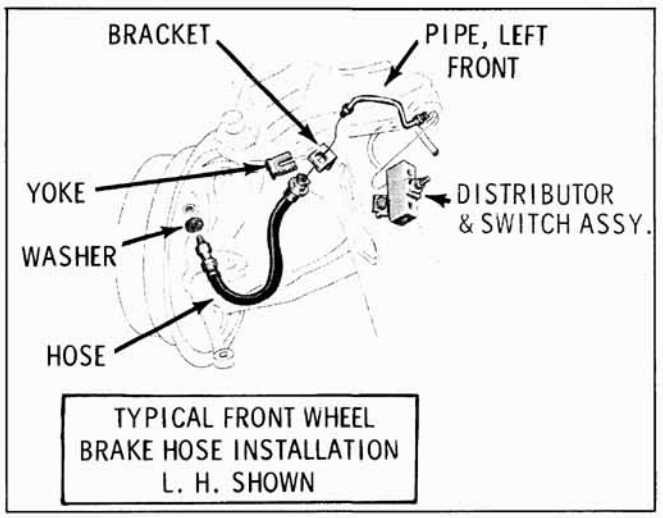


Fig. 5-20—Brake Hose—Front Wheel (54 thru 86 Series)

2. Install new cups. (Be sure cups are lint and dirt free). Do not lubricate cups prior to assembly.

3. Install new pistons as they are received in the parts package. Do not lubricate pistons with brake fluid.

4. Press new boots into cylinder counterbores by hand. Do not lubricate boots prior to assembly.

DISASSEMBLY
(54 through 86 Series)

1. Remove links and rubber boots.

2. Remove pistons, cups, expanders and spring from wheel cylinder bore.

CLEANING AND INSPECTION

1. Wash all metal parts in brake flushing fluid and blow out all passages with compressed air.

2. Inspect cups for a swelling or distorted condition, replace if damaged. If a swelling condition exists, the entire hydraulic system should be flushed (see FLUSHING HYDRAULIC SYSTEM) and all the rubber parts in the hydraulic system should be replaced.

3. Inspect the wheel cylinder bore for scores, rust, pits or etches. If any such conditions exist, the complete wheel cylinder will have to be replaced as an assembly.

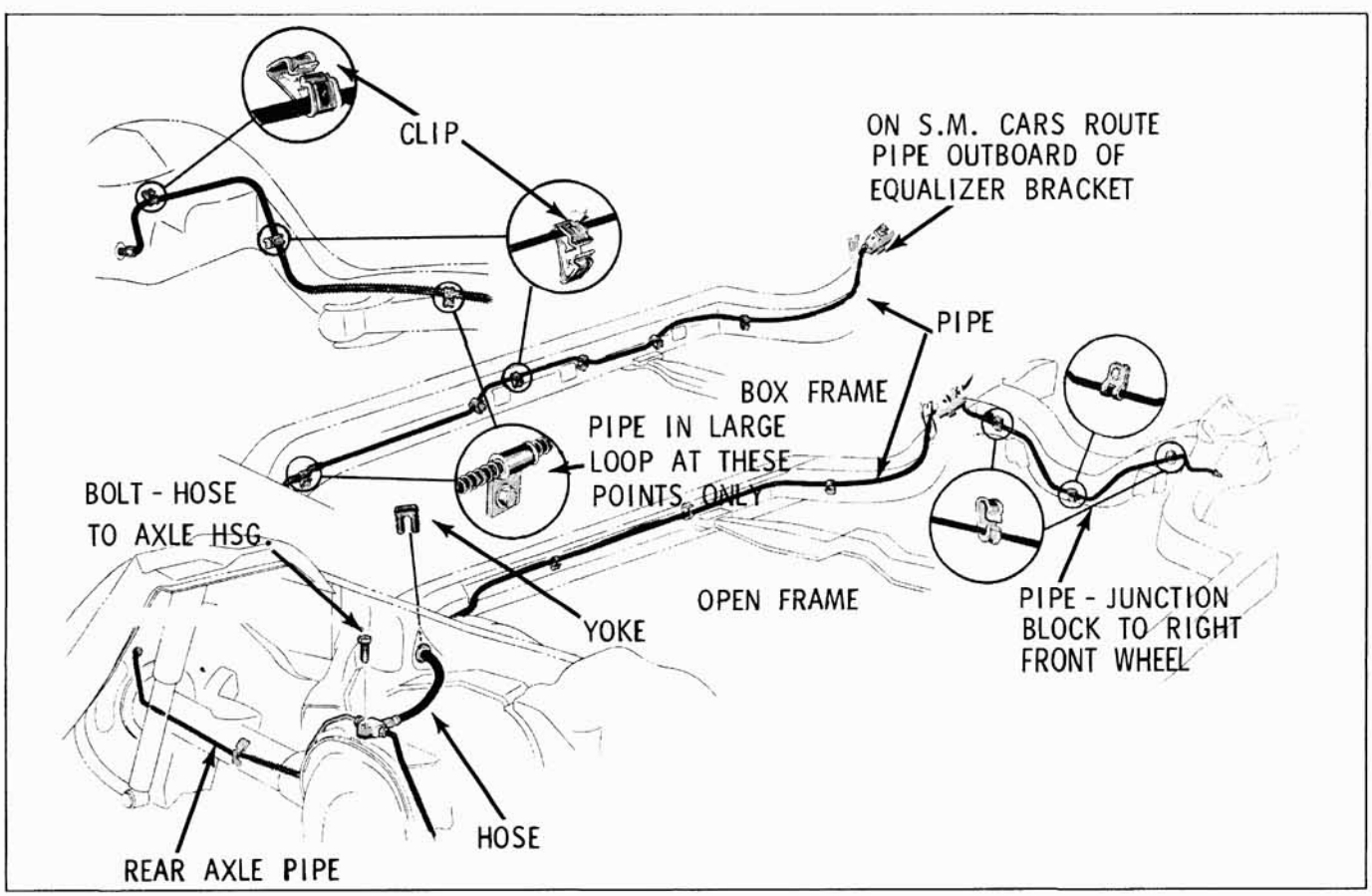


Fig. 5-21—Brake Line Routing (54 thru 86 Series)

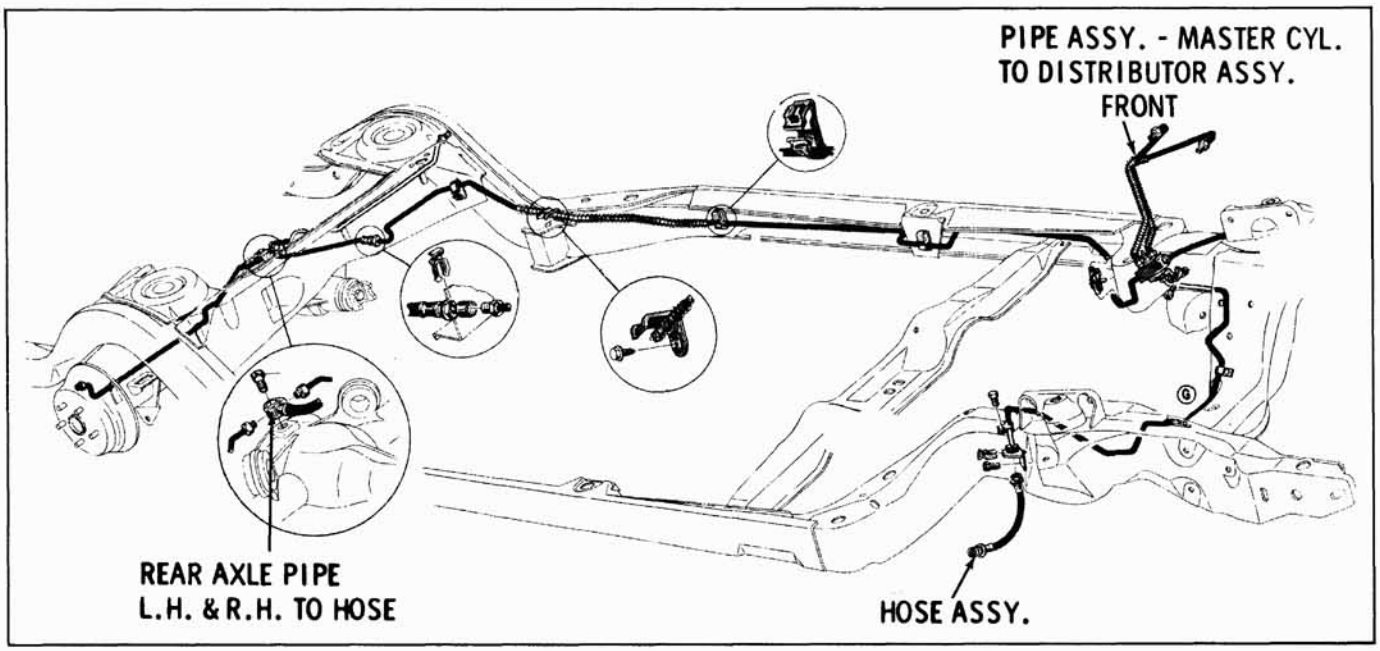


Fig. 5-22—Brake Line Routing (31 thru 48 Series)

Do not attempt to recondition a wheel cylinder bore as a means of salvaging the cylinder. Reconditioning of the bore leaves the walls sufficiently rough to cause premature failure of the rubber cups. It also enlarges the bore to the extent that the standard size pistons and seals will not fit properly.

ASSEMBLY

Lubricate the bore of the wheel cylinder with Brake Fluid, Delco Supreme No. 11 or equivalent and assemble as shown in Fig. 5-19.

DRUMS AND BRAKE ASSEMBLIES

INSPECTION

Whenever brake drums are removed, they should be inspected for scores, deep grooves, cracks and out-of-round.

Cracked drums must be replaced. However, cracks running circumferentially at the back corner of drum where the cast iron blends into the steel portion of the drum are of no consequence and drums should not be replaced.

Grooves extending around the entire braking surface of the brake drum are permissible providing the edges of the grooves that contact the shoes are smooth.

Drum out-of-round can be measured with a dial indicator

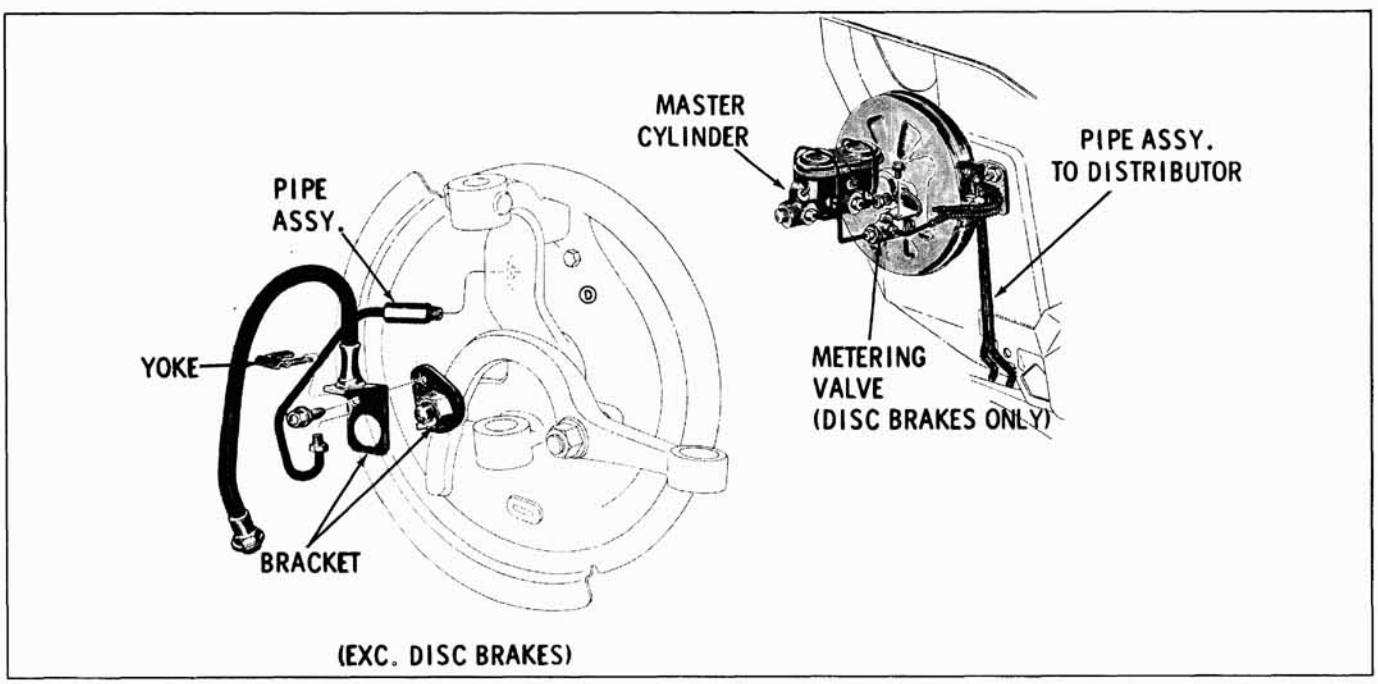


Fig. 5-23—Front Brake Lines with Disc Brakes (31 thru 48 Series)

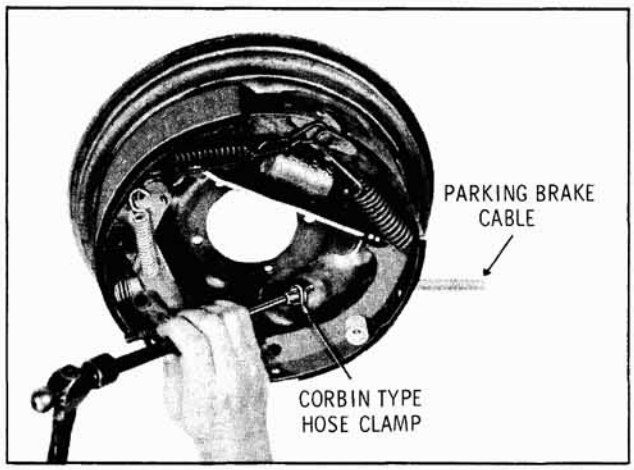


Fig. 5-24—Removing Parking Brake

and extension rod. Out-of-round measurements exceeding .005" front drum and .006" rear drum, (total indicator reading) require turning or replacement of drum.

TURNING DRUMS

If irregularities in the braking surface of the drum cannot be removed with emery cloth or out-of-round exceeds .005" front drum and .006" rear drum (total indicator reading), the drum should be turned to .060" greater than the original inside diameter; that is, after being turned the diameter should be 11.060" for all except 31-48 Series, or 9.560" on 31-48 Series. Oversize brake linings must be used with turned drums.

REPLACING DRUMS

Whenever new drums are to be installed, the braking surface of the drum must be thoroughly cleaned with lacquer thinner to remove the rust-proof coating.

BRAKE LINES

When replacing a damaged brake line, the damaged section should be cut off and replaced with steel brake tubing equivalent to the tubing listed under Group 8.964 in the Chassis Parts Book. Flare connections must be a double lap. Follow Flaring Tool Manufacturer"s instructions for proper flaring of the double lap flare.

Refer to Figs. 5-20 thru 5-23 for brake line routing and attachment.

BRAKE LINING

If linings are worn nearly flush with the rivets, new linings should be installed.

When brake lining replacement is necessary for any reason, it is recommended that primary and secondary linings on both front or both rear wheels be replaced at the same time.

PARKING BRAKE CABLE CONDUIT

Remove and Install

The parking brake cable conduit can be removed as follows:

1. Disconnect the cable at the connector.
2. Remove the retainer which holds the conduit to the bracket.
3. Remove the rear wheel and brake drum.
4. Disconnect the cable from the operating lever.
5. Install a corbin-type hose clamp over the conduit retainer fingers as shown in Fig. 5-24.
6. Tap the conduit lightly to remove from the backing plate.

To install, reverse the removal procedure. Adjust the parking brakes.

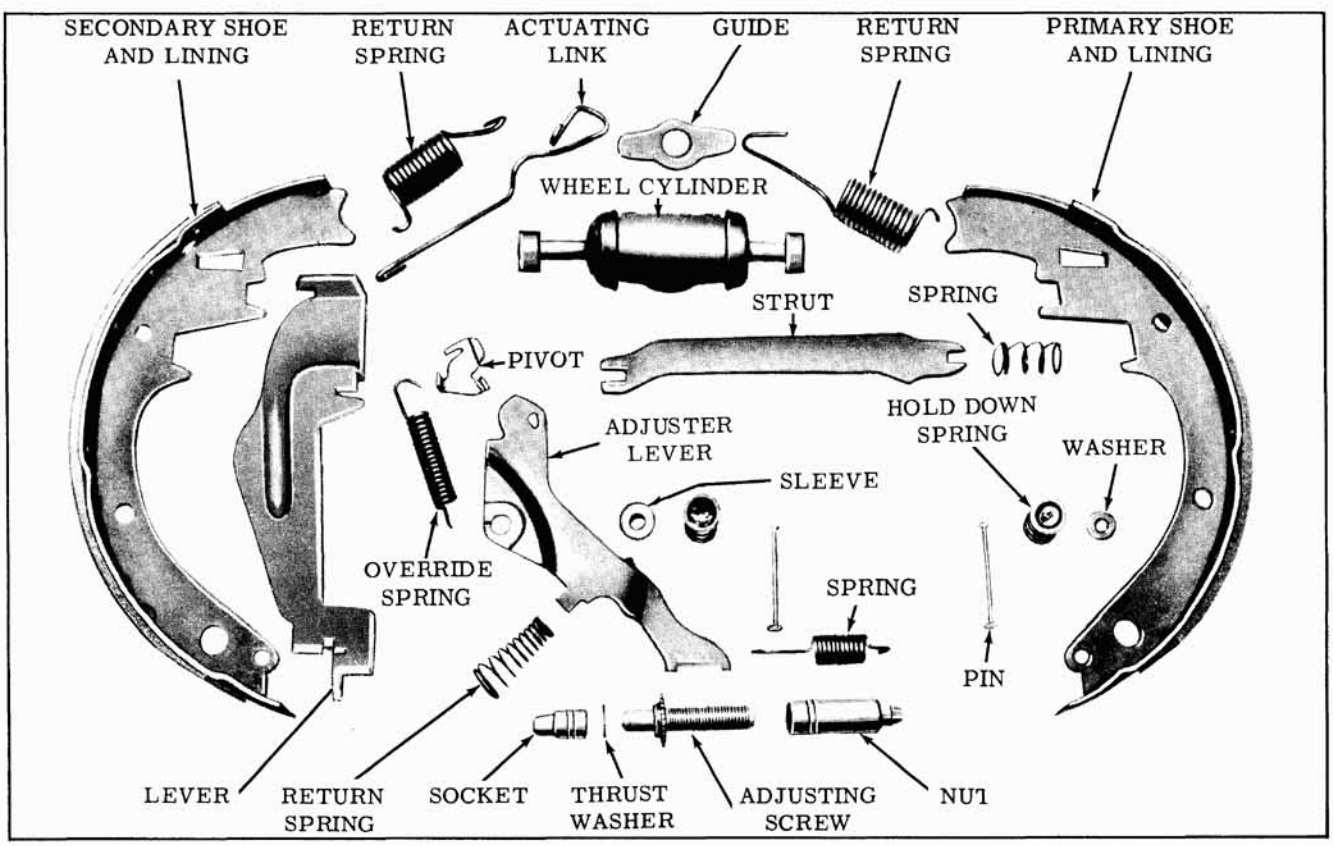


Fig. 5-25—Brake Assembly (54-86 Series)

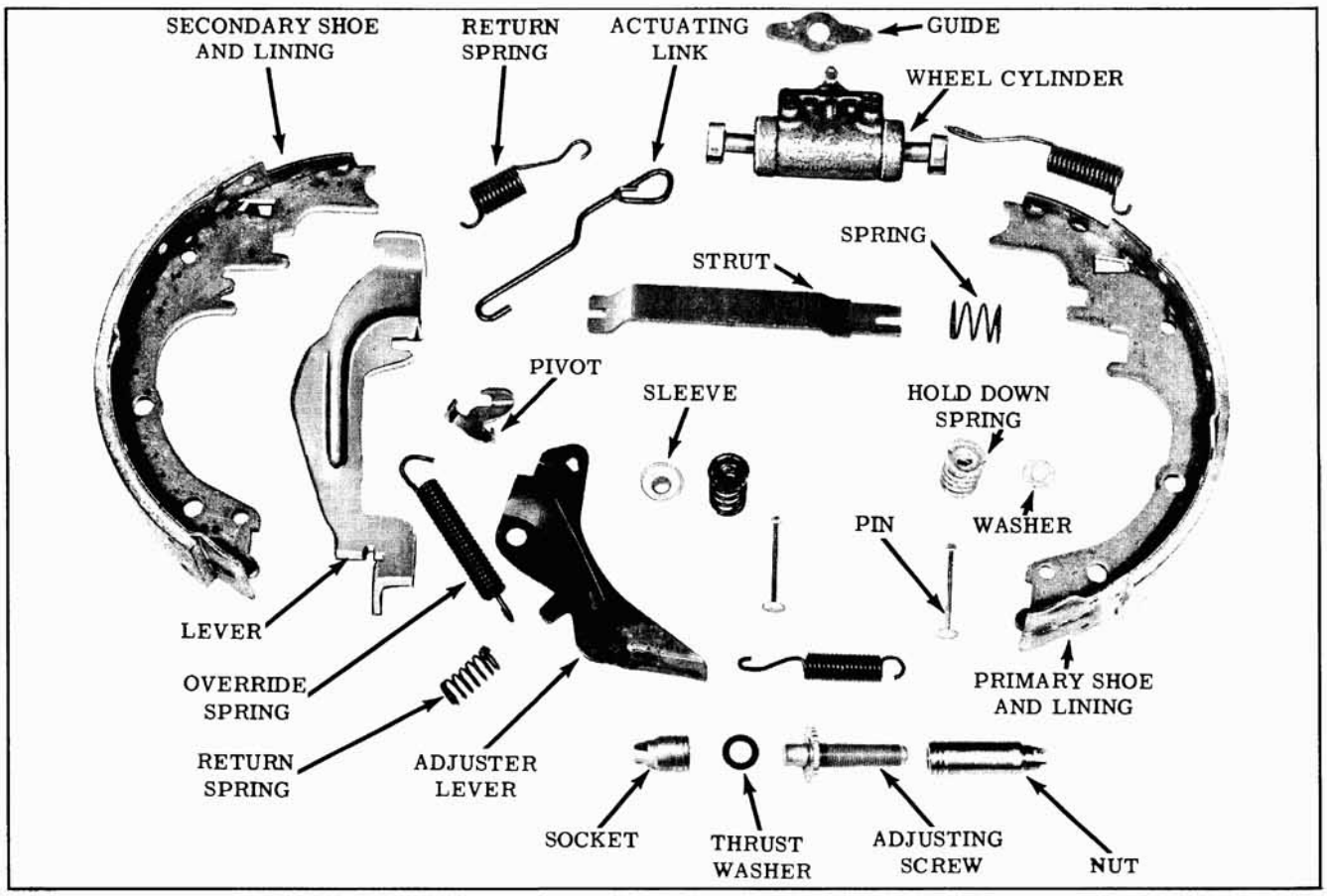


Fig. 5-26—Brake Assembly (31-48 Series)

FRONT BRAKE SHOES AND BACKING PLATE (DRUM TYPE)

Remove (Figs. 5-25 and 5-26)

1. Hoist car.
2. Remove the hub and drum assembly and the inner bearing race from the steering knuckle.

It may be necessary to back off the brake shoe adjustment before the brake drum can be removed. To back off the brake shoe adjustment, refer to Figs. 5-27 and 5-28.

3. Remove the primary and secondary shoe return springs and the actuating link.

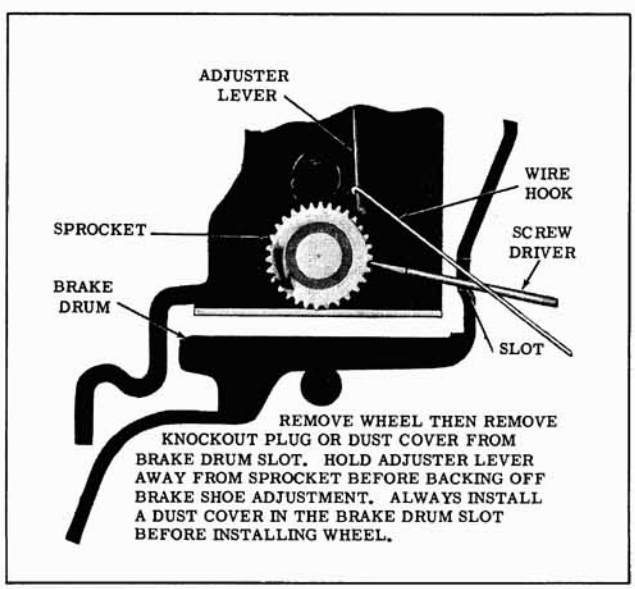


Fig. 5-27—Backing Off Brake Shoe Adjustment (54-86 Series)

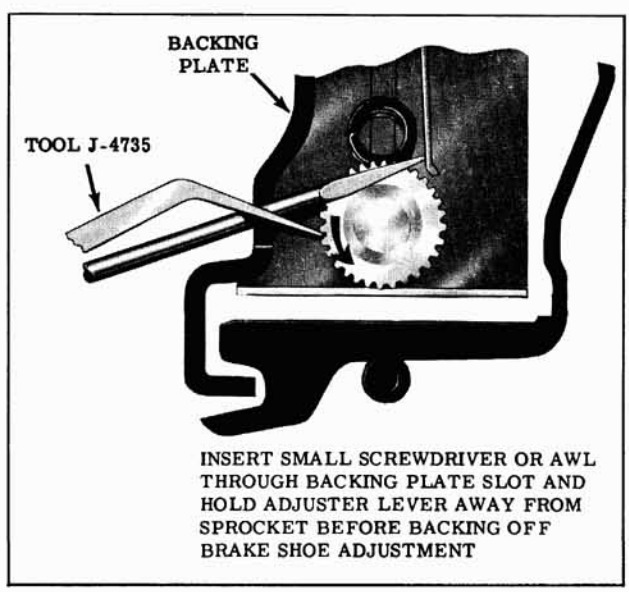


Fig. 5-28—Backing Off Brake Shoe Adjustment (31-48 Series)

4. Remove brake shoe hold-down springs, pins and washers and the adjuster lever and return spring.
5. Spread shoes to clear wheel cylinder links, then remove the primary and secondary shoes as an assembly.
6. Remove the primary to secondary shoe spring and the adjusting screw.
7. If the front backing plate is to be removed, proceed as follows:
   a. Loosen lock tab from anchor pin, then remove the anchor pin bolt.
   b. Remove the brake hose from the brake line.
   c. Remove the wheel cylinder and brake hose from the backing plate.
   d. Remove the steering arm to steering knuckle to backing plate bolts and nuts, then remove the backing plate.

REAR BRAKE SHOES AND BACKING PLATE (DRUM TYPE)

Remove

1. Hoist car, remove wheel and brake drum.

It may be necessary to back off the brake shoe adjustment before the brake drum can be removed. To back off brake shoe adjustment, refer to Figs. 5-27 and 5-28.

2. Remove the brake shoe return springs, actuating link and guide.
3. Remove the brake shoe hold-down springs, the adjuster lever and return spring and the parking brake lever strut and spring.
4. Spread shoes to clear wheel cylinder links, then remove the brake shoes as an assembly.
5. Disconnect the parking brake cable from the operating lever.
6. If necessary to remove the rear backing plate, proceed as follows:
   a. Remove the axle shaft.
   b. Remove brake line from wheel cylinder, remove wheel cylinder from backing plate.
   c. Disconnect the parking brake cable from the backing plate.
   d. Remove the backing plate.

CLEANING AND INSPECTION

1. Inspect linings for wear. If linings are worn nearly flush with rivets, new linings should be installed.
2. Check wheel cylinder for leakage by loosening the boot on 54 through 86 Series or by removing the link on 31 through 48 Series. If leak exists, remove wheel cylinder for service or replacement.
3. Clean inner surfaces of brake backing plates and all shoe contacting points.
4. Clean exposed portions of parking brake cables.
5. Disassemble the adjusting screw assembly. Clean and inspect as follows:
   a. Check thrust washer and mating surfaces for burrs or excessive wear.
   b. Inspect teeth on sprocket for wear.
   c. Remove all foreign material from adjusting screw and nut. Nut must rotate freely on threads.
6. Check the foot of the adjuster lever for wear. Replace if necessary.
7. Check the override pivot for wear or deformed parts.
8. Check brake drum inner diameter for build-up of rust and dirt. Remove build-up so that drums can be installed over pre-adjusted linings. Check drum for cracks and an out-of-round condition.

FRONT BRAKE AND BACKING PLATE (DRUM TYPE)

Install

1. If the front backing plate was removed, install as follows:
   a. Position the backing plate on the steering knuckle. Install the two steering arm to steering knuckle to backing plate bolts and nuts. Hold bolt and torque nuts to 130 ft. lbs. on 54-86 Series and 80 ft. lbs. on 31-48 Series.
   b. Install the wheel cylinder. Torque attaching bolts to 6 ft. lbs. Connect brake hose to brake line. Tighten brake line fittings.
   c. Install the brake hose retainer.
   d. Position a new lock tab over the anchor pin bolt and install bolt.
   e. Align the slot in the lock tab with the boss on the wheel cylinder. Torque anchor pin bolt to 135 ft. lbs. on 54-86 Series, to 95 ft. lbs. on 31-48 Series. Bend lock tab down until it contacts the anchor pin bolt head.
2. Lubricate the adjusting screw threads, thrust washer mating surfaces and backing plate ledges with brake lubricant, such as Part No. 1050110 or equivalent.
3. Assemble the adjusting screw.
4. Attach the primary to secondary shoe spring to the shoes and install the adjusting screw. The primary to secondary shoe spring must not contact the adjusting screw sprocket.

BRAKE ADJUSTER CHART

Wheel	Identification	Thread
Right Front	2 Flat Grooves	Left Hand
Left Front	2 "V" Grooves	Right Hand
Right Rear	2 Flat Grooves	Left Hand
Left Rear	2 "V" Grooves	Right Hand

5. Position shoe assembly on the backing plate. Be sure wheel cylinder links are properly positioned in the shoe notches.
6. Position the upper end of the actuating link on the brake shoe guide.
7. Engage the actuating link with the override pivot. Then position the adjuster lever and return spring on the secondary shoe. Position sleeve in the hole in secondary shoe and fasten to backing plate with hold down spring assembly and pin.
8. Install the remaining primary hold-down spring, washer and pin.
9. Install the primary and secondary brake shoe return springs.
10. Adjust brake shoes as outlined under ADJUSTMENTS - BRAKE SHOE.
11. Install the front hub and drum assembly. Adjust wheel bearings as outlined under WHEEL BEARING ADJUSTMENT, Section 3.
12. If wheel cylinder was removed, bleed brakes.
13. Check fluid level in master cylinder. Fluid level should be no more than 1/4" below the reservoir opening at rear.
14. Check brake pedal travel to be sure it is within specifications, then road test car for proper operation of the brake system.

REAR BRAKE AND BACKING PLATE (DRUM TYPE)

Install

1. If the backing plate was removed, install as follows:
   a. Install wheel cylinder on backing plate. Torque attaching bolts to 6 ft. lbs.
   b. Position backing plate on axle housing and install the axle shaft. Torque the backing plate to axle housing nuts to 35 ft. lbs.
   c. Install the parking brake cable on the backing plate.
2. Lubricate the adjusting screw threads, thrust washer mating surfaces and backing plate ledges with brake lubricant, such as Part No. 1050110 or equivalent.
3. Pull parking brake cables forward and rearward through conduits, lubricate freely with Lithium Soap Grease and return cable to normal position. Remove any excess lubricant.
4. Install the parking brake lever to the secondary shoe.
5. Assemble the adjusting screw.
6. Attach the primary to secondary shoe spring to the shoes, and install the adjusting screw. The primary to secondary shoe spring must not contact the adjusting screw sprocket.

Refer to Brake Adjuster Chart for identification of adjusters.

7. Position show assemblies on the backing plate. Be sure wheel cylinder links are properly positioned in the shoe notches. Install the parking brake strut and spring.
8. Position the upper end of actuating link over the anchor pin.
9. Engage the actuating link with the override pivot. Then position the adjuster lever and return spring on the secondary shoe. Insert adjuster sleeve into hold down hole in secondary shoe and fasten with the hold down spring assembly.
10. Install the remaining hold-down spring.
11. Install the parking brake cable on the parking brake lever.
12. Install the primary and secondary brake shoe return springs.
13. Adjust brake shoes as outlined under ADJUSTMENTS - BRAKE SHOE.
14. Install the rear brake drums and wheels.
15. Adjust the parking brake.
16. If the wheel cylinder was removed, bleed brakes.
17. Check fluid level in master cylinder. Fluid level should be no more than 1/4" below the reservoir opening at the rear.

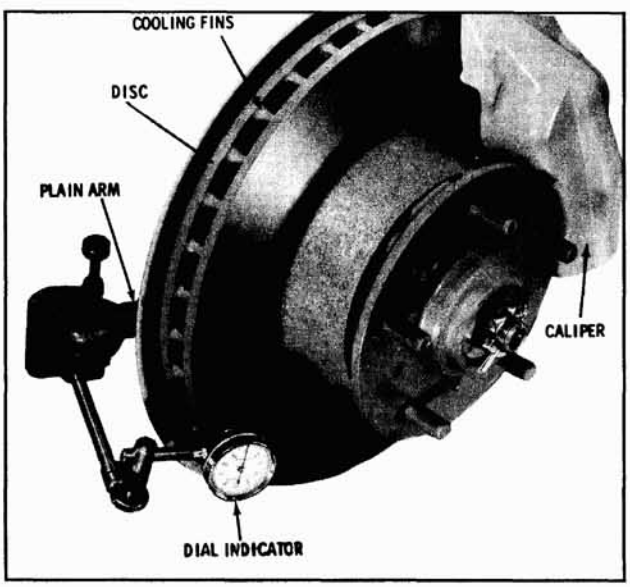


Fig. 5-29—Checking Disc Runout

18. Check brake pedal travel to be sure it is within specifications, then road test car for proper operation of the brake system.

BRAKE SHOE HOLD-DOWN SPRING AND PIN CHART

31-48 Series

FRONT
- Blue Spring - Primary shoe
- Orange Spring - Secondary Shoe
- Pin Number - 4

REAR
- Blue Spring - Front Shoe
- Orange Spring - Rear Shoe
- Pin Number - 2 (All except 4800 Series)
- Pin Number - 4 (4800 Series)

54-86 Series

FRONT
- Green Spring - Front Shoe
- Red Spring - Rear Shoe
- Pin Number - 6

REAR
- Green Spring - Front Shoe
- Red Spring - Rear Shoe
- Pin Number - 8 (All except 84 and 86 Series)
- Pin Number - 1 (84 and 86 Series)

DISC BRAKE ASSEMBLIES

Inspection

Whenever discs are removed, they should be inspected for scores, deep grooves, cracks and runout.

Light scoring of the disc surface is not detrimental to brake operation.

Disc runout can be checked by clamping a dial indicator to the caliper or plain arm so that the stylus touches the disc about an inch from its outer edge. (Fig. 5-29) Rotate disc and check indicator reading. If the lateral runout exceeds .004", the disc should be replaced or refinished.

Servicing The Disc

In manufacturing the brake disc, tolerances of the rubbing surfaces for flatness is .001" and for parallelism is .0005", while lateral runout of the faces must not exceed .004" total. The maintenance of these close controls of the shape of the rubbing surfaces is necessary to prevent brake roughness. In addition, the surface finish must be nondirectional and maintained at 30-50 micro-inches. This control of the rubbing surface finish is necessary to avoid pulls and erratic performance and promote long lining life and equal lining wear of both left and right brakes.

Light scoring of the disc surfaces not exceeding .015" in depth, which may result from normal use, is not detrimental to brake operation.

When the total disc thickness is less than .965 for the 1" thick disc or 1.215" for the 1-1/4" thick disc, it should be replaced. Disc thicknesses less than this can permit the shoes to come out of contact with the shoe abutments and cause malfunction.

Because performance is not impaired by surface imperfection not exceeding .015" deep, refinishing of the rubbing surface is not necessary.

Since extremely accurate control of the finishing operation is necessary for proper performance and excess metal removal can cause malfunction, refinishing of the rubbing surface is not recommended unless precision equipment is available and surfaces can be held within specifications listed.

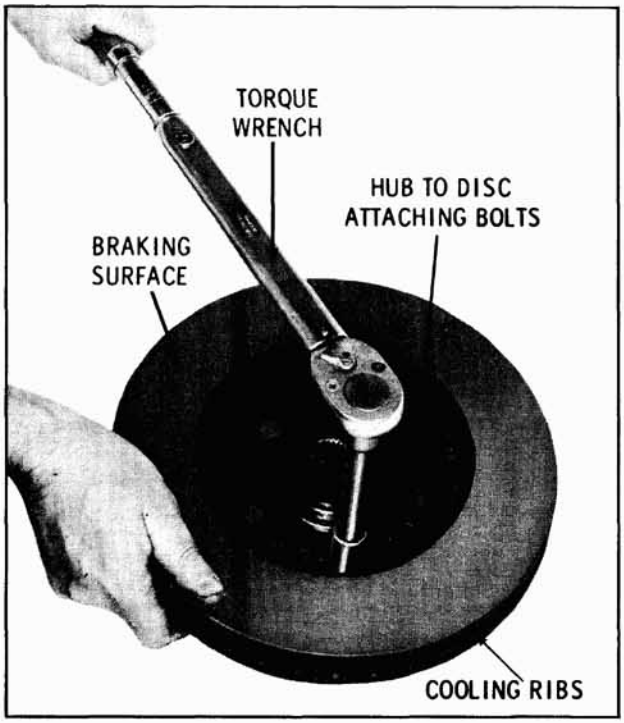


Fig. 5-30—Removing Disc from Hub (31-48 Series)

Disc Removal

Check the condition of the disc. If it is excessively warped, scored, distorted or worn, it should be replaced.

1. Raise vehicle evenly on hoist or jack-stands.
2. Remove front wheel.
3. Remove the brake shoes and the caliper assembly, but do not disconnect brake line. Suspend caliper from a wire hook or loop to avoid strain on hose.
4. Remove grease cup, cotter pin, nut and washer.
5. Pull disc and hub off wheel spindle and remove outer wheel bearing from hub.
6. Remove the attaching bolts holding disc to hub on 31-48 Series. (Fig. 5-30)

Installation

Reverse removal procedure. On 31-86 Series, torque attaching bolts to 70 ft. lbs.

DISTRIBUTOR ASSEMBLY (Fig. 5-31)

Brake lines from the metering valve and from the rear port of the master cylinder are routed to a distributor and switch assembly. In the distributor, the fluid from the two systems is separated by sealed pistons which are centrally positioned by springs from an electrical terminal. If a leak in either front or rear system should occur, a pressure differential (150 to 250 lbs.) during brake application will cause the piston to compress a spring and move in the bore until it contacts the electrical terminal causing the parking brake lamp on the instrument panel to light.

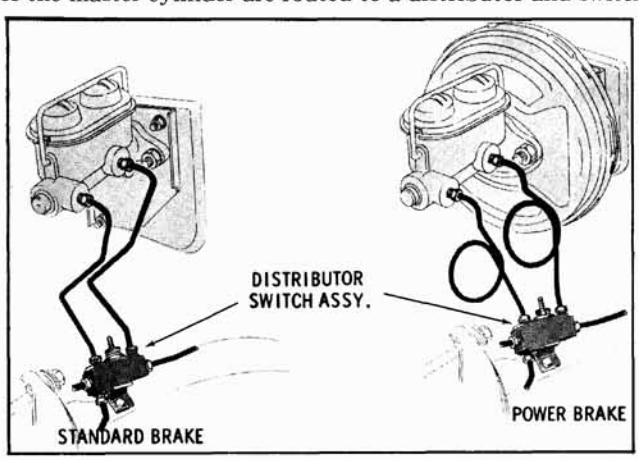


Fig. 5-31—Distributor and Switch Assembly

TESTING THE BRAKE WARNING LIGHT AND DISTRIBUTOR SWITCH

The operation of the light bulb can be checked by depressing the parking brake lever.

The switch can be checked by the following procedure:

1. Determine if bulb is functioning by depressing parking brake.
2. Check to make sure both master cylinder reservoirs are full.
3. Open one wheel cylinder bleed screw in either the front or rear brake system. (Do not remove one from each system.)
4. Depress brake pedal and hold. The light should come due to pressure difference between front and rear systems. Approximately 150-250 psi differential is needed to operate brake light.
5. Close bleed screw, release brake pedal and refill hydraulic reservoirs.

Caution should be taken to prevent air from entering hydraulic system during checks on switch.

The recommended checking interval should be 24 months or 12,000 miles, or any time major brake work is done. Additional checks of the switch should be made any time a customer complains of excessive pedal travel.

If distributor assembly is removed or replaced, the wheel cylinder on all four wheels must be bled.

BRAKE LINING INSPECTION

Remove wheel and check lining thickness through the inspection opening at the upper surface of the caliper. When the groove across the center of the pad is gone, only 1/16" of lining remains and the shoes must be replaced. Always replace shoes before they are worn down to the plate to avoid damage to the disc. Always replace shoes in full sets of four.

If old shoes are to be re-used after performing some other service or replacement, it is best to install the shoes in their original positions.

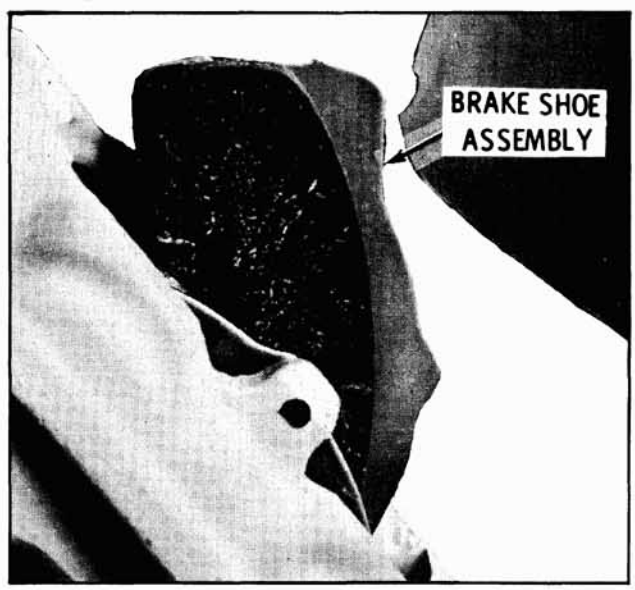


Fig. 5-32—Removing Brake Shoe

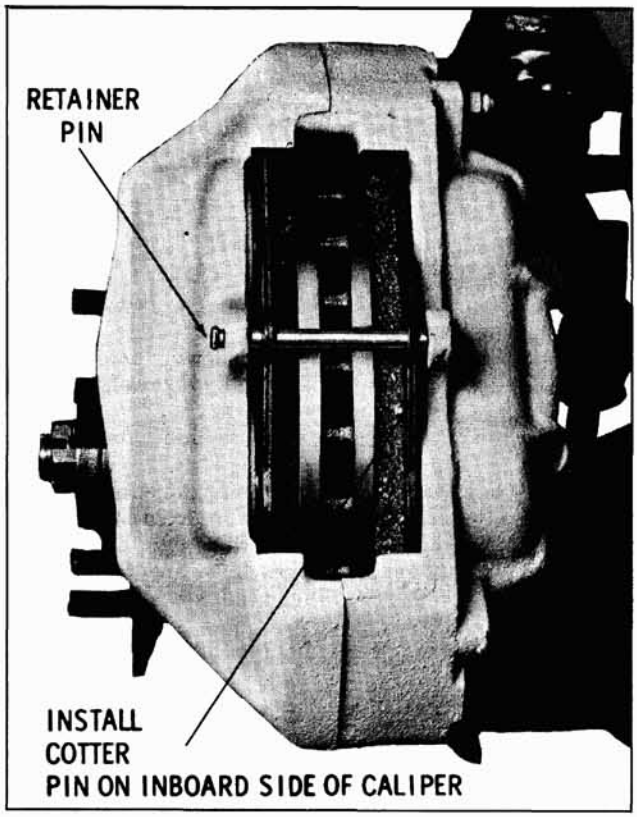


Fig. 5-33—Retaining Pin Installation

BRAKE SHOE REMOVAL AND INSTALLATION

If the master cylinder reservoir is full of fluid. Siphon or dip out 2/3 of the fluid to avoid overflow from the reservoir when fluid is returned from the calipers as pistons are depressed, or attach a hose to the bleed screw and drain excess fluid into a container. This procedure is necessary since the thickness of new linings will compress the pistons and cause the reservoir to overflow. Do not drain the reservoir completely or bleeding will be required.

1. Hoist car and remove wheels.
2. Remove brake shoe retainer pin.
3. Compress pistons into the housing and remove shoes and shims by tipping rear end down and front end up, and remove and discard old shoes. Save shims for installation. (Fig. 5-32)
4. Install new brake shoe assemblies using original shims. Pistons are spring-loaded and must be compressed to obtain clearance for shoe installation.
5. Install and secure retainer pin through caliper and friction pad backing plate holes. (Fig. 5-33)

REPEAT STEPS 1 THROUGH 5 ON OTHER WHEEL

6. Refill master cylinder. Bleeding should not be necessary. Pump brake pedal several times until a firm pedal is obtained. Install wheels.

Do not move car until firm brake pedal is obtained.

DISC BRAKE DISASSEMBLY

Caliper Removal

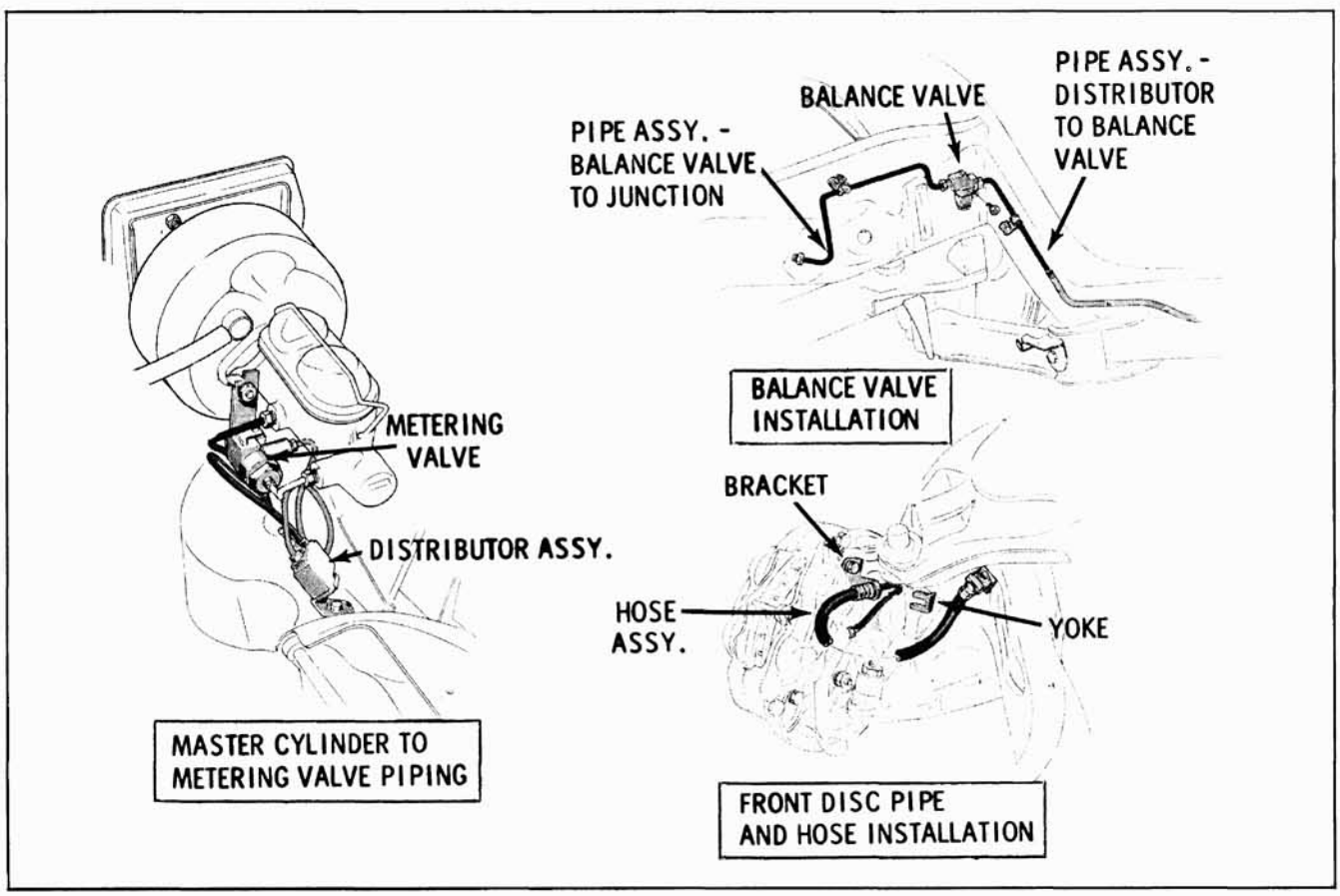


Fig. 5-34—Brake Line and Hose Connections (54-86 Series)

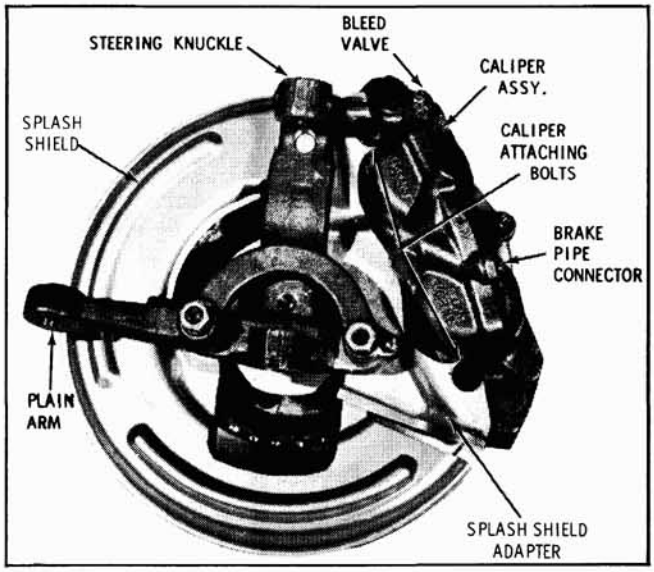


Fig. 5-35—Removing Caliper Assembly

1. Raise car and remove wheel.
2. Disconnect brake hose at brake line support bracket. Plug end of hose to prevent entry of dirt. (Fig. 5-34)
3. Remove retaining pin and brake shoe assemblies. If shoes are to be re-used, mark or scribe shoes to indicate direction of disc rotation. (Fig. 5-33)
4. Unbolt caliper assembly from mounting bracket by removing two hex-head bolts. (Fig. 5-35)
5. Clean the outside of the caliper with Declene or denatured alcohol and remove the brake pipe.

Caliper Disassembly

1. Disassemble the caliper halves by removing two caliper bolts. Lift small "O" rings from the recesses around the drilled passages. (Fig. 5-36)

Disengaging Dust Boot

2. Mount caliper half in vise and disengage dust boot from groove in piston by pressing it down with fingers. (Fig. 5-37)

Removing Piston

3. Install Tool BT-6709 Piston and Dust Boot Remover in piston groove and remove piston by tapping up on tool with plastic hammer. Lift out spring. Repeat operation on balance of pistons. (Fig. 5-38)
4. Remove seal and dust boot from piston.

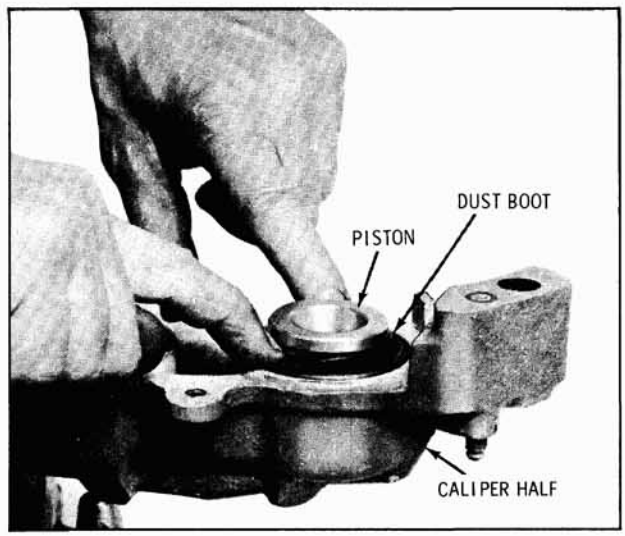


Fig. 5-37—Disengaging Dust Boot

Cleaning and Inspection

Clean all metal parts in Declene or clean brake fluid. Discard old rubber parts whenever caliper is disassembled. Use clean, dry compressed air to clean out and dry the bores, grooves and passages in the caliper.

Inspect pistons and cylinder bores for burrs, nicks or scoring. Use crocus cloth ONLY to remove defects and corrosive deposits.

Do not slide cloth in and out of bore; use circular motion when cleaning.

Replace damaged or badly worn parts. Replace caliper casting if cracks are evident around any caliper or mounting bolt holes.

Check piston fit in bore, using a feeler gauge. Clearance should be .0045" to .010". If bore is not damaged, but clearance exceeds upper limit, a new piston is required.

Lubricate the bores, pistons, seals, boots, "O" rings and through bolts with clean brake fluid before assembly.

Assembly of Caliper

1. Mount caliper half in vise and install piston springs in bottom of bore.

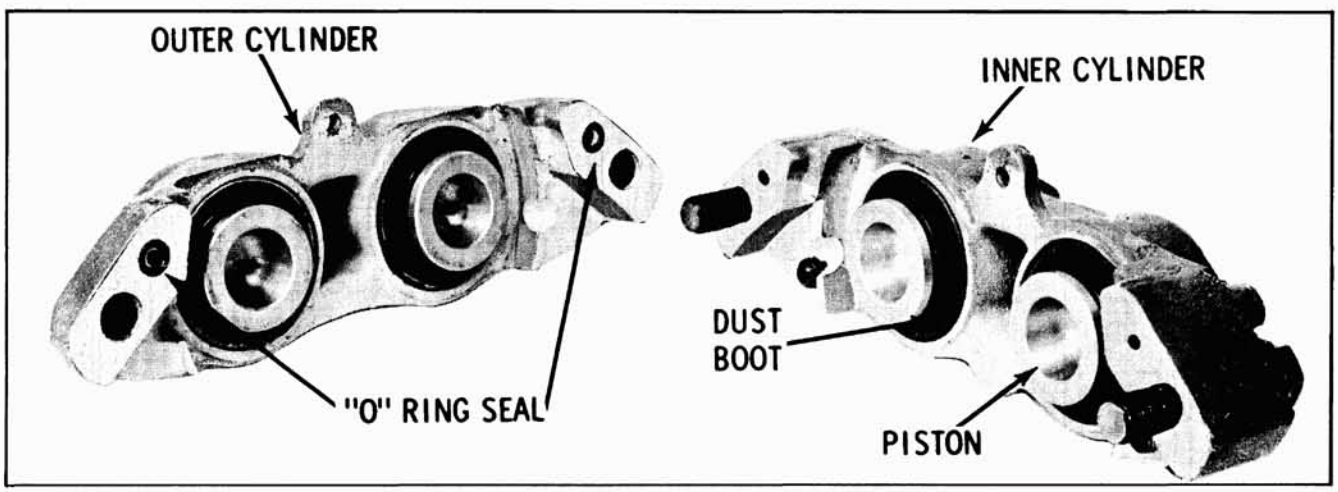


Fig. 5-36—Separating Caliper

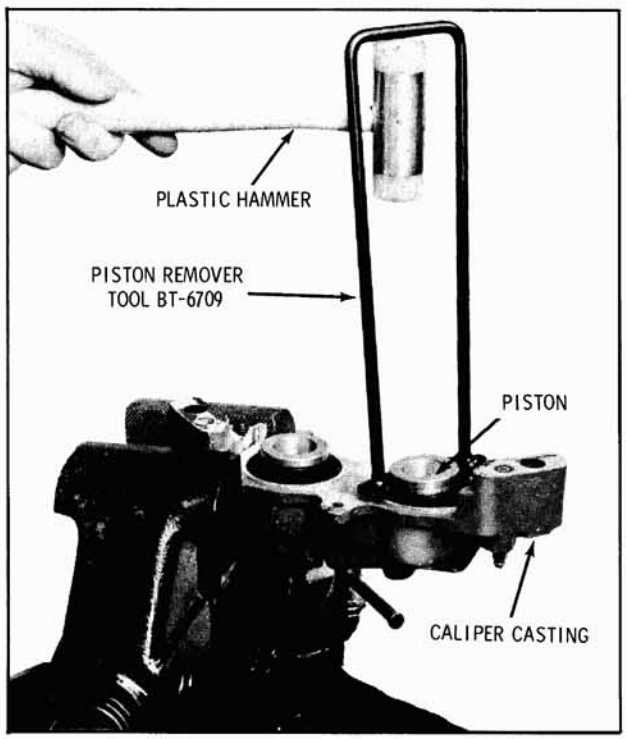


Fig. 5-38—Removing Pistons

2. Install seal in piston groove with lip away from dust boot groove.

Installing Piston

3. Install piston seal installer (J-22591) on piston to compress seal and push piston into bore. (Fig. 5-39)

4. While holding piston in bore, install dust boot on piston with lip of boot in piston groove, press flange of dust boot into seat to position it.

Installing Dust Boot

5. Install Tool J-6198 on J-8092 Driver Handle, and seat dust boot in caliper flush or below machined face of caliper. Install remaining pistons in the same manner. (Fig. 5-40)

6. Lubricate and install new "O"-rings in caliper recesses around drilled passages.

7. Lubricate caliper bolts with clean brake fluid and bolt

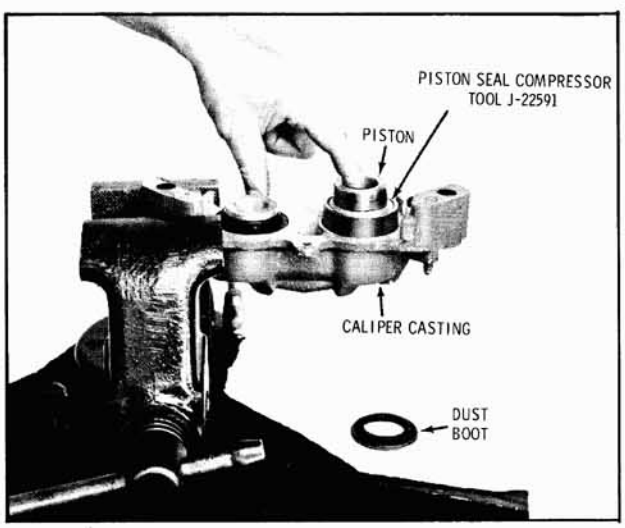


Fig. 5-39—Installing Pistons

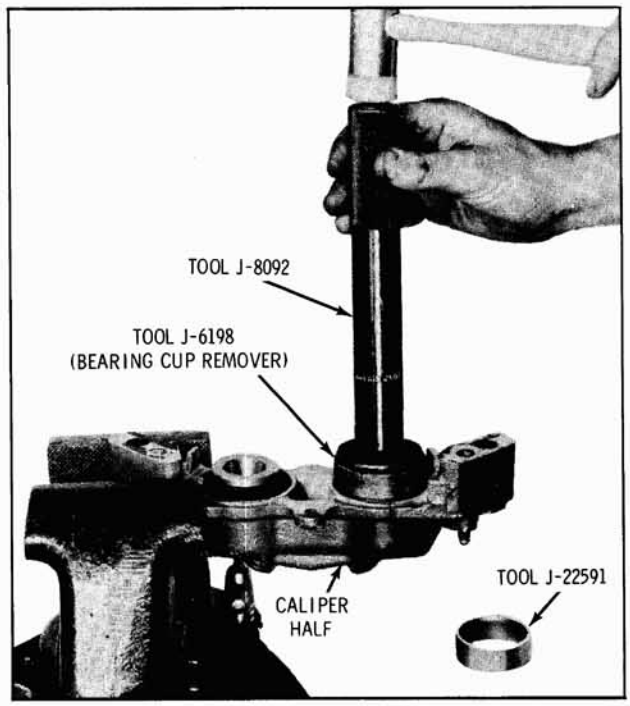


Fig. 5-40—Installing Dust Boot

caliper halves together and torque to 130 ft. lbs. using a reliable torque wrench.

Installation of Caliper

1. Install brake pipe on caliper and attach caliper to mounting bracket. Torque two mounting bolts to 70 ft. lbs.

2. Connect brake hose to brake pipe.

3. Press pistons into bores and install brake shoes and shims in same position as removed.

Install BT 6710 on metering valve when bleeding disc brakes, Fig. 5-41.

4. Bleed brakes and install front wheels.

5. Obtain firm pedal before moving car.

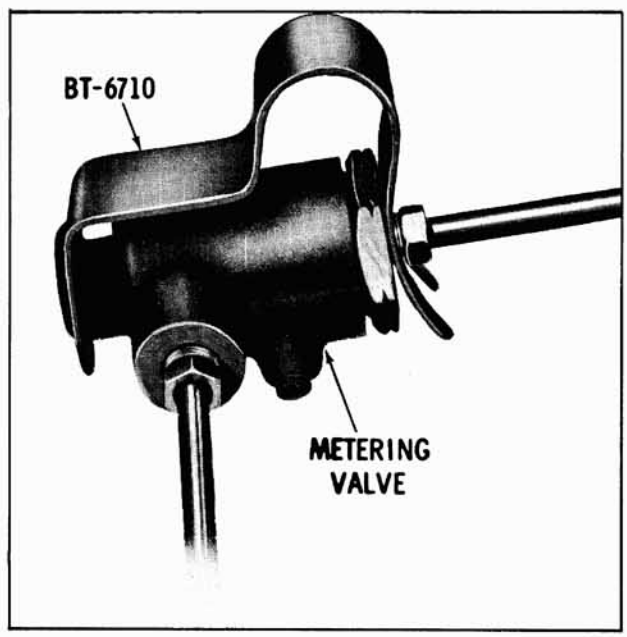


Fig. 5-41—Installing BT-6710 on Metering Valve

POWER BRAKES

DESCRIPTION

Power brakes are available on 31-66 series, including 31-48 Series equipped with 3 or 4-speed manual transmissions.

The 31-48 Series uses a 9 1/2" single diaphragm Moraine power brake booster, with drum brakes. The 54-86 Series uses a 9 1/2" single diaphragm Moraine or Bendix power brake booster, with drum brakes. All drum type brakes with a power brake booster will use a 1" dual master cylinder.

The 31-48 Series uses a 9 1/2" single diaphragm Moraine power brake booster with disc brakes and a 1 1/8" dual master cylinder. The 54-86 Series uses an 8" tandem diaphragm Bendix power brake booster, with disc brakes and a 1 1/8" dual master cylinder. Toronado uses an 8" tandem diaphragm Bendix power brake booster, with 1 1/8" dual master cylinder on all brakes.

The Moraine vacuum units are identical, with the exception of the mounting and the operating rod assembly. Service procedures for both units will be covered under one write-up.

Internally, all units differ in construction but all units are designed to seal off atmospheric pressure when the pedal is in the released position. The hydraulic master cylinder on the power brake boosters are similar in construction and service to the standard brake master cylinder. For removal and service of the power brake master cylinder, refer to MASTER CYLINDER.

A vacuum check valve traps vacuum inside the power brake unit, at the highest manifold vacuum available, making possible brake application after the engine has been shut off for several hours or more. If the engine should stall, several applications of the brakes can still be made with vacuum assist. After the vacuum supply is exhausted, brake applications can still be made; however, more effort is required due to the lack of vacuum assist.

MINOR SERVICE OPERATIONS

BRAKE PEDAL OR BRACKET

Remove and Install

The power brake pedal and mounting bracket is attached as shown in Fig. 5-42 or Fig. 5-43.

On cars equipped with power brakes and manual transmission, refer to the CLUTCH Section for clutch pedal removal.

On installation, lubricate nylon bushings and clevis pin with lubricant, such as No. 1050169 or equivalent. Torque pivot pin nut on 54-86 Series to 12 ft. lbs. and on 31-48 Series, torque the pivot pin nut to 40 ft. lbs. Check and adjust stop lamp switch.

The brake pedal height is not adjustable.

POWER BRAKE UNIT

Remove and Install (Fig. 5-44 or 5-45)

1. Disconnect vacuum hose from vacuum cylinder assembly. Cover openings to prevent entry of dust, dirt, etc.
2. Disconnect pipes from master cylinder outlets and cover openings in master cylinder and ends of pipes to prevent entry of dust, dirt, etc.
3. Loosen inboard master cylinder attaching nut to disengage metering valve (Disc Brakes Only).
4. Disconnect push rod from brake pedal.
5. Remove nuts and lock washers from vacuum cylinder studs and remove power brake assembly.
6. Clean exterior of power brake assembly and drain reservoir of hydraulic fluid.
7. To install, reverse removal procedure. Torque the vacuum cylinder mounting bolts to 24 ft. lbs. Fill master cylinder with Brake Fluid, Delco Supreme No. 11 or equivalent and bleed entire system. (See BLEEDING OF LINES.)

After unit is installed on the car, the engine must be started and vacuum allowed to build up before any brake applications are made.

MORAINE POWER BRAKE

PRINCIPLES OF OPERATION

Released Position (Fig. 5-46)

In the released position, both sides of the vacuum piston diaphragm are open to vacuum. This allows the vacuum piston to be held in the released position by the vacuum piston return spring. This is accomplished as follows:

In the released position, the air valve is seated on the float-

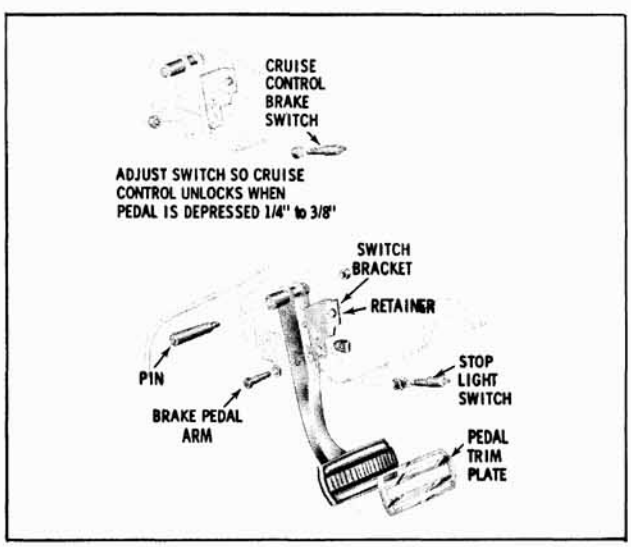


Fig. 5-42—Power Brake Pedal Mounting (54-86 Series)

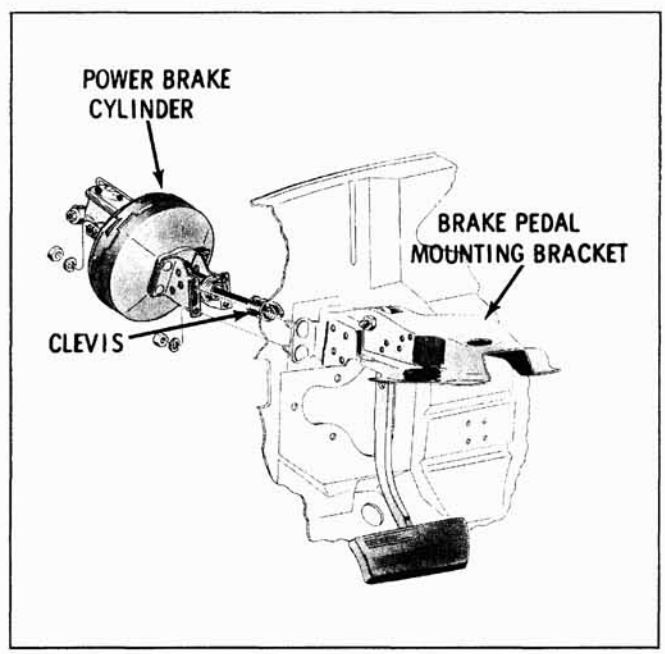


Fig. 5-43—Power Brake Pedal Mounting (31-48 Series)

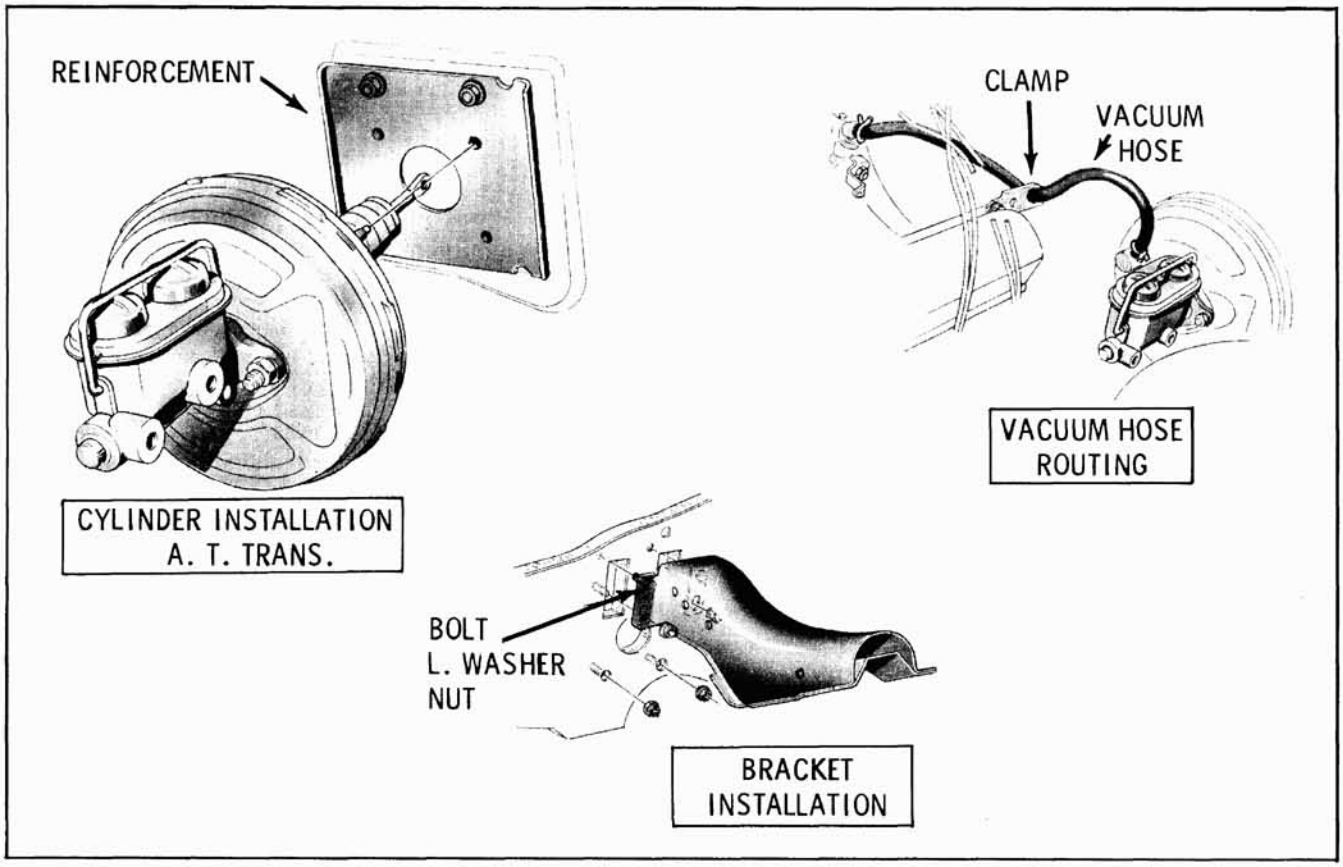


Fig. 5-44—Power Brake Mounting (54-86 Series)

ing valve. Air, under atmospheric pressure, is shut off at the air valve. The floating valve is held away from the valve seat in the power piston. Vacuum, which is present at all times at the forward side of the piston diaphragm evacuates any existing air at the rear of the piston diaphragm. This air is drawn through two small passages in the piston diaphragm over the valve seat to the forward side of the piston diaphragm.

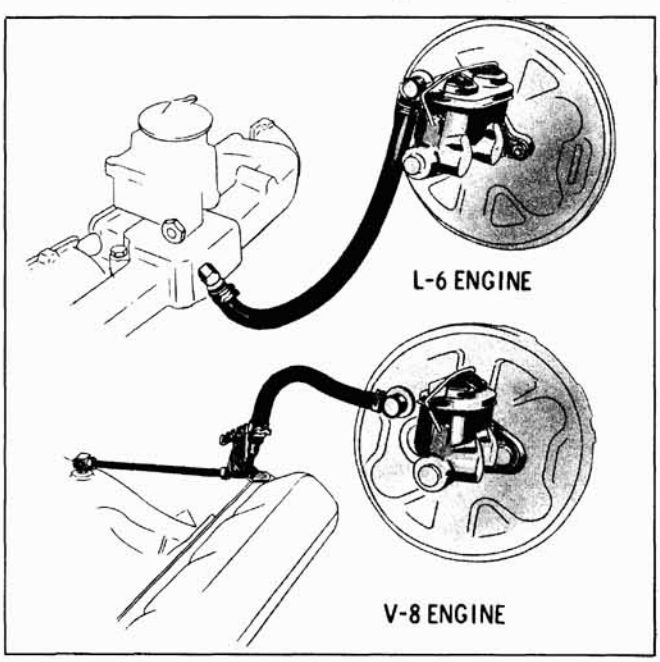


Fig. 5-45—Power Brake Vacuum Hose (31-48 Series)

The master cylinder piston push-rod, being attached to the vacuum piston assembly, is also held in the released position by the piston diaphragm return spring. In the released position, the compensating ports are open and fluid can flow in either direction between the master cylinder and the fluid reservoir. A slight pressure is maintained in the lines by the residual check valves.

Applying (Fig. 5-47)

As the pedal is depressed, the operating rod carries the air valve away from the floating valve. Further movement allows the floating valve to contact a seat in the power piston, shutting off the vacuum to the rear of the piston diaphragm. Air, under atmospheric pressure, can now enter through the air filter, travels past the air valve seat and through two passageways to the rear of the piston diaphragm. With vacuum on the forward side and atmospheric pressure at the rear, a force is developed which moves the piston diaphragm and the master cylinder piston push-rod in the apply direction.

The initial movement of the master cylinder pistons in the apply direction closes the bypass ports, sealing off the fluid reservoirs from the master cylinder. Further movement of the master cylinder pistons in the apply direction increases pressure in the master cylinder, forcing fluid past the residual check valves through the lines and into the wheel cylinders to apply the brakes.

As the pressure in the master cylinder increases, the force on the end of the master cylinder piston causes the piston push-rod reaction plate to move away from its stop and press against the reaction levers. The levers in turn, pivot and press against the end of the air valve and operating rod assembly. This allows approximately 30% of the load to be transferred back through the reaction system to the brake pedal. This gives the driver brake feel.

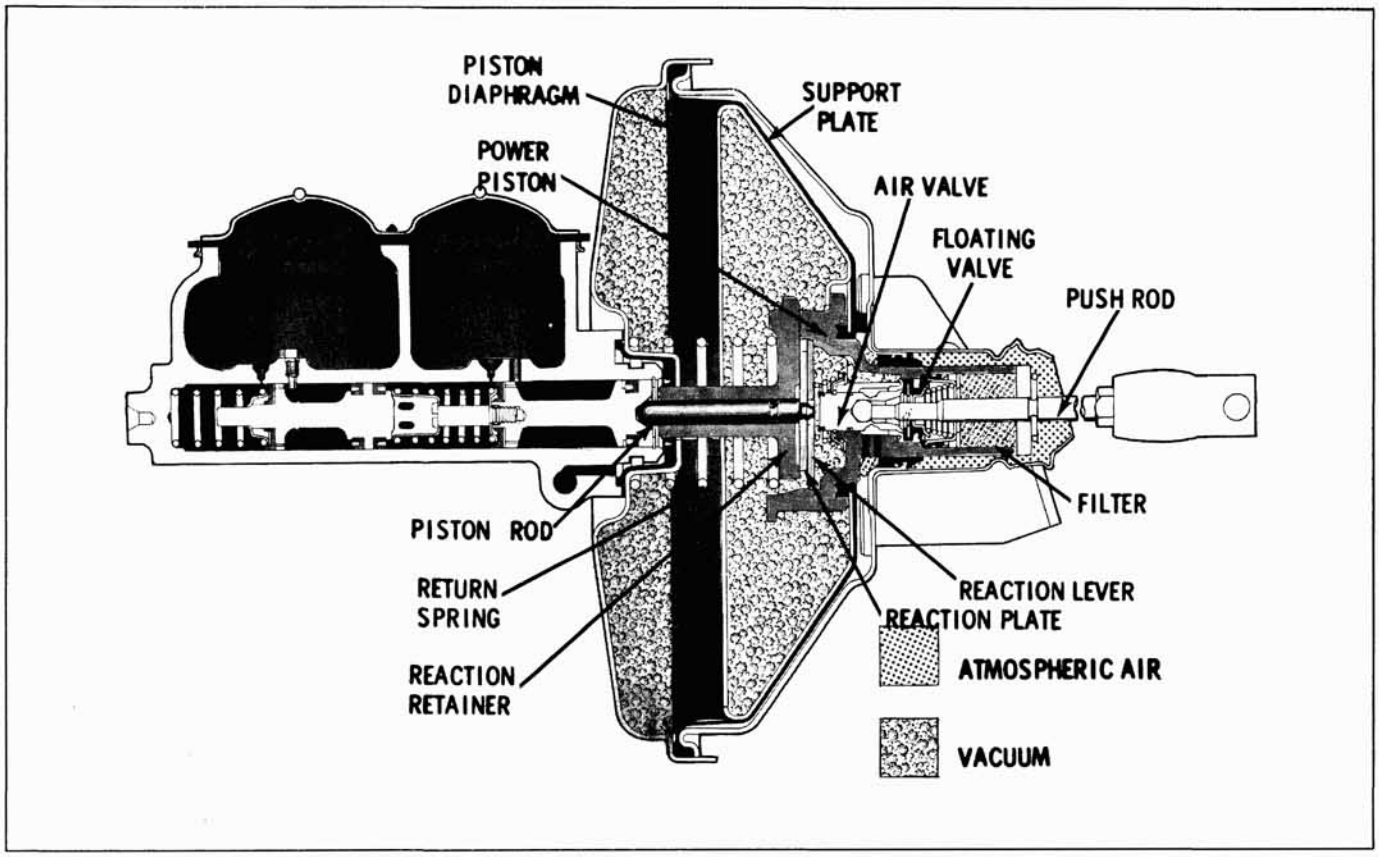


Fig. 5-46—Released Position

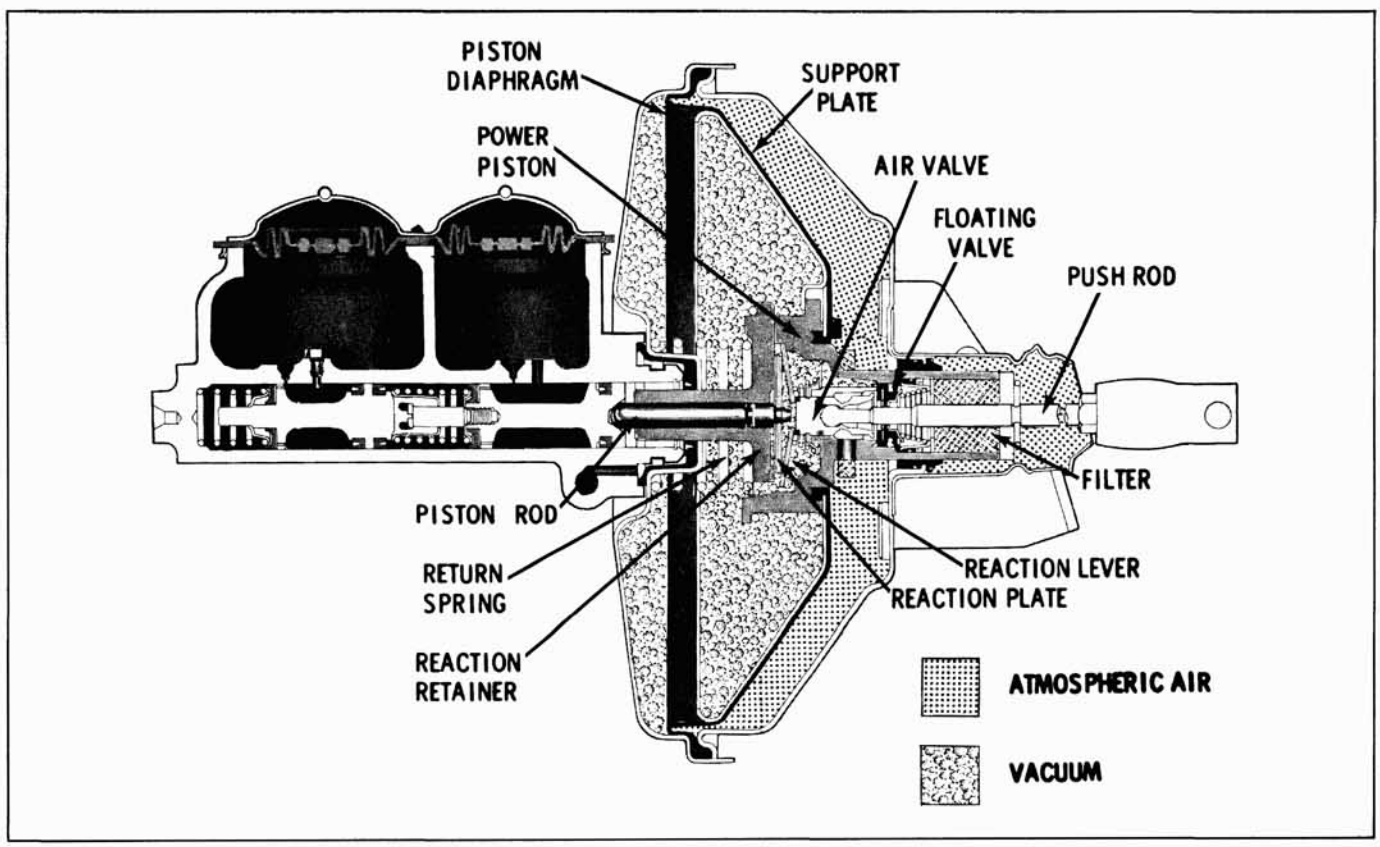


Fig. 5-47—Applied Position

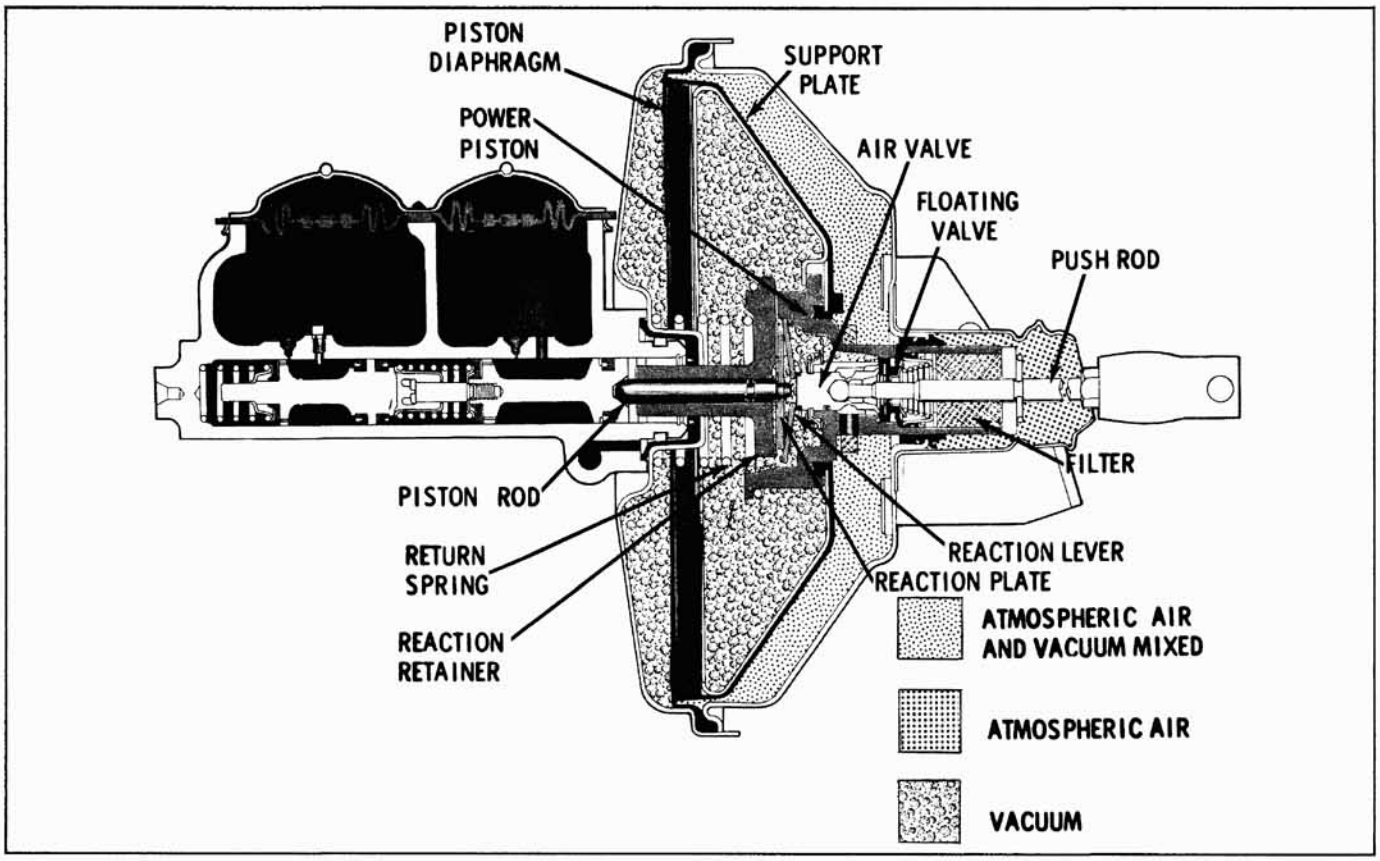


Fig. 5-48—Holding Position

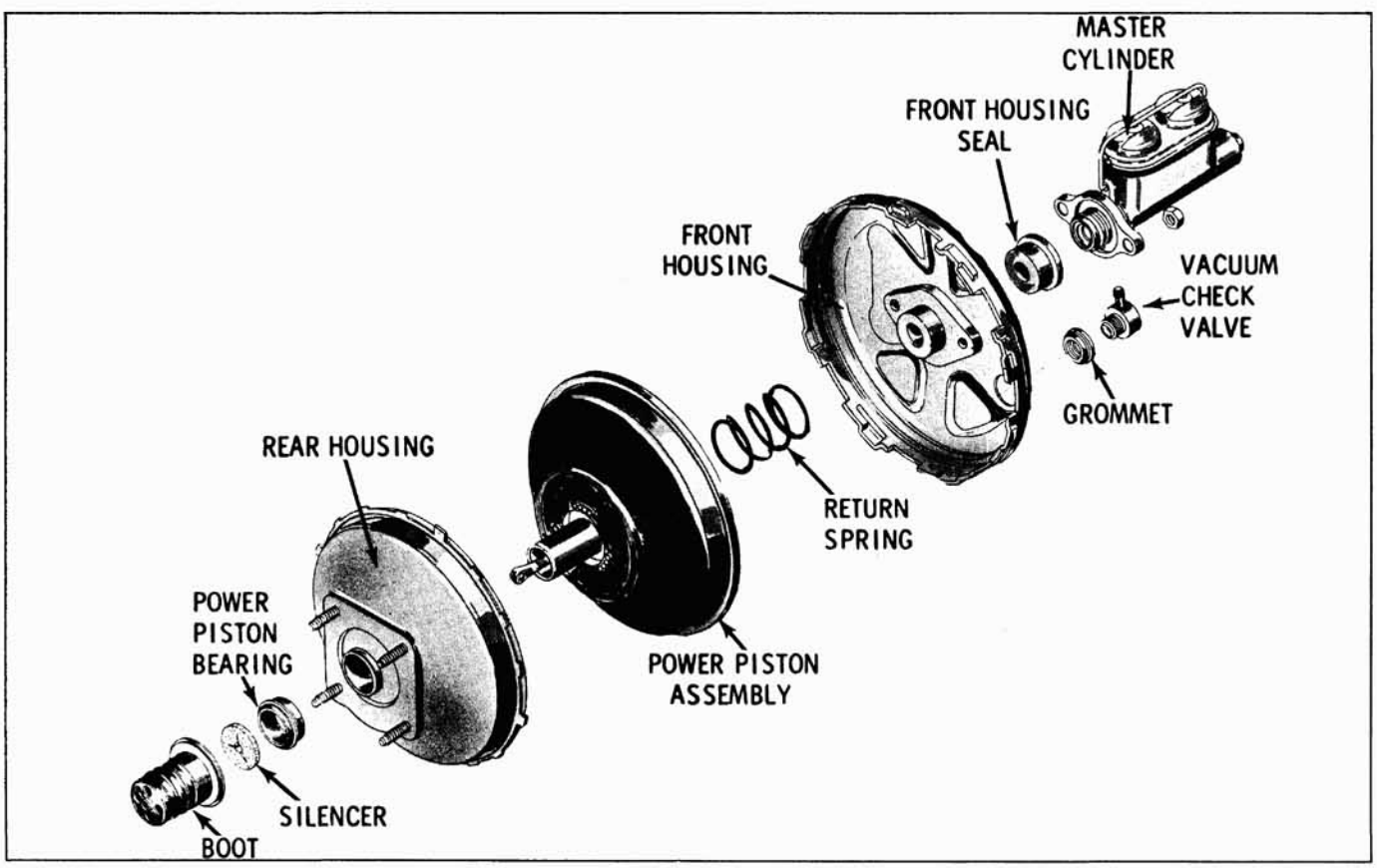


Fig. 5-49—Moraine Power Brake Assembly (54-86 Series)

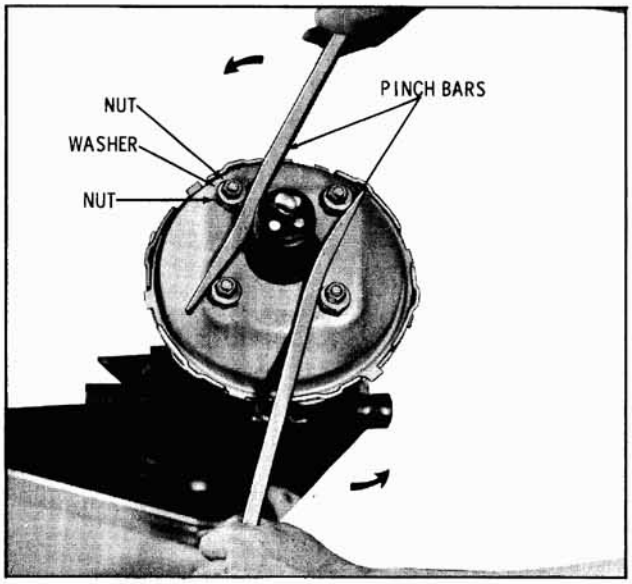


Fig. 5-50—Separating Housing (Without a Mounting Bracket)

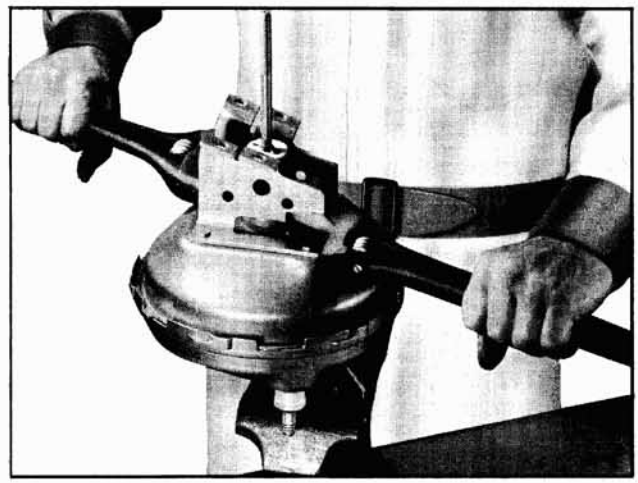


Fig. 5-51—Separating Housing (With a Mounting Bracket)

Holding (Fig. 5-48)

When the desired brake pedal pressure is obtained, the piston diaphragm continues to move forward until the floating valve, which is still seated on the power piston, again seats on the air valve. The piston diaphragm will remain stationary until pressure is applied or released at the brake pedal.

Releasing (Fig. 5-46)

As the pressure on the brake pedal is released, the air valve spring forces the air valve back until the snap ring contacts the power piston. Further movement of the air valve unseats the floating valve from the power piston. As the air valve seats on the floating valve, it shuts off the supply of air under atmospheric pressure. As the floating valve unseats from the vacuum plate, it opens the area to the rear of the piston diaphragm to vacuum.

With vacuum on both sides of the piston diaphragm the piston diaphragm return spring returns the vacuum piston together with the master cylinder piston push-rod into the released position. Brake fluid, under pressure, in the lines now flows back through the residual check valves and into the master cylinder reservoirs.

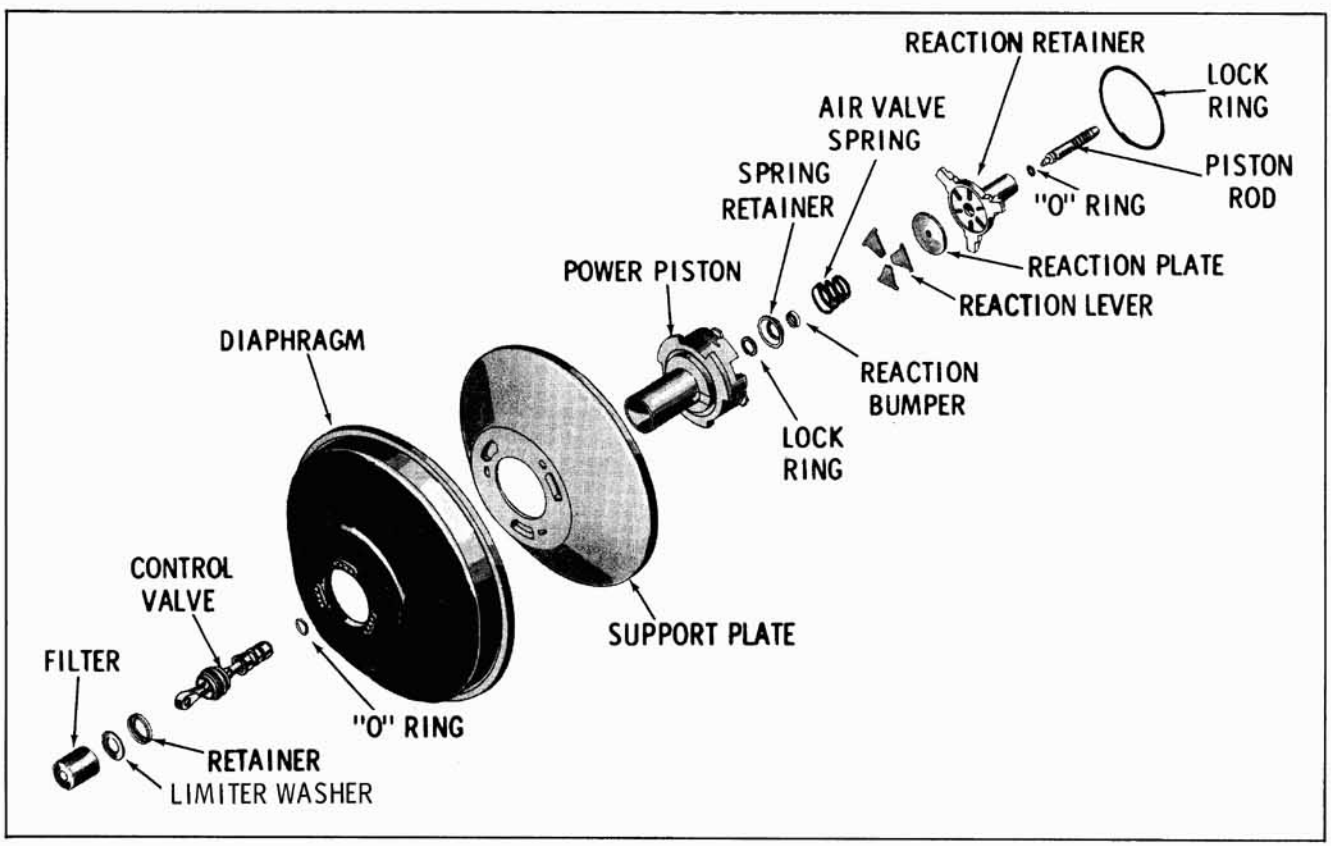


Fig. 5-52—Vacuum Piston Assembly (Moraine)

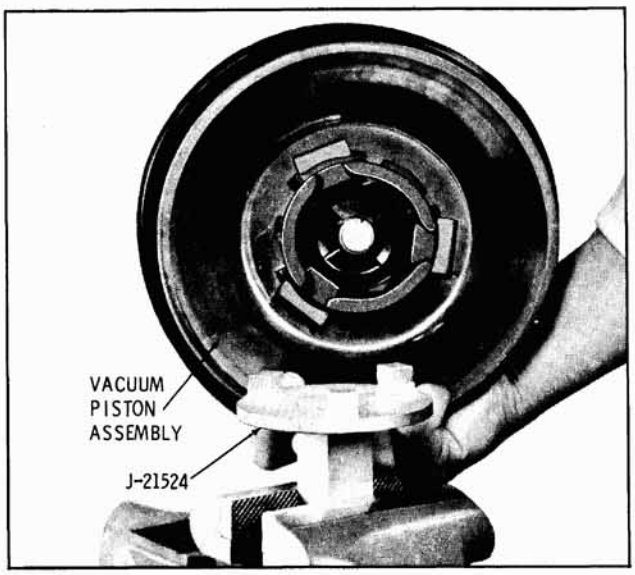


Fig. 5-53—Positioning Vacuum Piston on Tool J-21524

DISASSEMBLY OF MORAINE POWER BRAKE (Fig. 5-49)

Keep mineral oil or grease from coming in contact with hydraulic parts.

1. Deplete vacuum supply, then clean the outside of the power brake unit. Remove reservoir cover and empty brake fluid from master cylinder.
2. Clamp master cylinder in a vise with the operating rod up. Scribe an alignment mark on the top center of the front and rear housing.
3. Rotate the rear housing counterclockwise to separate the two housings. If the rear housing cannot be readily loosened, tap the rear housing lightly with a plastic hammer. (Figs. 5-50 or 5-51)

When separating housings, maintain pressure on the rear housing as it is under spring tension.

4. Remove the rear housing and vacuum piston assembly from the front housing.

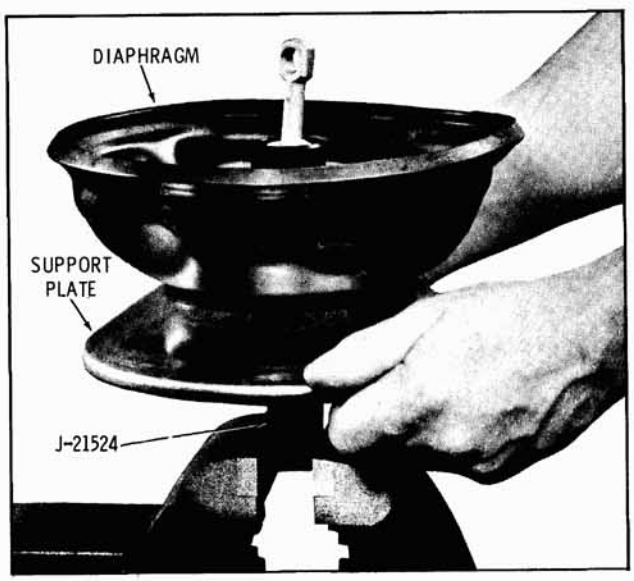


Fig. 5-54—Removing Support Plate

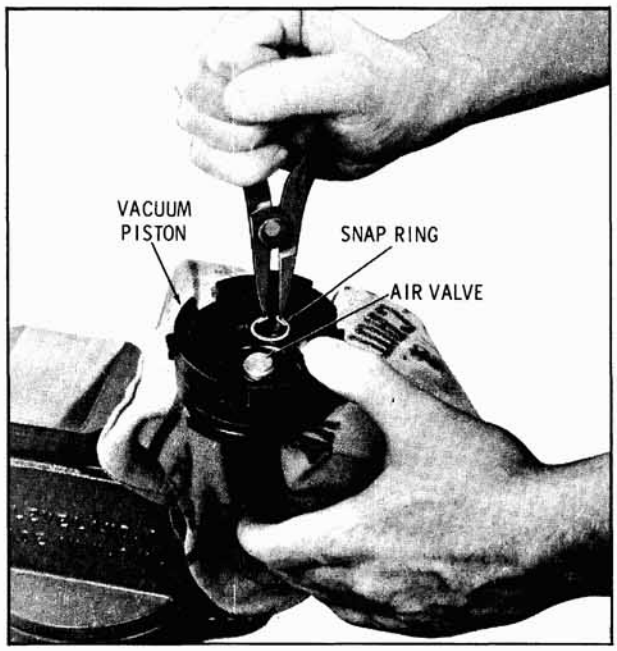


Fig. 5-55—Removing Snap Ring

5. On units without a mounting bracket, remove the rubber boot from the rear housing. Remove the filter from inside the boot.
6. On units with a mounting bracket, remove the plastic boot from between the mounting brackets. Remove the retaining ring, clevis and locknut, then remove the filter from the operating rod.
7. Remove the vacuum piston assembly from the rear housing.
8. Remove the seal from the rear housing.
9. Remove the master cylinder to front housing attaching nuts and remove the master cylinder from the front housing.
10. Remove the front housing seal, the vacuum check valve and seal from the front housing.

DISASSEMBLY OF VACUUM PISTON (Fig. 5-52)

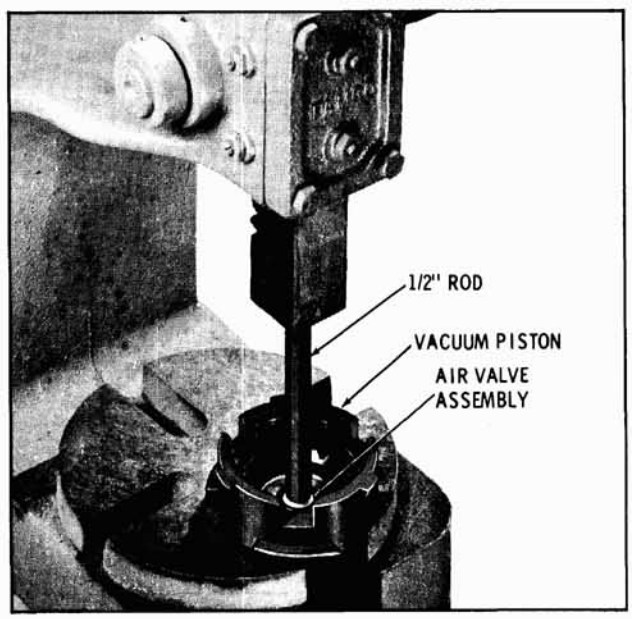


Fig. 5-56—Removing Air Valve

1. Remove the lock ring from the vacuum piston by prying one of the ends out from under the large divided locking lug.
2. Remove the reaction retainer and push-rod, reaction plate, reaction levers and air valve spring. Also, remove the small reaction bumper and the air valve spring seat from the air valve.
3. Install Tool J-21524 in a vise. Position the vacuum piston assembly on Tool J-21524 so that the three lugs on the tool fit into the three notches in the vacuum piston. (Fig. 5-53)
4. Fold the diaphragm away from the support plate so that the hands can grip the steel support plate and rotate support plate counterclockwise until the support plate separates from the vacuum piston. (Fig. 5-54)
5. Remove the diaphragm from the support plate.
6. Remove the silencer from the neck of the vacuum piston tube.
7. Position the vacuum piston in a vise padded with shop towels. Do not clamp vise on tube. Using Truarc Pliers J-4880, remove the snap ring from air valve. (Fig. 5-55)
8. Place the vacuum piston, tube down, in a press. Using a rod not exceeding 1/2" in diameter, press the air valve assembly from the vacuum piston. (Fig. 5-56)

On all series except 31-48, it is necessary to service the complete air valve, floating valve and operating rod assembly. On 31-48 Series, the air valve and operating rod do not have to be replaced if they are not defective. However, a new floating valve must be installed on the assembly.

9. Remove the limiter washer and air filter from the operating rod.
10. Remove the master cylinder push-rod from the reaction retainer. Remove the "O" ring from the push-rod.

CLEANING AND INSPECTION

1. Thoroughly wash all parts in alcohol, blow out all passages and air dry. Place parts on clean paper.
2. Inspect front and rear housing for scoring, pitting, dents or nicks. Small imperfections may be smoothed out with fine crocus cloth. Check housings for loose studs. Replace housings if they cannot be repaired.
3. Inspect vacuum piston diaphragm for deterioration or abrasions. Replace if damaged.
4. 31-48 Series - Inspect air valve and operating rod assembly for scratches, nicks, distortion or corrosion. Check seat for smoothness. Operating rod should move freely in air valve but should not pull out. REPLACE ASSEMBLY IF WORN OR DAMAGED.
5. Check vacuum piston support plate and reaction retainer for cracks, distortion, damaged reaction lever seats or rough and uneven floating valve seat. Be sure all openings and passages are clean.
6. Check reaction levers for distortion. Replace if damaged.
7. Replace air filters and silencer if dirty or torn.

ASSEMBLY OF MORAINE POWER BRAKES

For assembly of master cylinder, refer to MASTER CYLINDER - ASSEMBLY.

VACUUM PISTON

During assembly, when a lubricant is specified, use either the lubricant furnished with the repair kit or Seal Lubricant No. 1050169 or equivalent.

1. Install a new "O" ring, coated with lubricant on the push-rod.

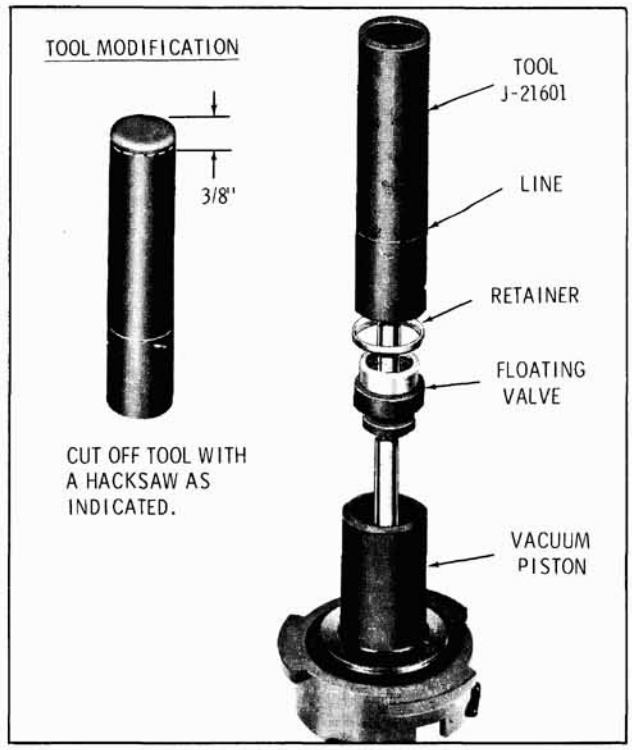


Fig. 5-57—Installing Floating Valve

2. Insert the push-rod so the round end of the piston protrudes from the end of the tube of the reaction retainer.
3. Wipe a film of lubricant on the large OD of the floating valve and on the "O" ring on the air valve. On 31-48 Series, install a new "O" ring on the air valve.
4. Position a new air valve and operating rod assembly, air valve first, into the tube of the vacuum piston. On 31-48 Series, install the new floating control valve so that the flat face of the valve seats against the air valve.
5. Position the floating valve retainer over the push-rod so that the flat side seats on the floating control valve.
6. Using Tool J-21601, press the floating valve until it seats in the vacuum piston. Line on tool will be flush with top of vacuum piston when floating valve is fully seated. (Fig. 5-57)
7. Position the operating rod limiter washer over the operating rod and down onto the floating valve.
8. Position the large ID air silencer over the neck of the vacuum piston. Install the small ID filter inside the neck of the vacuum piston over the operating rod.
9. Install Tool J-21524 in a vise. Position vacuum piston on the tool so that the three lugs fit into the notches in the vacuum piston.
10. Install the vacuum piston diaphragm on the diaphragm support plate, on the side opposite the locking tangs. The inner lip of the diaphragm must fit over the edge of the center hole of the support plate.
11. Coat the entire inner lip of the diaphragm with lubricant.
12. Position the support plate and diaphragm over the tube of the vacuum piston. The flange of the diaphragm fits into the groove on the power piston. (Fig. 5-58)
13. Press down and rotate the support plate clockwise until the lugs on the power piston rest against the stops on the support plate.
14. Position the vacuum piston assembly in a padded vise, tube down. Do not clamp tube. Using Truarc Pliers J-4880,

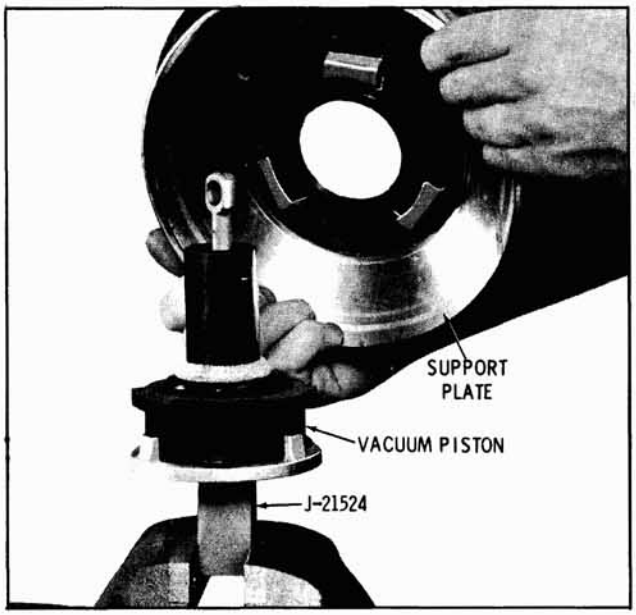


Fig. 5-58—Positioning Support Plate on Vacuum Piston

install the snap ring into the groove in the air valve. (Fig. 5-55)

15. Install the air valve spring seat, dished side down, so it seats on the snap ring. Install the reaction bumper into the groove in the end of the air valve.

16. Install the air valve return spring so the large end seats on the spring seat.

17. Install the three reaction levers in the slots in the vacuum piston.

18. Position the reaction plate, numbered side up, on top of the reaction levers. Press down on the reaction plate until the reaction levers pop up.

19. Position the reaction retainer and push-rod as shown in Fig. 5-59. While retaining pressure on the reaction retainer, install the lock ring as shown in Fig. 5-60.

ASSEMBLY OF POWER BRAKE UNIT

1. Coat the rear housing seal with lubricant and install in the rear housing with the large flange of the seal on the same side as the mounting studs.

2. Apply lubricant to the tube of the vacuum piston and insert the tube of the vacuum piston through the seal of the rear housing.

3. Coat the vacuum check valve seal with lubricant and install with the beveled side of the seal toward the inside of the front housing.

4. Install the vacuum check valve in the front housing.

5. Install the front housing seal and the master cylinder on the front housing. Torque master cylinder attaching nuts to 20-30 ft. lbs.

6. Clamp the master cylinder in a vise. Position the vacuum piston return spring over the hub of the front housing.

7. Position the rear housing over the front housing so that the scribe marks will be aligned when housings are assembled.

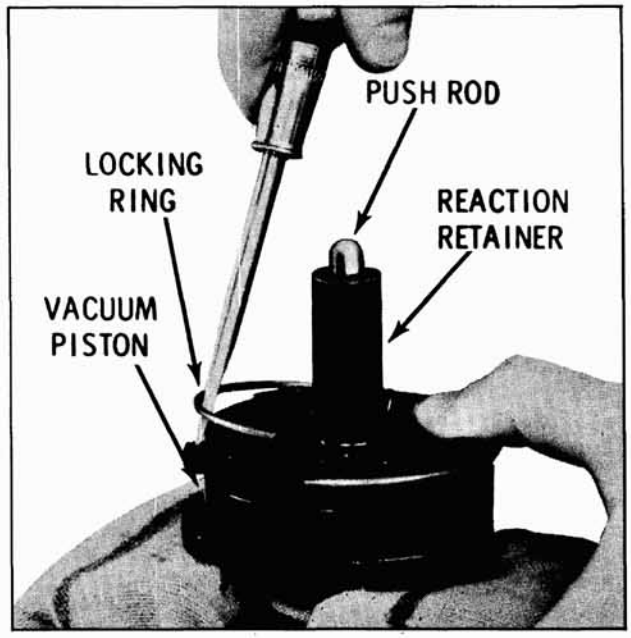


Fig. 5-60—Installing Locking Ring

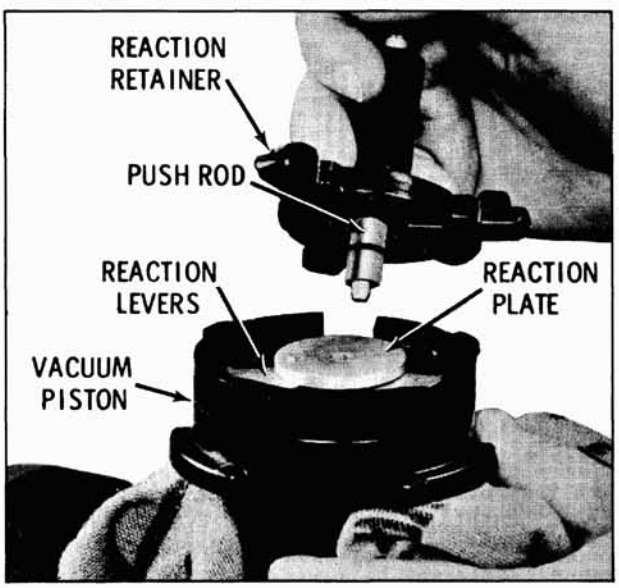


Fig. 5-59—Installing Reaction Retainer

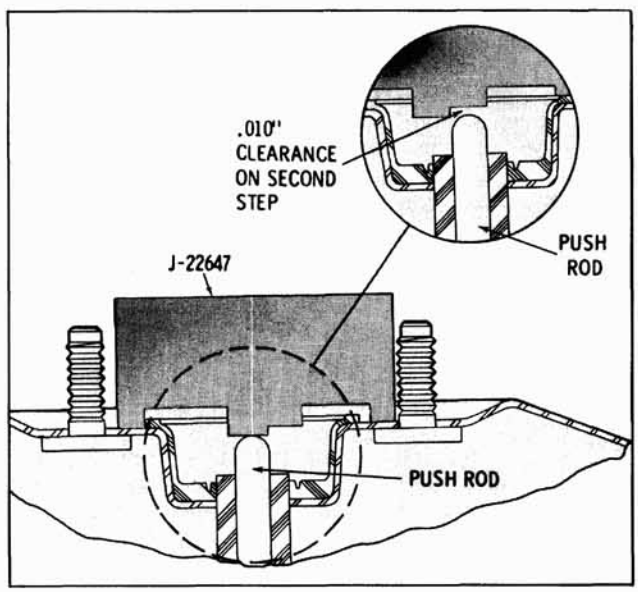


Fig. 5-61—Checking Push-Rod Adjustment (Moraine)

8. Depress and rotate rear houing clockwise until the front and rear housings are locked.

9. All series except 31-48 - Install the felt filter into the last fold of the rubber boot and install the boot over the operating rod.

10. 31-48 Series - Install the felt filter over the operating rod and install the retaining key. Install the plastic boot over the operating rod so the projections locate in the holes of the bracket. Install the locknut and clevis on 31-48 Series.

11. Check the push-rod adjustment as outlined under PUSH-ROD ADJUSTMENT.

PUSH-ROD ADJUSTMENT (Fig. 5-61)

The push-rod adjustment is important because the compensating port in the master cylinder must be open when the vacuum piston is in the released position.

The push-rod adjustment can be checked as follows:

1. With the vacuum unit assembled and the master cylinder and front housing seal removed, position Gauge J-22647 over the push-rod with the legs of the gauge resting on the front housing of the vacuum cylinder.

2. The adjustment is correct if the gauge just contacts the tip of the push-rod or if the tip of the push-rod is no more than .010" below the gauge.

3. If the push-rod is not within specifications, and the push-rod does not have an adjusting screw, a new service adjustable push-rod must be installed and adjusted to specification. If the push-rod, being checked, has an adjusting screw, adjust the push-rod to specification.

BENDIX POWER BRAKE "SINGLE AND TANDEM DIAPHRAGM"

PRINCIPLES OF OPERATION SIMILAR FOR SINGLE AND TANDEM DIAPHRAGM

Released Position (Fig. 5-63)

With the engine running and the brakes released, vacuum from the intake manifold is admitted through the vacuum check valve to the front (left) vacuum chamber and, through a port in the hub of the front plate, to the vacuum chamber to the front (left) of the rear diaphragm. In the released position (no pressure applied to the brake pedal), the valve operating rod and valve plunger are held to the rear in the valve housing by the valve return spring to CLOSE the atmospheric port and OPEN the vacuum port. With the valve in this position, the chambers to the rear of both the front and rear diaphragm are open to vacuum through the portings in the hub of the valve housing (rear plate) and around the edge of the center plate. The vacuum power diaphragms are then balanced or suspended in vacuum, since vacuum is present on both sides of both diaphragms. The vacuum diaphragm and plate return spring is then free to return the diaphragm and plate assembly with the hydraulic push rod to the fully

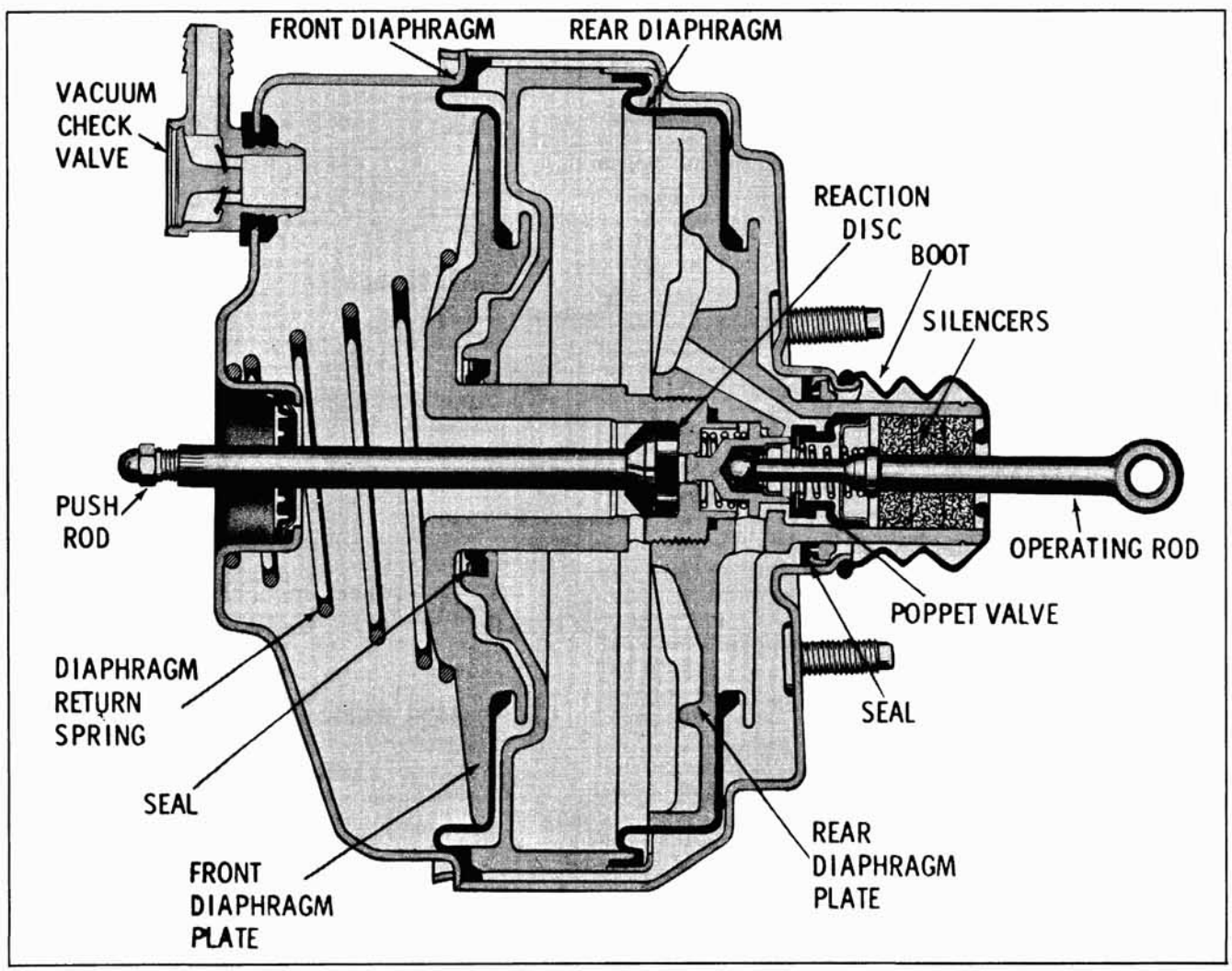


Fig. 5-62—Tandem Diaphragm Vacuum Cylinder

released position. With the hydraulic push rod in the released position, the hydraulic compensating ports in the master cylinder are open and permit fluid to return from the wheel cylinders to the separate fluid reservoirs or to enter either system from its reservoir to compensate for expansion or loss of fluid in either system.

Applied Position (Fig. 5-64)

As the brakes are applied by the driver, the valve operating rod and valve plunger move to the front in the diaphragm and plate assembly to compress the valve return spring and bring the poppet valve into contact with the vacuum seat in the valve housing to CLOSE the vacuum port. Any additional movement of the valve operating rod in the applied direction moves the valve plunger away from the poppet valve to OPEN the atmospheric port and admit atmosphere through the air filter, poppet and passages to the pressure chambers at the rear of both the front and rear diaphragms. With vacuum on the front and atmospheric pressure on the rear side of both diaphragms, a force is developed to move the vacuum power diaphragm and plate assembly, hydraulic push rod and hydraulic pistons to the front. This movement closes the compensating ports in the master cylinder and forces brake fluid under pressure through the outlet ports and brake tubes into the brake wheel cylinders. As hydraulic pressure is obtained, the front hydraulic piston "floats", providing equal line pressure to both systems. As this pressure increases in the brake systems, a counterforce (to the rear), acting through the hydraulic push rod and rubber reaction disc, sets up a reaction force against the hub of the diaphragm plate and the face of the valve plunger. The rubber disc distributes this pressure between the plate and plunger in proportion to their respective contact areas. The pressure acting against the valve plunger and operating rod tends to move the valve plunger slightly to the rear in relation to the hub of the diaphragm plate to close the atmospheric port on the valve poppet. Since part of the counterforce (to the rear) reacts through the valve plunger and operating rod against the driver's foot, a "feel" of braking effort is provided, which is always in direct proportion to the hydraulic pressure developed within the brake systems. Full power application has been attained with full atmospheric pressure admitted to the pressure chambers (to the rear) of both diaphragms and with constant vacuum to the front. Any increase in hydraulic pressure to the wheel brakes beyond this point must be supplied by physical effort of the driver.

Holding Position (Fig. 5-65)

During applications of the brakes, the "reaction" against the valve plunger works against the driver to close the atmospheric port. When both the atmospheric and vacuum ports are closed, the brake unit is in the holding position. In this position, the degree of braking application will be held until either the atmospheric port is reopened by an increase in pedal pressure to increase the brake application further or by a decrease in pedal pressure to reopen the vacuum port and

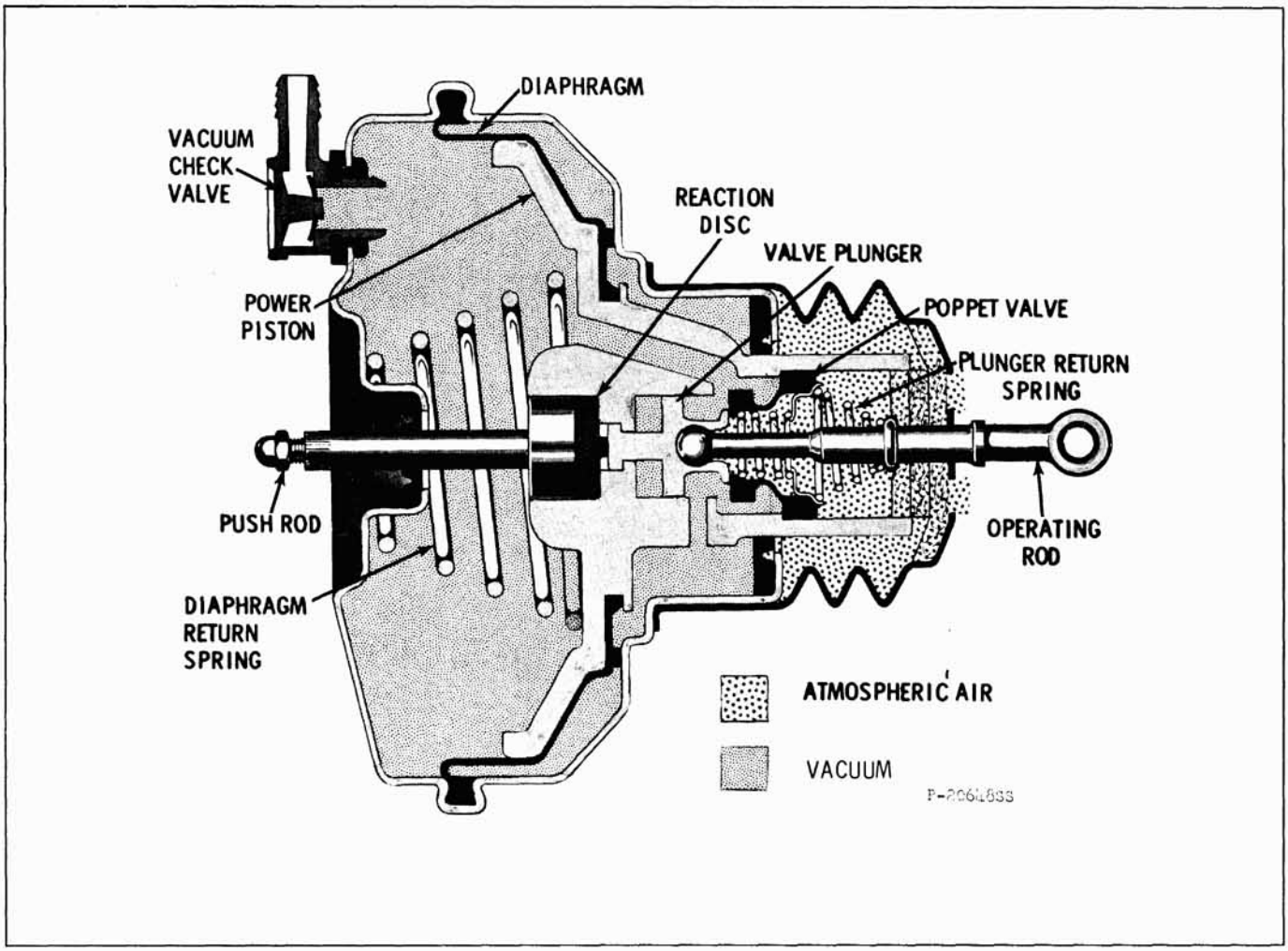


Fig. 5-63—Released Position

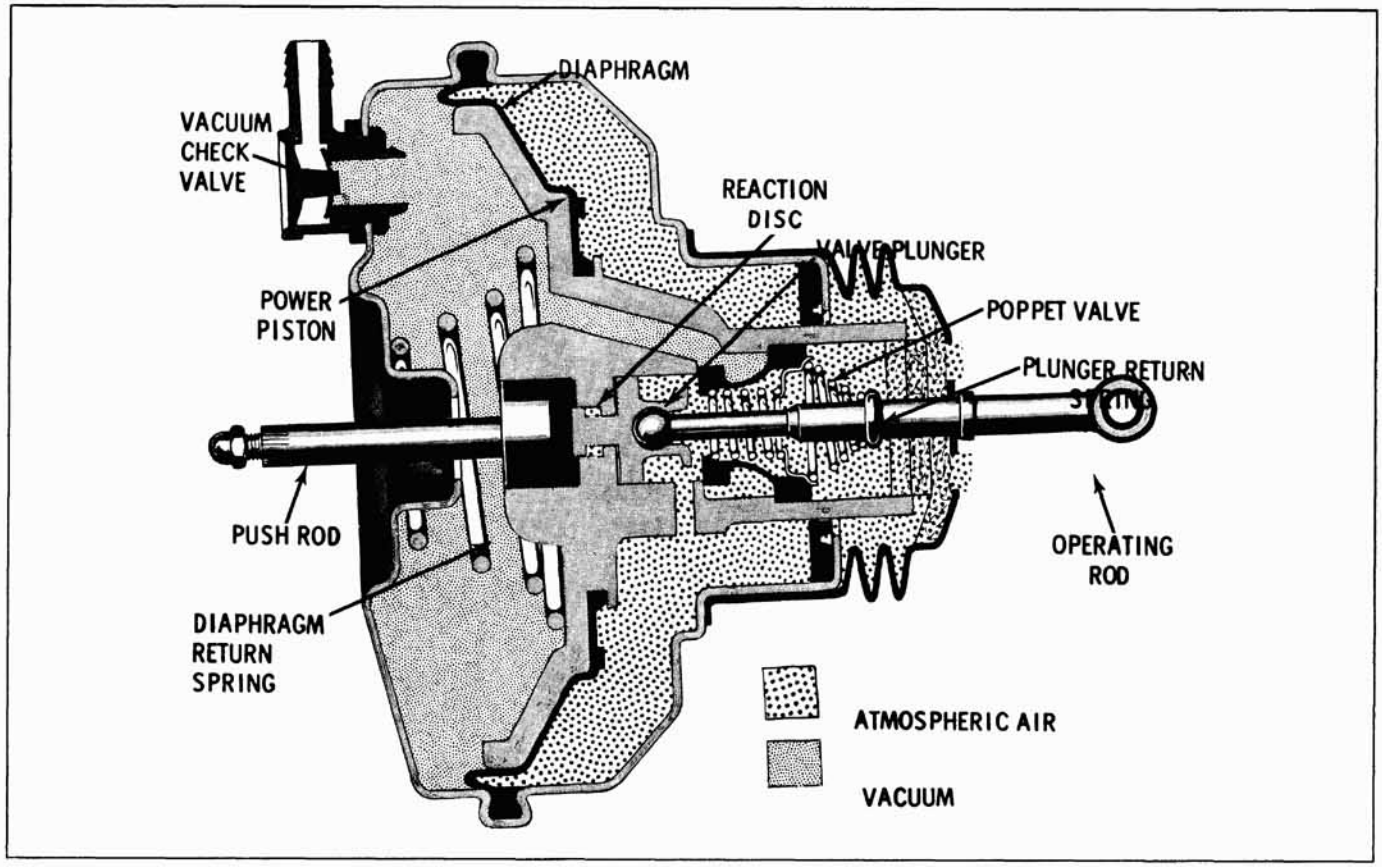


Fig. 5-64—Applied Position

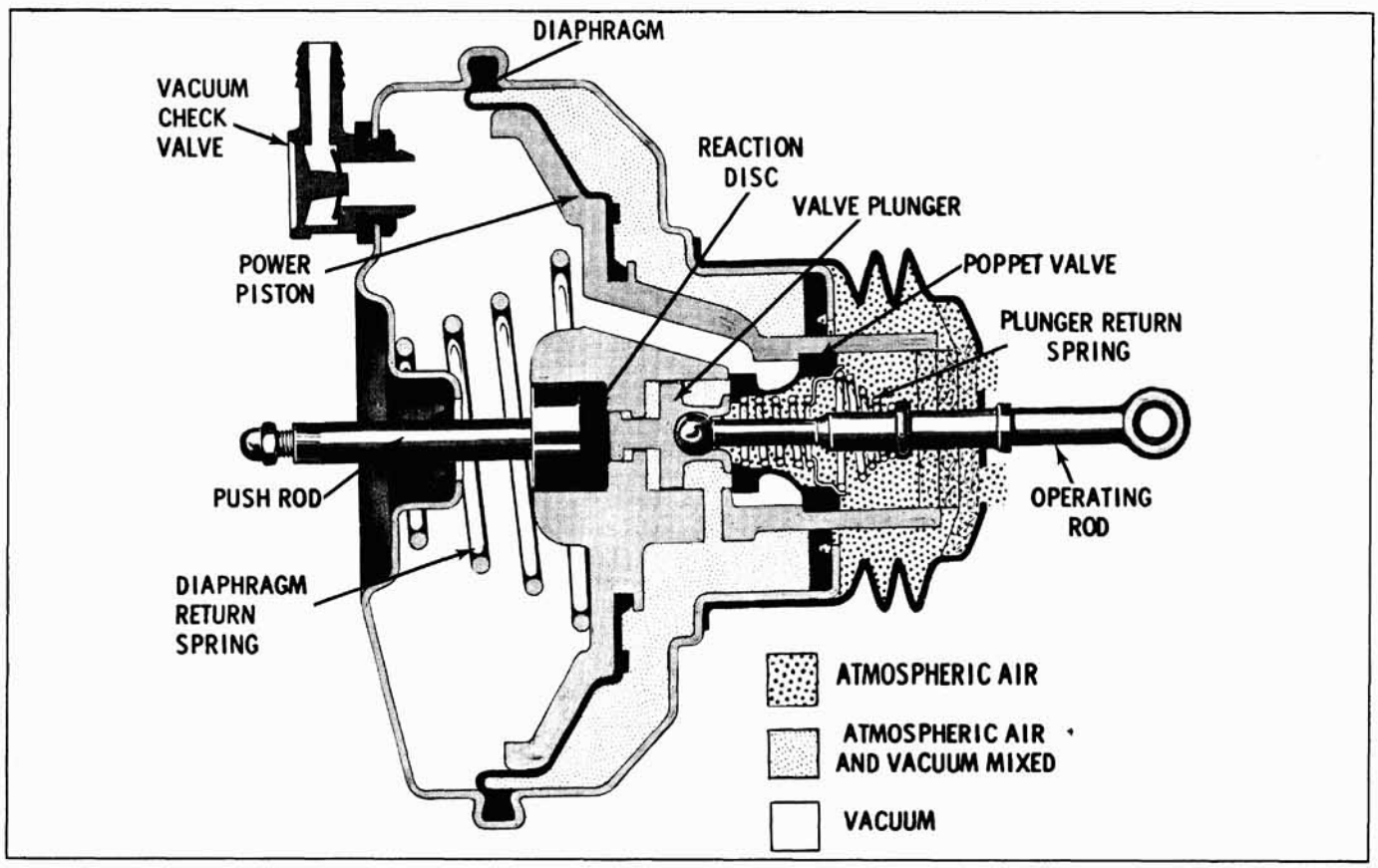


Fig. 5-65—Holding Position

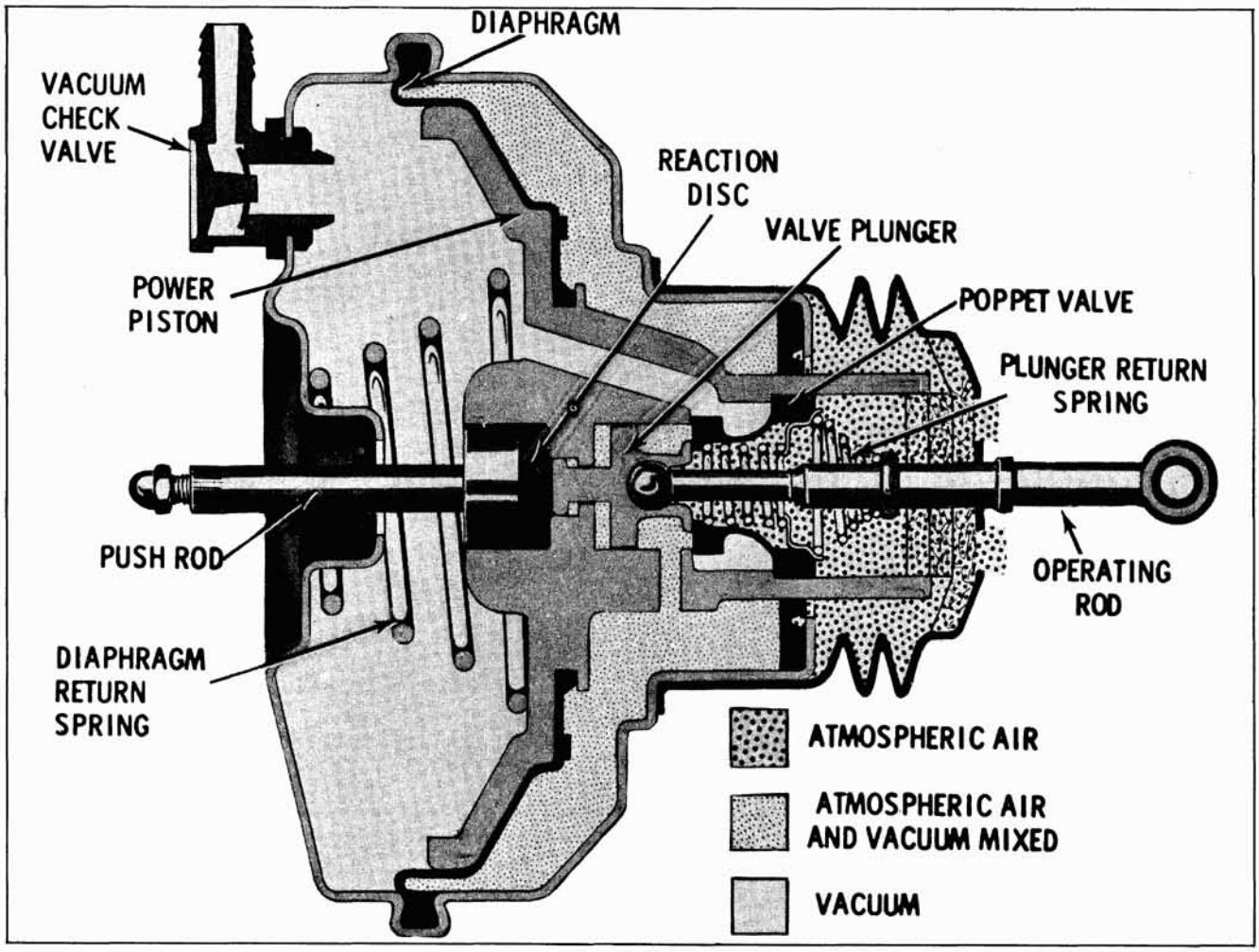


Fig. 5-66—Bendix Power Brake (Single Diaphragm)

decrease the brake application.

Whenever the pressure applied to the brake pedal is held constant, the valve returns to its holding position. However, when the fully applied position is reached, the valve plunger is held away from the valve poppet (the atmospheric valve seat) to admit maximum atmospheric pressure to the chambers behind both diaphragms. With the chambers in front of the diaphragms, open to manifold vacuum, full power application is attained which is referred to as the "runout" point of the power unit.

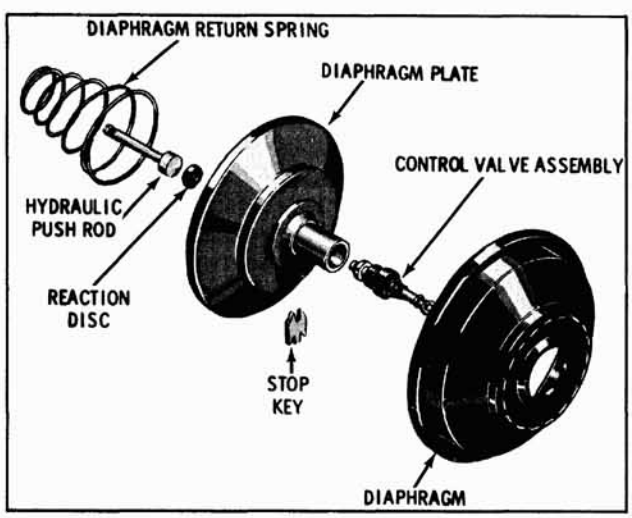


Fig. 5-67—Disassembly of Diaphragm and Plate Assembly

DISASSEMBLY OF BENDIX POWER BRAKE (Figs. 5-66 and 5-67)

(Single Diaphragm)

Keep mineral oil or grease from coming in contact with hydraulic parts.

1. Scribe across the outer edges of both shells and across the master cylinder. Drain and install master cylinder in vise with power brake unit up.

2. Remove air filter, if used, and vacuum seal and plate from push rod. Remove rubber boot from valve rod, felt and foam air cleaner-silencers from inside boot and plastic hub of power piston. Pull elbow or straight nipple vacuum check valve and grommet straight out of front shell.

3. To separate front and rear housing, install Tool J-9504 over studs on vacuum cylinder and secure with attaching nuts. Put a few drops of brake fluid on the locking surface of vacuum cylinder. Hold down on Tool J-9504 to overcome return spring pressure. Turn Tool J-9504 clockwise with a steady pull until cut-outs align with lock on front and rear housing. Housing will begin to separate as pressure on Tool J-9504 is released.

If shells do not separate, check cut-out and lock alignment and then tap shell flange lightly with soft hammer to break

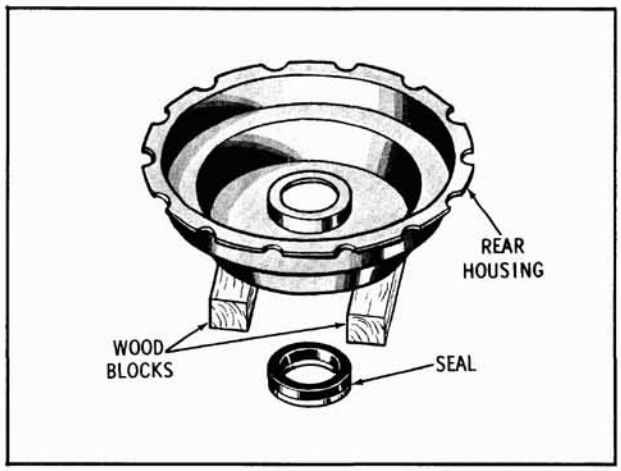


Fig. 5-68—Removal of Bearing Seal from Rear Housing

bond between diaphragm and shells.

Press down firmly on Tool J-9504 while separating front and rear housing to prevent internal spring force from causing housing to fly apart.

Remove rear housing, Tool J-9504 and return spring. Lift power piston and diaphragm assembly from rear shell and remove rear shell from Tool J-9504. Remove master cylinder from front housing.

4. Remove diaphragm from power piston. Press in on valve rod to permit removal of valve plunger retainer and then remove valve rod and plunger assembly. Do not attempt to disassemble valve rod and plunger assembly. Press reaction disc out of power piston hub from opposite end.

5. If necessary to replace rear vacuum seal and bearing, place shell on work bench, studs up, and drive seal out of shell.

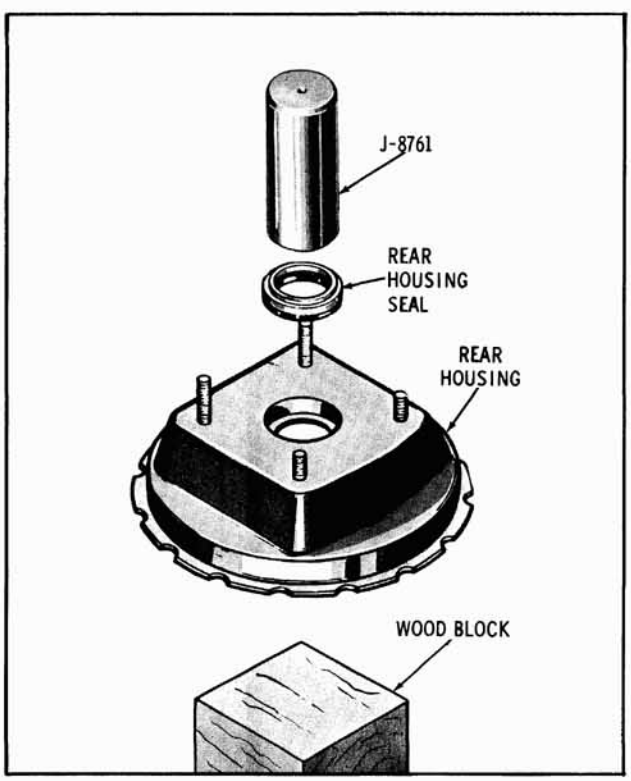


Fig. 5-69—Installing Rear Housing Seal

Do NOT remove seal unless a new seal is available. (Fig. 5-68)

CLEANING AND INSPECTION

After disassembly, all metal parts should be cleaned in metal parts cleaner, such as Bendix Metalclene or Speedclene. Plastic parts and rubber parts should be cleaned ONLY in alcohol. Care should be taken to prevent chipping or cracking plastic parts. Replace all rubber parts, except power diaphragm. After parts have been cleaned, wash them thoroughly with alcohol and use clean, dry compressed air to blow dirt and fluid out of recesses and internal passages.

Use all parts furnished in the Master-Vac repair kit.

Inspect all parts for damage or excessive wear. The power diaphragm must be free of kinks, cracks and tears. Replace any damaged, worn or chipped parts.

Assembly (Fig. 5-66)

1. If vacuum seal was removed from rear shell, press new seal into shell cavity using Tool J-8761. (Fig. 5-69)

2. Apply Bendix Type "O" lubricant or equivalent, to outer diameter of hub of power piston and to bearing surfaces of valve plunger and to outer edge of rubber valve poppet. Insert valve rod and plunger in hub of power piston. Press valve plunger and poppet into position and align slot in power piston with groove in valve plunger. Insert valve plunger retainer in slot and assemble diaphragm center bead in groove in power piston.

3. Install master cylinder and place in vise. Apply Silicon lubricant liberally to the outer flange of the rear housing and install Tool J-9504. Apply Bendix Type "O" lubricant or equivalent to the bearing seal in the rear shell and guide the valve rod and plastic hub of the power piston and diaphragm assembly through the rear bearing seal. Assemble diaphragm return spring on power piston with the front shell on the small coil of the spring. Align shells to scribe marks. Clamp shells together and compress spring until cut-outs and locks on outer flanges of shells mate. Then twist Tool J-9504 counterclockwise in relation to the front housing. Make sure the shells are fully locked. Remove Tool J-9504.

4. Remove master cylinder and apply Bendix Type "O" lubricant or equivalent sparingly to the shaft of the hydraulic push rod, keeping lubricant away from adjusting nut end. Use same lubricant to coat piston end of push rod and all surfaces of rubber reaction disc. Assemble flat side of disc against piston end of push rod. Guide disc and push rod into center bore of power piston. Press and twist push rod to seat push rod and disc firmly in power piston. Assemble push rod seal, plate side first, over end of push rod and press seal to bottom of shell cavity. If vacuum check valve and grommet were removed, wet new parts in alcohol and install in front shell. Beveled flange of grommet should be inside shell and shoulder of check valve should seat against outer flange of grommet. Assemble foam and felt air filter-silencers over valve rod and press them into or against end of plastic hub. Install new rubber boot on valve rod and seat boot against rear shell. Check push rod adjustment. Install master cylinder and torque nuts to 24 ft. lb.

PUSH ROD ADJUSTMENT PROCEDURE (Fig. 5-70)

The self-locking adjustment screw at the outer end of the hydraulic push rod is set to the correct dimension at the time of manufacture and no further adjustment should be needed. However, if the adjustment has been changed or a new push rod is installed, then adjustment may be required. Check push rod length by gauging from end of push rod to master cylinder mounting face of front shell. To adjust, turn nut in

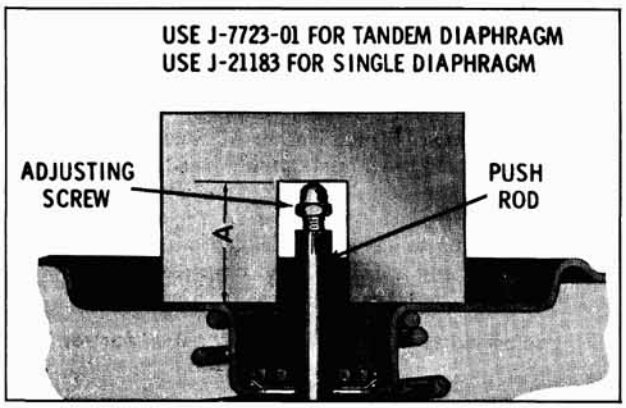


Fig. 5-70—Checking Push-Rod Adjustment

or out - but DO NOT scratch machined shaft of push rod. Use tool J-21183.

DISASSEMBLY OF BENDIX POWER BRAKE (Fig. 5-71)

(Tandem Diaphragm)

Keep mineral oil or grease from coming in contact with hydraulic parts.

1. Scribe across master cylinder flange and vacuum cylinder havles for correct assembly.
2. Remove cover from master cylinder and drain.
3. Remove vacuum check valve and grommet if required.
4. Remove dust boot and silencer from operating valve rod.
5. Remove dust guard retainer, dust guard and silencers from rear plate hub with an awl. Then reinstall steel retainer on hub.
6. Squirt alcohol down operating valve rod to lubricate rubber grommet in the valve plunger.
7. Install end of air valve rod in vise leaving just enough clearance to position two open end wrenches between vise and retainer on hub of rear plate.
8. Using the wrench nearest the vise as a pry, force the valve plunger grommet off from the ball end of the rod. Do not damage plastic hub or allow vacuum cylinder to fall to the floor. (Fig. 5-72)
9. Mount master cylinder in vise with vacuum cylinder up.
10. Remove retainer, valve return spring, poppet retainer and poppet from hub of rear plate.
11. Install Spanner Wrench Tool J-9504 on vacuum cylinder studs and secure with mounting nuts.

A few drops of brake fluid on the locking surfaces of

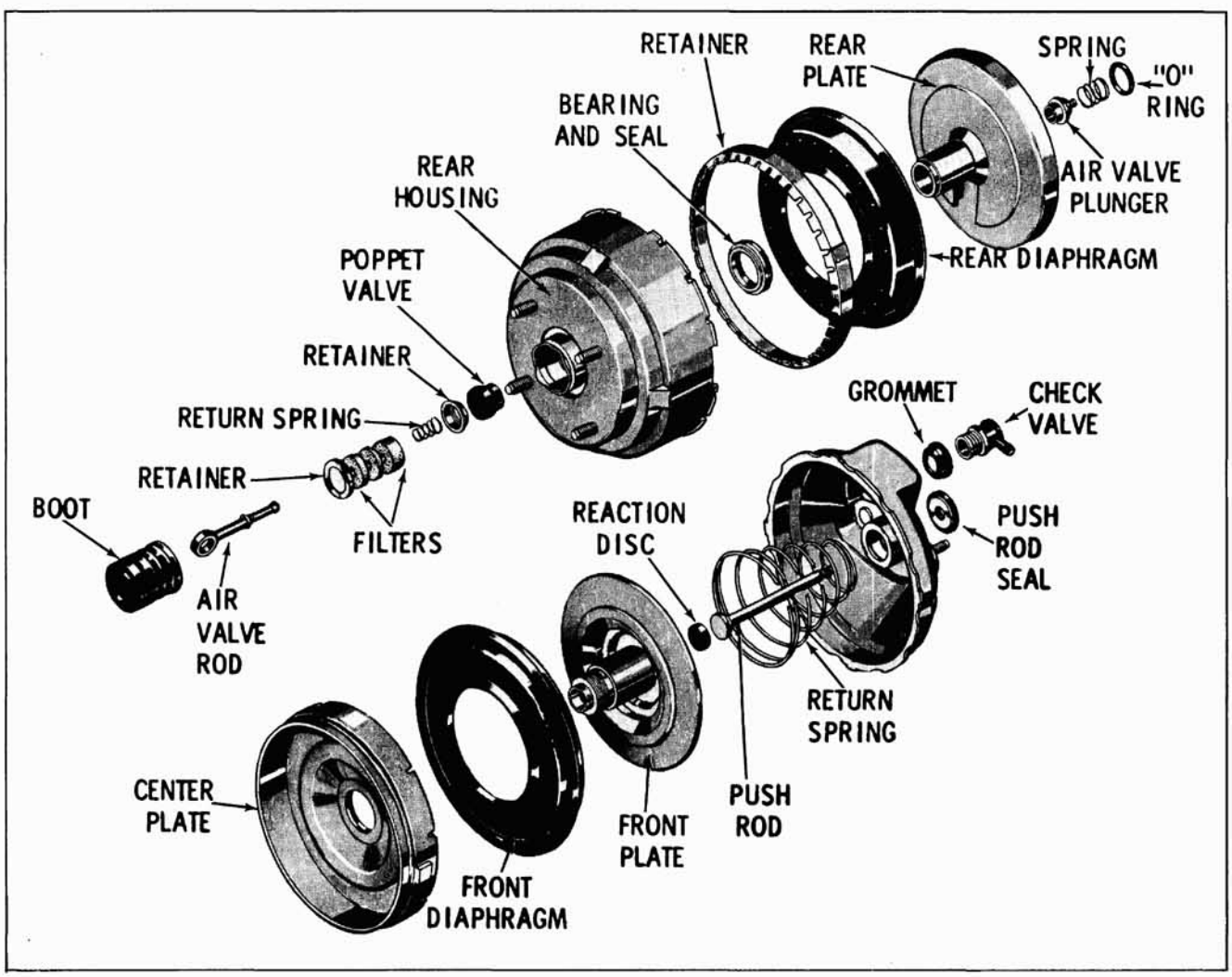


Fig. 5-71—Bendix Power Brake (Tandem Diaphragm)

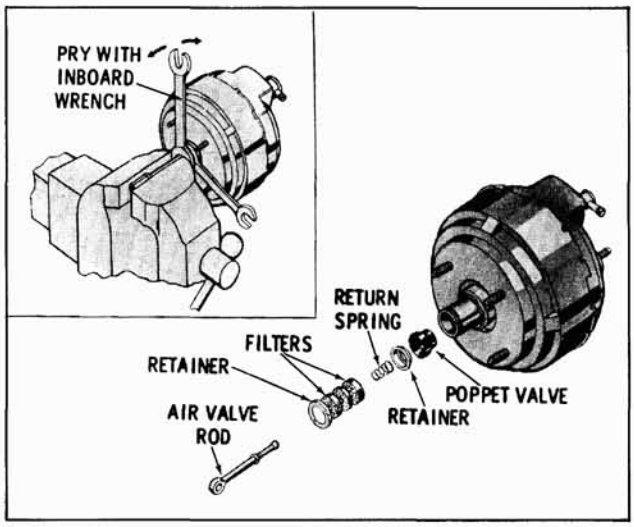


Fig. 5-72—Removing Valve Rod

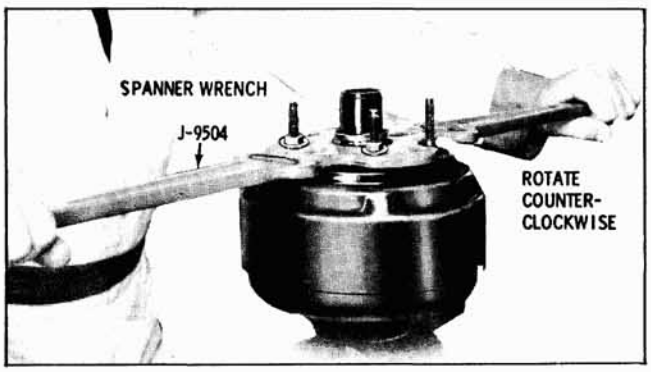


Fig. 5-73—Separating Vacuum Cylinder

the vacuum cylinder will aid in separation of vacuum cylinder.

12. Rotate Spanner Wrench counterclockwise to the release position. Maintain a steady pressure to permit seal to creep.

The tandem diaphragm unit is rotated in the opposite direction from previous units, to separate halves.

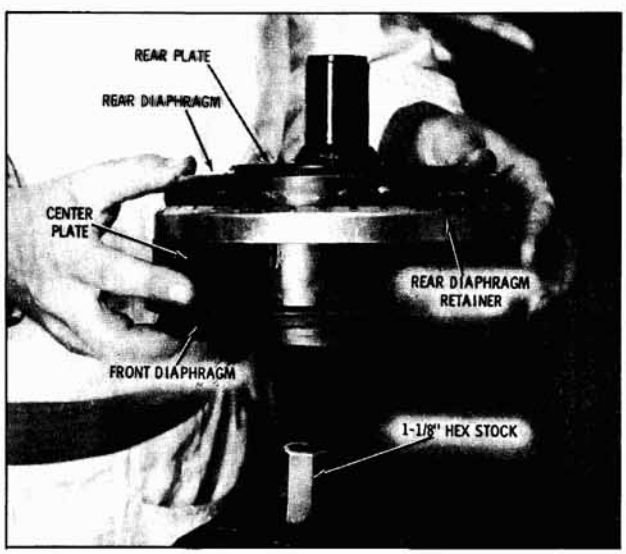


Fig. 5-74—Diaphragm and Plate Assembly

Fig. 5-75—Removing Rear Seal

13. Carefully separate front and rear housing and remove return spring.

14. Remove master cylinder from vacuum cylinder if necessary.

15. Remove Spanner Wrench from rear housing and work edges of front diaphragm from under lances of rear housing and remove the complete vacuum assembly from the rear housing using care not to damage the rear housing seal (Fig. 5-74)

Bosses on center plate must be aligned with cutouts in rear housing to remove the assembly.

16. If rear housing seal requires replacement, use a blunt punch or 1-1/4" socket to drive seal from housing from the rear. (Fig. 5-75)

17. Remove front housing from vise.

18. Install a length of hex stock 1-1/16" dia. in vise.

Tool J-2619-4, Slide Hammer Adapter may be used.

19. Install hex cavity of vacuum assembly on hex stock, remove rear diaphragm retainer using needle nose pliers and remove diaphragm.

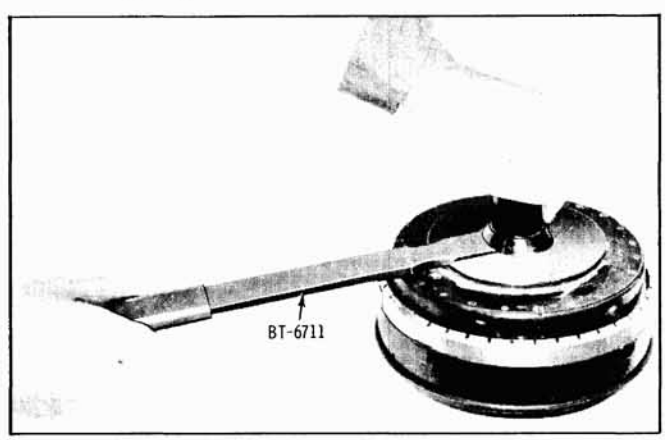


Fig. 5-76—Separating Front and Rear Plate

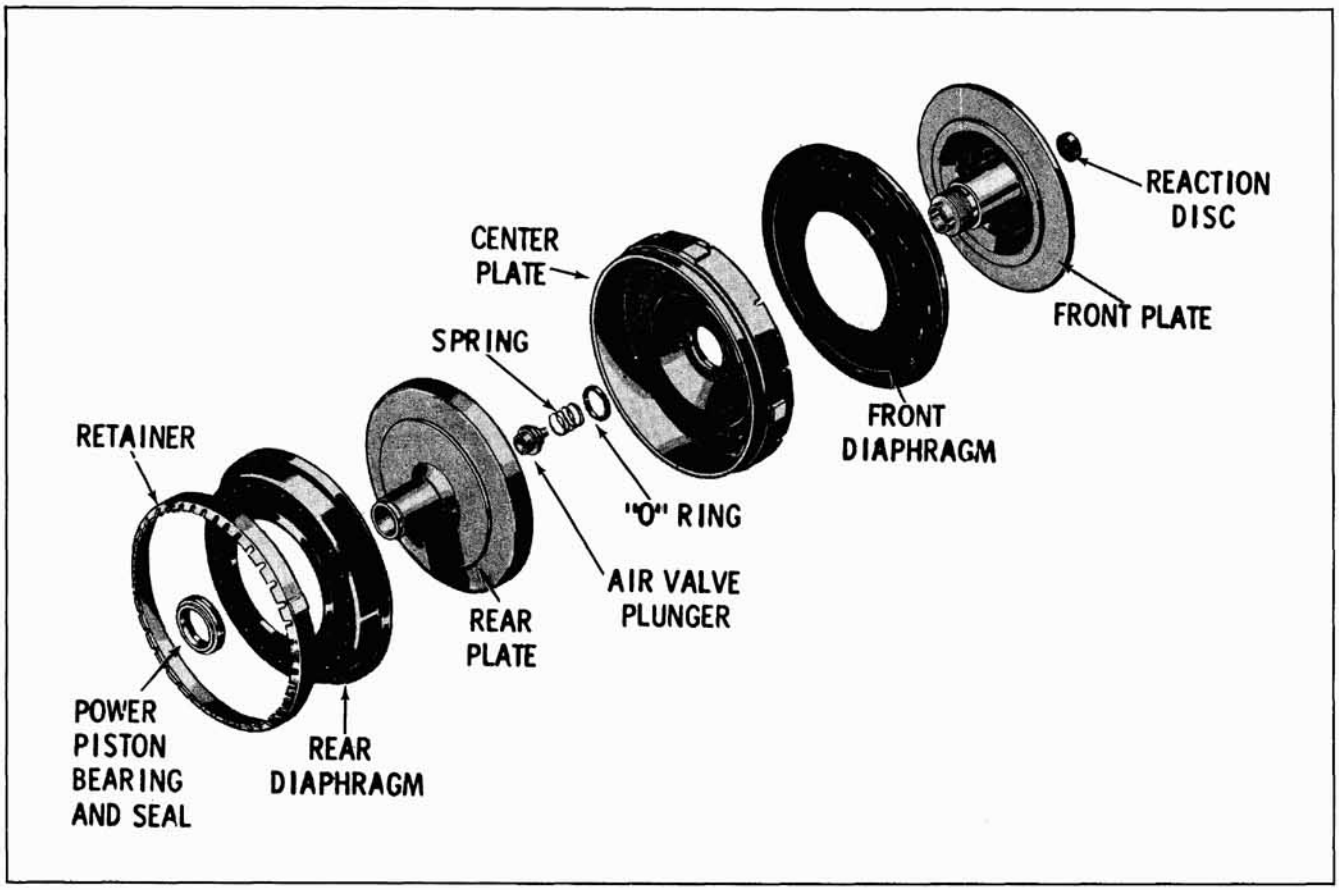


Fig. 5-77—Diaphragm and Plates

20. Using Tool BT-6711, twist rear plate counterclockwise to separate from front plate. (Fig. 5-76)

21. Lift front plate hub off and remove valve plunger, spring and square cut "O" ring seal from front plate hub. (Fig. 5-77)

Seal may be on shoulder of front plate or in recess of rear plate hub.

22. Lift center plate off from plate hub. Use care to prevent damage to center plate seal.

23. Remove diaphragm from front plate; mark diaphragm with colored pencil for correct installation.

24. Remove front plate from hex stock and use small rod to push reaction disc from bore of front plate.

Cleaning and Inspection

After disassembly, immerse all metal parts in metal cleaner. Plastic parts, such as the center plate and valve housing, as well as the rubber power diaphragms, should be cleaned only in alcohol. Care should be taken to avoid chipping or damaging plastic parts in handling. After parts have been thoroughly cleaned, those parts which come in contact with hydraulic brake fluid (that is, all master cylinder parts and the power section push rod) should be thoroughly washed in clean alcohol before assembly. Use air hose to blow out dirt and cleaning solvent from recesses and internal passages. DISCARD ALL OLD RUBBER PARTS EXCEPT THE POWER DIAPHRAGMS, AND CENTER PLATE SEAL.

Inspect all other parts for damage or excessive wear. Replace any damaged, worn or chipped parts. If front plate hub is scored or pitted, replace. If center plate seal is defective, or if center plate is damaged, replace center plate and seal assembly.

ASSEMBLY OF VACUUM CYLINDER

1. Install reaction disc in hub of front plate with small tip toward hole. Use rounded rod to seat disc.

2. Mount front plate on hex stock in vise.

3. Install front diaphragm on front plate. Long fold of diaphragm must be facing down.

4. Install Tool J-22733 over threads on front plate hub. (Fig. 5-78)

5. Apply a light film of special seal lubricant to front plate

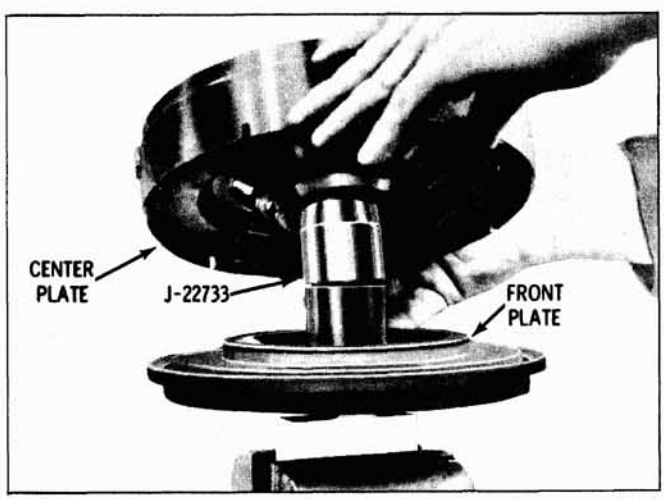


Fig. 5-78—Seal Protector Tool J-22733

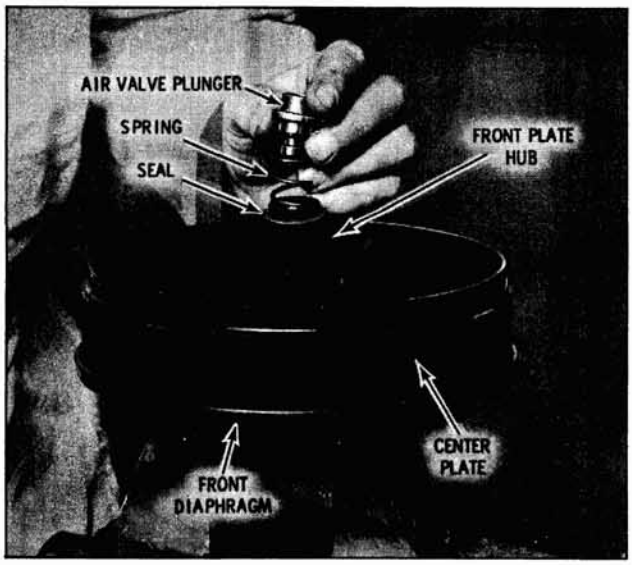


Fig. 5-79—Installing Air Valve Plunger

hub and to seal in center plate, then guide center plate, seal first, onto the front plate hub being careful not to damage center plate seal.

6. Apply special seal lubricant lightly to front and rear bearing surfaces of air valve plunger being careful not to apply lubricant to rubber grommet inside plunger. Install vacuum seal "O" ring on shoulder of front plate hub and valve plunger return spring and plunger in base of front plate hub. (Fig. 5-79)

7. Set rear plate over hub of front plate and using hands only, screw plate on hub, making sure that valve and spring are properly aligned. Hand torque plates to 150 in. lbs. Check travel of valve plunger with index finger.

8. Assemble rear diaphragm to rear plate and place lip of diaphragm in groove in rear plate. Install diaphragm retainer over rear diaphragm and lip of center plate. Using fingers, press retainer until it seats on shoulder of center plate. (Fig. 5-80)

9. Install master cylinder to front housing if removed and install master cylinder in vise.

10. If rear seal was removed, install new seal in rear housing using Tool J-22677. Install with large diameter of seal facing out. Support rear housing studs on wooden block and drive seal in, small diameter first, until seal is approximately 5/16" below surface of housing. (Fig. 5-81)

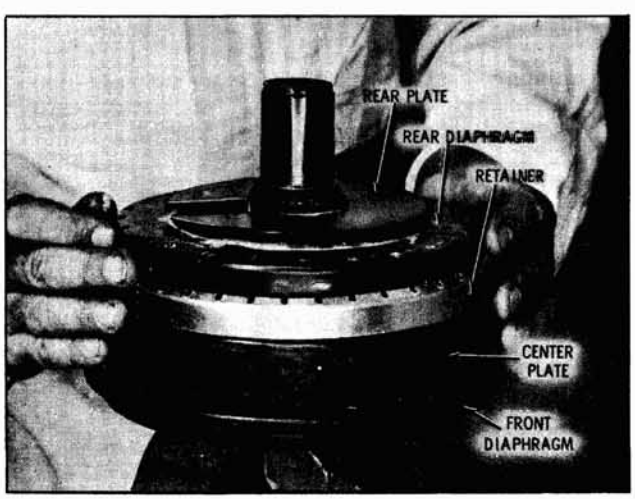


Fig. 5-80—Installing Rear Diaphragm Retainer

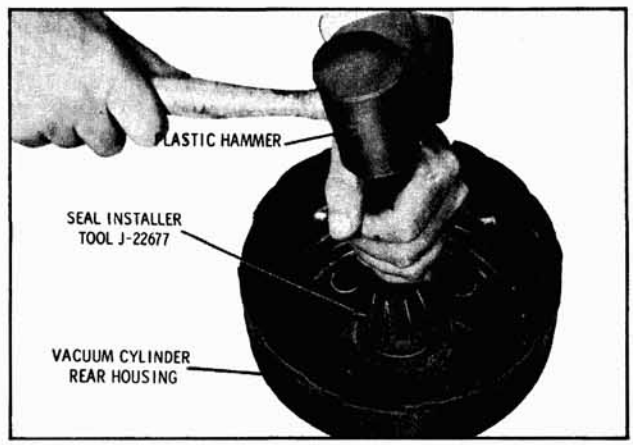


Fig. 5-81—Installing Rear Seal

11. Apply talcum powder to inside wall of rear housing and special seal lubricant to the scalloped cutouts of front housing and to seal in rear housing; assemble diaphragm and plate assembly into rear housing by carefully guiding rear plate hub through seal in rear housing. Bosses on center plate must be aligned between lances in rear housing for assembly. Work outer rim of front diaphragm into rear housing with screwdriver blade so that it is under lances in housing.

12. Bolt Tool J-9504 to rear housing; place diaphragm return spring on front housing and place rear housing over return spring so that scribe marks on housings will be aligned when the housings are locked together.

13. Press down on Spanner Wrench to compress return spring. Rotate Spanner Wrench clockwise until housings are locked together. Remove Spanner Wrench.

14. Wet poppet valve with alcohol and assemble in rear plate hub, small end first; wet poppet retainer with alcohol and assemble with shoulder inside poppet. Assemble retainer, filters, silencer over ridge on rod and return spring over ball end of operating valve rod. Wet grommet in valve plunger with alcohol and guide air valve rod into valve plunger. Tap end of operating valve rod with plastic hammer to lock ball in grommet. Press filters and silencers into hub and install retainer on hub.

15. Assemble silencer in dust boot, wet dust boot opening

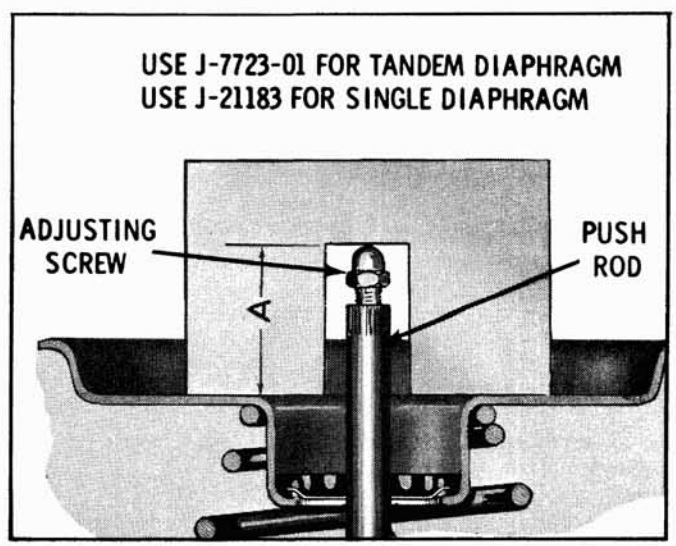


Fig. 5-82—Checking Push-Rod Adjustment

with alcohol and assemble over operating valve rod and over flange of rear housing.

16. Install check valve and grommet if removed.

17. Apply special seal lubricant to piston end of hydraulic push rod and insert in cavity in front plate. Twist rod to eliminate air bubbles at reaction disc. Assemble seal over push rod and press into recess in front housing.

18. Remove master cylinder and check push rod adjustment with Tool J-7723-01 that has not been modified. If adjustment is correct install master cylinder to vacuum cylinder.

PUSH ROD ADJUSTMENT (Fig. 5-82)

The self-locking screw is set to correct dimension at time of original assembly of power unit. Under normal service, no further adjustment should be needed provided push rod assembly remains in original unit. If however, push rod is transferred to another unit or new push rod is used, adjustment will be necessary. To adjust push rod, hold serrated end of push rod with pliers and turn adjusting screw in to shorten or out to lengthen push rod. Measure push rod height with push rod installed in unit, using Tool J-7723-01.

POWER BRAKE TESTING

Road test the brakes by making a brake application at about 20 mph to determine if the car stops evenly and quickly. If the pedal has a spongy feel, when applying the brakes, air is present in the hydraulic system. Bleed the system at each wheel cylinder.

With the engine stopped and the transmission in neutral, apply the brake several times to exhaust all vacuum in the system. While depressing the brake pedal, start the engine. If the vacuum system is operating, the pedal will tend to move away under foot pressure, and less pressure will be required to hold the pedal in the applied position. If no action is felt, the vacuum system is not functioning.

Stop the engine and again exhaust all vacuum in the system. Without starting the engine, depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away under foot pressure, the hydraulic system is leaking.

To check the vacuum check valve, start the engine and accelerate to 20 mph. Immediately close the throttle to build up the vacuum supply and turn off the ignition. Wait at least 10 seconds and apply the brakes. If not vacuum assisted, the vacuum check valve or vacuum cylinder is leaking.

SERVICE DIAGNOSIS CONDITIONS-POSSIBLE CAUSES

Excessive Pedal Travel (Low Pedal)

Master cylinder fluid level low.

Poor quality brake fluid (low boiling point in system).

Air in hydraulic system.

Hoses soft and weak (expanding under pressure).

Disc runout excessive.

Wheel bearings or steering parts loose or worn (causing shoe and lining knockback).

Shoe and lining knockback after violent cornering.

Brake shoes need adjusting.

Spongy Pedal (Springy Sensation to Pedal Upon Application)

Master cylinder fluid level low.

Poor quality brake fluid (low boiling point) in system.

Air in hydraulic system.

Hoses soft or weak (expanding under pressure).

Caliper seals soft or swollen.

Excessively worn or cracked brake drums.

Hard Pedal (Excessive Pedal Pressure Needed to Stop Vehicle)

Incorrect brake lining.

Power brake malfunctioning.

Linings glazed.

Linings soiled with brake fluid, oil or grease.

Lines, hoses or connections dented, kinked, collapsed or clogged.

Master cylinder cups swollen.

Master cylinder bore corroded or rough.

Caliper pistons frozen or seized.

Caliper cylinder bores corroded or rough.

Pedal push rod and linkage binding.

Vacuum cylinder inoperative.

Grabbing or Pulling (Severe Reaction to Pedal Pressure and Out of Line Stops)

Linings soiled with brake fluid, oil or grease.

Front end out of alignment.

Caliper loose.

Linings worn or glazed.

Poor linings to drum contact.

Lines, hoses or connections dented, kinked, collapsed or clogged.

Uneven tire pressure.

Master cylinder bore corroded or rough.

Wheel cylinders sticking.

Caliper pistons frozen or seized.

Caliper cylinder seals soft or swollen.

Caliper cylinder bores corroded or rough.

Pedal linkage binding (and suddenly releasing).

Metering valve not functioning properly.

Pedal Falling Away Under Steady Pressure

Poor quality brake fluid (low boiling point) in system.

Hydraulic connections loose; lines or hoses ruptured (causing leakage).

Master cylinder primary cup worn or damaged.

Master cylinder bore corroded, worn or scored.

Caliper cylinder seals worn or damaged.

Caliper cylinder bores corroded, worn or scored.

Bleed screw open.

Noise and Chatter (May be Accompanied by Brake Roughness and Pedal Pulsating)

Disc has excessive lateral runout.

Disc has excessive thickness variations (out of parallel).

Out-of-round brake drums.

Shoe and lining knockback after violent cornering.

Car creeping or moving slowly with brakes applied lightly may produce groan or crunching noise.

Dragging Brakes (Slow or Incomplete Release of Brakes)

Lines, hoses or connections dented, kinked, collapsed or clogged.

Brake pedal binding.

Incorrect brake adjustment.

Master cylinder compensating port restricted by swollen primary cup.

Master cylinder cup sticking.

Wheel cylinder sticking.

Caliper pistons frozen or seized.

Caliper cylinder seals swollen.

Caliper cylinder bores corroded or rough.

Hydraulic push rod on power brake out of adjustment or binding (causing primary cup to restrict master cylinder compensating port).

Vacuum cylinder sticking.

Weak or broken brake shoe return spring.

Wheel Locks

Distorted or improperly adjusted brake shoe.

Loose or torn brake lining.

Wheel cylinder cups sticking.

Brake Pedal Fails to Return

Pedal return spring weak or broken. (Standard Brake)

Vacuum cylinder inoperative. (Power Brake)

GENERAL SPECIFICATIONS

LINING AREA (Drum Brake)	
1. 31, 32, 35, 36, 42, and 44 Series	156.3 Sq. In.
2. 4800 Series	174.0 Sq. In.
3. 54, 64, and 66 Series	208.6 Sq. In.
4. 84 and 86 Series	229.2 Sq. In.
LINING AREA (Disc Brake)	
1. 31 thru 44 Series	114.2 Sq. In.
2. 4800 Series	131.6 Sq. In.
3. 54 thru 86 Series	128.8 Sq. In.
RATIO (Percentage of Braking Effect)	
1. 31, 32, 35, 36, 42 and 44 Series	
A. Front	68%
B. Rear	32%
2. 4800 Series	
A. Front	61%
B. Rear	39%
3. 54, 64, 66, 84 and 86 Series	
A. Front	56%
B. Rear	44%

GENERAL SPECIFICATIONS (Cont'd.)

DRUMS
1. 31-48 Series
   A. Inside Diameter ..... 9.50"
   B. Out-of-Round (Total Indicator Reading)
      1. Front ..... .005" Max.
      2. Rear ..... .006" Max.
2. 54, 64, 66, 84 and 86 Series
   A. Inside Diameter ..... 11.00"
   B. Out-of-Round (Total Indicator Reading)
      1. Front ..... .005" Max.
      2. Rear ..... .006" Max.

DISC
1. 31 thru 48 Series
   A. Disc Diameter ..... 11"
   B. Lateral Runout ..... .004"
   C. Parallelism ..... .0005"
   D. Disc Thickness
      1. Maximum ..... 1"
      . Minimum ..... .965"
2. 54 thru 86 Series
   A. Disc Diameter ..... 11-7/8"
   B. Lateral Runout ..... .004"
   C. Parallelism ..... .0005"
   D. Disc Thickness
      1. Maximum ..... 1-1/4"
      . Minimum ..... 1.215"

LININGS (Drum)
1. 31-48 Series
   A. Length - Primary ..... 7-1/2"
   B. Length - Secondary ..... 9-7/8"
   C. Width - Front ..... 2-1/2"
   D. Width - Rear
      1. 31, 32, 35, 36, 42 and 44 Series ..... 2"
      2. 4800 Series ..... 2-1/2"
   E. Thickness
      1. Primary ..... 3/16"
      2. Secondary ..... 1/4"
2. 54, 64, 66, 84 and 86 Series
   A. Length - Primary ..... 9-3/8"
   B. Length - Secondary ..... 12"
   C. Width - Front ..... 2-3/4"
   D. Width - Rear
      1. 54, 64 and 66 Series ..... 2"
      2. 84 and 86 Series ..... 2-1/2"
   E. Thickness
      1. Primary ..... 1/4"
      2. Secondary ..... 5/16"

LININGS (Disc)
1. 31 thru 48 Series
   A. Length ..... 6"
   B. Thickness ..... 1/2"
2. 54 thru 86 Series
   A. Length ..... 6"
   B. Thickness ..... 1/2"

PARKING BRAKE CABLE LENGTHS
1. 31-48 Series
   A. Front ..... 44"
   B. Center-Exc. 4800 ..... 104-1/2"
   C. Rear ..... 35"
2. 4800 Series
   A. Center ..... 113-1/4"

GENERAL SPECIFICATIONS (Cont'd)

3. 54 Series with Jetaway	
A. Front	44-3/8"
B. Center	132"
C. Rear	36"
4. 54-86 Series (Except Center 84 and 86 Series)	
A. Front	41-3/4"
B. Center	137"
C. Rear	36"
5. 84 and 86 Series	
A. Center	143"
FLUID TYPE	Delco Supreme No. 11
FLUID LEVEL (Power or Standard)	1/4" 1/8" Below Master Cylinder Opening
MASTER CYLINDER BORE	
A. All Series with Standard Brake	1"
B. All Series with Power Brake	1.0"
C. All Series with Disc Brakes	1-1/8"
WHEEL CYLINDER BORE (Drum Brake)	
1. 31, 32, 35, 36, 42 and 44 Series	
A. Front	1-1/8"
B. Rear	7/8"
2. 4800 Series	
A. Front	1-1/8"
B. Rear	1"
3. 54, 64, 66, 84 and 86 Series	
A. Front	1-1/8"
B. Rear	1"
WHEEL CYLINDER BORE (Disc Brake)	
1. 31, 32, 35, 36, 42 and 44 Series	
A. Front	2.06"
B. Rear	13/16"
2. 4800 Series	
A. Front	2.06"
B. Rear	15/16"
3. 54, 64, 66, 84 and 86 Series	
A. Front	2.06"
B. Rear	1"

ADJUSTMENTS

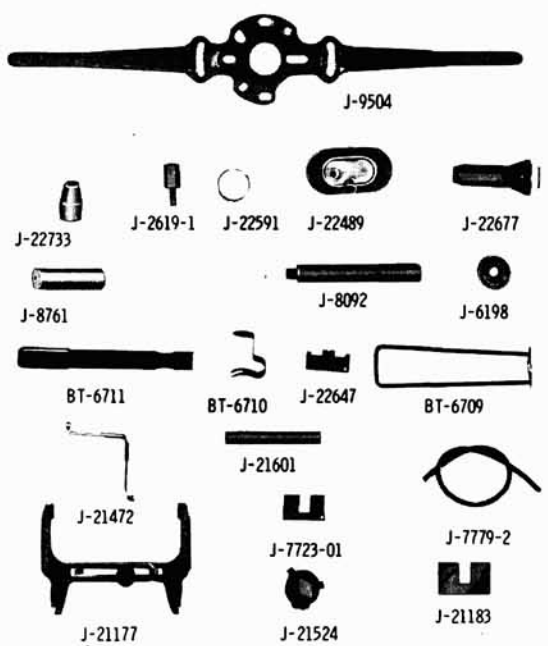
BRAKE SHOE (Standard and Power)	Self-Adjusting
MAXIMUM ALLOWABLE BRAKE PEDAL TRAVEL (BEFORE SHOE ADJUSTMENT)	
1. Standard	4.0"
2. Power	1-7/8"
PARKING BRAKE (Adjust with Parking Brake Released) Equalizer	Tighten equalizer adjusting nut until heavy drag is felt at rear wheels, then loosen nut seven turns.

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

	FT. LBS.
Anchor Pin to Steering Knuckle Bolt	
54, 64, 66, 84 and 86 Series	135
31, 32, 35, 36, 42, 44 and 48 Series	95
*Steering Arm to Steering Knuckle to Backing Plate Bolts and Nuts	
54, 64, 66, 84 and 86 Series	130
31, 33, 35, 36, 42, 44 and 48 Series	80
Backing Plate to Axle Housing Nuts	
54, 64, 66, 84 and 86 Series	45
31, 32, 35, 36, 42, 44 and 48 Series	35
Wheel Cylinder to Backing Plate Cap Screws	10
Splash Shield and Adapter Mounting-Bolt (Disc Brake)	130
*Splash Shield and Adapter Mounting-Nut (Disc Brake)	85
Caliper to Mounting Bracket-Bolt	70
Caliper Assembly-Bolt	130
Wheel Nuts	
54, 64, 66, 84 and 86 Series	75
31-48 Series	70
Parking Brake Lever to Cowl	
54 thru 86 Series	8
31 thru 48 Series	8
Parking Brake Lever to Instrument Panel Cap Screws	6
Pedal Mounting Bracket to Instrument Panel Cap Screws	6
Pedal Mounting Bracket and Master Cylinder Bolts to Cowl	24
*Pedal Pivot Bolt Nut	20
Master Cylinder to Front Housing	24
Rear Housing to Dash	24
Master Cylinder to Dash	24

* Hold the bolt and torque the nut.



J-2619-1	Hex Adapter
J-6198	Caliper Seal Installer
BT-6709	Piston Remover
BT-6710	Metering Valve Depressor
BT-6711	Piston Disengaging Tool
J-7723-01	Push Rod Adjusting Gauge
J-7779-2	Brake Bleeder Hose
J-8092	Driver Handle
J-8761	Seal Installer
J-9504	Spanner Wrench
J-21177	Drum and Shoe Gauge
J-21183	Push Rod Adjusting Gauge
J-21472	Bleeder Wrench
J-21524	Vacuum Piston and Support Remover and Installer
J-21601	Valve Retainer Installer
J-22489	Bleeder Adapter
J-22591	Piston Seal Installer
J-22647	Push Rod Adjusting Gauge
J-22677	Seal Installer
J-22733	Seal Protector

Fig. 5-83—Tools

ENGINE

ALL NEW 1968 OLDSMOBILES ARE CERTIFIED BY THE UNITED STATES DEPARTMENT OF HEALTH, EDUCATION AND WELFARE AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. FOR THIS REASON, THE FACTORY PROCEDURE FOR SETTING IGNITION TIMING, DWELL AND SLOW IDLE MUST BE FOLLOWED EXACTLY WHEN ADJUSTMENTS ARE MADE.

31 THROUGH 86 SERIES

FOR V-8 ENGINE REFER TO PAGE 6B-1
FOR TUNE-UP—L-6 AND V-8— REFER TO PAGE 6C-1
FOR ENGINE COOLING—L-6 AND V-8— REFER TO PAGE 6K-1
FOR CRANKCASE VENTILATION REFER TO PAGE 6H-1
FOR CARBURETION REFER TO PAGE 6M-1
FOR CONTROLLED COMBUSTION SYSTEM REFER TO PAGE 6N-1

CONTENTS OF SECTION 6A—L-6 ENGINE

Subject	Page
DESCRIPTION	6A-2
ENGINE ASSEMBLY	
REMOVAL	6A-2
INSTALLATION	6A-2
MANIFOLD ASSEMBLY	
REMOVAL	6A-2
INSTALLATION	6A-4
ROCKER ARM COVER	
REMOVAL	6A-4
INSTALLATION	6A-4
ROCKER ARM ASSEMBLY	
REMOVAL	6A-4
INSTALLATION AND ADJUSTMENT	6A-4
ROCKER ARM STUDS	
REMOVAL AND INSTALLATION	6A-5
VALVE LIFTERS	6A-5
LOCATING NOISY LIFTERS	6A-5
REMOVAL	6A-6
INSTALLATION	6A-6
DISASSEMBLY	6A-6
CLEANING AND INSPECTION	6A-7
ASSEMBLY	6A-7
VALVE STEM OIL SEAL AND/OR	
VALVE SPRING	6A-7
REPLACEMENT (ON CAR)	6A-7
CYLINDER HEAD ASSEMBLY	
REMOVAL	6A-8
INSTALLATION	6A-8
DISASSEMBLY	6A-8
CLEANING	6A-8
INSPECTION	6A-8
VALVE GUIDE BORES	6A-9
VALVE SEATS	6A-9
VALVES	6A-10
OIL PAN	
REMOVAL	6A-11
INSTALLATION	6A-11
OIL PUMP	
REMOVAL	6A-11
DISASSEMBLY	6A-12
CLEANING AND INSPECTION	6A-12
ASSEMBLY	6A-12
INSTALLATION	6A-12
REAR MAIN OIL SEAL	
REPLACEMENT	6A-12
TORSIONAL DAMPER	
REMOVAL	6A-13
INSTALLATION	6A-13
CRANKCASE FRONT COVER	
REMOVAL	6A-13
INSTALLATION	6A-13
OIL SEAL (FRONT COVER)	
REPLACEMENT	6A-14
CAMSHAFT	
MEASURING LOBE LIFT	6A-15
REMOVAL	6A-15
INSPECTION	6A-16
OIL NOZZLE REPLACEMENT	6A-16
CAMSHAFT GEAR REPLACEMENT	6A-16
INSTALLATION	6A-16
CAMSHAFT BEARING REPLACEMENT	6A-17
CRANKSHAFT GEAR REPLACEMENT	6A-17
MAIN BEARINGS	6A-17
CONNECTING ROD BEARINGS	6A-21
CONNECTING ROD AND PISTON	
REMOVAL	6A-21
DISASSEMBLY	6A-22
PISTON PINS	6A-22
PISTON RINGS	6A-23
CRANKSHAFT	
REMOVAL	6A-24
CLEANING AND INSPECTION	6A-24
INSTALLATION	6A-25
CYLINDER BLOCK	
CLEANING AND INSPECTION	6A-25
OIL FILTER BY-PASS VALVE	6A-25
DISTRIBUTOR BEARING	6A-25
REPAIRS	6A-26
CYLINDER CONDITIONING	6A-26
CYLINDER BORING	6A-26
PISTON SELECTION	6A-26
FLYWHEEL	
REMOVAL	6A-27
INSTALLATION	6A-27
ENGINE MOUNTS	6A-27
ENGINE TORQUES	6A-28
SPECIFICATIONS	6A-28
FUEL PUMP - Refer to V-8 Engine	
TOOLS	6A-30

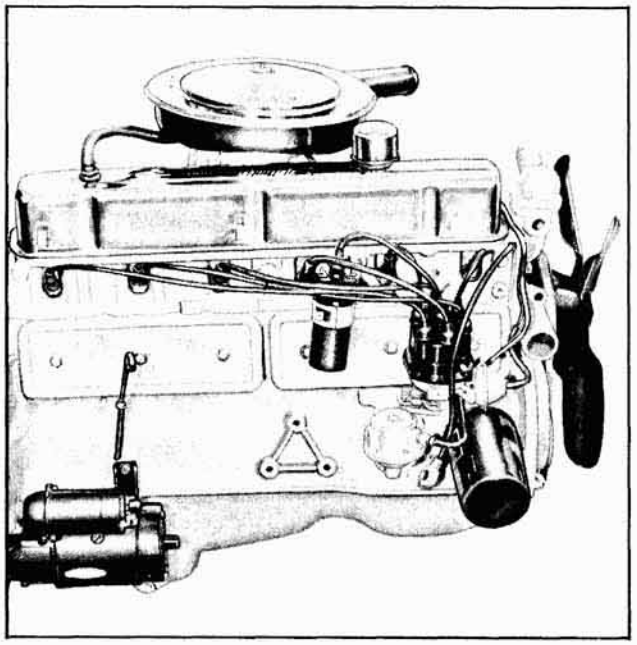


Fig. 6A-1—L-6 Engine

DESCRIPTION

The in-line L-6 250 cu. in. engine is standard in the 31 and 35 Series. (Fig. 6A-1)

The L-6 engine cylinders are numbered from front to rear with the firing order 1-5-3-6-2-4. Crankshaft rotation as viewed from the rear is counterclockwise.

The crankshaft has seven main bearings and the camshaft is supported by four bearings.

Full pressure lubrication, through a full flow oil filter is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump. The main oil gallery feeds oil, through drilled passages to the camshaft and crankshaft to lubricate the bearings. The main oil gallery also feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms. (Fig. 6A-2)

ENGINE ASSEMBLY

Removal

1. Drain cooling system.
2. Remove air cleaner and disconnect battery cables at battery.
3. Remove hood, marking hinge for reassembly.
4. Remove radiator shroud.
5. Remove fan blade and pulley.
6. Disconnect wires at:
   - Starter Solenoid
   - Delcotron
   - Temperature Switch
   - Oil Pressure Switch
   - Coil
7. Disconnect:
   - Accelerator linkage at manifold bellcrank.
   - Exhaust pipe at manifold flange.
   - Fuel line (from tank) at fuel pump.
   - Vacuum line to power brake unit at manifold (if so equipped).
   - Power steering pump lines at pump end (if so equipped).
   - Radiator hoses and heater hoses.
   - Air cleaner and hot air pipe.
8. Raise vehicle and place on jack stands.
9. Remove propeller shaft.

If plug for propeller shaft opening in transmission is not available, drain transmission.

10. Disconnect:
    - Shift linkage at transmission.
    - Speedometer cable at transmission.
11. On manual transmission equipped vehicles, disconnect clutch linkage at cross shaft, then remove cross shaft engine bracket.
12. Remove transmission assembly.
13. Remove front mount through bolts.
14. Attach BT-6606 and raise engine to take weight off front mounts, then remove rear mount bolts. (Fig. 6A-3)
15. Remove engine assembly from vehicle as a unit.
16. Mount engine in stand.

Installation

1. Attach BT-6606 to engine and remove engine from engine stand.
2. Tilt and lower engine assembly into the chassis, guiding engine to align front mounts with frame supports.
3. Install front mount through bolts and torque to specifications.
4. Raise engine enough to install rear crossmember, then install crossmember, install rear mount, lower engine and torque bolts to specifications.
5. Install transmission assembly.
6. Connect:
   - Speedometer cable.
   - Shift linkage at transmission.
7. Install propeller shaft.
8. Remove jack stands and lower vehicle.
9. Connect:
   - Power steering pump lines (if disconnected).
   - Vacuum line to power brake unit (if disconnected).
   - Fuel line at fuel pump.
   - Exhaust pipe at manifold flange.
   - Accelerator linkage at manifold bellcrank.
10. Connect wires at:
    - Coil
    - Oil pressure switch
    - Temperature switch
    - Delcotron
    - Starter solenoid
11. Install pulley, fan blade and fan belt.
12. Install radiator and shroud.
13. Install and adjust hood.
14. Connect battery cables.
15. Fill with coolant, engine oil and transmission oil, then start engine and check for leaks.
16. Perform necessary adjustments and install air cleaner and hot air pipe.

Refer to Model MV Carburetor Adjustment Charts, Pages 6M-12, 13 and 14.

MANIFOLD ASSEMBLY

Removal

1. Remove air cleaner, disconnect vacuum lines.
2. Disconnect throttle linkage at bellcrank and remove throttle return spring.
3. Disconnect fuel and vacuum lines at carburetor.
4. Disconnect crankcase ventilation hose at rocker arm cover.
5. Disconnect hot air pipe and exhaust pipe at manifold flange and discard packing.
6. Remove manifold attaching bolts and clamps, then remove manifold assembly and discard gaskets.

Refer to Section 6N for removal of exhaust manifold heat shroud.

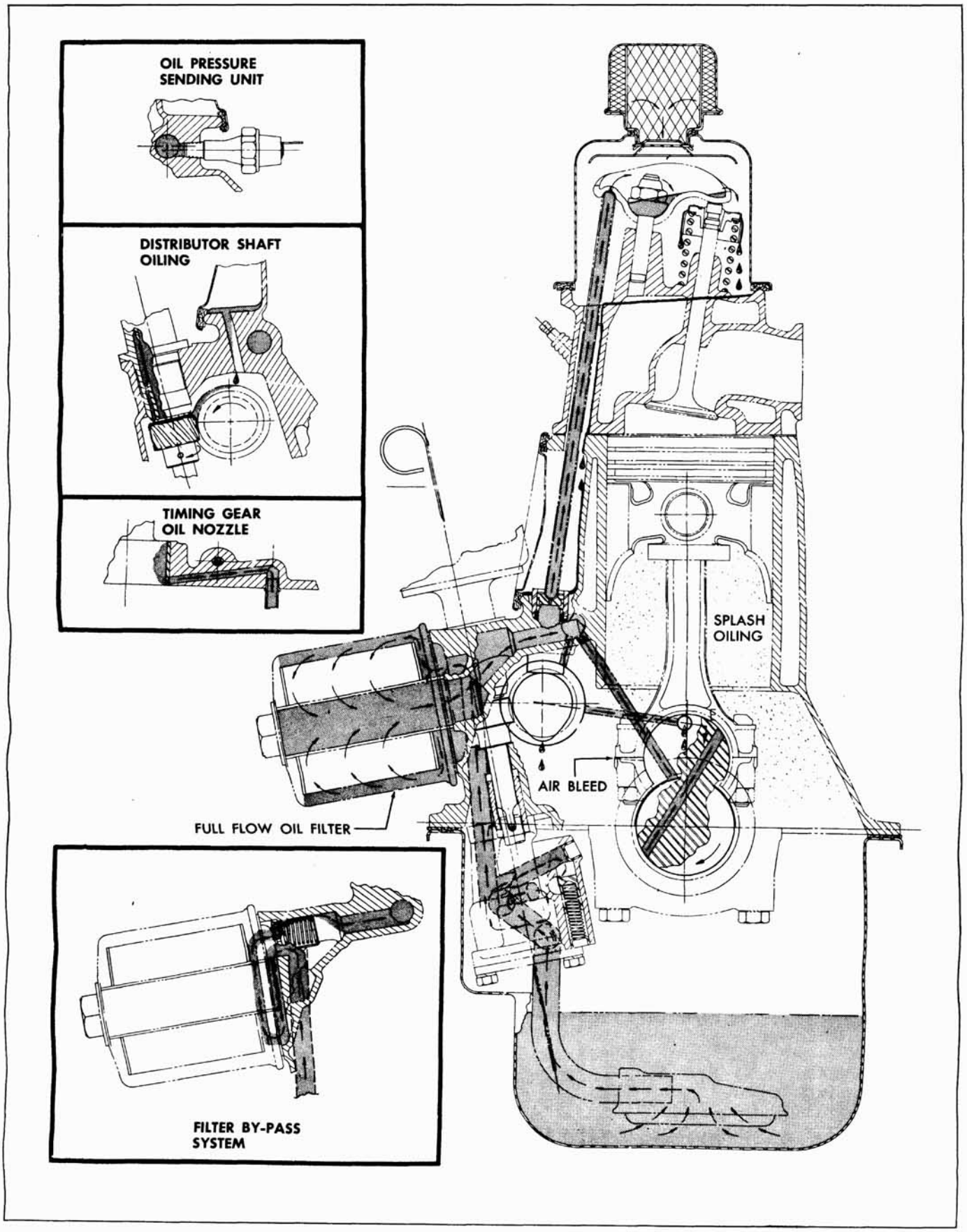


Fig. 6A-2—Engine Lubrication

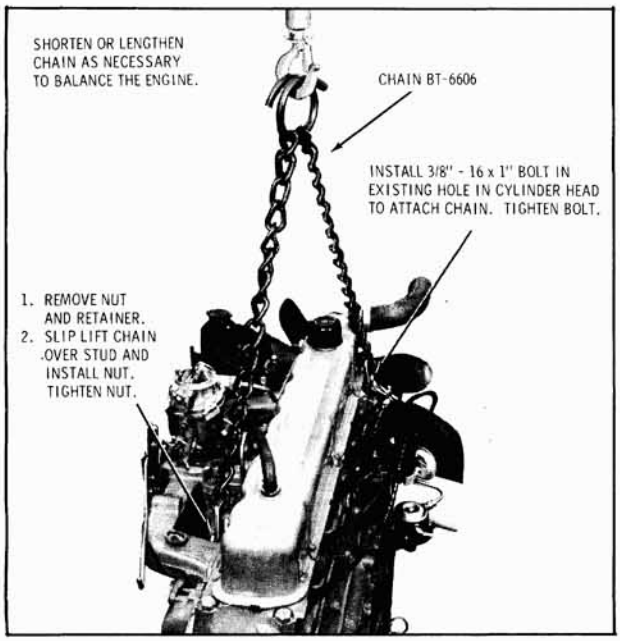


Fig. 6A-3—Lifting Engine

Fig. 6A-4—Valve Adjustment

7. Check for cracks in manifold castings.
8. Check operation of heat riser valve, if unable to free up, it will be necessary to replace the manifold.
9. If necessary to replace either intake or exhaust manifolds, separate them by removing one bolt and two nuts at center of assembly. Reassemble manifolds using a new gasket. Tighten finger tight and torque to specifications after assembly to cylinder head. Transfer all necessary parts.

Installation

1. Clean gasket surfaces on cylinder head and manifolds.
2. Position new gasket over manifold end studs on head and carefully install the manifold in position making sure the gaskets are in place.
3. Install bolts and clamps while holding manifold in place with hand.
4. Torque bolts to specifications.

Center bolt and end bolt torque differ.

5. Connect exhaust pipe to manifold using a new packing.
6. Connect crankcase ventilation hose at rocker arm cover.
7. Connect fuel and vacuum lines at carburetor.
8. Connect throttle linkage at bellcrank and install throttle return spring.
9. Install hot air pipe, connect vacuum lines, install air cleaner, start engine, check for leaks and adjust carburetor idle speed and mixture.

ROCKER ARM COVER

Removal

1. Disconnect crankcase ventilation hose(s) at rocker arm cover.
2. Remove air cleaner.
3. Disconnect temperature wire from rocker arm cover clips.
4. Remove rocker arm cover.

Do not pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber mallet.

Installation

1. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser, then using a new gasket, install rocker arm cover and torque bolts to specifications.
2. Connect temperature wire at rocker arm cover clips.
3. Install air cleaner.
4. Connect crankcase ventilation hoses.

ROCKER ARM ASSEMBLY

Removal

1. Remove rocker arm cover as outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same location.

Installation and Adjustment

Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with Molykote or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:

a. Mark distributor housing, with chalk, at each cylinder position (plug wire), then disconnect plug wires at spark plugs and coil and remove distributor cap and plug wire assembly (if not previously done).

b. Crank engine until distributor rotor points to number one cylinder position and breaker points are open. Both valves on number one cylinder may now be adjusted.

c. Back out adjusting nut until lash is felt at the push rod, then turn in adjusting nut until all lash is removed. This can be determined by checking push rod side play while turning adjusting nut. (Fig. 6A-4) When play has been removed, turn adjusting nut in one full additional turn (to center lifter plunger).

d. Adjust the remaining valves, one cylinder at a time,

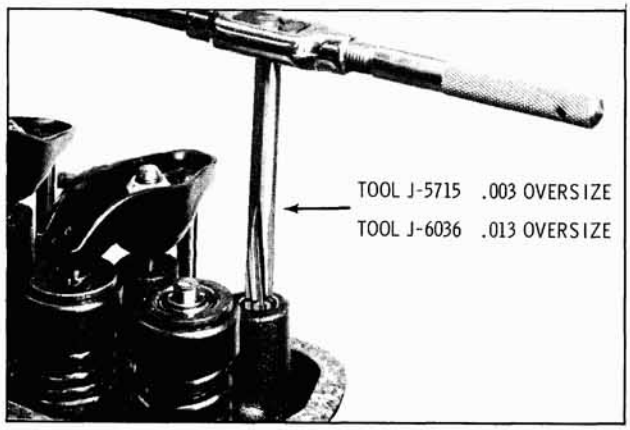


Fig. 6A-5—Reaming Rocker Arm Stud Hole

in the same manner.

4. Install distributor cap and spark plug wire assembly.
5. Install rocker arm cover as outlined.

ROCKER ARM STUDS

1. If rocker arm stud is loose or pulled out of head refer to Fig. 6A-5 and ream stud hole to next largest size.

Oversize studs have the size marked on the bottom. Example: A1 = .001" O.S., A3 = .003" O.S. and A13 = .013" O.S.

2. Install new O.S. stud as shown in Fig. 6A-6, tool should bottom on head.
3. If rocker arm stud is stripped refer to Fig. 6A-7 for rethreading and Fig. 6A-8 for pulling the stud.
4. Install new stud as shown in Fig. 6A-6; tool should bottom on head.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters require only that care and cleanliness be exercised in the handling of parts.

Locating Noisy Lifters

Locate a noisy valve lifter by using a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear. In this manner, the sound is localized making it easy to determine which lifter is at fault.

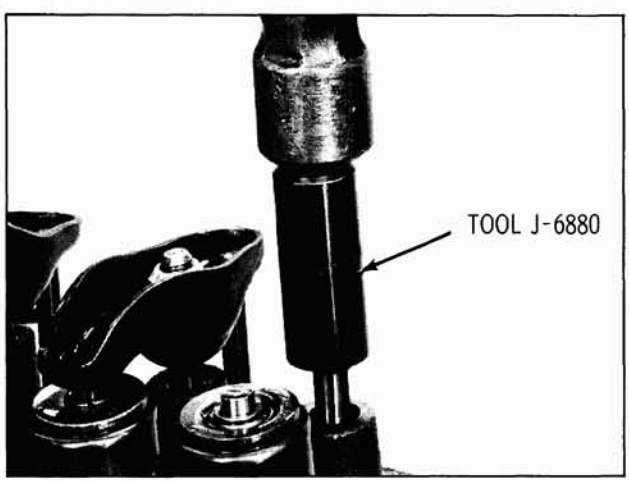


Fig. 6A-6—Installing Rocker Arm Stud

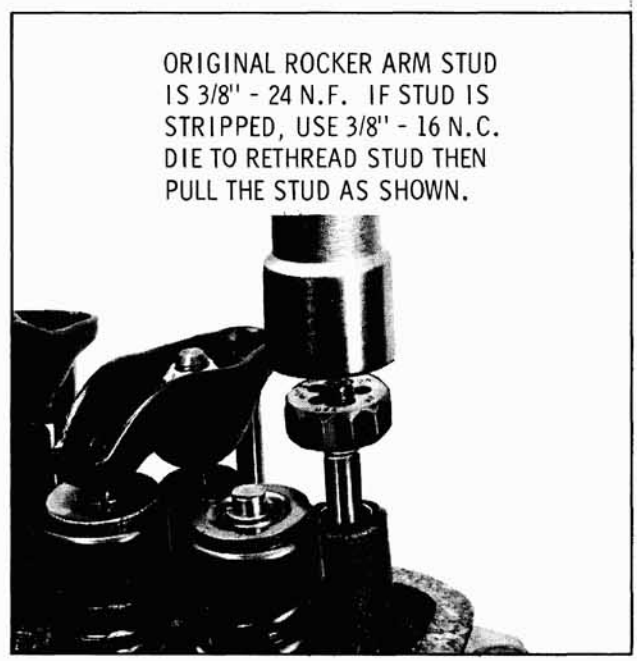


Fig. 6A-7—Removing Stripped Rocker Arm Stud

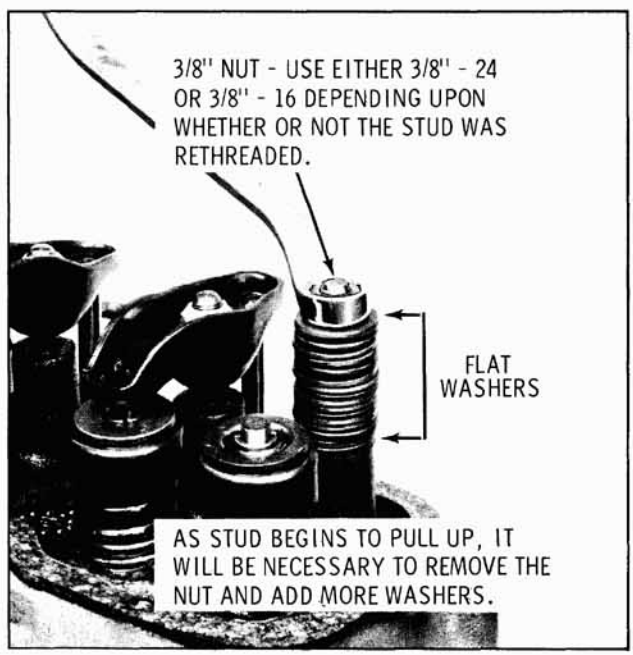
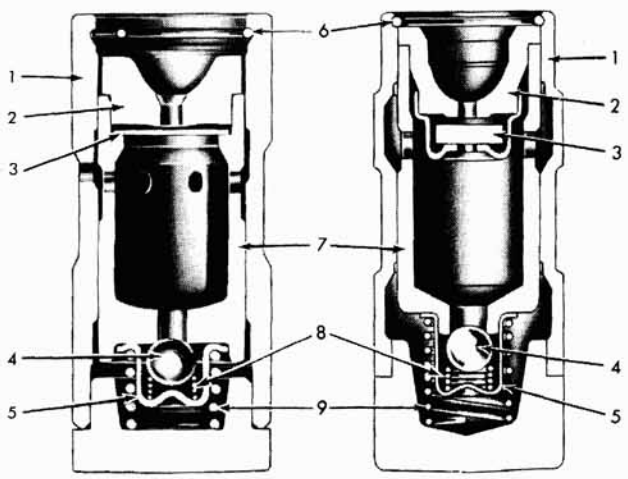


Fig. 6A-8—Removing Rocker Arm Stud

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. Hard Rapping Noise--Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit causing abnormal stickiness.
   b. Galling or "pickup" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.
2. Moderate Rapping Noise--Probable causes are:
   a. Excessively high leakdown rate.



1 Lifter Body
2 Push Rod Seat
3 Metering Valve (Lifter A)
Inertia Valve (Lifter B)
4 Check Ball
5 Check Ball Retainer
6 Push Rod Seat Retainer
7 Plunger
8 Check Ball Spring
9 Plunger Spring

Fig. 6A-9—Valve Lifter Assemblies

b. Leaky check valve seat.
c. Improper adjustment.

3. General Noise Throughout the Valve Train--This will, in almost all cases, be a definite indication of insufficient oil supply, or improper adjustment.

4. Intermittent Clicking -- Probable causes are:

a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.

b. In rare cases, the ball itself may be out-of-round or have a flat spot.

c. Improper adjustment.

In most cases where noise exists in more than one lifter all lifter units should be removed, disassembled, cleaned in a solvent, reassembled, and reinstalled in the engine. If dirt, varnish, carbon, etc., is shown to exist in one unit, it more than likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

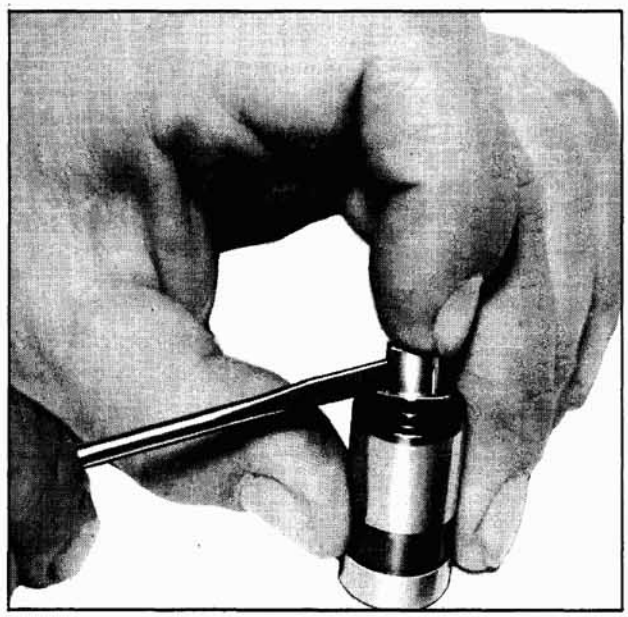


Fig. 6A-10—Removing Ball Check Valve

Removal

1. Remove valve mechanism as outlined.
2. Mark distributor housing, with chalk, at each cylinder position (plug wire), then disconnect plug wires at spark plugs and coil and remove distributor cap and plug wire assembly.
3. Crank engine until distributor rotor points to number one position, then disconnect distributor primary lead at coil and remove distributor.
4. Remove push rod covers (discard gaskets).
5. Remove valve lifters.

Place valve lifters in a rack so they may be reinstalled in the same location.

Installation

1. Install valve lifters.

Whenever new valve lifters are being installed, coat foot of valve lifters with Molykote or its equivalent.

2. Install push rod covers, using new gaskets, and torque bolts to specifications.
3. Install distributor, positioning rotor to number one cylinder position, then connect primary lead at coil.
4. Install and adjust valve mechanism as outlined.
5. Adjust ignition timing and carburetor idle speed and mixture.

VALVE LIFTERS (HYDRAULIC)

Two types of hydraulic lifters are used. Both types of lifters operate on the same principle and are serviced basically in the same manner. The complete lifter assemblies are interchangeable but parts from one lifter are not interchangeable with another. Both lifters are easily identified by the outside configuration of the lifter body. For purposes of identification we refer to them as lifter "A" and lifter "B". (Fig. 6A-9)

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve (lifter "A") or the push rod seat and inertia valve assembly (lifter "B"). (Fig. 6A-10)

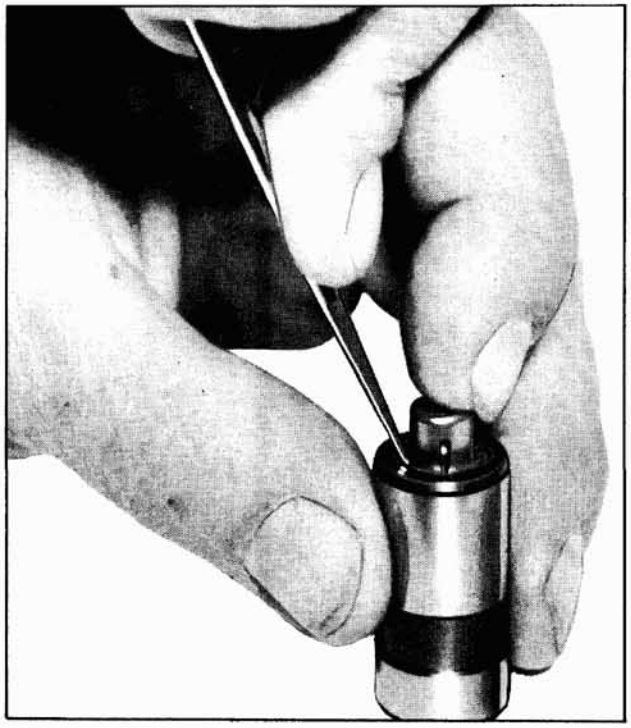


Fig. 6A-11—Installing Ball Check Valve

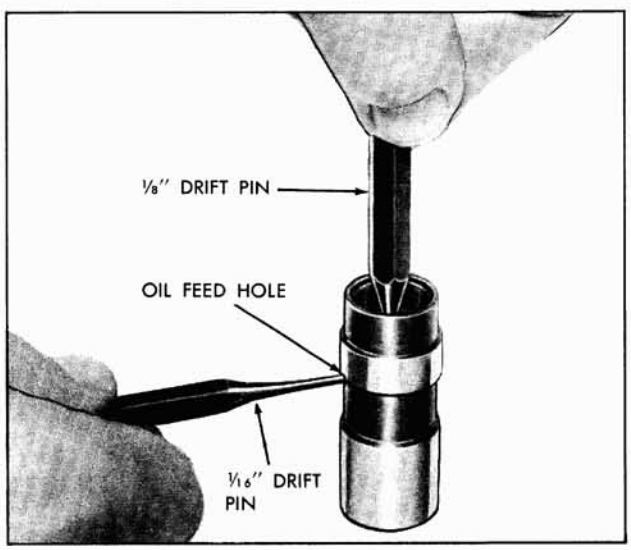


Fig. 6A-12—Assembling Hydraulic Lifters

3. Remove the plunger, ball check valve assembly and the plunger spring.

4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver. (Fig. 6A-10)

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore, if the bottom of the lifter is scuffed or worn inspect the camshaft lobe, if the push rod seat is scuffed or worn inspect the push rod.

Inertia valve and retainer (lifter "B") (Fig. 6A-9) should not be removed from the push rod seat. To check the valve, shake the push rod seat and inertia valve assembly and the valve should move.

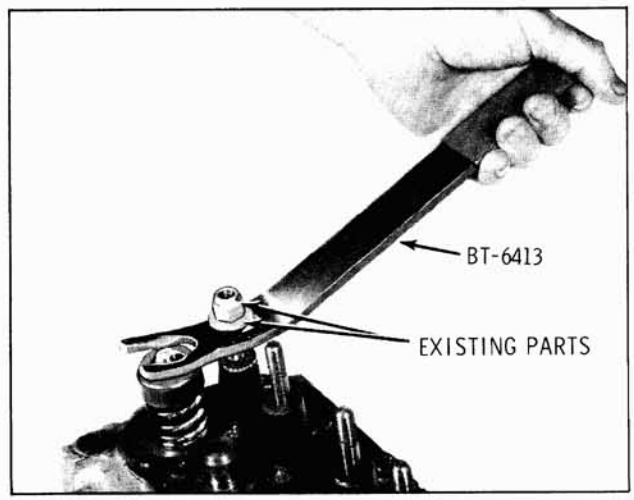


Fig. 6A-13—Removing Valve Spring

Assembly

1. Place the check ball on small hole in bottom of the plunger.

2. Insert check ball spring on seat in ball retainer and place retainer over ball so spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver. (Fig. 6A-11)

3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.

4. Fill the assembly with SAE 10 oil, then insert the end of a push rod into the plunger and press down solid. At this point oil holes in the lifter body and plunger assembly will be aligned. (Fig. 6A-12)

Do not attempt to force or pump the plunger.

5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension. (Fig. 6A-12)

On lifter "B" (Fig. 6A-9) the drifter pin must not extend inside the plunger.

6. Remove the push rod, refill assembly with SAE 10 oil.

7. Install the metering valve and push rod seat (lifter "A") or the push rod seat and inertia valve assembly (lifter "B"). (Fig. 6A-9)

8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation.

Before installing any new lifters, coat the bottom of the lifter with Molykote or its equivalent.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Replacement (On Car)

1. Remove rocker arm cover as outlined.

2. Remove spark plug, rocker arm and push rod from the cylinder(s) to be serviced.

3. Apply compressed air to the spark plug hole to hold the valves in place.

A tool to apply air to the cylinders to hold the valve is available, BT-72-1-B. Using the tool the valves can be removed with the cylinder head installed.

4. Using Tool BT-6413 to compress the valve spring, remove the valve locks, valve cap, valve shield and valve spring and damper. (Fig. 6A-13)

5. Remove the valve stem oil seal.

6. To replace, set the valve spring and damper, valve shield and valve cap in place. The close coiled end of the spring is installed against the cylinder head. Compress the spring with Tool BT-6413 and install oil seal in the lower groove of the stem, making sure the seal is flat and not twisted.

A light coat of oil on the seal will help prevent twisting.

7. Install the valve locks and release the compressor tool, making sure the locks seat properly in the upper groove of the valve stem.

Grease may be used to hold the locks in place while releasing the compressor tool.

8. Install spark plug, using a new gasket, and torque to specifications.

9. Install and adjust valve mechanism as outlined.

CYLINDER HEAD ASSEMBLY

Removal

1. Remove manifold assembly as outlined.
2. Remove valve mechanism as outlined.
3. Drain cooling system (block).
4. Remove fuel and vacuum line from retaining clip at water outlet, then disconnect wires from temperature sending units.
5. Disconnect upper radiator hose at water outlet housing and battery ground strap at cylinder head.
6. Remove coil.
7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Installation

The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolts must be cleaned. (Dirt will affect bolt torque.) Do not use gasket sealer on composition steel asbestos gasket.

1. Place the gasket in position over the dowel pins with the bead up.
2. Carefully guide cylinder head into place over dowel pins and gasket.
3. Coat threads of cylinder head bolts with sealing compound and install finger tight.
4. Tighten head bolts a little at a time until the specified torque is reached.
5. Install coil.
6. Connect upper radiator hose and engine ground strap.
7. Connect temperature sending unit wires and install fuel and vacuum lines in clip at water outlet.
8. Fill cooling system.
9. Install manifold assembly as outlined.
10. Install and adjust valve mechanism as outlined.

Do not install rocker arm cover. Engines using composition steel asbestos gaskets must have the cylinder head retorqued after engine warm-up.

Disassembly

1. With cylinder head removed, remove valve rocker arm nuts, ball and rocker arms (if not previously done).

Fig. 6A-14—Compressing Valve Springs

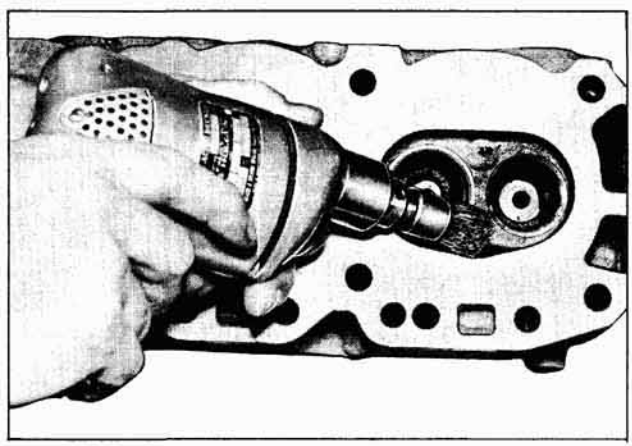


Fig. 6A-15—Cleaning Combustion Chamber

2. Using a valve spring compressing tool, compress the valve springs (Fig. 6A-14) and remove valve keys. Release the compressor tool and remove spring caps, spring shields, springs; then, remove oil seals and valve spring shims.

3. Remove valves from cylinder head and place them in a rack in their proper sequence so they can be assembled in their original positions.

Cleaning

1. Clean all carbon from combustion chambers and valve ports. (Fig. 6A-15)
2. Thoroughly clean the valve guides. (Fig. 6A-16)
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers or external cracks to the water chamber.

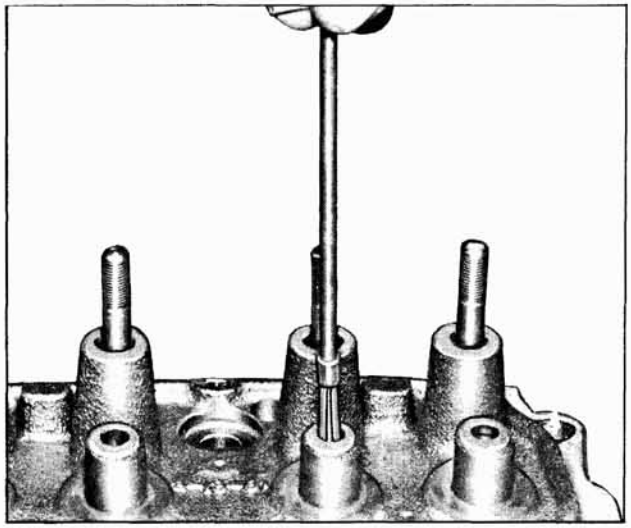


Fig. 6A-16—Cleaning Valve Guide

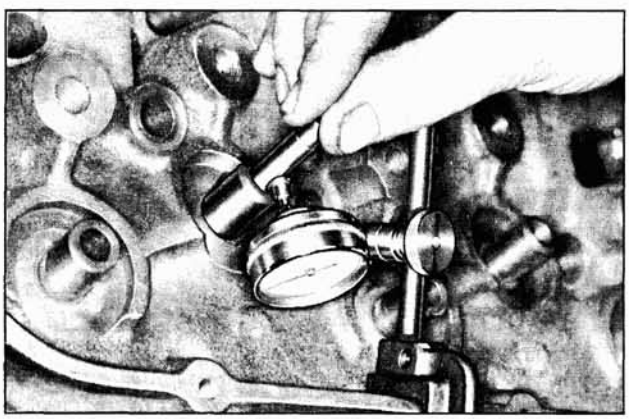


Fig. 6A-17—Measuring Valve Stem Clearance

2. Inspect the valves for burned heads, cracked faces or damaged stems.

Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.

3. Measure valve stem clearance (Fig. 6A-17) as follows:

Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail, locating the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide. With the valve head dropped about 1/16" off the valve seat, move the stem of the valve from side to side, using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves as outlined.

4. Clean and inspect valve springs. If a spring tension tool is available, the springs can be checked. (Fig. 6A-18) See Specification chart, if not within 10 lbs. of the specified load the spring should be replaced.

5. Inspect rocker arm studs for wear or damage.

VALVE GUIDE BORES

Valves with oversize stems are available. To ream the valve guide bores for oversize valves, use Tool Set J-5830. (Fig. 6A-19)

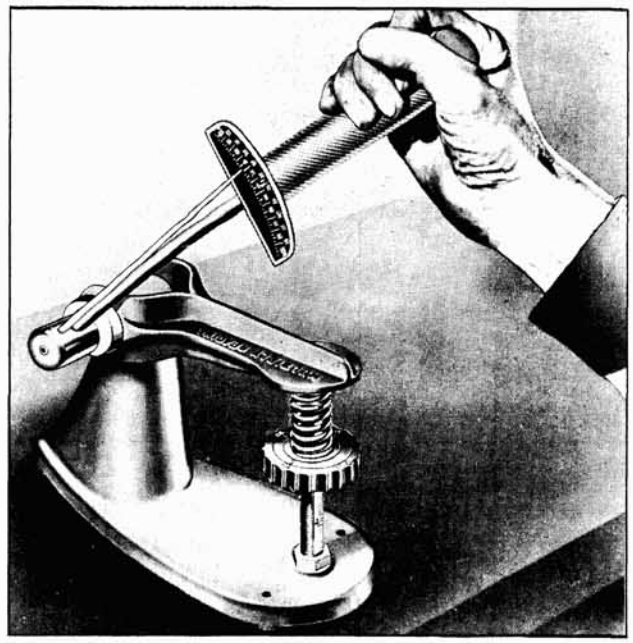


Fig. 6A-18—Checking Valve Spring Tension

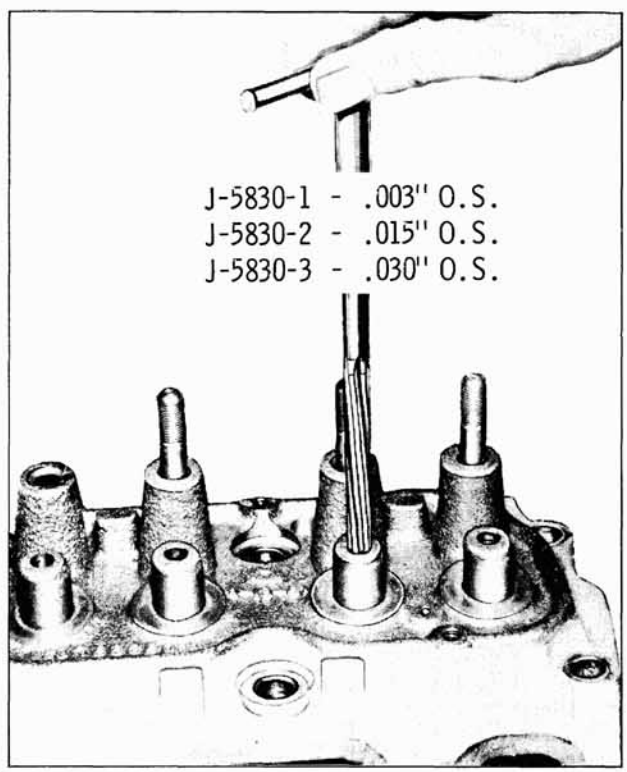


Fig. 6A-19—Reaming Valve Guide Bores

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

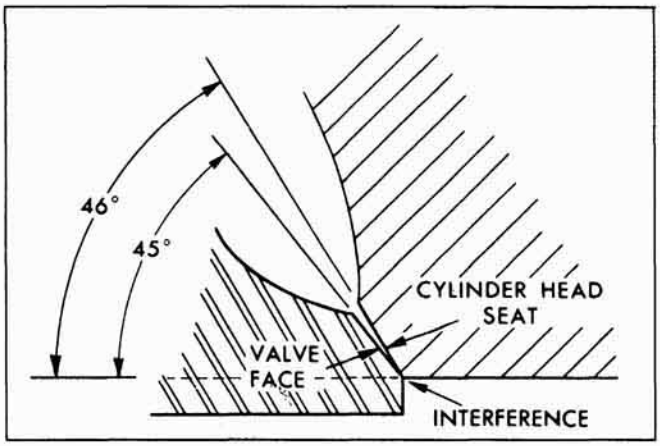


Fig. 6A-20—Relation of Valve and Seat Angles

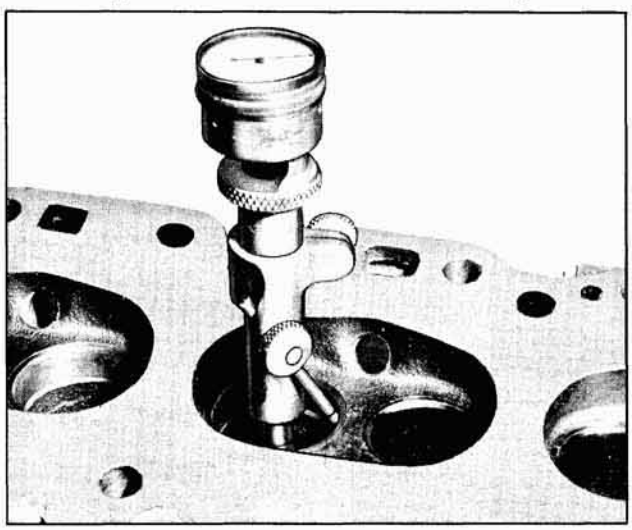


Fig. 6A-21—Measuring Valve Seat Concentricity

Several different types of equipment are available for reseating valve seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, it is essential that valve guide bores be free from carbon or dirt to insure proper centering of pilot in the guide.

1. Install expanding pilot in the valve guide bore.
2. Place roughing stone or forming stone over pilot and just clean up the valve seat. Use a stone cut to specifications.
3. Remove roughing stone or forming stone from pilot, place finishing stone, cut to specifications, over pilot and cut just enough metal from the seat to provide a smooth finish. Refer to specifications and Fig. 6A-20.
4. Narrow the valve seats to the specified width.

This operation is done by grinding the port side with A 30° stone to lower seat and a 60° stone to raise seat.

5. Remove expanding pilot and clean cylinder head carefully to remove all chips and grindings from above operations.
6. Measure valve concentricity. (Fig. 6A-21)

Valve seats should be concentric to within .002" total indicator reading.

VALVES

Valves that are pitted can be refaced to the proper angle,

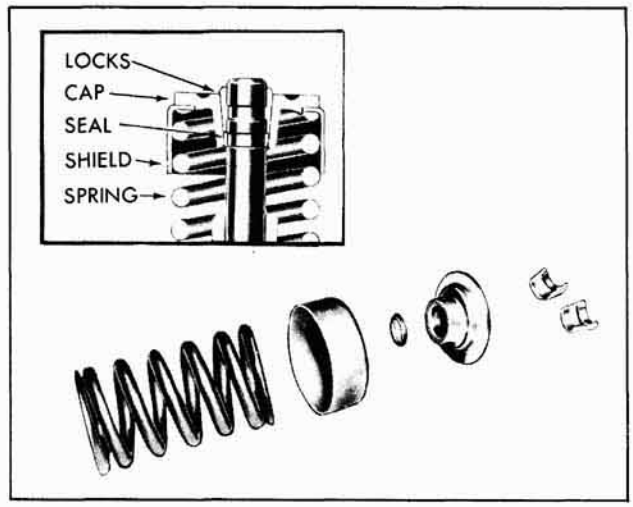


Fig. 6A-22—Valve Spring Installation

insuring correct relation between the head and stem, on a valve refacing mechanism. Valve stems which show excessive wear or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" thick after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

1. If necessary, dress the valve refacing machine grinding wheel to make sure it is smooth and true. Set check at angle specified for valve. Refer to specifications and Fig. 6A-20.
2. Clamp the valve stem in the chuck of the machine.
3. Start the grinder and move the valve head in line with the grinder wheel.
4. Turn the feed screw until the valve head just contacts wheel. Move valve back and forth across the wheel and regulate the feed screw to provide light valve contact.
5. Continue grinding until the valve face is true and smooth all around the valve. If this makes the valve head thin (1/32" min.) the valve must be replaced as the valve will overheat and burn.
6. Remove valve from chuck and place stem in "V" block. Feed valve squarely against grinding wheel to grind any pit from rocker arm end of stem.

Only the extreme end of the valve stem is hardened to resist wear. Do not grind end of stem excessively.

7. After cleaning valve face and cylinder head valve seat of grinding particles, make pencil marks about 1/4" apart across the valve face, place the valve in cylinder head and give the valve 1/2 turn in each direction while exerting firm pressure on head of valve.
8. Remove valve and check face carefully. If all pencil marks have not been removed at the point of contact with the valve seat, it will be necessary to repeat the refacing operation and again recheck for proper seating.
9. Grind and check the remaining valves in the same manner.

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:

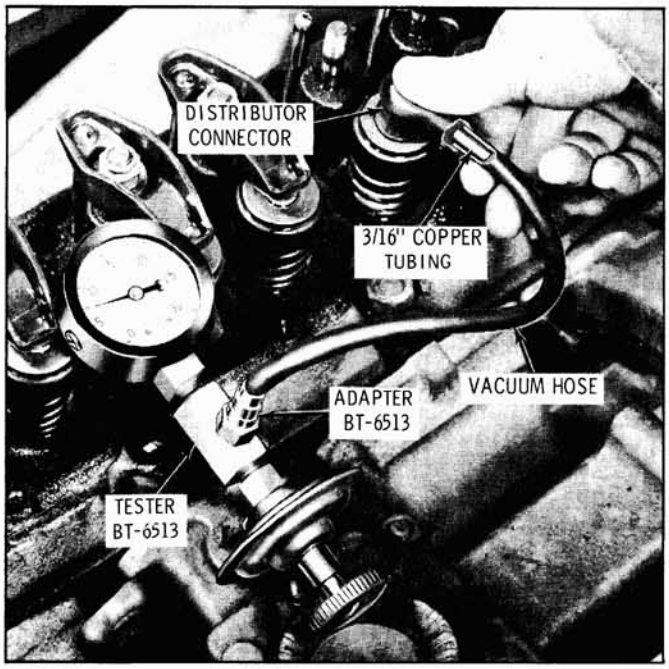


Fig. 6A-23—Vacuum Cup

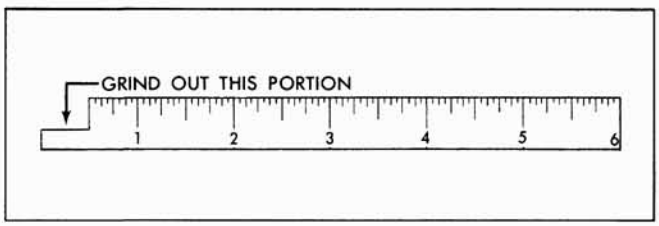


Fig. 6A-24—Cutaway Scale

a. Set the valve spring shim, valve spring, valve shield and valve cap in place. (Fig. 6A-22) The close coiled end of the spring is installed against the cylinder head.

b. Compress the spring.

c. Install oil seal in lower groove of stem. Be sure the seal is flat and not twisted.

d. Install the valve locks and release the compressor tool, making sure the locks seat properly in the upper groove of the valve stem.

Grease may be used to hold the locks in place while releasing the compressor tool.

3. Install the remaining valves.

4. Check each valve stem oil seal by placing a vacuum cup or similar device over the end of the valve stem and against the cap. Operate the vacuum and make sure no air leaks past the seal. A vacuum cup can be made from Tool BT-6513 and a high voltage shield. (Fig. 6A-23)

5. Check the installed height of the valve springs using a narrow thin scale. A cutaway scale will help. (Fig. 6A-24) Measure from the top of the shim or the spring seat to the top of the valve spring shield. (Fig. 6A-25) If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" thick. At no time should the spring be shimmed to give an installed height under the minimum specified.

OIL PAN

To remove the engine oil pan, it is necessary to remove the engine from the car. Refer to ENGINE, Removal and Installation. (Fig. 6A-25A illustrates gasket and seal installation.

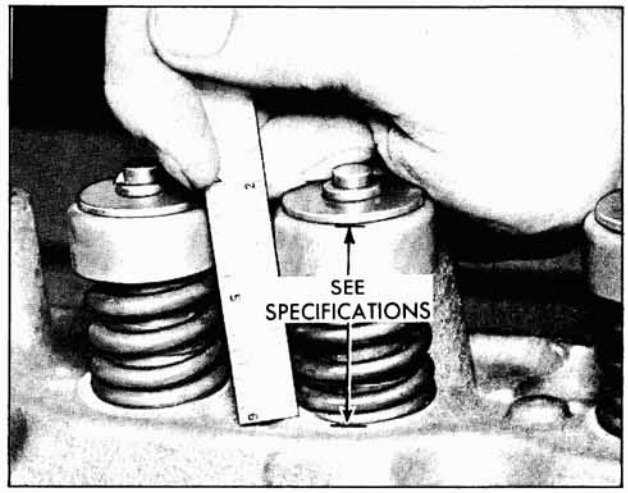


Fig. 6A-25—Measuring Valve Spring Installed Height

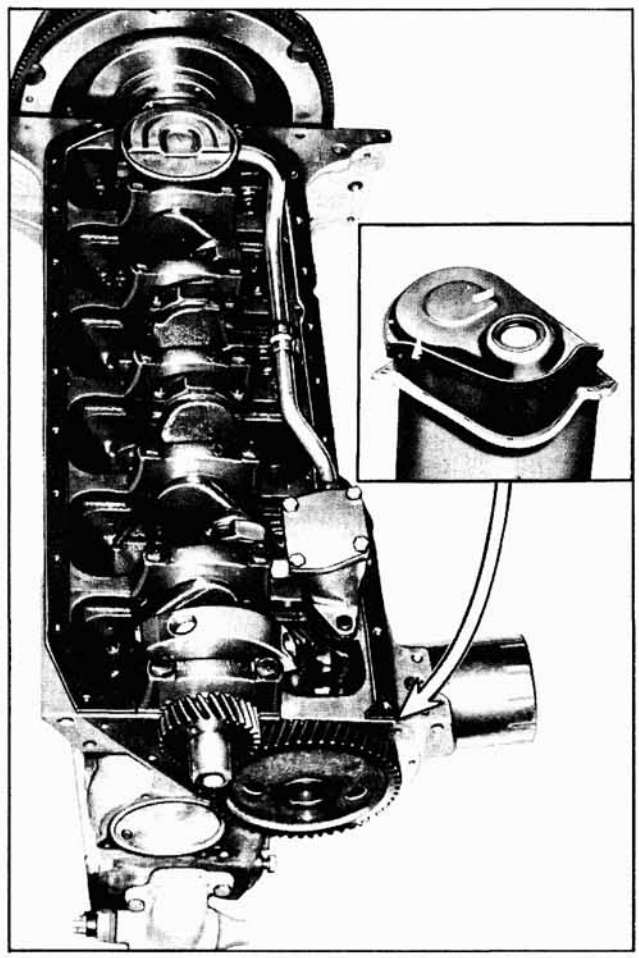


Fig. 6A-25A—Pan Gasket and Seals

OIL PUMP

The oil pump consists of two gears and a pressure regulator valve enclosed in a two-piece housing. The oil pump is driven by the distributor shaft which is driven by the helical gear on the camshaft. (Fig. 6A-26)

A baffle is incorporated on the pickup screen to eliminate pressure loss due to sudden stops.

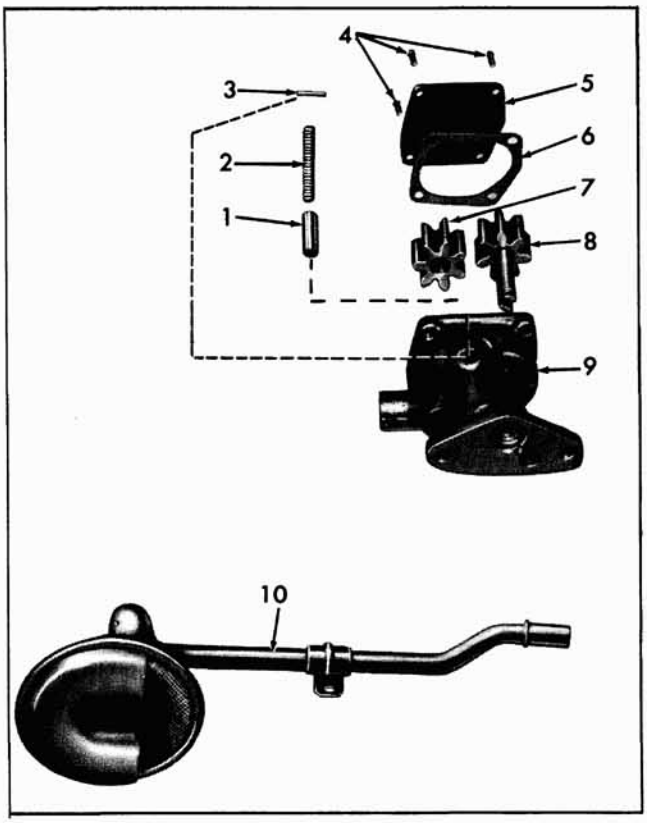


Fig. 6A-26—Oil Pump

1. Pressure Regulator Valve
2. Spring
3. Retaining Pin
4. Screws
5. Pump Cover
6. Cover Gasket
7. Idler Gear
8. Drive Gear and Shaft
9. Pump Body
10. Pick-up Screen and Pipe

Removal

1. Remove oil pan as outlined.
2. Remove two flange mounting bolts, pickup pipe bolt, then remove pump and screen as an assembly.

Disassembly (Fig. 6A-26)

1. Remove the pump cover attaching screws, the pump cover and the pump cover gasket.

Mark gear teeth so they may be reassembled with the same teeth indexing.

2. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump.

Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.

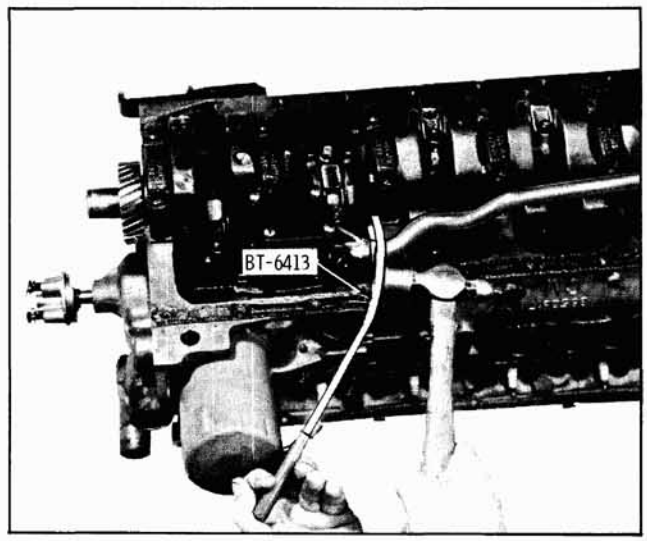


Fig. 6A-27—Installing Screen

6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.

Assembly

1. If the pickup screen and pipe assembly was removed, mount the pump in a soft-jawed vise, apply sealer to end of pipe and tap the pipe in place with a plastic hammer. (Fig. 6A-27)

Be careful of twisting, shearing or collapsing pipe while installing pump. Pickup screen must be parallel to bottom of oil pan.

2. Install the pressure regulator valve and related parts.
3. Install the drive gear and shaft in the pump body.
4. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.
5. Install the pump cover with new gasket and torque attaching screws to specifications.

Installation

1. Align oil pump drive shafts to match with distributor tang, then install oil pump to block positioning flange over distributor lower bushing. Use no gasket.

Oil pump should slide easily into place; if not, remove and reposition slot to align with distributor tang.

2. Install oil pan using new gaskets and seals as outlined.

OIL SEAL (REAR MAIN)

Replacement

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft.

Always replace the upper and lower seal as a unit. Install with the lip facing toward the front of the engine

1. With the oil pan removed, remove the rear main bearing cap.
2. Remove oil seal from the groove by lifting the end tab (Fig. 6A-28), then clean seal groove.

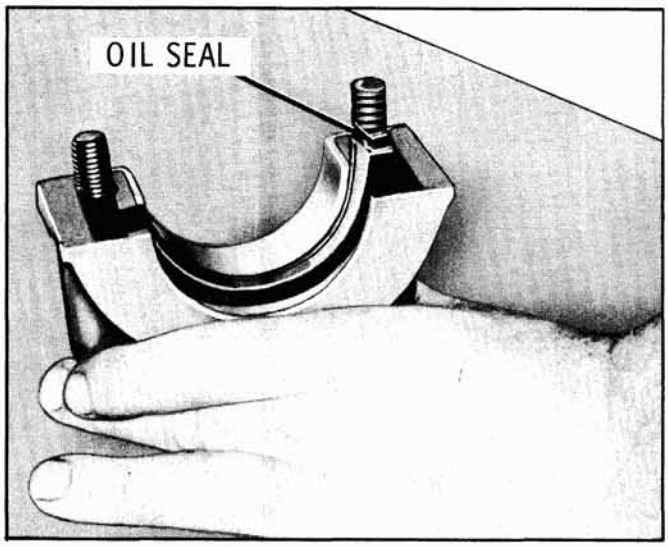


Fig. 6A-28—Removing Oil Seal (Lower Half)

3. Lubricate the lip and OD of a new seal with engine oil. Keep oil off the parting line surface. Insert seal in cap and roll it into place with finger and thumb, using light pressure so beads on seal OD are not cut by seal groove at cap parting line. Be sure tabs on seal are properly located in cross grooves.

4. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers. (Fig. 6A-29)

Always clean crankshaft surface removing all foreign deposits before installing a new seal. Also clean seal grooves.

5. Lubricate the lip and OD of a new seal with engine oil. Keep oil off the parting line surface. Gradually push with a hammer handle, while turning crankshaft, until seal is rolled into place. (Similar to installing a main bearing.) Be careful that seal bead on OD is not cut. Compress seal towards crankshaft as much as possible.

6. Install the rear main bearing cap (with new seal) and torque to specifications. Be sure cross seal tabs are in place and properly seated.

TORSIONAL DAMPER

Removal

1. Remove radiator.
2. Remove fan belt and (if so equipped) accessory drive pulley and belt.
3. Install tools as shown in Fig. 6A-30 and remove damper. Remove tools.

Installation

1. Coat front cover oil seal contact area of damper with engine oil.
2. Position damper on crankshaft and drive into position, using J-5154, until it bottoms against crankshaft gear. (Fig. 6A-31)
3. Install belts and adjust.
4. If so equipped, install accessory drive pulley and belt.
5. Install radiator, fill cooling system and check for leaks.

CRANKCASE FRONT COVER

Removal

1. Remove oil pan as outlined.
2. Remove crankshaft torsional damper as outlined.
3. Remove crankcase front cover attaching bolts, cover and gasket.

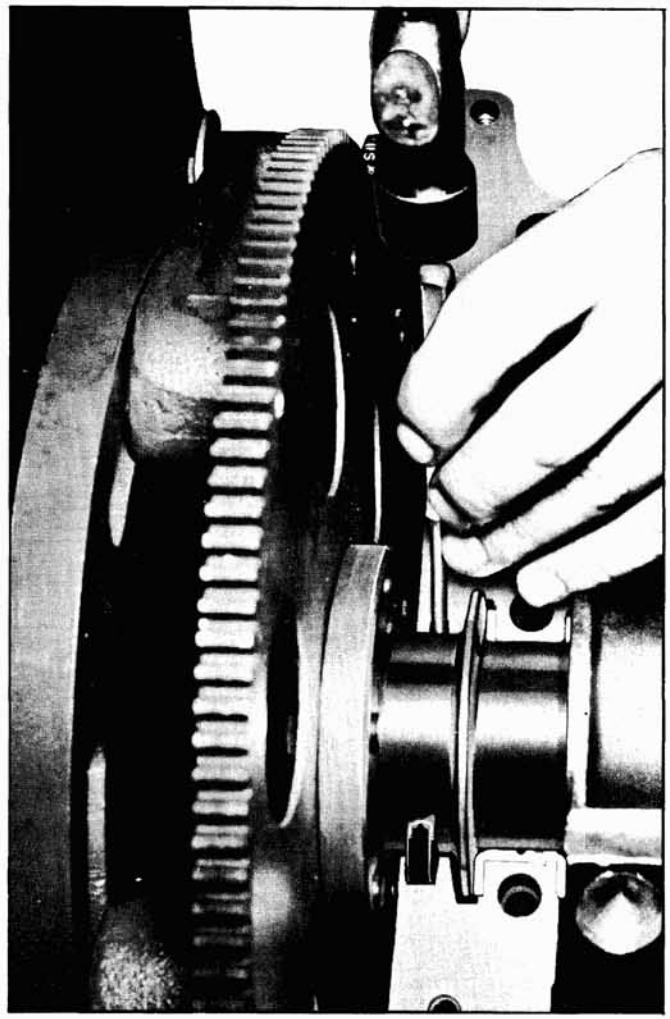


Fig. 6A-29—Removing Oil Seal (Upper Half)

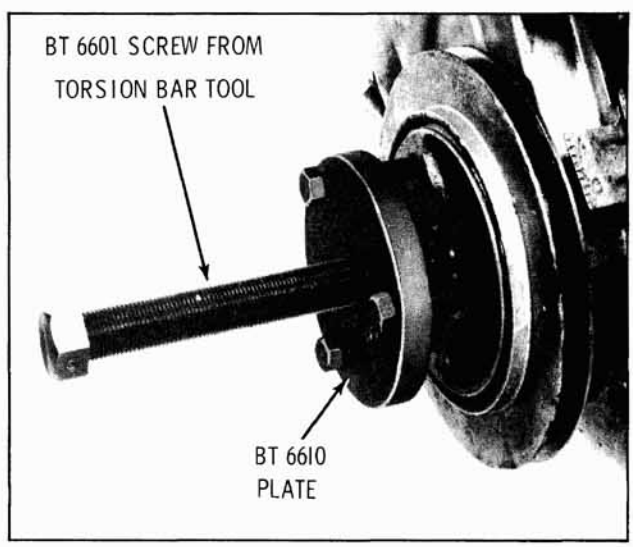


Fig. 6A-30—Removing Torsional Damper

Installation

1. Clean gasket surfaces on block and crankcase front cover.

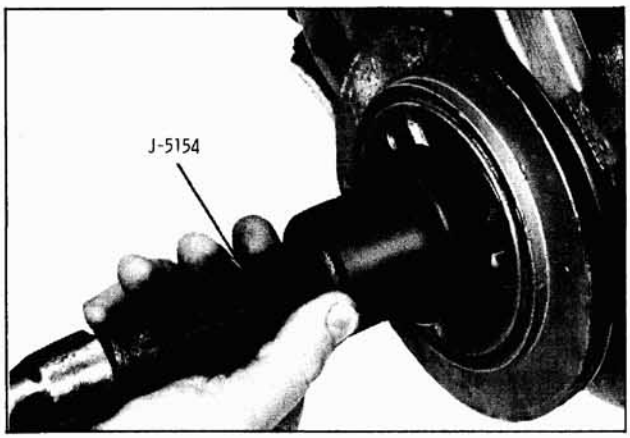


Fig. 6A-31—Installing Torsional Damper

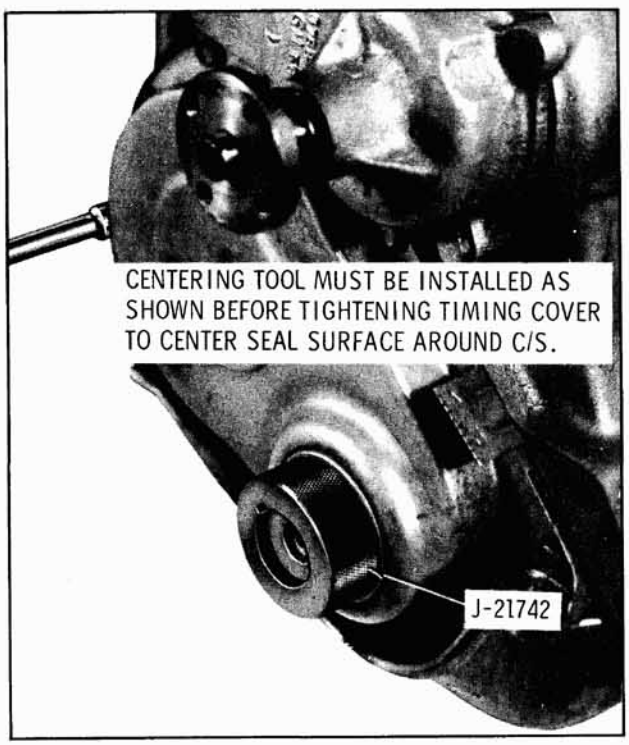


Fig. 6A-32—Installing Front Cover

2. Install centering Tool J-21742 in crankcase front cover seal. (Fig. 6A-32)
3. Coat the gasket with gasket sealer and place in position on cover, then install crankcase front cover to block and torque bolts to specifications.
4. Remove centering tool.

It is important that centering tool be used to align crankcase front cover so that crankshaft hub or torsional damper installation will not damage seal and to position seal evenly around the damper or hub surface.

5. Install crankshaft torsional damper as outlined.
6. Install oil pan with new gaskets and seals as outlined.

OIL SEAL (FRONT COVER)

Replacement (With Cover Removed)

1. With cover removed, pry old seal out of cover from the front with screw driver being careful not to distort cover.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-5154. (Fig. 6A-33)

Support cover at sealing area.

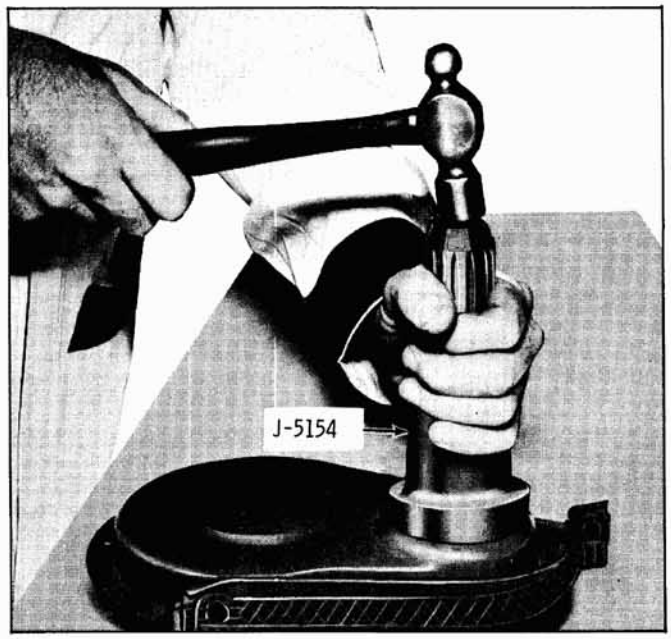


Fig. 6A-33—Installing Oil Seal (Cover Removed)

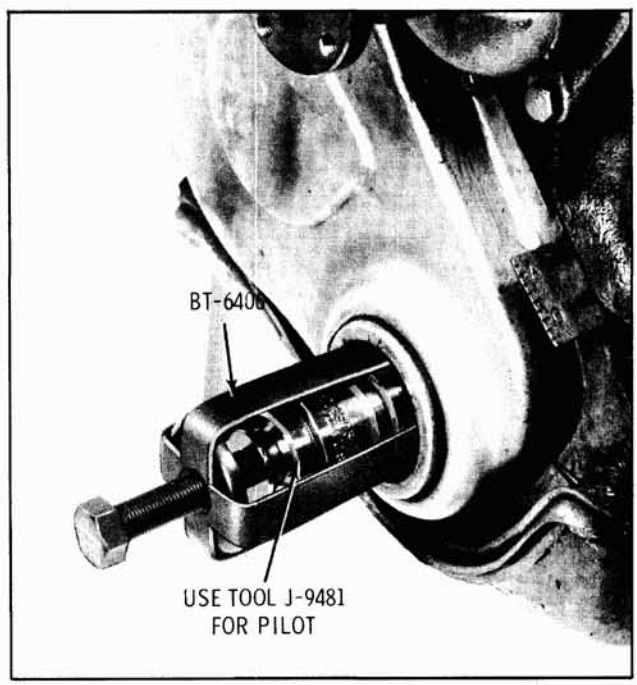


Fig. 6A-34—Removing Oil Seal (Cover Installed)

Without Cover Removed

1. With crankshaft torsional damper removed, install tools as shown in Fig. 6A-34 and remove seal.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-5154. (Fig. 6A-35)

Fig. 6A-35—Installing Oil Seal (Cover Installed)

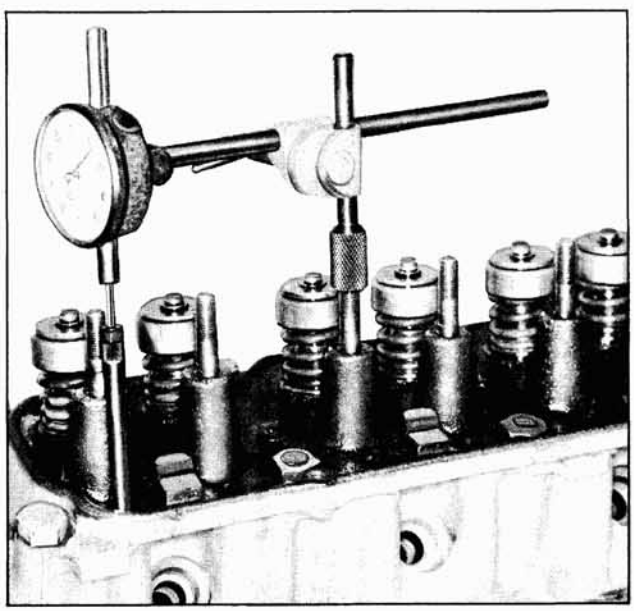


Fig. 6A-36—Measuring Camshaft Lobe Lift

CAMSHAFT

Measuring Lobe Lift

Procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure the lift of each push rod in consecutive order and record the readings.

1. Remove valve mechanism as outlined.
2. Position indicator with ball socket adapter on push rod. (Fig. 6A-36)
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is in the fully raised position.

The primary distributor lead must be disconnected from the negative post on the coil and the ignition switch must be in the ON position. Failure to do this will result in a damaged grounding circuit in the ignition switch.

5. Compare the total lift recorded from the dial indicator with specifications.
6. Continue to rotate the crankshaft until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

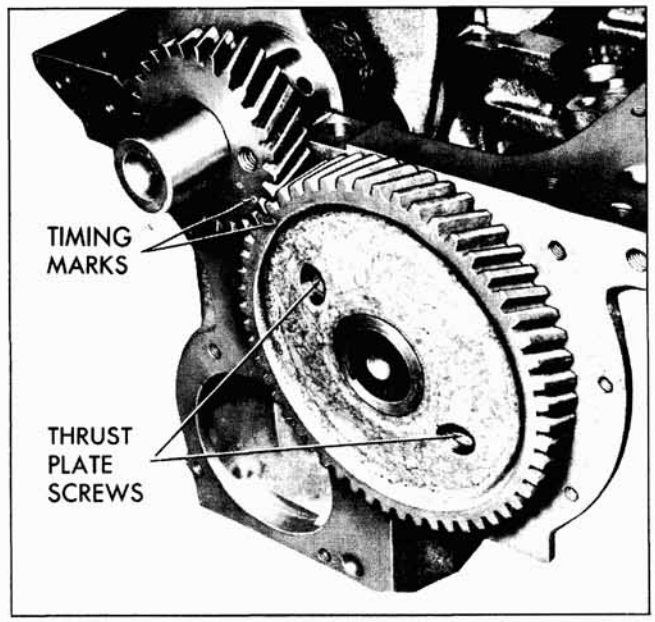


Fig. 6A-37—Timing Gear Marks

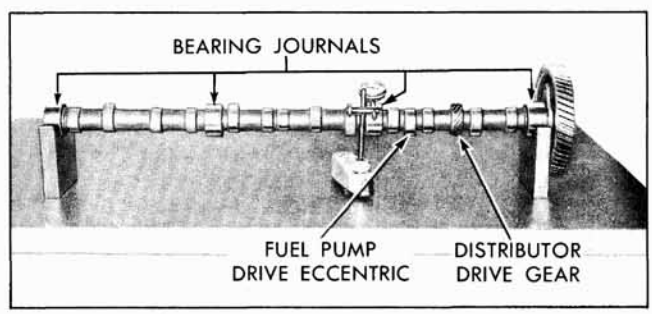


Fig. 6A-38—Checking Camshaft Alignment

Removal

1. Remove valve lifters.
2. Remove crankcase front cover.
3. Remove grille.
4. Remove fuel pump.
5. Align timing gear marks then remove the two camshaft thrust plate bolts by working through holes in the camshaft gear. (Fig. 6A-37)
6. Remove the camshaft and gear assembly by pulling it out through the front of the block.

Support camshaft carefully when removing so as not to damage camshaft bearings.

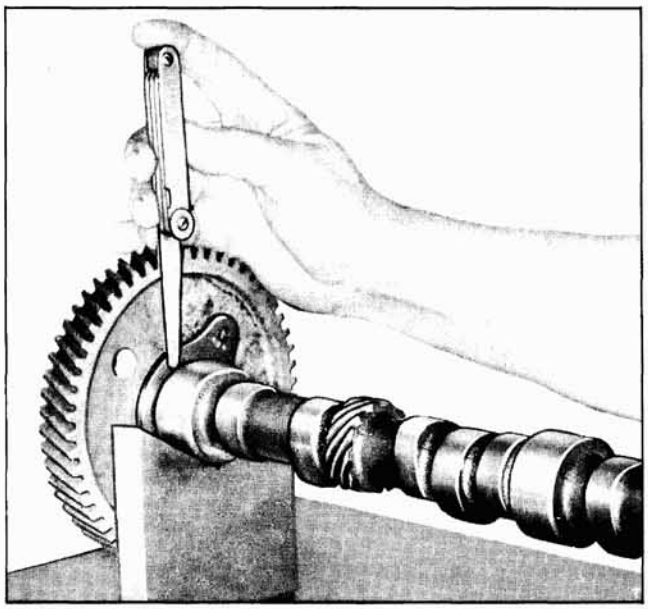


Fig. 6A-39—Checking Camshaft End Play

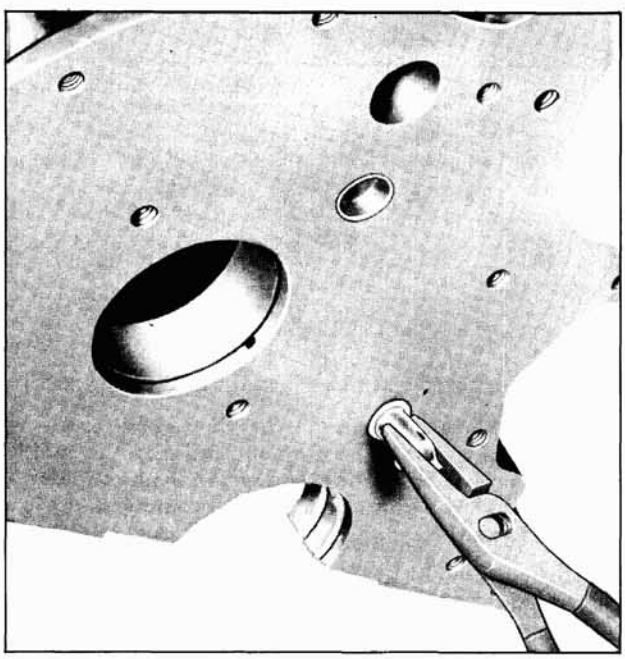


Fig. 6A-40—Oil Nozzle Replacement

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

The camshaft should also be checked for alignment. The best method is by use of "V" blocks and a dial indicator (Fig. 6A-38). The dial indicator will indicate the exact amount the camshaft is out of true. If it is out more than .002" dial indicator reading, the camshaft should be replaced.

Inspect the camshaft gear and thrust plate for wear or damage. Measure the camshaft end play. This should be .001" to .005". (Fig. 6A-39)

OIL NOZZLE REPLACEMENT

1. Remove nozzle with pliers. (Fig. 6A-40)
2. Drive new nozzle in place (oil hole in vertical position) using a suitable light plastic or rubber hammer.

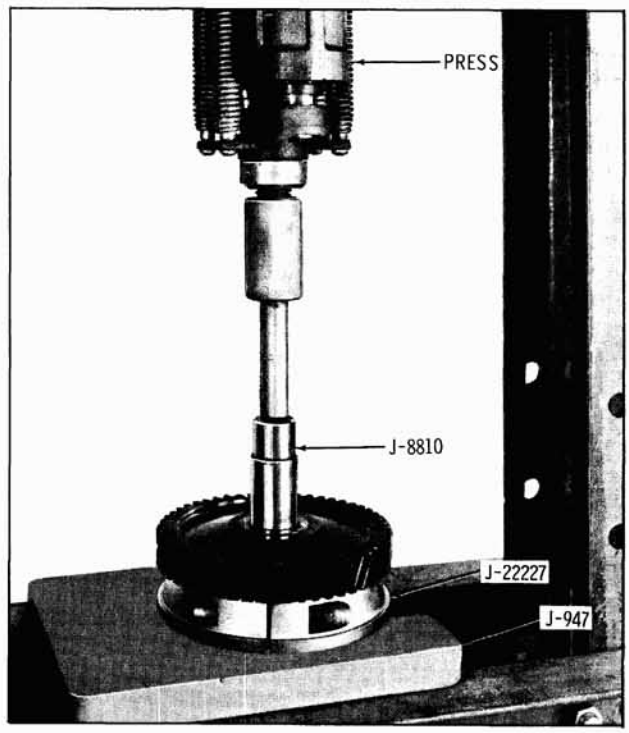


Fig. 6A-41—Removing Camshaft Gear

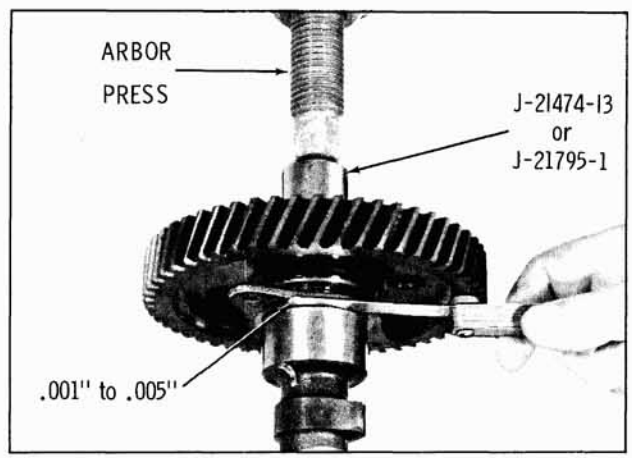


Fig. 6A-42—Installing Camshaft Gear

CAMSHAFT GEAR REPLACEMENT

1. If the inspection indicates that the shaft, gear or thrust plate should be replaced, the gear should be removed from the shaft. Refer to Fig. 6A-41 for gear removal.

Thrust plate must be positioned so that woodruff key and shaft does not damage it when the shaft is pressed out of gear.

2. To assemble cam shaft gear and thrust plate, use an arbor press and Tool as shown in Fig. 6A-42.
3. Place the gear on the shaft until clearance shown in Fig. 6A-42 is obtained.

Installation

1. Install the camshaft and gear assembly in the engine block, being careful not to damage camshaft bearings or camshaft.

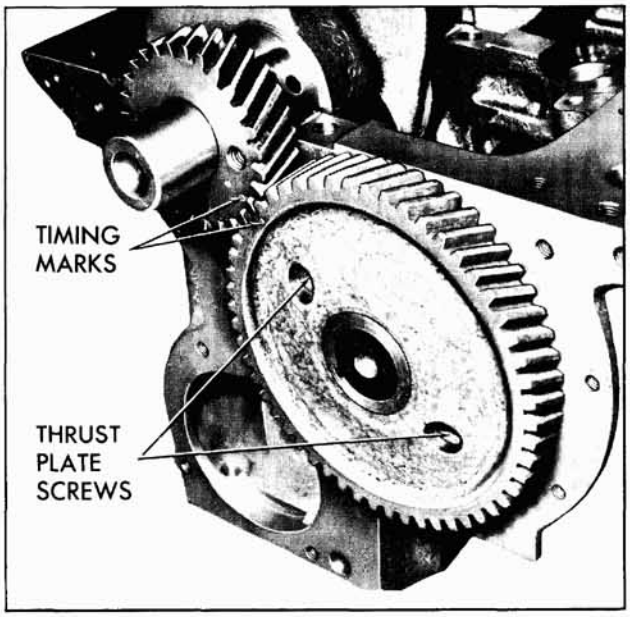


Fig. 6A-43—Timing Marks

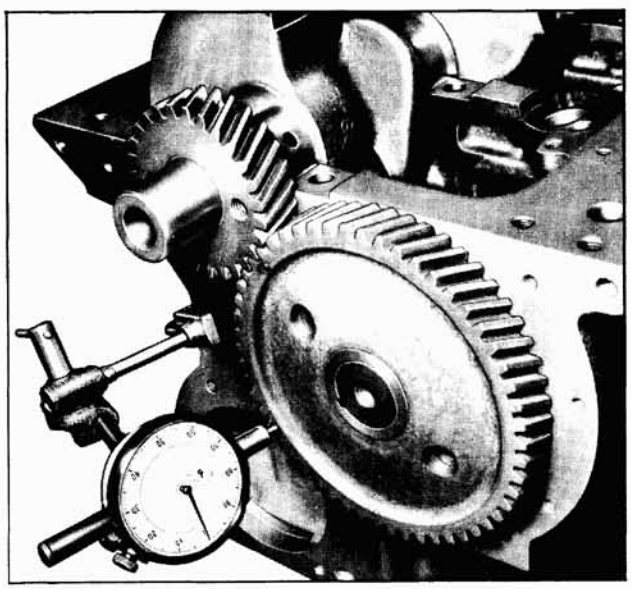


Fig. 6A-44—Checking Camshaft Gear Runout

2. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up (Fig. 6A-43). Push camshaft into position. Install camshaft thrust plate to block bolts and torque to specifications.

3. Check camshaft and crankshaft gear runout with a dial indicator. (Fig. 6A-44) The camshaft gear runout should not exceed .004" and the crankshaft gear runout should not exceed .003".

4. If gear runout is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear will have to be replaced.

5. Check the backlash between the camshaft and crankshaft gear teeth with a dial indicator in several places. (Fig. 6A-45) The backlash should not be less than .004" or more than .006".

6. Install fuel pump.

7. Install grille.

8. Install crankcase front cover.

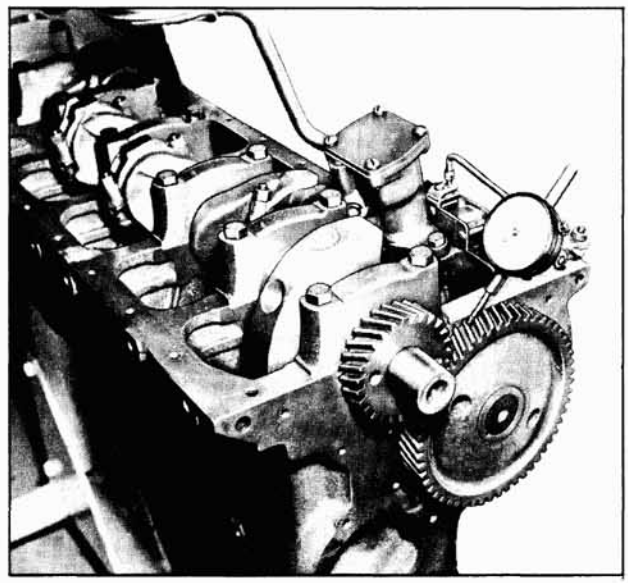


Fig. 6A-45—Checking Gear Backlash

9. Install valve lifters.

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced while the engine is removed for overhaul by removing the following parts: front cover, oil pan and oil pump and camshaft. Leave cylinder head and pistons intact.

1. With camshaft removed, drive out cam bearing No. 1, 2 and 3 using tools as shown in Fig. 6A-46.

After driving out No. 1, install pilot to drive out No. 2 and 3

2. Using tools shown in Fig. 6A-47, pull No. 4 bearing.

Slide slip ring forward on jaws of tool so that tool will enter behind the bearing, after positioning the tool behind the bearing pull the ring rearward so jaws of tool will expand behind the bearing.

Installation

1. With pilot installed as shown in Fig. 6A-46, install bearings No. 4, 3 and 2.

Make sure oil holes are aligned. Drive bearings No. 4, 3 and 2 in until the white marks on tool are flush with the pilot.

2. To install bearing No. 1, remove pilot and thread BT-6609-3 onto Handle BT-6609-5 and drive bearing into block until white line on Tool BT-6609-3 is flush with face of block.

CRANKSHAFT GEAR

Replacement

With camshaft removed, crankshaft gear may be removed using Tools shown in Fig. 6-48. To install crankshaft gear use Tools shown in Fig. 6-49.

MAIN BEARINGS

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Bearings are available in standard size and .001", .002", .009", .010", .020" and .030" undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances.

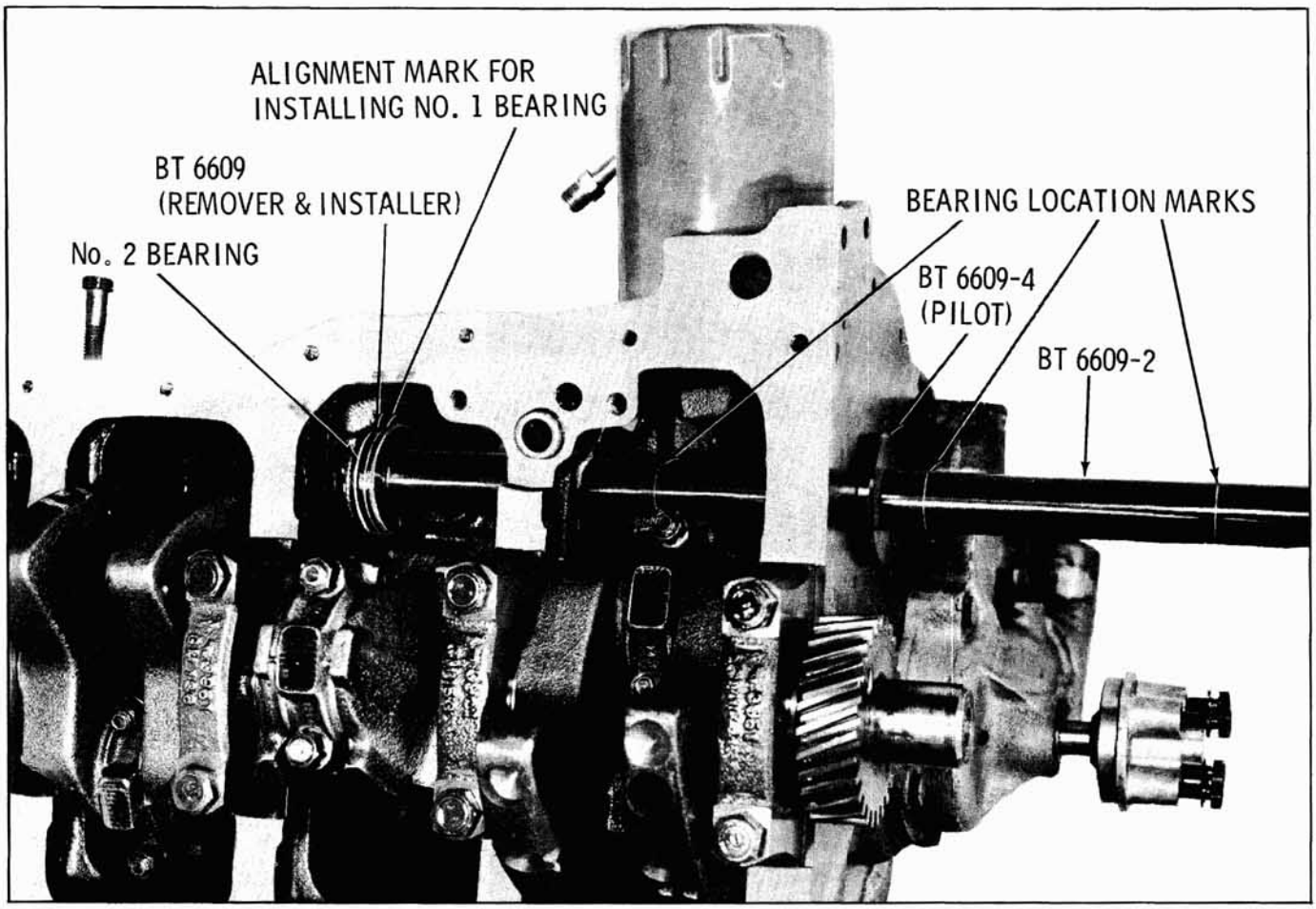


Fig. 6A-46—Removing No. 1, 2, and 3 Camshaft Bearing

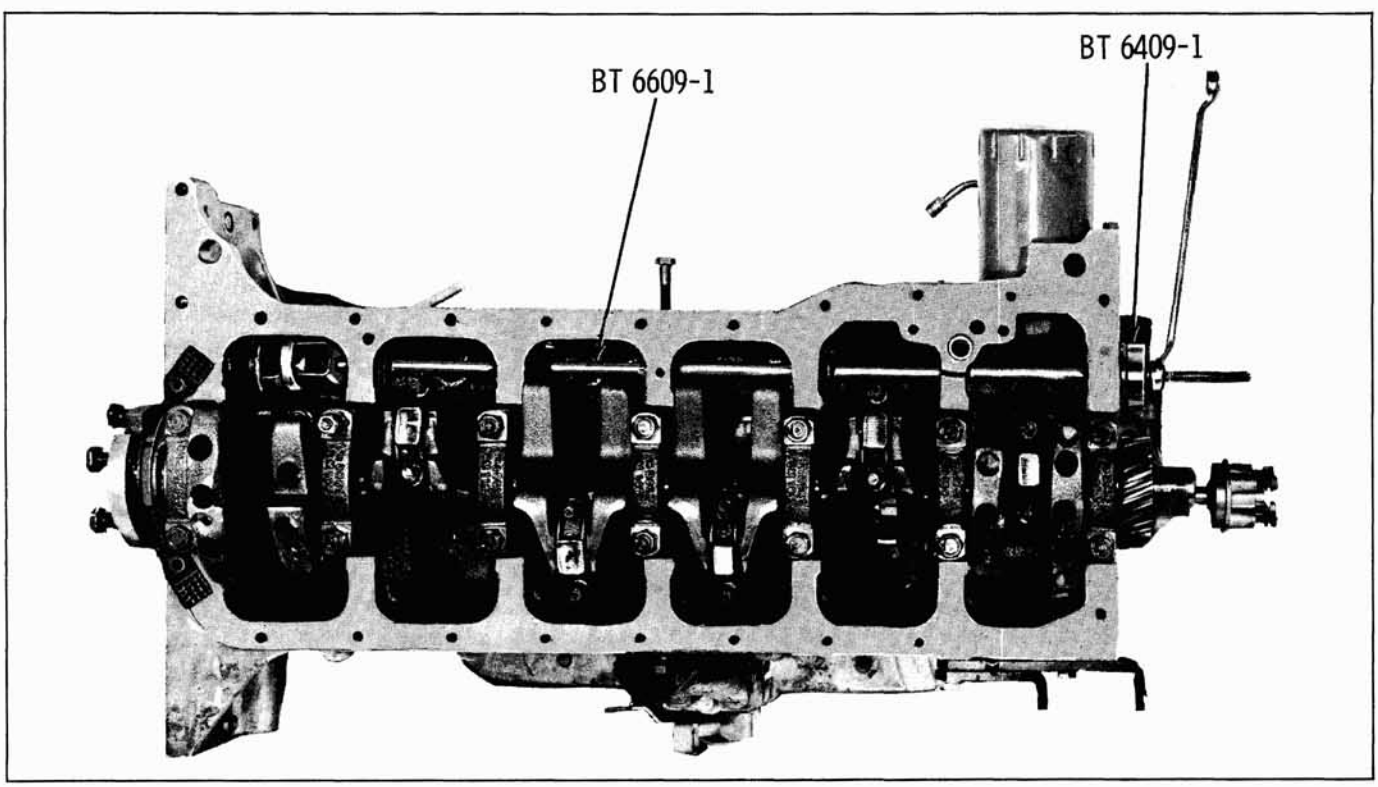


Fig. 6A-47—Removing No. 4 Camshaft Bearing

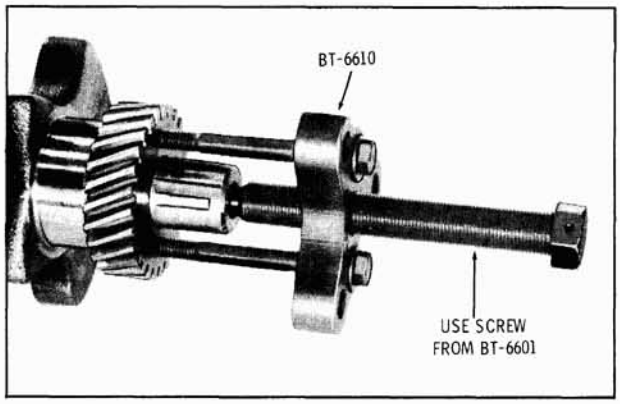


Fig. 6A-48—Removing Crankshaft Gear

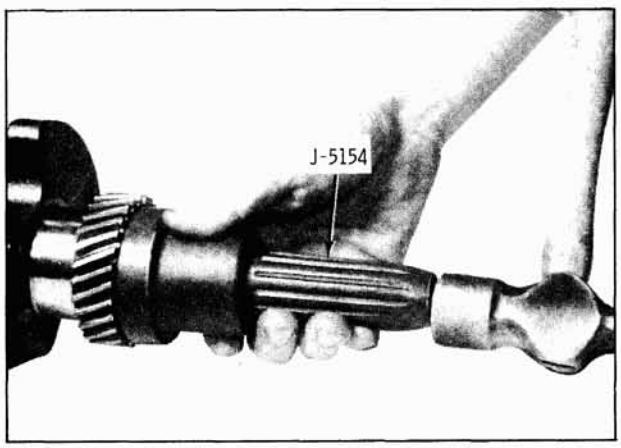


Fig. 6A-49—Installing Crankshaft Gear

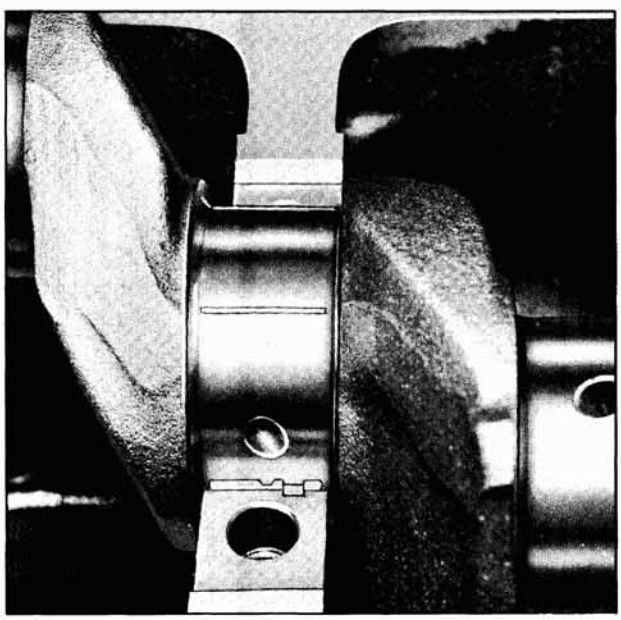


Fig. 6A-50—Gauging Plastic on Journal

For this reason, you may find one-half of a standard insert with one-half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009" undersize on main journals only. A .009" undersize bearing and .010" undersize bearing may be used for precision fitting in the same manner as previously described. Any engine fitted with a .009" undersize crankshaft will be identified by the following markings.

1. ".009" will be stamped on the crankshaft counterweight forward of the center main journal.
2. A Figure "9" will be stamped on the block at the left front oil pan rail.

If, for any reason, main bearing caps are replaced, shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing shows a greater wear and the most distress from fatigue. If upon inspection, the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one-half without replacing the other half.

Checking Clearance

To obtain the most accurate results with Plastigauge, (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed. With the engine out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed and starting with the rear main bearings, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gauging plastic the full width of the bearing (parallel to the crankshaft) on the journal. (Fig. 6A-50)

Do not rotate the crankshaft while the gauging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the retaining bolts to specifications.
4. Remove bearing cap. The flattened gauging plastic will be found adhering to either the bearing shell or journal. On the edge of gauging plastic envelope there is a graduated scale which is correlated in thousandths of an inch.
5. Without removing the gauging plastic, measure its compressed width (at the widest point) with the graduations on the gauging plastic envelope. (Fig. 6A-51)

Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001" max.), be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gauging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to

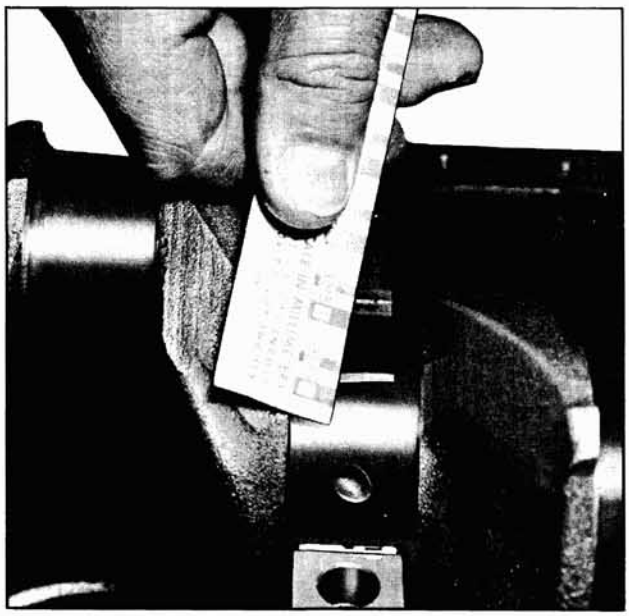


Fig. 6A-51—Measuring Gauging Plastic

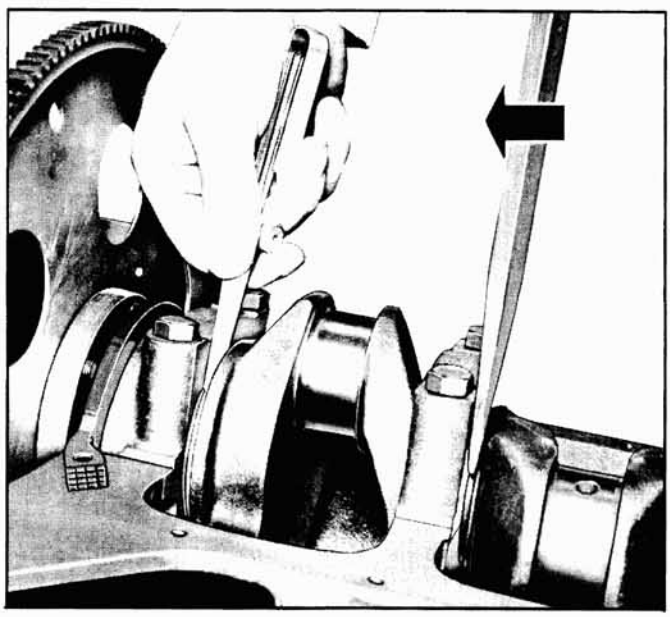


Fig. 6A-52—Measuring Crankshaft End Play

measure the journal with a micrometer if the flattened gauging plastic indicates more than .001" difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower insert as a unit.

If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks. If none are found, then install shims as required.

7. A .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

8. Proceed to the next bearing. After all bearings have been checked, rotate the crankshaft to see that there is no excessive drag.

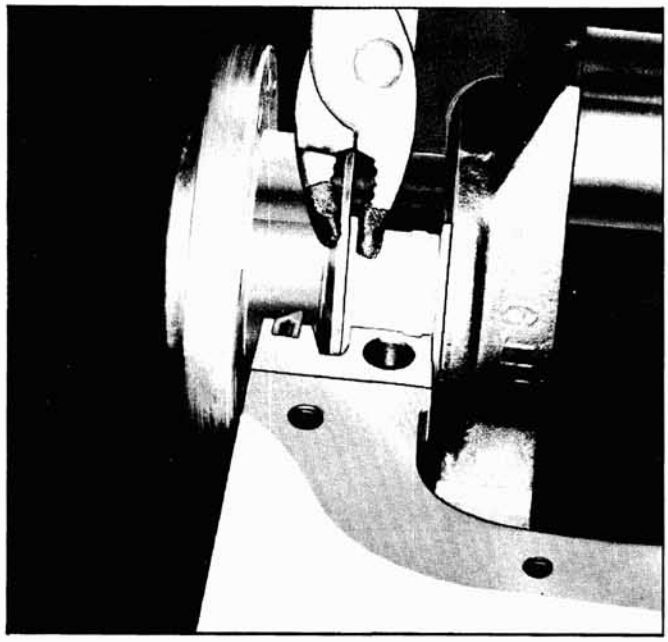


Fig. 6A-53—Rear Main Bearing Replacement

9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gauge. (Fig. 6A-52)

10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removed

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removed

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. The rear main journal has no oil hole. Replace the rear main bearing upper half as follows:
   a. Use a small drift punch and hammer to start the upper bearing half rotating out of block.
   b. Use a pair of pliers (with taped jaws) to hold the bearing thrust surface to the oil slinger and rotate the crankshaft to remove bearing. (Fig. 6A-53)
   c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block.
   d. Use pliers as in removing to rotate bearing into place. The last 1/4" movement may be done by holding just the slinger with the pliers or tap in place with a drift punch.
3. All other crankshaft journals have oil holes. Replace the main bearing upper half as follows:
   a. Install a main bearing removing installing tool in oil hole in crankshaft journal.

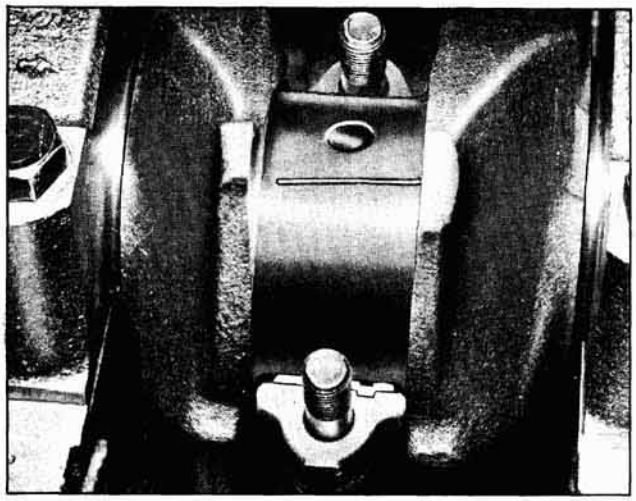


Fig. 6A-54—Gauging Plastic on Crankpin

If such a tool is not available, a cotter pin may be bent as required to do the job.

b. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.

c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.

4. Oil new lower bearing and install in bearing cap.

5. Install main bearing cap with arrows pointing toward front of engine.

6. Torque main bearing cap bolts to specifications.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive, a new bearing will be required. Bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.

2. Inspect the bearing for evidence of wear or damage. (Bearing showing the above should not be reinstalled).

3. Wipe the bearings and crankpin clean of oil.

4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.

5. If within specifications, measure new or used bearing clearances with Plastigage or its equivalent.

If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001", interference between the bearing and crankpin will result in rapid bearing failure.

a. Place a piece of gauging plastic the full width of the crankpin (parallel to the crankshaft). (Fig. 6A-54)

b. Install the bearing in the connecting rod and cap.

c. Install the bearing cap and evenly torque nuts to specifications.

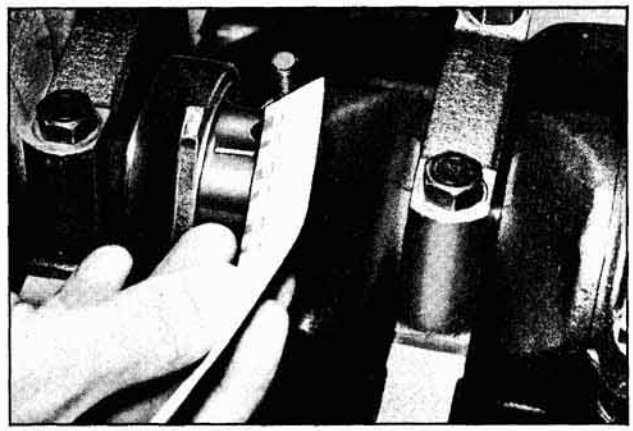


Fig. 6A-55—Measuring Gauging Plastic

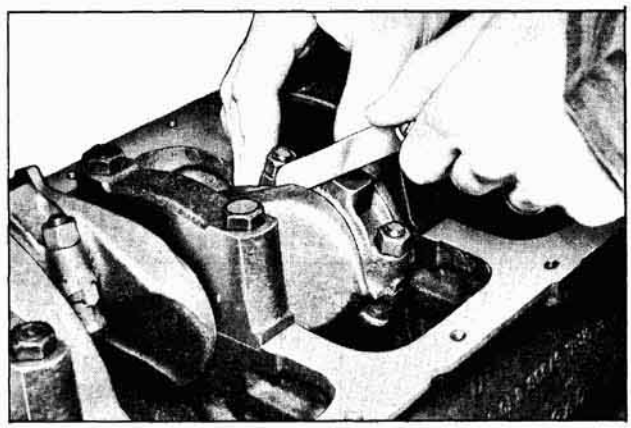


Fig. 6A-56—Measuring Connecting Rod Side Clearance

Do not turn the crankshaft with the gauging plastic installed.

d. Remove the bearing cap and using the scale on the gauging plastic envelope, measure the gauging plastic width at the widest point. (Fig. 6A-55)

6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.

8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to the crankpin) to make sure they have clearance.

9. Measure all connecting rod side clearances (see specifications), between the connecting rod cap and side of crankpin. (Fig. 6A-56)

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. With oil pan, oil pump and cylinder head removed, use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.

Before ridge and/or deposits are removed, turn crankshaft until piston is at the bottom of stroke and place a cloth on top of piston to collect the cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke and remove cloth and cuttings.

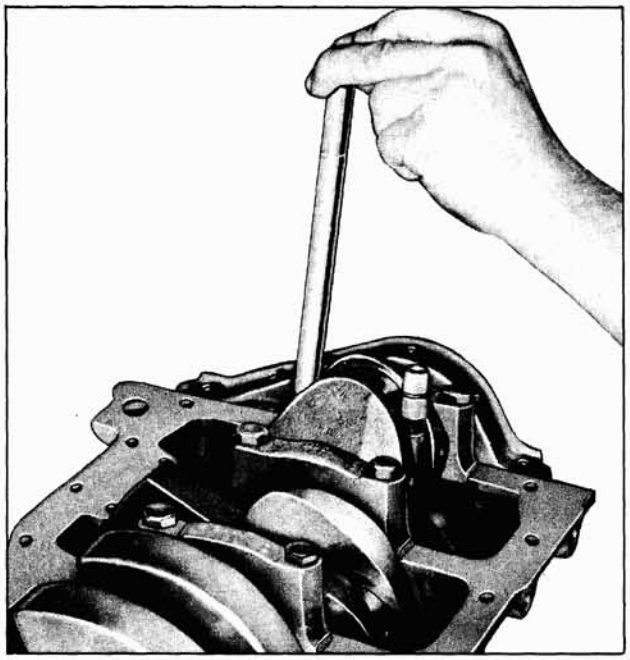


Fig. 6A-57—Removing Connecting Rod and Piston Assembly

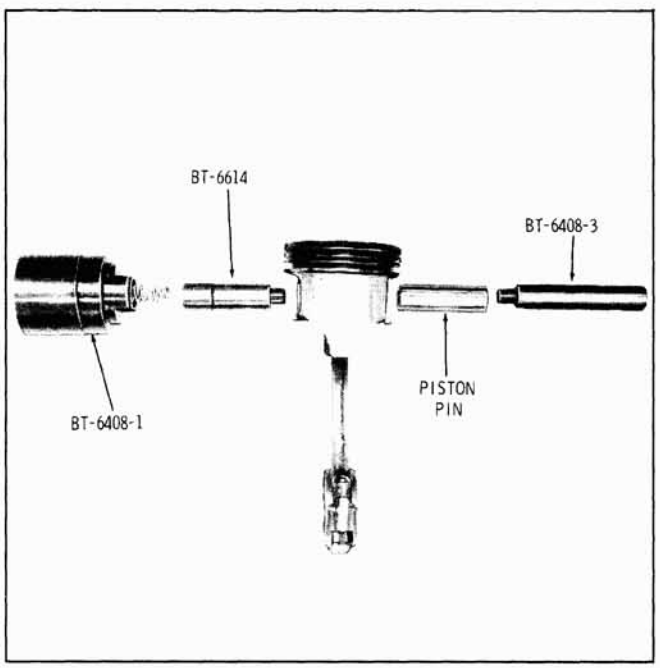


Fig. 6A-58—Piston Pin Removing

2. Inspect connecting rods and connecting rod caps for cylinder identification. If necessary, mark them.

3. Remove connecting rod cap and install Tool J-6305 (11/32") on studs. Push connecting rod and piston assembly out of top of cylinder block. (Fig. 6A-57)

It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

Disassembly

1. Remove connecting rod bearings from connecting rods and caps.

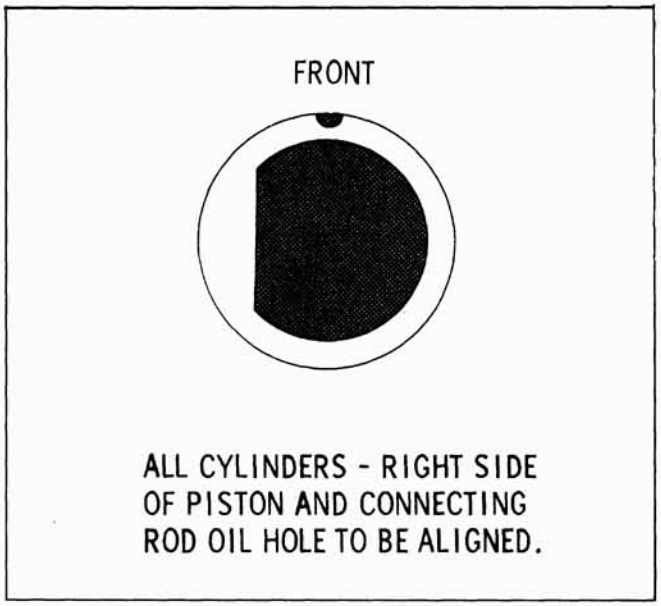


Fig. 6A-59—Connecting Rod and Piston Relationship

If connecting rod bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.

2. Remove piston rings by expanding them and sliding them off the pistons.

3. Using Tools BT-6408 shown in Fig. 6A-58, place connecting rod and piston assembly in an arbor press with piston on support; then, using remover, press piston pin out of connecting rod and piston.

4. Remove assembly from arbor press and remove tools, piston pin, connecting rod and piston.

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air.

Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are cleaned.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance as outlined under PISTON SELECTION.

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gauge or an inside micrometer. If clear-

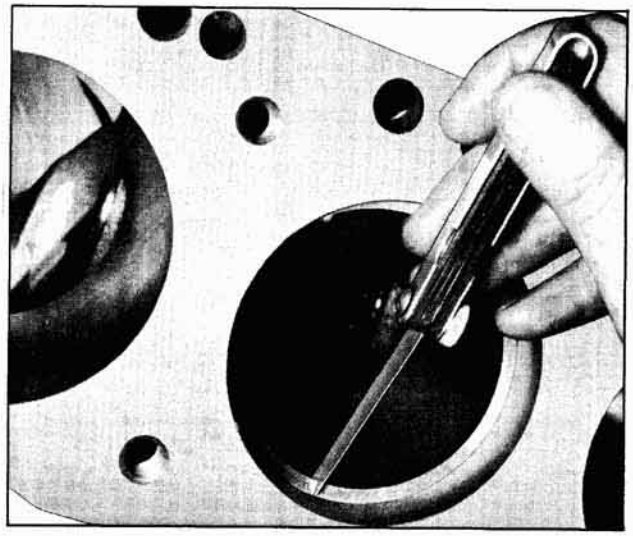


Fig. 6A-60—Measuring Ring Gap

ance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Using Tool BT-6408, place support with spring and pilot in place on an arbor press.
3. Position piston on connecting rod with appropriate side of piston and oiling hole in connecting rod aligned. (Fig. 6A-59)
4. Place piston on support, indexing pilot through piston and rod.
5. Place installer on piston pin, start piston pin into piston and press on installer until pilot bottoms in support.
6. Remove installer from connecting rod and piston assembly and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is chrome faced or treated with molybdenum for maximum life.

The oil control rings are of the three-piece type, consisting of two segments (rails) and a spacer.

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then, press the ring down into the cylinder bore about 1/4" below maximum upward travel. Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a gauge. (Fig. 6A-60)
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (Fig. 6A-61) to make sure that the ring is free. If binding occurs at any point, the cause should be determined and if caused by ring groove, remove by dressing with a fine cut file. If the binding is caused by a distorted ring, replace ring.
8. Install piston rings as follows: (Fig. 6A-62)

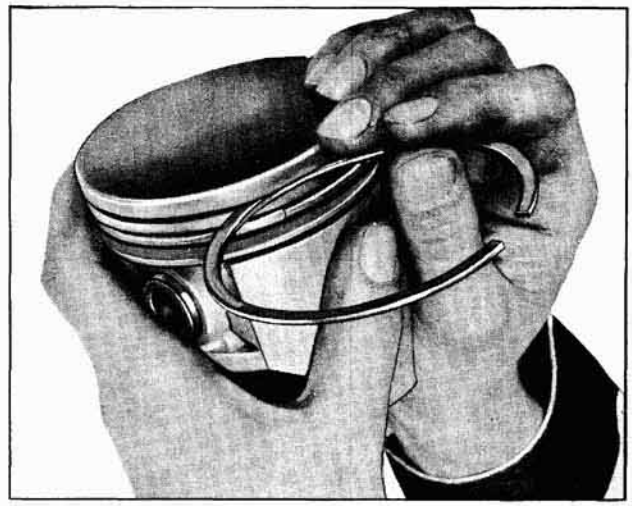


Fig. 6A-61—Checking Ring in Groove

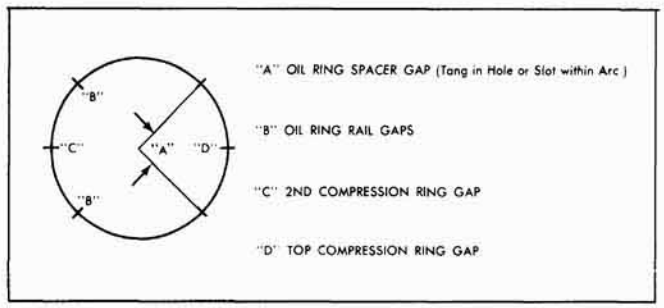


Fig. 6A-62—Ring Gap Location

Tool J-8021 (3-7/8") is available for this purpose.

a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.

b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.

c. Install upper steel oil ring rail with gap properly located.

d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, replace ring.

e. Install second compression ring expander, then ring with gap properly located.

f. Install top compression ring with gap properly located.

9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearance between the surfaces of the ring and groove should be measured. (Fig. 6A-63)

Installation

After honing the cylinder, bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash. After cleaning, the bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

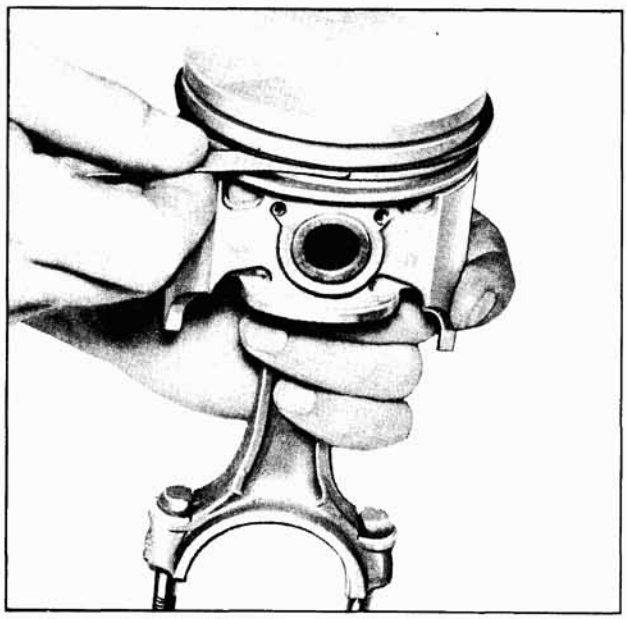


Fig. 6A-63—Measuring Ring Groove Clearance

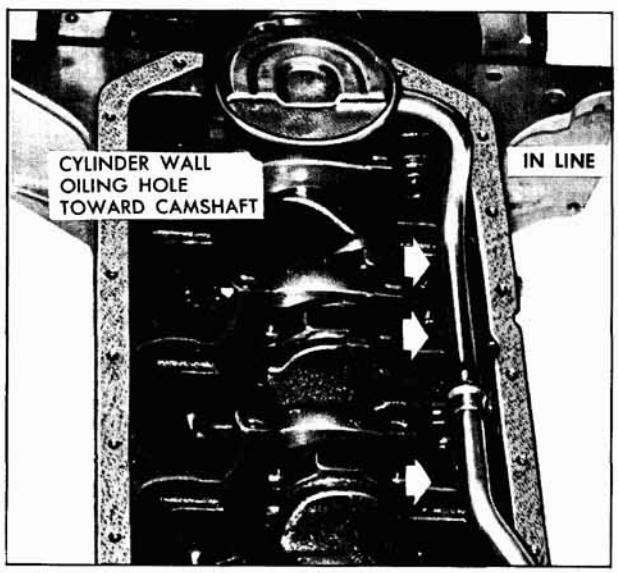


Fig. 6A-64—Connecting Rod - Installed Position

2. Lightly coat pistons, rings and cylinder walls with light engine oil.

3. With bearing caps removed, install short pieces of rubber hose over the connecting rod bolts.

Be sure ring gaps are properly positioned as previously outlined.

4. Install each connecting rod and piston assembly in its respective bore. Install with cylinder wall oiling hole in connecting rod towards camshaft. (Fig. 6A-64) Using a tool such as J-8307, compress the rings, (Fig. 6A-65) Guide the connecting rod into place on the crankshaft journal. Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.

5. Remove rubber hose from connecting rod bolts.

6. Install the bearing caps and torque nuts to specifications.

Fig. 6A-65—Installing Connecting Rod and Piston Assemblies

If bearing replacement is required, refer to CONNECTING ROD BEARINGS. Be sure to install new pistons in the same cylinders for which they were fitted and used pistons in the same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul or without complete disassembly as outlined below.

Removal

1. With the engine removed from the vehicle and the transmission and/or clutch housing removed from the engine, mount engine in overhaul stand and clamp securely.
2. Remove the oil dipstick.
3. Remove the starting motor, clutch assembly (if equipped) and flywheel.
4. Remove the spark plugs.
5. Remove crankshaft pulley and torsional damper.
6. Remove oil pan and oil pump.
7. Remove crankcase front cover.
8. Check the connecting rod caps for cylinder number identification. If necessary, mark them.
9. Remove the connecting rod caps and push the pistons to top of bores.
10. Remove main bearing caps and lift crankshaft out of cylinder block.
11. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

CLEANING AND INSPECTION

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and

crankpins with a micrometer for out-of-round, taper or undersize (see specifications).

3. Check crankshaft for runout by supporting at the front and rear main bearing journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator (see specifications).

4. Replace the crankshaft if out of specifications.

CRANKSHAFT GEAR REPLACEMENT

Refer to CRANKSHAFT GEAR - Replacement. Figs. 6A-48 and 6A-49 illustrate the tools used.

Installation

1. Install the crankshaft as follows:

a. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine.

b. Lubricate lip of seal with engine oil. Keep oil off parting line surface, this surface is treated with glue.

c. Install main bearings in cylinder block and main bearing caps, then lubricate bearing surface with engine oil.

d. Install crankshaft, being careful not to damage bearing surfaces.

e. Install main bearing caps with arrows pointing toward front of engine.

f. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 12 ft. lbs.; then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.

g. Measure crankshaft end play with a feeler gauge. (Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface). Refer to Fig. 6A-52.

h. With crankshaft installed, install the remaining previously removed parts.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.

2. Remove oil gallery plugs and clean all oil passages.

These plugs may be removed with a sharp punch or they may be drilled and pried out.

3. Clean and inspect water passages in the cylinder block.

4. Inspect the cylinder block for cracks in the cylinder walls, water jacket, valve lifter bores and main bearing webs.

5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gauge so that the thrust pin must be forced in about 1/4" to enter gauge in cylinder bore. Center gauge in cylinder and turn dial to "0". Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications honing or boring will be necessary. (Fig. 6A-66)

OIL FILTER BYPASS VALVE INSPECTION AND REPLACEMENT

With the oil filter removed, check the spring and fiber valve for operation. Inspect for a cracked or broken valve. If replacement is necessary, remove valve by prying it out with a screw driver. Install and seat a new valve by taping it in place, using a 9/16" thin-wall deep socket. (Fig. 6A-67)

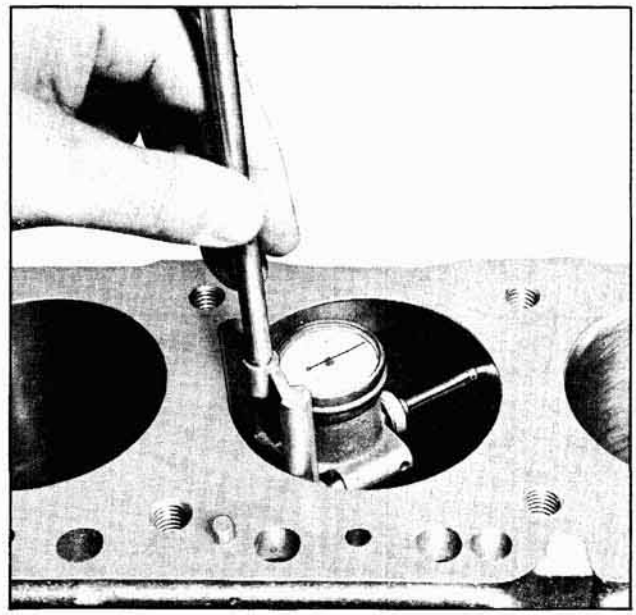


Fig. 6A-66—Measuring Cylinder Bore

DISTRIBUTOR LOWER BEARING AND THRUST WASHER REPLACEMENT

The distributor lower bearing is a bronze bushing pressed into the lower side of the engine block. Its upper diameter pilots the distributor shaft and the diameter extending below the block pilots the oil pump.

Some engines have a thrust washer at the upper end of the bushing bore. The thrust washer, where used, may be replaced at the same time the bushing is replaced.

Fig. 6A-67—Oil Filter Bypass Valve

The lower bushing will ordinarily require only a clearance or wear check during engine overhaul. When distributor shaft to bushing clearance exceeds .0035", the bushing should be replaced as follows with oil pump and distributor removed. (Fig. 6A-68)

1. Install Tool J-9534 into bushing and using a slide hammer, remove the bushing.

2. Using a drift up through bushing bore, drive thrust washer out of bore and remove from block.

3. Clean bushing bore in block and check for burrs or damage.

4. If thrust washer was removed, start new washer in position in bore and drive into place using Tool J-9535.

5. Using Tool J-9535 with driver-bolt in driver handle, install driver into new bushing from large inside diameter.

6. Position bushing and driver to block and drive the bushing in position, which is determined by tool bottoming against the block.

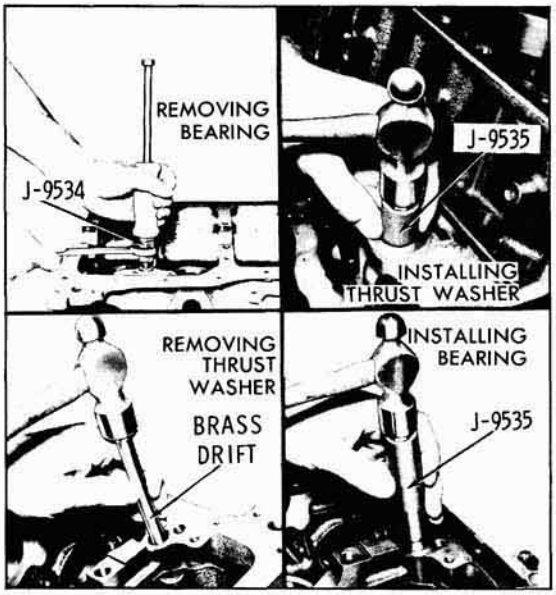


Fig. 6A-68—Replacing Distributor Bearing

7. Remove tool from bushing. It is possible that the bushing with minimum I.D. will collapse enough, during installation, to slightly seize the installer arbor, If this happens, remove installer tool using slide hammer in driver bolt hole of driver handle.

This will not damage the bushing and tool is designed for this purpose should it occur.

REPAIRS

Cylinder Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" taper or wear they can be conditioned with a hone and fitted with the high limit standard size pistons. A cylinder bore of less than .005" wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

CYLINDER BORING

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. Otherwise, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.

2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.

Fig. 6A-69—Cylinder Finish Marks

Hone cylinders as outlined under "Cylinder Honing and Piston Fitting".

3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

CYLINDER HONING

1. When cylinders are to be honed follow the hone manufacturers recommendations for the use of the hone and cleaning and lubrication during honing.

2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.

3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 45° to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal. (Fig. 6A-69)

4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as piston can be distorted through careless handling.

5. Thoroughly clean the cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil. The bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth. Cylinders should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

PISTON SELECTION

1. Check USED piston to cylinder bore clearance as follows:

a. Measure the "Cylinder Bore Diameter" with a telescope gauge (2-1/2" from top of cylinder bore).

b. Measure the "Piston Diameter" (at skirt across center line of piston pin).

c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".

d. Locate piston to bore clearance on Piston Selection Chart. (Fig. 6A-70) and determine if piston to bore clearance is in the acceptable range.

2. If used piston is not acceptable, check Piston Size Chart and determine if a new piston can be selected to fit cylinder bore within the acceptable range.

3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance (Preferable Range).

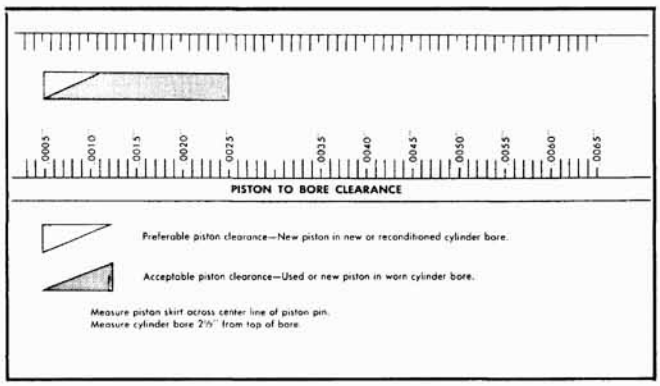


Fig. 6A-70—Piston Selection Chart

PISTON SIZES AVAILABLE			
Std.	Oversize		
	.001"	.020"	.030"
3.8750"	3.8760"	3.8937"	3.9037"
3.8760"	3.8780"	3.8957"	3.9057"

4. Mark the piston to identify the cylinder for which it was fitted.

FLYWHEEL

Removal

With transmission and/or clutch housing and clutch removed from engine, remove the flywheel.

Installation

1. Clean the mating surfaces of flywheel and crankshaft to make certain there are no burrs.
2. Install flywheel on crankshaft and position to align dowel hole of crankshaft flange and flywheel. (Fig. 6A-71)

On Automatic Transmission equipped engines, the flywheel must be installed with the flange collar to transmission side.

3. Install bolts and torque to specifications.

ENGINE MOUNTS

Engine mounts (Fig. 6A-72) are the nonadjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Front Mount Replacement

1. Remove nut, washer, spacer then engine mount through bolt.
2. Raise engine to release weight from mount.
3. Remove mount, stop bracket and frame bracket assembly from crossmember, then remove stop bracket and mount from frame bracket.
4. Install stop bracket and new mount on frame bracket, then install assembly on crossmember.
5. Lower engine, install through bolt and tighten all mount bolts to specified torques.

Rear Mount Replacement

1. Remove crossmember to mount bolts.

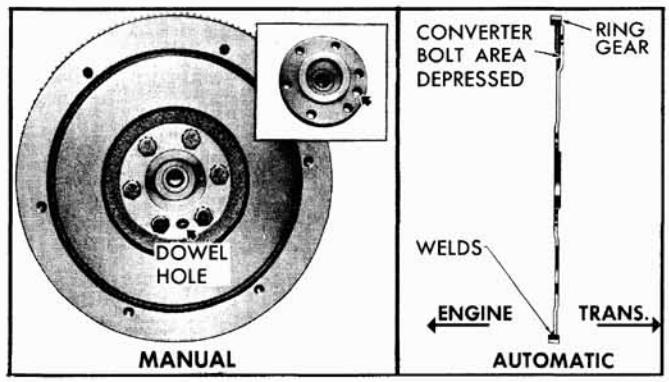


Fig. 6A-71—Flywheel Installation (Typical)

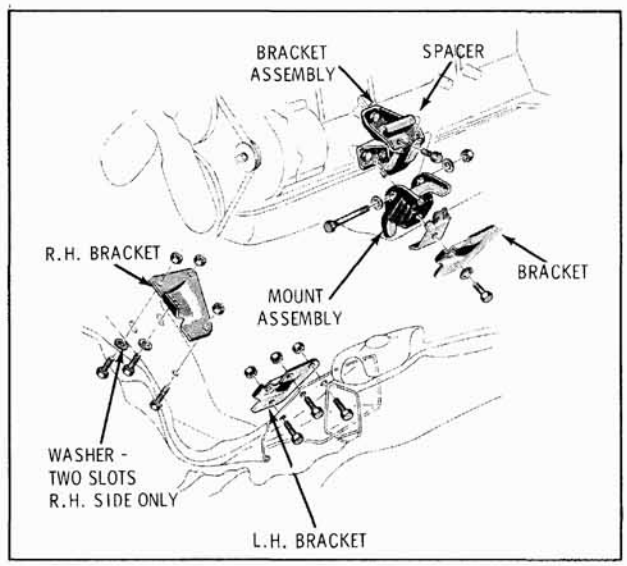


Fig. 6A-72—Engine Mounts

2. Raise transmission to release weight from mount.
3. Remove mount to transmission bolts, then remove mount and spacer.
4. Install spacer and new mount on transmission. Torque bolts to 55 ft. lbs.
5. While lowering transmission, align and start crossmember to mount bolts.
6. Lower transmission and torque transmission to crossmember bolts to 55 ft. lbs.

ENGINE OIL LEAK DIAGNOSIS

1. Clean engine with solvent to remove all traces of oil.
2. Remove the flywheel lower cover.
3. Spray suspected leak areas with foot powder (use a pressurized can).
4. Remove oil filler cap, crankcase breather and/or positive crankcase ventilation valve. Seal all openings with masking or cloth body tape.
5. Start engine and run at 3000 to 3500 rpm. This pressurization of the crankcase will cause even a small leak to become visible.
6. Repair any leaks which are detected and recheck as necessary. Remove tape and reinstall previously removed parts.

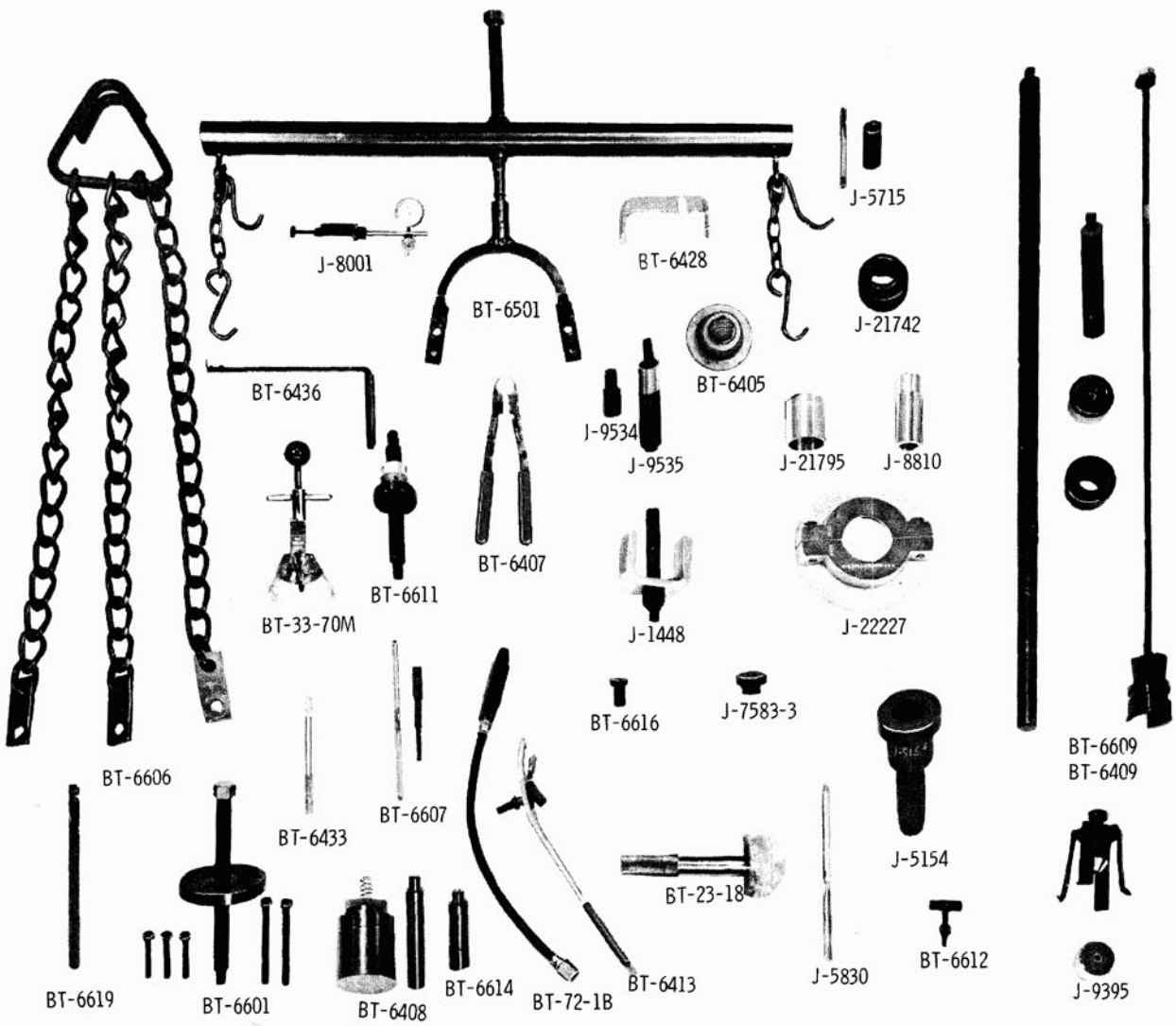
TORQUE SPECIFICATIONS		
SIZES	**APPLICATION**	**TORQUE**
1/4-20	Camshaft Thrust Plate	7 ft. lbs.
	Crankcase Front Cover	7 ft. lbs.
	Flywheel Housing Pans	7 ft. lbs.
	Oil Pan (To Crankcase)	7 ft. lbs.
	Oil Pan (To Front Cover)	5 ft. lbs.
	Oil Pump Cover	6 ft. lbs.
	Rocker Arm Cover	5 ft. lbs.
11/32-24	Connecting Rod Cap	35 ft. lbs.
5/16-18	Clutch Pressure Plate	20 ft. lbs.
	Oil Pan (To Crankcase)	10 ft. lbs.
	Oil Pump	9 ft. lbs.
	Push Rod Cover	7 ft. lbs.
	Water Pump	15 ft. lbs.
3/8-16	Distributor Clamp	10 ft. lbs.
	Flywheel Housing	30 ft. lbs.
	Manifold (Exhaust to Intake)	25 ft. lbs.
	Manifold Clamp (Outer)	20 ft. lbs.
	Manifold Clamp (All Others)	30 ft. lbs.
	Thermostat Housing	30 ft. lbs.
	Water Outlet	20 ft. lbs.
7/16-14	Main Bearing Cap	65 ft. lbs.
7/16-20	Flywheel	60 ft. lbs.
1/2-13	Cylinder Head	95 ft. lbs.
1/2-14	Temperature Sending Unit	20 ft. lbs.
1/2-20	Oil Filter	Hand Tight
	Oil Pan Drain Plug	20 ft. lbs.
14MM	Spark Plug	25 ft. lbs.

L-6 ENGINE SPECIFICATIONS

GENERAL DATA		
Displacement		250
Horsepower @ rpm		155 @ 4200
Torque @ rpm		235 @ 1600
Bore		3-7/8"
Stroke		3.53"
Compression Ratio		8.5:1
Firing Order		1-5-3-6-2-4
CYLINDER BORE		
Diameter		3.8745" - 3.8775"
Out-of-Round		.002" Max.
Taper		.005" Max.
PISTON		
Clearance		.0025" Max.
PISTON RING	Production	Service
Groove Clearance (Compression)	.0020"-.0038"	Hi Limit Production + .001"
Gap	.010"-.020"	Hi Limit Production + .01"
Groove Clearance (Oil)	.000"-.005"	Hi Limit Production + .001"
Gap	.015"-.055"	Hi Limit Production + .01"

L-6 ENGINE SPECIFICATIONS (Cont'd.)

PISTON PIN			
Diameter			.9270" - .9273"
Clearance			.001" Max.
Fit In Rod			.0008" - .0016" (Interference)
CRANKSHAFT			
Main Journal		Diameter	2.2983" - 2.2993"
Main Journal		Taper	.001" Max.
		Out-of-Round	.001" Max.
Main Bearing Clearance			.004" Max.
Crankshaft End Play			.002" - .006"
Crankpin		Diameter	1.999" - 2.000"
		Taper	.001" Max.
		Out-of-Round	.001" Max.
Rod Bearing Clearance			.004" Max.
Rod Side Clearance			.0085" - .0135"
CAMSHAFT			
Lobe Lift ± .002"		Intake	.2217"
		Exhaust	.2217"
Journal Diameter			1.8682" - 1.8692"
Camshaft Runout			.0015" Max.
VALVE SYSTEM			
Lifter			Hydraulic
Rocker Arm Ratio			1.75:1
Valve Lash			Intake One Turn Down From Zero Lash
			Exhaust One Turn Down From Zero Lash
Face Angle (Intake and Exhaust)			45°
Seat Angle (Intake and Exhaust)			46°
Seat Runout (Intake and Exhaust)			.002" Max.
Seat Width		Intake	1/32" - 1/16"
		Exhaust	1/16" - 3/32"
Stem Clearance		Intake	.0010" - .0027"
		Exhaust	.0015" - .0032"
Valve Spring	Free Length		1.90"
	Pressure	Closed	56 - 64 @ 1.66"
	Lbs. @ In.	Open	180 - 192 @ 1.27"
	Installed Height ± 1/32"		1-21/32"



BT-23-18	REAR SEAL MAIN BRG. SEAL INST. 400 & 425 CU. IN. ONLY (V-8)
BT-60	VALVE LIFTER BLEEDER (V-8 & L-6)
BT-72-1B	VALVE HOLDER AIR HOSE (V-8 & L-6)
J-1448	CLUTCH PILOT BUSHING REMOVER (L-6)
J-5154	CRANKSHAFT TIMING GEAR AND FRONT OIL SEAL INSTALLER (L-6)
J-5515	SCALE GAUGE (V-8 & L-6)
J-5715	ROCKER ARM STUD REAMER .003" O. S. (L-6)
J-5830	-1 - .003" O. S. VALVE GUIDE REAMER (L-6) -2 - .015" O. S. VALVE GUIDE REAMER (L-6) -3 - .030" O. S. VALVE GUIDE REAMER (L-6)
J-6036	ROCKER ARM STUD REAMER .013" O. S (L-6)
BT-6405	FRONT COVER SEAL INSTALLER (V-8)
BT-6406	FRONT SEAL REMOVER (V-8 & L-6)
BT-6407	VALVE LIFTER REMOVER (V-8 & L-6)
BT-6408	PISTON PIN TOOLS (V-8 & L-6)
BT-6409	CAMSHAFT BEARING SET (V-8)
BT-6413	VALVE SPRING COMPRESSOR (V-8 & L-6)
BT-6428	VALVE STEM HEIGHT GAUGE (V-8)
BT-6433	REAR MAIN BRG. OIL SEAL PUNCH (V-8)
BT-6436	REAR MAIN BRG. SEAL CUT-OFF TOOL (V-8)
BT-6501	ENG. SUPPORT BAR TO REMOVE OIL PAN (V-8) -1 - YOKE -2 - SCREW -3 - TUBE -4 - CHAIN
BT-6601	SCREW FROM TORSION BAR REM. & INST. (L-6)
BT-6606	ENGINE LIFT CHAIN (V-8 & L-6)
BT-6607	EXH. MAINFOLD HEAT RISER BUSHING SET (V-8)
BT-6609	CAMSHAFT BEARING SET (L-6)
BT-6610	CRANKSHAFT PULLEY AND GEAR REMOVER PLATE (L-6)
BT-6611	CRANKSHAFT PULLEY INSTALLER (V-8)
BT-6612	VALVE SPRING COMPRESSOR ADAPTER (V-8)
BT-6614	PISTON PIN ADAPTER (V-8 & L-6)
BT-6616	CRANKSHAFT PULLEY REMOVER PILOT SCREW 1/2" BOLT HOLE (V-8)
BT-6618	CLUTCH PILOT BEARING INSTALLER (V-8)
BT-6619	CLUTCH PILOT BEARING REMOVER (V-8)
J-7583-3	PILOT SCREW (USED WITH J-8614) 3/4" BOLT HOLE (V-8)
J-8001	DIAL INDICATOR (V-8 & L-6)
J-8810	CAMSHAFT GEAR REMOVER (L-6)
J-8880	VALVE ROCKER ARM STUD INSTALLER (L-6)
J-9395	PILOT FOR TOOL BT-6406 (L-6)
J-9534	DISTRIBUTOR BUSHING REMOVER (L-6)
J-9535	DISTRIBUTOR BUSHING INSTALLER (L-6)
J-21742	FRONT COVER CENTERING GAUGE (L-6)
J-21795	CAMSHAFT GEAR INSTALLER (L-6)
J-22227	CAMSHAFT GEAR REMOVAL PLATE (L-6)

Fig. 6A-73—Tools

V-8 ENGINE

CONTENTS OF SECTION 6B

Subject	Page
DESCRIPTION	6B-1
LUBRICATION SYSTEM	6B-1
ENGINE ASSEMBLY	
REMOVAL	6B-2
INSTALLATION	6B-3
ENGINE MOUNTING	6B-4
INTAKE MANIFOLD	6B-4
EXHAUST MANIFOLD	6B-5
MANIFOLD HEAT CONTROL VALVE	6B-6
VALVE COVER	6B-6
ROCKER ARMS	6B-6
VALVE LIFTERS	
OPERATION	6B-7
ASSEMBLY AND VALVE LIFTER LEAK-DOWN TEST	6B-8
VALVE LIFTER DIAGNOSIS	6B-9
CYLINDER HEAD AND GASKET	6B-10
VALVES AND SPRINGS (HEAD REMOVED)	6B-11
MEASURING VALVE STEM HEIGHT	6B-12
VALVE GUIDES	6B-13
REAMING PROCEDURE	6B-13
REPLACING VALVE SPRING (HEAD ON ENGINE)	6B-13
OIL PAN (350 and 455 CU. IN.)	6B-14
OIL PAN (400 CU. In.)	6B-15
OIL PUMP	6B-15
CONNECTING ROD AND PISTON ASSEMBLY	6B-15
ROD BEARINGS	6B-16
ROD ASSEMBLY	6B-17
PISTON	
MEASURING PISTON	6B-17
CHECKING CYLINDER BORE	6B-18
CLEANING PISTON	6B-18
RINGS	
RING TOLERANCE	6B-18
PISTON RING AND RAIL GAP	6B-18
SIDE CLEARANCE	6B-18
RING IDENTIFICATION AND INSTALLATION	6B-19
ROD AND PISTON ASSEMBLY	6B-19
PISTON PINS	6B-19
CRANKSHAFT PULLEY	6B-20
HARMONIC BALANCER	6B-20
FRONT COVER	6B-22
OIL SEAL	6B-22
TIMING CHAIN AND GEARS	6B-22
CHECKING VALVE TIMING WITHOUT REMOVING FRONT COVER	6B-23
CAMSHAFT	6B-23
CAMSHAFT BEARINGS	6B-24
CAMSHAFT AND OIL GALLEY PLUGS	6B-25
CRANKSHAFT	6B-25
MAIN BEARINGS	6B-27
REAR MAIN OIL SEAL	6B-28
PILOT BEARING	6B-29
FLYWHEEL	6B-30
FUEL PUMPS	6B-31
OIL DIPSTICK IDENTIFICATION	6B-33
SPECIFICATIONS	6B-34
TORQUE SPECIFICATIONS	6B-40
TOOLS	6B-41
ENGINE VIEW	6B-42

DESCRIPTION

The same basic V-8 engine is used in all series. The 350, 400 and 455 cu. in. engines, with the exception of cylinder bore size, are very similar. Because of the similarity between the three engines, the service procedures and illustrations, unless otherwise specified, will be combined.

The left bank of cylinders (as viewed from the driver's seat) are numbered (from front to rear) 1-3-5-7. Cylinders in the right bank are numbered (from front to rear) 2-4-6-8. (Fig. 6B-100)

The required engine maintenance, engine unit numbers and engine identification is outlined in Section 0 of this manual. The engine specifications are listed at the back of this section.

For servicing the Controlled Combustion System, refer to Section 6N of this manual.

ENGINE LUBRICATION SYSTEM

The engine oil pan forms a reservoir for engine oil to provide lubrication and also hydraulic fluid to operate the valve lifters. Oil pressure for lubrication is furnished by a gear type oil pump that is bolted to the rear main bearing cap and driven by a camshaft gear through a hexagonal drive shaft.

Oil enters the pump through a screened inlet located near the bottom rear of the oil pan. The pressurized oil from the pump passes through the oil filter located on the right rear side of the engine block. It then enters the right oil gallery from which passages distribute it to the five main bearings. The right bank of valve lifters receive oil from this gallery from eight feed holes that intersect the gallery.

The five camshaft bearings are lubricated from vertical passages intersecting the main bearing oil passages. At the front main bearing a third passage connects the right main oil gallery to the left gallery which then feeds the left bank of valve lifters.

The engine oil pressure warning light switch is connected to the front of the left oil gallery. The switch is calibrated to actuate the instrument panel warning light when engine oil pressure is too low. At the front end of the right gallery a small orifice sprays oil to lubricate the fuel pump eccentric cam and the timing chain.

The oil pump and distributor drive gear are lubricated by splash from the rear cam bearing and connecting rod bearings.

The rocker arms and valve tips are lubricated by means of oil furnished to them through the hydraulic lifters and hollow push-rods. A disc valve in the lifter meters oil to the push-rods.

The connecting rod bearings are oiled by constant oil flow

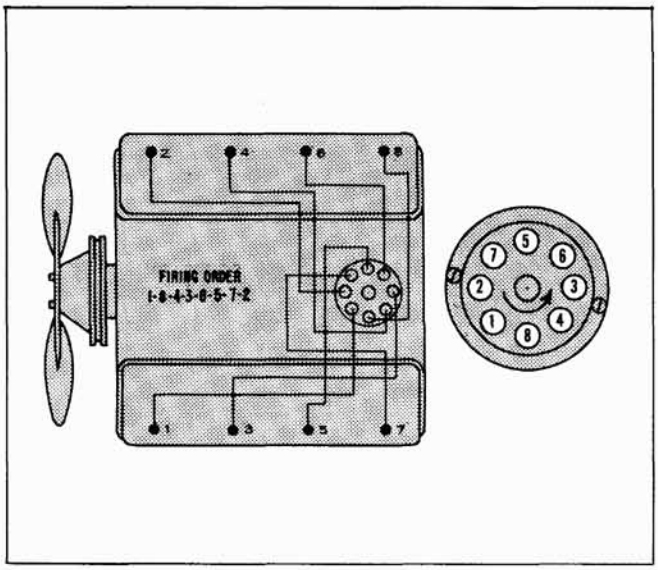


Fig. 6B-100—Cylinder Numbers

from passages drilled through the crankshaft connecting the main journals to the rod journals. A groove around each main bearing furnishes oil to the drilled crankshaft passages. An intermittent spray from the connecting rods lubricates the cylinder walls and piston pins when the drilled hole in the rod indexes with the rod journal passage.

Oil returns to the oil pan reservoir from the rocker arms through passages at each end of the cylinder heads. Oil from the valve lifter compartment returns through clearance holes in the lower portion of the compartment near the camshaft. The timing chain compartment drains directly into the oil pan.

ENGINE ASSEMBLY

Removal

1. Drain radiator.
2. Remove hood, mark hinge for reassembly.
3. Disconnect battery.
4. Remove air cleaner and hot air pipe.
5. Disconnect radiator hoses, heater hoses, vacuum hoses, power steering pump hoses (as necessary), starter cable at battery engine to body ground strap, fuel hose from fuel line, wiring and accelerator linkage.
6. Remove fan blade and fan pulley, coil and upper radiator support.
7. Raise car.
8. Disconnect exhaust pipes at manifold.
9. Remove torque converter cover and install Converter Holding Tool J-21654.
10. Remove engine mount through bolts.
11. Secure transmission chain support BT-6322 to frame.
12. Remove three bolts, converter to flywheel.
13. Remove five bolts, transmission to engine, leaving top left bolt in to hold engine and transmission together.
14. Lower car.
15. Secure Lift Chain BT-6606 to engine, remove remaining transmission to engine bolt and remove engine. (Fig. 6B-101)

Be careful of vacuum modulator line.

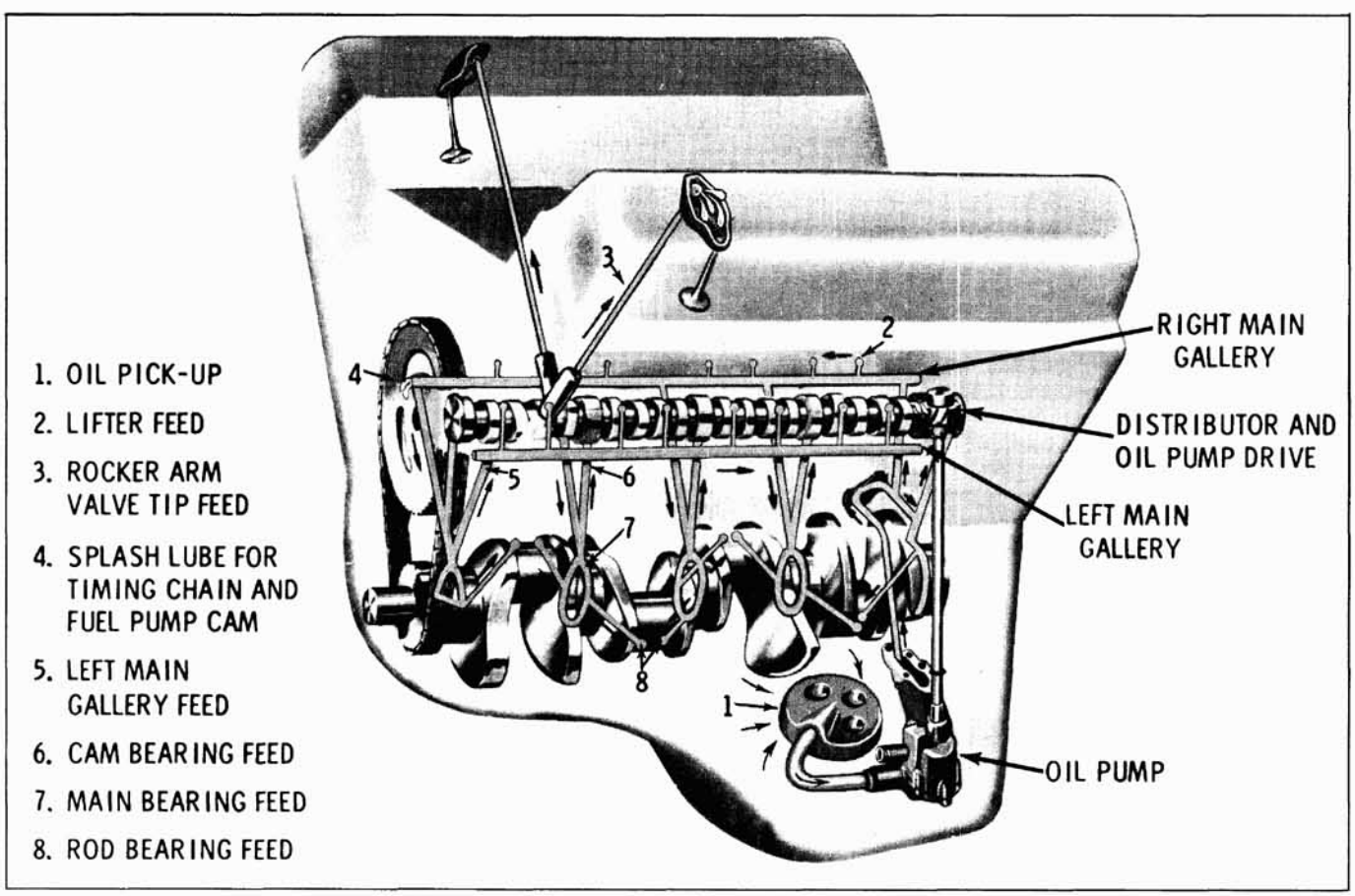


Fig. 6B-100A—Engine Lubrication System

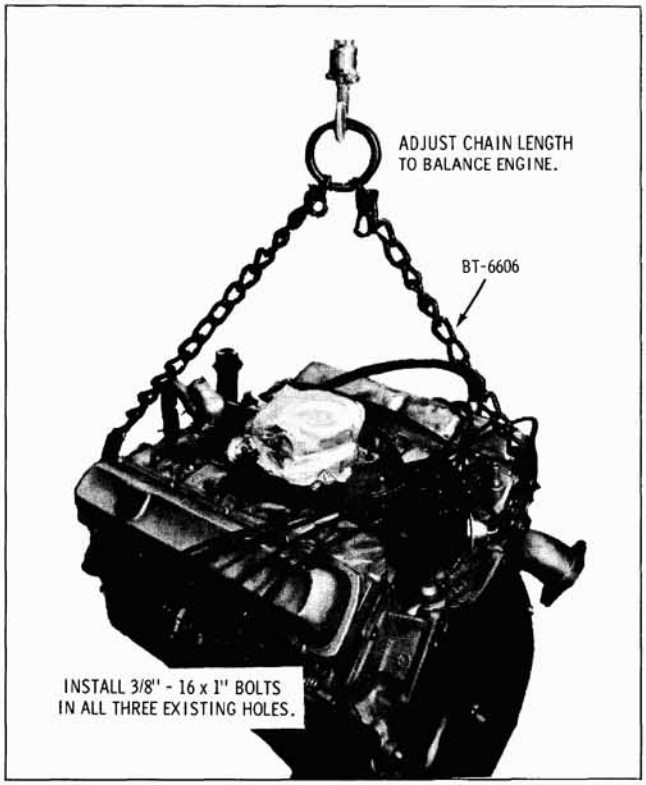


Fig. 6B-101—Engine Lift Fixture

Installation

1. Fasten Chain BT-6606 to engine.

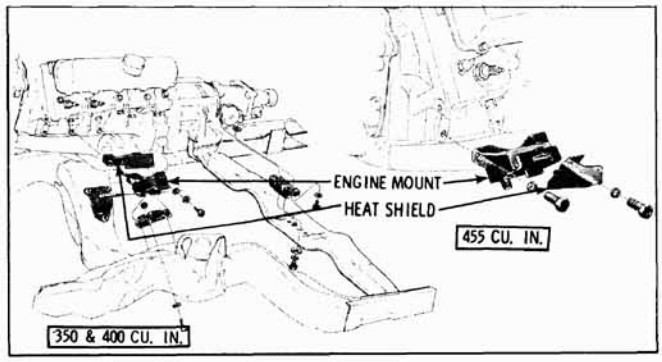


Fig. 6B-102—Engine Mounting Heat Shield

2. Locate engine dowels into transmission and position through bolts into mounts and tighten.
3. Raise car.
4. Replace six bolts, transmission to engine.
5. Replace three bolts, converter to flywheel.
6. Remove Converter Holding Tool J-21654 and replace torque converter cover.
7. Remove transmission support chain.
8. Connect exhaust pipes to manifold.
9. Lower car and remove lift chain.
10. Reconnect radiator hoses, heater hoses, vacuum hoses, power steering pump hoses (as necessary), starter cable at junction block, engine to body ground strap, fuel hose to fuel line, wiring and accelerator linkage.
11. Replace fan pulley, fan blade, upper radiator support and coil. Replace hot air pipe and air cleaner.

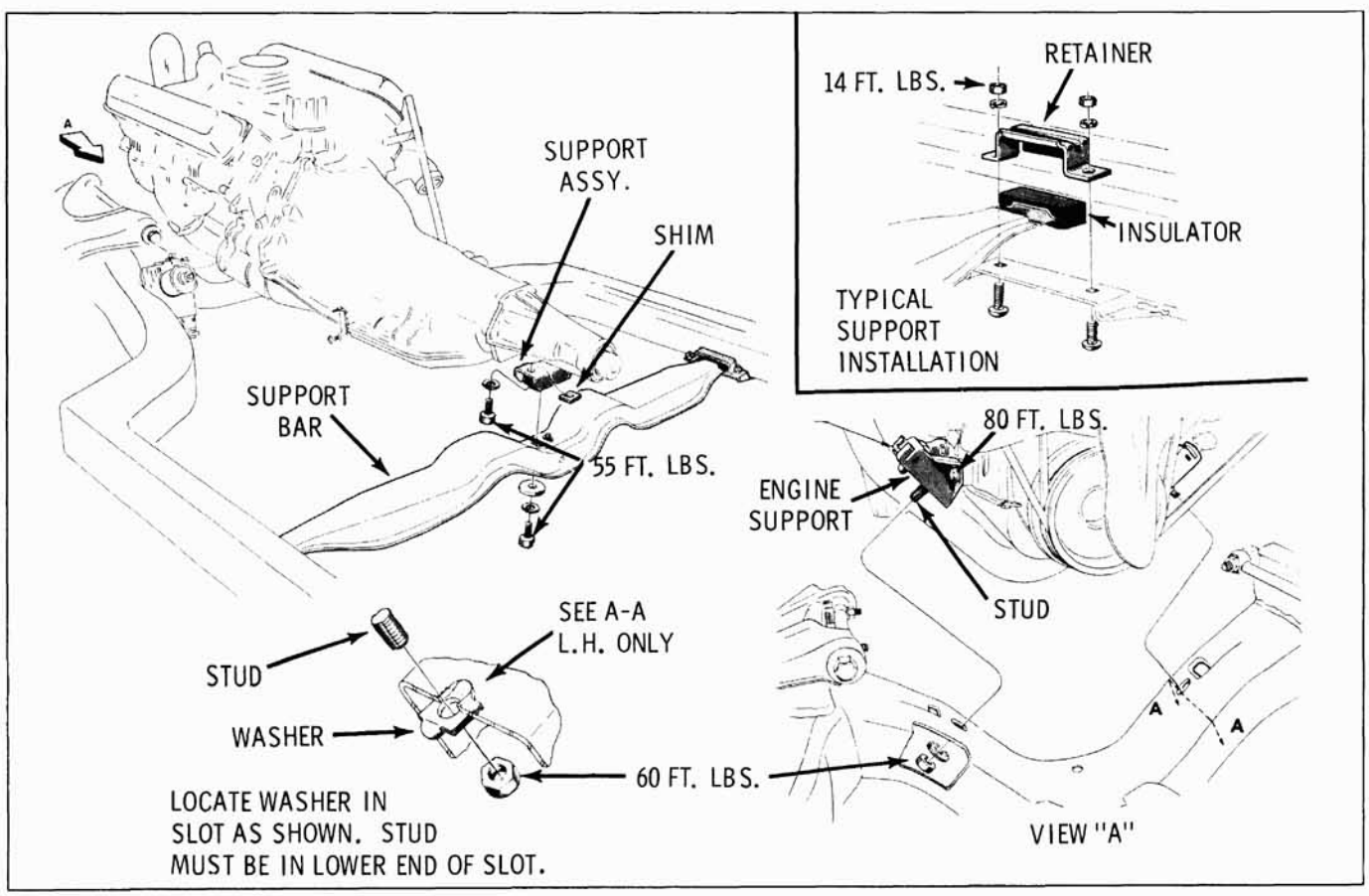


Fig. 6B-103—Engine Mounting (54-86 Series)

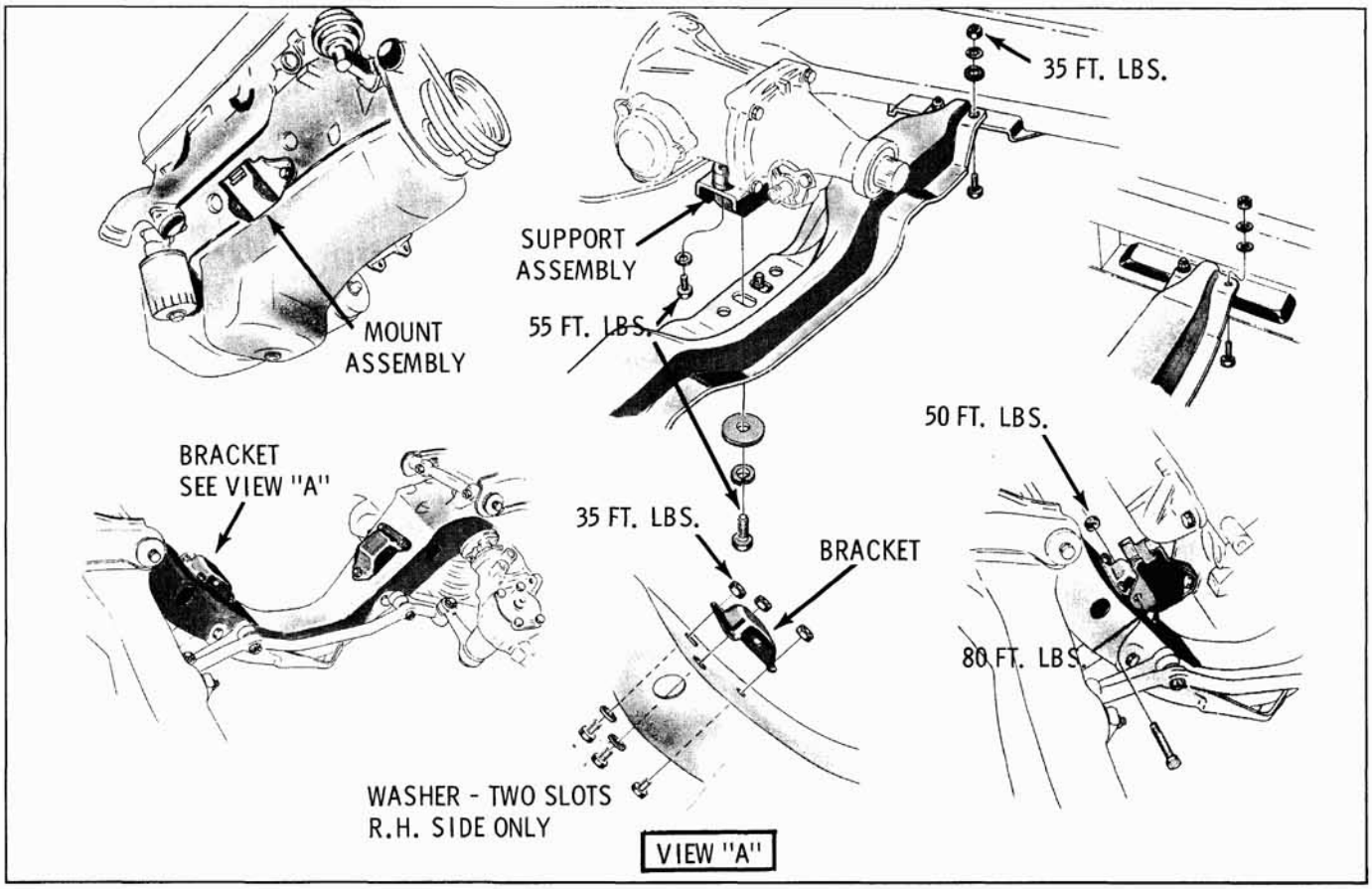


Fig. 6B-104—Engine Mounting (32, 36, 42, 44, 48 Series)

12. Install and align hood.
13. Fill radiator.
14. Connect battery.

ENGINE MOUNTING

Refer to Figs. 6B-102, 6B-103 and 6B-104.

INTAKE MANIFOLD

Removal

1. Remove air cleaner assembly.
2. Drain radiator, then disconnect upper radiator hose and thermostat bypass hose from water outlet. Also, disconnect heater hose at rear of manifold.

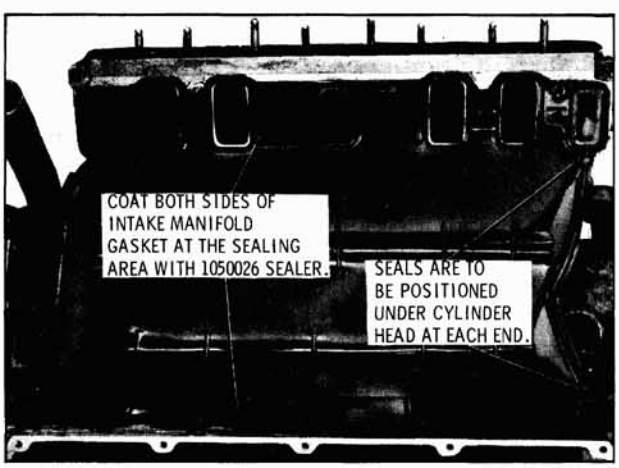


Fig. 6B-106—Intake Manifold Gasket

3. Disconnect throttle linkage.
4. Remove fuel and all vacuum lines.
5. Remove coil mounting bolt. Wires may be left connected to coil if desired.
6. Disconnect and/or remove delcotron and air conditioning compressor brackets as necessary.
7. Disconnect temperature gauge wire.
8. Remove intake manifold bolts; then remove manifold with carburetor attached.

It will be necessary to remove the distributor on 400 and 455 cu. in. engines to provide removal clearance.

9. Clean machined surfaces of cylinder head and intake manifold with a putty knife. Use care not to gouge or scratch machined surface.

Installation

1. Coat both sides of gasket sealing surface that seal the intake manifold to the head with 1050026 Sealer or equivalent and position intake manifold gasket.
2. Install end seals, make sure that ends are positioned under cylinder heads as shown in Fig. 6B-106.
3. Position intake manifold on engine and connect thermostat bypass hose to water pump.
4. Dip intake manifold bolts in engine oil and torque in sequence shown to 15 ft. lbs. Then re-torque to 35 ft. lbs. (Fig. 6B-107). Position coil and install mounting bolt.
5. Connect temperature gauge wire.
6. Install fuel and vacuum lines.
7. Connect upper radiator hose, spark plug wires, heater hose, throttle linkage and install air cleaner assembly.
8. Fill cooling system.

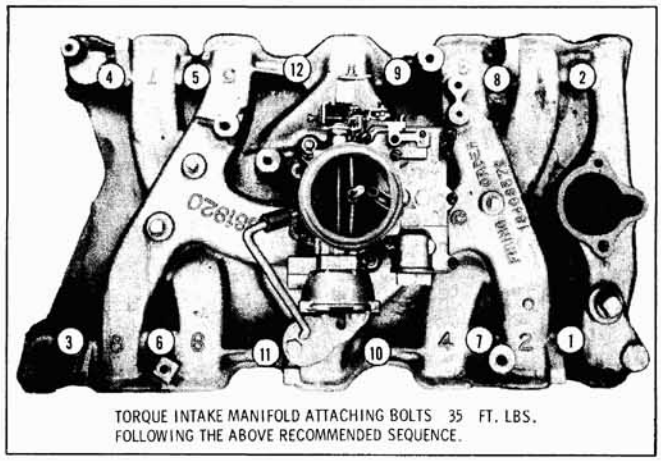


Fig. 6B-107—Intake Manifold Torque Sequence

Refer to Section 0, PERIODIC MAINTENANCE, for cooling system recommendations.

CHOKE HEAT STOVE

Fig. 6B-108 shows an exploded view of the 2 barrel choke heat stove.

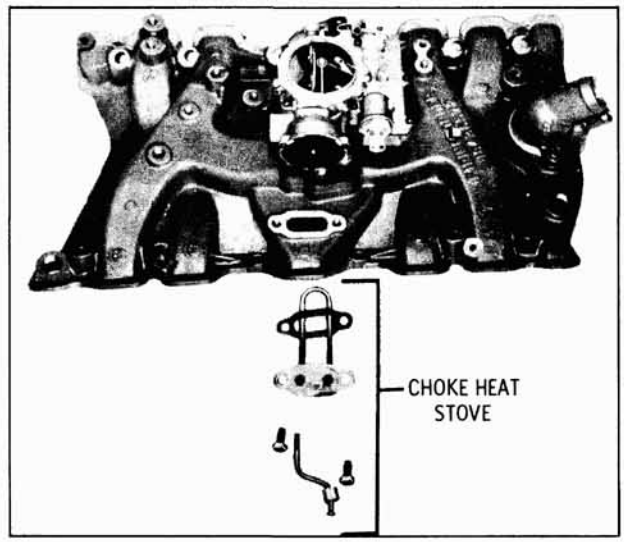


Fig. 6B-108—Intake Manifold Choke Heat Stove

EXHAUST MANIFOLD

Removal

1. Remove the crossover pipe (disconnect exhaust pipe if equipped with dual exhaust).
2. For the right manifold, disconnect the exhaust pipe.
3. Straighten lock tabs and remove the manifold to head attaching bolts, washers and locks and remove the manifold.
4. Remove sheet metal screws from the manifold shroud.
5. Clean manifold and cylinder head machined surfaces with a putty knife. Use care not to gouge or scratch machined surfaces.

Installation

1. Install shroud sheet metal screws.
2. Install manifold to head bolts and torque to 25 ft. lbs.
3. Bend bolt locks to retain bolts.
4. Reconnect disconnected parts.

L.H. EXHAUST MANIFOLD 455 CU. IN. ENGINE

1. Disconnect battery cable.
2. Remove flywheel housing cover.

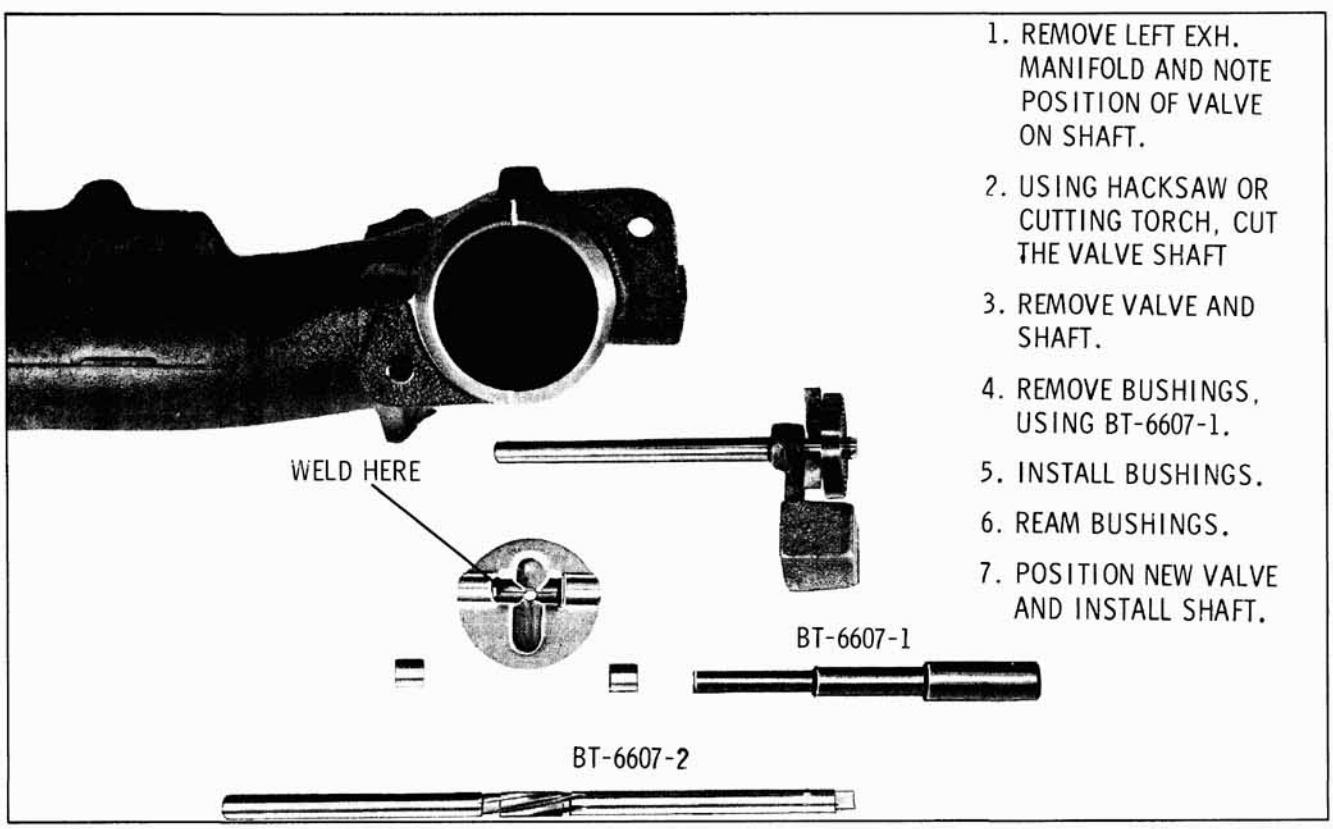


Fig. 6B-109—Heat Control Valve Installation

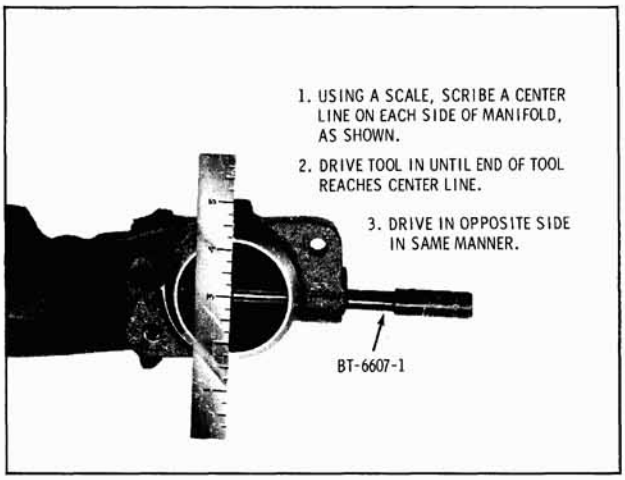


Fig. 6B-110—Scribing Exhaust Manifold

3. Remove starter attaching bolts and wire or tie starter to one side to gain access.
4. Disconnect exhaust pipe.
5. Straighten manifold attaching bolt lock tabs. Remove bolts and locking tabs.
6. Remove manifold from underside of engine.

To install, reverse removal procedure. Refer to Torque Specification chart for correct torque.

MANIFOLD HEAT CONTROL VALVE

Refer to Figs. 6B-109, 6B-110 and 6B-111.

VALVE COVER

Removal

1. Disconnect positive crankcase ventilation from valve cover.
2. Disconnect spark plug wires and move away from valve cover.
3. Remove valve cover to cylinder head attaching screws. Remove accessory mounting brackets as necessary and remove valve cover.

Installation

Reverse removal procedure. Torque valve cover attaching screws to 7 ft. lbs. For mounting bracket, torque attaching bolts as follows:

5/16" thread	25 ft. lbs.
3/8" thread	35 ft. lbs.
7/16" thread	50 ft. lbs.

ROCKER ARM ASSEMBLIES (Fig. 6B-112)

Removal

1. Remove valve cover.
2. Remove rocker arm, flanged bolts, pivot and rocker arms.

Remove each set (one set per cylinder) as a unit.

Installation

1. Position a set of rocker arms (for one cylinder) in the proper location.
2. Lubricate wear points with 1050169 Lubricant or equivalent and install the pivots.

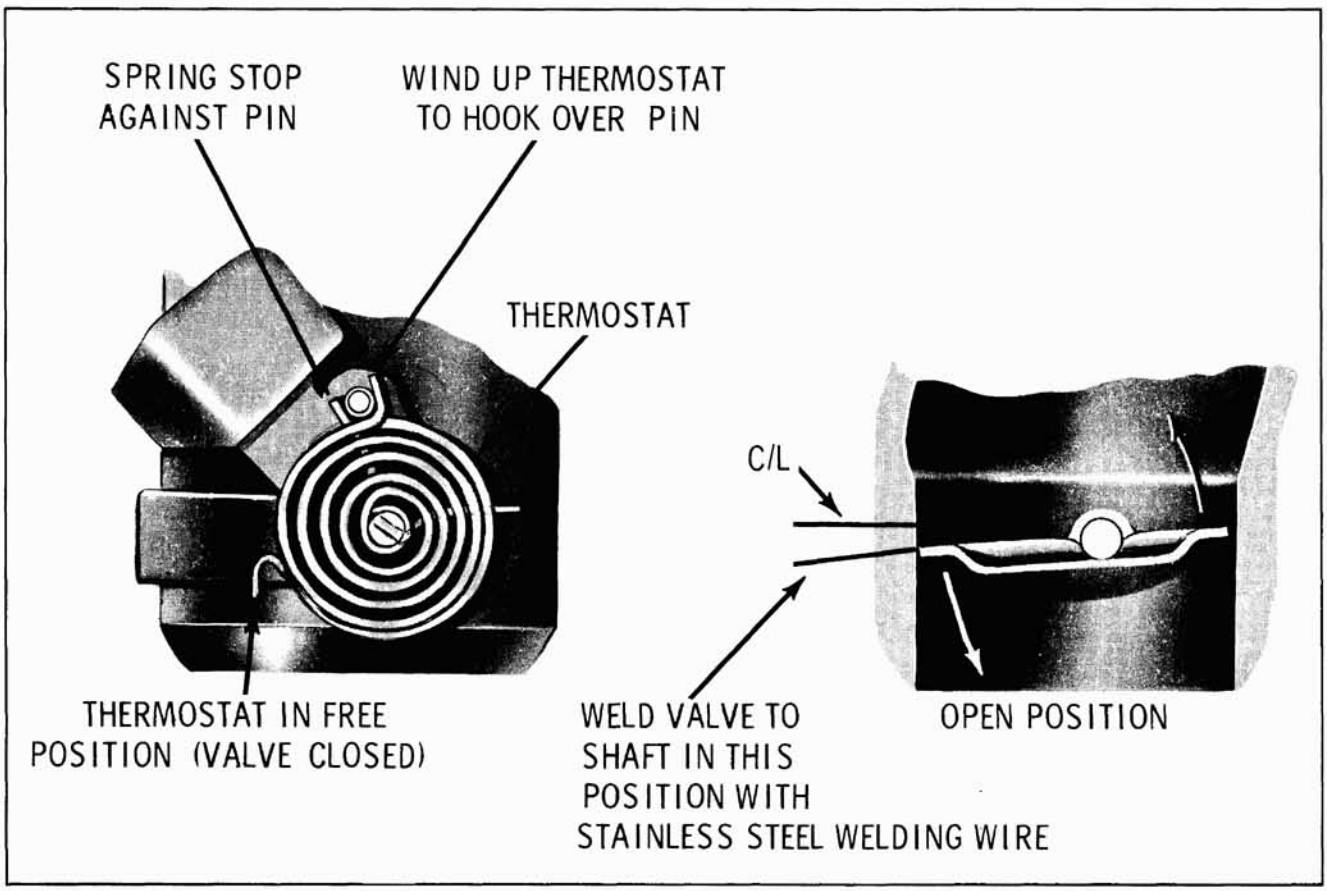


Fig. 6B-111—Heat Control Valve Operation

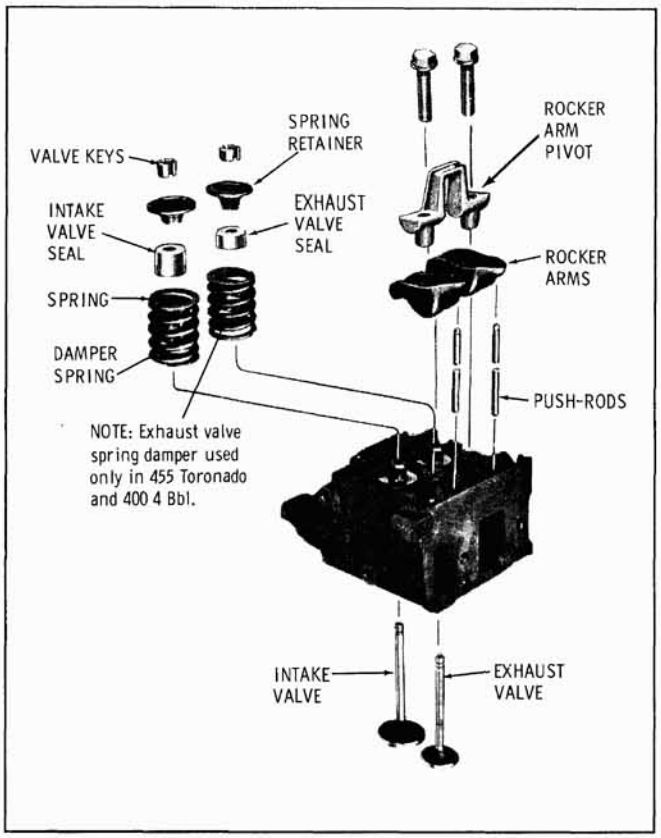


Fig. 6B-112—Cylinder Head Exploded View

3. Install the hardened flanged bolts. Torque bolts to 25 ft. lbs.

Both lifters should be in closed valve position when installing bolts.

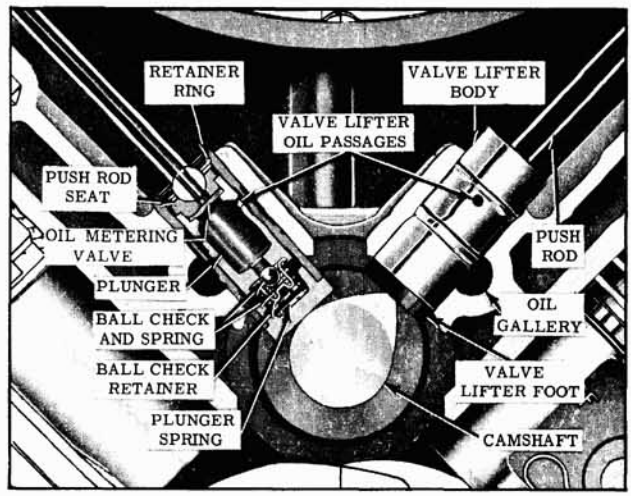


Fig. 6B-113—Valve Lifter Operation

VALVE LIFTERS

Operation

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the push-rods to the rocker arms. (Fig. 6B-113)

When the lifter begins to ride up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push-rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push-rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rides down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring

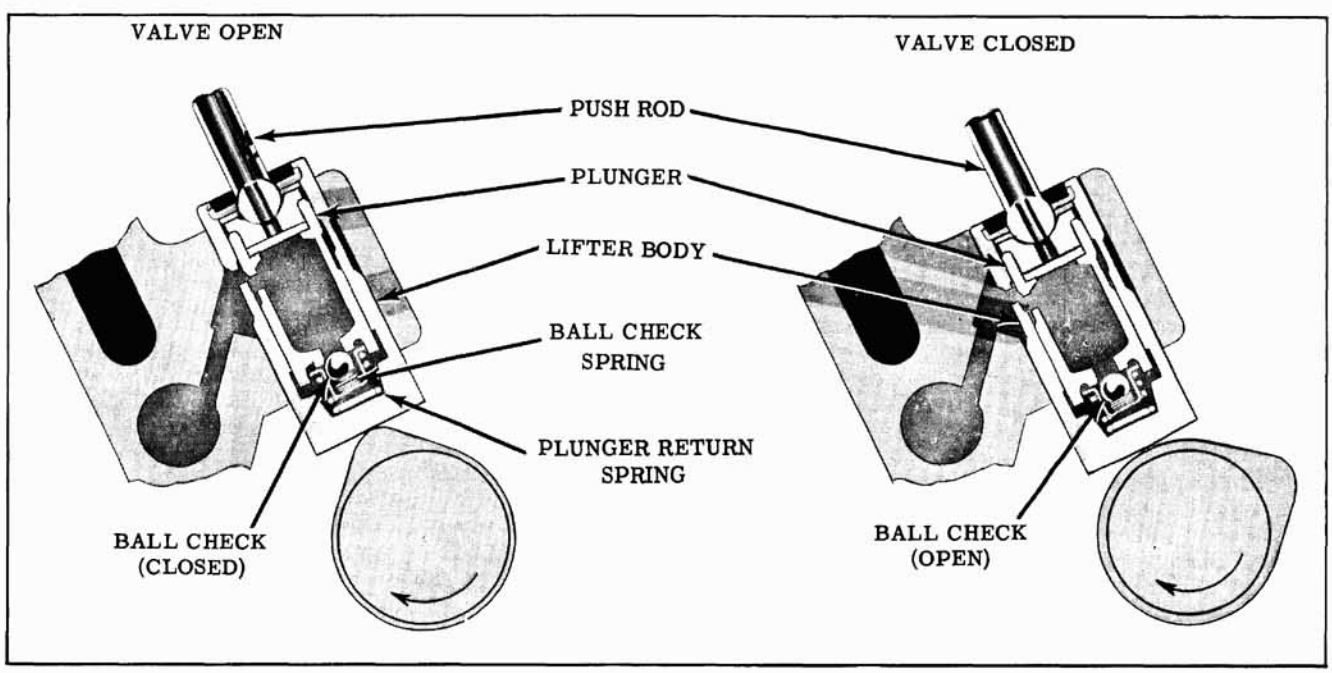


Fig. 6B-114—Valve Lifter Cutaway

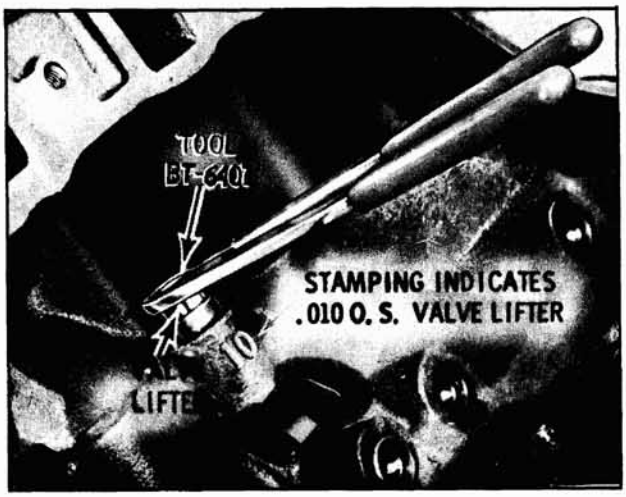


Fig. 6B-115—Removing Valve Lifter

quickly moves the plunger back (up) to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash. (Fig. 6B-114)

Removal

Valve lifters and push-rods should be kept in order so they can be reinstalled in their original position. Some engines will have both standard and .010" oversize valve lifters, the .010" oversize lifter is etched "10" on the side of the lifter. The cylinder block will also be marked if the oversize lifter is used.

1. Remove intake manifold and gasket.
2. Remove valve covers, rocker arm assemblies and push-rods.
3. On varnished lifters, apply carburetor cleaning solution to lifter body. Allow five minutes for solution to remove varnish.

Carburetor cleaning solvent should be used in a well ventilated room. Avoid contact with skin and prolonged breathing of fumes.

4. Remove lifters. Use of Tool BT-6407 will aid in removal of varnished lifters. (Fig. 6B-115)

Disassembly

1. Remove retainer spring with Tool BT-31 or small screwdriver.
2. Remove push-rod seat and oil control valve.
3. Remove plunger and plunger spring. If plunger is stuck tight, allow lifter to soak in carburetor cleaning solvent for approximately five minutes, then remove. Available Tool BT-6438 can be used to remove plunger.

Remove ball check retainer from plunger, then remove ball and spring.

Cleaning and Inspection

After lifters are disassembled, all parts should be cleaned in clean solvent. A small particle of foreign material under the ball check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the body or plunger is defective, replace with a new lifter assembly.

Do not condemn valve lifters that have a slight gap or show evidence of leakage where the lifter foot is welded to the lifter body, unless the leak-down rate is not within specifications. (See VALVE LIFTER LEAK-DOWN)

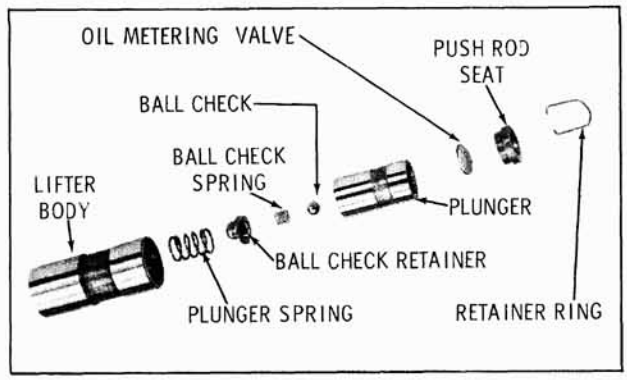


Fig. 6B-116—Valve Lifter Exploded View

Whenever lifters are removed, check the lifter foot for abnormal wear as follows:

1. Place a straight edge across the lifter foot.

Lifter foot must be clean and dry.

2. While holding the lifter at eye level, check for light between the straight edge and lifter foot.
3. If light indicates a flat or concave surface of the lifter foot, the lifter should be replaced and the camshaft inspected for wear. Wear at the CENTER of the cam base circle is NORMAL. The camshaft should be replaced ONLY when wear is present across FULL WIDTH of cam base circle.

Assembly and Valve Lifter Leak-Down Test

Lifters must be assembled while submerged in Hydraulic Lifter Test Fluid BT-59 and leak-down tested before placing into service.

1. Install adapter BT-105-2 in reservoir of Tester BT-60; then, fill reservoir with Hydraulic Lifter Test Fluid BT-59, 1/2" below top of reservoir.
2. Assemble ball check and retainer into plunger. (Fig. 6B-116) Make sure retainer flange is pressed tight against bottom of recess in plunger.
3. Install plunger spring over ball check retainer.
4. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.
5. Place assembly into the tester cup, then position oil control valve and push-rod seat onto plunger.
6. Position the 1/4" steel ball on the push-rod seat. Lower tester ram until it contacts the steel ball.
7. Allow ram to move downward by its own weight until air bubbles disappear.
8. Raise ram, then allow to lower as in Step 7. Repeat this procedure several times or until all air is expelled from lifter.

Do not attempt to expell air from lifter by pumping on ram.

9. After all air is expelled, allow ram to bleed down lifter until retaining groove is exposed.
10. Install retaining ring.
11. Adjust ram screw so that it contacts the steel ball in the push-rod seat when the pointer is at the start line.
12. Raise arm, then start test by resting ram on steel ball. Rotate reservoir one revolution every two seconds and time the indicator from the start to the stop line. (Fig. 6B-117) Allowable leak-down rate is six seconds minimum for used lifters and 9 to 60 seconds for new lifters.
13. If leak-down tolerance is within specifications, the lifter can be placed in service without removing test fluid.

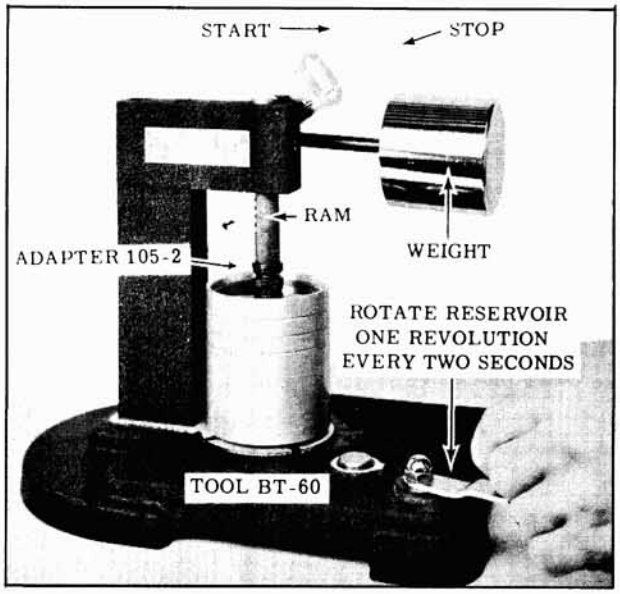


Fig. 6B-117—Valve Lifter Bleed-Down Test

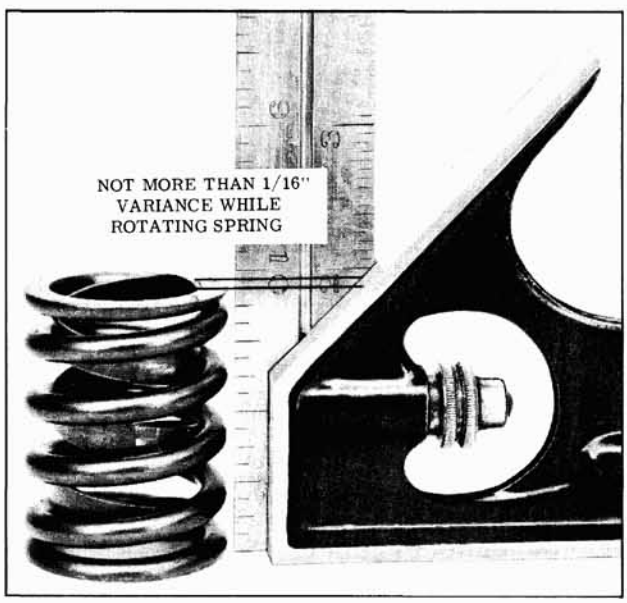


Fig. 6B-118—Valve Spring Checking

Valve Lifter Diagnosis

1. Momentarily Noisy When Car is Started:

This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.

2. Intermittently Noisy on Idle Only, Disappearing When Engine Speed is Increased:

Intermittent clicking may be an indication of a flat or pitted ball, or it may be caused by dirt.

Correction: Clean the lifter and inspect. If ball is defective, replace lifter.

3. Noisy At Slow Idle or With Hot Oil, Quiet With Cold Oil or As Engine Speed is Increased:

Insert a .015" feeler gauge between the rocker arm and valve stem. If noise momentarily disappears and then reappears after a few seconds with the feeler still inserted, it is an indication that the lifter leak-down rate is too fast.

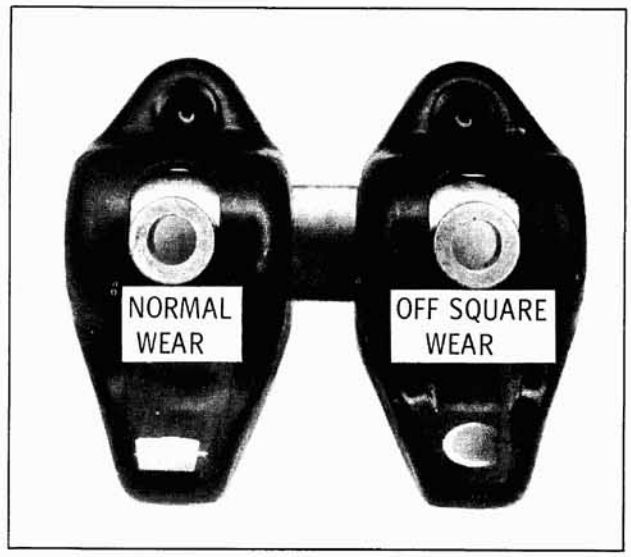


Fig. 6B-119—Rocker-Arm Wear

Correction: The lifter must be replaced.

4. Noisy at High Car Speeds and Quiet at Low Speeds.

a. High oil level - Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into the lifters, they will become noisy since a solid column of oil is required for proper operation.

a. Correction: Drain oil until proper level is obtained. See PERIODIC MAINTENANCE Section.

b. Low oil level - Oil level below the "Add" mark allows the pump to pump air at high speeds which results in noisy lifters.

b. Correction: Fill until proper oil level is obtained, See PERIODIC MAINTENANCE Section.

5. Noisy at Idle Becoming Louder as Engine Speed is Increased to 1500 rpm.

a. This noise is not connected with lifter malfunction. It becomes most noticeable in the car at 10 to 15 mph "L" range, or 30 to 35 mph "D" range and is best described as a hashy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:

(1) Badly worn or scuffed valve tip and rocker arm pad.
(2) Excessive valve stem to guide clearance.
(3) Excessive valve seat runout.
(4) Off square valve spring.
(5) Off square rocker arm pad.
(6) Excessive valve face runout.
(7) Valve spring damper clicking on retainer.

Correction:

Remove valve covers and while listening with a stethoscope, locate noisy valves by increasing engine speed slightly above idle, about 1500 rpm. With gloved hand, push sideways on valve spring. Noise will change, either becoming louder or disappearing completely. Some noise will be present in all valve locations. It is necessary to determine which are actually responsible for the noise.

a. Occasionally this noise can be eliminated by rotating the valve spring and valve. Crank engine until noisy valve is off its seat. Rotate spring. This will also rotate valve. Repeat until valve becomes quiet. If correction is obtained, check for an off square valve spring. If spring is off square more than 1/16" in free position, replace spring. (Fig. 6B-118)

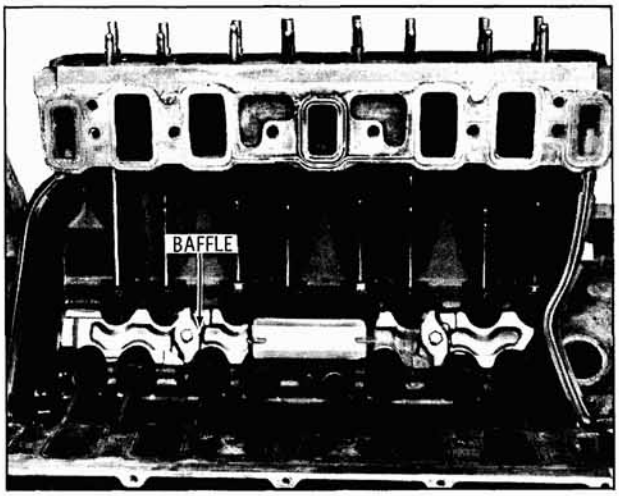


Fig. 6B-120—Baffle Installation

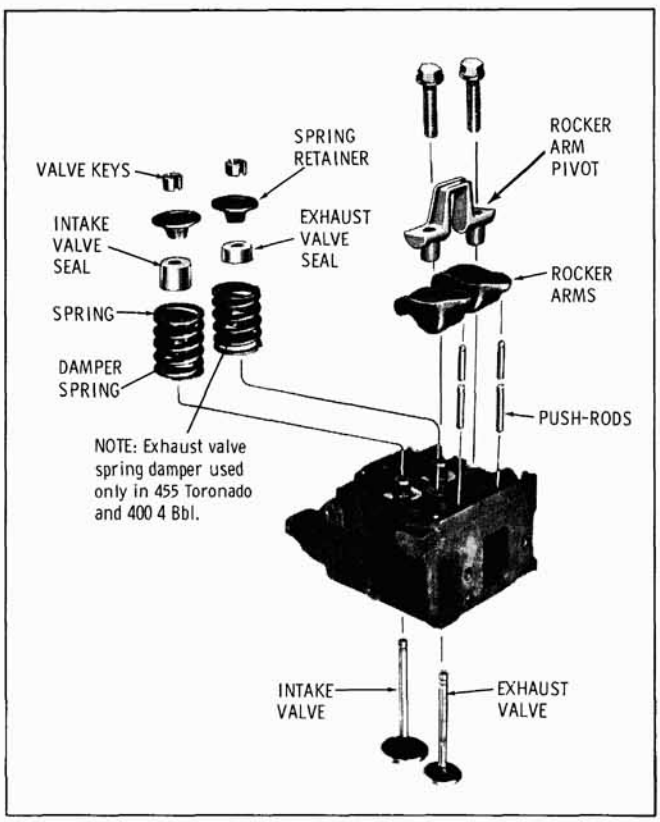


Fig. 6B-121—Cylinder Head Exploded View

b. Observe rocker arm pad for excessive wear or excessive off square. Replace as required. (Fig. 6B-119)

c. Check for excessive valve stem to guide clearance. If necessary, correct as required.

6. Valves Noisy Regardless of Engine Speed.

This condition can be caused by foreign particles or excessive valve lash.

Correction:

a. With transmission in NEUTRAL and parking brake on, run the engine at a moderate speed.

If this method does not quiet the lifter, strike the rocker arm above the push-rod with a mallet while the engine is idling. This method of correction has proven successful for dislodging a foreign particle which is preventing

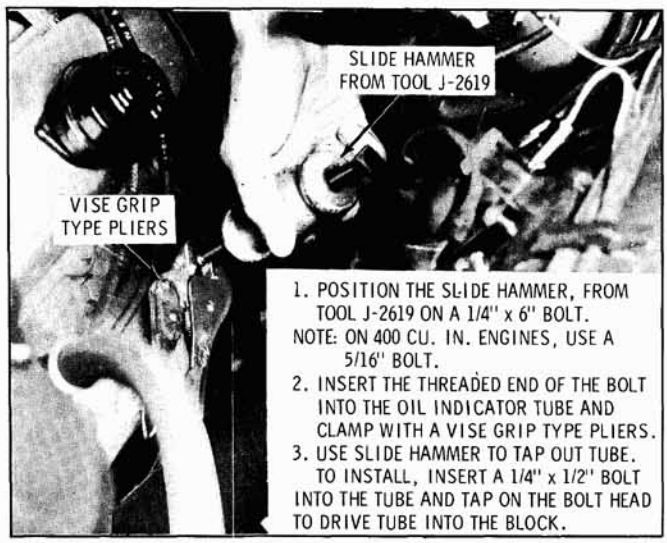


Fig. 6B-121A—Oil Dip Stick Tube Removal

the ball from seating properly.

b. Check for valve lash by turning engine so the piston in that cylinder is on top dead center of firing stroke. If valve lash is present, the push-rod can be freely moved up and down a certain amount with rocker arm held against valve.

Valve lash indicates one of the following:

(1) Worn push-rod.

(2) Worn rocker arm.

(3) Lifter plunger stuck in down position due to dirt or varnish.

(4) Defective lifter.

Checking of the above four items:

Remove the rocker arm assemblies then proceed as follows:

1. Observe upper end of push-rod. Excessive wear of the spherical surface indicates one of the following conditions.

a. Improper hardness of the push-rod ball. The push-rod and rocker arm must be replaced.

b. Improper lubrication to the push-rod. The push-rod and rocker arm must be replaced. The oiling system to the push-rod should be checked.

2. If push-rod appears in good condition and has been properly lubricated, replace rocker arm and recheck valve lash.

3. If valve lash exists and push-rod and rocker arm are okay, trouble is in the lifter. Lifter should be replaced.

Installation

1. Install lifters and push-rods into original position in cylinder block. See note under Removal.

2. Install baffle (if removed) in 400 and 455 cubic inch engines as shown in Fig. 6B-120. Install manifold gaskets and manifold.

3. Position rocker arms, pivots and bolts on cylinder head as shown in Fig. 6B-121.

4. Install valve covers, connect spark plug wires and install air cleaner.

CYLINDER HEAD AND GASKET

Removal

1. Drain radiator and cylinder block.

2. Remove intake manifold.

3. Disconnect exhaust crossover pipe for left side and/or crossover pipe and exhaust pipe for right side.

4. Remove valve cover.

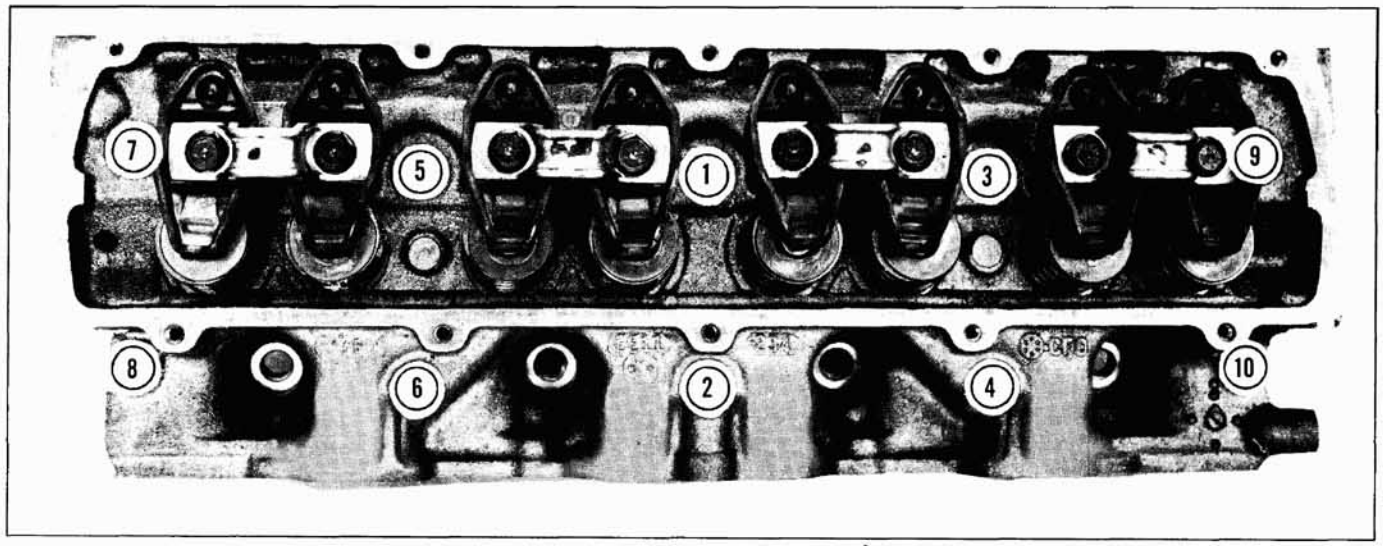
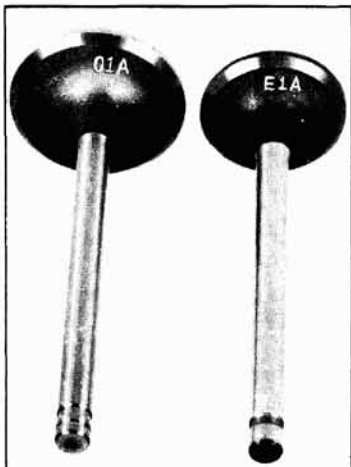


Fig. 6B-122—Cylinder Head Torque Sequence



TYPE	ENGINE USAGE	PAINT CODE	FORGED LETTER	HEAD DIAMETER	*LENGTH	SEAT ANGLE
INTAKE	350 CU. IN.	WHITE OR PLAIN	"01A" "S1A"	1.875	4.620	45°
INTAKE	400 CU. IN. 4 Bbl.	RED	"04A" "S4A"	2.062	4.593	30°
INTAKE	455 CU. IN. EXC. TORONADO 400 CU. IN. 2 Bbl.	LIGHT BLUE	"03A" "S3A"	2.000	4.593	45°
EXHAUST	350 CU. IN.	YELLOW OR PLAIN	"E1"A "T1"A	1.562	4.620	45°
EXHAUST	400 CU. IN. 455 CU. IN.	BLACK	"E3"A "T3"A	1.625	4.587	45°

*MEASURED FROM CENTER OF SEAT TO TIP OF STEM.

Fig. 6B-123—Valve Identification

Loosen or remove any accessory brackets which interfere.

5. Remove ground strap from right cylinder head.
6. Remove dip stick tube as shown in Fig. 6B-121A.

Do not bend oil dip stick tube when removing or installing.

7. Remove cylinder head bolts and remove cylinder head with exhaust manifold and rocker arms attached.

Installation

Head gasket should be coated on both sides with No. 1050026 Sealer or equivalent before installation.

Clean and dip cylinder head bolts in engine oil, torque bolts to 70 ft. lbs. in sequence shown, then re-torque in sequence to 80 ft. lbs. (Fig. 6B-122)

VALVES AND SPRINGS WITH HEAD REMOVED (6B-123)

Removal

1. Remove spark plugs and exhaust manifold.
2. Remove valve keys by compressing valve spring with a tool such as J-7541 or OTC-CF-11.
3. Remove valve spring retainers and springs.
4. Remove oil seals from valve stems by breaking.
5. Remove valves. Keep valves separated so they can be installed in their original locations. (Fig. 6B-124)

Installation

1. Install valves in their respective guides.

Standard, .003" and .005" oversize valve stem seals are ivory colored; .010" and .013" oversize are blue-green.

2. Install new oil seals over valve stem, using Tool BT-6804. (Fig. 6B-125)

Position seals down as far as possible on valve stem. The seals will correctly position themselves when the engine is started.

Inspect seal for cracks after installation.

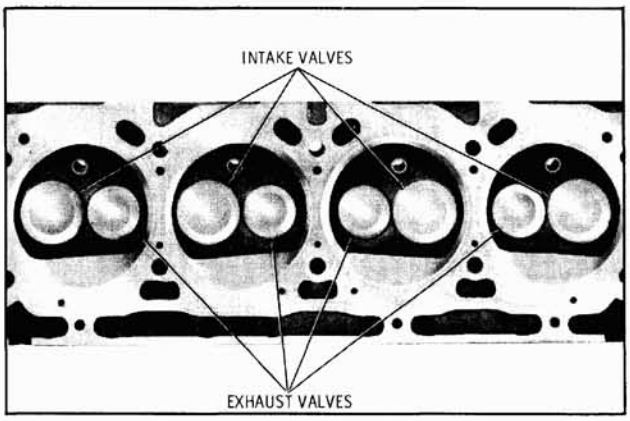


Fig. 6B-124—Valve Location

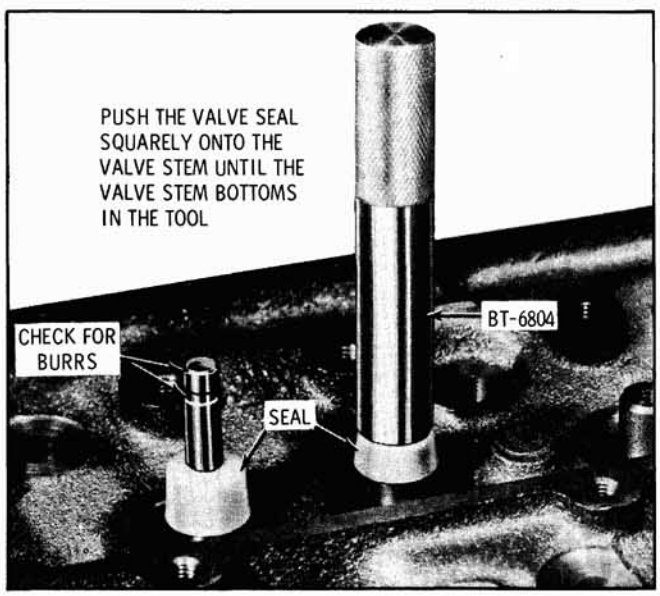


Fig. 6B-125—Valve Seal Installation

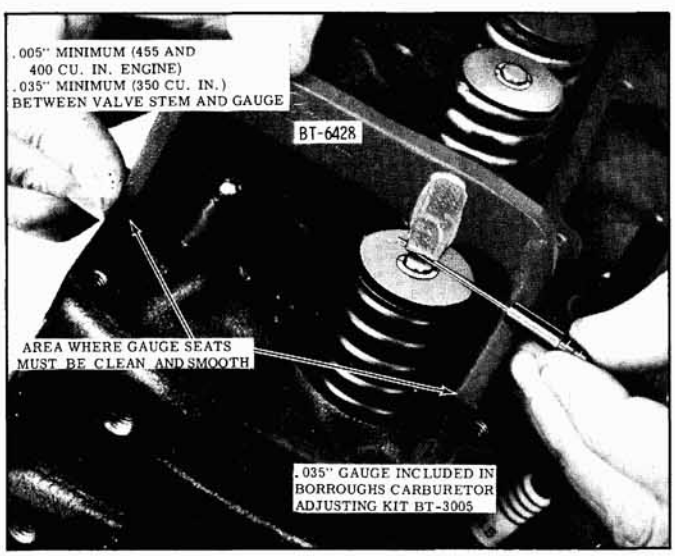


Fig. 6B-126—Measuring Valve Stem Height

3. Position valve springs over valve stems.

4. Install valve spring retainers; then, compress springs with a tool such as J-7541 or OTC-CF-11 and install valve stem keys.

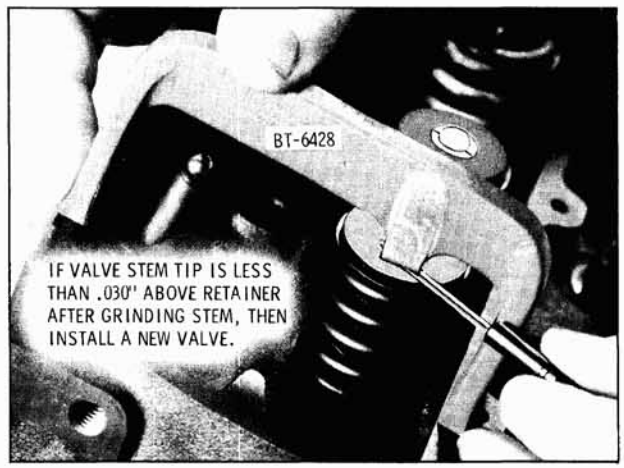


Fig. 6B-127—Measuring Valve Retainer Height

5. Check valve springs and keys to be sure they are properly seated.

6. Install exhaust manifold and shroud. Torque bolts and nuts to 25 ft. lbs. Bend exhaust manifold bolt lock tabs.

7. Set spark plug gap. Lubricate plug threads with one drop of SAE 10W30 oil and re-install plugs. Torque to 35 ft. lbs.

Reconditioning Valves

When reconditioning valves and valve seats, clean carbon from cylinder heads and valves using care not to gouge or scratch machined surfaces. A soft wire brush is suitable for this purpose. Whenever valves are replaced or new valves installed, the valve seats must be reconditioned. If valve guide bores are worn excessively, they can be reamed oversize. This will require replacement of the valves with oversize valves (stems). The guide bores should be reamed before grinding the valve seats. Valve clearance in guide bore should be .001" to .004".

Measuring Valve Stem Height

Whenever a new valve is installed, or after grinding valves, it will be necessary to measure valve stem height as follows:

Install Gauge BT-6428 as shown in Fig. 6B-126.

There should be at least .035" clearance on all 350 cu. in. engines. 400 and 455 engines have a clearance of at least .005" between gauge surface and end of valve stem. (Valve stem can be gauged with or without the valve spring retainer on the valve.) If clearance is less than specifications, remove valve and grind tip of valve stems as required on a valve refacing machine using the "Vee" block attachment to insure a smooth 90° end. Also be certain to break sharp edge on ground valve tip. Observe an original valve to determine chamfer.

After all valve keys have been installed on valves, tap each valve stem end with a hammer to seat valve retainers and keys. Using Gauge BT-6428 as shown in Fig. 6B-126 and Fig. 6B-127, re-gauge all valves between valve stem and gauge and valve retainer and gauge. If any valve stem end is less than .030" above retainer, the valve is too short and a new valve must be installed.

EXAMPLE:

Valve Retainer to Gauge Clearance	.060"
Minus Valve Stem to Gauge Clearance	.035"
	.025"

This is less than .030" and a new valve should be installed.

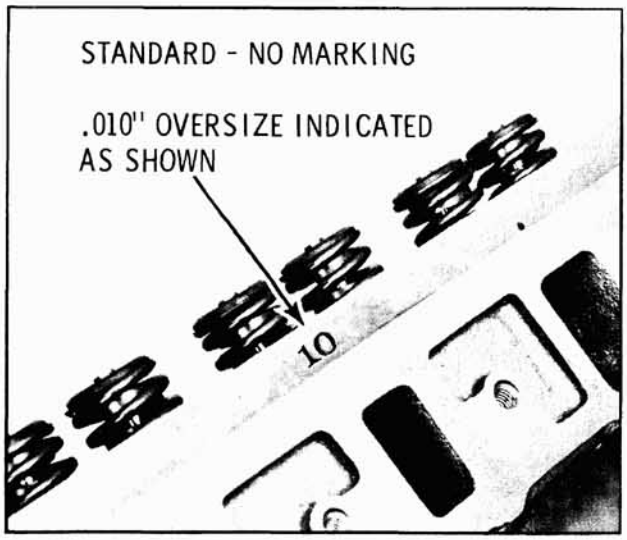


Fig. 6B-128—Valve Guide Bore Marking

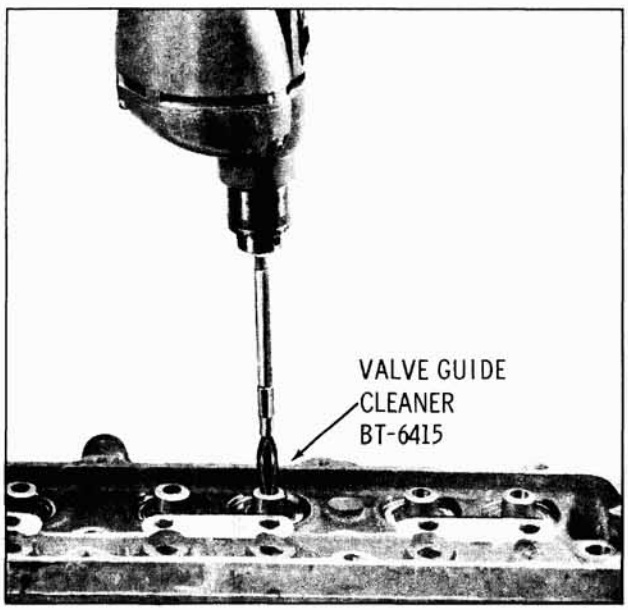


Fig. 6B-129—Cleaning Valve Guide Bores

VALVE GUIDE BORES

As previously stated, if the valve guide bores are worn excessively, they can be reamed oversize. The following reamers are available:

BT-6414-1 .003" Oversize Valve Guide Reamer
BT-6414-4 .005" Oversize Valve Guide Reamer
BT-6414-3 .013" Oversize Valve Guide Reamer

If a standard valve guide bore is being reamed, use the .003" or .005" oversize reamer. For the .010" oversize valve guide bore, use the .013" oversize reamer. If too large a reamer is used and the spiraling is removed, it is possible that the valve will not receive the proper lubrication.

Occasionally a valve guide bore will be oversize as manufactured. These are marked on the inboard side of the cylinder heads on the machined surface just above the intake manifold surface, Fig. 6B-128. These markings are visible without removing any parts other than the air cleaner assembly. Before removing the cylinder heads to perform service to either the valves or valve guide bores, the cylinder heads should be inspected to determine if these markings are present. If no markings are present, the guide bores are standard. If oversize markings are present, any valve replacement will require an oversize valve. If the oversize marking is present, only that particular bore would be oversize, not all bores in that cylinder head. Service valves are available in five different stem diameters: Standard, .003" oversize, .005" oversize, .010" oversize, and .013" oversize.

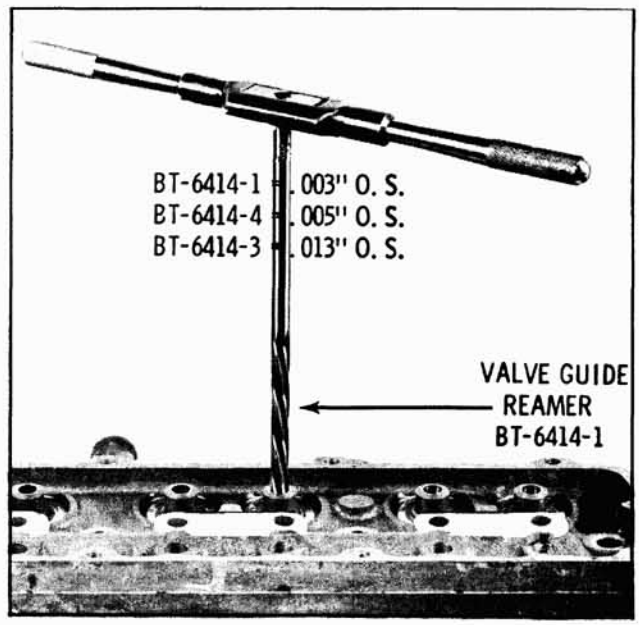


Fig. 6B-130—Reaming Valve Guide Bore

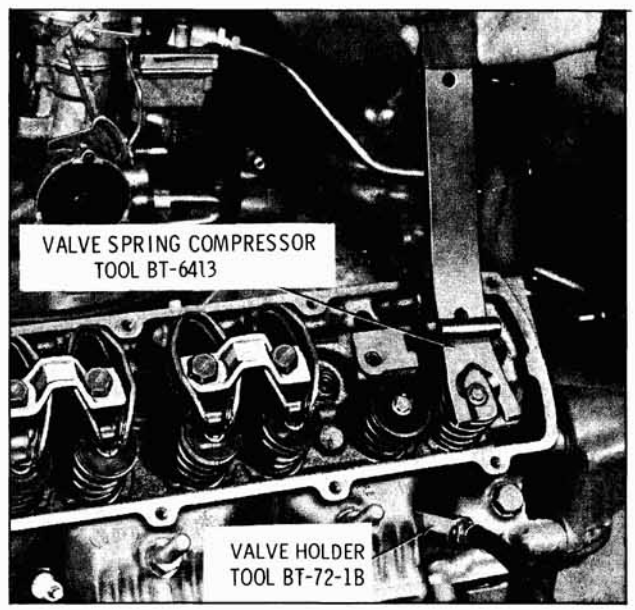


Fig. 6B-131—Removing Valve Spring

REAMING PROCEDURE

Before attempting to ream the valve guide bores they should be cleaned using Tool BT-6415 as shown in Figure 6B-129.

This procedure to ream valve guide bores using Tool BT-6414 is shown in Fig. 6B-130. Use care to hold reamer straight in valve guide bore.

REPLACING VALVE SPRING (HEAD ON ENGINE) (Fig. 6B-131)

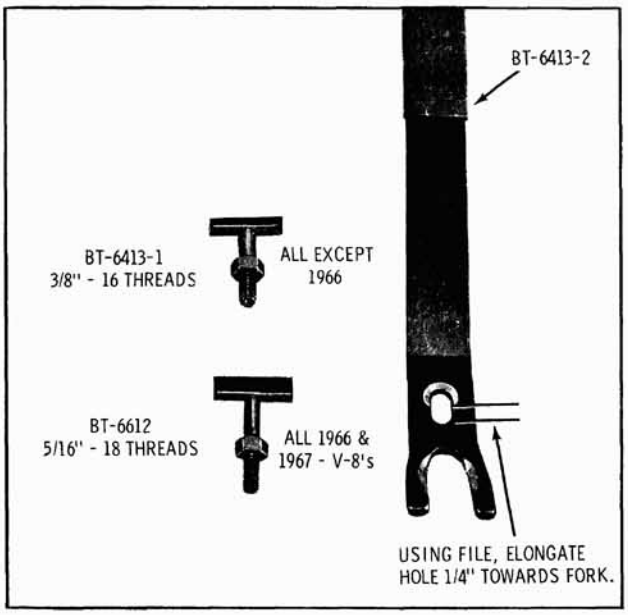


Fig. 6B-132—Valve Spring Tool

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

Removal

1. Remove rocker arm assemblies.
2. Remove spark plug and install Tool BT-72-1-B into spark plug hole and attach to an air hose to hold the valve against its seat.
3. Install Tool BT-6413, (Fig. 6B-132) compress the valve spring until valve keys are accessible, then remove keys, spring retainer cups and springs.

If valve spring does not compress, tap tool with a hammer to break bind at retainer and keys.

Installation

1. Install valve spring and spring retainer. Using Tool BT-6413 compress the valve spring until the valve keys can be installed.
2. Install spark plugs. Torque 35 ft. lbs.
3. Install rocker arm assemblies.

OIL PAN (350 and 455 CU. IN.)

Removal

1. Disconnect "Neg." battery cable. Remove the dip stick.
2. Remove upper radiator support and fan shroud attaching screws.
3. Hoist the car and drain oil.
4. a. (32, 36, 42 and 48 Series) Disconnect exhaust pipe from right exhaust manifold.
   b. (54 through 86 Series) Lower relay rod by disconnecting idler arm or pitman arm.
5. Disconnect engine mounts and jack front of engine up as far as possible using Engine Support Tool BT-6501.
6. Remove crossover pipe and starter.
7. Remove oil pan attaching bolts. Position No. 1 crankshaft throw up and remove oil pan.

Installation (Fig. 6B-133)

1. Apply 1050026 Sealer or equivalent to both sides of pan

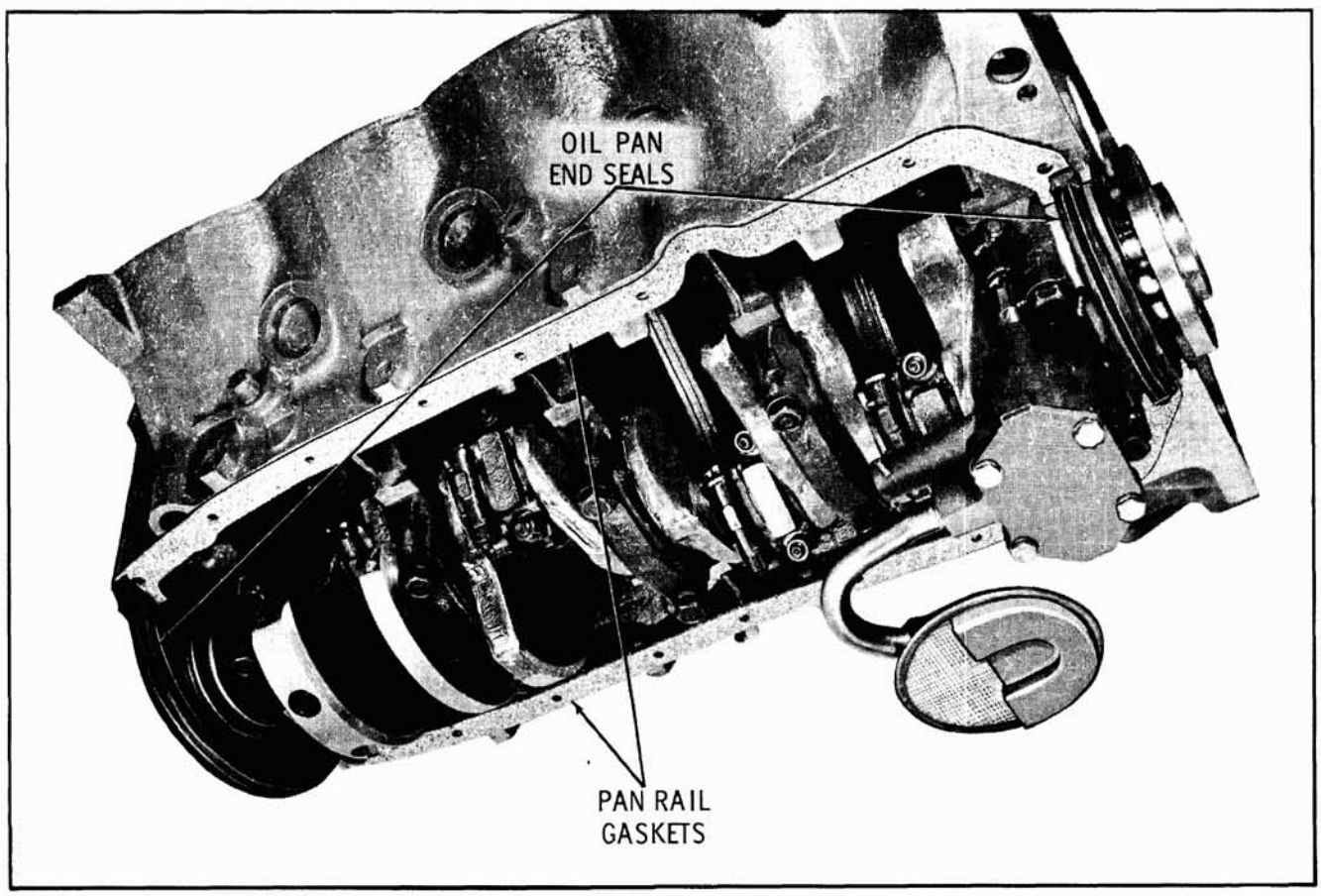


Fig. 6B-133—Oil Pan Installation

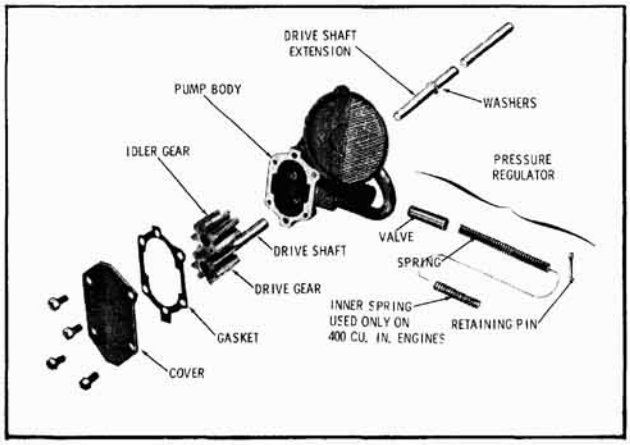


Fig. 6B-134—Oil Pump Exploded View

gaskets (cork) and install on block.

2. Install front and rear seal (rubber).

3. Wipe Lube, 1050169, or equivalent on seal area and install pan. Torque 5/16" bolts to 15 ft. lbs. and 1/4" bolts to 10 ft. lbs. Fill crankcase as explained in the PERIODIC MAINTENANCE Section.

OIL PAN (400 Cu. In.)

Removal

1. Disconnect "Neg" battery cable.
2. Remove upper radiator baffle.
3. Remove drive shaft, transmission crossmember, transmission and flywheel. Disconnect left exhaust pipe and starter.
4. Disconnect right hand engine mount.

It is necessary to raise both the front and rear of the engine and tilt it to the left, using the left engine mount as a pivot.

5. Install Tool BT-6424-1 Engine Support Bar and insert a 1" block between tool and right rear corner of oil pan to obtain additional lift on right side.
6. Use Tool BT-6501-3 to raise front of engine.

Remove the lower two right hand engine cover bolts to permit Tool BT-6501-3 to clear the water pump outlet. DO NOT BOLT TOOL TO BLOCK since engine must rock when raised. Position fork of tool to lift pulley hub. (Fig. 6B-184)

7. Raise right side of engine approximately 2-1/2" and insert block Tool J-21662-1, between upper and lower right hand mounts.
8. Remove Engine Support Bar Tool BT-6424-1 from rear of engine.
9. Remove oil pan attaching bolts and remove oil pan toward rear of engine.

No. 1 and No. 2 connecting rod journals should be at 4 or 7 o'clock position as viewed from front of engine.

Installation (400 cu. in.)

Refer to oil pan installation 350 and 455 cu. in. engines for gasket sealing and reverse the removal procedure.

OIL PUMP

Removal

1. Remove oil pan. (Refer to OIL PAN Removal)
2. Remove the oil pump to rear main bearing cap attaching bolts, then remove pump and drive shaft extension.

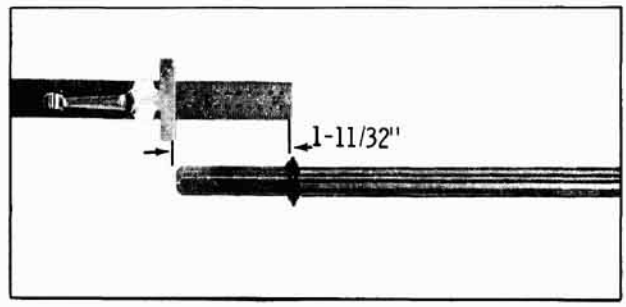


Fig. 6B-135—Oil Pump Drive Shaft Extension

Disassembly (Fig. 6B-134)

1. Remove the oil pump drive shaft extension.

Do not attempt to remove the washers from the drive shaft extension. The drive shaft extension and washers must be serviced as an assembly. (Fig. 6B-135)

2. Remove the cotter pin, cup, spring and the pressure regulator valve.

Position thumb over pressure regulator bore before removing cotter pin, as the spring is under pressure.

3. Remove the oil pump cover attaching screws and remove the oil pump cover and gasket.
4. Remove the drive gear and idler gear from the pump body.

Inspection

Check the gears for scoring or other damage. If they are damaged, new gears should be installed. During assembly, the gear end clearance should be gauged. Proper end clearance is .0025" to .0065". Also check the pressure regulator valve, valve spring and bore for damage. Proper valve to bore clearance is .0025" to .0050".

Assembly

1. Install the drive gear into the pump with the hex ID of the drive shaft toward the oil pump mounting pad, then install the idler gear.
2. Position a new gasket on the pump body and install the oil pump cover. Tighten the cover screws to 8 ft. lbs.
3. Position the pressure regulator valve into the pump cover, closed end first, then install the spring cup and retaining pin.

When assembling the drive shaft extension to the drive shaft, the END OF THE EXTENSION NEAREST THE WASHERS MUST BE INSERTED INTO THE DRIVE SHAFT

Installation

1. Insert the drive shaft extension through the opening in the main bearing cap and block until the shaft mates into the distributor drive gear.
2. Position pump onto the rear main bearing cap and install attaching bolts. Torque bolts to 35 ft. lbs. (Fig. 6B-136)
3. Install the oil pan. Refer to OIL PAN Installation.

CONNECTING ROD AND PISTON ASSEMBLY

Removal

1. Remove intake manifold, head or heads.
2. Remove oil pan.

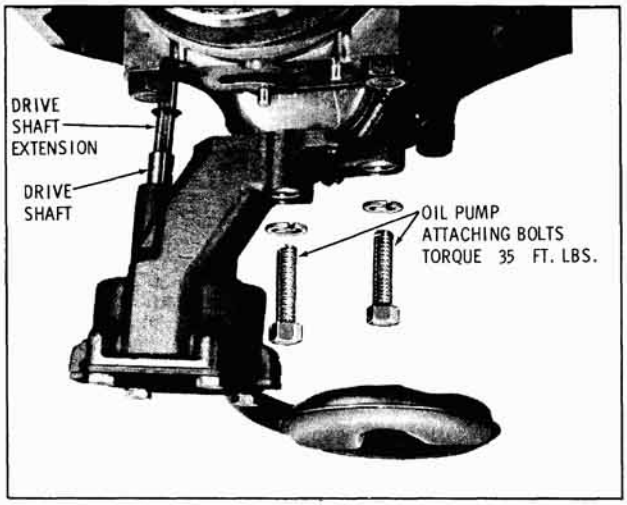


Fig. 6B-136—Oil Pump Installation

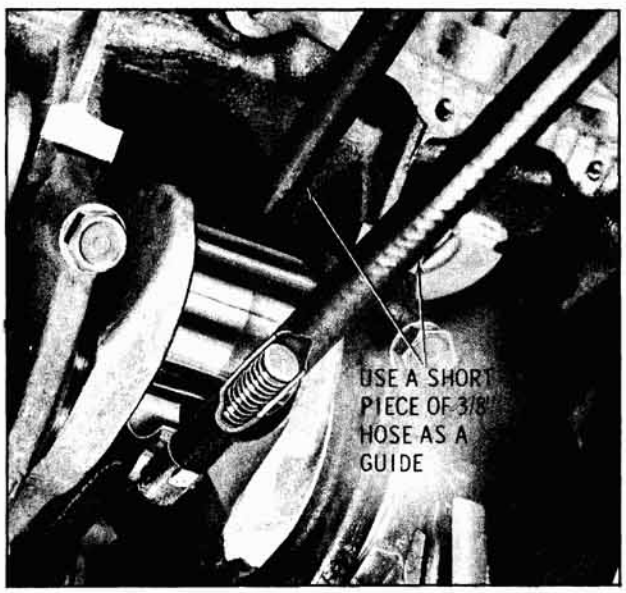


Fig. 6B-137—Connecting Rod Bolt Guide

3. Remove oil pump assembly.

Stamp cylinder number on the machined surfaces of the bolt bosses of the connecting rod and cap for identification when reinstalling. If the pistons are to be removed from the connecting rod, mark cylinder number on piston with a silver pencil or quick drying paint for proper cylinder indentification and cap to rod location. The right bank is numbered 2-4-6-8, left bank 1-3-5-7.

Examine the cylinder bore above ring travel. If ridge exists, remove ridge with ridge reamer before attempting to remove the piston and rod assembly.

4. Remove rod bearing cap and bearing.
5. Install guide hose over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads. (Fig. 6B-137)
6. Remove rod and piston assembly through the top of the cylinder bore.
7. Remove other rod and piston assemblies in the same manner.

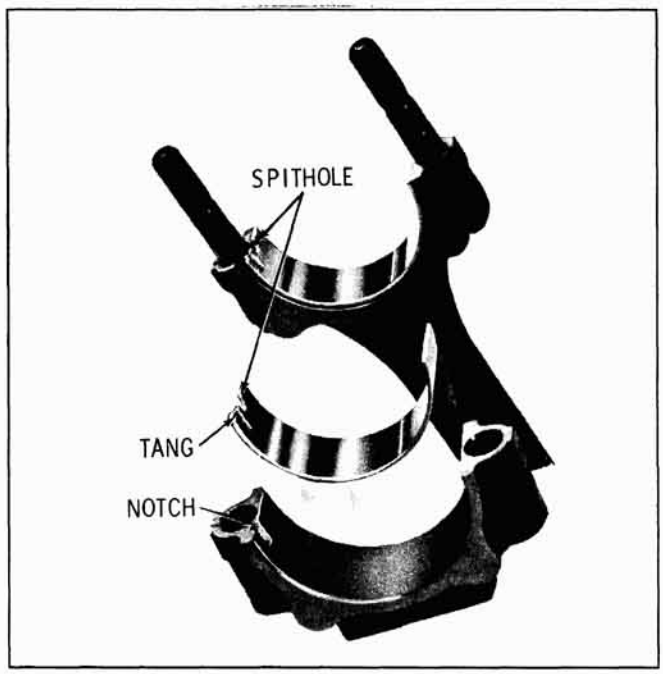


Fig. 6B-138—Bearing Tang and Notch

ROD BEARINGS

The connecting rod bearings are designed to have a slight projection above the rod and cap faces to insure a positive contact.

Connecting rod bearings can be replaced without removing the rod and piston assembly from the engine.

1. Remove oil pan.

It may be necessary to remove oil pump to provide access to rear connecting rod bearings.

2. With connecting rod journal at the bottom, stamp cylinder number on machined surfaces of connecting rod and cap for identification when reinstalling, then remove caps.
3. Inspect journals for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone. If the journals are scored or ridged, the crankshaft must be replaced.
4. The connecting rod journals can be checked for out-of-round with the use of a micrometer. Maximum out-of-round must not exceed .0015".

Refer to ENGINE SPECIFICATIONS Chart at the back of this section.

If plastigauge is to be used:

5. Clean oil from journal bearing cap, connecting rod and outer and inner surface of bearing inserts. Position insert so that tang is properly aligned with notch in rod and cap. (Fig. 6B-138)
6. Place a piece of plastigauge in the center of lower bearing shell.
7. Reinstall bearing cap and torque to 42 ft. lbs.
8. Remove bearing cap and determine bearing clearances by comparing the width of the flattened plastigauge at its widest point with the graduation on the plastigauge container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. If this clearance is greater than .0035", replace the bearing and recheck clearance with plastigauge.

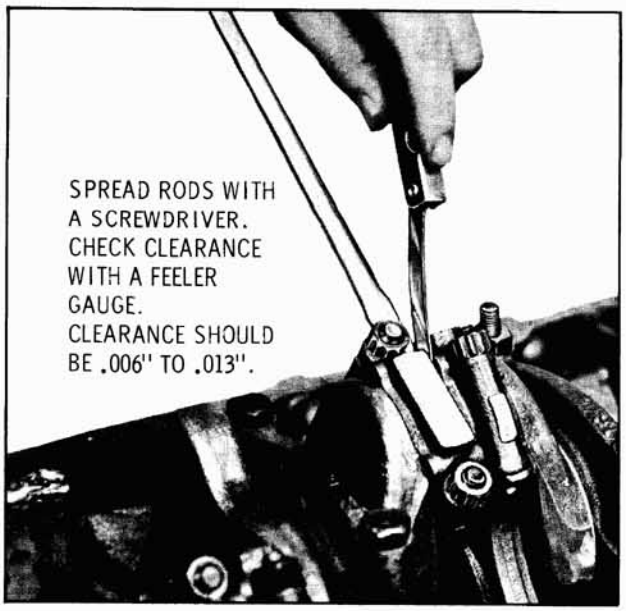


Fig. 6B-139—Connecting Rod Side Clearance

Lubricate bearing with SAE 10W30 oil before installation. Repeat Steps 2 through 8 on remaining connecting rod bearings. All rods must be connected to their journals when rotating the crankshaft to prevent engine damage.

9. Measure the rod side clearance as shown in Fig. 6B-139.

ROD ASSEMBLY

If a rod is twisted or bent, a new rod must be installed. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.

PISTON (Fig. 6B-140)

MEASURING PISTON

Refer to ENGINE SPECIFICATIONS Chart at the back of this section.

When replacing pistons, the original cylinder size is stamped with a code letter on the block near each cylinder on the cylinder head surface. (Fig. 6B-141)

When measuring piston for size or taper, measurement must be made on skirt 90° from piston pin hole (with the piston pin removed).

When measuring taper, the largest reading must be at the bottom of the skirt. Allowable taper is .000" to .001".

The piston and cylinder bore must be free of oil and at the same temperature.

On some cars, oversize pistons may be found. These pistons will be .010" oversize.

1. Place a strip of .0015" feeler gauge against the upper side of the bore, at 90° to the normal piston pin location. Attach Scale J-5515 to feeler gauge. (Fig. 6B-142)
2. Insert piston upside down with pin and rings removed, into bore.

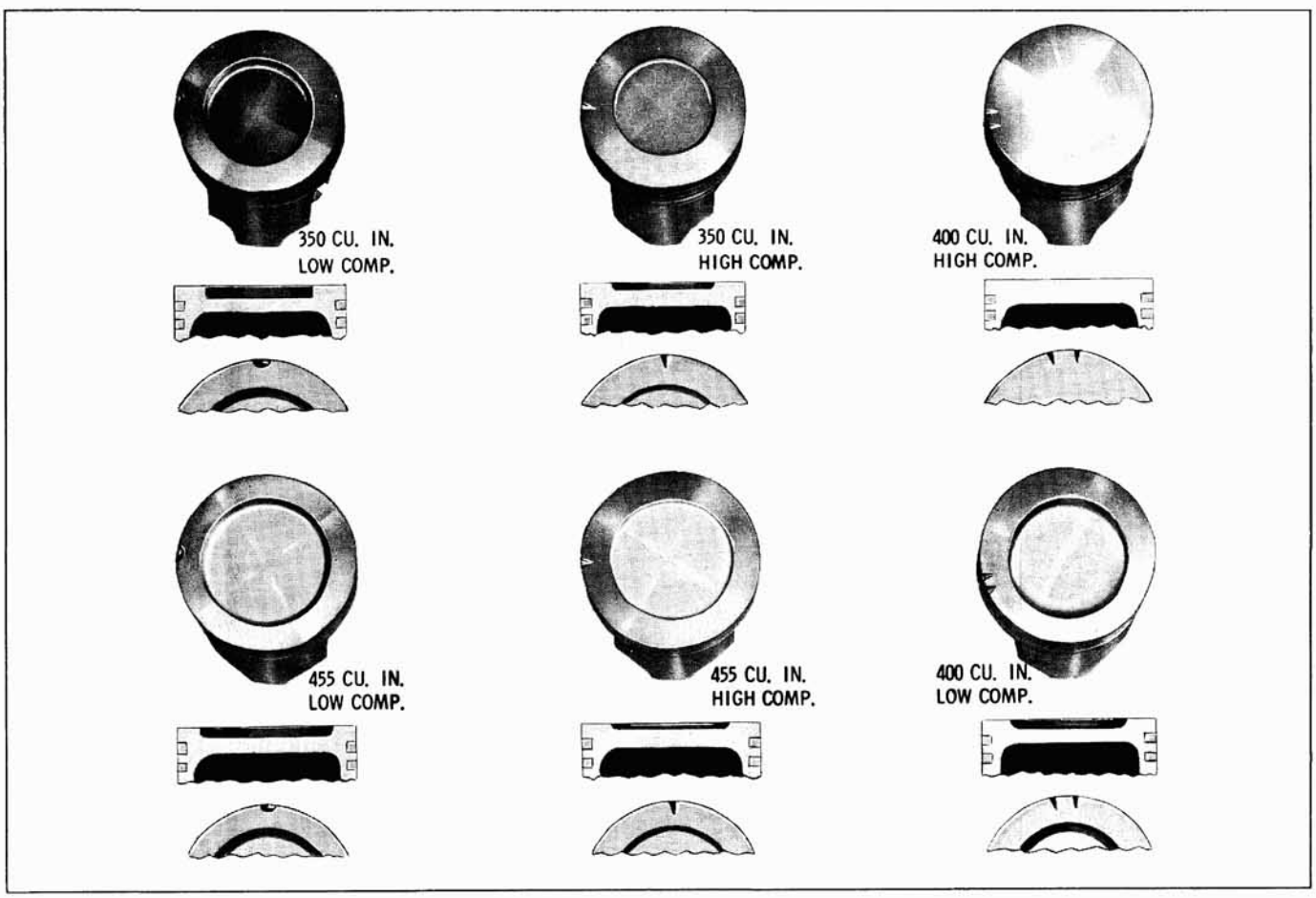


Fig. 6B-140—Piston Identification

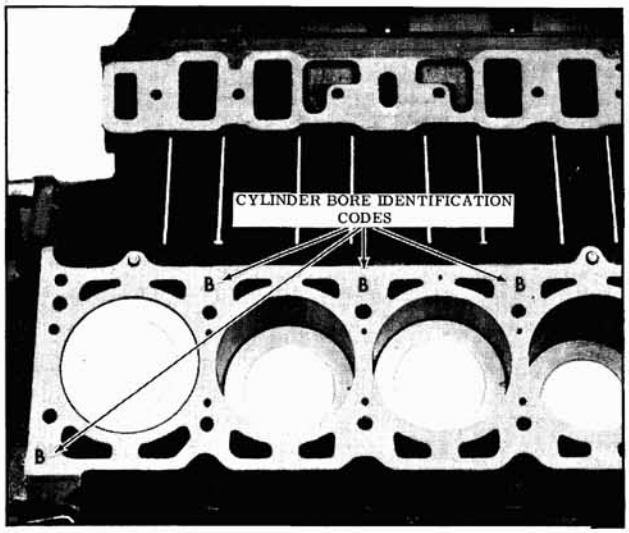


Fig. 6B-141—Cylinder Bore Marking

3. While holding the piston in the center of its normal travel, slowly pull the scale in a straight line and note the reading on the scale. The reading should be between 3 to 12 pounds while pulling the feeler gauge out of the bore.

Each piston should be fitted to its individual cylinder and marked for that cylinder.

CHECKING CYLINDER BORE

Refer to ENGINE SPECIFICATIONS Chart at the back of this section.

Cylinder bore size can be measured with inside micrometers or a cylinder gauge. Maximum allowable taper of the cylinder bore is .010". The most wear will occur at the top of the ring travel.

Reconditioned cylinder bores should be held to not more than .001" out-of-round and .001" taper.

If the cylinder bores are smooth, the cylinder walls should not be deglazed. If the cylinder walls are scored, the walls may have to be honed before installing new rings. It is important that reconditioned cylinder bores be thoroughly washed with a soap and water solution to remove all traces of abrasive material to eliminate premature wear.

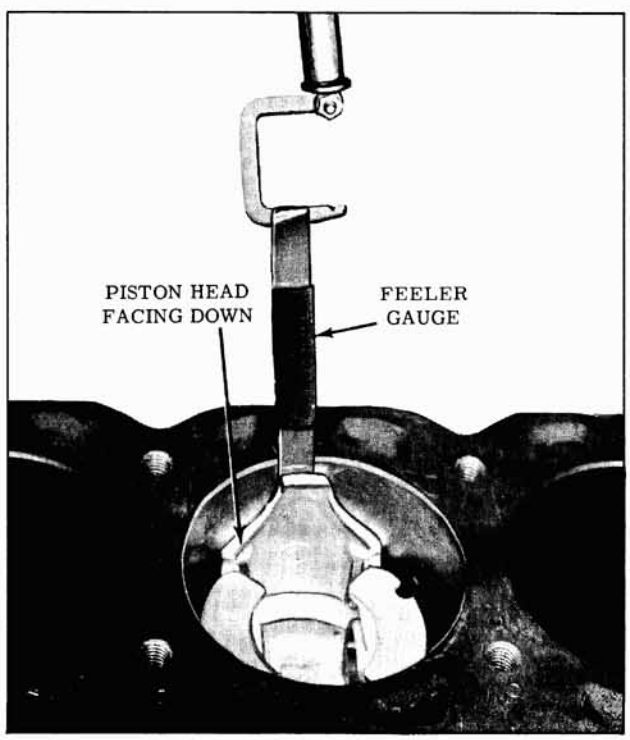


Fig. 6B-142—Checking Piston Clearance

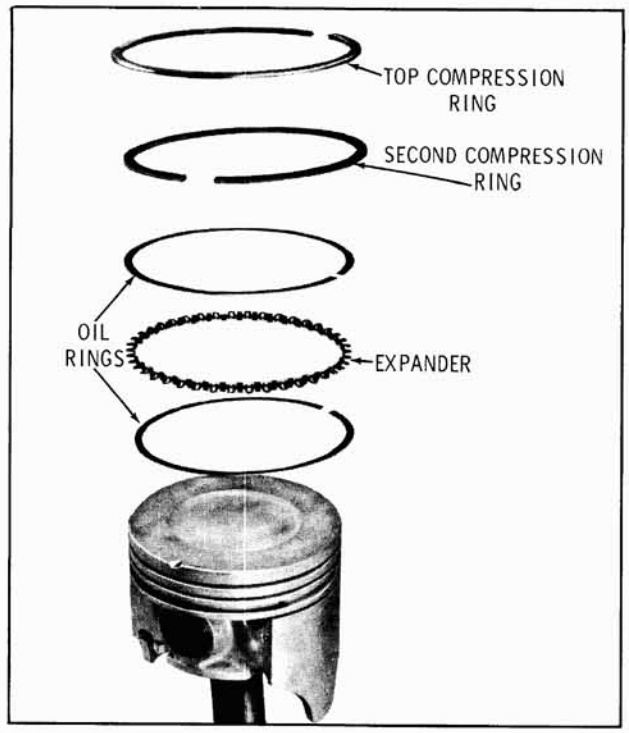


Fig. 6B-143—Piston Rings

CLEANING PISTON

Clean the pistons by scraping carbon off the top of the piston. Deposits in the ring grooves should be removed with a suitable ring groove cleaning tool. It is important that the ring grooves be completely free of deposits.

RINGS (Fig. 6B-143)

The pistons have three rings (two compression rings and one oil ring). The oil ring consist of two rails and an expander.

Ring Tolerances

When installing new rings, ring gap and side clearance should be checked as follows:

Piston Ring and Rail Gap

Each ring and rail gap must be measured with the ring or rail positioned squarely and at the bottom of the ring-travel area of the bore. (Fig. 6B-144)

The gap measurement should be .013" to .023" for compression rings and .015" to .055" for oil rings.

Side Clearance

Each ring must be checked for side clearance (see chart) in its respective piston groove by inserting a feeler gauge between the ring and its upper land. (Fig. 6B-145) The piston grooves must be cleaned before checking ring for side clearance.

To check oil ring side clearance, the oil rings must be installed on the piston.

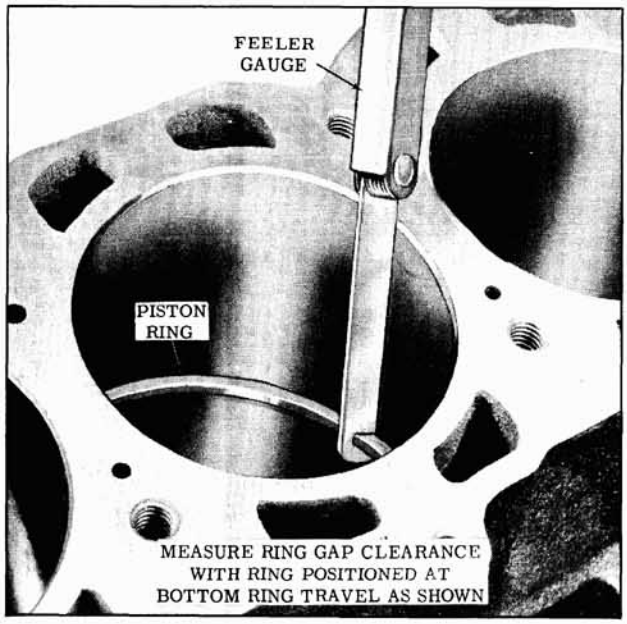


Fig. 6B-144—Measuring Piston Ring Gap

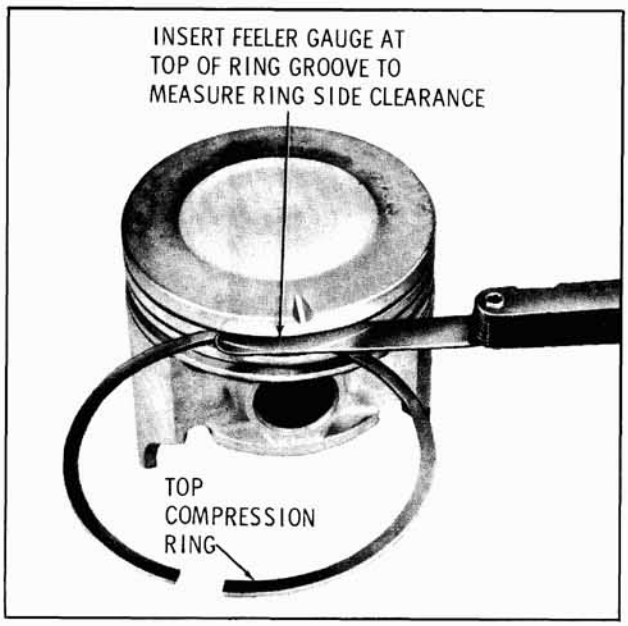


Fig. 6B-145—Piston Ring Side Clearance

ALLOWABLE SIDE CLEARANCE

Compression Rings	.002" to .004"
Oil Ring	
350 Cu. In.	.001" to .005"
400 Cu. In.	.001" to .010"
455 Cu. In.	.002" to .008"

RING IDENTIFICATION AND INSTALLATION (Fig. 6B-146)

For service ring specifications and detailed installation instructions, refer to the instructions furnished with the parts package.

ROD AND PISTON ASSEMBLY

Installation

1. Install connecting rod bolt guide hose over rod bolt threads. (Fig. 6B-147)
2. Apply SAE 10W30 oil to rings and piston, then install piston ring compressing tool on piston. (Fig. 6B-148)
3. Install assembly in its respective cylinder bore so notch cast in top of piston is towards the front of engine.
4. Lubricate the crankshaft journal with SAE 10W30 oil and install connecting rod bearing and cap, with bearing index tang in rod and cap on same side.

When more than one rod and piston assembly is being installed, the connecting rod cap attaching nuts should only be tightened enough to keep each rod in position until all have been installed. This will facilitate installation of remaining piston assemblies.

The clearance between the adjacent rods, when checked with a feeler gauge on each crankpin, should be from .002" to .011". (Fig. 6B-149)

5. Torque rod bolt nuts to 42 ft. lbs.

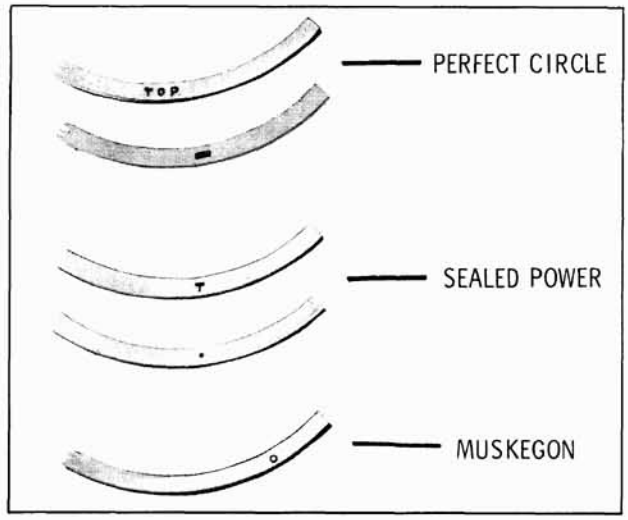


Fig. 6B-146—Piston Ring Identification

PISTON PINS

The correct piston pin fit in the piston is .0003" to .0005" loose. If the pin to piston clearance is to the high limit

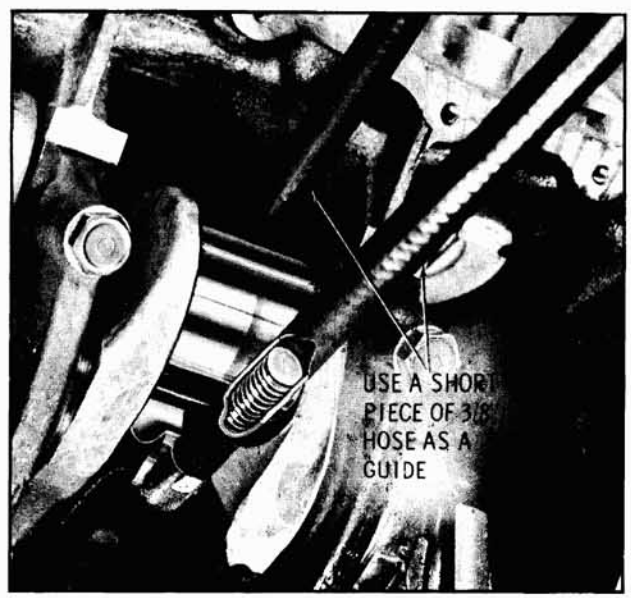


Fig. 6B-147—Connecting Rod Bolt Guides

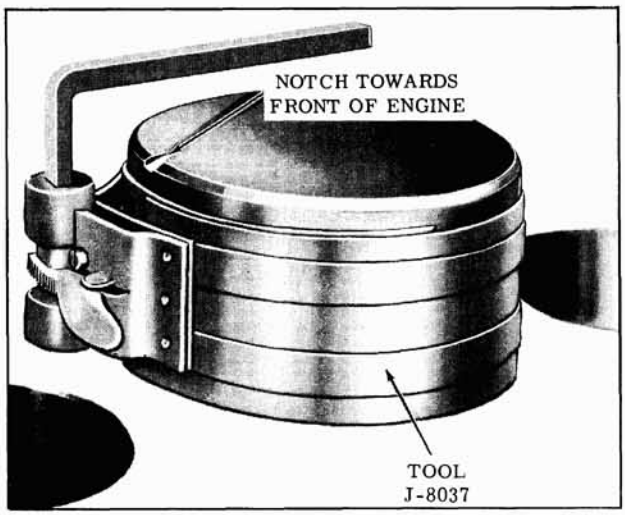


Fig. 6B-148—Piston Ring Compressor

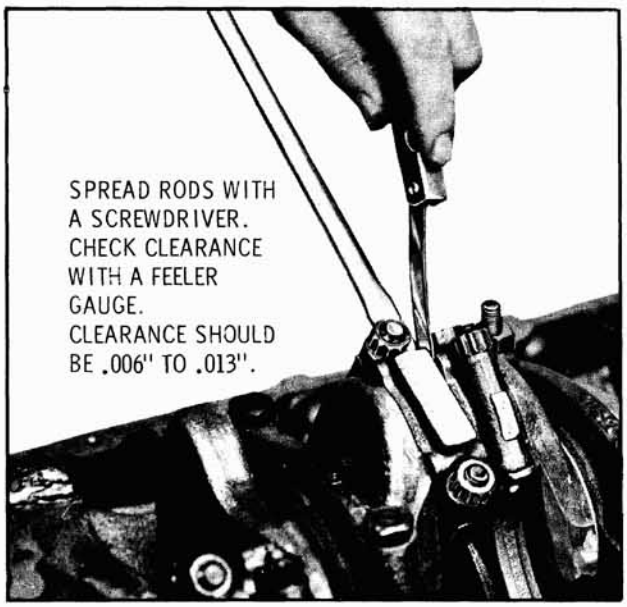


Fig. 6B-149—Connecting Rod Side Clearance

(.0005"), the pin can be inserted in the piston with very little hand pressure and will fall through the piston by its own weight. If the clearance is .0003", the pin will not fall through. It is important that the piston pin hole be clean and free of oil when checking pin fit. The pin is a press fit in the connecting rod.

Whenever the replacement of a piston pin is necessary, use the following procedure.

Removal

1. Place piston on piston pin remover Tool BT-6408-1, with the letter "F" on piston facing up.
2. Place Remover Tool BT-6408-3 in piston pin as shown in Fig. 6B-150, and press pin out.

Installation

1. Place piston on Tool BT-6408-1 with letter "F" facing up. Refer to Fig. 6B-151 for correct rod and piston assembly.
2. Coat piston with SAE 10W30 oil. Place pin in piston as shown in Fig. 6B-152. Press in piston pin until it makes contact with Guide Stop Tool BT-6408-2 in Main Body Tool BT-6408-1. This will automatically center the pin in the piston. Pin to connecting rod fit is .0008" to .0016" tight.

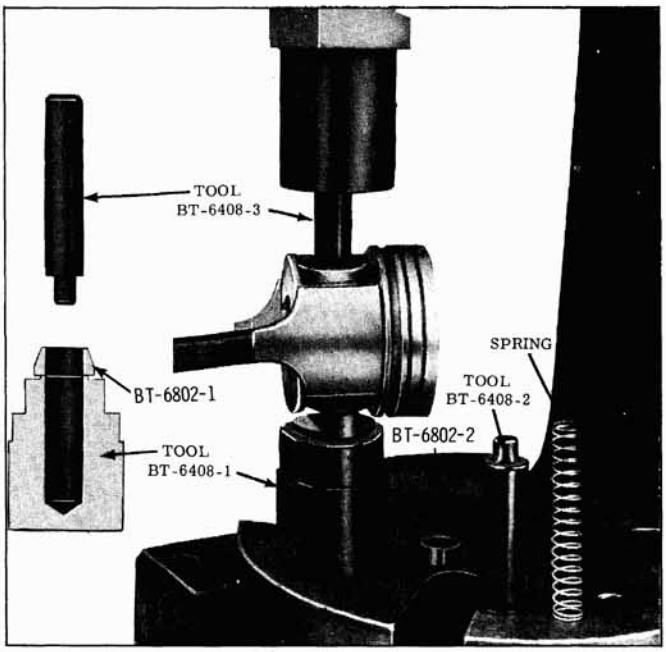


Fig. 6B-150—Removing Piston Pin

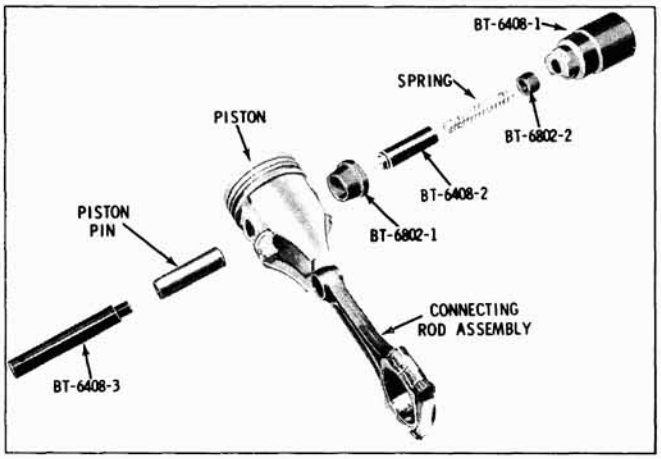


Fig. 6B-151—Tool BT-6408

CRANKSHAFT PULLEY

Removal

1. Remove belt(s) and fan.
2. Hoist car.
3. Remove four pulley bolts and pulley.

Installation

1. Install pulley, and four bolts. Torque to 20 ft. lbs.
2. Install fan pulley and fan.
3. Install belt(s). Adjust belts using Tool BT-33-70M.

HARMONIC BALANCER

A harmonic balancer is used in place of the pulley hub on all except two barrel low compression 350 cu. in. engines.

Removal

Balancer can be removed on air conditioned cars without disconnecting any of the condenser lines.

1. Remove belts, fan, fan pulley and crankshaft pulley.

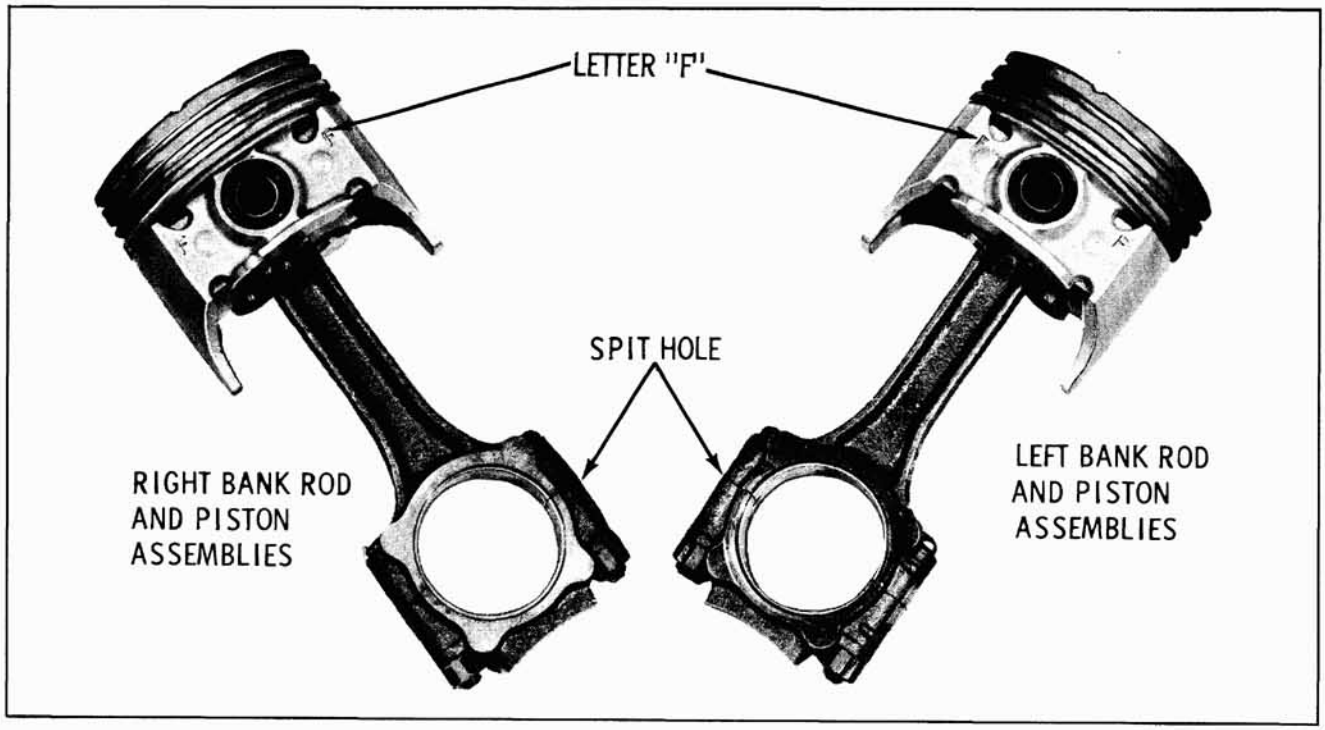


Fig. 6B-152—Piston and Connecting Rod Assembly

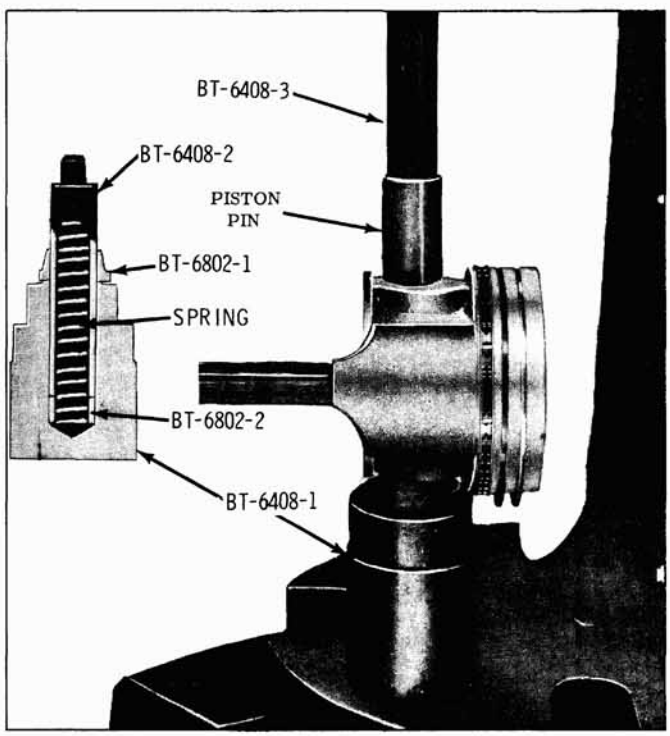


Fig. 6B-153—Installing Piston Pin

2. Remove harmonic balancer hub bolt and washer.
3. Using balancer puller, remove balancer as shown in Fig. 6B-154.

Use of any other type puller such as a universal claw type which pulls on the outside of the hub can destroy the balancer. The outside ring of the balancer is bonded in rubber to the hub; by pulling on the outside, rather than the hub, it is possible to break the bond. The timing mark is on the outside ring of the balancer; if the bond between the hub and the outside ring is broken, the outside ring could slip which would change the location of the timing mark.

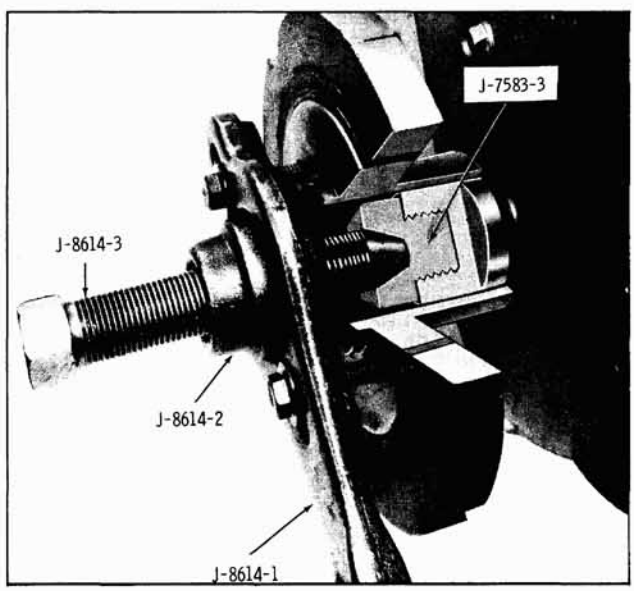


Fig. 6B-154—Removing Harmonic Balancer

Installation

1. Apply sealer 1050026 or equivalent, to inside diameter of pulley hub and to crankshaft key to prevent possible oil leakage. Coat outside area of crankshaft pulley hub which enters seal with Special Seal Lubricant No. 1050169, or equivalent.
2. Install harmonic balancer on crankshaft. (Fig. 6B-155)

Balancer to crankshaft fit is .001" tight to .0007" loose

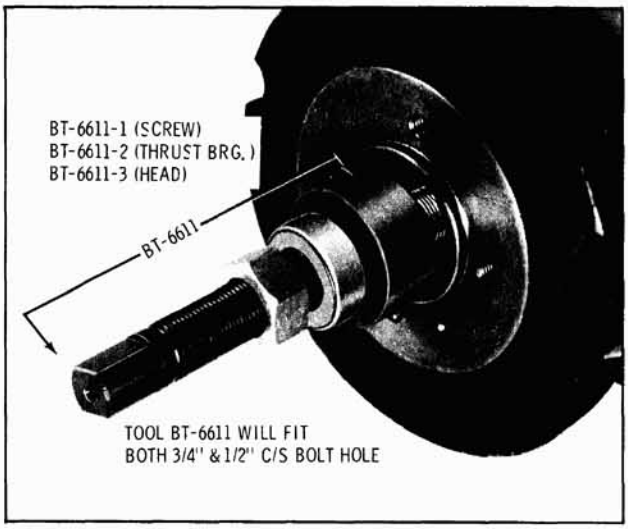


Fig. 6B-155—Installing Harmonic Balancer

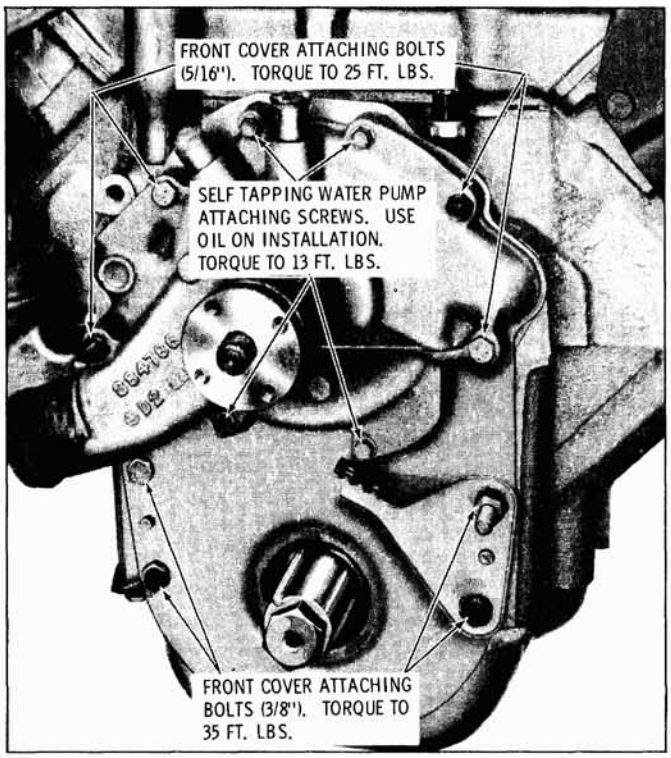


Fig. 6B-156—Engine Front Cover Bolts

3. Install washer and bolt. Torque 160 ft. lbs.
4. Install pulley and belt(s). Use Tool BT-33-70M and adjust.

FRONT COVER

Removal

1. Drain cooling system.
2. Disconnect heater hose, bypass hose, and both radiator hoses.
3. Remove all belts, fan and fan pulley, crankshaft pulley, and pulley hub.
4. Remove oil pan.
5. Remove cover to block attaching bolts and remove cover, timing pointer and water pump assembly. (Fig. 6B-156)

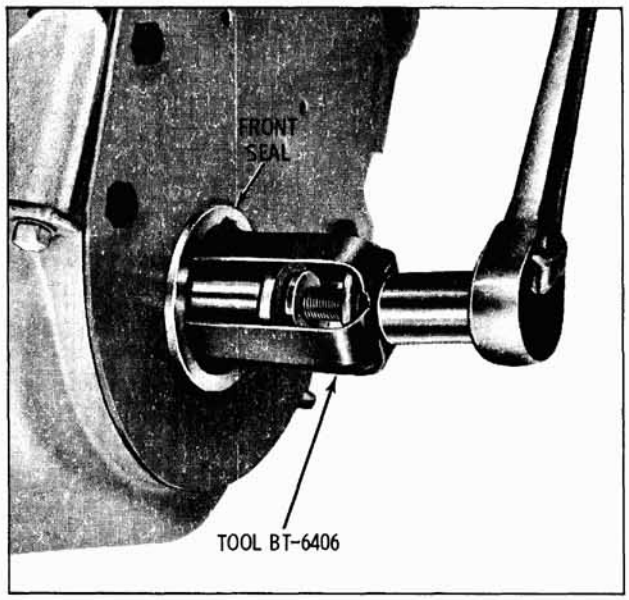


Fig. 6B-157—Front Oil Seal Removal

Installation

1. Install new cover gasket. Apply 1050026 or equivalent, sealer to gasket around water holes and place on block.
2. Install front cover, timing indicator and water pump assembly.
3. Apply SAE 10W30 oil to bolts (threads and heads) and install. Torque bolts evenly as indicated.
4. Apply lubricant 1050169 or equivalent, on pulley hub seal surface.
5. Install oil pan and lower engine.
6. Install pulley hub and pulley hub bolt. Torque to 160 ft. lbs. min.
7. Connect heater hose, bypass hose and radiator hoses.
8. Install crankshaft pulley and four attaching bolts. Torque to 20 ft. lbs.
9. Install fan pulley, fan and four attaching bolts. Torque bolts to 20 ft. lbs.
10. Install belts and adjust using Tool BT-33-70M.
11. Fill radiator and crankcase.

OIL SEAL

Removal (Front Cover Installed)

1. Remove the belts.
2. Remove the crankshaft pulley and pulley hub.
3. Using Tool BT-6406, remove oil seal as shown in Fig. 6B-157.

Installation

1. Apply 1050026 Sealer or equivalent, to outside diameter of seal.
2. Using Tool BT-6405, install oil seal as shown in Fig. 6B-158.
3. Install the pulley hub and crankshaft pulley.
4. Install and adjust belts.

TIMING CHAIN AND GEARS (With Front Cover Removed)

Removal

1. Remove fuel pump eccentric.
2. Remove oil slinger, cam gear and timing chain.
3. Remove crankshaft gear and key using tool BT-6812-1. (Fig. 6B-159)

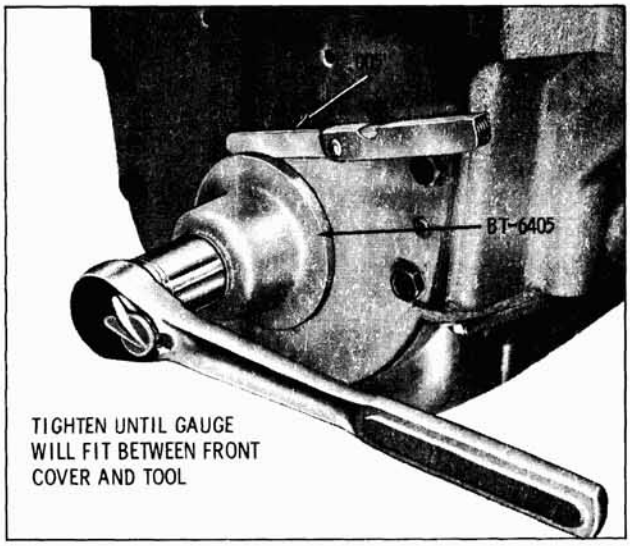


Fig. 6B-158—Front Oil Seal Installation

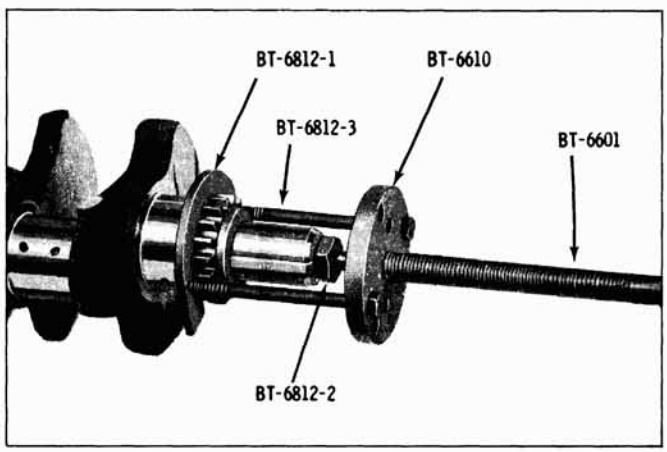


Fig. 6B-159—Removing Crankshaft Gear

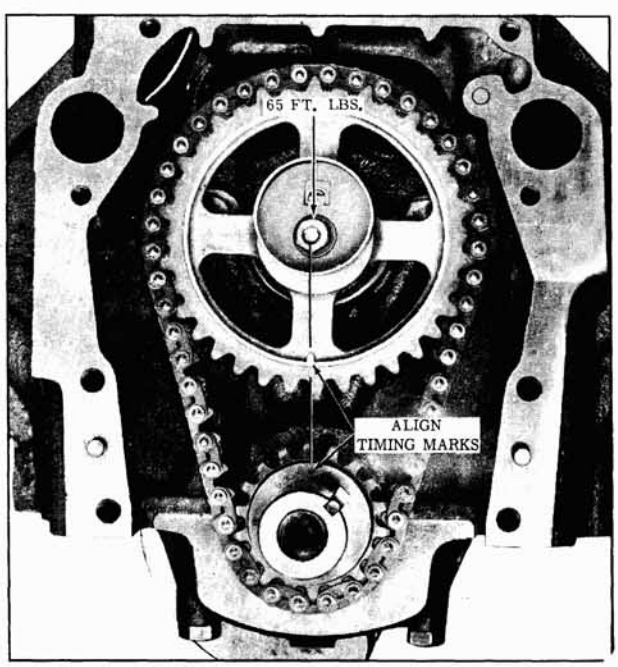


Fig. 6B-160—Timing Gear Position

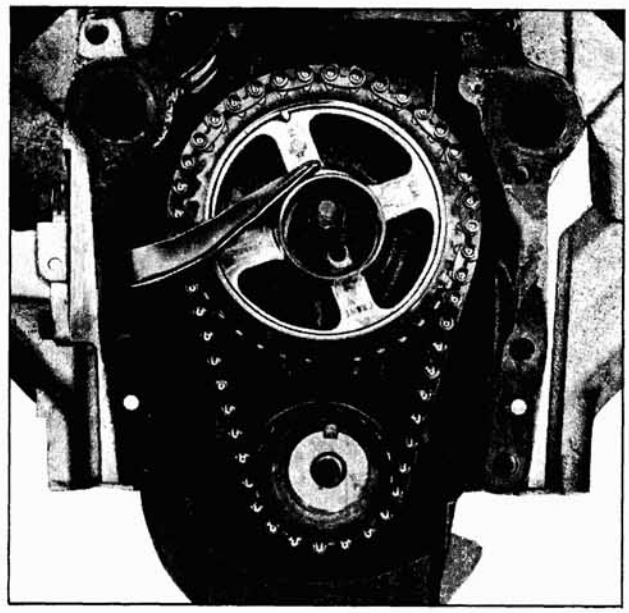


Fig. 6B-161—Fuel Pump Eccentric

Installation

1. Install camshaft gear, crankshaft gear and timing chain together, and align timing marks. (Fig. 6B-160)
2. Install fuel pump eccentric with flat side rearward. (Fig. 6B-161)
3. Drive key in with a brass hammer until it bottoms in gear.
4. Install oil slinger.

CHECKING VALVE TIMING WITHOUT REMOVING FRONT COVER

1. Remove distributor cap, right valve cover, No. 4 cyl. intake and exhaust rocker arms and pivot.
2. Ground coil wire to engine.
3. Turn ignition switch on. Crank engine until rotor is in line with No. 4 spark plug wire position. No. 4 piston will be approximately at the top of the cylinder.
4. Measure from pivot boss on head surface to top of No. 4 intake push-rod. Record measurement. (Fig. 6B-162)
5. Slowly turn engine 1-1/2 revolutions until rotor approaches No. 1 spark plug wire position. Continue to turn engine until timing mark on crank pulley is aligned with 0 on indicator. This is top dead center of No. 1 piston.
6. Again measure from pivot boss surface to top of No. 4 cyl. push-rod. (Fig. 6B-162)
7. Measurement should increase over the first measurement, as shown on chart. (Fig. 6B-162)
8. If measurement increase is not within 1/32" of that shown on chart, camshaft is advanced or retarded.

CAMSHAFT (Fig. 6B-163)

Removal

1. Remove radiator and front end sheet metal as necessary. The air conditioning condenser can be moved out of the way without disconnecting any of the lines.
2. Remove fuel pump.
3. Remove front cover.
4. Remove oil slinger, timing chain and gears.
5. Remove distributor.
6. Remove intake manifold.
7. Remove rocker-arm assemblies, push-rods and valve lifters.

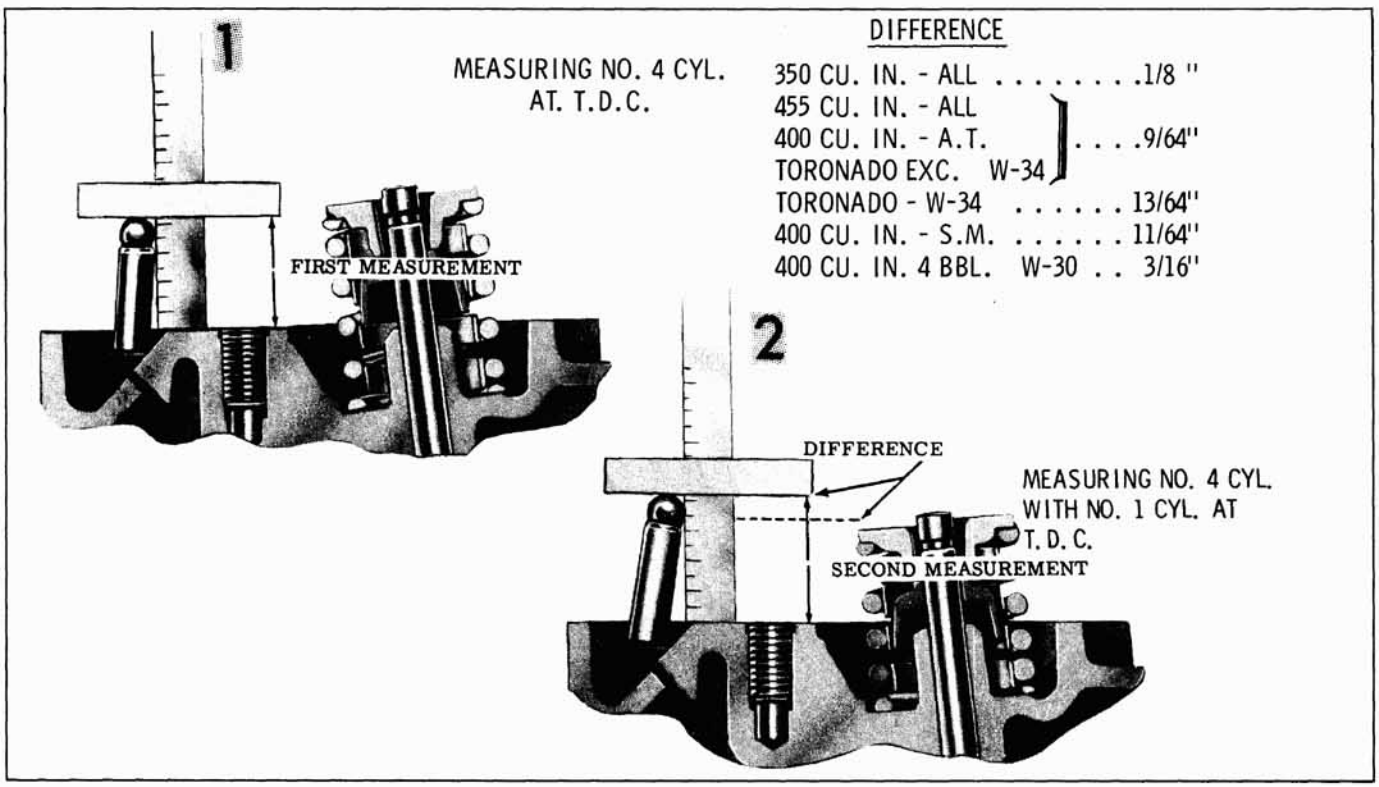


Fig. 6B-162—Checking Valve Timing

8. Remove camshaft by carefully sliding it out the front of the engine.

Installation

Service camshafts can be identified as in Fig. 6B-163 or will have the part number stamped on the rear end.

To insure proper camshaft installation and to provide initial lubrication, it is important that whenever a camshaft is installed it must first be coated liberally with Concentrate, No. 582099, or equivalent.

1. Install camshaft CAREFULLY to prevent damaging camshaft bearings.
2. Install valve lifters, push-rods and rocker arm assemblies and valve covers.
3. Install intake manifold.
4. Install timing chain and gears, oil slinger and front cover.
5. Install fuel pump.
6. Install radiator, air conditioning condenser and front end sheet metal as necessary.
7. Install distributor. Refer to ELECTRICAL Section.

CAMSHAFT BEARINGS

The camshaft bearings must be replaced in complete sets. All bearings must be removed before any can be installed. Number 1 bearing must be removed first, then number 2, then 3, 4 and 5. When installing the bearings, number 5 must be installed first, then number 4, 3, 2 and 1.

Included with the available tools in Camshaft Bearing Remover and Installer Set BT-6409.

This set can be used to remove cam bearings with the engine either in or out of the car. To replace bearings with engine in car, proceed as follows:

Removal

(Camshaft Removed)

1. Install No. 1 Cam Bearing Remover and Installer BT-6409-1 on Handle J-8092 (existing tool) and drive out front cam bearing.
2. Place Pilot BT-6409-6 on Driver BT-6409-7 and install No. 2 Cam Bearing Tool BT-6409-2 on driver and drive out No. 2 bearing.
3. Remove No. 3 and No. 4 bearings in the same manner, using BT-6409-3 and BT-6409-4 removers.

Each cam bearing is a different diameter and the correct sequence must be used both for removal and installation.

4. To remove No. 5 bearing with engine in chassis, use Puller BT-6409-8.

Installation

To aid aligning bearings with oil passages, place each bearing in the front bore with tapered edge toward block and align the oil hole in the bearing with the center of the oil slot in the bore. Mark top of bearing. When installing the bearings the mark will act as a guide.

1. Place new No. 5 bearing on BT-6409-5 and drive bearing in until the last white line on the driver is flush with the front face of the pilot. (Fig. 6B-164)
2. Use BT-6409-9 to check oil hole opening as shown in Fig. 6B-165.
3. Remove BT-6409-5 Installer and install BT-6409-4. Place No. 4 bearing on installer and drive in until second to last white line on driver is flush with pilot.
4. Follow the same procedure to install No. 3 and No. 2.
5. Install Tool BT-6409-1 on Handle J-8092 and place No.

END VIEW OF CAMSHAFT	VALVE TIMING	COLOR CODE	ENGINE USAGE
*	T.D.C.	ONE BLUE STRIPE OR ONE ORANGE AND ONE BLUE STRIPE	350 CU. IN. EXC. W-31
*	T.D.C.	ONE GREEN STRIPE OR ONE GREEN AND ONE ORANGE STRIPE	455 CU. IN. ALL EXC. W-34
	T.D.C.	TWO ORANGE STRIPES	400 CU. IN. 2BBL. AND 4BBL. A.T. EXC. W-30
	T.D.C.	TWO WHITE STRIPES OR TWO WHITE AND ONE ORANGE STRIPE	455 CU. IN. W-34
	T.D.C.	TWO BLUE STRIPES	400 CU. IN. M.T. EXC. W-30
REAR END VIEW	T.D.C.	ONE WHITE STRIPE	350 CU. IN. 4BBL. M.T. W-31
REAR END VIEW	T.D.C.	TWO GREEN STRIPES	400 CU. IN. W-30
*MAY HAVE LOCATING NOTCH AT DOTTED LINES.			

Fig. 6B-163—Camshaft Identification

1 bearing on installer. Drive bearing in until white line on Installer BT-6409-1 is flush with front face of block. (Fig. 6B-166)

6. Use BT-6409-9 to check all oil hole openings. Wire must enter hole or the bearing will not receive sufficient lubrication. (Fig. 6B-165)

Camshaft and Oil Galley Plugs (Fig. 6B-167)

The left hand rear oil galley plug is not shown. It is a threaded plug in the end of the left galley just forward of the distributor. A small hole is provided in the plug for distributor lubrication. The cup plug shown provides access to the threaded plug.

The front oil galley plugs (not shown) are threaded. The plug on the right side has a small hole which provides lubrication for the timing chain and gears.

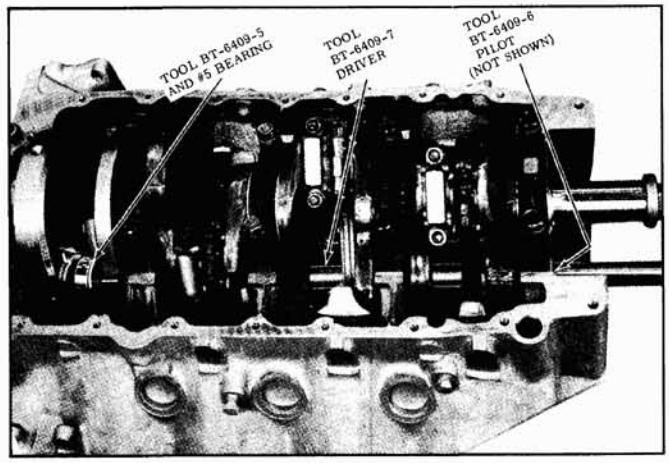


Fig. 6B-164—Installing Rear Cam Bearing

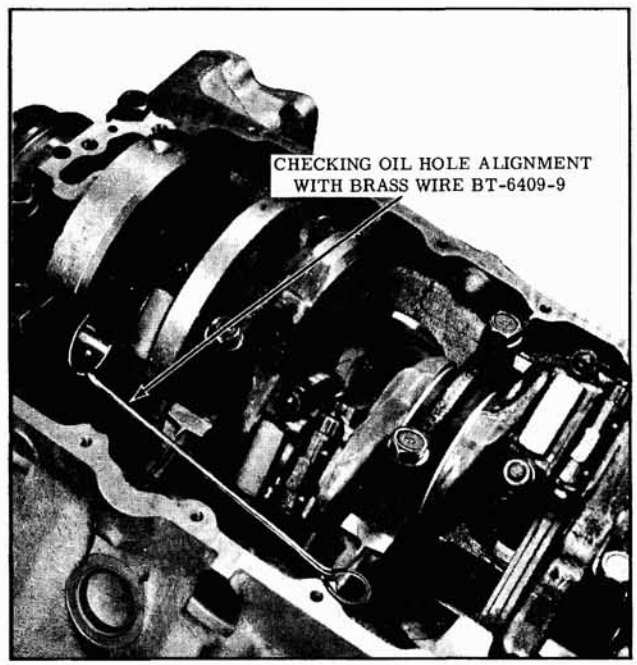


Fig. 6B-165—Checking No. 5 Oil Hole

CRANKSHAFT

REMOVAL (Cylinder Heads On)

1. With engine on stand and oil pan, oil pump and front cover removed, rotate crankshaft to the position where the connecting rod nuts are most accessible. Fig. 6B-168 shows a V-8 engine with the No. 3 and No. 4 rods in the fully extended position.

2. Remove main bearing caps.

3. Remove connecting rod caps and install thread protectors.

4. Note position of keyway in crankshaft so it can be installed in the same position.

5. Lift crankshaft out of block. Rods will pivot to the center of the engine when the crankshaft is removed.

Do not allow pistons to move in their bore during or after crankshaft removal.

Installation

1. Install sufficient oil pan bolts in pan rails to align rods with rubber bands as shown in Fig. 6B-168.

Align rods so that the inner thread protectors of adjacent

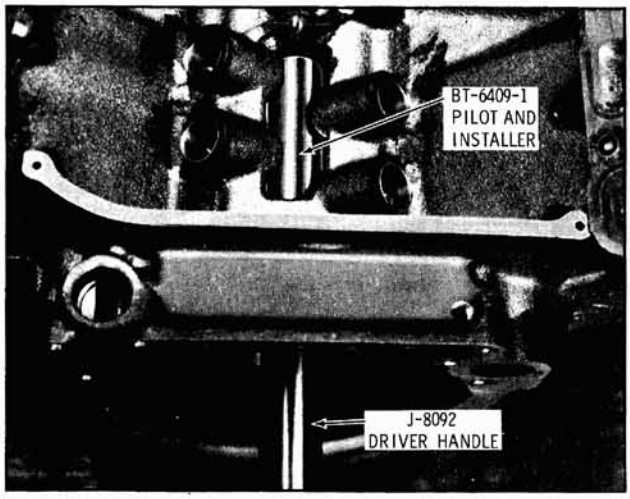


Fig. 6B-166—Installing No. 1 Cam Bearing

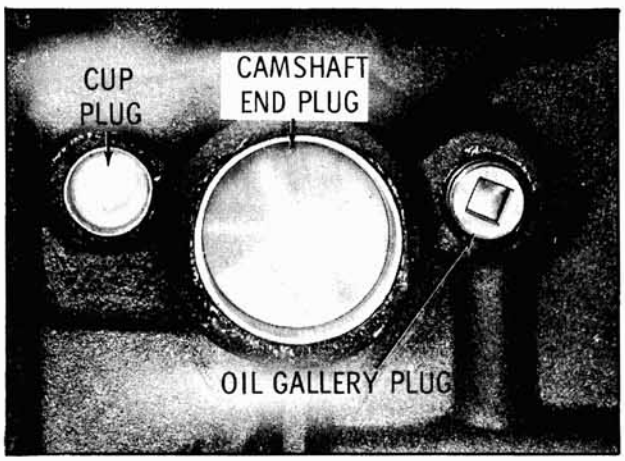


Fig. 6B-167—Camshaft and Oil Gallery Plugs

rods overlap approximately one inch as shown. Alignment can be adjusted by increasing tension on rubber bands with additional turns around the pan bolts or thread protectors.

2. Position crankshaft keyway in the same position as removed and lower into block. The connecting rods will follow the crank pins into the correct position as the crankshaft is lowered.

3. Remove rubber bands, thread protectors and pan bolts and assemble engine.

REMOVAL (Cylinder Heads Removed)

1. With engine on stand, remove oil pan, front cover, connecting rods, and oil pump.

2. Remove main bearing caps and lift crankshaft out of block.

Installation

1. Measure the crankshaft journals with a micrometer to determine the correct size rod and main bearings to be used.

Whenever a new or reconditioned crankshaft is installed, new connecting rod bearings and main bearings should be installed.

2. Position upper half of main bearings in block and lubricate with SAE 10W30 oil.

3. Install a new rear main bearing seal. (Fig. 6B-169 for 350 cubic inch engine or Fig. 6B-170 for 400 and 455 cubic inch engines)

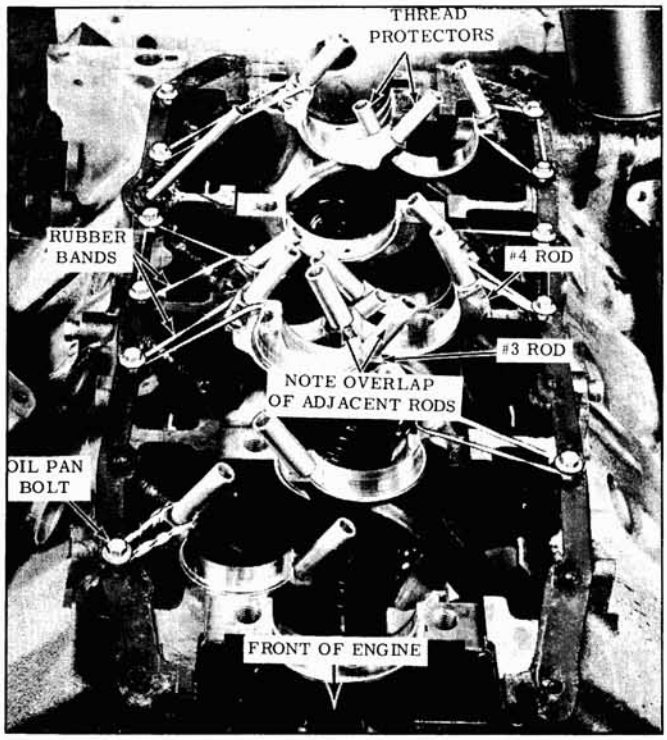


Fig. 6B-168—Crankshaft Removal

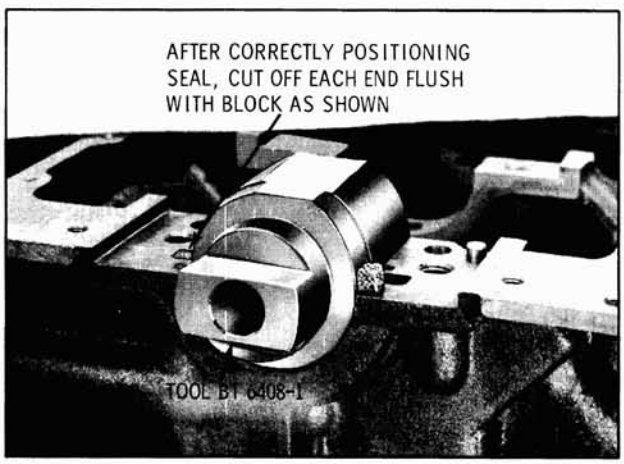


Fig. 6B-169—Installing Rear Main Oil Seal - Upper Half 400 and 455 Cu. In.

4. After oil passages in crankshaft have been checked for being open and shaft is clean, place shaft in block. Lubricate thrust flanges of the center bearing with 1050169 Lubricant or equivalent. Install caps with lower half of bearing lubricated with SAE 10W30 oil. Lubricate cap bolts with No. 1050125 or equivalent, and install, but do not tighten.

5. With a block of wood (Fig. 6B-171) bump shaft in each direction to align thrust flanges of center main bearing.

After bumping shaft in each direction, wedge the shaft to the front and hold it while torquing 3 cap bolts.

6. Torque Nos. 1, 2, 3 and 4 main bearing cap bolts to 80 ft. lbs. and No. 5 bolt to 120 ft. lbs. (350 cu. in. engine). Torque Nos. 1 through 5 to 120 ft. lbs. (400 and 455 cu. in. engines).

7. Reassemble engine and install in chassis.

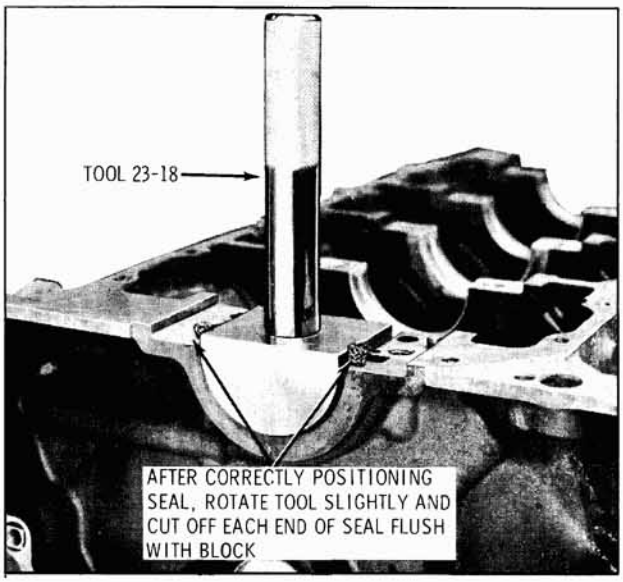


Fig. 6B-170—Installing Rear Main Oil Seal - Upper Half 400 and 455 Cu. In.

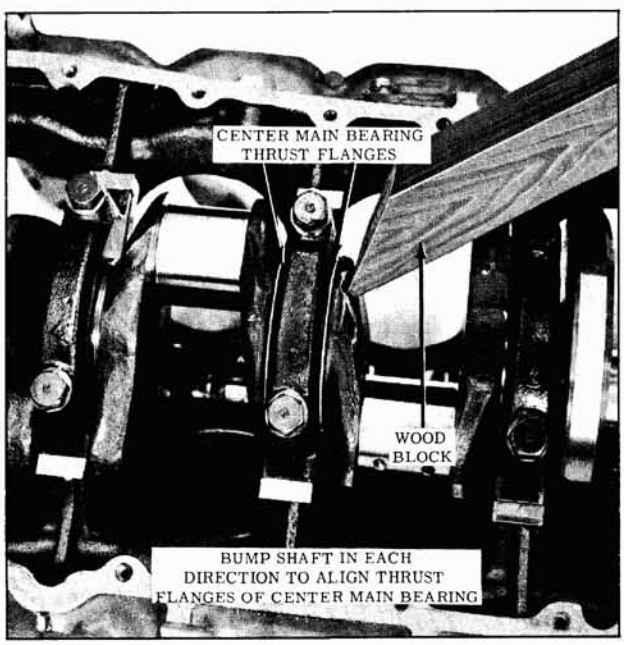


Fig. 6B-171—Aligning Center Main Bearing Flanges

MAIN BEARINGS

Main bearing clearance must not exceed .0035" on all bearings. The .0035" clearance is permissible only if the engine is disassembled for other than a bearing noise condition. If bearings are noisy or if a visual inspection indicates defective bearings, new bearings must be installed within the specifications outlined under MAIN BEARINGS - REPLACE.

Bearings which fall within the .0035" specification should not be rejected if the bearings show a normal wear pattern or slight radial grooves, unless it has been established to be defective.

Checking Bearing Clearances

1. Remove bearing cap and wipe oil from crankshaft journal and outer and inner surfaces of bearing shell.
2. Place a piece of plastigauge in the center of bearing.

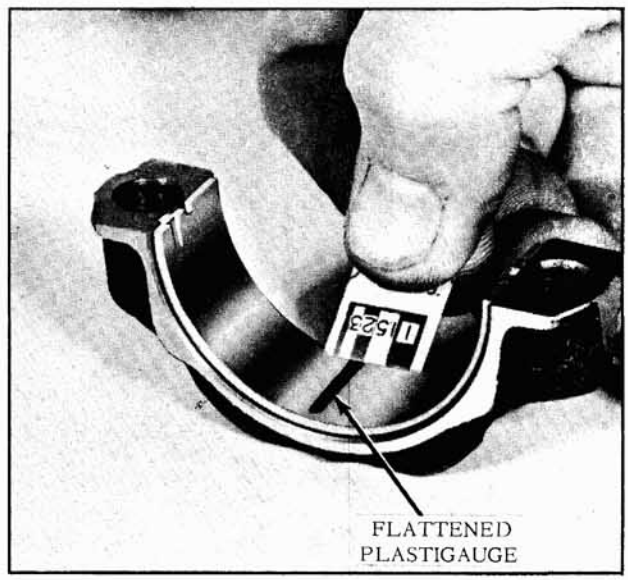


Fig. 6B-172—Checking Oil Clearance

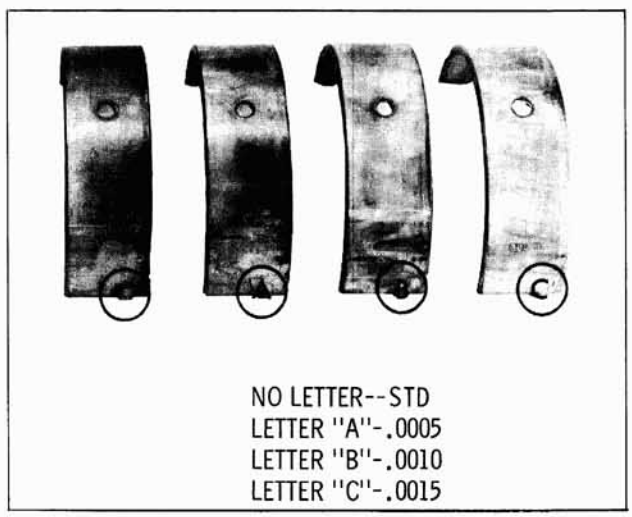


Fig. 6B-173—Main Bearing Identification

3. Use a floor jack or other means to hold crankshaft against upper bearing shell. This is necessary to obtain accurate clearance readings when using plastigauge.
4. Reinstall bearing cap and bearing. Place Lubricant No. 1050125 or equivalent on cap bolts and install.

Torque Nos. 1, 2, 3 and 4 bolts to 80 ft. lbs. and No. 5 bolt to 120 ft. lbs. (350 cu. in. engine).

Torque Nos. 1 through 5 to 120 ft. lbs. (400 and 455 cu. in. engines).

5. Remove bearing cap and determine bearing clearance by comparing the width of the flattened plastigauge at its widest point with graduation on the plastigauge container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. (Fig. 6B-172) If this clearance is greater than .0035", REPLACE BOTH BEARING SHELLS AS A SET. Recheck clearance after replacing shells. (Refer to MAIN BEARINGS - REPLACE).

Main bearing end thrust clearance should be .004" to .008" as checked with a dial indicator.

Main Bearings—Replace

Main bearing clearances not within specifications (.0005" to .0021") must be corrected by the use of selective upper and

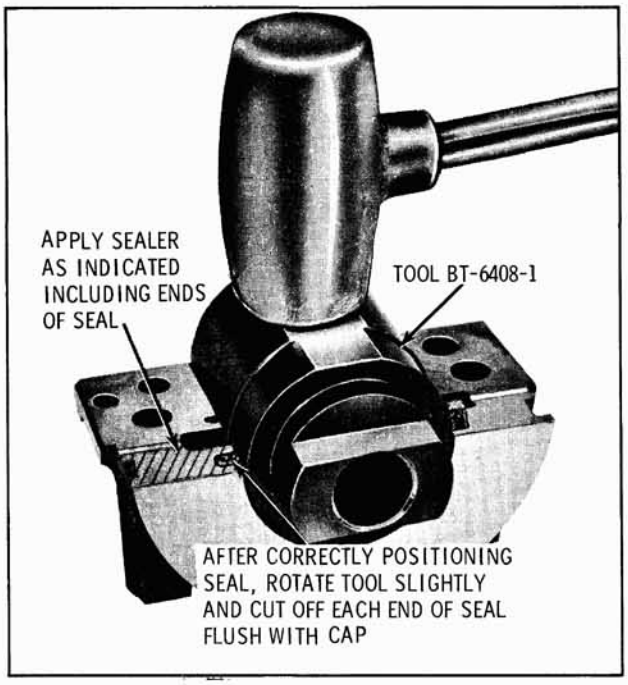


Fig. 6B-174—Installing Rear Main Oil Seal Lower Half - 350 Cu. In.

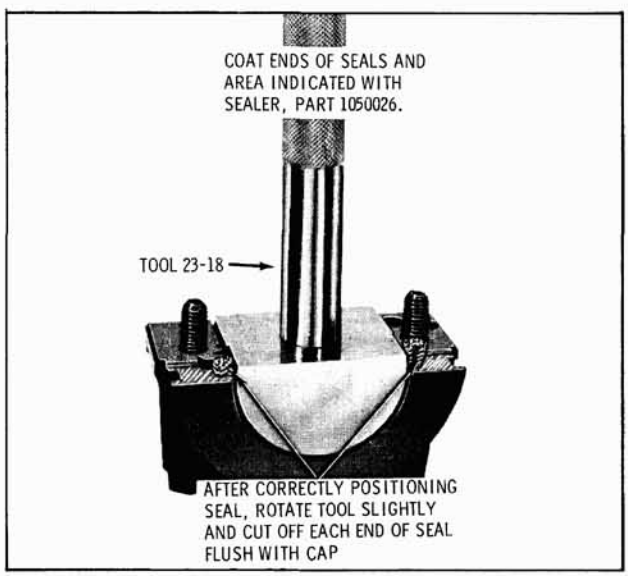


Fig. 6B-175—Installing Rear Main Oil Seal Lower Half - 400 and 455 Cu. In.

lower shells. UNDER NO CIRCUMSTANCES should the use of shims behind the shells, to compensate for wear, be attempted.

The upper and lower shells must be installed in pairs. Sizes of the bearings are located on the tang. (Fig. 6B-173) It is possible to have more than one bearing size in the same engine.

To install main bearing shells, proceed as follows:

1. Remove bearing cap and remove lower shell.
2. Insert a flattened cotter pin or roll out pin in the oil passage hole in the crankshaft, then rotate the crankshaft in the direction opposite to cranking rotaion. The pin will contact the upper shell and roll it out.
3. The main bearing journals should be checked for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with SAE 10W30 oil. Burrs may be removed with a fine oil stone. If the journals are scored or ridged, the crankshaft must be replaced.

Fig. 6B-176—Packing Oil Seal

The journals can be measured for out-of-round with the crankshaft installed by using a crankshaft caliper and inside micrometer or a main bearing micrometer. The upper bearing shell must be removed when measuring the crankshaft journals. Maximum out-of-round of the crankshaft journals must not exceed .0015".

4. Clean crankshaft journals and bearing caps thoroughly before installing new main bearings.
5. Apply Special Lubricant, No. 1050169 or equivalent to the thrust flanges of bearing shells on No. 3 bearing.
6. Place new upper shell on crankshaft journal with locating tang in correct position and rotate shaft to turn it into place using cotter pin or roll out pin as during removal.
7. Place new bearing shell in bearing cap.
8. No. 5 bearing - install new asbestos oil seal in the rear main bearing cap. (REAR MAIN BEARING OIL SEAL) (Fig. 6B-174 for 350 cubic inch engine or Fig. 6B-175 for 400 and 455 cubic inch engines)
   a. Install sealer on cap as shown.
9. Install bearing caps, lubricate bolt threads with No. 1050125 Lubricant or equivalent, and install.

Torque Nos. 1 through 4 to 80 ft. lbs. and No. 5 to 120 ft. lbs. (350 cu. in. engine)

Torque Nos. 1 through 5 to 120 ft. lbs. (400 and 455 cu. in. engines)

REAR MAIN BEARING UPPER OIL SEAL

Repair

Tools have been released to provide a means of correcting engine rear main bearing upper seal leaks without the necessity of removing the crankshaft. The procedure for seal leak correction is listed below.

1. Drain oil and remove oil pan and rear main bearing cap.
2. Insert Packing Tool BT-6433 or BT-6434 against one end of seal in cylinder block and drive the old seal gently into the groove until it is packed tight. This varies from 1/4" to 3/4" depending on the amount of pack required. (Fig. 6B-176)
3. Repeat this on the other end of the seal in the cylinder block.
4. Measure the amount the seal was driven up on one side; add 1/16", then cut this length from the old seal removed

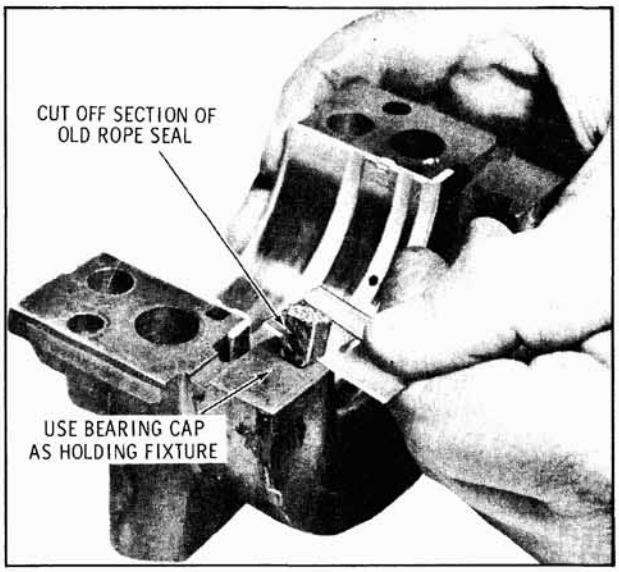


Fig. 6B-177—Cutting off Lower Seal Ends

Fig. 6B-178—Cutting off Upper Seal Ends

from the main bearing cap with a single edge razor blade. Measure the amount the seal was driven up on other side. Add 1/16" and cut another length from old seal. Use main bearing cap as a holding fixture when cutting seal as shown in Fig. 6B-177.

5. Place a drop of 1050026 Sealer or equivalent, on each end of seal and cap as indicated.

6. Work these two pieces of seal into the cylinder block (one piece on each side) with two small screwdrivers. Using Packing Tool, pack these short pieces up into the block. Use Seal Trimming Tool BT-6436 to trim seal flush with block as shown in Fig. 6B-178.

Place a piece of shim stock between seal and crankshaft to protect bearing surface before trimming.

7. Form a new rope seal in the rear main bearing cap as outlined.

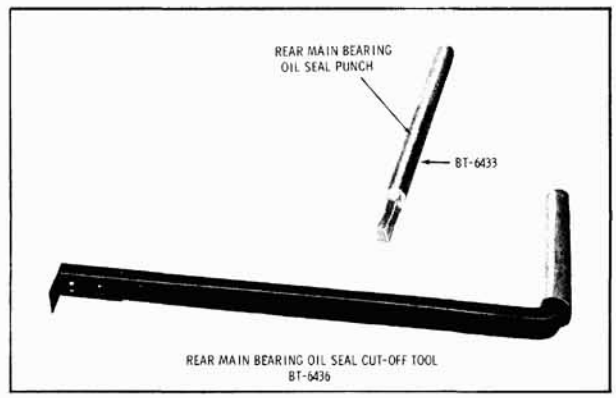


Fig. 6B-179—Rear Main Seal Tools

8. Assemble the cap to the block and torque to specifications.

REAR MAIN LOWER OIL SEAL

Removal

1. Remove oil pan.
2. Remove the rear main bearing cap.
3. Remove rear main bearing insert and old seals.
4. Clean bearing cap and seal grooves and inspect for cracks.

Installation

1. Install seal into bearing cap, packing by hand.
2. Using seal installer, hammer seal into groove. (Fig. 6B-174 for 350 cubic inch engine or Fig. 6B-175 for 400 and 455 cubic inch engines)

To check if seal is fully seated in the bearing cap, slide the tool away from seal. With tool fully seated in the bearing cap, slide tool against the seal. If undercut area of tool slides over the seal, the seal is fully seated. If tool butts against the seal, the seal must be driven further into the seal groove. Rotate tool before cutting off excess seal packing.

3. With tool slightly rotated, cut seal flush with mating surface. With screwdriver, pack seal end fibers towards center, away from edges. Rotate seal installer when cutting seal to avoid damage to tool.
4. Clean bearing insert and install in bearing cap.
5. Clean crankshaft bearing journal and seal contact.
   a. Install sealer on cap as shown.
6. Install bearing cap, lubricate bolt threads with No. 1050125 Lubricant or equivalent and install. Torque No. 5 to 120 ft. lbs. (350 cu. in. engine). Torque No. 5 to 120 ft. lbs. (400 and 455 cu. in. engines).
7. Install pan with new gaskets.
8. Install lower flywheel cover.

PILOT BEARING (Manual Transmission)

On manual transmission equipped cars a pilot bearing is located in a bore in the rear end of the crankshaft.

When removing the pilot bearing, remove with Pilot Bearing Puller BT-6619. (Fig. 6B-181) All old lubricant in the reservoir behind the bearing should be removed.

Install the new bearing, using Tool BT-6618. (Fig. 6B-182) Stake bearing. (Fig. 6B-183)

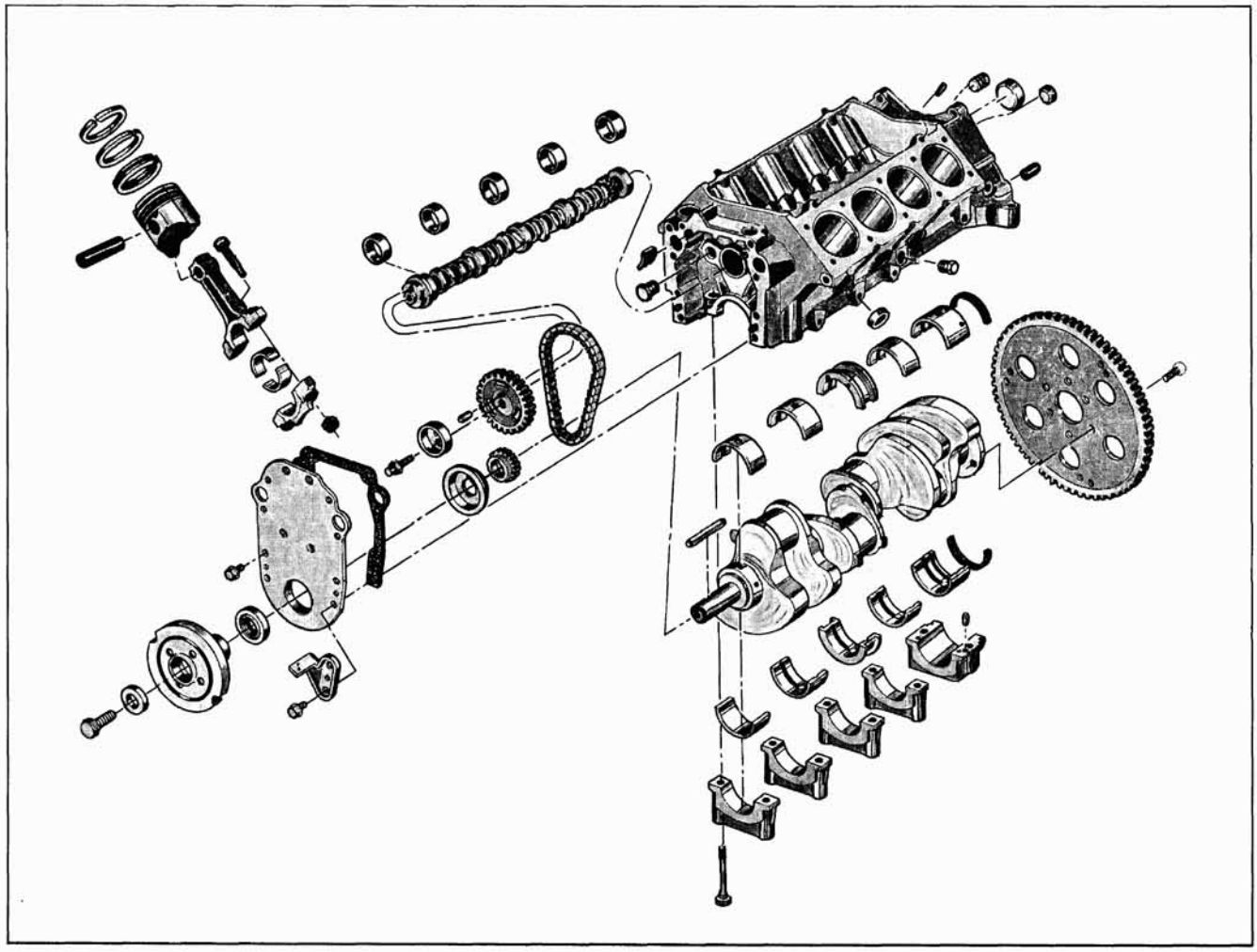


Fig. 6B-180—Engine Layout

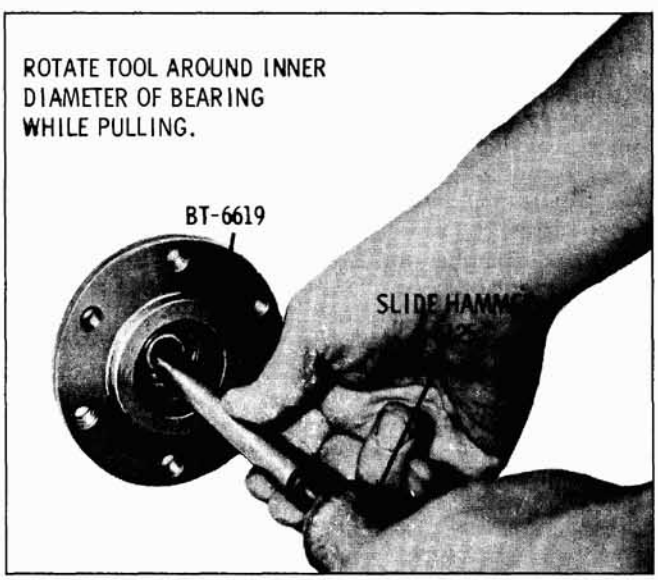


Fig. 6B-181—Removing Pilot Bearing

FLYWHEEL

One bolt hole in the flywheel is offset and it will attach to the crankshaft in only one position.

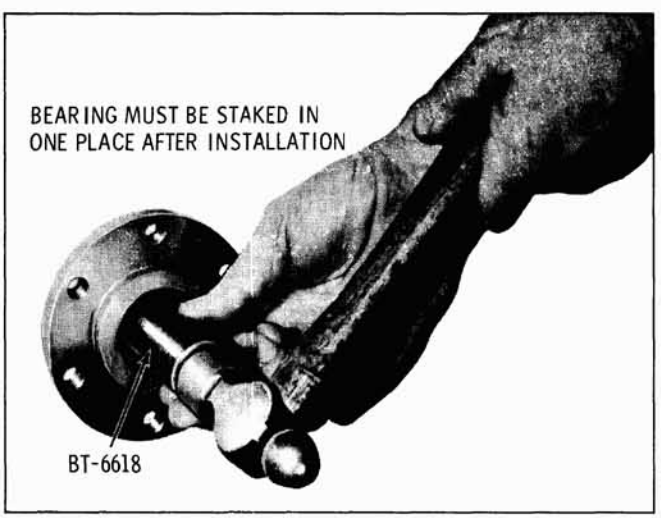


Fig. 6B-182—Installing Pilot Bearing

FLYWHEEL RING GEAR

The flywheel ring gear may be replaced if damaged. Drill two 3/16" holes in the gear and then split with a sharp chisel.

Heat the new gear with a torch and place in position on the flywheel. As the gear cools, it will become tight on the flywheel.

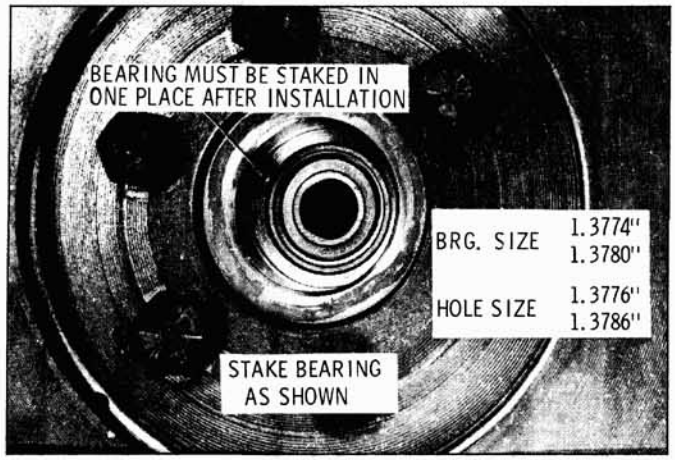


Fig. 6B-183—Staking Pilot Bearing

FUEL PUMPS (Fig. 6B-185)

Four different pumps are used, three on V-8 engines and one for L-6 engines. All pumps are the single action type.

The fuel pump rocker arm is held in constant engagement with the eccentric on the camshaft by the rocker arm spring. As the end of the rocker arm which is in contact with the eccentric moves upward, the fuel link pulls the fuel diaphragm downward. The action of the diaphragm enlarges the fuel chamber drawing fuel from the tank through the inlet valve and into the fuel chamber.

The pump delivers fuel to the carburetor only when the pressure in the outlet line is less than the pressure maintained by the diaphragm spring. Therefore, when the carburetor float needle valve opens, the spring will expand to move the diaphragm upward to force fuel past the outlet valve to the carburetor. When the carburetor float needle valve closes, the pump builds up pressure in the fuel chamber until the diaphragm spring is again compressed. The diaphragm will then remain stationary until more fuel is required by the carburetor.

INSPECTION AND TEST

There are three tests that can be performed to evaluate the fuel pump without removing the pump from the engine. It is important that the pump performs properly using all three tests.

1. Be sure there is gasoline in the tank.
2. Check for loose line connections. A leak at the pressure side of the system (line from pump to carburetor) will be indicated by dripping fuel. A leak in the suction side of the system (line from gas tank to pump) will not be apparent except in its effect of reducing volume of fuel on the pressure side of the system.
3. Look for bends or kinks in lines or hoses which will reduce flow. Check the fuel pump inlet hose routing to be sure it is not bent or kinked.

Fuel Flow Test

a. Ground primary terminal of distributor with jumper

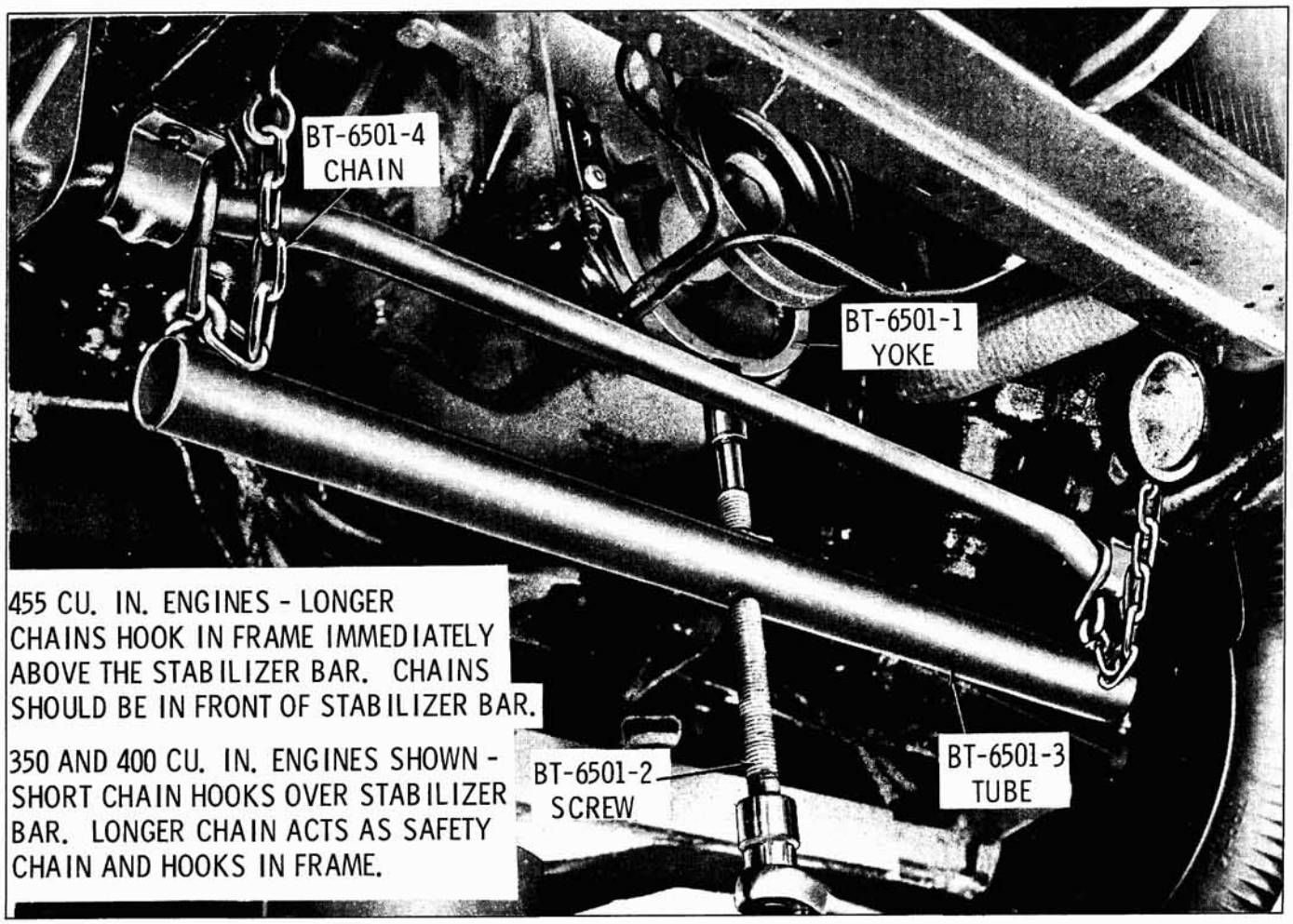


Fig. 6B-184—Engine Support Tool - BT-6501

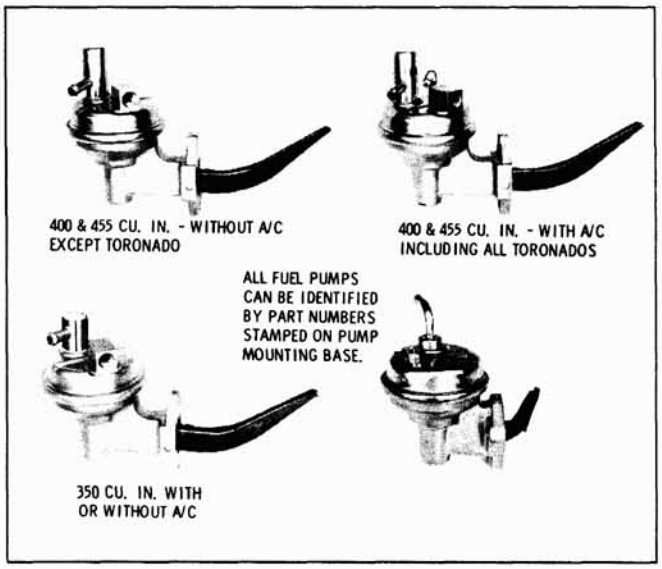


Fig. 6B-185—Fuel Pump Identification

lead so that engine can be cranked without firing.

b. Disconnect fuel line at the carburetor inlet fitting. Install a rubber hose approximately 8-10" long over the end of the fuel line.

c. Place suitable container at end of the hose and crank engine a few revolutions.

If little or no gasoline flows from open end of line, then the fuel line is restricted, gas tank filter restricted or the pump is inoperative. Before removing pump, disconnect fuel lines at fuel pump and at gas tank and blow through them with an air hose to make sure they are clear. Reconnect fuel lines to pump and gas tank.

d. Reconnect fuel line at the carburetor, start engine and check for leaks.

Pump (Outlet) Pressure

Even if fuel flows in good volume from line at carburetor, it is advisable to make certain that pump is operating within limits.

a. Disconnect fuel line at the carburetor inlet fitting. Install a rubber hose approximately 8-10" long over the line and attach a low reading pressure gauge. Hold the gauge up so that it is approximately 16" above the fuel pump.

b. Start engine and run at slow idle (using gasoline in carburetor bowl) and note reading on pressure gauge.

c. If pump is operating properly, the pressure should be 5 to 7 psi. constant for V-8 and 3 to 5 psi. constant for L-6. If pressure is too high or too low or varies materially at different engine speeds, the pump should be replaced.

When checking pressure on cars equipped with a fuel return line the return line must be plugged.

Pump (Inlet) Vacuum

Low vacuum or complete loss of vacuum provides insufficient fuel to the carburetor to operate the engine throughout normal speed range.

a. Disconnect hose from fuel tank to fuel pump at the fuel pump. Fasten hose in an up position so that fuel will not run out.

b. Connect one end of a short hose to the fuel pump inlet and attach a vacuum gauge to the other end. Start engine, gauge should register not less than 15 in. vacuum. If less than 15 in. vacuum replace pump.

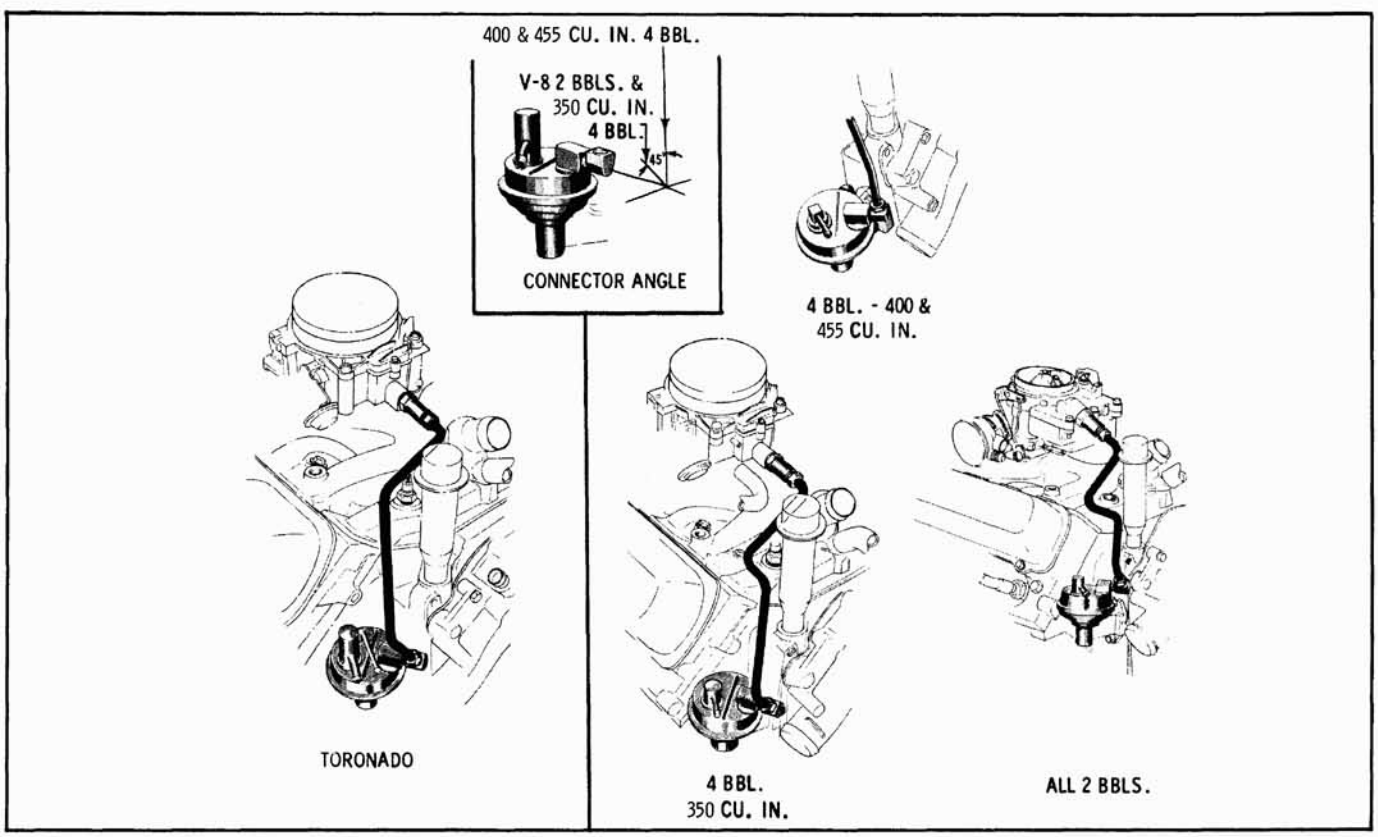


Fig. 6B-186—Fuel Line Routing

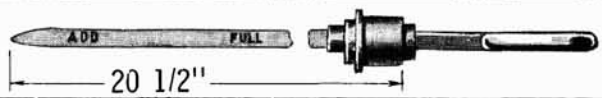
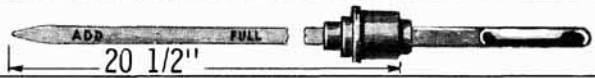
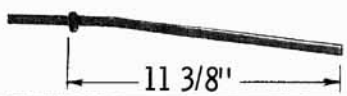
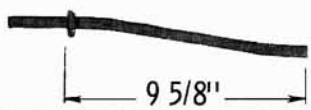
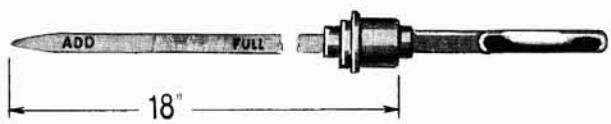
ENGINE	OIL LEVEL GUIDE	OIL LEVEL INDICATOR
455 CU. IN. - TORONADO		
400 CU. IN.		
455 CU. IN. - EXC. TORONADO		
350 CU. IN.		

Fig. 6B-187—Oil Dipstick Identification

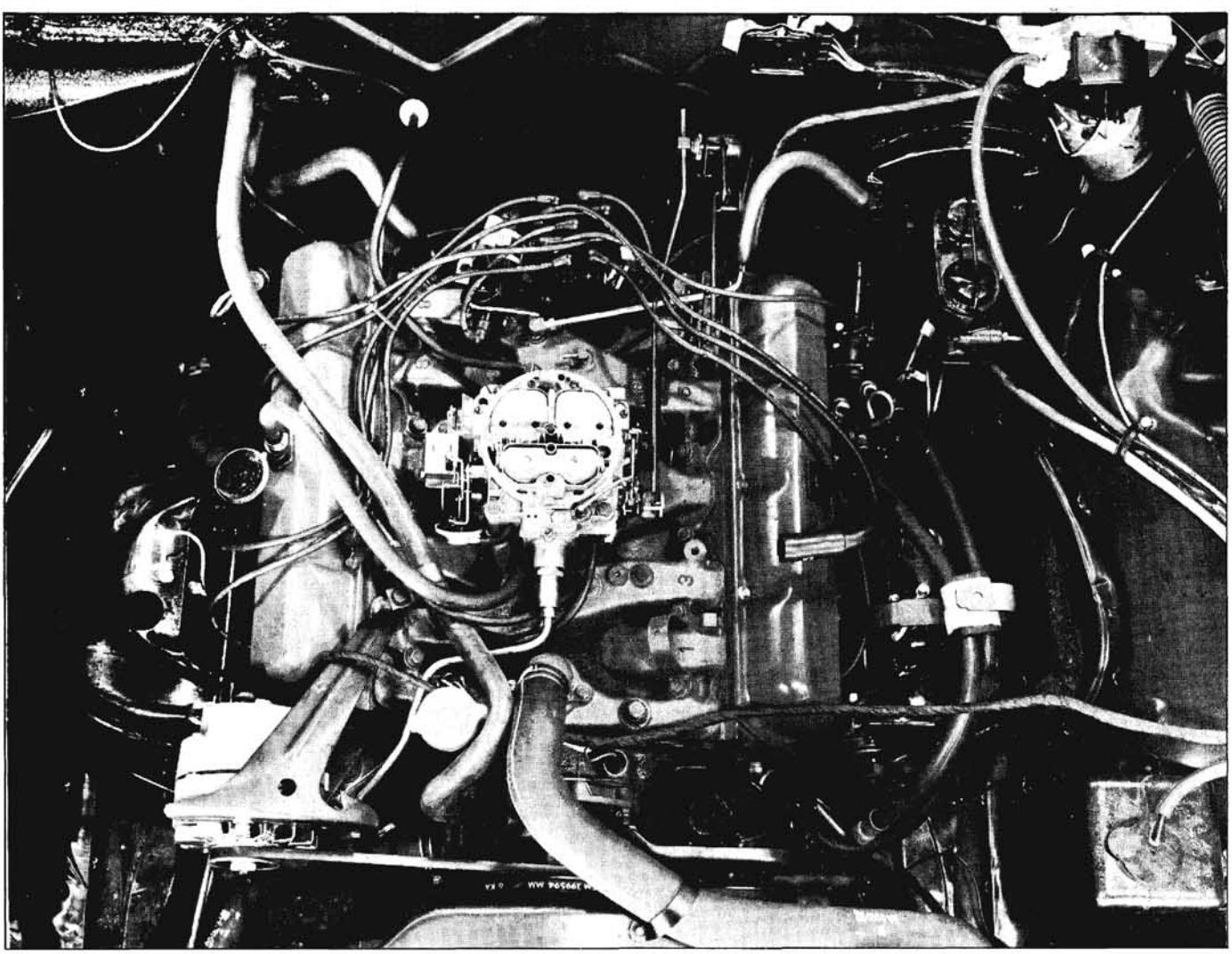


Fig. 6B-188—Typical V-8 Engine - 455 Cu. In. Shown

350 CUBIC INCH ENGINE SPECIFICATIONS

CYLINDER BLOCK	
Engine Type	90° V-Type
No. of Cylinders	8
Bore and Stroke (all)	4.057" x 3.3850"
Piston Displacement (all)	350 Cu. In.
Compression Ratio	2 Bbl. 9.0:1, 4 Bbl. 10.00:1
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (I.D.)	2.687"-2.688"
CRANKSHAFT	
Diameter-Main Bearing Journal (all)	2.4995"-2.4985"
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 & 4	1.156"-1.166"
No. 3	1.199"-1.201"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.1248"-2.1238"
Width-Connecting Rod Bearing (with fillets)	1.877"-1.880"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	.201"-.209"
Clearance - Crankshaft End Thrust	.004"-.008"
MAIN BEARINGS	
Oil Clearance-Crankshaft Vertical (#1, 2, 3 & 4)	.0005"-.0021"
Oil Clearance-Crankshaft Vertical (#5)	.0015"-.0031"
Width-Bearing Shell	
No. 1, 2, and 4	.970"-.980"
No. 3	1.193"-1.195"
No. 5	1.624"
CONNECTING RODS	
Length-Center to Center	5.998"-6.002"
Diameter-Connecting Rod Bore	2.2495"-2.2500"
Diameter-Pin Bore	.9789"-.9795"
Bearing Clearance - Crankshaft (vertical)	.0009"-.0031"
Side Clearance - Crankshaft End	.002"-.013"
PISTON	
Diameter Nominal Outside	4.056"
Length Overall	3.620"
Top of Piston to Center of Pin	1.613"-1.617"
Clearance at Thrust Surface (selective)	.00075"-.00125"
Weight Less Pin & Rings (all)	22.611 oz.
Skirt Taper	.0000"-.0010" Larger at Bottom
Ring Width (2 compression)	.0798"-.0808"
(1 oil)	.1881"-.1891"
PISTON PINS	
Diameter	.9807"-.9803"
Length Overall	2.980"
Pin to Piston Clearance	.0003"-.0005" Loose
Pin to Rod Clearance	.0008"-.0018" Press
PISTON RINGS	
No. of Compression Rings (per piston)	2
Width of Compression Rings (top & bottom)	.0780"-.0775"
Gap Clearance Compression Rings	.010"-.020"
Clearance in Groove Compression Rings - Upper	.002"-.004"
- Lower	.002"-.004"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015"-.055"
Clearance in Groove - Oil Ring	.001"-.005"

350 CUBIC INCH ENGINE SPECIFICATIONS (Cont'd.)

CAMSHAFT	
Bearing Journal Diameters	
No. 1	2.0365"-2.0357"
No. 2	2.0165"-2.0157"
No. 3	1.9965"-1.9957"
No. 4	1.9765"-1.9757"
No. 5	1.9565"-1.9557"
Width (including chamfers)	
No. 1	.810"
No. 2, 3, and 4	.761"
No. 5	.778"
Journal Clearance in Bearing (all)	.0020"-.0058"
End Thrust	.011"-.077"
VALVE - INTAKE	
Diameter - Head	1.886"-1.870"
Diameter - Stem	.3425"-.3432"
Angle - Valve	46°
Angle - Valve Seat	45°
Width - Valve Seat (on Cylinder Head)	.037"-.075"
Overall Length (all)	4.740"
Clearance in Guide	.0010"-.0027"
Lash	Hydraulic
VALVE - EXHAUST	
Diameter - Head	1.567"-1.557"
Diameter - Stem	.3420"-.3427"
Angle - Valve	46°
Angle - Valve Seat	45°
Width - Valve Seat (on Cylinder Head)	.037"-.075"
Overall Length (all)	4.728"
Clearance in Guide	.0015"-.0032"
Lash	Hydraulic
VALVE GUIDES - (Int. & Exh.)	
Inside Diameter (Std.)	.3442"-.3452"
VALVE SPRINGS	
Length	1.96"
Diameter - Wire	.192"
Inside Diameter	1.065"-1.041"
Load @ 1.670"	76-84 Lbs.
Load @ 1.270"	180-194 Lbs.
VALVE LIFTERS	
Diameter - Body (Std.)	.8422"-.8427"
Diameter - Body (.010" Over Size)	.8522"-.8527"
Length - Overall	2.000"
Clearance in Boss (selective)	.0005"-.0020"
CAMSHAFT SPROCKET	
Width of Sprocket	.410"-.400"
Pitch	.500"
No. of Teeth	36
Overall Width of Gear	.471"-.461"
CRANKSHAFT SPROCKET	
Width of Sprocket	.410"-.400"
Overall Width of Gear	1.001"-.993"
Pitch	.500"
No. of Teeth	18
TIMING CHAIN	
Width	Morse-.750", Linkbelt .740"-.750"
No. of Links	48
Pitch	.500"

400 CUBIC INCH ENGINE SPECIFICATIONS

CYLINDER BLOCK	
Engine Type	90° V-Type
No. of Cylinders	8
Bore and Stroke (all)	3.870" x 4.250"
Piston Displacement (all)	400 Cu. In.
Compression Ratio - Exc. L-65 Option (10.50:1)	L-65 Option (9.00:1)
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (I.D.)	3.188"-3.189"
CRANKSHAFT	
Diameter-Main Bearing Journal (all)	3.0003"-2.9993"
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 & 4	1.156"-1.166"
No. 3	1.199"-1.201"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.4498"-2.4988"
Width-Connecting Rod Bearing (with fillets)	1.877"-1.880"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	.201"-.209"
Clearance - Crankshaft End Thrust	.004"-.008"
MAIN BEARINGS	
Oil Clearance-Crankshaft Vertical 1, 2, 3 & 4	.0005"-.0021"
5	.0020"-.0034"
Width-Bearing Shell	
No. 1, 2, and 4	.970"-.980"
No. 3	1.193"-1.195"
No. 5	1.624"
CONNECTING RODS	
Length-Center to Center	6.733"-6.737"
Diameter-Connecting Rod Bore	2.6243"-2.6250"
Diameter-Pin Bore	.9789"-.9795"
Bearing Clearance - Crankshaft (vertical)	.0004"-.0033"
Side Clearance - Crankshaft End	.002"-.011"
PISTON	
Diameter Nominal Outside	3.870"
Length Overall	3.490"
Top of Piston to Center of Pin	1.738"-1.742"
Clearance at Thrust Surface (selective)	.00075"-.00125"
Weight Less Pin & Rings (all)	21.094 Oz.
Skirt Taper	.0000"-.0010" Larger at Bottom
Ring Width (2 compression)	.0798"-.0808"
(1 oil)	.1881"-.1891"
Pin Hole	.9807"-.9811"
PISTON PINS	
Diameter	.9803"-.9807"
Length Overall	2.980"
Pin to Piston Clearance	.0003"-.0005" Loose
Pin to Rod Clearance	.0008"-.0018" Press
PISTON RINGS	
No. of Compression Rings (per piston)	2
Width of Compression Rings (top & bottom)	.0780"-.0770"
Gap Clearance Compression Rings	.010"-.020"
Clearance in Groove Compression Rings - Upper	.002"-.004"
Lower	.002"-.004"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015"-.055"
Clearance in Groove - Oil Ring	.001"-.010"

400 CUBIC INCH ENGINE SPECIFICATIONS (Cont'd.)

CAMSHAFT	
Bearing Journal Diameters	
No. 1	2.0365"-2.0357"
No. 2	2.0165"-2.0157"
No. 3	1.9965"-1.9957"
No. 4	1.9765"-1.9757"
No. 5	1.9565"-1.9557"
Width (including chamfers)	
No. 1	.810"
No. 2, 3, and 4	.761"
No. 5	.788"
Journal Clearance in Bearing (all)	.0020"-.0058"
End Thrust	.011"-.077"
Push Rod - Length	9.556"
VALVE - INTAKE	
Diameter Head - 4 Bbl.	2.077"-2.067"
Diameter Head - 2 Bbl.	2.000"-1.990"
Diameter - Stem	.3425"-.3432"
Angle - Valve - 4 Bbl.	30°
Angle - Valve - 2 Bbl.	46°
Angle - Valve Seat - 4 Bbl.	30°
Angle - Valve Seat - 2 Bbl.	45°
Width - Valve Seat (Cylinder Head)	.030"-.045"
Overall Length	4.703"
Clearance in Guide	.0010"-.0027"
Lash	Hydraulic
VALVE - EXHAUST	
Diameter - Head	1.629"-1.619"
Diameter - Stem	.3420"-.3427"
Angle - Valve	46°
Angle - Valve Seat	45°
Width - Valve Seat (Cylinder Head)	.037"-.075"
Overall Length	4.695"
Clearance In Guide	.0015"-.0032"
Lash	Hydraulic
VALVE SPRINGS	
Length	1.96"
Diameter - Wire	.192"
Inside Diameter	1.065"-1.041"
Load @ 1.670"	76-84 Lbs.
Load @ 1.270"	180-194 Lbs.
VALVE LIFTERS	
*Diameter - Body	.8422"-.8427"
Length - Overall	2.000"
Clearance in Boss (selective)	.0005"-.0020"
*Also available in .010" Over Size	
CAMSHAFT SPROCKET	
Width of Sprocket	.529"-.521"
Pitch	.500"
No. of Teeth	36
Overall Width of Gear Hub	.471"-.461"
CRANKSHAFT SPROCKET	
Width of Sprocket	.530"-.520"
Overall Width of Gear	1.001"-.991"
Pitch	.500"
No. of Teeth	18
TIMING CHAIN	
Width	.875"-Morse, .844"-Linkbelt
No. of Links	48
Pitch	.500"

455 CUBIC INCH ENGINE (EXC. TORONADO) SPECIFICATIONS

CYLINDER BLOCK	
Engine Type	90° V-Type
No. of Cylinders	8
Bore and Stroke (all)	4.126" x 4.250"
Piston Displacement (all)	455 Cu. In.
Compression Ratio	See Engine Ident. Chart Section "O"
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (I.D.)	3.188"-3.189"
CRANKSHAFT	
Diameter-Main Bearing Journal (all)	3.0003"-2.9993"
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 & 4	1.156"-1.166"
No. 3	1.199"-1.201"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.4998"-2.4988"
Width-Connecting Rod Bearing (with fillets)	1.877"-1.880"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	.201"-.209"
Clearance - Crankshaft End Thrust	.004"-.008"
MAIN BEARINGS	
Oil Clearance-Crankshaft Vertical 1, 2, 3 & 4	.0015"-.0021"
5	.0020"-.0034"
Width-Bearing Shell	
No. 1, 2, and 4	.970"-.980"
No. 3	1.193"-1.195"
No. 5	1.624"
CONNECTING RODS	
Length-Center to Center	6.733"-6.737"
Diameter-Connecting Rod Bore	2.6243"-2.6250"
Diameter-Pin Bore	.9789"-.9795"
Bearing Clearance - Crankshaft (vertical)	.0004"-.0033"
Side Clearance - Crankshaft End	.002"-.011"
PISTON	
Diameter Nominal Outside	4.125"
Length Overall	3.490"
Top of Piston to Center of Pin	1.740"
Clearance at Thrust Surface (selective)	.00075"-.00125"
Weight Less Pin & Rings (all)	24.057 Oz.
Skirt Taper	.0000"-.0010" Larger at Bottom
Ring Width (2 compression)	.0798"-.0808"
(1 oil)	.1881"-.1891"
PISTON PINS	
Diameter	.9803"-.9807"
Length Overall	2.980"
Pin to Piston Clearance	.0003"-.0005" Loose
Pin to Rod Clearance	.0008"-.0018" Press
PISTON RINGS	
No. of Compression Rings (per piston)	2
Width of Compression Rings (top & bottom)	.0770"-.0780"
Gap Clearance Compression Rings	.013"-.023"
Clearance in Groove Compression Rings - Upper	.002"-.004"
Lower	.002"-.004"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015"-.055"
Clearance in Groove - Oil Ring	.002"-.008"

455 CUBIC INCH ENGINE (EXC. TORONADO) SPECIFICATIONS (Cont'd.)

CAMSHAFT	
Bearing Journal Diameters	
No. 1	2.0365"-2.0357"
No. 2	2.0165"-2.0157"
No. 3	1.9965"-1.9957"
No. 4	1.9765"-1.9757"
No. 5	1.9565"-1.9557"
Width (including chamfers)	
No. 1	.810"
No. 2, 3, and 4	.761"
No. 5	.788"
Journal Clearance in Bearing (all)	.0020"-.0058"
End Thrust	.011"-.077"
VALVE - INTAKE	
Diameter - Head (Exc. Toronado)	2.000"-1.990"
Diameter - Head (Toronado)	2.077"-2.067"
Diameter - Stem	.3425"-.3432"
Angle - Valve (Exc. Toronado)	46°
Angle - Valve (Toronado)	30°
Angle - Valve Seat (Exc. Toronado)	45°
Angle - Valve Seat (Toronado)	30°
Width Valve Seat (Cylinder Head)	.030"
Overall Length	4.707"
Clearance in Guide	.0010"-.0027"
Lash	Hydraulic
VALVE EXHAUST	
Diameter - Head	1.629"-1.619"
Diameter - Stem	.3420"-.3427"
Angle - Valve	46°
Angle - Valve Seat	45°
Width - Valve Seat (Cylinder Head)	.037"-.075"
Overall Length	4.695"
Clearance in Guide	.0015"-.0032"
Lash	Hydraulic
VALVE GUIDES	
Inside Diameter (intake & exhaust)	.3442"-.3452"
VALVE SPRINGS	
Length	1.96"
Diameter - Wire	.192"
Inside Diameter	1.065"-1.041"
Load @ 1.670"	76-84 Lbs.
Load @ 1.270"	180-194 Lbs.
VALVE LIFTERS	
*Diameter - Body	.8422"-.8427"
Length - Overall	2.000"
Clearance in Boss (selective)	.0005"-.0020"
*Also available in .010" Over Size	
CAMSHAFT SPROCKET	
Width of Sprocket	.529"-.521"
Pitch	.500"
No. of Teeth	36
Overall Width of Gear Hub	.471"-.461"
CRANKSHAFT SPROCKET	
Width of Sprocket	.530"-.520"
Overall Width of Gear	1.001"-.991"
Pitch	.500"
No. of Teeth	18
TIMING CHAIN	
Width	.875"-Morse, .844"-Linkbelt
No. of Links	48
Pitch	.500"

ENGINE SPECIFICATIONS (ALL V-8 ENGINES)

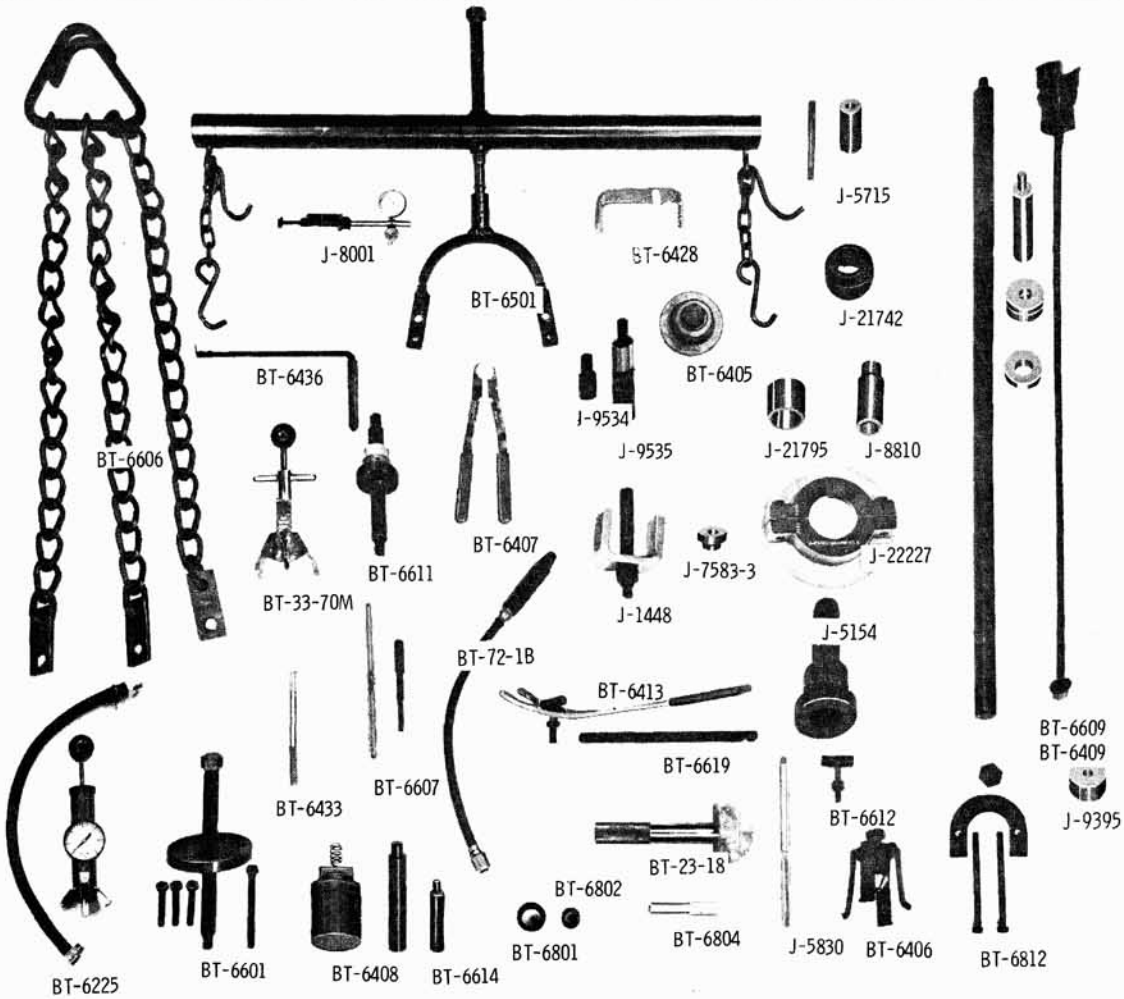
FLYWHEEL	
No. of Teeth on Starter Gear	166
No. of Teeth on Starter Pinion	9
LUBRICATION SYSTEM	
Crankcase Capacity Drain and Refill	4 Qts.
Drain & Refill with Filter Change	5 Qts.
Oil Pump	
Clearance Pressure Relief Valve in Bore	.0025"-.0050"
End Clearance - Gear	.0025"-.0065"

TORQUE SPECIFICATIONS (ALL V-8 ENGINES)

NOTE: Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below specification.

Application	Ft. Lbs.
FUEL PUMP	
Fuel Pump to Block Bolt and Nut	25
Fuel Pump Eccentric to Camshaft	65
EXHAUST SYSTEM	15-20
ENGINE	
Crankshaft Bearing Cap Bolts (400 cu. in. and 455 cu. in. engines)	120
Crankshaft Bearing Cap Bolts Nos. 1, 2, 3 & 4 (350 cu. in. engine)	80
Crankshaft Bearing Cap No. 5 (350 cu. in. engine)	120
Flywheel to Crankshaft (Automatic)	60
Flywheel to Crankshaft (Synchromesh)	80
Oil Pump to Bearing Cap Bolts	35
Oil Pump Cover to Pump Bolts	8
Rocker Arm Pivot Bolt to Head	25
Valve Cover Bolts	7
Oil Pan Bolts 5/16"	12
Oil Pan Bolts 1/4"	8
Oil Pan Drain Plug	30
Crankshaft Balancer or Hub to Crankshaft Bolt	160 Min.
Oil Filter Element to Base	20
Oil Filter Assembly to Cylinder Block Bolts	35
Front Cover to Cylinder Block Bolts 3/8"	35
Fan Driven Pulley to Hub Bolts	20
Fan Driving Pulley to Hub or Balancer Bolts	20
Water Pump to Front Cover Bolts	13
Water Outlet to Manifold Bolts	20
*Intake Manifold to Cylinder Head Bolts	35
Intake Manifold Baffle to Cylinder Block Bolts	8
Exhaust Manifold to Cylinder Head Bolts	25
Carburetor to Intake Manifold Bolts	15
Tube and Plate to Intake Manifold Bolts	15
Air Cleaner to Carburetor Stud	5
Motor Mount to Cylinder Block Bolts	50
Starter to Cylinder Block Bolts	35
Starter Brace to Cylinder Block Bolt	25
Starter Brace to Starter Bolt	15
Distributor Clamp to Cylinder Block Bolt	17
Spark Plugs	35
Coil to Intake Manifold Bolt	15
Cylinder Head Bolts	80
*Connecting Rod Nuts	42

*Clean and dip entire bolt in engine oil before tightening to avoid an erroneous torque reading.



BT-23-18 REAR SEAL MAIN BRG. SEAL INST. 400 & 425 CU. IN. ONLY (V-8)
BT-60 VALVE LIFTER BLEEDER (V-8 & L-6)
BT-72-1B VALVE HOLDER AIR HOSE (V-8 & L-6)
J-1448 CLUTCH PILOT BUSHING REMOVER (L-6)
J-5154 CRANKSHAFT TIMING GEAR AND FRONT OIL SEAL INSTALLER (L-6)
J-5515 SCALE GAUGE (V-8 & L-6)
J-5715 ROCKER ARM STUD REAMER .003" O. S. (L-6)
J-5830 -1 - .003" O. S. VALVE GUIDE REAMER (L-6)
-2 - .015" O. S. VALVE GUIDE REAMER (L-6)
-3 - .030" O. S. VALVE GUIDE REAMER (L-6)
J-6036 ROCKER ARM STUD REAMER .013" O. S. (L-6)
BT-6225 COOLING SYSTEM TESTER (V-8 & L-6)
BT-6815 COOLING SYSTEM TESTER ADAPTER
BT-6405 FRONT COVER SEAL INSTALLER (V-8)
BT-6406 FRONT SEAL REMOVER (V-8 & L-6)
BT-6407 VALVE LIFTER REMOVER (V-8 & L-6)
BT-6408 PISTON PIN TOOLS (V-8 & L-6)
BT-6801 PISTON PIN TOOL ADAPTER (V-8 ONLY)
BT-6802 PISTON PIN TOOL SPACER (V-8 ONLY)
BT-6409 CAMSHAFT BEARING SET (V-8)
BT-6413 VALVE SPRING COMPRESSOR (V-8 & L-6)
BT-6428 VALVE STEM HEIGHT GAUGE (V-8)
BT-6433 REAR MAIN BRG. OIL SEAL PUNCH (V-8)
BT-6436 REAR MAIN BRG. SEAL CUT-OFF TOOL (V-8)
BT-6501 ENG. SUPPORT BAR TO REMOVE OIL PAN (V-8)
-1 - YOKE
-2 - SCREW
-3 - TUBE
-4 - CHAIN
BT-6601 SCREW FROM TORSION BAR REM. & INST. (L-6)
BT-6606 ENGINE LIFT CHAIN (V-8 & L-6)
BT-6607 EXH. MANIFOLD HEAT RISER BUSHING SET (V-8)
BT-6609 CAMSHAFT BEARING SET (L-6)
BT-6610 CRANKSHAFT PULLEY AND GEAR REMOVER PLATE (L-6)
BT-6611 CRANKSHAFT PULLEY INSTALLER (V-8)
BT-6612 VALVE SPRING COMPRESSOR ADAPTER (V-8)
BT-6614 PISTON PIN ADAPTER (V-8 & L-6)
BT-6618 CLUTCH PILOT BEARING INSTALLER (V-8)
BT-6619 CLUTCH PILOT BEARING REMOVER (V-8)
BT-6804 VALVE SEAL INSTALLER
BT-6812 CRANKSHAFT PULLEY REMOVER
-1 - REMOVER PLATE
-2 - PILOT SCREW
-3 - PULLER BOLTS
J-7583-3 PILOT SCREW (USED WITH J-8614) 3/4" BOLT HOLE (V-8)
J-8001 DIAL INDICATOR (V-8 & L-6)
J-8810 CAMSHAFT GEAR REMOVER (L-6)
J-8880 VALVE ROCKER ARM STUD INSTALLER (L-6)
J-9395 PILOT FOR TOOL BT-6406 (L-6)
J-9534 DISTRIBUTOR BUSHING REMOVER (L-6)
J-9535 DISTRIBUTOR BUSHING INSTALLER (L-6)
J-21742 FRONT COVER CENTERING GAUGE (L-6)
J-21795 CAMSHAFT GEAR INSTALLER (L-6)
J-22227 CAMSHAFT GEAR REMOVAL PLATE (L-6)

Fig. 6B-189—Tools

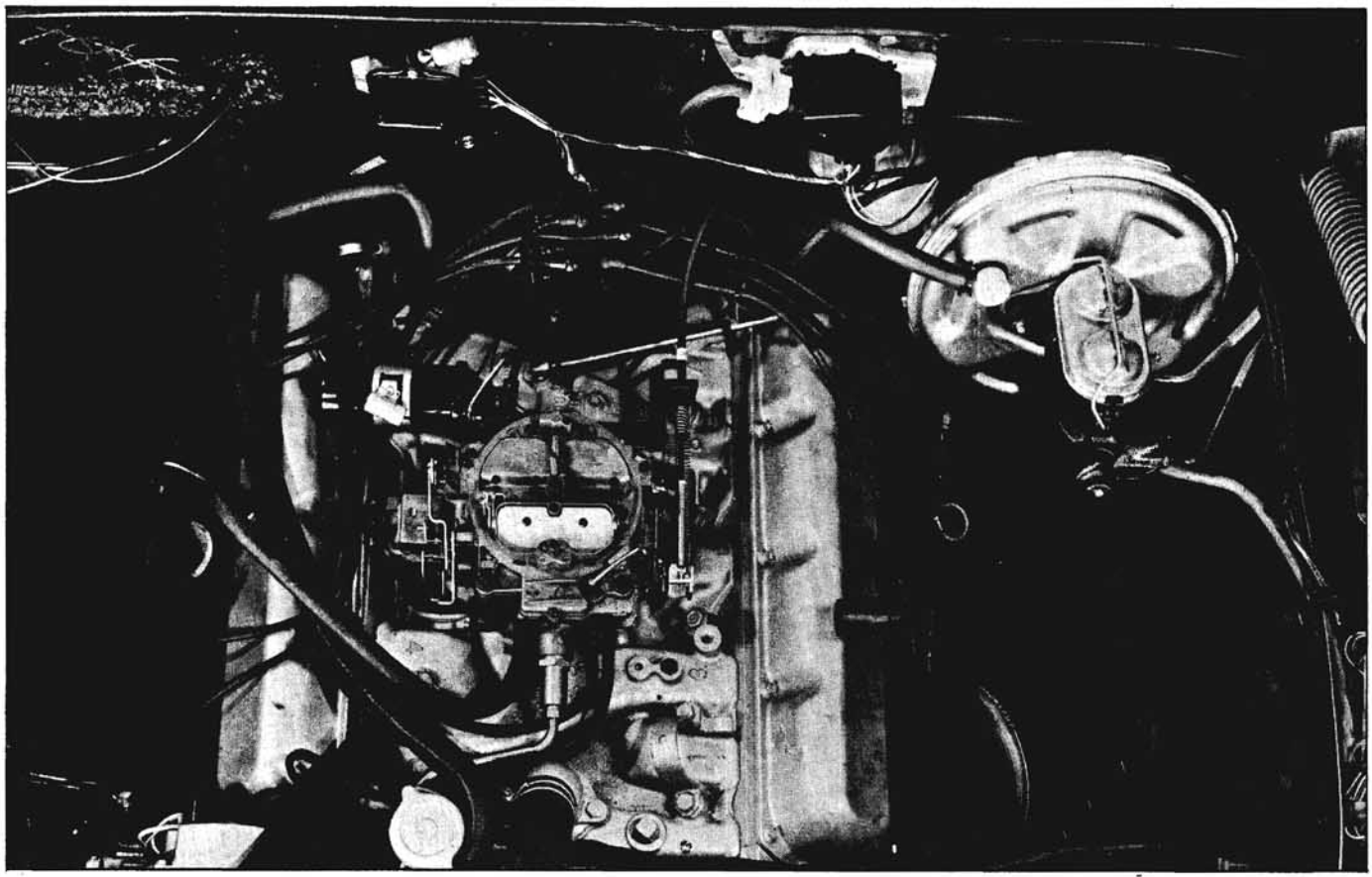
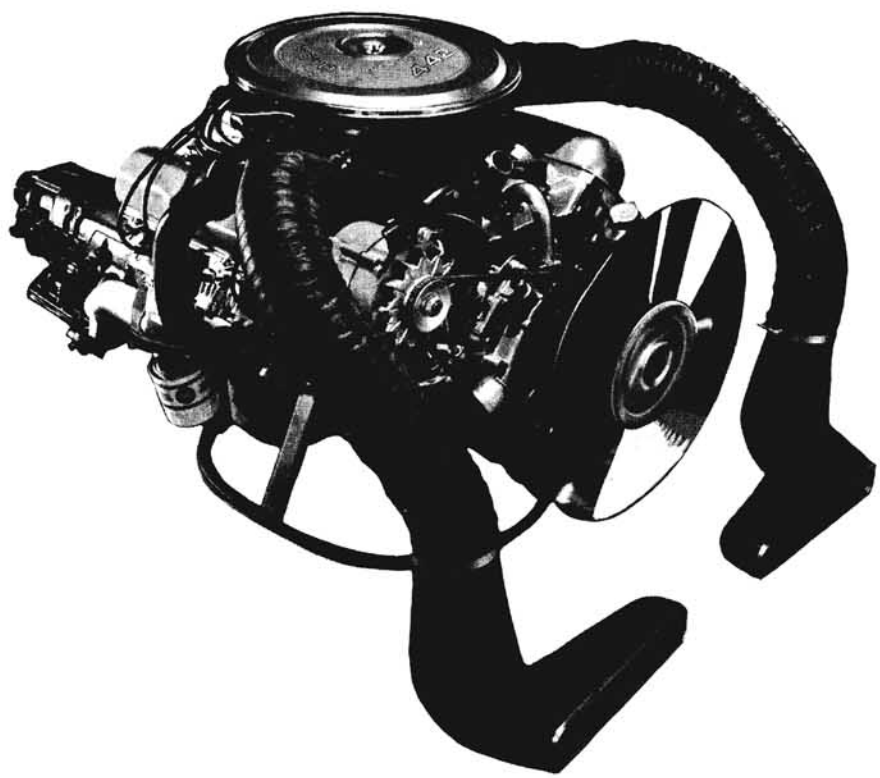


Fig. 6B-190—Typical V-8 Engine - 350 Cu. In. Shown



442 ENGINE - WITH W-30 OPTION

ENGINE TUNE-UP

ALL 1968 OLDSMOBILES ARE CERTIFIED BY THE UNITED STATES DEPARTMENT OF HEALTH, EDUCATION AND WELFARE AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. FOR THIS REASON, THE FACTORY PROCEDURE FOR SETTING IGNITION TIMING, DWELL AND SLOW IDLE MUST BE FOLLOWED EXACTLY WHEN ADJUSTMENTS ARE MADE.
IN ORDER TO INSURE THAT CRANKCASE AND EXHAUST EMISSION LEVELS ARE BELOW THE STANDARDS SET BY FEDERAL REGULATIONS, THE IGNITION TIMING, DWELL AND CARBURETOR SLOW IDLE MUST BE ADJUSTED ACCORDING TO FACTORY PROCEDURES AND SET AT THE LISTED SPECIFICATIONS.

(ALL SERIES)

CONTENTS OF SECTION 6C

Subject	Page	Subject	Page
ENGINE TUNE-UP	6C-1	L-6 CYLINDER HEAD TORQUE	6C-4
SPARK PLUGS	6C-1	L-6 VALVE ADJUSTMENT (ENGINE RUNNING)	6C-4
DISTRIBUTOR CONTACT POINTS	6C-2	COMPRESSION TEST	6C-5
DWELL ANGLE	6C-2	IGNITION SYSTEM DIAGNOSIS	6C-5
IGNITION TIMING	6C-2	ENGINE TUNE-UP CHART	6C-6
CARBURETOR ADJUSTMENTS	6C-4	DISTRIBUTOR TEST SPECIFICATIONS	6C-7

ENGINE TUNE-UP

To maintain the most satisfactory engine performance and to maintain the proper exhaust emission levels, it is recommended that the following items be performed every 12,000 miles or every twelve months:

Spark Plugs	- Clean and gap or replace.
Distributor	- Adjust or replace contact points and adjust dwell and timing.
Carburetor	- Replace fuel inlet filter, adjust idle speeds and mixture.
Heat Control Valve	- Check for freeness of operation. If sticking, free up using choke valve lubricant.
Crankcase Ventilation System (P.C.V.)	- Replace valve (P.C.V.), clean hoses and filter.

Cars equipped with K-66 option (Capacitor Discharge Ignition System) do not require ignition points or dwell setting.

EMISSION CONTROL ADJUSTMENT

To be performed at the first oil change (4 months or 6,000 miles, whichever occurs first).

1. Adjust timing and dwell angle.
2. Adjust idle speed and mixture.
3. Check operation of P.C.V. Valve.

SPARK PLUGS

1. Remove foreign material from around the spark plug holes and remove the spark plugs.
2. Clean exterior of plugs and inspect for cracked insulators, poor sealing gaskets or excessively burned electrodes.
3. Clean all serviceable plugs with an abrasive type cleaner. File center electrode flat. (Fig. 6C-1) Do not file center electrode on new plugs.

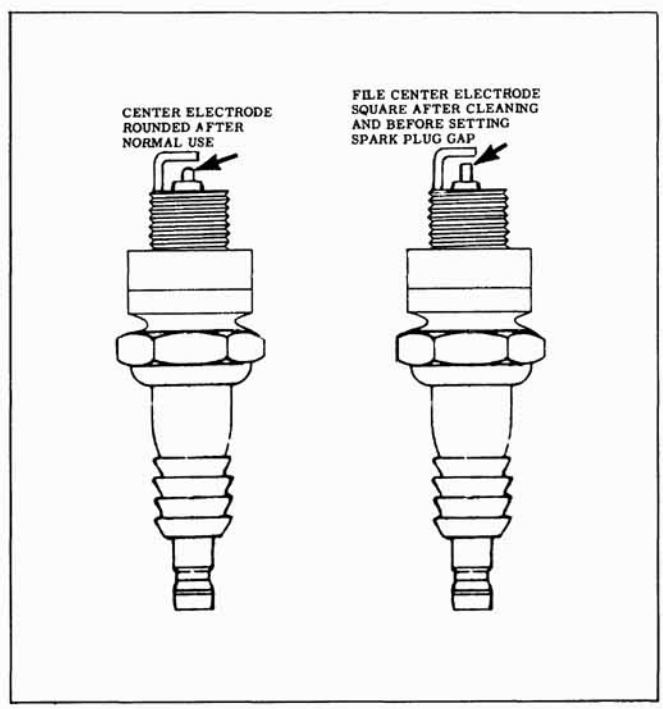


Fig. 6C-1—Filing Center Electrode

4. Adjust spark plug gap using a round feeler gauge.

Gap
All except K-66 option - .030"
With K-66 option - .045"

5. Install plugs and torque.

Torque
V-8 - 35 ft. lbs.
L-6 - 25 ft. lbs.

Spark plug gaskets are the captive type and are not to be replaced each time the plug is removed. The same gasket will usually seal even if the plug is removed up to four times.

DISTRIBUTOR CONTACT POINTS

1. Inspect points; check for excessive burning or pitting. Replace if necessary.
2. Inspect spark plug wires, distributor cap, rotor and terminals for cracks, corrosion or damage. Replace if necessary.
3. Remove scale from points with a fine cut contact point file. Do not attempt to remove all roughness.
4. Apply a film of cam and ball bearing lubricant or equivalent to the breaker cam.

Contact Point Adjustment (L-6 Engine)

1. Rotate engine until breaker arm rubbing block is on high point of lobe.
2. Adjust distributor contact point gap to .019" (new points) or .016" (used points), using a feeler gauge or dial indicator. (Fig. 6C-2)

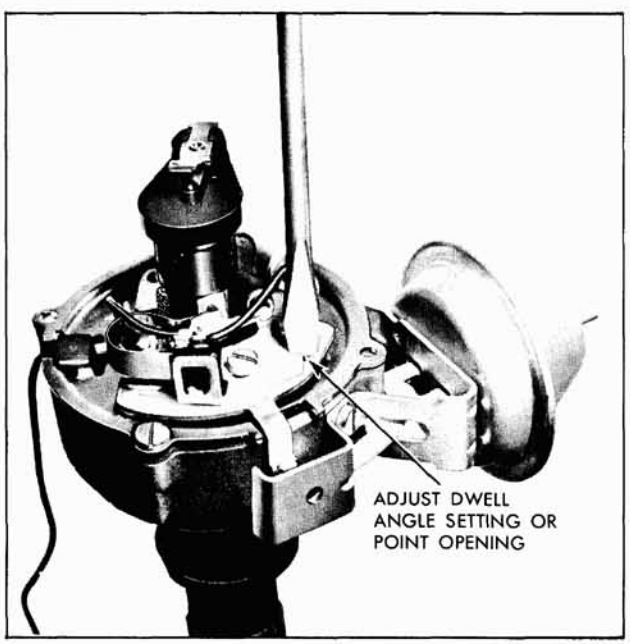


Fig. 6C-2—Contact Point Adjustment (L-6 Engine)

DWELL ANGLE (V8 ENGINE) (EXC. K66)

1. Calibrate dwell meter to set line and connect one lead of dwell meter to the primary distributor lead terminal (negative (-) terminal of coil) and other lead to ground.
2. With engine running at idle speed, insert Dwell Adjusting Tool J-6296 or BT-1501 through distributor window into the head of the adjusting screw. (Fig. 6C-3) Adjust dwell angle to 30°.

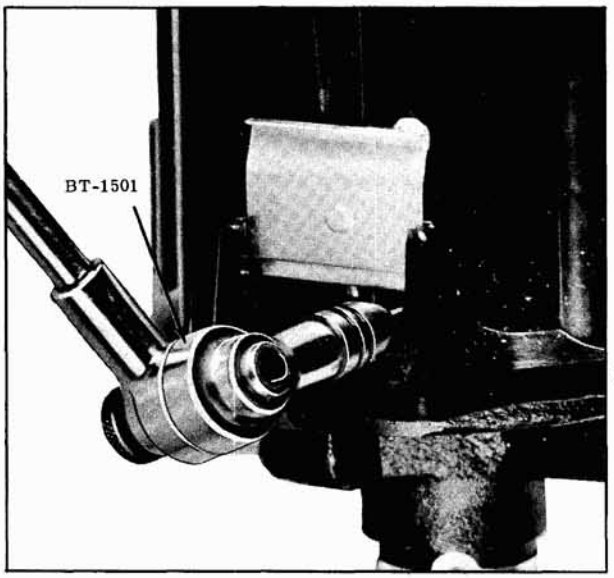


Fig. 6C-3—Adjusting Dwell Angle (V-8 Engine)

IGNITION TIMING

The ignition timing marks are located on the engine front cover. A saw slot on the balancer indicates engine top dead center. (Fig. 6C-4)

To adjust ignition timing, proceed as follows:

1. Disconnect vacuum hose at distributor and plug hose.

If air cleaner is removed, it will also be necessary to plug vacuum hose fitting with tape.

2. Connect tachometer and adjust engine speed.

L-6
Jetaway Transmission ..... 500 rpm
Manual Transmission ..... 700 rpm

V-8
All Models (exc. W-30) Option ..... 850 rpm
W-30 Engine Option ..... 1250 rpm

If car is equipped with K-66 option and a tachometer, it will be necessary to disconnect the in-car tachometer before attaching an external tachometer as shown in Fig. 6C-5.

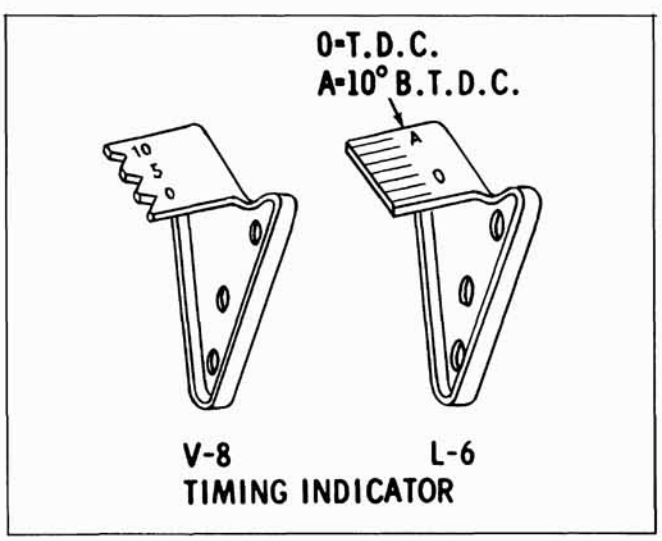


Fig. 6C-4—Timing Marks

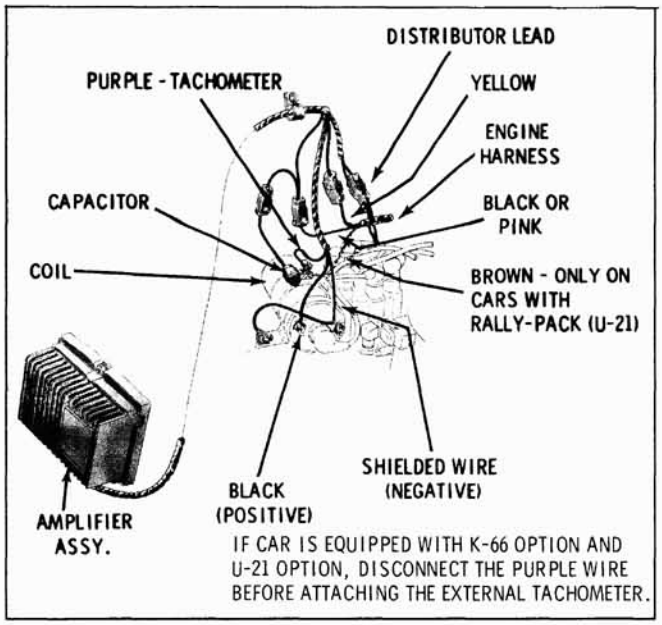


Fig. 6C-5—External Tachometer Connections

3. With the use of a timing light, set timing to specification shown on TUNE-UP CHART by loosening the distributor clamp bolt and rotating the distributor until the specification is obtained.

The L-6 timing indicator is marked in 2° increments. The "O" marking is TDC and all BTDC settings are on the "A" (advance) side of "O". The V-8 indicator has three "V" slots; each slot represents 5°. A 7-1/2° BTDC timing specification is obtained when the saw slot on the balancer is midway between the 5° and 10° slot.

4. Tighten the distributor clamp bolt and recheck timing to make sure distributor was not moved during tightening of bolt.

If a tuned engine detonates with this setting, the cause is low octane fuel or excessive carbon build-up in the combustion chamber. If these factors are not corrected, the timing should be retarded 2-1/2° from the specified settings.

5. Remove plug from distributor vacuum hose and connect hose. If air cleaner was removed, remove tape from manifold fitting and connect vacuum hose, install air cleaner.

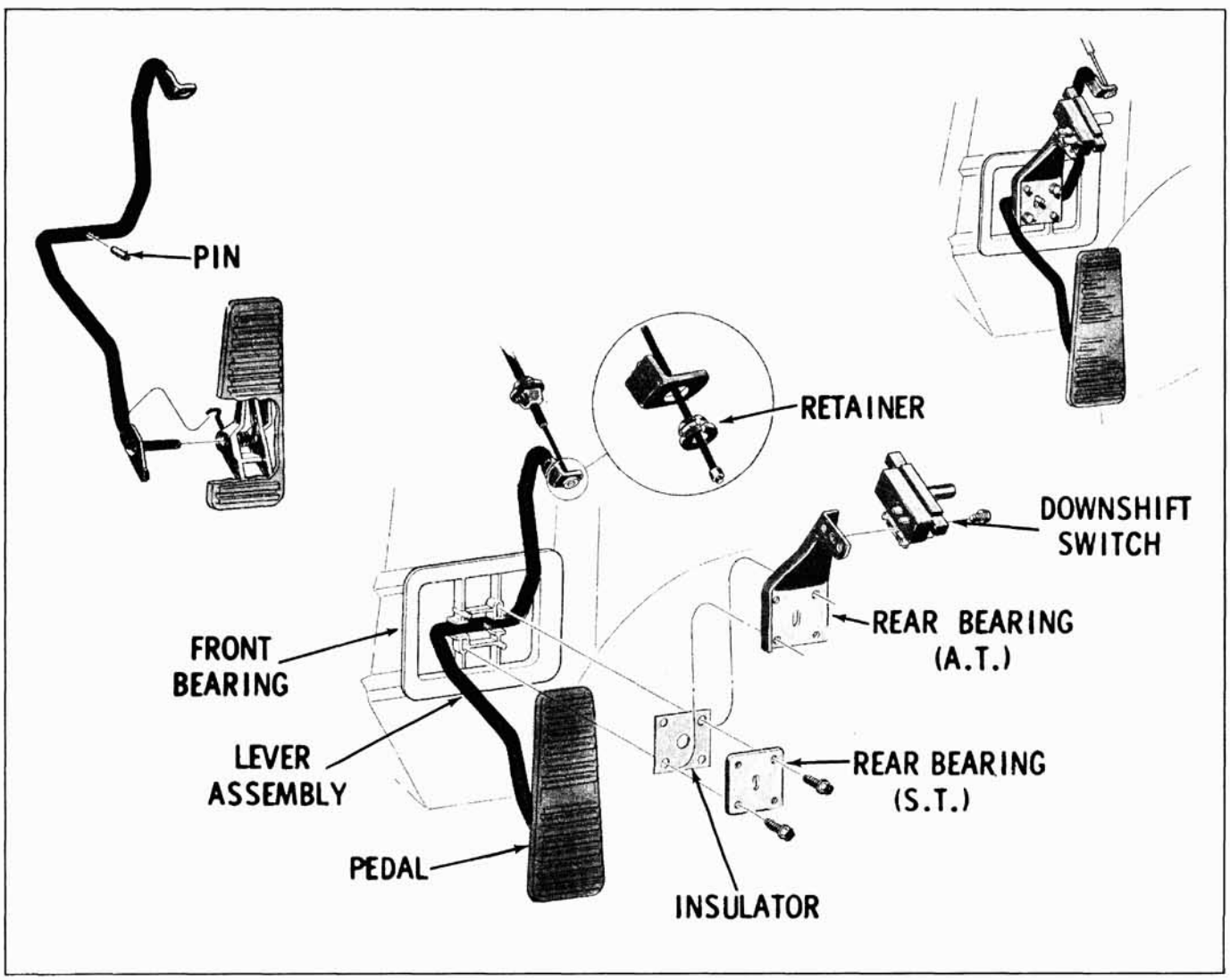


Fig. 6C-6—Throttle Controls - 31 through 48 Series

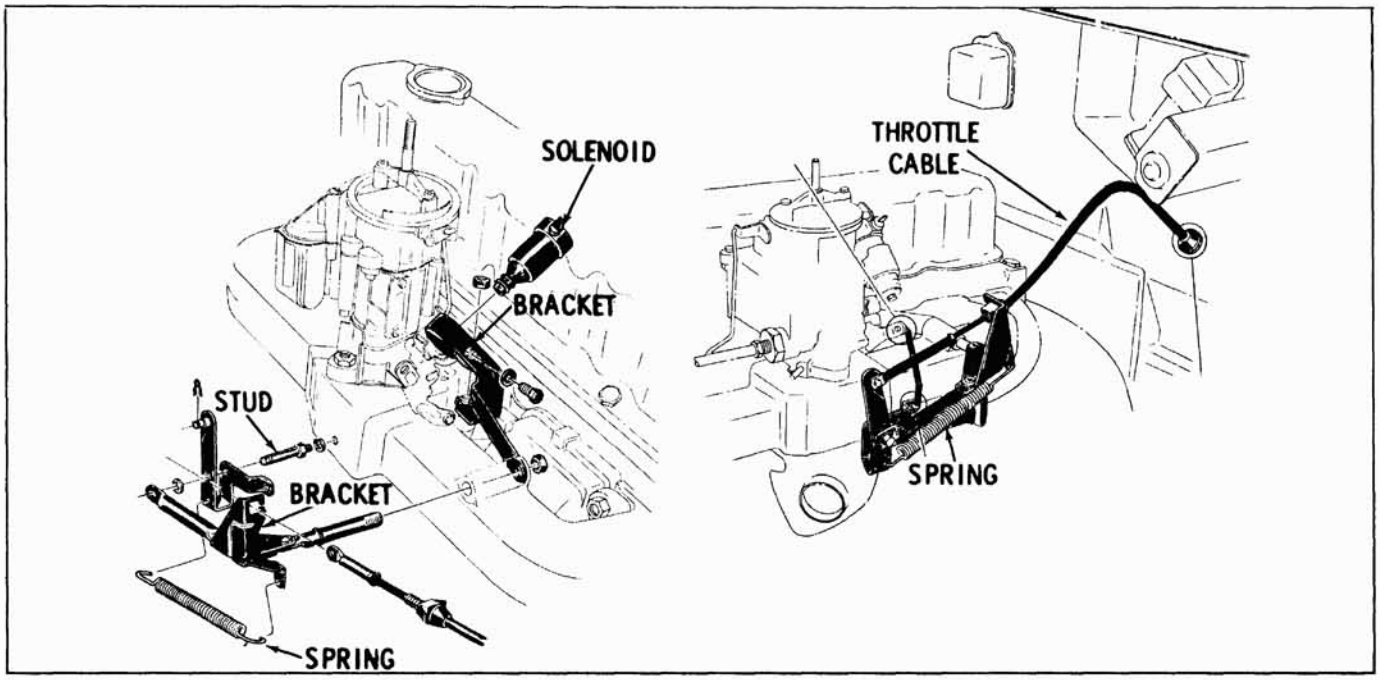


Fig. 6C-7—Throttle Control (L-6)

CARBURETOR ADJUSTMENTS

For the following adjustments refer to the specific "Carburetor Adjustment Charts."

Fast Idle
Slow Idle and Throttle Closing Solenoid.
Choke
Dashpot
Carburetor Rod
Downshift Throttle Switch

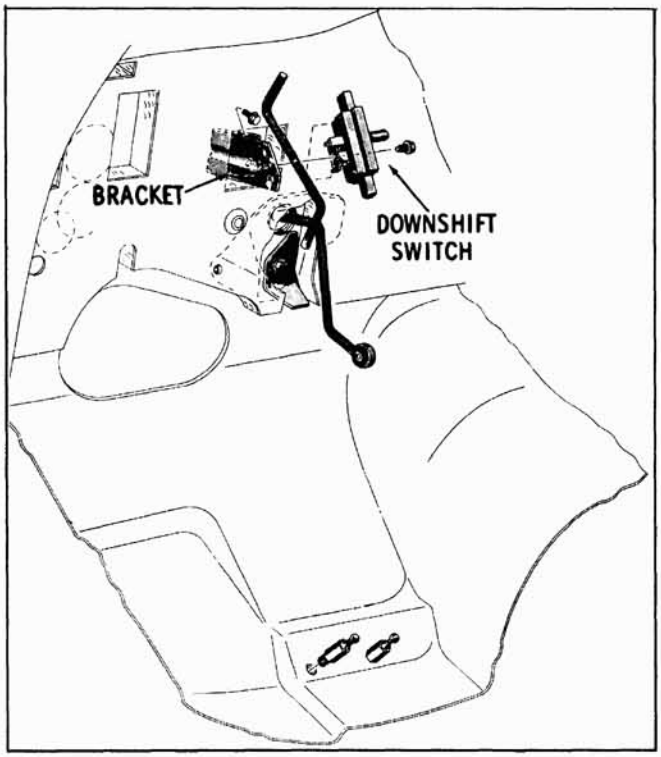


Fig. 6C-8—Throttle Control - 54 through 86 Series

CYLINDER HEAD TORQUE AND VALVE ADJUSTMENT (L-6 ONLY)

Retorquing the cylinder head bolts is not necessary unless a gasket has been replaced, or a leak is suspected. Valve lash must always be adjusted after the head has been torqued.

Before adjusting the valve stem to rocker arm clearance, it is extremely important that the engine be thoroughly warmed up to normalize the expansion of all parts. This is very important because during the warm-up period, the valve clearances will change considerably. Adjusting the valves during or before this warm-up period will produce clearances which will be far from correct after the engine reaches normal operating temperature.

Tests have shown that valve clearances will vary as much as .005" from a cold check through the normalizing range, consequently the engine should be run 15-20 minutes to properly normalize all parts.

Covering the radiator will not materially hasten this normalizing process because even with the water temperature quickly raised, it does not change the rate at which the oil temperature increases or the engine parts become normalized.

The actual temperature of the oil is not as important as stabilizing the oil temperature. The expansion or contraction of the valves, push rods, cylinder head and cylinder block are relative to this oil temperature. Therefore, only after the oil temperature is stabilized, do these parts stop expanding and valve clearance changes cease to take place.

PROCEDURE

1. After the engine has been normalized, remove rocker arm cover and gasket.

Do not pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber mallet.

2. With the engine running at idle, back off valve rocker arm nut until the valve rocker arm starts to clatter.

3. Turn rocker arm nut down slowly until the clatter just stops. This is the zero lash position.

4. Turn nut down 1/4 additional turn and pause 10 seconds until engine runs smoothly. Repeat additional 1/4 turns, pausing 10 seconds each time, until nut has been turned down 1 full turn from the zero lash position.

This 1 turn pre-load adjustment must be done slowly to allow the lifter to adjust to prevent the possibility of interference, between the inlet valve head and top of piston, which might result in internal damage and/or bent push rods. Noisy lifters should be replaced.

5. Repeat Steps 2, 3 and 4 to adjust the rest of the valves.
6. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser then install rocker arm cover, using a new gasket and torque bolts to specifications.

COMPRESSION TEST

The ignition resistor is by-passed during cranking through a contact in the starter instead of through a contact in the ignition switch.

With this system, the starter must not be energized when the ignition switch is in the "off" position. In this position, the ignition system primary is grounded in the ignition switch. Energizing the starter will cause damage to the ground contact in the ignition switch and to the ignition contact in the starter solenoid. Before energizing the starter, turn ignition switch to "ON", disconnect the coil lead at the center of the distributor and attach a jumper cable from it to ground. This assures the engine not starting while conducting the test and prevents damage to the wiring harness.

To determine if the valves or pistons are at fault, a test should be made to determine the cylinder compression pressure. When checking cylinder compression, the throttle and choke should be open, all spark plugs removed, and the battery at or near full charge. The lowest reading cylinder should not be less than 80% of the highest, and no cylinder reading should be less than 100 pounds.

Normal - Compression builds up quickly and evenly to specified compression on each cylinder.

Piston Rings - Compression low on first stroke tends to build up on following strokes but does not reach normal. Improves considerably with addition of oil.

Valves - Low on first stroke does not tend to build up on following strokes. Does not improve much with addition of oil.

IGNITION SYSTEM DIAGNOSIS

If car is equipped with K-66 option (Capacitor Discharge Ignition) in addition to the diagnosis listed here, refer to the Electrical Section.

For carburetor diagnosis refer to the specific diagnosis chart in Section 6M.

HIGH SPEED PERFORMANCE

1. Distributor points or incorrect dwell and ignition timing.
2. Spark plugs fouled, incorrect gap or heat range.
3. Stuck heat riser valve.
4. Stuck power valve or piston.
5. Closed or partially closed choke.
6. Foreign material or water in fuel.
7. Lack of fuel at carburetor.
8. Low fuel pump pressure.
9. Restricted high speed jets, low floats.
10. Burned or sticky valves, weak or broken springs.
11. Worn or seized piston rings.
12. Vapor lock.
13. Excessive carbon in heads.
14. Restricted exhaust system.
15. Transmission slipping.
16. Plugged carburetor air cleaner.
17. Insufficient vacuum advance.
18. Weak or shorted coil or condenser.
19. Retarded valve timing.
20. High engine oil pump pressure.

ENGINE WILL CRANK BUT WON'T START

1. Weak or shorted coil, no spark at plugs.
2. Distributor points misadjusted or burned or shorted condenser.
3. Lack of fuel at carburetor.
4. Low battery.
5. Starter drawing excessive amperage.
6. Low compression.
7. Retarded or advanced valve timing.

IDLE—MISSES OR ROUGH

1. Spark Plugs fouled or cracked.
2. Spark plug or distributor wires loose or shorted.
3. Plugged positive crankcase ventilation system.
4. Vacuum leak.
5. Plugged idle jets or improperly adjusted idle screws.
6. Weak or shorted coil.
7. Distributor points burned.
8. Burned or sticky valves, weak or broken springs.
9. Leaky head gaskets.
10. High fuel pump pressure.
11. Worn cam lobe.
12. Carburetor icing.
13. Stuck heat riser valve.

ENGINE WON'T CRANK

1. Low battery and loose or corroded cables.
2. Misadjusted or defective neutral start switch.
3. Defective starter motor.
4. Ignition switch problems.
5. Hydrostatic lockup. Remove spark plugs to look for water or gasoline in cylinders.
6. Seized engine. Turn crank pulley with socket and ratchet.

GAS MILEAGE

1. Distributor points burned or misadjusted.
2. Incorrect dwell and ignition timing.
3. Low engine vacuum.
4. Spark plugs fouled.
5. Plugged carburetor air cleaner.
6. Discrepancy while flow meter testing and driver's habits.
7. Closed or partially closed choke.
8. Plugged positive crankcase ventilation system.
9. Incorrect air/fuel ratio at 1500 rpm test.
10. Stuck heat riser valve.
11. Black smoke at tail pipe, shows rich gas mixture.
12. High or misaligned floats.
13. High fuel pump pressure.
14. Stuck power piston or wrong size in metering jets.
15. Brake drag.
16. Transmission slipping or high shifts.
17. Wrong speedometer gear.
18. Incorrect axle ratio.
19. Low tire pressure.

For additional diagnosis refer to Carburetor Diagnosis charts Section 6M of this manual.

HARD START HOT

1. Flooding condition.
2. Distributor points burned or misadjusted.
3. Closed choke.
4. Plugged carburetor air cleaner.
5. Spark plugs fouled.
6. Low compression.
7. Weak or shorted coil.
8. Loose coil or ignition wires.
9. Battery cables loose or corroded.
10. Low battery.
11. Starter drawing excessive amperage.
12. Carburetor or atmospheric vent closed.
13. Vapor lock.
14. Stuck heat riser valve.

HARD START COLD

1. Low battery.
2. Choke stuck open.
3. Loose coil or ignition wires.
4. Distributor points burned or misadjusted.
5. Flooding condition.
6. Spark plugs fouled.
7. Lack of fuel at carburetor.
8. Weak or shorted coil.
9. Starter drawing excessive amperage.
10. Battery cables loose or corroded.
11. Shorted distributor condenser.
12. Low compression.
13. Ignition switch problems.
14. Carburetor dechoker misadjusted.
15. Foreign material or water in fuel system.

ENGINE TUNE-UP CHART

Model	Engine	Engine Code Identification	AC Spark Plug Type	Plug Gap	Dwell	*Ignition Timing	Tune-Up Label Code Letter
3100 Thru 4800	250 Cu. In. L-6 1 Bbl.	VA, VB	46N	.035"	31° to	0° BTC @ 700 rpm	ON or OG
		VE, VF			34°	4° BTC @ 500 rpm	OP or OH
	350 Cu. In. L.C. 2 Bbl.	QA, QB, QI,	45S	.030"	30°	5° BTC @ 850 rpm	OA
	350 Cu. In. H.C. 4 Bbl.	QN, QP, QV,	44S	.030"	30°	7.5° BTC @ 850 rpm	OB
	400 Cu. In. L.C. 2 Bbl.	QL	45S	.030"	30°	5° BTC @ 850 rpm	OL
	400 Cu. In. H.C. 4 Bbl.	QR, QS	44S	.030"	30°	7.5° BTC @ 850 rpm	OC
	400 Cu. In. H.C. 4 Bbl.	QW	44S	.030"	30°	2.5° BTC @ 850 rpm	OK
	400 Cu. In. H.C. 4 Bbl. W-30	QT, QU	44S	.030"	30°	12.5° BTC @ 1250 rpm	OM
5400 Thru 8600	350 Cu. In. L.C. 2 Bbl.	TB, TD, TL	45S	.030"	30°	5° BTC @ 850 rpm	OA
	350 Cu. In. H.C. 4 Bbl.	TN	44S	.030"	30°	7.5° BTC @ 850 rpm	OB
	455 Cu. In. L.C. 2 Bbl.	UC, UD, UJ	45S	.030"	30°	5° BTC @ 850 rpm	OD
	455 Cu. In. H.C. 2 Bbl.	UA, UB	44S	.030"	30°	7.5° BTC @ 850 rpm	OJ
	455 Cu. In. H.C. 4 Bbl.	UN, UO	44S	.030"	30°	7.5° BTC @ 850 rpm	OC
Police	455 Cu. In. H.C. 4 Bbl.	UL	43S	.030"	30°	10° BTC @ 850 rpm	OF
Toronado	455 Cu. In. H.C. 4 Bbl.	US, UT	44S	.030"	30°	7.5° BTC @ 850 rpm	OC
	455 Cu. In. H.C. 4 Bbl. W-34	UW, UV	44S	.030"	30°	10° BTC @ 850 rpm	OF
Export	250 Cu. In. L.C. 1 Bbl.	VJ, VK	46N	.035"	31° to	4° BTC @ 500 rpm	Manual
					34°	8° BTC @ 500 rpm	Automatic
	350 Cu. In. L.C. 2 Bbl.	QC, QK	46S	.030"	30°	5° BTC @ 850 rpm	
	350 Cu. In. L.C. 4 Bbl.	QQ, QY	46S	.030"	30°	5° BTC @ 850 rpm	
	455 Cu. In. L.C. 2 Bbl.	UE, UK	46S	.030"	30°	5° BTC @ 850 rpm	
	455 Cu. In. L.C. 4 Bbl.	UR	46S	.030"	30°	5° BTC @ 850 rpm	

K-66 Option only available on 400 and 455 Cu. In. engines; spark plug gap to be set at .045".

NOTE: After initial engine wear-in, slow and fast idle rpm may increase. If so, reset to specifications. For additional adjustments such as idle adjustments etc., refer to Carburetor and Linkage Adjustment charts.

*Vacuum Hose Disconnected at distributor and plugged - Air Cleaner Vacuum Source Plugged

DISTRIBUTOR TEST SPECIFICATIONS

Engine	Distributor		Vacuum and Mechanical Advance			
Cu. In. Disp.	Part No.	Vacuum Unit No.	Vacuum Advance @ Inches of Vacuum		Mechanical Advance @ Distributor rpm	
L-6 (250)	1110351	1116235	Start 10°	5 to 7 In. Hg. 14 1/2 In. Hg.	0°-2.5° 2.7°-4.7° 10.5°-12.5° 13°-15°	500 rpm 600 rpm 1150 rpm 1400 rpm
350 (L.C.)	1111286	1973406	Start 12°	8 to 10 In. Hg. 18 1/2 to 20 1/2 In. Hg.	0°-1.8° 1.7°-4° 2.2°-4.2° 14°-16°	400 rpm 500 rpm 520 rpm 2000 rpm
350 (H.C.)	1111299	1115361	Start 9°	8 to 10 In. Hg. 16 1/2 to 18 1/2 In. Hg.	0°-2° 6°-8° 10°-12°	400 rpm 900 rpm 2000 rpm
400 (L.C.)	1111466	1973407	Start 12°	6 to 8 In. Hg. 15 to 17 1/2 In. Hg.	0°-2° 6.5°-8.5° 11°-13°	650 rpm 1300 rpm 2000 rpm
400 H.C.-SMT (Exc. W-30 Option)	1111287 (K-66 Option-1111290)	1973408	Start 12°	8 to 10 In. Hg. 18 1/2 to 20 1/2 In. Hg.	.4°-2.4° 8° -10° 10°-12°	500 rpm 900 rpm 2000 rpm
400 H.C.-AMT & SMT (With W-30 Option)	1111468 (K-66 Option-1111470)	1973418	Start 8°	10 to 12 In. Hg. 16 to 18 In. Hg.	.5°-2.5° 7°-9° 9°-11°	450 rpm 1000 rpm 1900 rpm
455 L.C.	1111288 (K-66 Option-1111291)	1973407	Start 12°	6 to 8 In. Hg. 15 to 17 1/2 In. Hg.	0°-2° 6.5°-8.5° 13°-15°	400 rpm 1200 rpm 2000 rpm
455 H.C. (Exc. Option W-34)	1111289 (K-66 Option-1111292)	1973408	Start 12°	8 to 10 In. Hg. 18 1/2 to 20 1/2 In. Hg.	.4°-2.4° 6°-8°	700 rpm 1500 rpm
455 H.C. (With Option W-34)	1111469 (K-66 Option-1111471)	1973408	Start 12°	8 to 10 In. Hg. 18 1/2 to 20 1/2 In. Hg.	0°-2° 5°-7° 9°-11°	550 rpm 1000 rpm 1800 rpm

CRANKCASE VENTILATION SYSTEM

CONTENTS OF SECTION 6H

ALL SERIES

Subject	Page	Subject	Page
PERIODIC MAINTENANCE	6H-1	V-8 SYSTEM	6H-2
L-6 SYSTEM	6H-2	OPERATION	6H-2
		DIAGNOSIS	6H-3

PERIODIC MAINTENANCE

CRANKCASE VENTILATION FILTER

At every oil change, more often under dusty conditions, remove the clip retaining the filter to the engine air cleaner and remove the filter. Wash filter in kerosene and re-oil with engine oil.

CRANKCASE VENTILATION VALVE (P.C.V. VALVE)

Once a year or every 12,000 miles (or at the oil change period nearest to this interval) replace the ventilation valve. The rest of the system should be serviced at this interval by washing the parts in kerosene and blowing out the hoses and/or pipes with compressed air.

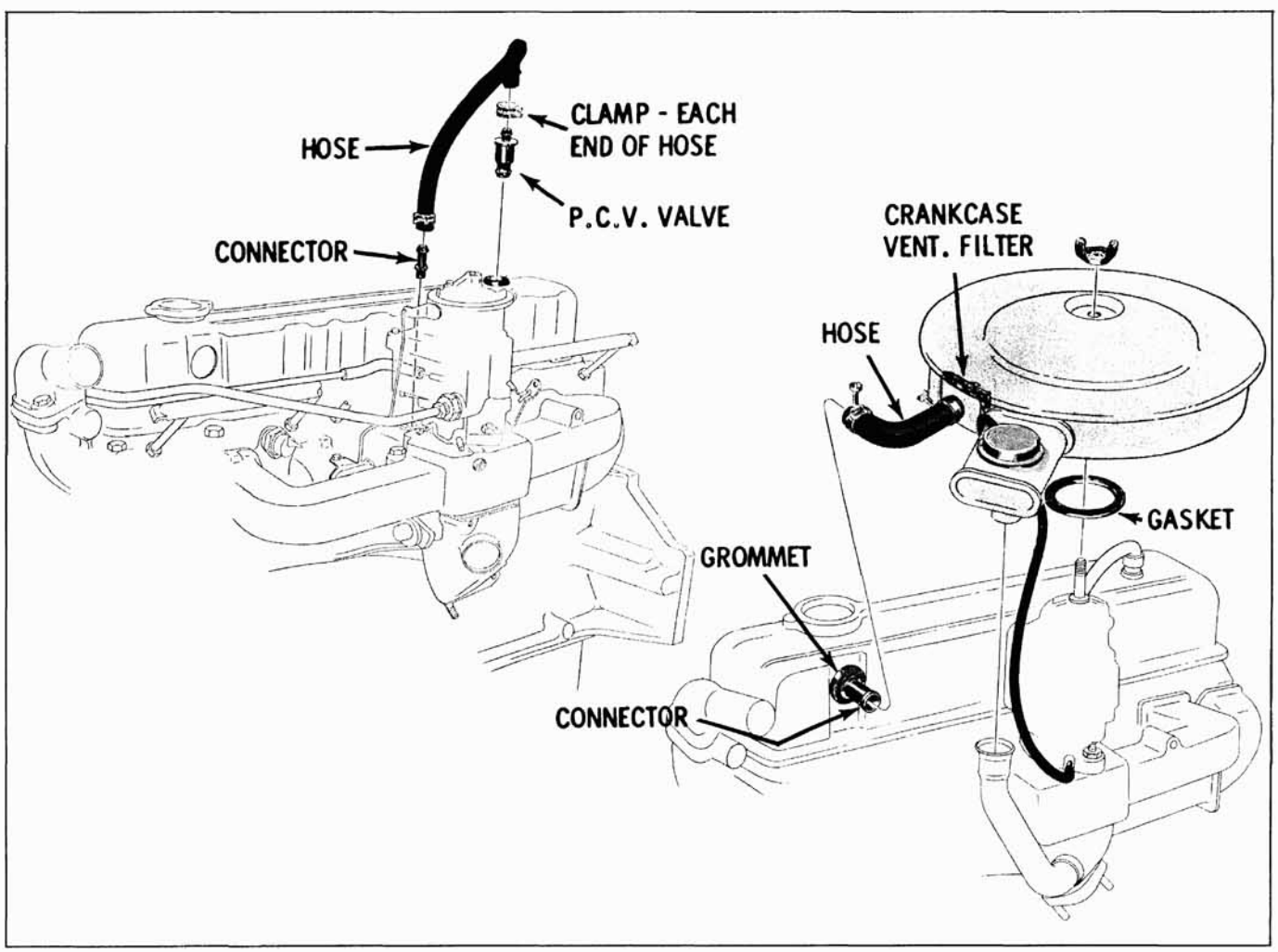


Fig. 6H-1— L-6 Crankcase Ventilation

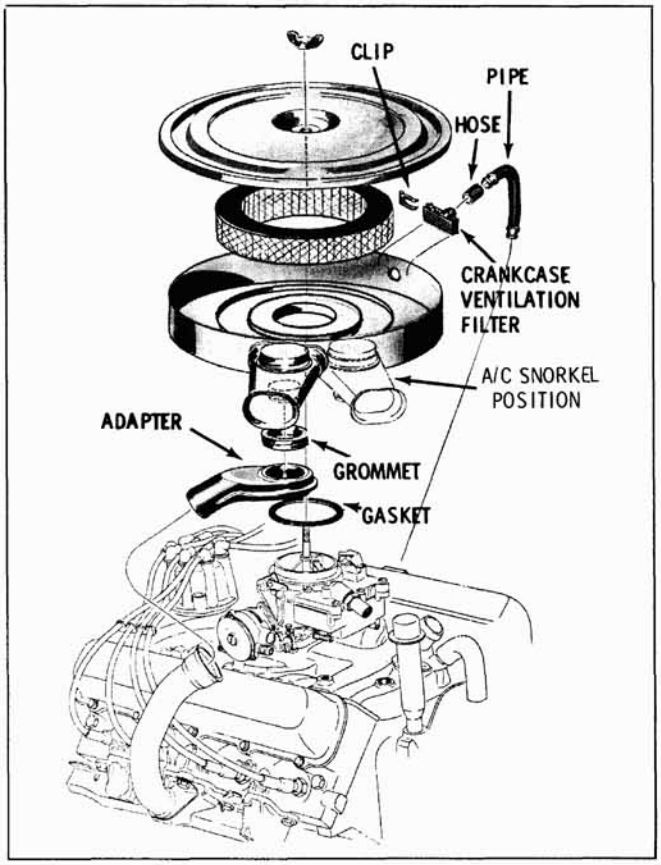


Fig. 6H-2—Typical V-8 Filter Installation

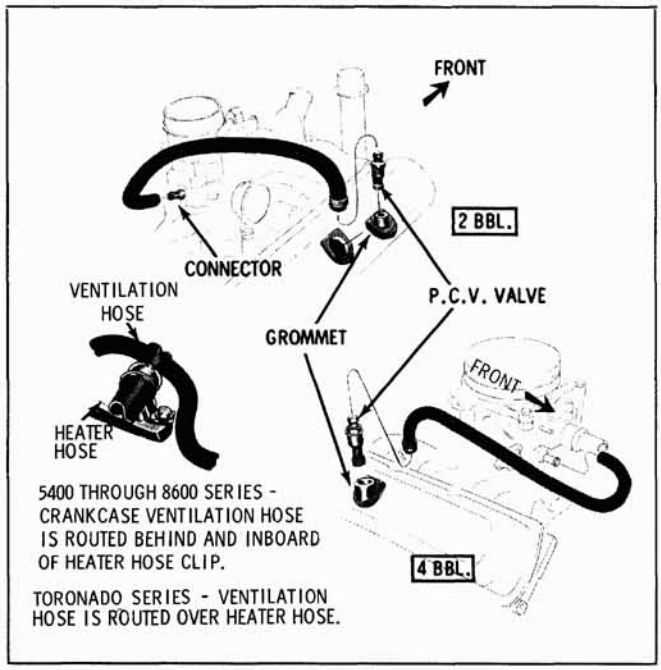


Fig. 6H-3—Typical V-8 P.C.V. to Carburetor Connection

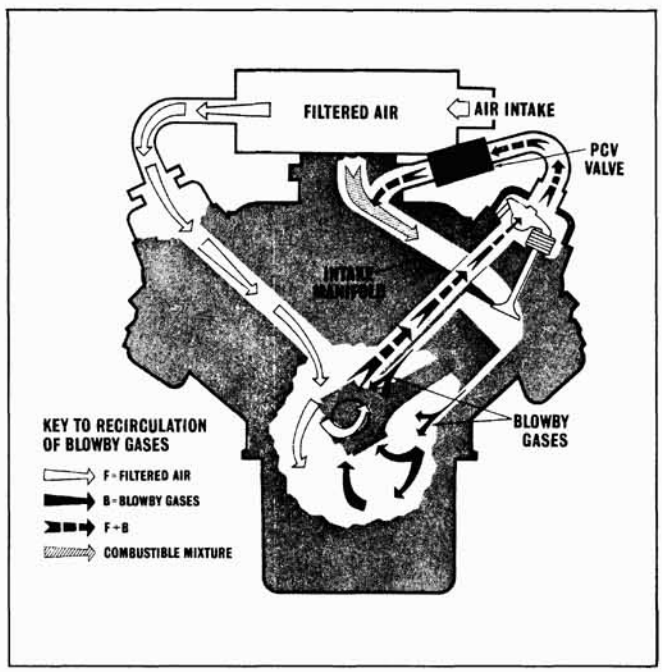


Fig. 6H-4—Typical V-8 Flow Chart

L-6 SYSTEM (FIG. 6H-1)

The crankcase ventilation system receives its air through the engine air cleaner snorkel. After the air enters the carburetor air cleaner, it passes through a filter clipped to the inside of the air cleaner, then through a hose to the left side of the valve cover where it mixes with the crankcase vapors. The vapors are then drawn through the spring loaded valve (P.C.V.) located in the top of the valve cover then through a hose into the intake manifold where they are burned.

This system uses only the closed type oil filler cap. Use of a filter type filler cap will make the system inoperative.

V-8 SYSTEM (FIGS. 6H-2 and 6H-3)

The crankcase ventilation system receives its air through the engine air cleaner snorkel. After the air enters the air cleaner, it passes through a filter clipped to the inside of the air cleaner, then through a hose and pipe to the left hand valve cover where it mixes with crankcase vapors. The vapors are then drawn through a spring loaded valve (P.C.V.) located in the right valve cover, then through a hose into the intake manifold at the base of the carburetor where they are burned.

This system uses only the closed type oil filler cap. Use of a filter type filler cap will make the system inoperative.

OPERATION

At idle or normal road speeds, intake manifold vacuum causes fresh air to be drawn into the engine through the filter, located in the engine air cleaner, then to the valve cover where it joins with the crankcase vapors. This mixture is then drawn through the P.C.V. valve to the intake manifold where the vapors are mixed with the normal fuel-air mixture and burned.

When the engine is running either at idle or car is traveling at normal road speeds, intake manifold vacuum is sufficient to draw crankcase vapors caused by engine blow-by through the spring loaded valve (P.C.V. valve) as indicated in Fig. 6L-4.

At high road speeds or heavy acceleration, the engine blow-by is increased and at the same time, intake manifold vacuum decreases. When this occurs, there is a reverse action, as shown in Fig. 6H-4 and crankcase vapors are released through the crankcase filter located in the carburetor air cleaner and return back into the intake manifold through the

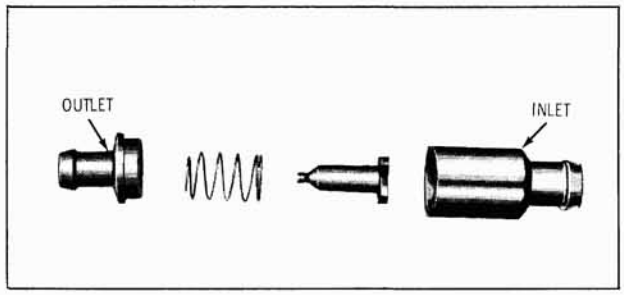


Fig. 6H-5—Ventilation Valve

carburetor. When operating the engine under zero vacuum or a manifold pressure condition such as a backfire or during engine cranking, the check valve is closed by spring tension to prevent fuel vapor from entering the crankcase. The valve is also closed under wide-open throttle condition but since this is for a very short duration of time, no irregularity will exist.

CRANKCASE VENTILATION VALVE DIAGNOSIS (Fig. 6H-5)

If excessive sludging of the valve occurs it will not operate and the valve may be closed. This will cause high crankcase pressure at highway speeds. This pressure can cause the engine to blow out oil through the engine seals and gasket.

A plugged system will definitely cause a rough idle. A quick check to see if rough idle is caused by the crankcase vent valve is to:

1. Connect tachometer to the engine.
2. Start the engine and adjust idle.
3. Clamp off the hose that goes from the valve to the carburetor base.
4. If the ventilation system is working properly, the engine rpm will change 50 to 60 rpm. You should be able to hear the valve click shut when clamping off the line and releasing it several times.

There will be no change in engine rpm if the valve or hoses are sludged up and restricted.

ENGINE COOLING SYSTEM

ALL ENGINES

CONTENTS OF SECTION 6K

Subject	Page
MAINTENANCE RECOMMENDATIONS	6K-1
ENGINE COOLING SYSTEM	6K-1
COOLING SYSTEM - V-8	6K-1
COOLING SYSTEM - L-6	6K-3
COOLING SYSTEM DIAGNOSIS	6K-3
COOLANT PRESSURE—TEMPERATURE CHART	6K-4
DRAIN AND REFILL	6K-4
CHECKING COOLING SYSTEM	6K-5
FAN	6K-6
WATER PUMP	6K-6
REMOVAL	6K-6
INSTALLATION	6K-6
THERMOSTAT	6K-6
THERMOSTATIC VACUUM SWITCH	6K-7

MAINTENANCE RECOMMENDATIONS

For maintenance recommendations and cooling system capacities, refer to Section 0, GENERAL INFORMATION AND PERIODIC MAINTENANCE.

ENGINE COOLING SYSTEM

The engine cooling system is the pressure type with thermostatic control of coolant circulation.

The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. (Fig. 6K-2) The higher pressure raises the boiling point of the coolant and increases the cooling efficiency of the radiator. The 15 pound pressure cap used raises the coolant boiling point approximately 46°.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring of predetermined strength which protects the radiator by relieving the pressure if the pressure should exceed that for which the radiator is designed.

The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created when the system cools off.

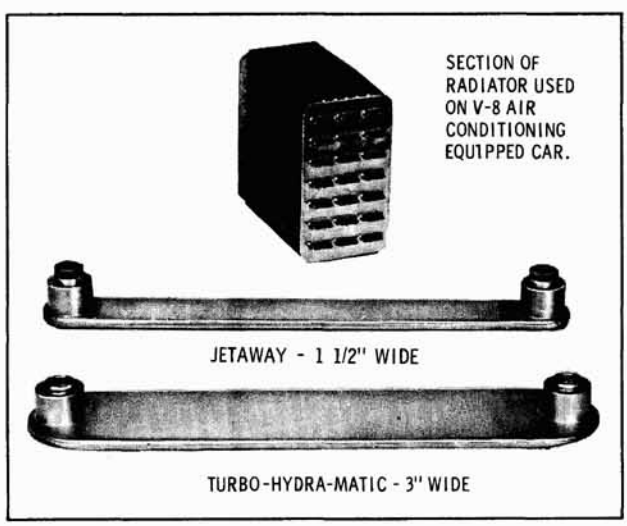


Fig. 6K-1—Radiator and Oil Coolers

The radiator cap should be washed with clean water and pressure checked every 12,000 miles or 12 months which ever occurs first.

COOLING SYSTEM CIRCULATION
V-8 ENGINE (Fig. 6K-3)

The coolant is circulated by a centrifugal pump mounted on the front cover which forms the outlet side of the pump. The engine fan and pulley(s) are bolted to the pump shaft hub at its forward end. Thus both the fan and pump are belt driven by a crankshaft pulley bolted to the harmonic balancer. The pump shaft and bearing assembly is pressed in the water pump cover. The bearings are permanently lubricated during manufacture and sealed to prevent loss of lubricant and entry of dirt. The pump is sealed against coolant leakage by a packless non-adjustable seal assembly mounted on the pump cover in position to bear against the impeller hub. The inlet pipe cast in the pump cover feeds into the passage formed by the cover and the front face of the impeller, which is mounted on the bearing shaft with the vanes facing rearward. Coolant flows through the inlet passage to the low pressure area at the center where it then flows rearward through three openings in the impeller. Vanes on the rotating impeller cause the coolant to flow radially outward through two discharge passages cast in the engine block. These passages deliver an equal quantity of coolant to each cylinder bank water jacket.

The coolant then flows rearward through the water jacket which surrounds each cylinder barrel and extends below the lower limit of piston ring travel. After flowing the full length of the cylinder banks, the coolant flows up through openings to the rear of the cylinder bank into the cylinder heads. The coolant flows forward in the cylinder heads to cool the combustion chamber areas. At the forward end of the cylinder heads the coolant flows into the intake manifold.

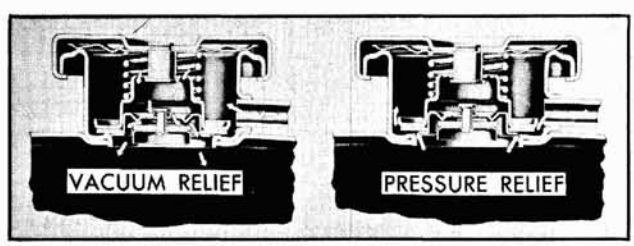


Fig. 6K-2—Pressure Radiator Cap

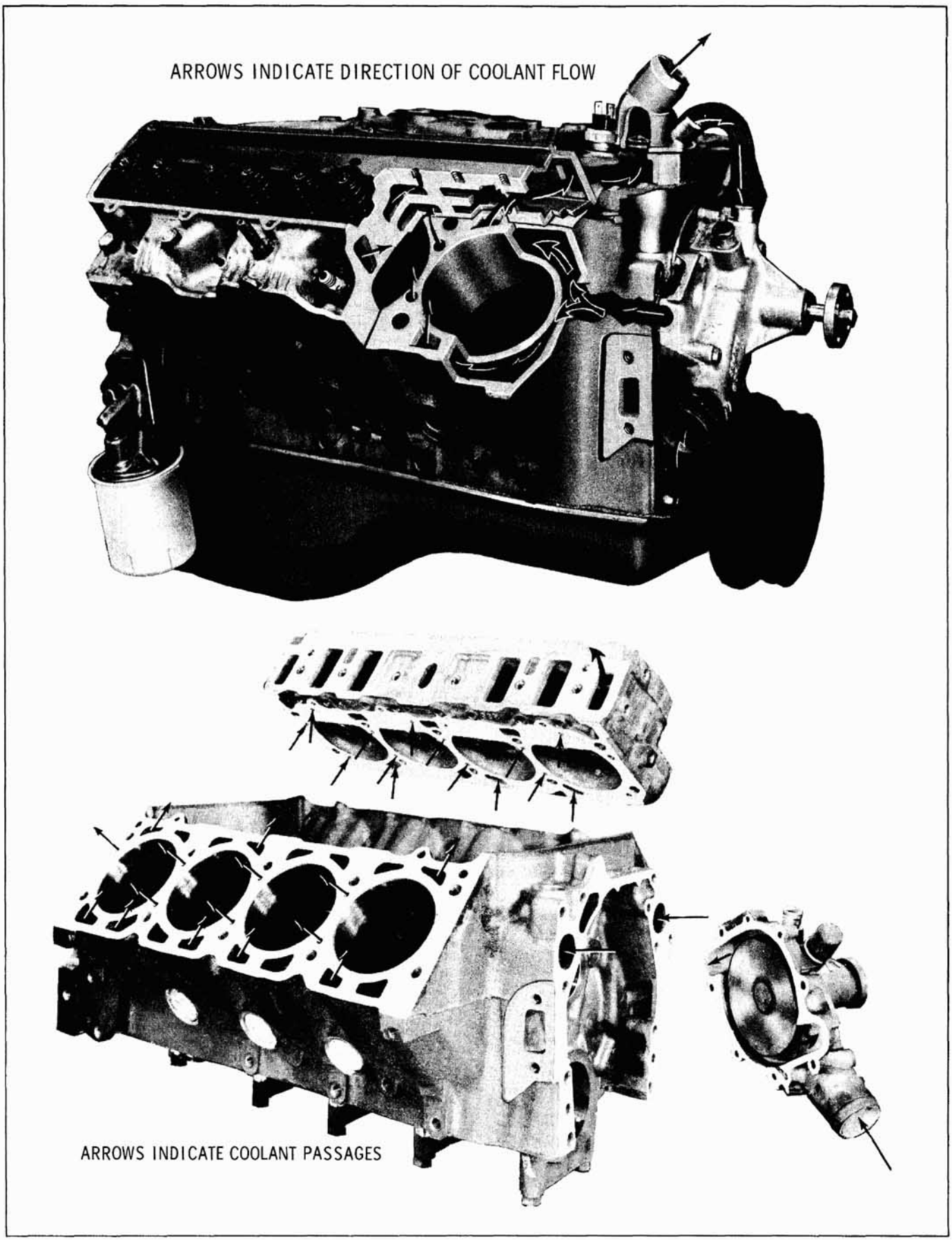


Fig. 6K-3—Engine Coolant Flow (V-8 Engine)

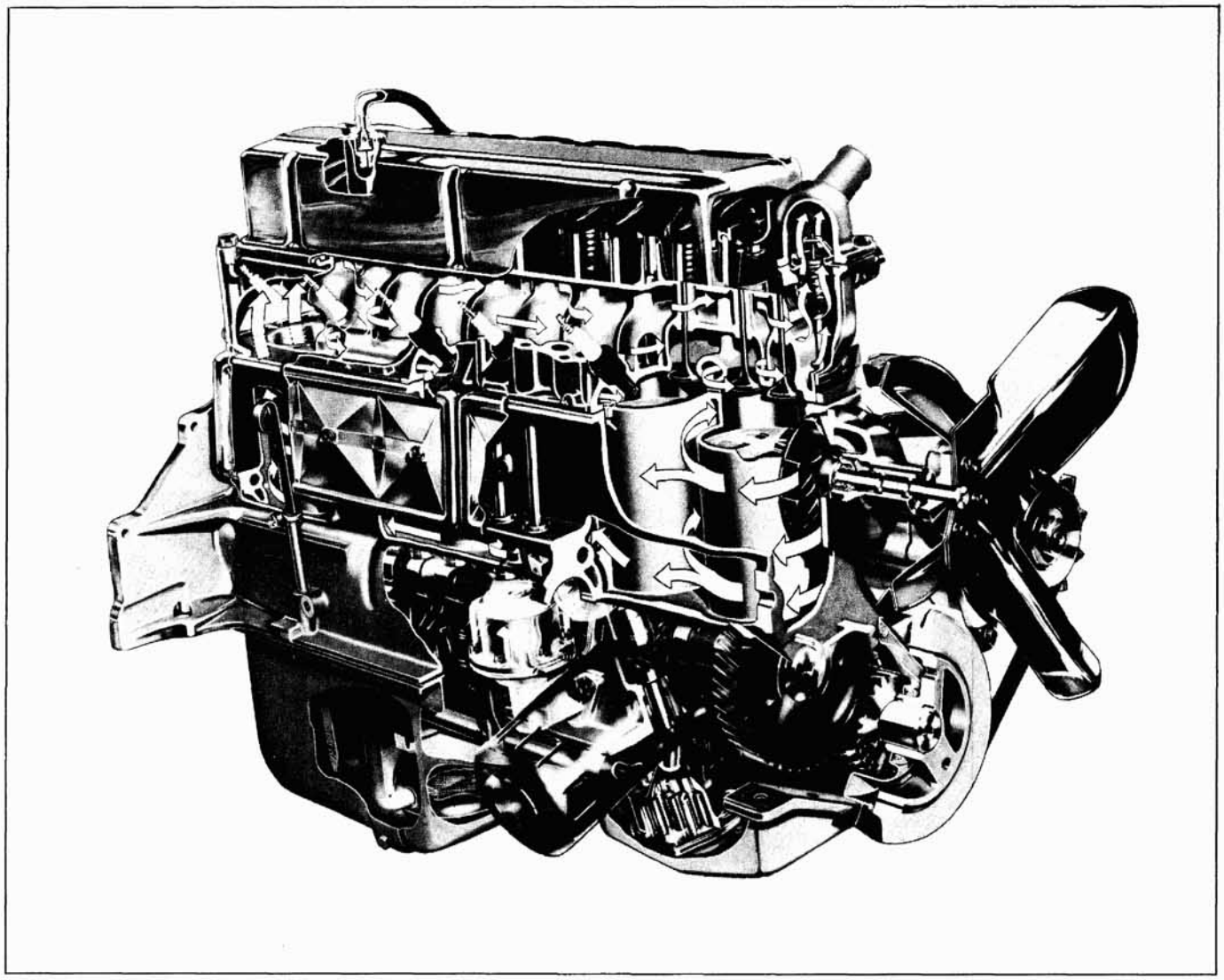


Fig. 6K-4—Engine Coolant Flow (L-6 Engine)

Next, the coolant flows into the intake manifold water passage from the forward port of the cylinder heads to the thermostat housing and thermostat by-pass. A nipple in the manifold allows connection of the heater hose.

A pellet type thermostat housed in the forward (outlet) end of the intake manifold controls the circulation of water through the engine radiator. During cold engine operation when the thermostat is closed, a thermostat bypass, open at all times, allows recirculation of coolant through the engine to provide rapid warm-up. When the thermostat opens, (195°F.) coolant is directed to the left tank of the radiator, through the radiator core and right tank to the water pump inlet where the cycle is repeated.

COOLING SYSTEM CIRCULATION L-6 ENGINE (Fig. 6K-4)

The centrifugal-type water pump contains an impeller which turns on a steel shaft which rotates in a ball bearing. A bellows-type seal is seated in the water pump body between the bearing and impeller.

The inlet side of the pump is connected to the right radiator tank by a hose. Above the pump inlet from the radiator is the inlet from the heater core. Located in the coolant outlet at the front of the cylinder head is the outlet to the heater core from beneath the thermostat.

The water pump discharges coolant into the water jacket chamber between the front face of the block and the number one cylinder. Coolant then flows through the block toward the rear, passing through two large cast openings into the cylinder head to cool the valve seats and forward to the front of the head. Coolant then flows through the coolant outlet and the pellet-type thermostat to the radiator. Some coolant is directed through a small hole in the cylinder head gasket to an area around each spark plug.

During engine warm-up, when the thermostat is closed, water is redirected to the engine.

COOLING SYSTEM DIAGNOSIS

The coolant can be boiling without the temperature indicator light coming on if any of the following are incorrect.

1. Pressure cap.
2. Coolant level.
3. Coolant and anti-freeze mixture.
4. Radiator core (external or internal restrictions).

The engine water temperature sending switch closes at 248° ±2°F causing the temperature indicator light to come on. Refer to Coolant Pressure - Temperature Chart, if the pressure in the cooling system or percentage of anti-freeze (ethylene glycol) is too low, the coolant will boil without the temperature indicator light coming on. Pure water could boil

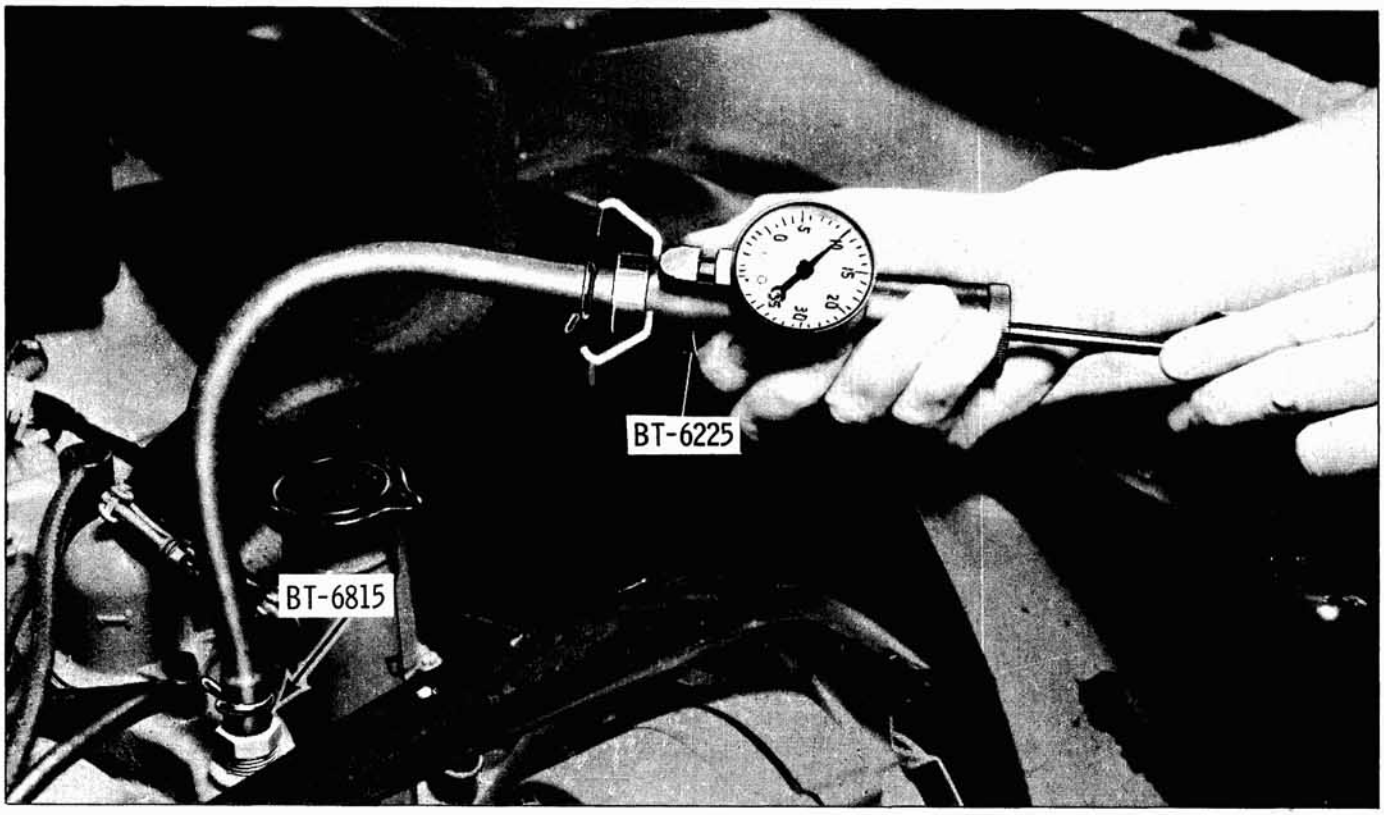


Fig. 6K-5—Pressurizing Cooling System

at 247° and the temperature indicator light would not come on even with a 15 p.s.i. cooling system. Pure water lacks the necessary rust inhibitors and water pump lubricant. The engine should never be run without the cap or with the cap loose as the coolant will boil before the temperature indicator light comes on.

Adding anti-freeze to prevent the coolant from boiling too soon is permissible but too much will affect the freezing point.

A solution stronger than 65% anti-freeze should not be used, as the freeze level rises rapidly after this point. Pure anti-freeze will freeze at - 8°F.

When adding mixture due to loss of coolant, a 50%-50% solution should be added. When a freeze level below -20°F is desired, pure ethylene glycol should be added until the desired temperature protection is reached. It is recommended that the coolant level be checked at each oil change and maintained at the "FILL COLD" mark on the radiator tank. DO NOT OVERFILL.

DRAIN AND REFILL

Before draining the cooling system, inspect the system and perform any necessary service to insure that it is clean, does not leak and is in proper working order.

1. Completely drain the system by opening the drain petcock at the bottom of the radiator. For V-8, remove the cylinder block plugs on each side of the block. For L-6, open the cylinder drain petcock located on the left side of the block.

If coolant drains out dirty, or if deposits are seen in the radiator, the cooling system should be flushed before refilling.

2. Refill cooling system with recommended coolant. (Refer

COOLANT PRESSURE—TEMPERATURE CHART

Radiator Cap Blow-Off Pressure (Check Cap with BT-6225)

Hydrometer Reading of Coolant	0	11	12	13	14	15
+32°F	212°F	235°F	238°F	241°F	244°F	247°F
0°F	220°F	242°F	245°F	248°F	251°F	254°F
- 10°F	222°F	244°F	247°F	250°F	253°F	256°F
- 20°F	224°F	246°F	249°F	252°F	255°F	258°F
- 30°F	226°F	248°F	251°F	254°F	257°F	260°F
- 40°F	228°F	250°F	253°F	256°F	259°F	262°F
- 50°F	230°F	252°F	255°F	258°F	261°F	264°F

Light Off Coolant Boiling

Light On Coolant Boiling

NOTE: One quart additional anti-freeze will lower Hydrometer reading approximately 12°F.

to GENERAL INFORMATION Section 0 for recommended coolant if new coolant is used.)

CHECKING COOLING SYSTEM (Fig. 6K-5)

1. Clean oil or grease off of nipple on pressure pump, BT-6225, then install the adapter, BT-6815. Retain the hose on the pump nipple with the hose clamp provided.
2. After engine has cooled slightly, place cloth over radiator cap, then carefully remove the radiator cap. Cap should not be removed while the engine is at or near operating temperature to prevent loss of coolant.
3. After cooling system pressure has been released, wet the rubber sealing surface of the pressure cap and reinstall cap tightly on the radiator.
4. Disconnect the electrical connector from the engine temperature sending unit and remove the temperature sending unit from the manifold.

With the radiator cap installed, only a minute amount of coolant will be lost when the sending unit is removed.

5. Install the fitting of adapter tool, BT-6815, tightly into the intake manifold.
6. Check to make sure the radiator overflow hose is in good condition and firmly installed on the overflow tube. Insert the other end of the overflow hose into a container of water.
7. Using the pressure pump, BT-6225, pressurize the cooling system until bubbles are observed in the water container. Discontinue pumping when bubbles appear.

As soon as the bubbles cease, read the pressure gauge. The gauge reading, when the bubbles cease, is the pressure relief specification of the cap and should be within 14 to 17 psi.

8. If bubbles continue and the pressure drops below the 14 to 17 psi specification, the pressure cap is not holding pressure. Release pressure and wash cap in clean water to dislodge any foreign matter from the valves. Check the rubber sealing surface of the cap and also the cap sealing surface in the radiator neck. Recheck cap as outlined in step 7. If cap still does not hold pressure, the cap is defective and must be replaced. Recheck system after a new cap is installed to assure that the system will now hold pressure.
9. If the bubbles in the water container cease and the pressure cap is within specifications, observe gauge reading for approximately two minutes. Pressure should not drop during this time.
10. If pressure drops, check for leaks at the engine to heater core hoses, engine to radiator hoses, by-pass hose, thermostat housing gasket, etc. Any leaks which are found must be corrected and the system rechecked.
11. If the system holds pressure, remove the radiator cap to release the pressure, then reinstall the cap.
12. Remove the adapter from the manifold and reinstall the temperature sending unit. Check coolant level and replenish if necessary with the correct coolant solution.

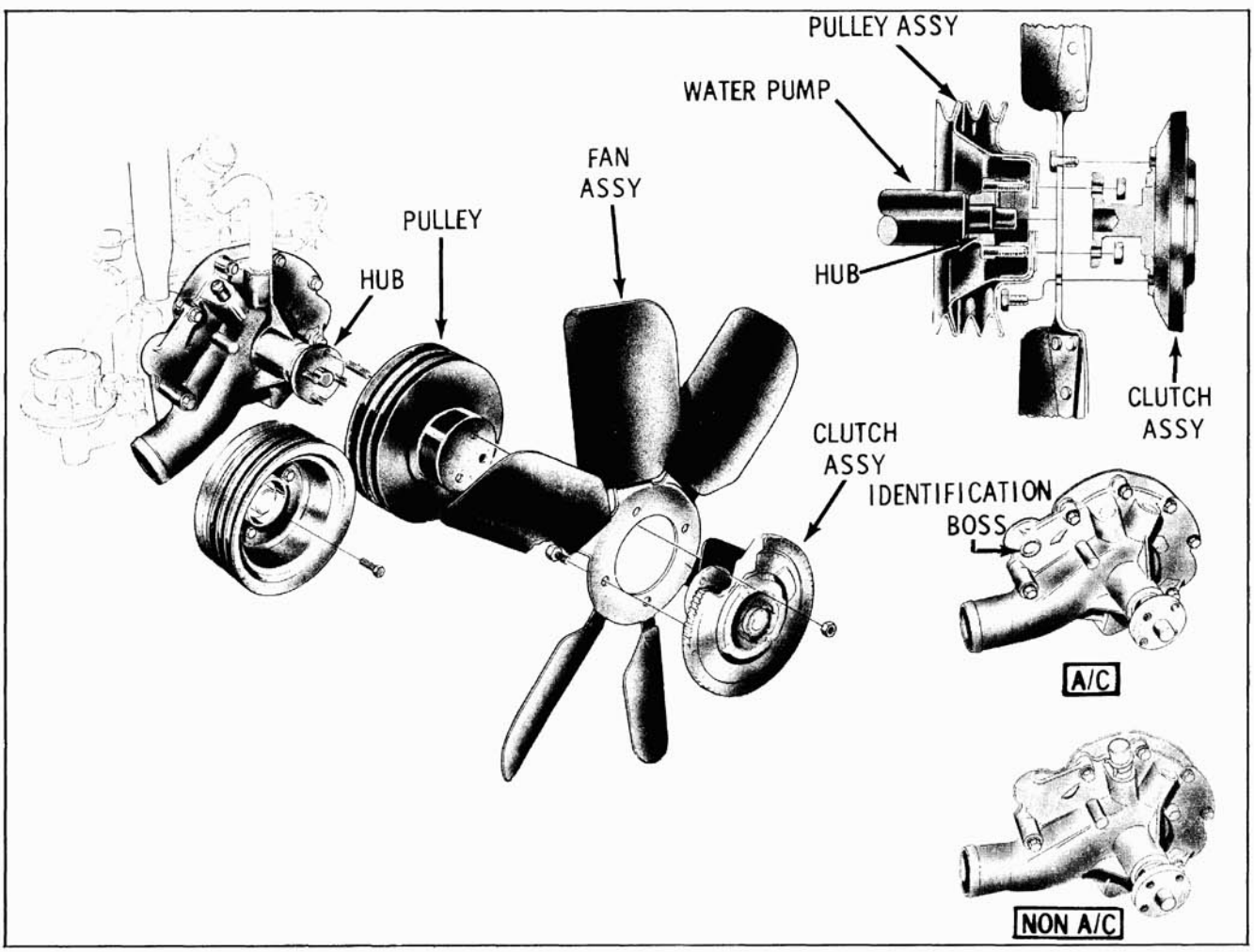


Fig. 6K-6—Fan Installation (V-8 Engine)

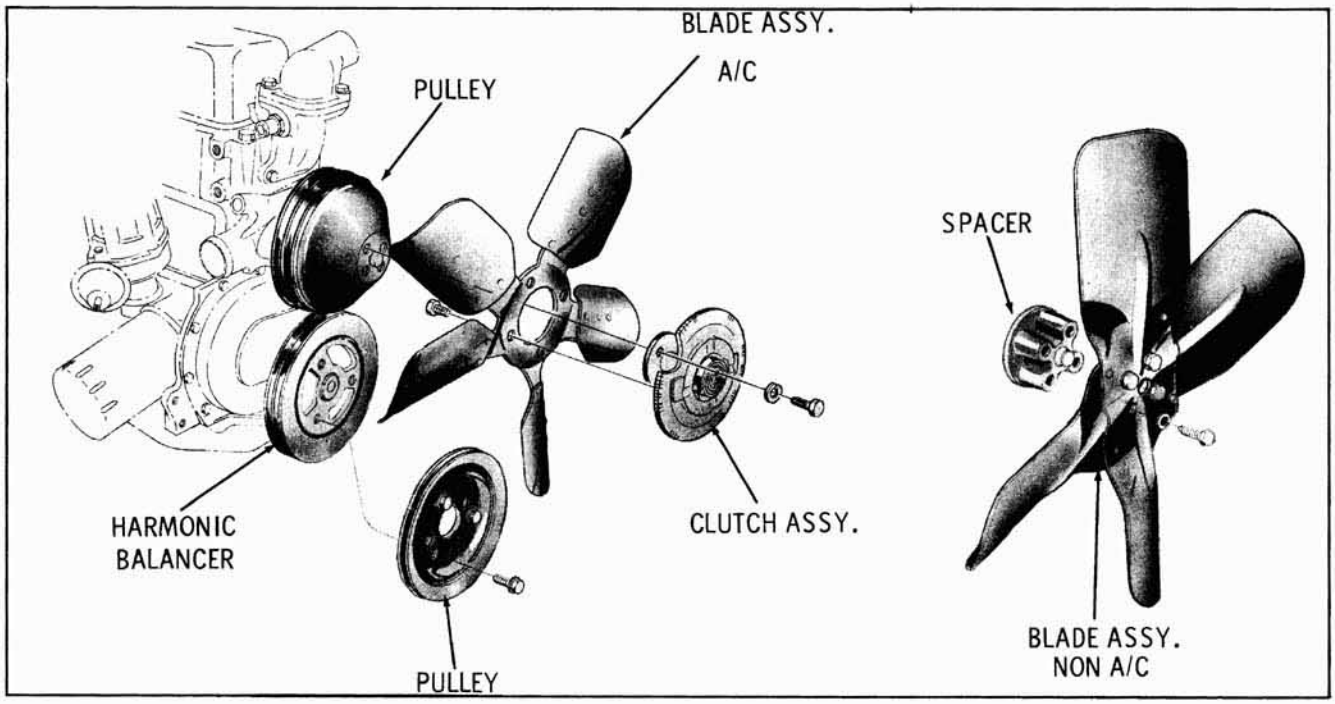


Fig. 6K-7— Fan Installation (L-6 Engine)

FAN (Figs. 6K-6 and 6K-7)

The fan blades and pulley can be removed without disturbing the water pump or radiator. On air conditioned equipped cars it will be necessary to detach fan shroud and slide it back over the fan.

If, belt tension on pulley is not released, the fan can be removed without disturbing the pulley by removing four attaching bolts. When the first two bolts are removed, replace with aligning studs. The tension of the belt will keep the pulley in position.

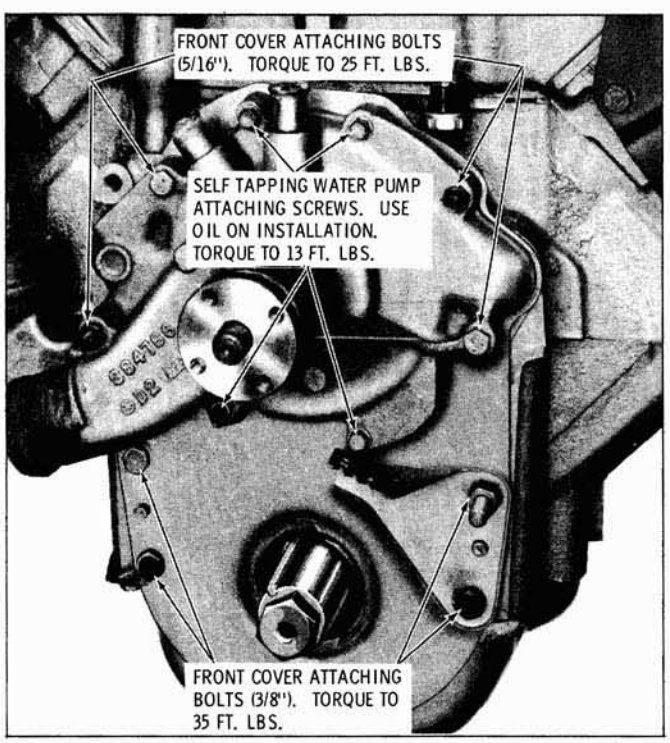


Fig. 6K-8— Water Pump Installation (V-8 Engine)

WATER PUMP

Removal

1. Drain radiator.
2. Disconnect heater and bypass hose and lower radiator hose from pump.
3. Loosen pulley belts and remove fan and pulley. On air conditioned equipped cars, remove the clutch and fan assembly and pulley.
4. Remove water pump attaching bolts.

On L-6 engines, pull the pump straight out of the block to avoid damage to impeller.

Installation

1. Apply a thin coat of 1050026 Sealer or equivalent to the pump housing to retain the gasket, then position new gasket on the housing.
2. Install the pump assembly. Torque self-tapping bolts to 13 ft. lbs. and 5/16" bolts to 25 ft. lbs. Use oil on the self-tapping bolts. (Fig. 6K-8)
3. Install pulley and fan. Torque fan to pump bolts to 20 ft. lbs. On air conditioned equipped cars, install pulley and fan and clutch assembly. Torque nuts to 20 ft. lbs.
4. Install pulley belt(s) and adjust belt tension using Tool BT-33-70-M.

If car is equipped with air conditioning and power steering, tighten steering belt first with delcotron belt loose. Tighten remaining belts.

5. Refill cooling system. If new coolant is used, see Section 0, PERIODIC MAINTENANCE for recommended coolant.

THERMOSTAT

The thermostat consists of a restriction valve actuated by a thermostatic element. (Use of thermostats rated above 195°F. control temperatures are not recommended.) This is mounted

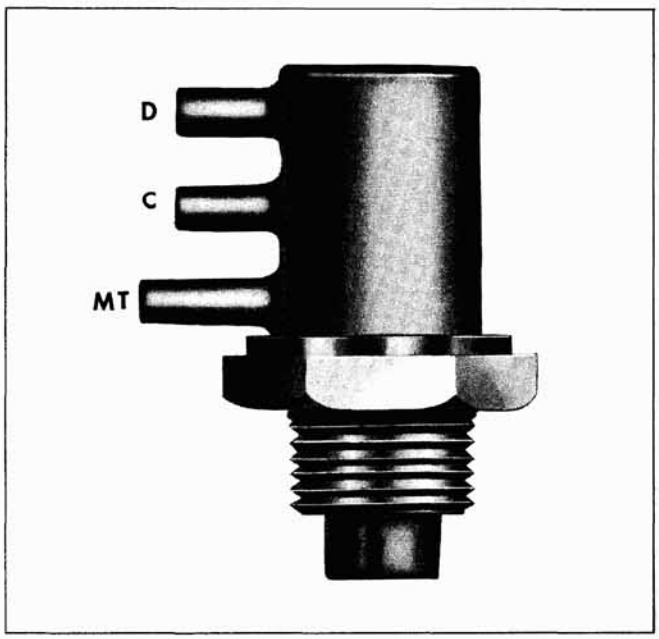


Fig. 6K-9—Thermostatic Vacuum Switch

in the housing at the cylinder head water outlet above the water pump. Thermostats are designed to open and close at predetermined temperatures and if not operating properly should be removed and tested as follows:

1. Remove radiator to water outlet hose.
2. Remove thermostat housing bolts and remove water outlet and gasket from thermostat housing.
3. Inspect thermostat valve to make sure it is in good condition.
4. Place thermostat in hot water 25°F. above the temperature stamped on the thermostat valve.
5. Submerge the valve completely and agitate the water thoroughly. Under this condition the valve should open fully.
6. Remove the thermostat and place in water 10°F. below temperature indicated on the valve.
7. With valve completely submerged and water agitated thoroughly, the valve should close completely.
8. If thermostat checks satisfactorily, re-install, using a new housing gasket.
9. Refill cooling system.

THERMOSTATIC VACUUM SWITCH DIAGNOSIS (Figs. 6K-9 and 6K-10)

All Toronados, 400 cu. in. engines (exc. L-65) and air conditioned cars are equipped with a thermostatic vacuum switch. This switch is used to advance the ignition timing at idle when high coolant temperatures are encountered. When the coolant temperature reaches 220°F, the switch valve moves to allow full engine vacuum to be directed to the distributor to advance the timing and allow the engine to run cooler.

When an overheating problem exists at idle speeds only, red light on, disconnect the distributor vacuum hose at the thermostatic switch, Port D, and connect a vacuum gauge to the port. (Fig. 6K-9) If the gauge indicates full engine vacuum, the switch is functioning and is not the cause for overheating. There should be only about 2"-5" vacuum at this port at normal engine coolant temperatures.

Unit must be installed with a soft setting sealant on threads. After installation, the ports will rotate after the nut is tightened for correct alignment. See Fig. 6K-10 for correct hose routings.

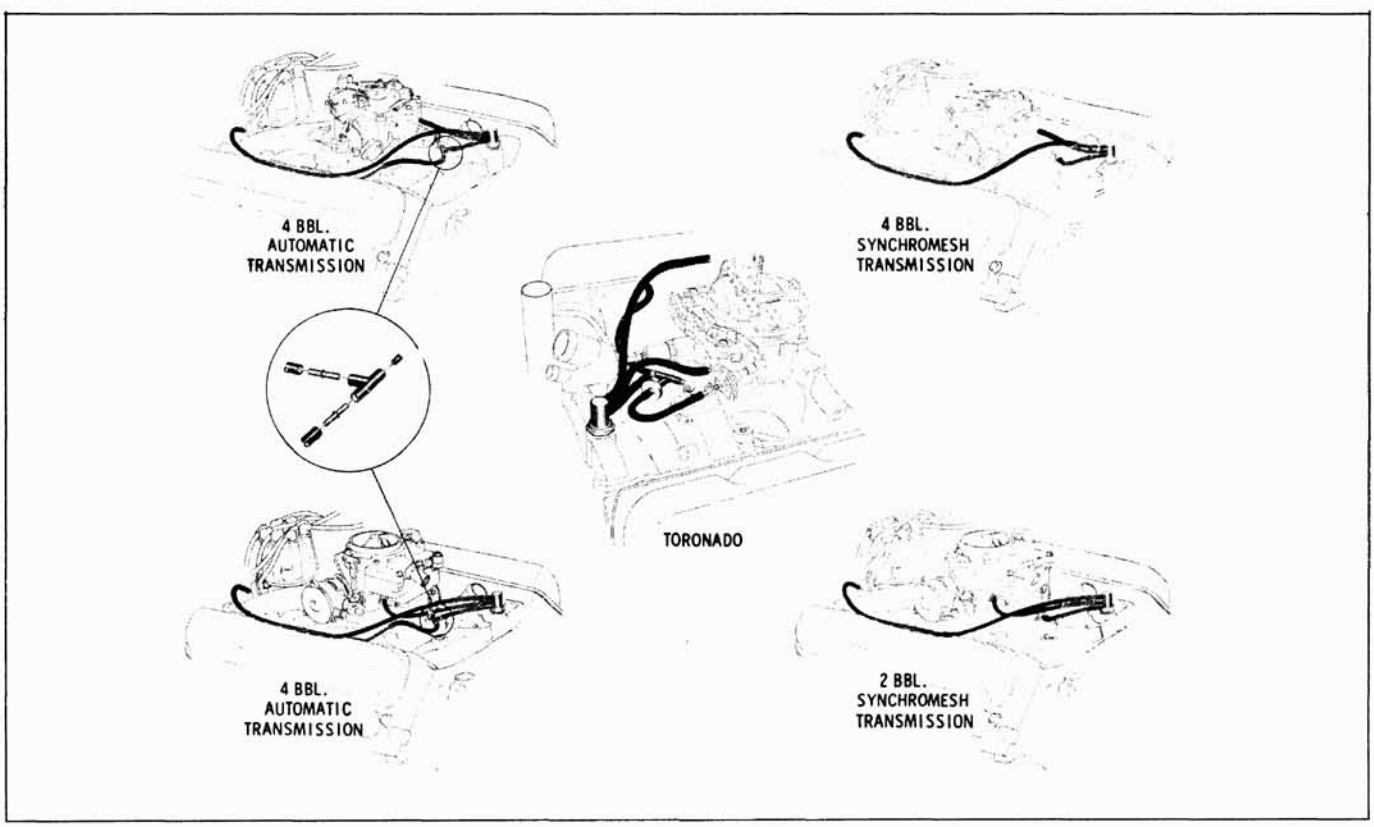


Fig. 6K-10—Hose Routings

FAN BLADE INFORMATION

ENGINE	FAN DIA.	NO. OF BLADES
350 Cu. In. (Exc. 5400 Series)	17 1/2"	4
350 Cu. In. - 5400 Series 455 Cu. In. - Exc. Toronado 400 Cu. In.	18"	4
Toronado - Without A/C	17 1/2"	5
350 Cu. In. 400 Cu. In. 455 Cu. In. Equipped with A/C, H.D. Cooling or W-30 Option	19"	6
Toronado - With A/C	18"	7

FAN CLUTCH INFORMATION

ENGINE	*CODE	HUB LENGTH	OPERATION TEMPS	
			Engaged	Disengaged
350 Cu. In. - With A/C or W-30 Option	OX	1 1/2"	170°	140°
455 Cu. In. - With A/C (Exc. Toronado)	OS	1 1/2"	170°	140°
Toronado - With A/C	OT	2"	175°	145°
350 Cu. In. 400 Cu. In. 455 Cu. In. (Exc. Toronado) With H.D. Cooling	OU	1 1/2"	155°	125°
Toronado - With H.D. Cooling	OV	2"	155°	125°

*Code letters located on front face of fan clutch.

CARBURETION

ALL SERIES

ALL NEW 1968 OLDSMOBILES ARE CERTIFIED BY THE UNITED STATES DEPARTMENT OF HEALTH, EDUCATION AND WELFARE AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. FOR THIS REASON, THE FACTORY PROCEDURE FOR SETTING IGNITION TIMING, DWELL AND SLOW IDLE MUST BE FOLLOWED EXACTLY WHEN ADJUSTMENTS ARE MADE.

SPECIFICATIONS

The adjustment charts for Model MV, Model 2GC and Model 4MV carburetors are found within each of their respective sections. For the step by step disassembly and assembly procedure, refer to the appropriate sub-section (Model MV, 2GC and 4MV).

MODEL 2GC

Refer to Page 6M-15

MODEL 4MV

Refer to Page 6M-25

ADJUSTMENT SPECIFICATIONS

MV CARBURETOR	Pages 6M-12, 13 and 14
2GC CARBURETOR	Pages 6M-22, 23 and 24
4MV CARBURETOR	Pages 6M-38, 39, 40 and 41

MODEL MV

CONTENTS OF SECTION

Subject	Page
DESCRIPTION	6M-1
OPERATING SYSTEMS	6M-2
REMOVE AND INSTALL	6M-5
DISASSEMBLY	
AIR HORN	6M-6
FLOAT BOWL	6M-7
THROTTLE BODY	6M-8
CLEANING AND INSPECTION	6M-8
ASSEMBLY	
THROTTLE BODY	6M-9
FLOAT BOWL	6M-9
FLOAT LEVEL ADJUSTMENT	6M-9
METERING ROD ADJUSTMENT	6M-9
AIR HORN	6M-9
DIAGNOSIS CHART	6M-11
ADJUSTMENTS	6M-12
TOOLS	6M-42

GENERAL DESCRIPTION

The MODEL MV carburetor is a single bore downdraft carburetor using a triple venturi in conjunction with a plain tube nozzle.

Fuel flow through the main metering system is controlled by a mechanically and vacuum operated variable orifice jet. A vacuum operated enrichment system is used to provide good performance during moderate to heavy accelerations.

The idle system incorporates a hot idle compensator to maintain smooth engine idle during periods of extreme hot engine operation.

The Model MV carburetor has an automatic choke system. The vacuum diaphragm unit is an integral part of the air horn. The choke coil is mounted on the manifold and is connected to the choke valve shaft by a rod.

The choke system has a new feature to give added enrichment during cold start.

An integral fuel inlet filter is mounted in the fuel bowl behind the fuel inlet nut to give maximum filtration of incoming fuel.

Other features of the MODEL MV include an aluminum throttle body and a thick throttle body to bowl insulator

gasket. The carburetor has internally balanced venting through a vent hole in the air horn. An external idle vent valve is used for improved hot engine idle and starting.

The model identification location is shown in Fig. 6M-1; if replacing the float bowl assembly, follow the manufacturer's instructions contained within the service package to transfer the information to the new float bowl.

A throttle closing solenoid is used on all Monojet (L-6) applications. The switch is electrically controlled in conjunction with the ignition switch. When the ignition switch is turned "OFF", the throttle closing switch is de-energized allowing the carburetor throttle blade to close completely preventing the engine from running after the ignition switch is turned "OFF". For adjustment refer to the Monojet Carburetor and Linkage Adjustment chart.

There are six basic systems of operation used. They are float, idle, main metering, power enrichment, pump and choke.

OPERATING SYSTEMS

FLOAT SYSTEM: Fig. 6M-2

The float system controls the amount and level of the fuel in the carburetor float bowl.

It is important as on all carburetors, that the float be set to the recommended specifications.

The float system is located adjacent to the main venturi. It consists of the following: A fuel inlet filter and pressure relief spring, a solid single plastic pontoon float, a needle and seat and a float hinge pin.

The float operates as follows: Fuel from the engine fuel pump is forced through the fuel inlet filter, then passes from the filter chamber up through the float needle seat and spills into the float bowl. As the float bowl fills with fuel it lifts the float pontoon upward until the correct fuel level is reached in the float bowl. At this point, the float arm forces the float needle against the float needle seat shutting off fuel flow. As fuel is used from the float bowl the float drops downward allowing the float needle to move off its seat and more fuel to enter the float bowl. This cycle continues throughout engine operation keeping a nearly constant fuel level in the float bowl.

The fuel inlet filter has a pressure relief spring located at the rear of the filter. It seats between the rear of the filter and inlet casting. Should the filter become clogged from improper servicing or excessive amounts of dirt in the system, the relief spring lets the filter move off its seat. This prevents complete stoppage of fuel flow to the carburetor until the filter can be replaced.

The carburetor float chamber is both internally and externally vented. The internal vent channel is located in the air horn above the float chamber. The purpose of the internal vent is to balance air pressure on the fuel in the float bowl with carburetor inlet air. With this feature a balanced air-/fuel mixture ratio can be maintained during part throttle and power operation because the air pressure acting on the fuel in the float bowl will be balanced with the air flowing through the carburetor bore.

The internal vent tube also allows the escape of fuel vapors from the float chamber during very hot engine operation. This prevents fuel vapor pressurization in the float bowl from causing excessive pressure build-up resulting in overly rich mixtures and fuel spillage from the main discharge nozzle.

The carburetor has an external idle vent valve located at the top of the carburetor air horn. It is actuated by a tang located on the accelerator pump plunger lever.

When the throttle valve is returned to idle position, the tang on the pump plunger lever pushes upward on the vent valve stem and opens the idle vent valve. This allows fuel vapors which may form in the float bowl during hot engine idle and hot "soak", to be vented outside, so they will not be drawn into the engine manifold.

When the throttle valve is opened to the off-idle and part throttle position the idle vent valve closes, returning the carburetor to internal balanced venting.

IDLE SYSTEM: Fig. 6M-3

The purpose of the idle system is to control fuel mixtures to the engine during idle and low speed operation.

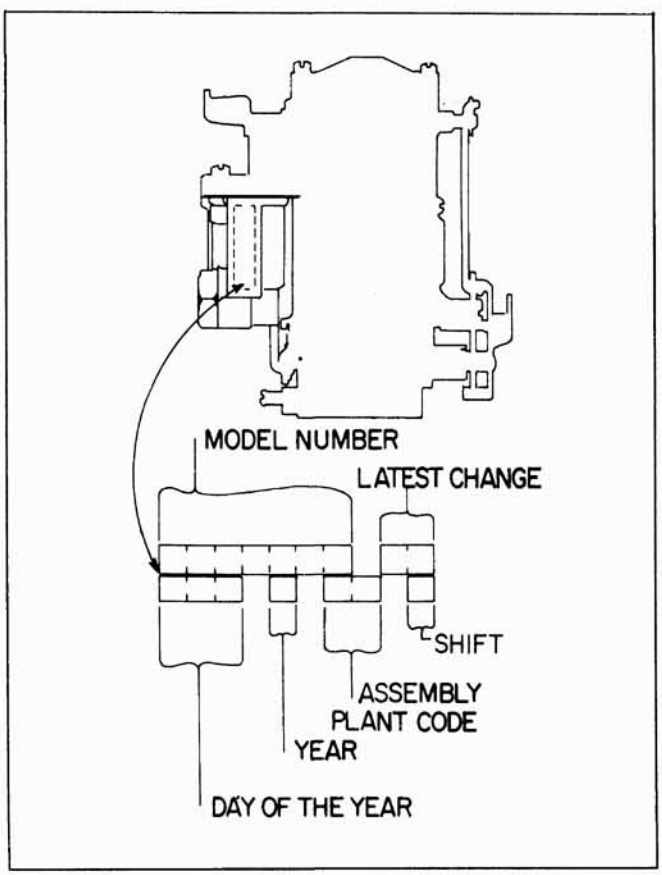


Fig. 6M-1—Model MV Identification

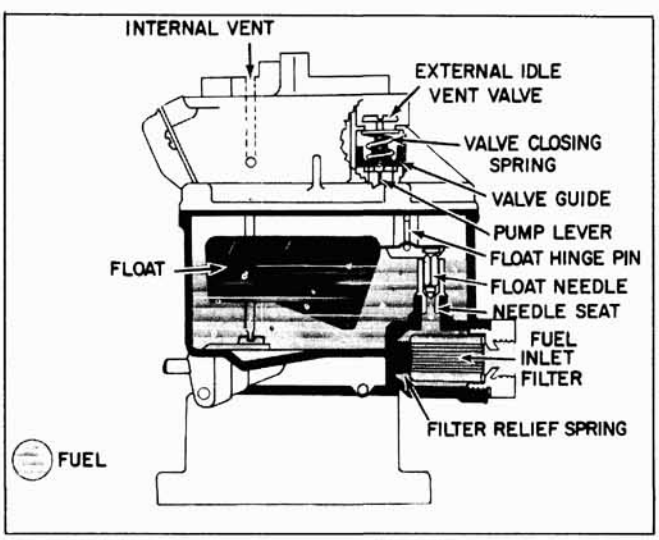


Fig. 6M-2—Model MV Float System

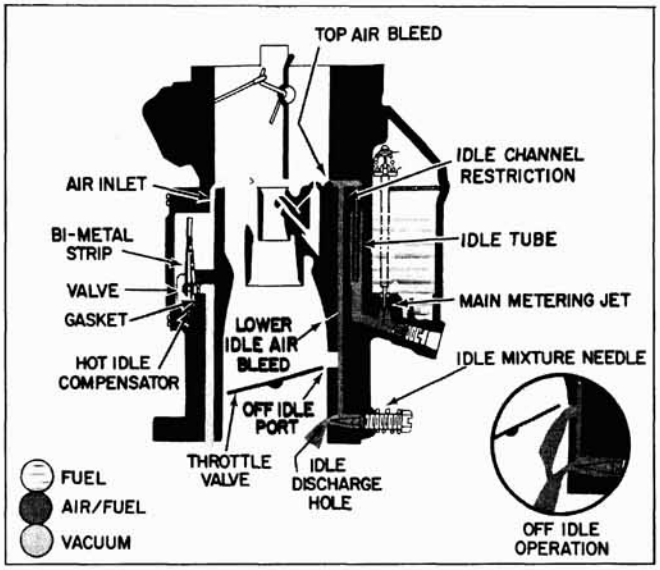


Fig. 6M-3—Model MV Idle System

The idle system consists of a removable idle tube, idle passages, idle channel restriction, idle air bleeds, slotted off-idle port, idle mixture adjusting needle and the idle mixture discharge hole.

Operation

Atmospheric pressure forces fuel from the float bowl down through the main metering jet into the main fuel well where it is picked up and metered at the lower tip of the idle tube. It passes up the idle tube and is mixed with air at the top of the idle channel through the idle air bleed hole. The air/fuel mixture passes over through the cross channel and then downward through the calibrated idle channel restriction where it is further metered. The mixture continues down the idle passage past the lower idle air bleed hole and off idle discharge port just above the throttle valve where it is again mixed with air. The air/fuel mixture then moves downward past the idle mixture needle and out through the idle discharge hole into the carburetor bore. Here it mixes with the air passing around the slightly open throttle valve and then continues through the intake manifold into the engine cylinders as a combustible mixture.

Off Idle Operation (See Inset Fig. 6M-3)

As the throttle valve is opened from curb idle to increase engine speed, additional fuel is needed to combine with the extra air entering the engine. This is accomplished by the slotted off idle port. As the throttle valve is opened, it passes the off idle port, gradually exposing it to high vacuum below the throttle valve. The additional fuel from the off idle port mixes with the increased air flow past the opening throttle valve to meet increased engine air and fuel demands.

The lower idle air bleed is used strictly as an air bleed during idle operation. It supplies additional air to the idle circuit for improved atomization and fuel control at low engine speeds.

The same air bleed is used as an additional fuel feed at higher engine speeds, to supplement main discharge nozzle delivery, during operation of the main metering system.

HOT IDLE COMPENSATOR: Fig. 6M-3

The hot idle compensator is located in a chamber on the float bowl casting. Its purpose is to offset enrichening effects caused by changes in air density and fuel vapors generated during hot engine operation.

The compensator consists of a thermostatically controlled valve, a bi-metal strip which is heat sensitive, a valve holder and bracket. The valve closes off an air channel which leads from a hole inside the air horn to a point below the throttle valve where it exits into the throttle body bore.

Normally the compensator valve is held closed by tension of the bi-metal strip and engine vacuum. At a pre-determined temperature when extra air is needed to offset the enrichening effects of fuel vapors, the bi-metal strip bends and unseats the compensator valve. This allows enough air to be drawn into the engine manifold to offset the richer mixtures and maintain a smooth engine idle. When the engine cools and the extra air is not needed, the bi-metal strip closes the valve and operation returns to normal.

The compensator valve assembly is held in place by the dust cover over the valve chamber. A seal is used between the compensator valve and float bowl casting.

In order to insure proper idle adjustment when the engine is hot, the compensator valve must be closed. To check this, plug the compensator inlet hole inside the air horn bore (wooden pencil can be used). If no drop in engine RPM is noted on a tachometer, the valve is closed. If the valve is open, leave plug in hole when adjusting idle or cool engine down to a point where the valve automatically closes for proper idle adjustment.

Always remove plug used in inlet hole after completing idle adjustment, otherwise, the compensator will not operate.

MAIN METERING SYSTEM: Fig. 6M-4

The main metering system supplies fuel to the engine from off idle to wide open throttle operation.

The main metering system consists of a main metering jet, a mechanical and vacuum operated metering rod, a main fuel well, main well air bleeds, fuel discharge nozzle and triple venturi.

The main metering system operates in the following manner. As the throttle valve is opened beyond the off idle range, allowing more air to enter the engine manifold, air velocity increases in the carburetor venturi. This causes a drop in pressure in the main venturi which is increased many times in the double boost venturi. Since the low pressure (vacuum) is now in the smallest venturi, fuel flows from the main discharge nozzle in the following manner.

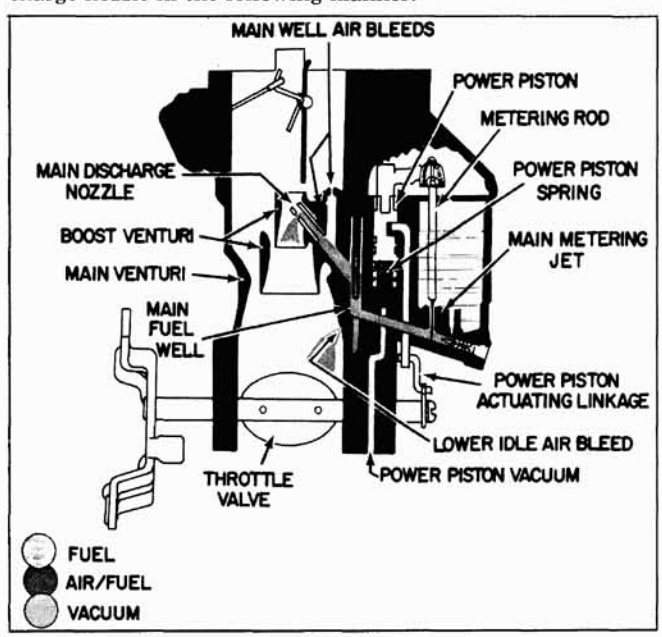


Fig. 6M-4—Model MV Main Metering System

Fuel in the float bowl passes between the tapered metering rod and the main metering jet where it is metered and flows on into the main fuel well. In the main well the fuel is mixed with air from the air bleed at the top of the well and another air bleed which leads into the main well from the discharge nozzle cavity. After the fuel in the main well is mixed with air from the air bleeds it then passes up the discharge nozzle where it sprays into the small boost venturi. At the boost venturi the fuel mixture then combines with air entering the engine through the carburetor bore to provide the correct air-/fuel mixtures to the engine cylinders for efficient combustion.

Fuel flow to the main discharge nozzle is controlled by a tapered metering rod which is actuated by linkage connected directly to the throttle shaft. As the throttle valve is opened from idle position, the tapered metering rod is gradually raised out of the main metering jet orifice. Fuel flow from the main discharge nozzle is controlled by throttle opening and the depth of the metering rod in the main metering jet orifice. With the fuel metering mechanically controlled by the throttle valve angle, it is possible to maintain very accurate mixture ratios throughout part throttle to wide open throttle operation.

An initial metering rod adjustment is required to set the depth of the rod in the main metering jet.

It should be noted that there is a supplementary fuel feed passage in the bottom of the float bowl adjacent to the main metering jet. Fuel is picked up from the float bowl and passes through a calibrated hole past a calibration screw and on into the same fuel passage which leads from the main metering jet to the main fuel well. The calibration screw is factory adjusted and SHOULD NOT be readjusted in the field. If the adjustment is tampered with, it will require complete float bowl or unit replacement.

POWER ENRICHMENT SYSTEM: Fig. 6M-5

The vacuum operated enrichment system is used to slightly enrichen mixture ratios during moderate to heavy loads during acceleration. The necessary enrichment is obtained by movement of a spring loaded vacuum piston which senses changes in manifold vacuum. The amount of enrichment is controlled by the clearance between the groove in the power piston and the diameter of the power piston drive rod.

During part throttle and cruising ranges, manifold vacuum is sufficient to hold the power piston down against spring tension. The upper part of the groove in the power piston is held down against the top side of the drive rod. This places the main metering rod lower in the jet for maximum economy. On moderate to heavy accelerations, manifold vacuum drops and the power piston spring pushes the power piston up so that the lower edge of the slot in the power piston strikes the bottom side of the drive rod. This moves the tapered metering rod slightly upward and out of the main metering jet. This allows more fuel to flow through the jet, enrichening the fuel mixture slightly.

ACCELERATING PUMP SYSTEM: Fig. 6M-6

Extra fuel for smooth, quick acceleration is supplied by the pump system. The accelerating pump is located at the side of the main fuel bowl adjacent to the venturi area. It consists of a spring loaded pump plunger and pump return spring operating in a fuel well. The pump plunger is connected by linkage directly to a lever on the throttle shaft.

When the pump plunger moves upward in the pump well, as happens during throttle closing, fuel from the float bowl enters the pump well through a slot in the side of the pump well. It flows past the synthetic pump cup seal into the bottom of the pump well. The pump cup is a floating type. (The cup moves up and down on the pump plunger head). When the pump plunger is moved upward the flat on the top of the cup unseats from the flat on the plunger head and allows free movement of fuel through the inside of the cup into the bottom of the pump well. This also vents any vapors which may be in the bottom of the pump well so that a solid charge of fuel can be maintained in the fuel well beneath the plunger head.

When the throttle valve is opened, as happens during acceleration, the connecting pump linkage forces the pump plunger downward. The pump cup seats instantly and fuel is forced through the pump discharge passage, where it unseats the pump discharge check ball and passes on through the passage to the pump jet located at the top of the float bowl, where it sprays into the boost venturi area.

The pump discharge check ball prevents any "pull over" or discharge of fuel from the pump jet when the accelerator pump is not in operation. It also keeps the pump discharge passage filled with fuel to prevent pump discharge lag.

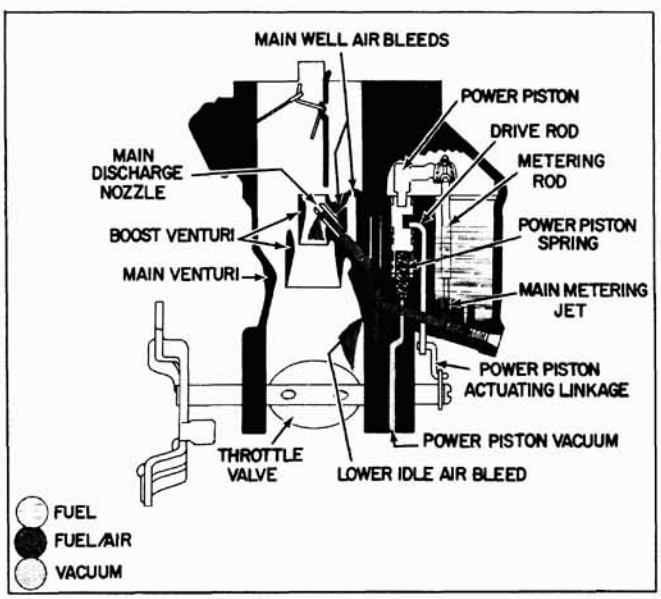


Fig. 6M-5—Model MV Power System

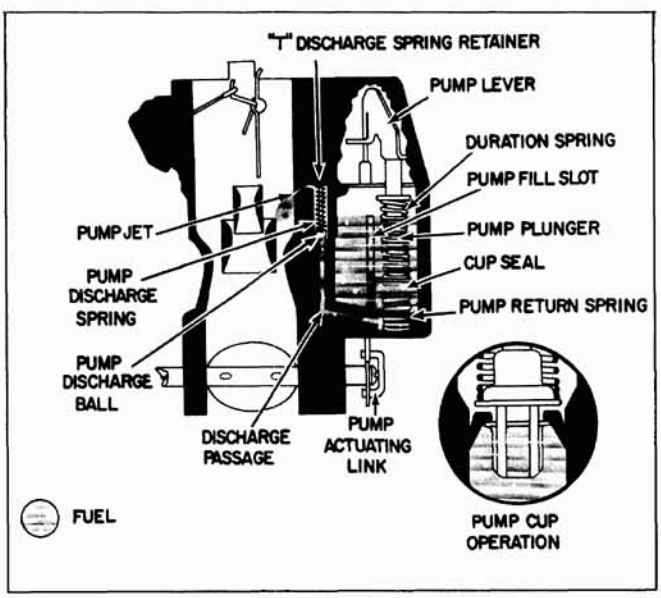


Fig. 6M-6—Model MV Pump System

CHOKE SYSTEM: Fig. 6M-7

The purpose of the choke system is to provide a richer mixture for cold engine starting and operation.

The carburetor is equipped with a fully automatic choke control. The thermostatic coil is mounted on the engine manifold and is connected by a link to the lever on the choke valve shaft. The vacuum break unit is diaphragm operated and is an integral part of the air horn casting. In addition, the choke system has an added feature called a cranking enrichment valve, to reduce engine cranking time during cold starts.

The choke system operates as follows: When the engine is cold, prior to starting, depressing the accelerator pedal opens the carburetor throttle valve. This allows tension from the thermostatic coil to close the choke valve. This also rotates the fast idle cam so the high step is in line with the fast idle tang on the throttle lever. As the throttle is released the fast idle tang comes to rest on the high step of the fast idle cam. This provides enough throttle valve opening to keep the engine running after cold start. When the choke valve closes, it also pushes downward on the cranking enrichment valve stem and opens the valve. During cranking, engine vacuum below the choke valve pulls fuel from the idle circuit and main discharge nozzle. It is supplemented with fuel from the cranking valve channel which leads directly from the bottom of the fuel bowl. This provides adequate enrichment from the fuel circuits for cold starts.

When the engine starts, manifold vacuum is transmitted through a vacuum channel to the vacuum break diaphragm unit. This moves the diaphragm plunger until it strikes the cover, which in turn, opens the choke valve to a point where the engine runs without loading or stalling. This is called the vacuum break position. The choke valve has also opened far enough at this point to allow the cranking enrichment valve to close, shutting off fuel flow from the enrichment channel.

As the engine warms up, the thermostatic coil is heated and gradually relaxes its spring tension so that air velocity through the air horn can continue to open the choke valve. This continues until the engine is warm. At this time the choke coil tension is completely relaxed and the choke valve is wide open.

The fast idle cam has graduated steps so that engine speed is lowered gradually during the engine warm up period. The fast idle cam follows rotation of the choke valve. When the choke valve is completely open and the engine is warm the fast idle tang on the throttle lever will be in the clearance area of the fast idle cam. At this time, the idle stop screw controls normal engine idle speed.

An unloader mechanism is provided should the engine become flooded during the starting period. Unloading is accomplished by depressing the accelerator pedal to the floor, so that wide open throttle is obtained. When this is done a tang on the throttle lever contacts an arm on the fast idle cam and forces the choke valve partially open. The extra air leans out the fuel mixture enough so that the engine will start.

CARBURETOR ASSEMBLY

REMOVAL (Fig. 6M-8)

1. Remove engine air cleaner and gasket.
2. Disconnect fuel and vacuum lines.
3. Disconnect choke coil rod.
4. Disconnect throttle bell crank rod from throttle lever.
5. Remove two nuts securing carburetor to intake manifold and remove carburetor and mounting gasket.

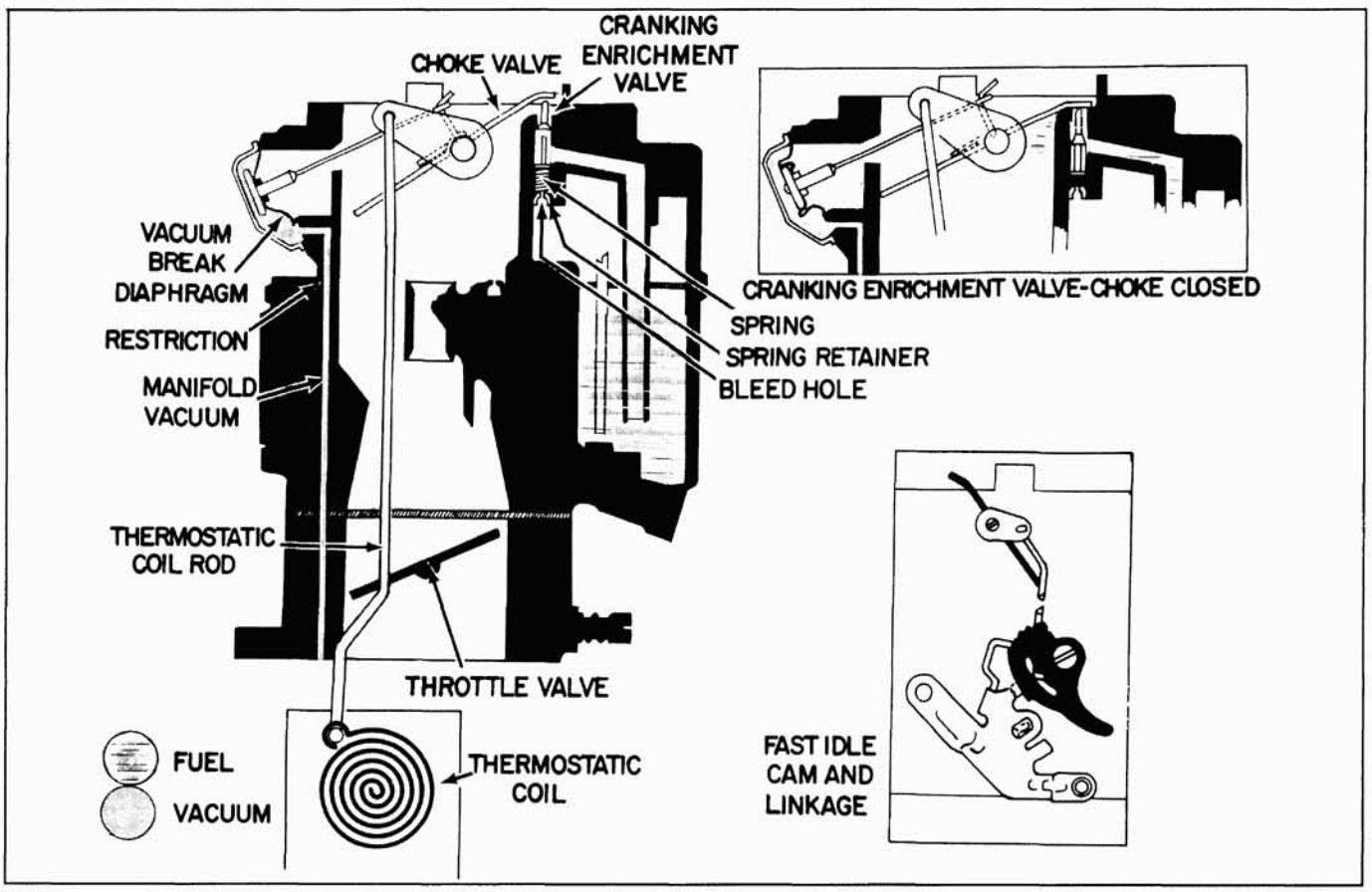


Fig. 6M-7—Model MV Choke System

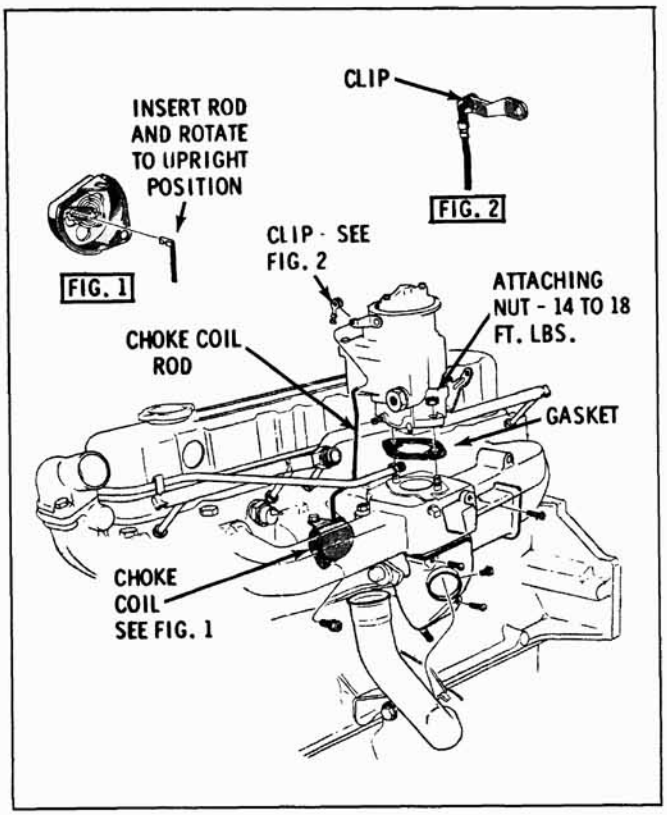


Fig. 6M-8—Model MV Carburetor Mounting

INSTALLATION (Fig. 6M-9)

1. Clean throttle body and intake manifold gasket surfaces and install new mounting gasket over studs.
2. Position carburetor over mounting studs and start the attaching nuts; do not tighten.
3. Connect main fuel line.
4. Torque carburetor attaching nuts 14 to 18 ft. lbs.
5. Connect vacuum lines; connect choke coil rod and throttle rod.
6. Install engine air cleaner and gasket.

DISASSEMBLY

AIR HORN REMOVAL

1. Remove upper choke lever retaining screw and remove choke lever and rod from shaft. Note position of rod in relation to levers for ease in reassembly. (Fig. 6M-10)
2. Remove choke rod from slot in fast idle cam by rotating rod. Remove upper lever from other end of choke rod.
3. Remove six air horn to float bowl attaching screws.
4. Remove air horn by lifting straight up. Invert air horn and place on clean bench. Air horn to bowl gasket can remain on bowl for removal later.

AIR HORN DISASSEMBLY

1. Remove two vacuum break diaphragm cover screws. Then carefully remove diaphragm cover.
2. To remove vacuum break diaphragm and plunger rod, hold choke valve open. Then push upward on eyelet on choke valve at a 45° angle until the looped end of rod slides off wire lever attached to choke valve. Then remove diaphragm plunger rod through hole in air horn. (Fig. 6M-11)

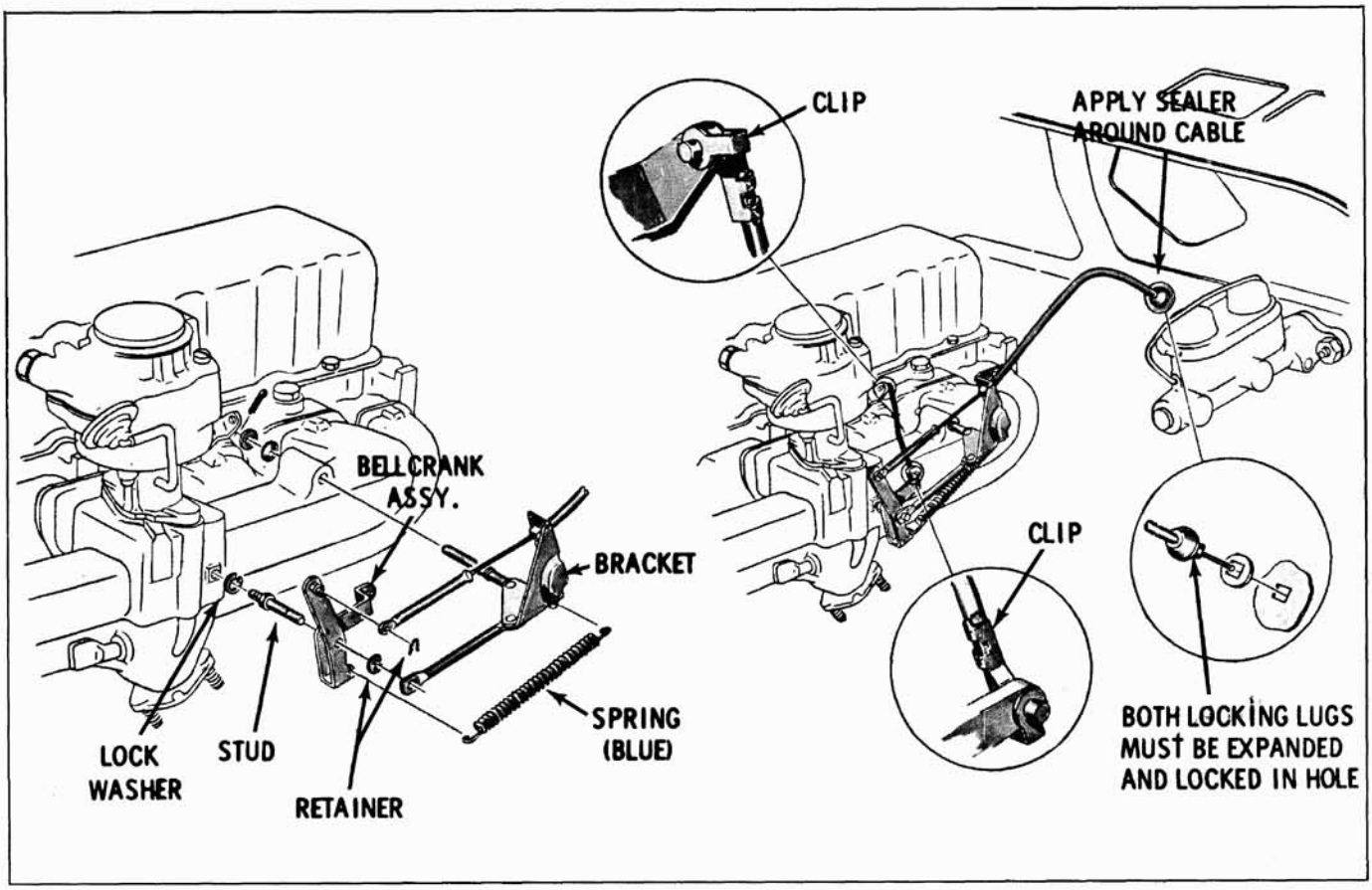


Fig. 6M-9—Model MV Carburetor Linkage

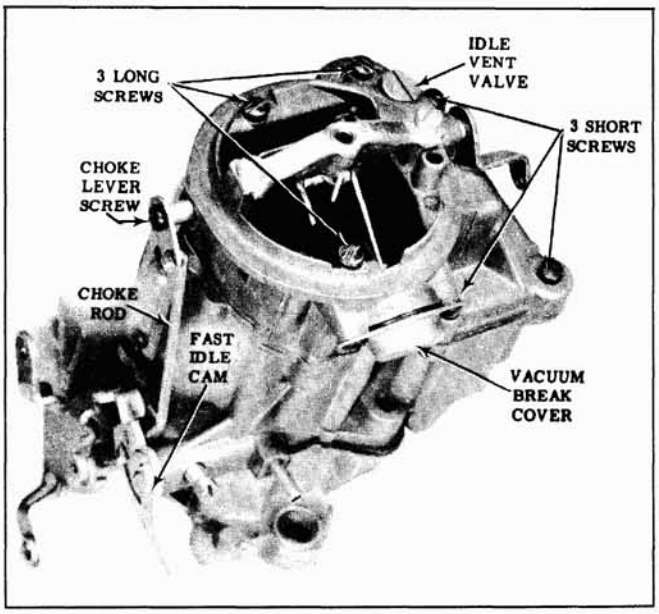


Fig. 6M-10—Model MV Carburetor Assembly

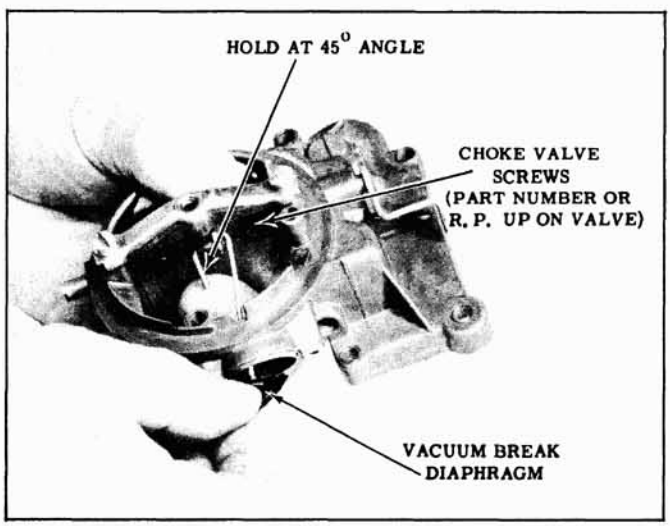


Fig. 6M-11—Model MV Vacuum Break

3. If desired, the choke valve, vacuum break lever and choke shaft can be removed from air horn by removing two choke valve screws. Staking on choke valve screws should be filed off before removing so as not to ruin threads and distort choke shaft.

4. No further disassembly of the air horn is necessary. The idle vent valve can be removed by turning screw head out of plastic guide. A repair kit is available if replacement parts are needed.

FLOAT BOWL DISASSEMBLY (Fig. 6M-12)

1. Remove air horn to float bowl gasket. Gasket is slit next to metering rod lever so that it can be slid over lever for ease in removal.

2. Remove float assembly from float bowl by lifting upward on float hinge pin. Remove hinge pin from float arm.

3. Remove float needle from seat.

4. Remove hair pin clip holding pump link to actuator lever. Disengage link from lever. (Fig. 6M-13)

Hold down on pump and piston while removing links as they are spring loaded.

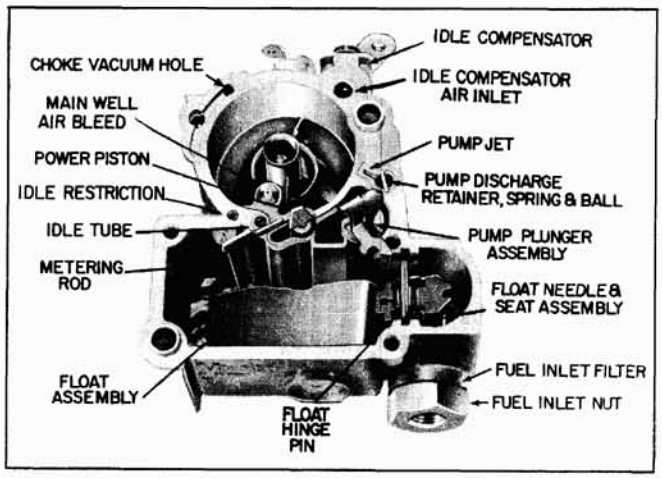


Fig. 6M-12—Model MV Bowl Assembly

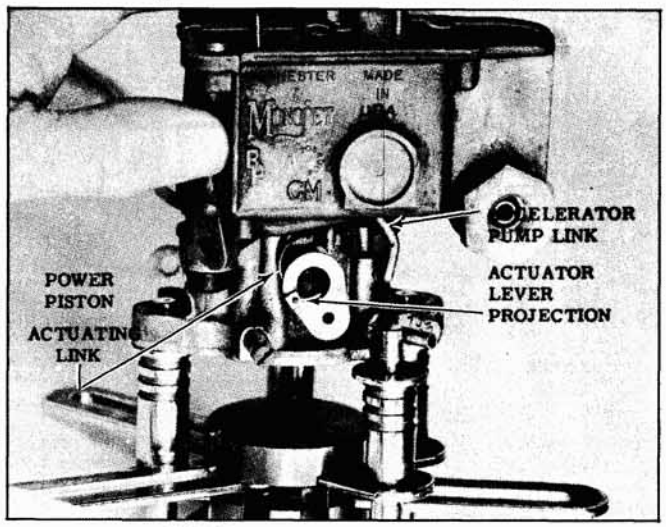


Fig. 6M-13—Model MV Pump Actuator Lever

5. Push down on power piston and remove actuator attaching screw.

6. Push down on power piston and remove lever and link from actuating rod. (Fig. 6M-14)

7. Push down on accelerator pump and remove actuator link by rotating until tang on rod is aligned with slot on pump plunger lever. Remove the link.

8. Remove pump lever and pump assembly.

9. Remove power piston, actuator rod, metering rod and piston return spring from the bowl. (Fig. 6M-15)

10. Remove accelerator pump return spring.

11. Remove "T" guide and pump discharge spring using needle nose pliers.

12. Pump discharge ball and idle tube can be removed at the same time by inverting the bowl. (Fig. 6M-16)

13. Remove main metering jet from bottom of fuel bowl.

14. Remove float needle seat and gasket using Tool BT-3007.

15. Remove two screws from idle compensator cover. Then remove cover, hot idle compensator and seal from recess in bowl. (Fig. 6M-17)

Hot idle compensator is used on all automatic transmission equipped cars and all cars with air conditioning.

16. Throttle stop screw and fast idle cam can be removed at this time if desired.

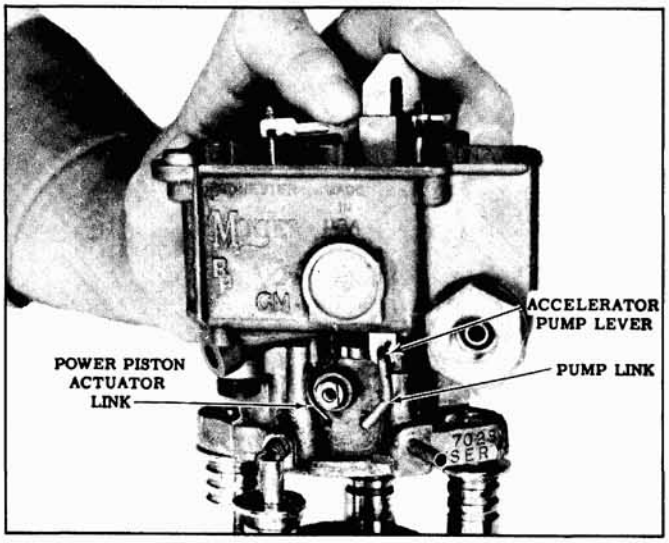


Fig. 6M-14—Removing Pump Assembly

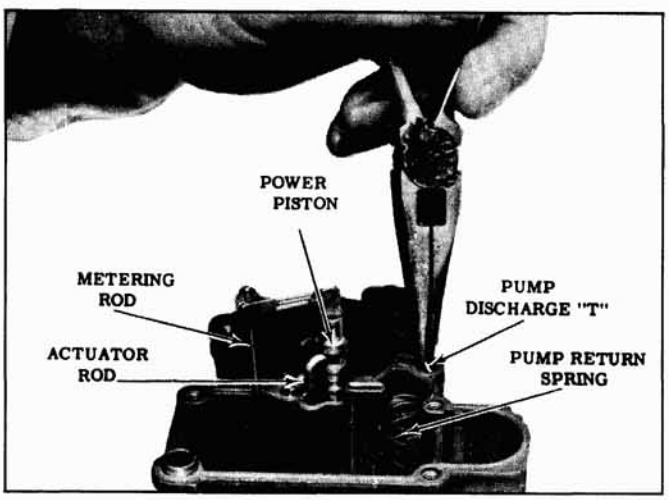


Fig. 6M-15—Power Piston Assembly

17. Remove the fuel inlet nut and gasket; then remove the filter and relief spring.

No further disassembly of the float bowl is required.

THROTTLE BODY REMOVAL AND DISASSEMBLY

1. Invert carburetor bowl on bench and remove two throttle body to bowl attaching screws. Throttle body and insulator gasket may now be removed.

2. Remove idle mixture needle and spring. (Fig. 6M-18)

Due to the close tolerance fit of the throttle valve in the bore of the throttle body, do not remove the valve or shaft.

CLEANING AND INSPECTION

The carburetor should be cleaned in a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as Carbon X (X-55) or its equivalent.

Rubber and plastic parts should not be immersed in carburetor cleaner. However, the air horn which has the plastic vent valve guide and cranking enrichment valve will withstand normal cleaning in carburetor cleaner. Make sure the cleaner is thoroughly removed from choke enrichment valve cavity.

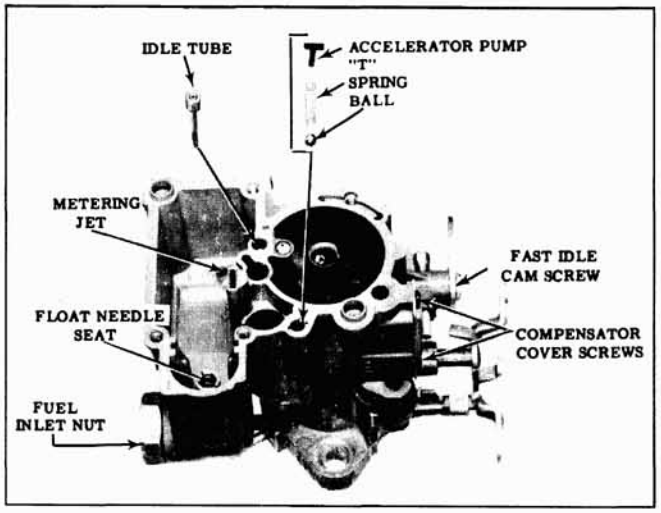


Fig. 6M-16—Float Bowl Assembly

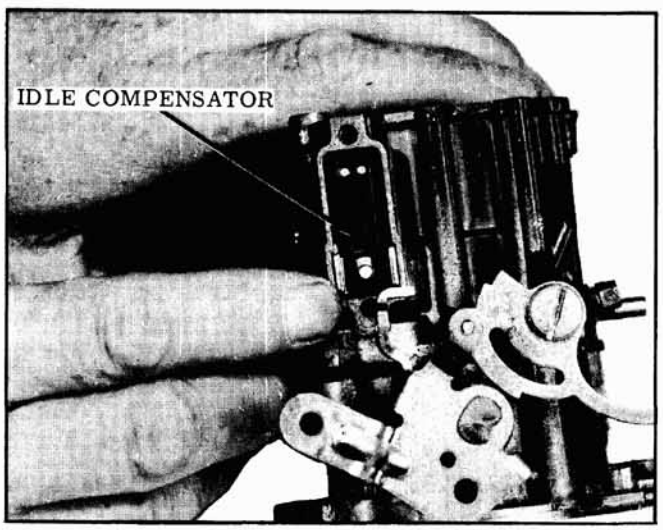


Fig. 6M-17—Idle Compensator

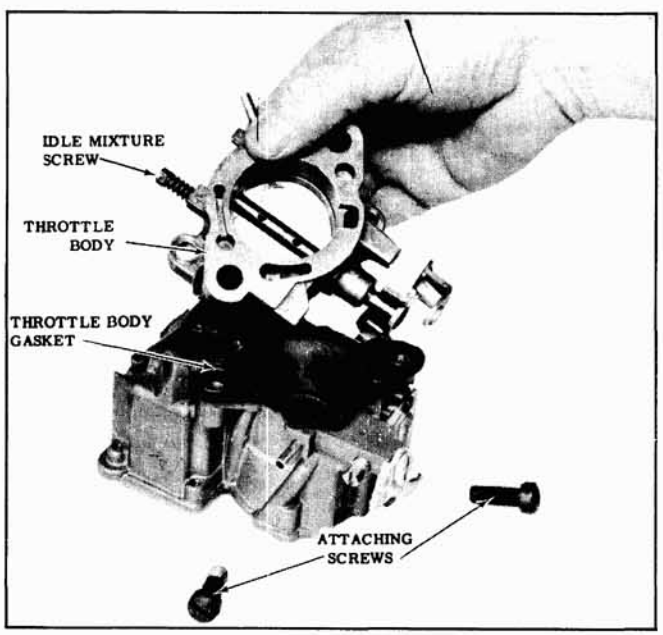


Fig. 6M-18—Throttle Body

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Inspect idle mixture needle for damage.
4. Examine float needle and seat assembly for wear. Install a new factory matched set if worn.
5. Inspect upper and lower casting sealing surfaces for damage.
6. Inspect holes in levers for excessive wear or out of round condition. If levers or rods are worn they should be replaced.
7. Examine fast idle cam for excessive wear or damage.
8. Check throttle and choke levers and valves for binds and other damage.
9. Check all springs for distortion or loss in tension; replace as necessary.

When carburetor has been disassembled, new gaskets and filter must be used.

CARBURETOR ASSEMBLY

THROTTLE BODY

1. Install idle mixture needle and spring until lightly seated. Back out 1-1/2 to 2 turns as a preliminary idle adjustment.
2. Invert float bowl and install new throttle body to bowl insulator gasket.
3. Install throttle body on bowl gasket so that all holes in throttle body are aligned with holes in gasket.
4. Install two throttle body to bowl attaching screws. Tighten evenly and securely. (12 - 15 ft. lbs. of torque)

FLOAT BOWL ASSEMBLY

1. Install fast idle cam to boss on float bowl, attaching with fast idle cam screw. Tighten securely. Part number on cam faces outboard.
2. Install throttle stop screw, if removed.
3. Install seal into recess in idle compensator cavity in float bowl then install idle compensator assembly. (Fig. 6M-17)
4. Install idle compensator cover, retaining with two attaching screws. Tighten securely.
5. Install main metering jet into bottom of fuel bowl. Tighten securely.
6. Using Tool BT-3007 install needle seat and gasket.
7. Install idle tube flush with bowl casting.
8. Install pump ball, spring and "T" into pump discharge hole.
9. Push down on pump discharge "T" until flush with bowl casting. (Fig. 6M-15)
10. Install fuel filter spring, filter, inlet nut and gasket. (Fig. 6M-15)
11. Install accelerator pump return spring.
12. Install power piston return spring into piston cavity in the bowl.
13. Install power piston actuating rod (right angle end) into slot in the power piston.
14. Install piston, metering rod and actuating rod assembly into the float bowl. End of actuating rod must enter hole in bowl. Locate metering rod into jet orifice.
15. Install pump plunger assembly into pump well with actuating lever protruding through bottom of bowl casting. Push downward on pump lever and install pump assembly drive link into hole in lower end of shaft. Ends of drive link point inboard toward carburetor bore. Tang on upper end of link retains link to pump shaft. (Fig. 6M-14)
16. Push down on power piston so actuator rod link hole can be seen. Install actuator link. Lower end of link faces outboard.
17. Install power piston and accelerator pump actuating lever onto power piston actuating rod link part number on lever facing outboard and "D" hole lined up with flats on throttle shaft. Install attaching screw. (Fig. 6M-18)
18. Install accelerator pump link to actuating lever and retain with hairpin clip.
19. Install float needle valve into needle seat.
20. Insert float hinge pin into float arm. Then install float and hinge pin into float bowl. (Fig. 6M-19)

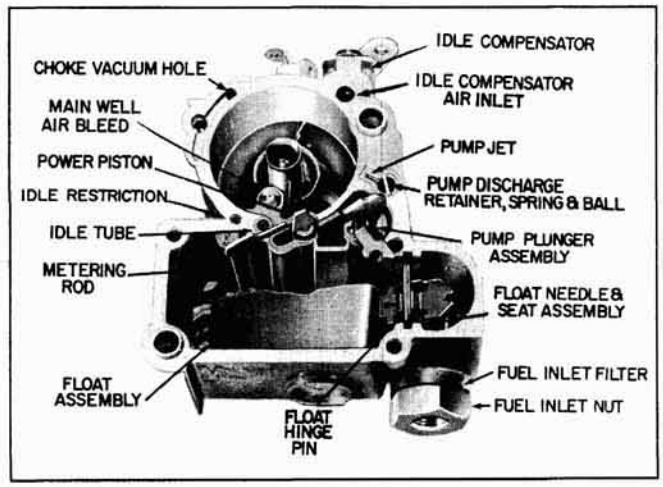


Fig. 6M-19—Model MV Bowl Assembly

FLOAT LEVEL ADJUSTMENT

1. Hold float retaining pin firmly in place and float arm against top of float needle.
2. With adjustable T-scale, measure distance from top of float at toe to float bowl gasket surface (gasket removed). Measurement should be made at point 1/16" in from end of flat surface at float toe (not on radius).
3. Bend float pontoon up or down at float arm junction to adjust. See MV ADJUSTMENT CHART.

METERING ROD ADJUSTMENT

1. Open throttle valve, slide metering rod out of holder and remove from main metering jet.
2. To check adjustment, back out slow idle screw and rotate fast idle cam so that fast idle cam follower is not contacting steps on cam.
3. With throttle valve completely closed, apply pressure to top of power piston and hold piston down against its stop.
4. Holding downward pressure on power piston, swing metering rod holder over flat surface of bowl casting next to carburetor bore. See MV ADJUSTMENT CHART.
5. Insert gauge between bowl casting and lower surface of metering rod holder. Gauge should have a slide fit between both surfaces, as shown.
6. To adjust, carefully bend metering rod holder up or down at point shown using Tool BT-3007.
7. After adjustment, install metering rod and spring assembly. Install rod in jet then install in hanger.
8. Install air horn gasket on float bowl by carefully sliding slit portion of gasket over metering rod holder. Then align gasket with dowels provided on top of bowl casting and press gasket firmly in place.

AIR HORN ASSEMBLY

1. Install idle vent valve assembly, if removed.
2. Install choke shaft, choke valve and vacuum break lever, if removed. Align choke valve, tighten two retaining screws and stake securely.

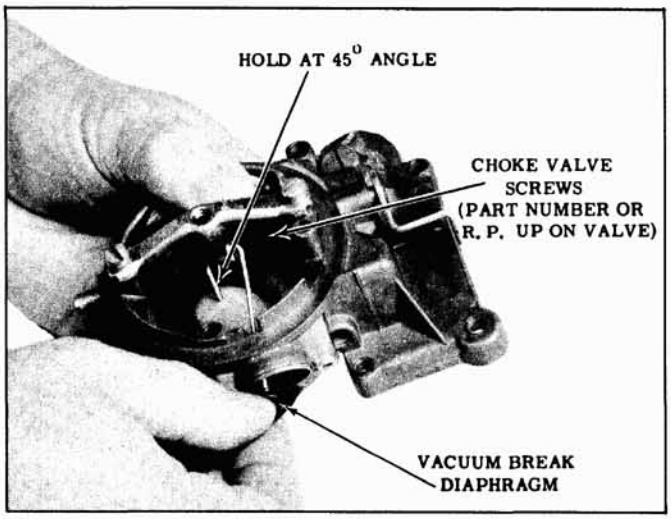


Fig. 6M-20—Model MV Vacuum Break

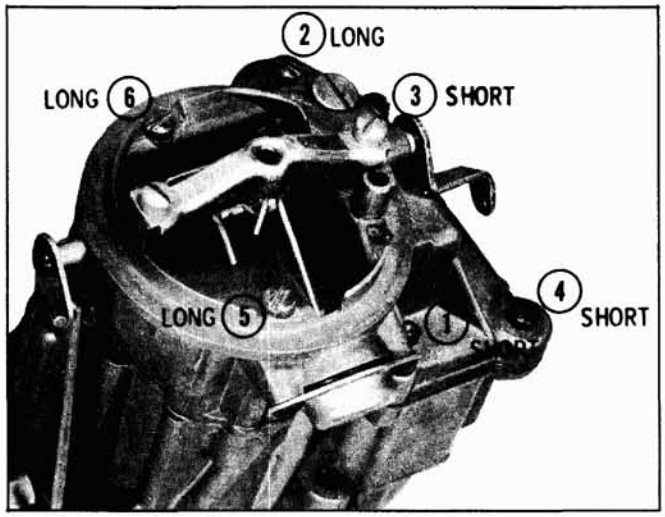


Fig. 6M-21—Tightening Sequence

3. Install vacuum break diaphragm and plunger into cavity at side of air horn. With choke valve in the open position, hold eyelet tang at 45° angle. (Fig. 6M-20) Slide eyelet of plunger rod over end of vacuum break lever on choke valve.

4. Seat vacuum break diaphragm over sealing bead on air horn casting. With diaphragm held in place, carefully install diaphragm cover and two retaining screws. Tighten screws securely.

5. Install air horn to float bowl by lowering gently onto float bowl until seated. Install three long and three short air horn to float bowl attaching screws. Tighten securely using tightening sequence. (Fig. 6M-21)

6. Assemble choke rod to the choke shaft lever. End of rod points away from air horn casting when installed properly. (Fig. 6M-22)

7. Install lower end of choke rod into curved slot in fast idle cam. Steps on fast idle cam should face fast idle tang on throttle lever.

8. Install upper choke lever to choke shaft. End of lever faces toward vacuum break diaphragm. Install choke lever screw. Tighten securely.

Refer to MV ADJUSTMENT CHART for the remaining adjustments; adjustments must be performed in the sequence shown. Slow and fast idle rpm specifications are also shown on the chart.

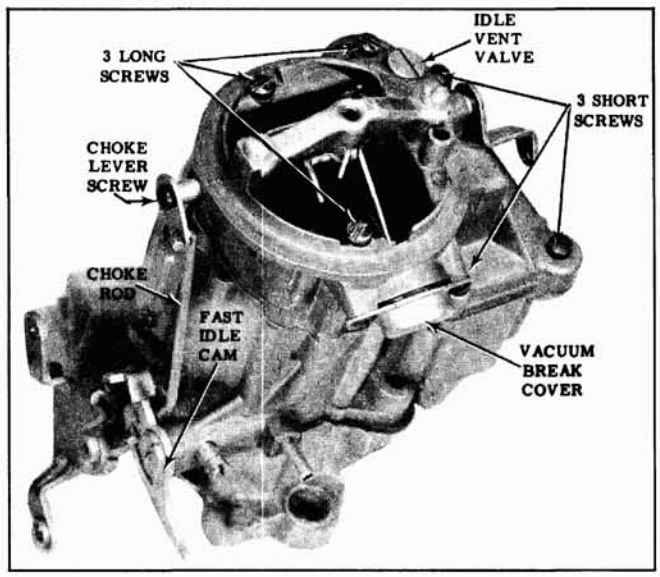
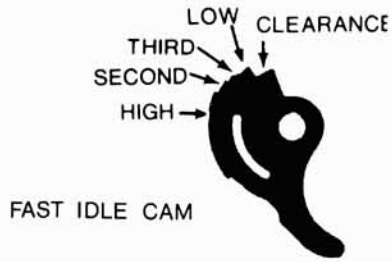


Fig. 6M-22—Model MV Carburetor Assembly

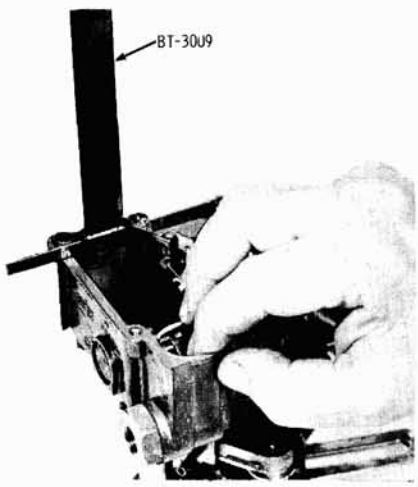
MODEL MV DIAGNOSIS CHART

CONDITION										CHECK POINTS
HARD STARTING—COLD	HARD STARTING—HOT	POOR OPERATION—DURING WARM UP	STUMBLE ON ACCELERATION	STALLING	ROUGH IDLE	ECONOMY	FLOODING	SURGE	LACK OF HIGH SPEED PERFORMANCE	**IMPORTANT** Before attempting carburetor diagnosis as outlined below, all other engine systems must be operating properly. Diagnosis of these systems (electrical, exhaust, mechanical, and in the case of fuel economy, odometer accuracy) is found in this Service Manual. The numbers 1, 2 and 3, under the CONDITION are the order of probability. The * indicates additional possibilities.
1	1					1				Driver Habits (Instruct Owner on Proper Procedures)
2		1			*	3				Check Choke Parts Stuck, Dirty, Bound-Up or Gummed-Up
*		*								Check Choke Rod Adjustment
*		*								Check Choke Unloader Adjustment
*	*	3			2	*				Check Choke Setting
*			1							Check Accelerator Pump Rod Adjustment
*			2							Accelerator Pump Circuit Dirty, Plugged or Inoperative
						*		*	2	Fuel Pump Pressure or Volume Not to Specification
			*	1	1	*		*		Check Slow Idle Adjustment and Mixture
		2		*		*				Check Fast Idle Adjustment
						*		1	*	Metering Jet Loose, Wrong Part or Rod Adjustment
			*			4		3	3	Power Piston Sticking or Wrong Part
	*						*			Float Sticking
*	*				*	*	*			Float Bowl Porous, Cracked, Etc.
	2				*	*	*	*	*	Check Float Level Adjustment
*					*				*	Throttle Body to Float Bowl Screws Loose
	*					*	2	2		Needle & Seat Dirty, Sticking, Loose
	*	*	*		*					Idle Compensator Not Opening or Closing
	3		*		*	*		*		Check Idle Vent Adjustment
				2	3			*		Idle Passages Plugged, Dirty
			*			*			*	Power Piston Vacuum Passage Plugged
				3	*	*				Crankcase Vent Valve Plugged
								*	*	Fuel Filter in Gas Tank Plugged
							1	*	1	Fuel Filter in Carb. Plugged, By Passing Fuel
						2			*	Air Cleaner or Element Plugged or Dirty
								*	*	Hole in Fuel Pump Suction Line or Kinked Hose
									*	No Full Throttle Opening at Carburetor
	*	*	*			*				Check Heat Riser, Stuck Open or Closed
*		*	3							Accelerator Pump Inoperative
3		*								Check Vacuum Break Adjustment
									*	Fuel Tank Vent Plugged
			*	*	*					Throttle Closing Solenoid Inoperative

1	2	3	4
FLOAT LEVEL	METERING ROD	CHOKE ROD	VACUUM BREAK
11/32"	AUTO TRANS. .120" MANUAL TRANS. .150"	AUTO TRANS. .180" MANUAL TRANS. .190"	.260"



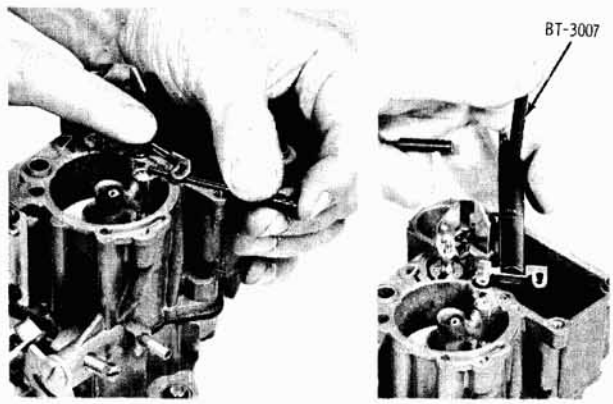
1 ADJUSTMENTS MUST BE PERFORMED IN NUMBERED SEQUENCE



1. HOLD DOWN ON FLOAT HINGE PIN RETAINER WITH ONE FINGER AND PUSH DOWN ON FLOAT ARM WITH OTHER FINGER.
2. GAUGE FROM TOP OF CASTING (GASKET REMOVED) TO TOP OF FLOAT 1/16" BACK FROM RADIUS.
3. TO ADJUST BEND FLOAT ARM IMMEDIATELY NEXT TO FLOAT.

FLOAT LEVEL ADJUSTMENT

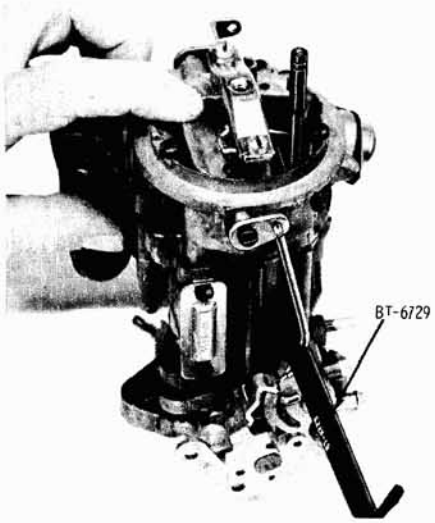
2



1. OPEN THROTTLE VALVE AND REMOVE METERING ROD AND SPRING.
2. BACK OUT THROTTLE STOP SCREW TO COMPLETELY CLOSE THROTTLE VALVE.
3. SWING METERING ROD HOLDER OVER FLAT SURFACE OF BOWL WITH GASKET REMOVED.
4. HOLD POWER PISTON DOWN WITH FINGER AND GAUGE BETWEEN BOWL CASTING AND METERING ROD HOLDER.
5. TO ADJUST BEND METERING ROD HOLDER AS SHOWN WITH TOOL BT-3007.

METERING ROD ADJUSTMENT

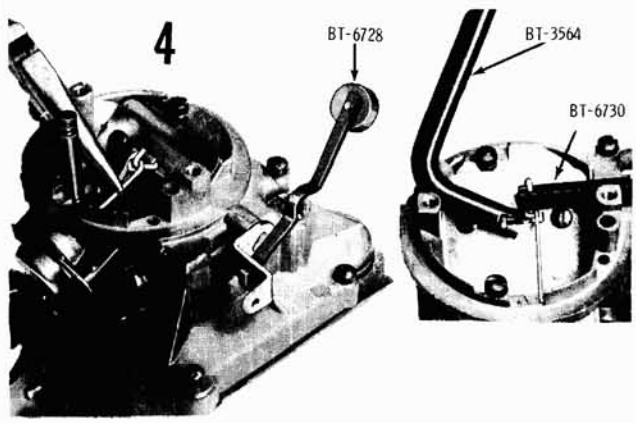
3



1. PLACE FAST IDLE CAM FOLLOWER ON SECOND STEP AND AGAINST HIGH STEP OF FAST IDLE CAM.
2. HOLD CHOKE VALVE TOWARDS CLOSED CHOKE WITH FINGER.
3. GAUGE BETWEEN LOWER CENTER OF CHOKE VALVE AND AIR HORN WALL.
4. TO ADJUST BEND CHOKE ROD AS SHOWN WITH TOOL BT-6729.

CHOKE ROD ADJUSTMENT

4

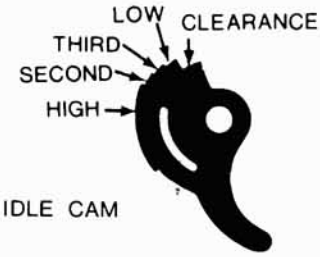


1. DISCONNECT CHOKE COIL ROD FROM CARBURETOR AND INSTALL WEIGHT BT-6728 ON CHOKE ARM AS SHOWN TO KEEP CHOKE VALVE TOWARDS CLOSED CHOKE POSITION.
2. SEAT DIAPHRAGM BY PUSHING PLUNGER IN WITH NEEDLE NOSE PLIERS. BE CERTAIN PLUNGER LINK IS IN RADIUS OF CHOKE VALVE LINK.
3. GAUGE BETWEEN LOWER EDGE OF CHOKE VALVE AND AIR HORN WALL.
4. TO ADJUST BEND LINK ON CHOKE VALVE WITH TOOL BT-3564 WHILE HOLDING WITH TOOL BT-6730.

VACUUM BREAK ADJUSTMENT

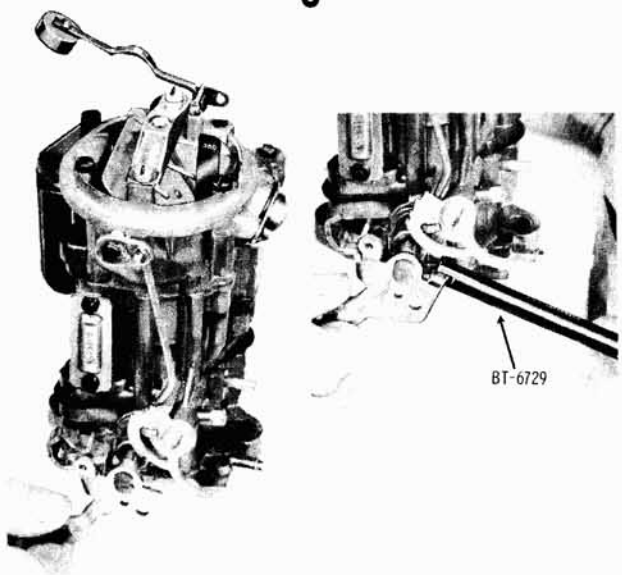
Fig. 6M-23—Model MV Carburetor and Linkage Adjustments

5	6	7	
UNLOADER .350"	CHOKE COIL ROD SEE STEP 6 BELOW	SLOW IDLE SEE STEP 7 BELOW	



FAST IDLE CAM

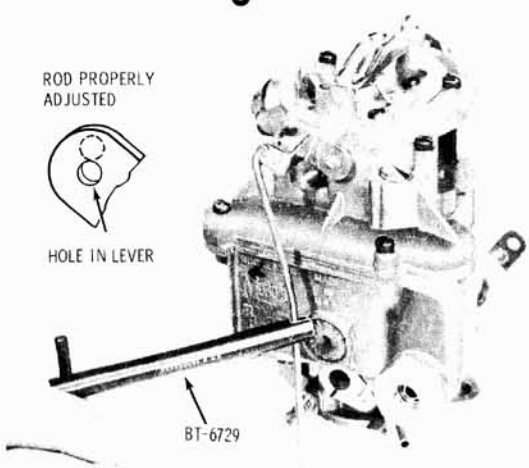
5



1. DISCONNECT CHOKE COIL ROD FROM CARBURETOR AND INSTALL WEIGHT BT-6728 ON CHOKE ARM AS SHOWN TO KEEP CHOKE VALVE CLOSED.
2. HOLD THROTTLE VALVE WIDE OPEN. (ENGINE OFF) GAUGE BETWEEN LOWER CENTER EDGE OF CHOKE VALVE AND AIR HORN CASTING.
3. IF NECESSARY TO ADJUST BEND UNLOADER TANG AS SHOWN WITH TOOL BT-6729.

UNLOADER ADJUSTMENT

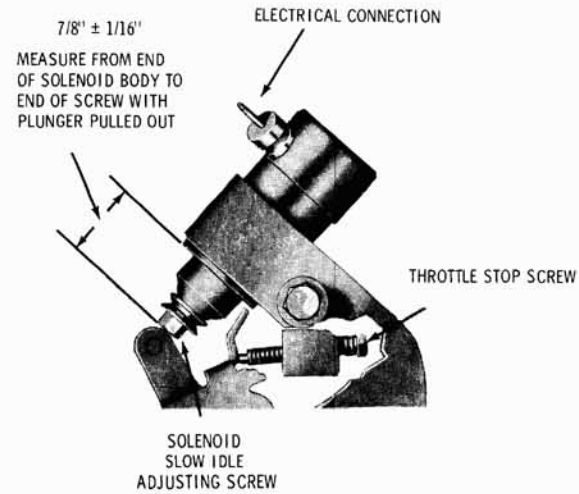
6



1. DISCONNECT CHOKE COIL ROD FROM CARBURETOR AND HOLD CHOKE VALVE CLOSED.
2. PULL UPWARD ON CHOKE COIL ROD TO END OF TRAVEL.
3. ROD MUST BE ONE ROD DIAMETER ABOVE HOLE IN CHOKE VALVE ARM AS SHOWN.
4. TO ADJUST BEND ROD AT KINK WITH TOOL BT-6729.

CHOKE COIL ROD ADJUSTMENT

7



1. ENGINE AT NORMAL OPERATING TEMPERATURE, REMOVE AIR CLEANER, DISCONNECT AIR CLEANER VACUUM HOSE AT BASE OF CARBURETOR, THEN PLUG FITTING.

   DISCONNECT VACUUM HOSE AT DISTRIBUTOR AND PLUG END OF HOSE.
2. SET PARKING BRAKE, BLOCK DRIVE WHEELS, TURN AIR COND. OFF, AUTOMATIC TRANS. IN DRIVE, MANUAL TRANS. IN NEUTRAL, CHOKE FULLY OPEN, FAST IDLE CAM FOLLOWER OFF THE CAM, SOLENOID WIRE CONNECTED AND THROTTLE STOP SCREW SHOULD NOT CONTACT THROTTLE LEVER.
3. ADJUST SOLENOID SLOW IDLE SCREW TO OBTAIN APPROX. 575 RPM
4. WITH SOLENOID ENERGIZED (OPEN THROTTLE SLIGHTLY TO ALLOW PLUNGER TO COME OUT OF SOLENOID) MEASURE DISTANCE BETWEEN END OF SOLENOID BODY AND END OF SOLENOID SCREW. THIS MUST BE 7/8" ± 1/16". IF NOT, REFER TO "SOLENOID LOCATION ADJUSTMENT" BELOW.
5. ADJUST SOLENOID SLOW IDLE SCREW AND IDLE MIXTURE SCREW ALTERNATELY TO OBTAIN THE BEST IDLE AT:

   575 RPM IN DRIVE AUTOMATIC TRANSMISSION
   725 RPM IN NEUTRAL MANUAL TRANSMISSION

   NOTE: PLUG HOT IDLE COMPENSATOR HOLE, LOCATED INSIDE AIR HORN WITH ERASER END OF PENCIL.
6. TURN IDLE MIXTURE SCREW IN TO OBTAIN A 20 TO 25 RPM REDUCTION FOR FINAL IDLE SPEED.
7. TURN THROTTLE STOP SCREW IN UNTIL IT CONTACTS THROTTLE LEVER.
8. DISCONNECT SOLENOID WIRE AND ADJ. THROTTLE STOP SCREW TO 400 RPM IN DRIVE, AUTO. TRANS. AND NEUTRAL, MANUAL TRANS. DO NOT READJUST IDLE MIXTURE SCREW. RECONNECT SOLENOID WIRE.

   UNPLUG DISTRIBUTOR VACUUM HOSE AND RECONNECT TO DISTRIBUTOR.
9. UNPLUG VAC. FITTING AT BASE OF CARB. AND CONNECT AIR CLEANER HOSE, REINSTALL AIR CLEANER, BEING SURE HOT AIR ADAPTER AND VENTILATION TUBE ARE CONNECTED AND SEATED PROPERLY.

SOLENOID LOCATION ADJUSTMENT

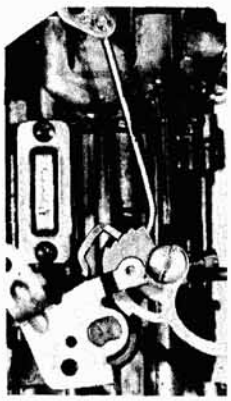
1. ADJ. THROTTLE STOP SCREW TO HOLD APPX. 575 RPM.
2. LOOSEN CLAMP AND SLIDE SOLENOID AWAY FROM THROTTLE LEVER.
3. WITH SOLENOID ENERGIZED, OR PLUNGER HELD OUT, ADJUST SOLENOID IDLE SCREW SO THAT HEAD OF SCREW IS 7/8" ± 1/16" OUT OF SOLENOID BODY.
4. WITH SOLENOID ENERGIZED AND ELECT. TERMINAL 30° REARWARD TOWARDS COWL, HOLD SOLENOID LIGHTLY AGAINST CARB. LEVER, THEN TIGHTEN CLAMP.
5. TURN THROTTLE STOP SCREW OUT SO IT WILL NOT CONTACT THROTTLE LEVER DURING SLOW IDLE ADJUSTMENT.

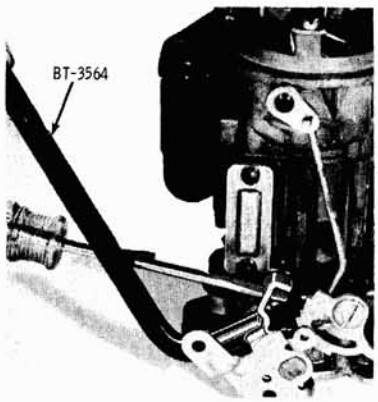
SLOW IDLE ADJUSTMENT WITH THROTTLE CLOSING SOLENOID

Fig. 6M-24—Model MV Carburetor and Linkage Adjustments

8	9
FAST IDLE	IDLE VENT
SEE STEP 8 BELOW	.050"

8

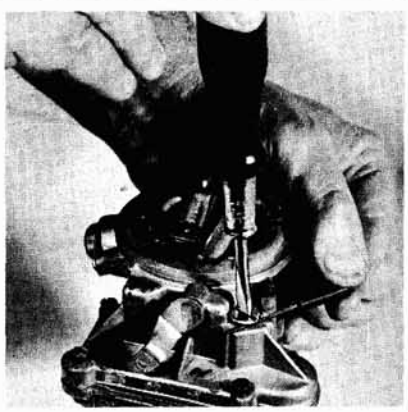




1. REMOVE AIR CLEANER, DISCONNECT AIR CLEANER VACUUM HOSE AT BASE OF CARBURETOR, THEN PLUG FITTING.
2. SET PARKING BRAKE AND BLOCK DRIVE WHEELS.
3. PLACE MANUAL TRANS. IN NEUTRAL, AUTO TRANS. IN PARK.
4. ENGINE AT NORMAL OPERATING TEMP., AIR COND. OFF, CLOSE HOT IDLE COMPENSATOR HOLE INSIDE AIR HORN WITH ERASER ON PENCIL.
5. TO CHECK, DISCONNECT WIRE FROM SOLENOID. PLACE FAST IDLE CAM FOLLOWER ON THIRD STEP AND AGAINST SECOND STEP.
6. CHECK RPM WITH A TACHOMETER. IT SHOULD BE 750 RPM ON THIRD STEP OF CAM.
7. IF NECESSARY TO ADJUST, TURN IGNITION OFF. HOLD CAM FOLLOWER WITH TOOL BT-3564. INSERT A SCREWDRIVER IN SLOT OF CAM FOLLOWER AND BEND CAM FOLLOWER AWAY FROM CAM TO DECREASE AND TOWARDS CAM TO INCREASE FAST IDLE.
8. RECHECK IDLE WITH ENGINE RUNNING. RECONNECT WIRE TO SOLENOID, REMOVE PENCIL, UNPLUG VAC. FITTING AT BASE OF CARB. AND REINSTALL AIR CLEANER HOSE. REINSTALL AIR CLEANER, BEING SURE HOT AIR ADAPTER AND VENTILATION TUBE ARE CONNECTED AND SEATED PROPERLY.

FAST IDLE ADJUSTMENT

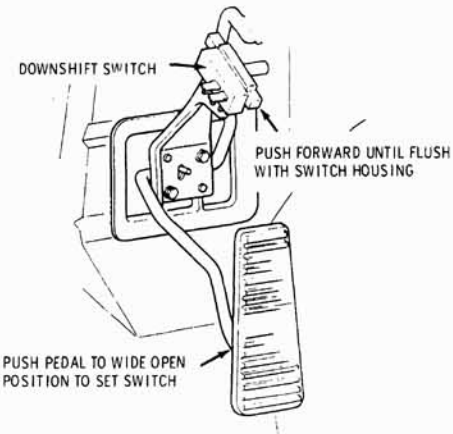
9



1. SLOW IDLE PROPERLY ADJUSTED.
2. CHOKE VALVE WIDE OPEN AND FAST IDLE CAM FOLLOWER IN CLEARANCE CUT OUT OF FAST IDLE CAM.
3. WITH ENGINE OFF, SOLENOID ENERGIZED, (PLUNGER OUT) HOLD THROTTLE LEVER AGAINST SOLENOID SLOW IDLE ADJUSTING SCREW.
4. GAUGE BETWEEN AIR HORN CASTING AND VENT SCREW AS SHOWN.
5. TO ADJUST, TURN SCREW OUT TO INCREASE GAP AND IN TO DECREASE GAP.

IDLE VENT ADJUSTMENT

10



1. PUSH PLUNGER OF DOWNSHIFT SWITCH FORWARD UNTIL FLUSH WITH SWITCH HOUSING.
2. PUSH ACCELERATOR PEDAL TO WIDE OPEN POSITION TO SET SWITCH.
3. ENERGIZING OF DOWNSHIFT SWITCH CIRCUIT CAN BE CHECKED WITH A TEST LIGHT.

DOWNSHIFT THROTTLE SWITCH ADJUSTMENT

Model	Carburetor No.	Engine	Transmission
MV	7028014	L6	A/T with or without A/C
MV	7028057	L6	M/Twith or without A/C
2GC	7028155	455	M/T
2GC	7028156	350	A/T, M/T, A/C
2GC	7028158	400/455	A/T
2GC	7028159	400/455	A/T, M/T, A/C
4MV	7028250	350	A/T, M/T with or without A/C
4MV	7028251	400/455	A/T, M/T with or without A/C
4MV	7028252	455	Toronado with or without A/C

Fig. 6M-25—Model MV Carburetor and Linkage Adjustments

MODEL 2GC CARBURETOR

ALL NEW 1968 OLDSMOBILES ARE CERTIFIED BY THE UNITED STATES DEPARTMENT OF HEALTH, EDUCATION AND WELFARE AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. FOR THIS REASON, THE FACTORY PROCEDURE FOR SETTING IGNITION TIMING, DWELL AND SLOW IDLE MUST BE FOLLOWED EXACTLY WHEN ADJUSTMENTS ARE MADE.

Subject	Page
THEORY OF OPERATION	6M-15
FLOAT SYSTEM	6M-15
IDLE SYSTEM	6M-15
PART THROTTLE SYSTEM	6M-15
POWER SYSTEM	6M-15
PUMP SYSTEM	6M-16
CHOKE SYSTEM	6M-16
CARBURETOR ASSEMBLY	
REMOVE AND INSTALL	6M-16
DISASSEMBLY	6M-17
CLEANING OF PARTS	6M-18
INSPECTION OF PARTS	6M-19
ASSEMBLY	6M-19
COMPLETION OF CARBURETOR ASSEMBLY	6M-20
DIAGNOSIS CHART	6M-21
ADJUSTMENTS	6M-22
TOOLS	6M-42

THEORY OF OPERATION

There are six basic systems used in the Model 2GC; float, idle, part throttle, power, pump and choke.

FLOAT SYSTEM (Fig. 6M-51)

The 2GC carburetor employs a single float. As fuel is consumed, the float drops and opens the needle seat. Fuel then enters the float bowl, raises the float and closes the needle seat, maintaining correct fuel level in the float bowl under all operating conditions.

IDLE SYSTEM (Fig. 6M-52)

The idle system supplies the fuel required for normal curb idle, off idle and low speed operation.

To minimize fuel vapor formation in the carburetor bowl, an external vent opens when the throttle valves are in the idle position.

Cars equipped with factory installed A/C have a carburetor with an idle compensator to prevent stalling under prolonged "hot idle" conditions. When underhood temperatures rise, a bi-metal strip lifts the valve off its seat allowing additional air to enter below the throttle valves, offsetting the enrichening effects of the higher temperatures.

PART THROTTLE (Fig. 6M-53)

As the throttle valves open, the speed of air entering the carburetor bore increases and raises the vacuum in the small venturi area. Fuel is then drawn from the float bowl into the main well, where air bleeds are provided, and into the venturi. A pre-adjusted part throttle feature is incorporated in all carburetors. The adjustment is made by the manufacturer and no attempt should be made to re-adjust it.

POWER SYSTEM (Fig. 6M-54)

When more power is needed or high speed driving is maintained, a vacuum operated power piston and power valve provide additional fuel.

When manifold vacuum drops below approximately 9" hg. the power piston spring forces the piston down to unseat the spring loaded power valve, permitting additional fuel to flow through the main well tubes.

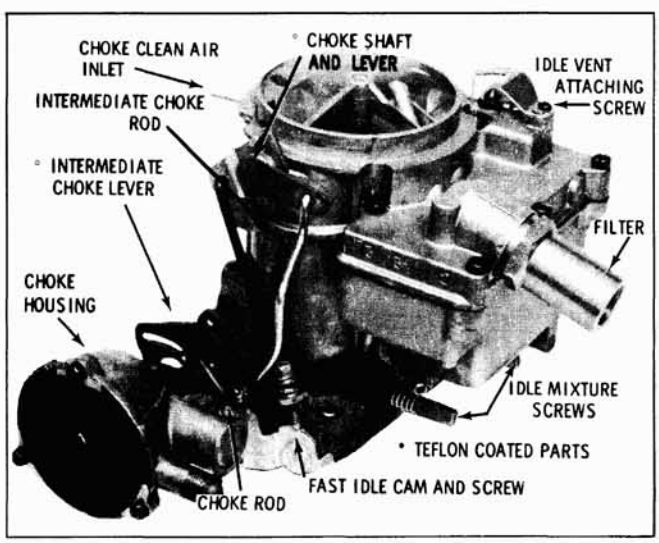


Fig. 6M-50—2GC Carburetor Assembly

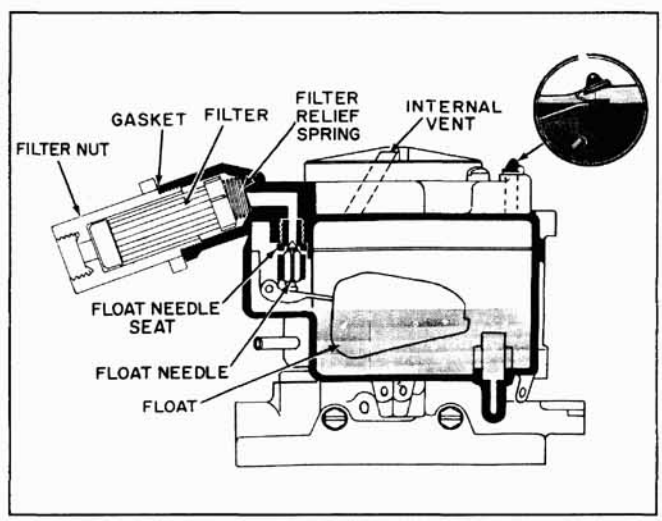


Fig. 6M-51—2GC Float System

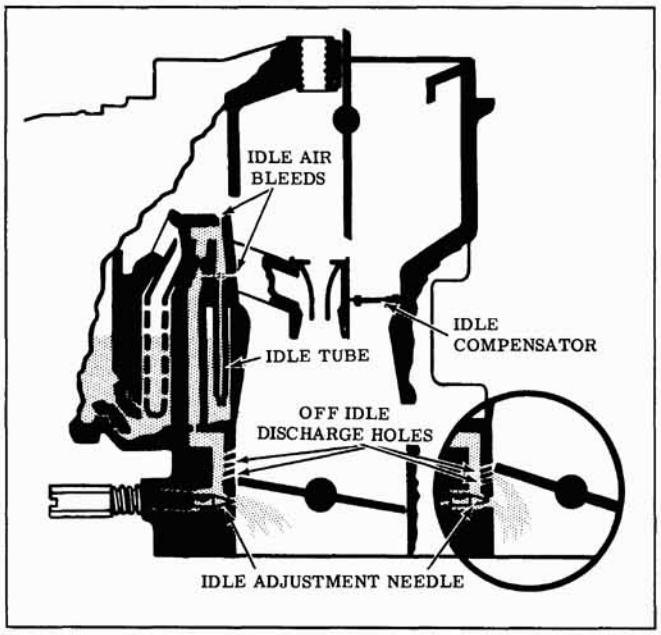


Fig. 6M-52—2GC Idle System

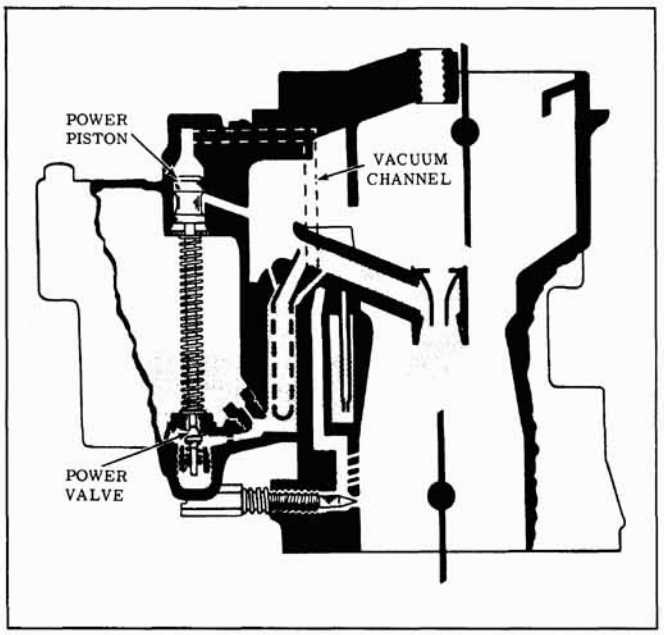


Fig. 6M-54—2GC Power System

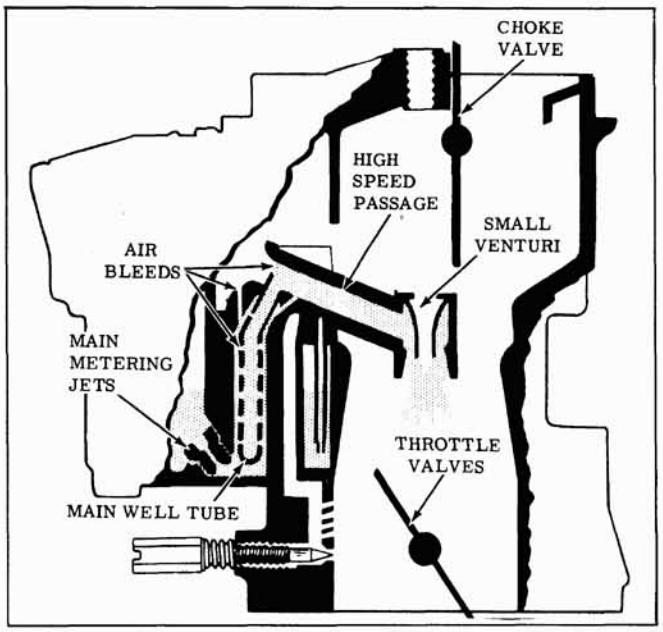


Fig. 6M-53—2GC Part Throttle System

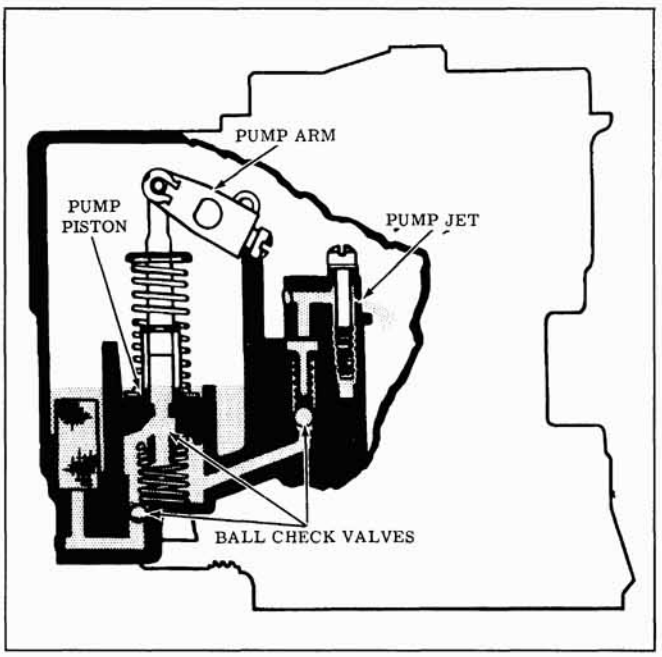


Fig. 6M-55—2GC Pump System

PUMP SYSTEM (Fig. 6M-55)

The accelerator pump provides the fuel necessary for smooth operating during acceleration by forcing additional fuel into the air stream.

CHOKE SYSTEM (Fig. 6M-56)

The choke system is designed to work independently of the fast idle which provides a relatively short choking period with adequate fast idle for a cold engine. A thermostatic coil closes the choke valve for cold operation and gradually releases the choke during the warm-up period. To maintain a more exacting air-fuel ratio during warm-up, the force of the thermostatic coil is opposed by air velocity against the offset choke valve and a vacuum piston and link assembly. To prevent a closed choke condition with a wide open throttle, a tang on the unloader lever contacts the choke lever and holds the choke valve partially open to prevent a loading condition. This also provides an unloader to open the choke valve when starting a flooded engine.

CARBURETOR ASSEMBLY

REMOVE AND INSTALL (Fig. 6M-57)

1. Remove air cleaner.
2. Disconnect throttle linkage from carburetor throttle lever.
3. Disconnect fuel line from carburetor.
4. Disconnect choke pipes.
5. Disconnect vacuum lines.
6. Remove throttle body to intake manifold bolts.
7. Remove carburetor.

To install, reverse removal procedure and make adjust-

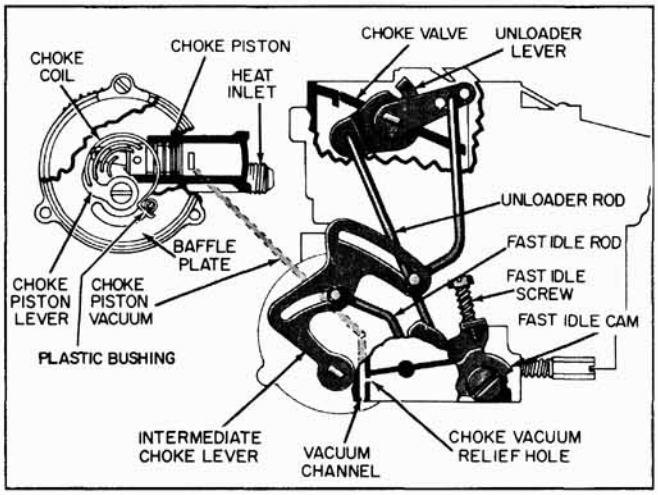


Fig. 6M-56—2GC Choke System

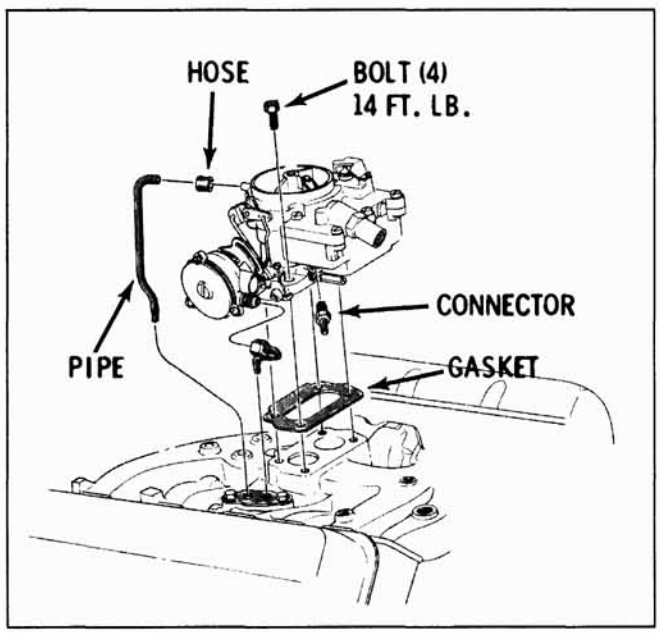


Fig. 6M-57—2GC Carburetion Installation

ments outlined under ADJUSTMENTS.

Torque carburetor to intake manifold bolts to 14 ft. lbs.

CARBURETOR DISASSEMBLY

AIR HORN

1. Mount carburetor on Holding Fixture BT-30-14 or J-5923-B.
2. Remove fuel inlet fitting and gasket, then remove the filter. (Fig. 6M-58)
3. Remove the idle vent valve retaining screw, shield and vent.
4. Remove retainer clip from the intermediate choke rod and unloader rod and remove the intermediate choke and unloader rods.
5. Remove retainer spring clip from the upper end of the pump rod at the pump lever and disconnect the upper end of the pump rod.
6. Remove the eight air horn attaching screws, then lift the air horn straight up to remove.
7. Invert the air horn and place on a flat surface; then

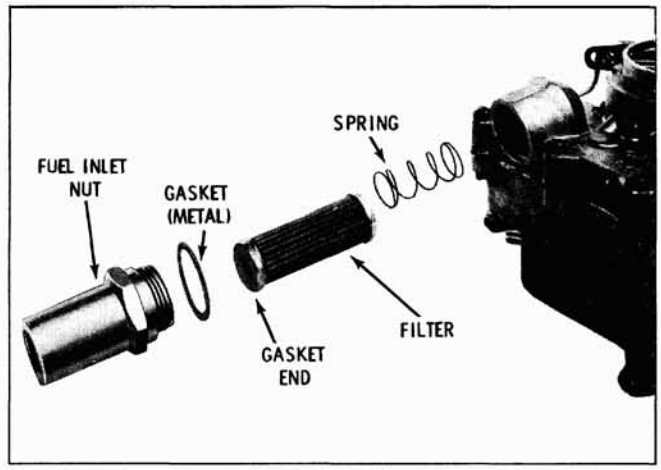


Fig. 6M-58—2GC Filter Assembly

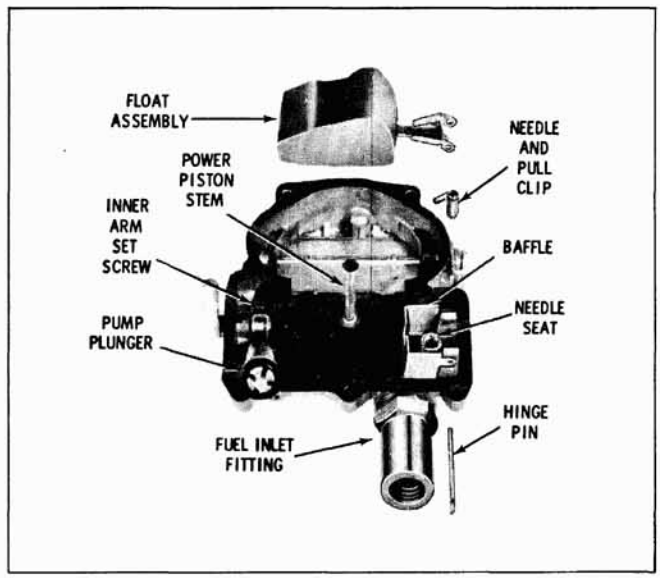


Fig. 6M-59—2GC Air Horn

remove the float hinge pin, float and needle assembly. (Fig. 6M-59)

8. Remove the float needle and seat and gasket.
9. Remove the power piston by depressing piston stem and allowing it to snap free.
10. Remove the retainer from the pump plunger shaft and remove pump plunger.
11. If the pump lever and shaft or inner arm is to be replaced, loosen the set screw on the inner arm.
12. Remove the air horn gasket.
13. If the choke valve or shaft is to be replaced, remove the two choke valve attaching screws; then remove the choke valve, choke valve shaft and unloader from the air horn.

FLOAT BOWL (Fig. 6M-60)

1. Remove pump inlet filter screen and pump plunger return spring; then remove pump ball retainer and ball check from bottom of pump well. (Fig. 6M-61)
2. Remove main metering jets and power valve.
3. If equipped with an idle compensator (factory installed air conditioned cars only) remove attaching screws and remove idle compensator and gasket.
4. Remove venturi cluster attaching screws and remove cluster and gasket.

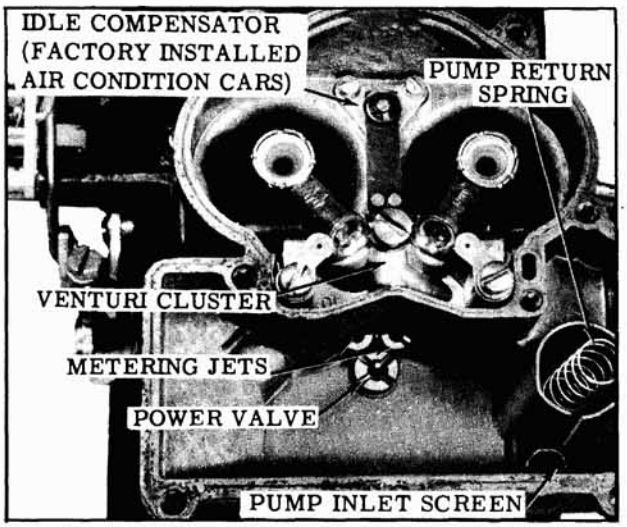


Fig. 6M-60—2GC Float Bowl Assembly

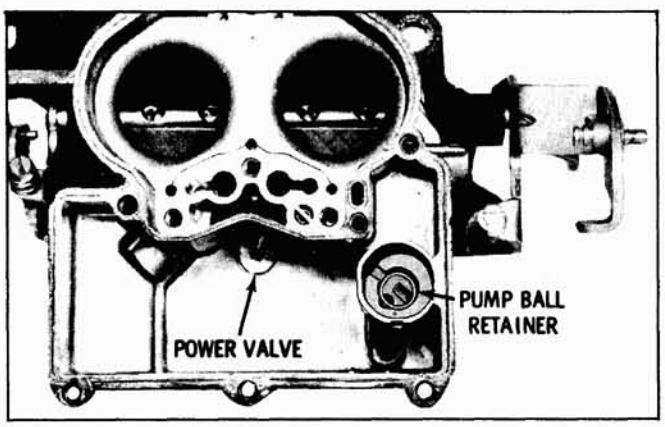


Fig. 6M-61—2GC Pump Ball Retainer

The cluster center screw is larger and has a gasket since it is located in the pump discharge passage.

5. Using a pair of needle-nosed pliers, remove the pump discharge spring guide, then remove the spring and steel ball. (Fig. 6M-62)

6. Invert float bowl and remove the three throttle body attaching screws, then remove the throttle body and gasket.

THROTTLE BODY AND CHOKE LINKAGE (Fig. 6M-63)

1. Remove the fast idle cam attaching screw.

2. Remove the three choke cover attaching screws and retainers, then remove the cover and gasket.

3. Remove baffle plate from choke housing.

4. Remove the choke piston attaching screw, then remove piston, link and lever assembly. The piston can be removed from the link by removing the piston pin.

5. Remove the two choke housing attaching screws, then remove the choke housing with linkage.

6. Remove the choke housing gasket, and seal, then remove the choke lever, shaft with linkage from the choke housing. Remove felt seal, from shaft. (Fig. 6M-64)

7. The idle mixture needle screws may be removed for cleaning or replacement.

No attempt should be made to remove the throttle valves or shaft as it may be impossible to reassemble the throttle valves correctly in relation to the idle discharge orifices.

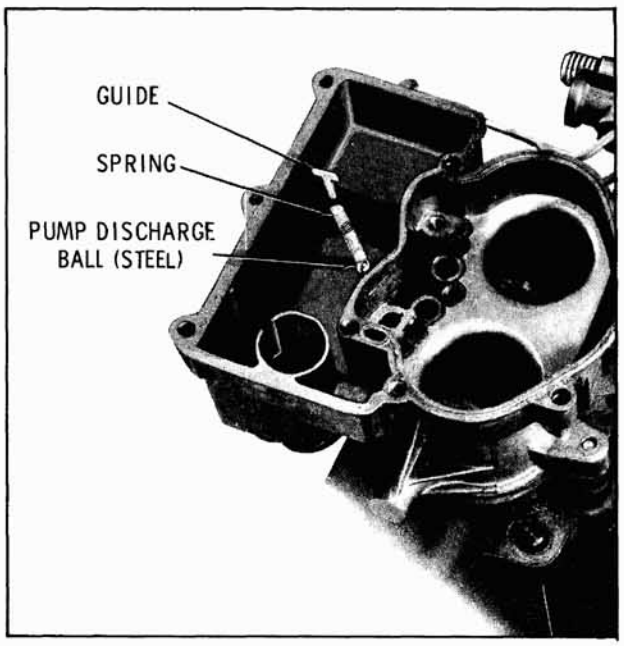


Fig. 6M-62—2GC Pump Discharge Guide

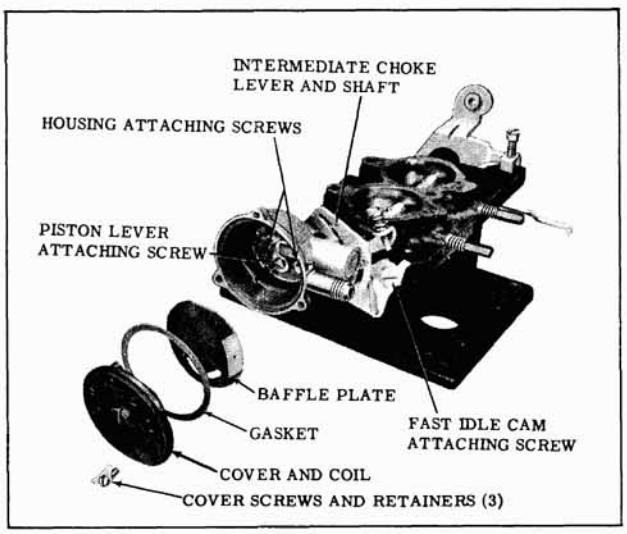


Fig. 6M-63—2GC Throttle Body And Choke

CLEANING OF PARTS

The choke shaft and intermediate choke shaft are teflon coated; sanding, wire brushing or filing will destroy the coating.

The carburetor should not be cleaned in any solution other than a cold immersion type cleaner.

1. Thoroughly clean carburetor castings and metal parts in carburetor solvent.

The choke coil, housing and pump plunger should not be immersed in solvent. Clean pump in clean gasoline only.

2. Clean and dry all passages in casting with compressed air. Do not pass drills through jets or passages.

3. Check condition of fuel inlet filter. If filter is plugged, it should be replaced.

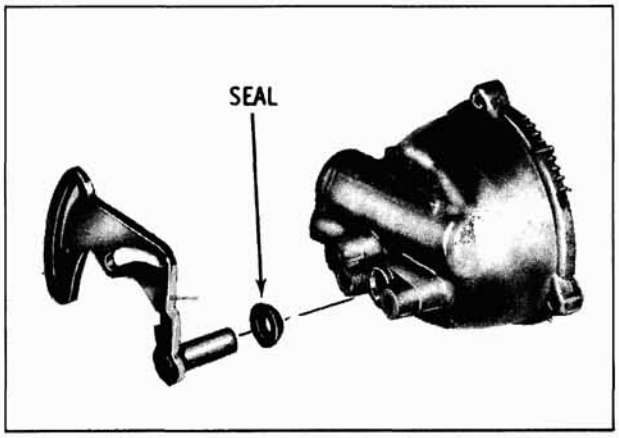


Fig. 6M-64—2GC Choke Shaft Seal

INSPECTION OF PARTS

1. Check float for excessive wear at hinge pin holes.
2. Examine float needle and seat. If grooved, replace with a new matched float needle, seat and gasket assembly.
3. Inspect the idle mixture adjusting needles for burrs or ridges. Replace if necessary.
4. Inspect the upper and lower surfaces of the float bowl to see that the small sealing beads are not damaged. Damaged beading may result in air or fuel leaks at that point.
5. Inspect holes in pump rocker arm, fast idle cam and throttle shaft lever. If holes are worn excessively or out-of-round to the extent of improper operation of the carburetor, the worn parts should be replaced.
6. Inspect the steps on the fast idle cam for excessive wear. If worn, replace cam to assure proper engine operation during the warm-up and choking periods.
7. Inspect the pump plunger for cracks or creases. If damaged, replace the pump plunger as an assembly.
8. Inspect the throttle body to make sure idle passages and vacuum channels are open.

CARBURETOR ASSEMBLY

THROTTLE BODY (Fig. 6M-63)

1. If removed, install the idle stop speed screw.
2. If removed, install the fast idle lever on the end of the throttle shaft with attaching screw. Install the fast idle speed screw and spring in the lever.
3. If removed, install the idle mixture needles and springs in the throttle body. Tighten finger tight, then back out 1-1/2 turns as a preliminary idle adjustment.
4. Install felt seal on intermediate choke shaft. Install the intermediate choke lever and shaft, with linkage attached, in the choke housing. The lever should extend upward between the attaching screw bosses.
5. Install the choke housing gasket, then position the choke housing on the throttle body and install the two attaching screws.
6. If removed, install the choke piston on the link so that the piston hole is facing outward.
7. Install the choke piston lever and link assembly in the choke housing, then install the attaching screw.

Be sure plastic tube is pressed on the choke actuating tang (Fig. 6M-65).

8. Position the fast idle cam on the throttle body and install attaching screw.
9. Place a new gasket on the bottom of the float bowl with holes aligned, then position the throttle body on the gasket and install the three attaching screws. Tighten screws evenly and securely.

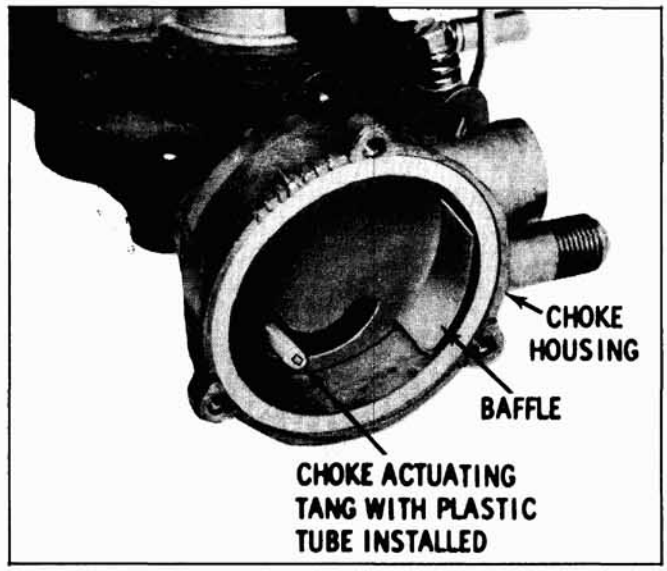


Fig. 6M-65—2GC Choke Actuating Tang

FLOAT BOWL

1. Install the pump discharge (steel) ball, spring and guide in the passage in the venturi cluster mounting surface. (Fig. 6M-62)
2. Install the venturi cluster, gasket, and attaching screws. Screw with gasket must be inserted in center hole.
3. If equipped with idle compensator, install compensator and gasket between the two large venturi, using two self-tapping screws. Do not overtighten.
4. Install the main metering jets and power valve.
5. Install the pump inlet (aluminum) ball, retainer and the pump return spring in the pump well. (Fig. 6M-61) Install the pump inlet screen in the float bowl.

AIR HORN

1. If removed, install choke unloader lever on choke shaft. Tang on unloader lever faces outward. Install the choke shaft in air horn by inserting it from the choke side, then install choke valve in the choke shaft with the letters RP facing upward.
   a. Install the choke valve screws. Center the choke valve before tightening choke valve screws. .020" clearance should be maintained between choke unloader lever and the air horn casting. Tighten choke valve screws and stake lightly in place.
2. If removed, position the pump inner lever in the air horn, install the pump lever and shaft and tighten retaining screw.

Lubricate shaft with light grease.

3. Install the pump plunger shaft in the pump lever so that the end is pointing inward, then install the retainer.
4. Position the float needle seat gasket and install seat in air horn.
5. Install the power piston and lightly stake the casting. Make sure piston travels freely.
6. Install the air horn gasket, float and needle assembly and float hinge pin. (Fig. 6M-66)

FLOAT LEVEL ADJUSTMENT

Make sure the float is properly aligned on the air horn. If it is necessary to bend the float arm for alignment purposes, recheck the float level setting. See adjustment chart.

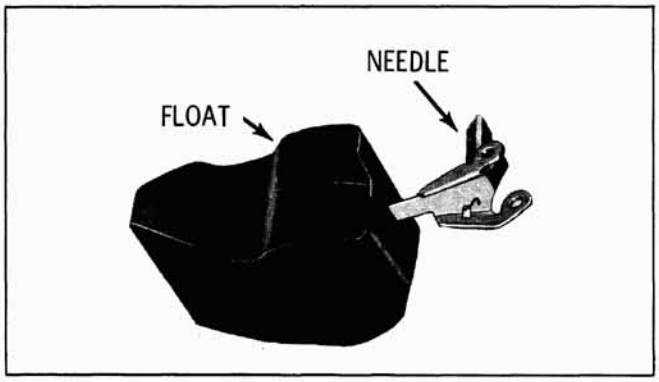


Fig. 6M-66—Model GC Float and Needle Assembly

FLOAT DROP ADJUSTMENT

If necessary to adjust, bend the float tang which contacts the needle seat. Bend the tang toward the seat to decrease the float drop and away from the seat to increase the drop. See adjustment chart.

COMPLETION OF CARBURETOR ASSEMBLY (Fig. 6M-66)

1. Install the air horn on the float bowl while guiding accelerator pump in place. Install and tighten the eight air horn screws evenly and securely.
2. Position the upper end of the pump rod on the pump lever and retain with spring clip.
3. Position idle vent valve and shield on air horn and retain with attaching screw.
4. Install the fuel inlet filter, gasket end out, then install the inlet fitting and gasket. (Fig. 6M-58)

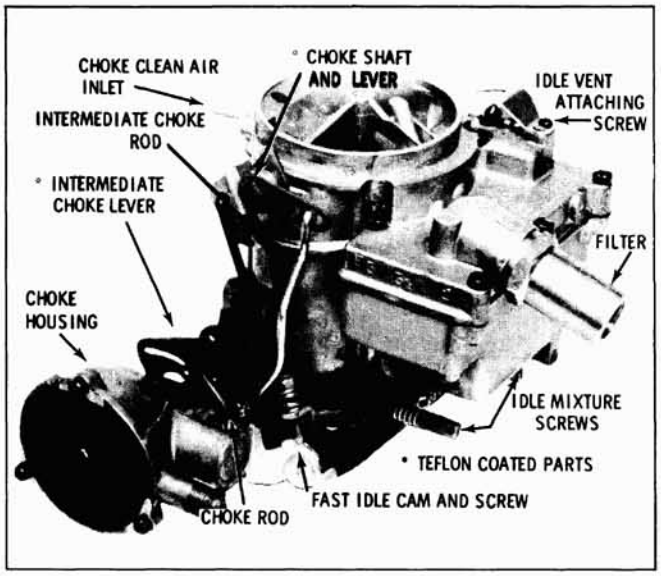


Fig. 6M-67—Model GC Carburetor Assembly

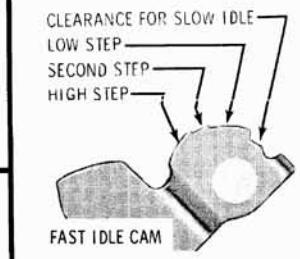
5. Install choke unloader rod into unloader lever (end of rod facing inward). Then connect lower end of rod to fast idle lever, retaining with clip.
6. Install intermediate choke rod into upper choke lever (end of rod facing inward). Then connect lower end of rod to intermediate lever retaining with horseshoe clip.

Refer to 2GC adjustment chart for the remaining adjustments; adjustments must be performed in the sequence shown. Slow and fast idle rpm specifications are also shown on the chart.

MODEL 2GC DIAGNOSIS CHART

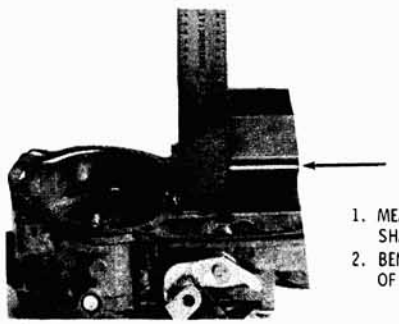
CONDITION										CHECK POINTS
HARD STARTING—COLD	HARD STARTING—HOT	POOR OPERATION—DURING WARM UP	STUMBLE ON ACCELERATION	STALLING	ROUGH IDLE	ECONOMY	FLOODING	SURGE	LACK OF HIGH SPEED PERFORMANCE	**IMPORTANT** Before attempting carburetor diagnosis as outlined below, all other engine systems must be operating properly. Diagnosis of these systems (electrical, exhaust, mechanical, and in the case of fuel economy, odometer accuracy) is found in this Service Manual. The numbers 1, 2 and 3, under the CONDITION are the order of probability. The * indicates additional possibilities.
1	1					1				Driver Habits (Instruct Owner on Proper Procedures)
2		1				2				Check Choke Parts Stuck, Dirty, Bound-Up or Gummed-Up
*		*								Check Choke Intermediate Rod Adjustment
*		*								Check Choke Rod Adjustment
*		*								Check Choke Unloader Adjustment
3	*	*			*	*				Check Choke Setting
*			1							Check Accelerator Pump Rod Adjustment
*			2							Accelerator Pump Circuit Dirty, Plugged or Inoperative
				3						Check Throttle Return Check Adjustment
						*		*	*	Fuel Pump Pressure or Volume Not to Specification
			*	1	1	*		*		Check Slow Idle Adjustment
		2		*		*				Check Fast Idle Adjustment
						*		1	*	Metering Jets Loose, Plugged, Wrong Part
			*			3		*	2	Power Piston Sticking or Wrong Part
						*		*	3	Power Valve Sticking
	*					*		2	*	Venturi Cluster Loose, Dirty or Plugged
	*					*	*	*		Float Sticking
*	*				*	*	*			Float Bowl Porous, Cracked, Etc.
	2				*	*	*	*	*	Check Float Level Adjustment
*					*				*	Throttle Body to Float Bowl Screws Loose
	*					*	2	3		Needle & Seat Dirty, Sticking, Loose
	*	*	*		*					Idle Compensator Not Opening or Closing
	3		*		*	*		*		Check Idle Vent Adjustment
				2	2			*		Idle Passages Plugged, Dirty
			*			*				Power Piston Vacuum Passage Plugged
		3				*				Choke Heat Tube or Vacuum Passage Plugged
				*	*	*				Crankcase Vent Valve Plugged
								*	*	Fuel Filter in Gas Tank Plugged
							1	*	1	Fuel Filter in Carb. Plugged, By Passing Fuel
						*		*	*	Air Cleaner or Element Plugged or Dirty
								*	*	Hole in Fuel Pump Suction Line or Kinked Hose
									*	No Full Throttle Opening at Carburetor
	*	*	*			*				Check Heat Riser, Stuck Open or Closed
*		*	3							Accelerator Pump Inoperative
									*	Fuel Tank Vent Plugged
			*	*	*					Throttle Closing Solenoid Inoperative

1	2	3	4	5
FLOAT LEVEL 9/16"	FLOAT DROP 1 3/8"	PUMP ROD 1 7/16"	INTERMEDIATE CHOKE ROD SEE STEP 4 BELOW	CHOKE SETTING SEE STEP 5 BELOW



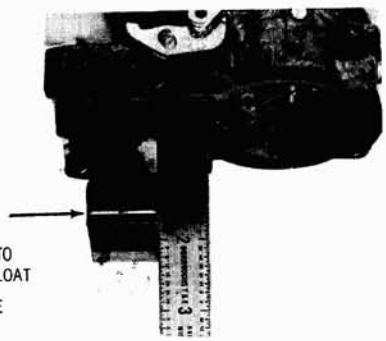
1 FLOAT LEVEL ADJUSTMENT

ADJUSTMENTS MUST BE PERFORMED IN NUMBERED SEQUENCE



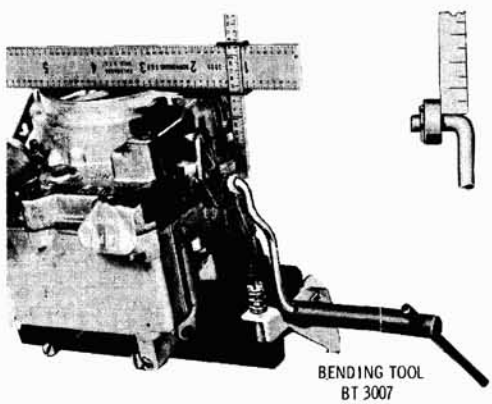
1. MEASURE FROM GASKET TO SHARP LINE OFFSET IN FLOAT
2. BEND FLOAT ARM AT REAR OF FLOAT TO ADJUST

2 FLOAT DROP ADJUSTMENT



1. MEASURE FROM GASKET TO SHARP LINE OFFSET IN FLOAT
2. BEND TAB BEHIND NEEDLE SEAT TO ADJUST

3 PUMP ROD ADJUSTMENT



1. FAST IDLE SCREW IN CLEARANCE STEP OF FAST IDLE CAM.
2. BACK OUT THROTTLE STOP SCREW TO COMPLETELY CLOSE THROTTLE VALVES.
3. PULL PUMP ROD OUT AS SHOWN ON INSET UNTIL RETAINER CONTACTS ARM TO OBTAIN AN ACCURATE SETTING.
4. BEND PUMP ROD IF NECESSARY WITH TOOL BT-3007 AS SHOWN TO OBTAIN SPECIFICATION.

4 INTERMEDIATE CHOKE ROD ADJUSTMENT

350 CU. IN. ENGINE CARBURETOR FIRST GROOVE EXPOSED FROM BORE

400 AND 455 CU. IN. ENGINE CARB. PISTON FLUSH WITH EDGE OF BORE

1. OPEN THROTTLE HALFWAY.
2. PUSH UP ON INTERMEDIATE CHOKE LEVER WITH FINGER AS SHOWN TO CLOSE CHOKE VALVE.
3. BEND INTERMEDIATE CHOKE ROD, IF NECESSARY, WITH TOOL BT-6729 UNTIL PISTON IS FLUSH WITH BORE ON 400 AND 455 CU. IN. ENGINES AND HAS FIRST GROOVE EXPOSED ON 350 CU. IN. ENGINES.

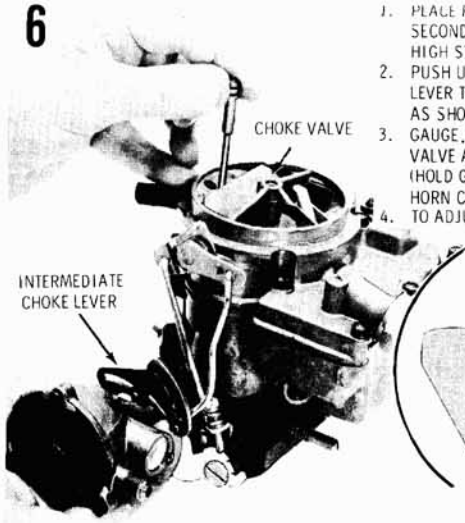
5 CHOKE SETTING

1. LOOSEN THE THREE RETAINING SCREWS.
2. ROTATE BAKELITE COVER WITH A SCREWDRIVER IN SLOT AT CENTER OF COVER.
3. ADJUST THE 455 CU. IN. MANUAL TRANSMISSION CHOKE 1 NOTCH LEAN, ALL OTHERS ARE SET ON INDEX.
4. TIGHTEN THE THREE RETAINING SCREWS EVENLY TO PREVENT A VACUUM LEAK.

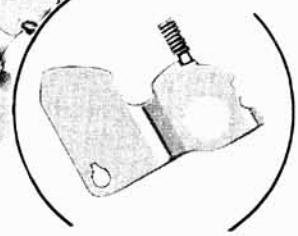
Fig. 6M-68—Carburetor and Linkage Adjustments (2GC)

6	7	8	9	10	
CHOKE ROD	UNLOADER	SLOW IDLE	FAST IDLE	IDLE VENT	
.150"	.160"	SEE STEP 8 BELOW	SEE STEP 9 BELOW	.025"	

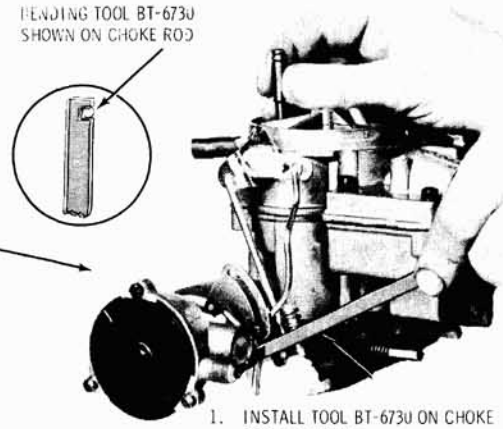
6



1. PLACE FAST IDLE SCREW ON SECOND STEP AND AGAINST HIGH STEP AS SHOWN ON INSET
2. PUSH UP ON INTERMEDIATE CHOKE LEVER TO REMOVE SLACK IN LINKAGE AS SHOWN
3. GAUGE .150" BETWEEN TOP OF CHOKE VALVE AND AIR HORN CASTING (HOLD GAUGE PARALLEL WITH AIR HORN CASTING)
4. TO ADJUST SEE



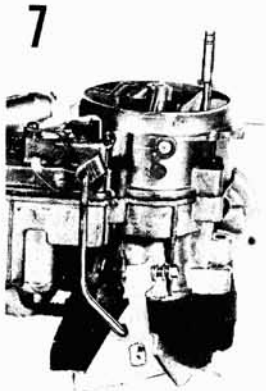
BENDING TOOL BT-6730 SHOWN ON CHOKE ROD



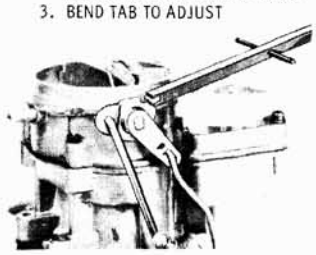
1. INSTALL TOOL BT-6730 ON CHOKE ROD AS SHOWN
2. LENGTHENING ROD WILL DECREASE GAP BETWEEN CHOKE VALVE AND AIR HORN

CHOKE ROD ADJUSTMENT

7



1. OPEN THROTTLE VALVES UNTIL THROTTLE LEVER STOP CONTACTS CASTING
2. GAUGE BETWEEN TOP OF CHOKE VALVE AND AIR HORN (HOLD GAUGE PARALLEL TO AIR HORN)
3. BEND TAB TO ADJUST



UNLOADER ADJUSTMENT

8

1. ENGINE AT NORMAL OPERATING TEMP. REMOVE AIR CLEANER, DISCONNECT AIR CLEANER VACUUM HOSE AT INTAKE MANIFOLD, THEN PLUG FITTING.
2. DISCONNECT VACUUM HOSE AT DISTRIBUTOR AND PLUG END OF HOSE.
3. SET PARKING BRAKE, BLOCK DRIVE WHEELS, TURN AIR COND. OFF, AUTOMATIC TRANS. IN DRIVE, MANUAL TRANS. IN NEUTRAL, CHOKE FULLY OPEN, FAST IDLE ADJUSTING SCREW IN "CLEARANCE" STEP OF CAM.
4. ADJUST THROTTLE STOP SCREW AND IDLE MIXTURE SCREWS ALTERNATELY TO OBTAIN THE BEST IDLE AT:

575 RPM	IN DRIVE	AUTOMATIC TRANSMISSION
675 RPM	IN NEUTRAL	MANUAL TRANSMISSION

NOTE: ON A/C CARS, HOLD HOT IDLE COMPENSATOR CLOSED.

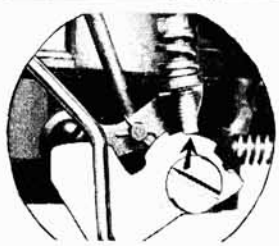
5. TURN IDLE MIXTURE SCREWS IN TO OBTAIN A 10 TO 15 RPM REDUCTION WITH EACH SCREW. FINAL IDLE SPEED SHOULD BE 20 TO 30 RPM LESS THAN ABOVE.
6. UNPLUG DISTRIBUTOR VACUUM HOSE AND RECONNECT TO DISTRIBUTOR. UNPLUG VACUUM FITTING AT INTAKE MANIFOLD AND RECONNECT AIR CLEANER HOSE, REINSTALL AIR CLEANER, BEING SURE HOT AIR ADAPTER AND VENTI LATION TUBE ARE CONNECTED AND SEATED PROPERLY.

NOTES: RECHECK SLOW IDLE WITH AIR CLEANER ON CARBURETOR.

ON CARS WITH THROTTLE CLOSING SOLENOID, SEE NEXT PAGE.

SLOW IDLE ADJUSTMENT

9



1. ENGINE AT NORMAL OPERATING TEMP. REMOVE AIR CLEANER, DISCONNECT AIR CLEANER VACUUM HOSE AT INTAKE MANIFOLD, THEN PLUG FITTING.
2. SET PARKING BRAKE, BLOCK DRIVE WHEELS, TURN A/C OFF, MANUAL TRANS. IN NEUTRAL, AUTOMATIC TRANS. IN PARK.
3. POSITION FAST IDLE CAM SCREW ON LOW STEP AND AGAINST SECOND STEP AS SHOWN, THEN ADJUST FAST IDLE TO 900 RPM.

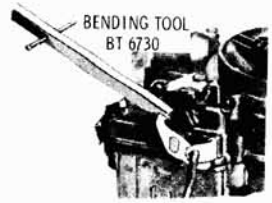
   NOTE: ON AIR COND. CARS, HOLD HOT IDLE COMPENSATOR CLOSED.

4. UNPLUG VACUUM FITTING AT INTAKE MANIFOLD AND RECONNECT AIR CLEANER HOSE, REINSTALL AIR CLEANER, BEING SURE HOT AIR ADAPTER AND VENTILATION TUBE ARE CONNECTED AND SEATED PROPERLY.

FAST IDLE ADJUSTMENT

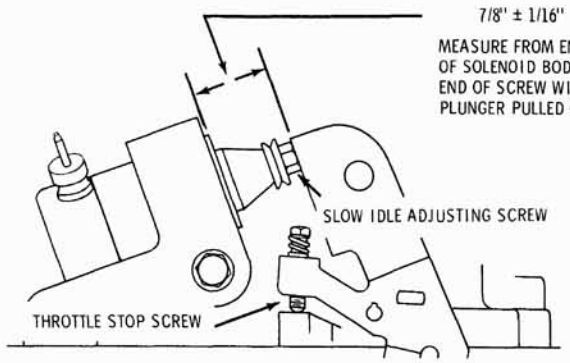
10

1. WITH SLOW IDLE ADJUSTED GAUGE .025" BETWEEN WIDEST OPENING OF SEAL AND VENT HOLE IN CASTING.
2. BEND TAB TO ADJUST.



IDLE VENT ADJUSTMENT

Fig. 6M-69—Carburetor and Linkage Adjustments (2GC)



1. ENGINE AT NORMAL OPERATING TEMP. REMOVE AIR CLEANER, DISCONNECT AIR CLEANER VACUUM HOSE AT INTAKE MANIFOLD, THEN PLUG FITTING.
2. DISCONNECT VACUUM HOSE AT DISTRIBUTOR AND PLUG END OF HOSE.
3. SET PARKING BRAKE, BLOCK DRIVE WHEELS, TURN AIR COND. OFF. AUTOMATIC TRANS. IN DRIVE, MANUAL TRANS. IN NEUTRAL, CHOKE FULLY OPEN, FAST IDLE CAM SCREW IN "CLEARANCE" STEP OF CAM. SOLENOID WIRE CONNECTED AND THROTTLE STOP SCREW SHOULD NOT CONTACT THROTTLE BODY.
4. ADJUST SOLENOID SLOW IDLE SPEED SCREW TO OBTAIN APPROX. 575 RPM
5. WITH SOLENOID ENERGIZED (OPEN THROTTLE SLIGHTLY TO ALLOW PLUNGER TO COME OUT OF SOLENOID) MEASURE DISTANCE BETWEEN END OF SOLENOID BODY AND END OF SOLENOID SCREW. THIS MUST BE 7/8" ± 1/16". IF NOT, REFER TO SOLENOID LOCATION ADJUSTMENT BELOW.
6. ADJUST SOLENOID SLOW IDLE SCREW AND MIXTURE SCREWS ALTERNATELY TO OBTAIN THE BEST IDLE AT:

575 RPM	IN DRIVE	AUTOMATIC TRANSMISSION
675 RPM	IN NEUTRAL	MANUAL TRANSMISSION

NOTE: ON A/C CARS, HOLD HOT IDLE COMPENSATOR CLOSED.

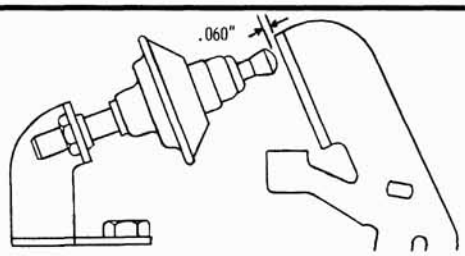
7. TURN IDLE MIXTURE SCREWS IN TO OBTAIN A 10 TO 15 RPM REDUCTION WITH EACH SCREW. FINAL SPEED TO BE 20 TO 30 RPM'S LESS THAN ABOVE.
8. TURN THROTTLE STOP SCREW IN UNTIL IT CONTACTS THROTTLE BODY.
9. DISCONNECT SOLENOID WIRE AND ADJUST THROTTLE STOP SCREW TO 400 RPM IN DRIVE, AUTOMATIC TRANS. AND NEUTRAL, MANUAL TRANS. DO NOT READJUST IDLE MIXTURE SCREWS. RECONNECT SOLENOID WIRE.
10. UNPLUG DISTRIBUTOR VACUUM HOSE AND RECONNECT TO DISTRIBUTOR. UNPLUG VACUUM FITTING AT INTAKE MANIFOLD AND RECONNECT AIR CLEANER HOSE. REINSTALL AIR CLEANER, BEING SURE HOT AIR ADAPTER AND VENTILATION TUBE ARE CONNECTED AND SEATED PROPERLY.

NOTE: RECHECK SLOW IDLE WITH AIR CLEANER ON CARBURETOR.

SOLENOID LOCATION ADJUSTMENT

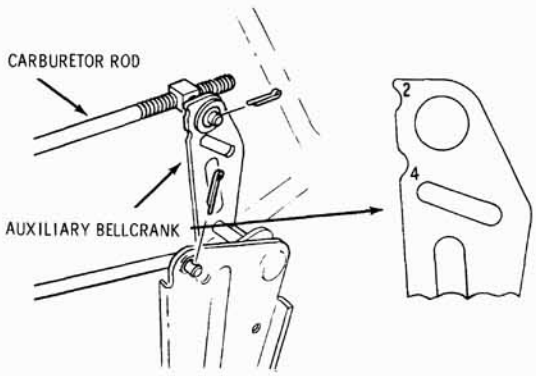
1. ADJUST THROTTLE STOP SCREW TO HOLD APPROX. 575 RPM
2. LOOSEN CLAMP AND SLIDE SOLENOID AWAY FROM THROTTLE LEVER.
3. WITH SOLENOID ENERGIZED OR PLUNGER HELD OUT, ADJUST SOLENOID IDLE SCREW SO THAT HEAD OF SCREW IS 7/8" ± 1/16" OUT OF SOLENOID BODY.
4. WITH SOLENOID ENERGIZED, AND ELECTRICAL TERMINAL 90° INBOARD, HOLD SOLENOID LIGHTLY AGAINST CARBURETOR LEVER, THEN TIGHTEN CLAMP.
5. TURN THROTTLE STOP SCREW OUT SO THROTTLE VALVE IS COMPLETELY CLOSED.

SLOW IDLE ADJUSTMENT WITH THROTTLE CLOSING SOLENOID



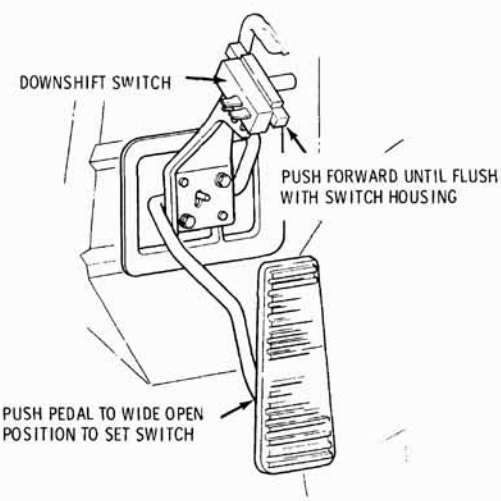
1. SLOW IDLE ADJUSTED, IGNITION OFF, CHOKE OPEN, FAST IDLE OFF.
2. WITH DASHPOT FULLY COMPRESSED, ADJUST FOR .060" CLEARANCE BETWEEN DASHPOT AND THROTTLE LEVER.

DASHPOT ADJUSTMENT



1. SLOW IDLE ADJUSTED, ENGINE OFF, CHOKE OPEN, FAST IDLE OFF.
2. DISCONNECT SWIVEL ON CARBURETOR ROD FROM AUXILIARY BELLCRANK.
3. PUSH UPPER LEVER OF AUXILIARY BELLCRANK TOWARDS FIREWALL UNTIL IT HITS ITS STOP.
4. PULL CARBURETOR ROD TOWARDS FIREWALL UNTIL THROTTLE IS WIDE OPEN. THEN ADJUST SWIVEL UNTIL SWIVEL PIN ENTERS THE "2" NOTCH FOR 2 BBL. CARBURETOR OR THE "4" NOTCH FOR A 4 BBL. CARBURETOR.
5. RECONNECT CARBURETOR ROD TO AUXILIARY BELLCRANK.

CARBURETOR ROD ADJUSTMENT



1. PUSH PLUNGER OF DOWNSHIFT SWITCH FORWARD UNTIL FLUSH WITH SWITCH HOUSING.
2. PUSH ACCELERATOR PEDAL TO WIDE OPEN POSITION TO SET SWITCH.
3. ENERGIZING OF DOWNSHIFT SWITCH CIRCUIT CAN BE CHECKED WITH A TEST LIGHT

DOWNSHIFT THROTTLE SWITCH ADJUSTMENT

Fig. 6M-70—Carburetor and Linkage Adjustments (2GC)

MODEL 4MV CARBURETOR

All new 1968 Oldsmobiles are certified by the United States Department of Health, Education and Welfare as conforming to the requirements of the Regulations for the Control of Air Pollution from New Motor Vehicles. This certification is contingent on certain adjustments being set to Factory standards. For this reason, the Factory procedure for setting Ignition Timing, Dwell and Slow Idle must be followed exactly when adjustments are made.

Subject	Page
GENERAL DESCRIPTION	6M-25
THEORY OF OPERATION	
FLOAT SYSTEM	6M-25
IDLE SYSTEM	6M-26
OFF IDLE OPERATION	6M-27
HOT IDLE COMPENSATOR	6M-27
MAIN METERING SYSTEM	6M-27
POWER SYSTEM	6M-28
AIR VALVE DASHPOT	6M-29
ACCELERATING PUMP SYSTEM	6M-29
CHOKE SYSTEM	6M-31
CARBURETOR	
REMOVE AND INSTALL	6M-32
CARBURETOR DISASSEMBLY	
AIR HORN REMOVAL	6M-32
AIR HORN DISASSEMBLY	6M-33
FLOAT BOWL DISASSEMBLY	6M-33
THROTTLE BODY DISASSEMBLY	6M-35
CLEANING AND INSPECTION	6M-35
CARBURETOR ASSEMBLY	6M-35
THROTTLE BODY	6M-35
FLOAT BOWL	6M-35
AIR HORN	6M-36
AIR HORN TO BOWL INSTALLATION	6M-36
DIAGNOSIS CHART	6M-37
ADJUSTMENT CHART	6M-38
TOOLS	6M-42

GENERAL DESCRIPTION

The Model 4MV (Quadrajet) is a 4 barrel carburetor having two stages of operation.

The primary (fuel inlet) side has two small bores each with a triple venturi which are equipped with a discharge nozzle. Fuel is metered to the primary bores by two tapered metering rods connected to a power piston which is actuated by manifold vacuum.

The secondary side has two very large bores which have greatly increased air capacity to meet engine demands. The air valve opens as air velocity increases and thereby controls the air/fuel mixture in the secondary bores. This mixture combines with the fuel mixture in the primary side. Using the air valve principle, fuel is metered in direct proportion to the air passing through the secondary bores.

The fuel reservoir is centrally located and uses a single float pontoon.

A pleated paper fuel filter is mounted in the fuel inlet casting of the float bowl and is easily removed for replacement.

The primary side of the carburetor has six systems of operation. They are float, idle, main metering, power, pump, and choke. The secondary side has one metering system for controlling the air/fuel mixture which combines with the primary side. The primary and secondary side receive fuel from a common float bowl.

Carburetor identification information is located as shown on Fig. 6M-74. If replacing a float bowl assembly follow the directions received in the service package to transfer the information.

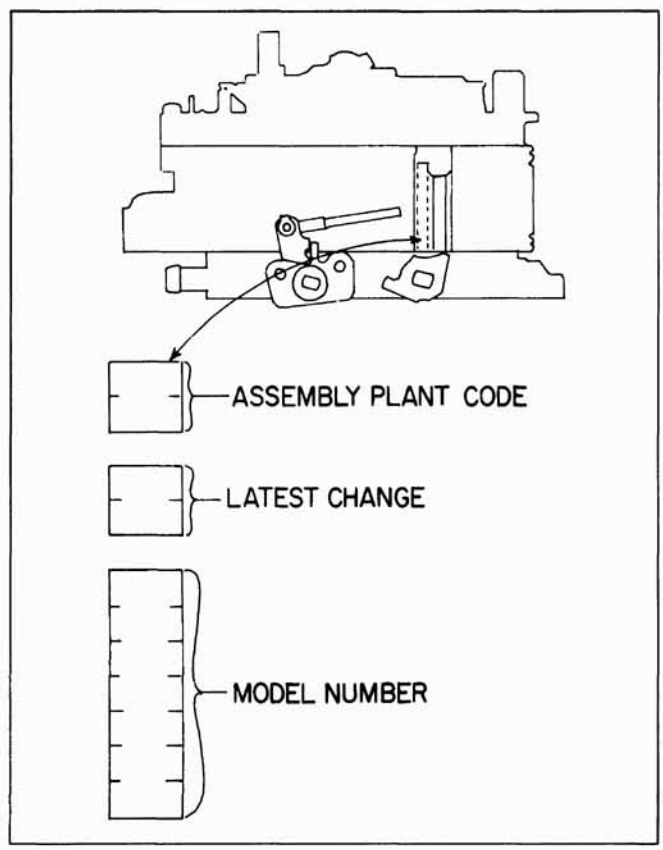


Fig. 6M-74—Carburetor Identification

THEORY

FLOAT SYSTEM (Fig. 6M-75)

The float system consists of a float chamber, plastic float pontoon assembly, float hinge pin, and retainer combination, a float valve and needle assembly and a needle valve pull clip. The float system operates as follows:

Fuel from the engine fuel pump enters the carburetor fuel inlet passage. It passes through the filter element and on into the float inlet valve chamber. The open needle valve allows fuel to enter the float bowl.

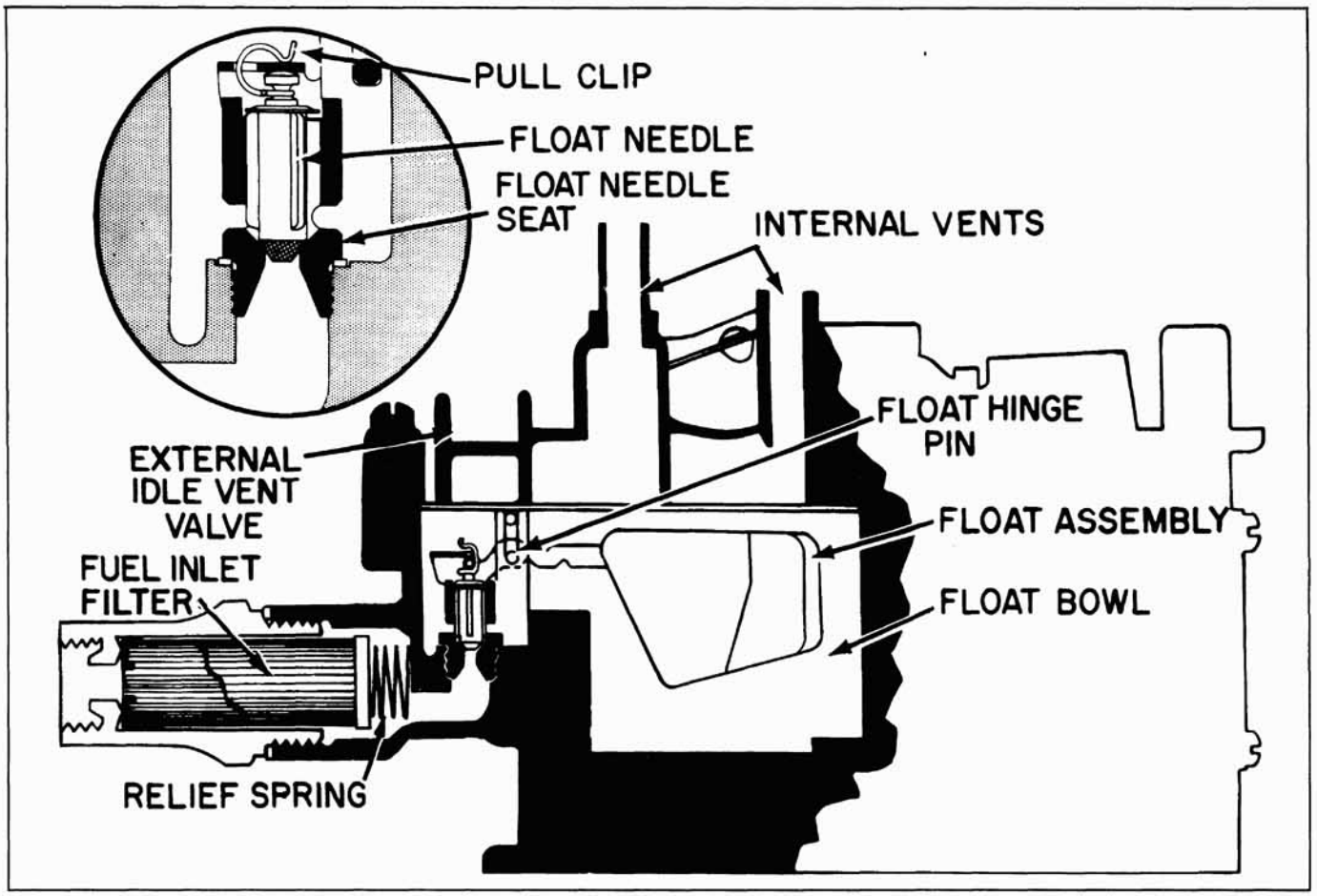


Fig. 6M-75—4MV Float System

As incoming fuel fills the float bowl to the prescribed fuel level, the float pontoon rises and forces the fuel inlet valve closed, shutting off all fuel flow. As fuel is used from the float bowl, the float drops and allows more incoming fuel to enter the float bowl until the correct fuel level is reached. This cycle continues, constantly maintaining a positive fuel level in the float bowl.

A needle valve pull clip, is used to assist in lifting the needle valve off its seat whenever fuel pump pressure or the fuel level in the float bowl is low.

A plastic filler block is located in the top of the float chamber in the area just above the float valve. This block prevents fuel slosh on severe brake applications maintaining a more constant fuel level to prevent stalling.

The carburetor float bowl is internally vented. Internal vent tubes are located in the primary side of the carburetor air horn just above the float bowl. The purpose of the internal vents is to equalize the air pressure on the fuel in the float bowl with the air pressure within the air cleaner. Therefore, a balanced air/fuel mixture ratio can be maintained during part throttle and power operation because the same pressure acting upon the fuel in the float bowl will be balanced with the air flow through the carburetor bores. The internal vent tubes allow the escape of fuel vapors in the float bowl during hot engine operation. This prevents fuel vaporization from causing rich mixtures due to excessive pressure in the float bowl.

IDLE SYSTEM (Fig. 6M-76)

The idle system is used only in the two primary bores of the carburetor. Each bore has a separate idle system. They consist of idle tubes, idle passages, idle air bleeds, idle channel restrictions, idle mixture adjustment needles, and idle discharge holes.

During curb idle the throttle valve is held slightly open by the throttle stop screw to give the engine the desired idle speed. Since the engine requires very little air for idle and low speeds, the idle discharge holes below the throttle valves are exposed to the engine manifold vacuum. With the idle discharge holes in a very low pressure area and the fuel in the float bowl vented to atmosphere (high pressure), the idle system operates as follows:

Engine manifold vacuum at the idle discharge ports causes fuel to flow from the float bowl through the primary metering jets. The fuel is metered at the tip of the idle tubes. Metered fuel flowing up the idle tubes is mixed with air at the idle air bleeds at the top of the idle tubes. The fuel/air mixture then crosses over to the idle down channels where it passes through a calibrated idle channel restriction.

It then passes down the idle channel past the lower idle air bleed holes and off-idle ports, where it is mixed with more air. The air/fuel mixture then moves down to the idle discharge holes where it enters the carburetor bores and mixes with air passing around the slightly open throttle valve. It then enters the intake manifold as a combustible mixture.

The idle mixture needles are adjustable and control the amount of air/fuel mixture going to the engine. Turning the mixture screw clockwise (inward) gives a leaner mixture and turning the mixture screw counterclockwise (outward) enriches the idle fuel mixture.

It should be noted there is a hot idle vapor bleed located in each idle tube channel. The air bleed leads from the top of

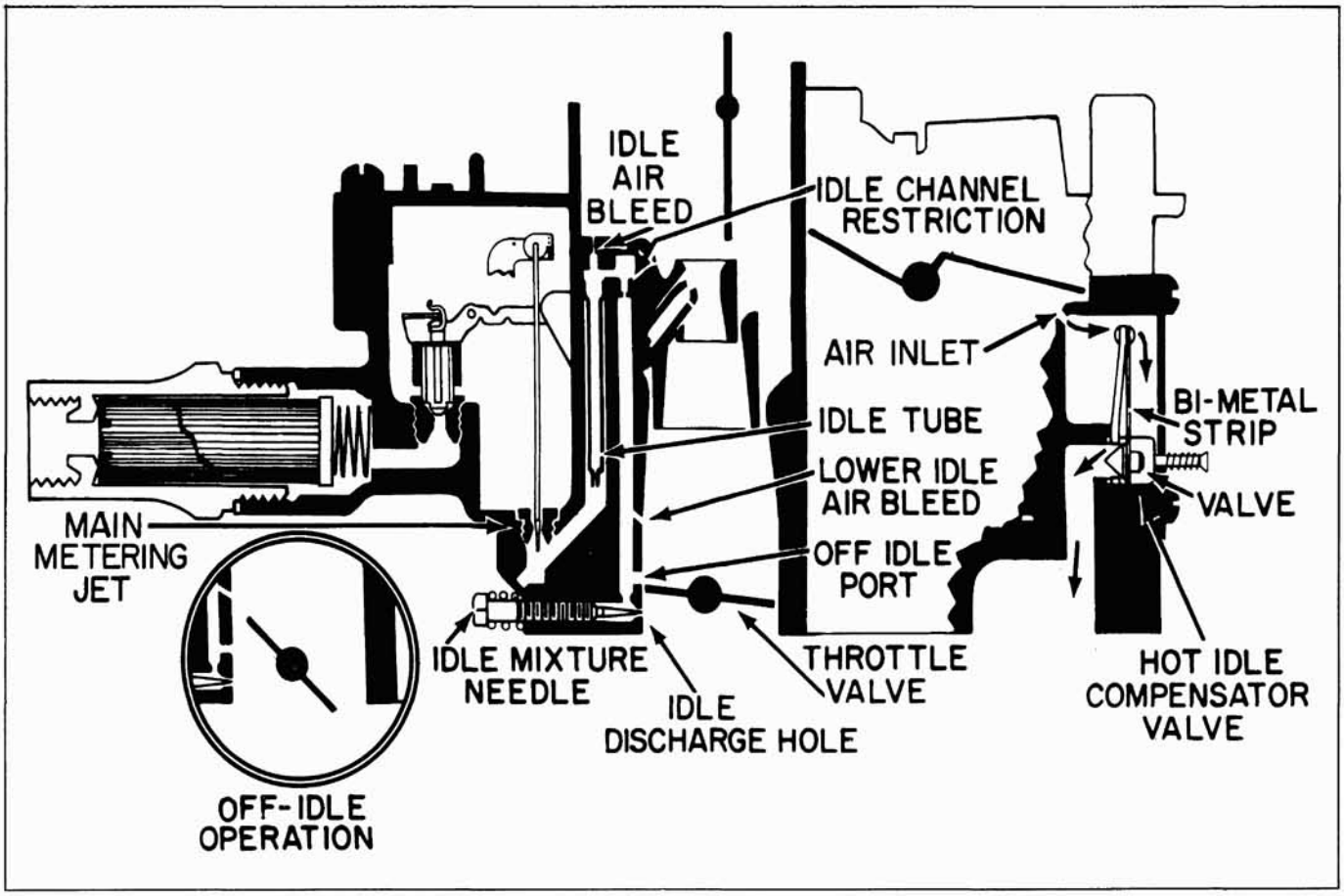


Fig. 6M-76—4MV Idle System

this channel into the top of the main fuel well where it is vented into the air horn above the venturi. The purpose of the bleed is to allow any fuel vapors in the idle tube channel during hot idle to escape and prevent them from mixing with fuel being picked up by the idle tube. This gives a more consistent idle fuel mixture during periods of hot engine idling.

OFF IDLE OPERATION

As the primary throttle valves are opened from curb idle, additional fuel is needed to combine with the extra air entering the engine. This is accomplished by the slotted, off-idle discharge ports. The primary throttle valves open gradually exposing the off-idle ports to high engine vacuum below the throttle valves. The additional fuel added from the off-idle ports mixes with the increasing air flow past the opening throttle valves to meet increased engine air and fuel demands.

Further opening of the throttle valves causes low pressure at the lower idle air bleeds. As a result, fuel begins to discharge from the lower idle air bleed hole and continues to do so from part throttle to wide open throttle.

HOT IDLE COMPENSATOR

The hot idle compensator is located in a chamber at the rear of the carburetor float bowl. Its purpose is to provide additional air to prevent a rich mixture caused by fuel vapors during hot engine idle.

The hot idle compensator is a thermostatically controlled valve consisting of a bi-metal strip which is heat sensitive, a valve holder and bracket. The valve is in an air channel which leads from holes under the air valve to a point below the secondary throttle valves.

Normally the compensator valve is held closed by tension of the bi-metal strip. During extreme hot engine operation, high temperature causes excessive fuel vapors resulting in a richer mixture than normally required. At a predetermined temperature, the compensator valve opens allowing additional air to flow through the air channel below the secondary throttle valves into the intake manifold. The additional air offsets the rich mixture allowing the engine to idle smooth. As the engine cools, the valve closes returning to normal operation.

The compensator valve assembly is held in place by the dust cover over the valve chamber. A seal is used between the compensator valve and the float bowl casting.

The compensator valve must be closed when making idle adjustment with a hot engine. A pin extends through the compensator cover to facilitate closing the valve when the idle is adjusted.

MAIN METERING SYSTEM (Fig. 6M-77)

The main metering system consists of main metering jets; vacuum operated metering rods; main fuel well; main well air bleeds; fuel discharge nozzles; and triple venturi. The system operates as follows:

During cruising speeds and light engine loads, engine manifold vacuum is high. Manifold vacuum holds the main metering rods down in the main metering jets against spring tension. Manifold vacuum is supplied through a channel to the vacuum operated power piston connected to the primary main metering rods. Fuel flow from the float bowl is metered between the metering rods and main metering jet orifice.

Primary throttle valves opened beyond off-idle range allows more air to enter the manifold which increases air velocity in the venturi. This causes a drop in pressure in the large venturi and a much greater drop in pressure in the small

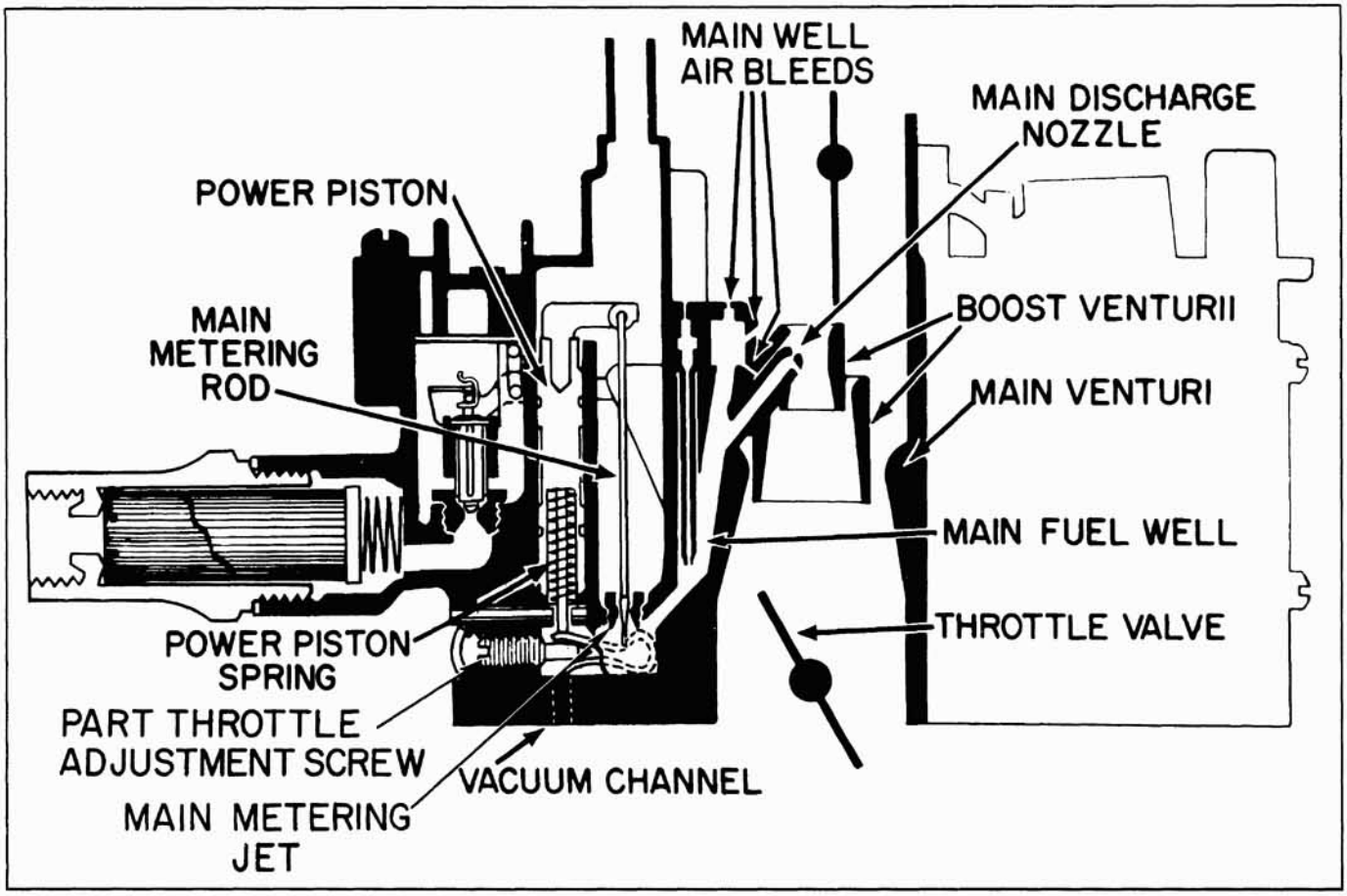


Fig. 6M-77—4MV Main Metering System

venturi. Low pressure in the small boost venturi causes air fuel to flow from the main discharge nozzle.

Fuel flows from the float bowl through the main fuel well metering jets into the main fuel well. The fuel in the main fuel well is mixed with air from the main well air bleeds then passes through the main discharge nozzles into the boost venturi. The fuel mixture is combined with air in the boost venturi into a combustible mixture and passes through the throttle bores.

An adjustable part throttle feature is incorporated in all 4MV applications. This adjustment is made at the factory and no attempt should be made to adjust it in the field. The adjustable part throttle feature includes a new power piston and primary metering rods. The new piston has a pin pressed into it, which protrudes through the float bowl and gasket and contacts the adjustable link in the throttle body. The new primary metering rods have a different taper than the rods used in 1967. These rods can be identified by the suffix "B" stamped after the diameter on the rod. The purpose of this feature is to give better control of the fuel during the main metering range for improved exhaust emissions.

POWER SYSTEM (Fig. 6M-78)

The power system in the Quadrajet carburetor provides an extra mixture under heavy acceleration or high speed operation. The richer mixture is supplied through the main metering system in the primary and secondary sides of the carburetor.

The power system located in the primary side consists of a spring loaded power piston located in a cylinder which is exposed to manifold vacuum. The spring loaded power piston tends to push upward against manifold vacuum.

On part throttle and cruising ranges, manifold vacuum is sufficient to hold the power piston down against spring tension so that the larger diameter of the metering rod tip is held in the main metering jet orifice. When engine load is increased to a point where an extra rich mixture is required, the spring tension overcomes the vacuum pull on the power piston and the tapered primary metering rod tip moves upward in the main metering jet orifice. The smaller diameter of the metering rod tip allows more fuel to pass through the main metering jet and enrich the mixture flowing into the primary main wells and out the main discharge nozzles. When the engine operation is returned to part throttle and cruising ranges, increased manifold vacuum overcomes the power piston spring and returns the larger portion of the metering rod into the metering jet orifice giving a leaner mixture.

When engine speed is increased to a point where the primary side of the carburetor cannot supply sufficient air and fuel requirements, the secondary side of the carburetor is used.

The secondary throttle valves are actuated by a connecting linkage to the primary throttle lever. With the throttle valves opened, a low pressure (vacuum) is created beneath the air valve. Atmospheric pressure on top of the offset spring loaded air valve forces the valve open allowing the required air to flow through the throttle bores to meet engine demands.

As the air valve opens, the upper edge passes the accelerating well port causing a low pressure (vacuum) at that point. Fuel starts flowing immediately and continues to flow until the well is empty.

Due to the high temperature at the base of the carburetor during hot engine operation, the fuel begins to boil thus eva-

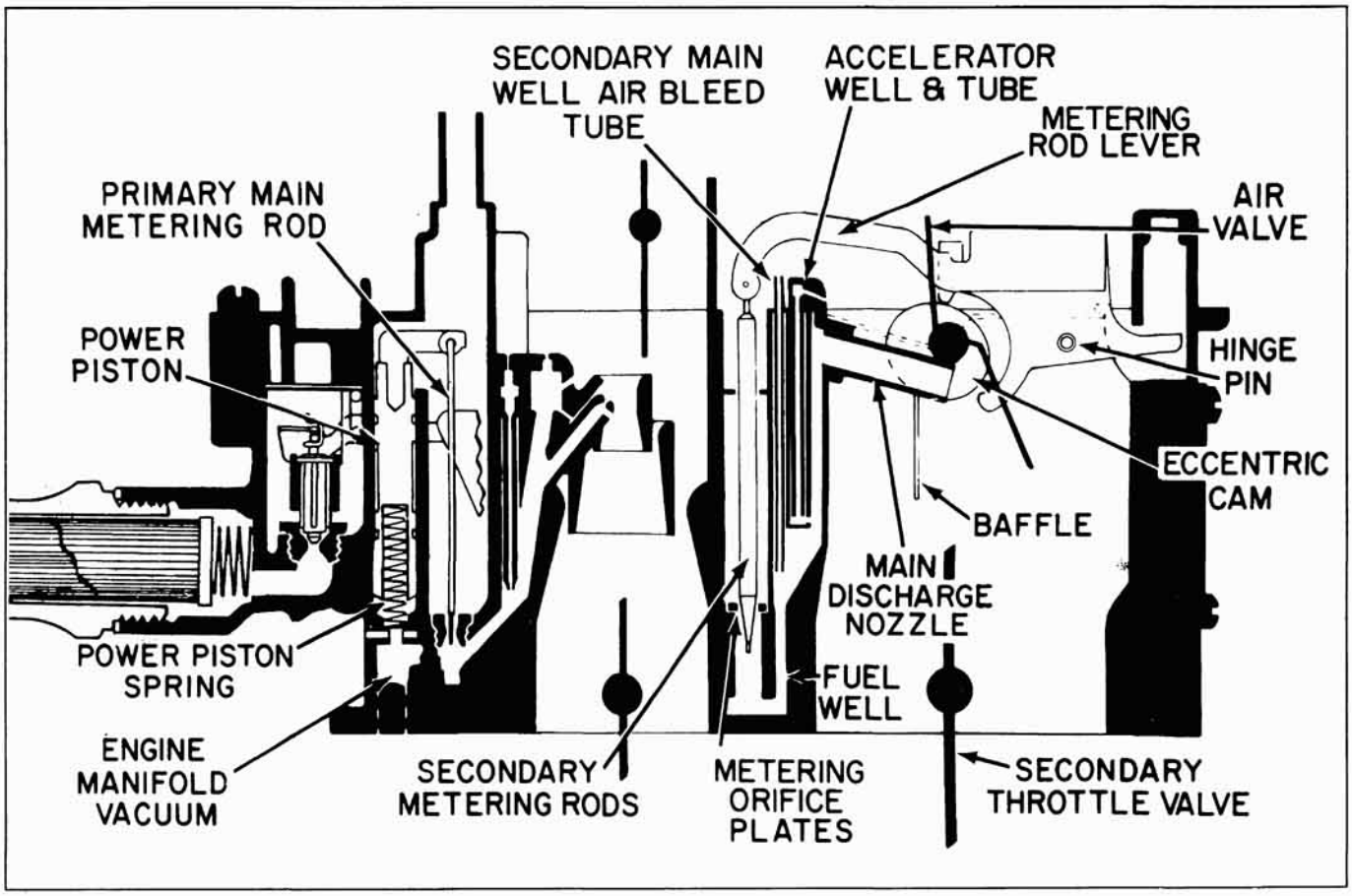


Fig. 6M-78—4MV Power System

porating the fuel out of the main fuel well. The secondary metering rods have a small vertical slot milled in the side at the tip to keep the main fuel wells full at all times so there will be a supply of fuel for the accelerating ports giving immediate fuel delivery.

The fuel from the accelerating ports prevents a momentary hesitation and provides an immediate charge of fuel until air-/fuel begins to flow from the secondary discharge nozzles.

The secondary main discharge nozzles (one for each secondary bore) are located just below the air valve and above the secondary throttle valves in the area of lowest pressure. As the air valve opens, it rotates a plastic cam attached to the center of the main air valve shaft. The cam lifts a lever attached to the secondary main metering rods out of the secondary orifice discs. Fuel flows from the float bowl through the secondary orifice discs into secondary main wells, where it is mixed with air from the secondary main well air bleed tubes. The air/fuel mixture travels from the main wells to the secondary discharge nozzles and is expelled into the secondary bores. The air/fuel mixture is mixed with more air traveling through the secondary bores and combined with the air/fuel mixture delivered from the primary bores, and enters the engine cylinders as a combustible mixture.

As the secondary throttle valve is opened further, the increase in air flow through the throttle bores opens the air valve which rotates the eccentric cam lifting the tapered secondary metering rods further out of the metering orifice discs, increasing fuel flow in direct portion to air passing through the secondary throttle bores. By using this principle a correct air/fuel ratio can be maintained throughout the operation of the secondary side of the carburetor.

A baffle plate is used in each secondary bore extending up and around the secondary fuel discharge nozzles. Their purpose is to provide good fuel distribution at lower air flows by preventing too much fuel from going to the front of the engine.

The depth of the main metering rods in the orifice discs in relation to the air valve position are factory adjusted to meet the air/fuel requirements for the specific engine model. No further adjustment should be required.

AIR VALVE DASHPOT (Fig. 6M-79)

The secondary air valve is connected to the vacuum break unit by a rod, to control the opening rate of the air valve and prevent any fuel lag from the secondary discharge nozzle.

Whenever manifold vacuum is above 5" to 6" vacuum, the vacuum break diaphragm stem is seated and pulls the rod to the end of the slot in the air valve shaft lever, holding the air valve closed. However, when the secondary valves are opened and manifold vacuum drops below 5" to 6" vacuum, the spring in the vacuum break unit will force the diaphragm and stem off its seat. The rate of movement off the seat is controlled by a restriction in the cover of the vacuum break unit.

ACCELERATING PUMP SYSTEM (Fig. 6M-80)

During quick acceleration when the throttle valves are opened rapidly, the sudden increase in air flow passing the fuel discharge nozzles tends to leave the fuel behind, which is heavier, causing a momentary leanness. The accelerator pump provides an additional charge of fuel during this time.

The accelerating pump system is located in the primary side of the carburetor consisting of a spring loaded pump plunger and pump return spring, located in the pump bore.

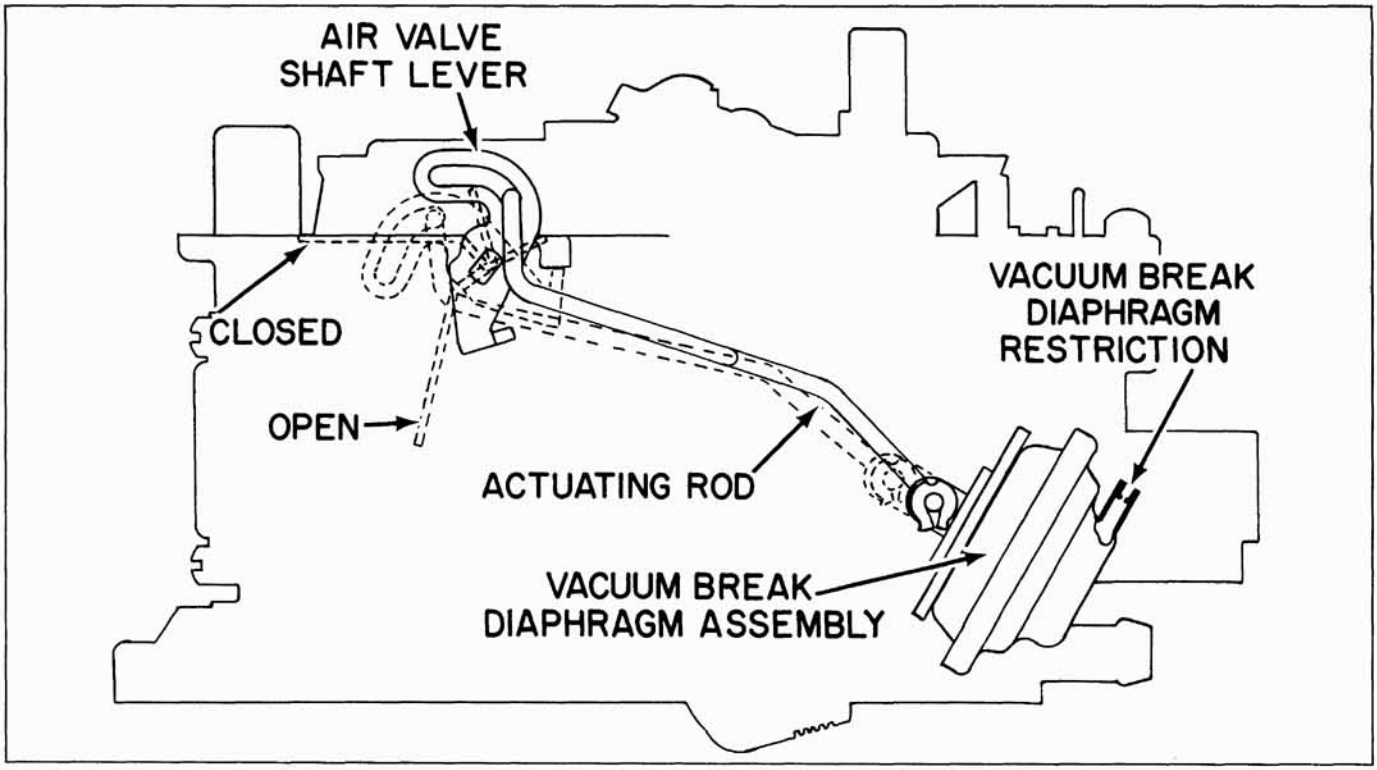


Fig. 6M-79—4MV Air Valve Dashpot

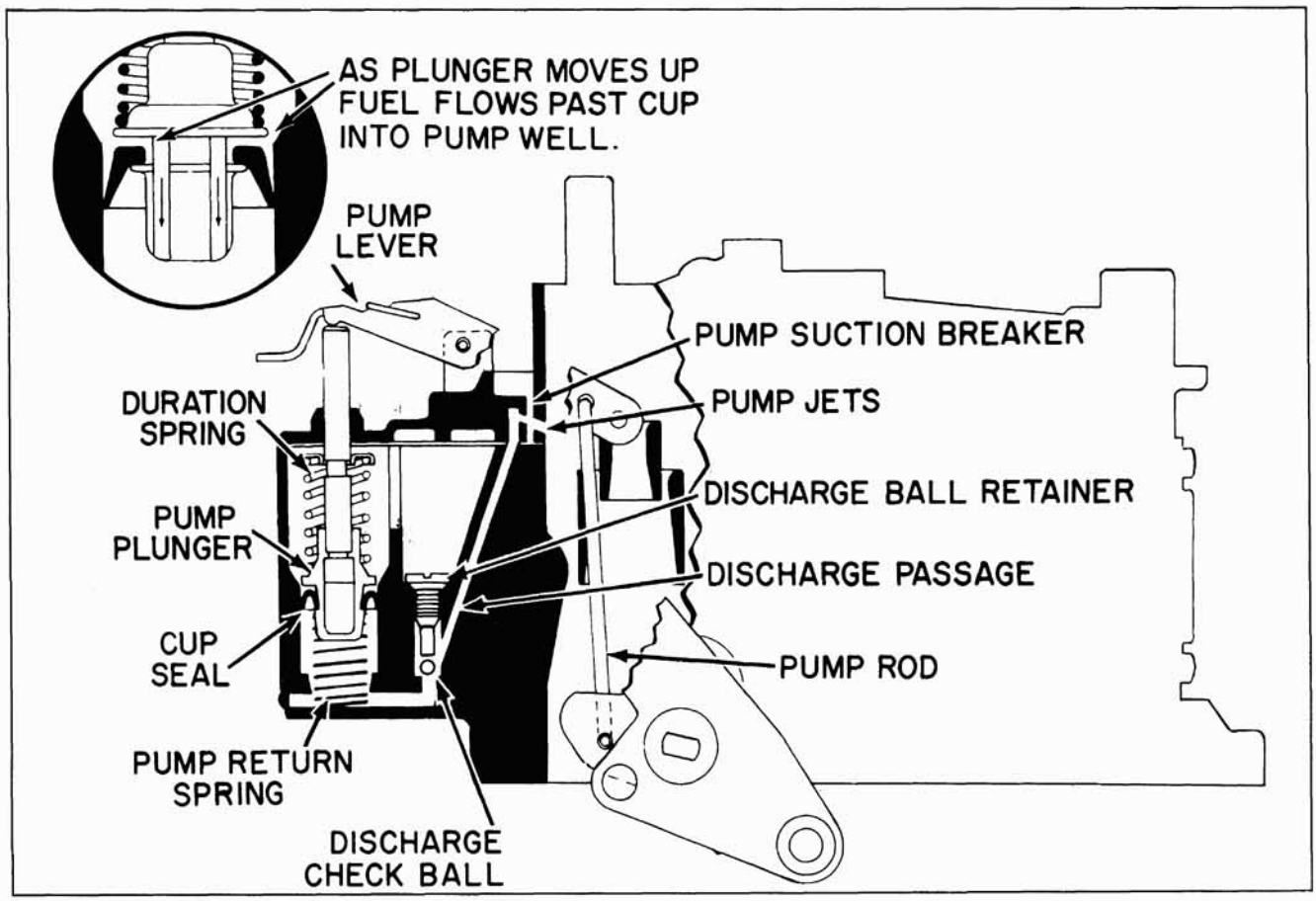


Fig. 6M-80—4MV Accelerating Pump System

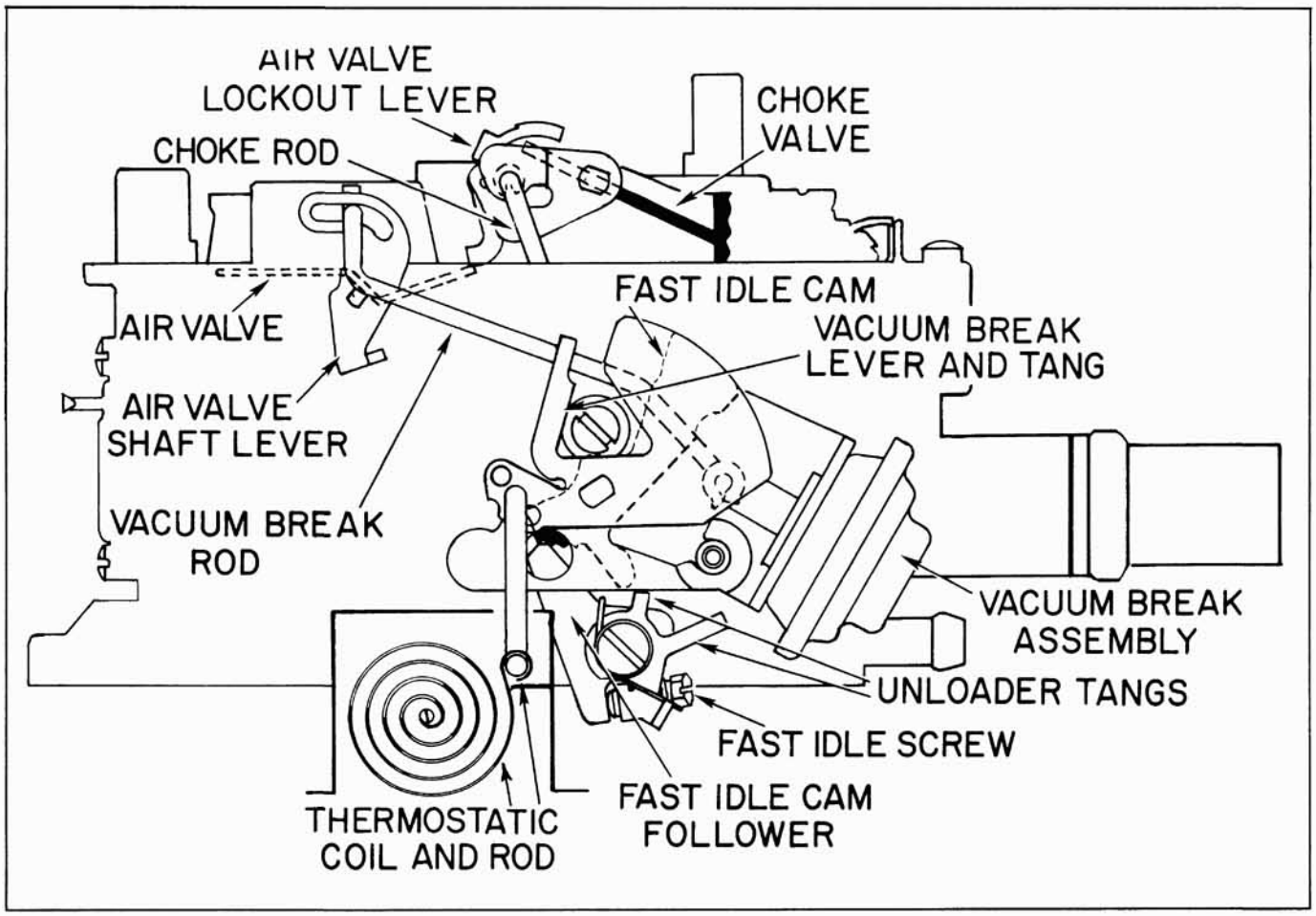


Fig. 6M-81—4MV Choke System

The pump plunger is operated by a pump lever on the air horn which is connected directly to the throttle lever by a pump rod.

As the throttle is returned from an open to a closed position, the pump return spring pushes the pump plunger upward against the pump lever. As the pump begins to move up, the discharge check ball immediately seats in the pump discharge passage so that no air will be drawn into the passage, which could cause a hesitation. The pump well is always filled with fuel from the float bowl through a slot in the top of the pump well which is lower than the fuel level. When the pump plunger moves up, the floating pump cup unseats (moves down) from the flat surface on the plunger head and allows free flowing of fuel through the inside of the cup into the bottom of the pump well. This also vents any vapors which may be in the bottom of the pump well so that a solid charge of fuel can be maintained in the fuel well. When the primary throttle valves are opened, the connecting linkage forces the pump plunger down instantly seating the pump cup against the plunger forcing fuel through the discharge passage unseating the discharge check ball. The fuel is then forced up through a passage to the pump jets located in the air horn and sprayed into the venturi area of each primary bore.

It should be noted that the pump plunger is spring loaded. The top pump duration spring is calibrated so as to deliver a smooth charge of fuel from the pump jets by applying a pressure on the fuel that remains constant through pump travel regardless of speed or distance the throttle linkage is moved. When the throttle valves are opened instantly to wide open position, the spring loaded plunger will continue to supply fuel until the plunger reaches the bottom of the pump well insuring an adequate fuel supply until the fuel starts to flow from the main discharge nozzle.

Due to vacuum at the pump jets during high speed operation, the pump discharge passage has been vented to the top of the air horn, outside the carburetor bores to balance the air pressure on the fuel in the pump discharge passage with the fuel in the float bowl. This prevents fuel from being pushed out of the pump jets when the pump is not in use.

CHOKE SYSTEM (Fig. 6M-81)

The choke system consists of a choke valve located in the primary air horn bore, a vacuum diaphragm unit, fast idle cam, connecting linkage, air valve lockout lever and a thermostatic coil.

The thermostatic coil located on the engine manifold is calibrated to hold the choke valve closed when the engine is cold.

To close the choke valve the primary throttle valves have to be opened to allow the fast idle cam follower to by-pass the steps on the fast idle cam and come to rest on the highest step of the fast idle cam.

When the choke valve is closed, the air valve lock-out lever is weighted so that a tang on the lever catches the upper edge of the air valve and keeps the air valve closed.

During engine cranking, the choke is held closed by the tension of the thermostatic coil. This restricts air flow through the carburetor to provide a richer starting mixture. When the engine starts and is running manifold vacuum applied to the vacuum diaphragm unit mounted on the float

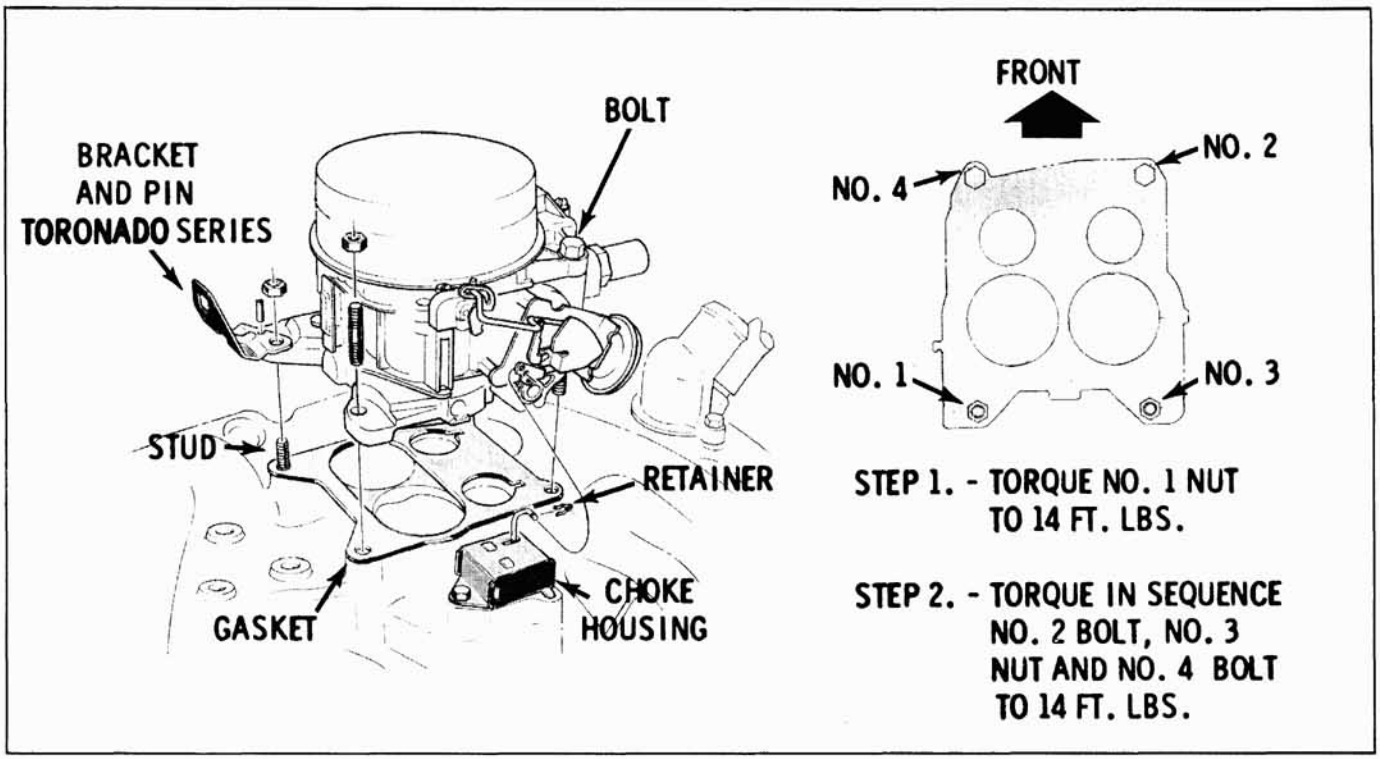


Fig. 6M-82—4MV Carburetor Installation

bowl will open the choke valve to a point where the engine will run without loading or stalling. At the same time, the fast idle cam follower lever on the end of the primary throttle shaft will drop from the highest step on the fast idle cam to a lower step when the throttle is opened. This gives the engine sufficient fast idle and correct fuel mixture for running until the engine begins to warm up and heat the thermostatic coil. As the thermostatic coil on the engine manifold becomes heated, it relaxes its tension and allows the choke valve to open further because of intake air pushing on the off-set choke valve. Choke valve opening continues until the thermostatic coil is completely relaxed at which point the choke valve is wide open.

When the engine is thoroughly warm, the choke coil pulls the intermediate choke lever completely down and allows the fast idle cam to rotate so that the cam follower drops off the last step of the fast idle cam allowing the engine to run at normal speeds. When the choke shaft lever moves toward the up position, the end of the rod strikes a tang on the air valve lock-out lever. As the rod moves to the end of its travel, it pushes the lock-out tang upward and unlocks the air valve.

The choke system is equipped with an unloader mechanism which is designed to partially open the choke valve, should the engine become loaded or flooded. To unload the engine the accelerator pedal must be depressed so that the throttle valves are held wide open. A tang on a lever on the choke side of the primary throttle shaft contacts the fast idle cam and through the intermediate choke shaft forces the choke valve slightly open. This allows extra air to enter the carburetor bores and pass on into the engine manifold and cylinders to lean out the fuel mixture so that the engine will start.

4MV CARBURETOR ASSEMBLY

REMOVE AND INSTALL

1. Remove air cleaner.
2. Disconnect fuel inlet line.
3. Disconnect vacuum hoses.
4. Disconnect carburetor rod and thermostatic choke rod.
5. Remove air cleaner stud.
6. Remove the two front carburetor to manifold attaching bolts.
7. Remove the two rear carburetor to manifold attaching nuts.

To install, reverse the removal procedure using a new carburetor to manifold gasket. Torque the attaching bolts and nuts to 14 ft. lbs. Refer to TUNE-UP Section for idle specifications.

4MV CARBURETOR DISASSEMBLY

Before performing any service on this carburetor, it is essential that the carburetor be placed on a holding fixture such as tool BT 30-15. The secondary throttle valves in the wide open position extend below the throttle body casting. Without the use of the carburetor stand it is possible to bend or nick the aluminum throttle valves.

AIR HORN REMOVAL

1. Remove clip from upper end of choke rod and remove rod. (Fig. 6M-83)
2. Remove spring clip from upper end of pump rod then disconnect pump rod from pump lever.
3. Remove clip from lower end of vacuum break rod and remove rod.
4. Remove nine air horn to bowl attaching screws; two attaching screws are located next to the primary venturi. (two long screws, five short screws, two countersunk screws) (Fig. 6M-84)
5. Remove air horn by lifting straight up. Air horn gasket should remain on bowl for removal later.

Care must be taken not to bend the small tubes protruding from air horn. These are permanently pressed into casting DO NOT REMOVE.

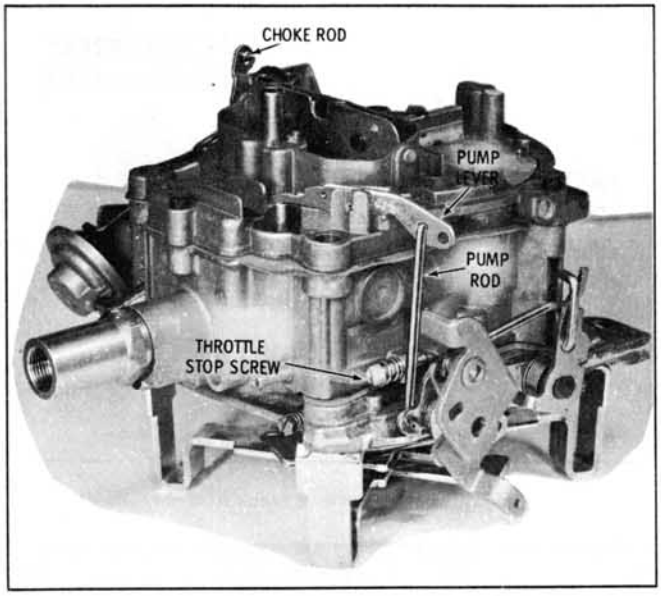


Fig. 6M-83—4MV Carburetor Assembly

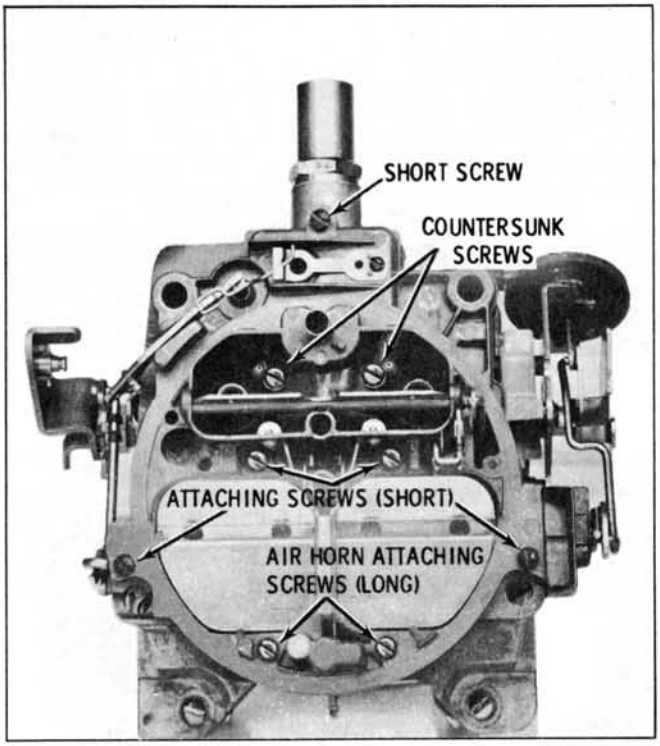


Fig. 6M-84—4MV Air Horn Attaching Screws

AIR HORN DISASSEMBLY

1. Remove secondary metering rods by holding air valve wide open, then tilt and slide rods from holes in hanger. (Metering rods and hanger can be removed by removing small screw from metering rod hanger, located between air valves.) Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, proceed as follows:
2. Remove choke valve attaching screws then remove choke valve and shaft.
3. Remove pump lever roll pin then pump lever.

Air valves and air valve shaft should not be removed.

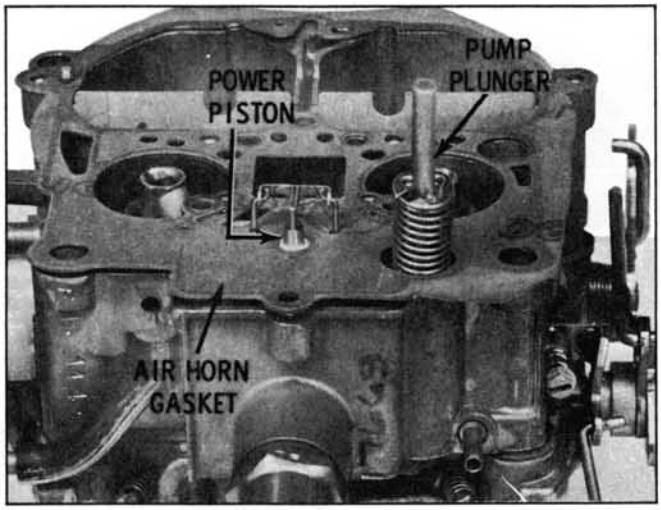


Fig. 6M-85—4MV Float Bowl Assembly

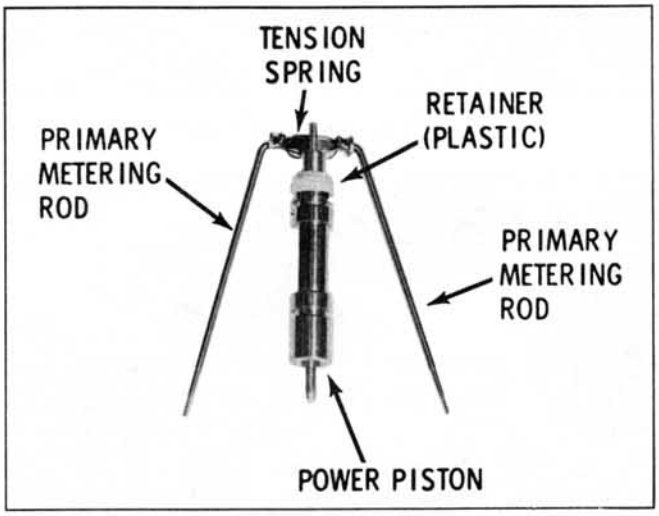


Fig. 6M-86—4MV Power Piston And Metering Rods

FLOAT BOWL DISASSEMBLY

1. Remove pump plunger from pump well (Fig. 6M-85).
2. Remove air horn gasket from float bowl.
3. Remove pump return spring from pump well.
4. Remove plastic filler over float valve.
5. Remove power piston and primary metering rods, using needle nosed pliers to pull straight up on metering rod hanger directly over power piston. Remove power piston spring from well. Pulling up will remove the plastic retainer.
6. Remove metering rods from power piston by disconnecting tension spring from top of each rod then rotating rod to remove from hanger (Fig. 6M-86)
7. Remove float assembly and float needle by pulling up on retaining pin. Remove float needle seat and gasket (Fig. 6M-87).
8. Remove primary metering jets. No attempt should be made to remove secondary metering plates (Fig. 6M-88).
9. Remove pump discharge check ball retainer and check ball.
10. Remove baffle from secondary side of bowl.
11. Remove vacuum hose from vacuum break.

Do not place vacuum break assembly in carburetor cleaner. Remove choke assembly (Fig. 6M-89).

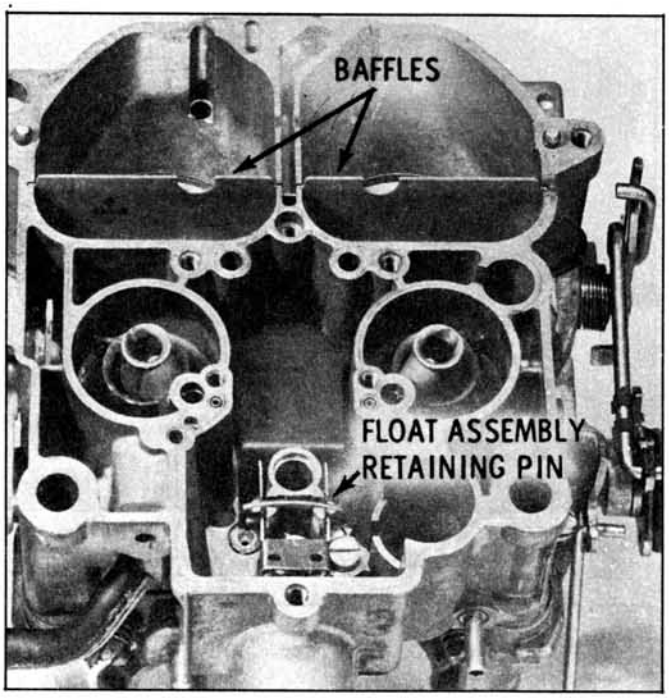


Fig. 6M-87—4MV Float Assembly

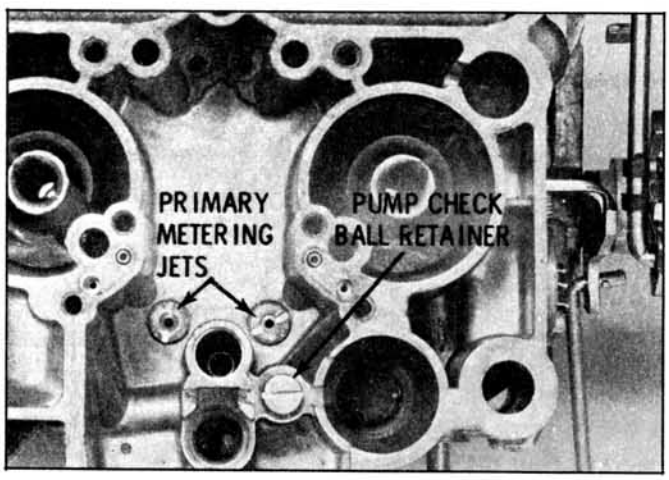


Fig. 6M-88—Primary Metering Jets

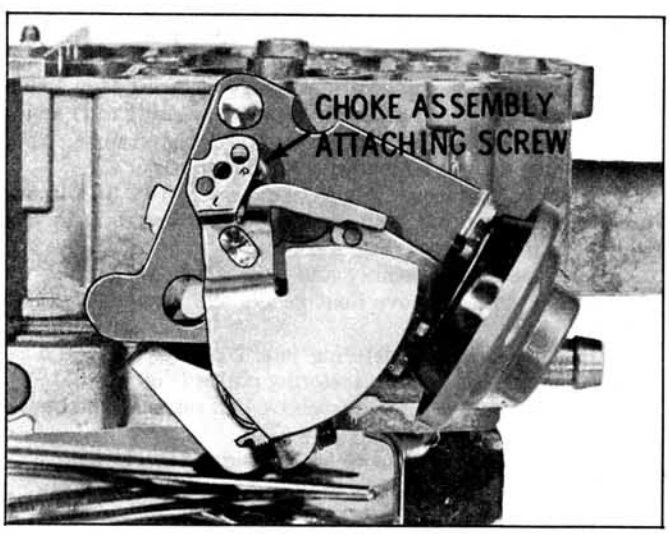


Fig. 6M-89—Choke Assembly

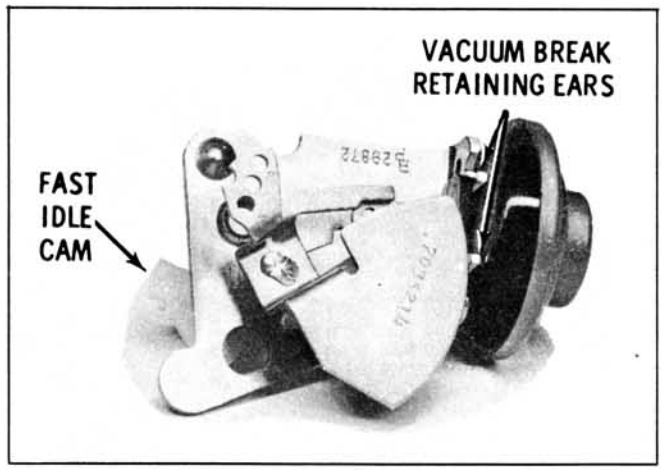


Fig. 6M-90—Vacuum Break Assembly

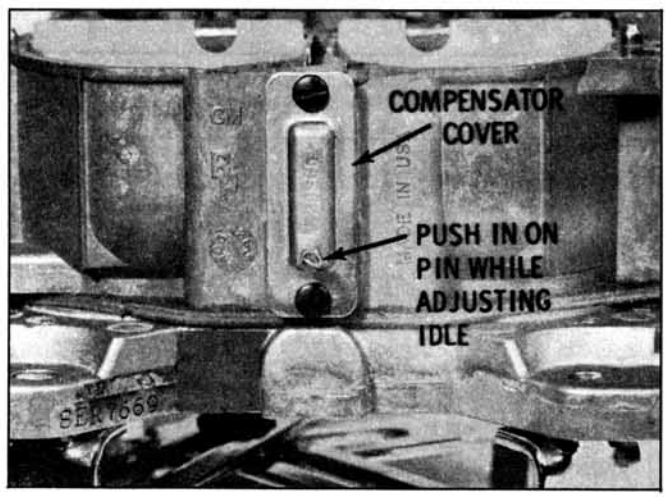


Fig. 6M-91—Compensator Cover

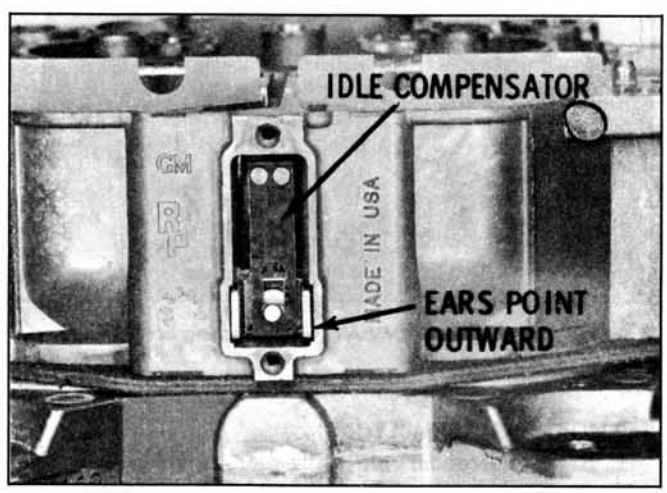


Fig. 6M-92—Hot Idle Compensator

If further disassembly is necessary, spread the retaining ears on bracket next to vacuum break assembly, then remove vacuum break from bracket (Fig. 6M-90).

12. Remove choke rod actuating lever from inside of float bowl well.

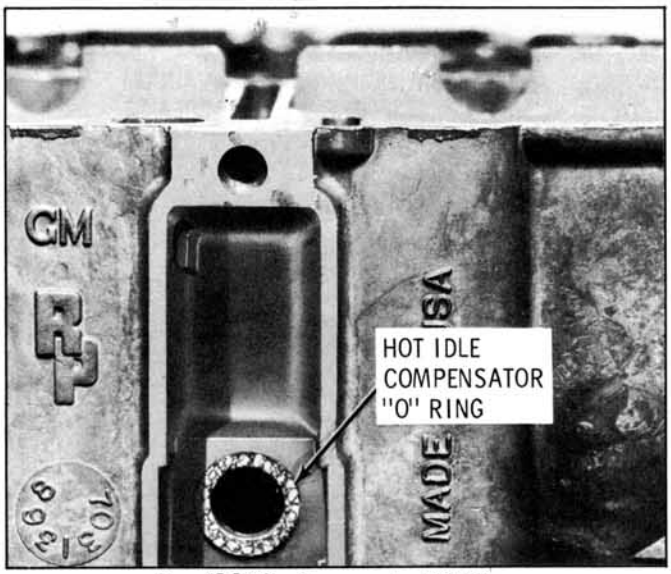


Fig. 6M-93—Compensator "O" Ring

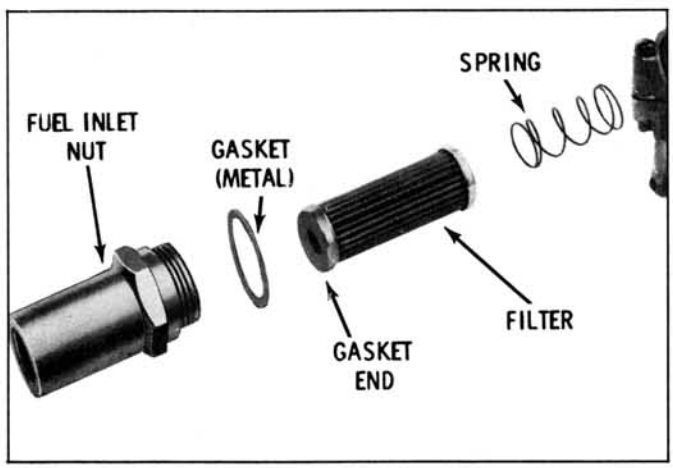


Fig. 6M-94—Fuel Filter

13. Remove hot idle compensator cover then remove hot idle compensator and "O" ring from float bowl (Figs. 6M-91, 6M-92 and 6M-93).

14. Remove fuel inlet nut, gasket and filter (Fig. 6M-94).

15. Remove throttle body by removing throttle body to bowl attaching screws (Fig. 6M-95).

16. Remove throttle body to bowl insulator gasket (Fig. 6M-96).

THROTTLE BODY DISASSEMBLY

1. Remove pump rod from throttle lever.
2. Remove idle mixture screws and springs.

Care must be taken to avoid damaging secondary throttle valves. No further disassembly of the throttle body is required.

CLEANING AND INSPECTION

1. Thoroughly clean carburetor castings and metal parts in an approved carburetor cleaner such as Carbon-X (X-55) or its equivalent.

Rubber parts, plastic parts, and pump plungers, should not be immersed in carburetor cleaner. However, the delrin cam on the air valve shaft and the throttle valve shafts will withstand normal cleaning in carburetor cleaner.

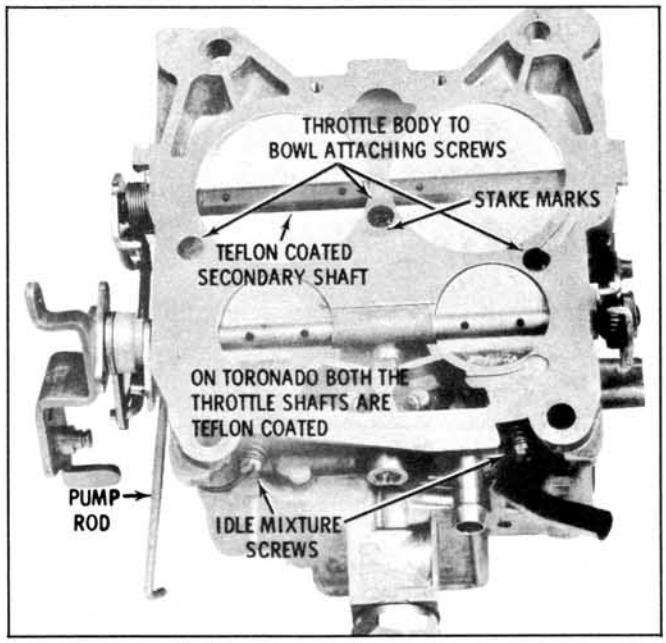


Fig. 6M-95—Throttle Body Attaching Screws

2. Blow out all passages in castings with compressed air. Do not pass drills through jets or passages.
3. Inspect idle mixture needles for damage.
4. Examine float needle and seat for wear. Replace if necessary with float needle assembly.
5. Inspect upper and lower surfaces of carburetor castings for damage.
6. Inspect holes in levers for excessive wear or out of round conditions. If worn, levers should be replaced.
7. Examine fast idle cam for wear or damage.
8. Check air valve for binding conditions. If air valve is damaged air horn assembly must be replaced.
9. Check all throttle levers and valves for binds or other damage.

4MV CARBURETOR ASSEMBLY

THROTTLE BODY ASSEMBLY

1. Install idle mixture needles and springs until seated. Back out needles two turns as a preliminary idle adjustment.
2. Install pump rod in throttle lever by rotating rod.

FLOAT BOWL ASSEMBLY

1. Install new throttle body to bowl gasket over two locating dowels on bowl (Fig. 6M-96).
2. Install throttle body making certain throttle body is properly located over dowels on float bowl then install throttle body to bowl screws and tighten evenly and securely (Fig. 6M-95).

A thread sealer such as Loc-Tite should be used on the center screw.

3. Install fuel inlet filter, new gasket and inlet nut and tighten nut securely (Fig. 6M-94).
4. Install hot idle compensator "O" ring seal in recess in bowl then install hot idle compensator (Fig. 6M-92).

If vacuum break assembly was removed from

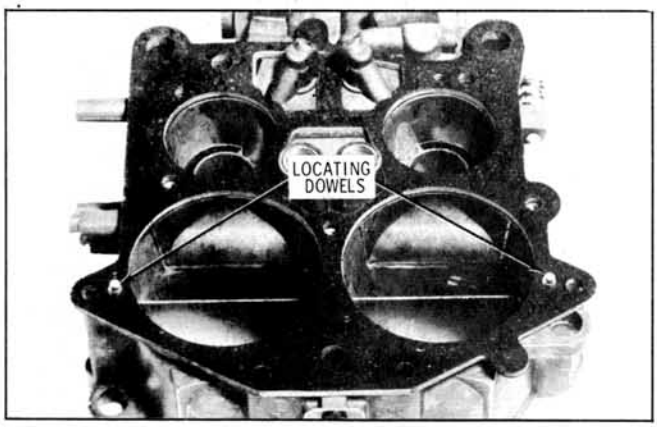


Fig. 6M-96—Throttle Body Gasket

bracket, slide vacuum break assembly between retaining ears and bend ears down slightly to hold securely.

5. Install fast idle cam on vacuum break assembly. Be sure fast idle cam actuating pin on intermediate choke shaft is located in cut out area of fast idle cam (Fig. 6M-97).

6. Connect choke rod to choke rod actuating lever (plain end) then holding choke rod, with grooved end pointing inward, position choke rod actuating lever in well of float bowl and install choke assembly engaging shaft with hole in actuating lever. Install retaining screw and tighten securely. Remove choke rod from lever for installation later.

7. Install vacuum hose on bowl and vacuum break assembly.

8. Install baffle in secondary side of bowl with notches toward top.

9. Install pump discharge check ball and retainer in passage next to pump well.

10. Install primary main metering jets (Fig. 6M-88).

11. Install new needle seat assembly.

To make float adjustment easier, bend float arm upward at notch in arm before assembly.

12. Install float by sliding float lever under pull clip from front to back. With float lever in pull clip, hold float assembly at toe and install retaining pin from pump well side.

13. Float Level Adjustment.

a. With adjustable T-scale, measure from top of float bowl gasket surface (gasket removed) to top of float at toe (locate gauging point 1/16" back from toe).

Make sure float retainer is held firmly in place and arm of float is seated on float needle.

b. Bend float arm as necessary for proper adjustment by pushing on pontoon. Refer to adjustment chart for specification.

14. Install power piston spring in power piston well. If primary main metering rods were removed from hanger reinstall making sure that tension spring is connected to top of each metering rod (Fig. 6M-86). Install power piston assembly in well with metering rods properly positioned in metering jets. Press down firmly on power piston to make sure the retainer is positioned flush to the top of the bore.

15. Install plastic filler over float needle, pressing downward until seated properly.

16. Install pump return spring in pump well.

17. Install air horn gasket around primary metering rods and piston. Position gasket over two dowels on secondary side of bowl.

18. Install pump plunger in pump well.

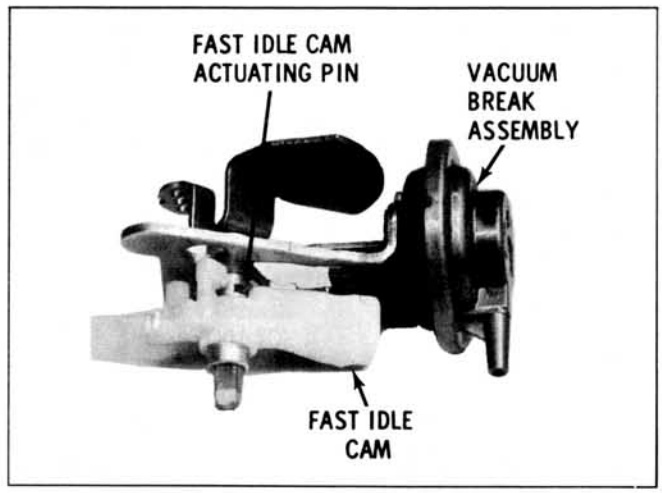


Fig. 6M-97—Installing Fast Idle Cam

AIR HORN ASSEMBLY

1. Install the following, if removed.
   a. Position pump lever and retain with roll pin.
   b. Choke shaft, choke valve and two attaching screws.
2. Install secondary metering rods. With air valve held wide open, rods, should be positioned with upper ends through air horn gasket.

AIR HORN TO BOWL INSTALLATION

1. Place air horn assembly on bowl carefully positioning secondary metering rods, vent tubes, and accelerating well tubes through air horn gasket. Do not force air horn assembly onto float bowl as distortion of secondary metering plates will result. A slight sideward movement will center metering rods in metering plates.
2. Install two long air horn screws, five short screws and two countersunk screws in primary venturi area. All screws must be tightened evenly and securely (Fig. 6M-98).
3. Connect pump rod in pump lever and retain with spring clip.
4. Connect choke rod in lower choke lever and retain in upper lever with spring clip.
5. Install vacuum break rod and clip.

Refer to 4MV ADJUSTMENT CHART for the remaining adjustments, adjustments must be performed in the sequence shown. Slow and fast idle rpm specifications are also shown on the chart.

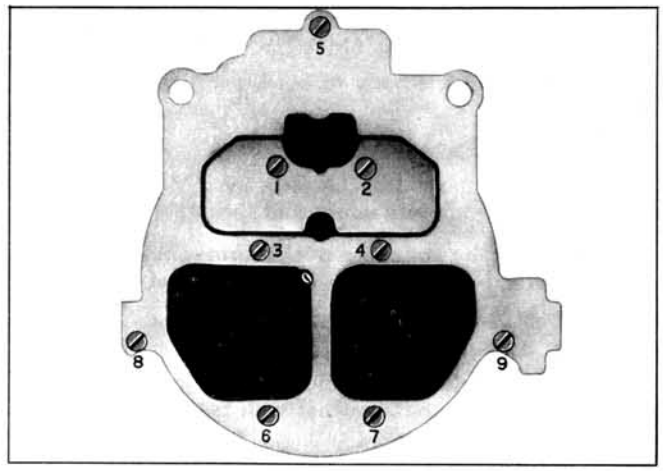


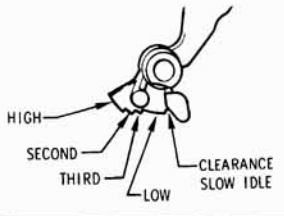
Fig. 6M-98—4MV Air Horn Tightening Sequence

MODEL 4 MV DIAGNOSIS CHART

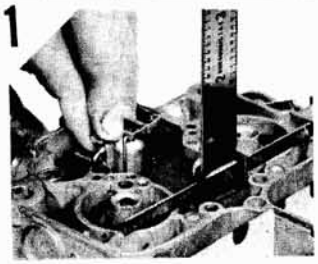
CONDITION										CHECK POINTS
HARD STARTING—COLD	HARD STARTING—HOT	POOR OPERATION—DURING WARM UP	STUMBLE ON ACCELERATION	STALLING	ROUGH IDLE	ECONOMY	FLOODING	SURGE	LACK OF HIGH SPEED PERFORMANCE	**IMPORTANT** Before attempting carburetor diagnosis as outlined below, all other engine systems must be operating properly. Diagnosis of these systems (electrical, exhaust, mechanical, and in the case of fuel economy, odometer accuracy) is found in this Service Manual. The numbers 1, 2 and 3, under the CONDITION are the order of probability. The * indicates additional possibilities.
1	1					1				Driver Habits (Instruct Owner on Proper Procedures)
*		4				*				Check Choke Rod Adjustment
*		*				*				Check Vacuum Break Adjustment
*		*				*				Check Thermostatic Choke Rod Adjustment
*										Check Choke Unloader Adjustment
2		1				2				Check Choke Valve & Linkage, Binding, Stuck or Gummed Up
			3						3	Air Valve Binding, Stuck, Wrong Spring Tension Adj.
			*						*	Check Air Valve Lock-Out Adjustment
			*						*	Secondary Metering Rods Bent, Wrong Part
			*							Secondary Baffle Plates Missing
			*						*	Secondary Main Discharge Nozzles Plugged or Dirty
			*			3		3	*	Power Piston Stuck or Binding
			*			*		*		No Vacuum to Power Piston
			*			4		*	*	Primary Metering Rods Altered, Bent or Wrong Part
*		*	1							Check Accelerator Pump System & Adjustment
				3						Throttle Return Check Misadjusted
									2	Fuel Pump Pressure or Vacuum Not to Specification
			*	1	1	*				Check Slow Idle Adjustment
		2		*		*				Check Fast Idle Adjustment
						*		1	*	Primary Metering Jets Loose or Wrong Part
	*		*		*	*	2	4	*	Float Sticking or Level Misadjusted
*	*				*	*	3	*		Float Bowl Porous, Cracked, Etc.
*					*				*	Throttle Body to Float Bowl Screws Loose
	2	*		*		*	1	2		Needle Leaking
	*	*	*	*	3		*			Idle Compensator Not Opening or Closing
				*	2					Idle Passages Plugged or Dirty
				*	*	*				Crankcase Vent Valve Plugged
								*	*	Fuel Filter in Gas Tank Plugged
							*	*	1	Fuel Filter in Carburetor Plugged or Dirty, By Passing Fuel
						6				Air Cleaner Element Plugged
								*	4	Hole in Fuel Pump Suction Line or Kinked Hose
		3				5				Heat Riser Valve Stuck Open or Closed
*	*	*	*	2	*					Secondary Throttle Valves Sticking Open
									*	Check for Full Throttle Position at Carburetor
*		*	2							Accelerator Pump Inoperative
									*	Fuel Tank Vent Plugged

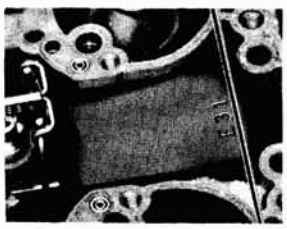
1	2	3	4
FLOAT LEVEL	PUMP	CHOKE ROD	AIR VALVE DASHPOT
1/4"	5/16"	.140"	.015" TO .050"

IDENTIFICATION OF STEPS ON FAST IDLE CAM



1



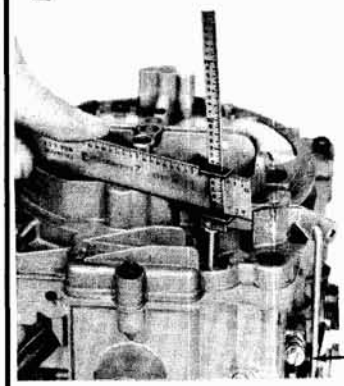


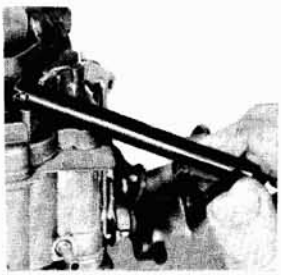
ADJUSTMENTS MUST BE PERFORMED IN NUMBERED SEQUENCE

1. GASKET REMOVED, WITH ONE FINGER HOLD FLOAT PIN RETAINER DOWN AND WITH OTHER FINGER PUSH DOWN ON FLOAT ARM UNTIL NEEDLE SEATS.
2. GAUGE FROM TOP OF CASTING TO TOP OF FLOAT 3/16" BACK FROM FLOAT RADIUS AS SHOWN. DO NOT PLACE GAUGE ON TOP OF RAISED NUMERALS ON FLOAT.
3. TO ADJUST, BEND FLOAT ARM AT NOTCHES IN FLOAT ARM.

FLOAT LEVEL ADJUSTMENT

2



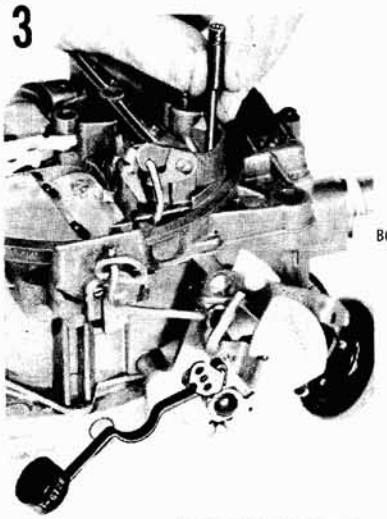


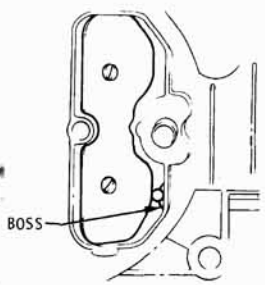
THROTTLE STOP SCREW

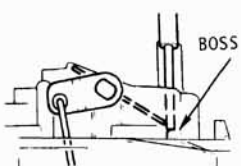
1. CHOKE WIDE OPEN AND CAM FOLLOWER OFF STEPS OF FAST IDLE CAM.
2. THROTTLE STOP SCREW BACKED OUT TO COMPLETELY CLOSE THROTTLE VALVES.
3. GAUGE FROM TOP OF AIR HORN CASTING TO TOP OF PUMP STEM AS SHOWN.
4. TO ADJUST, BEND PUMP ACTUATING ARM AS SHOWN WITH TOOL BT-6729.

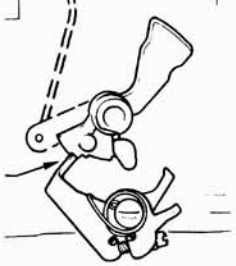
PUMP ADJUSTMENT

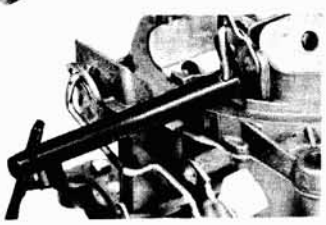
3







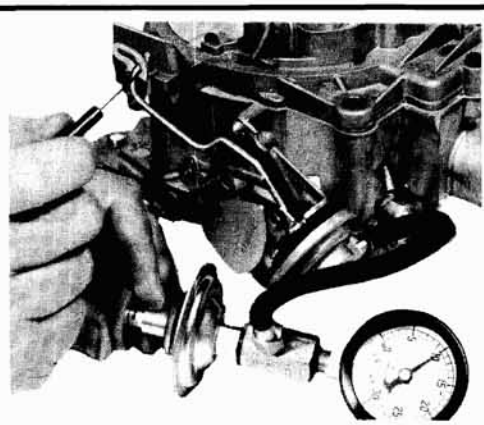


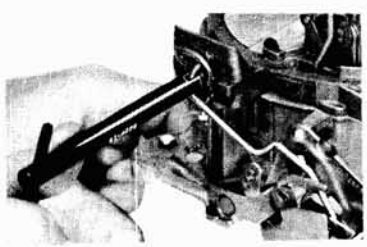


1. MOVE DASH POT TO CLEAR THROTTLE LEVER.
2. IF NECESSARY, TURN FAST IDLE SCREW UNTIL CAM FOLLOWER CONTACTS SECOND STEP, THEN PLACE CAM FOLLOWER ON THE SECOND STEP AND AGAINST HIGH STEP AS SHOWN.
3. ~~INSTALL~~ WEIGHT BT-6728 ON VACUUM BREAK LEVER AS SHOWN.
4. TAP DOWNSIDE OF CHOKE VALVE TO REMOVE SLACK FROM LINKAGE THEN GAUGE BETWEEN DOWN SIDE OF CHOKE VALVE AND AIR HORN CASTING AS SHOWN.
5. TO ADJUST, BEND CHOKE ROD WITH TOOL BT-3564. SHORTENING ROD DECREASES GAP. BE CERTAIN AIR VALVES ARE CLOSED.

CHOKE ROD ADJUSTMENT

4





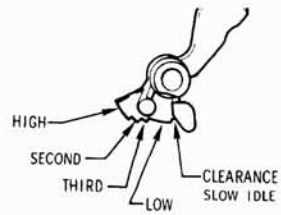
1. SEAT DIAPHRAGM USING BT-6513 AND A MINIMUM OF 10 INCHES VACUUM AS SHOWN.
2. WITH AIR VALVE CLOSED, GAUGE BETWEEN ROD AND END OF SLOT IN LEVER.
3. TO ADJUST, BEND ROD AS SHOWN WITH TOOL BT-6729.

AIR VALVE DASHPOT ADJUSTMENT

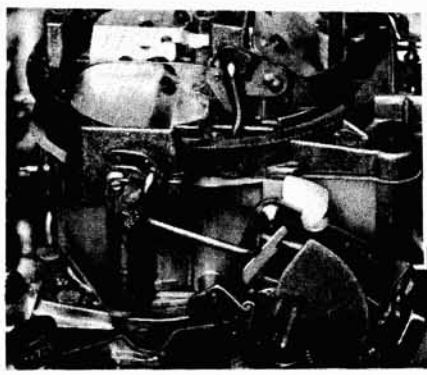
Fig. 6M-99—Carburetor and Linkage Adjustments (MV)

5	6	7	8
VACUUM BREAK	UNLOADER	AIR VALVE LOCKOUT	AIR VALVE CLEARANCE
.180"	.200"	.020"	.010"

IDENTIFICATION OF STEPS ON FAST IDLE CAM



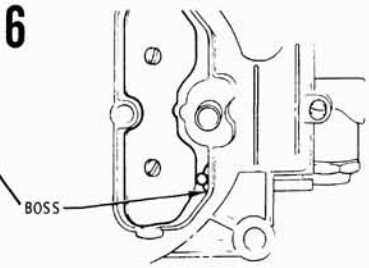
5



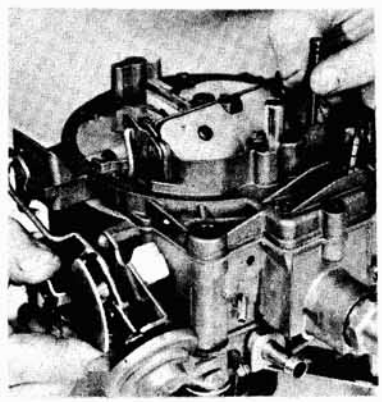
1. INSTALL WEIGHT BT-6728 ON THE VACUUM BREAK LEVER AS SHOWN.
2. PLACE FAST IDLE CAM FOLLOWER ON THE HIGH STEP AS SHOWN.
3. SEAT DIAPHRAGM USING BT-6513 AND A MINIMUM OF 10 INCHES VACUUM AS SHOWN.
4. TAP DOWNSIDE OF CHOKE VALVE TO REMOVE SLACK FROM LINKAGE THEN GAUGE BETWEEN DOWNSIDE OF CHOKE VALVE AND AIR HORN CASTING AS SHOWN.
5. TO ADJUST, BEND THE VACUUM BREAK TANG WITH TOOL BT-3006M WHILE HOLDING LEVER WITH NEEDLE NOSE PLIERS. ROTATING BENDING TOOL CLOCKWISE DECREASES THE GAP.

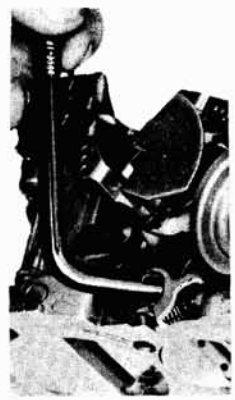
VACUUM BREAK ADJUSTMENT

6



– PLACE GAUGE BETWEEN CHOKE VALVE AND AIR HORN - DO NOT ALLOW GAUGE TO FALL OVER BOSS IN AIR HORN

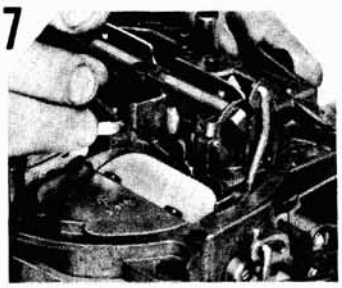


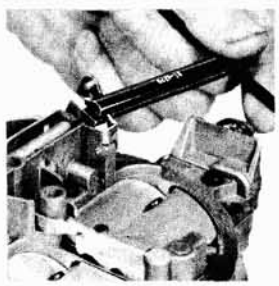


1. ROTATE VACUUM BREAK LEVER TO CLOSE CHOKE VALVE AND WHILE HOLDING LEVER PUSH THROTTLE WIDE OPEN, THIS WILL ALLOW CHOKE VALVE TO OPEN FOR UNLOADER.
2. GAUGE BETWEEN AIR HORN WALL AND DOWNSIDE OF CHOKE VALVE.
3. TO ADJUST, BEND TANG AS SHOWN WITH TOOL BT-3564.

UNLOADER ADJUSTMENT

7

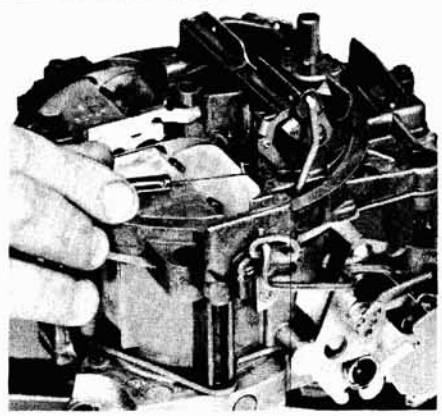




1. HOLD CHOKE VALVE WIDE OPEN.
2. LOCK OUT TANG CONTACTING CHOKE LEVER.
3. OPEN AIR VALVE SLIGHTLY AND GAUGE BETWEEN EDGE OF AIR VALVE AND TANG AS SHOWN.
4. TO ADJUST, BEND TANG ARM AS SHOWN WITH TOOL BT-6729.

AIR VALVE LOCKOUT ADJUSTMENT

8



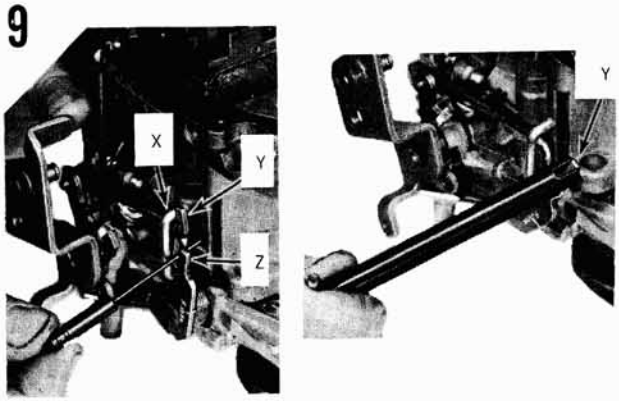
1. CLOSE CHOKE VALVE PARTLY TO ALLOW LOCK OUT TANG TO MOVE OVER AIR VALVE.
2. GAUGE BETWEEN BOTTOM OF LOCK-OUT TANG AND EDGE OF AIR VALVE AS SHOWN.
3. TO PROVIDE CLEARANCE, FILE TOP EDGE OF AIR VALVE.

AIR VALVE CLEARANCE ADJUSTMENT

Fig. 6M-100—Carburetor and Linkage Adjustments (MV)

9	10	11	12
SECONDARY OPENING .070"	AIR VALVE SPRING SEE STEP 10 BELOW	AUTOMATIC CHOKE SEE STEP 11 BELOW	SLOW IDLE SEE STEP 12 BELOW

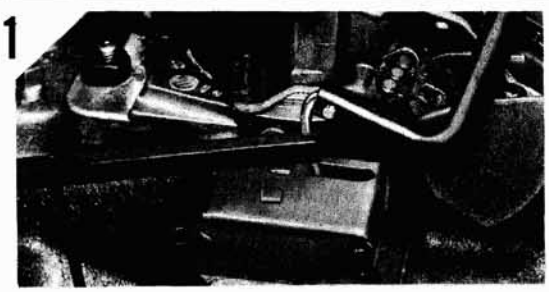
9

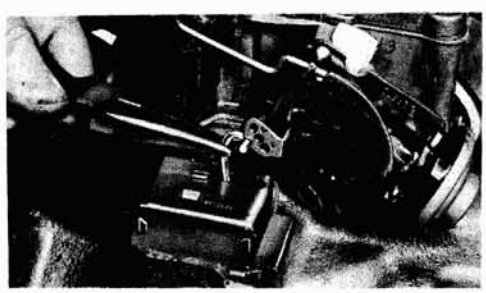


1. PUSH LIGHTLY ON THROTTLE LEVER UNTIL ROD X CONTACTS TANG Y. (DO NOT ALLOW SECONDARY THROTTLE VALVES TO OPEN.)
2. GAUGE BETWEEN ROD X AND TANG Z.
3. TO ADJUST, BEND TANG Y.

SECONDARY OPENING ADJUSTMENT

11

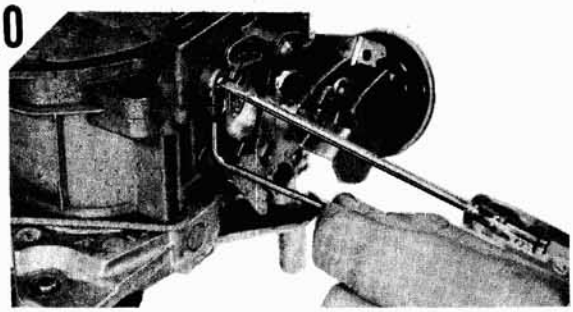




1. REMOVE CHOKE HOUSING ATTACHING BOLT AND REMOVE CHOKE LINK FROM LEVER. REINSTALL CHOKE HOUSING AND BOLT.
2. PLACE FAST IDLE CAM FOLLOWER ON HIGH STEP AND HOLD CHOKE VALVE CLOSED BY ROTATING VACUUM BREAK LEVER COUNTERCLOCKWISE.
3. PUSH DOWN ON CHOKE LINK WITH A NEEDLE NOSE PLIERS, LINK SHOULD ENGAGE SLOT IN LEVER AS SHOWN.
4. TO ADJUST, HOLD LINK WITH BT-3564 AND BEND LINK WITH BT-6729.
5. REMOVE CHOKE HOUSING TO RECONNECT LINK IN CENTER HOLE THEN REINSTALL BOLT.

AUTOMATIC CHOKE ADJUSTMENT

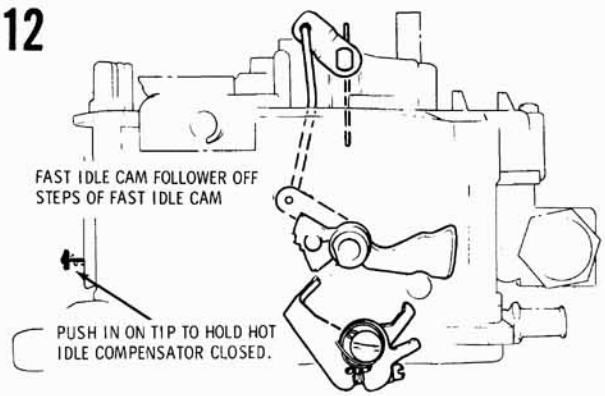
10



1. REMOVE VACUUM BREAK ROD.
2. LOOSEN LOCK SCREW WITH 3/32" ALLEN WRENCH.
3. LOOSEN ADJUSTING SCREW WITH SCREWDRIVER UNTIL AIR VALVE OPENS.
4. TIGHTEN ADJUSTING SCREW UNTIL AIR VALVE JUST CLOSES. FROM THIS POINT TIGHTEN 1/2 TURN MORE FOR 350 CU. IN. ENGINES AND 3/4 TURN FOR 400 AND 455 CU. IN. ENGINES.
5. TIGHTEN LOCK SCREW. REINSTALL VACUUM BREAK ROD

AIR VALVE SPRING ADJUSTMENT

12



1. REMOVE AIR CLEANER, DISCONNECT AIR CLEANER VACUUM HOSE AT INTAKE MANIFOLD AND PLUG VACUUM FITTING ON MANIFOLD.
2. DISCONNECT VACUUM HOSE AT DISTRIBUTOR AND PLUG END OF HOSE.
3. ENGINE AT NORMAL OPERATING TEMP., SET PARKING BRAKE AND BLOCK DRIVE WHEELS, AIR COND. OFF, CHOKE FULLY OPEN, FAST IDLE CAM FOLLOWER OFF STEPS OF CAM, HOLD HOT IDLE COMPENSATOR CLOSED, ADJUST THROTTLE STOP SCREW AND IDLE MIXTURE SCREWS ALTERNATELY TO OBTAIN THE BEST IDLE AT:

   * 725 RPM IN NEUTRAL MANUAL TRANSMISSION 400 CU. IN. ENGINE
   * ON 400 CU. IN. MANUAL TRANS. WITHOUT W-30 OPTION, DISCONNECT DISTRIBUTOR VACUUM HOSE FROM THERMOSTATIC VACUUM SWITCH, DISCONNECT VACUUM HOSE AT CARBURETOR AND CONNECT TO DISTRIBUTOR NIPPLE ON T.V.S., CONNECT DIST. VAC. HOSE DIRECTLY TO CARBURETOR BEFORE MAKING SLOW IDLE ADJUSTMENT. RECONNECT HOSES IN PROPER POSITION AFTER IDLE ADJUSTMENT IS COMPLETED.

   675 RPM IN NEUTRAL MANUAL TRANSMISSION 350 & 455 CU. IN. ENGINE
   575 RPM IN DRIVE AUTOMATIC TRANSMISSION 350, 400 & 455 CU. IN. ENGINE
   750 RPM AUTOMATIC OR MANUAL TRANSMISSION 400 CU. IN. WITH W-30 OPT.

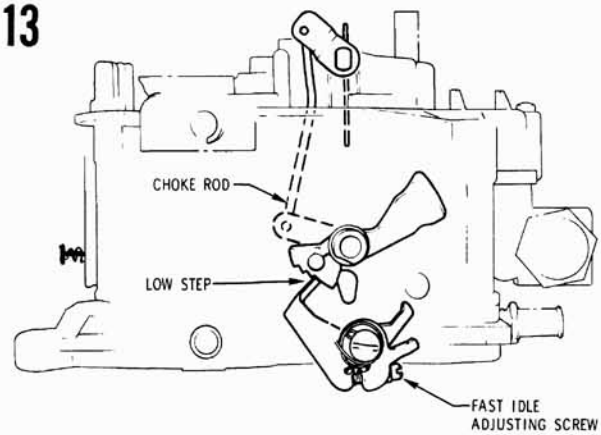
4. TURN IDLE MIXTURE SCREWS IN TO OBTAIN A 10 TO 15 RPM REDUCTION WITH EACH SCREW. IDLE SPEED TO BE 20 TO 30 RPM LESS THAN ABOVE.
5. TURN EACH IDLE MIXTURE SCREW OUT 1/4 TURN (EXCEPT THE 725 RPM MANUAL TRANS. 400 CU. IN. ENGINE CARB.)
6. UNPLUG DIST. VAC. HOSE AND RECONNECT TO DIST.
7. UNPLUG VAC. FITTING ON MANIFOLD AND REINSTALL AIR CLEANER HOSE.
8. REINSTALL AIR CLEANER, BEING SURE HOT AIR ADAPTER AND VENTILATION TUBE ARE CONNECTED AND SEATED PROPERLY.
9. RECHECK WITH AIR CLEANER ON CARBURETOR.

SLOW IDLE ADJUSTMENT

Fig. 6M-101—Carburetor and Linkage Adjustments (MV)

13	14	15
FAST IDLE	SECONDARY CLOSING	DASHPOT
SEE STEP 13 BELOW	.020"	.060"

13



POSITION OF FOLLOWER ON FAST IDLE CAM FOR FAST IDLE ADJUSTMENT

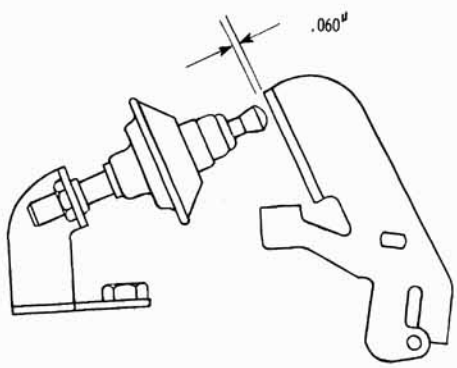
1. REMOVE AIR CLEANER, DISCONNECT AIR CLEANER VACUUM HOSE AT INTAKE MANIFOLD AND PLUG VACUUM FITTING ON MANIFOLD.
2. SET PARKING BRAKE AND BLOCK DRIVE WHEELS.
3. PLACE MANUAL TRANSMISSIONS IN NEUTRAL AND AUTOMATIC TRANSMISSIONS IN PARK.
4. ENGINE AT NORMAL OPERATING TEMP., AIR COND. OFF.
5. PLACE FAST IDLE CAM FOLLOWER ON LOW STEP AND AGAINST THIRD STEP AS SHOWN.
6. HOLD HOT IDLE COMPENSATOR CLOSED, LOCATED ON BACK OF CARBURETOR. ADJUST FAST IDLE AS FOLLOWS:

   700 RPM ALL 4MV EXCEPT:
   900 RPM MANUAL TRANSMISSION "442"
   900 RPM MANUAL TRANSMISSION W-30 OPTION
   1300 RPM AUTOMATIC TRANSMISSION W-30 OPTION

7. UNPLUG VAC. FITTING ON MANIFOLD AND REINSTALL AIR CLEANER HOSE. REINSTALL AIR CLEANER, BEING SURE HOT AIR ADAPTER AND VENTILATION TUBE ARE CONNECTED AND SEATED PROPERLY.

FAST IDLE ADJUSTMENT

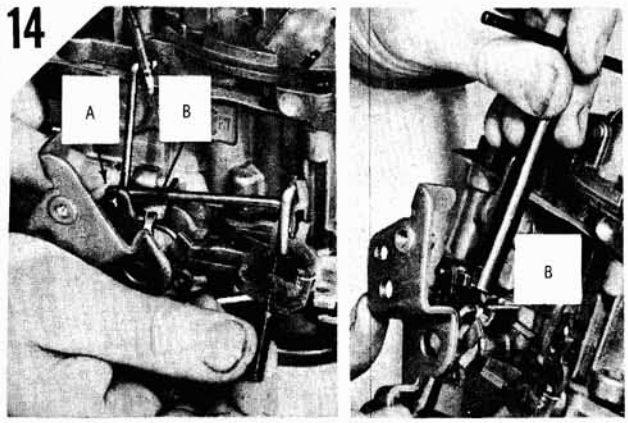
15



1. SLOW IDLE ADJUSTED, CHOKE FULLY OPEN, FAST IDLE CAM FOLLOWER OFF STEPS OF FAST IDLE CAM.
2. WITH DASHPOT FULLY COMPRESSED, ADJUST FOR .060" CLEARANCE BETWEEN DASHPOT AND THROTTLE LEVER AS SHOWN.

DASHPOT ADJUSTMENT

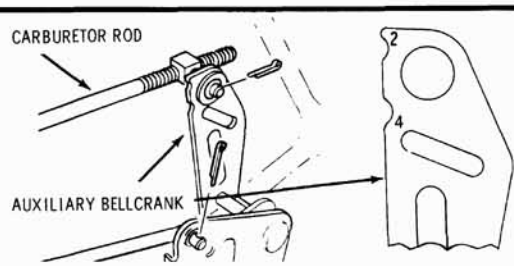
14



1. CHOKE FULLY OPEN AND FAST IDLE CAM FOLLOWER OFF STEPS OF FAST IDLE CAM.
2. SLOW IDLE PROPERLY SET.
3. WITH FINGER, PUSH LIGHTLY LEVER "A" AGAINST TANG "B" (DO NOT ALLOW THROTTLE VALVES TO OPEN).
4. GAUGE BETWEEN ROD AND END OF SLOT IN LEVER AS SHOWN.
5. TO ADJUST, OPEN THROTTLE SLIGHTLY AND BEND TANG "B" WITH TOOL BT-6729 AS SHOWN.

SECONDARY CLOSING ADJUSTMENT

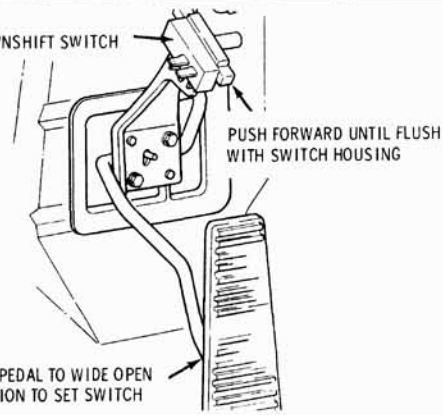
16



1. SLOW IDLE ADJUSTED AND ADJUSTING SCREW OFF OF FAST IDLE CAM.
2. DISCONNECT SWIVEL ON CARBURETOR ROD FROM AUXILIARY BELLCRANK.
3. PUSH UPPER LEVER OF AUXILIARY BELLCRANK TOWARDS COWL UNTIL IT HITS ITS STOP.
4. PULL CARBURETOR ROD TOWARDS FIREWALL UNTIL THROTTLE IS WIDE OPEN. THEN ADJUST SWIVEL UNTIL SWIVEL PIN ENTERS THE "2" NOTCH FOR 2 BBL. CARBURETOR OR THE "4" NOTCH FOR A 4 BBL. CARBURETOR.
5. RECONNECT CARBURETOR ROD TO AUXILIARY BELLCRANK.

CARBURETOR ROD ADJUSTMENT

17



1. PUSH PLUNGER OF DOWNSHIFT SWITCH FORWARD UNTIL FLUSH WITH SWITCH HOUSING.
2. PUSH ACCELERATOR PEDAL TO WIDE OPEN POSITION TO SET SWITCH.
3. ENERGIZING OF DOWNSHIFT SWITCH CIRCUIT CAN BE CHECKED WITH A TEST LIGHT ACROSS THE TWO TERMINALS OF SWITCH.

DOWNSHIFT THROTTLE SWITCH ADJUSTMENT

Fig. 6M-102—Carburetor and Linkage Adjustments (MV)

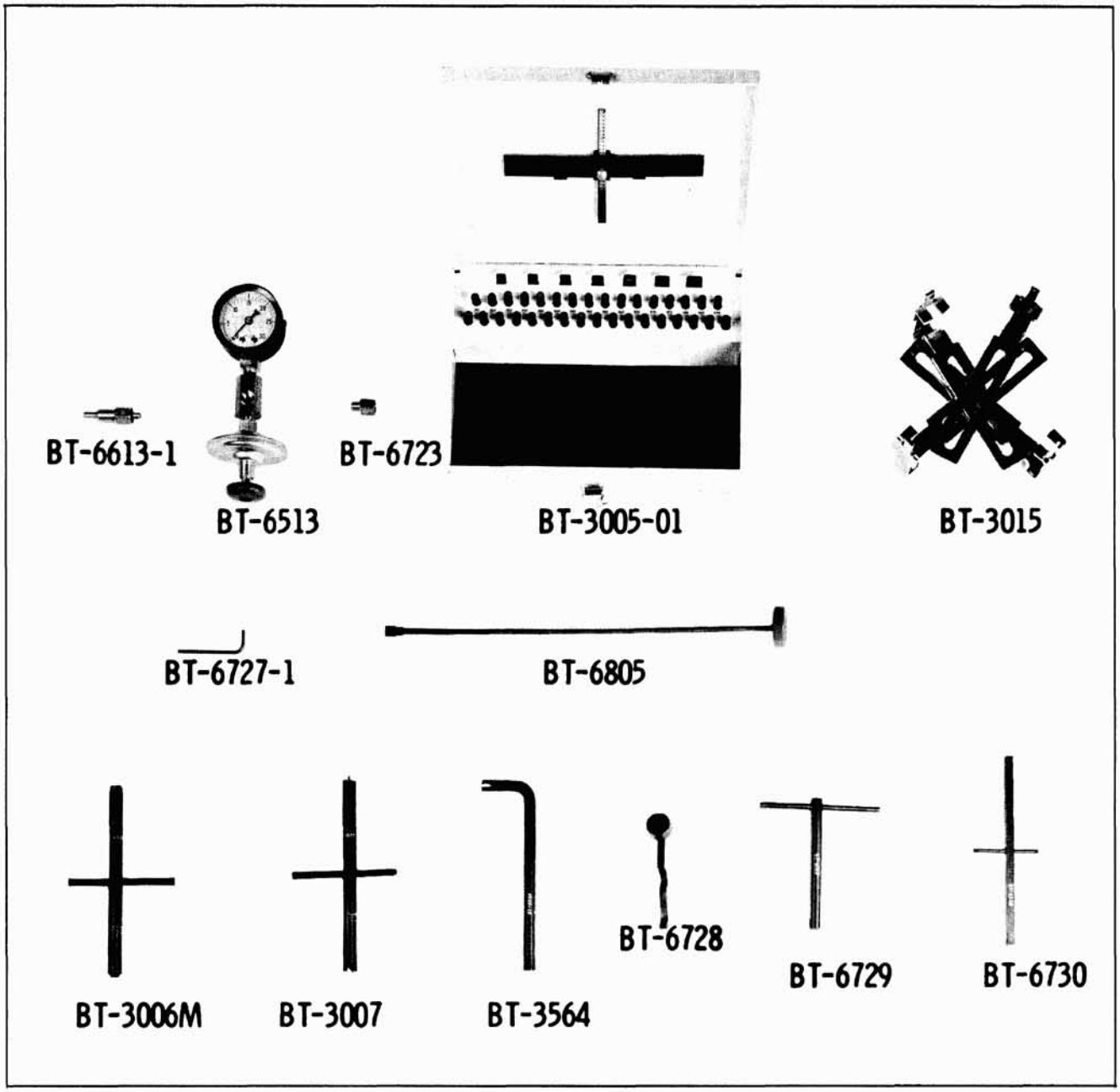


Fig. 6M-103—Tools

BT-3005-01	Box with Gauges and "T" Scale	BT-6723	Adapter to Test Needle and Seat
BT-3006M	Needle Seat Installer and Bending Tool	BT-6727-1	Allen Wrench 3/32" to Adjust Air Valve
BT-3007	Bending Tool and Power Valve Wrench	BT-6728	Vacuum Break Weight
BT-3015	Carburetor Holding Fixture	BT-6729	Bending Tool "T" Handle
BT-3564	Bending Tool "L" Shape	BT-6730	Bending Tool
BT-6513	Needle, Seat and Vacuum Break Tester	BT-6805	Idle Adjusting Tool (Flexible)
BT-6613-1	Adapter Vacuum Break		

CONTROLLED COMBUSTION SYSTEM

ALL SERIES—SECTION 6N

Subject	Page	Subject	Page
PERIODIC MAINTENANCE	6N-1	FUNCTIONAL CHECKS	6N-2
DESCRIPTION	6N-1	VACUUM MOTOR REPLACEMENT	6N-2
PURPOSE	6N-2	SENSOR REPLACEMENT	6N-4
OPERATION	6N-2	EXHAUST MANIFOLD SHROUD	6N-5

PERIODIC MAINTENANCE

The proper operation of the Controlled Combustion System is dependent upon proper engine tune-up and maintenance of the Controlled Combustion System. Refer to ENGINE TUNE-UP Section 6C for tune-up specifications. Maintenance intervals for air cleaner element, crankcase ventilation filter and crankcase ventilation valves are in the Periodic Maintenance Chart Section 0.

Use only Oldsmobile recommended tune-up specifications to obtain maximum benefit from the Controlled Combustion System.

DESCRIPTION (Fig. 6N-1)

A Controlled Combustion System is standard equipment on all V-8 and L-6 engines. The Controlled Combustion System consists of an air cleaner assembly which includes a

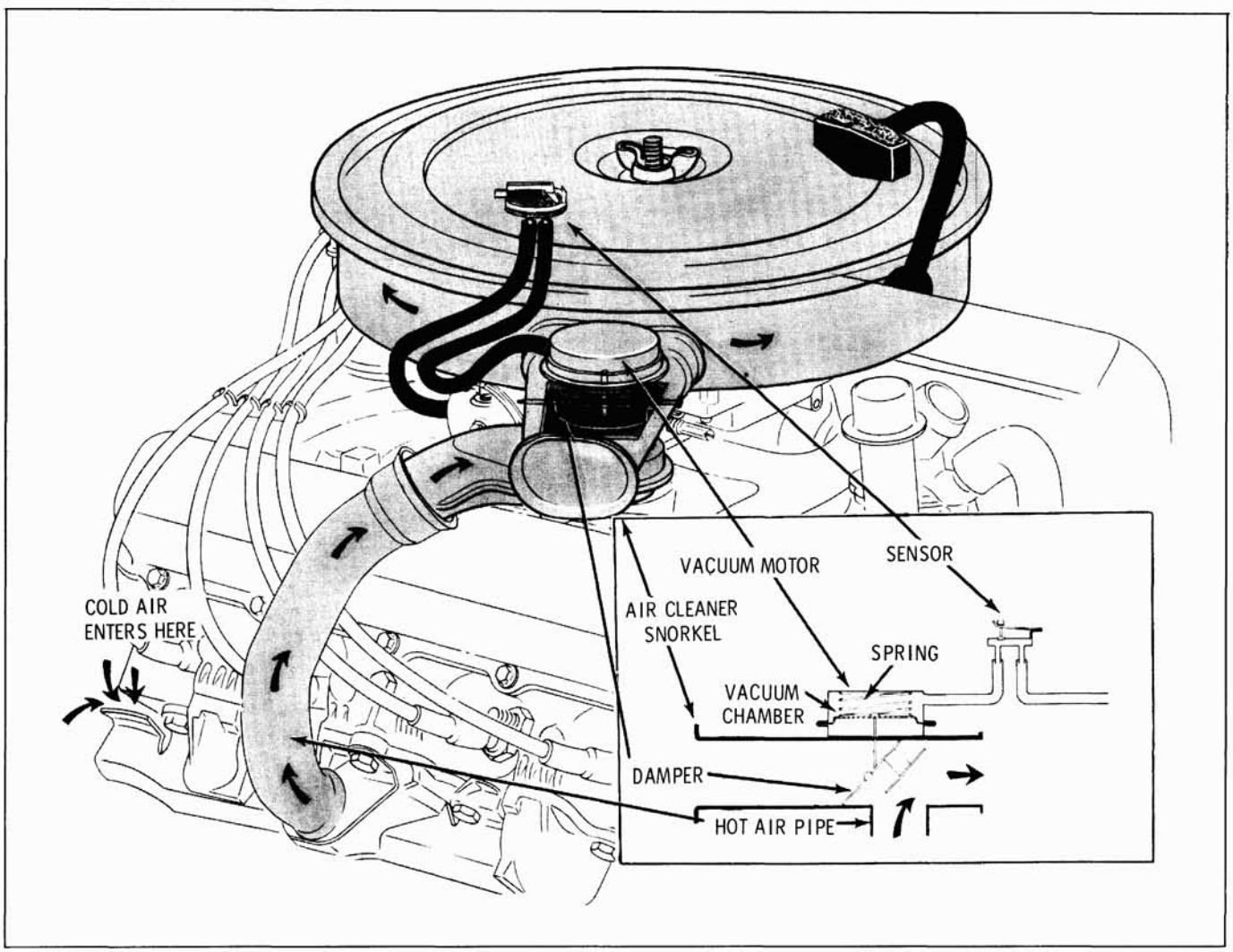


Fig. 6N-1—Controlled Combustion System

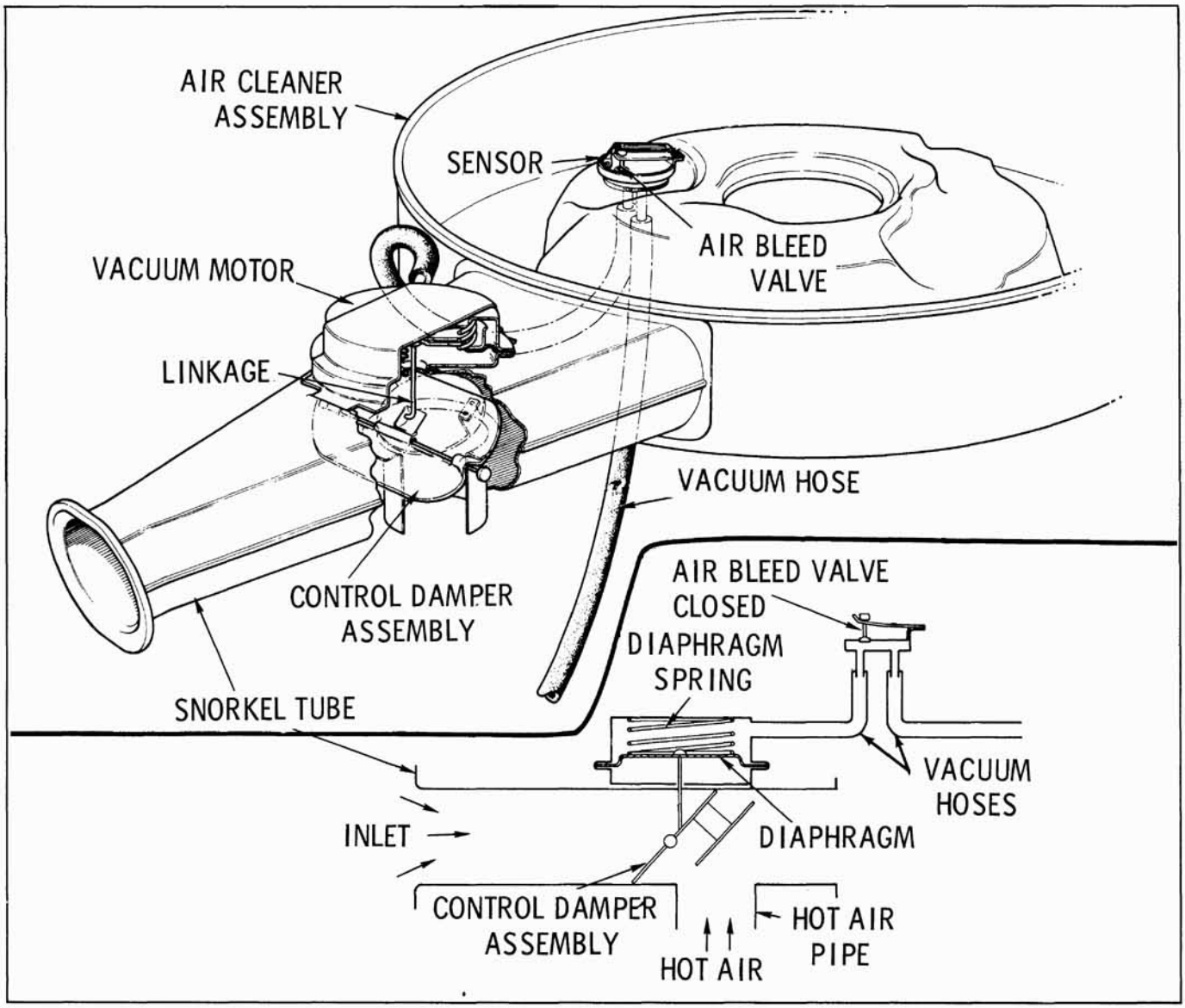


Fig. 6N-2—Hot Air Delivery Mode

temperature sensor, vacuum motor, control damper assembly and connecting vacuum hoses. The motor is controlled by the temperature sensor. The vacuum motor operates the air control damper assembly to control the flow of pre-heated and non pre-heated air. The pre-heated air is obtained from the hot air pipe and shroud on the exhaust manifold.

PURPOSE

At underhood temperatures below 100° F, the Controlled Combustion System directs heated air into the air cleaner. This system provides the most desirable emission control throughout the operating range of the car and results in improved fuel economy, improved engine warm-up and eliminates tendency for ice to form in the carburetor.

OPERATION (Figs. 6N-1, 6N-2, 6N-3, 6N-4)

During engine warm-up with engine compartment temperatures 85°F or below, the temperature sensor is closed. This allows engine vacuum to be directed to the vacuum motor closing the damper assembly to outside air. With the damper closed, the cool air will flow through the openings at the ends of the shroud where it is heated. The heated air then flows up through the hot air pipe and adapter into the air cleaner. As the temperature inside the air cleaner reaches approximately 100°F, the sensor bleeds off vacuum to the vacuum motor causing the control damper to open allowing underhood air to be mixed with the heated air as needed to keep the air temperature approximately 100°F if the ambient temperature is 100°F or below.

Under full throttle or below 6" Hg. to 8" Hg. of vacuum, the vacuum motor will no longer hold the valve open to hot air. The hot air pipe is closed off allowing only outside air to enter the air cleaner.

The vacuum motor and control damper assembly in the left snorkel on 4400 Series with W-30 Option does not have a sensor and is controlled only by intake manifold vacuum. This snorkel remains closed until full throttle is obtained. With intake manifold vacuum at 6" to 8", the control damper assembly will open allowing maximum air flow into the air cleaner.

FUNCTIONAL CHECKS

VACUUM MOTOR AND DAMPER ASSEMBLY

1. With engine off, remove air cleaner cover and tape thermometer J-5421 in air cleaner next to sensor. (Fig. 6N-5)

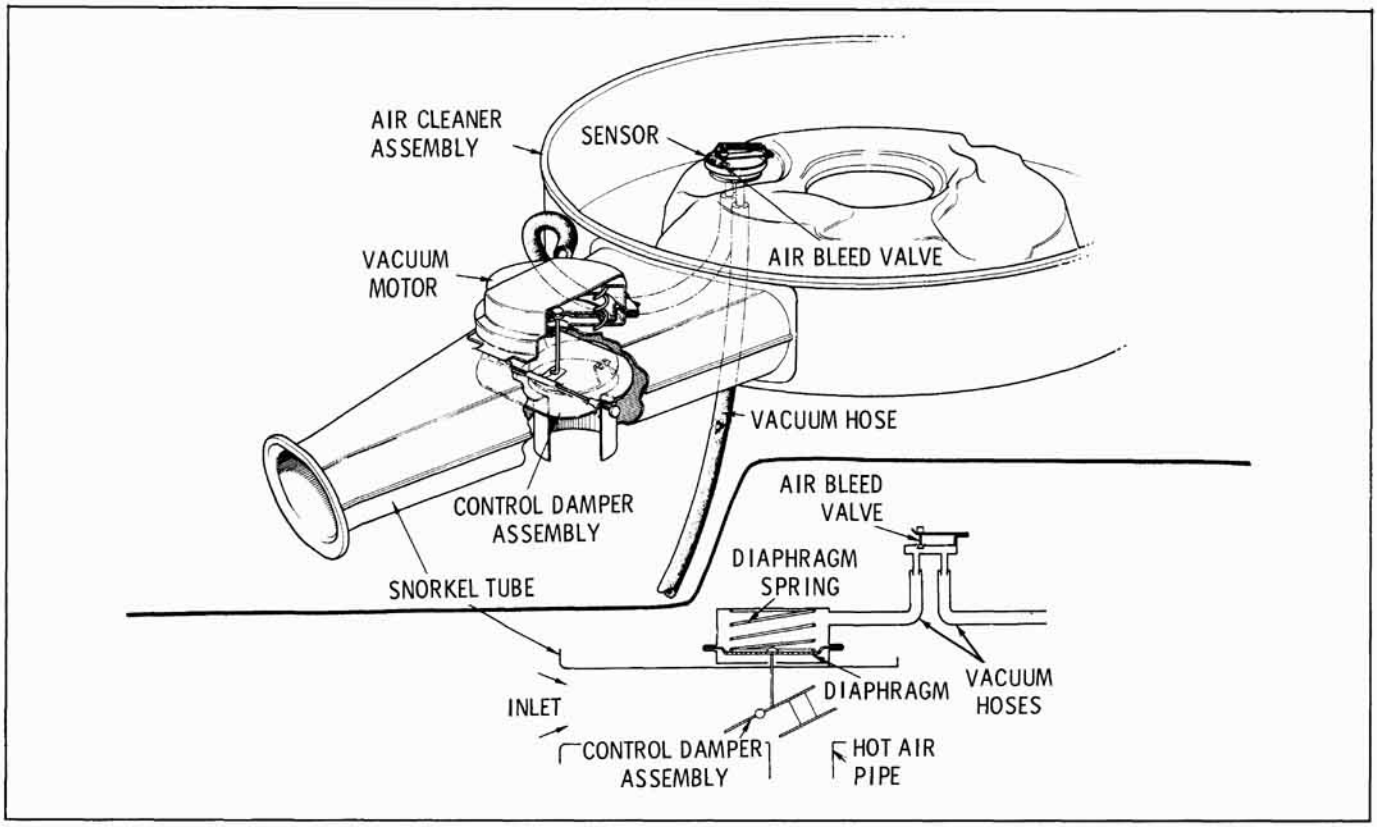


Fig. 6N-3—Regulating Mode

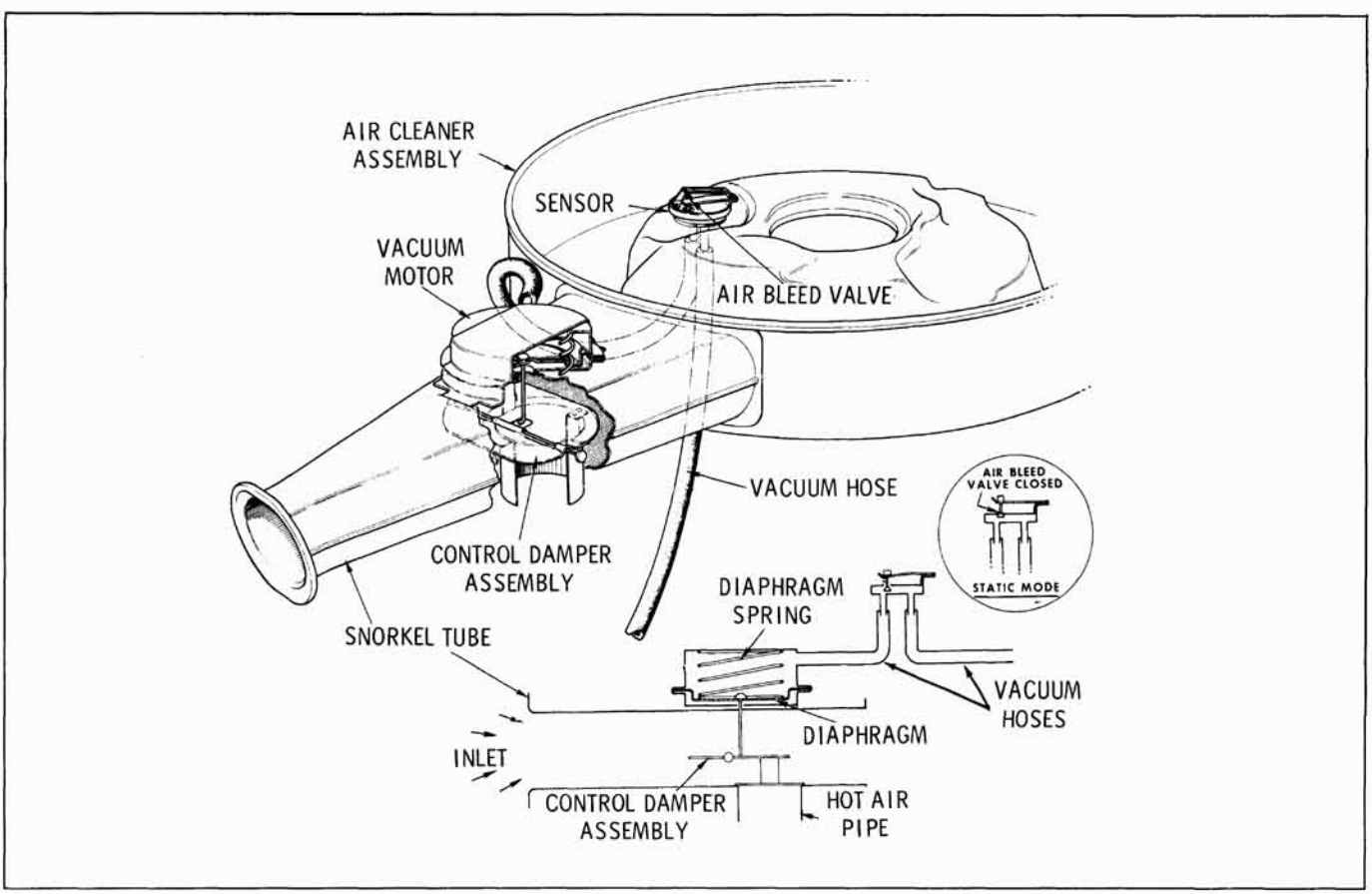


Fig. 6N-4—Cold Air Delivery Mode

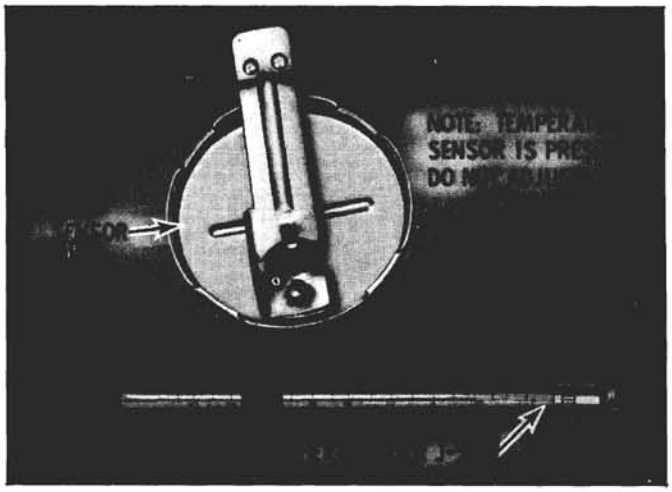


Fig. 6N-5—Checking Sensor

If temperature is below 80°F, continue to Step 2. If temperature is above 80°F, remove air cleaner and allow to cool to at least 75°F.

2. Install a tee in vacuum line at vacuum motor and connect a vacuum gauge in line.
3. With engine off, control damper will be open. This can be checked by looking in the end of the snorkel.
4. Install the cover on air cleaner without wing nut and start the engine.
5. With engine at idle speed, the control damper should close unless ambient temperature is above 85°F.

If ambient temperature is above 85°F, it will only be necessary to make sure control damper is completely open by 128°F.

6. Observe control damper in snorkel; when it begins to move toward the open position (outside air), quickly remove cover on air cleaner and record reading on thermometer and reading on vacuum gauge.

SPECIFICATIONS FOR DAMPER OPERATION

Temperature: 85°F Starts to Open
128°F Full Open
Damper Assembly: 5" Hg. to 9" Hg. damper should be open. Full vacuum, damper should be closed.

DIAGNOSIS

A. If temperature is within specifications, Controlled Combustion System is functioning properly.
B. If temperature is out of specifications and vacuum is correct (5 Hg. to 9 Hg.), replace sensor.
C. If both temperature and vacuum are not within specifications, replace vacuum motor.

VACUUM MOTOR REPLACEMENT

Remove (Fig. 6N-6)

1. Remove air cleaner.
2. Disconnect vacuum hose from motor.
3. Drill out the two spot welds initially with a 1/16" drill, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.
4. Remove motor retaining strap.
5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.

Replace

1. Drill a 7/64" hole in snorkel tube at point "A" as shown in Fig. 6N-6.

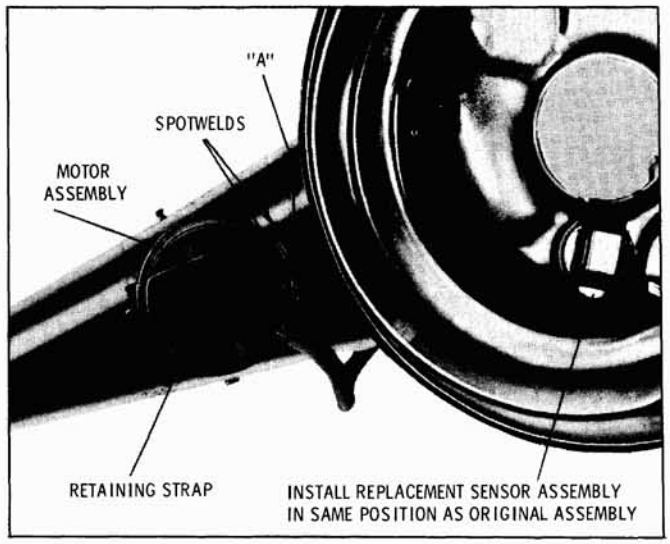


Fig. 6N-6—Removing Vacuum Motor

2. Insert vacuum motor linkage into control damper assembly.
3. Use the motor retaining strap and sheet metal screw provided in the motor service package to secure the retaining strap and motor to the snorkel tube.
4. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.
5. Connect vacuum hose to motor and install air cleaner.

SENSOR REPLACEMENT

Remove (Fig. 6N-7)

1. Remove air cleaner.
2. Detach hoses at sensor.
3. Pry up tabs on sensor retaining clip and remove clip and sensor from air cleaner. Note position of sensor for installation.

Replace (Fig. 6N-6)

1. Install sensor and gasket assembly in original position.
2. Press retainer clip on hose connectors.
3. Connect vacuum hoses and install air cleaner on engine.

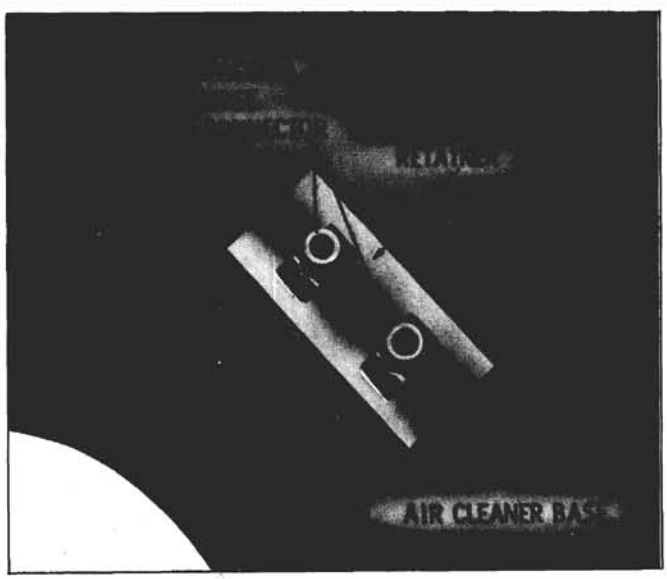


Fig. 6N-7—Removing Sensor Retaining Clip

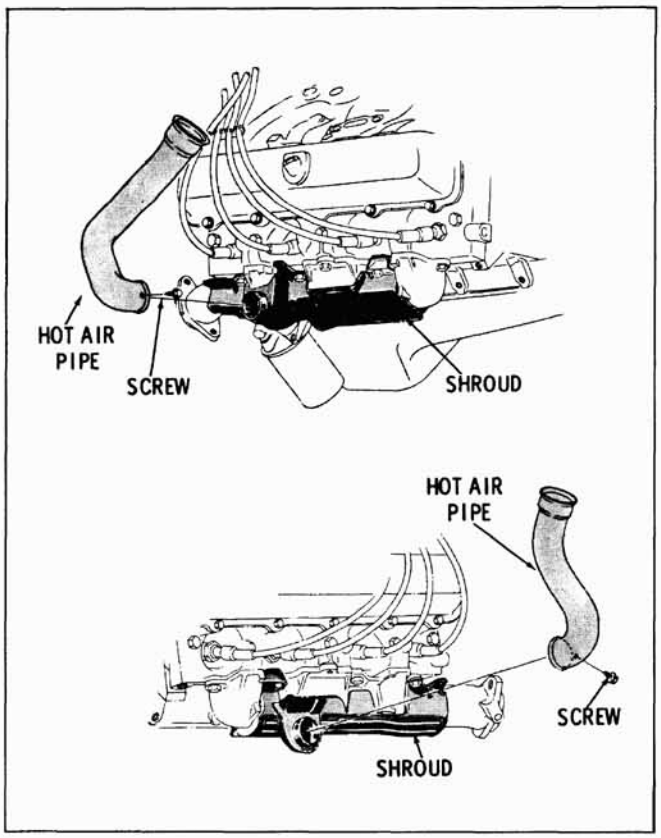


Fig. 6N-8—Exhaust Manifold Heat Shroud

EXHAUST MANIFOLD SHROUD (V-8)

Remove (Fig. 6N-8)

1. Remove air cleaner and adapter assembly.
2. Remove sheet metal screw that retains hot air pipe and remove pipe.
3. Disconnect exhaust pipe from manifold.
4. Straighten lock tabs and remove the manifold to head attaching bolts, washers and locks and remove the manifold and shroud.
5. Remove sheet metal screws from shroud and remove shroud from manifold.
6. Clean manifold and cylinder head machined surfaces with a putty knife. Use care not to gouge or scratch machined surfaces.

Install

1. Install inner and outer shroud to manifold with sheet metal screws.

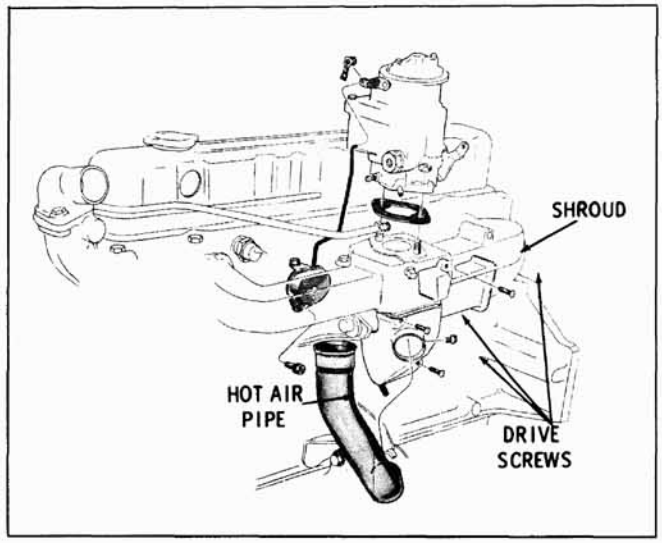


Fig. 6N-9—Exhaust Manifold Heat Shroud (L-6)

2. Install manifold to head bolts and torque to 25 ft. lbs.
3. Bend lock tabs to retain bolts.
4. Connect exhaust pipe to manifold.
5. Connect hot air pipe to shroud with sheet metal screw.
6. Install air cleaner adapter and air cleaner.

EXHAUST MANIFOLD HEAT SHROUD L-6 ENGINE (Fig. 6N-9)

Remove

1. Disconnect hoses and remove air cleaner.
2. Remove sheet metal screw that retains hot air pipe and remove pipe.
3. Use a small chisel and drive under head of drive screw to loosen. Then remove drive screws with pliers.

DO NOT cut off head of drive screws.

4. Remove shroud from manifold.

Install

1. Install heat shroud to manifold.
2. Install new drive screws by driving into original holes.
3. Insert hot air pipe into shroud and install sheet metal screw to retain hot air pipe.
4. Install air cleaner and connect hoses.

TRANSMISSION AND CLUTCH

TURBO HYDRA-MATIC	7-1	**MANUAL TRANSMISSION**	7-601
JETAWAY	7-301	**CLUTCH**	7-634

TURBO HYDRA-MATIC CONTENTS

Subject	Page	Subject	Page
PERIODIC MAINTENANCE	7-1	FRONT SERVO	7-39
GENERAL DESCRIPTION	7-3	REAR SERVO	7-40
VALVES AND THEIR FUNCTIONS	7-4	CONTROL VALVE	7-40
OIL FLOW CIRCUITS	7-6	OIL PUMP	7-42
OPERATIONS NOT REQUIRING REMOVAL OF TRANSMISSION	7-22	FORWARD CLUTCH	7-45
TRANSMISSION REMOVAL	7-22	DIRECT CLUTCH AND INTERMEDIATE SPRAG	7-50
TRANSMISSION INSTALLATION	7-22	CASE CENTER SUPPORT	7-55
MINOR SERVICE OPERATIONS	7-23	REACTION CARRIER, REAR SPRAG AND OUTPUT CARRIER	7-58
OIL COOLER LINES	7-24	PINION GEARS	7-58
MANUAL LINKAGE ADJUSTMENTS	7-25	SPEEDOMETER DRIVE GEAR	7-59
GENERAL SERVICE PRECAUTIONS	7-26	REAR UNIT	7-61
PARTS CLEANING AND INSPECTION	7-26	ASSEMBLY OF TRANSMISSION	7-64
TRANSMISSION DISASSEMBLY	7-27	EXTENSION HOUSING	7-69
CONVERTER AND MODULATOR	7-27	CHECK BALLS, FRONT SERVO, GASKETS, SPACER AND SOLENOID	7-70
GOVERNOR, PAN AND STRAINER	7-27	REAR SERVO	7-71
CONTROL VALVE, GOVERNOR PIPES AND DETENT SPRING	7-28	CONTROL VALVE AND GOVERNOR PIPES	7-73
REAR SERVO, VALVE BODY SPACER, GASKET AND REAR SERVO	7-29	STRAINER AND INTAKE PIPE	7-73
REAR OIL SEAL AND EXTENSION HOUSING	7-30	MODULATOR VALVE AND VACUUM MODULATOR	7-73
FRONT UNIT END PLAY CHECK	7-31	VACUUM MODULATOR DIAGNOSIS	7-73
OIL PUMP	7-32	SPEEDOMETER DRIVEN GEAR	7-73
REAR UNIT END PLAY CHECK	7-34	GOVERNOR	7-74
DISASSEMBLY AND ASSEMBLY OF INDIVIDUAL UNITS	7-36	DIAGNOSIS	7-74
GEAR UNIT	7-36	TRANSMISSION IDENTIFICATION CHART	7-84
GOVERNOR	7-38	TORQUE SPECIFICATIONS	7-78
		BUSHING SERVICE	7-85
		TOOLS	7-82

PERIODIC MAINTENANCE

The fluid level should be checked at each oil change. The fluid and strainer should be replaced every 24 months. If more than 24,000 miles are driven in a 24 month period, change the fluid every 24,000 miles. Under heavy duty operating conditions or excessive stop and go driving, replace fluid and strainer every 12,000 miles.

Use only automatic transmission fluid identified by the mark DEXRON. This type fluid has been especially formulated and tested for use in automatic transmissions. Dexron fluid is available from many lubricant suppliers.

DEXRON type automatic transmission fluid is also preferred for use in all pre 1968 model GM automatic transmissions. Type A, Suffix A fluids identified by the mark "AQ-ATF" and a number followed by the suffix letter A (AQ-ATF-XXXXA) continue to be satisfactory for use in pre 1968 GM automatic transmissions.

CHECKING AND ADDING FLUID (Transmission at Operating Temperature)

The automatic transmission is designed to operate at the full mark on the dip stick at normal operating temperature (170°F.) and should be checked under these conditions. The normal operating temperature is obtained only after at least 15 miles of highway type driving or the equivalent of city driving.

To determine proper level, proceed as follows:

1. Apply parking brake and block car wheels.
2. With the selector lever in the PARK position, start engine. DO NOT RACE ENGINE. Move selector lever through each range.
3. Immediately check fluid with the selector lever in PARK, engine running at SLOW IDLE and the car on a LEVEL surface. The fluid level on the dip stick should be at the "FULL" mark.
4. If additional fluid is required, add sufficient fluid to bring it to the "FULL" mark on the dip stick.

CHECKING AND ADDING FLUID (Transmission at Room Temperature)

If the car has not been driven sufficiently to bring the transmission to operating temperature and it becomes necessary to check the fluid level, the transmission may be checked at room temperature (80°F.) as follows:

1. With parking brake applied, car wheels blocked, selector lever in PARK position, start engine. DO NOT RACE ENGINE. Move selector lever through each range.
2. Immediately check fluid level with selector lever in PARK, engine running at SLOW IDLE and car on a LEVEL surface. The fluid level on the dip stick should be 3/4" below the "FULL" mark.

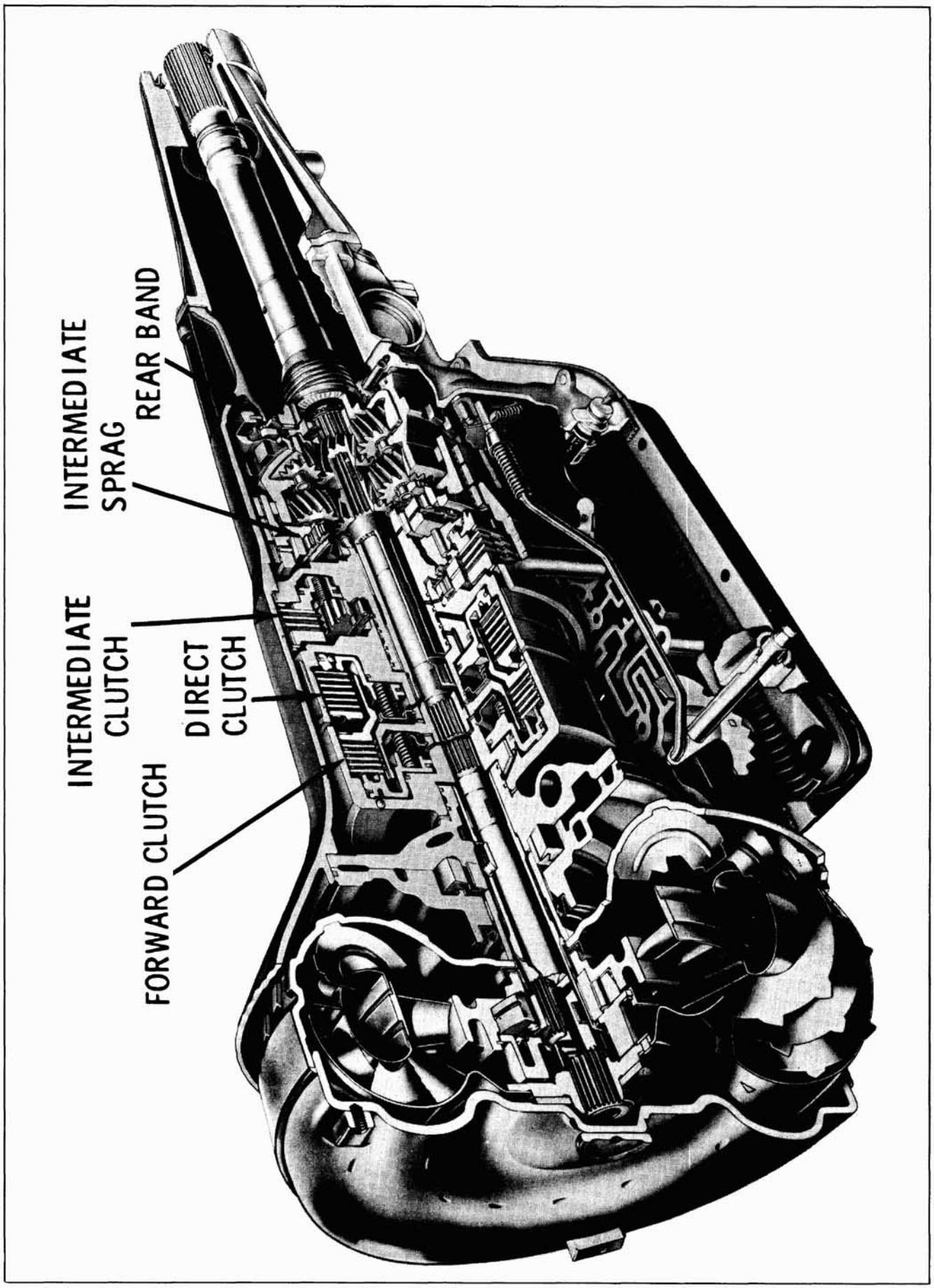


Fig. 7-1 Turbo Hydra-Matic Transmission

3. If additional fluid is required, add sufficient fluid to bring level to 3/4" below the "FULL" mark on the dip stick.

If transmission fluid level is correctly established at 80°F., it will appear at the "FULL" mark on the dip stick when the transmission reaches normal operating temperature (170°F.). The fluid level is set 3/4" below the "FULL" mark on the dip stick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature of 170°F.

Do not overfill as foaming and loss of fluid through the vent pipe might occur as the fluid expands. If fluid is too low, especially when cold, complete loss of drive may result which can cause transmission failure.

CHECKING AND ADDING FLUID
(After Transmission Service)

If work has been performed on the transmission, add the following quantity of fluid, then check fluid as outlined in Steps 1, 2 and 3 under CHECKING AND ADDING FLUID (Transmission at Room Temperature).

1. Pan Removal - 3 quarts
2. Converter Change - 2 quarts
3. Overhaul - 10 quarts

A point to remember when adding fluid to the transmission is that the quantity of fluid alone is not important. The important factor is the relation of the fluid level to the "FULL" mark, dependent on temperature, on the dip stick.

The end result of the checking and adding procedure is to assure that the fluid level is at the "FULL" mark when the transmission is at operating temperature.

GENERAL DESCRIPTION

The Turbo Hydra-Matic transmission is a fully automatic unit consisting primarily of a three element hydraulic torque converter and a compound planetary gear-set. Three multiple-disc clutches, one sprag, one roller clutch, and two bands provide the friction elements required to obtain the desired function of the compound planetary gear-set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear-set produces three forward speeds and reverse.

The three element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly. The stator is mounted on a one-way roller clutch which allows the stator to turn clockwise but not counterclockwise.

The torque converter housing is filled with oil and is attached to the engine crankshaft by a flex plate. The converter pump is an integral part of the converter housing. The pump blades, rotating at engine speed, set the oil within the converter into motion and direct it to the turbine, causing the turbine to rotate.

As the oil passes through the turbine it is traveling in such a direction that if it were not redirected by the stator it would hit the rear of the converter pump blades and impede its pumping action. At low turbine speeds, the oil is redirected by the stator to the converter pump in such a manner that it actually assists the converter pump to deliver power, or multiply engine torque.

As turbine speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, the roller clutch releases, and the stator revolves freely on its shaft. Once the stator becomes inactive, there is no further multiplication of engine torque within the converter. At this point, the converter is merely acting as a fluid coupling, as both the converter pump and turbine are being driven at approximately the same speed - or at a one-to-one ratio.

A gear-type pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to transmission are:

Manual Linkage	- To select the desired operating range.
Engine Vacuum	- To operate a vacuum modulator unit.
12-Volt Electrical Signal	- To operate an electrical detent solenoid.

Approximate gear or torque ratios of the transmission are as follows:

First	- 2.5 gear ratio x 2. converter stall ratio	= 5. :1
* Second	- 1.5 gear ratio	= 1.5:1
* Third	- 1. :1	
Reverse	- 2. :1 gear ratio x 2. converter stall ratio	= 4. :1

* Second and third are also multiplied.

A vacuum modulator is used to automatically sense any change in the torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator for line pressure control, to the 12 accumulator valve, and to the shift valves so that all torque requirements and shift speed requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

The detent solenoid is activated by an electric switch in the throttle linkage. When the throttle is fully opened, the switch located above the accelerator pedal is closed, activating the detent solenoid and causing the transmission to downshift at speeds below approximately 70 mph.

The selector quadrant has six positions: Park, R, N, D, S, L.

Park - Park position positively locks the output shaft to the transmission case by means of a locking pawl to prevent the car from moving in either direction. The engine may be started in park position.

R. - Reverse enables the car to be operated in a reverse direction.

N. - Neutral position enables the engine to be started and run without driving the car.

D. - Drive range is used for all normal driving conditions and maximum economy.

Drive range has three gear ratios from the starting ratio to direct drive. Detent downshifts are available for safe passing by depressing the accelerator to the floor.

S. - Super range provides performance for congested traffic or hilly terrain. Super range has the same starting ratio as drive range, but prevents the transmission from shifting above second speed to maintain second speed acceleration when extra performance is desired. Super range can also be used for engine braking.

Super range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in second until the car speed or the throttle is changed to obtain first gear operation in the same manner as in "D" range.

L. - Low range can be selected at any car speed, and the transmission will shift to second gear and remain in second until car speed is reduced to approximately 40 mph, depending on axle ratio.

Low range position prevents the transmission from shifting out of low gear. This is particularly beneficial for maintaining maximum engine braking, when continuous low gear operation is desirable.

VALVES AND THEIR FUNCTION

PRESSURE REGULATOR (Fig. 7-2)

1. Regulates line pressure according to a fixed spring force and forces controlled by modulator and reverse pressures.
2. Controls the flow of oil that charges the torque converter, feeds the oil cooler and provides lubrication for the transmission.

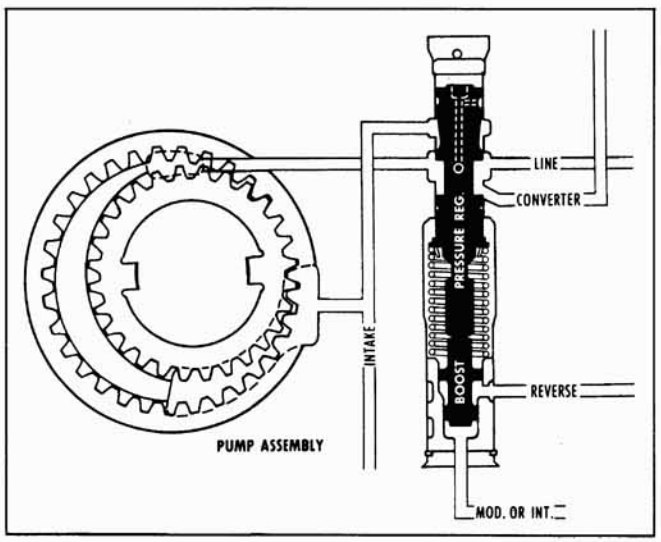


Fig. 7-2 Pressure Regulator Valve

MANUAL VALVE (Fig. 7-3)

Establishes the range of transmission operation, for Park, R, N, D, S, L.

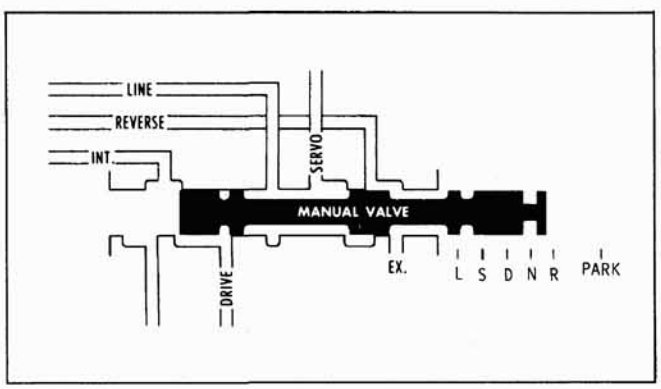


Fig. 7-3 Manual Valve

GOVERNOR ASSEMBLY (Fig. 7-4)

Generates a speed sensitive oil pressure that increases with output shaft or car speed. Governor pressure is used to vary the shift points and modulator pressure regulation.

MODULATOR VALVE (Fig. 7-5)

Regulates line pressure to a modulator pressure that varies with torque to the transmission. It senses forces created by:

1. The vacuum modulator bellows that increase modulator pressure.
2. Engine vacuum acting on a diaphragm to decrease modulator pressure.
3. Governor pressure which is generated by the governor assembly. Governor pressure tends to decrease modulator pressure.

1-2 SHIFT VALVE (Fig. 7-6)

Controls the oil pressure that causes the transmission to shift from 1-2 or 2-1. Its operation is controlled by governor pressure, low oil pressure, detent pressure, modulator pressure, and spring force.

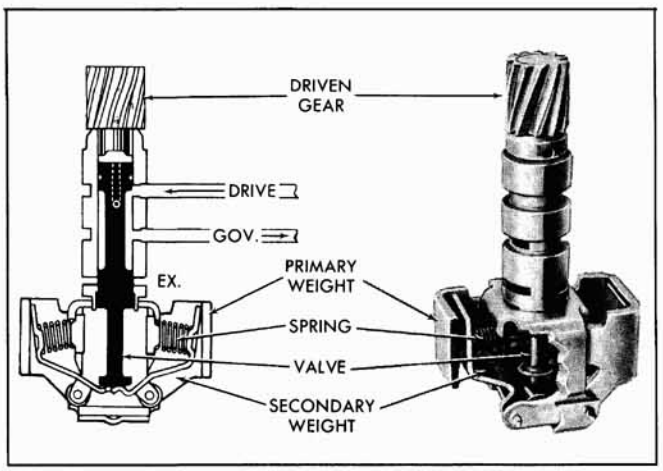


Fig. 7-4 Governor Assembly

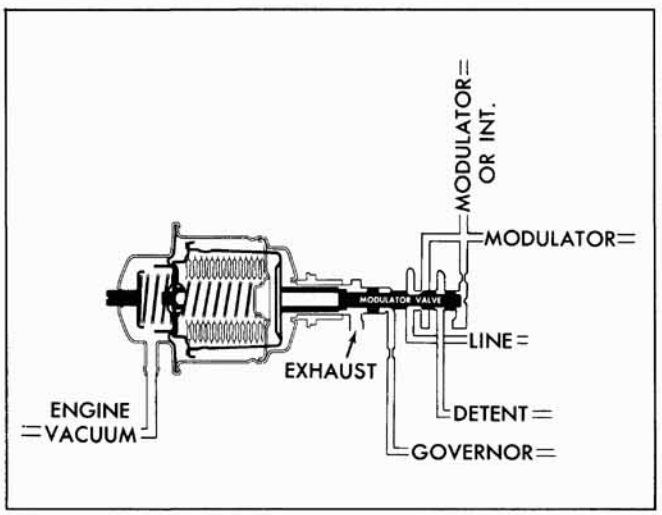


Fig. 7-5 Vacuum Modulator Assembly

1-2 REGULATOR VALVE (Fig. 7-6)

Regulates modulator pressure to a pressure proportional to modulator pressure, tending to keep the 1-2 shift valve in the downshift position.

1-2 DETENT VALVE (Fig. 7-6)

Senses regulated modulator pressure tending to hold the 1-2 shift valve in the downshift position and provides an area for detent pressure for detent 2-1 shifts.

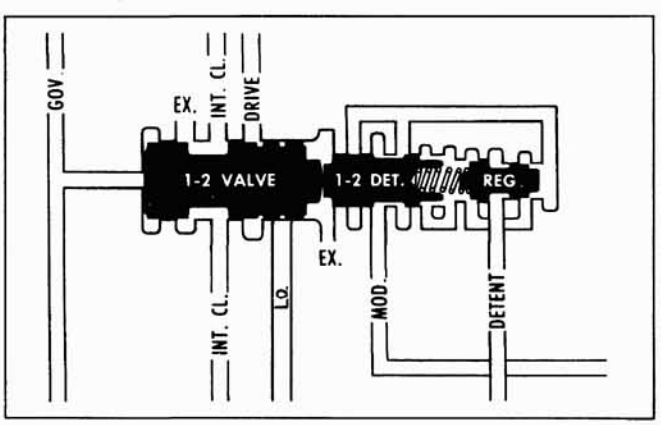


Fig. 7-6 1-2 Shift Valve

2-3 SHIFT VALVE (Fig. 7-7)

Controls the oil pressure that causes the transmission to shift from 2-3 or 3-2. Its operation is controlled by modulator, intermediate, governor and detent pressure as well as a spring force.

2-3 MODULATOR VALVE (Fig. 7-7)

Senses modulator pressure to apply a variable force proportional to modulator pressure which tends to hold the 2-3 shift valve downshifted.

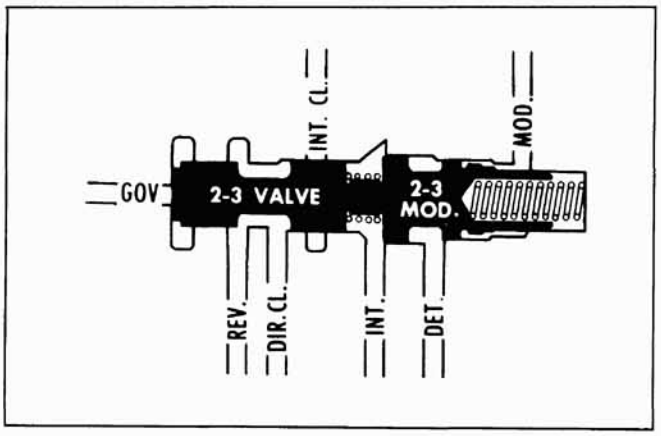


Fig. 7-7 2-3 Shift Valve

3-2 VALVE (Fig. 7-8)

Shuts off modulator pressure from acting on the shift valve trains after the direct clutch has been applied. This allows fairly heavy throttle operation in third speed without downshifting. A part-throttle downshift can be obtained, however, by increasing modulator pressure (sudden throttle opening) to a point where, when combined with the 3-2 valve spring, it is greater than direct clutch pressure. In third speed, detent pressure can be directed to the shift valves to provide the detent downshift forces.

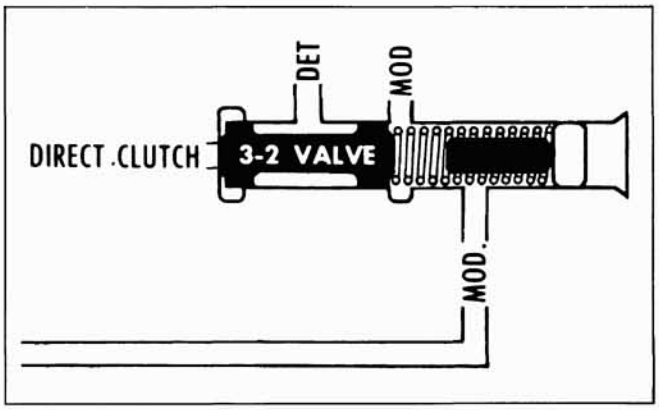


Fig. 7-8 3-2 Valve

1-2 ACCUMULATOR VALVE (Fig. 7-9)

Regulates drive pressure to a 1-2 accumulator pressure which as modulator pressures increase to control the intermediate clutch pressure during the 1-2 shift. Detent and low oil pressures increase 1-2 accumulator pressure.

DETENT VALVE

Shifts when line oil is exhausted at the end of the valve when the detent solenoid is energized. This allows the detent regulator valve to regulate and directs detent pressure to the 1-2 and 2-3 modulator valve.

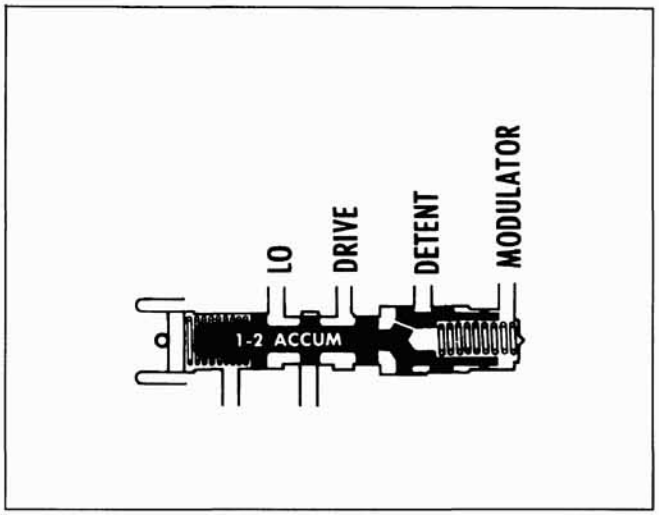


Fig. 7-9 1-2 Accumulator Assembly

DETENT REGULATOR VALVE

When the detent valve shifts, the detent regulator is free to allow drive oil to enter the detent passage and thus becomes regulated to a value of 70 psi. Detent pressure will also flow into the modulator passage which flows to the shift valves. Low oil moves the detent regulator open to drive oil allowing drive oil to enter the modulator and detent passages.

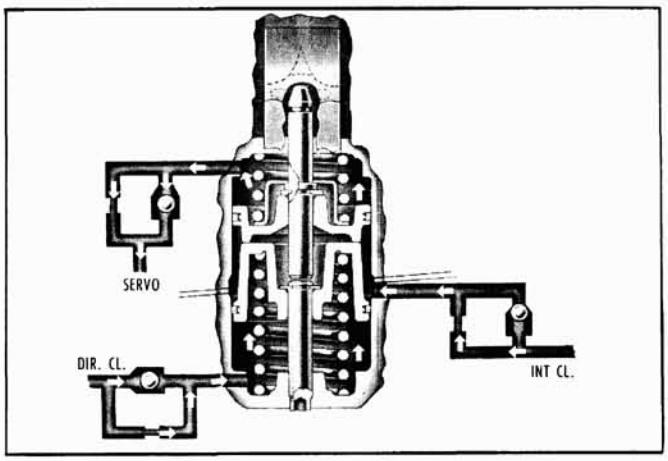


Fig. 7-13 Front Servo

REAR SERVO AND ACCUMULATOR

The rear servo and accumulator assembly serves three functions:

1. The band apply piston provides the band apply force to hold the rear band in reverse.
2. The band apply piston provides the band apply force for overrun band apply in low range first gear.
3. The accumulator piston in conjunction with 1-2 accumulator oil provides the accumulator function for the apply of the intermediate clutch.

FRONT SERVO (Fig. 7-13)

The front servo serves two functions:

1. Intermediate clutch oil applies the front servo to apply the front band in second gear, intermediate and low range.
2. During a 2-3 shift, direct clutch oil utilizes the servo and accumulator pistons as the accumulator for direct clutch apply.

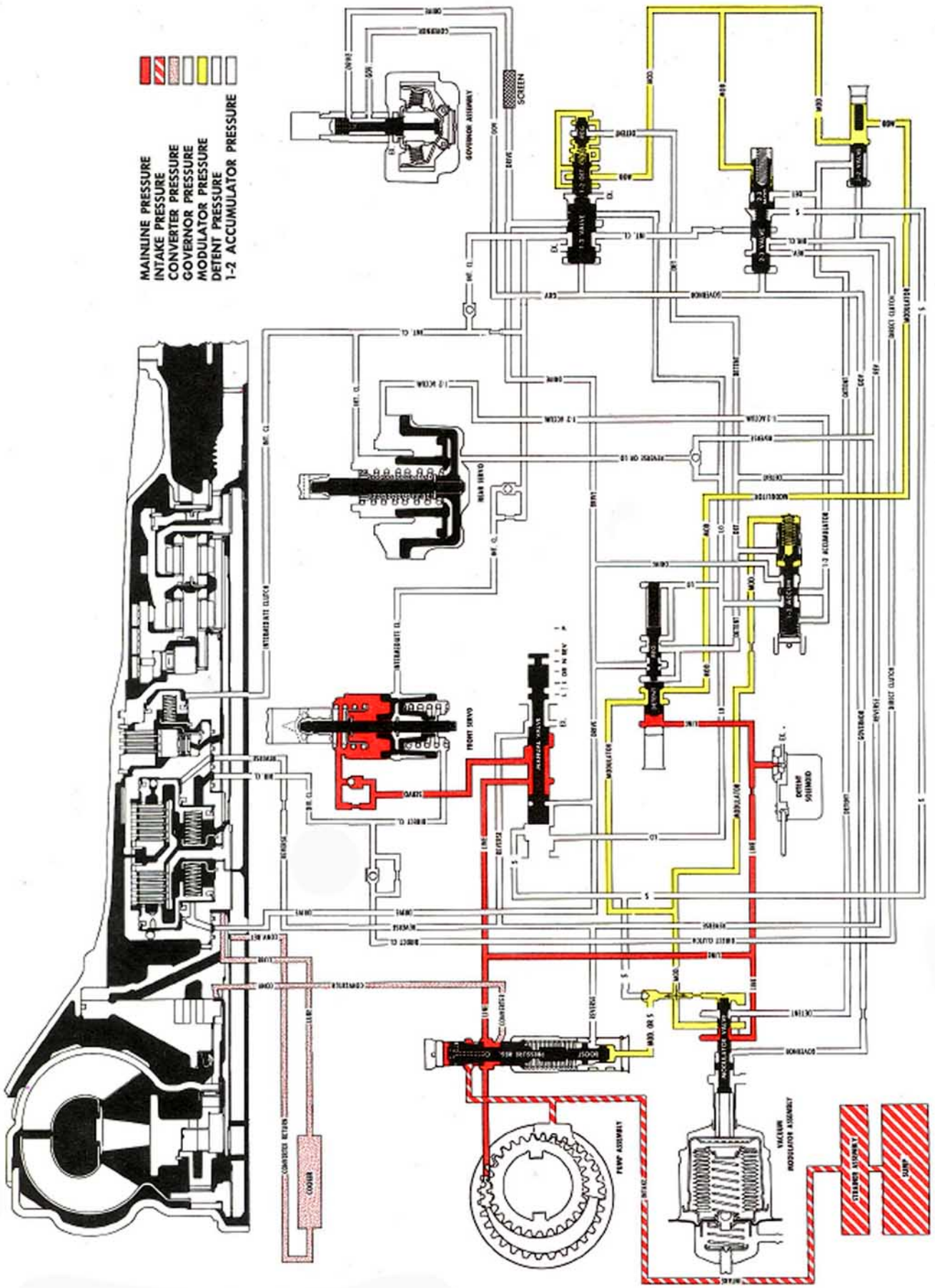


Fig. 7-14 Park or Neutral-Engine Running

OIL FLOW CIRCUIT (Fig. 7-14)
PARK OR NEUTRAL—ENGINE RUNNING

FORWARD CLUTCH - RELEASED
DIRECT CLUTCH - RELEASED

INTERMEDIATE CLUTCH - RELEASED
LOW SPRAG - INEFFECTIVE

FRONT BAND - RELEASED
INTERMEDIATE SPRAG - INEFFECTIVE
REAR BAND - RELEASED

Whenever the engine is running at idle with the selector lever in "P" or "N", oil from the pump is directed to the:

1. Pressure Regulator Valve
2. Converter
   a. Oil Cooler
   b. Lubrication System
   c. Stator Valve
3. Manual Valve
4. Detent Valve
5. Detent Solenoid
6. Vacuum Modulator Valve
7. Front Servo (Neutral only)

COOLING AND LUBRICATION

Oil flows from the pump to the pressure regulator valve which regulates the pump pressure. When the pump output exceeds the demand of line pressure, oil from the pressure regulator is directed to the converter feed passage to fill the converter. Oil from the converter, termed converter return oil, is directed to the transmission cooler. Oil from the cooler is directed to the transmission lubrication system.

Line pressure acts on the:

1. Manual Valve
2. Detent Valve
3. Detent Solenoid
4. Modulator Valve

Line pressure at the modulator valve is regulated to a pressure called modulator oil, which acts on the pressure boost valve, 1-2 accumulator and primary valves, and passes through the detent valve and 3-2 valve to the 1-2 and 2-3 valve trains.

SUMMARY

The converter is filled, all clutches and bands are released. The transmission is in Neutral.

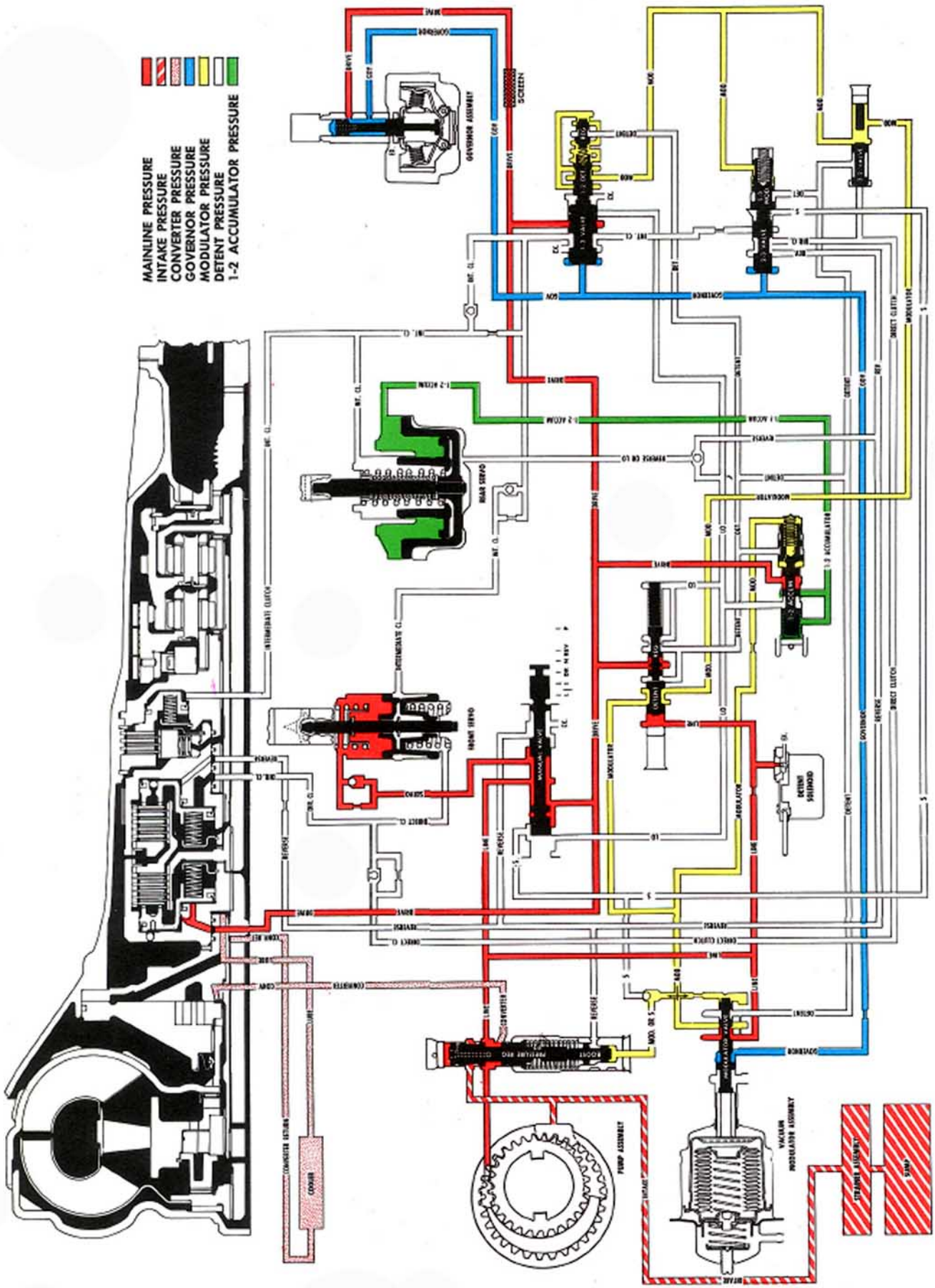


Fig. 7-15 Drive Range — First Speed

OIL FLOW CIRCUIT (Fig. 7-15)
DIRVE RANGE—FIRST SPEED

FORWARD CLUTCH - APPLIED
LOW SPRAG - EFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - RELEASED

REAR BAND - RELEASED
INTERMEDIATE CLUTCH - RELEASED
INTERMEDIATE SPRAG - INEFFECTIVE

When the selector lever is moved to the "D" position, the manual valve is repositioned to allow line pressure to enter the drive circuit. Drive oil then flows to the:

1. Forward clutch
2. 1-2 Shift Valve
3. Governor Assembly
4. 1-2 Accumulator Valve
5. Detent Regulator Valve

BASIC CONTROL

Drive oil is directed to the forward clutch where it acts on two areas of the clutch piston to apply the forward clutch. The first, or inner area, is fed through an unrestricted passage. The outer area is fed through an orifice to insure a smooth shift from Park, Neutral and Reverse to Drive.

Drive oil at the governor assembly is regulated to a variable pressure. This pressure, called governor oil, increases with car speed and acts against the ends of the 1-2 and 1-3 shift valves and an area on the modulator valve.

Drive oil is also regulated to another variable pressure at the 1-2 accumulator valve. This pressure, called 1-2 accumulator oil, is controlled by modulator oil which is directed to the rear servo. 1-2 accumulator oil at the rear servo acts on the accumulator piston.

SUMMARY

The converter is filled. The forward clutch is applied. The transmission is in low gear.

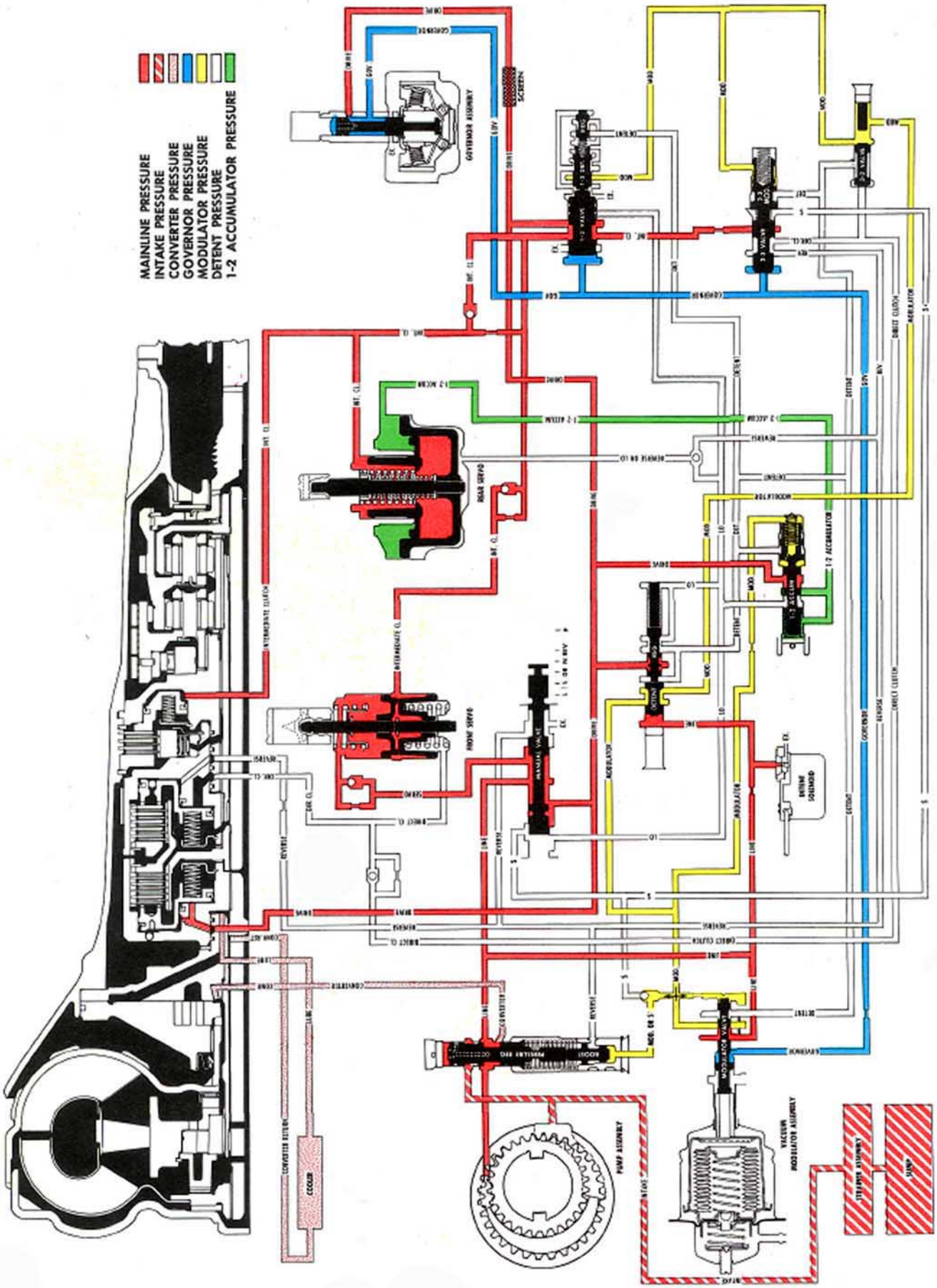


Fig. 7-16 Drive Range — Second Speed

OIL FLOW CIRCUIT (Fig. 7-16)
DRIVE RANGE—SECOND SPEED

FORWARD CLUTCH - APPLIED
LOW SPRAG - INEFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - RELEASED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - APPLIED
INTERMEDIATE SPRAG - EFFECTIVE

As both car speed and governor pressure increase, the force of governor oil acting on the 1-2 shift valve will overcome the force of re-regulated modulator oil pressure. This allows the 1-2 shift valve to open, permitting drive oil to enter the intermediate clutch passage. Oil in this passage is called intermediate clutch oil.

Intermediate clutch oil from the 1-2 shift valve is directed to the:

1. Intermediate Clutch
2. Rear Servo
3. Front Servo and Accumulator Pistons
4. 2-3 Shift Valve

BASIC CONTROL

Intermediate clutch oil from the 1-2 shift valve seats a one-way check ball and flows through an orifice to the intermediate clutch piston to apply the intermediate clutch. At the same time, intermediate clutch oil moves the accumulator piston against the 1-2 accumulator oil and accumulator spring to maintain lower pressure in the clutch during a 1-2 shift for a smooth clutch apply. Intermediate clutch oil seats a second one-way check ball and flows to the front servo and accumulator pistons. Intermediate clutch oil is also directed to a land of the 2-3 shift valve.

SUMMARY

The forward and intermediate clutches are applied. The transmission is in second gear.

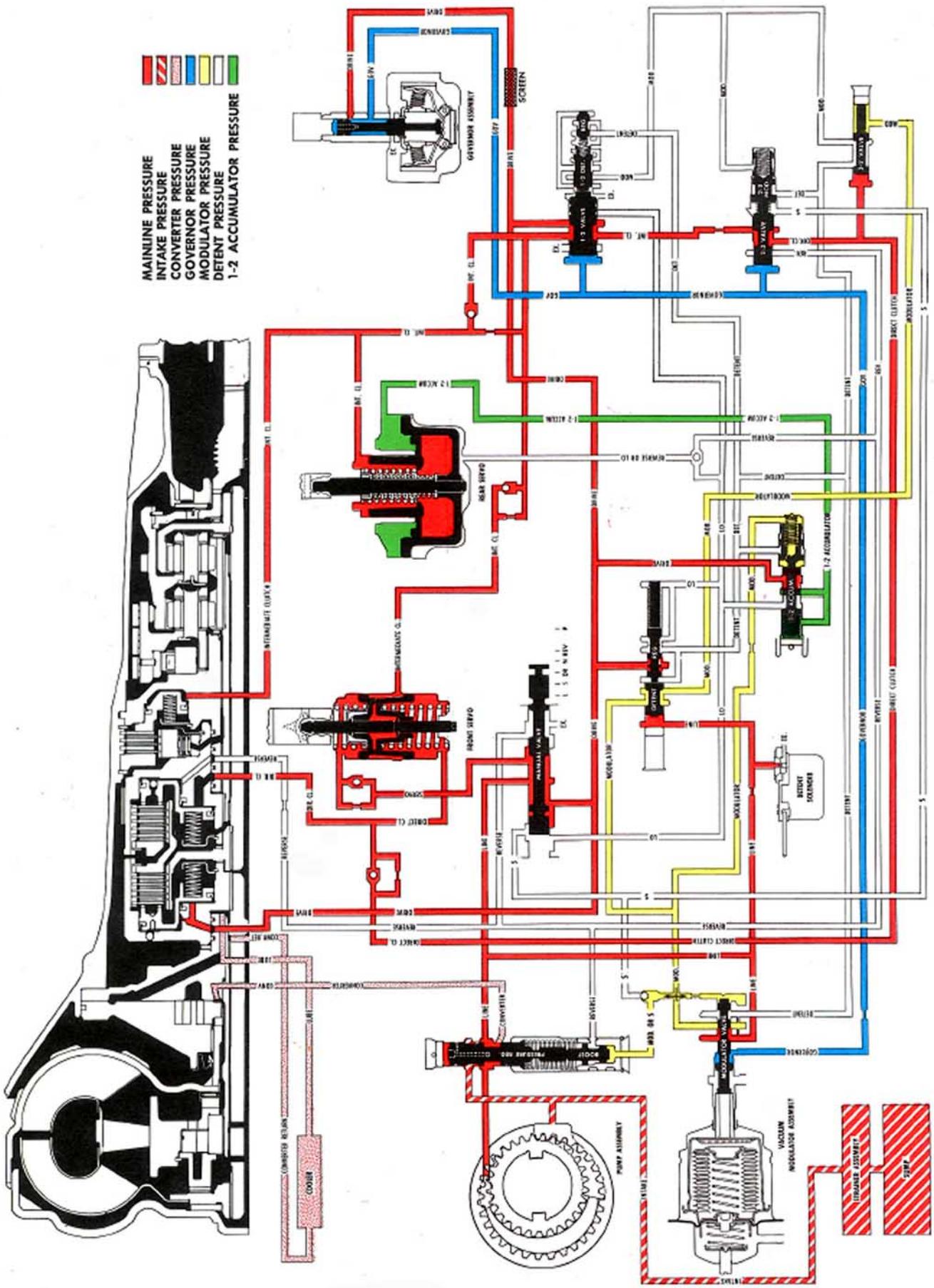


Fig. 7-17 Drive Range — Third Speed

OIL FLOW CIRCUIT (Fig. 7-17)
DRIVE RANGE—THIRD SPEED

FORWARD CLUTCH - APPLIED
LOW SPRAG - INEFFECTIVE

DIRECT CLUTCH - APPLIED
FRONT BAND - RELEASED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - APPLIED
INTERMEDIATE SPRAG - INEFFECTIVE

As car speed and governor pressure increase, the force of governor oil acting on the 2-3 shift valve overcomes the force of the 2-3 shift valve spring and modulator oil. This allows the 2-3 shift valve to move, feeding intermediate clutch oil to the direct clutch passage. This oil is termed direct clutch oil.

Direct clutch oil from the 2-3 shift valve is directed to the:

1. Direct Clutch
2. Front Accumulator Piston
3. 3-2 Valve

BASIC CONTROL

Direct clutch oil from the 2-3 shift valve flows past a one-way check valve to the inner area of the direct clutch piston to apply the direct clutch. Simultaneously, direct clutch oil is fed to the front accumulator piston. The pressure of the direct clutch oil, combined with the accumulator spring, moves the accumulator and servo pistons against servo oil. This acts as an accumulator for a smooth direct clutch apply.

Direct clutch oil is also supplied to the 3-2 valve to move the valve against modulator pressure. This cuts off modulator oil to the 1-2 regulator and 2-3 modulator valves and allows the transmission to utilize the torque multiplying characteristics of the converter.

SUMMARY

The forward, intermediate and direct clutches are applies. The transmission is in third gear (direct drive).

PART THROTTLE DOWNSHIFT

A part throttle 3-2 downshift can be accomplished below approximately 33 mph by depressing the accelerator far enough to raise modulator pressure to approximately 105 psi. Modulator pressure and the 3-2 valve spring will move the 3-2 valve against direct clutch oil and allow modulator oil to act on the 2-3 modulator valve. This moves the 2-3 valve train against governor oil and shifts the transmission to second speed.

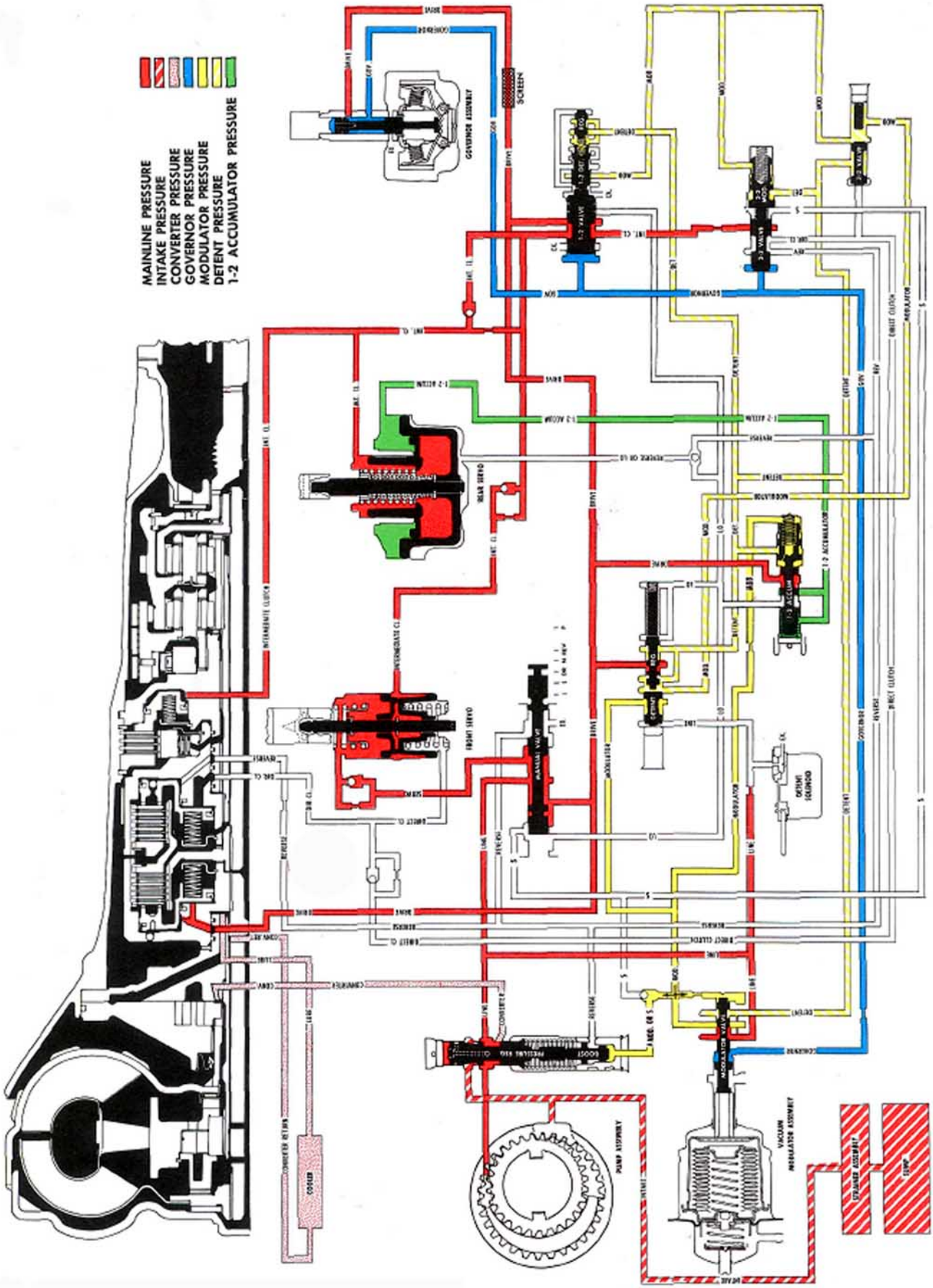


Fig. 7-18 Detent Downshift

OIL FLOW CIRCUIT (Fig. 7-18)

DETENT DOWNSHIFTS

(Valves in Second Speed Position)

FORWARD CLUTCH - APPLIED
LOW SPRAG - INEFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - RELEASED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - APPLIED
INTERMEDIATE SPRAG - EFFECTIVE

While operating at speeds below approximately 70 mph a forced or detent 3-2 downshift is possible by depressing the accelerator fully. This engages an electrically operated switch and actuates the detent solenoid. The detent solenoid opens an orifice that allows line oil at the detent valve to be exhausted, thus permitting the detent regulator valve to operate. Line oil acting on the detent valve and solenoid is supplied by a smaller orifice.

Drive oil on the detent regulator valve is then regulated to a pressure of approximately 70 psi and called detent oil. Detent oil is then routed to the:

1. Modulator Passage
2. 1-2 Regulator Valve
3. 2-3 Modulator Valve
4. 3-2 Valve
5. 1-2 Primary Accumulator Valve
6. Vacuum Modulator Valve

Detent oil in the modulator passage and at the 2-3 modulator valve will close the 2-3 shift valve below approximately 70 mph, shifting the transmission to second gear.

A detent 2-1 downshift can also be accomplished below approximately 20 mph because detent oil is directed to the 1-2 regulator valve, regulating or exhaust port. This allows detent oil to act on the 1-2 regulator and 1-2 detent valve to close the 1-2 shift valve, shifting the transmission to low gear.

To insure clutch durability during 1-2 upshifts under detent conditions, detent oil is directed to the 1-2 accumulator primary valve to increase 1-2 accumulator oil pressure acting on the rear servo accumulator piston.

Detent oil is also directed to the modulator valve to prevent modulator pressure from regulating below 70 psi at high speeds or at high altitudes.

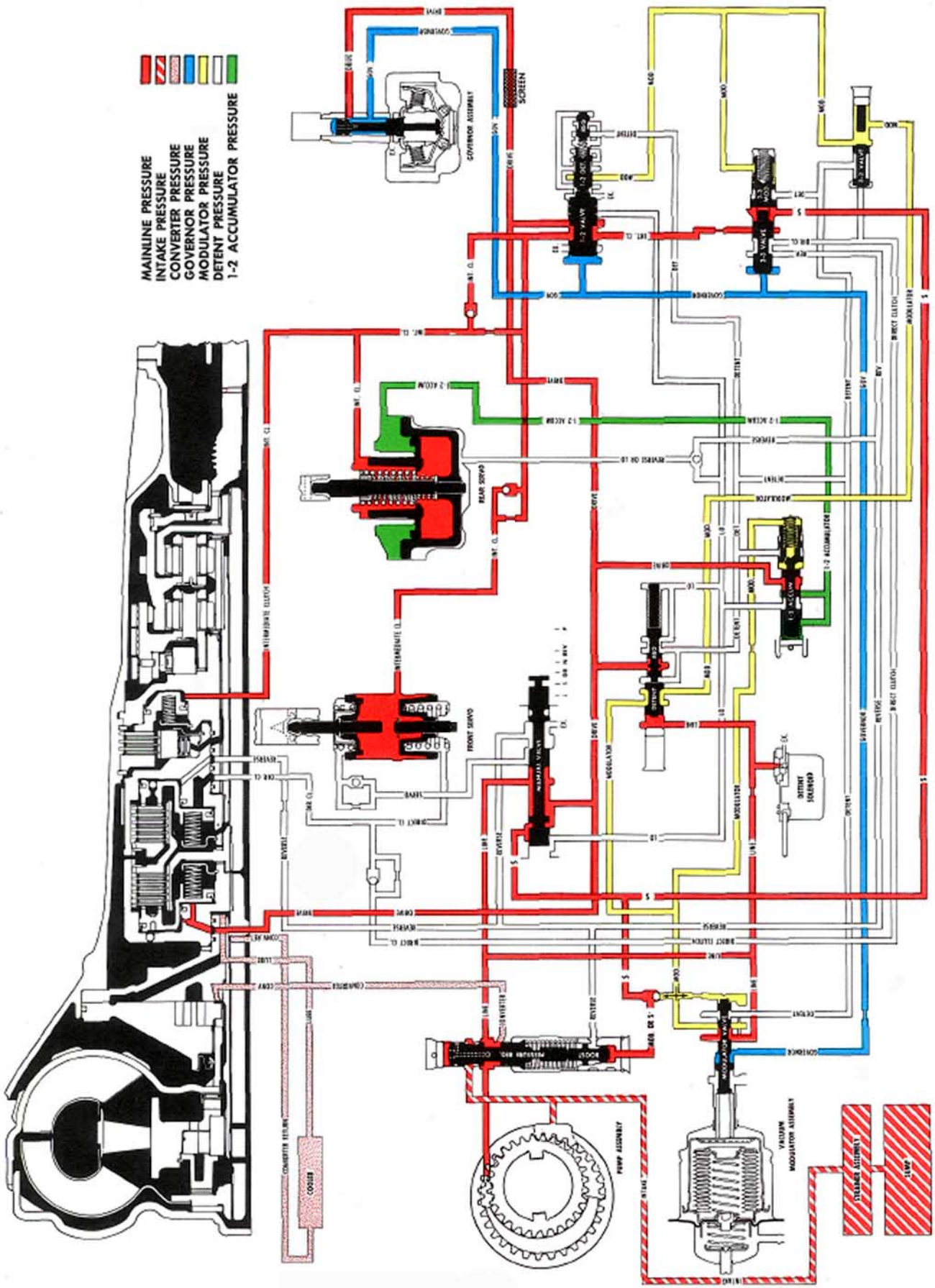


Fig. 7-19 Super Range

OIL FLOW CIRCUIT (Fig. 7-19)
SUPER

(Valves in Second Speed Position)

FORWARD CLUTCH - APPLIED
LOW SPRAG - INEFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - APPLIED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - APPLIED
INTERMEDIATE SPRAG - EFFECTIVE

A 3-2 downshift can be accomplished by moving the selector lever from Drive to Super Range. When the selector lever is in "S", intermediate oil from the manual valve is directed to the:

1. Pressure Boost Valve

2. 2-3 Shift Valve

Intermediate oil at the boost valve will increase line pressure to 150 psi. This increased intermediate oil pressure at the 2-3 shift valve will close the 2-3 shift valve regardless of car speed.

For engine braking the front band is applied by exhausting servo oil at the manual valve in Super range. This allows intermediate clutch oil, acting on the servo piston, to move the piston and apply the front band. Once the transmission is in second speed - Super range, it cannot upshift to third gear regardless of car speed.

SUMMARY

The forward and intermediate clutches and front band are applied. The transmission is in second gear - Super Range.

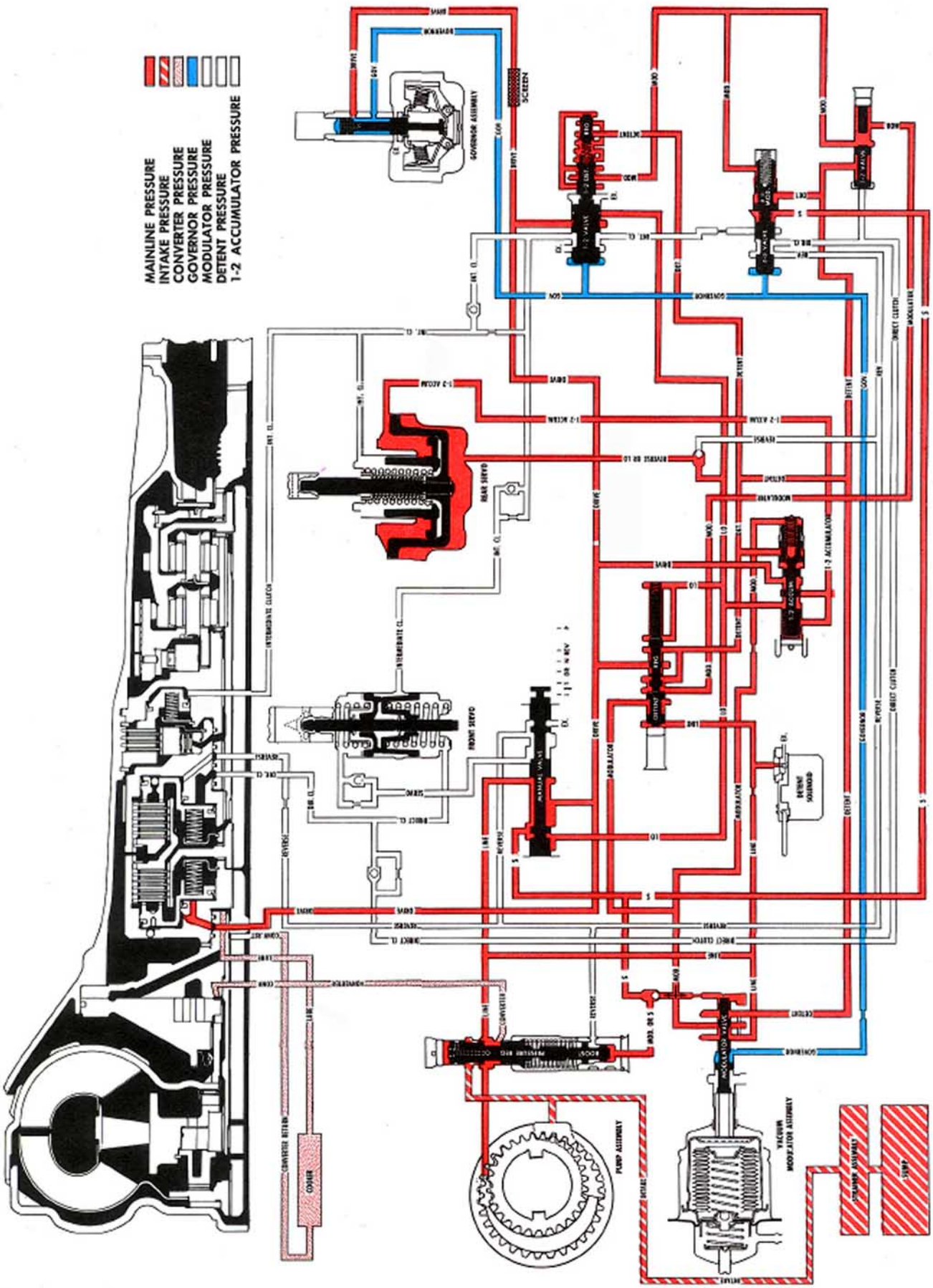


Fig. 7-20 Low Range — First Speed

OIL FLOW CIRCUIT (Fig. 7-20)
LOW RANGE—FIRST SPEED

(Valves in First Speed Position)

FORWARD CLUTCH - APPLIED
LOW SPRAG - EFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - RELEASED
REAR BAND - APPLIED

INTERMEDIATE CLUTCH - RELEASED
INTERMEDIATE SPRAG - INEFFECTIVE

Maximum downhill braking can be attained at speeds below 40 mph with the selector lever in "L" position as this directs low oil from the manual valve to the:

1. Rear Servo
2. 1-2 Accumulator Valve
3. Detent Regulator Valve
4. 1-2 Shift Valve

BASIC CONTROL

Low oil flows past a ball check to the apply side of the rear servo piston and to the 1-2 accumulator valve to raise the 1-2 accumulator oil to line pressure for a smooth band apply.

Low oil acts on the detent regulator valve. Combined with the detent spring, low oil holds the detent valve against line oil acting on the detent valve, causing drive oil to flow through the detent regulator valve into the detent and modulator passages. Modulator and detent oil at line pressure acting on the 1-2 regulator and 1-2 detent valve overcomes governor oil and low oil on the 1-2 shift valve at approximately 40 mph and the transmission will shift to low gear.

With the transmission in first speed - Low Range, the transmission cannot upshift to second speed regardless of car or engine speed.

SUMMARY

The forward clutch and rear band are applied. The transmission is in first speed - Low Range.

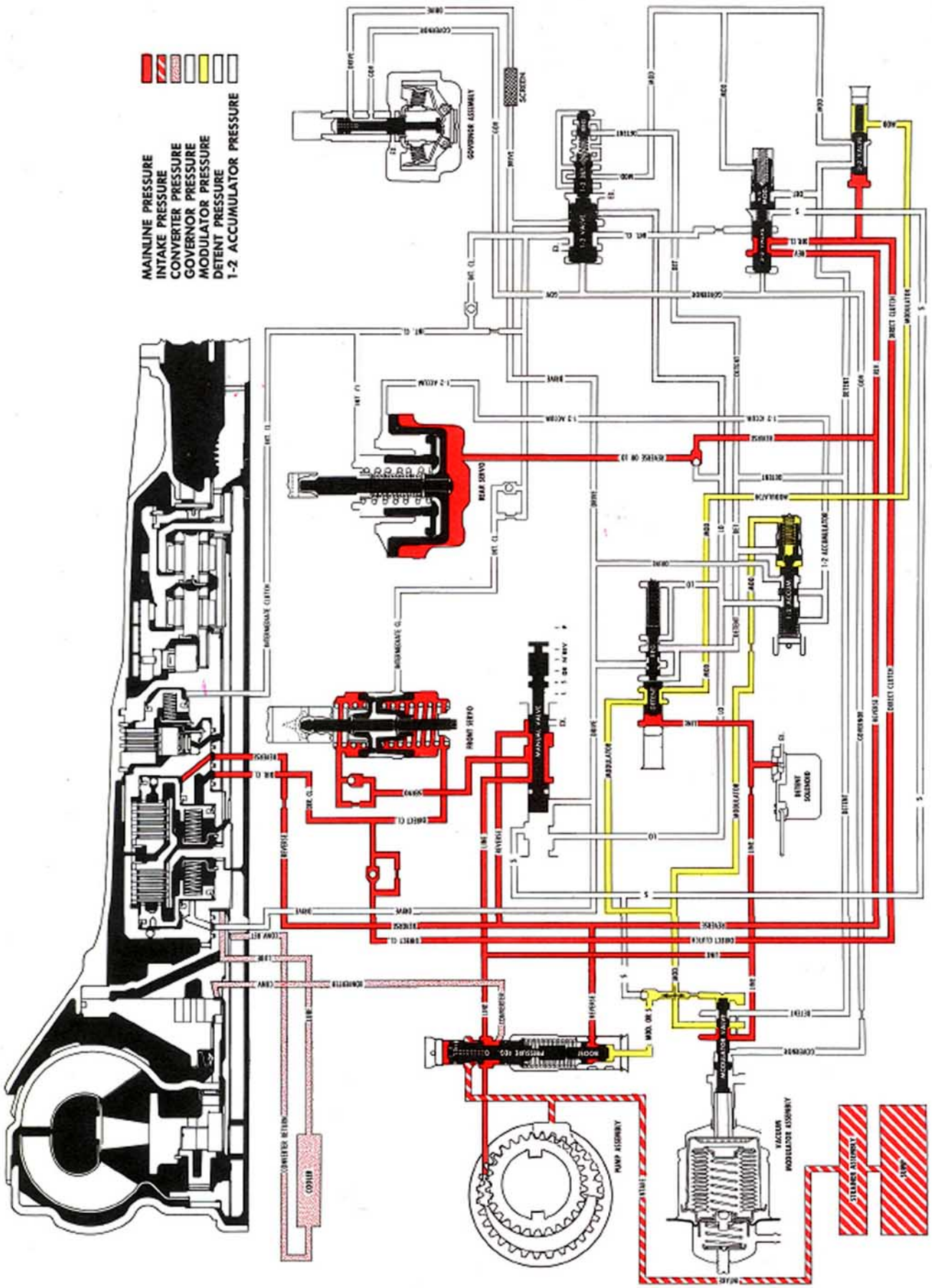


Fig. 7-21 Reverse

OIL FLOW CIRCUIT (Fig. 7-21)
REVERSE

FORWARD CLUTCH - RELEASED
LOW SPRAG - INEFFECTIVE

DIRECT CLUTCH - APPLIED
FRONT BAND - RELEASED
REAR BAND - APPLIED

INTERMEDIATE CLUTCH - RELEASED
INTERMEDIATE SPRAG - INEFFECTIVE

When the selector lever is moved to the "R" position, the manual valve is repositioned to allow line pressure to enter the reverse circuit. Reverse oil then flows to the:

1. Direct Clutch
2. 2-3 Shift Valve
3. Rear Servo Piston
4. Pressure Boost Valve

BASIC CONTROL

Reverse oil from the manual valve flows to the large area of the direct clutch piston and to the 2-3 shift valve. From the 2-3 shift valve, it enters the direct clutch passage and is directed to the small area of the direct clutch piston to apply the direct clutch.

Reverse oil flows to the rear servo and acts on the servo piston to apply the rear band. Reverse oil also acts on the pressure boost valve to boost line pressure.

SUMMARY

The direct clutch and the rear band are applied. The transmission is in reverse.

OPERATIONS NOT REQUIRING REMOVAL OF TRANSMISSION

Some of the parts and/or units can be removed from the transmission without removing the transmission assembly from the car. The procedures for such operations are not specifically outlined; however, the basic procedure and specifications as outlined under DISASSEMBLY OF THE TRANSMISSION and ASSEMBLY OF THE TRANSMISSION will apply.

UNITS OR PARTS THAN CAN BE READILY REMOVED FROM THE TRANSMISSION ARE:

Output Shaft "O" Ring
Oil Pan and Gasket
Extension Housing Gasket and/or Seal
Governor
Vacuum Modulator and Modulator Valve
Rear Seal
Oil Cooler Lines
Speedometer Driven Gear
Speedometer Drive Gear

UNITS OR PARTS THAN CAN BE REMOVED AFTER OIL PAN REMOVAL ARE:

Strainer Assembly and "O" Ring
Manual Detent Lever, Shaft and/or Seal
Park Lock Actuator
Pressure Regulator Valve and Regulator Boost Valve
Parking Pawl and/or Shaft and Cup Plug
Solenoid Plug (In Case)
Rear Servo
Detent Solenoid
Control Valve Body and/or Separator Plate
Check Balls - Refer to Fig. 7-252 for correct location of check balls on spacer plate.
Front Servo

TRANSMISSION REMOVAL

1. Remove flywheel cover.
2. Remove torque converter attaching bolts.

Mark flywheel and converter so they can be installed in the same position.

3. Install Engine Support Bar BT-30-16. (Fig. 7-22).
4. Disconnect solenoid wire and manual shift linkage at side of transmission.
5. Disconnect oil cooler lines, vacuum modulator line and filler pipe.
6. Disconnect parking brake cable.
7. Remove propeller shaft assembly.

Scribe marks on drive shaft and companion flange for correct assembly.

8. Disconnect exhaust pipe bracket at rear of crossmember.
9. Position transmission jack under transmission.
10. Remove crossmember.
11. Remove transmission to block attaching bolts.
12. Move transmission away from engine and install Tool J-21654 to hold converter in place. (Fig. 7-248)
13. Lower transmission and remove from car. (Fig. 7-23)

TRANSMISSION INSTALLATION

To install, reverse the removal procedure and include the following:

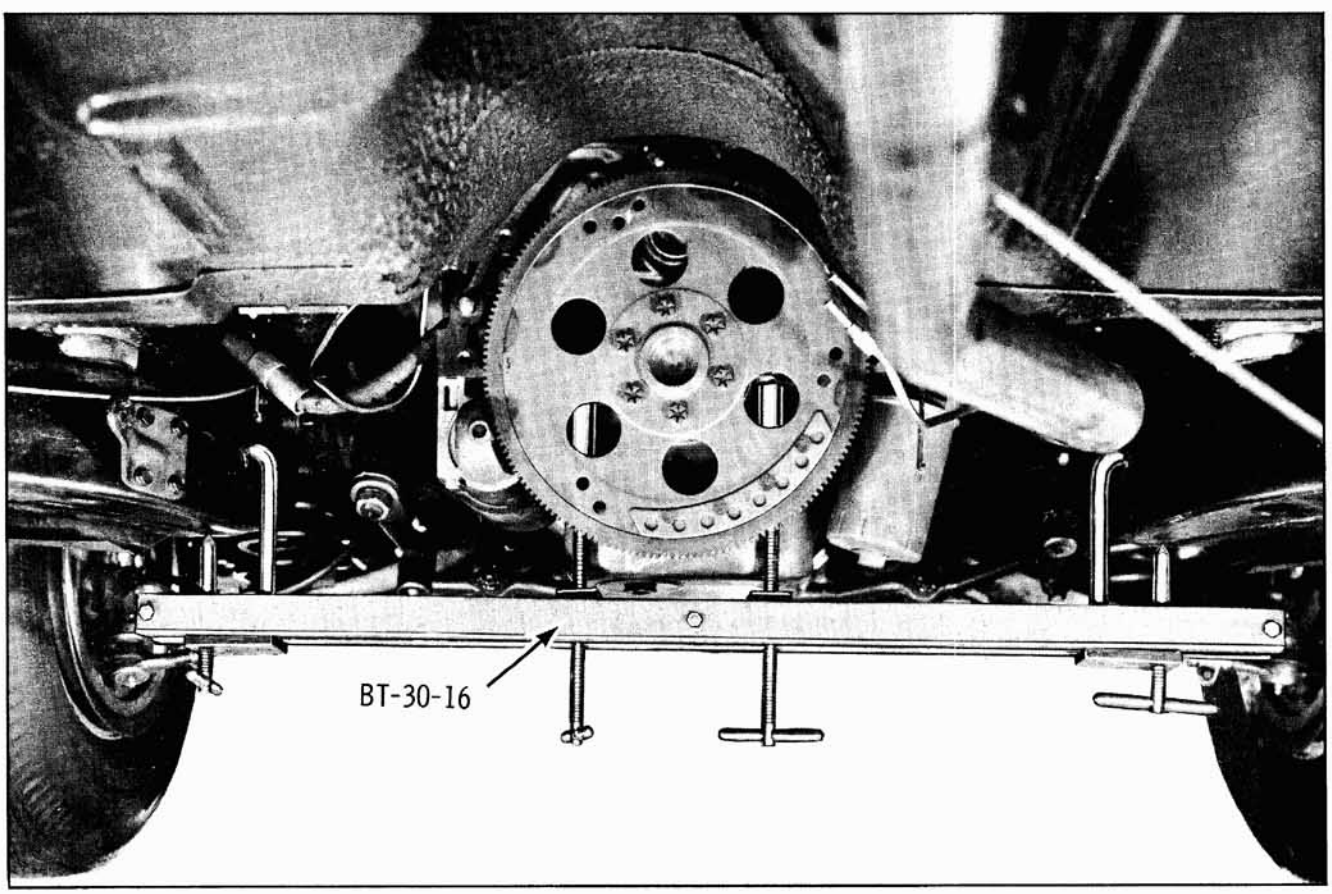


Fig. 7-22 Engine Support Bar

Before installing the flex plate to converter bolts, make certain that the weld nuts on the converter are flush with the flex plate and the converter rotates freely by hand in this position. Hand start the three bolts and tighten finger tight, then torque to specifications. This will insure proper converter alignment.

After transmission is installed, add approximately three quarts of Hydra-Matic fluid if pan was removed. Add approximately ten quarts if transmission was overhauled.

A point to remember when adding fluid to the transmission is that the quantity of fluid alone is not important. The important factor is the relation of the fluid level to the "FULL" mark, dependent on temperature, on the dip stick.

The end result of the checking and adding procedure is to assure that the fluid level is at the "FULL" mark when the transmission is at operating temperature. Refer to PERIODIC MAINTENANCE at the front of this Section for checking procedures.

MINOR SERVICE OPERATIONS

SERVICING THE OIL COOLER

The oil cooler is located in the side tank of the radiator and its purpose is to cool the oil in the event excessive temperature tends to develop. (Fig. 7-24)

In a major transmission failure, where particles of metal have been carried with the oil throughout the units of the transmission, it will be necessary to flush out the oil cooler and connecting lines. The oil cooler is a sealed container providing a passage for oil to flow from the inlet to the outlet. Clean solvent can be flushed through the cooler with air pressure. (An engine desludge gun may be used.) The cooler should be back-flushed first through the return line to remove all foreign material possible. Then flush through the inlet line and finish by flushing through the return line. Clean remaining solvent from cooler with compressed air applied to the return line and flush with Hydra-Matic oil.

THROTTLE LINKAGE ADJUSTMENTS
(Refer to Engine Section 6)

MANUAL LEVER ADJUSTMENT
(WITHOUT CONSOLE)

The manual lever adjustment provides proper clearance between the "D" detent in the transmission and the stop for the manual shift lever in the upper steering column mast jacket. The adjustment is made as outlined in Fig. 7-26.

CONSOLE SHIFT LINKAGE

For linkage removal, refer to Fig. 7-27 and 7-28. To remove the shift lever or bracket assembly, the console must be removed.

MANUAL LEVER ADJUSTMENT
(WITH CONSOLE)

1. Place shift lever in park position.

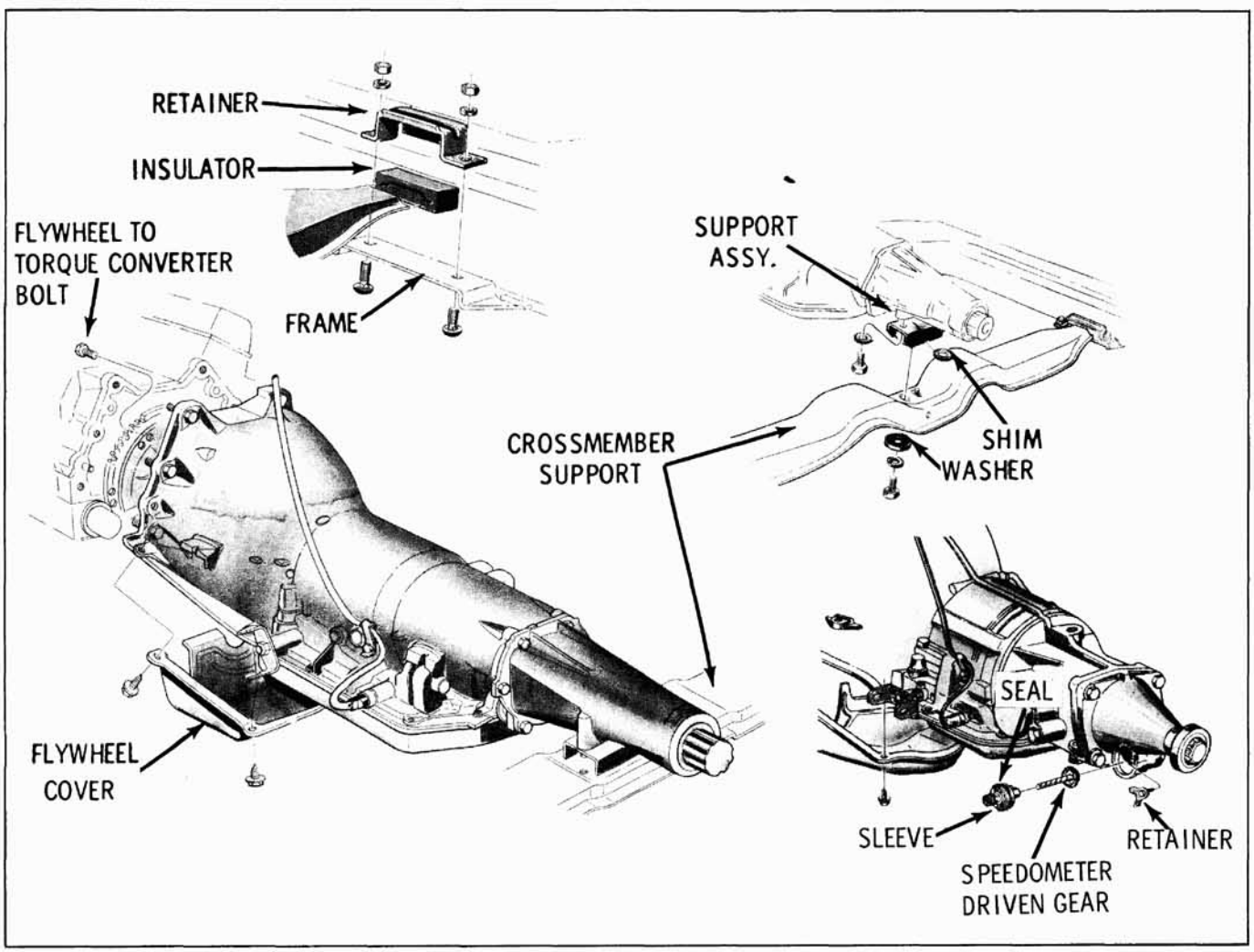


Fig. 7-23 Transmission Attachment

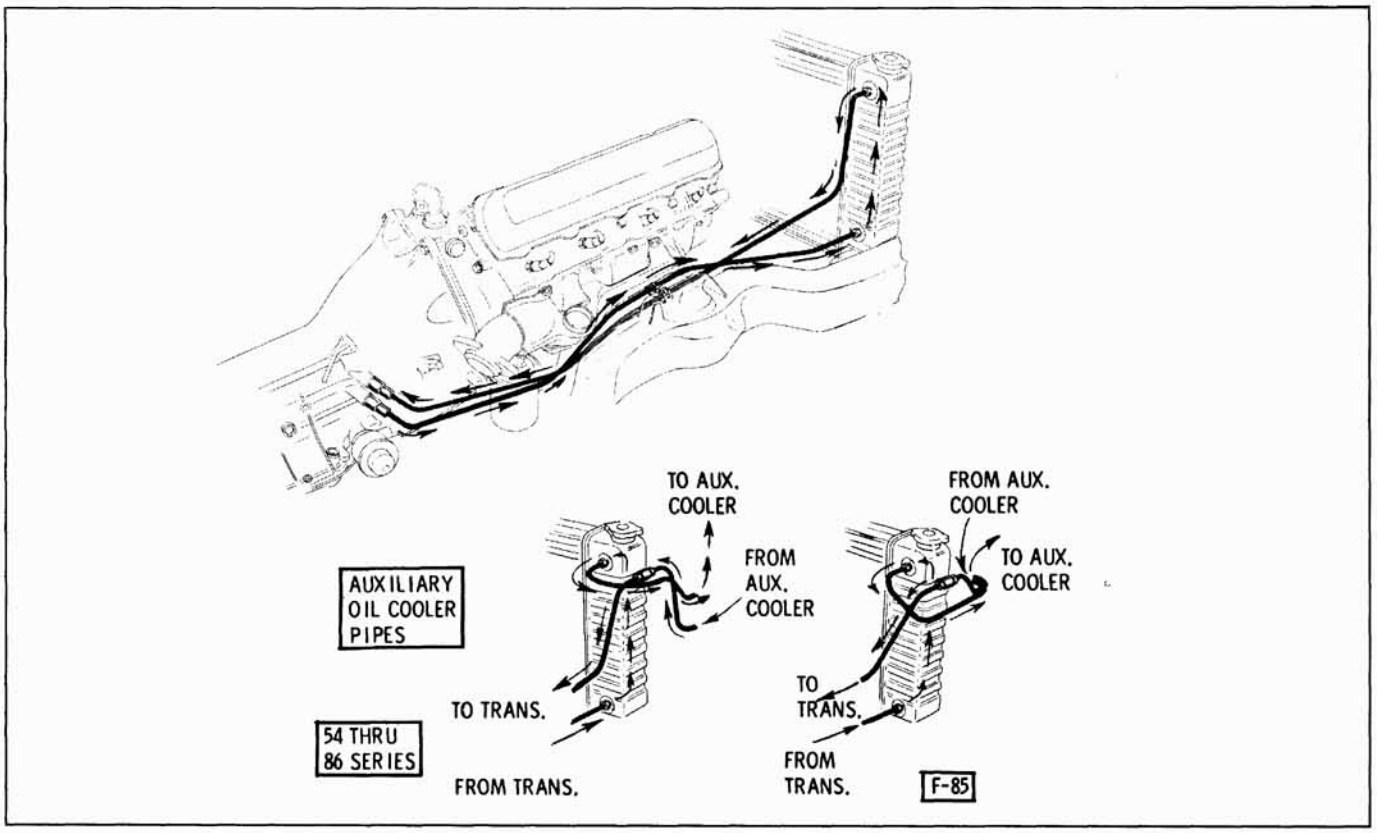


Fig. 7-24 Oil Cooler Lines

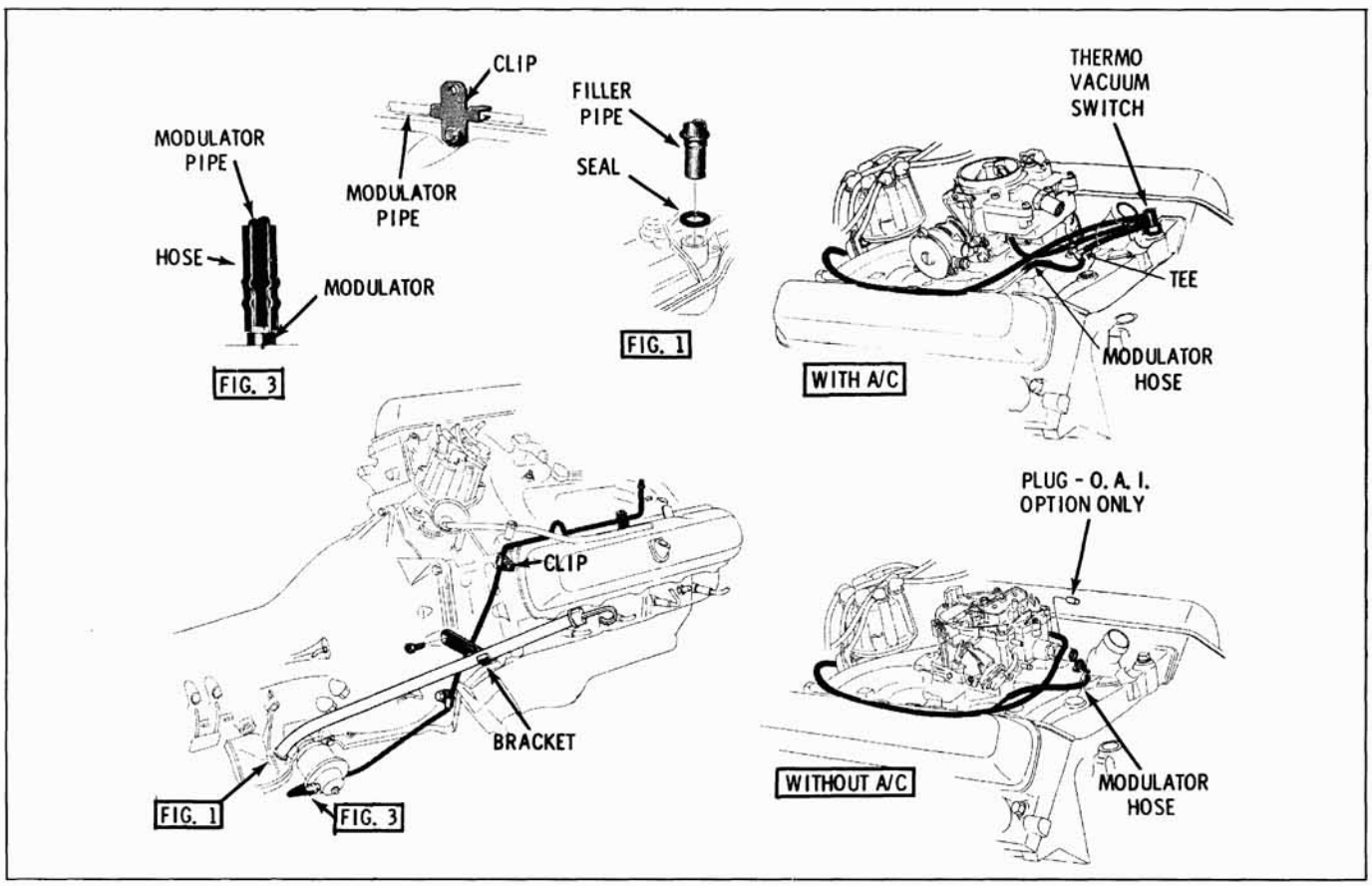


Fig. 7-25 Modulator Lines

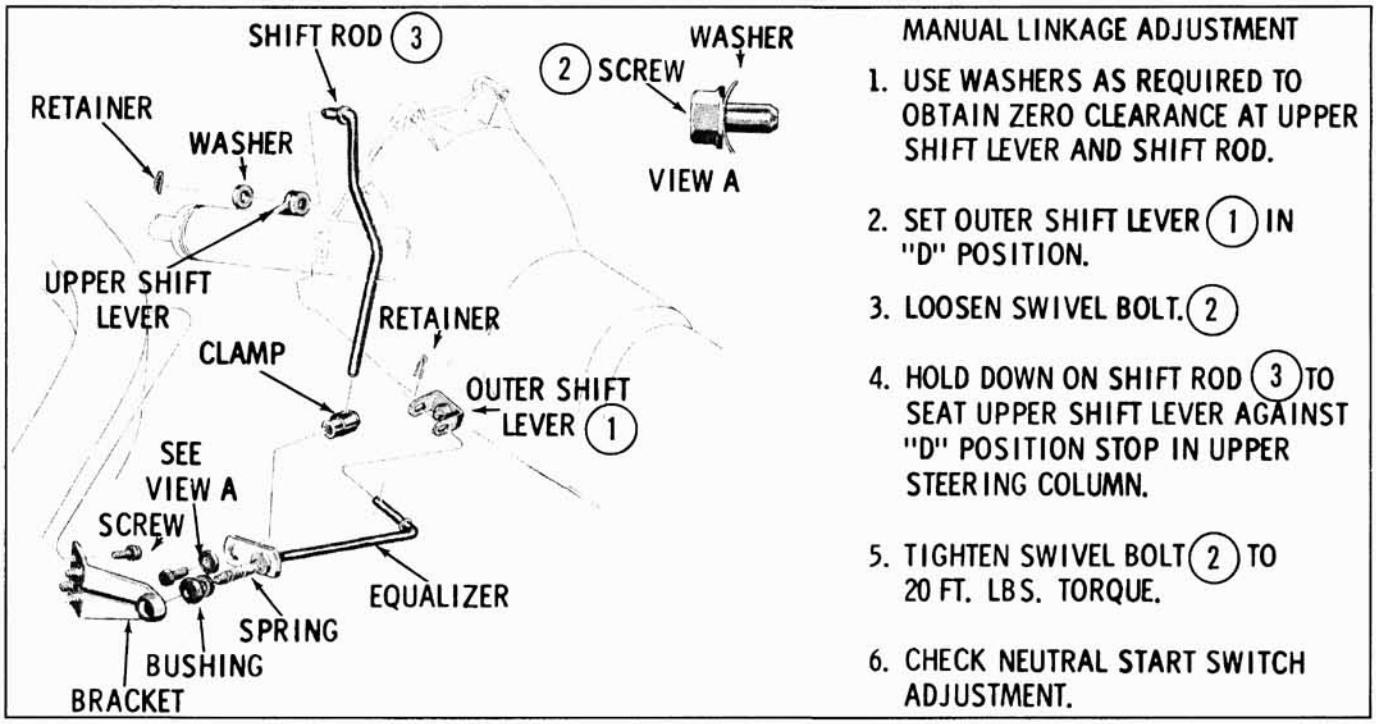


Fig. 7-26 Manual Linkage Adjustment (Column Shift)

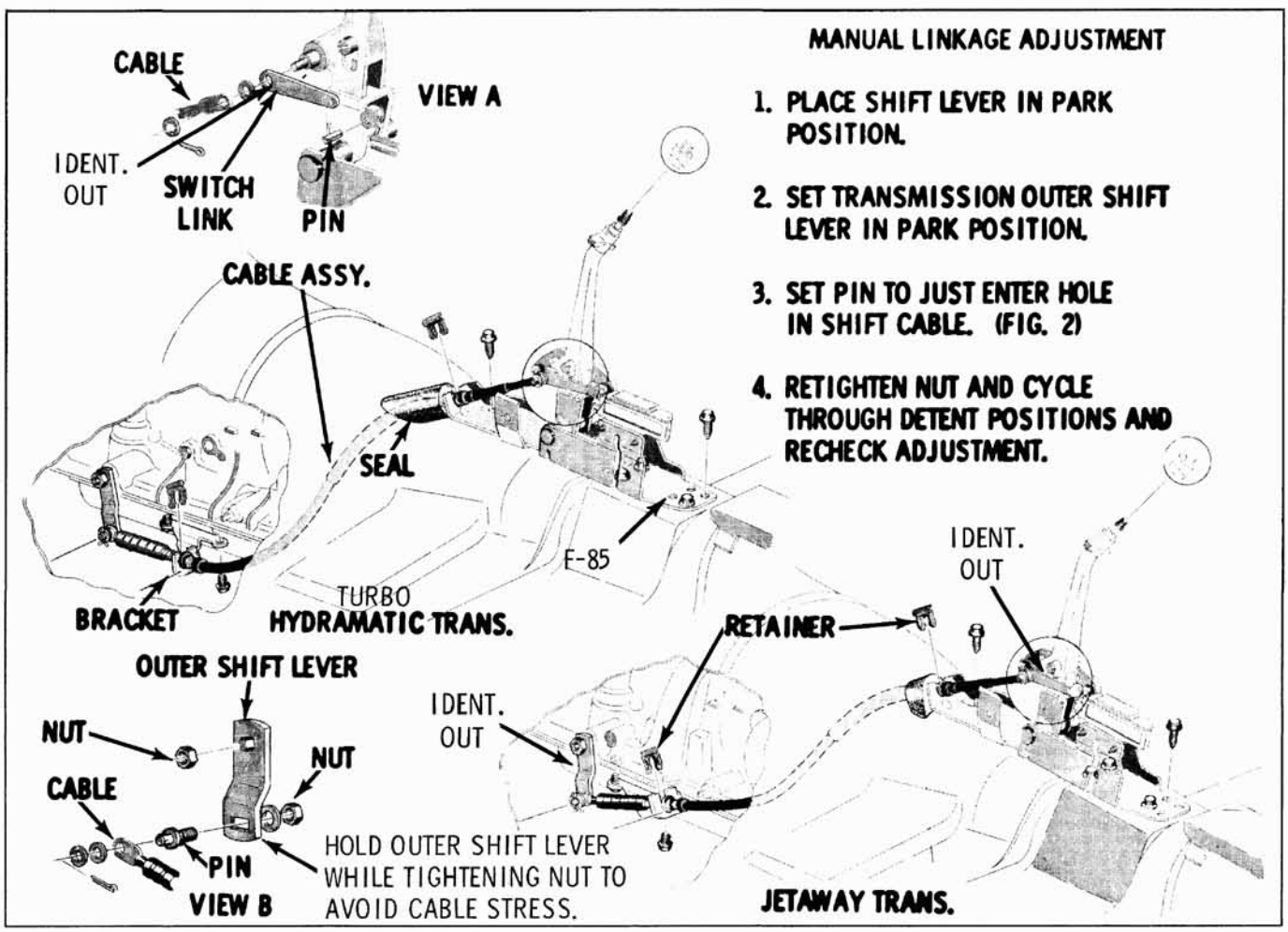


Fig. 7-27 Manual Linkage Adjustment (Console Equipped)

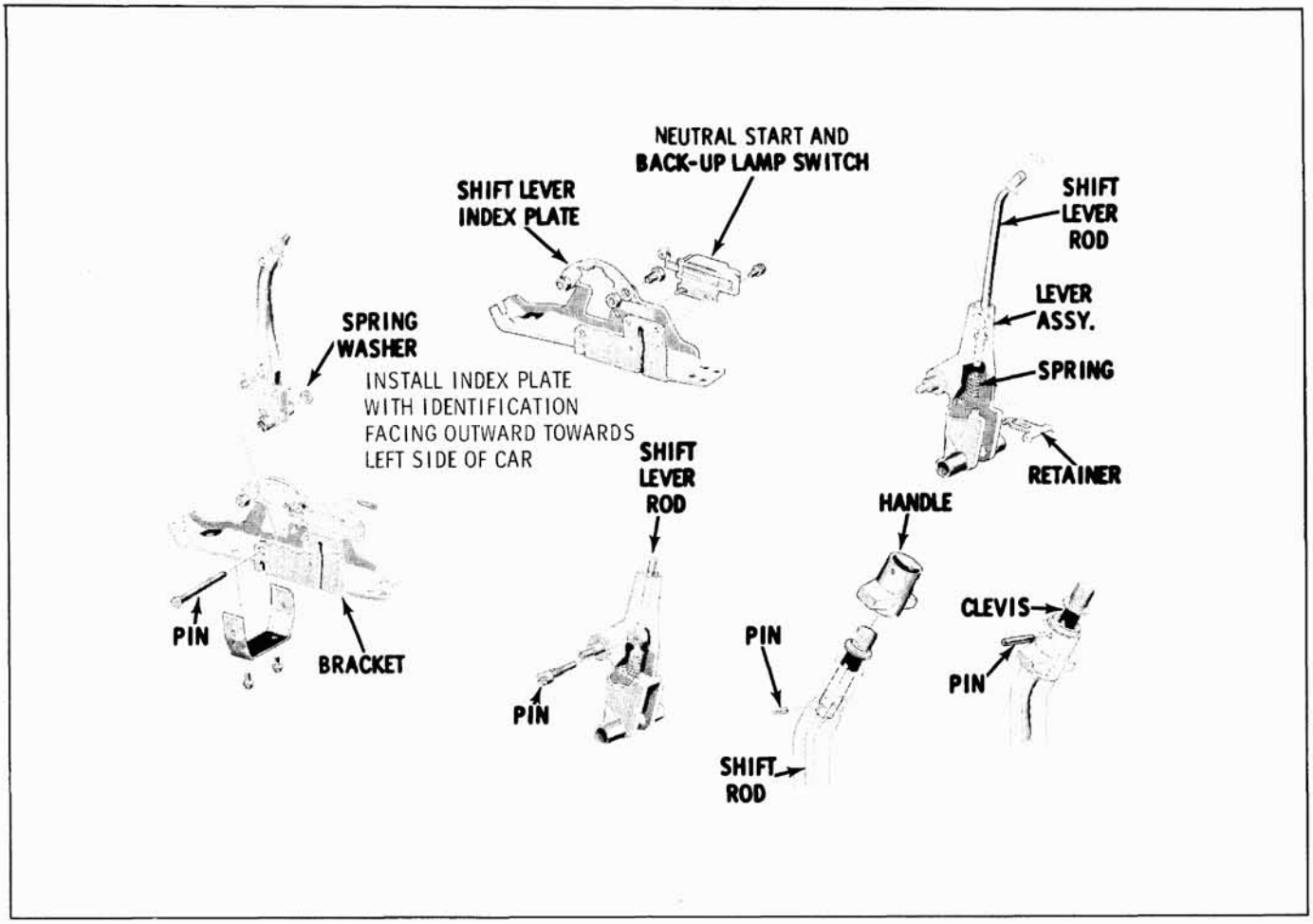


Fig. 7-28 Console Shift Components

2. Set transmission outer shift lever in park position.
3. Set pin to just enter hole in shift cable.
4. Retighten nut and cycle through detent positions and recheck adjustment (Fig. 7-27 and 7-28)
5. Check neutral start switch adjustment.

GENERAL SERVICE PRECAUTIONS

When servicing the transmission, it is recommended that upon disassembly of a unit, all parts should be cleaned and inspected as outlined under CLEANING AND INSPECTION. The unit should be reassembled before disassembly of other units to avoid confusion and interchanging of parts.

1. Before disassembly of the unit, thoroughly clean the exterior.
2. Disassembly and reassembly of the unit and the subassemblies must be made on a clean work bench. As in repairing any hydraulically operated unit, cleanliness is of the utmost importance; therefore, the bench, tools, and parts must be kept clean at all times.
3. Before installing cap screws into aluminum parts, ALWAYS DIP SCREWS INTO HYDRA-MATIC OIL to prevent cap screws from galling the aluminum threads and also to prevent the screws from seizing.
4. Always use a torque wrench when installing cap screws into aluminum parts to prevent the possibility of stripping the threads.
5. If tapped threads in aluminum parts are stripped or damaged, the part can be made serviceable by the use of Heli-Coils.
6. Seal protecting tools must be used when assembling the units to prevent damage to the seals. The slightest flaw in the sealing surface of the seal can cause an oil leak.
7. The aluminum castings and the valve parts are very susceptible to nicks, burrs, etc., and care should be exercised when handling them.
8. The internal snap rings should be expanded and the external snap rings compressed if they are to be reused. This will insure proper seating when installed.
9. Replace all "O" rings, gaskets and oil seals that are removed.
10. During assembly of each unit, all internal parts must be lubricated with Hydra-Matic oil.

PARTS CLEANING AND INSPECTION

After complete disassembly of a unit, all metal parts should be washed in a clean solvent and dried with compressed air. All oil passages should be blown out and checked to make sure that they are not obstructed. Small passages, should be checked with tag wire. All parts should be inspected to determine which parts are to be replaced.

The various inspections of parts are as follows:

1. Inspect linkage and pivot points for excessive wear.
2. Bearing and thrust surfaces of all parts should be checked for excessive wear and scoring.
3. Check for broken seal rings, damaged ring lands and damaged threads.
4. Inspect seals and "O" rings.
5. Mating surfaces of castings and end plates should be checked for burrs and irregularities. If a good seal is not

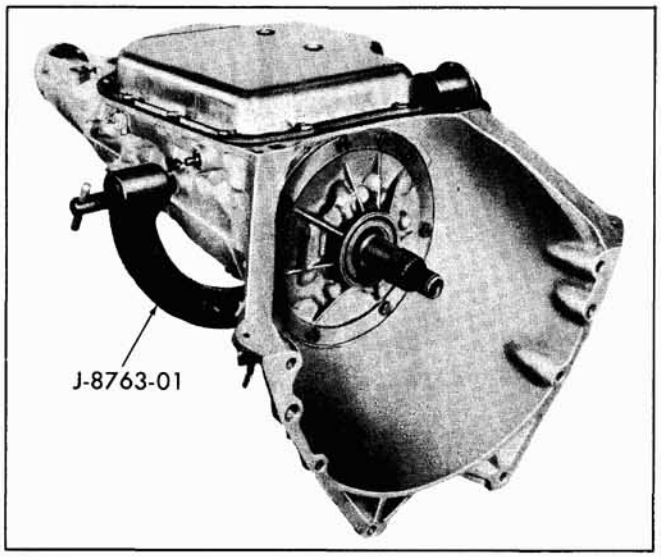


Fig. 7-29 Transmission in Holding Fixture

apparent, burrs and irregularities may be removed by lapping the surface with crocus cloth. The crocus cloth should be held on a flat surface, such as a piece of plate glass.

6. Castings should be checked for cracks and sand holes.

7. Gear teeth should be checked for chipping, scoring, and excessive wear.

8. Valves should be free of burrs and the shoulders of the valves must be square. Any burrs or irregularities may be removed by honing. Valves should be free to slide in their respective bores.

9. Inspect composition clutch plates for damaged surfaces and loose facings. If flakes of facing material can be removed with the thumbnail, the plates should be replaced; however, composition plate discoloration is not an indication of failure.

10. Inspect steel clutch plates for scored surfaces.

11. Inspect springs for distortion or collapsed coils. Slight wear (bright spots) on the sides of the springs is permissible.

12. When inspecting bushings, fit the mating part into the bushing and observe the amount of looseness. Bushing clearance is excessive if more than .008" exists when checked with a wire feeler gauge.

13. If the transmission shows evidence that foreign material has circulated throughout the transmission or if the oil strainer is dirty, the oil strainer should be discarded and a new one installed upon assembly of the transmission.

14. Check for lubrication holes in turbine shaft to be sure they are open.

TRANSMISSION DISASSEMBLY

CONVERTER AND MODULATOR

Remove

1. With transmission in cradle on portable jack, remove the converter assembly by pulling straight out.

The converter contains a large amount of oil.

2. Install Holding Fixture J-8763-01 on the transmission so that the modulator assembly will be located on the side of the holding fixture that is nearest the bench.

Do not overtorque holding screw.

3. Install Fixture and transmission into Holding Tool Base J-3289-20 with bottom pan facing up. (Fig. 7-29)

4. Remove modulator assembly attaching bolt and retainer. (Fig. 7-30)

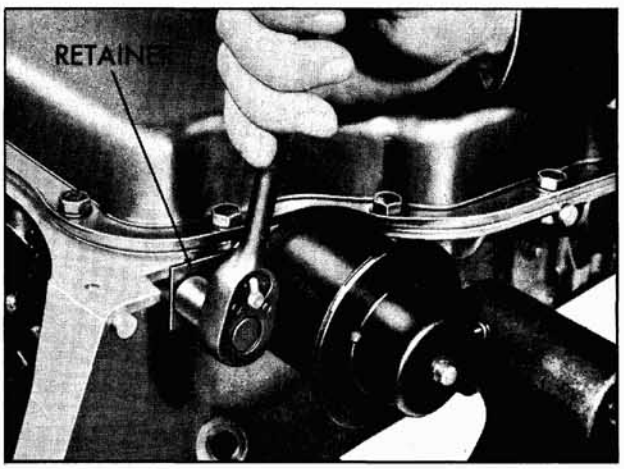


Fig. 7-30 Removing Modulator Retaining Bolt

5. Remove modulator assembly and "O" ring seal from case. Discard "O" ring. (Fig. 7-31)

6. Remove modulator valve from transmission case.

7. Models OA, OP, OG and OH only - Remove attaching screw, retainer and speedometer drive gear and sleeve.

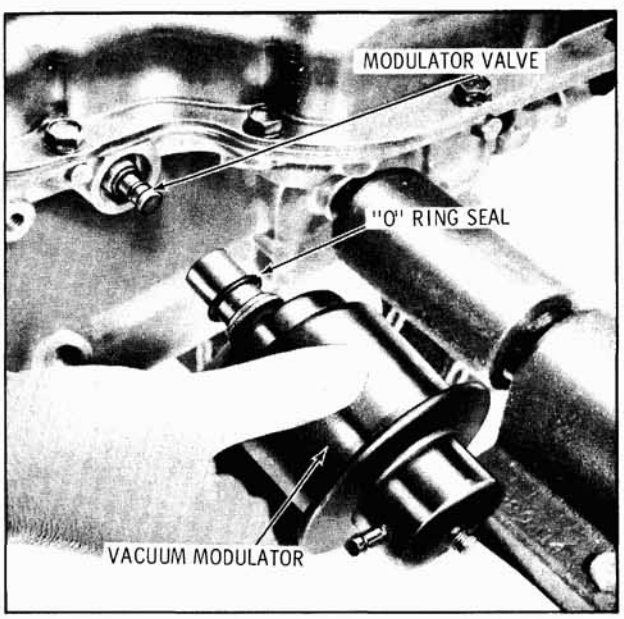


Fig. 7-31 Removing Modulator and Valve

GOVERNOR, PAN, STRAINER AND INTAKE PIPE

Removal

1. Remove attaching bolts, governor cover and gasket. (Fig. 7-32)

2. Withdraw governor assembly from case. (Fig. 7-33)

3. Remove bottom pan attaching bolts.

4. Remove pan and gasket, discard gasket.

5. Remove strainer retainer bolt. (Fig. 7-34)

6. Remove intake pipe and strainer assembly. (Fig. 7-35)

7. Remove intake pipe from strainer assembly and discard strainer.

8. Remove the intake pipe to case "O" ring seal from the intake pipe and discard.

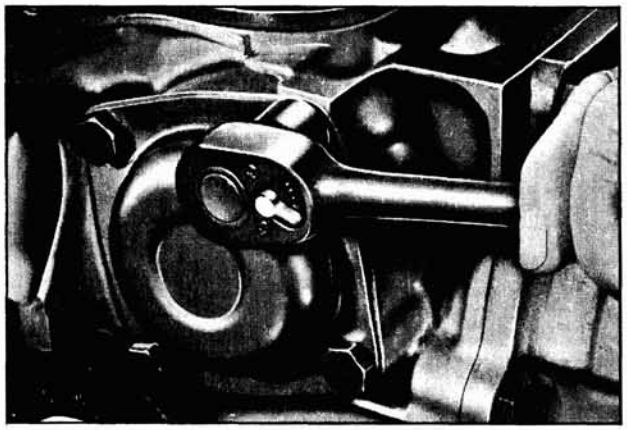


Fig. 7-32 Removing Governor Cover

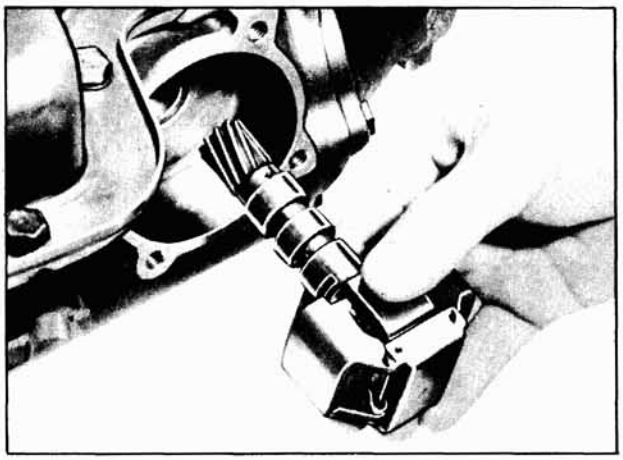


Fig. 7-33 Removing Governor

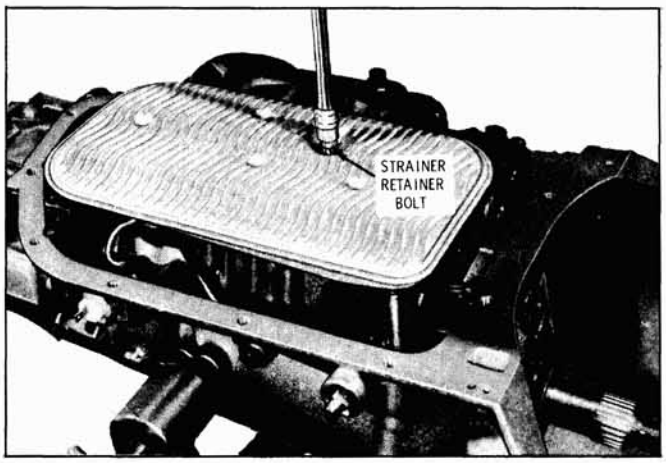


Fig. 7-34 Strainer Retainer Bolt

CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND DETENT SPRING ASSEMBLY

Removal

1. Remove the control valve body attaching bolts and detent roller spring assembly. (Fig. 7-36)

Do not remove solenoid attaching screws.

2. Remove the control valve body assembly and governor pipes. (Fig. 7-37)

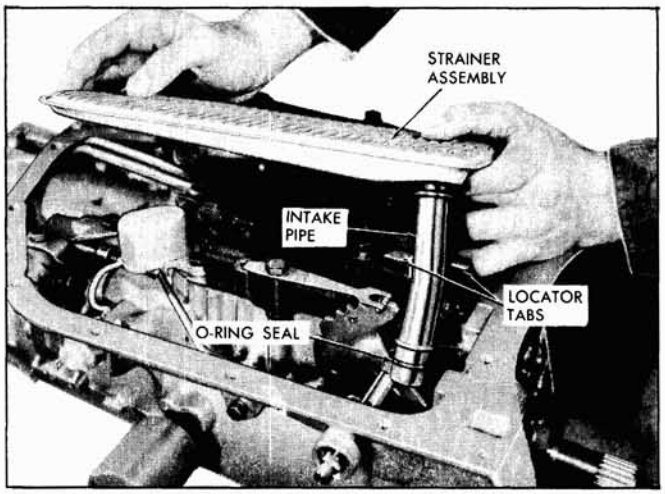


Fig. 7-35 Removing Strainer Assembly

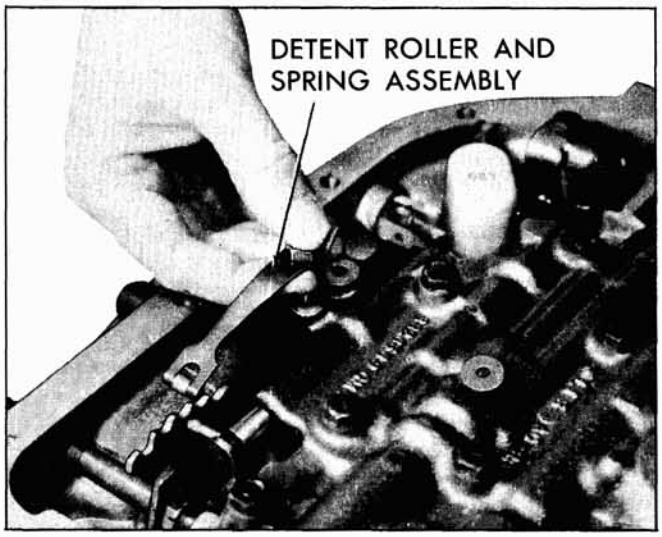


Fig. 7-36 Removing Detent Roller and Spring Assembly

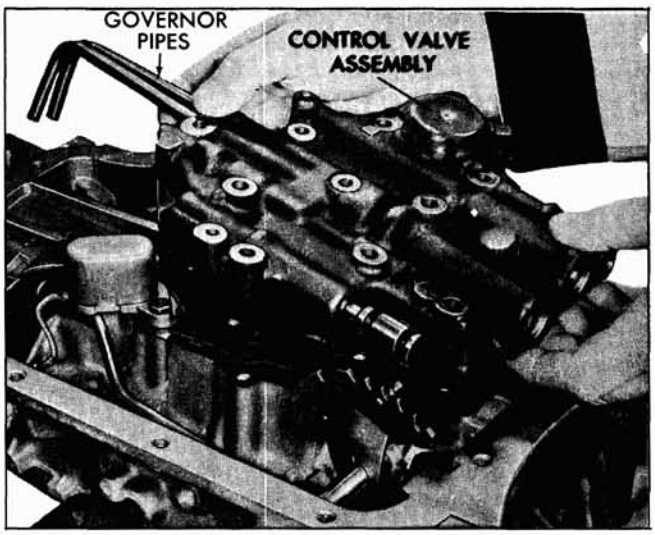


Fig. 7-37 Removing Control Valve Assembly

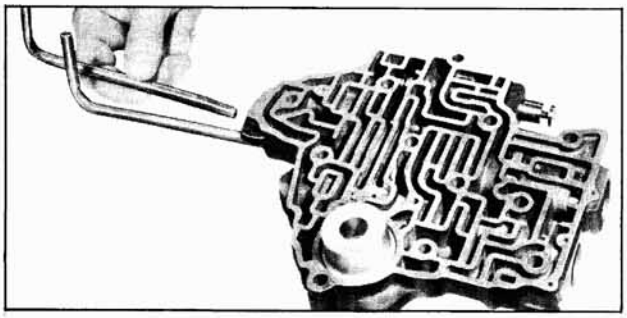


Fig. 7-38 Removing Governor Pipes

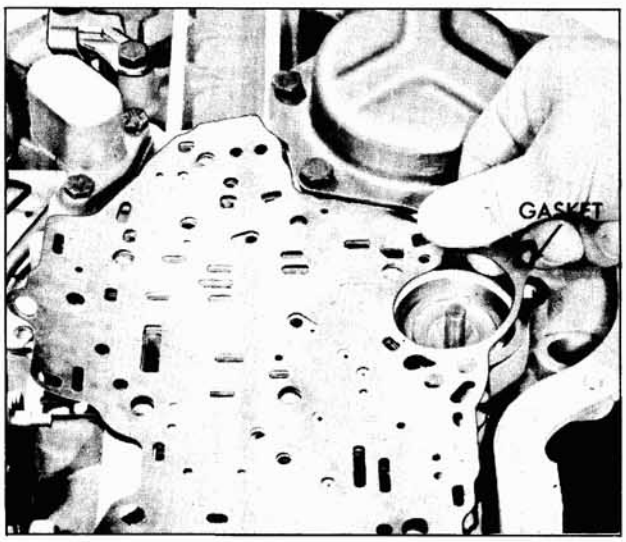


Fig. 7-39 Removing Spacer Gasket

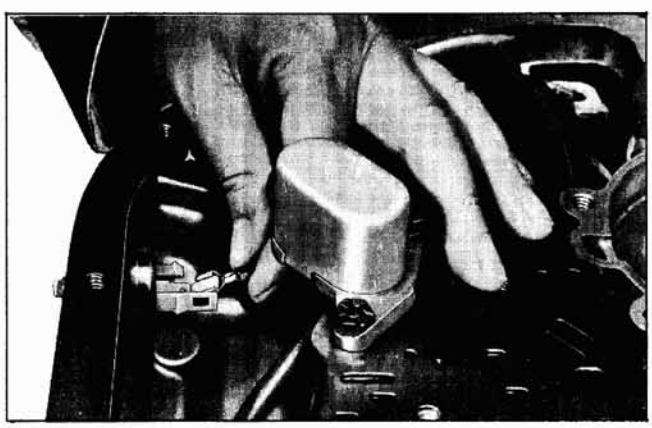


Fig. 7-40 Disconnecting Detent Wire from Case Connector

Do not allow manual valve to fall out of control valve assembly.

3. Remove the governor pipes from control valve assembly. (Fig. 7-38)
4. Remove the control valve assembly to spacer gasket. (Fig. 7-39)
5. Disconnect detent solenoid wire from case connector. (Fig. 7-40)

REAR SERVO, VALVE BODY SPACER, GASKET AND FRONT SERVO

Removal

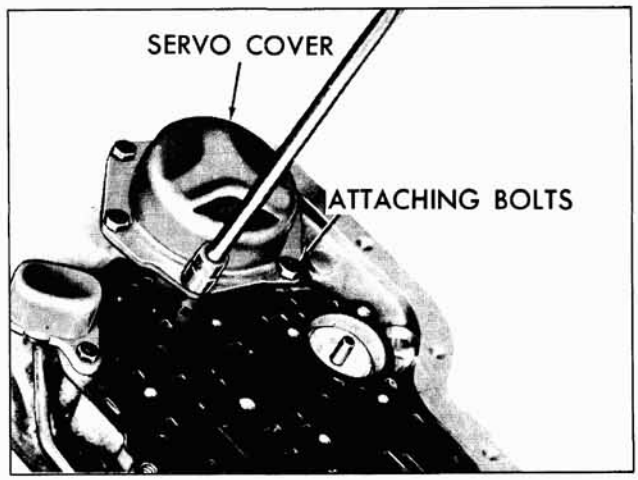


Fig. 7-41 Removing Rear Servo Cover Attaching Bolts

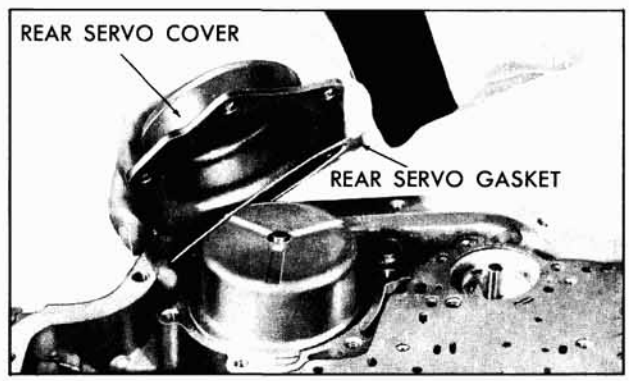


Fig. 7-42 Removing Servo Cover and Gasket

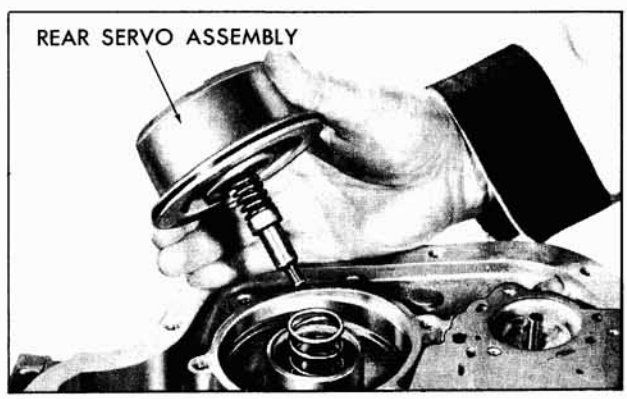


Fig. 7-43 Removing Rear Servo From Case

1. Remove the rear servo cover attaching screws, the servo cover and gasket. Discard gasket. (Figs. 7-41 and 7-42)
2. Remove the rear servo assembly from the case. (Fig. 7-43)
3. Remove rear servo accumulator spring. (Fig. 7-44)
4. Make band apply pin selection check. (Fig. 7-45)

Band Apply Pin Selection

a. Attach the band apply pin selection Gauge J-21370-6, to the transmission case with attaching bolts, checking to make certain Gauge Pin J-21370-5 does not bind.

b. Apply 25 ft. lb. torque and select proper pin to be used during assembly of transmission.

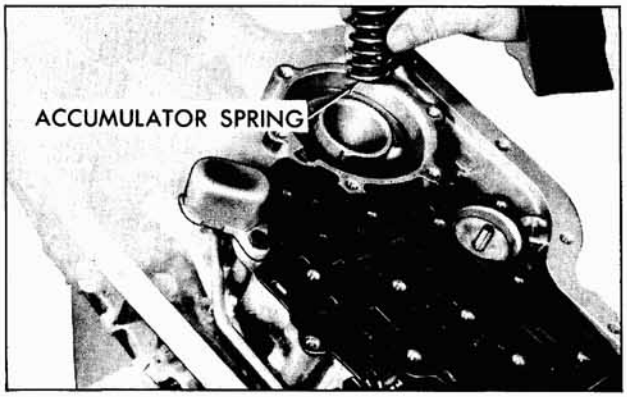


Fig. 7-44 Removing Rear Accumulator Spring

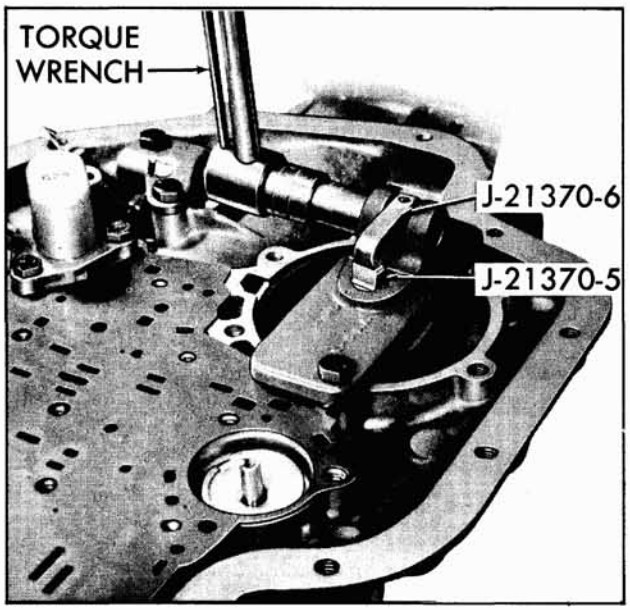


Fig. 7-45 Checking Rear Band Apply Pin

STEP LOCATION	PIN IDENT.	SIZE
TOP STEP OR ABOVE	THREE RINGS	LONG
THIS AREA	TWO RINGS	MED.
LOWER STEP OR BELOW	ONE RING	SHORT

J-21370-5

The identification ring is located on the band lug end of the pin. Selecting the proper pin is the equivalent of adjusting the band.

5. Remove the detent solenoid attaching screws, solenoid assembly and gasket. (Fig. 7-46)

6. Withdraw case sleeve connector and "O" ring seal from case. (Fig. 7-47)

Use an 11/16" box wrench to compress the connector tangs.

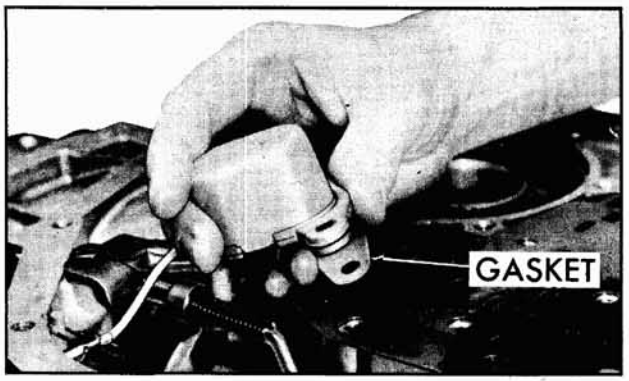


Fig. 7-46 Removing Detent Solenoid and Gasket

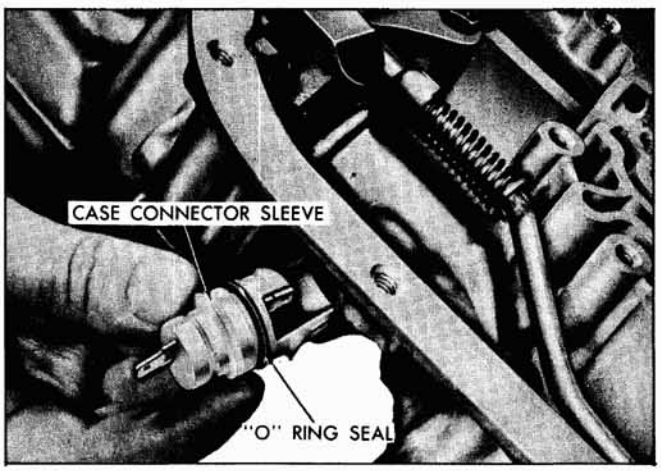


Fig. 7-47 Removing Case Connector

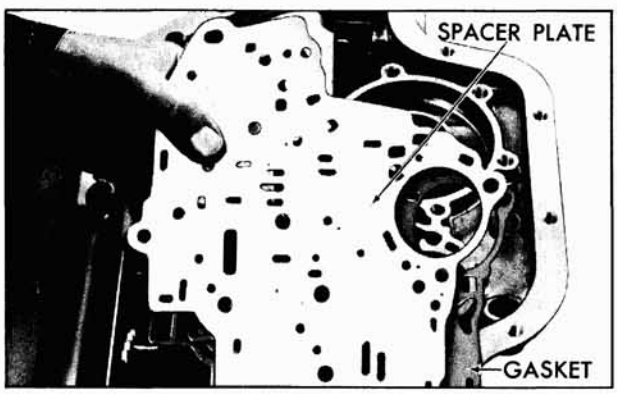


Fig. 7-48 Removing Spacer Plate and Gasket

7. Remove the control valve assembly spacer plate and gasket. (Fig. 7-48)

8. Remove six check balls from cored passages in transmission case. (Fig. 7-49)

9. Remove the front servo piston, washer, pin, retainer and spring from transmission case. (Figs. 7-50 and 7-51)

REAR OIL SEAL AND EXTENSION HOUSING

Removal

1. If necessary to replace, pry the rear oil seal from the extension housing. (Fig. 7-52)

2. Remove the extension housing to case attaching bolts.

3. Remove the extension housing and extension housing to case gasket. (Fig. 7-53)

4. Make front unit end play check as follows: (Fig. 7-54)

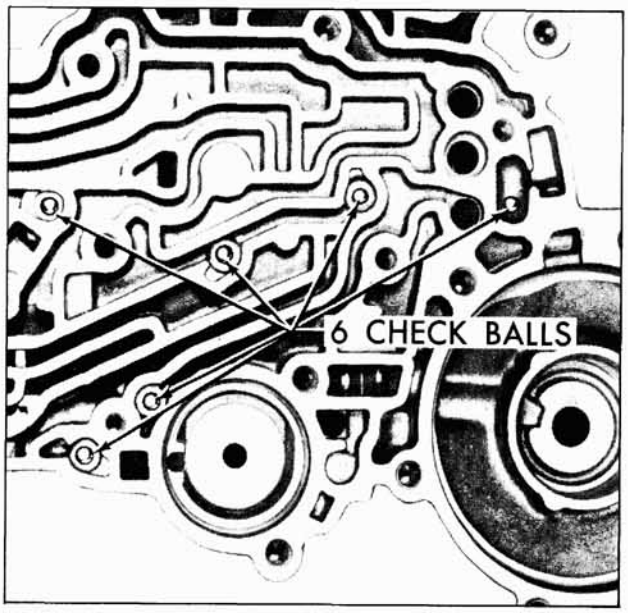


Fig. 7-49 Check Ball Location

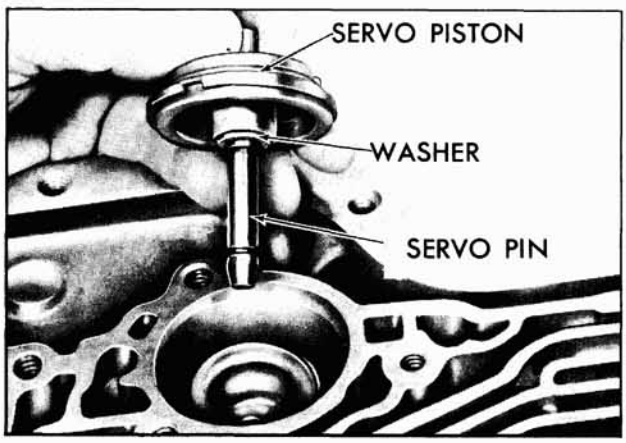


Fig. 7-50 Removing Front Servo

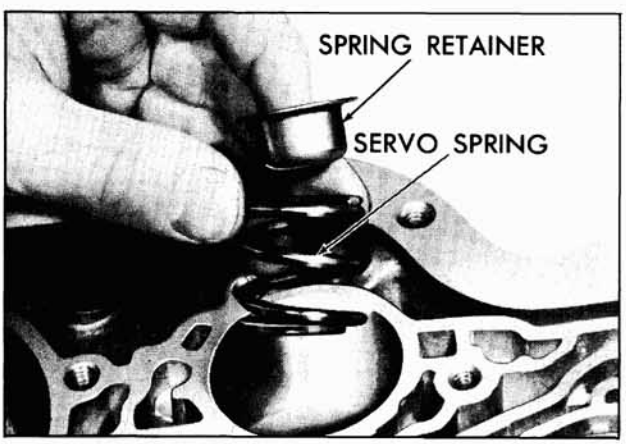


Fig. 7-51 Removing Front Servo Spring and Retainer

a. Remove one front pump attaching bolt, and bolt seal.
b. Install a Slide Hammer Bolt into bolt hole in pump.
c. Mount a dial indicator on the rod and index indicator to register with end of turbine shaft.

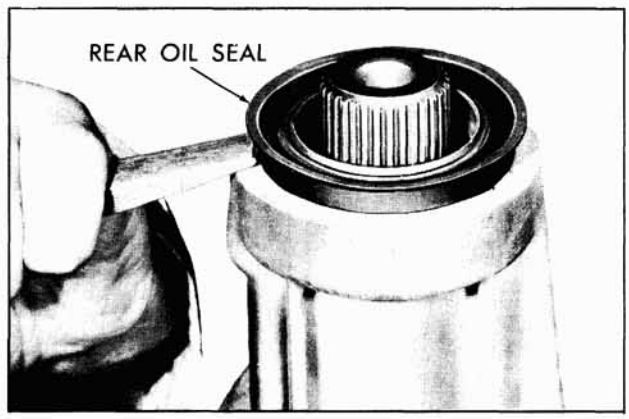


Fig. 7-52 Removing Rear Oil Seal

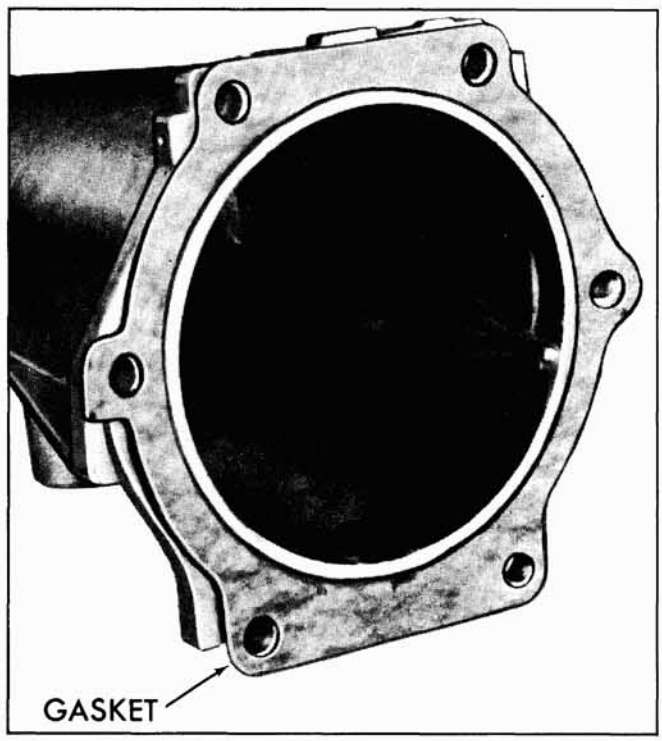


Fig. 7-53 Extension Housing and Seal

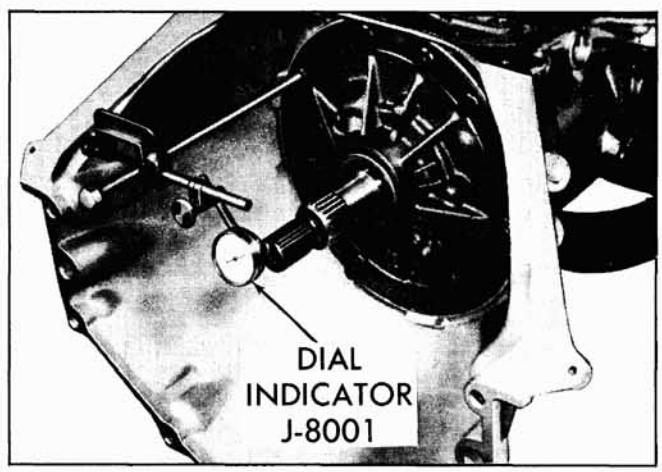


Fig. 7-54 Checking Front Unit End Play

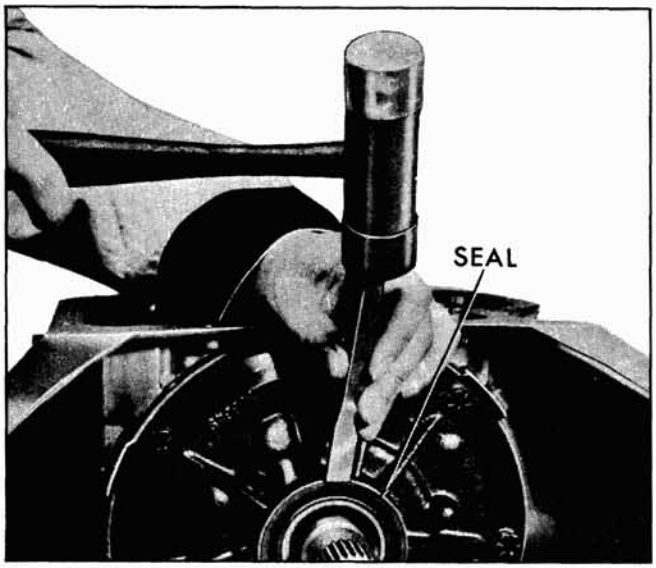


Fig. 7-55 Removing Front Seal

d. Push on turbine shaft rearward.
e. Push output shaft forward.
f. Set dial indicator to zero.
g. Pull turbine shaft forward.

Read the resulting travel or end play which should be .003" to .024".

The selective washer controlling this end play is the washer located between the pump cover and the forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select the proper washer from the chart below:

Thickness	Color
.060" to .064"	Yellow
.071" to .075"	Blue
.082" to .086"	Red
.093" to .097"	Brown
.104" to .108"	Green
.115" to .119"	Black
.126" to .130"	Purple

An oil soaked washer may tend to discolor so that it will be necessary to measure the washer for its actual thickness.

OIL PUMP

Removal

1. If necessary to replace, pry front seal from pump. (Fig. 7-55)
2. Remove the pump attaching bolts. Install bolts with Slide Hammers J-6125, into threaded bolt holes in pump body and remove pump assembly and gasket. (Fig. 7-56)
3. Remove and discard pump to case seal "O" ring.
4. Remove forward clutch assembly and turbine shaft from transmission. (Fig. 7-58)
5. Remove forward clutch hub to direct clutch housing thrust washer, if it did not come out with forward clutch housing assembly.
6. Remove the direct clutch assembly. (Fig. 7-59)
7. If necessary, remove manual linkage as follows:
   a. Unthread the jam nut holding detent lever to manual shaft. (Fig. 7-60)

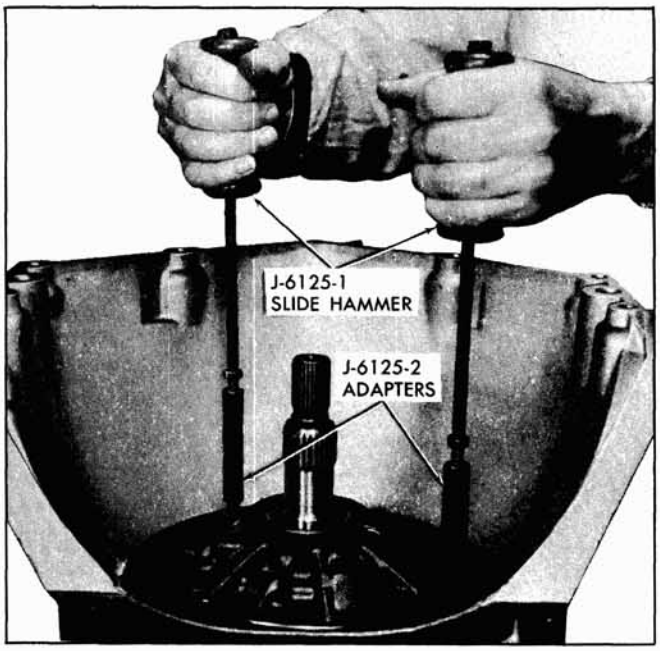


Fig. 7-56 Removing Front Pump

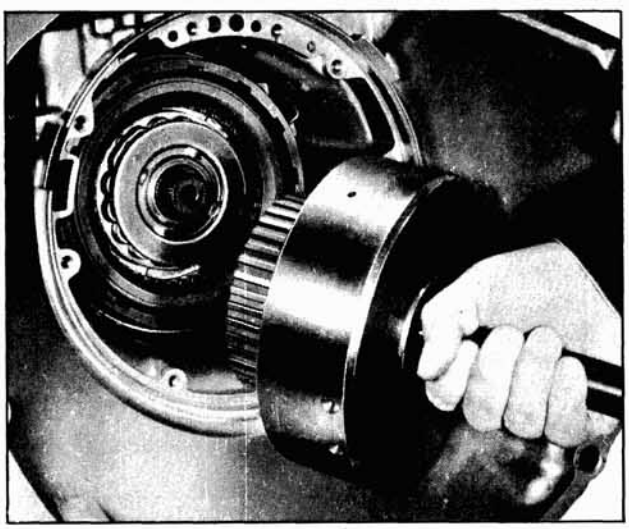


Fig. 7-58 Removing Forward Clutch Assembly

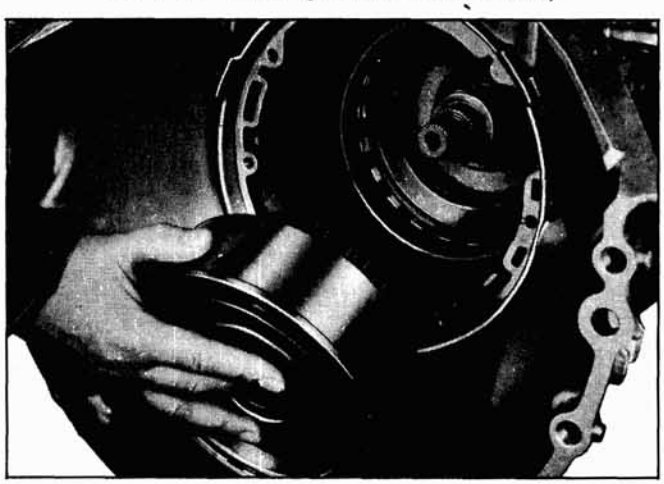


Fig. 7-59 Removing Direct Clutch Assembly

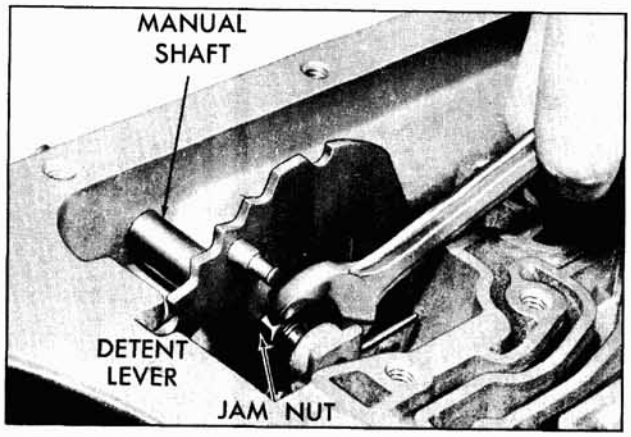


Fig. 7-60 Removing Manual Shaft Nut

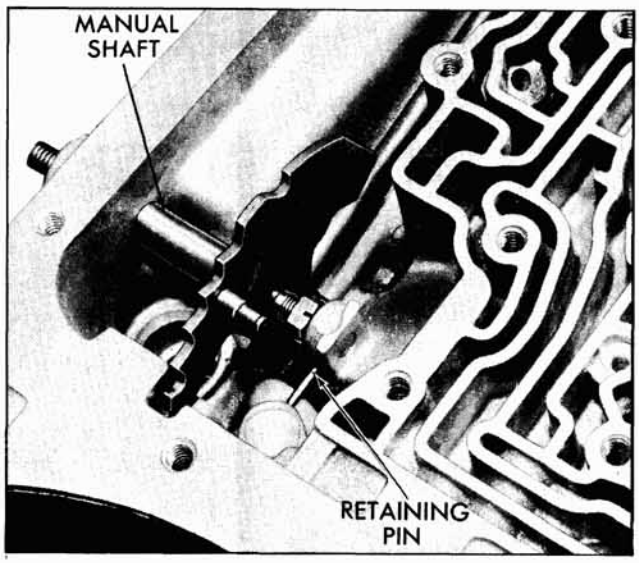


Fig. 7-61 Removing Retaining Pin

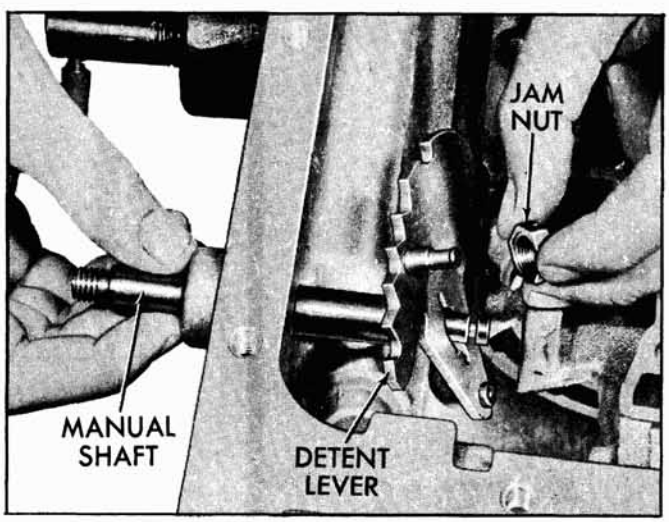


Fig. 7-62 Removing Detent Lever

b. Remove manual shaft retaining pin from case. (Fig. 7-61)

c. Remove jam nut and the detent lever from the manual shaft. (Fig. 7-62)

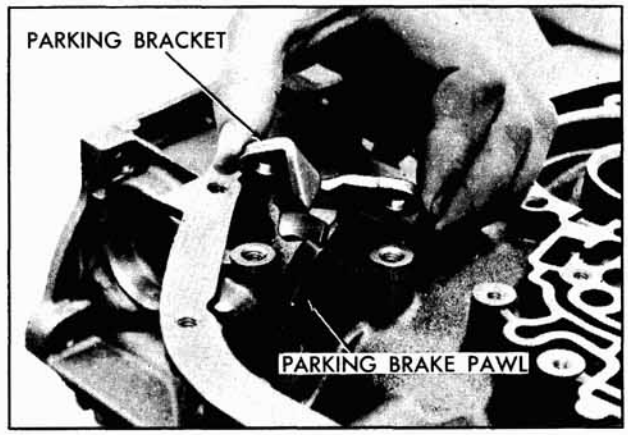


Fig. 7-63 Removing Parking Bracket

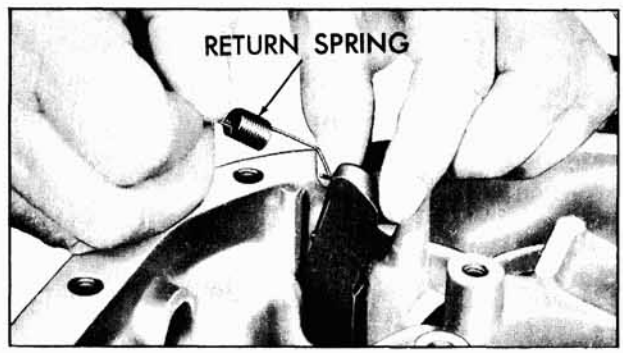


Fig. 7-64 Removing Parking Pawl Return Spring

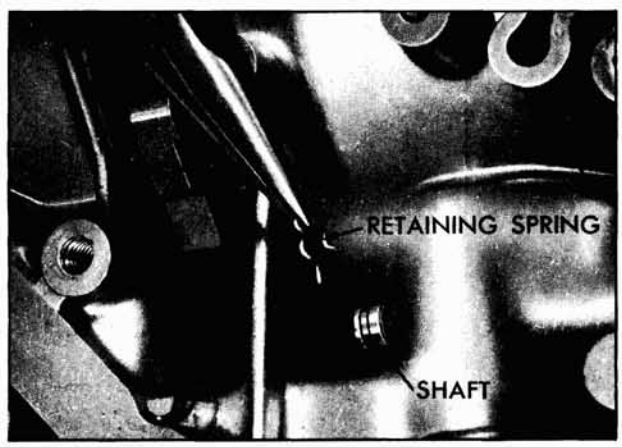


Fig. 7-65 Removing Retaining Spring Clip

Do not lose the jam nut as it becomes free from the manual shaft.

d. Remove manual shaft from case.

Manual shaft seal should NOT be removed from case unless replacement is required.

e. Remove attaching bolts and parking bracket. (Fig. 7-63)

f. Remove parking pawl return spring. (Fig. 7-64)

The following steps are to be completed only if one or more of the parts involved require replacement.

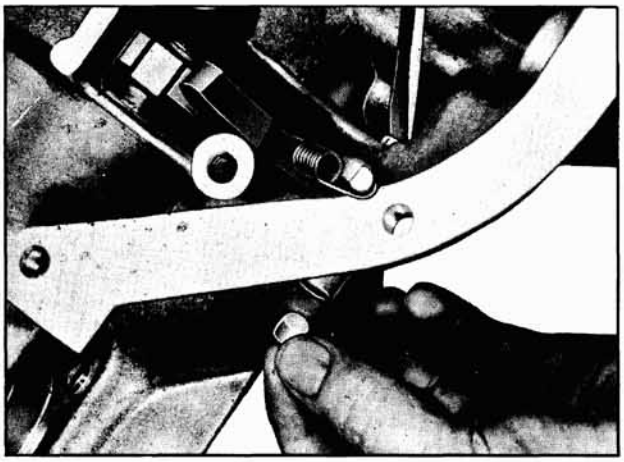


Fig. 7-66 Removing Cup Plug

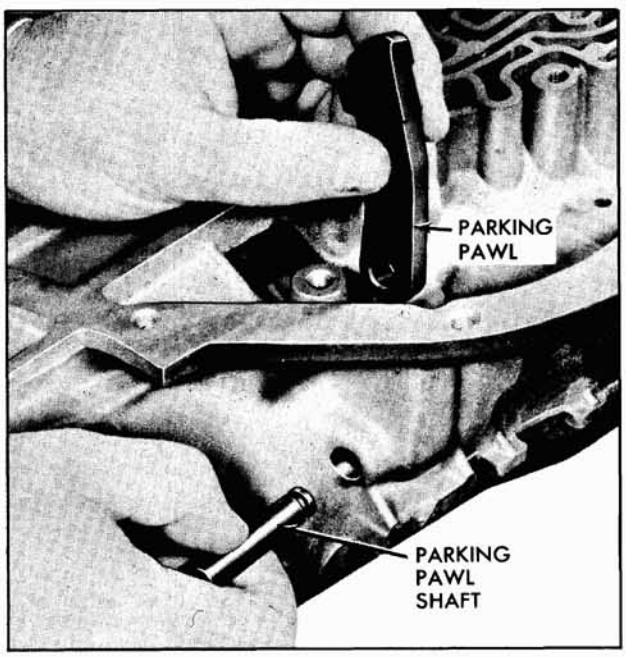


Fig. 7-67 Removing Parking Pawl

g. Remove parking pawl shaft retainer. (Fig. 7-65)

h. Remove parking pawl shaft cup plug by inserting a screwdriver between the parking pawl shaft and the case rib, and prying outwards. (Fig. 7-66)

i. Remove parking pawl shaft and parking pawl. (Fig. 7-67)

8. Remove the front band assembly. (Fig. 7-68)

9. Remove the sun gear shaft. (Fig. 7-69)

10. Check rear end play as follows: (Fig. 7-70)

a. Install J-21661 into an extension housing attaching bolt hole.

a. Mount the Dial Indicator, J-8001, on the rod and index with the end of the output shaft.

c. Move the output shaft in and out to read the end play. End play should be from .003" to .019". The selective washer controlling this end play is the steel washer having three lugs that is located between the thrust washer and the rear face of the transmission case.

If a different washer thickness is required to bring the end play within specification, it can be selected from the following chart.

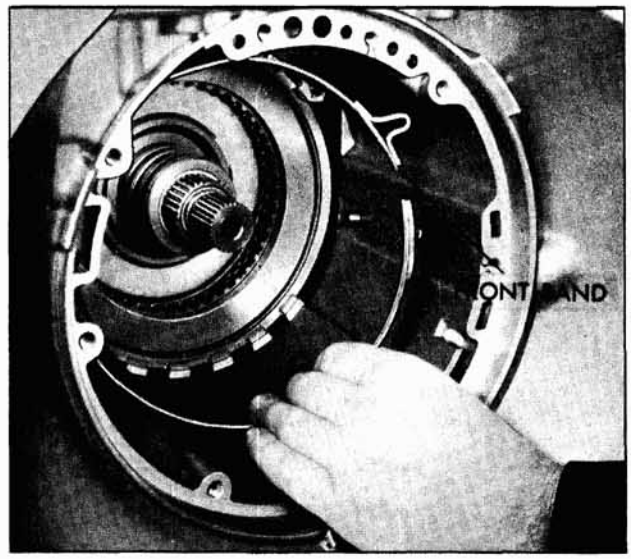


Fig. 7-68 Removing Front Band

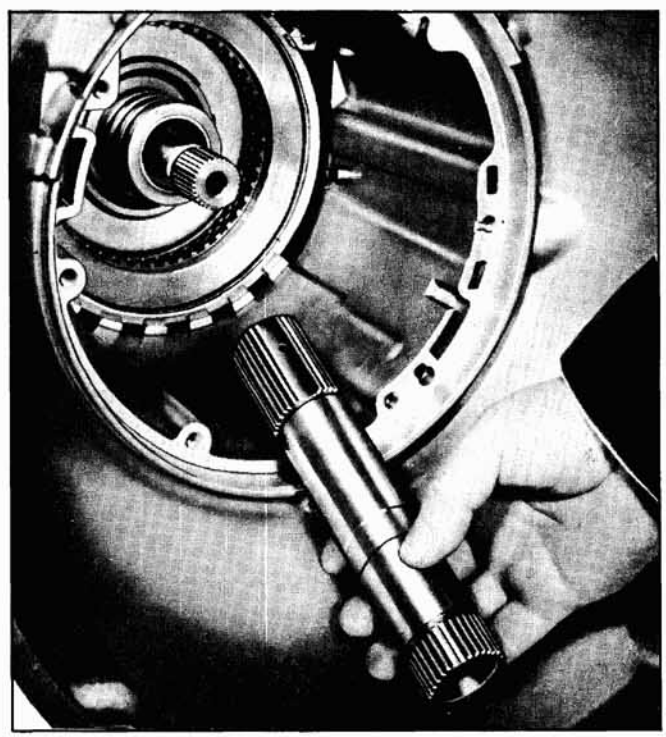


Fig. 7-69 Removing Sun Gear Shaft

Thickness	Notches or Numeral
.074" to .078"	None 1
.082" to .086"	1 Tab Side 2
.090" to .094"	2 Tab Side 3
.098" to .102"	1 Tab O.D. 4
.106" to .110"	2 Tabs O.D. 5
.114" to .118"	3 Tabs O.D. 6

11. Remove the case center support to case bolt with a 3/8" 12 point socket. (Fig. 7-71)

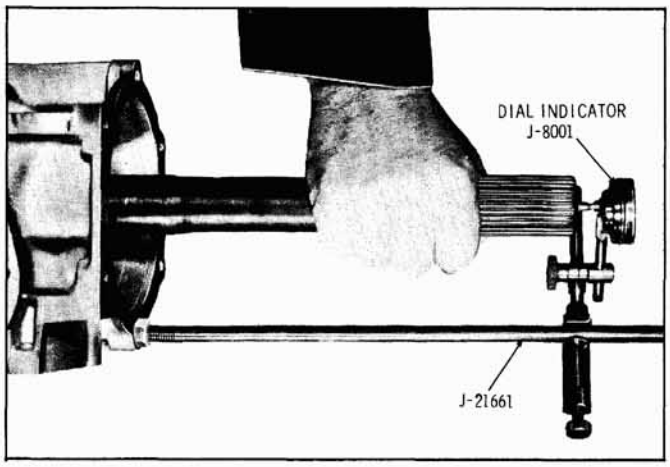


Fig. 7-70 Checking Rear Unit

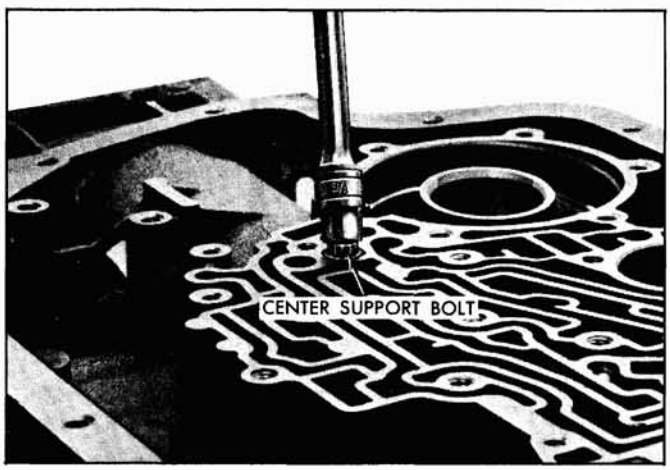


Fig. 7-71 Removing Case Center Support

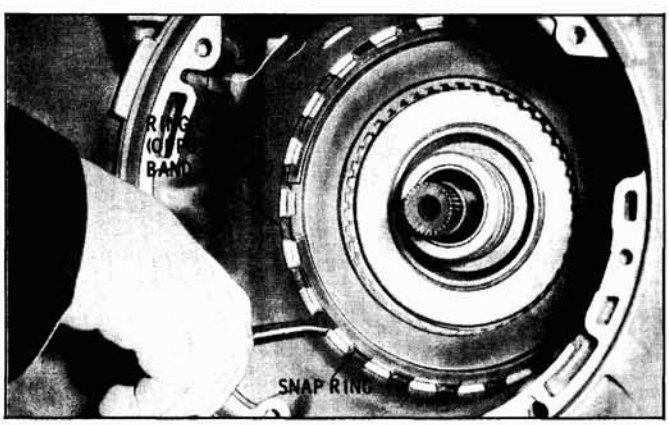


Fig. 7-72 Removing Snap Ring

12. Remove the intermediate clutch backing plate to case snap ring (Fig. 7-72)

13. Remove the intermediate clutch backing plate, three composition and three steel clutch plates. (Fig. 7-73)

14. Remove the center support to case retaining snap ring. (Fig. 7-74)

15. Remove the entire gear unit assembly by lifting with Gear Assembly Installing and Removing Tool J-21795 and J-6125 Slide Hammer. (Fig. 7-75)

16. Remove the output shaft to case thrust washer from the rear of the output shaft or inside the case. (Fig. 7-76)

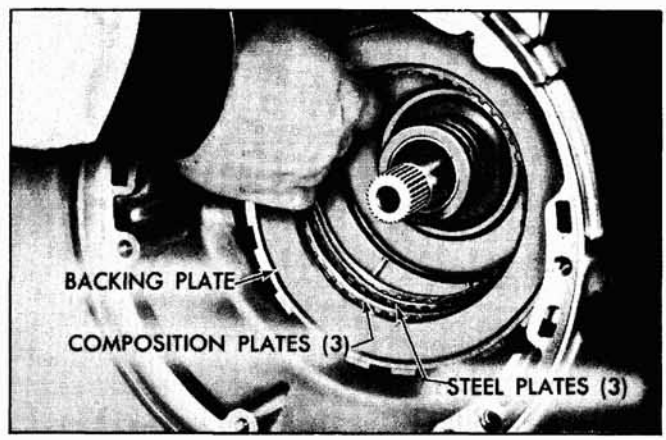


Fig. 7-73 Removing Clutch Plates

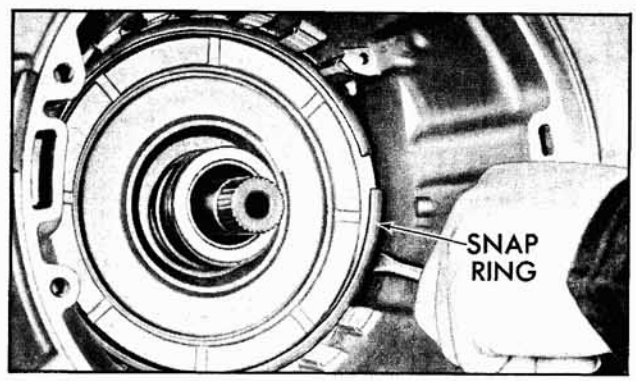


Fig. 7-74 Removing Snap Ring

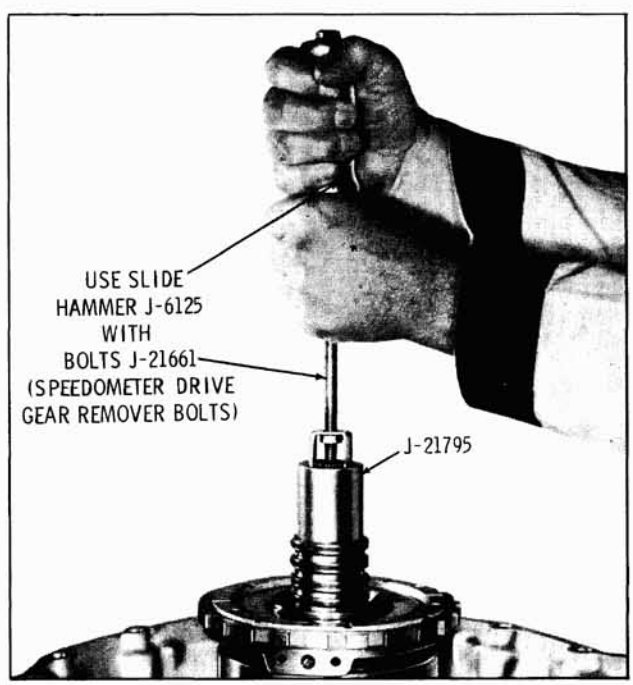


Fig. 7-75 Removing Gear Assembly

17. Place the gear unit assembly with output shaft facing down in hole in work bench or Holding Fixture J-6116. (Fig. 7-77)

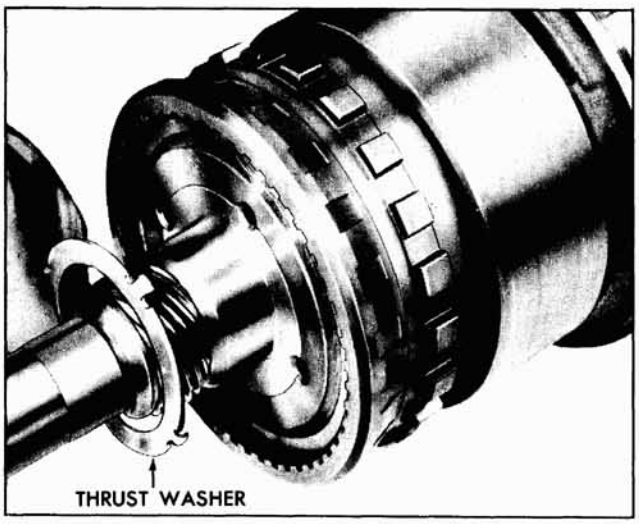


Fig. 7-76 Removing Thrust Washer

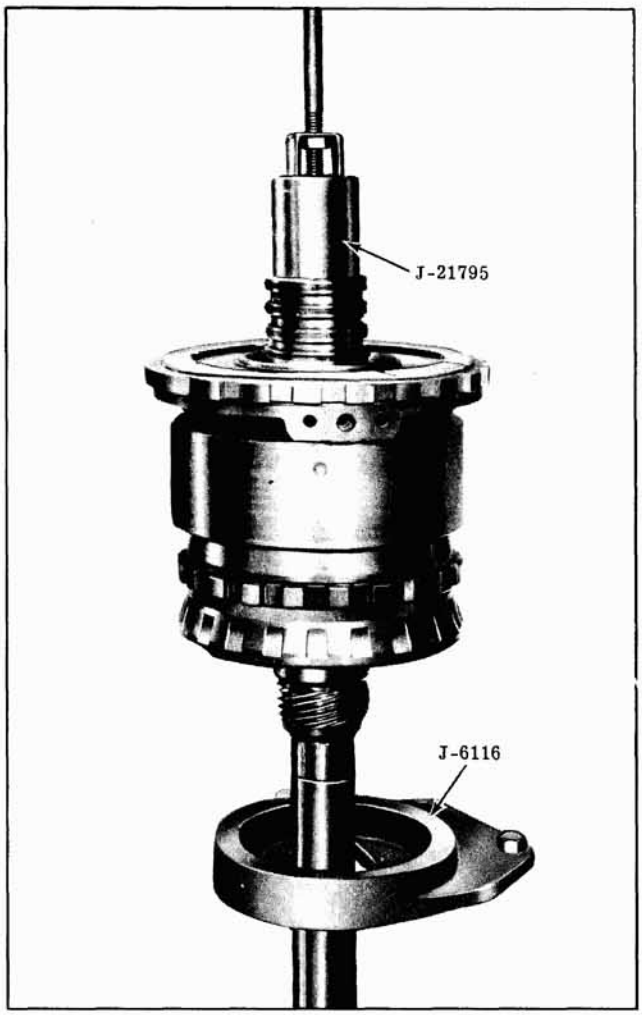


Fig. 7-77 Positioning Unit in Holding Fixture

18. Remove the rear unit selective washer from the transmission case. (Fig. 7-78)
19. Remove the rear band assembly. (Fig. 7-79)

Fig. 7-78 Removing Selective Washer

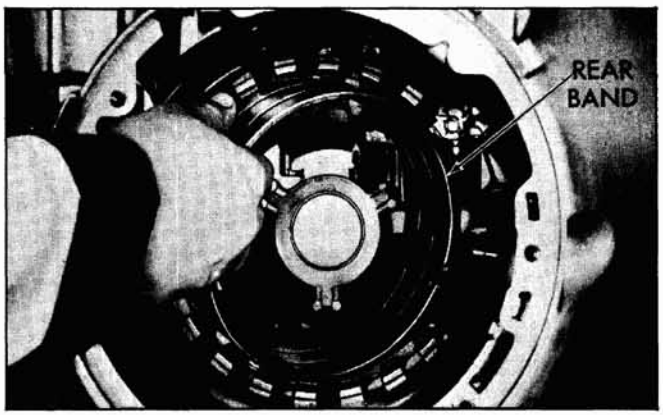


Fig. 7-79 Removing Rear Band

DISASSEMBLY AND ASSEMBLY OF INDIVIDUAL UNITS

GEAR UNIT

Disassembly

1. Remove the case center support assembly. (Fig. 7-80)

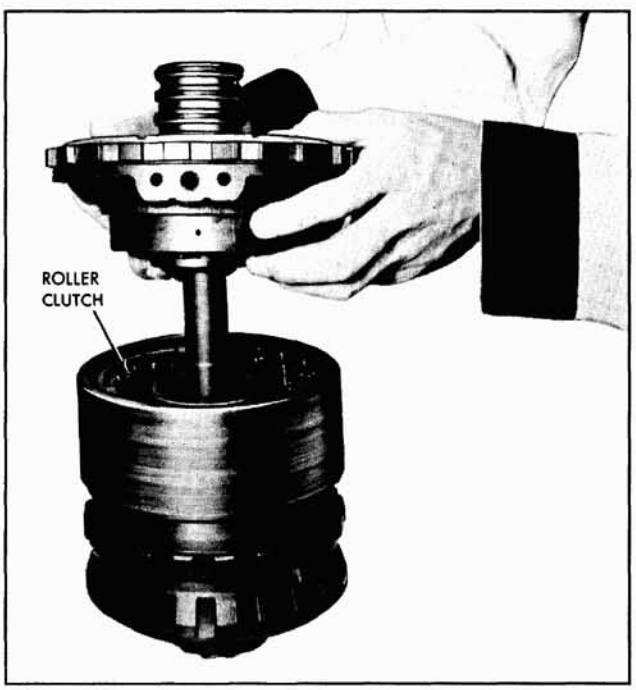


Fig. 7-80 Removing Case Center Support

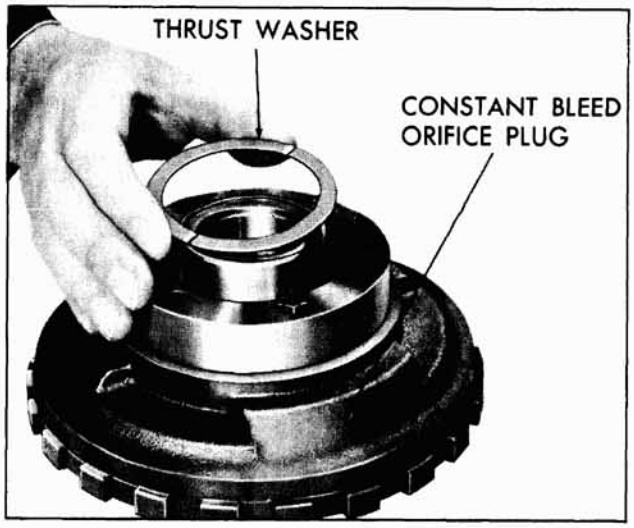


Fig. 7-81 Removing Thrust Washer

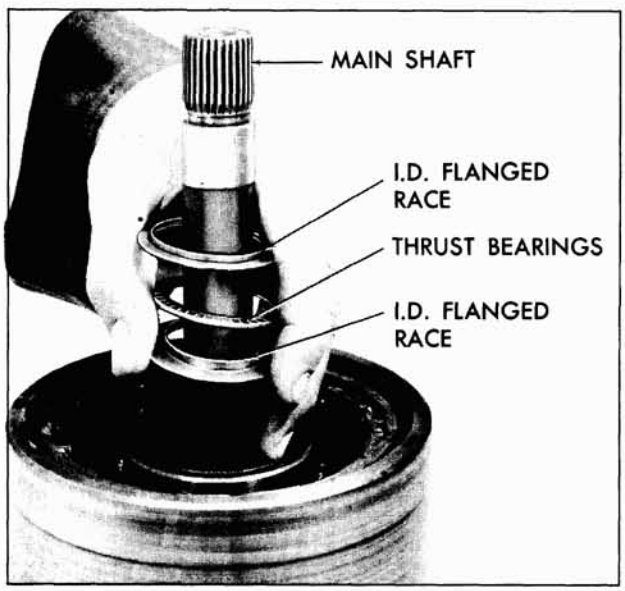


Fig. 7-82 Removing Sun Gear Races and Bearings

2. Remove the center support to reaction carrier thrust washer. (Fig. 7-81)

3. Remove the center support to sun gear races and thrust bearing. (Fig. 7-82)

One of the races may have been removed with the center support.

4. Remove the reaction carrier and roller clutch assembly. (Fig. 7-83)

5. Remove front internal gear ring from output carrier assembly. (Fig. 7-84)

6. Remove sun gear. (Fig. 7-85)

7. Remove reaction carrier to output carrier thrust washer. (Fig. 7-86)

8. Turn assembly over.

9. Remove output shaft to output carrier snap ring and remove output shaft. (Fig. 7-87)

10. Remove output shaft to rear internal gear thrust bearing and two races. (Fig. 7-88)

11. Remove the rear internal gear and mainshaft (Fig. 7-89)

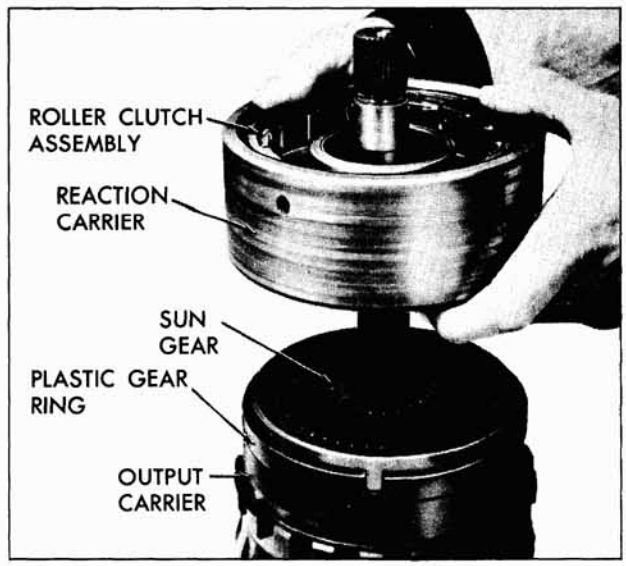


Fig. 7-83 Removing Reaction Carrier and Sprag

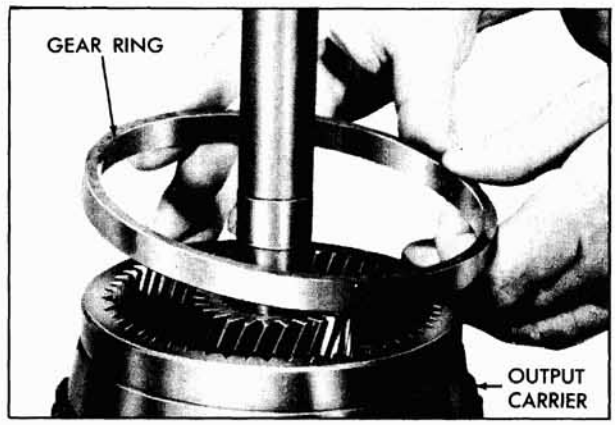


Fig. 7-84 Removing Gear Ring

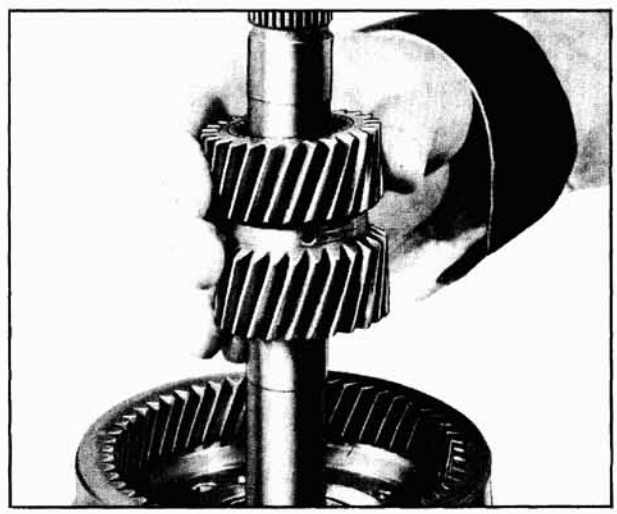


Fig. 7-85 Removing Sun Gear

Do not drop bearings.

12. Remove the rear internal gear to sun gear thrust bearing and two races. (Fig. 7-90)

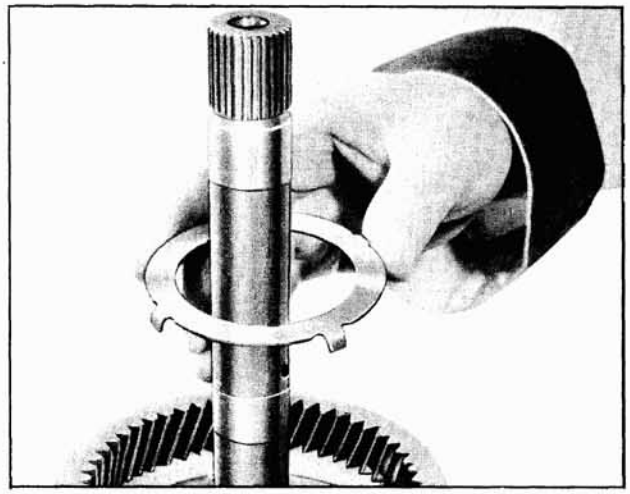


Fig. 7-86 Removing Thrust Washer

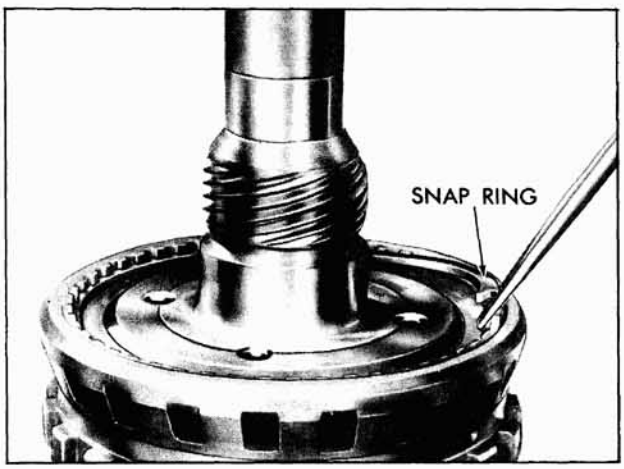


Fig. 7-87 Removing Snap Ring

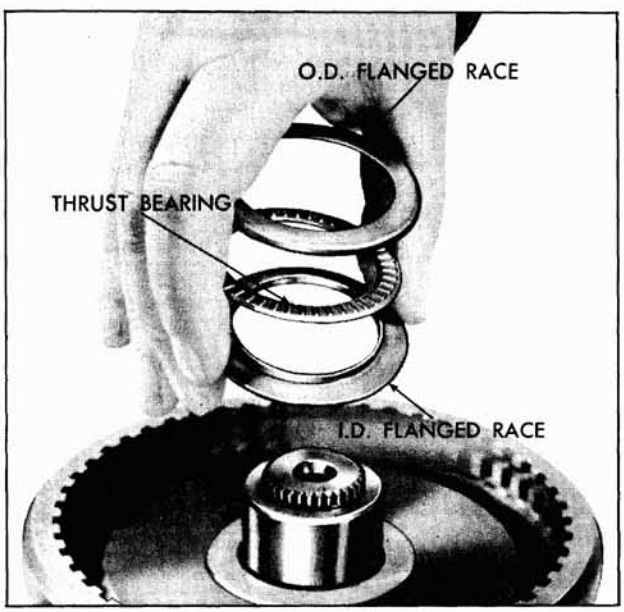


Fig. 7-88 Removing Thrust Bearing

13. If necessary, remove the rear internal gear to mainshaft snap ring, to remove the mainshaft.

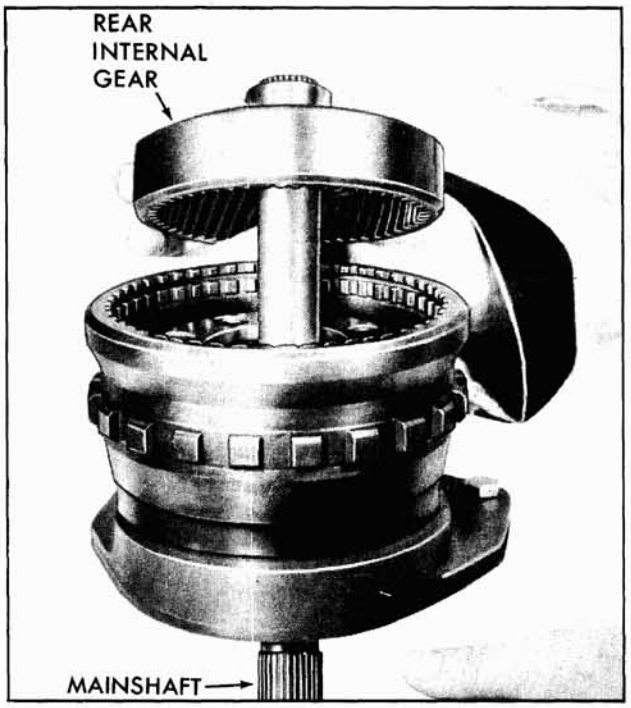


Fig. 7-89 Removing Rear Internal Gear and Mainshaft

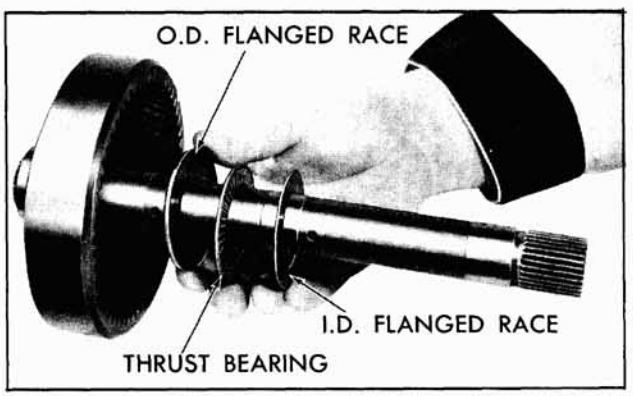


Fig. 7-90 Removing Thrust Bearing

GOVERNOR

All components of the governor assembly, with the exception of the driven gear, are a select fit. Each assembly is factory calibrated. The governor, including the driven gear, is serviced as a complete assembly; however, the driven gear can be replaced if necessary.

GOVERNOR DRIVEN GEAR REPLACEMENT

To facilitate governor driven gear repair, a service package containing a nylon driven gear, two governor weight retaining pins and one governor driven gear split retaining pin is available.

If replacement of the driven gear is necessary, use extreme care and proceed in the following recommended manner:

1. Cut off one end of each governor weight retaining pin, remove the pins, thrust cap, primary and secondary weights, two springs and the governor valve. Primary and secondary weights and the springs are interchangeable. (Fig. 7-91)

Do not damage governor valve.

2. While supporting the governor with a wood block, remove the driven gear split retaining pin from the governor sleeve with a 1/8" punch.

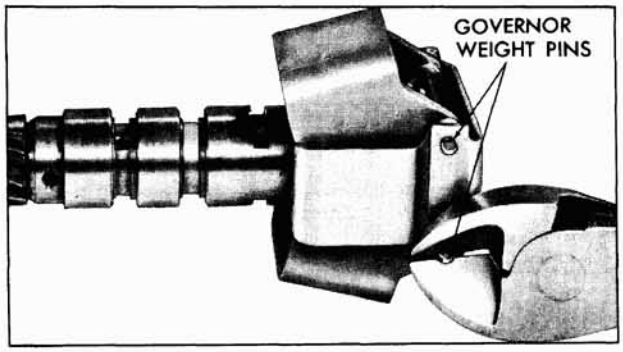


Fig. 7-91 Removing Governor Weight Pins

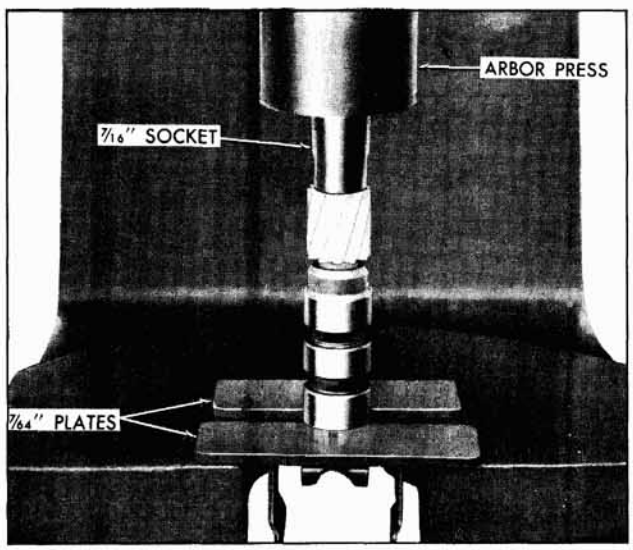


Fig. 7-92 Installing Driven Gear

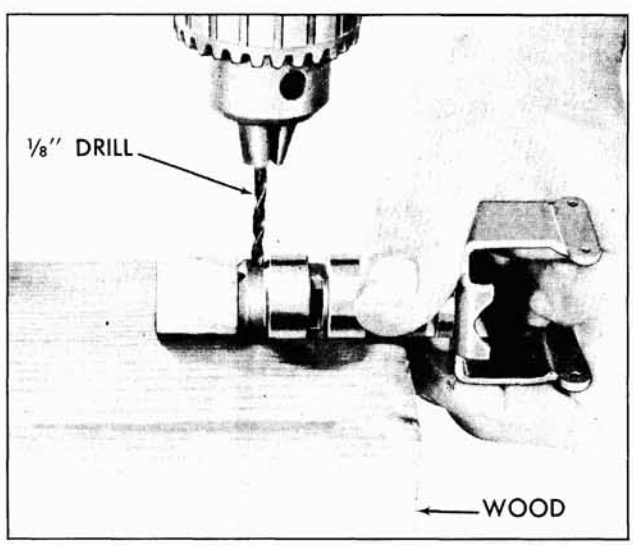


Fig. 7-93 Drilling Hole in Driven Gear

3. Clamp the driven gear in a vise and remove the driven gear from the governor sleeve with a twisting motion.

4. Carefully, clean the chips that may have entered the governor sleeve by washing the assembly thoroughly in a clean solvent.

5. Support governor body on two 7/64" plates installed in the exhaust slots of the governor sleeve. Position the governor assembly and plates in an arbor press. Install driven gear into governor sleeve with the arbor press, using a 7/16" socket to protect the governor thrust tip. (Fig. 7-92) Carefully remove any chips that may have shaved off nylon gear hub.

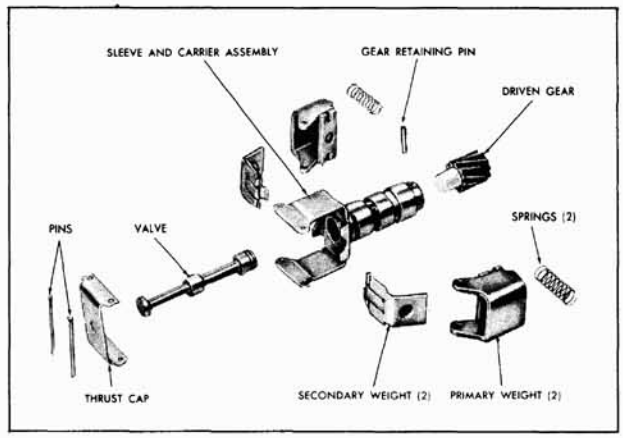


Fig. 7-94 Governor Assembly

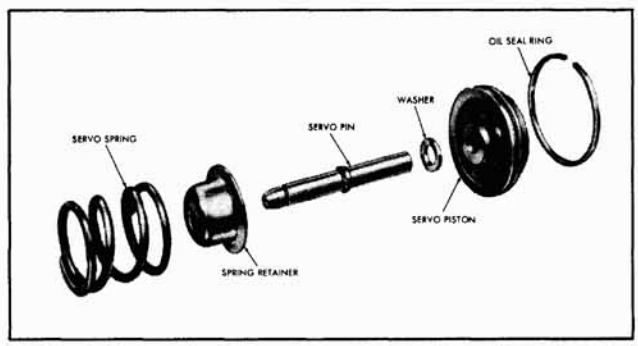


Fig. 7-95 Front Servo

6. Using a 1/8" drill and drill halfway through the existing retaining pin hole in the governor bushing. Rotate the governor assembly 180° and finish drilling the hole for the split retaining pin. (Fig. 7-93)

CARE SHOULD BE USED IN DRILLING THESE HOLES HALFWAY THROUGH SO THAT THEY WILL MEET IN THE CENTER OF THE GEAR.

7. Install split driven gear retaining pin into governor sleeve assembly.

8. Wash governor assembly thoroughly to remove any chips that may have collected during the assembly and drilling operations.

9. Inspect orifice in end of valve making sure it is not blocked, install governor valve into bore of governor sleeve, wide land first. (Fig. 7-94)

10. Install primary and secondary weights, springs and thrust cap on governor sleeve assembly.

11. Install new retaining pins and crimp.

12. Check governor weights and valve for freeness of operation after assembly is completed.

FRONT SERVO (Fig. 7-95)

Inspection

1. Inspect servo pin for damage.

2. Inspect piston for damaged oil ring groove, check freedom of ring in groove and case bore.

3. Inspect piston for cracks or porosity.

4. Check fit of servo pin in piston and case bore.

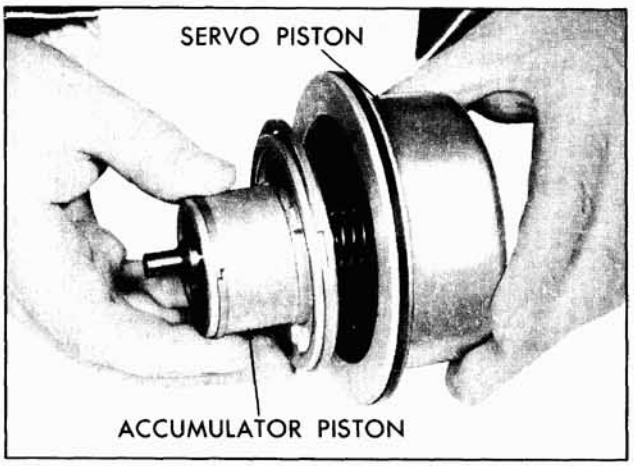


Fig. 7-96 Removing or Installing Accumulator Piston

REAR SERVO ASSEMBLY

Disassembly

1. Remove the rear accumulator piston from rear servo piston. (Fig. 7-96)
2. Remove "E" ring retaining rear servo piston to band apply servo pin. (Fig. 7-97)
3. Remove rear servo piston and seal from band apply pin. (Fig. 7-98)
4. Remove washer, spring, and retainer.

Inspection

1. Inspect freedom of accumulator rings in piston and their respective bores.
2. Inspect fit of band apply pin in servo piston and case bore.
3. Inspect band apply pin for scores or cracks.
4. Inspect servo piston for cracks or porosity.

Assembly

1. Install spring retainer, cup side toward band apply end of pin, spring and washer on servo pin. (Fig. 7-98)
2. Install servo pin, retainer, spring and washer into bore of servo piston and secure with "E" ring.
3. Install oil seal ring on servo piston, if removed.
4. Install outer and inner oil rings on accumulator piston if removed and assemble into bore of servo piston. (Fig. 7-96)

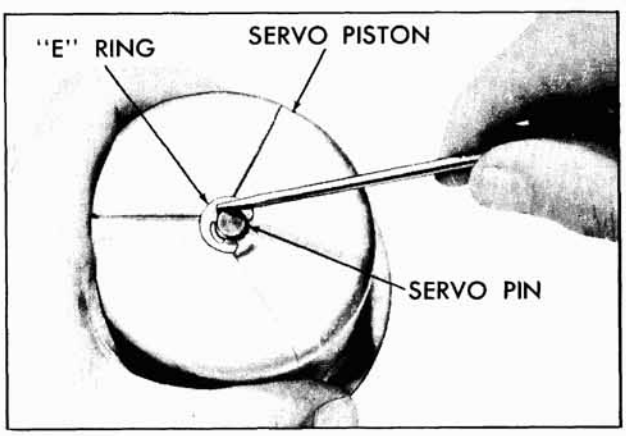


Fig. 7-97 Removing "E" Ring

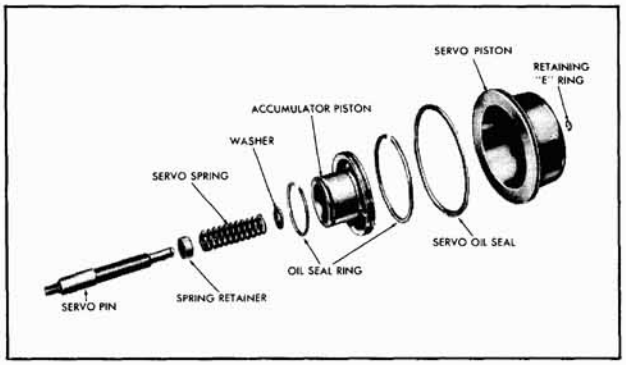


Fig. 7-98 Rear Servo and Accumulator Assembly

CONTROL VALVE ASSEMBLY (Fig. 7-100)

Disassembly

1. Position control valve assembly with cored face up.
2. Remove manual valve from upper bore.
3. Remove the accumulator piston retaining ring as shown in Fig. 7-99.
4. Remove front accumulator piston and spring. (Fig. 7-101)
5. On the right side, top bore, remove the retaining pin, 1-2 modulator bushing, 1-2 regulator valve and 1-2 regulator spring.
6. Remove the 1-2 detent valve and 1-2 valve.
7. From the next bore down, remove the retaining pin and 2-3 valve spring, 2-3 modulator bushing and valve, and 3-2 intermediate spring.
8. Remove the 2-3 valve.
9. From the next bore down, remove the retaining pin, bore plug, 3-2 valve, 3-2 valve spring and spacer.
10. At the other end of the assembly, top bore, remove the retaining pin and bore plug.
11. Remove the detent valve, detent regulator valve, spring and spacer.

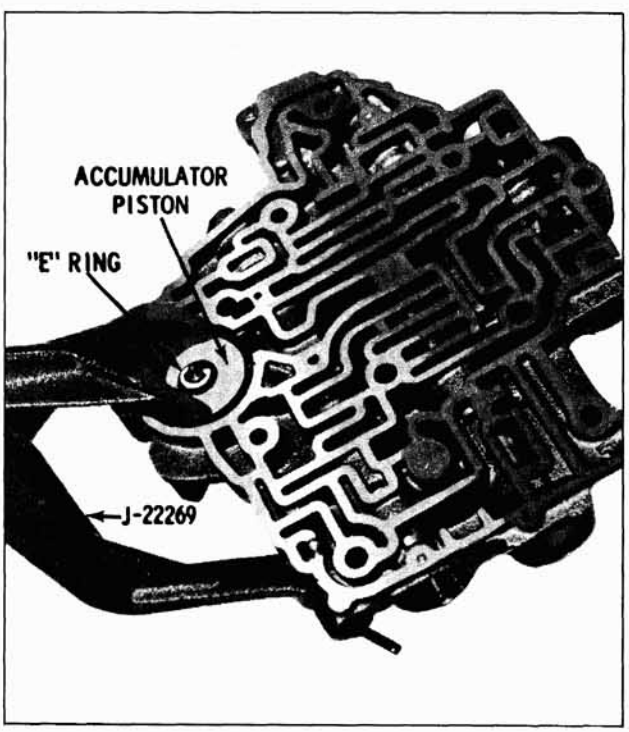
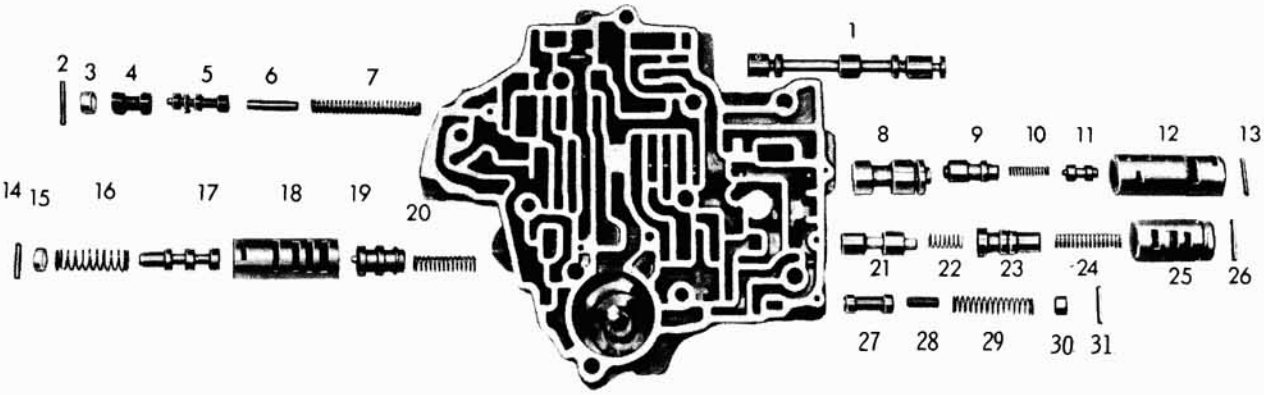


Fig. 7-99—Removing Front Accumulator



1. Manual Valve
2. Retaining Pin
3. Bore Plug
4. Detent Valve
5. Detent Regulator Valve
6. Spacer Pin
7. Detent Regulator Spring
8. 1-2 Shift Valve
9. 1-2 Detent Valve
10. 1-2 Regulator Spring
11. 1-2 Regulator Valve
12. 1-2 Modulator Bushing
13. Retaining Pin
14. Grooved Retaining Pin
15. Bore Plug
16. 1-2 Accumulator Secondary Spring
17. 1-2 Accumulator Secondary Valve
18. 1-2 Accumulator Bushing
19. 1-2 Primary Accumulator Valve
20. 1-2 Accumulator Primary Spring
21. 2-3 Shift Valve
22. 3-2 Intermediate Spring
23. 2-3 Modulator Valve
24. 2-3 Valve Spring
25. 2-3 Modulator Bushing
26. Retaining Pin
27. 3-2 Valve
28. Spacer Pin
29. 3-2 Valve Spring
30. Bore Plug
31. Retaining Pin

Fig. 7-100—Valve Body Assembly

12. From the next bore remove the 1-2 accumulator valve grooved retainer pin and bore plug.
13. Remove 1-2 accumulator bushing, secondary spring and the 1-2 accumulator secondary valve.
14. From the same bore, remove the primary 1-2 accumulator valve and spring.
15. From the governor oil feed hole, remove the screen assembly. (Fig. 7-102)

Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
2. Inspect the bushing for cracks, scratches or distortion.
3. Inspect the body for cracks or scored bores.
4. Check all springs for distortion or collapsed coils.
5. Clean governor oil screen in clean solvent.

Assembly

1. Install front accumulator spring and piston into valve body.
2. Using tools as shown in Fig. 7-103, install the accumulator spring and piston and secure with retaining ring. While installing servo, jiggle valve body while rotating screw to prevent piston binding. Push in on sides of piston ring 90° from gap to start ring in bore.
3. Install the 1-2 accumulator valve secondary spring and 1-2 accumulator bore plug into the bushing.
4. Compress the bore plug past the retaining pin hole and install the grooved retaining pin from the cast surface side of the valve body with grooves entering the pin hole last.
5. Tap grooved retaining pin with hammer until it is flush with the cast surface of the valve body.
6. Install the detent regulator spring and spacer in next bore up. (Fig. 7-104)

Compress spring and retain in place using a .005" to .015" feeler gauge.

7. Install the detent regulator valve, wide land first.

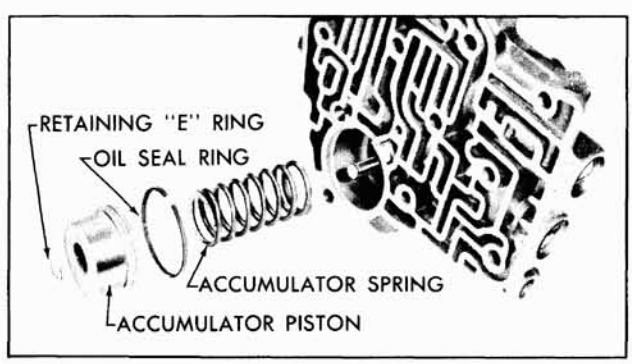


Fig. 7-101 Front Accumulator Piston and Spring

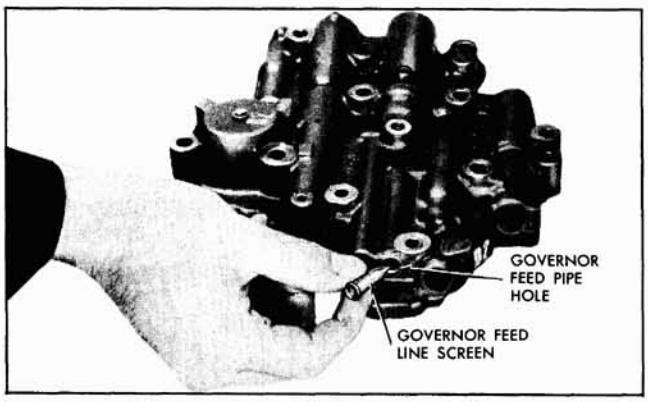


Fig. 7-102 Remove and Install Governor Feed Screen

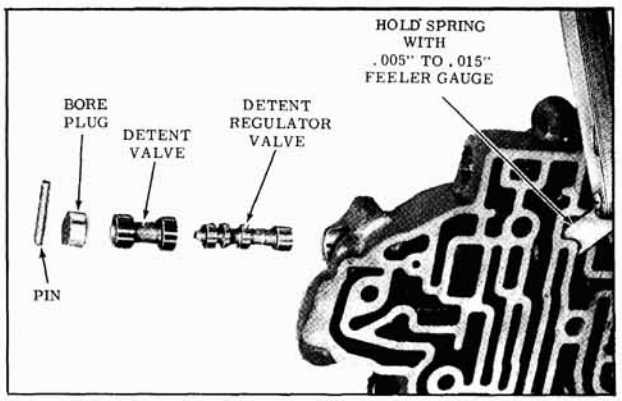


Fig. 7-104 Installing Detent Regulator and Valve

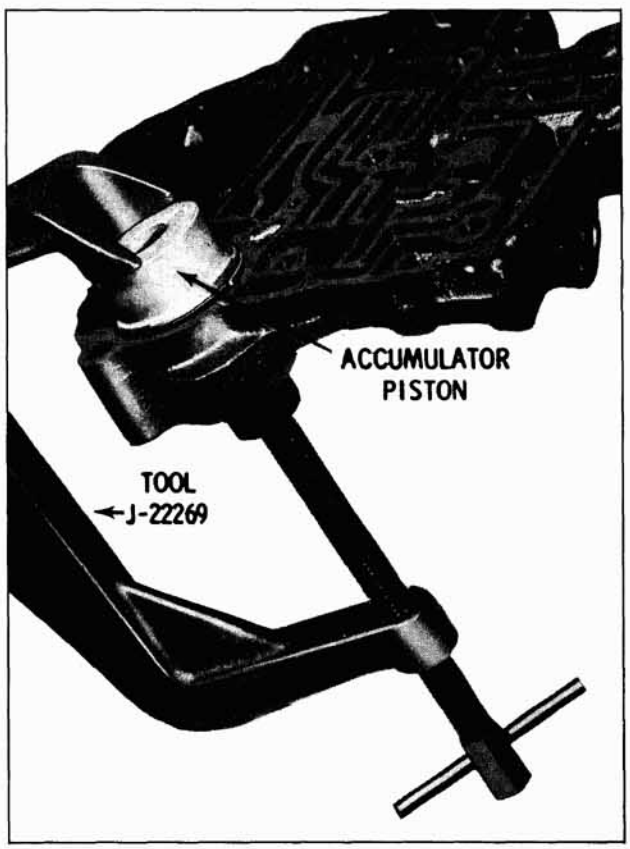


Fig. 7-103 Installing Front Accumulator

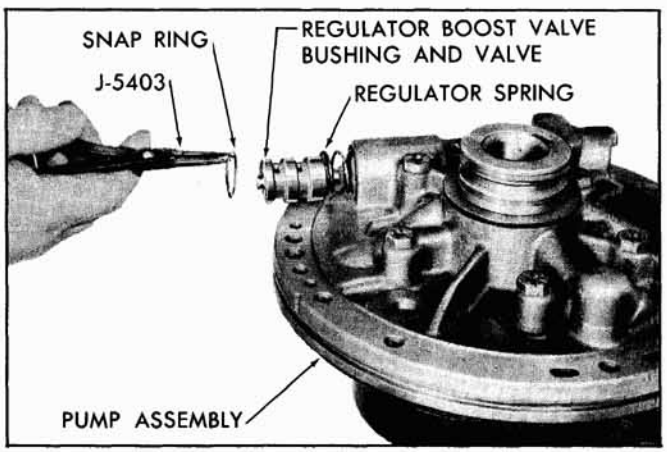


Fig. 7-105 Removing Snap Ring

8. Install the detent valve, narrow land first.
9. Install bore plug, open end out, and install retaining pin. Remove the feeler gauge.
10. In the lower right hand bore, install the 3-2 valve.
11. Install the spacer, 3-2 valve spring, bore plug with hole out and retaining pin.
12. In the next bore up, install the 2-3 valve, stem end out, and 3-2 intermediate spring.
13. Install the 2-3 modulator valve into the bushing and install both parts into the valve bore.
14. Install the 2-3 valve spring and install the retaining pin.
15. In the next bore, install the 1-2 valve, stem end out.
16. Install the 1-2 regulator valve, spring and detent valve, into the bushing, aligning spring in bore of detent valve, and install parts into the valve bore.
17. Compress the bushing against the spring and install the retaining pin.
18. Install the governor oil screen assembly into the governor oil feed hole, pinched end first. (Fig. 7-102)

Screen is held in place by the governor feed pipe when installed on transmission case.

19. Install the manual valve with detent pin groove to the right.

OIL PUMP

Disassembly

1. Place pump assembly in hole in bench or Holding Fixture J-6116.
2. Compress the regulator boost valve bushing against the pressure regulator spring and remove the snap ring, using J-5403 Pliers. (Fig. 7-105)
3. Remove the regulator boost valve bushing and valve.
4. Remove the pressure regulator spring.
5. Remove the regulator valve, spring retainer and spacer(s) if present. (Fig. 7-106)
6. Remove pump cover to body attaching bolts and remove pump cover from body.
7. Remove the retaining pin and bore plug from the pressure regulator bore. (Fig. 7-107)
8. Remove the hook type oil rings from the pump cover. (Fig. 7-109)
9. Remove the pump to forward clutch housing selective washer (fiber).
10. Mark drive and driven gears for reassembly and remove drive gear. (Fig. 7-110)

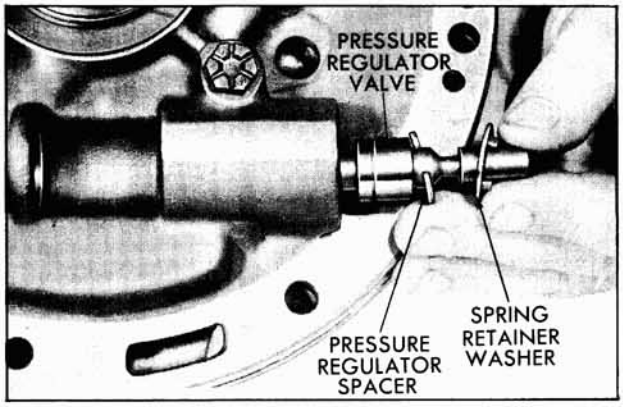


Fig. 7-106 Removing Valve Spacer and Retainer

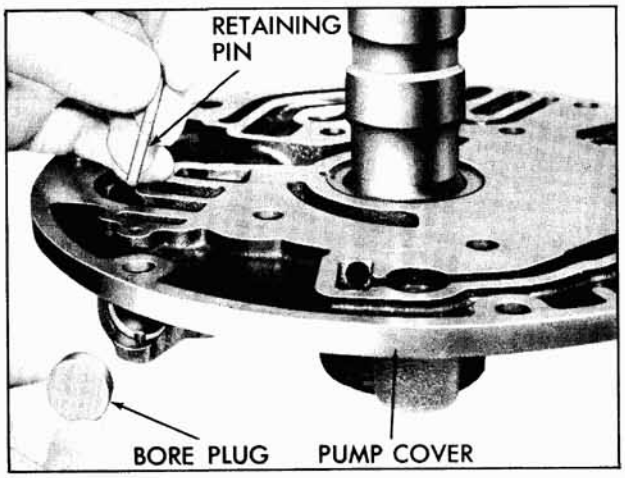


Fig. 7-107 Removing Pin and Bore Plug

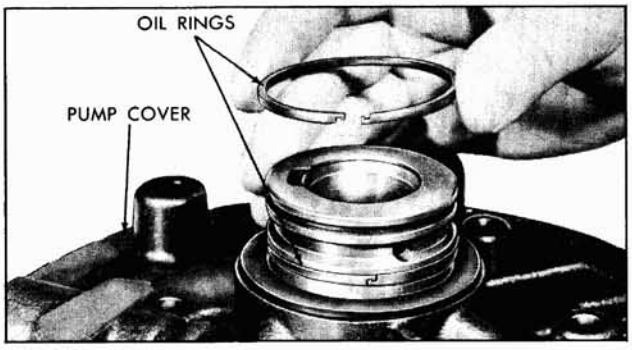


Fig. 7-109 Removing Oil Ring

11. Remove the driven gear from pump body. (Fig. 7-111)

Inspection

1. Inspect the gear pocket and crescent for scoring, galling or other damage.
2. Place pump gears in pump and check end clearance.

Pump body face to gear face clearance should be .0008" to .0015". (Fig. 7-112)

3. Check face of pump body for scores or nicks.
4. Check oil passages.
5. Check for damaged cover bolt attaching threads.
6. Check for over-all flatness of pump body face.

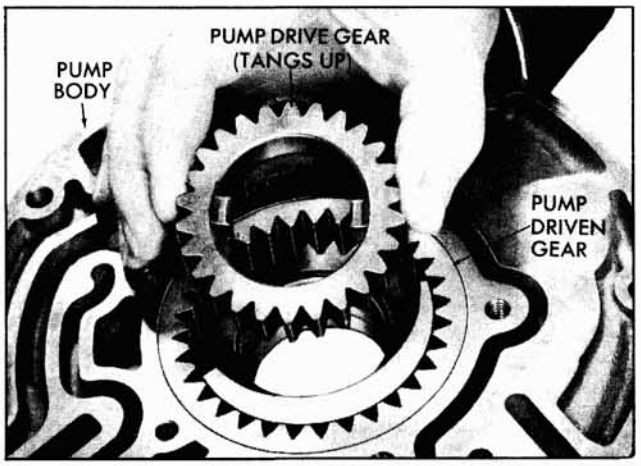


Fig. 7-110 Removing Drive Gear

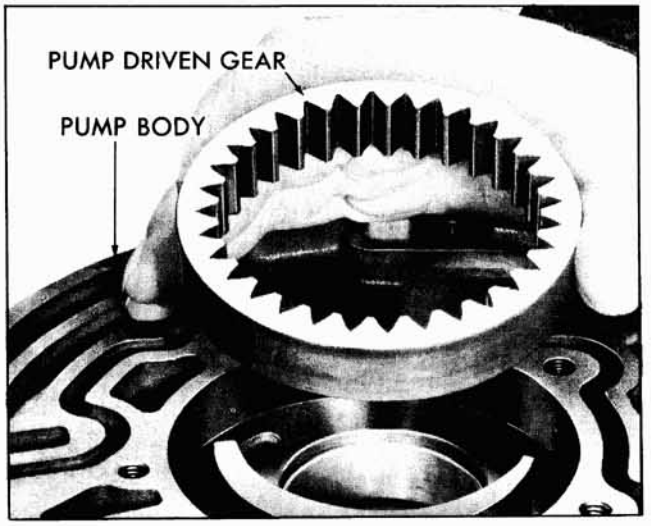


Fig. 7-111 Removing Driven Gear

Fig. 7-112 Checking Clearance

7. Check bushing for scores or nicks.
8. Inspect the pump attaching bolt seals for damage, replace if necessary.
9. Inspect pump cover face for over-all flatness.
10. Check for scores or chips in pressure regulator bore.
11. Check that all passages are open and not interconnected.

12. Check for scoring or damage at pump gear face.
13. Inspect stator shaft for damaged splines or scored bushings.
14. Inspect oil ring grooves for damage or wear.
15. Inspect selective washer thrust face for wear or damage.
16. Inspect pressure regulator and boost valve for free operation.
17. Inspect pump cover for open 1/8" dia. breather hole.

Assembly (Fig. 7-113)

1. Install the drive and driven pump gears into the pump body with alignment marks up. (Figs. 7-114 and 7-115)

Install the drive gear with drive tangs up.

2. Protect stator shaft and install pump cover in vise.
3. Install the spacer(s) if used, retainer and spring, into the pressure regulator bore. (Fig. 7-116)
4. Install the pressure regulator valve from opposite end of bore, stem end first.
5. Install the boost valve into the bushing, stem end out, and install both parts into the pump cover by compressing the bushing against the spring. Insert a small screwdriver between a spring coil and the bore of the boost valve to keep the spring compressed, so the retaining ring can be installed. (Fig. 7-117)
6. Install the pressure regulator valve bore plug and retaining pin into opposite end of bore.
7. Install the previously selected front unit selective thrust washer (fiber) over the pump cover delivery sleeve. (Fig. 7-118)
8. Install two hook-type oil seal rings. (Fig. 7-119)
9. Assemble pump cover to pump body with attaching bolts.

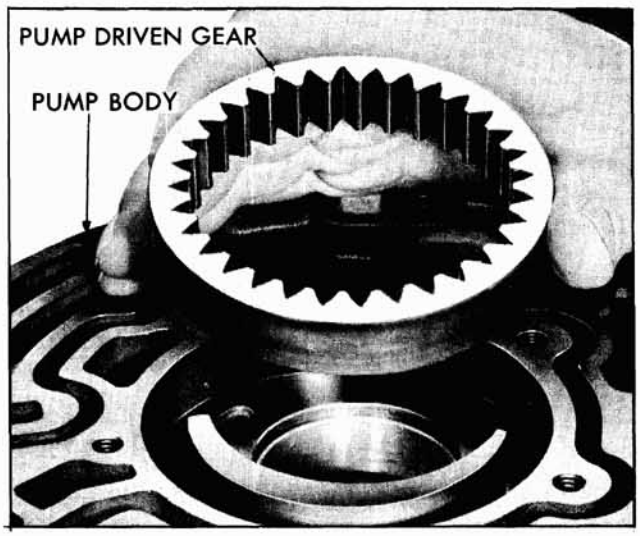


Fig. 7-114 Installing Driven Gear

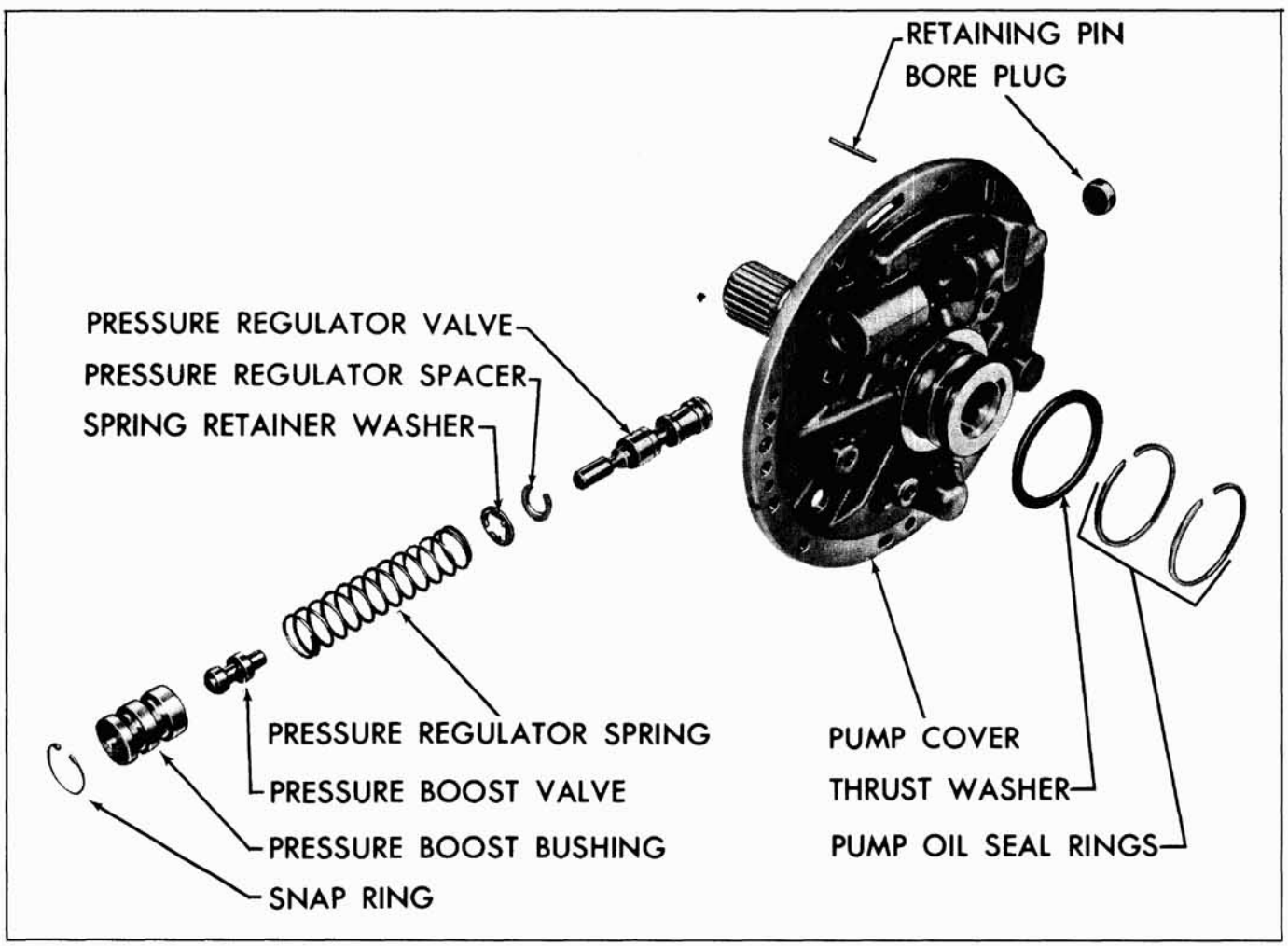


Fig. 7-113 Oil Pump Cover Assembly

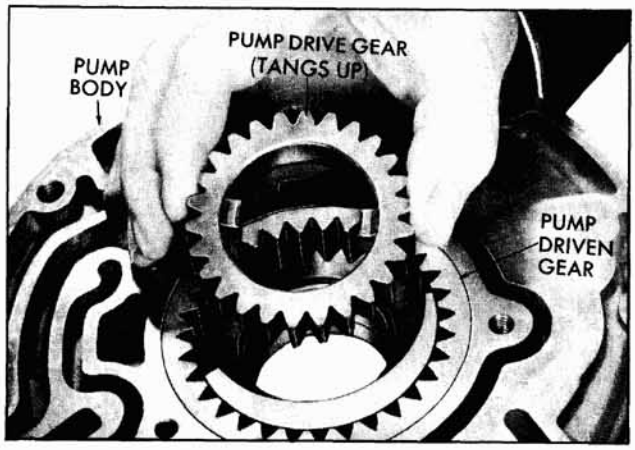


Fig. 7-115 Installing Drive Gear

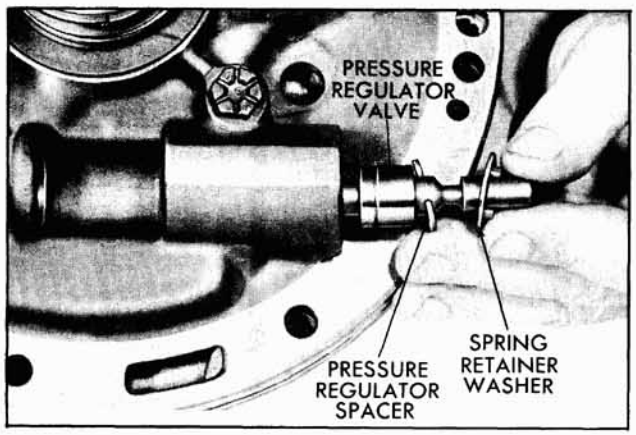


Fig. 7-116 Installing Pressure Regulator Valve

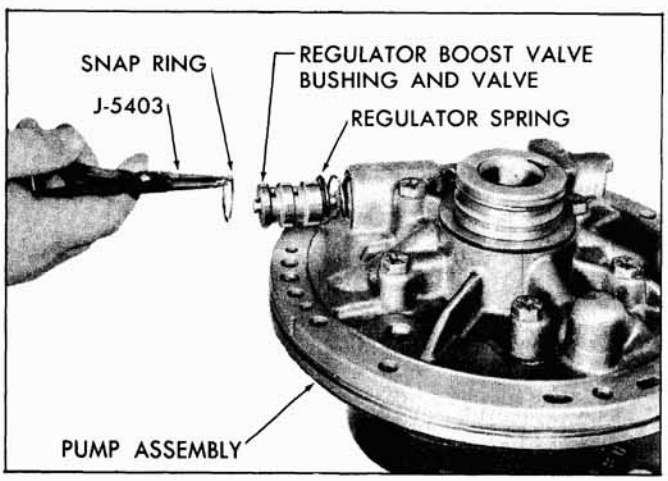


Fig. 7-117 Installing Snap Ring

Leave the bolts one turn loose at this time.

10. Place Pump Aligning Strip, J-21368, over pump body and cover, and tighten tool. (Fig. 7-120)
11. Torque pump cover bolts to 20 ft. lbs.
12. Install and align pump to case gasket.
13. Install the pump to case "O" ring seal.

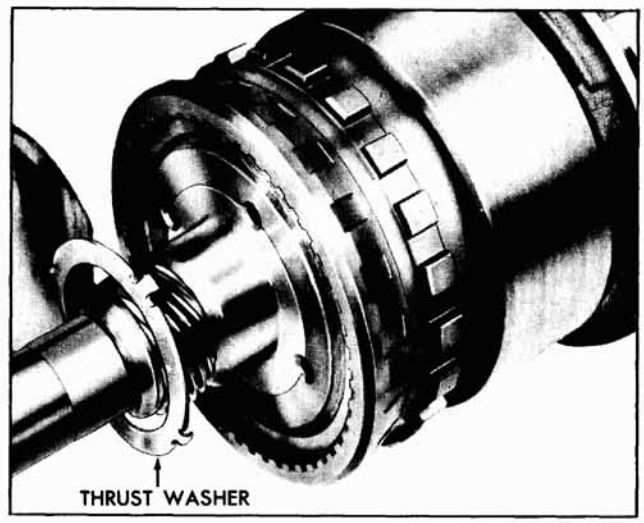


Fig. 7-118 Installing Thrust Washer

Fig. 7-119 Installing "O" Rings

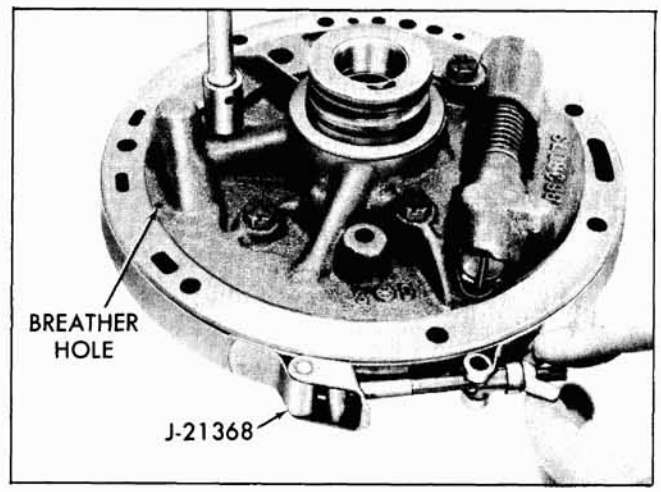


Fig. 7-120 Installing Pump Body

FORWARD CLUTCH

Disassembly

1. Place forward clutch assembly with turbine shaft in hole in bench, or Holding Fixture J-6116, and remove the forward clutch housing to direct clutch hub snap ring. (Fig. 7-121)
2. Remove the direct clutch hub. (Fig. 7-122)
3. Remove the forward clutch hub and bronze or phenolic thrust washers. (Fig. 7-123)
4. Remove five composition and five steel clutch plates. (Fig. 7-124)

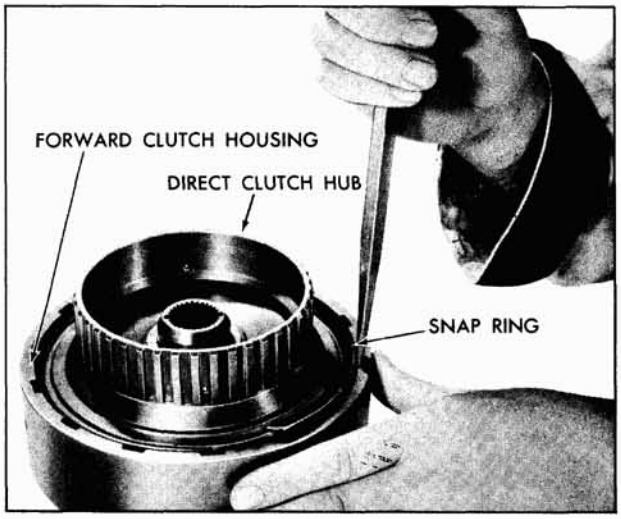


Fig. 7-121 Removing Snap Ring

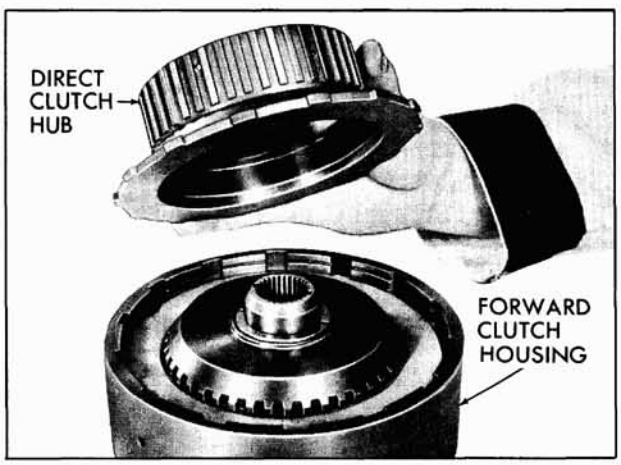


Fig. 7-122 Removing Direct Clutch Hub

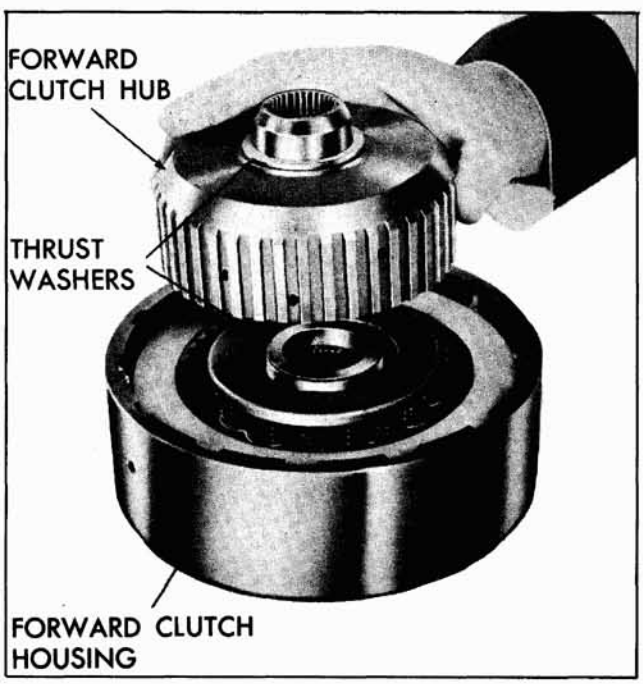


Fig. 7-123 Removing Forward Clutch

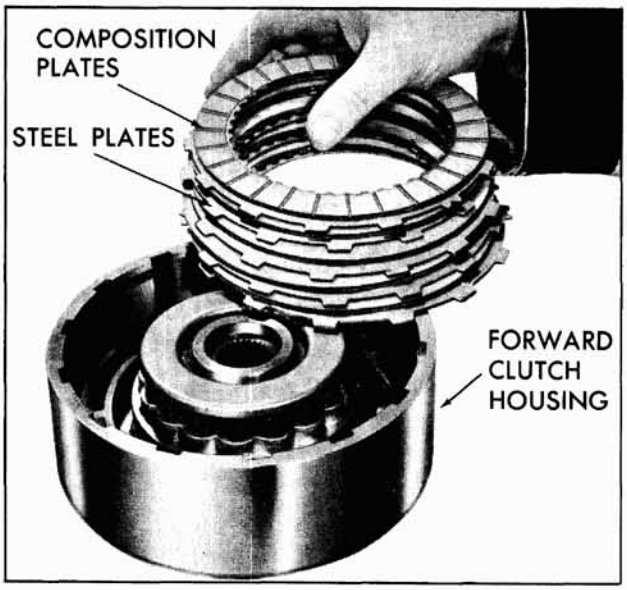


Fig. 7-124 Removing Clutch Plates

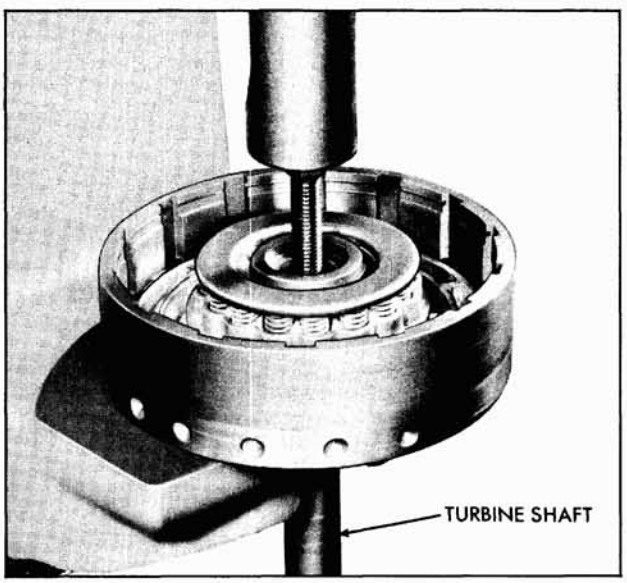


Fig. 7-125 Removing Turbine Shaft

5. If necessary, remove the turbine shaft and oil seal by installing in arbor press. (Fig. 7-125)

6. Using J-4670-14 Clutch Spring Compressor, with Adapters J-6129 and J-8765, compress the spring retainer and remove the snap ring. (Fig. 7-126)

7. Remove the tools, snap ring, spring retainer and 16 clutch release springs. (Fig. 7-127)

8. Remove the forward clutch piston. (Fig. 7-128)

9. Remove the inner and outer clutch piston seals. (Figs. 7-129 and 7-130)

10. Remove the center piston seal from the forward clutch housing. (Fig. 7-131)

Inspection

1. Inspect the drive and driven clutch plates for signs of burning, scoring, or wear.

2. Inspect 16 springs for collapsed coils or signs of distortion.

3. Inspect the clutch hubs for worn splines, proper lubrica-

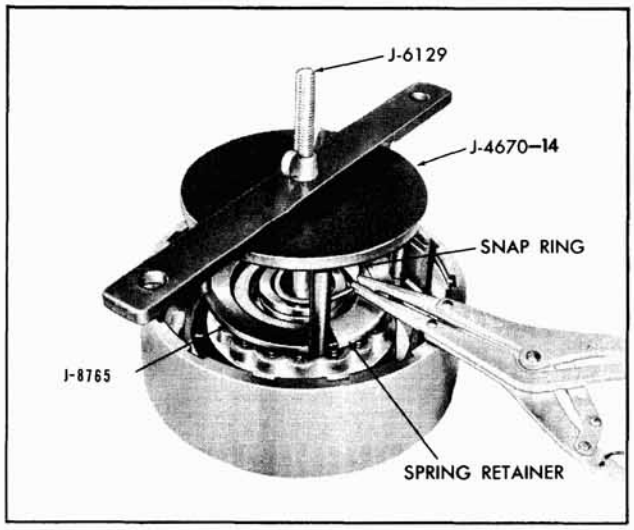


Fig. 7-126 Removing Snap Ring

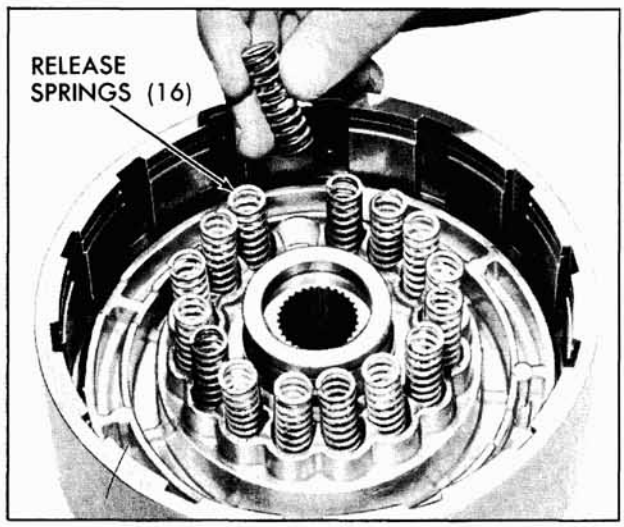


Fig. 7-127 Removing Release Springs

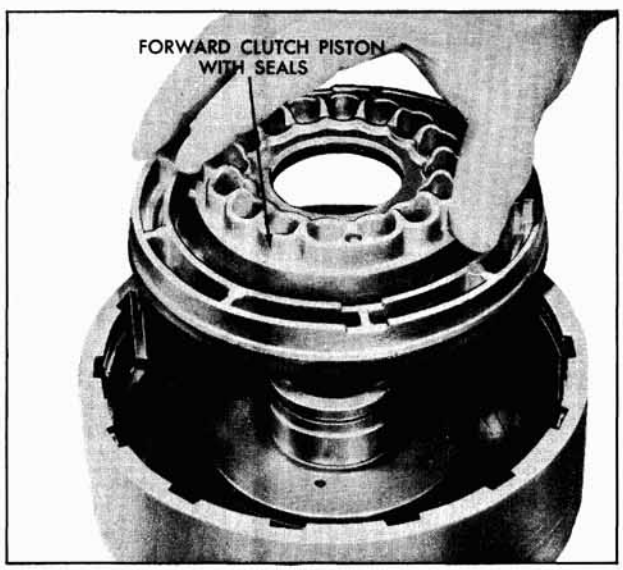


Fig. 7-128 Removing Forward Clutch Piston

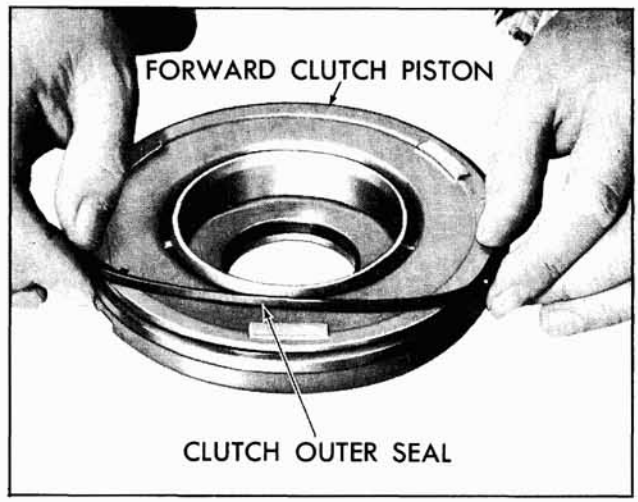


Fig. 7-129 Removing Outer Piston Seal

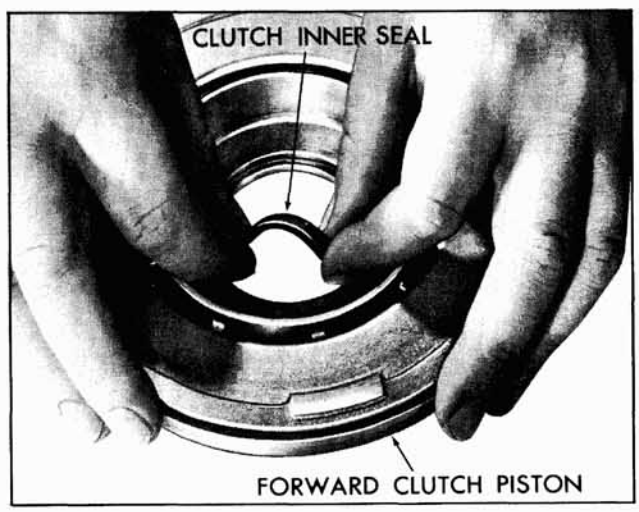


Fig. 7-130 Removing Inner Piston Seal

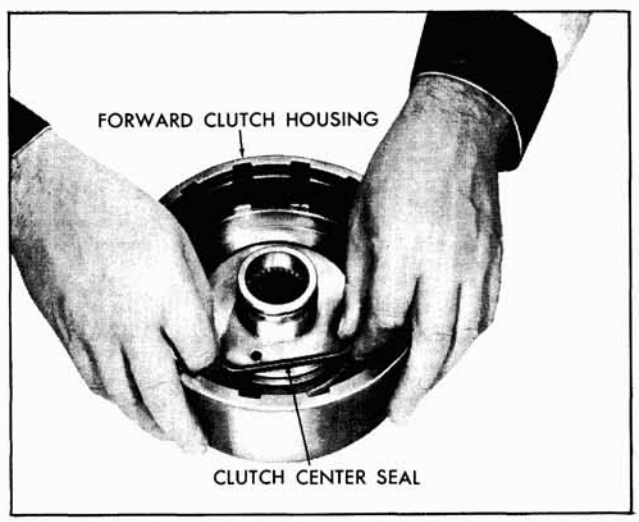


Fig. 7-131 Removing Center Seal

tion holes, thrust faces.

4. Inspect the piston for cracks or porosity.

5. Inspect the clutch housing for wear, scoring, open oil passages and free operation of the ball check.

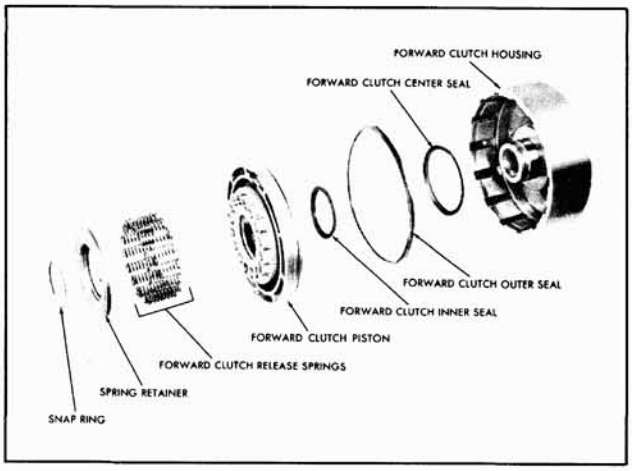


Fig. 7-132 Forward Clutch Piston Assembly

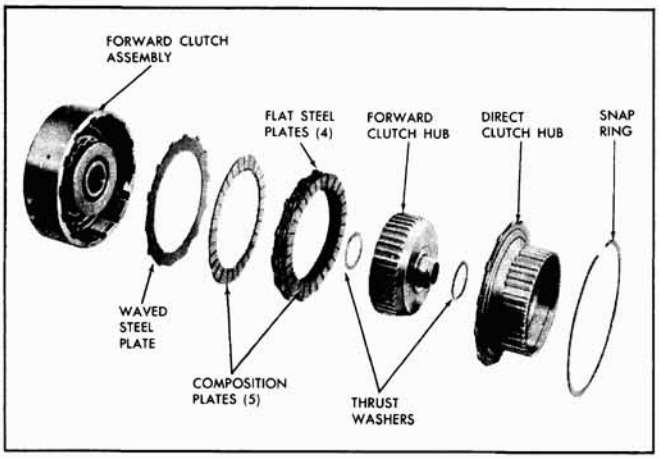


Fig. 7-133 Forward Clutch Assembly

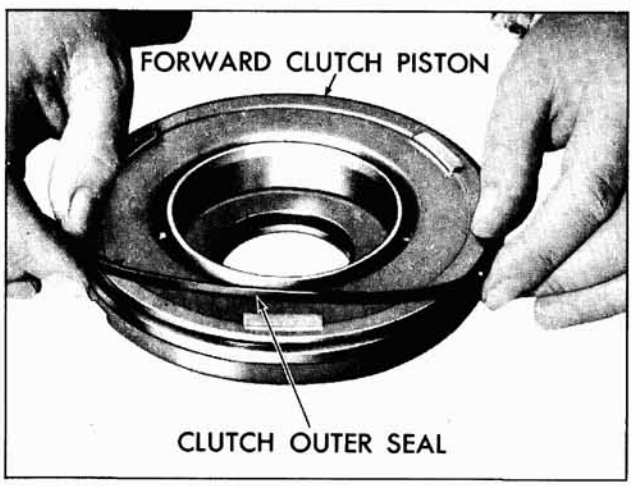


Fig. 7-134 Installing Piston Outer Seal

Turbine Shaft Inspection

1. Inspect for open lubrication passages at each end and cross holes to make certain they are open to oil flow.
2. Inspect the splines for damage.
3. Inspect the ground bushing journals for damage.
4. Inspect the shaft for cracks or distortion.

Assembly (Figs. 7-132 and 7-133)

Apply transmission fluid to all seals and clutch plates before reassembly.

1. Place new inner and outer oil seals on clutch piston, lips face away from spring pockets. (Figs. 7-134 and 7-135)

The forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during reassembly, therefore, care should be exercised to make certain the proper piston be installed in the clutch assemblies.

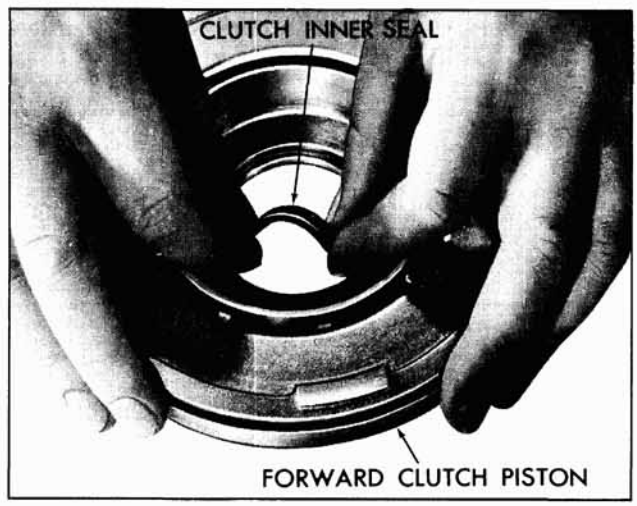


Fig. 7-135 Installing Piston Inner Seal

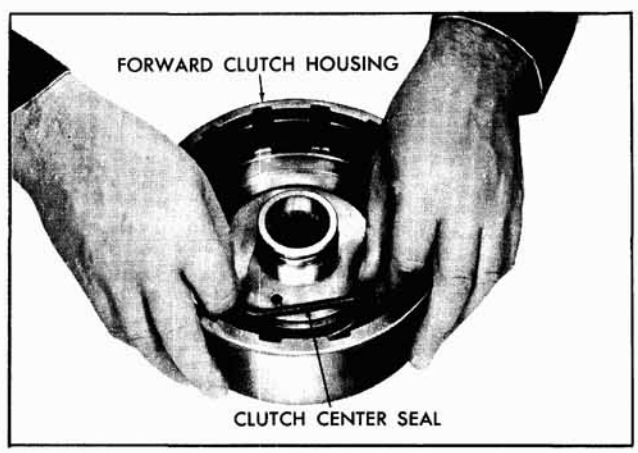


Fig. 7-136 Installing Piston Center Seal

As shown in Fig. 7-159, the forward clutch piston can be identified by the blind hole in the clutch apply face of the piston.

2. Place a new center seal on the clutch housing, lip faces up. (Fig. 7-136)
3. Place Seal Protector Tool J-21362 over clutch hub and install outer clutch piston Seal Protector J-21409, into clutch drum and install piston, rotating piston in drum until seated. (Fig. 7-137)
4. Install 16 clutch release springs into pockets in piston. (Fig. 7-138)
5. Place spring retainer and snap ring on springs.
6. Compress springs using Clutch Compressor Tools J-4670-14, J-6129, and J-8765, and install snap ring. (Fig. 7-139)

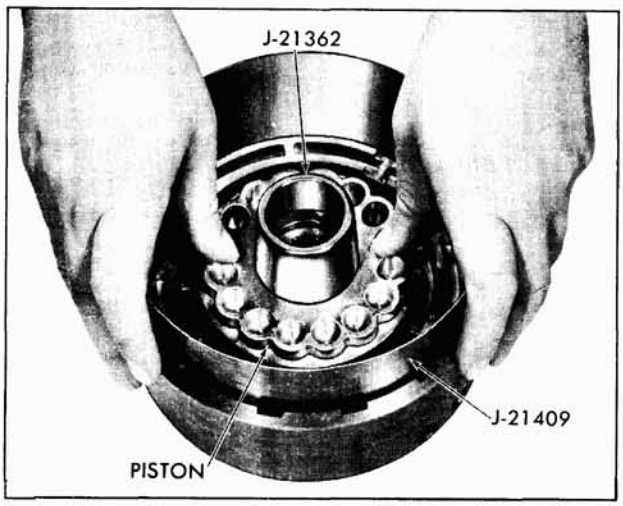


Fig. 7-137 Installing Clutch Piston

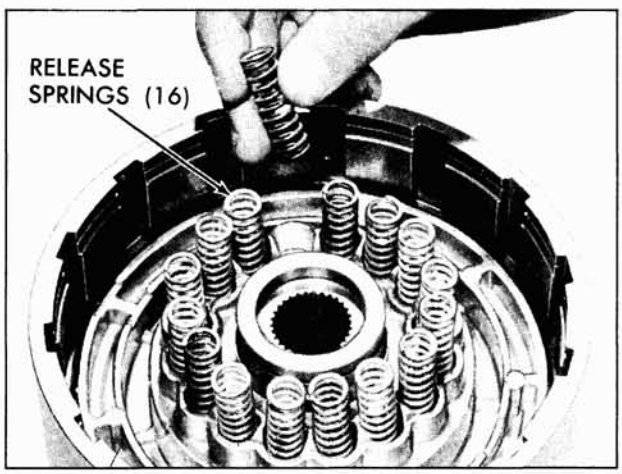


Fig. 7-138 Installing Release Springs

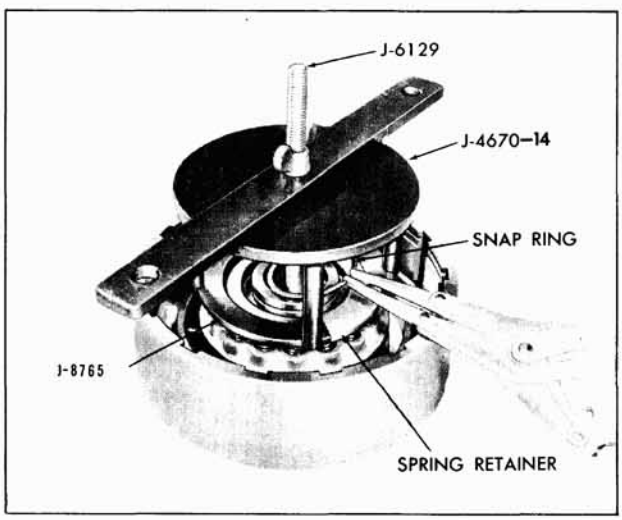


Fig. 7-139 Installing Snap Ring

7. If removed, install oil seal ring on turbine shaft and install in forward clutch housing, using arbor press. (Fig. 7-140)

8. Place clutch hub to clutch housing thrust washers on clutch hub. Retain with petrolatum.

9. Place forward clutch hub into forward clutch housing. (Fig. 7-141)

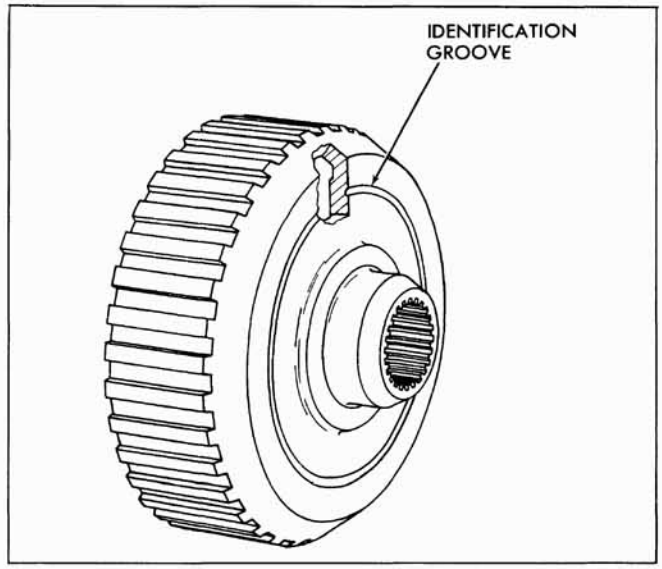


Fig. 7-140A Forward Clutch Hub

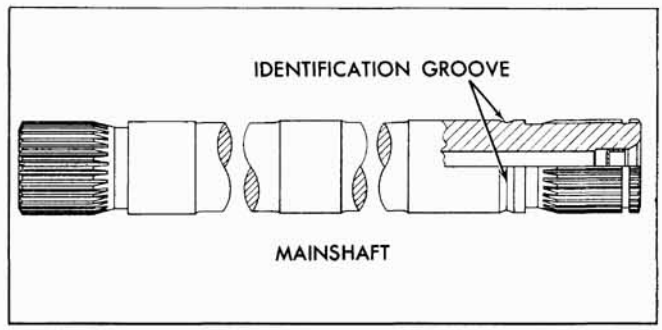


Fig. 7-140B Mainshaft Identification

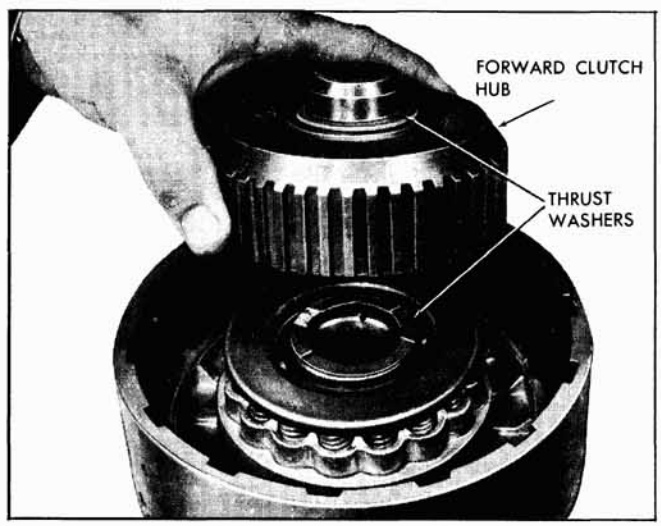


Fig. 7-141 Installing Forward Clutch Hub

The forward clutch hub, identified by a machined groove on the rear or hub side, is not interchangeable with past model parts. (Fig. 7-140A) Due to a spline change, if replacement of either the forward clutch hub or mainshaft is required, only current model parts should be used. The mainshaft is identified by a "V" groove on the rear, or internal gear end of the shaft. (Fig. 7-140B)

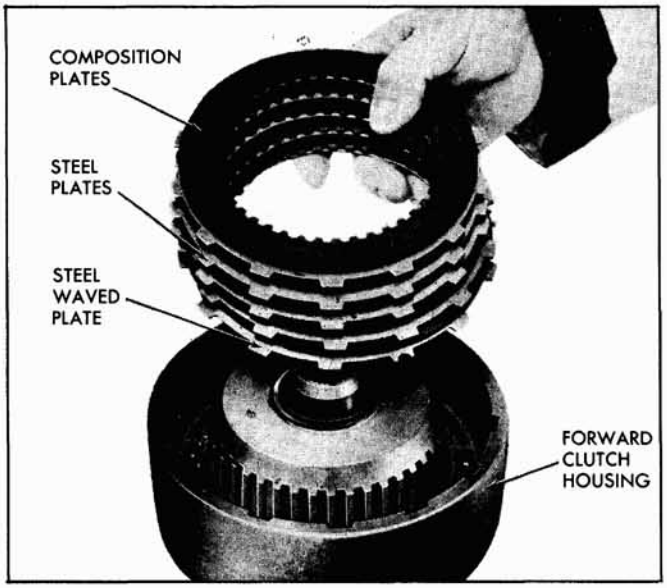


Fig. 7-142 Installing Forward Clutch Plates

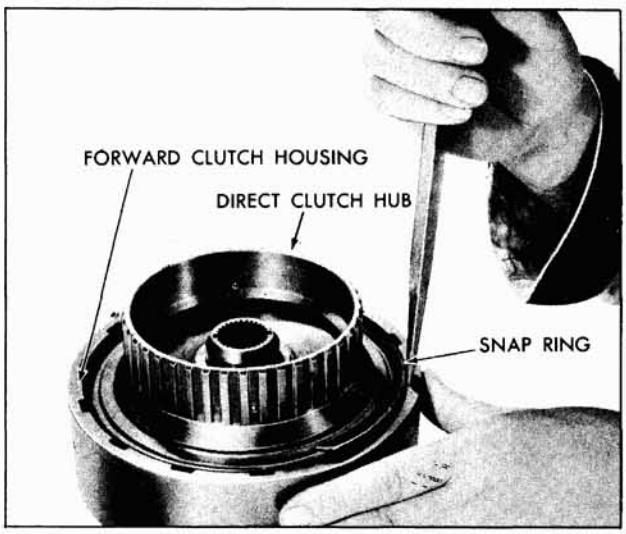


Fig. 7-143 Installing Snap Ring

10. Oil and install five composition and four flat steel and one waved steel clutch plate (plate with notches), starting with the waved steel and alternating steel and composition. (Fig. 7-142)

Radially grooved composition plates are installed at the factory only. All service plates are smooth.

11. Install the direct clutch hub and retaining snap ring. (Fig. 7-143)

The direct clutch hub is identified by a machined groove on the rear face, or long splined side, of the hub. This part change, because of the 6 plate direct clutch assembly in the "OB" and "OL" models, necessitates the use of current model part only. If replacement is required, a past model part must not be used with the 6 plate direct clutch assembly.

12. Place forward clutch housing on pump delivery sleeve and air check clutch operation. (Fig. 7-144)

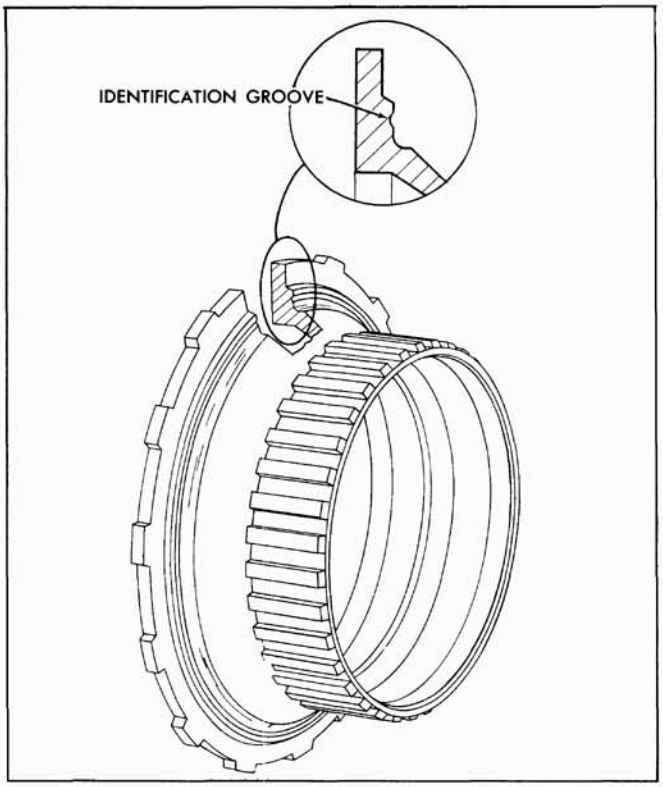


Fig. 7-143A Direct Clutch Hub Identification

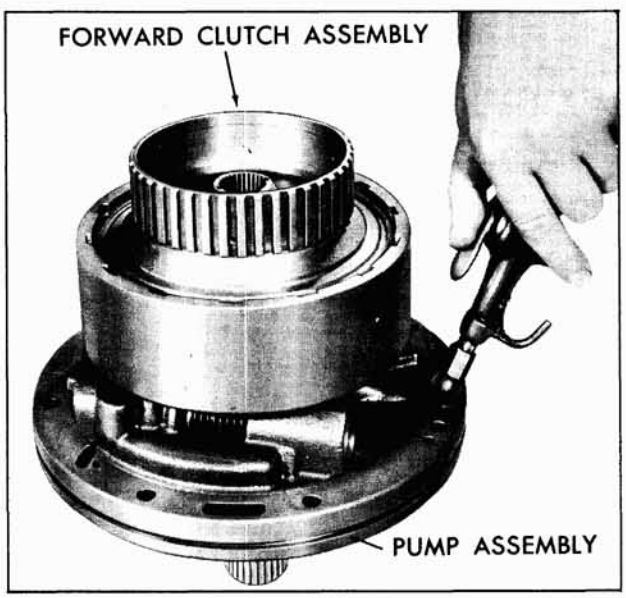


Fig. 7-144 Air Checking Forward Clutch

DIRECT CLUTCH AND INTERMEDIATE SPRAG

Disassembly

1. Remove sprag retainer snap ring and retainer (Fig. 7-145)
2. Remove sprag outer race, bushings and sprag assembly. (Fig. 7-146)
3. Turn unit over and remove backing plate to direct clutch housing snap ring. (Fig. 7-147)
4. Remove direct clutch backing plate, composition and steel clutch plates. (Fig. 7-148)
5. Using Clutch Compressor Tool J-4670-14, J-6129, and

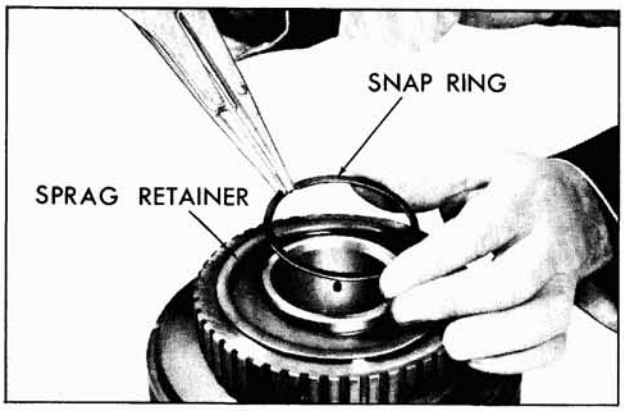


Fig. 7-145 Removing Snap Ring

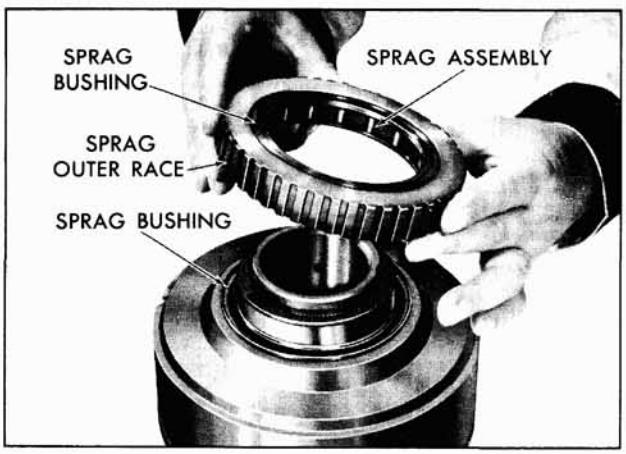


Fig. 7-146 Removing Intermediate Sprag

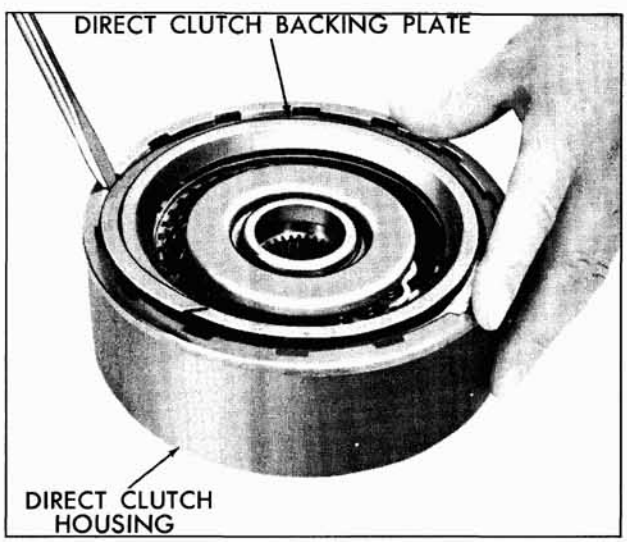


Fig. 7-147 Removing Snap Ring

J-8765, compress spring retainer and remove snap ring. (Fig. 7-149)

6. Remove retainer and 16 piston release springs. (Fig. 7-150)
7. Remove the direct clutch piston. (Fig. 7-151)
8. Remove the outer seal from the piston. (Fig. 7-152)
9. Remove the inner seal from the piston. (Fig. 7-153)
10. Remove the center piston seal from the direct clutch housing. (Fig. 7-154)

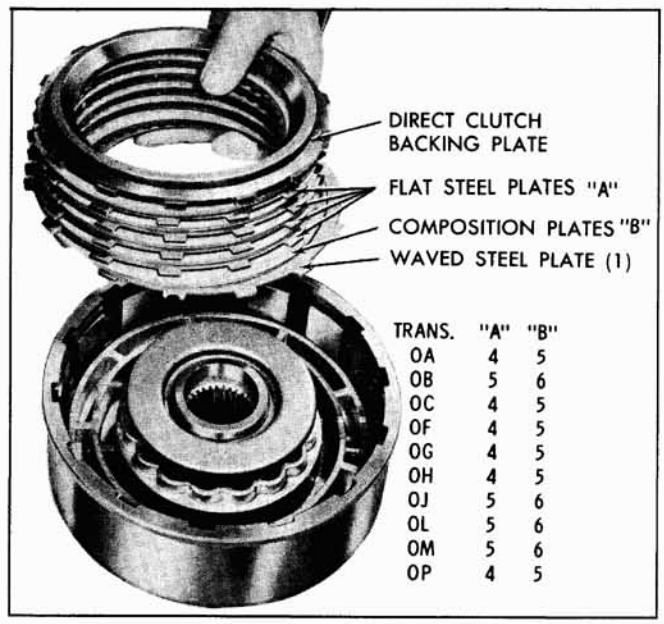


Fig. 7-148 Removing Direct Clutch Plates

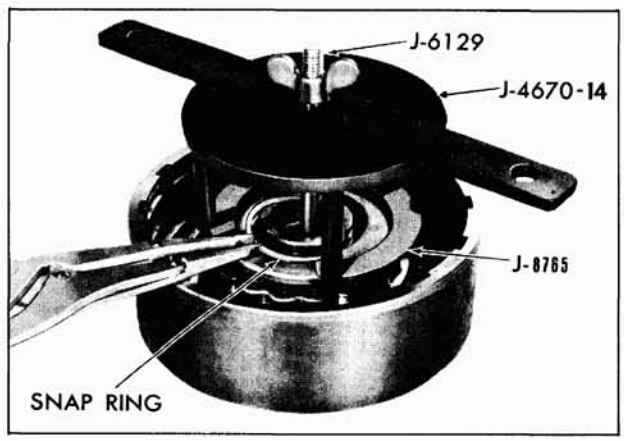


Fig. 7-149 Removing Snap Ring

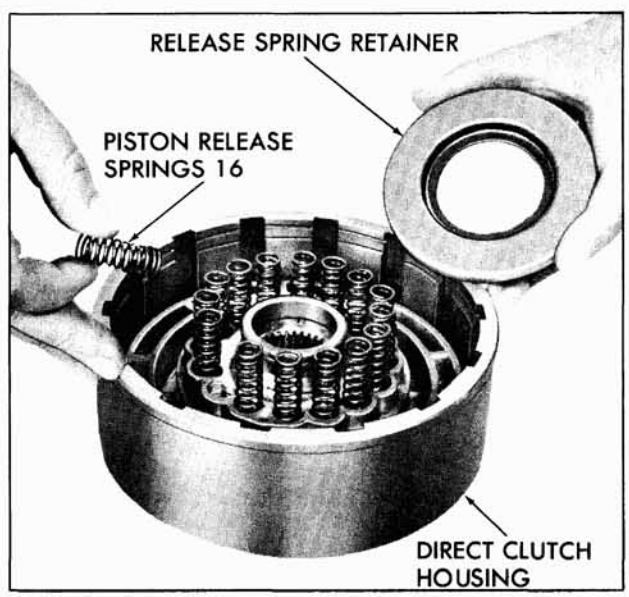


Fig. 7-150 Removing Release Springs

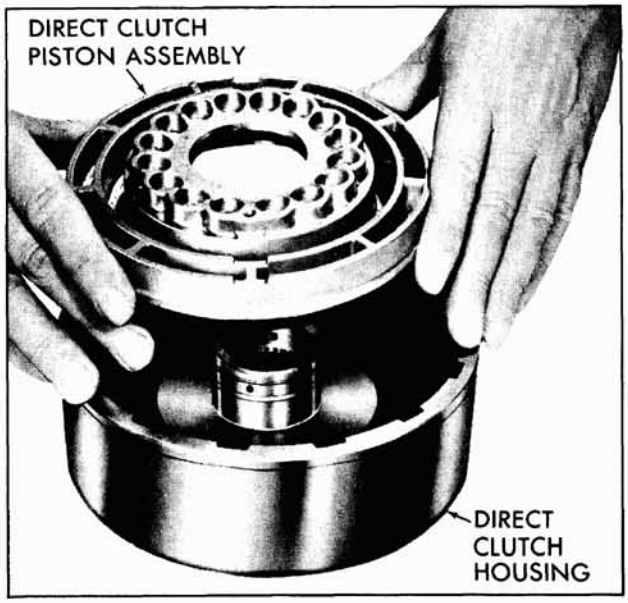


Fig. 7-151 Removing Direct Clutch Piston

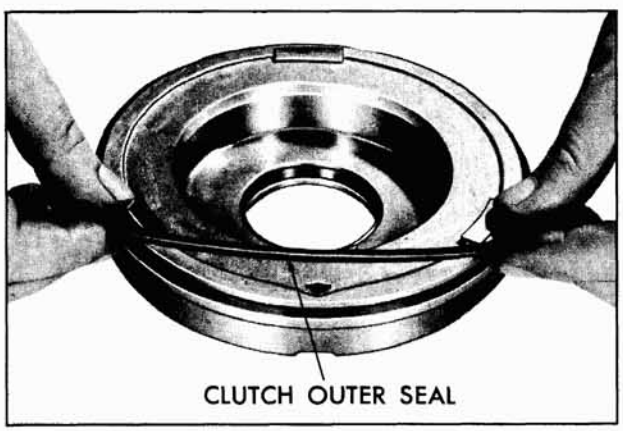


Fig. 7-152 Removing Piston Outer Seal

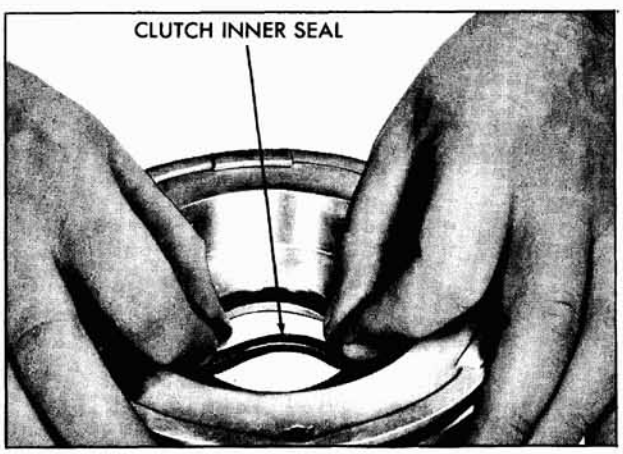


Fig. 7-153 Removing Piston Inner Seal

Inspection

1. Inspect sprag assembly for popped or loose sprags.
2. Inspect sprag bushings for wear or distortion.
3. Inspect the inner and outer races for scratches or wear.

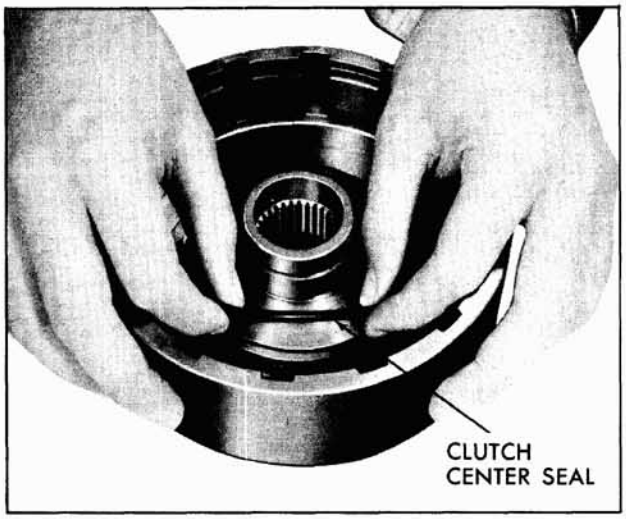


Fig. 7-154 Removing Piston Center Seal

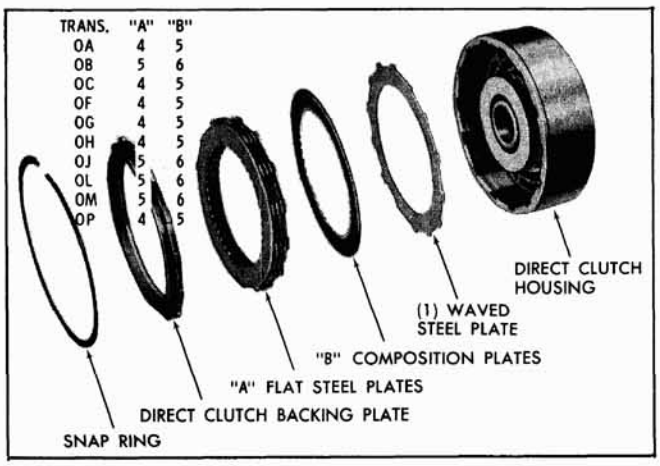


Fig. 7-155 Direct Clutch Assembly

4. Inspect the clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.
5. Inspect the drive and driven clutch plates for sign of wear or burning.
6. Inspect the backing plate for scratches or other damage.
7. Inspect the clutch piston for cracks and free operation of the ball check.

Assembly (Figs. 7-155 and 7-156)

Apply transmission fluid to all oil seals and clutch plates before reassembly.

1. Install a new inner clutch piston seal on piston with lip facing away from spring pockets. (Fig. 7-157)
2. With lip facing away from spring pocket, install a new outer clutch piston seal. (Fig. 7-158)

Make certain the piston has a ball check. The piston with a blind hole is for the forward clutch assembly. (Fig. 7-159)

3. Install a new center seal on clutch housing with lip of seal facing up. (Fig. 7-160)

The direct clutch housing for the "OB and "OL" models has been changed to accommodate the six plate clutch assembly in 1968. This housing can be identified by the elimination of the I.D. chamfer on the

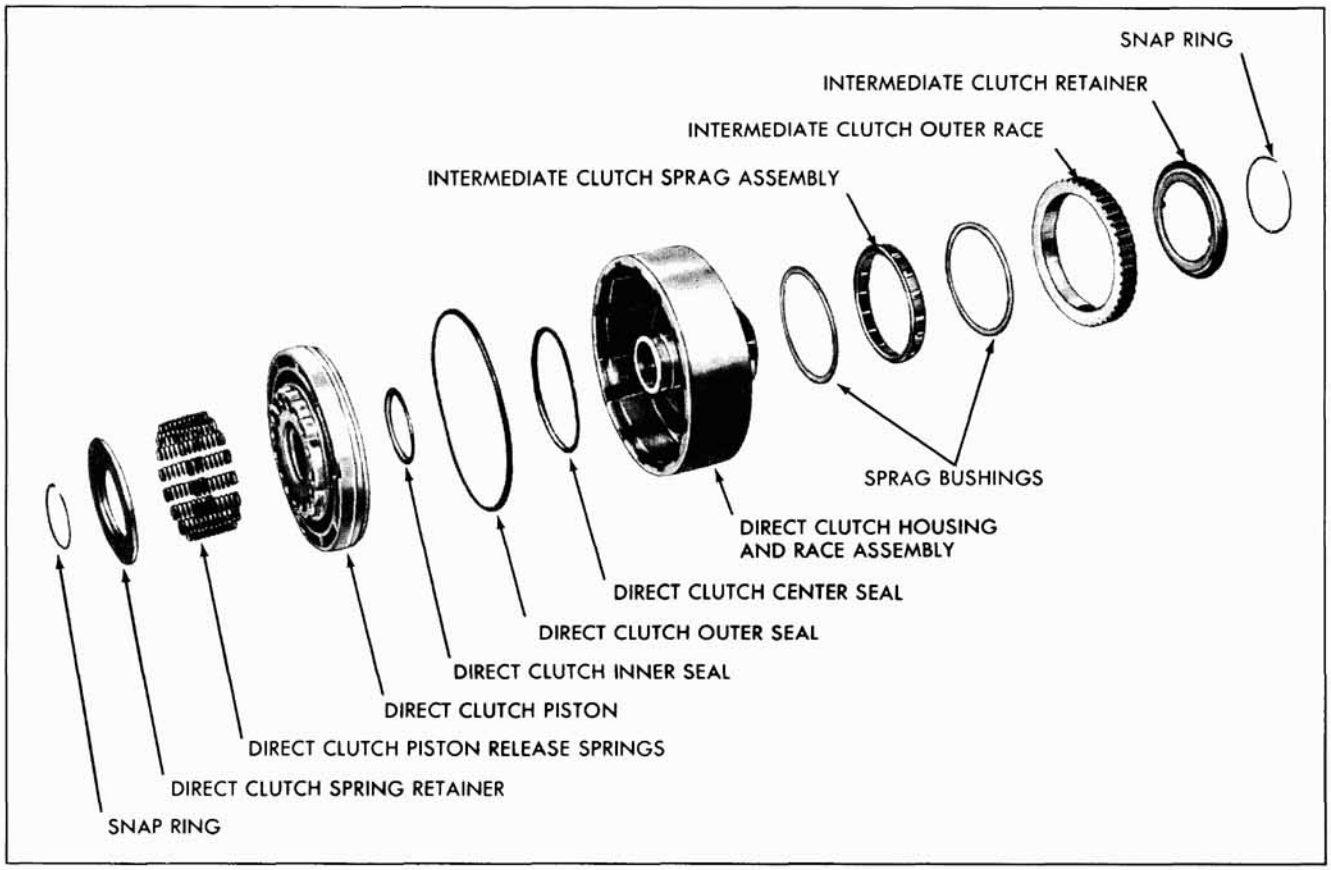


Fig. 7-156 Direct Clutch and Sprag Assembly

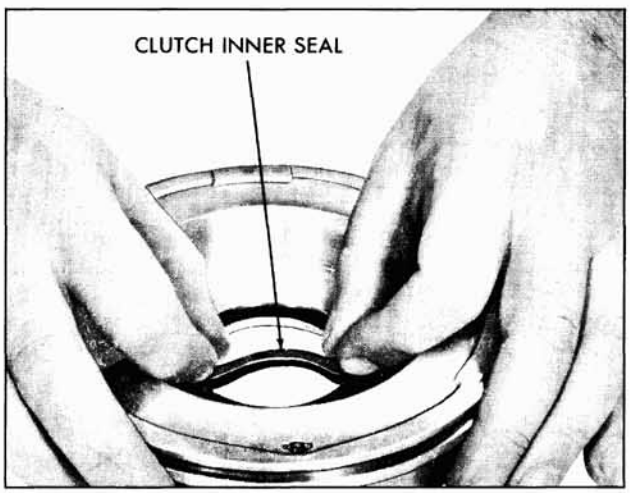


Fig. 7-157 Installing Piston Inner Seal

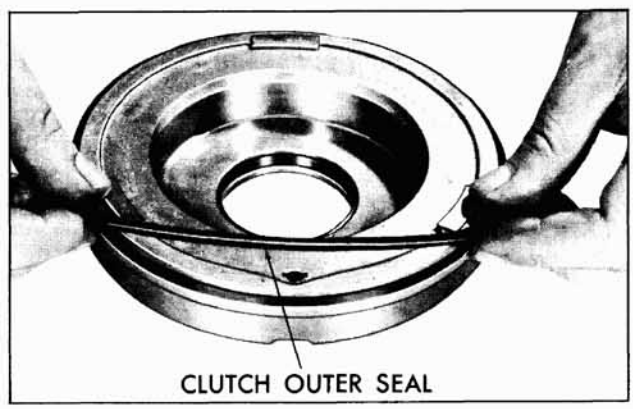


Fig. 7-158 Installing Piston Outer Seal

clutch plate end of the housing. (Fig. 7-160A) Should replacement of the housing become necessary, extreme care must be taken in obtaining the correct part for the model application involved.

4. Place Seal Protectors, Tools J-21362-Inner, J-21409-Outer, over hub and clutch housing and install clutch piston with rotating motion. (Fig. 7-161)

5. Install 16 release springs (black) into the piston. (Fig. 7-162)

6. Place spring retainer and snap ring on springs.

7. Using Clutch Compressor Tool J-4670-14, J-6129 and J-8765, install snap ring. (Fig. 7-163)

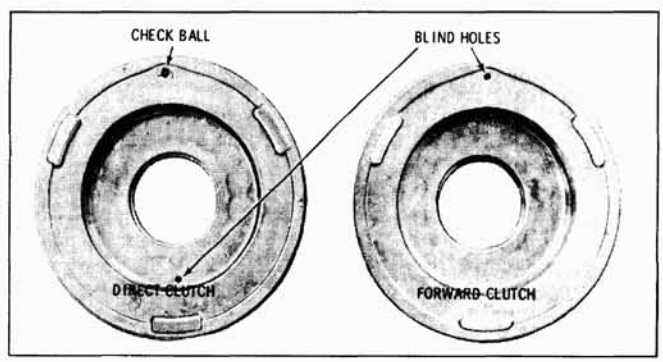


Fig. 7-159 Piston Identification

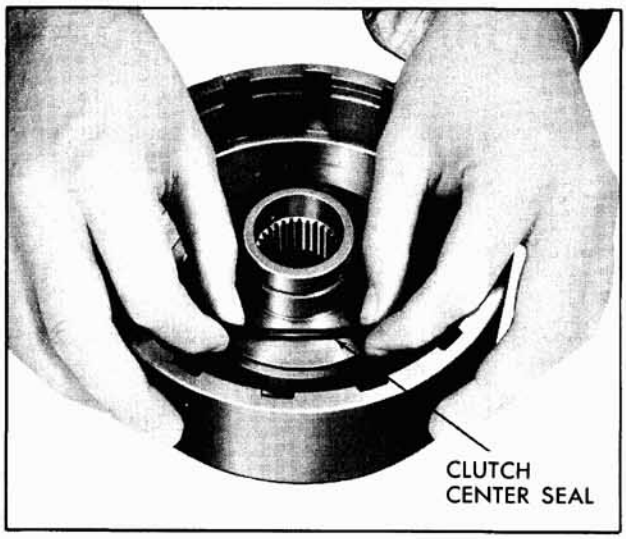


Fig. 7-160 Installing Piston Center Seal

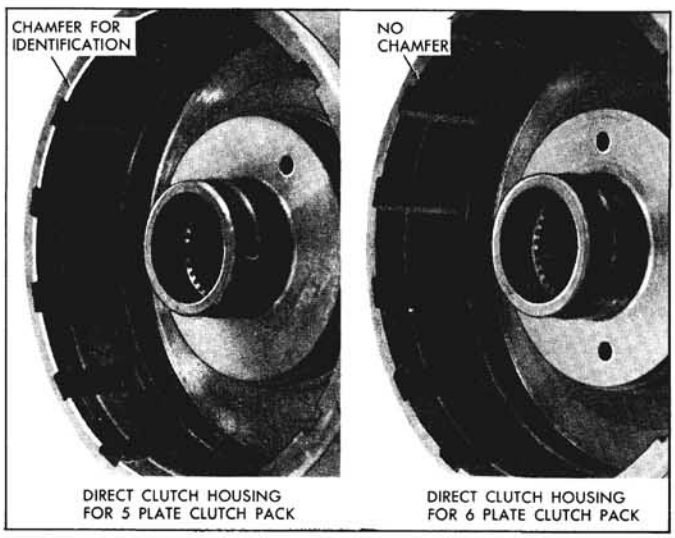


Fig. 7-160A Direct Clutch Housing Identification

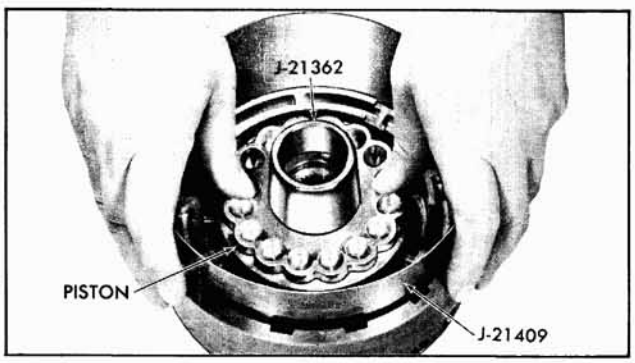


Fig. 7-161 Installing Clutch Piston

8. Install composition and steel clutch plates, starting with the waved steel plate and alternating steel and composition plates. (Fig. 7-164)

Do not use the radial groove composition plates here.

9. Install the clutch backing plate and the backing plate retaining ring. (Fig. 7-165)

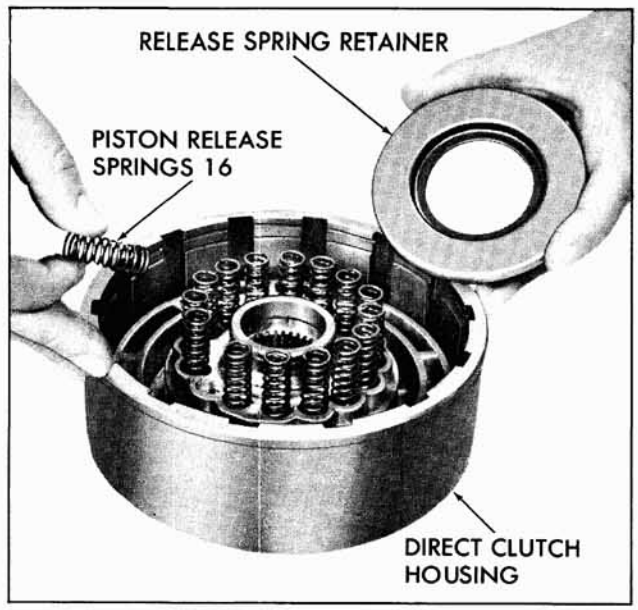


Fig. 7-162 Installing Release Springs

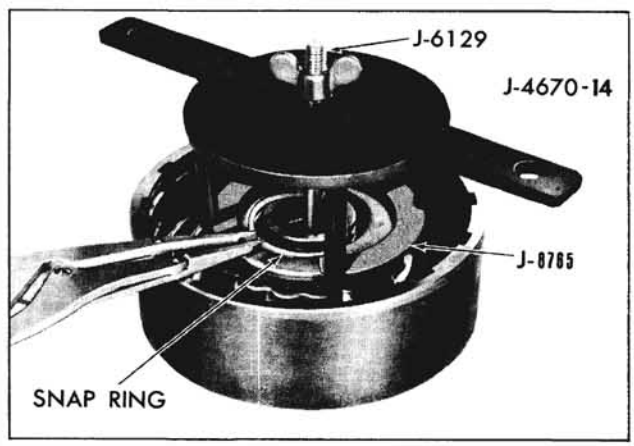
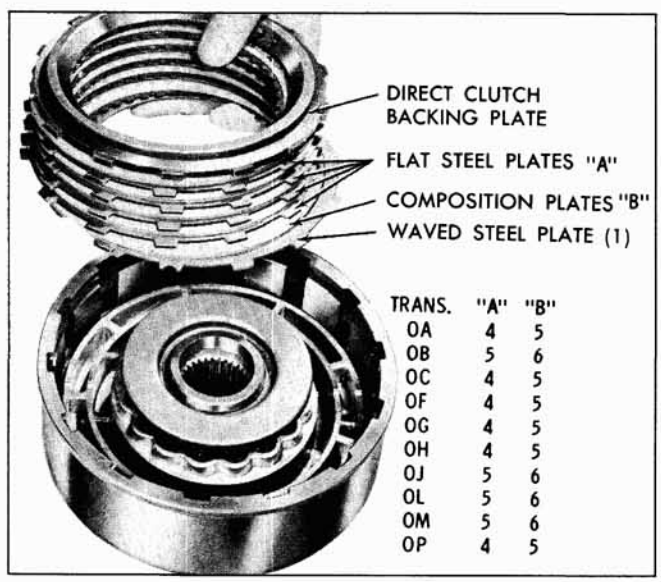


Fig. 7-163 Installing Snap Ring



TRANS.	"A"	"B"
OA	4	5
OB	5	6
OC	4	5
OF	4	5
OG	4	5
OH	4	5
OJ	5	6
OL	5	6
OM	5	6
OP	4	5

Fig. 7-164 Installing Direct Clutch Plates

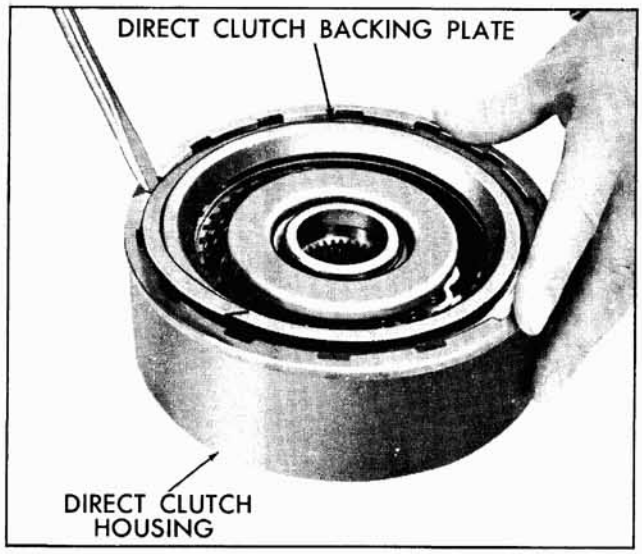


Fig. 7-165 Installing Snap Ring

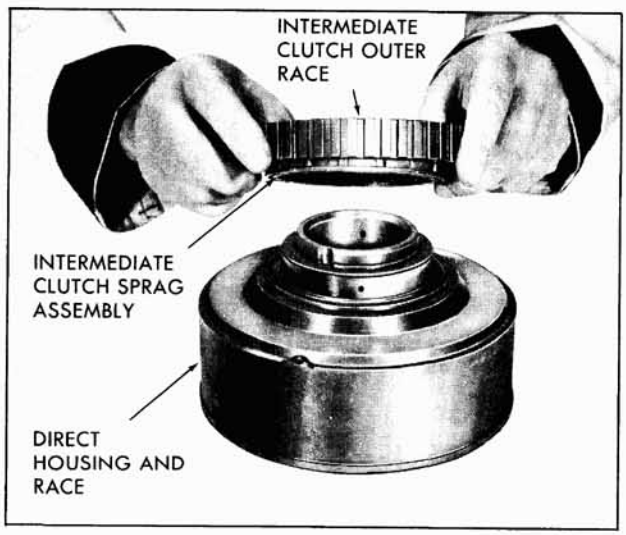


Fig. 7-166 Installing Intermediate Sprag

10. Turn unit over and install one sprag bushing, cup side up, over inner race.
11. Install sprag assembly into outer race.
12. With ridge or shoulder on inner cage down, start sprag and outer race over inner race with clockwise turning motion. (Fig. 7-166)

Outer race should not turn counterclockwise after installation. (Fig. 7-166A)

13. Install sprag bushing over sprag, cup side down.
14. Install sprag retainer and snap ring. (Fig. 7-167)
15. Place direct clutch assembly over center support and air check operation of direct clutch. (Fig. 7-168)

If air is applied through reverse passage, it will escape from the direct clutch passage. This is normal.

CASE CENTER SUPPORT

Disassembly

1. Remove four hook type oil seal rings from center support. (Fig. 7-169)
2. Using Clutch Compressor, J-4670 and J-6129, compress the spring retainer and remove the snap ring. (Fig. 7-170)

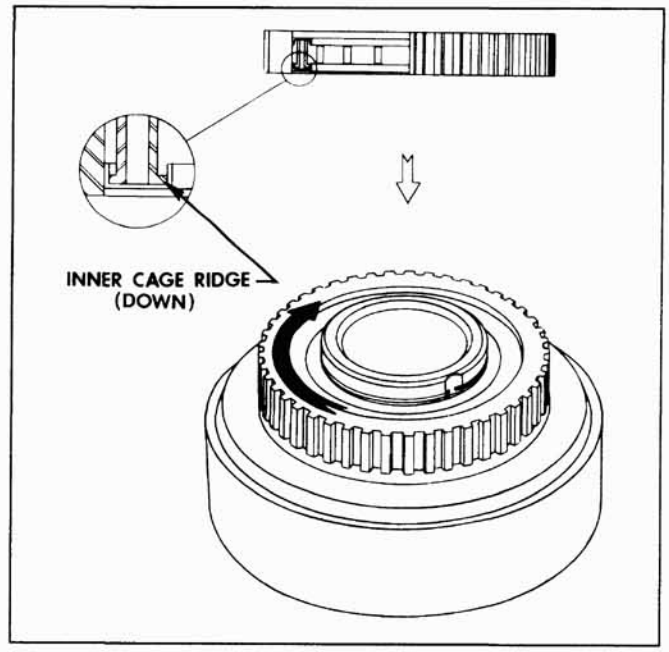


Fig. 7-166A Sprag Rotation

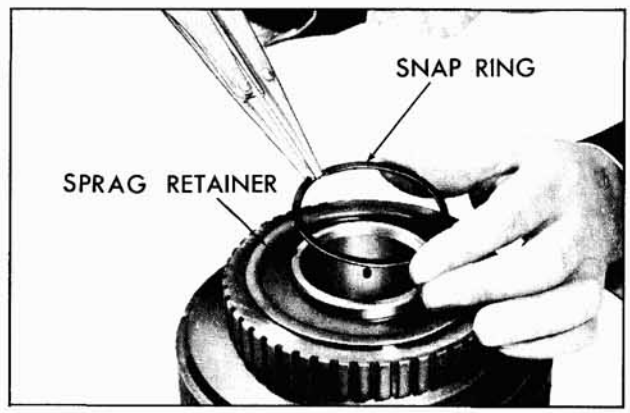


Fig. 7-167 Installing Snap Ring

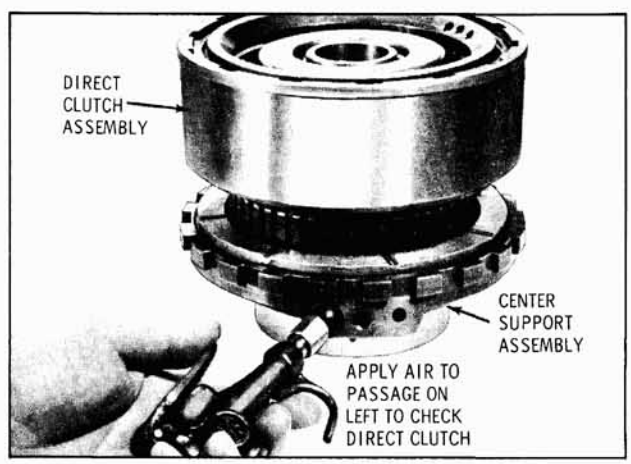


Fig. 7-168 Air Checking Direct Clutch

3. Remove the spring retainer and 3 clutch release springs. (Figs. 7-171 and 7-172)
4. Remove the intermediate clutch piston. (Fig. 7-173)

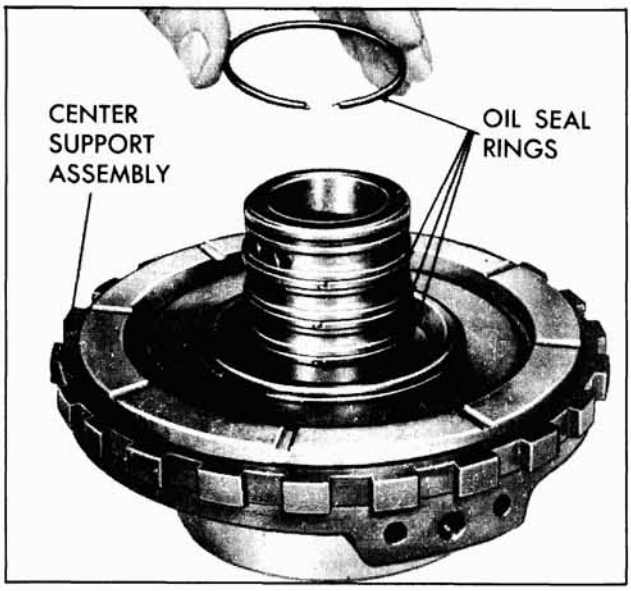


Fig. 7-169 Removing Oil Rings

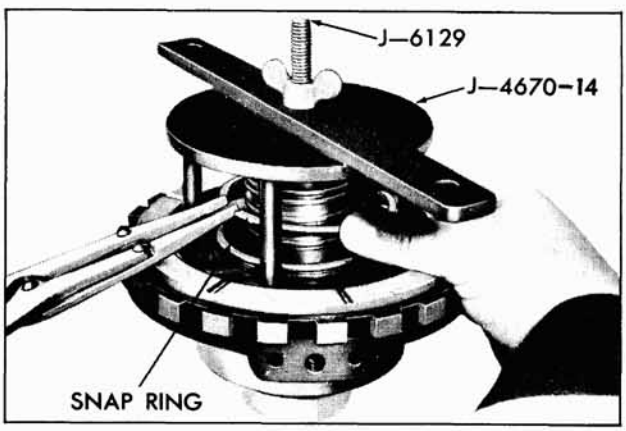


Fig. 7-170 Removing Snap Ring

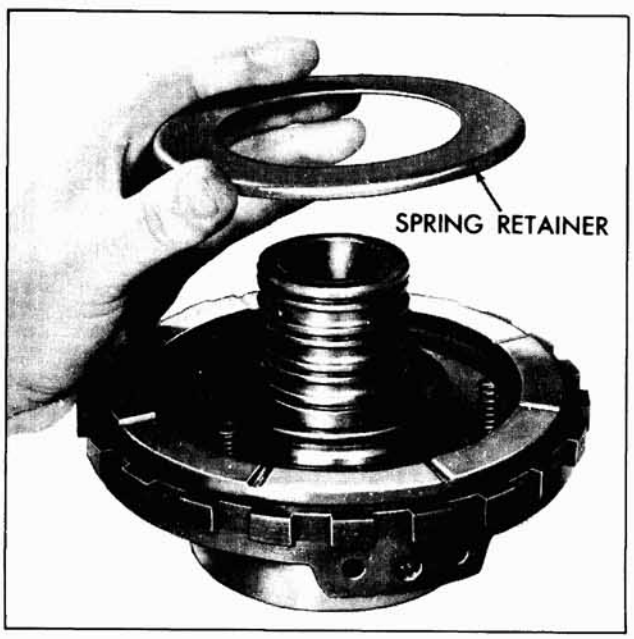


Fig. 7-171 Removing Spring Retainer

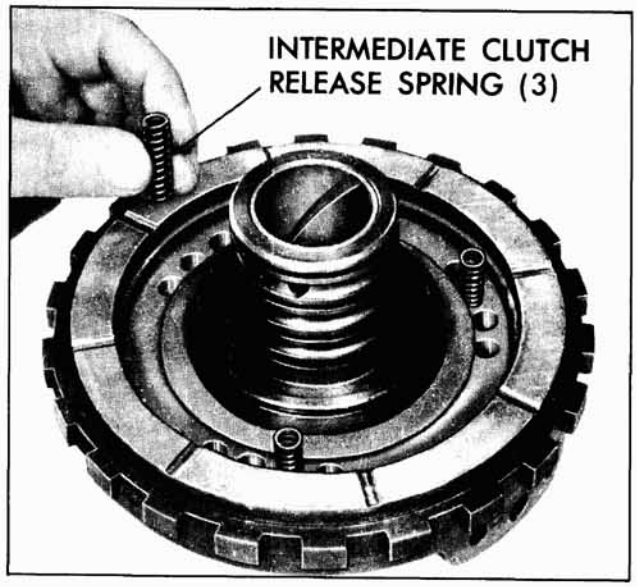


Fig. 7-172 Removing Release Spring

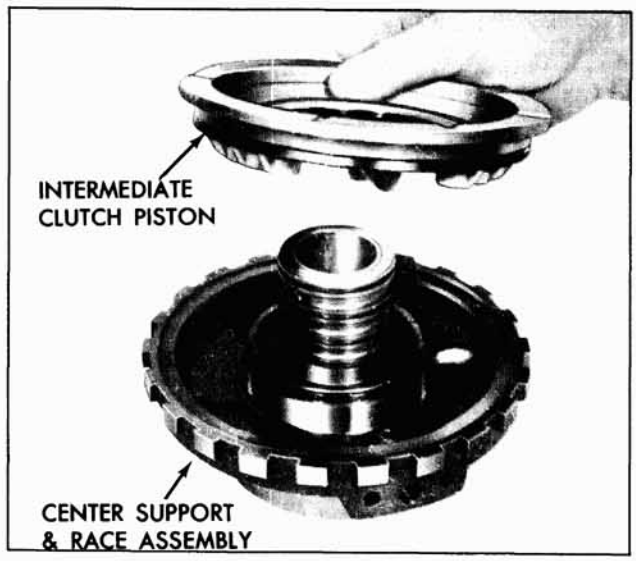


Fig. 7-173 Removing Clutch Piston

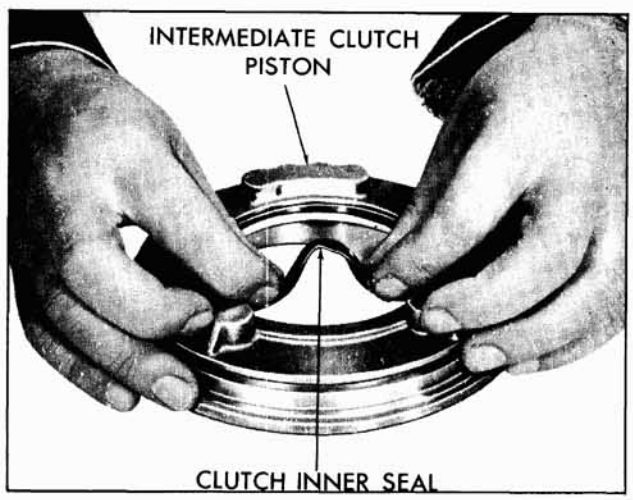


Fig. 7-174 Removing or Installing Piston Inner Seal

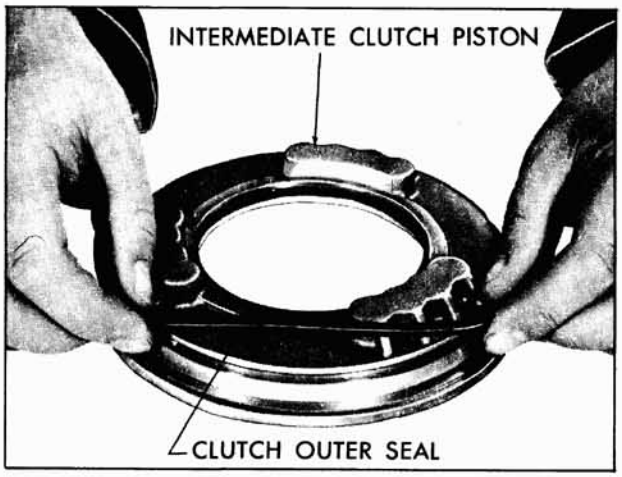


Fig. 7-175 Removing or Installing Piston Outer Seal

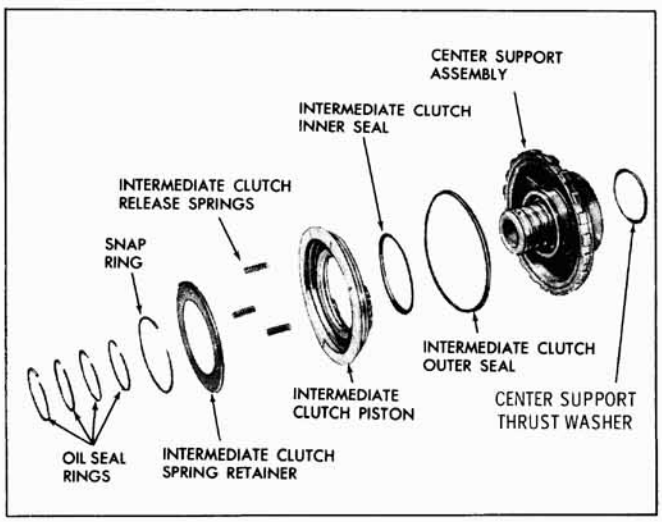


Fig. 7-176 Center Support Assembly

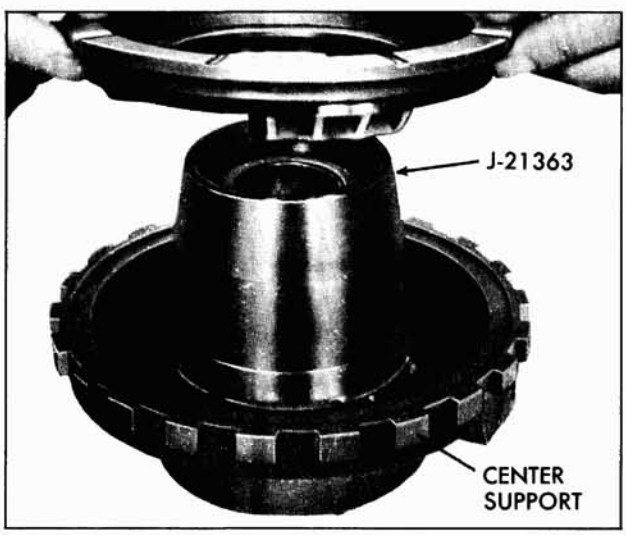


Fig. 7-177 Installing Intermediate Clutch Piston

5. Remove the inner piston seal. (Fig. 7-174)
6. Remove the outer piston seal. (Fig. 7-175)

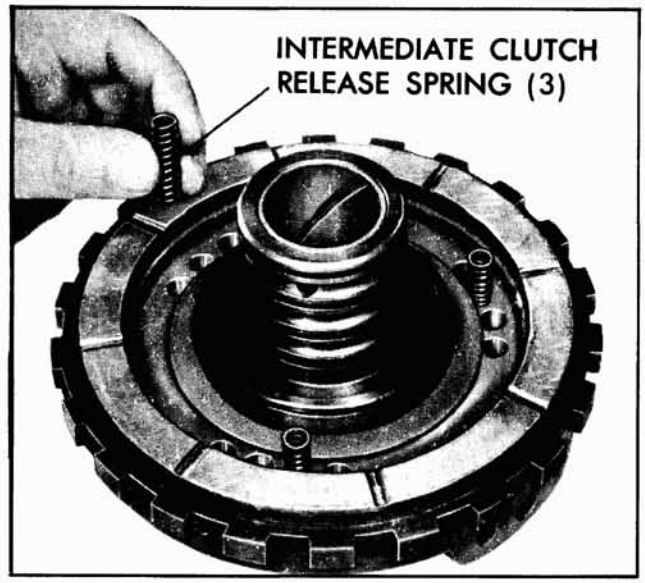


Fig. 7-178 Installing Release Springs

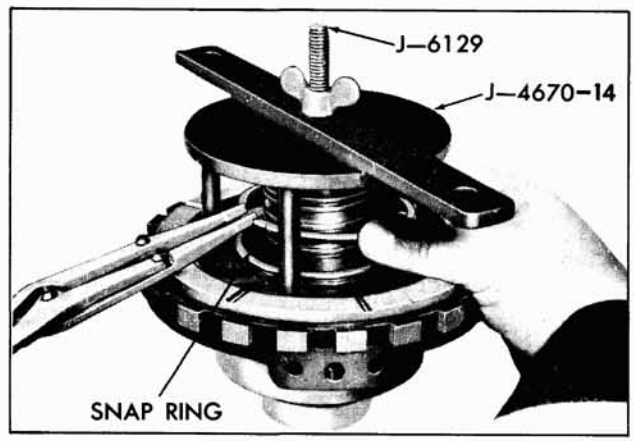


Fig. 7-179 Installing Snap Ring

Do not remove the three screws retaining the roller clutch inner race to the center support.

Inspection

1. Inspect the roller clutch inner race for scratches or indentations. Be sure the lubrication hole and .020" constant bleed orifice is open.
2. Inspect the bushing for scoring, wear or galling.
3. Check oil ring grooves for damage and ring fit in groove.
4. Air check the oil passages to be sure they are open and not interconnected.
5. Inspect the piston sealing surfaces for scratches.
6. Inspect the piston seal grooves for nicks or other damage.
7. Inspect the piston for cracks or porosity.
8. Inspect the release springs for distortion.

Assembly (Fig. 7-176)

1. Lubricate and install new inner seal on the piston with lip of seal facing away from the spring pocket. (Fig. 7-176)
2. Lubricate and install new outer seal with lip of seal facing away from the spring pockets. (Fig. 7-175)
3. Install Inner Seal Protector Tool J-21363, on the center support hub, install the piston, indexing spring pockets in drum and piston. (Fig. 7-177)

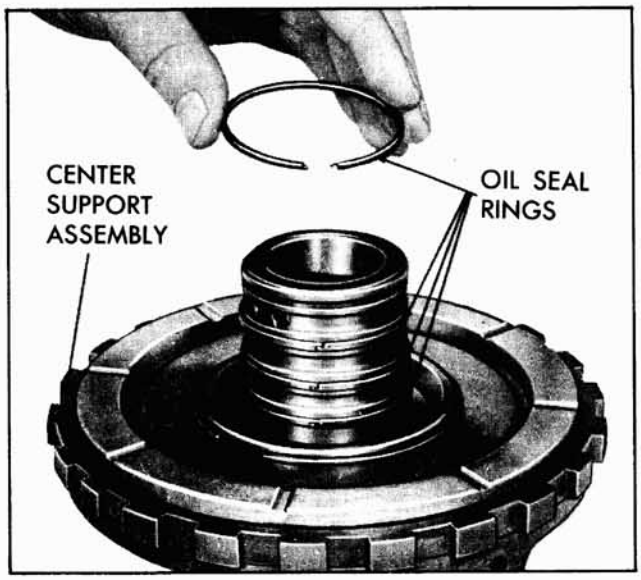


Fig. 7-180 Installing Oil Rings

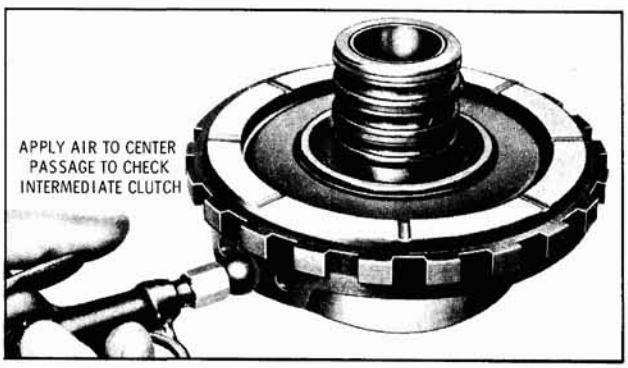


Fig. 7-181 Air Checking Intermediate Piston

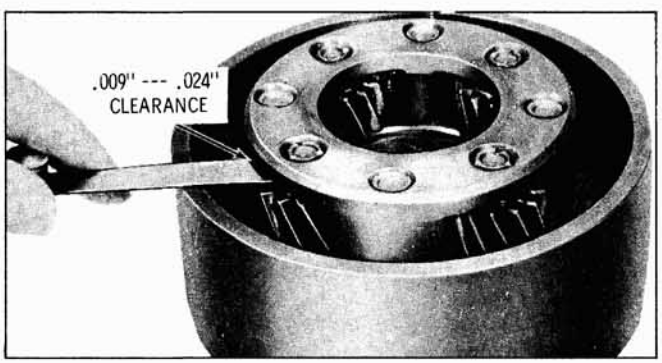


Fig. 7-182 Checking Pinion Gear End Play

4. Install three release springs into the piston. (Fig. 7-178)

Space springs equally during assembly.

5. Place the spring retainer and snap ring over the springs.
6. Using Clutch Spring Compressor, J-4670-14 and J-6129, compress the springs and install the snap ring. (Fig. 7-179)
7. Install four hook-type oil rings. (Fig. 7-180)
8. Air check operation of intermediate clutch piston. (Fig. 7-181)

REACTION CARRIER, ROLLER CLUTCH AND OUTPUT CARRIER ASSEMBLY

Inspection

1. Inspect band surfaces on reaction carrier for signs of burning or scoring.
2. Inspect the roller clutch outer race for scoring or wear.
3. Inspect the thrust washer surfaces for signs of scoring or wear.
4. Inspect the bushing for damage. If bushing is damaged, the reaction carrier must be replaced.
5. Inspect the pinions for damage, rough bearings or excessive tilt.
6. Check pinion end play. Pinion end play should be .009" to .024". (Fig. 7-182)
7. Inspect the roller clutch for damaged members.
8. Inspect the roller clutch cage and retaining springs for damage.
9. Inspect the front internal gear for damaged teeth.
10. Inspect the output carrier pinions for damage, rough bearings or excessive tilt.
11. Check output pinion end play. Pinion end play should be .009" to .024". (Fig. 7-183)
12. Inspect the parking pawl lugs for cracks or damage.
13. Inspect the output shaft locating splines for damage.
14. Inspect front internal gear ring for flaking or cracks.

Fig. 7-183 Checking Output Carrier Pinion Gear End Play

PINION GEARS

Remove and Install

1. Support the carrier assembly on its front face.
2. Using a 1/2" dia. drill remove the stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the probability of cracking the carrier when pinion pins are pressed out.

Do not allow drill to remove any stock from the carrier, as this will weaken the part.

3. Using a tapered punch, drive or press the pinions out of the carrier. (Fig. 184)
4. Remove the pinions, thrust washers and roller needle bearings.
5. Inspect the pinion pocket thrust faces for burrs and remove if present.
6. Install 19 needle bearings into each pinion, thumb lock needle bearings to hold them in place. (Fig. 7-185)
7. Place a bronze and steel thrust washer on each side of pinion so steel washer is against pinion. Hold them in place with petrolatum.
8. Place the pinion assembly in position in the carrier and install a pilot shaft through the rear face of the assembly to hold the parts in place.

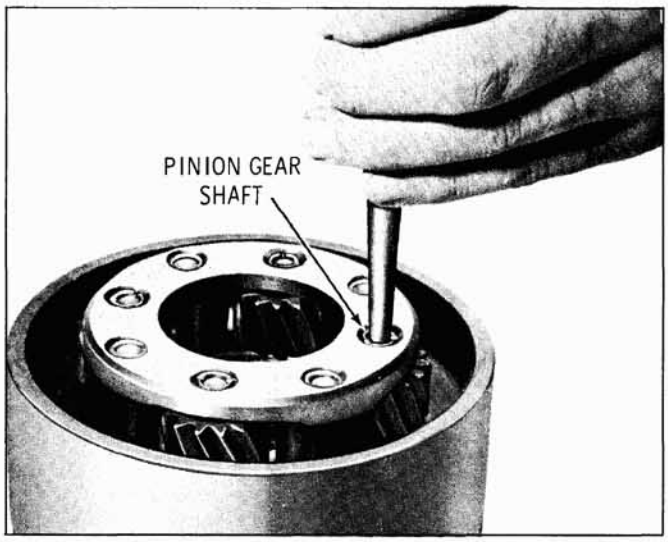


Fig. 7-184 Removing Pinion Gears

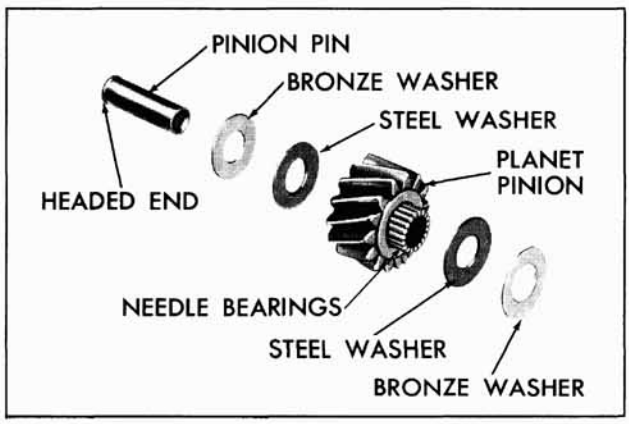


Fig. 7-185 Planet Pinion Assembly

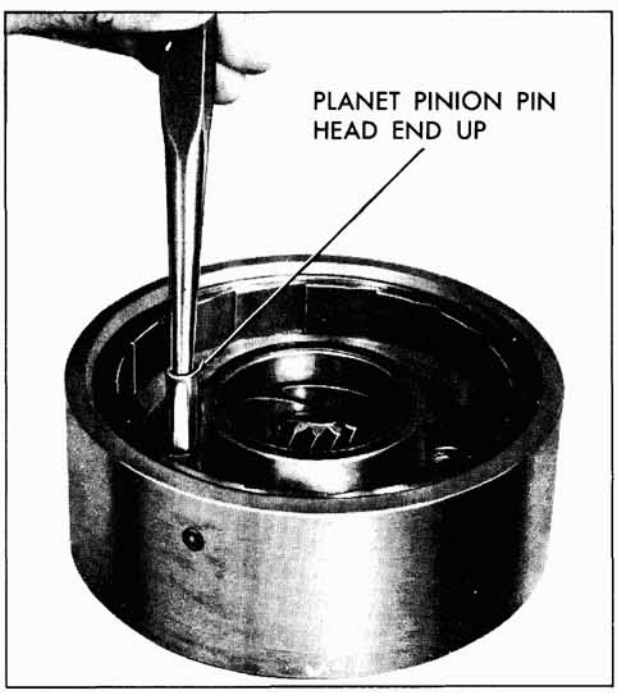


Fig. 7-186 Installing Pinion Pin

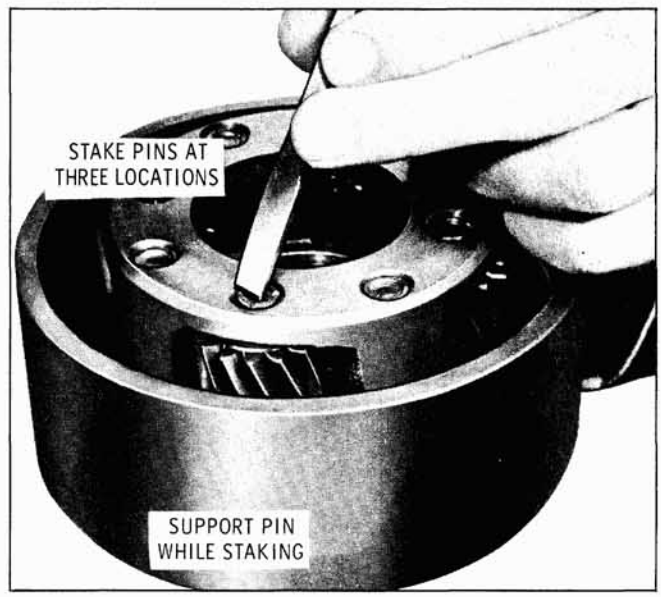


Fig. 7-187 Staking Pinion Pin

9. Drive a new pinion pin into place while rotating pinion from the front being sure that the headed end is flush or below the face of the carrier. (Fig. 7-186)

10. Place a large punch in a bench vise to be used as an anvil, while staking the opposite end of the pinion pin in three places. (Fig. 7-187)

Both ends of the pinion pins must lie below the face of the carrier or interference may occur.

INSPECTION

Output Shaft

1. Inspect the bushing for wear or galling.
2. Inspect the bearing and thrust washer surfaces for damage.
3. Inspect the governor drive gear for rough or damaged teeth.
4. Inspect the splines for damage.
5. Inspect the orificed cup plug in the lubrication passage.
6. Inspect the drive lugs for damage.
7. Inspect speedometer drive gear on Models OA, OP, OG and OH.

If replacement of the speedometer drive gear is necessary, proceed as follows:

a. Install Speedometer Gear Removing Tool, J-21427, and suitable puller such as J-6123-01, on output shaft and remove speedometer drive gear.

b. Install new speedometer drive gear using J-21470, positioning gear at the following dimensions. Models OA and OP - 11 15/32" from spline end of output shaft to rear face of gear. Models OG and OH - 5 21/32" from spline end of output shaft to rear face of gear.

Rear Internal Gear

1. Inspect the gear teeth for damage or wear.
2. Inspect the splines for damage.
3. Inspect the gear for cracks.

Sun Gear

1. Inspect the gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open.

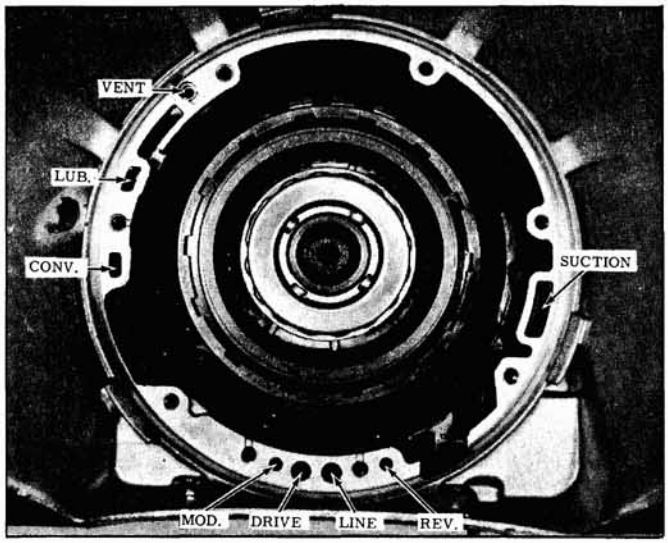


Fig. 7-188 Passage Identification

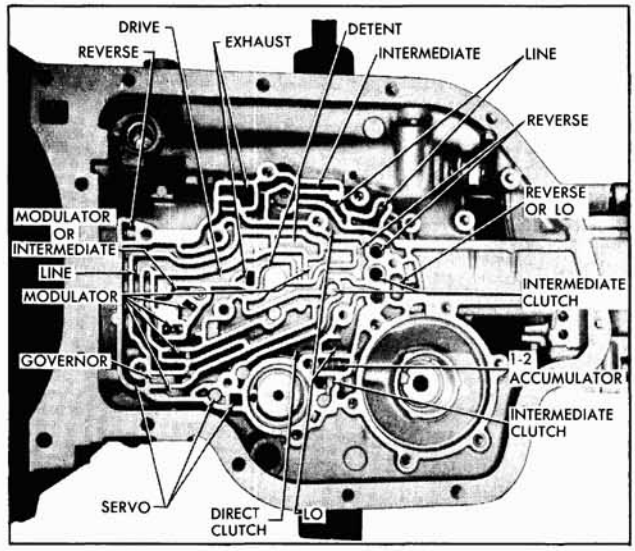


Fig. 7-189 Case Inspection

Sun Gear Shaft

1. Inspect shaft for cracks or splits.
2. Inspect splines for damage.
3. Inspect bushings for scoring or galling.
4. Inspect the ground bushing journals for damage.
5. Be sure the oil lubrication hole is open.

Mainshaft

1. Inspect the shaft for cracks or distortion.
2. Inspect the splines for damage.
3. Inspect the ground bushing journals for damage.
4. Inspect the snap ring groove for damage.
5. Inspect the orificed cup plug pressed into end of the mainshaft. Be sure it is not plugged and oil lubrication holes are open.

If mainshaft replacement is required, it is necessary to use a shaft with a "v" identification groove on the ground journal at the rear internal gear end of the shaft. Because of a spline change, the current model shaft is not interchangeable with past model shafts.

Front and Rear Bands

1. Inspect the lining for cracks, flaking, burning or looseness.
2. Inspect the bands for cracks or distortion.
3. Inspect the end for damage at the anchor lugs or apply lugs.

Case Extension

1. Inspect the bushing for excessive wear or damage.
2. Inspect the gasket mounting face for damage and flatness.
3. Inspect the housing for cracks or porosity.
4. Be sure rear seal drain back port is not obstructed.

Modulator and Valve

1. Inspect the modulator assembly for any signs of bending or distortion.
2. Inspect the "O" ring seal seat for damage.
3. Apply suction to the vacuum tube and check for diaphragm leaks.
4. Inspect the modulator valve for nicks or damage.
5. Check freeness of valve operation in case bore.
6. Check modulator bellows, modulator plunger is under pressure (16 lbs). If bellows is damaged the plunger will have very little pressure.

See "Vacuum Modulator Diagnosis".

Manual and Parking Linkage

1. Inspect the parking actuator rod for cracks or broken spring retainer lugs.
2. Inspect the actuator spring for damage.
3. Inspect actuator for a free fit on the actuator rod.
4. Inspect the parking pawl for cracks or wear.
5. Inspect the manual shaft for damaged threads, or loose lever.
6. Inspect the inside detent lever for cracks or a loose pin.
7. Inspect the parking pawl shaft for damaged retainer groove.
8. Inspect the parking pawl return spring for deformed coils or ends.
9. Inspect the parking bracket for cracks or wear.
10. Inspect detent roller and spring assembly.

Case Assembly

1. Inspect case assembly for cracks, porosity or interconnected passages. (Figs. 7-188 and 7-189)
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. Inspect the intermediate clutch driven plate lugs for damage or brinelling.
5. Inspect the snap ring grooves for damage.
6. Inspect the bore of the governor assembly for scratches or scoring.
7. Inspect the modulator valve bore for scoring or damage.
8. Inspect the cup plugs inside the case for good staking.

Converter

1. Check converter for leaks as follows: (Fig. 7-190)
   a. Install Tool J-21369 and tighten.
   b. Fill converter with air, 80 psi.
   c. Submerge in water and check for leaks.
2. Check converter hub surfaces for signs of scoring or wear.
3. Check converter end clearance as follows:
   a. Install Tool J-21371-8 and tighten brass nut. (Fig. 7-191)
   b. Install Tool J-21371-3 and tighten hex nut. (Fig. 7-192)
   c. Install Dial Indicator and set at ZERO as shown in Fig. 7-192.
   d. Loosen hex nut. When nut is fully loosened, the reading obtained on the dial indicator will be the converter end

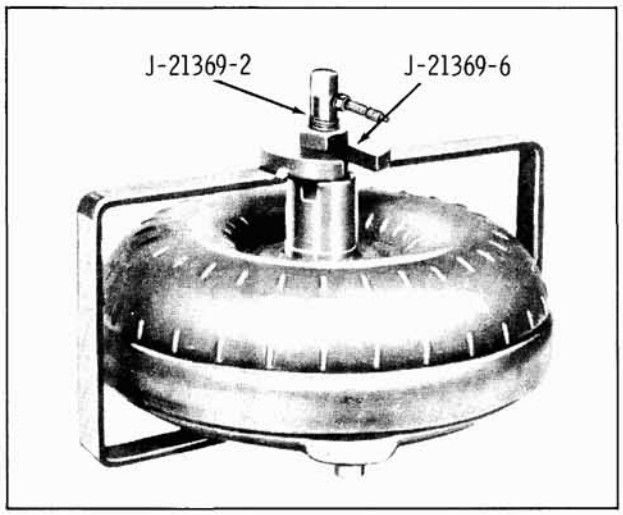


Fig. 7-190 Air Checking Converter

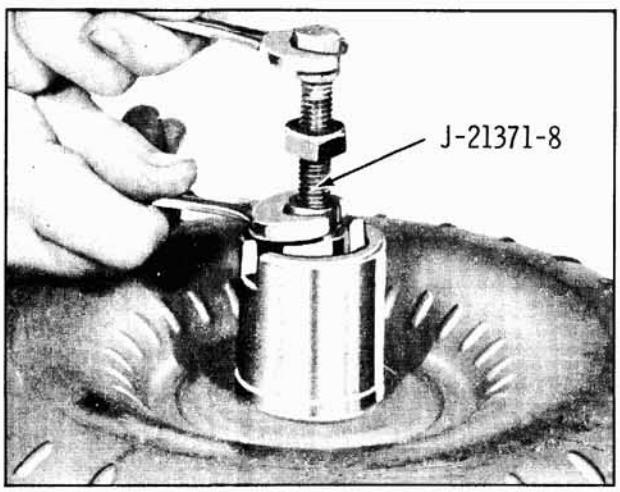


Fig. 7-191 Installing Tool J-21371-8

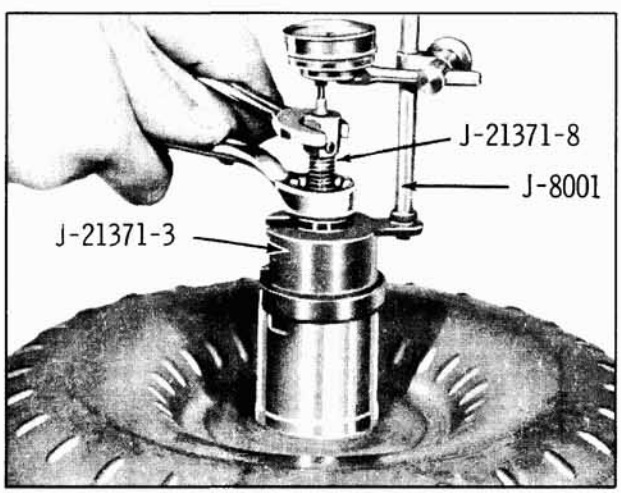


Fig. 7-192 Checking Clearance

clearance. End clearance should be less than .050". If converter end clearance is greater than .050", the converter must be replaced.

GEAR UNIT (Fig. 7-193)

Assembly

1. Install rear internal gear on end of mainshaft.

See Fig. 7-193 for identification of mainshaft.

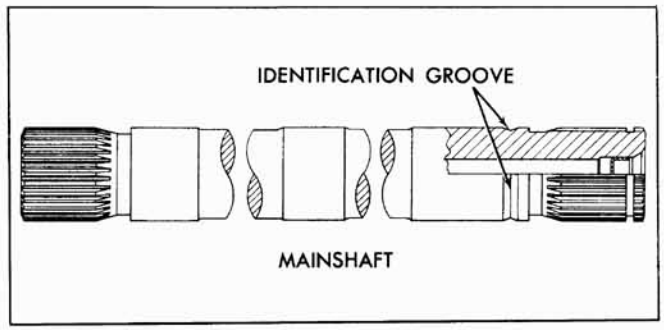


Fig. 7-193 Mainshaft Identification

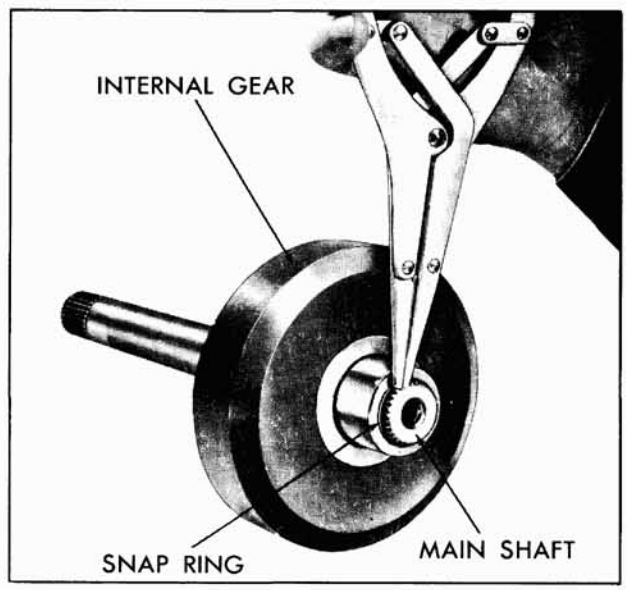


Fig. 7-194 Installing Snap Ring

2. Install internal gear retaining snap ring. (Fig. 7-194)
3. Install the sun gear to internal gear thrust races and bearings against the inner face of the rear internal gear as follows, and retain with petrolatum.
   a. Place the large race against the internal gear with flange facing forward or up. (Fig. 7-195)
   b. Place the thrust bearing against the race.
   c. Place the small race against the bearing with the inner flange facing into the bearing or down.
4. Install the output carrier over the mainshaft so that the pinions mesh with the rear internal gear. (Fig. 7-196)
5. Place the above portion of the "build-up" through hole in bench so that mainshaft hangs downward.
6. Install the rear internal gear to output shaft thrust races and bearings as follows; and retain with petrolatum. (Fig. 7-197)
   a. Place the small diameter race against the internal gear with the center flange facing up.
   b. Place the bearing on the race.
   c. Place the second race on the bearing with the outer flange cupped over the bearing.
7. Install the output shaft into the output carrier assembly.

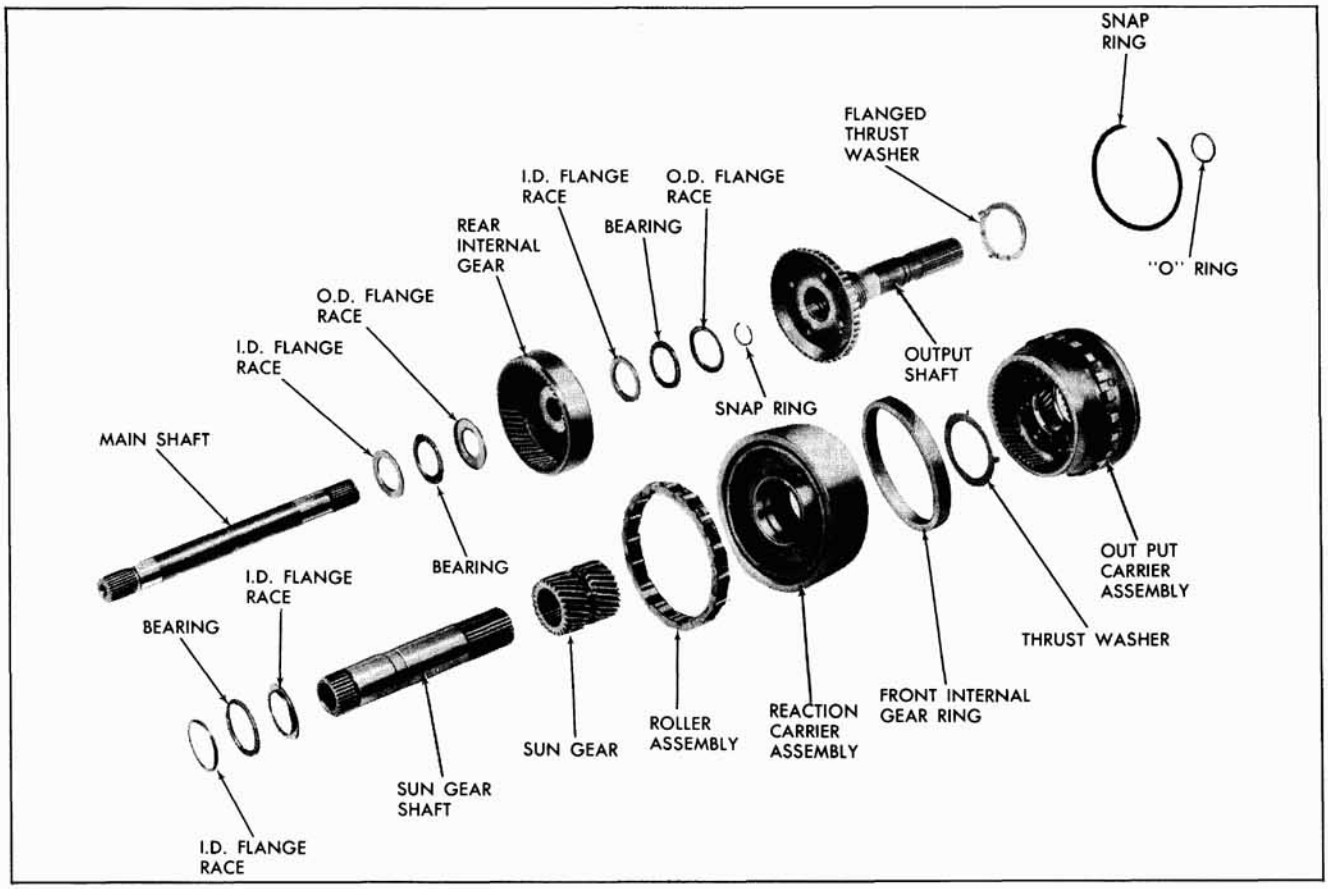


Fig. 7-195A Gear Unit

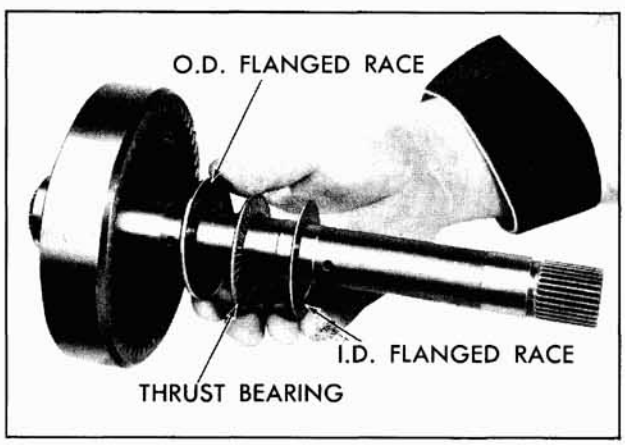


Fig. 7-195 Installing Thrust Bearing

8. Install the output shaft to output carrier snap ring with bevel side up. (Fig. 7-198)
9. Turn assembly over and support so that the output shaft hangs downward.
10. Lubricate and install the reaction carrier to output carrier thrust washer with the tabs facing down in pockets. (Fig. 7-199)

Production thrust washers will be either phenolic or steel. Service replacement will be steel only.

11. Install the sun gear, I.D. splines with chamfer down. (Fig. 7-200)

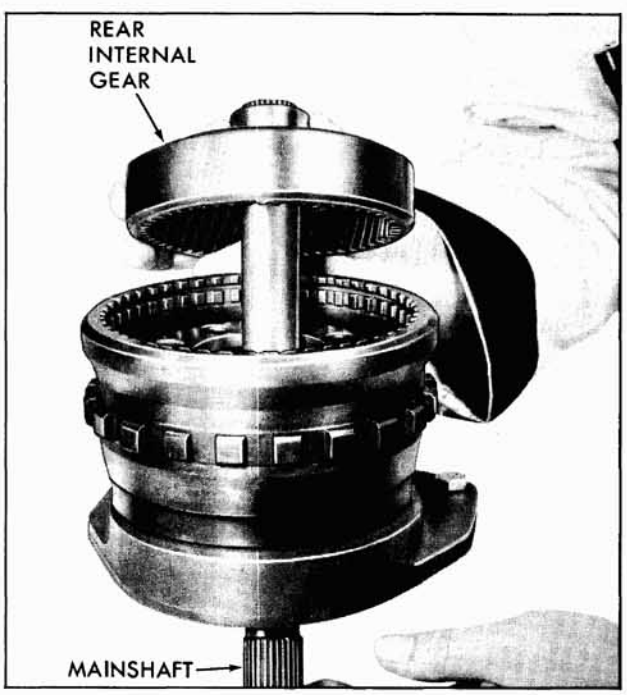


Fig. 7-196 Installing Rear Internal Gear

12. Install front internal gear ring over output carrier. (Fig. 7-201)
13. Install the sun gear shaft.
14. Install the reaction carrier. (Fig. 7-202)

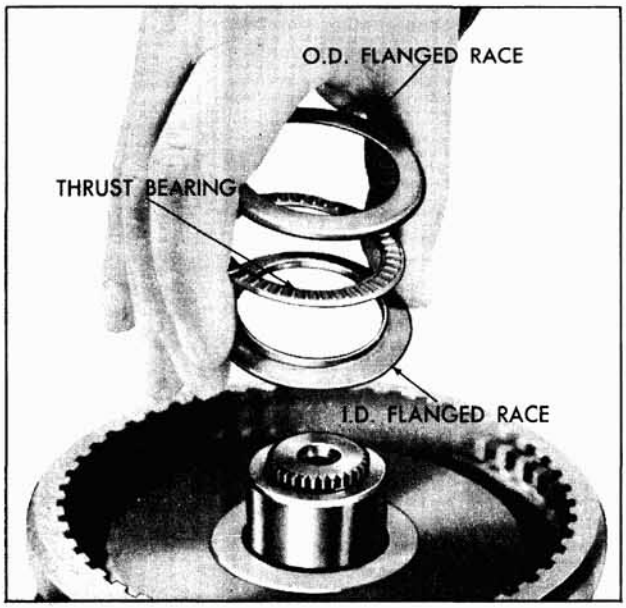


Fig. 7-197 Installing Thrust Bearing

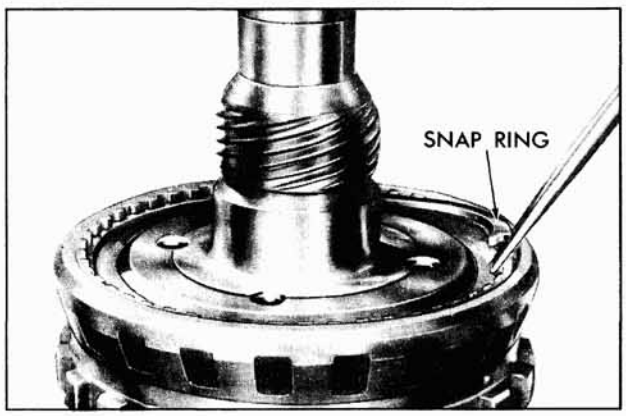


Fig. 7-198 Installing Snap Ring

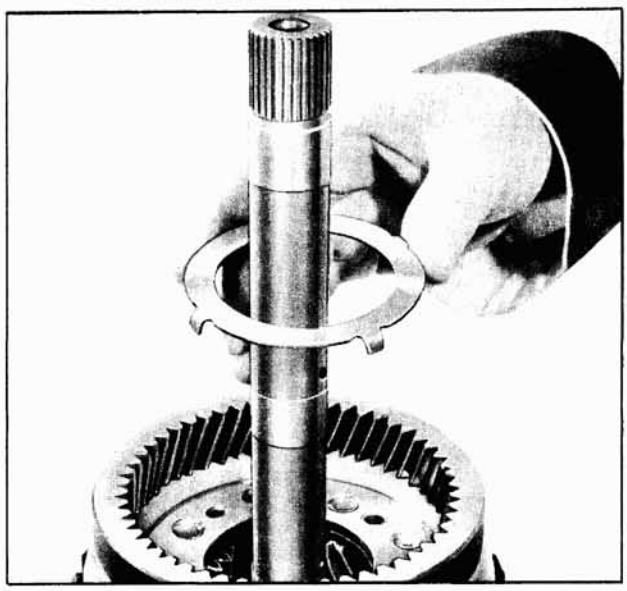


Fig. 7-199 Installing Thrust Washer

15. Install the center support to sun gear thrust races and bearing as follows:

a. Install the large race, center flange up over the sun gear shaft.

b. Install the thrust bearing against the race.

c. Install the second race, center flange up. (Fig. 7-203)

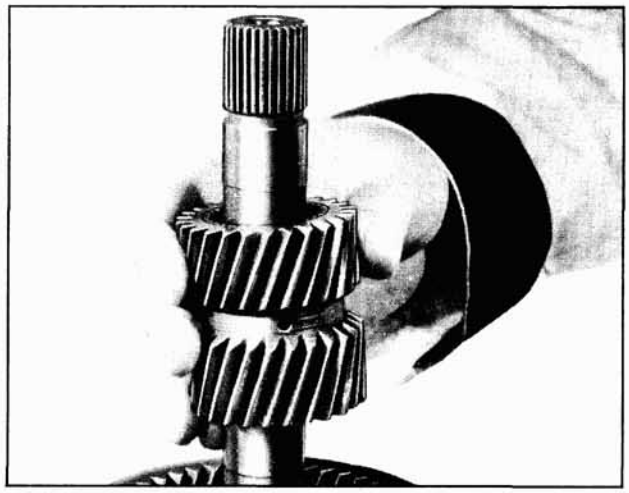


Fig. 7-200 Installing Sun Gear

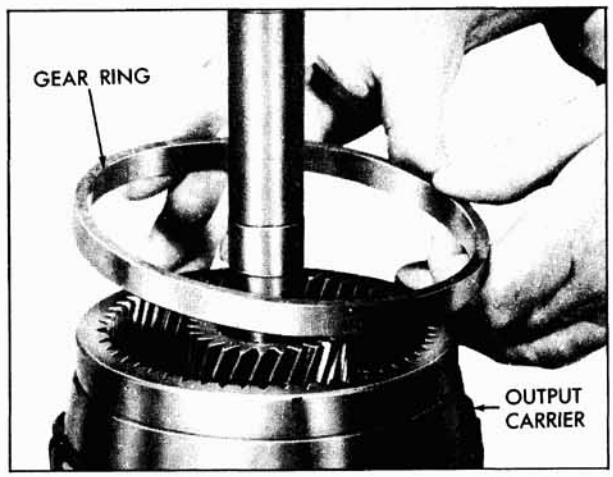


Fig. 7-201 Installing Gear Ring

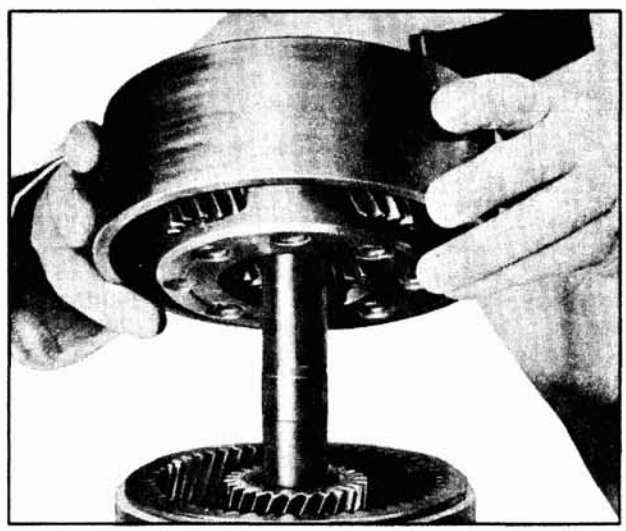


Fig. 7-202 Installing Reaction Carrier

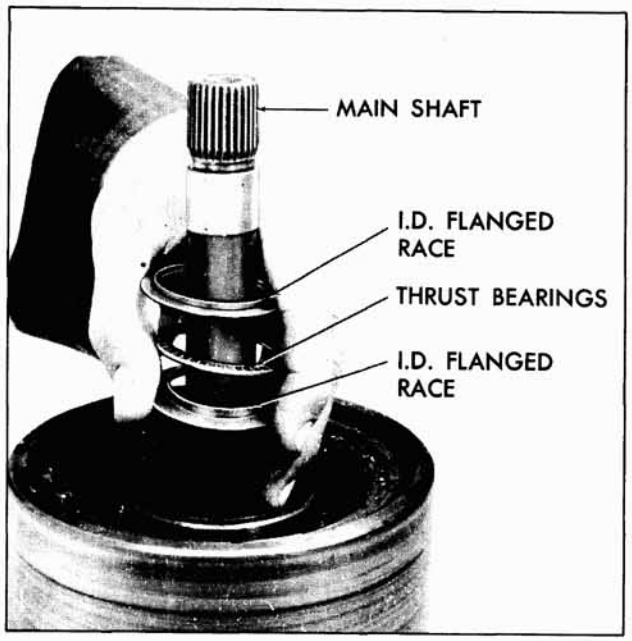


Fig. 7-203 Installing Thrust Bearings

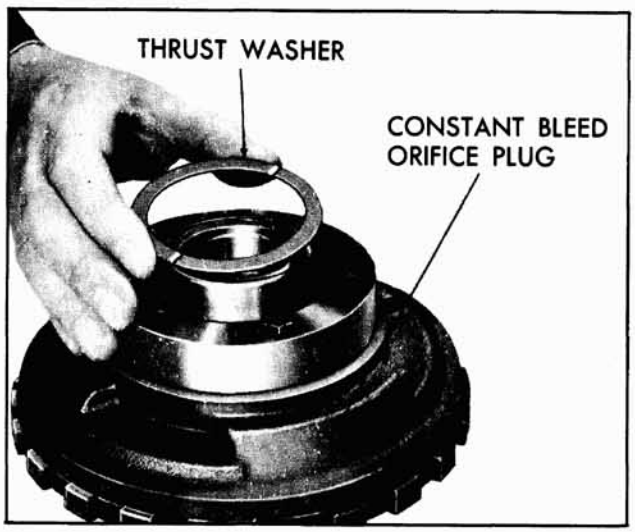


Fig. 7-204 Installing Thrust Washer

16. Install the phenolic center support to reaction carrier thrust washer into the recess in the center support. Retain with petrolatum. (Fig. 7-204)

17. Install rollers that may have come out of the roller cage by compressing the energizing spring with forefinger and inserting the roller from the outer side. (Fig. 7-205)

18. Install the roller clutch assembly into the reaction carrier outer race. (Fig. 7-206)

19. Install the case center support into the reaction carrier and roller clutch assembly. (Fig. 7-207)

With reaction carrier held, case support should only turn counterclockwise.

ASSEMBLY OF UNITS INTO TRANSMISSION CASE

The first three steps can be omitted if the parts involved were not removed on disassembly.

1. Install the parking pawl tooth toward the inside of case and parking pawl shaft. (Fig. 7-208)

Fig. 7-205 Installing Roller in Cage

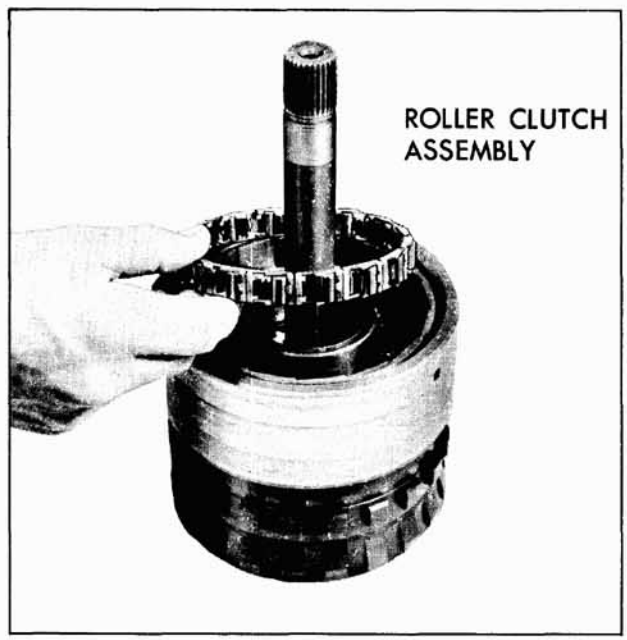


Fig. 7-206 Installing Roller Clutch

2. Install the parking pawl shaft retainer clip. (Fig. 7-209)

3. Install parking pawl shaft cup plug and drive into the case using a 3/8" dia. rod, until the parking pawl shaft bottoms on the case rib. (Fig. 7-210)

4. Install the parking pawl return spring, square end hooked on pawl and other end on case. (Fig. 7-211)

5. Install the parking brake bracket guides over parking pawl and torque to 20 ft. lbs. (Fig. 7-212)

6. Install the rear band assembly so that two lugs index with the two anchor pins. (Fig. 7-213) Check band to be sure band ends are seated on lugs.

7. Install the proper rear selective washer (proper washer determined by previous end play check) into slots provided inside rear of transmission case. (Fig. 7-214)

8. Install output shaft to case thrust washer onto rear face of output shaft, tabs in pocket and retain with petrolatum. (Fig. 7-215)

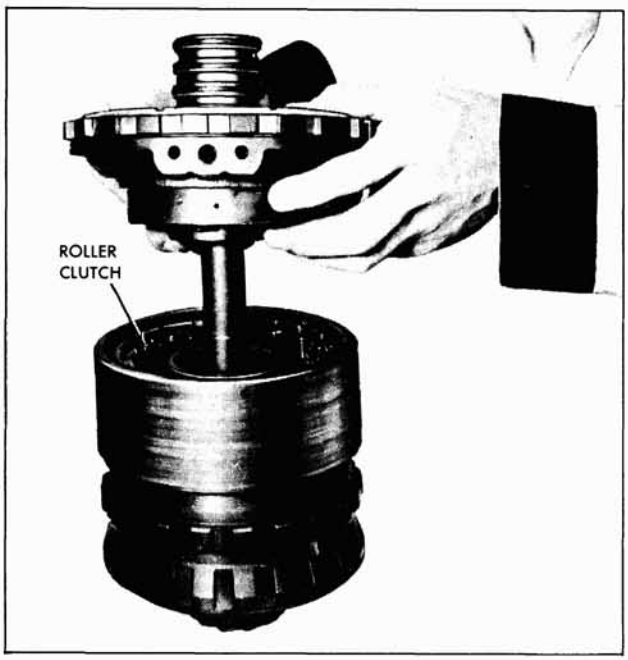


Fig. 7-207 Installing Center Support

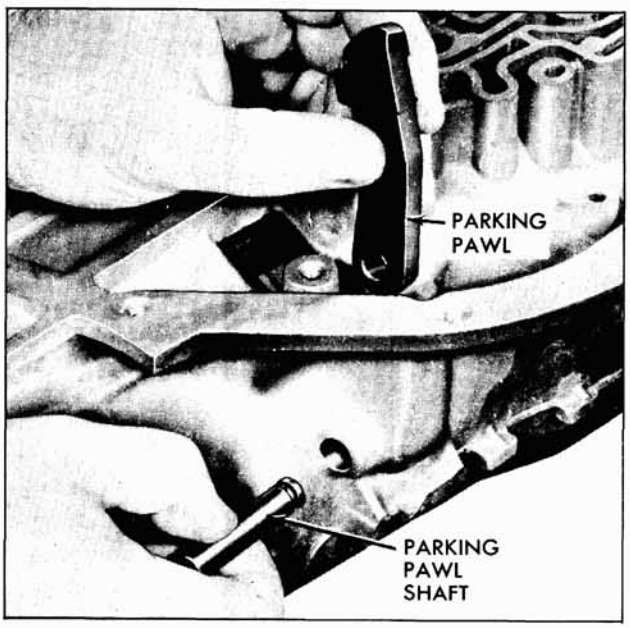


Fig. 7-208 Installing Parking Pawl

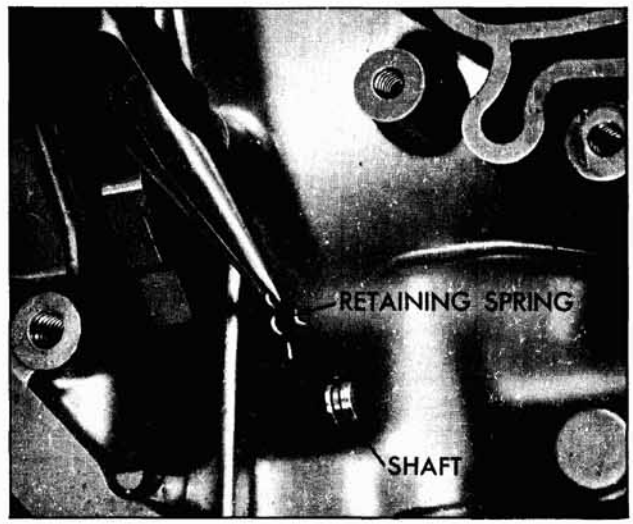


Fig. 7-209 Installing Retainer Clip

Fig. 7-210 Installing Cup Plug

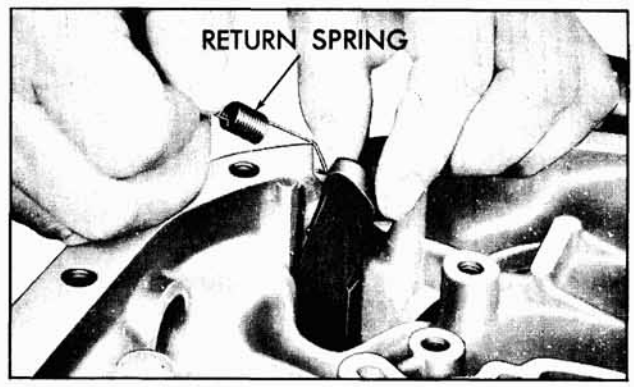


Fig. 7-211 Installing Return Spring

9. Install the complete gear unit assembly into the case, using Tool J-21795 making certain the center support bolt hole is properly aligned with the hole in the case. (Fig. 7-216)

10. Oil and install center support to case retaining snap ring with the bevel side up and locating gap adjacent to band anchor pin. Make certain ring is properly seated in case. (Fig. 7-217)

11. Install case to center support locating screw and torque to 2 ft. lbs. Lubricate and install case to center support bolt and torque to 20 ft. lbs. Remove locating screw and keep for use on future rebuild jobs to properly locate the case center support. (Fig. 7-218)

12. Lubricate and install three steel and three composition intermediate clutch plates. Start with the waved steel plate and alternate the plates. (Fig. 7-219)

13. Install the intermediate clutch backing plate, ridge up.

14. Install the backing plate to case snap ring, locating gap opposite band anchor pin. (Fig. 7-220)

15. Check Rear End Play as Follows:

a. Install J-21661 into an extension housing attaching bolt hole. (Fig. 7-221)

b. Mount the Dial Indicator J-8001, on the rod and index with the end of the output shaft.

c. Move the output shaft in and out to read the end

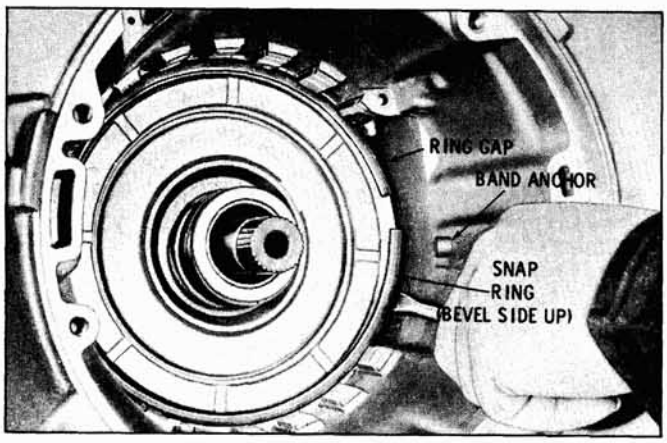


Fig. 7-212 Installing Parking Bracket

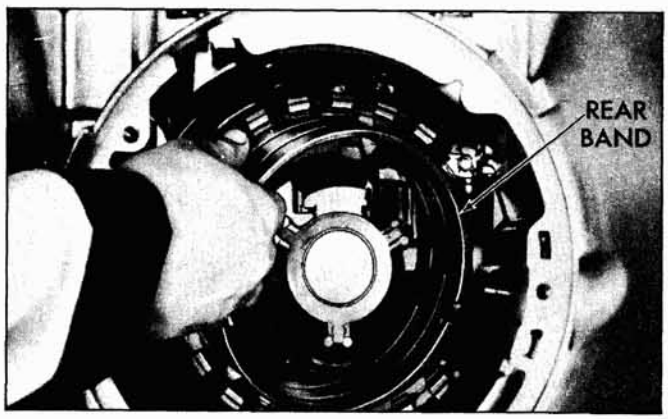


Fig. 7-213 Installing Rear Band

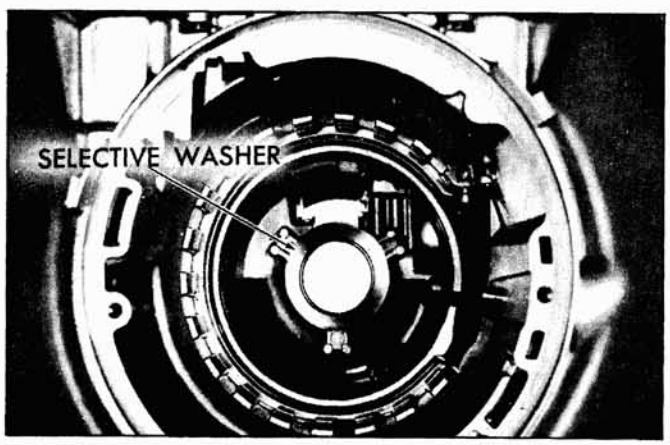


Fig. 7-214 Installing Selective Washer

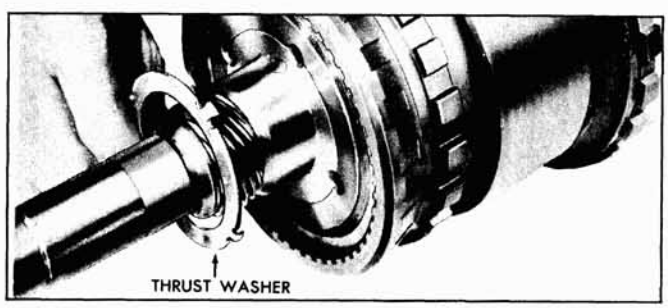


Fig. 7-215 Installing Thrust Washer

Fig. 7-216 Installing Case Center Support

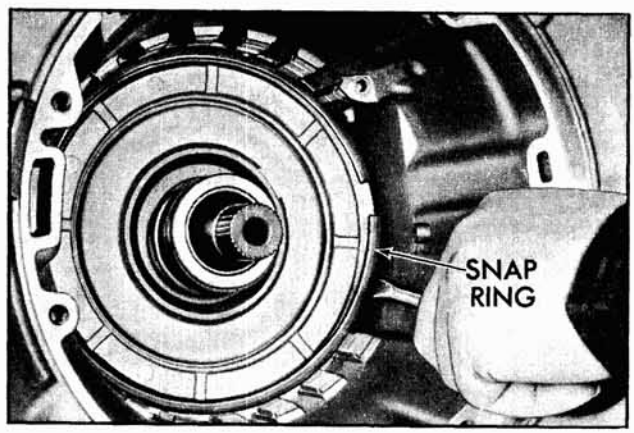


Fig. 7-217 Installing Snap Ring

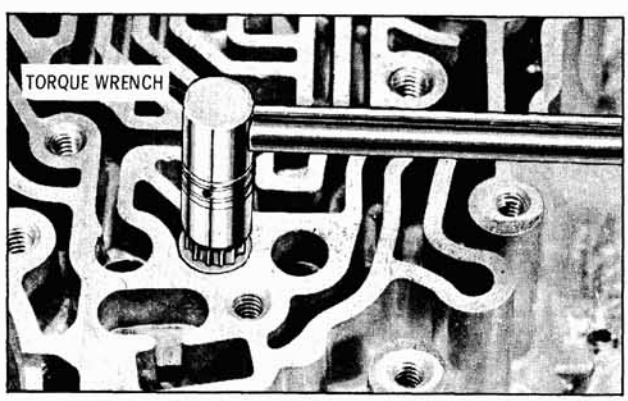


Fig. 7-218 Installing Case Center Support Bolt

play. End play should be from .003" to .019". The selective washer controlling this end play is the steel washer having three lugs that is located between the thrust washer and the rear face of the transmission case.

If a different washer thickness is required to bring the end play within specification, it can be selected from the following chart:

Thickness	Notches or Numeral
.074" to .078"	None 1
.082" to .086"	1 Tab Side 2
.090" to .094"	2 Tab Side 3
.098" to .102"	1 Tab O.D. 4
.106" to .110"	2 Tabs O.D. 5
.114" to .118"	3 Tabs O.D. 6

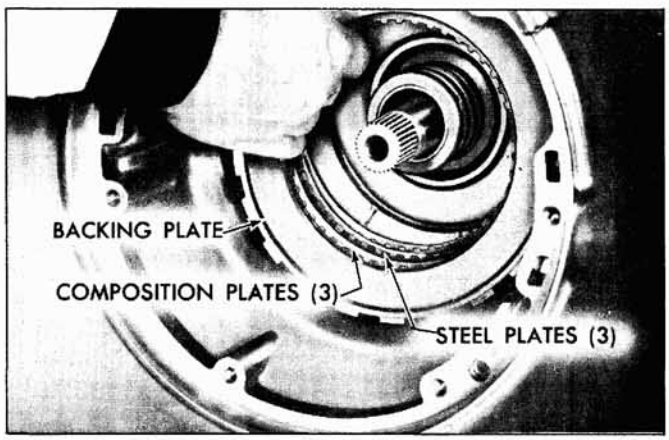


Fig. 7-219 Installing Clutch Plates

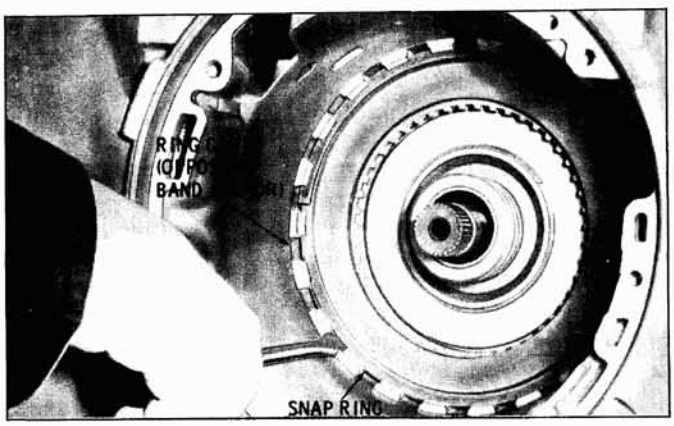


Fig. 7-220 Installing Snap Ring

16. Install front band with anchor hole placed over the band anchor pin and apply lug facing servo hole. (Fig. 7-222)

17. Install manual linkage as follows:

a. If necessary, install a new manual shaft seal into the case using a 3/4" diameter rod to seat the seal.

b. Insert the actuator rod into the manual detent lever from the side opposite the pin.

c. Install the actuator rod plunger under the parking bracket and over the parking pawl. (Fig. 7-223)

d. Install the manual shaft through the case and detent lever. (Fig. 7-224)

e. Install the retaining hex locknut on the manual shaft. (Fig. 7-225) Tighten detent retaining nut.

f. Install retaining pin, indexing with groove in manual shaft. (Fig. 7-226)

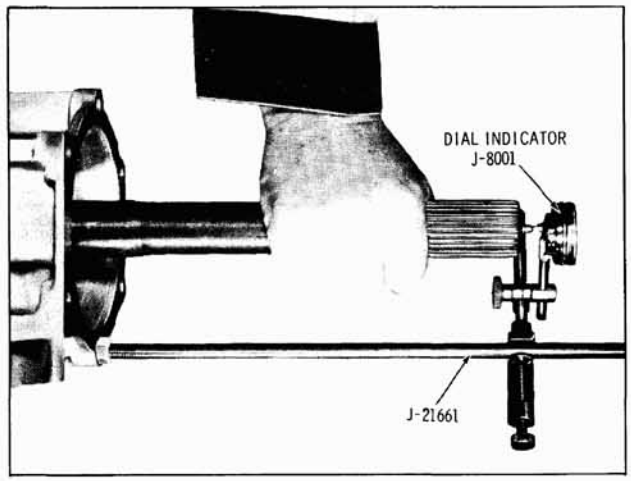


Fig. 7-221 Checking Rear Unit End Play

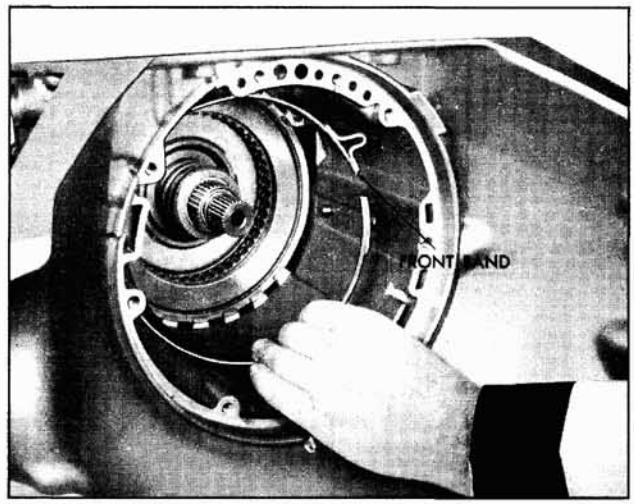


Fig. 7-222 Installing Front Band

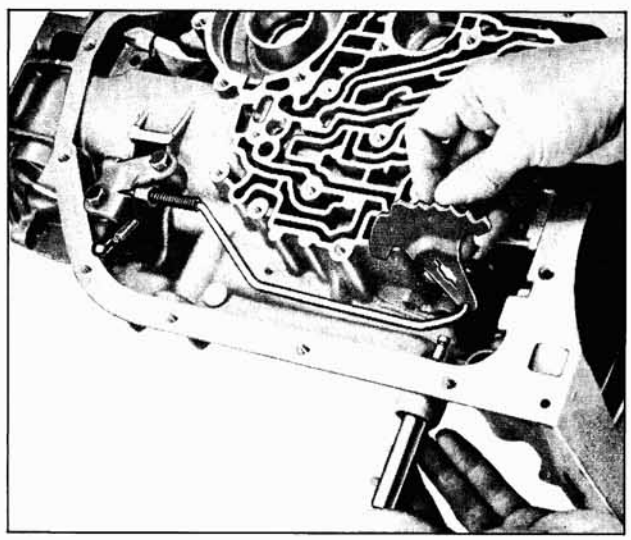


Fig. 7-223 Installing Manual Shaft

18. Install the direct clutch and intermediate sprag assembly. It will be necessary to twist the housing to allow the sprag outer race to index with the clutch drive plates. The housing hub will bottom on the sun gear shaft. (Fig. 7-227)

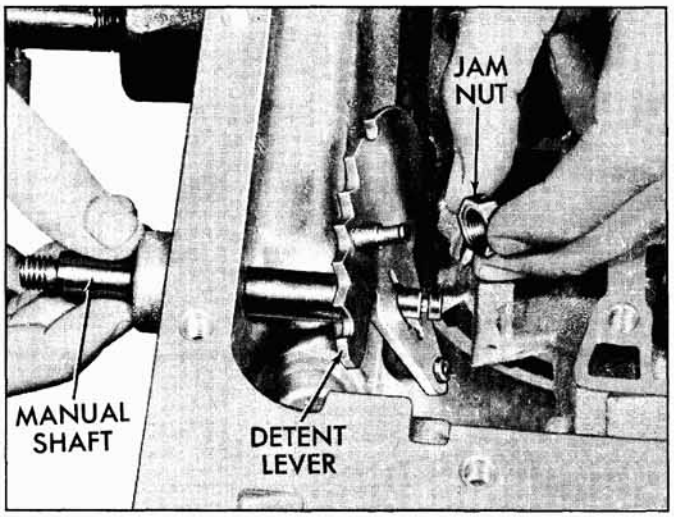


Fig. 7-224 Installing Detent Lever

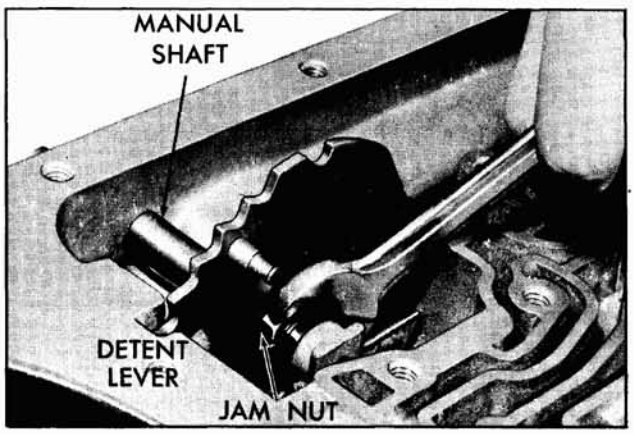


Fig. 7-225 Tightening Jam Nut

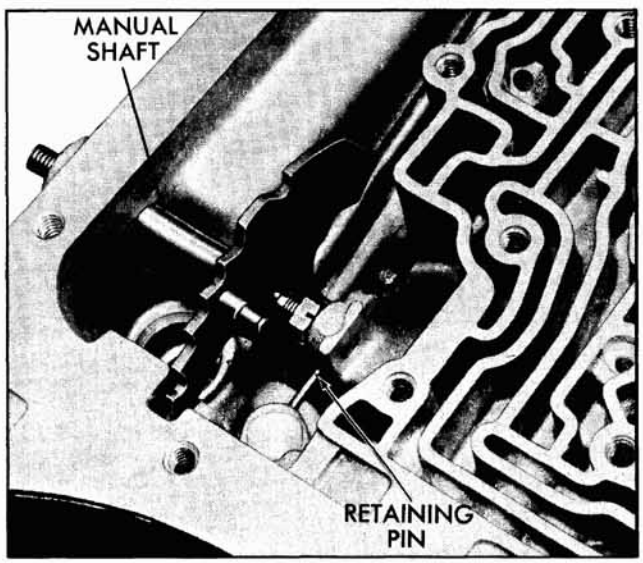


Fig. 7-226 Installing Retaining Pin

After clutch plates have been aligned, applying the intermediate clutch plates, with air pressure, will assist in installing the direct clutch assembly. Air is applied at the case center support bolt hole.

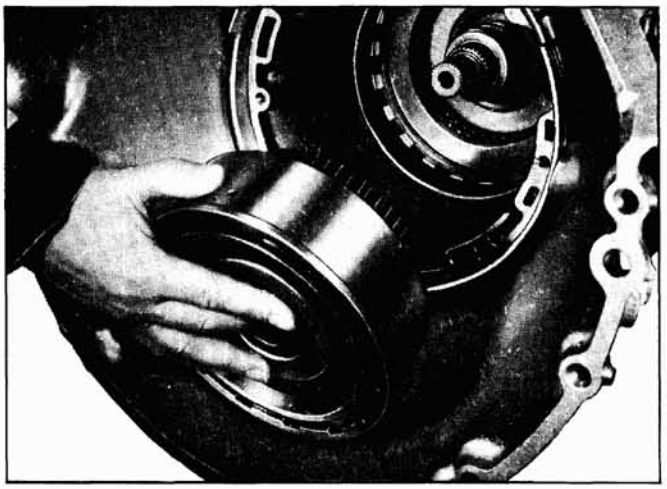


Fig. 7-227 Installing Direct Clutch

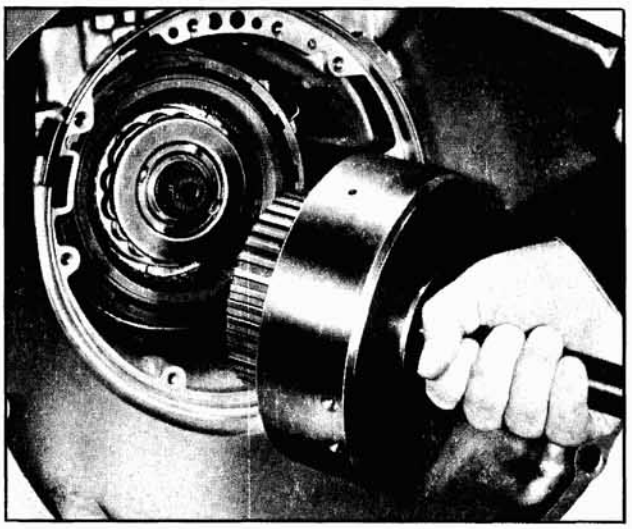


Fig. 7-228—Installing Forward Clutch Assembly

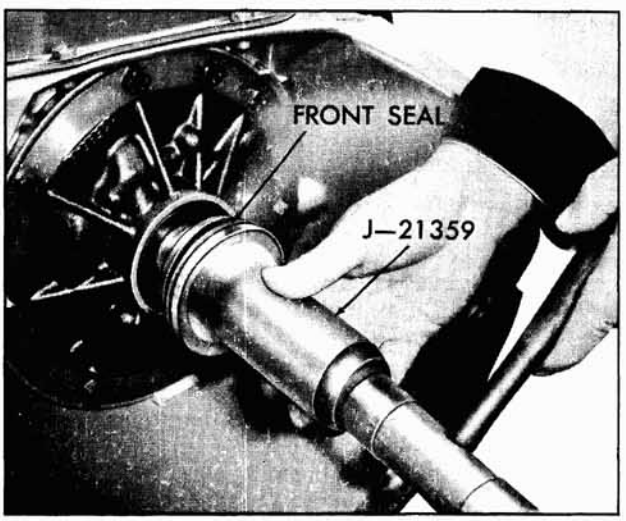


Fig. 7-230 Installing Front Pump Seal

19. Install the forward clutch hub to direct clutch housing thrust washer on the forward clutch hub. Retain with petrolatum.

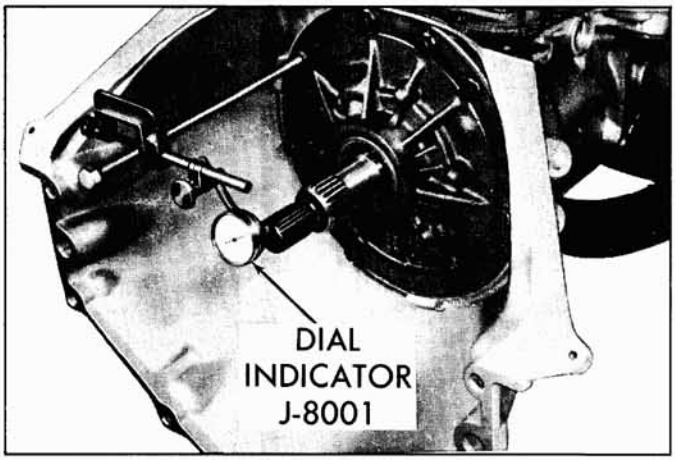


Fig. 7-231 Checking Front Unit End Play

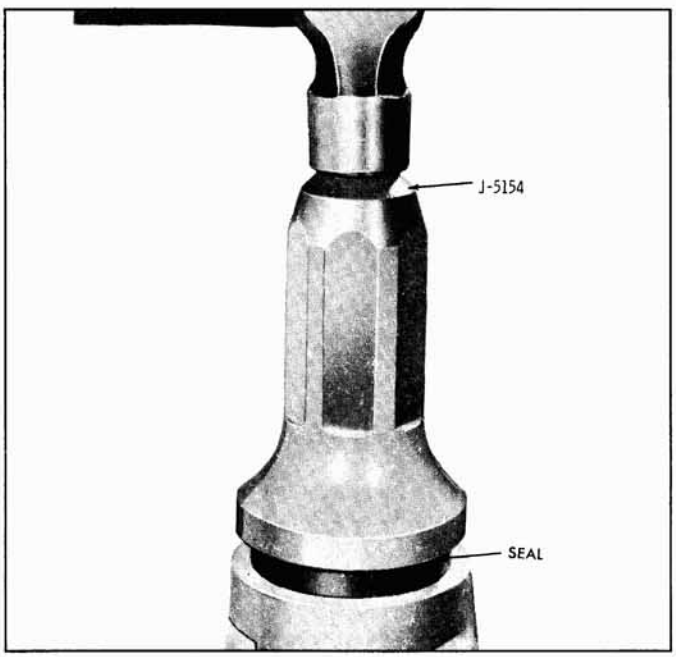


Fig. 7-232 Installing Rear Oil Seal

20. Install the forward clutch assembly and turbine shaft, indexing the direct clutch hub so end of the mainshaft will bottom on end of the forward clutch hub. When forward clutch is seated the housing will be approximately 1-1/4" from pump face in case. (Fig. 7-228)

21. Install the front pump gasket and pump assembly.

22. Using new attaching bolt sealing washers, install all but one pump attaching bolt and washer. Torque to 25 ft. lbs. lbs.

If the turbine shaft cannot be rotated as the pump is being pulled into place, the forward or direct clutch housings have not been properly installed to index with all the clutch plates. This condition must be corrected before the pump is pulled fully into place.

23. If necessary, install a new front seal using Tool J-21359 to drive the seal in place. (Fig. 7-230)

24. Check Front Unit End Play as follows: (Fig. 7-231)

a. Install a Slide Hammer bolt into bolt hole in pump.

b. Mount a Dial Indicator J-8001 on the rod and index indicator to register with end of turbine shaft.

c. Push on turbine shaft rearward.

d. Push output shaft forward.

e. Set Dial Indicator to Zero.

f. Pull turbine shaft forward.

Read the resulting travel or end play, which should be .003" to .024". The selective washer controlling this end play is the washer located between the pump cover and the forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select the proper washer from the chart below:

THICKNESS	COLOR
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

An oil soaked washer may tend to discolor so that it will be necessary to measure the washer for its actual thickness.

25. Install the remaining front pump attaching bolt and sealing washer. Torque bolt to 25 ft. lbs.

EXTENSION HOUSING

1. Install the extension housing to case gasket on the extension housing.

2. Attach the extension housing to the case using attaching bolts. Torque to 25 ft. lbs.

3. If necessary, install new seal with Tool J-5154. (Fig. 7-232)

CHECK BALLS, FRONT SERVO, GASKETS, SPACER AND SOLENOID

Installation

1. Install front servo spring and retainer into transmission case. (Fig. 7-233)

2. Install flat washer on front servo pin on end opposite taper.

3. Install pin and washer into case so that tapered end is contacting band.

4. Install oil seal ring on front servo piston if removed and install on apply pin so that identification numbers on shoulders are positioned toward bottom pan. (Fig. 7-234)

5. Check freeness of piston by stroking piston in bore.

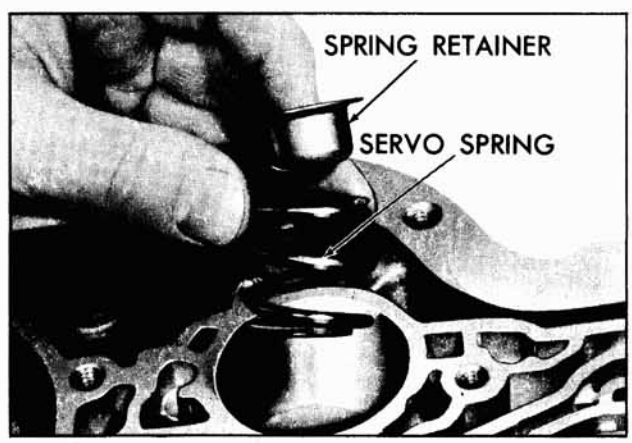


Fig. 7-233 Installing Front Servo Spring

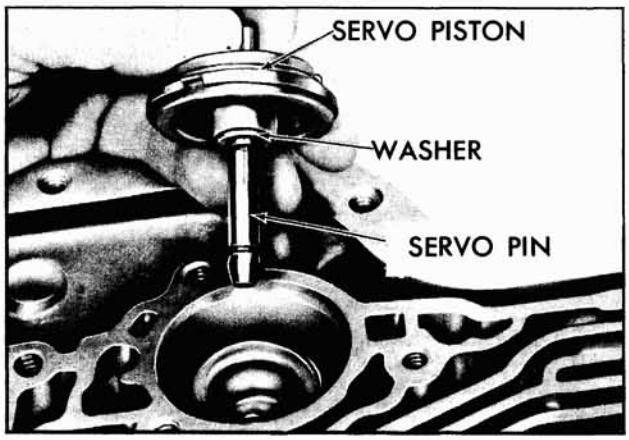


Fig. 7-234 Installing Servo Piston

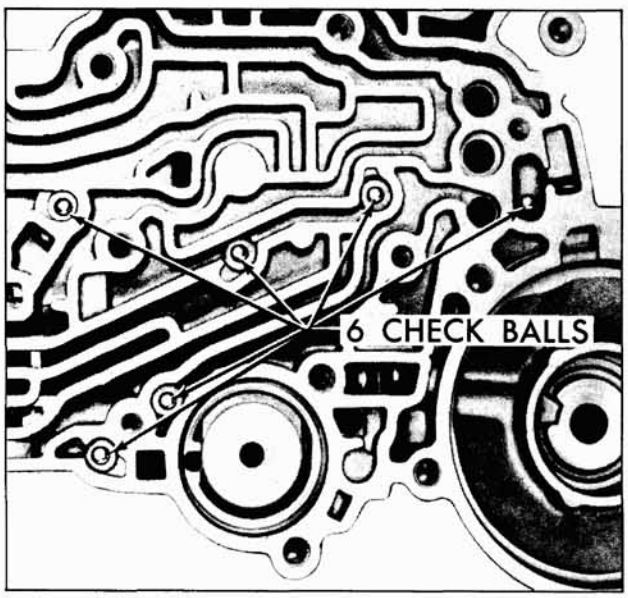


Fig. 7-235 Check Ball Location

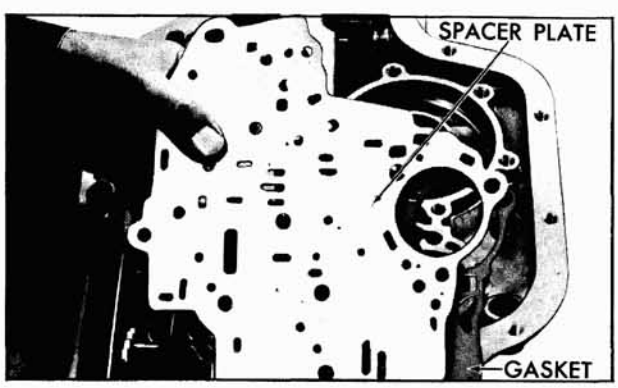


Fig. 7-236 Installing Spacer Plate and Gasket

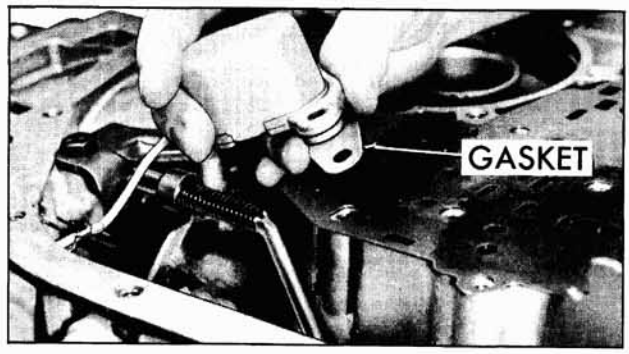


Fig. 7-237 Installing Detent Solenoid and Gasket

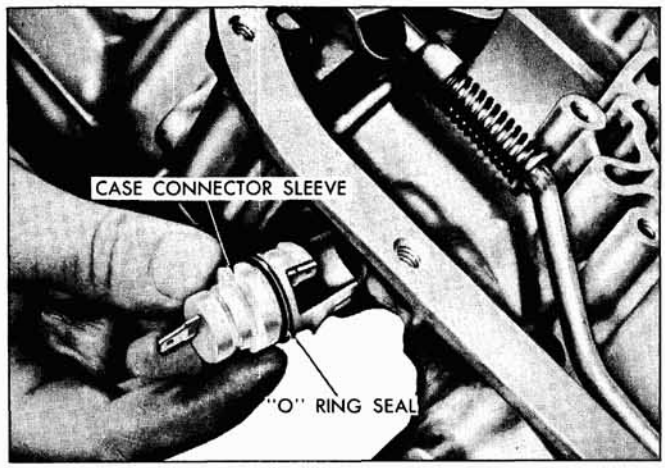


Fig. 7-238 Installing Case Connector

6. Install six check balls into the transmission case pockets. (Fig. 7-235)

7. Install the valve body spacer to case gasket and spacer. Gasket with extension for detent solenoid. (Fig. 7-236)

8. Install the detent solenoid assembly and gasket with connector facing outer edge of case with attaching bolts. (Fig. 7-237)

Do not tighten bolts at this time.

9. Install the "O" ring seal on the case connector.

10. Lubricate and install case connector with lock tabs facing into case, positioning locator tab in notch on side of case. (Fig. 7-238)

11. Install detent connector terminal into case connector, pushing inward so that detent terminal is locked.

Check by pulling on detent connector wire. If detent connector wire can be removed, turn wire connector over and reinstall into case connector.

REAR SERVO

Install

Before installing the rear servo assembly check band apply pin using Tool J-21370-5 and 6 as follows:

1. Attach the band apply pin selection Gauge J-21370 to the transmission case with attaching screws.

Attach tool attaching screws finger tight and check freeness of selective pin. Torque attaching screws and recheck pin to make certain it does not bind.

2. Apply 25 ft. lbs. torque and select proper servo pin to be used from scale on tool. (Fig. 7-240)

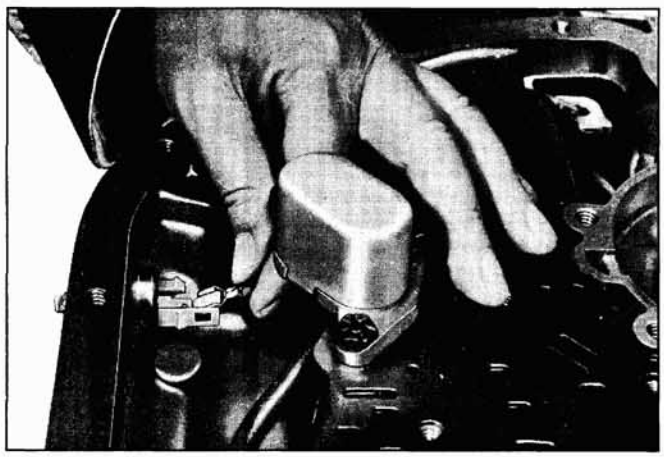


Fig. 7-239 Installing Detent Wire

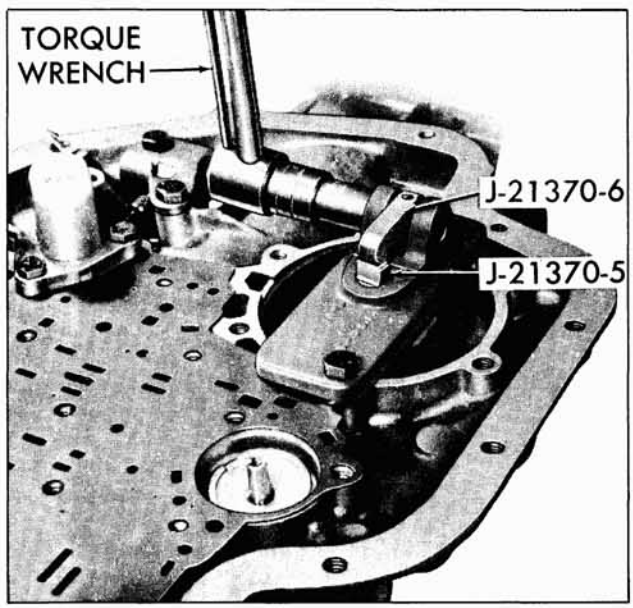


Fig. 7-240 Checking Rear Band Pin

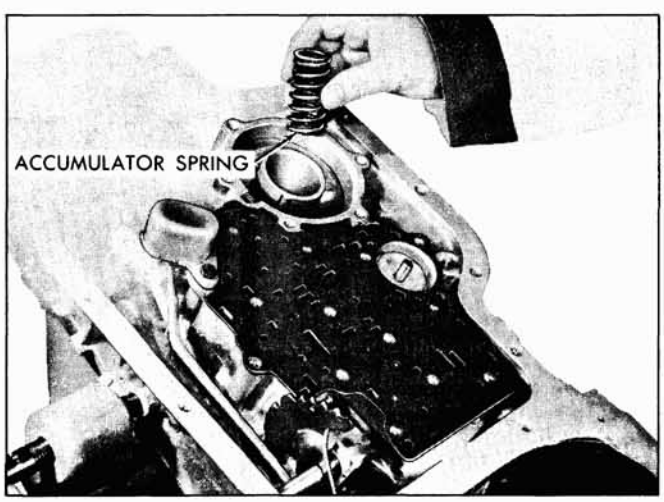


Fig. 7-241 Installing Accumulator Spring

3. Remove the tool and make note of the proper pin to be used during assembly of the transmission.

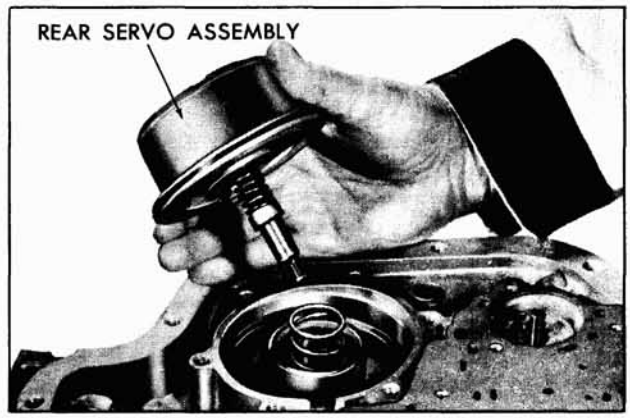


Fig. 7-242 Installing Rear Servo

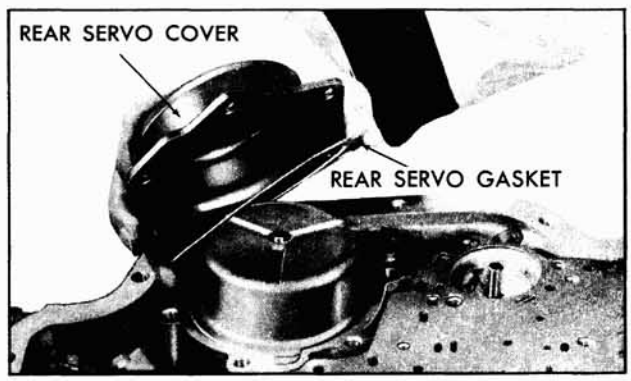


Fig. 7-243 Installing Servo Cover and Gasket

There are three selective pins identified as shown in the following chart.

STEP LOCATION	PIN IDENT.	SIZE
TOP STEP OR ABOVE	THREE RINGS	LONG
THIS AREA	TWO RINGS	MED.
LOWER STEP OR BELOW	ONE RING	SHORT

J-21370-5

The identification ring is located on the band lug end of the pin. Selecting the proper pin is the equivalent of adjusting the band.

1. Install rear accumulator spring into case. (Fig. 7-241)
2. Lubricate and install the rear servo assembly into case. (Fig. 7-242)
3. Install the rear servo gasket and cover. (Fig. 7-243)
4. Install attaching screws. Torque to 20 ft. lbs.

CONTROL VALVE ASSEMBLY AND GOVERNOR PIPES

Install

1. Install control valve to spacer gasket. (Fig. 7-244)
2. Install governor pipes into valve body. (Fig. 7-245)

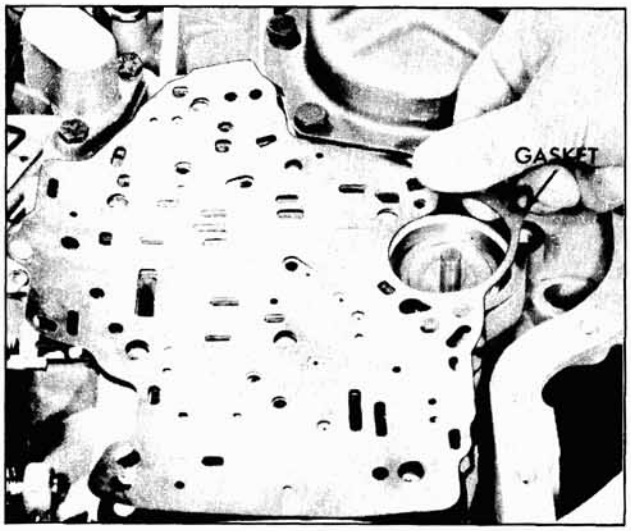


Fig. 7-244 Installing Spacer Gasket

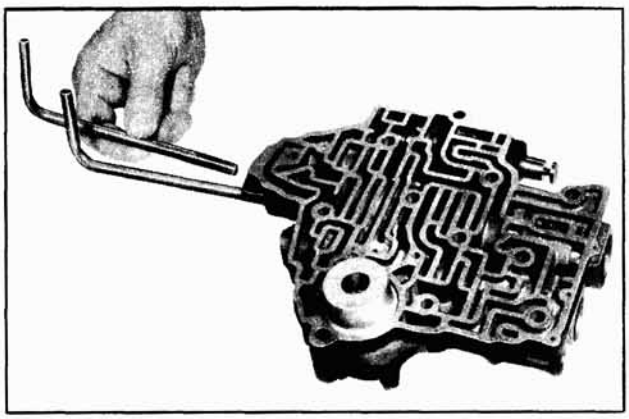


Fig. 7-245 Installing Governor Pipes

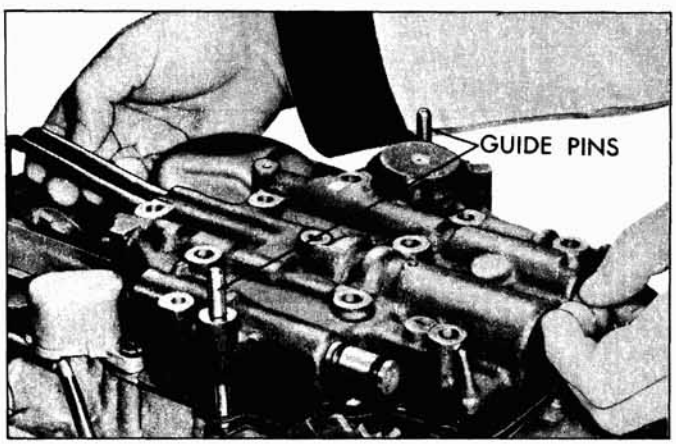


Fig. 7-246 Installing Control Valve Assembly

3. Install two guide pins (control valve assembly attaching screws, with heads removed). (Fig. 7-246)
4. Install control valve assembly and governor pipes to the transmission.

Be sure the manual valve is properly indexed with the pin on the manual detent lever and governor pipes are properly installed in case.

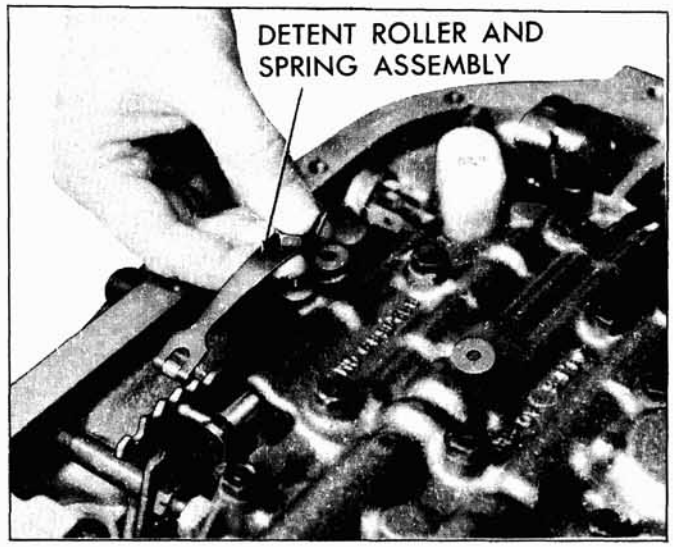


Fig. 7-247 Installing Detent Roller Assembly

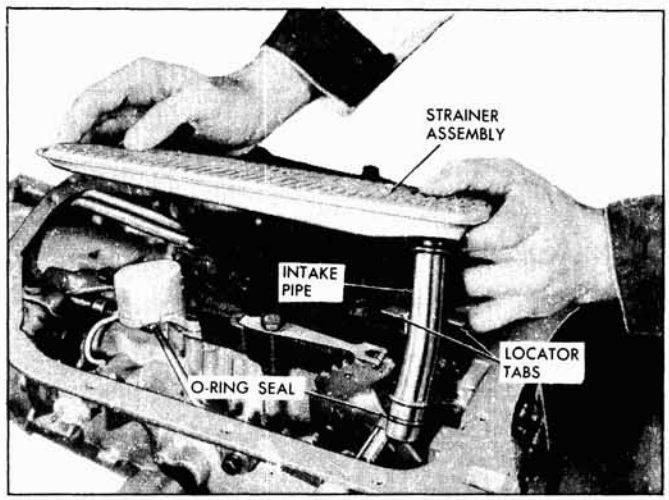


Fig. 7-248 Installing Strainer Assembly

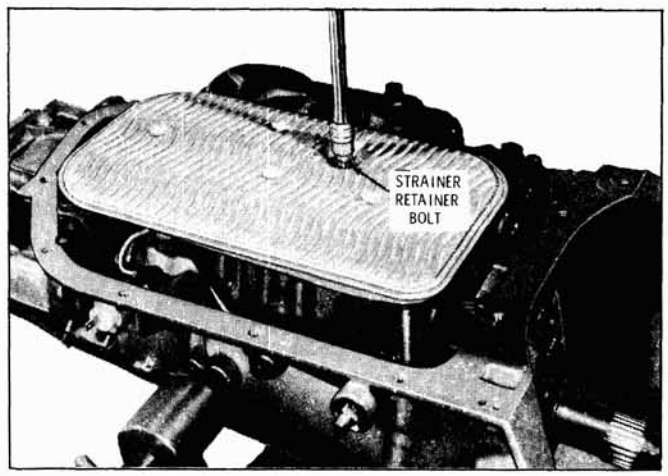


Fig. 7-248A Strainer Retaining Bolt

5. Install the control valve assembly attaching bolts, and manual detent and roller assembly. (Fig. 7-247)
6. Tighten the solenoid and control valve attaching bolts. Torque valve body bolts to 10 ft. lbs. and solenoid bolts to 14 ft. lbs.

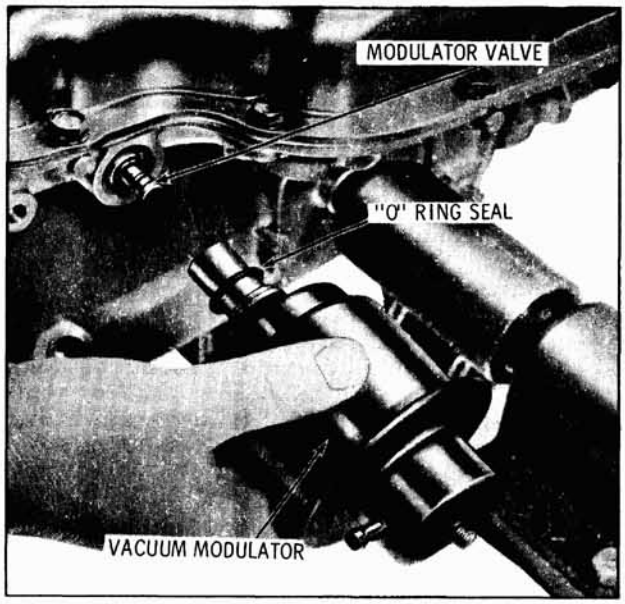


Fig. 7-249 Installing Modulator

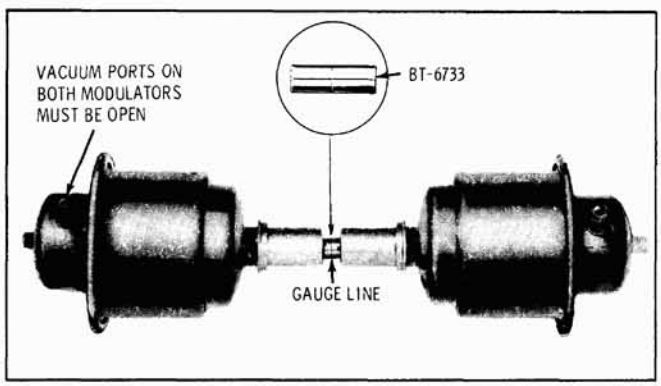


Fig. 7-249A Checking Modulator

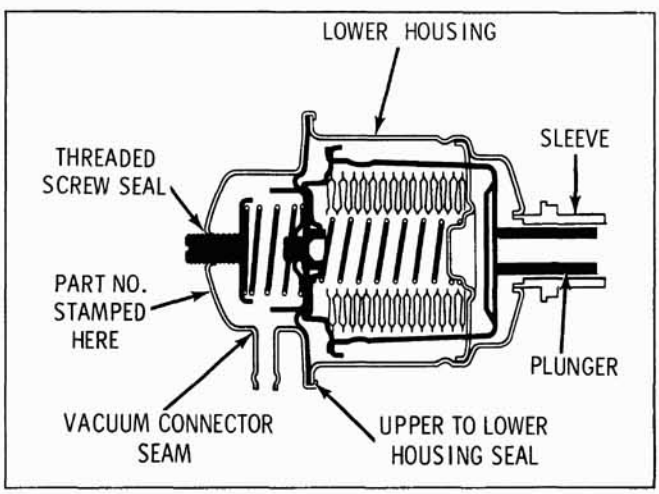


Fig. 7-249B Modulator Assembly

STRAINER AND INTAKE PIPE

Install

1. Install the case to intake pipe "O" ring on intake pipe and install intake pipe into new strainer.
2. Position the strainer and intake pipe assembly. (Fig. 7-248)
3. Install strainer retaining bolt. (Fig. 7-248A)
4. Install pan using new gasket. Torque attaching screws to 13 ft. lbs.

MODULATOR VALVE AND VACUUM MODULATOR

Install

1. Install the modulator valve into the case, stem end out. (Fig. 7-249)
2. Install the "O" ring seal on vacuum modulator.
3. Install the vacuum modulator into the case.
4. Install the modulator retainer and attaching bolt. Torque bolt to 20 ft. lbs.

VACUUM MODULATOR DIAGNOSIS

Vacuum Diaphragm Check

Insert a pipe cleaner as far as possible into the vacuum connector pipe and check for the presence of transmission fluid. If transmission fluid is found, the modulator should be replaced.

Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, proceed to the next check.

Atmospheric Leak Check

1. Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal. (Fig. 7-249A)
2. Using a short piece of rubber hose, apply air pressure to the vacuum pipe by blowing into the tube and observing for bubbles. If bubbles appear, replace the modulator.

Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

Bellows Comparison Check

This check is made using an available tool, BT-6733. The gauge compares the load of a know good modulator with a modulator being checked.

1. Install the modulator that is known to be acceptable on either end of the gauge.
2. Install the modulator in question on the opposite end of the gauge. (Fig. 7-249B)
3. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gauge. The gap between the opposite modulator sleeve end and the gauge line should be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

When making the comparison, make sure that both modulators are of the same type. The part numbers are stamped on the dome of the modulator.

Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

If the vacuum modulator assembly passes all of the above checks, it is an acceptable part and should be reused.

SPEEDOMETER DRIVEN GEAR INSTALLATION

Models OA, OP, OG and OH Only

1. Install speedometer driven gear into gear sleeve and install assembly into transmission case.

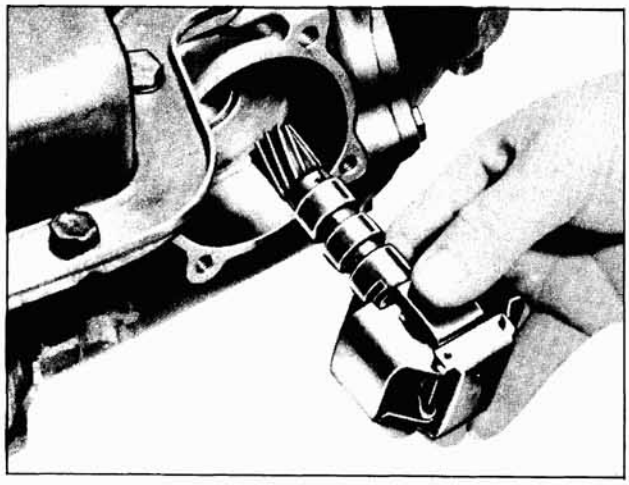


Fig. 7-250 Installing Governor

2. Install speedometer driven gear retainer with tangs in sleeve positioning bosses. Torque attaching bolt to 6 ft. lbs.

GOVERNOR ASSEMBLY

Install

1. Install the governor assembly into the case. (Fig. 7-250)
2. Attach the governor cover and gasket with four attaching bolts. Torque bolts to 20 ft. lbs.
3. Rotate transmission holding fixture so front pump faces up.
4. Install converter, aligning the notches in the front pump with the notches in the front pump converter.
5. Install Converter Holding Tool J-21654 as shown in Fig. 7-251.

DIAGNOSIS GUIDE

NO DRIVE IN "D" RANGE

Possible Causes

A. Low Oil Level
Correct level - check for external leaks or vacuum modulator. See "Vacuum Modulator Diagnosis".

B. Manual Linkage
Maladjusted; check manual linkage adjustment.

C. Low Oil Pressure - Refer to Oil Pressure Chart for specifications and connect oil pressure gauge J-5907 to transmission.

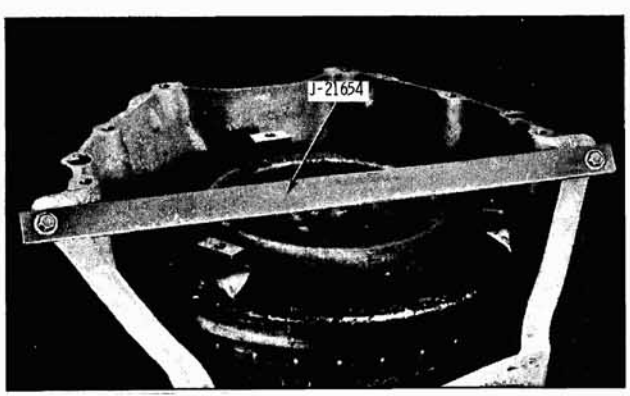


Fig. 7-251 Converter Holding Tool

1. Strainer assembly - "O" ring missing or damaged, strainer blocked, leak at intake grommet.
2. Pump assembly - pressure regulator; pump drive gear - tangs damaged by converter.
3. Case - porosity in intake bore.

D. Control Valve Assembly
Manual valve disconnected from manual lever pin. (Other shift lever positions would also be affected.)

E. Forward Clutch
1. Forward clutch does not apply - piston cracked; seals missing, damaged; clutch plates burned.
2. Pump feed circuit to forward clutch - oil seal rings missing, broken; leak in feed circuits; pump to case gasket mispositioned or damaged; piston ball check in drum stuck or missing.

F. Roller Clutch Assembly
Broken springs or damaged cage.

NO DRIVE IN "R" OR SLIPS IN REVERSE

Possible Causes

A. Low Oil Level
B. Manual Linkage Incorrectly adjusted
C. Oil Pressure - Refer to Oil Pressure Chart for specifications.
1. Vacuum modulator assembly - defective.
2. Vacuum modulator valve - sticking.
3. Restricted strainer or leak at intake pipe grommet or intake "O" ring.
4. Pump assembly - regulator or boost valve sticking.

D. Control Valve Assembly
1. Valve body gaskets - leaking, damaged. (Other malfunctions may also be indicated.)
2. Low reverse check ball - missing from case (this will also cause no overrun braking in low range).
3. 2-3 valve train stuck open (this will also cause 1-3 upshift in drive range).
4. Reverse feed passage - not drilled; also check case passages.

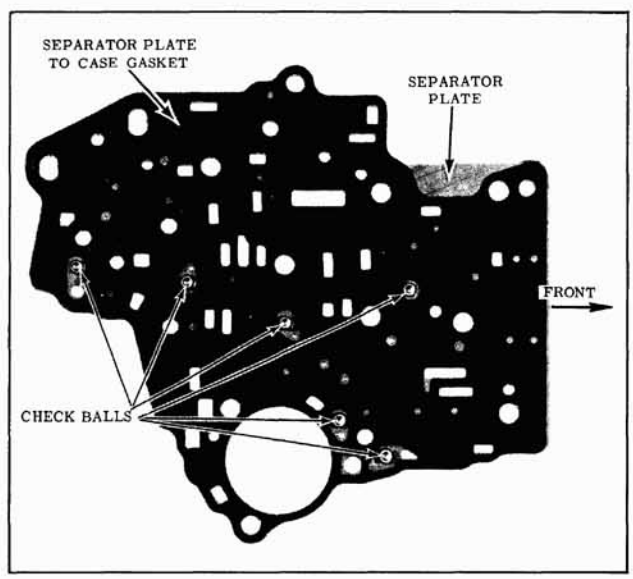


Fig. 7-252 Check Ball Location on Spacer Plate (With Transmission in Car)

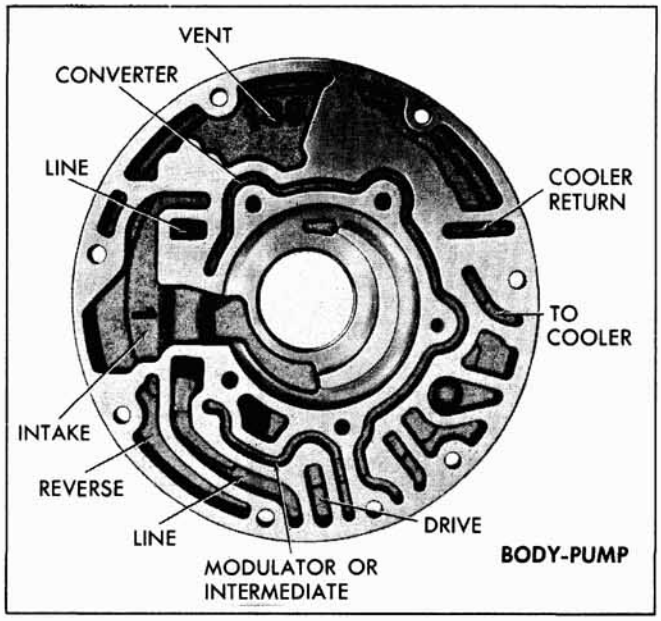


Fig. 7-253 Oil Passage Identification

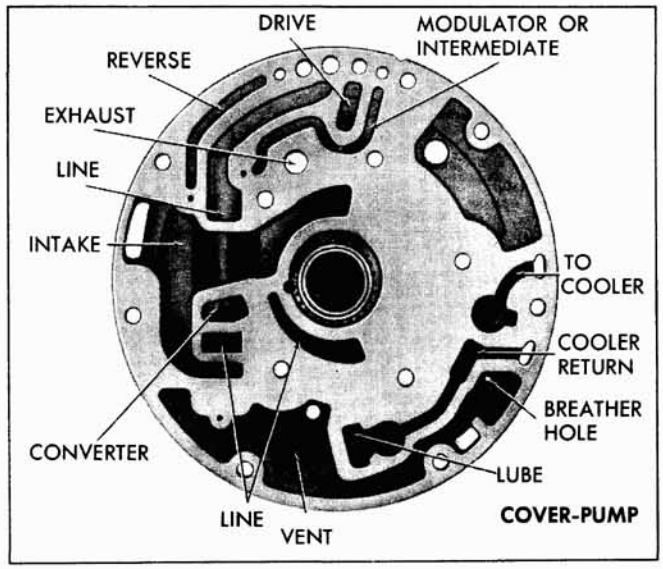


Fig. 7-253A Pump Cover

E. Rear Servo and Accumulator
1. Servo piston seal ring, broken or missing.
2. Band apply pin too short (this may also cause no overrun braking or slip in overrun braking in low range).

F. Rear Band
Burned, loose lining, apply pin or anchor pins not engaged, band broken.

G. Direct Clutch
1. Outer seal damaged or missing.
2. Clutch plates burned - may be caused by stuck ball check in piston.

H. Forward Clutch
Clutch does not release (will also cause drive in neutral range).

DRIVE IN NEUTRAL

Possible Causes

A. Manual Linkage
Maladjusted.

B. Forward Clutch
Clutch does not release (this condition will also cause "No Reverse").

NO DETENT DOWNSHIFTS

Possible Causes

A. Detent Switch
Adjustment, connections loose.

B. Solenoid
Inoperative, connections loose.

C. Control Valve Assembly
Detent valve train stuck.
3-2 valve stuck - spring missing or broken.

NO PART THROTTLE DOWNSHIFT

Possible Causes

A. Oil Pressure - Refer to chart for oil pressure specifications.
Vacuum modulator assembly, modulator valve, pump regulator, valve train. (Other malfunctions may also be noticed.)

B. Control Valve Assembly
3-2 valve stuck; spring missing or broken.

NO ENGINE BRAKING—SUPER RANGE—SECOND SPEED

Possible Causes

A. Front Servo Accumulator Assembly
Servo or accumulator oil rings or bores leaking. Servo stuck.

B. Front Band
Front band broken, burned (check for cause) not engaged on anchor pin and/or servo pin.

NO ENGINE BRAKING—LOW RANGE—FIRST SPEED

Possible Causes

A. Control Valve Assembly
Low-reverse check ball missing from case.

B. Rear Servo
1. Oil seal ring, bore or pistoned damaged; leaking apply pressure.
2. Rear band apply pin too short; improperly assembled.

C. Rear Band
Rear band - broken, burned (check for cause) not engaged on anchor pin or servo pin.

Items A, B and C will also cause slip in reverse or "No Reverse".

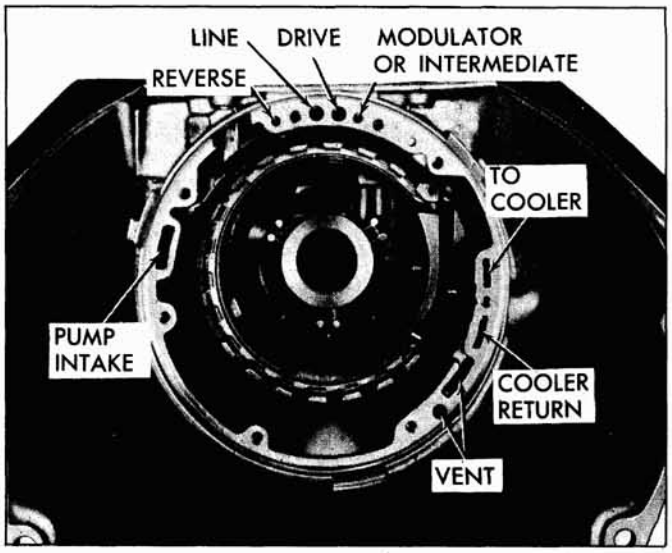


Fig. 7-254 Oil Passage Identification

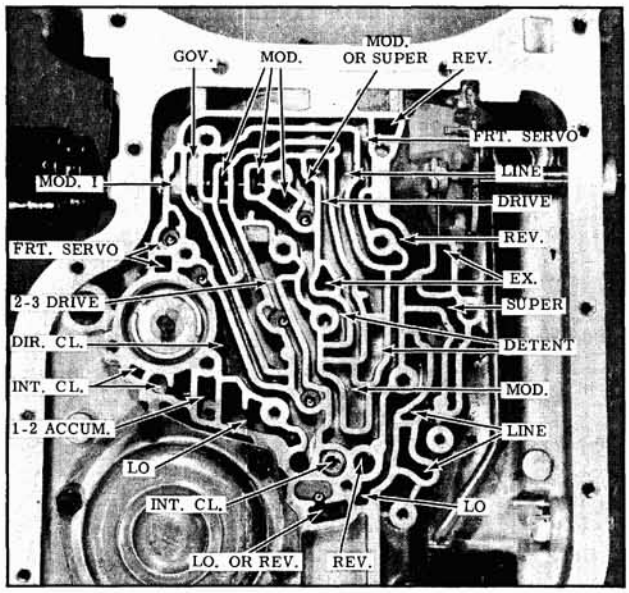


Fig. 7-255 Oil Passage Identification

TRANSMISSION WILL NOT HOLD CAR IN PARK POSITION

Possible Causes

A. Manual Linkage - maladjusted

B. Internal Linkage
1. Parking brake lever and actuator assembly - defective. (Check for chamfer on actuator rod sleeve.)
2. Parking pawl broken or inoperative.

TRANSMISSION NOISE

Possible Causes

A. Pump Noise
1. Oil low or high; water in oil.
2. Cavitation due to plugged strainer; strainer "O" ring damaged, porosity in intake circuit.
3. Pump gears - driving gear assembled backwards; gears damaged or scored.

B. Gear Noise - first gear (Drive Range)
Planetary gear set.

C. Clutch Noise - during application
1. Forward clutch - (neutral to drive, park to drive). Check clutch plates.
2. Intermediate clutch - (1-2 in super and drive range). Check clutch plates.
3. Direct clutch - (2-3 shift in drive range and in neutral to reverse, park to reverse). Check clutch plates.

OIL LEAKS

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "black light"* to identify the oil at the source of the leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dip stick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission "oil filler tube to case leak" will sometimes appear as a leak at the rear of the transmission. In determining the source of an oil leak, it is most helpful to keep the engine running.

*A "black light" testing unit such as J-6640 may be obtained from service tool suppliers.

Possible Points of Oil Leaks

1. Transmission Oil Pan Leak
   a. Attaching bolts not correctly torqued.
   b. Improperly installed or damaged pan gasket.
   c. Oil pan gasket mounting face not flat.
2. Rear Extension Leak
   a. Attaching bolts not correctly torqued.
   b. Rear seal assembly - damaged or improperly installed.
   c. Gasket (extension to case) damaged or improperly installed.
3. Case Leak
   a. Filler pipe "O" ring seal damaged or missing; mispositioning of filler pipe bracket to engine - "loading" one side of "O" ring.
   b. Modulator assembly "O" ring seal - damaged or improperly installed.
   c. Governor cover, gasket and bolts - damaged or loose; case face leak.
   d. Manual shaft seal - damaged, improperly installed.
   e. Line pressure tap plug - stripped, not sealed.
4. Front End Leak
   a. Front seal - damaged (check converter neck for nicks, etc., also for pump bushing moved forward); garter spring missing.
   b. Pump attaching bolts and seals - damaged, missing, bolts loose.
   c. Converter - leak in weld.
   d. Pump "O" ring seal - damaged. (Also check pump groove and case bore.)
5. Oil Comes Out Vent Pipe
   a. Transmission overfilled. Refer to "Periodic Maintenance".

TURBO HYDRA-MATIC DIAGNOSIS GUIDE (INCLUDES TORONADO) 1964 THROUGH 1968

Dependability of this Diagnosis Guide depends upon:

1. Careful analysis of symptoms so that proper malfunction on the charts will be used.
2. Accurate oil pressure check with a known good gauge is made as indicated on the chart and these readings recorded so that they can be compared with the following diagnosis chart.
3. Oil pressure readings must be made with transmission oil at normal operating temperatures.
4. Refer to detailed diagnosis charts for additional diagnosis on 1-2 and 2-3 shift malfunction diagnosis.

PRELIMINARY CHECKING PROCEDURE

↓

CHECK **TRANS. OIL LEVEL** →

↓

INSTALL OIL PRESSURE GAGE AND TACHOMETER ← ***CHECK*** **MANUAL LINKAGE**

↓

CHECK **OIL PRESSURES IN FOLLOWING MANNER**

RANGE	NORMAL P.S.I.
DRIVE—BRAKES APPLIED ENGINE AT 1000 RPM	60 TO 90
SUPER-LO—BRAKES APPLIED ENGINE AT 1000 RPM	135 TO 160
REVERSE-BRAKES APPLIED ENGINE AT 1000 RPM	95 TO 150
NEUTRAL-BRAKES APPLIED ENGINE AT 1000 RPM	55 TO 70
DRIVE-IDLE SET ENGINE IDLE TO SPECIFICATIONS	60 TO 85
DRIVE—30 MPH CLOSED THROTTLE	55 TO 70

CAUTION—**TOTAL RUNNING TIME FOR THIS COMBINATION NOT TO EXCEED 2 MINUTES.**

TRANSMISSION MALFUNCTION RELATED TO OIL PRESSURE

(Refer to Oil Pressure Chart on preceding page)

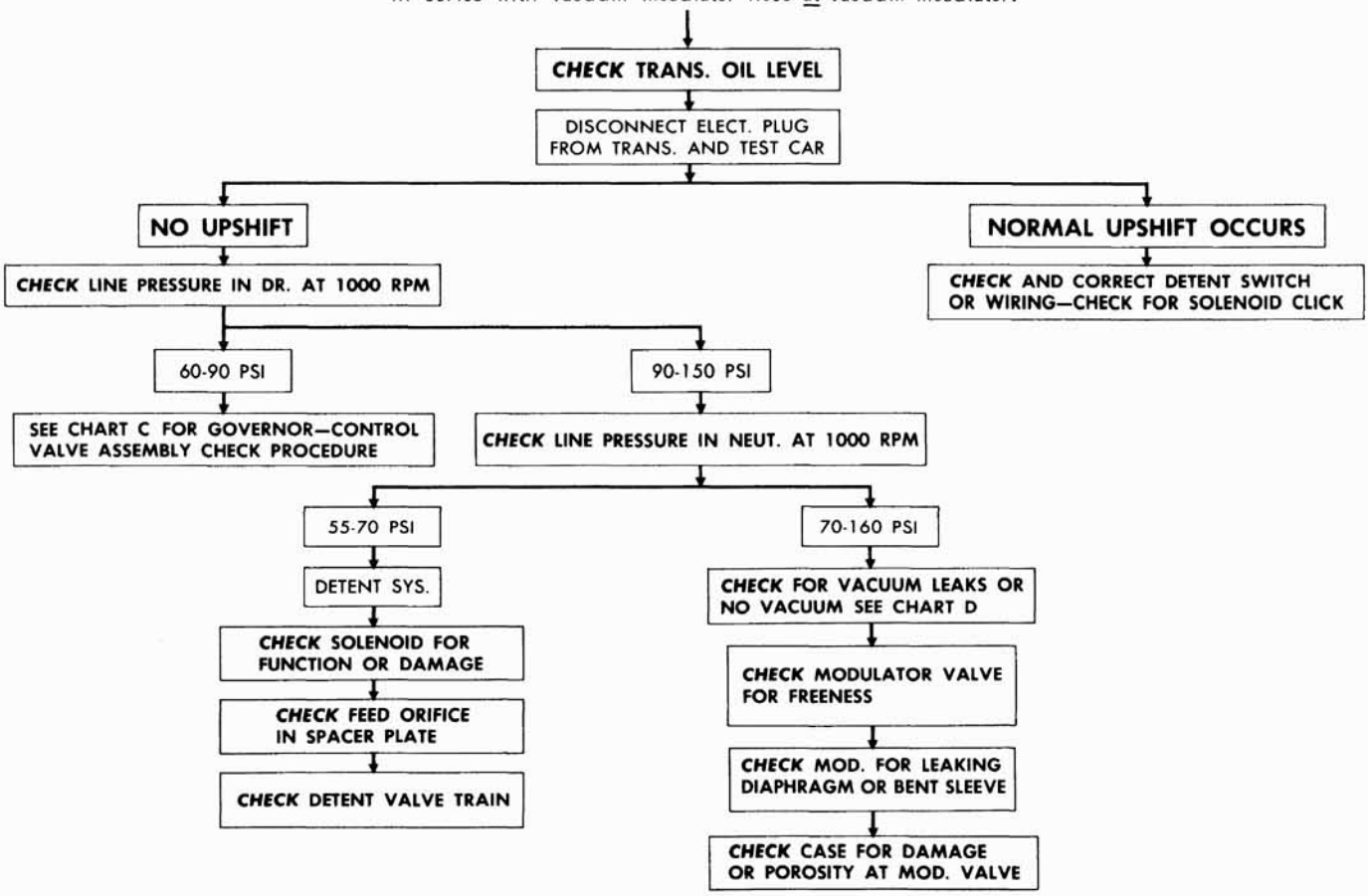
MALFUNCTION	DRIVE BRAKES APPLIED 1000 RPM OIL PRESSURE	REVERSE BRAKES APPLIED 1000 RPM OIL PRESSURE	SUPER-LO BRAKES APPLIED 1000 RPM OIL PRESSURE	NEUTRAL BRAKES APPLIED 1000 RPM OIL PRESSURE	DRIVE IDLE OIL PRESSURE	PRESSURE DROP OCCURS WHILE ENGINE RPM INCREASES FROM 1000 TO 3000 RPM WHEELS FREE TO MOVE	DRIVE 30 MPH CLOSED THROTTLE OIL PRESSURE	POSSIBLE CAUSE OF MALFUNCTION
NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	DROP	NORMAL	MALFUNCTION IN CONTROL VALVE ASSY.
	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NO DROP	NORMAL	MALFUNCTION IN GOVERNOR OR GOVERNOR FEED SYSTEM
	HIGH	NORMAL	NORMAL	NORMAL	—	—	HIGH	MALFUNCTION IN DETENT SYSTEM
	HIGH	HIGH	NORMAL	HIGH	—	—	—	MALFUNCTION IN MODULATOR OR VACUUM FEED SYSTEM TO MODULATOR
SLIPPING—REVERSE	NORMAL	LOW	LOW TO NORMAL	NORMAL	—	—	NORMAL	OIL LEAK IN FEED SYSTEM TO THE DIRECT CLUTCH
SLIPPING—1ST GEAR	LOW	NORMAL	NORMAL	NORMAL	—	—	NORMAL	OIL LEAK IN FEED SYSTEM TO THE FORWARD CLUTCH
DOWNSHIFT WITH ZERO THROTTLE AND NO ENGINE BRAKING IN DRIVE	NORMAL	NORMAL	NORMAL	NORMAL	HIGH	—	HIGH	STATOR AND DETENT WIRES SWITCHED (1965-1967)

TORQUE CHART

APPLICATION	TORQUE FT. LBS.
Transmission Case to Cylinder Block Bolts	30
Converter Cooler Pan to Transmission Case	12
Cooler Lines to Transmission Case	35
Flywheel to Converter Attaching Bolts	35
Support Assembly to Transmission	35
Propeller Shaft to Rear Companion Flange	16
Governor Cover to Transmission Case	20
Modulator to Transmission Case	20
Rear Extension Housing to Transmission Case	25
Bottom Pan to Transmission Case	13
Parking Pawl Guide to Transmission Case	20
Detent Solenoid to Transmission Case	18
Valve Body to Transmission Case	10
Rear Servo Cover to Transmission Case	20
Pump Assembly to Transmission Case	20
Case Center Support to Transmission Case	25
Pump Cover to Pump Body Attaching Bolts	20
Speedometer Driver Gear to Case Attaching Bolt	6
Strainer to Valve Body Retainer	10

NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT

1. Record oil pressures as directed in preliminary checking procedure.
2. Leave oil pressure gauge connected and connect vacuum gauge in series with vacuum modulator hose at vacuum modulator.



— CHART C —

CONTROL VALVE ASSEMBLY—GOVERNOR LINE PRESSURE CHECK

1. INSTALL LINE PRESSURE GAGE
2. DISCONNECT VACUUM LINE TO MODULATOR.
3. WITH CAR ON HOIST (REAR WHEELS, OFF GROUND), FOOT OFF BRAKE, IN DRIVE, CHECK LINE PRESSURE AT 1000 RPM.
4. SLOWLY INCREASE ENGINE RPM TO 3000 RPM AND DETERMINE IF A PRESSURE DROP OCCURS (7-10 PSI MIN.)
5. IF PRESSURE DROP OCCURS, DISASSEMBLE, CLEAN AND INSPECT CONTROL VALVE ASSEMBLY.
6. IF NO PRESSURE DROP OCCURS:
   - A. INSPECT GOVERNOR
     1. STUCK VALVE.
     2. WEIGHT FREENESS.
     3. RESTRICTED ORIFICE IN GOVERNOR VALVE.
   - B. GOVERNOR FEED SYSTEM
     1. CHECK SCREEN IN CONTROL VALVE ASSEMBLY.
     2. CHECK FOR RESTRICTIONS IN GOVERNOR PIPE.

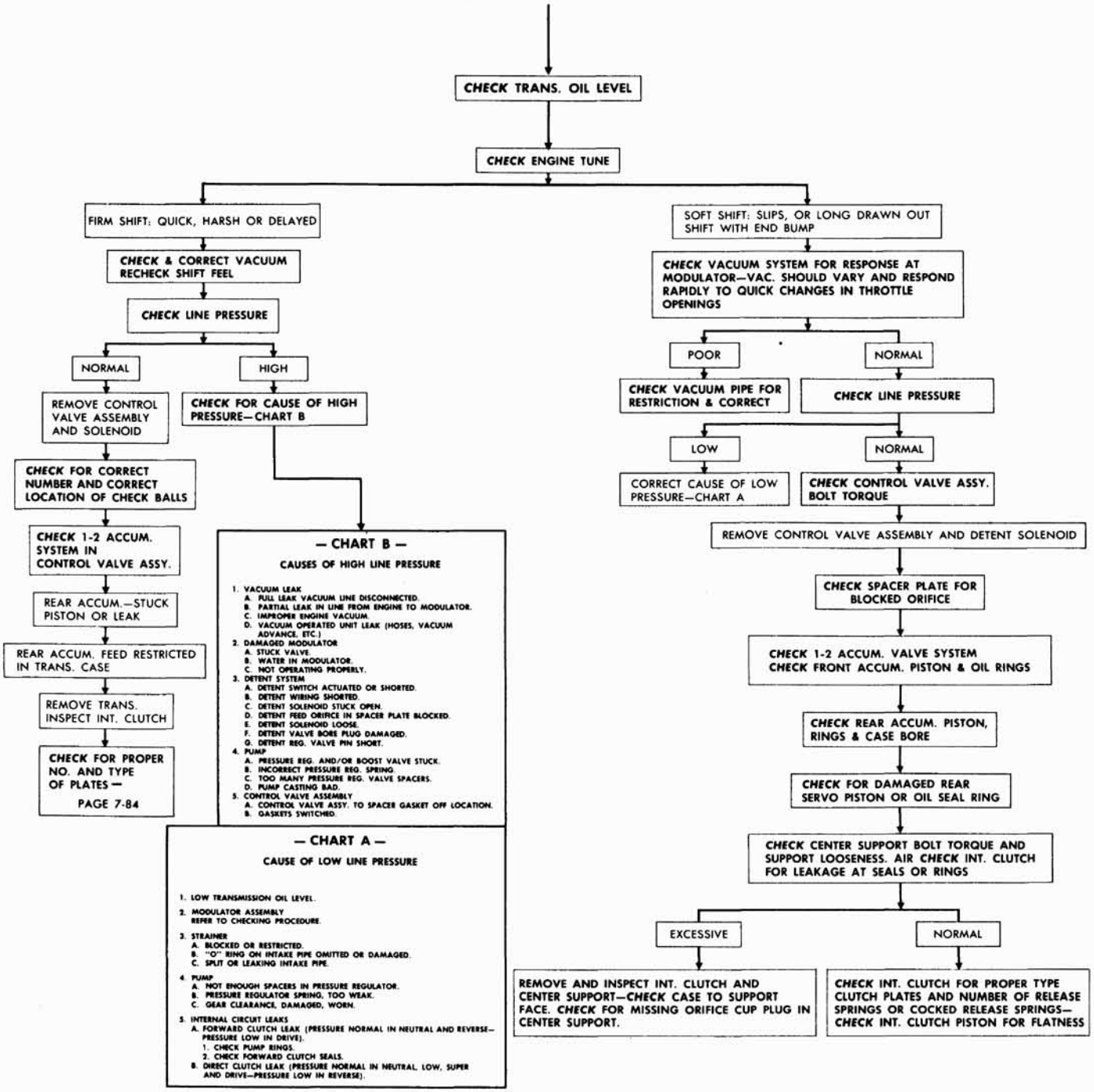
— CHART D —

CAUSES OF IMPROPER VACUUM AT MODULATOR

1. ENGINE
   - A. TUNE UP
   - B. LOOSE VACUUM FITTINGS
   - C. VACUUM OPERATED UNIT LEAK (HOSES, VACUUM ADVANCE, ETC.)
2. VACUUM LINE TO MODULATOR
   - A. LEAK
   - B. LOOSE FITTING
   - C. RESTRICTED ORIFICE
   - D. CARBON BUILD UP AT MOD. VAC. FITTING
   - E. PINCHED LINE
   - F. GREASE IN PIPE (NO OR DELAYED UPSHIFT-COLD)

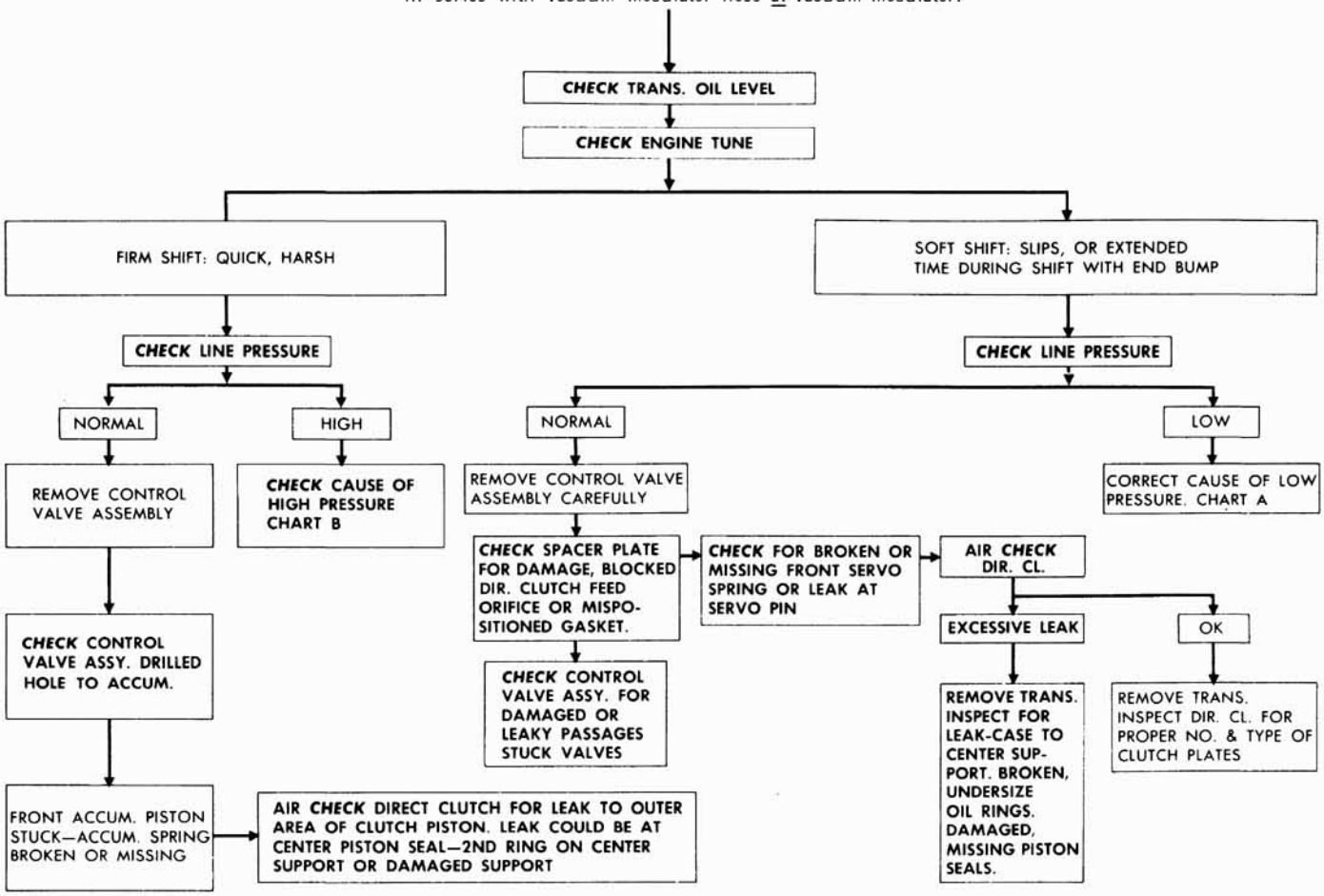
SUB-STANDARD 1-2 SHIFT FEEL

1. Record oil pressures as directed in preliminary checking procedure.
2. Leave oil pressure gauge connected and connect vacuum gauge in series with vacuum modulator hose at vacuum modulator.



SUB-STANDARD 2-3 SHIFT

1. Record oil pressures as directed in preliminary checking procedure.
2. Leave oil pressure gauge connected and connect vacuum gauge in series with vacuum modulator hose at vacuum modulator.



— CHART A —

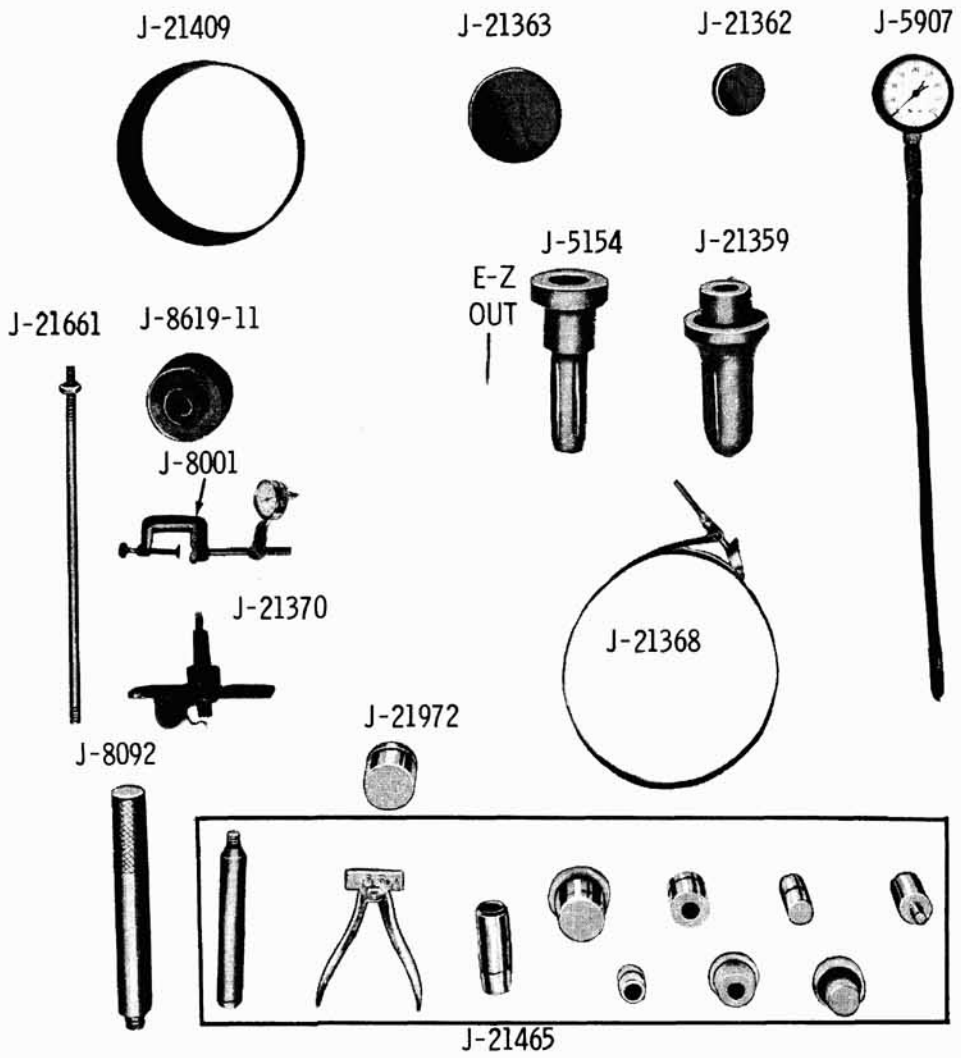
CAUSE OF LOW LINE PRESSURE

1. LOW TRANSMISSION OIL LEVEL.
2. MODULATOR ASSEMBLY
   REFER TO CHECKING PROCEDURE.
3. STRAINER
   A. BLOCKED OR RESTRICTED.
   B. "O" RING ON INTAKE PIPE OMITTED OR DAMAGED.
   C. SPLIT OR LEAKING INTAKE PIPE.
4. PUMP
   A. NOT ENOUGH SPACERS IN PRESSURE REGULATOR.
   B. PRESSURE REGULATOR SPRING, TOO WEAK.
   C. GEAR CLEARANCE, DAMAGED, WORN.
5. INTERNAL CIRCUIT LEAKS
   A. FORWARD CLUTCH LEAK (PRESSURE NORMAL IN NEUTRAL AND REVERSE—PRESSURE LOW IN DRIVE).
      1. CHECK PUMP RINGS.
      2. CHECK FORWARD CLUTCH SEALS.
   B. DIRECT CLUTCH LEAK (PRESSURE NORMAL IN NEUTRAL, LOW, SUPER AND DRIVE—PRESSURE LOW IN REVERSE).

— CHART B —

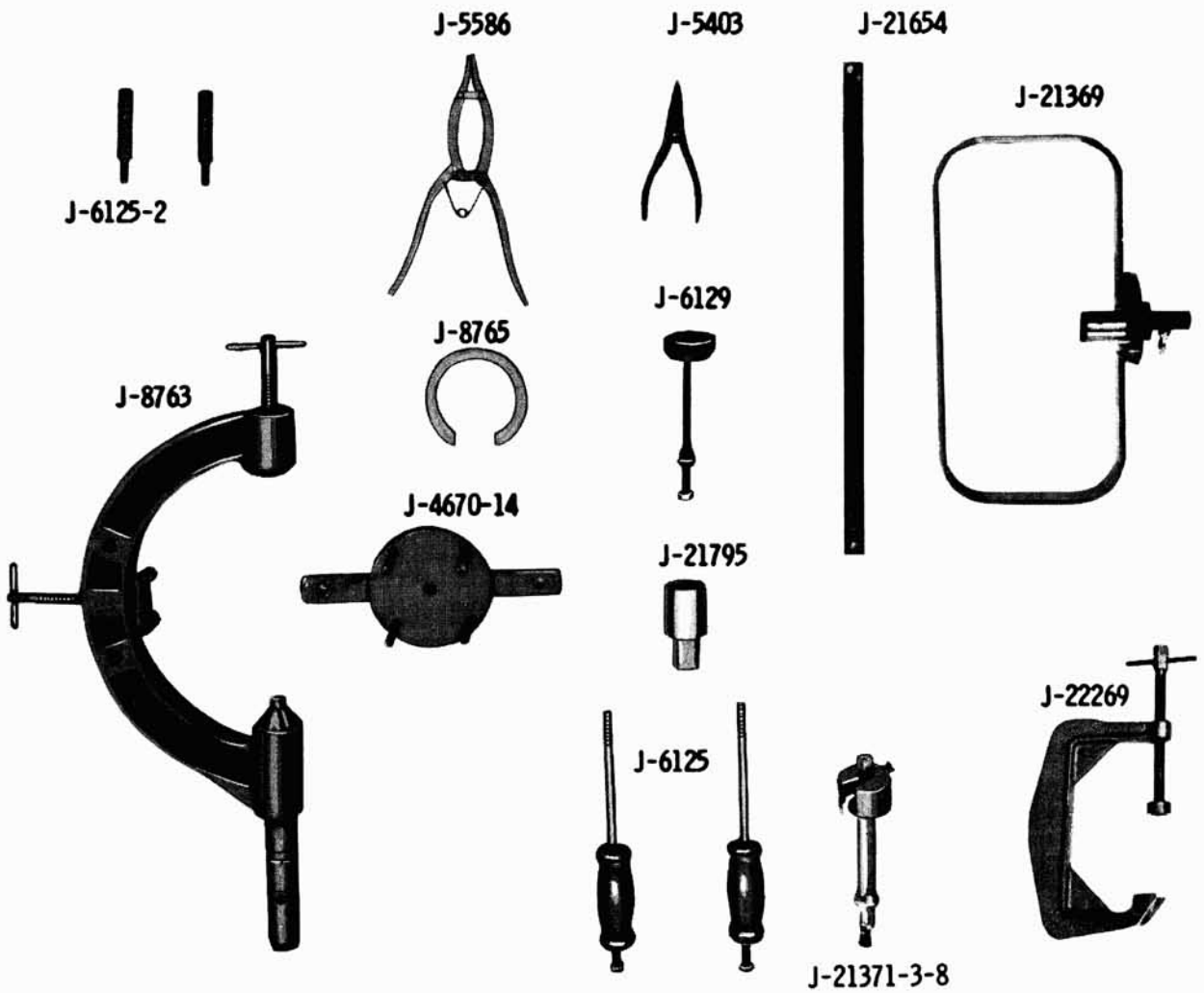
CAUSE OF HIGH LINE PRESSURE

1. VACUUM LEAK
   A. FULL LEAK-VACUUM LINE DISCONNECTED.
   B. PARTIAL LEAK IN LINE FROM ENGINE TO MODULATOR.
   C. IMPROPER ENGINE VACUUM.
   D. VACUUM OPERATED UNIT LEAK. (HOSES, VACUUM ADVANCE, ETC.)
2. DAMAGED MODULATOR
   A. STUCK VALVE.
   B. WATER IN MODULATOR.
   C. NOT OPERATING PROPERLY.
3. DETENT SYSTEM
   A. DETENT SWITCH ACTUATED OR SHORTED.
   B. DETENT WIRING SHORTED.
   C. DETENT SOLENOID STUCK OPEN.
   D. DETENT FEED ORIFICE IN SPACER PLATE BLOCKED.
   E. DETENT SOLENOID LOOSE.
   F. DETENT VALVE BORE PLUG DAMAGED.
   G. DETENT REG. VALVE PIN SHORT.
4. PUMP
   A. PRESSURE REG. AND/OR BOOST VALVE STUCK.
   B. INCORRECT PRESSURE REG. SPRING.
   C. TOO MANY PRESSURE REG. VALVE SPACERS.
   D. PUMP CASTING BAD.
5. CONTROL VALVE ASSEMBLY
   A. CONTROL VALVE ASSY. TO SPACER GASKET OFF LOCATION.
   B. GASKETS SWITCHED.



J-5154	Rear Oil Seal Installer	J-21362	Clutch Inner Seal Protector
J-5907	Pressure Checking Gauge (0 to 300 psi)	J-21363	Clutch Inner Seal Protector
J-8001	Dial Indicator Set	J-21368	Pump Body and Cover Alignment Band
J-8092	Driver Handle	J-21370	Band Apply Pin Gauge
J-8619-11	Piston Gauge Plate (Used to hold Dial Indicator when Checking Front Pump End Clearance)	J-21409	Clutch Outer Seal Protector
		J-21465	Bushing Service Set
E-Z Out	Size 1	J-21661	Extension Rod
J-21359	Pump Oil Seal Installer	J-21972	Extension Housing Bushing & Installer

Fig. 7-256 Tools



J-4670-14	Clutch Spring Compressor	J-8765	"C" Washer
J-5403	Snap Ring Pliers	J-21369	Converter Leak Test Fixture
J-5586	Snap Ring Pliers	J-21371-3-8	Converter Stator/Turbine End Play Checking Fixture
J-6125	Slide Hammer Assembly	J-21654	Converter Holding Strap
J-6129	Spring Compressor	J-21795	Gear Unit Assembly Holding Fixture
J-6125-2	5/16" to 3/8" Adapters	J-22269	Accumulator Piston Remover
J-8763	Transmission Holding Fixture		

Fig. 7-257 Tools

TURBO HYDRA-MATIC INFORMATION

Turbo Hydra-Matic Model	Car Model	Engine	Converter Identification Number *	Forward Clutch					Direct Clutch		
				Flat Steel Plates		No. of Waved Steel Plates	No. of Dished Steel Plates	No. of Composition Plates	No. of Flat Steel Plates	No. of Waved Steel Plates	No. of Composition Plates
				No.	Thickness						
OA	Vista-Cruiser	350 Cu. In. - 2 Bbl. Low and 4 Bbl. High Comp.	5	4	.0775"	1	0	5	4	1	5
OB	98**	455 Cu. In. - 4 Bbl. Hi Comp.	5	4	.0915"	1	0	5	5	1	6
OC	Delta & Delmont	455 Cu. In. - 2 Bbl. Low and High Comp.	5	4	.0775"	1	0	5	4	1	5
OF	Delmont	350 Cu. In. - 2 Bbl. Low and 4 Bbl. High Comp.	5	4	.0775"	1	0	5	4	1	5
OG	F-85-Cutlass 442 & L77	400 Cu. In. - 4 Bbl. Hi Comp.	5	4	.0775"	1	0	5	4	1	5
OG	4400 - L65	400 Cu. In. - 4 Bbl. Hi Comp.	5	4	.0775"	1	0	5	4	1	5
OH	442	400 Cu. In. - 2 Bbl. Low Comp.	5	4	.0775"	1	0	5	4	1	5
OJ	Toronado	455 Cu. In. - 4 Bbl. Hi Comp.	5	5	.0915"	0	1	5	5	1	6
OM	Toronado	455 Cu. In. - 4 Bbl. Hi Comp. W-34 (Performance Option)	5	5	.0915"	0	1	5	5	1	6
OL	Police Option Heavy Duty	455 Cu. In. - 4 Bbl. Hi Comp.	5	4	.0915"	1	0	5	5	1	6
OP	Vista-Cruiser ***	400 Cu. In. - 2 Bbl. Low Comp. and 4 Bbl. Hi Comp.	5	4	.0775"	1	0	5	4	1	5

*The Number is Painted on the Flywheel Side of Converter
**Engine and Transmission Optional (Delmont and Delta with 455 Cu. In. Engine)
***Optional Engine

Waved steel plate thickness - All Models = .0615"
Dished steel plate thickness = .054"
Direct Clutch Flat Steel plate thickness - All Models = .0915"

TURBO HYDRA-MATIC BUSHING SERVICE

(ALL 1965 THROUGH 1968) EXCEPT TORONADO

BUSHING SERVICE

Bushings are available and can be replaced in the following units. Service bushings do not require reaming.

1. Pump Body
2. Sun Gear Shaft
3. Case Center Support
4. Output Shaft
5. Case
6. Extension Housing
7. Stator Shaft
   a. Front Bushing
   b. Rear Bushing

Tools required are: J-21465-1, -5, -6, -8, -9, -10, -13, -15, -16, -17, -19, -20, -21, J-2619, J-2619-4, J-8092.

PUMP BODY BUSHING - (Figs. 7-275 and 7-276)

With pump disassembled and front seal removed, support pump body on wood blocks. Drive bushing out from front as shown using J-8092 Drive Handle and J-21465-17 Bushing Remover and Installer. Use a lead or brass hammer to drive out bushing.

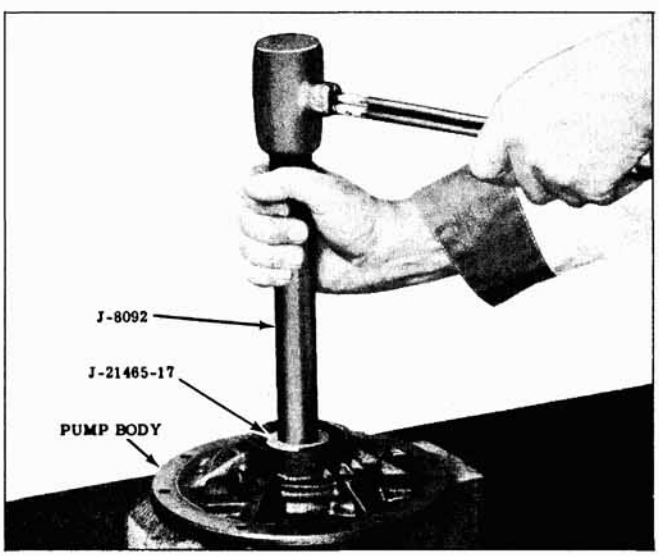


Fig. 7-275—Pump Bushing Removal

Clean pump bushing bore, install new bushing on shoulder of Tool J-21465-17 with J-8092; invert pump and drive bushing squarely into the bore until it is flush to .010" below gear pocket face. Remove tool and inspect bushing.

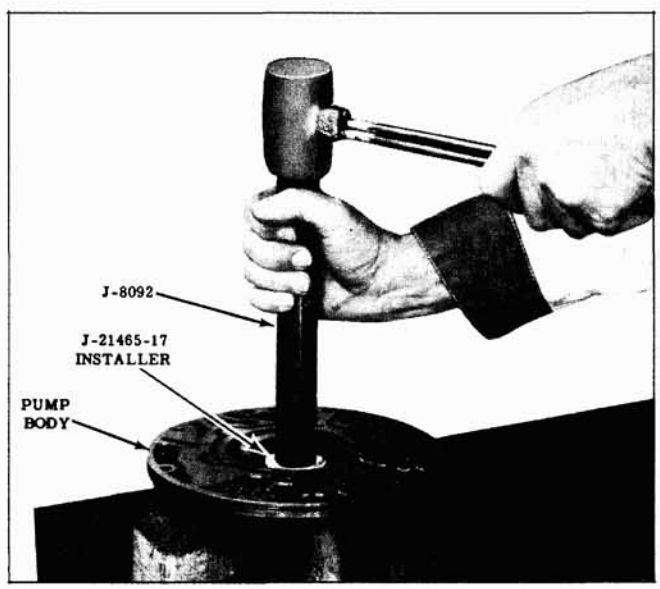


Fig. 7-276—Pump Bushing Installation

SUN GEAR SHAFT BUSHING - (Figs. 7-277 and 7-278)

Assemble Slide Hammer J-2619 and Adapter J-2619-4 to J-21465-15. Clamp sun gear shaft in vise with brass jaws to prevent damage to shaft and thread remover into bushing. Remove bushing with slide hammer as shown.

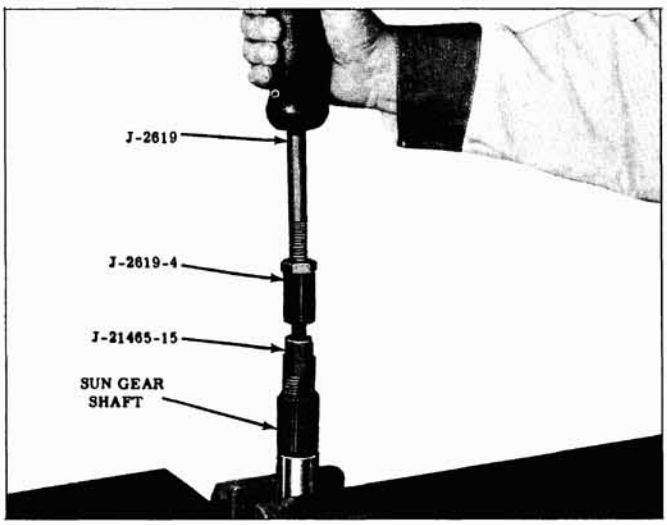


Fig. 7-277—Sun Gear Shaft Bushing Removal

Clean all shavings from shaft. Assemble Tool J-21465-5 on Drive Handle J-8092. Install bushing on shoulder of installer and drive bushing squarely into bore of shaft until installer bottoms as shown. Use lead or brass hammer to drive bushing in. Remove tool and inspect bushing.

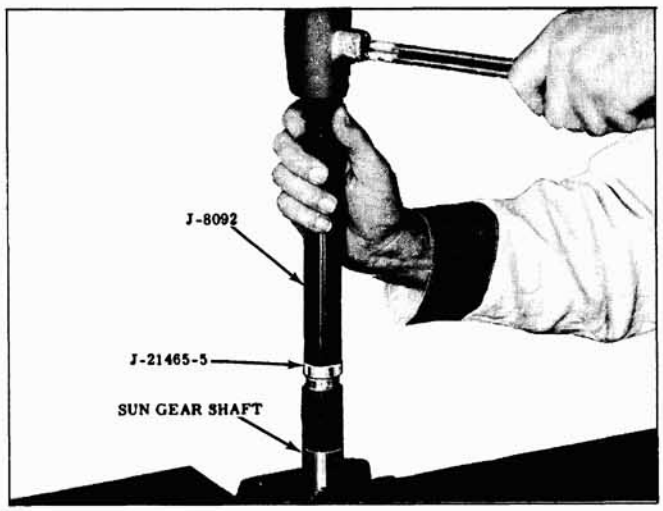


Fig. 7-278—Sun Gear Shaft Bushing Installation

CASE CENTER SUPPORT BUSHING - (Figs. 7-279 and 7-280)

Position case center support, oil delivery sleeve down, on wooden blocks that are long enough to clear bushing during removal. Assemble remover Tool J-21465-6 to Drive Handle J-8092 and drive bushing out as shown using a lead or brass hammer.

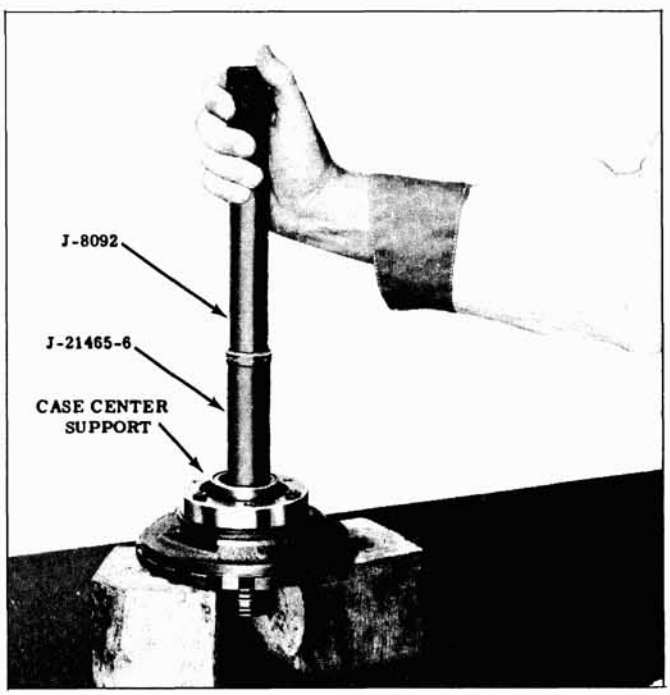


Fig. 7-279—Case Center Support Bushing Removal

Slot in bushing must be aligned with the drilled hole in the oil delivery sleeve closest to the piston.

Invert case center support and using the same tools drive new bushing squarely into the bore until bushing is flush to .010" below end of oil delivery sleeve as shown. Remove tools and inspect bushing and oil hole alignment.

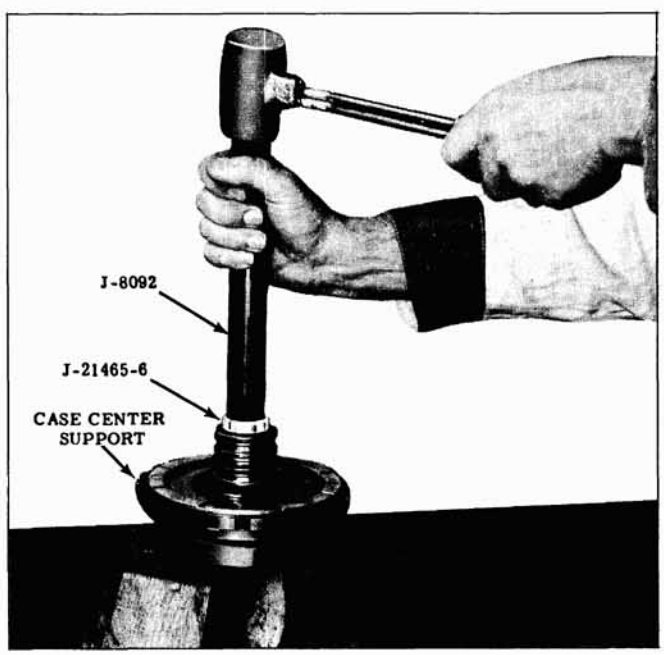


Fig. 7-280—Case Center Support Bushing Installation

OUTPUT SHAFT BUSHING - (Figs. 7-281 and 7-282)

Install output shaft in vise. Use brass jaws to prevent damage to shaft. Assemble Slide Hammer J-2619 and Adapter J-2619-4 on Remover Tool J-21465-16. Thread remover into bushing and drive out with slide hammer as shown.

Clean shavings from output shaft bore. Assemble Drive Handle J-8092 on Installer J-21465-1. Install new bushing on shoulder of installer and drive bushing squarely into bore until tool bottoms using a lead or brass hammer as shown. Remove tool and inspect bushing.

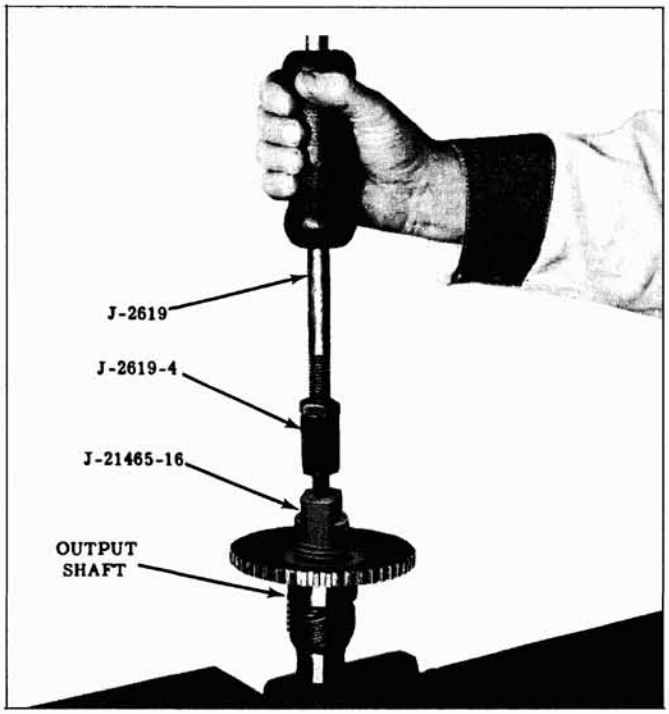


Fig. 7-281—Output Shaft Bushing Removal

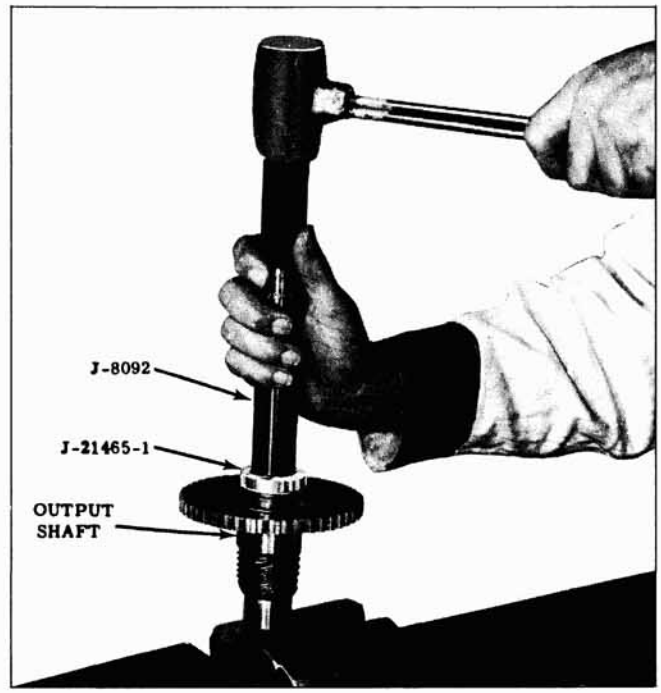


Fig. 7-282—Output Shaft Bushing Installation

TRANSMISSION CASE BUSHING - (Figs. 7-283, 7-284 and 7-285)

Position transmission case (converter end down). Assemble Remover Tool J-21465-8 on Drive Handle J-8092 and drive bushing out using a lead or brass hammer, as shown.

Invert transmission case in holder. Assemble Drive Handle J-8092 and Adapter J-21465-13 on Installer J-21465-8. Assemble Adapter Ring J-21465-9 on installer and install new bushing on shoulder of installer with lube passage facing adapter ring, see illustration. Drive bushing squarely into bore with lead or brass hammer until adapter ring bottoms, as shown. This will leave the bushing .040" to .055" above the selective thrust washer surface.

Remove tools and stake bushing with Tool J-21465-10 as shown in Fig. 7-285. Stake marks must be in the bushing groove. Remove staking tool and inspect bushing.

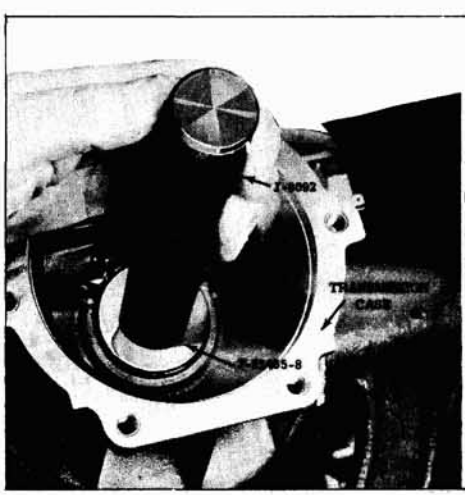


Fig. 7-283—Transmission Case Bushing Removal

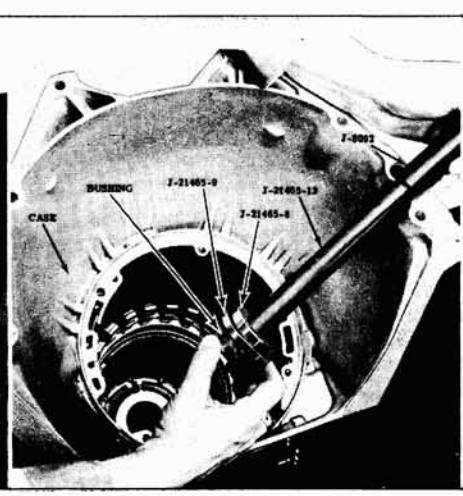


Fig. 7-284—Transmission Case Bushing Installation

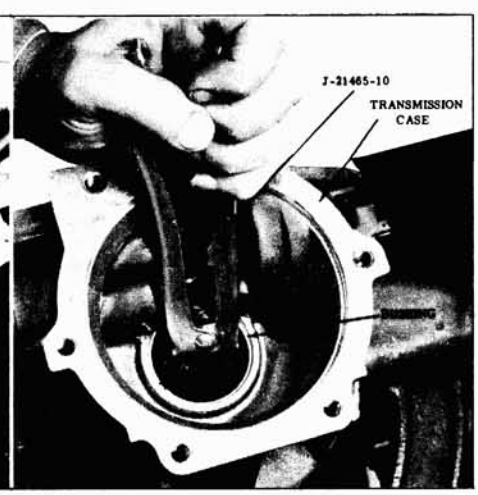


Fig. 7-285—Staking Transmission Case Bushing

EXTENSION HOUSING BUSHING - (Figs. 7-286, 7-287 and 7-288)

With rear seal removed, position extension housing on bench, seal end up. Assemble Remover J-21465-17 on Drive Handle J-8092 and drive out bushing with lead or brass hammer, as shown.

Assemble Drive Handle J-8092 and new bushing on Tool J-21465-17 and drive bushing squarely into bore until flush to .010" below oil seal counter bore surface using a lead or brass hammer, as shown.

Remove tools and use Tool J-21465-10 to stake bushing in place as shown in Fig. 7-288. Stake marks must be in bushing lubrication grooves. Remove tool and inspect bushing.

Staking in production bushings may or may not be in lubrication grooves. Production equipment does not distort bushing surface making location of stakes optional.

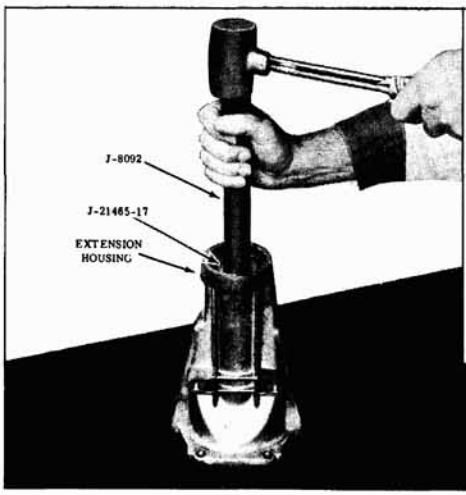


Fig. 7-286—Removing Extension Housing Bushing

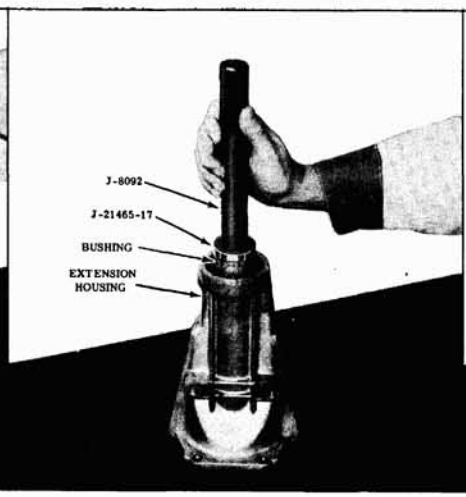


Fig. 7-287—Installing Extension Housing Bushing

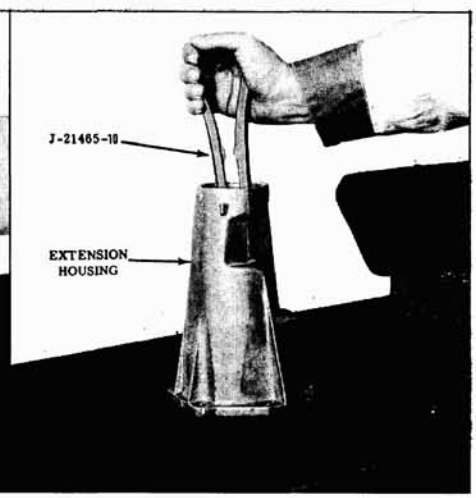


Fig. 7-288—Staking Extension Housing Bushing

STATOR SHAFT--FRONT BUSHING - (Figs. 7-289 and 7-290)

Mount pump cover and stator shaft in vise as shown. Use brass jaws to protect shaft. Assemble Slide Hammer J-2619 and Adapter J-2619-4 on Remover J-21465-15. Thread remover into front bushing and remove bushing with slide hammer.

Clean all shavings from stator shaft. Support pump cover on Tool J-21465-21 so as not to damage ring land of stator shaft. Assemble Installer J-21465-19 to Drive Handle J-8092. Locate new bushing on shoulder of installer and drive bushing squarely into bore with a lead or brass hammer, as shown, until installer bottoms. Remove tool and inspect bushing.

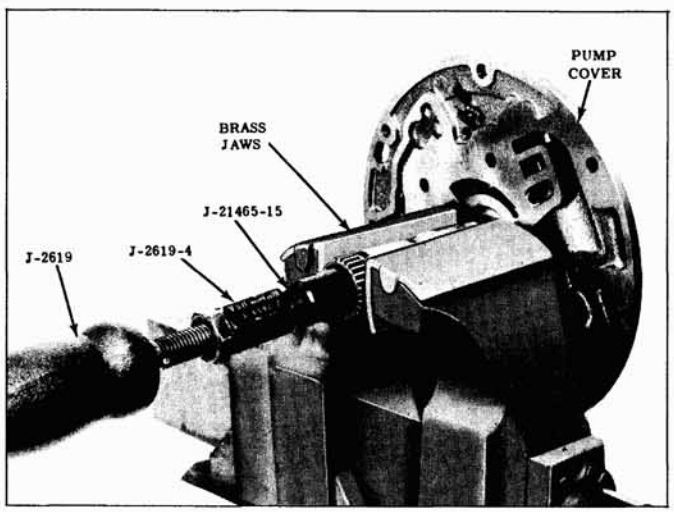


Fig. 7-289—Removing Stator Shaft Front Bushing

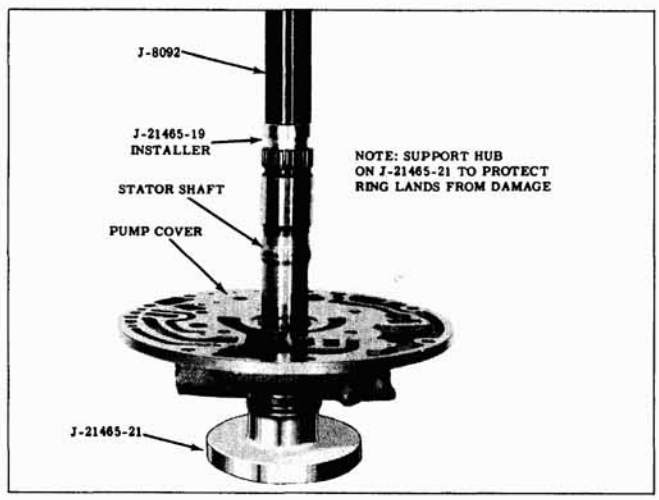


Fig. 7-290—Installing Stator Shaft Front Bushing

STATOR SHAFT--REAR BUSHING - (Figs. 7-291 and 7-292)

Mount pump cover and stator shaft in vise as shown. Use brass jaws to protect shaft. Assemble Remover J-21465-15 to J-2619 Slide Hammer and J-2619-4 Adapter. Thread remover into rear bushing and remove bushing with slide hammer.

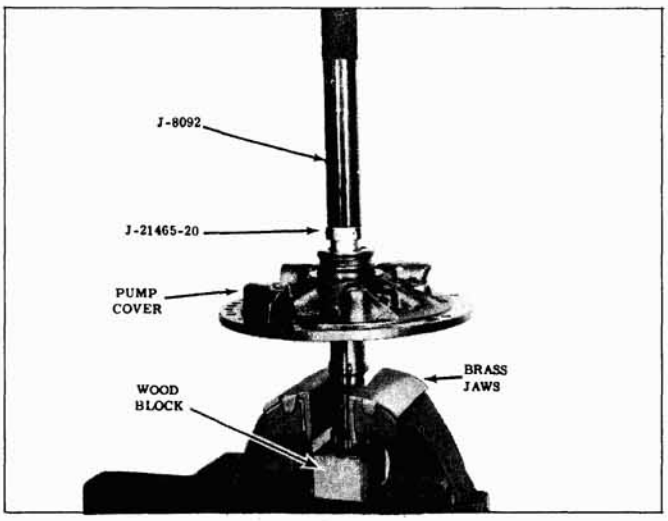


Fig. 7-291—Removing Stator Shaft Rear Bushing

Clean all shavings from stator shaft bore. Install pump cover in vise supporting shaft on wood block. Assemble Installer J-21465-20 to J-8092 Drive Handle. Install new bushing on shoulder of installer and drive bushing squarely into the bore until the installer bottoms using a lead or brass hammer as shown. Remove tools and inspect bushing.

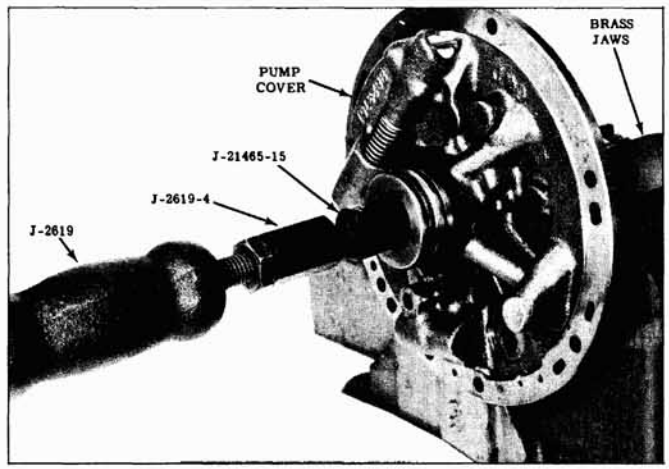


Fig. 7-292—Installing Stator Shaft Rear Bushing

TOOLS-(Fig. 7-293)

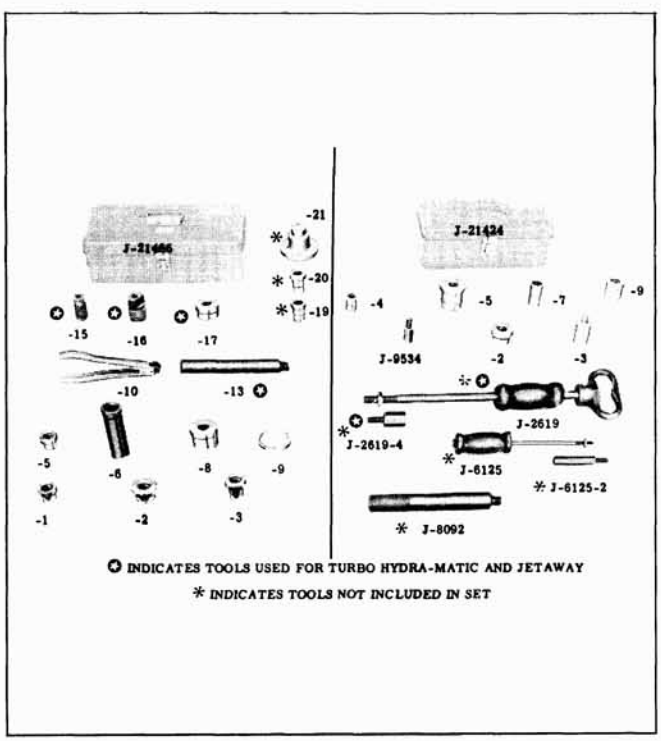


Fig. 7-293—Tools

J-21424-2	Transmission Case Bushing Installer
J-21424-3	Output Shaft Bushing Installer
J-21424-4	Sun Gear and Flange Bushing Remover and Installer
J-21424-5	Forward Clutch Drum Bushing Remover and Installer
J-21424-7	Stator Shaft Bushing Installer
J-21424-9	Extension Housing Bushing Remover and Installer
J-9534	Output Shaft Bushing Remover
J-2619	Slide Hammer (Large)
J-2619-4	Slide Hammer (Thread Reducer Adapter)
J-6125	Slide Hammer (Small)
J-6125-2	Slide Hammer (Thread Reducer Adapter)
J-8092	Driver Handle (Universal)
J-21465-1	Output Shaft Bushing Installer
J-21465-5	Sun Gear Shaft Bushing Installer
J-21465-6	Case Center Support Bushing Remover and Installer
J-21465-8	Transmission Case Bushing Remover and Installer
J-21465-9	Transmission Case Bushing Installer Adapter Ring
J-21465-10	Transmission Case and Extension Housing Bushing Staking Pliers
J-21465-13	Transmission Case Bushing Extension Handle
J-21465-15	Sun Gear Shaft and Stator Shaft Bushing Remover
J-21465-16	Output Shaft Bushing Remover
J-21465-17	Pump Body Bushing and Extension Housing Bushing Remover and Installer
J-21465-19	Stator Shaft Front Bushing Installer
J-21465-20	Stator Shaft Rear Bushing Installer
J-21465-21	Pump Cover Support

JETAWAY

USED ON L-6 AND 350 CU. IN. ENGINES NOT AVAILABLE ON 400 CU. IN. ENGINES

CONTENTS OF THIS SECTION

Subject	Page
DESCRIPTION	7-301
PERIODIC MAINTENANCE	7-302
TORQUE CONVERTER	7-304
OIL PUMP	7-304
PLANETARY GEAR SET	7-304
REVERSE CLUTCH	7-304
GOVERNOR	7-304
VALVE BODY	7-304
POWER FLOW	
NEUTRAL	7-305
LOW RANGE	7-307
DRIVE RANGE	7-308
REVERSE	7-309
HYDRAULIC CONTROLS	
OIL PUMP AND PRESSURE REGULATOR	7-310
VALVES AND THEIR FUNCTIONS	7-310
OIL CIRCUITS	
PARK OR NEUTRAL	7-314
LOW RANGE	7-316
DRIVE RANGE - BEFORE UPSHIFT	7-318
DRIVE RANGE - UPSHIFTED PART THROTTLE	7-320
DRIVE RANGE - DOWNSHIFTED (FULL THROTTLE)	7-322
REVERSE	7-324
MANUAL SHIFT LINKAGE ADJ.	7-326
SHIFT INDICATOR ADJUSTMENT	7-326
MODULATOR PIPES	7-326
ENGINE SUPPORT BAR	7-326
THROTTLE LINKAGE ADJUSTMENT	7-326
OPERATIONS NOT REQUIRING TRANSMISSION REMOVAL	7-326
TRANSMISSION	
REMOVAL	7-327
INSTALLATION	7-327
DISASSEMBLY	7-329
OIL PAN	7-329
OIL STRAINER AND PIPE	7-329
VALVE BODY	7-329
LOW SERVO	7-332
OIL PUMP	7-334
FORWARD CLUTCH	7-335
LOW BAND	7-335
SPEEDOMETER DRIVEN GEAR	7-335
REAR BEARING RETAINER	7-335
SPEEDOMETER DRIVE GEAR	7-335
GOVERNOR	7-336
VACUUM MODULATOR	7-336
PLANETARY GEAR SET	7-337
REVERSE CLUTCH	7-337
SELECTOR LEVER	7-339
REPAIR OF UNITS	7-340
SHIFT LEVER OIL SEAL	7-340
CASE BUSHING	7-340
VALVE BODY	7-340
LOW SERVO	7-342
OIL PUMP	7-342
FORWARD CLUTCH	7-346
SPEEDOMETER DRIVEN GEAR	7-349
GOVERNOR DRIVEN GEAR	7-349
PLANET CARRIER	7-350
REVERSE CLUTCH PISTON SEALS	7-355
TRANSMISSION ASSEMBLY	
SELECTOR LEVER	7-355
REVERSE CLUTCH	7-356
PLANETARY GEAR SET	7-357
LOW SERVO	7-357
LOW BAND	7-358
FORWARD CLUTCH	7-360
OIL PUMP	7-361
LOW BAND ADJUSTMENT	7-363
SPEEDOMETER DRIVE GEAR	7-363
REAR BEARING RETAINER	7-363
SPEEDOMETER DRIVEN GEAR	7-365
VALVE BODY	7-365
GOVERNOR	7-367
VACUUM MODULATOR	7-367
VACUUM MODULATOR DIAGNOSIS	7-367
CHECKING CONVERTER	7-369
DIAGNOSIS	7-369
EXTERNAL OIL LEAKS	7-369
DIAGNOSIS CHART	7-370
OIL PRESSURE CHART	7-374
TORQUE CHART	7-374
MODEL DESIGNATION AND PARTS IDENTIFICATION CHART	7-375
TOOLS	7-376
BUSHING SERVICE	7-377

DESCRIPTION

Three Jetaway transmission models are used, models LC, MM and MT. The model LC is used only with the L-6 engine and models MM and MT are used with the 350 cu. in. engine. The model MT is used only in the 5400 Series. The model MT transmission differs from the other two models in that a part throttle downshift is provided below 32 mph. A full throttle detent downshift can be obtained between 15-60 mph.

The Jetaway transmission is a combination torque converter, two-speed planetary geared transmission. Torque multiplication is obtained hydraulically through the converter, and mechanically through a compound planetary gear set. The gear set, in combination with the torque converter, provides a high starting ratio for acceleration from a stop, up steep grades, etc. The torque converter provides torque multiplication for performance and exceptionally smooth operation. It functions as a fluid coupling at normal road load

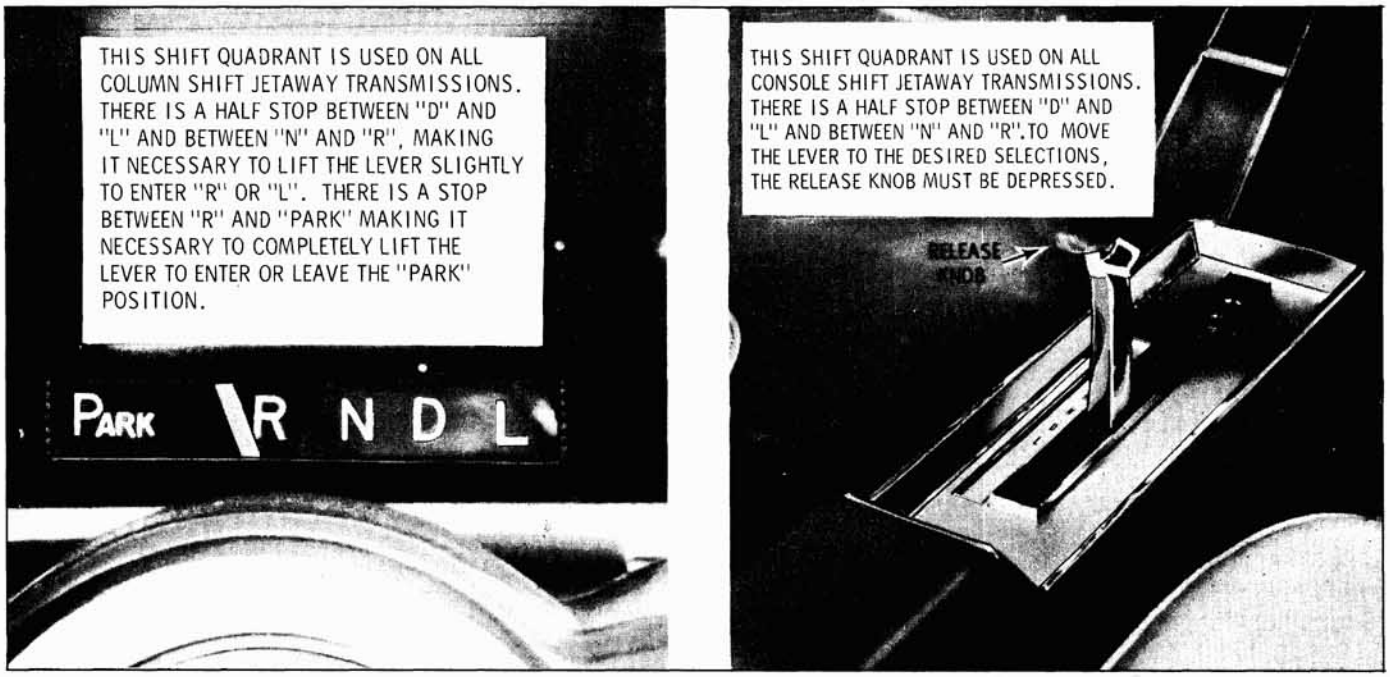


Fig. 7-301—Shift Quadrant

conditions and at higher speeds. Description of transmission is divided into six basic sections: (1) Torque Converter, (2) Oil Pump, (3) Planetary Gear Set and Controls, (4) Reverse Clutch, (5) Governor, (6) Valve Body.

PERIODIC MAINTENANCE

Change transmission fluid, wash strainer and adjust band every 24 months or 24,000 miles, whichever occurs first. Under heavy duty operating conditions or extensive stop and go driving, replace fluid, wash strainer and adjust band at 12,000 mile intervals.

Use only automatic transmission fluids identified with the mark "Dexron."

DEXRON type automatic transmission fluid is also preferred for use in all pre 1968 model GM automatic transmissions. Type A, Suffix A fluids identified by the mark "AQ-ATF" and a number followed by the suffix letter A (AQ-ATF-XXXXA) continue to be satisfactory for use in pre 1968 GM automatic transmissions.

Checking and Adding Fluid (Transmission at Operating Temperature)

The automatic transmission is designed to operate at the full mark on the dip stick at normal operating temperature (170°F.) and should be checked under these conditions. The normal operating temperature is obtained only after at least 15 miles of highway type driving or the equivalent of city driving.

To determine proper level, proceed as follows:

1. Apply parking brake.
2. With the selector lever in the PARK position and car wheels blocked, start engine. DO NOT RACE ENGINE. Move selector lever through each range.
3. Immediately check fluid with the selector lever in PARK, engine running at SLOW IDLE and the car on LEVEL surface. The fluid level on the dip stick should be at the "FULL" mark.
4. If additional fluid is required, add sufficient fluid to bring it to the "FULL" mark on the dip stick.

Checking and Adding Fluid (Transmission at Room Temperature)

If the car has not been driven sufficiently to bring the transmission to operating temperature and it becomes necessary to check the fluid level, the transmission may be checked at room temperature (80°F.) as follows:

1. With parking brake applied and car wheels blocked, selector lever in PARK position, start engine. DO NOT RACE ENGINE. Move selector lever through each range.
2. Immediately check fluid level with selector lever in PARK, engine running at SLOW IDLE and vehicle on a LEVEL surface. The fluid level on the dip stick should be 1" below the "FULL" mark.

If transmission fluid level is correctly established at 80°F., it will appear at the "FULL" mark on the dip stick when the transmission reaches normal operating temperature (170°F.). The fluid level is set below the "FULL" mark on the dip stick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature of 170°F.

Do not overfill as foaming and loss of fluid through the vent pipe might occur as the fluid expands. If fluid is too low, especially when cold, complete loss of drive may result which can cause transmission failure.

Checking and Adding Fluid (After Transmission Service)

If work has been performed on the transmission, add the following quantity of fluid, then check fluid as outlined in Steps 1 and 2 under CHECKING AND ADDING FLUID (Transmission at Room Temperature).

1. Pan Removal - 2 quarts
2. Overhaul - 8 quarts

A point to remember when adding fluid to the transmission is that the quantity of fluid alone is not important. The important factor is the relation of the fluid level to the "FULL" mark, dependent on temperature, on the dip stick.

The end result of the checking and adding procedure is to assure that the fluid level is at the "FULL" mark when the transmission is at operating temperature.

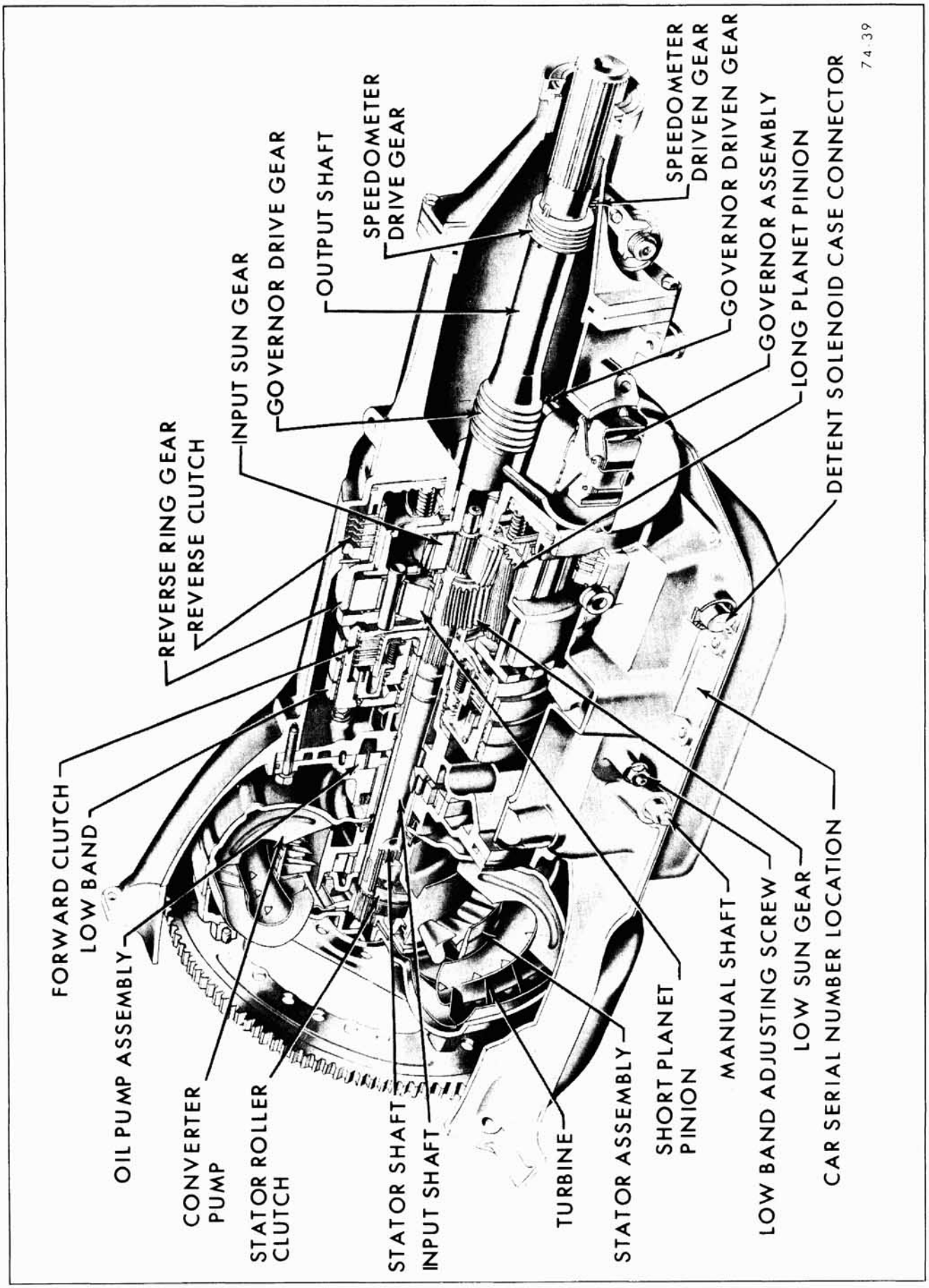


Fig. 7-302—Jetaway Transmission Assembly

TORQUE CONVERTER

The torque converter is connected to the engine flywheel and serves as a hydraulic coupling through which engine torque is transmitted to the input shaft. The torque converter steps up or multiplies engine torque whenever operating conditions demand greater torque than the engine alone can supply. The torque converter consists of three (3) basic sections: (a) Converter Pump, (b) Stator, (c) Converter Turbine.

Converter Pump (Fig. 7-302)

The function of the converter pump is to convert engine torque into an energy transmitting flow of oil to drive the converter turbine into which the oil is projected. The converter pump operates as a centrifugal pump, picking up oil at its center and discharging the oil at its rim. However, the converter is shaped to discharge the oil parallel to its axis in the form of a spinning hollow cylinder.

Fixed Stator (Fig. 7-302)

The stator is located between the converter turbine and the converter pump, and is supported by the stator shaft. The stator is equipped with an overrunning clutch assembly. When the clutch assembly is held stationary, it changes the direction of oil flow from the turbine to the proper angle for smooth entrance into the converter pump. As the turbine approaches pump speed the direction of oil flow changes until the stator no longer opposes pump rotation. The stator then free wheels so that it will not interfere with the flow of oil between the turbine and converter pump.

Converter Turbine (Fig. 7-302)

The function of the converter turbine is to absorb energy from the oil projected into it by the pump and convert the energy into torque and transmit that torque to the input shaft.

OIL PUMP (Fig. 7-302)

A positive displacement internal-external gear type oil pump is used to supply oil to fill the converter, for engagement of forward and reverse clutches, for application and release of the low band and to provide oil for lubrication and heat transfer.

PLANETARY GEAR SET

The planetary gear set consists of an input sun gear, low sun gear, short and long pinions, a reverse ring gear and a planet carrier. The input sun gear is splined to the input shaft. The low sun gear, which is part of the forward clutch assembly, may revolve freely until the low band or high clutch is applied. The input sun gear is in mesh with three (3) long pinions and the long pinions are in mesh with three (3) short pinions. The short pinions are in mesh with the low sun gear and reverse ring gear. The input sun gear and short pinions always rotate in the same direction. Application of either the low band or the reverse clutch determines whether the output shaft rotates forward or backward.

Forward Clutch (Fig. 7-302)

The forward clutch assembly consists of a drum, piston, cushion ring, springs, piston seals, and a clutch pack. These parts are retained inside the drum by the low sun gear and the flange assembly and retainer ring. When oil pressure is applied to the piston, the clutch plates are pressed together connecting the clutch drum to the input shaft through the clutch hub. Engagement of the clutch causes the low sun gear to rotate with the input shaft.

Low Band

The low band is a double-wrap steel band faced with a bonded lining which surrounds the forward clutch drum. The band is hydraulically applied by the low servo piston, and released by spring pressure.

REVERSE CLUTCH (Fig. 7-302)

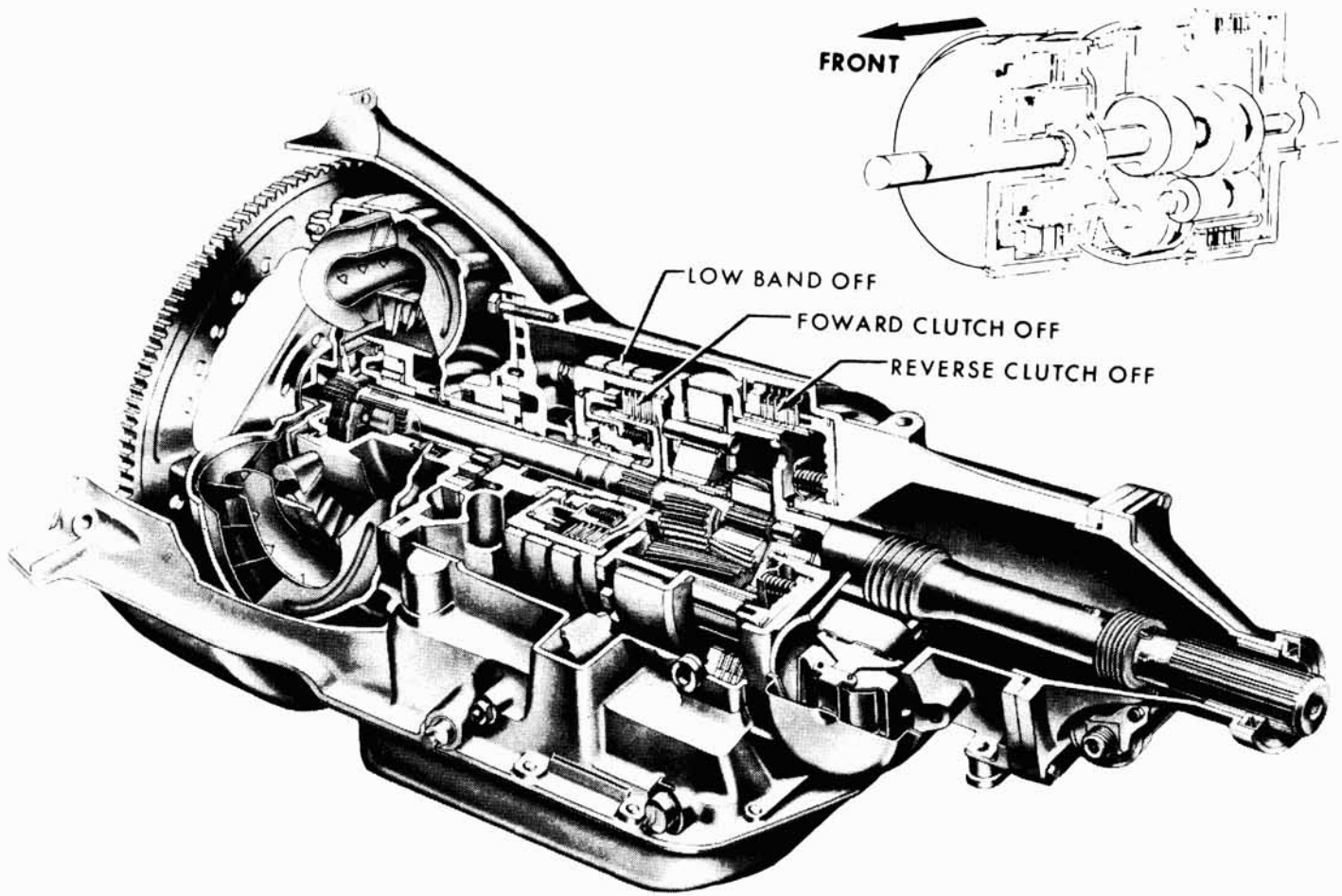
The reverse clutch assembly consists of a piston, cushion ring, inner and outer seal, coil springs, clutch pack, and reaction plate. These parts are retained inside the case by a retaining snap ring. When oil pressure is applied to the piston, the clutch plates are pressed together holding the reverse ring gear stationary. This engagement of the clutch causes reverse rotation of the output shaft.

GOVERNOR

The governor is located to the rear of the transmission case on the left side and is driven off the output shaft. The purpose of the governor is to generate a speed sensitive modulating oil pressure that increases up to a point with output shaft or car speed.

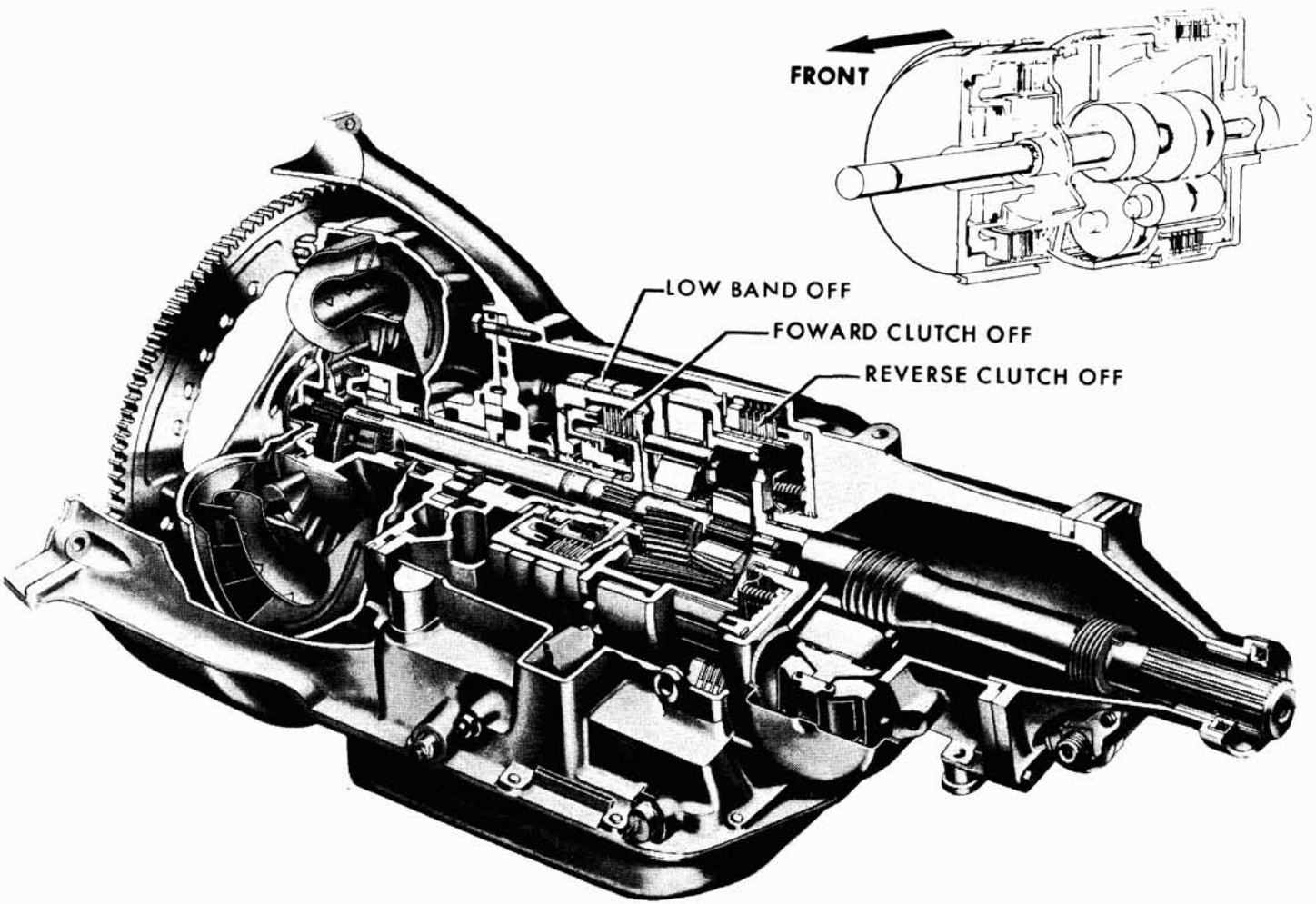
VALVE BODY

The valve body assembly is bolted to the bottom of the transmission case and is accessible for service by removing the oil pan. The valve body assembly consists of manual control valve, detent valve, shift valve, modulator limit valve, and high speed downshift timing valve.



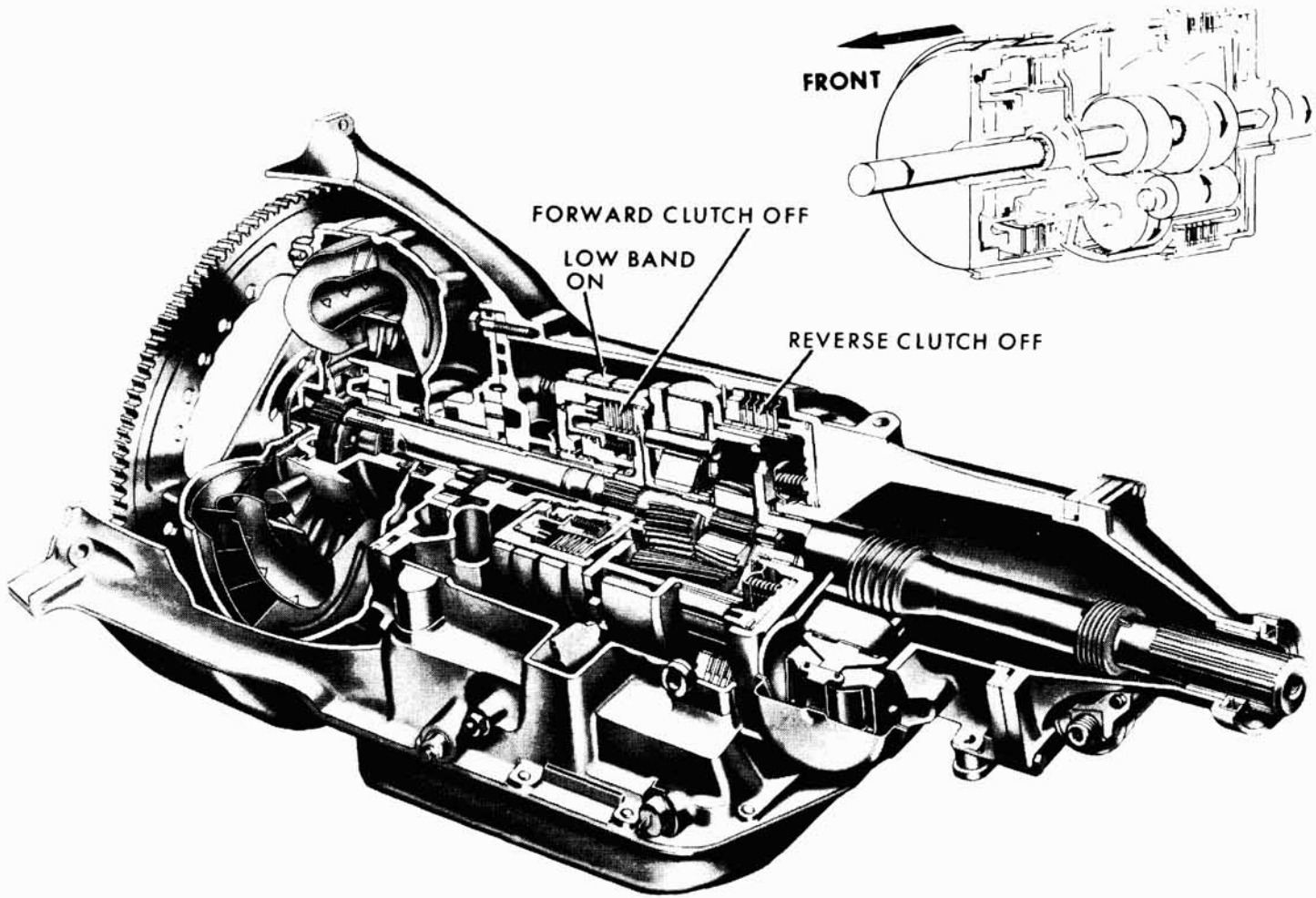
With the shift control lever in Neutral position, the output shaft remains stationary. The clutches and low band are released; therefore, there is no reaction member to provide positive drive. All gears are free to spin around their own axis, and no motion is imparted to the planet carrier.

Fig. 7-303—Operation in Neutral



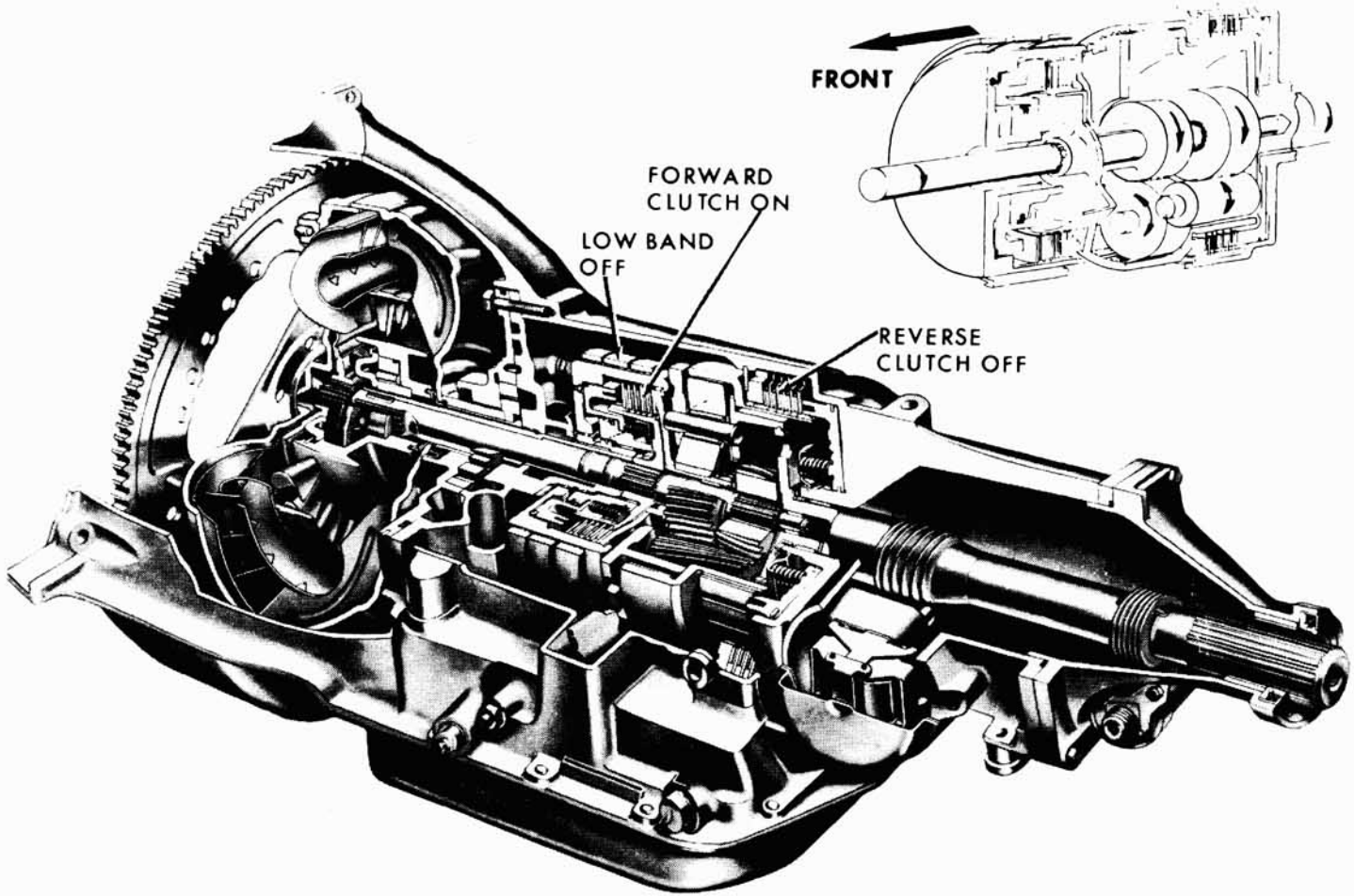
In Park Position, all reaction members are released as in Neutral. A positive gear train lock is provided when the parking pawl is engaged with the heavy teeth spaced around the front face of the planetary carrier. The linkage is actuated by direct manual action, but the parking pawl is activated by spring action. If the pawl is in line with a tooth of the planet carrier, rather than a spacer between teeth, the linkage remains in the park position with the spring holding pressure against the pawl. Slight rotation of the planet carrier will immediately seat the pawl and lock the output shaft to the case.

Fig. 7-303A—Operation in Park Position



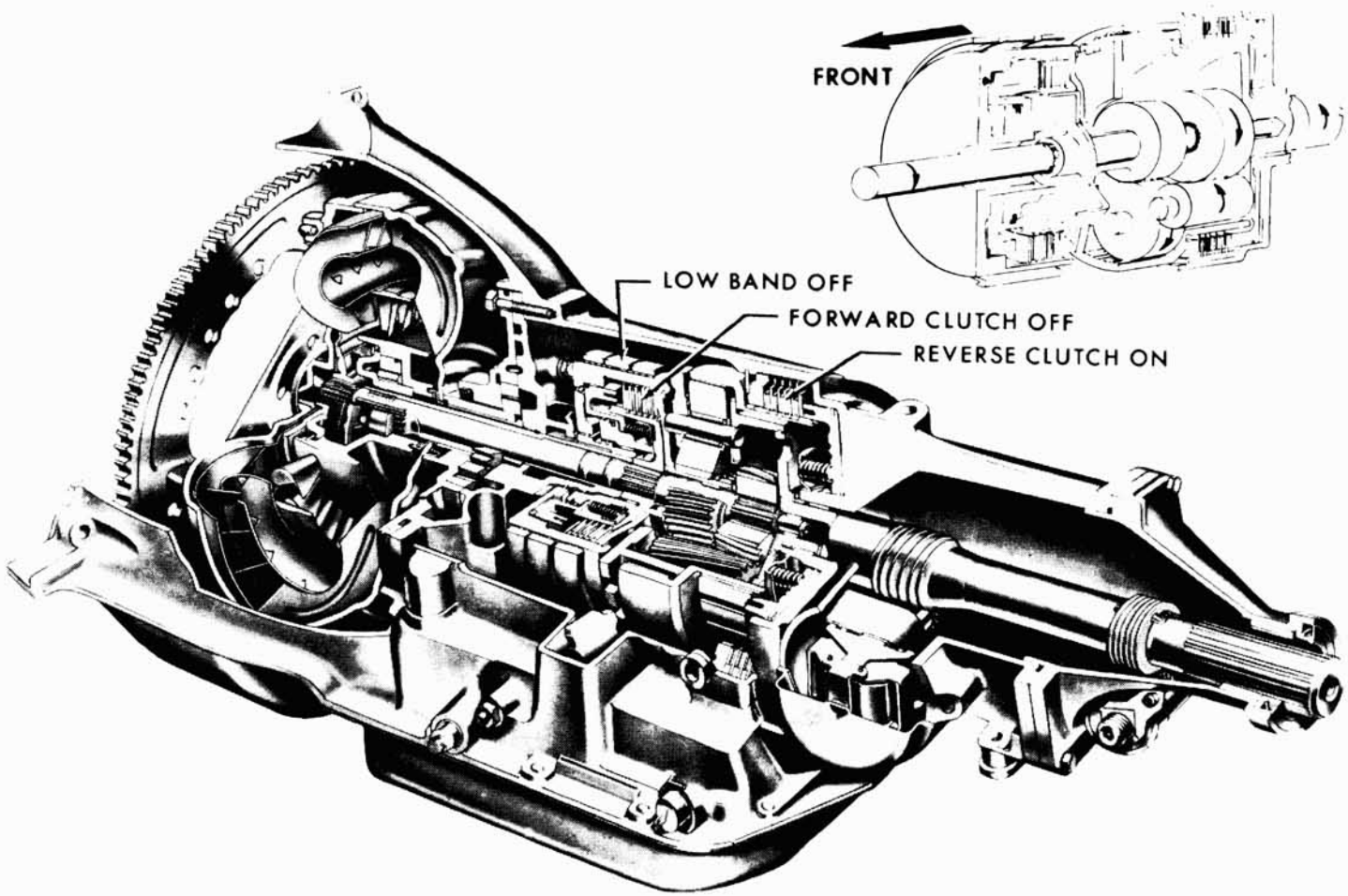
In Low range, the forward clutch is released and the low band is applied to the outside diameter of the forward clutch drum. With the low band applied, the low sun gear and flange assembly is held stationary. Drive is from the converter through the input shaft to the input sun gear in the planetary gear set. The input sun gear drives the long planet pinions which are in mesh with the short planet pinions. Since the low sun gear is held stationary with the low band applied, the short pinions walk around the low sun gear, and as they walk around the sun gear, they carry with them the planet carrier and the output shaft to which they are attached at a reduction of 1.76 to 1.

Fig. 7-304—Operation in Low Range



With the manual control lever in Drive range, the transmission is started automatically in Low range. The upshift into Drive range is dependent upon car speed and throttle opening. When the shift occurs, the low band is released and the forward clutch is applied. Application of the forward clutch locks the planetary system causing it to rotate as a unit. With the clutch applied, the clutch hub which is splined to the input shaft is locked to the low sun gear and flange assembly through the clutch plates. The low sun gear is meshed to the short pinions, the short pinions are meshed with the long pinions, and the long pinions are meshed with the input sun gear; the sun gear is also splined to the input shaft. Since both the low sun gear and input sun gear are now locked to the input shaft, the entire planetary unit will revolve at input shaft speed.

Fig. 7-305—Operation in Drive Range



When the manual control lever is in Reverse range, the forward clutch and low band are released, and the reverse clutch is applied, holding the ring gear stationary. Drive is through the input shaft and input sun gear to the long pinions and then to the short pinions. The short pinions mesh with the reverse ring gear which is held stationary by the reverse clutch. The short pinions walk around the inside of the ring gear in a reverse direction, turning the output shaft to which they are attached at a reduction of 1.76 to 1.

Fig. 7-306—Operation in Reverse

HYDRAULIC CONTROLS

OIL PUMP AND PRESSURE REGULATOR

A positive displacement internal-external gear-type oil pump is used to supply oil to fill the converter, engage the forward and reverse clutches, apply and release the low band, and furnish oil for lubrication and heat transfer.

The pressure regulator valve, located in the pump cover, is used as the basic control of hydraulic pressure within the transmission.

First Stage Regulation (Fig. 7-307)

When the engine is idling or has just been started, oil enters the main pressure regulator valve from the line passage and flows through the drilled passages in the valve to force the valve to the left against its spring to uncover the port which directs oil to the converter, oil cooler and transmission lubrication system.

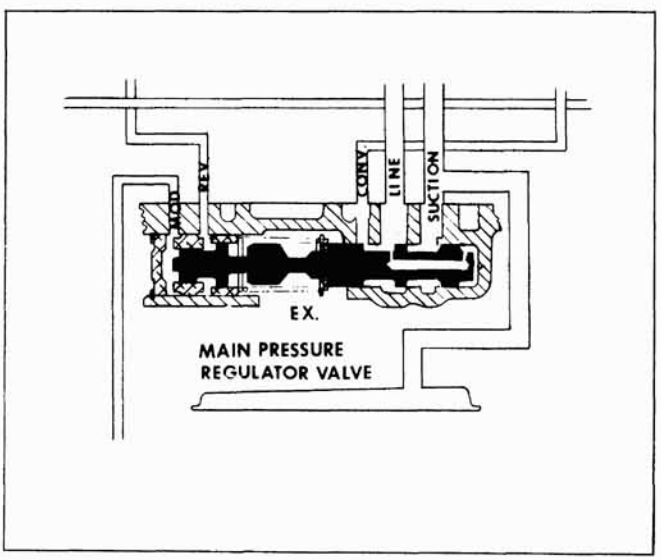


Fig. 7-307—First Stage Regulation

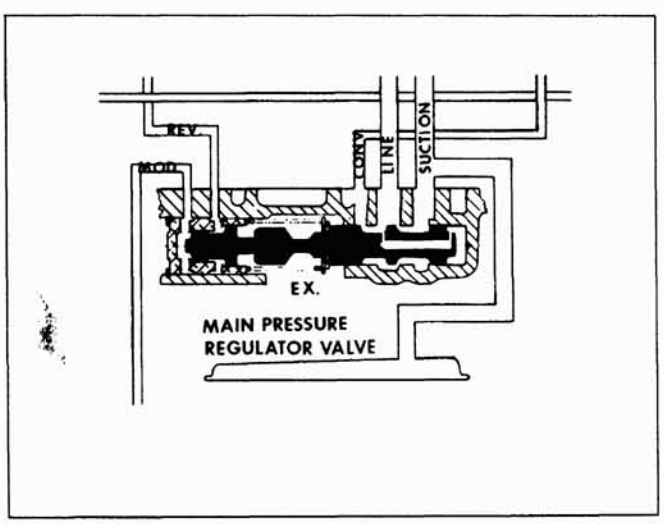


Fig. 7-308—Second Stage Regulation

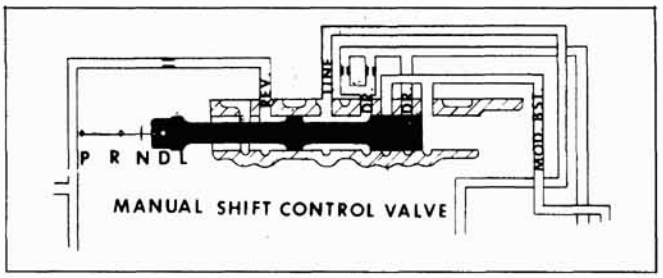


Fig. 7-309—Manual Shaft Control Valve

Second Stage Regulation (Fig. 7-308)

As higher engine speeds are attained, the volume of oil leaving the pump increases until the valve moves to the position shown, which opens a port to allow main line oil to escape to the suction side of the pump to regulate pressure. Second stage regulation occurs when pump capacity exceeds line requirements.

Boost Valve

A boost valve at the spring end of the pressure regulator valve functions to raise line pressure, when necessary, by adding hydraulic pressure to the spring pressure on the main pressure regulator valve.

Modulator Boost

With the manual shift control valve in "D" range, oil under pressure varied by operating conditions (load, car speed, grade, etc.) is directed through the modulator passage to assist the spring to force the valve to the right. Oil under pressure in this space has the same effect as increasing the spring pressure against the pressure regulator valve; that is, it increases main line oil pressure.

Reverse Boost

With the manual shift control valve positioned in "R" range, oil under pressure is directed through the reverse passage and acts on the boost valve. The boost valve acts on the spring end of the pressure regulator valve adding to the spring pressure of the valve, thus increasing main line oil pressure for operation in reverse range.

VALVES AND THEIR FUNCTIONS

MANUAL SHIFT CONTROL VALVE (Fig. 7-309)

The manual shift control valve in the valve body directs oil to the controlling devices that govern operation in "D", "L" (Mod. Bst.) and "R". In "N" and "P" ranges, the manual shift control valve cuts off oil pressure to the low servo and forward clutch ("D" passage). The manual shift control valve is connected by mechanical linkage to the manual control lever.

SHIFT VALVE AND SHIFT CONTROL VALVE (Fig. 7-310 and 7-311)

The shift valve and shift control valve are in the same bore in the main valve body. They react to oil pressure from the governor valve and vacuum modulator valve to make the shift from reduction to direct drive or from direct drive to reduction.

Upshift From Reduction to Direct Drive (Fig. 7-312)

Before the upshift occurs, the shift valve and shift control valve are positioned as shown. (Figs. 7-310 and 7-311) The shift control valve is held against the end of its bore by spring

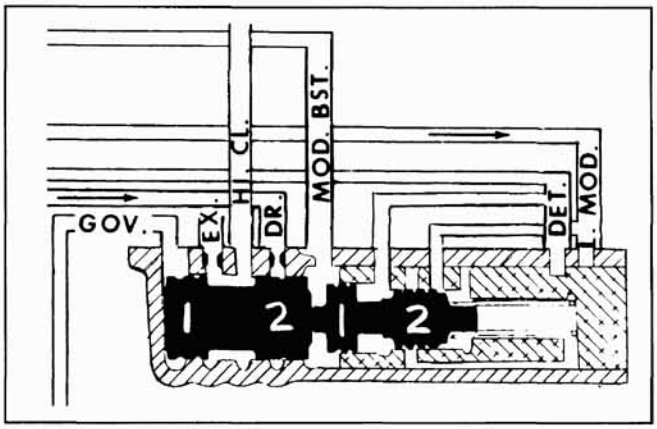


Fig. 7-310—Shift Valve and Shift Control Valve (Models LC and MM)

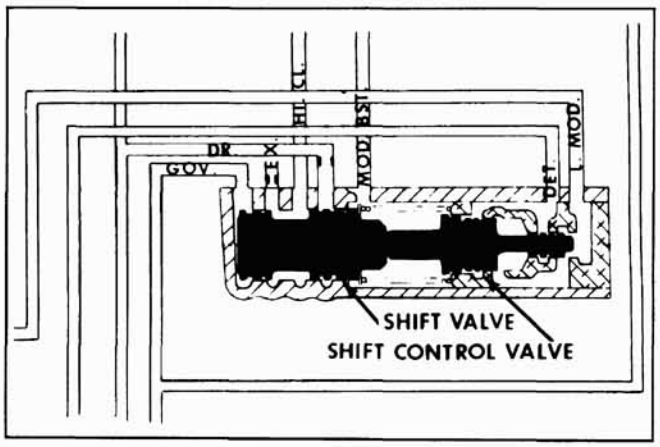


Fig. 7-311—Shift Valve and Shift Control Valve (Model MT Only)

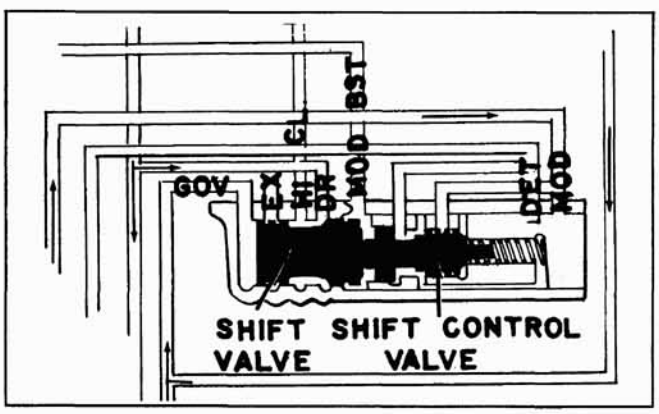


Fig. 7-312—Upshifted (Model LC and MM)

force and L. Mod. pressure. With the shift valve in this position, the high clutch piston and spring side of the low servo piston are open to exhaust. The high clutch is released and the low band is applied; the transmission is in reduction.

When the proper relationship between car speed and throttle opening exists, governor oil pressure on the shift control valve will overcome spring force and limited modulator oil pressure and move both valves to the right as shown in Fig. 7-312.

With the valves thus positioned, oil under pressure is directed to the forward clutch piston and the spring side of the low servo piston to apply the clutch and release the band.

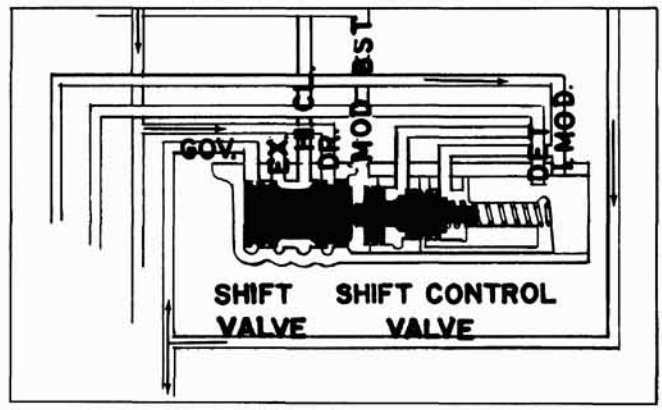


Fig. 7-313—Manual Low Range (Model LC and MM)

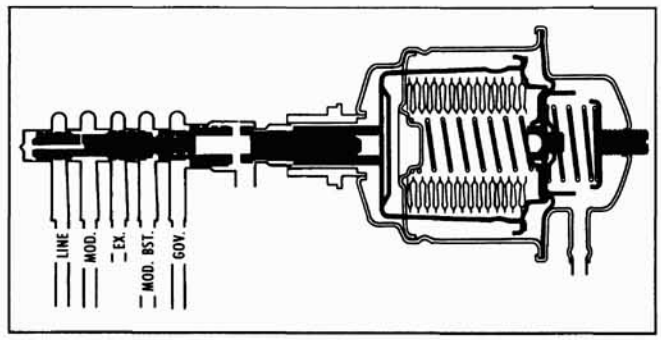


Fig. 7-314—Vacuum Modulator and Valve

Downshift From Drive to Reduction
Model LC and MM

When the shift valve spring against the right end of the shift control valve overcomes governor valve pressure against the left end of the shift valve, both valves move to the left and the transmission is downshifted by cutting off oil pressure to the forward clutch and spring side of the low servo piston. (Fig. 7-310)

Model MT

The operation is identical to the model LC and MM except that limited modulator pressure works in addition to the shift valve spring to provide a part throttle downshift. (Fig. 7-311)

Low Range
(Fig. 7-313)

With the manual shift control valve positioned in "L" range, Mod. Bst. pressure is directed to the space between the shift valve and the shift control valve. This pressure adds to the shift valve spring force and keeps the shift valve to the left. With the shift valve in this position, an upshift will not occur.

VACUUM MODULATOR AND VALVE

(Fig. 7-314)

The vacuum modulator and valve assembly is a device to translate load (engine manifold vacuum), barometric pressure (altitude) and speed (governor valve oil pressure) into modulated oil pressures to regulate main line oil pressure to an efficient value.

Main line oil enters the valve through the drilled ports and is directed to the left end of the valve. This oil, when it reaches sufficient pressure, moves the valve against its spring to regulate the exhausting of modulator oil.

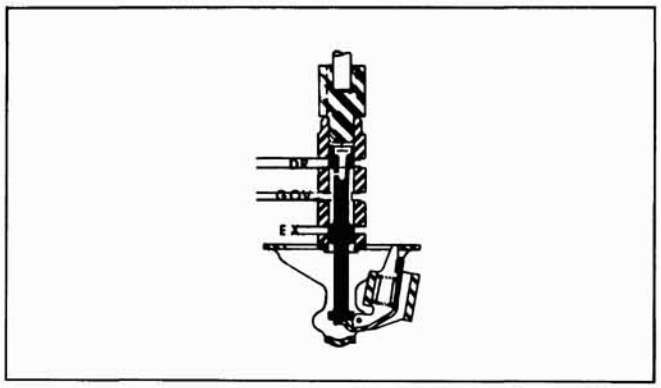


Fig. 7-315—Governor Valve

Manifold Vacuum Effect

The modulator valve spring is housed in a sealed container in such a way that engine manifold vacuum may act upon it to reduce the force of the spring against the valve and thus affect modulator oil pressure. Conditions of load or grade that lowers manifold vacuum increases modulator oil pressure, while high manifold vacuum decreases modulator oil pressure.

Altitude or Barometric Pressure Effect

If the car is operated at high altitudes where barometric pressure is reduced, the aneroid device in the vacuum modulator housing expands and acts against the valve spring to reduce modulator oil pressure in proportion to the barometric pressure.

At high altitudes, engine output is reduced. Comparable reduction in transmission main line oil pressure is necessary to accomplish smooth shifts under these conditions.

Governor

As car speed increases, governor valve oil pressure increases (up to the limit of the valve). Governor pressure acting on the vacuum modulator valve has the effect of reducing the spring force against the valve, thereby reducing modulator oil pressure as governor pressure (car speed) increases.

Modulator Boost Effect

With the manual shift control valve positioned in "L" range, main line pressure separates the two pieces of the modulator valve and tends to move the valve to the bottom of its bore. Thus, modulator oil under pressure is directed to the main line pressure regulator valve to provide an increase in main line oil pressure in low range, regardless of engine vacuum. If driving conditions result in low engine vacuum however, the vacuum modulator valve spring will move the two sections of the valve back together. Then both the valve spring and the pressure of main line oil at the line port of the valve will regulate modulator oil pressure.

GOVERNOR VALVE (Fig. 7-315)

The governor valve is a pressure regulator valve. Governor pressure is determined by car speed acting through the centrifugal force of a pair of dual weights; the inner pair of which is spring loaded.

As the car begins to move, the weight assemblies move outward to provide a regulating force against the valve through the springs between the primary and secondary weights. As car speed is further increased, regulating force against the valve is provided by the secondary weights moving outward. At approximately 20 mph, the primary weights have reached the limit of their travel and the force against the valve is then entirely through the secondary weights.

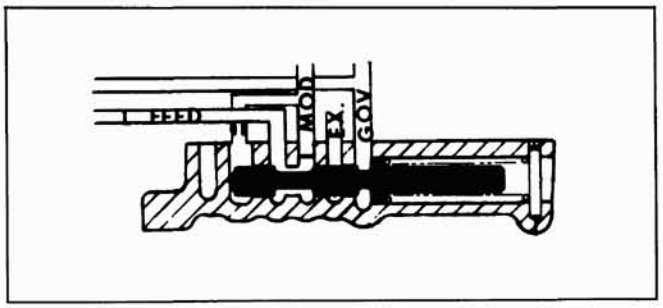


Fig. 7-316—Modulator Limit Valve (First Stage)

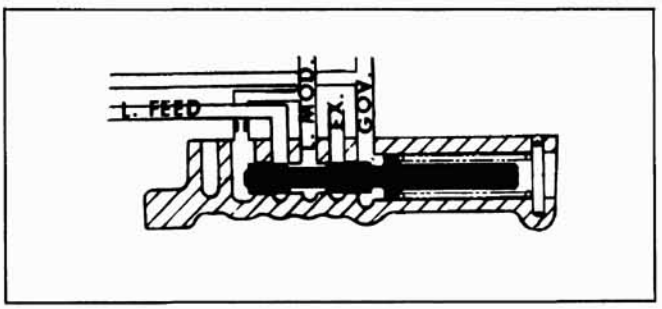


Fig. 7-317—Modulator Limit Valve (Second Stage)

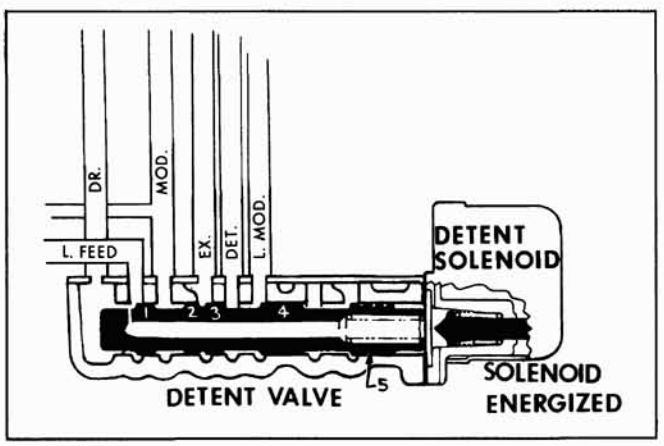


Fig. 7-318—Solenoid Energized

Thus, governor pressure is determined at very low speeds by the primary and secondary weights and at higher speeds by the secondary weights plus the force of the springs between the weights. In this manner, governor pressure is increased rapidly but smoothly from very low speeds to approximately 20 mph, where it levels off.

Regulated oil from the governor valve is channeled to the shift valve, vacuum modulator valve, modulator limit valve and high speed downshift timing valve.

MODULATOR LIMIT VALVE (Fig. 7-316)

The modulator limit valve is a pressure regulator valve that regulates the point at which a wide open throttle upshift will occur.

The valve regulates limited feed oil (main line pressure) to provide diminishing oil pressure acting at the L. Mod. port and on the shift control valve as car speed is increased. This decrease in oil pressure is accomplished by governor valve pressure directed through the governor port and on the valve to oppose spring force as car speed (governor pressure) increases. See Figs. 7-316 and 7-317.

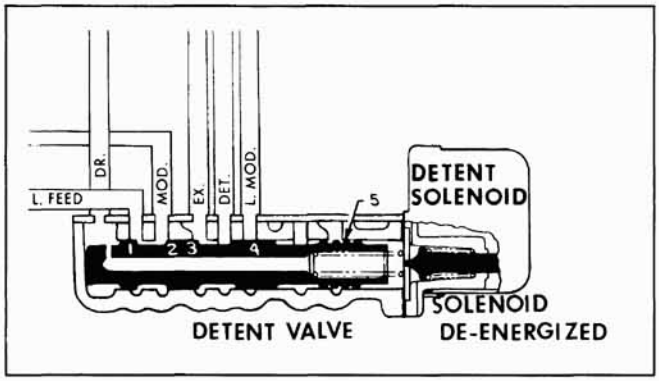


Fig. 7-319—Solenoid De-Energized

The modulator limit valve is in operation only before the upshift during wide open throttle operation with the manual shift control valve in "D" position.

DETENT VALVE (Fig. 7-319)

The detent valve is a solenoid operated two-position valve that provides a downshift at wide open throttle, if car speed is low enough.

Electrical contacts on the throttle linkage energize the detent solenoid as wide open throttle is reached. Energizing the solenoid retracts its plunger and allows oil from the center of the valve to flow to exhaust. Main line oil pressure at the drive port and left end of the valve moves the valve against its spring as shown. (Fig. 7-318)

With the valve in this position, ports are opened to direct oil at drive line pressure to the modulator limit valve and limited modulator oil to flow to the detent port of the shift control valve. When the solenoid is de-energized, the spring loaded plunger seals the port in the valve center. Oil at main line pressure then occupies the center of the valve and acts against the right end of the valve as well as the left end. The detent valve spring then moves the valve to the position shown, closing off the detent and limited modulator ports. (Fig. 7-319)

HIGH SPEED DOWNSHIFT TIMING VALVE (Fig. 7-320)

The high speed downshift timing valve is a spring loaded valve located in the valve body. The new valve meters the rate of oil flow to the low servo through the whole speed range by use of three orifices.

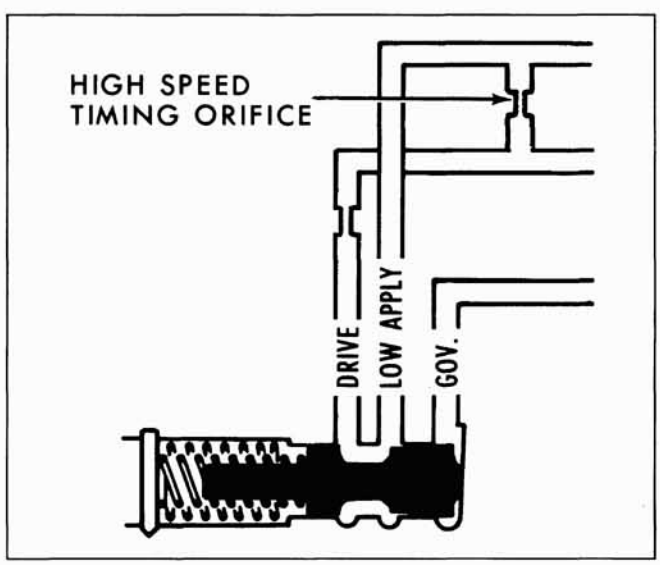


Fig. 7-320—High Speed Downshift Timing Valve

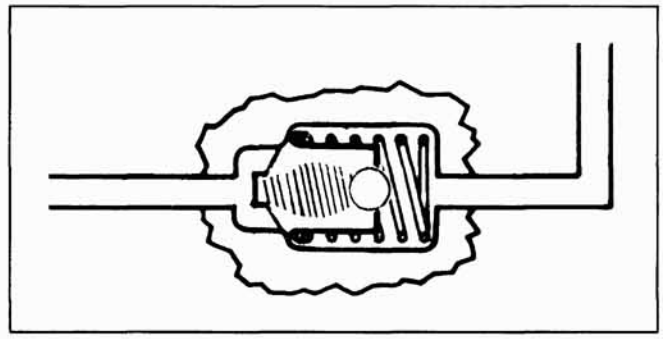


Fig. 7-321—Coast Downshift Timing Valve (Model MM and MT Only)

At lower car speeds, governor pressure is not sufficient to overcome the high speed downshift valve springs. Oil is then allowed to flow unrestricted by the valve to the orifice at the low servo. (Fig. 7-320)

As car speed increases governor pressure on the end of the valve increases to overcome the force of one spring. The valve will then begin to move to the left. With the valve in this position oil has to flow simultaneously around the flats on the number 1 land of the valve (which acts as an orifice) and through the high speed timing orifice before flowing through the orifice at the low servo to apply the low band.

At higher car speeds governor pressure on the end of the valve increases to overcome force of two (2) springs. The valve will then move over to the retaining pin. This prohibits oil from passing through the valve and allows it to pass through the high speed timing orifice only before flowing through the orifice at the low servo to apply the low band.

COAST DOWNSHIFT TIMING VALVE (Fig. 7-321) (MODEL MM and MT ONLY)

As the car is decelerating with closed throttle or very light throttle (such as when approaching a stop) governor pressure diminishes to a point where spring pressure moves the shift valve to the downshift position. When this occurs, oil is exhausted from the band release chamber of the low servo through the coast downshift timing valve.

A rush of oil through the valve moves the ball retainer and ball against light spring pressure off its seat, oil may then escape around the ball retainer and spring. This action cushions the initial engagement of the low band.

CONVERTER BLOW OFF VALVE (FIG. 7-321A)

The converter blow off valve is located in the pump cover and stator shaft assembly. The valve consists of a relief ball, spring, and retaining pin. When converter pressure reaches 150 psi the relief ball opens a port and exhausts converter pressure. Therefore, converter pressure is never allowed to go above 150 psi.

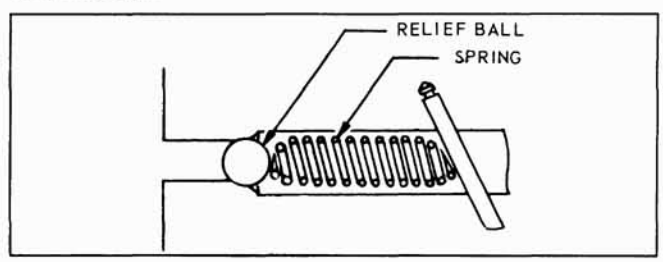


Fig. 7-321A—Converter Blow-Off Valve

74-7 HYDRAULIC OPERATION

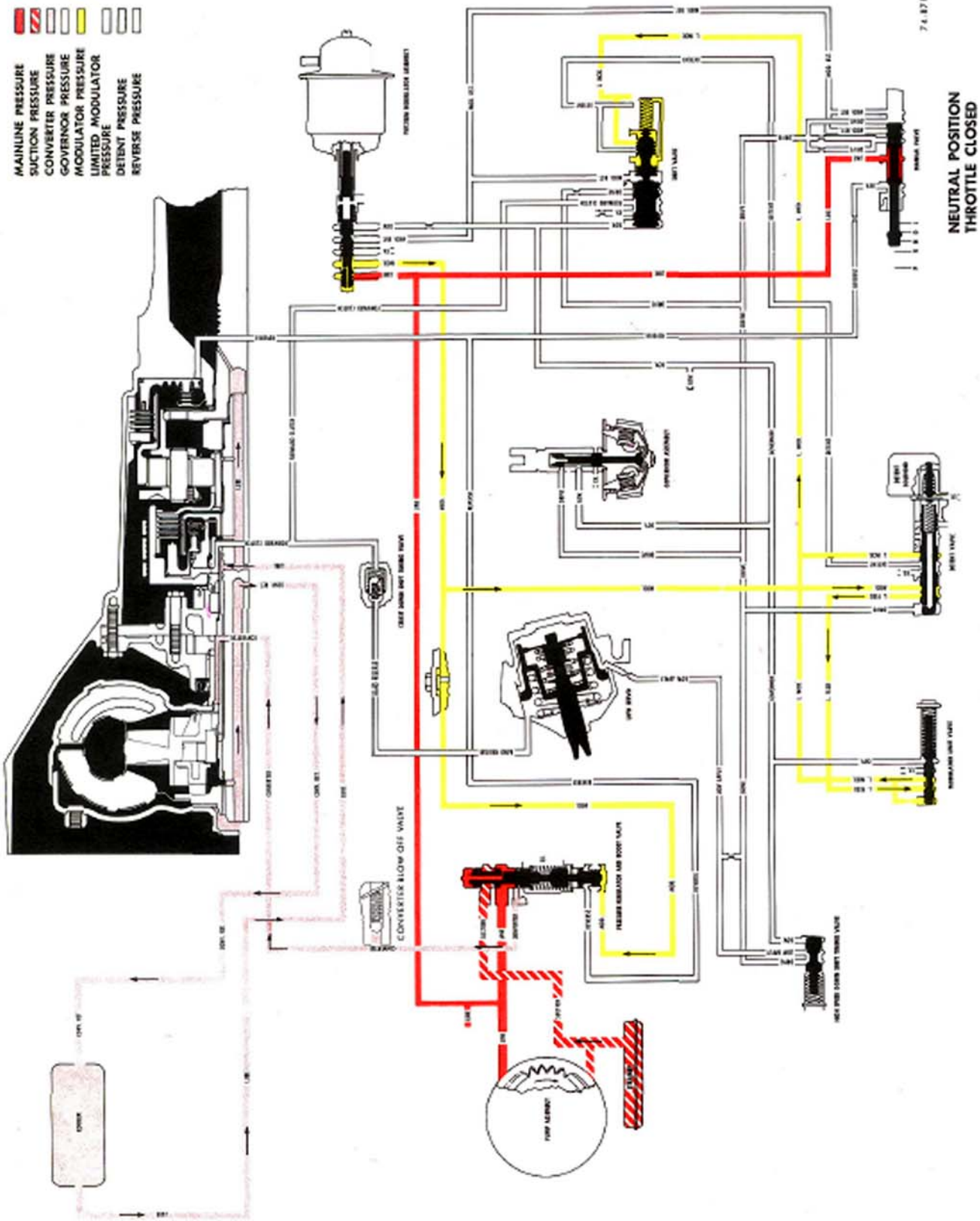


Fig. 7-322—Park or Neutral (Throttle Closed)

OPERATION OF HYDRAULIC CONTROLS IN PARK OR NEUTRAL (CLOSED THROTTLE)

REVERSE CLUTCH—OFF **BAND—OFF** **FORWARD CLUTCH—OFF**

When the engine is started, the oil pump directs pressure to the hydraulic control system, converter, cooler and lubrication system. The converter remains pressurized in all ranges and speeds.

During operation in neutral, the manual shift control valve is positioned as shown. Main line oil is directed to the manual shift control valve and to the vacuum modulator valve.

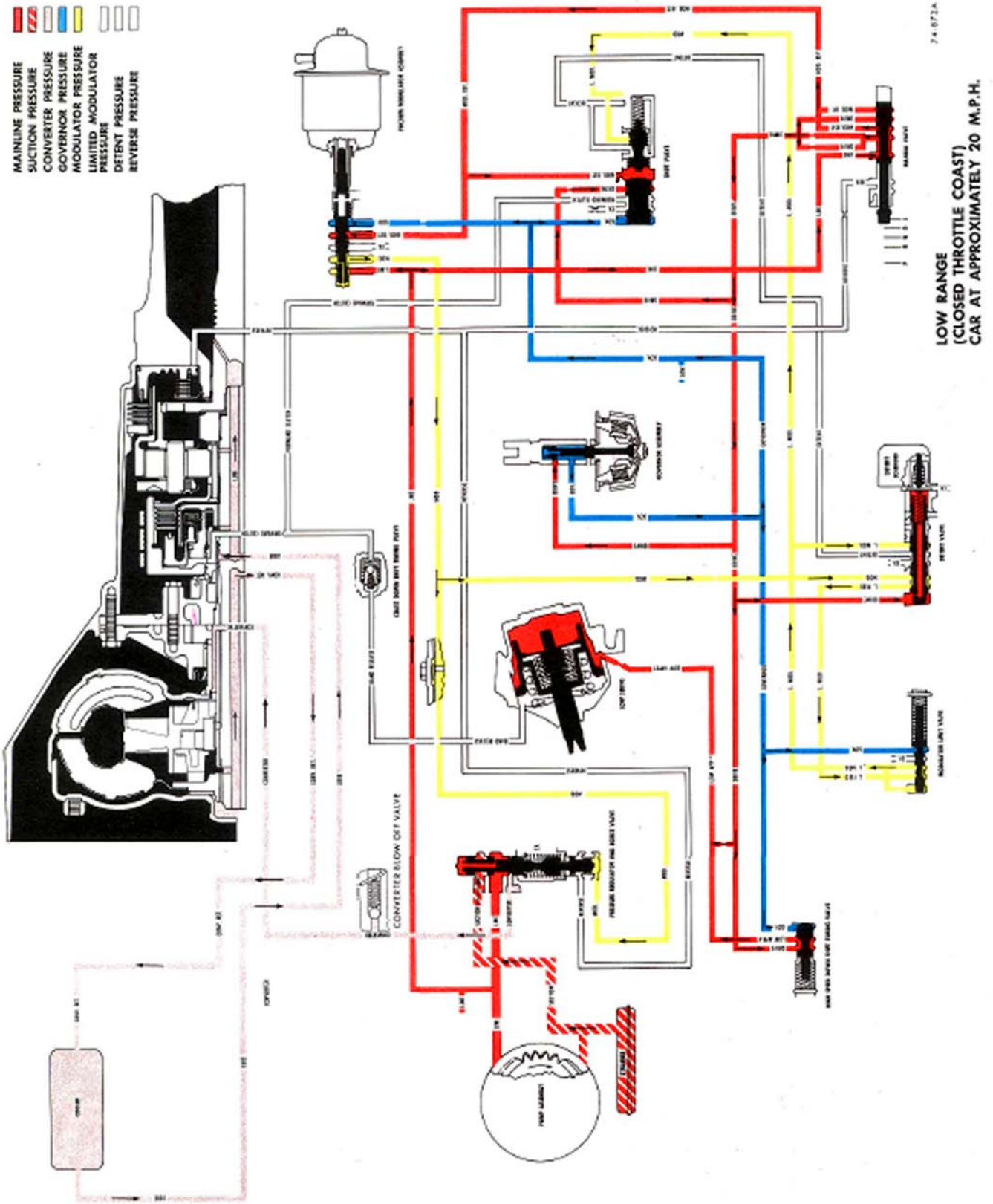


Fig. 7-323—Low Range - Reduction

OPERATION OF HYDRAULIC CONTROLS IN LOW RANGE— (CLOSED THROTTLE COAST)

FORWARD CLUTCH—OFF

LO RANGE

During operation in low range, the manual shift control valve is positioned as shown. During closed throttle in low range, main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is directed into the drive oil passage and modulator boost passage. Oil in the drive oil passage is directed to the governor valve, shift valve, detent valve, high speed downshift timing valve and low servo piston. Oil in the modulator boost passage is directed to the shift valve and vacuum modulator valve.

Modulator boost oil separates the two pieces of the modulator valve and tends to move the valve to the bottom of its bore independent of the vacuum modulator spring. Modulator oil under pressure is directed to the main line pressure regulator valve to provide an increase in main line oil pressure in low range, regardless of engine vacuum.

Modulator boost oil enters the shift valve between the shift valve and the shift control valve, moving the shift valve to the left and holding it in the bottom of its bore, thus exhausting the forward clutch. Drive oil directed from the manual shift control valve will apply the low servo.

BAND—APPLIED

DRIVE RANGE

During operation in drive range reduction the manual shift control valve is positioned to the left to block the modulator boost passage, with the passage blocked the shift valve and shift control valve will be positioned against the shift valve allowing governor pressure to upshift the valve.

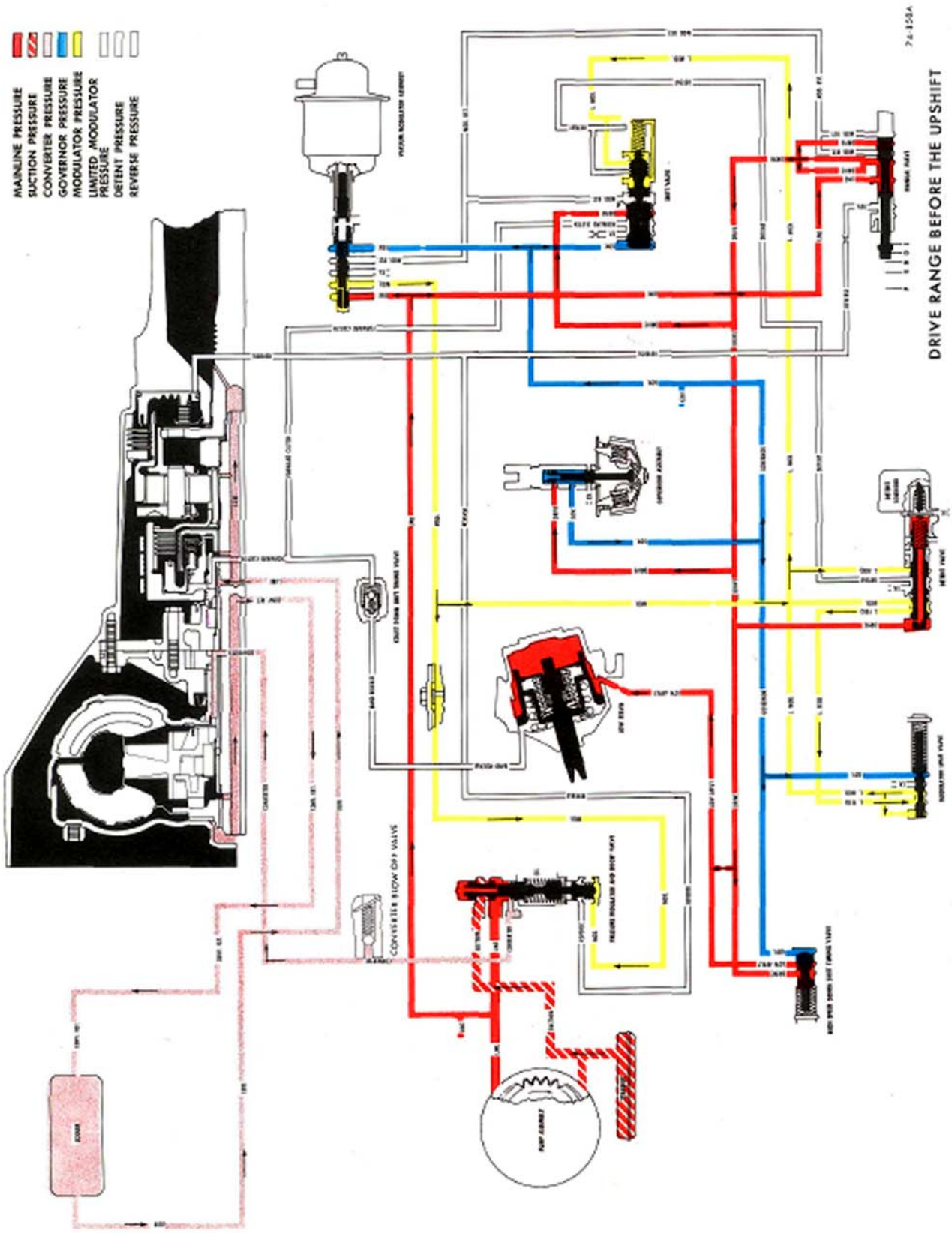


Fig. 7-323A—Drive Range - Before the Upshift (Exc. Model MT)

OPERATION OF CONTROLS DRIVE RANGE—BEFORE UPSHIFT (EXC. MODEL MT)

LOW BAND—OFF **FORWARD CLUTCH—ON** **REVERSE CLUTCH—OFF**

During operation in Drive range the manual shift control valve is positioned as shown. During an acceleration, main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is routed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed downshift timing valve and the low servo applying the low band.

Main line oil being directed to the modulator valve enters between the first and second lands. At low engine vacuum the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position oil is delivered through a drilled passage in the valve to the space between the first land of the valve and the valve body. Oil under pressure in this area plus governor pressure on the second land of the second modulator valve tends to move the valve against the force of its spring to regulate modulator oil pressure leaving the valve.

Modulator oil leaves the modulator valve and is routed to the boost valve, detent valve, modulator limit valve, and to the shift control valve. Modulator pressure applies a force to the space between the first land of the boost valve and the oil pump body causing it to move to the right. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in higher main line pressure.

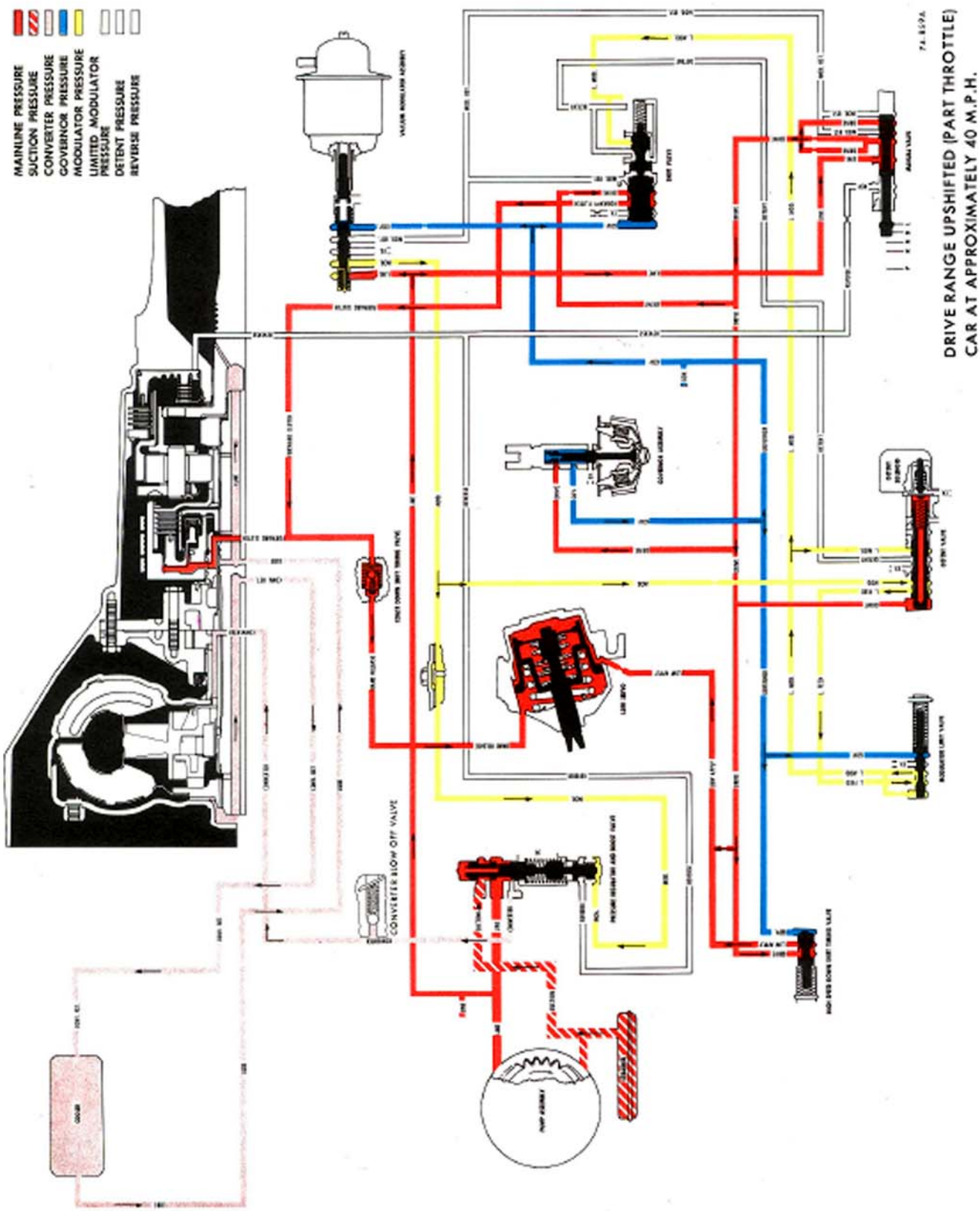


Fig. 7-324—Drive Range - Upshifted (Part Throttle)

OPERATION OF HYDRAULIC CONTROLS IN DRIVE RANGE—UPSHIFTED (PART THROTTLE)

FORWARD CLUTCH—APPLIED **REVERSE CLUTCH—OFF** **BAND—OFF**

During operation in drive range, the manual shift control valve is positioned as shown. During part throttle acceleration, main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is directed into the drive oil passage and then to the governor valve, shift valve, detent valve, high speed downshift timing valve and low servo piston.

Main line oil directed to the modulator valve enters between the lands. At low engine vacuum, the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position, oil is delivered through a drilled passage in the valve to the space between the end of the valve and the valve body. Oil under pressure in this area, plus governor pressure on the land of the modulator valve, tends to move the valve against the force of the vacuum modulator spring to regulate modulator oil pressure. Modulator oil leaves the modulator valve and is directed to the boost valve, detent valve, modulator limit valve and to the shift control valve. Modulator pressure directed to the boost valve moves it to the right. As the boost valve moves to the right, it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in higher main line pressure. Also, modulator pressure is directed through the detent valve and modulator limit valve to apply force to the shift control valve to oppose governor pressure on the other end of the valve.

When sufficient car speed has been obtained, governor pressure is directed to the left end of the shift valve, to the vacuum modulator valve, modulator limit valve and to the high speed downshift timing valve. As governor pressure increases on the modulator valve, it will tend to move the valve against the vacuum modulator spring, reducing modulator pressure.

When governor pressure reaches a high enough value, the shift valve will move to the right, allowing drive oil to apply the forward clutch and release the low band.

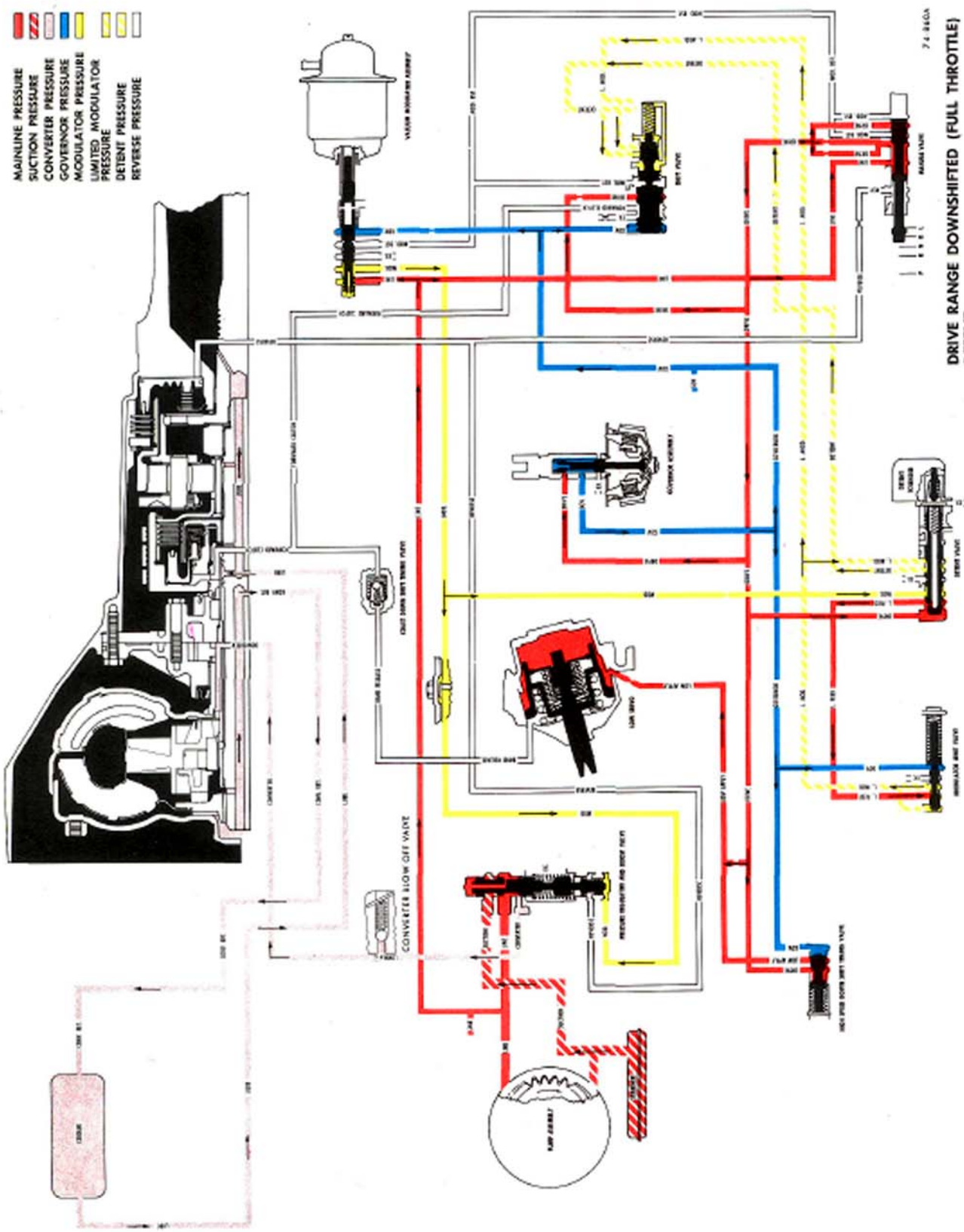


Fig. 7-325—Drive Range - Downshifted (Full Throttle) (Detent Downshift)

OPERATION OF HYDRAULIC CONTROLS IN DRIVE RANGE DOWNSHIFTED (FULL THROTTLE)—DIRECT DRIVE (DETENT DOWNSHIFT)

FORWARD CLUTCH—OFF **REVERSE CLUTCH—OFF** **BAND—APPLIED**

During operation in drive range, at full throttle through the detent, the detent valve solenoid is energized. The manual shift control valve is positioned as shown.

Energizing the detent solenoid allows oil from the center of the valve to flow to exhaust. Drive oil pressure in the area between the valve body and the end of the valve moves the valve against its spring force to the bottom of its bore.

During full throttle acceleration, main line oil is directed to the modulator valve and manual shift control valve. Main line oil through the manual shift control valve is directed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed downshift timing valve, and modulator limit valve and low servo.

Main line pressure is increased as follows: Main line oil directed to the modulator valve enters between the lands. At low engine vacuum, the vacuum modulator spring tends to keep the valve toward the bottom of its bore. In this position, oil is delivered through a drilled passage in the valve to the space between the end of the valve and the valve body. Oil pressure in this area, plus governor pressure on the land of the second modulator valve, tends to move the valve against the vacuum modulator spring to regulate oil pressure leaving the valve.

Modulator pressure applies force to the left end of the boost valve causing it to move to the right. As the boost valve moves to the right, it contacts the pressure regulator valve. This hydraulic force, combined with normal spring force on the pressure regulator valve, results in a higher main line pressure. With the detent valve solenoid energized, drive oil pressure will enter into the limited feed line. When limited modulator pressure reaches a high enough value and exerts enough force to overcome spring force on the modulator limit valve, the valve will regulate, governing the limited modulator and detent pressure to the shift control valve.

As higher governor pressure is reached, it acts on the first land of the high speed downshift timing valve until governor pressure overcomes spring force and moves the high speed downshift timing valve to the right. This movement blocks the nonrestricted line, directing the servo apply oil through the restricted orifice. On a downshift, this restriction of flow causes the band apply to be delayed slightly and is thus timed to the forward clutch release for a smooth downshift.

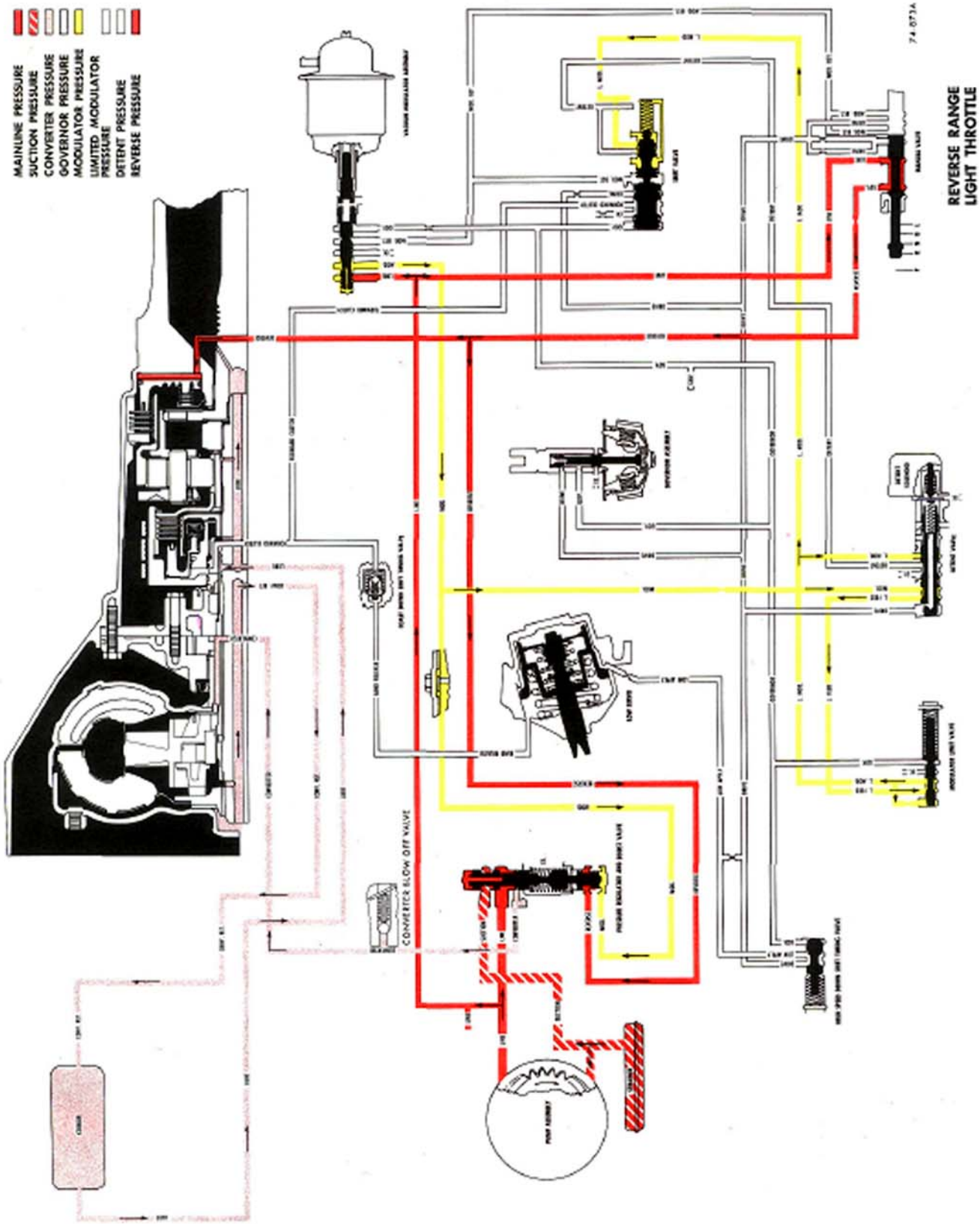


Fig. 7-326—Reverse

OPERATION OF HYDRAULIC CONTROLS IN REVERSE—(LIGHT THROTTLE)

REVERSE CLUTCH—APPLIED **BAND—OFF** **REVERSE CLUTCH—OFF**

During operation in Reverse range the manual shift control valve is positioned as shown in Fig. 7-309. During light throttle in reverse, main line oil is directed to the manual shift control valve. Main line oil entering the manual shift control valve is directed to the reverse clutch and between the 1st and 2nd lands of the boost valve. Main line pressure applies a force to the 2nd land of the boost valve causing it to move to the right. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in a higher main line pressure needed for reverse operation. When the manual shift control valve is in reverse the forward clutch and low servo are exhausted.

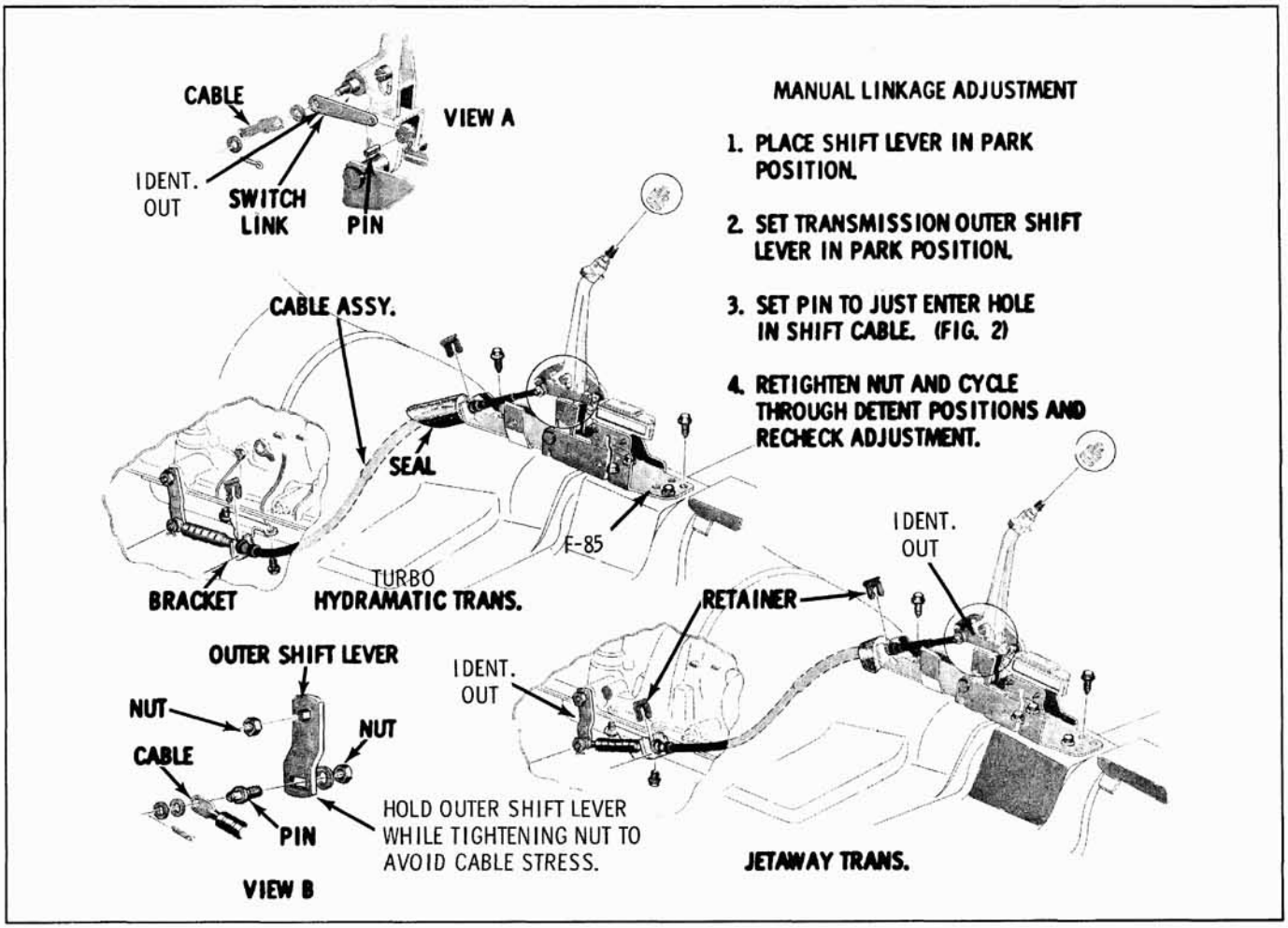


Fig. 7-327—Shift Cable (Console)

SHIFT LINKAGE (Figs. 7-327, 7-328 and 7-329)
CONSOLE

The console shift lever is connected to the transmission outer shift lever by a flexible cable assembly. To service the shift lever and its components refer to Figs. 7-327 and 7-328.

COLUMN

For column shift linkage installation and adjustment refer to Fig. 7-329.

OIL COOLER LINERS

Refer to Figure 7-330

SHIFT INDICATOR ADJUSTMENT

The shift indicator can be adjusted by removing the trim cap and snap-on cover. Loosen the set screw and adjust as necessary.

MODULATOR PIPE

Refer to Figures 7-331 and 7-332.

ENGINE SUPPORT BAR
(Fig. 7-333)

The engine support bar must be installed whenever the transmission assembly is removed from the car.

THROTTLE LINKAGE ADJUSTMENT

If improper full throttle downshift is encountered, it will be necessary to adjust the throttle linkage. Refer to CARBURETOR ADJUSTMENT CHARTS, Section 6.

OPERATIONS NOT REQUIRING TRANSMISSION REMOVAL

The following operations can be performed as outlined below without removing the transmission from the car.

1. Oil Pan
   Refer to Figures 7-338 and 7-528.
* 2. Oil Strainer
   Refer to Figures 7-339, 7-349 and 7-527.
3. Rear Bearing Retainer

It will be necessary to remove the propeller shaft.

Refer to Figures 7-359 through 7-362 and 7-510 through 7-517.

4. Vacuum Modulator
   Refer to Figures 7-366, 7-367, 7-368, 7-531 and 7-532.
* 5. Valve Body
   Refer to Figures 7-341 through 7-347, 7-388 through 7-392 and 7-518 through 7-522.
6. Governor
   Refer to Figures 7-364, 7-365, 7-437 through 7-442, 7-529 and 7-530.

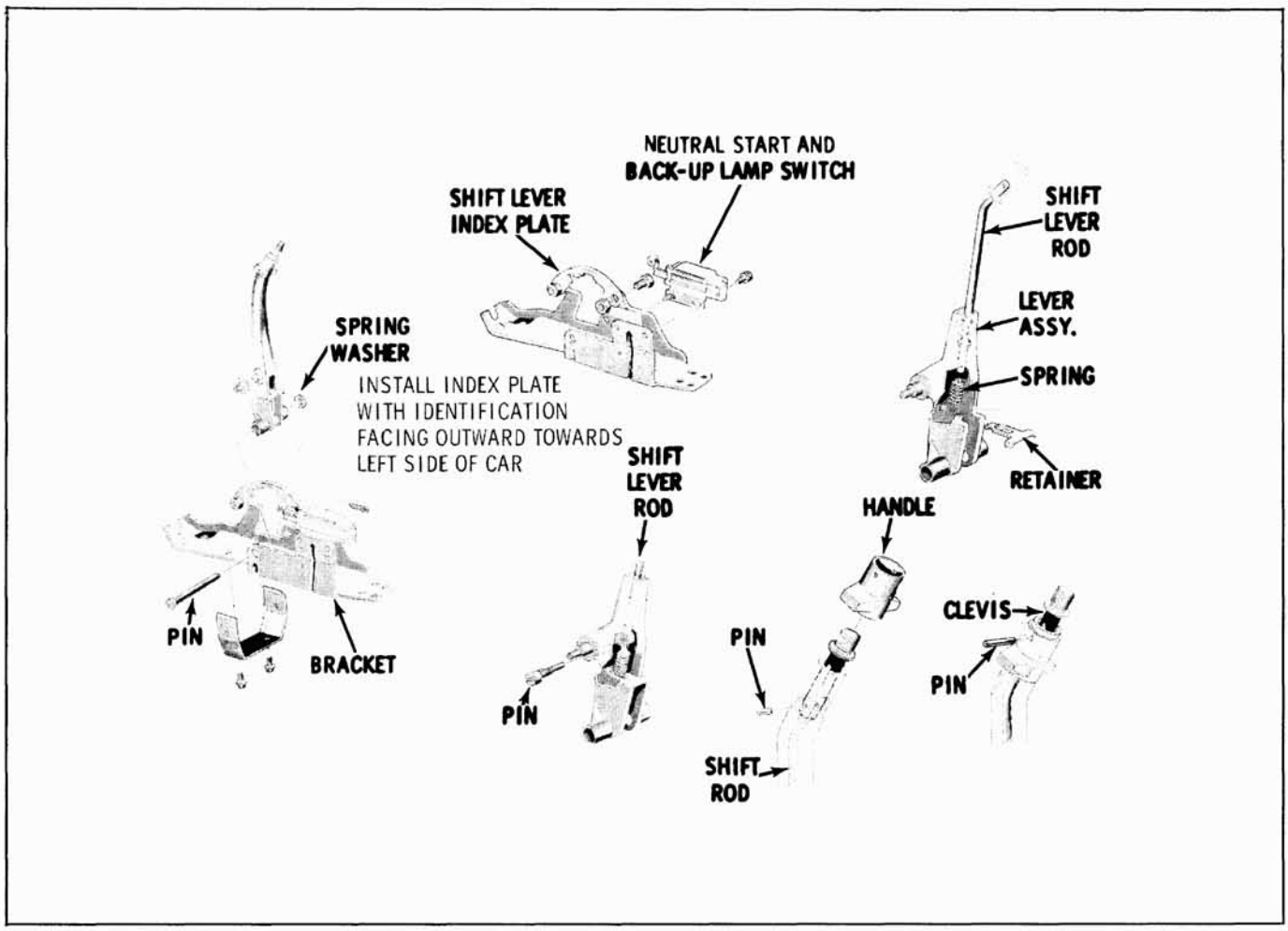


Fig. 7-328—Shift Handle (Console)

7. Low Servo Cover or Servo
Refer to Figures 7-349 and 7-350.

* 8. Selector and Parking Mechanism
Refer to Figures 7-378 through 7-385 and 7-469 through 7-474.

* 9. Pressure Regulator Valve
Refer to Figures 7-413 and 7-414.

* These operations require the removal of the oil pan.

JETAWAY TRANSMISSION ASSEMBLY

REMOVAL (Fig. 7-334)

1. Remove transmission filler pipe.
2. Raise car on hoist.
3. Disconnect transmission control wire at transmission.
4. Disconnect manual rod from transmission lever.
5. Remove propeller shaft assembly.
6. Remove flywheel dust cover.
7. Install Engine Support Bar (Fig. 7-333).
8. Remove transmission cross support bar to rear transmission mount attaching bolts.
9. Remove cross support bar to frame attaching brackets and remove cross support bar.

On models equipped with dual exhaust, it may be necessary to disconnect the left hand exhaust pipe at the exhaust manifold to provide clearance.

10. Disconnect oil cooler lines and cap immediately.
11. Disconnect modulator line.
12. Disconnect speedometer cable (or speed adapter, if so equipped) from speedometer driven gear.
13. Remove three flywheel to converter attaching bolts.

Mark flywheel and converter so they can be reassembled in the same relationship.

14. Support transmission with unit lift and remove transmission to flywheel housing bolts.

It may be necessary to lower engine slightly to permit removal of transmission to flywheel housing upper bolts.

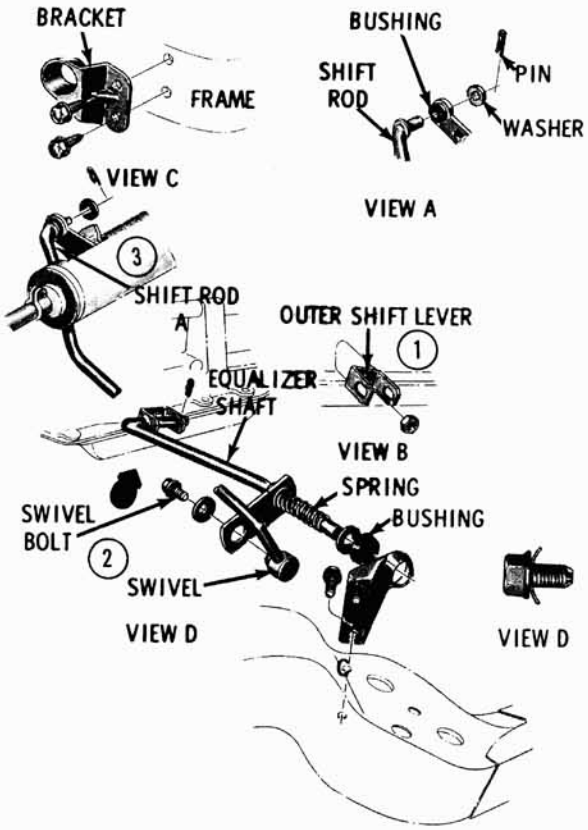
15. Carefully move transmission rearward.
16. Install Converter Holding Tool J-21654 (Fig. 7-335) and lower from car.

INSTALLATION

When installing transmission, tighten the attaching parts to the following specified torque ratings:

a. Transmission to flywheel	35 ft. lbs.
b. Flywheel to converter	32 ft. lbs.
c. Cross Support Bar Brackets to Frame	35 ft. lbs.
d. Cross Support Bar to Rear Transmission Mount	52 ft. lbs.
e. Flywheel dust cover	7 ft. lbs.
f. Propeller Shaft U-Bolt Nuts	14 ft. lbs.

Fill transmission as recommended in PERIODIC MAINTENANCE, at the front of this section.



MANUAL LINKAGE ADJUSTMENT

1. SET OUTER SHIFT LEVER (1) IN "D" POSITION.
2. LOOSEN SWIVEL BOLT (2)
3. HOLD DOWN ON SHIFT ROD (3) TO SEAT UPPER SHIFT LEVER AGAINST "D" POSITION STOP IN UPPER STEERING COLUMN.
4. TIGHTEN SWIVEL BOLT (2) TO 20 FT. LBS. TORQUE.
5. CHECK NEUTRAL START SWITCH ADJUSTMENT.

Fig. 7-329—Column Shift Linkage

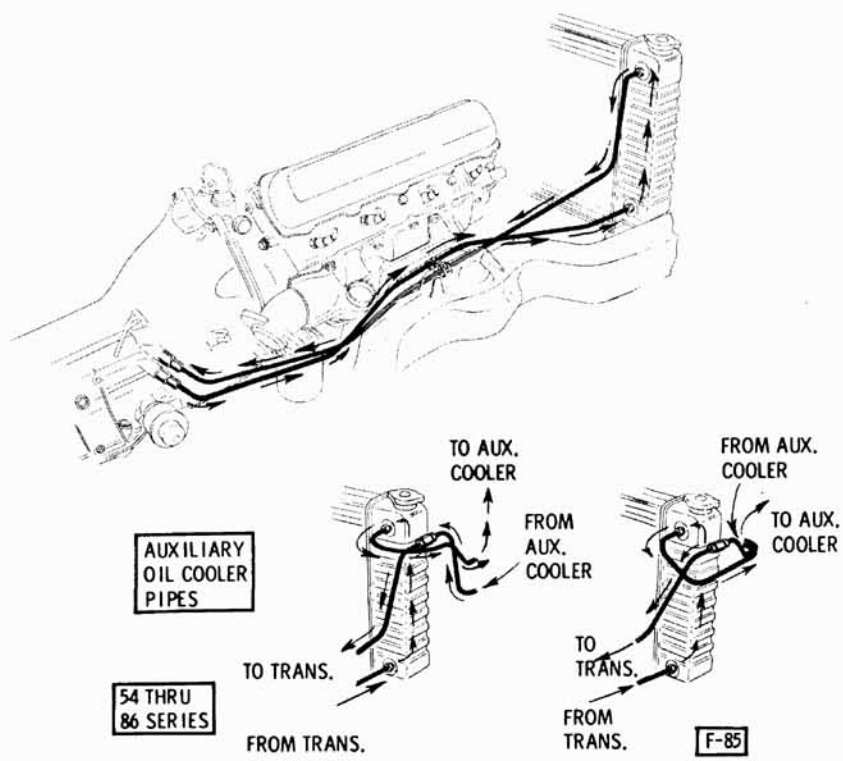


Fig. 7-330—Oil Cooler Lines

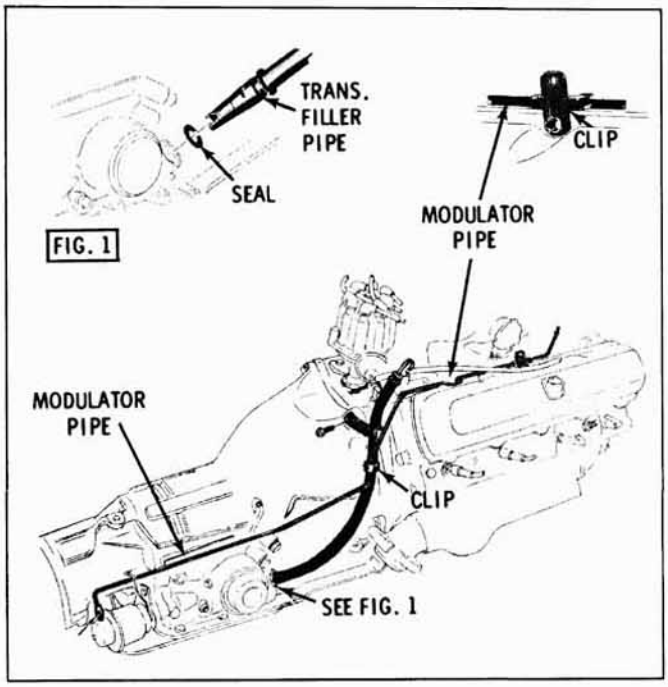


Fig. 7-331—Modulator Pipe - V-8

DISASSEMBLY

Before starting disassembly of the transmission, it should be thoroughly cleaned externally to avoid getting dirt inside.

Place transmission on a CLEAN work bench and use CLEAN tools during disassembly. Provide CLEAN storage space for parts and units removed from transmission. An excellent working arrangement is provided by assembling the transmission to Holding Fixture J-8763. (Fig. 7-337)

The transmission contains parts which are ground and highly polished, therefore, parts should be kept separated to avoid nicking and burring surfaces.

When disassembling transmission, carefully inspect all gaskets at times of removal. The imprint of parts on both sides of an old gasket will show whether a good seal was obtained. A poor imprint indicates a possible source of oil leakage due to gasket condition, looseness of bolts or uneven surfaces of parts.

None of the parts require forcing when disassembling or assembling transmission. Use a rawhide or plastic mallet to separate tight fitting cases; do not use a hard hammer.

REMOVAL OF OIL PAN

1. With transmission in horizontal position, remove converter holding tool and pull converter from case. (Fig. 7-336)
2. Place transmission in Fixture J-8763. (Fig. 7-337)
3. Remove 14 oil pan attaching bolts. (Fig. 7-338)
4. Remove oil pan and gasket from transmission.

REMOVAL OF OIL STRAINER ASSEMBLY

1. Remove the strainer. (Fig. 7-339)
2. Examine oil strainer to case oil seal. If nicked, torn or worn, remove seal. (Fig. 7-340)

REMOVAL OF VALVE BODY

1. Disconnect detent solenoid wire from case connector. (Fig. 7-341)

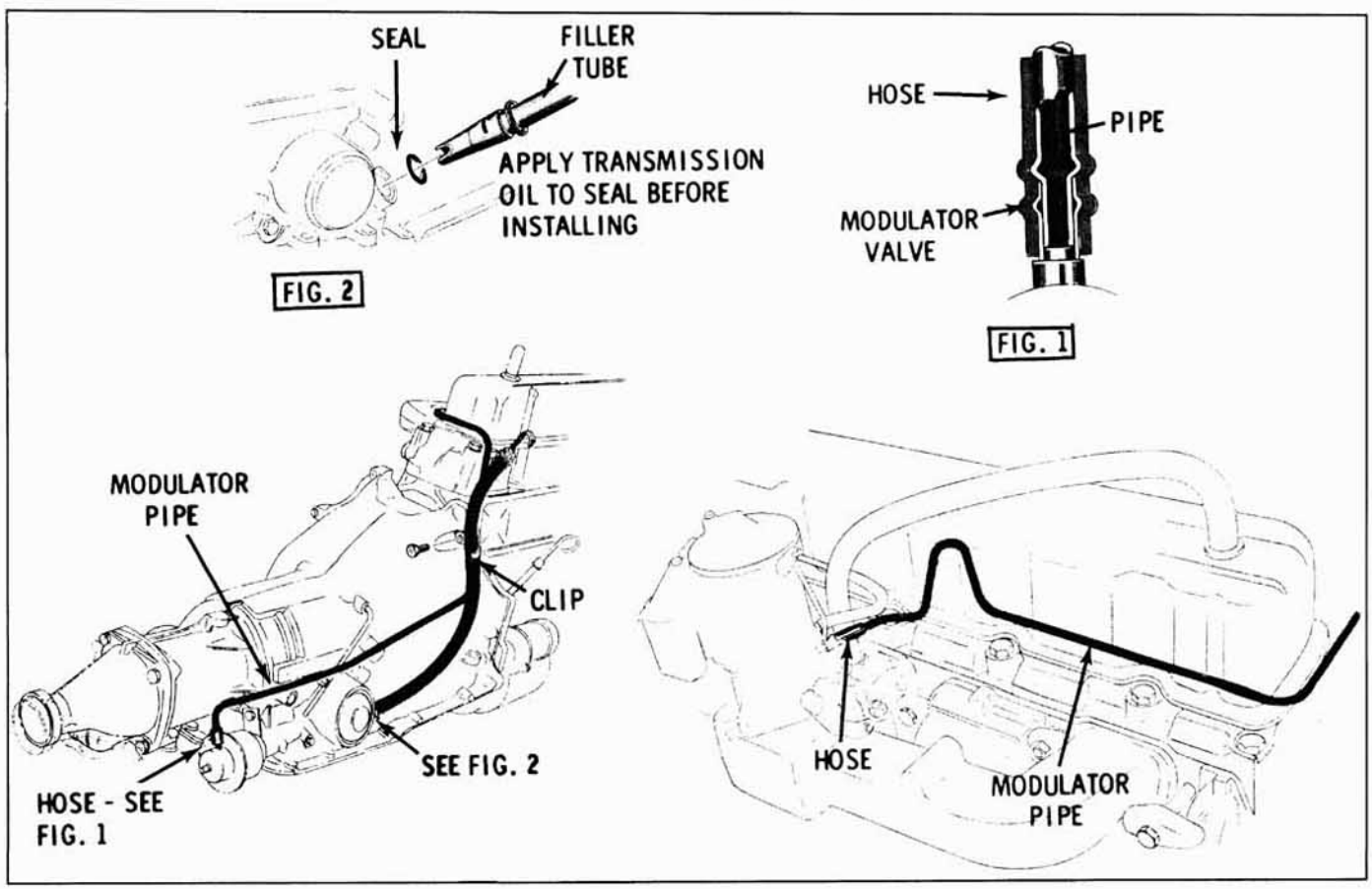


Fig. 7-332—Modulator Pipe L-6

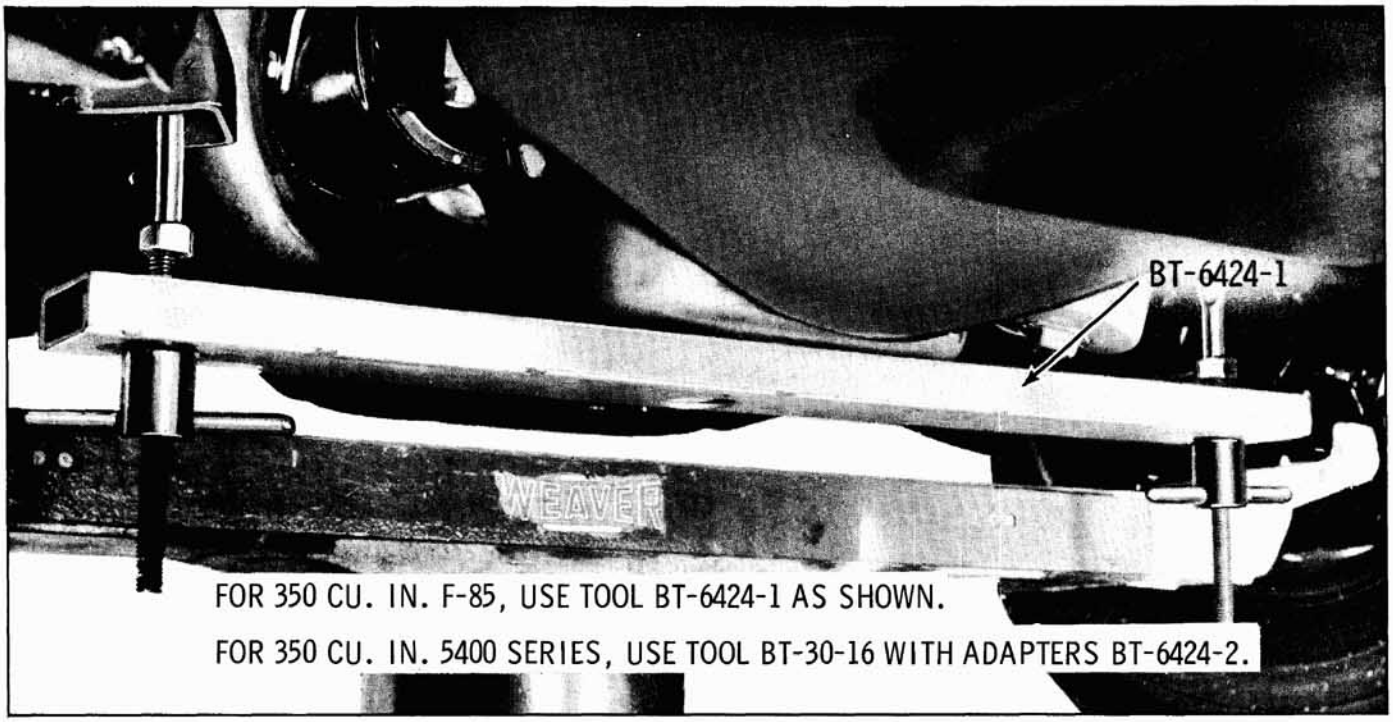


Fig. 7-333—Engine Support Tool

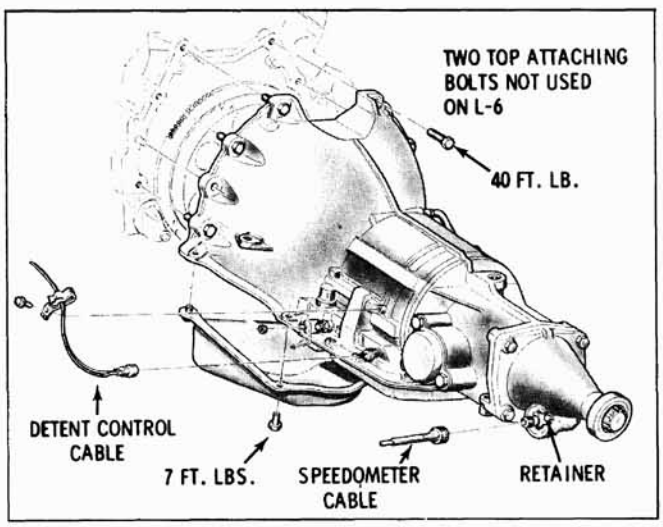


Fig. 7-334—Transmission Assembly

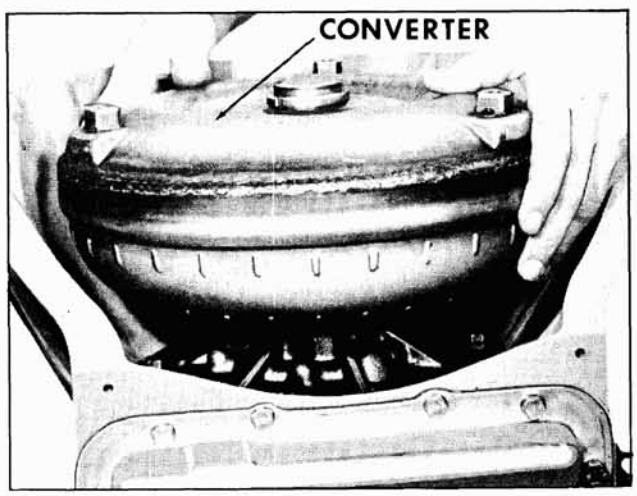


Fig. 7-336—Removing Converter

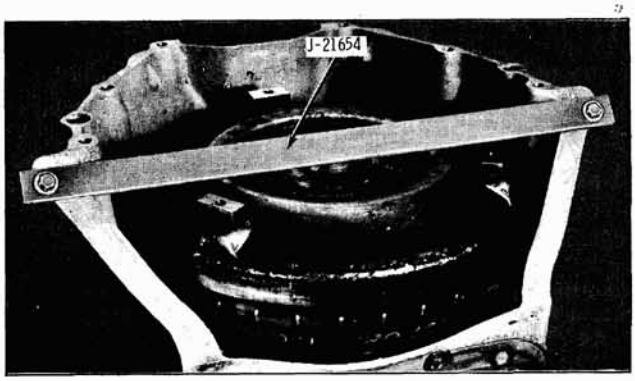


Fig. 7-335—Converter Holding Tool

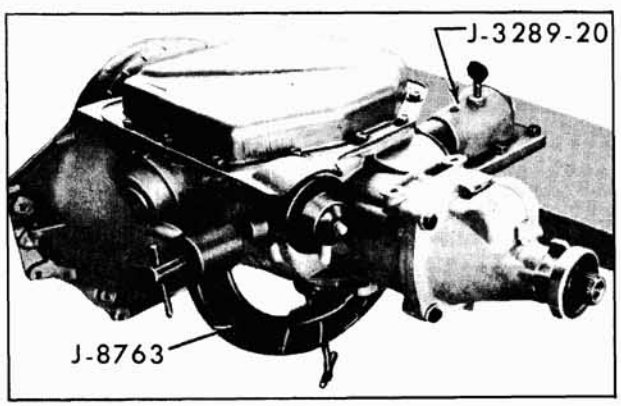


Fig. 7-337—Transmission Holding Tool

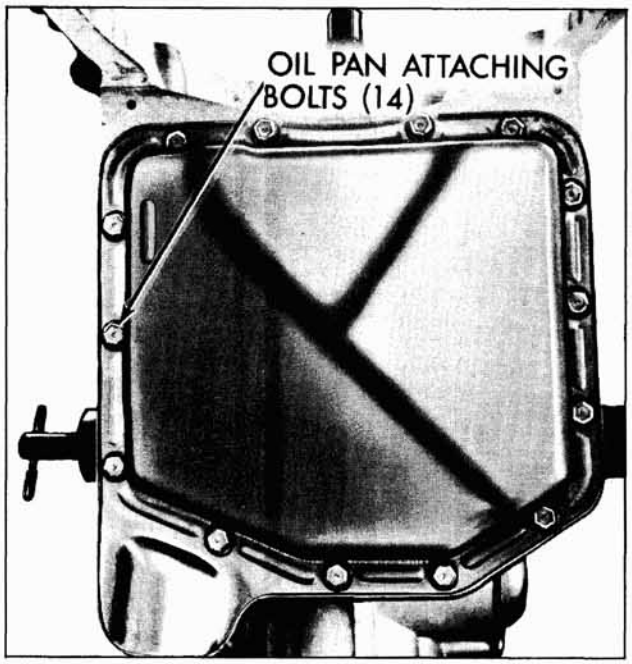


Fig. 7-338—Removing Oil Pan

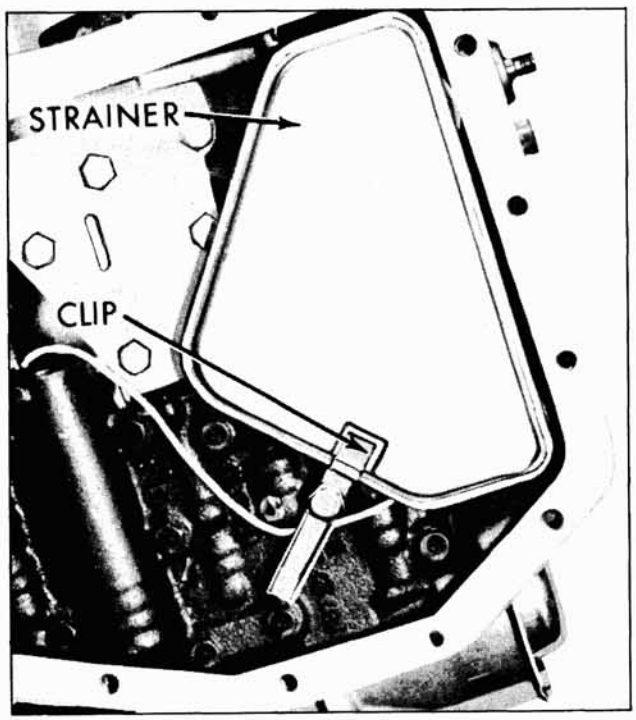


Fig. 7-339—Removing Oil Strainer

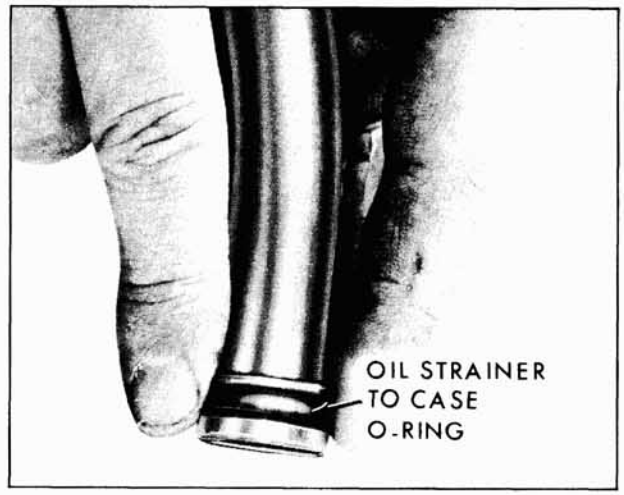


Fig. 7-340—Oil Strainer to Case Oil Seal

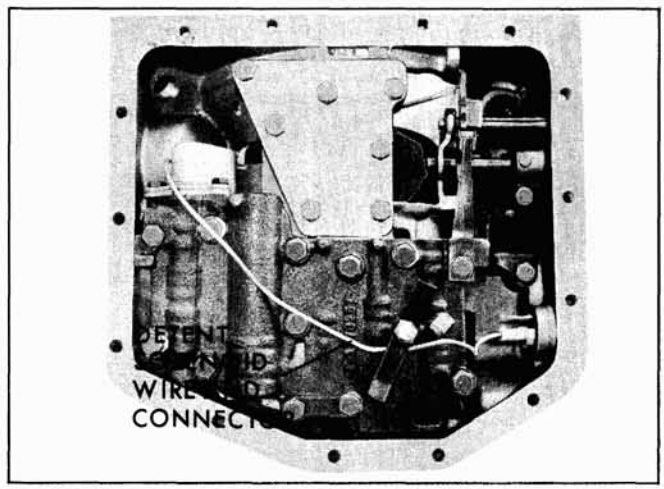


Fig. 7-341—Disconnecting Detent Wire

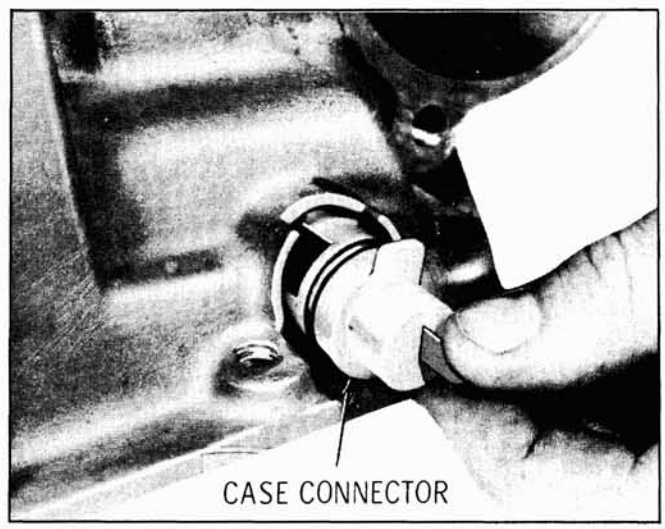


Fig. 7-342—Removing Detent Connector

2. Remove case connector from case. Inspect connector "O" ring. If nicked, torn or worn, replace. (Fig. 7-342)

3. Remove spring detent assembly bolt and spring detent assembly from valve body. (Fig. 7-343)

4. Remove oil channel support plate. (Fig. 7-344)

5. Remove 12 valve body to case bolts. Do not remove valve body. (Fig. 7-345)

6. Remove manual control valve link by rotating valve body in a counterclockwise direction to remove link from park lock and range selector inner lever. (Fig. 7-346)

7. Remove manual control valve and link from valve body assembly. Remove valve body.

8. Remove valve body plate and gasket. (Fig. 7-347)

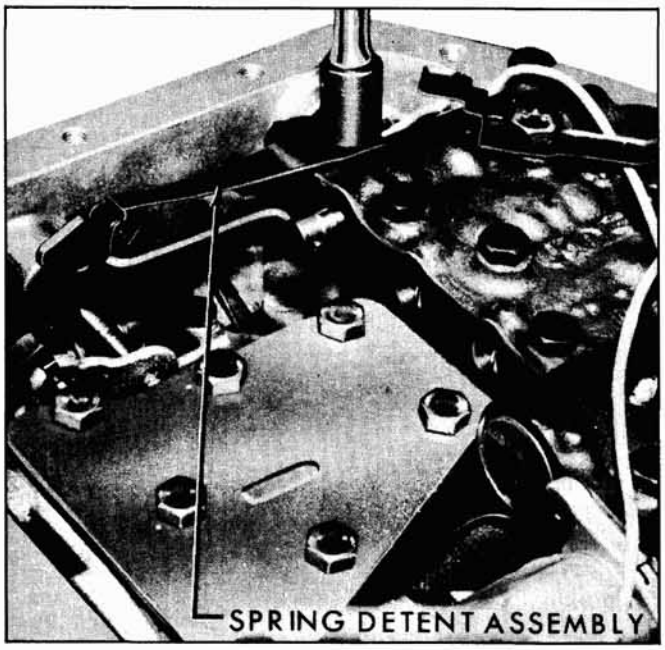


Fig. 7-343—Removing Spring Detent

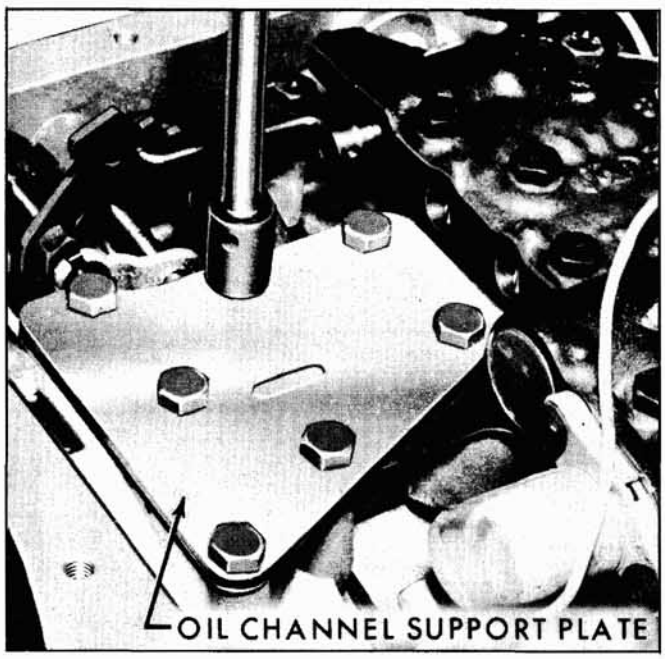


Fig. 7-344—Removing Oil Channel Support Plate

REMOVAL OF LOW SERVO COVER AND PISTON ASSEMBLY (ON CAR)

1. Remove transmission to support bar attaching bolts.
2. Using a wooden block, wedge block between transmission and floor pan. (Fig. 7-349)
3. Using an awl through the hole in the case, press in on the cover retaining ring while prying inward on cover.
4. With the cover pryed inward, remove the snap ring using a screwdriver. (Fig. 7-350)
5. Remove low servo cover, inspect the cover seal, if nicked, torn or worn, discard.
6. Remove low servo piston assembly from case.

To install, reverse the removal procedure using the pry bar to compress the cover while installing the snap ring. Torque transmission to support bolts to 52 ft. lbs.

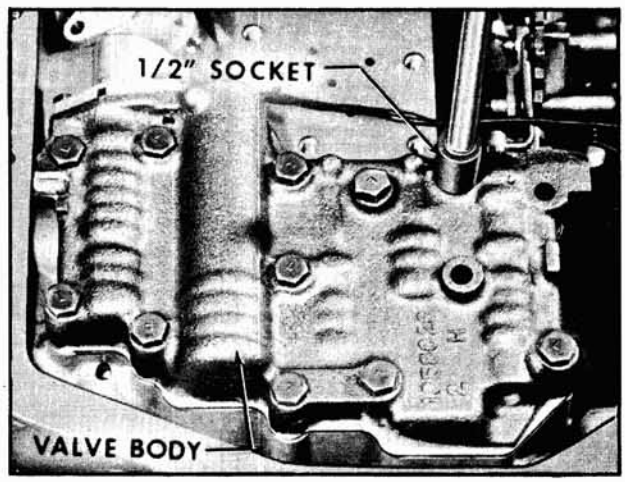


Fig. 7-345—Removing Valve Body

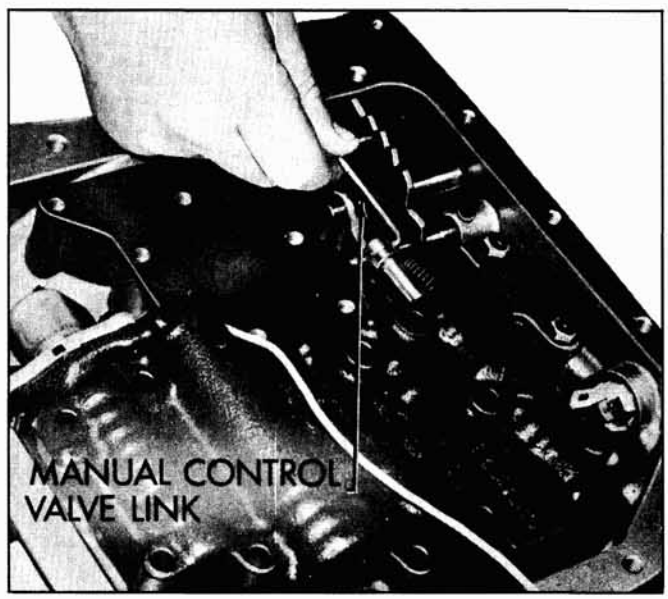


Fig. 7-346—Removing Inner Lever

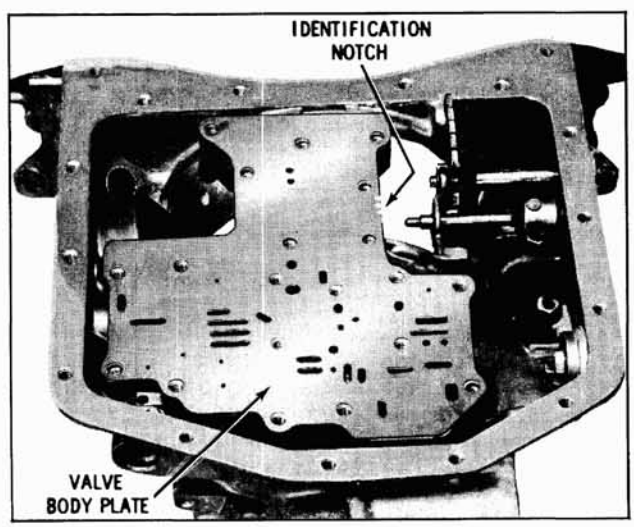


Fig. 7-347—Removing Valve Body Plate and Gasket

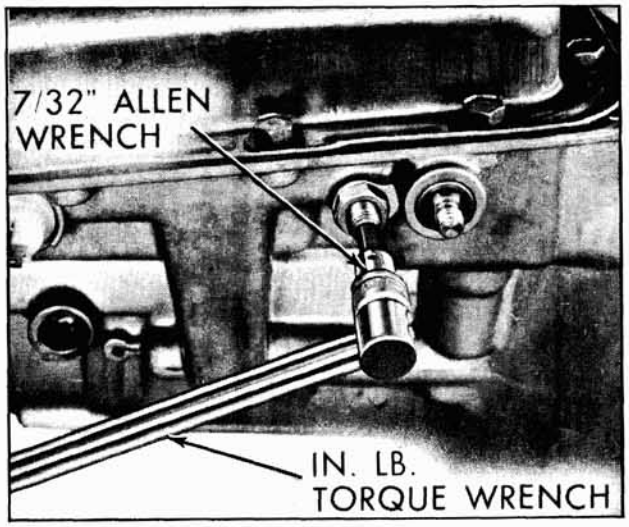


Fig. 7-348—Low Band Adjusting Screw

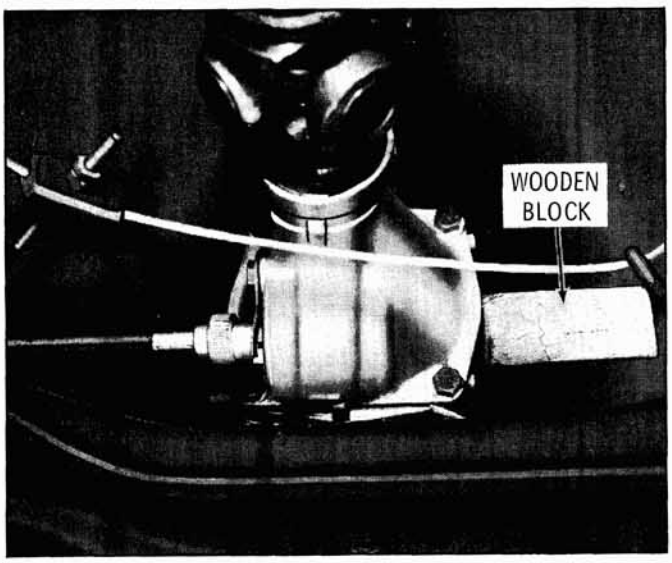


Fig. 7-349—Blocking Transmission

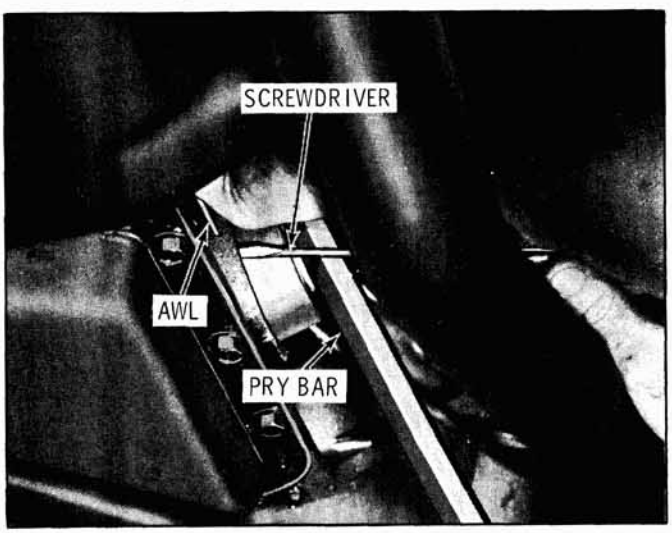


Fig. 7-350—Removing Servo Cover (On Car)

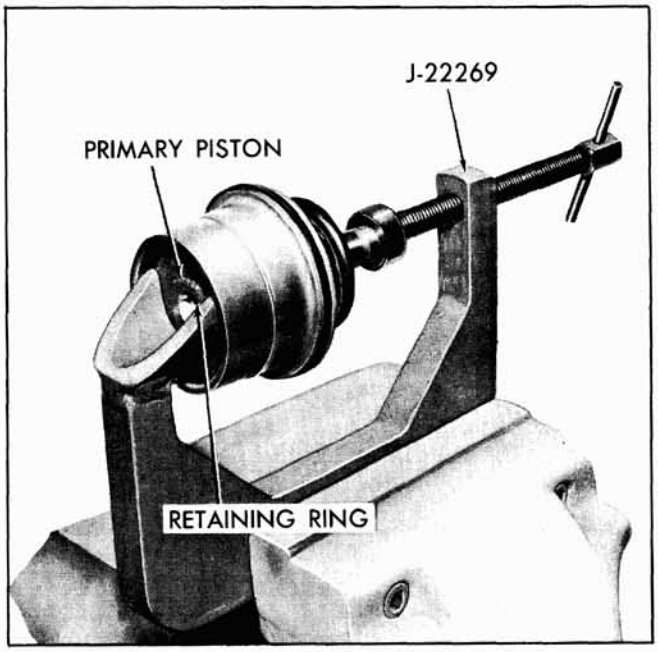


Fig. 7-351—Removing Servo Cover (On Bench)

Fig. 7-352—Servo Cover Seal

REMOVAL OF LOW SERVO COVER AND PISTON ASSEMBLY (ON BENCH)

1. Release tension on low band adjusting screw retaining nut. Release tension on low band by turning adjusting screw in a counterclockwise direction. Use a 7/32" Allen wrench. (Fig. 7-348)
2. Remove low servo cover snap ring. Use Tool J-22269 to compress servo cover so snap ring can be removed. (Fig. 7-351)
3. Remove tool from case and remove low servo cover.

If low servo cover is being replaced, stamp all model information on new cover.

4. Inspect low servo cover seal. If nicked, torn or worn, discard. (Fig. 7-352)

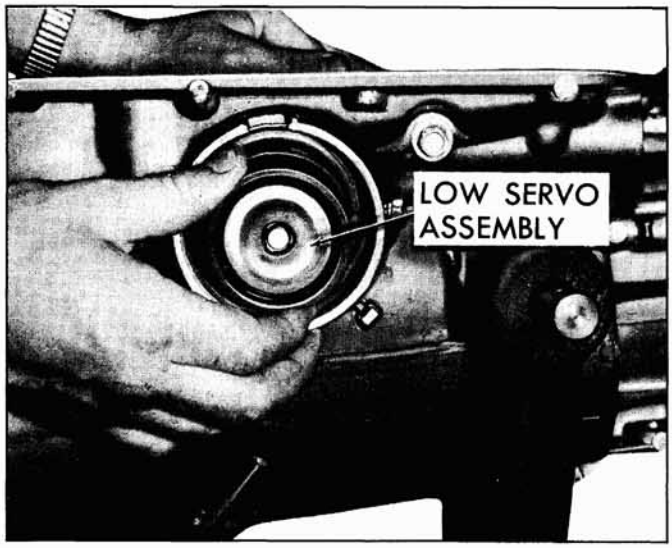


Fig. 7-353—Removing Low Servo Piston

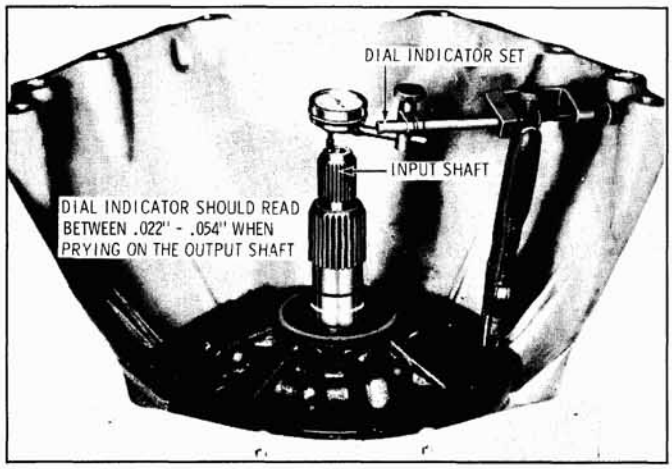


Fig. 7-354—Oil Pump End Play Check

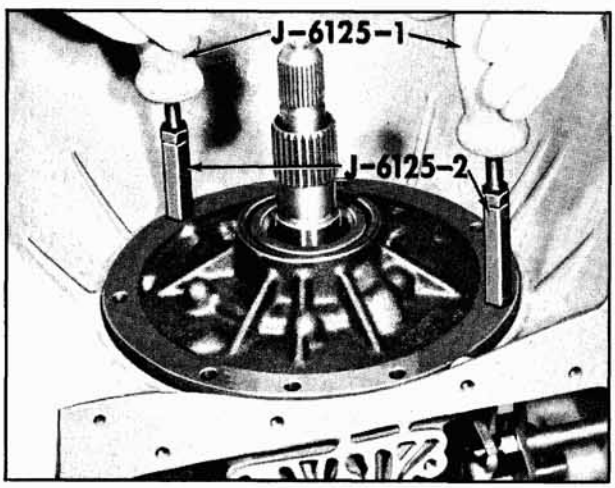


Fig. 7-355—Removing Oil Pump

5. Remove low servo piston assembly from case. (Fig. 7-353)

REMOVAL OF OIL PUMP

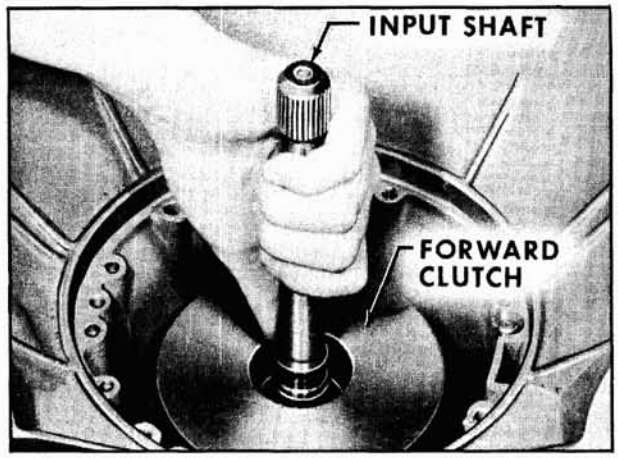


Fig. 7-356—Removing Input Shaft

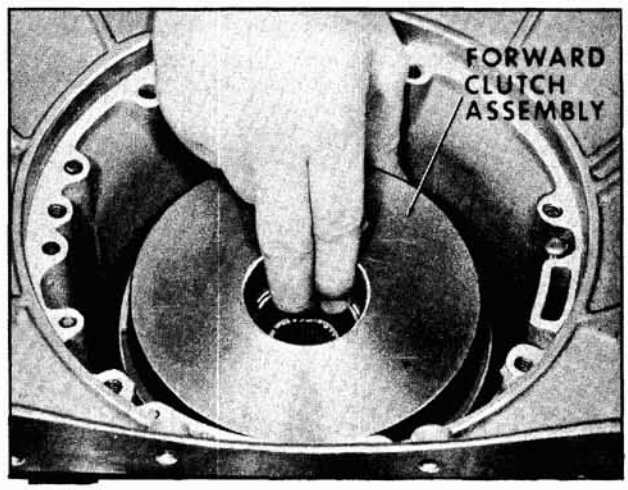


Fig. 7-357—Removing Forward Clutch

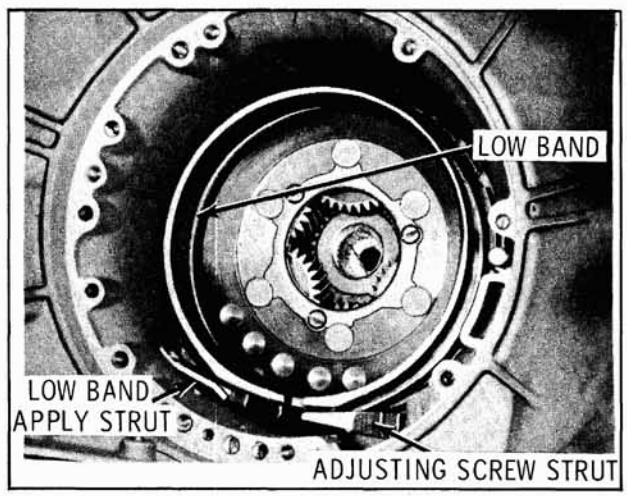


Fig. 7-358—Removing Low Band

Before removing oil pump assembly, check oil pump clearance as shown in Fig. 7-354 and record reading.

1. With transmission in vertical position, remove eight pump attaching bolts with washer type seals, then install slide hammers J-6125-1 with Adapters J-6125-2 into threaded holes in pump. Using slide hammers, loosen pump from case. Remove pump and gasket from case. (Fig. 7-355)

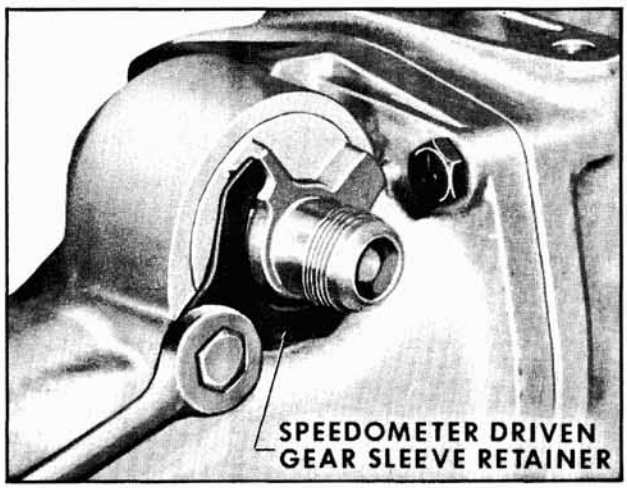


Fig. 7-359—Removing Speedometer Driven Gear Retainer (Exc. Model MT)

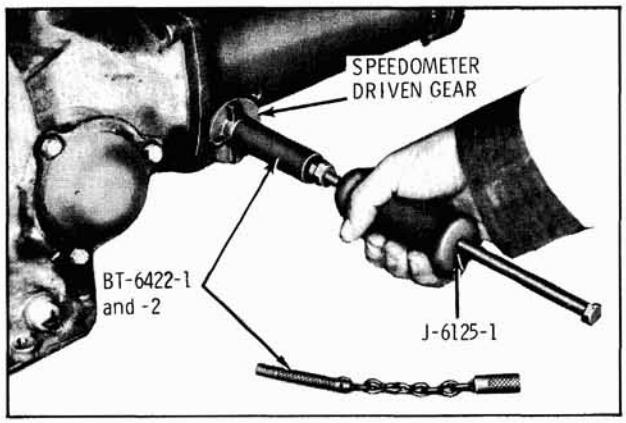


Fig. 7-360—Removing Speedometer Driven Gear (Exc. Model MT)

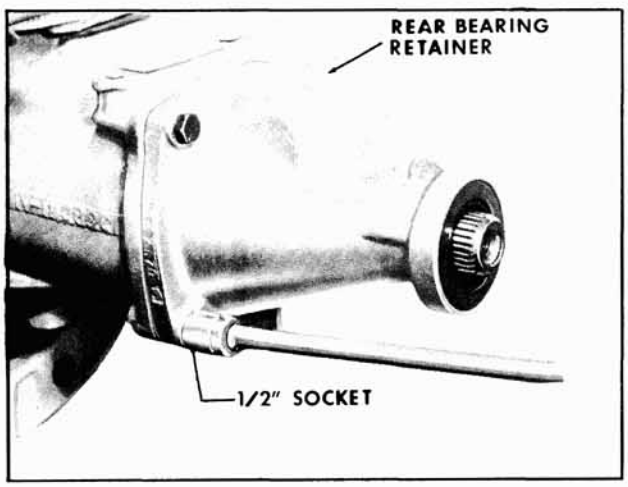


Fig. 7-361—Removing Rear Bearing Retainer

REMOVAL OF FORWARD CLUTCH

1. Remove input shaft from forward clutch drum. (Fig. 7-356)
2. Examine input shaft oil rings. If nicked or worn, remove rings.
3. Remove forward clutch assembly by pulling straight out of case. Make certain low band has been released before attempting to remove forward clutch. (Fig. 7-357)

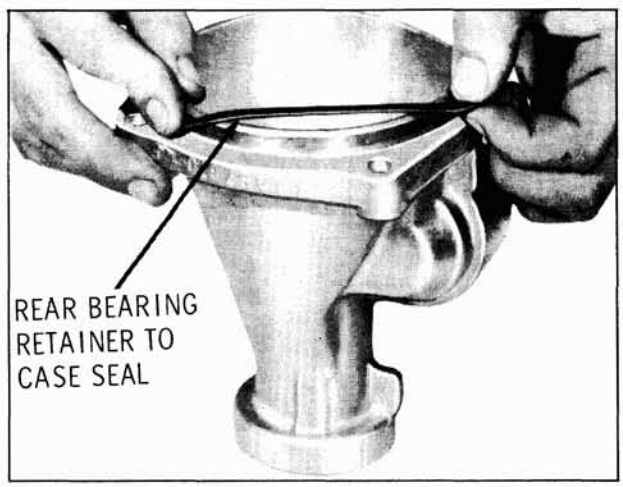


Fig. 7-362—Removing Rear Bearing Retainer to Case Seal

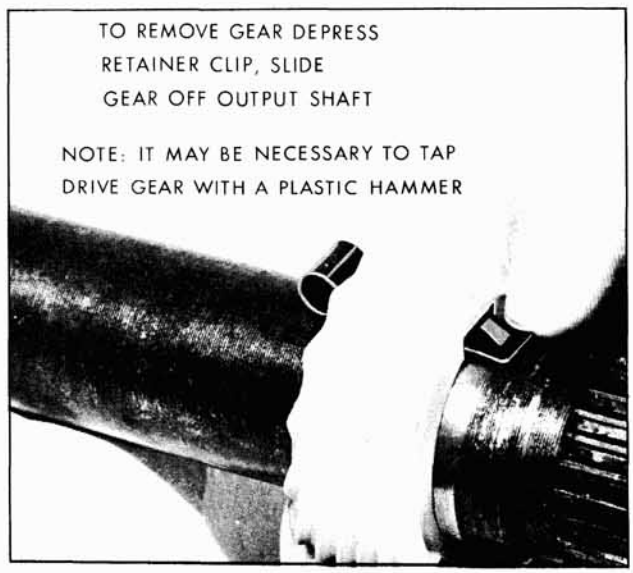


Fig. 7-363—Removing Speedometer Drive Gear

REMOVAL OF LOW BAND

1. Remove low band adjusting screw.
2. Remove low band and struts from inside the case. (Fig. 7-358)

REMOVAL OF SPEEDOMETER DRIVEN GEAR (Exc. MODEL MT)

1. With transmission in horizontal position, remove speedometer driven gear sleeve retainer. (Fig. 7-359)
2. Remove speedometer driven gear sleeve. If speedometer driven gear sleeve cannot be removed by hand, available Tool BT-6422 may be used as shown in Fig. 7-360.

REMOVAL OF REAR BEARING RETAINER

1. Remove four rear bearing retainer bolts. Remove rear bearing retainer from case. (Fig. 7-361)
2. Remove rear bearing retainer to case seal. (Fig. 7-362)

REMOVAL OF SPEEDOMETER DRIVE GEAR (EXC. MODEL MT)

1. Depress retainer clip and slide gear off output shaft. (Fig. 7-363)

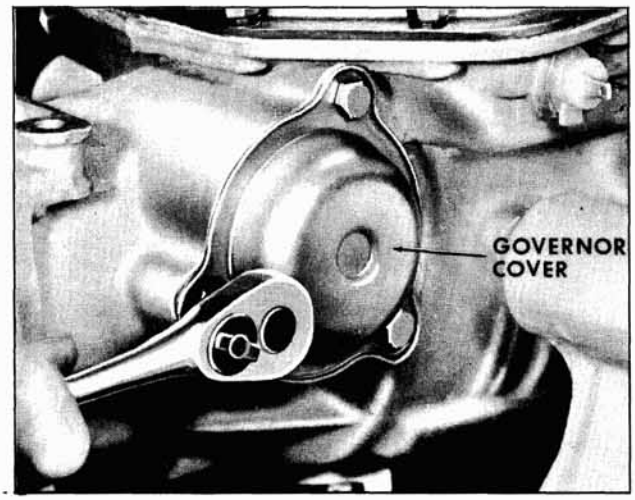


Fig. 7-364—Removing Governor Cover

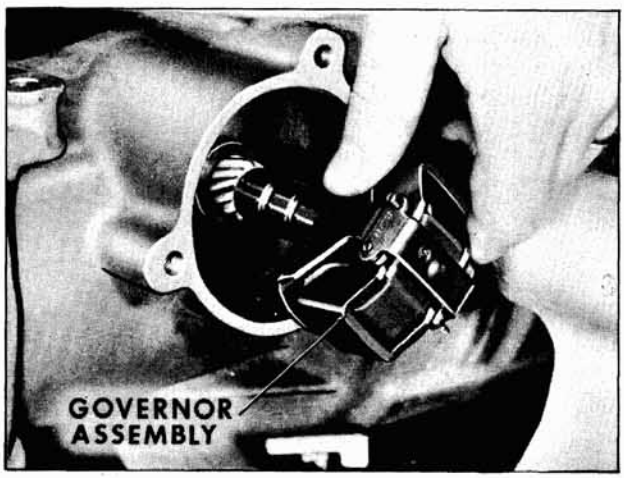


Fig. 7-365—Removing Governor

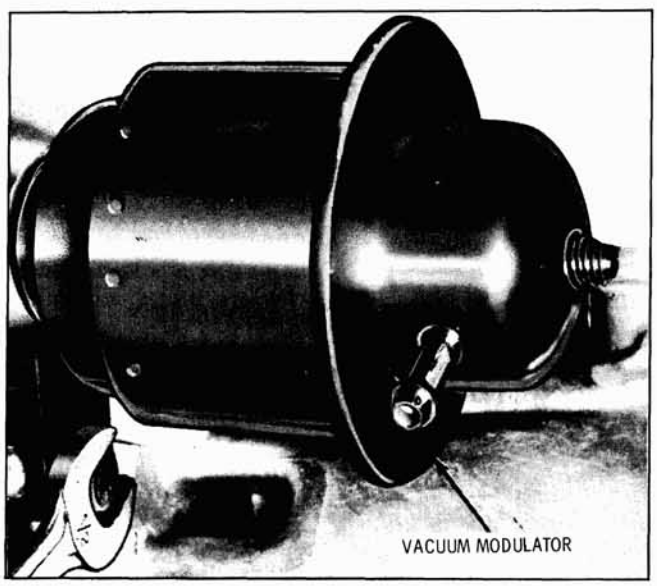


Fig. 7-366—Removing Vacuum Modulator Retainer

REMOVAL OF GOVERNOR

1. Remove three attaching bolts retaining governor cover to case. Remove cover and gasket. (Fig. 7-364)

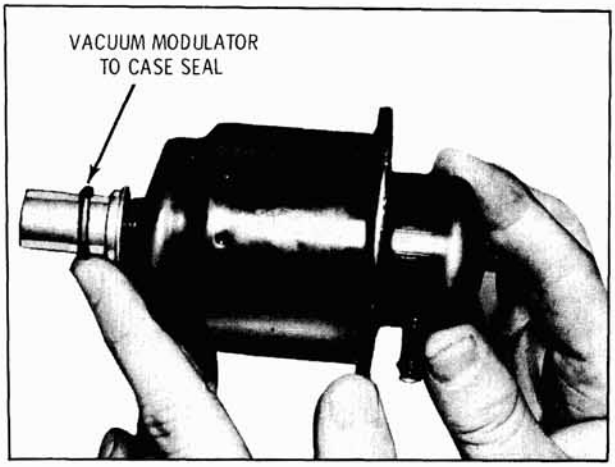


Fig. 7-367—Removing Vacuum Modulator

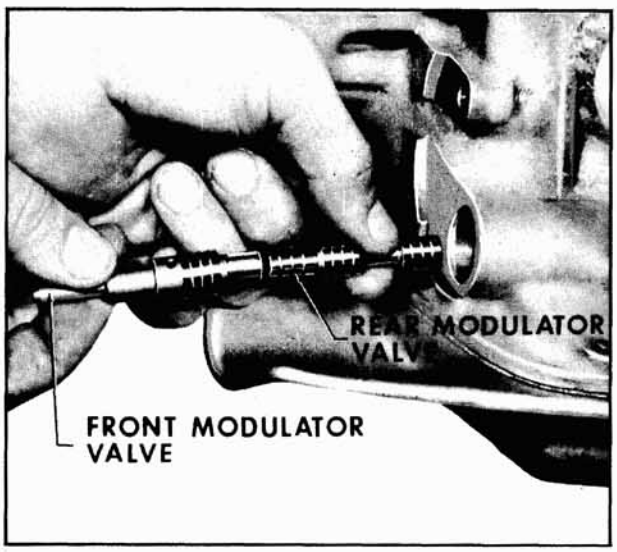


Fig. 7-368—Removing Vacuum Modulator Valve

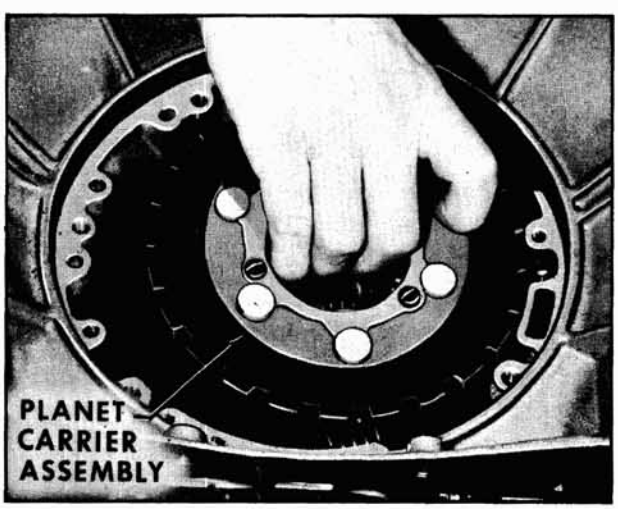


Fig. 7-369—Removing Planetary Gear Set

2. With a twisting motion, slide governor assembly out of its bore in case. (Fig. 7-365)

REMOVAL OF THE VACUUM MODULATOR ASSEMBLY

1. Remove vacuum modulator retainer bolt and retainer.

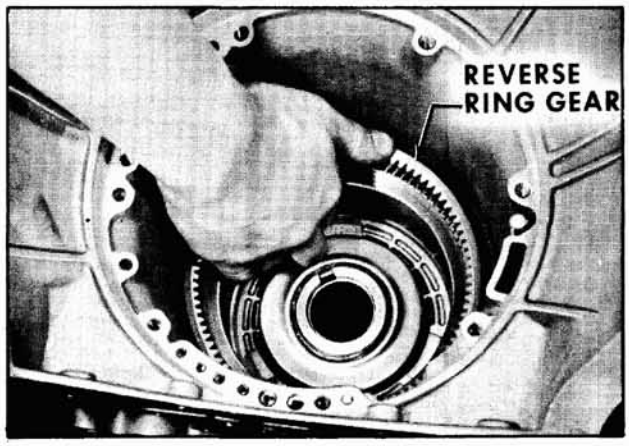


Fig. 7-370—Removing Reverse Ring Gear

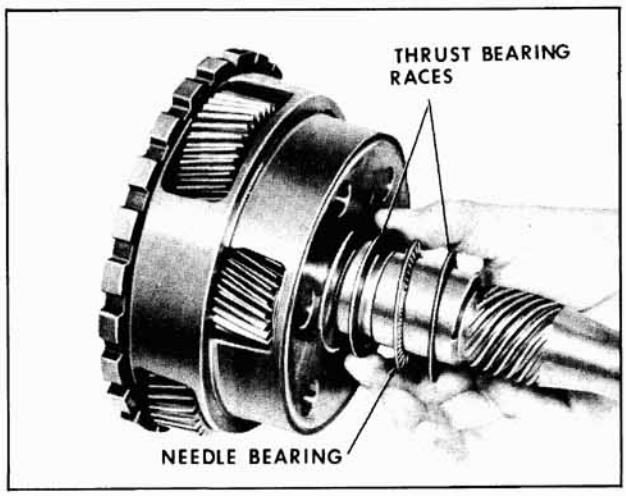


Fig. 7-371—Removing Planetary Gear Thrust Bearing

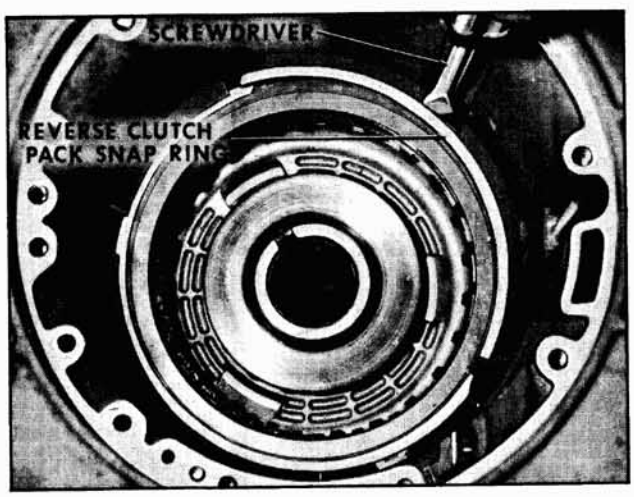


Fig. 7-372—Removing Reverse Clutch Snap Ring

Remove vacuum modulator and valve assembly. (Figs. 7-366, 7-367 and 7-368)

2. Inspect and if necessary, remove vacuum modulator to case oil seal. (Fig. 7-367)

REMOVAL OF PLANETARY GEAR SET

1. Remove planet carrier assembly from case, using care not to damage case bushing. (Fig. 7-369)

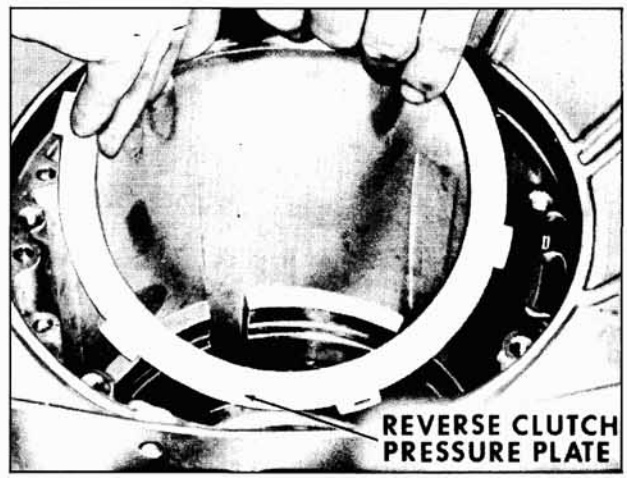


Fig. 7-373—Removing Reverse Clutch Pressure Plate

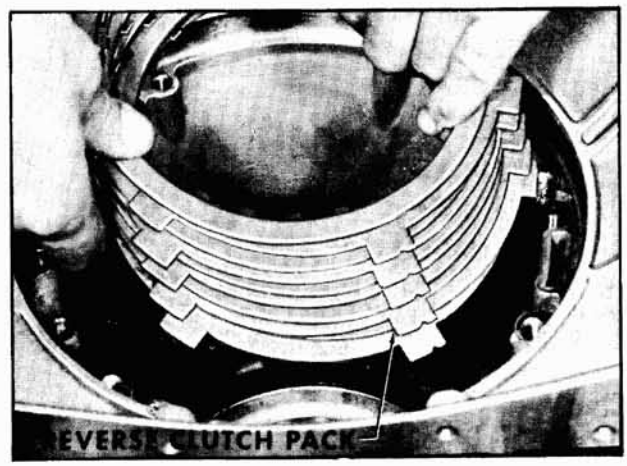


Fig. 7-374—Removing Reverse Clutch Pack

2. Remove reverse ring gear from case. (Fig. 7-370)

3. Remove needle bearing and two bearing races from rear of planet carrier. (Fig. 7-371)

Bearing assembly may stay in transmission when planet carrier is removed.

REMOVAL OF REVERSE CLUTCH

The Jetaway used with L-6 engine has four steel reverse plates and four lined reverse plates. The V-8 engine requires one additional steel and one additional lined plate.

1. Place transmission in vertical position and remove reverse clutch pack snap ring with screwdriver. (Fig. 7-372)

2. Lift reverse clutch pressure plate from transmission case. (Fig. 7-373)

3. Remove reverse clutch pack from transmission case. (Fig. 7-374)

4. To remove reverse piston, center Tool J-21420-1 on reverse piston return seat. Install Flat Plate J-21420-2 over threaded shaft at rear of case. Position webs of tool away from end of snap ring. Tighten nut to compress piston return seat, then remove snap ring with Pliers J-5586. (Fig. 7-375)

5. Remove Tool J-21420-1 and 2 being careful that piston return seat does not catch in snap ring groove. Remove piston return seat and remove 17 piston return springs. (Fig. 7-376)

6. Place transmission in a horizontal position and remove reverse clutch piston with compressed air. As air is applied to the rear surface of the piston, it will pop out far enough so it

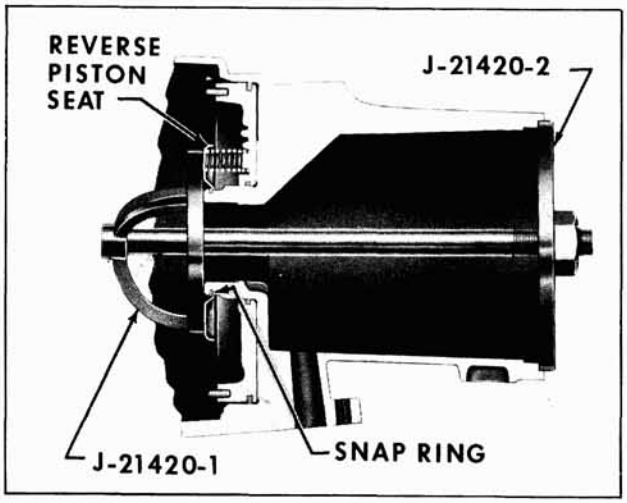


Fig. 7-375—Removing Reverse Clutch Piston

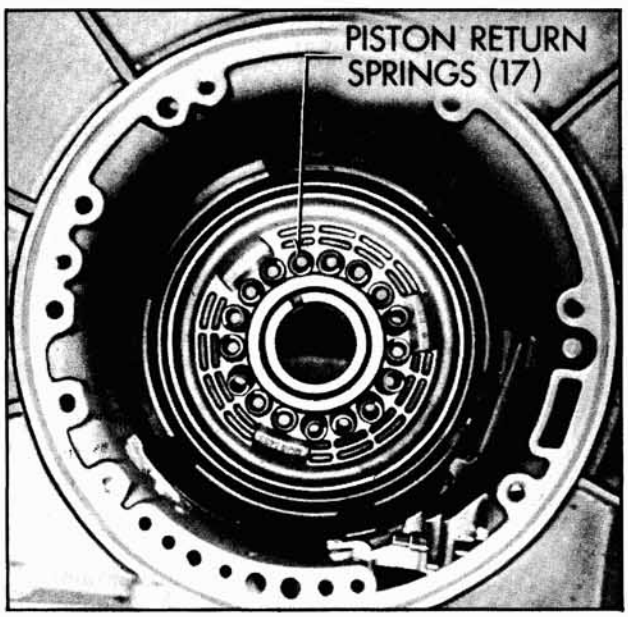


Fig. 7-376—Removing Reverse Clutch Piston Return Springs

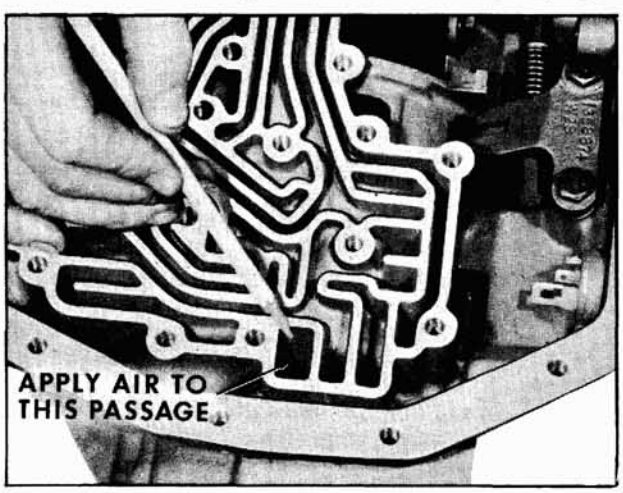


Fig. 7-377—Reverse Clutch Apply Passage

can be removed. Insert air nozzle to rear of case as shown in Fig. 7-377.

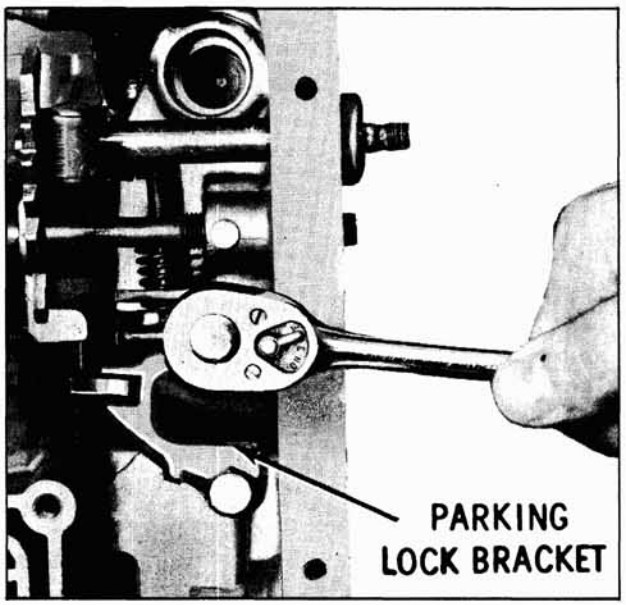


Fig. 7-378—Removing Parking Lock Bracket

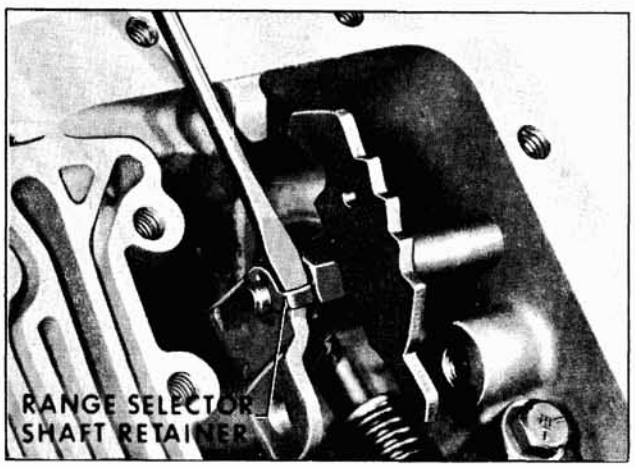


Fig. 7-379—Removing Selector Shaft Retainer

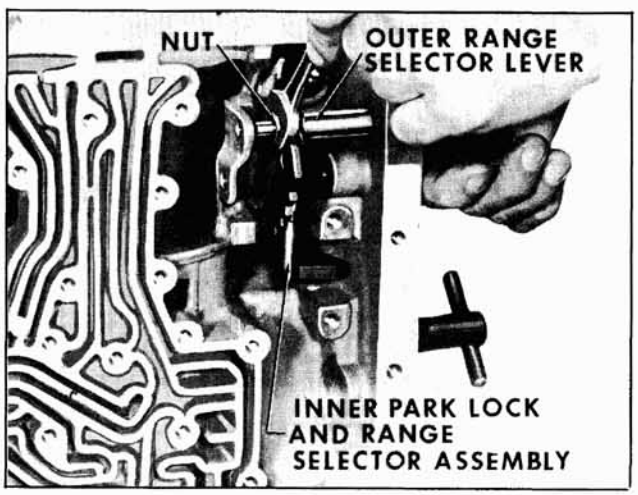


Fig. 7-380—Loosening Selector Lever Locknut

Piston may fall out of transmission if not held.

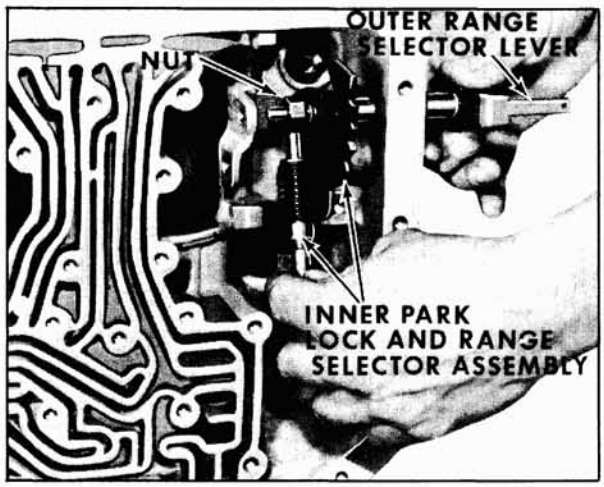


Fig. 7-381—Removing Outer Range Selector Lever

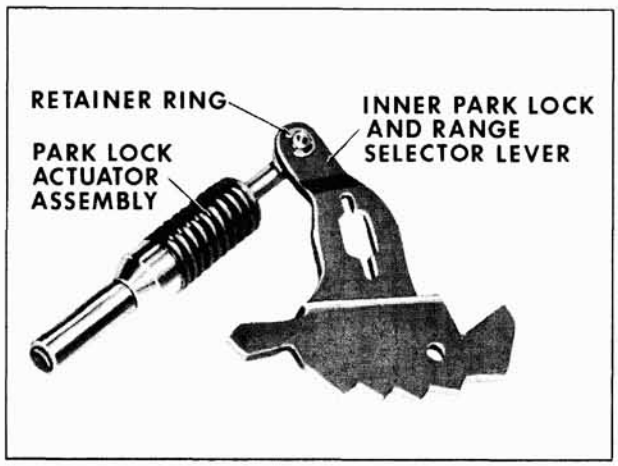


Fig. 7-382—Removing Park Lock Actuator

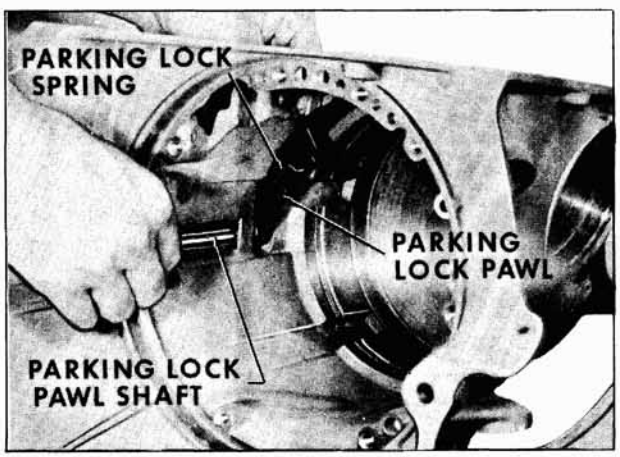


Fig. 7-383—Removing Parking Pawl

Fig. 7-384—Removing Outer Shift Lever Seal

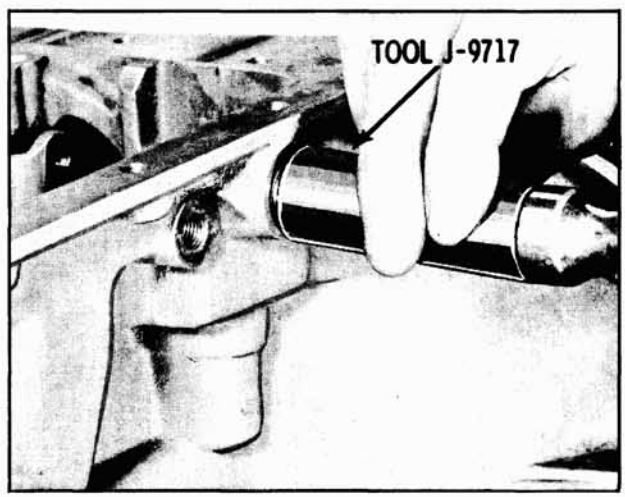


Fig. 7-385—Installing Outer Shift Lever Seal

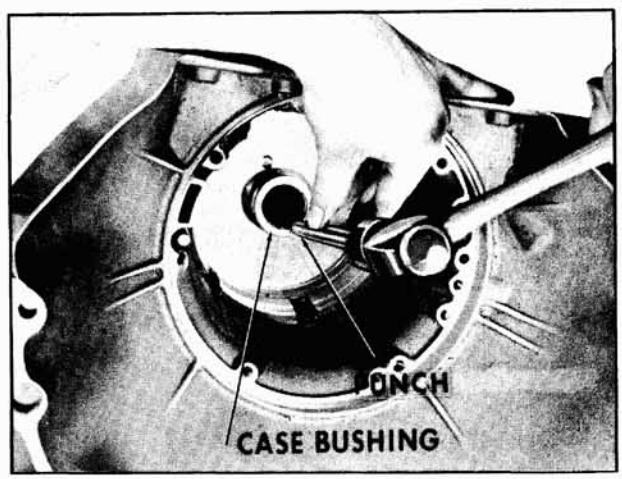


Fig. 7-386—Removing Case Bushing

REMOVAL OF RANGE SELECTOR LEVER, SHAFT AND PARKING LOCK ACTUATOR

1. Remove two parking lock bracket bolts with 1/2" socket. Remove parking lock bracket. (Fig. 7-378)
2. Remove range selector shaft retainer. (Fig. 7-379)
3. Fully loosen nut that retains outer range selector lever to inner park lock and range selector lever. (Fig. 7-380)
4. Slide outer range selector lever out of case. Remove nut, inner park lock and range selector lever. (Fig. 7-381)
5. Remove retaining ring which holds inner park lock and range selector to park lock assembly. (Fig. 7-382)
6. Disconnect parking lock pawl spring, then slide parking lock pawl shaft out of parking lock pawl. Remove parking lock pawl and spring. (Fig. 7-383)

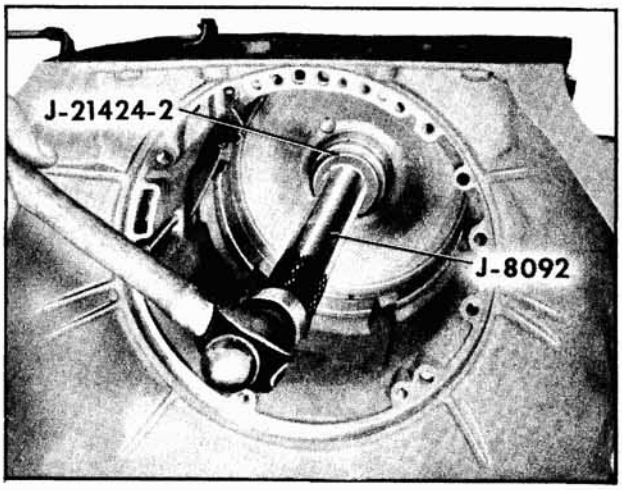


Fig. 7-387—Installing Case Bushing

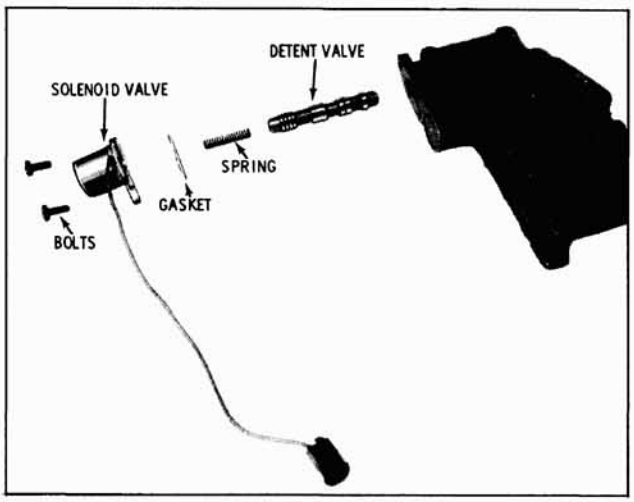


Fig. 7-388—Removing Detent Solenoid and Detent Valve

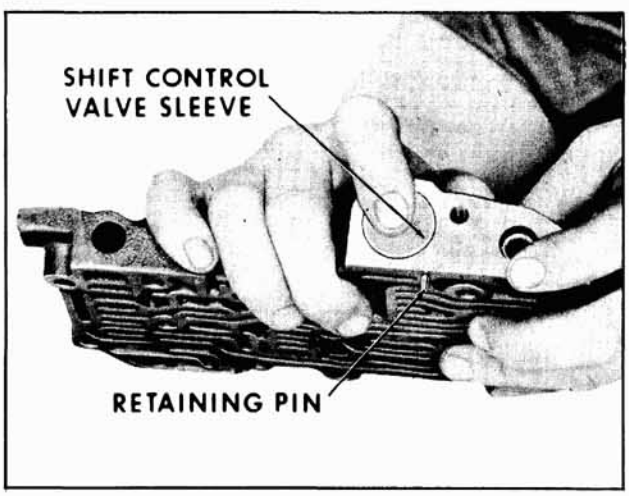


Fig. 7-389—Removing Shift Control Valve and Shift Valve (Exc. Model MT)

REPAIR OF UNITS

At this point all of the main units have been removed from the transmission. The following pages cover the repair of each of these individual units.

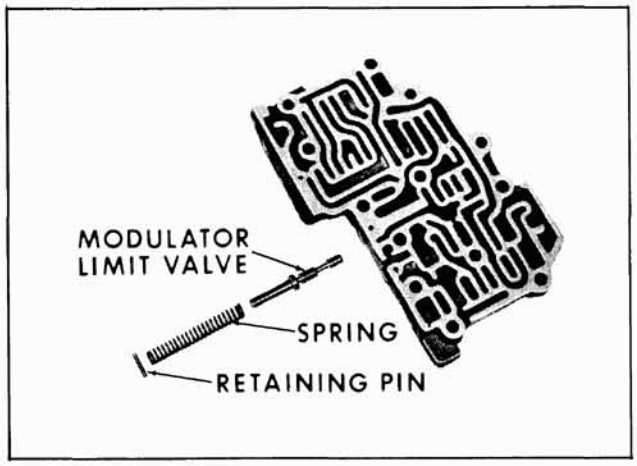


Fig. 7-390—Modulator Limit Valve (Exc. Model MT)

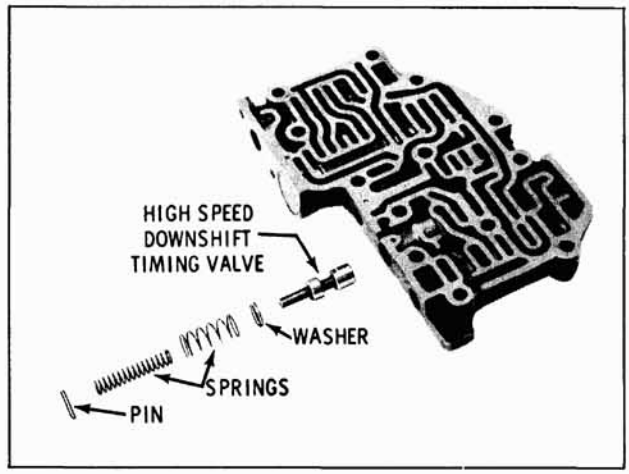


Fig. 7-391—High Speed Downshift Timing Valve (Exc. Model MT)

OUTER SHIFT LEVER OIL SEAL

Examine outer shift lever oil seal. If nicked, torn or worn, remove seal. (Fig. 7-384)

Install outer shift lever seal using J-9717. Make certain lip of seal points toward center of case. (Fig. 7-385)

REMOVAL OF CASE BUSHING

1. Inspect case bushing for nicks, scoring or excessive wear. If damaged, remove as follows: Place small punch or Tool J-8400-1 in notch in case, then tap with hammer to collapse bushing. (Fig. 7-386)
2. Install case bushing. (Fig. 7-387)

VALVE BODY DISASSEMBLY, INSPECTION AND REASSEMBLY

DISASSEMBLY

1. Remove two bolts attaching detent solenoid valve. Remove the solenoid valve, gasket, spring and detent valve. (Fig. 7-388)

Notice cutout notch on solenoid valve gasket.

2. Except Model MT - Depress shift control valve sleeve and remove retaining pin by turning valve body over so pin will fall free. Remove shift control valve sleeve, retainer, shift control valve, spring, washer and shift valve. (Fig. 7-389)
3. Model MT - Depress shift control valve sleeve and remove retaining pin. Remove shift control valve sleeve, shift control valve, spring, washer and shift valve.

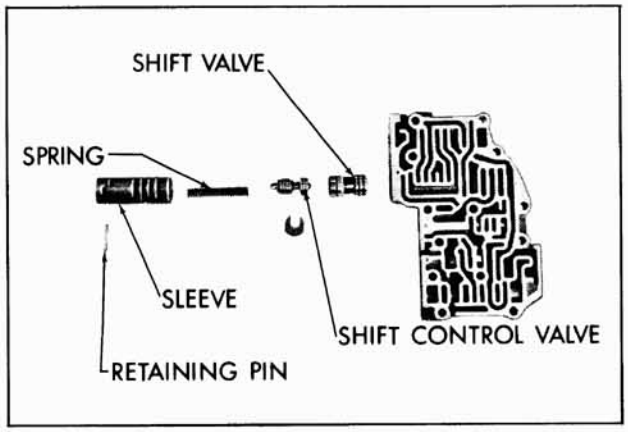


Fig. 7-392—Shift Control Valve (Exc. Model MT)

4. Depress modulator limit spring, turn valve body over and retaining pin will fall free. Remove spring and valve from body. (Fig. 7-390)

Modulator limit spring is under moderate pressure. Care should be exercised in removal.

5. Depress high speed downshift timing valve springs and remove pin. Remove springs, washer, and valve. (Fig. 7-391)

Inspection

1. Thoroughly clean all valves and valve body in solvent. Inspect valves and valve body for evidence of wear or damage due to foreign material. Dry valve body and valves with clean air blast.

2. Test each valve in its bore. All valves must move freely of their own weight.

Reassembly of Valve Body

1. Install high speed downshift timing valve and spring. Depress plug with finger and install retaining pin. (Fig. 7-392)

2. Install modulator limit valve and spring into bore of valve body. Compress spring and install retaining pin. (Fig. 7-390)

3. Model LC and MM - Install spring and shift control valve into sleeve. Depress spring and valve and insert retainer in groove. Install shift valve and sleeve assembly. (Fig. 7-392)

4. Model MT - Install shift control valve into sleeve. Install shift valve, washer, spring and sleeve assembly. Depress sleeve and install retaining pin. (Fig. 7-393)

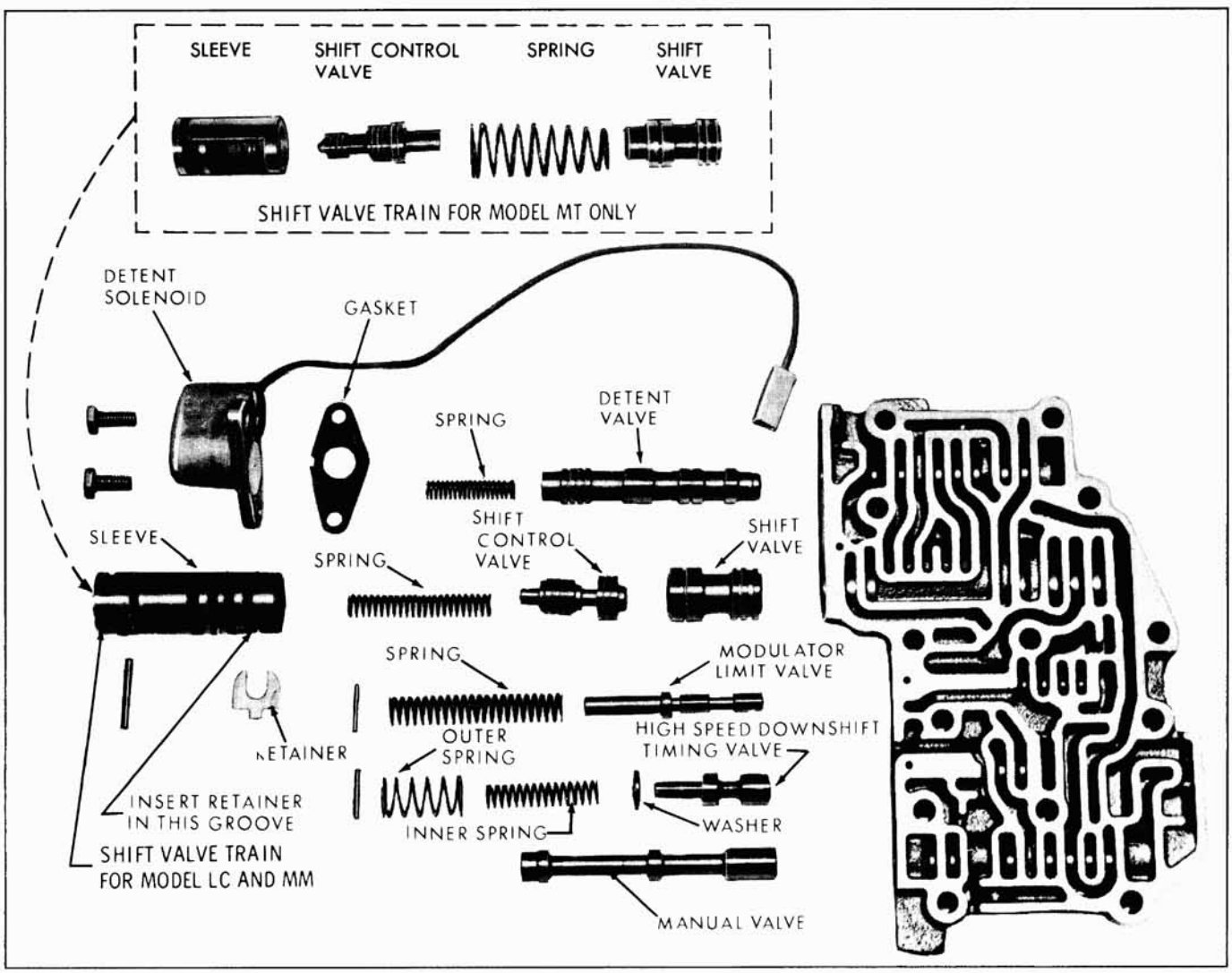


Fig. 7-393—Valve Body Assembly (Exploded View)

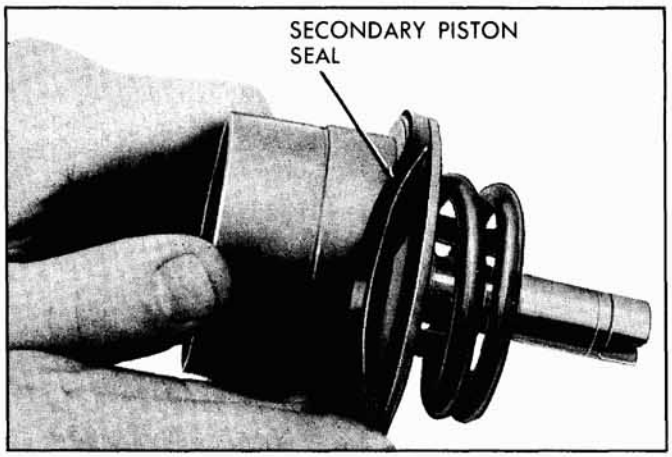


Fig. 7-394—Low Servo Piston Seal

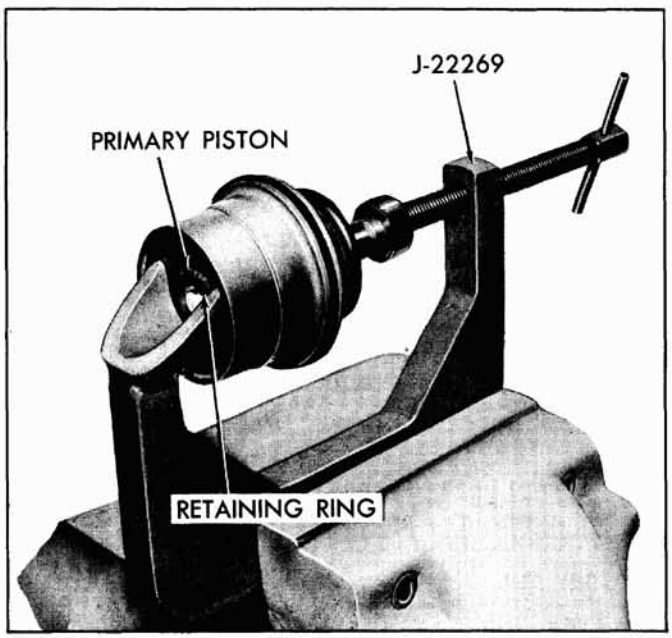


Fig. 7-395—Disassembly of Low Servo

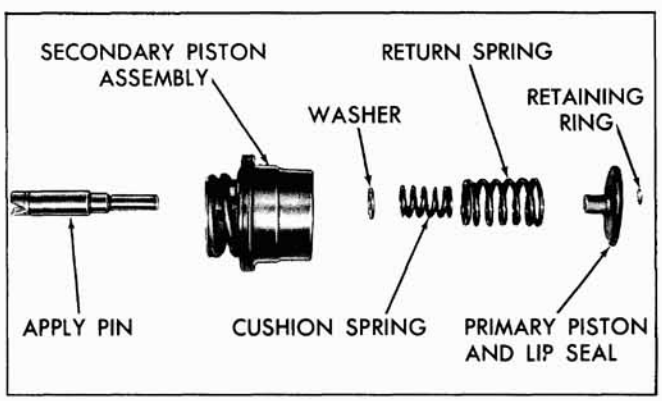


Fig. 7-396—Low Servo Piston Assembly

LOW SERVO

Disassembly

1. Remove low servo secondary piston seal. (Fig. 7-394)

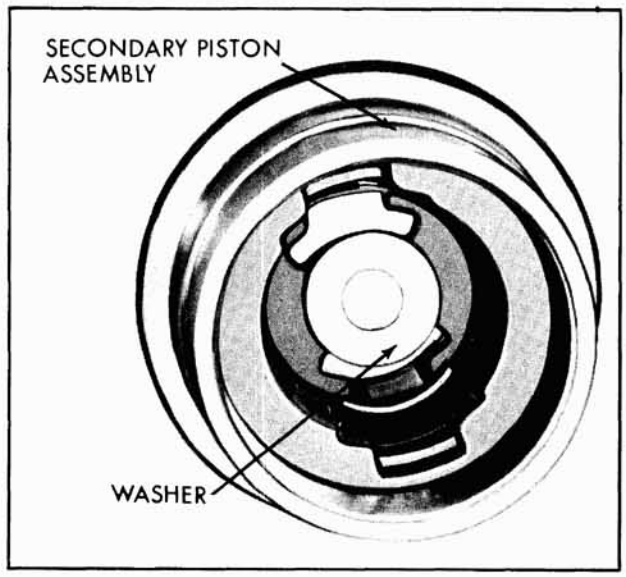


Fig. 7-397—Installing Washer

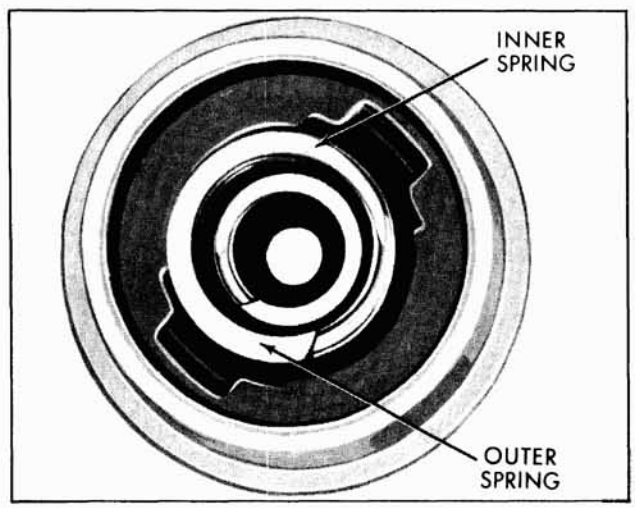


Fig. 7-398—Installing Springs

2. Compress primary piston using J-22269 and remove retaining snap ring. Release J-22269. (Fig. 7-395) Remove primary piston, springs, apply pin and washer from secondary piston assembly. (Fig. 7-396)
3. Inspect primary piston lip seal, if nicked, torn or worn, replace piston.

Reassembly

1. Install washer into secondary piston assembly. (Fig. 7-397)
2. Install inner and outer springs into secondary piston assembly. (Fig. 7-398)
3. Install primary piston. Compress piston using J-22269. Install new retaining snap ring.

OIL PUMP

Disassembly

1. Remove the two lock-type oil sealing rings from pump hub. (Fig. 7-399)
2. Remove pump cover to forward clutch drum thrust washer. (Fig. 7-400)
3. Remove oil pump to case seal and discard. (Fig. 7-401)
4. Support oil pump on wood blocks. Remove five pump

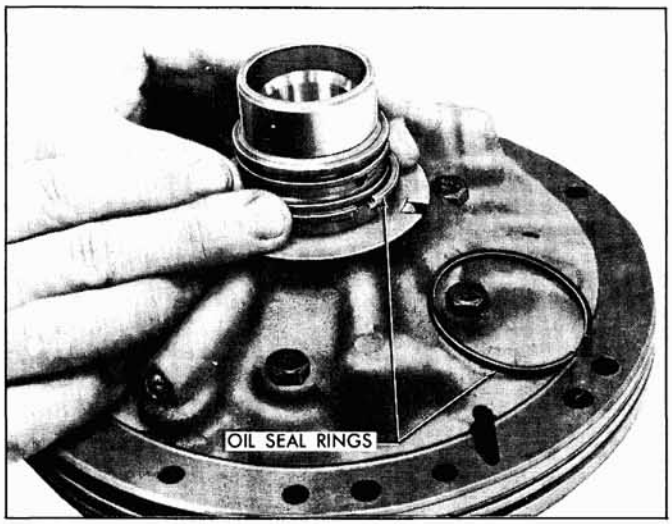


Fig. 7-399—Removing Oil Rings

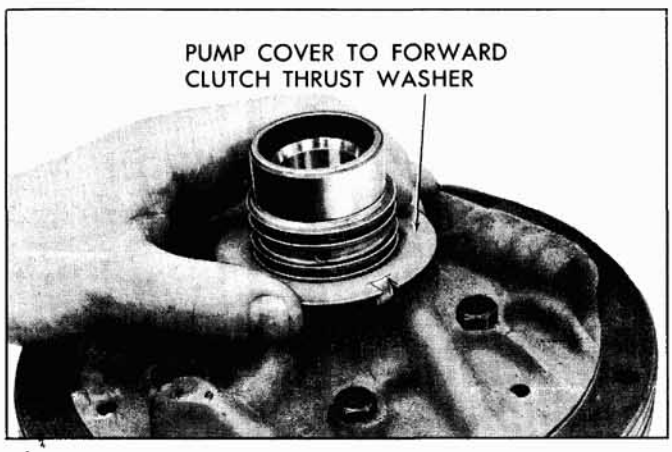


Fig. 7-400—Removing Thrust Washer

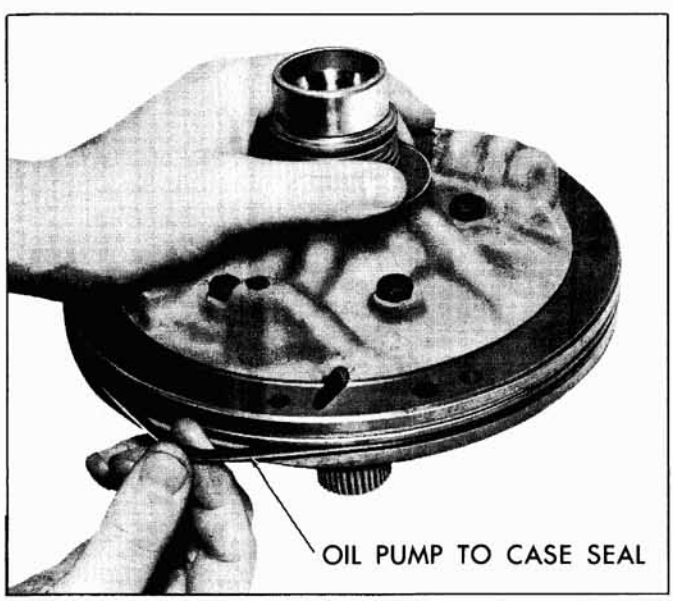


Fig. 7-401—Removing Pump to Case Seal

cover bolts and remove cover.

5. Mark, but do not scar, gear faces so gears can be reassembled in same manner. (Fig. 7-403)

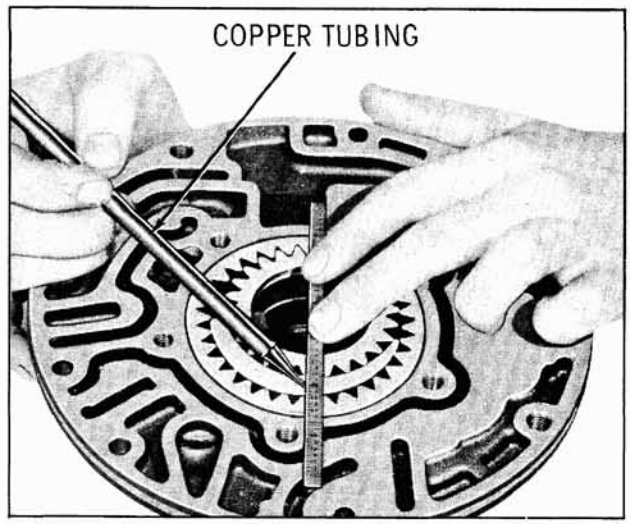


Fig. 7-403—Marking Oil Pump Gears

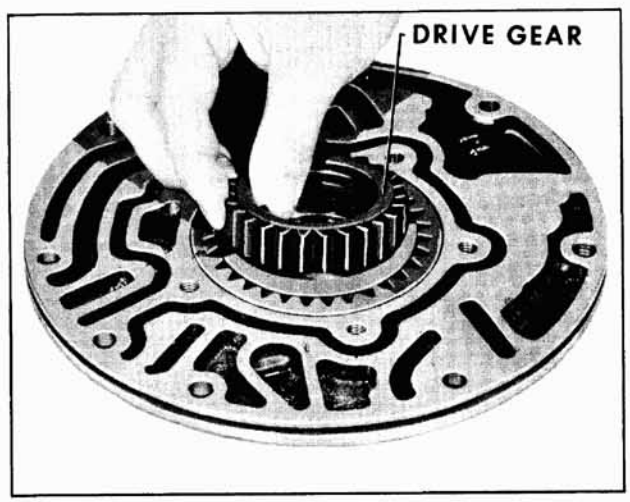


Fig. 7-404—Removing Oil Pump Drive Gear

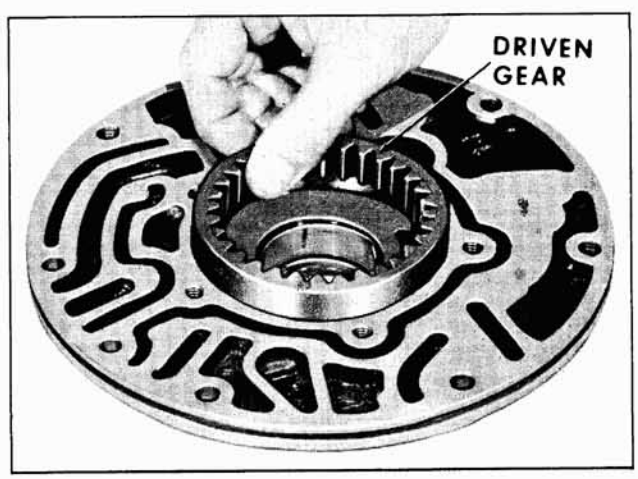


Fig. 7-405—Removing Oil Pump Driven Gear

6. Remove oil pump drive gear. (Fig. 7-404)
7. Remove oil pump driven gear. (Fig. 7-405)
8. Depress converter pressure relief valve spring.
9. Remove retaining pin, spring and relief ball. (Fig. 7-406)

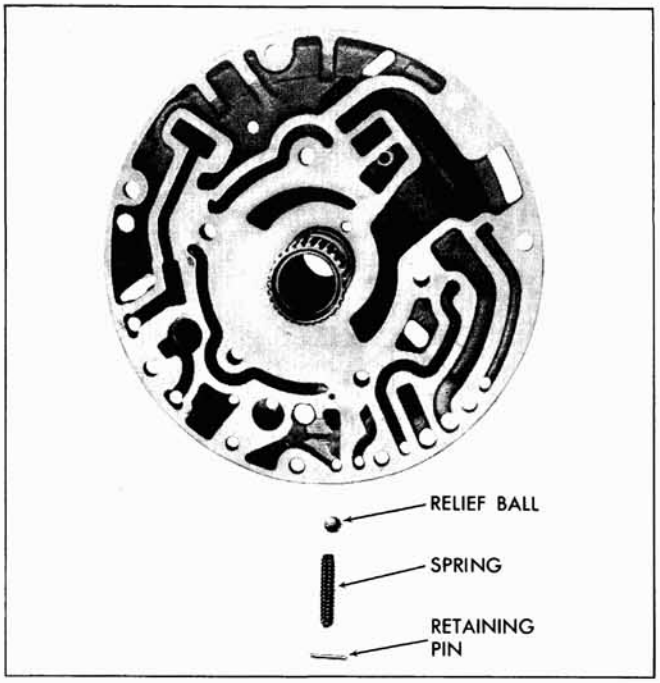


Fig. 7-406—Converter Pressure Relief Ball

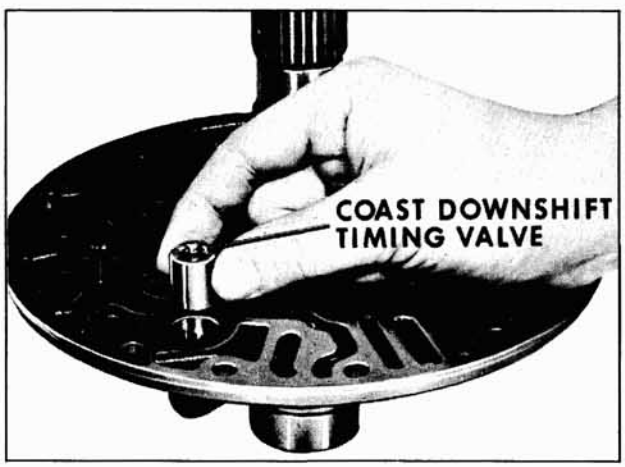


Fig. 7-407—Removing Coast Downshift Timing Valve

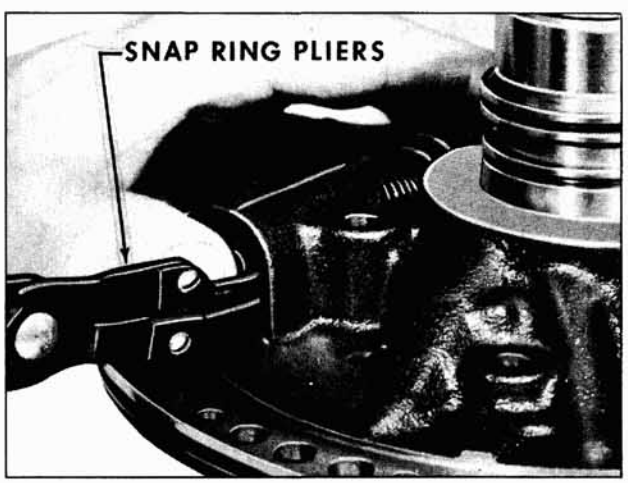


Fig. 7-408—Removing Snap Ring

10. Model MM and MT - Remove coast-downshift timing valve from pump cover (Fig. 7-407)

11. Compress reverse and modulator boost valve with thumb and remove retaining snap ring. (Fig. 7-408)

Reverse and modulator boost valve sleeve is under extreme spring pressure. Extreme care should be taken after retaining snap ring has been removed.

12. After retaining snap ring has been removed, remove reverse and modulator boost valve sleeve and valve, spring,

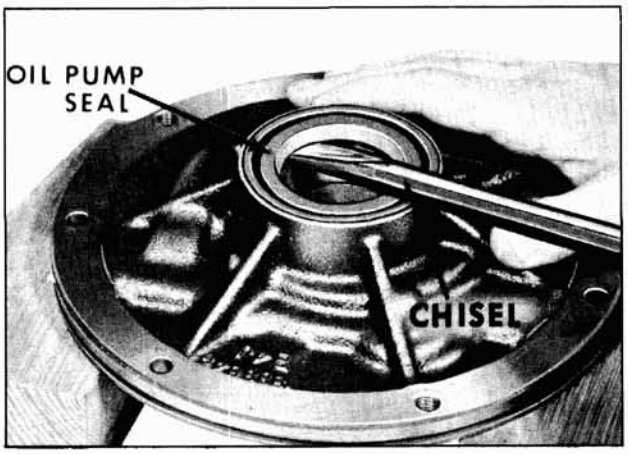


Fig. 7-409—Removing Oil Seal

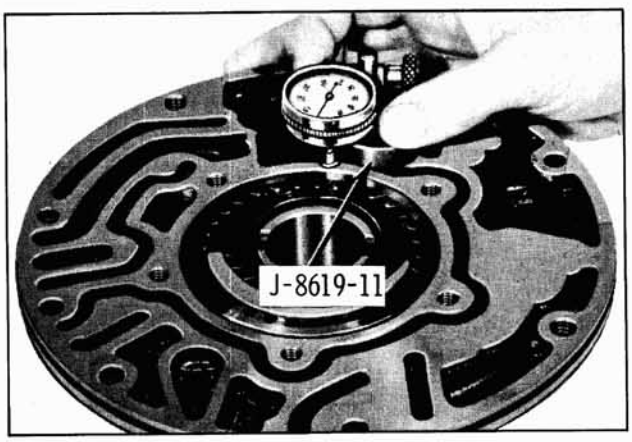


Fig. 7-410—Checking End Clearance

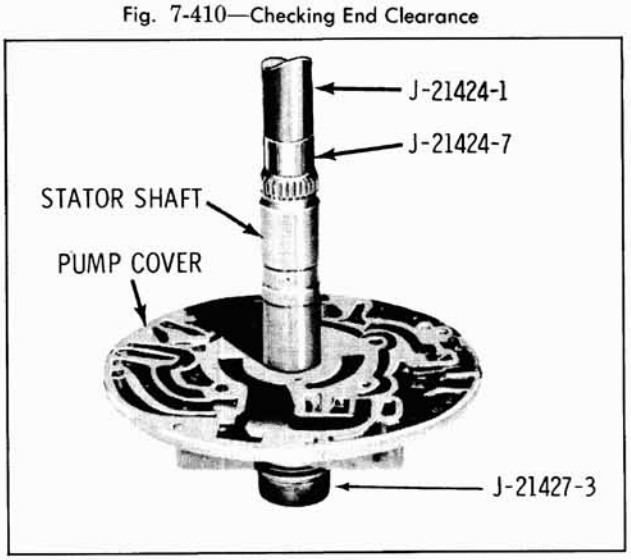


Fig. 7-411—Installing Oil Seal

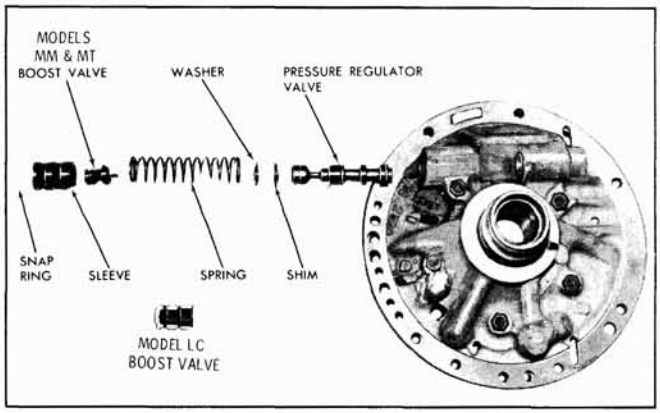


Fig. 7-413—Pressure Regulator Valve - Exploded View

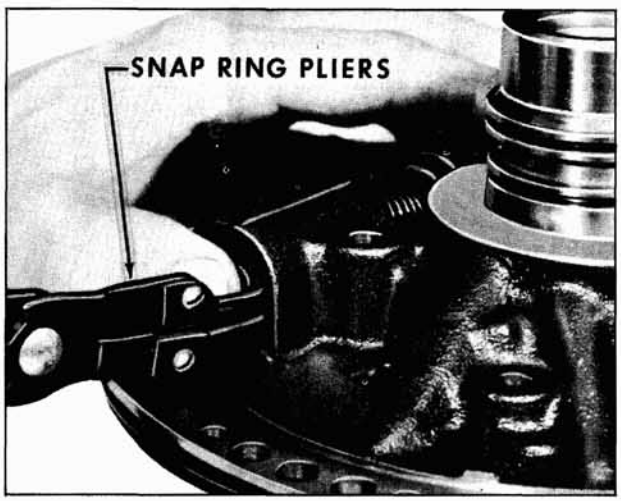


Fig. 7-414—Installing Snap Ring

washer and pressure regulator valve.

13. Examine oil pump seal. If nicked, torn or worn, remove seal as follows: Support oil pump body on wood blocks. Remove oil seal with a chisel and discard. (Fig. 7-409)

If seal is being replaced with pump in transmission, pry under lip of seal.

Check oil pump bushing and stator shaft bushing for nicks, severe scoring or wear. If bushing replacement is necessary, refer to "Bushing Service" at the rear of this section.

Inspection

1. Wash all parts in a cleaning solvent and blow out oil passages with compressed air.
2. Inspect pump gears for nicks or damage.
3. Inspect pump body for nicks or scoring.
4. Check condition of bushing in oil pump body, if damaged replace.
5. With parts clean and dry, install pump gears, noting mark on gears for identification of the side that faces the pump cover. After gears have been installed, proceed as follows:

a. With dial indicator set, check end clearance. The clearance allowed is .0005" to .0035". (Fig. 7-410)

Reassembly

1. If seal was removed, using Installer J-21359, tap in new oil seal. (Fig. 7-411)

Seal can be installed with pump in transmission.

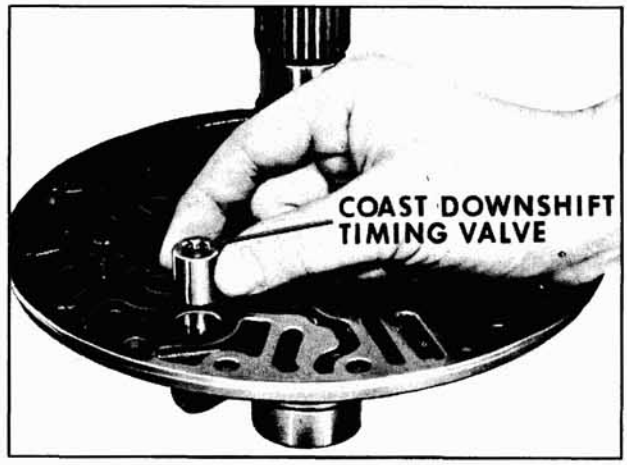


Fig. 7-415—Installing Coast Downshift Timing Valve

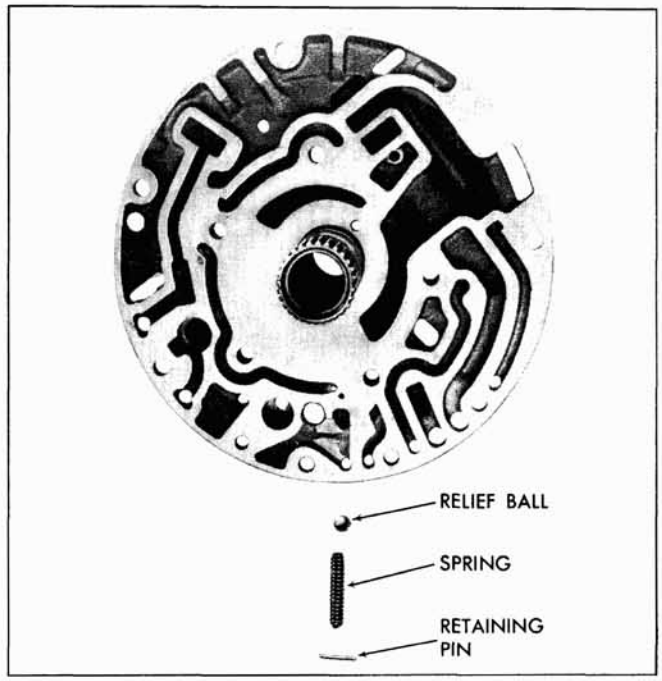


Fig. 7-416—Converter Pressure Relief Ball

2. Assemble pressure regulator valve, washer, spring, reverse and modulator boost valve and sleeve. (Fig. 7-413) When installing spring and shim, make certain the same springs and the proper number of shims are installed.

Color of Spring	Number of Shims
Maroon	None
Pink	One
White	Two

3. Compress reverse and modulator boost valve with thumb, then install retaining snap ring. (Fig. 7-414)

4. Model MM and MT - Install coast downshift timing valve "button end up" in cover. (Fig. 7-415)

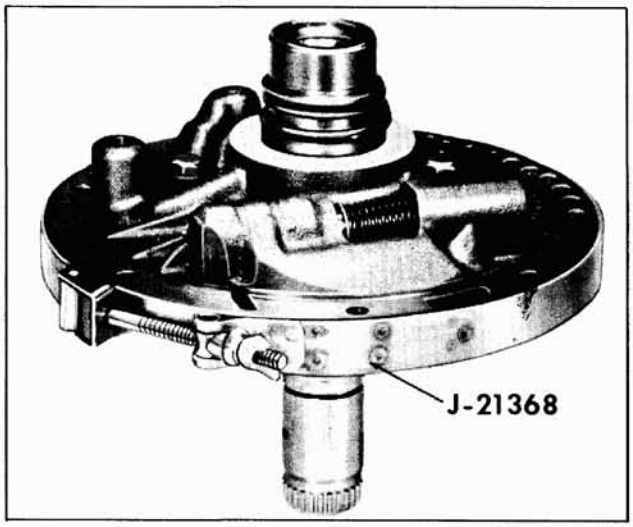


Fig. 7-417—Installing Pump Cover to Pump Body

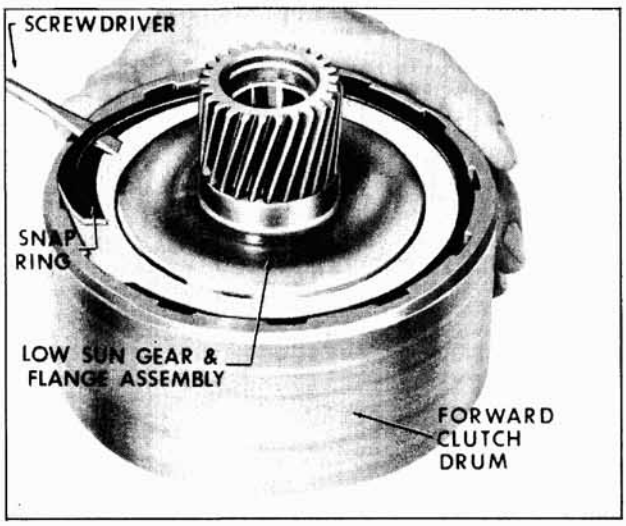


Fig. 7-418—Removing Snap Ring

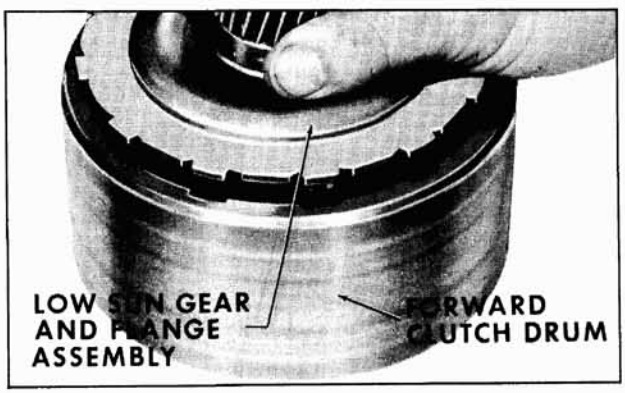


Fig. 7-419—Removing Low Sun Gear and Flange Assembly

Button Color
Model MM Black
Model MT Orange

5. Install converter pressure relief ball and spring.
6. Depress spring and install retaining pin. (Fig. 7-416)

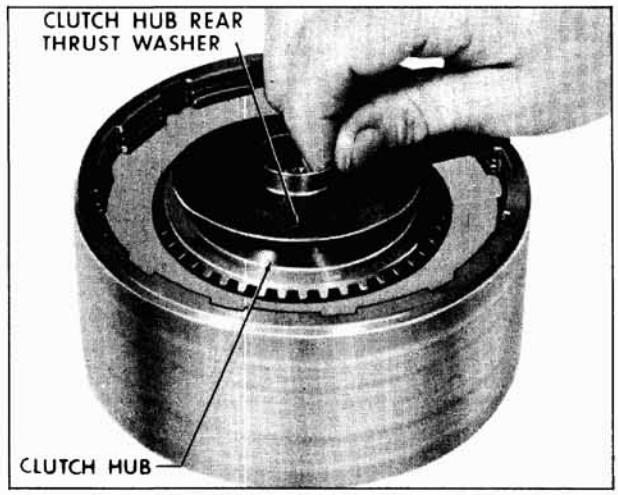


Fig. 7-420—Removing Thrust Washer

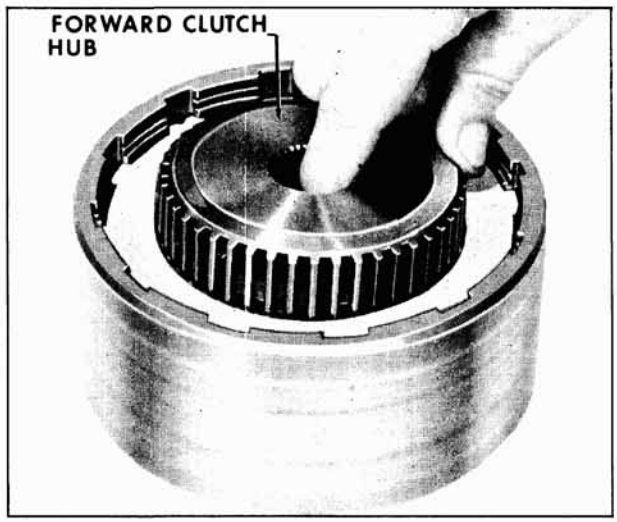


Fig. 7-421—Removing Clutch Hub

Thrust washer and oil pump sealing rings will be installed during later operation.

7. Install pump cover to pump body. Install five retaining bolts but do not tighten. Place Tool J-21368 around pump to obtain proper alignment. Tighten bolts to 24 ft. lbs. (Fig. 7-417)

The bolt location at the pressure regulator takes a longer bolt.

FORWARD CLUTCH

Disassembly

1. Remove low sun gear and flange assembly retainer snap ring. (Fig. 7-418)
2. Remove low sun gear and flange assembly. (Fig. 7-419)
3. Remove clutch hub rear thrust washer. (Fig. 7-420)
4. Lift forward clutch hub from clutch pack. (Fig. 7-421)
5. Remove clutch hub front thrust washer. (Fig. 7-422)
6. Remove clutch pack from forward clutch drum. (Fig. 7-423)
7. Using Tools J-4670-14, J-8765 and J-6129, compress spring retainer and remove snap ring. Remove tools and component parts, being careful that spring retainer does not catch in snap ring groove. (Fig. 7-424)
8. Lift off spring retainer and 24 clutch springs. (Fig. 7-425)

Fig. 7-422—Removing Thrust Washer

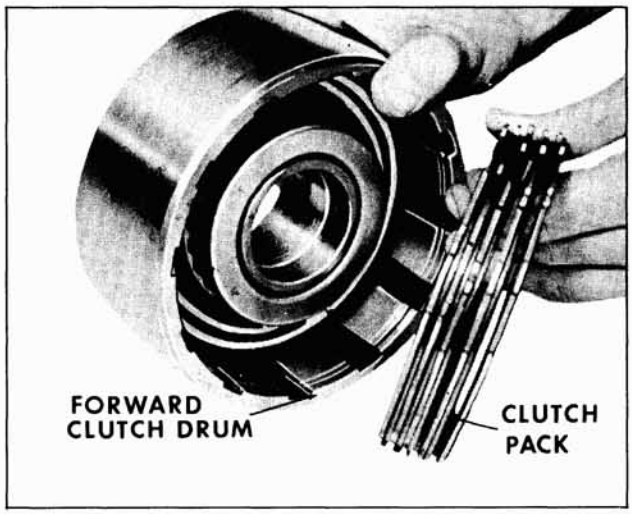


Fig. 7-423—Removing Clutch Pack

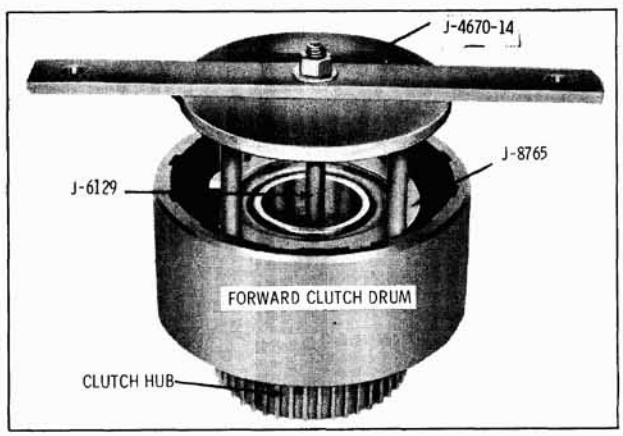


Fig. 7-424—Removing Snap Ring

9. Lift up on forward clutch piston with a twisting motion and remove. (Fig. 7-426)

10. Examine forward clutch piston outer seal. If nicked, torn or worn, remove seal. (Fig. 7-427)

11. Examine cushion ring. If nicked, torn or worn, replace clutch piston and ring as an assembly.

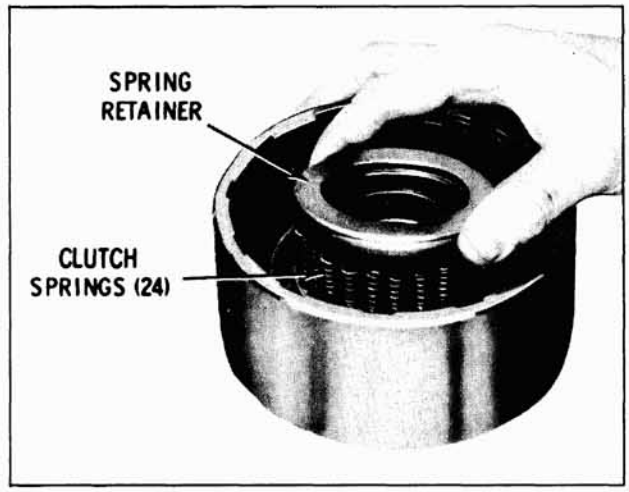


Fig. 7-425—Removing Spring Retainer and Springs

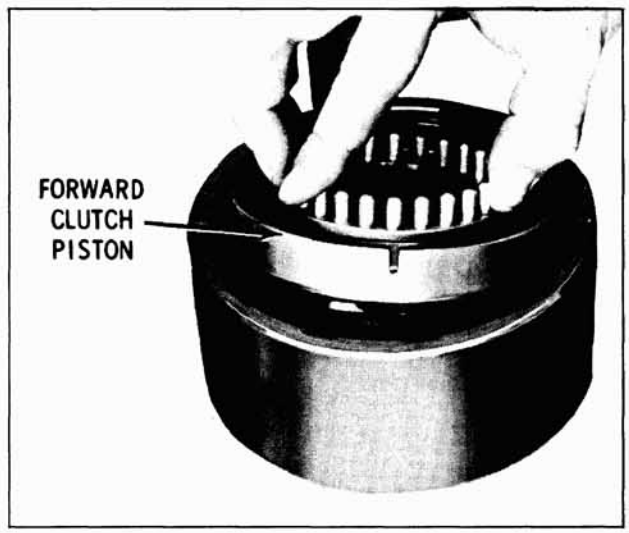


Fig. 7-426—Removing Forward Clutch

Cushion ring is bonded to piston.

12. Examine forward clutch piston inner seal. If nicked, torn or worn, remove seal.

13. Check forward clutch drum and low sun gear and flange assembly for nicks, severe scoring or wear. If bushing replacement is necessary, refer to "Bushing Service" at the rear of this section.

Inspection

1. Wash all parts in a suitable cleaning solvent. Use compressed air to dry.

2. Check steel ball in the forward clutch drum. Be sure it is free to move in hole and that orifice leading to front of clutch drum is open.

3. Check clutch plates for wear or scoring.

Reassembly

1. Lubricate with transmission oil and install new forward clutch piston inner seal with seal lip pointing downward.

Run hand around seal after it is installed to see if seal is fully in groove.

2. Lubricate with transmission oil and install new forward clutch piston outer seal in clutch piston. Seal lip must point down. (Fig. 7-427)

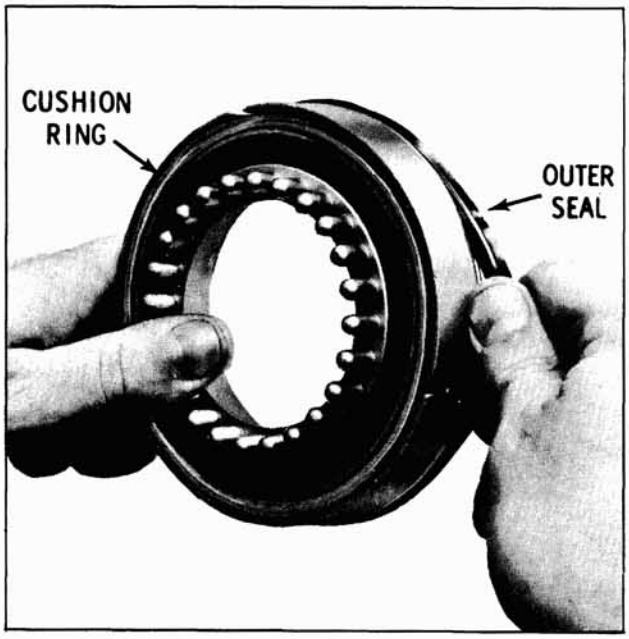


Fig. 7-427—Forward Clutch Outer Seal

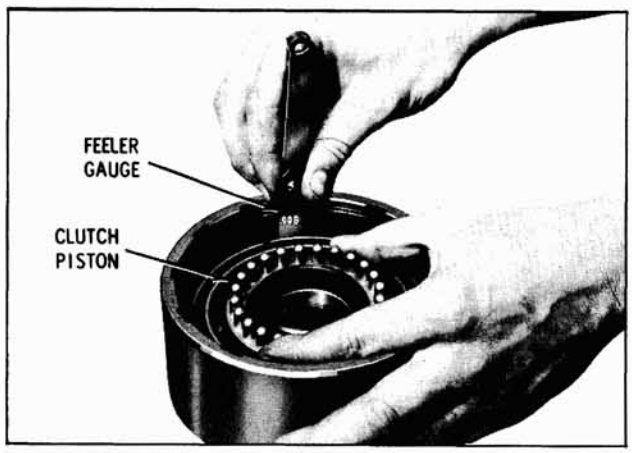


Fig. 7-428—Installing Clutch Piston

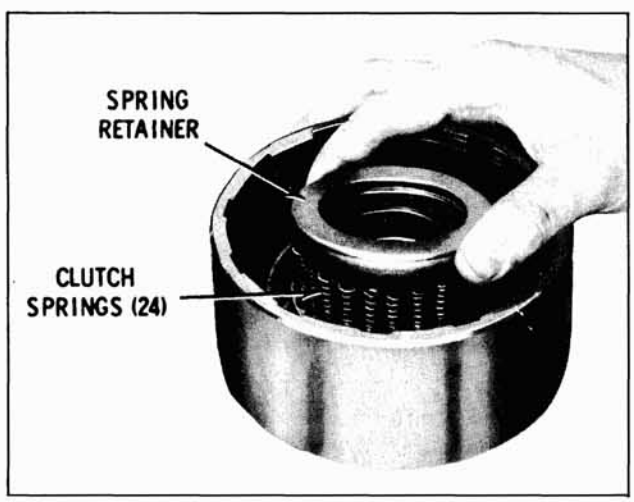


Fig. 7-429—Installing Springs and Retainer

3. Install forward clutch piston into clutch drum using a .005" feeler gauge to start lip of seal into bore. (Fig. 7-428)

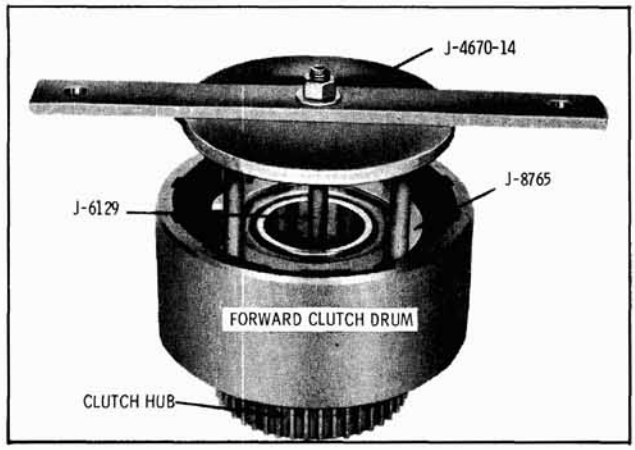


Fig. 7-430—Installing Snap Ring

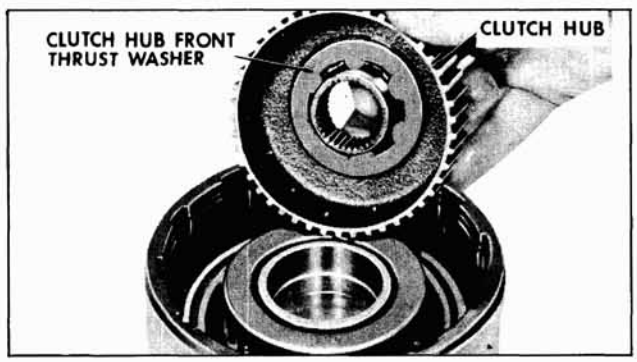


Fig. 7-431—Installing Clutch Hub

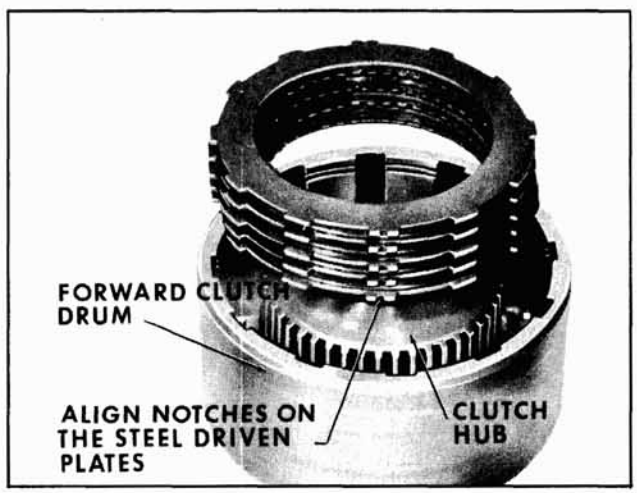


Fig. 7-432—Installing Clutch Pack

4. Carefully reassemble return spring, retainer and snap ring. (Fig. 7-429)

5. With spring retainer in place, compress spring retainer with Tools J-4670-14, J-8765 and J-6129 far enough so the spring retainer snap ring can be installed. Make sure retainer doesn"t catch in snap ring groove when compressing spring. (Fig. 7-430)

6. Install cushion ring in piston groove, install clutch hub front thrust washer to clutch hub (retain with grease). Install clutch hub. (Fig. 7-431)

7. Align notches on steel driven plates. Install steel driven plates and lined drive plates alternately, beginning with a steel driven plate. (Fig. 7-432)

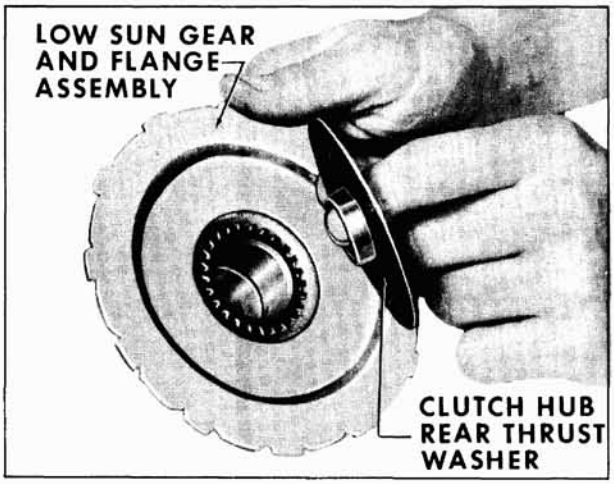


Fig. 7-433—Installing Thrust Washer

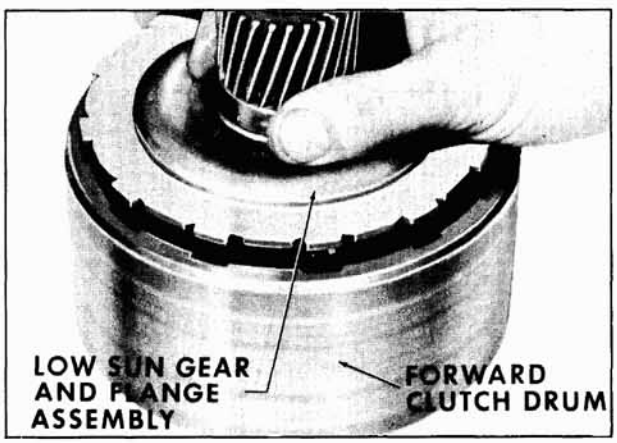


Fig. 7-434—Installing Low Sun Gear and Flange Assembly

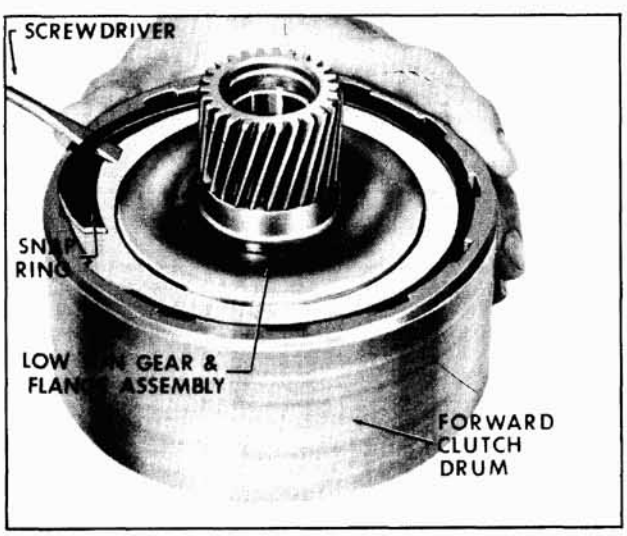


Fig. 7-435—Installing Snap Ring

Cars with L-6 engines have four drive plates and five driven plates. Cars with 350 cu. in. V-8 engines have five drive plates and six driven plates.

8. Install clutch hub rear thrust washer with its flange toward low sun gear and flange assembly. (Fig. 7-433)
9. Install low sun gear and flange assembly. (Fig. 7-434)
10. Install low sun gear and flange assembly retaining ring. Position snap ring so gap is centered between slots in drum. (Fig. 7-435)

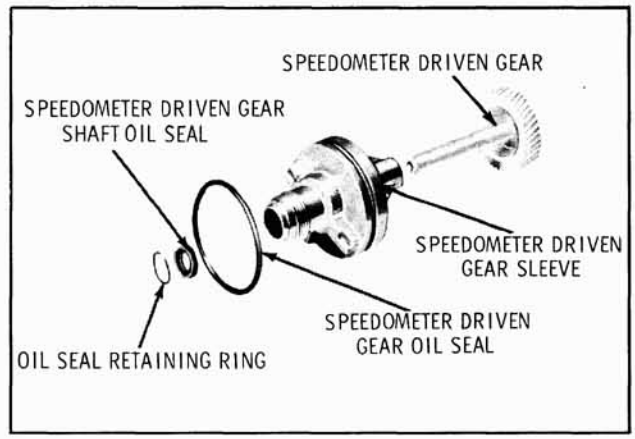


Fig. 7-436—Speedometer Driven Gear

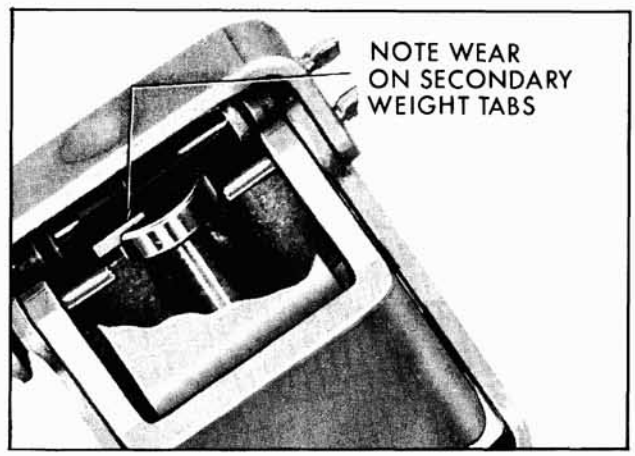


Fig. 7-437—Checking Governor Weight Tab Wear

SPEEDOMETER DRIVEN GEAR

Disassembly

1. Remove speedometer driven gear. (Fig. 7-436)
2. Examine speedometer driven gear oil seal. If nicked, torn or worn, remove seal.
3. Examine speedometer driven gear shaft oil seal. If nicked, torn or worn, remove seal.

Reassembly

1. Install speedometer driven gear shaft oil seal with lip of seal pointing toward rear of speedometer gear sleeve. Install oil seal retaining ring.
2. Install speedometer driven gear oil seal. (Fig. 7-436)
3. Install speedometer driven gear.

GOVERNOR DRIVEN GEAR

Before any attempt is made to service the governor gear, the following checks must be made.

1. Check for secondary governor weight tab wear. (Fig. 7-437)
2. Check governor feed port opening. (Fig. 7-438)

If either secondary tab shows wear or feed port opening is found to be less than .019" the complete governor assembly must be replaced.

Removal

1. Support governor sleeve on wood block and remove roll

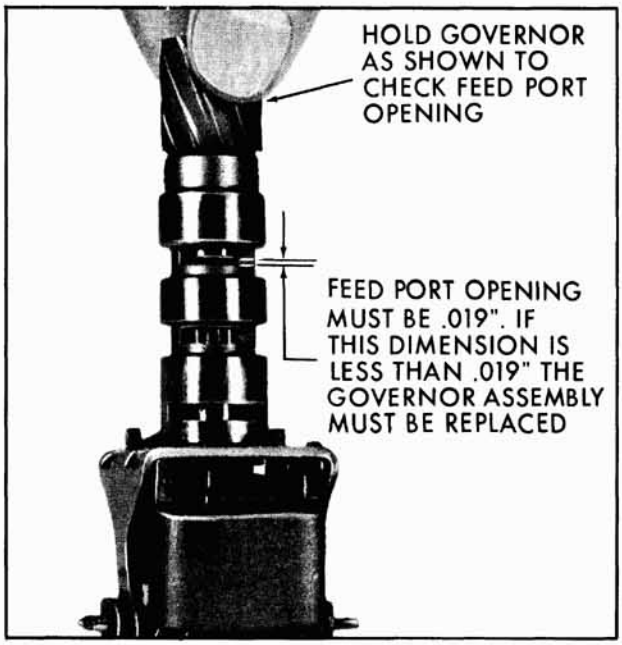


Fig. 7-438—Checking Governor Feed Port

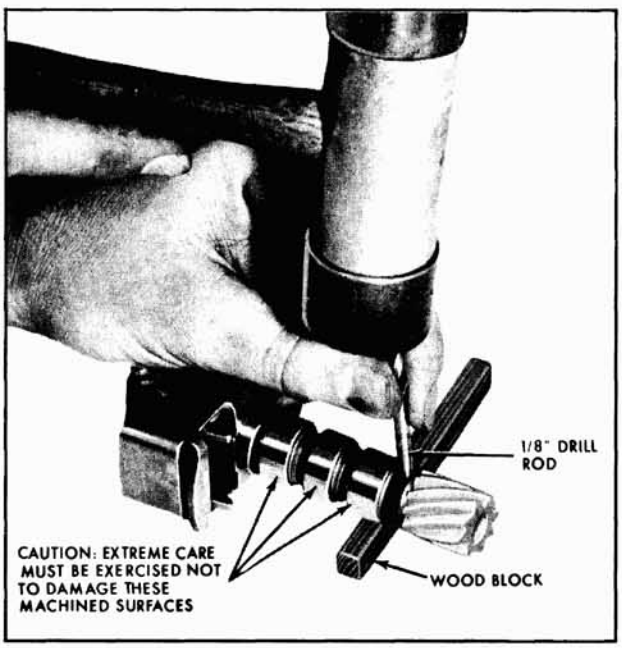


Fig. 7-439—Removing Governor Gear Pin

pin with a 1/8" drill rod. (Fig. 7-439)

If wood block is placed under nylon gear, breakage of gear inside governor sleeve will result. Do not damage machine surfaces of governor sleeve.

2. Remove driven gear. Remove any chips or burrs from inside governor sleeve.

Installation

Install replacement gear by carefully:

1. Pressing new gear into sleeve.
2. Using Press Plate J-8853, place shim supplied in replacement gear kit between the second and third lands of governor sleeve. (Fig. 7-440)
3. Make certain new gear is positioned squarely on sleeve

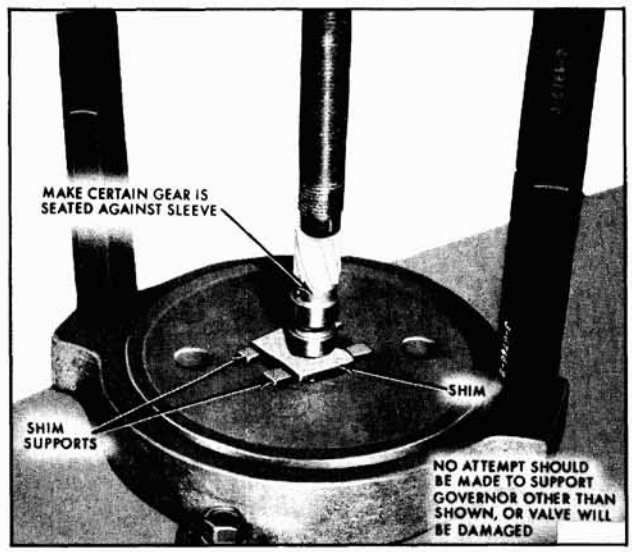


Fig. 7-440—Installing Governor Gear

Fig. 7-441—Drilling Governor Gear

and press gear onto sleeve. Gear must be seated against sleeve. (Fig. 7-440)

Do not support or hammer on rear of governor.

4. Through existing hole in governor sleeve, drill a 1/8" hole half-way through from each end. (Fig. 7-441)

It is important that the hole for roll pin be drilled straight as possible to insure proper retention and installation of roll pin and gear.

5. Support end of governor sleeve (not gear) on a wooden block. Install new roll pin; then using a small chisel, stake pin in place at both ends of pin to prevent pin from becoming loose. (Fig. 7-442)
6. Check for burrs on sleeve to see if valve is free in its bore. Any burrs that are left on governor sleeve will damage the case.

PLANET CARRIER

Disassembly

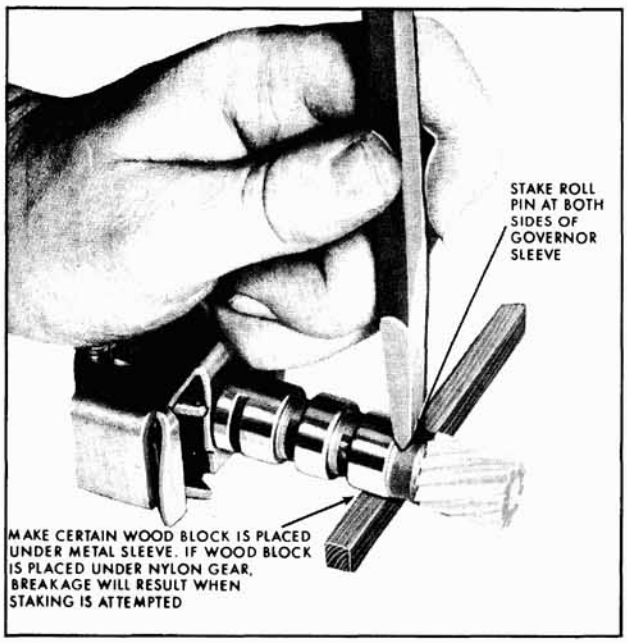


Fig. 7-442—Staking Governor Gear Roll Pin

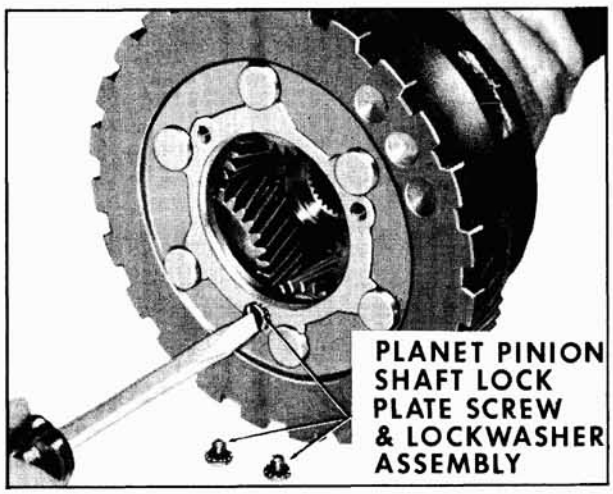


Fig. 7-443—Removing Planet Pinion Lock Plate Screws

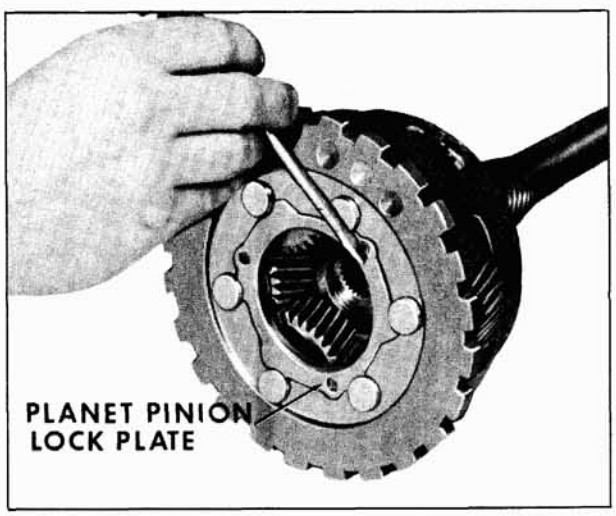


Fig. 7-444—Removing Lock Plate

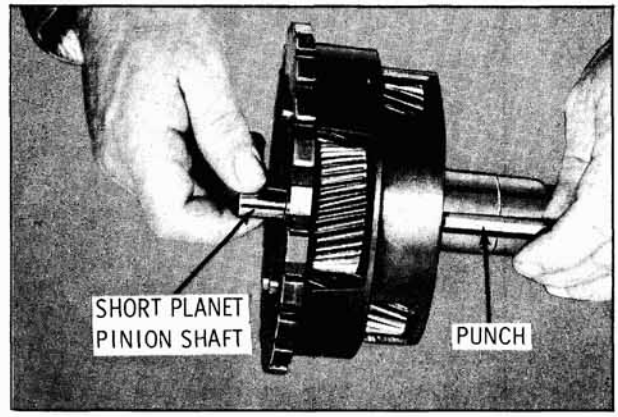


Fig. 7-445—Removing Short Planet Pinion Gear

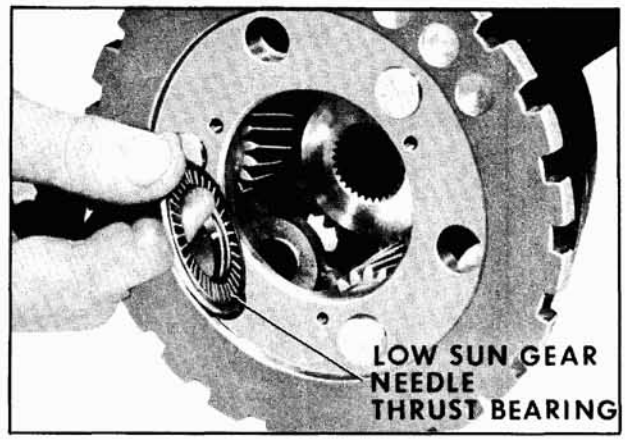


Fig. 7-446—Removing Low Sun Gear Thrust Bearing

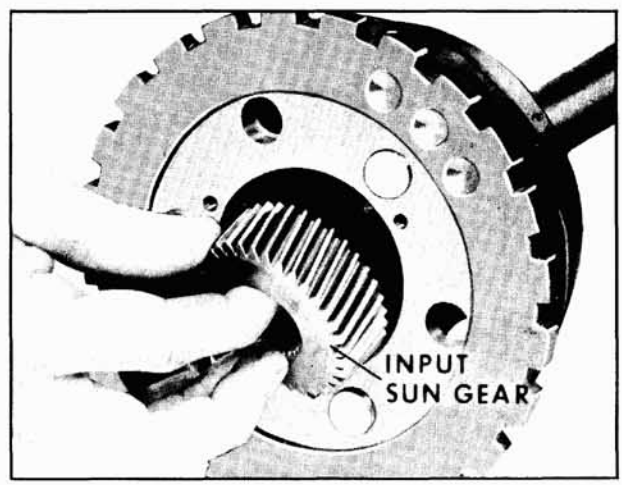


Fig. 7-447—Removing Input Sun Gear

1. Remove three planet pinion shaft lock plate screws and lockwashers. (Fig. 7-443)
2. Rotate planet pinion lock plate and remove. (Fig. 7-444)
3. Remove the short planet pinion shafts and short pinions. (Fig. 7-445)
4. Remove needle bearings and thrust washers from the short planet pinion gears.
5. Remove low sun gear needle thrust bearing. (Fig. 7-446)
6. Remove input sun gear. (Fig. 7-447)

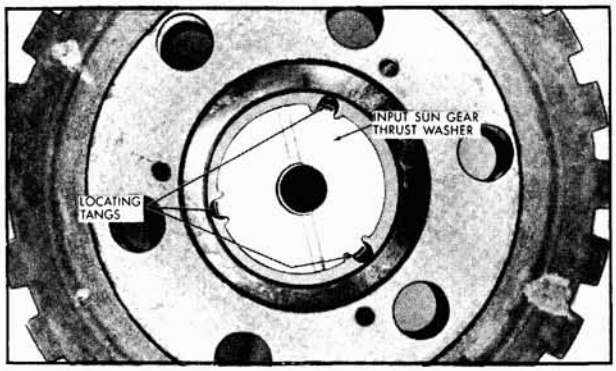


Fig. 7-448—Removing Front Thrust Washer

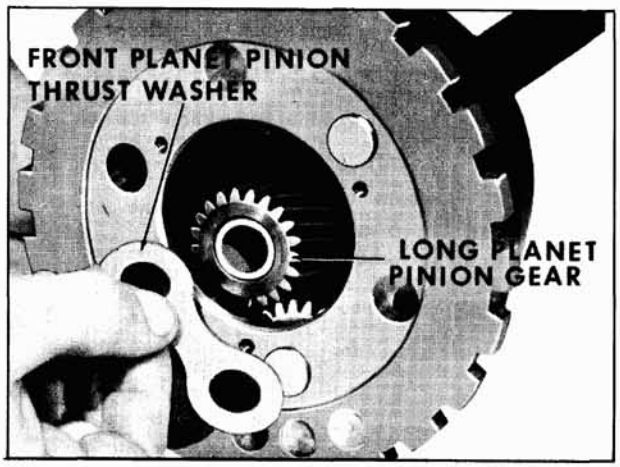


Fig. 7-449—Removing Long Planet Pinion Gear

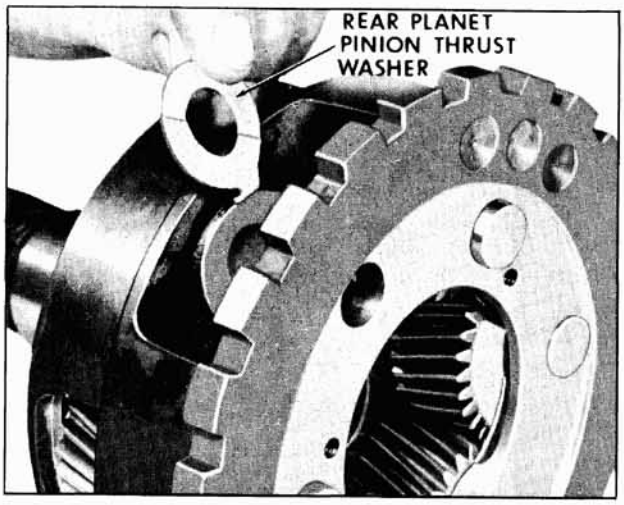


Fig. 7-450—Removing Rear Thrust Washer

7. Remove input sun gear thrust washer. (Fig. 7-448)
8. Remove the long planet pinion shafts and long planet pinion gears. (Fig. 7-449)
9. Remove front planet pinion thrust washer. (Fig. 7-449)
10. Remove needle bearings, spacers and thrust washers from the long planet pinion gears.
11. Remove rear planet pinion thrust washer. (Fig. 7-450)

Inspection of Planet Carrier Parts

1. Wash all parts in a cleaning solvent and air dry.
2. Check the planet pinion gears and input sun gear tooth for excessive wear.

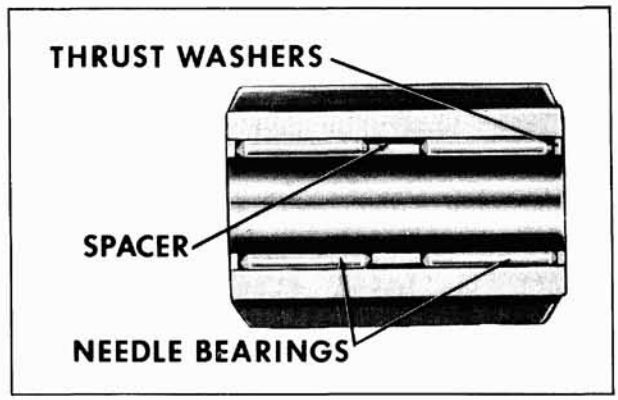


Fig. 7-451—Long Pinion Gear

Fig. 7-452—Locking Needle Bearings

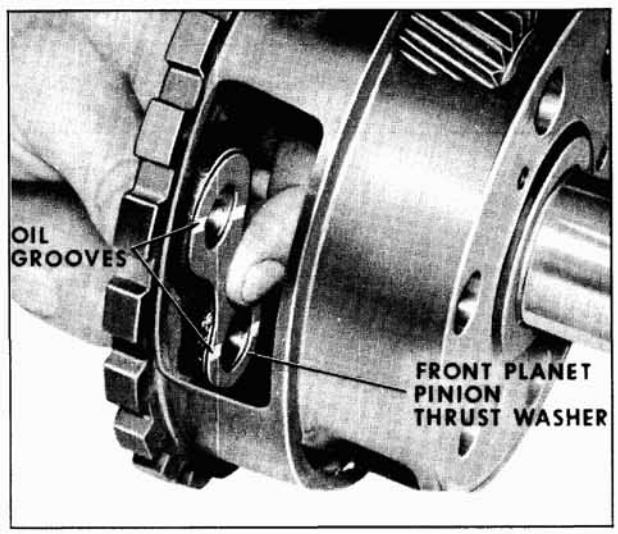


Fig. 7-453—Installing Front Thrust Washer

3. Check the planet pinion thrust washers and input sun gear thrust washer.
4. Check planet pinion needle bearings. If bearings show

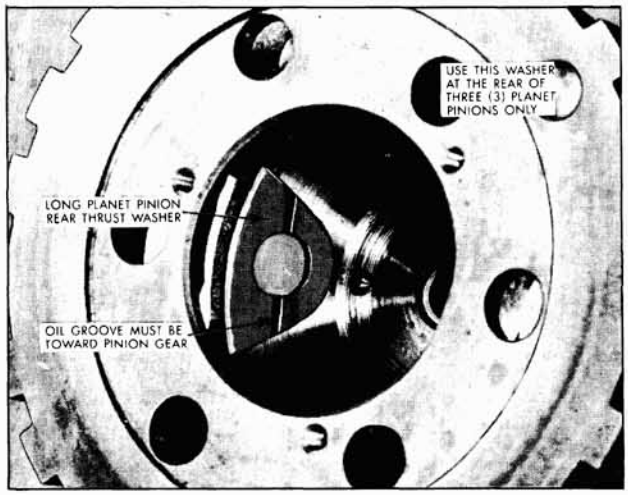


Fig. 7-454—Installing Rear Thrust Washer

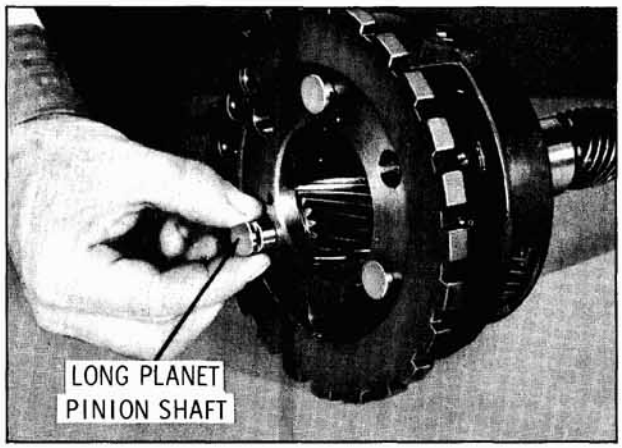


Fig. 7-455—Installing Long Pinion Gear Shaft

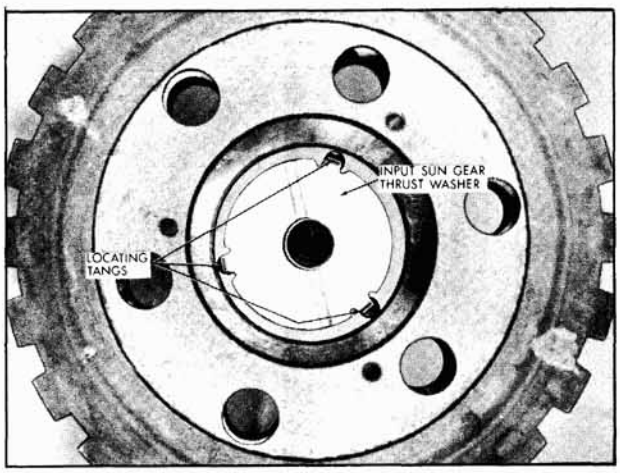


Fig. 7-456—Installing Thrust Washer

excessive wear, all the needle bearings must be replaced.

5. Check the planet pinion shafts closely, if worn, replace the worn shafts.

6. Check output shaft bushing for nicks, severe scoring or wear. If bushing replacement is necessary, refer to "Bushing Service" at the rear of this section.

Reassembly

1. Coat inside pinion gear with grease. Install pinion shaft into long planet pinion gear. Install 20 needle bearings, spacer, 20 more needle bearings and two thrust washers. (Fig. 7-451) Remove pinion shaft and with a twisting motion, lock both sets of needle bearings in place. (Fig. 7-452)

2. Install front planet pinion thrust washer. Retain thrust washer to carrier with grease. Oil grooves on the thrust washer must be toward the pinion gears. (Fig. 7-453)

3. Install the long planet pinion rear thrust washers. Retain with grease. Oil grooves must be toward pinion gear. (Fig. 7-454)

4. Position the long planet pinions with the thrust washers at each end in the planet carrier. Install the pinion shafts

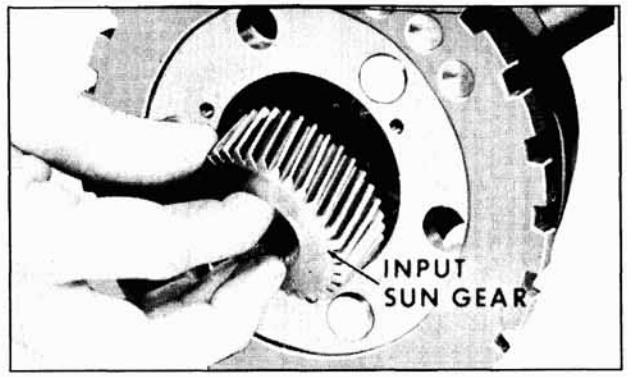


Fig. 7-457—Installing Input Sun Gear

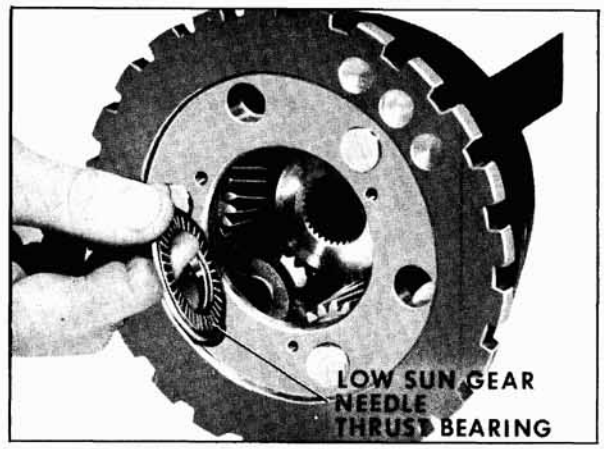


Fig. 7-458—Installing Thrust Bearing

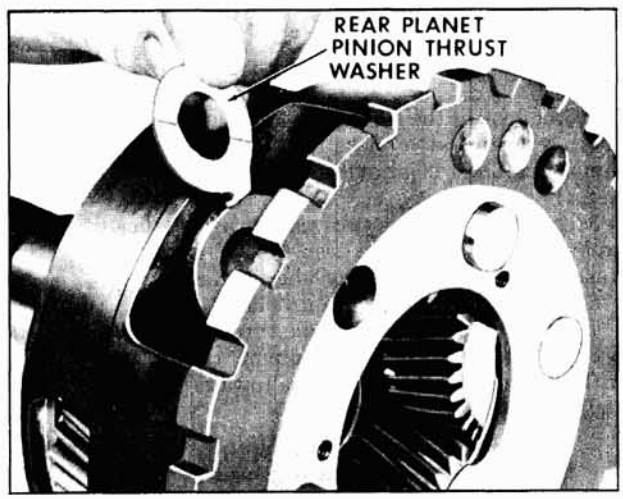


Fig. 7-459—Installing Rear Planet Pinion Thrust Washer

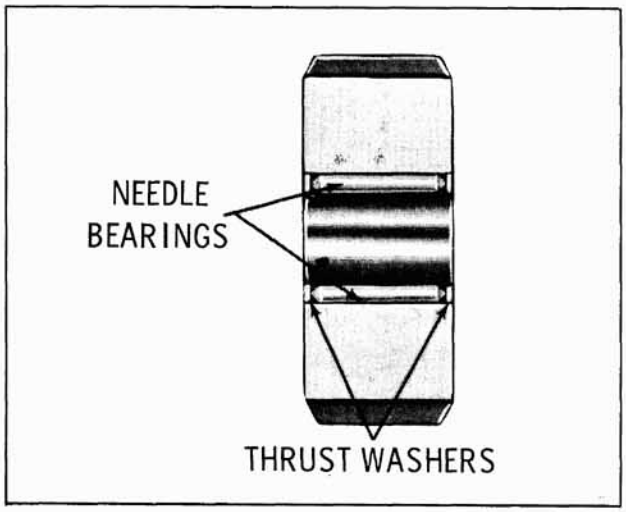


Fig. 7-460—Short Pinion Gear

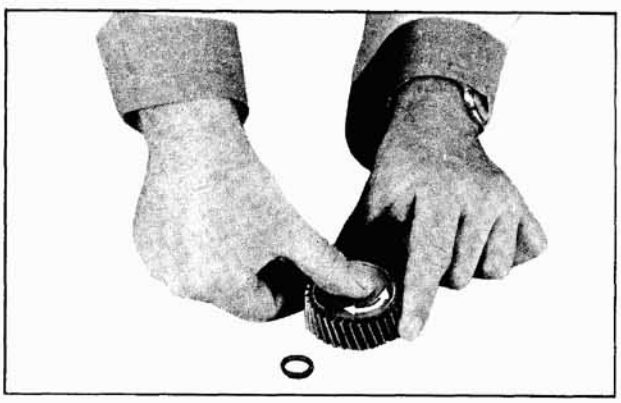


Fig. 7-461—Locking Needle Bearings

from the rear of the carrier. As the shaft is being pushed in, make certain that it picks up the thrust washer. Turn the pinion shaft so the grooves face the center of the planet carrier. (Fig. 7-455)

5. Install the input sun gear thrust washer with the oil grooves facing input sun gear. (Fig. 7-456) Tangs on thrust washer must be in holes in planet carrier.

6. Install input sun gear into planet carrier. (Fig. 7-457)

7. Install low sun gear needle thrust bearing. (Fig. 7-458)

8. Install the rear planet pinion thrust washer. Retain with grease. Oil grooves must be toward pinion gear. (Fig. 7-459)

The front thrust washer already installed with the long planet pinions also is used for the short planet pinions, as the two pinions are paired together on one set of thrust washers.

9. Install needle bearings (20) and thrust washers. (Fig. 7-460) Lock needle bearings as shown in Fig. 7-461.

10. Position short planet pinions with thrust washers at each end of the planet carrier. Install pinion shafts from the front of planet carrier. As the pinion shaft is being pushed in, make certain that it picks up the thrust washers. Turn the pinion shaft so the groove faces center of planet carrier. (Fig. 7-462)

11. Install planet pinion lock plate. Rotate plate so extended portions align with slots in planet pinion shafts and three attaching screw holes. (Fig. 7-463)

12. Install three planet pinion shaft lock plate screws and lockwashers. (Fig. 7-464)

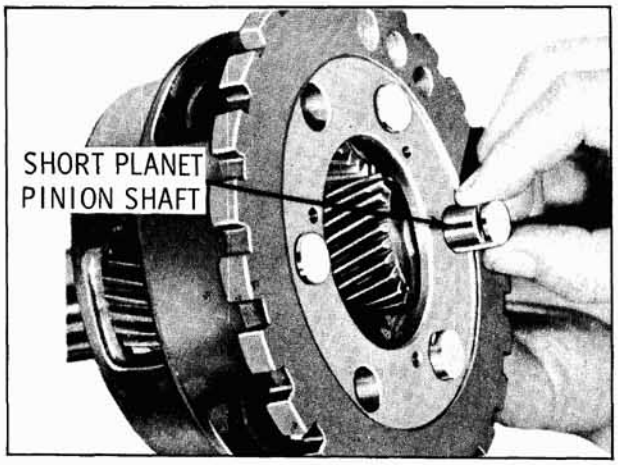


Fig. 7-462—Installing Short Pinion Shaft

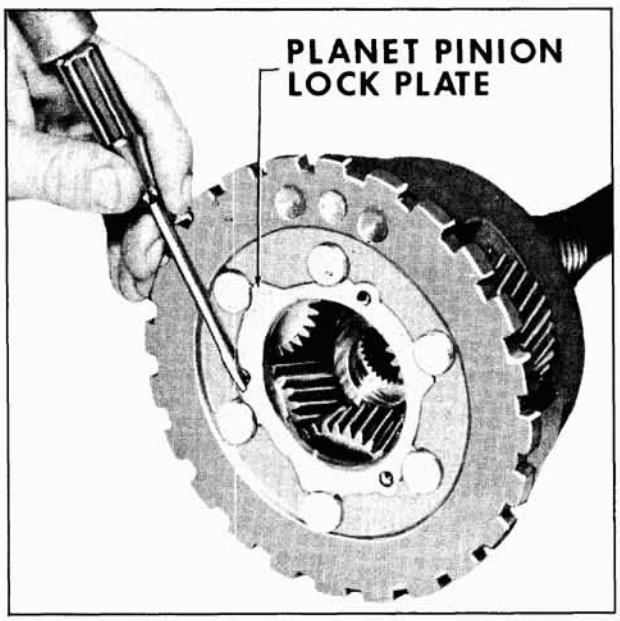


Fig. 7-463—Installing Lock Plate

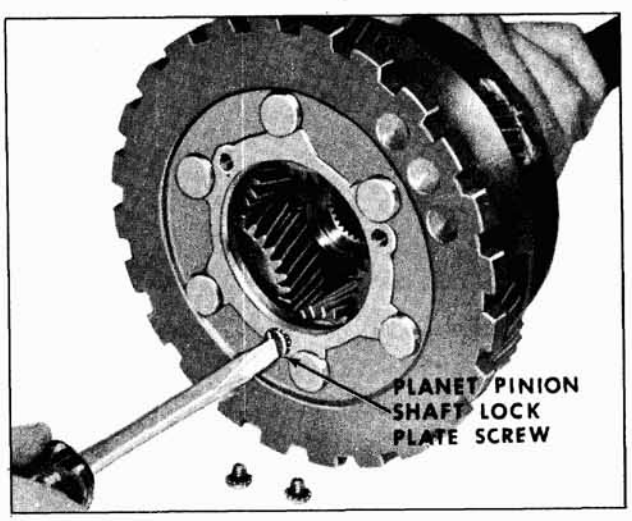


Fig. 7-464—Installing Lock Plate Screws

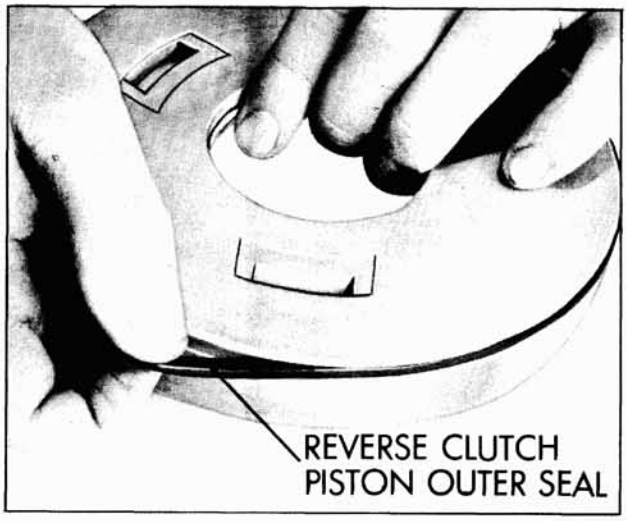


Fig. 7-465—Installing Reverse Outer Seal

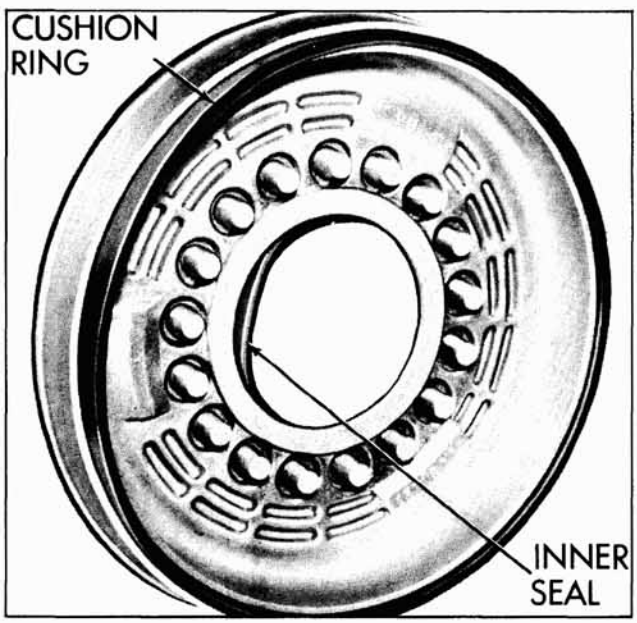


Fig. 7-466—Reverse Piston Inner Seal

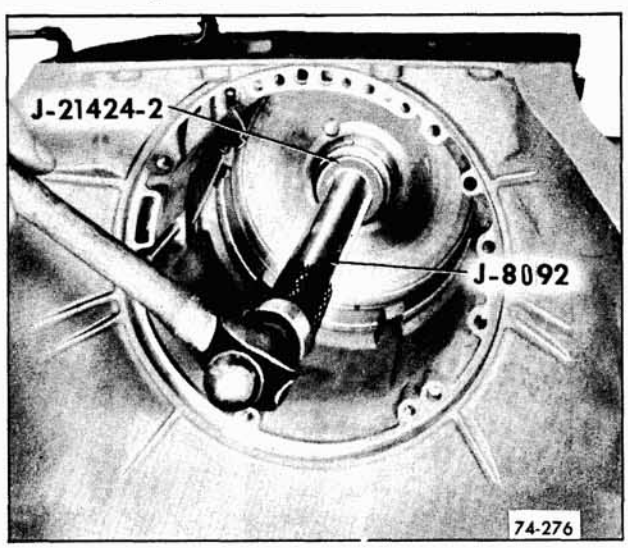


Fig. 7-467—Installing Case Bushing

Fig. 7-468—Installing Parking Lock

REVERSE CLUTCH PISTON SEALS

1. Examine reverse clutch piston outer seal. If nicked, torn or worn, remove seal. (Fig. 7-465)
2. Lubricate with transmission oil and install reverse clutch piston outer seal. (Fig. 7-465)
3. Examine reverse clutch piston inner seal. If nicked, torn or worn, remove seal. (Fig. 7-466)
4. Lubricate with transmission oil and install reverse clutch piston inner seal. (Fig. 7-466)
5. Examine cushion ring. If nicked, torn or worn, replace ring.

ASSEMBLY

Before starting to assemble the transmission, make certain that all parts are absolutely clean. Keep hands and tools clean to avoid getting dirt into assembly. If work is stopped before assembly is completed, cover all openings with clean cloths.

All moving parts should be given a light coating of transmission oil before installation. Thrust washers may be held in place with petrolatum, sparingly applied.

Replace all "O" rings, gaskets and oil seals that are removed.

Use care to avoid making nicks or burrs on parts, particularly at bearing surfaces and surfaces where gaskets are used.

Tighten all parts evenly and in proper sequence to avoid distortion of parts and leakage at gaskets and other joints. Use a reliable torque wrench to tighten all bolts to specified torque and in the specified sequence.

INSTALLING RANGE SELECTOR LEVER, SHAFT AND PARKING LOCK ACTUATOR

1. Install case bushing, make certain split on bushing is opposite notch in case. (Fig. 7-467)
2. Retain parking lock pawl and spring in case with parking lock pawl shaft. Position spring as shown. (Fig. 7-468)

Make certain parking pawl shaft is bottomed in its bore in case.

3. With a twisting motion, insert outer range selector lever into case. (Fig. 7-469) Use new seal with lip of seal towards case.
4. Assemble park lock actuator assembly to inner park

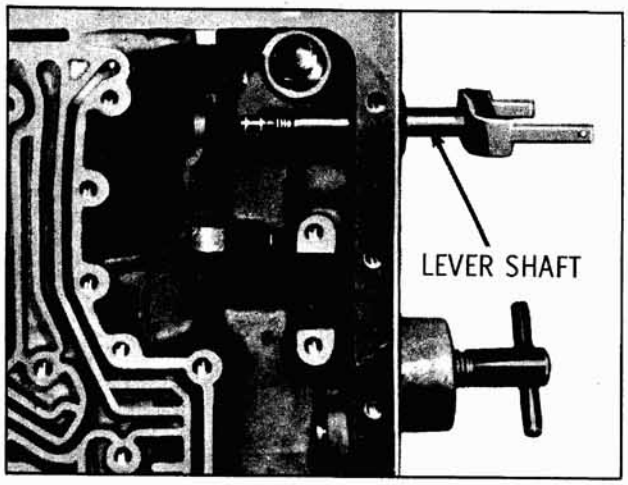


Fig. 7-469—Installing Selector Lever

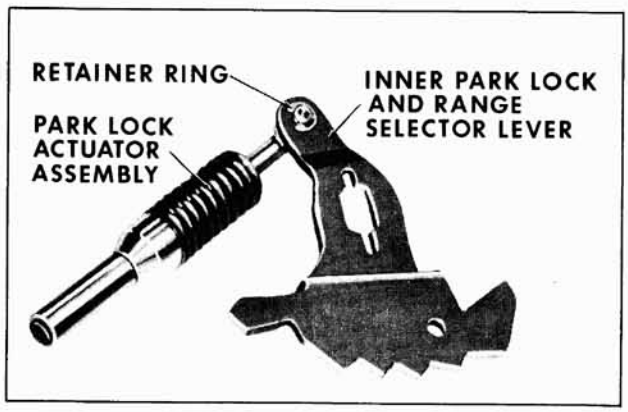


Fig. 7-470—Assembling Actuator

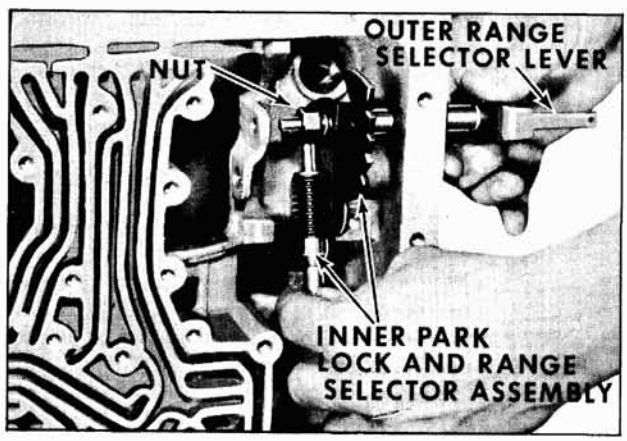


Fig. 7-471—Installing Actuator and Selector Assembly

lock and range selector. (Fig. 7-470)

5. Install inner park lock and range selector assembly to outer range selector lever. Install nut on range selector lever. (Fig. 7-471)

Make certain longest end on range selector lever is to the bottom of transmission.

6. Slide outer range selector lever into case and tighten nut using a 9/16" wrench. (Fig. 7-472)

7. Install range selector shaft retainer. (Fig. 7-473)

8. Install parking bracket to transmission case. Torque bolts 10 ft. lbs. (Fig. 7-474)

9. If outer range selector lever was removed, install nut and torque to 22 ft. lbs.

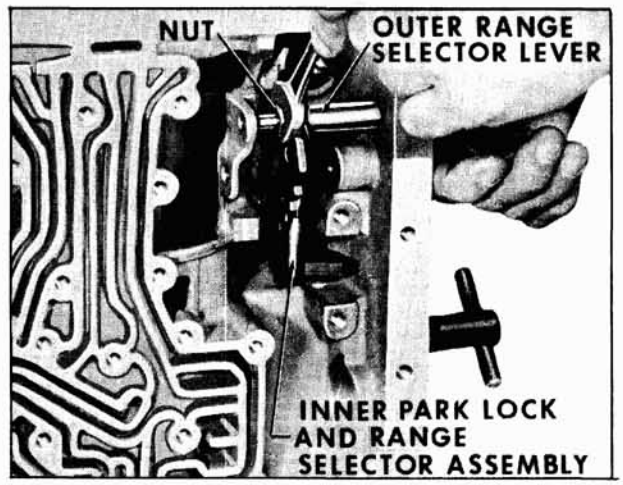


Fig. 7-472—Installing Outer Range Selector Lever

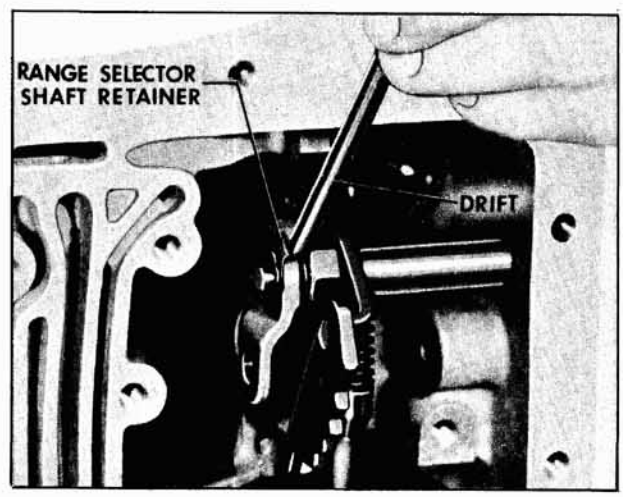


Fig. 7-473—Installing Retainer

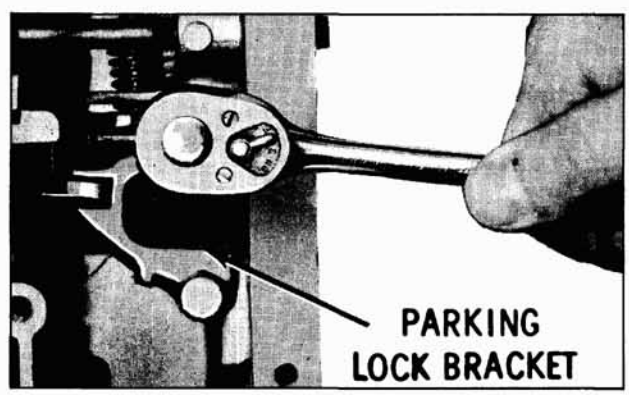


Fig. 7-474—Installing Parking Lock Bracket

INSTALLING REVERSE CLUTCH

1. Lubricate with transmission oil and install reverse clutch piston outer seal. (Fig. 7-475)

2. Lubricate with transmission oil and install reverse clutch piston inner seal. (Fig. 7-476)

3. Install cushion ring. (Fig. 7-476)

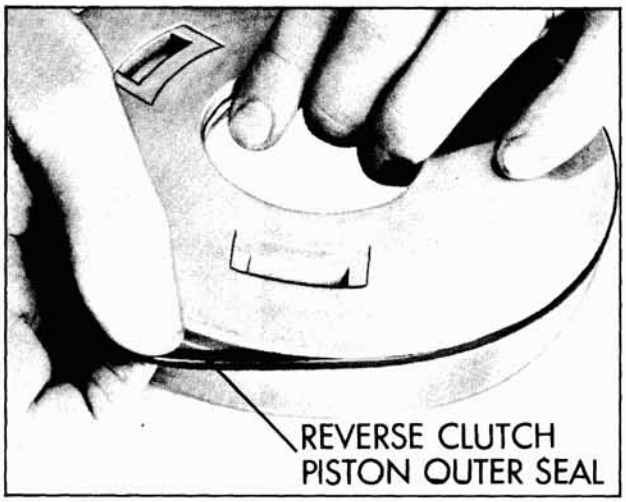


Fig. 7-475—Installing Reverse Clutch Piston Outer Seal

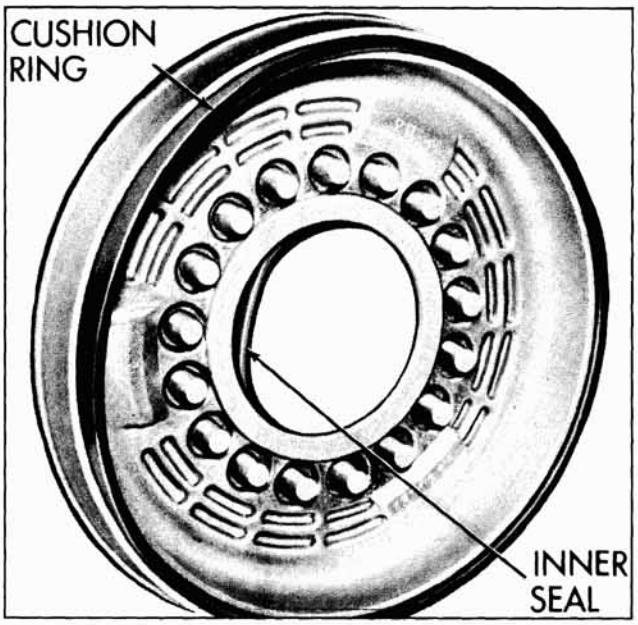


Fig. 7-476—Installing Reverse Clutch Piston Inner Seal

4. With transmission in vertical position, install the reverse clutch piston into case. Tap piston with hammer handle to make certain piston is seated in case. (Fig. 7-477)

5. Install 17 clutch piston return springs. (Fig. 7-478)

6. Position piston return seat on piston return springs. Place snap ring on return seat so that ring may be easily installed when seat is compressed with tool. (Fig. 7-479)

7. Using J-21420-1 and J-21420-2, compress piston return seat so snap ring may be installed with J-5586 Pliers as spring retainer is compressed. (Fig. 7-480)

Make certain inner edge of seat does not hang up on snap ring groove.

8. Align notches on the steel driven plates. Install the steel driven plates and lined drive plates alternately, beginning with a steel driven plate. The notched lug on each driven plate goes in the five o"clock groove in case. (Fig. 7-481)

Cars equipped with L-6 engines have four driven and four drive plates. Cars with 350 cu. in. V-8 engines have five driven and five drive plates.

9. Install reverse clutch pressure plate with the identification mark being installed in the five o"clock groove in case. (Fig. 7-482)

10. Install reverse clutch pack snap ring. (Fig. 7-483)

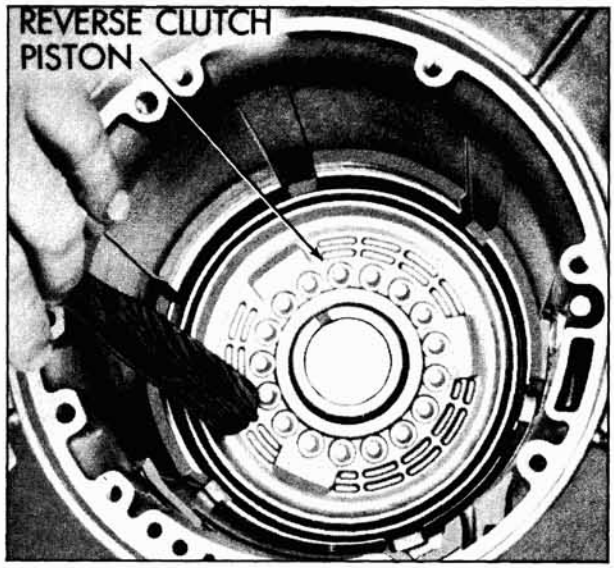


Fig. 7-477—Installing Reverse Clutch Piston

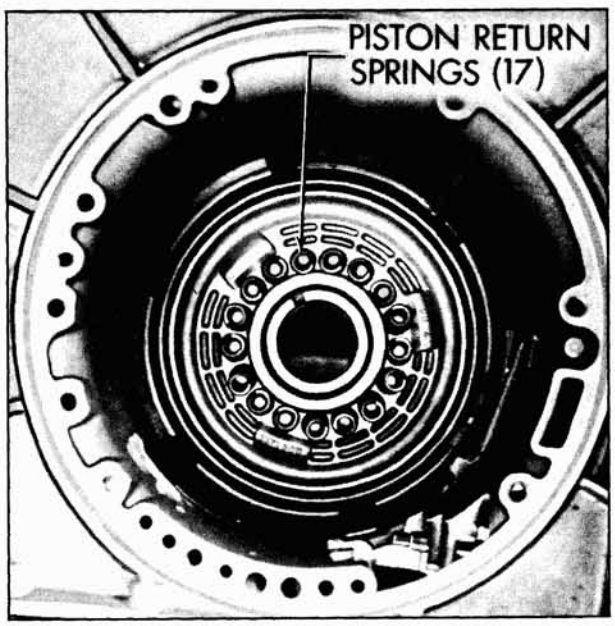


Fig. 7-478—Installing Return Springs

INSTALLING PLANETARY GEAR SET

1. Install thrust bearing race with a lip, needle bearing and then a second plain thrust bearing race to the rear face of the planetary gear set. Retain with grease. (Fig. 7-484)
2. Install reverse ring gear into case. (Fig. 7-485)
3. Install planetary gear set into case. (Fig. 7-486)

INSTALLING LOW SERVO

1. Install low servo piston assembly into case. (Fig. 7-487)
2. Install low servo cover oil seal. (Fig. 7-488)
3. Install low servo cover to case. (Fig. 7-489)

If a new servo cover is installed, transfer the information stamped on the original cover.

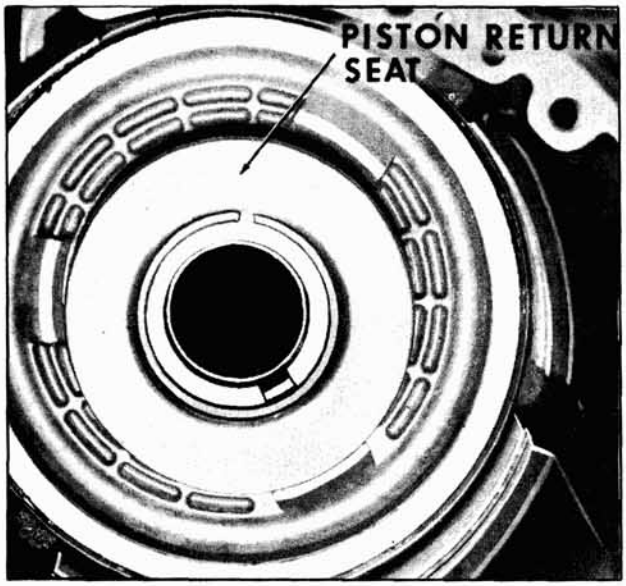


Fig. 7-479—Installing Return Seat

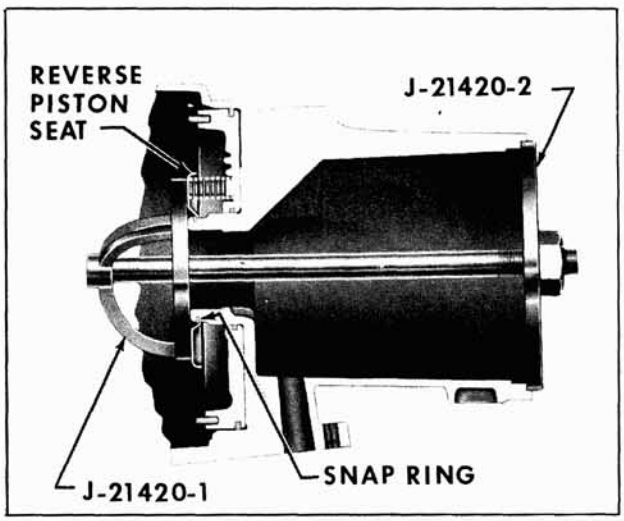


Fig. 7-480—Installing Snap Ring

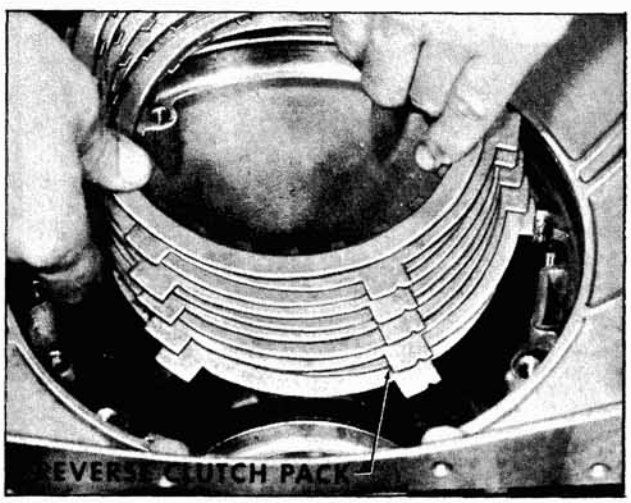


Fig. 7-481—Installing Reverse Clutch Pack

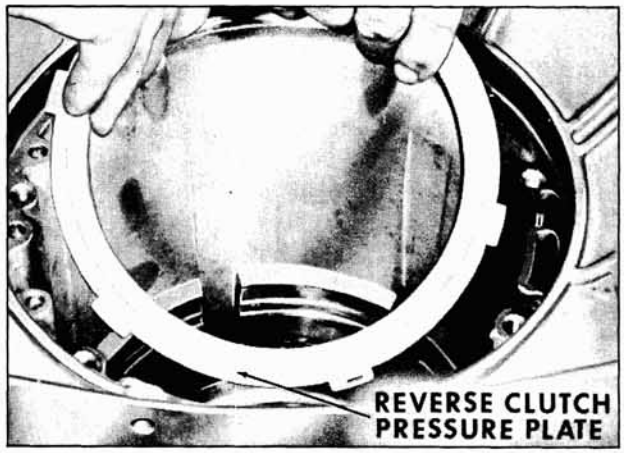


Fig. 7-482—Installing Pressure Plate

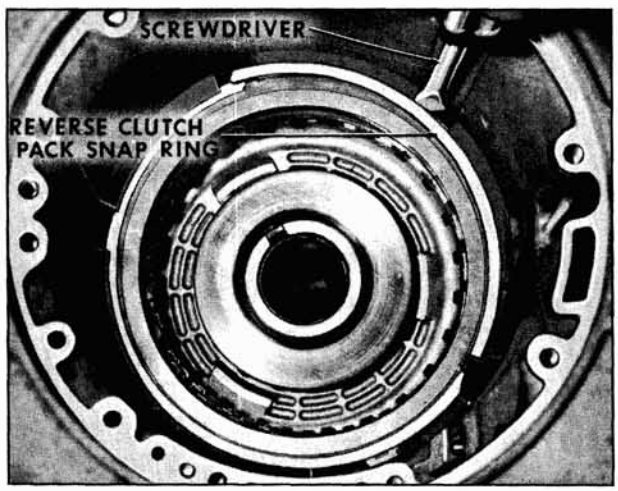


Fig. 7-483—Installing Snap Ring

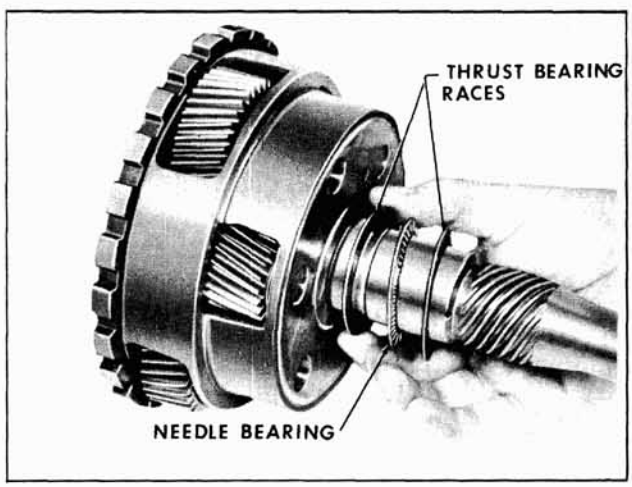


Fig. 7-484—Installing Thrust Bearing

4. Compress the low servo cover with J-21495 and install retaining snap ring. (Fig. 7-490)

INSTALLING LOW BAND

1. With transmission in vertical position, install band adjusting screw into case. (Fig. 7-491)
2. Install low band into case. (Fig. 7-492)

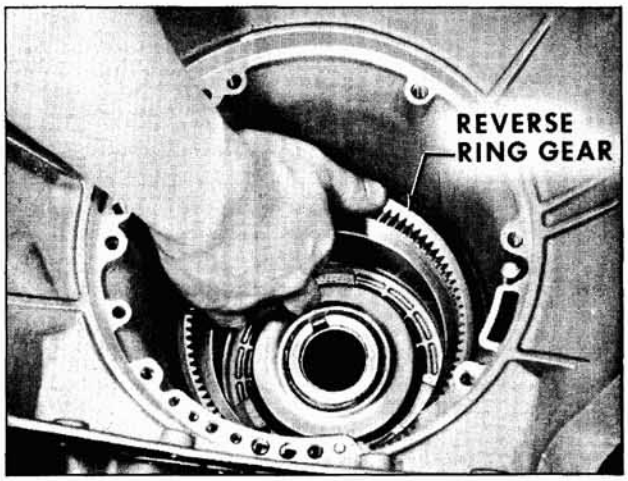


Fig. 7-485—Installing Reverse Ring Gear

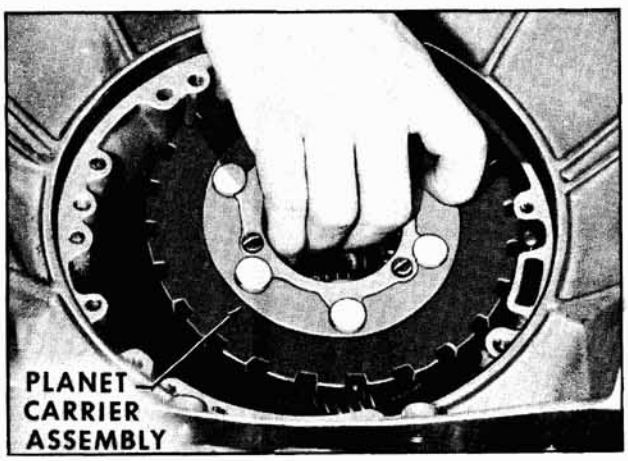


Fig. 7-486—Installing Planet Carrier

Fig. 7-487—Installing Low Servo

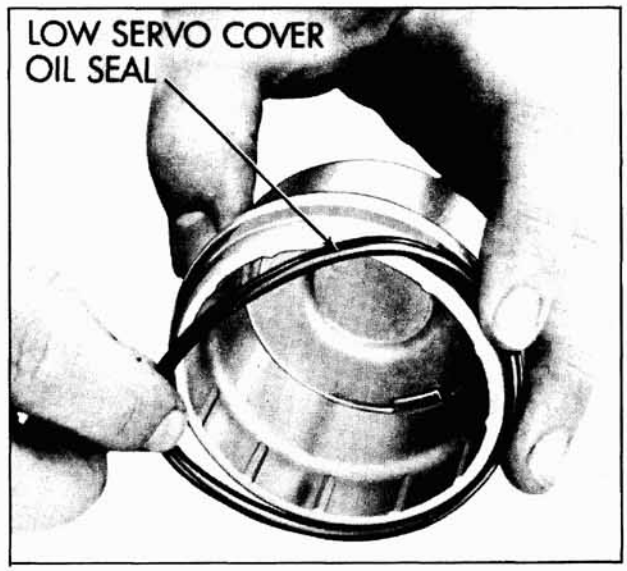


Fig. 7-488—Installing Low Servo Cover Oil Seal

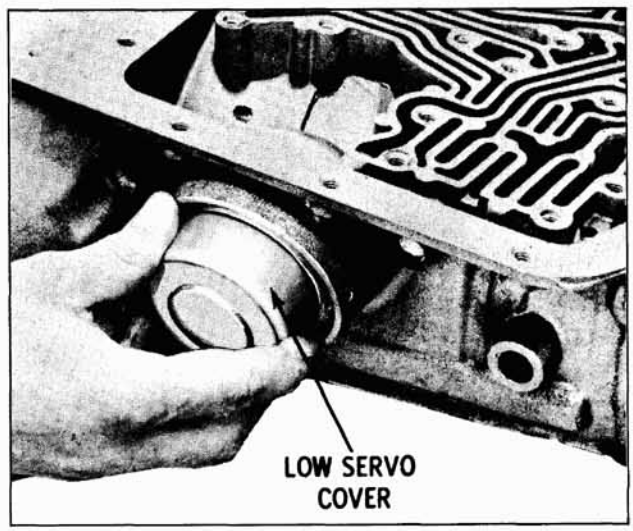


Fig. 7-489—Installing Low Servo Cover

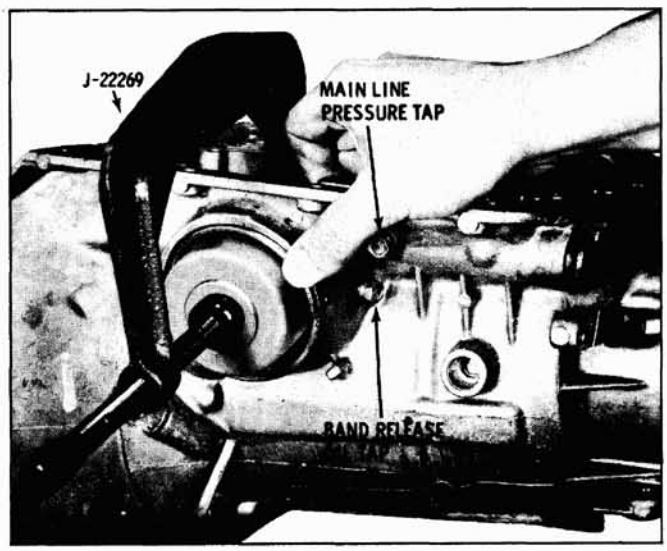


Fig. 7-490—Installing Snap Ring

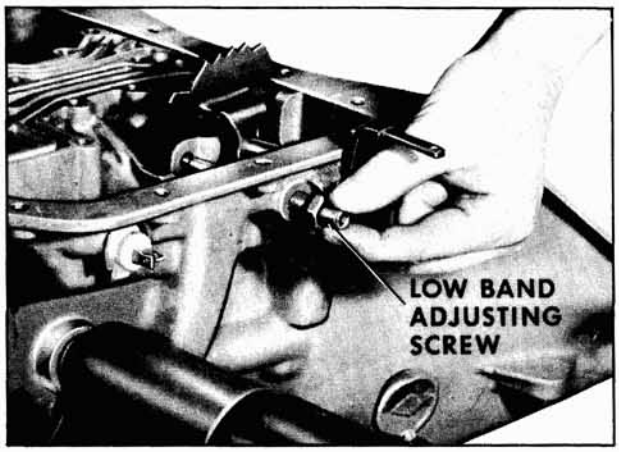


Fig. 7-491—Installing Low Band Adjusting Tool

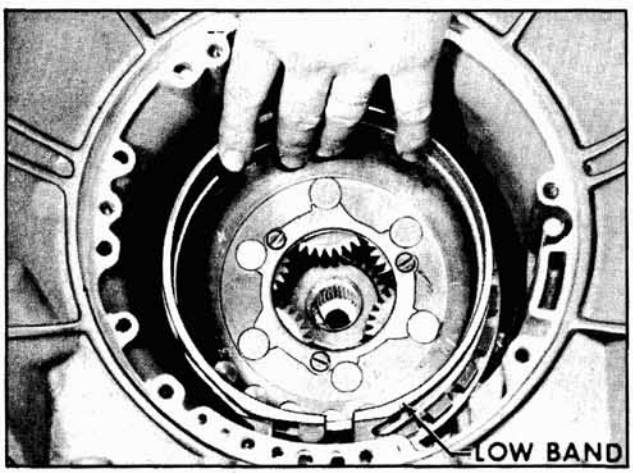


Fig. 7-492—Installing Low Band

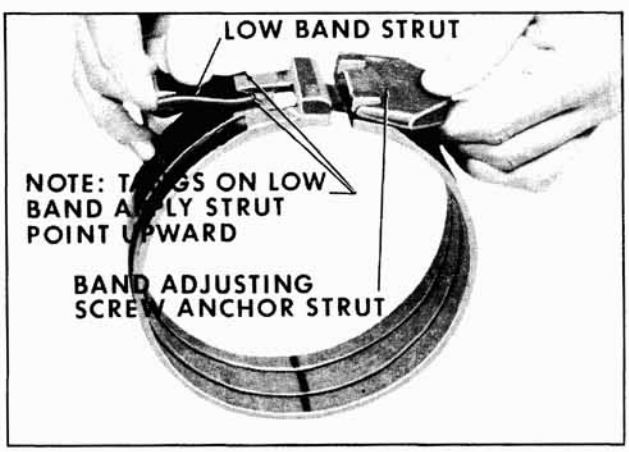


Fig. 7-493—Positioning Band Apply Strut

3. Figure 7-493 illustrates the proper positioning of the low band apply strut and band adjusting screw anchor strut.

4. Install low band apply strut and band adjusting screw strut. After both struts have been installed, tighten low band adjusting screw enough to prevent struts from falling out. (Fig. 7-494)

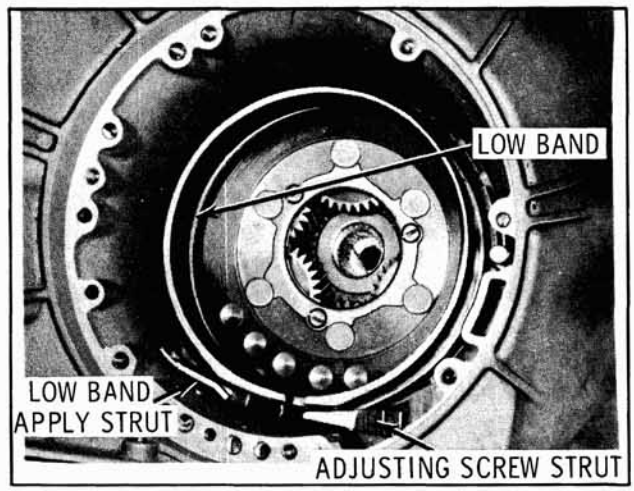


Fig. 7-494—Installing Band Apply Strut

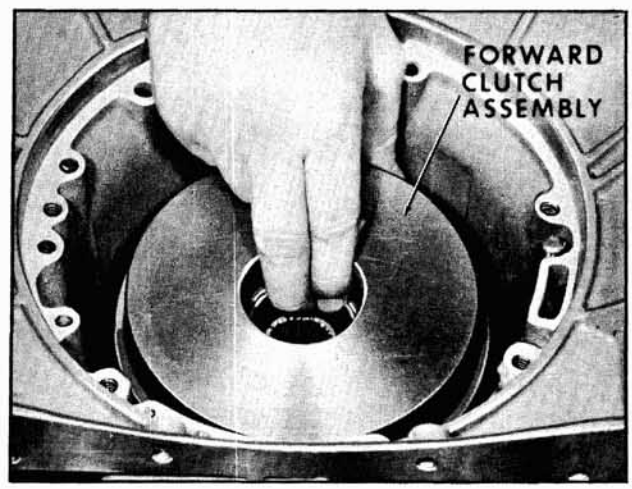


Fig. 7-495—Installing Forward Clutch

Fig. 7-496—Installing Selective Washer

INSTALLING FORWARD CLUTCH ASSEMBLY

1. Install forward clutch assembly, turning slightly to engage low sun gear with planet pinions. (Fig. 7-495)

Fig. 7-497—Installing Oil Sealing Rings

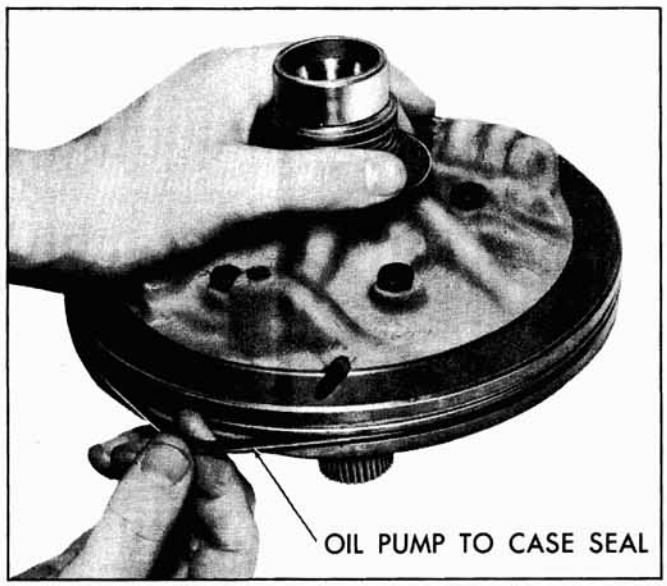


Fig. 7-498—Installing Oil Pump to Case Seal

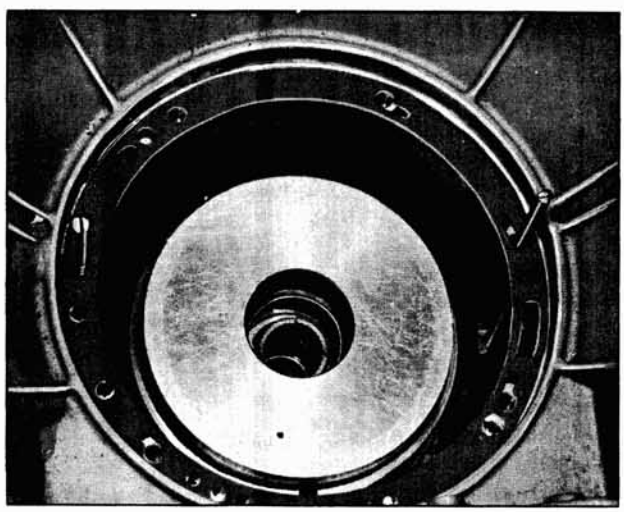


Fig. 7-499—Installing Oil Pump Guide Pins and Gasket

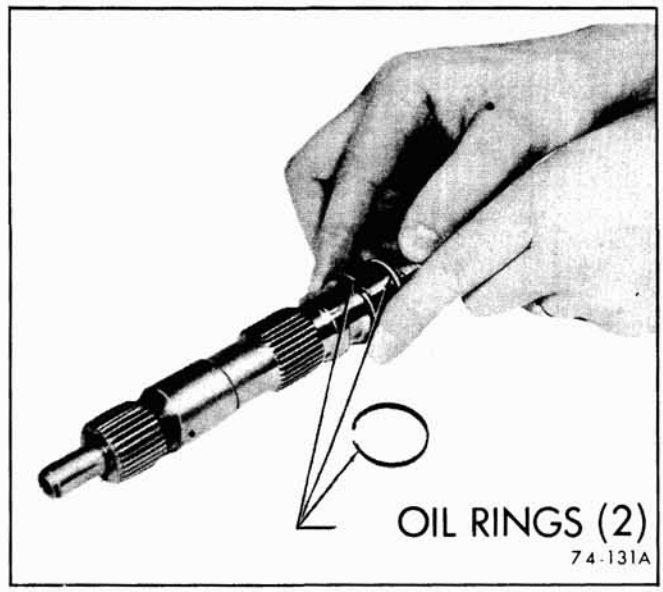


Fig. 7-500—Installing Oil Rings on Input Shaft

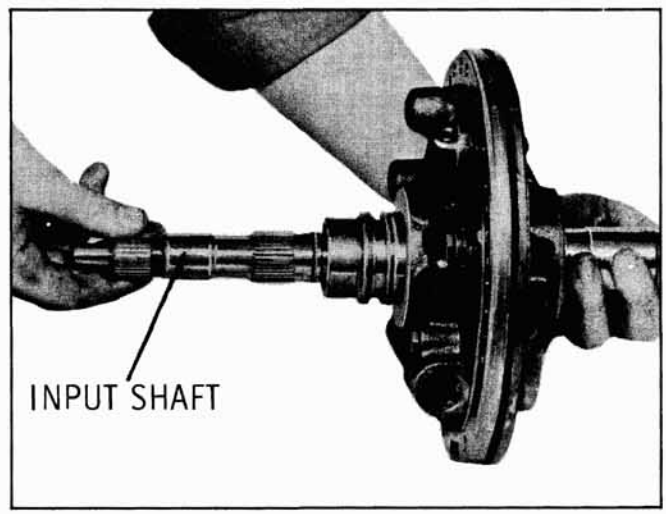


Fig. 7-501—Installing Input Shaft

INSTALLING OIL PUMP GUIDE PIN, GASKET AND OIL PUMP ASSEMBLY

If the previously recorded pump end play clearance was within specifications and if any of the units that affect the end play were not changed, it will not be necessary to recheck the end play.

1. Install selective fit washer to pump cover hub. (Fig. 7-496)
2. Install two pump cover to clutch drum oil sealing rings. (Fig. 7-497)
3. Install oil pump to case seal. (Fig. 7-498)

Chamfer on corners of seal to be to the outside.

4. Install guide pins and new pump gasket. (Fig. 7-499)
5. Install input shaft oil rings. (Fig. 7-500)
6. Install input shaft into oil pump; then install pump into case. Apply a thin coat of oil around edge of pump. (Fig. 7-501)
7. Remove guide pins and install eight retaining bolts (with new washer type seals). (Fig. 7-502)

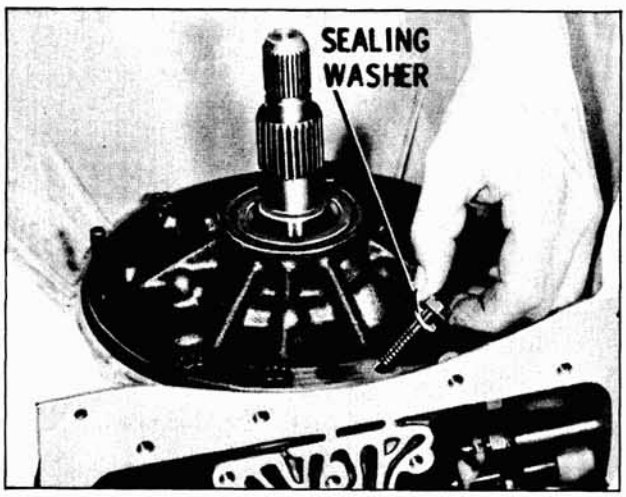


Fig. 7-502—Installing Pump

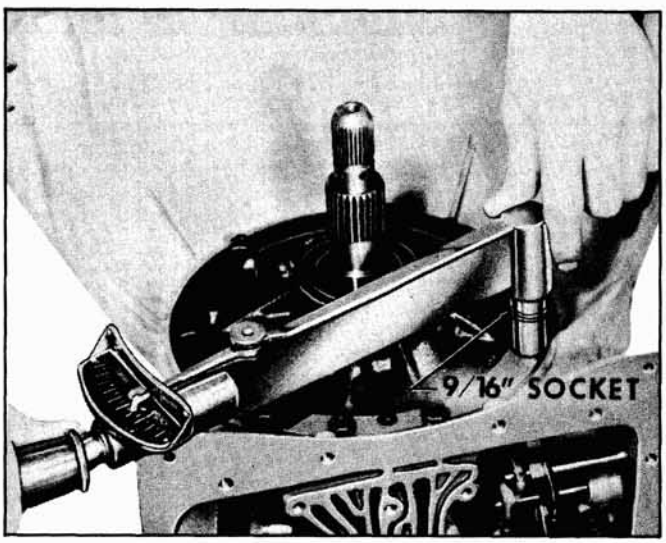


Fig. 7-503—Installing Pump Attaching Bolts

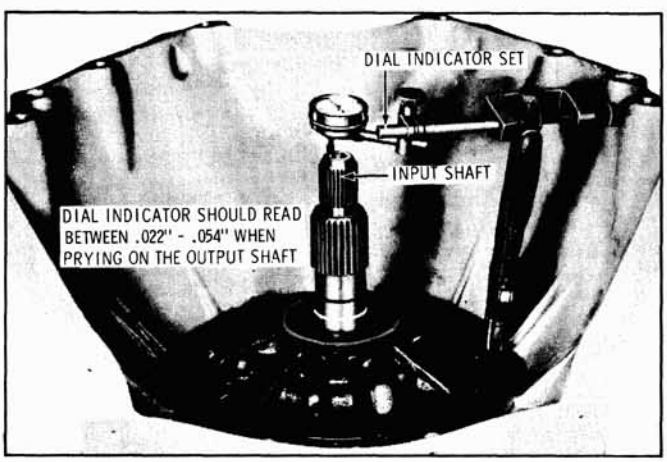


Fig. 7-504—Oil Pump End Play Check

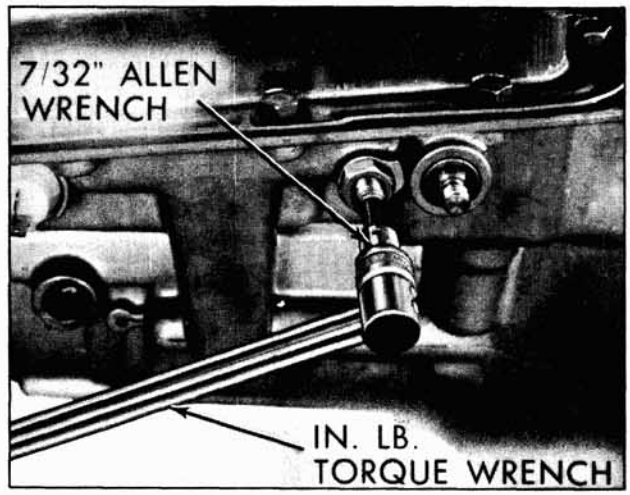


Fig. 7-505—Low Band Adjustment

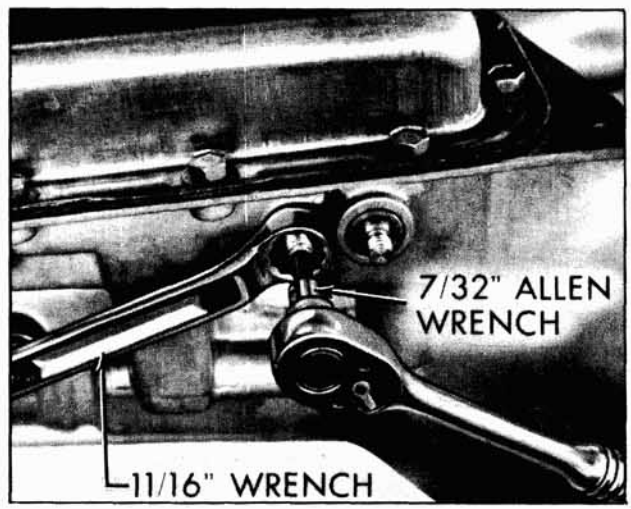


Fig. 7-506—Low Band Lock Nut

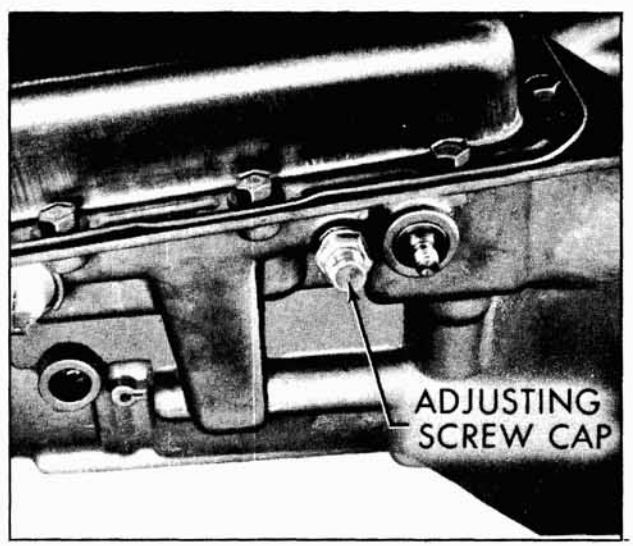


Fig. 7-507—Installing Adjusting Screw Cap

8. Tighten bolts evenly and torque to 24 ft. lbs. (Fig. 7-503)

9. Check forward clutch to oil pump clearance as follows:

a. Position a dial indicator on the end of the input shaft. (Fig. 7-504)

b. Push the input shaft rearward and zero the dial indicator.

c. Pry the output shaft forward and read the dial indica-

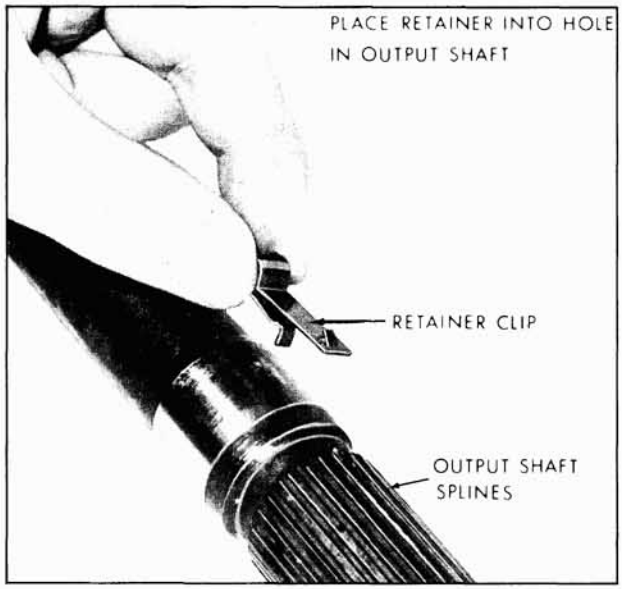


Fig. 7-508—Installing Gear Retainer

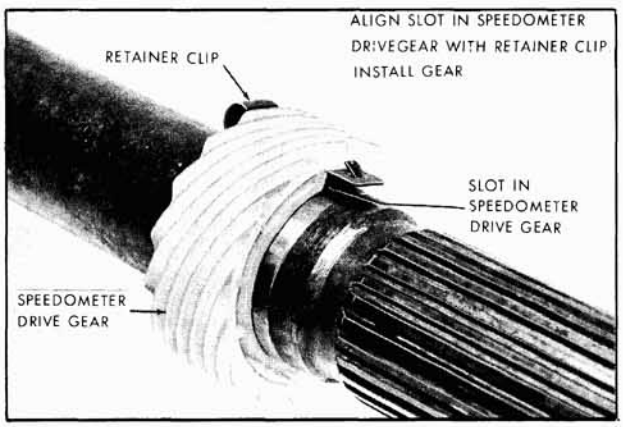


Fig. 7-509—Installing Speedometer Drive Gear

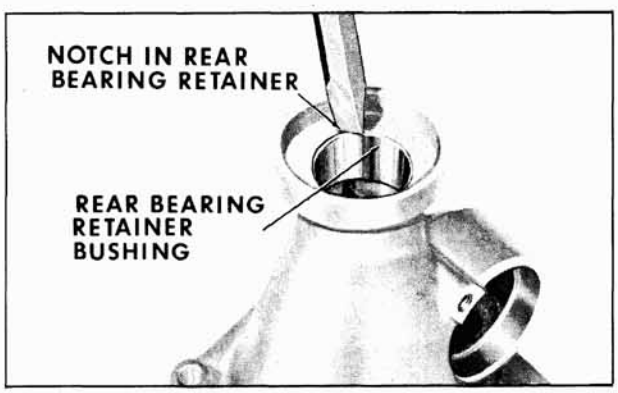


Fig. 7-510—Removing Rear Bearing Retainer Bushing

tor. The reading should be between .022" and .054".

d. If the end play is not within specifications, remove the oil pump and with a micrometer, determine the thickness of the selective thrust washer and replace with the proper selective thrust washer to bring it within specifications. Thrust washers are available in three sizes:

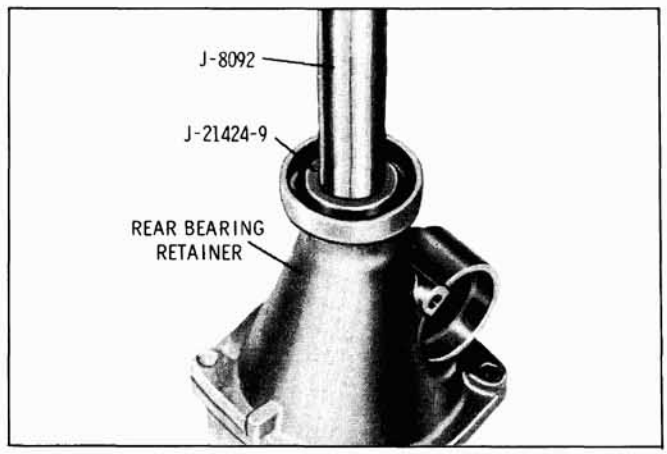


Fig. 7-511—Installing Rear Bearing Retainer Bushing

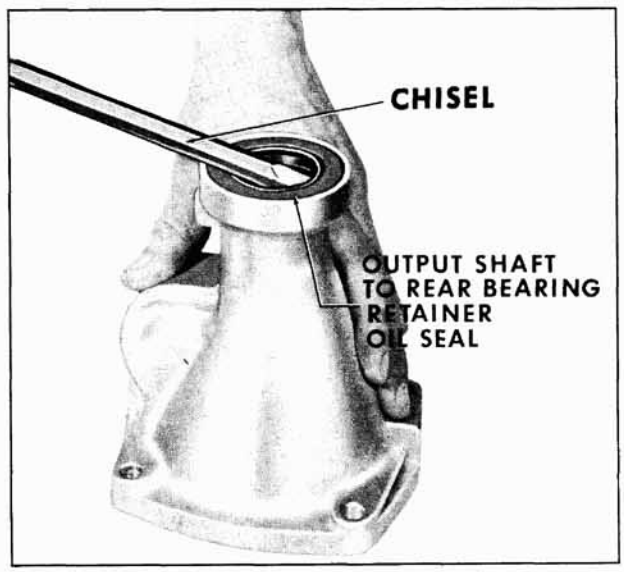


Fig. 7-512—Removing Oil Seal

.059"-.063"
.077"-.081"
.095"-.099"

These washers have no identification other than the part numbers on the packages.

LOW BAND ADJUSTMENT

1. While rotating output shaft, adjust low band by first tightening adjusting screw to 40 in. lbs. torque. (Fig. 7-505)
2. Back off band adjusting screw four turns and lock nut. (Fig. 7-506)
3. Install adjusting screw cap. (Fig. 7-507)

INSTALLING SPEEDOMETER DRIVE GEAR

1. Place retainer into hole in output shaft. (Fig. 7-508)
2. Align slot in speedometer drive gear with retainer clip. (Fig. 7-509)

REAR BEARING RETAINER OIL SEAL AND BUSHING

Removal and Installation

1. Remove the rear bushing as shown in Fig. 7-510.
2. Using Drive Handle J-8092 and Installer J-21424, install rear bearing retainer bushing. (Fig. 7-511)
3. Remove the rear bearing oil seal as shown in Fig. 7-512.

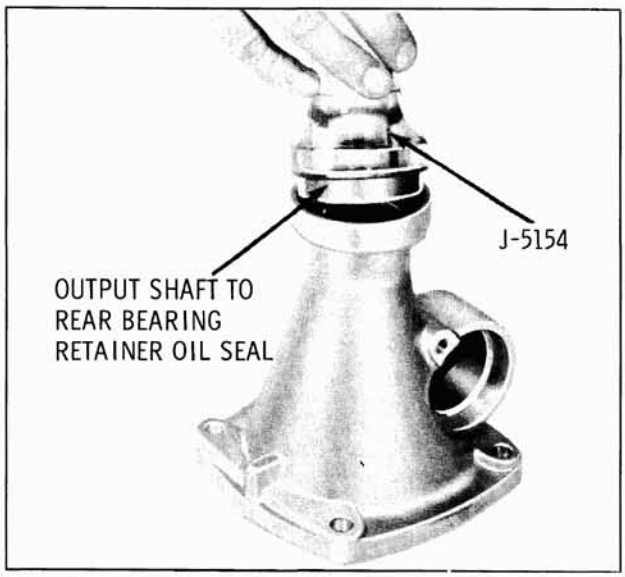


Fig. 7-513—Installing Oil Seal

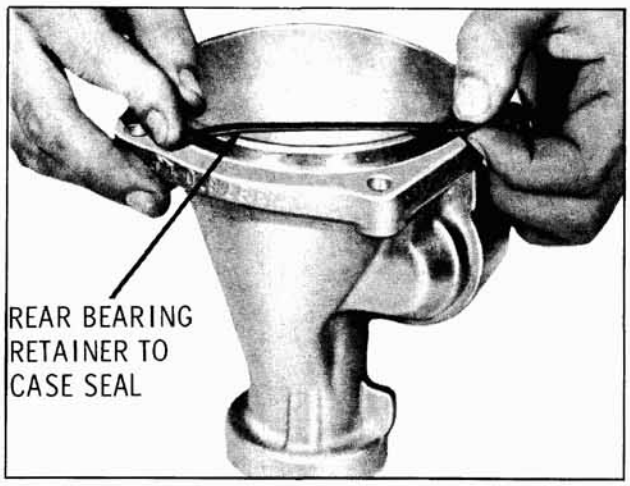


Fig. 7-514—Installing Rear Bearing Retainer to Case Seal

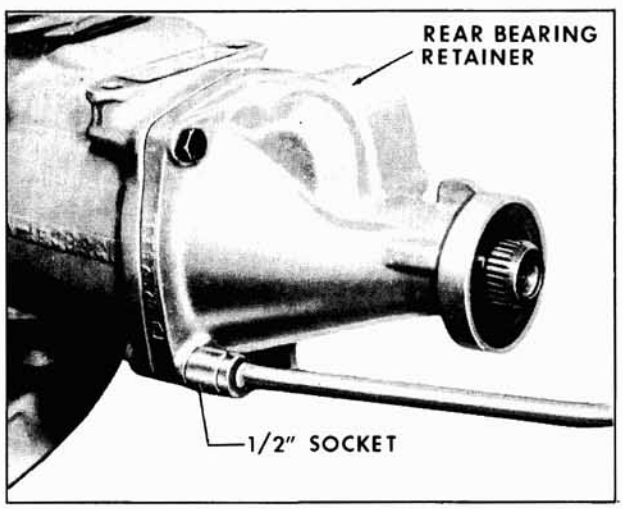


Fig. 7-515—Installing Rear Bearing Retainer

The seal can be replaced with the rear bearing retainer attached to the transmission and the transmission installed by using Tools BT-6629-3 and BT-6629-1.

Fig. 7-516—Installing Speedometer Driven Gear

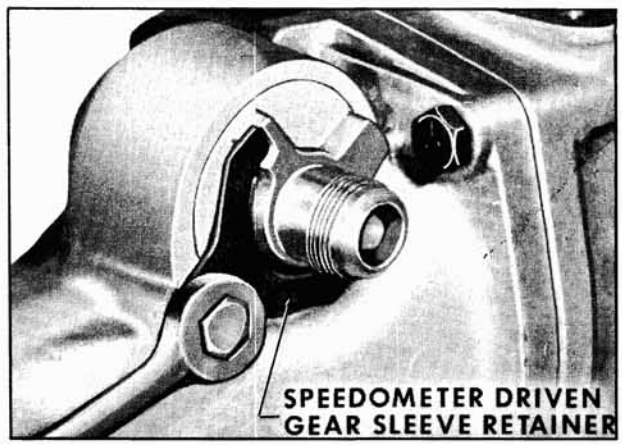


Fig. 7-517—Installing Speedometer Driven Gear Retainer

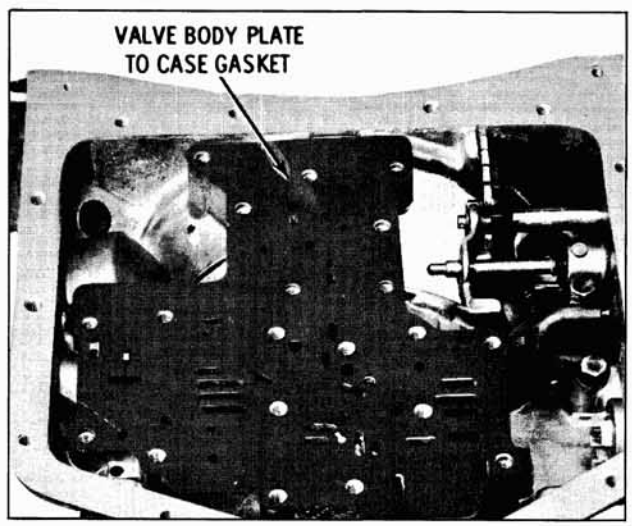


Fig. 7-518—Installing Valve Body Gasket

4. Install output shaft to rear bearing retainer oil seal using Installer J-5154. (Fig. 7-513)

Installing Rear Bearing Retainer

1. Install rear bearing retainer to case oil seal. (Fig. 7-514)
2. Install rear bearing retainer to case and install four retaining bolts. Torque bolts to 35 ft. lbs. (Fig. 7-515)

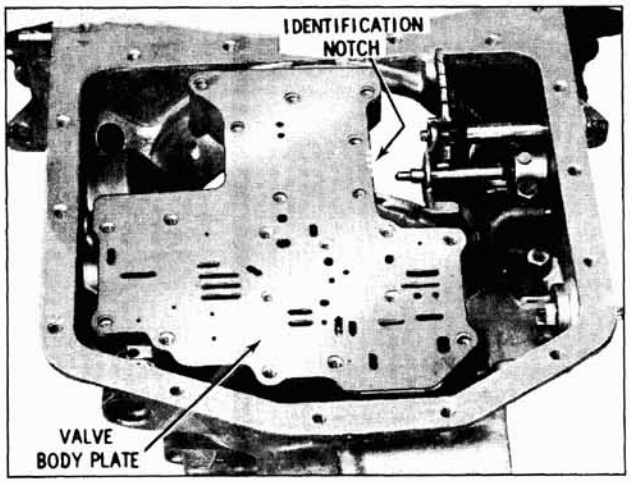


Fig. 7-519—Installing Valve Body Plate

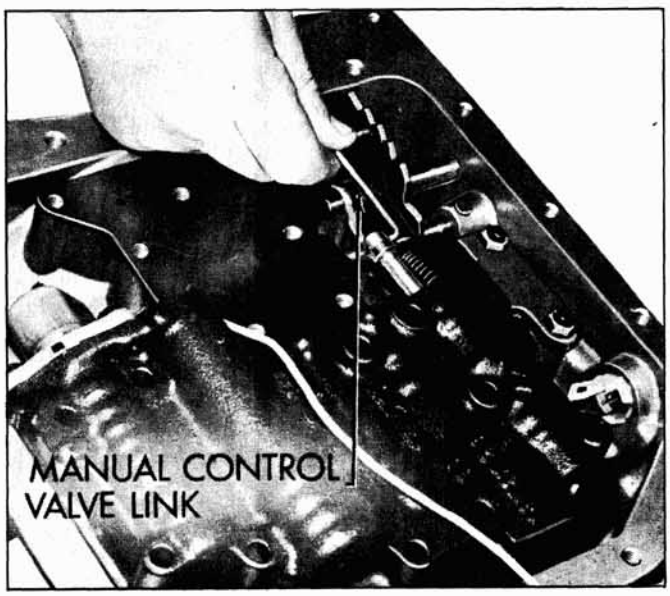


Fig. 7-520—Installing Link

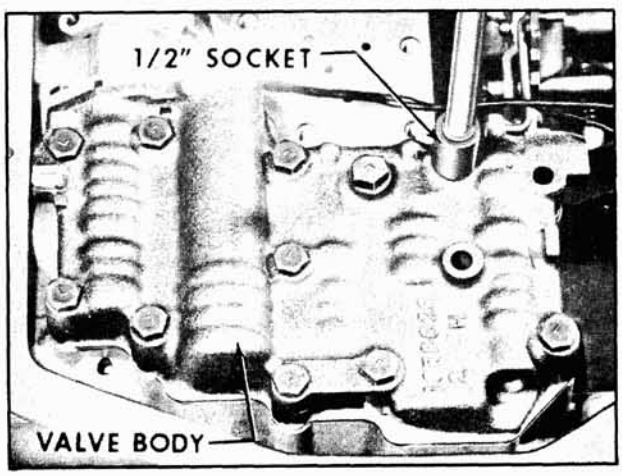


Fig. 7-521—Installing Valve Body Attaching Bolts

INSTALLING SPEEDOMETER DRIVEN GEAR ASSEMBLY

1. Install speedometer driven gear assembly into rear bearing retainer. (Fig. 7-516)
2. Install speedometer driven gear sleeve retainer. Torque bolt to 12 ft. lbs. (Fig. 7-517)

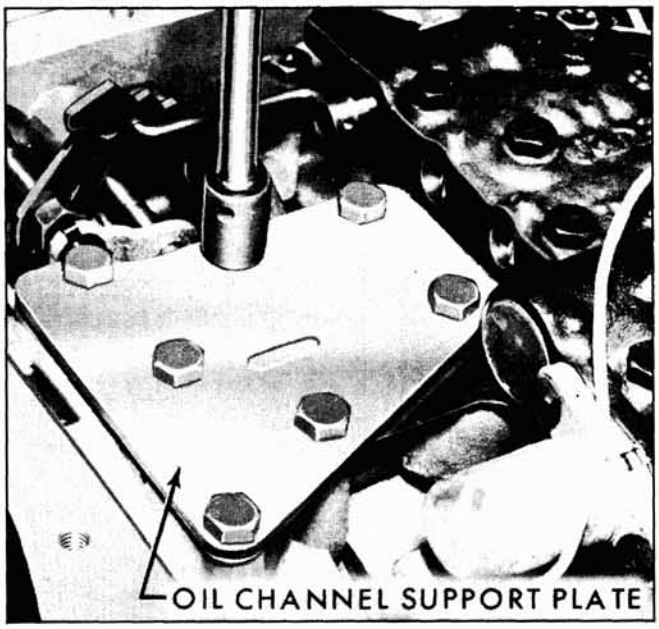


Fig. 7-522—Installing Oil Channel Support Plate

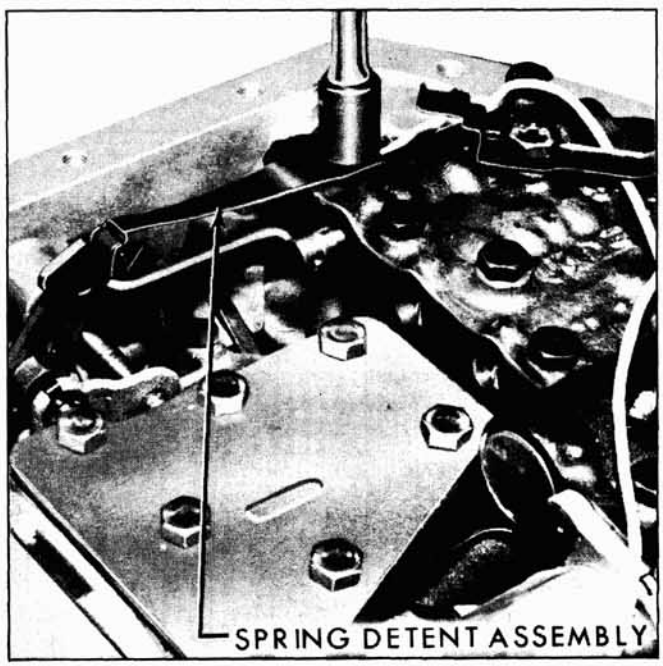


Fig. 7-523—Installing Spring and Detent Assembly

INSTALLING VALVE BODY

1. With transmission in horizontal position, install valve body to plate gasket. (Fig. 7-518)
2. Install valve body plate (Fig. 7-519)
3. Install manual control valve and link into valve body assembly.
4. Install manual control valve link into park lock and range selector inner lever. (Fig. 7-520)
5. Install 11 valve body to case retaining bolts. Torque bolts to 12 ft. lbs. (Fig. 7-521)
6. Install the oil channel support plate. Torque bolts to 12

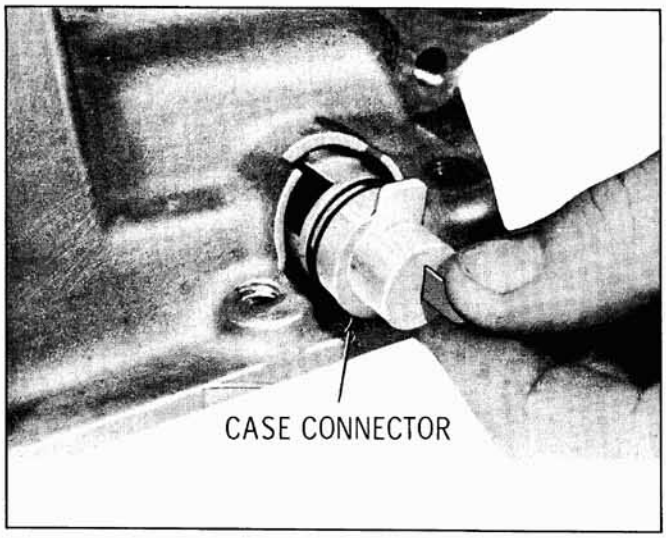


Fig. 7-524—Installing Case Connector

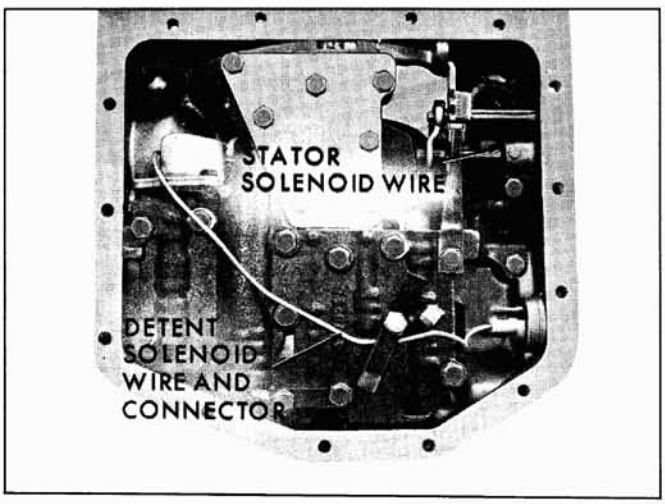


Fig. 7-525—Installing Detent Solenoid Wire

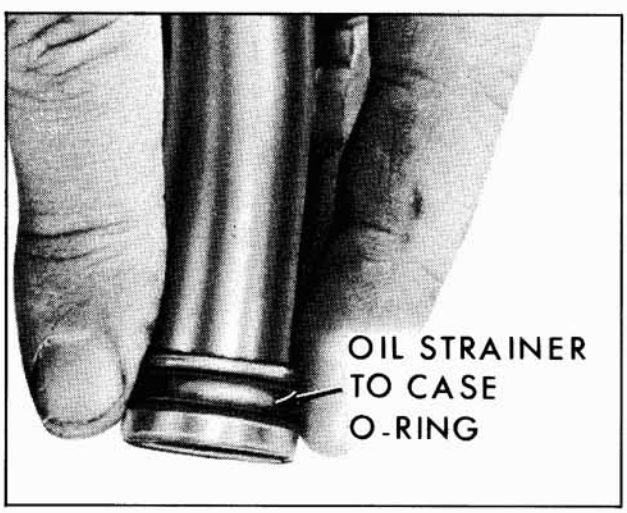


Fig. 7-526—Installing Oil Strainer to Case Oil Seal

ft. lbs. (Fig. 7-522)

7. Before installing spring detent assembly, note routing of solenoid wire. Install spring detent assembly. Torque bolt to 12 ft. lbs. (Fig. 7-523)

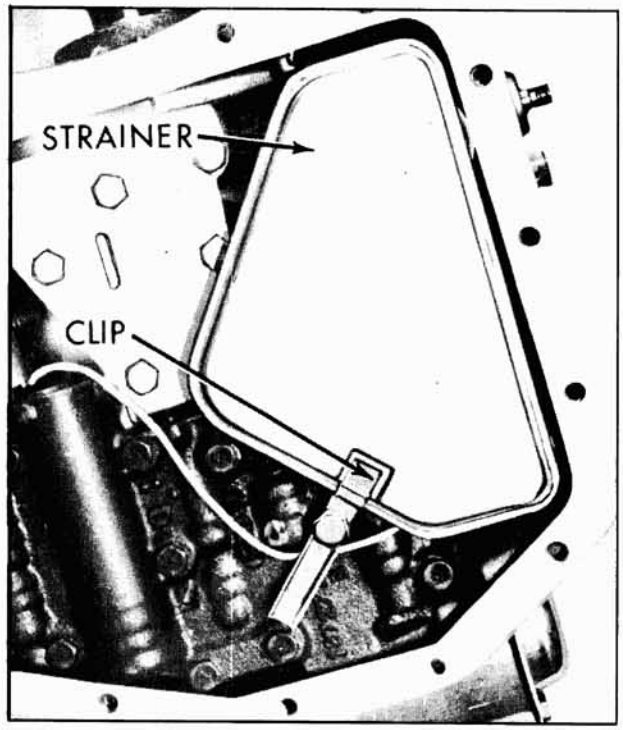


Fig. 7-527—Installing Oil Strainer

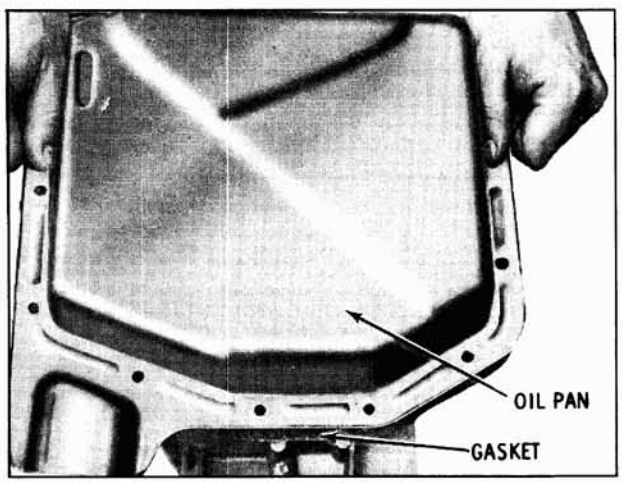


Fig. 7-528—Installing Oil Pan Gasket

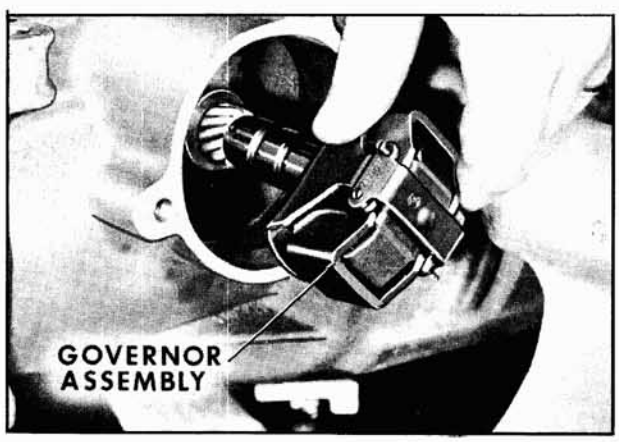


Fig. 7-529—Installing Governor Assembly

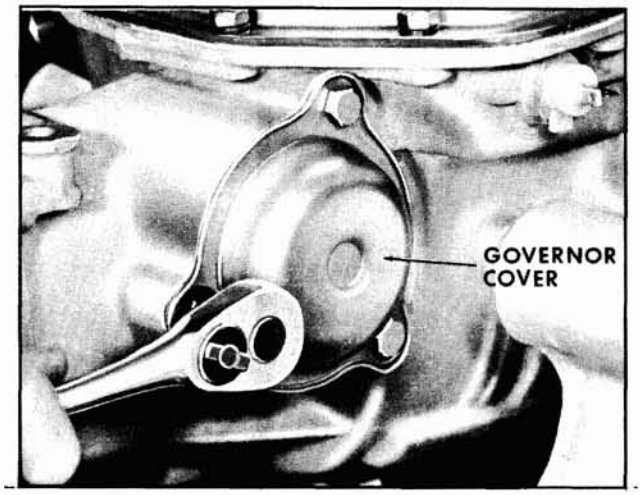


Fig. 7-530—Installing Governor Cover

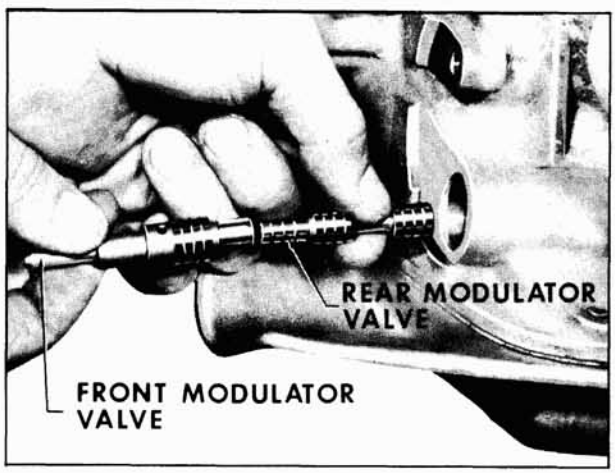


Fig. 7-531—Installing Modulator Valve

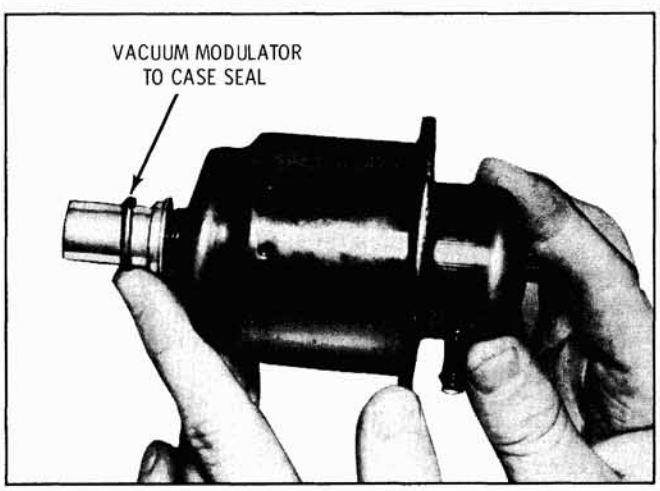


Fig. 7-532—Installing Vacuum Modulator

8. Install case connector into case. (Fig. 7-524)
9. Install detent solenoid wire to connector. (Fig. 7-525)
10. Install new oil strainer pipe to case seal. (Fig. 7-526)
11. Install strainer into case. (Fig. 7-527)
12. Install oil pan gasket and pan. Torque bolts to 12 ft. lbs. (Fig. 7-528)

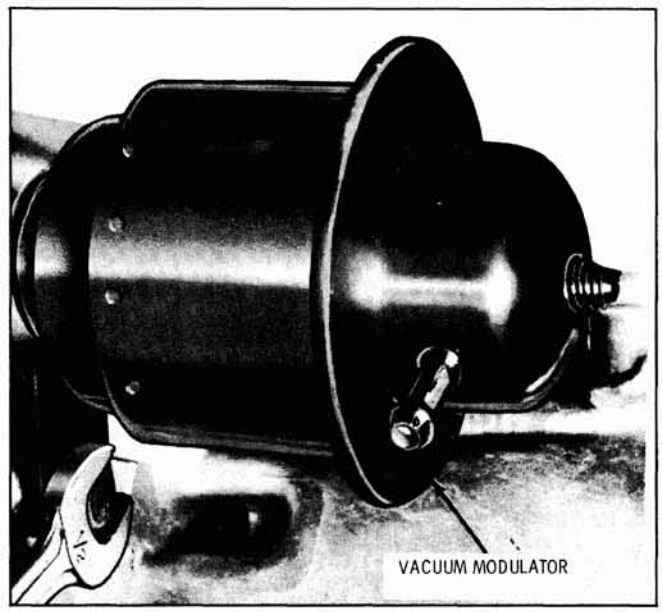


Fig. 7-533—Installing Vacuum Modulator Retainer

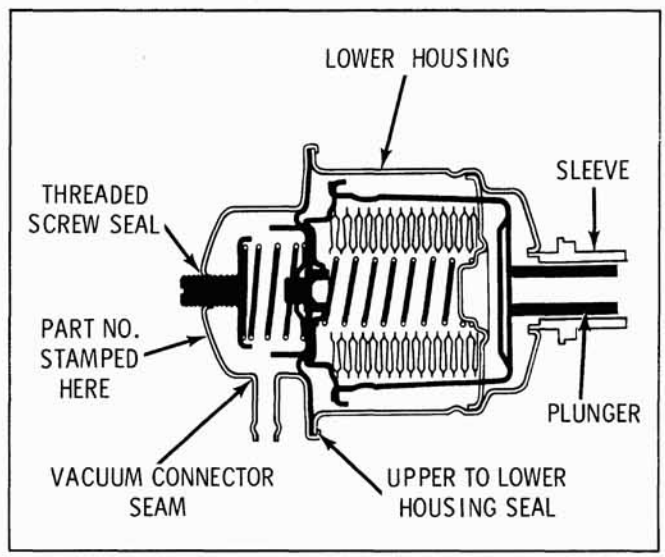


Fig. 7-534—Vacuum Modulator

INSTALLING GOVERNOR

1. Slide governor into its bore in case. Turn governor assembly so teeth on governor gear engage teeth on output shaft. (Fig. 7-529)
2. Install governor gasket and cover to case. Torque bolts to 12 ft. lbs. (Fig. 7-530)

INSTALLING VACUUM MODULATOR

1. Slide front modulator valve into rear modulator valve; then install valve into case. (Fig. 7-531)
2. Install case to vacuum modulator oil seal. Install modulator into case. (Fig. 7-532)
3. Install vacuum modulator retainer. Install retainer so tang points toward vacuum modulator. Torque bolts to 12 ft. lbs. (Fig. 7-533)

VACUUM MODULATOR DIAGNOSIS

Vacuum Diaphragm Check

Insert a pipe cleaner as far as possible into the vacuum connector pipe and check for the presence of transmission fluid.

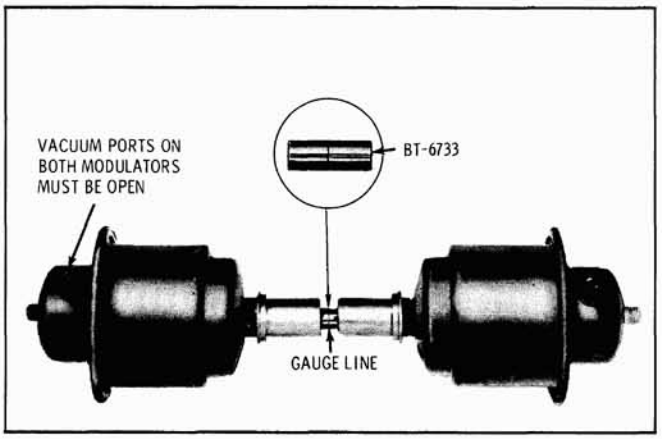


Fig. 7-535—Checking Vacuum Modulator

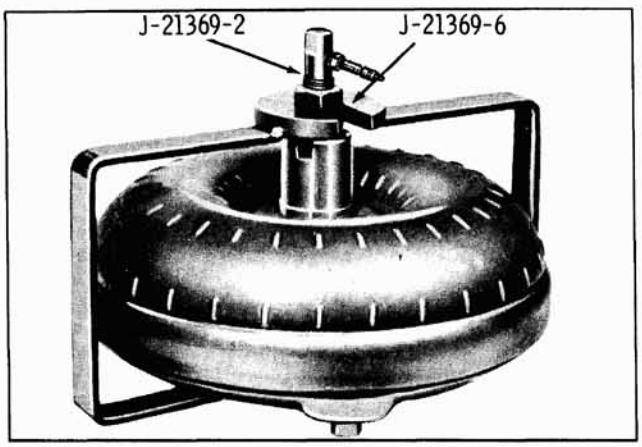


Fig. 7-536—Installing Tool J-21369

If transmission fluid is found, the modulator should be replaced.

Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, proceed to the next check.

Atmospheric Leak Check

1. Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal. (Fig. 7-534)
2. Using a short piece of rubber hose, apply air pressure to the vacuum pipe by blowing into the tube and observing for bubbles. If bubbles appear, replace the modulator.

Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

Bellows Comparison Check

This check is made using an available tool, BT-6733. The gauge compares the load of a known good modulator with a modulator being checked.

1. Install the modulator that is known to be acceptable on either end of the gauge.
2. Install the modulator in question on the opposite end of the gauge. (Fig. 7-535)
3. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gauge. The gap between the opposite modulator sleeve end and the gauge line should be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

When making the comparison, make sure that both modulators are of the same type. The part numbers are stamped on the dome of the modulator.

Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

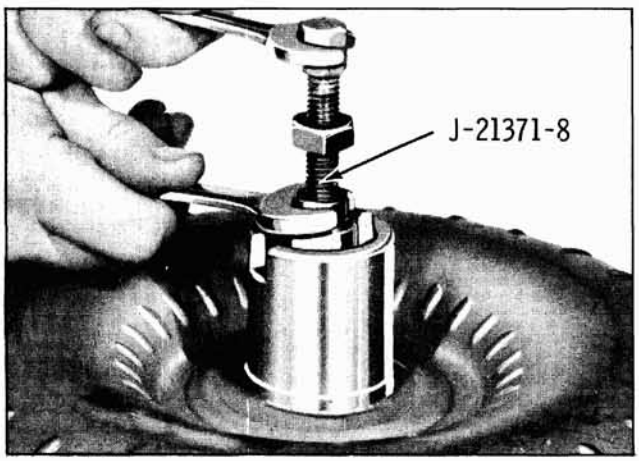


Fig. 7-537—Installing Tool J-21371-8

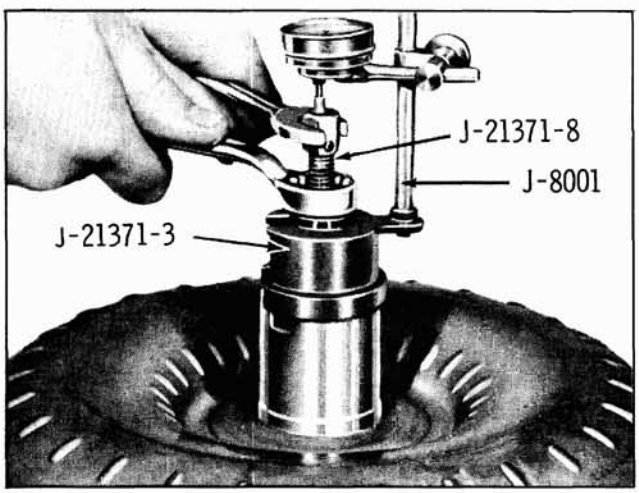


Fig. 7-538—Installing Tool J-21371-3

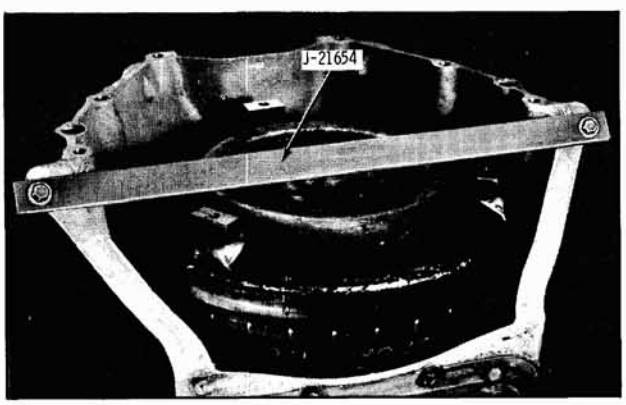


Fig. 7-539—Coverter Holding Tool

If the vacuum modulator assembly passes all of the checks, it is an acceptable part and should be reused.

CHECKING CONVERTER

1. Check converter for leaks as follows:
   a. Install available Tool J-21369 and tighten. (Fig. 7-536)
   b. Fill converter with air; 80 psi.
   c. Submerge in water and check for leaks.
2. Check converter end clearance as follows:
   a. Install available Tool J-21371-8 and tighten brass nut. (Fig. 7-537)
   b. Install available Tool J-21371-3 and tighten hex nut. (Fig. 7-538)
   c. Install dial indicator set at zero.
   d. Loosen hex nut. When nut is fully loosened, the reading obtained on the dial indicator will be converter end clearance. End clearance should be less than .050".
3. Install converter.
4. Install Coverter Holding Tool J-21654. (Fig. 7-539)

DIAGNOSIS

DIAGNOSIS SEQUENCE

1. Check and correct oil level.
2. Check and correct detent switch.
3. Check and correct vacuum line and fittings.
4. Check and correct manual linkage.
5. Road test car.
   a. Install oil pressure gauge.
   b. Road test using all selective ranges, noting when discrepancies in operation or oil pressure occur.
   c. Attempt to isolate the unit or circuit involved in the malfunction.
   d. If engine performance indicates an engine tune-up is required, this should be performed before road testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

EXTERNAL OIL LEAKS

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission.

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a black light to locate the point at which the oil is leaking is helpful. Comparing the oil from the leak to that on the engine or transmission dip stick, when viewed by black light, will determine the source of the leak - engine or transmission.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission oil filler tube to case leak will sometimes appear as a leak at the rear of the transmission. In determining the source of a leak, proceed as follows:

1. Degrease underside of transmission.
2. Road test to get unit at operating temperature.
3. Inspect for leak with engine running.
4. With engine off, check for oil leaks due to the raised oil level caused by drain back.

POSSIBLE POINTS OF OIL LEAKS

Transmission Oil Pan Leak

Attaching bolts not correctly torqued.
Improperly installed or damaged pan gasket.
Oil pan gasket mounting face not flat.

Rear Bearing Retainer

Attaching bolts not correctly torqued.
Rear seal assembly damaged or improperly installed.
Square seal, extension to case, damaged or improperly installed.
Porous casting.

Case Leak

Filler pipe "O" ring seal damaged or missing; misposition of filler pipe bracket to engine.
Modulator assembly "O" ring seal damaged or improperly installed.
Solenoid connector "O" ring seal damaged or improperly installed.
Governor cover bolts not torqued, gasket damaged or leak between case face and gasket.
Speedometer gear "O" ring damaged.
Manual shaft seal damaged or improperly installed.
Line pressure band release tap plug loose. (Fig. 7-490)
Vent pipe (refer to Oil Comes Out Vent Pipe).
Porous casting.

Leak at Front of Transmission

Front pump seal leaks.
Seal lip cut. Check converter hub, etc.
Bushing moved and damaged. Oil return hole plugged.
No oil return hole.
Front pump attaching bolts loose or washer type seals damaged or missing.
Front pump housing "O" ring damaged or cut.
Converter leak in weld area.
Porous casting (pump).

Oil Comes Out Vent Pipe

Transmission overfilled. Refer to "Periodic Maintenance" at the front of this section.
Water in oil.
Foreign material between pump and case or between pump cover and body.
Case - porous near converter bosses. Front pump cover or housing oil channels shy of stock near breather.
Pump to case gasket mispositioned.

Case Porosity Repair

Leaks caused by case porosity can be repaired with the transmission in the car by using the following procedures:

1. Road test and bring the transmission to operating temperature, approximately 180°.
2. Raise car, with engine running, to locate source of oil leak. Check for leaks in low, drive, and reverse.

Use of a mirror is helpful in finding leaks.

3. Shut engine off and thoroughly clean area to be repaired with a suitable solvent and a brush - air dry.

A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement.

4. Using instructions of the manufacturer, mix a sufficient amount of epoxy, No. 1360016, or equivalent, to make the repair.

Observe cautions in handling.

5. While the transmission case is still HOT, apply the epoxy to the area to be repaired.

Make certain the area to be repaired is fully covered.

6. Allow cement to cure for three hours before starting engine.
7. Road test and check for leaks.

TROUBLE DIAGNOSIS CHART

PROBLEM	PROBABLE CAUSES
No Drive in Any Selector Position	Check oil pressure. Check manual shift linkage adjustment. Check internal linkage. Check for defective pressure regulator valve. Check for pressure regulator valve retaining ring out of groove. Check for defective front pump.
Erratic Operating and Slippage (Light to Medium Acceleration)	Check suction pipe assembly for leaks. Check strainer pipe "O" ring. Low oil level. Check for defective modulator.
Excessive Slip or Engine Flare on Coasting to a Stop or When Cornering	Check engine idle. Check for suction leak. Check low band adjustment. Check for proper modulator can assembly. See parts identification chart. Check pump cover to stator shaft for cross-leakage. (Fig. 7-540) Check for defective modulator can, no bellows load. Check for leak at inner hole low servo piston assembly. Check for a sticking coast downshift timing valve. Minimum line pressure below specification.
No Reverse	Check reverse clutch piston seals. Check freedom of reverse clutch piston. Check for open feed lines to reverse clutch. (See Figs. 7-541 through 7-545)
Slips (In Any Range)	Refer to "Erratic Operation and Slippage" and "All Plates Burned" problems.
Harsh Neutral to Drive Shaft at Idle	Check vacuum line connections. Check engine idle adjustment.
No Upshift	On "no upshift" complaints, road test car or check on a twin post hoist by accelerating slowly to approximately 65 mph. If a shift occurs at approximately 65 mph, look for: 1. Open detent solenoid. 2. Loose detent solenoid attaching bolts. 3. Stuck detent valve. 4. No vacuum to modulator. If "no shift" occurs, look for: 1. Governor. 2. Stuck shift valve or shift control valve. If transmission has "no upshift" cold but is satisfactory when warm, look for sticky shift valve or shift control valve and improper bolt torque.
Long Shift Time - Shift Does Not Have Positive Engagement	Check for proper modulator can assembly. Check for leak in clutch circuit. Check valve body port between modulator boost and clutch feed in shift valve bore. If foreign material in oil pan indicates a clutch failure, replace clutch plates and necessary parts.

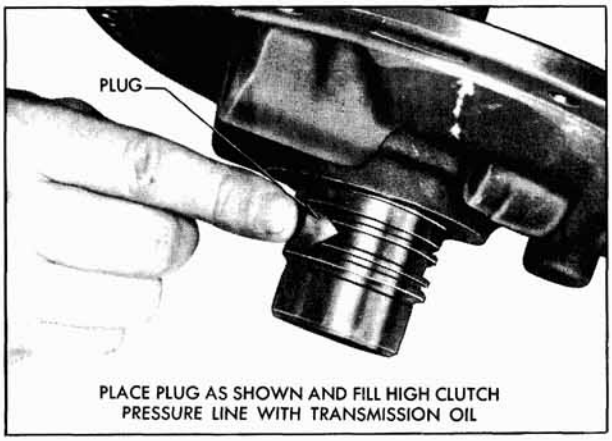


Fig. 7-540—Checking for Leak Between Pump Cover and Stator Shaft

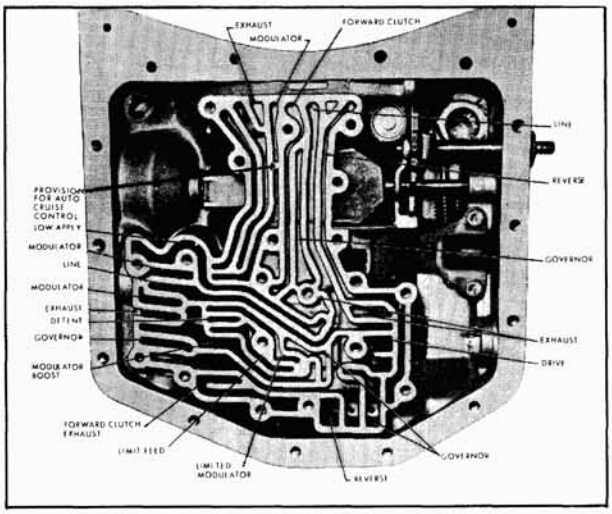


Fig. 7-541—Oil Passages in Bottom of Transmission Case

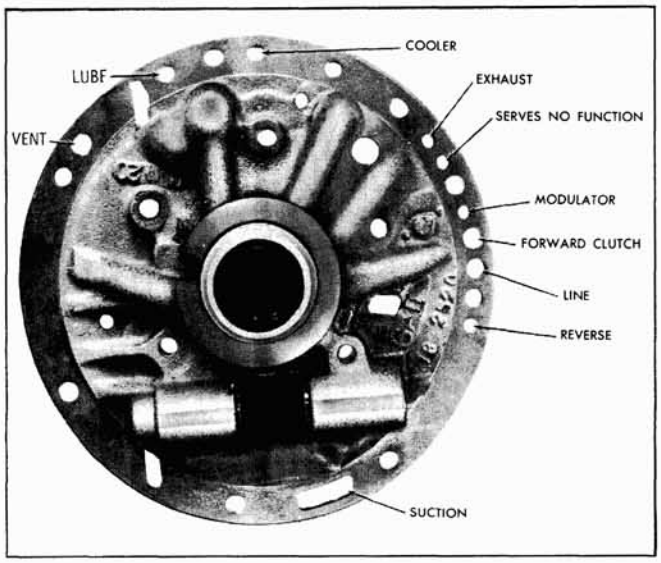


Fig. 7-542—Oil Passage in Rear Face of Pump Cover

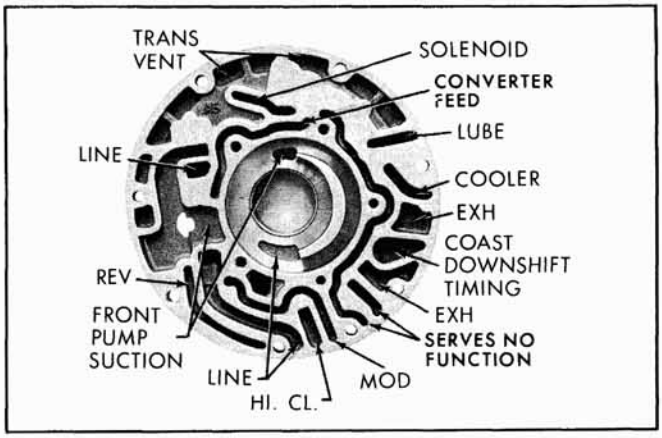


Fig. 7-543—Oil Passages in Pump Body

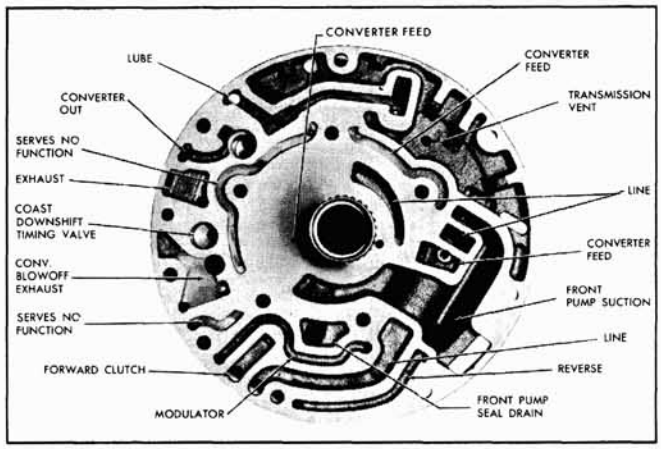


Fig. 7-544—Oil Passages in Pump Cover

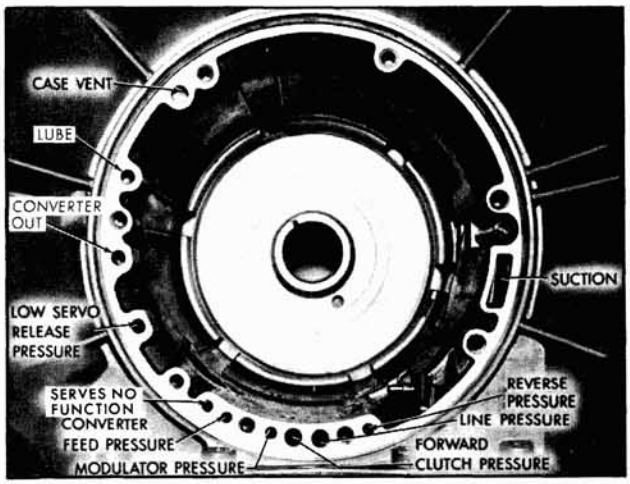


Fig. 7-545—Oil Passages in Front of Transmission Case

TROUBLE DIAGNOSIS CHART (Cont'd.)

PROBLEM	PROBABLE CAUSES
Late Upshift	Check vacuum line connections. Stuck detent valve. Open detent solenoid or loose solenoid attaching bolts. Sticky shift valve. Check governor assembly. If upshifts occur late cold, but are satisfactory warm, check for no roll pin in governor pinion or improper valve body bolt torque.
Upshifts-Downshifts Erratic	Refer to GOVERNOR DRIVEN GEAR. Scored governor bore.
No Wide Open Throttle Downshift	Check downshift throttle switch adjustment and continuity in wiring. Check for stuck detent valve and shift valves. Check orifice in detent valve. Check solenoid on valve body.
Engine Flares on Upshift	Refer to Drive Clutch Plates Burned.
Engine Flares on Wide Open Throttle Downshift	Check low band adjustment. Check for restriction in vacuum line or fitting to transmission. Check for correct valve body plate. (Fig. 7-549)
Delayed Engagement of Manual Low	Check freedom of two-piece modulator valve.
Oil Spews Out Breather	High oil level. Water in oil. Chip or burr between pump cover and housing or between complete pump assembly and case. Direct leak from front pump pressure line into vent chamber.
Drive Clutch Plates Burned. (Usually Low Band and Reverse Clutch Good) Will Cause Engine Flare-Up	Check for leakage in clutch circuit. Check ball in forward clutch drum. Check lines in front pump cover and stator shaft assembly. Steel ball in pump cover assembly missing. (Fig. 7-548) Clutch piston seals. Clutch feed oil rings. Check for proper number of clutch plates and correct piston.
Drive Clutch Plates, Low Band and Reverse Clutch Plates All Burned. Engine Will Flare on Wide Open Throttle Downshift	Check the following causes of low maximum line pressure. 1. Modulator can load check. 2. Check for proper modulator can. See Parts Identification Chart. 3. Check modulator valve and bore in case for freedom of movement. 4. Check freedom of boost valve in front pump regulator. 5. Valve body bolts loose. 6. Low oil level.

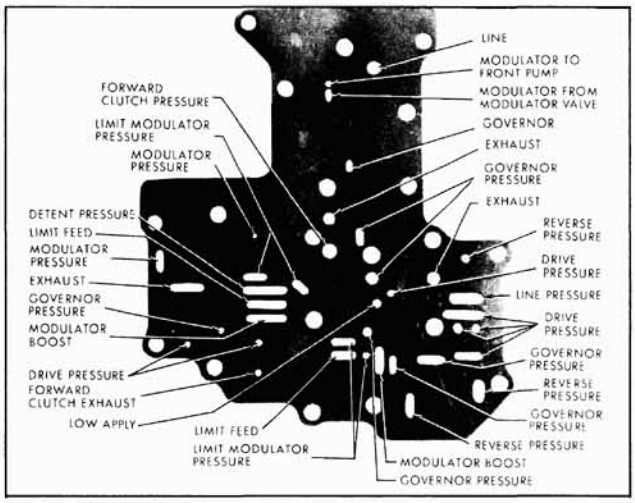


Fig. 7-546—Valve Body Plate

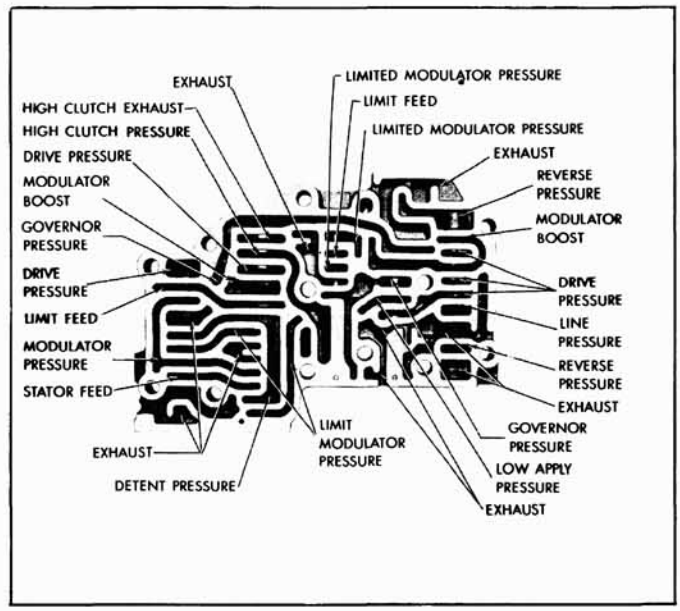


Fig. 7-547—Oil passages in Valve Body

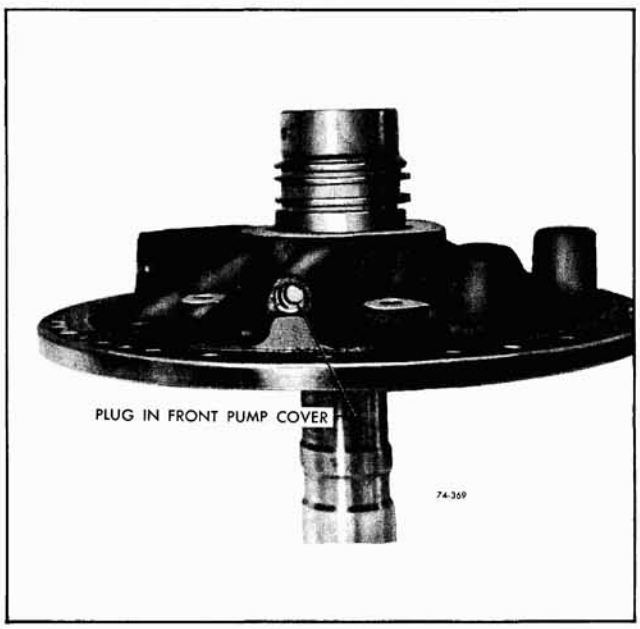


Fig. 7-548—Checking for Plug in Pump Cover

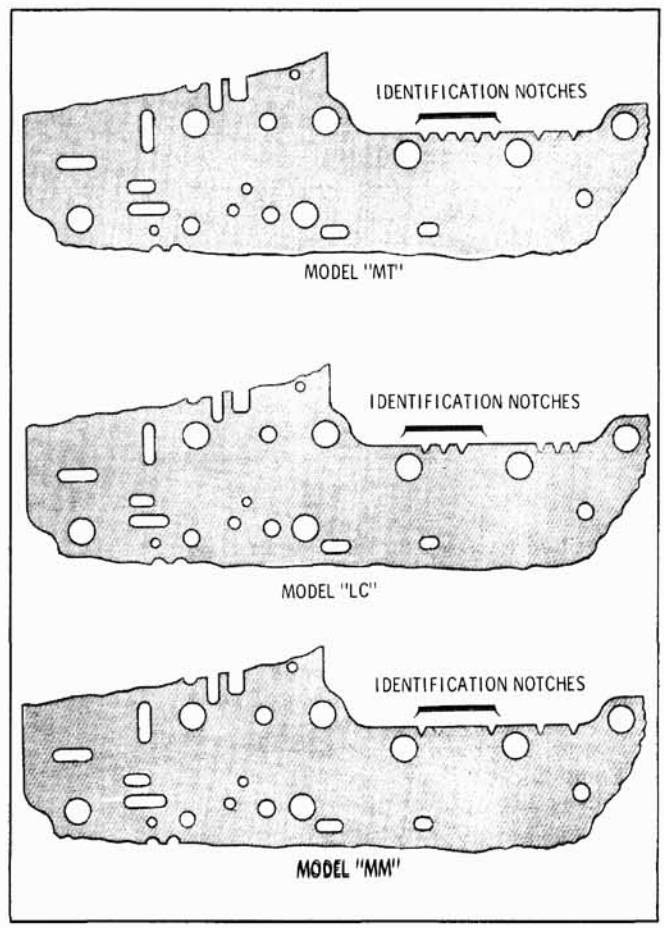


Fig. 7-549—Valve Body Plate Identification

TRANSMISSION PRESSSURE CHECKS

MAXIMUM MAIN LINE PRESSURE CHECKS are to be made in the garage bay with the vacuum modulator line disconnected and plugged. The engine speed set at 1000 rpm.

ALTITUDE	Barometric Pressure (in. hg.) At Standard Conditions*	Model LC L-6 - 250 Cu. In. Vacuum Modulator 1367032		Model MM and MT V-8 - 350 Cu. In. Vacuum Modulator 8623365	
		D & L ±4 PSI	R ±6 PSI	D & L ±4 PSI	R ±6 PSI
SEA LEVEL	29.29	160	243	161	257
2,000 FT.	27.82	152	230	153	243
5,000 FT.	24.89	138	210	140	224
10,000 FT.	20.58	119	180	123	196

MINIMUM LINE PRESSURE CHECKS are to be made while road testing car. The vacuum modulator line connected. Engine and/or car speed as shown in note below.**

MINIMUM LINE PRESSURE CHECKS FOR ALL MODELS REGARDLESS OF VACUUM MODULATOR USED. (Pressures not affected by Altitude or Barometric Pressure)

Park, Neutral and Drive	56 ± 2 psi	PRESSURE TAP IS LOCATED
Low	92 ± 4 psi	BESIDE THE LOW SERVO
Reverse	89 ± 4 psi	COVER. SEE FIG. 7-490.

*Line pressures vary 3.5 psi for each 1 in. hg. change in Barometric Pressure.

**Minimum line pressure checks to be made as follows:

1. Drive --20-40 mph coast with foot off throttle. Park and Neutral can be checked at 1000 rpm.
2. Low --20-40 mph coast with foot off throttle.
3. Reverse -coast with foot off throttle.

TORQUE CHART

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

APPLICATION	FT. LBS.
Case to Cylinder Block	35
Converter Cover Pan to Transmission Case	20
Oil Cooler Pipes to Transmission Case	25
Oil Cooler Pipes to Radiator	25
Nut for Low Band Adjusting Screw	30
Pump Body to Pump Cover	24
Valve Body Assembly to Transmission Case	12
Solenoid Valve to Valve Body	8
Vacuum Modulator to Transmission Case	12
Pump Assembly to Transmission Case	24
Rear Bearing Retainer to Transmission Case	35
Oil Pan to Transmission Case	12
Speedo Sleeve Retainer to Bearing Retainer	12
Governor Cover to Transmission Case	12
Transmission to Flywheel	35
Flywheel to Converter	32
Cross Support Bar Brackets to Frame	35
Cross Support Bar to Rear Transmission Mount	52
Flywheel Dust Cover	20
Propeller Shaft U-Bolt Nuts	14

MODEL DESIGNATION AND PARTS IDENTIFICATION

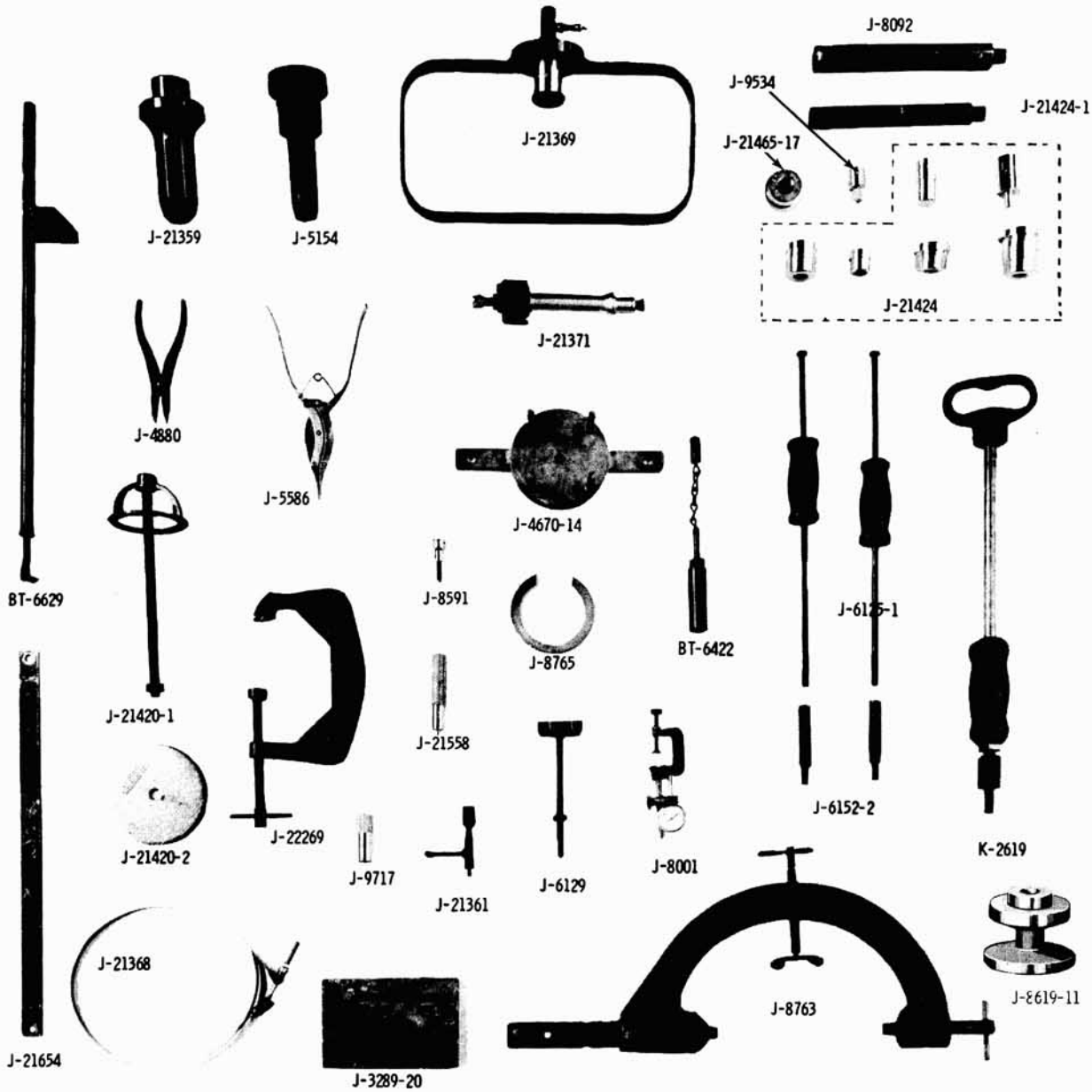
[1] Trans. Model	Converter Assembly Information	Valve Body Plate	Reverse Clutch Piston	Reverse Clutch		Forward Clutch		[2] Forward Clutch Piston	[2] Modulator Can Assembly	Coast Downshift Timing Valve	Model Usage
				Driven Plates Req'd.	Drive Plates Req'd.	Driven Plates Req'd.	Drive Plates Req'd.				
[3] LC	Green Dot of Paint	1385405 See Fig. 7-549	1371899	4	4	5	4	1378662	1367032 (Service 1367032)	No Color	L-6 Engine
[3] MM	Yellow Dot of Paint	1385876 See Fig. 7-549	1371900	5	5	6	5	1378663	8623365 (Service 8623947)	Black	V-8, 350 Cu. In. (Exc. 5400 Series)
[4] MT	Yellow Dot of Paint	1385000 See Fig. 7-549	1371900	5	5	6	5	1378663	8623365 (Service 8623947)	Orange	V-8, 350 Cu. In. (5400 Series Only)

[1] See Section 0, GENERAL INFORMATION & PERIODIC MAINTENANCE, for location of transmission code letters.

[2] Part numbers stamped on the modulator assembly and pistons.

[3] Heavy-duty option not available.

[4] Heavy-duty option uses the Turbo Hydra-Matic.



J-2619	SLIDE HAMMER	J-9717	SHIFTER SHAFT OIL SEAL INST.
J-3289-20	HOLDING FIXTURE BASE	J-21359	FRONT SEAL INSTALLER
J-4670-14	FORWARD CLUTCH SPRING COMPRESSOR	J-21361	CHECK VALVE SEAT REMOVER
J-4880	INTERNAL SNAP RING PLIERS	J-21368	PUMP BODY TO COVER ALIGNMENT BAND
J-5154	REAR SEAL INST.	J-21369	CONVERTER PRESSURE CHECKING FIXTURE
J-5586	EXTERNAL SNAP RING PLIERS	J-21371	CONVERTER END PLAY CHECKING FIXTURE
J-6125-1	SMALL SLIDE HAMMERS	J-21420-1	REVERSE CLUTCH SPRING COMPRESSOR
J-6125-2	5/16" TO 3/8" ADAPTERS FOR SLIDE HAMMER	J-21420-2	REVERSE CLUTCH SPRING COMPRESSOR WASHER
J-6129	FORWARD CLUTCH SPRING COMPRESSOR BOLT	J-21424	BUSHING REMOVER AND INSTALLER SET
BT-6422	SPEEDO DRIVEN GEAR REMOVER	J-21424-1	EXTENSION HANDLE FOR BUSHING DRIVERS
BT-6629	UNIVERSAL SEAL PULLER	J-21465-17	PUMP BODY BUSHING REM. & INST.
J-8001	DIAL INDICATOR SET	J-21558	CHECK VALVE SEAT INST.
J-8092	UNIVERSAL DRIVER HANDLE	J-21654	CONVERTER HOLDING STRAP
J-8591	ALLEN WRENCH	J-22269	LOW SERVO COVER REM. & INST.
J-8619-11	GAUGE PLATE		
J-8763	HOLDING FIXTURE		
J-8765	FORWARD CLUTCH SPRING COMPRESSOR ADAPTER		
J-9534	PLANET CARRIER BUSHING REMOVER		

Fig. 7-550—Tools

JETAWAY BUSHING SERVICE

(ALL 1964 THROUGH 1968)

BUSHING SERVICE

Bushings are available and can be replaced in the following units. Service bushings do not require reaming.

1. **Pump Body**
2. **Sun Gear and Flange**
3. **Forward Clutch Drum**
4. **Output Shaft**
5. **Case**
6. **Extension Housing**
7. **Stator Shaft**

Tools required are: J-21424, J-21465 (Turbo Hydra-Matic and Jetaway) J-8092, J-6125, J-6125-2, J-2619, J-2619-4 and J-9534.

PUMP BODY BUSHING - (Figs. 7-575 and 7-576)

With pump disassembled and front seal removed, support pump body on wood blocks. Drive bushing out from front as shown using J-8092 Drive Handle and J-21465-17 (Turbo Hydra-Matic) Bushing Remover and Installer. Use a lead or brass hammer to drive out bushing.

Clean pump bushing bore. Install new bushing on shoulder of installer J-21465-17; drive bushing squarely into the bore until it is flush to .010" below gear pocket face as shown. Remove tools and inspect bushing.

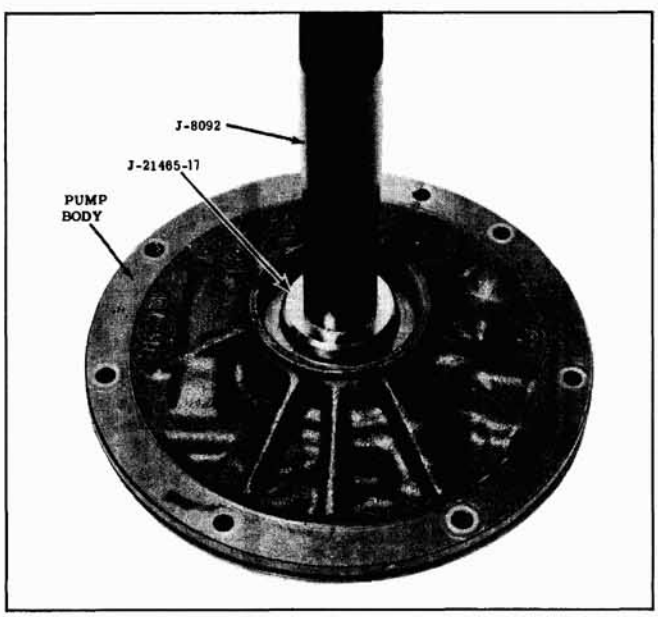


Fig. 7-575—Removing Pump Body Bushing

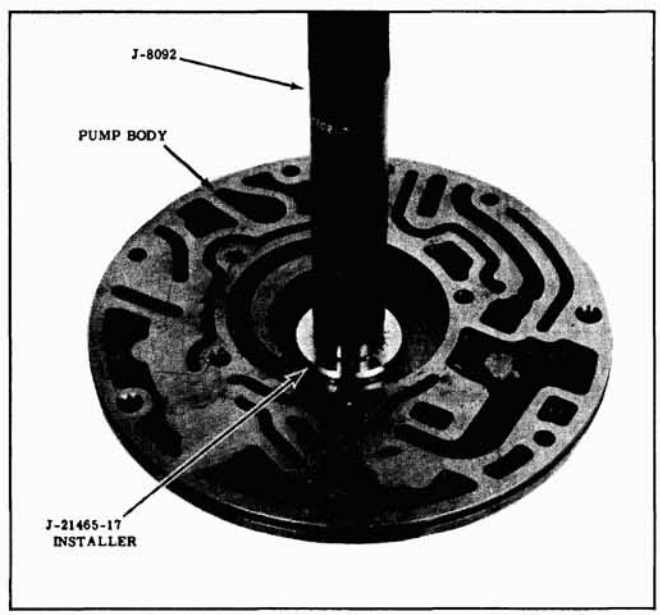


Fig. 7-576—Installing Pump Body Bushing

SUN GEAR AND FLANGE BUSHING - (Figs. 7-577 and 7-578)

Support sun gear and flange assembly on wood blocks, flange up. Assemble Extension J-21465-13 (Turbo Hydra-Matic) to Drive Handle J-8092 and install Remover J-21424-4 on Extension. Drive out bushing as shown using a lead or brass hammer.

Clean bushing bore. Assemble Installer J-21424-4 to Drive Handle J-8092 and install new bushing on shoulder of installer. Drive bushing squarely into the bore until Tool J-21424-4 is flush to .010" below top of sun gear as shown. Remove tools and inspect bushing.

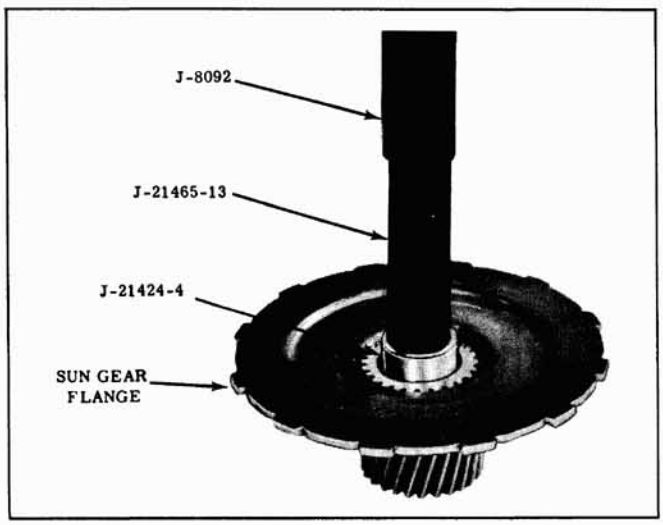


Fig. 7-577—Removing Sun Gear and Flange Bushing

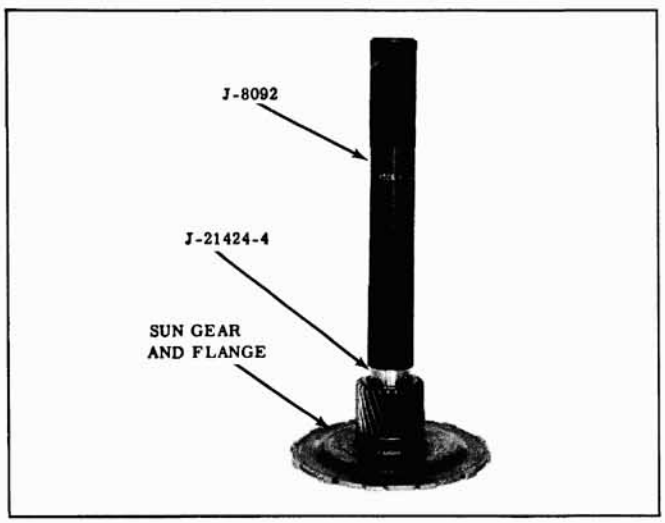


Fig. 7-578—Installing Sun Gear and Flange Bushing

FORWARD CLUTCH DRUM BUSHING - (Figs. 7-579 and 7-580)

Position forward clutch drum with open end up. Assemble Remover J-21424-5 to Drive Handle J-8092 and drive bushing out as shown using a lead or brass hammer.

Reverse the drum and clean bore. Install new bushing on shoulder of Installer J-21424-5 and drive bushing squarely into bore until tool bottoms on face of drum as shown. Remove tools and inspect bushing.

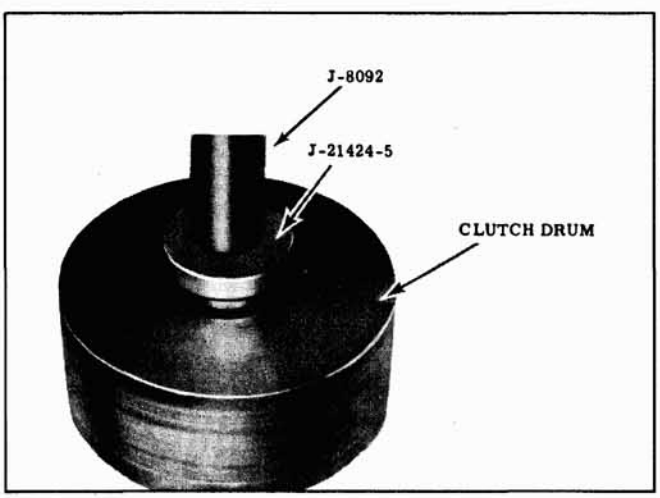


Fig. 7-579—Removing Forward Clutch Drum Bushing

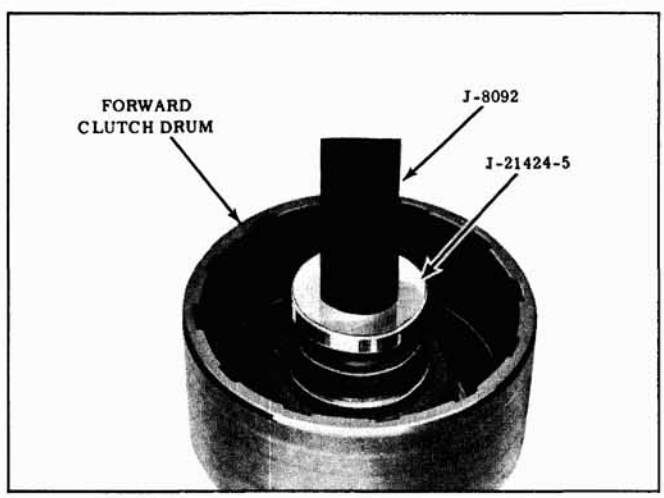


Fig. 7-580—Installing Forward Clutch Drum Bushing

OUTPUT SHAFT BUSHING - (Figs. 7-581 and 7-582)

Install output shaft in vise using brass jaws to protect the shaft. Install Distributor Shaft Pilot Bearing Remover J-9534 and Adapter J-6125-2 on Slide Hammer J-6125. Thread remover into output shaft bushing and drive out with Slide Hammer as shown.

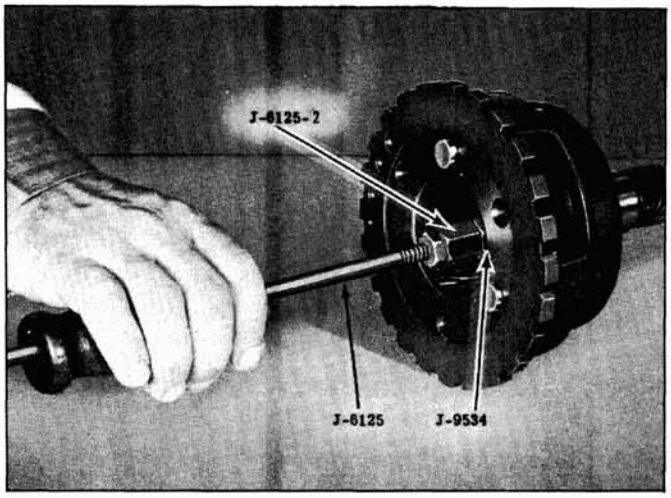


Fig. 7-581—Removing Output Shaft Bushing

Clean all shavings from bushing recess. Assemble Installer J-21424-3 on Drive Handle J-8092. Install new bushing on shoulder of installer as shown and drive bushing squarely into the bore until installer bottoms on machined surface of planet carrier using a lead or brass hammer. Remove tools and inspect bushing.

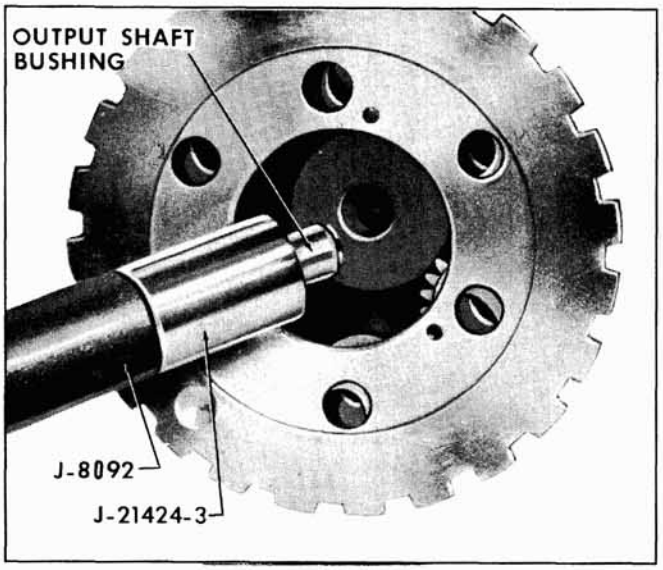


Fig. 7-582—Installing Output Shaft Bushing

CASE BUSHING - (Figs. 7-583 and 7-584)

Assemble Adapter J-2619-4 and Remover J-21465-16 on Slide Hammer J-2619. Thread remover into case bushing and drive out with Slide Hammer as shown.

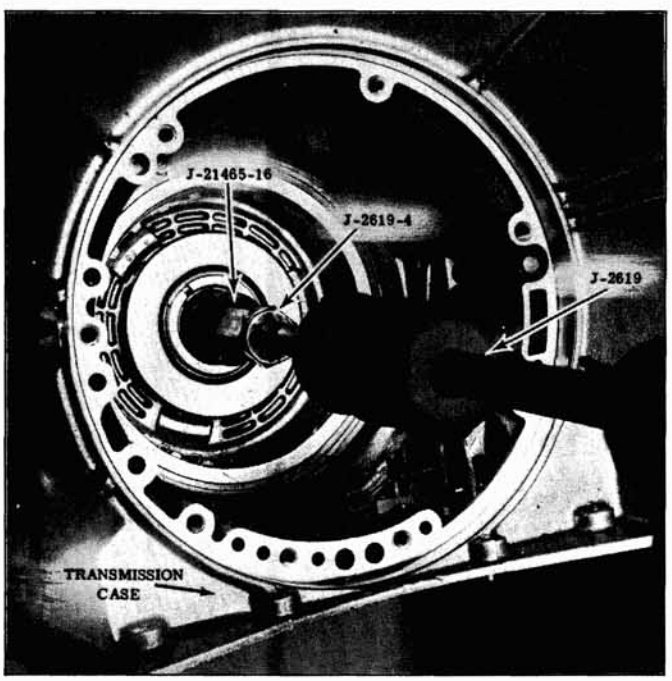


Fig. 7-583—Removing Case Bushing

Clean all shavings from case. Assemble Installer J-21424-2 on Drive Handle J-8092 and install new bushing on shoulder of installer and drive bushing squarely into the bore using a lead or brass hammer until the installer bottoms as shown. Remove tools and inspect bushing.

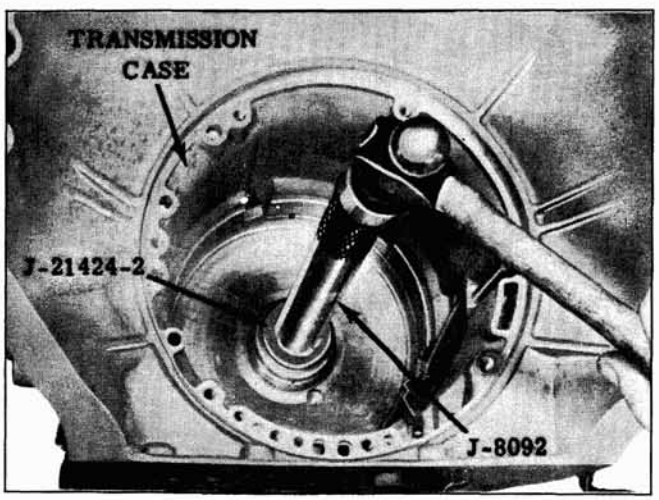


Fig. 7-584—Installing Case Bushing

EXTENSION HOUSING - (Figs. 7-585 and 7-586)

Position extension housing on bench, bushing end up. Assemble J-21424-9 Remover to J-8092 Drive Handle and drive out bushing using a lead or brass hammer as shown.

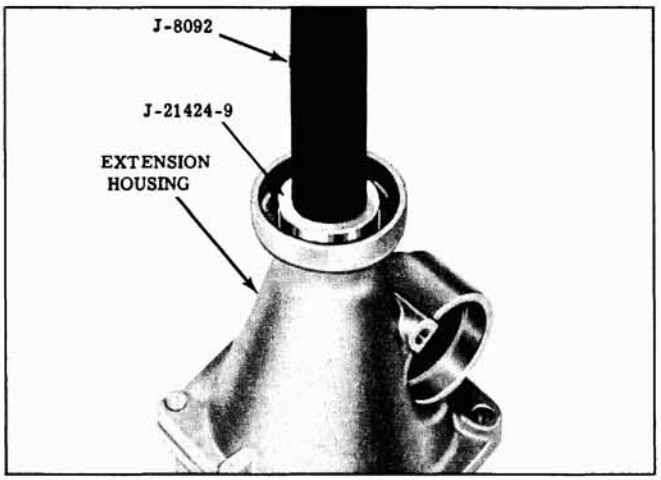


Fig. 7-585—Removing Extension Housing Bushing

Clean extension housing bushing bore. Assemble new bushing on shoulder of Installer J-21424-9 and drive bushing squarely into bore until it is flush to .010" below chamfer in extension housing as shown. Remove tools and inspect bushing.

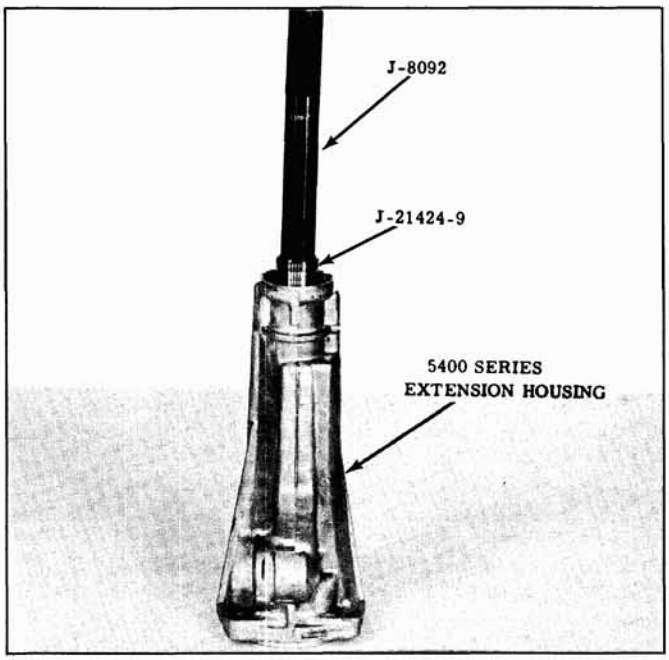


Fig. 7-586—Installing Extension Housing Bushing

STATOR SHAFT BUSHING - (Figs. 7-587 and 7-588)

Install pump cover and stator shaft in vise, using brass jaws to protect stator shaft. Assemble Adapter J-2619-4 and Remover J-21465-15 (Turbo Hydra-Matic) to Slide Hammer J-2619. Thread remover into bushing and drive out with Slide Hammer as shown.

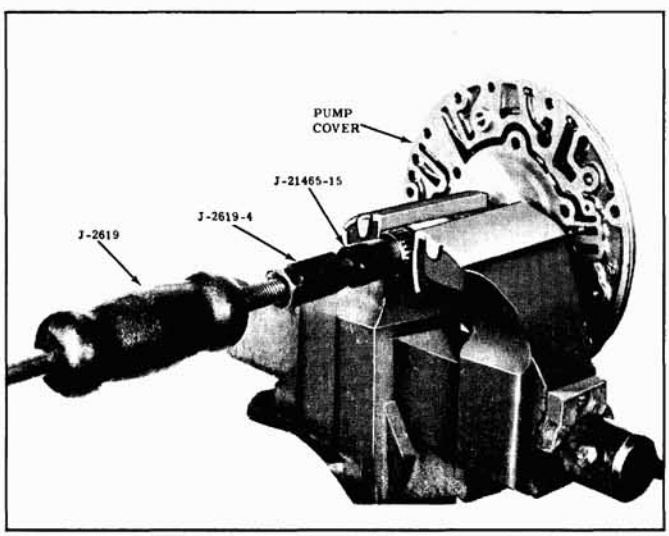


Fig. 7-587—Removing Stator Shaft Bushing

Clean all shavings from stator shaft. Position hub of pump cover on wood block. Assemble Installer J-21424-7 and Extension J-21465-13 (Turbo Hydra-Matic) on Drive Handle J-8092 (not shown). Install new bushing on shoulder of installer and drive bushing squarely into bore until bushing bottoms using a lead or brass hammer as shown. Remove tools and inspect bushing.

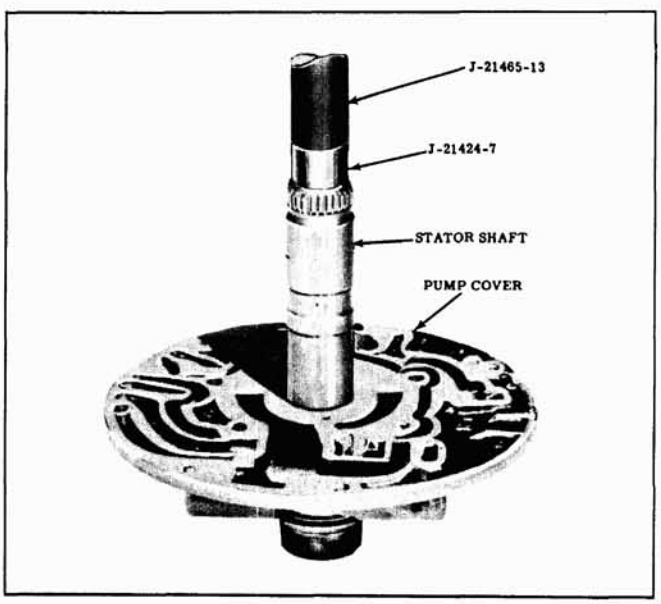
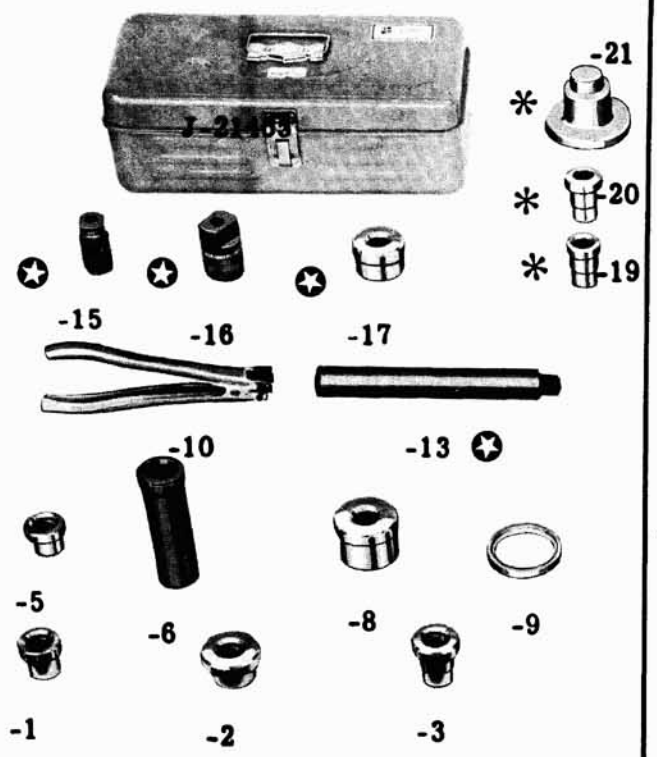
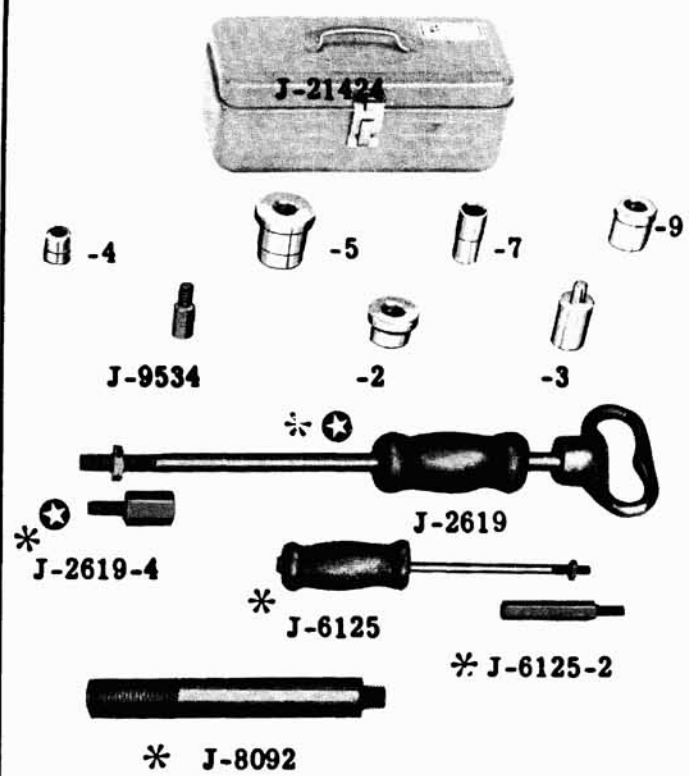


Fig. 7-588—Installing Stator Shaft Bushing





✪ INDICATES TOOLS USED FOR TURBO HYDRA-MATIC AND JETAWAY

*** INDICATES TOOLS NOT INCLUDED IN SET**

J-21424-2 TRANSMISSION CASE BUSHING INSTALLER
J-21424-3 OUTPUT SHAFT BUSHING INSTALLER
J-21424-4 SUN GEAR AND FLANGE BUSHING REMOVER AND INSTALLER
J-21424-5 FORWARD CLUTCH DRUM BUSHING REMOVER AND INSTALLER
J-21424-7 STATOR SHAFT BUSHING INSTALLER
J-21424-9 EXTENSION HOUSING BUSHING REMOVER AND INSTALLER
J-9534 OUTPUT SHAFT BUSHING REMOVER
J-2619 SLIDE HAMMER (LARGE)
J-2619-4 SLIDE HAMMER (THREAD REDUCER ADAPTER)
J-6125 SLIDE HAMMER (SMALL)
J-6125-2 SLIDE HAMMER (THREAD REDUCER ADAPTER)
J-8092 DRIVER HANDLE (UNIVERSAL)
J-21465-1 OUTPUT SHAFT BUSHING INSTALLER
J-21465-5 SUN GEAR SHAFT BUSHING INSTALLER
J-21465-6 CASE CENTER SUPPORT BUSHING REMOVER AND INSTALLER
J-21465-8 TRANSMISSION CASE BUSHING REMOVER AND INSTALLER
J-21465-9 TRANSMISSION CASE BUSHING INSTALLER ADAPTER RING
J-21465-10 TRANSMISSION CASE AND EXTENSION HOUSING BUSHING STAKING PLIERS
J-21465-13 TRANSMISSION CASE BUSHING EXTENSION HANDLE
J-21465-15 SUN GEAR SHAFT AND STATOR SHAFT BUSHING REMOVER
J-21465-16 OUTPUT SHAFT BUSHING REMOVER
J-21465-17 PUMP BODY BUSHING AND EXTENSION HOUSING BUSHING REMOVER AND INSTALLER
J-21465-19 STATOR SHAFT FRONT BUSHING INSTALLER
J-21465-20 STATOR SHAFT REAR BUSHING INSTALLER
J-21465-21 PUMP COVER SUPPORT

Fig. 7-589—Tools

MANUAL TRANSMISSION AND CLUTCH

31 THROUGH 66 SERIES

CONTENTS OF SECTION

THREE-SPEED TRANSMISSION
31 THROUGH 42 AND 4800 SERIES

Subject	Page
GENERAL DESCRIPTION	7-601
MAINTENANCE AND ADJUSTMENTS	7-601
SHIFT LINKAGE ADJUSTMENT	7-601
REAR BEARING RETAINER OIL SEAL AND BUSHING REPLACEMENT	7-602
SPEEDOMETER DRIVEN GEAR	7-602
TRANSMISSION SIDE COVER	7-603
MAJOR SERVICE OPERATIONS	7-603
TRANSMISSION REMOVAL	7-603
TRANSMISSION INSTALLATION	7-604
MAIN DRIVE GEAR SEAL	7-604
TRANSMISSION DISASSEMBLY	7-604
TRANSMISSION ASSEMBLY	7-607
TRANSMISSION ALIGNMENT	7-609
DIAGNOSIS	7-631
SPECIFICATIONS	7-632
SPECIAL TOOLS	7-633

THREE-SPEED HEAVY DUTY TRANSMISSION
Std. For 44, 54, 64 and 66 Series Page 7-610
Option M-14 for 32, 36 and 42 Series

FOUR SPEED TRANSMISSION (OPTIONS M20 and M21)
Optional for 32, 36, 42 and 44 Series Page 7-619
CLUTCH (ALL SERIES) Page 7-634

THREE SPEED TRANSMISSION
(COLUMN SHIFT)

GENERAL DESCRIPTION (Fig. 7-601)

A 3-speed transmission synchronized in all forward gears is used as standard equipment on 31 through 42 and 48 Series. However, because of gear ratio differences, two transmission assemblies are required.

The transmissions are identified by 1" high letters located on the right hand side of the case. The L-6 transmission is identified by the letters QP. The V-8 transmission is identified by the letters RJ.

The servicing of both transmissions is identical.

The transmissions incorporate all helical gears which are machined from drop forged steel gear blanks, heat treated and shot peened for strength and long life. The shafts are machined from high grade steel, heat treated and ground to close limits.

The rear end of the clutch gear is supported by a heavy-duty ball bearing at the front end of the transmission case and is piloted at its front end in an oil impregnated bushing, mounted in the engine crankshaft on the L-6 and in a ball bearing on the V-8. The front end of the mainshaft is piloted in a roller bearing set into the hollow end of the clutch gear and the rear end is carried by a ball bearing.

The countergear is carried on roller bearings at both ends while thrust is taken on thrust washers located between each end of gear and the case. An anti-lash plate and two damper springs are retained to the countergear by three rivets.

The reverse idler gear is carried on a bronze bushing.

Gearshifting is manual through shift control rods to the transmission. Shifting is accomplished by two rotating cranks which directly engage the gears to be shifted, thus affording a highly efficient mechanical action.

MAINTENANCE AND ADJUSTMENTS

Shift Linkage Adjustment

The shift linkage is attached as shown in Fig. 7-602. To adjust, proceed as follows:

1. Position the transmission in neutral.
2. Loosen the swivel nuts on the shift rods at the transmission. Be sure shift rods are free to move in the swivels.
3. Insert a 3/16" rod through the shift levers and into the upper hole of the column bracket. (Fig. 7-603)
4. With the transmission levers in the neutral position, tighten the swivel nuts to 23 ft. lbs. torque.
5. Remove the 3/16" rod. Make sure the neutral positions of the column shift levers are exactly in line. If not, readjust one rod to bring them in line.
6. Check shift operation with the engine off. Start engine and recheck.

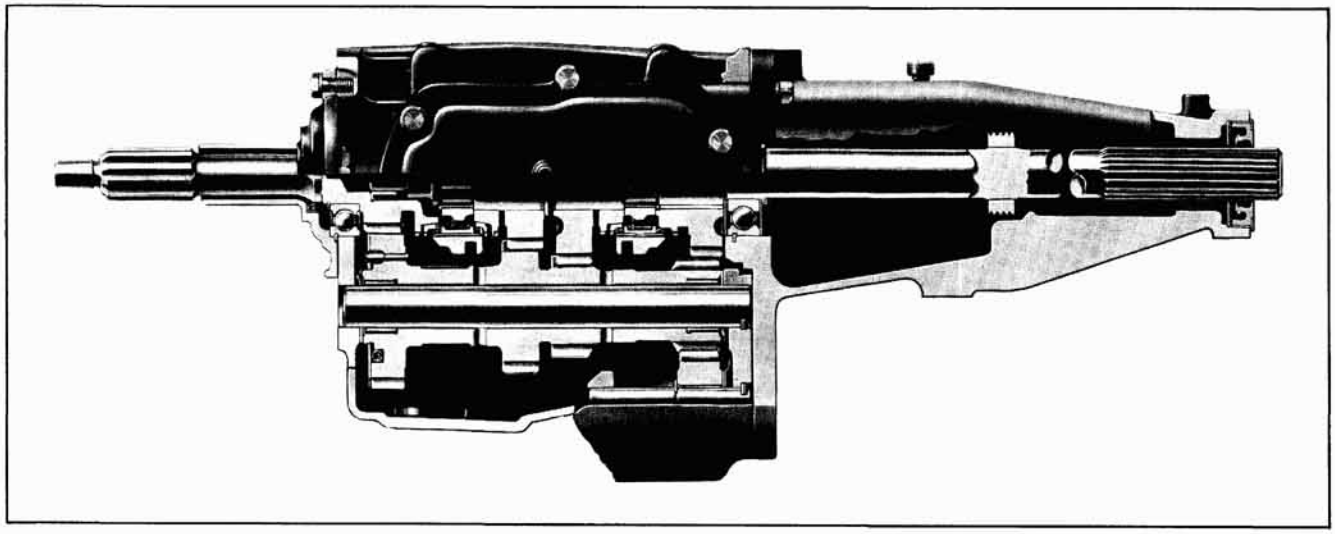


Fig. 7-601—Three Speed Transmission

REAR BEARING RETAINER OIL SEAL AND BUSHING REMOVAL

1. Remove propeller shaft.
2. Tap seal inward to break bond then using Tool BT-6629-1 and BT-6629-3 remove seal. (Fig. 7-604)
3. After removing the seal, if bushing replacement is necessary, the bushing can be removed as shown in Fig. 7-605.
4. If the bushing was removed, it can be installed using tools as shown in Fig. 7-606. Coat ID of bushing with automatic transmission fluid.
5. Coat the outside of new seal sparingly with Sealer, No. 1050026, or equivalent. Apply Lubricant, No. 1050169, or equivalent to the sealing lip of seal.
6. Drive seal into the rear bearing retainer using Tool J-5395 until seal is fully seated (Fig. 7-607). Tool J-6403-6 and J-6403-5 can also be used.

SPEEDOMETER DRIVEN GEAR

Disconnect speedometer cable, remove retainer to housing bolt and remove retainer. Insert screwdriver into retainer slot in sleeve and pry sleeve and driven gear from housing. (Fig. 7-602 View A)

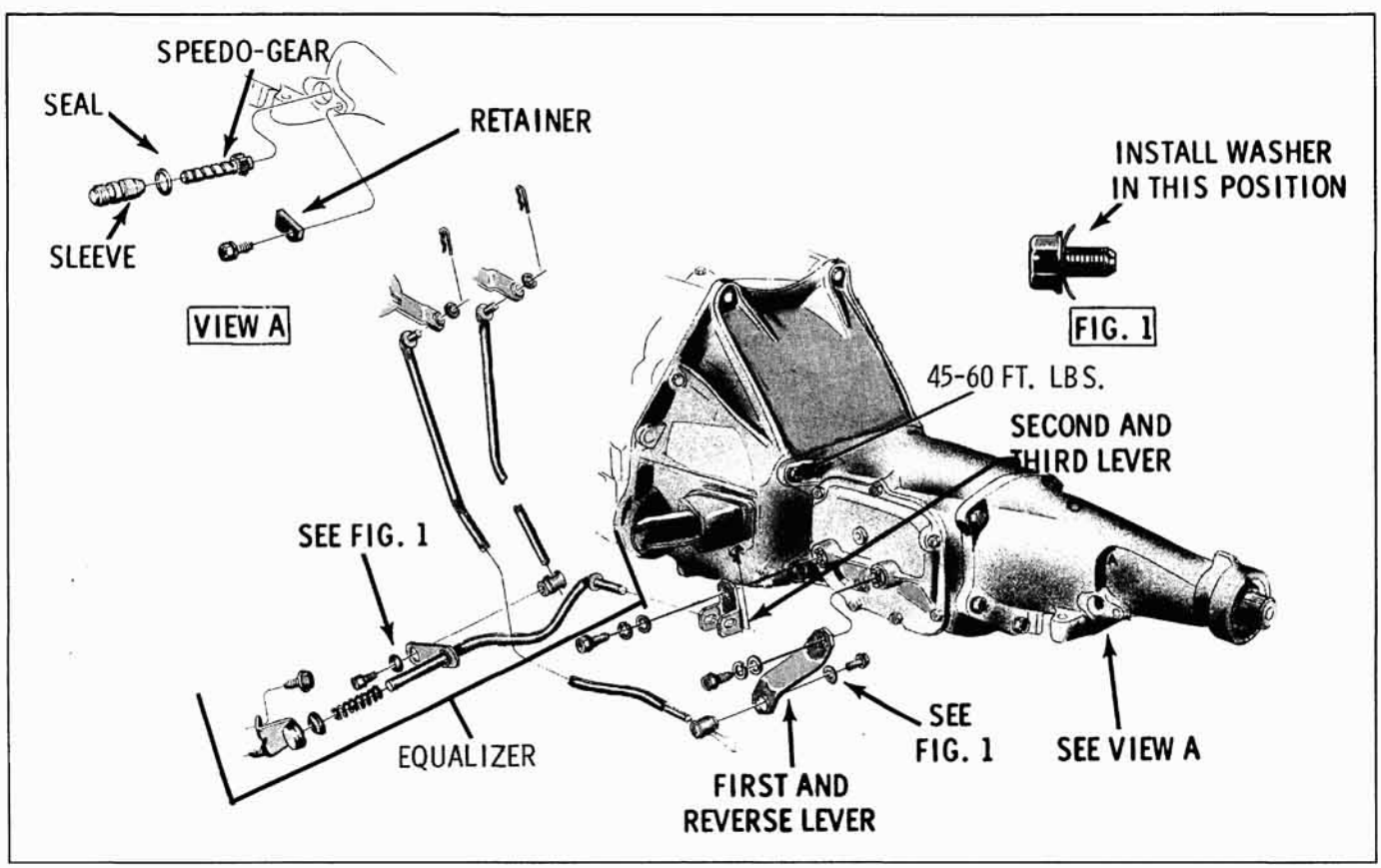


Fig. 7-602—Shift Linkage

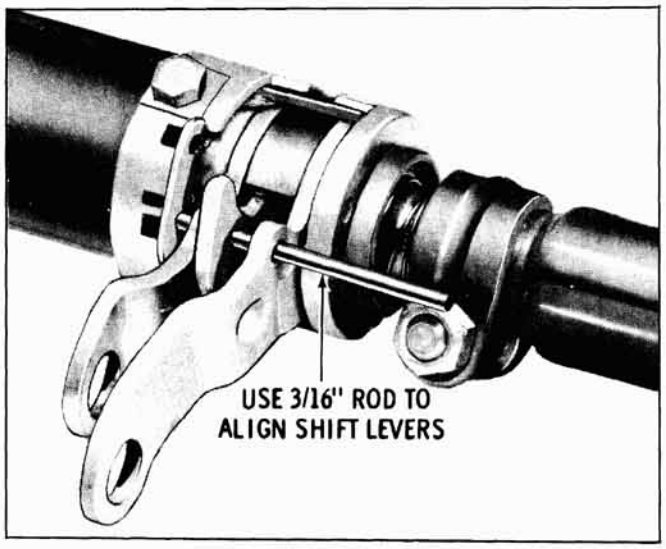


Fig. 7-603—Shift Lever Positioning

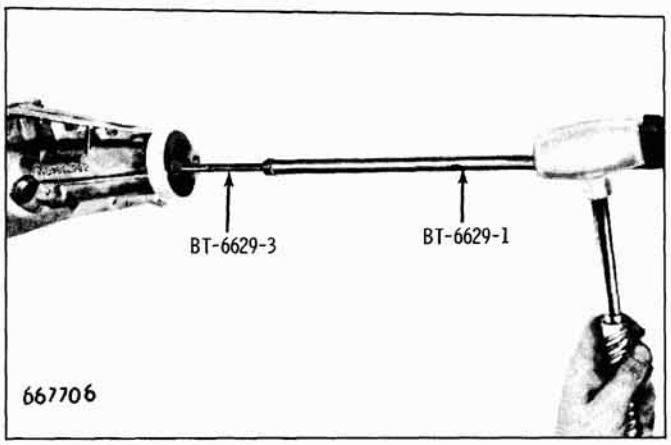


Fig. 7-604—Removing Seal

Coat seal and speedometer gear shaft with automatic transmission lubricant and insert gear. Push sleeve into housing until the retainer can be inserted into the groove in the sleeve and install the retainer.

TRANSMISSION SIDE COVER

Removal and Installation

1. Disconnect shift rods from levers.
2. Remove cover assembly from transmission.
3. Remove outer shifter lever retainer bolts and washers and pull levers from shafts.
4. Remove snap ring. This will allow removal of shifter shaft, fork assembly and cam assembly, or interlock, from cover.
5. Replace necessary parts. Coat shift shaft "O" ring seal with transmission lubricant before installing in cover. Install shifter interlock detent cams and snap ring.
6. Install 1st-Rev. and 2nd-3rd levers and retaining screws.
7. With transmission gears in neutral and shifter forks in neutral, install cover to transmission using a new gasket. Coat screws with 1050026 Sealer or equivalent. Tighten cap screws to 18 ft. lbs. torque.
8. Attach shift rods to shifter levers.
9. Fill transmission with transmission lubricant as specified in Section 0 to level of filler plug.

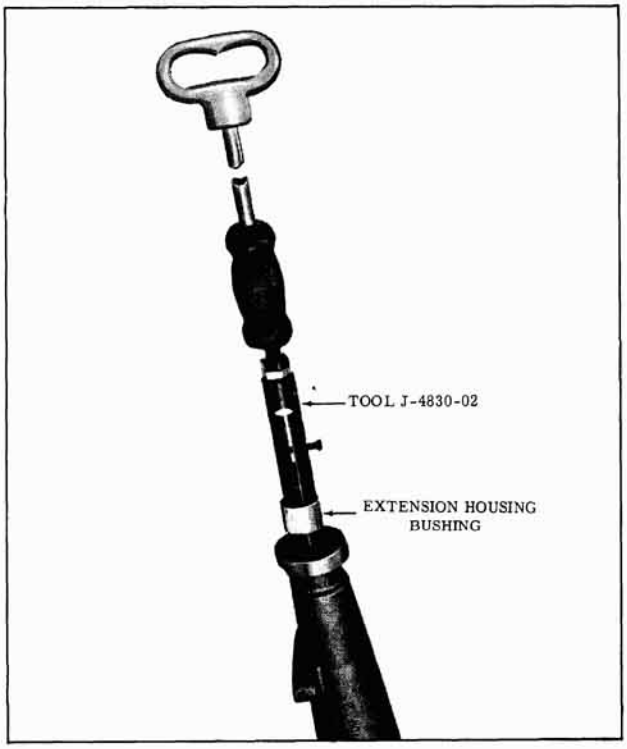


Fig. 7-605—Removing Bushing

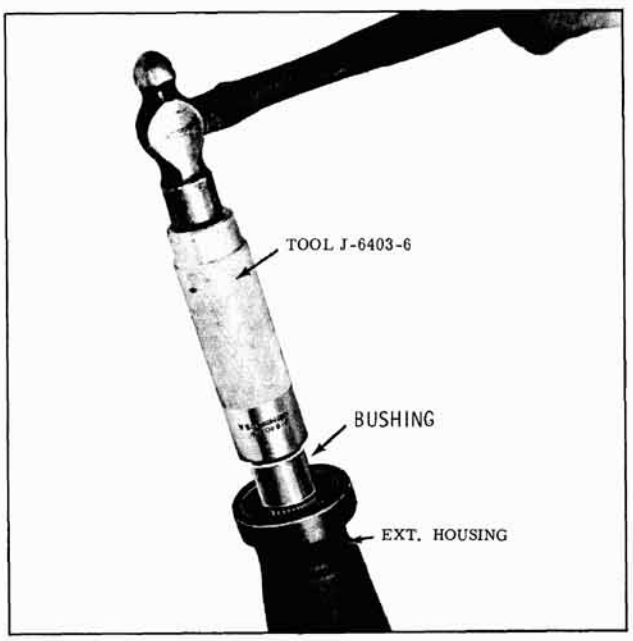


Fig. 7-606—Installing Bushing

MAJOR SERVICE OPERATIONS

Removal

1. Disconnect throttle linkage from cowl bracket to prevent damage.
2. Raise car.
3. Remove propeller shaft.
4. Disconnect shift rods from shift levers.
5. For 31 and 35 Series, install Engine Support Bar BT-6424-1 with Adapter BT-6424-2. For 32, 36, 42 and 48 Series, install Engine Support Bar BT-6424-1. If equipped with air conditioning, install Adapter BT-6424-3.

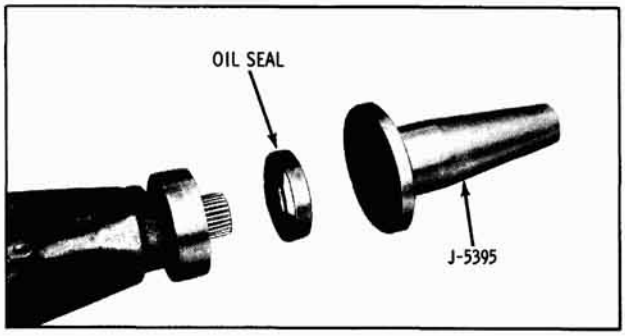


Fig. 7-607—Installing Seal

6. Remove cross support bar to rear transmission mount attaching bolts.
7. Disconnect parking brake cables from cross support and remove cross support bar.

If equipped with dual exhaust, it may be necessary to disconnect the left hand exhaust pipe at the exhaust manifold to provide clearance.

8. Disconnect speedometer cable.
9. Remove transmission upper attaching bolts. Install aligning studs. (1/2"-13 x 2-1/2" threaded headless bolts.)

Aligning studs must be used to support transmission to prevent distortion of the clutch driven plate hub when removing transmission.

10. Remove transmission lower attaching bolts.
11. Carefully slide transmission rearward and remove from car.

Installation

1. Inspect clutch pilot bearing or bushing and replace if necessary.
2. Reverse removal procedure, using the following specified torque ratings for the attaching parts:

a. Transmission to engine	50 ft. lbs.
b. Exhaust pipe to exhaust manifold	15 ft. lbs.
c. Cross support bar brackets to frame	35 ft. lbs.
d. Cross support bar to rear transmission mount	50 ft. lbs.
e. Propeller shaft U-bolt nuts	14 ft. lbs.

Main Drive Gear Bearing Seal Replacement

1. Remove transmission from car.
2. Remove main drive gear bearing retainer and gasket.
3. Remove seal from retainer by prying out with screwdriver.
4. Coat the outside of new seal sparingly with Sealer, No. 1050026, or equivalent. Apply lubricant No. 1050169, or equivalent to the sealing lip of the seal.
5. Center seal in retainer, spring side out, using Tool J-8615, tap seal into place. (Fig. 7-608)

DISASSEMBLY

1. Remove side cover attaching screws and remove side cover assembly and shift forks.
2. Remove main drive gear bearing retainer.
3. Remove main drive gear bearing to gear stem snap ring, then remove main drive gear bearing by pulling outward on main drive gear until a screwdriver or other suitable tool can be inserted between bearing large snap ring and case to complete removal. (Fig. 7-610) The main drive gear bearing is

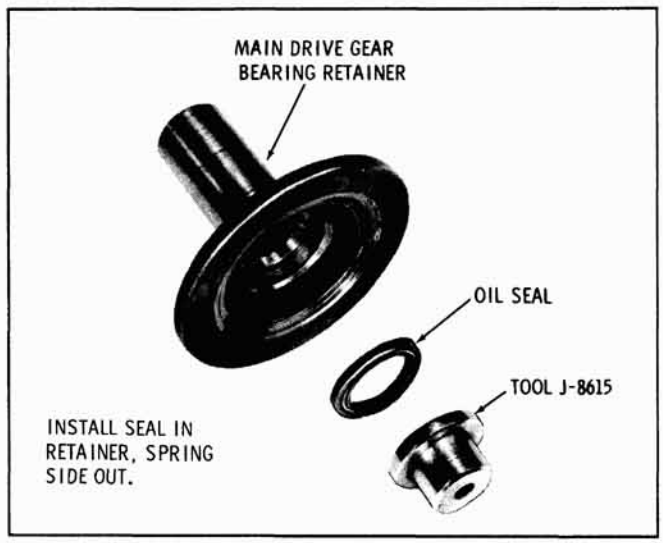


Fig. 7-608—Main Drive Gear Bearing Seal

a slip fit on the gear and into the case bore. (This provides clearance for removal of main drive gear and mainshaft assembly.)
4. Remove extension to case attaching bolts.
5. Remove the reverse idler shaft snap ring.
6. Remove main drive gear, mainshaft and extension assembly together through the rear case opening.
7. Using snap ring pliers, expand the snap ring in the extension which retains the mainshaft rear bearing (Fig. 7-611) and remove the extension.
8. Using J-22246 at the front of the countershaft, drive the shaft and its woodruff key out the rear of the case. (Fig. 7-612) Tool J-22246 will now hold the roller bearings in position within the countergear bore. Remove the gear and bearings.
9. Use a long drift or punch through the front bearing case bore and drive the reverse idler shaft and woodruff key through the rear of the case . (Fig. 7-613)
10. Using snap ring pliers, remove the second and third-speed sliding synchronizer hub snap ring from mainshaft and remove synchronizer assembly, second-speed blocker ring and second-speed gear from front of mainshaft. Hub must be pressed off, mark for re-installation.
11. Remove rear bearing snap ring from mainshaft groove.
12. Support reverse gear with suitable press plate and press on rear of mainshaft to remove reverse gear, thrust washer, spring washer, rear bearing, snap ring and finally the speedometer drive gear from rear of mainshaft. (Fig. 7-614)

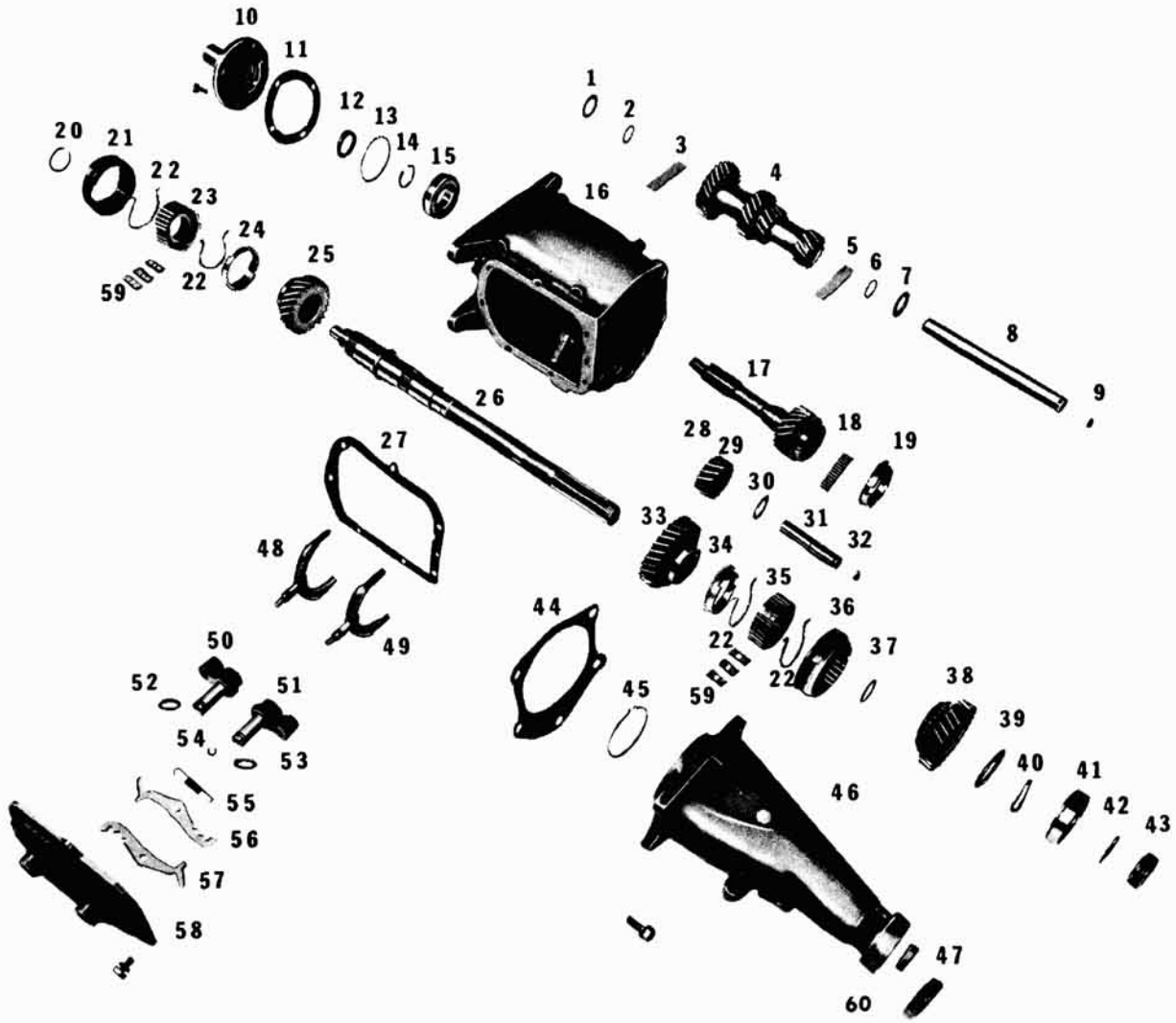
When pressing rear bearing, be careful to center gear, washers, bearings and snap ring on mainshaft before attempting to press off the speedometer drive gear. If only speedometer gear is to be removed, refer to Fig. 7-615.

13. Remove the first and reverse synchronizer hub snap ring from mainshaft and remove the synchronizer assembly, first-speed blocker ring and first-speed gear from the rear of the mainshaft. Hub must be pressed off, mark for re-installation.

CLEANING AND INSPECTION

Transmission Case

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.
2. Check the front and rear faces for burrs and if present, dress them off with a fine mill file.



1. Gear Thrust Washer
2. Bearing Thrust Washer
3. Bearing Rollers (27)
4. Countergear
5. Bearing Rollers (27)
6. Spacer
7. Tanged Washer
8. Countershaft
9. Key
10. Bearing Retainer
11. Gasket
12. Seal
13. Bearing Snap Ring
14. Bearing Retaining Snap Ring
15. Main Drive Gear Bearing
16. Transmission Case
17. Main Drive Gear
18. Mainshaft Pilot Bearings (14)
19. 3rd Speed Blocker Ring
20. Snap Ring
21. 2-3 Synchronizer Sleeve
22. Synchronizer Clutch Key Spring
23. Synchronizer Clutch Hub
24. 2nd Speed Blocker Ring
25. 2nd Speed Gear
26. Mainshaft
27. Gasket
28. Snap Ring
29. Reverse Idler Gear
30. Tanged Thrust Washer
31. Reverse Idler Shaft
32. Key
33. 1st Speed Gear
34. 1st Speed Blocker Ring
35. Synchronizer Clutch Hub
36. 1st Speed Synchronizer Sleeve
37. Snap Ring
38. Reverse Gear
39. Reverse Gear Thrust Washer
40. Spring Washer
41. Rear Bearing
42. Snap Ring
43. Speedometer Drive Gear
44. Gasket
45. Rear Bearing Snap Ring
46. Case Extension
47. Rear Oil Seal
48. 2nd and 3rd Shift Fork
49. 1st and Reverse Shift Fork
50. 2nd and 3rd Shifter Lever
51. 1st and Reverse Shifter Lever
52. Seal
53. Seal
54. Snap Ring
55. Detent Cam Spring
56. Detent Cam
57. Detent Cam
58. Transmission Side Cover
59. Synchronizer Clutch Key
60. Bushing

Fig. 7-609—Three Speed Manual Transmission

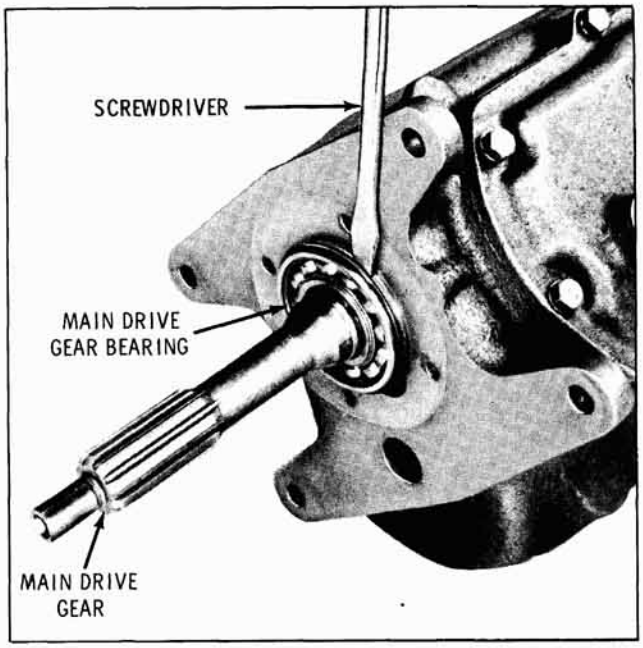


Fig. 7-610—Removing Main Drive Gear Bearing

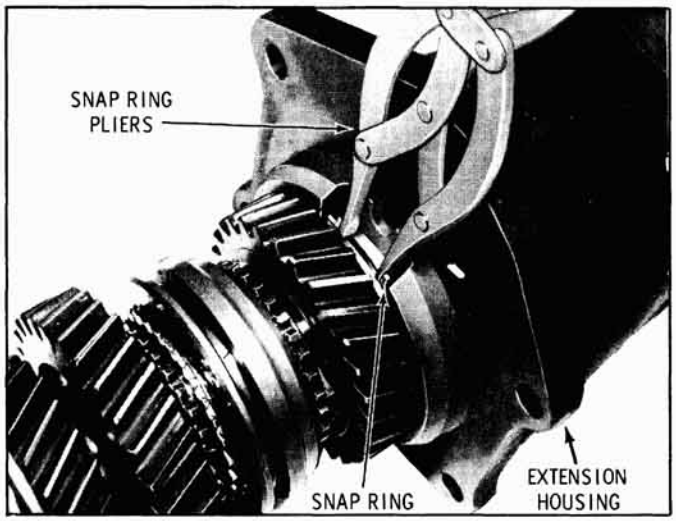


Fig. 7-611—Removing Rear Bearing Snap Ring

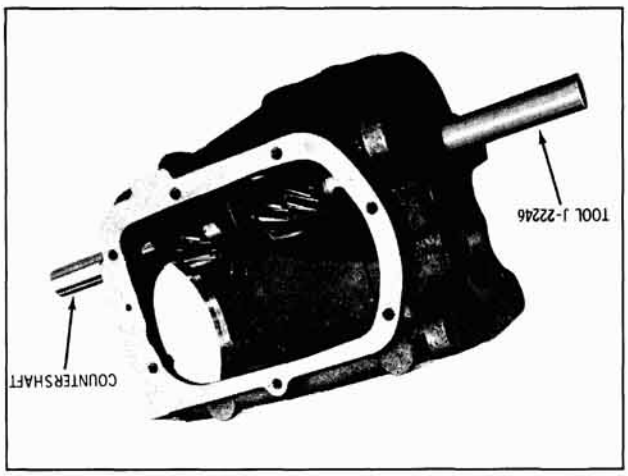


Fig. 7-612—Removing Countershaft

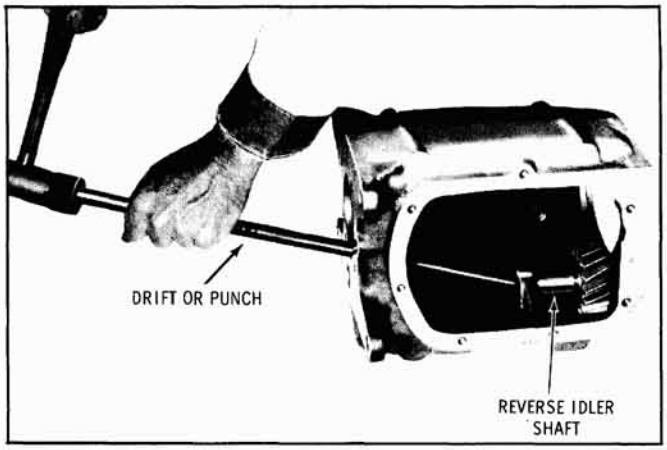


Fig. 7-613—Removing Reverse Idler Gear

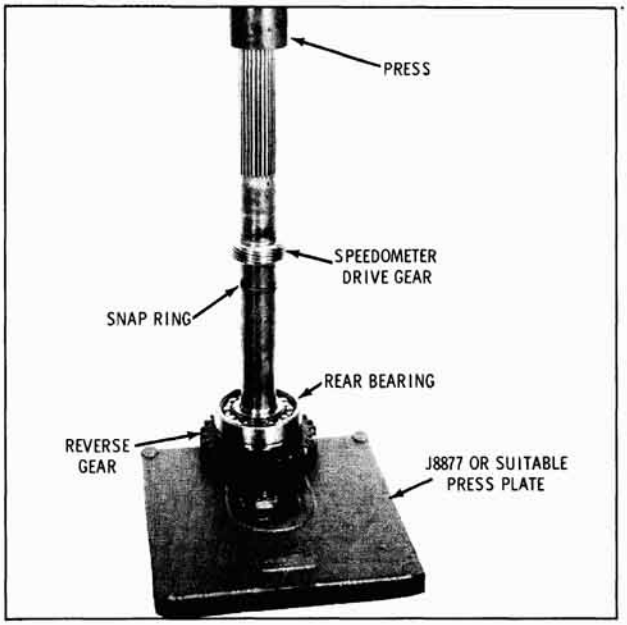


Fig. 7-614—Removing Reverse Gear and Rear Bearing

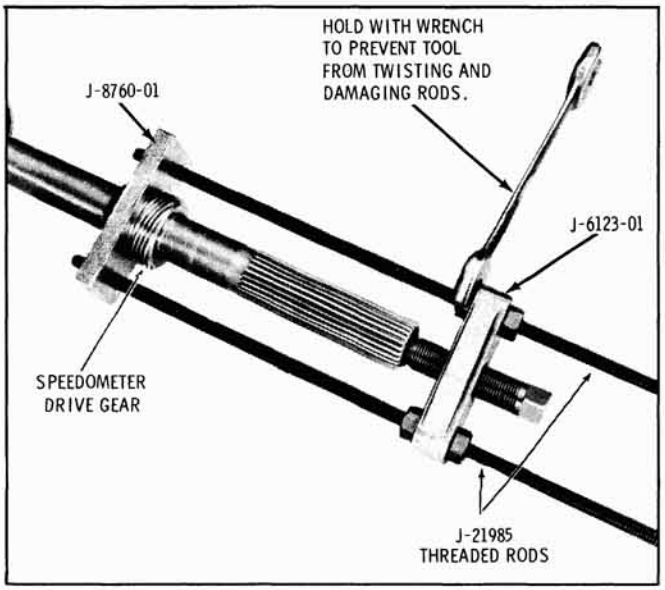


Fig. 7-615—Removing Speedometer Drive Gear

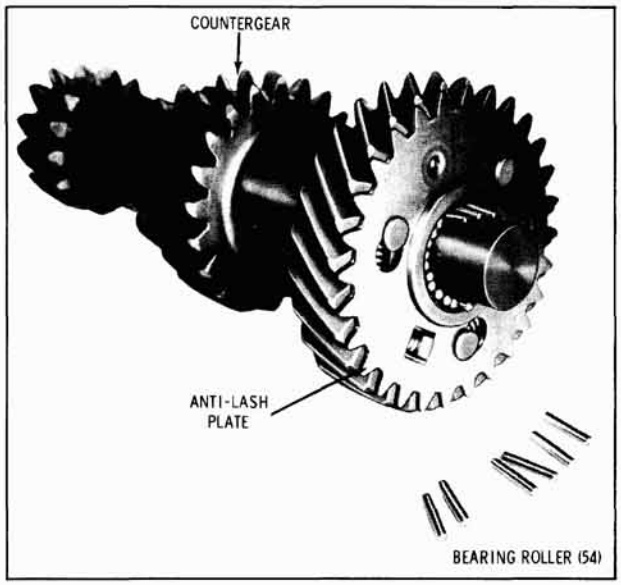


Fig. 7-616—Countergear Assembly

3. Check bearing bores in case and, if damaged, replace case.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

Do not allow the bearings to spin, turn them slowly by hand. Spinning bearings will damage the race and balls.

3. Make sure bearings are clean, then lubricate with light engine oil and check them for roughness by slowly turning the race by hand.

Bearing Rollers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time, replace if necessary. Replace all worn washers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Inspect reverse gear bushing and if worn or damaged, replace the entire gear.

Reverse gear bushing is not serviced separately.

3. Check both synchronizing sleeves to see that they slide freely on their hubs.

Reverse Idler Gear Bushing

The bushing used in the idler gear is pressed into the gear and finish bored in place. This insures the positive alignment of the bushing and shaft as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushing is not serviced separately.

Countergear Anti-Lash Plate

Inspect the plate teeth for wear or other damage. The plate and two damper springs are retained to the countergear by three rivets. Disassembly is not recommended. (Fig. 7-616)

REPAIRS

Synchronizer Clutch Keys and Springs

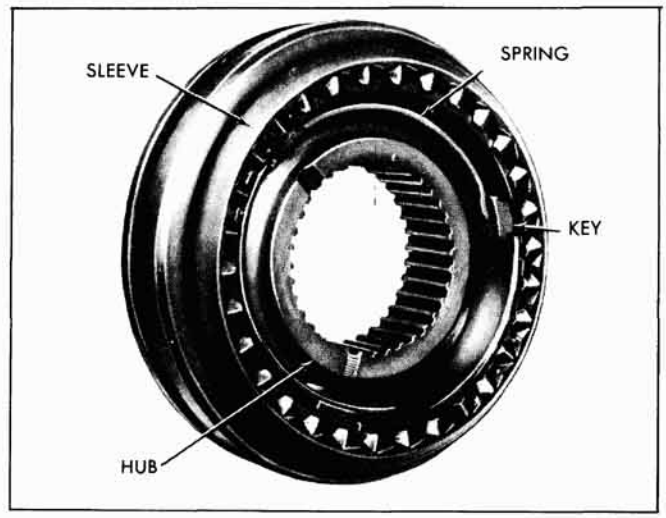


Fig. 7-617—Synchronizer Assembly

The synchronizer clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

Replacement

1. Mark hub and sleeve so they can be matched upon reassembly.
2. Push the hub from the sliding sleeve, the keys and the springs may be easily removed.
3. Place the three keys and two springs in position (one on each side of hub), so all three keys are engaged by both springs. (Fig. 7-617) The tanged end of each synchronizer spring should be installed into different key cavities on either side. Slide the sleeve onto the hub aligning the marks made before disassembly.

A groove around the outside of the synchronizer hub identifies the end that must be opposite the fork slot in the sleeve when assembled. This groove indicates the end of the hub with a 1/16" greater recess depth.

Extension Oil Seal or Bushing

Refer to "Rear Bearing Retainer Oil Seal" and "Bushing Removal" (on car) for correct tools.

Main Drive Gear Oil Seal

Refer to "Main Drive Gear Bearing Seal Replacement" under "Major Service Operations" for necessary tools and procedure.

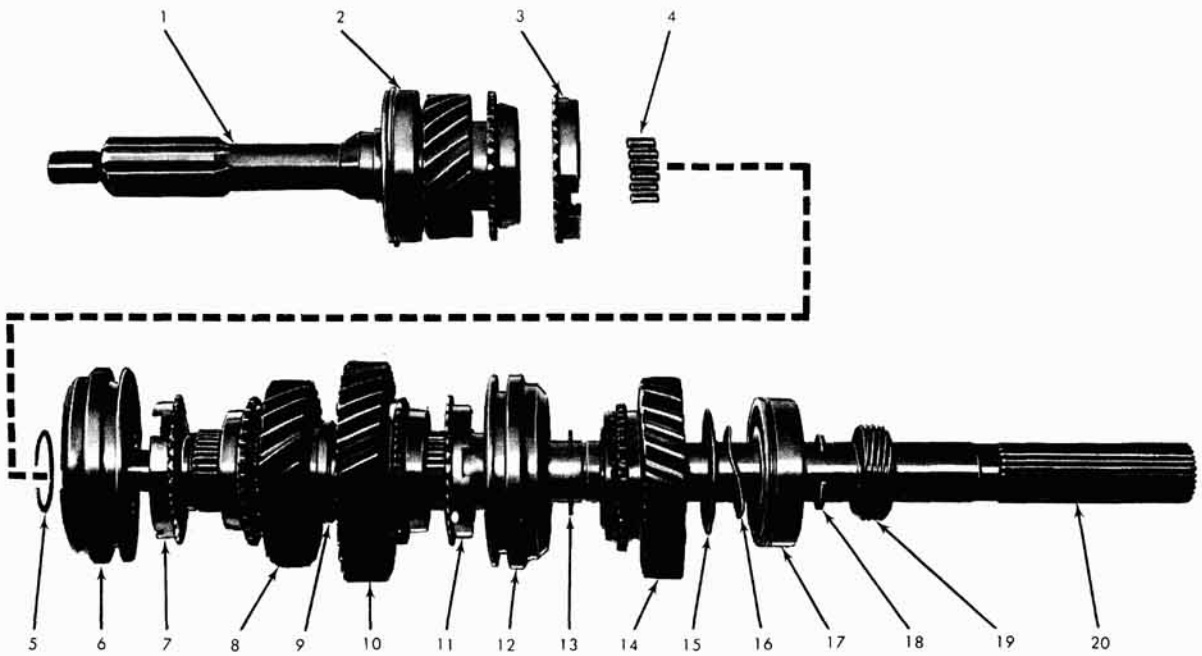
ASSEMBLY

When installing new gaskets, do not coat with grease.

Mainshaft (Fig. 7-618)

Turn the front of the mainshaft upward. Install the following components on the mainshaft.

1. Install the second-speed gear with synchronizing teeth upward. The rear face of the gear will butt against the flange on the mainshaft.
2. Install a blocking ring with clutching teeth downward over the synchronizing surface of the second-speed gear. All three blocker rings used in this transmission are identical.
3. Install the second and third synchronizer assembly with the fork slot downward, press it onto splines on the mainshaft



1. Main Drive Gear
2. Main Drive Gear Bearing
3. 3rd Speed Blocker Ring
4. Mainshaft Pilot Bearings (14)
5. Snap Ring
6. 2-3 Synchronizer Assembly
7. 2nd Speed Blocker Ring
8. 2nd Speed Gear
9. Shoulder (part of Mainshaft)
10. 1st Speed Gear
11. 1st Speed Blocker Ring
12. 1st Speed Synchronizer Assembly
13. Snap Ring
14. Reverse Gear
15. Reverse Gear Thrust Washer
16. Spring Washer
17. Rear Bearing
18. Snap Ring
19. Speedo Drive Gear
20. Mainshaft

Fig. 7-618—Mainshaft Layout

until it bottoms out. Both synchronizer assemblies used in this transmission are identical.

Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

4. Install synchronizer hub to mainshaft snap ring. Both synchronizer snap rings are identical.

Turn the rear of the mainshaft upward. Install the following components on the mainshaft:

5. Install the first-speed gear with clutching teeth upward. The front face of the gear will butt against the flange on the mainshaft.

6. Install a blocker ring with clutching teeth downward over synchronizing surface of the first-speed gear.

7. Install the first and reverse synchronizer assembly with fork slot downward; press it onto splines on the mainshaft.

Be sure the notches of the blocker ring align with the keys of the synchronizer assembly.

8. Install synchronizer hub to mainshaft snap ring.
9. Install reverse gear with synchronizing teeth downward.
10. Install reverse gear thrust washer (steel).
11. Install reverse gear spring washer.
12. Install rear ball bearing with snap ring slot downward; press onto mainshaft.
13. Install rear bearing to mainshaft snap ring.
14. Install speedometer drive gear using Tool J-21470. Drive gear on mainshaft until the upper face of the gear is 6" above upper face of rear bearing.

This completes the assembly of the mainshaft.

Assembly of Case Components

1. Using Tool J-22246, load a row of roller bearings (27) and a bearing thrust washer at each end of the countergear. Use petrolatum sparingly to hold them in place.

2. Place countergear assembly through case rear opening along with a countergear thrust washer (tang away from gear) at each end and install countergear shaft and woodruff key from rear of case.

Be sure countershaft picks up both thrust washers and that the tangs are aligned with their notches in the case.

3. Install reverse idler gear thrust washer, gear and shaft with its woodruff key from the rear of case. Be sure the thrust washer is between the gear and rear of case with its tang

toward notch in case. Do not install idler shaft snap ring at this time.

4. Using snap ring pliers, expand the snap ring in the extension and assemble extension over rear of mainshaft and onto rear bearing. Seat snap ring in rear bearing groove. (Fig. 7-611)

5. Load the mainshaft pilot bearings (14) into the main drive gear cavity with light grease and assemble the third-speed blocker ring onto the main drive gear clutching surface with its teeth toward the gear.

6. Pilot the main drive gear, pilot bearings and third-speed blocker ring assembly over the front of the mainshaft assembly. Do not assemble bearing to gear yet.

Be sure the notches in the blocker ring align with the keys in the 2-3 synchronizer assembly.

7. Place extension to case gasket at rear of case and, from the rear of case, assemble the main drive gear, mainshaft and extension to case as an assembly.

8. Install extension to case retaining bolts.

9. Install main drive gear bearing outer snap ring to bearing and position bearing over stem of main drive gear and into front case bore.

10. Install snap ring to main drive gear stem and main drive gear bearing retainer and gasket to case.

The retainer oil return hole should be at the bottom, and gasket positioned for free oil return.

11. Install reverse idler gear retainer "E" ring to shaft. Be sure thrust washer tang engages notch in case.

12. Shift synchronizer sleeves to neutral positions and install cover, gasket and fork assembly to case. Be sure forks align with their synchronizer sleeve grooves.

13. Tighten all bolts to specified torque.

TRANSMISSION ALIGNMENT (Fig. 7-619)

If transmission slips out of high gear, particularly at 50 mph and up, after all other probable causes have been corrected as outlined under DIAGNOSIS, the alignment of the engine crankshaft pilot, clutch housing bore and the transmission should be checked.

A special tool on which is mounted a dial indicator is necessary to check the transmission rear bearing bore alignment. This tool may be made from a new, or good used, main drive gear which has a good bearing surface on the crankshaft pilot and main drive gear bearing.

The splines on the clutch gear shaft should be ground off so the shaft may be rotated in a clutch disc hub without interference when assembled in the car. Weld a piece of 1/4" rod 8" long in the mainshaft pilot bore. Assemble a good bearing on the shaft and secure it with the snap ring.

Procedure

1. Remove the transmission from the car and completely disassemble as outlined.

In any case where the main drive gear pilot or pilot bearing is excessively loose or worn, the pilot bearing or bushing should be replaced before checking the transmission rear bearing bore alignment by the dial indicator method.

2. Install the case extension on the case and tighten the extension to case bolts securely.

3. Carefully install the special tool with the dial indicator into the transmission case with the face of the indicator and the tracing finger to the rear of the transmission. Secure in place with a main drive gear bearing retainer.

4. Carefully rotate the gear and make final adjustment of the indicator with the tracing finger of the indicator in the center of the rear bearing bore in the case extension.

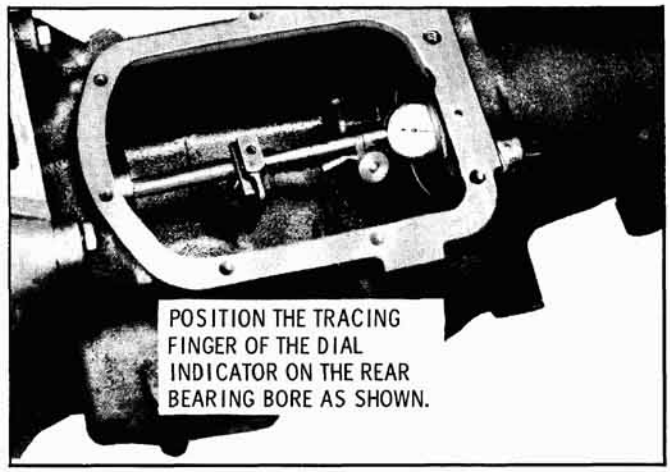


Fig. 7-619—Checking Transmission Alignment

5. Assemble the transmission case to the clutch housing and tighten the four transmission mounting bolts securely.

Be sure to clean off any paint or other foreign material on the mating faces of the clutch housing and transmission as any foreign material on these faces will change alignment. Also, check carefully for dings or burrs on these mating surfaces and remove carefully as necessary.

6. Install transmission support and support to transmission mounting block bolts.

7. Remove the jack or other support from under the engine, let the weight of the engine rest on the transmission mounting in the normal position.

8. Dial indicate the transmission rear bearing bore and record the indicator readings in the 12, 3, 6 and 9 o"clock positions, with the weight on the transmission mounting as outlined above.

Start the reading at the 6 o'clock position then record the 9, 12 and 3 o'clock readings.

9. Install temporary shims between the transmission case and the clutch housing at the bolt locations as necessary to bring misalignment at the transmission rear bearing bore to a maximum of .010" indicator reading in either the vertical or horizontal plane.

Installation of a .002" shim between the transmission case and the clutch housing at two bolt locations opposite to the high indicator reading will change the transmission rear bore reading approximately .003" to .004".

10. After the position and quantity of shims has been determined and recorded, transmission case may be removed.

The clutch housing should then be marked, showing the position where shims are to be installed and the thickness of shims at each location.

11. Inspect the clutching teeth of the main drive gear. Inspect the second and third-speed clutch teeth and the internal clutching teeth on the high gear (forward end). If the teeth of either gears are worn or tapered due to long continued previous disengagement, the gears should be replaced. Reassemble transmission.

12. Install the transmission assembly to the clutch housing, using the correct number of shims at the proper locations as previously determined.

THREE-SPEED TRANSMISSION

**STANDARD FOR 44, 54, 64 AND 66 SERIES—
OPTIONAL HEAVY-DUTY FOR ALL
32, 36 AND 42 SERIES
(Floor Shift Only-Option Code M-14)**

Subject	Page	Subject	Page
GENERAL DESCRIPTION	7-610	SHIFT LEVER SHAFT OR SEAL REPLACEMENT	7-614
SHIFT LINKAGE ADJUSTMENT	7-610	MAIN DRIVE GEAR BEARING REPLACEMENT	7-614
REAR BEARING RETAINER OIL SEAL AND BUSHING REPLACEMENT	7-612	MAINSHAFT DISASSEMBLY	7-614
SPEEDOMETER DRIVEN GEAR	7-612	MAINSHAFT ASSEMBLY	7-614
TRANSMISSION REMOVE	7-613	TRANSMISSION ASSEMBLY	7-616
TRANSMISSION INSTALLATION	7-613	DIAGNOSIS	7-631
MAIN DRIVE GEAR SEAL REPLACEMENT	7-613	SPECIFICATIONS	7-632
MAIN DRIVE GEAR SEAL DISASSEMBLY	7-614	TORQUE SPECIFICATIONS	7-632
		TOOLS	7-633

GENERAL DESCRIPTION

This transmission is available only as a column shift on the 54, 64 and 66 Series. When used as a heavy-duty option for the 32, 36 and 42 Series, it is available only with floor shift (M14).

The transmissions are identified by 2" high letters located on the right hand side of the extension housing. The transmission used on 54, 64 and 66 Series is identified by the letters DA. The transmission used as heavy-duty option on 32, 36 and 42 Series is identified by the letters DB.

This transmission is fully synchronized in all forward gears.

All forward speed changes are accomplished with synchronizer sleeves (Fig. 7-625) which permits quicker and quiet shifts. The synchronizers permit downshifting from 3rd to 2nd between 20-40 mph and from 2nd to 1st below 20 mph.

SHIFT LINKAGE ADJUSTMENT
(Figs. 7-626, 7-627, 7-628 and 7-629)

Refer to the appropriate Figures depending on how the car is equipped.

1. Position the transmission in neutral.
2. Loosen the clamp screws on the shift rods at the transmission. Be sure shift rods are free to move in the swivels.
3. Insert a 3/16" rod through the shift levers and into the upper hole of the column bracket. (Fig. 7-628)

On 32, 36, 42 and 44 Series equipped with floor shift, a 1/4" diameter pin is inserted through the shift lever bracket and levers as shown in Fig. 7-629.

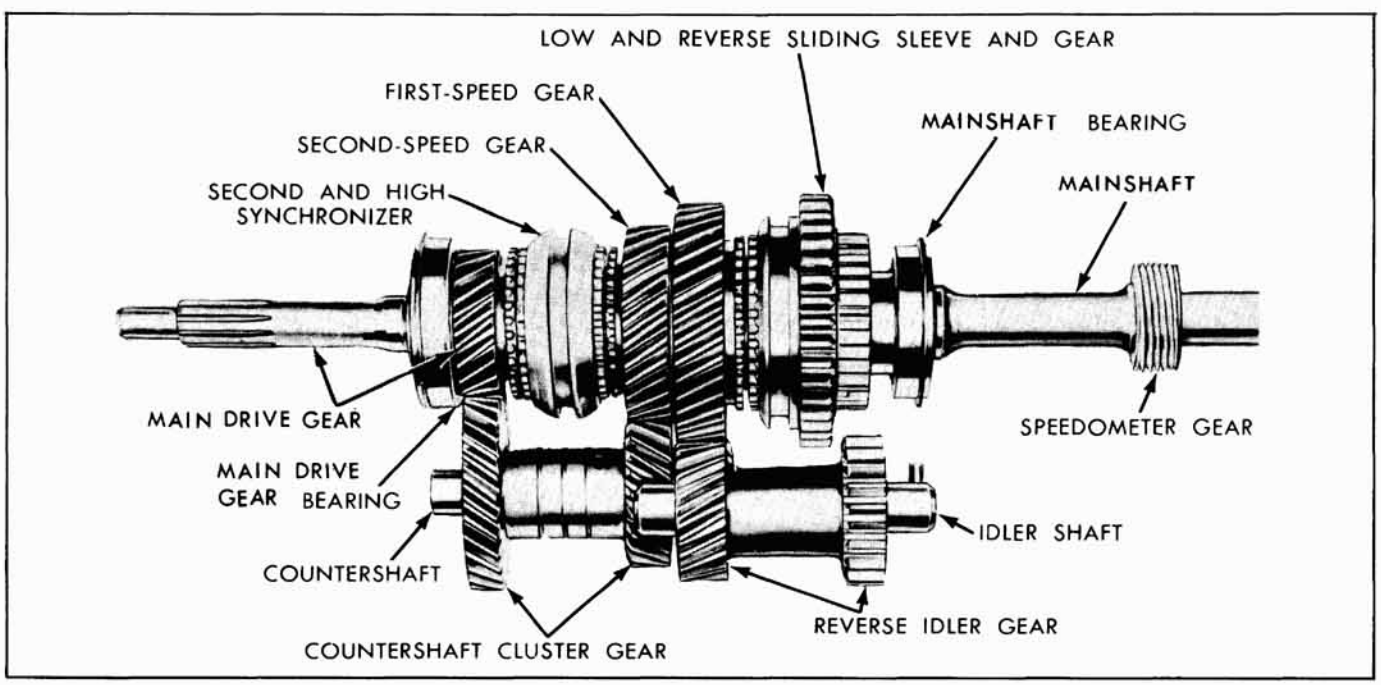


Fig. 7-625—Transmission Gear Train

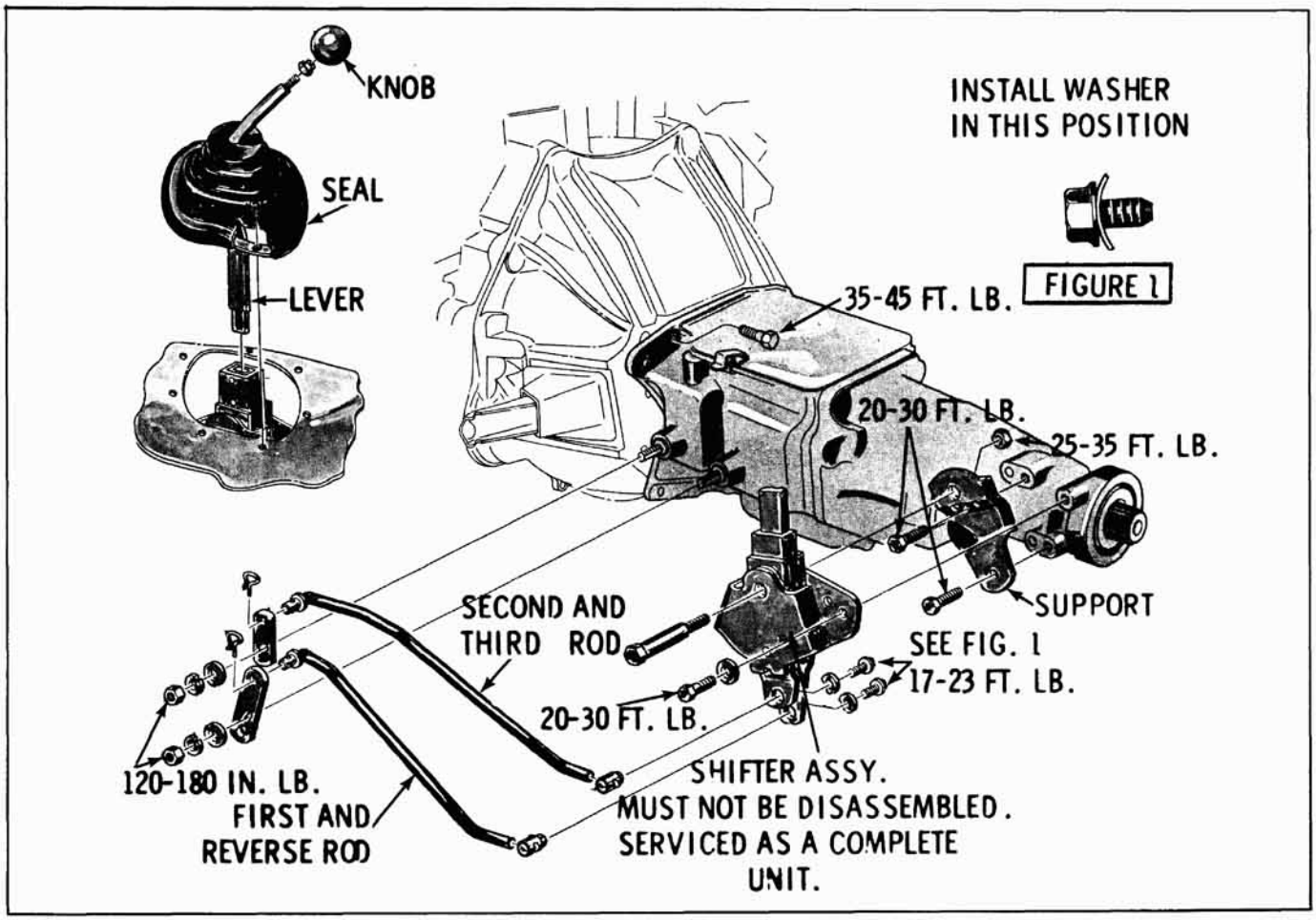


Fig. 7-626—32, 36, 42 and 44 Series Floor Shift Linkage (M-14)

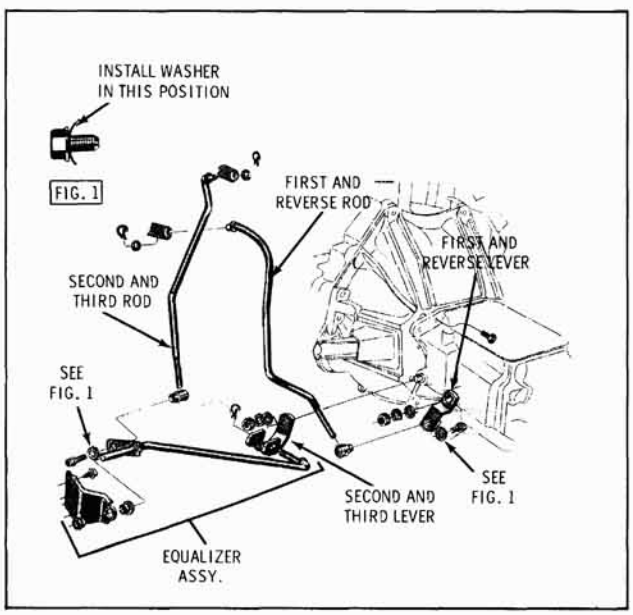


Fig. 7-627—54 thru 66 Series Column Shift

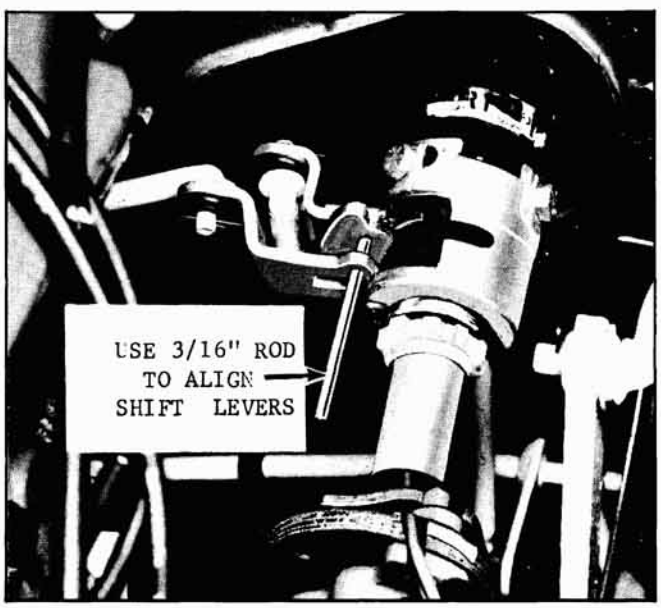


Fig. 7-628—54 thru 66 Column Shift Lever Positioning

4. With the transmission levers in the neutral position, tighten the clamp screws to 23 ft. lbs. torque.

5. Remove the 3/16" rod. Make sure the neutral positions of the column shift levers are exactly in line. If not, readjust one rod to bring them in line.

6. Check shift pattern with the engine off, then start the engine and recheck shift pattern.

SHIFT LEVER REMOVAL

The shift lever assembly can be removed after removing

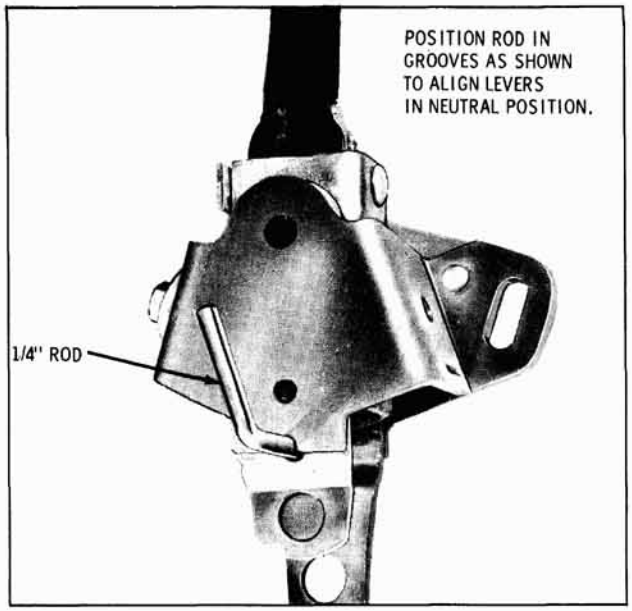


Fig. 7-629—32, 36, 42, and 44 Series Floor Shift Lever Positioning

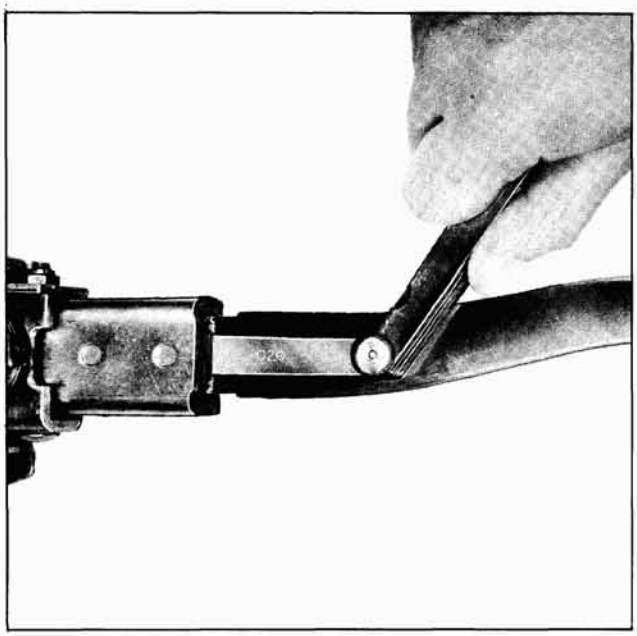


Fig. 7-630—Removing Shift Lever

the console assembly, if so equipped, and the floor pan seal. Fig. 7-630 illustrates a feeler gauge or feeler stock being used to trip the detent spring. To replace the lever, push down on the lever until it engages the detent spring.

REAR BEARING RETAINER OIL SEAL AND BUSHING REMOVAL

1. Remove propeller shaft.
2. Tap seal inward to break bond then using Tool BT-6629-1 and BT-6629-3 remove seal. (Fig. 7-631)
3. After removing the seal, if bushing replacement is necessary, the bushing can be removed as shown in Fig. 7-632.
4. If the bushing was removed, it can be installed using tools as shown in Fig. 7-633.
5. Coat the outside of new seal sparingly with Sealer, No. 1050026, or equivalent. Apply Lubricant, No. 1050169, or equivalent to the sealing lip of seal.

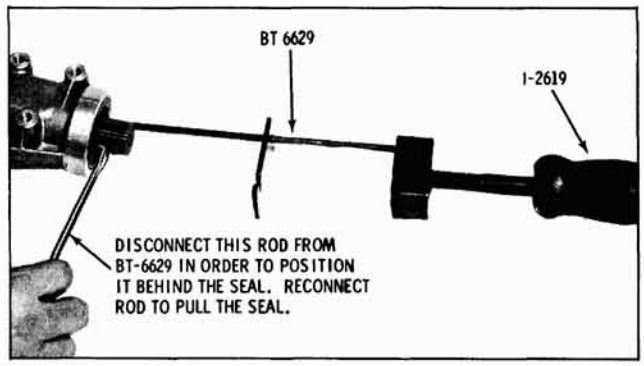


Fig. 7-631—Removing Seal

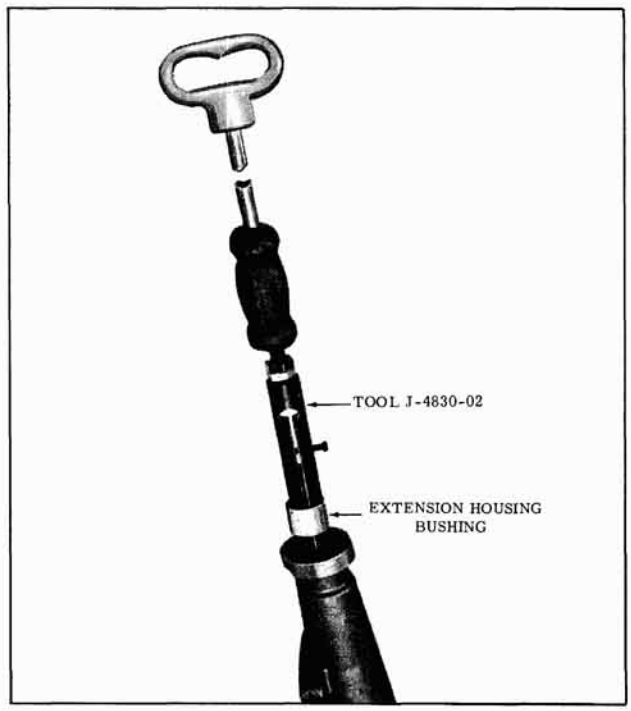


Fig. 7-632—Removing Rear Bushing

6. Drive seal into the rear bearing retainer using Tool J-5395 until seal is fully seated. (Fig. 7-634) The seal can also be installed using tools shown in Fig. 7-635.

SPEEDOMETER DRIVEN GEAR OR PLUG AND OIL SEAL—(32, 36, 42 AND 44 SERIES)

Replacement

Disconnect speedometer cable, remove retainer to housing bolt and lockwasher and remove retainer. Insert screwdriver in slot in sleeve and pry sleeve, gear and shaft from housing. Pry "O" ring from groove in sleeve.

Install new "O" ring in groove and insert shaft. Hold the assembly so slot in sleeve is toward boss on housing and install in housing. Push sleeve into housing until retainer can be inserted in groove and install retainer lockwasher and bolt.

54 through 66 Series

The speedometer for this series is driven off the left front wheel; therefore, a plug is installed in the extension housing. This plug and seal is replaced in the same manner as the driven gear and seal on the 31 through 44 Series.

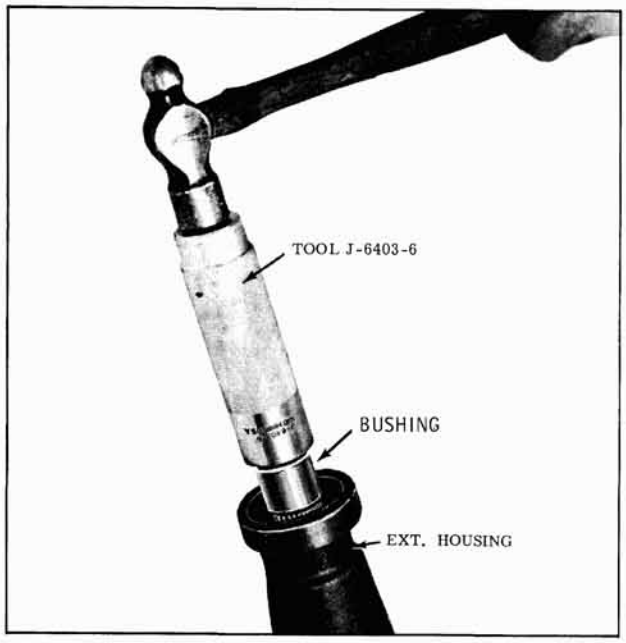


Fig. 7-633—Installing Rear Bushing

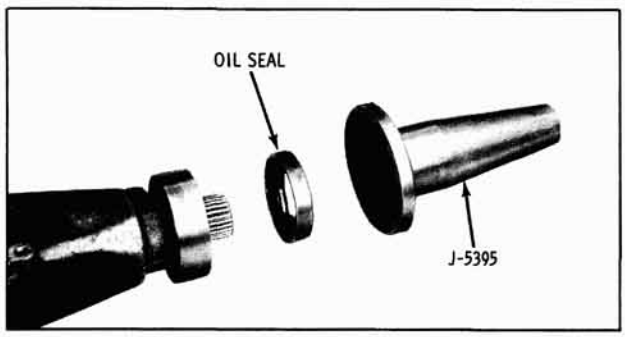


Fig. 7-634—Installing Rear Seal

MAJOR SERVICE OPERATIONS

Removal

1. Disconnect throttle linkage from cowl bracket to prevent damage.
2. Raise car.
3. Remove propeller shaft.
   a. Column Shift - Disconnect shift rods from shift levers.
   b. Floor Shift - Remove shift lever knob and disconnect back-up lamp wiring if so equipped.
4. Disconnect equalizer shaft at side of transmission, 54 through 66 Series.
5. For 32, 36, 42 and 44 Series, install Engine Support Bar BT-6424-1. If equipped with Air Conditioning, install Adapter BT-6424-3. For 54 Series (350 cu. in.), install Engine Support Bar BT-30-16 and Adapter Sleeve Set BT-6410. For 54 (with 455 cu. in.), 64 and 66 Series, install Engine Support Bar BT-30-16.
6. Disconnect parking brake cable.
7. Remove cross support bar to rear transmission mount attaching bolts.
8. Remove cross support bar to frame attaching bracket and remove cross support bar.

It may be necessary to disconnect the left exhaust pipe at the exhaust manifold to provide clearance if equipped with dual exhaust.

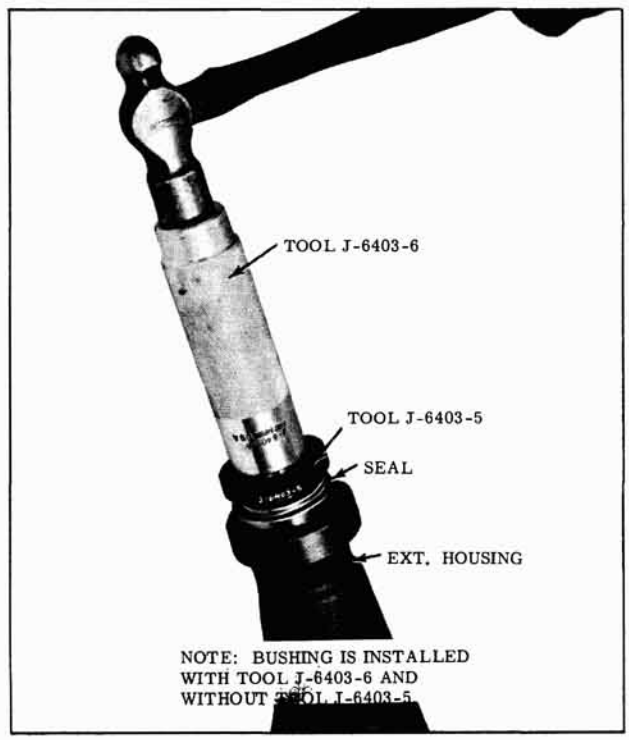


Fig. 7-635—Installing Rear Seal

9. Remove transmission upper attaching bolts. Install aligning studs (7/16" 14 x 2 1/2" headless bolts).

Aligning studs must be used to support transmission to prevent distortion of the clutch driven plate hub when removing transmission.

10. Remove transmission lower attaching bolts.
11. Carefully slide transmission rearward and remove from car.

Installation

1. Inspect clutch pilot bearing and replace if necessary.
2. The transmission is mounted slightly counterclockwise in relation to the Flywheel housing. Start the lower inner mounting bolts but do not tighten. Remove aligning studs and install upper mounting bolts in the inner holes. Use the following torques for attaching parts.

a. Transmission to engine	50 ft. lbs.
b. Exhaust pipe to exhaust manifold	15 ft. lbs.
c. Cross support bar brackets to frame	35 ft. lbs.
d. Cross support bar to rear transmission mount	50 ft. lbs.
e. Propeller shaft U-bolt nuts	14 ft. lbs.

3. Install linkage as shown in Figs. 7-626 and 7-627.
4. Adjust linkage as outlined under SHIFT LINKAGE ADJUSTMENT.

MAIN DRIVE GEAR SEAL REPLACEMENT

1. Remove transmission from car.
2. Remove main drive gear bearing retainer and gasket.
3. Remove seal from retainer by prying out with screwdriver.
4. Coat the outside of new seal sparingly with Sealer, No. 1050026, or equivalent. Apply lubricant No. 1050169 or equivalent to the sealing lip of the seal.

Fig. 7-636—Installing Main Drive Gear Retainer

5. Center seal in retainer, spring side out, using Tool J-8615. Tap seal into place (Fig. 7-636)

DISASSEMBLY OF TRANSMISSION (Fig. 7-637)

1. Drain lubricant.
2. Remove main drive bearing retainer and gasket.
3. Remove access cover and gasket.
4. Remove extension housing and gasket.
5. Through filler plug hole, drive out countershaft to case retaining pin.
6. Remove detent pin retaining set screw, spring and detent pin. (Fig. 7-638)
7. With transmission in neutral, remove first and reverse shift fork set screw.
8. Slide second and third shift fork rearward to gain access to set screw and remove set screw.
9. With second and third shift shaft in neutral position, remove first and reverse shift shaft out of rear of case.
10. Using pliers, rotate second and third shift shaft 90° to disengage detent pin. (Fig. 7-639)
11. Using brass drift, drive second and third shift shaft and expansion plug out front of case.
12. Using Tool J-21775-01, drive countershaft out rear of case (Fig. 7-640) while holding the countershaft gear with a hook to prevent it from dropping into bottom of case. After removing countershaft, lower countershaft gear to bottom of case.
13. Remove speedometer drive gear snap ring, drive gear and retaining ball.
14. Remove both the small and large rear bearing retainer snap rings.
15. Slide Tool J-21774-1 over bearing and position tool snap ring into the bearing snap ring groove. (Fig. 7-641)
16. With snap ring reinstalled in speedometer drive gear retaining groove, install Tool J-21774-5 over mainshaft, then thread Tool J-21774-2 into Tool J-21774-1 until bearing is free.
17. Remove bearing and tool.
18. Slide main drive gear forward until gear is against the case.
19. Remove shift forks.
20. Remove mainshaft assembly through top of case.
21. Remove main drive gear bearing retaining snap ring and while tapping on end of shaft, lift main drive gear out through top of case.
22. Remove countergear and thrust washers.
23. Using a brass drift, drive reverse idler gear shaft out rear of case. (Fig. 7-642) Remove gear and thrust washers from case.
24. Remove second and third shift shaft detent pin and spring.

SHIFT LEVER SHAFT OR SEAL REPLACEMENT

1. Remove nut, lockwasher and flat washer.
2. Remove shift lever.
3. Slide shift lever shaft out of case and discard "O" ring seal.
4. Lubricate new seal and slide on shaft.
5. Install shaft in case.
6. Install shift lever and secure with nut, lockwasher and flat washer.

MAIN DRIVE GEAR BEARING REPLACEMENT

1. Reinstall main drive gear assembly in case.
2. Install large snap ring on bearing.
3. Remove bearing to shaft retaining snap ring.
4. Position case in press (Fig. 7-643) and press gear out of bearing.
5. Remove gear from case and position new bearing on shaft.
6. Position the bearing and shaft in press (Fig. 7-644) and press the shaft into the bearing.
7. Install the snap ring on the shaft and remove the snap ring from the bearing.

DISASSEMBLY OF MAINSHAFT

1. Mark hub and sleeve so they can be matched upon reassembly.
2. Remove front blocking ring.
3. Remove synchronizer insert retaining spring.
4. Remove second and third gear synchronizer sleeve.
5. Remove synchronizer hub retaining snap ring, hub and blocking ring.
6. Remove second gear.
7. Remove first gear retaining snap ring, thrust washer, first gear and blocking ring.
8. Remove reverse gear hub retaining snap ring and gear.
9. Remove reverse gear synchronizer hub.

ASSEMBLY OF MAINSHAFT

1. Install rear insert retaining spring into the groove in the first and reverse synchronizer hub. (Fig. 7-645) Make sure spring covers all insert grooves. If the tip of the rear insert spring is less than .120" in length, replace the spring.
2. Position the three inserts into the slots of the hub with the small end down and over the rear insert spring.
3. Slide the sleeve, shifter fork groove up, over the hub until the detent is engaged.

There may be alignment marks on the hub and sleeve. If so, they must be aligned.

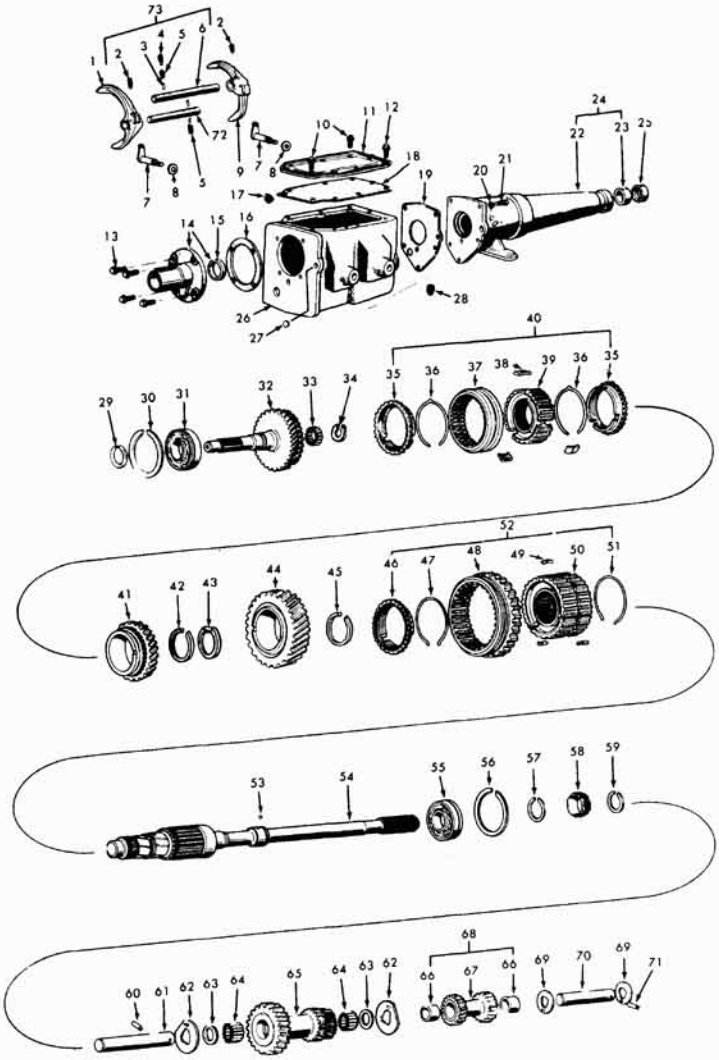
4. Install the second and third synchronizer sleeves over the hub. (Fig. 7-646)

There may be alignment marks on the hub and sleeve. If so, they must be aligned.

5. Slide the three inserts into the slots of the hub.
6. Install an insert spring so that all three inserts are covered. (Fig. 7-646)

The tang on the insert spring should be centered in one of the inserts.

7. Install the remaining insert spring so that the tang on the spring is centered in the same insert.
8. Place a blocking ring on each end of the synchronizer sleeve.



1. FORK (2nd and 3rd)
2. SCREW
3. PIN
4. SCREW
5. SPRING
6. SHAFT (1st and Rev.)
7. LEVER ASSY.
8. SEAL
9. FORK
10. SCREW (2 Req.)
11. COVER
12. SCREW (7 Req.)
13. SCREW
14. RETAINER PKG.
15. SEAL
16. GASKET
17. PLUG, FILLER
18. GASKET
19. GASKET
20. WASHER
21. BOLT
22. EXTENSION
23. BUSHING
24. EXTENSION ASSY.
25. SEAL
26. CASE
27. PLUG
28. PLUG, DRAIN
29. SNAP RING (To Shaft)
30. SNAP RING (To Case)
31. BEARING
32. GEAR
33. BEARING (15 Req.)
34. SNAP RING
35. RING
36. SPRING
37. SLEEVE
38. INSERT
39. HUB
40. CLUTCH ASSY. (2nd and 3rd)
41. GEAR
42. SNAP RING
43. WASHER
44. GEAR
45. SNAP RING
46. RING
47. SPRING
48. GEAR
49. INSERT
50. HUB
51. SPRING
52. CLUTCH ASSY. (1st & Rev.)
53. BALL
54. SHAFT
55. BEARING
56. SNAP RING (To Case)
57. SNAP RING (To Shaft)
58. GEAR
59. SNAP RING
60. PIN
61. COUNTERSHAFT
62. WASHER
63. WASHER, BEARING
64. BEARING (50 Req.)
65. GEAR
66. BUSHING
67. GEAR
68. GEAR ASSY.
69. WASHER
70. SHAFT
71. PIN
72. SHAFT (2nd & 3rd)
73. SHAFT PKG. (inc. 72)

Fig. 7-637—Three Speed Heavy-Duty Manual Transmission

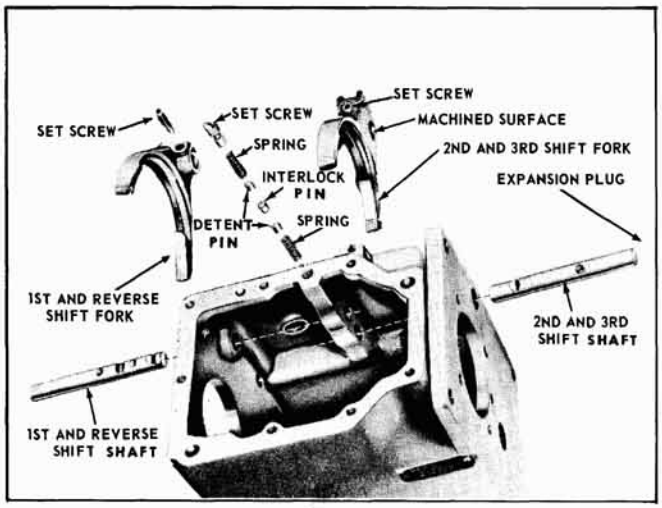


Fig. 7-638—Transmission Shift Shafts and Forks

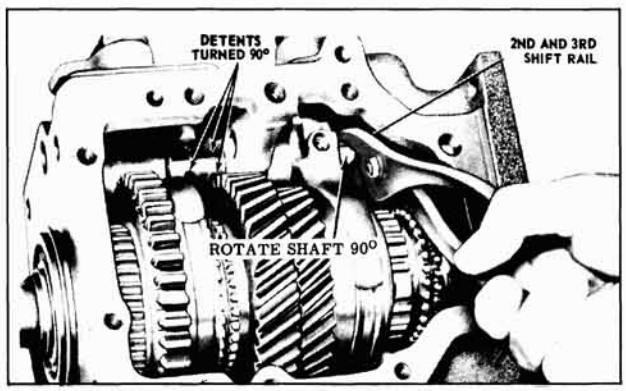


Fig. 7-639—Rotating Shaft For Removal

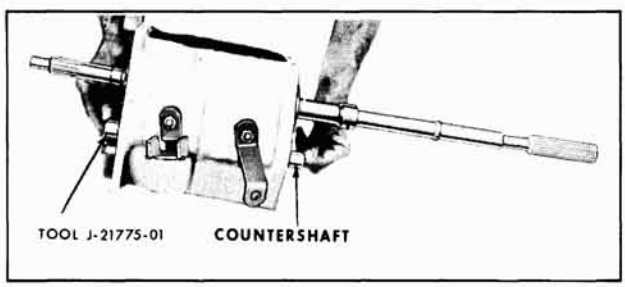


Fig. 7-640—Removing Countershaft

9. Lubricate mainshaft splines and machined surfaces with transmission lubricant.

10. Slide the reverse gear and sleeve on to the mainshaft with the teeth end of the gear facing towards the rear of the shaft and install snap ring.

11. Coat the tapered machined surface on the first gear with grease. Place the blocking ring on the greased surface.

12. Slide first gear with blocking ring towards rear of shaft. Rotate the gear to engage the notches in the blocking ring with the inserts. Secure first gear with thrust washer and snap ring.

13. Coat the tapered machined surface of second gear with grease and slide the blocking ring onto it.

14. Slide second gear with blocking ring and second and third gear synchronizer on the mainshaft. The tapered machined surface of second gear must be towards the front of the shaft. With the notches in the blocking ring engaging the synchronizer inserts, secure the synchronizer with a snap ring.

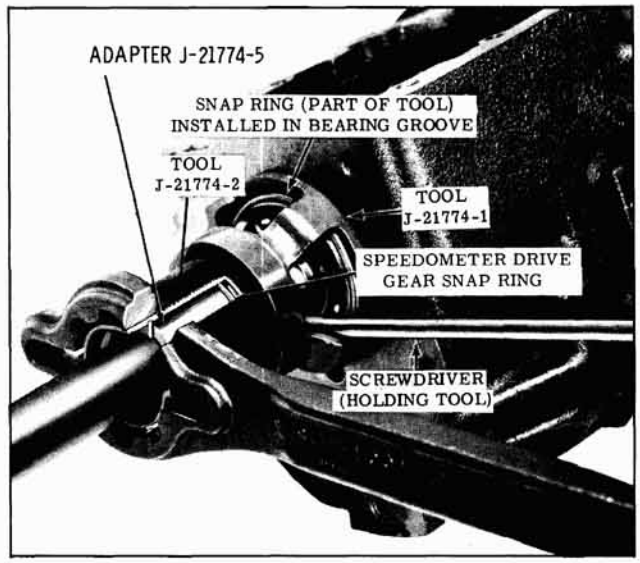


Fig. 7-641—Removing Rear Bearing

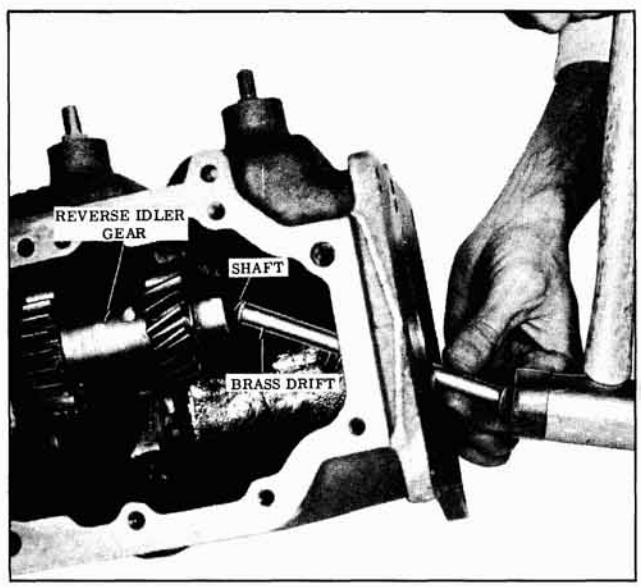


Fig. 7-642—Removing Reverse Idler Shaft

ASSEMBLY OF TRANSMISSION

When installing new gaskets, do not coat with grease.

1. Install reverse idler gear, with a thrust washer on each end in case, being sure that roll pin (Fig. 7-647) is seated in slot in back face of case.

2. Assemble the countergear, with Tool J-21775-01 in place, bearings and thrust washers and place in bottom of case. The assembly will remain in the bottom of the case until the mainshaft and main drive gear are installed.

3. Coat the bore of the main drive gear with a thin film of grease and install the 15 roller bearings. (Fig. 7-648)

A thick film of grease will plug the lubricant holes and prevent lubrication of the bearings.

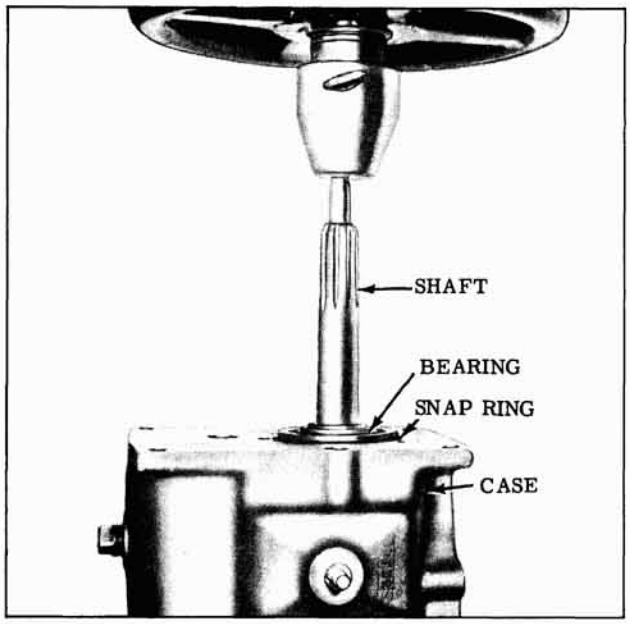


Fig. 7-643—Removing Main Drive Gear Bearing

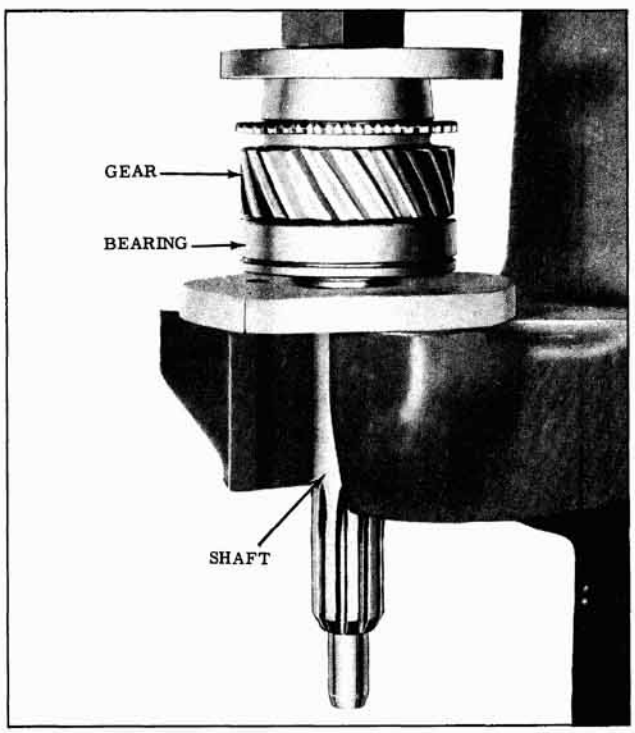


Fig. 7-644—Install Main Drive Gear Bearing

4. Position the main drive gear and bearing into the case from the top. Do not install the bearing fully into the bore.
5. Position the mainshaft assembly into the case.
6. Position the second and third-speed shift fork on the second and third synchronizer. Engage the roller bearings in the main drive gear.
7. Place a detent pin spring and detent pin in the case.

A piece of windshield washer hose will assist in installing the detent pin.

8. Position second and third synchronizer in second-speed position (towards rear of case).

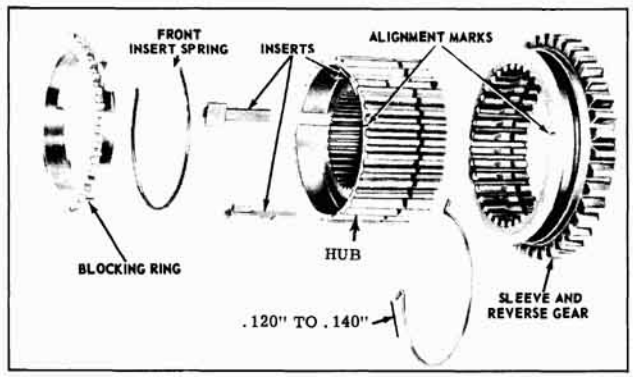


Fig. 7-645—First and Reverse Synchronizer

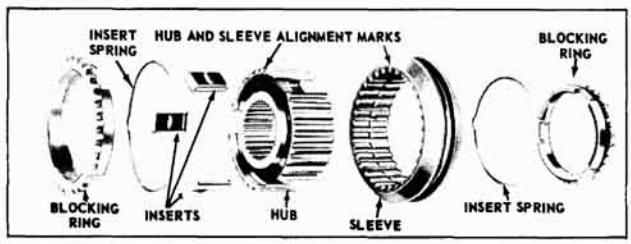


Fig. 7-646—Second and Third Synchronizer

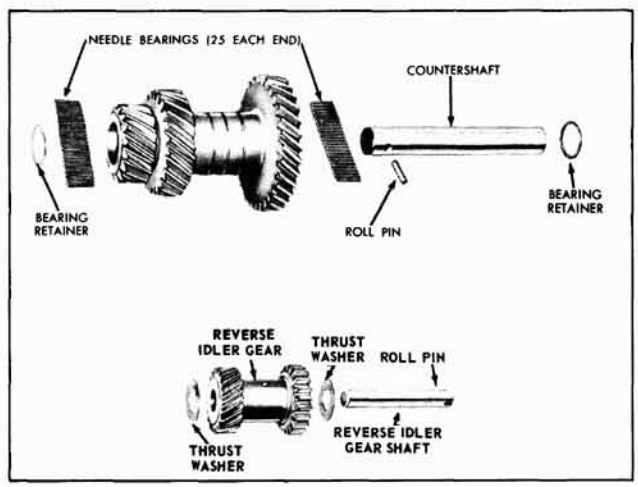


Fig. 7-647—Countergear and Reverse Idler Gear Assemblies

9. Align the shift fork and install second and third-speed shift shaft.

It will be necessary to depress detent pin to install the shaft in the bore. Move the shaft in until the detent pin engages the forward notch.

10. Secure the shift fork to the shift shaft with set screw.
11. Move the synchronizer to the neutral position.
12. Install the interlock pin in the case. If the second and third-speed shift shaft is in the neutral position, the top of the interlock will be slightly lower than the surface of the first and reverse shift shaft bore.
13. Move the first and reverse synchronizer forward and place first and reverse shift fork in the groove of the synchronizer.
14. Align the shift fork and install the first and reverse shift shaft. Move the shaft in until the center notch is aligned with the detent bore.
15. Install the remaining detent pin and spring. Secure the

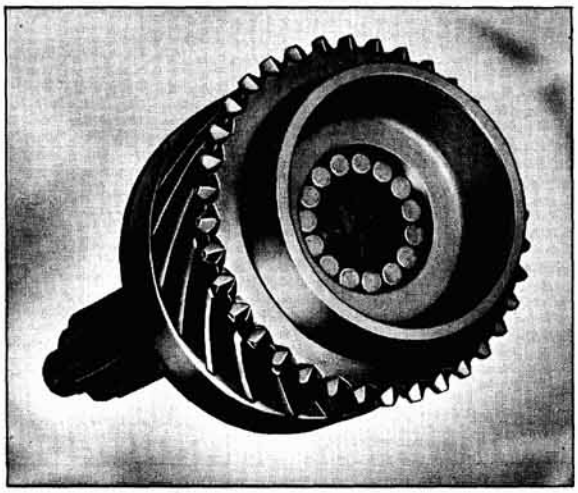


Fig. 7-648—Main Drive Gear

spring with the set screw. Tighten screw until head is flush with case.

16. Secure the shift fork to the shift shaft with set screw.
17. Install a new shaft expansion plug in front of case.
18. While holding the main drive gear and blocking ring in position, move the mainshaft forward to seat the mainshaft pilot in the roller bearings of the main drive gear.
19. Tap the main drive gear bearing into place in the case while holding the mainshaft to prevent the roller bearings from dropping out. Install the bearing snap ring.
20. Install the main drive gear bearing retainer and gasket, making sure the oil return slot is toward bottom of case. Torque attaching bolts to 25 ft. lbs.
21. Install the snap ring on the rear bearing and tap the bearing into place, using Tool J-21470. (Fig. 7-649) Install snap ring on mainshaft behind rear bearing.
22. Place speedometer drive gear locking ball in the detent in the mainshaft and slide speedometer gear into place. Secure with snap ring.
23. Using a hook or with hand, lift the countergear from the bottom of the case and align it and the thrust washers with the bore in the case.

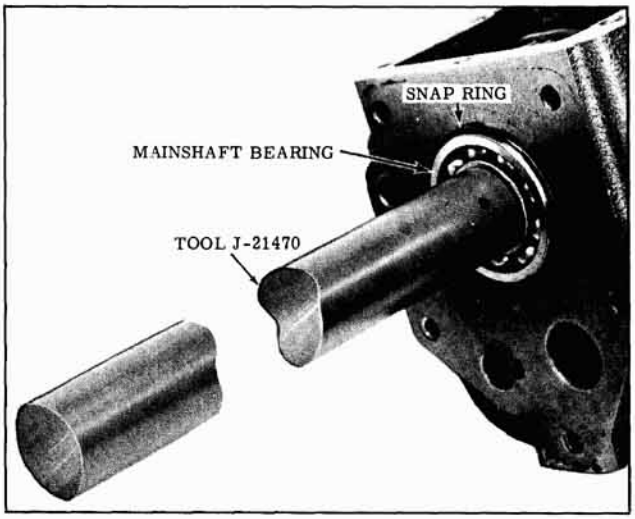


Fig. 7-649—Installing Mainshaft Bearing

24. From the rear of the case, using the countershaft, push Tool J-21775-01 out of the countergear. Before the countershaft is completely installed, align the locking pin hole in the shaft with the pin hole in the case.
25. Install the locking pin.
26. Position extension housing and gasket to case. Apply Sealer No. 1050026 or equivalent to threads of the attaching bolts. Torque bolts to 50 ft. lbs.
27. Install filler and drain plugs, being sure that magnetic plug is installed in drain hole.
28. Place transmission in gear and while applying transmission lubricant over the entire gear train, check operation of transmission.
29. Install cover and gasket. Torque bolts to 19 ft. lbs.

TRANSMISSION ALIGNMENT ..... **Page 7-609**
DIAGNOSIS ..... **Page 7-631**
TRANSMISSION SPECIFICATIONS ..... **Page 7-632**
TRANSMISSION TORQUE SPECIFICATIONS ... **Page 7-632**
TRANSMISSION TOOLS ..... **Page 7-633**

FOUR-SPEED TRANSMISSION (M20 & M21)

32, 36, 42, 44 AND 48

CONTENTS OF SECTION

Subject	Page
GENERAL DESCRIPTION	7-619
MAINTENANCE AND ADJUSTMENTS	7-619
SHIFT LINKAGE ADJUSTMENT	7-619
SPEEDOMETER DRIVEN GEAR	7-619
TRANSMISSION SIDE COVER	7-619
EXTENSION OIL SEAL AND BUSHING	7-620
TRANSMISSION ASSEMBLY REMOVAL	7-622
INSTALLATION	7-622
DISASSEMBLY	7-623
CLEANING AND INSPECTION	7-624
REPAIRS	7-626
ASSEMBLY	7-627
DIAGNOSIS	7-631
SPECIFICATIONS	7-632
TOOLS	7-633

GENERAL DESCRIPTION

The 4-speed transmission is available in two different ratios, wide ratio (option code M20) and close ratio (option code M21). The transmission is available only as a floor shift model. The two transmissions can be identified by 1" high letters located on the right side of the case. The wide ratio (M20) is identified by the letters HP and the close ratio (M21) is identified by the letters HF. The internal service procedures are the same for both models.

The 4-speed transmission (Fig. 7-660) incorporates helical gears throughout, specially designed to provide high torque capacity without additional weight, and gear teeth proportioned to operate at high speeds with neither excessive heat generation nor excessive frictional losses. Shafts, bearings, high capacity clutches and other precision parts are held to close limits, providing proper clearances necessary for durability during extended heavy usage.

The main drive gear is supported by a heavy-duty ball bearing at the front end of the transmission case and is piloted at its front end in a pilot bearing mounted in the engine crankshaft. The front end of the mainshaft is piloted in a row of roller bearings set into the hollow end of the main drive gear and the rear end is carried by a heavy-duty ball bearing mounted at the rear end of the transmission case in a retainer casting.

The countergear is carried on a double row of rollers at both ends while thrust is taken on thrust washers located between the ends of the gear and the thrust bosses in the case. An anti-lash plate and damper spring are retained to the countergear by three rivets.

The two-piece reverse idler gear is carried on bronze bushings while thrust is taken on thrust washers located between the front of the gear and the back of the reverse idler thrust boss and between the rear of the gear and the reverse idler shaft boss in the case extension.

Gearshifting is manual through shift control rods to the transmission cover shifter levers for first through fourth gears, and to the reverse lever located in the case extension. The shifter lever to the rear of the transmission cover controls first and second gears while the lever to the front controls third and fourth gears. All four forward gears are fully synchronized. The transmission may be used as an aid in deceleration by downshifting in sequence without double clutching or gear clashing. Reverse is not synchronized, however it is a helical gear to ensure quiet operation.

MAINTENANCE AND ADJUSTMENTS NOT REQUIRING TRANSMISSION REMOVAL

SHIFT LINKAGE ADJUSTMENT

1. Place transmission levers in neutral. (Fig. 7-661)
2. Using a 1/4" rod, align levers in neutral position as shown in Fig. 7-662.
3. Adjust swivels so as to obtain a "free pin" fit at the levers.

SPEEDOMETER DRIVEN GEAR

Replacement

Disconnect speedometer cable, remove retainer to housing bolt and lockwasher and remove retainer. Insert screwdriver in slot in fitting and pry sleeve, gear and shaft from housing. Pry "O" ring from groove in sleeve.

Install new "O" ring in groove and insert shaft. Hold the assembly so slot in sleeve is toward boss on housing and install in housing. Push sleeve into housing until retainer can be inserted in groove and install retainer lockwasher and bolt.

TRANSMISSION SIDE COVER

Removal

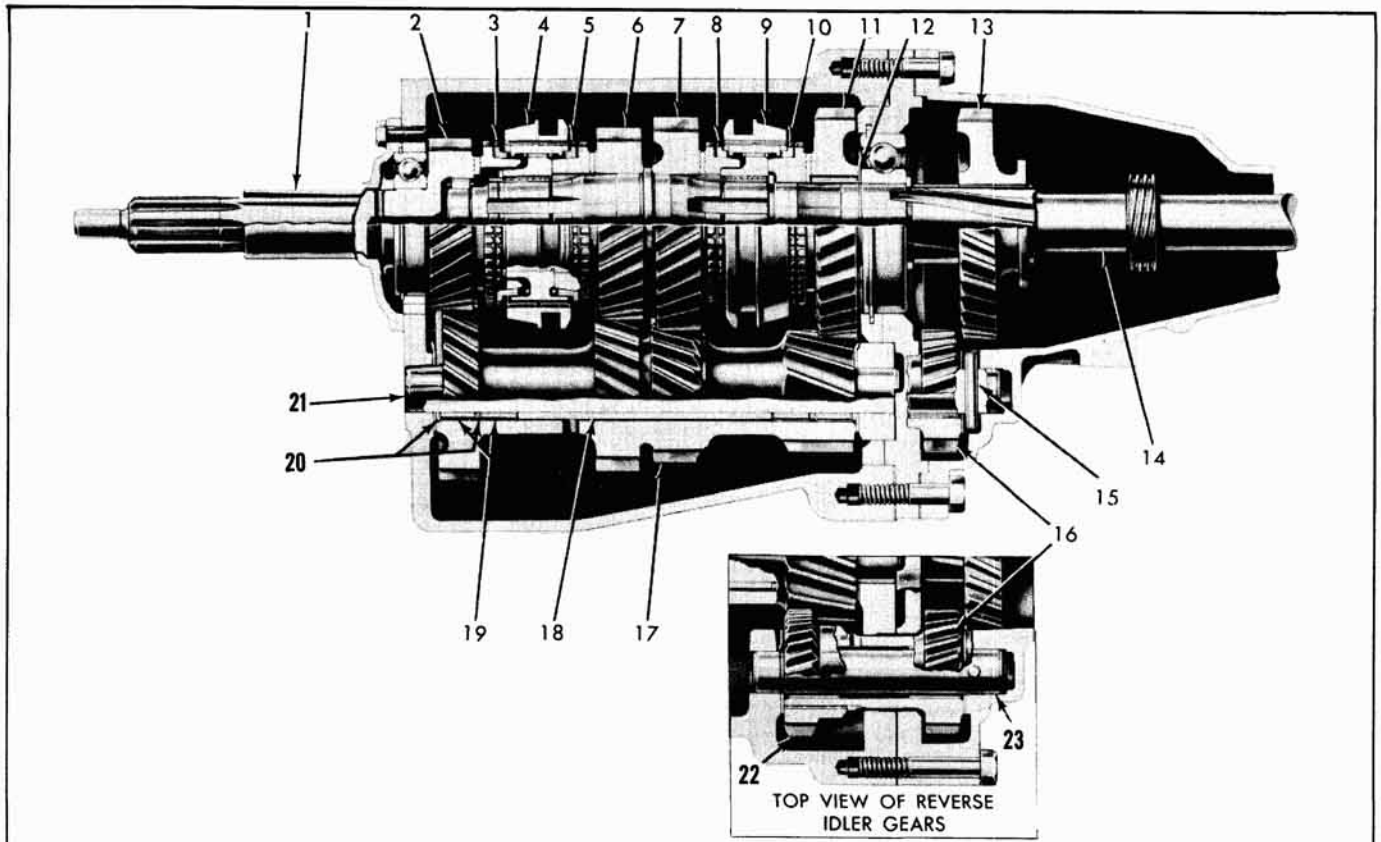
1. Disconnect control rods from levers.
2. Shift transmission into second speed before removing cover by moving 1-2 (rear) shifter lever into forward detent position.
3. Remove cover assembly from transmission case carefully and allow oil to drain.

Disassembly (Fig. 7-663)

1. Remove the outer shifter lever nuts, lockwashers and flat washers. Pull levers from shafts.
2. Remove both shift forks from shifter shaft and detent plate assemblies. Remove both shifter shaft assemblies from cover. Lip seals in side cover may now by pryed out if replacement is required because of damage.
3. Remove detent cam spring and pivot retainer "C" ring. Remove both detent cams.
4. Replace necessary parts.

Assembly (Fig. 7-663)

When installing new gaskets, do not coat with



1. Bearing Retainer
2. Main Drive Gear
3. Fourth Speed Synchronizing Ring
4. Third and Fourth Speed Synchronizer Assy.
5. Third Speed Synchronizing Ring
6. Third Speed Gear
7. Second Speed Gear
8. Second Speed Synchronizing Ring
9. First and Second Speed Synchronizer Assy.
10. First Speed Synchronizing Ring
11. First Speed Gear
12. Thrust Washer
13. Reverse Gear
14. Mainshaft
15. Reverse Idler Shaft Roll Pin
16. Reverse Idler Gear (Rear)
17. Countergear
18. Countershaft Bearing Roller Spacer
19. Countershaft Bearing Roller
20. Countergear Spacer Washer
21. Countershaft
22. Reverse Idler Gear (Front)
23. Reverse Idler Shaft

Fig. 7-660—Four Speed Transmission Cross Section

grease.

1. Install 1-2 detent cam to cover pivot pin first, then install 3-4 detent cam so the detent spring notches are offset or opposite each other. Detent cam notches must be facing downward.
2. Install detent cam retaining "C" ring to pivot shaft and hook spring into detent cam notches.
3. Install both shifter shaft assemblies in cover, being careful not to damage lip seals. Install both shift forks to detent plates, lifting up on detent cam to allow forks to fully seat into position.
4. Install outer shifter levers, flat washers, lockwashers and nuts.

Installation (Fig. 7-664)

1. Shift 1-2 shifter lever into second-speed (forward) position. Position cover gasket on case.
2. Carefully position side cover into place, making sure the shift forks are aligned with their respective mainshaft synchronizer sliding sleeves.
3. Install cover attaching bolts and tighten evenly to 20 ft. lbs. torque.
4. Remove filler plug and add lubricant to level of filler plug hole.

EXTENSION HOUSING OIL SEAL AND BUSHING REPLACEMENT

Removal

1. Remove propeller shaft.
2. Tap seal inward to break bond, then using Tool BT-6629-1, -3 remove seal. (Fig. 7-665)
3. After removing the seal, if bushing replacement is necessary, the bushing can be removed as shown in Fig. 7-666.
4. If the bushing was removed, it can be installed using tools as shown in Fig. 7-667.
5. Coat the outside of new seal sparingly with Sealer, No. 1050026 or equivalent. Apply Lubricant, No. 1050169 or equivalent to the sealing lip of seal.
6. Drive seal into the rear bearing retainer using Tool J-5395 until seal is fully seated. (Fig. 7-668). The seal can also be installed using tools shown in Fig. 7-669.

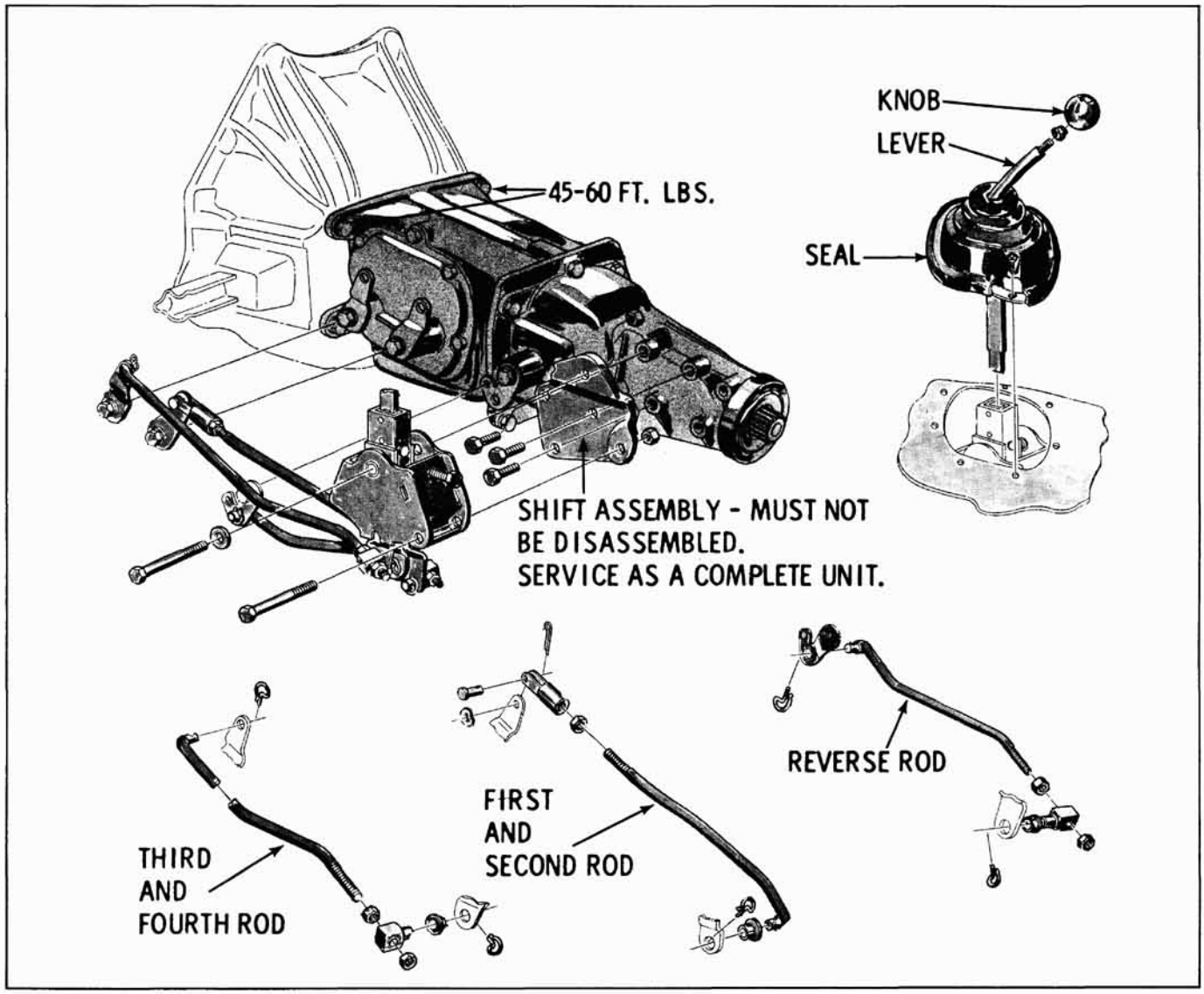


Fig. 7-661—Shift Linkage

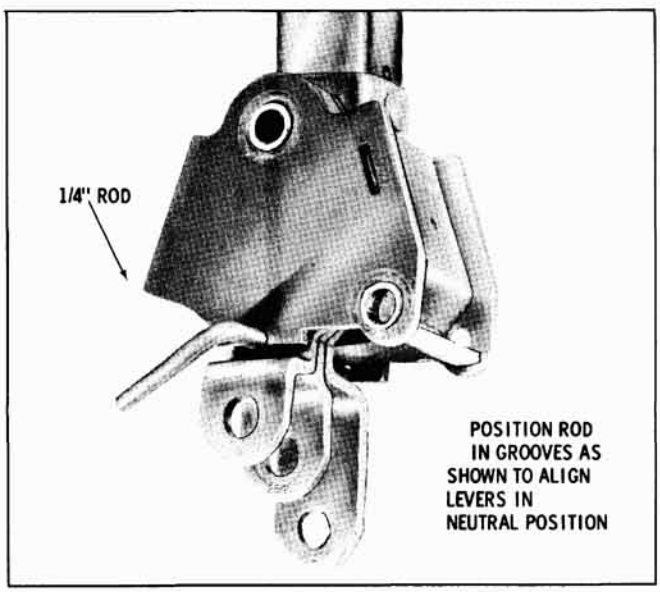


Fig. 7-662—Shift Lever Positioning

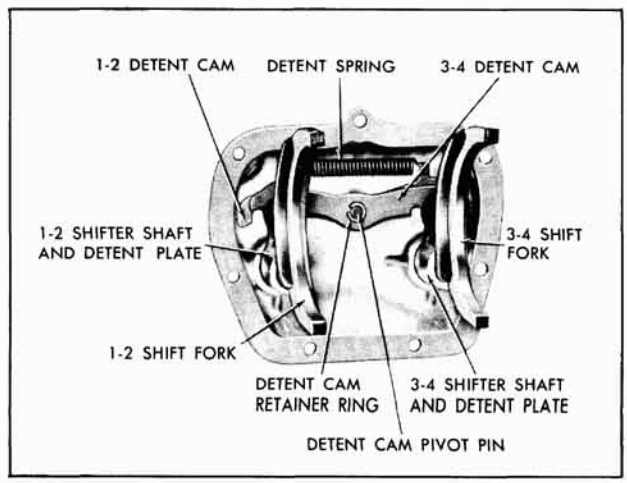


Fig. 7-663—Transmission Side Cover Assembly

SHIFT LEVER REMOVAL

The shift lever assembly can be removed after removing the console assembly, if so equipped, and the floor pan seal.

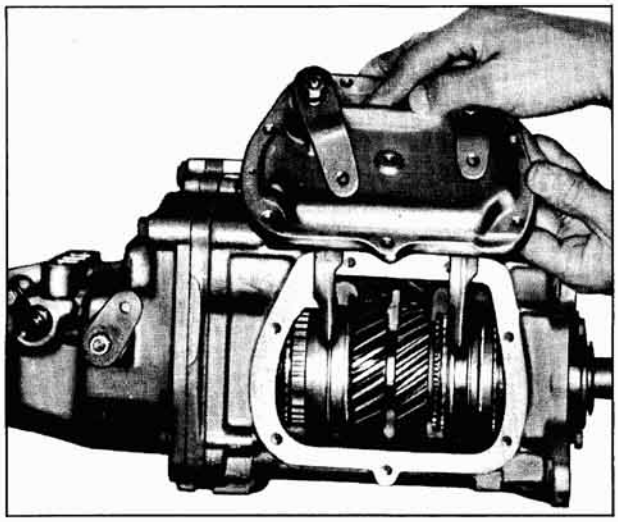


Fig. 7-664—Installing Side Cover Assembly

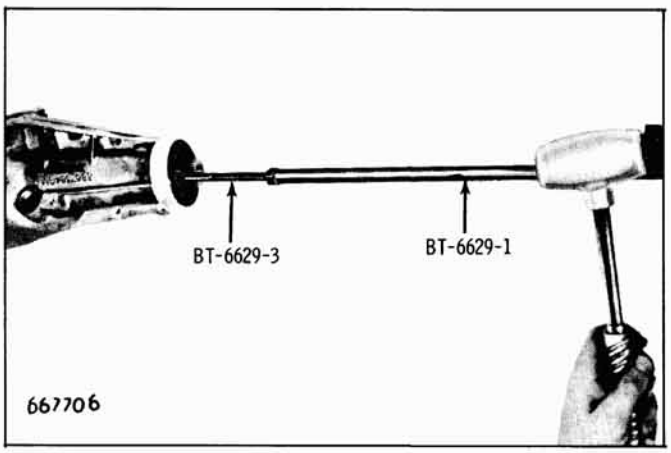


Fig. 7-665—Removing Rear Seal

Fig. 7-670 illustrates a feeler gauge or feeler stock being used to trip the detent spring. To replace the lever, push down on the lever until it engages the detent spring.

TRANSMISSION ASSEMBLY

Removal

1. Disconnect throttle linkage from cowl bracket to prevent damage.
2. Raise car.
3. Remove propeller shaft.
4. Disconnect shift rods from shift levers.
5. Disconnect back-up lamp switch wires.
6. Install Engine Support Bar BT-6424-1. If equipped with air conditioning, use Support Bar Adapter BT-6424-3.
7. Remove cross support bar to rear transmission mount attaching bolts.
8. Disconnect parking brake cables from cross support and remove cross support bar.

On models equipped with dual exhaust, it may be necessary to disconnect the left hand exhaust pipe at the exhaust manifold to provide clearance.

9. Disconnect speedometer cable at transmission.
10. Remove three bolts that retain shift lever assembly to extension housing. If shift lever assembly removal is not required, it may be left hanging in floor seal.

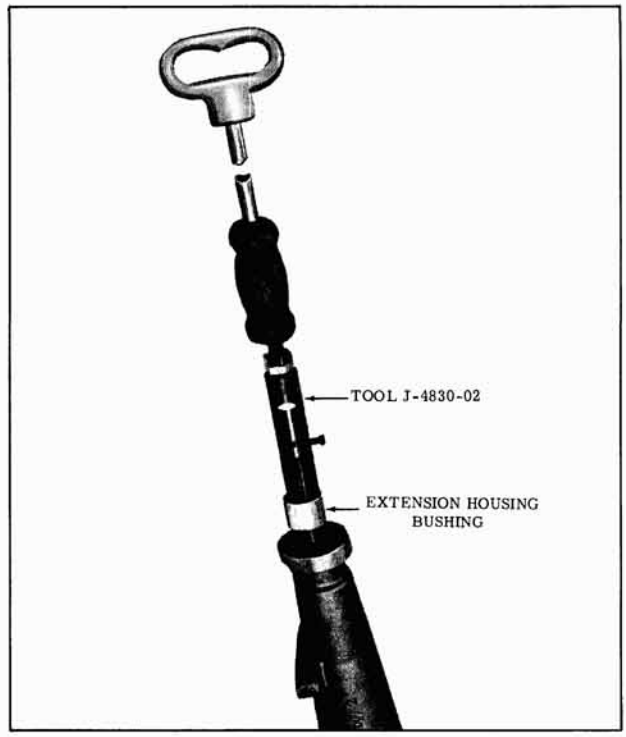


Fig. 7-666—Removing Rear Bushing

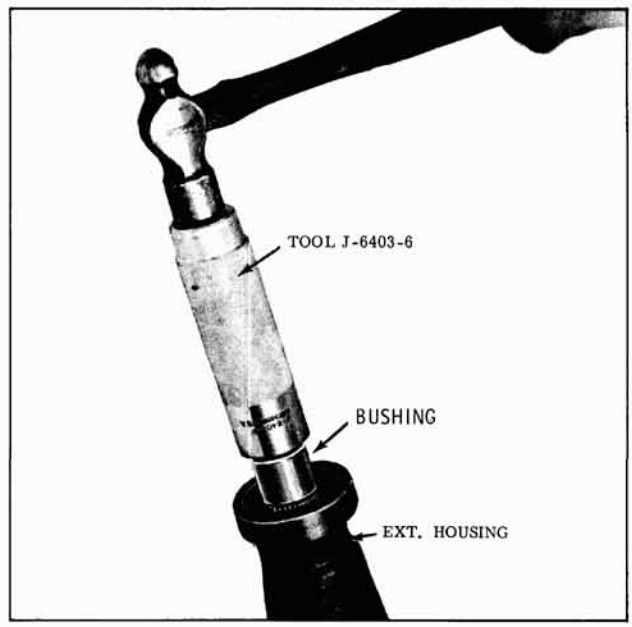


Fig. 7-667—Installing Rear Bushing

11. Remove transmission upper attaching bolts. Install aligning studs (7/16"-14 x 2 1/2" headless bolts.)

Aligning studs must be used to support transmission to prevent distortion of the clutch driven plate hub when removing transmission.

12. Remove transmission lower attaching bolts.
13. Carefully slide transmission rearward and remove from car.

Installation

1. Inspect clutch pilot bearing and replace if necessary.

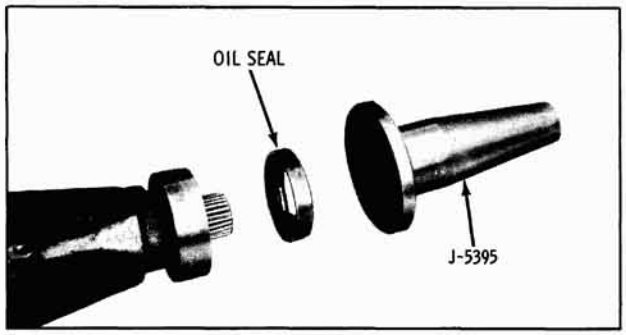


Fig. 7-668—Installing Rear Seal

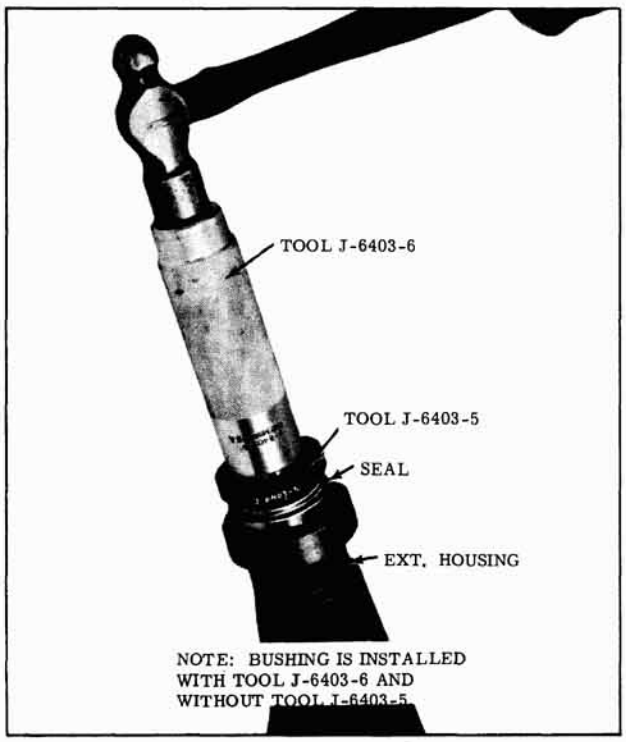


Fig. 7-669—Installing Rear Seal

2. Reverse removal procedure using the following specified torque ratings for the attaching parts:

a. Transmission to engine	70 ft. lbs.
b. Shift lever assembly to extension housing	25 ft. lbs.
c. Exhaust pipe to manifold	15 ft. lbs.
d. Cross support bar brackets to frame	35 ft. lbs.
e. Cross support bar to rear transmission mount	50 ft. lbs.
f. Propeller shaft U-bolt nuts	14 ft. lbs.

DISASSEMBLY (Fig. 7-671)

1. Remove transmission side cover as outlined under MAINTENANCE AND ADJUSTMENTS.

2. Straighten lock tangs away from front bearing retainer attaching bolts. Remove four bolts from retainer and remove retainer and gasket.

3. Remove the main drive gear retaining nut (Fig. 7-672) using Tool J-0933-02 after locking up transmission by shifting into two gears. The retaining nut has a left hand thread and is staked in place. This staking must be removed before removing nut.

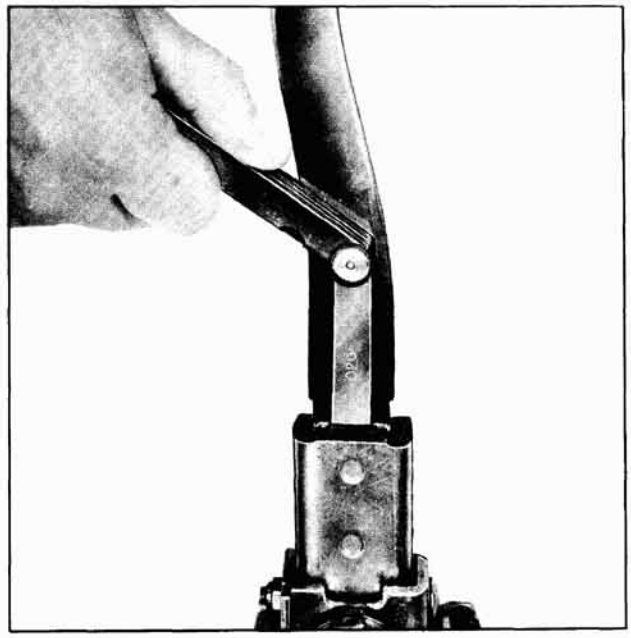


Fig. 7-670—Removing Shift Lever

4. With transmission gears in neutral, drive lock pin from reverse shifter lever boss as shown in Fig. 7-673, and pull shifter shaft out about 1/8". This disengages the reverse shift fork from reverse gear.

5. Remove six bolts attaching the case extension to the case. Tap extension with soft hammer in a rearward direction to start. When the reverse idler shaft is out as far as it will go, move extension to left so reverse fork clears reverse gear and remove extension and gasket.

6. The rear reverse idler gear, shaft and flat thrust washer may now be removed.

7. Remove speedometer gear and reverse gear. The speedometer gear may be removed using Tools as shown in Fig. 7-674.

Slide 3-4 synchronizer clutch sleeve to fourth-speed gear position (forward) before trying to remove mainshaft assembly from case. (Fig. 7-675)

8. Carefully remove the rear bearing retainer and entire mainshaft assembly from the case by tapping bearing retainer with a soft hammer.

9. Unload bearing rollers from main drive gear and remove fourth-speed synchronizer blocker ring.

10. Lift the front half of reverse idler gear and its tanged thrust washer from case.

11. Press main drive gear down from front bearing. (Fig. 7-676)

12. From inside case, tap out front bearing and snap ring.

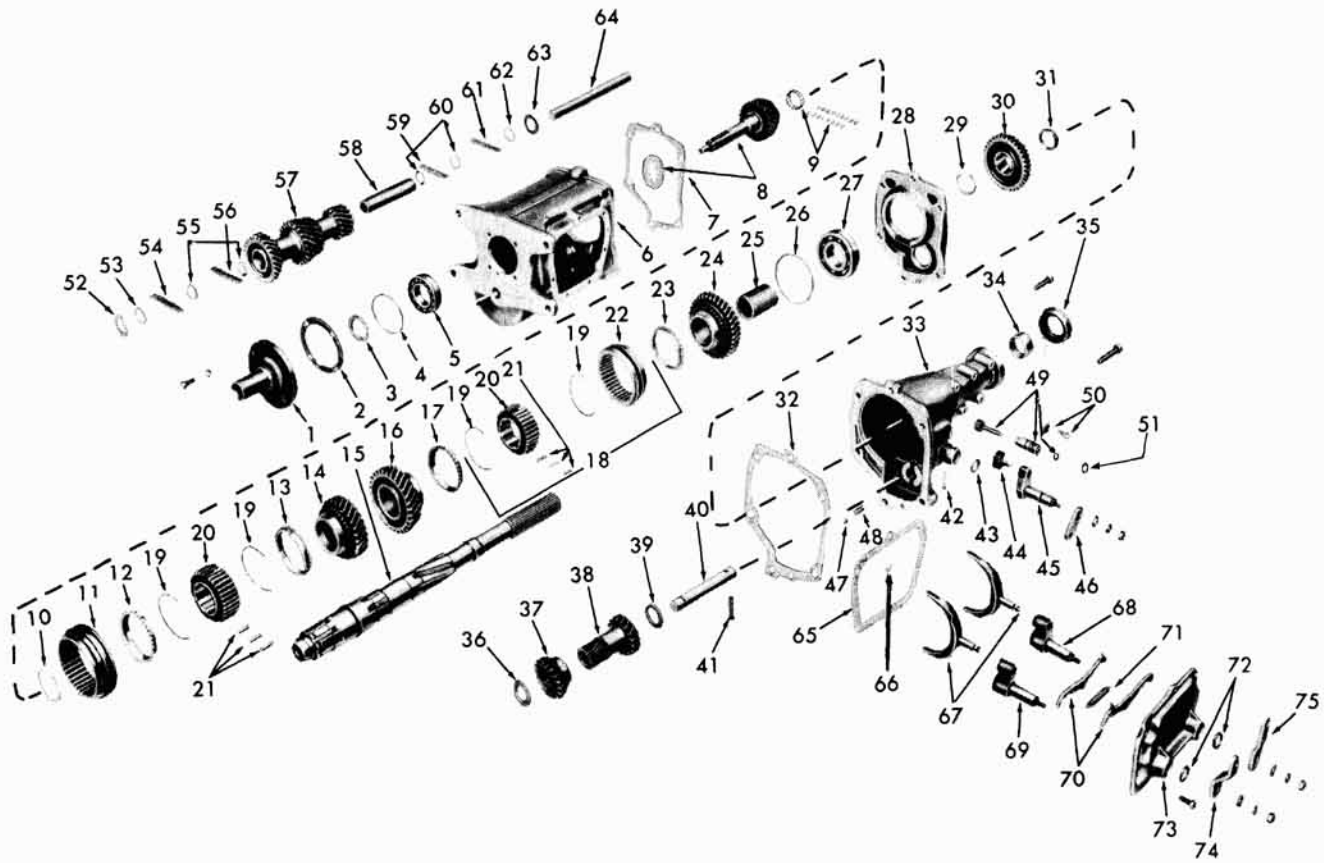
13. From the front of the case, press out the countershaft using Tool J-22379, then remove the countergear and both tanged gear thrust washers. (Fig. 7-677)

14. Remove the 112 rollers, 6 - .075" countergear spacer washers and bearing spacer from countergear.

15. Remove mainshaft front snap ring as shown in Fig. 7-678 and slide third and fourth-speed synchronizer assembly, third-speed gear and synchronizing ring from front of mainshaft.

16. Spread rear bearing retainer snap ring and press mainshaft out of the retainer. (Fig. 7-679)

17. Remove the mainshaft rear snap ring. Support first-speed gear as shown in Fig. 7-680 and press against rear of mainshaft to remove shaft from rear bearing, first-speed gear



1. Bearing Retainer
2. Gasket
3. Bearing Retaining Nut
4. Bearing Snap Ring
5. Main Drive Gear Bearing
6. Transmission Case
7. Rear Bearing Retainer Gasket
8. Main Drive Gear Oil Slinger
9. Bearing Rollers (17) and Cage
10. Snap Ring
11. Third and Fourth Speed Clutch Sliding Sleeve
12. Fourth Speed Gear Synchronizing Ring
13. Third Speed Synchronizing Ring
14. Third Speed Gear
15. Mainshaft
16. Second Speed Gear
17. Second Speed Gear Synchronizing Ring
18. First and Second Speed Clutch Assembly
19. Clutch Key Spring
20. Clutch Hub
21. Clutch Plates
22. First and Second Speed Clutch Sliding Sleeve
23. First Speed Gear Synchronizing Ring
24. First Speed Gear
25. Sleeve
26. Rear Bearing Snap Ring
27. Rear Bearing
28. Rear Bearing Retainer
29. Selective Fit Snap Ring
30. Reverse Gear
31. Speedometer Drive Gear
32. Rear Bearing Retainer to Case Extension Gasket
33. Case Extension
34. Extension Bushing
35. Rear Oil Seal
36. Reverse Idler Front Thrust Washer (Tanged)
37. Reverse Idler Gear (Front)
38. Reverse Idler Gear (Rear)
39. Flat Thrust Washer
40. Reverse Idler Shaft
41. Reverse Idler Shaft Roll Pin
42. Reverse Shifter Shaft Lock Pin
43. Reverse Shifter Shaft Seal
44. Reverse Shift Fork
45. Reverse Shifter Shaft and Detent Plate
46. Reverse Shifter Lever
47. Reverse Shifter Shaft Ball
48. Reverse Shifter Shaft Ball Detent Spring
49. Speedometer Driven Gear and Sleeve and Seal
50. Retainer and Bolt
51. "O" Ring Seal
52. Countergear Thrust Washer
53. Countergear Spacer Washers
54. Bearing Rollers (28)
55. Countergear Spacer Washers
56. Bearing Rollers (28)
57. Countergear
58. Countergear Roller Spacer
59. Bearing Rollers (28)
60. Countergear Spacer Washers
61. Bearing Rollers (28)
62. Countergear Spacer Washers
63. Countergear Thrust Washer
64. Countershaft
65. Gasket
66. Detent Cams Retainer Ring
67. Forward Speed Shift Forks
68. First and Second Speed Gear Shifter Shaft Assembly
69. Third and Fourth Speed Gear Shifter Shaft and Detent Plate
70. Detent Cams
71. Detent Cam Spring
72. Lip Seals
73. Transmission Side Cover
74. Third and Fourth Speed Shifter Lever
75. First and Second Speed Shifter Lever

Fig. 7-671—Four Speed Transmission Parts Layout

thrust washer, first-speed gear and synchronizing ring.

18. Remove 1-2 speed gear sleeve (Fig. 7-681) and remove 1-2 synchronizer assembly, second-speed synchronizer ring and second-speed gear from mainshaft.

CLEANING AND INSPECTION

Transmission Case

Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the front face which

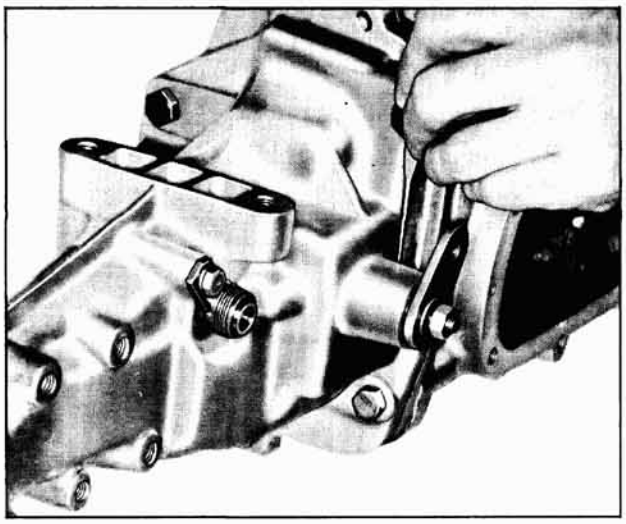


Fig. 7-672—Removing Reverse Shifter Shaft Lock Pin

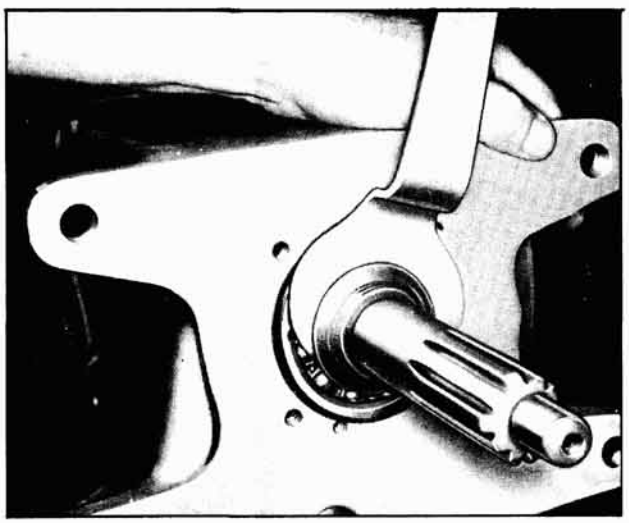


Fig. 7-673—Removing Main Drive Gear Retaining Nut

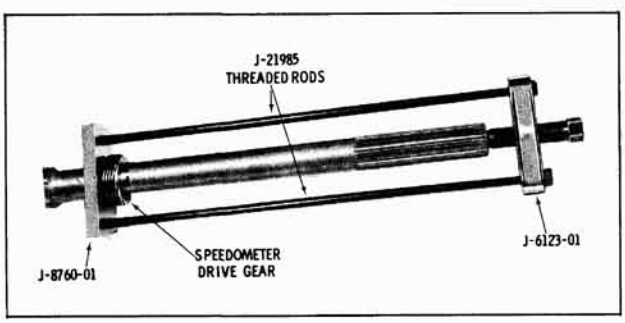


Fig. 7-674—Removing Speedometer Gear

fits against clutch housing for burrs and if any are present, dress them off with a fine cut mill file. Clean chips from magnet in bottom of case.

Front and Rear Bearings

1. Wash the front and rear bearings thoroughly in a cleaning solvent.

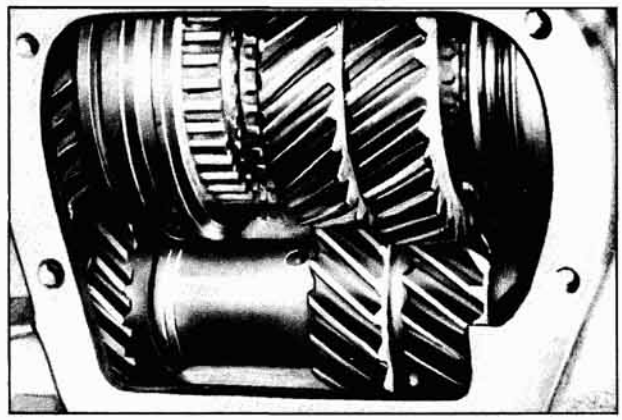


Fig. 7-675—Third and Fourth Speed Synchronizer in Fourth Gear Position

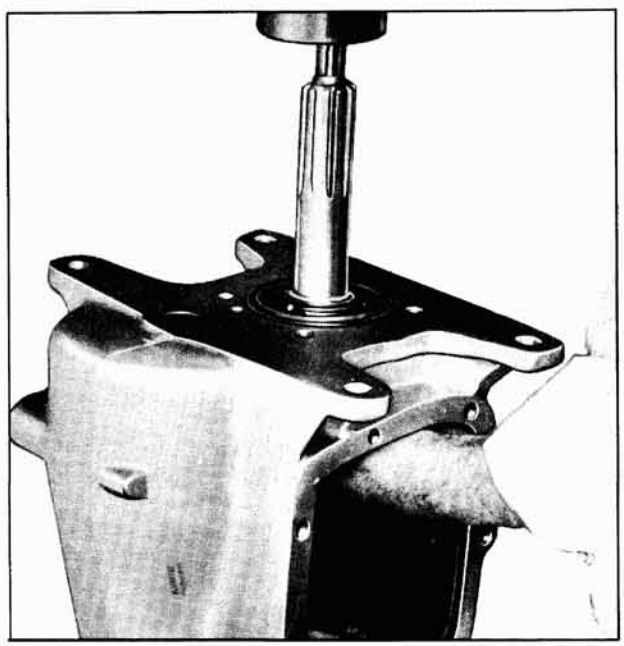


Fig. 7-676—Removing Main Drive Gear

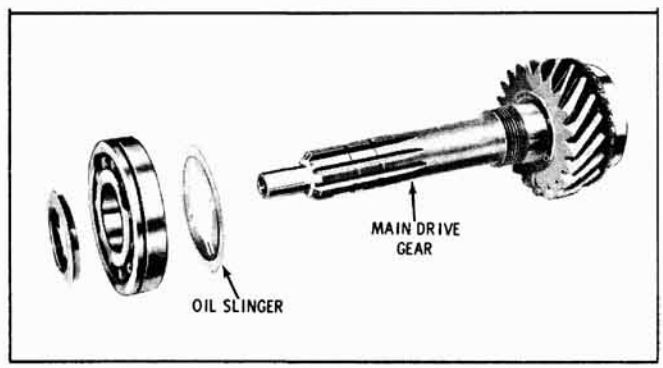


Fig. 7-676A—Main Drive Gear and Bearing

2. Blow out bearing with compressed air.

Do not allow bearings to spin, but turn them slowly by hand. Spinning bearings will damage the race and balls.

3. Make sure bearings are clean, then lubricate them with light engine oil and check them for roughness. Roughness

Fig. 7-677—Removing Countershaft

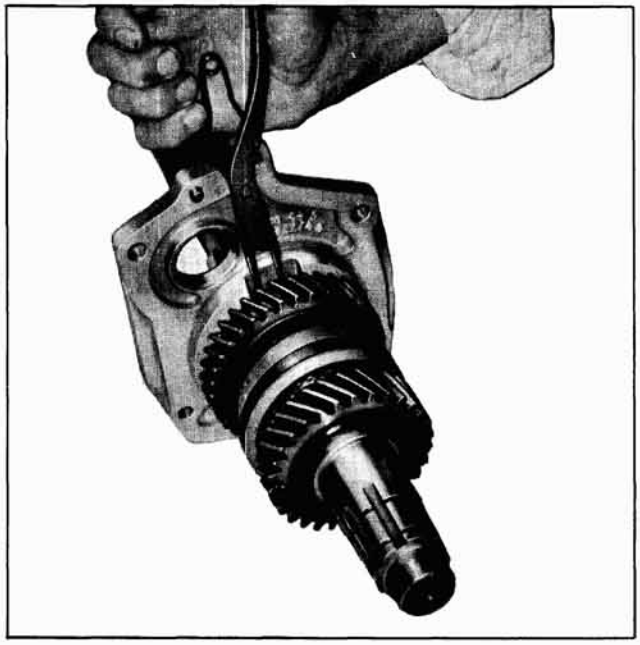


Fig. 7-679—Removing Rear Bearing Retainer

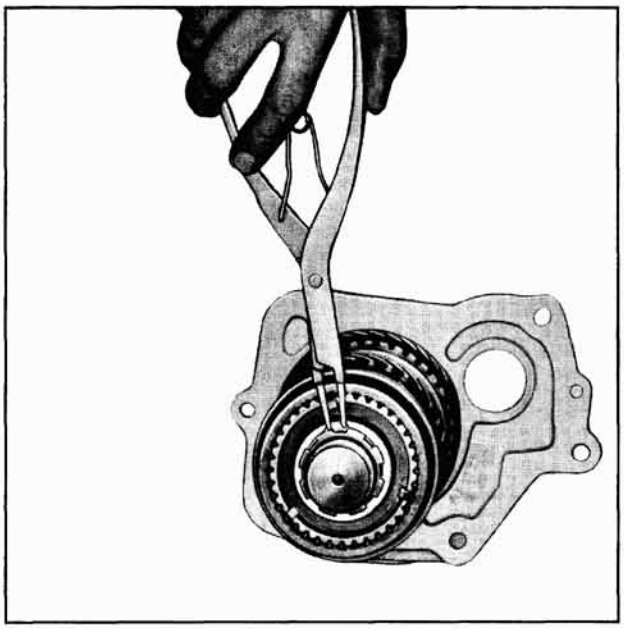


Fig. 7-678—Removing Mainshaft Front Snap Ring

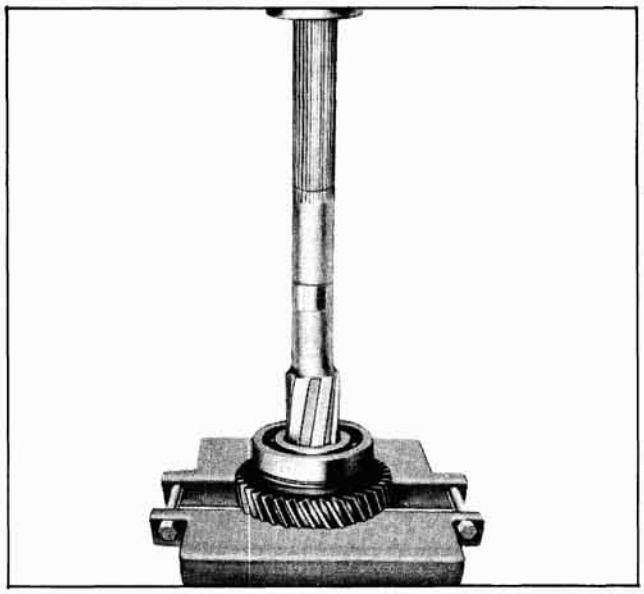


Fig. 7-680—Removing Mainshaft From Rear Bearing Gear and First Speed

may be determined by slowly turning the outer race by hand.

Bearing Rollers and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft at the same time and replace if necessary. Replace all worn spacers.

Gears

Inspect all gears and replace all that are worn or damaged.

Reverse Idler

1. The bushings used in the idler gear are pressed into the gear, then peened into holes in the bores and are bored in place. This insures the positive alignment of the bushings and their shafts, as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushings are not serviced separately.

2. Check bushings for excessive wear by using a narrow feeler gauge between the shaft and the bushing or use a micrometer. The proper clearance is from .003" to .005".

Countergear Anti-Lash Plate

Inspect the plate teeth for wear or other damage. The plate and damper spring are retained to the countergear by three rivets. Disassembly is not recommended. (Fig. 7-682)

REPAIRS

REVERSE SHIFTER SHAFT AND SEAL

Replacement

1. With case extension removed from transmission, the

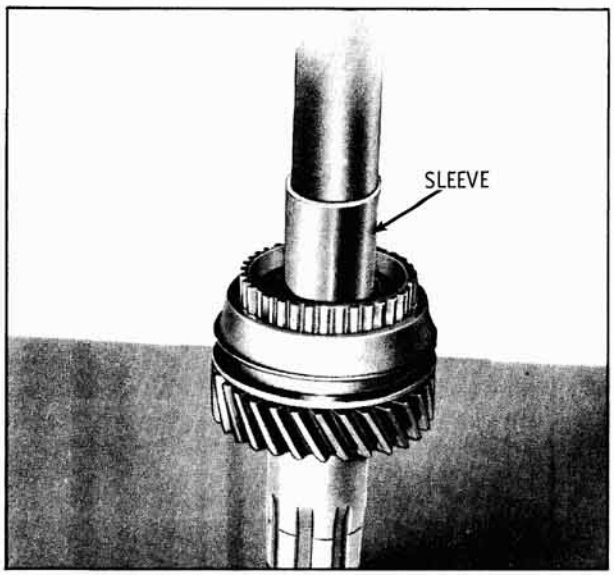


Fig. 7-681—Removing 1-2 Speed Gear Sleeve

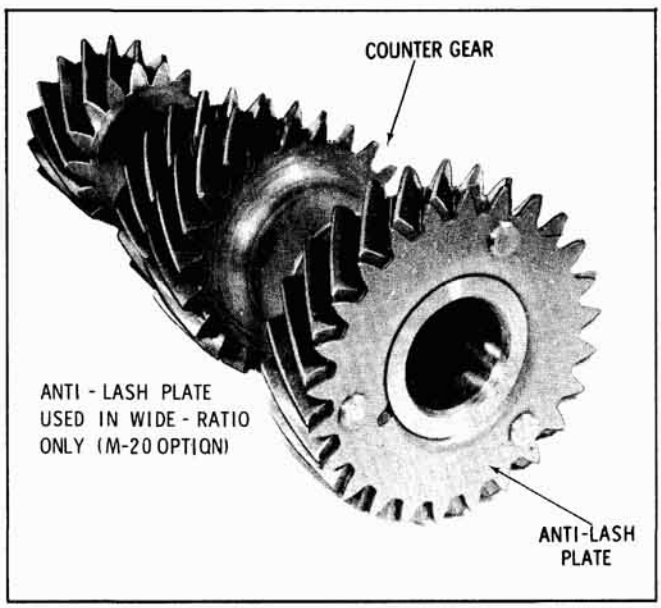


Fig. 7-682—Countergear Assembly

reverse shifter shaft lock pin will already be removed. (See Step 4 under DISASSEMBLY)

2. Remove shift fork.

3. Carefully drive shifter shaft into case extension, allowing ball detent to drop into case. Remove shaft and ball detent spring.

4. Place ball detent spring into detent spring hole and place detent ball on top of the spring.

5. While holding the ball down as shown in Fig. 7-683, push the shifter shaft in until the ball engages the shaft detent plate.

6. Install shift fork.

Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission case.

Extension Oil Seal or Bushing

Refer to "Extension Housing Oil Seal" and "Bushing Removal" (on car).

Fig. 7-683—Installing Reverse Shifter Shaft and Ball

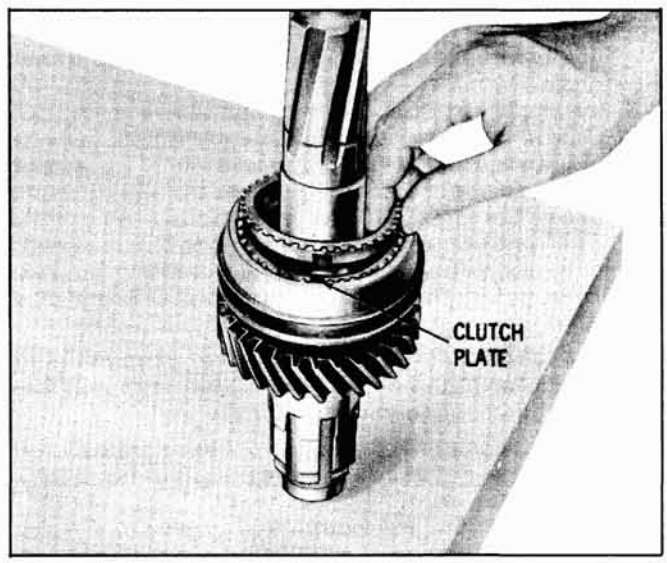


Fig. 7-684—Installing Synchronizing Ring

Synchronizer Clutch Plates and Springs

The synchronizer clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the three plates and two springs may be replaced if worn or broken.

Replacement

1. Push the hub from the sliding sleeve. The plates will fall free and the springs may be easily removed.

2. Place the two springs in position (one on each side of the hub), so all three plates are engaged by both springs. Place the plates in position and, holding them in place, slide the hub into the sleeve.

ASSEMBLY

Mainshaft Assembly

1. From the rear of the mainshaft, assemble the second-speed gear (with hub of gear toward rear of shaft).

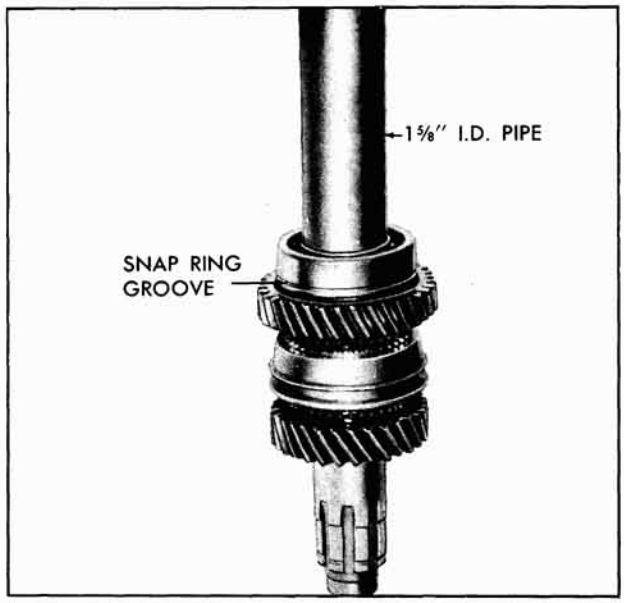


Fig. 7-685—Installing Rear Bearing

2. Install 1-2 synchronizer clutch assembly to mainshaft (sliding sleeve taper toward the rear, hub to the front); together with a synchronizing ring on either side so their keyways line up with the synchronizer plates. (Fig. 7-684) Install 1-2 gear sleeve.

3. Install the first-speed gear with hub toward front.

4. Using 1-5/8" ID pipe cut to a suitable length, press on the rear bearing with the snap ring groove toward the front of the transmission. (Fig. 7-685) Firmly seat the bearing.

5. Choose the correct selective fit snap ring (.091", .094", .097", .100" or .104") and install it in the groove in mainshaft behind the rear bearing. With proper ring, maximum distance between snap ring and rear face of bearing will be from zero to .005".

Always use new snap rings when reassembling transmission and do not expand the snap ring further than necessary for assembly.

6. Install the third-speed gear hub to front of transmission and the third-speed gear synchronizing ring (notches to front of transmission).

7. Install the third and fourth-speed synchronizer assembly (hub and sliding sleeve) with both sleeve taper and hub toward the front, making sure the plates in the hub correspond to the notches in the third-speed gear synchronizing ring.

8. Install snap ring in the groove in mainshaft in front of the third and fourth-speed synchronizer assembly with ends of snap ring seated behind spline teeth.

9. Install the rear bearing retainer. (Fig. 7-686) Spread the snap ring in the plate to allow the snap ring to drop around the rear bearing and press on the end of the mainshaft until the snap ring engages the groove in the rear bearing.

10. Install the reverse gear (shift collar to rear).

11. Drive speedometer gear onto mainshaft (Fig. 7-687)

Countergear Assembly

Install bearing spacer, bearings and countergear spacer washers as shown in Fig. 7-688. Retain bearings with grease and insert countergear loading Tool J-22379 into countergear.

TRANSMISSION ASSEMBLY

1. Rest the transmission case on its side with the side cover opening toward the assembler. Place countergear front tanged thrust washer in case, retaining with grease.

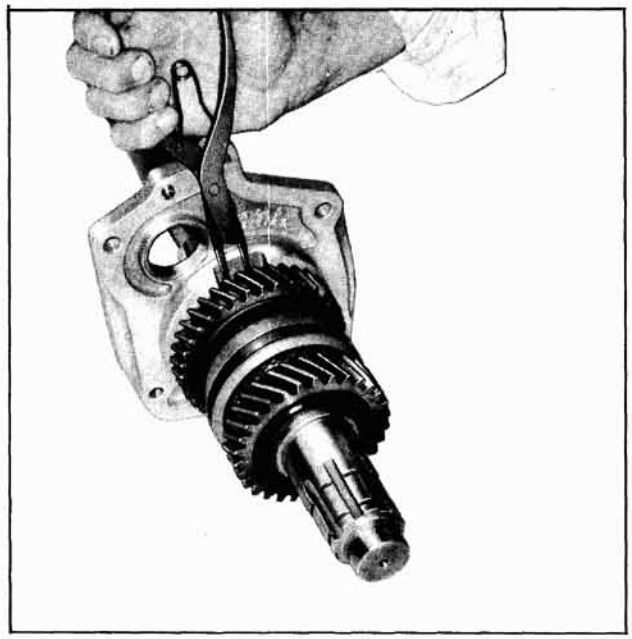


Fig. 7-686—Installing Rear Bearing Retainer

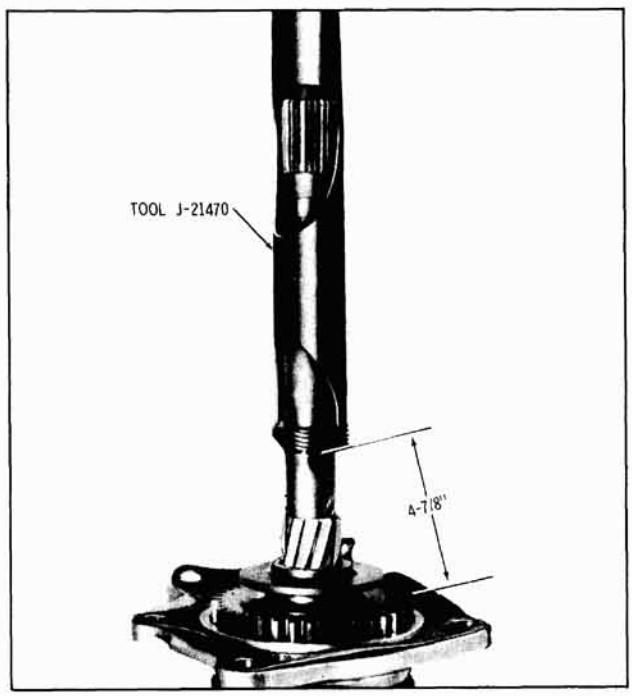


Fig. 7-687—Installing Speedometer Drive Gear

2. Set countergear in place in bottom of transmission case, making sure that tanged thrust washer is not knocked out of place.

3. Position the transmission case resting on its front face and install rear countergear thrust washer in case.

4. Lubricate and insert countershaft in rear of case. Turn countershaft so flat on end of shaft is horizontal and facing bottom of case.

The flat on shaft must be horizontal and toward the bottom to mate with rear bearing retainer when installed.

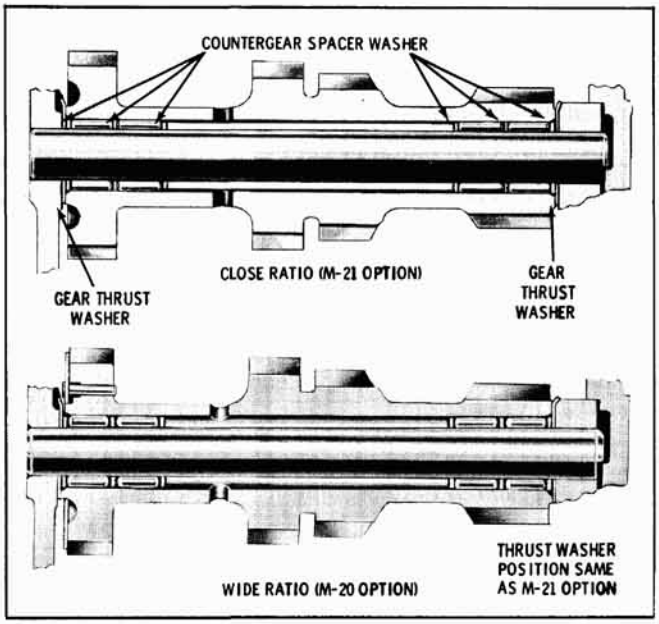


Fig. 7-688—Cross Section of Countergear Assembly

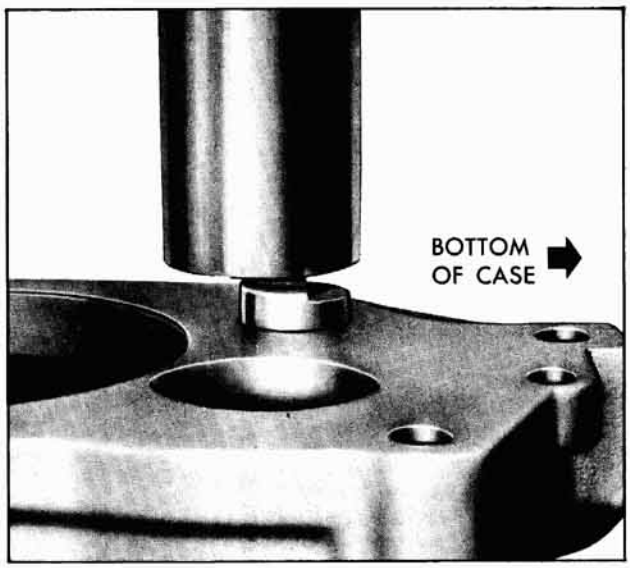


Fig. 7-689—Installing Countershaft

5. Align countergear with shaft in rear and hole in front of case and press countershaft into case (pushing assembly tool out front of case) until flat on shaft is flush with rear of case. Be sure thrust washers remain in place. (Fig. 7-689)

6. Attach a dial indicator as shown in Fig. 7-690 and check end play of the countergear. If end play is greater than .025", new thrust washers must be installed.

7. Install the 17 roller bearings into main drive gear, using light coating or petrolatum to hold the bearings and cage in place.

8. Install main drive gear and pilot bearings through the side cover opening and into position in transmission front bore.

9. Place gasket in position on front face of rear bearing retainer.

10. Install the fourth-speed synchronizing ring on main drive gear with the notches toward the rear of the transmission.

11. Position the reverse idler gear thrust washer (tanged) on the machined face of the ear, cast in the case, for the reverse idler shaft and hold with grease. Position the front reverse idler gear next to the thrust washer, with the hub facing toward rear of the case.

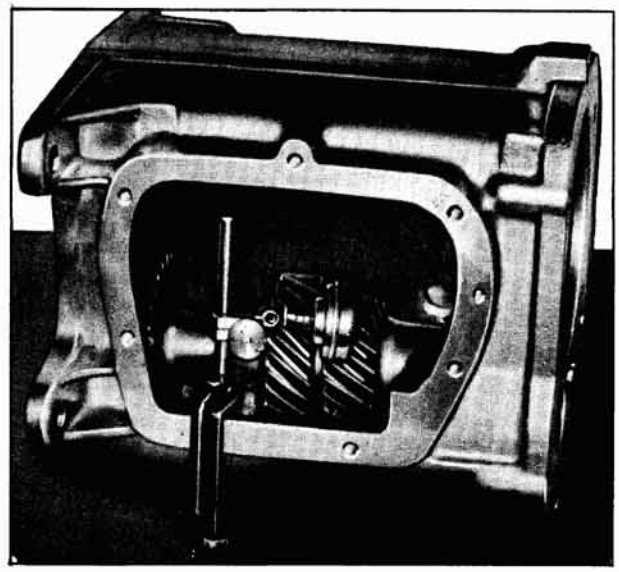


Fig. 7-690—Checking Countergear End Play

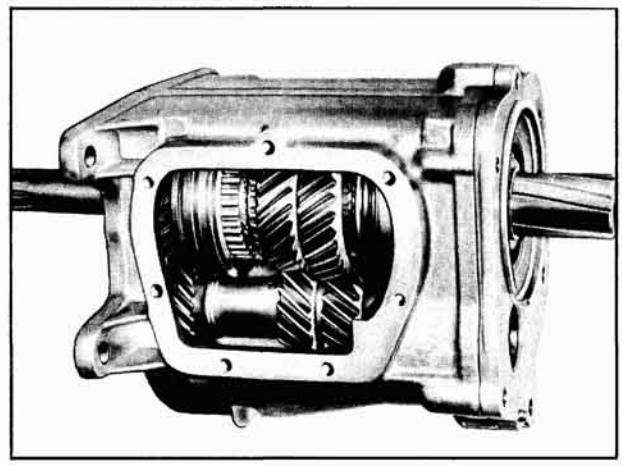


Fig. 7-691—Third and Fourth Synchronizer in Fourth Position

Before attempting to install mainshaft assembly to case, slide the 3-4 synchronizing sleeve forward into fourth-speed detent position. (Fig. 7-691)

12. Lower the mainshaft assembly into the case, making certain the notches on the fourth-speed synchronizing ring correspond to the plates in the synchronizer assembly. (Fig. 7-692)

13. With the guide pin in rear bearing retainer aligned with hole in rear of case, tap rear bearing retainer into position with a soft hammer.

14. From the rear of the case, insert the rear reverse idler gear, engaging the splines with the portion of the front gear inside the case.

15. Place gasket in position on rear face of rear bearing retainer.

16. Install the remaining flat thrust washer on reverse idler shaft. If new idler shaft is being used, drive out the roll pin and press it into new shaft.

17. Install reverse idler shaft, roll pin and thrust washer into gears and front boss of case. Make sure to pick up front

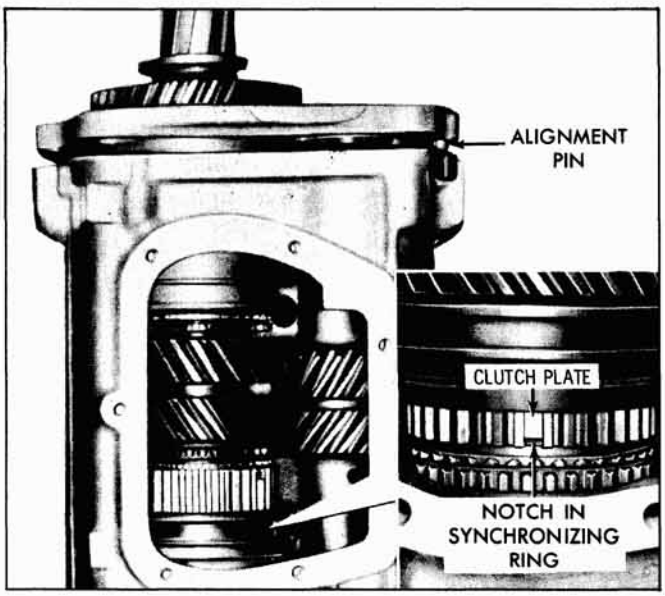


Fig. 7-692—Installing Mainshaft Assembly

tanged thrust washer.

Roll pin should be in a vertical position.

18. Pull reverse shifter shaft to left side of extension and rotate shaft to bring reverse shift fork forward in extension (reverse detent position). Start the extension onto the transmission case (Fig. 7-693), while slowly pushing in on the shifter shaft to engage the shift fork with the reverse gear shift collar; then pilot the reverse idler shaft into the extension housing, permitting the extension to slide onto the transmission case.

19. Install six extension and retainer to case attaching bolts. Torque upper three bolts to 25 ft. lbs.; lower three bolts to 35 ft. lbs.

20. Push or pull reverse shifter shaft to line up groove in the shaft with the holes in the boss and drive in the lock pin. Install shifter lever.

21. Press bearing onto main drive gear (snap ring groove to front) and into case until several main drive gear retaining nut threads are exposed.

22. Lock up transmission by shifting into two gears. Install main drive gear retaining nut on the gear shaft and draw

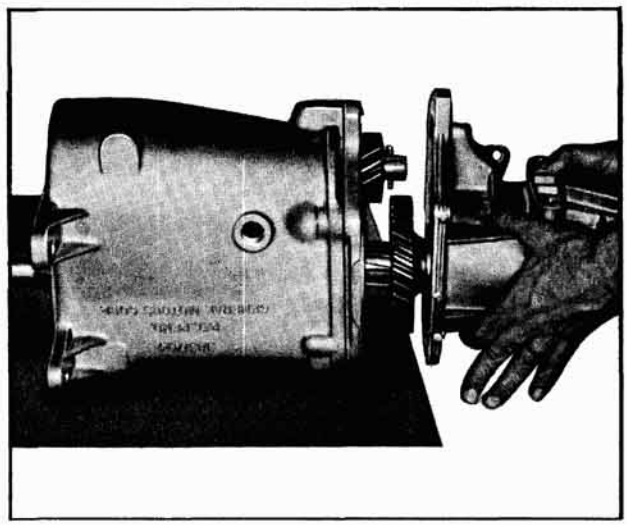


Fig. 7-693—Installing Case Extension

it up tight using Tool J-0933-02. Be sure bearing fully seats against shoulder on gear. Torque retaining nut to 40 ft. lbs. and lock in place by staking securely into main drive gear shaft hole with a center punch. Care must be used to avoid damaging the threads on the shaft.

23. Install the main drive gear bearing retainer, gasket and four attaching bolts using 1050026 Sealer or equivalent on bolts. Torque to 20 ft. lbs. and bend locking tangs against bolt heads.

24. Shift mainshaft 3-4 sliding synchronizer sleeve into neutral position and 1-2 sliding synchronizer sleeve into second gear (forward) detent position. Shift side cover 3-4 shifter lever into neutral detent and 1-2 shifter lever into second gear detent position.

25. Install side cover gasket and carefully position side cover into place. There is a dowel pin in the cover to assure proper alignment with the case. Install attaching bolts and tighten evenly to avoid side cover distortion. Torque to 20 ft. lbs.

TRANSMISSION ALIGNMENT ..... **Page 7-609**
DIAGNOSIS ..... **Page 7-631**
TRANSMISSION SPECIFICATIONS ..... **Page 7-632**
TRANSMISSION TORQUE SPECIFICATIONS ... **Page 7-632**
TRANSMISSION TOOLS ..... **Page 7-633**

DIAGNOSIS (3-Speed, 3-Speed H.D. & 4-Speed)

CONDITION AND CAUSE	CORRECTION
Slips out of High Gear	
a. Transmission loose on clutch housing. b. Shift rods interfere with engine mounts or clutch throw-out lever. c. Shift linkage does not work freely; binds. d. Damaged mainshaft pilot bearing. e. Main drive gear bearing retainer broken or loose. f. Dirt between transmission case and clutch housing. g. Misalignment of transmission. h. Stiff shift lever seal.	a. Tighten mounting bolts. b. Replace or bend levers and rods to eliminate interference. c. Adjust and free up shift linkage. d. Replace pilot bearing. e. Tighten or replace main drive gear bearing retainer. f. Clean mating surfaces. g. Refer to TRANSMISSION ALIGNMENT. h. Replace seal.
Noisy in all Gears	
a. Insufficient lubricant. b. Worn countergear bearings. c. Worn or damaged main drive gear and countergear. d. Damaged main drive gear or mainshaft bearings. e. Worn or damaged countergear anti-lash plate. (Exc. H.D. 3 speed)	a. Fill to correct level. b. Replace countergear bearings and shaft. c. Replace worn or damaged gears. d. Replace damaged bearings or main drive gear. e. Replace countergear.
Noisy in High Gear	
a. Damaged main drive gear bearing. b. Damaged mainshaft bearing.	a. Replace damaged bearing. b. Replace damaged bearing.
Noisy in Neutral with Engine Running	
a. Damaged main drive gear bearing. b. Damaged mainshaft pilot bearing. c. Worn or damaged countergear anti-lash plate. (Exc. H.D. 3 speed) d. Worn countergear bearings.	a. Replace damaged bearing. b. Replace pilot bearing. c. Replace countergear. d. Replace countergear bearings and shaft.
Noisy in all reduction Gears	
a. Insufficient lubricant. b. Worn or damaged main drive gear or countergear.	a. Fill to correct level. b. Replace faulty or damaged gears.
Noisy in Second Only	
a. Damaged or worn second-speed constant mesh gears. b. Worn or damaged countergear rear bearings.	a. Replace damaged gears. b. Replace countergear bearings and shaft.
Noisy in Third Only (Four Speed)	
a. Damaged or worn third-speed constant mesh gears. b. Worn or damaged countergear bearings.	a. Replace damaged gears. b. Replace damaged countergear bearings and shaft.
Noisy in Reverse Only	
a. Worn or damaged reverse idler gear. b. Worn reverse idler bushings. c. Damaged or worn reverse countergear.	a. Replace reverse idler gear assembly. b. Replace reverse idler gear assembly. c. Replace countergear assembly.
Excessive Backlash in all Reduction Gears	
a. Worn countergear bearings. b. Excessive end play in countergear.	a. Replace bearings. b. Replace countergear thrust washers.

DIAGNOSIS (3-Speed, 3-Speed H.D. & 4-Speed) (Cont'd.)

CONDITION AND CAUSE	CORRECTION
Leaks Lubricant	
a. Drain to correct level. b. Tighten or replace retainer. c. Replace gasket. d. Tighten cover or replace gasket. e. Replace seal. f. Replace case. g. Replace seal.	a. Excessive amount of lubricant in transmission. b. Loose or broken main drive gear bearing retainer. c. Main drive gear bearing retainer gasket damaged. d. Side cover loose or gasket damaged. e. Rear bearing retainer oil seal leaks. f. Countershaft loose in case. g. Shift lever seals leak.
Shifts Hard	
a. Clutch slow or not releasing engine. b. Shift linkage binding or not properly adjusted.	a. Refer to CLUTCH Section. b. Free up linkage and adjust.
Shifts Hard on Downshift	
a. Downshifting at too high an engine speed. b. Lubricant cold or too high viscosity.	a. Shift down at slower speeds. b. Check at normal operating temperature and replace lubricant if necessary.

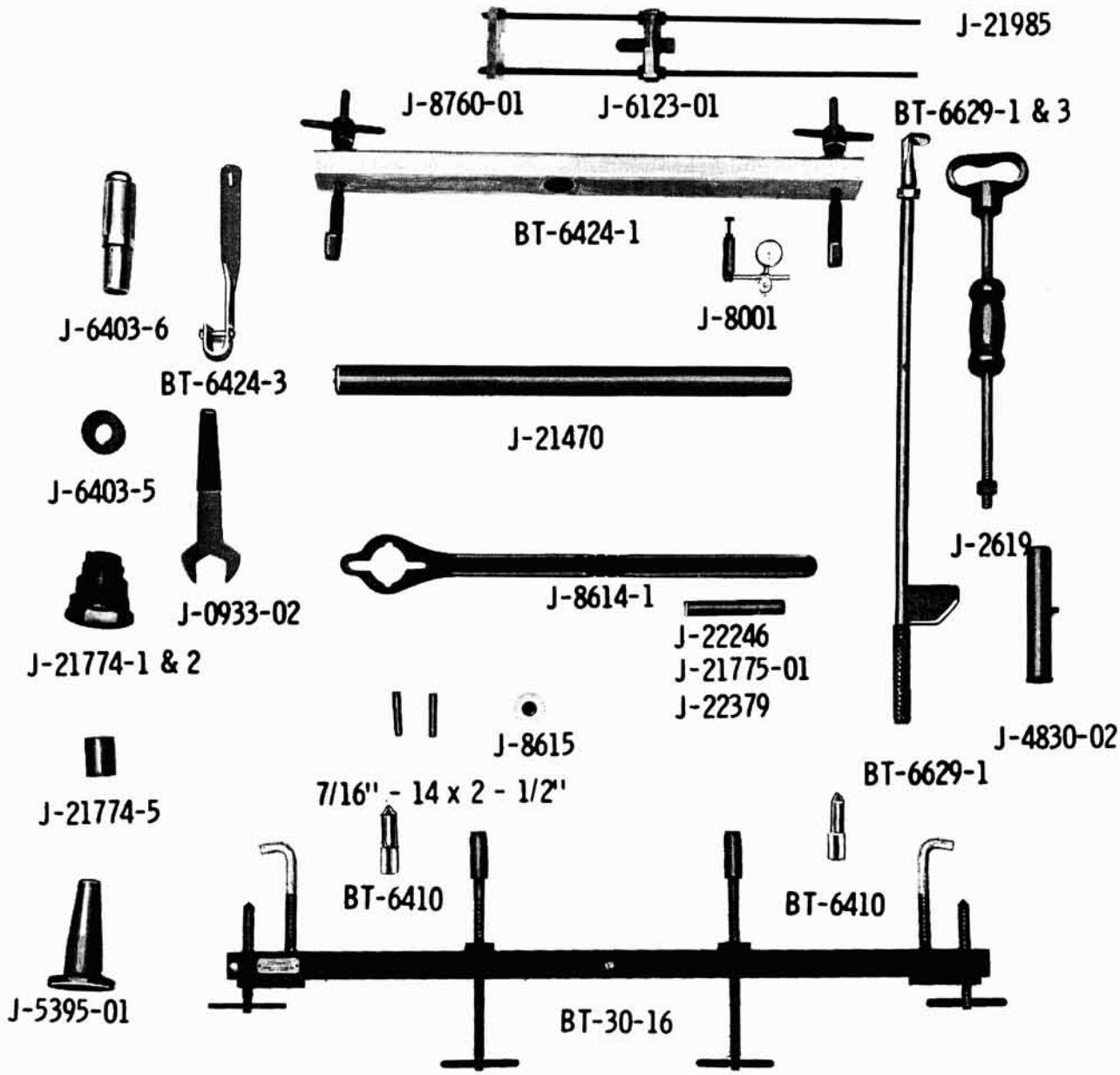
SPECIFICATIONS

	3-Speed	3-Speed H.D.	M-20 4-Speed	M-21 4-Speed
CAPACITY	3 1/2 Pints	4 1/2 Pints	2 1/4 Pints	2 1/4 Pints
GEAR RATIO				
First	2.85 to 1 (L-6) 2.54 to 1 (V-8)	2.42 to 1	2.52 to 1	2.20 to 1
Second	1.68 to 1 (L-6) 1.50 to 1 (V-8)	1.61 to 1	1.88 to 1	1.64 to 1
Third	Direct	Direct	1.46 to 1	1.28 to 1
Fourth			Direct	Direct
Reverse	2.95 to 1 (L-6) 2.63 to 1 (V-8)	2.33 to 1	2.59 to 1	2.27 to 1

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

APPLICATION	FT. LBS.
Side Cover Bolts	20
Transmission to Engine Bolts	65
Cross Support Bar Brackets to Frame	35
Transmission Mount to Cross Support Bar	50
Propeller Shaft U-Bolt Nuts	14
Bearing Retainer to Transmission Case Bolts 4-Speed	20
3-Speed and 3-Speed H.D.	25
Rear Bearing Retainer to Transmission Bolts	
Three Upper 4-Speed	25
Three Lower 4-Speed	35
3-Speed and 3-Speed H.D.	50



J-0933-02	Main Drive Gear Retaining Nut Wrench (4 Speed)	BT-6629-3	Seal Remover (Universal)
BT-3016	Engine Support Bar	J-8001	Dial Indicator
J-2619	Slide Hammer	J-8614-1	Holder for J-21774-1&2
J-4830-02	Extension Housing Bushing Remover (with extension housing on transmission)	J-8615	Front Oil Seal Installer
J-5395-01	Extension Housing Oil Seal Installer (Alternate)	J-8760-01	Speedo Drive Gear Remover Plate (3 and 4 Speed)
J-6123-01	Speedo Drive Gear Remover Screw Assembly (3 and 4 Speed)	J-21470	Mainshaft Bearing Installer
J-6403-5	Extension Housing Oil Seal Installer	J-21774-1&2	Front Oil Seal Installer (3 Speed H. D.)
J-6403-6	Extension Housing Bushing Installer (not necessary to remove extension housing)	J-21774-5	Mainshaft Bearing Remover Spacer
BT-6410	Engine Support Bar Adapters	J-21775-01	Countergear Loading Tool (3 Speed H. D.)
BT-6424-1	Engine Support Bar	J-21985	Speedo Drive Gear Remover Threaded Rod (3 and 4 Speed)
BT-6424-3	Engine Support Bar A/C Adapter	J-22246	Countergear Loading Tool (3 Speed)
BT-6629-1	Seal Remover (Universal)	J-22379	Countergear Loading Tool (4 Speed)
		7/16"-14x2-1/2"	Headless Bolts to Guide Transmission onto Bellhousing

Fig. 7-694—Tools

CLUTCH

31 THROUGH 66 SERIES

CONTENTS OF SECTION

Subject	Page
MAINTENANCE RECOMMENDATIONS	7-634
DESCRIPTION	7-634
MAINTENANCE AND ADJUSTMENTS	7-634
CLUTCH LINKAGE	7-634
MINOR SERVICE OPERATIONS	7-635
CLUTCH ASSEMBLY	
REMOVAL	7-635
INSTALLATION	7-635
DIAGNOSIS	7-637
SPECIFICATIONS	7-638

MAINTENANCE RECOMMENDATIONS

The clutch release bearing is a prepacked sealed unit which requires no periodic lubrication. The clutch linkage should be lubricated at each lubrication period with engine oil. The clutch pedal free travel should be checked whenever the car is in the service area. Free travel should be 3/4" to 1".

DESCRIPTION

A single plate, dry disc-type clutch is used on all series cars with manual transmissions. The clutch assembly consists of the clutch driven plate assembly, the clutch cover and pressure plate assembly and the clutch release mechanism.

The driven plate incorporates a damper assembly in the hub to prevent the transmitting of vibration from the engine to the transmission. Grooves on both sides of the clutch plate lining prevent the sticking of the plate to the flywheel and pressure plate due to vacuum between the members.

The clutch pressure plate is of the disc spring type. The L-6, V-8 and V-8 special duty clutch pressure plates differ in size and spring load. There is an overcenter effect inherent in the action of the disc spring itself. This eliminates the need for an overcenter assist spring.

Pressure plate spring pressure forces the driven plate against the flywheel, thereby coupling the engine to the transmission.

The clutch release mechanism consists of a ball thrust bearing, appropriate levers and linkage to manually control the action of the bearing. When pressure is applied to the clutch pedal to release the clutch, the clutch release yoke pivots on its ball socket. The inner end then pushes the release bearing forward so that it presses against the inner ends of the clutch release levers, releasing the clutch. Pedal effort is transmitted by the pedal to the equalizer assembly and thence through the clutch release yoke.

MAINTENANCE AND ADJUSTMENTS

CLUTCH LINKAGE (Figs. 7-701 and 7-702)

1. Check for worn linkage, broken or disconnected pedal return spring.
2. Lubricate with engine oil as required.

Clutch Pedal Free Travel Adjustment

1. Check the free travel of clutch pedal. If necessary to adjust, proceed as follows:
   a. Loosen locknut on adjusting rod and remove swivel retainer.
   b. Adjust swivel to obtain proper clutch pedal free travel of 3/4" to 1".

Install retainer in swivel before checking the pedal free travel.

2. Tighten swivel locknut and recheck adjustment.

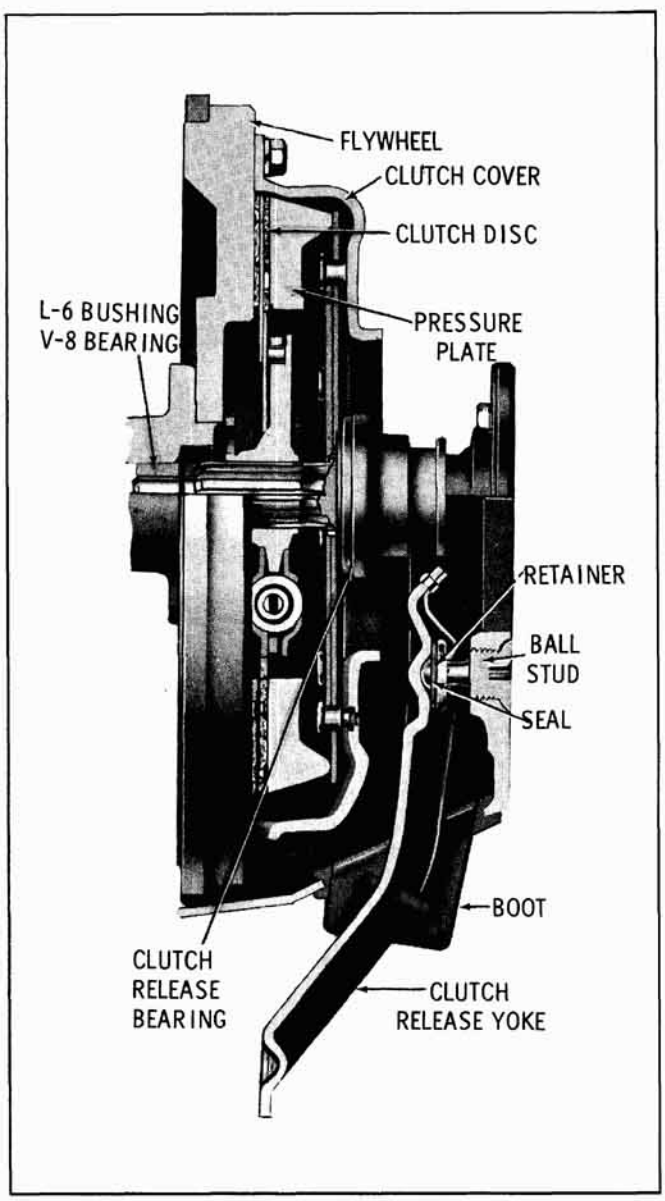


Fig. 7-700—Clutch Assembly

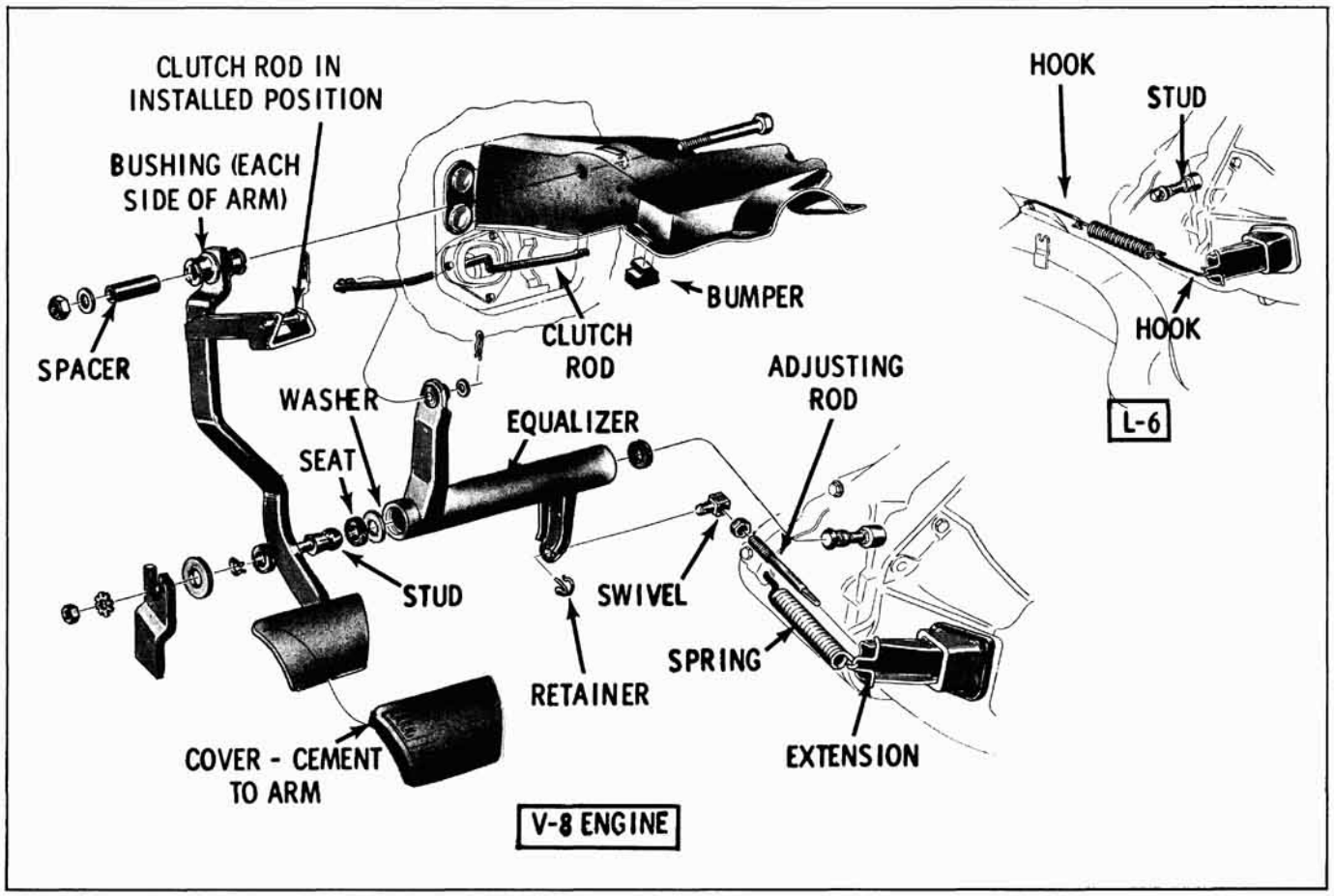


Fig. 7-701—31 thru 48 Series Clutch Linkage

MINOR SERVICE OPERATIONS

CLUTCH PEDAL (54 Through 66 Series)

Remove

1. Disconnect the clutch rod at the clutch pedal.
2. Remove pedal shaft nut, washer and sleeve.
3. Slide the clutch pedal off the shaft.

Install

1. Reverse removal procedure.
2. Check and adjust clutch pedal free travel if necessary.

31 Through 48 Series

Remove

1. Disconnect the clutch rod at the clutch pedal.
2. Remove pedal shaft retainer.
3. Disconnect speedometer cable from speedometer head.
4. Slide the clutch pedal and shaft assembly from the bracket.

Install

1. Reverse removal procedure.
2. Check and adjust clutch pedal free travel, if necessary.

CLUTCH ASSEMBLY, RELEASE BEARING, RELEASE YOKE, AND BALL STUD

Removal

1. Remove transmission.
2. Disconnect the clutch return spring and clutch rod assembly.
3. Remove the clutch release bearing. (Fig. 7-703)
4. Remove flywheel housing leaving starter attached to engine. Release yoke and ball stud will remain with housing. The clutch release yoke, boot and ball stud are accessible for service. (Fig. 7-704)
5. Scribe an "X" mark on the flywheel opposite the "X" on the cover. The cover is marked "X" for balance purposes. (Fig. 7-705)
6. Loosen pressure plate attaching bolts evenly approximately one turn at a time.

DO NOT LUBRICATE splines as the lubricant will be forced into the dampener friction surfaces by centrifugal force and clutch rattle can occur.

Installation

1. V-8 - Inspect clutch pilot bearing and replace if necessary. L-6 - Lubricate pilot bushing with wheel bearing grease.

If necessary to replace pilot bearing or bushing, refer to ENGINE, Section 6 for procedure.

2. Install clutch disc (Fig. 7-706) and clutch cover assembly, being careful to align "X" marks. Install attaching bolts finger tight.
3. Place an old drive gear in disc and into pilot bearing to align disc. Tighten clutch cover assembly as follows:
   a. Tighten 3 bolts in holes marked "L" until cover assembly is within 1/4" of flywheel.
   b. Tighten next 3 bolts until cover assembly is within 1/4" of flywheel.
   c. Tighten 3 bolts in holes marked "L" to 17 ft. lbs.
   d. Tighten remaining 3 bolts to 17 ft. lbs.
4. Remove old drive gear, lubricate the internal groove of

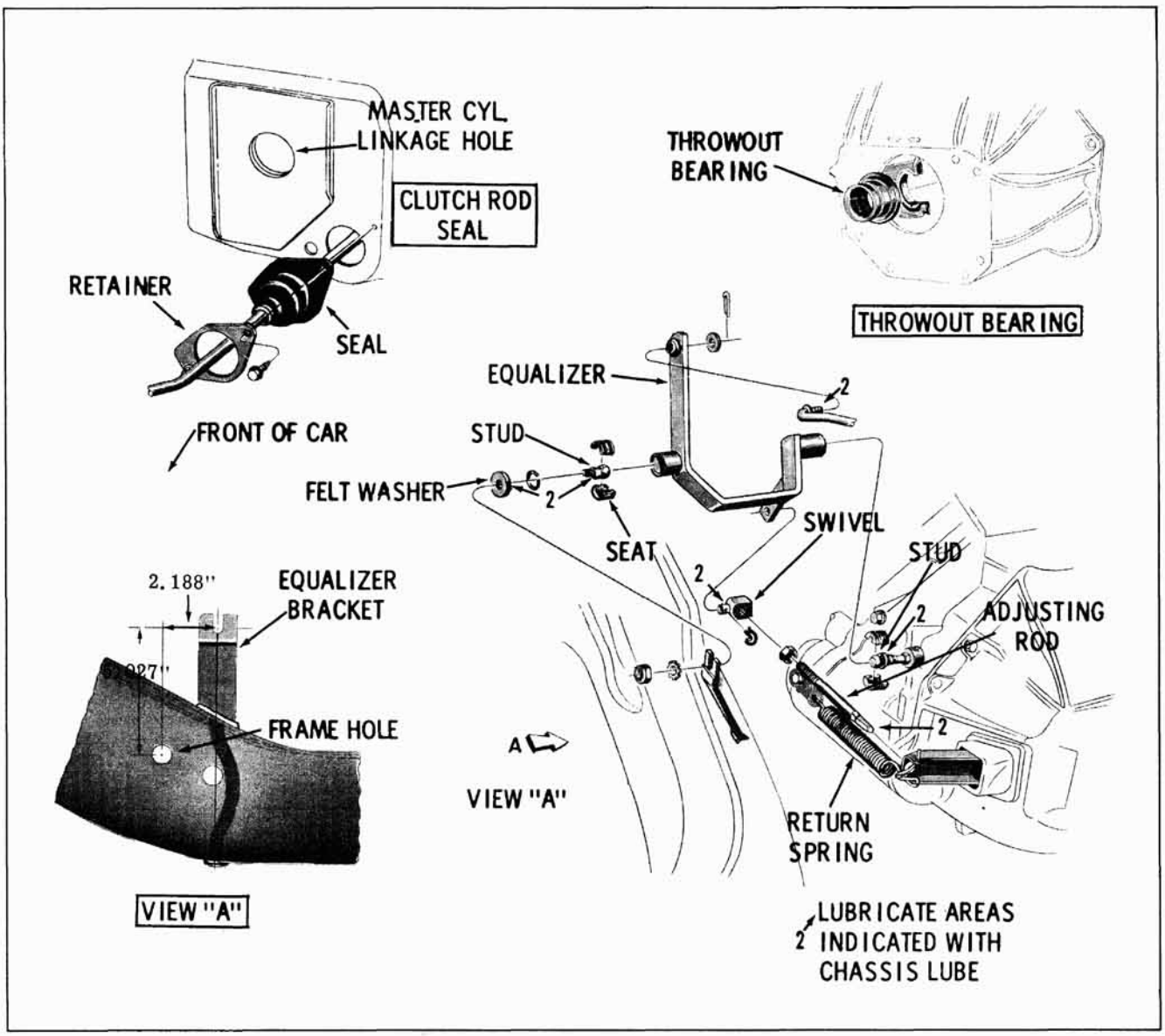


Fig. 7-702—54 thru 66 Series Clutch Linkage

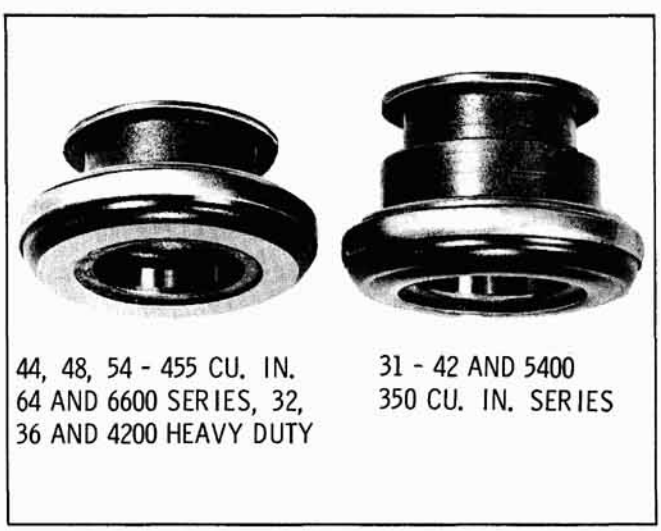


Fig. 7-703—Clutch Release Bearing Identification

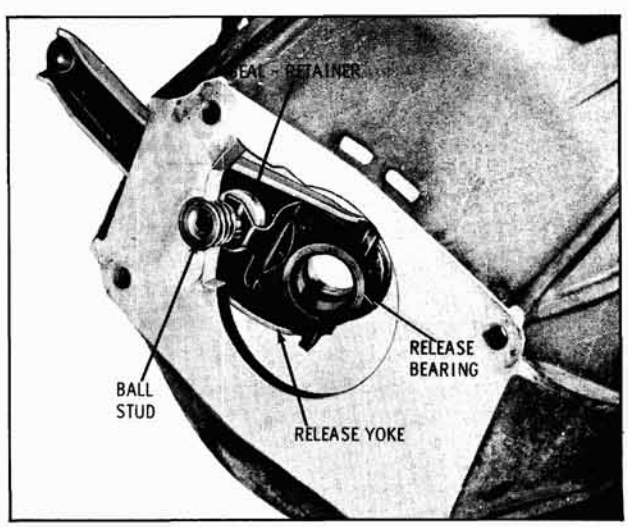


Fig. 7-704—Clutch Release Bearing

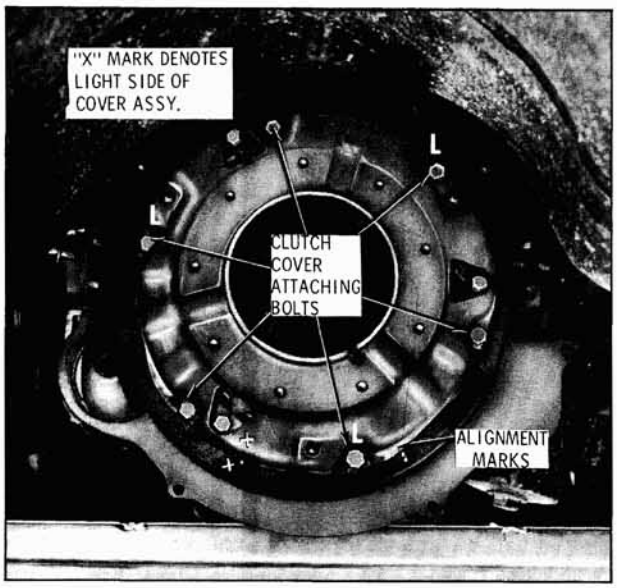


Fig. 7-705—Clutch Cover Alignment

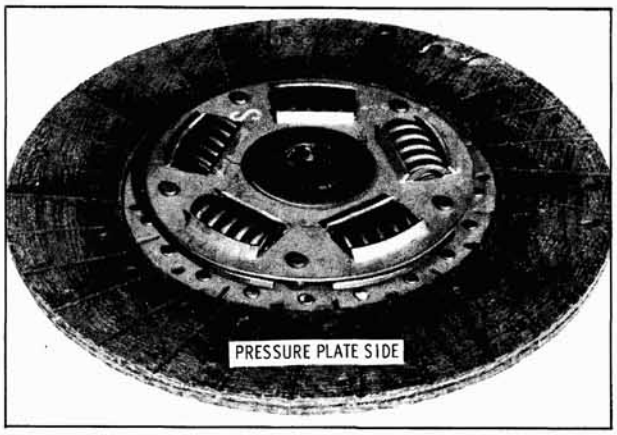


Fig. 7-706—Clutch Disc Installation

the release bearing and the release yoke ball stud with wheel bearing grease and install bearing.

5. Install flywheel housing and transmission. Connect and adjust linkage.

CLUTCH TROUBLE DIAGNOSIS

CONDITION AND CAUSE	CORRECTION
Fails to Release (Pedal Pressed to Floor— Shift Lever Does Not Move Freely In and Out of Reverse Gear)	
a. Improper linkage adjustment.	a. Adjust linkage.
b. Improper pedal travel.	b. Trim bumper stop and adjust linkage.
c. Loose linkage.	c. Replace as necessary.
d. Faulty pilot bearing.	d. Replace bearing.
e. Faulty driven disc.	e. Replace disc.
f. Fork off ball stud.	f. Install properly and lubricate fingers at throw-out bearing with wheel bearing grease.
g. Clutch disc hub binding on clutch gear spline.	g. Repair or replace clutch gear.
h. Clutch disc warped or bent.	h. Replace disc (runout should not exceed .025").
Slipping	
a. Improper adjustment (no lash).	a. Adjust linkage.
b. Oil soaked driven disc.	b. Install new disc and correct oil leak at its source.
c. Worn facing or facing torn from disc.	c. Replace disc.
d. Warped pressure plate or flywheel.	d. Replace same.
e. Weak diaphragm spring.	e. Replace pressure plate.
f. Driven plate not seated in.	f. Make 30 to 40 normal starts.
g. Driven plate overheated.	g. Allow to cool - check lash.
Grabbing	
a. Oil on facing or burned or glazed facings.	a. Install new disc.
b. Worn splines on clutch gear.	b. Replace transmission clutch gear.
c. Loose engine mountings.	c. Tighten or replace mountings.
d. Warped pressure plate or flywheel.	d. Replace pressure plate or flywheel.
e. Burned or smeared resin on flywheel or pressure plate.	e. Sand off if superficial, replace burned or heat checked parts.
Rattling—Transmission Click	
a. Weak retracting springs.	a. Replace pressure plate.
b. Throw-out fork loose on ball stud or in bearing groove.	b. Check ball stud and retaining spring and replace if necessary.
c. Oil in driven plate damper.	c. Replace driven disc.
d. Driven plate damper spring failure.	d. Replace driven disc.

DIAGNOSIS (CONT'D.)

CONDITION AND CAUSE	CORRECTION
Throw-Out Bearing Noise with Clutch Fully Engaged	
a. Improper adjustment. No lash. b. Throw-out bearing binding on transmission bearing retainer. c. Insufficient tension between clutch fork spring and ball stud. d. Fork improperly installed. e. Weak linkage return spring.	a. Adjust linkage. b. Clean, relubricate, check for burrs, nicks, etc. c. Replace fork. d. Install properly. e. Replace spring.
Noisy	
a. Worn throw-out bearing. b. Fork off ball stud (heavy clicking).	a. Replace bearing. b. Install properly and lubricate fork fingers at bearing.
Pedal Stays on Floor When Disengaged	
a. Bind in linkage. b. Springs weak in pressure plate.	a. Lubricate and free up linkage. b. Replace pressure plate.
Hard Pedal Effort	
a. Bind in linkage. b. Driven plate worn.	a. Lubricate and free up linkage. b. Replace driven plate.

CLUTCH SPECIFICATIONS

DISC FACINGS

Diameter - Outside

31-35 Series	9.12"
32-36-42-48-54 Series	10.40"
42-48-64-66 Series and H.D.	11.00"

Thickness - Inside Disc

All Series	.135"

Thickness - Outside Disc

31-32-35-36-42-48-54 Series	.135"
44-64-66 Series and H.D.	.150"

Hub Dimensions	1-1/8"-10 Spline

TORQUE SPECIFICATIONS

CLUTCH

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

APPLICATION	FT. LBS.
Clutch Cover	17
Flywheel Housing to Block	30
Ball Stud Equalizer to Engine	28
Ball Stud Equalizer to Frame	22
Clutch Release Fork Ball Stud	45
Cross Support Bar Brackets to Frame	35
Transmission Mount to Cross Support Bar	50
Shift Equalizer Rod to Transmission	18
Propeller Shaft U-Bolt Nuts	14
Clutch Pedal Pivot Bolt Nut	20

FUEL TANK AND EXHAUST

31 THROUGH 86 SERIES

CONTENTS OF SECTION 8

Subject	Page
FUEL	8-1
DESCRIPTION	8-1
FUEL GAUGE TANK UNIT	8-3
DRAINING FUEL TANK	8-3
FUEL TANK REMOVAL	8-4
FUEL LINE REPAIR	8-4
EXHAUST SYSTEM	8-5
TORQUE SPECIFICATIONS	8-8

FUEL SYSTEM

DESCRIPTION (Figs. 8-1 through 8-3)

All 31 through 48 Series fuel tanks have a capacity of 20 gallons and all 54 through 86 Series have a capacity of 25 gallons. The filler cap is located behind the license plate on all models except station wagons. On station wagons, the filler cap is located in the left quarter panel.

On 31 through 86 Series, except station wagons venting is provided by two hoses routed up to and ending behind the right rear coil spring seat. Station wagons will use a vented filler cap.

The tank units on all models have a Saran fuel filter on the end of the suction pipe which prevents entry of dirt or water into the fuel lines. Two different tank units are used on the 31 through 48 Series; one unit for the 350 cu. in. engine and one unit for the 400 cu. in. engine. Two different tank units are used on the 54 through 86 Series; one unit has a fuel return and the other unit does not.

The 350 cu. in. engine does not have a fuel return system, regardless of equipment. All 400 cu. in. engines use a fuel return system, regardless of equipment. The 455 cu. in. engines will have a fuel return pipe if equipped with air conditioning.

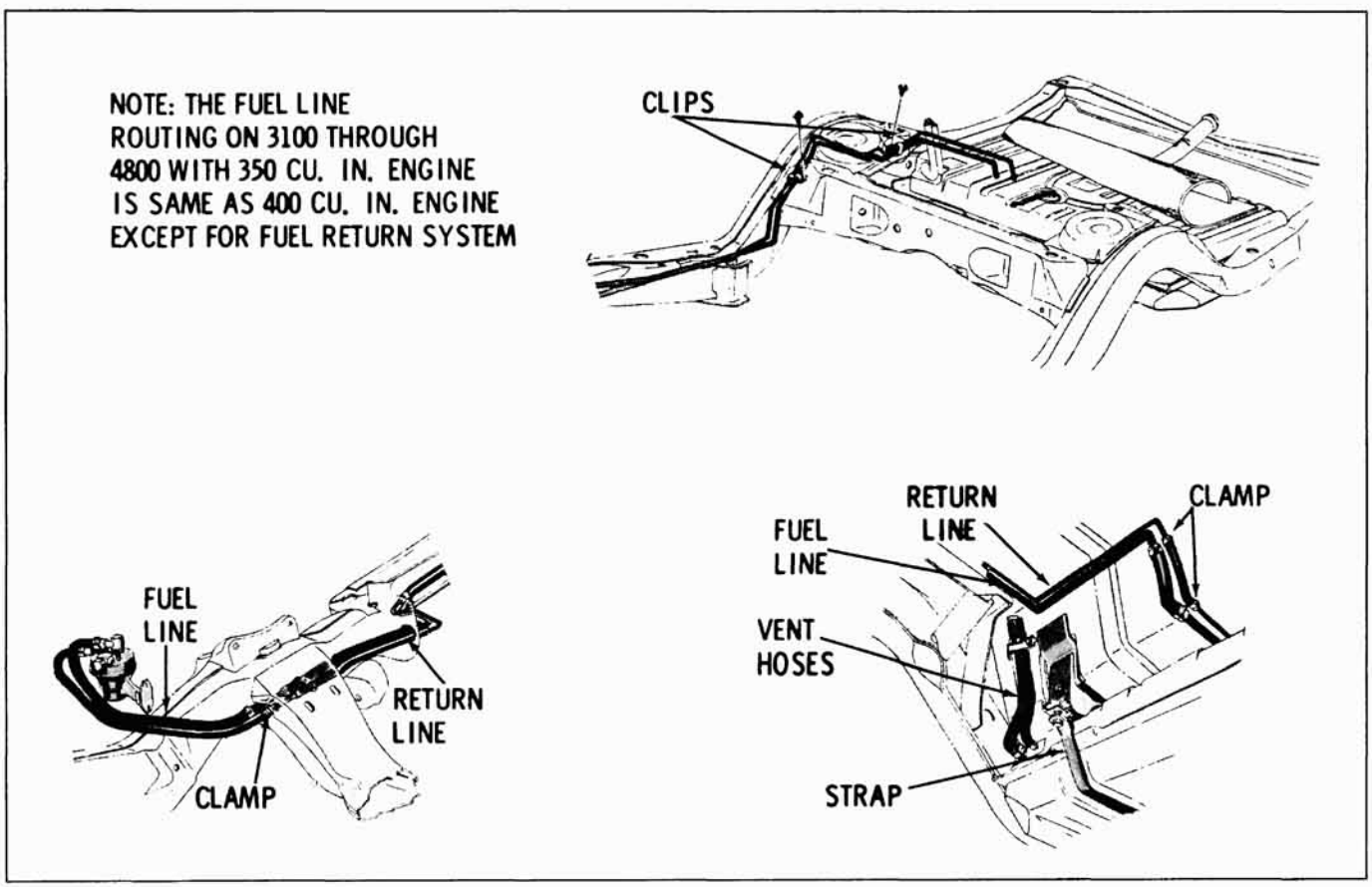


Fig. 8-1—Fuel System 400 Cu. In. Engine Exc. Station Wagon

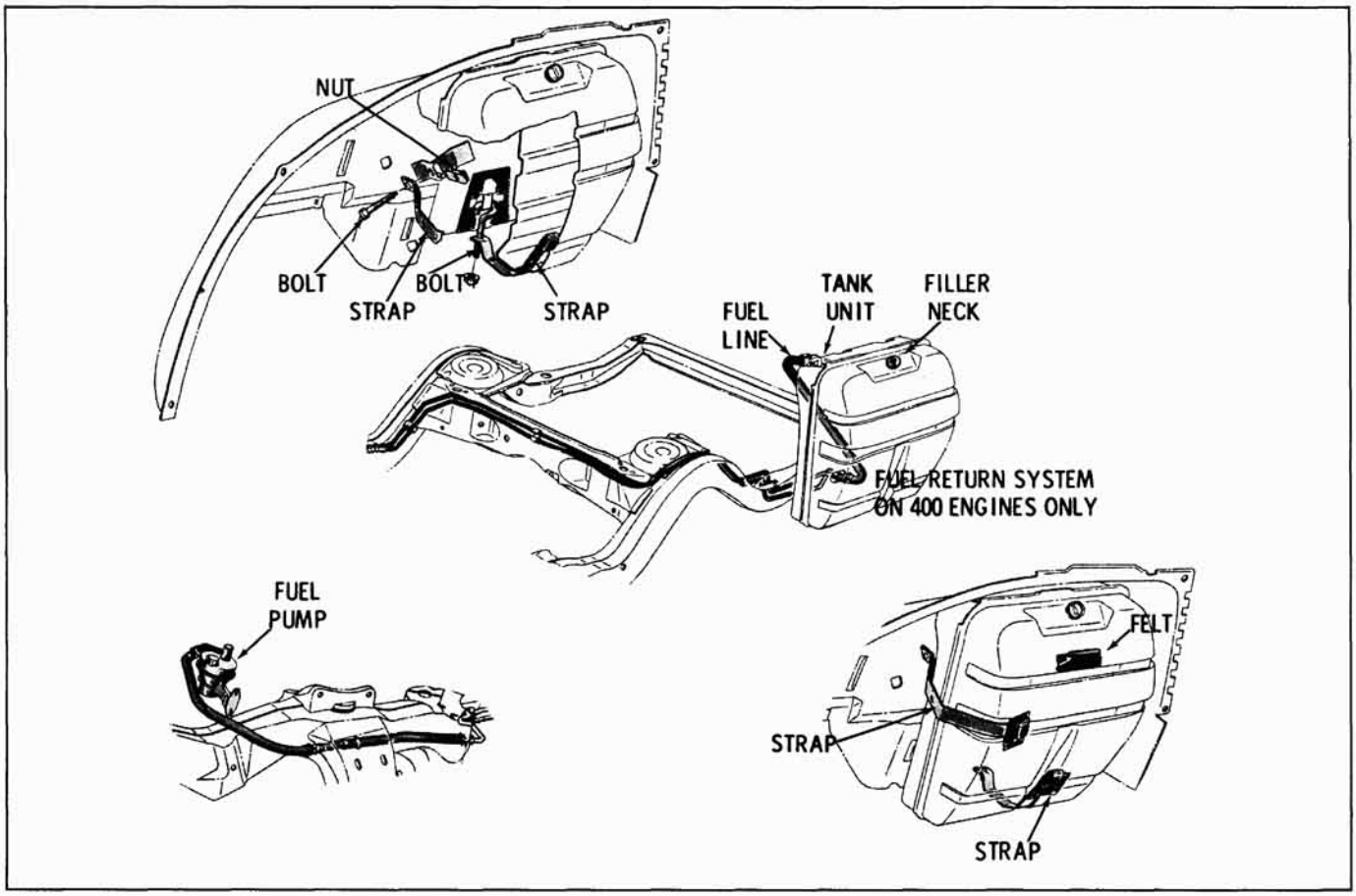


Fig. 8-2—Fuel System Station Wagon and Vista Cruiser

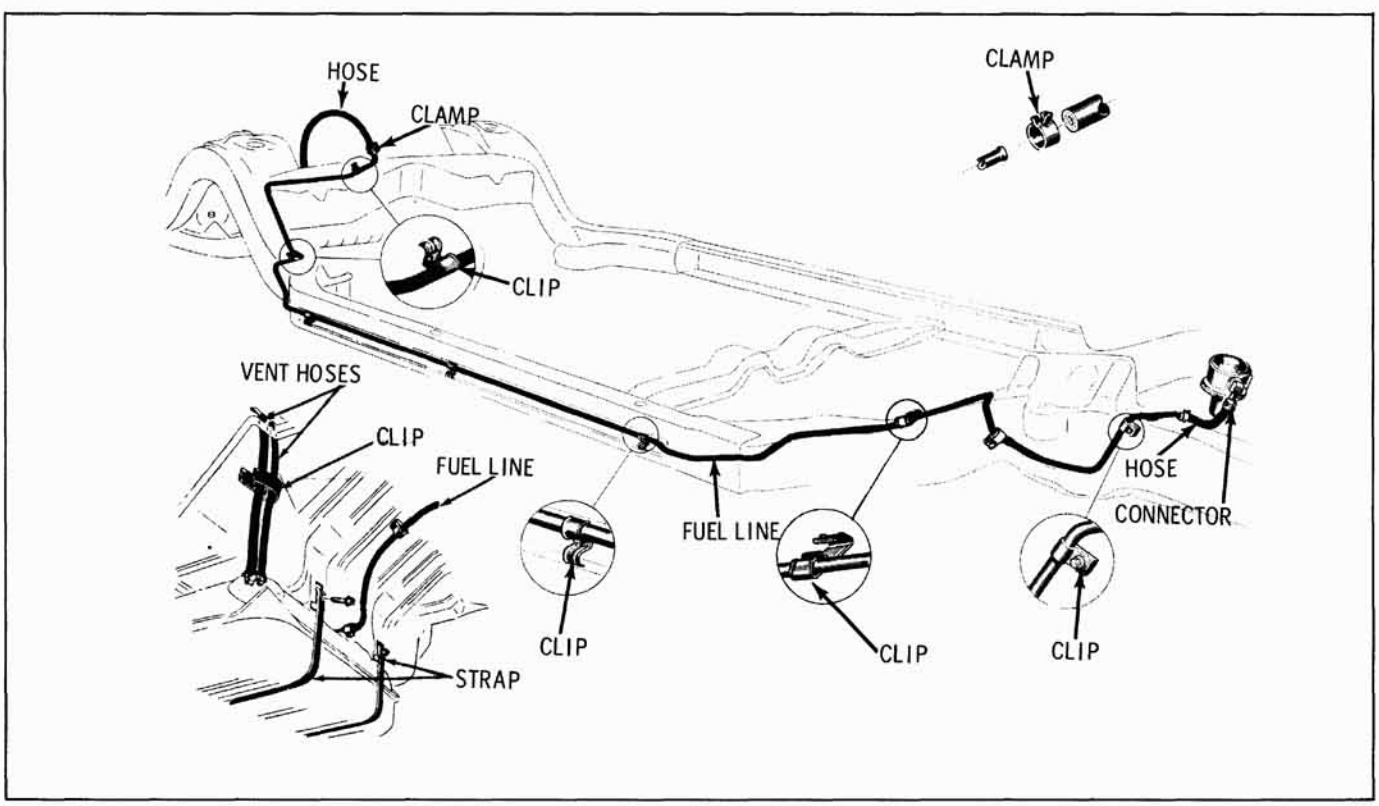


Fig. 8-3—Fuel System 54 thru 86 Series Without Fuel Return

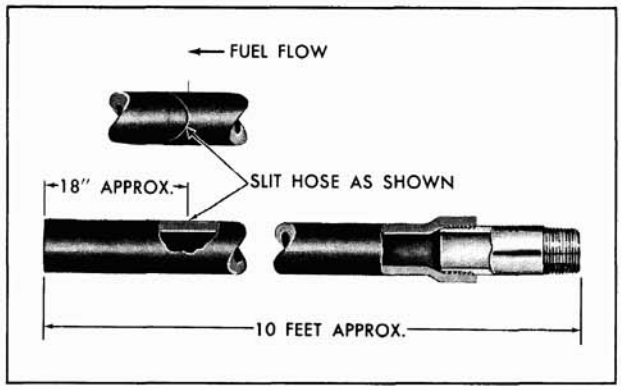


Fig. 8-4—Fuel Tank Drain Hose

The fuel tank on all 54 through 86 Series is designed with a single baffle running laterally through the tank. The tank used on all 31 through 44 Series does not contain a baffle. On 31 through 44 Series, except station wagons, an insulation pad is used between the fuel tank and body. The station wagon does not use a pad between the fuel tank and body.

FUEL TANK

Draining Fuel Tank

If a car is to be stored for any appreciable length of time, the gasoline should be drained from the complete system, including carburetor, fuel pump, all fuel lines and fuel tank in order to prevent gum formations and resultant improper engine performance.

1. Using approximately 10 feet of 3/8" ID hose, cut a slit 18" from one end. Make the slit towards the short end. (Fig. 8-4)
2. Insert a pipe nipple into the opposite end of the hose.
3. Insert the nipple end of the hose into the tank until the nipple rests on the bottom of the tank.
4. Insert an air hose in the downward position into the slit. A short blast of air will cause the fuel to flow.

The tank can be siphoned rapidly by raising the car several feet higher in the front than the rear.

FUEL GAUGE TANK UNIT

For checking and testing of fuel gauges, refer to ELECTRICAL, Section 12.

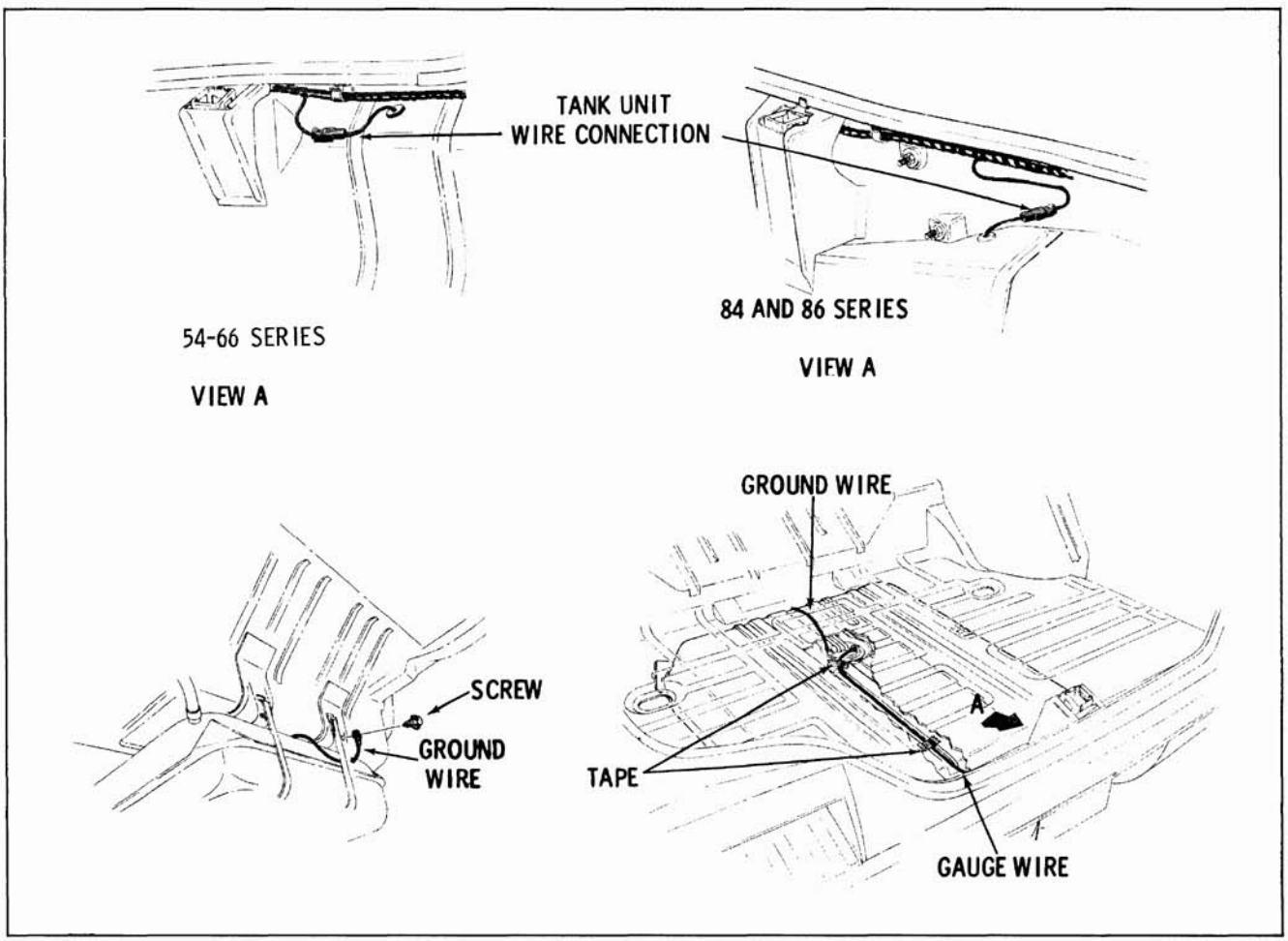


Fig. 8-5—Tank Unit Wiring Connections 54 thru 86 Series

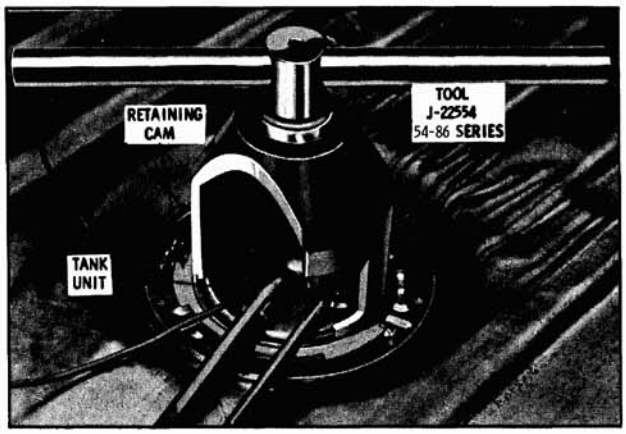


Fig. 8-6—Tank Unit Removal and Installation 54 thru 86 Series

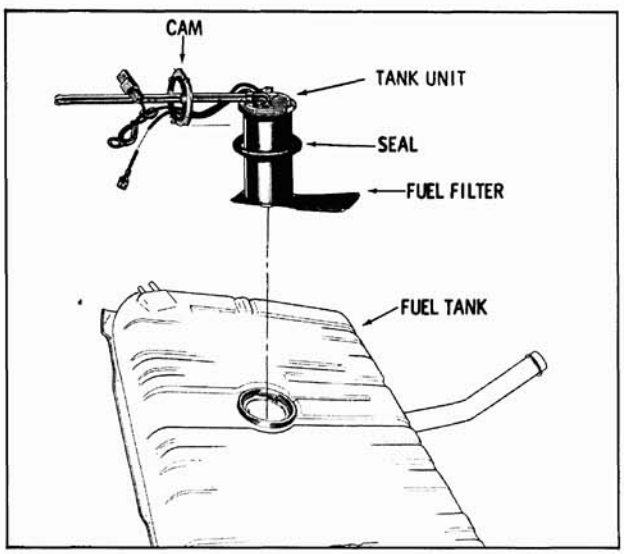


Fig. 8-7—Installing Tank Unit 54 thru 86 Series

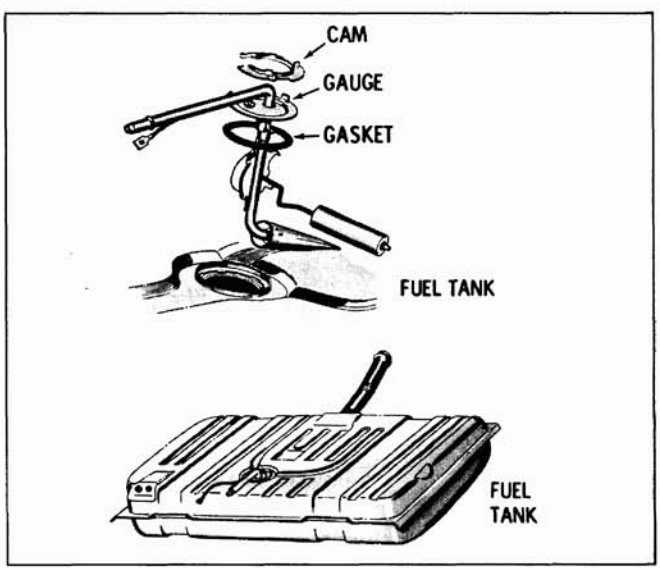


Fig. 8-8—Installing Tank Unit 31 thru 44 Series Except Station Wagon

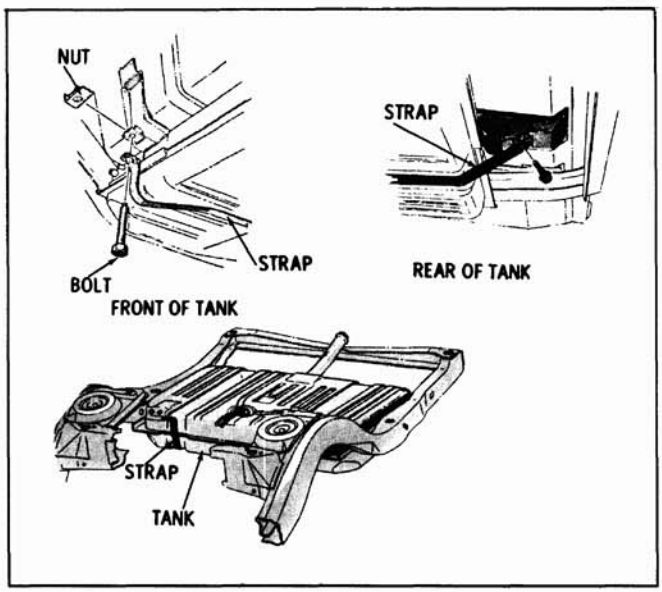


Fig. 8-9—Fuel Tank Installation 31 thru 44 Series Exc. S.W.

REMOVAL OF TANK AND TANK UNIT

3100 Through 8600 Series (Except Station Wagon)

1. Drain tank.
2. Disconnect tank unit wire from connector in rear compartment. (Fig. 8-5)
3. Remove ground wire retaining screw from underbody. (Fig. 8-5)
4. Remove vent hoses from retaining clip. (Fig. 8-3)
5. Disconnect fuel hose from tank unit.
6. Support fuel tank and disconnect the two fuel tank retaining straps.
7. Remove tank from car.
8. Remove fuel gauge retaining cam using Tool J-21518. (Fig. 8-6) For 31 thru 44 Series except wagons and J-22554 for 54 thru 86.
9. Remove tank unit from tank.

Installation

1. Reverse removal procedure. (Fig. 8-7 and 8-8)
2. Tighten fuel tank retaining strap nuts to 9 ft. lbs. (Fig. 8-9)

Removal (Station Wagon and Vista Cruiser)

1. Drain fuel tank. (Fig. 8-2)
2. Raise vehicle.
3. Remove gas tank shield at the back of the left rear wheel; remove all (5) screws.
4. Disconnect fuel line and gauge wires from tank unit.
5. Remove strap assembly nut and carefully lower tank.

It may be necessary to disconnect tail pipe hanger for clearance

6. Remove tank unit retaining cam using Tool J-21518.
7. Remove tank unit from tank.

Installation (Station Wagons and Vista Cruiser)

1. Reverse removal procedure. (Fig. 8-10)
2. Tighten bolts on fuel tank retaining straps to 8 to 10 ft. lbs. (Fig. 8-3)

FUEL AND FUEL RETURN LINE REPAIR PROCEDURE

1. Cut out damaged portion of fuel line.

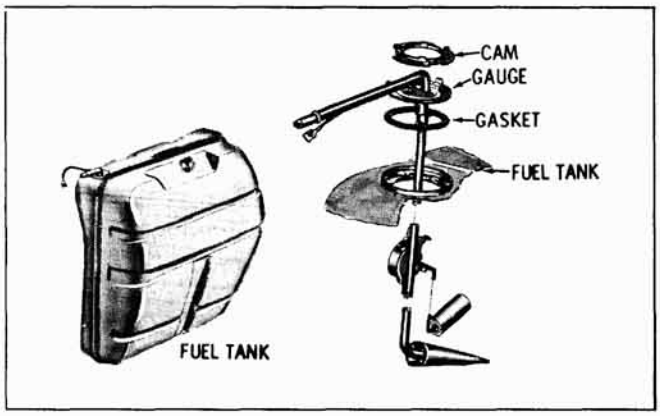


Fig. 8-10—Installing Fuel Tank Unit Station Wagon and Vista Cruiser

2. Cut a piece of hose 4" longer than portion of line removed.

Fuel hose is 3/8" ID. and fuel return hose is 1/4" ID.

3. Slide clamps onto pipe and push hose 2" onto each portion of fuel pipe.
4. Clamp hose to pipe on each side of repair.

EXHAUST SYSTEM

DESCRIPTION (Figs. 8-15 through 8-21)

Periodic maintenance of the exhaust system is not required; however, if the car is raised for other service, it is advisable to check that the drain holes in the mufflers and resonators are in the down position and open to prolong their life.

The exhaust system is suspended by hangers attached to the frame members by self-tapping screws along the length of the car. If the attaching screws should become stripped or the screw hole become oversize, new self-tapping hex head screws, 3/8"-16 x 1-1/8", should be used.

Annoying rattles and noise vibrations in the exhaust system are usually caused by misalignment of parts. When aligning the system, it must be remembered that the pipes will become longer when they get hot. The total length can increase as much as 3/4" at the tail pipe.

For servicing the exhaust manifold heat valve, refer to ENGINE, Section 6.

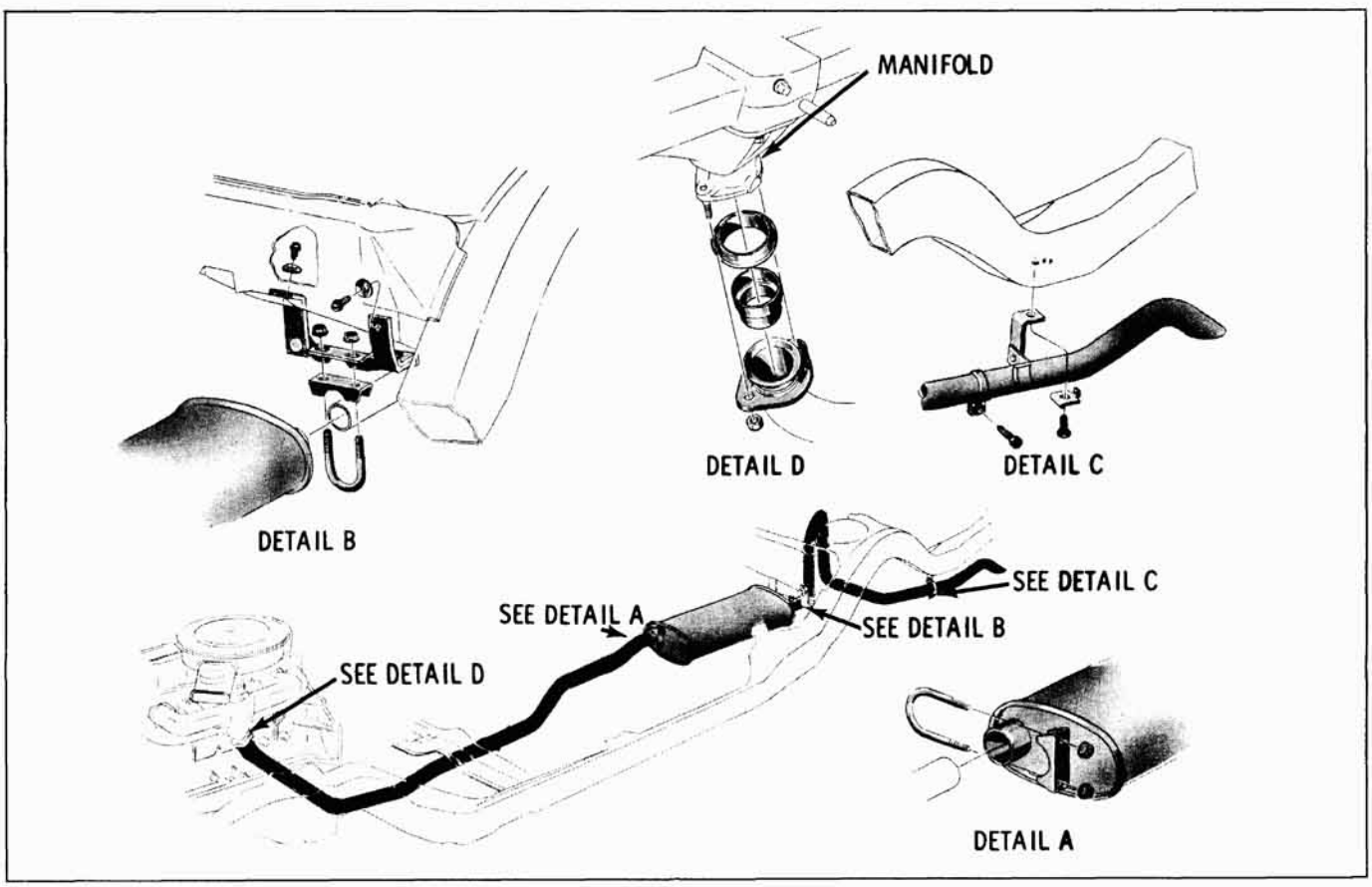


Fig. 8-15—Exhaust System 31 and 35 Series

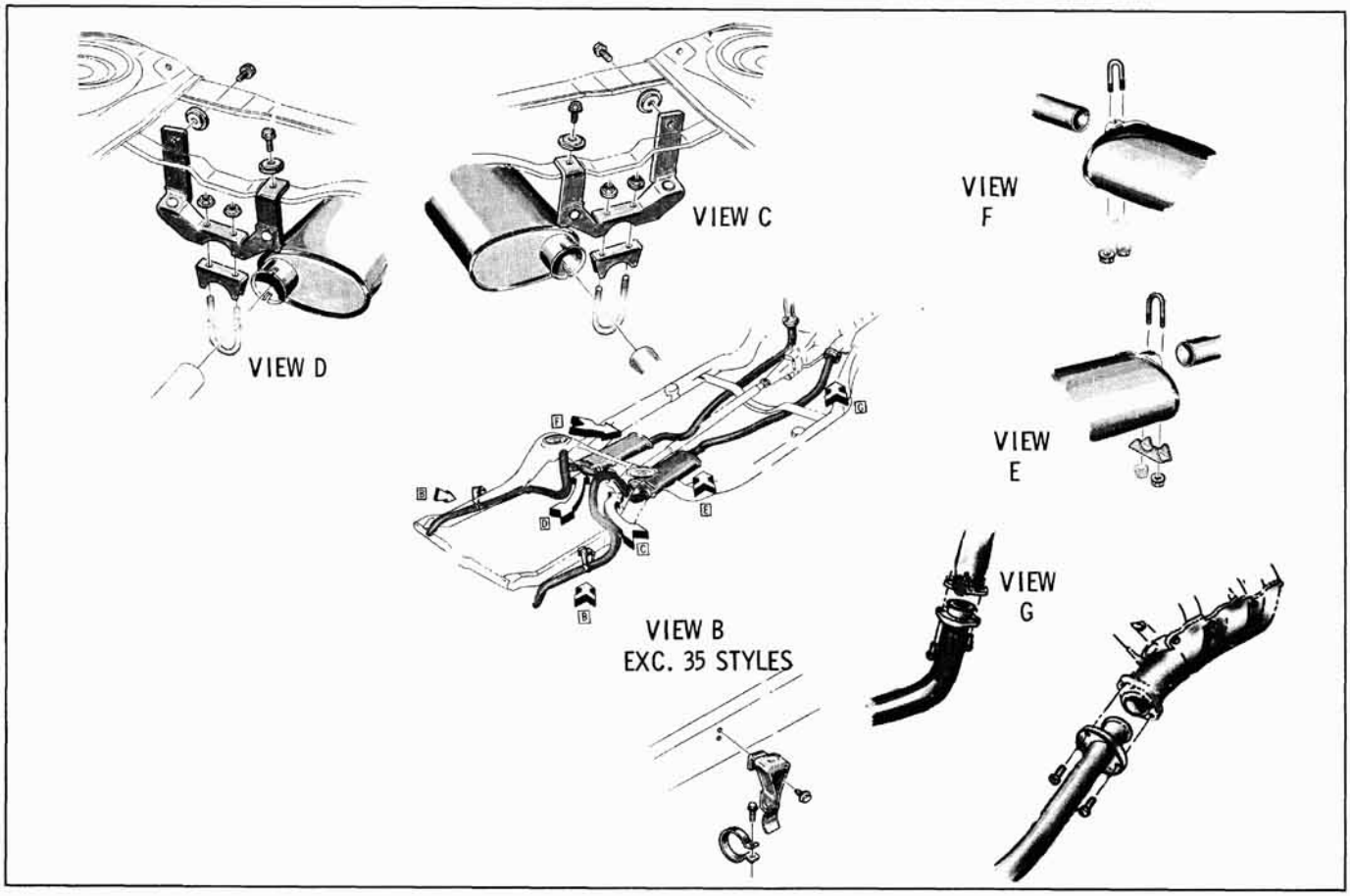


Fig. 8-16—Dual Exhaust System 32, 36 and 42 Series

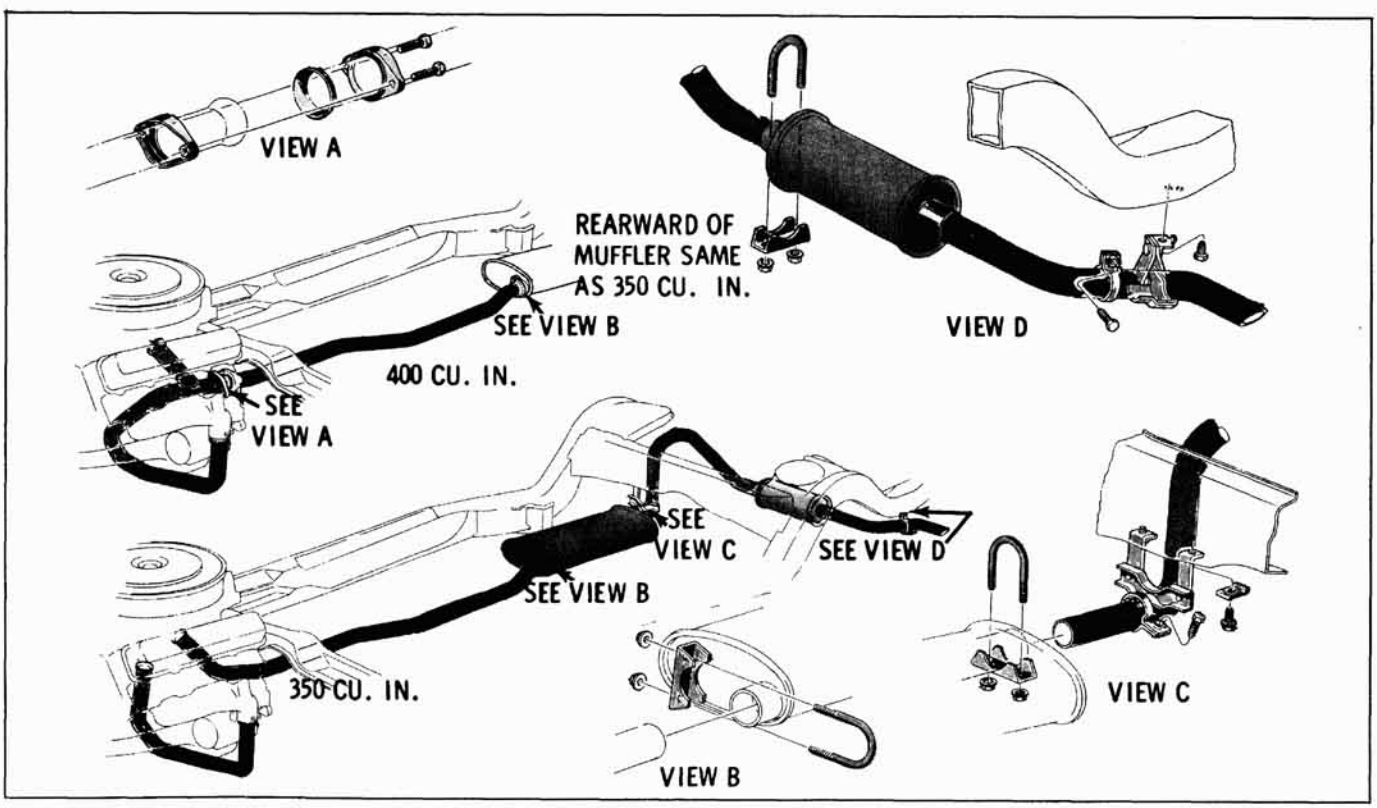


Fig. 8-17—Single Exhaust System 48 Series

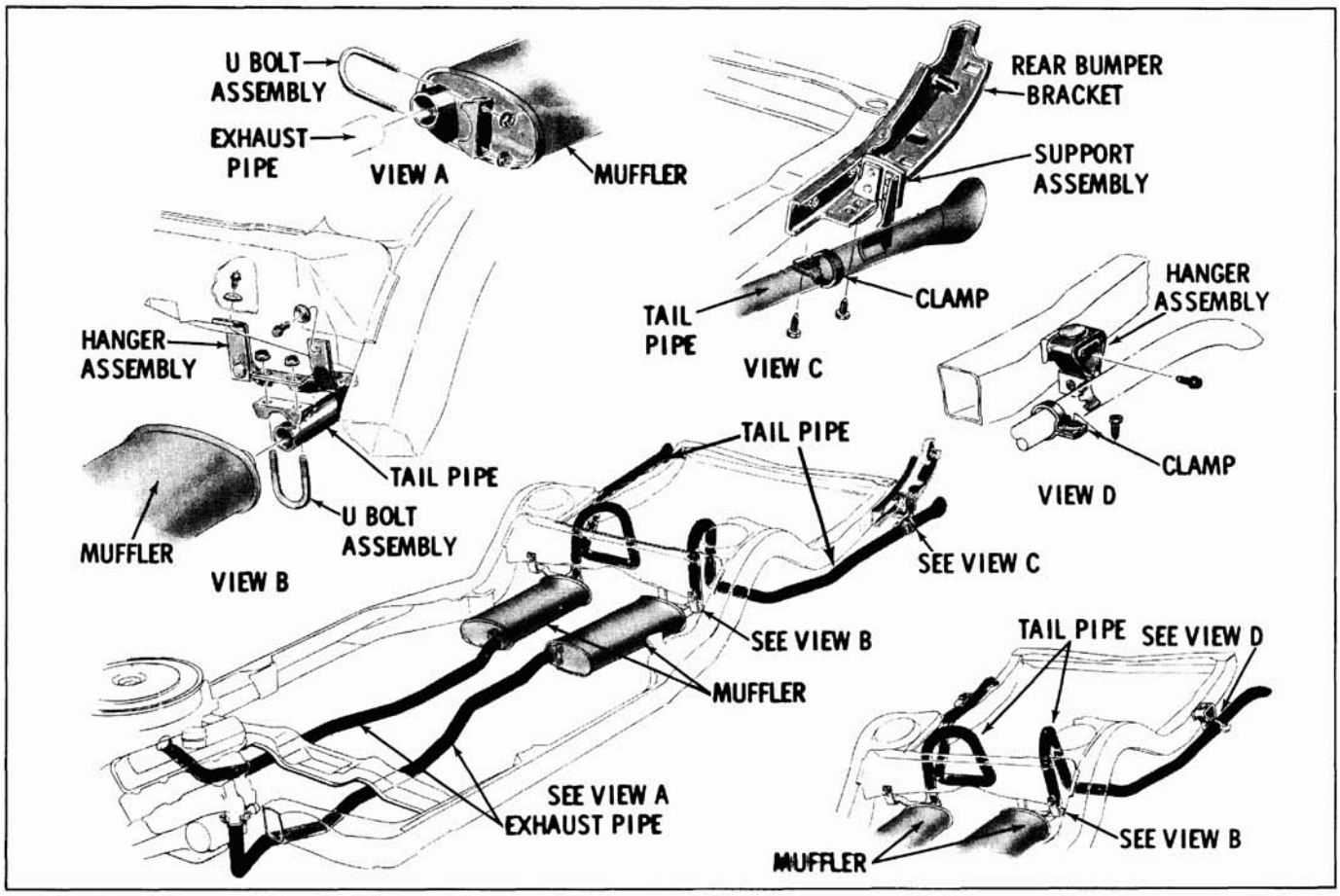


Fig. 8-18—Exhaust System 44 Series

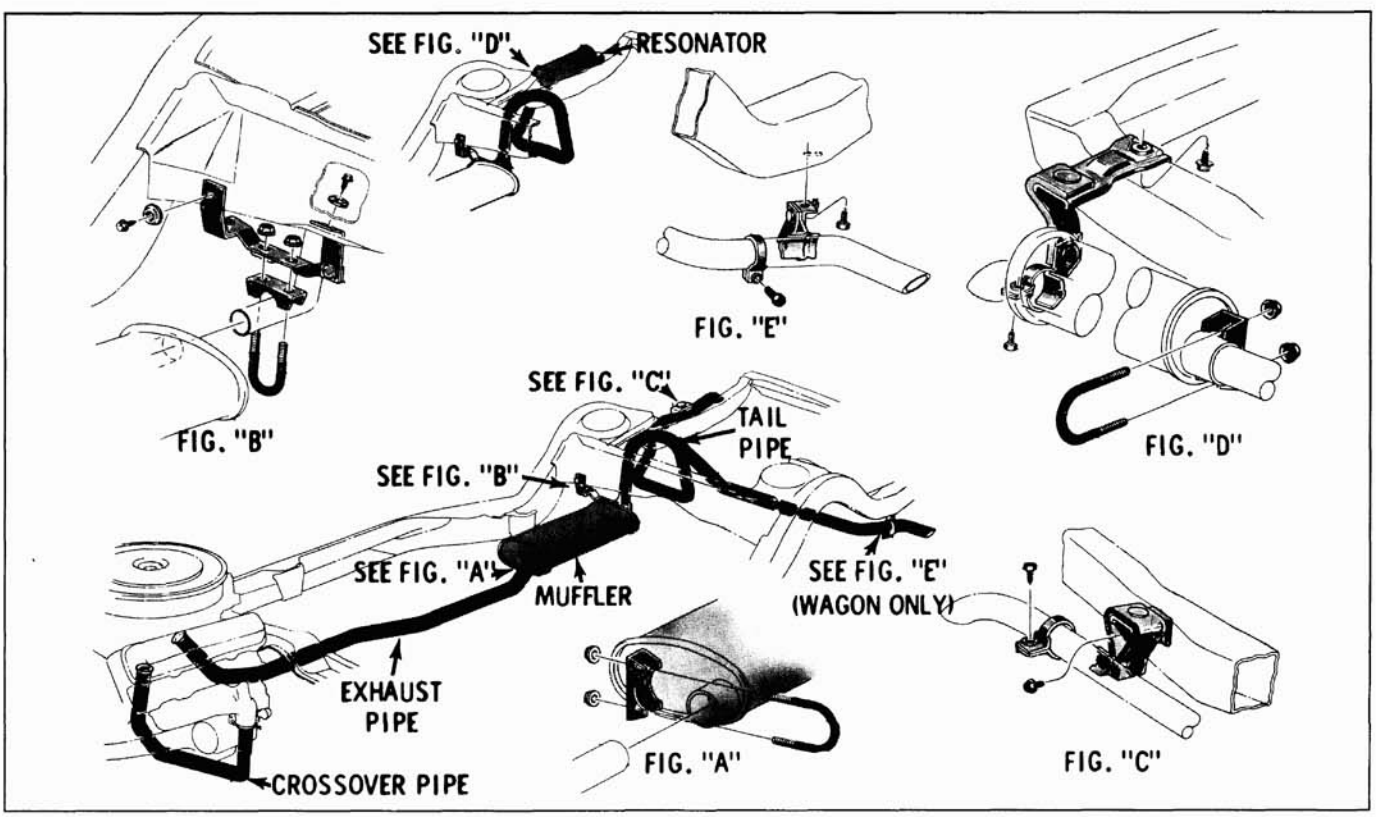


Fig. 8-19—Single Exhaust System 32, 36 and 42 Series

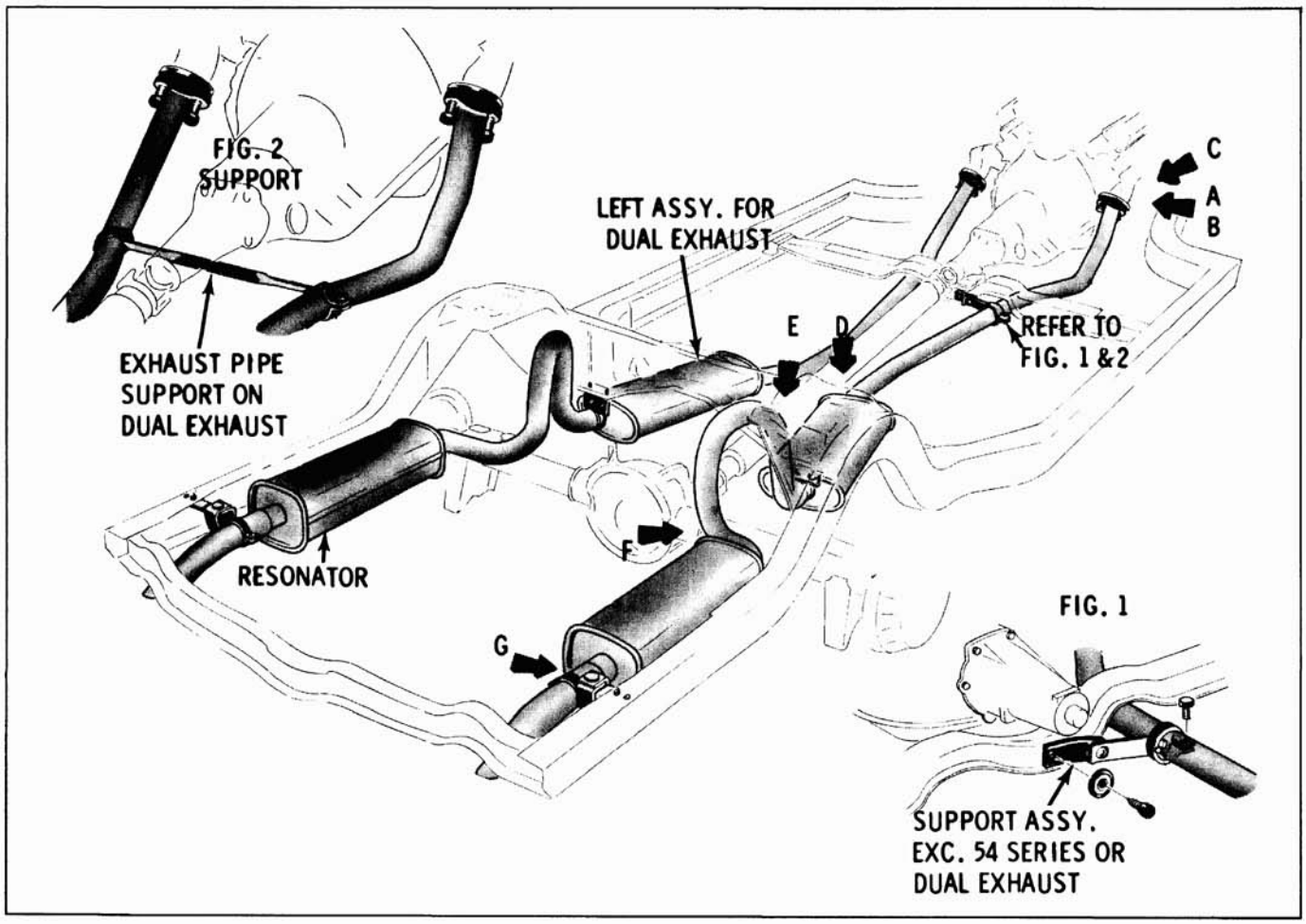


Fig. 8-20—Exhaust System 54-86 Series

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

APPLICATION	TORQUE
Fuel Tank Attaching Nuts (Except Station Wagon)	18 ft. lbs.
Fuel Tank Attaching Nuts (Station Wagon)	9 ft. lbs.
Support Bar Screws	21 ft. lbs.
Clamp Attaching Nuts	13 ft. lbs.
Exhaust Pipe To Exhaust Manifold Attaching Bolts (V-8) Nuts (L-6)	14 ft. lbs.
Resonator To Rear Support Assembly	10 ft. lbs.
Muffler Support To Frame Attaching Screws	7 ft. lbs.

STEERING

(LINKAGE, GEARS AND PUMPS)

(31 THROUGH 86 SERIES)
CONTENTS OF SECTION 9

Subject	Page
PERIODIC MAINTENANCE	9-1
STEERING LINKAGE	9-1
GENERAL INFORMATION	9-1
STEERING LINKAGE	9-1
PITMAN ARM	9-1
LINKAGE JOINTS	9-3
IDLER ARM AND SUPPORT	9-3
TIE RODS	9-3
LINKAGE ADJUSTMENT	9-4
MANUAL STEERING	
ADJUSTMENTS (ON CAR)	9-4
REMOVE AND INSTALL	9-5
DISASSEMBLY	9-6
SERVICING INDIVIDUAL UNITS	9-6
ASSEMBLY	9-7
POWER STEERING PUMP	
MINOR SERVICE OPERATIONS	9-8
BELT ADJUSTMENT	9-8
FLOW CONTROL VALVE	9-8
PUMP SHAFT OIL SEAL	9-9
REMOVAL AND INSTALLATION	9-10
DISASSEMBLY	9-10
CLEANING AND INSPECTION	9-12
ASSEMBLY	9-13
POWER STEERING GEAR	
OPERATION	9-15
NEUTRAL	9-15
RIGHT TURN	9-15
LEFT TURN	9-17
ADJUSTMENT (ON CAR)	9-18
REMOVAL AND INSTALLATION	9-18
DISASSEMBLY	9-18
SERVICING INDIVIDUAL UNITS	
ADJUSTER PLUG	9-21
VALVE AND LOWER SHAFT	9-22
PITMAN SHAFT AND SIDE COVER	9-23
RACK-PISTON	9-24
HOSE CONNECTORS	9-26
ASSEMBLY	9-26
DIAGNOSIS	9-28
GENERAL SPECIFICATIONS	9-31
TORQUE SPECIFICATIONS	9-32
TOOLS	9-33
STEERING WHEELS AND COLUMNS	9A-

PERIODIC MAINTENANCE

Manual steering gear requires checking lubricant at 36,000 miles or 36 months and does not require regular or seasonal changes. When checking remove bolt in side cover at "Check Lube", Fig. 9-10, lubricant should be visible. When necessary to add lubricant, remove bolt "A", Fig. 9-10, and fill gear through bolt hole at "Check Lube" until lubricant is forced from bolt hole "A". Replace bolts and torque to 30 ft. lbs. Use water resistant E.P. Chassis Lubricant.

Power Steering gear lubrication is accomplished by the oil supplied through the gear by the power steering pump. Regular or seasonal changes are unnecessary. Refer to PERIODIC MAINTENANCE, Section 0, for steering linkage lubrication requirements.

STEERING LINKAGE
(Figs. 9-1 and 9-2)

GENERAL INFORMATION

The only steering linkage adjustment is at the tie rod sleeves for the setting of steering wheel spoke alignment and front wheel toe-in.

SUSPENSION AND STEERING LINKAGE CHECK

1. Raise car on one side at frame torque box located directly behind the front wheel so that tire is approximately one inch off the floor.
2. Position dial indicator as shown in Fig. 9-3.
3. Grasp front wheel as shown in Fig. 9-3. With wheels in straight ahead position, move wheel back and forth without moving steering wheel. Gauge reading should not exceed .180".
4. If gauge reading is not within specifications, a check should be made of all suspension and linkage parts.

STEERING GEAR LASH CHECK

1. With the front wheels on the floor and in the straight ahead position, move steering wheel in both directions without moving the front wheels.

If car is equipped with power steering, the engine must be running.

2. If steering gear lash exceeds two inches maximum and/or the gear binds when turning steering wheel from stop to stop, the gear must be adjusted or the cause of the bind corrected.

REPLACEMENT OF STEERING LINKAGE PARTS

PITMAN ARM

To disconnect the pitman arm from the pitman shaft use Tool J-5504-B or a similar puller. Upon assembly, install the pitman arm with the front wheels in the straight ahead position and with the steering wheel at the center of its travel. Torque pitman shaft nut to specifications.

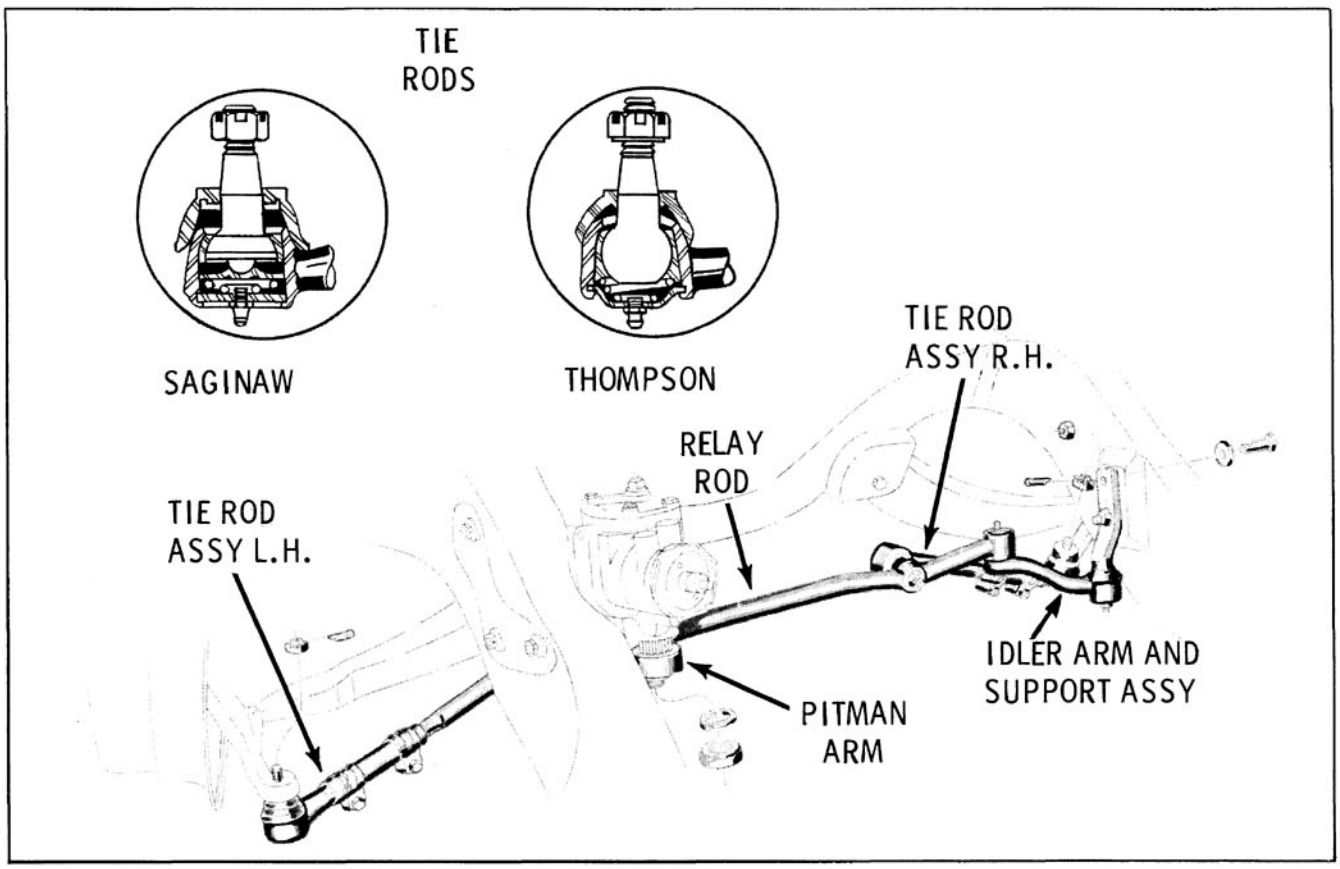


Fig. 9-1—Steering Linkage (54-86 Series)

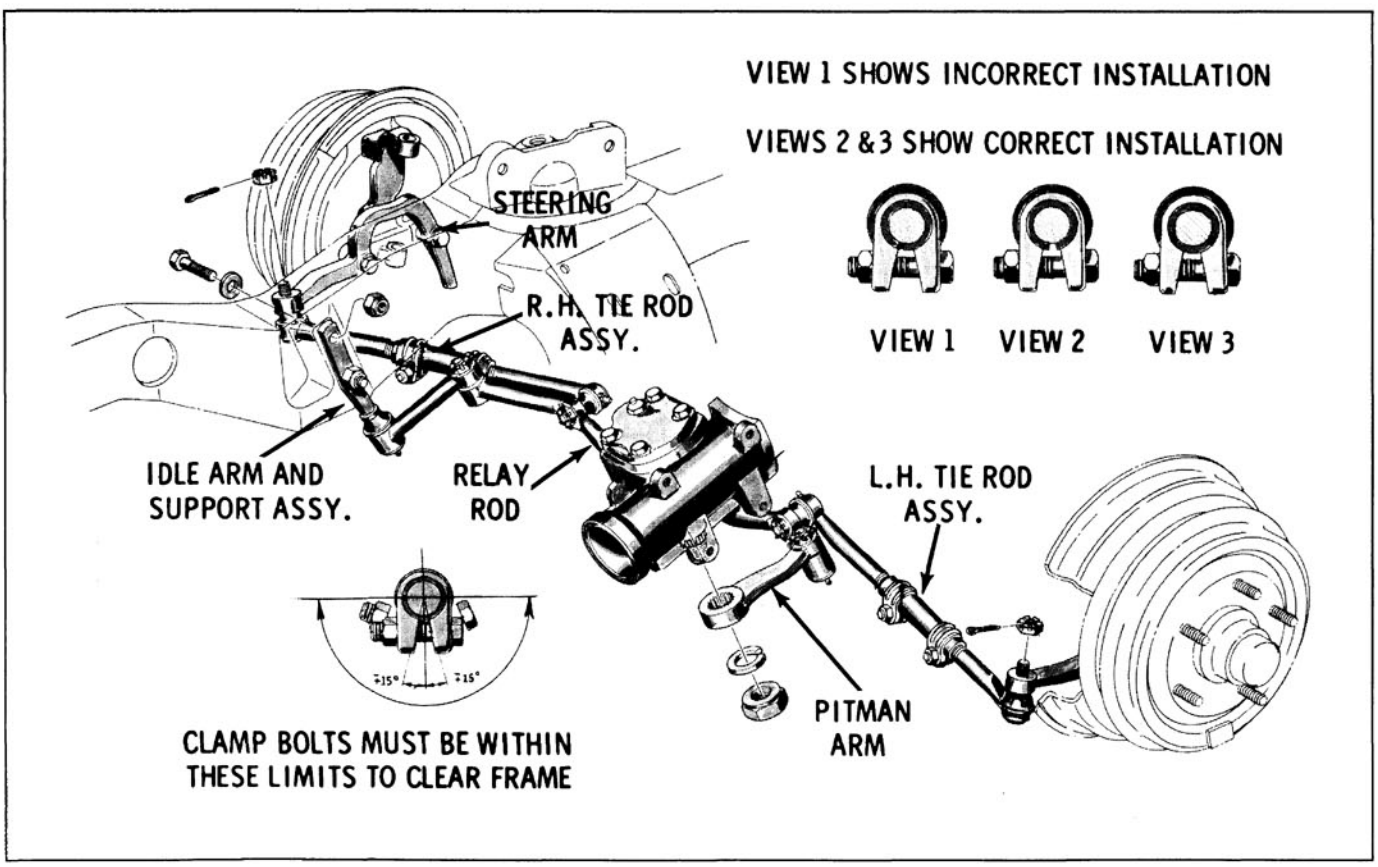


Fig. 9-2—Steering Linkage (31-48 Series)

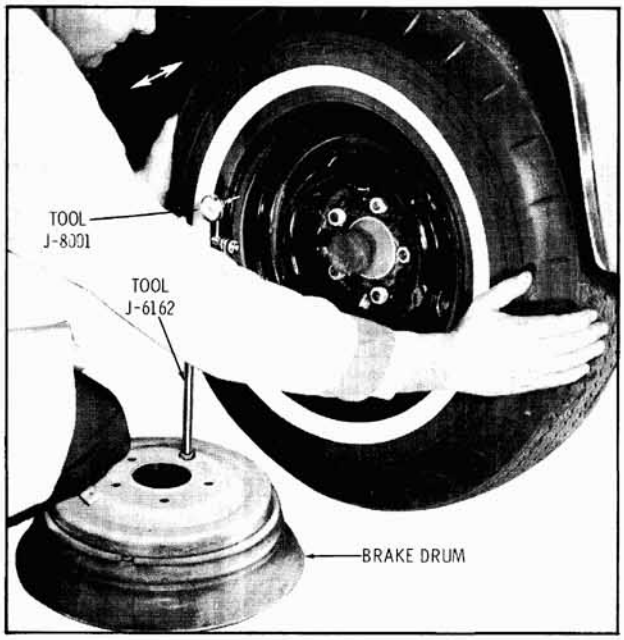


Fig. 9-3—Suspension and Linkage Check

LINKAGE JOINTS

When disconnecting a linkage joint, no attempt should be made to disengage the joint by driving a wedge between the joint and the attached part.

Tie rod joints should be disconnected from the relay rod, after removing the attaching nut, by using Tool J-22292. (Fig. 9-4) To disconnect the outer end of a tie rod, remove the tie rod to steering arm attaching nut, then tap the END of the steering arm with a hammer to free the tie rod from the steering arm. Tool BT-6320 can be used to remove the tie rod ends. (Fig. 9-5) Use new seals on assembly. Upon reassembly, the tie rod joint nuts should be torqued to 45 ft. lbs. To remove the pitman arm or idler arm from the relay rod, the steering linkage should be removed from the car. After removing the nut, the relay rod can be clamped in a vise or supported so that the joint can be driven out of the relay rod. To reassemble pitman arm, torque the nut to 45 ft. lbs. upon reassembly of the idler arm torque the nut to 45 ft. lbs.

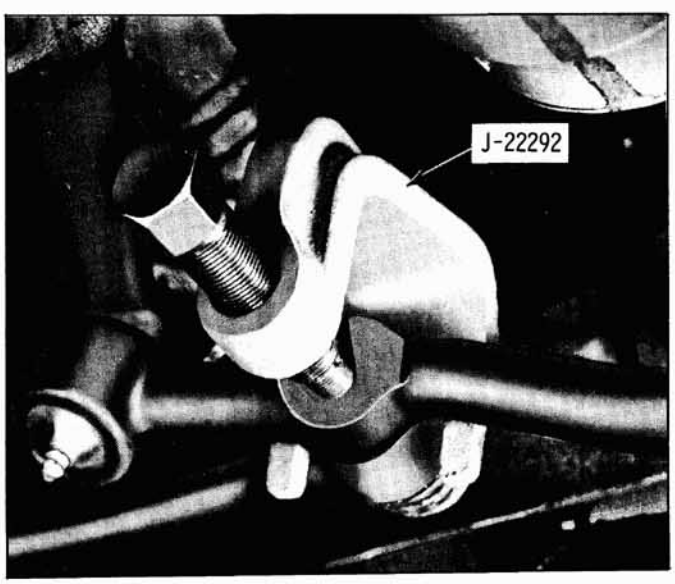


Fig. 9-4—Disconnecting Linkage Joint

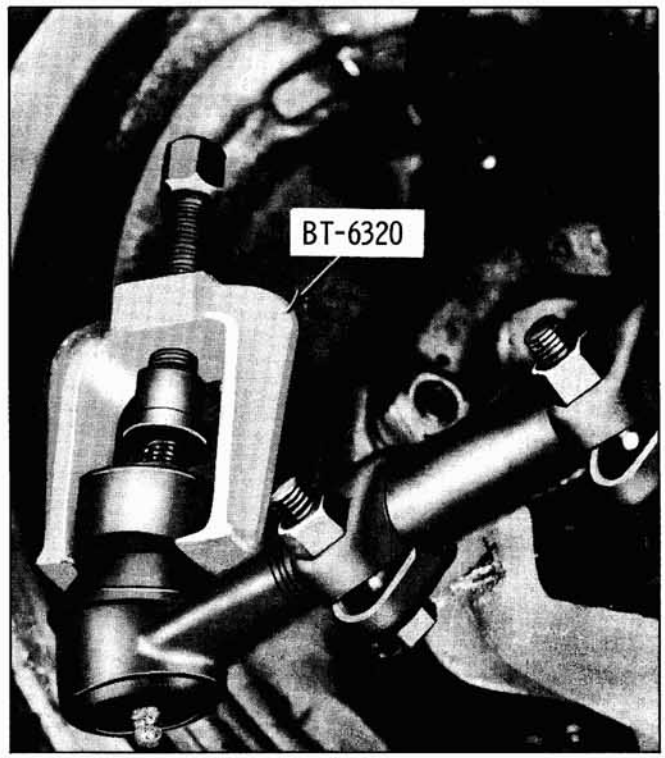


Fig. 9-5—Disconnecting Linkage Joint

IDLER ARM AND SUPPORT ASSEMBLY

The idler arm and support is serviced as an assembly and no adjustments are required. When installing the support to the frame bracket, torque the nuts to 40 ft. lbs.

TIE RODS

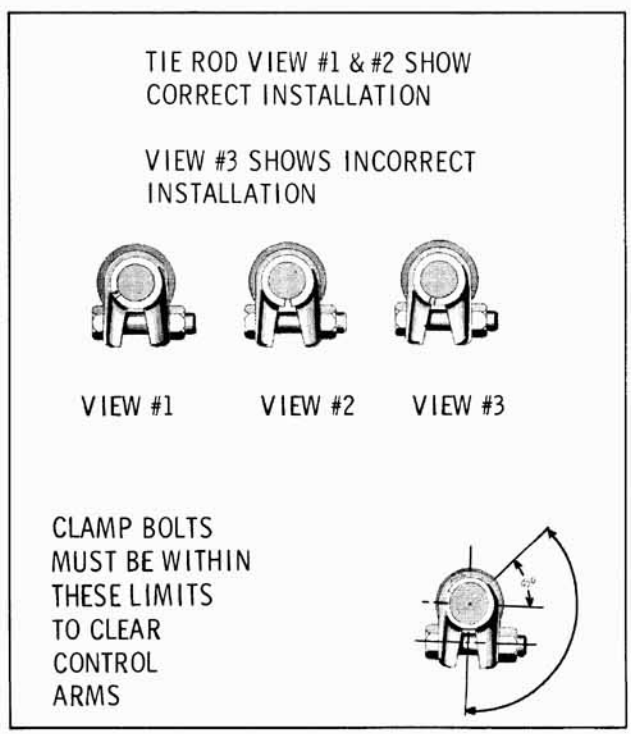


Fig. 9-6—Tie Rod Clamp Positioning (54-86 Series)

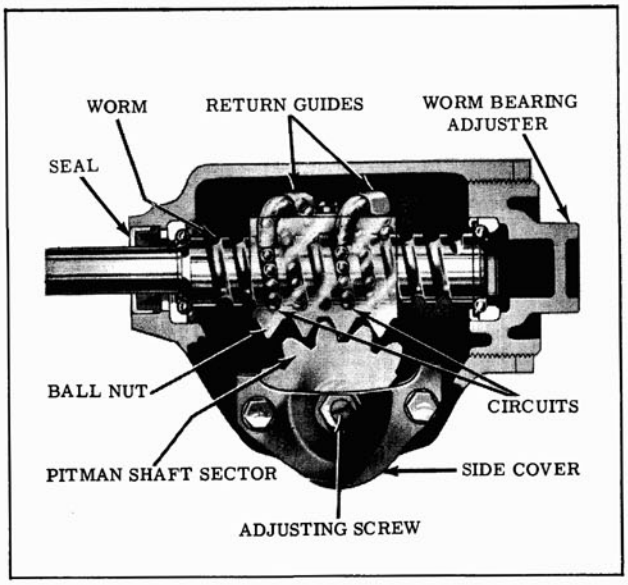


Fig. 9-7—Manual Steering Gear

Whenever the tie rod end is assembled to the tie rod and prior to assembling the tie rod end to the steering arm, make certain that an equal number of tie rod and tie rod end threads are exposed at each end of the tie rod sleeve.

LINKAGE ADJUSTMENT

Toe-in and steering wheel spoke alignment is obtained by turning the adjusting sleeves on the tie rods which in turn lengthen or shorten the tie rod assemblies. Refer to WHEEL ALIGNMENT. After adjusting toe-in, make certain that the sleeve clamps are positioned as shown in Figs. 9-2 or 9-6, and the tie rod assemblies are free to rotate thru approx. 18°.

MANUAL STEERING (Fig. 9-7) ADJUSTMENTS (ON CAR)

Before any adjustments are made to the steering gear in an attempt to correct such conditions as shimmy, hard or loose steering, or road shock, a careful check should be made to determine that front end alignment, shock absorbers, wheel balance, and tire pressure are correct.

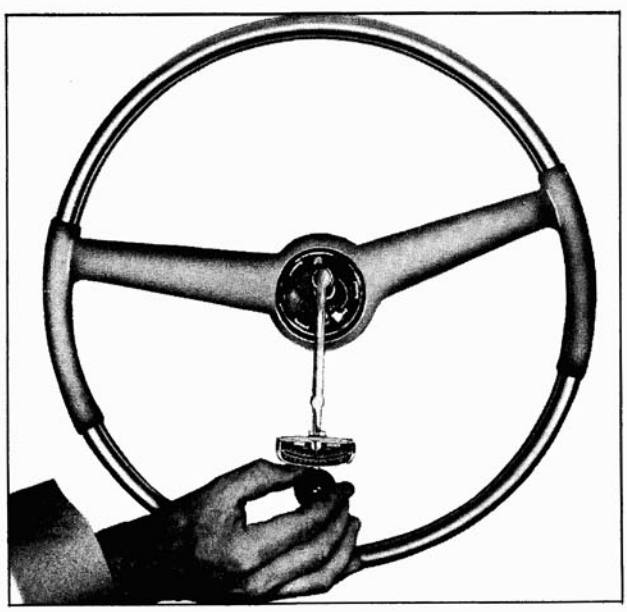


Fig. 9-8—Checking Worm Bearing Pre-load

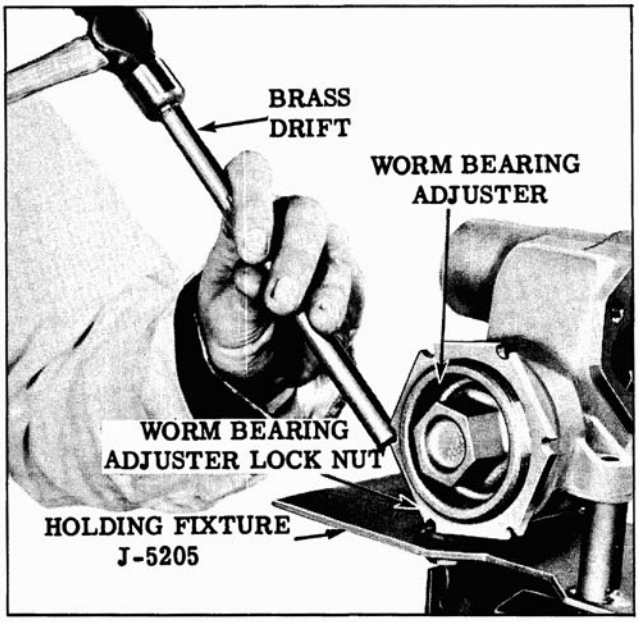


Fig. 9-9—Loosening Locknut

There are two adjustments on the manual steering gear:

a. WORM BEARING PRE-LOAD ADJUSTMENT
b. OVERCENTER ADJUSTMENT

The worm bearing pre-load adjustment must be checked and corrected if necessary before the overcenter adjustment is made. Failure to follow the proper sequence may result in damage to the steering gear.

WORM BEARING PRE-LOAD ADJUSTMENT

1. Disconnect the pitman arm from pitman shaft using Tool J-5504-B or a similar puller.
2. Loosen pitman shaft adjusting screw locknut and loosen adjusting screw a few turns. (Fig. 9-7)

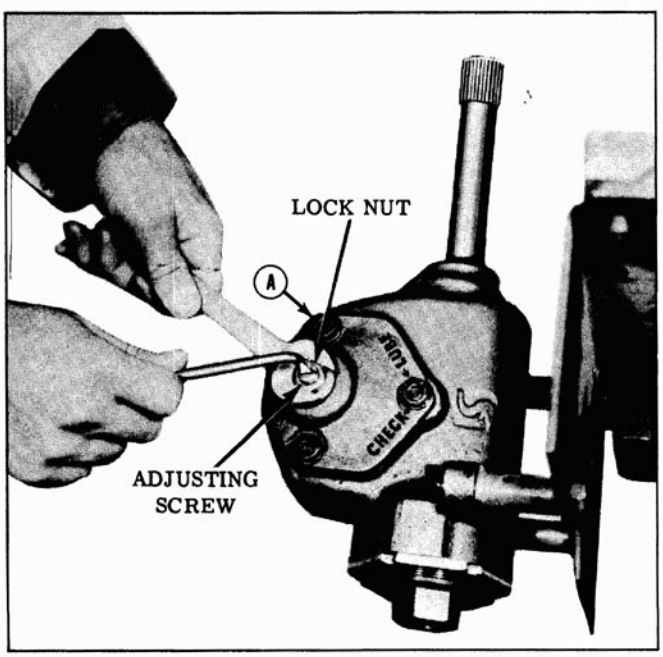


Fig. 9-10—Overcenter Adjustment

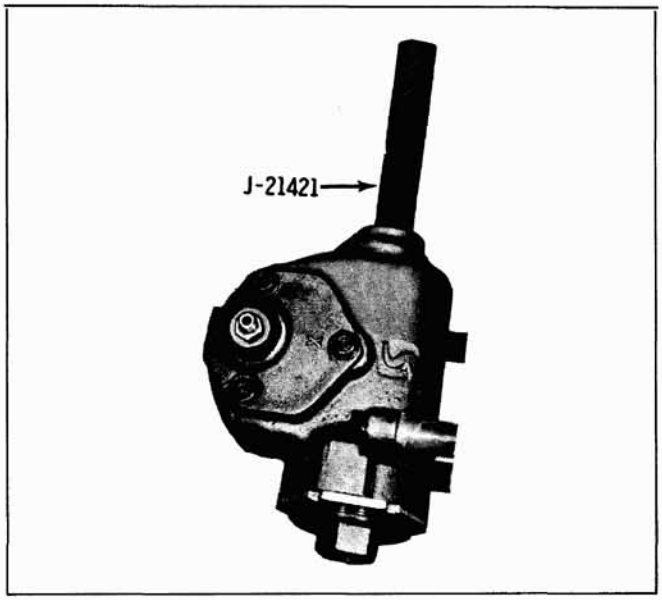


Fig. 9-11—Installing Upper Worm Shaft Seal

3. Using an inch pound torque wrench measure the torque which is required to keep the steering wheel in motion at about 30° off straight ahead position. (Fig. 9-8)

4. The torque required should be between 4 and 8 inch pounds. If it is not, it will be necessary to loosen the worm bearing adjuster locknut with a brass drift (Fig. 9-9) and turn the worm bearing adjuster the required amount to bring the torque within limits.

5. When adjustment is correct, retighten locknut to 100 ft. lbs. and recheck pre-load.

OVERCENTER ADJUSTMENT

1. After making the worm bearing adjustment, the pitman shaft adjusting screw should be tightened until a pull of 4 to 10 inch pounds in excess of worm bearing pre-load is required to turn the wheel through the center range. (Approximately 2-7/8 turns from either end of travel on car or 3-1/8 turns for bench adjustment.) (Fig. 9-10) Tighten the locknut to 27 ft. lbs. and recheck the overcenter adjustment.

2. After adjustments have been made, assemble pitman arm to pitman shaft with front wheels and steering wheel in the straight ahead position so that splines will align properly. Torque pitman shaft nut to 135 ft. lbs.

GEAR ASSEMBLY

Remove and Install

1. Remove the two flex coupling flange attaching nuts and lockwashers.

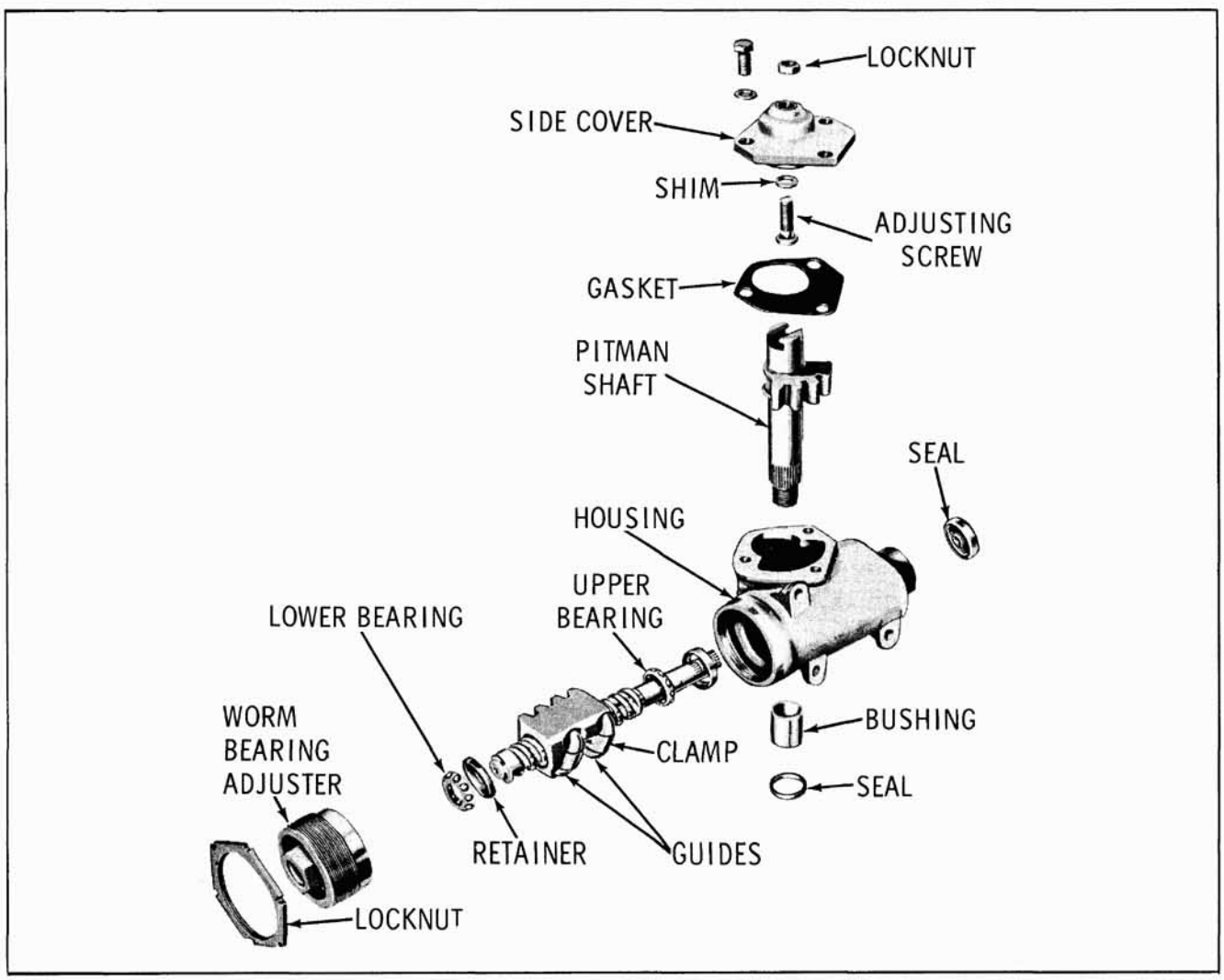


Fig. 9-12—Manual Steering Gear

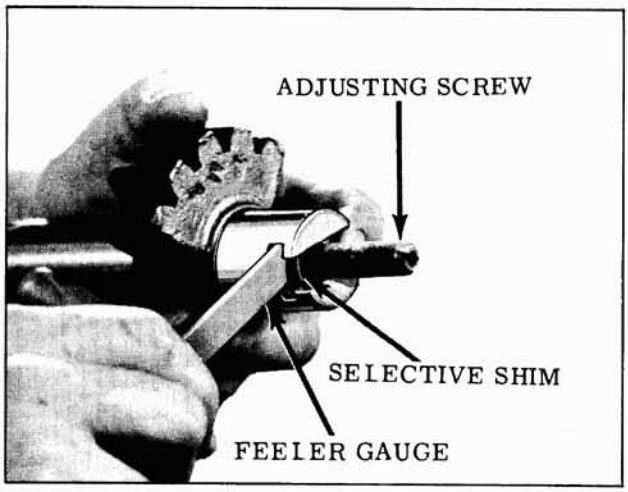


Fig. 9-13—Checking End Clearance

2. Hoist front of car and support car with floor stands under outer ends of lower control arms.

3. Remove pitman shaft nut and pull pitman arm from shaft using Tool J-5504-B or a similar puller.

4. Remove gear to frame bolts, position steering linkage and speedometer cable, if so equipped, out of the way and withdraw gear assembly from under car.

If necessary to remove the upper worm shaft seal with the gear assembled, punch a small hole in the seal and install a small metal screw approximately two turns, then pry out the seal with a pair of side cutters. Drive new seal flush with housing with Tool J-21421. (Fig. 9-11)

To install gear, apply wheel bearing grease to the gear mounting pads to prevent gear to frame squeak, then reverse removal procedure. Torque steering gear to frame bolts to 80 ft. lbs. Torque pitman shaft nut to 135 ft. lbs.

DISASSEMBLY OF GEAR

1. Clamp gear in a vise.

2. Loosen the pitman shaft adjusting screw locknut.

3. Rotate worm shaft 3-1/8 turns from end of travel, then remove side cover and pitman shaft from steering gear housing.

4. Loosen worm bearing adjuster locknut with a brass drift, then remove locknut and adjuster assembly from gear housing.

5. Remove worm shaft assembly (with ball nut) out through bottom of housing. Remove upper worm bearing from steering shaft.

SERVICING INDIVIDUAL UNITS

PITMAN SHAFT AND SIDE COVER

Disassembly

1. Remove pitman shaft adjusting screw locknut.

2. Thread adjusting screw through pitman shaft cover, and remove cover and gasket.

3. Wash all parts in clean solvent and dry with compressed air. Inspect parts.

If the bushing in the side cover is defective the side cover must be replaced as the bushing is not serviced separately.

Assembly

1. Check the end clearance of the adjusting screw in the slot of the pitman shaft. (Fig. 9-13) The screw should rotate freely but not have more than .002" clearance. If clearance exceeds .002", select the proper shim to bring the clearance to specification. (Shim thicknesses are .063", .065", .067", and .069")

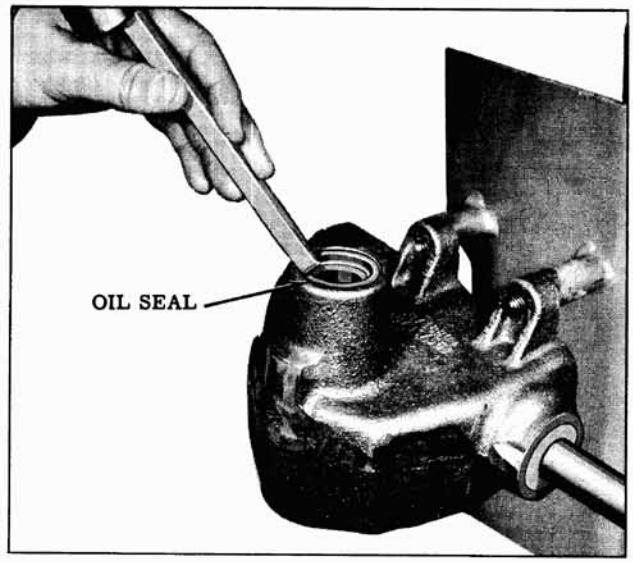


Fig. 9-14—Removing Pitman Shaft Seal

2. Assemble the pitman shaft and adjusting screw (with proper shim) to side cover. Thread the adjusting screw through the side cover until the side cover bottoms on the pitman shaft.

3. Install locknut but do not tighten.

HOUSING

Disassembly

1. If pitman shaft seal ONLY is to be replaced, use a small chisel to collapse the seal so it can be lifted from the housing. (Fig. 9-14)

2. If pitman shaft bushing is to be replaced, use Tool J-

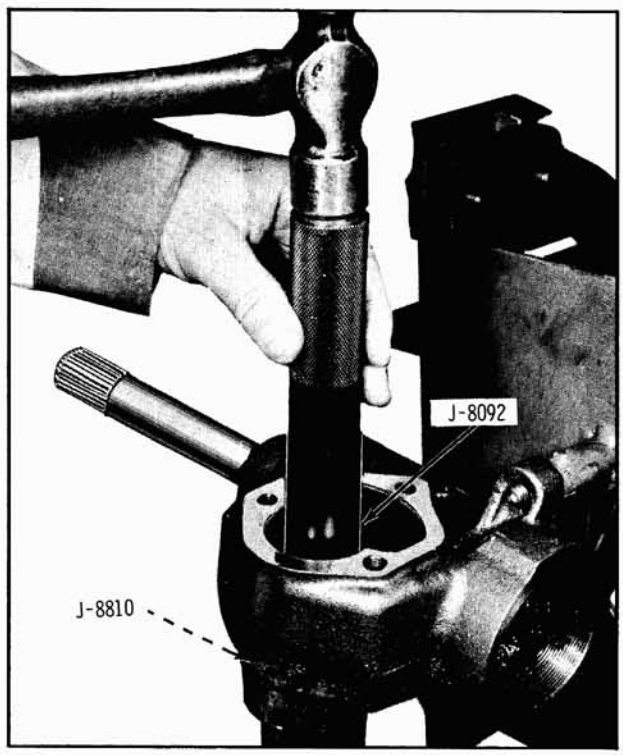


Fig. 9-15—Removing Bushing

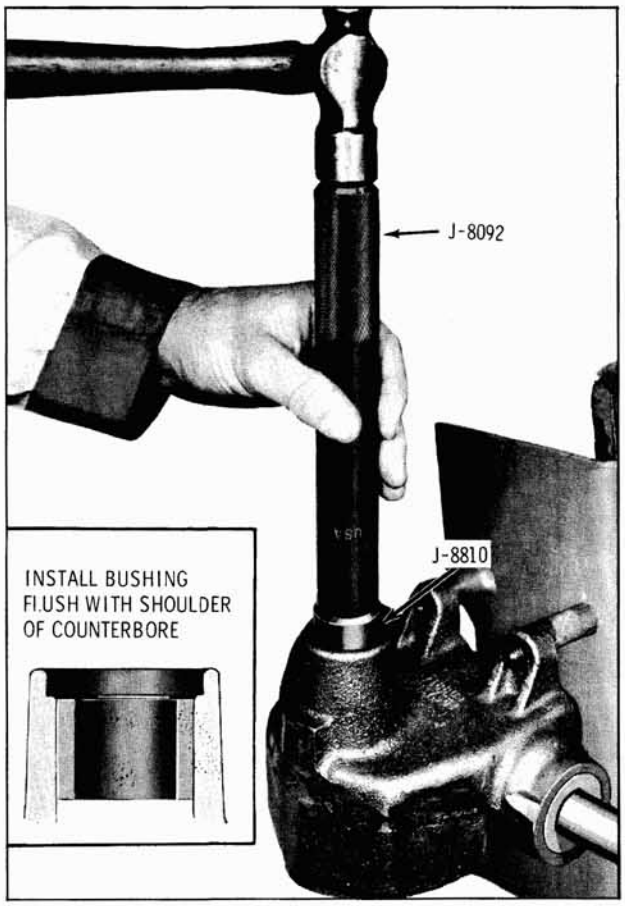


Fig. 9-16—Installing Pitman Shaft Bushing

8810 with Driver Handle J-8092 to drive bushing and seal from housing. (Fig. 9-15)

3. The upper worm bearing race can be removed with a brass drift and installed with Tool J-8811.

4. Wash housing in clean solvent and dry with compressed air.

Assembly

1. If pitman shaft bushing was removed, place a new bushing over end of Tool J-8810, then drive bushing into housing as shown in Fig. 9-16.

2. Place a new seal into housing with lip of seal facing inward. Drive seal in the housing until it bottoms against shoulder of counterbore, using Tool J-8811. (Fig. 9-17) Coat lip of seal with seal lubricant, No. 1050169 or equivalent.

WORM BEARING ADJUSTER

1. Pry lower worm bearing retainer from adjuster, then remove lower worm bearing.

2. Wash all parts in clean solvent and dry with compressed air. Inspect parts for wear.

Assemble

Pack lower worm bearing with water resistant E.P. grease, then place bearing on race and install retainer.

BALL NUT

Remove

1. Remove ball return guide clamp and guides from ball nut.

2. Rotate worm until all balls have dropped out of the nut, then remove nut from worm.

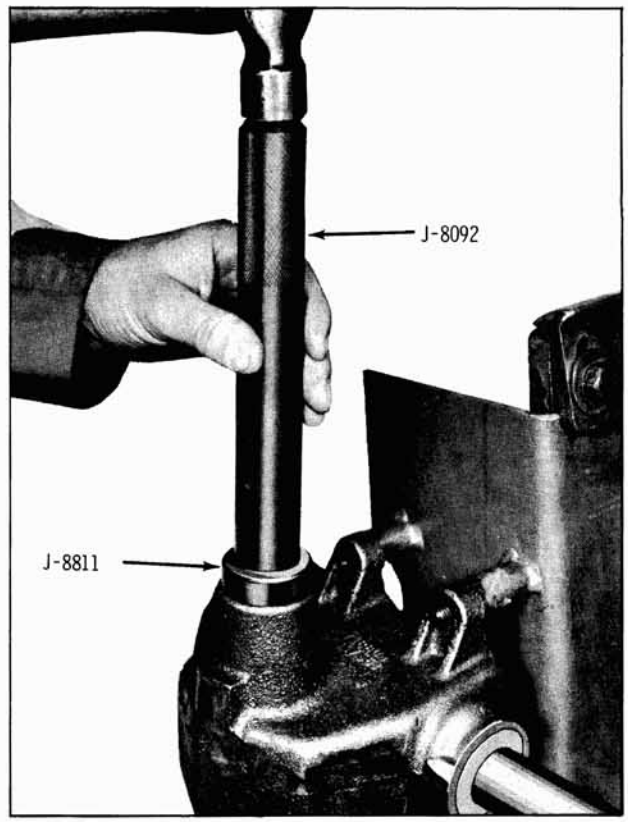


Fig. 9-17—Installing Pitman Shaft Seal

3. Wash all parts in clean solvent and dry with compressed air. Inspect parts for wear.

Install

1. Coat ball nut and worm with steering gear lubricant.
2. Slide ball nut over worm. (Fig. 9-18)
3. Position the ball return guides on the ball nut.
4. Install 25 balls into each circuit through the hole in the return guides. (Fig. 9-19)
5. Install the guide clamp.

ASSEMBLY OF STEERING GEAR

1. Pack the upper worm bearing with water resistant E.P. grease (Multi-Purpose Gear Lubricant), then slide upper worm bearing over worm shaft and position bearing against

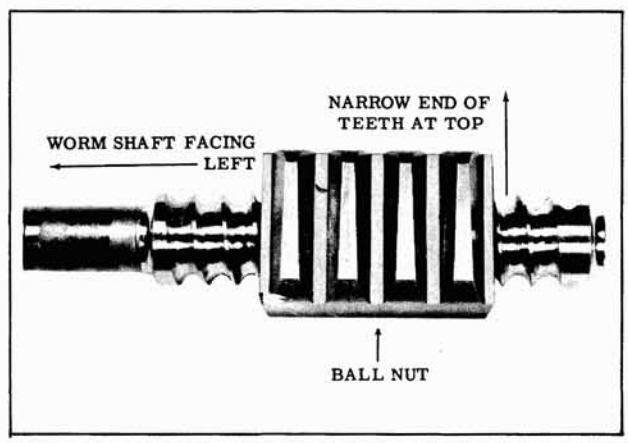


Fig. 9-18—Positioning Ball Nut

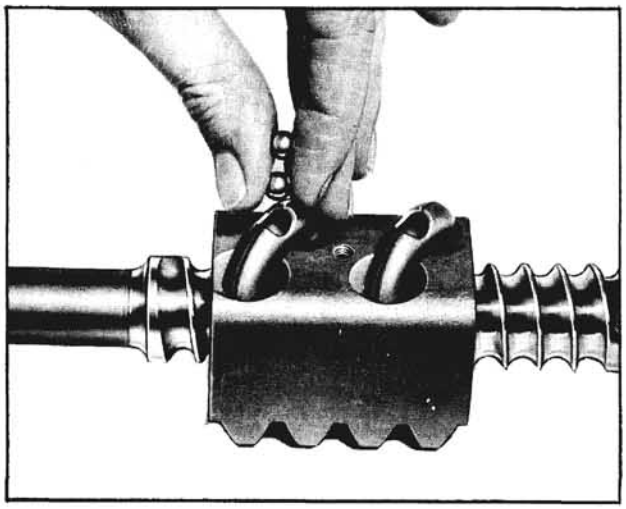


Fig. 9-19—Ball Installation

worm. Install grommet. Slide worm shaft, bearing and ball nut assembly into gear housing.

2. Install worm bearing adjuster into gear housing Adjuster should be installed just tight enough to hold worm bearing in place. Final adjustment will be made later.

3. Install pitman shaft and side cover assembly and gasket, with sector and ball nut teeth centered as shown in Fig. 9-20.

4. Fill steering gear with 11 oz. of water resistant E.P. grease. Align side cover assembly and gasket, torque to 30 ft. lbs.

5. Steering gear should be bench adjusted before it is installed in the car as follows:

a. Attach Torque Wrench J-5853 to worm shaft and turn shaft to extreme right or left position.

b. Turn worm bearing adjuster to obtain a reading of 4 to 8 in. lbs. with worm shaft turning slowly. Worm bearing pre-load adjustment must be made within 1/2 turn of worm shaft from extreme position.

c. Tighten worm bearing adjuster locknut and recheck reading.

d. Turn worm shaft from one extreme to the other while counting turns, then turn back 1/2 the total number of turns. This places the steering gear on the "overcenter"—or "high point" position.

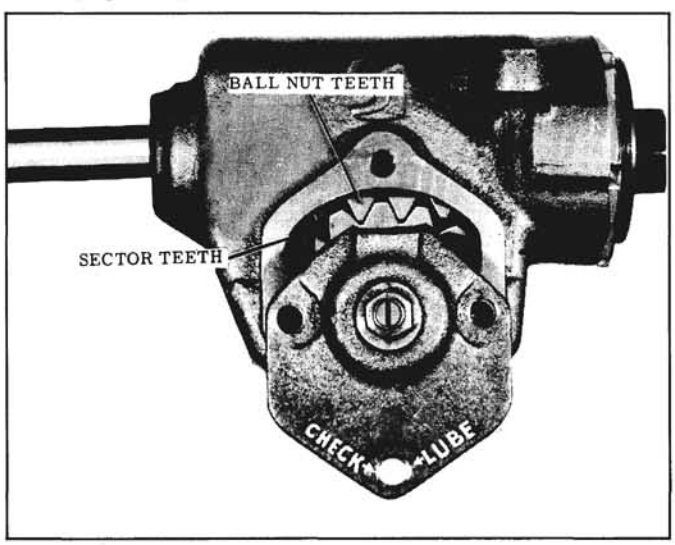


Fig. 9-20—Sector and Ball Nut Centered

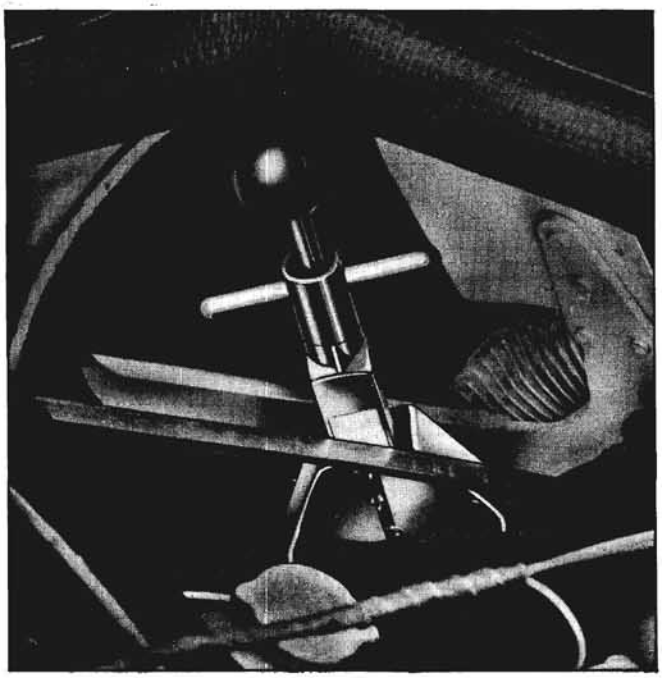


Fig. 9-21—Adjusting Power Steering Belt

e. Loosen pitman shaft adjuster screw locknut and turn screw until a reading of 4 to 10 inch pounds higher than worm bearing pre-load is obtained while rotating worm through the "overcenter" range. Tighten locknut and recheck reading. Total "overcenter" pull should not exceed 16 inch pounds.

POWER STEERING PUMP MINOR SERVICE OPERATIONS

PUMP BELT ADJUSTMENT

Checking

Position Gauge BT 33-70M on pump belt as shown in Fig. 9-21. If the pointer of tool does not index with correct mark, corresponding with the type of belt to be adjusted, the belt should be adjusted as follows:

Adjustment—All L-6 and V8 w/o A.C.

With Gauge BT 33-70M positioned on pump belt, loosen the pump attaching bolts and adjust the belt tension by moving the pump away from engine.

Adjustment—V8-w/A.C.

With Gauge BT 33-70M positioned on pump belt, loosen generator attaching bolts and remove all tension on generator belt. Loosen pump attaching bolts and adjust the pump belt tension by moving the pump away from the engine. Remove gauge BT 33-70M from pump belt and position gauge on generator belt and adjust to specified tension.

SERVICING OF THE FLOW CONTROL VALVE (WITHOUT REMOVING PUMP ASSEMBLY FROM CAR)

1. Disconnect high pressure hose from pump union and drain oil.

2. Remove union and withdraw flow control valve and spring with a magnet.

Inspection

1. Flow control valve must slide freely in housing bore. If

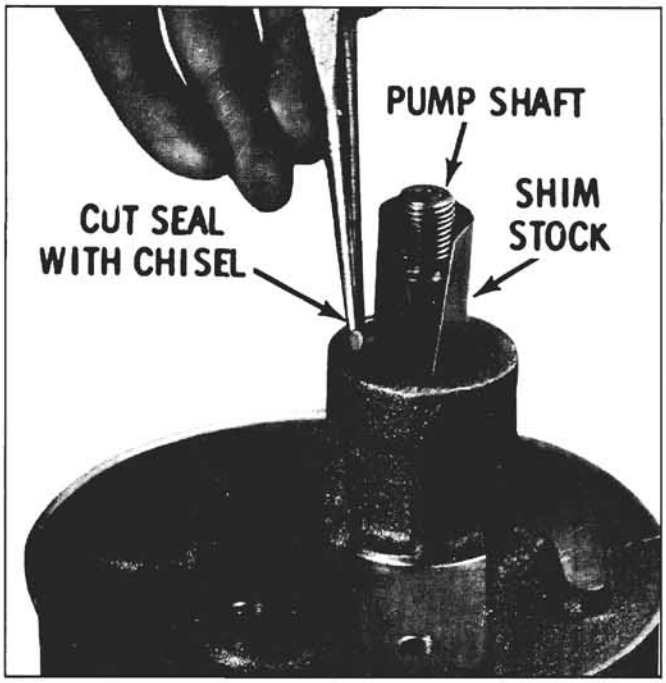


Fig. 9-22—Cutting Pump Seal

sticking occurs, check for dirt or burrs.

2. Check cap screw in the end of valve for looseness; if loose, tighten, being careful not to damage machined surfaces.

3. If the flow control plunger is suspected of being faulty, install new valve. This is serviced as a unit and is factory calibrated.

To install reverse the above procedure and install a new "O" ring seal on the union.

PUMP SHAFT OIL SEAL REPLACEMENT (WITHOUT DISASSEMBLING PUMP)

The pump shaft oil seal can be replaced without disassembling the pump as follows:

1. With the pump pulley removed, bend a piece of .005" shim stock (approximately 2-1/2" long) into a cylindrical shape, then push the shim stock past seal until it bottoms in pump body. (Fig. 9-22)

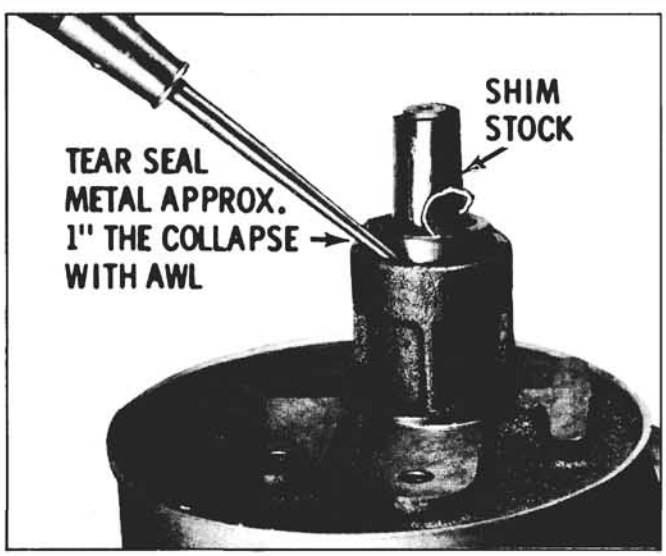


Fig. 9-23—Removing Pump Seal

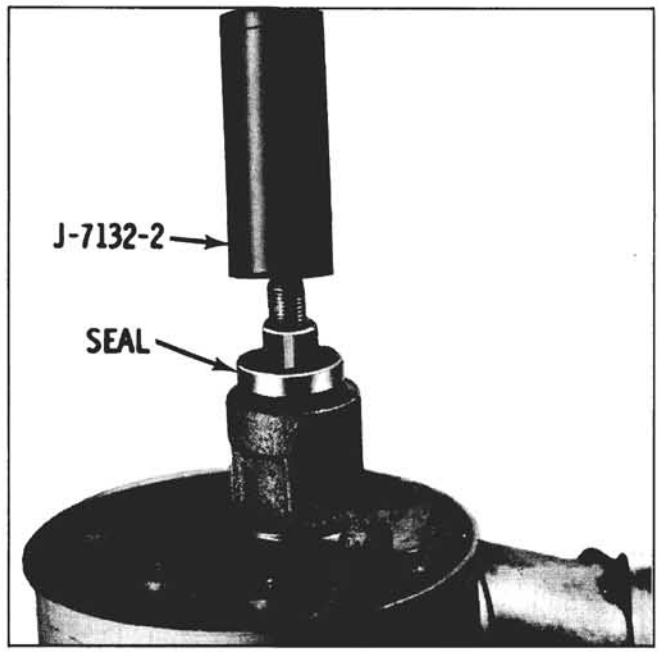


Fig. 9-24—Installing Pump Seal

The use of shim stock around the pump shaft will prevent damage to the machined surfaces of the shaft when removing seal.

2. Cut metal body of seal with a small chisel as shown in Fig. 9-22.

3. Tear metal body approximately 1" with diagonals. Force an awl between the pump body and the OD of seal to collapse the seal, then pry seal from pump body. (Fig. 9-23) Remove shim stock.

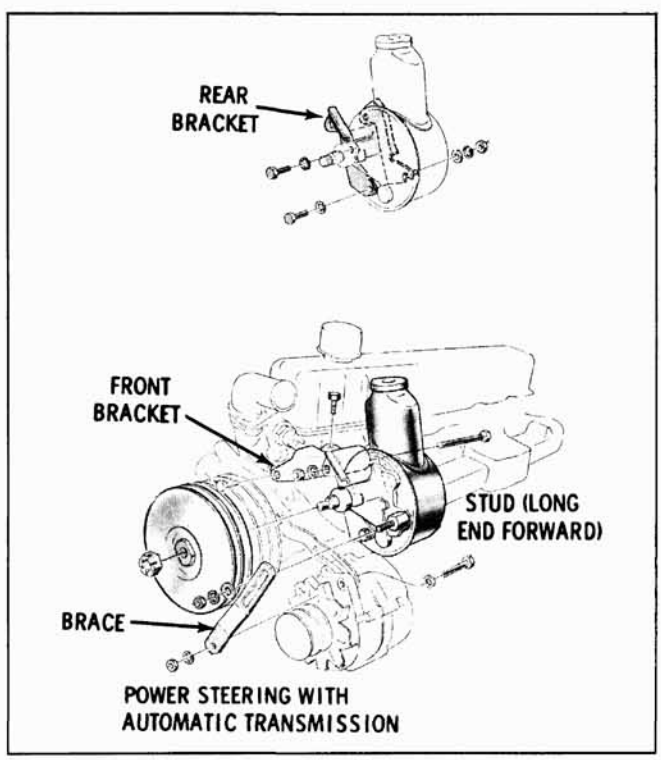


Fig. 9-25—Pump Mounting - L-6 With A.T.

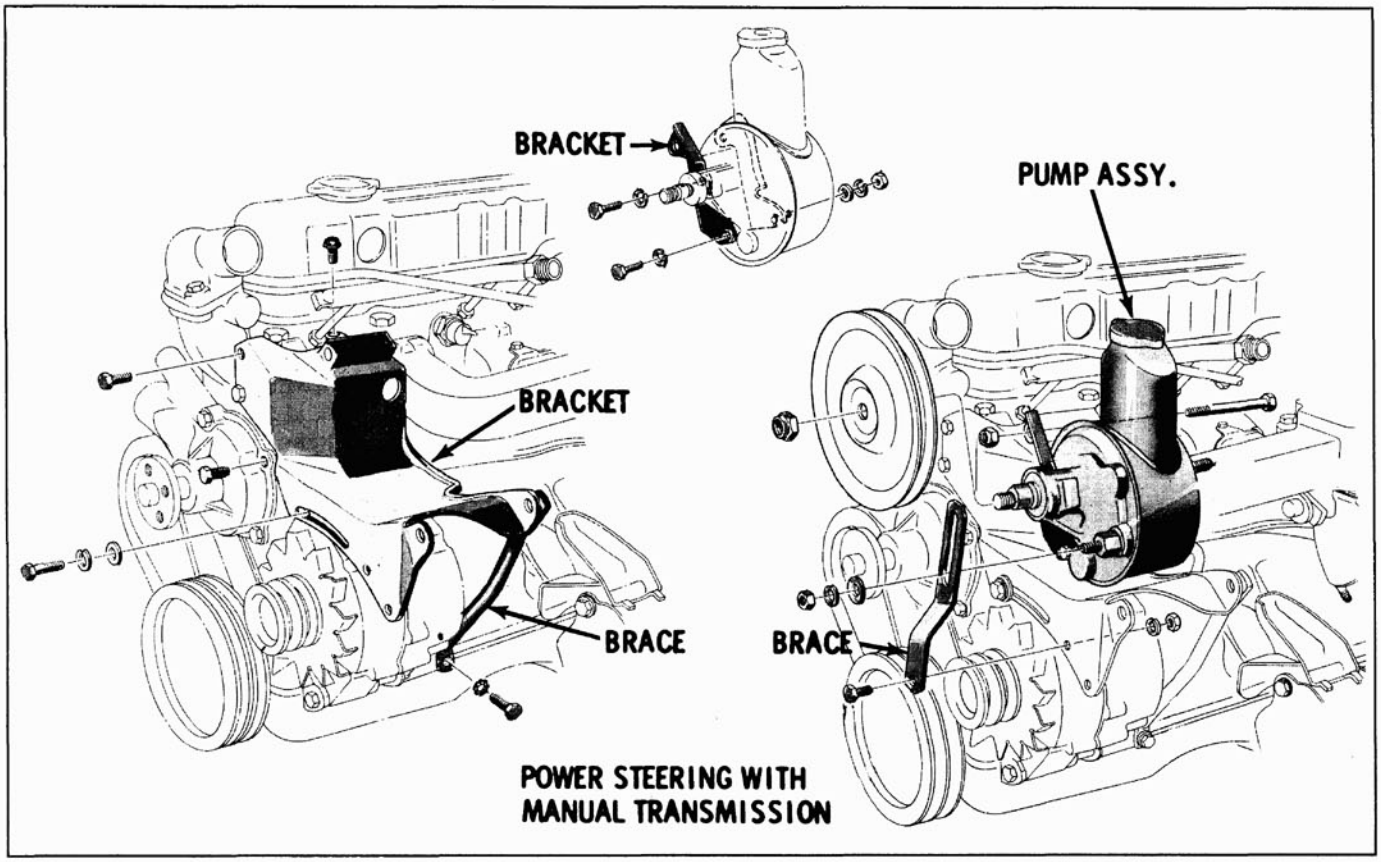


Fig. 9-25A—Pump Mounting - L-6 With M.T.

4. Apply special seal lubricant No. 1050169 or equivalent to the sealing lip of a new seal, then install seal over pump shaft with metal side of seal outboard.

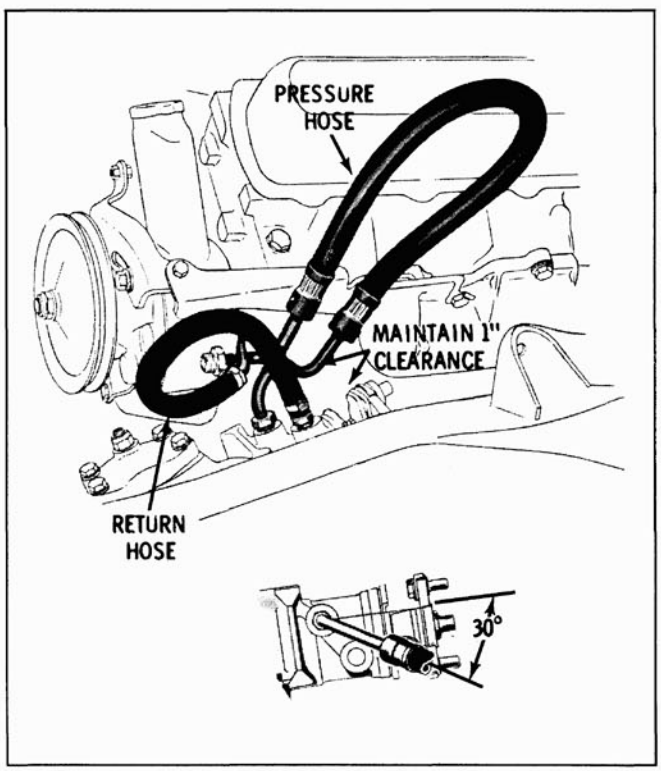


Fig. 9-26—Hose Routing (32-36-42-44-48 Series)

5. Slide Tool J-7132-2 over pump shaft, then drive seal into pump body. (Fig. 9-24)

POWER STEERING PUMP

Removal and Installation

The power steering pump is attached as shown in Figs. 9-25, 25A, 26, 27 and 27A. When removing the pulley nut do not loosen the belt tension as the belt tension will prevent the pulley from turning.

When disconnecting the hoses from the pump, secure the end of the hoses above the fluid level. Cap the pump fittings.

To install, reverse the removal procedure. Fill reservoir with Fluid, No. 1050017 or equivalent then bleed pump by turning pulley counterclockwise until air bubbles cease to appear. Refill reservoir to proper fluid level, if necessary. Adjust pump belt as outlined under PUMP BELT ADJUSTMENT.

POWER STEERING PUMP (Fig. 9-28)

Disassembly (Fig. 9-29)

1. Remove pump from car.

Clean outside of pump in a nontoxic solvent before disassembly.

2. Place pump assembly in vise, hub down, using flat on hub for one clamping surface. Do not exert excessive force on hub as this may distort pump housing.

3. Remove pressure union and "O" ring seal from rear of pump assembly. Discard "O" ring seal.

Spring loaded flow control valve tends to "pop" out when pressure union is removed.

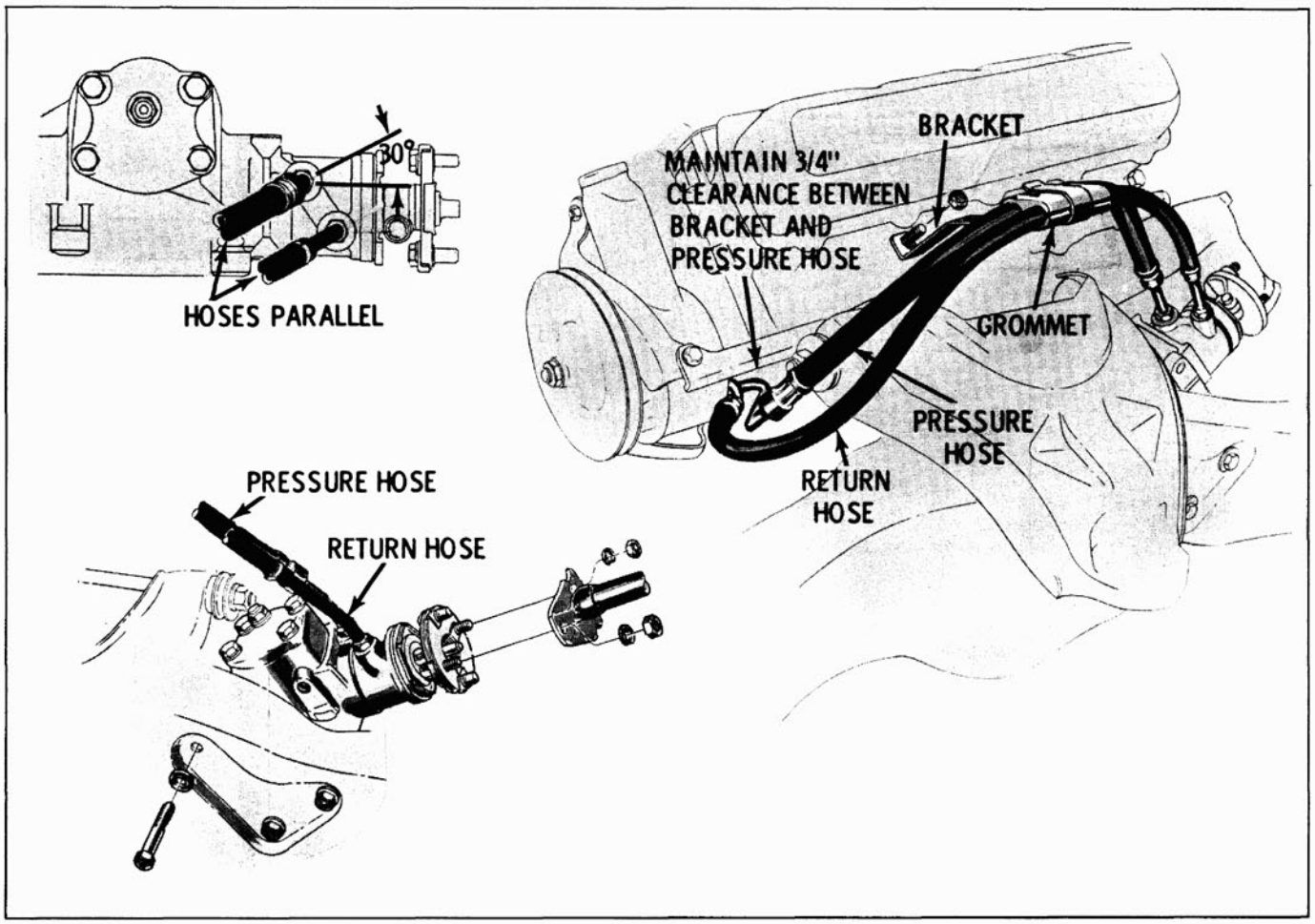


Fig. 9-27—Hose Routing (54-86 Series)

4. Lift reservoir from pump housing by rocking reservoir up and away from housing.
5. Remove and discard outer pump housing "O" ring seal, mounting bolt "O" ring seals, and flow control valve opening "O" ring seal.

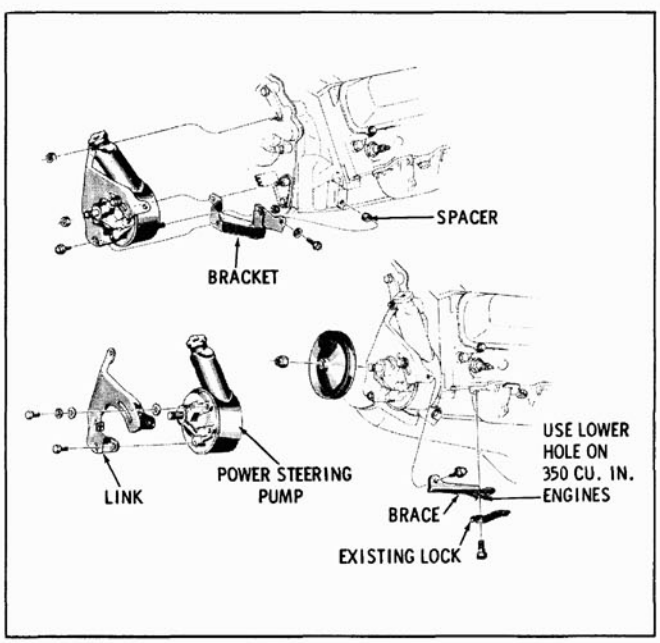
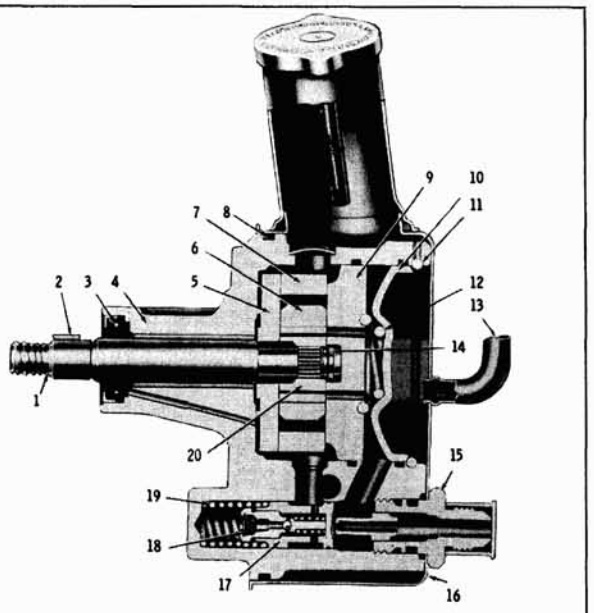


Fig. 9-27A—Pump Mounting (exc. 31 and 35 Series)

6. Rotate end plate retaining ring so that one end of ring is over hole in housing. Spring one end of ring with punch to allow screwdriver to be inserted to lift ring out. (Fig. 9-30)
7. Remove end plate. End plate is spring loaded and will generally raise above the housing, making removal easy. However, if end plate should stick, a slight rocking action on top surface will free the plate.
8. Remove pressure plate spring.
9. Remove woodruff key from shaft.
10. Remove pump from vise, and remove flow control valve and spring. Flow control valve is serviced as a unit and should not be disassembled.
11. Remove pressure plate, cam ring, and dowel pins from pump housing.
12. Tap end of shaft lightly on bench until shaft is free from pump housing. Then remove shaft with rotor and vanes, and thrust plate attached.
13. Remove vanes from rotor, then remove retaining ring from splined end of shaft and remove rotor and thrust plate from shaft.

To remove retaining ring, clamp shaft in soft jawed vise, and using a pair of long nose pliers or a screwdriver, pry retaining ring off shaft. Be careful not to damage shaft with vise jaws.

14. Remove pressure plate "O" ring seal and end plate "O" ring seal from bore of housing and discard.



1. Shaft
2. Woodruff Key
3. Shaft Seal
4. Pump Body
5. Thrust Plate
6. Vanes
7. Pump Ring
8. Reservoir "O" Ring Seal
9. Pressure Plate
10. End Cover
11. End Cover Retaining Ring
12. Pressure Plate Spring
13. Pump Inlet Tube
14. Rotor to Drive Shaft Retaining Ring
15. Pump Outlet Union
16. Reservoir
17. Flow Control Valve
18. Flow Control Valve Cap Screw
19. Flow Control Valve Spring
20. Rotor

Fig. 9-28—Power Steering Pump

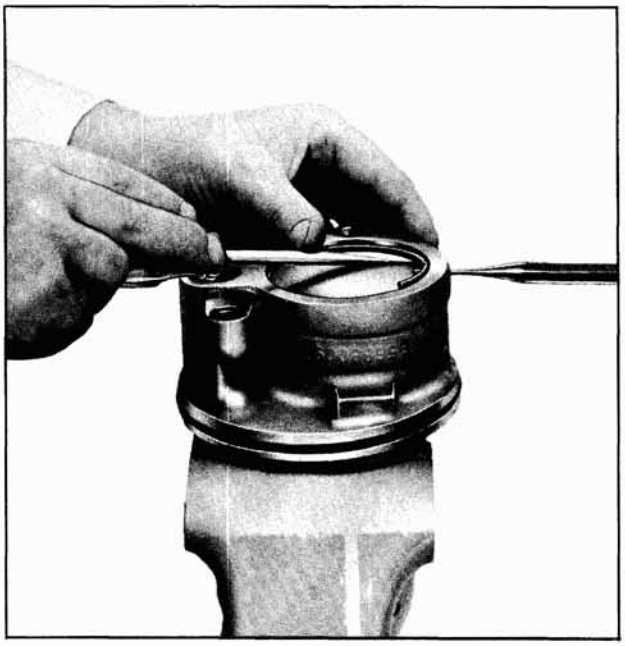
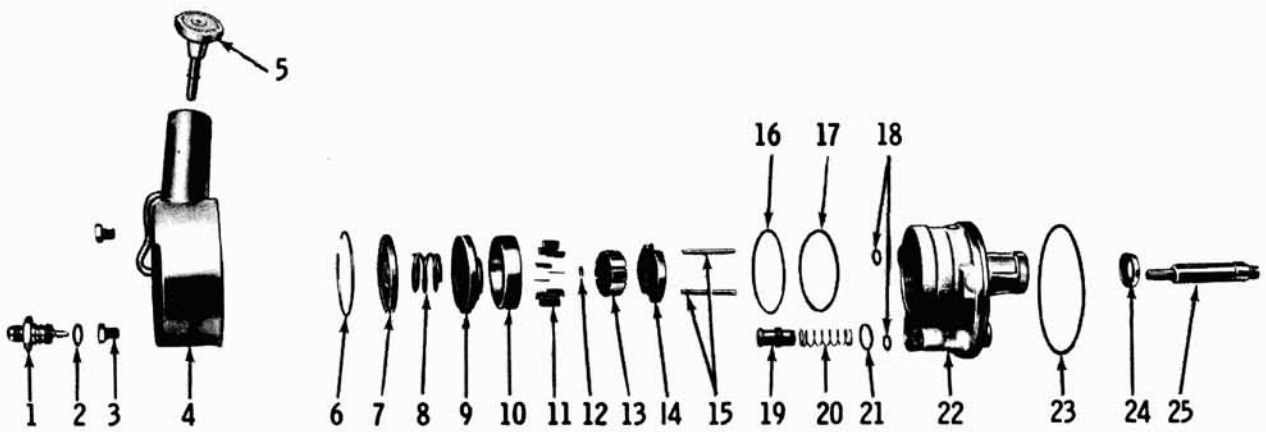


Fig. 9-30—Removing End Cover Ring

15. Remove shaft seal from housing only if defective, since it will be destroyed if it is removed. Remove shaft seal if necessary by prying out with screwdriver.

Cleaning and Inspection

Carefully clean all pump parts in cleaning solvent. Do not immerse the pump shaft seal in cleaning solvent as this could damage it. Replace any damaged or worn parts.



1. Union
2. Seal
3. Mounting Studs
4. Reservoir
5. Dip Stick and Cover
6. End Cover Retaining Pin
7. End Cover
8. Spring
9. Pressure Plate
10. Pump Ring
11. Vanes
12. Drive Shaft Retaining Ring
13. Rotor
14. Thrust Plate
15. Dowel Pins
16. End Cover "O" Ring
17. Pressure Plate "O" Ring
18. Mounting Stud "O" Ring Seals
19. Flow Control Valve
20. Flow Control Valve Spring
21. Flow Control Valve "O" Ring Seal
22. Pump Body
23. Reservoir "O" Ring Seal
24. Shaft Seal
25. Shaft

Fig. 9-29—Power Steering Pump

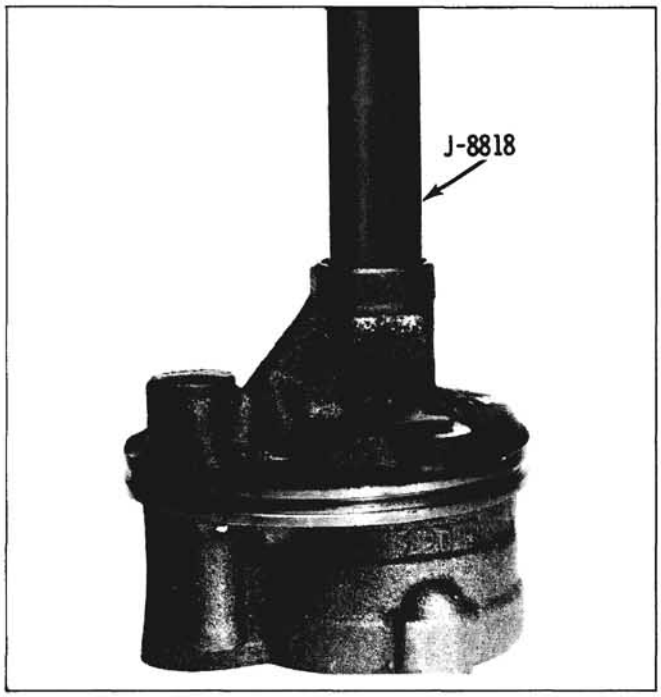


Fig. 9-31—Installing Seal

1. Inspect flow control valve assembly for score marks, wear, burrs, or other damage.
2. Inspect castings for cracks or other visual evidences of damage. Check machined surfaces, especially mating surfaces on "O" ring seats, for scratches or burrs that might permit leaks. Examine the V-shaped notches at edges of discharge ports on pressure plate. These notches must be clean and undamaged if pump noise is to be avoided, as they cushion the hydraulic shock when each vane passes the port.
3. Inspect cam ring end surfaces for score marks.

Cam ring is treated with "Lubrite" which leaves a dull gray-black finish on wear surface. Wavy grain appearance inside cam ring is normal.

4. Inspect pump shaft for score marks, excessive wear, or damage -- particularly at splines, keyway, and at bearing and seal surfaces. Separate and inspect rotor and vanes for wear and general condition.
5. Inspect shaft bushing in pump housing, and replace pump housing if bushing is scored or excessively worn.
6. If any internal parts are found to be worn or damaged, flush steering gear or disassemble gear and clean internal parts.

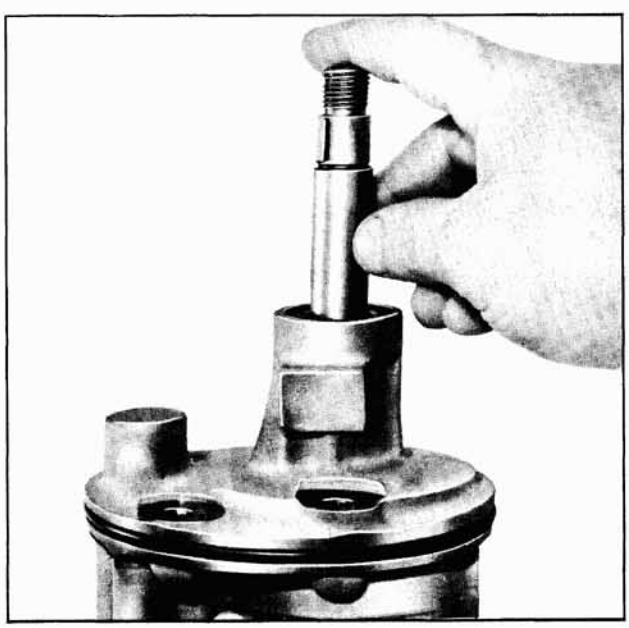


Fig. 9-32—Shaft Installation

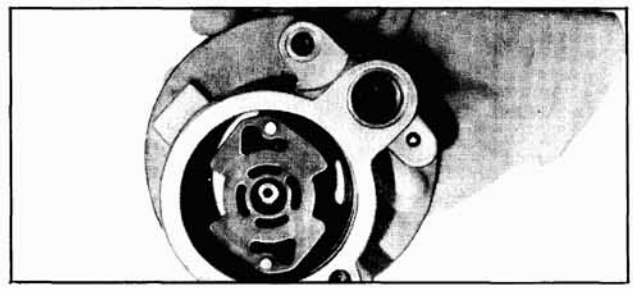


Fig. 9-33—Installing Thrust Plate

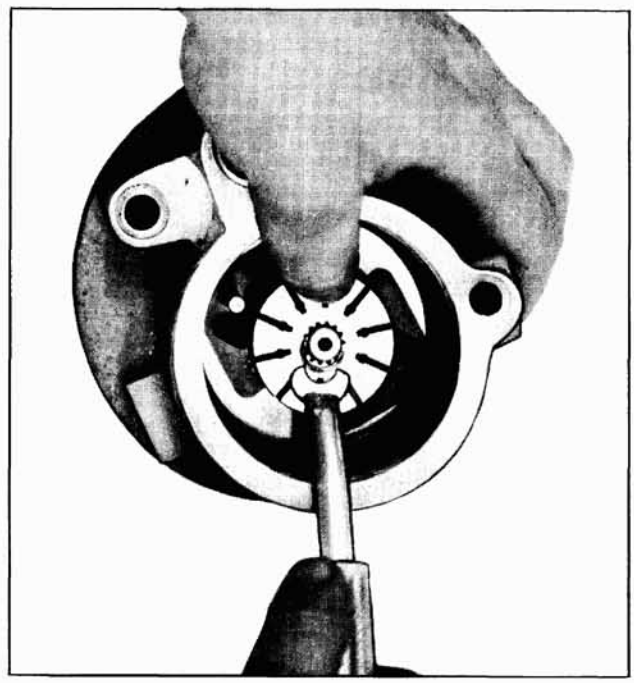


Fig. 9-34—Installing Shaft Retaining Ring

Assembly

Be sure all parts are clean during reassembly.

1. Install new shaft seal, using Tool J-8818 as shown in Fig. 9-31 and insert shaft at hub end of housing, spline end entering mounting face side. (Fig. 9-32)
2. Install thrust plate on dowel pins with ported face to rear of pump housing. (Fig. 9-33)
3. Install rotor, which must be free on splines, on pump shaft over splined end.

Assemble rotor with countersunk side toward shaft.

4. Using suitable tool, install shaft retaining ring. (Fig. 9-34)
5. Install pump ring on dowel pins with direction of rotation arrow to the rear of the pump housing. (Fig. 9-35) Rotation is clockwise as viewed from pulley.

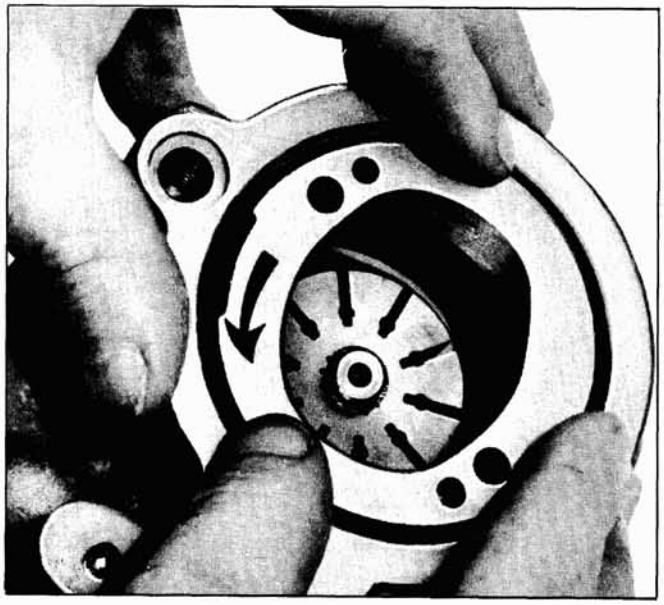


Fig. 9-35—Installing Pump Ring

6. Install vanes in rotor slots with radius edge towards outside as shown in Figs. 9-36 and 9-37.

7. Lubricate outside diameter and chamfer of pressure plate with petrolatum to insure against damaging "O" ring and install on dowel pins with ported face toward the pump ring. Seat pressure plate by placing large socket on top of plate and pushing down with hand. (Pressure plate will travel about 1/16" to seat.)

8. Install pressure plate spring in center groove of pressure plate. (Fig. 9-38)

9. Install end plate "O" ring.

10. Lubricate outside diameter and chamfer of end plate with petrolatum to insure against damaging "O" ring and install in housing using an arbor press as shown in Fig. 9-39.

11. Install end plate retaining ring while pump is in arbor press. Be sure it is completely seated in the groove of the housing and that ring gap is in position shown in Fig. 9-39.

12. Install stud seals and union seal.

13. Place reservoir in normal position and press down until reservoir seats on housing. Check position of stud seals and union seal.

14. Install flow control valve spring and flow control valve. Be sure hex head screw goes into bore first. (Fig. 9-40)

15. Install studs, union and pump shaft woodruff key. Support the shaft on the opposite side of key when tapping key into place.

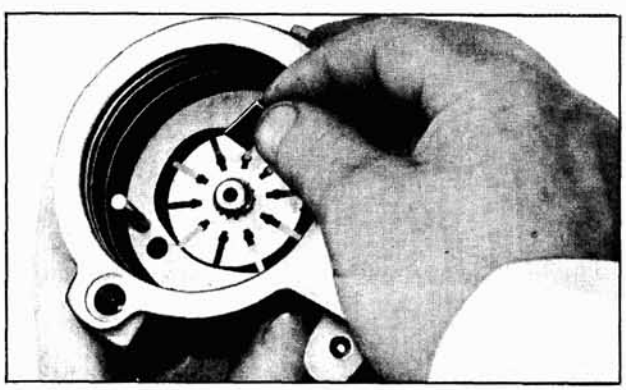


Fig. 9-36—Installing Vanes

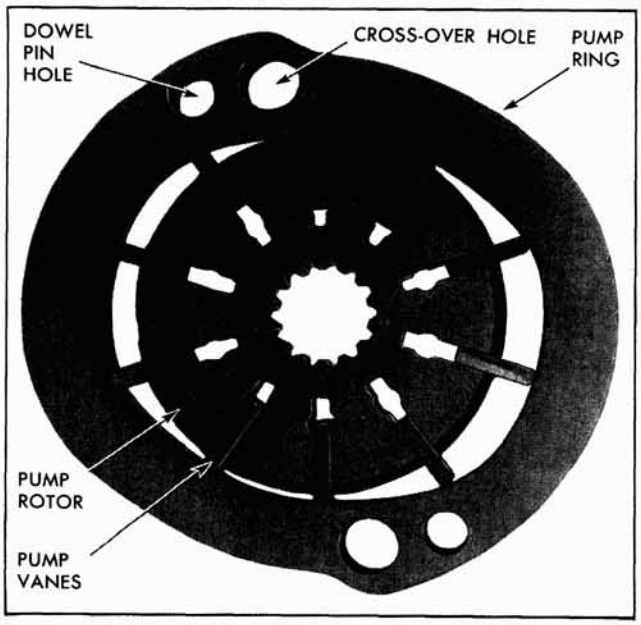


Fig. 9-37—Correct Vane Assembly

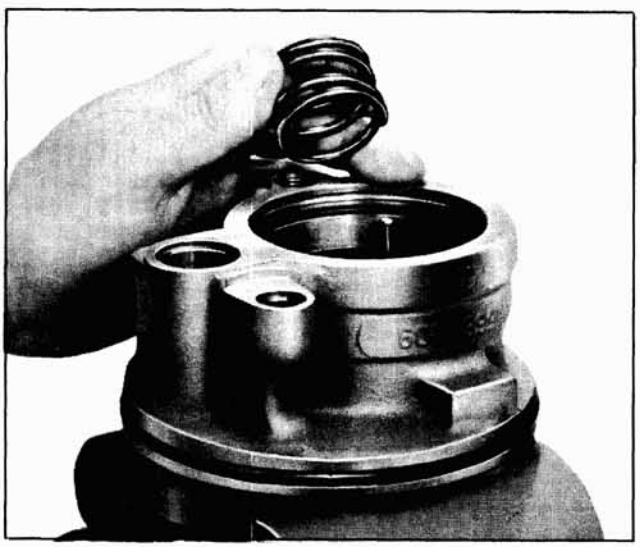


Fig. 9-38—Installing Pressure Plate Spring

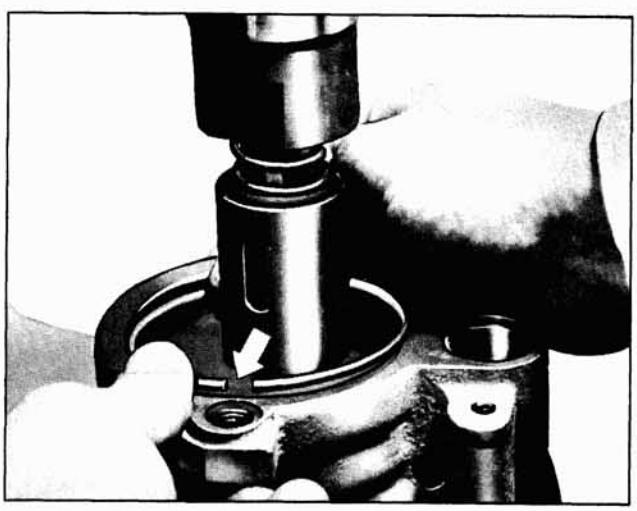


Fig. 9-39—Installing End Cover Retaining Ring

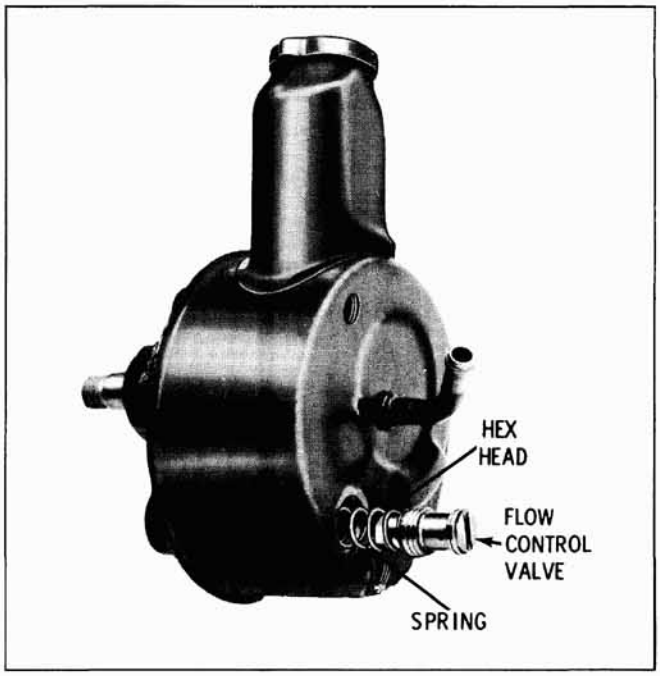


Fig. 9-40—Installing Flow Control Valve

16. Slide pulley on shaft. Do not hammer pulley.
17. Install pulley nut and torque to 40 ft. lbs.

Always use a new pulley nut.

18. Install pump on car. Fill reservoir with Fluid, No. 1050017 or equivalent, then bleed pump by turning pulley counterclockwise until air bubbles cease to appear. Refill reservoir to proper fluid level, if necessary. Adjust pump belt as outlined under PUMP BELT ADJUSTMENT.

POWER STEERING GEAR

OPERATION

NEUTRAL (STRAIGHT AHEAD POSITION) (Fig. 9-42)

When turning effort is not being applied at the steering wheel, the slots in the spool valve are positioned so that oil entering the valve body from the housing pressure port passes through the slots in the spool valve to the oil return port in the housing. The chambers at both ends of the rack-piston and around the pitman shaft are always full of oil, which acts as a cushion to absorb road shock so that they are not transferred to the driver. In addition, this oil lubricates all the internal components of the gear.

RIGHT TURN (Fig. 9-43)

When the steering wheel is turned to the right, the worm resists being turned because of the resistance offered by the front wheels. The valve body also resists turning because it is pinned to the worm. Driver force exerted at the steering wheel

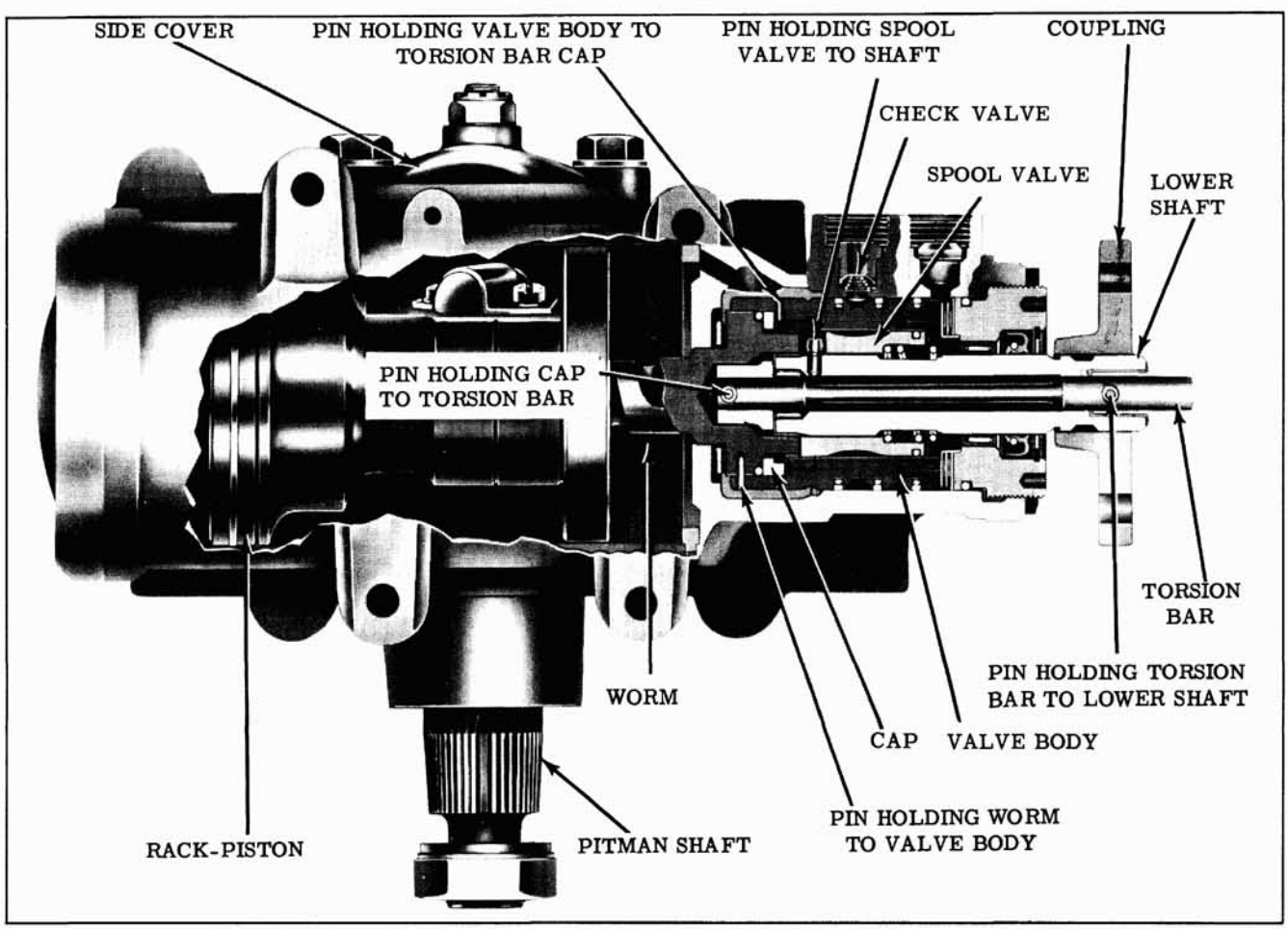


Fig. 9-41—Power Steering Gear

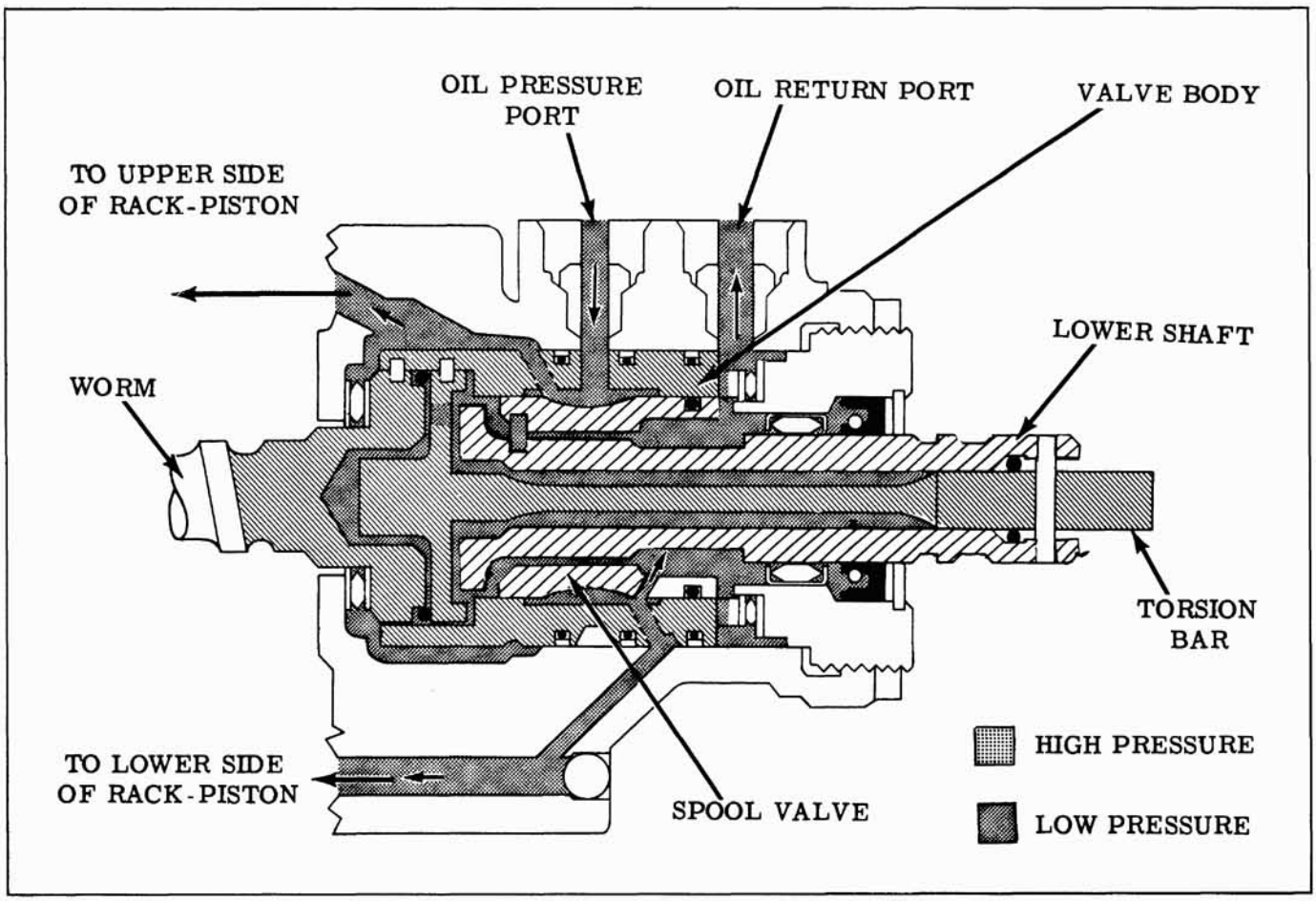


Fig. 9-42—Neutral Position

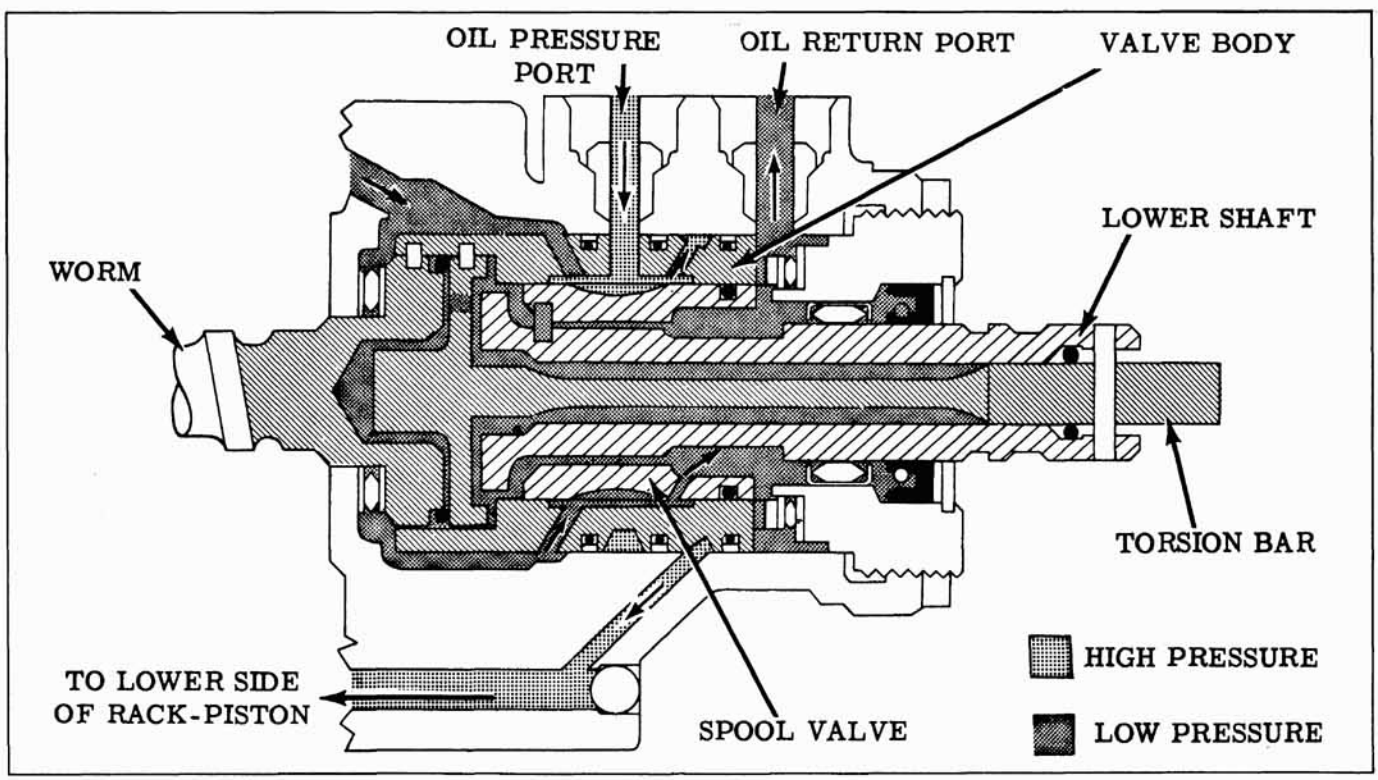


Fig. 9-43—Right Turn Position

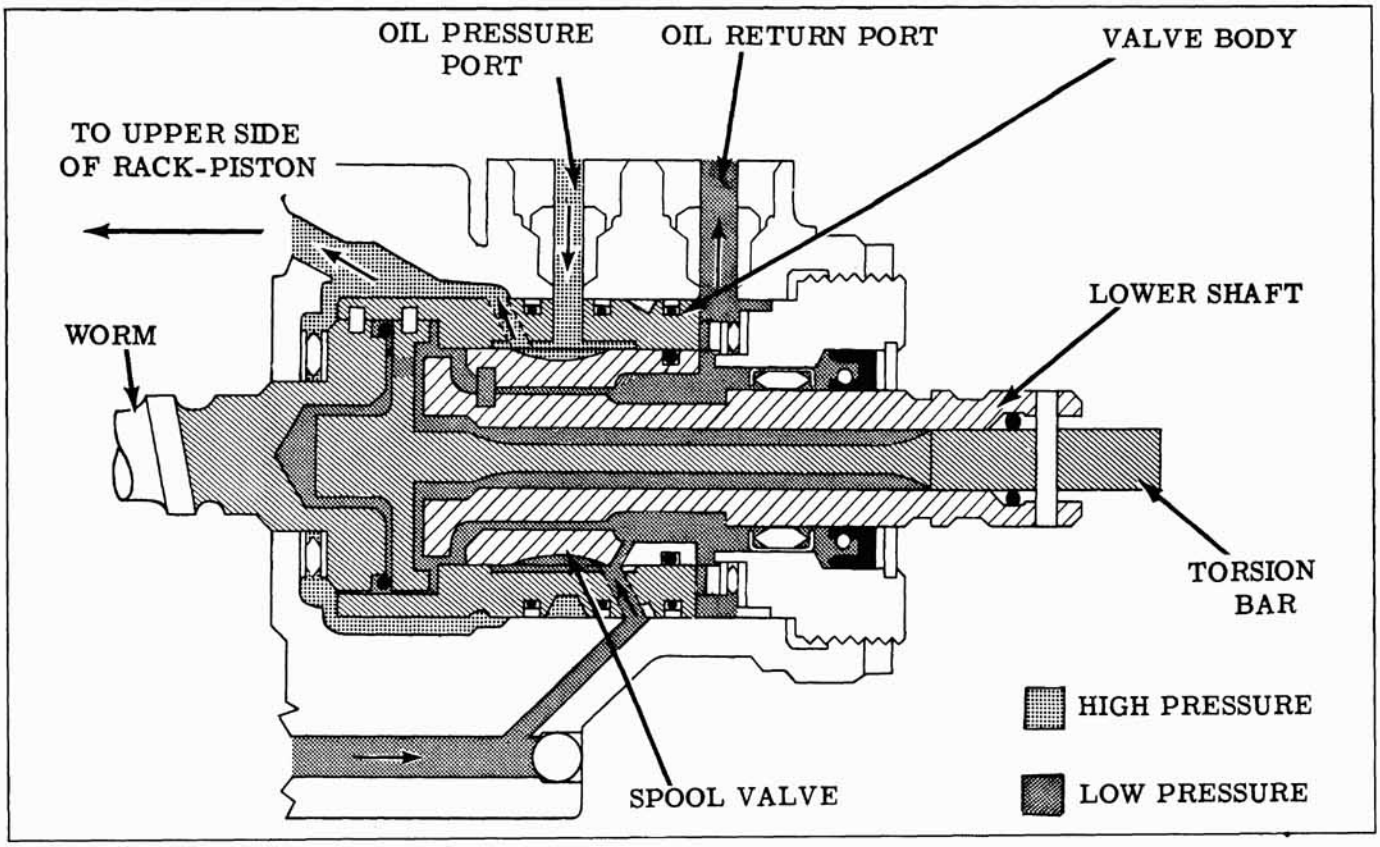


Fig. 9-44—Left Turn Position

turns the lower shaft and spool valve a slight amount in relation to the valve body because of the twisting action of the torsion bar. This slight amount of turning of the spool valve is sufficient to position the slots in the valve body and spool valve for power assist.

The right turn slots in the spool valve are closed off from the return (wide) slots in the valve body and opened more to the pressure (narrow) slots in the valve body. The left turn slots in the spool valve are closed off from the pressure slots in the valve body and opened more to the return slots in the valve body.

Pressure immediately begins to build up against the lower end of the rack-piston, forcing it upward to apply turning effort to the pitman shaft. The oil in the chamber at the upper end of the rack-piston is then forced out through the valve body and spool valve through the oil return port to the pump reservoir.

The instant the driver stops applying turning effort to the steering wheel, the spool valve is forced back into its neutral position by the torsion bar. Oil pressure on the lower end of the rack-piston then decreases so that pressure is again equal on both sides of the rack-piston, and the front wheels return to the straight ahead position, when the car is moving.

Under normal driving conditions, oil pressure does not exceed 200 psi except when turning corners where it does not ordinarily exceed 600 psi. Oil pressure, when parking, ranges from 900 to 1,300 psi depending upon road conditions and weight of the car. The steering effort during normal driving, ranges from 1 to 2 lbs. and during parking from 2 to 3-1/2 lbs. again depending upon road conditions.

A check valve located under the high pressure connector seat (Fig. 9-41) hydraulically dampens the shock transmitted to the steering gear when driving on washboard roads.

LEFT TURN (Fig. 9-44)

When the steering wheel is turned to the left, the relationship between the spool valve slots and valve body slots is again changed through twisting of the torsion bar. Pressure immediately builds up against the upper end of the rack-piston, forcing it downward to apply turning effort to the pitman shaft. The oil in the chamber at the lower end of the rack-piston is forced out through the valve body and spool valve to the pump reservoir.

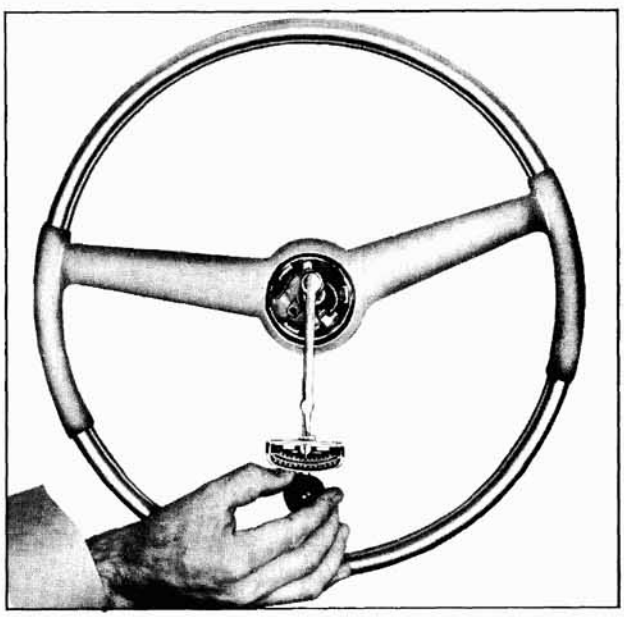


Fig. 9-45—Checking Worm Bearing Pre-load

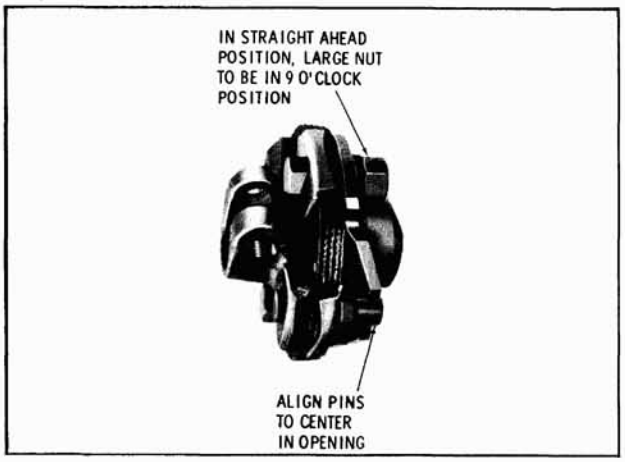


Fig. 9-46—Flex-Coupling

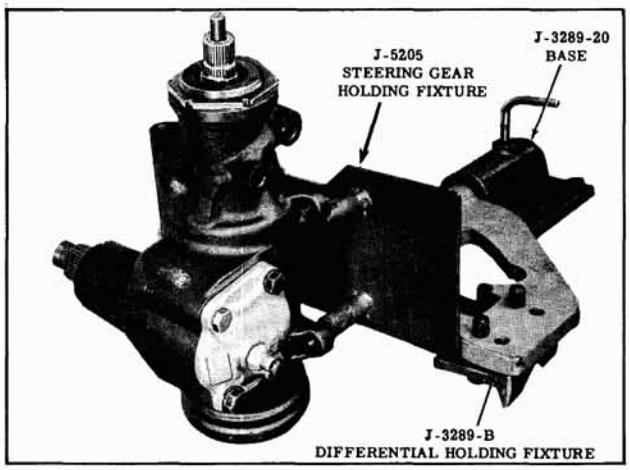


Fig. 9-48—Holding Fixture J-5205

ADJUSTMENT (ON CAR)

OVERCENTER ADJUSTMENT

The overcenter adjustment is the only power steering gear adjustment which can be made on the car; however, in order to make this adjustment, it is also necessary to check the combined ball and thrust bearing pre-load.

1. Remove the pitman shaft nut, then disconnect the pitman arm from the pitman shaft using Puller J-5504-B or a similar puller.
2. Loosen the pitman shaft adjusting screw locknut and thread the adjusting screw out to the limit of its travel through the pitman shaft side cover, then turn the screw back 1/2 turn.
3. Disconnect the horn wire at the relay, then remove the horn button or ornament from the steering wheel.
4. Count the number of turns of the steering wheel through its full travel to locate the steering wheel at its center of travel.
5. Check the combined ball and thrust bearing pre-load with an inch-pound torque wrench on the steering shaft nut by rotating through the center of travel. (Fig. 9-45) Note the highest reading.
6. Tighten the pitman shaft adjusting screw until the torque wrench reads 4 to 8 in. lbs. higher than the previous reading on the steering shaft. Rotate torque wrench through the center of travel (at least 1/2 turn each side of center) while making this adjustment. The total overcenter pre-load should not exceed 16 in. lbs.
7. While holding the pitman shaft adjusting screw, tighten the locknut and recheck the adjustment.
8. Install the horn button or ornament and connect the horn wire. Connect the pitman arm to the pitman shaft. Torque pitman shaft nut to 150 ft. lbs.

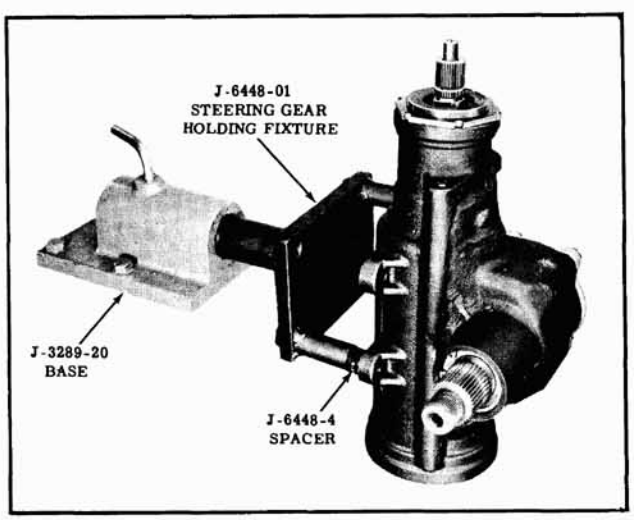


Fig. 9-47—Holding Fixture J-6448-01

Removal and Installation

1. Remove the coupling flange hub bolt. (Fig. 9-46)
2. Disconnect the hoses from the pump and cap the pump and hose fittings.
3. Hoist the car.
4. Remove the pitman shaft nut, then disconnect the pitman arm from the pitman shaft using Puller J-5504-B or a similar puller.
5. Remove the three bolts attaching the gear to the frame side rail, permit the lower shaft to slide free of the coupling flange then remove the gear with the hoses attached.

Before installing the steering gear, apply a sodium soap fine fiber grease to the gear mounting pads to prevent squeaks between the gear housing and the frame. Before positioning the gear, note that the flat on the gear lower shaft must index with the flat in the coupling flange. Make certain there is a minimum of .040" clearance between coupling hub and steering gear upper seal. Install the coupling flange hub bolt and torque to 25 ft. lbs. Before tightening the steering gear to frame bolts, shift the steering gear as necessary to place it in the same plane as the steering shaft so that the flexible coupling is not distorted. Tighten the steering gear to frame bolts to 80 ft. lbs. and the pitman shaft nut to 150 ft. lbs.

After the hoses are connected to the pump, add Power Steering Fluid No. 1050017 or equivalent as necessary to bring the fluid level to the full mark. Run engine at idle for 30 seconds, then run at fast idle for one minute before turning steering wheel. With the engine running, turn the steering wheel through its full travel two or three times to bleed air from the system. Recheck the oil level and add oil if necessary.

Disassembly

In many cases, complete disassembly of the gear will not be necessary since most of the component parts can be removed without complete disassembly of the gear. The procedure for such operations are not specifically outlined; however, the following basic procedure and specifications will apply.

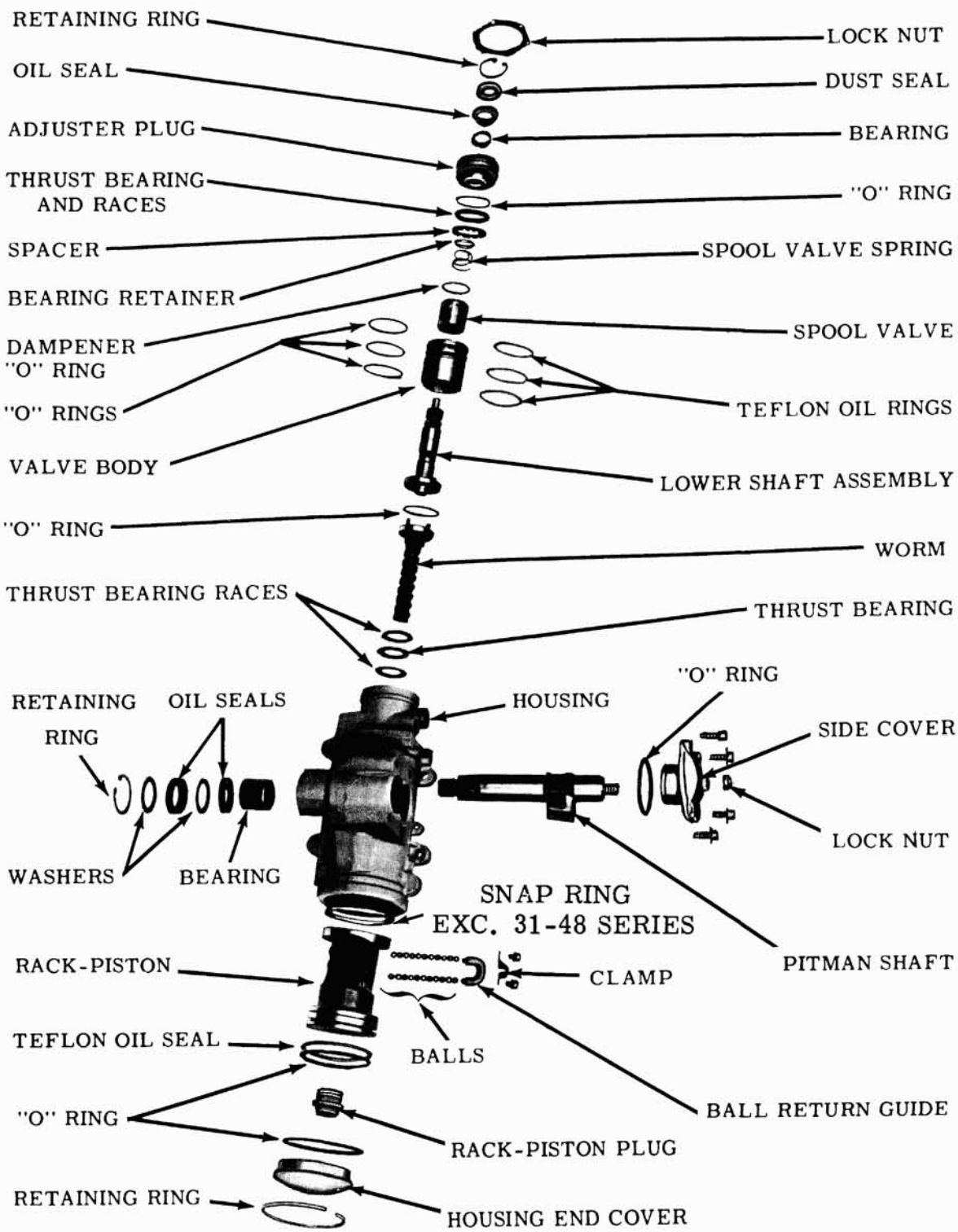


Fig. 9-49—Power Steering Gear

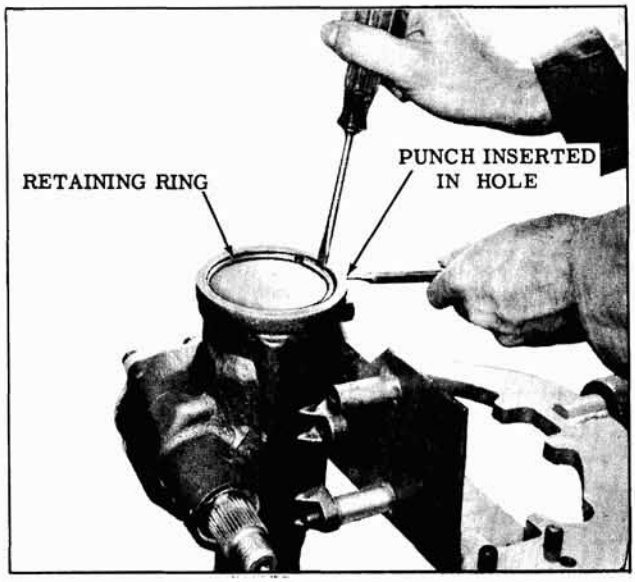


Fig. 9-50—Removing End Cover Ring

To facilitate servicing of the gear, the gear should be mounted in Holding Fixture J-6448-01 (Fig. 9-47) or Holding Fixture J-5205. Holding Fixture J-5205 is designed to be used with Modified Differential Holding Fixture J-3289-B. (Fig. 9-48)

1. Rotate end cover retaining ring so that one end of the ring is over hole in side of housing then force end of ring from its groove and remove ring. (Fig. 9-50)
2. Turn lower shaft counterclockwise until rack-piston just forces end cover out of housing, otherwise the worm may thread out of the rack-piston and the balls will fall out of their circuit. Remove cover and discard "O" ring.
3. Remove the rack-piston plug from rack-piston as shown in Fig. 9-51.
4. Remove the pitman shaft and side cover as follows:
   a. Loosen the overcenter adjusting screw locknut and remove the four side cover attaching cap screws and three lockwashers.
   b. Rotate side cover until the rack-piston and pitman shaft teeth are visible, then turn the coupling flange until the pitman shaft teeth are centered in the housing opening. Tap pitman shaft with a soft hammer and remove the pitman shaft and side cover from the housing. Remove the side cover "O" ring and discard.

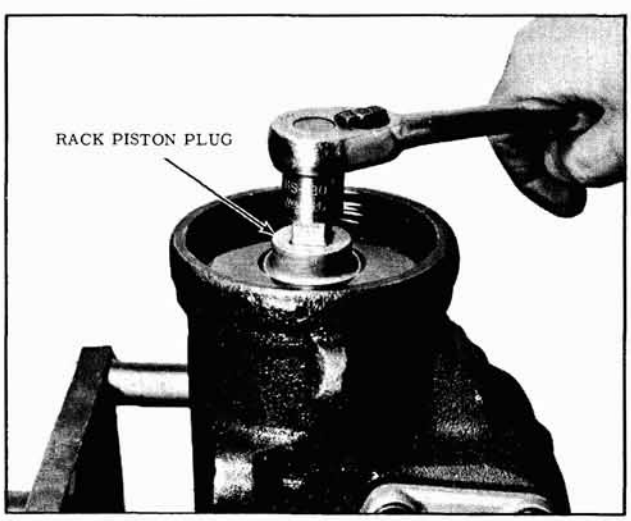


Fig. 9-51—Removing Rack-Piston Plug

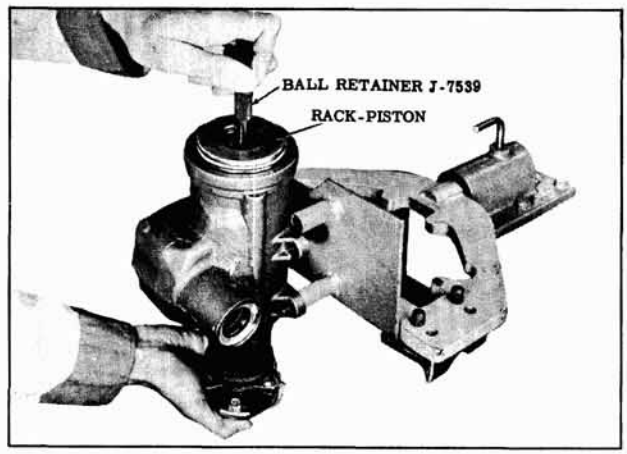


Fig. 9-52—Removing Rack-Piston

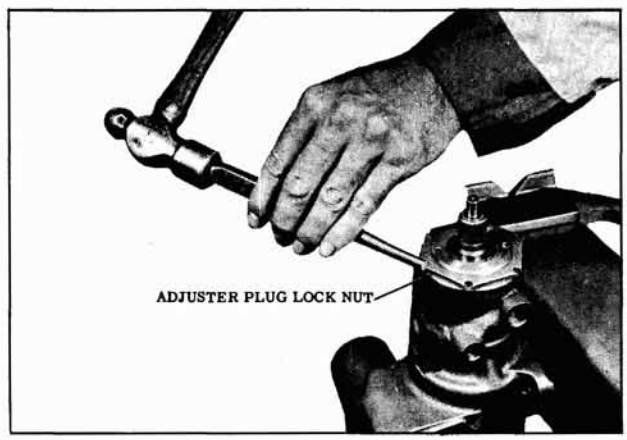


Fig. 9-53—Loosening Locknut

5. Remove the rack-piston as follows:
   a. Insert Ball Retainer Tool J-7539 into the rack-piston bore with pilot of tool seated in the end of the worm. (Fig. 9-52) Turn lower shaft counterclockwise while holding tool tightly against worm. The rack-piston will be forced onto the tool.
   b. Remove the rack-piston with Ball Retainer Tool J-7539 from gear housing.
6. Remove the adjuster plug as follows:
   a. Loosen the adjuster plug locknut with punch. (Fig. 9-53)

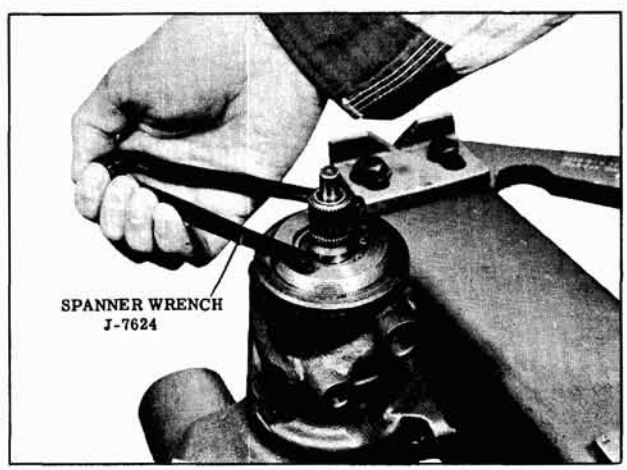


Fig. 9-54—Removing Adjuster Plug

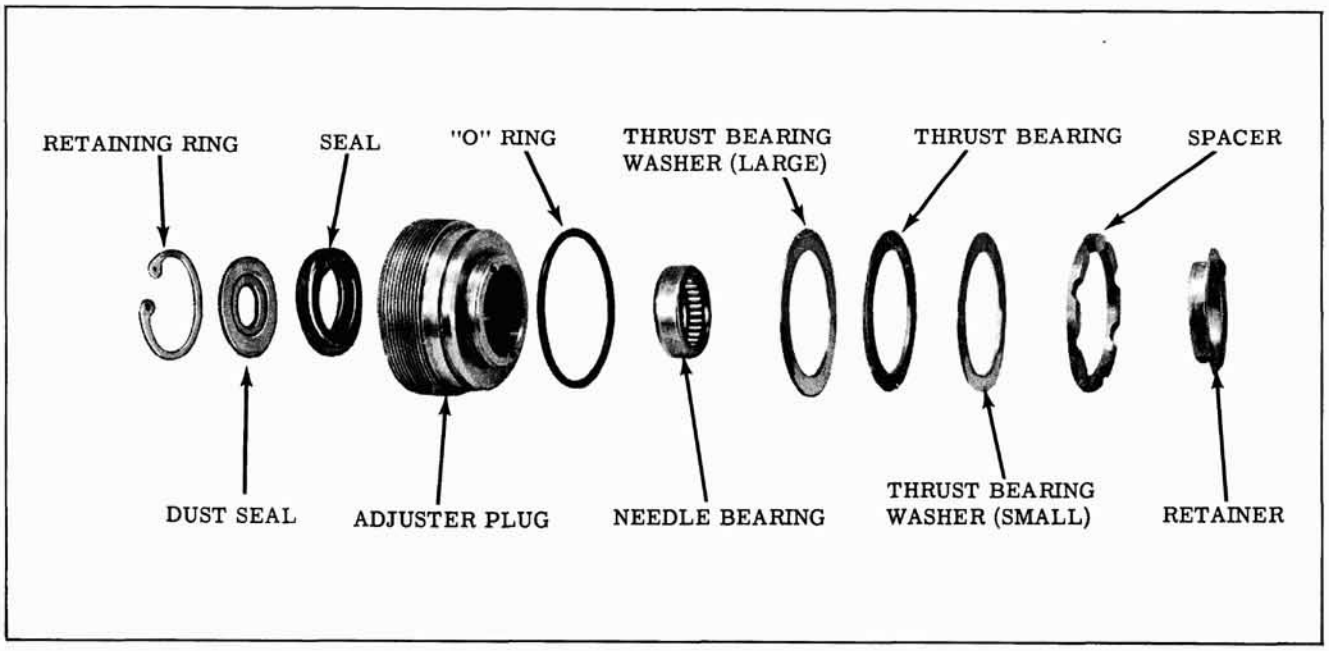


Fig. 9-55—Adjuster Plug Assembly

b. Remove adjuster plug assembly with Spanner Wrench J-7624. (Fig. 9-54) Remove and discard the plug "O" ring.

7. Grasp the lower shaft and pull the valve and shaft assembly from the housing bore. Separate worm and shaft and remove the lower shaft cap "O" ring and discard.

8. If the worm or lower thrust bearing and race(s) remained in the gear housing, remove at this time.

SERVICING INDIVIDUAL UNITS

ADJUSTER PLUG ASSEMBLY (Fig. 9-55)

Disassembly

1. Remove the thrust bearing retainer by prying at the two raised areas with an awl or small screwdriver, remove the thrust bearing spacer, thrust bearing and washers.

2. If the seal ONLY is to be replaced and not the bearing, remove the retaining ring with internal pliers, then remove the dust seal. Pry the seal from the bore of the adjuster plug. Discard seal.

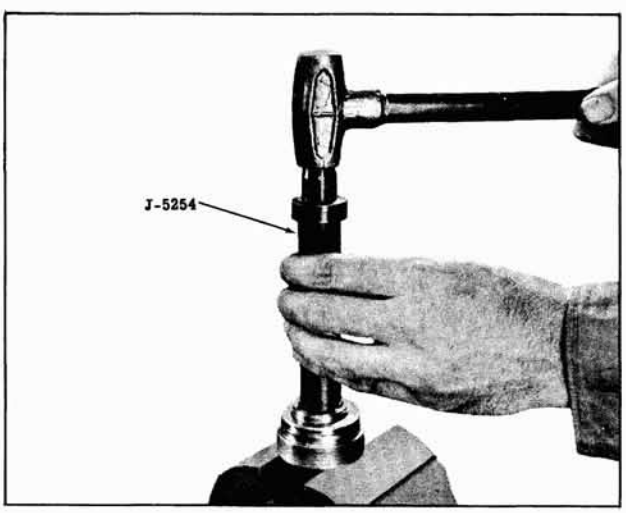


Fig. 9-56—Seal and Bearing Removal

3. If the needle bearing is to be replaced, remove the retaining ring using internal pliers, then drive the dust seal, seal and bearings from the adjuster plug with Tool J-5254. (Fig. 9-56) Discard seal and bearing.

Cleaning and Inspection

1. Wash all parts in clean solvent and dry parts with compressed air.

2. Inspect thrust bearing spacer for wear or cracks. Replace if damaged.

3. Inspect thrust bearing rollers and washers for wear, pitting or scores. If any of these conditions exists, replace the bearing and washers.

Assembly

1. If the needle bearing was removed, place new needle bearing over Tool J-5254 with the manufacturer's identification against the tool and drive or press bearing until it is flush with the surface of the seal bore. (Fig. 9-57)

2. If seal was removed, temporarily install the adjuster plug in the gear housing and place dust seal and a new oil seal on Tool J-5254 (lip of seal away from tool). Lubricate seal with oil, No. 1050017 or equivalent and drive or press seal

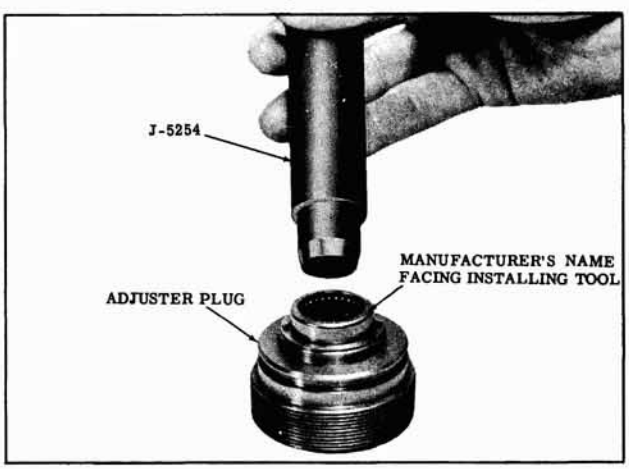


Fig. 9-57—Installing Bearing

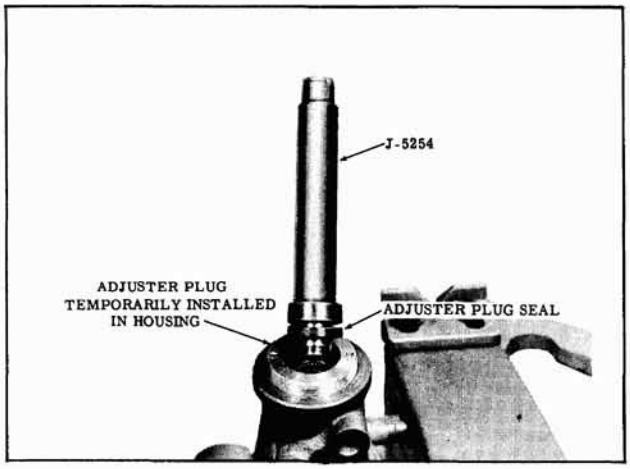


Fig. 9-58—Installing Seal

into adjuster plug just far enough to provide clearance for the dust seal and the retaining ring. (Fig. 9-58) Tool J-5254 must be free of burrs that could scratch the seal.

3. Install dust shield.

4. Install retaining ring with internal pliers, then remove the adjuster plug from the housing.

5. Lubricate the thrust bearing assembly with oil, No. 1050017 or equivalent. Place the large thrust bearing washer on the adjuster plug hub, then install the upper thrust bearing, small bearing washer and spacer (grooves of spacer away from bearing washer).

6. Install a new bearing retainer on the adjuster plug by carefully tapping on the flat surface of the retainer. (Fig. 9-59)

The projections must not extend beyond the spacer when the retainer is seated. The spacer must be free to rotate.

VALVE AND LOWER SHAFT ASSEMBLY (Fig. 9-60)

Disassembly

1. Remove the spool valve spring by carefully prying top coil out of groove in the lower shaft, then slide the spring from the shaft.

2. To remove the lower shaft assembly from the valve body, proceed as follows:

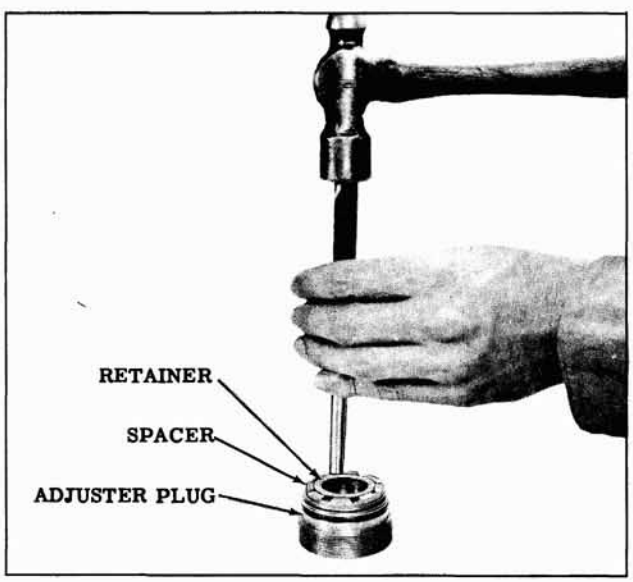


Fig. 9-59—Installing Bearing Retainer

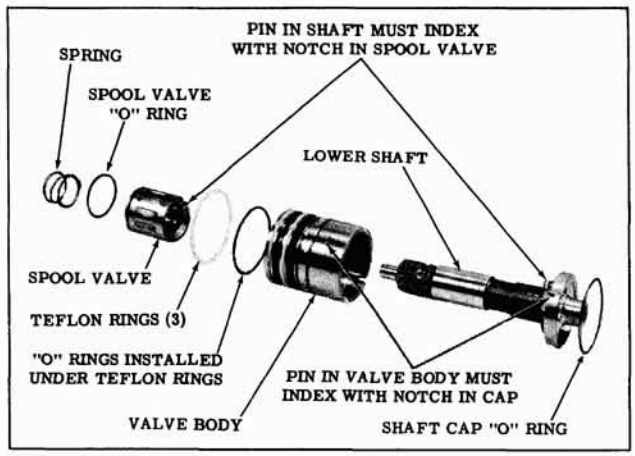


Fig. 9-60—Valve and Lower Shaft Assembly

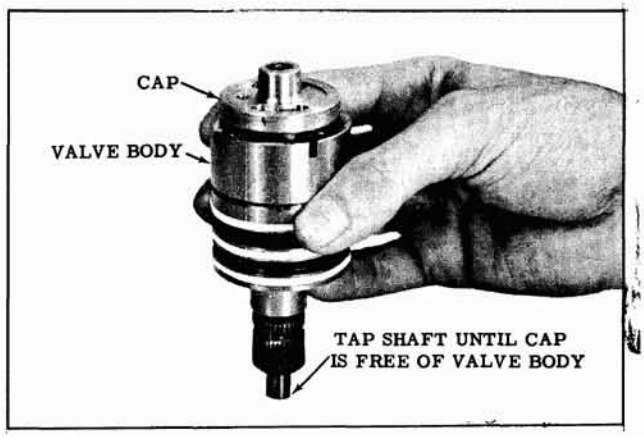


Fig. 9-61—Freeing Shaft Cap

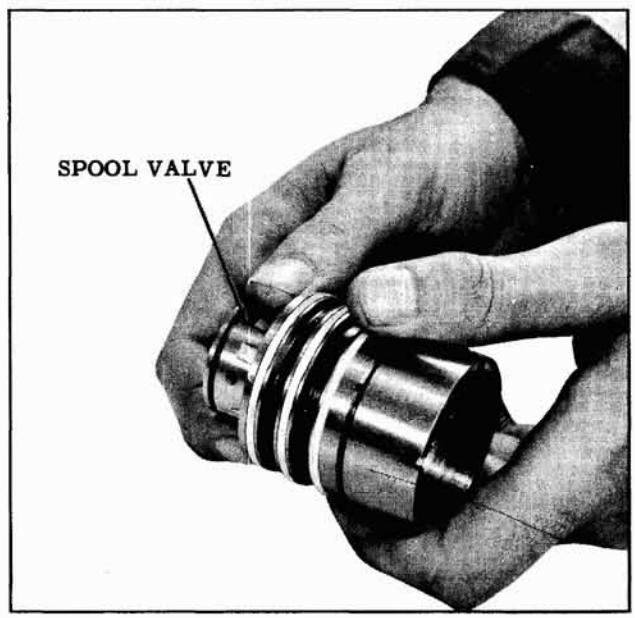


Fig. 9-62—Removing Spool Valve

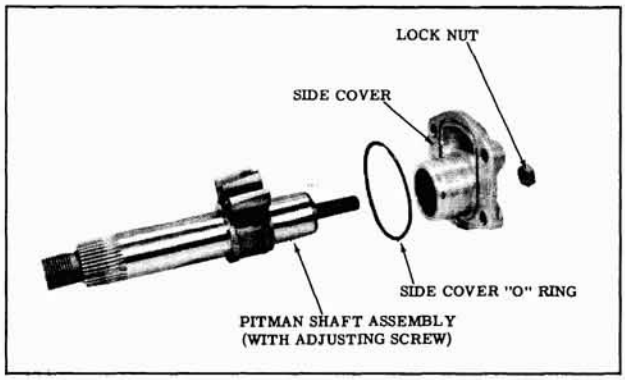


Fig. 9-63—Pitman Shaft and Side Cover

a. While holding the assembly (lower shaft down), lightly tap the lower shaft against the bench until the shaft cap is free from the valve body. (Fig. 9-61) The spool valve should be held in the valve body while tapping the shaft.

b. Carefully remove the lower shaft assembly so as not to cock the spool valve in the valve body.

3. Push the spool valve out of the flush end of the valve body until the dampener "O" ring is exposed, then carefully pull the spool from the valve body while rotating the valve. (Fig. 9-62) If the spool valve becomes cocked, reverse the withdrawal procedure, then again attempt to remove the valve.

Do not attempt to force the spool valve in or out of the valve body. If the spool is cocked in the valve body, straighten the spool by tapping with a plastic or rawhide mallet, then push the spool back into the body and repeat the removal procedure.

4. Remove the dampener "O" ring from the spool valve and discard.

5. If the teflon oil rings are to be replaced, cut the three teflon oil rings and "O" rings from the valve body and discard.

Cleaning and Inspection

1. Wash all parts in clean solvent and blow out all oil holes with compressed air.

2. If the drive pin in the lower shaft or valve body is cracked, or broken, replace the complete valve and shaft assembly.

3. If there is evidence of leakage between the torsion bar and the lower shaft, or scores, nicks, or burrs on the ground surface of the lower shaft that cannot be cleaned up with crocus cloth, the entire valve and shaft assembly must be replaced.

4. Check the OD of the spool valve and the ID of the valve body for nicks, burrs, or bad wear spots. If the irregularities cannot be cleaned up by the use of crocus cloth, the complete valve and shaft assembly will have to be replaced.

5. If the small notch in the skirt of the valve body is excessively worn, the complete valve and shaft assembly will have to be replaced.

6. Lubricate the spool valve with oil No. 1050017 or equivalent and check the fit of the spool valve in the valve body (with the spool valve dampener "O" ring removed). If the valve does not rotate freely without binding, the complete valve and shaft assembly will have to be replaced.

7. Check the overall length of the spool valve spring. The spring should be approximately 3/4". If it is less than 11/16", replace the spring.

Assembly (Fig. 9-60)

1. Install the three valve body "O" rings in the oil ring grooves and lubricate with oil No. 1050017 or equivalent.

2. Lubricate the three teflon oil rings with petrolatum and install in grooves over "O" rings.

The oil rings may appear to be distorted, but the heat of the oil during operation of the gear will straighten them out.

3. Assemble the lower shaft assembly in the valve body so the notch in the lower shaft cap engages with the pin in the valve body. (Fig. 9-60) If necessary, tap the shaft cap with a plastic hammer until cap is seated in the valve body.

4. Install the spool valve as follows:

a. Lubricate the spool valve dampener "O" ring with petrolatum and install over spool valve.

b. Lubricate the spool valve with oil No. 1050017 or equivalent and slide the valve over the lower shaft (notch in spool towards the valve body). Rotate the spool valve while pushing the valve into the valve body until the notch in the spool engages the pin in the lower shaft.

c. Center the dampener "O" ring into its groove until the spool valve can be pushed all the way in to the valve body. The spool valve is properly seated when it is flush with the top of valve body.

Exercise care during this operation so the "O" ring will not be cut.

5. Slide the valve spring over the lower shaft and down into the spool valve until the top coil of the spring is in the shaft groove.

PITMAN SHAFT AND SIDE COVER (Fig. 9-63)

Disassembly

Remove the locknut and side cover from the adjusting screw. Do not attempt to disassemble pitman shaft. Discard locknut.

The power steering gear is equipped with a self-adjusting type of pitman shaft which automatically compensates for wear of the rack piston teeth and pitman shaft teeth and keeps the overcenter adjustment within specifications for a limited mileage (up to approximately 10,000 miles). This is accomplished by the use of a wear washer and a heavy spring in the pitman shaft assembly. The wear washer is calibrated to wear at the same rate as the other components of the gear. Replacement pitman shafts do not have this feature and adjusting screw torque is zero.

In cases where gear chucking or "clunk" cannot be corrected by performing the overcenter adjustment (See POWER STEERING GEAR ADJUSTMENT-ON CAR), the trouble may be due to excessive wear in the pitman shaft or a broken spring in the pitman shaft.

To check the pitman shaft for excessive wear or a broken spring:

1. With the side cover removed from the pitman shaft, clamp the shaft in a vise and thread two 7/16" SAE nuts on the adjusting screw. Tighten nuts so they are locked on the screw.

2. Using a 5/8" socket and an inch-pound torque wrench, measure the torque required to turn the adjusting screw. (Fig. 9-64) Torque reading should be 1 to 15 in. lbs.

3. If the reading is not within this range, the complete pitman shaft assembly must be replaced. DO NOT ATTEMPT TO CORRECT READING BY DISASSEMBLING THE PITMAN SHAFT.

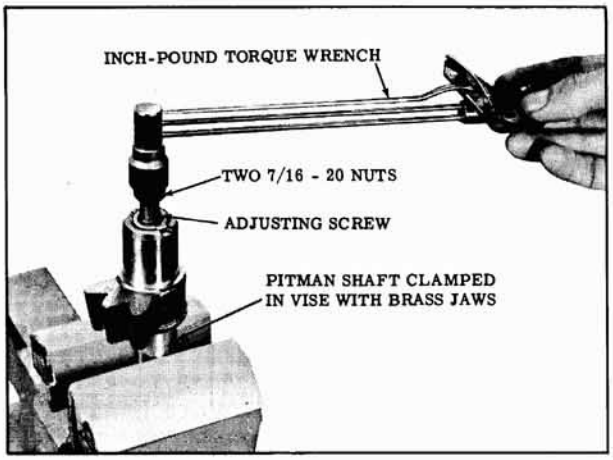


Fig. 9-64—Checking Adjusting Screw Torque

4. Remove the torque wrench and the two 7/16" nuts from the adjusting screw.

Cleaning and Inspection

1. Wash all parts in clean solvent and dry parts with compressed air.
2. Check pitman shaft bearing surface in the side cover for scoring. If badly worn or scored, replace the side cover.
3. Check the sealing and bearing surfaces of the pitman shaft for roughness, nicks, etc. If minor irregularities in surface cannot be cleaned by use of crocus cloth, replace the pitman shaft.
4. Replace pitman shaft assembly if teeth are damaged or if the bearing surfaces are pitted or scored.

Assembly

Thread the side cover onto the pitman shaft adjusting screw until it bottoms. Install, but do not tighten, a new adjusting screw locknut.

RACK-PISTON

Disassembly

1. Check the ball pre-load as follows:
   a. Lightly clamp the rack-piston assembly in a brass jawed vise with Tool J-7539 still in place.
   b. Thread worm into rack-piston while holding Tool J-7539 tightly against worm so the balls will not fall out of the rack-piston. When the worm is in place, remove Tool J-7539.

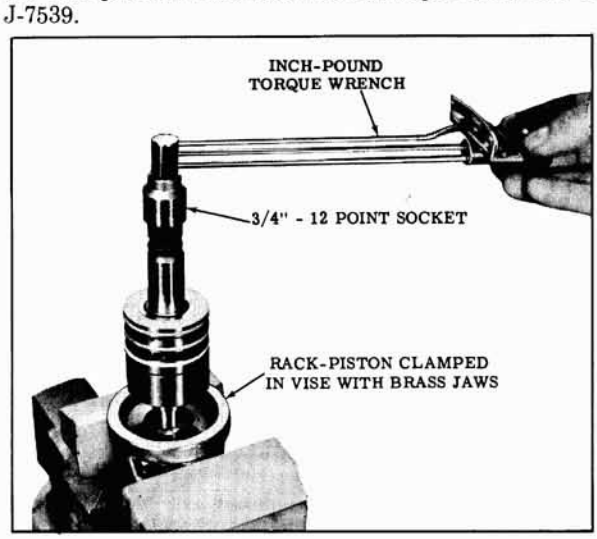


Fig. 9-65—Checking Pre-load

   c. Clamp rack-piston (flanged end of worm up) in vise, then install the valve and lower shaft assembly so that the small notch in the valve body engages the drive pin in the worm. Locate the overcenter position of the worm by slowly turning the worm and noting the area where the turning effort is highest. DO NOT THREAD THE WORM OUT TOO FAR SINCE THIS MAY CAUSE SOME OF THE BALLS TO DROP OUT OF THE RACK-PISTON.
   d. Using a torque wrench and a 3/4" 12 point socket, check the pre-load while rotating the torque wrench in a 120° arc. The reading should be 1 to 4 in. lbs. (Fig. 9-65)
   e. If the pre-load is not within limits, a new set of balls must be installed upon reassembly. Install the next size larger balls to increase the pre-load or the next size smaller balls to decrease the pre-load, black balls need not be replaced unless they are defective. A change of one ball size will change the pre-load approximately 1 in. lb.

Standard ball size is number 7.

   f. Remove the torque wrench and valve and shaft assembly.
2. Thread the worm out of the rack-piston, remove ball return guide clamp, guide halves and balls.
3. If necessary to replace the teflon oil seal and "O" ring, remove at this time.

Cleaning and Inspection

1. Wash all parts in clean solvent and dry with compressed air.
2. Inspect the worm and rack-piston grooves and all the balls for scoring. If either the worm or rack-piston needs replacing, both must be replaced as a matched assembly.
3. Inspect ball return guide halves, making sure that the ends where the balls enter and leave the guides are not damaged.
4. Inspect lower thrust bearing and washers for scores or excessive wear. If any of these conditions are found, replace the thrust bearing and washers.
5. Inspect rack-piston teeth for scores or excessive wear. Inspect the external ground surfaces for wear, scoring or burrs.
6. Inspect the rack-piston stop ring (inside of housing) and replace if damaged.

Stop ring not used in 31 through 48 Series.

Assembly

1. If the teflon oil seal and "O" ring were removed, install a new "O" ring and seal lubricated with oil, No. 1050017 or equivalent in the groove of the rack-piston.
2. Slide the worm all the way into the rack-piston. It is not

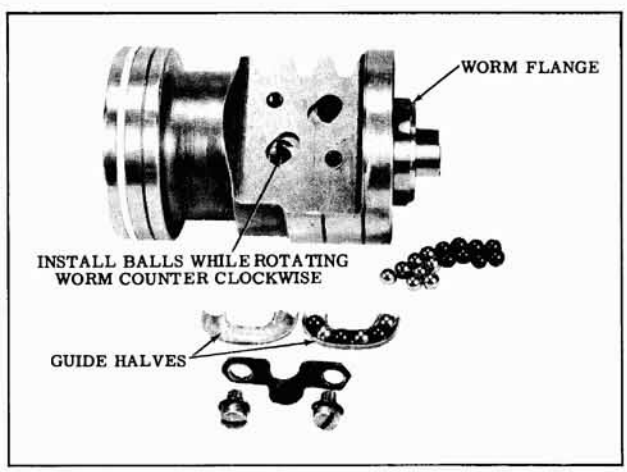


Fig. 9-66—Installing Balls in Rack Piston

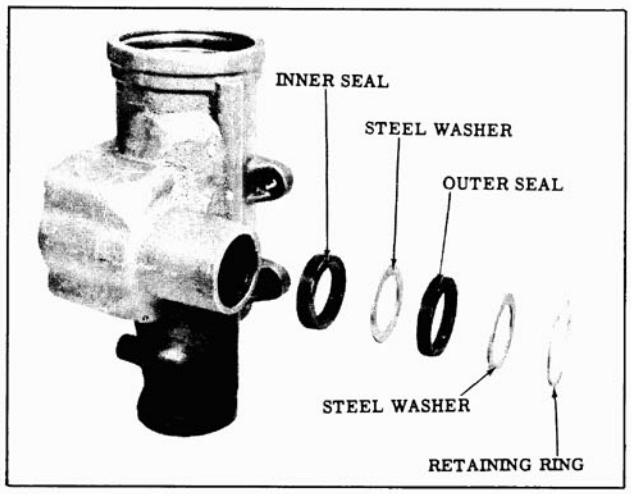


Fig. 9-67—Pitman Shaft Seals

necessary to have the thrust bearing assembly on the worm at this time.

3. Turn the worm until the worm groove is aligned with the lower ball return guide hole. (Fig. 9-66)

4. Lubricate the balls with oil No. 1050017 or equivalent, then feed 16 balls into the rack-piston while slowly rotating the worm counterclockwise.

The black balls are .0005" smaller than the silver balls. The black and silver balls must be installed alternately into the rack-piston and return guide. If the balls have been in use, dark coloring may be almost entirely worn off so that there is only a slight color difference.

5. Alternately install six balls into the return guide and retain with petrolatum. Install the return guide assembly onto the rack-piston. Install the return guide clamp and tighten the two clamp screws to 12 ft. lbs.

6. Check the ball pre-load if it was necessary to install a new set of balls to correct the pre-load. Refer to RACK-PISTON - DISASSEMBLY (Step 1).

7. Insert Bearing Retainer Tool J-7539 into the rack-piston, then while holding tool tightly against end of worm, thread worm out of the rack-piston.

PITMAN SHAFT NEEDLE BEARING AND SEALS (Fig. 9-67)

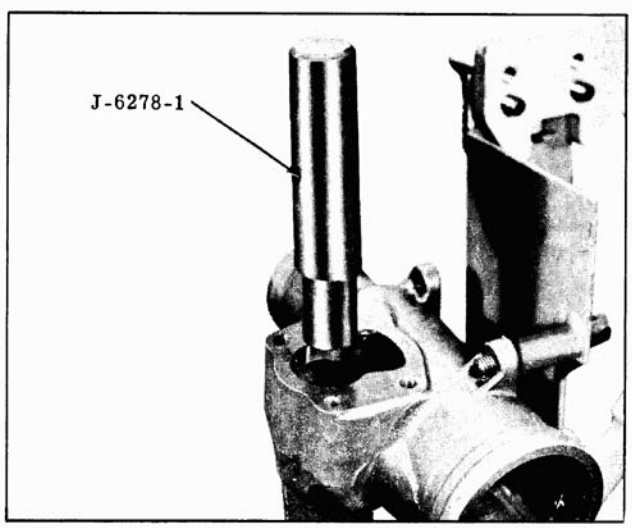


Fig. 9-68—Needle Bearing and Seal Removal

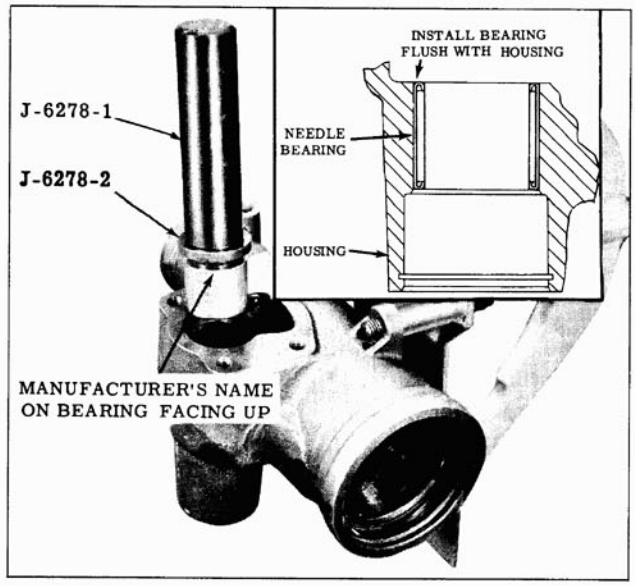


Fig. 9-69—Installing Needle Bearing

Remove

1. If pitman shaft seals ONLY are to be replaced, remove the seal retaining ring and outer steel washer, then pry out the outer seal. Remove the inner steel washer, then drive out the inner seal.

2. If pitman shaft needle bearing replacement is necessary, remove the seal retaining ring, outer steel washer, then drive needle bearing, seals and inner washer out with Tool J-6278-1. (Fig. 9-68)

Install

1. If the pitman shaft needle bearing was removed, place Adapter J-6278-2 over Tool J-6278-1; slide the new needle bearing on the tool with the manufacturer's identification against the adapter and drive the bearing into the housing until adapter bottoms in housing. (Fig. 9-69)

2. Coat the lips of the oil seals with special lubricant, No. 1050169 or equivalent.

3. Install the pitman shaft oil seals as follows:

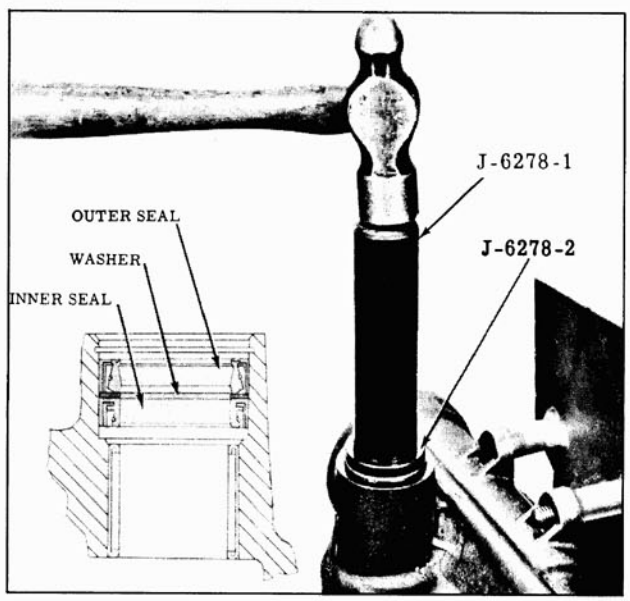


Fig. 9-70—Installing Oil Seals

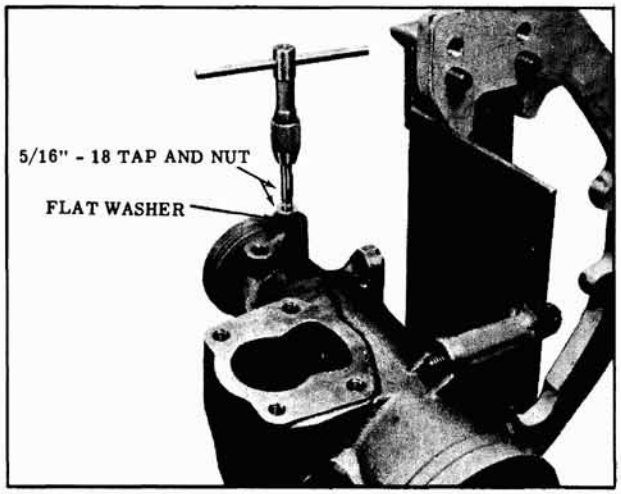


Fig. 9-71—Removing Connector Seat

a. Place Adapter J-6278-2 over Tool J-6278-1; then install the outer seal, inner steel washer, and inner seal with the lips on the seals facing away from the adapter.

b. Drive the seals into the housing until the top of Adapter J-6278-2 is flush with the housing. (Fig. 9-70)

c. Remove the tool and adapter, then install the outer steel washer and seal retaining ring. The retaining ring will not seat in the groove at this time.

d. Reinsert Tool J-6278-1 with Adapter J-6278-2 and continue driving the seals until the retainining ring seats in its groove (inset, Fig. 9-70), then remove the tool and adapter.

HOSE CONNECTORS

Remove

If the hose connections were leaking at the connector seats in the housing, remove one or both connector seats as follows:

1. Thread a nut and place a washer on a 5/16"-18 tap.
2. If the connector seat is being removed from an assembled gear, coat the end of the tap with petrolatum to prevent chips from entering the passage while tapping the seat.
3. With the steering gear in a vertical position, thread the tap into the connector seat not more than three turns. (Fig. 9-71)
4. Tighten the nut to remove the seat.

A check valve and spring is located below the high pressure connector seat and can be replaced when seat is removed.

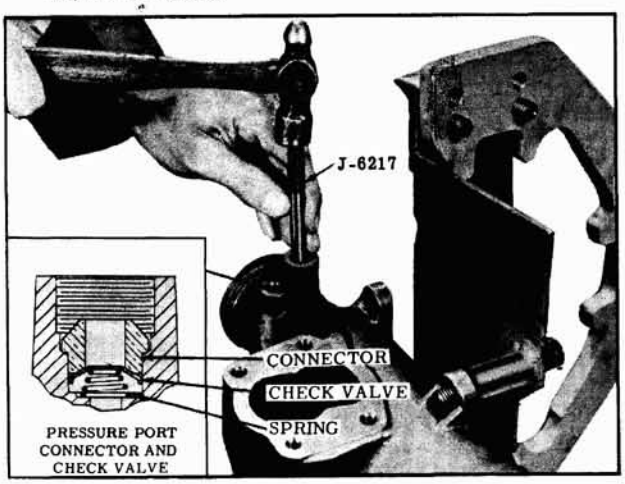


Fig. 9-72—Installing Connector Seat

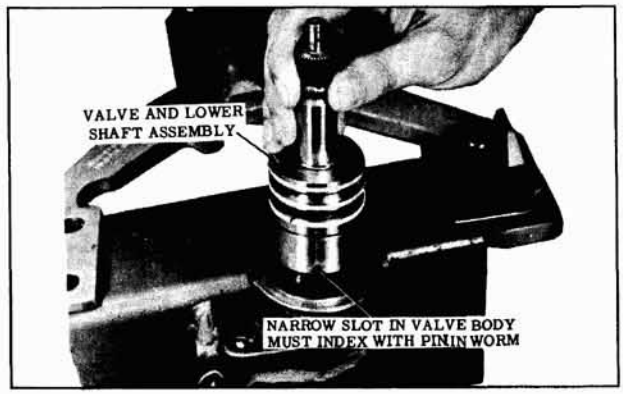


Fig. 9-73—Installing Valve and Lower Shaft Assembly

Install

To install a new connector seat, use Tool J-6217 to seat it in the housing. (Fig. 9-72)

STEERING GEAR ASSEMBLY

1. Install the worm as follows:

a. Lubricate the worm, lower thrust bearing and the two thrust washers with oil No. 1050017 or equivalent, then install one thrust washer, the bearing, and the other thrust washer over the end of the worm.

b. With the valve bore end of gear housing down, insert the worm and thrust bearing assembly into the housing. While holding the worm in place, turn the gear housing so the valve bore end of the housing is up.

2. Install the valve and lower shaft assembly as follows:

a. Lubricate the valve body teflon rings and a new lower shaft cap "O" ring with petrolatum. Install the lower shaft cap "O" ring in the valve body so it is seated against the lower shaft cap. Align the NARROW NOTCH in the valve body with the pin in the worm, then install the valve and shaft assembly in the gear housing. (Fig. 9-73) Apply pressure to the VALVE BODY when installing. If pressure is applied to the lower shaft during installation, the shaft may be forced out of the valve body.

The valve body is properly seated when the oil return hole in the housing is entirely uncovered. (Fig. 9-74)

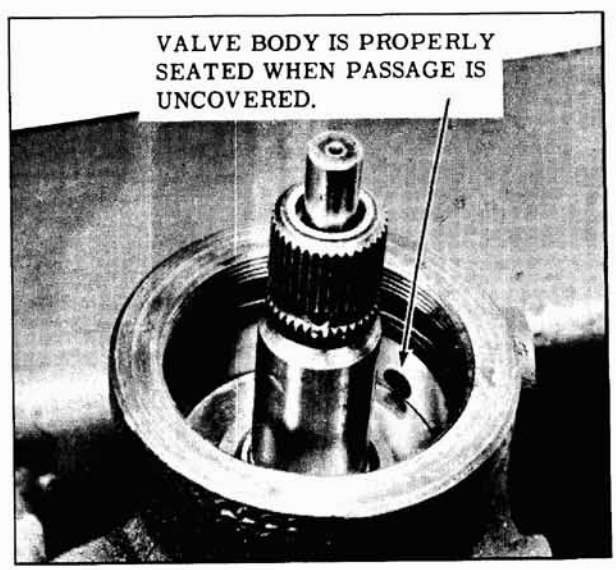


Fig. 9-74—Valve Body Properly Seated

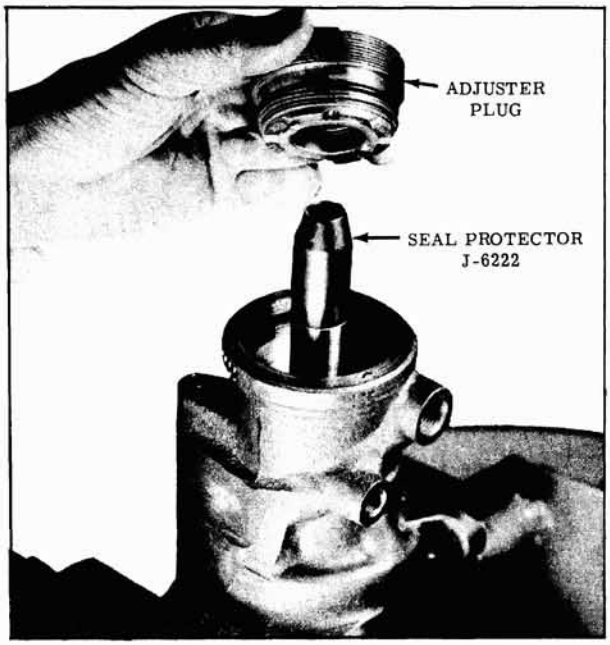


Fig. 9-75—Installing Adjuster Plug

3. Lubricate a new adjuster plug "O" ring with petrolatum and install in groove on adjuster plug. Place Seal Protector J-6222 over lower shaft, then install the adjuster plug assembly in the housing until it seats against the valve body. (Fig. 9-75) Remove Seal Protector. Do not adjust the thrust bearing pre-load at this time.

4. Install the rack-piston as follows:

a. Lubricate the rack-piston teflon seal with petrolatum.

b. With the rack-piston bore of the housing facing up, position Seal Compressor J-7576 against the shoulder in the housing.

c. With Ball Retainer J-7539 in place in the rack-piston, push the rack-piston into the housing until Tool J-7539 contacts the worm. (Fig. 9-76)

d. Turn the lower shaft clockwise with a 3/4" 12-point socket or a replacement coupling flange to thread the rack-piston onto the worm while holding Tool J-7539 against the end of the worm.

e. When the rack-piston is completely threaded on the worm, remove Ball Retainer J-7539 and Seal Compressor J-7576.

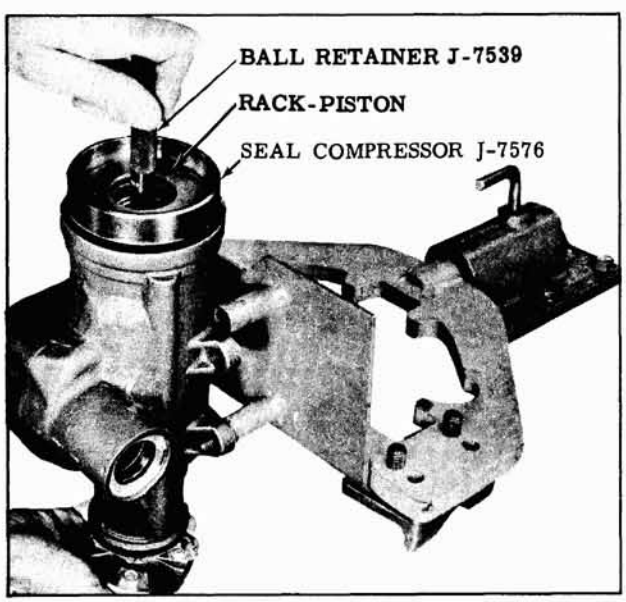


Fig. 9-76—Installing Rack Piston

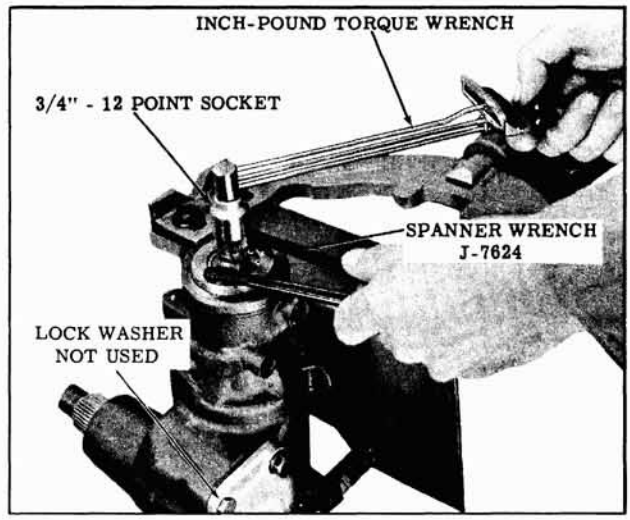


Fig. 9-77—Adjusting Thrust Bearing Pre-load

5. Install the rack-piston plug in the rack-piston and torque to 65 ft. lbs.

6. Install a new housing end cover "O" ring and lubricate it with petrolatum, then install the end cover and retaining ring.

7. Install the pitman shaft and side cover as follows:

a. Install a new "O" ring in the pitman shaft side cover and retain with petrolatum.

b. Turn the lower shaft until the rack-piston teeth are centered in the pitman shaft opening, then install the pitman shaft and side cover so that the center tooth of the pitman shaft engages the center groove of the rack-piston.

c. Install the four side cover bolts and three lockwashers and tighten to 30 ft. lbs. Refer to Fig. 9-77 for washer location.

8. Adjust the thrust bearing pre-load as follows:

a. Turn the adjuster plug clockwise with Spanner Wrench J-7624 until it is tight, then loosen it 1/8 turn.

b. Install an inch-pound torque wrench with a 3/4" 12-point socket on the lower shaft splines. (Fig. 9-77)

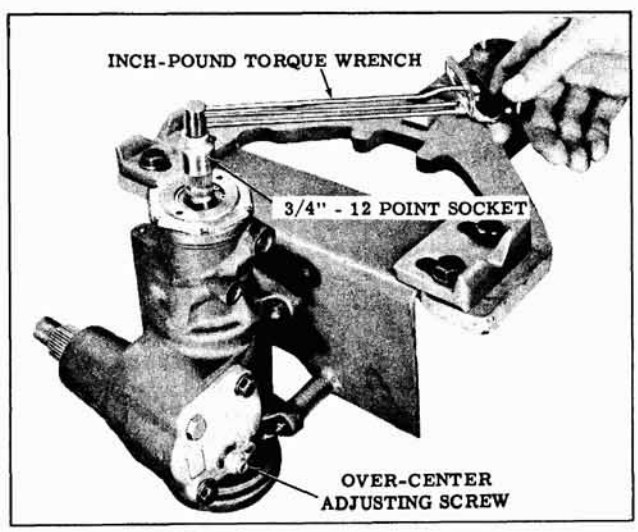


Fig. 9-78—Checking Over-Center Pre-load

c. Rotate the torque wrench in a 45° arc and note the highest reading.

d. Tighten the adjuster plug with Spanner Wrench J-7624 until the torque wrench reads 1 to 3 in. lbs. higher than the initial load reading.

e. Install the adjuster plug locknut and tighten with Spanner Wrench J-972-A.

f. Recheck the adjustment to be sure it is still only 1 to 3 in. lbs. higher than the initial load reading. If the adjustment changed when tightening the locknut, readjust the adjuster plug.

9. Adjust the overcenter pre-load as follows:

a. Make sure the overcenter adjusting screw is backed all the way out.

b. Install an inch-pound torque wrench with a 3/4" 12-point socket on the lower shaft splines.

c. Rotate the lower shaft from one stop to the other to count the number of turns and locate the center of travel, then check the combined ball and thrust bearing pre-load by rotating the torque wrench through the center of travel. (Fig. 9-78) Note the highest reading.

d. Tighten the pitman shaft adjusting screw until the torque wrench reads 4 to 8 in. lbs. higher than the previous reading. The total reading should not exceed 16 in. lbs.

e. While holding the adjusting screw, tighten the locknut and recheck the adjustment.

10. Position the coupling flange onto the lower shaft, then install the flange attaching bolt and lockwasher. Position the flange so that there is a minimum of .040" clearance between the coupling hub and steering gear upper seal.

DIAGNOSIS OF MANUAL AND POWER STEERING

Items identified by (M.S.) apply to manual steering only and items identified by (P.S.) apply to power steering only All items not identified by (M.S.) or (P.S.) apply to both units.

HARD STEERING WHILE DRIVING OR POOR RETURN OF STEERING TO CENTER

CAUSE	CORRECTION
1. Tight steering shaft bearings.	1. Replace bearings.
2. Lower coupling flange rubbing against adjuster plug. (P.S.)	2. Loosen bolt and reposition for clearance.
3. Steering wheel rubbing against turn signal collar.	3. Adjust mast jacket endwise.
4. Tires not properly inflated.	4. Inflate to specifications.
5. Steering linkage tie-rod joints misaligned.	5. Loosen tie-rod sleeve and center ball joint.
6. Steering gear misaligned.	6. Align at frame.
7. Tight overcenter adjustment.	7. Adjust in car to specifications.
8. Thrust bearing adjustment too tight.	8. Adjust to specifications.
9. Ball pre-load too tight. (P.S.)	9. Remove gear and change ball size as required.
10. Loose pump belt.	10. Adjust to specifications.
11. Sticky spool valve. (P.S.)	11. Remove and clean valve or replace valve assembly.
12. Lack of lubricant in steering linkage.	12. Lubricate linkage.
13. Sticking pump flow control valve. (P.S.)	13. Remove valve and clean.

CAR LEADS TO ONE SIDE OR THE OTHER

CAUSE	CORRECTION
1. Front end misaligned.	1. Adjust to specifications.
2. Worn or damaged valve shaft assembly. (P.S.)	2. Replace valve and shaft assembly.
If this is the cause, steering effort will be very light in direction of lead and heavy in opposite direction.	

MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO THE RIGHT OR LEFT (P.S.)

CAUSE	CORRECTION
1. Low oil level in pump.	1. Check oil level in pump reservoir.
2. Pump belt slipping.	2. Tighten or replace belt.
3. Excessive internal leakage.	3. Replace rack-piston teflon seal and "O" ring and/or replace spool valve.

DIAGNOSIS OF MANUAL AND POWER STEERING (Cont'd.)

EXTERNAL OIL LEAKS

(WIPE GEAR THOROUGHLY AND MAKE SURE SOURCE OF LEAKAGE IS DETERMINED)

CAUSE	CORRECTION
1. Reservoir oil level too high.	1. Remove excess oil.
2. Damaged reservoir cap.	2. Replace cap.
3. Loose hose connections. (P.S.)	3. Tighten.
4. Damaged hose. (P.S.)	4. Replace.
5. Side cover "O" ring seal. (P.S.)	5. Replace seal.
6. Pitman shaft seals.	6. Replace seals.
7. Housing end cover "O" ring seal. (P.S.)	7. Replace seal.
8. Adjuster plug seals. (P.S.)	8. Replace seals.
9. Torsion bar seal. (P.S.)	9. Replace valve and shaft assembly.
10. Defective housing.	10. Replace housing.

GEAR NOISE (RATTLE, CREAK OR CHUCKING)

CAUSE	CORRECTION
1. Loose overcenter adjustment. **A slight rattle may occur on turns because of the increased lash off the "high point". This is normal and the lash must not be reduced below the specified limits to eliminate this slight rattle.**	1. Adjust to specification.
2. Gear loose on frame.	2. Check gear to frame mounting bolts. Tighten bolts to specification.
3. Loose steering linkage.	3. Check linkage pivot points for wear.

GEAR NOISE ("HISSING" SOUND) (P.S.)

There is some noise in all power steering systems. One of the most common is a "hissing" sound most evident at standstill parking. There is no relationship between the noise and performance of the gear. "Hiss" may be expected when steering wheel is at end of travel or when slowly turning at standstill.	Do not replace valve and shaft assembly unless "hiss" is extremely objectionable. Slight "hissing" is satisfactory and in no way affects steering. A replacement valve and shaft assembly may also exhibit slight noise and is not always a cure for the objection. Check clearance around drive bolts in flexible coupling. Be sure steering shaft and gear are aligned so the flexible coupling rotates in a flat plane and is not distorted as shaft rotates. Any metal to metal contact through the flexible coupling will transmit the valve "hiss" into the car.

LOOSE STEERING

CAUSE	CORRECTION
1. Lash in steering linkage.	1. Replace parts affected.
2. Lash between pitman shaft and rack-piston.	2. Make overcenter adjustment.
3. Loose thrust bearing adjustment.	3. Adjust to specification.
4. Ball and worm pre-load incorrect. (P.S.)	4. Remove rack-piston and worm, and change balls to obtain specified pre-load.
5. Ball joint lash.	

STEERING WHEEL SURGES OR JERKS WHEN TURNING, ENGINE RUNNING, ESPECIALLY DURING PARKING (P.S.)

CAUSE	CORRECTION
1. Loose pump belt.	1. Adjust to specification.
2. Sticky flow control valve.	2. Inspect for varnish or damage, replace if necessary.

DIAGNOSIS OF MANUAL AND POWER STEERING (Cont'd.)

HARD STEERING WHEN PARKING

CAUSE	CORRECTION
1. Loose pump belt. (P.S.)	1. Adjust to specification.
2. Low oil in reservoir. (P.S.)	2. Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage.
3. Lack of lubricant in ball joints or steering linkage.	3. Add lubricant.
4. Tires not properly inflated.	4. Inflate to recommended pressure.
5. Insufficient oil pressure. (P.S.)	5. If all of the above checks do not reveal the cause of hard steering, make the following tests of oil pressure. a. Disconnect the pressure line at pump, then install Gauge Set J-5176-01. (Fig. 9-79) b. With engine at slow idle and gauge valve open, note the oil pressure on the gauge while turning steering wheel from one extreme position to the other. Especially note the maximum pressure which can be built up with the wheel held in either right or left extreme position. **Do not hold wheel in extreme position for an extended period of time because it will drastically increase the oil temperature and will cause undue wear on the pump.** c. With oil temperature between 150°F. and 170°F. (measured with a thermometer in the reservoir) oil pressure should not be less than 850 psi - L-6, 1050 psi - V8-exc. Toronado, 1200 psi - Toronado for satisfactory power steering operation. d. If the maximum oil pressure is less than specified in step "c", it indicates trouble in the pump, hoses, steering gear, or a combination of these parts. To eliminate the hoses and gear, close the gauge valve and quickly test pressure of the pump only with the engine at slow idle, then open the valve to avoid increasing oil temperature. e. Comparing the maximum pressure obtained in these two tests will indicate source of trouble as follows: (1) First step (step c) pressure low, and second test (step d) pressure normal - indicates faulty hoses or steering gear. (2) First test (step c) and second test (step d) pressure equally low - indicates faulty oil pump.
6. Low oil pressure due to restriction in hose. (P.S.)	6. Clean or replace as required.
7. Low oil pressure due to steering gear. (P.S.) a. Pressure loss in cylinder due to worn rack-piston seal, damaged "O" ring or scored housing bore. b. Leakage at valve rings, valve body to worm seal. c. Loose fit of spool in valve body or leaky valve body.	7. Remove steering gear for disassembly. a. Inspect rack-piston seal and "O" ring and housing bore. b. Replace rings and seals. c. Replace valve and shaft assembly.

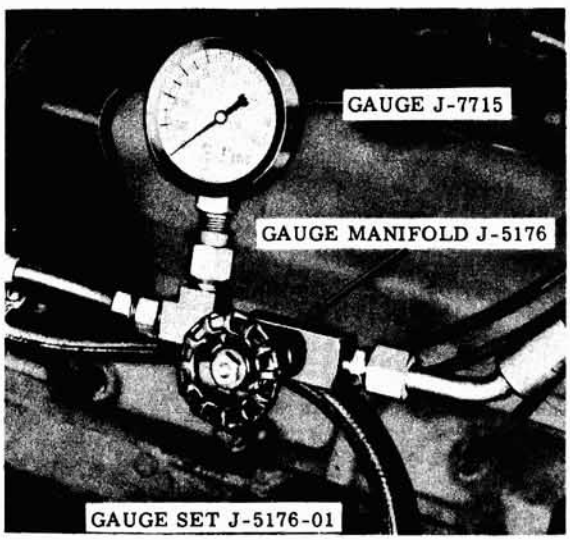


Fig. 9-79—Oil Pressure Gauge

VALVE "SQUAWK" WHEN TURNING OR WHEN RECOVERING FROM A TURN (P.S.)

CAUSE	CORRECTION
1. Cut or worn dampener "O" ring on spool valve.	1. Replace dampener ring.
2. Loose or worn valve.	2. Replace valve and shaft assembly.

DIAGNOSIS OF MANUAL AND POWER STEERING (Cont'd.)

NO EFFORT REQUIRED TO TURN (P.S.)

CAUSE	CORRECTION
Broken torsion bar.	Replace valve and shaft assembly.

PUMP NOISE

CAUSE	CORRECTION
1. Loose belt.	1. Tighten belt.
2. Hose(s) touching other parts of car.	2. Adjust hose position.
3. Low oil level.	3. Fill reservoir.
4. Air in the oil.	4. Check oil level.
5. Excessive back pressure caused by hoses or steering gear.	5. Locate restriction and correct.
6. Scored pressure plate.	6. Lap away light scoring. Replace heavily scored part.
7. Vanes not installed properly.	7. Install properly.
8. Vanes sticking in rotor slots.	8. Free up by removing burrs or dirt.
9. Extreme wear of pump ring.	9. Replace part.
10. Face of thrust plate scored.	10. Lap away light scoring. Replace heavily scored part.
11. Scored rotor.	11. Lap away light scoring. Replace heavily scored part.

INOPERATIVE, POOR, OR NO ASSIST: (PUMP ASSEMBLY)

CAUSE	CORRECTION
1. Loose drive belt.	1. Tighten belt.
2. Low oil level.	2. Fill reservoir.
3. Air in the oil.	3. Add oil to pump reservoir.
4. Flow control valve stuck.	4. Remove burrs or dirt.
5. Vanes sticking in rotor slots.	5. Free up by removing burrs or dirt.
6. Faulty flow control valve assembly.	6. Clean and free up parts. Replace part(s) as necessary.

GENERAL SPECIFICATIONS

MANUAL STEERING

RATIO	24:1
LUBRICANT	Water Resistant E.P. (Multi-Purpose Gear Lubricant)
ADJUSTMENTS	
1. Worm Bearing Pre-Load	4 to 8 in. lbs.
2. Overcenter Adjustment	4 to 10 in. lbs. in excess of worm bearing pre-load (16 in. lbs. Max.)
3. Pitman Shaft Adjusting Screw End Clearance	.002" Max.

POWER STEERING

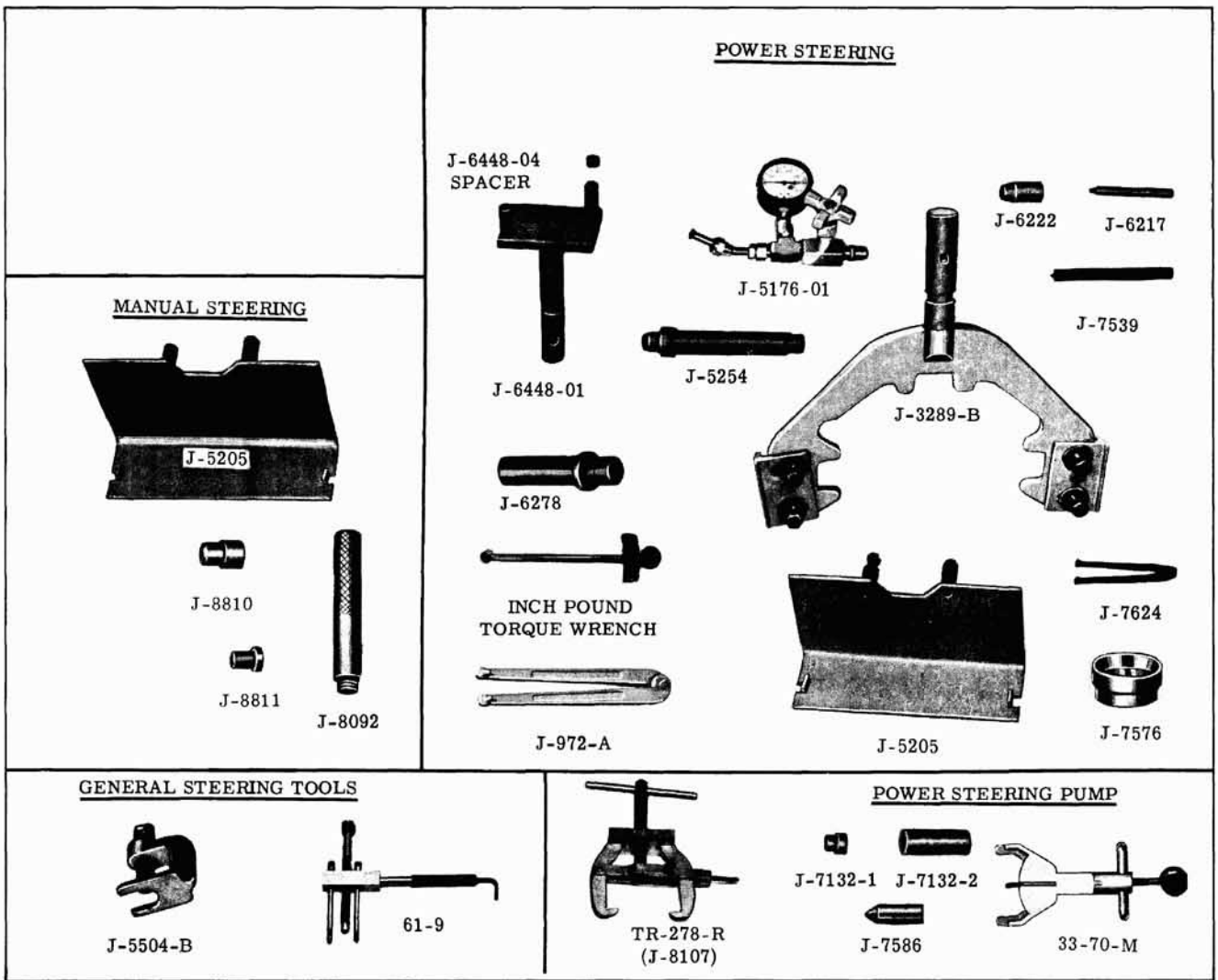
Ratio	17.5:1
LUBRICATION	
4. Lubricant	Power Steering Fluid No. 1050017 or equivalent
5. Capacity - Complete System	1-3/4 Qts.
6. Capacity - Pump Only	1 Qt.
ADJUSTMENTS	
7. Ball Pre-load	1 to 4 in. lbs.
8. Thrust Bearing Pre-load	1 to 3 in. lbs. in excess of initial load
9. Overcenter Adjustment	4 to 8 in. lbs. in excess of combined ball and thrust bearing pre-load

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

Application	Ft. Lbs.
STEERING LINKAGE	
Idler Arm Support to Frame Nuts	40
Tie Rod Clamp Nuts	15
Tie Rod to Steering Arm and Relay Rod Nuts	45
Steering Wheel Nut	35
Idler and Pitman Arm to Relay Rod Nut	45 *
Tie Rod to Relay Rod Nut	45 *
MANUAL STEERING GEAR	
Gear to Frame Bolts	70
Pitman Shaft Nut	135
Side Cover Bolts	30
Pitman Shaft Adjusting Screw Locknut	27
Bearing Pre-load Adjuster Locknut	100
Coupling Flange Nuts	15
POWER STEERING PUMP	
Pulley Nut	45
Pump Mounting Stud	35
Union	35
Flow Control Valve Plug	4
Pressure Hose	35
POWER STEERING GEAR	
Gear to Frame Bolts	70
High Pressure Line Fitting (At Gear)	35
Oil Return Line Fitting (At Gear)	35
Pitman Shaft Adjusting Screw Locknut	30
Side Cover Bolts	35
Adjuster Plug Locknut	110
Coupling Flange Nuts	15
Return Guide Clamp Screws	12
Rack-Piston Plug	65
Pitman Shaft Nut	150

* Do not back off to insert cotter pin - turn to next hole.



BT-61-9	Steering Wheel Puller
TR-278-R	(J-8107) Differential Side Bearing Puller (Used for Pump End Cover Installation)
J-3289-B	Differential Holding Fixture (Used for Mounting Gear Holding Fixture J-5405)
33-70 M	Belt Tensioning Gauge
J-5176-01	Pressure Testing Manifold (Used with Gauge J-7715)
J-5254	End Cover Seal and Needle Bearing Installer (Used for Removing and Installing Adjuster Plug Oil Seal and Needle Bearing)
J-5205	Steering Gear Holding Fixture
J-5504-B	Pitman Arm Puller
J-6217	Hose Connector Installer
J-6222	End Cover Seal Protector (Used for Installing Adjuster Plug
J-6278	Pitman Shaft Bearing Remover and Installer
J-6278-2	Adapter (Used with J-6278 for Installing Pitman Shaft Seals and Bearing)
J-6448-01	Power Steering Gear Holding Fixture
J-6448-04	Spacer (Used With J-6448-01)
J-7132-1	Seal Protector
J-7132-2	Seal Installer
J-7539	Ball Retainer
J-7576	Rack-Piston Teflon Ring Compressor
J-7586	Pump Oil Seal Protector
J-7624	Spanner Wrench (Used for Removing and Installing Adjuster Plug. Also used for Adjusting Thrust Bearing Preload)
J-7715	Pressure Testing Gauge (Used with Gauge Manifold J-5176)
J-8092	Drive Handle
J-8810	Pitman Shaft Bushing Installer
J-8811	Upper Bearing Race Installer and Pitman Shaft Oil Seal Installer
J-972-A	Differential Adjusting Nut Wrench (Used for Tightening Adjuster Plug Locknut)

Fig. 9-80—Tools

STEERING

STEERING WHEELS AND COLUMNS

CONTENTS OF SECTION 9A

Subject	Page
DESCRIPTION	9A-1
STEERING WHEEL AND HORN CONTACT (EXCEPT TILT AND TRAVEL) HORN CAP OR EMBLEM	9A-2
STEERING WHEEL	9A-2
STEERING WHEEL (TILT AND TRAVEL)	9A-4
SHROUD	9A-5
HORN UPPER CONTACT ASSY. AND LOCKING LEVER	9A-5
STEERING COLUMNS	
REMOVAL	9A-6
INSTALLATION	9A-11
In Car Procedures	
TURN SIGNAL SWITCH	
EXC. TILT-AWAY OR TILT AND TRAVEL	
DISASSEMBLY	9A-11
ASSEMBLY	9A-14
TILT-AWAY	
REMOVAL	9A-16
INSTALLATION	9A-16
TILT AND TRAVEL	
REMOVAL	9A-17
INSTALLATION	9A-17
HOUSING	
EXC. TILT-AWAY OR TILT AND TRAVEL	9A-18
TILT-AWAY	
REMOVAL	9A-18
INSTALLATION	9A-19
TILT AND TRAVEL	
REMOVAL	9A-19
INSTALLATION	9A-20
STEERING SHAFT-EXC. TILT-AWAY OR TILT AND TRAVEL	
REMOVAL	9A-21
INSTALLATION	9A-22
TILT-AWAY	
REMOVAL	9A-22
INSTALLATION	9A-23
TILT AND TRAVEL	
REMOVAL	9A-23
INSTALLATION	9A-24
SUPPORT	
TILT OR TILT AND TRAVEL	
REMOVAL	9A-24
INSTALLATION	9A-25
BOWL	
WITHOUT TILT OR TILT AND TRAVEL	
REMOVAL	9A-25
INSTALLATION	9A-25
Out of Car Procedures	
BOWL, SHIFT TUBE OR JACKET (TILT-AWAY)	
REMOVAL	9A-25
INSTALLATION	9A-26
BOWL, SHIFT TUBE OR JACKET (TILT AND TRAVEL)	
REMOVAL	9A-27
INSTALLATION	9A-29
SHIFT TUBE AND OR JACKET (WITHOUT TILT-AWAY OR TILT AND TRAVEL)	
REMOVAL	9A-32
INSTALLATION	9A-33
NEUTRAL START AND OR BACKUP SWITCH	9A-35
INTERMEDIATE SHAFT AND COUPLING	9A-35
TOOLS	9A-36

DESCRIPTION

The Energy Absorbing Steering Column assembly is used on all series cars. This column is designed to compress under impact. When an automobile is being driven, the forward movement of the automobile and the forward movement of the driver both constitute a form of energy or force. When an automobile is involved in a frontal collision, the primary force (forward movement of the car) is suddenly halted, while the secondary force (the driver) continues its forward direction. A severe collision generally involves these two forces - the primary and the secondary forces. The secondary impact occurs when the driver is thrust forward onto the steering wheel and column.

The Energy Absorbing Column is designed to absorb these primary and secondary forces to the extent that the severity of the secondary impact is reduced. During a collision the steering column compresses, thereby reducing its tendency to move rearward into the driver 's compartment. A split second later when the driver is thrown forward (the secondary impact) his energy is also partially absorbed by the compression characteristics of the column.

The Energy Absorbing Column assembly may be disassembled and reassembled. The serviceman should be aware that it is important that only the specified screws, bolts and nuts be used as designated during reassembly, and that they are tightened to their specified torque. This precaution will insure the energy absorbing action of the assembly. Care should be exercised in using overlength bolts as they may prevent a portion of the assembly from compressing under impact. Equally as important is correct torque of the bolts and nuts. Care should be taken to assure that the bolts or nuts securing the column mounting bracket to the instrumental panel are torqued to the proper specification in order that the bracket will break away under impact.

When the Energy Absorbing Column is installed in a car it is no more susceptible to damage through usage than an ordinary column; however, when the column is removed, special

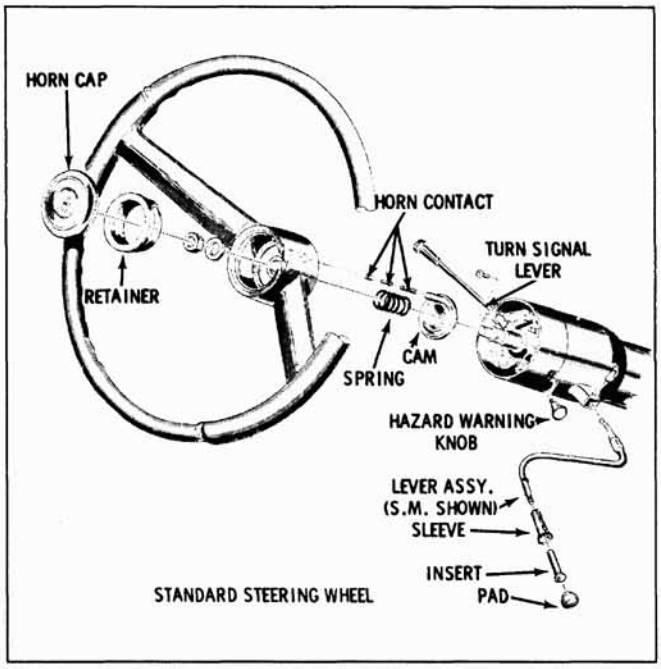


Fig. 9A-1—Standard Steering Wheel (54-86 Series)

care must be taken in handling this assembly. Only the specified wheel puller should be used. When the column is removed from the car, such actions as a sharp blow on the end of the steering shaft or shift levers, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity. It is therefore important that the removal and installation, and the disassembly and reassembly procedures be carefully followed when servicing this assembly.

STEERING WHEEL AND HORN CONTACT (EXCEPT TILT AND TRAVEL)

HORN CAP OR EMBLEM

Removal

1. Disconnect negative battery cable.

Standard Wheel: Pull horn cap and retainer assembly from wheel. Fig. 9A-1 (54-86 Series), Fig. 9A-2 (31-48 Series).

Deluxe Wheel: Carefully pry the emblem assembly from the wheel to disengage locking tabs. Fig. 9A-3 (54-86 Series), Fig. 9A-4 (31-48 Series).

Wood Grain Wheel: Carefully pry the horn cap assembly from wheel. (Fig. 9A-5)

HORN BUTTON CONTACTS

Removal

Remove horn button contact assemblies following exploded views on Figs. 9A-5 and 9A-6.

STEERING WHEEL (Exc. Tilt and Travel)

Removal

1. Remove horn cap or emblem. Refer to Horn Cap or Emblem Removal.
2. Remove the steering wheel attaching nut and washer, then using a puller such as BT-61-9, remove the steering wheel from the steering shaft (Fig. 9A-7). Remove puller from steering wheel.

31-48 deluxe steering wheels require removing middle spoke shroud to install steering wheel puller.

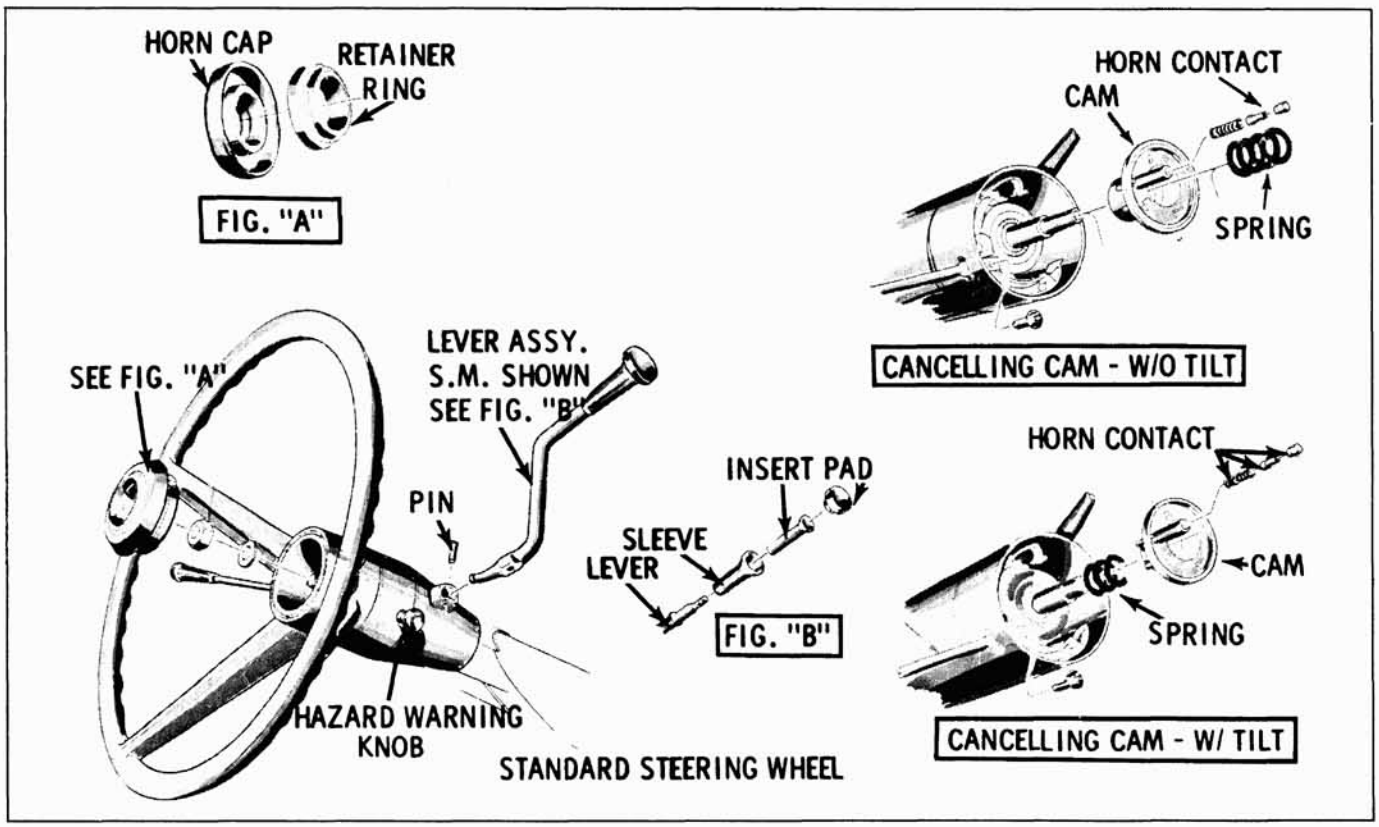


Fig. 9A-2—Standard Steering Wheel (31-48 Series)

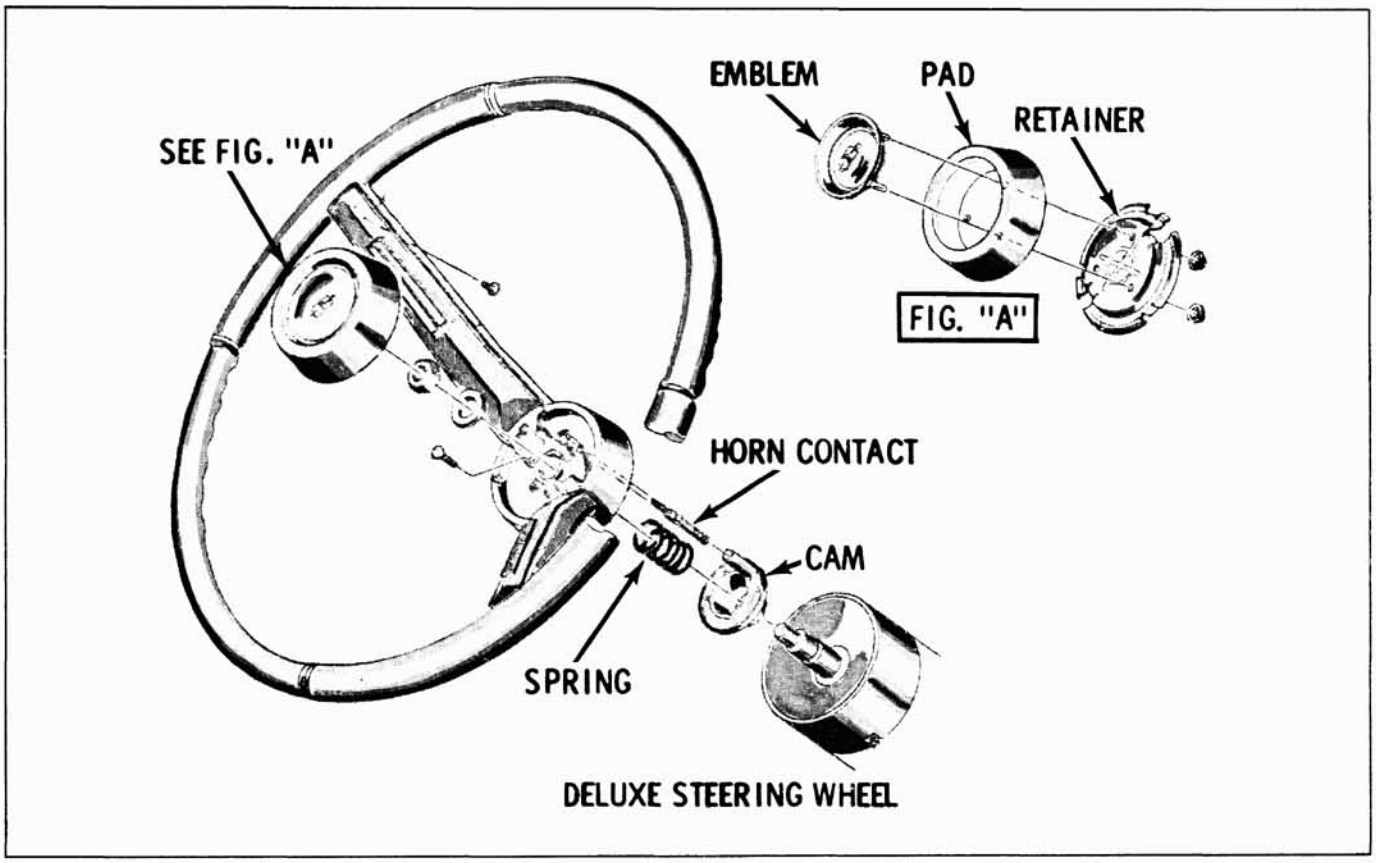


Fig. 9A-3—Deluxe Steering Wheel (54-86 Series)

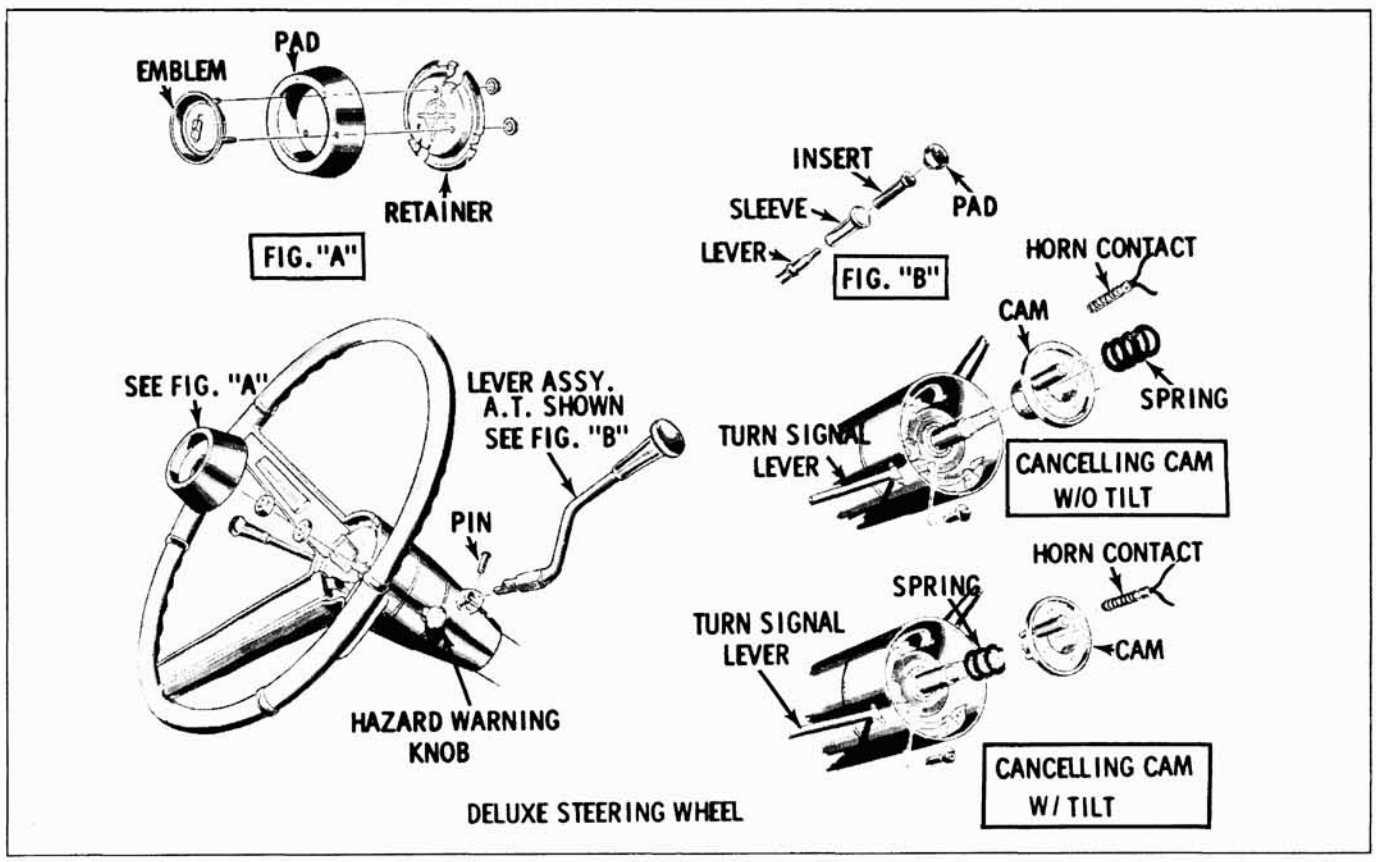


Fig. 9A-4—Deluxe Steering Wheel (31-48 Series)

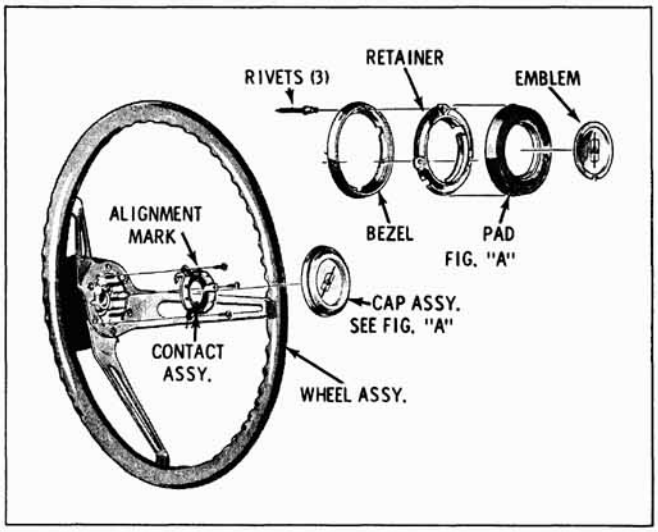


Fig. 9A-5—Wood Grain Steering Wheel (Optional)

Installation

1. With the marks on the steering wheel and steering shaft aligned, install the wheel, flatwasher and nut.

When mark on steering wheel hub and steering shaft are lined up, wheel spokes should be horizontal as car is driven straight ahead.

If spokes are not horizontal, it will be necessary to adjust the tie rod ends until steering wheel assumes its proper position. When a new steering gear is installed, it may be necessary to adjust steering wheel spoke alignment even though spoke alignment had been correct for the old gear.

2. Torque the nut to 35 ft. lbs. On standard steering wheels, install lens and bezel assembly. Water may be used on bezel retainer ring to aid installation. DO NOT USE LUBRICANT ON RETAINER RING. On deluxe steering wheels, install emblem assembly into slots in hub of wheel and push into position.

3. Connect negative battery cable.

STEERING WHEEL (TILT AND TRAVEL)

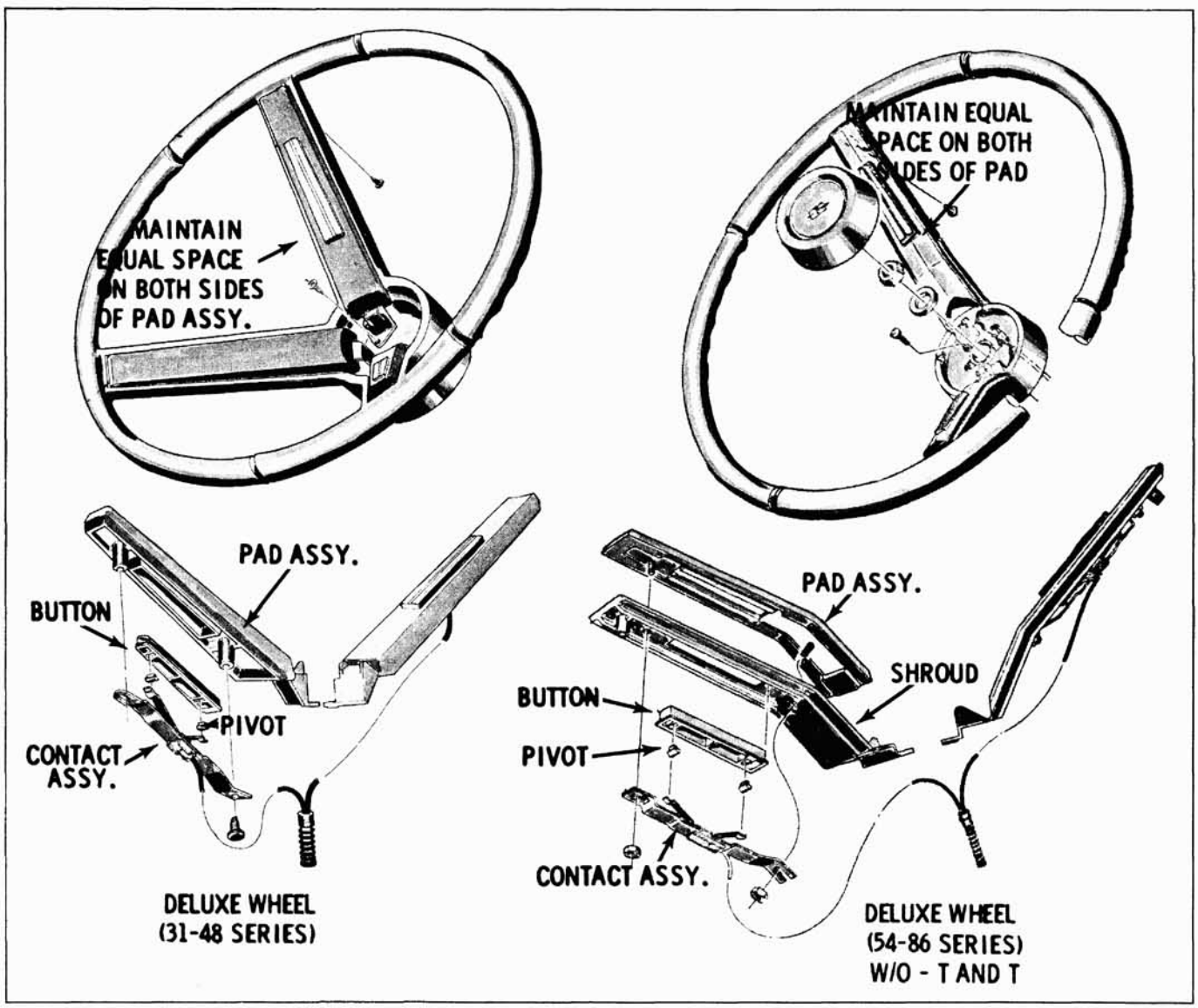


Fig. 9A-6—Horn Contacts - Deluxe Steering Wheels

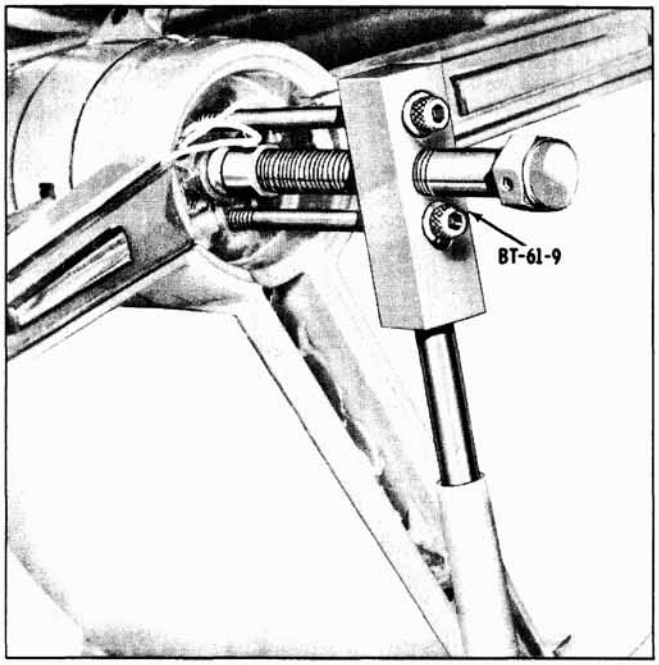


Fig. 9A-7—Typical Steering Wheel Removal

Removal

1. Disconnect negative battery cable.
2. Pull up on pad assembly at positions shown in Fig. 9A-8 and remove.
3. Push locking lever counterclockwise until full release position is obtained.
4. Scribe plate assembly where the two attaching screws attach plate assembly to locking lever and remove the two screws.
5. Unscrew plate assembly and remove.
6. Remove steering shaft nut.
7. Using Tool BT-61-9, remove steering wheel assembly with shroud attached.

Installation

1. Install a 5/16" x 18 set screw into upper shaft at the full extended position and lock.
2. Install steering wheel, aligning scribe mark on hub with slash mark on end of shaft. Make certain that unattached end of horn upper contact assembly is seated flush against top of horn contact carrier assembly.
3. Install nut on upper steering shaft. Torque to 35 ft. lbs.
4. Remove set screw installed in Step 1.
5. Install plate assembly and tighten finger tight.
6. Position locking lever in the vertical position and move lever counterclockwise until holes in plate align with holes in lever. Install attaching screws (Fig. 9A-8).
7. Align pad assembly retaining clips with holes in shroud and push pad assembly until retained.
8. Connect negative battery cable.

SHROUD

For replacement of shroud, steering wheel must be removed to gain access to center attaching screw (hub to shroud). (Fig. 9A-8)

HORN CONTACT

Horn contact is an integral part of the steering wheel and

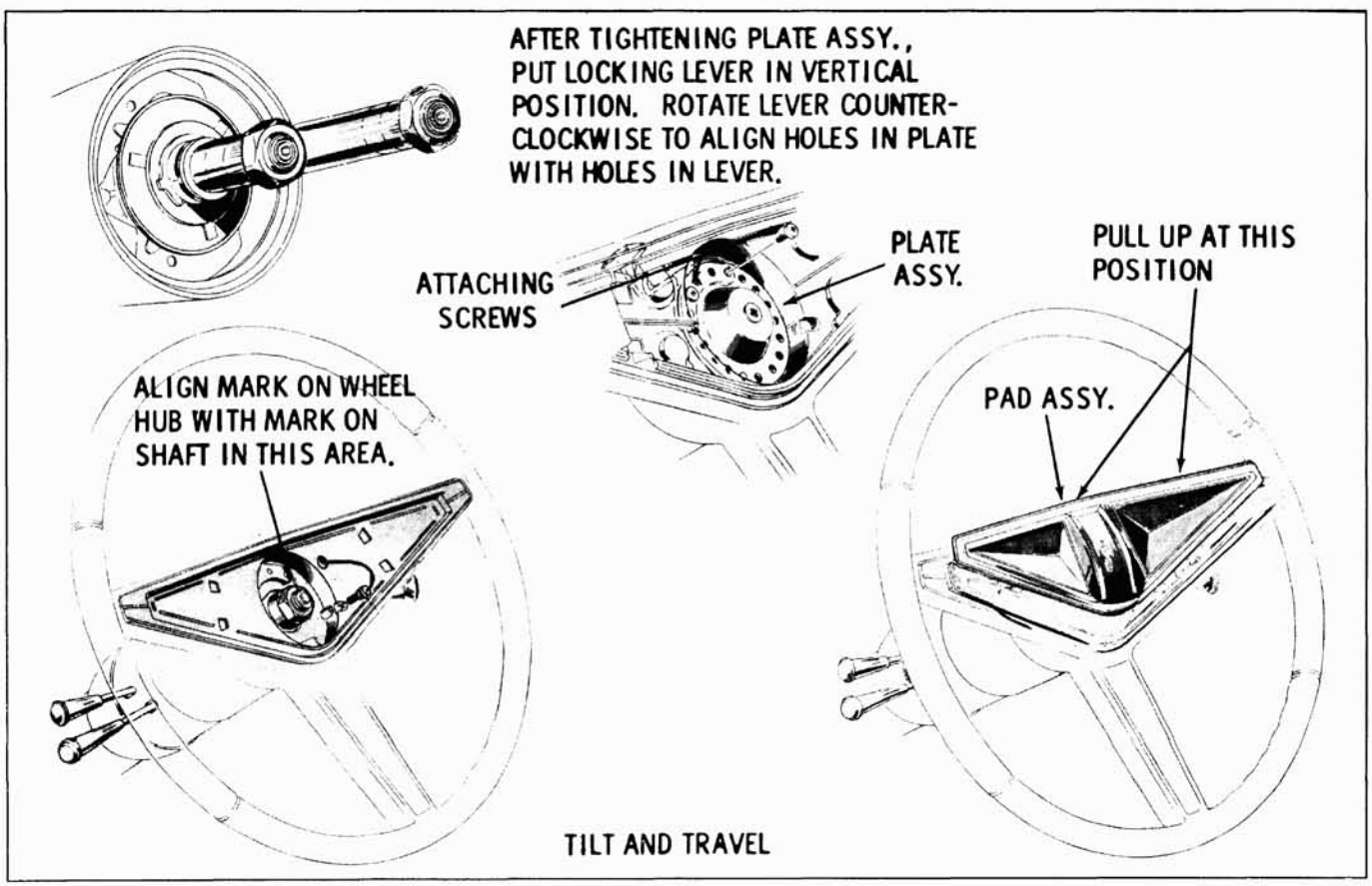


Fig. 9A-8—Steering Wheel Attachment - Tilt and Travel

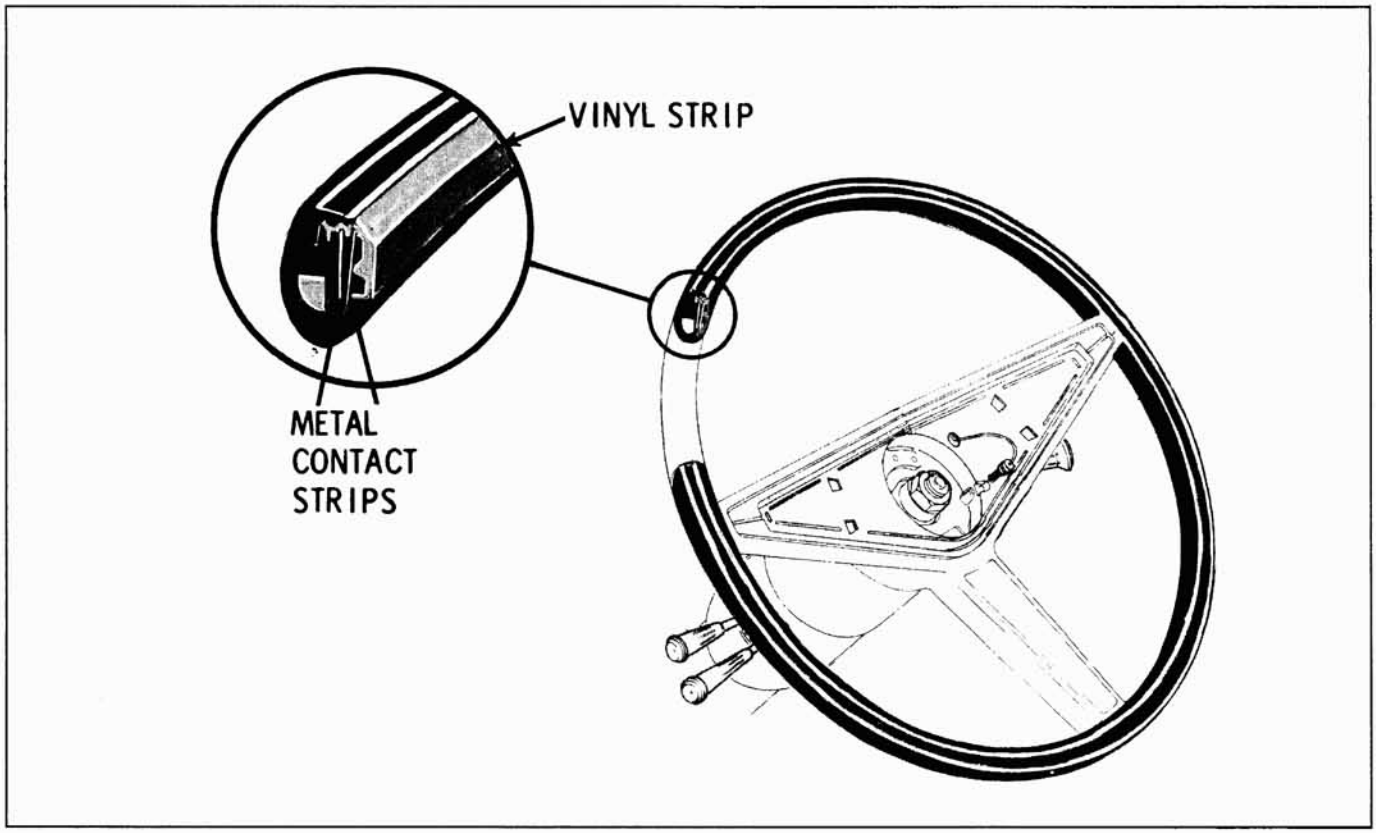


Fig. 9A-9—Horn Contact - Tilt and Travel

requires replacement of the steering wheel if a failure should occur. (Fig. 9A-9)

LOCKING LEVER

Removal

1. Remove steering wheel. Refer to "Steering Wheel - Removal".

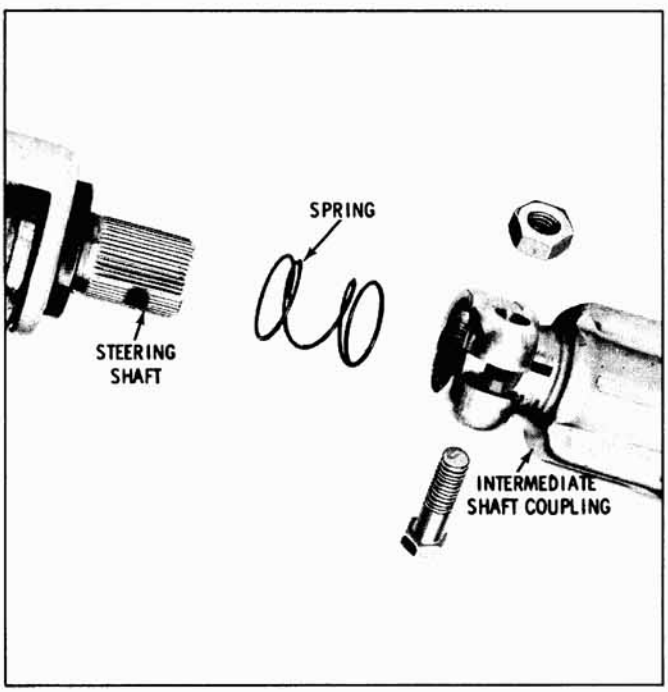


Fig. 9A-10—Steering Shaft Attachment (31-48 Series)

With steering wheel removed, locking lever may now be removed if necessary.

STEERING COLUMNS (Figs. 9A-11, 9A-12, 9A-13 and 9A-14)

Removal

1. Disconnect negative battery cable.
2. Remove steering wheel - refer to "Steering Wheel - Removal".
3. Disconnect shift levers from lower end of column.
4. a. 31-48 Series: Remove bolt from lower shaft coupling clamp. (Fig. 9A-10)
   b. 54-86 Series w/o Tilt and Travel: Remove nuts at flex-coupling.
   c. 54-86 Series w/Tilt and Travel: Remove bolt at flange to steering shaft.
   d. Toronado: Place daub of paint on steering shaft at slot in joint assembly and remove bolt from joint assembly.
5. Disconnect turn signal and cornering light wiring connectors.
6. Disconnect neutral start and back-up wiring connectors, if so equipped.
7. a. 54-86 Series and Toronado: Remove shift indicator needle if so equipped.
   b. 31-48 Series: Disconnect link from hook. (Fig. 9A-15)
8. Remove toe pan cover and cowl insulator.
9. Remove screws from inner and outer covers at floor pan (Figs. 9A-15, 9A-16 and 9A-17).
10. Loosen both toe pan clamp attaching screws.
11. Remove four bolts "Z" from bracket assembly. (Figs. 9A-15, 9A-16 and 9A-17)
12. Remove nut or bolt "C" (Figs. 9A-15, 9A-16 and 9A-17).
13. Remove nuts "A" and "B" (Figs. 9A-15, 9A-16 and 9A-17).

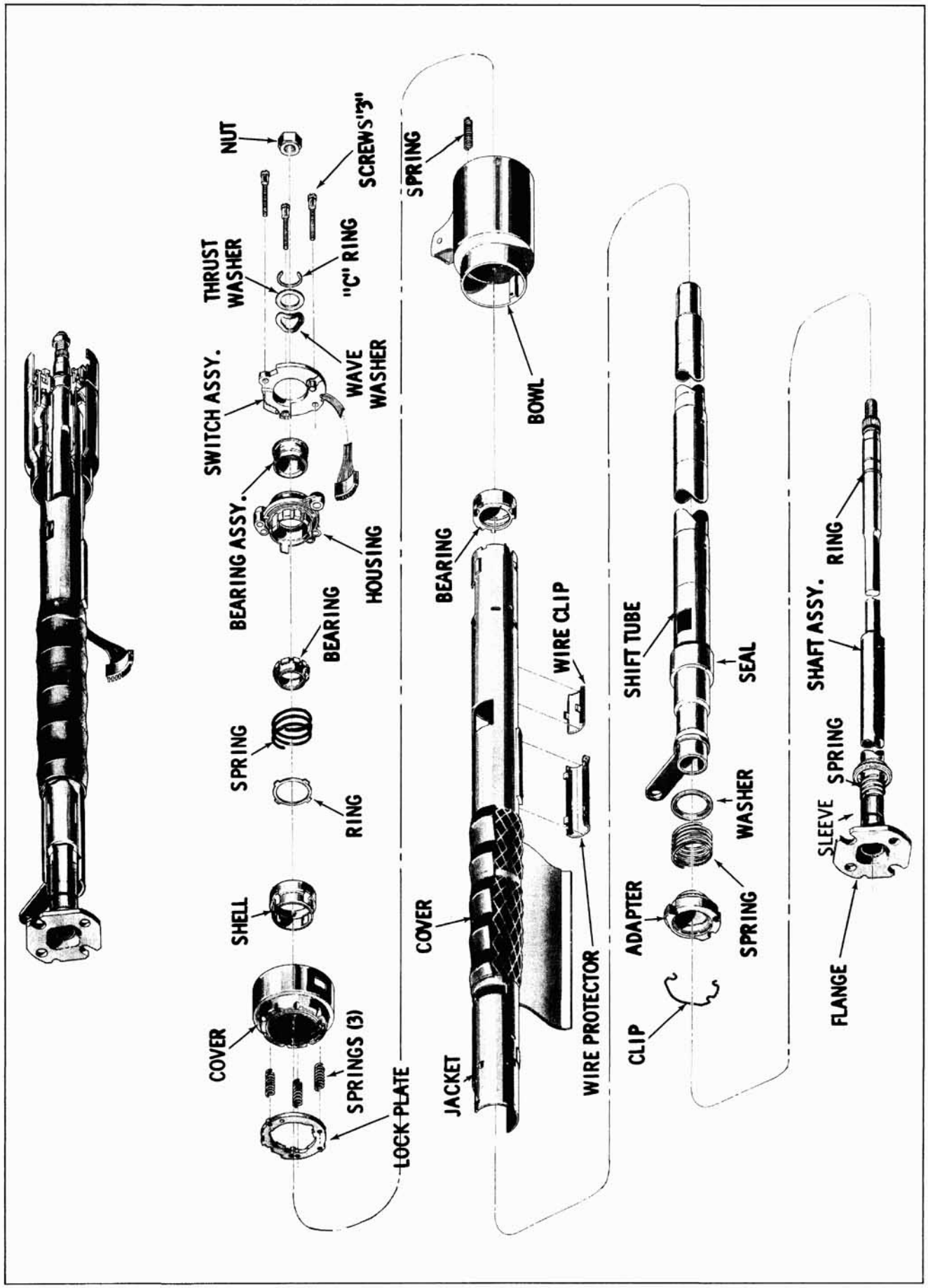


Fig. 9A-11—Steering Column with A.T.

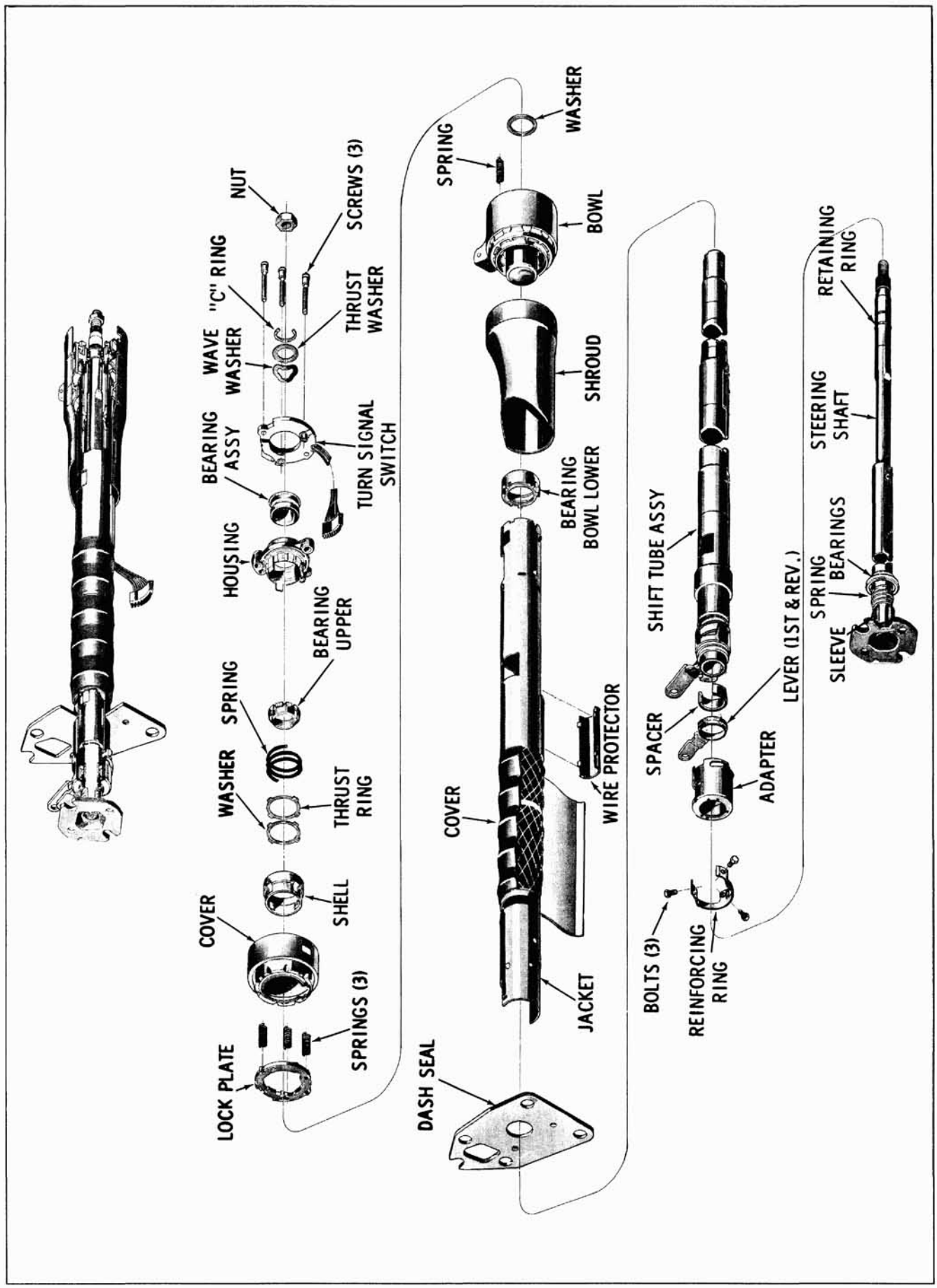


Fig. 9A-12—Steering Column with M.T.

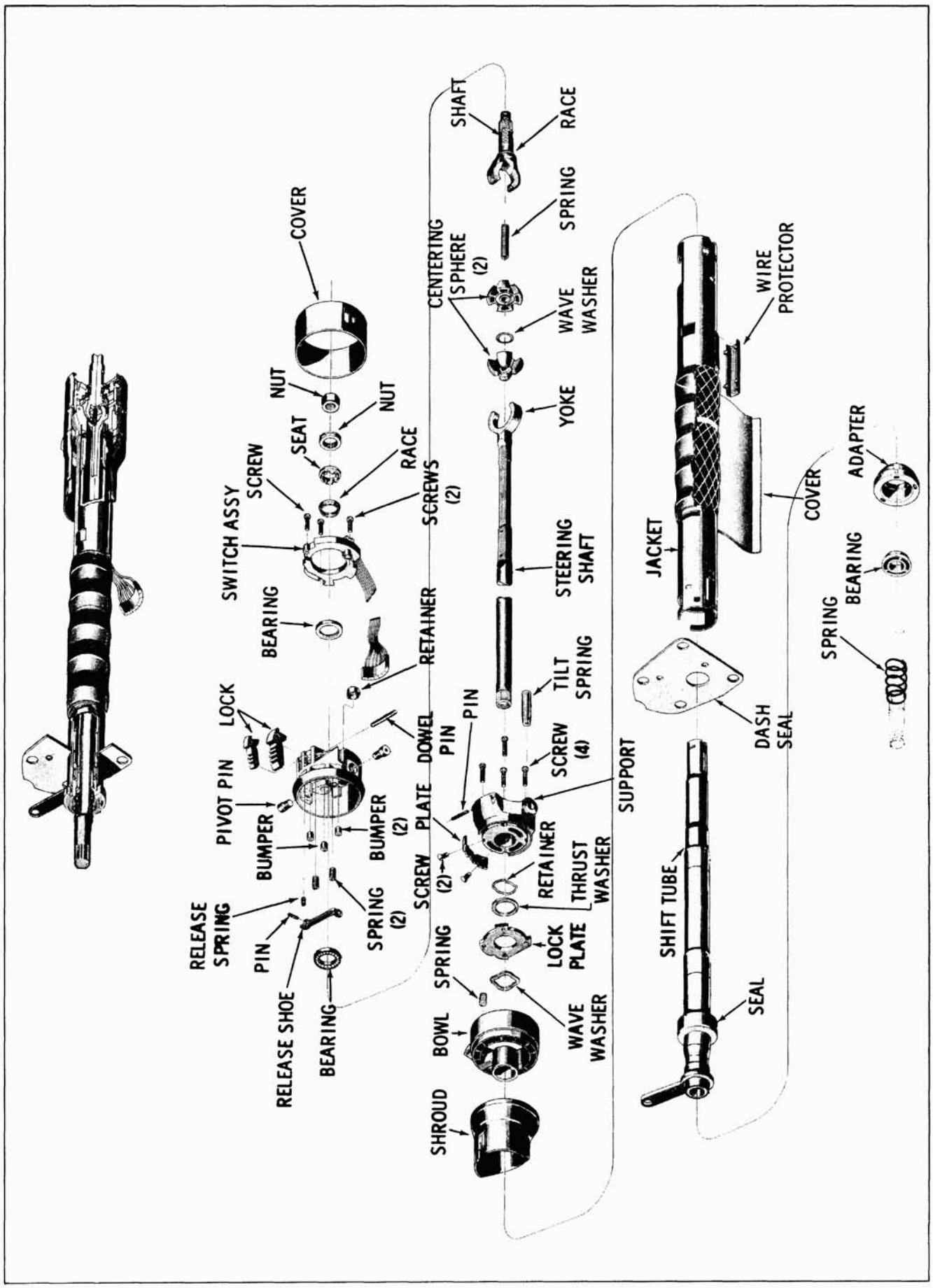


Fig. 9A-13—Steering Column with Tilt-Away

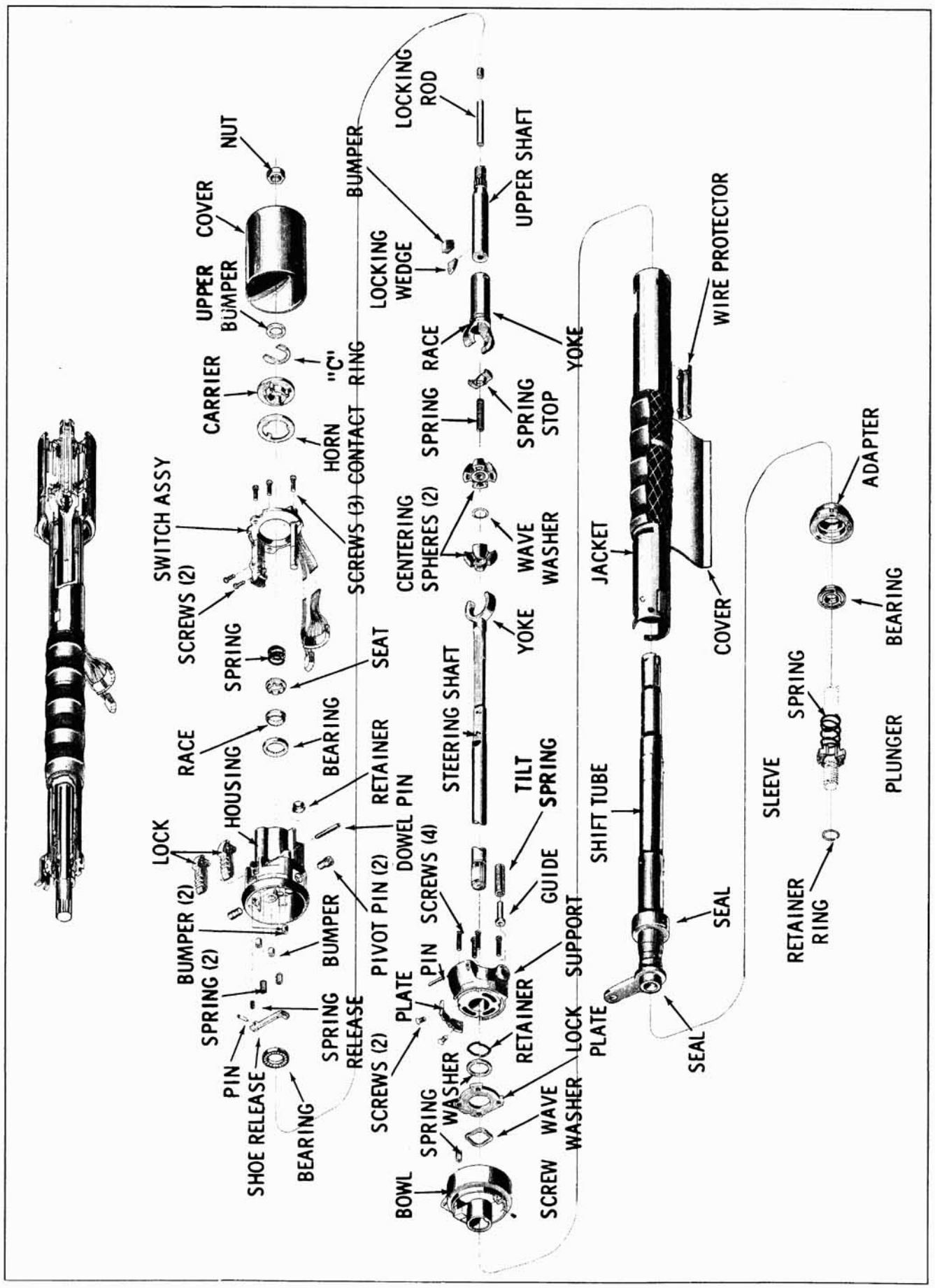


Fig. 9A-14—Steering Column with Tilt and Travel

If spacers are used, note how many and position for ease on installation. Remove bracket assembly and wedge.

14. Carefully lift steering column from inside of car.

All elements of energy absorbing steering columns are sensitive to damage and MUST BE HANDLED WITH CARE.

15. Install column in vise using holding fixture J-22573 as shown in Fig. 9A-18.

Installation

1. Remove column from holding fixture and carefully position through toe-pan. With the aid of a helper at lower end of column, proceed as follows:

a. 31-48 Series: Install spring over lower end of steering shaft and align bolt groove in shaft and coupling, then install bolt and nut. Torque to 35 ft. lbs.

b. 54-86 Series (w/o Tilt and Travel): Align flange to flex-coupling and attach nuts. Torque to 20 ft. lbs.

c. 54-86 Series (w/Tilt and Travel): Install spring over lower end of steering shaft and align bolt groove in shaft and flange, then install bolt and nut. Torque to 35 ft. lbs.

d. Toronado: Align paint mark on steering shaft with slot in joint assembly and attach bolt and nut. Torque to 80 ft. lbs.

2. Loosely attach bracket assembly or clamp assembly to support with wedge and spacers (if used) and install nuts "A" and "B" (Figs. 9A-15, 9A-16 and 9A-17) loosely.

3. Install 4 bolts "Z" to bracket. Torque to 15 ft. lbs.

4. With the aid of a helper, align flex coupling and with mechanic inside of car, torque nuts "A" and "B" to 20 ft. lbs.

5. Position wedge rearward until finger tight and install bolt or nut "C" and torque to 20 ft. lbs.

6. Install toe pan screws ("1") and torque to 4 ft. lbs.

7. Install the top and bottom toe pan clamp screws ("2"). Torque to 4 ft. lbs.

8. Install remaining toe pan screws ("3") and torque to 4 ft. lbs.

9. Install the cowl insulator and toe pan cover.

10. Connect neutral start and backup switch wiring connector.

11. Connect turn signal and cornering light wiring connectors.

12. Install shift indicator needle is so equipped.

13. Connect shift levers at lower end of column.

If necessary to adjust shift linkage refer to appropriate transmission section for procedures.

14. Install steering wheel. Refer to "Steering Wheel - Installation".

15. Connect negative battery cable.

IN CAR PROCEDURES

TURN SIGNAL SWITCH (EXCEPT TILT-AWAY OR TILT AND TRAVEL)

Disassembly

1. Disconnect negative battery cable.

2. Remove emblem from steering wheel. Remove steering wheel with Tool BT-61-9.

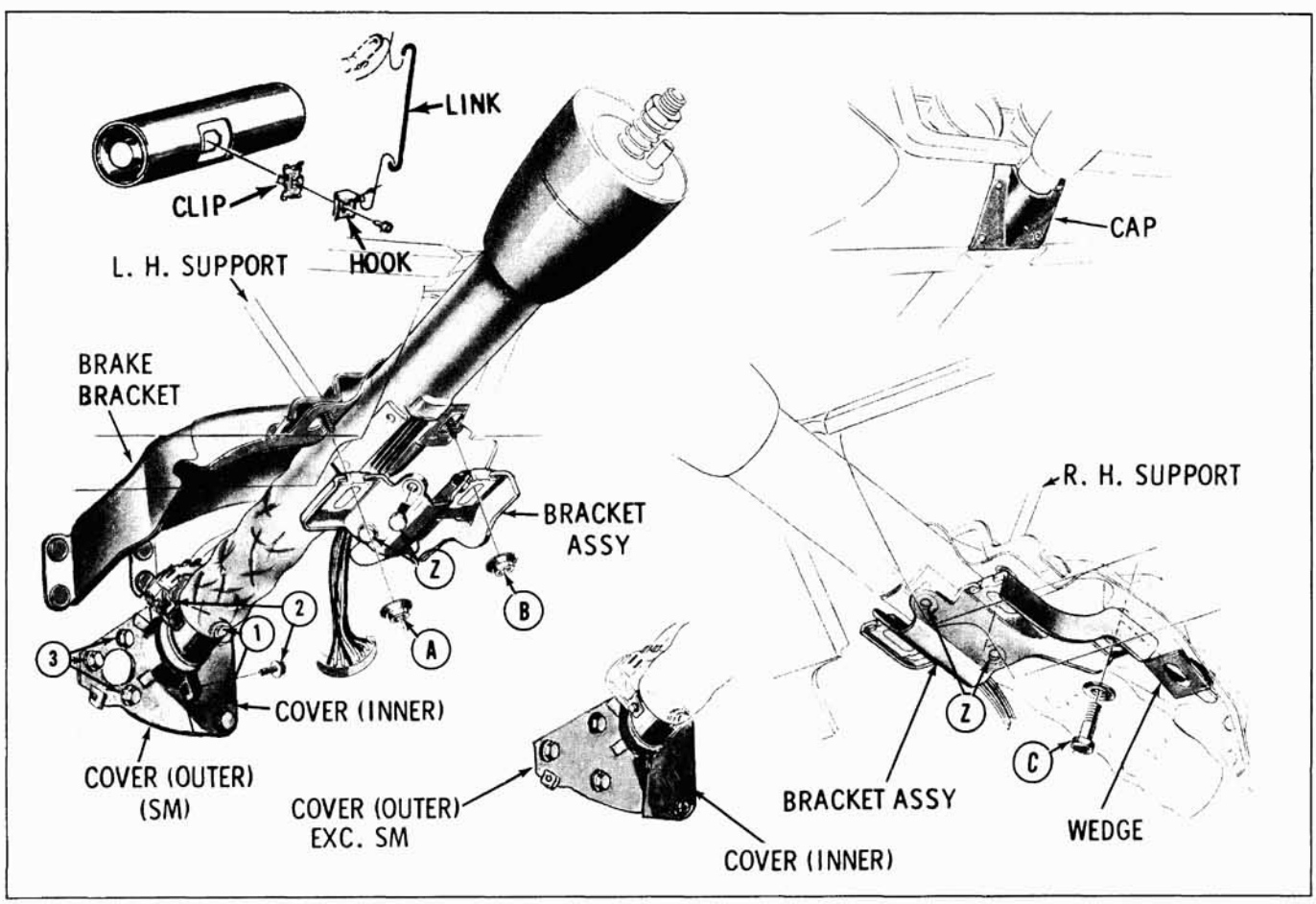


Fig. 9A-15—Column Attachment (31-48 Series)

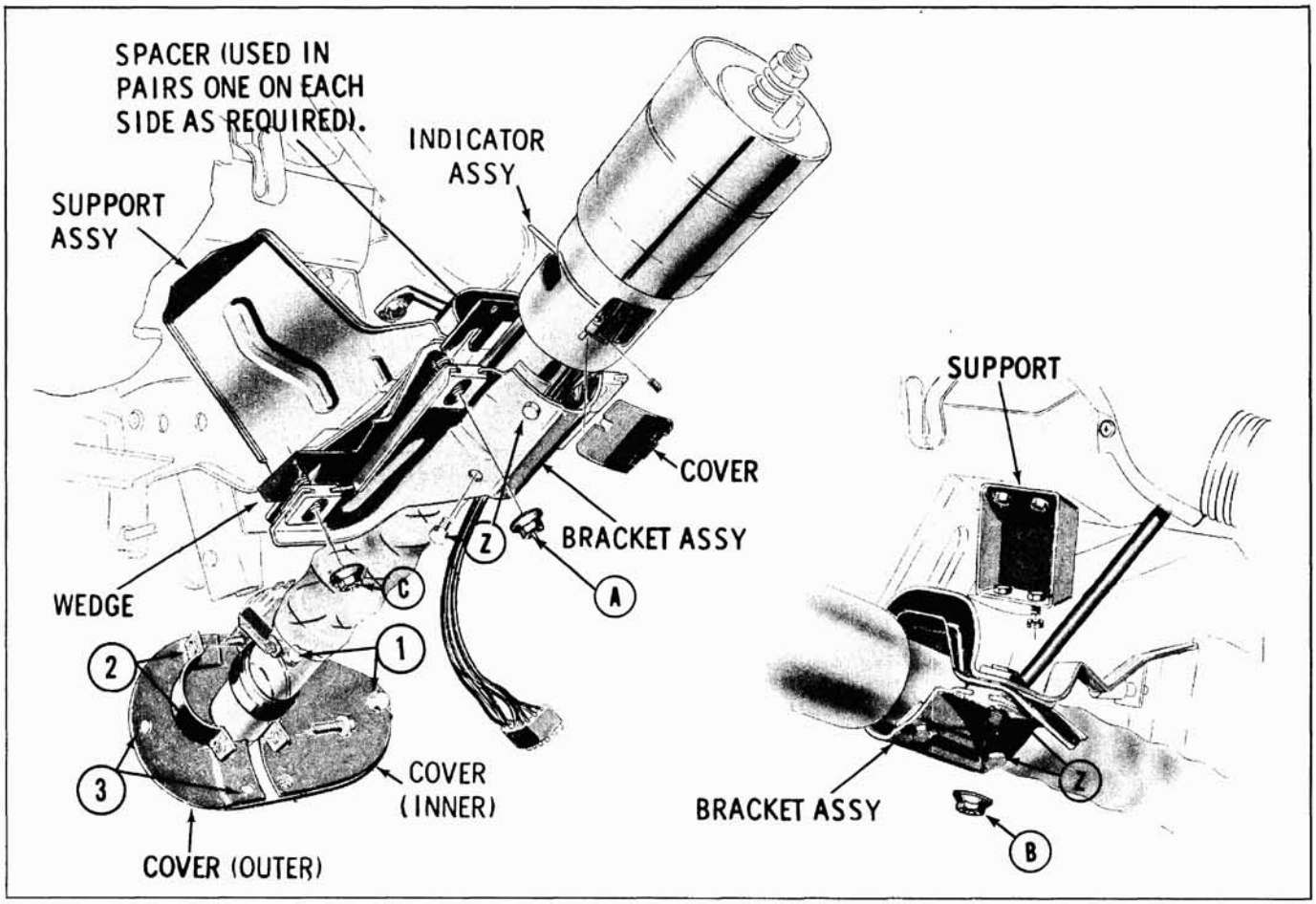


Fig. 9A-16—Column Attachment (54-86 Series)

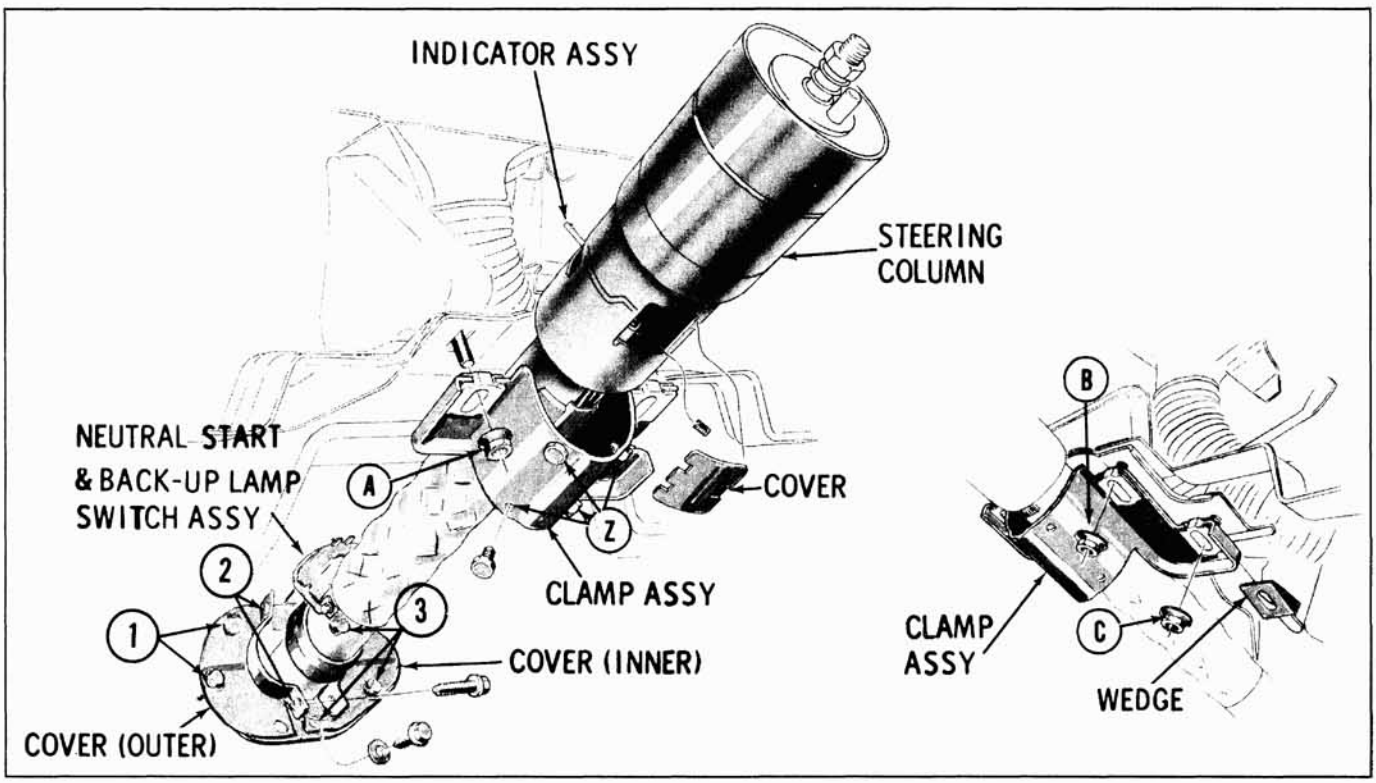


Fig. 9A-17—Column Attachment (Toronado)

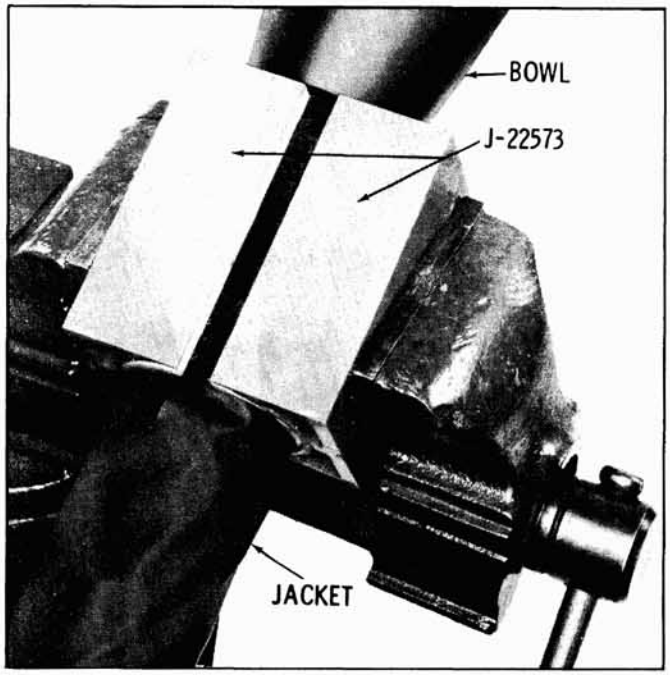


Fig. 9A-18—Steering Column Holding Tool

Steering wheel must be removed as shown in Fig. 9A-7).

3. Disconnect turn signal switch connector.
4. Remove cap or trim cover from instrument panel below steering column.
5. Remove four bolts "Z" (Figs. 9A-15, 9A-16 and 9A-17) from bracket assembly (31-86 Series), clamp assembly (Toronado).
6. Remove bolt or nut "C". (Figs. 9A-15, 9A-16 and 9A-17)
7. While holding column against support assembly perform the following:
   a. Remove nuts "A" and "B" (Figs. 9A-15, 9A-16 and 9A-17).
   b. Remove bracket, wedge and spacers (if used) (Fig. 9A-15 and 9A-16)or clamp assembly and wedge (Fig. 9A-17).
   c. Using a small screwdriver, pry wiring clip and/or protector from between welded pads on jacket, DO NOT PRY AGAINST WIRES (Fig. 9A-19).
   d. With wiring now hanging loosely from jacket and outside of bracket or clamp assembly reinstall clamp assembly or bracket assembly in position and install nuts "A" and "B" finger tight. (Figs. 9A-15, 9A-16 and 9A-17).
8. Remove turn signal cancelling cam and spring from upper steering shaft.
9. Remove turn signal lever attaching screw and remove lever. (Fig. 9A-20)
10. Push hazard warning switch knob in and then unscrew knob.
11. Remove "C" ring from upper steering shaft with Tool J-22569 by turning counterclockwise. (Fig. 9A-21). DO NOT PRY AGAINST SWITCH PARTS.
12. Slide thrust washer and wave washer off steering shaft. (Fig. 9A-22)
13. Loosen three turn signal switch attaching screws approximately five turns each. (Fig. 9A-20). Rotate cover assembly counterclockwise and pull straight off top of jacket. (Fig. 9A-23).

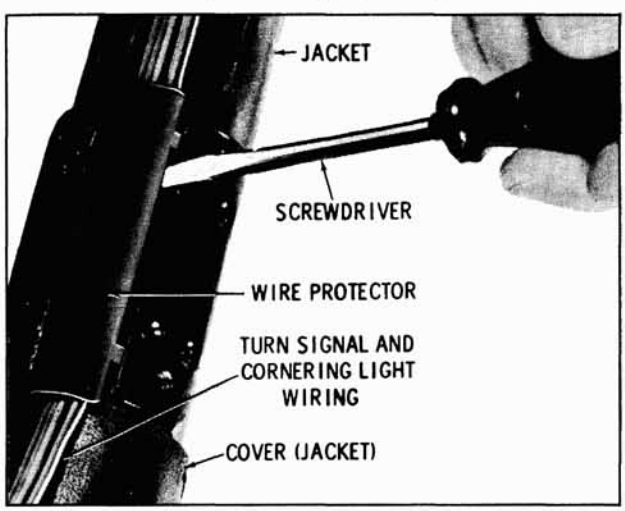


Fig. 9A-19—Wiring Clip Removal or Installation

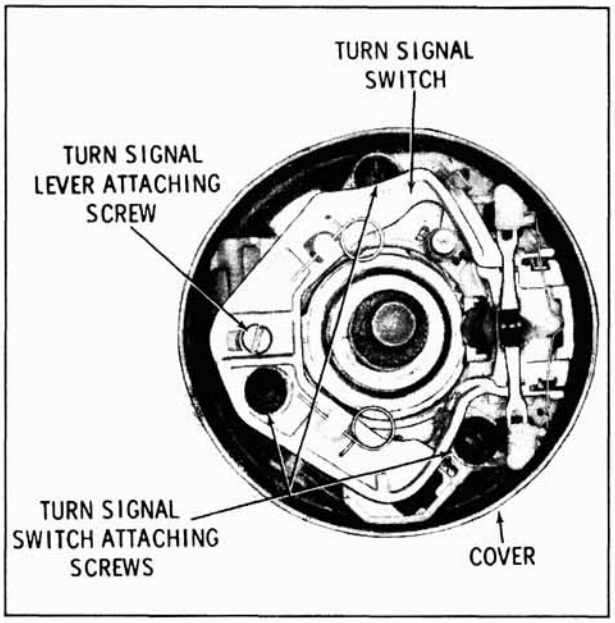


Fig. 9A-20—Turn Signal Switch and Lever Attachment

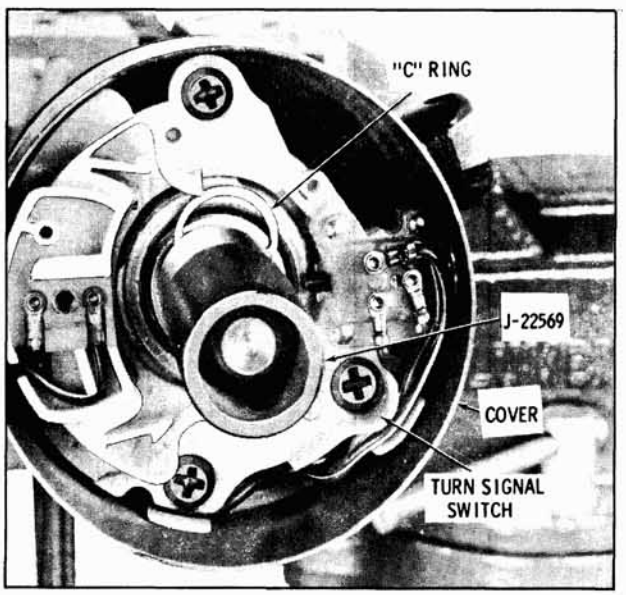


Fig. 9A-21—Removing "C" Ring

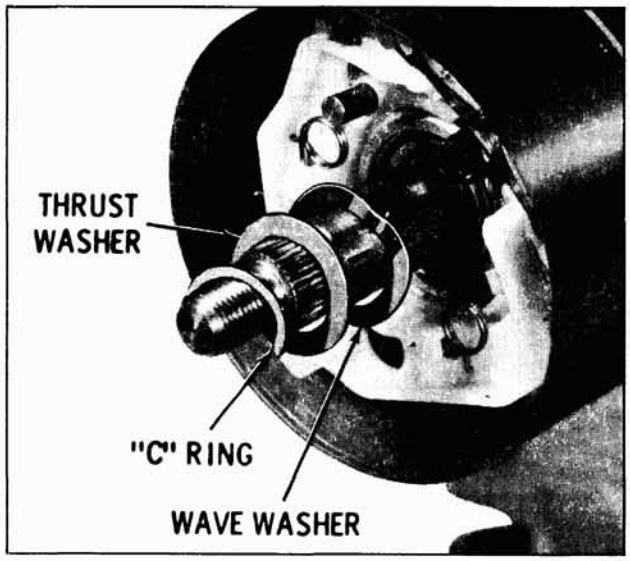


Fig. 9A-22—Removing Thrust and Wave Washers

14. Using side cutters, cut turn signal wiring harness at bottom of cover assembly. Bend wiring harness over bowl for aid in installation.

15. Lock plate and cover should be marked (with colored pencil) at this time for easier reassembly.

16. Remove three turn signal switch attaching screws from lock plate being careful not to lose springs.

17. Turn signal switch can now be removed from housing assembly and cover.

Assembly

1. Install turn signal switch to housing, aligning pins for proper match, Fig. 9A-24.

2. Position switch and housing into cover so that access holes in cover align with turn signal lever mounting and hazard warning button.

3. Insert three turn signal switch attaching screws through

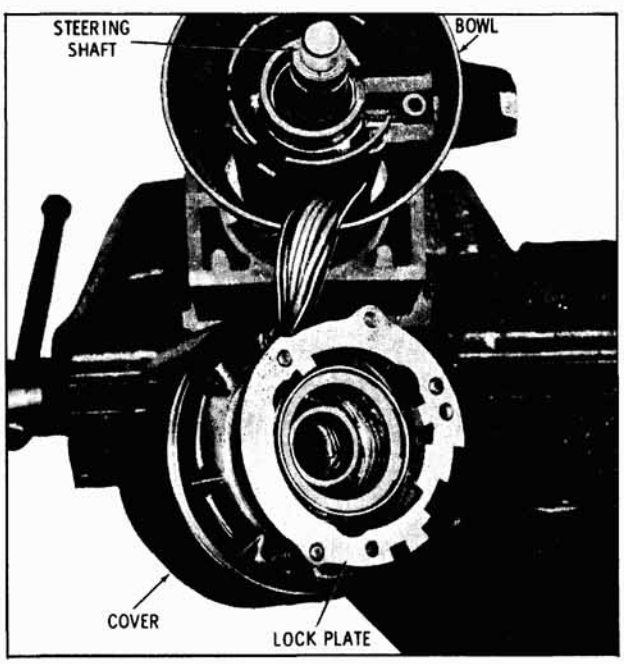


Fig. 9A-23—Removing Cover Assembly

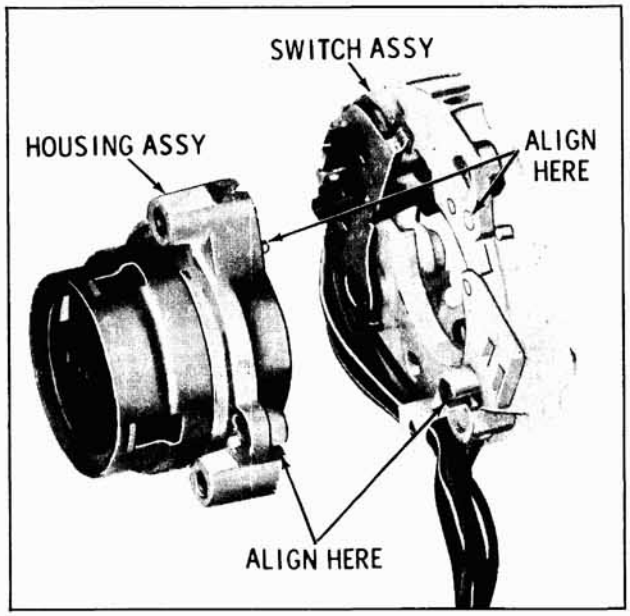


Fig. 9A-24—Aligning Turn Signal Switch with Housing

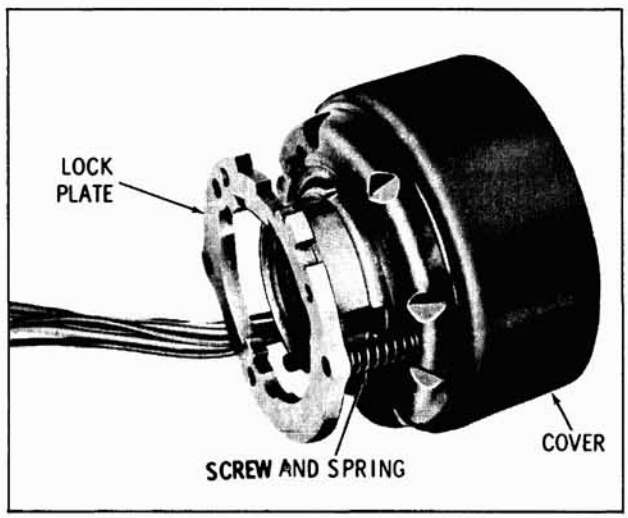


Fig. 9A-25—Installing Screws into Lock Plate

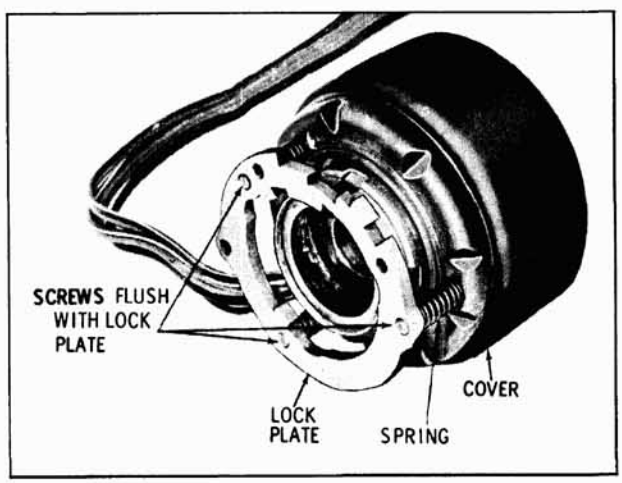


Fig. 9A-26—Screws Flush with Lock Plate

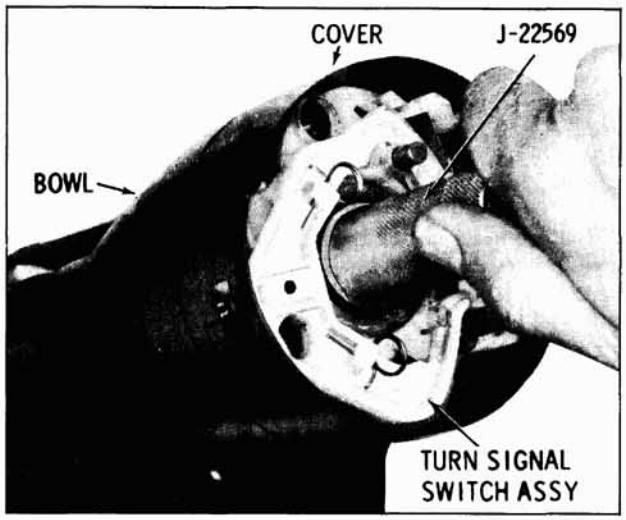


Fig. 9A-27—Installing "C" Ring

assembly and slide one spring on each screw. (Fig. 9A-25)

4. With lock plate aligned with cover (marked in step 15 on Disassembly) turn each screw until flush with bottom edge of lock plate. (Fig. 9A-26)

5. Carefully tape new turn signal wiring clips to existing wiring and pull wiring through bowl. Taped joint must be as flat as possible.

6. Position cover assembly on top of jacket making sure that tangs on the inside diameter of the lock plate are aligned with the slots in the jacket.

Care must be exercised at this time so that wiring is not pinched or insulation damaged.

7. Push down on cover assembly and turn clockwise until fully locked.

8. Alternately screw turn signal switch attaching screws in until torque of 35 inch pounds is obtained.

9. While holding column against support assembly perform the following from Figs. 9A-15, 9A-16 and 9A-17.

a. Remove nuts "A" and "B", installed loosely on REMOVAL, step 7D.

b. Position wiring as shown in Fig. 9A-19, and install

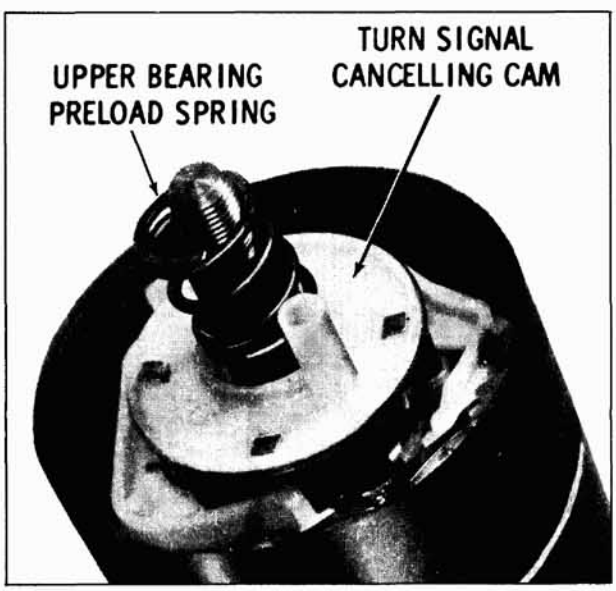


Fig. 9A-28—Cancelling Cam and Pre-load Spring

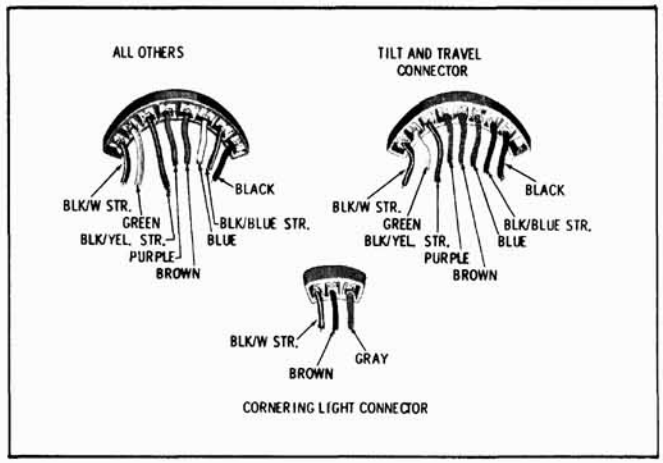


Fig. 9A-29—Turn Signal Wire Coding

wiring clip and/or protector between welded pads on jacket. DO NOT PRY AGAINST WIRES.

c. Install four bolts "Z". Torque to 15 ft. lbs. Make sure wiring is movable and not pinched at this time.

d. Position wedge and install bracket assembly and spacers (if used) and install nuts "A" and "B". Torque to 20 ft. lbs.

e. Push wedge rearward until finger tight and install bolt or nut "C" and torque to 20 ft. lbs.

f. Check to see if wiring is moveable (up and down column) and not pinched.

10. Slide wave washer and thrust washer over steering shaft and against bearing.

11. Start "C" ring on steering shaft taper and slide down steering shaft with Tool J-22569 until it snaps into groove. Slide "C" ring sideways until it completely seats. (Fig. 9A-27)

12. Install turn signal lever and screw. Torque to 25 inch pounds. Position lever in neutral position.

13. Install hazard warning knob. Pull knob out to "OFF" position.

14. Slide turn signal cancelling cam and upper bearing pre-

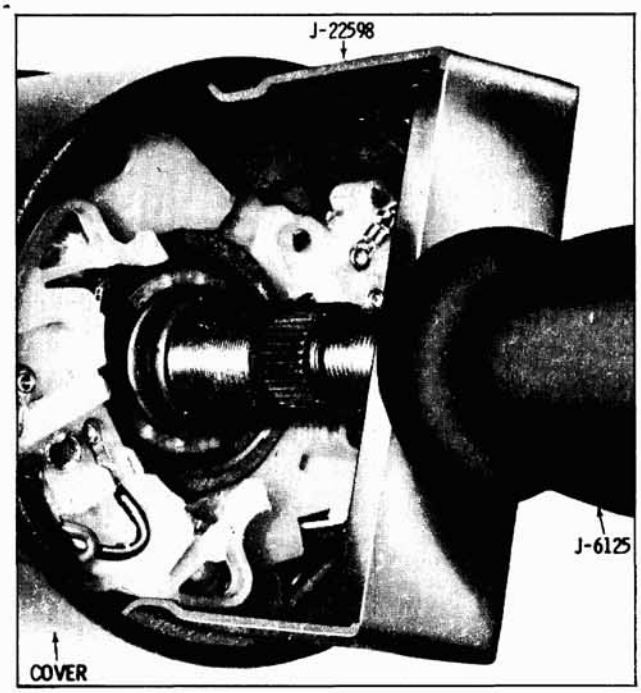


Fig. 9A-30—Cover Removal - Tilt-Away

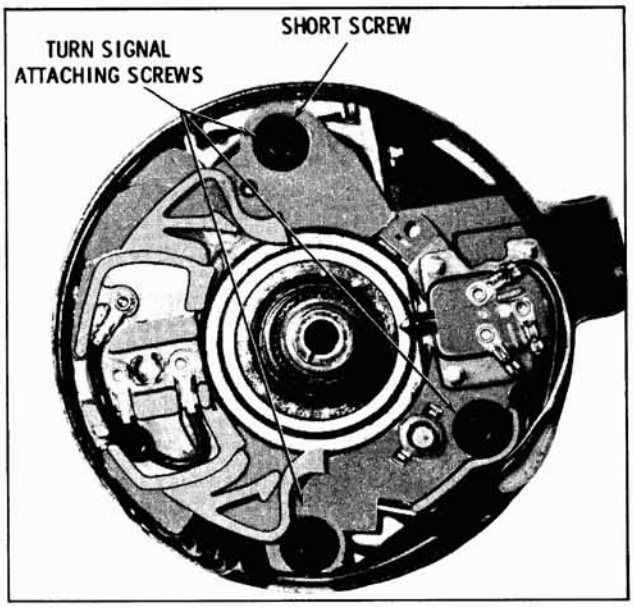


Fig. 9A-31—Turn Signal Switch - Tilt-Away

load spring onto steering shaft. (Fig. 9A-28)

15. Install cap or trim cover to lower part of instrument panel.

16. With the marks on the steering wheel and steering shaft aligned, install the wheel, flat-washer and nut. Torque the nut to 35 ft. lbs.

When mark on steering wheel hub and steering shaft are lined up, wheel spokes should be horizontal as car is driven straight ahead. If spokes are not horizontal, it will be necessary to adjust the tie rod ends until steering wheel assumes its proper position.

17. On standard steering wheels, install lens and bezel assembly. Water may be used on bezel retainer ring to aid installation. DO NOT USE LUBRICANT ON RETAINER RING. On deluxe steering wheels, install cap and emblem assembly by aligning tangs into hub of steering wheel and push into place.

18. Insert turn signal and cornering light wiring clips into connector as shown in Fig. 9A-29. MAKE CERTAIN COLOR CODING ON WIRING CORRESPONDS TO FIG. 9A-29.

19. Connect negative battery cable.

TURN SIGNAL SWITCH (TILT-AWAY)

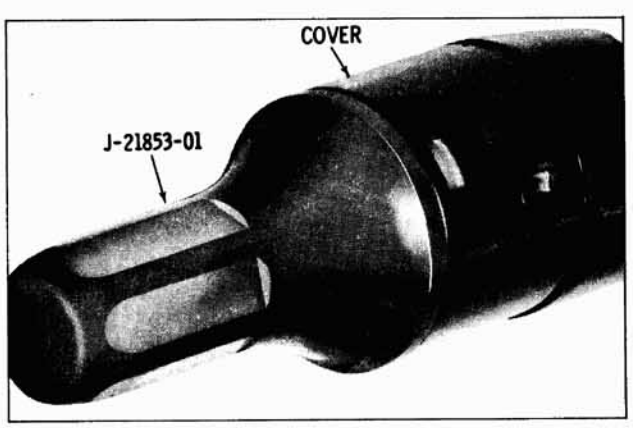


Fig. 9A-32—Installing Cover - Tilt-Away

Removal

1. Disconnect negative cable from battery.
2. Disconnect turn signal wiring connector from behind instrument panel.
3. Remove steering wheel. Refer to "Steering Wheel Removal".
4. Remove turn signal cancelling cam and pre-load spring.
5. Remove tilt release lever.
6. Push in on hazard warning knob and turn counterclockwise to remove.
7. Remove turn signal cover using Tool J-22598 and slide hammer J-6125-1. (Fig. 9A-30)
8. Remove trim cap from under steering column (Fig. 9A-15).
9. Remove four bolts "Z" (Fig. 9A-15) from bracket assembly.
10. Remove bolt "C" (Fig. 9A-15).
11. While holding column against support assembly, perform the following:
    a. Remove nuts "A" and "B" (Fig. 9A-15) and remove bracket assembly and wedge.
    b. Using a small screwdriver, pry clip and/or protector from between welded pads on jacket. DO NOT PRY AGAINST WIRES. (Fig. 9A-19)
    c. With wiring now hanging loosely from jacket and outside of bracket on clamp assembly, reinstall bracket assembly in position with nuts "A" and "B" finger tight (Fig. 9A-15).
12. Remove turn signal switch attaching screws from housing and lift switch.

Short length screw in top position. (Fig. 9A-31)

13. Using side cutters, cut turn signal wiring harness as close to turn signal switch as possible.

Installation

1. Carefully tape new turn signal wiring clips to existing wiring and pull wiring through housing and bowl. Care must be used so that wire insulation is not damaged.
2. Position turn signal switch on housing and install turn signal switch attaching screws and torque to 35 inch lbs. (Place short length screw in top position above lock shoes). (Fig. 9A-31)

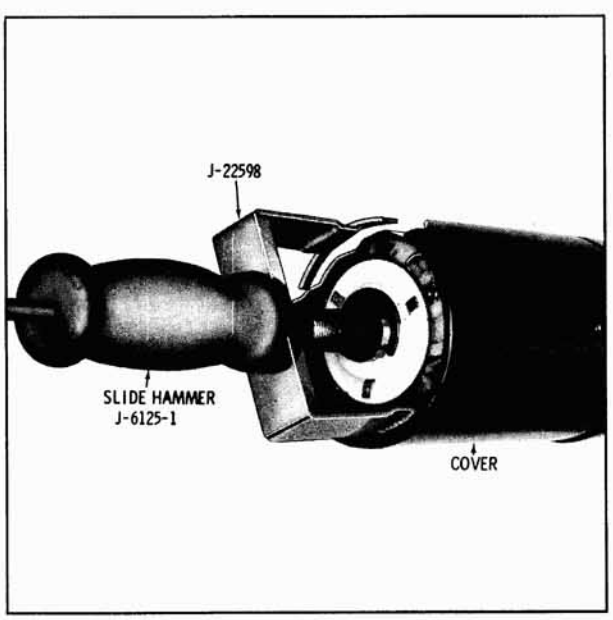


Fig. 9A-33—Removing Cover - Tilt and Travel

3. While holding column against support assembly perform the following:

a. Remove bolts "A" and "B", installed loosely on REMOVAL, Item 11C.

b. Position wiring as shown in Fig. 9A-19, and install wiring clip and/or protector between welded pads on jacket. DO NOT PRY AGAINST WIRES.

c. Install four bolts "A" (Fig. 9A-15). Torque to 15 ft. lbs.

Make sure wiring is free to move axially along column.

d. Position wedge and install bracket assembly and install nuts "A" and "B" and torque to 20 ft. lbs.

e. Push wedge rearward until finger tight and install bolt "C" (Fig. 9A-15) and torque to 20 ft. lbs.

4. Install cover using Tool J-21853-01. (Fig. 9A-32)

5. Install hazard warning knob. Pull knob out to the "OFF" Position.

6. Install turn signal lever and screw. Torque to 25 inch lbs. Position lever in neutral position.

7. Install turn signal cancelling cam and pre-load spring.

8. Install steering wheel. Refer to steering wheel installation.

9. Insert turn signal wiring clips into connector as shown in Fig. 9A-29. MAKE CERTAIN COLOR CODING ON WIRING CORRESPONDS TO FIG. 9A-22.

10. Connect negative cable to battery.

TURN SIGNAL SWITCH (TILT AND TRAVEL)

Removal

1. Disconnect negative cable from battery.

2. Disconnect turn signal and cornering light (if so equipped) wiring from connectors behind instrument panel.

3. Remove steering wheel. Refer to steering wheel removal.

4. Push in and turn hazard warning knob, tilt lever and turn signal lever by turning counterclockwise.

5. Using slide hammer, J-6125-1, and cover remover, J-22598, remover cover. (Fig. 9A-33)

6. Remove four bolts "Z" (Figs. 9A-16 and 9A-17) from bracket assembly (54-86 Series) clamp assembly (Toronado).

7. Remove nut "C" (Fig. 9A-16). On Toronado remove nut "C". (Fig. 9A-17)

8. While holding column against support assembly perform the following:

a. Remove nuts "A" and "B" (Figs. 9A-16 and 9A-17).

b. Remove bracket assembly, wedge and spacers (if used) (Fig. 9A-16) or clamp assembly and wedge (Fig. 9A-17).

c. Using a small screwdriver, pry wiring clip and/or protector from between welded pads on jacket. DO NOT PRY AGAINST WIRES. (Fig. 9A-19)

d. With wiring now hanging loosely from jacket and outside of bracket or clamp assembly, reinstall clamp assembly or bracket assembly in position and install nuts "A" and "B" finger tight. (Figs. 9A-16 and 9A-17)

9. Remove lower bumper (rubber washer) from upper shaft.

10. Using Tool J-22191, screw 5/16" bolt into upper shaft until bolt contacts locking rod. Lift upper shaft 1" and lock in position with bolt. Position half-socket portion of tool on inner shoulder of horn contact carrier assembly, Fig. 9A-34, steady tool with hand and turn nut until "C" ring is free and remove.

11. Remove Tool J-22191.

12. Remove horn contact carrier assembly.

13. Remove upper bearing spring.

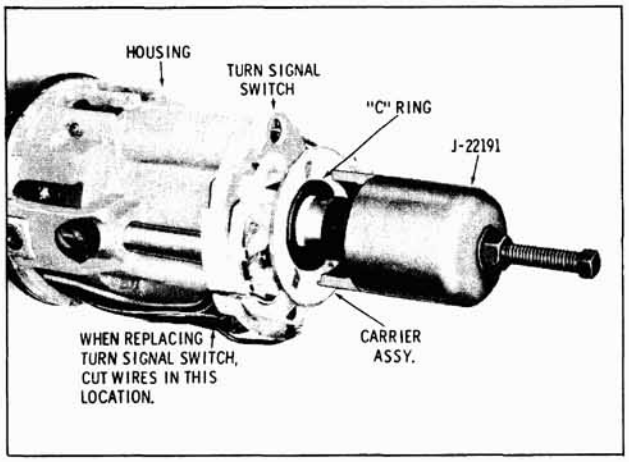


Fig. 9A-34—Removing "C" Ring - Tilt and Travel

14. Using side cutters, cut turn signal and cornering light wiring as close as possible to turn signal switch (Fig. 9A-34). Do not pull wiring from column at this time.

15. Using new replacement turn signal switch tape terminal ends of wiring to existing wiring still in column assembly keeping the taped joint as flat as possible for ease when installing.

16. Remove five attaching screws, Fig. 9A-35, turn signal switch assembly to housing assembly and remove turn signal switch assembly.

The turn signal switch and the hazard warning switch are connected together and serviced only as an assembly.

Installation

1. Carefully pull existing wiring while guiding new wiring through housing and bowl. Remove tape and discard old wiring.

2. Position new turn signal switch into position and install the five attaching screws (Fig. 9A-35).

3. Install upper bearing spring.

4. Install horn contact carrier assembly.

5. Using Tool J-22191, screw 5/16" bolt into upper shaft until contact is made with locking rod. Turn steering shaft assembly until keyway is in the uppermost position, lift upper shaft 1" and lock with 5/16" bolt. Position half socket of tool on inner shoulder of horn contact carrier assembly with "C" ring as shown. Steady tool with one hand and tighten nut until "C" ring will insert in upper yoke. (Fig. 9A-34)

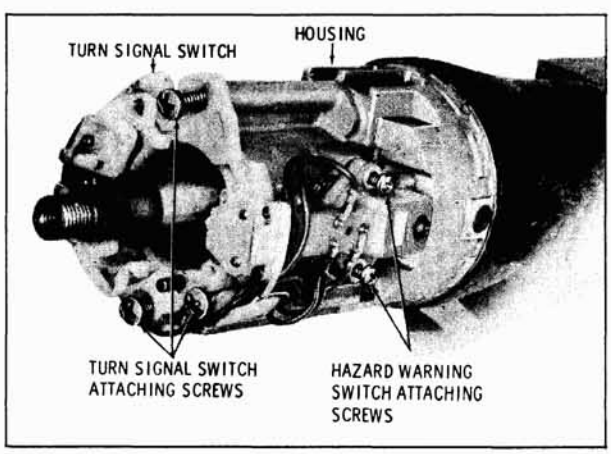


Fig. 9A-35—Turn Signal and Hazard Warning Switch Attachment

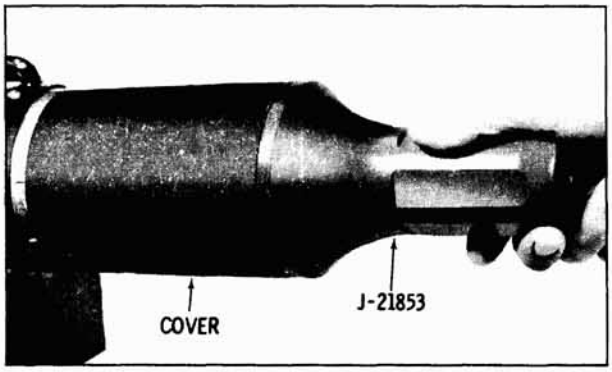


Fig. 9A-36—Installing Cover - Tilt and Travel

6. Remove Tool J-22191.
7. Install lower bumper (rubber washer) over upper shaft.
8. While holding column against support assembly, perform the following from Figs. 9A-16 and 9A-17.
   a. Remove nuts "A" and "B" installed loosely on Removal, Step 8D.
   b. Position wiring as shown in Fig. 9A-19, and install wiring clip and/or protector between welded pads on jacket. DO NOT PRY AGAINST WIRES.
   c. Install four bolts "Z". Torque to 15 ft. lbs.

Check to see if wiring is movable (up and down column) and not pinched.

   d. Position wedge and install bracket assembly and spacers (if used) and install nuts "A" and "B". Torque to 20 ft. lbs.
   e. Push wedge rearward until finger tight and install nut "C", torque 20 ft. lbs.
9. Using Tool J-21853-01 align tang on cover with slots in housing and carefully drive cover until fully seated. (Fig. 9A-36)

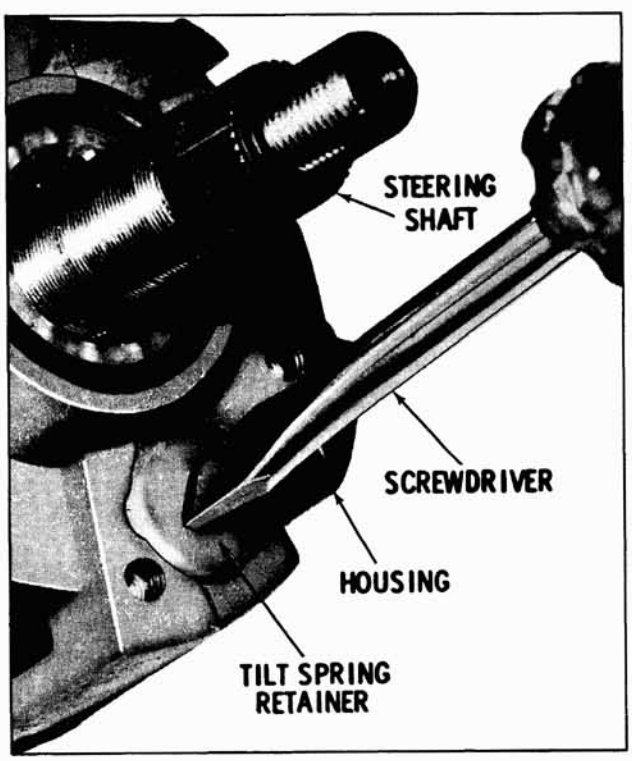


Fig. 9A-37—Removing or Installing Tilt Spring Retainer

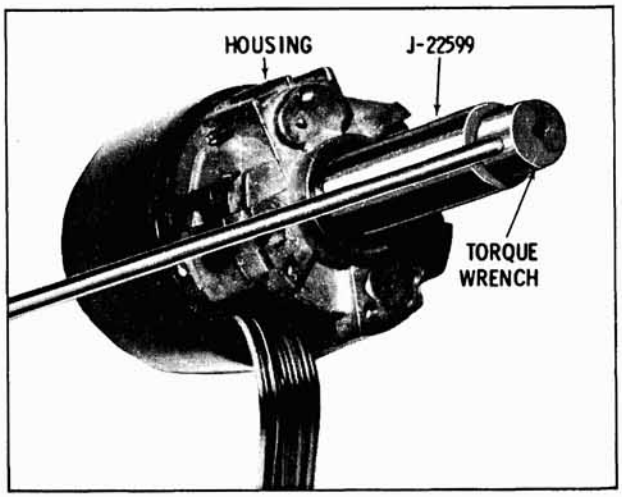


Fig. 9A-38—Removing or Installing Locknut

10. Install hazard warning knob, tilt lever and turn signal lever.

Pull hazard warning knob out to the "OFF" Position. Position turn signal lever in neutral position.

11. Install steering wheel. Refer to Steering Wheel Installation.
12. Insert turn signal and cornering light wiring clips into connector as shown in Fig. 9A-29. MAKE CERTAIN COLOR CODING ON WIRING CORRESPONDS TO FIG. 9A-29.
13. Connect negative battery cable.

HOUSING (EXCEPT TILT-AWAY OR TILT AND TRAVEL)

Removal of the housing (except Tilt or Tilt and Travel) is the same procedure listed under "Turn Signal Switch (Except Tilt or Tilt and Travel) Disassembly" except the following:

Do not perform Step 14.

Installation of the housing is the same procedure listed under assembly of the Turn Signal Switch (Except Tilt or Tilt and Travel) except the following:

Do not perform Steps 5 and 18.

HOUSING (TILT-AWAY)

Removal

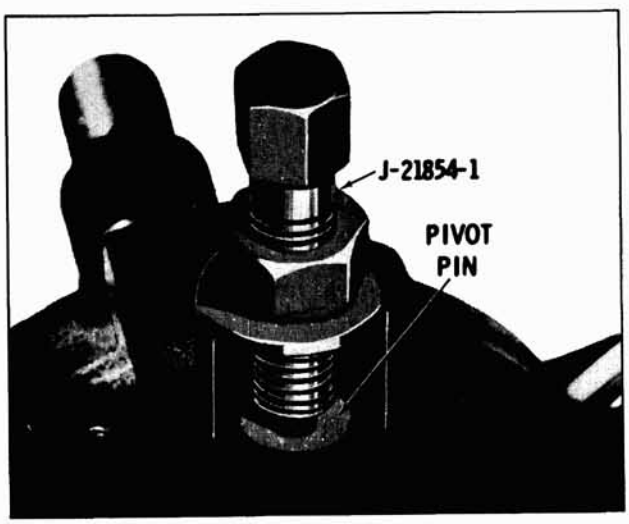


Fig. 9A-39—Removing Pivot Pins - Tilt-Away

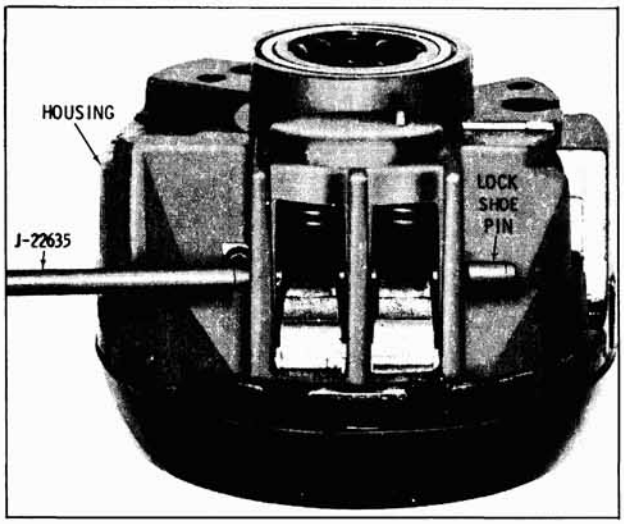


Fig. 9A-40—Lock Shoe Removal - Tilt-Away

1. Remove turn signal switch (TILT-AWAY). Refer to Turn Signal Switch (Tilt-Away Removal.) Do not perform Step 13.
2. Install tilt lever and position column in the full up position.
3. Using a large screwdriver, insert blade into slot of the tilt spring retainer, press in and turn counterclockwise approximately 1/8 turn until ears align with grooves in housing, remove spring and retainer (Fig. 9A-37)
4. Remove steering shaft bearing locknut with Tool J-22599, Fig. 9A-38, then remove inner race seat and inner race.
5. Remove pivot pins with Tool J-21854-1, similar to Fig. 9A-39.
6. Lift up on tilt lever to disengage lock shoes and remove housing. Care must be exercised that turn signal wiring is not damaged at this time. Remove tilt lever.
7. With a small screwdriver, disengage turn signal wiring clips from connector.
8. Tape a length of cord to wiring terminals and pull up on turn signal wiring until taped joint is through shroud, bowl and support. Remove tape and attach cord to support. This will be used on installation.
9. Remove turn signal wiring from housing.
10. Lock shoes and springs and shoe release lever and springs can be removed at this time if necessary (Figs. 9A-40 and 41), using Tool J-22635.

Installation

1. If lock shoes and springs or shoe release lever was removed, install into housing at this time.
2. Install turn signal wiring harness through housing and tape to cord used in Step 8 on "Removal".
3. Pull cord at bottom of bowl and feed turn signal wiring harness through support, bowl and shroud.
4. Reinstall connector on clip end of wiring as shown in Fig. 9A-29.
5. Install tilt lever and holding lock shoes in disengaged position, assemble housing over steering shaft until pivot pin holes line up.

Housing bearings must be in position in housing in order to correctly install housing.

6. Install pivot pins using a brass drift to fully seat pins.
7. Lift tilt lever and position housing in full up position.
8. Install tilt spring (tapered end of spring must fit over spring guide post on support) and spring retainer. Using screwdriver in slot of retainer push in and turn 1/8 turn clockwise until locked in position.
9. Install inner race, inner race seat and steering shaft bearing locknut. Using Tool J-22599, tighten locknut until all end play is removed from steering shaft.

Remove all end play but do not pre-load upper bearing.

10. Remove tilt lever.
11. Install turn signal switch. Refer to "Turn Signal Switch (Tilt-Away) Installation". Do not perform Steps 1 and 9.

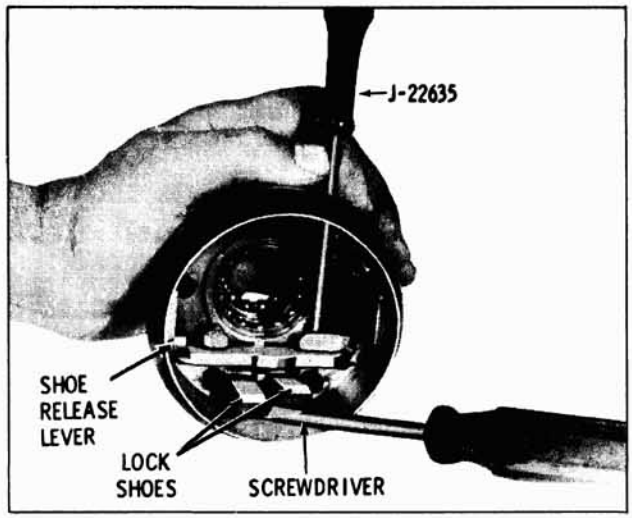


Fig. 9A-41—Shoe Release Removal - Tilt-Away

HOUSING (TILT AND TRAVEL)

Removal

1. Remove turn signal switch. Refer to "Turn Signal Switch (Tilt and Travel) Removal". Do not perform steps 14 and 15.
2. Install tilt lever into housing and tilt to maximum up position.
3. Remove upper bearing seat and race (Fig. 9A-42).
4. Insert a large screwdriver into slot of tilt spring retainer, press in, turn counterclockwise until ears of retainer align with housing. Remove retainer, tilt spring and guide (Fig. 9A-43).
5. Remove two pivot pins from support assembly using Pivot Pin Adapter, J-21854-1 and Screw, J-21179-5. Insert Screw J-21179-5 through Adapter, J-21854-1 and screw into

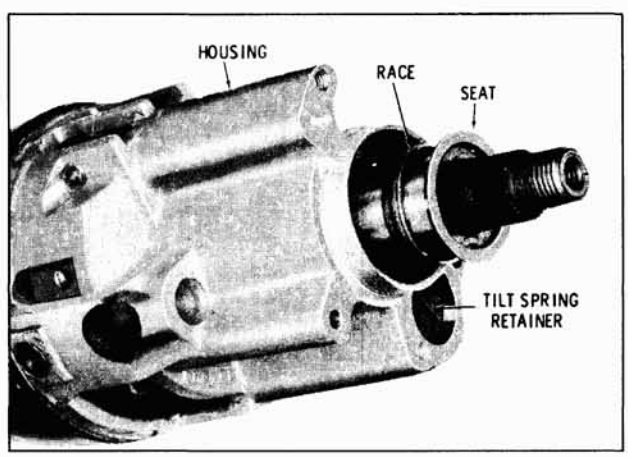


Fig. 9A-42—Bearing Seat and Race - Tilt and Travel

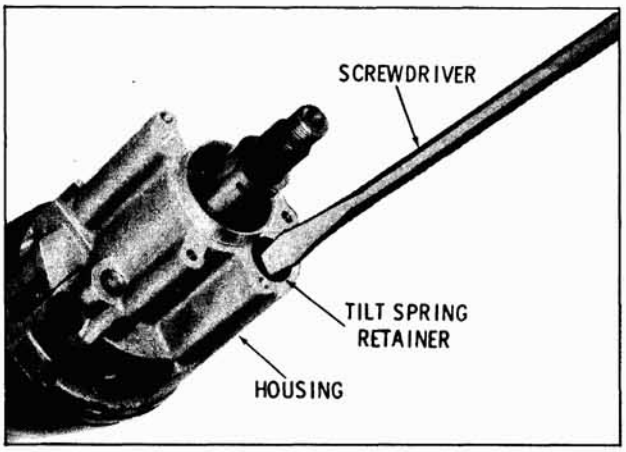


Fig. 9A-43—Removing or Installing Tilt Spring Retainer - Tilt and Travel

pivot pin. Holding Screw, J-21179-5 with wrench, tighten nut against Adapter J-21854-1 which should be centered over pivot pin with open edges of adapter facing shift lever bowl (Fig. 9A-44).

6. Lift tilt lever to disengage lock shoes from pin and remove housing from upper yoke.

If housing assembly sticks to upper yoke, tap lightly with a plastic hammer to free.

7. With a small screwdriver, disengage turn signal wiring clips from connector.

8. Tape a length of cord to wiring terminals and pull up on turn signal wiring until taped joint is through bowl and support. Remove tape and attach cord to support. This will be used on installation.

9. If necessary, remove tilt release lever pin with Tool J-22635 and remove lever and spring. (Fig. 9A-45).

10. Lock shoes or springs can be removed at this time if necessary. Using Tool J-22635 drive lock shoe pin from housing and remove lock shoes and springs. (Fig. 9A-46).

Installation

1. If tilt release lever and spring or lock shoes and springs were removed, they should be installed at this time. Refer to Figs. 9A-45 and 9A-46.

2. Insert turn signal wiring harness through housing and tape cord to harness that was used on removal Step 8. Carefully pull cord until harness is through support and bowl.

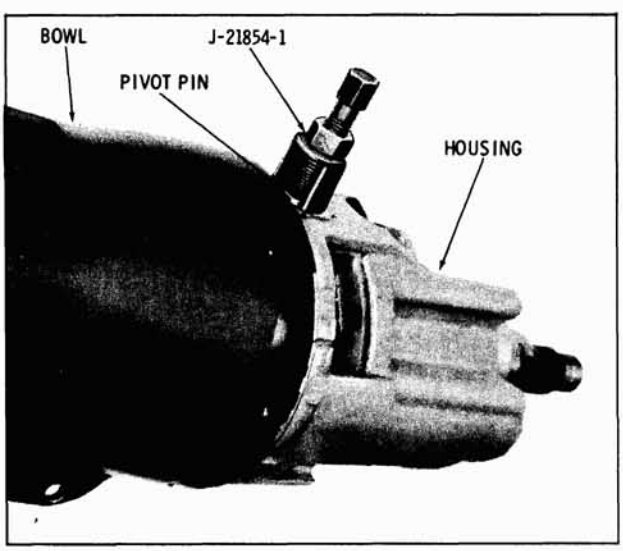


Fig. 9A-44—Removing Pivot Pins - Tilt and Travel

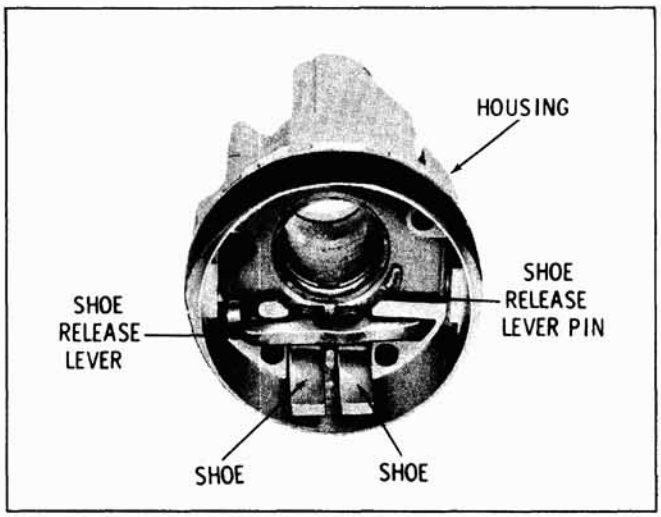


Fig. 9A-45—Tilt Release Lever

3. Attach turn signal wiring harness clips to connector as shown in Fig. 9A-29.

4. Install tilt lever and while holding lock shoes in disengaged position, install housing over steering shaft until pivot pin holes line up.

Housing bearings must be in position in housing for proper installation of housing.

Care must be exercised so that turn signal wiring is not pinched or damaged at this time.

5. Install pivot pins using a brass drift to fully seat pins.

6. Lift tilt lever and position housing in full up position.

7. Install guide and tilt spring into housing. Be sure guide and spring seat over post on support. Install tilt spring retainer. With screwdriver in retainer slot, push in and turn 1/8 turn clockwise until locked in position.

8. Install upper bearing race and seat. (Fig. 9A-42)

9. Lift tilt lever and center housing. Remove lever.

10. Install turn signal switch. Refer to "Turn Signal Switch (Tilt and Travel) Installation". Do not perform Steps 1 and 12.

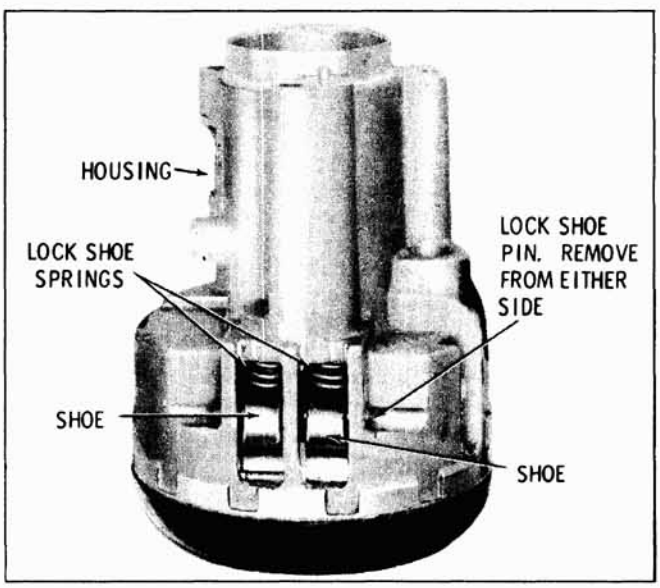


Fig. 9A-46—Lock Shoe Position in Housing

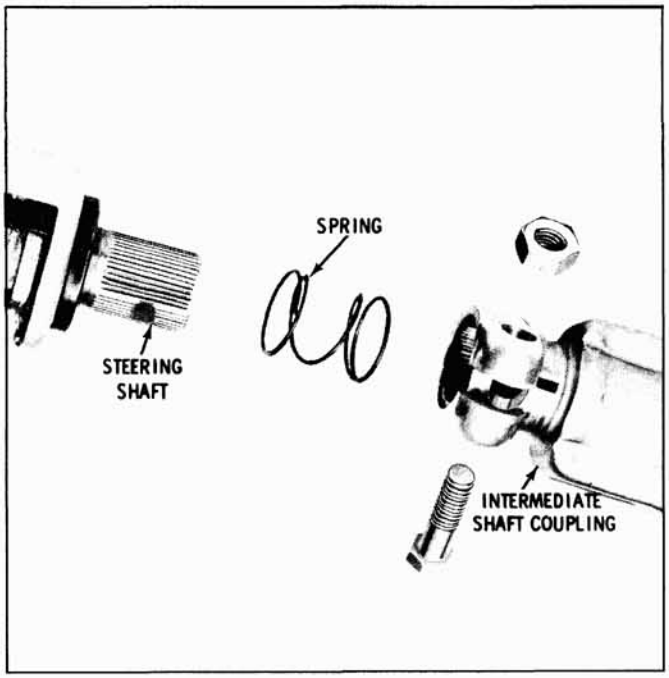


Fig. 9A-47—Clamp Attachment (31-48 Series)

STEERING SHAFT (WITHOUT TILT OR TILT AND TRAVEL)

Removal

1. Disconnect negative battery cable.
2. Remove steering wheel - Refer to Steering Wheel - Removal.
3. a. 31-48 Series - Disconnect clamp from lower end of steering shaft. (Fig. 9A-47)
   b. 54-86 Series - Disconnect flexible coupling.
   c. Toronado - Disconnect joint assembly from lower end of steering shaft.
4. a. 54-86 Series - Remove screws from lower radiator deflector and remove deflector.

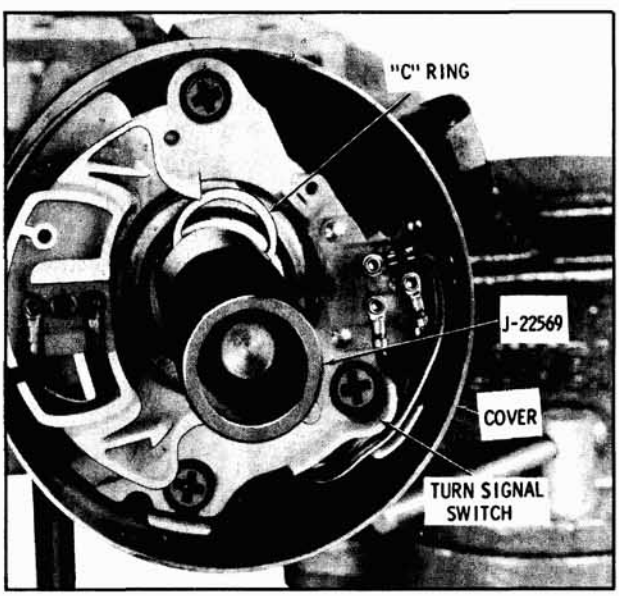


Fig. 9A-48—Removing "C" Ring

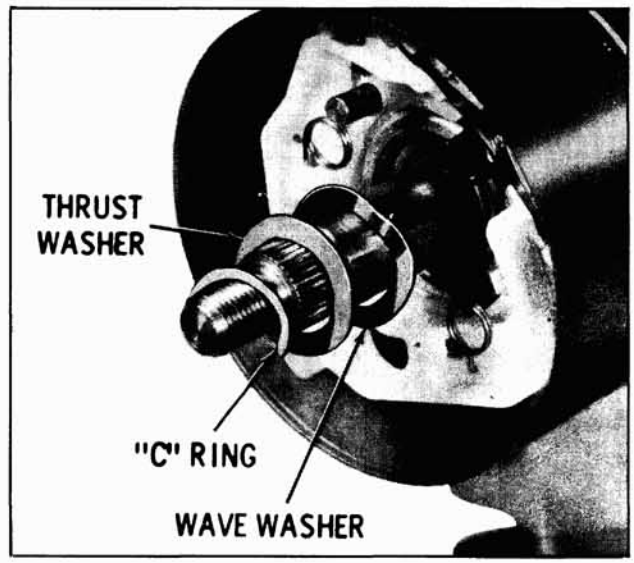


Fig. 9A-49—Thrust Washer and Wave Washer

b. 54-86 Series - Remove steering gear to frame attaching bolts and move gear toward center of car.

5. Remove turn signal cancelling cam and upper bearing pre-load spring.
6. Remove upper bearing "C" ring. (Fig. 9A-48)
7. Remove thrust washer and wave washer. (Fig. 9A-49)
8. a. 31-48 Series - Remove steering shaft from inside of car. Lower pre-load spring will fall off lower end of shaft. Retain spring.
   b. Toronado - Using a small screwdriver or cotter pin puller, remove retaining ring from below threaded plastic sleeve at lower end of steering shaft. Push up on shaft until threaded plastic sleeve and spring can be removed. Discard sleeve and spring. Remove steering shaft from inside of car.
   c. 1st. Type:
   54-86 Series - Remove steering shaft from bottom end of steering column. With shaft removed, remove spring, threaded sleeve and retaining ring and discard.
   c. 2nd. Type:
   54-86 Series - Remove steering shaft from bottom end of

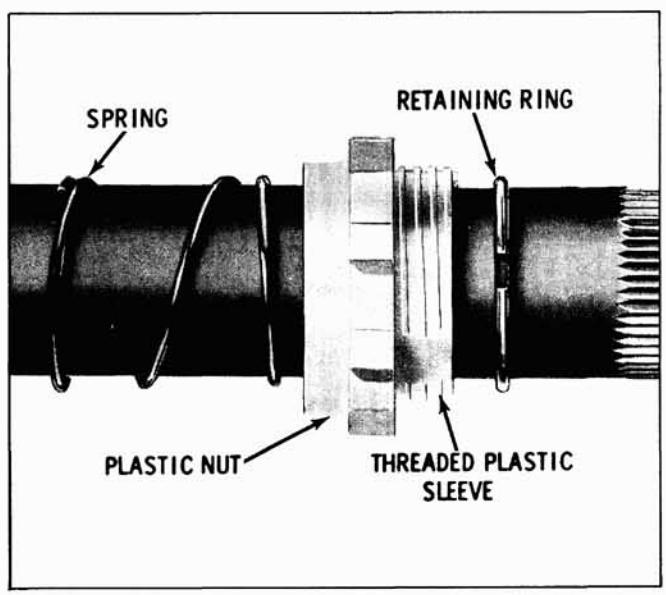


Fig. 9A-50—Lower Shaft Attachment

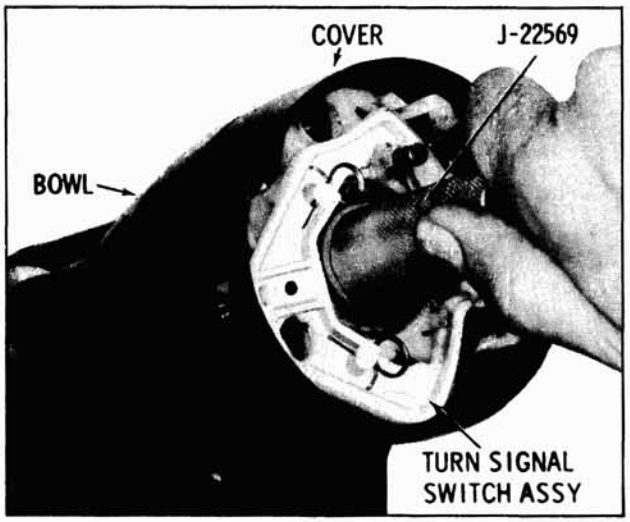


Fig. 9A-51—Installing "C" Ring

steering column. With shaft removed, remove spring and plastic sleeve.

Installation

1. 1st Type:

54-86 Series - Loosely install new (Service Kit) retaining ring, threaded plastic sleeve and spring over top end of steering shaft. Slide parts to lower end of shaft at this time. (Fig. 9A-50)

1. 2nd Type:

54-86 Series - Install plastic sleeve and spring over top end of steering shaft and slide parts to lower end of shaft at this time.

2. Install steering shaft into lower end of column, pushing up on shaft until a helper inside of car can install wave washer and thrust washer (Fig. 9A-49) and "C" ring. (9A-51)

31-48 SERIES

1. Install steering shaft into upper end of column and with the aid of a helper, position pre-load spring on lower end of shaft and align bolt slot in shaft with bolt slot in joint assembly.

2. Install bolt through clamp and torque to 35 ft. lbs.

TORONADO

1. Install steering shaft into upper end of column and with the aid of a helper, position new (Service Kit) spring, threaded sleeve and retaining ring on lower end of shaft.

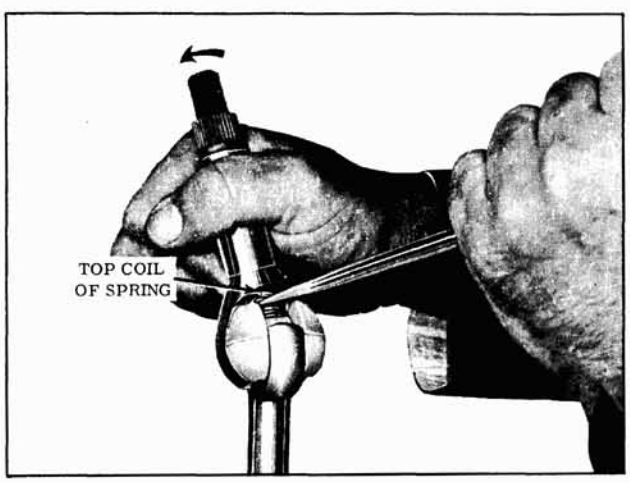


Fig. 9A-52—Removing Spherical Joint Spring

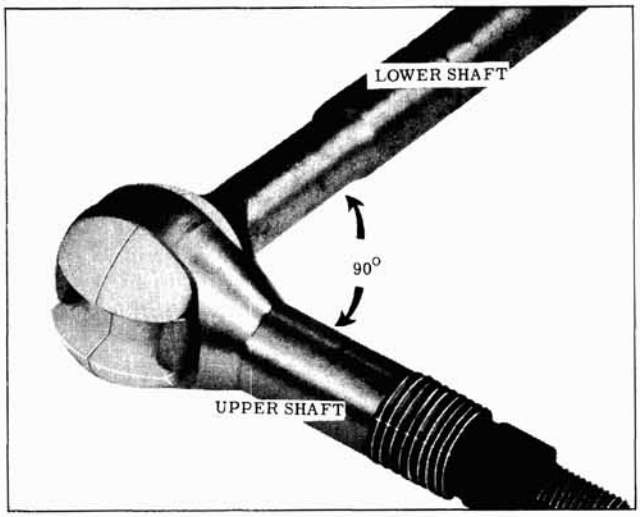


Fig. 9A-53—Removing Sphere and Upper Shaft

2. Align slot in shaft with bolt hole in joint assembly and install bolt. Torque to 80 ft. lbs. As helper pushes up on steering shaft, install wave washer and thrust washer (Fig. 9A-49) and install "C" ring. (Fig. 9A-51)

3. 1st Type 54-86 and Toronado - Slide retaining ring up shaft until fully seated in groove at lower end of steering shaft. Tighten threaded nut on sleeve finger tight, so that no axial movement can be felt in steering shaft. Stake nut to threaded sleeve with a hot soldering gun at three evenly spaced places.

4. a. 54-86 Series: Lubricate mounting pads of steering gear with sodium soap fine fiber grease to prevent squeaks between gear and frame.

b. Align flexible coupling and position gear to frame. Install gear attaching bolts and torque to 80 ft. lbs.

c. Install lower radiator deflector. Torque screw to 30 in. lbs.

d. Install flexible coupling nuts and torque to 20 ft. lbs.

5. Install upper bearing pre-load spring and cancelling cam.

6. Install steering wheel. Refer to Steering Wheel - Installation.

7. Connect negative cable to battery.

STEERING SHAFT (TILT-AWAY)

Removal

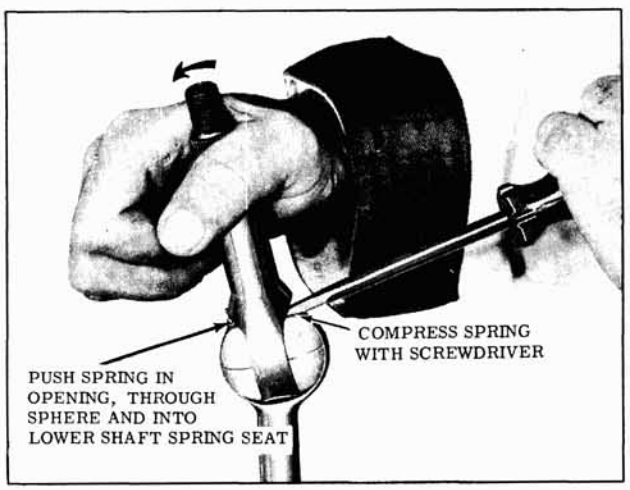


Fig. 9A-54—Installing Spherical Joint Spring

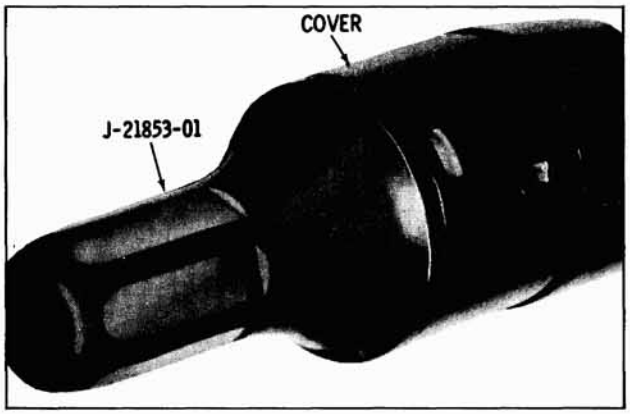


Fig. 9A-55—Installing Cover - Tilt-Away

1. Remove turn signal switch. Refer to "Turn Signal Switch (Tilt-Away) Removal". Do not perform Steps 8 through 11C and 13. Care must be exercised when performing Step 12 so that turn signal wiring is not chafed on bracket assembly or wire clip on jacket.
2. Remove housing. Refer to "Housing (Tilt-Away) Removal". Steps 2 thru 6.
3. Remove joint assembly clamp bolt which secures steering shaft.
4. Carefully push steering shaft upward so that pre-load spring can be removed from lower end of shaft.
5. Lift steering shaft (inside of car) from column.
6. Clamp the steering shaft in brass jawed vise.
7. Move the upper shaft fully from centerline of lower shaft.
8. Remove upper end of spherical joint pre-load spring from its seat in the upper shaft by compressing the coils with a narrow bladed screwdriver. (Fig. 9A-52)
9. Move the upper shaft aside and allow the spring to snap out of the opening between the shaft and the sphere.
10. Remove the spring.
11. Turn the upper shaft 90° from the center line of the lower shaft and remove the upper shaft and sphere from the lower shaft (Fig. 9A-53)
12. Remove the sphere from the upper shaft by rotating so flats on sphere align with socket.

Installation

1. Using chassis lubricant, lubricate both halves of the centering sphere, then assemble the two halves of the centering sphere together with the small wave washer between, then place the sphere in the upper shaft socket.

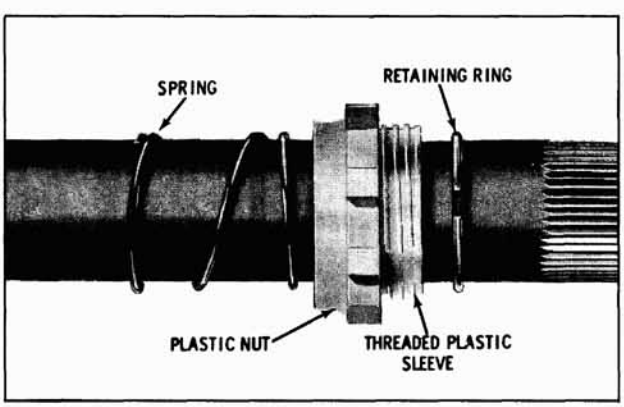


Fig. 9A-56—Lower Shaft Attachment

2. Turn the sphere so the lower shaft can be installed over the flat area of the sphere (Fig. 9A-53) approximately 90° from centerline of lower shaft, then, install lower shaft socket over the sphere and straighten the shaft.
3. Install the pre-load spring through the centering sphere and into the spring seat in the lower shaft. Compress the spring into the opening between the sphere and the upper shaft, then move upper shaft to hold spring. With a screwdriver, inserted through the coils from the opposite side of the shaft, compress the spring so the upper end will snap into the spring seat in the upper shaft. (Fig. 9A-54)
4. Install the steering shaft assembly into the column from inside of the car.
5. Lift up on lower end of shaft and install pre-load spring and position clamp of joint assembly in line with slot in steering shaft and install bolt and nut to clamp. Torque to 35 ft. lbs.
6. Install housing. Refer to "Housing (Tilt-Away) Installation". Steps 5 thru 10.
7. Install cover Using Tool J-21853-01. (Fig. 9A-55)
8. Install hazard warning knob. Pull knob out to the "OFF" Position.
9. Install turn signal lever and attaching screw. Torque to 25 in. lbs. Position lever in the neutral position.
10. Install turn signal cancelling cam and pre-load spring.
11. Install steering wheel, refer to Steering Wheel - Installation.

STEERING SHAFT (TILT AND TRAVEL)

Removal

1. Remove housing. Refer to housing (Tilt and Travel) Removal. Do not perform Steps 7-8-9 and 10.
2. Remove steering shaft flange bolt from flange.
3. Using screwdriver remove retaining ring from slot in steering shaft at lower end.
4. Push up on steering shaft until free from flange and retainer ring, sleeve and spring can be removed. (Fig. 9A-56)
5. Steering shaft assembly can now be removed from upper end (inside of car).

If repair is to be done only on the upper shaft, yoke or centering spheres, it will not be necessary to remove steering shaft completely from column.

6. Remove spring and spring stop by pushing spring stop from either side with a narrow bladed screwdriver (Fig. 9A-57)
7. Hold hand over open end of upper shaft to prevent dropping of locking rod when removing upper shaft. Turn upper shaft on a right angle to centerline of lower shaft (90°),

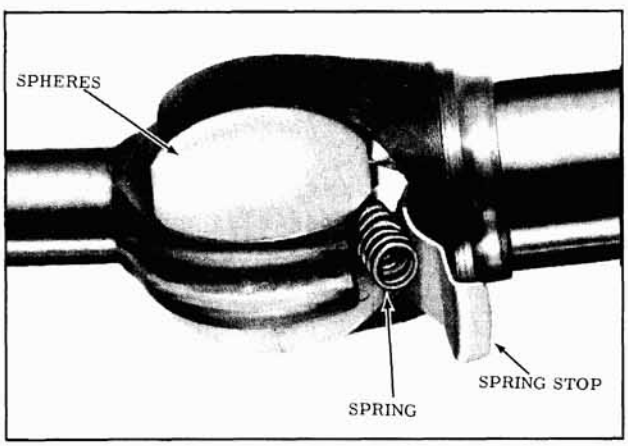


Fig. 9A-57—Removing Spherical Spring and Stop - Tilt and Travel

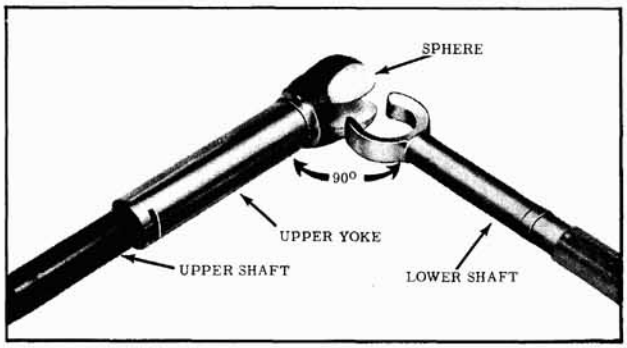


Fig. 9A-58—Removing Spherical Joints

align flats on centering sphere with lower shaft coupling and remove upper shaft with sphere. (Fig. 9A-58)

8. Remove locking rod from upper shaft.

9. Hold yoke, upper shaft and sphere assembly with sphere up. Remove two-piece centering sphere from upper yoke by rotating sphere so flats align with yoke opening, then remove sphere. A wave washer is now used between spheres.

10. Upper shaft will come out of either end of upper yoke. (Fig. 9A-59)

11. Remove locking rod, locking wedge and upper bumper from upper shaft.

Installation

When assembling, use Chassis Lubricant whenever lubricant is specified in the following procedure:

1. Insert upper shaft into upper yoke from top with keyway aligned. Tap upper shaft until locking wedge can be installed. Now tap upper shaft until locking wedge stays in position. (Fig. 9A-59)

2. Lubricate centering spheres (two-piece) and install spheres and wave washer removed during disassembly into upper yoke.

3. Rotate centering sphere so that lower steering shaft can be installed over flats on sphere (approximately 90° from centerline of upper shaft), then install lower shaft coupling over the sphere.

4. Lubricate spring seat in lower shaft coupling and stop spring.

5. Turn upper shaft slightly from center line of lower shaft and insert one end of spring thru hole in centering sphere into lower shaft coupling. Place spring stop over spring. Using a narrow bladed screwdriver, compress spring with screwdriver and slide spring stop in so that it seats in upper yoke. (Fig. 9A-57)

6. Lubricate spring and outer surfaces of centering sphere.

7. Install steering shaft assembly into shift tube from upper end.

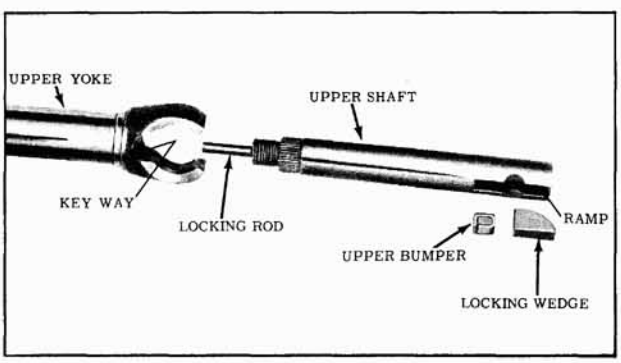


Fig. 9A-59—Upper Shaft Components

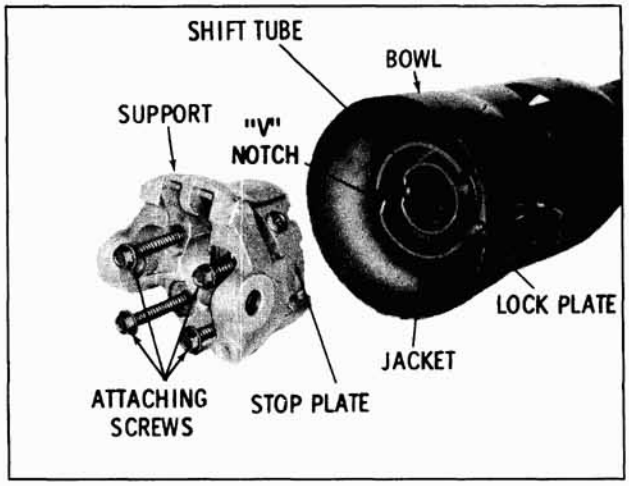


Fig. 9A-60—Support Attachment

8. Install spring, threaded sleeve, threaded nut and wire retainer ring (Service Kit) to lower end of steering shaft loosely. Make sure nut is not tight against adapter bearing at this time. Install steering shaft into companion flange and install bolt. Torque companion flange bolt to 35 ft. lbs.

9. Slide retaining ring up shaft until fully seated on steering shaft. (Fig. 9A-56)

10. Install housing. Refer to Housing - Installation (Tilt and Travel). Do not perform Steps 1-2 and 3.

11. Tighten threaded nut (installed in Step 8 - STEERING SHAFT (Tilt and Travel) (Installation) finger tight, so that no axial movement can be felt in steering shaft. Stake nut to threaded sleeve with a hot soldering gun at three evenly spaced places.

SUPPORT (TILT OR TILT AND TRAVEL)

Removal

1. Remove steering shaft. Refer to Steering Shaft Removal (Tilt) or (Tilt and Travel).

2. Remove four attaching screws, support to lock plate, and lift support from upper end of shift tube. (Fig. 9A-60)

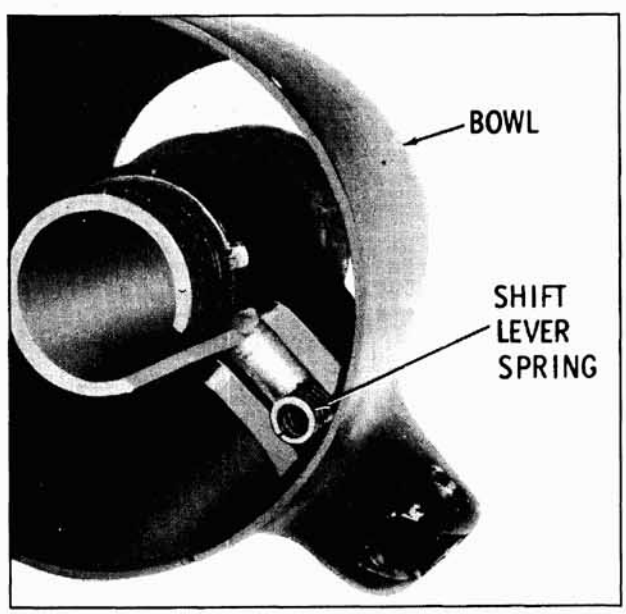


Fig. 9A-61—Shift Lever Spring

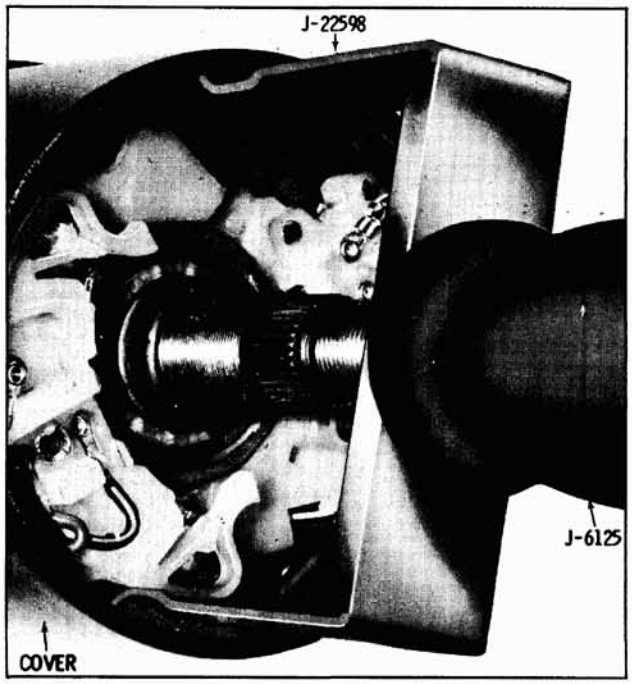


Fig. 9A-62—Cover Removal - Tilt-Away

3. If stop plate is to be replaced, remove two attaching screws and remove stop plate. (Fig. 9A-60)

Installation

1. Install two attaching screws, stop plate to support.
2. Install support by aligning "V" in support with "V" notch in jacket. Install four attaching screws through support into lock plate. Torque to 50 inch pounds.
3. Install steering shaft. Refer to Steering Shaft Installation (Tilt) or (Tilt and Travel).

BOWL (WITHOUT TILT OR TILT AND TRAVEL)

Removal

1. Remove turn signal switch. Refer to Turn Signal Switch (except Tilt or Tilt and Travel). Do not perform steps 9, 10, 14 thru 17.
2. Lift bowl from shift tube and remove turn signal wiring.
3. Using a punch and hammer, remove shift lever pivot pin. Remove shift lever. To remove shift lever spring, insert screwdriver into spring and turn counterclockwise. A new spring must be used if removed. (Fig. 9A-61)

Installation

1. Insert turn signal switch wiring through bowl and position bowl on shift tube.
2. Install turn signal switch. Refer to turn signal switch (except Tilt or Tilt and Travel). Do not perform steps 1 thru 5, 12, 13 and 18.

OUT OF CAR PROCEDURES

BOWL, SHIFT TUBE OR JACKET (TILT-AWAY)

Removal

1. Remove steering column. Refer to Steering Column Removal.
2. Remove turn signal cancelling cam and pre-load spring.
3. Remove tilt release lever.
4. Push in on hazard warning knob and turn counterclockwise to remove.

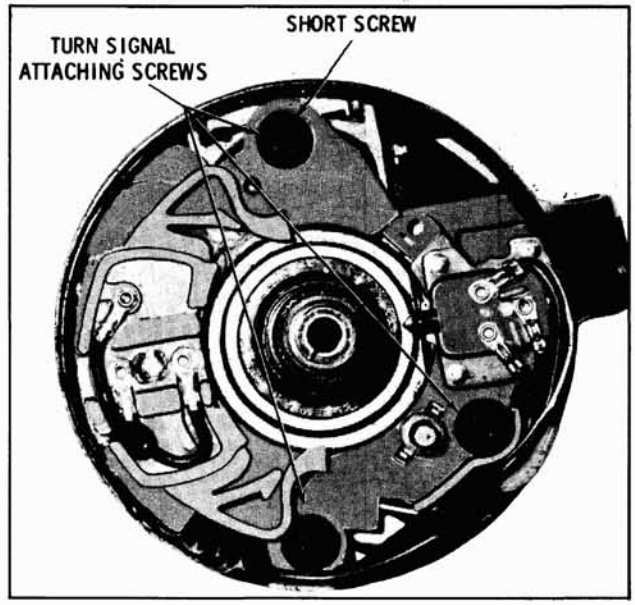


Fig. 9A-63—Turn Signal Switch Attaching Screws - Tilt-Away

5. Remove turn signal cover using Tool J-22598 and slide hammer, J-6125. (Fig. 9A-62)
6. Remove the three attaching screws, turn signal switch to housing. Lift turn signal switch off housing and upper end of steering shaft.

Short length screw in top position above lock shoes. (Fig. 9A-63)

7. Install tilt lever and position column in the full up position.
8. Using a large screwdriver, insert blade into slot of the tilt spring retainer, press in and turn counterclockwise ap-

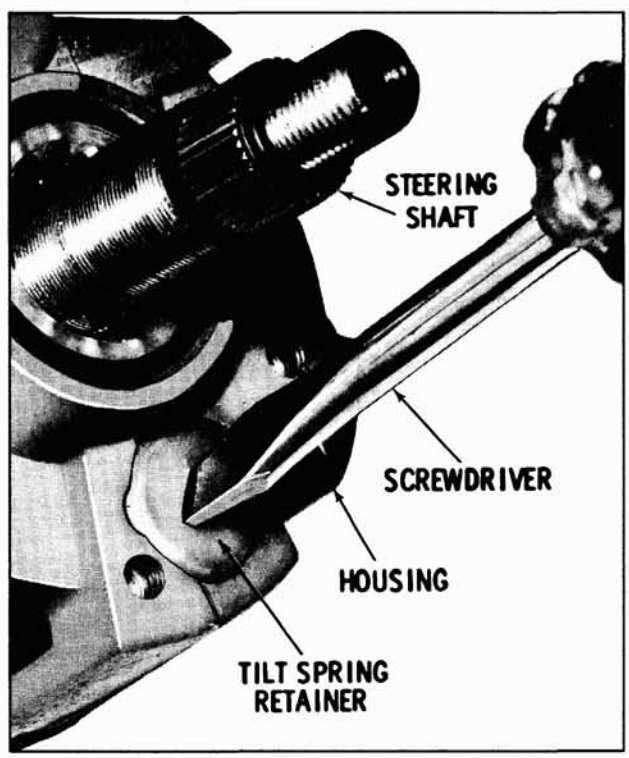


Fig. 9A-64—Removing or Installing Tilt Spring Retainer

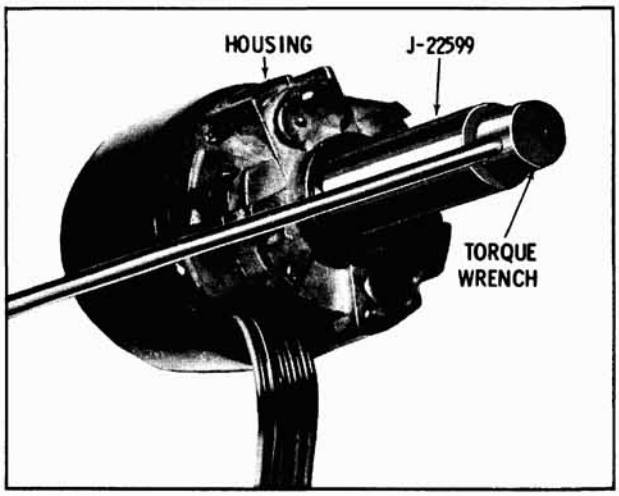


Fig. 9A-65—Removing or Installing Locknut

proximately 1/8 turn until ears align with grooves in housing, remove spring and retainer. (Fig. 9A-64)

9. Remove steering shaft bearing locknut with Tool J-22599, Fig. 9A-65, then remove inner race seat and inner race.

10. Remove pivot pins with Tool J-21854-1. (Fig. 9A-66)

11. Lift up on tilt lever to disengage lock shoes and remove housing. Care must be exercised that turn signal wiring is not damaged at this time. Remove tilt lever.

12. Lift steering shaft from column.

13. Remove four attaching screws, support to lock plate and lift support from upper end of shift tube. (Fig. 9A-60)

14. Remove retainer and thrust washer from top end of shift tube. (Fig. 9A-67)

15. Lift up on locking tabs of adapter assembly at lower end of jacket and tap lightly with plastic hammer against adapter to remove. If necessary to remove bearing from adapter, drive out with hammer and punch. (Fig. 9A-68)

16. Remove neutral start and backup switch, if so equipped.

17. Install Tool J-22551 into shift tube as shown in Fig. 9A-69. Turn nut of tool clockwise, making sure that lower shift lever is in alignment with slot in bottom of jacket. (Fig. 9A-70)

18. Remove Tool J-22551.

19. Remove shift tube from jacket.

20. Remove lock plate and wave washer from inside of bowl.

21. Remove bowl from jacket. Carefully remove turn signal wiring.

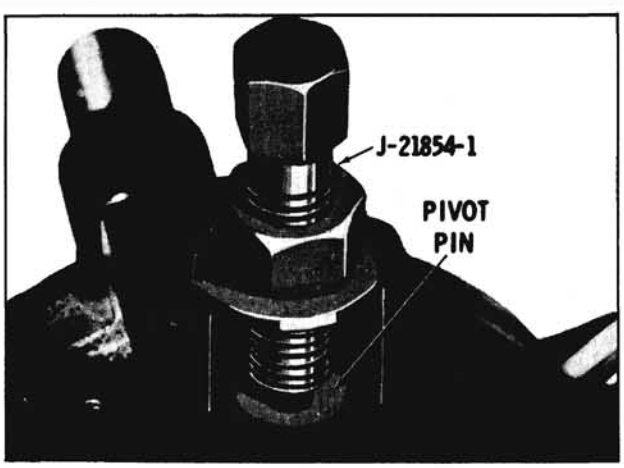


Fig. 9A-66—Removing Pivot Pins

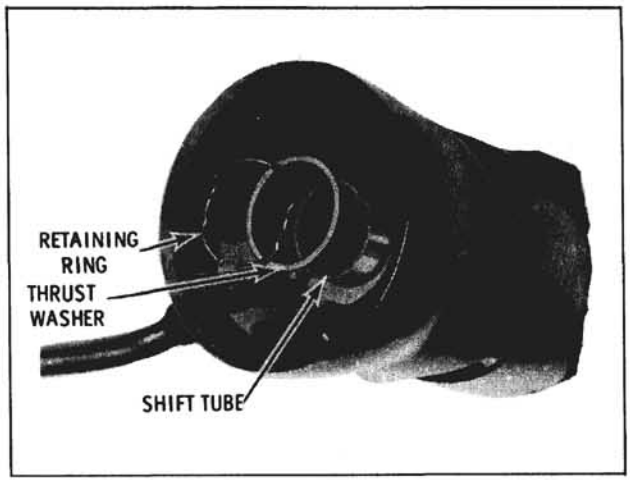


Fig. 9A-67—Removing or Installing Retainer and Thrust Washer

22. Plastic cover which covers mesh of jacket can be removed by opening cover with a knife at sealed joint and unwrapping from jacket.

Installation

Apply a thin coat of chassis grease to all friction parts.

1. Rewrap mesh cover, if removed, hold in place with tape, such as electricians plastic tape.

2. Insert turn signal switch wiring through access hole in lower portion of bowl. Support housing so that wiring is not damaged.

3. Slide bowl into jacket.

4. Install wave washer and lock plate in place. Wave washer must be between hub of bowl and lock plate. Position lock plate into notches in jacket by tipping lock plate toward bowl hub and 12 o'clock position and under jacket opening. Slide lock plate into notches in jacket.

5. Insert shift tube into lower end of jacket. Align keyway in tube with key in bowl. Install Tool J-22549 through lock plate, wave washer and into inside of shift tube. Turn bolt of tool until tool locks inside of shift tube. With lower shift lever in alignment with slot in jacket, turn nut of tool until a definite change in torquing is felt. Shift tube should be in place at this time. (Fig. 9A-71)

6. Remove Tool J-22549 and install thrust washer and retainer. It may be necessary to lift up on bowl to compress wave washer to install retainer. (Fig. 9A-67)

7. Position "V" in the support with the "V" notch in jacket and install the four attaching bolts into the lock plate. Tor-

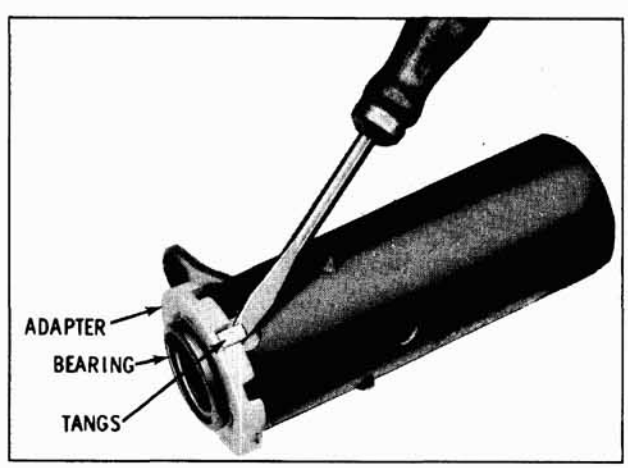


Fig. 9A-68—Removing Adapter - Tilt-Away

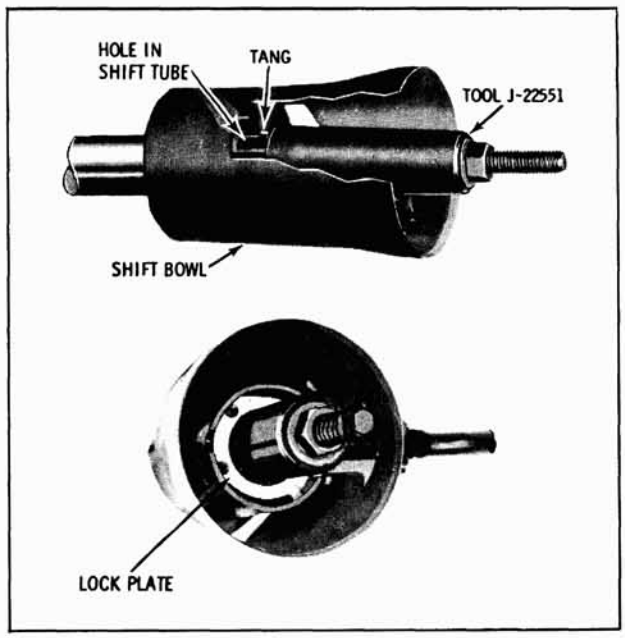


Fig. 9A-69—Installing Tool into Shift Tube

que bolts to 50 inch pounds. (Fig. 9A-72)

8. Align plastic fingers of the adapter with holes in the lower end of jacket. While piloting shift tube, push adapter and bearing assembly into a lock-in position. (Fig. 9A-73)

9. Install steering shaft from upper end carefully guiding shaft through shift tube, lower seal and bearing in adapter.

10. Install tilt lever into housing and while holding lock shoes in disengaged position, assemble housing over steering shaft until pilot pin holes line up.

11. Install pivot pins. Drive pivot pins in until flush with housing with brass drift.

12. Lift tilt lever and position housing in the full up position. Install tilt spring (taper end first over spring guide boss on support) and tilt spring retainer using large screwdriver in slot of retainer pushing in and aligning ears with grooves in housing, turn clockwise approximately 1/8 turn to lock.

13. Install three turn signal switch attaching screws (short length screw in position above lock shoes) and torque to 35 inch pounds. (Fig. 9A-74)

14. Install inner race and inner race seat.

15. Install bearing locknut using Tool J-22599. Do not tighten against inner race seat at this time.

16. Remove tilt lever.

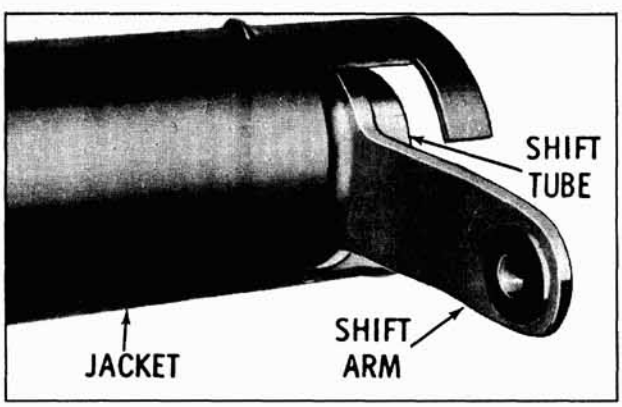


Fig. 9A-70—Shift Tube Alignment

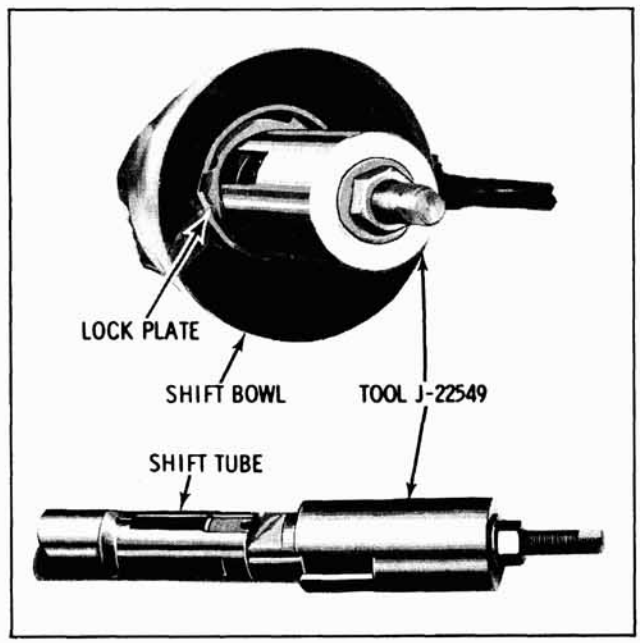


Fig. 9A-71—Installing Tool J-22549

17. Align key in the cover with keyway in the housing and using Tool J-21853-01 carefully tap cover into place. (Fig. 9A-75)

Press hazard warning button in before installing cover.

18. Install tilt release lever, turn signal lever and hazard warning knob.

19. Install steering column. Refer to Steering Column Installation, steps 1 thru 10.

20. Using Tool J-22599, tighten locknut (installed in Step 15) until all end play is removed from steering shaft. Do not pre-load upper bearing. Remove Tool J-22599.

21. Slide cancelling cam and cancelling cam spring on upper steering shaft.

22. Install steering wheel. Refer to Steering Wheel - Installation.

BOWL, SHIFT TUBE OR JACKET (TILT AND TRAVEL)

Removal

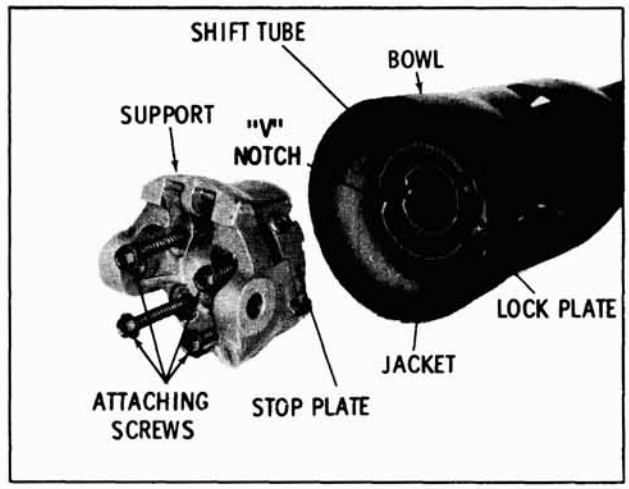


Fig. 9A-72—Support Attachment

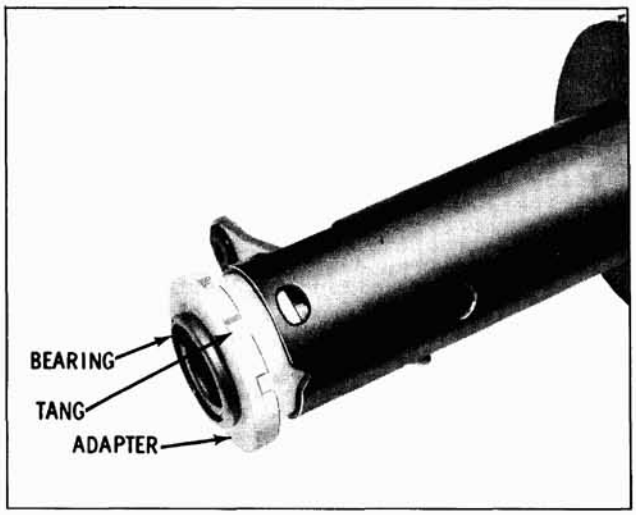


Fig. 9A-73—Installing Adapter

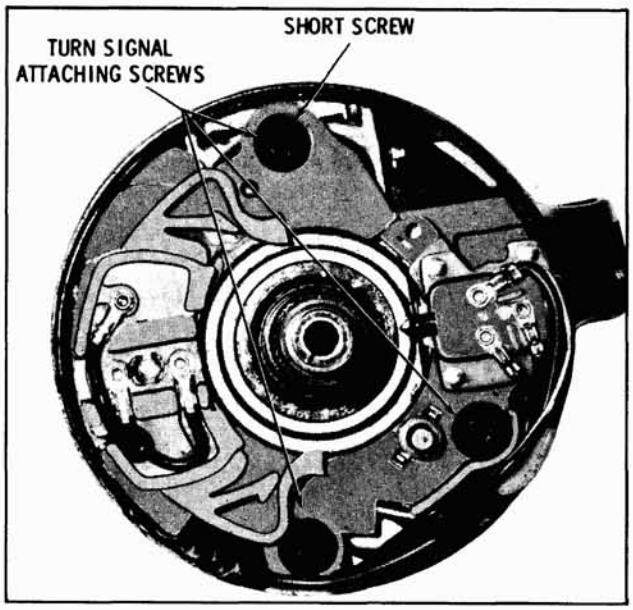


Fig. 9A-74—Turn Signal Attaching Screws - Tilt-Away

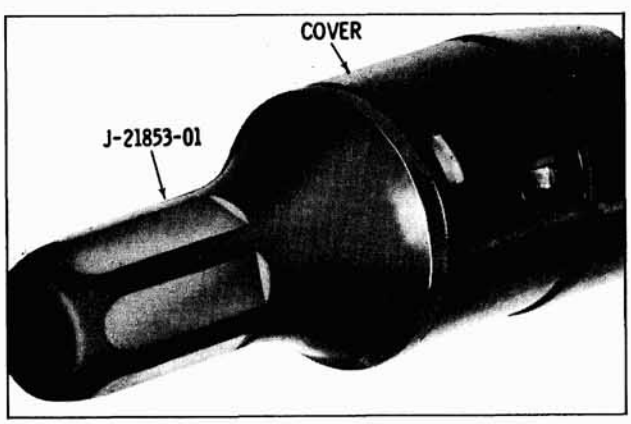


Fig. 9A-75—Installing Cover - Tilt-Away

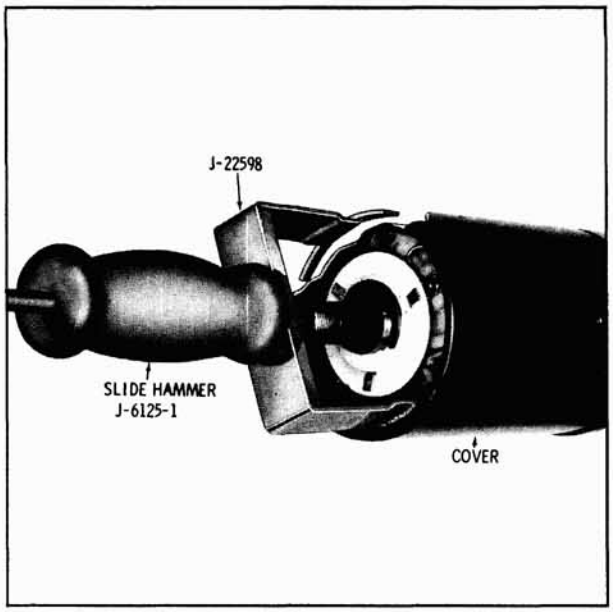


Fig. 9A-76—Removing Cover - Tilt and Travel

1. Remove steering column. Refer to Steering Column Removal.
2. Remove tilt release and turn signal levers.
3. Push in on hazard warning knob. Then unscrew counterclockwise to remove.
4. Using slide hammer, J-6125-1, and cover remover, J-22598, remove cover. (Fig. 9A-76)
5. Remove lower bumper (rubber washer) from upper shaft.
6. Using Tool J-22191, screw 5/16" bolt into upper shaft until bolt contacts locking rod. Lift upper shaft 1" and lock in position with bolt. Position half-socket portion of tool on inner shoulder of horn contact carrier assembly, (Fig. 9A-77) steady tool with hand and turn nut until "C" ring is free and remove.
7. Remove Tool J-22191.
8. Remove horn contact carrier assembly.
9. Remove upper bearing spring, seat and race. (Fig. 9A-78)
10. Install tilt lever and position column in the full up position.
11. Remove the five screws attaching turn signal and

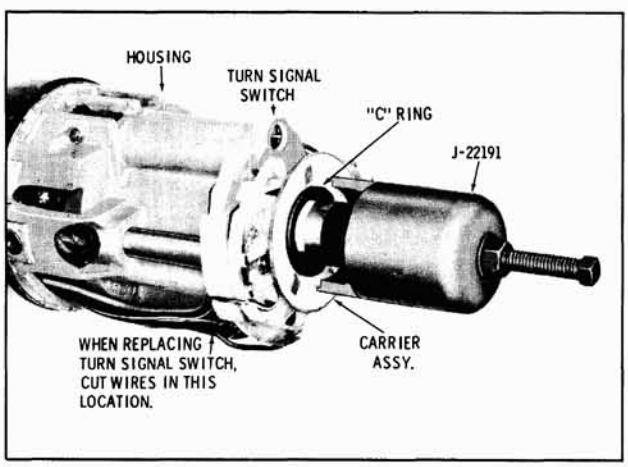


Fig. 9A-77—Removing "C" Ring

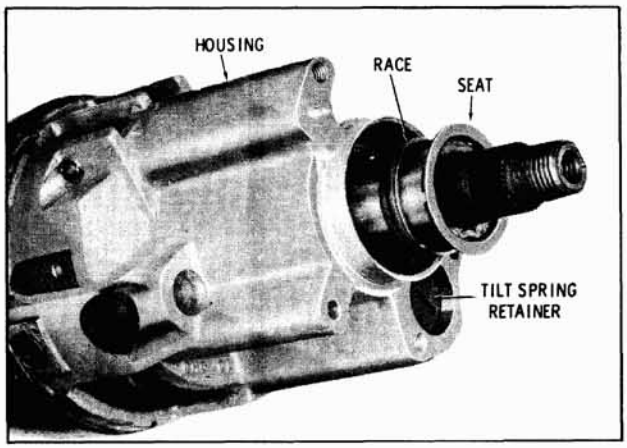


Fig. 9A-78—Removing Bearing Seat and Race - Tilt and Travel

hazard warning switch. Lift switch off housing and upper end of steering shaft. (Fig. 9A-79)

12. Using a large screwdriver, insert blade into slot of the tilt spring retainer, press in and turn counterclockwise approximately 1/8 turn until ears align with grooves in housing, remove spring, spring guide and retainer. (Fig. 9A-80)

13. Remove pivot pins with Tool J-21854-1. (Fig. 9A-81)

14. Lift up on tilt lever to disengage lock shoes and remove housing. Care must be exercised that turn signal wiring is not damaged at this time. Remove tilt lever.

15. Push up on plastic sleeve at bottom of shaft so that round wire retainer ring can be removed. Then carefully push steering shaft upward so that loose components can be removed from lower end of shaft. (Fig. 9A-82)

16. Lift steering shaft from column.

17. Remove four attaching screws, support to lock plate and lift support from upper end of shift tube. (Fig. 9A-83)

18. Remove retainer and washer from top end of shift tube. (Fig. 9A-84)

19. Lift up on locking tabs of adapter assembly at lower end of jacket and tap lightly with plastic hammer against adapter to remove. If necessary to remove bearing from adapter, drive out with hammer and punch. (Fig. 9A-85)

20. Remove neutral start and backup switch, if so equipped.

21. Install Tool J-22551 into shift tube as shown in Fig. 9A-86. Turn nut of tool clockwise, make sure that lower shift lever is in alignment with opening in bottom of jacket. (Fig. 9A-87)

22. Remove Tool J-22551.

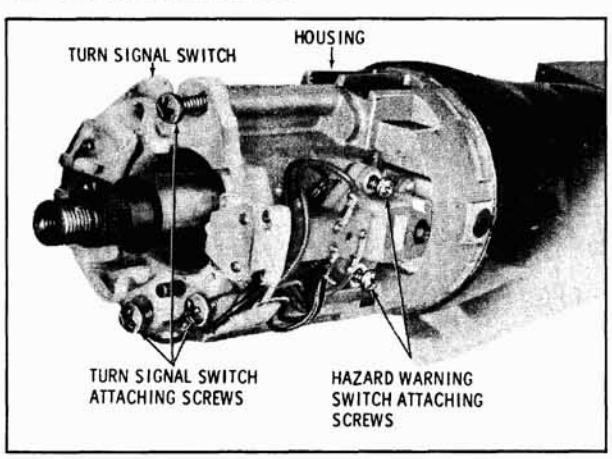


Fig. 9A-79—Turn Signal and Hazard Warning Attaching Screws

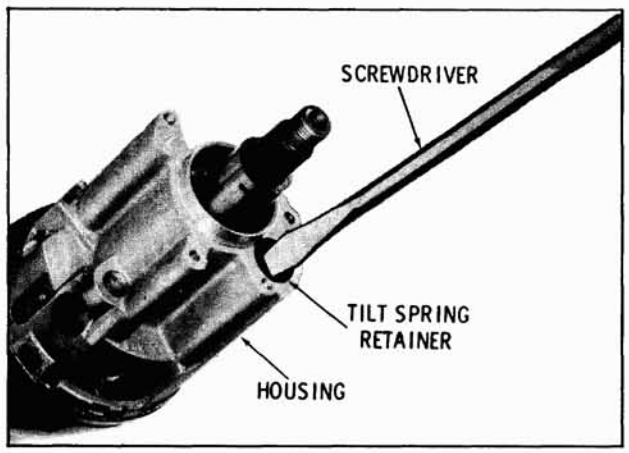


Fig. 9A-80—Removing or Installing Tilt Spring Retainer - Tilt and Travel

23. Remove shift tube from jacket.

24. Remove lock plate and wave washer from inside of bowl.

25. Remove bowl from jacket.

26. Plastic cover which covers mesh of jacket can be removed by opening cover with a knife at sealed joint and unwrapping from jacket.

Installation

Apply a thin coat of chassis grease to all friction parts.

1. Rewrap mesh cover, if removed, hold in place with tape, such as electricians plastic tape.

2. Insert turn signal switch wiring through access hole in lower portion of bowl. Support housing so that wiring is not damaged.

3. Slide bowl into jacket.

4. Install wave washer and lock plate in place. Wave washer must be between hub of bowl and lock plate. Position lock plate into notches in jacket by tipping lock plate toward bowl hub and 12 o'clock position and under jacket opening. Slide lock plate into notches in jacket.

5. Insert shift tube into lower end of jacket. Align keyway in tube with key in bowl. Install Tool J-22549 through lock plate, wave washer and into inside of shift tube. Turn bolt of tool until tool locks inside of shift tube. With lower shift lever in alignment with slot in jacket, turn nut of tool until a definite change in torquing is felt. Shift tube should be in

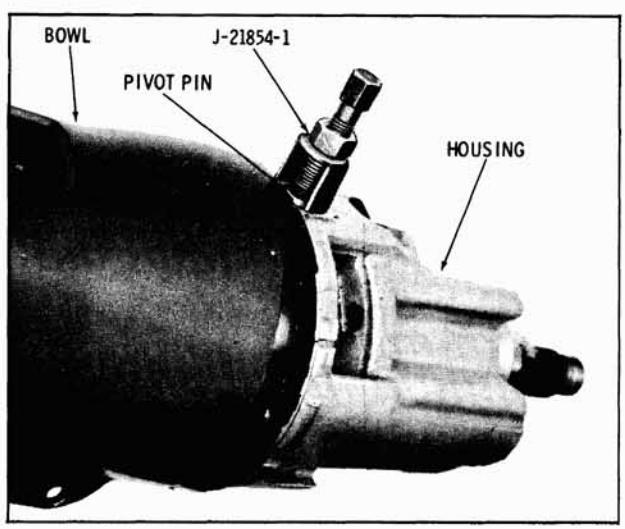


Fig. 9A-81—Removing Pivot Pins - Tilt and Travel

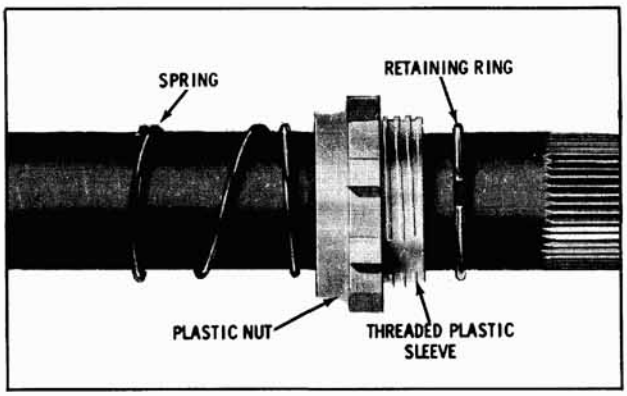


Fig. 9A-82—Lower Shaft Attachment

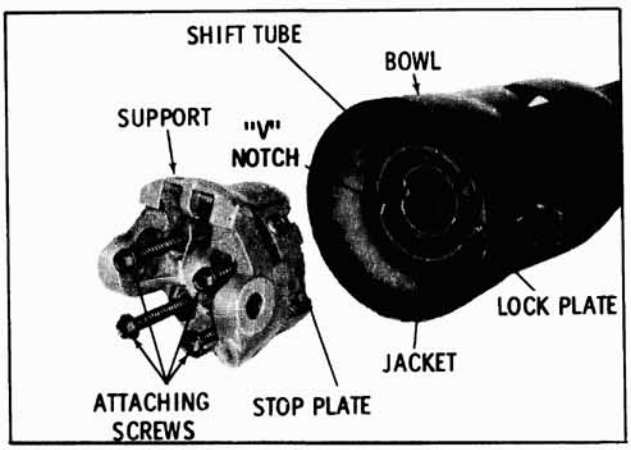


Fig. 9A-83—Support Attachment

place at this time. (Fig. 9A-88)

6. Remove Tool J-22549 and install thrust washer and retainer. It may be necessary to lift up on bowl to compress wave washer to install retainer. (Fig. 9A-84)

7. Position "V" in the support with the "V" notch in jacket and install the four attaching bolts into the lock plate. Torque bolts to 50 inch pounds. (Fig. 9A-83)

8. Align plastic fingers of the adapter with holes in the lower end of jacket. While piloting shift tube, push adapter and bearing assembly into a lock-in position. (Fig. 9A-89)

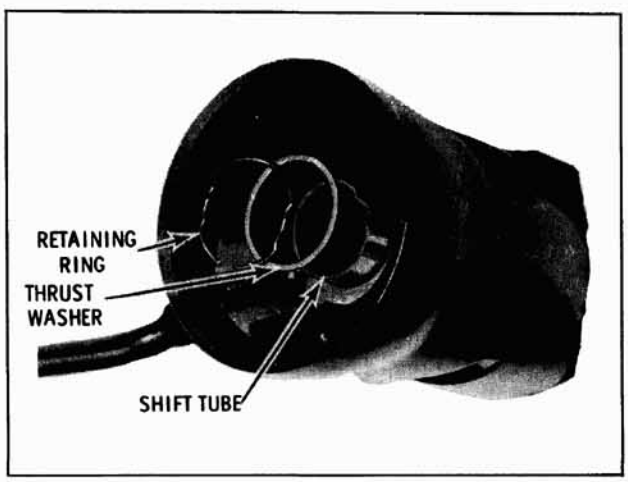


Fig. 9A-84—Removing or Installing Retainer or Thrust Washer

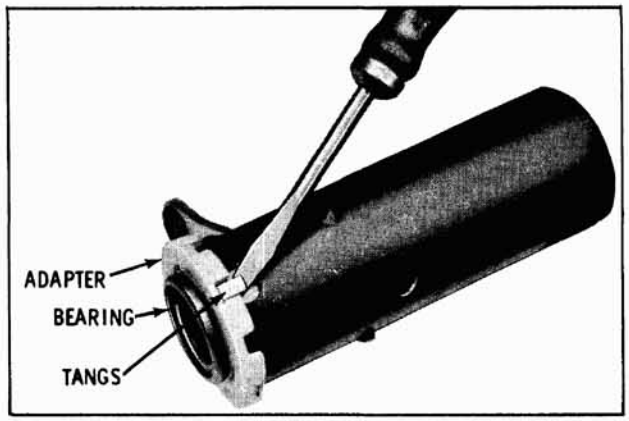


Fig. 9A-85—Removing Adapter - Tilt and Travel

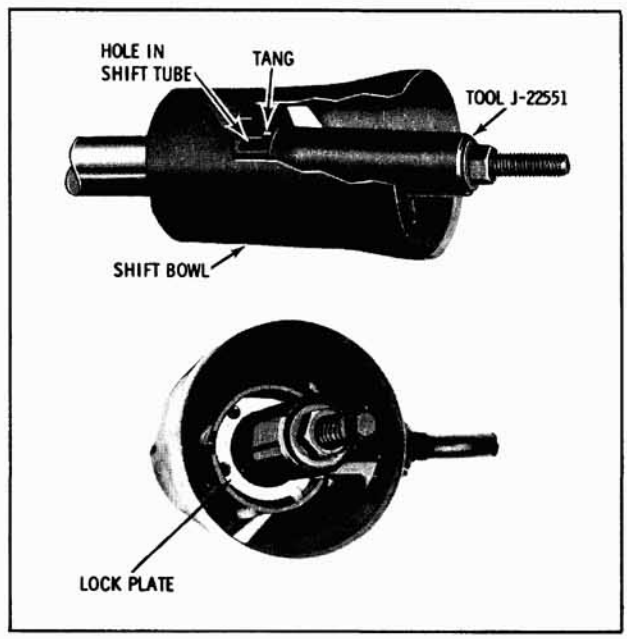


Fig. 9A-86—Installing Tool into Shift Tube

9. Install steering shaft from upper end carefully guiding shaft through shift tube, lower seal and bearing in adapter.

10. Install tilt lever into housing and while holding lock shoes in disengaged position, assemble housing over steering shaft until pivot pin holes line up.

11. Install pivot pins. Drive pivot pins in until flush with

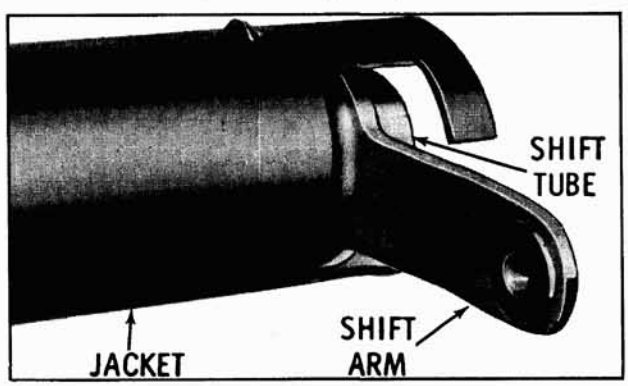


Fig. 9A-87—Shift Tube Alignment

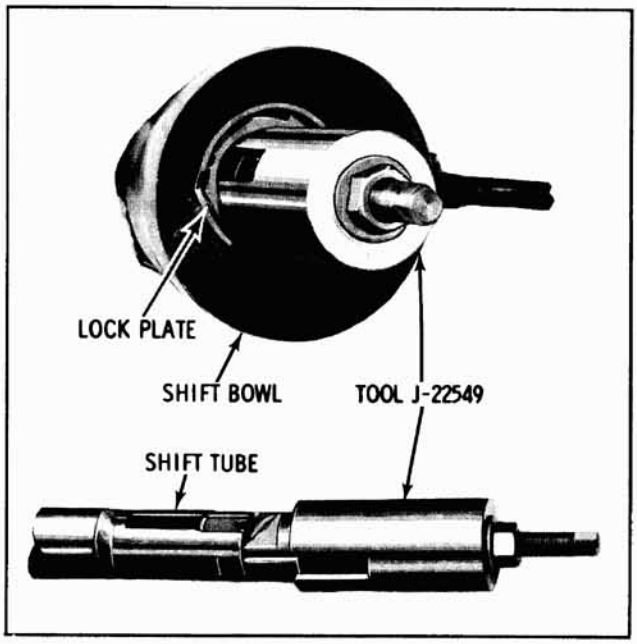


Fig. 9A-88—Installing Tool J-22549

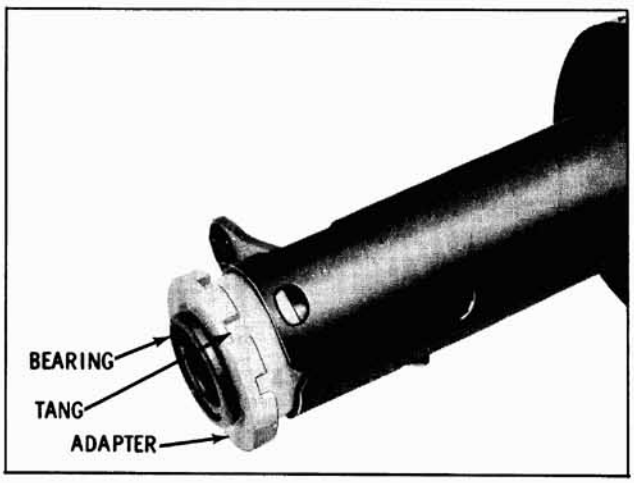


Fig. 9A-89—Installing Adapter

housing with brass drift.

12. Lift tilt lever and position housing in the full up position, Install tilt spring and guide into assembly. Spring guide must be inside lower end of spring and must engage support pivot post on assembly. Install retainer using large screwdriver in slot of retainer and pushing in and aligning ears with grooves in housing, turn clockwise approximately 1/8 turn to lock. (Fig. 9A-90)

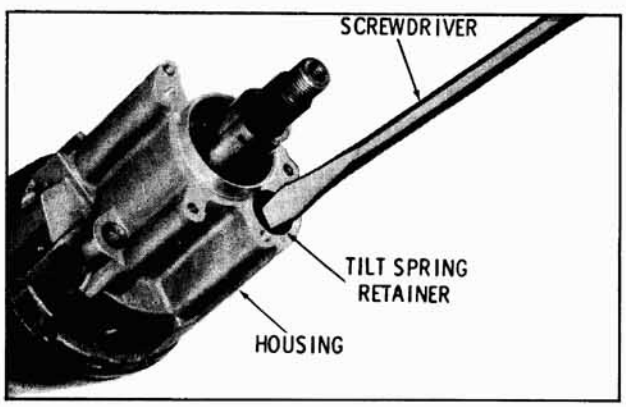


Fig. 9A-90—Installing Tilt Spring Retainer - Tilt and Travel

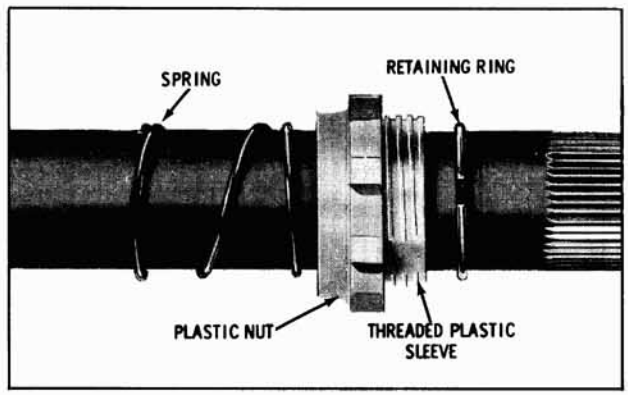


Fig. 9A-91—Lower Shaft Attachment

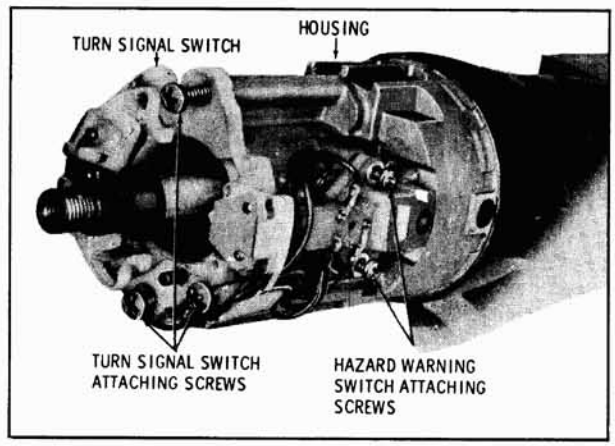


Fig. 9A-92—Turn Signal and Hazard Warning Attaching Screws

13. Install spring, threaded sleeve, threaded nut and wire retainer ring (Service Kit) to lower end of steering shaft loosely. Make sure nut is not tight against adapter bearing at this time. (Fig. 9A-91)

14. Position turn signal switch into position and install the five attaching screws. (Fig. 9A-92)

15. Install upper bearing race, seat and spring. (Fig. 9A-93)

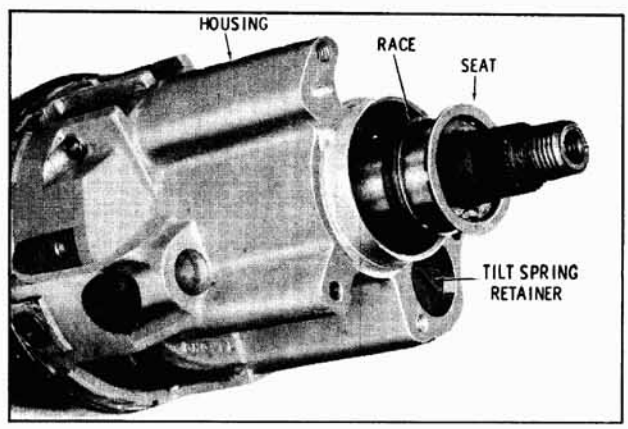


Fig. 9A-93—Installing Bearing Seat and Race - Tilt and Travel

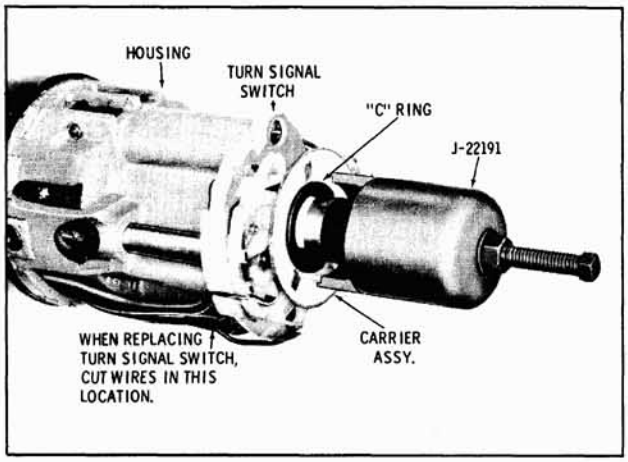


Fig. 9A-94—Installing "C" Ring - Tilt and Travel

16. Install horn contact carrier assembly.

17. Using Tool J-22191, screw 5/16" bolt into upper shaft until contact is made with locking rod. Turn steering shaft assembly until keyway is in the uppermost position, lift upper shaft 1" and lock with 5/16" bolt. Position half socket of tool on inner shoulder of horn contact carrier assembly with "C" ring of carrier in the uppermost position. Steady tool with one hand and tighten nut until "C" ring will insert in upper yoke. (Fig. 9A-94)

18. Remove Tool J-22191.

19. Install lower bumper (rubber washer) over upper shaft.

20. Install steering column. Refer to Steering Column Installation.

SHIFT TUBE AND OR JACKET (WITHOUT TILT-AWAY OR TILT AND TRAVEL)

Removal

1. Remove steering column. Refer to Steering Column Removal.

2. Remove turn signal cancelling cam and upper bearing spring from upper steering shaft.

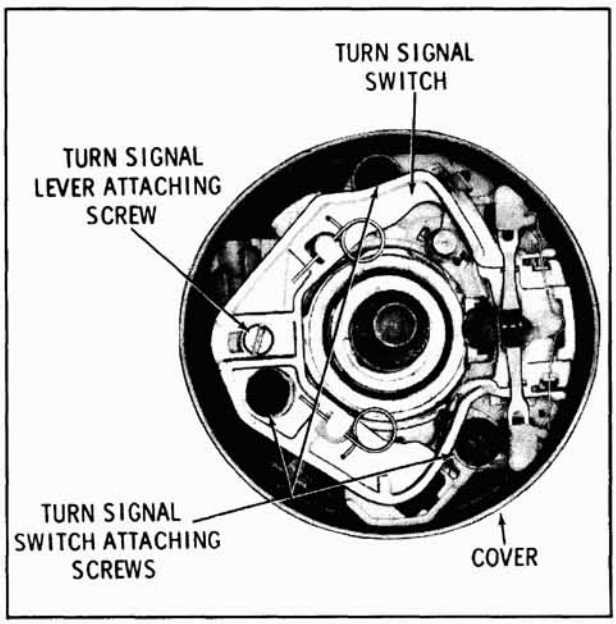


Fig. 9A-95—Turn Signal Switch Attaching Screws

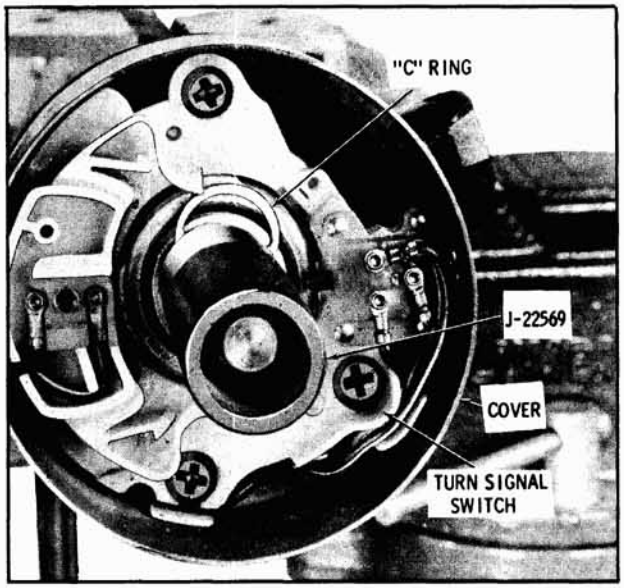


Fig. 9A-96—Removing "C" Ring

3. Remove turn signal lever attaching screw and remove lever. (Fig. 9A-95)

4. Push hazard warning switch in and then unscrew knob.

5. Remove "C" ring from upper steering shaft with Tool J-22569 by turning counterclockwise. (Fig. 9A-96) DO NOT PRY AGAINST SWITCH PARTS.

6. Slide thrust washer and wave washer off upper steering shaft. Remove steering shaft from lower end of column. (Fig. 9A-97)

7. Loosen three turn signal switch mounting screws approximately five turns each. (Fig. 9A-95) Rotate cover assembly counterclockwise and pull straight off top of jacket.

8. Lift bowl from shift tube. (This is a slip fit).

9. Remove neutral start and backup switch, if so equipped.

10. a. Automatic transmission or floor shift, remove clip from adapter at lower end of jacket. (Fig. 9A-98)

b. Remove bearing adapter, bearing and shift tube spring. (Bearing may be removed from adapter by a light

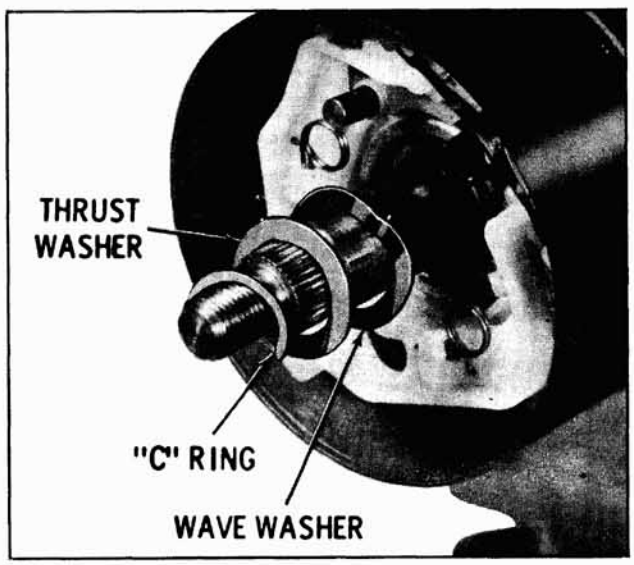


Fig. 9A-97—Removing Thrust and Wave Washers

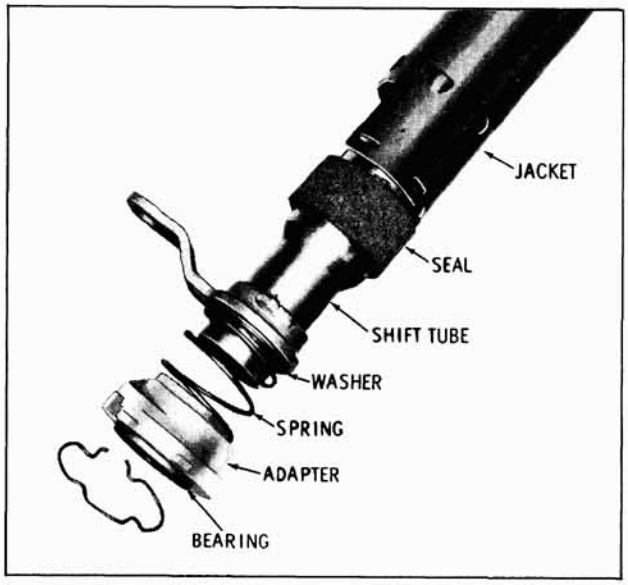


Fig. 9A-98—Shift Tube Attachment

press-out operation on the outer race). (Fig. 9A-98)

c. Slide shift tube assembly out of lower end of jacket.

d. If necessary to remove lower bowl bearing, drive out top of jacket with a wood dowel. This lower bowl bearing may be used again ONLY in this jacket.

e. Unwrap mesh cover, if required.

11. a. Manual transmission, remove three attaching bolts, reinforcing ring to shift tube assembly. (Fig. 9A-99)

b. Remove reinforcing ring, adapter assembly, bearing, 1st and reverse shift lever and spacer from lower end of column. (Lower bearing may be pressed from adapter if necessary). (Fig. 9A-99)

c. Slide shift tube out of lower end of jacket.

d. If necessary to remove lower bowl bearing, drive out of top of jacket with a wood dowel. This lower bowl bearing may be used again ONLY in this jacket.

e. Unwrap mesh cover, if required.

Installation

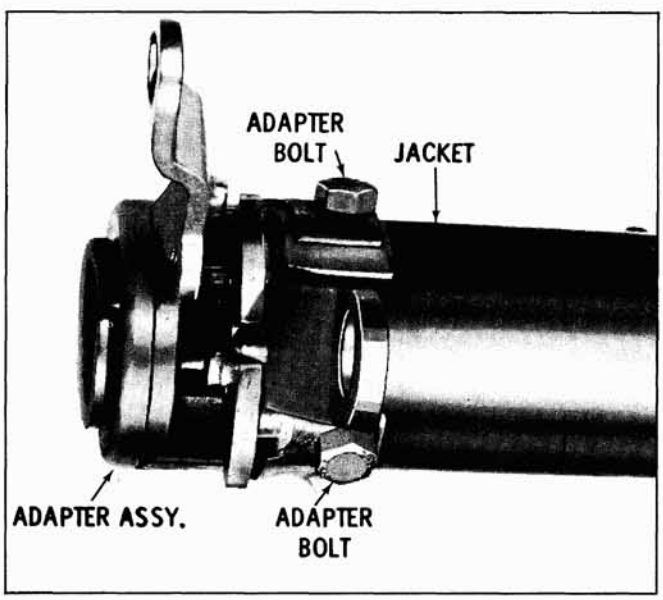


Fig. 9A-99—Manual Transmission Attachment

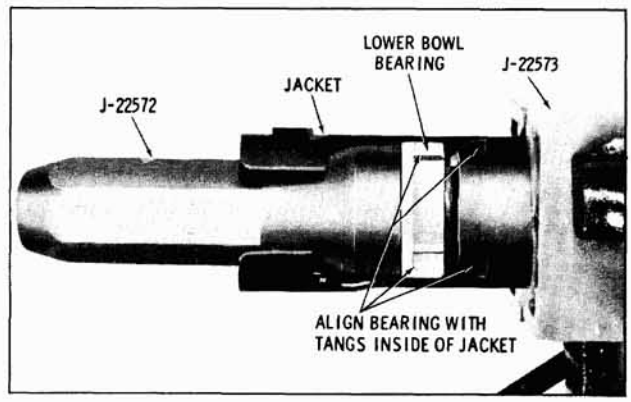


Fig. 9A-100—Lower Bowl Bearing Installation

Apply a thin coating of chassis grease to all friction surfaces.

1. Rewrap mesh cover, if removed, hold in place with tape, such as electricians plastic tape.

2. Using Tool J-22572, install lower bowl bearing into jacket making sure grooves in bearing align with tangs inside of jacket. (Fig. 9A-100)

3. a. Automatic transmission or floor shift, if removed, press lower bearing into adapter.

b. Install spring and bearing adapter to shift tube and slide assembly into jacket. (Fig. 9A-98)

c. Install bearing adapter retainer.

3. a. Manual transmission, if removed, press lower bearing into adapter.

b. Insert shift tube assembly into lower end of jacket and rotate until the upper shift tube keys into the bowl keyway.

c. Install lever spacer, then install first and reverse. (Fig. 9A-101)

d. Install adapter assembly and reinforcing ring to lower end of jacket and loosely install the three attaching bolts.

e. Place a .005" shim between either lever and the spacer.

f. Install Tool J-22568 as shown in Fig. 9A-101 and turn clockwise (viewed from lower end of jacket) until tight.

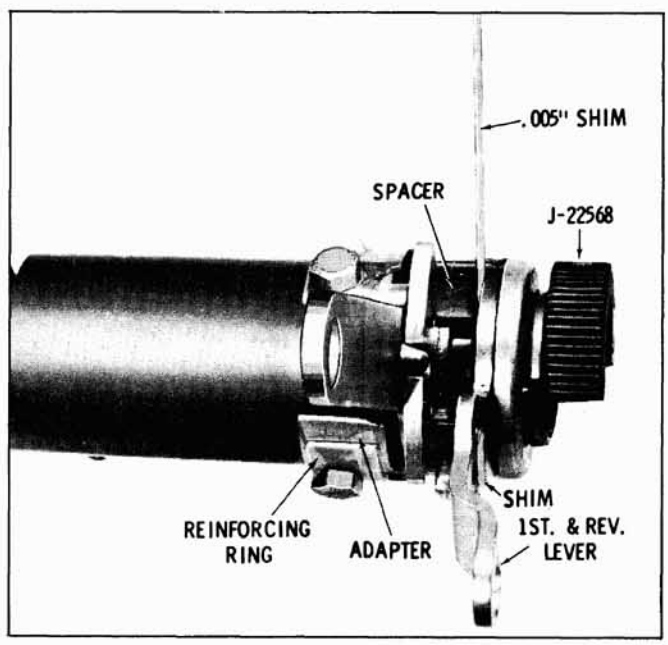


Fig. 9A-101—Adjusting Shift Lever Clearance

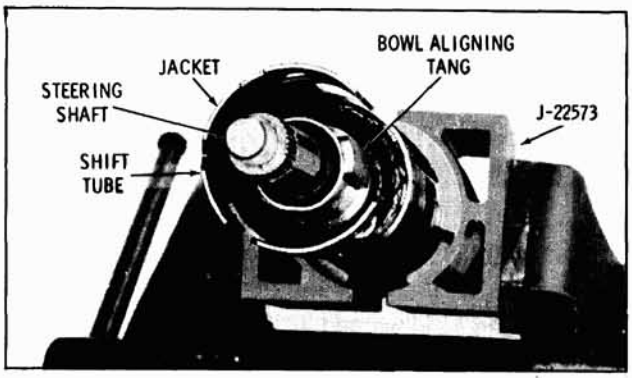


Fig. 9A-102—Shift Tube Aligning Tang

g. Torque the three attaching bolts to 10 ft. lbs. Remove .005" shim.

4. 1st Type:

54-86 Series - Install spring, threaded sleeve, threaded nut and wire retainer ring (Service Kit) to lower end of steering shaft loosely.

4. 2nd Type:

54-86 Series - Install plastic sleeve and spring to lower end of steering shaft.

5. Slide steering shaft into lower end of jacket. Care must be exercised at this time to prevent shaft from falling out of column.

6. Install neutral start and backup switch loosely (if so equipped). Adjustment will be performed after installation of column in the car.

7. Insert turn signal wiring through bowl.

8. Install bowl onto upper end of shift tube aligning keyways. (Fig. 9A-102)

9. Place cover assembly on top of jacket making sure that the tangs on the I.D. of the lock plate are aligned with the slots in the jacket.

10. Push down on cover assembly and rotate clockwise until assembly is fully locked, approximately 1/8 turn.

11. Torque turn signal attaching screws alternately until 35 inch pound is obtained.

12. Make sure turn signal wiring harness is free to move at this time.

13. Install wave washer and thrust washer over upper end of steering shaft.

14. Start "C" ring on steering shaft taper and while holding

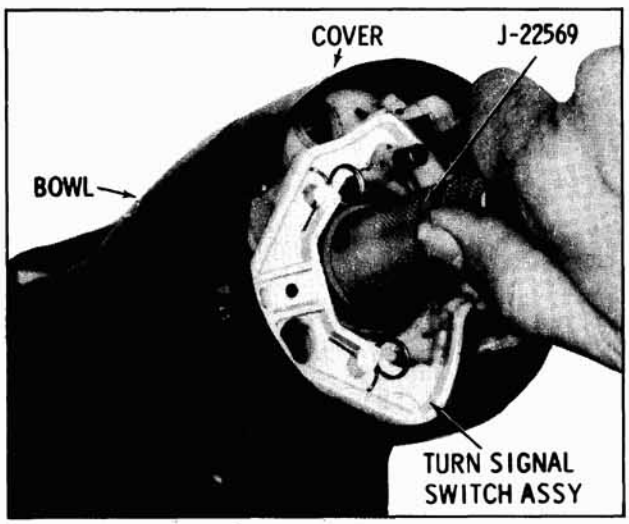


Fig. 9A-103—Installing "C" Ring

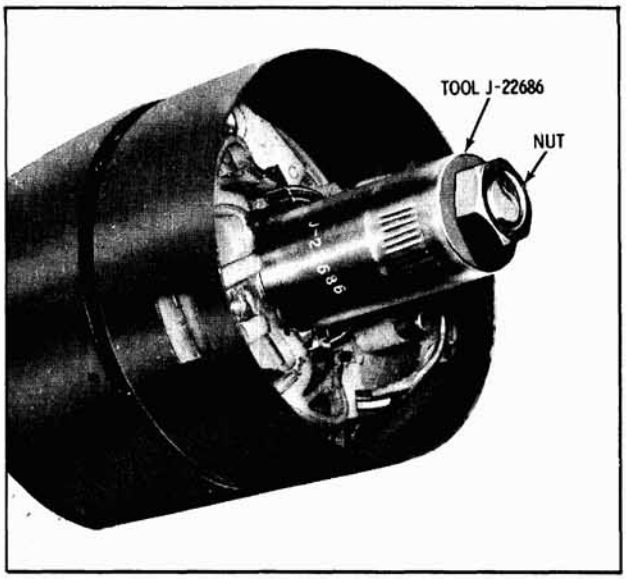


Fig. 9A-104—Installing Tool J-22686

up on flange, install Tool J-22569 and push "C" ring into groove in steering shaft. (Fig. 9A-103)

15. 1st Type:

54-86 Series: Install Tool J-22686 as shown in Fig. 9A-104. Torque steering shaft nut finger tight. Tighten threaded nut (installed in Step 4) finger tight, so that no axial movement can be felt in steering shaft. Stake nut to threaded sleeve with a hot soldering gun at three evenly spaced places. Remove Tool J-22686.

16. Install hazard warning knob.

17. Install turn signal lever and screw. Torque to 27 inch pounds.

18. Install cancelling cam and upper bearing spring on shaft.

19. Install steering wheel. Refer to steering wheel installation.

20. Install steering column. Refer to steering column installation.

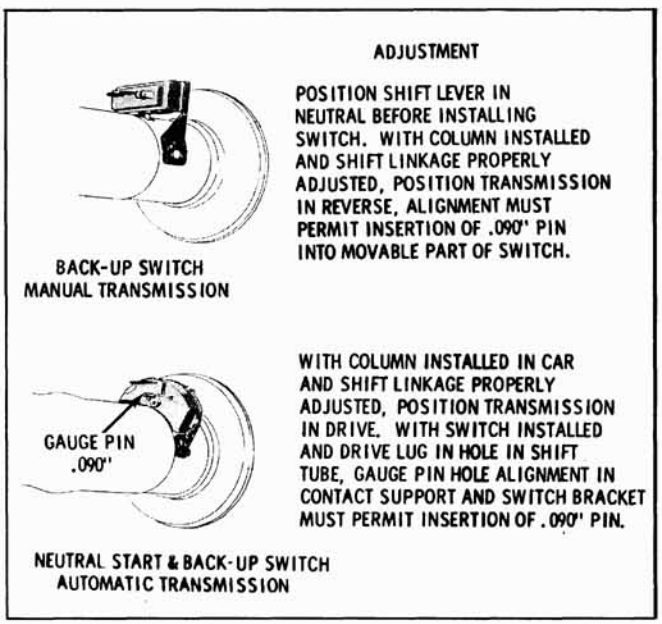


Fig. 9A-105—Neutral Start and Back-up Switch Adjustment

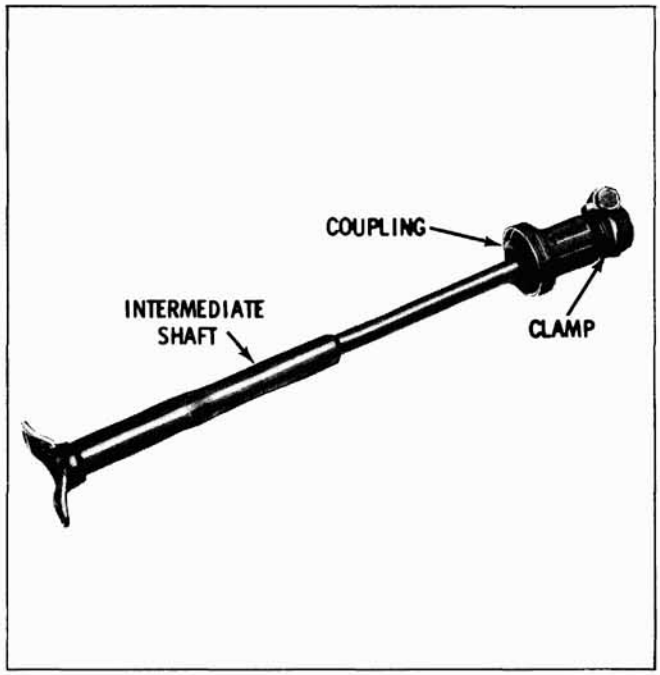


Fig. 9A-106—Intermediate Shaft

NEUTRAL START AND OR BACK-UP SWITCH (EXC. FLOOR SHIFT)

Adjustment

Complete adjustments may be found on Fig. 9A-105.

INTERMEDIATE SHAFT AND COUPLING (Fig. 9A-106) 31-48 SERIES

Removal

1. Remove flexible coupling nuts.
2. Remove coupling clamp to steering shaft attaching bolt.
3. Pull intermediate shaft off flex coupling and then pull down on intermediate shaft until coupling is removed from steering shaft.

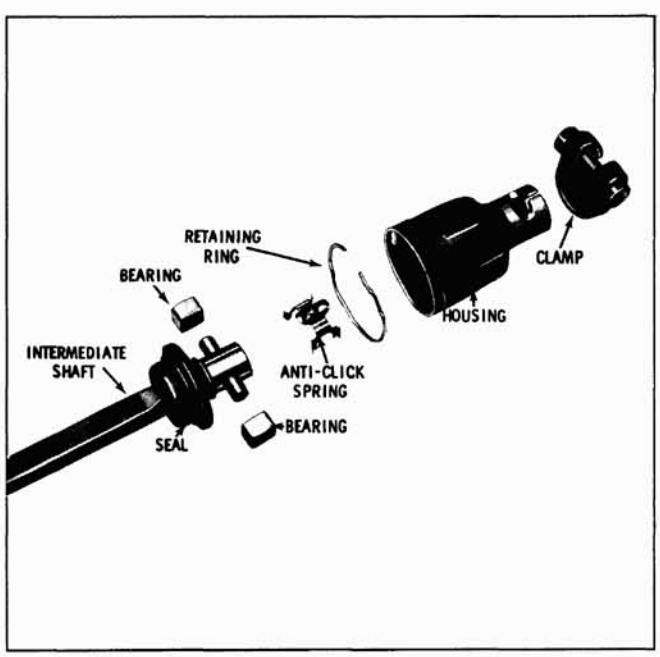


Fig. 9A-107—Intermediate Shaft Coupling

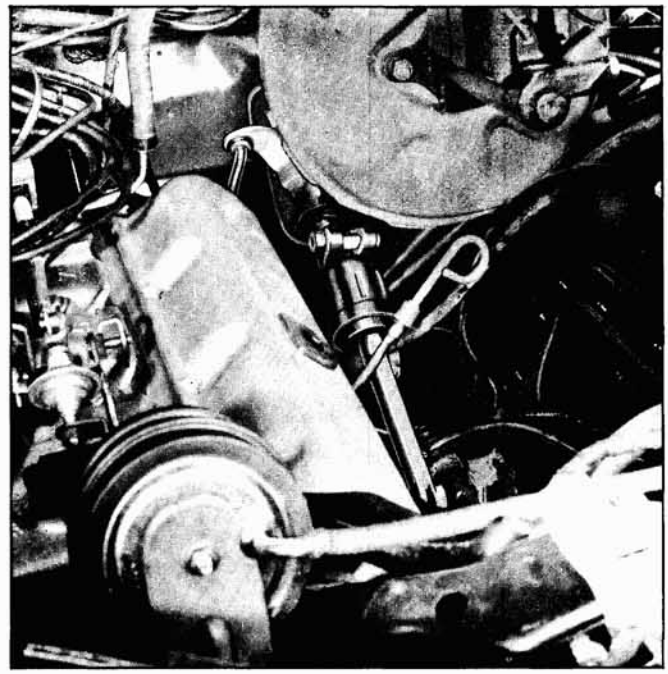


Fig. 9A-108—Intermediate Shaft Installed

Be sure lower bearing pre-load spring stays in position on lower end of steering shaft at this time.

Disassembly

1. Remove seal retaining ring. (Fig. 9A-107)
2. Slide coupling housing off shaft.
3. Remove anti-click spring and both bearings from pivot shaft.
4. Clean and inspect parts for damage or excessive wear.

Assembly

1. Lubricate coupling parts and pack coupling housing with chassis lubricant.
2. Install bearings on pivot pin and position anti-click spring over bearings. Retain in position with lubricant.
3. Align slots in coupling housing with bearings and push together until seal can be seated in coupling housing.
4. Install seal retaining ring.

Installation (Fig. 9A-108)

1. With lower bearing pre-load spring in position on steering shaft, position coupling clamp slot in alignment with slot in lower end of steering shaft and install clamp bolt. Torque to 35 ft. lbs.
2. Push up on intermediate shaft until flex-coupling can be installed in position. Install flex-coupling lockwashers and nuts. Torque to 20 ft. lbs.

BT-61-9	STEERING WHEEL PULLER	J-22569	SNAP RING REM. & INST. STD. COL.
J-6125	SLIDE HAMMER	J-22572	SHIFT BOWL BRG. INST.
J-21853-01	UPPER COVER INST. (TILT & T&T)	J-22573	COLUMN HOLDING FIXTURES
J-21854-01	PIVOT PIN REMOVER	J-22598	UPPER COVER REMOVER
J-22191	SPRING COMPRESSOR	J-22599	LOCK NUT SOCKET (TILT ONLY)
J-22549	SHIFT TUBE INST.	J-22635	LOCK SHOE & RELEASE LEVER PIN (REM. & INST.)
J-22551	SHIFT TUBE REMOVER	J-22686	STEERING SHAFT SPACER
J-22568	LOWER SHIFT LEVER LASH ADJUSTER		

Fig. 9A-109—Tools

WHEELS AND TIRES

31 THROUGH 86 SERIES

CONTENTS OF SECTION 10

Subject	Page
MAINTENANCE RECOMMENDATIONS	10-1
TIRE AND WHEEL RUNOUT	10-1
TIRE ROTATION	10-1
WHEEL AND TIRE BALANCE	10-1
TIRE INFLATION	10-2
TIRE NOISE	10-2
TIRE WEAR	10-2
Underinflation	10-2
Overinflation	10-2
Toe-In or Toe-Out	10-2
Camber	10-3
Driver Habits	10-3
Mechanical	10-3
DISMOUNTING AND MOUNTING	10-3
TIRE REPAIRING	10-3
SPARE TIRE STORAGE	10-7
TIRE CHART	
31 Through 86 Series	10-7

MAINTENANCE RECOMMENDATIONS

For tire inflation recommendations, refer to TIRE PRESSURE CHART

TIRE AND WHEEL RUNOUT

Inflate tires to recommended pressure. Tires should be checked immediately after car has been driven to avoid false readings due to the tendency of tires to take a temporary "set" after standing for a period of time.

Wheels and tires can be checked for runout at points indicated and should not exceed the following limits. (Figs. 10-1 and 10-2)

31 Through 48 Series

Tire and Wheel Assembly

- Radial	.063"
- Lateral	.081"

Wheel

- Radial	.035"
- Lateral	.045"

54 Through 86 Series

Tire and Wheel Assembly

- Radial	.080"
- Lateral	.100"

Wheel

- Radial	.035"
- Lateral	.045"

TIRE ROTATION

To equalize wear it is recommended that the four road tires be rotated at least every 6000 miles as shown in Fig. 10-3. It is not necessary to rotate the spare.

WHEEL AND TIRE BALANCE

Wheel, tire and brake drum balance must be maintained within certain limits; otherwise, wheel tramp and high speed shimmy will result.

Front wheel tramp and front wheel shimmy are two entirely different conditions. Front wheel tramp, which usually oc-

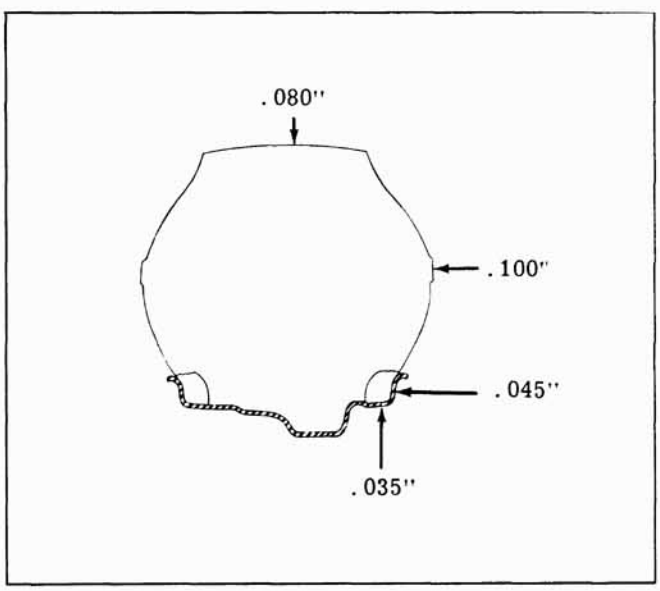


Fig 10-1—Wheel and Tire Specifications 54-86 Series

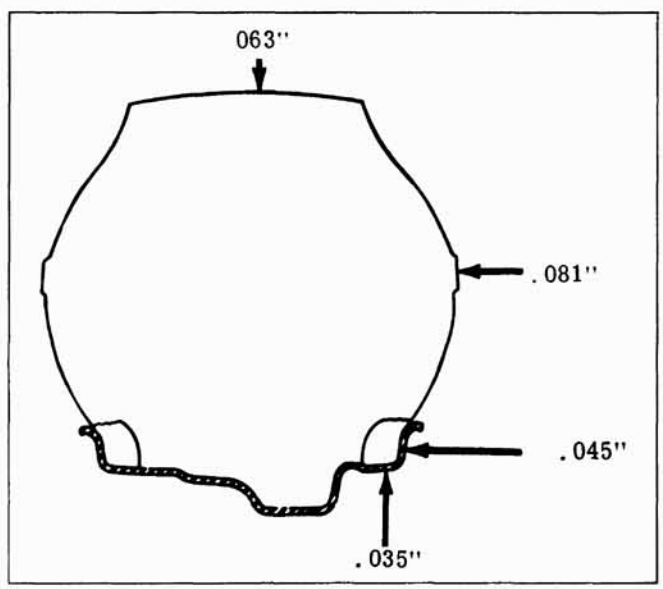


Fig 10-2—Wheel and Tire Specifications 31-48 Series

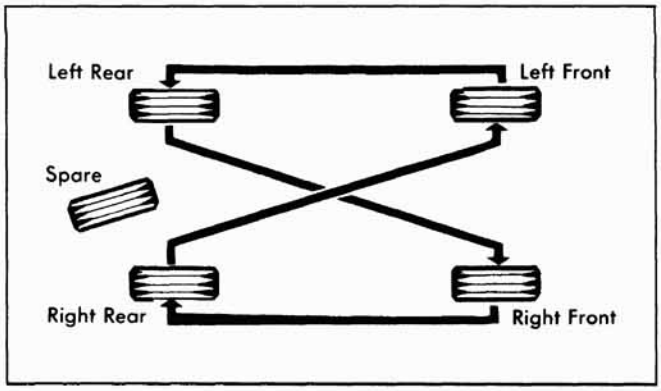


Fig 10-3—Tire Rotation Chart

curs at high speed, is a wheel hop caused from unbalanced tires or wheels, loose linkage in the front end, or improperly operating shock absorbers.

Shimmy may occur at lower speeds and is a wobbly condition of the front wheels caused from an unbalanced condition, loose front end linkage, loose steering gear parts or faulty steering gear adjustment. Tramp and shimmy will be felt in the whole car, however, shimmy can also be felt on the steering wheel. Shimmy is a front wheel condition entirely, whereas it is possible to have tramp in front or rear wheels.

Due to the irregularities in tread wear caused by sudden brake application, misalignment, low inflation pressure, or tire repair, etc., a wheel and tire assembly may lose its original balance. Consequently, if front end instability develops, the tire and wheel assembly should be checked for static and dynamic balance.

When installing wheel weights on cars with wheel discs, use a weight of such size that it will not interfere with disc.

TIRE INFLATION

Maintaining the correct inflation pressure is one of the most important elements in tire care.

For recommended tire pressure (tires cold) refer to TIRE PRESSURE CHART.

Too great a tire pressure is detrimental, but not so much as underinflation. Higher inflation pressure than recommended will cause:

1. A harder riding car.
2. A tire more susceptible to various types of bruises.
3. Tire chatter, resulting in uneven wear.
4. Excessive wear at the center of the tire tread.

Even when a tire is properly inflated, it is flat where it contacts the road so that the car at all times is in effect being pushed up hill. This condition is exaggerated on an underinflated tire.

Inflation pressures lower than recommended will result in:

1. Higher gasoline consumption.
2. Rapid and uneven wear on the edges of the tire tread.
3. A tire more susceptible to rim buises and various types of rupture.
4. Increased cord fatigue or broken tire cords.
5. Hard steering.
6. High tire temperatures.
7. Car roll on sharp curves.
8. Tire squeal on curves.

TIRE NOISE

Complaints of axle noise are more frequently caused by tires than by differential gears, bearings, etc.

Tire noise is frequently diagnosed as axle noise. Tire noise is related directly to the speed of the car and the road surface.

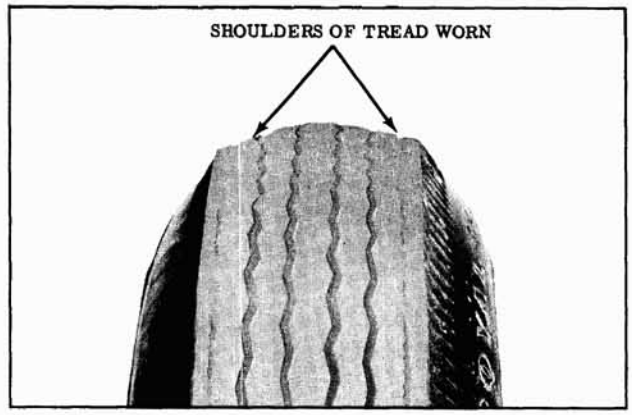


Fig 10-4—Under Inflation Wear

Tests made for drive, float, and coast noise as used for differential testing will have little or no effect on noise level if tires are the cause.

To determine if tires are the cause of noise, the questionable tires should be substituted with a set of tires known to be good.

TIRE WEAR

Underinflation Wear

Underinflation results in abnormal wear of the tread shoulder, caused by the tires rolling on the shoulders with a wiping action. (Fig. 10-4)

In addition, underinflated tires are subjected to continual flexing, causing high internal temperatures and cracking of the sidewall.

Overinflation Wear

Overinflation causes the center section of the tread to receive excessive driving and braking, therefore, the center section is worn more than the shoulders. (Fig. 10-5) An overinflated tire is subject to breaks in the fabric from severe impacts and is more easily cut or punctured.

Toe-in or Toe-out Wear

Excessive toe-in or toe-out has the effect of dragging the tires sideways down the road, which results in feathering the raised portions of the tread.

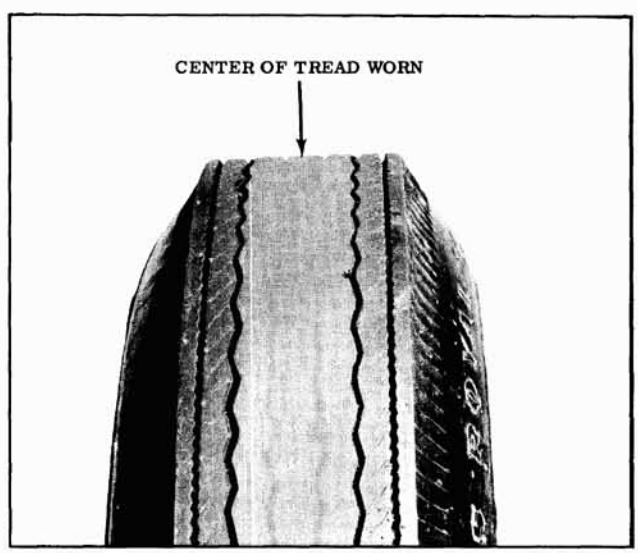


Fig 10-5—Over Inflation Wear

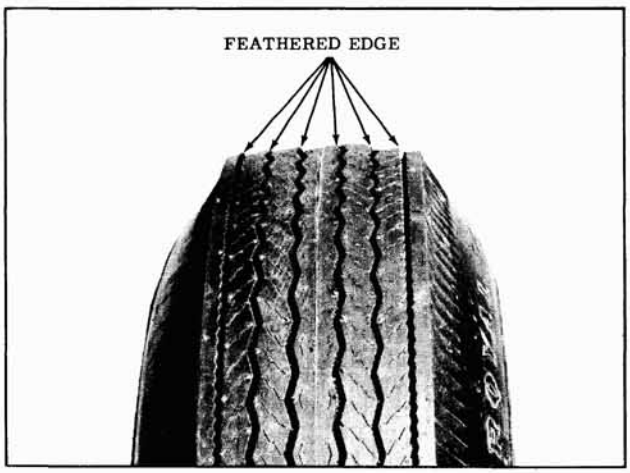


Fig. 10-6—Toe-in Wear

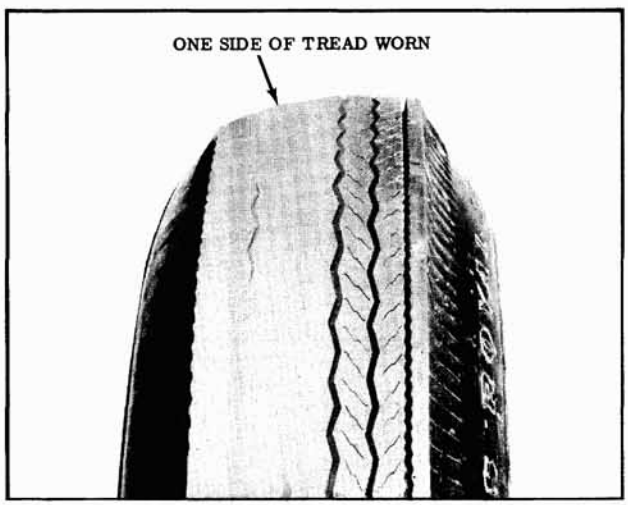


Fig. 10-7—Camber Wear

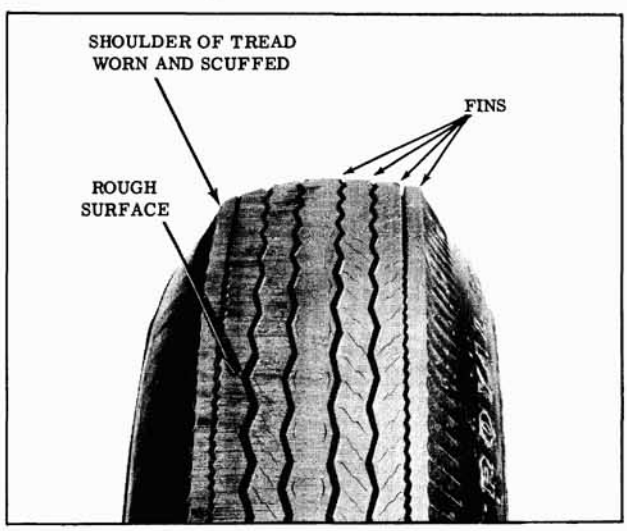


Fig. 10-8—Cornering Wear

Improper toe-in is indicated by feather edges on the inner side of the tread. (Fig. 10-6) Toe-out is indicated by the feather edges on the outer side of the tread.

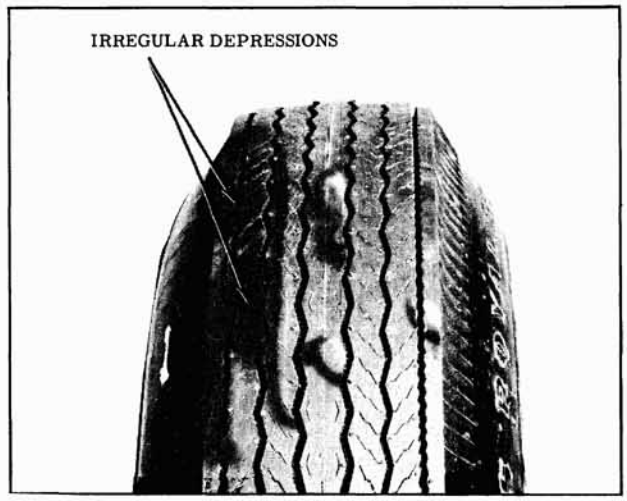


Fig. 10-9—Mechanical Wear

Camber Wear

Excessive positive camber will cause wear on the outer side of the tread. (Fig. 10-7) Excessive negative camber will cause wear on the inner side of the tread. Camber wear may also be evident if the car is driven continually on highly crowned roads.

Wear Due to Driver Habits

Owner driving habits may cause cornering wear, rear tire inside wear, and front tire heel and toe wear even though all wheel alignment factors are within specifications and tires are properly inflated.

Cornering wear, caused by high speeds on turns, is identified by the rounded shoulders of the tire and small rough abrasions and fins raised by cornering friction against the road. (Fig. 10-8)

Rear tire inside wear is caused by rapid acceleration which causes the axle housing to bend slightly in a horizontal plane to toe-in the rear tires. This results in excessive wear on the inner shoulders of the rear tires and is similar in appearance to camber wear. (Fig. 10-7)

Wear Due to Mechanical Conditions

Loose parts of the front suspension system such as worn ball joints, mountings of the upper and lower control arms, inoperative shock absorbers and unbalanced wheels and tires, will cause flat spots, cups, gouges and wavy wear. (Fig. 10-9)

DISMOUNTING AND MOUNTING TIRES

Several types of bead breakers are available to loosen tire from rim.

DO NOT USE TIRE IRONS AS THIS MAY DAMAGE SEALING BEADS.

Tire mounting machines may be used to mount tires, but extreme care must be taken not to damage sealing beads.

Tire lubricating soap should be used on beads, but an excessive amount may cause tire slippage on wheel.

Inflate tire to approximately 40 psi to seat sealing beads. Be sure bead position is even all around, then deflate to recommended pressure.

TIRE REPAIRING

There are several methods of repairing tubeless tires. Oldsmobile recommends the "hot patch or self-vulcanizing method".

These methods are not recommended for punctures over 3/16" diameter. For repairs larger than this, consult the tire manufacturer's recommendations.

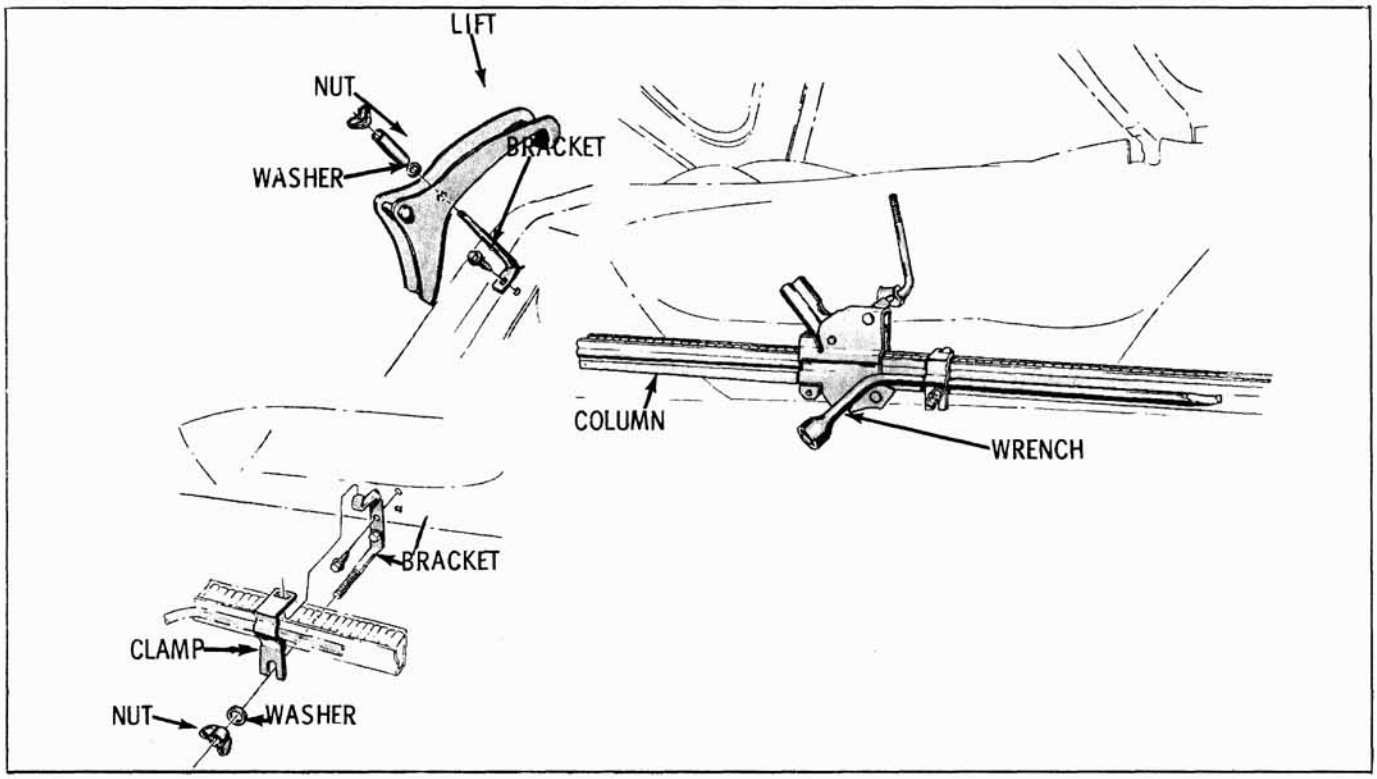


Fig 10-10—Jack Stowage - Exc Conv. 54-86 Series

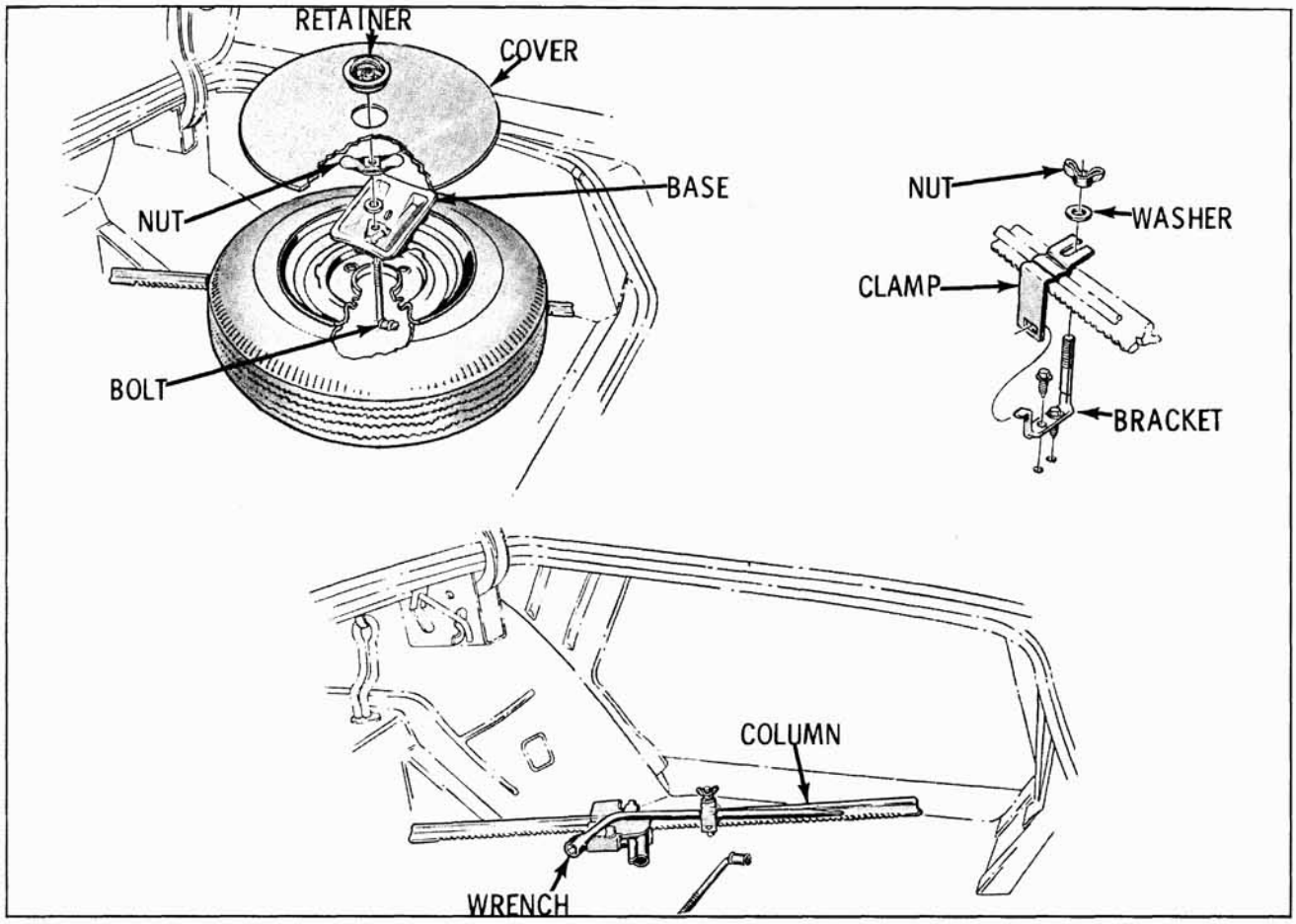


Fig 10-11—Jack Hold Down - Conv. 54-86 Series

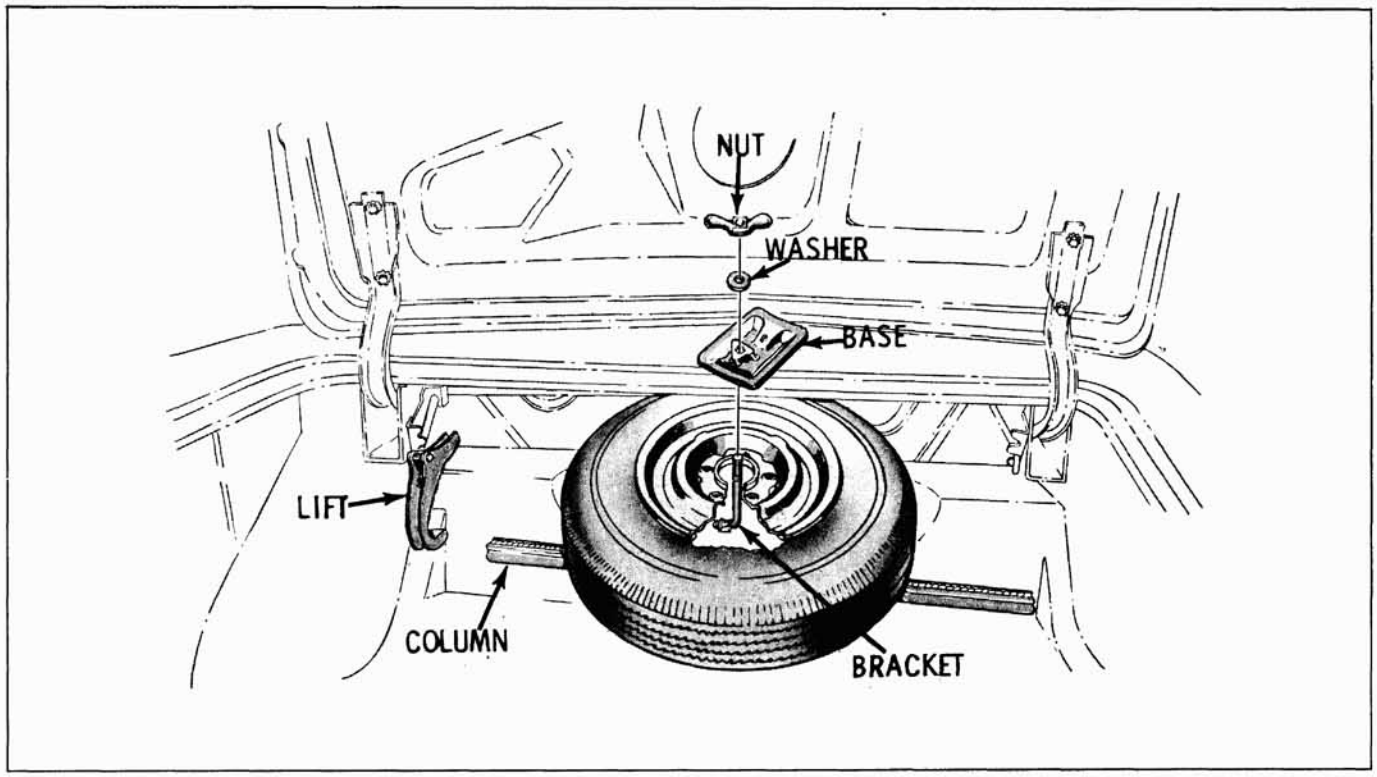


Fig 10-12—Spare Wheel Stowage - Exc. Conv. 54-86 Series

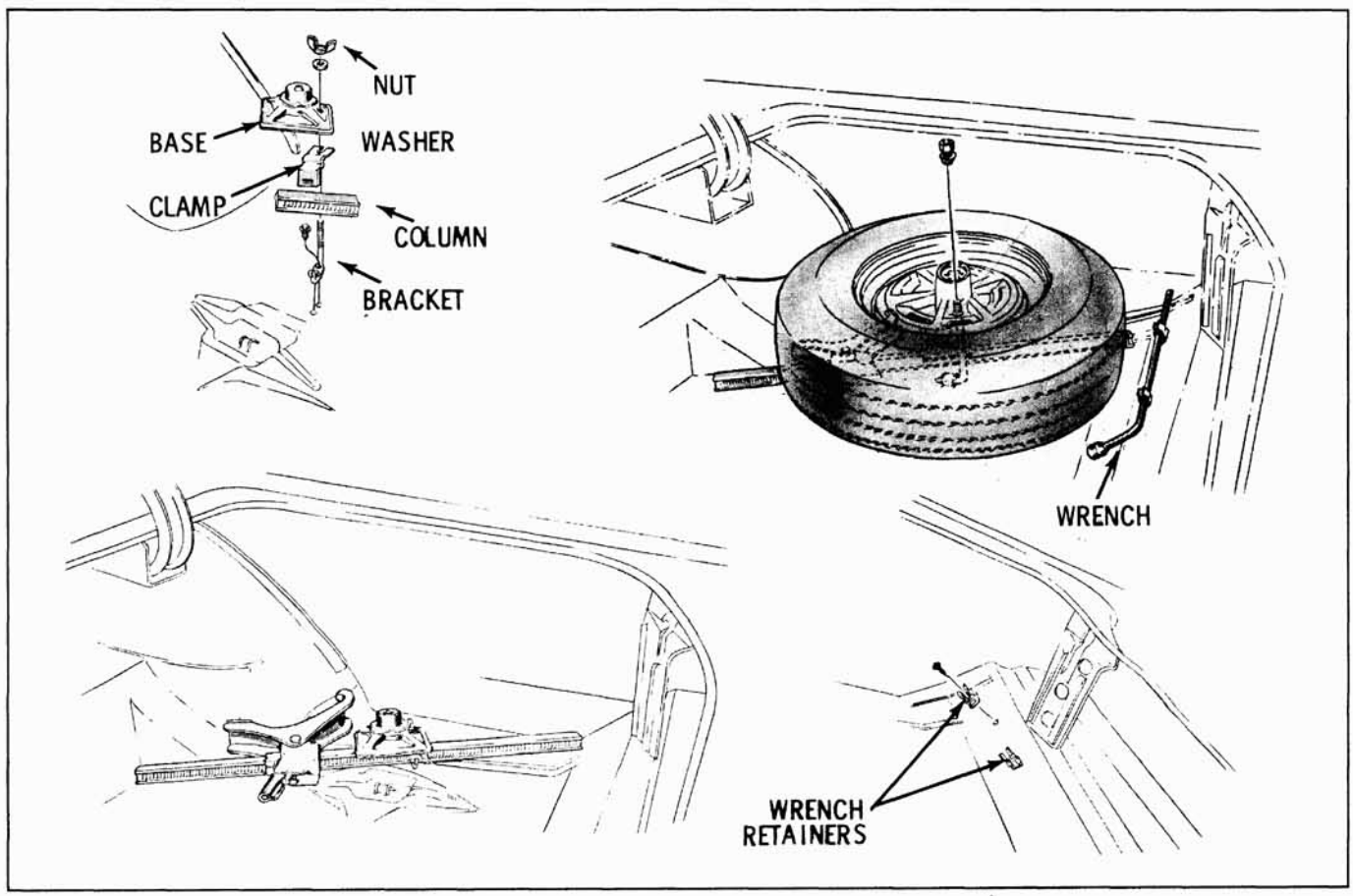


Fig. 10-13—Spare Wheel and Jack Stowage - PO5 Wheel 31-44 Series

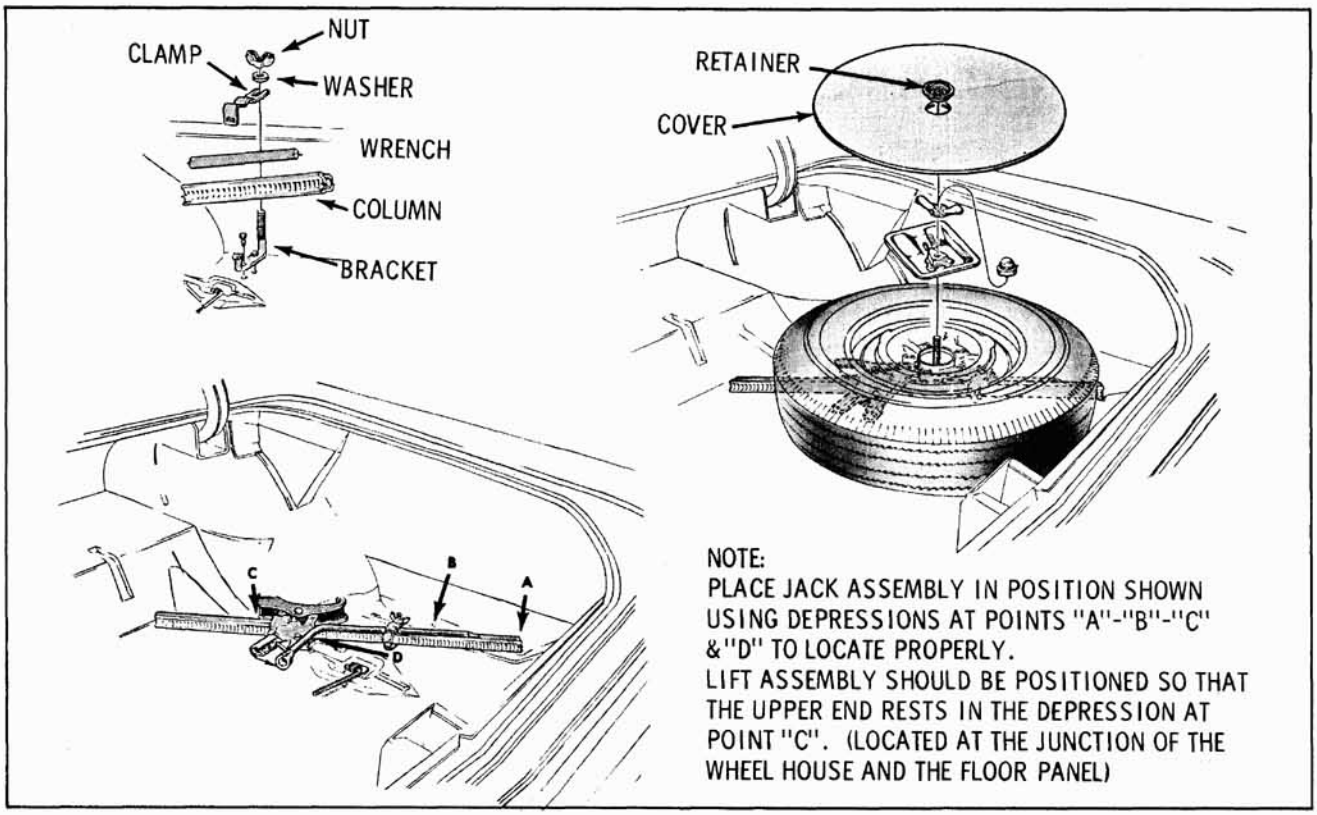


Fig 10-14—Spare Wheel and Jack Stowage - Exc. S.W. - 31-44 Series

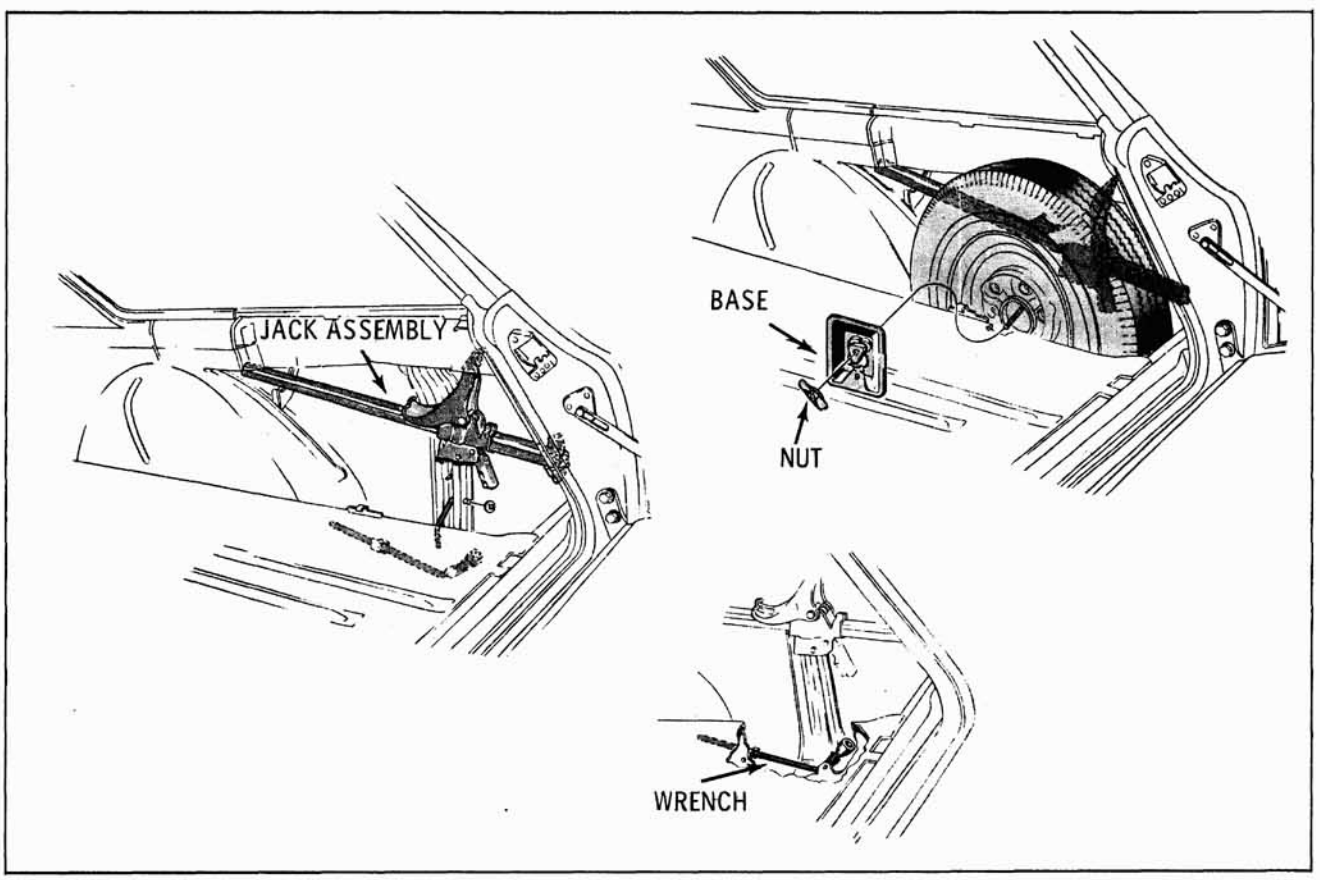


Fig 10-15—Spare Wheel and Jack Stowage 35-48 Series S.W.

SPARE TIRE STORAGE

The spare tire, jack assembly and wrench for 52 through 86 series are stored as shown in Figs. 10-10, 10-11 and 10-12.

The spare tire, jack assembly and wrench for 31 through 48 series are stored as shown in Figs. 10-13, 10-14 and 10-15.

TIRE INFORMATION

The factory installed tires are selected to provide the best all around tire performance for normal operation.

They are also designed to operate satisfactorily with loads up to and including the full rated load capacity when inflated as recommended in the following tire pressure chart.

INFLATION PRESSURES

To insure the proper tire inflation, follow the recommendations in the tire pressure chart. Keep tires properly inflated, and check inflation pressures periodically. This will insure best tire life and riding comfort over the full range of driving conditions.

When the car is driven a few miles, tires warm up causing pressure increase. If tire pressures are checked when tires are warm, they may be up to 6 pounds higher than the pressures shown on the chart.

RECOMMENDED COOL TIRE INFLATION PRESSURES - POUNDS PER SQUARE INCH

	Tire Ply Rating	All Loads	
		Front	Rear
All Models - Except Station Wagons & 4-4-2	4	24	24
	8	24	24
	Radial	24	24
Station Wagons	4	24	32
	8	24	32
	Radial	24	32
4-4-2	4	26	26

When towing trailers, the allowable passenger and cargo load must be reduced by an amount equivalent to the trailer tongue load on the trailer hitch.

Vehicles with luggage racks do not have a load limit greater than specified in the tire pressure chart

For continuous high speed operation (over 75 mph) increase tire pressure (cool) 4 pounds over the above recommended inflation pressures, up to a maximum of 32 pounds for 4-ply rating tires, or 40 pounds for 8-ply rating tires.

Over inflation at light loads will have an adverse effect on the car ride and tire tread wear pattern. Under inflation will promote heat and abnormal wear.

TIRE ROTATION

To equalize wear, it is recommended that the four road tires be rotated every 6,000 miles, see Fig. 10-3. It is not necessary to rotate the spare. Upon rotation, tire pressures must be adjusted (front and rear) in accordance with the recommendations in the tire pressure chart. Also keep tires balanced, the front wheels aligned, and periodically examine tires for unusual wear.

VEHICLE LOAD CAPACITY AND DISTRIBUTION

	Full Load Capacity Is:
All Models - Except Station Wagons	1100 Lbs. Total: 3 Passengers front seat 3 Passengers rear seat 200 Lbs. luggage 950 Lbs. Total: Bucket seats 5 Passengers
Station Wagons 2 Seat	1200 Lbs. Total: 3 Passengers front seat 3 Passengers rear seat 300 Lbs. luggage
Station Wagons 3 Seat	1200 Lbs. Total: 3 Passengers front seat 3 Passengers second seat 2 Passengers third seat or 300 Lbs. luggage

The original tires on your Oldsmobile incorporate built-in tread wear indicators to assist in determining when the tires have been worn to the point of needing replacement. These indicators are molded into the bottom of the tread grooves and will appear as 1/2-inch wide bands when the tire tread depth becomes 1/16th of an inch. When the indicators appear in two or more adjacent grooves, tire replacement due to tread wear is recommended.

TIRE SIZES

SERIES	TIRE SIZE
F-85 Exc. Vista-Cruiser & 442	
Std. Size & 8 Ply Option	7.75 x 14
Radial Ply Option	205R14
Vista-Cruiser	
Std. Size & 8 Ply Option	8.25 x 14
Radial Ply Option	205R14
442	
Std. Size (Nylon)	F70 x 14
4 Ply Option (Nylon)	7.75 x 14
Radial Ply Option	
Exc. with 4 Bbl. Engine	205R14
Delmont & Delta	
Without Disc Brakes	
Std. Size	8.55 x 14
Radial Ply Option	225R15
With Disc Brakes	
Std. Size & 8 Ply Option	8.45 x 15
Radial Ply Option	225R15
Ninety-Eight	
Without Disc Brakes	
Std. Size	8.85 x 14
Radial Ply Option	225R15
With Disc Brakes	
Std. Size & 8 Ply Option	8.85 x 15
Radial Ply Option	225R15
All Std. Tires are 2-Ply - 4-Ply Rating.	

CHASSIS SHEET METAL

CONTENTS OF SECTION 11

Subject	Page
54 Through 86 Series	
HOOD ALIGNMENT	11-1
HOOD ASSEMBLY	11-1
HOOD HINGE SPRING	11-3
HOOD HINGE REMOVAL AND INSTALL	11-3
HOOD MOLDINGS	11-3
HOOD LATCH ASSEMBLY	11-3
FENDER AND FILLER PANEL	
REMOVAL	11-3
INSTALLATION	11-5
RADIATOR SUPPORT ASSEMBLY	11-5
MOLDINGS	11-5

Subject	Page
31 Through 48 Series	
HOOD ASSEMBLY	11-10
HOOD HINGE SPRING	11-10
HOOD HINGE	11-10
HOOD LATCH ASSEMBLY	11-11
HOOD MOLDINGS	11-11
RADIATOR SUPPORT ASSEMBLY	11-11
FENDER ASSEMBLY	
REMOVAL	11-11
INSTALLATION	11-14
FILLER PLATE	11-14
MOLDINGS	11-15
HEADLAMP ASSEMBLY	11-15
BATTERY SUPPORT	11-15

54 THROUGH 86 SERIES

HOOD ALIGNMENT

The hood hinge adjustment provides lateral and vertical alignment of the rear edge of the hood in relation to the front fenders.

1. Raise hood and loosen hinge bracket to cowl bolts and the hinge bracket to fender bolt on each side of car. (Fig. 11-1) For fore or aft adjustment, loosen hood hinge to hood bolts.
2. Shift hood until clearances shown in Fig. 11-2 are obtained.
3. Tighten bolts and recheck alignment.
4. The rubber bumpers must be adjusted for alignment of the forward edge of the hood with the forward edge of the fenders. Vertical adjustment can be made by loosening the locknuts on the rubber bumpers and turning bumpers either up or down.

HOOD ASSEMBLY

Remove and Install

1. Raise hood and install protective coverings over fender areas to prevent damage to paint and moldings when removing or installing hood.

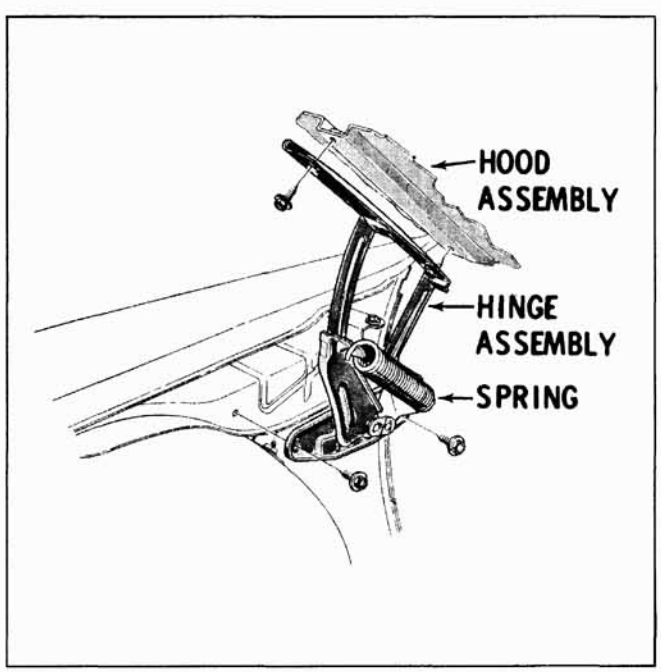


Fig. 11-1—Hood Hinge Attachment (54-86 Series)

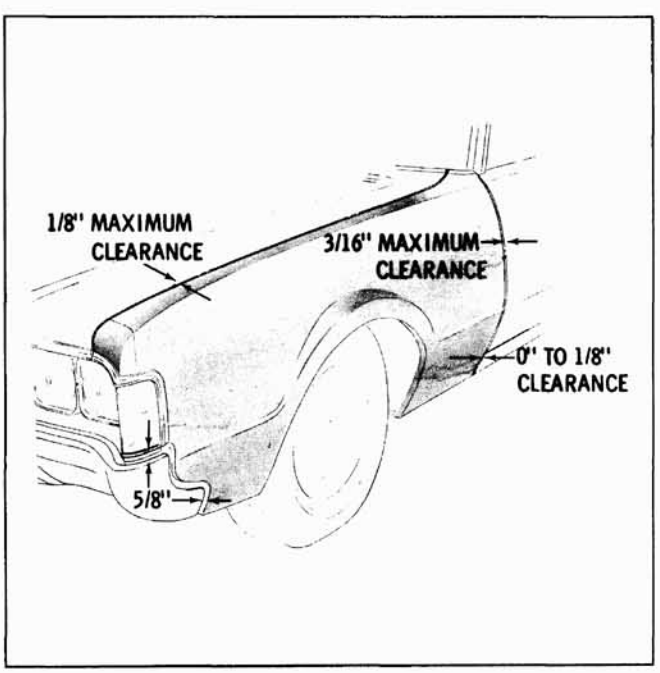


Fig. 11-2—Sheet Metal Clearances (54-86 Series)

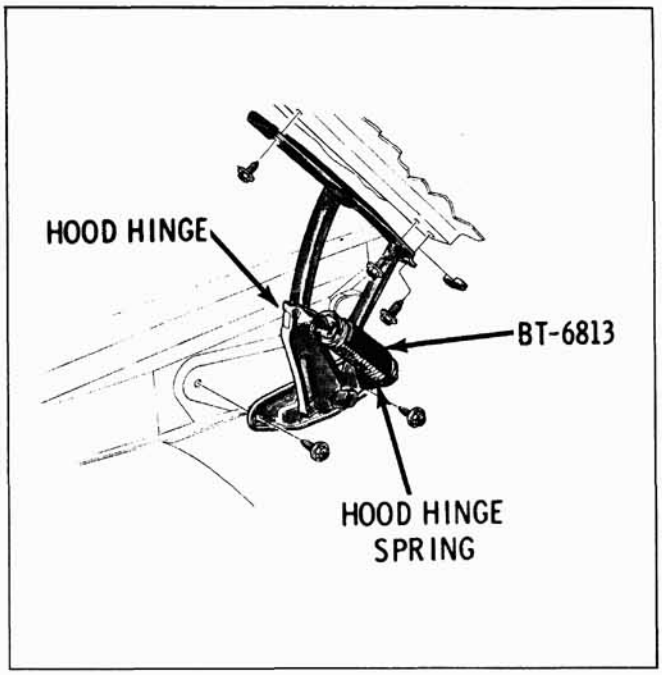


Fig. 11-3—Hinge Spring Tool in Position (54-86 Series)

2. Disconnect underhood lamp wire and washer hoses.
3. Mark position of hinge on hood to facilitate alignment on installation.

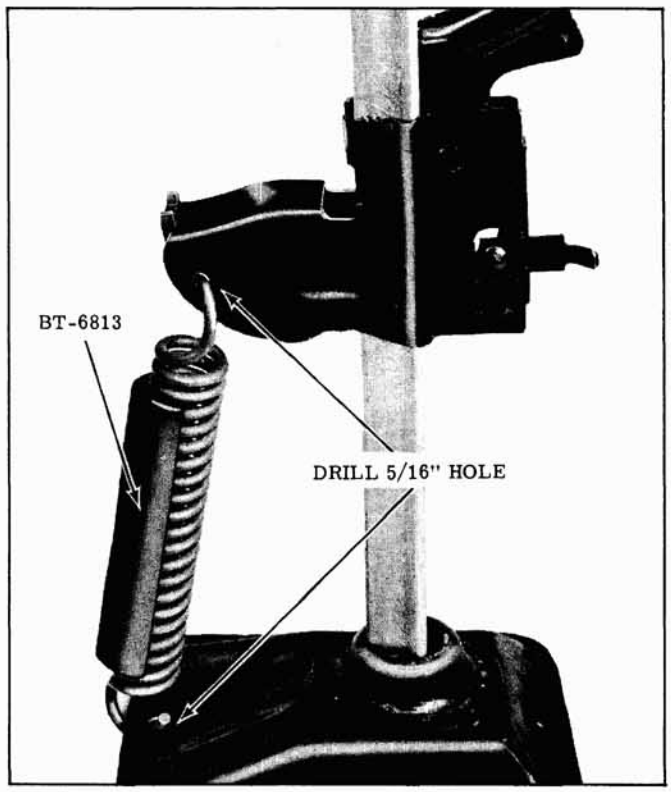


Fig. 11-4—Installing Hinge Spring Tool (54-86 Series)

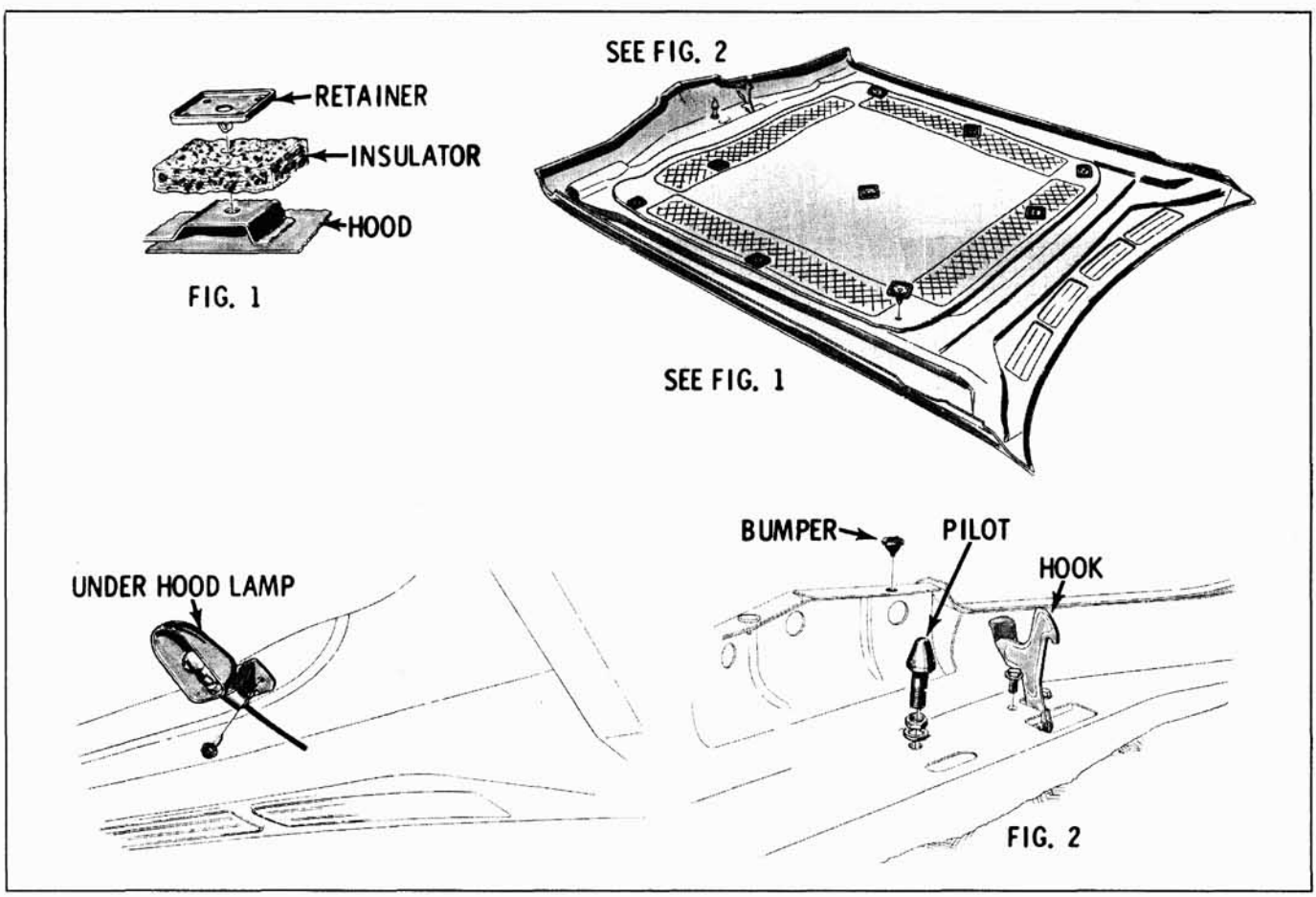


Fig. 11-5—Hood Assembly (54-86 Series)

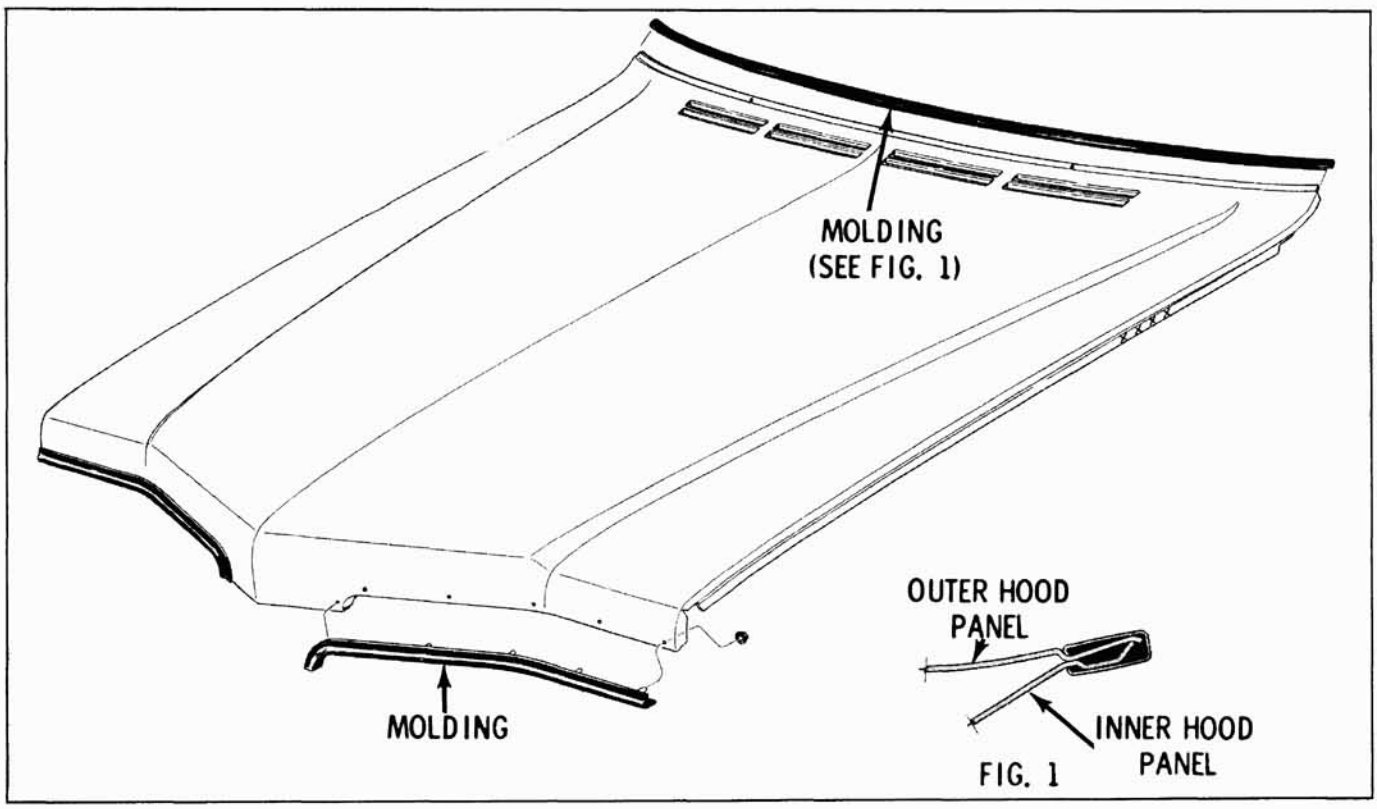


Fig. 11-6—Hood Molding (54-86 Series)

4. While supporting hood, remove hinge to hood bolts on each side of hood. (Fig. 11-1)
5. Remove hood assembly.

To install, reverse removal procedure and check hood alignment.

If necessary to install a new insulator, apply cement to within two inches of outer edges of insulator and install with smooth side exposed. (Fig. 11-5)

The mounting holes in the hood hinge bracket are enlarged to provide a slight fore and aft adjustment of the hood panel.

HOOD HINGE SPRING

Remove and Install

1. Raise hood just enough to place Tool BT-6813 over the spring (Fig. 11-3)
2. Raise hood and remove spring.

When installing new spring, a suitable expander must be used to stretch the spring so that Tool BT-6813 can be placed over the spring. (Fig. 11-4)

3. Position spring (with tool in place) on hinge.
4. Lower hood slightly to expand spring, then remove Tool BT-6813.

HOOD HINGE REMOVE AND INSTALL (With Spring Removed)

1. Mark the hinge outline on the cowl to facilitate alignment on installation.
2. While supporting hood, remove the hinge to hood bolts, then remove the hinge to cowl and fender bolts.

To install, apply auto body caulking compound around cowl bolt holes and reverse removal procedure. Align hood after hinge is installed.

HOOD MOLDINGS

The hood moldings are attached by self-threading nuts which are accessible from the underside of the hood. (Fig. 11-6)

HOOD LATCH ASSEMBLY

The hood latch assembly is bolted to the hood latch support. The bolt holes are elongated for alignment purposes. The assembly should be lubricated periodically with lubriplate. (Fig. 11-7) Torque screws to 20 ft. lbs.

FENDER AND FILLER PANEL

Removal

1. Cover front edge of door and fender to prevent chipping of paint.
2. Remove bolts from front bumper brackets and lower bumper.
3. Remove battery and battery support (L.H. only).
4. Disconnect wiring and horn relay (L.H. only).
5. Disconnect parking lamp wiring at connector.
6. Remove refrigerant line clamp. (R.H. only) if equipped.
7. Remove headlamp door.
8. Scribe hood hinge outline on fender for alignment.
9. Support hood and remove hinge to fender bolts.
10. Remove bolts from fender as shown in Fig. 11-8. Make note of alignment shims for installation.
11. Remove filler panel to radiator support bolts as shown in Fig. 11-10.
12. Lift fender and filler panel from car.

If necessary to remove filler panel from fender, remove filler panel attaching screws as shown in Fig. 11-9 and remove filler panel.

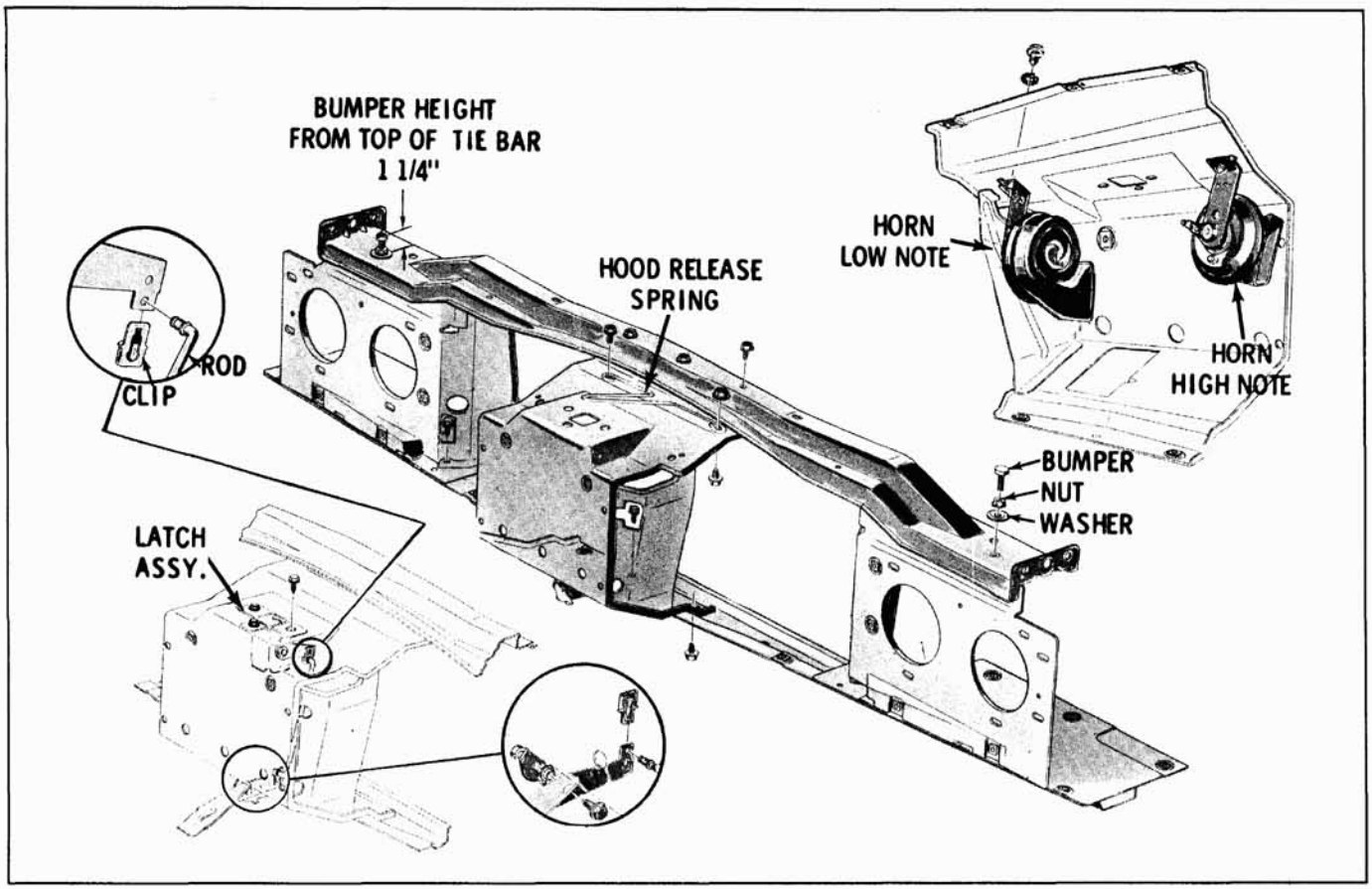


Fig. 11-7—Hood Latch Assembly (54-86 Series)

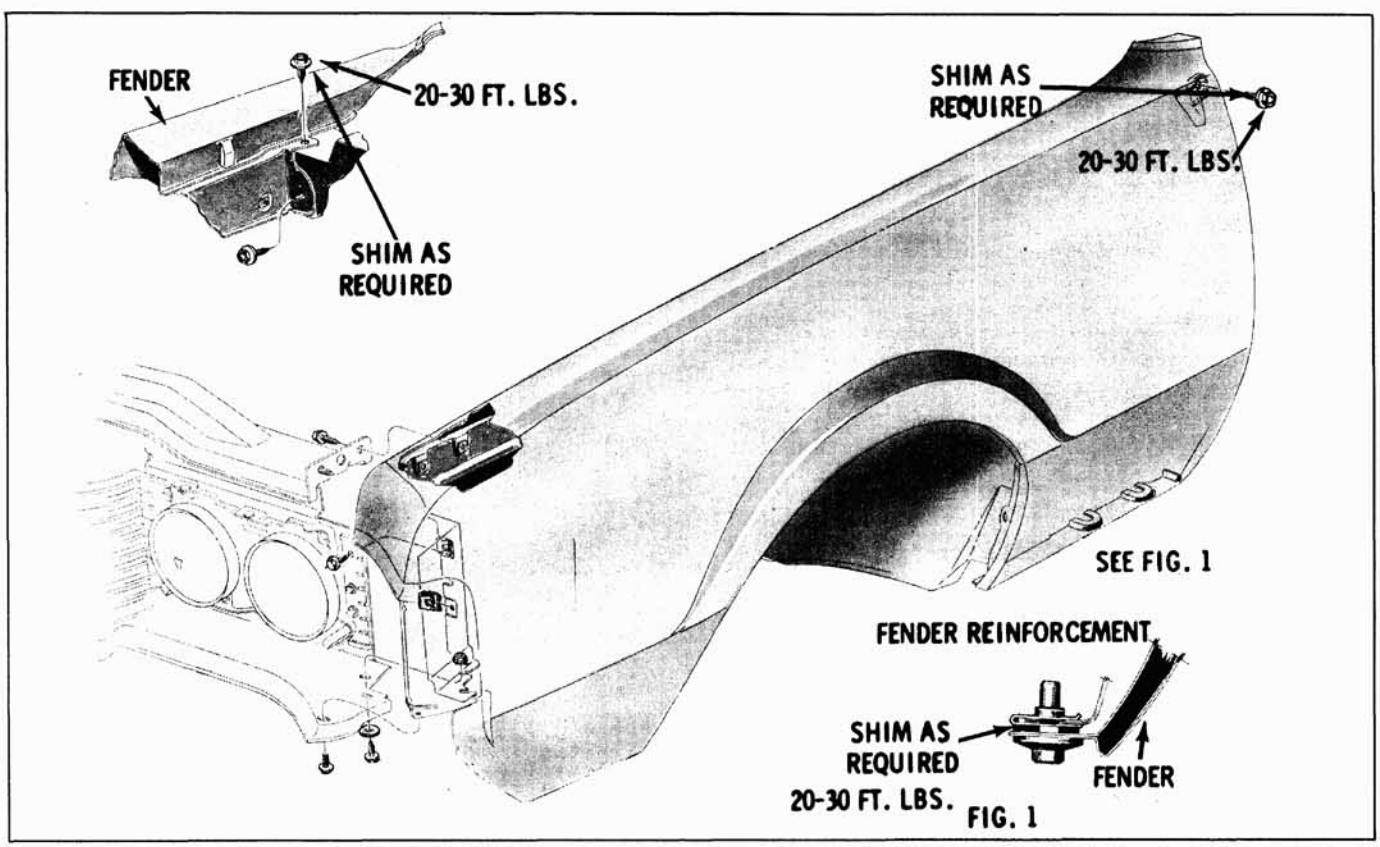


Fig. 11-8—Fender Installation (54-86 Series)

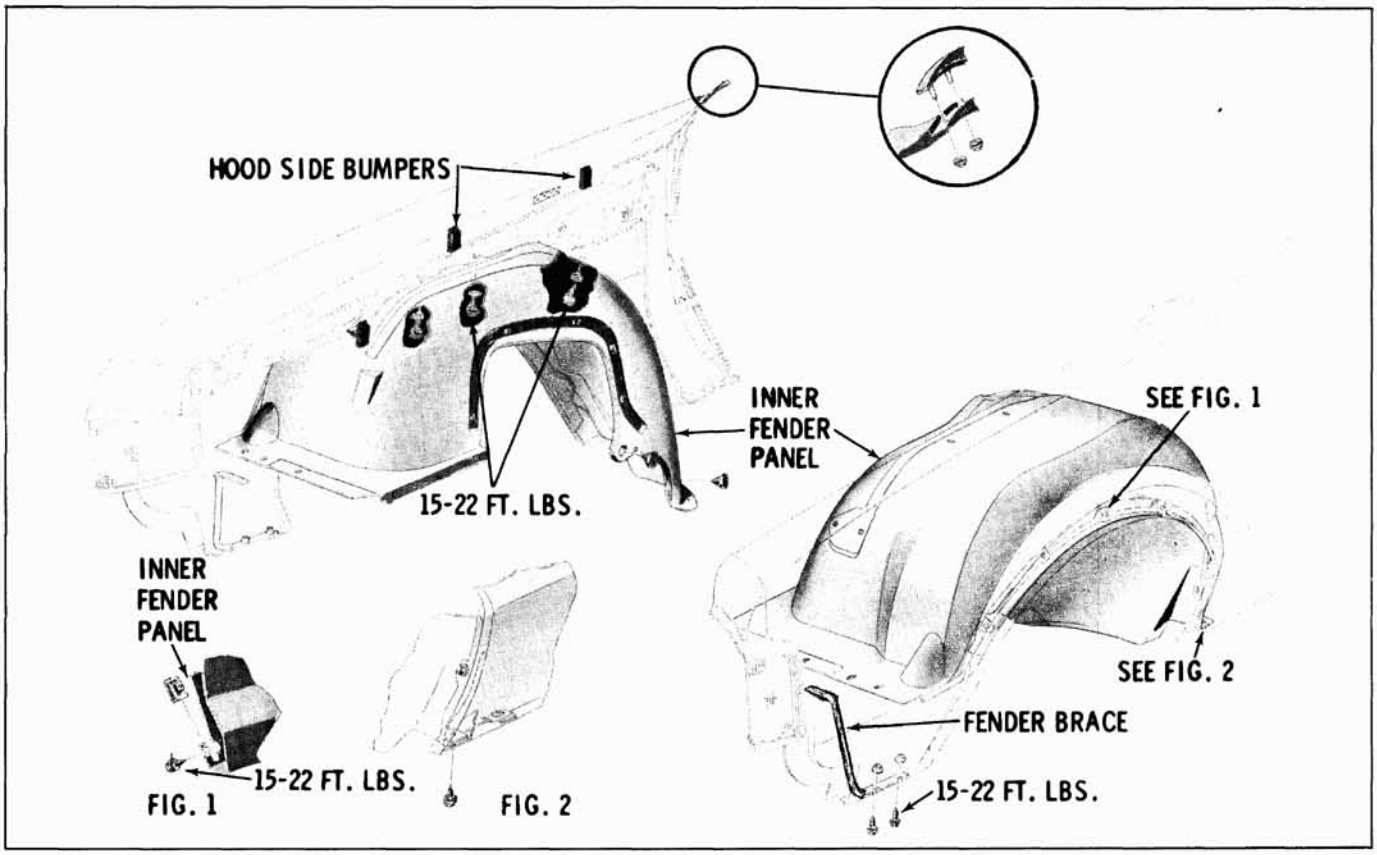


Fig. 11-9—Inner Fender Panel Attachment (54-86 Series)

Installation

To install the fender, reverse the removal procedure. Refer to ACCESSORIES Section for manual antenna installation. The fender attaching bolt holes are elongated to permit adjustment and, in addition, there are shims available to be used at five locations. Four of the shim locations are used to obtain alignment of the fender to the door; the other shim location is at the fender tie bar and is used to obtain fender to hood alignment. (Fig. 11-2)

When installing a fender, tighten the attaching bolts just enough to permit shifting as required. After proper alignment is obtained, tighten all attaching screws and bolts. Torque fender-to-body bolts to 28 ft. lbs. Torque remaining screws to 20 ft. lbs.

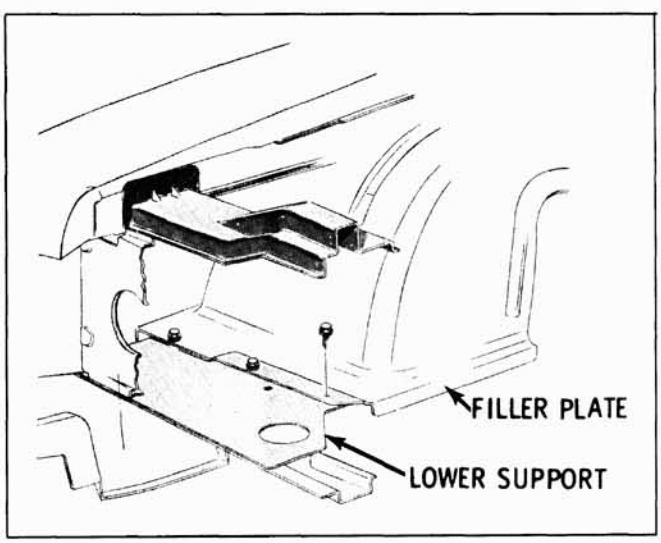


Fig. 11-10—Radiator Support (54-86 Series)

RADIATOR SUPPORT ASSEMBLY (Figs. 11-11, 11-12 and 11-13)

The radiator support assembly is a welded assembly and will be serviced as a complete assembly.

MOLDINGS

Fender Moldings Script, and Rocker Panel Moldings

To remove moldings and script, refer to Figs. 11-14, 11-15, 11-16 and 11-17.

Brush a thick application of sealer over studs and nuts of moldings and scripts after assembly.

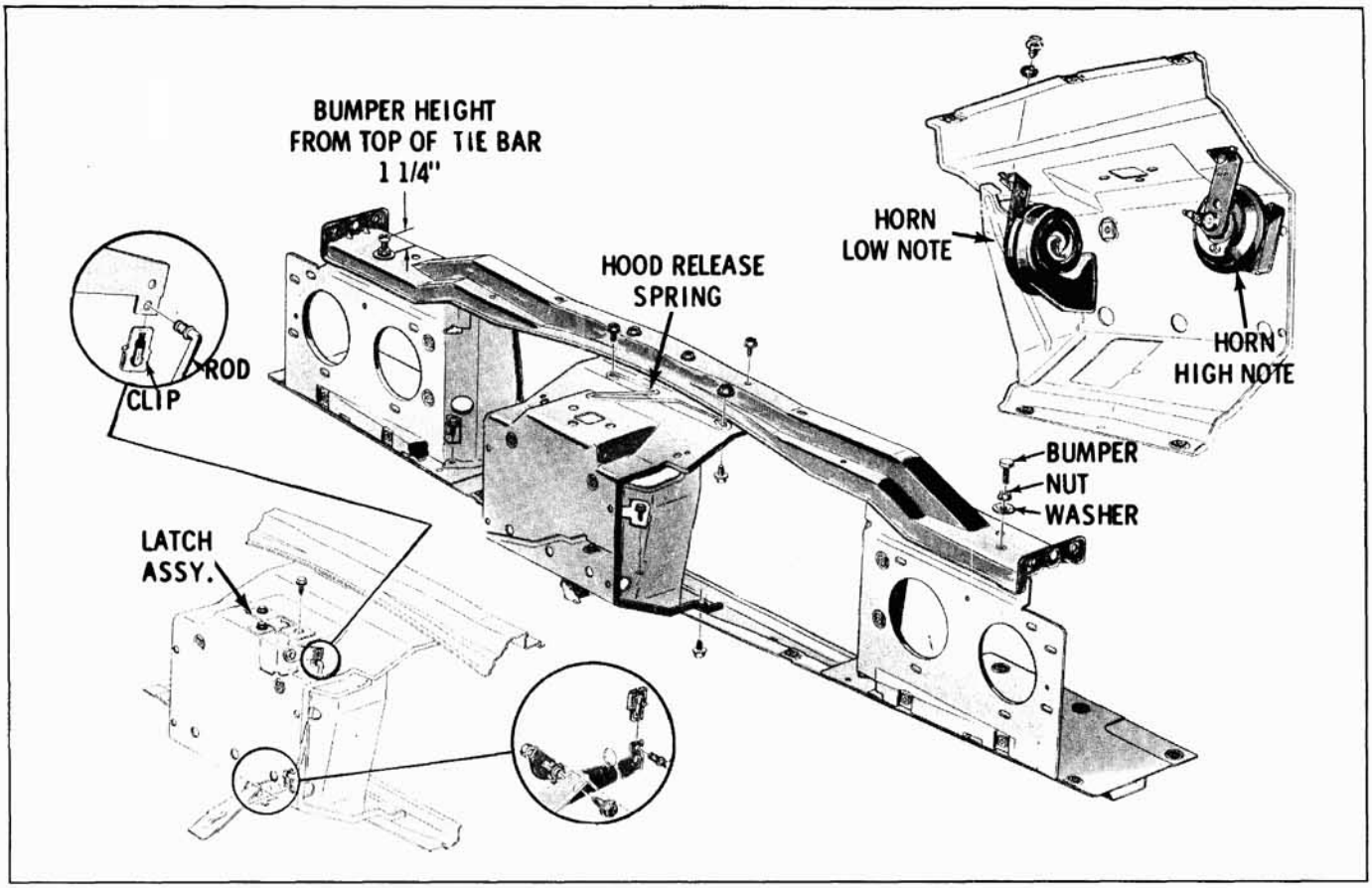


Fig. 11-11—Radiator Support (54-86 Series)

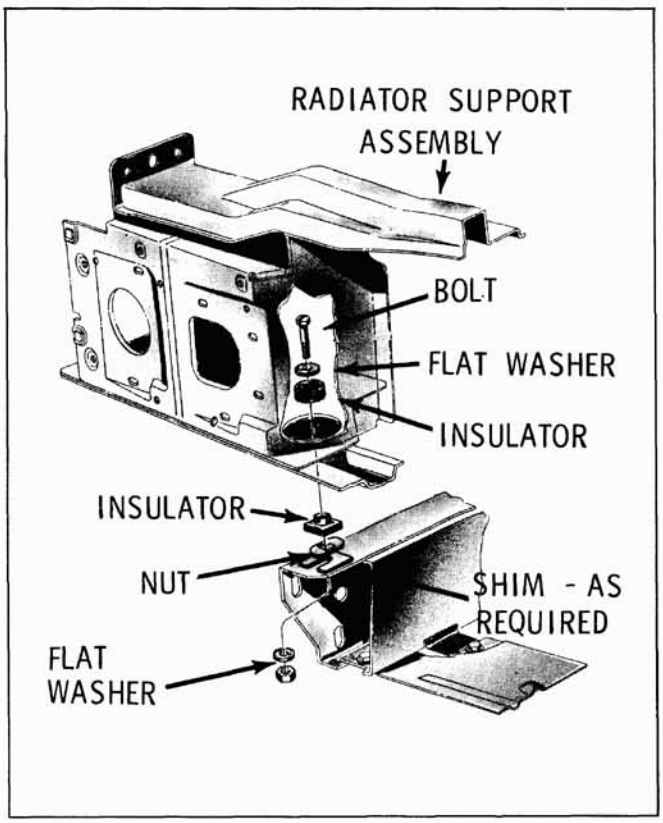


Fig. 11-12—Radiator Support to Frame (54-86 Series)

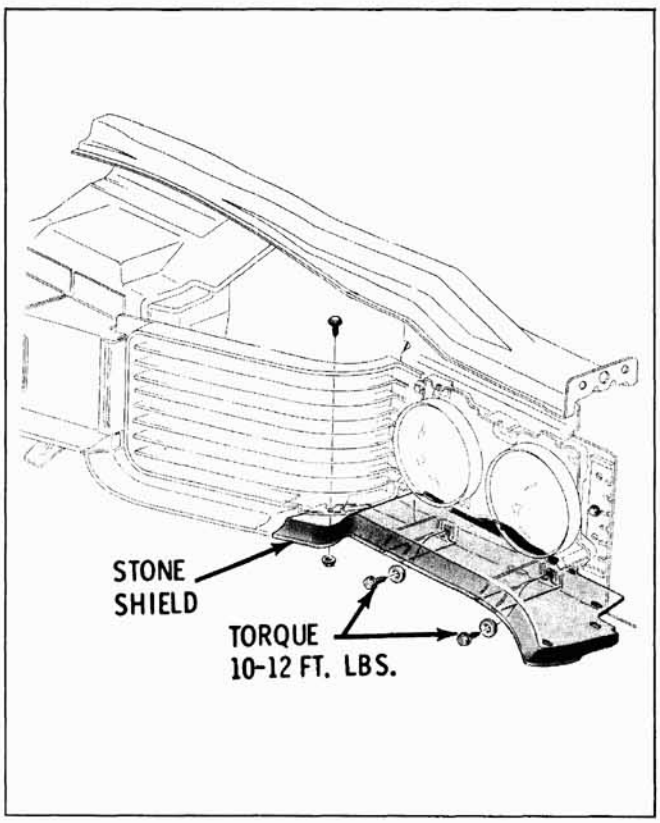


Fig. 11-13—Stone Shield Attachment (54-86 Series)

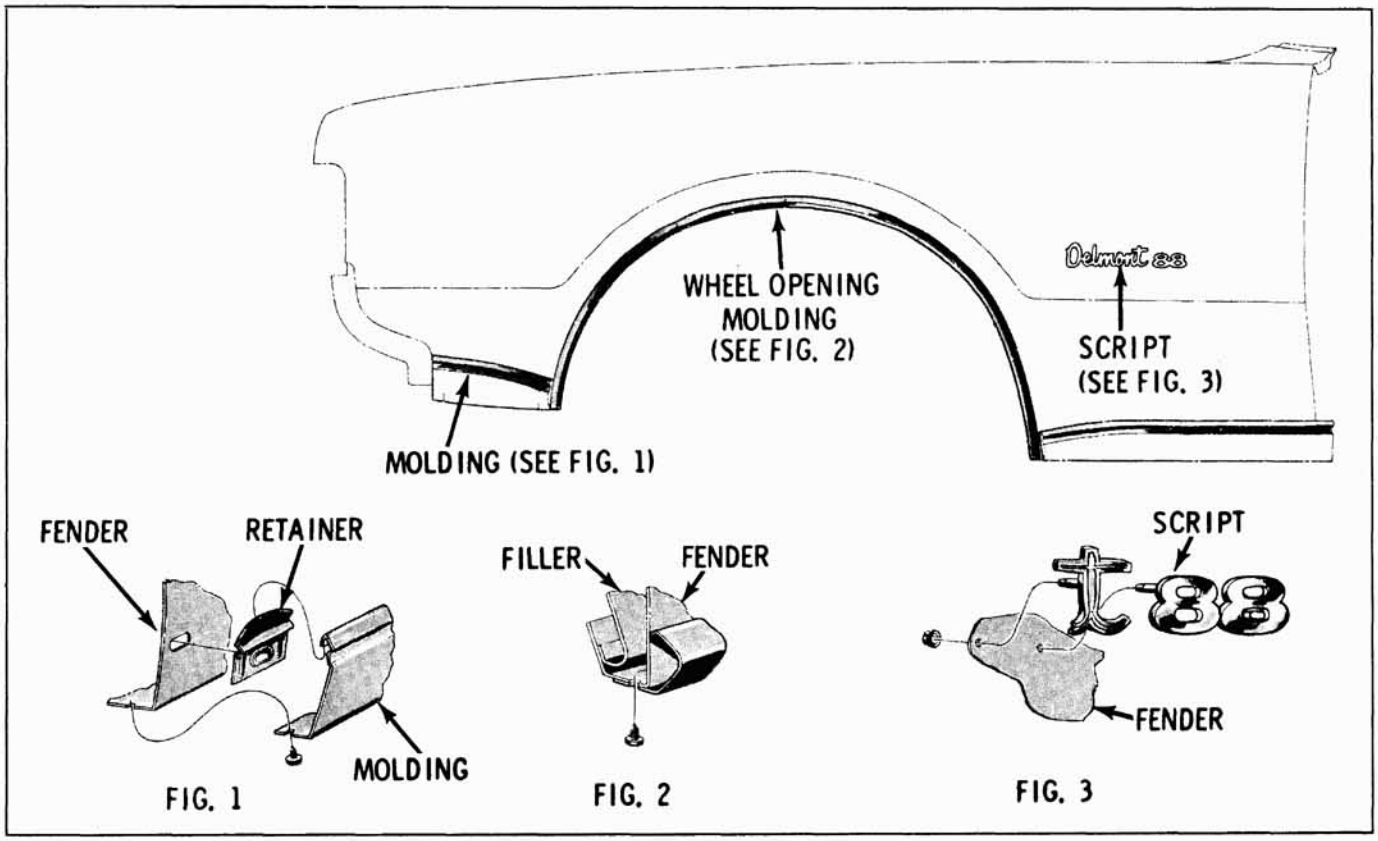


Fig. 11-14—Fender Moldings (5400 Series)

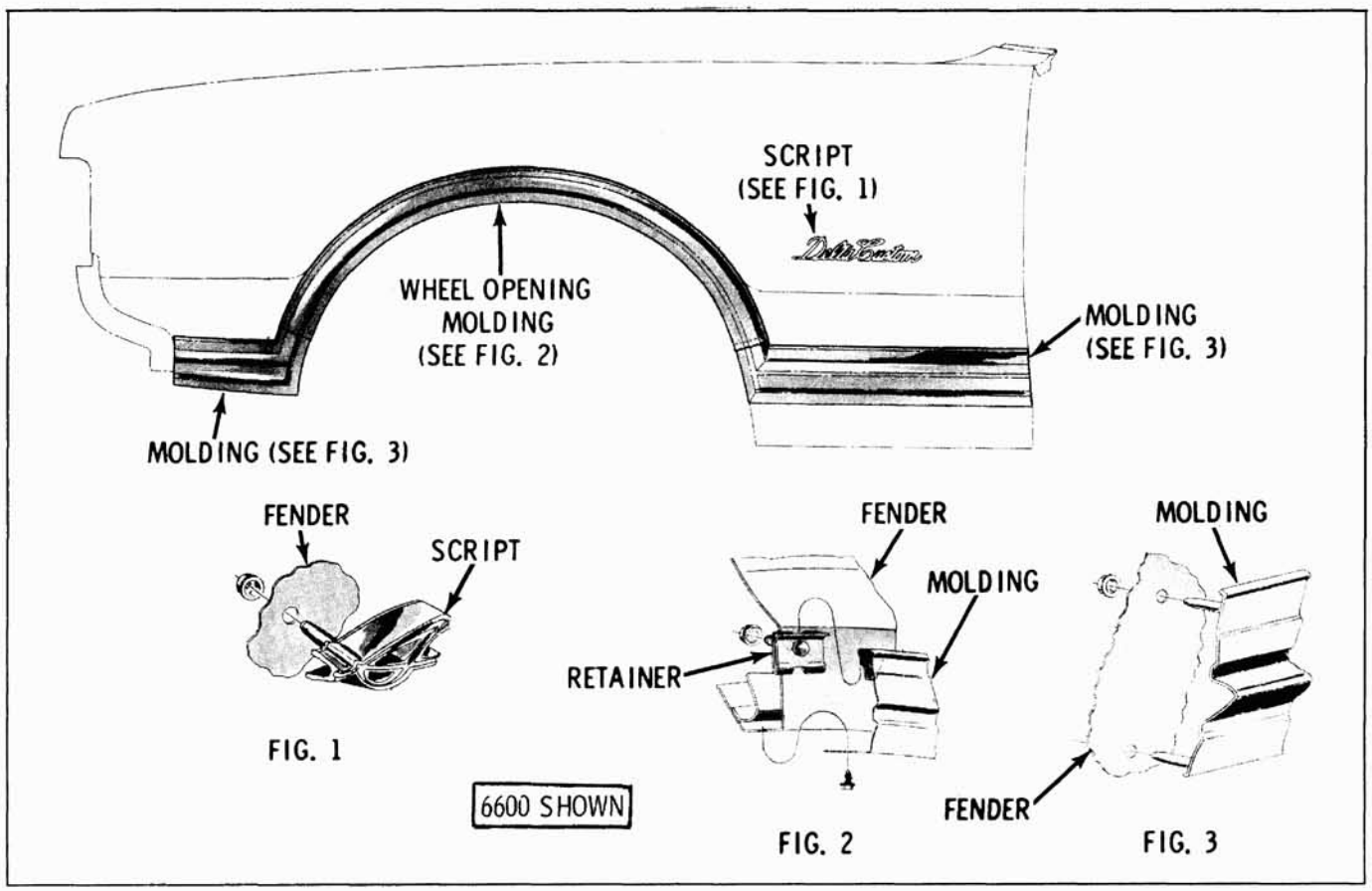


Fig. 11-15—Fender Moldings (64-66 Series)

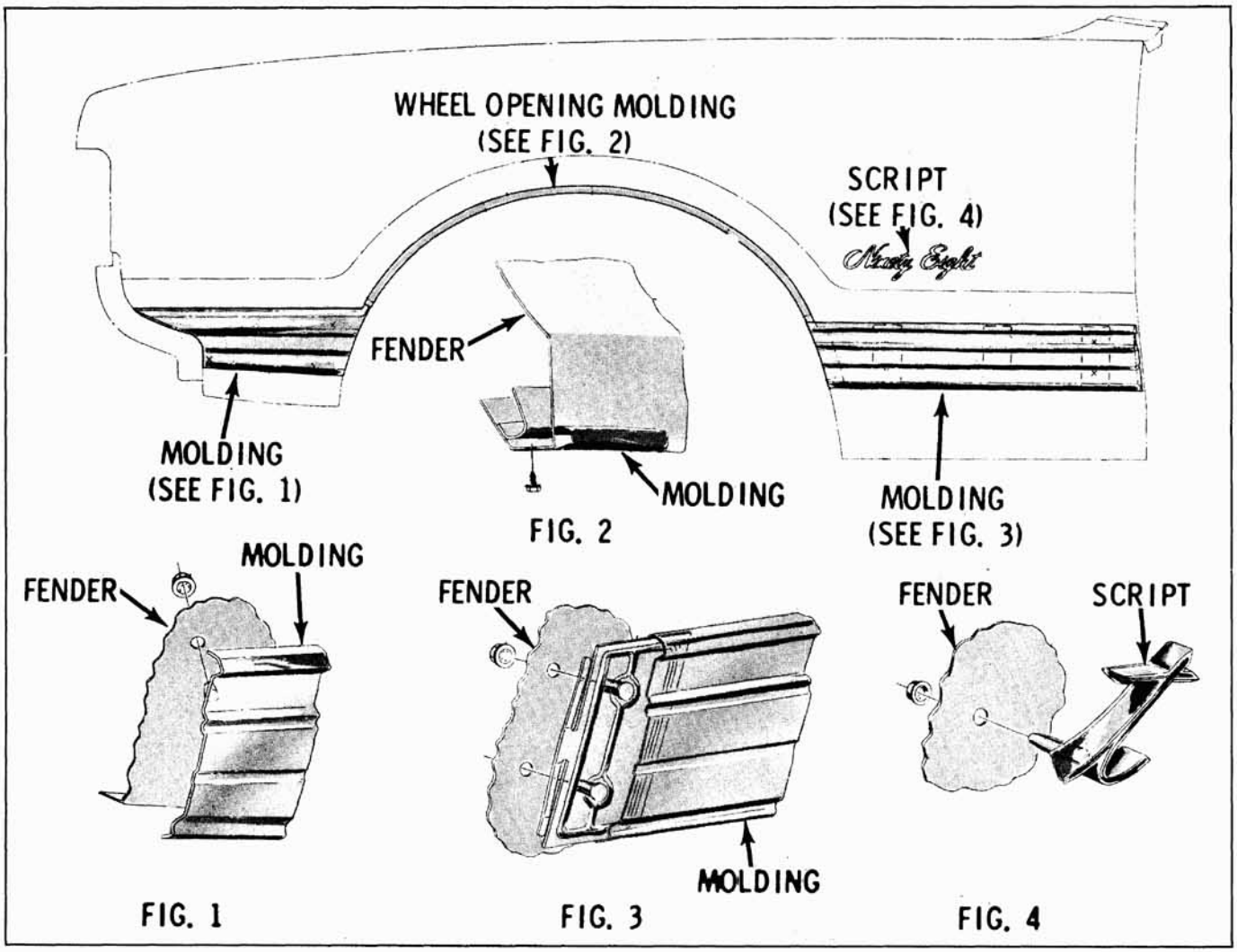


Fig. 11-16—Fender Moldings (84-86 Series)

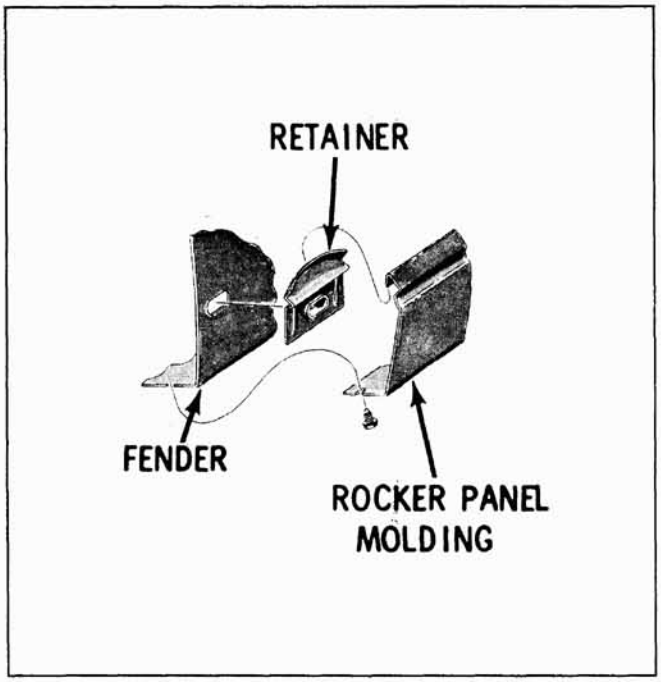


Fig. 11-17—Rocker Panel Molding Installation (5400 Series)

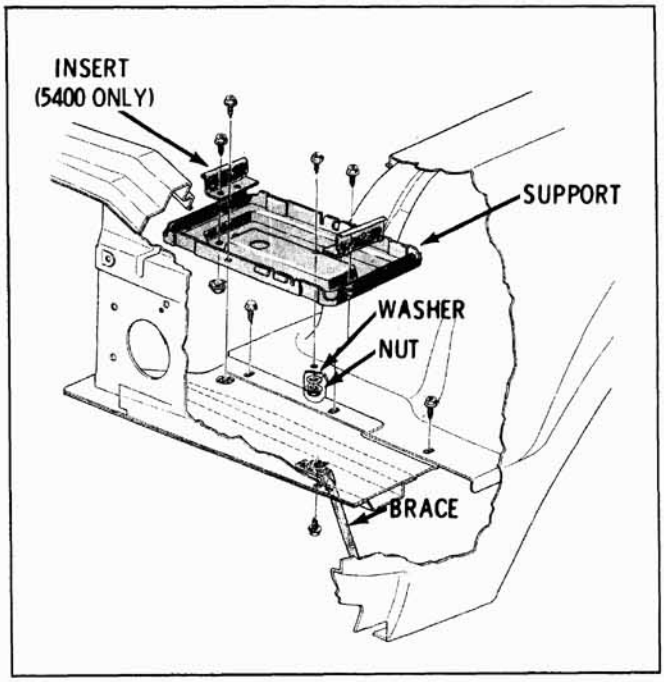


Fig. 11-18—Battery Support

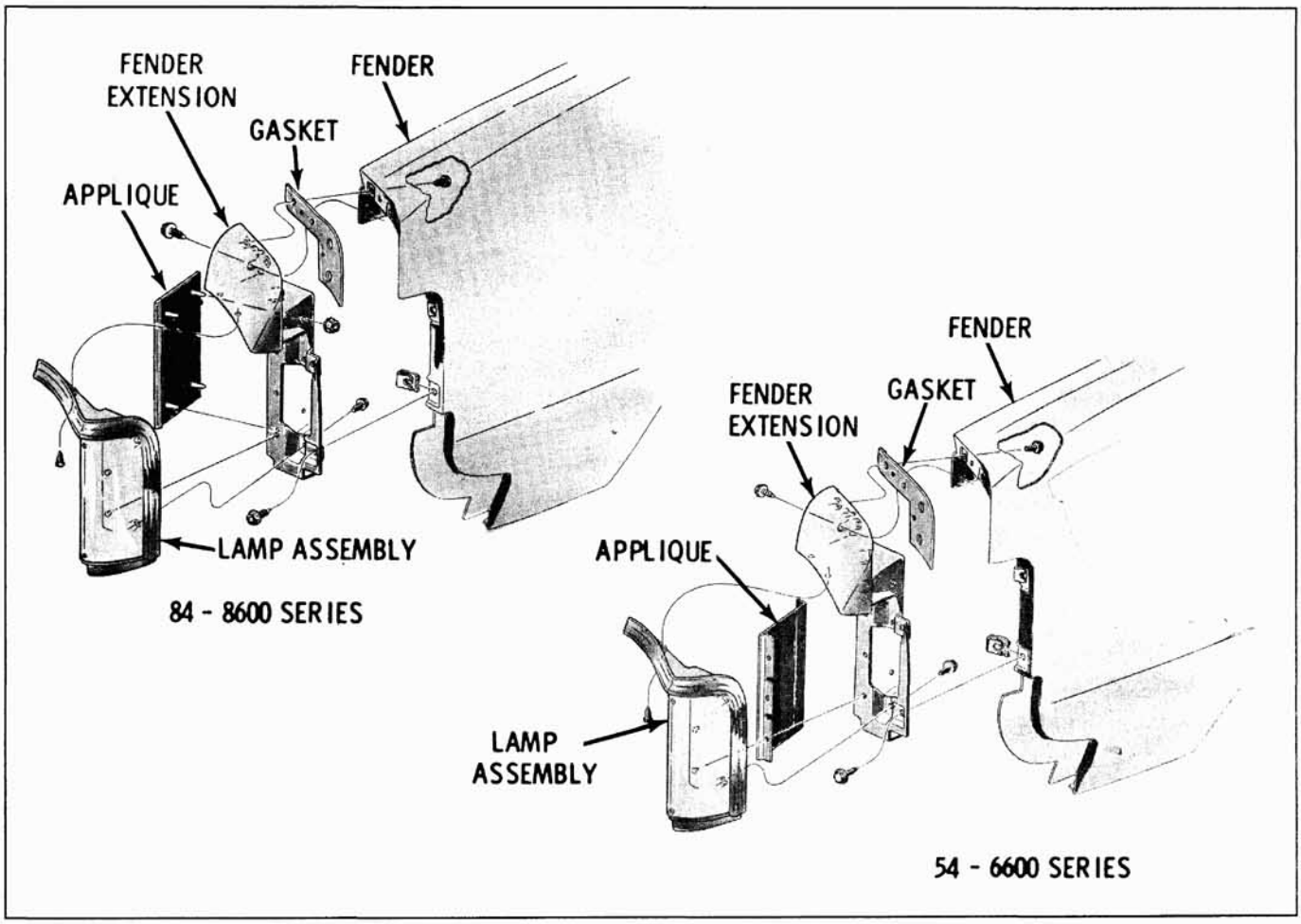


Fig. 11-19—Fender Extension (54-86 Series)

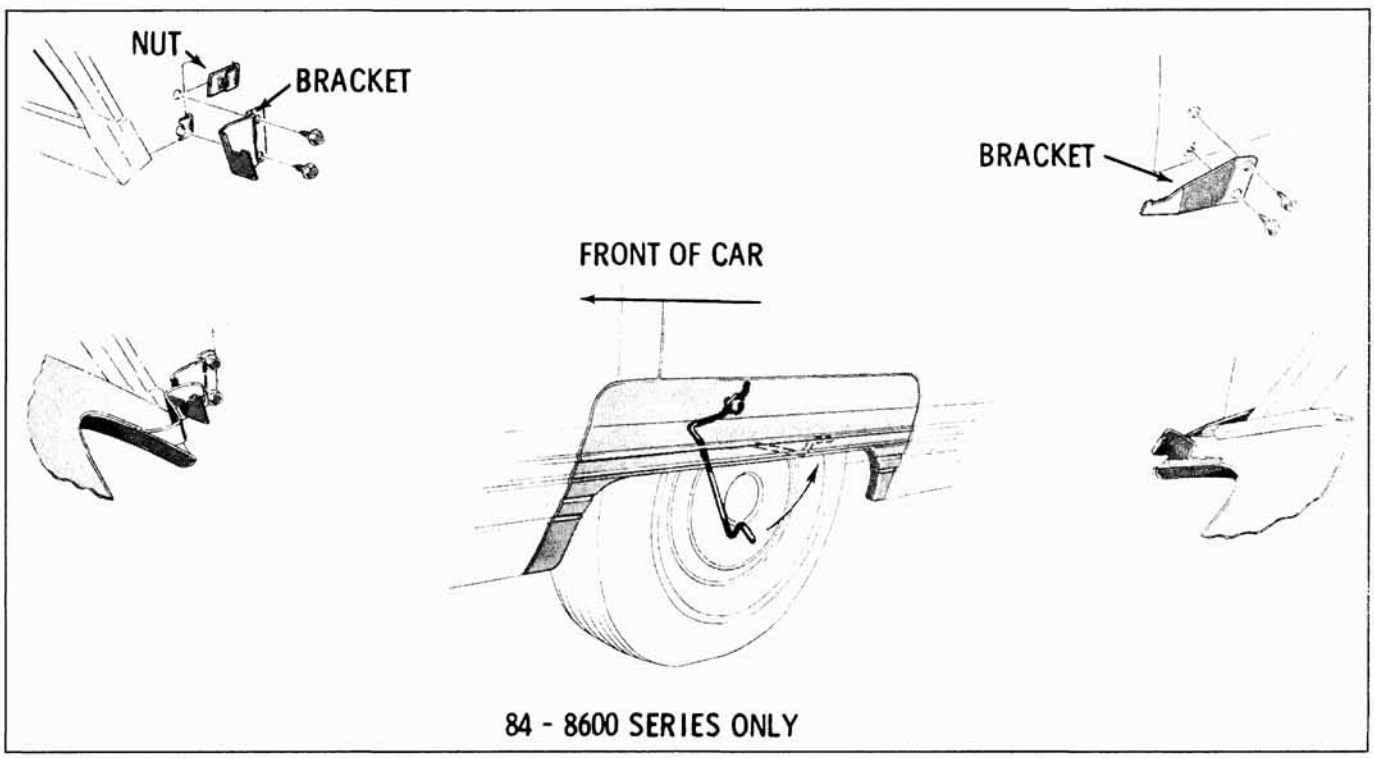


Fig. 11-20—Fender Panels (84 and 86 Series Only)

31 THROUGH 48 SERIES

HOOD ASSEMBLY

Removal and Installation

Prior to removal of the hood, it is suggested that adjoining areas be covered to prevent damage.

With the hood supported, scribe the hinge position on the hood screws from each hinge. (Fig. 11-21)

When installing hood, position the hood to the scribed lines, torque screws to 28 ft. lbs. If further adjustment is necessary, follow the hood and hinge alignment procedure. If necessary to install a new hood insulator, refer to Fig. 11-22.

HOOD HINGE SPRING

Removal and Installation

To remove the spring from the hood hinge, raise hood approximately 12" and place Tool BT-6813 over the spring. (Fig. 11-21) Raise hood and the spring will unhood. Block hood in this position and remove spring.

When installing a new spring, stretch the spring (Fig. 11-23) and place Tool BT-6813 over the spring. Position spring (with tool in place) on hinge. Lower hood slightly to expand spring, then remove tool.

HOOD HINGE

Removal and Installation with Spring Removed

Place protective covers on fender at hinge area. Mark the hinge outline on fender and hood to facilitate alignment. (Fig. 11-21) Support the hood at front and rear and remove the hinge-to-hood screws, then remove the hinge-to-fender screws.

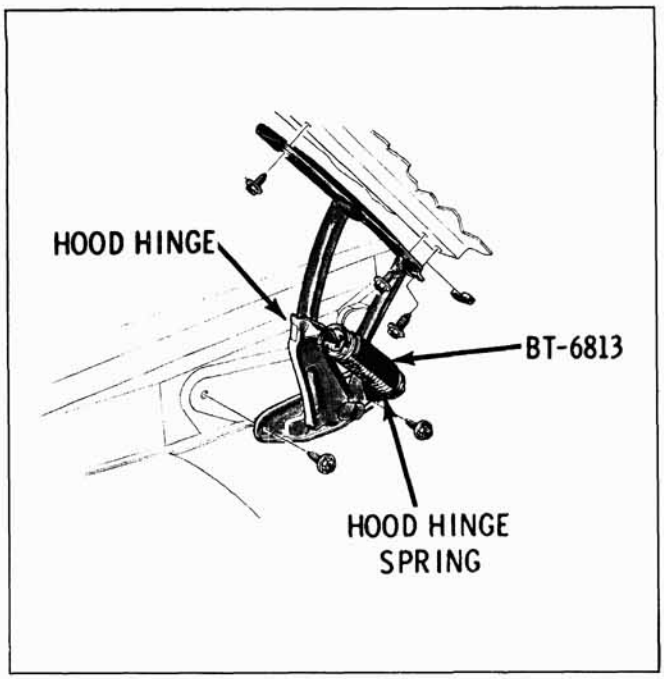


Fig. 11-21—Hood Hinge Spring Removal (31-48 Series)

Using the scribe marks as a guide, install the hinge screws and torque to 28 ft. lbs. Check hood alignment after hinge installation. The hinge is provided with elongated holes for alignment and if necessary, shift hood to properly align.

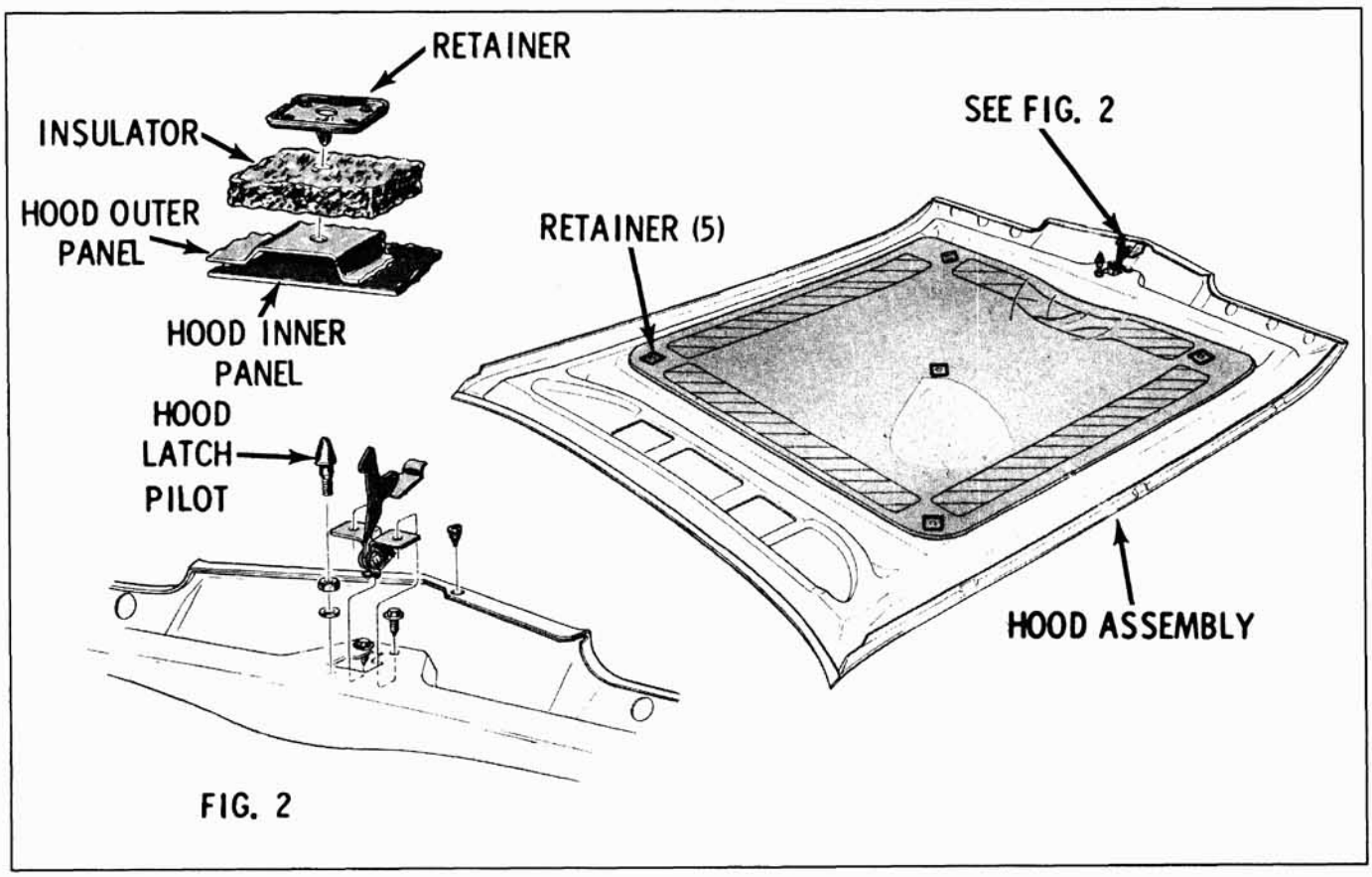


Fig. 11-22—Hood Insulator (31-48 Series)

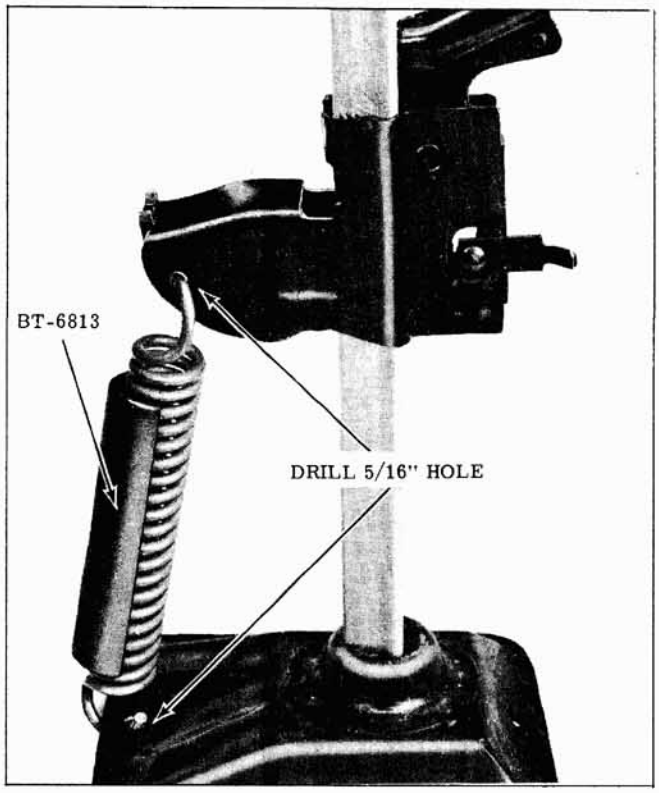


Fig. 11-23—Installing Hinge Spring Tool (31-48 Series)

HOOD LATCH ASSEMBLY

The hood latch assembly is bolted to the upper support assembly and center support. The hood latch can be removed and installed as shown in Figs. 11-24 and 11-24A.

HOOD MOLDINGS

The hood moldings are attached by self-threading nuts and sheet metal screws which are accessible from the underside of the hood. (Fig. 11-25)

RADIATOR SUPPORT ASSEMBLY (Fig. 11-24)

The radiator support assembly is a welded unit and will be serviced as a complete assembly.

FENDER ASSEMBLY

Removal (Fig. 11-26)

Install protective covering on door and fender edges when removing or installing fenders.

1. Remove fender to filler plate attaching screws as shown in Fig. 11-27.
2. Remove the two fender filler screws. (Fig. 11-28)
3. Remove fender attaching screws as shown in Fig. 11-26.
4. Disconnect side marker lamp socket.
5. Remove hood hinge to fender attaching screws and support hood.

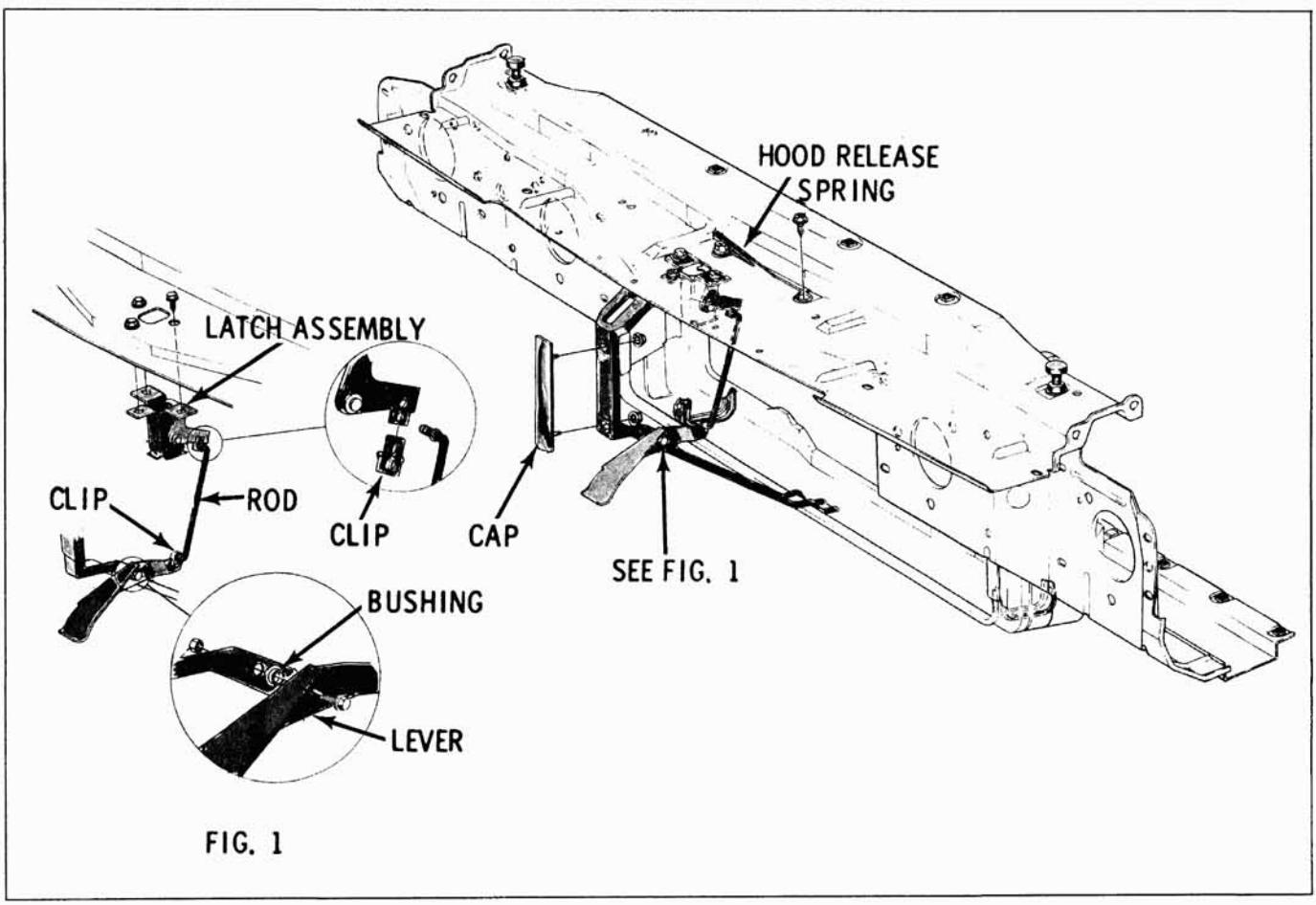


Fig. 11-24—Hood Latch and Radiator Support (31-48 Series) (1st Type)

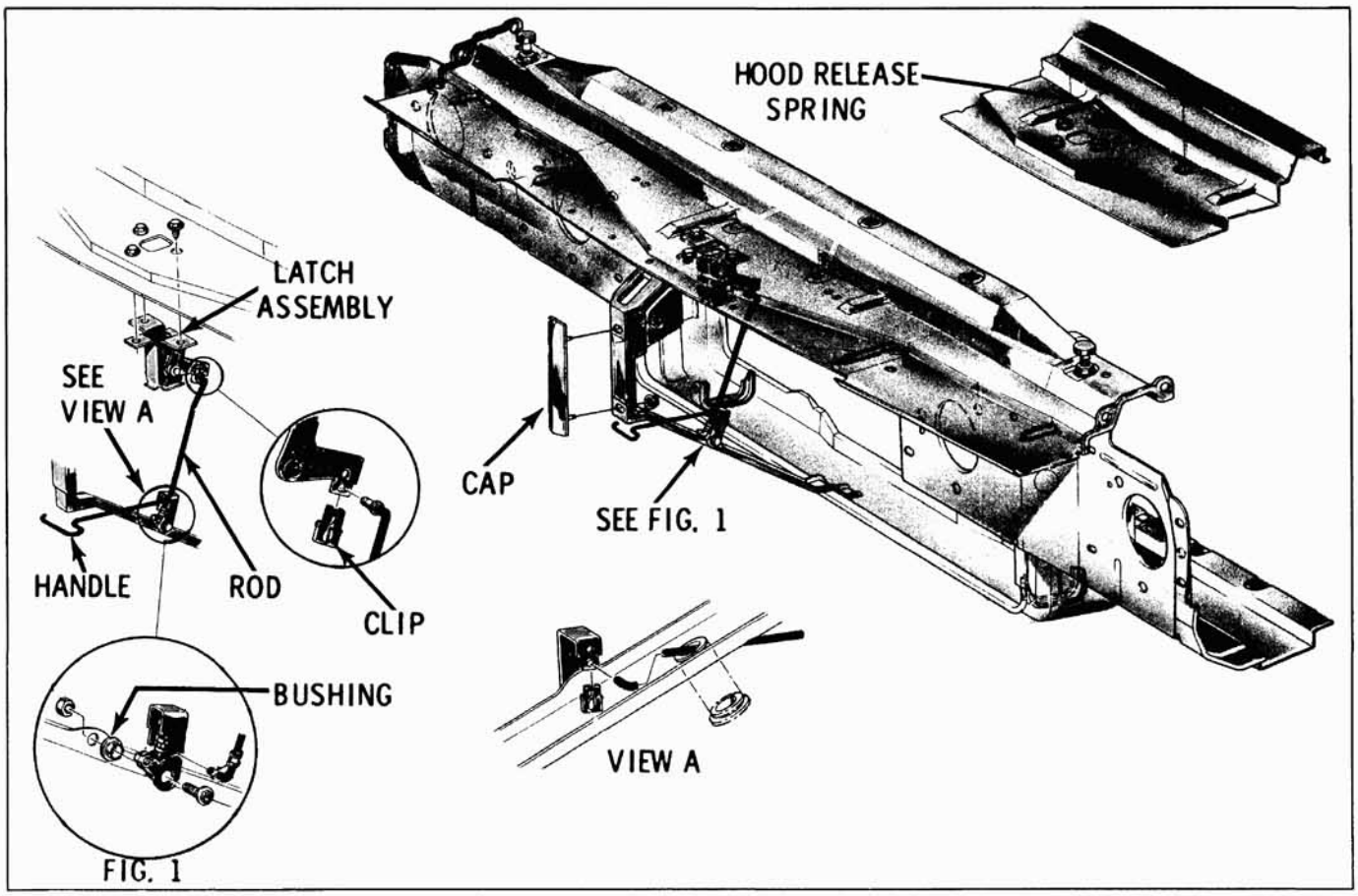


Fig. 11-24A—Hood Latch and Radiator Support (31-48 Series) (2nd Type)

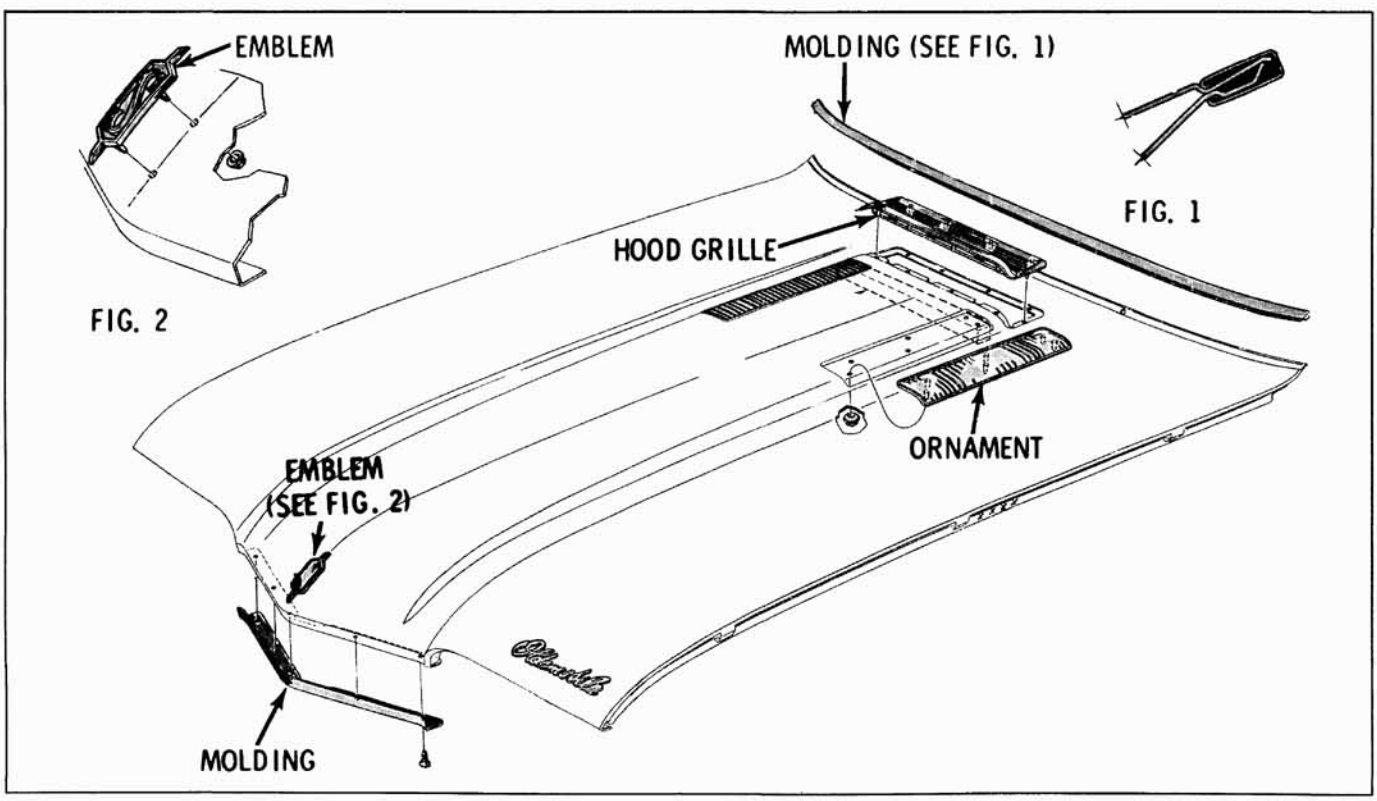


Fig. 11-25—Hood Moldings (31-48 Series)

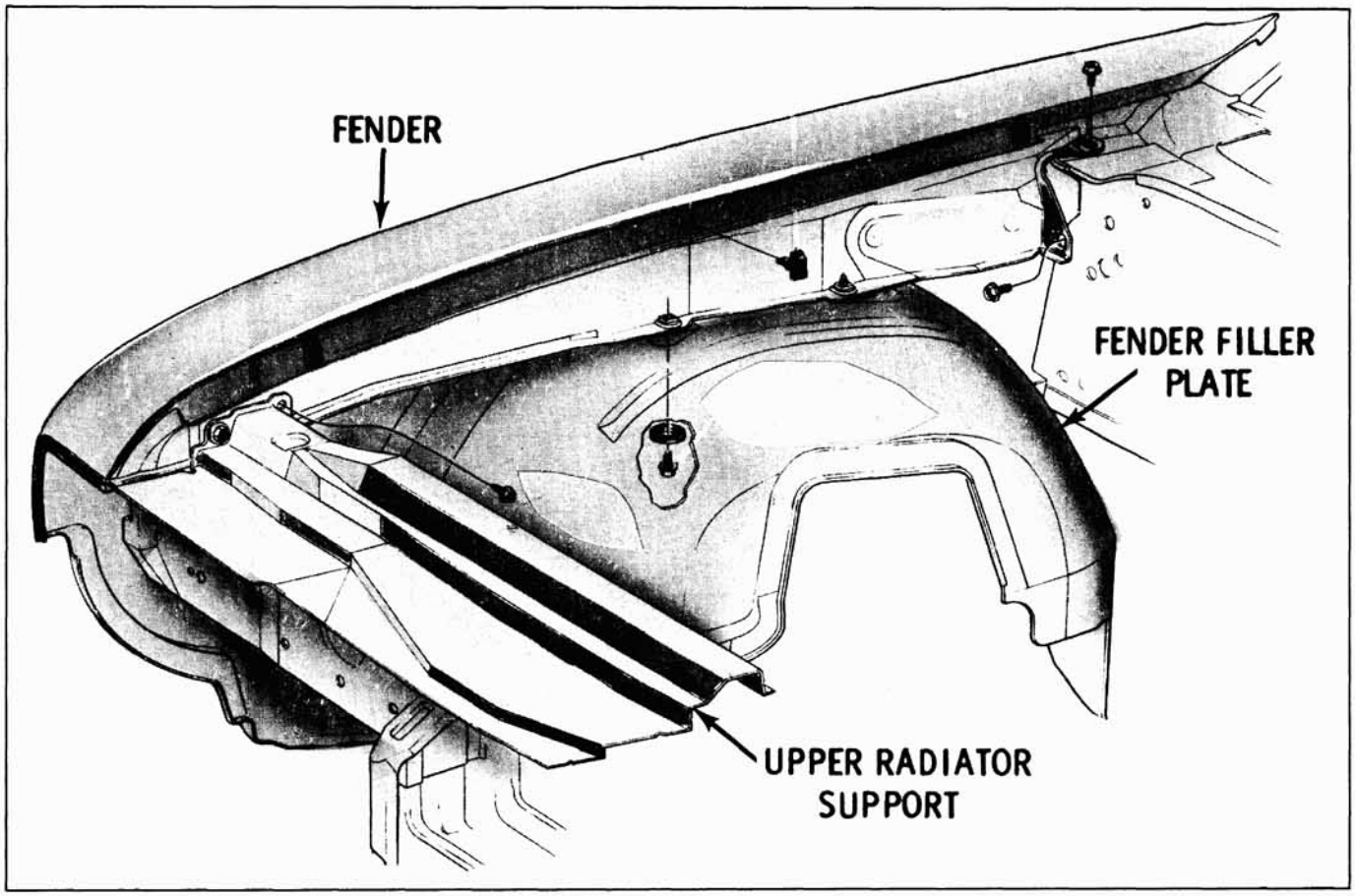


Fig. 11-26—Fender Installation (31-48 Series)

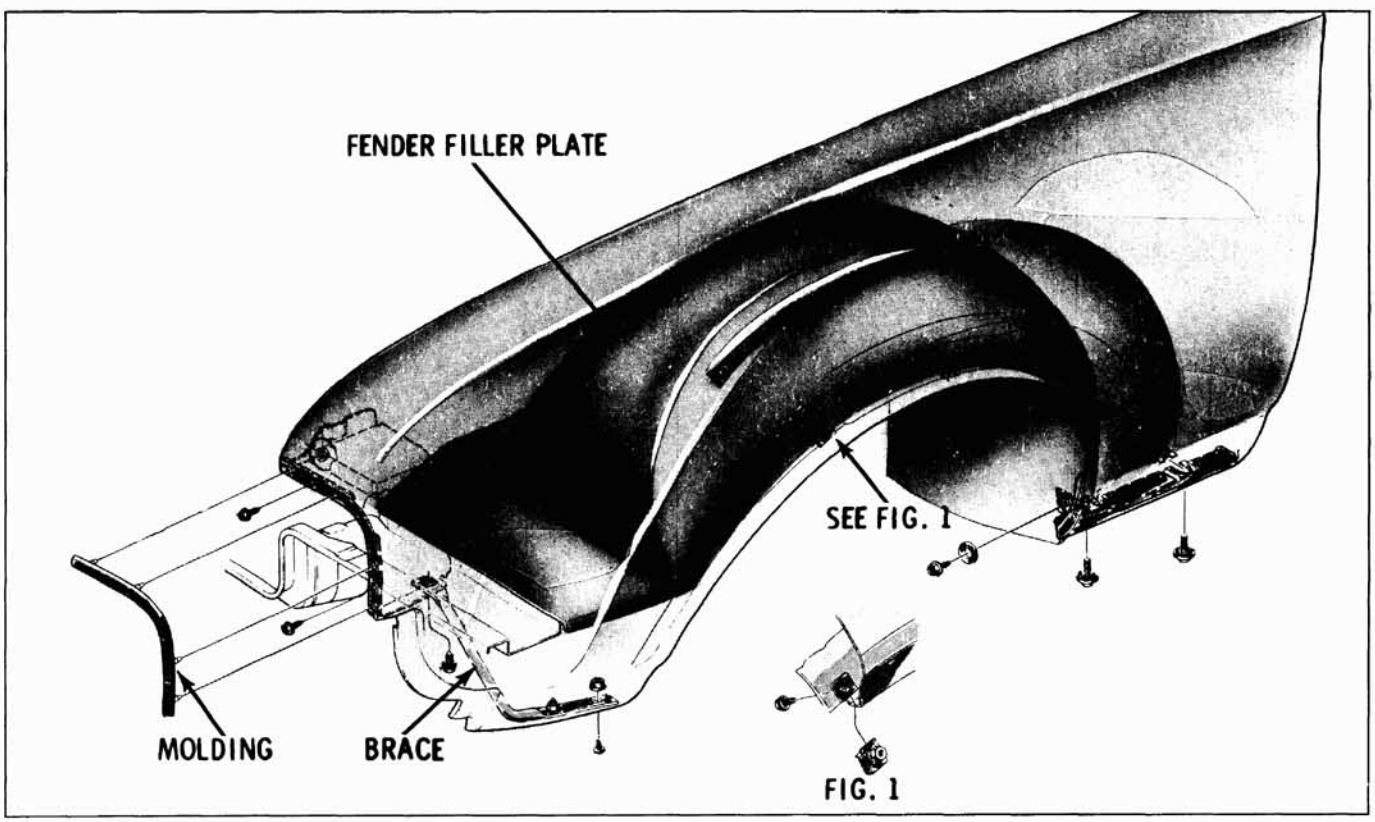


Fig. 11-27—Fender to Filler Plate Attachments (31-48 Series)

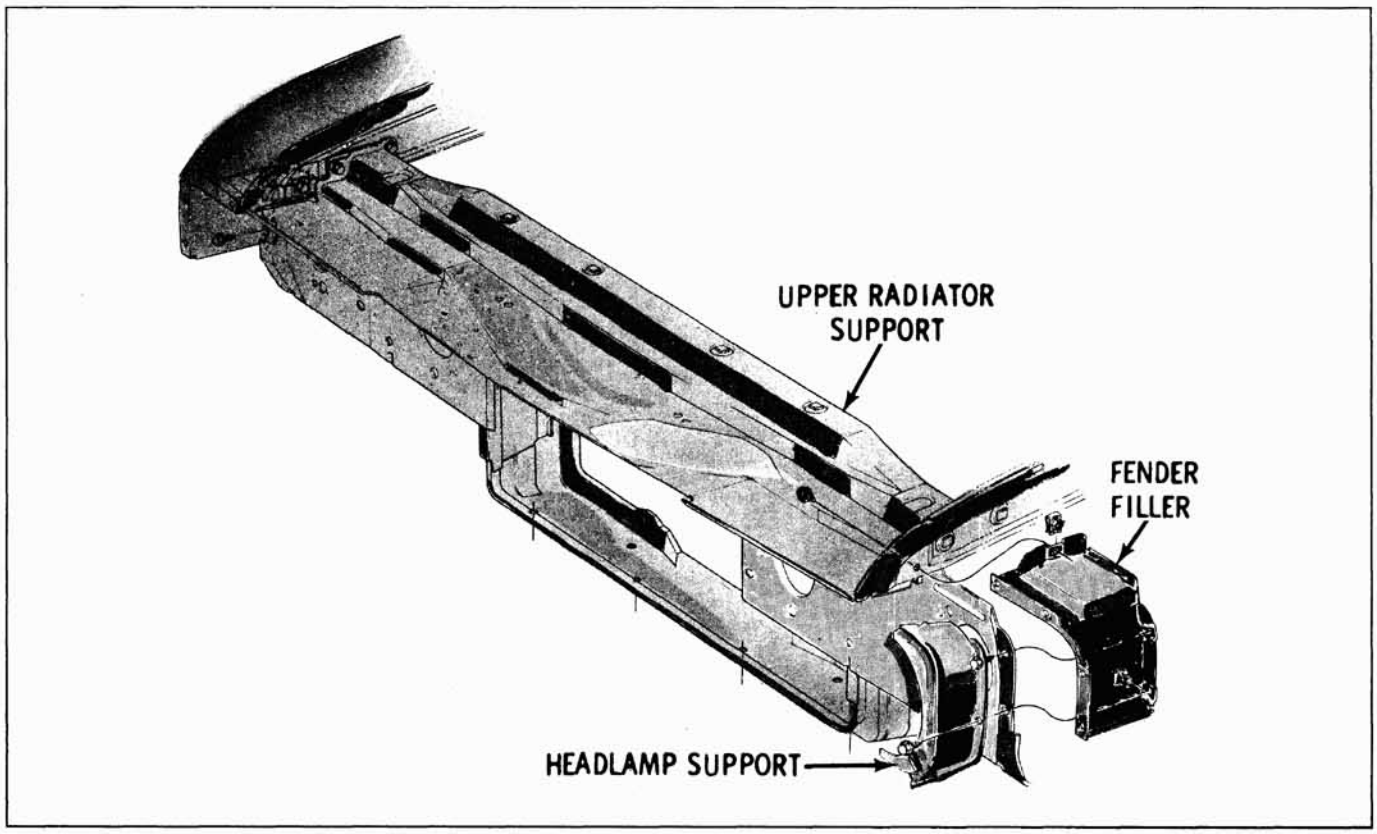


Fig. 11-28—Headlamp to Fender Filler Attachment (31-48 Series)

6. For right fender, if equipped with manual antenna, it will be necessary to:

a. Loosen plastic nut and remove mast assembly.

b. Remove the lead-in assembly mounting nut, upper spacer and gasket.

c. Push the lead-in assembly down through the fender and body.

7. For left fender, remove horn relay buzzer and if equipped with cruise control, remove regulator ground wire.

Installation

To install the fender, reverse the removal procedure. Refer to ACCESSORIES Section for manual antenna installation. The fender attaching bolt holes are elongated to permit adjustment and, in addition, there are shims available to be used at five locations. Four of the shim locations are used to obtain alignment of the fender to the door; the other shim location is at the fender tie bar and is used to obtain fender to hood alignment. (Fig. 11-29)

When installing a fender, tighten the attaching screws and bolts. Torque fender-to-body bolts to 28 ft. lbs. Torque remaining screws to 20 ft. lbs.

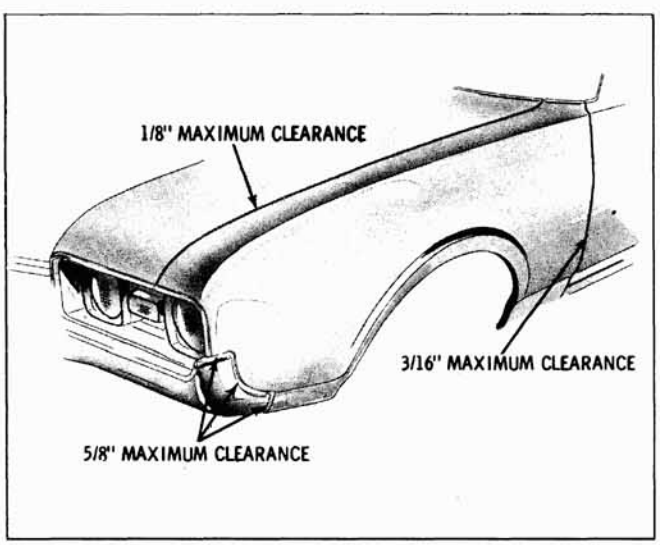


Fig. 11-29—Sheet Metal Clearences (31-48 Series)

FILLER PLATE (Fig. 11-27)

Remove and Install

1. Raise car support on floor stands, remove wheel assembly.

2. If side being serviced has battery support attached, remove battery and battery support. (Fig. 11-30)

3. For left side, remove windshield washer jar.

4. Disengage wiring harness clips from filler plate.

5. For left side if equipped with cruise control, remove bracket and regulator ground wire.

6. Remove screws securing filler plate to lower radiator support. (Fig. 11-30)

7. Remove screws along inner edge of fender securing filler plate to fender. (Fig. 11-27) If equipped with air conditioning for right side, remove clamp securing refrigerant line to filler plate. To install, reverse removal procedure. Torque all attaching screws to 20 ft. lbs.

MOLDINGS

Fender Moldings and Script

To remove moldings and script, refer to Figs. 11-31, 11-32, 11-33 and 11-34.

Brush a thick application of sealer over studs and nuts of moldings and scripts after assembly.

HEADLAMP ASSEMBLY (Fig. 11-35)

The headlamp doors are attached to the lamp assembly by two screws accessible from the front side. The sealed beam units can be removed after removing the headlamp doors by removing three screws from sealed beam retaining ring, pulling sealed beam forward and disconnecting wire connector. The headlamp assembly is retained to the radiator side baffle by six screws. Four of the screws are accessible from the back side of the side baffle and the two remaining are accessible from the front outboard side of the headlamp assembly. Depending upon which assembly is being replaced and whether it is a L-6 or V-8, it may be necessary to remove the battery to gain access. Torque headlamp to side baffle screws to 20 ft. lbs.

BATTERY SUPPORT

The battery is located on the left side with the V-8 engine and on the right side with the L-6 engine.

Removal (Fig. 11-30)

1. Disconnect battery cables.
2. Remove battery.
3. Remove screws securing battery support to radiator support and filler plate, then remove support.

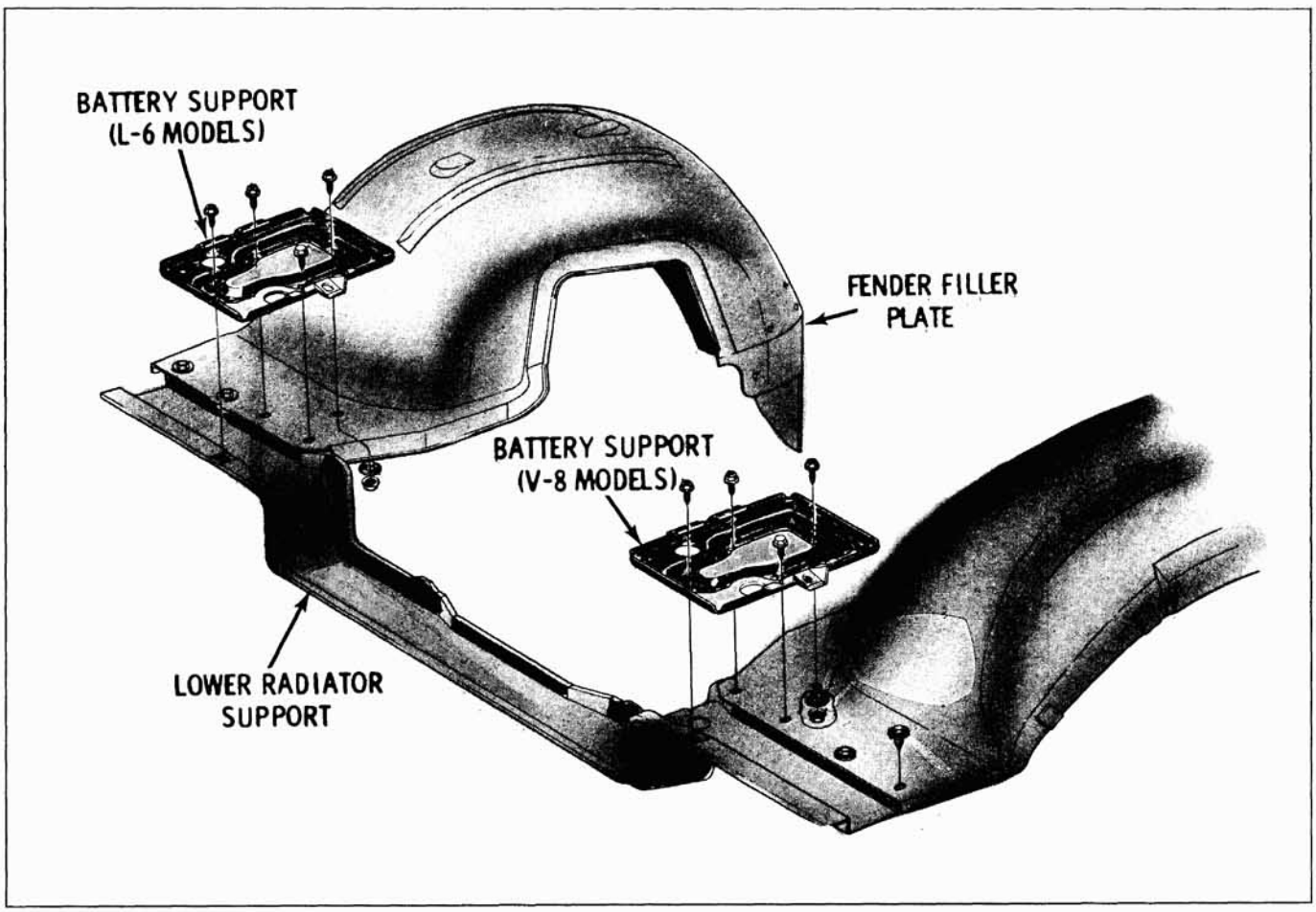


Fig. 11-30—Battery Support (31-48 Series)

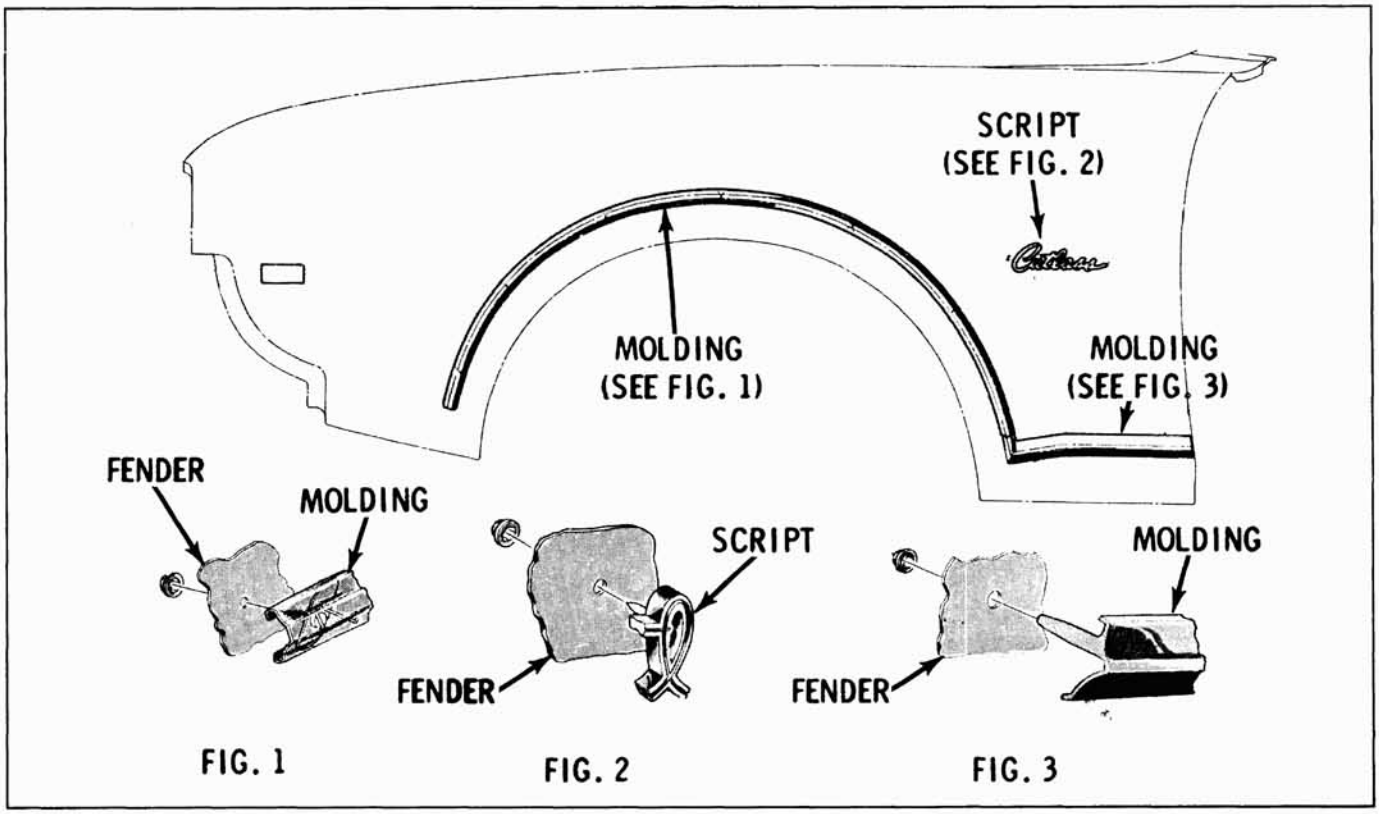


Fig. 11-31—Fender Moldings (35-36 Series)

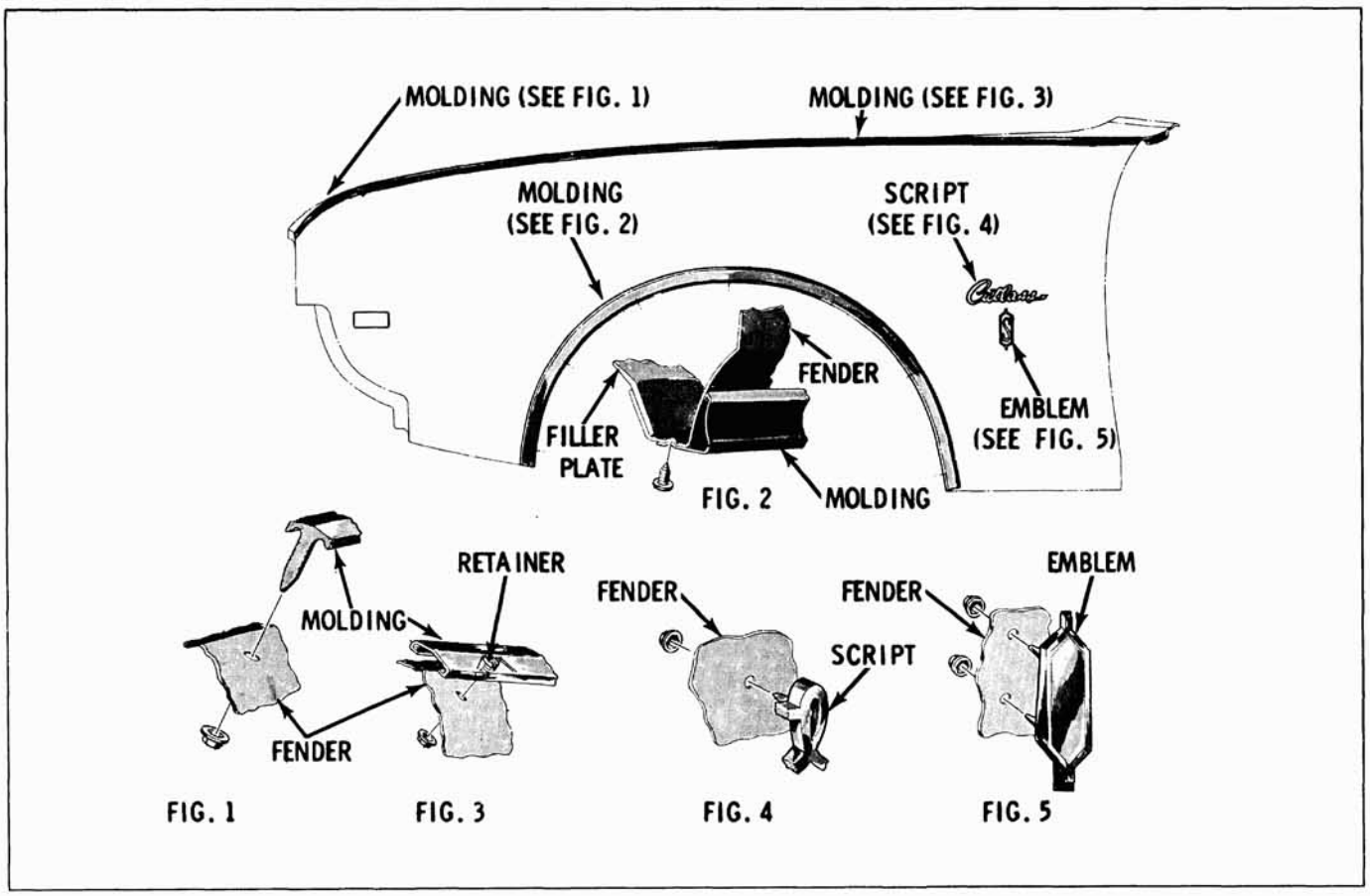


Fig. 11-32—Fender Moldings (35-36 Series)

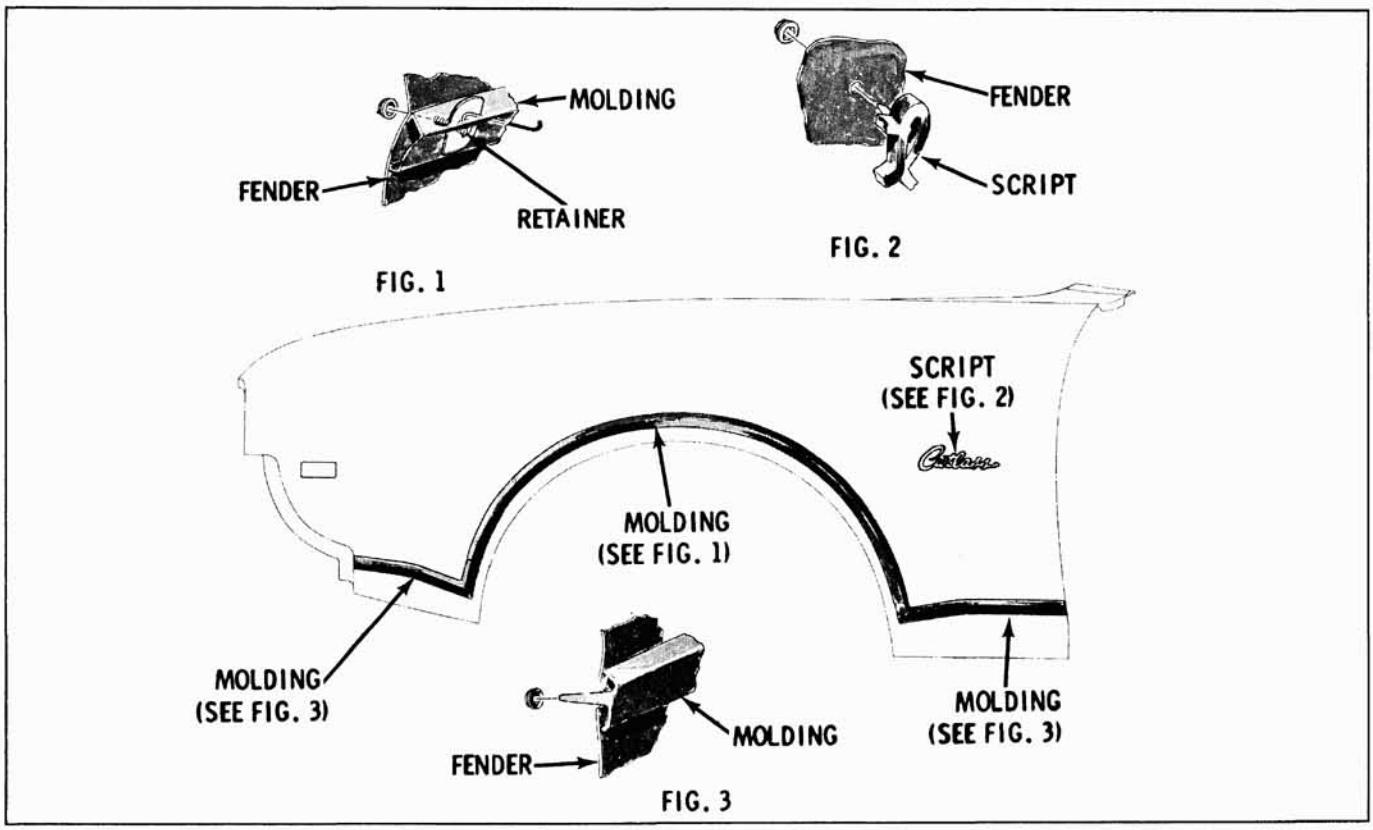


Fig. 11-33—Fender Moldings (4200 Series)

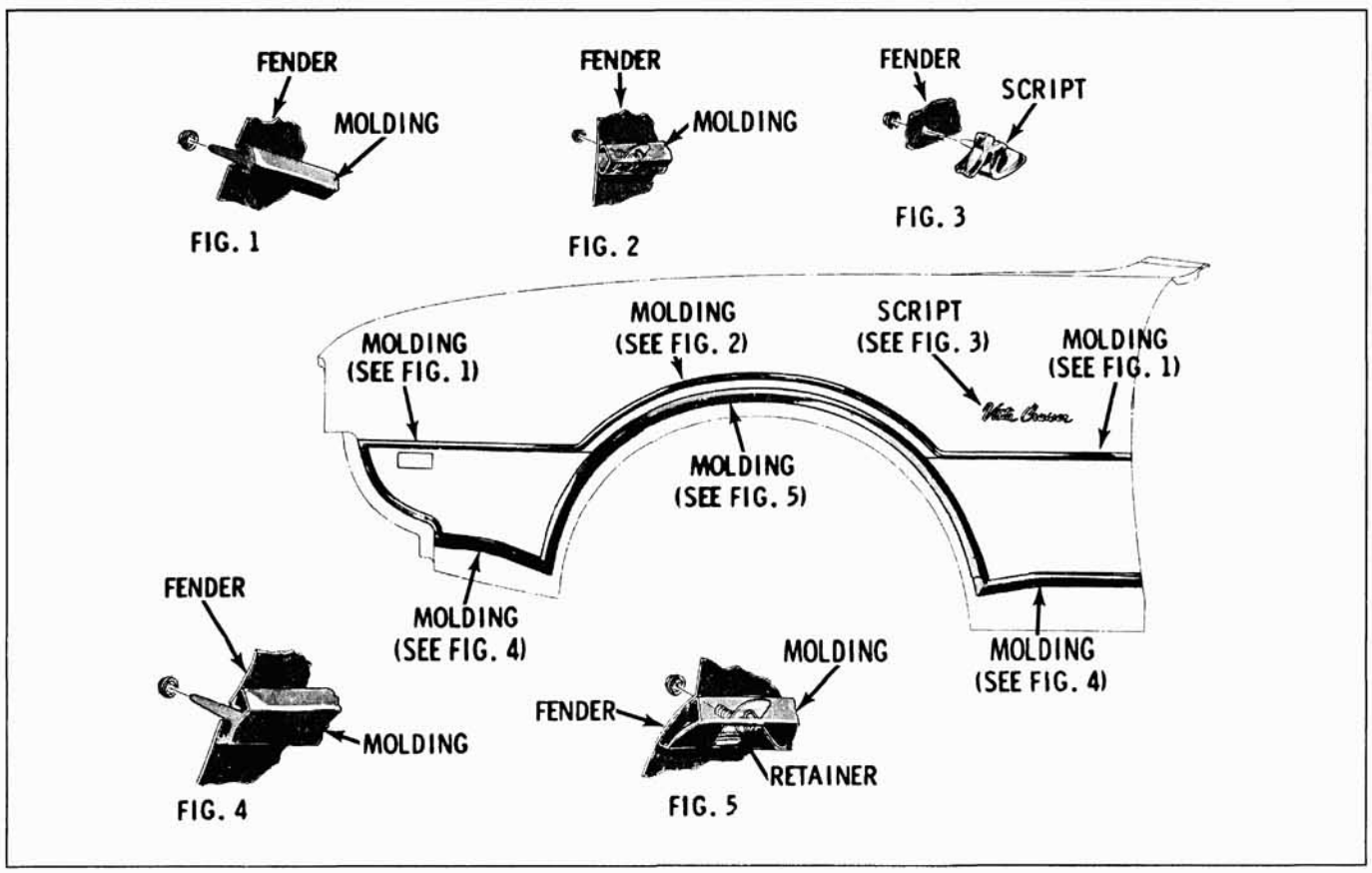


Fig. 11-34—Fender Moldings (4800 Series)

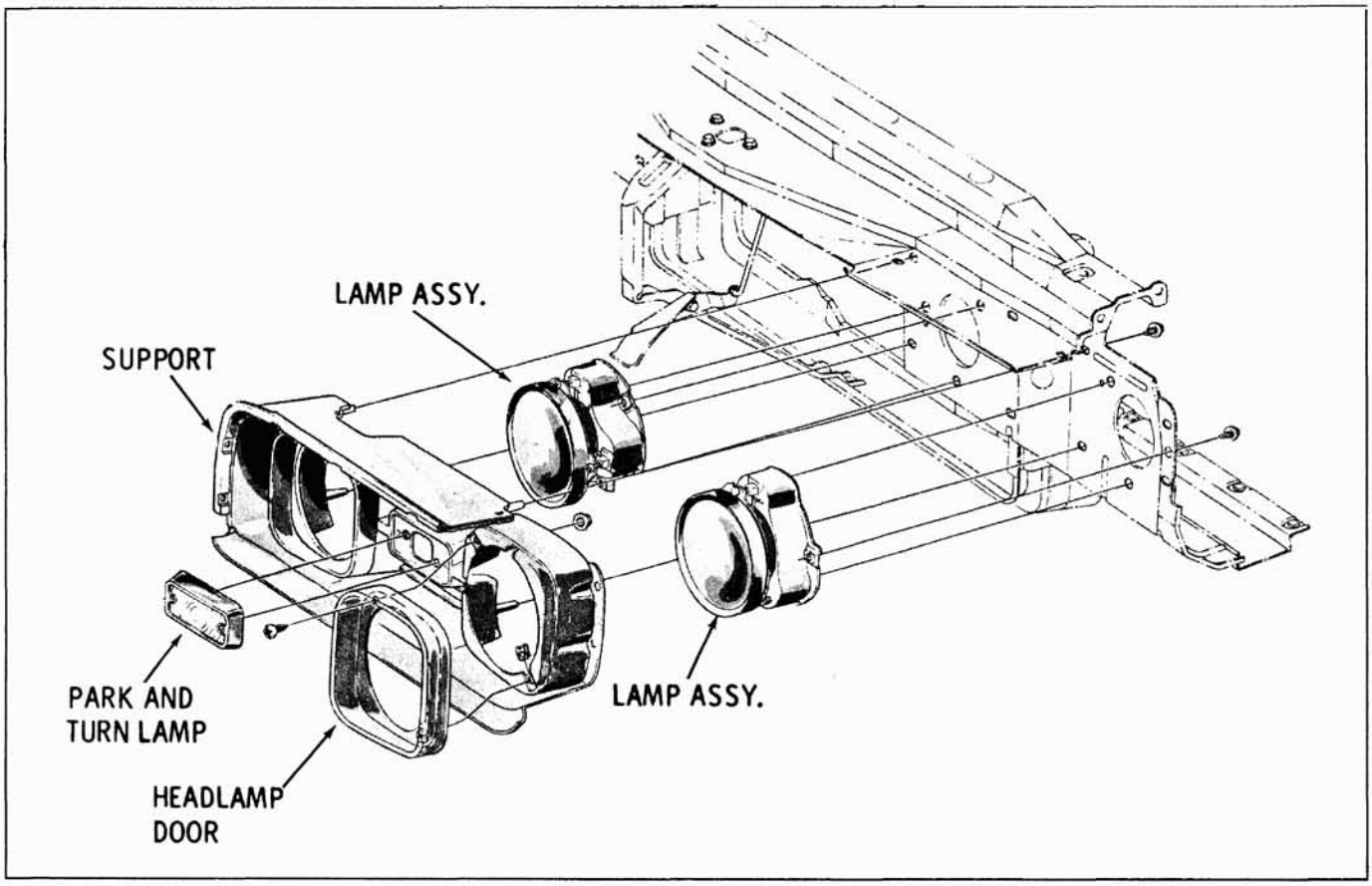


Fig. 11-35—Headlamp Assembly (31-48 Series)

CHASSIS ELECTRICAL, INSTRUMENTS AND WIPERS

31 THROUGH 86 SERIES

CONTENTS OF SECTION 12

Subject	Page
PERIODIC MAINTENANCE	12-1
BATTERY (ENERGIZER)	12-1
DELCOTRON GENERATOR	12-4
DISTRIBUTOR	12-4
WIRING CIRCUIT	12-4
CHARGING CIRCUIT	12-4
DESCRIPTION	12-7
BATTERY (ENERGIZER)	12-8
DELCOTRON GENERATOR	12-8
VOLTAGE REGULATOR	12-10
FIELD RELAY	12-10
WARNING LIGHT	12-10
SERVICE PRECAUTIONS	12-10
CHECKS AND ADJUSTMENTS OF THE CHARGING CIRCUIT	12-11
WARNING LIGHT CIRCUIT AND FIELD RELAY CHECK	12-11
DELCOTRON GENERATOR OUTPUT	12-11
VOLTAGE REGULATOR	12-11
TAILORING THE VOLTAGE SETTING	12-12
SERVICING OF UNITS IN THE CHARGING CIRCUIT	
BATTERY (ENERGIZER)	12-13
REGULATOR	12-14
DELCOTRON GENERATOR	
REMOVAL AND INSTALLATION	12-14
DISASSEMBLY	12-14
CLEANING AND INSPECTION	12-15
DIODE CHECKING	12-16
DIODE REMOVAL	12-17
DIODE INSTALLATION	12-17
ASSEMBLY	12-17
STARTING CIRCUIT	
SERVICING STARTER MOTOR	12-18
IGNITION CIRCUIT	12-24
DISTRIBUTOR V-8	12-25
DISTRIBUTOR L-6	12-28
CAPACITOR DISCHARGE IGNITION SYSTEM	12-31
COIL, STARTING SWITCH AND PLUGS	12-36
DIAGNOSIS	12-38
HORNS	12-40
KEY WARNING BUZZER	12-41
TURN SIGNAL	12-42
DIAGNOSIS	12-42
HAZARD WARNING SYSTEM	12-43
TEMPERATURE INDICATOR	12-43
OIL PRESSURE INDICATOR	12-43
FUEL GAUGE	12-43
HEADLAMPS	12-45
AIMING	12-45
TAIL LAMP	12-45
HEADLAMP SWITCH	12-45
DIMMER SWITCH	12-46
NEUTRAL START AND BACKUP LAMP SWITCH	12-46
BRAKE SWITCH	12-46
DIAGNOSIS	12-46
SPECIFICATIONS	12-47
TOOLS	12-52
INSTRUMENTS (54-86 SERIES)	12A-1
INSTRUMENTS (31-48 SERIES)	12AA-1
WIPERS	12B-1

PERIODIC MAINTENANCE

BATTERY (ENERGIZER)

1. The electrolyte level in the energizer should be checked regularly. In hot weather, particularly during trip driving, checking should be more frequent because of more rapid loss of water. The electrolyte level should reach the bottom of the "split vent" at the bottom of the vent well. DO NOT OVERFILL.

2. The energizer features a Delco Eye, which is a specially designed vent plug with a transparent rod extending through the center. When the electrolyte is at the proper level the lower tip of the rod is immersed, and the exposed top of the rod will appear very dark; when the level falls below the tip of the rod, the top will glow. The Delco Eye is used in only one cell because when the electrolyte level is low in one cell, it is normally low in all cells. If one cell needs water, then all cells should be checked.

To properly clean battery:

a. Make sure vent plugs are installed tight.

b. Remove battery cables from battery.

c. Clean battery and battery cable clamps with a diluted ammonia or soda solution and a brush. When the solution stops foaming, rinse with clear water.

d. Apply a thin coating of petrolatum to terminals and clamps after installing clamps.

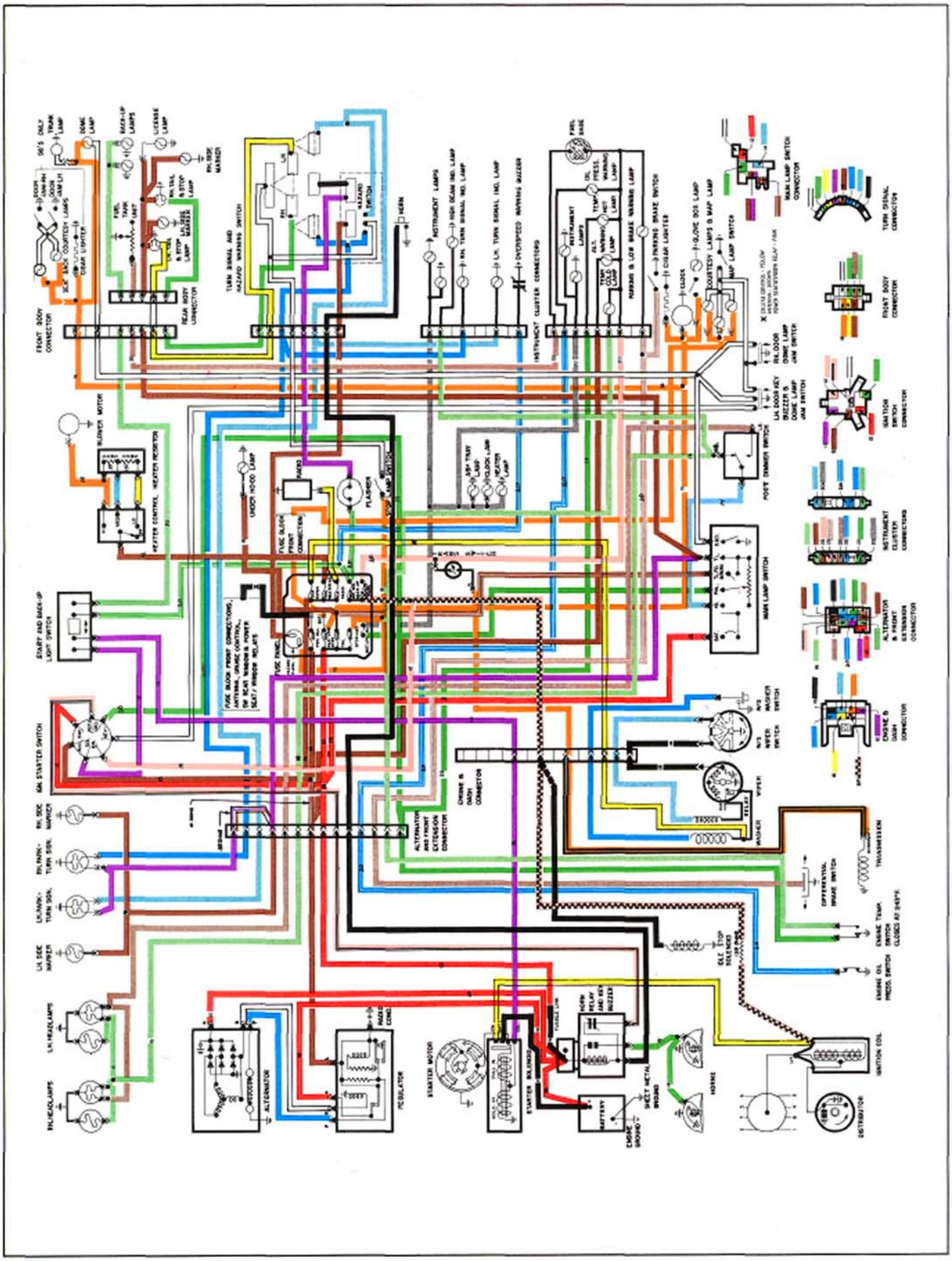


Fig. 12-1—Wiring Diagram (54 through 86)

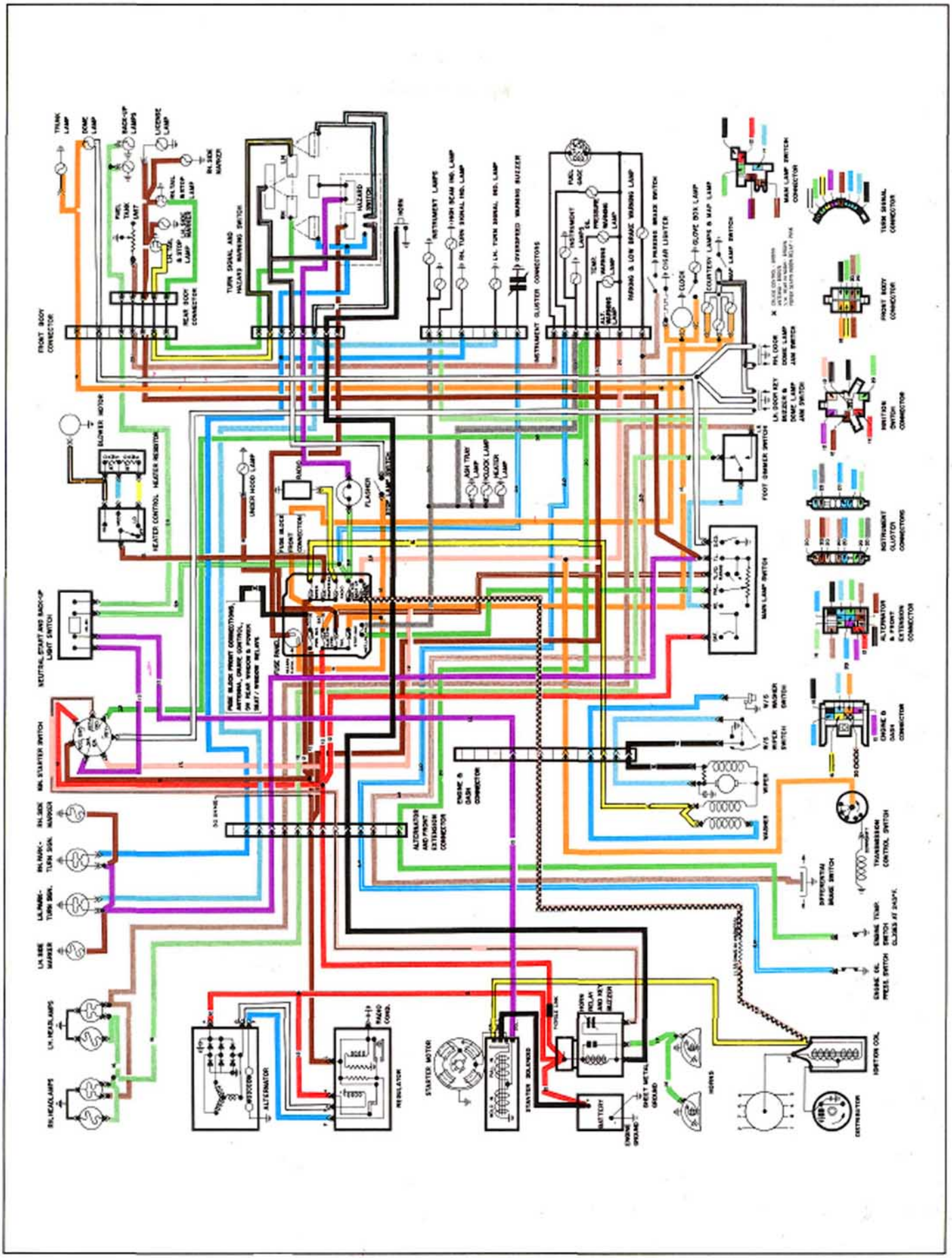


Fig. 12-2—Wiring Diagram (32, 36, 42, 44 and 48 Series)

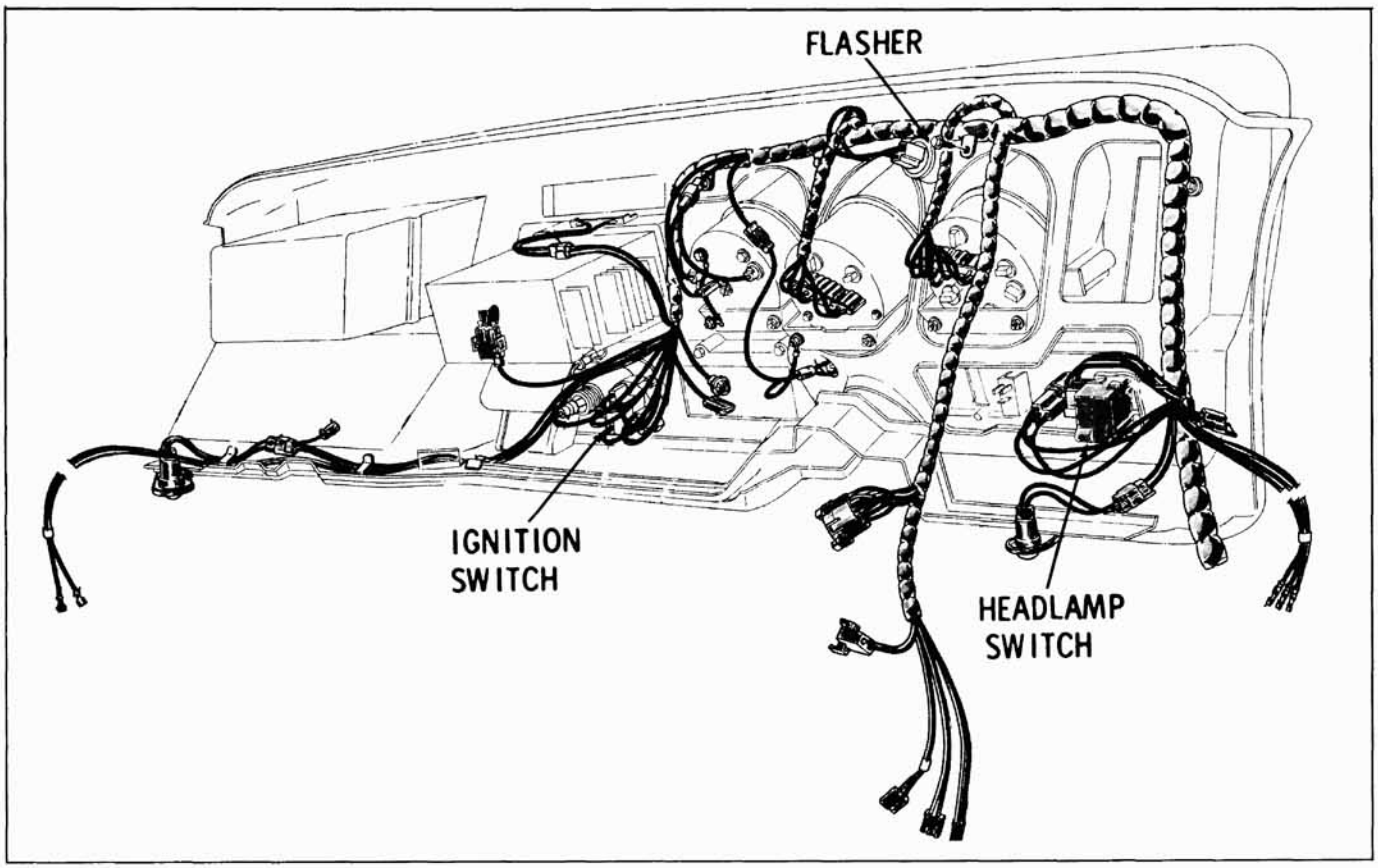


Fig. 12-3—Instrument Panel Wiring (54 through 86)

DELCOTRON GENERATOR

The generator belt tightness should be checked with Tool 33-70M and adjusted if necessary. No periodic lubrication is required on the generator.

DISTRIBUTOR

The distributor requires periodic inspection of the cap, rotor, wiring, contact points and timing.

When replacing the contact point assembly, apply a small amount of ball bearing lubricant or equivalent to the breaker cam. No other lubrication is required.

WIRING CIRCUIT

A combination junction and fuse block is mounted on the cowl under the instrument panel. Each wire from the fuse panel is color coded to simplify servicing.

On 31 through 86 Series the chassis wiring, in the engine compartment, plugs into the rear of the fuse block.

The wiring harness installation under the instrument panel is shown in Figs. 12-3 and 12-5.

The wiring harness installation in the engine compartment is shown in Figs. 12-6 and 12-7.

The fuse block, fuse size and location are shown in Fig. 12-8.

FUSE HOLDER OR CONNECTOR TERMINAL REPLACEMENT

The fuse holders and connector terminals can be removed by compressing the small tangs on both sides of the holder while applying pressure to the holder. A tool to compress the tangs can be made with a cotter pin, or by using a small screwdriver or awl.

FUSIBLE LINK

A fusible link, located in the main chassis wiring harness at the junction block is being used on all series.

The purpose of the fusible link is to protect the main chassis wiring harness in the event a short circuit would occur in an unfused circuit. If a short circuit occurs, the fusible link opens protecting the rest of the circuit. (Fig. 12-9) The circuit can be repaired by splicing a new fusible link into the circuit.

A new fusible link can be installed, after the short circuit is located and repaired, as follows: (Fig. 12-10)

1. Disconnect the negative battery cable.
2. Remove the fusible link from the junction block.
3. If necessary, remove the fusible link connection covering to expose the connector. Cut the wire directly behind the connector.
4. Bare all wires, including the fusible link, approximately 1/2".
5. Position the clip around the wires and crimp so that all wires are securely fastened.
6. Solder the connection using rosin core solder. Use sufficient heat to obtain a good solder joint.
7. Tape all exposed wires with plastic electrical tape to prevent corrosion and shorting.
8. Connect fusible link to junction block.
9. Connect negative battery terminal.

CHARGING CIRCUIT (Fig. 12-12)

The charging circuit consists of the battery, Delcotron generator, regulator and the warning lamp and necessary wiring. Cars without air conditioning are equipped with a 37 and 42 ampere generator. Cars with factory installed air conditioning are equipped with a 55 ampere generator. The generator output is stamped on top of the generator just behind the adjusting lug. (Fig. 12-13)

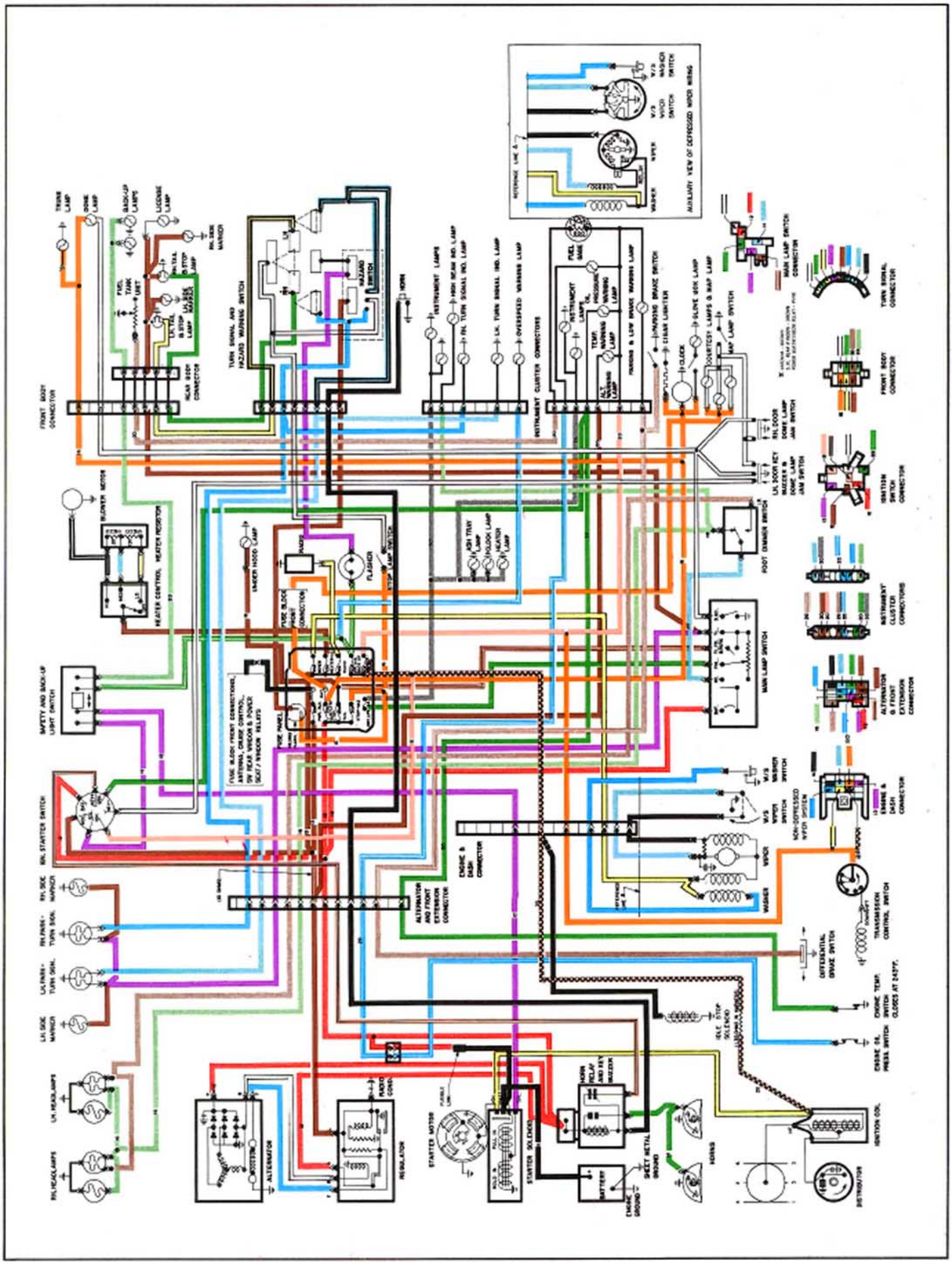


Fig. 12-4—Wiring Diagram (31 and 35 Series) (L-6)

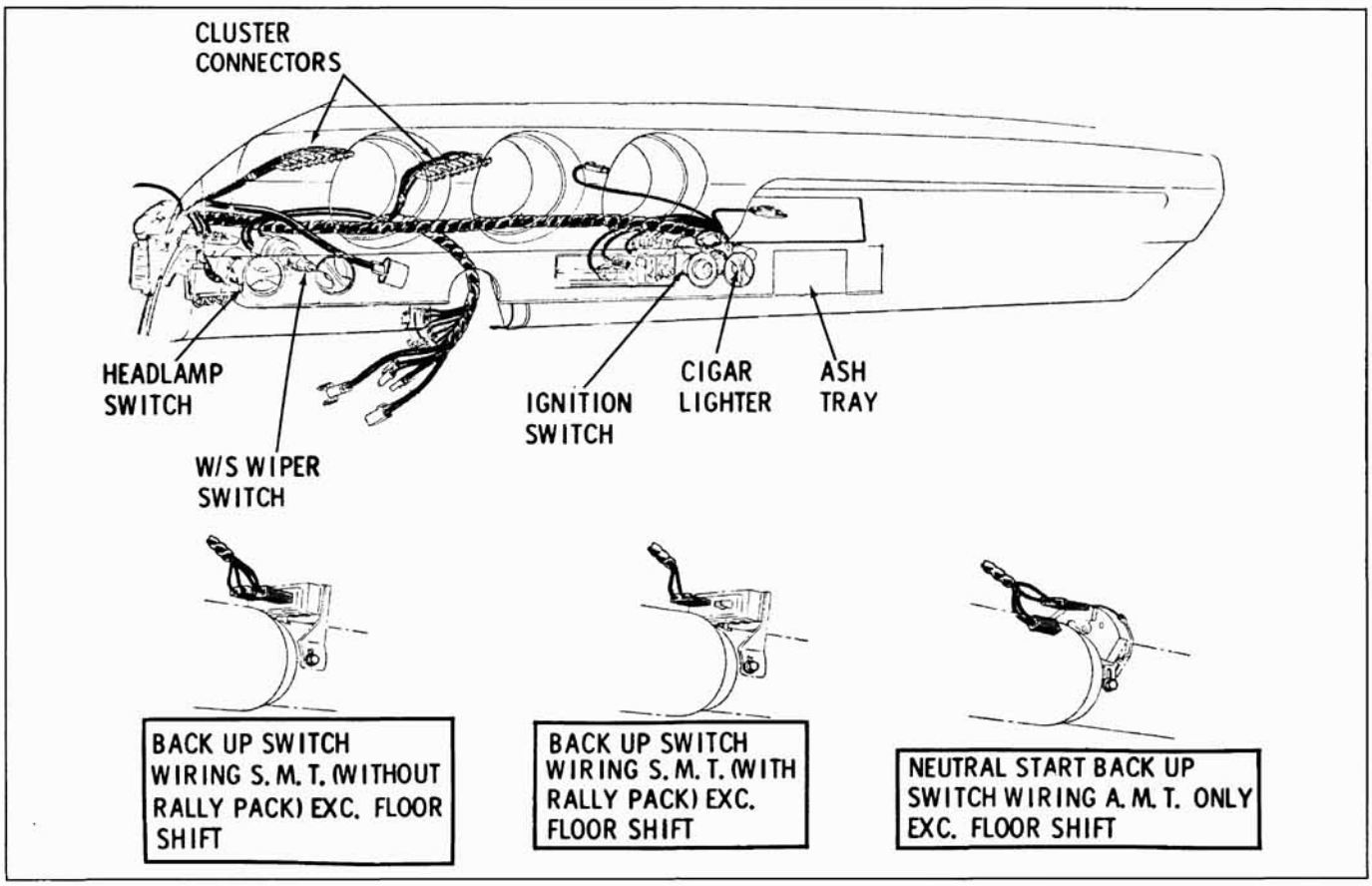


Fig. 12-5—Instrument Panel Wiring (31 through 48)

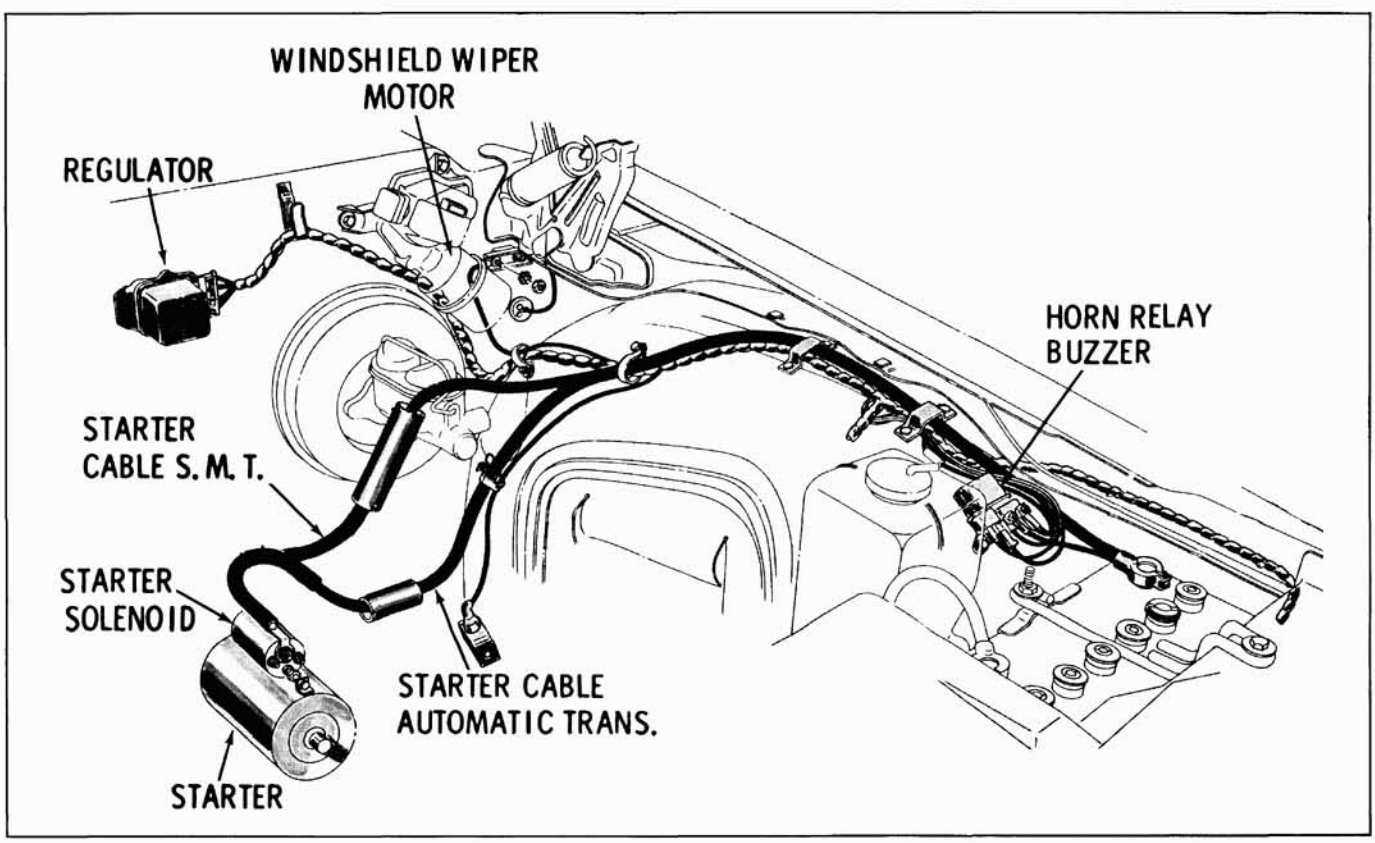


Fig. 12-6—Chassis Wiring Harness (54 through 86)

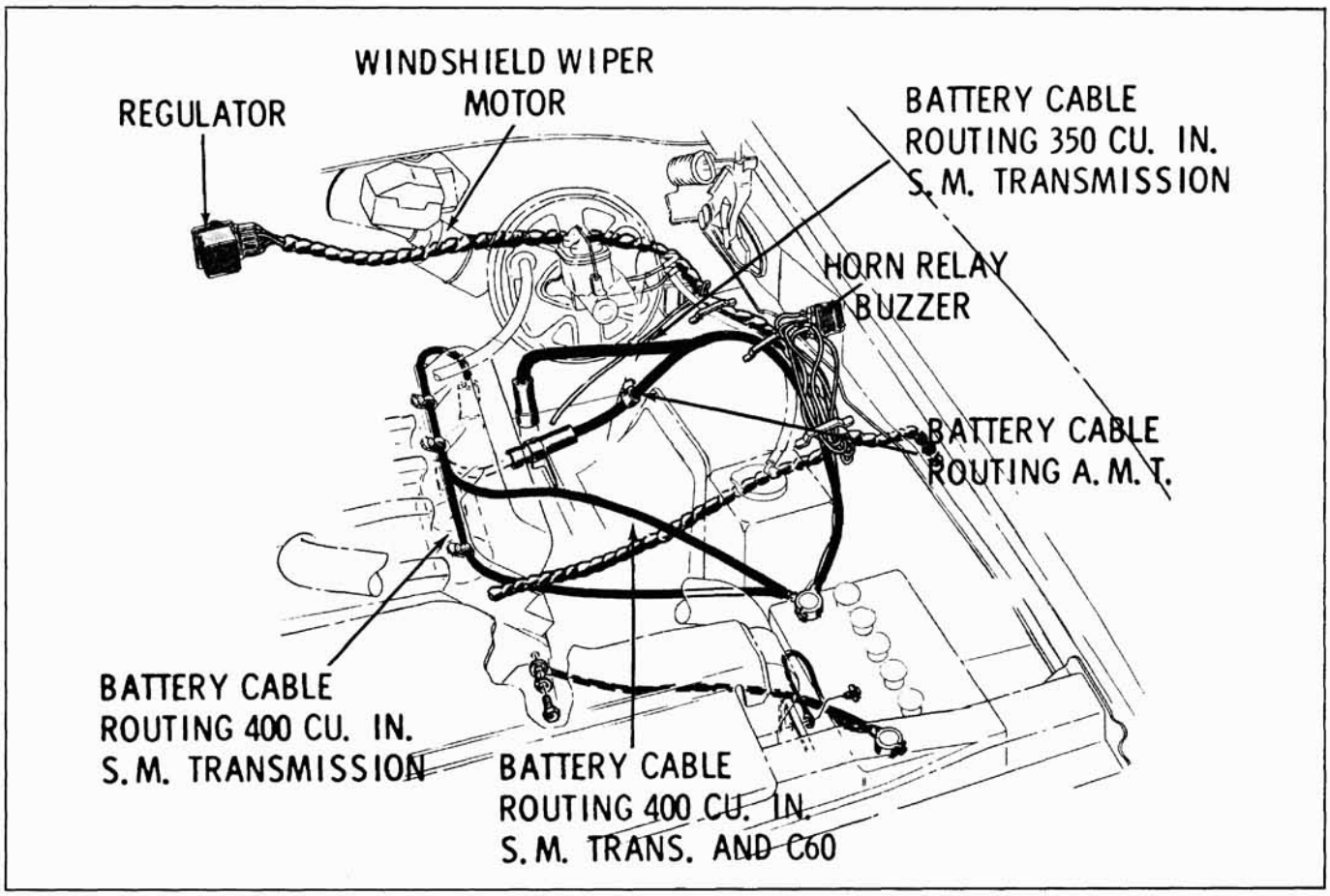


Fig. 12-7—Chassis Wiring Harness (32, 36, 42, 44 and 48)

DESCRIPTION

With the ignition switch on, before the engine has started, the indicator lamp lights to indicate the generator is not charging. Current flows from the battery to the BAT terminal on the switch, through the indicator lamp and resistor, which is in parallel, and then through the voltage regulator contacts. It continues to flow through the generator field winding to ground, completing the circuit. Current through this circuit energizes the field windings sufficiently to insure voltage buildup in the stator windings when the engine starts. The voltage generated in the stator windings are then changed or rectified by the six generator diodes to a DC voltage which appears at the BAT or output terminal on the generator. The resistor, in parallel with indicator lamp, allows more current to flow through the field winding to insure voltage build-up in the stator windings.

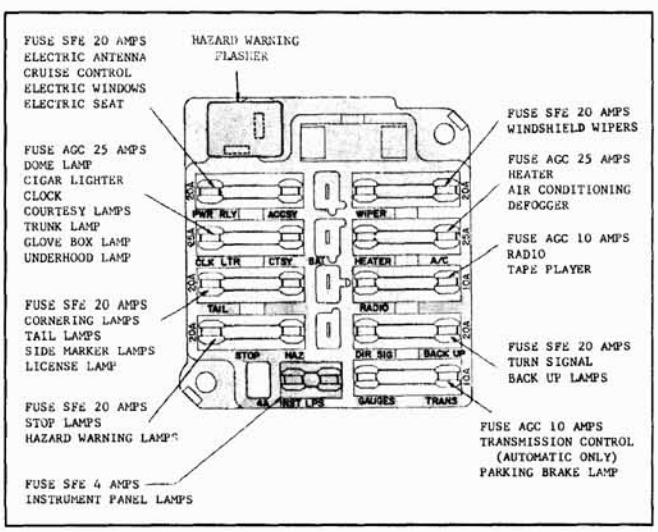


Fig. 12-8—Fuse Block (31 through 86 Series)

As the generator begins to operate, voltage from the "R" terminal is impressed through the regulator No. 2 terminal across the field relay winding, causing the relay contacts to close. This connects the regulator No. 4 terminal directly to the battery through the field relay contacts, causing the indicator lamp to go out. Generator field current then flows from the battery to the regulator No. 3 terminal and then through the field relay contacts and voltage regulator lower or series contacts to the field winding.

As the speed of the generator increases, the voltage at the BAT terminal of the generator also increases. This impresses a higher voltage through the field relay contacts and across the voltage regulator shunt winding. The increased magnetism, created by this higher voltage across the winding, causes the lower or series contacts of the voltage regulator to separate. Field current then flows through a resistor which reduces the field current. This reduced field current causes the generator voltage to decrease; thereby decreasing the magnetic pull of the voltage regulator shunt winding. Consequently the spring causes the contacts to reclose. This cycle repeats many times per second to limit the generator voltage to a pre-set value.

As the generator speed increases even further, the resistor, connected across the contacts, is not of sufficient high value to maintain voltage control on the contacts. Therefore, the voltage increases slightly causing the upper or "shorting" con-

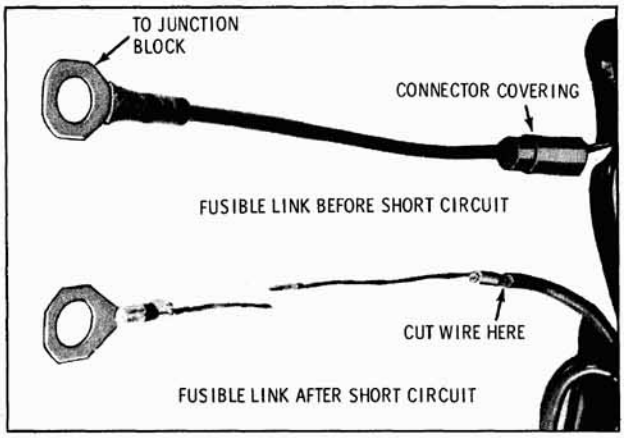


Fig. 12-9—Fusible Link

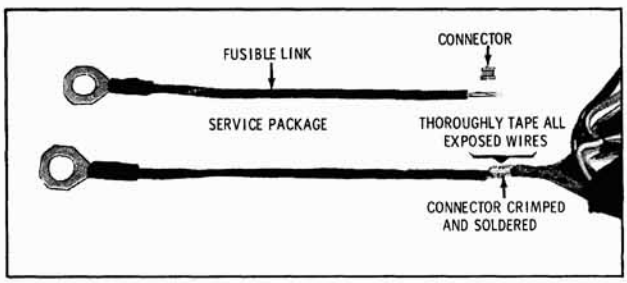


Fig. 12-10—Fusible Link

tacts to close. When this happens, the generator field winding is shorted and no current passes through the winding. With no current in the field winding, the generator voltage decreases which also decreases the magnetism in the shunt winding and the upper contact points open. With these points open, field current flows through the resistor and the field winding. As the voltage increases, the contacts reclose. This cycle then repeats many times per second to limit the generator voltage to a pre-set value at high generator speeds. The voltage regulator unit thus operates to limit the value of generator voltage throughout the rpm range. Consequently the electrical accessories are protected from excessive voltage which would cause damage. This also prevents over charging of the battery.

BATTERY

For battery usage, refer to the BATTERY CHART.

BATTERY CHART

Series	Engine	Amp. Hr.	Plates	Watts
31 and 35	L-6	45	54	2,300
32, 36, 42 48 and 54	V8	61	66	2,900
44 and 48 (400 Cu. In.)	V8	70	66	3,150
54-66	V8	73	78	3,350
54-86	V8 4 Bbl. H.C.	75	90	3,600

DELCOTRON GENERATOR

The generator consists of a rotor, a stator, two brushes and slip rings and six diode rectifiers. (Fig. 12-13)

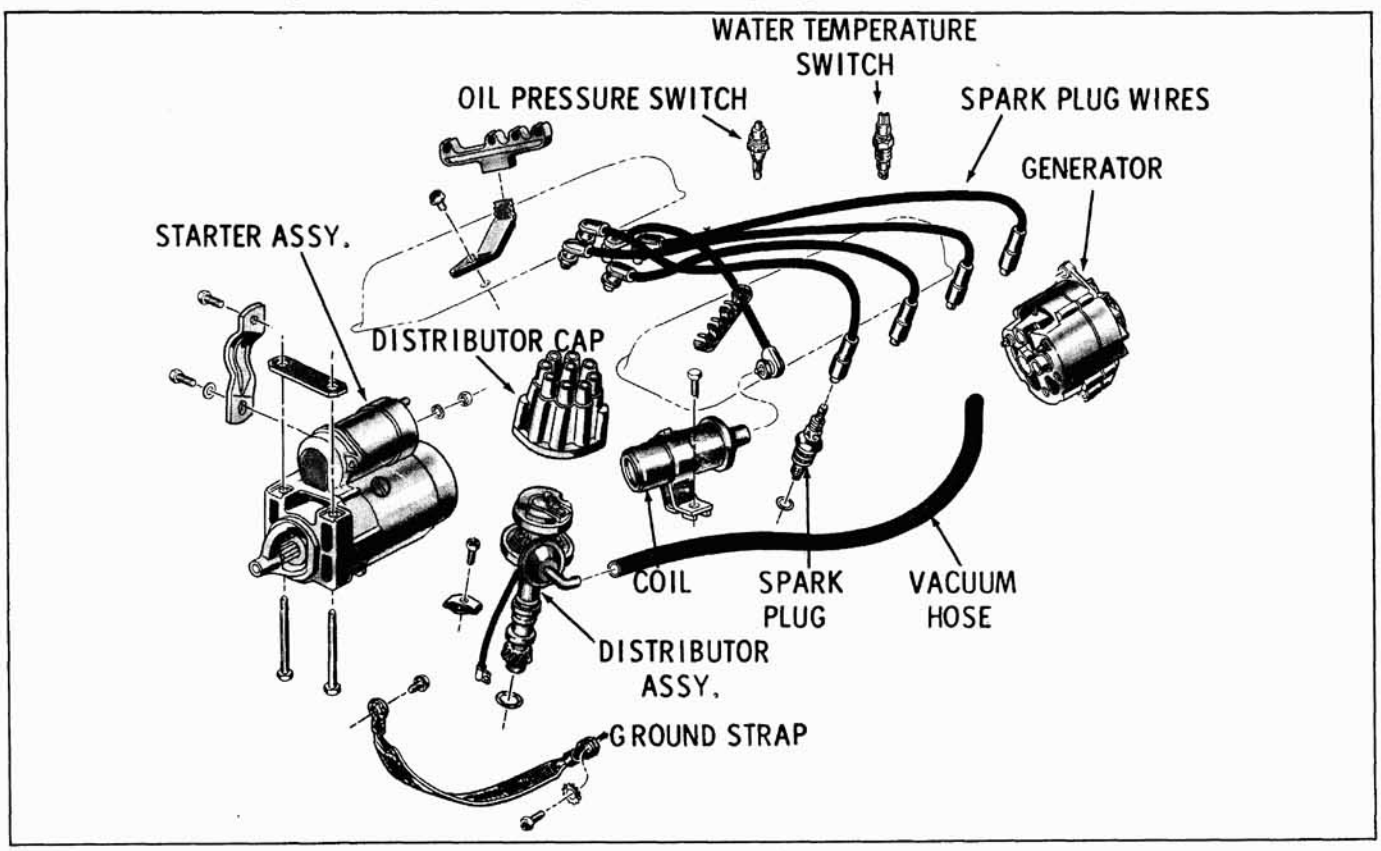


Fig. 12-11—Engine Electrical

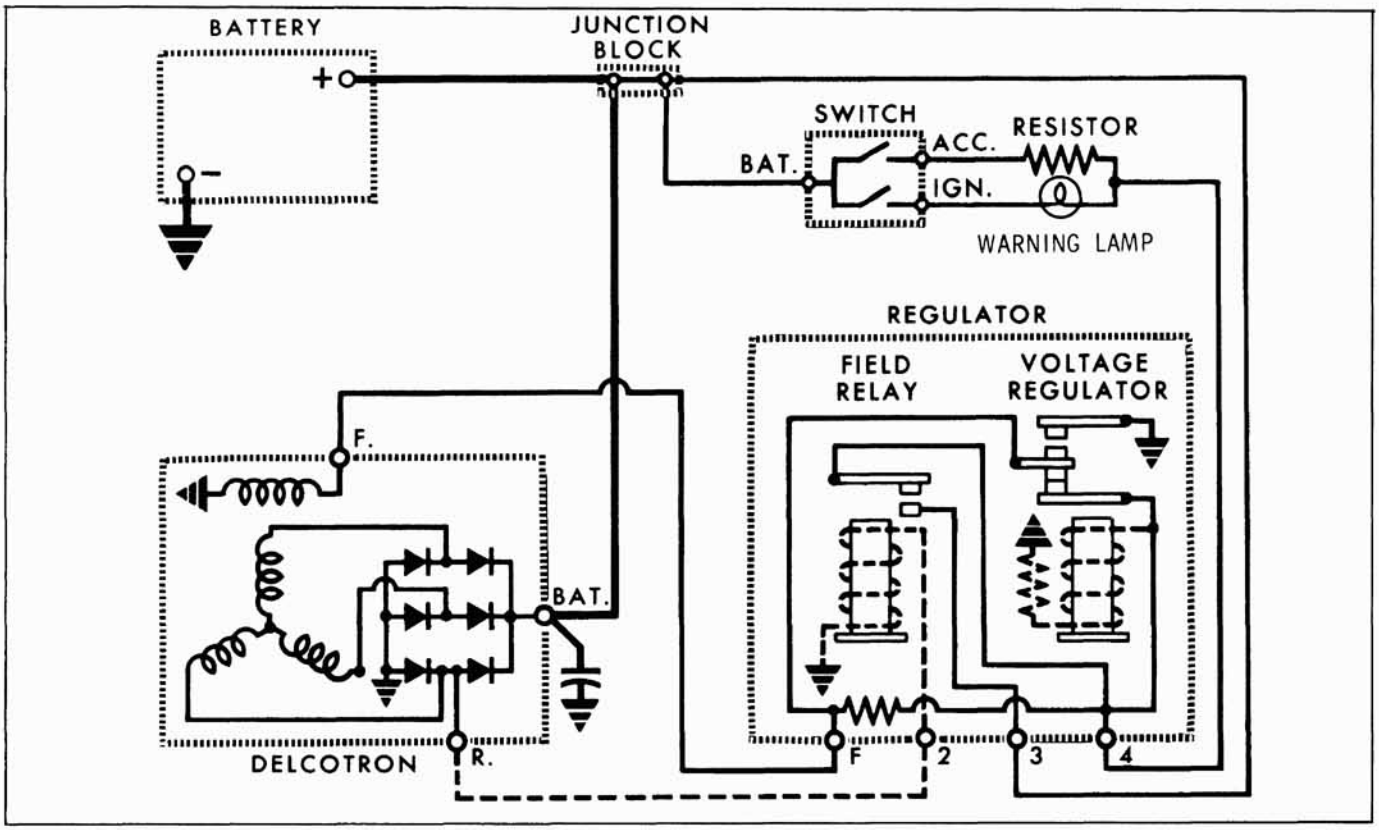


Fig. 12-12—Charging Circuit

The brushes and slip rings allow battery current to flow through the rotor creating a magnetic field. The stator consists of three sets of windings, each set containing seven coils, alternately spaced around the stator ring. The magnetic field produced by the rotor induces an AC voltage in the stator windings. This AC voltage is then directed to diode rectifiers.

A diode rectifier is an electrical device which resists current flow in one direction but allows it to flow in the other. Six diode rectifiers are used in the generator. Three of the diode

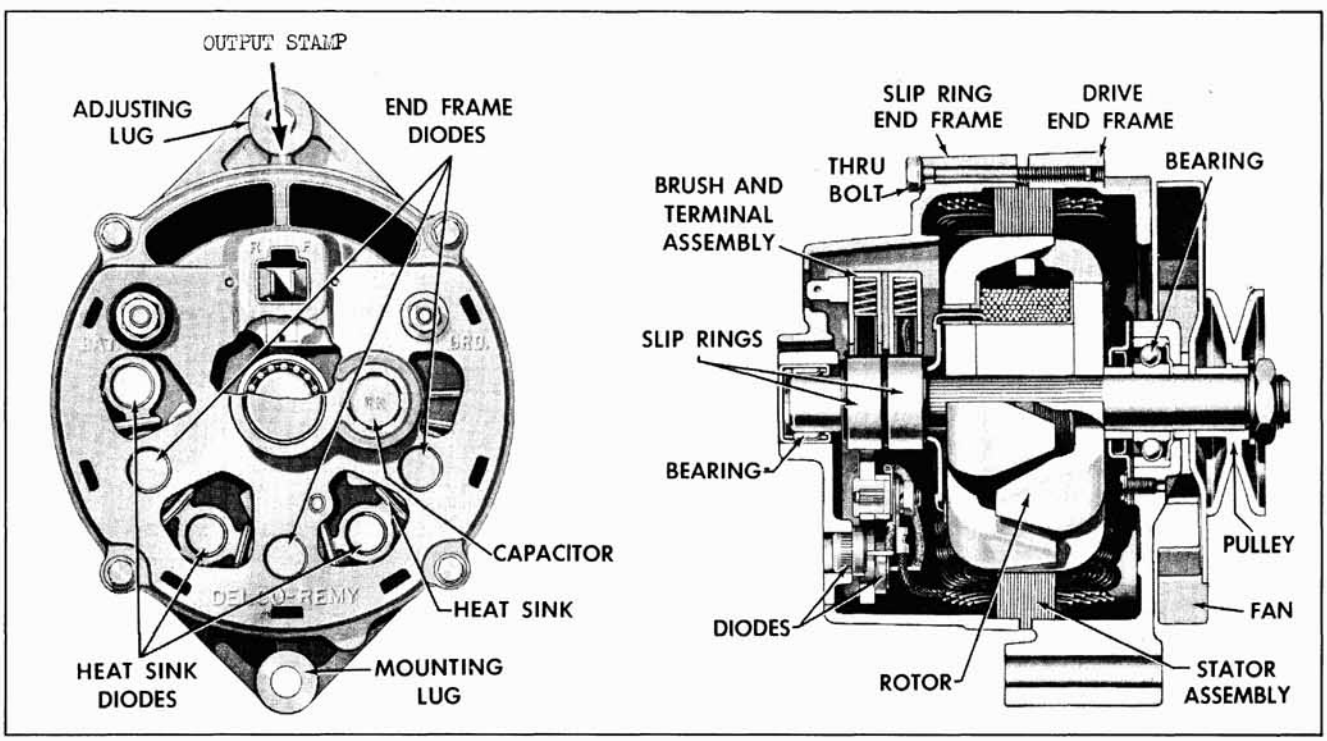


Fig. 12-13—Delcotron Generator

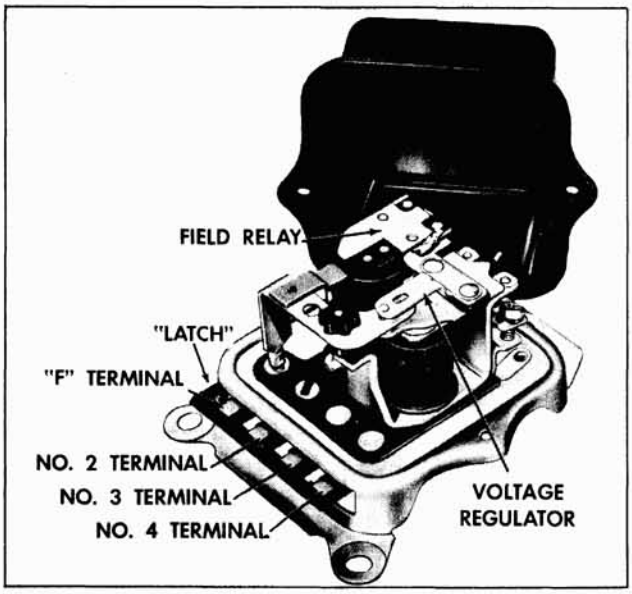


Fig. 12-14—Voltage Regulator

rectifiers are positive and three are negative and are arranged so that the AC voltage produced by the generator is changed to a DC voltage. This DC voltage is used to charge the battery and operate electrical accessories.

REGULATOR

The regulator contains a voltage regulator and a field relay. (Fig. 12-14) A current regulator is not required because the generator is capable of self-regulating the current at a given speed and voltage. A cut-out relay is not required because the action of the diode rectifiers prevent battery voltage from discharging through the generator.

Voltage Regulator

The voltage regulator limits the voltage of the electrical system to a specified maximum. The contacts of the voltage regulator oscillate at a high speed, opening and closing the points. This action intermittently introduces resistance into the field circuit, thereby reducing voltage.

The voltage regulator has a double set of contacts to regulate voltage. The lower set of contacts limits voltage at low generator rpm. Vibration of the lower contacts intermittently inserts a resistance in the field circuit. This resistance is satisfactory at low rpm; however, when the rpm is increased the lower set of points can no longer control the voltage and the upper contacts close. A vibrating action takes place on the upper set of contacts which intermittently grounds the field to control voltage to a safe value.

When the ignition switch is closed, before the engine has started, the indicator lamp lights to indicate the generator is not charging. The current flow can be traced from the battery to the "BAT" terminal on the switch, through the indicator lamp and resistor which is in parallel, and then through the voltage regulator contacts. From here it continues to flow on through the generator field winding to ground, completing the circuit back to the battery. Current through this circuit energizes the field windings sufficiently to insure voltage build-up in the stator windings when the engine starts. The voltage generated in the stator windings are then changed or rectified by the six generator diodes to a DC voltage which appears at the "BAT" or output terminal on the generator. The resistor allows more current to flow through the field winding to insure voltage build-up in the stator windings.

Field Relay

The field relay acts as an "on-off" switch between the field winding and the battery.

As the generator begins to operate, voltage from the "R" or relay terminal is impressed through the regulator No. 2 terminal across the field relay winding, causing the relay contacts to close. This connects the regulator No. 4 terminal directly to the battery through the field relay contacts, causing the indicator lamp to go out. Generator field current then flows from the battery to the regulator No. 3 terminal, and then through the field relay contacts and voltage regulator lower or series contacts to the field winding.

WARNING LIGHT

The red warning light located in the instrument panel should light when the ignition key is turned on and the engine is not running. When the engine is started, the light will go out indicating that the generator is operating. If the light remains on with the ignition key in the OFF position, it indicates a shorted positive diode in the generator, or a short in the regulator wiring.

The warning light will light dimly with the ignition key in the ACCESSORY position, with the radio or other accessory operating. This condition is normal.

SERVICE PRECAUTIONS

The following precautions must be observed when servicing the charging circuit to prevent serious damage to the electrical equipment:

1. When installing a battery, using jumper cables, a booster battery or connecting a charger, the negative terminals of the battery or charger must be connected to the ground side of the system and the positive terminals of the battery or charger, to the positive side of the system. Failure to observe polarity will result in the battery being directly shorted through the diodes and could result in a burned wiring harness or damaged diodes.
2. Never operate the generator with any of the wires or connectors disconnected or loose. Operating the generator with disconnected or loose connections could result in development of extremely high voltages.
3. Do not short across or ground any of the terminals on the generator or regulator as damage to these units could result.
4. Do not attempt to polarize the generator or regulator as these units could be damaged. Polarization is not required with this type of charging circuit.
5. When removing the generator from the car or working in the engine compartment near the generator, always disconnect the battery negative cable first; as the red wire connected to the BAT terminal on the generator is connected to battery voltage.

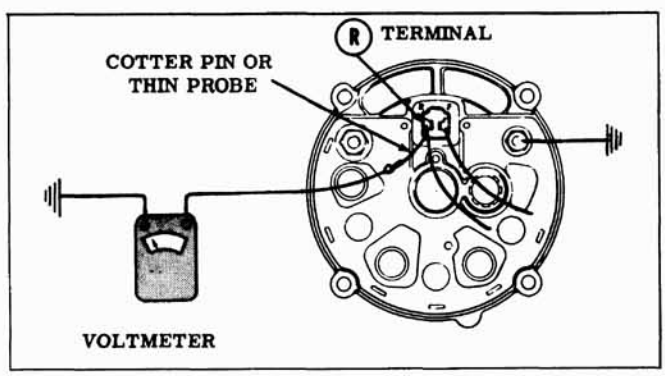


Fig. 12-15—Field Relay Check

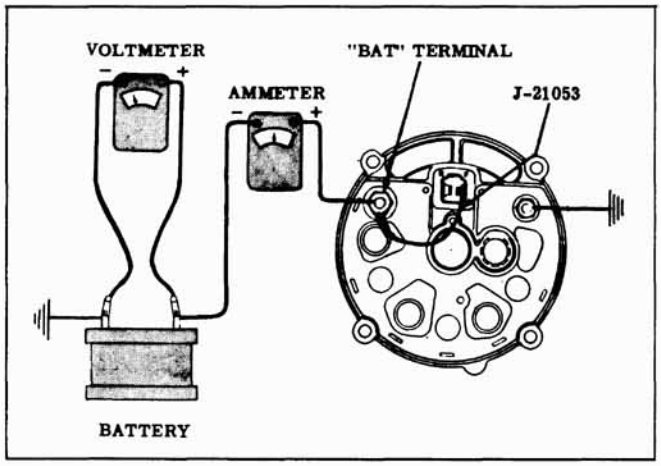


Fig. 12-16—Checking Generator Output

CHECKS AND ADJUSTMENTS OF THE CHARGING CIRCUIT

Trouble in the charging circuit will usually show up as faulty warning light operation or by an undercharged or overcharged battery. Before attempting any checks and adjustments, be sure that all wiring connections are clean and tight and that the battery is in satisfactory condition.

WARNING LIGHT CIRCUIT AND FIELD RELAY CHECK (Fig. 12-15)

If the warning light fails to light when the ignition switch is turned on, engine not running, check for a burned out bulb or fuse. If the light stays on with the ignition switch off, check for a shorted positive diode in the generator, or shorts between lead 2, 3 and 4 at regulator.

If the warning light fails to go out with the generator in operation, the trouble is in either the field relay or the generator. Check the field relay first as follows:

1. Connect a voltmeter from No. 2 terminal of regulator to ground.
2. Operate engine slightly above idle speed.
3. If voltmeter reads 5 volts or above and the indicator lamp fails to go out, replace regulator.
4. If reading is below 5 volts, connect voltmeter from generator "R" terminal to ground.
5. If reading now is 5 volts or above, lead between generator "R" terminal and regulator No. 2 terminal is defective.
6. If reading is still below 5 volts, proceed to "Generator Output Check".
7. Shut off engine.

GENERATOR OUTPUT CHECK (Fig. 12-16)

1. Disconnect battery ground strap.
2. Connect an ammeter in the circuit at the "BAT" terminal of the generator and a voltmeter from the "BAT" terminal to ground.
3. Remove the "F" and "R" terminal connector from the generator.
4. Install the test adapter. Connect J-21053 to the "F" terminal of the generator. Attach the alligator clip to the "BAT" terminal.
5. Connect the negative battery cable. Load the battery with a carbon pile rheostat or by turning on the lights and accessories to prevent excessive voltage.
6. Operate engine at 1500-2500 rpm as required to obtain maximum current output.

Variations in engine rpm are necessitated by differences in pulley ratio. Do not allow the output voltage to exceed 16 volts.

7. If ampere output is within 10 amperes of rated output as stamped on generator frame (Fig. 12-13), generator is good. Otherwise it will be necessary to disassemble and test the components within the generator.
8. Stop engine and disconnect battery.
9. Disconnect the test adapter, ammeter and voltmeter.
10. Install the connector on the "F" and "R" terminals and the red wire to the "BAT" terminal of the generator.
11. Install the battery cable.

Voltage Regulator

The only adjustment to be performed on the double contact voltage regulator, is the voltage setting.

VOLTAGE REGULATOR DIAGNOSIS (COVER REMOVED)

When a diagnosis of a charging circuit defect indicates that a new voltage regulator must be installed, the defective regulator should be inspected to determine the cause of failure.

If any of the following conditions are found, they must be corrected to prevent damaging the new regulator: (Fig. 12-12)

CONDITION	POSSIBLE CAUSES
Burned Field Relay Blade--This condition is caused by abnormally high current through the relay blade. This high current is the result of a ground on the field side of the relay contacts.	a. The Delcotron generator is charging and a ground occurs in the system between the F terminal of the generator and the F terminal of the regulator. b. Shorted regulator radio capacitor. c. Removing the regulator cover while the regulator is in operation and the cover touches the regulator component parts.
Burned or Welded Voltage Regulator Points--This condition can only occur if there is abnormally high current across the Voltage Regulator lower contacts.	a. An intermittent ground occurring between the F terminal of the Delcotron generator and the F terminal of the regulator. b. Shorted generator rotor. c. Removing the regulator cover as previously outlined.
Damaged or Burned Shorting Lead from Upper Contact to Ground--This condition is caused by abnormally high current through the shorting contacts. This is the result of direct battery voltage through the system between the F terminal of the Delcotron generator and the F terminal of the regulator.	a. A short occurring between the F terminal and the #3 terminal of the regulator due to a short in the harness. b. Wiring between F terminal of Delcotron and the F terminal of the regulator coming in contact with any other leads that are at battery potential.
Burned Field Relay Coil--This condition is caused by operating the Delcotron generator with an open circuit. This causes excess current at the #2 terminal of the regulator.	a. Loose connections at the battery terminal of generator or where the lead from the #3 terminal connects to the junction block.

Voltage Setting

Disconnect the wiring harness connector from regulator when removing or installing regulator cover.

Before making any voltage adjustments, position a mercury type glass thermometer within 1/4" of the regulator cover. This measures the surrounding temperature of the regulator. After the temperature is known, the voltage settings can be made in relation to the temperature.

1. Check battery and charge, if necessary, as the voltage setting must be made with a fully charged battery, to limit the Delcotron output to 10 amperes or less. Correct voltage settings cannot be made if the Delcotron output is greater than 10 amperes.

If the battery is suspected of being defective, a 421 test should be performed to determine the condition of the battery.

AMBIENT TEMPERATURE	VOLTAGE SETTING
65	13.9 to 15.0
85	13.8 to 14.8
105	13.7 to 14.6
125	13.5 to 14.4
145	13.4 to 14.2
165	13.2 to 14.0
185	13.1 to 13.9
205	13.0 to 13.8

Fig. 12-17—Temperature Voltage Chart

2. Connect a voltmeter across the battery terminals.
3. Position the bulb of a glass mercury type thermometer, such as J-5421, within 1/4" of the regulator cover.
4. Start the engine and run for 15 minutes at approximately 1200 rpm. Leave the cover on the regulator to establish operating temperature. All accessories and lights must be turned off.
5. After the 15-minute warm-up, cycle the generator by shutting off the engine and restarting.

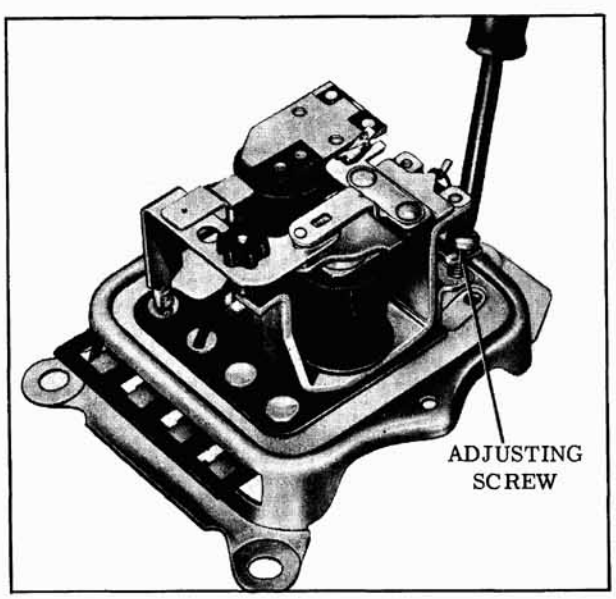


Fig. 12-18—Adjusting Voltage Setting

6. Raise engine speed to 2200 rpm. The regulator should be operating on the upper contacts. Note the voltage reading on the voltmeter. The voltage reading should be within the voltage specifications as indicated by the temperature voltage chart. (Fig. 12-17)
7. If the voltage does not fall within the normal specification range, remove the regulator cover. The voltage can be adjusted by turning the adjusting screw. (Fig. 12-18)

Always make final setting by turning the screw clockwise. This insures that the spring holder will be against the head of the screw. If it is necessary to turn the screw head counterclockwise, turn it until the screw head is approximately 1/8" above the adjusting bracket, then pry holder up against screw head, then turn screw clockwise to make setting.

8. Cycle the generator and recheck voltage reading. Readjust if necessary.

When checking voltage, regulator cover should be in place.

9. Turn on the lights and accessories to operate the voltage regulator on the lower set of contact points. Run the engine at 2200 rpm and note the voltage reading. The voltage should be .1 to .4 volts lower than the reading obtained in Step 8.
10. If necessary to adjust, turn the nylon nut counterclockwise to increase the difference and clockwise to decrease the difference between the upper and lower points. After making the adjustments, it is necessary to recheck the voltage setting on both upper and lower contact points.
11. Install the regulator cover and remove the voltmeter. Avoid contact with the regulator units when installing the regulator cover.

TAILORING THE VOLTAGE SETTING

The voltage setting for one type of operating condition may not be satisfactory for a different type of operating condition. Vehicle underhood temperatures, operating speeds, and the amount of night-time driving are factors which determine the proper voltage setting. The proper voltage setting is attained when the battery remains fully charged with a minimum use of water.

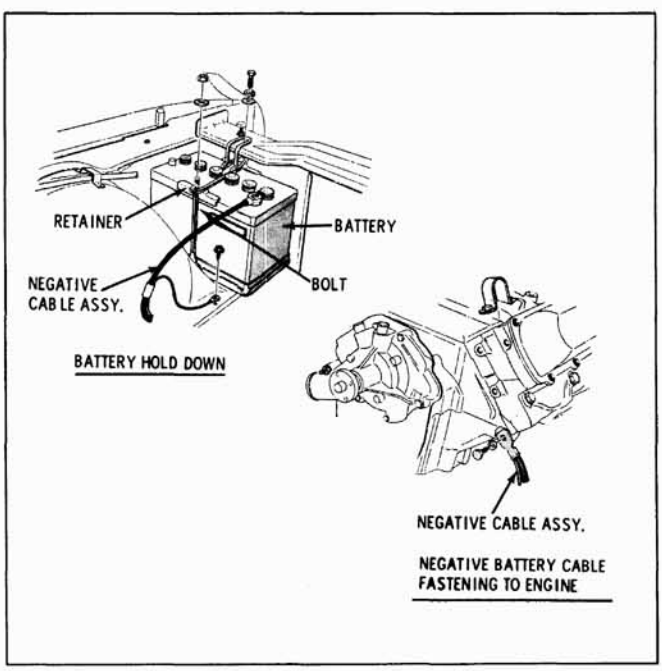


Fig. 12-19—Battery Installation (54 through 86 Series)

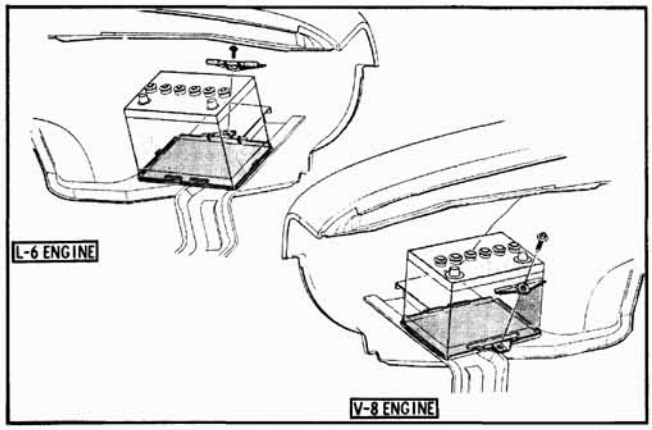


Fig. 12-20—Battery Installation (31 through 48 Series)

If no circuit defects are found, yet the battery remains undercharged, raise the voltage setting by .3 volt, and then check for an improved battery state-of-charge.

BATTERY

421 TEST PROCEDURE

1. Visual inspection.
   a. Check for broken or cracked case or cover.
   b. Check for loose terminal posts.
   c. Check for defective or mutilated sealing compound.
   d. Check for other visible signs of physical damage.
2. a. Energizers or batteries should NOT be charged prior to making this test. Defects within the unit can be hidden by the charging.

   b. Erratic or extremely low initial meter readings may indicate poor connections at the tester terminals. Obtain clean and tight connections before performing the 421 Test.

   c. All meter readings should be made immediately after the meter indicator light comes "on" even if the meter needle is still moving.

   d. If additional discharges are required after the initial discharge, set meter indicator following the last discharge cycle.
3. a. Batteries designated as "bad" by the tester should be replaced except as noted.

   A battery in a car that has been in inactive storage may have become discharged due to the time of inactivity. This battery cannot be tested by any method because it will have no load capability and must be recharged using slow charge method.

   The slow charge method consists of charging at approximately a 4 ampere rate for 24 hours or more if necessary to bring the energizer to full charge. A fully charged condition is reached when the cells are gassing freely and three corrected specific gravity readings taken at hourly intervals shown no increase.

   b. Batteries designated as "good" with no complaint or indication of poor performance should be left in service. Posts, cable clamps and top should be cleaned, water added and recharging performed if required. For reliable battery service, the battery should be in at least a 75% state of charge.

   c. Batteries designated as "good" that are suspected of being questionable because of complaint or age of the battery should be further tested by the Hydrometer Test.

HYDROMETER TESTING

A hydrometer test will indicate the state of charge of a battery unless water has recently been added to the battery or the battery has been recently fast charged. A good hydrometer reading does not necessarily indicate that the battery will perform its normal functions.

A battery with a corrected specific gravity reading of 1.215 is half charged. A battery with a specific gravity reading of 1.270 ±.010 at 80°F. is fully charged.

The specific gravity of the electrolyte, as measured by the hydrometer, must be "corrected for temperature" for a true specific gravity reading. The thermometer is used to measure the temperature of the electrolyte in the center cell of the battery. Based on this temperature reading, the specific gravity reading of each cell is "corrected" by adding .004 points for each 10°F. above 80°F. or subtracting .004 points for each 10°F. below 80°F.

Examples

A. Hydrometer gravity reading 1.235
   Electrolyte temperature 110°F.
   Correction (4 x 3) ..... +.012
   Corrected gravity reading 1.247

B. Hydrometer gravity reading 1.250
   Electrolyte temperature 0°F.
   Correction (4 x 8) ..... -.032
   Corrected gravity reading 1.218

HYDROMETER TEST PROCEDURE

1. Visually inspect the battery for a broken or cracked case, broken or cracked cover, bad odors, leaks around damaged terminal posts, etc. If severe damage is found, replace the battery.
2. Measure the specific gravity of each cell in the battery and the temperature of one of the center cells. Interpret readings as shown in chart below.

   (A) Fully charge and re-test those batteries which pass the specific gravity test but fail to perform satisfactorily.

   If the electrolyte is too low to be checked by a hydrometer, adjust electrolyte to the proper level by adding colorless, odorless, drinking water. After water addition, the specific gravity check cannot be made until the battery is charged at a rate high enough to cause vigorous gassing for a period of 15 minutes or more. This insures that added water is mixed with the electrolyte before a specific gravity reading is taken.

Specific Gravity Difference Between Highest and Lowest Cells	Specific Gravity of Lowest Cell (Temp. Corrected)	Interpretation
Less than 50 points	More than 1.200	Good battery - Satisfactorily charged
Less than 50 points	Less than 1.200	Good battery - Requires charging
More than 50 points	--	Defective battery - Replace

SLOW CHARGING

Batteries removed from the car for charging should be charged continuously at a low rate. Batteries may be safely low-charged at a rate in amperes equal to 7% of the battery"s ampere-hour capacity or 4 amps if ampere-hour rate is not shown. This is called the "Normal" charge rate.

Although the slow-charge method is recommended for charging all batteries, discharged batteries in otherwise good condition, may be given a "boost" with a fast charger if time does not permit complete slow-charging. When using a fast charger, it must be remembered that the battery is only receiving a partial charge and that the battery electrolyte temperature must not be allowed to exceed 125°F. If the battery heats excessively, quick charging must be discontinued.

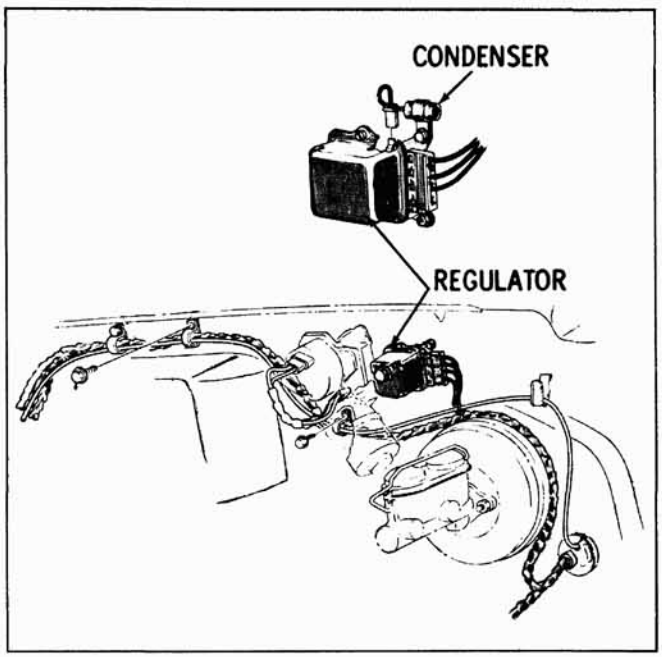


Fig. 12-21—Regulator Installation

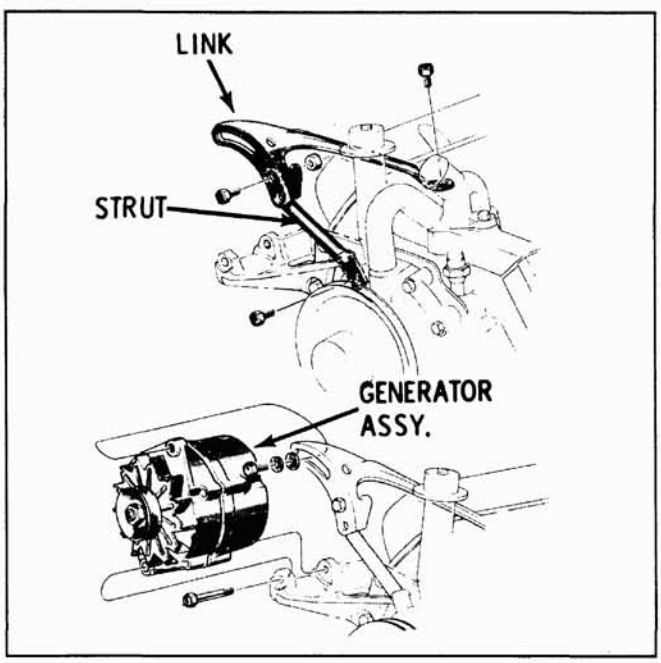


Fig. 12-22—Generator Installation (V-8 Engine)

REGULATOR (Fig 12-21)

Removal and Installation

1. Disconnect electrical connector from regulator by lifting the connector retainer.
2. Remove the regulator attaching screws and remove regulator. To install, reverse the removal procedure. DO NOT ATTEMPT TO POLARIZE THE DELCOTRON GENERATOR.

GENERATOR

Removal and Installation

The generator is attached as shown in Figs. 12-22 and 12-23. Before removing the generator, disconnect the battery negative cable.

After installing the generator, tighten the belt using Tool 33-70M.

Disassembly (Fig. 12-24)

1. Scribe alignment marks on the end frames, then remove the four through-bolts.
2. Separate the drive end-frame and rotor assembly from the stator assembly by prying at the stator slot.
3. Position the rotor in a vise and tighten only enough to permit loosening of the shaft nut. Avoid excessive tightening to prevent distortion of the rotor. Tool BT-6317 will easily remove the pulley nut without clamping the rotor in a vise.
4. Remove the shaft nut, wave washer, pulley, fan and collar. Separate the drive end-frame and spacer from the rotor shaft.
5. If necessary to remove the bearing from the drive end-frame, proceed as follows:
   a. Remove the staking from around the bearing retainer screws then remove the screws, bearing retainer and gasket.

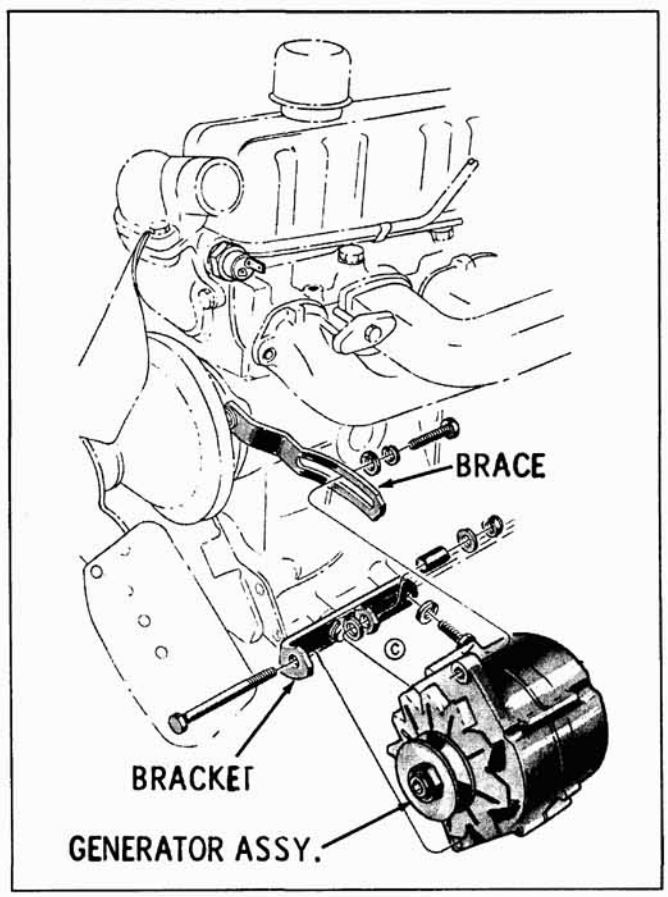


Fig. 12-23—Generator Installation (L-6 Engine)

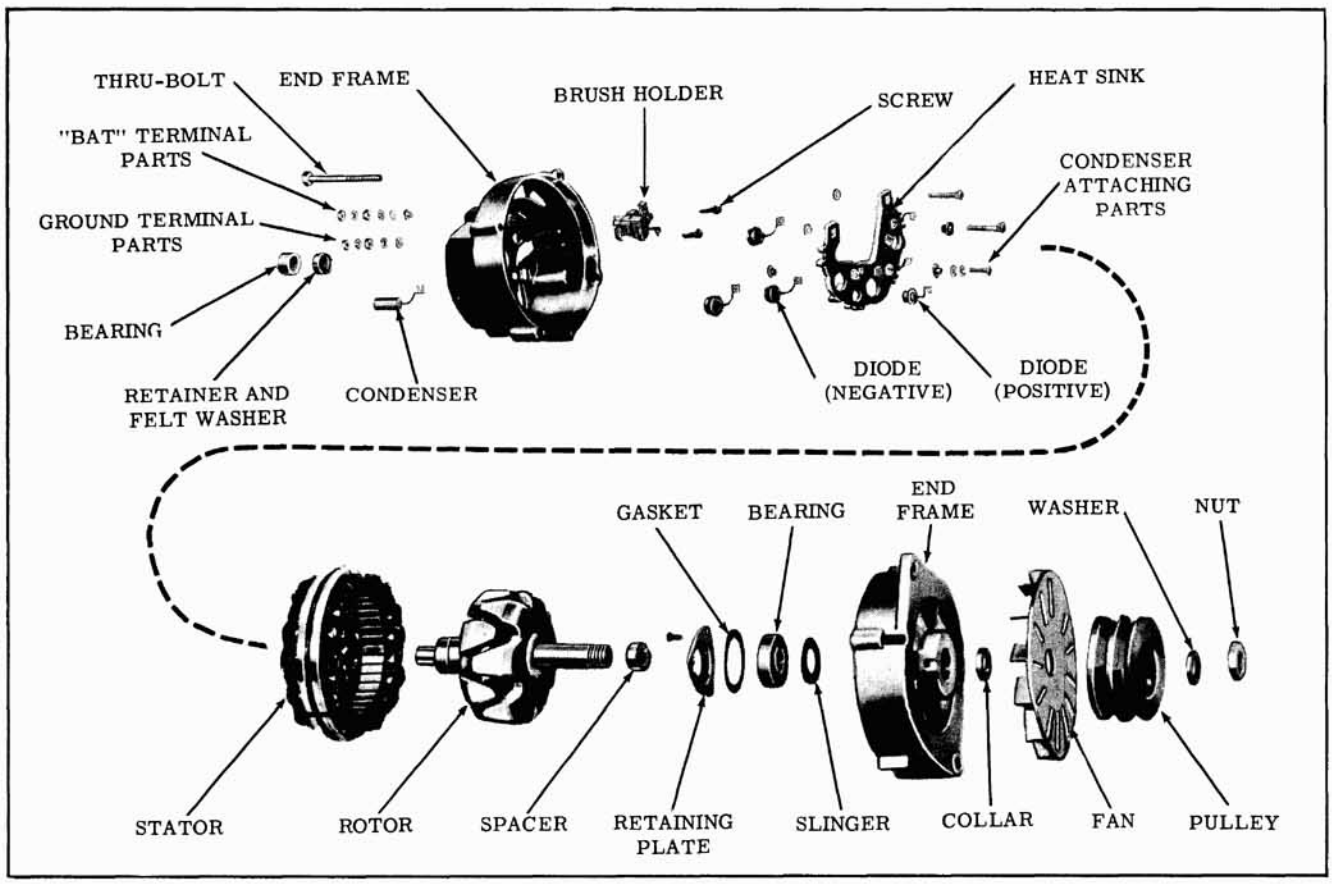


Fig. 12-24—Generator Assembly

b. Back-up the bearing housing with Tool J-7584-1 (Front Cover Seal Installer).

c. Drive out bearing with Tool J-5158-2 (Valve Guide Installer).

6. Remove the three stator winding to diode attaching nuts and separate the stator from the slip ring end-frame.

7. Remove the two brush holder attaching screws and remove the brush holder assembly from the end-frame.

The brush holder, brushes, springs and connectors are serviced as an assembly.

8. Remove the condenser to heat sink attaching screw and fiber washer.

9. Remove the BAT and GRD terminal nuts, bolts and washers; then remove the heat sink.

10. If necessary to remove the condenser, it can be removed by pushing it out to the rear of the end-frame.

CLEANING AND INSPECTION

1. Check roller bearing in slip ring end-frame. If bearing has sufficient lubricant and shows no sign of damage, protect the bearing opening with masking tape to prevent entrance of foreign material, and clean end-frame with compressed air. If bearing shows roughness or lack of lubricant, the bearing should be replaced as follows:

a. Position end-frame on the open jaws of a vise so that the jaws support the area around the bearing.

b. Using Valve Guide Installer J-5158-2, press bearing rearward out of end-frame. Clean end-frame in clean solvent.

c. To install new bearing, back up the inside area of the end-frame surrounding the bearing with Tool J-8810.

d. Press on closed end of needle bearing until bearing is flush with the end-frame housing.

e. Install a new retainer and felt washer with J-5158-2 until retainer seats against bearing.

2. Wash metal parts except stator and rotor in cleaning solvent. Degreasing solvent will damage the rotor and stator insulation. The rotor and stator should be cleaned with compressed air.

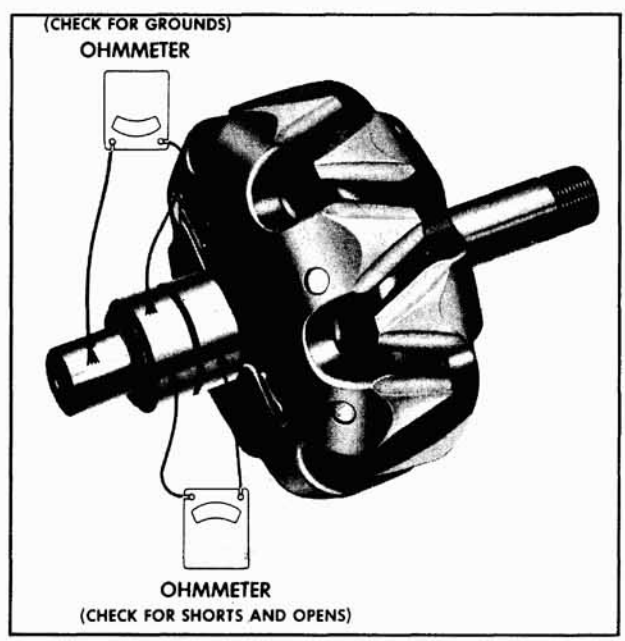


Fig. 12-25—Checking Rotor

3. Check the rotor as follows:

a. To check rotor for grounds, connect a 12-volt test lamp or ohmmeter from either slip ring to the rotor shaft or poles. If the lamp lights or the ohmmeter reading is low, the field winding is grounded and the rotor must be replaced. (Fig. 12-25)

b. To check rotor for opens, connect the test lamp or an ohmmeter lead to each slip ring. If the test lamp does not light or no reading can be obtained on the ohmmeter, the field winding is open and the rotor must be replaced. (Fig. 12-25)

c. To check rotor for short circuits, connect a 12-volt battery and an ammeter in series with the two slip rings. The ammeter should read 2.2 to 2.6 amps. If ammeter reading is higher than specified, the field windings are shorted and the rotor must be replaced.

d. The slip rings on the rotor can be cleaned with 400 grain or finer polishing cloth. When cleaning slip rings, the rotor must be rotating to prevent flat spots on the slip rings which could cause brush noise.

Slip rings which are rough or out-of-round should be trued in a lathe with a .002" maximum indicator reading. After turning slip rings in a lathe, polish with 400 grain or finer polishing cloth. Thoroughly clean away all dust particles.

4. The stator can be checked as follows:

a. Connect a 12 volt test lamp or an ohmmeter from a stator lead to the stator frame. If the lamp lights or the ohmmeter reading is low, the winding is grounded and the stator must be replaced. If lamp does not light or there is no ohmmeter reading (infinite) obtained, the stator is not grounded.

b. Connect a 12-volt test lamp or an ohmmeter between each pair of stator leads. If the lamp fails to light or the ohmmeter reading is high between any pair of leads, the stator winding is open and the stator must be replaced. (Fig. 12-26)

c. A short circuit in the stator windings is difficult to locate without special test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the Delcotron fails to supply rated output, it is an indication that the stator windings are shorted.

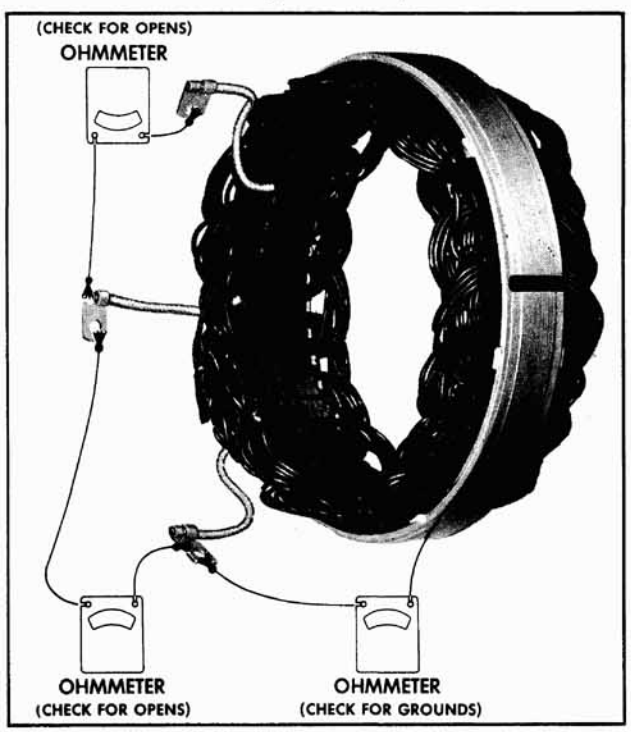


Fig. 12-26—Checking Stator

5. Check each diode for a shorted or open condition. Refer to diode checking.

6. Inspect the drive end frame bearing for roughness.

7. Inspect brushes and brush springs. Brushes, springs, connectors and brush holder are serviced as an assembly.

8. Inspect drive end-frame bearing retainer plate felt. If felt is hard or worn, the retainer plate should be discarded.

Diode Checking

The positive diodes, located in the heat sink, are checked as follows:

A. Attach the positive test lamp lead to a diode lead.

B. Attach the negative test lamp lead to the heat sink; the lamp should light indicating a good positive diode.

C. Check the other two positive diodes in the same manner.

D. Reverse the test lamp leads and again check the three positive diodes. The lamp should not light, indicating a good positive diode.

The negative diodes, located in the slip ring end-frame are checked as follows:

A. Attach the negative test lamp lead to a diode lead.

B. Attach the positive test lamp lead to the slip ring end frame, the lamp should light, indicating a good negative diode.

C. Check the other two negative diodes in the same manner.

D. Reverse the test lamp leads and again check the three negative diodes. The lamp should not light, indicating a good negative diode.

If the lamp lights in both checks of each diode, or fails to light in both checks, the diode is shorted or open and must be replaced. This procedure can also be used to determine the polarity of a new diode. If necessary to replace a diode, refer to DIODE - Removal and Installation.

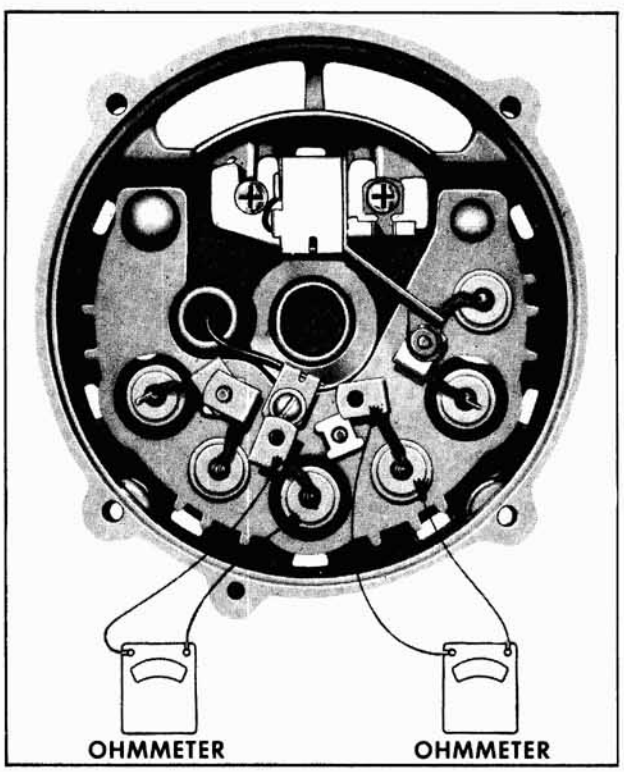


Fig. 12-27—Checking Diodes

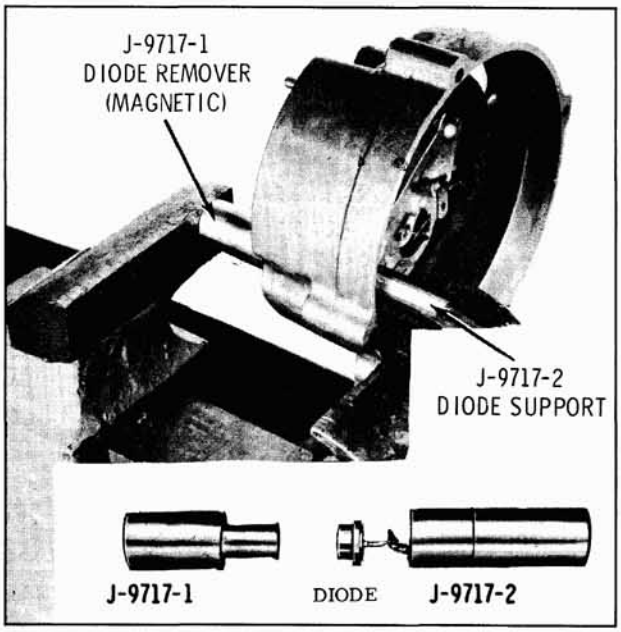


Fig. 12-28—Diode Removal

Ohmmeter Method (Fig. 12-27)

The lowest range scale on the ohmmeter should be used and the ohmmeter should have a 1-1/2 volt battery. To determine the cell voltage, turn the selector to the lowest scale, and then connect the ohmmeter leads to a voltmeter. The voltmeter will indicate the cell voltage.

Check the diode in the heat sink by connecting one of the ohmmeter leads to the heat sink, and the other ohmmeter lead to the diode lead and note the reading, then reverse the ohmmeter lead connections and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading. Check the other two diodes in the heat sink in the same manner.

To check a diode mounted in the end-frame connect one of the ohmmeter leads to the end frame, and the other ohmmeter lead to the diode lead and note the reading, then reverse the ohmmeter lead connections, and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading. Check the other two diodes in the end-frame in the same manner.

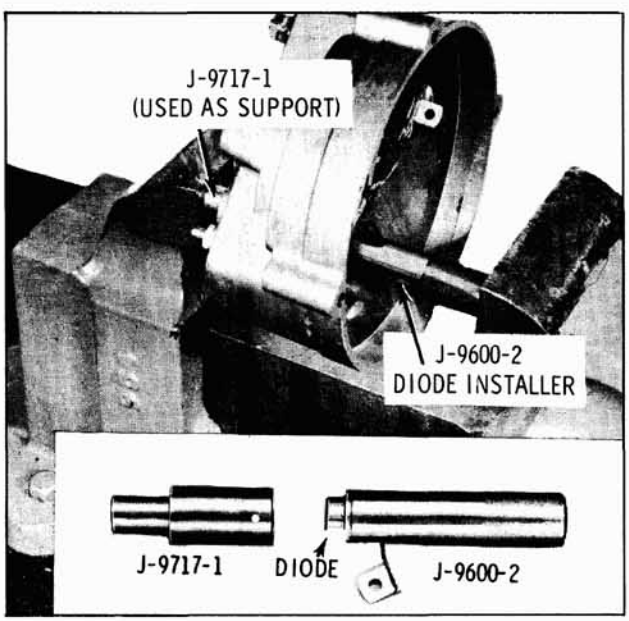


Fig. 12-29—Diode Installation

Special Tester Method

Special testers are available for checking diodes. To use these testers, follow the tester manufacturer's recommendations.

DIODE

Remove

1. With the generator disassembled and the stator removed, position Tool J-9717-1, J-9717-2 and the slip ring end-frame in a vise as shown in Fig. 12-28.

Diodes can be removed from either the end frame or the heat sink without removing the heat sink.

2. Operate vise until the defective diode is removed from the end-frame or heat sink.
3. Remove tools, diode and end-frame from the vise.

Install

1. Insert a diode into Tool J-9600-2 as shown in inset, Fig. 12-29.

The positive diode rectifiers are located in the heat sink and the negative diode rectifiers are located in the end-frame.

2. Position Tools J-9717-1, J-9600-2 (with diode) and end-frame as shown in Fig. 12-29.
3. Operate vise until the diode shoulder bottoms against the end-frame or heat sink.
4. Remove tools and end-frame from vise.

Generator Assembly

If a new slip ring end-frame is to be installed, stamp the last three numbers of the old end-frame on the new end-frame as shown in Fig. 12-30.

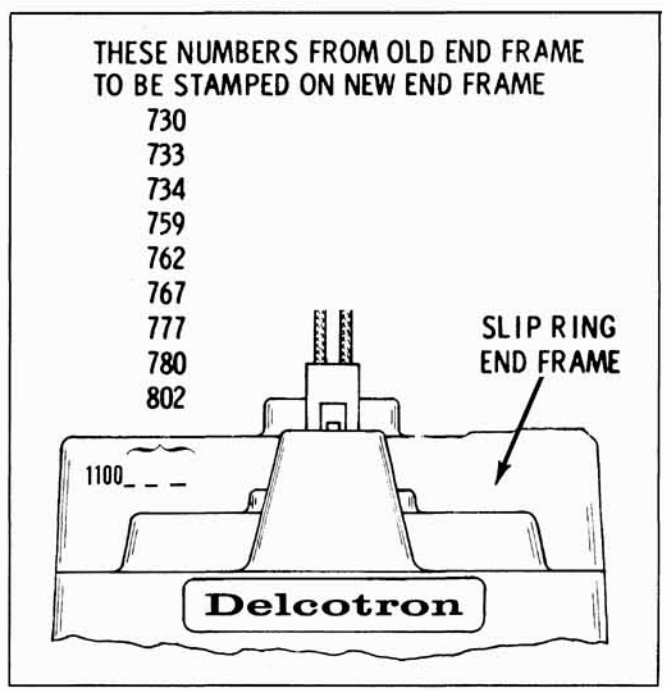


Fig. 12-30—Delcotron Generator Part Number

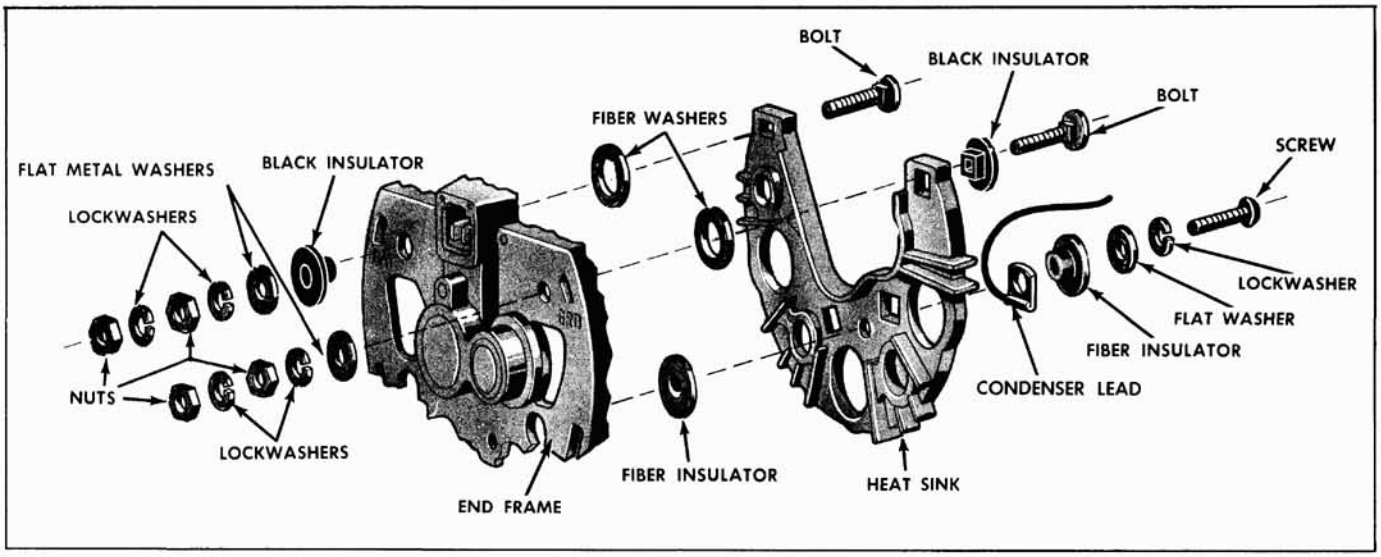


Fig. 12-31—Slip Ring End Frame

1. If the capacitor was removed, install from the inside of the end-frame until the capacitor is flush with capacitor housing.
2. Install the heat sink, making sure insulated washers are installed as shown in Fig. 12-31.
3. Install the capacitor to heat sink lead.
4. If the original brushes are re-used, install the brush springs and brushes into the brush holder and retain with a straight piece of wire inserted through the hole in the brush holder. (Fig. 12-32)
5. Install the brush holder assembly into the end frame and retain with the two attaching screws.
6. Position the stator into the slip ring end frame with the stator leads aligned with the stator and diode lead attaching studs. Before installing the attaching nuts, position the relay lead over the diode lead attaching stud. Tighten all nuts. (Fig. 12-33)
7. If the bearing in the drive end-frame is to be re-used, it should be re-packed one-quarter full of lubricant No. 1948791 or equivalent. Install the bearing into the drive end-frame as follows:
   a. Position drive end-frame on a flat surface.
   b. Retain grease slinger to the bearing with grease.
   c. Using Tool J-6133 (Speedometer Gear Installer) press bearing into position.
   d. Install bearing retainer. Tighten screws to 36 in. lbs. torque and peen flange of retainer against screw heads.
8. Position the rotor in a vise. Tighten vise only enough to permit tightening the shaft nut.
9. Install the spacer, drive end-frame, collar, fan, pulley, wave washer and rotor nut. Tighten nut to 60 ft. lbs.
10. Assemble the two end-frames with scribe marks aligned and install the through-bolts.
11. Remove the brush retaining wire. The brushes will seat on the slip rings.

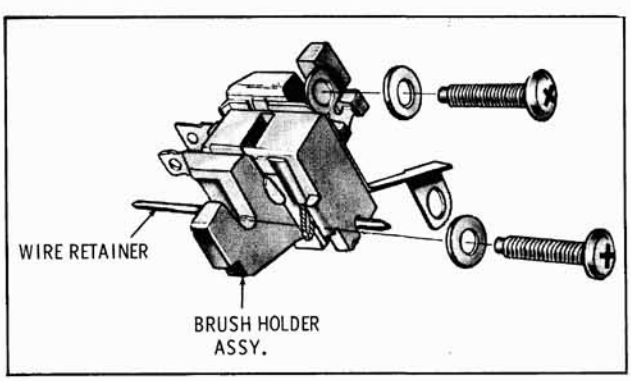


Fig. 12-32—Brush Holder Assy.

STARTING CIRCUIT

STARTING MOTOR ASSEMBLY (Fig. 12-34)

The starting motor is a 12 volt unit having four poles and a compound field. The starting motor used on the L-6 engine (Fig. 12-35) has four field coils connected in series between the terminal and the armature.

Three starting motors are used on V-8 engines. (Figs. 12-36, 12-37) One has two field coils in series with the armature circuit and in parallel to each other. The other two field coils are in parallel with each other and are connected from the

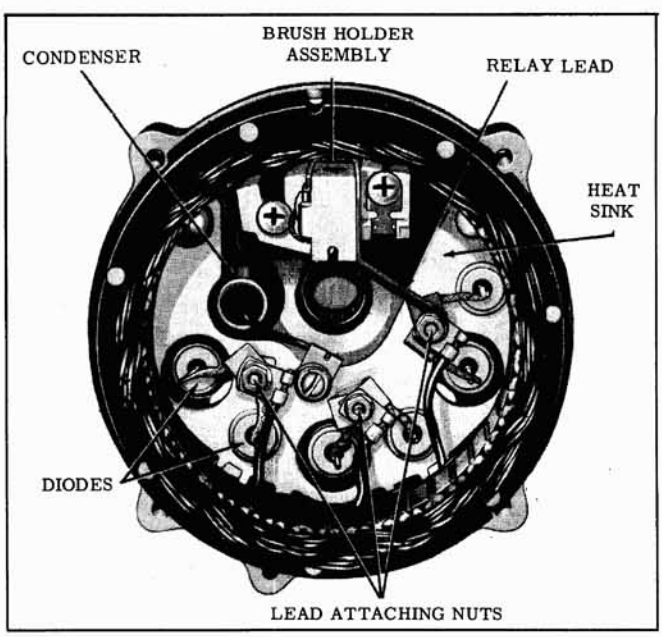


Fig. 12-33—Stator and Diode Lead

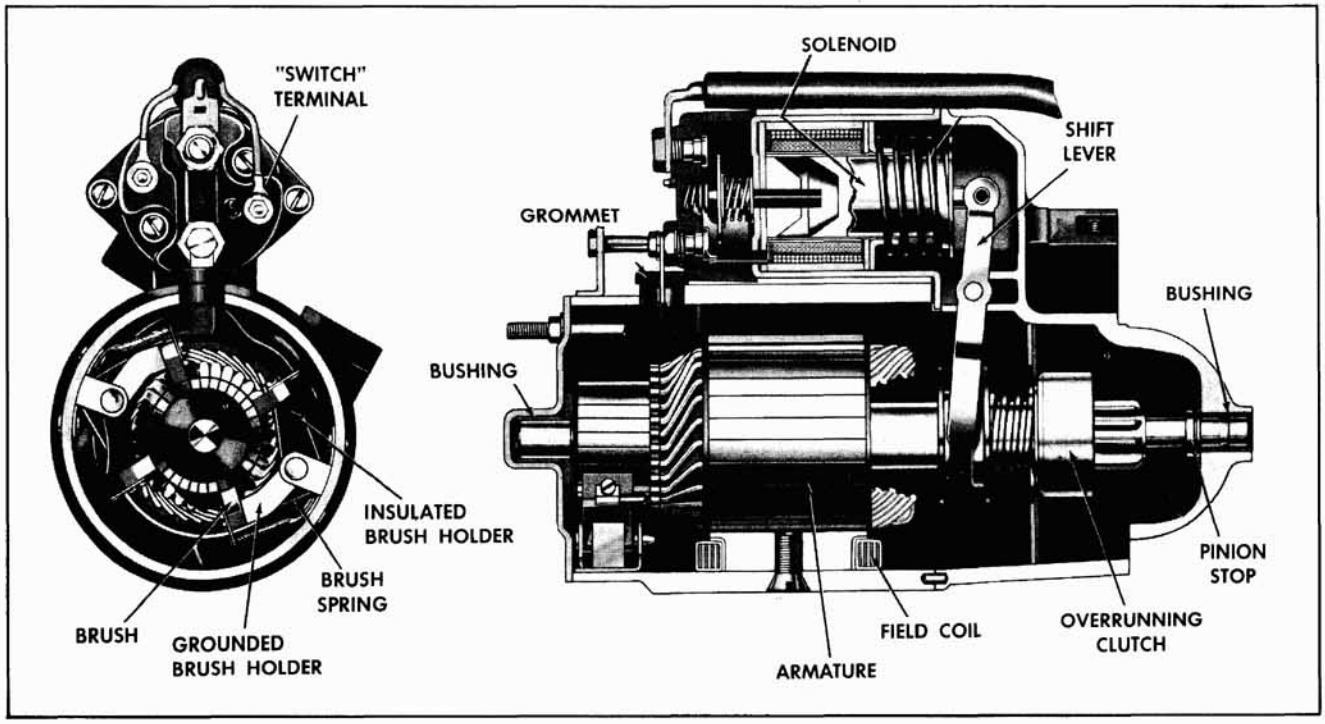


Fig. 12-34—Starter Motor

field terminal to ground. One motor has three fields in series with the armature and one field connected from the motor terminal to ground. The 4 bbl. H.C. 455 cu. in. engine will use a ultra high performance starter with a series compound field windings. (Fig. 12-38)

The armature rotates in bushings at both ends. An overrunning clutch drive is used to engage the cranking motor pinion with the flywheel. The overrunning action of the clutch protects the cranking motor armature from excessive speed when the engine starts.

A solenoid switch, integral with the solenoid assembly, operates the overrunning clutch drive by means of a linkage to the shift lever. When the ignition switch is turned to the starting position, the solenoid is energized, moving the cranking motor pinion into mesh with the flywheel. The solenoid switch contacts are then closed so that battery current is delivered to the cranking motor.

To provide full battery voltage to the coil, the ignition resistor is by-passed during cranking. The resistor is by-passed at the "R" terminal on the starting motor.

The armature shaft and clutch have spiral splines which prevent full cranking power until the clutch pinion is fully engaged in the flywheel ring gear. A pinion stop, consisting of

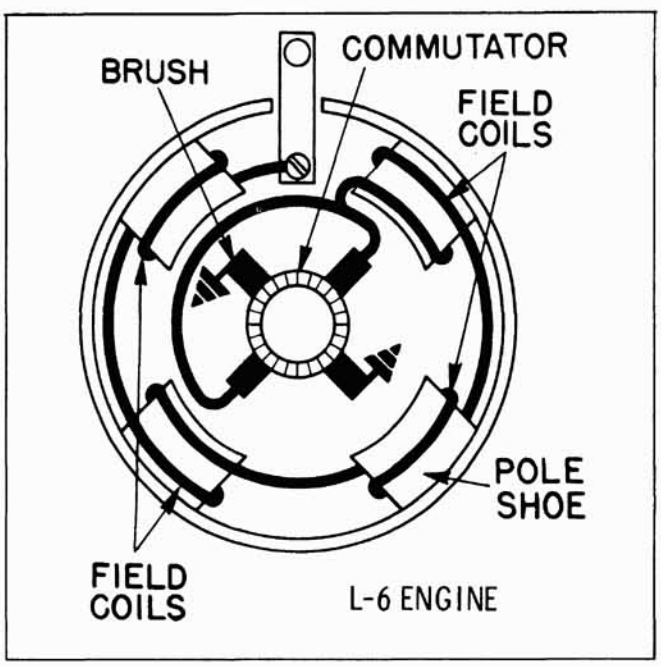


Fig. 12-35—Field Windings (L-6 Engine)

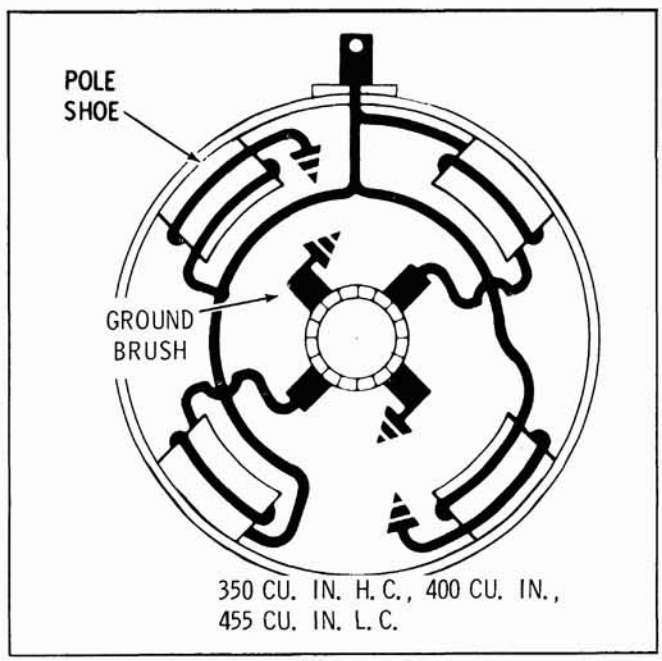


Fig. 12-36—Field Windings (V-8 Engine)

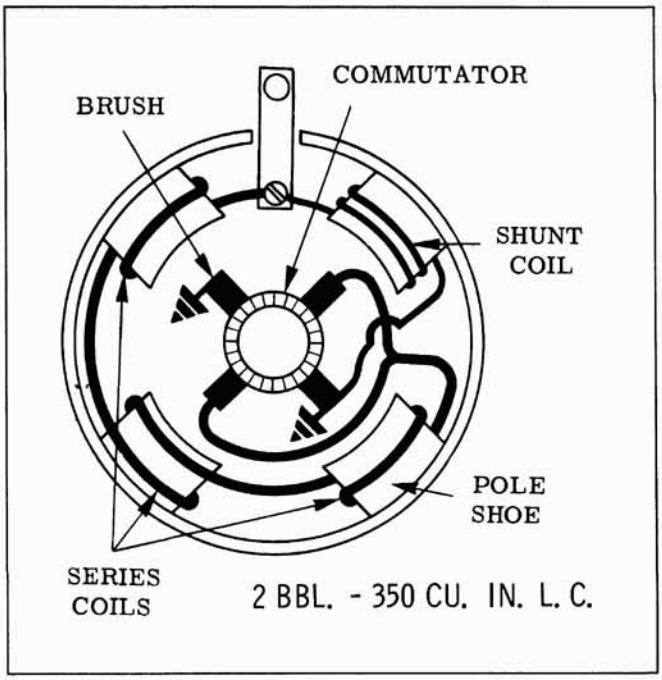


Fig. 12-37—Field Windings (V-8 Engine)

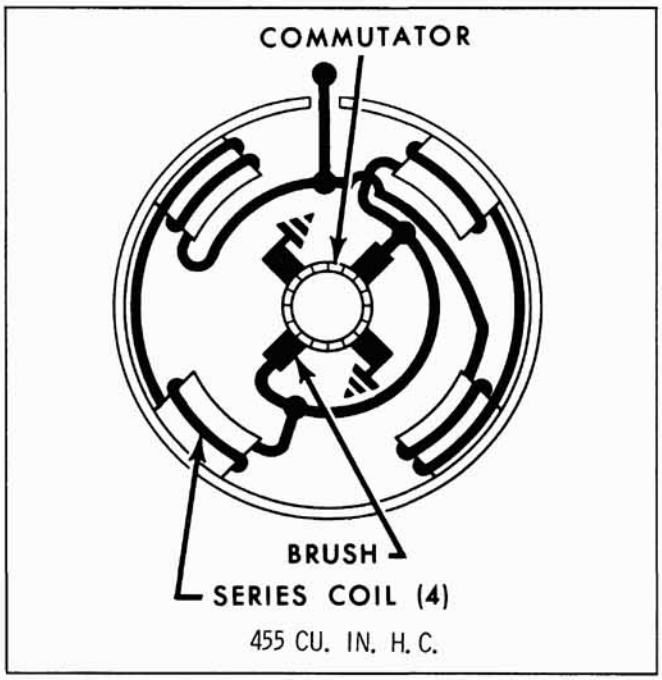


Fig. 12-38—Field Windings (V-8 Engine)

a snap ring retainer and thrust collar assembled on the armature shaft, takes all the end thrust.

STARTER

Removal—All except 400 cubic inch engine

1. Disconnect battery.
2. Noting position of wires, disconnect starter wiring.
3. If equipped with Manual Transmission remove four screws securing flywheel housing cover and remove cover.
4. Remove upper support attaching bolt.
5. Remove two mounting bolts and remove starter.

If car is equipped with dual exhaust, the L.H. exhaust pipe may have to be disconnected to provide clearance.

To install, reverse the removal procedure.

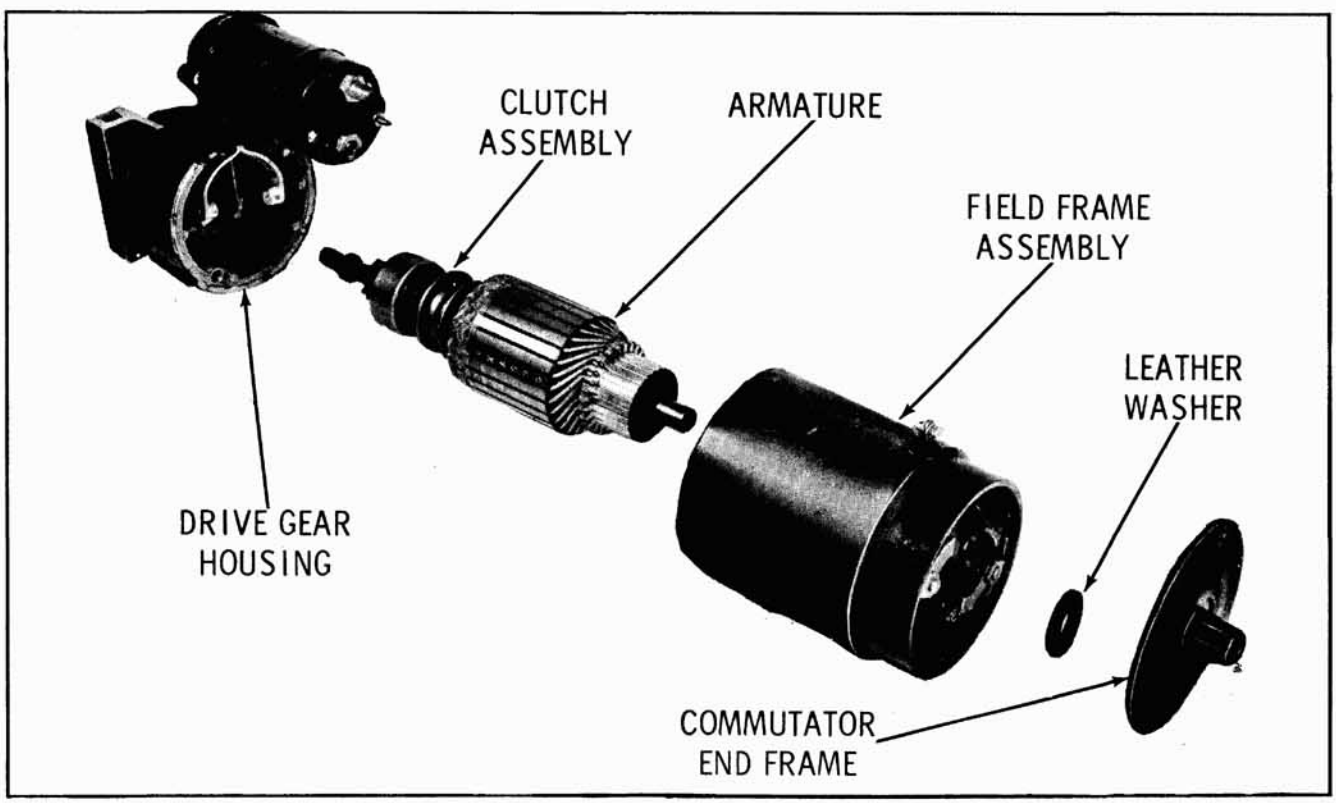


Fig. 12-39—Starter Motor Disassembled

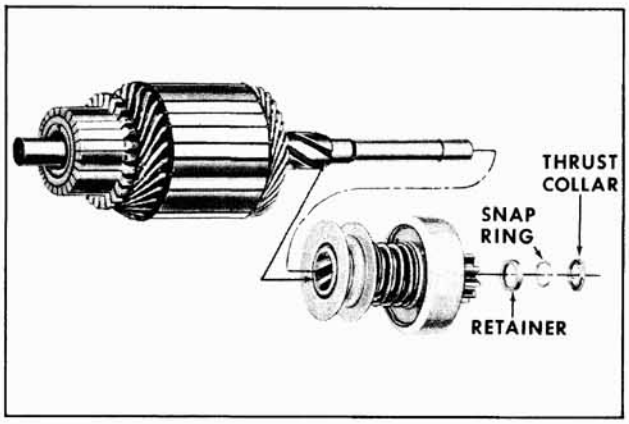


Fig. 12-40—Overrunning Clutch

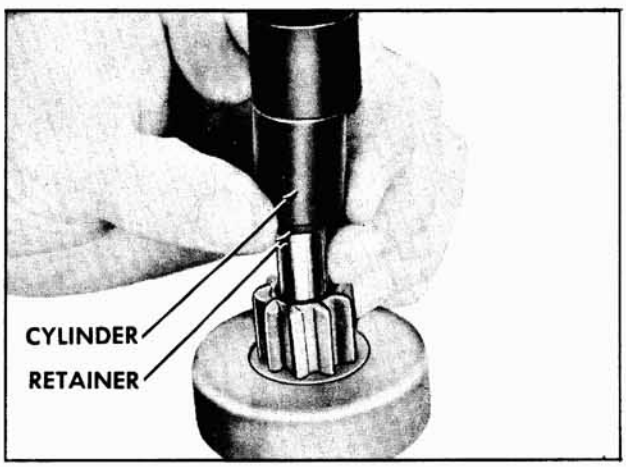


Fig. 12-41—Removing Pinion Retainer

Removal—400 Cubic Inch Engine

1. Disconnect battery and hoist car.
2. Disconnect clutch return spring at clutch release yoke.
3. Disconnect exhaust pipe from left manifold.

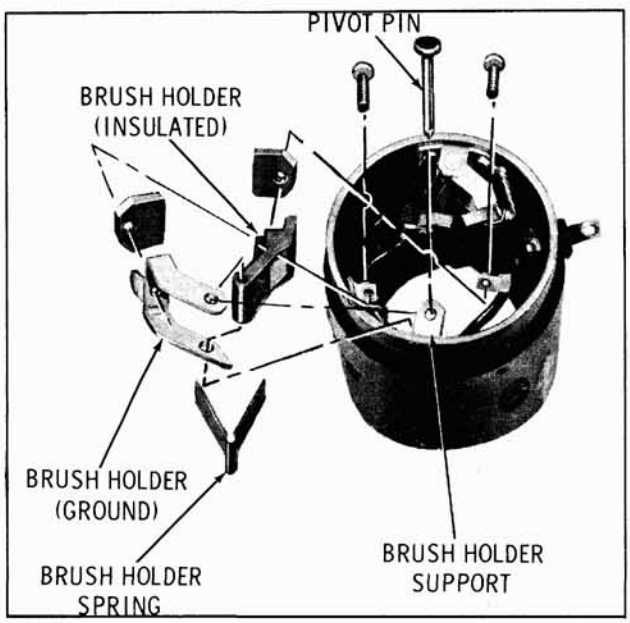


Fig. 12-42—Brush Installation

4. Loosen upper and remove lower starter to engine block brace bolts.
5. Remove 2 starter to block bolts.
6. Move starter forward and downward then disconnect wires from 3 starter terminals.
7. Rotate starter counterclockwise while pulling forward and downward on front of starter and withdraw starter from car.

On 4-4-2's equipped with a Turbo Hydra-Matic transmission, adequate clearance can be obtained by removing the flywheel housing cover.

To install, reverse removal procedure.

Disassembly (Fig. 12-39)

1. Disconnect the field coil connector from the solenoid terminal.
2. Remove through-bolts, then remove commutator end frame and leather washer.
3. Remove field frame assembly, armature, and clutch assembly from drive gear housing.
4. If necessary to remove overrunning clutch from armature shaft, proceed as follows:
   a. Remove thrust collar from armature shaft. (Fig. 12-40)
   b. Slide a standard half-inch pipe coupling or other metal cylinder of suitable size (an old pinion can be used if available) over shaft against retainer to be used as a driving tool. (Fig. 12-41) With armature shaft supported on wood block, tap end of driving tool until retainer clears snap ring.
   c. Remove snap ring from groove in shaft using pliers or other suitable tool. If the snap ring is distorted during removal, it will be necessary to use a new one upon reassembly.
   d. Remove retainer and clutch assembly from armature shaft.
5. If necessary to replace brush holding parts, refer to Fig. 12-42, then proceed as follows:
   a. Remove brush holder pivot pin which positions one insulated and one grounded brush.
   b. Remove brush spring.
   c. Replace brushes as necessary.

To assemble, reverse removal procedure.

6. If necessary to remove solenoid assembly or shift lever, proceed as follows:

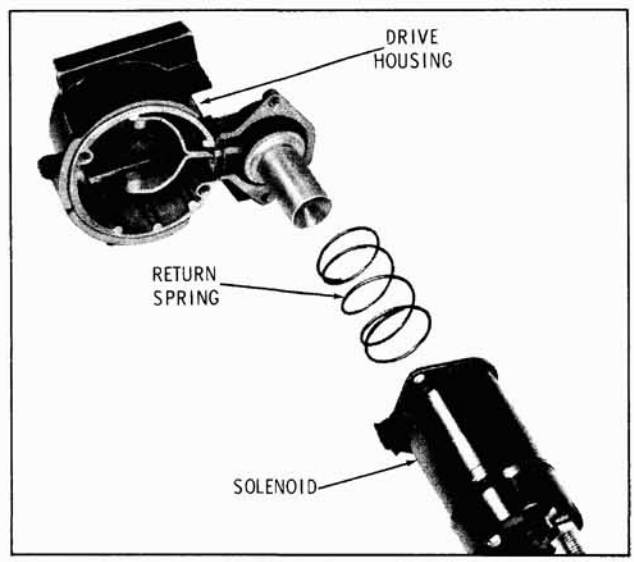


Fig. 12-43—Solenoid Removal

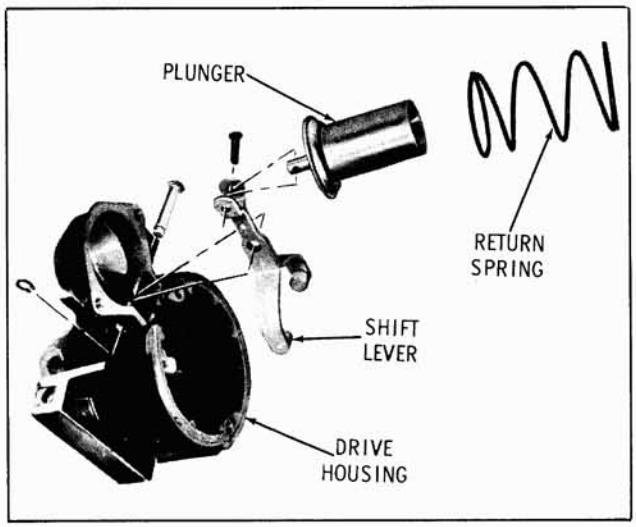


Fig. 12-44—Shift Lever Assembly

a. Remove solenoid to drive gear housing attaching screws, then remove solenoid assembly. (Fig. 12-43)

b. To remove shift lever and/or plunger, remove shift lever pivot bolt. (Fig. 12-44)

c. Disassemble shift lever from plunger.

Cleaning, Inspection and Tests

1. Clean all starting motor parts, but DO NOT USE GREASE DISSOLVING SOLVENTS FOR CLEANING THE OVERRUNNING CLUTCH, ARMATURE, AND FIELD COILS, since such solvent would dissolve the grease packed in the clutch mechanism and would damage armature and field coil insulation.

2. Test overrunning clutch action. The pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Replace assembly if necessary.

3. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.

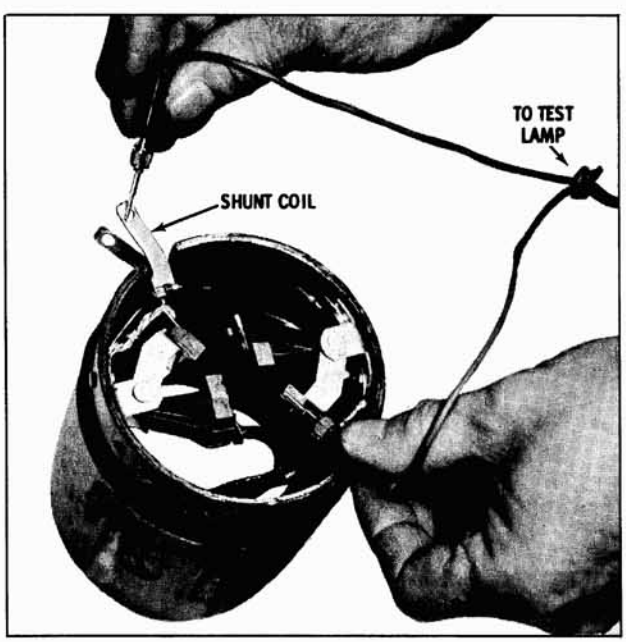


Fig. 12-45—Checking Field Coil for Open

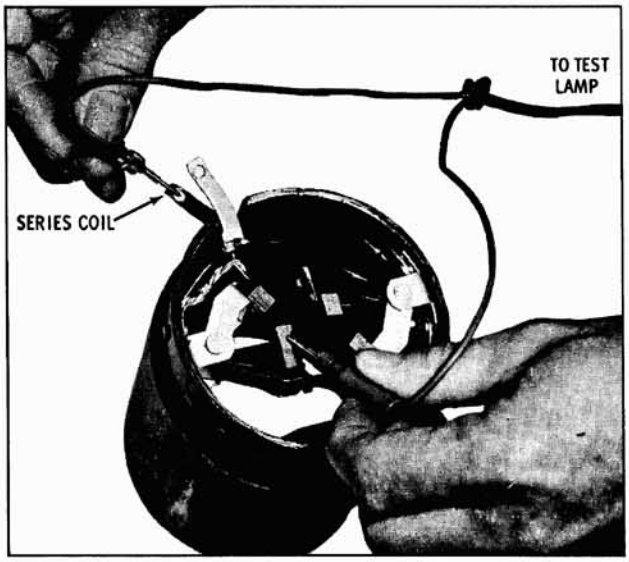


Fig. 12-46—Checking Field Coil for Ground

4. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.

5. Inspect armature commutator. If commutator is rough or out-of-round, it should be turned down and the mica undercut 1/32". Inspect the points where the armature conductors join the commutator bars to make sure they have a good connection. A burned commutator bar is usually evidence of a poor connection.

6. If test equipment is available:

a. Check the armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between the commutator bars. If saw blade still vibrates, replace the armature.

b. Using a 110 volt test lamp, place one lead on the shunt coil terminal and connect the other lead to a ground brush. (Fig. 12-45)

This test should be made from both ground brushes to insure continuity through both brushes and leads. If the lamp fails to light, the field coil is open and will require repair or replacement.

c. Using a 110 volt test lamp, place one lead on the series coil terminal and the other lead on the insulated brush. (Fig. 12-46) If the lamp fails to light, the series coil is open and will require repair or replacement.

This test should be made from each insulated brush to check brush and lead continuity.

d. Using a 110 volt test lamp, place one lead on the grounded brush holder and the other lead on either insulated brush. (Fig. 12-47) If the lamp lights, a grounded series coil is indicated and must be repaired or replaced.

e. Check the current draw of the solenoid winding as follows: (Fig. 12-48)

If solenoid is not removed from starting motor, the connector strap must be removed from the terminal on the solenoid before making these tests. Complete tests in a minimum of time to prevent overheating of the solenoid.

To check hold-in winding, connect an ammeter and a variable resistance in series with a 12-volt battery and the "switch" terminal on the solenoid. Connect a voltmeter to the "switch" terminal and to ground. Adjust the voltage to

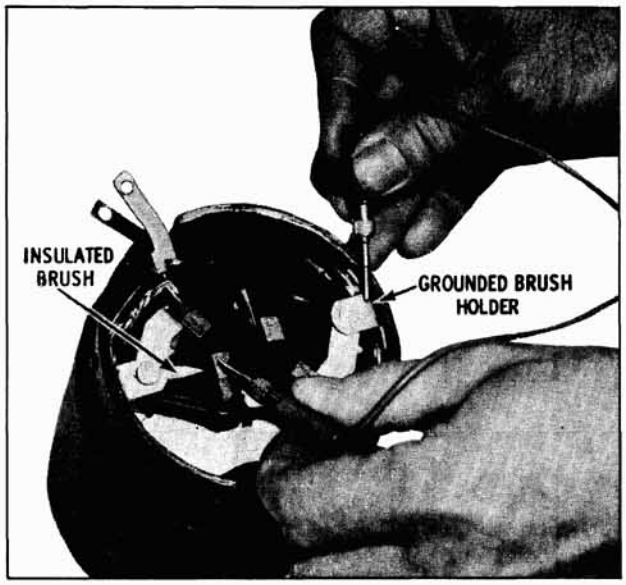


Fig. 12-47—Checking Coil for Open

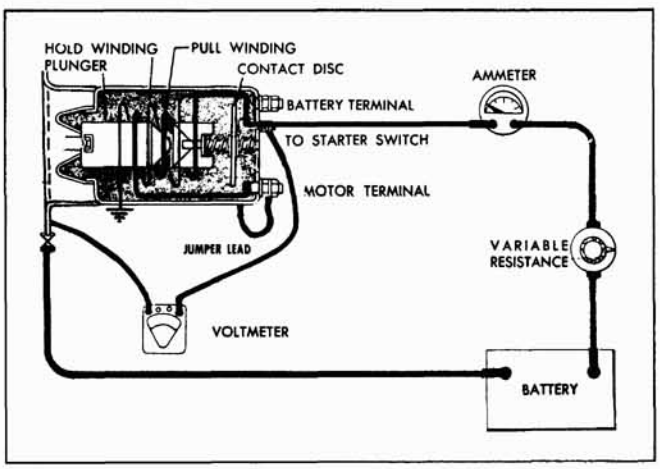


Fig. 12-48—Checking Solenoid Windings

10 volts and note the ammeter reading. It should be 14.5 to 16.5 amperes for all starting motors.

To check both windings, connect the ammeter, variable

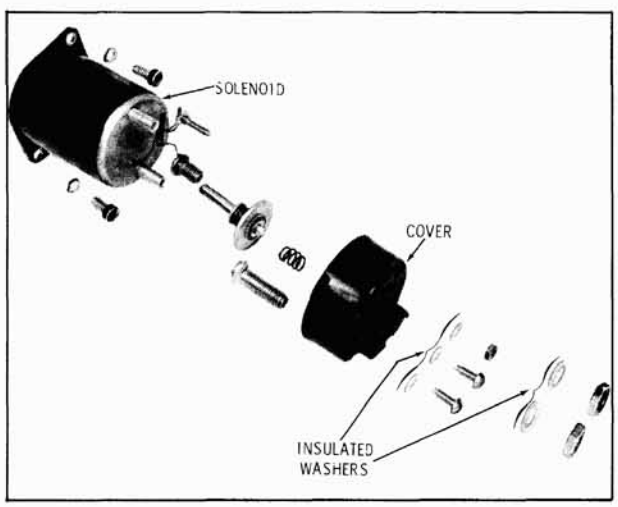


Fig. 12-49—Solenoid Assembly

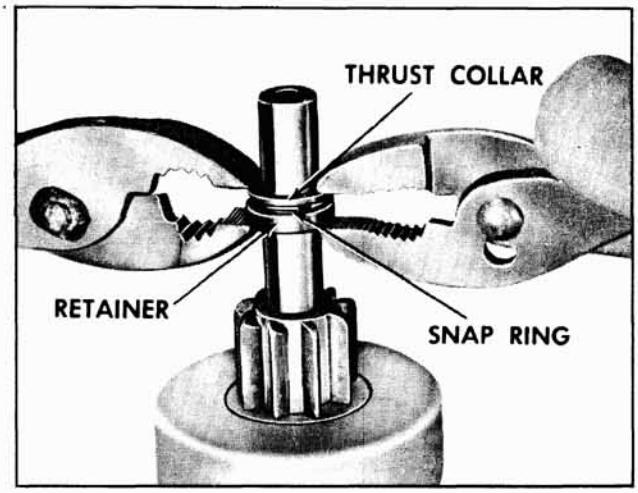


Fig. 12-50—Installing Retainer and Snap Ring

resistance and voltmeter as for previous test. Ground the solenoid motor terminal. Adjust the voltage to 10 volts and note the ammeter reading. It should be 41 to 47 amperes for all starting motors.

Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid and the solenoid should be replaced. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit. Check connections then replace solenoid if necessary.

Assembly

1. If the solenoid assembly or shift lever was removed, proceed as follows:
   a. Assemble shift lever and plunger.
   b. Position shift lever and plunger assembly in drive gear housing and install lever pivot bolt. (Fig. 12-44)
   c. Install solenoid assembly to drive gear housing. (Fig. 12-43)
2. If the overrunning clutch was removed from the armature shaft, assemble as follows:
   a. Lubricate drive end of armature shaft with SAE 10W-30 oil.
   b. Slide clutch assembly onto armature shaft with pinion away from armature. (Fig. 12-40)
   c. Slide retainer onto shaft with cupped surface facing away from clutch assembly.
   d. Install snap ring into groove on armature shaft.
   e. Assemble thrust collar onto shaft with shoulder next to snap ring.
   f. Position retainer and thrust collar next to snap ring. Using two pliers, grip retainer and thrust collar and squeeze until snap ring is forced into retainer and is held securely in groove in armature shaft. (Fig. 12-50)
3. Lubricate drive gear housing bushing with four or five drops of SAE 10W-30 oil.
4. With thrust collar in place against snap ring and retainer, slide armature and clutch assembly into drive gear housing and engage clutch with shift lever yoke.
5. Apply sealer, No. 1050026 or equivalent on solenoid flange as shown in Fig. 12-51.
6. Position field frame against drive gear housing using care to prevent damage to brushes.
7. Lubricate commutator end-frame bushing with four or five drops of SAE 10W-30 oil.
8. Install leather washer on armature shaft and slide end frame onto shaft, then install and tighten through-bolts.

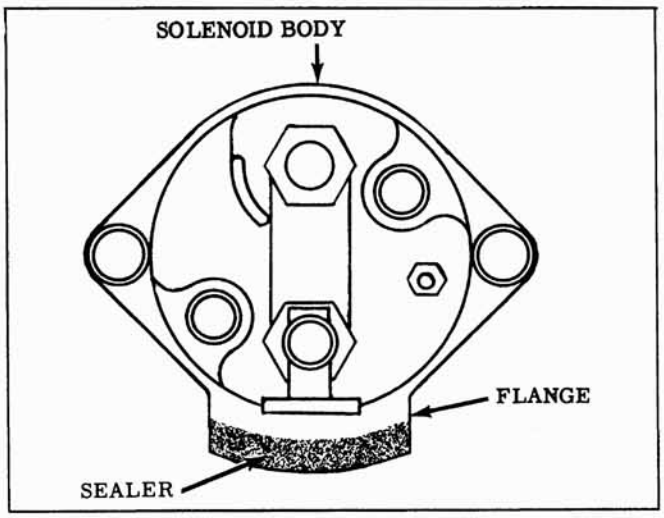


Fig. 12-51—Sealing Solenoid Housing

9. Connect the field coil connector to the solenoid terminal.

10. Check pinion clearance as outlined under PINION CLEARANCE.

Pinion Clearance

Whenever the cranking motor has been disassembled or the solenoid has been replaced, it is necessary to check the pinion clearance. Pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during cranking.

To check, connect a voltage source of approximately 6 volts between the solenoid switch terminal and ground.

If a 6-volt battery is not available, a 12-volt battery may be used PROVIDING ONLY THREE CELLS ARE CONNECTED IN SERIES. TO PREVENT MOTORING, CONNECT A HEAVY JUMPER LEAD FROM THE SOLENOID MOTOR TERMINAL TO GROUND.

Energize the solenoid to shift the clutch, push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gauge. (Fig. 12-52) The clearance should be .010" to .140".

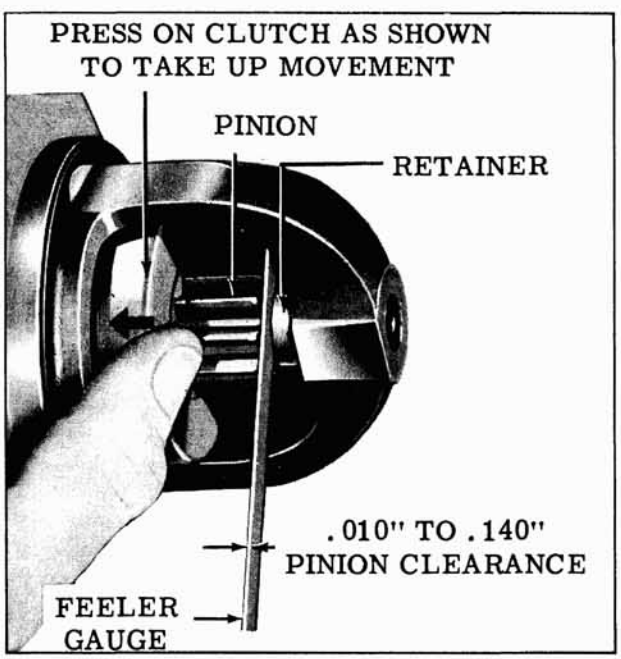


Fig. 12-52—Checking Pinion Clearance

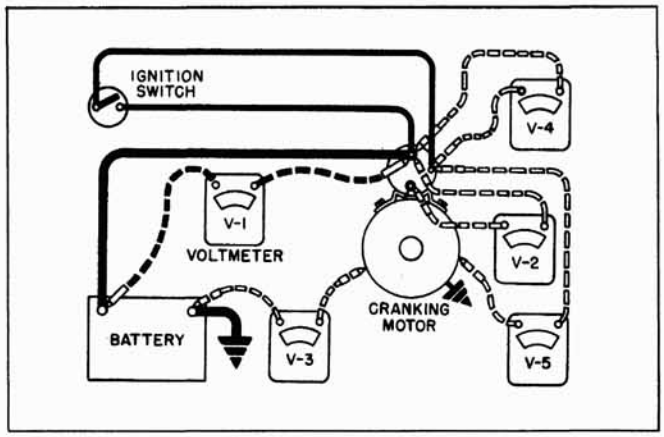


Fig. 12-53—Checking Starter Circuit Resistance

Means for adjusting pinion clearance is not provided on the starter motor. If the clearance does not fall within limits, check for improper installation and replace all worn parts.

CHECKING STARTING CIRCUIT RESISTANCE (Fig. 12-53)

Whenever the starting motor turns over slowly or not at all, or the solenoid fails to engage the starter with the flywheel, excessive resistance of the starter circuit may be the cause.

The following checks for excessive resistance can be performed with the starter motor on the car:

1. Test battery and charge if necessary.

To prevent the engine from firing during the following checks, ground the distributor primary lead.

2. Measure the voltage drop (VI) during cranking between the positive battery post and the "battery" terminal of the solenoid. (Fig. 12-53)

3. Measure the voltage drop (V2) during cranking between the "battery" terminal and the solenoid and the "motor" terminal of the solenoid.

4. Measure the voltage drop (V3), during cranking between the negative battery post and the starter motor frame.

If the voltage drop for any one of the above three checks exceeds 0.2 volt, excessive resistance is indicated in that portion of the starting circuit being checked. Locate and eliminate the cause for any excessive voltage drop in these circuits in order to obtain maximum efficiency of the starting system.

If the solenoid fails to pull in, the trouble may be due to excessive voltage drop in the solenoid circuit. To check for this condition, measure the voltage drop (V4) during cranking, between the "battery" terminal of the solenoid and the "switch" terminal of the solenoid. If the voltage drop exceeds 2.5 volts, the resistance is excessive in the solenoid circuit.

If the voltage drop does not exceed 2.5 volts and the solenoid does not pull in, measure the voltage (V5) available at the "switch" terminal of the solenoid. The solenoid should pull in with 8.0 volts at temperatures up to 200°F. If not, remove the starter motor and test the solenoid.

IGNITION CIRCUIT

The ignition circuit includes the distributor, ignition coil, ignition resistor wire, ignition switch, spark plugs, and battery. For servicing of the battery, see CHARGING CIRCUIT.

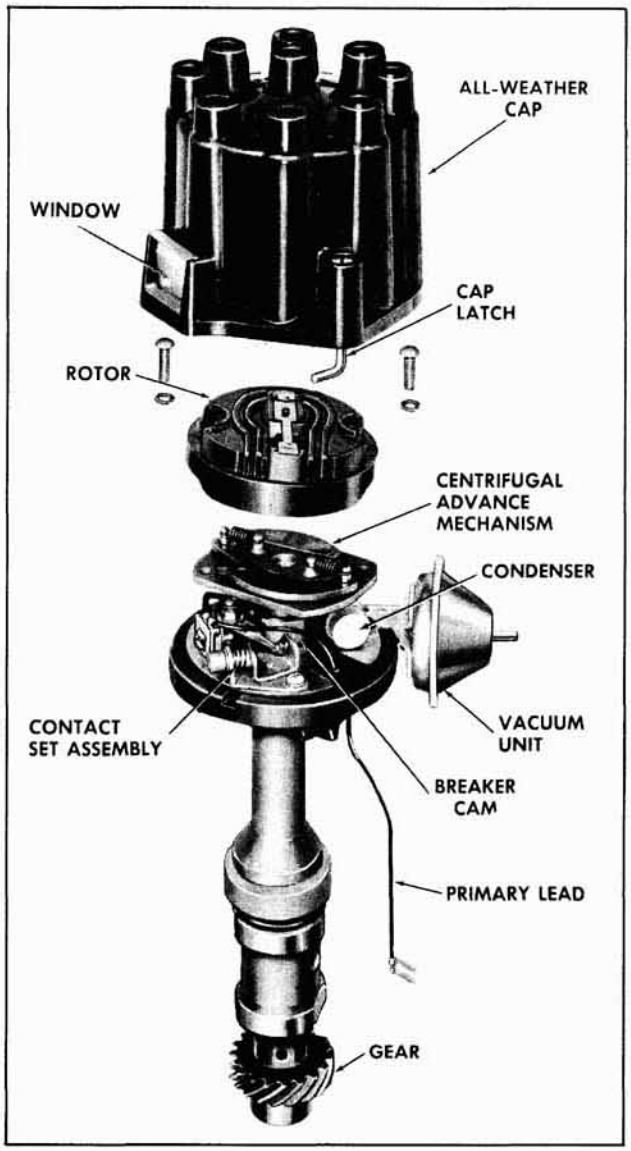


Fig. 12-54—Distributor (V-8)

DISTRIBUTOR—(Fig. 12-54) (Except L-6)

DESCRIPTION

The distributor cap has a window for adjusting point opening (dwell angle) except L-6 while the cap is mounted and the engine is running. The contact point set is replaced as one complete assembly. The service replacement contact set has the BREAKER LEVER SPRING TENSION AND POINT ALIGNMENT pre-adjusted. Only the POINT OPENING requires adjusting after replacement.

Under part throttle operation, the intake manifold vacuum actuates the vacuum control diaphragm, thus advancing the spark and increasing fuel economy. During fast acceleration or when the engine is pulling heavily, the vacuum is not sufficient to actuate the diaphragm; therefore, the movable breaker plate is held so that the ignition timing is retarded.

The centrifugal advance mechanism consists of a cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, centrifugal advance weights move outward which advances the cam, causing the contact points to open earlier, thus advancing the spark.

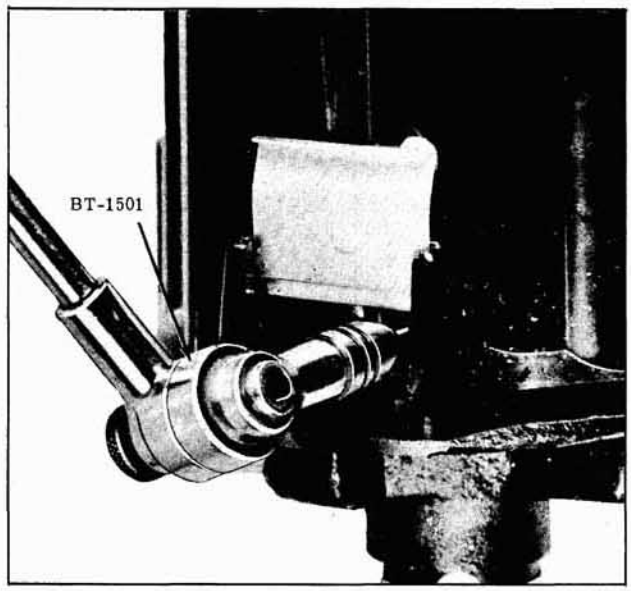


Fig. 12-55—Adjusting Dwell Angle (V-8)

Adjustment of Distributor Dwell Angle (On Car) (Except L-6) (Fig. 12-55)

1. Remove the distributor cap and inspect contact points; clean if necessary. Lubricate cam with cam and bearing lubricant. Install cap.
2. Connect a dwell meter to the primary distributor lead terminal on the coil and a suitable ground.
3. Raise window on side of distributor cap.
4. With the engine running at idle speed, insert Dwell Ad-

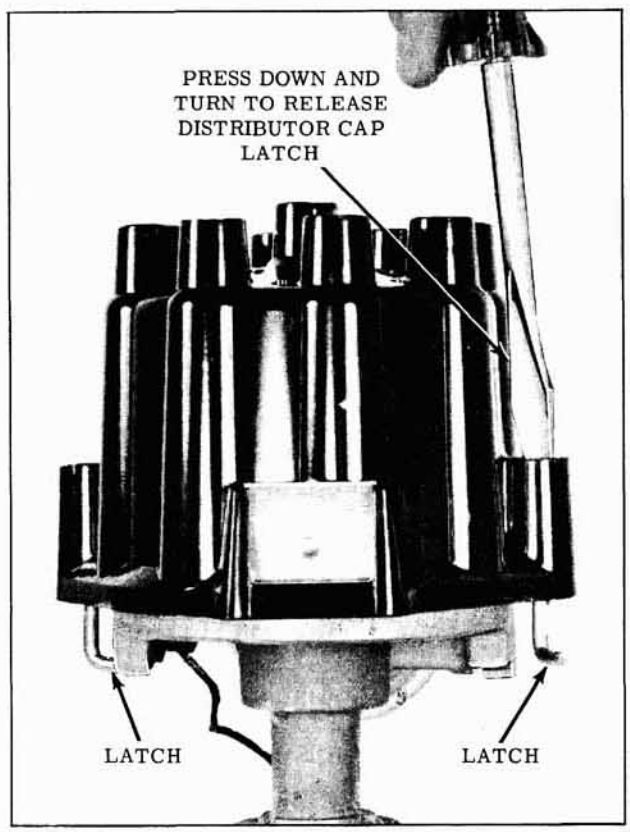


Fig. 12-56—Removing Distributor Cap (V-8)

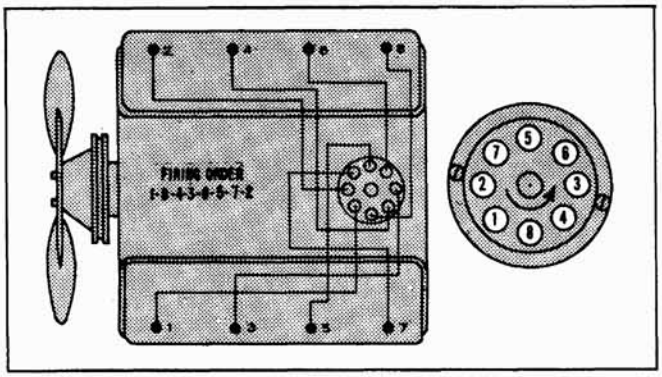


Fig. 12-57—Spark Plug Wiring (V-8)

justing Tool BT-1501 into the head of the adjusting screw as shown in Fig. 12-55 and adjust dwell angle to 30°.

If the dwell angle reading is erratic, check the contact points and condenser.

The dwell angle variation should not exceed 3° at engine speeds between idle and 1750 rpm. Excessive variation indicates distributor wear.

Removal

1. Disconnect the distributor wire from coil.
2. Remove distributor cap as shown in Fig. 12-56.

If necessary to remove secondary wires from cap, mark position on cap tower for lead to No. 1 cylinder. This will aid in installation of leads. (Fig. 12-57)

3. Remove vacuum hose line from vacuum advance unit.
4. Remove distributor clamp screw and hold-down clamp.
5. Note position of rotor, then pull distributor up until rotor just stops turning counterclockwise and again note position of rotor.

To install, reverse removal procedure.

To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted in Step 5.

If the engine has been turned after the distributor was removed, it will be necessary to install a jumper wire and crank engine until the saw slot on the harmonic balancer indexes with the 0° timing mark on the engine front cover. If both valves of the No. 1 cylinder are closed, the piston will be on top dead center of the firing stroke and the distributor can be installed with the rotor pointing to the No. 1 spark plug terminal in the distributor cap. If not, crank engine one complete revolution, then install distributor.

Tests (Distributor Removed from Car)
Except L-6

With the distributor removed from the car, place the distributor in a distributor testing machine. When mounting distributor in tester, first secure the gear in the drive mechanism, then push distributor housing down toward the gear to take up end play between the gear and housing, and finally secure the housing in the tester. Test the distributor for variation of spark, correct centrifugal and vacuum advance (See SPECIFICATIONS), and condition of contact points. This test will give valuable information on the distributor condition and indicates parts replacement which may be necessary.

Replacing Distributor Contact Set (Except L-6)

1. Remove distributor cap.

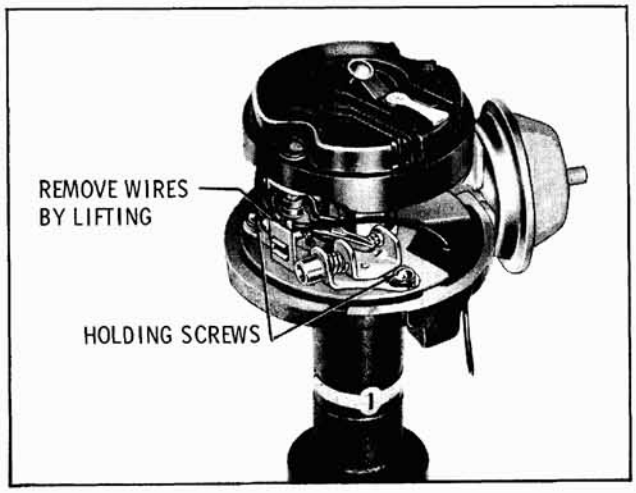


Fig. 12-58—Removing Contact Point Set

2. Loosen the two attaching screws which hold the base of contact set, turn and lift out the assembly. (Fig. 12-58)
3. Upon reassembly, make sure that hole "A" in the contact set is centered over the dowel on the distributor plate and install the primary leads as shown in Fig. 12-59. Leads must be properly located to eliminate lead interference between cap, weight base, and breaker advance plate.
4. Apply a film of cam and ball bearing lubricant, or equivalent, to the breaker cam.

Adjusting Distributor Dwell Angle (Except L-6)

1. With distributor mounted in distributor testing machine, connect the dwell meter to the distributor primary lead.
2. Turn the adjusting screw to set the dwell angle at 30°.

If a distributor tester is not available, the dwell angle may be adjusted as follows:

1. Mount distributor in a vise.
2. Connect a testing lamp between the primary lead and ground.
3. Rotate the shaft until one of the breaker cam lobes is under the center of the rubbing block on the moveable point.
4. Turn the adjusting screw clockwise until the lamp

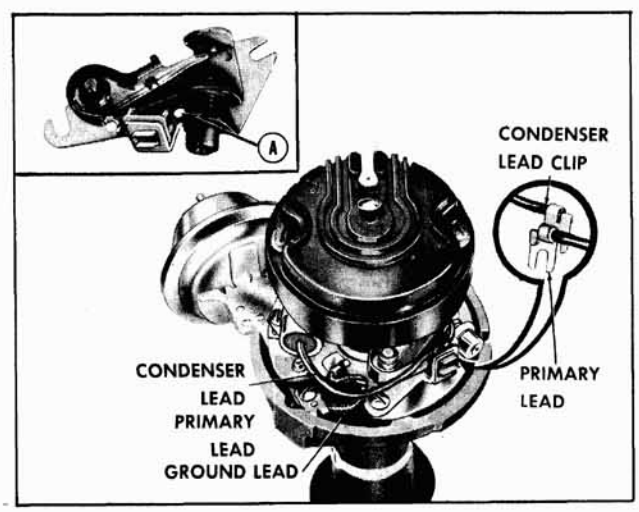


Fig. 12-59—Installing Contact Point Set

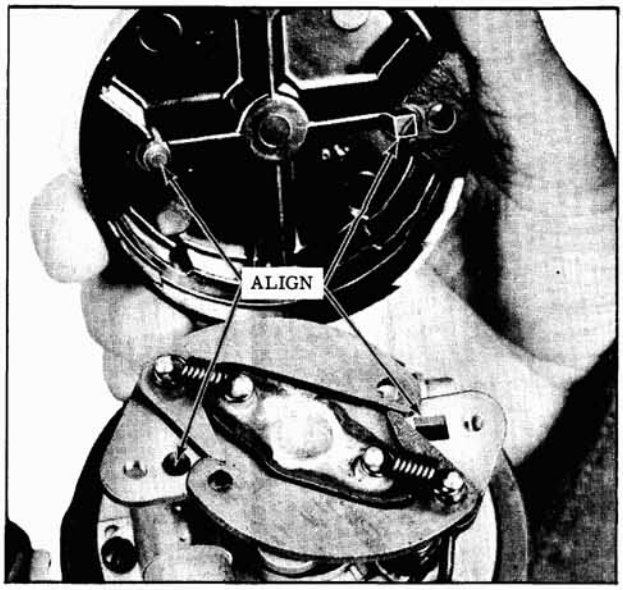


Fig. 12-60—Installing Rotor

lights, then give the wrench one-half turn in the opposite direction.

When distributor has been installed in car, point opening must be reset by connecting a dwell meter to the primary distributor lead terminal on the coil and a suitable ground. The dwell angle must be set at 30° with the engine running at idle speed.

Rotor (Except L-6)

The rotor is retained by two screws and is provided with round and square lugs which engage with the mechanical advance plate so that the rotor may be installed in only one position. (Fig. 12-60)

Mechanical Advance (Except L-6)

The mechanical advance weights and springs are accessible by removing the rotor. The mechanical advance plate is assembled to the breaker cam. In order to remove the breaker

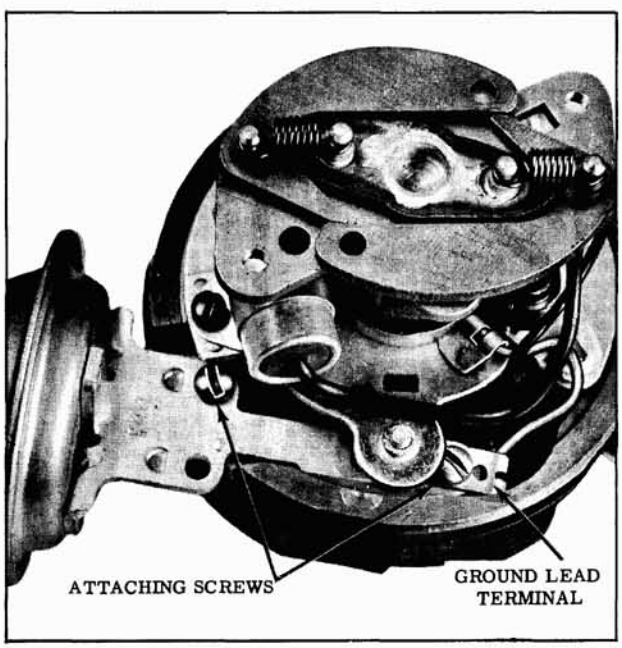


Fig. 12-61—Vacuum Advance Unit

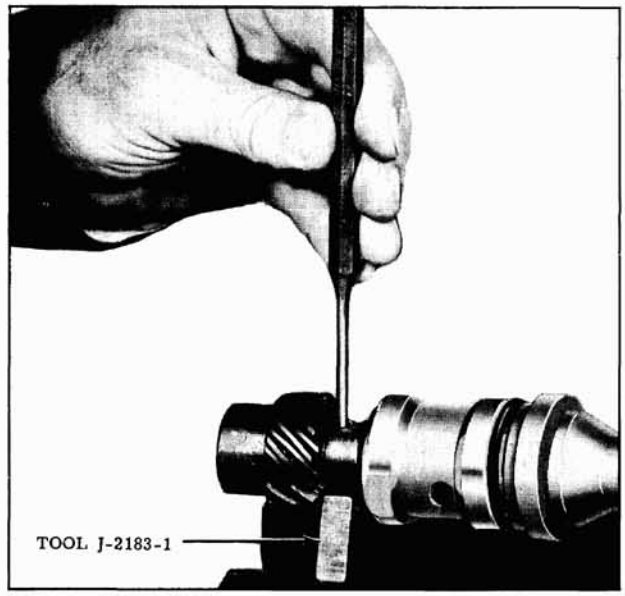


Fig. 12-62—Removing Roll Pin

cam and advance plate, follow the procedure for DISTRIBUTOR-DISASSEMBLY and ASSEMBLY.

VACUUM ADVANCE UNIT (Except L-6)

Removal

1. Remove the two vacuum advance attaching screws. (Fig. 12-61)
2. Turn the breaker plate clockwise and push the rod end of the vacuum advance down so that it will disengage and clear the breaker plate. Remove vacuum advance unit.

Installation

1. Position the rubber sleeve over the rod end of the vacuum advance.
2. Insert the rod end of the unit between the housing and the breaker plate.
3. Turn the breaker plate clockwise so that the rod end can be inserted into the hole in the breaker plate.
4. Install the attaching screws with the ground lead terminal under the inner mounting screw. (Fig. 12-61)

DISTRIBUTOR (EXCEPT L-6)

Disassembly

1. Mark distributor shaft and gear so that they may be reassembled in the same position.
2. Drive out the roll pin. (Fig. 12-62)
3. Pull the distributor assembly from the gear and pull the distributor shaft and breaker cam from the housing.
4. Remove the retaining ring from the upper bushing and lift the breaker plate and felt wick from the bushing. (Fig. 12-63)
5. Remove the two retaining screws and the vacuum advance.

Assembly

1. Install the vacuum advance with the ground lead terminal under the inner mounting screw. (Fig. 12-61)
2. Place the felt wick on the upper bushing, then place the breaker plate over the upper bushing and vacuum advance link.
3. Install the retaining ring on the upper housing.
4. Slide the distributor shaft through housing bushings.

5. Push the driven gear onto the distributor shaft with the holes aligned.
6. Install the roll pin.
7. Check and adjust dwell angle, vacuum advance, the mechanical advance. Refer to ELECTRICAL SPECIFICATIONS (Distributor).

DISTRIBUTOR L-6

(Figs. 12-64, 12-65, and 12-66)

Description

The distributor cap (Fig. 12-67 is bolted directly to the housing and no provision is made to adjust the dwell angle with the motor running. The contact point set is replaced as a complete assembly. Only the point opening requires adjustment after replacement.

Under part throttle operation, the intake manifold vacuum actuates the vacuum control diaphragm, thus advancing the spark and increasing fuel economy. During fast acceleration or when the engine is pulling heavily, the vacuum is not sufficient to actuate the diaphragm; therefore, the movable breaker plate is held so that the ignition timing is retarded.

The centrifugal advance mechanism consists of a cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, the centrifugal advance weights move outward which advances the cam, causing the contact points to open earlier, thus advancing the spark.

SETTING DWELL ANGLE L-6 (Fig. 12-68)

The point opening of new points can be checked with a feeler gauge, but the use of a feeler gauge on rough or uncleaned

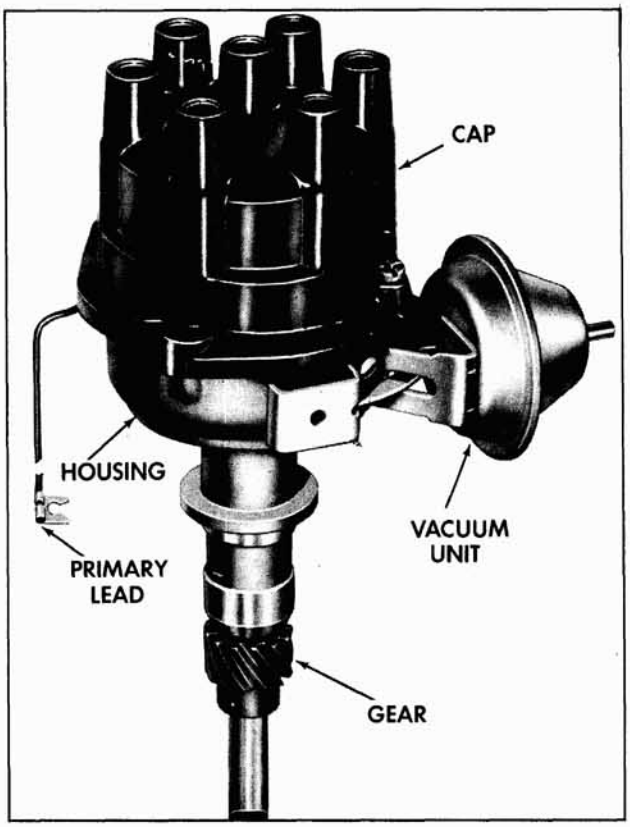


Fig. 12-64—Distributor (L-6)

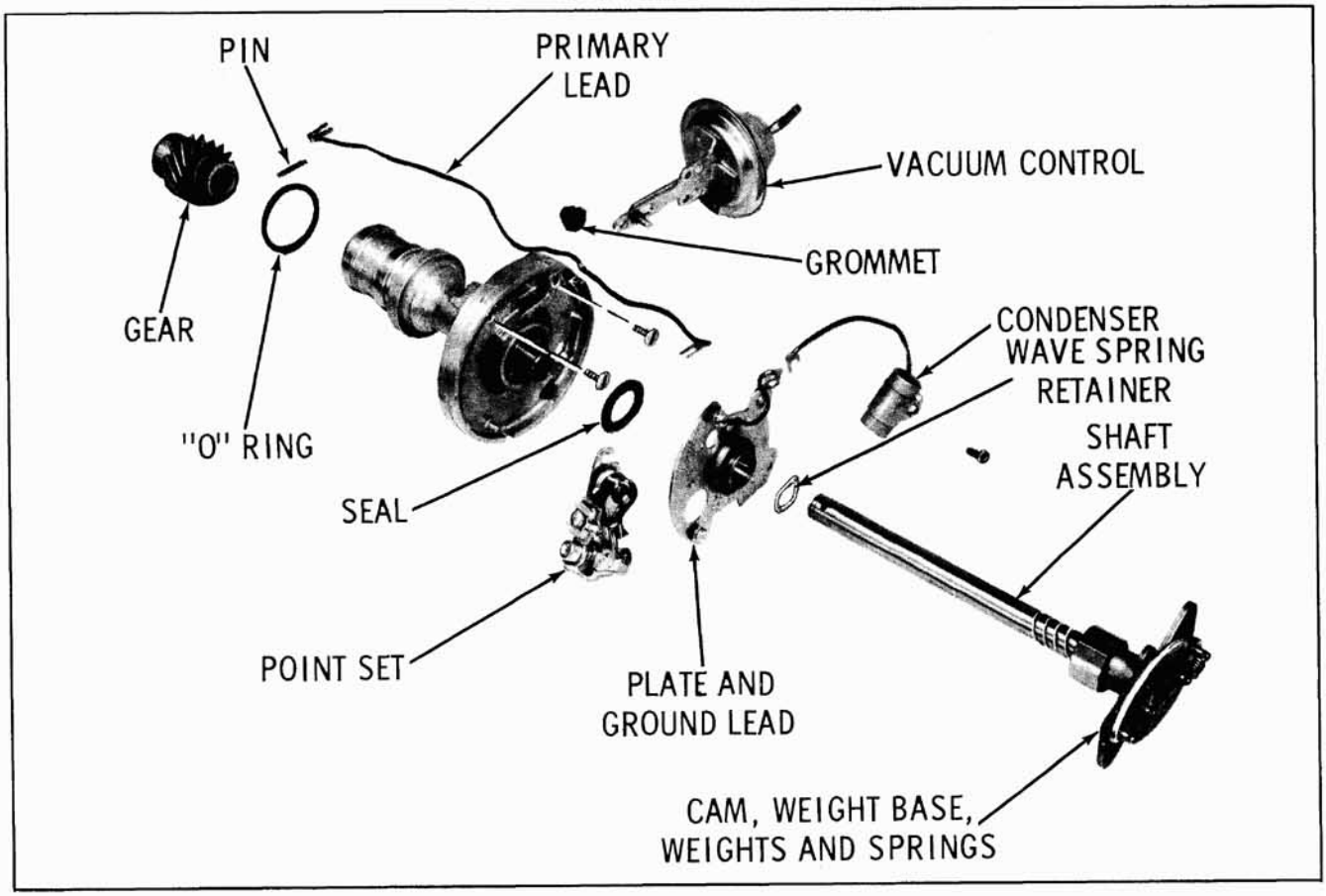


Fig. 12-63—Distributor Disassembled

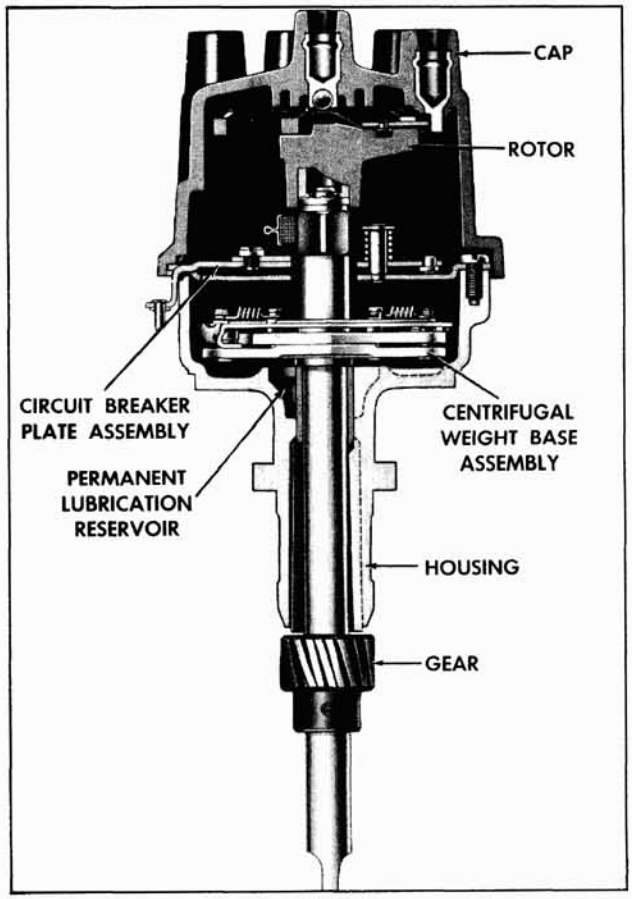


Fig. 12-65—Cutaway of L-6 Distributor

used points is not recommended since accurate mechanical gauging cannot be done on such points.

Contact points must be set to the proper opening. Points set too close may tend to burn and pit rapidly. Points with excessive separation tend to cause a weak spark at high speed.

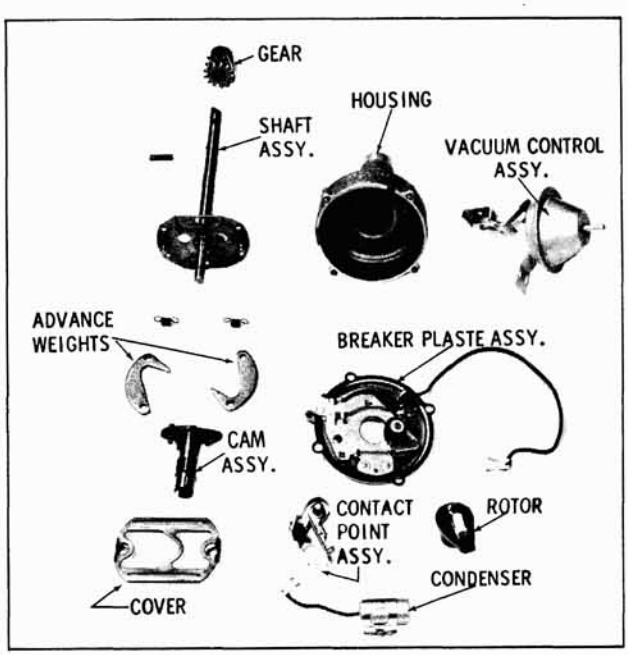


Fig. 12-66—Distributor Disassembled (L-6)

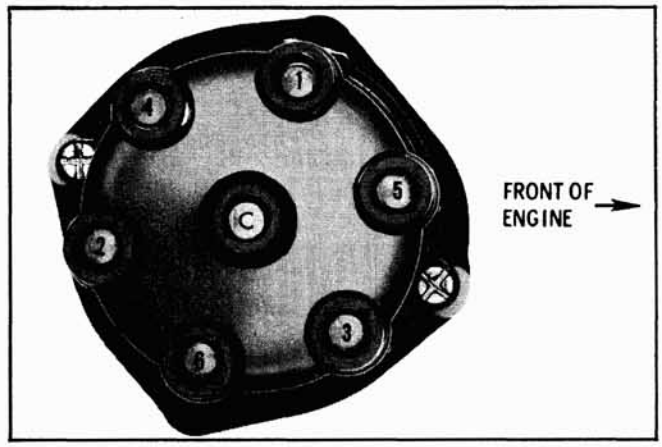


Fig. 12-67—Distributor Cap (L-6)

Proper point setting is:

.019" for new points
.016" for used points

New points must be set to the larger opening as the rubbing block will wear down slightly while seating to the cam. Contact points should be cleaned before adjusting if they have been in service.

To adjust the contact point opening:

1. If necessary, align points by bending the fixed contact support. Do not bend the breaker lever. Do not attempt to align used points; replace them where serious misalignment is observed. Use an aligning tool if available.
2. Turn or crank the distributor shaft until the breaker arm rubbing block is on the high point of the cam lobe. This will provide maximum point opening.
3. Loosen the contact support lock screw.
4. Use a screw driver (Fig. 12-68) to move the point support to obtain a .019" opening for new points and a .016" opening for used points.
5. Tighten the contact support lock screw and recheck the point opening.
6. After checking and adjusting the contact point opening to specifications, the cam angle or dwell should be checked with a dwell angle meter if such equipment is available. Correct dwell angle is 31° to 34°. If the cam angle is less than the specified minimum, check for defective or misaligned contact points or worn distributor cam lobes. The variation in cam angle readings between idle speed and 1750 engine rpm should not exceed 3°. Excessive variation in this speed range indicates wear in the distributor.

Cam angle readings taken at speeds above 1750 engine rpm may prove unreliable on some cam angle meters.

BREAKER POINT

Removal

1. Release distributor cap hold-down screws, remove cap and place it out of work area.
2. Remove rotor.
3. Pull primary and condenser lead wires from contact point quick disconnect terminal.
4. Remove contact set attaching screw, lift contact point set from breaker plate.
5. Clean breaker plate of oil smudge and dirt.
6. Place new contact point assembly in position on breaker plate, install attaching screw.

Carefully wipe protective film from point set prior to installation.

Pilot on contact set must engage matching hole in breaker plate.

7. Connect primary and condenser lead wires to quick disconnect terminal on contact point set.
8. Check and adjust points for proper alignment and breaker arm spring tension. Use an aligning tool to bend stationary contact support if points need alignment.

The contact point pressure must fall within specified limits. Weak tension will cause chatter resulting in arcing and burning of the points and an ignition miss at high speed, while excessive tension will cause undue wear of the contact points, cam and rubbing block. Breaker arm spring tension should be 19-23 ounces. The contact point pressure should be checked with a spring gauge. The scale should be hooked to the breaker lever and the pull exerted at 90 degrees to the breaker lever. The reading should be taken just as the points separate. The pressure can be adjusted by bending the breaker lever spring. If the pressure is excessive, it can be decreased by pinching the spring carefully. To increase pressure, the lever must be removed from the distributor so the spring can be bent away from the lever. Avoid excessive spring distortion.

9. Set point opening (.019" for new points).
10. Add a small amount of cam and bearing lubricant to the breaker cam.
11. Reinstall rotor, position and install distributor cap to housing.
12. Start engine and test point dwell and ignition timing.

DISTRIBUTOR

Removal

1. Release the distributor cap hold-down screws, remove the cap and place it clear of the work area.

If necessary, remove secondary leads from the distributor cap after first marking the cap tower for the lead to No. 1 cylinder. This will aid in the reinstallation of leads in the cap.

2. Disconnect the distributor primary lead from the coil terminal.
3. Scribe a realignment mark on the distributor bowl and engine in line with the rotor segment.
4. Disconnect vacuum line to distributor, remove the distributor hold-down bolt and clamp, remove the distributor from the engine. Note position of vacuum advance mechanism relative to the engine.

Avoid cranking the engine with the distributor removed as the ignition timing will be upset.

It is advisable to place the distributor in a distributor testing machine or synchroscope prior to disassembly. When mounting distributors for test, first secure the gear in the test drive mechanism, then push the distributor housing downward toward the gear to take up any end play between the gear and the housing.

Test the distributor for variation of spark, correct centrifugal and vacuum advance and condition of contacts. This test will give valuable information on distributor condition and indicate parts replacement which may be necessary. Check the area on the breaker plate just beneath the contact points. A smudgy line indicates that oil or crankcase vapors have been present between the points.

Disassembly

1. Remove the rotor.
2. Remove the vacuum control assembly retaining screws, detach the unit from the distributor housing.
3. Disconnect the primary and condenser leads from the contact point quick disconnect terminal, remove the contact point set attaching screw, condenser attaching screw. Remove the point set and condenser from the breaker plate.
4. Remove the breaker plate attaching screws, remove the breaker plate from the distributor housing. (Fig. 12-66)

Do not disassemble breaker plate any further.

5. Remove the roll pin retaining the driven gear to the mainshaft, slide the gear from the shaft.
6. Slide the cam and mainshaft from the distributor housing.
7. Remove the weight cover and stop plate screws, remove the cover, weight springs, weights and slide cam assembly from the mainshaft.

CLEANING AND INSPECTION

1. Wash all parts in cleaning solvent except cap, rotor, condenser, breaker plate assembly and vacuum control unit. Degreasing compounds may damage insulation of these parts or saturate the lubricating felt in the case of the breaker plate assembly.
2. Inspect the breaker plate assembly for damage or wear and replace if necessary.
3. Inspect the shaft for wear and check its fit in the bushings in the distributor body. If the shaft or bushings are worn, the parts should be replaced.
4. Mount the shaft in "V" blocks and check the shaft alignment with a dial gauge. The runout should not exceed .002".
5. Inspect the advance weights for wear or burrs and free fit on their pivot pins.
6. Inspect the cam for wear or roughness. Then check its fit on the end of the shaft. It should be absolutely free without any roughness.
7. Inspect the condition of the distributor points. Dirty points should be cleaned and badly pitted points should be replaced.
8. Test the condenser for series resistance, microfarad capacity (.18 to .23) and leakage or breakdown, following the

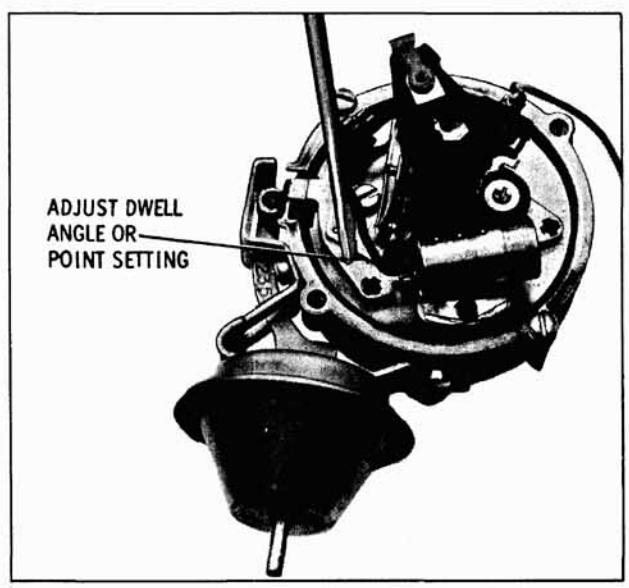


Fig. 12-68—Dwell Setting - Point Opening (L-6)

instructions given by the manufacturer of the test equipment used.

9. Inspect the distributor cap and spark plug wires for damage and replace if necessary.

Assembly

1. Replace cam assembly to mainshaft.
2. Install governor weights on their pivot pins, replace weight springs. Install weight cover and stop plate.
3. Lubricate mainshaft and install it in distributor housing.
4. Install distributor driven gear to mainshaft and insert retaining roll pin. Check to see that shaft turns freely.
5. Install breaker plate assembly in the distributor body and attach retaining screws.
6. Attach condenser and contact point set in proper location and appropriate attaching screws.

Contact point set pilot must engage matching hole in breaker plate. Connect primary and condenser leads to contact set quick-disconnect terminal.

7. Attach vacuum control assembly to distributor housing.
8. Check and adjust contact point opening and alignment.
9. Check breaker lever spring tension which should be 19-23 ounces.

Installation

1. Turn the rotor about 1/8 turn in a clockwise direction past the mark previously placed on the distributor housing to locate rotor.
2. Push the distributor down into position in the block with the housing in a normal "installed" position.

It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place.

3. Tighten the distributor clamp bolt snugly and connect vacuum line. Connect primary wire to coil terminal and install cap. Also install spark plug and high tension wires if removed.

It is important that the spark plug wires be installed in their proper location in the supports.

4. Time ignition as previously described under Tune-Up in Section 6C.

CAPACITOR DISCHARGE IGNITION SYSTEM

The C. D. (Capacitor Discharge) ignition system includes a pulse distributor, an ignition pulse amplifier and a special coil. The system operates to charge a capacitor to a high voltage which, on a signal from the distributor, is then discharged through the ignition coil primary to fire the spark plugs.

The distributor (Fig. 12-69) resembles a standard distributor; the only external difference is the red cap on the C. D. system. Inside the C. D. distributor (Fig. 12-70) an iron timer core replaces the conventional breaker cam. The timer core has the same number of equally spaced projections as engine cylinders. The timer core rotates inside a magnetic pickup assembly, which replaces the conventional breaker plate, contact point set and condenser assembly.

The magnetic pickup assembly consists of a ceramic permanent magnet, a pole piece and a pickup coil. The pole piece is a metal plate having equally spaced internal teeth, one tooth for each cylinder of the engine. The magnetic pickup assembly is mounted over the main bearing on the distributor housing and is actuated by the vacuum control unit to provide vacuum advance. The timer core is moved by conventional advance weights to provide centrifugal advance (mechanical).

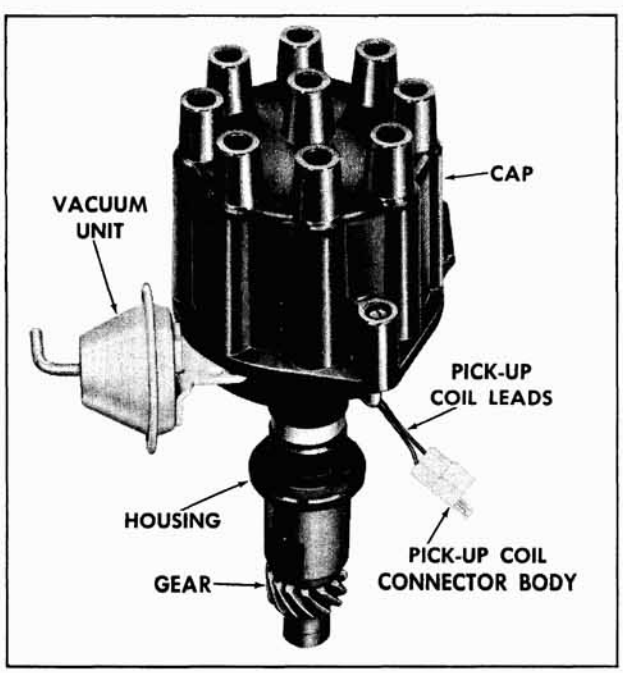


Fig. 12-69—C.D. Distributor

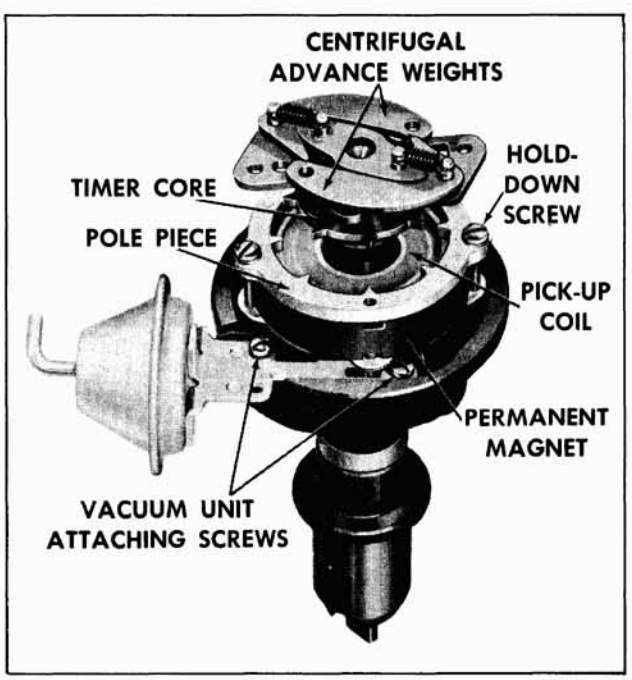


Fig. 12-70—C.D. Distributor

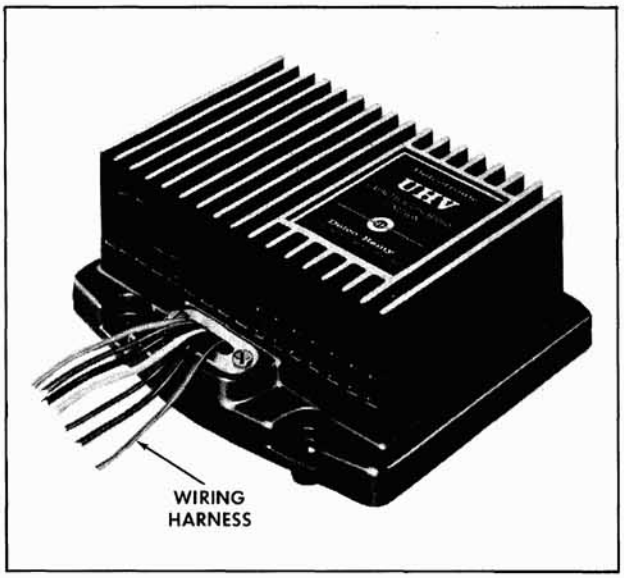


Fig. 12-71—Amplifier

The ignition pulse amplifier (Fig. 12-71) consists of transistors, diodes, resistors, capacitors, a thyristor and a transformer. These components are mounted on a printed circuit panelboard; there are no moving parts in the amplifier. Fig. 12-72 shows location of the various components in the system.

PRINCIPLES OF OPERATION

Transistor Q2 and accompanying circuitry momentarily supplies voltage through the primary of transformer T1. This voltage is increased through transformer action and a much higher voltage is induced in the secondary. The four diodes, CR3, 4, 5 and 6 form a full wave rectifier which has the capability of delivering maximum DC voltage from the transformer T1 secondary. It is this voltage that charges the capacitor C1.

The following is a list of the parts, and their function, used in the amplifier as shown in Fig. 12-73.

Transistor

Q1	Initiates turn-on and turn-off of Q5.
Q2	Turns T1 primary on and off.
Q3	Turns Q2 on and off with engine running.
Q4	Triggers Thyristor THY.
Q5	When on, it turns off Q3 and Q4.

Diode

CR1	Blocks 3 line current through CR2.
CR2 (Zener)	Clips T1 primary voltage to limit secondary output to approximately 300 volts across C1.
CR3,CR4, CR5,CR6	Provide full wave rectification of T1 secondary voltage.
CR7	Provides proper bias to Q2.
CR8	Clips FB voltage of T1 to limit reverse voltage across E-B of Q2.

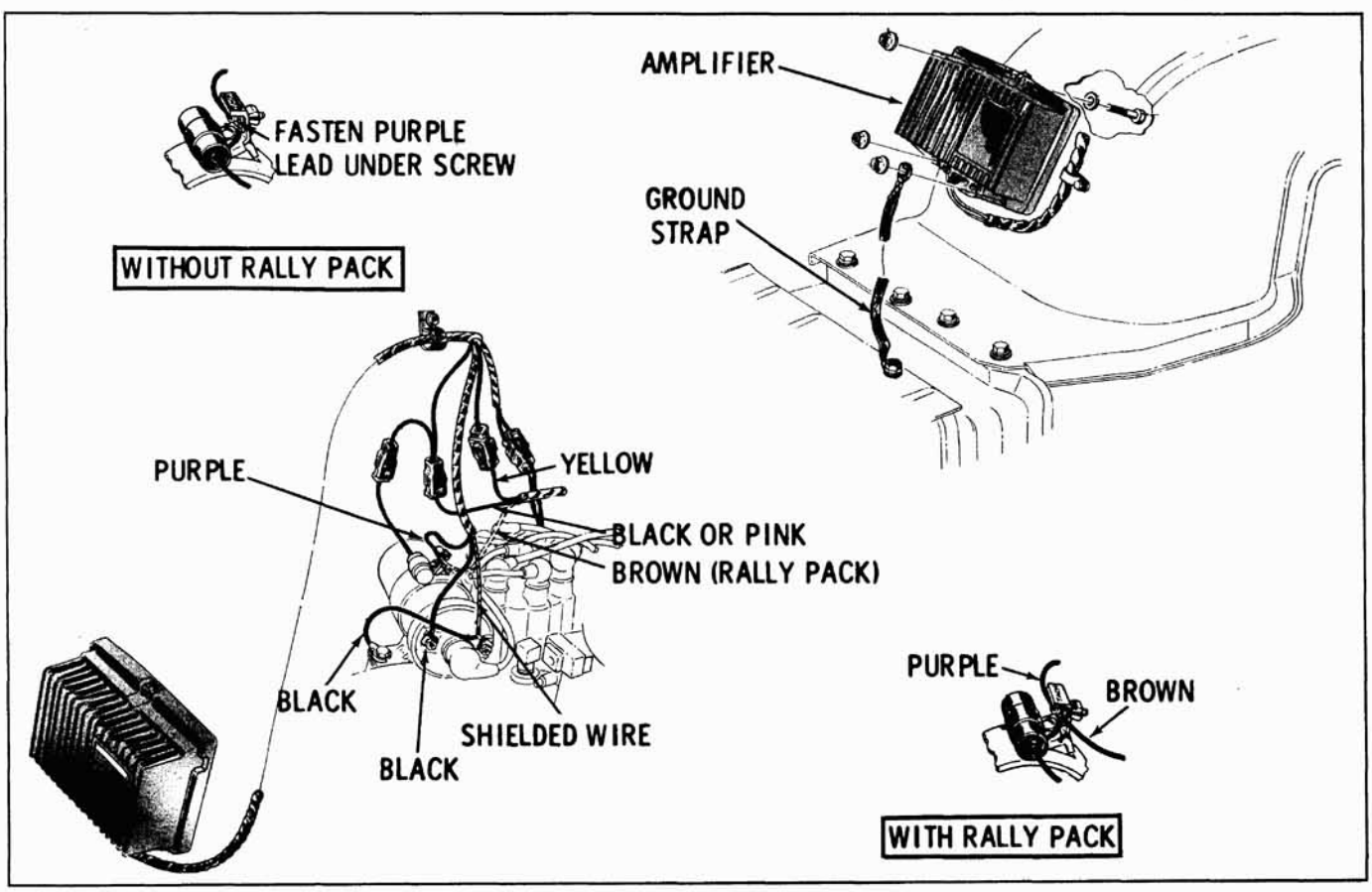


Fig. 12-72—Pictorial Diagram

CR9	Provides proper biasing of THY.
CR10	Eliminates reverse voltage across THY, allows ignition coil primary to partially recharge C1.
CR11	Provides proper biasing of THY.
CR12	With C7 and R17 reduces rate of voltage increase across THY.
CR13	Protects amplifier in case of battery reverse polarity, or lead reversal.
CR15	Half wave rectifies T1 tachometer winding voltages for proper tachometer operation.
CR16	With R19 prevents erroneous tachometer reading during cranking.

Resistor

R1	Prevents T1 secondary rectified voltage from being shorted to ground when THY is on.
R2	Provides proper biasing of Q3.
R3	Limits current through Q3.
R4	Provides proper biasing of Q2.
R5	Prevents damage to amplifier if #2 lead is grounded.
R6	Limits current through Q5.
R7	Provides proper biasing of Q4.
R8	Limits current through Q4.
R9	Provides feed back for Q1, holds Q1 on after pick up coil voltage has ceased.
R10	Provides signal to Q5 when Q1 turns on.
R11	Limits current through Q2 from FB winding of T1.
R12	Provides bias to THY.
R13	Biases B-E of Q5.
R14	Biases E-B of Q1.
R15	Allows C1 to bleed off during shut-down.
R16	Provides proper voltage to tachometer.
R17	Reduces rate of voltage change imposed on THY when C7 discharges.
R18	Prevents damage to amplifier if #1 lead is grounded.
R19	With CR16 prevents erroneous tachometer reading during cranking.

Capacitor

C1	Stores charge from T1 to energize ignition coil primary.
C2	Protects Q1 from transient voltages.
C3	Turns Q3 off.
C4	Turns Q4 off.
C5	Protects Q4 from transient voltages.
C6	Protects Q1 from transient voltages.
C7	With CR12 and R17 reduces rate of voltage increase across THY.
C8	Reduces radio noise.

Transformer

T1	Steps up voltage to charge C1; provides voltage to operate tachometer; provides feed back voltage to operate Q2.

Thyristor

THY	Discharges C1 through primary of ignition coil.

TROUBLE SHOOTING PROCEDURES

The special coil used in this system cannot be tested on a conventional coil tester.

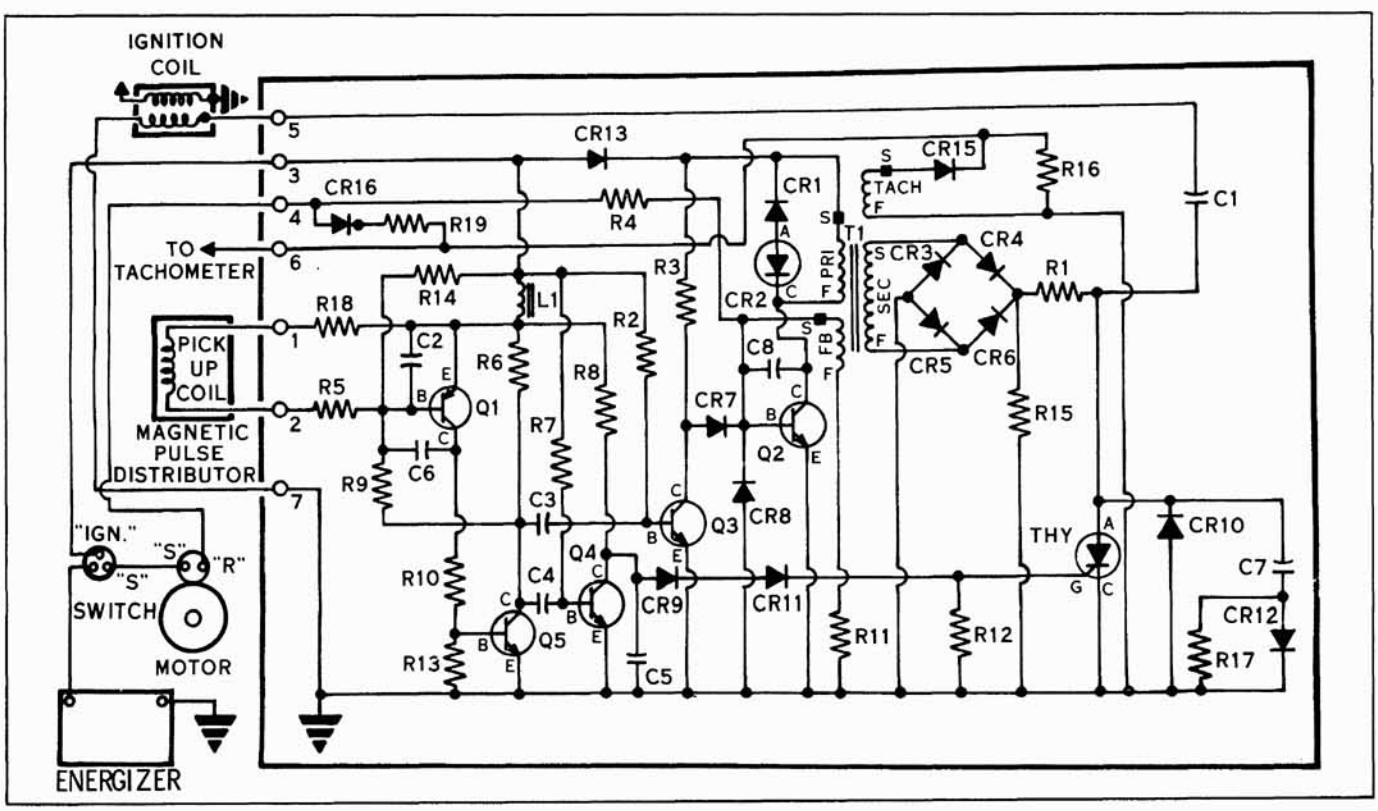


Fig. 12-73—C.D. Schematic

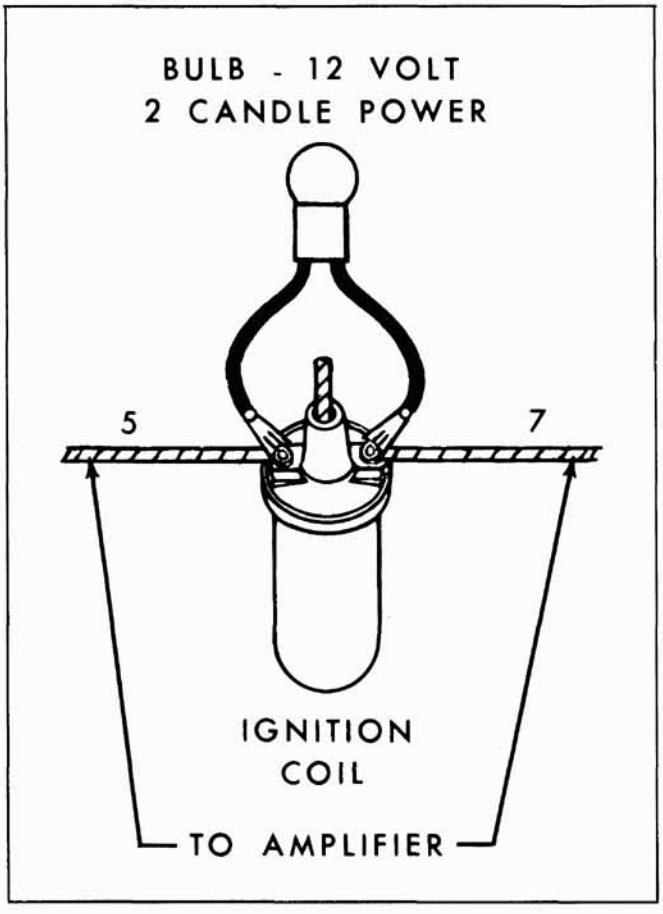


Fig. 12-74—Amplifier Output Test

Faulty engine performance usually will be evidenced by one of the following conditions:

A. Engine will not run at all.
B. Engine will start but not run.
C. Engine miss or surge.

When troubleshooting the system, use care to avoid accidental shorts or grounds, which may cause instant damage to the amplifier and wiring.

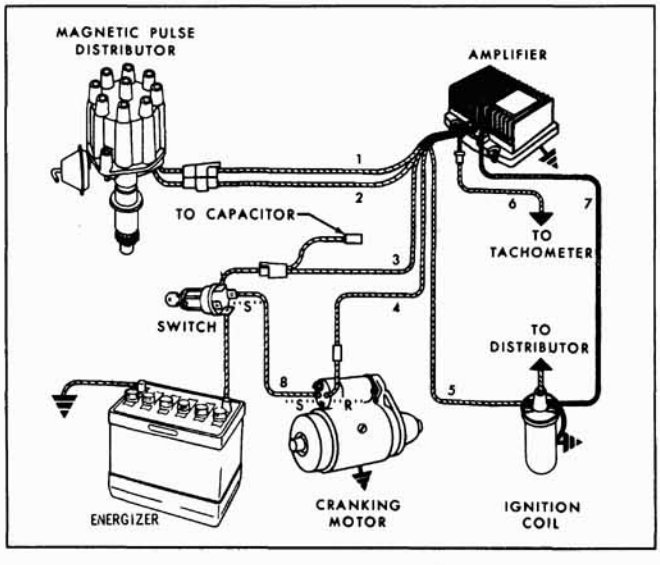


Fig. 12-75—Pictorial Diagram

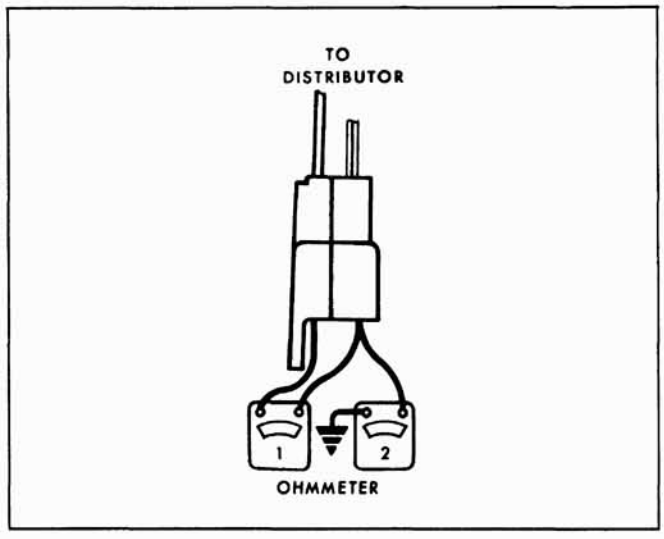


Fig. 12-76—Distributor Test

A. ENGINE WILL NOT RUN AT ALL

To determine if the ignition system is operating, hold one spark plug lead about 1/4 inch from the engine block and crank the engine. If sparking occurs, the trouble most likely is not ignition. If sparking does not occur, and the vehicle fuel system is satisfactory, check the ignition system. The spark plugs, wiring, distributor cap and rotor can be checked in the conventional manner. Only the coil requires a different procedure. The ignition coil can be checked for primary and secondary winding continuity with an ohmmeter as follows: With leads disconnected from coil, connect ohmmeter across primary terminals. If reading is infinite, winding is open. To check secondary, connect ohmmeter to high voltage (center tower) and coil case. An infinite reading means coil secondary is open.

When checking secondary, use middle or high resistance range on ohmmeter.

Amplifier

Check the amplifier as follows:

1. Temporarily connect a jumper lead from the amplifier housing to a good ground.

If the engine will now start and run, the amplifier is not properly grounded. Correct as required.

2. Connect a 12-volt 2-candlepower bulb, to the primary terminals of the ignition coil. (Fig. 12-74)

A test bulb socket with leads is available from United Motors Service and other sources.

3. Crank the engine.

a. If the bulb flickers on and off, the amplifier is operating properly. In this case, recheck the secondary system for the cause of the "no run" condition.

b. If the bulb does not flicker on and off, proceed to Distributor Checks.

Distributor Checks

To check the distributor, observe the following procedure.

1. Insure that the two distributor leads are connected to the distributor connector body as shown in Fig. 12-75.

2. With the distributor connector disconnected from the harness connector, connect an ohmmeter (1) to the two terminals of the distributor connector as shown in Fig. 12-76.

3. Connect a test stand vacuum source to the distributor,

and observe the ohmmeter reading throughout the vacuum range. (The distributor need not be removed from the engine.)

4. Any reading outside the 550-750 ohm range indicates a defective pickup coil in the distributor.
5. Remove one ohmmeter (2) lead from the connector body and connect to ground. (Fig. 12-76)
6. Observe the ohmmeter reading throughout the vacuum range.
7. Any reading less than infinite indicates a defective pickup coil.
8. Reconnect the harness connector to the distributor connector.

Continuity Checks

Carefully inspect all wiring connections to insure that they are clean and tight. If satisfactory, disconnect the amplifier No. 3 and No. 4 leads from the two connectors. Proceed as follows:

1. Connect a voltmeter from ground to the No. 4 connector lead.
2. Turn switch to "Start" position.
3. If reading is zero, circuit is open between connector body and battery.
4. If reading is obtained, connect voltmeter from ground to the No. 3 connector lead.
5. Turn switch to the run position.
6. If reading is zero, circuit is open between connector body and switch.
7. If reading is obtained, replace amplifier.

B. ENGINE WILL START BUT NOT RUN

If the engine starts, but then stops when the switch is returned to the run position, check as follows:

1. Insure that the leads are properly connected in the No. 3 lead connector body.
2. If satisfactory, connect a voltmeter from ground to the terminal connection inside the connector.
3. Turn switch to run position.
4. If reading is zero, lead between connector and ignition switch is open.
5. If reading is obtained, replace amplifier.

C. ENGINE MISS OR SURGE

The vehicle fuel system should be checked in the usual manner. If satisfactory, check the ignition system as follows:

Timing, Spark Plugs, Wiring, Distributor Cap and Ignition Coil

Checks in these areas should be made in the same manner as for a standard ignition system. In particular the spark plugs should be checked in the usual manner as recommended by the manufacturer. Also the timing, the high-voltage wiring, the ignition coil tower, and the distributor cap inside and out should be checked or inspected for evidence of arc-over or leakage to ground. The ignition coil can be checked for primary and secondary winding continuity with an ohmmeter, as follows: Disconnect coil leads and connect ohmmeter across primary terminals. If reading is infinite (No Reading) winding is open. To check secondary, connect ohmmeter to high voltage (center tower) and coil case. An infinite reading means coil secondary is open.

When checking secondary, use middle or high resistance range on ohmmeter.

Amplifier

A poorly grounded amplifier can cause an engine miss or surge. To check, temporarily connect a jumper lead from the amplifier housing to a good ground. If the engine performance improves, the amplifier is poorly grounded. Correct as required.

If no defects up to this point have been found, and the secondary system (plugs, wiring, distributor cap and coil) have been thoroughly checked, the most likely cause of the engine miss condition is a defective amplifier.

Removal—C. D. Distributor

1. Disconnect the harness connector.
2. Remove distributor cap as shown in Fig. 12-56.

If necessary to remove secondary wires from cap, mark position on cap tower for lead to No. 1 cylinder. This will aid in reinstallation of leads.

3. Remove vacuum hose line from vacuum advance unit.
4. Remove distributor clamp screw and hold down clamp.
5. Note position of rotor, then pull distributor up until rotor just stops turning counterclockwise and again note position of rotor.

To install, reverse removal procedure.

To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted in Step 5.

If the engine has been turned after the distributor was removed, it will be necessary to install a jumper wire and crank engine until the saw slot on the harmonic balancer indexes with the 0° timing mark on the engine front cover. If both valves of the No. 1 cylinder are closed, the piston will be on top dead center of the firing stroke.

Disassemble Distributor (Fig. 12-77)

1. Remove screws securing rotor and remove rotor.
2. Remove centrifugal weight springs if necessary.
3. Remove centrifugal weights.
4. Remove roll pin.
5. Remove drive gear and washer.
6. Remove drive shaft.
7. Remove weight support and timer core from drive shaft.
8. Remove screws securing magnetic core assembly and remove assembly.
9. Remove connector from primary lead by disengaging leads from connector.
10. Remove coil assembly.
11. Remove retaining ring which secures magnetic core support plate and remove plate.
12. Remove brass washer and felt.
13. Remove vacuum advance unit.

To assemble, reverse disassemble procedure.

Removal C. D. Amplifier (Fig. 12-72)

1. Disconnect negative battery cable.
2. Disconnect the following leads from the amplifier harness assembly.
   a. Tachometer Pickup
   b. Harness Ground
   c. + and - Coil Wires
   d. Distributor Connector
   e. Connectors at Fuse Panel
   f. Connector at Junction Block
3. Remove three retaining nuts from amplifier assembly and remove amplifier.

To install, reverse removal procedure.

No adjustments can be made to the C. D. Ignition System and no periodic maintenance is required.

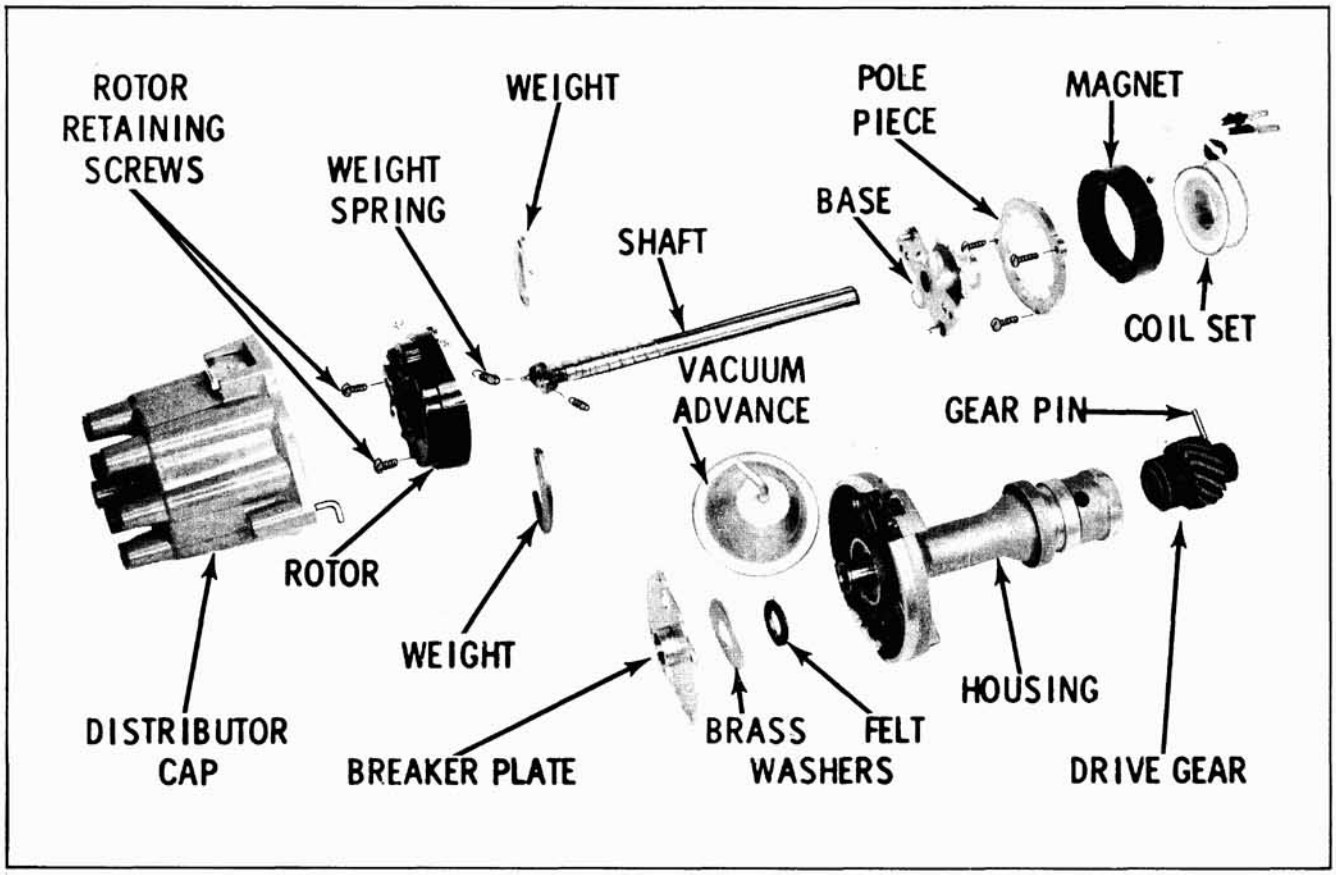


Fig. 12-77—C.D. Distributor Disassembled

THE FOLLOWING MATERIAL APPLIES TO EITHER THE C.D. IGNITION SYSTEM OR THE STANDARD IGNITION SYSTEM WITH THE EXCEPTION OF IGNITION SYSTEM DIAGNOSIS.

IGNITION COIL AND IGNITION RESISTOR (Except C.D. System)

The ignition resistor, connected in series with the primary circuit between the battery and coil, limits the primary current at low speeds and allows the coil to operate at maximum efficiency at road speeds. The resistor is by-passed during cranking, thereby connecting the ignition coil directly to the battery. This makes full battery voltage available at the coil and keeps ignition voltage as high as possible during cranking. The by-passing of the resistor during cranking is accomplished at the "R" terminal of the starter solenoid.

IGNITION AND STARTING SWITCH

The ignition and starting switch is key-operated to close the ignition primary circuit and to energize the solenoid for cranking. The ignition key must be turned to the extreme clockwise position to energize the starter solenoid. Spring tension returns the key to the normal ignition position when it is released.

The ignition resistor is by-passed during cranking through a contact in the starter instead of through a contact in the ignition switch.

With this system, the starter must not be energized when the ignition switch is in the "off" position. In this position, the ignition system primary is grounded in the ignition switch. Energizing the starter will cause damage to the ground contact in the ignition switch and to the ignition contact in the starter solenoid.

Accessories may be used when the engine is not running if the ignition key is turned counterclockwise.

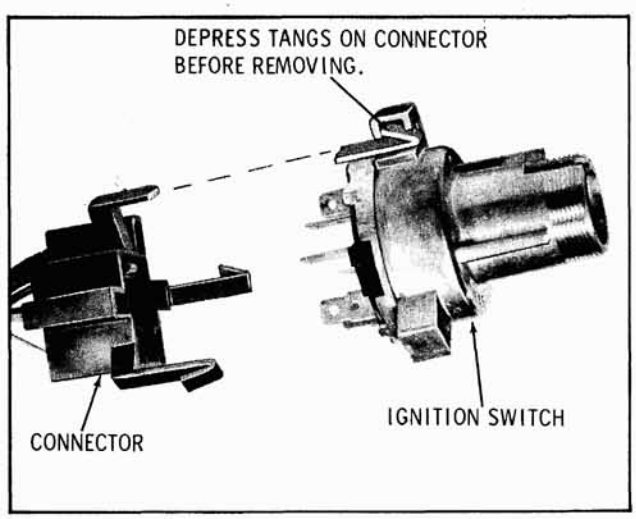


Fig. 12-78—Ignition Switch

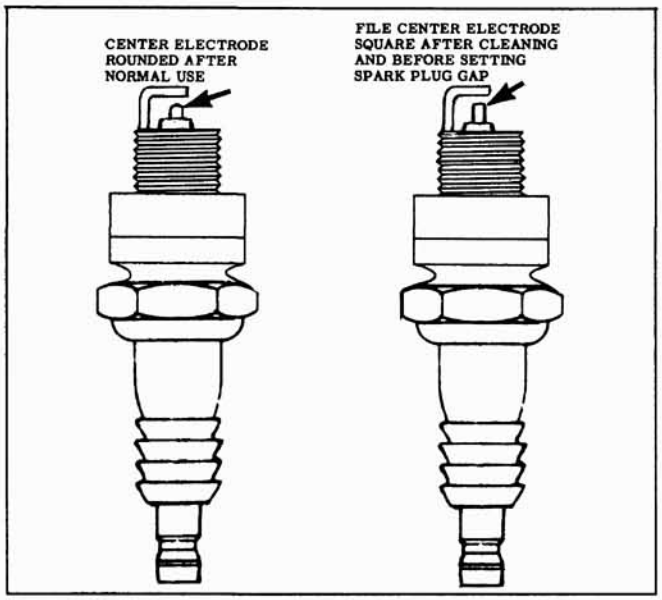


Fig. 12-79—Filing Center Electrode

Removal and Installation

1. Disconnect battery.
2. Insert key into ignition switch and press while turning fully counterclockwise. While holding the key in the counterclockwise position, depress the lock cylinder retainer with a thin wire through the small hole in the face of the lock cylinder.
3. Remove the key and lock cylinder.
4. Remove the ignition switch escutcheon.
5. After removing the ignition switch from the instrument panel, the connector can be removed as shown in Fig. 12-78.

To install, reverse the removal procedure.

SPARK PLUGS

Whenever spark plugs are removed from the car and cleaned, the following precautionary steps should be followed:

1. The center electrode should be filed flat before the gap setting is made. (Fig. 12-79) Spark plug gap should be .030", except L-6. L-6 - .035" and capacitor discharge ignition system - .045".

Do not file electrodes when setting gap on new plugs.

2. Any traces of paint or dirt should be cleaned from the spark plug procelain.
3. All plugs should be checked for cracks in the porcelain. These cracks are not always visible because they may be hidden by the steel body. Use a spark plug tester to test plugs. If the spark plug porcelain is cracked, a new spark plug must be installed.

SPARK PLUG CHART	
Engine	Spark Plug
V-8 L.C.	45S
V-8 H.C.	44S
L-6	46N

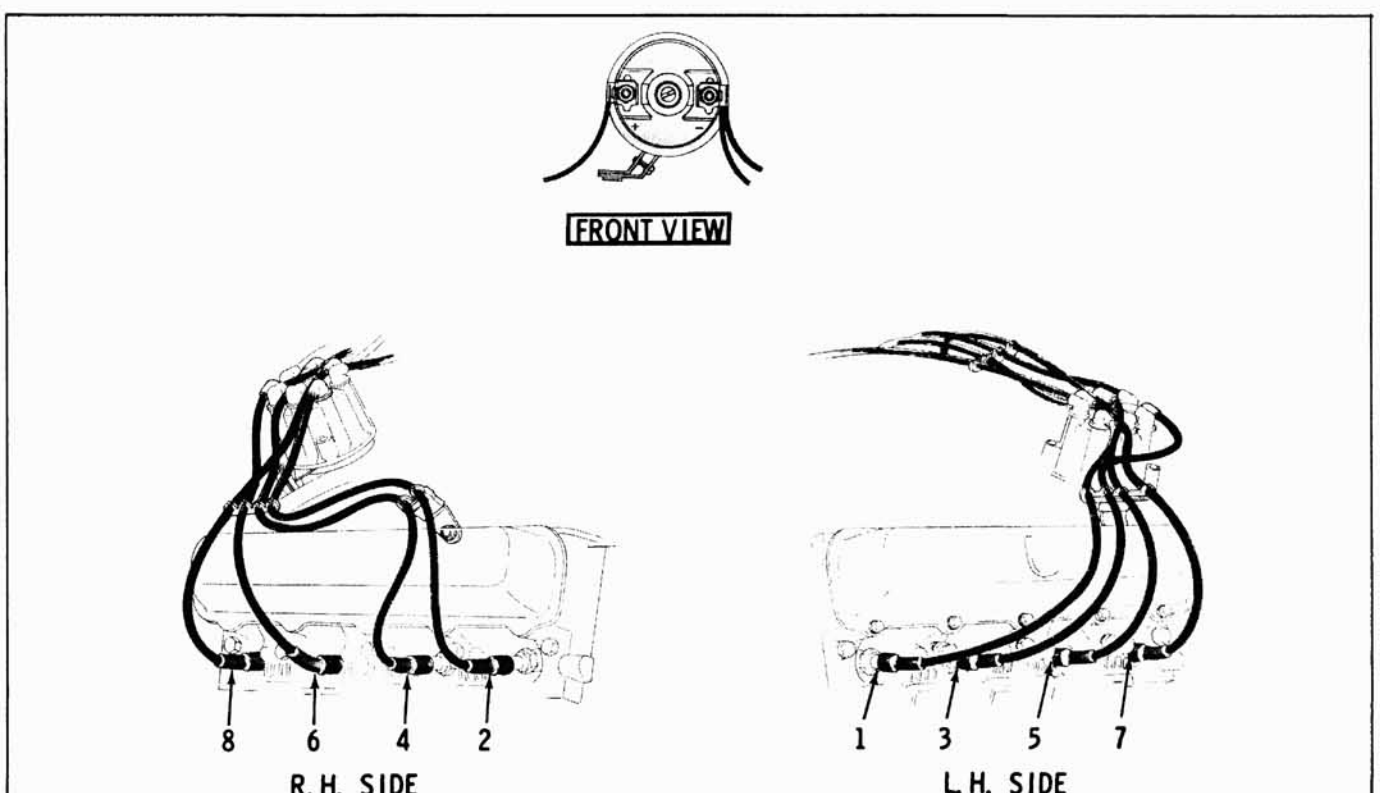


Fig. 12-80—Spark Plug Wiring (V-8 Engine)

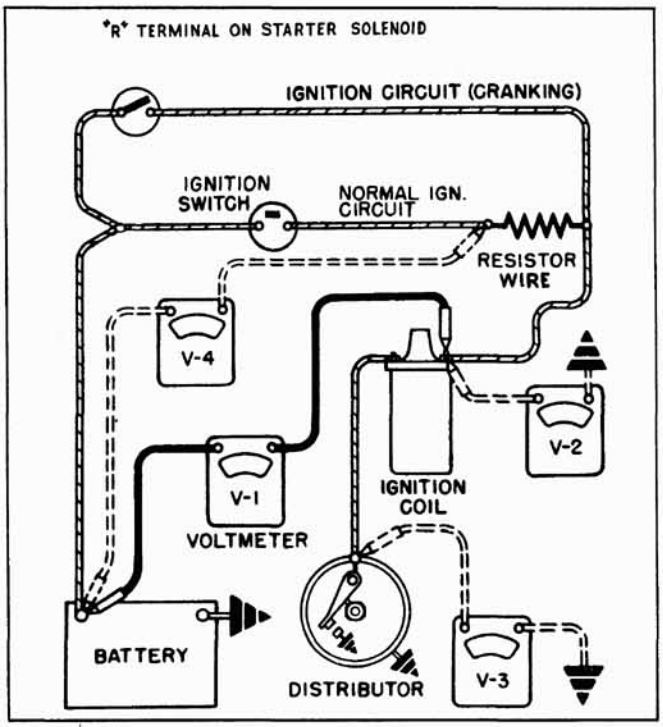


Fig. 12-81—Ignition System Test

IGNITION SYSTEM DIAGNOSIS

If the engine does not run, the ignition system may be at fault if:

1. There is no spark during cranking when a spark plug wire is held 1/4" from the engine.
2. The engine starts but immediately stops when the ignition switch is released from the "START" position.

If the above checks indicate that the ignition system is at fault, the following checks may be made to help locate the difficulty, or locating trouble in the ignition system if the car runs, but not satisfactory. (Fig. 12-81 and IGNITION SYSTEM CHECK CHART) All checks are to be made with the lights and accessories off and in the sequence shown.

MILLIAMP TEST

The milliamp test will indicate the presence of faulty ignition cables, cracked distributor cap, or burned rotor. Refer to Figs. 12-80 and 12-82 for spark plug wire routing.

When making a milliamp test, use the indicated reading values as furnished by the testing equipment manufacturers.

1. Connect tachometer, start engine, and set engine speed according to the directions on the test equipment.
2. Set meter knob to secondary efficiency position.
3. Ground positive lead.
4. Check each spark plug lead by connecting the negative lead of the meter directly to the cable. A variation of five graduations between plugs is allowable.
5. A low reading indicates high resistance in the circuit. If a low reading is encountered, disconnect the cable from the spark plug and check the reading again. If the reading increases, the spark plug is partially shorted.
6. A low reading with the cable disconnected from the spark plug indicates:
   a. Poor connection on either end of the cable.
   b. Burned or corroded connector inside the distributor cap.

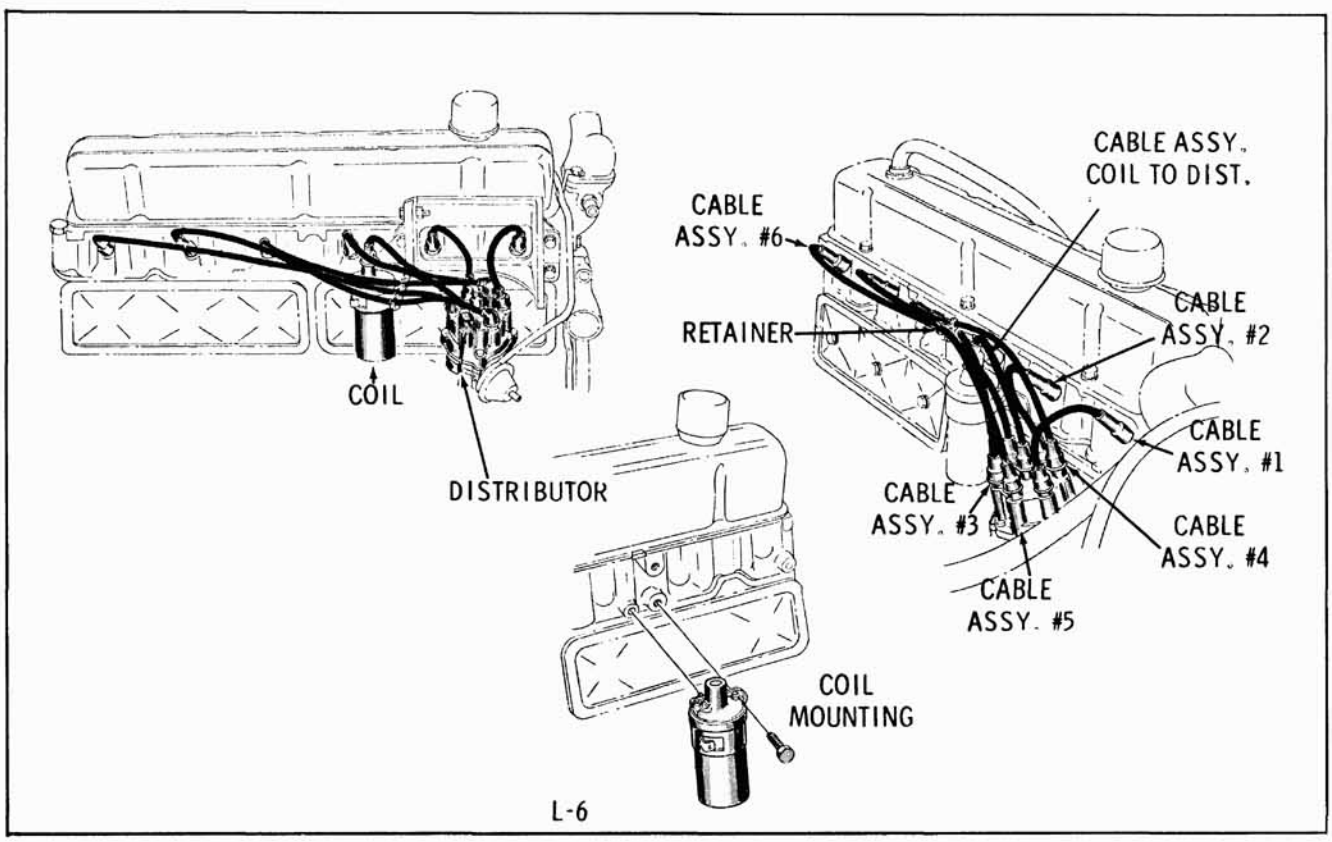


Fig. 12-82—Spark Plug Wiring (31 and 35 Series)

IGNITION SYSTEM CHECK CHART

Step No.	Operation	Specification	Possible Trouble
1	Check all connections in Primary and Secondary circuit		
2	Remove secondary coil wire from distributor cap. Hold 1/4" from engine while cranking and observe if spark occurs.		IF SPARK OCCURS: Distributor cap Rotor Spark plug wiring
3	Check Voltage V1 while cranking	1 volt Max.	Open circuit from battery side of coil to IGN, on ignition switch. Ignition switch not closing ignition circuit in start position. Ground in circuit from coil terminal to IGN, on ignition switch. Ground in coil.
4	Check Voltage V2 ignition switch "On", points open	Normal Battery	Low battery Points not open Ground in circuit from coil to distributor Ground in distributor Ground in coil Ground in circuit from coil to ignition switch or to resistor
5	Check Voltage V2 ignition switch "On", points closed	5 to 7 Volts	IF UNDER 5 VOLTS: Loose connection from resistor through ignition switch circuit to battery. Loose connection between resistor and coil. Resistor is open or has too much resistance. IF OVER 7 VOLTS: Loose connection between coil and distributor. Resistor out of circuit due to shorted or incorrect wiring. Resistor has too little resistance Coil primary is open
6	Check Voltage V3 ignition switch "On", points closed	0.2 Volt Max.	Contacts not closed Loose connection in distributor Distributor not grounded to engine Faulty contacts
7	Check Voltage V4 ignition switch "On", points closed	0.7 Volt Max.	Loose connection from resistor through ignition switch circuit to battery
8	If these checks fail to find cause of trouble - remove distributor and coil from engine and check to specifications. Also check wiring harness and ignition resistor.		

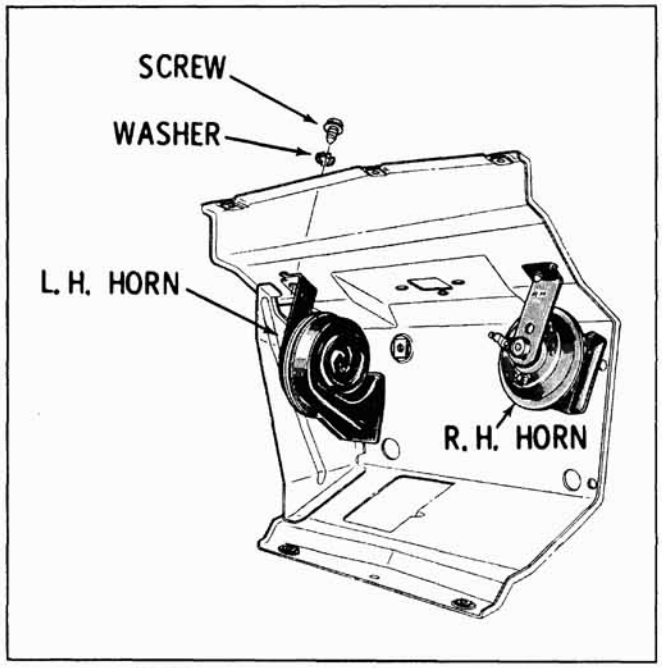


Fig. 12-83—Horn Mounting (54 through 86 Series)

c. Damaged or broken cable.

Clean and inspect the distributor cap terminals on both ends. Check cable insulation for cracks, pinholes, or an oil-soaked condition. DO NOT attempt to shorten, rework, or repair cables.

If the milliamp reading is still unsatisfactory, carefully check the distributor cap and rotor for leakage or cracks. Test the coil, condenser, and primary circuit, including starter solenoid connections, ignition switch and terminals, as well as the coil and distributor terminals.

7. A low reading on all cables indicates:
   a. Burned or broken rotor.
   b. Faulty distributor cable.

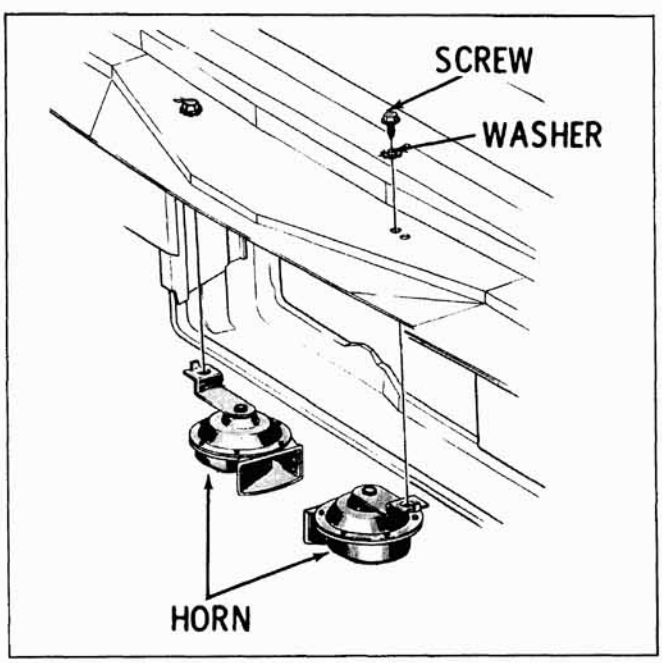


Fig. 12-84—Horn Mounting (31 through 48 Series)

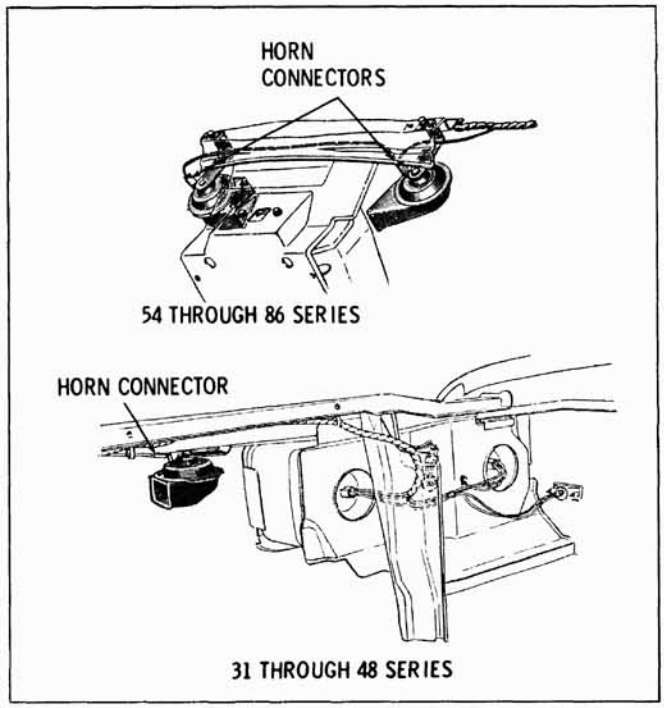


Fig. 12-85—Wiring Connectors to Horns

c. Weak coil.
d. Cables not tight in distributor cap.
e. Excessively burned rotor or distributor cap terminal electrodes.
f. Spring button not contacting carbon brush in distributor cap.
g. Incorrect contact point tension (19 to 23 ounces).

HORNS

The horns are mounted as shown in Figs. 12-83, 12-84 and 12-85. When installing a new horn, the horn service replacement package also contains two mounting brackets. Use the correct bracket which will allow the horn to be mounted in the same position and location as the original.

Removal (54 through 86 Series)

Remove horn wire connector, retaining screw, washer and remove horn. (Fig. 12-83 and 12-85)

Removal (31 through 48 Series)

Same as 54 through 86 Series. (Fig. 12-84 and 12-85)

QUICK CHECKS FOR HORN TROUBLE

When horn trouble is encountered, the difficulty may be in the horn relay, wiring, or the horn itself. Quick checks to determine cause for trouble may be made as follows:

1. Hold the horn button down to energize horn.
2. While energized, tap horn lightly. If horn fails to blow after tapping, see Step 7. If horn should start to blow after tapping, proceed to Step 3.
3. Release horn button so that the horn will stop blowing.
4. Hold horn button down again. If the horn blows normally, a particle of foreign material between the contact points caused the trouble and no adjustment is needed. If the horn still fails to blow until tapped again, proceed with Step 5.
5. To adjust horns which blow only when tapped, turn adjustment screw one full turn counterclockwise.

This adjustment is sensitive. Do not turn screw more than one full turn or in the wrong direction. Misadjustment will require removing the horn for adjustment on the bench.

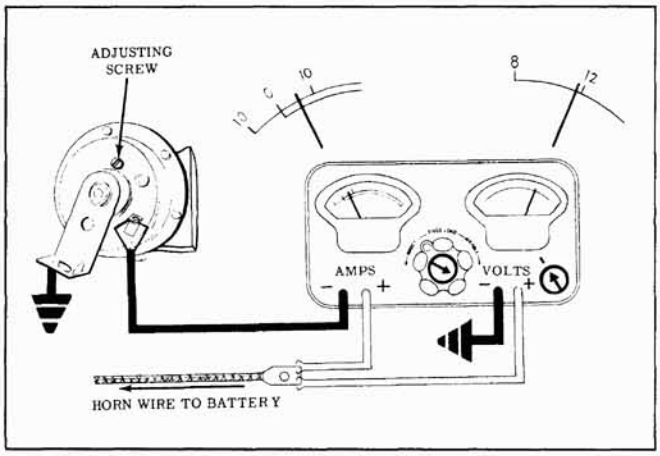


Fig. 12-86—Checking Current Draw

6. Check horn for normal operation and if still inoperative, remove for a bench check.

7. For horns that will not blow after tapping, check to make sure that voltage is available at the horn terminal or for a poor ground connection at the horn mounting. If no trouble is located during these checks and horn is inoperative, remove for a bench check.

Bench Checks

1. No current may indicate a broken connection or an open circuit due to a broken lead or overheating. Most horn failures are caused by horns being operated continuously which develops sufficient heat to melt the wires in the winding causing an open circuit. Overheating is accompanied by a burned odor which indicates that the horn should be replaced.

2. No current can also indicate that the contact points are open and a current adjustment is required.

3. High current over 20 amperes indicates an overheated winding or shorted horn which should be replaced.

4. A reading of approximately 18 amperes for a 12-volt horn indicates a condition in which the contact points are not opening. A current adjustment is required.

HORN CURRENT ADJUSTMENT

Connect an ammeter and a voltmeter as shown in Fig. 12-86. With horn operating, the current draw should be 4.5 to 5.5 amperes at 11.5 volts.

Current adjustment is made by turning the adjusting screw counterclockwise to increase the current or clockwise to decrease the current until the specified current is reached. Care must be taken not to turn the adjusting screw too far. Turn only 1/4 of a turn at one time. If adjustment loosens the screw excessively, it may be staked with punch.

Other Horn Problems

A. Poor Tone

1. Harsh tone - caused by loose bolts in sheet metal mounting area.

2. Low pitch roar - sounds like a "mooing" and is caused by too high a current. Horn needs adjusting.

3. Weak tone - caused by too low a current. Horn needs adjusting.

4. Weak strained tone - foreign body in horn trumpet that should be shaken out or removed.

5. Harsh vibration - caused by horn touching sheet metal, bend bracket to provide clearance.

B. Horn Blows Constantly

1. This can be caused by a sticking horn relay.

2. Horn relay can be energized by grounded or shorted wiring.

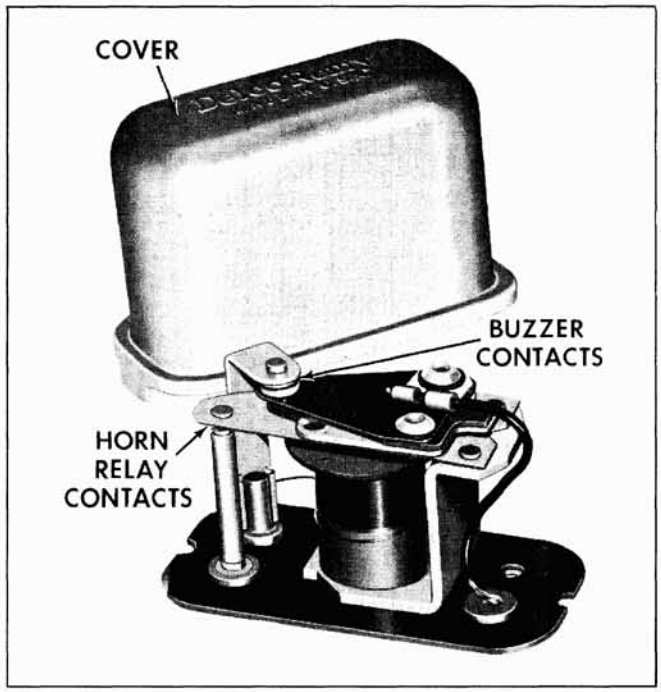


Fig. 12-87—Horn Relay-Buzzer

3. Horn button can be grounded by sticking closed.

Most horns with burned open windings are caused by one of the above malfunctions. Before replacing a horn with open windings, check to make sure that none of the above conditions exist which would cause a repeat failure.

HORN RELAY-BUZZER (ANTI-THEFT KEY WARNING SYSTEM)

DESCRIPTION

The horn relay-buzzer on 31 through 8600 Series includes both the horn relay and reminder buzzer. (Fig. 12-87) The horn relay-buzzer operates when the driver's door is opened to remind the driver that the ignition key has been left in the ignition switch.

BUZZER OPERATION (Fig. 12-88)

With the key in the off position and fully inserted into the ignition switch, the No. 4 terminal on the horn relay-buzzer is connected to ground through the door switch when the driver's door is opened. Current then flows from the battery, energizing the coil, then through the buzzer contacts, (upper contact points) the ignition switch and door switch to ground. The energized coil causes the buzzer contacts to open, which de-energizes the coil, and the buzzer contacts then reclose. This cycle then repeats many times per second to give the buzzing sound. Closing the door, or removing the key will stop the buzzing action.

HORN OPERATION 31 THROUGH 86 SERIES (Fig. 12-88)

When the horn switch is closed, the coil is energized and the armature moves toward the core to close the horn relay contacts (lower contact points). The horns are then connected to the battery, and operate accordingly. With the horn switch closed, the buzzer contacts remain separated.

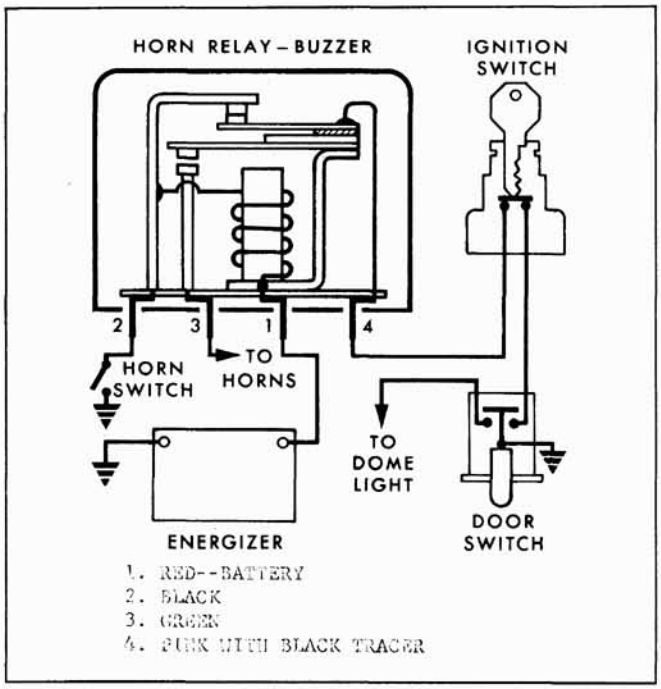


Fig. 12-88—Wiring Diagram

BUZZER CHECK

1. Make sure the key is fully inserted into the ignition switch and in the "off" position.
2. Open the driver's door, and observe the dome lamp.
3. If both the dome lamp and buzzer fail to operate, check the door switch for defects.
4. If the dome lamp is on, but the buzzer fails to operate, remove the buzzer from its mounting.
5. Connect a jumper lead from the No. 4 terminal to ground.
6. If now the buzzer operates, check the ignition switch wiring and ignition switch.
7. If the buzzer does not operate, connect a voltmeter from No. 1 terminal to ground.
8. If the reading is zero, the circuit is open between this point and the battery.

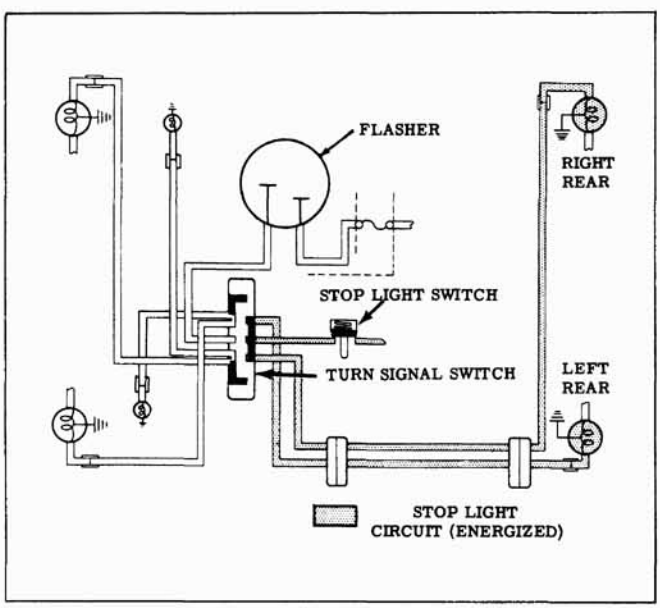


Fig. 12-89—Turn Signal Circuit (Off Position)

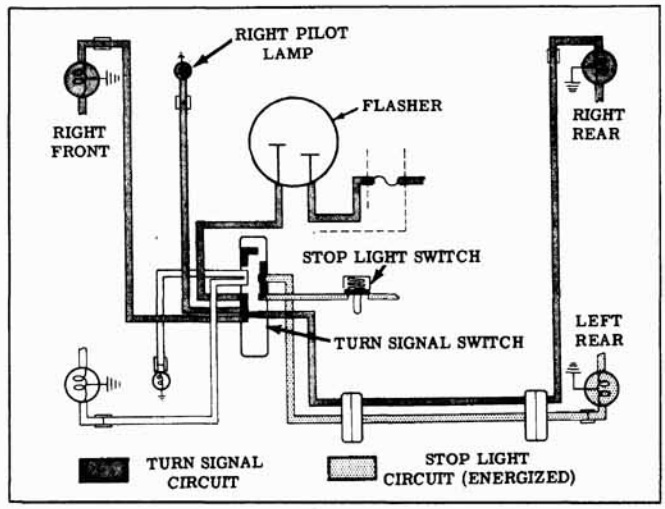


Fig. 12-90—Right Turn Position

9. If a voltage reading is obtained, replace the buzzer.

HORN RELAY CHECK (31 THROUGH 86 SERIES)

1. Remove the horn relay-buzzer from its mounting.
2. Connect a jumper from the No. 2 terminal to ground.
3. If the horns operate, check the No. 2 terminal wire and horn switch for defects.
4. If the horns do not operate, leave the No. 2 terminal connected to ground, and connect a voltmeter from the No. 3 terminal to ground.
5. If a reading is obtained, check the horn wiring and horns.
6. If no reading is obtained, replace the horn relay-buzzer.

TURN SIGNAL

The turn signal circuit consists of the switch, flasher, two pilot lamps in the instrument panel, the stop lamp filaments in the rear lamps, and the turn signal filaments in the parking lamps. (Fig. 12-89)

See SECTION 9A for servicing of turn signal switch.

TURN SIGNAL DIAGNOSIS (Figs. 12-90 and 12-91)

The turn signal wiring diagrams indicate the stop light circuit and the turn signal circuit energized at the same time in

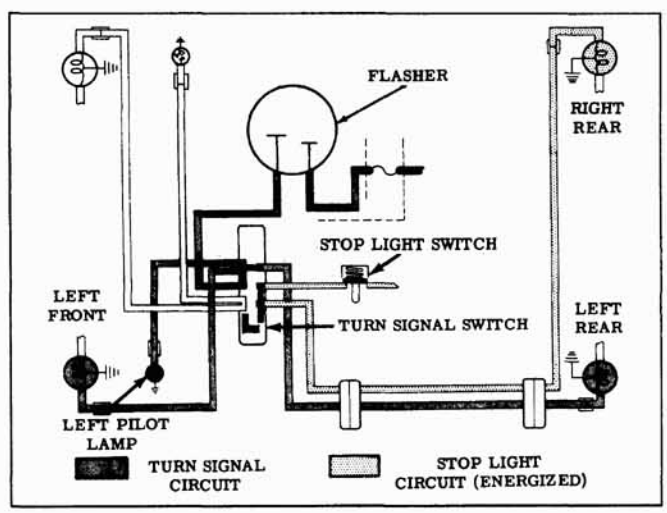


Fig. 12-91—Left Turn Position

order to show how the stop light circuit is changed to a turn signal circuit when the turn signal switch is actuated.

1. PILOT LIGHT REMAINS ON
   a. Right turn - right rear or right front turn signal filaments burned out, light bulb base not grounded or an open in the front or rear turn signal circuit.
   b. Left turn - left rear or left front turn signal filaments burned out, light bulb base not grounded or an open in the front or rear turn signal circuit.
   c. Flasher inoperative.
2. ONE PILOT LIGHT INOPERATIVE
   a. Pilot light filament burned out.
   b. Poor connection or a defective printed circuit.
3. ALL TURN SIGNAL LIGHTS INOPERATIVE
   a. Flasher inoperative.
   b. Defective turn signal switch.
   c. Open circuit in the wire from fuse block to flasher or in the wire from flasher to turn signal switch.

FLASHER SERVICE

If the turn signal circuit components seem to be functioning properly, but the flashing rate is not satisfactory, then heavy duty flasher, (round-gold) should be installed. This flasher is designed to flash from two to ten lamps and it must be used if the car pulls a trailer with turn signal lights connected to car wiring.

TURN SIGNAL SWITCH

The turn signal switch is an electrically operated self-contained unit. No adjustments are required on the turn signal switch. However, if any malfunctions should occur, the switching mechanism should be checked for defective parts. For switch removal, refer to STEERING, Section 9A.

HAZARD WARNING FLASHER DIAGNOSIS (Figs. 12-1, 12-2, 12-4)

A. Quick Check
   1. Push in hazard warning switch to ON position. The rear turn signal bulbs should flash as well as the front turn signal bulbs and the turn signal indicator bulbs.

All lamps will burn continuously when the brake pedal is depressed. This is a normal condition.

B. Only Pilot Bulbs Fail to Flash
   1. Check for burned out bulbs and loose or defective wiring. Check printed circuit for breaks, shorts or grounds. Replace necessary parts. If this fails to correct condition, replace turn signal switch.

C. All Bulbs Fail to Flash
   1. Check for burned out 20 amp directional signal and back-up lamp fuse.
   2. Check for defective hazard warning flasher.
   3. Check for loose harness connectors.
   4. After all above checks have been made and all bulbs still fail to flash, replace switch and harness assembly.

D. Some Bulbs Fail to Flash While Others are Operative
   1. Place the ignition switch in the ON position and pull the hazard warning switch into the OFF position.
   2. Place turn signal lever first to right and then to left turn position. If turn signal circuits operate properly, the hazard warning switch and harness assembly should be replaced.
   3. If the same bulbs fail to flash, the cause is most likely a burned out bulb.

If any turn signal bulb fails to flash when the turn signal circuit is actuated, the reduced current in the circuit will cause the remaining signals on that side of the car to burn steadily. If the hazard warning flasher is energized, however, all turn signal bulbs will flash except those that have a circuit defect.

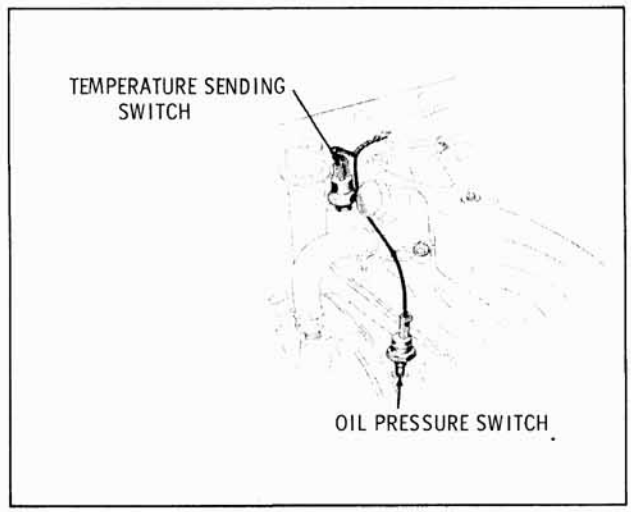


Fig. 12-92—Oil and Temperature Switches (V-8)

TEMPERATURE INDICATOR

Refer to Section 15 if unit is equipped with rally pack for service procedures.

The engine temperature indicator lights are controlled by a thermal switch located as shown in Fig. 12-92 and 12-93.

If the engine cooling system is not functioning properly, the thermal switch will close the circuit to the red light when the engine temperature reaches 253°F. ± 2°F. The thermal switch does not require servicing. If it is defective, it should be replaced. (Figs. 12-92 and 12-93)

OIL PRESSURE INDICATOR

The engine oil pressure indicator light is controlled by a pressure operated switch. When the engine is running, the light operates only when the oil pressure is not satisfactory. This light should come on when the ignition is turned on and the engine is not running. If the switch is defective it must be replaced. (Figs. 12-92 and 12-93)

FUEL GAUGE

The fuel gauge circuit consists of an electrical indicator in the instrument panel and a float-controlled rheostat in the tank.

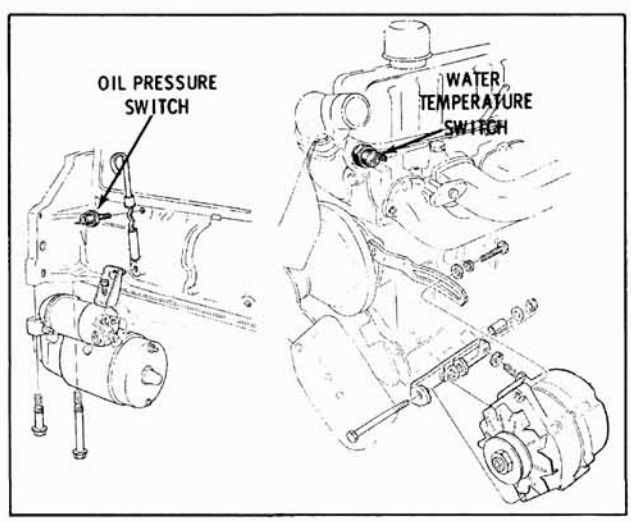


Fig. 12-93—Oil and Temperature Switches (L-6)

CHECKING FUEL GAUGE

Testing Fuel Gauge Circuit

Engine must be running when testing the fuel gauge to insure adequate operating voltage (14.5 volts) at the gauge.

When checking either at the trunk compartment or the instrument cluster, be sure that the correct sequence is followed to insure accurate readings. The checking procedure must be started with Tester BT-6508 on the "F" position, then moved to the "1/2" and "E" positions in that order. If checks are made in any other sequence, it will be necessary to stop the engine and restart it before taking each fuel gauge reading.

Fuel Gauge Check at Trunk Compartment

1. Set Tester BT-6508 on "F" position.
2. Disconnect the tank unit connector. Connect one lead of the tester to the tan wire from the instrument panel gauge and the other lead to ground.
3. Start the engine and run at idle. Gauge should read on the "F" graduation or above.

Most gauges will read above the "F" graduation.

4. Set the tester on "1/2" position. Gauge should read on the "1/2" graduation or 1/8" above or below the "1/2" graduation.
5. Set tester on "E" position. Gauge should read on "E" graduation or below. If gauge reads above "E" position, replace gauge.

If the gauge registers correctly during this test, the trouble is in the tank unit or the wire from the trunk compartment connector, to the tank unit. If the gauge registers full, regardless of the position of the tester, there is an open circuit in the wire from the instrument panel gauge to the trunk compartment connector.

When removing the tank unit for inspection, if it appears to be defective, check as follows:

1. Remove the fuel tank unit. Clean all dirt from around the tank unit terminal.
2. Connect an ohmmeter to the tank unit and check the resistance at top, bottom and midpoint of float arm travel.
3. Resistance at empty should be between 0 and .6 ohms. At mid-point, resistance should be 45 ohms plus or minus .1 ohm. At full, the resistance should be between 88 and 90 ohms. If ohmmeter check indicates that tank unit gauge reads within specifications, check for poor connections between tank gauge and body. Resistance between tank gauge and body should be less than .1 ohm.
4. If the tank unit is replaced, always check the new unit before installing it in the tank.

Fuel Gauge Check at Cluster

To determine whether the instrument panel gauge or wiring to the trunk compartment connector is at fault proceed as follows:

With the printed circuit, it is not possible to disconnect the tank unit wire at the dash gauge. To check the dash gauge alone, disconnect the tank gauge in the trunk compartment.

1. Remove the plastic cap from the terminals of the dash gauge.
2. Connect one lead of tester to the left terminal of the gauge (as viewed from the rear of the instrument cluster) and the other lead to ground.
3. Repeat Steps 3, 4 and 5 of Fuel Gauge Check at Trunk Compartment.

If the dash gauge does not register correctly, make a visual inspection of the printed circuit. Defects will show up in the

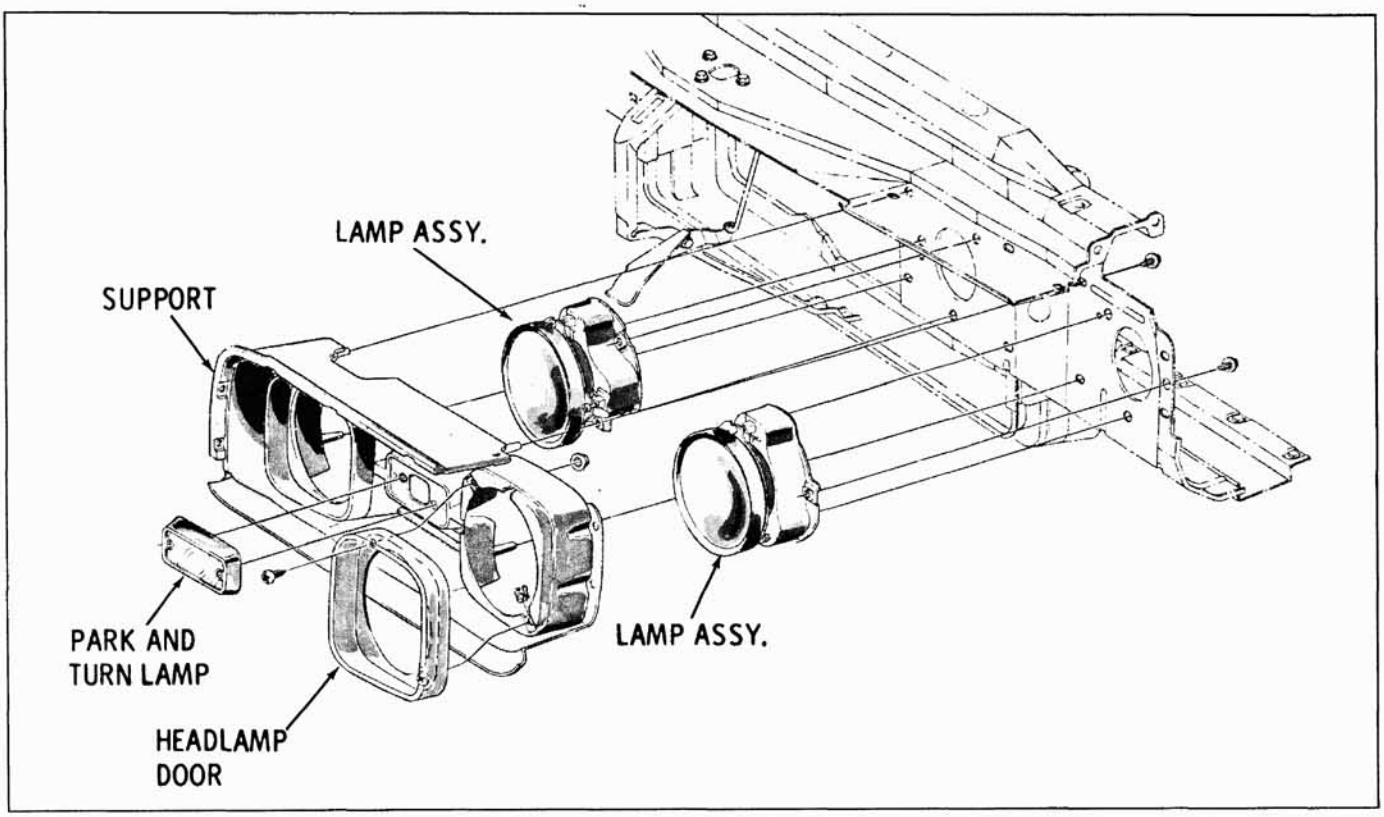


Fig. 12-94—Headlamps (31 through 48 Series)

form of blisters or breaks in the circuit. Shorts or breaks in the wiring can be isolated by making a continuity check of the wiring. If printed circuit is not defective, replace dash gauge. (Refer to the INSTRUMENT PANEL SECTION for gauge removal.)

HEADLAMP

The dual headlight system consists of four headlights paired horizontally. Each pair of lights consists of a sealed beam unit (inner unit with No. 1 embossed on the lens) with one filament which provides an upper beam only, and a sealed beam unit (outer unit, with No. 2 embossed on the lens) with two filaments which provides both an upper and lower beam. The sub-body is also identified.

Since the No. 2 headlight lens is designed to provide maximum illumination on lower beam and the upper beam filament is not at the focal point of the No. 2 light, the major portion of the upper beam illumination is supplied by the No. 1 unit. Thus, the upper beam is supplied by all four headlights.

When the lower beam is desired, the No. 1 lights are turned off, the upper filament of the No. 2 lights are turned off and the lower filaments of the No. 2 lights are turned on.

SEALED BEAM UNIT

Remove and Install (Figs. 12-94 and 12-95)

1. Remove headlight rim.
2. Disengage the coil spring from the retaining ring, then pull the assembly out of the body and disconnect plug from rear of sealed beam unit.
3. Remove the two retaining ring attaching screws, then remove retaining ring and sealed beam unit and sub-body.

To install unit, reverse the removal procedure.

The locating bosses on the back of the sealed beam units are designed so that the No. 1 and No. 2 units are not interchangeable.

HEADLIGHT AIMING

For headlight aiming, refer to the headlight aiming equipment manufacturers instructions and specifications.

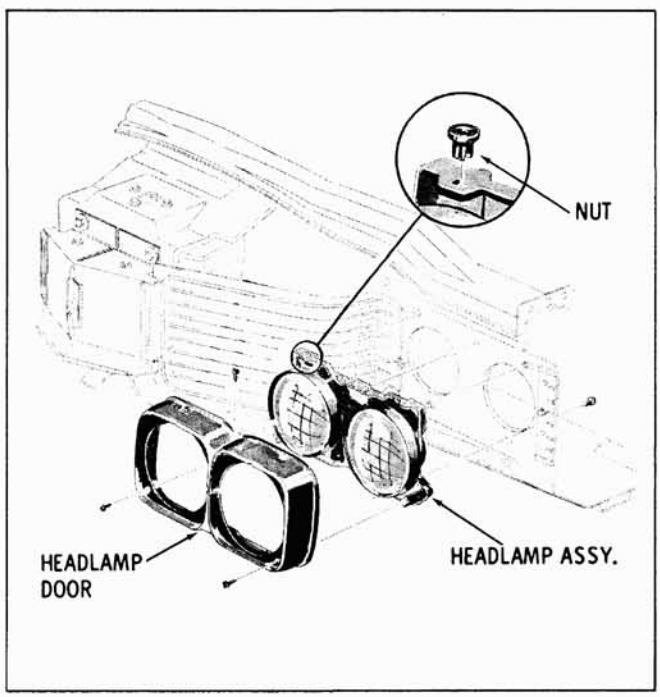


Fig. 12-95—Headlamps (54 through 86 Series)

TAIL LAMPS

The tail light bulbs on 31-44 and 84-86 Series except station wagons can be replaced from the rear of the lamp by removing the socket from the tail lamp housing. When installing the socket, align the tang of the socket with the slot in the housing and push until socket snaps into place.

On station wagons and 54 through 66 Series, it is necessary to remove the tail lamp lens to gain access to the bulb.

LAMP ASSEMBLY OR LENS (84 and 86 Series)

To remove housing assembly, remove the four retaining nuts inside trunk and remove assembly.

LAMP ASSEMBLY OR LENS (54-66 SERIES)

To remove lamp assembly remove four retaining screws on back of lamp (behind bumper) and remove assembly.

It will be necessary to loosen rear bumper assembly to gain clearance for removal of retaining screws.

To remove lens it will be only necessary to remove the four lens retaining screws and remove lens.

LAMP ASSEMBLY OR LENS (31 THROUGH 44 SERIES) EXC. STATION WAGONS

To remove the housing assembly, remove retaining nuts inside trunk and remove lamp assembly.

It will be necessary to remove bumper bolts and lower bumper only enough to remove lamp assembly.

SIDE MARKER LENS OR BULB (Fig. 12-96)

The lens are part of the lamp assembly and are not removable.

To remove the bulb rotate the socket one-quarter turn and remove from lamp assembly.

HEADLAMP SWITCH

The headlamp switch controls the headlamps, parking lamps, tail lamps, and instrument panel lamps. The dome lamps are actuated by turning the headlamp switch fully counterclockwise. These circuits are protected by a circuit breaker incorporated in the headlamp switch. In addition, the tail lamps and instrument panel lamps are protected by fuses located in the fuse block. The brightness of the instrument panel lamps is adjustable by means of a rheostat built into the headlamp switch. Turning the knob of the switch operates the rheostat.

HEADLAMP CIRCUIT BREAKER

The normal lighting load is not sufficient to cause the circuit breaker (located on the headlamp switch) to open. If a

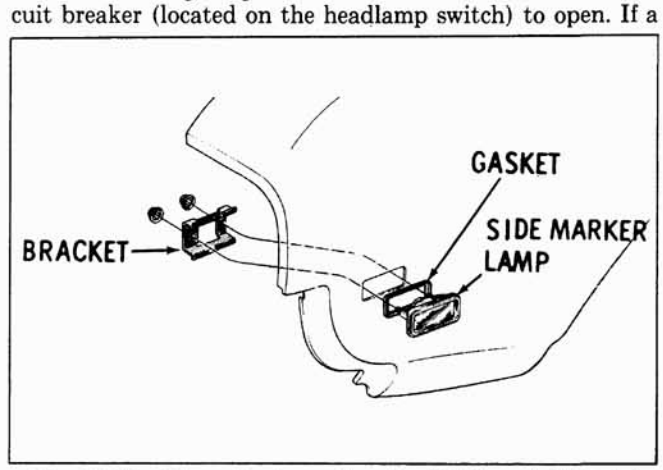


Fig. 12-96—Sidemarker Lamp Mounting (31 through 48 Series)

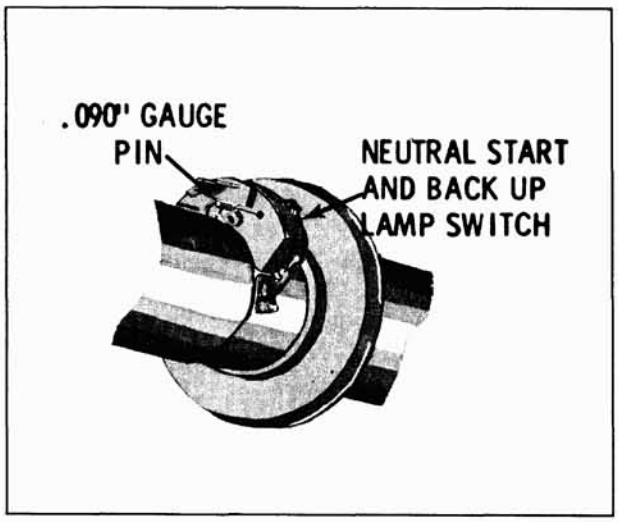


Fig. 12-97—Neutral Start Switch (Column Shift)

short occurs, the circuit breaker will cause the lights to flicker. This flickering will continue until the cause of the short is corrected. The circuit breaker is not adjustable.

DIMMER SWITCH

The foot dimmer switch is used to select high or low beam of the headlights as desired.

NEUTRAL START AND BACK-UP LAMP SWITCH

A neutral start and back-up lamp switch, mounted on the steering column, or inside the console, with automatic transmission prevents starting of the engine with the transmission in gear. The engine may be started with the selector lever in "Neutral" or "Park" position.

CHECKING

1. Apply parking brake firmly.
2. Position selector lever into "D" range and turn ignition switch to "Start".
3. While holding ignition switch on "Start", slowly move selector lever toward "N" position until engine cranks and starts.
4. Without moving the selector lever after engine starts, depress accelerator pedal slightly to determine whether or not transmission is in gear. If neutral starter switch is properly adjusted, transmission will not be in gear.

If equipped with back-up lights, the lights should operate with the ignition on and the selector lever in reverse.

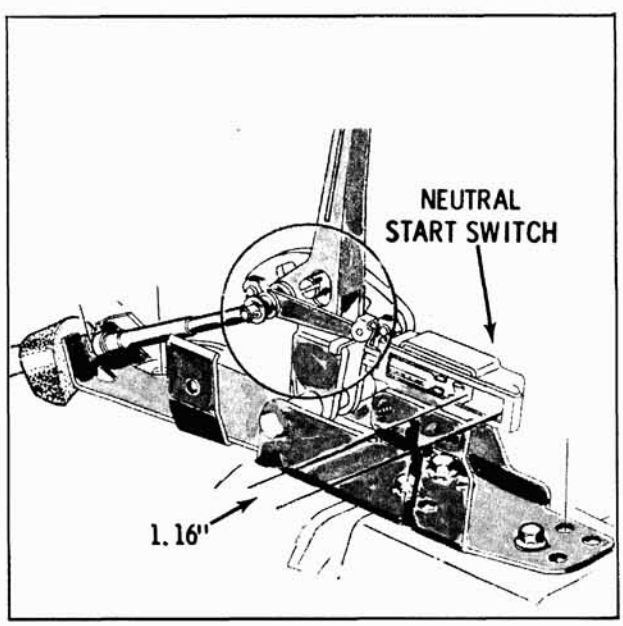


Fig. 12-98—Neutral Start Switch (Console Shift)

ADJUSTMENT (ALL EXCEPT CONSOLE EQUIPPED) (Fig. 12-97)

1. Place transmission in drive detent with switch installed and drive lug engaged in shift tube.
2. Adjust switch so gauge pin hole will align between contact support and switch bracket permitting insertion of a .090" pin.

ADJUSTMENT (CONSOLE EQUIPPED) (Fig. 12-98)

1. If console equipped, remove console.
2. Place shift lever against neutral stop.
3. Adjust switch to dimension shown.

HYDRAULIC BRAKE SWITCH TESTING

For service procedures on this switch, refer to Periodic Service Chart in General Information Section.

ELECTRICAL CIRCUIT DIAGNOSIS PROCEDURE

The fuel tank gauge unit can be partially or completely damaged by a momentary surge of 12 volt current across the resistance coil in the tank gauge. To prevent damaging the tank unit resistance coil, it is recommended that the tank wires be disconnected before any electrical tests or repairs are made in the wiring harness. The above should also be exercised whenever the chassis to body wiring connector plug has to be disconnected.

Failures in a circuit are usually caused by short or open circuits. Open circuits are usually caused by breaks in the wiring, faulty connections or mechanical failure in a component such as a switch or circuit breaker. Short circuits are usually caused by wires from different components of the circuit contacting one another or by a wire or component grounding to the metal of the body due to a screw driven through the wire, insulation cut through by a sharp metal edge, etc.

If a failure is encountered in one of the body circuits, the circuit diagrams should be thoroughly reviewed to become familiar with the circuit before performing an intensive checking procedure to determine the cause and location of the failure. The body circuit diagrams are located in the BODY SERVICE MANUAL. The following information may aid in locating and correcting a failure in the body wiring electrical system.

1. If a major portion of the electrical circuit becomes inoperative simultaneously, the failure may be due to improper connections between the front and rear harness, or between the front harness and the chassis wiring connector.
2. If only one of the circuits is inoperative, the failure is due to an open circuit or short in the affected circuit. Short circuits usually result in blown fuses or in the case of power equipment circuits, in the circuit breaker opening the circuit. If the fuse is not blown and the circuit affected is a lamp circuit, check the bulb before proceeding with any checking procedures.
3. The dome lamp and courtesy lamp circuits are designed so that the switches are in the "ground" side of the circuit. If a

condition is encountered where the lamps remain "on" even though the jamb or courtesy lamp switches are not actuated, the failure is probably due to defective switches, or to the wire leading to the switches being grounded to the metal body.

TESTING WITH BT-11-20

If the preliminary checks have not located the cause of failure, Tester BT-11-20 can be used to isolate the defective circuit without the unnecessary removal of trim or hardware.

TESTING FOR SHORT CIRCUIT

If the turn signal fuse is blown, remove the flasher and install a jumper wire in its place before connecting test leads. Do not use BT-11-20 in the clock, radio or fuel gauge circuits.

1. Move detector switch to TEST.
2. Remove blown fuse and connect a test lead to each fuse clip. Move detector switch to SHORT.
3. Turn on all switches in the blown fuse circuit.
4. Observe each unit or light in shorted circuit. Units or lights that operate momentarily (when tester light is out) are not shorted.
5. Position meter over the shorted circuit, at the fuse block, with the base of the meter or arrows directly above the wiring. The meter needle will deflect AWAY from the direction of the short each time the tester completes the circuit. Note the amount of needle deflection.
6. Move meter progressively from the fuse block toward the unit that is not operating. The location of the short will be indicated by a reduction in needle deflection. If the needle ceases to deflect, the short circuit has been passed, the wrong circuit has been followed or the meter is not above the circuit.
7. After the short is located and repaired, remove the test leads and replace the fuse.

FUSE SPECIFICATION AND LOCATION 3100 THROUGH 8600 SERIES

Application	Name of Fuse Circuit On Fuse Block	Fuse Type and Amperes
Electric Antenna Cruise Control Electric Windows Electric Seat	PWR RLY	SFE 20
Dome Lamp Cigar Lighter Clock Courtesy Lamps Trunk Lamp Glove Box Lamp Underhood Lamp	CLK - LTR - CTSY	AGC 25
Cornering Lamps Tail Lamps Side Marker Lamps License Lamp	TAIL	SFE 20
Stop Lamps Hazard Warning Lamps	STOP-HAZ	SFE 20
Instrument Panel Lamps	INST LPS	SFE 4
Windshield Wipers	WIPER	SFE 20
Heater Air Conditioning Defogger	HEATER - A/C	AGC 25
Radio Tape Player	RADIO	AGC 10
Turn Signals Back-Up Lamps	DIR SIG - BACK UP	SFE 20
Transmission Control (Automatic Only) Parking Brake Lamp	GAUGES - TRANS	AGC 10

1968 LAMP USAGE
31 THROUGH 48 SERIES

Trade No.	Usage
194	Instrument Cluster Lighting-Speedometer
* 194	Instrument Cluster Lighting-Fuel Gauge & Tell Tale
194	Turn Signal Indicator
194	High Beam Indicator
161	Generator Warning
161	Brake Warning
168	Oil Pressure Warning-Except Rocket Rally Pac
168	Engine Temperature Indicator-Except Rocket Rally Pac
168	Clock-Tachometer (Rocket Rally Pac)
1445	Ash Tray Lamp
1445	Heater Control
1895	HMT Shift Indicator-Console Only
1895	Console Compartment
1893	Glove Box
1893	Electric Clock-Except Rocket Rally Pac
1893	Radio Dial
562	Map Lamp
211	Dome Lamp
212	Rear Quarter Lamps
212	Lamp Over Tailgate On Vista Cruiser
90	Courtesy Lamp
90	Armrest
97	Courtesy Lamp-Console
631	Trunk

EXTERNAL LAMPS

97	License
1157NA	Parking & Turn Signals
**1157	Tail & Stop
1156	Back-Up Lamps
L-4001	Headlamp-Upper Beam
L-4002	Headlamp-Upper & Lower Beam
194	Side Marker-Rear (All Except SW)
194A	Side Marker-Front

*Rocket Rally Pac Gauges & Tell Tale uses #168 - 2-1/2 C.P. Bulbs.
**Station Wagons Use 2

1968 LAMP USAGE
54 THROUGH 86 SERIES

Trade No.	Usage
194	Speedometer and Odometer
194	High Beam Indicator
194	Fuel Gauge
194	Turn Signal Indicator
161	Engine Temperature Indicator (Cold)
161	Generator Warning
161	Brake Warning Lamp
168	Engine Temperature Indicator (Hot)
168	Oil Pressure Warning
1895	Console Compartment
1895	Shift Indicator HMT-Floor
1445	Heater, Ventilation & Air Conditioning Control
1445	Ash Tray and Ignition Switch-Fiber Optic
1445	Cruise Control
1893	Radio Dial
1893	Electric Clock
1816	Shift Indicator HMT-Panel
631	Underhood
631	Trunk
562	Map Lamp
90	Courtesy
90	Side Roof or Rear Quarter
90	Arm Rest
97	Console Lamps
211	Dome
* 212	Door Lamps
212	Glove Box

EXTERNAL LAMPS

** 97	License
1157NA	Parking & Turn Signal
1157	Tail and Stop
1156	Back-Up
1293	Cornering Lamp
97A	Side Marker-Front
194	Side Marker-Rear
L-4001	Headlamp-Upper Beam
L-4002	Headlamp-Upper & Lower Beam

*98 Luxury Sedans Use 8
**98 Models Use 2

The following circuits either employ circuit breakers or have fuses located as indicated.

31 THROUGH 86 SERIES

APPLICATION	TYPE	LOCATION
Tachometer	In-Line Fuse 2 AMP	Brown feed wire from Tachometer
Comfortron Air Conditioning	In-Line Fuse 30 AMP	In wire between junction block and high blower relay
Cruise Control (32,36,42,44 & 48)	In-Line Fuse 5 AMP	In Cruise Control Wiring Harness
Headlights	Circuit Breaker	Built-in light switch
Electric Seat, Windows and/or Convertible Top Motor	Circuit Breaker	Left side front of dash in the engine compartment
Turn Signal Flashers 31 Through 44 Series Exc. Station Wagons	3 Lamp-Yellow Cover	In clip on back of instrument panel
Turn Signal Flasher Station Wagons Only	2 Lamp-Blue Cover	In clip on back of instrument panel
Turn Signal Flasher 54 through 86	3 Lamp-Yellow Cover	In clip on back of instrument panel
Turn Signal Flashers For Trailer Towing Only	2-10 Lamp-Gold Cover	In clip on back of instrument panel
Hazard Warning Flasher	2-8 Lamp-Green Cover	In fuse panel

GENERAL SPECIFICATIONS

STARTING MOTOR

a. Make	Delco-Remy
b. Brush Spring Tension	35 oz. Min.
c. Number of Brushes	4
d. Number of Fields	4
e. Rotation, Viewed From Drive End	Clockwise
f. Pinion Clearance	.010" to .140"
g. Free Speed (Model 1108333) 7800 to 12000 rpm at 10.6 Volts	70 to 99 amps*
h. Free Speed (Model 1108348) 3800 to 6200 rpm at 10.6 Volts	70 to 105 amps*
i. Free Speed (Model 1108349) 3600 to 5100 rpm at 10.6 Volts	65 to 100 amps*
j. Free Speed (Model 1108352) 3800 to 6200 rpm at 10.6 Volts	70 to 105 amps*
k. Free Speed (Model 1108365) 6200 to 10700 rpm at 10.6 Volts	49 to 87 amps*

REGULATOR

Delcotron Generator

a. Field Current Draw at 12 Volts, 80°F	2.2 to 2.6 amps
b. Voltage Setting	Refer to Fig. 12-23 ("67" S.M.)

Energizer 12 Volt

Series	Engine	Amp. Hr.	Plates
31 & 35	L-6	45	54
32, 36, 42, 48 & 54	V-8 (350 Engine)	61	66
44 & 48	400 Cu. In. Engine	70	66
54, 64, 66, 84 & 86	V-8	73	78
54, 64, 66, 84, 86, Toronado	H.C. 455 V-8	75	90

Specific Gravity for Fully Charged Battery . . . . . 1.270±.010 at 80°F.

COIL (EXCEPT C.D. SYSTEM)

a. Primary Resistance V-8	75°F.	1.77 to 2.05 Ohms
Primary Resistance L-6	75°F.	1.45 to 1.63 Ohms
b. Secondary Resistance	75°F.	6500 to 9500 Ohms

RESISTOR, IGNITION COIL (IN WIRING HARNESS)

a. Resistance 80°F. - V-8	1.35 Ohms
Resistance 80°F. - L-6	1.85 Ohms

DISTRIBUTOR (For additional Specs., Refer to Tune-Up Section)

a. Cam Angle Range V-8	28° to 32° (Adjust to 30°)
Cam Angle Range L-6	31° to 34° (Adjust to 32°)
b. Contact Point Opening V-8	.016"
Contact Point Opening L-6	.019"
c. Contact Arm Spring Tension	19 to 23 oz.
d. Condenser Capacity	.18 to .23 Mfd.

SPARK PLUGS - Refer to Tune-Up Section

HORNS

a. Current Draw at 11.5 Volts	4.5 to 5.5 amps

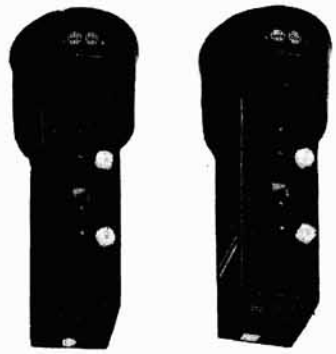
HORN RELAY

a. Closing Voltage	1.5 to 9.5 Volts

*Includes Solenoid

BT-11-20

421 BATTERY TESTER


J-6878-01

BT-6508

J-5421

J-9600

J-9717-1

J-9717-2

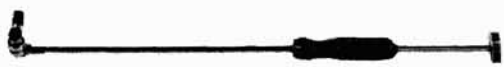
BT-6426

BT-6317

J-5184

J-9782

BT-33-70-M


BT-1501

J-21053

BT-11-20	SHORT DETECTOR	J-6878-01	HEADLIGHT AIMER
BT-33-70-M	DRIVE BELT TENSION GAUGE	J-9600	DIODE INSTALLER
BT-1501	DIST. DWELL ANGLE ADJ. TOOL	J-9717-1	DIODE REMOVER
J-5184	SPRING TENSION SCALE	J-9717-2	DIODE SUPPORT
J-5421	THERMOMETER	J-9782	DELCOTRON TESTING LEAD
BT-6317	DELCOTRON PULLEY NUT TOOL	J-21053	DELCOTRON TESTING LEAD
BT-6426	HORN ADJUSTING TOOL	"421"	BATTERY TESTER/CHARGER
BT-6508	FUEL GAUGE TESTER		

Fig. 12-99—Tools

INSTRUMENT PANEL

(54 THROUGH 86 SERIES)

CONTENTS OF SECTION 12 A

Subject	Page	Subject	Page
CONTROL PANEL	12A-1	BLOWER SWITCH	12A-9
PAD ASSEMBLY	12A-2	ASH TRAY ASSEMBLY	12A-9
FUEL GAUGE CLUSTER	12A-5	ASH TRAY DOOR	12A-9
FUEL GAUGE CLUSTER BEZEL	12A-5	MAP LIGHT	12A-9
FUEL GAUGE PRINTED CIRCUIT	12A-5	GLOVE BOX LAMP SWITCH	12A-9
SPEEDOMETER CLUSTER	12A-6	VACUUM TRUNK SWITCH	12A-9
SPEEDOMETER CLUSTER BEZEL	12A-6	A.C. CENTER OUTLET DUCT	12A-9
SPEEDOMETER CLUSTER PRINTED CIRCUIT	12A-6	A.C. CENTER OUTLET	12A-9
CLOCK CLUSTER	12A-6	A.C. AIR OUTLET HOUSING—L.H.	12A-9
CLOCK BEZEL	12A-6	A.C. AIR OUTLET DUCT ASSEMBLY—R.H.	12A-9
HEADLIGHT SWITCH	12A-6	CRUISE CONTROL	12A-9
WASHER AND WIPER SWITCH	12A-7	APPLIQUE	12A-9
IGNITION SWITCH	12A-7	SHIFT INDICATOR HOUSING OR DIAL	12A-9
CIGAR LIGHTER	12A-8	ACCESSORY SWITCHES	12A-10
RADIO	11A-8	SPEEDOMETER CABLE	12A-10
RADIO SPEAKER	12A-8	CONSOLE	12A-10
HEATER OR A.C. CONTROL	12A-8		

CONTROL PANEL (Fig. 12A-1)

The control panel is a removable panel and is retained by sheet metal screws. All instruments and controls can be removed without removing control panel.

For additional removal procedures refer to individual unit removal procedures.

Removal

1. Disconnect negative battery cable.
2. If A/C equipped, remove manifold.
3. Remove trim pad below steering column and remove shift indicator needle.
4. Remove fuel gauge, speedometer and clock clusters.
5. Remove radio.
6. Remove attaching screws from heater or A/C control and position control behind instrument panel with all wiring, cables and vacuum hoses attached.
7. If equipped with cruise control, disconnect wiring connector and remove selector cable at regulator and remove control assembly from control panel.
8. Remove ignition switch cylinder, then remove escutcheon with Tool BT-6817-1 and leave switch connected to wiring.
9. Remove headlight switch control knob and remove escutcheon with Tool BT-6817-2 and leave switch connected to wiring.
10. Remove wiper and washer knob and remove escutcheon with Tool BT-6817-2 and leave switch connected to wiring.
11. Disconnect wiring connectors from the following:
    A. Accessory switches
    B. Lighter
    C. Map lamp
12. Remove ash tray receiver.

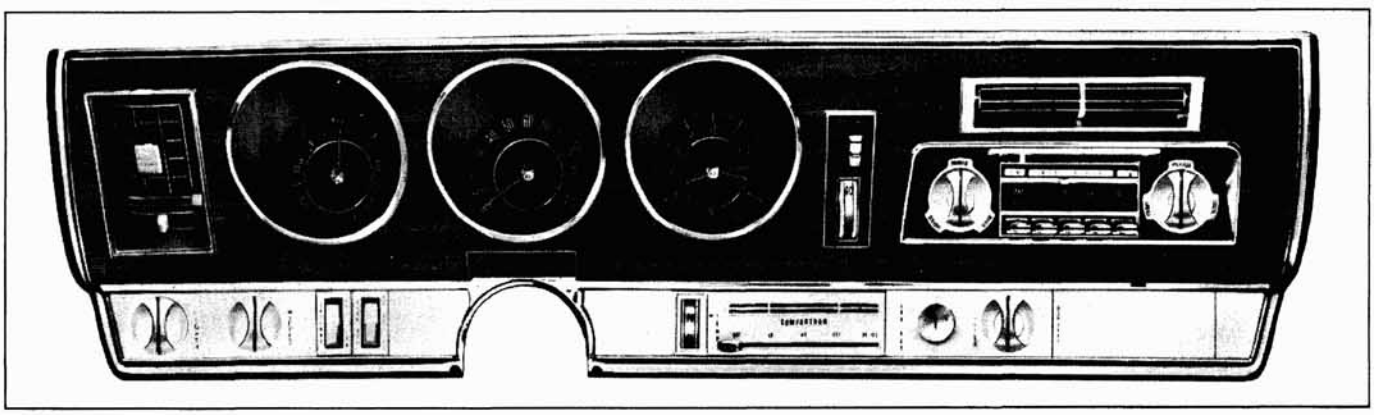


Fig. 12A-1—Control Panel Assembly

13. If A/C equipped, remove L.H. A/C air outlet housing by removing the knob and removing the 2 screws through the housing deflector.

14. Remove control panel attaching screws (10) Fig. 12A-2. Then tilt top edge away from pad assembly and carefully remove control panel toward right side of car.

15. To install, reverse removal procedures.

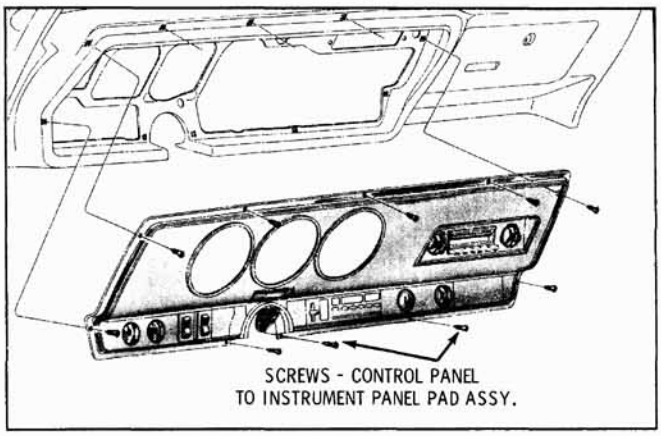


Fig. 12A-2—Control Panel Attachment

PAD ASSEMBLY (Fig. 12A-3)

Removal

1. Disconnect negative battery cable.

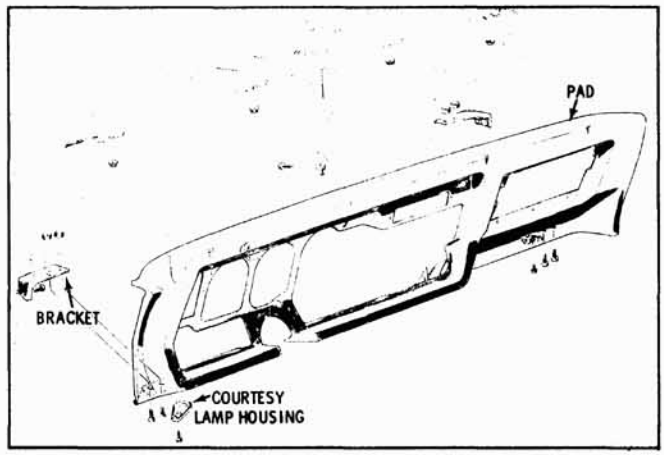


Fig. 12A-3—Pad Assembly

2. Remove shift indicator needle.

3. Remove nuts from steering shaft flex-coupling and disconnect shift linkage from steering column shift levers.

4. Disconnect the following wiring connectors.
   A. Neutral start and back-up switch (if so equipped).
   B. Turn signal and cornering light.

5. Remove bolts "1" and "3" as shown on Fig. 12A-4.

6. Remove nuts "C", "A" and "B" (Fig. 12A-4) and remove steering column. Spacers (if used) and wedge must be retained at this time.

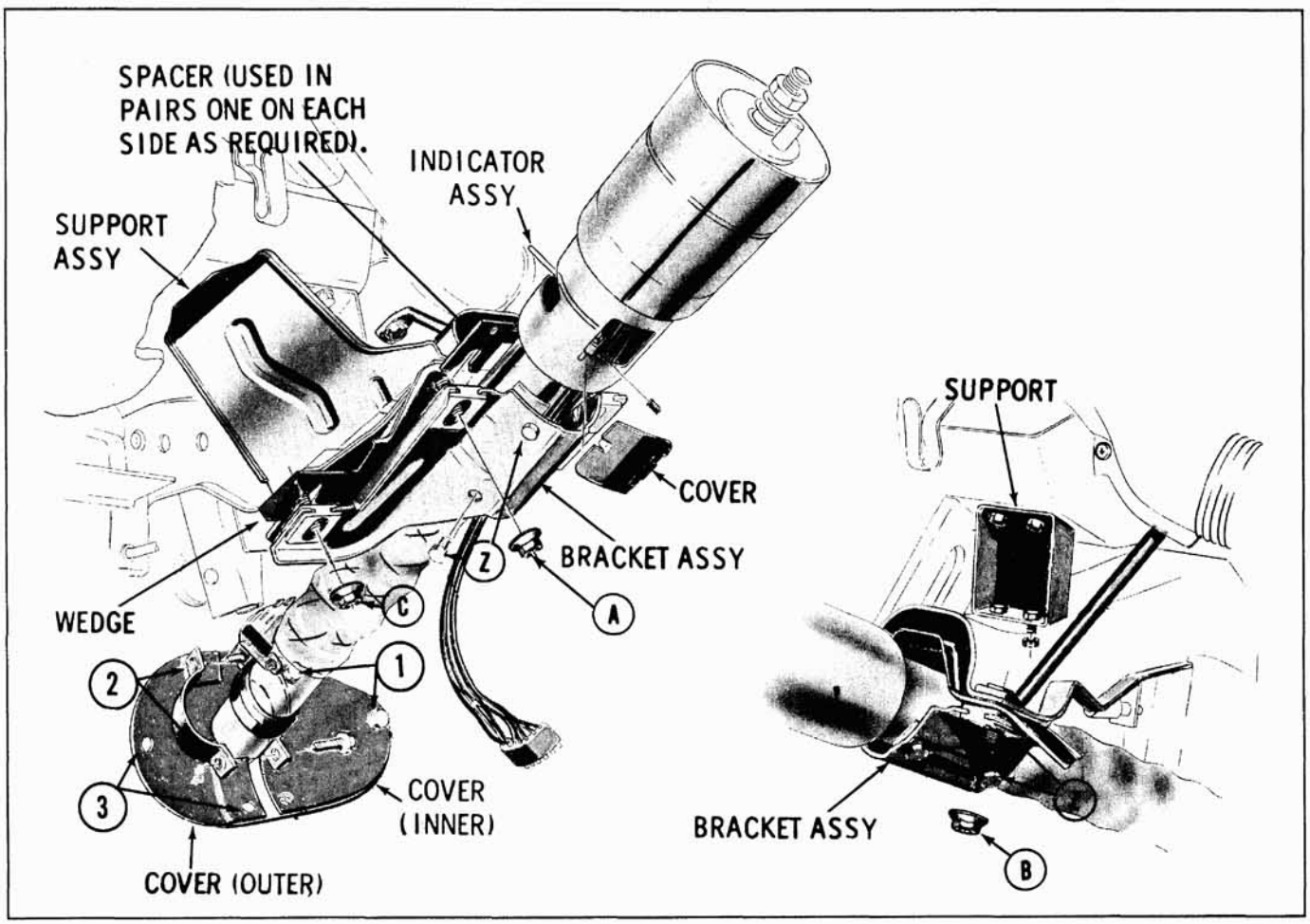


Fig. 12A-4—Steering Column Attachment

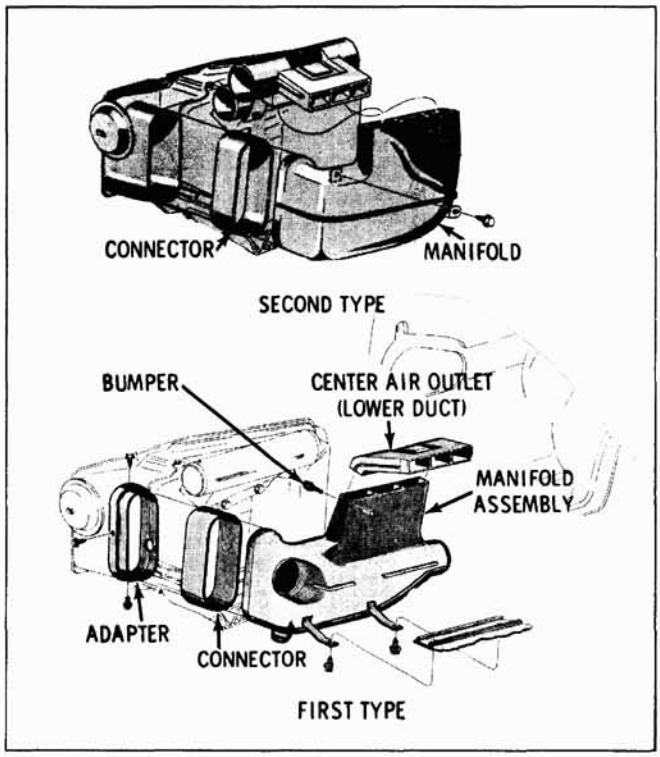


Fig. 12A-5—A/C Manifold

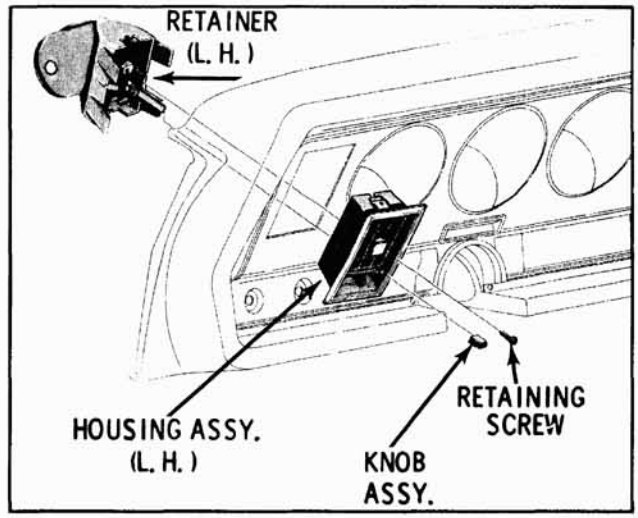


Fig. 12A-6—A/C Air Outlet L.H.

7. If equipped with A/C, remove manifold (Fig. 12A-5) and left air outlet. (Fig. 12A-6)
8. Disconnect speedometer cable at speedometer.
9. Remove the following from control panel.
   A. Ignition switch. Refer to IGNITION SWITCH—REMOVAL.
   B. Heater or A/C control. Refer to HEATER OR A/C CONTROL—REMOVAL.
   C. Ash tray receiver.

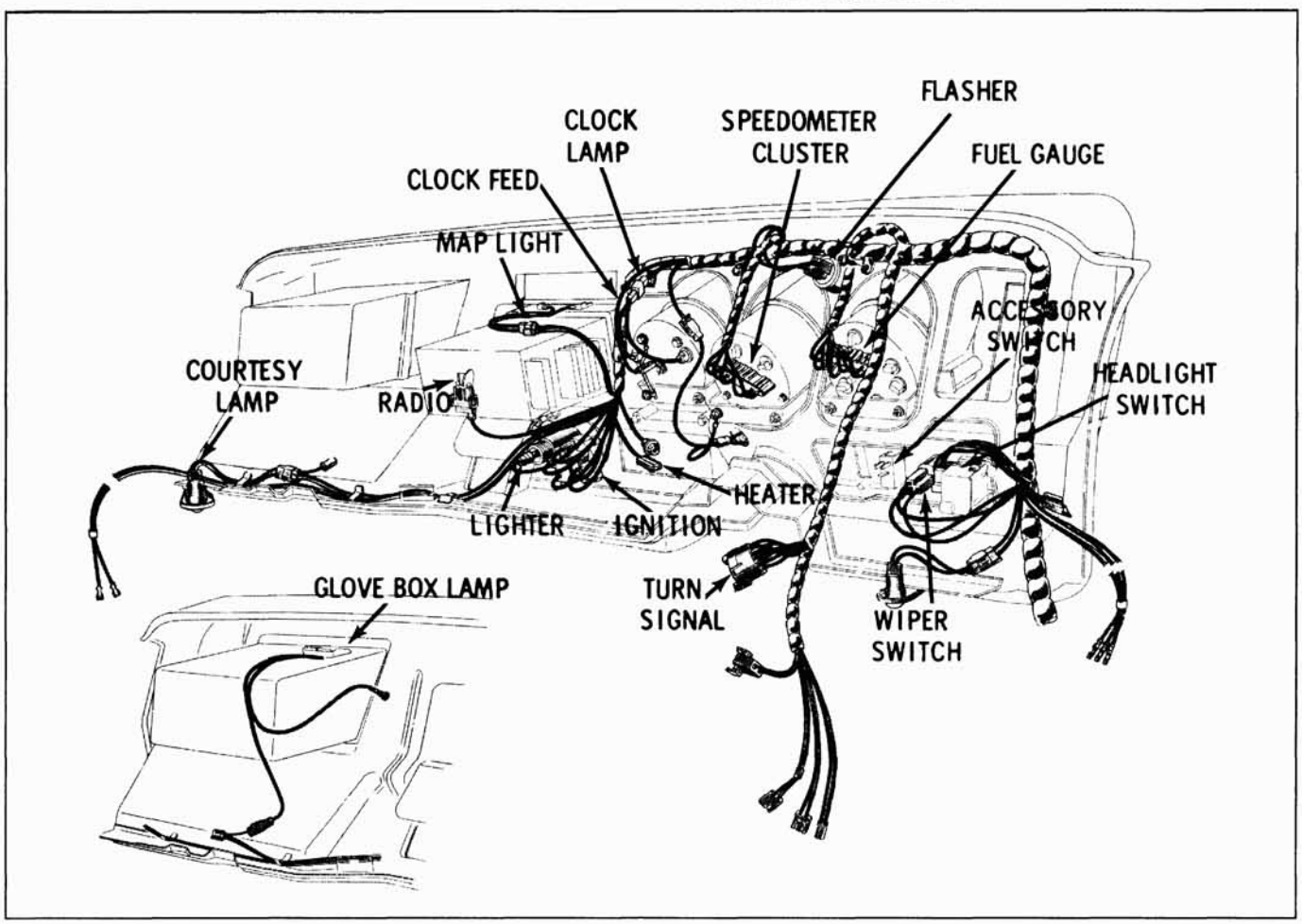


Fig. 12A-7—Control Panel Electrical Connectors

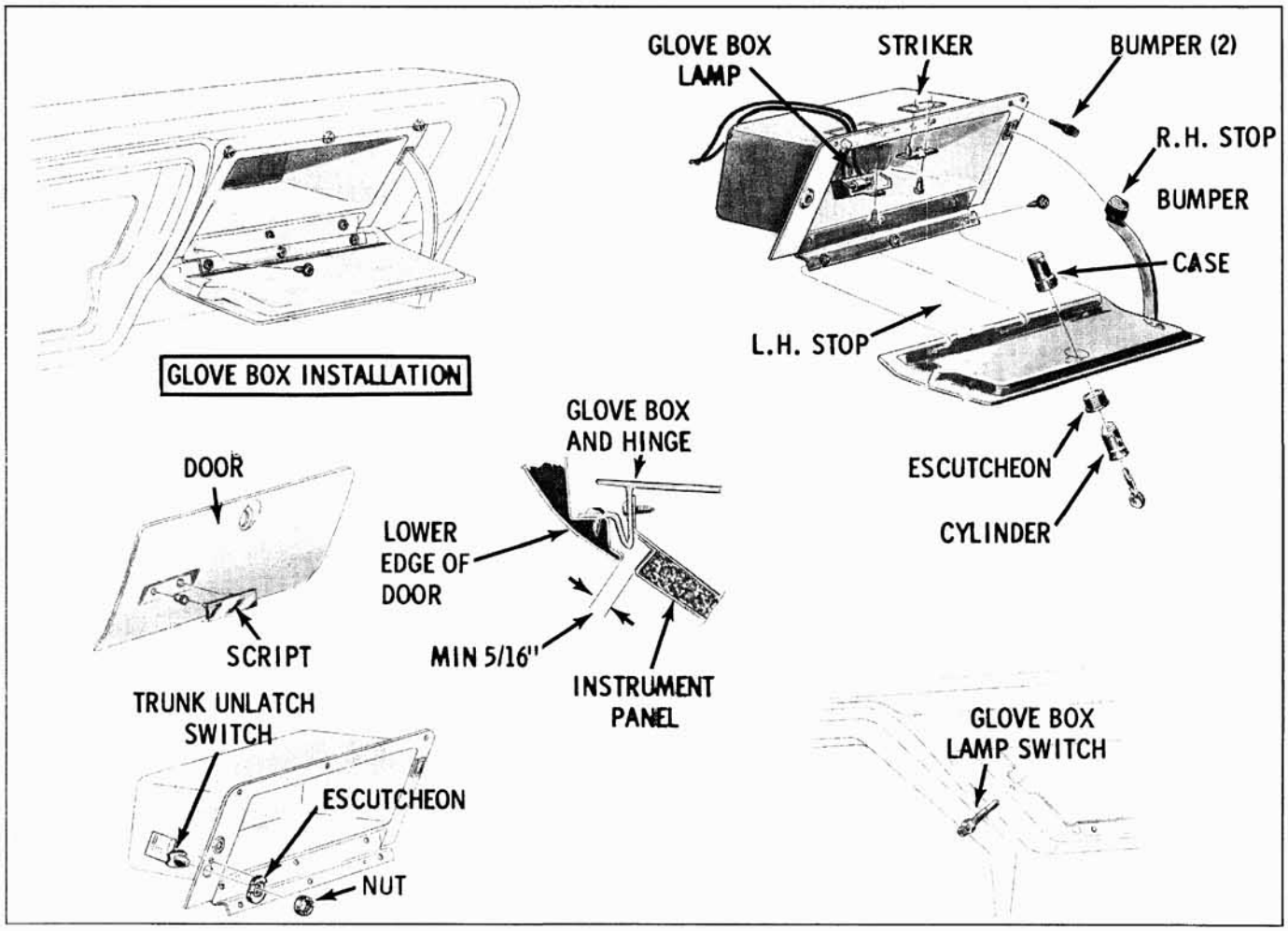


Fig. 12A-8—Glove Box Attachment

D. Light switch.
E. Washer and wiper switch.

10. Disconnect the following electrical connectors. (Fig. 12A-7)
A. Accessory switches.
B. Fuel gauge cluster.
C. Speedometer cluster.
D. Clock and map lamp.
E. Cruise control (if equipped).
F. Radio.
G. Lighter.
H. Ash tray and shift indicator lamps.

11. Remove antenna lead-in from radio.
12. Disconnect cruise control cable at regulator.
13. Remove control panel attaching screws (Fig. 12A-2), then remove control panel.

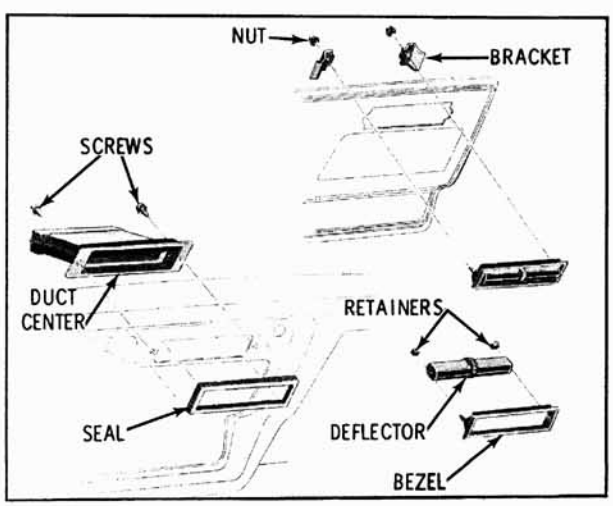


Fig. 12A-9—A/C Center Outlet

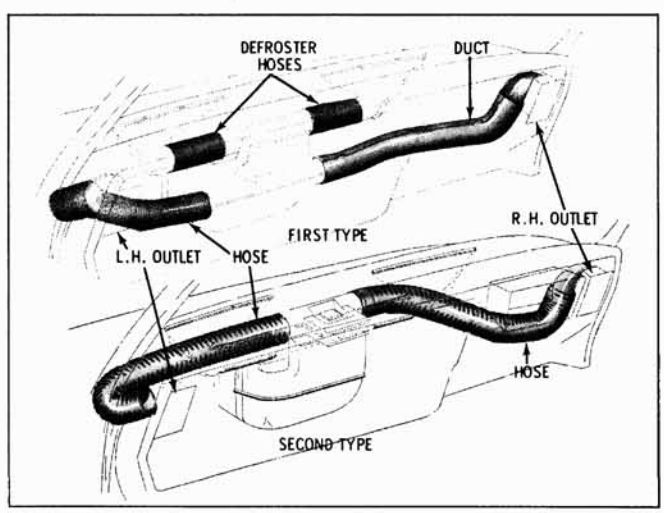


Fig. 12A-10—A/C Outlet Hoses

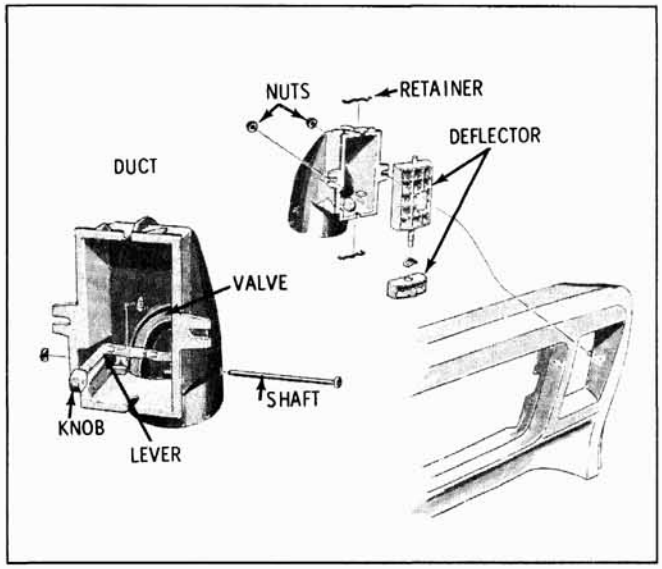


Fig. 12A-11—A/C Air Outlet R.H.

14. Disconnect the following:
A. Glove box lamp.
B. Glove box switch.
15. If vacuum trunk unlatch switch equipped, remove nut and escutcheon and let switch hang with vacuum hoses attached behind pad assembly. (Fig. 12A-8)
16. Remove glove box and door. (Fig. 12A-8)
17. Remove center A/C outlet duct, (Fig. 12A-9) if so equipped.
18. Remove R.H. A/C air outlet duct, (1st type) or hose (2nd type) if so equipped. (Fig. 12A-10)
19. Remove courtesy light housing attaching screws and let courtesy lights hang on wiring. (Fig. 12A-3)
20. Loosen the 4 upper nuts that secure the pad to the instrument panel. (Fig. 12A-3)
21. Remove the remaining 5 attaching bolts from the brackets to pad assembly. (Fig. 12A-3)
22. Pull top of pad assembly straight out of instrument panel and remove the 4 wiring harness attaching screws.

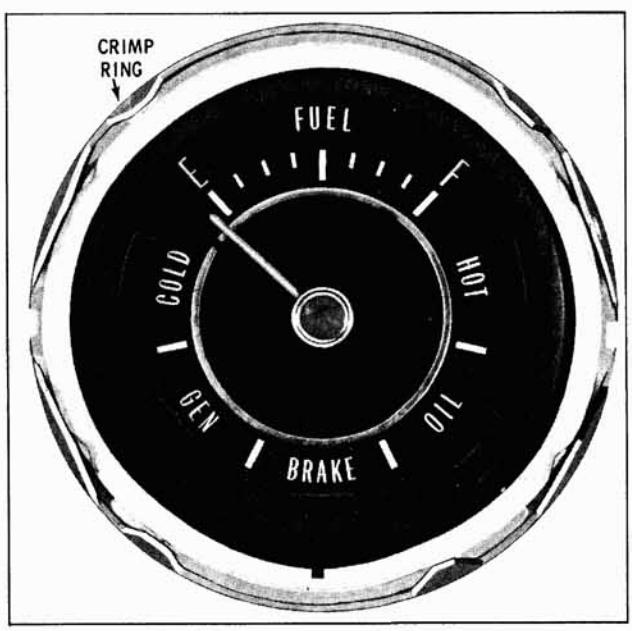


Fig. 12A-12—Fuel Gauge Cluster

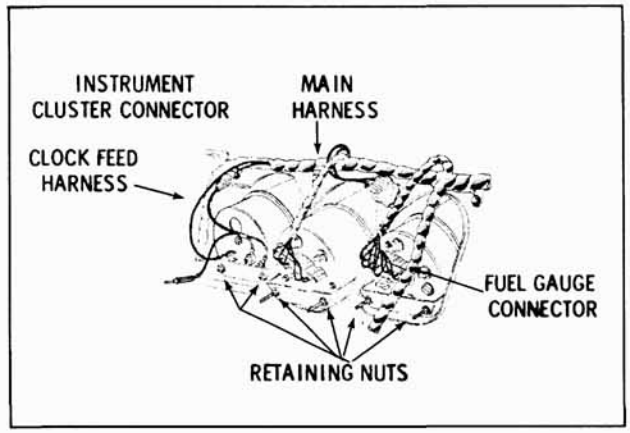


Fig. 12A-13—Cluster Attachment

23. Remove pad assembly.
24. If A/C equipped, remove R.H. air outlet from pad assembly as shown in Fig. 12A-11.
25. To install, reverse removal procedures.

FUEL GAUGE CLUSTER (Fig. 12A-12)

Removal

1. Disconnect negative battery cable.
2. Remove Phillips screw from upper front part of bezel.
3. Disconnect fuel gauge cluster multiple connector from printed circuit. (Fig. 12A-7)
4. Remove rear cluster retaining nuts. (Fig. 12A-13)
5. Remove fuel gauge cluster assembly from front of control panel.

FUEL GAUGE CLUSTER BEZEL (Fig. 12A-14)

Removal

1. Remove fuel gauge cluster. Refer to FUEL GAUGE CLUSTER—REMOVAL.
2. Remove the 4 bezel to cluster attaching screws.

FUEL GAUGE PRINTED CIRCUIT (Fig. 12A-15)

Removal

1. Remove fuel gauge cluster. Refer to FUEL GAUGE CLUSTER—REMOVAL.

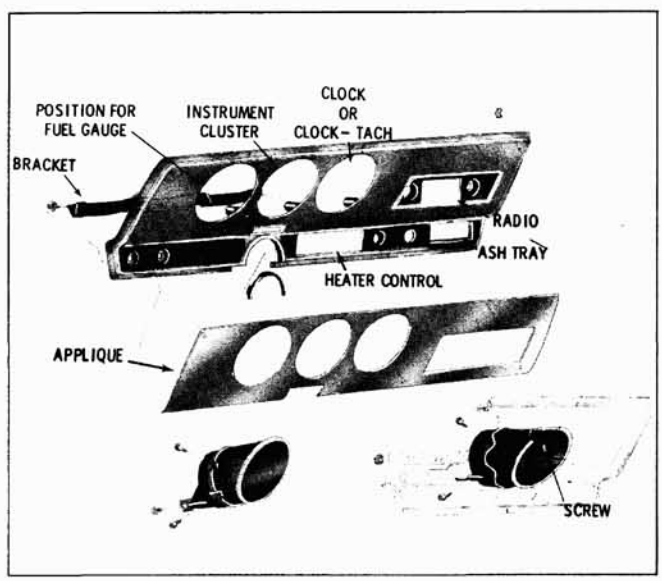


Fig. 12A-14—Control Panel Clusters

Fig. 12A-15—Fuel Gauge Printed Circuit

2. Remove lamp sockets from printed circuit board by turning the socket 1/8 of a turn counterclockwise.
3. Remove the plastic protector from the fuel gauge resistor, then remove the two resistor attaching nuts and remove resistor.
4. Remove the three printed circuit attaching screws and remove the printed circuit.

SPEEDOMETER CLUSTER (Fig. 12A-16)

Removal

1. Disconnect negative battery cable.
2. Disconnect speedometer cable at speedometer.
3. Disconnect speedometer cluster multiple connector from printed circuit. (Fig. 12A-7)
4. Remove Phillips screw from under front part of bezel.

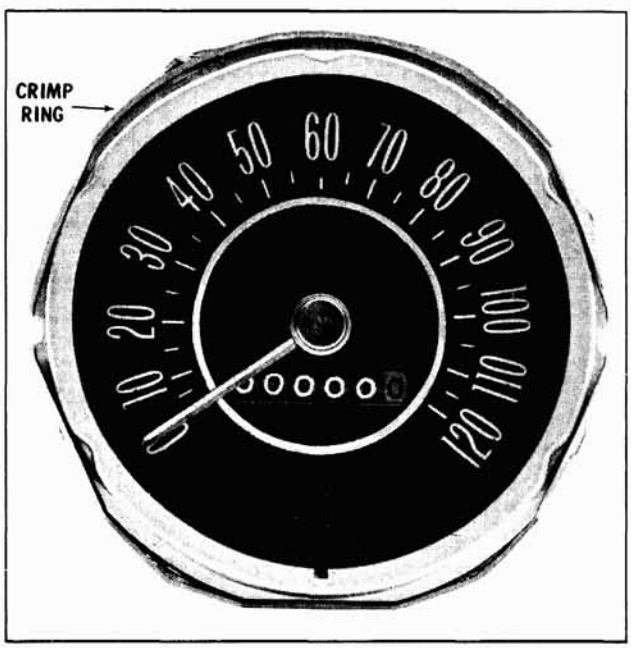


Fig. 12A-16—Speedometer Cluster

5. Remove rear cluster retaining nuts.
6. Remove speedometer cluster assembly from front of control panel.

SPEEDOMETER CLUSTER BEZEL

Removal

1. Remove speedometer cluster. Refer to SPEEDOMETER CLUSTER—REMOVAL.
2. Remove the 4 bezel to cluster attaching screws.

SPEEDOMETER CLUSTER PRINTED CIRCUIT (Fig. 12A-17)

Removal

1. Remove speedometer cluster. Refer to SPEEDOMETER CLUSTER—REMOVAL.
2. Remove lamp sockets from printed circuit board by turning the socket 1/8 of a turn counterclockwise.
3. Remove the 3 printed circuit attaching screws and remove the printed circuit board.

CLOCK CLUSTER (Fig. 12A-18)

Removal

1. Disconnect negative battery cable.
2. Disconnect lamp wiring and clock feed.
3. Remove Phillips screw from front of bezel.
4. Remove the 2 clock cluster retaining nuts. (Fig. 12A-13)
5. Disconnect clock cluster ground from cluster retaining bolt and remove cluster from front of control panel.

CLOCK BEZEL

Removal

1. Remove clock cluster. Refer to CLOCK CLUSTER —REMOVAL.
2. Remove the 4 bezel to cluster attaching screws.

HEADLIGHT SWITCH (Fig. 12A-19)

All connections in the headlight switch are connected by a multiple connector. The brightness of the instrument panel lights are controlled through a variable resistor unit by turning the headlight switch knob right or left. Rotating the headlight switch knob fully counterclockwise will cause the dome lamp to light.

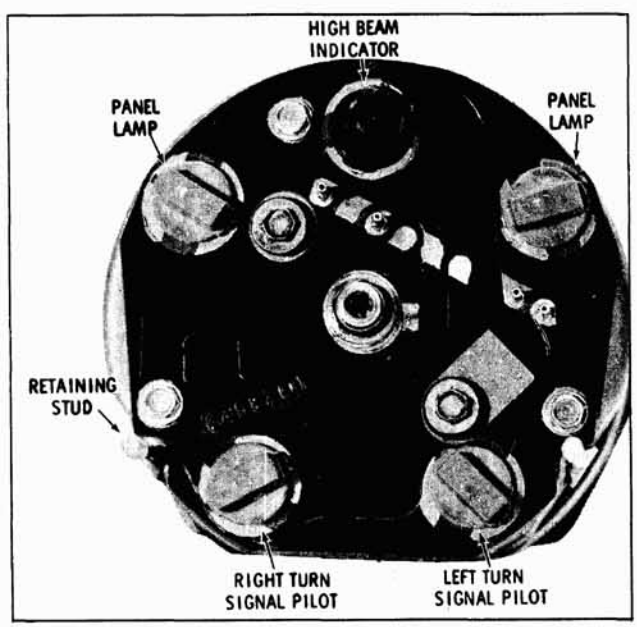


Fig. 12A-17—Speedometer Printed Circuit

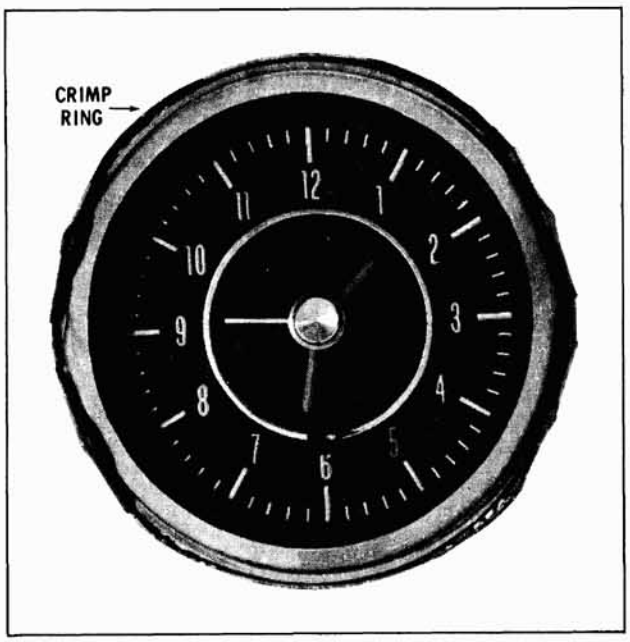


Fig. 12A-18—Clock Cluster

Removal

1. Remove knob by first pulling knob out to the HEADLIGHT ON position, then depress the spring loaded button on the switch body and pull knob out of switch assembly.
2. Remove escutcheon using Tool BT-6817-2.
3. Remove headlight switch from rear of control panel.
4. Disconnect multiple connector from headlight switch.

WASHER AND WIPER SWITCH (Fig. 12A-19)

Removal

1. Pull wiper knob from switch. (Fig. 12A-19)
2. Remove escutcheon using Tool BT-6817-2 and remove washer and wiper switch from rear of control panel.
3. Remove wiring connector from switch.

IGNITION SWITCH (Fig. 12A-20)

Removal

1. If A.C. equipped, remove manifold. (Fig. 12A-5)
2. Disconnect negative battery cable.
3. Turn switch to ACCESSORY position.
4. Insert a straightened-out paper clip into small hole in the front side of the switch and depress, while turning the key counterclockwise, the lock will then pop out.
5. Remove the escutcheon using Tool BT-6817-1.
6. Push the switch behind the control panel and remove the wiring connector as shown in Fig. 12A-7.

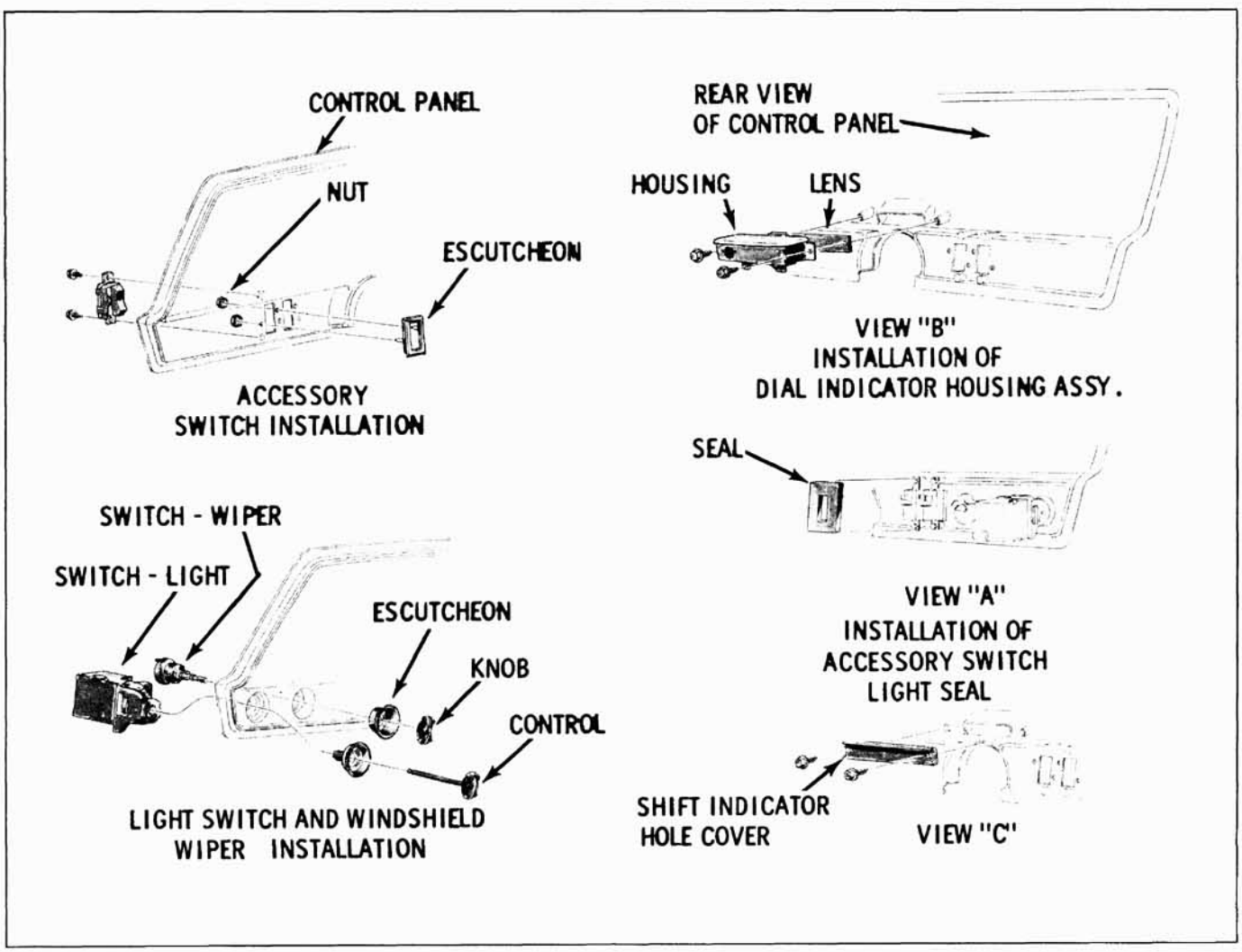


Fig. 12A-19—Switch Installations

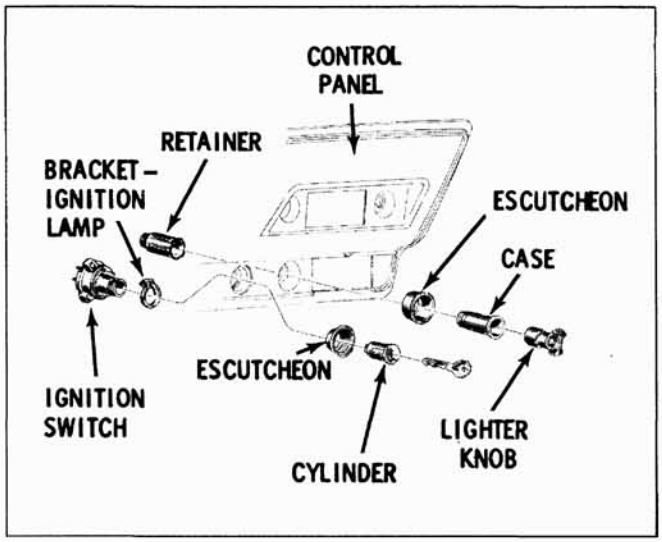


Fig. 12A-20—Ignition And Lighter Switch

CIGAR LIGHTER (Fig. 12A-20)

Removal

1. If A.C. equipped, remove manifold. (Fig. 12A-5)
2. Disconnect feed wire from lighter.
3. Unscrew retainer from rear of control panel while holding lighter case and escutcheon.
4. Remove case and escutcheon from front of control panel.

RADIO (Fig. 12A-21)

Removal

1. If A.C. equipped, remove manifold. (Fig. 12A-5)
2. Disconnect antenna lead-in, 12 volt feed and speaker connectors.
3. Remove knobs from front of dash, then remove attaching nuts.
4. Remove attaching bolt (bracket to control panel) and remove radio from rear of control panel.

RADIO SPEAKER

Removal

1. Remove radio.

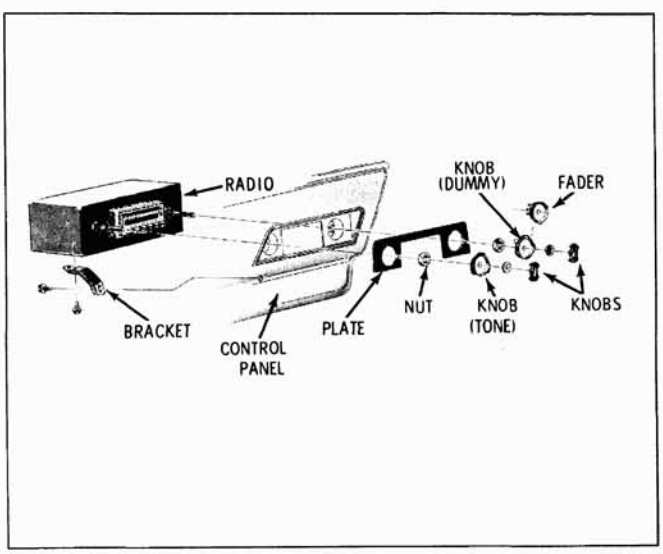


Fig. 12A-21—Radio Installation

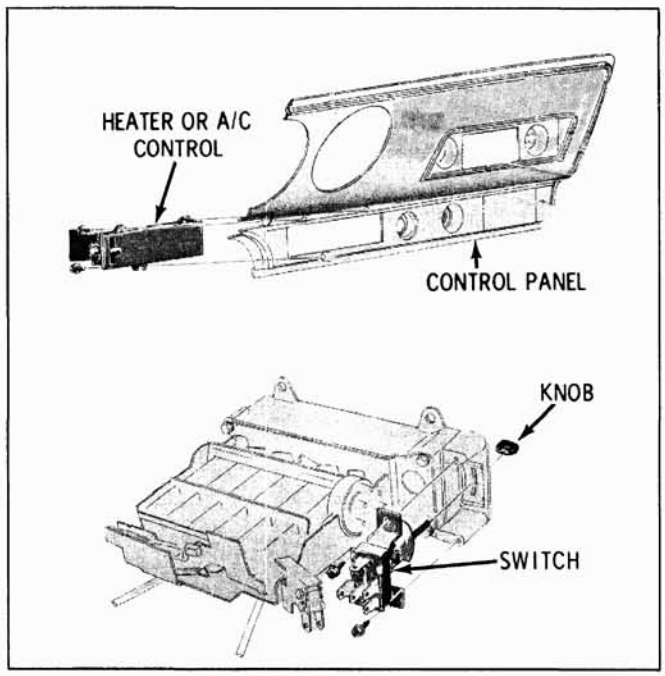


Fig. 12A-22—Heater Or A/C Control

2. If A.C. equipped, remove manifold and lower center outlet duct from center outlet.
3. Remove two screws (speaker to instrument panel) and remove speaker.

HEATER OR A.C. CONTROL (Fig. 12A-22)

Removal

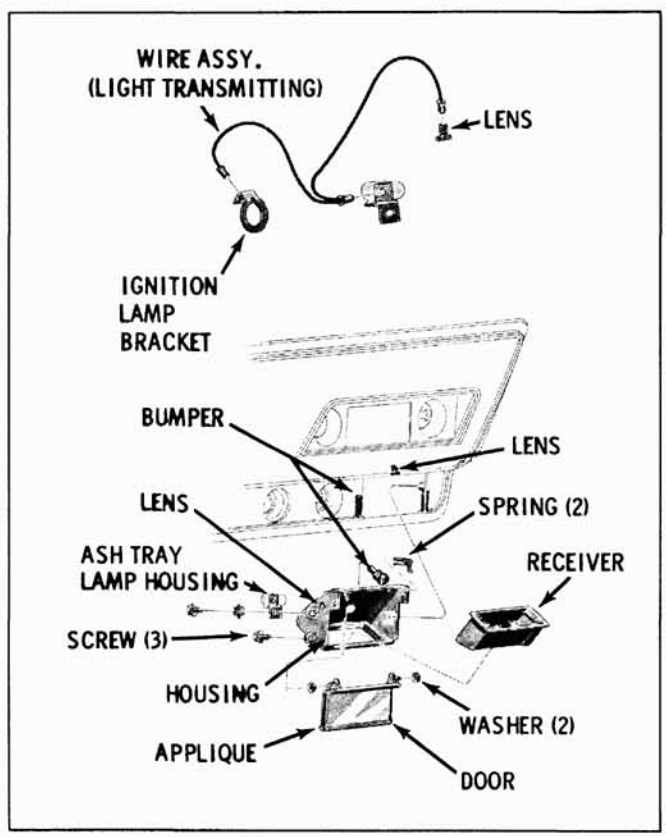


Fig. 12A-23—Ash Tray Assembly

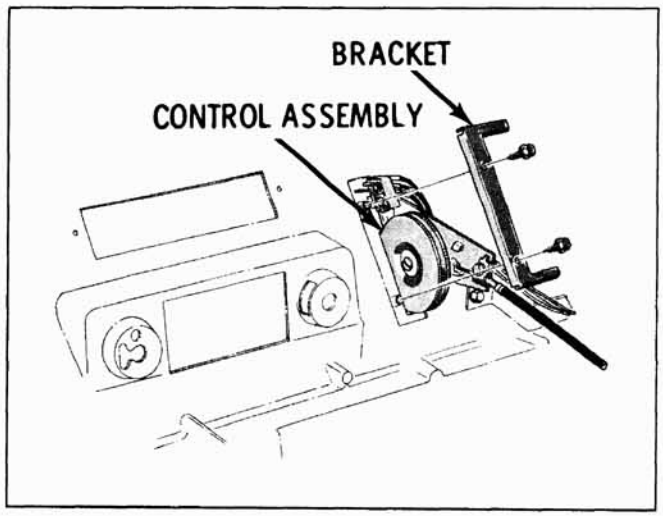


Fig. 12A-24—Cruise Control Attachment

1. If A.C. equipped, remove manifold. (Fig. 12A-5)
2. Disconnect negative battery cable.
3. Remove 3 attaching screws (control to control panel) and remove control. If necessary to remove control cables or vacuum hoses, refer to Section I.
4. Disconnect blower switch multiple connector.

BLOWER SWITCH (Fig. 12A-22)

Removal

1. If A.C. equipped, remove manifold. (Fig. 12A-5)
2. Disconnect negative battery cable.
3. Disconnect blower switch multiple connector.
4. Loosen set screw in knob and remove knob.
5. Remove two attaching screw (switch to heater or A.C. control) and remove switch.

ASH TRAY ASSEMBLY (Fig. 12A-23)

Removal

1. If A/C equipped, remove manifold. (Fig. 12A-5)
2. Disconnect negative battery cable.
3. Push ash tray door to the open position and lift out ash tray receiver.
4. Remove 3 attaching screws (ash tray housing to control panel).
5. Remove ash tray housing from rear of control panel.

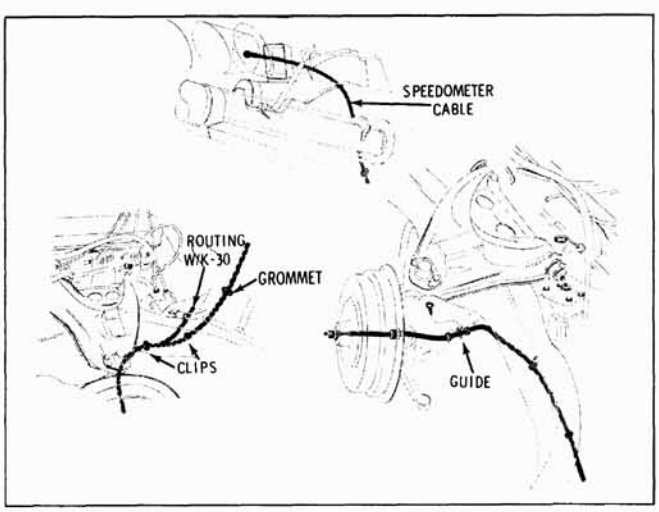


Fig. 12A-25—Speedometer Cable

ASH TRAY DOOR (Fig. 12A-23)

Removal

1. Remove ash tray assembly.
2. Carefully spread ash tray housing until ash tray door and the 2 wave washers can be removed.

MAP LIGHT

Remove attaching screws and pull wiring through map light hole in control panel until connector can be disconnected.

GLOVE BOX LAMP SWITCH (Fig. 12A-8)

Disconnect lamp feed wire and unscrew switch out from inside of glove box.

VACUUM TRUNK SWITCH (Fig. 12A-8)

Remove switch nut and escutcheon, then pull vacuum hoses from under dash until vacuum hoses can be removed from switch.

A.C. CENTER OUTLET DUCT (Fig. 12A-9)

Removal

1. Remove radio. Refer to RADIO REMOVAL.
2. Remove 2 attaching screws (A.C. center duct to pad assembly).

A.C. CENTER OUTLET (Fig. 12A-9)

Removal

1. Remove A.C. center outlet duct. Refer to A.C. CENTER OUTLET DUCT REMOVAL.
2. Remove bezel attaching nuts and brackets and remove center outlet from front of dash.

A.C. AIR OUTLET HOUSING—L.H. (Fig. 12A-6)

Removal

1. Insert screwdriver between center louvers of housing assembly and remove the two attaching screws.
2. Carefully pull housing assembly from front of control panel.

A.C. AIR OUTLET DUCT ASSEMBLY—R.H. (Fig. 12A-11)

Removal

1. Remove R.H. air outlet duct or hose. (Fig. 12A-10)
2. Remove attaching screws (2) as shown in Fig. 12A-11 and remove duct assembly from rear of pad assembly.

CRUISE CONTROL (Fig. 12A-24)

Removal

1. Disconnect negative battery cable.
2. If A.C. equipped, remove manifold. (Fig. 12A-5)
3. Disconnect control cable at regulator.
4. Disconnect wiring harness.
5. Remove bracket to control attaching screws. (Fig. 12A-24)
6. Remove cruise control from front of control panel.

APPLIQUE (Fig. 12A-14)

Removal

1. Remove the three instrument clusters. Refer to each for procedures.
2. If A.C. equipped, remove center outlet and air outlet housing—L.H.
3. If cruise control equipped, refer to CRUISE CONTROL REMOVAL for procedures.
4. Remove the 6 retaining nuts and remove applique.

SHIFT INDICATOR HOUSING OR DIAL (Fig. 12A-19)

Removal

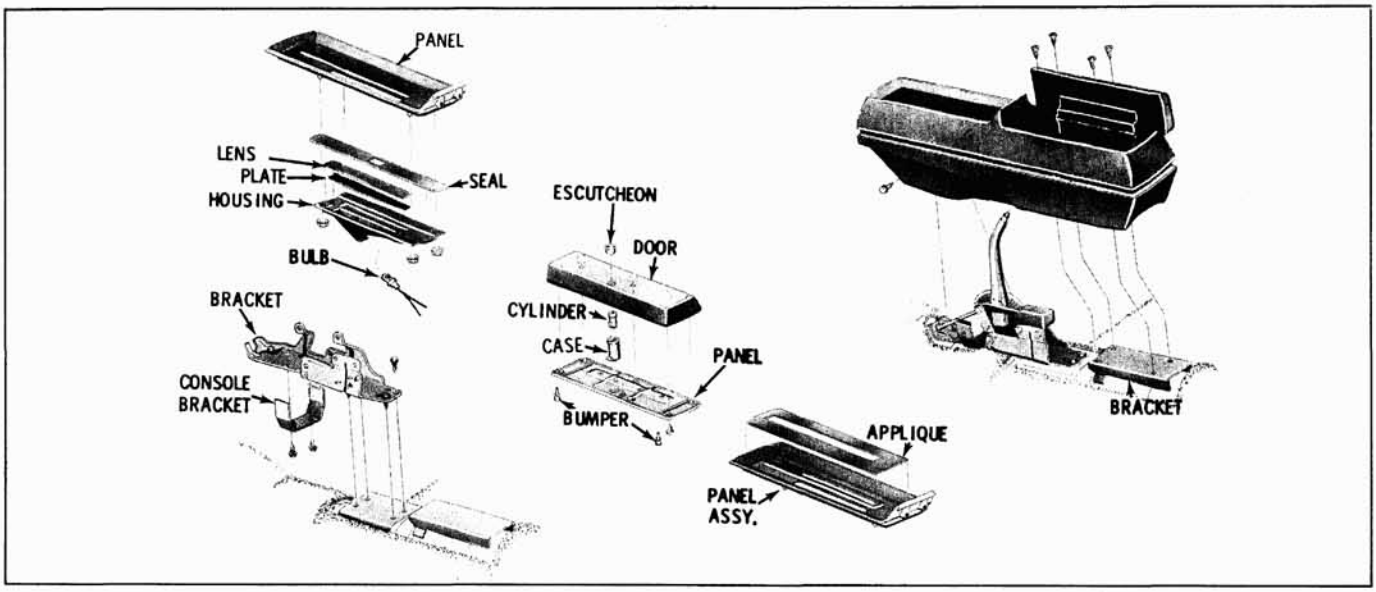


Fig. 12A-26—Console Components

1. Remove the three instrument clusters, fuel gauge, speedometer and clock. Refer to individual cluster removal procedures.
2. Remove trim cap from below steering column.
3. Remove shift indicator needle.
4. If equipped with cruise control, it may be necessary to disconnect control cable at regulator.
5. Remove the ten control panel attaching screws.
6. Tilt control panel top edge away from pad assembly until shift indicator housing attaching screws are accessible.
7. To install, reverse removal procedure.

ACCESSORY SWITCHES (Fig. 12A-19)

Removal

1. Disconnect negative battery cable.
2. Disconnect multiple wiring connector from switch.
3. Remove light seal from back side of switch.
4. Remove attaching screws from switch and remove.
5. If switch escutcheon is to be replaced, remove attaching nuts and remove from front of control panel.

SPEEDOMETER CABLE (Fig. 12A-25)

Removal

1. Disconnect cable from speedometer cluster.
2. Remove the grommet from the cowl and withdraw cable into engine compartment.
3. Disconnect clips at frame and remove attaching screw from guide.
4. Remove the cable housing retaining nut at the steering knuckle (left front wheel). Tool BT-6633 is available to assist in removing cable housing retaining nut.
5. To install, reverse removal procedure.

If the cable housing retaining nut cannot be readily started into the steering knuckle, the speedometer cable is not indexed with the dust cap. Rotate wheel slightly until cable will index.

CONSOLE

For detailed disassembly and assembly, refer to Figs. 12A-26 and 27.

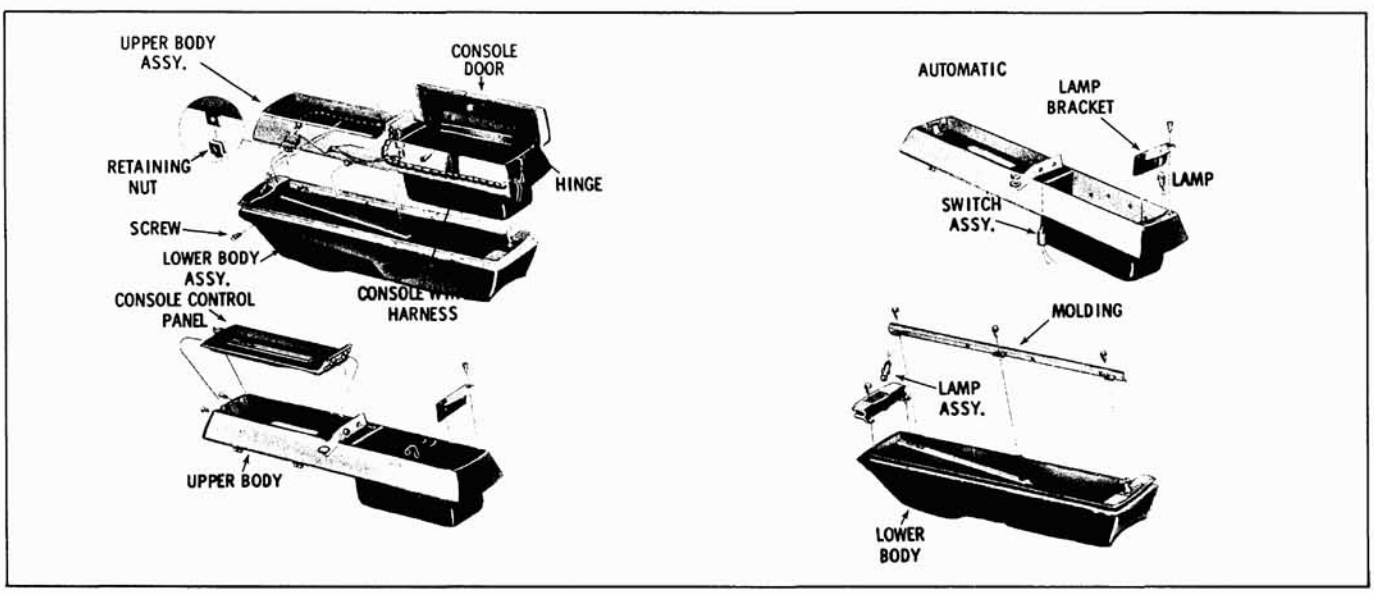


Fig. 12A-27—Console Components

INSTRUMENT PANEL

CONTENTS OF SECTION 12AA

Subject	Page	Subject	Page
DESCRIPTION	12AA-1	SPEEDOMETER CLUSTER	12AA-5
PAD AND CONTROL PANEL	12AA-2	SPEEDOMETER BEZEL	12AA-6
PAD ASSEMBLY	12AA-3	SPEEDOMETER PRINTED CIRCUIT	12AA-6
CONTROL PANEL	12AA-3	SHIFT INDICATOR	12AA-7
GLOVE BOX AND/OR DOOR	12AA-4	CLOCK CLUSTER	12AA-7
GLOVE BOX LOCK	12AA-4	CLOCK BEZEL	12AA-7
RADIO	12AA-4	HEATER OR A.C. CONTROL	12AA-7
RADIO SPEAKER	12AA-4	BLOWER SWITCH	12AA-7
IGNITION SWITCH	12AA-4	ASH TRAY ASSEMBLY	12AA-8
CIGAR LIGHTER	12AA-5	ASH TRAY DOOR	12AA-9
WASHER AND WIPER SWITCH	12AA-5	A.C. AIR OUTLET-R.H. OR L.H.	12AA-9
HEADLIGHT SWITCH	12AA-5	A.C. CENTER OUTLET	12AA-9
ACCESSORY SWITCHES	12AA-5	GLOVE BOX LAMP SWITCH	12AA-9
MAP LIGHT	12AA-5	VACUUM TRUNK SWITCH	12AA-9
FUEL GAUGE CLUSTER	12AA-5	CONSOLE (MANUAL TRANS.)	12AA-9
FUEL GAUGE BEZEL	12AA-5	CONSOLE (AUTO. TRANS.)	12AA-10
FUEL GAUGE PRINTED CIRCUIT	12AA-5	CONSOLE WIRING	12AA-10
FUEL GAUGE	12AA-5	SPEEDOMETER CABLE	12AA-10

DESCRIPTION

The instruments and controls are mounted in a control panel assembly which is bolted to the instrument panel. The control panel assembly can be removed from the instrument panel in a single unit with all controls, instruments and accessories attached to the panel, however it is not necessary to remove the complete panel to service individual units. (Fig. 12AA-1)

All the instruments are electrically operated, except the speedometer and automatic transmission indicator, which are mechanically operated. The generator, temperature and oil pressure indicators use colored lights to warn the driver of conditions other than normal when the engine is operating at speeds above idle, or when the engine is operating at normal operating temperature.

A rally pack option is available which uses gauges instead of warning lights. Refer to Section 15 for procedures.

The lamp sockets used in the printed circuit board can be removed by turning the socket 1/8 of a turn counterclockwise. The lamp bulb can then be removed from the socket by simply pulling the bulb straight out of the socket.

The instruments and lamps are of the printed circuit type and they are connected to the chassis wiring harness by multiple connector plugs on the printed circuit boards.

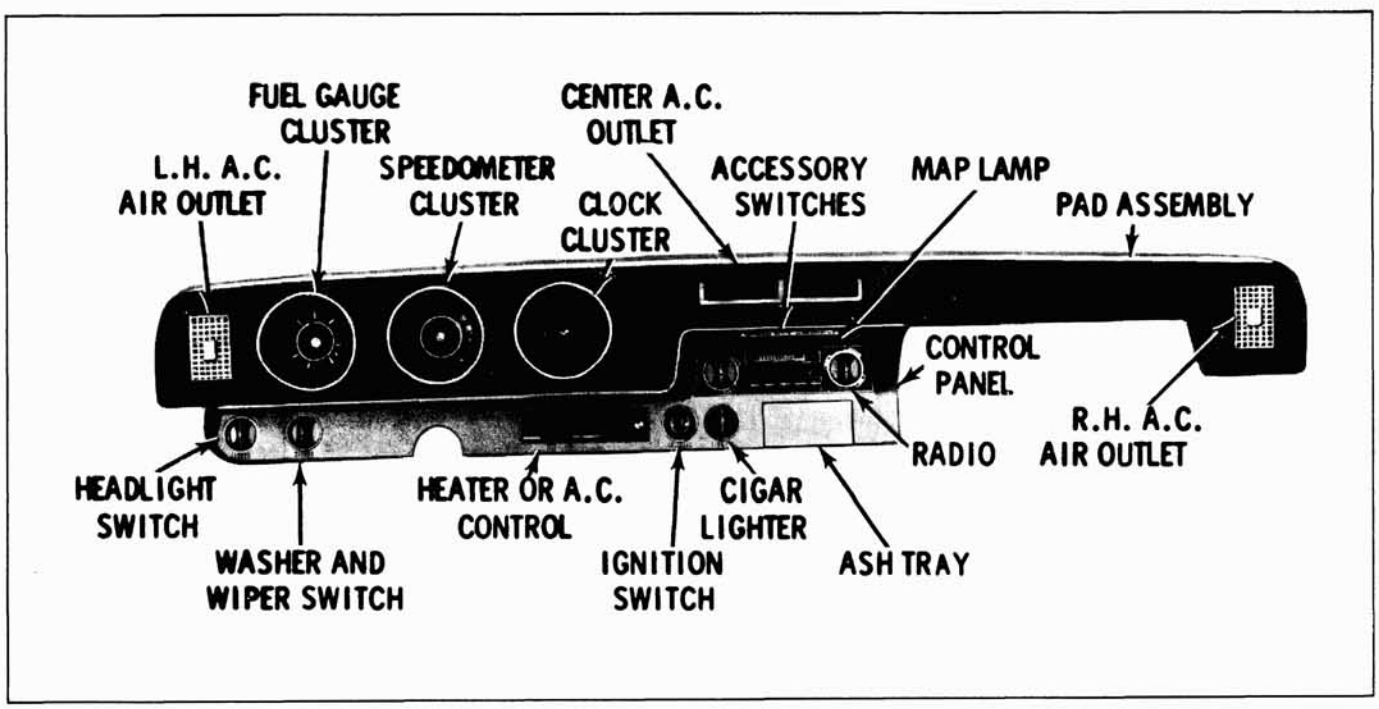


Fig. 12AA-1—Control Panel Assembly

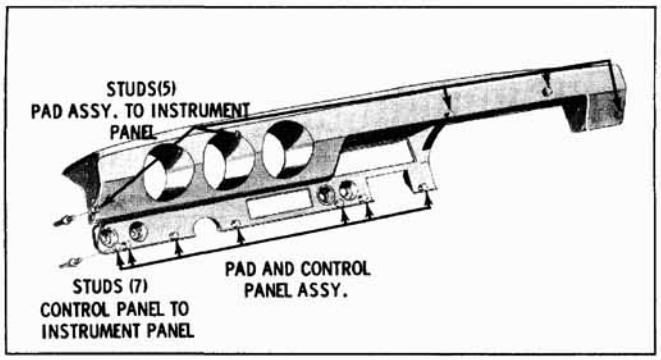


Fig. 12AA-2—Control Panel Attachment

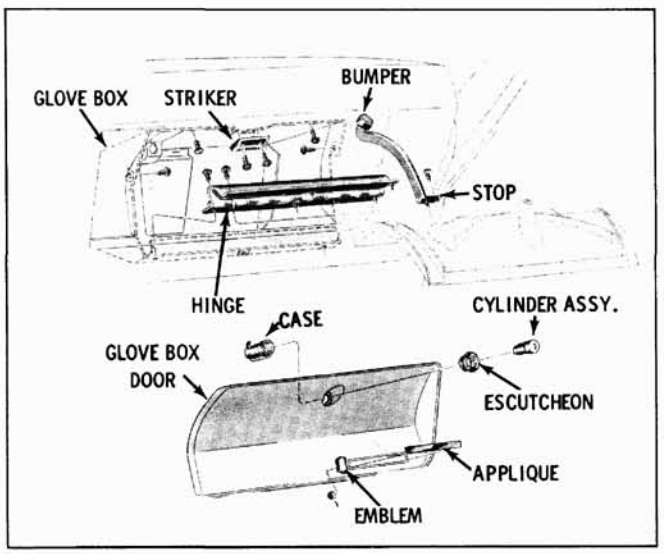


Fig. 12AA-3—Glove Box Attachment

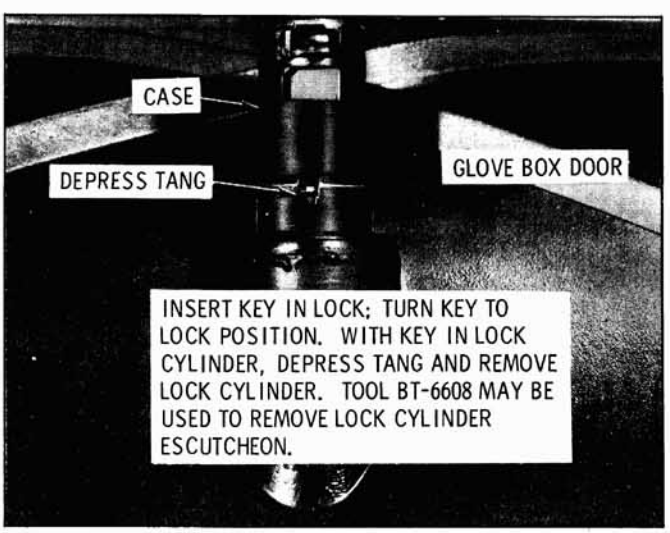


Fig. 12AA-3A—Glove Box Lock

PAD AND CONTROL PANEL (Fig. 12AA-2)

Removal

1. Disconnect negative battery cable.
2. Remove glove box door and glove box. (Fig. 12AA-3)
3. If A.C. equipped, remove A.C. manifold and R.H. and L.H. air outlet ducts. (Fig. 12AA-4)

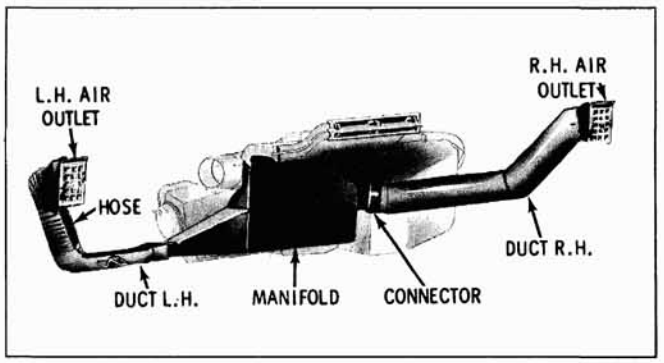


Fig. 12AA-4—A.C. Manifold and Ducts

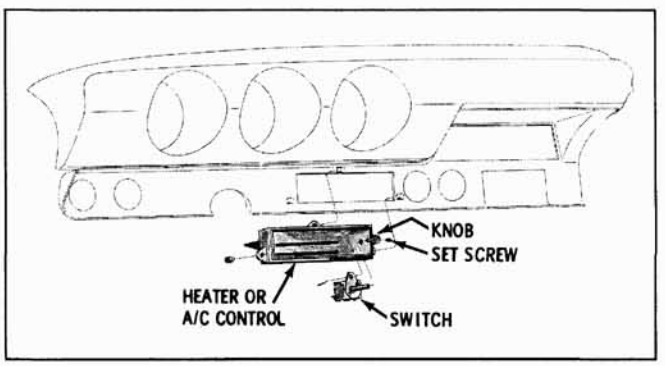


Fig. 12AA-5—Heater or A.C. Control

4. Remove attaching screws from heater or A.C. control. (Fig. 12AA-5) Do not disconnect vacuum hoses or control cables.
5. Disconnect antenna lead-in and speaker connector at radio.
6. Disconnect the following electrical connectors.
   a. Radio.
   b. Courtesy lights.
   c. Cigar lighter
   d. Map light.
   e. Accessory switches
   f. Clock and/or tachometer feed and clock light.
   g. Speedometer cluster.
   h. Fuel gauge cluster.
   i. Wiper and washer switch.
   j. Headlamp switch.
7. Using Tool BT-6817-1, remove escutcheon from ignition switch. Position switch behind dash.
8. Disconnect speedometer cable at speedometer.
9. Remove main wiring harness clamp attaching bolt. (Fig. 12AA-6)
10. Disconnect link from shift indicator lever on speedometer cluster if so equipped. (Fig. 12AA-7)
11. Remove trim cap below steering column.
12. Remove the 12 attaching nuts from studs shown in Fig. 12AA-2.
13. Remove bolt "C" and nuts "A" and "B" from bracket to steering column. (Fig. 12AA-7) Lower column and let steering wheel rest on seat cushion.
14. Remove pad and control panel assembly from instrument panel.

Installation

Reverse removal procedures.

When installing pad and control panel assembly, care must be exercised so that main wiring harness is not pinched between speedometer cluster and in-

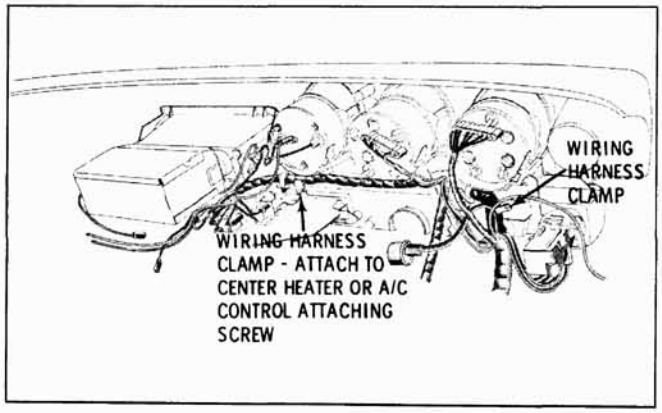


Fig. 12AA-6—Main Wiring Harness Attachment

strument panel.

PAD ASSEMBLY

Removal

1. Remove pad and control panel assembly. Refer to Pad and Control Panel Removal.
2. With assembly on the bench, remove speedometer cluster, fuel gauge cluster and clock and/or tachometer cluster. Clusters are removed from front of pad assembly after attaching bolts to control panel are removed. (Fig. 12AA-8)
3. If A.C. equipped, remove center and R.H. and L.H. outlet assemblies. (Fig. 12AA-9)

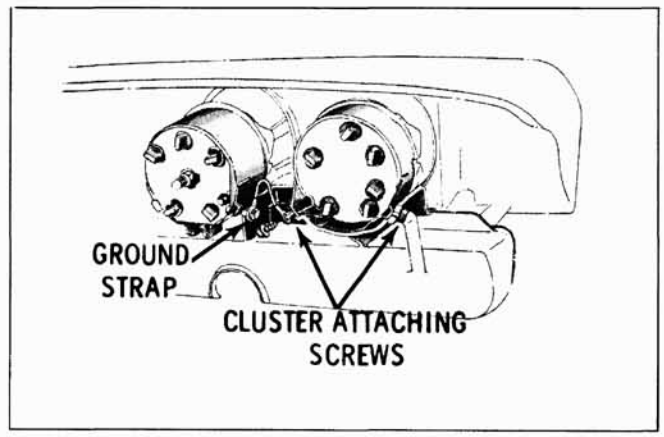


Fig. 12AA-8—Cluster Attachment

4. Remove 6 screws - control panel to pad assembly and remove pad. (Fig. 12AA-10)

Installation

Reverse removal procedures.

CONTROL PANEL

Removal

1. Remove pad and control panel assembly. Refer to Pad and Control Panel Removal.
2. With assembly on the bench, remove speedometer cluster, fuel gauge cluster and clock and/or tachometer cluster.

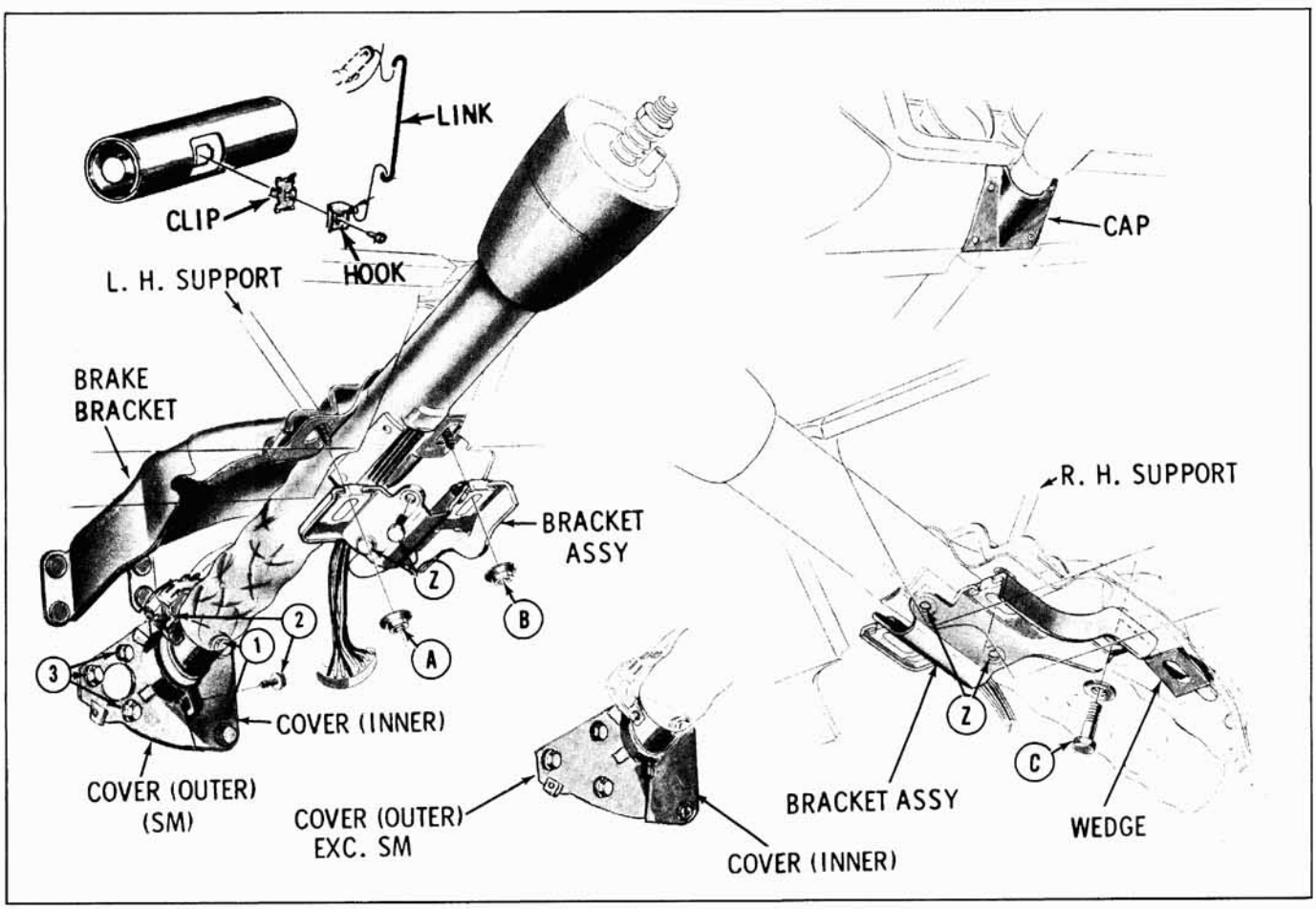


Fig. 12AA-7—Steering Column Attachment

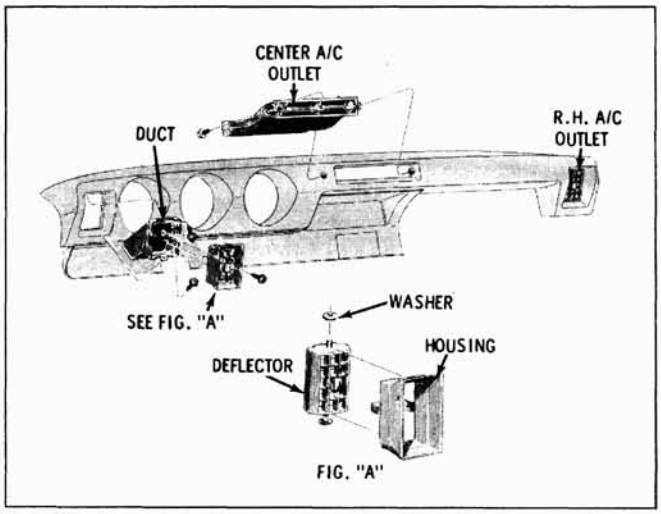


Fig. 12AA-9—A.C. Outlet Assemblies

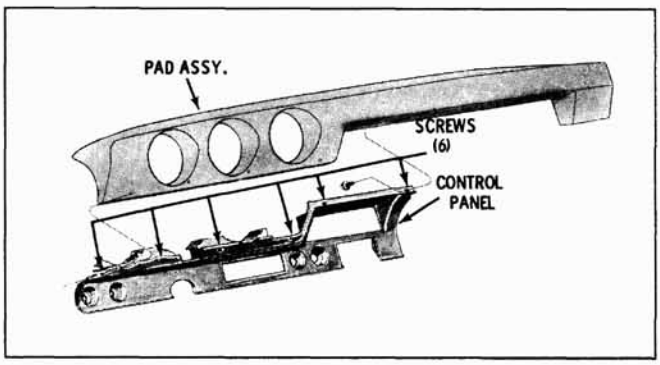


Fig. 12AA-10—Pad to Control Panel Attachment

3. Remove 6 screws - control panel to pad assembly and remove pad. (Fig. 12AA-10)

4. Remove headlamp switch, wiper switch (use Tool BT-6817-2 for escutcheon removal), cigar lighter assembly from control panel (Fig. 12AA-11), also accessory switches and map lamp. (Fig. 12AA-12)

5. Remove 7 studs from control panel as shown in Fig. 12AA-2.

Installation

Reverse removal procedure.

GLOVE BOX AND/OR DOOR

Refer to Fig. 12AA-3 for attachment. Glove box door can be removed without removing glove box.

GLOVE BOX LOCK CYLINDER

Refer to Fig. 12AA-3A for procedures.

RADIO (Fig. 12AA-14)

Removal

1. If A.C. equipped, remove manifold. (Fig. 12AA-4)
2. Disconnect antenna lead-in, 12 volt feed and speaker connectors.
3. Remove knobs from front of dash, then remove attaching nuts.
4. Remove attaching bolt (bracket to control panel) and remove radio from rear of control panel.

RADIO SPEAKER (Fig. 12AA-14A)

Removal

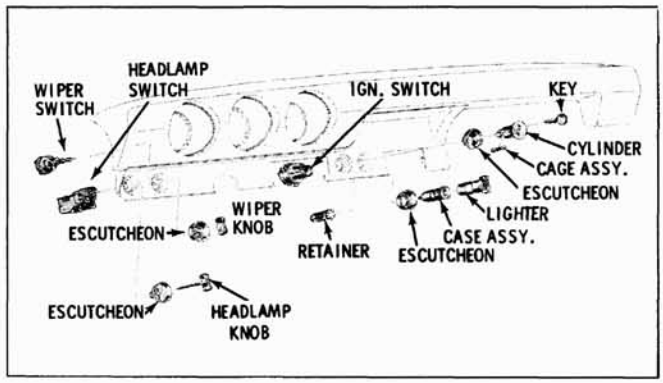


Fig. 12AA-11—Switch Attachments to Control Panel

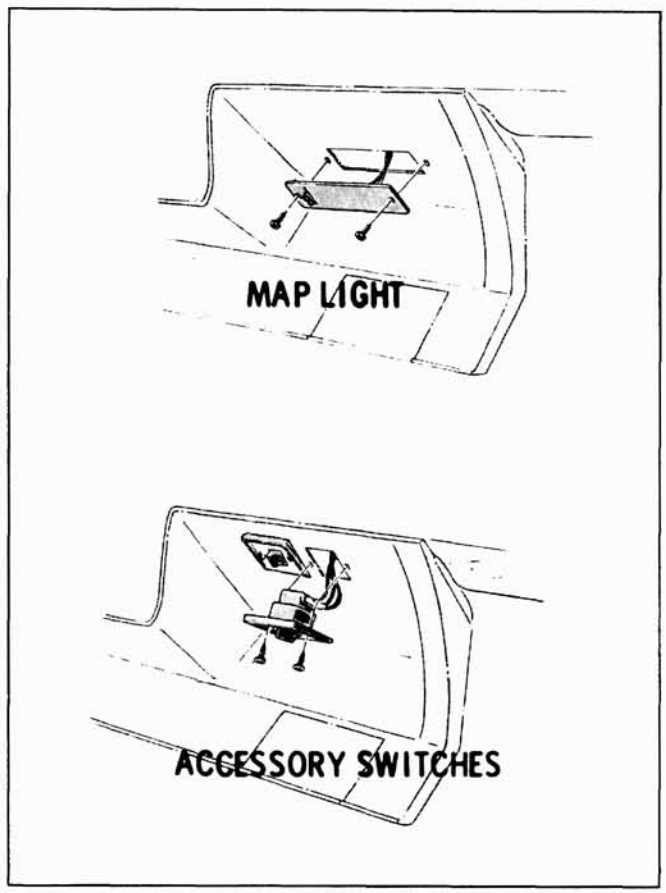


Fig. 12AA-12—Accessory Switch and Map Lamp Attachment

1. Remove radio. Refer to RADIO, REMOVAL.
2. If A.C. equipped, remove manifold and lower center outlet duct from center outlet.
3. Remove two screws (speaker to instrument panel) and remove speaker.

IGNITION SWITCH

Removal

1. If A.C. equipped, remove manifold. (Fig. 12AA-4)
2. Disconnect negative battery cable.
3. Turn switch to ACCESSORY position.
4. Insert a straightened-out paper clip into small hole in the front side of the switch and depress, while turning the key counterclockwise, the lock will then pop out.
5. Remove the escutcheon using Tool BT-6817-1.
6. Push the switch behind the control panel and discon-

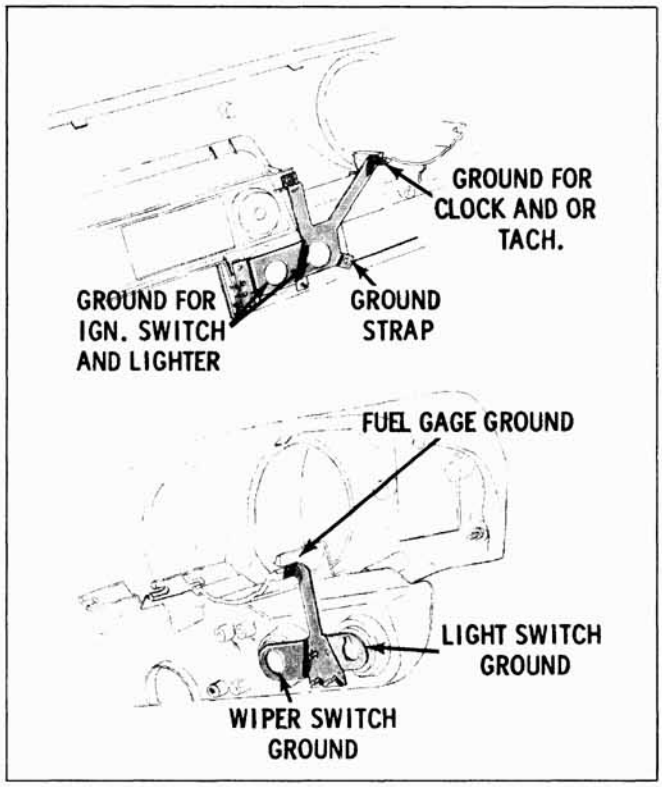


Fig. 12AA-13—Control Panel

nect the wiring connector as shown in Fig. 12AA-15.

CIGAR LIGHTER

Removal

1. If A.C. equipped, remove manifold. (Fig. 12AA-4)
2. Disconnect feed wire from lighter.
3. Unscrew retainer from rear of control panel while holding lighter case and escutcheon.
4. Remove case and escutcheon from front of control panel.

WASHER AND WIPER SWITCH

Removal

1. If A.C. equipped, remove L.H. air outlet duct. (Fig. 12AA-4)
2. Pull wiper knob from switch. (Fig. 12AA-11)
3. Remove escutcheon using Tool BT-6817-2 and remove washer and wiper switch from rear of control panel.
4. Disconnect switch wiring.

HEADLIGHT SWITCH

All connections in the headlight switch are connected by a multiple connector. The brightness of the instrument panel lights are controlled through a variable resistor unit by turning the headlight switch knob right or left. Rotating the headlight switch knob fully counterclockwise will cause the dome lamp to light.

Removal

1. If A.C. equipped, remove L.H. air outlet duct. (Fig. 12AA-4)
2. Disconnect multiple connector from headlight switch.
3. Remove knob by first pulling knob out to the HEADLIGHT ON position, then depress the spring loaded button on the switch body and pull knob out of switch assembly.
4. Remove escutcheon using Tool BT-6817-2.
5. Remove headlight switch from rear of control panel.

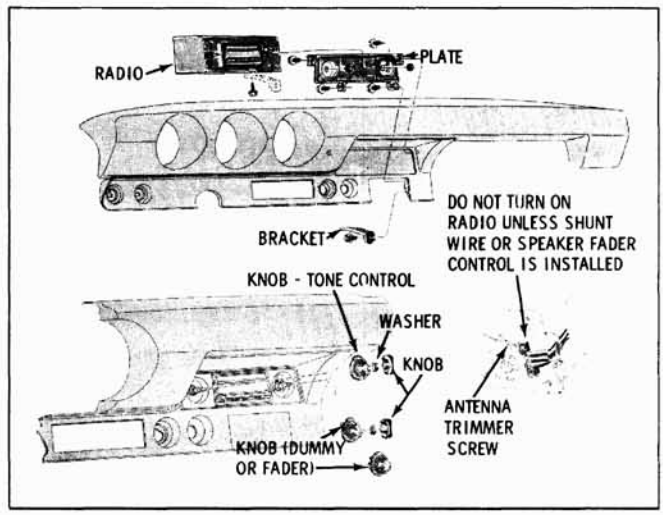


Fig. 12AA-14—Radio Attachment

ACCESSORY SWITCHES

Remove attaching screws as shown in Fig. 12AA-12 and pull wiring through switch hole in control panel until connector can be disconnected.

MAP LIGHT

Remove attaching screws as shown in Fig. 12AA-12 and pull wiring through map light hole in control panel until connector can be disconnected.

FUEL GAUGE CLUSTER (Fig. 12AA-16)

Removal

1. If A.C. equipped, remove L.H. air outlet duct. (Fig. 12AA-4)
2. Disconnect negative battery cable.
3. Disconnect printed circuit multiple connector.
4. Remove the 2 attaching screws, Fig. 12AA-17 (cluster assembly to control panel) and remove cluster assembly through front of pad assembly.

FUEL GAUGE BEZEL

Remove fuel gauge cluster, then remove the 4 bezel to cluster screws. (Fig. 12AA-18)

FUEL GAUGE PRINTED CIRCUIT (Fig. 12AA-19)

Removal

1. Remove fuel gauge cluster.
2. Remove lamp sockets from printed circuit board by turning the socket 1/8 of a turn counterclockwise.
3. Remove the plastic protector from fuel gauge resistor, then remove the two resistor attaching nuts and remove resistor.
4. Remove the three printed circuit attaching screws and remove the printed circuit.

FUEL GAUGE

The fuel gauge cluster is replaced as an assembly less the bezel and the printed circuit board and resistor.

SPEEDOMETER CLUSTER (Fig. 12AA-20)

Removal

1. If A.C. equipped, remove L.H. air outlet duct. (Fig. 12AA-4)
2. Disconnect negative battery cable.
3. Disconnect speedometer cable at speedometer.
4. Disconnect multiple wiring connector from printed circuit.

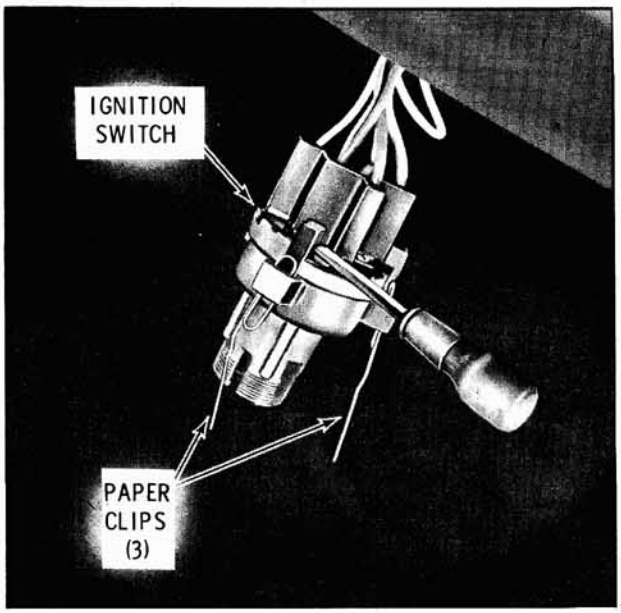


Fig. 12AA-15—Disconnecting Ignition Switch Connector

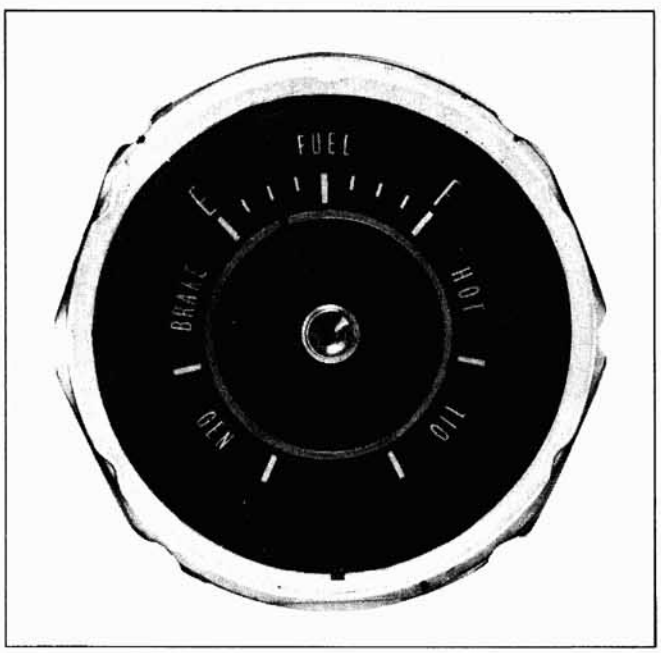


Fig. 12AA-16—Fuel Gauge Cluster (Bezel Removed)

5. If column shift equipped (automatic), disconnect shift indicator link. (Fig. 12AA-7)

6. Remove the two attaching screws, Fig. 12AA-17 (cluster assembly to control panel) and remove cluster through front of pad assembly.

SPEEDOMETER BEZEL

Remove the speedometer cluster, then remove the 4 bezel to cluster screws. (Fig. 12AA-21)

SPEEDOMETER CLUSTER PRINTED CIRCUIT (Fig. 12AA-22)

Removal

1. Remove speedometer cluster.

2. Remove lamp sockets from printed circuit board by turning the socket 1/8 turn counterclockwise.

3. Remove the three printed circuit attaching screws and

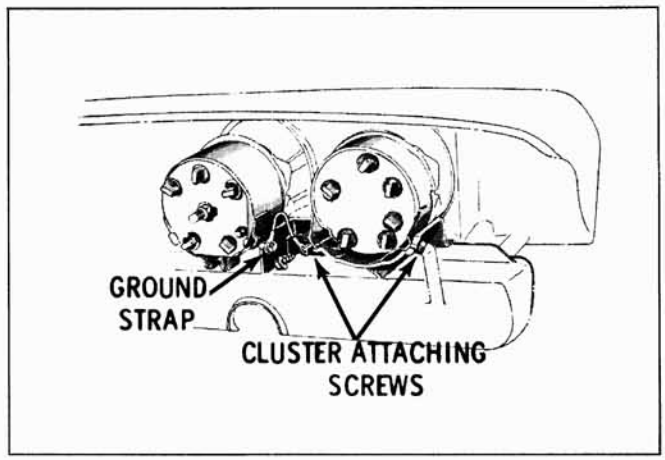


Fig. 12AA-17—Typical Cluster Attachment

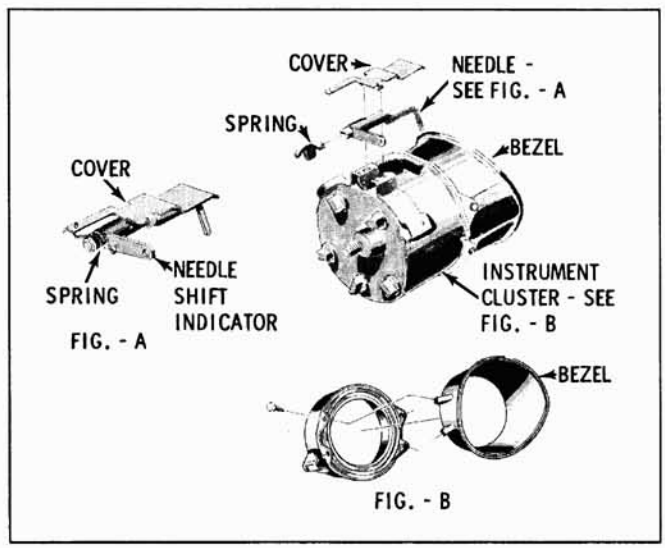


Fig. 12AA-18—Typical Bezel Attachment

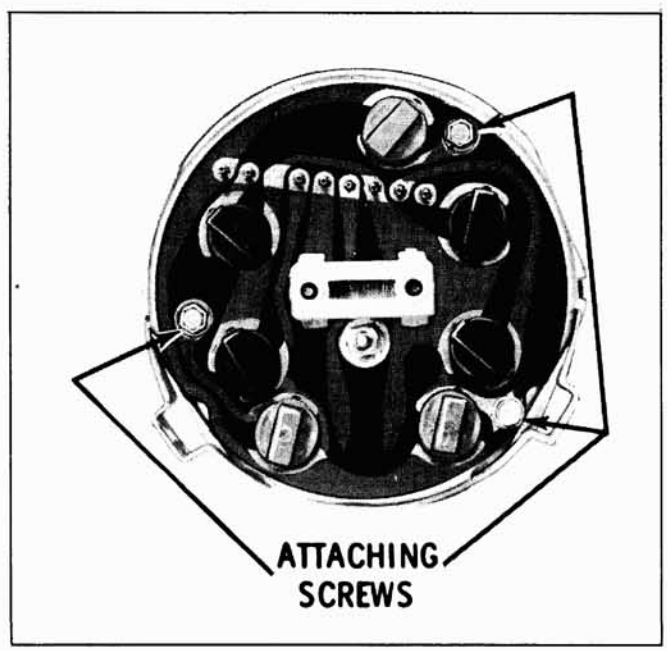


Fig. 12AA-19—Fuel Gauge Printed Circuit

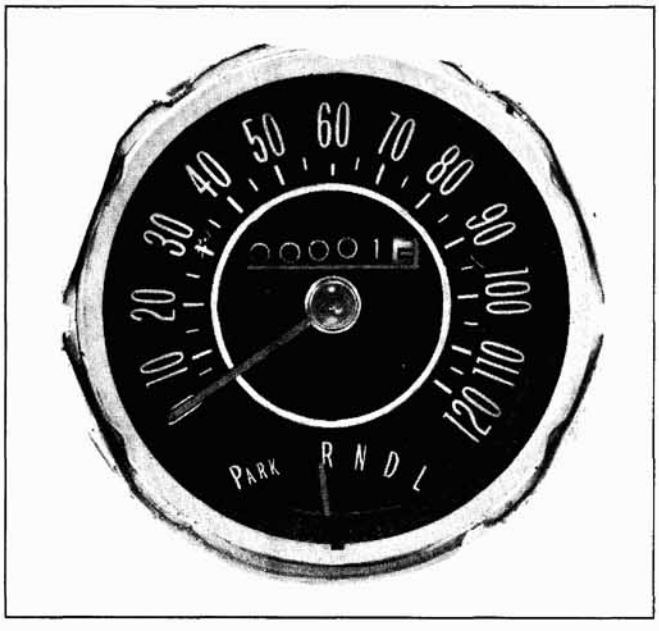


Fig. 12AA-20—Speedometer Cluster (Bezel Removed)

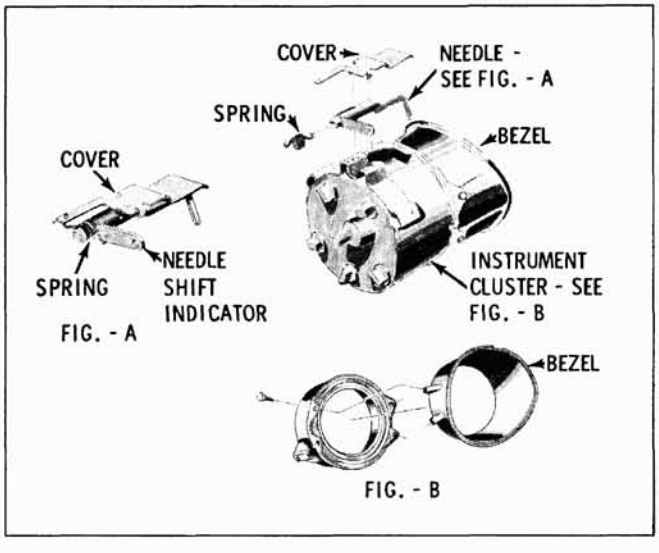


Fig. 12AA-21—Bezel and Shift Indicator Attachment

remove printed circuit board.

SHIFT INDICATOR (Fig. 12AA-21)

Removal

1. Remove speedometer cluster.
2. Remove spring from cover and needle.
3. Using a screw driver, carefully pry cover from speedometer cluster.
4. Lift needle straight up out of speedometer cluster.

CLOCK CLUSTER (Fig. 12AA-23)

Removal

1. If A.C. equipped, remove L.H. air outlet duct. (Fig. 12AA-4)
2. Disconnect negative battery cable.
3. Disconnect clock feed connector and illumination lamps.
4. Remove the two attaching screws, Fig. 12AA-23 (cluster assembly to control panel) and remove cluster through front of pad assembly.

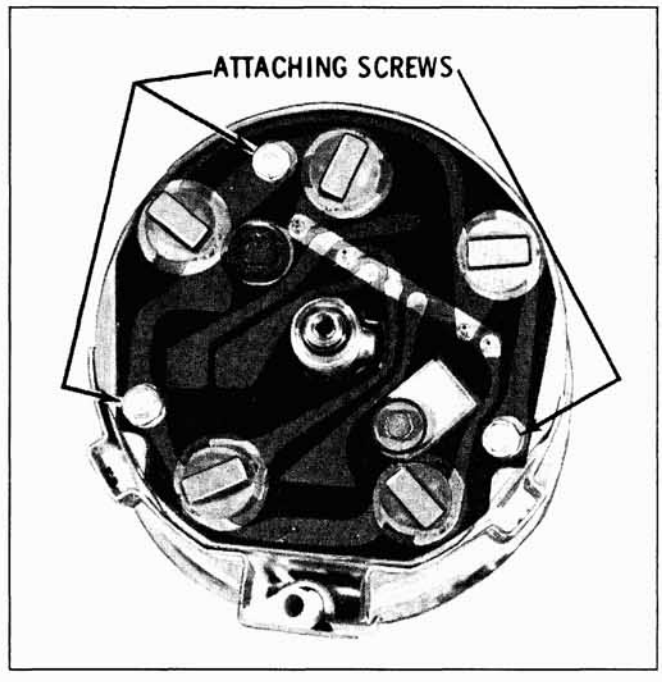


Fig. 12AA-22—Speedometer Cluster Printed Circuit

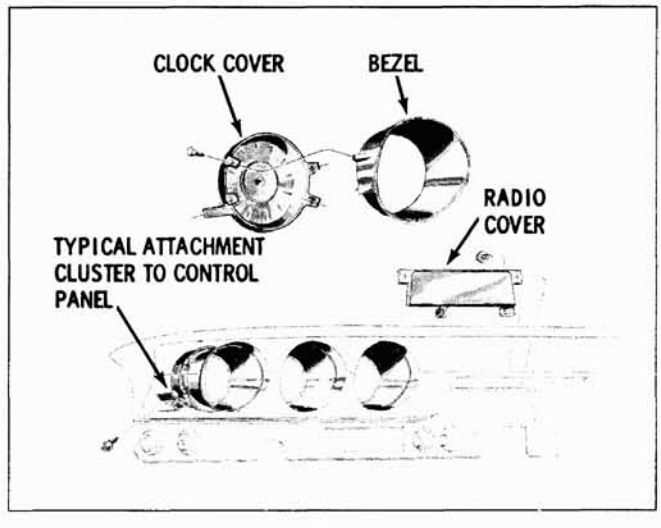


Fig. 12AA-23—Clock Attachment

CLOCK BEZEL

Remove the clock cluster, then remove the 4 bezel to cluster attaching screws. (Fig. 12AA-23)

HEATER OR A.C. CONTROL (Fig. 12AA-24)

Removal

1. If A.C. equipped, remove manifold. (Fig. 12AA-4)
2. Disconnect negative battery cable.
3. Disconnect blower switch multiple connector.
4. Remove 3 attaching screws (control to control panel) and remove control. If necessary to remove control cables or vacuum hoses, refer to Section I.

BLOWER SWITCH (Fig. 12AA-24)

Removal

1. If A.C. equipped, remove manifold. (Fig. 12AA-4)
2. Disconnect negative battery cable.
3. Disconnect blower switch multiple connector.

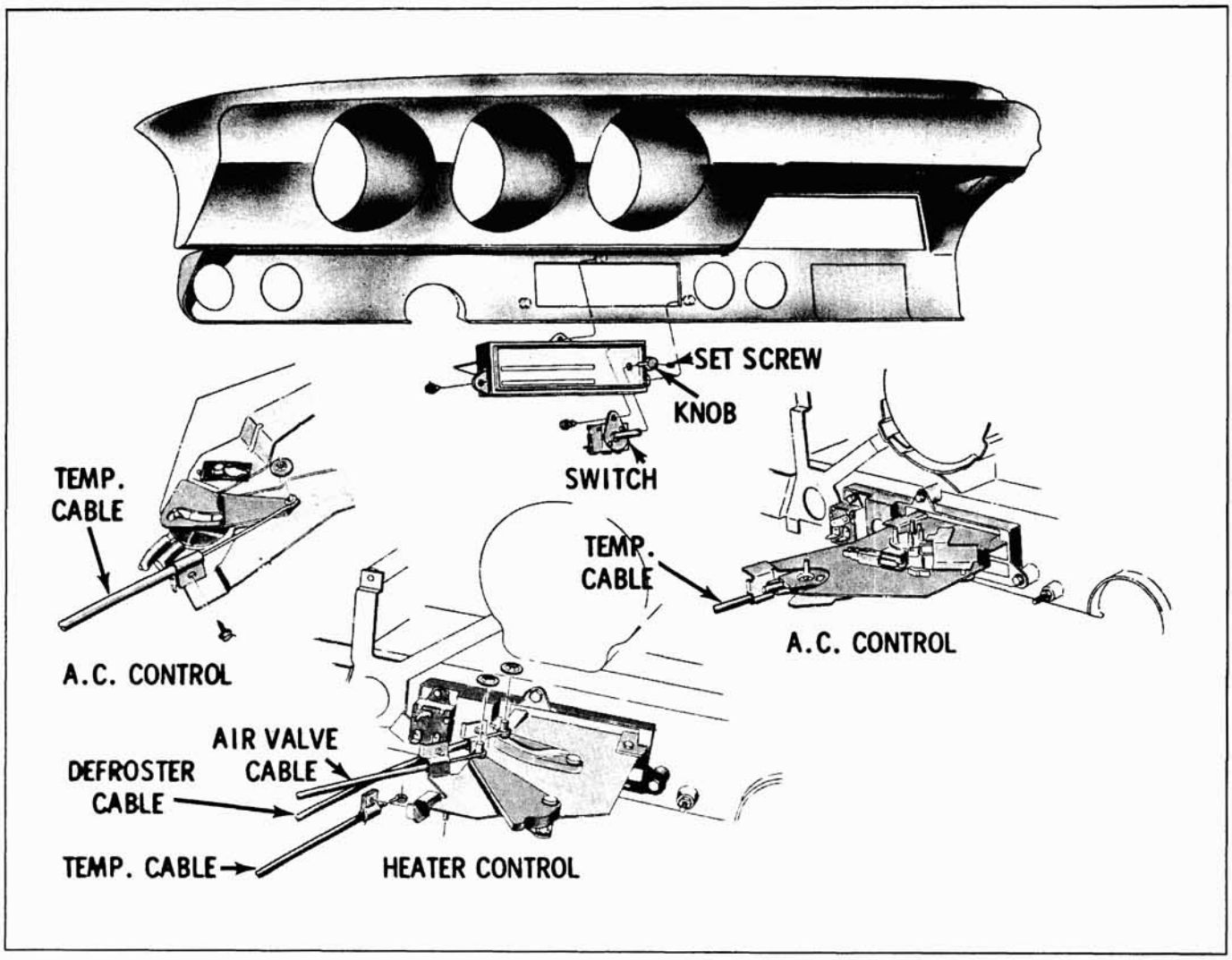


Fig. 12AA-24—Heater or A.C. Control Attachment

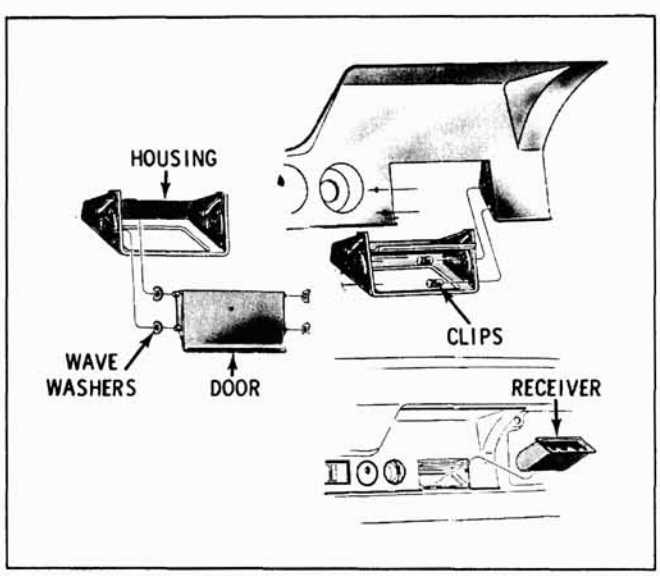


Fig. 12AA-25—Ash Tray Attachment

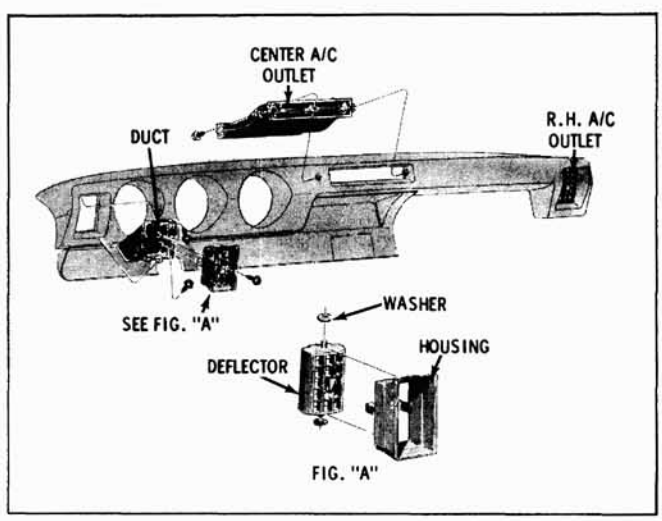


Fig. 12AA-26—A.C. Outlet Assemblies

4. Loosen set screw in knob and remove knob.
5. Remove one attaching screw (switch to heater or A.C. control) and remove switch.

ASH TRAY ASSEMBLY (Fig. 12AA-25)

Removal

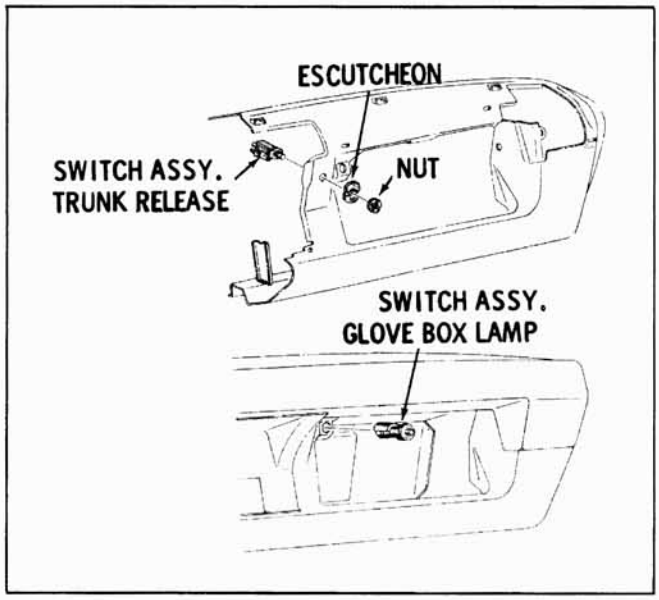


Fig. 12AA-27—Trunk and Glove Box Switches

1. Push ash tray door to the open position and lift out ash tray receiver.
2. Using diagonal pliers (side cutters) cut the head off of the 4 clips inside of the ash tray housing.
3. Push out the remaining portion of the clips from inside the ash tray housing to remove clips.
4. Lift ash tray housing from control panel.
5. Use new clips when installing ash tray assembly.

ASH TRAY DOOR (Fig. 12AA-25)

Removal

1. Remove ash tray assembly.
2. Carefully spread ash tray housing until ash tray door and the 4 wave washers can be removed.

A.C. AIR OUTLET - R.H. OR L.H. (Fig. 12AA-26)

Removal

1. Insert screwdriver between center louvers of housing assembly and remove the two attaching screws.
2. Carefully pull housing assembly from front of pad assembly.
3. Remove the two attaching screws (duct assembly to pad assembly).
4. Carefully disconnect hose from duct assembly and remove duct assembly from front of pad assembly.

A.C. CENTER OUTLET ASSEMBLY (Fig. 12AA-26)

Removal

1. Remove radio, refer to Radio Removal.
2. Loosen R.H. screw attaching center outlet to pad assembly.
3. Remove L.H. center outlet attaching screw and slide center outlet to the left and remove from behind pad assembly.

GLOVE BOX LAMP SWITCH (Fig. 12AA-27)

Disconnect lamp feed wire and push switch out from inside of glove box.

VACUUM TRUNK SWITCH (Fig. 12AA-27)

Remove switch nut and escutcheon, then pull vacuum hoses from under dash until vacuum hoses can be disconnected from switch.

CONSOLE (MANUAL TRANS.)

For removal, disassembly and assembly, and installation,

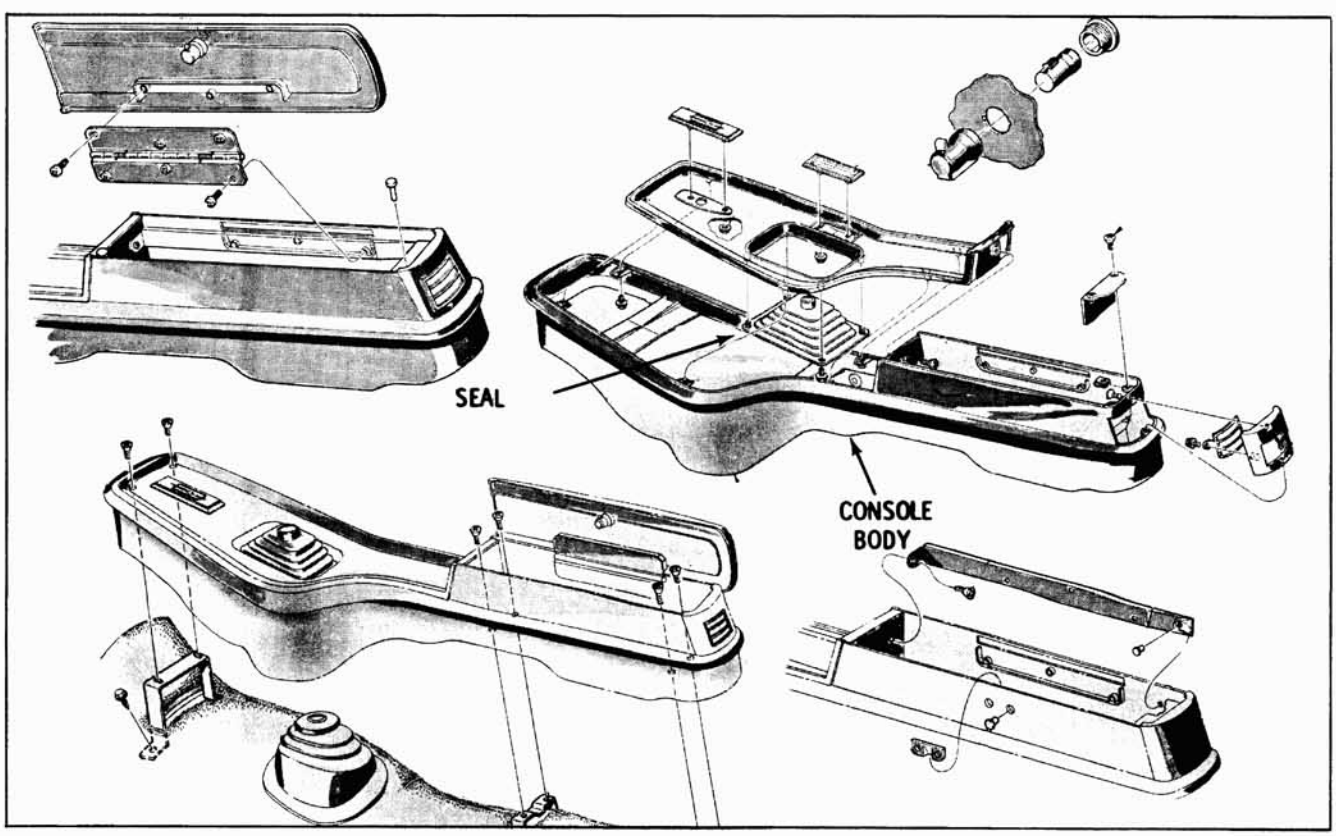


Fig. 12AA-28—Console Mounting - Manual Transmission

WINDSHIELD WIPER SYSTEM

CONTENTS OF SECTION 12B

31 THROUGH 86 SERIES

Subject	Page
WINDSHIELD WIPER SYSTEM	
DESCRIPTION	12B-1
TWO SPEED—RECTANGULAR MOTOR	
DESCRIPTION	12B-1
CIRCUITS	
LO SPEED	12B-2
HI SPEED	12B-2
PARKING	12B-2
DIAGNOSIS-WIPER ON CAR	12B-3
WIPER ASSEMBLY	
REMOVAL	12B-4
INSTALLATION	12B-4
DIAGNOSIS-WIPER OFF CAR	12B-6
GEAR BOX	
DISASSEMBLY	12B-7
REASSEMBLY	12B-8
MOTOR	
DISASSEMBLY	12B-9
REASSEMBLY	12B-10
SPECIFICATIONS	12B-32
TWO SPEED—ROUND MOTOR	
DESCRIPTION	12B-10
CIRCUITS	
WIPER OFF	12B-11
LO SPEED	12B-11
HI SPEED	12B-11
PARKING	12B-11
DIAGNOSIS-WIPER ON CAR	12B-14
WIPER ASSEMBLY	
REMOVAL	12B-15
INSTALLATION	12B-15
DIAGNOSIS-WIPER OFF CAR	12B-16
MOTOR	
DISASSEMBLY	12B-19
REASSEMBLY	12B-20
GEAR BOX	
DISASSEMBLY	12B-21
REASSEMBLY	12B-22
SPECIFICATIONS	12B-32
WASHER SYSTEM—RECTANGULAR MOTOR	
DESCRIPTION	12B-24
OPERATION	12B-25
DIAGNOSIS-ON CAR	12B-27
DIAGNOSIS-OFF CAR	12B-28
PUMP	
DISASSEMBLY	12B-28
REASSEMBLY	12B-28
WASHER SYSTEM—ROUND MOTOR	
DESCRIPTION	12B-28
OPERATION	12B-28
CHECKING PROCEDURES	12B-31
DISASSEMBLY AND ASSEMBLY	12B-31

WINDSHIELD WIPER SYSTEM

DESCRIPTION

A two-speed wiper motor equipped with windshield washer system is standard equipment on all models.

The 35 through 86 Series uses a round motor incorporating the wiper blade recessed park position. The wipers will park in a recessed area of the cowl.

The 31 and 32 Series uses a rectangular shaped motor with non-recessed wiper blade park position. If the recessed park option (C-24) is ordered, a round motor incorporating the wiper blade recessed park position is used.

The 31 through 48 Series uses 16" wiper blades with a tandem wiping action; if option (C-24) is ordered, the articulated wiping option is used. The 54 through 86 Series uses 18" wiper blades with the articulated wiping action as standard equipment.

TWO SPEED—RECTANGULAR MOTOR

DESCRIPTION

The system consists of a compound wound rectangular-shaped motor attached to a gear box containing a parking switch in addition to the gear train. The gear train consists of a motor armature helical gearshaft which drives an intermediate gear and pinion assembly. The pinion gear of the intermediate gear and pinion drives an output gear and shaft assembly. (Fig. 12B-1)

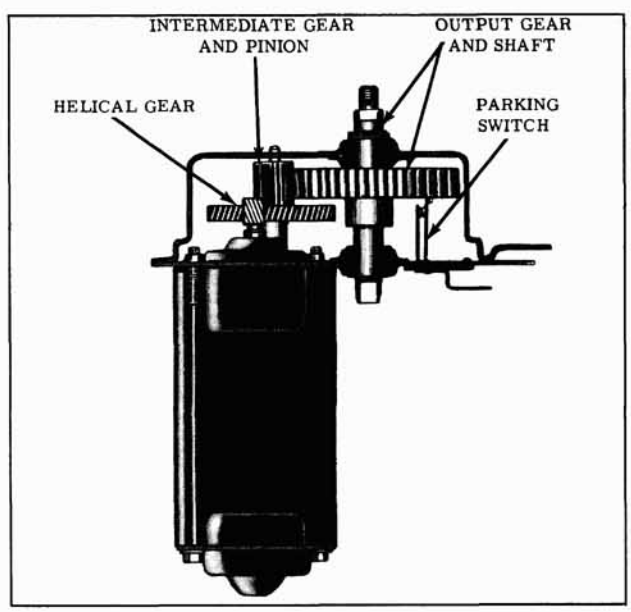


Fig. 12B-1—Gear Train

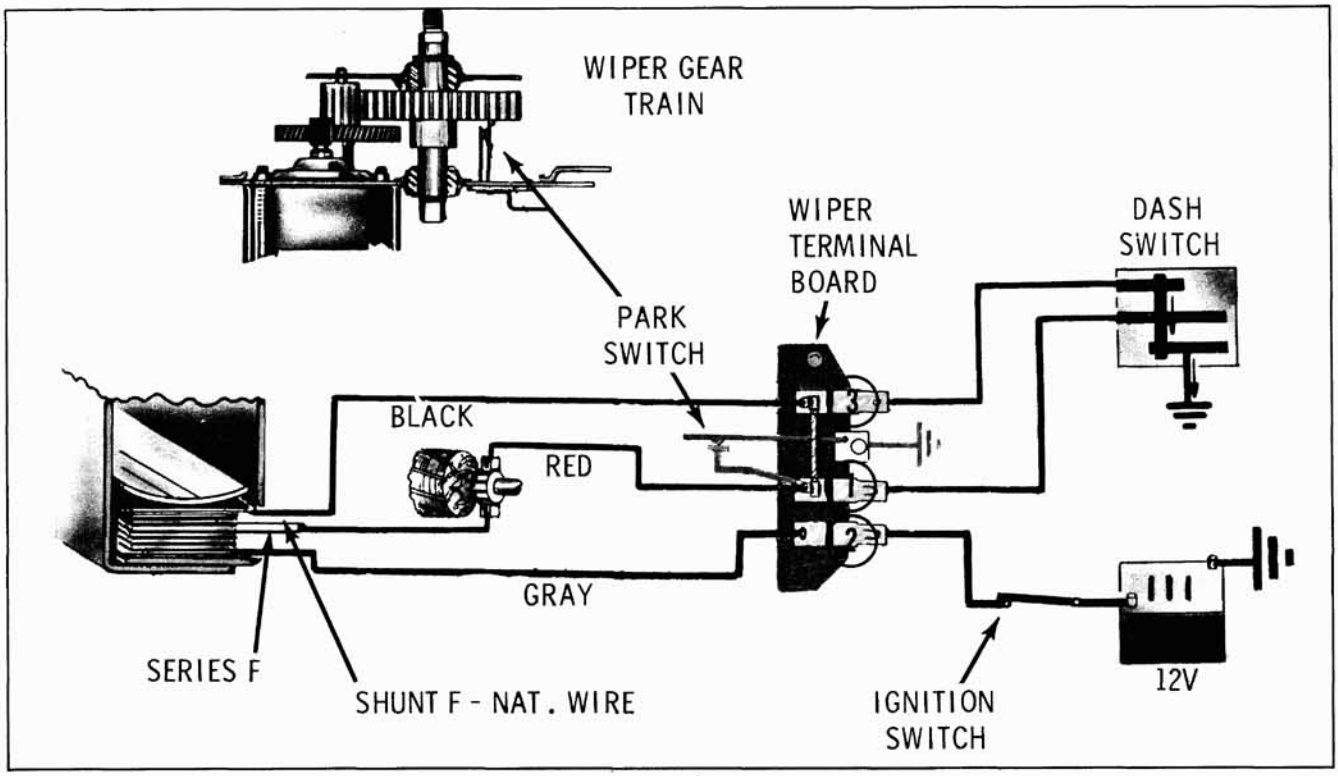


Fig. 12B-2—"Lo" Speed Circuit

"LO" SPEED CIRCUIT

Turning the wiper switch to the "LO" speed position completes the circuits from the wiper terminals 1 and 3 to ground. Current then flows from the battery via wiper terminal No. 2 through the series field and divides; (1) part passes through the armature to ground via wiper terminal No. 1 to the wiper switch. (Fig. 12B-2)

"HI" SPEED

Moving the wiper switch to the "HI" speed position opens the shunt field circuit to ground. However, the shunt field is connected to a 20 ohm resistor which is connected across wiper terminals 1 and 3. The shunt field current then flows via terminal No. 3 through the resistor to terminal No. 1 to the switch, to ground. (Fig. 12B-3)

PARKING CIRCUIT

This circuit covers that portion of wiper operation when the owner first turns the wiper "OFF" at the switch and the wiper blades have not reached the normal park or "OFF"

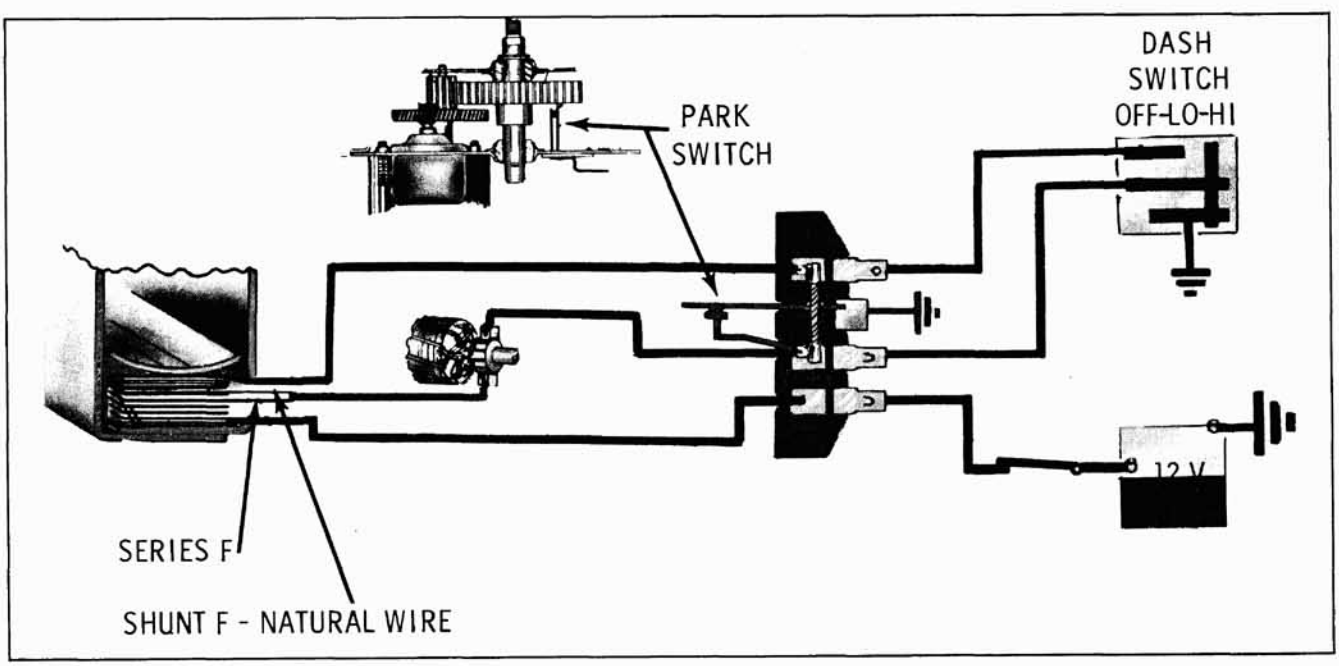


Fig. 12B-3—"Hi" Speed Circuit

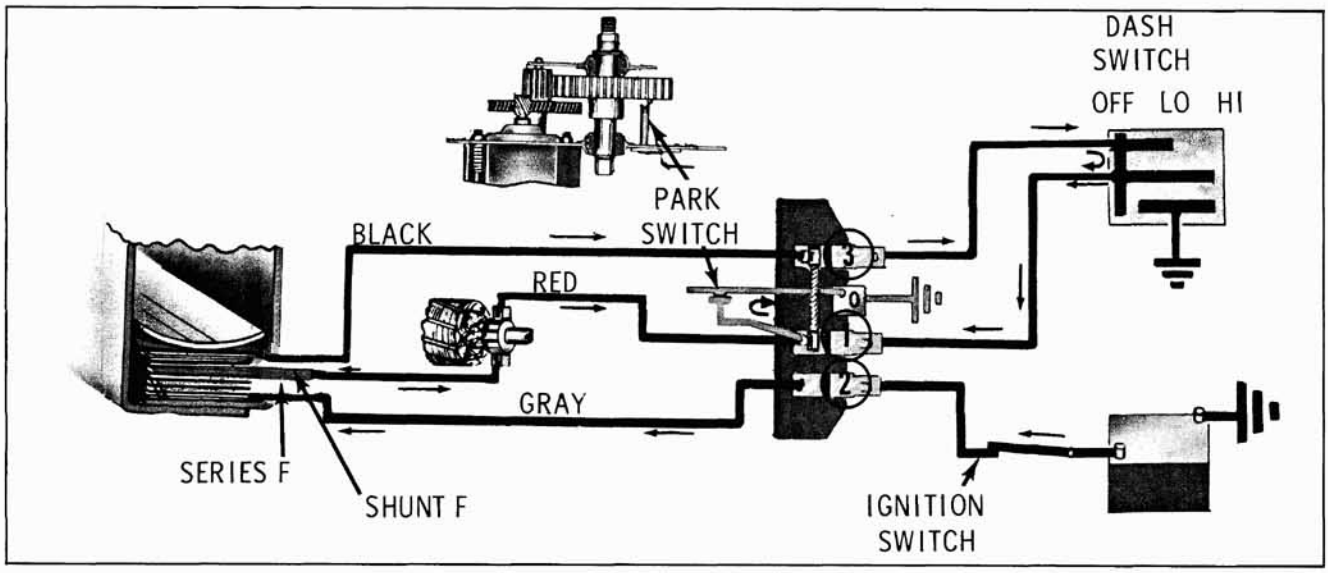


Fig. 12B-4—Parking Circuit

position. (Park or "OFF" position of the blades is approximately 1" - 1-1/2" above the lower windshield molding).

When the wiper blades are not in the normal "OFF" or park position, the parking switch contacts are still closed. The wiper will continue to operate until the wiper output gear is turned to a position where its cam opens the park switch. Referring to Fig. 12B-4 it can be seen that the wiper motor circuits are completed to ground through the parking switch as follows:

The shunt field circuit is completed from terminal No. 3 via the switch to terminal No. 1 through the parking switch to ground. The series field and armature circuit is also completed from terminal No. 1 through the parking switch to ground.

The shunt field is connected direct to ground by bypassing the resistor. This results in "LO" speed operation during the parking operation.

When the output gear cam opens the park switch contacts, the wiper is "OFF".

DIAGNOSIS—WIPER ON CAR

1. Inspect for the following items:
   a. Wiring harness is securely connected to wiper and switch.
   b. Wiper motor ground strap is securely connected to car chassis.
   c. Wiper switch is securely mounted.
   d. Check fuse.
2. If items in Step 1 check out, try operating wiper in both "LO" and "HI" speeds, then turn wiper off (blades should return to park position). If wiper fails to operate correctly, proceed to Step 3.
3. Disconnect wiring harness from wiper and try operating wiper as shown in Fig. 12B-5.
   a. If wiper operates correctly independently of switch and car wiring, refer to the DIAGNOSIS CHART - WIPER ON CAR.
   b. If wiper still fails to operate correctly in Step 3, disconnect wiper linkage from wiper crankarm and try operating wiper again. If wiper operates correctly independently of linkage, check linkage for cause of wiper malfunction.
   c. If wiper fails to operate correctly independently of linkage, remove wiper from car and refer to DIAGNOSIS - WIPER OFF CAR.

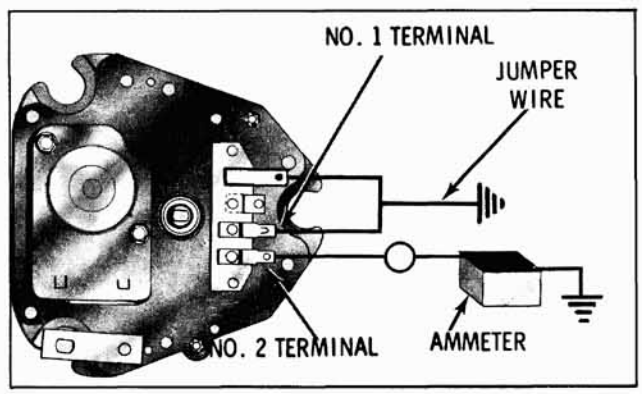


Fig. 12B-5—Wiper Connections

DIAGNOSIS CHART - WIPER ON CAR

Ignition Switch Must Be ON For All Electrical Tests

If wiper operated correctly independently of car wiring and switch but original trouble was:	Possible Cause of Trouble
Wiper Inoperative	Check for 12 volts at harness terminal that connects to wiper terminal No. 2. If no voltage reading is obtained, recheck fuse and check for broken feed wire to wiper terminal No. 2.

DIAGNOSIS CHART—WIPER ON CAR (Cont'd.)

Wiper Inoperative (Cont'd)	Loose wiper switch mounting or defective wiper switch. Wire from wiper terminal No. 1 broken.
Wiper Will Not Shut Off And: a. Wiper had both "LO" and "HI" speeds. b. Wiper had "LO" speed only. c. Wiper had "HI" speed only.	 Lead between wiper terminal No. 1 and wiper switch grounded. Defective wiper switch. Lead between wiper terminal No. 3 and wiper switch grounded. Defective wiper switch.
Wiper has "HI" Speed only.	Lead between wiper terminal No. 3 and wiper switch grounded.
Wiper has "LO" Speed only.	Defective wiper switch.
Blades Do Not Return to Park Position When Wiper is Turned OFF	Recheck for loose wiper ground strap connection.
Wiper Speed Normal in "LO" (70 to 90 wipes per min.) but too fast in "HI" (exceeds 160 wipes per min.)	Remove wiper from car and follow DIAGNOSIS CHART - WIPER OFF CAR.
Intermittent Operation	Recheck wiper switch mounting. Recheck harness connections to wiper motor and wiper switch.

WIPER MOTOR REMOVAL (31-48 SERIES)

Figs. 12B-6, 12B-6A and 12B-6B

1. Disconnect wiring.
2. Disconnect washer hoses.
3. Remove wiper blade and arm assembly.

Rectangular Motor - Lift up on arm assembly and carefully pry arm up off from transmission.

Round Motor - Refer to Fig. 12B-6B.

4. Remove the motor attaching screws.
5. Lift left rear edge of vent screen and loosen the two nuts attaching the transmission to motor crankarm.

Loosen bolts only until the crankarm will slide out of the transmission socket.

WIPER INSTALLATION

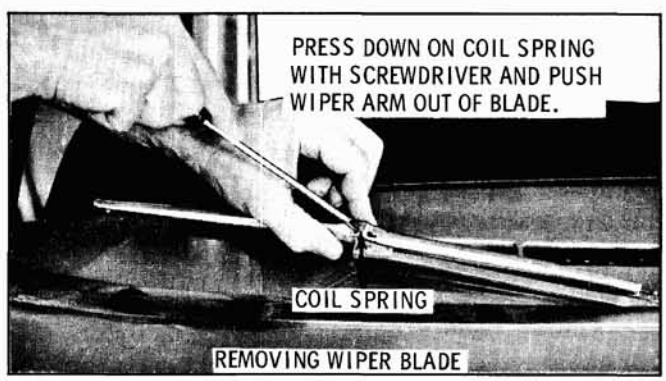
To install, reverse the removal procedure. After installing the motor, it will be necessary to install the arm and blade assembly using the following procedure to assure proper adjustment.

Rectangular Motor:

With the windshield wiper motor in the park position, install the wiper arms on wiper transmission so the blades are parallel with the windshield reveal molding and the wiping pattern overlaps in the center of the windshield.

Round Motor:

1. With the windshield wiper motor in the park position, install the left hand wiper arm and articulating arm on wiper transmission. (Fig. 12B-6B)



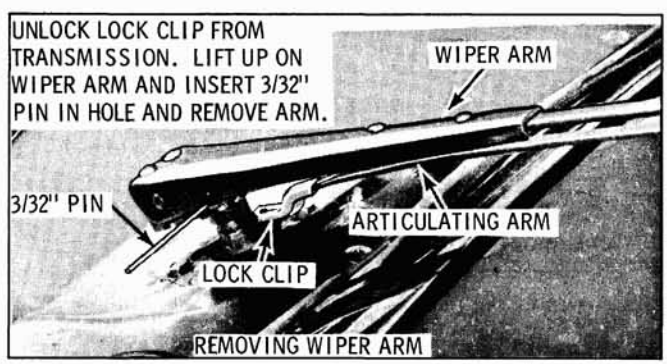


Fig. 12B-6—Wiper Blade and Arm

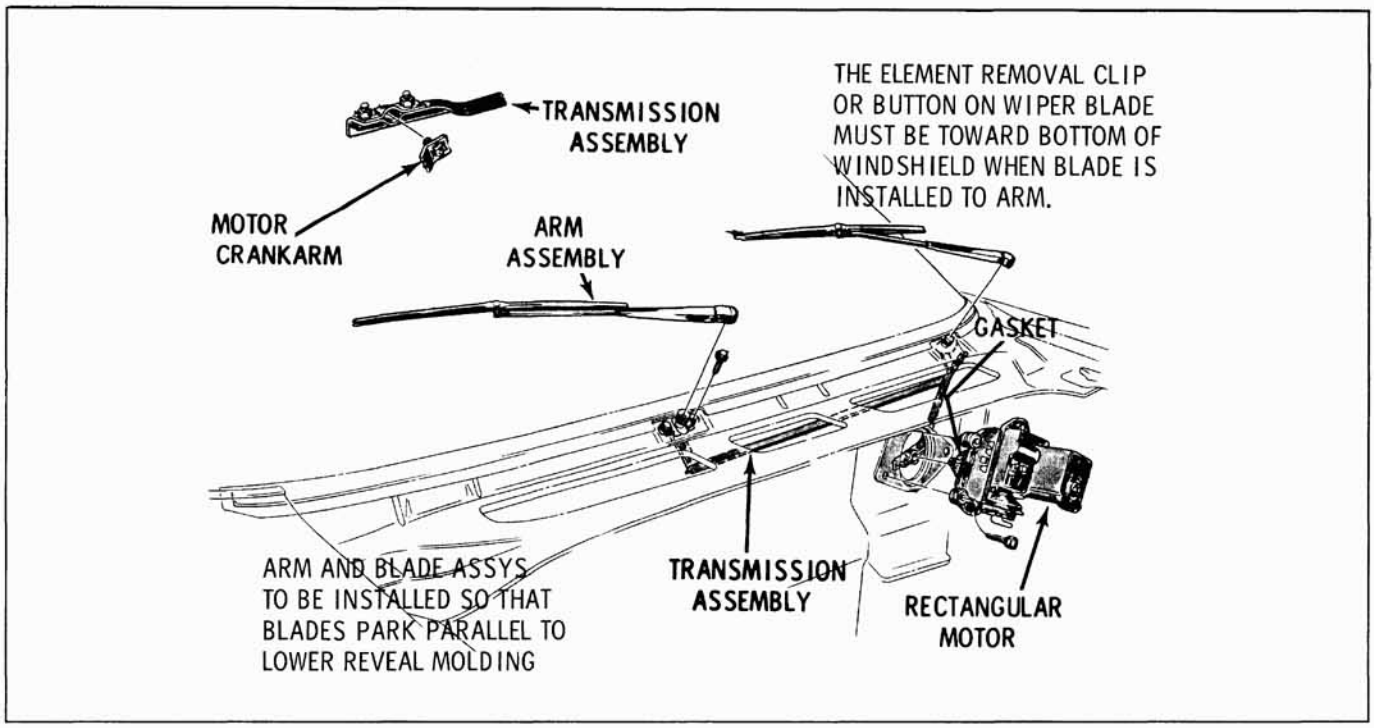


Fig. 12B-6A—Rectangular Motor

The wiper arm can be installed in only one position on wiper transmission.

2. Lift up left rear corner of shroud screen and loosen the two transmission to wiper motor attaching nuts.

3. Lift up left blade and place on bottom front edge of blade stop.

4. Tighten the two transmission to wiper motor nuts.

5. Install right wiper arm so blade is positioned on bottom front edge of blade stop.

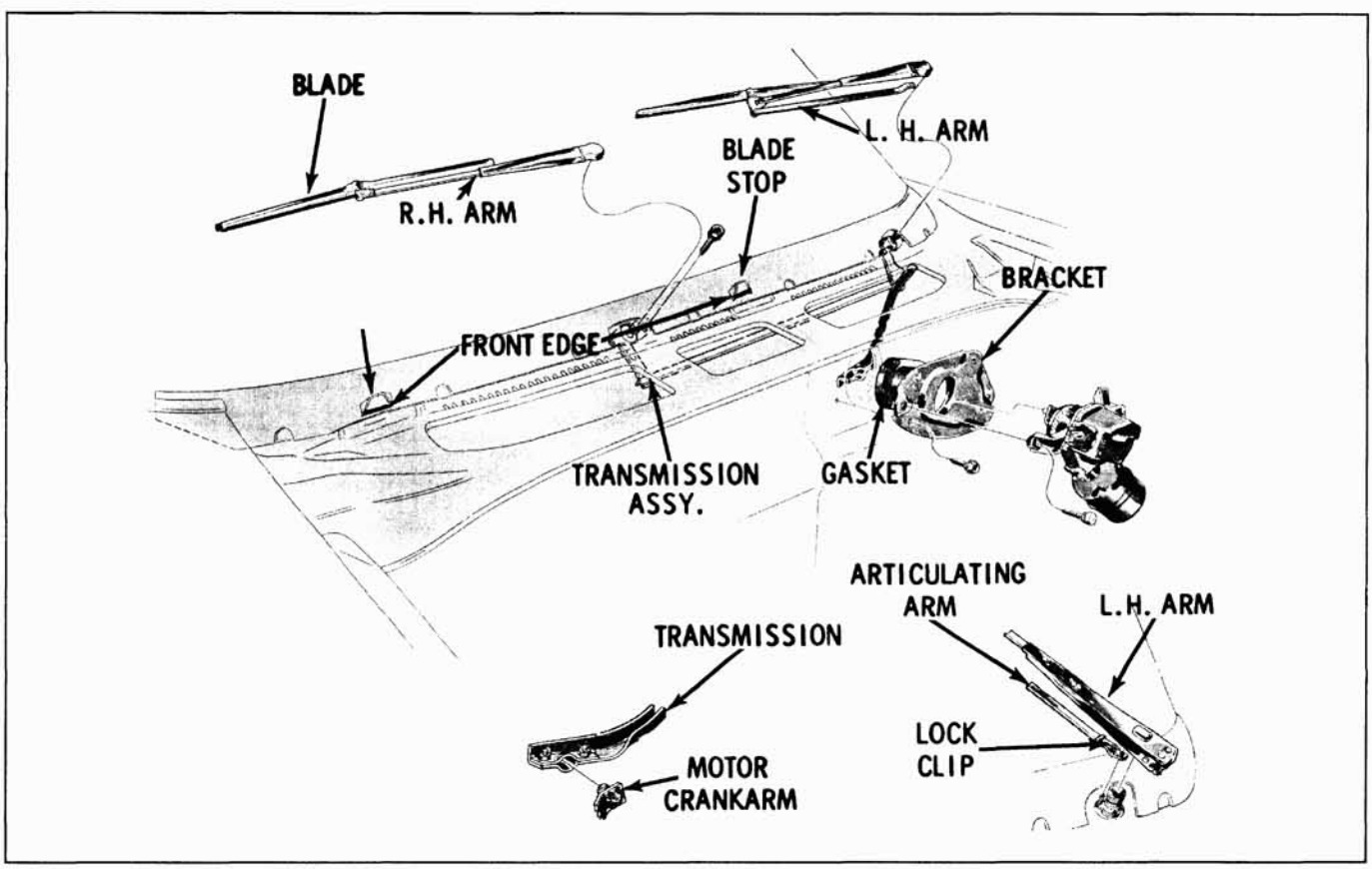
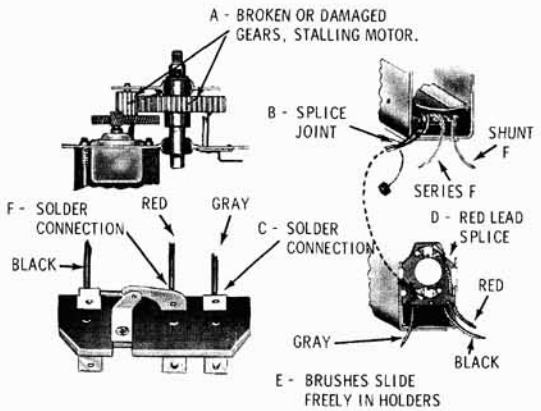
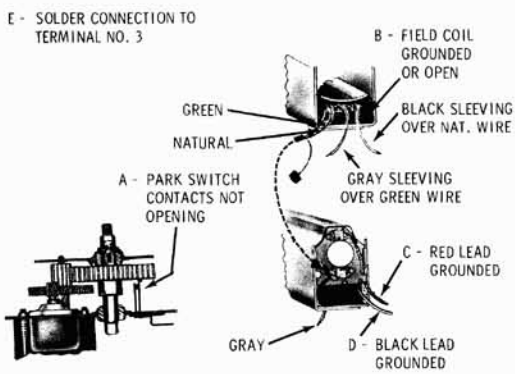
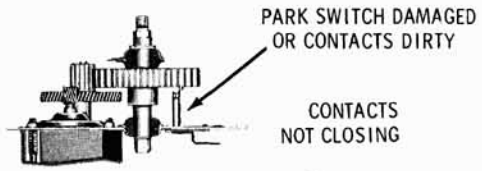


Fig. 12B-6B—Round Motor

DIAGNOSIS CHART - WIPER OFF CAR

Before using chart, the wiper should be operated as shown in Fig. 12B-11. Use an ammeter capable of reading at least 30 amperes in the feed wire circuit and observe current draw in "LO" speed position.

Type of Trouble	Possible Cause of Trouble
Wiper Inoperative Current Draw - 0 amps. Check Items B, C Current Draw - 1 - 1.5 amps. Check Items B, D, E, F Current Draw - 11 - 12 amps. Check Item A (armature)	 Fig. 12B-7—Wiper Connections
Wiper Will Not Shut OFF and: Has both "LO" and "HI" speeds. Check Items A, C Has "LO" speed only. Check Items B, D (ground field coil) Has "HI" speed only. Check Items B, E	 Fig. 12B-8
Wiper Has "HI" Speed Only	Check Item C in Fig. 12B-8
Wiper Has "LO" Speed Only	Check Item B in Fig. 12B-8
Wiper Doesn't Stop in Park Position - Stops Immediately When Jumper Wire is Disconnected From Ground (Fig. 12B-11)	 Fig. 12B-9
Wiper Operation in "HI" Speed Range Too Fast - (Output Gearshaft RPM's Exceed 160)	Check for Open Resistor. Check Views B, C, D, E and F in Fig. 12B-7. Also check for open armature.

DIAGNOSIS CHART—WIPER ON CAR (Cont'd.)

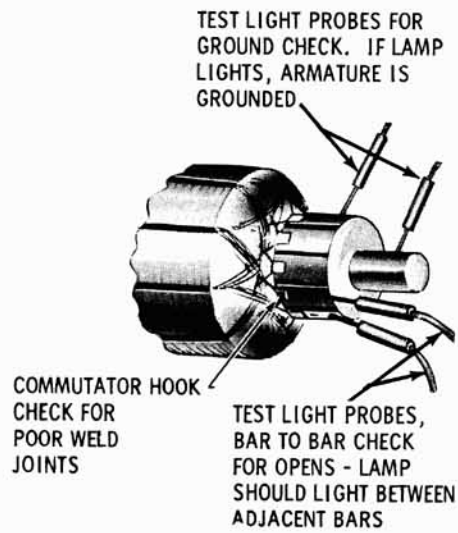
Type of Trouble	Possible Cause of Trouble
Intermittent Operation	

Fig. 12B-10

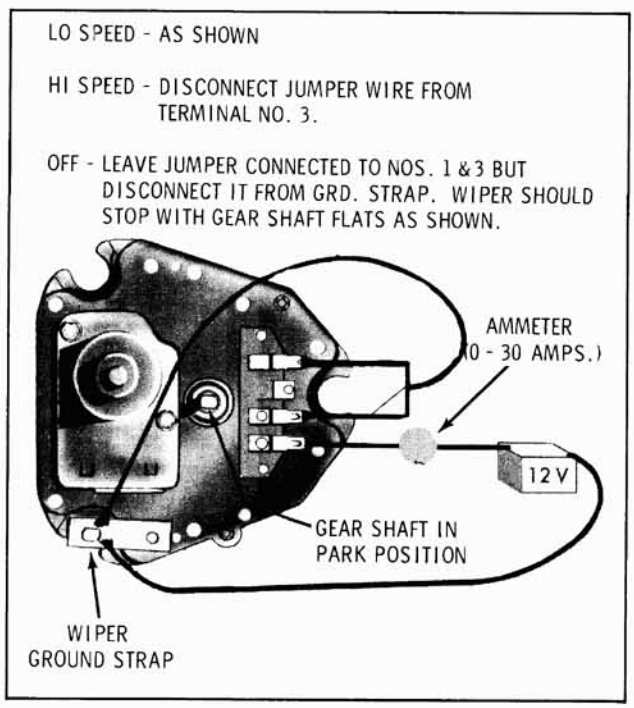


Fig. 12B-11—Wiper Connections

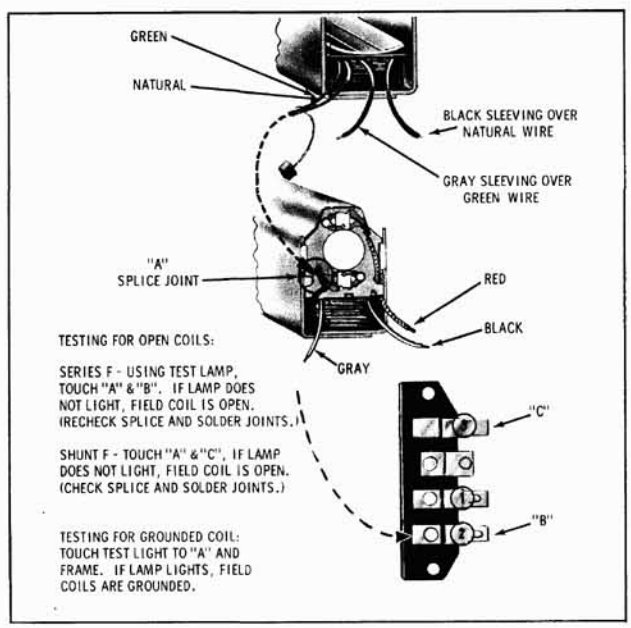


Fig. 12B-12—Testing Field Coils

DISASSEMBLY—ASSEMBLY PROCEDURE

The disassembly-reassembly procedures for the wiper are broken down into two major areas: the motor section and gear box section.

GEAR BOX DISASSEMBLY

1. Remove washer pump as follows:

a. Remove the two washer pump mounting screws (Fig. 12B-13) and carefully lift the washer pump off the wiper.

b. Remove the washer pump four lobe drive cam. The cam is a press fit on the wiper gearshaft and it may be necessary to use a small puller.

c. Remove the felt washer from the wiper gearshaft.

2. Clamp crankarm in a vise and remove crankarm retaining nut.

Failure to clamp crankarm may result in stripping of wiper gears.

3. Remove crankarm, seal cap, Tru-Arc retaining ring and end play washers. (Fig. 12B-14)

Seal cap should be cleaned and repacked with a waterproof type grease before reassembly.

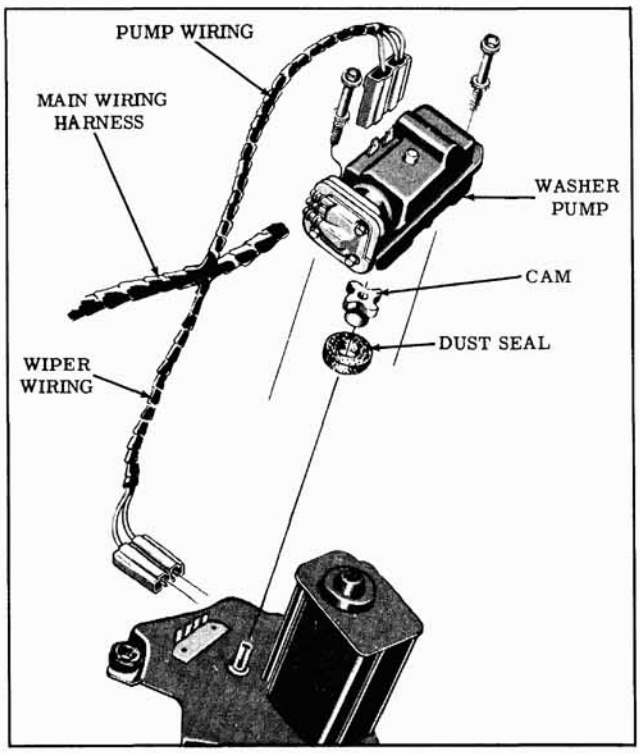


Fig. 12B-13—Washer Mounting

4. Drill out staking that secures gear box cover. (Fig. 12B-14A) Use a 9/32" drill.

Mark ground strap location and save ground strap for reassembly.

5. Remove output gear and shaft assembly; then, slide intermediate gear and pinion assembly off shaft.

6. If required, remove terminal board and park switch assembly as follows:

a. Note position of motor leads on terminals, then unsolder.

b. Drill out rivets that secure terminal board and park switch ground strap to plate.

Screws, nuts and washers for attaching a replacement terminal board park switch assembly are included with the replacement assembly.

GEAR BOX REASSEMBLY

Lubricate all gear teeth with Cam and Ball Bearing Lubricant.

1. If park switch and terminal board assembly were removed, reinstall replacement assembly using the attaching screws and nuts included in the service package. Resolder leads to terminals. (Fig. 12B-15)

2. Install wave washer and intermediate gear on intermediate gearshaft.

3. Install output gear and shaft assembly with cam in position shown in Fig. 12B-16.

4. Assemble gear box cover to wiper. Be careful to locate cover over locating dowels and intermediate gearshaft.

5. Secure cover to gear mounting plate over dowels. Be sure to reinstall ground strap.

Screws, nuts and lockwashers for reassembling cover to wiper are contained in a Service Repair Package.

6. Reassemble end play washers and retaining ring over

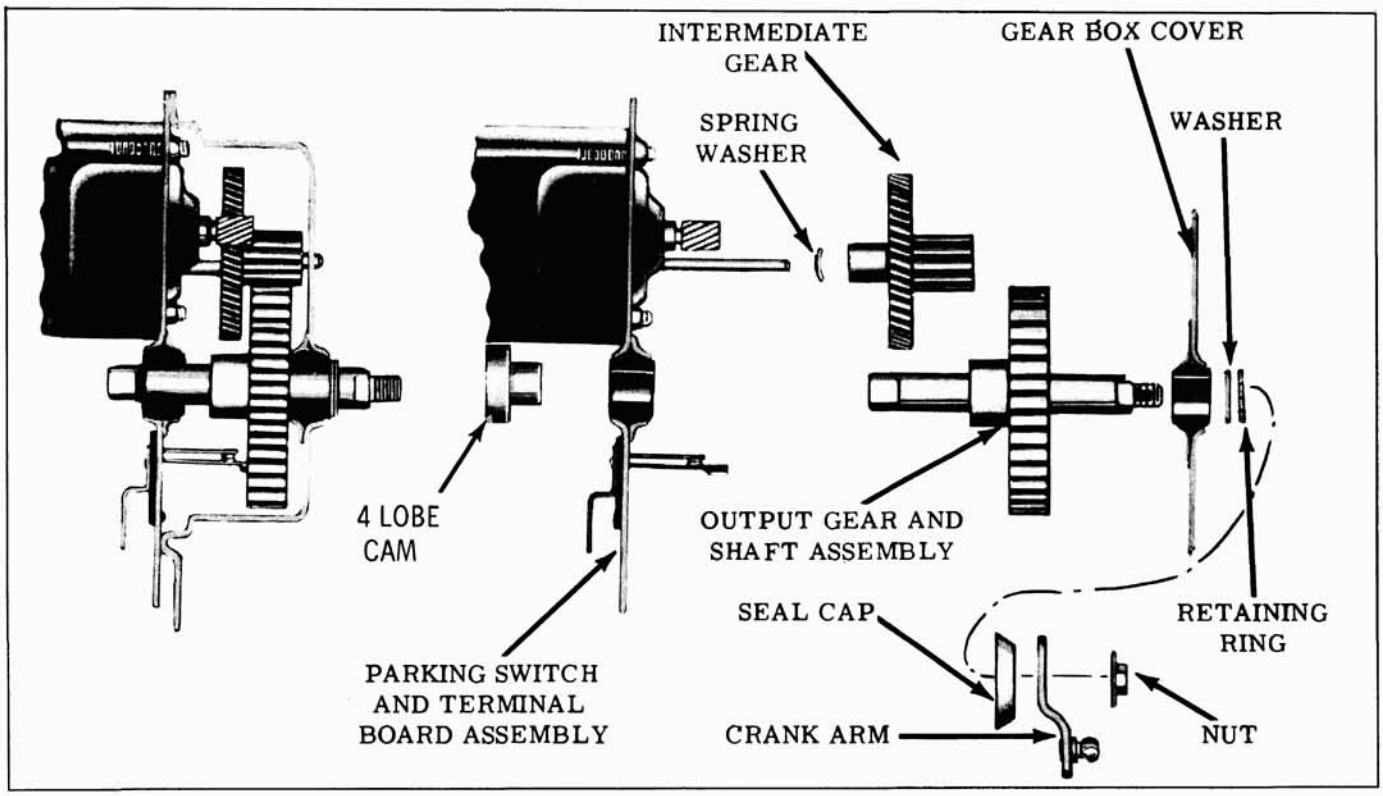


Fig. 12B-14—Gear Box

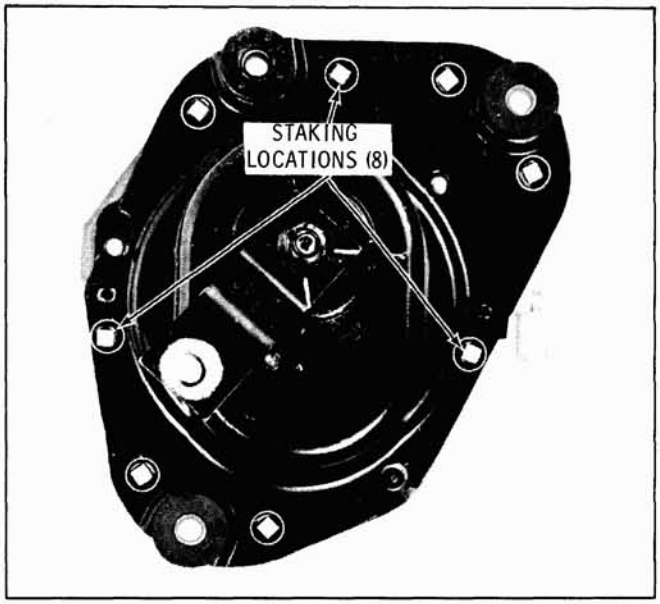


Fig. 12B-14A—Staking Locations

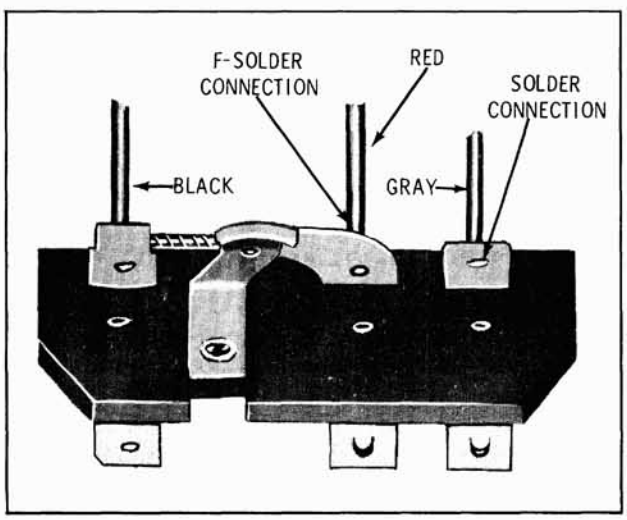


Fig. 12B-15—Parking Switch and Terminal Board

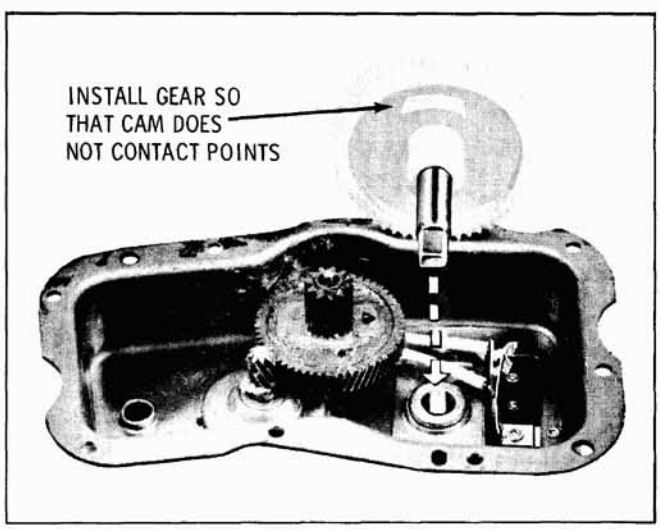


Fig. 12B-16—Gear Installation

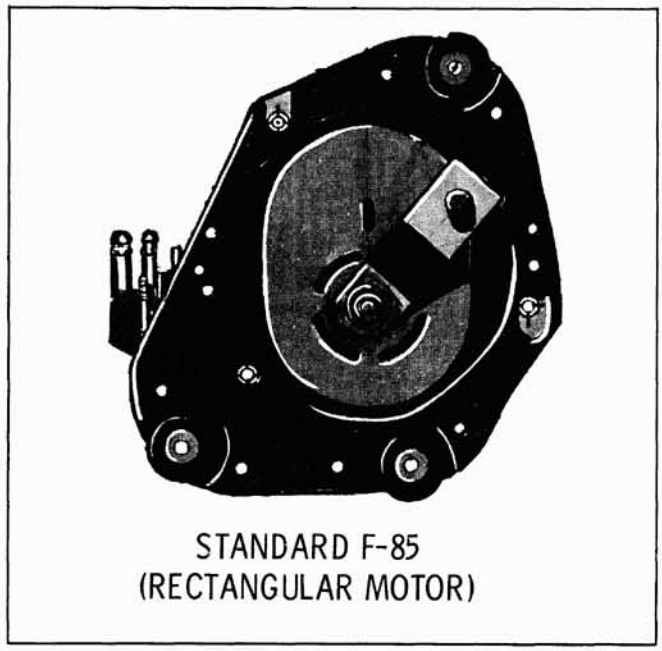


Fig. 12B-17—Park Position

output gearshaft. (Fig. 12B-14) Use end play washers as required to obtain .005" maximum end play.

7. Install seal cap.

8. To reassemble crankarm in proper position, operate wiper to park or "OFF" position (Fig. 12B-11) and install crankarm so that index marks on crankarm line up with those on the gear box cover. (Fig. 12B-17)

Clamp crankarm in vise before securing the retaining nut.

9. Operate wiper (Fig. 12B-11) and check performance per data in specification table.

10. Washer pump to wiper reassembly.

Reassemble washer pump to wiper, reversing disassembly Steps 1 (a) through 1 (d). Observe precautions listed below.

a. Support crankarm end of wiper output shaft (threaded end) and using a suitable mallet, drive the four lobe cam on the wiper output shaft until it bottoms against the shoulders of the shaft flats. (Fig. 12B-13)

b. Position four lobe cam as shown in Fig. 12B-18. It may be necessary to manually rotate crankarm.

MOTOR DISASSEMBLY

1. Disassemble gear box as required to gain access to internal solder connections at wiper terminal board and unsolder motor leads from terminals.

2. Remove motor tie bolts. (Fig. 12B-19)

3. Hold end cap against frame and field and disengage complete motor section from gear box.

4. Turn motor section as required to gain access to brush plate assembly and release brush spring pressure against brushes. (Fig. 12B-20)

5. Move brushes away from armature commutator and remove armature and end cap from frame and field assembly.

6. Remove end cap from end of armature shaft.

Be careful not to lose the plastic thrust plug in end of armature.

7. Remove end play washers from commutator end of armature shaft. When reassembling armature in wiper, install washers as shown in Fig. 12B-21.

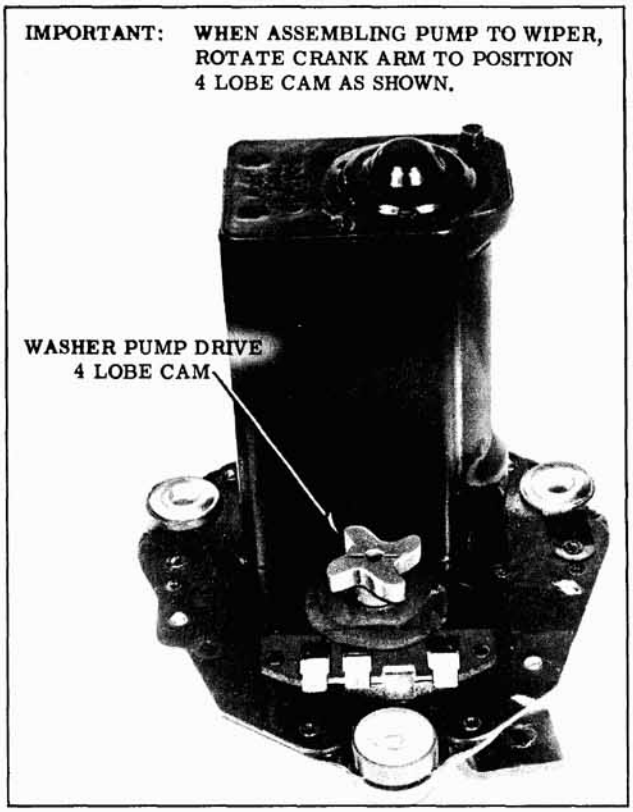


Fig. 12B-18—Cam Positioning

8. To replace brushes, cut brush pigtail approximately 1/4" from splicing clip. Splice the new brush pigtail to the 1/4" of pigtail left from the original brush.

Splicing clips are provided in the replacement brush packages.

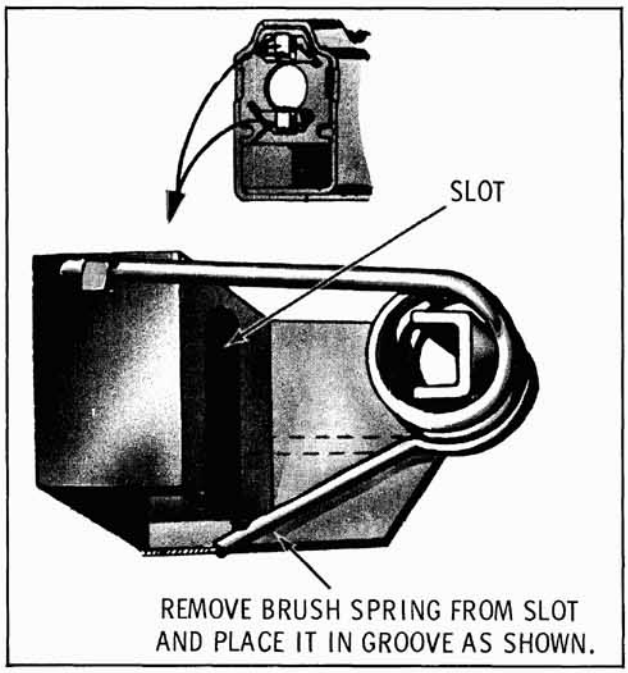


Fig. 12B-20—Removing Brush Spring

MOTOR REASSEMBLY

Reverse disassembly Steps 1 through 7 and reassemble gear box. Lubricate all gear teeth with Cam and Ball Bearing Lubricant and oil armature shaft and bearings with light machine oil.

TWO SPEED—ROUND MOTOR

DESCRIPTION (Fig. 12B-22)

The round two speed motor used on the 5400 through 8600 series is three grommet mounted and is approximately 4 1/2"

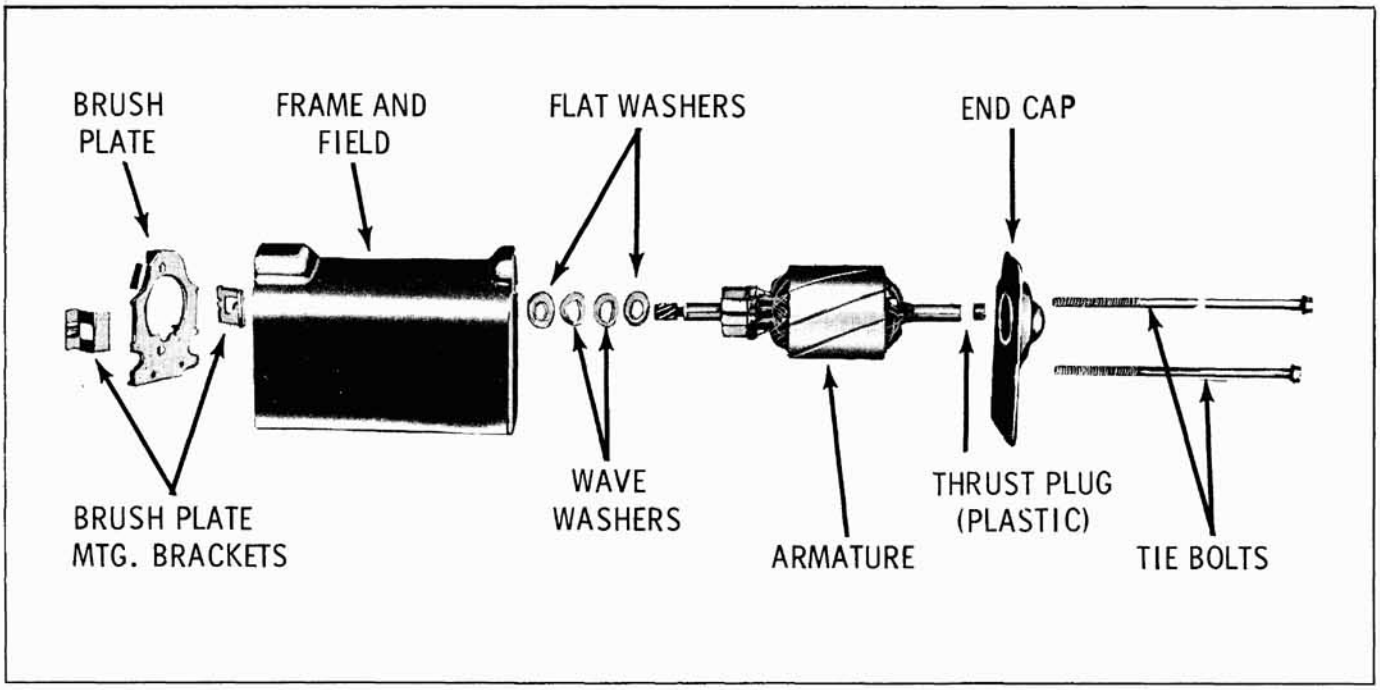


Fig. 12B-19—Wiper Motor

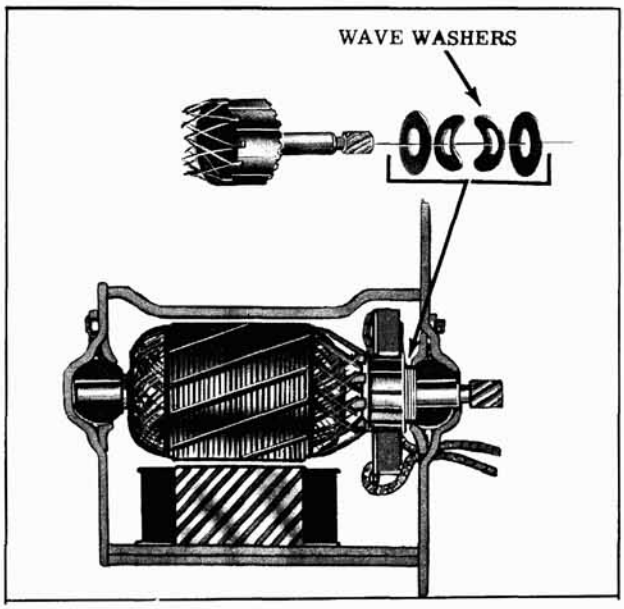


Fig. 12B-21—Armature End Play Washers

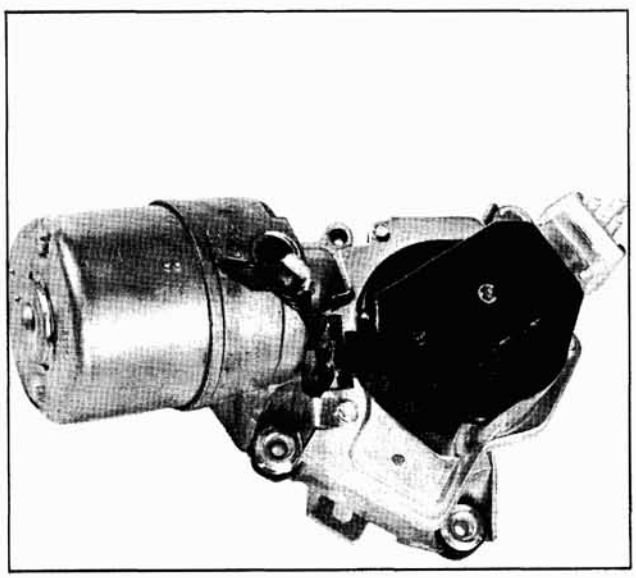


Fig. 12B-22—Wiper Assembly

in overall external length. It uses a grey colored drive gear with ratio of 51:1.

The round two speed motor used on 3100 through 4800 series is also three grommet mounted but it uses a 4" motor with a blue colored drive gear having a ratio of 45:1.

The servicing procedures for both motors are the same. The wiper assembly part number is stamped on the end of the end cap.

In the round two speed motor the brush plate and circuit breaker assembly is attached to a new type field assembly. The field assembly is staked into the end cap, the end cap and field assembly will be serviced as a unit. (Fig. 12B-23) The brush plate and circuit breaker must be detached from the field assembly in order to replace the armature. The motor has only two external leads.

WIPER CIRCUITS

WIPER OFF

Fig. 12B-24 illustrates the internal wiring with wiper in the "OFF" position. The 12 volt circuit to the center terminal of

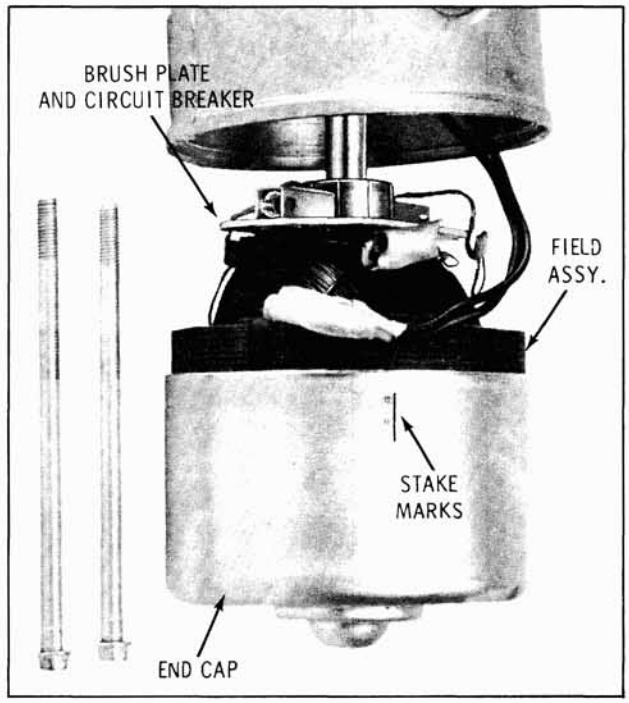


Fig. 12B-23—Field and End Cap Assembly

the wiper terminal board is completed through the ignition switch.

"LO" SPEED (Fig. 12B-25)

Moving the wiper switch to the "LO" speed position completes the relay coil circuit to ground. With the relay coil energized, the relay contacts close completing the 12V circuit to ground at the wiper switch. With the relay coil energized, the relay contacts close completing the 12V circuit to the motor windings. Current then flows through the series field coil and divides, part passing through the shunt field coils, the other through the armature to ground via the internal circuit breaker. The shunt field circuit is completed to ground at the wiper switch.

"HI" SPEED CIRCUIT (Fig. 12B-26)

Moving the wiper switch to the "HI" speed position maintains the relay coil circuit to ground and opens the shunt field circuit to ground. The shunt field current then flows via the resistor located on wiper terminal board to ground. With a weakened shunt field, the motor runs faster.

PARKING CIRCUIT (Fig. 12B-27)

Turning the wiper switch off is merely the first step in shutting the wiper off. The wiper motor itself actually completes the shutting off of the wiper. When the wiper switch is in the "OFF" position to shut the wipers off, two simultaneous functions are accomplished:

1. The relay coil circuit is opened and this allows the spring loaded relay latch arm to move out into the path of the gear drive pawl. (Fig. 12B-28) The relay-switch contacts, however, are still closed at this stage of operation and the wiper motor continues to run.
2. The shunt field circuit is connected to ground at the switch and the wiper operates in "LO" speed during this stage.

The wiper gear mechanism completes the shutting off the

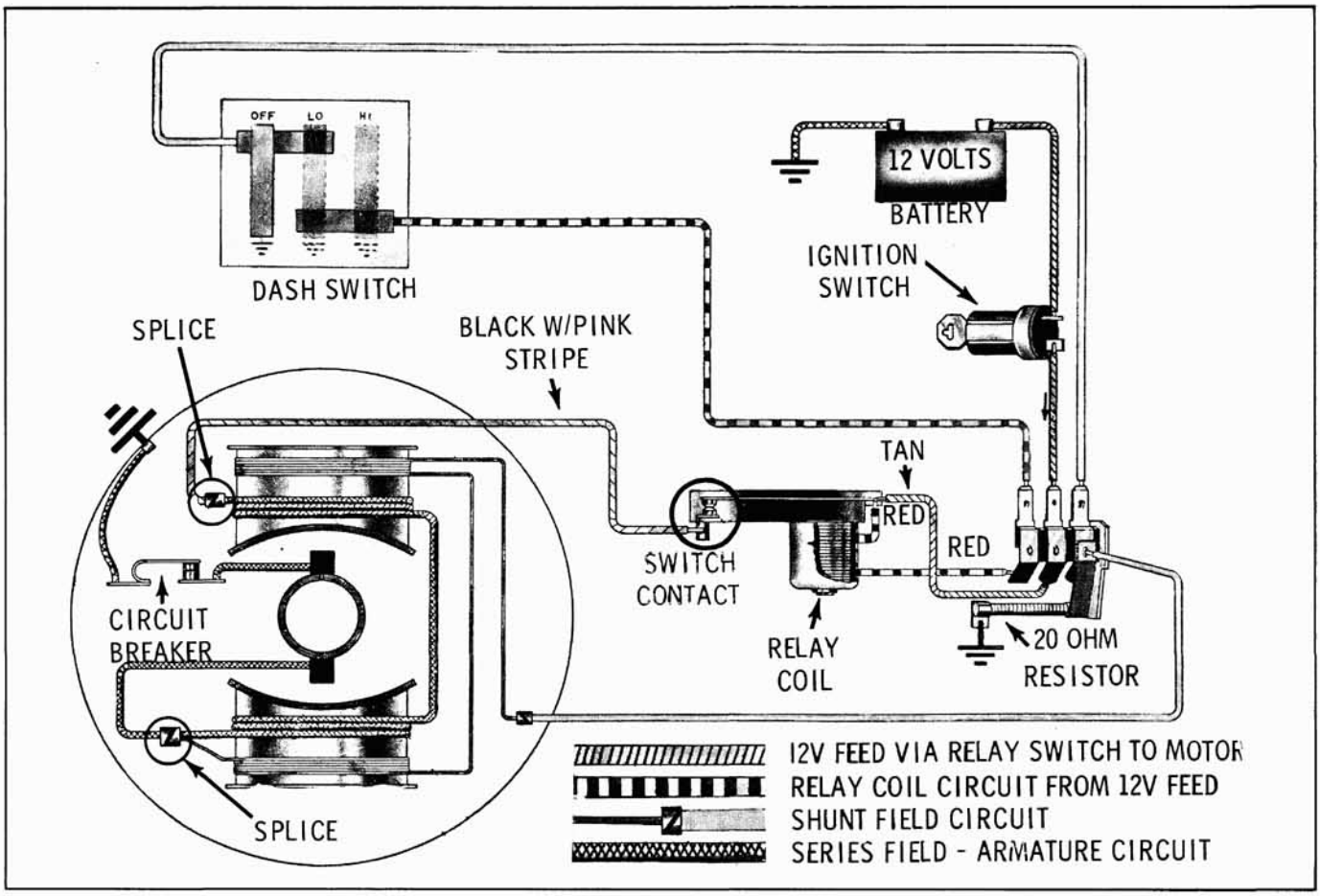


Fig. 12B-24—Wiper Wiring - "Off" Position

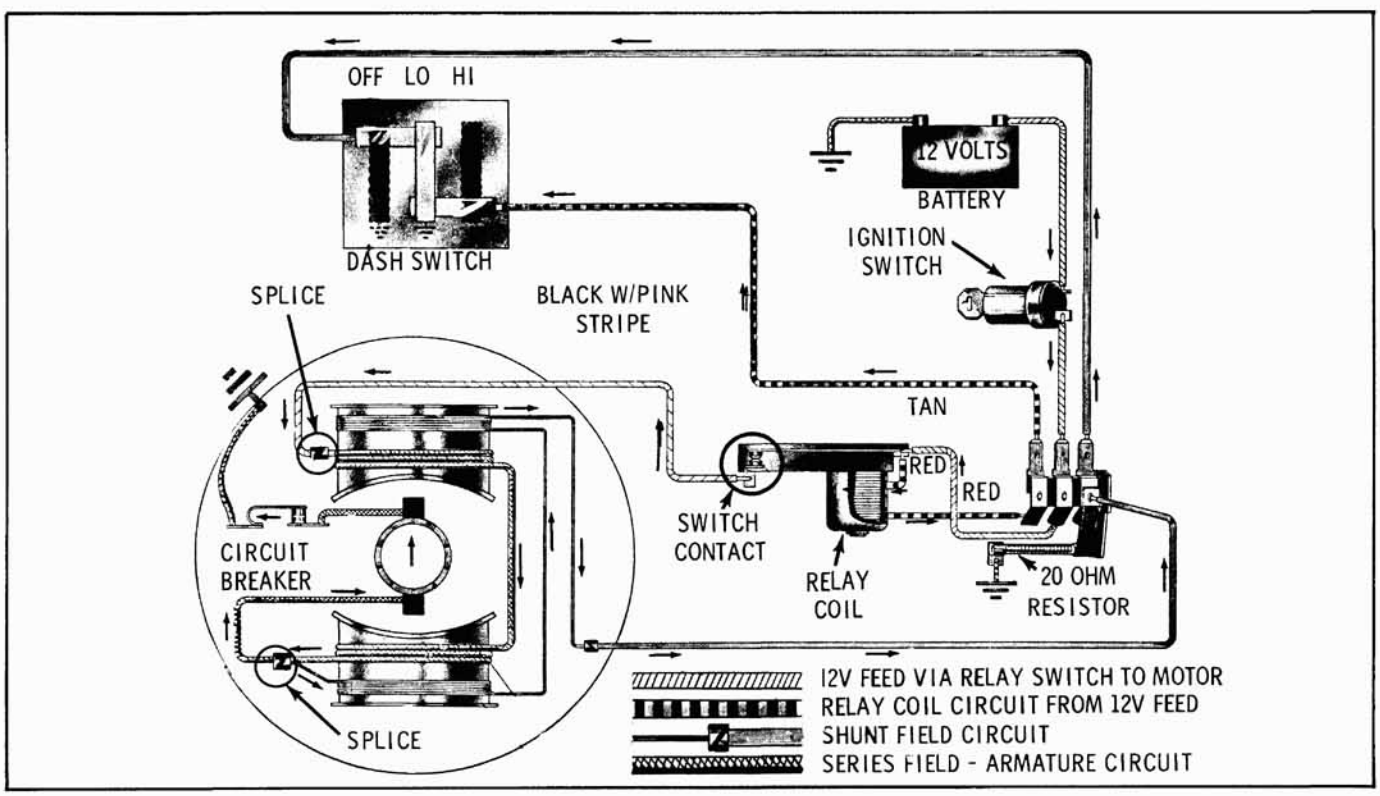


Fig. 12B-25—Wiper Wiring - "Lo" Speed

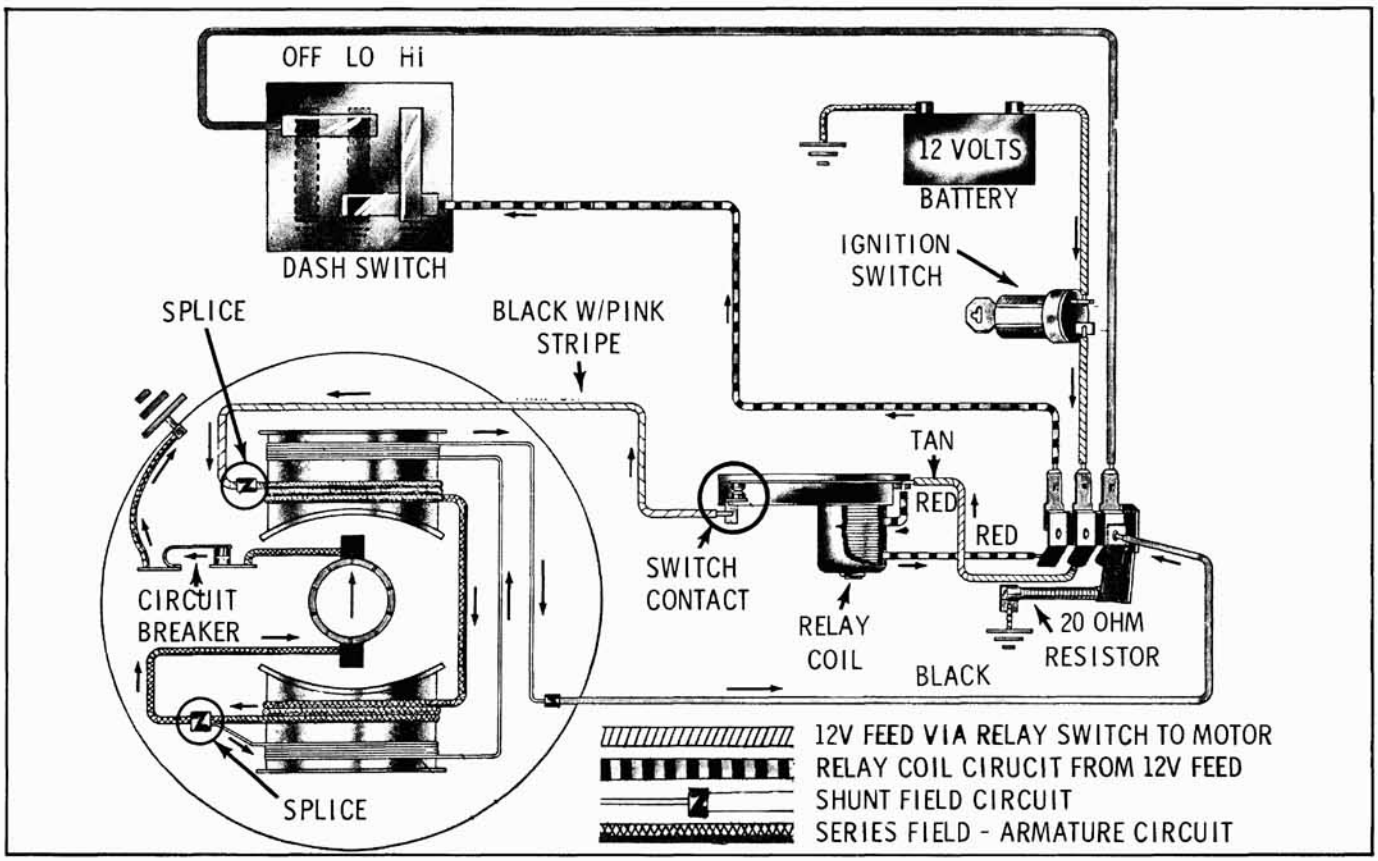


Fig. 12B-26—Wiper Wiring - "Hi" Speed

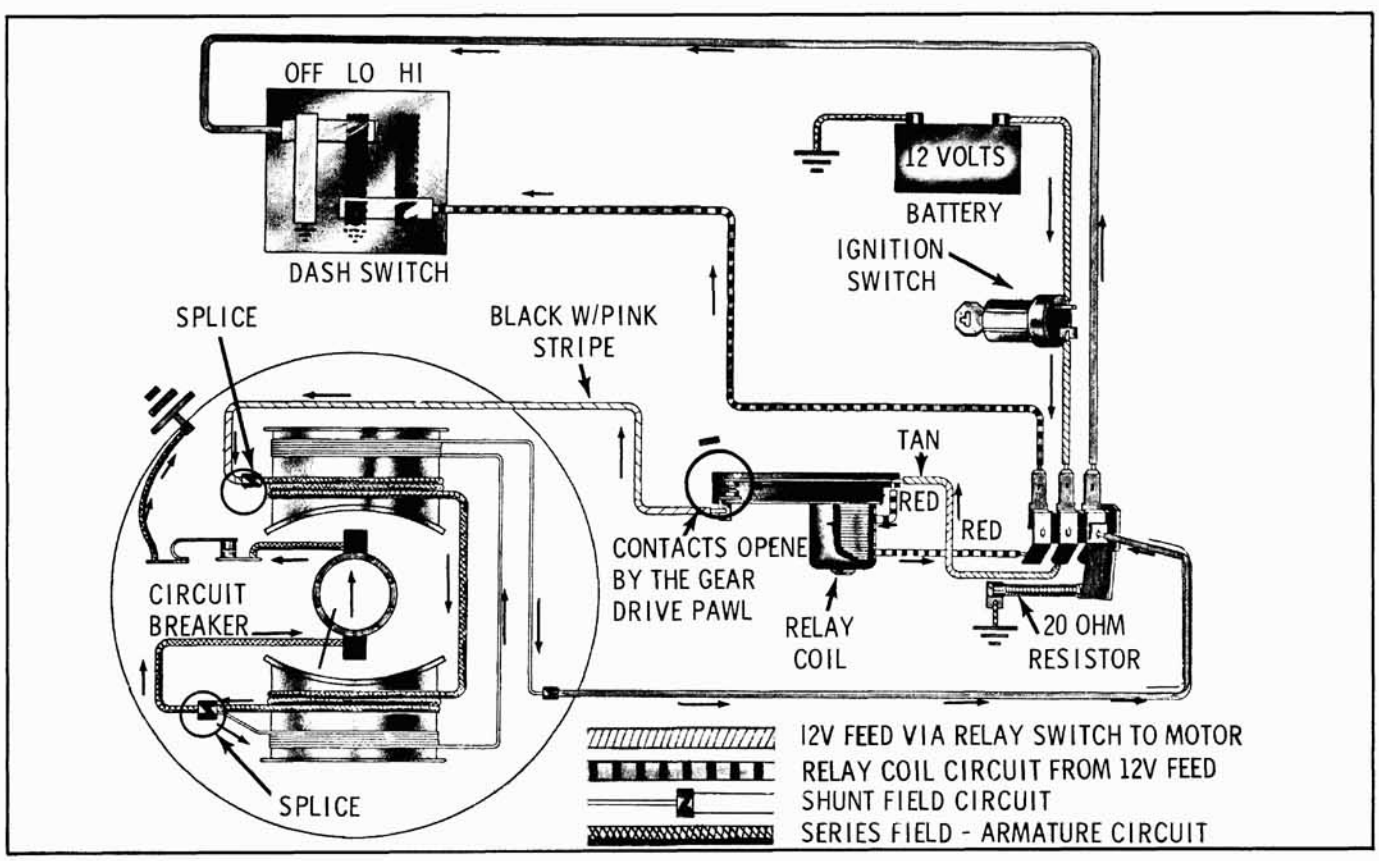


Fig. 12B-27—Parking Circuit

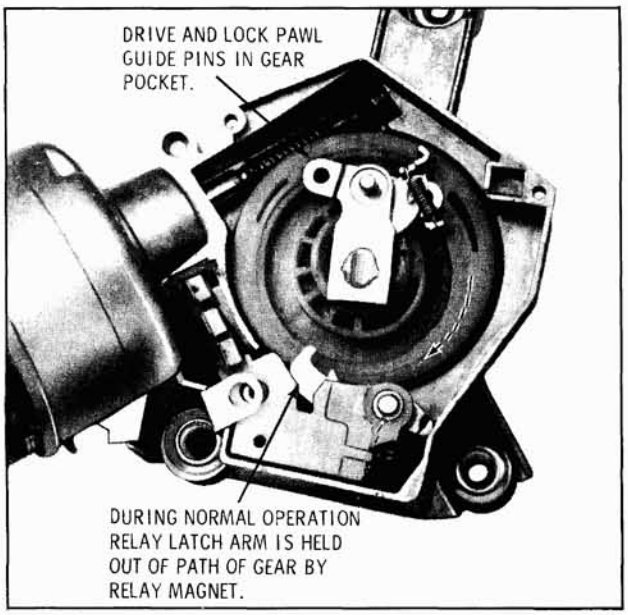


Fig. 12B-28—Gear in Normal Run Position

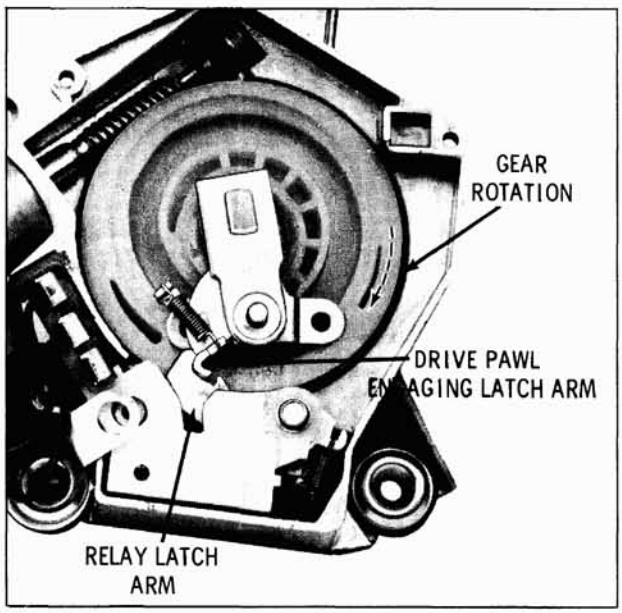


Fig. 12B-29—Wiper Shutting Off

wiper as follows: Since the wiper motor continues to run when the switch is first turned off, the continuing rotation of the gear causes the drive to engage the relay latch arm. (Fig. 12B-29) This action unlocks the gear from the drive pawl, lock pawl and the drive plate and output shaft assembly. With the drive plate and output shaft unlocked from the gear, and since the output shaft extends thru the gear shaft off center, the continuing rotation of the gear at this point causes a cam action between the output shaft and the gear shaft. This cam action causes the gear drive pawl to move into the relay switch slot. As the drive pawl moves into the switch slot, it pushes the relay latch arm against the relay-switch flexible contact. This action opens the relay-switch contacts which cuts the 12V feed to the motor windings. (Fig. 12B-30)

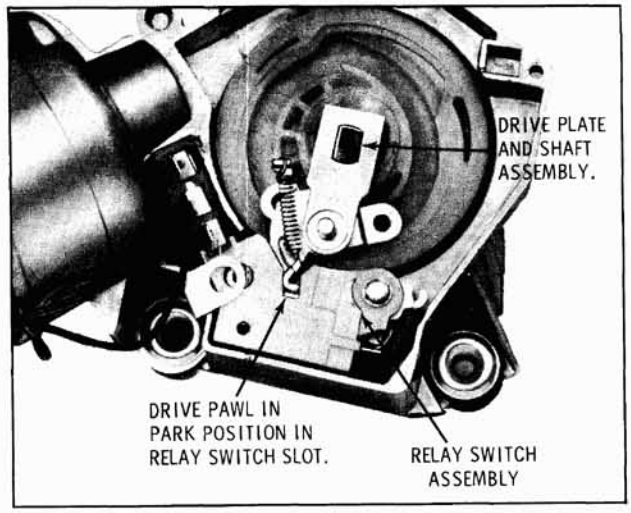


Fig. 12B-30—Wiper Shut Off in Park Position

DIAGNOSIS CHART—WIPER ON CAR

A. Preliminary Inspection

Check the following items:

1. Body wiring properly connected to wiper terminal board and wiper switch.
2. Wiper motor to dash mounting screws tight.
3. Wiper switch securely mounted.
4. Fuse.
5. With ignition switch turned on, there is a 12-volt supply at center terminal of wiper terminal board.

B. Checking Wiper Operation

Operate wiper independently of the car wiring or wiper switch, as shown in Fig. 12B-31. Check switch operation in "OFF", "LO" and "HI" positions.

1. If wiper operates correctly, see DIAGNOSIS CHART.
2. If wiper still fails to operate correctly, disconnect

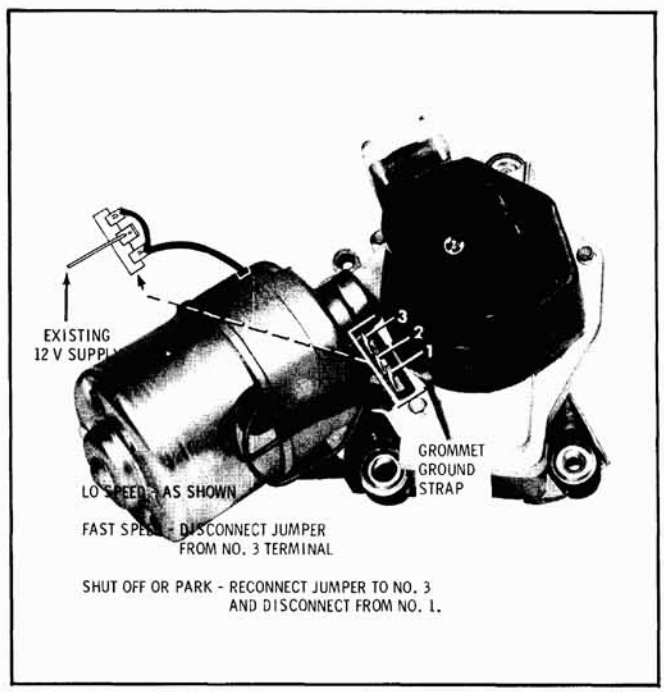


Fig. 12B-31—Checking Wiper Operation

wiper linkage from wiper motor and recheck for proper wiper motor operation.

a. If wiper motor operates correctly in Step 2, check linkage for severe binding condition or breakage.

b. If wiper fails to operate correctly in Step 2, remove wiper from car and check per instructions DIAGNOSIS -WIPER OFF CAR

DIAGNOSIS CHART - WIPER ON CAR

If wiper operated correctly independently of wiper switch and car wiring, but original trouble was:	Check the Following Items
Wiper inoperative	Open lead wire from wiper terminal No. 1 to wiper switch. Wiper switch not securely mounted. Wiper switch defective.
Will not shut off (Blades make full wipe stroke)	Grounded condition in lead from wiper terminal No. 1 to wiper switch. Check for corroded wiper terminals. Clean terminals and spread a thin coat of waterproof grease over board. Defective wiper switch.
Will not shut off (Blades move up and down about 15° from lower windshield molding)	Open in lead wire from wiper terminal No. 3 to wiper switch. Wiper switch mounting loose. Wiper switch defective.
Has one speed, "HI"	Lead wire from wiper terminal No. 3 to wiper switch open. Wiper switch defective.
Has one speed, "LO"	Grounded condition in lead from wiper terminal No. 3 to wiper switch. Defective wiper switch.
Intermittent operation	Check for loose wiper switch mounting.

WIPER REMOVAL AND INSTALLATION
Figs. 12B-32 and 12B-32A

1. Disconnect wiring.
2. Disconnect washer hoses.
3. Remove three motor attaching screws.
4. Remove access hole plug.
5. Reaching through access hole, loosen the two transmission crankarm attaching nuts.
6. Hold motor with one hand and with the other hand move the wiper arm half way through its travel, this will center the crankarm in the dash hole.
7. Remove motor while guiding crankarm through hole.

To install, reverse the removal procedure.

WIPER ADJUSTMENT

1. With wiper motor in park position, install the left hand wiper arm and blade so that the blade rests on bottom front edge of blade stop.
2. Install left wiper arm and blade so that the blades rest on the bottom front edge of blade stop.
3. Lift up on both arm assemblies and then lower so that the blades rest on the stops.
4. Start wipers, check wiping pattern and park position.

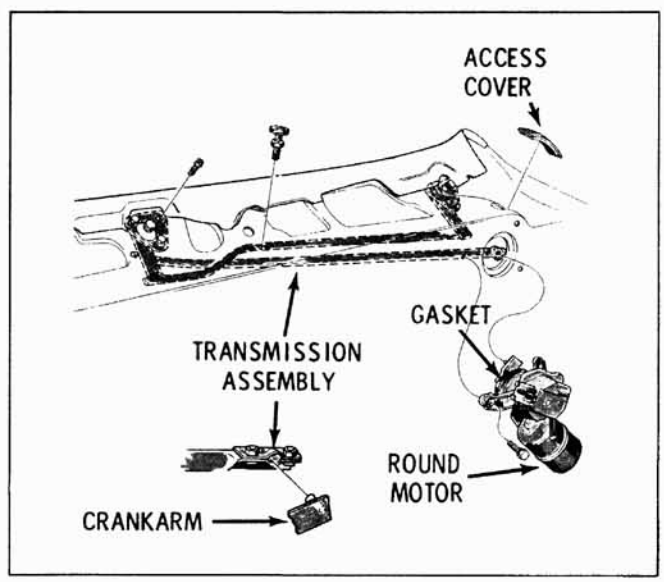


Fig. 12B-32—Wiper Blade and Arm

DIAGNOSIS CHART—WIPER OFF CAR

Before using chart, try operating wiper as shown in Fig. 12B-33. Check if wiper has "LO" and "HI" speeds and shuts off correctly. Match the trouble found with the trouble shown in the chart. Use checking procedure as indicated to locate cause of trouble.

Trouble	Possible Cause	Use Checking Procedure
Wiper Inoperative (Motor doesn't run)	Open relay coil Circuit breaker open Open armature Motor series field open Brushes sticking Defective solder joints-relay switch Binding condition-relay latch arm	A
Wiper will not shut off (Crankarm rotates through 360°)	Relay coil grounded Relay latch spring disconnected or broken Latch arm binding	B
Wiper will not shut off (Crankarm moves back and forth in a horizontal plane accompanied by a loud "klunk")	Relay switch contacts shorting together Drive pawl spring disconnected Wiper has one speed, "HI", caused by open shunt field	C
Wiper has one speed, "HI"	Shunt field open Defective soldering at terminal No. 3 on wiper terminal board	C
Wiper has one speed, "LO"	Shunt field internally grounded Shunt field lead to terminal board (black) grounded Shorted armature	D
Wiper has excessive speed in "Hi"; "Lo" speed normal	Open speed resistor Poor resistor ground connection	E
Wiper stops at random (Crankarm stops rotating immediately and does not return to full park position.	Relay switch contacts dirty or broken	Replace Relay Switch Assembly
Intermittent Operation	Defective circuit breaker (weak) Circuit breaker tripping because of shorted armature and/or fields causing motor to draw excessive current	F
No apparant trouble on bench test but fails occasionally on car	Armature end play tight Gear assembly end play tight Loose solder or weld joints	See Adjustments

PROCEDURE "A" (WIPER INOPERATIVE)

1. Remove washer pump to gain access to relay switch assembly.

2. Connect 12-volt source to wiper, hot side to center terminal, ground side to gear housing. (Fig. 12B-34) Do not connect jumper to terminal 1 and 3.

3. To determine if relay coil is open, connect test lamp to wiper terminal No. 1. Test lamp should light. (Fig. 12B-34)

4. Test relay switch as follows:

If gear mechanism is in full park position (Fig. 12B-34), use a small screwdriver in the switch slot and push latch arm down toward relay coil. Next, remove a small amount of insulation from black lead with pink tracer and touch test lamp to exposed wire.

a. Test lamp lights but motor doesn't run. Proceed to Step 6.

b. Test lamp doesn't light, relay switch defective.

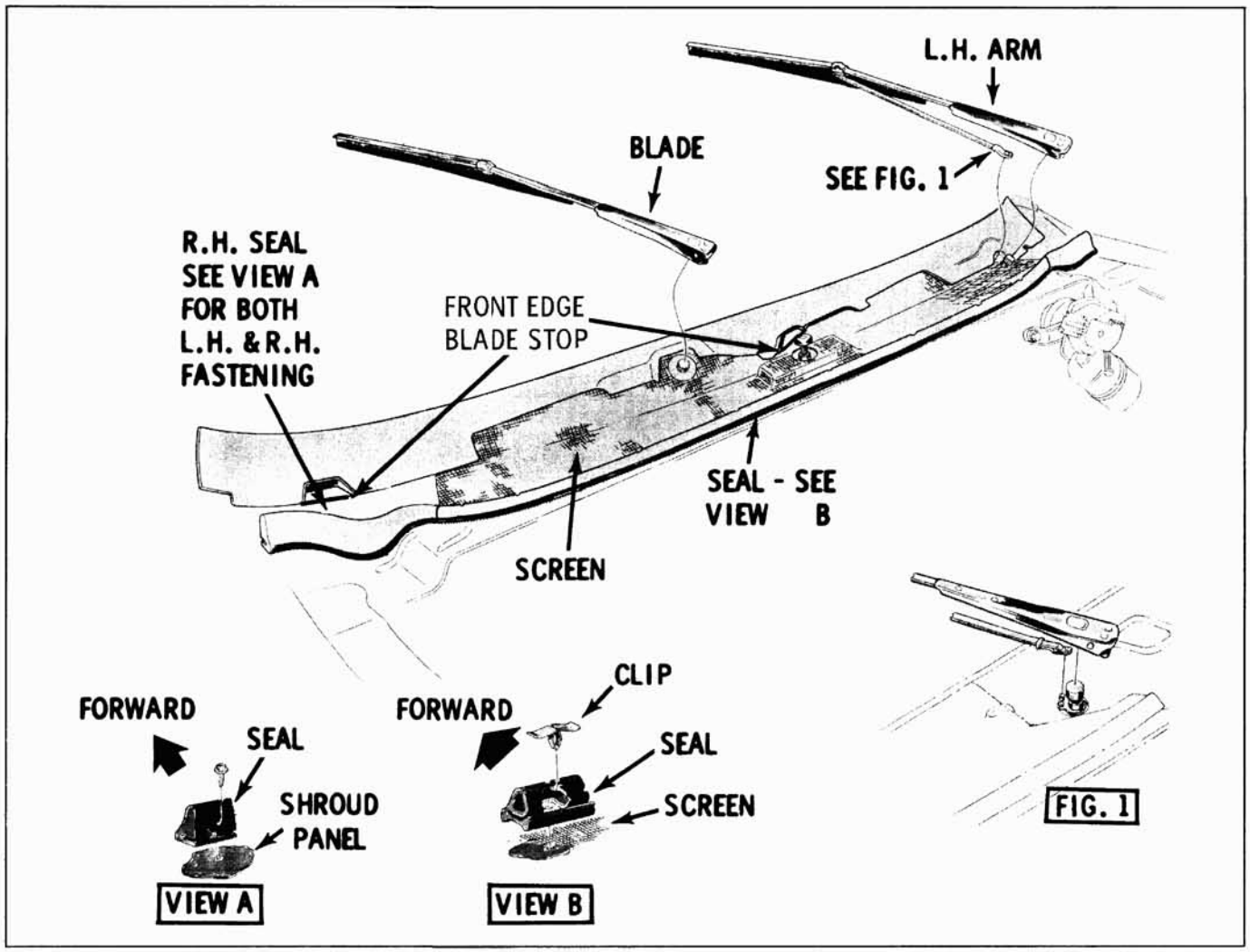


Fig. 12B-32A—Wiper Layout-54 through 86 Series

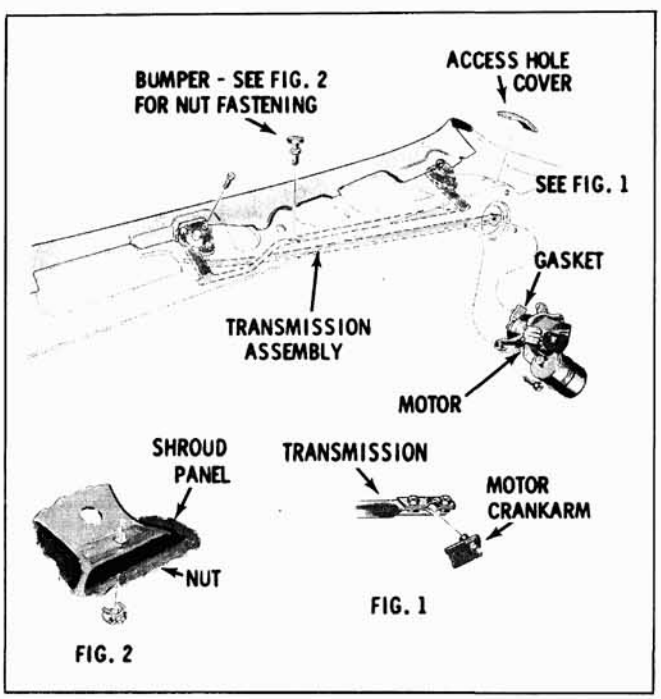


Fig. 12B-32B—Wiper and Transmission Attachment

Cover exposed wire with tape after the test.

6. Disassemble motor section and check the following:
   a. Hung brush.
   b. Solder connections at brush holders.
   c. Splice joints at field coil connections to leads.
   d. Open armature.
   e. Series field ground connection on field lamination.
   f. To check the circuit breaker, disassemble motor section of wiper and visually inspect the circuit breaker for dirty or burnt contacts or solder connections to circuit breaker terminals. (Fig. 12B-35)

PROCEDURE "B" (WIPER WILL NOT SHUT OFF—CRANKARM ROTATES 360°)

1. Observe if relay latch arm spring is connected properly. (Fig. 12B-35)

2. Manually operate latch arm to check it for possible binding condition.

3. If items in 1 and 2 check out, connect power source to wiper and connect jumper wire from terminal No. 3 to wiper housing. (Fig. 12B-35) DO NOT make any connections from terminal No. 1. Manually actuate latch arm in direction of arrow (Fig. 12B-35) and observe if it remains in energized position (inside plastic switch housing out of path of gear drive pawl). If it remains in energized position, check for grounded red lead from coil to terminal No. 1. If red lead is not grounded, coil is probably grounded internally and relay

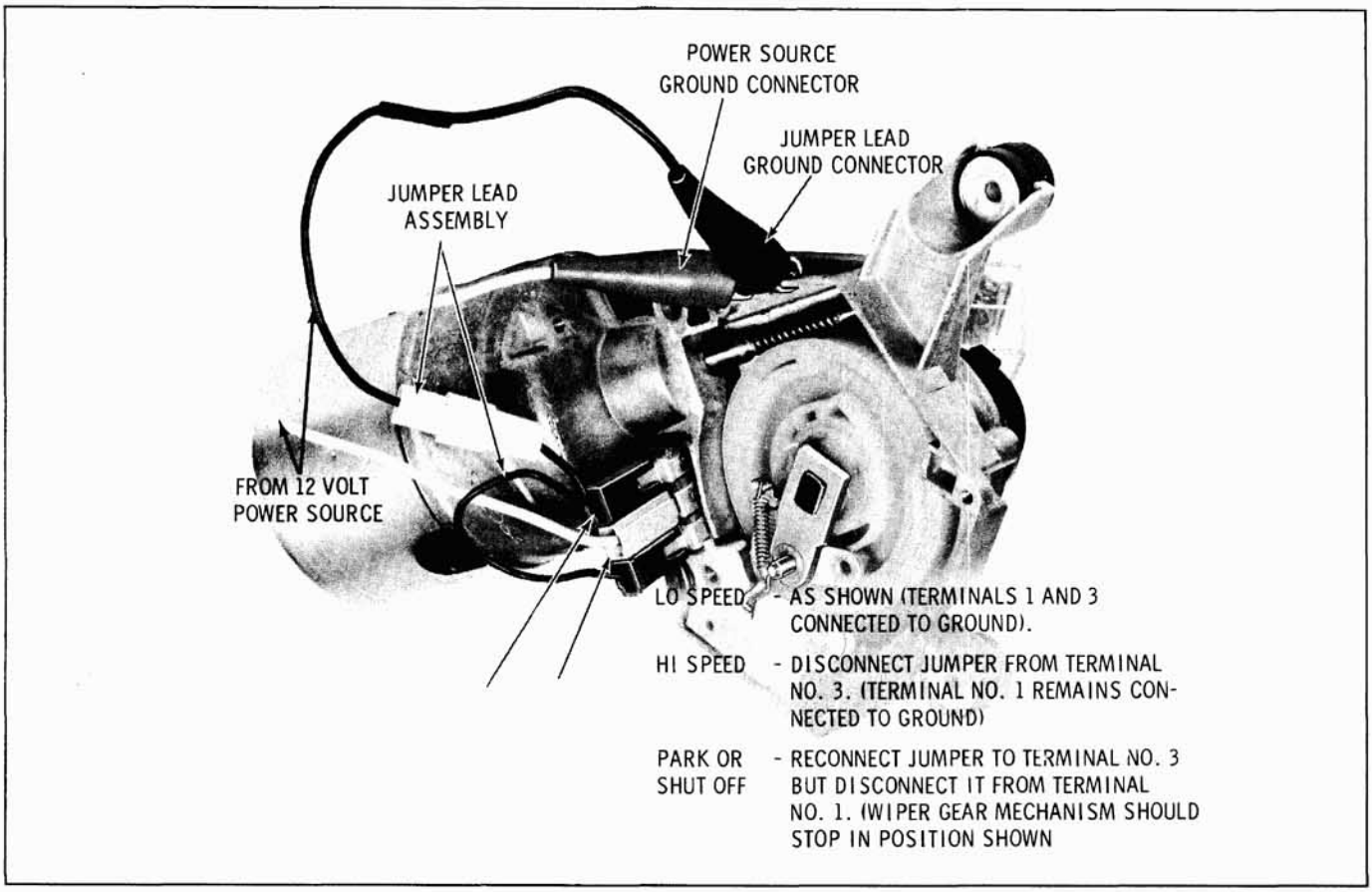


Fig. 12B-33—Checking Wiper Operation on Bench

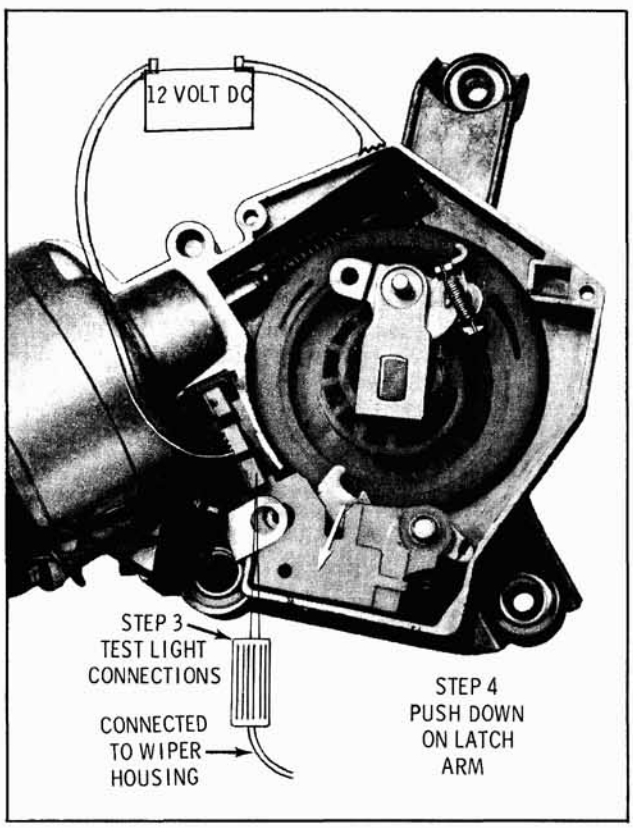


Fig. 12B-34—Checking Connections

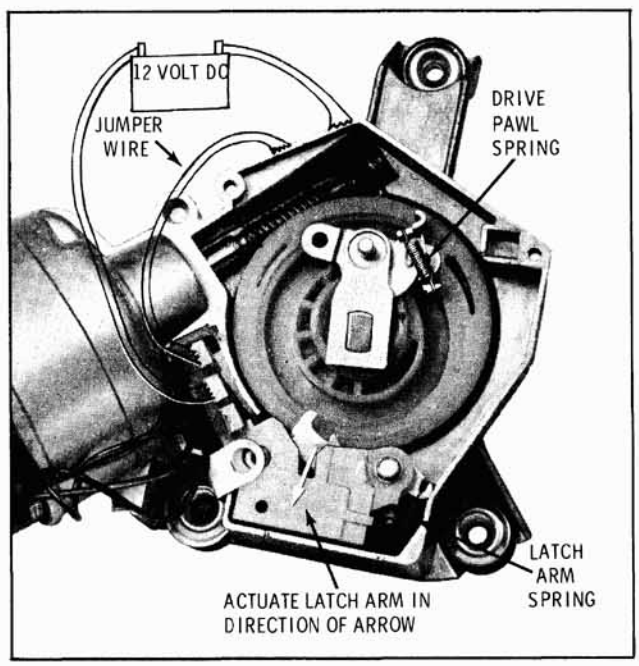


Fig. 12B-35—Latch Mechanism

switch should be replaced.

PROCEDURE "C" (WIPER WILL NOT SHUT OFF—RECYCLES)

Crankarm oscillates in a somewhat horizontal plane and is accompanied by a loud "knock" with each

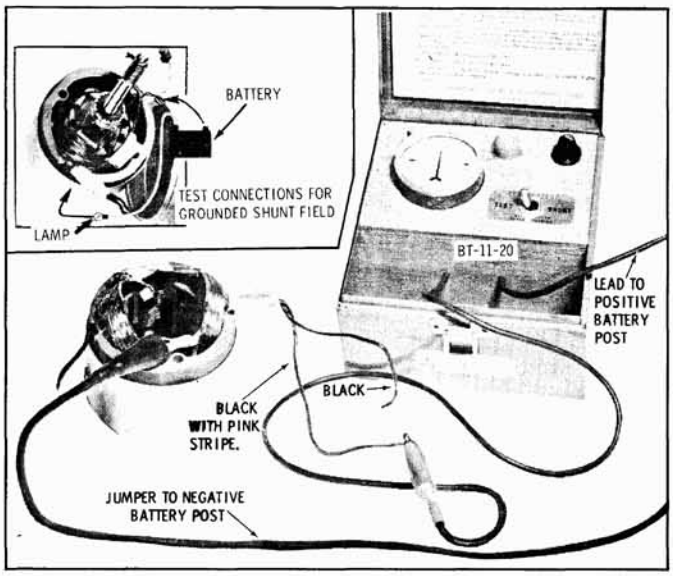


Fig. 12B-36—Testing Coils

revolution of the gear.

1. Check that drive pawl and relay latch arm springs are properly connected. (Fig. 12B-35)
2. Check wiper for "LO" speed operation. (Fig. 12B-33) If wiper has "HI" speed only, check the following items:
   a. Solder joint at No. 3 wiper terminal.
   b. Splice joint - black lead with pink stripe to field coil leads.
   c. Splice joint - black lead to field coil.
3. Check relay switch as follows:
   a. Remove small amount of insulation from black lead with pink stripe and connect test light between exposed wire and wiper housing.
   b. Connect power source and jumper to wiper as shown in Fig. 12B-35 and observe if test light goes out once for each revolution of gear or if light glows steady. If light glows steady, relay switch contacts are not opening and switch is defective. If light goes out each time drive pawl moves into relay switch slot, relay switch is functioning correctly.

PROCEDURE "D" (WIPER HAS ONE SPEED, "LO")

1. Check for grounded condition in the internal black lead that connects to wiper terminal No. 3. Refer to Fig. 12B-33 for terminal No. 3 location.
2. Disassemble motor section of wiper and check for grounded shunt field coil. (Fig. 12B-36)

IMPORTANT: Occasionally the field coils are loose on the poles and this enables them to slide into a position where they short on the corners of the poles. Center the coils on the poles and wedge them in a fixed position.

PROCEDURE "E" (WIPER HAS EXCESSIVE SPEED IN "HI" BUT "LO" SPEED IS NORMAL)

(Crankarm rpm exceeds 70 at 12 volts)

1. Check for open resistor and the resistor ground connection. (20 ohm resistor)

PROCEDURE "F" (INTERMITTENT OPERATION)

1. Check solder connections at wiper terminal board.
2. Connect up wiper to operate in "LO" speed. (Fig. 12B-33) Connect ammeter (range 0-30 amps.) in feed wire circuit to wiper and observe current draw. Allow motor to run until it becomes hot.
   a. If current draw is normal (3.5 - 5 amps. max.) and wiper cycles on and off, a weak circuit breaker is indicated. Replace case and brush assembly.
   b. If current draw exceeds 5 amps., proceed to Steps 3, 4 and 5.
3. Adjust armature end play as required and recheck current draw.
4. Adjust gear assembly end play as required and recheck current draw.
5. If adjustments in Steps 3 and 4 fail to correct excessive current draw condition, disassemble motor section of wiper and check armature on growler for shorted or grounded condition.

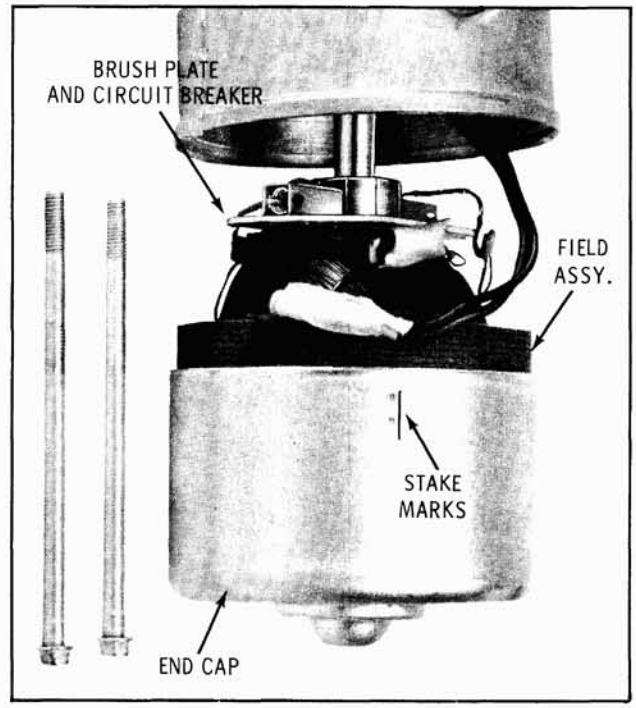


Fig. 12B-37—Field and End Cap Assembly

DISASSEMBLY—REASSEMBLY PROCEDURE

The disassembly-reassembly procedures for the wiper are broken down into two major areas; the motor section and gear box section. Each section may be serviced independently of the other.

MOTOR

BRUSH PLATE AND CIRCUIT BREAKER REMOVAL

1. Scribe a reference line along the side of the casting and end cap to insure proper reassembly.
2. Remove the two motor thru bolts.
3. Feed exposed excess length of motor leads through the casting grommet and carefully back the case and field assembly plus the armature away from the casting. (Fig. 12B-37)

It may be necessary to remove the armature end play adjusting screw and insert a rod through the opening in order to apply pressure against the end of the armature.

4. Unsolder the black lead from circuit breaker.
5. Straighten out the 4 tabs that secure the brush plate to the field coil retainers.

Be careful not to break any of the retainer tabs.

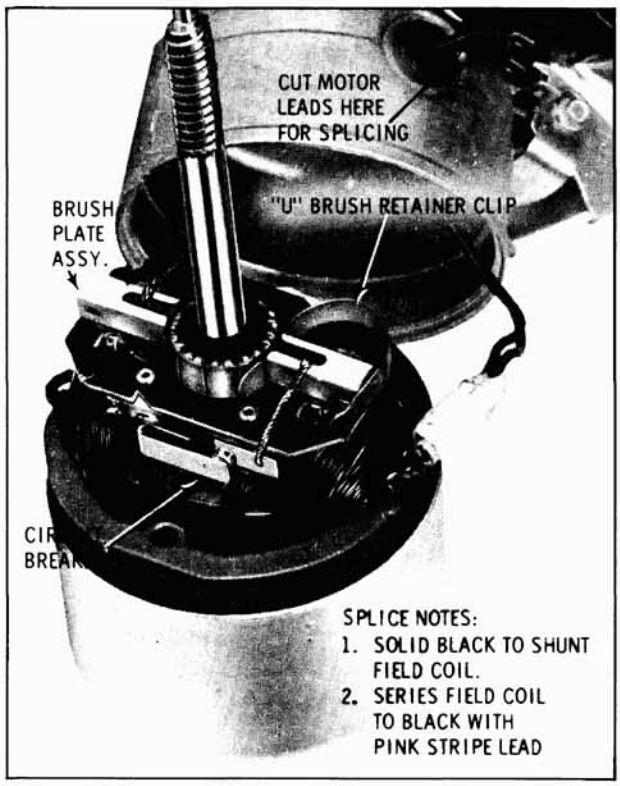


Fig. 12B-38—Brush Plate Assembly

6. Install "U" shaped brush retainer clip over brush holder that has brush lead attached to circuit breaker. (Fig. 12B-38)

7. Holding the opposite brush from that retained in Step 6, carefully lift the brush holder off the mounting tabs far enough to clear the armature commutator. (Fig. 12B-39)

8. Allow the brush, held in Step 7 to move out of its holder. Remove the brush spring and lift the brush holder off the armature shaft.

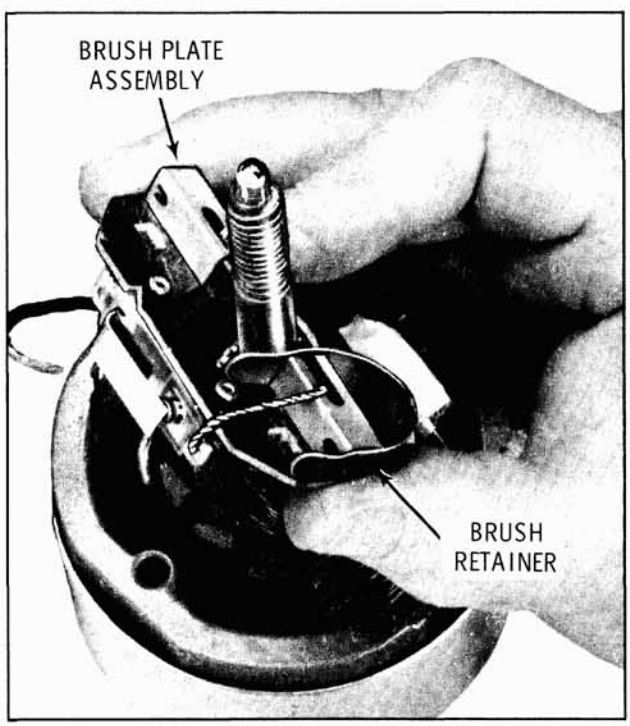


Fig. 12B-39—Removing Brush Plate Assembly

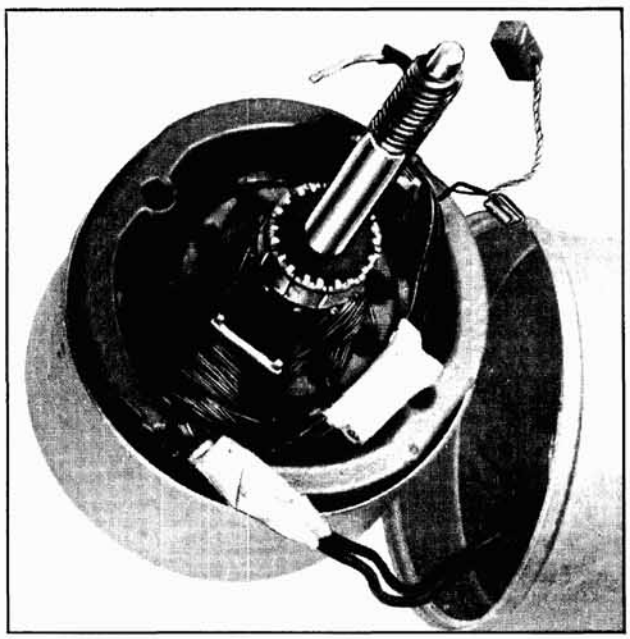


Fig. 12B-40—Installing Armature

ARMATURE REMOVAL

1. Follow Steps 1 thru 8 under brush plate removal.
2. Lift armature out of case and field assembly.
3. Remove thrust ball from end of armature shaft and save for reassembly.

Thrust ball may be easily removed with a magnet.

CASE AND FIELD ASSEMBLY REMOVAL

1. Remove brush plate and armature.
2. The end case and field assembly is serviced as a unit. To free the field and case assembly, cut the solid black and black with pink stripe leads in a location convenient for splicing —preferably near the wiper terminal board. (Fig. 12B-38)
3. Remove steel thrust plate and rubber disc from case bearing.

MOTOR REASSEMBLY

1. If new field and case assembly is being installed, splice the black and black with pink stripe leads of the new field with the corresponding leads of the wiper.
2. Install the rubber thrust disc, steel thrust disc and felt lubricating washer in the case assembly bearing in the order indicated.
3. Lubricate end of armature shaft that fits in case bearing with recommended type grease. Next, install thrust ball in end of shaft. (Fig. 12B-40)
4. Assemble armature in the case and field assembly. (Fig. 12B-40)
5. Position the partially assembled brush plate, Fig. 12B-41, over the armature shaft far enough to allow reassembly of the remaining brush in its brush holder; then position the brush plate assembly on the mounting tabs in the position shown in Fig. 12B-38.

Circuit breaker ground lead will not reach circuit breaker terminal if brush plate is positioned wrong.

6. Center the brush plate mounting holes over the mounting tabs and bend the tabs toward the brush holders as required to secure the brush plate in position.

Be sure tabs are centered in brush plate mounting holes.

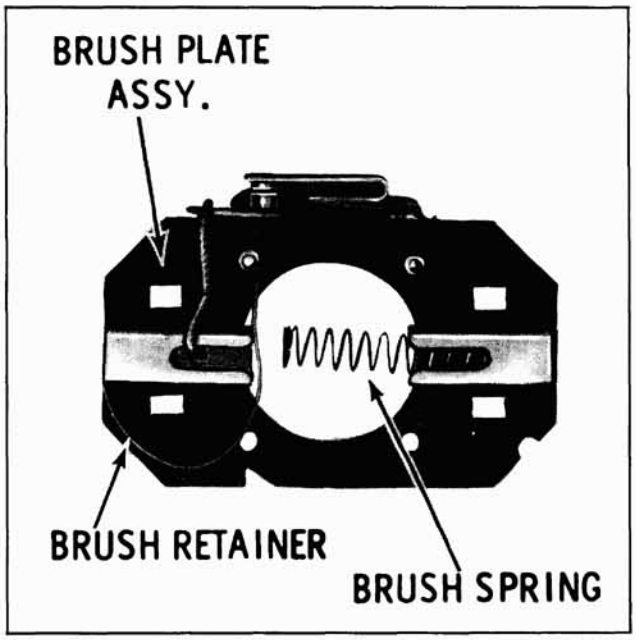


Fig. 12B-41—Brush Plate Assembly

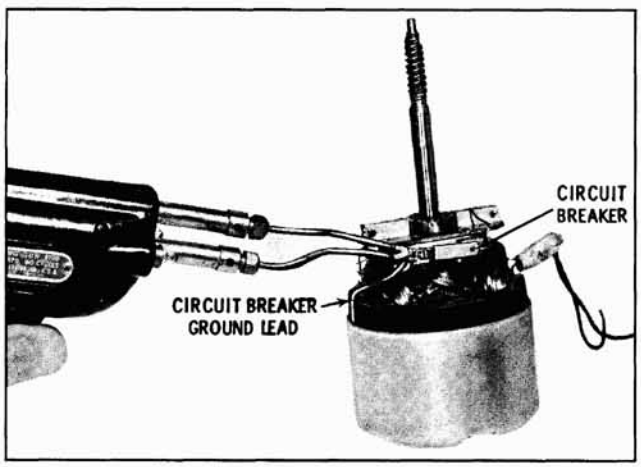


Fig. 12B-42—Resoldering Ground Lead

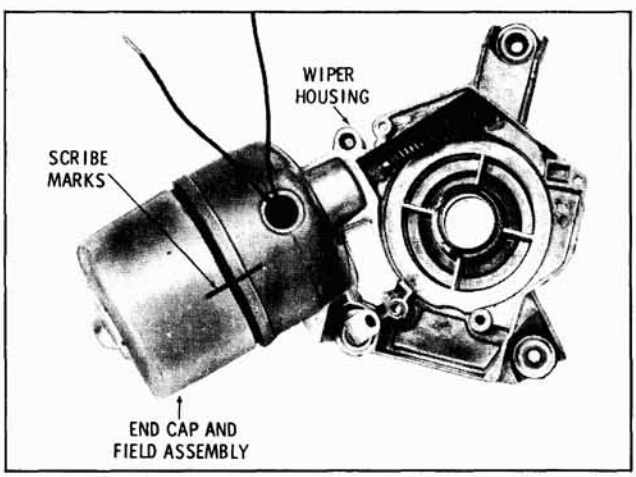


Fig. 12B-43—Aligning Scribe Marks

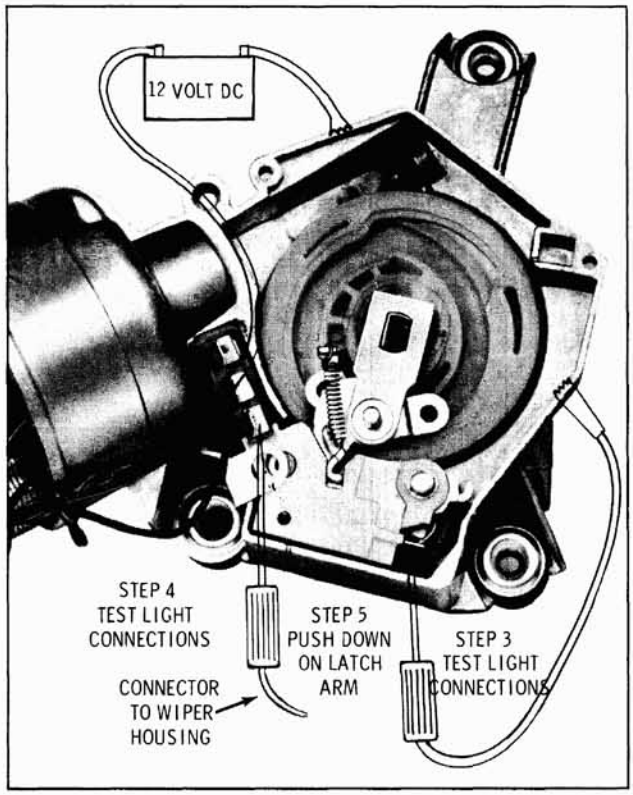


Fig. 12B-44—Park Position

7. Remove brush retainer clips and resolder circuit breaker ground lead to circuit breaker. (Fig. 12B-42)

8. If new case and field assembly is used, scribe a line on it in the same location as the one scribed on the old case. This will insure proper alignment of the new case with the scribed line made on the housing.

9. Position armature worm shaft inside the housing and, using the scribed reference marks, line up as near as possible the case and field assembly with the housing. (Fig. 12B-43)

10. Maintaining the armature in its assembled position in the case, start the armature worm shaft through the field and housing bearing until it starts to mesh with the worm gear. At the same time carefully pull the excess black and black with pink stripe leads through the housing grommet.

It may be necessary at this point to rotate armature slightly before the armature worm will engage with worm gear teeth.

11. Rotate the case as required to align the bolt holes in the case with those in the housing.

12. Secure the case to the housing with the two thru bolts.

GEAR BOX

RELAY SWITCH-LATCH ASSEMBLY— TERMINAL BOARD REMOVAL

1. Remove washer pump.

2. If wiper gear drive pawl is in full park position (Fig. 12B-44), remove gear assembly. (See GEAR ASSEMBLY - Removal)

If wiper gear mechanism is not in park position (drive pawl away from latch arm Fig. 12B-45), proceed to Step 3.

3. Remove relay switch attaching screw (Fig. 12B-45) and carefully lift the relay switch assembly out of the gear box. Unsolder leads from switch terminals as required. Refer to Fig. 12B-46 when resoldering leads.

4. To remove terminal board assembly, simply slide it out

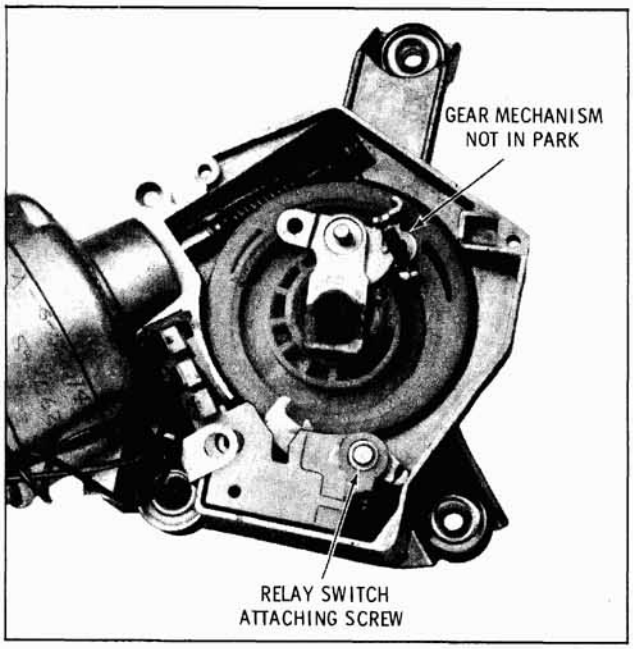


Fig. 12B-45—Gear and Relay Switch

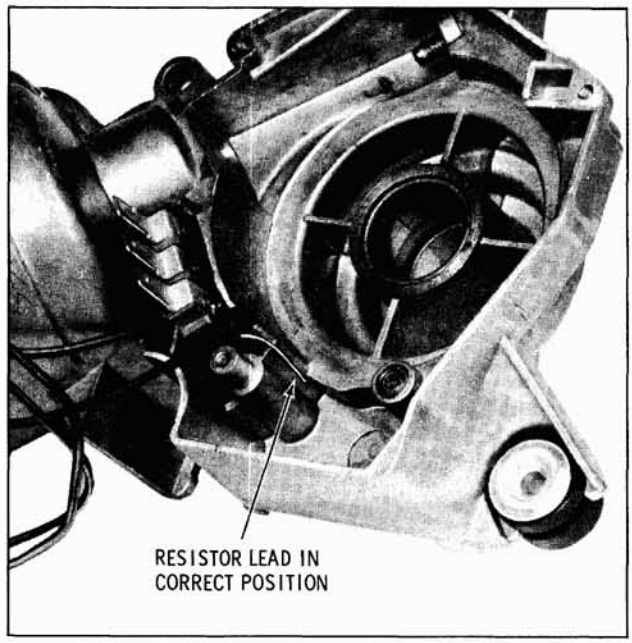


Fig. 12B-47—Positioning Resistor Lead

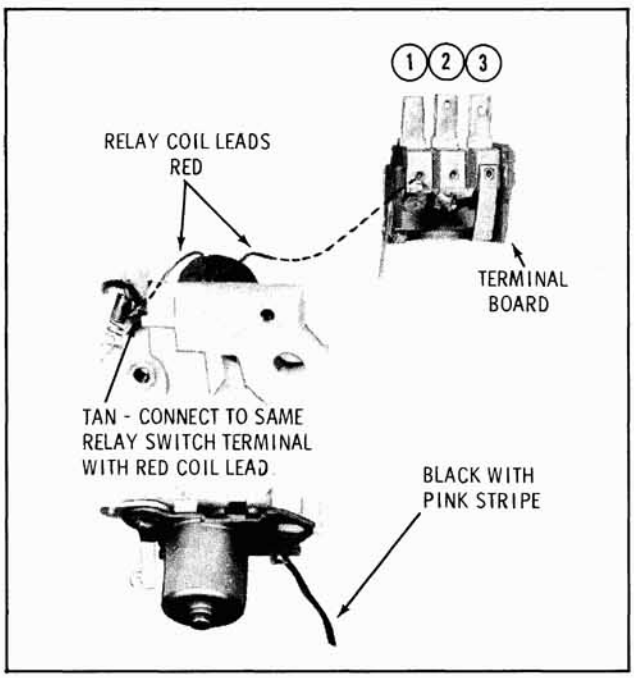


Fig. 12B-46—Terminal Board

of housing and unsolder leads as required.

REASSEMBLY OF RELAY SWITCH—LATCH AND TERMINAL BOARD

1. Resolder red coil lead to wiper terminal board as required. (Fig. 12B-46)
2. Slide terminal board into wiper housing being careful to position the terminal board resistor lead as shown in Fig. 12B-47.

With the relay switch assembly replaced in the housing and washer pump reinstalled, the relay switch plastic housing applies pressure against the resistor lead to form a positive ground connection to the wiper housing.

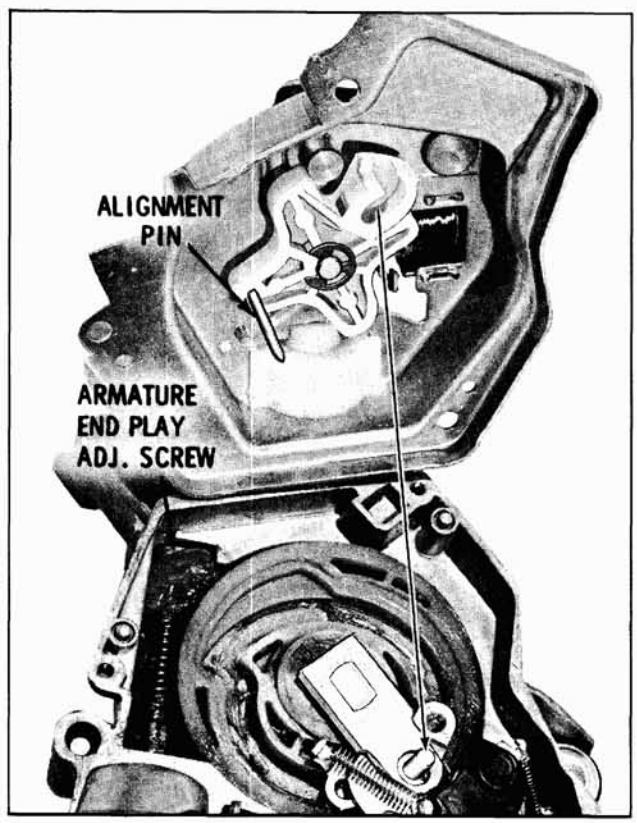


Fig. 12B-48—Positioning Pump to Gear

3. Resolder leads to relay switch assembly as required. (Fig. 12B-46)
4. Position relay switch assembly in housing. (Fig. 12B-45)

Be very careful to route leads in such a manner as to avoid having them pinched between relay and wiper housing.

5. Install relay switch mounting screw. (Fig. 12B-45)

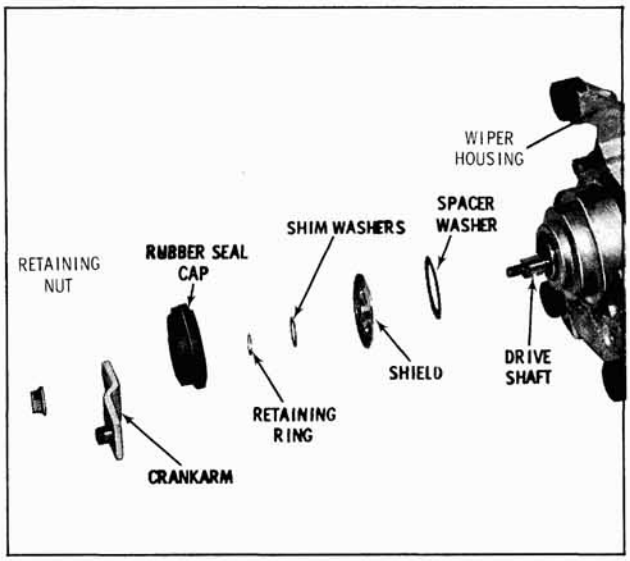


Fig. 12B-49—Exploded View of Crankarm Parts

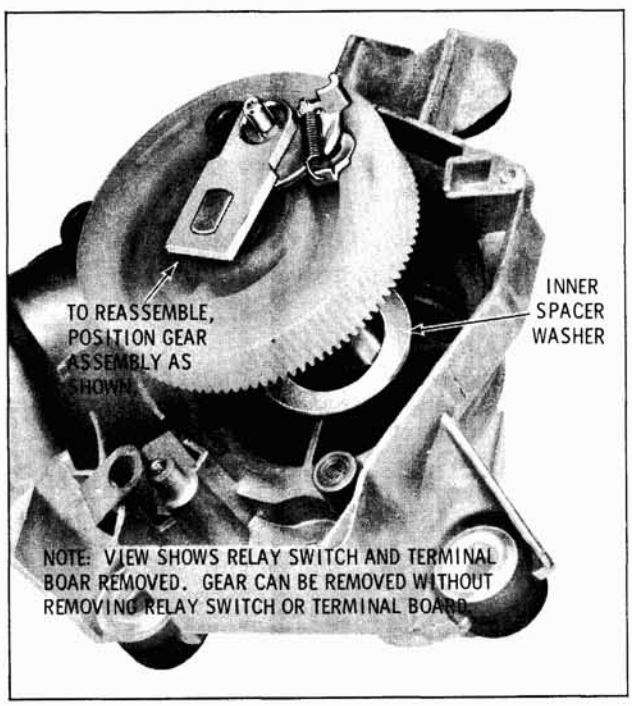


Fig. 12B-50—Removing Gear

6. Assemble washer pump to wiper being careful that the ground strap is properly connected. Refer to Fig. 12B-48 for assembly of washer pump to gear housing.

DRIVE GEAR DISASSEMBLY

1. Remove crankarm retaining nut, crankarm, rubber seal cap, retaining ring, shim washers, shield and spacer washer in the order indicated. (Fig. 12B-49)
2. Slide gear assembly out of housing. (Fig. 12B-50)
3. Slide drive plate and shaft out of gear and remove the drive pawl, lock pawl and coil spring as required. (Fig. 12B-51)

DRIVE GEAR REASSEMBLY

1. Position drive pawl on drive plate as shown in Fig. 12B-52.

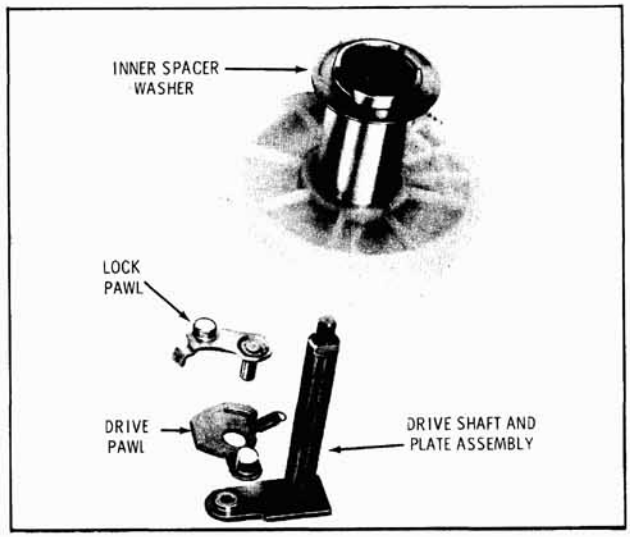


Fig. 12B-51—Gear Removal

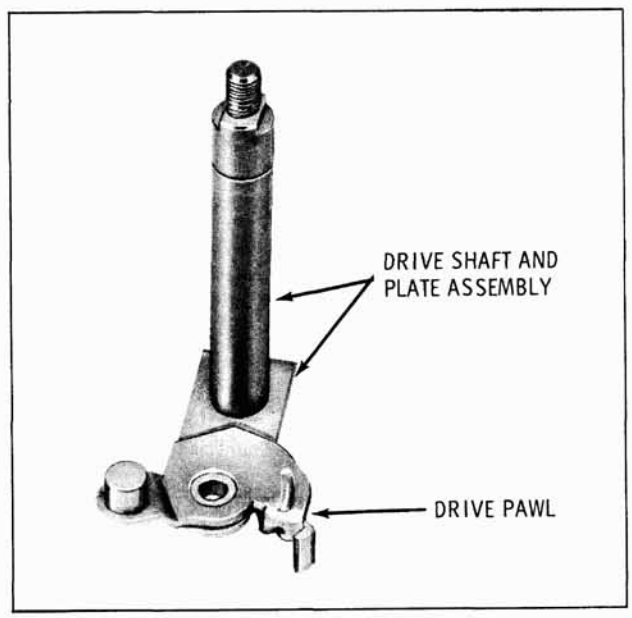


Fig. 12B-52—Drive Pawl

2. Assemble lock pawl over drive pawl as shown in Fig. 12B-53.
3. Slide gear and tube over the drive shaft. (Fig. 12B-54) (Move drive and lock pawls as required to allow their respective pins to fit in the gear guide channel.)
4. Holding the gear, manually rotate the drive plate in the direction of the arrow until the drive and lock pawl guide pins snap into their respective pockets in the gear. (Fig. 12B-55)
5. Reinstall coil spring between lock and drive pawls. (Fig. 12B-55)

Be very careful to maintain lock and drive pawl guide pins in their respective pockets during Step 6.

6. Assemble inner spacer washer over gearshaft and assemble gear mechanism in housing so that it is positioned with respect to the housing in the approximate location shown in Fig. 12B-50.
7. Reassemble the outer spacer washer, shield, shim washers, as required to obtain .005" maximum end play, snap ring and rubber seal cap in the order indicated. Refer to Fig. 12B-49.

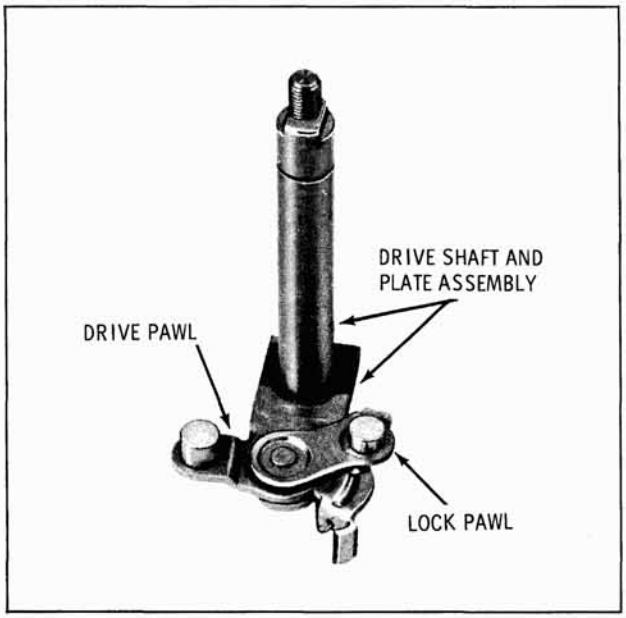


Fig. 12B-53—Lock Pawl

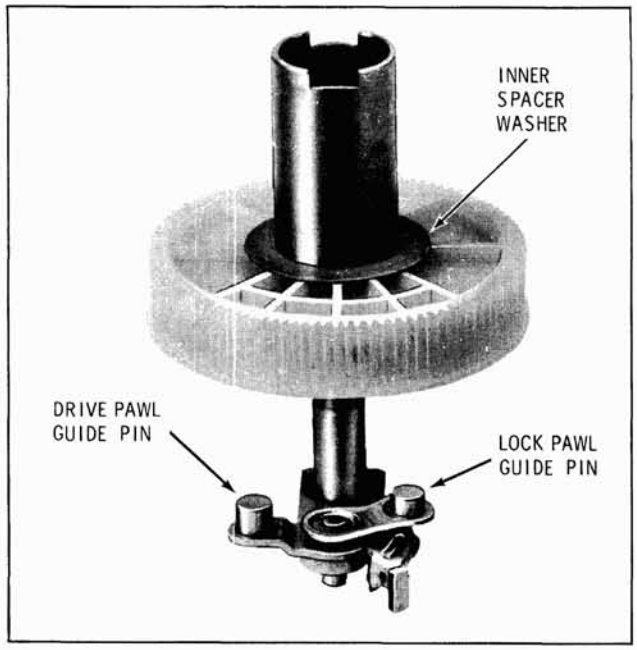


Fig. 12B-54—Installing Gear

8. Operate wiper to park or OFF position and install crankarm in the approximate position shown in Fig. 12B-56.
9. Reassemble washer pump to wiper. (Fig. 12B-48)

ASSEMBLY OF WASHER PUMP TO WIPER

For assembly of washer pump to wiper motor refer to washer system (Round Motor) Section.

WIPER ADJUSTMENTS

ARMATURE END PLAY

1. Loosen adjusting screw locknut (Fig. 12B-48) and tighten or loosen the adjusting screw as required until end of screw barely touches end of armature.
2. Back off adjusting screw 1/4 turn and tighten locknut.

GEAR ASSEMBLY END PLAY

1. Add or remove end play washers as required to obtain .006" minimum end play.

WASHER SYSTEM
(Used on Rectangular Motor)

DESCRIPTION

The washer pump is a positive displacement type pump employing a small bellows, bellows spring and valve arrangement. The pump mechanism is actuated by a four lobe cam driven by the wiper.

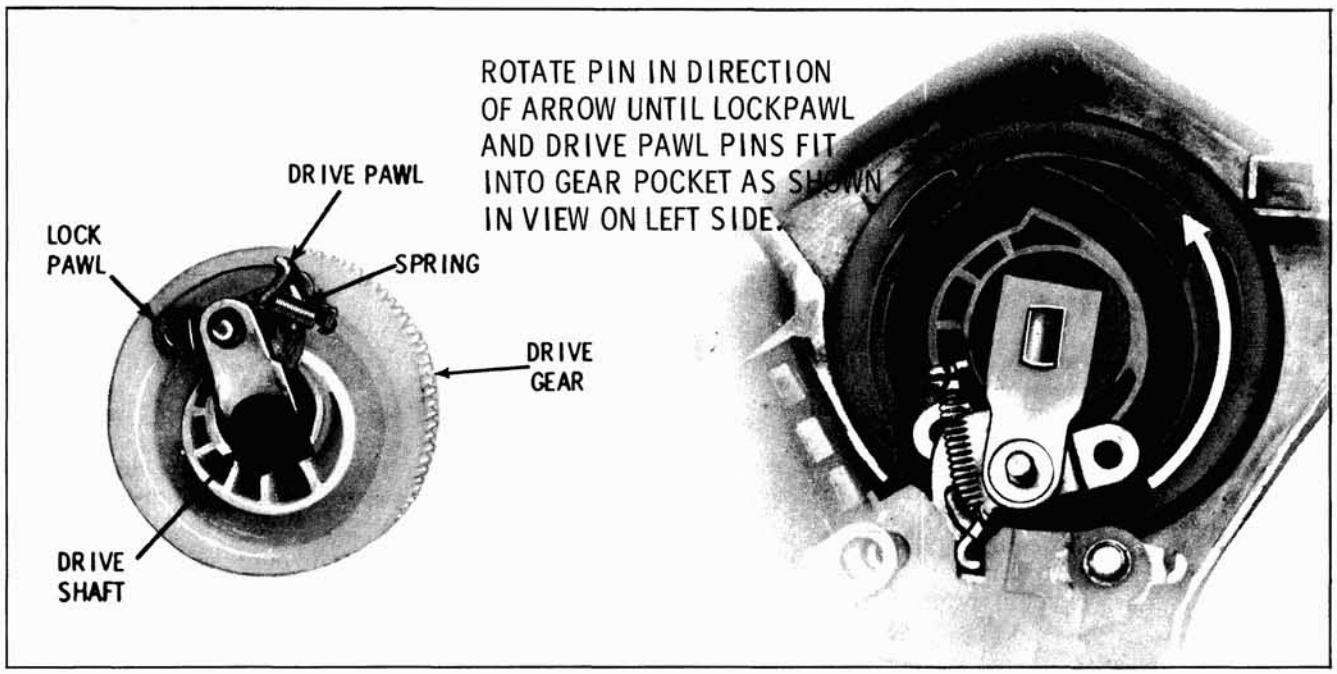


Fig. 12B-55—Lock Pawl and Drive Pin Positioning

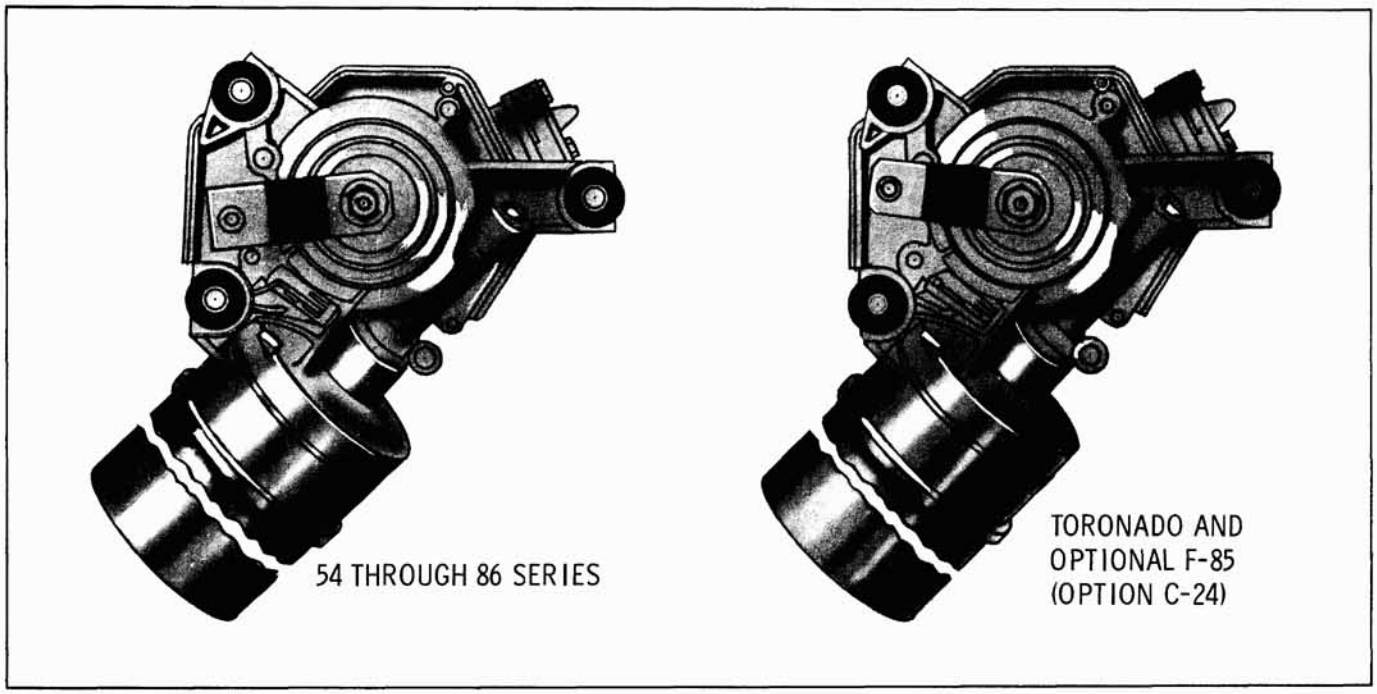


Fig. 12B-56—Wiper and Crankarm in Park Position

OPERATION

The starting and completion of a wash cycle is accomplished electrically and mechanically by a relay assembly and ratchet wheel arrangement. (Fig. 12B-57)

WIPER ON—WASHER OFF

With the washer pump mounted on the wiper, the four lobe cam actuates a spring-loaded plate and ratchet pawl assembly. (Fig. 12B-58) Thus, with the wiper running, the four lobe cam rotates continuously actuating the plate and ratchet pawl assembly back and forth in a horizontal plane. A pin, attached to the plate and ratchet pawl assembly, extends through a slot in the bellows plunger arm. This pin moves freely back and forth in the slot while the pumping mechanism is in the "locked out" position and no pump action develops.

The pump is in the "lockout" position when the relay holding contacts are open and a tang on the plunger arm rests against the widest part of an eccentric ramp on the bottom of the ratchet wheel. The tang holds the bellows plunger arm in

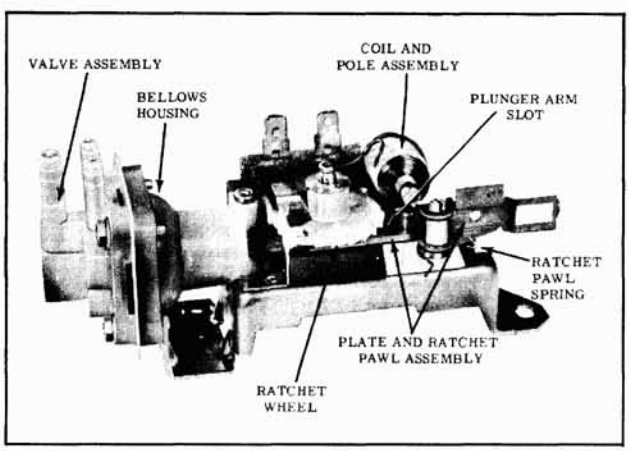


Fig. 12B-57—Pump Assembly

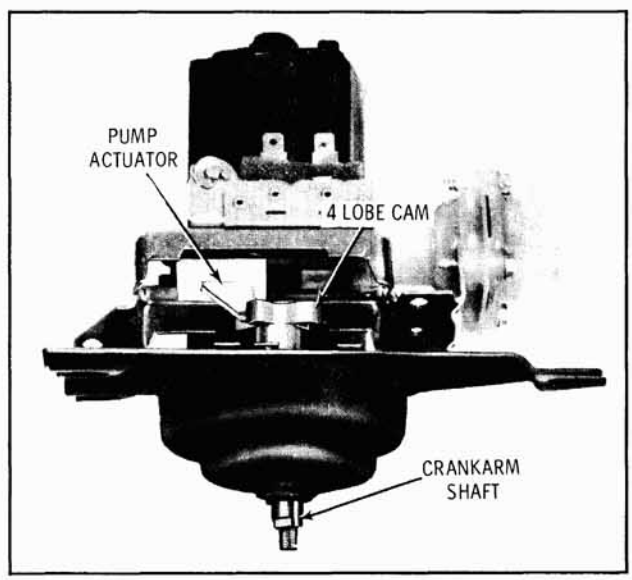


Fig. 12B-58—Pump Actuator

a retracted position (bellows spring compressed) allowing the plunger arm pin to move back and forth in the plunger arm slot preventing pumping action. (Fig. 12B-59)

The ratchet pawl is spring-loaded to keep it from engaging the ratchet wheel until the pump relay is energized by the wiper switch washer button.

WASHER ON

Depressing the washer button, closes the washer pump relay circuit to ground (if the wiper was off, the wiper switch is mechanically turned on by the washer button). (Fig. 12B-60)

With the washer coil energized, the pawl, normally held away from the ratchet by spring force, is pulled towards the coil pole and engages the ratchet wheel. The ratchet pawl and plate assembly, which moves back and forth any time the

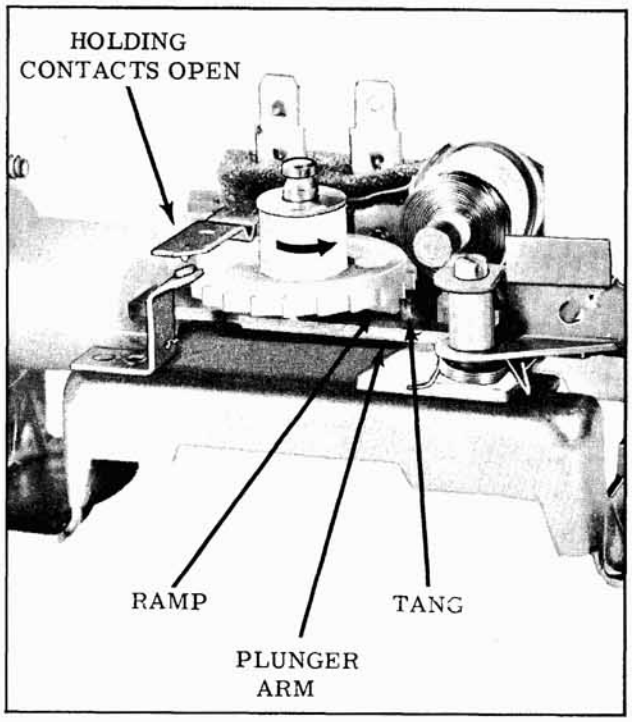


Fig. 12B-59—Pump Lockout Position (Pump Parts Idling)

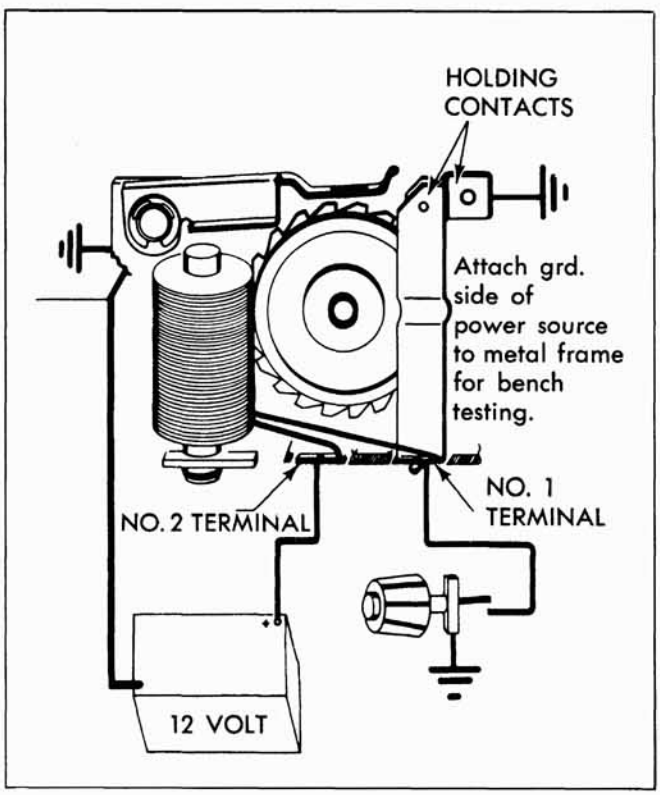


Fig. 12B-60—Pump Wiring Circuit

wiper is on, now starts to rotate the ratchet wheel. (Fig. 12B-61)

When the ratchet wheel has been rotated one tooth, two functions occur:

1. The eccentric ramp on the ratchet wheel is moved away from the plunger arm tang releasing the pump mechanism from its locked-out position. (Fig. 12B-59)

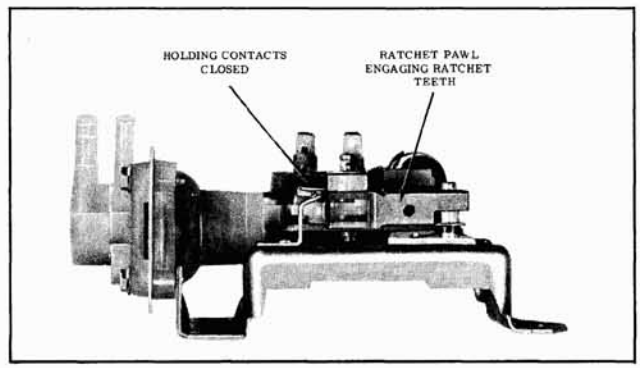


Fig. 12B-61—Relay Coil Energized

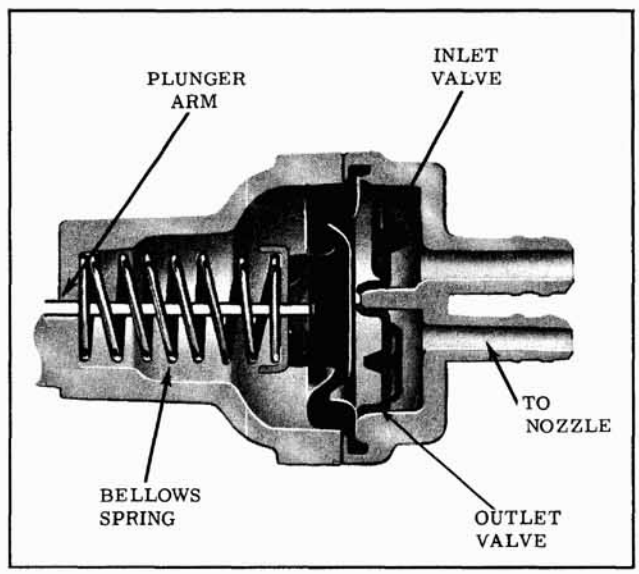


Fig. 12B-62—Exhaust Half of Pump Stroke

2. A set of holding contacts close (Fig. 12B-61) maintaining the coil circuit to ground. The contacts remain closed until the ratchet wheel is turned through 360°, at which time the ratchet wheel again opens the contacts.

PUMPING CYCLE

Exhaust Half of Pump Stroke

With the pumping mechanism released from the "lockout" position, the bellows spring expands collapsing the bellows forcing the fluid out through two outlet valves. (Fig. 12B-62) The plunger arm, attached to the bellows, is pulled forward with the bellows and the back edge of the plunger arm slot moves up tight against the plunger arm actuator pin. The actuator pin, which was previously moving back and forth freely in the plunger arm slot, pulls the plunger arm back and compresses the bellows spring each time a lobe of the cam actuates the plate and ratchet assembly.

Intake Half of Pump Stroke

Pulling the plunger arm back compresses the bellows spring and fluid is drawn into the bellows through the intake valve. (Fig. 12B-63) During the intake of fluid, the exhaust or outlet valves are drawn tight against their seats. During each intake stroke of the pumping mechanism, the ratchet wheel is rotated one tooth.

The wash cycle is completed when the electrical circuit to the relay coil is opened and the pumping mechanism reaches its "lockout" position. This is accomplished as follows:

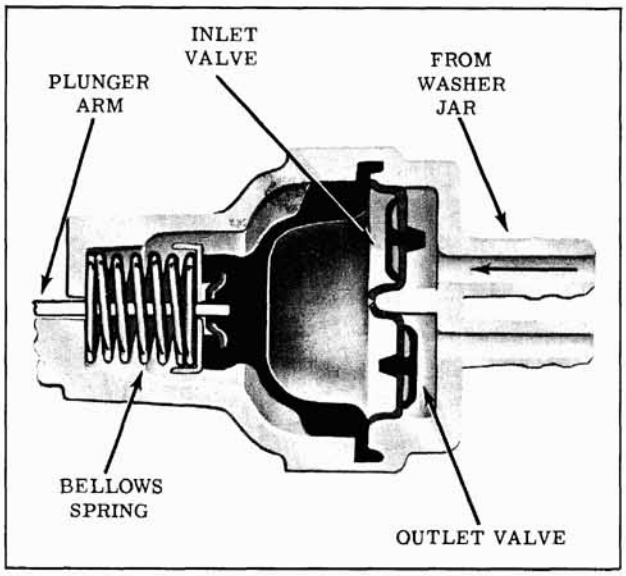


Fig. 12B-63—Intake Half of Pump Stroke

When the ratchet wheel has been rotated through 360° or 21 teeth, the relay coil holding contacts are pushed open by a "hump" on the ratchet wheel. This opens the coil circuit and the spring loaded ratchet pawl moves away from the ratchet wheel preventing further rotation of the ratchet wheel.

As the ratchet wheel rotates, the tang on the bellows plunger arm starts to ride up the eccentric ramp on the lower surface of the ratchet wheel. The full "lockout" position of the pumping mechanism is reached when the tang is up on the widest part of the ramp. (Fig. 12B-59) The tang reaches the "lockout" position at the same time the relay coil holding contacts open.

DIAGNOSIS (ON CAR)

Washer Inoperative

1. Check the following items:
   a. Jar had adequate quantity of washer solution.
   b. Hoses are not damaged and hose connections are tight.
   c. Screen at end of jar cover hose is not plugged.
   d. Electrical connections to washer pump and wiper switch.
   e. Nozzles are not plugged.
2. If all items in Step 1 check out, start wiper motor only, then push washer button and listen for "click" as washer relay pulls in. If no "click" is heard, check for 12 volts at terminal No. 2 (Fig. 12B-60) No voltage indicates defective wiring. If "click" is heard, proceed to Step 4.
3. If correct voltage was found in Step No. 2, connect a jumper wire from terminal No. 1 to ground (Fig. 12B-60) and operate wiper. If washer relay "click" is heard and pump functions correctly, a defective wiper switch or an open circuit between washer pump and wiper switch is indicated - "No Click" indicates an open relay coil.
4. If relay "click" is heard in Step 2, listen for the soft clicking as the pump ratchet wheel is rotated. If "soft clicking" is

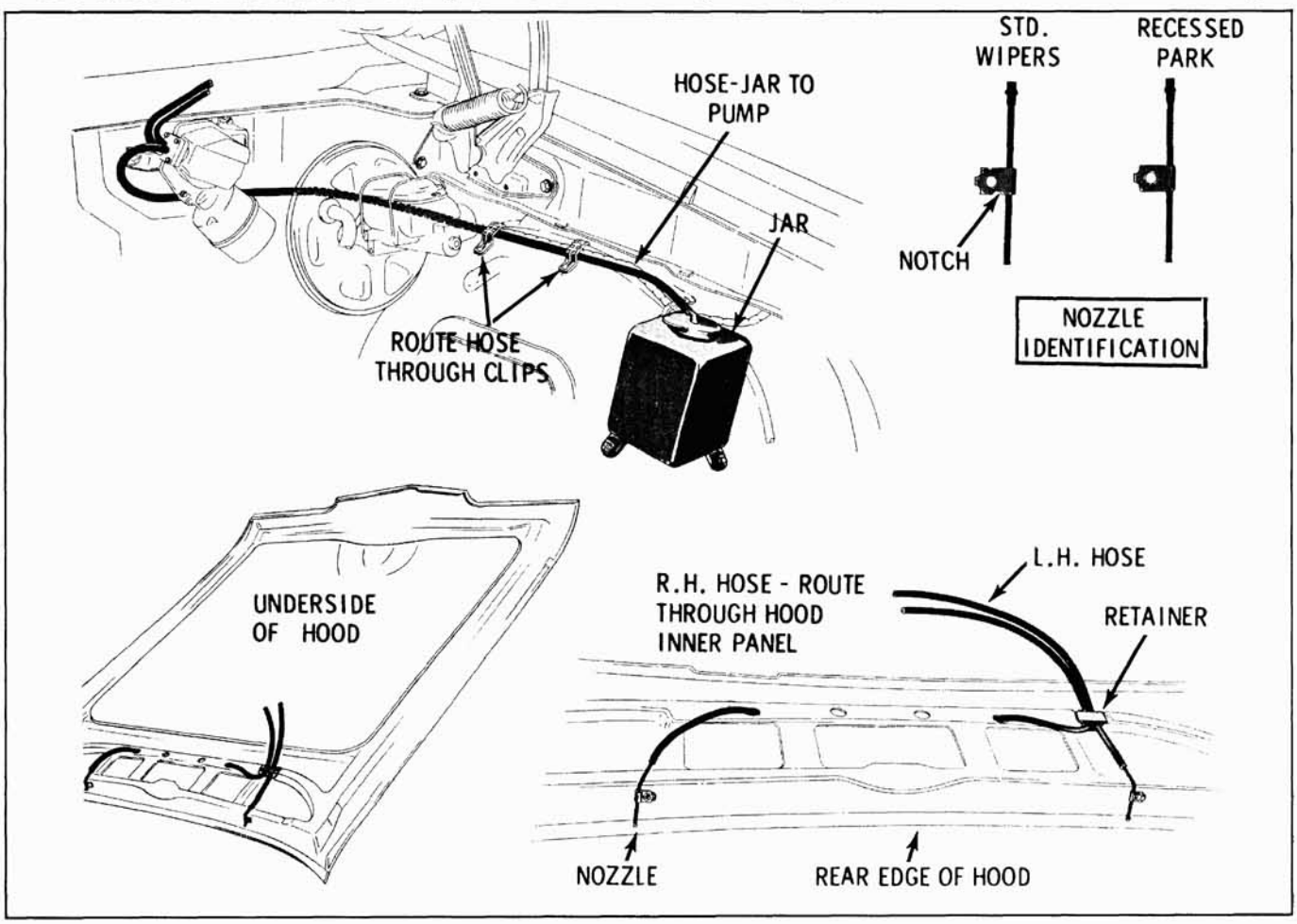


Fig. 12B-64—Washer Hose Routing-31 through 48 Series

not heard, the pump mechanism is faulty and should be removed from the wiper motor and checked. If "soft clicking" is heard but no pumping action occurs, replace the valve assembly and recheck pump.

DIAGNOSIS (OFF CAR)

1. Remove washer pump cover and connect 12-volt power supply to washer pump as shown in Fig. 12B-60. Connect jumper wire from terminal No. 1 to ground. Turn ratchet pawl to position shown in Fig. 12B-60.

Ratchet pawl should be pulled toward relay pole and engage ratchet teeth. Failure to do as described indicates an open relay coil.

2. If relay and ratchet pawl perform correctly in Step 1, manually actuate the washer pump to rotate the ratchet wheel one tooth. Observe if relay holding contacts close and the pump plunger arm is released from its "lockout" position. Figure 12B-59 shows plunger in "lockout" position.

3. Disconnect jumper wire from terminal Number 1. Relay coil should remain energized and hold ratchet pawl against ratchet wheel. Failure to do so indicates open or dirty holding contacts.

4. If pump performs correctly in Step 3, continue to manually actuate the slide and ratchet pawl assembly until the ratchet wheel has been turned through 360° or 21 teeth. After the ratchet wheel has been rotated 21 teeth, the holding contacts should be opened by a "hump" on the wheel and the pump plunger arm should be in the "lockout" position. (Fig. 12B-59)

Check Valve Assembly as Follows:

1. Attach a hose to the large or intake pipe. You should be able to blow through it but not draw through it.

2. Attach a hose individually to each of the small or exhaust pipes. You should be able to draw through them but not blow through them.

If any of the three valves allow air to pass in both directions, the valve assembly is defective.

PUMP DISASSEMBLY—Refer to Fig. 12B-57

Relay

1. Remove washer pump cover.
2. Unsolder coil leads from terminals. (Note: No coil polarity is necessary when resoldering coil leads.)
3. Remove coil retainer clip and slip coil assembly out of mounting bracket.

Ratchet Pawl

1. Remove washer pump cover.
2. Disengage spring from ratchet pawl.

Be sure spring is properly assembled before replacing washer pump cover.

3. Slide ratchet pawl off plastic shaft by squeezing together the slotted post.

Valve Assembly

Remove the four screws that secure the valve assembly to the bellows housing.

It is sometimes necessary to carefully pry the bellows lip out of the valve body groove.

Bellows

1. Remove valve body.
2. Manually operate pump to release pump from "lockout" position (See "Checking Washer Pump Detached").
3. Hold bellows plunger arm from moving, then push in against bottom of bellows with thumb and twist bellows 90°. This should release bellows and bellows spring.

ASSEMBLY

To assemble the relay, ratchet pawl, valve assembly or bellows, reverse the disassembly procedure. For washer hose routing and jar installation on 31 through 48 series, see Fig. 12B-64.

SPECIFICATIONS

Number of "squirts" at full Pressure	12
Pressure (PSI)	11-15
Coil Resistance (ohms)	20

WASHER SYSTEM (Used With Round Motor)

The washer pump closely resembles past models in physical appearance. However some internal changes have been made to improve pumping action and provide a faster response when the switch is actuated.

The major changes are: a redesigned four lobe cam, a 12 tooth ratchet wheel instead of the past model 21 tooth, a piston type pump, and a modified ratchet pawl and relay armature.

For washer hose routing and jar installation on 54 through 86 Series, see Fig. 12B-65 and 12B-65A.

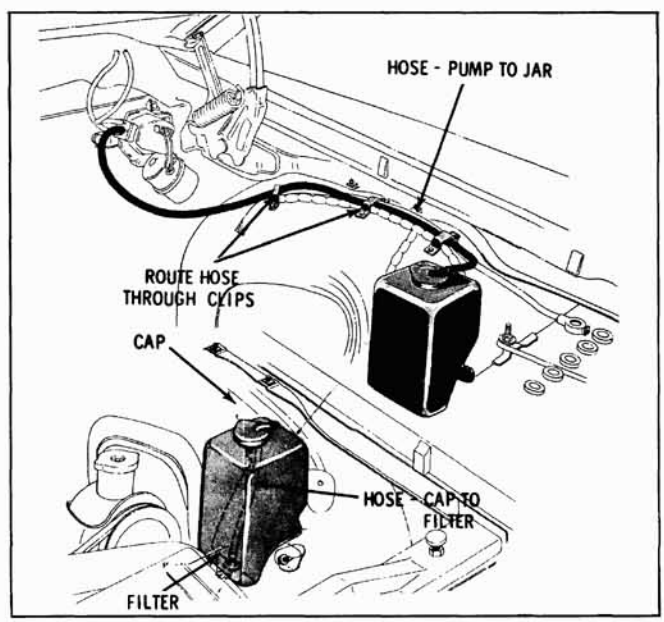


Fig. 12B-65—Washer Hose Routing-54 through 86 Series

OPERATION

The explanation of operation is divided into three general areas (1) Assembly of Washer Pump to Wiper Motor, (2) Pumping Action and (3) Programming (starting and stopping the pump action).

1. Assembly of Washer Pump to Wiper Motor

Wiper Motor Gear must be in PARK position (Fig. 12B-66) to assemble pump to wiper motor.

a. Remove pump cover retaining ring and cover.

b. Rotate the 4-lobe cam until index hole (.125" dia.) in the cam is aligned with the hole in the pump mounting plate. Insert a pin through both holes to maintain cam in position. (Fig. 12B-67)

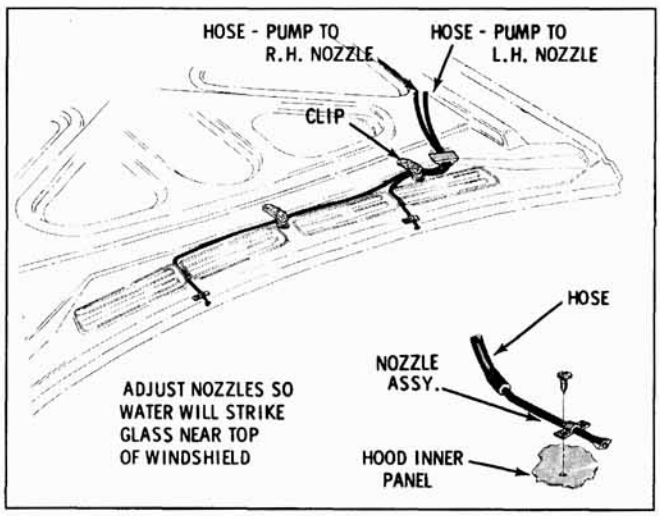


Fig. 12B-65A—Washer Hose Routing-54 through 86 Series

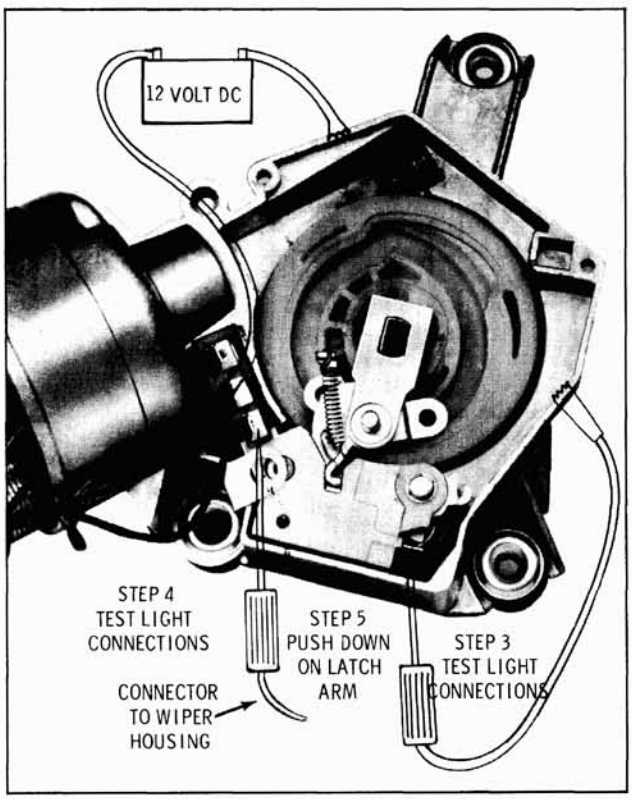


Fig. 12B-66—Wiper Gear in Park Position

To relieve the pump spring tension, while installing the aligning pin, position the tang on the piston actuator against the ratchet wheel ramp. Then move the ratchet pawl and relay armature leg away from the ratchet wheel.

c. Position pump on wiper so that slot in 4-lobe cam fits over the gear drive pin. (Fig. 12B-68) Secure pump to gear housing and remove locator pin.

d. Turn on wiper and washer pump to check pump operation.

A loud knocking noise would indicate that the pump cam has not engaged the drive pin properly. Install pump cover.

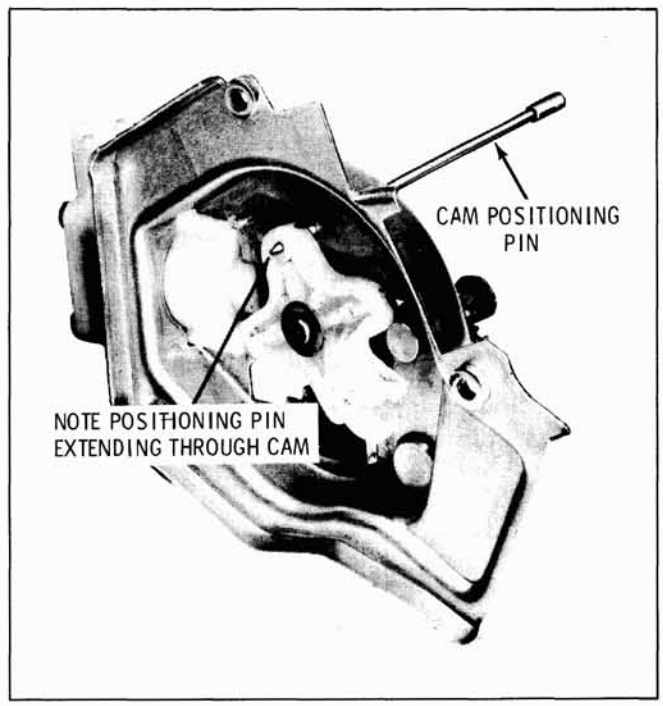


Fig. 12B-67—Cam Alignment Pin Installation

2. Basic Pump Action:

This explanation covers only that part of the washer assembly that actually does the pumping.

The basic pumping mechanism consists of a spring-loaded piston assembly enclosed in a plastic cylinder. Attached to the piston and extending out of the cylinder housing is an

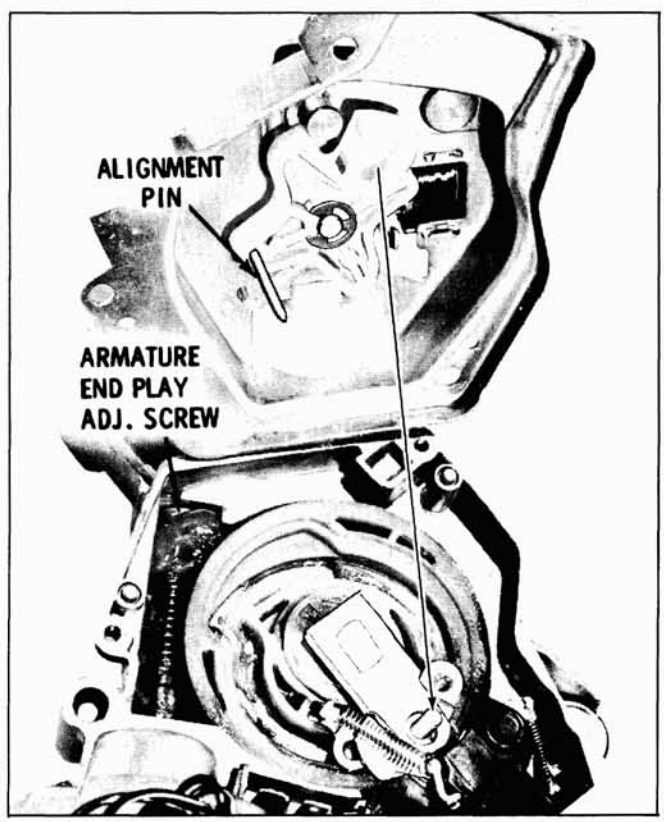


Fig. 12B-68—Installing Washer to Pump

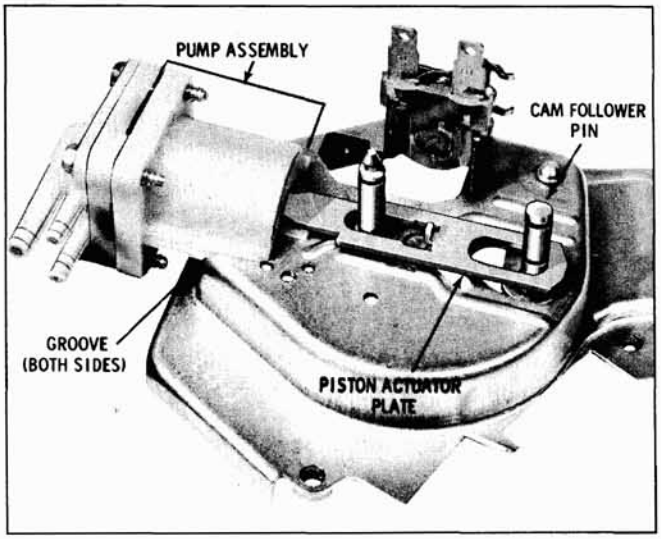


Fig. 12B-69—Pump Intake Stroke

actuator plate. A valve assembly consisting of two exhaust valves and one intake valve is attached to the opposite end of the cylinder housing and controls the flow of washer solution.

Referring to Fig. 12B-69, note that the elongated slot of the piston actuating plate fits over a pin. This pin is a part of a cam-follower assembly which is actuated by the 4-lobe cam located on the underside of the pump mounting plate. When the wiper is running, the drive gear rotates the 4-lobe cam which in turn causes the cam-follower to move back and forth.

Intake Stroke:

When the cam-follower moves in the direction indicated by the arrow in Fig. 12B-69, the cam-follower pin, which extends thru the piston actuating plate, pulls the actuator plate away from the valve assembly compressing the piston spring. As the piston moves away from the valve assembly, a vacuum is created in the cylinder which opens the intake valve, drawing washer solution into the cylinder. (Fig. 12B-70)

Exhaust Stroke:

As the 4-lobe cam continues to rotate, the cam-follower moves in the opposite direction described in the Intake Stroke. This permits the piston spring to expand which in turn pushes the piston toward the valve assembly creating pressure between the piston and valve assembly. This pressure "build-up" forces the two exhaust valves open compelling the washer solution to flow to the nozzles. See Fig. 12B-71.

For purposes of explanation, only one exhaust valve opening is shown in Fig. 12B-71).

The intake and exhaust stroke cycle will occur four times

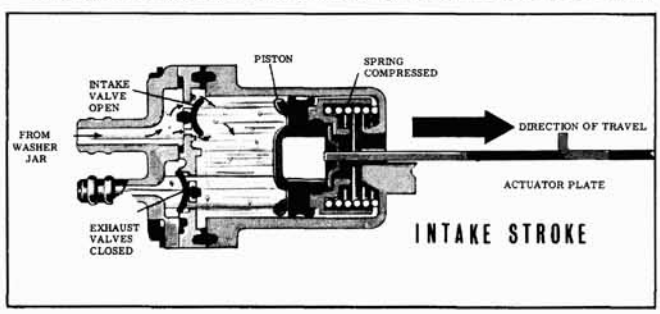


Fig. 12B-70—Pump Intake Stroke

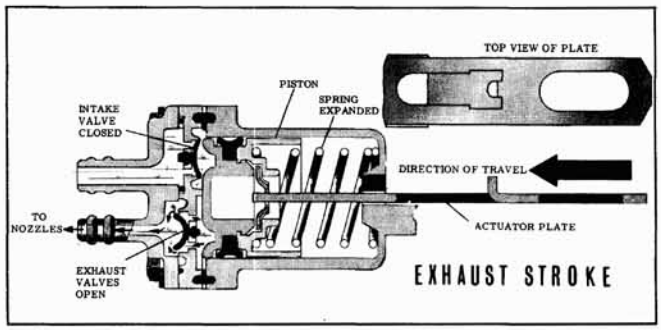


Fig. 12B-71—Pump Exhaust Stroke

for each revolution of the wiper drive gear while the washer pump is operating.

3. Programming (Starting and Stopping of Pumping Action):

The programming section of the pump mechanism consists of a relay; ratchet pawl; ratchet wheel, and ratchet wheel dog (Fig. 12B-72)

Pump Idling. (No Pumping Action)

Refer to Fig. 12B-72 and note that a tang on the piston actuator plate is resting against a ramp on the lower surface of the ratchet wheel. This, in effect, holds the piston actuator plate in a lock-out position. With actuator plate in this position and the wiper running, the cam-follower merely moves back and forth in the elongated slot of the piston actuator plate and no pumping action can occur.

The ratchet wheel, which, if rotated, would move the ramp away from the tang of the actuator plate releasing the pump action, is prevented from rotating as follows: The relay assembly, consisting of a coil and armature, is constructed in such a way that the ratchet wheel pawl extends through an opening in the relay armature, (Fig. 12B-72) preventing it from engaging the ratchet wheel teeth.

Starting the Pump:

Actuating the washer button to obtain windshield washer pump operation starts the wiper motor and energizes the relay. When relay is energized, the relay armature is pulled suddenly toward the coil, allowing the ratchet wheel pawl to drop out of the relay armature opening and engage the teeth of the ratchet wheel.

The ratchet wheel pawl, which is actuated by the same

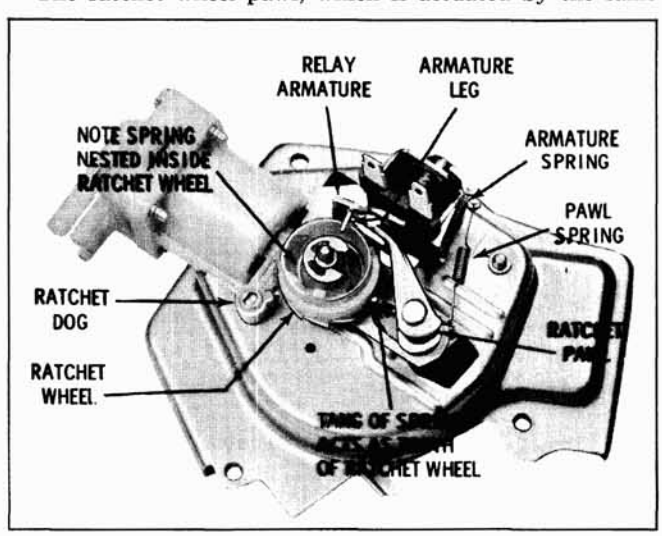


Fig. 12B-72—Pump Mechanism

cam-follower pin that moves the piston actuating plate, begins to rotate the ratchet wheel. Rotating the ratchet wheel one tooth moves the ratchet wheel ramp away from the tang of the piston actuating plate (Fig. 12B-73), permitting the piston spring to expand which in turn forces the piston toward the valve assembly resulting in the first exhaust stroke. This sequence then repeats through the remaining cycles.

Stopping the Pump (Completion of the Wash Cycle):

The pumping operation is terminated automatically when the ratchet wheel has rotated a full 360° and the 12th cycle is completed. This is accomplished as follows.

As the ratchet wheel approaches the completion of its 360° travel, two functions occur simultaneously:

1. A leg on the relay armature rides up a ramp located on the outer surface of the ratchet wheel. When the leg reaches the top of the ramp, it moves over the top edge of the ratchet wheel. This action allows the ratchet wheel pawl to re-enter the armature opening preventing further rotation of the ratchet wheel until the next time the relay coil is energized from the washer button. (Refer to Fig. 12B-72 for position of armature leg while pump is idling.)
2. The tang on the piston actuating plate is resting once more against the ramp on the lower side of the ratchet wheel. (Fig. 12B-73)

CHECKING PROCEDURES:

Checking the Washer Pump on The Car

Washer Pump Inoperative

1. Check the following items:
   a. Jar has adequate quantity of washer solution.
   b. Hoses are not damaged and hose connections are tight.

   If a valve has been previously replaced and the hose connections have been disturbed, it may be necessary to cut a short length off the end of each hose to insure an air tight connection.

   c. Screen at end of jar cover hose is not plugged.
   d. Electrical connections to washer pump and wiper switch.
   e. Nozzles are not plugged.
2. If items in step 1 check out, start wiper motor first, then push washer button and listen for "click" as washer relay pulls in. If no "click" is heard, check power supply (12 volt) at washer pump wiring connector. No voltage indicates shorted or inoperative car wiring.
3. If correct voltage reading was obtained in step 2, start wiper first, then connect 12 volt supply to one wiper terminal and ground other. If washer relay "click" is heard, an inoperative wiper switch is indicated.
4. If washer relay "click" is not heard in step 3, a faulty washer pump relay coil is indicated.
5. If relay "click" is heard in step 2, 3 or 4 listen for the "soft clicking" as the pump ratchet wheel is rotated. If "soft clicking" is not heard, the pump mechanism is faulty and should be removed from the wiper motor and checked.

If "soft clicking" is heard but no pumping action occurs, replace the valve assembly and recheck pump.

Washer Pumps Continuously When Wiper is On

1. Disconnect wiring from washer pump. If pump shuts off, trouble is in wiring or switch.
2. If pump fails to shut off in step 1, remove pump assembly from car for further checking.

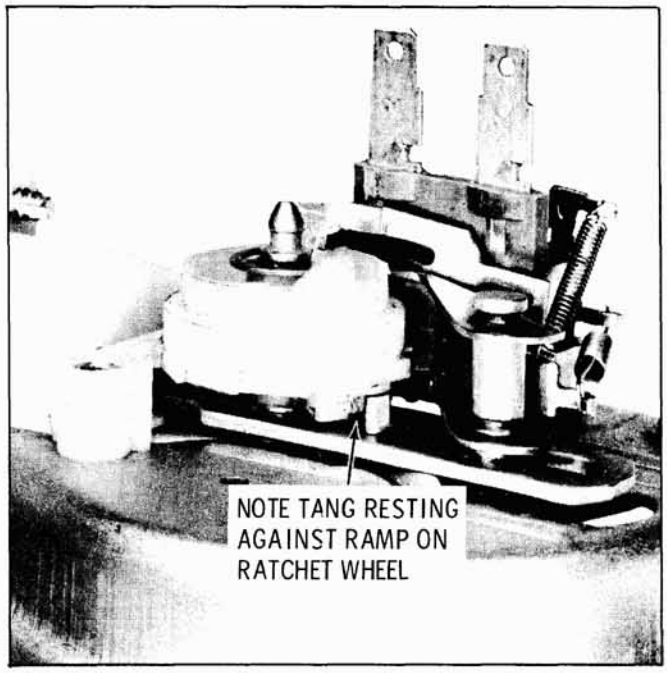


Fig. 12B-73—Ratchet Wheel-Ramp

Washer Pump Detached

1. Connect 12 volt supply to one washer terminal and ground other. Manually rotate rotor cam and observe if relay armature pulls in. Failure of relay to pull in indicates an open relay coil or poor solder connections.
2. If relay pulled in, in step 1, manually rotate rotor cam (counterclockwise looking at rotor) through complete cycle (ratchet wheel rotated through 360° or 12 teeth), carefully observing if performance matches that as explained under washer operation. Binds or any other type of malfunction can usually be located in this manner.

WASHER PUMP DISASSEMBLY PROCEDURES: (Fig. 12B-72)

Four-Lobe Cam:

1. Remove "E" retaining ring and slide cam off shaft. (Fig. 12B-74)

Ratchet Wheel:

1. Remove pump cover retaining ring and cover.
2. Remove "E" retaining ring, hold relay armature against relay coil and slide ratchet wheel off shaft.

When reassembling ratchet wheel be careful not to damage ratchet dog.

Ratchet Pawl and Pawl Spring:

1. Disengage pawl spring from pawl and slide pawl off cam-follower pin.

Ratchet Dog:

1. Remove attaching screw and lift ratchet dog off mounting plate.

Relay-Terminal Board Assembly:

1. Remove 4-lobe cam.
2. Remove ratchet pawl and pawl spring.
3. Remove relay armature and spring.
4. Chisel off the four bent-over tabs that secure the coil mounting bracket to the base Fig. 12B-74. Remove and dis-

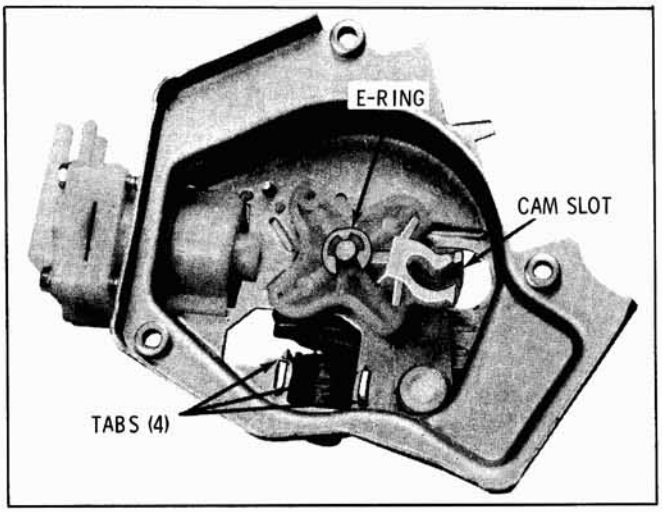


Fig. 12B-74—Removing Four Lobe Cam

card relay coil and terminal board assembly. To mount a replacement relay assembly, hold it securely against the base mounting surface and bend locking tabs over.

Be careful not to damage coil winding or terminals.

5. To check the pump programming mechanism, manually rotate the 4-lobe cam through complete 12-tooth cycle (360°) and observe if pump is operating as explained in the PRINCIPLE OF OPERATION section.

Valve Assembly:

1. Note position of valve assembly relative to the pump housing for reassembly then remove four screws that secure valve assembly to housing.
2. Remove housing-to-valve-body gasket and save for reassembly.

Pump Assembly:

1. Remove ratchet wheel, ratchet wheel dog, ratchet pawl and spring.
2. To release the plastic pump housing from the sheet-metal base, pull it in the direction toward the valve end. Next, detach the assembly from the cam-follower pin (Fig. 12B-69)

The pump and plastic housing is serviced as a complete assembly.

SPECIFICATIONS - RECTANGULAR MOTOR

Operating Voltage		12 Volts D.C.
Current Draw (Amps.)		
No Load ("LO" Speed)		3.6 Max.
Installed On Car (Dry Glass)		4.5 Max.
Stall		12 Max.
Gear Ratio		36:1
Gear Color		Green
Crankarm Speed (RPM's)		
"LO"	31 Min.	12V
"HI"	55 Min.	12V
Crankarm Letter (Stamped on Arm)		C

SPECIFICATIONS - ROUND MOTOR

OPERATING VOLTAGE		12-14 Volts D.C.
Crankarm Speed Current Draw (Amps.)		(R.P.M.'s)
BENCH CHECK (NO LOAD)		
"Lo" Speed		5.0 Max. 35 - 50
"Hi" Speed		4.0 Max. 70 - 85
WIPER INSTALLED - OPERATING		5.5 Max. 30 - 44
COMPLETE SYSTEM (WET WINDSHIELD)		4.5 Max. 60 - 75
Gear Ratio	54 through 86 Series	51:1
	31 through 48 Series	45:1
Gear Color	54 through 86 Series	Grey
	31 through 48 Series	Blue
Crankarm Letter (Stamped on Crankarm)	54 through 86 Series	D
	31 through 48 Series	A
LUBRICATION		
Gear Teeth and Gear Clutch Mechanism Gearshift Seal Cap (inside) Armature Worm		Cam and Ball Bearing Lubricant

RADIATOR AND GRILLE

31 THROUGH 86 SERIES

CONTENTS OF SECTION 13

Subject	Page	Subject	Page
RADIATOR	13-1	GRILLE ASSEMBLY	13-3

MAINTENANCE RECOMMENDATIONS

For maintenance recommendations, refer to Section 6K, ENGINE COOLING SYSTEM. For cooling system capacities, refer to Section 0, GENERAL INFORMATION AND PERIODIC MAINTENANCE.

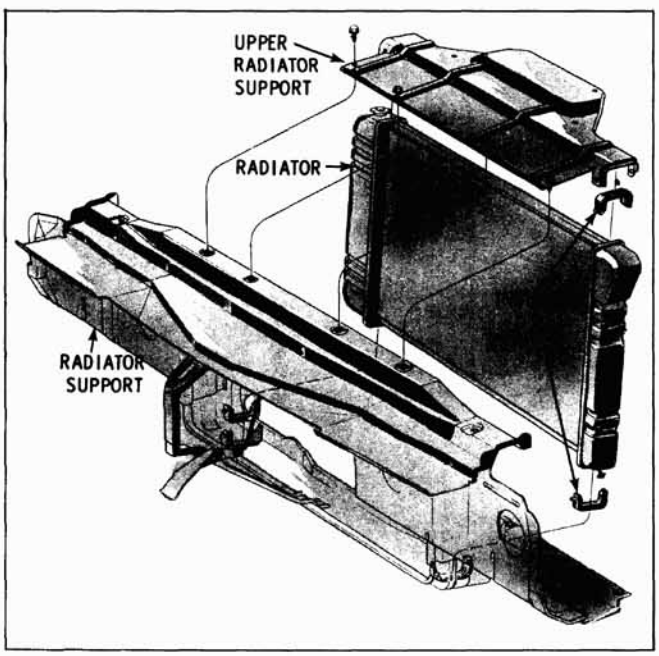


Fig. 13-1—Radiator and Upper Support Installation 31-48 Series

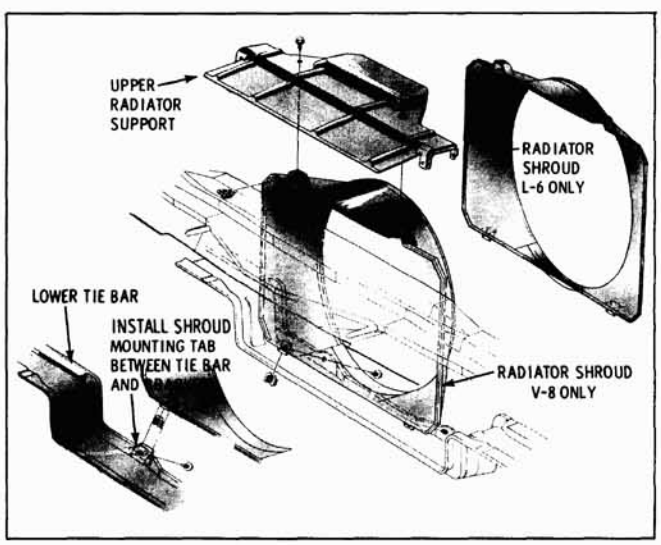


Fig. 13-2—Fan Shroud Installation 31-48 Series

RADIATOR

31 thru 48 Series. Figs. 13-1 through 13-3
54 thru 86 Series. Figs. 13-4 and 13-5

Removal

1. Drain cooling system.

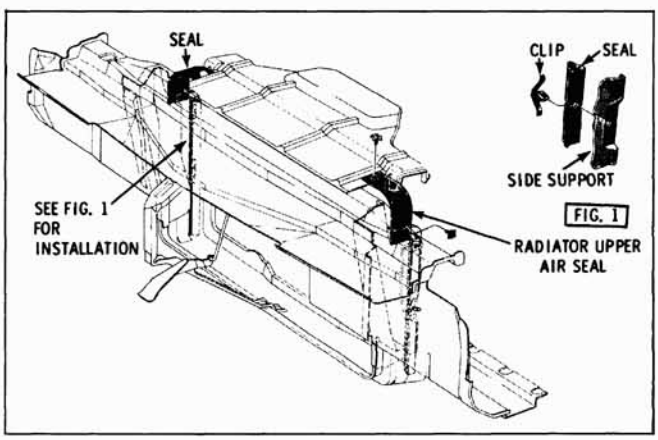


Fig. 13-3—Radiator Support Seals 31-48 Series

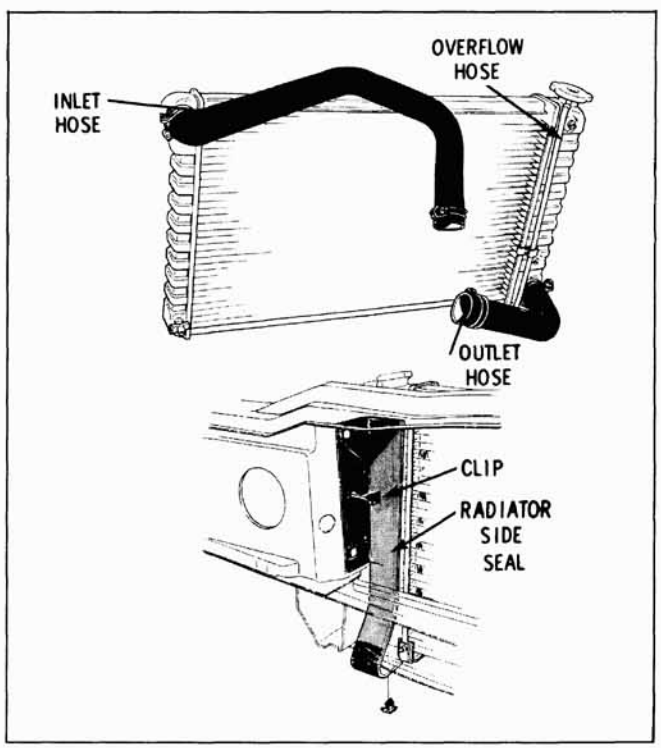


Fig. 13-4—Radiator, Hoses and Seals 54-86 Series

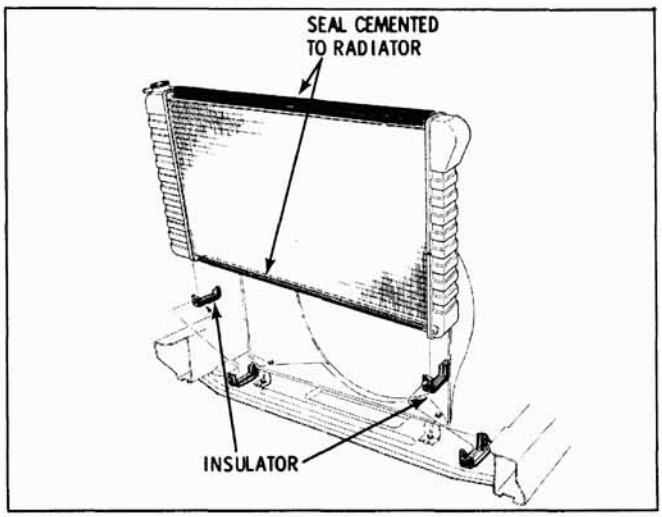


Fig. 13-4A—Radiator Installation 54-86 Series

2. Remove upper radiator baffle. Detach the fan shroud and slide back over fan.
3. Remove upper and lower radiator hose and overflow hose.
4. If car is equipped with an automatic transmission, disconnect and cap cooler lines.
5. Lift radiator upward to disengage from lower supports and remove from car.

Installation

1. Install radiator in lower support being sure seals are correctly positioned.
2. Connect automatic transmission cooler lines, upper and lower radiator hoses and overflow hose.
3. Install fan shroud and upper radiator baffle.
4. Fill radiator using existing coolant or new coolant as recommended in GENERAL INFORMATION, Section 0.

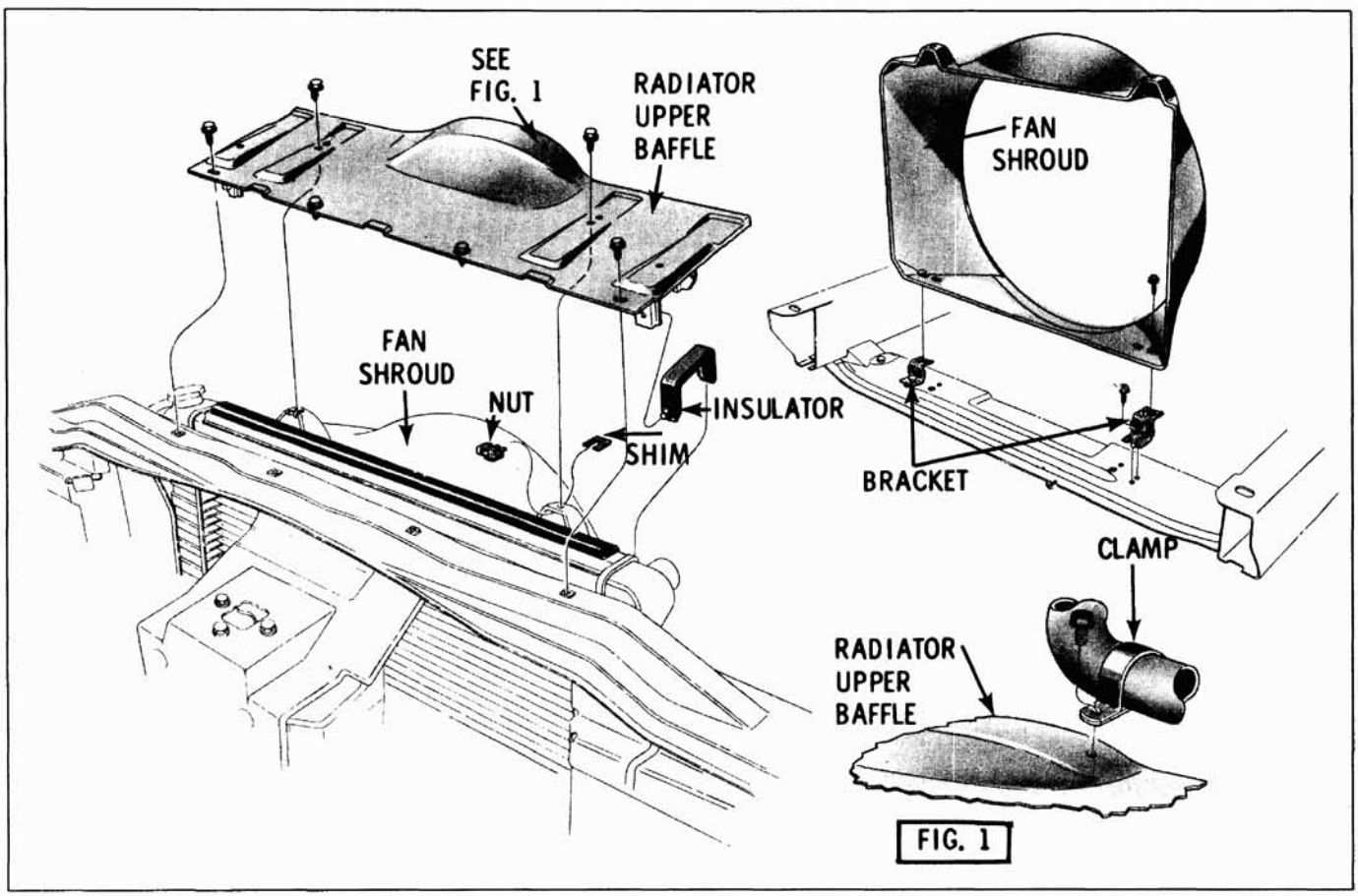


Fig. 13-5—Radiator Shroud and Baffle 54-86 Series

GRILLE ASSEMBLY (31-48 SERIES)

Removal

1. Remove attaching screws and remove grille. (Fig. 13-6)
2. Remove emblem.

Installation

1. Install emblem.
2. Install grille assembly.

GRILLE ASSEMBLY (54-86 SERIES)

Removal

1. Remove panel assembly. (Fig. 13-7)
2. Remove headlight door and support. (Fig. 13-8)
3. Remove grille and script.

Installation

1. Install script on grille.
2. Install grille on support.
3. Install headlamp support and door.
4. Install panel assembly.

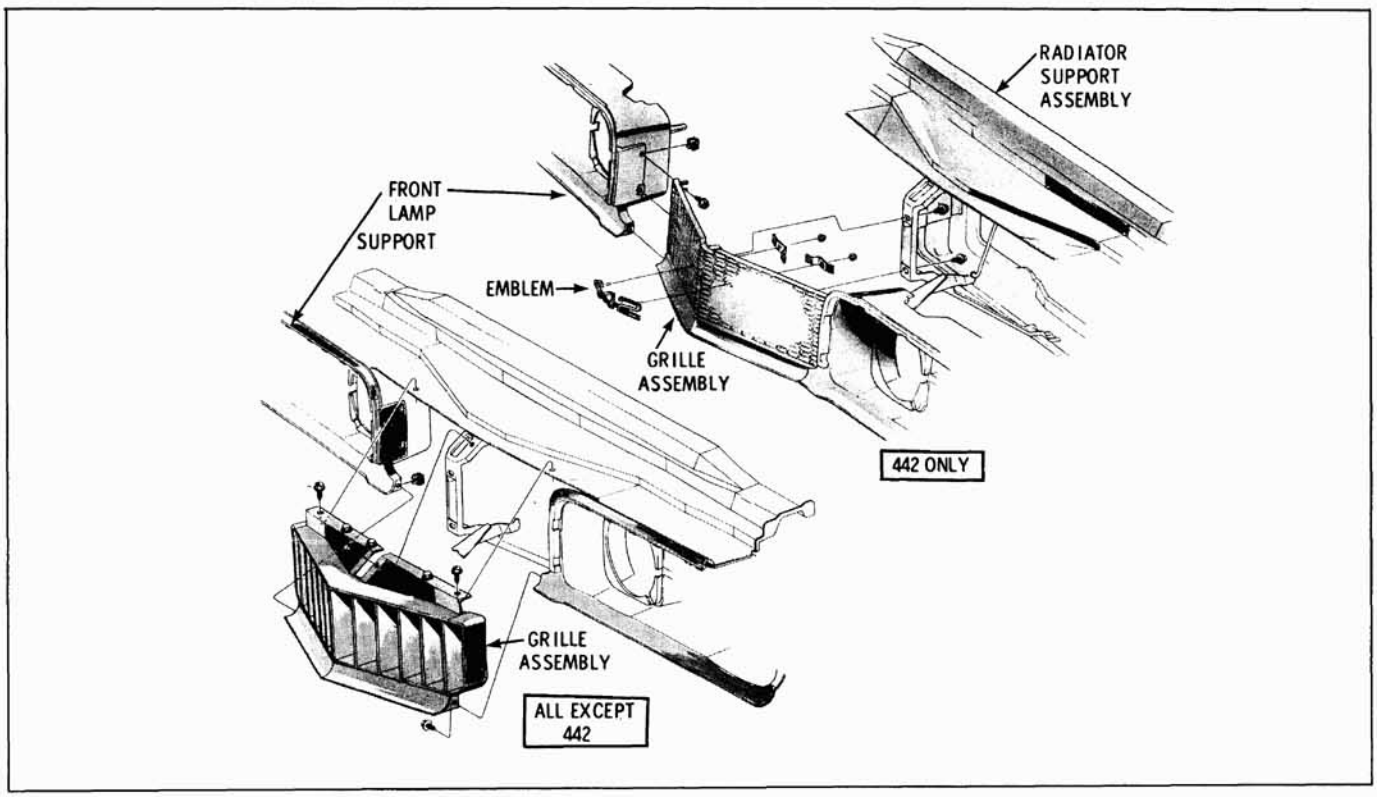


Fig. 13-6—Grille Assembly 31-48 Series

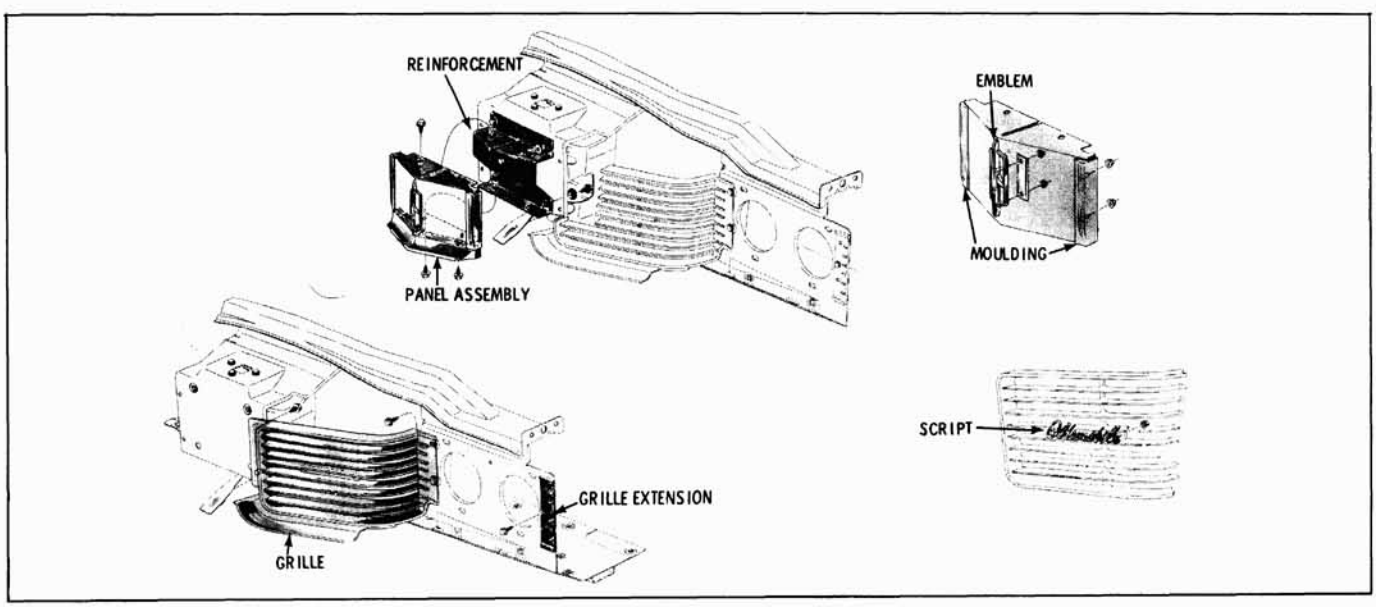


Fig. 13-7—Grille Assembly 54-86 Series

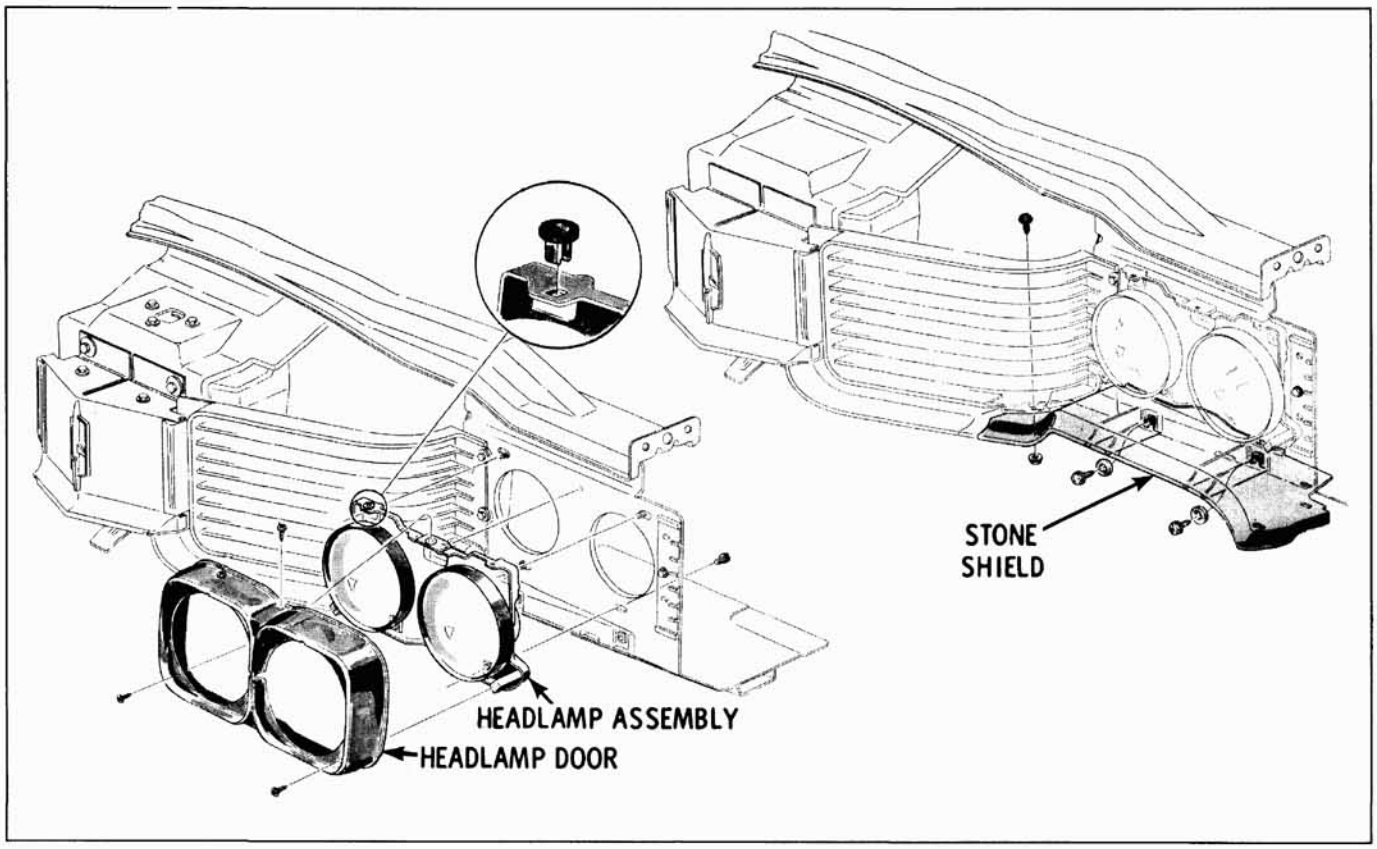


Fig. 13-8—Headlamp Door and Stone Shield 54-86 Series

TORQUE SPECIFICATIONS

Application	Torque
Radiator Support to Upper Tie Bar	18 Ft. Lbs.
Radiator Support to Fan Shroud	18 Ft. Lbs.
Radiator Support to Headlamp Assembly	18 Ft. Lbs.
Radiator Grille to Lamp Support Assembly	18 Ft. Lbs.
Grille to Radiator Support Assembly	12 Ft. Lbs.
Grille to Hood Latch Support	12 Ft. Lbs.
Radiator Support Assembly to Frame	40 Ft. Lbs.
Radiator Shroud to Lower Tie Bar	18 Ft. Lbs.

BUMPERS

31 THROUGH 86 SERIES

CONTENTS OF SECTION 14

Subject	Page	Subject	Page
FRONT BUMPER	14-1	TAIL LAMP (31-44 SERIES EXC. WAGONS)	14-3
REAR BUMPER	14-3	TAIL LAMP (ALL WAGONS)	14-3
BUMPER MOLDING	14-3	TAIL LAMP (54-66 SERIES)	14-3
BACK-UP LAMPS (31-44 SERIES EXCEPT WAGONS)	14-3	FUEL FILLER DOOR	14-5
BACK-UP LAMPS (4800 AND WAGONS)	14-3	LICENSE LAMP	14-5
BACK-UP LAMPS (54-86 SERIES)	14-3	TORQUE SPECIFICATIONS	14-5

FRONT BUMPER (Figs. 14-1 and 14-2)

Removal

Remove bolts securing bumper braces to bumper. Then remove bolts securing bumper brackets to bumper. Remove bumper.

Installation

To install, reverse removal procedure. If necessary, align bumper horizontally and laterally so that bumper to body clearance is the same on both ends. The bumper brackets and frame bolt holes are elongated to provide a means of alignment. Torques are listed under TORQUE SPECIFICATIONS at the end of this section.

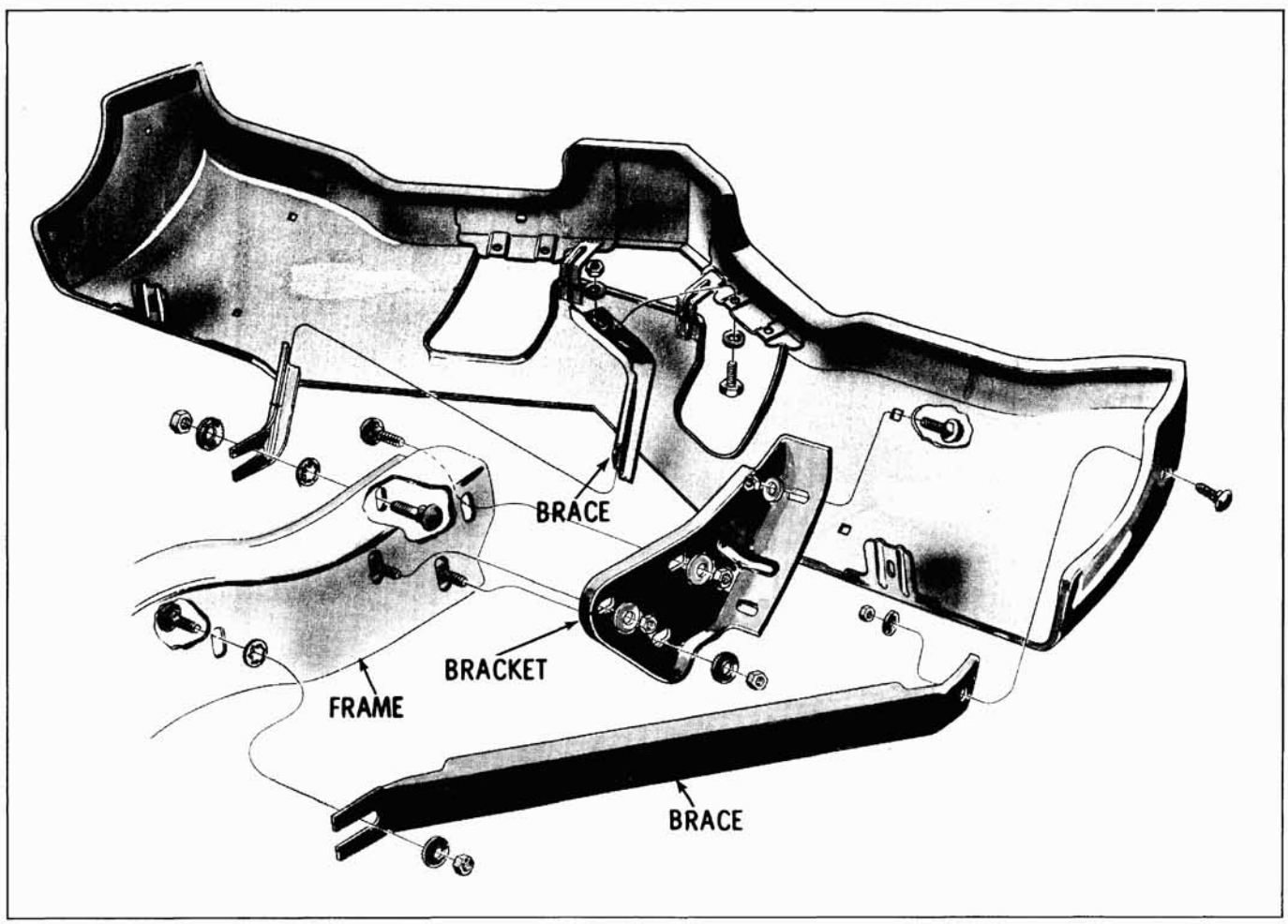


Fig. 14-1—Front Bumper 54-86 Series

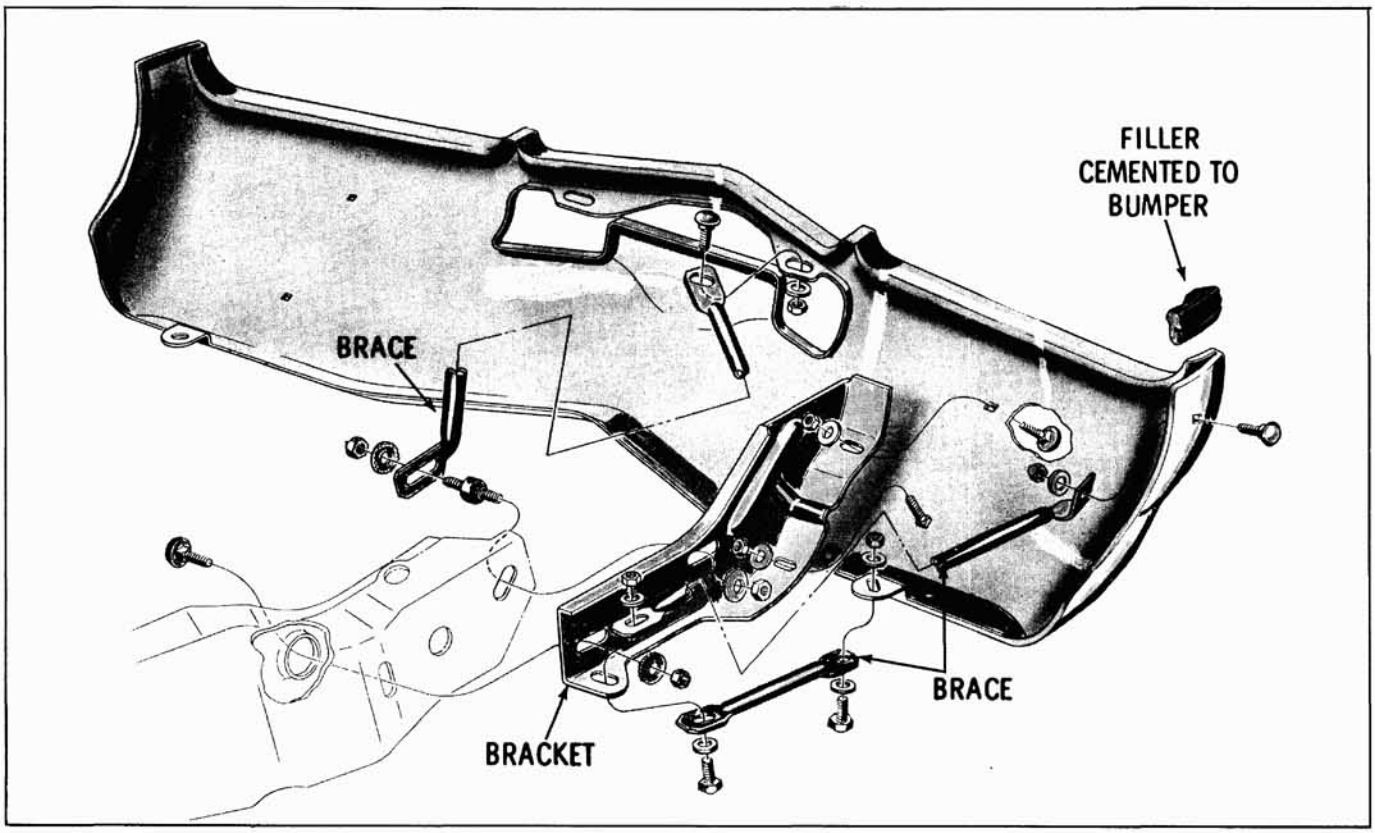


Fig. 14-2—Front Bumper 31-48 Series

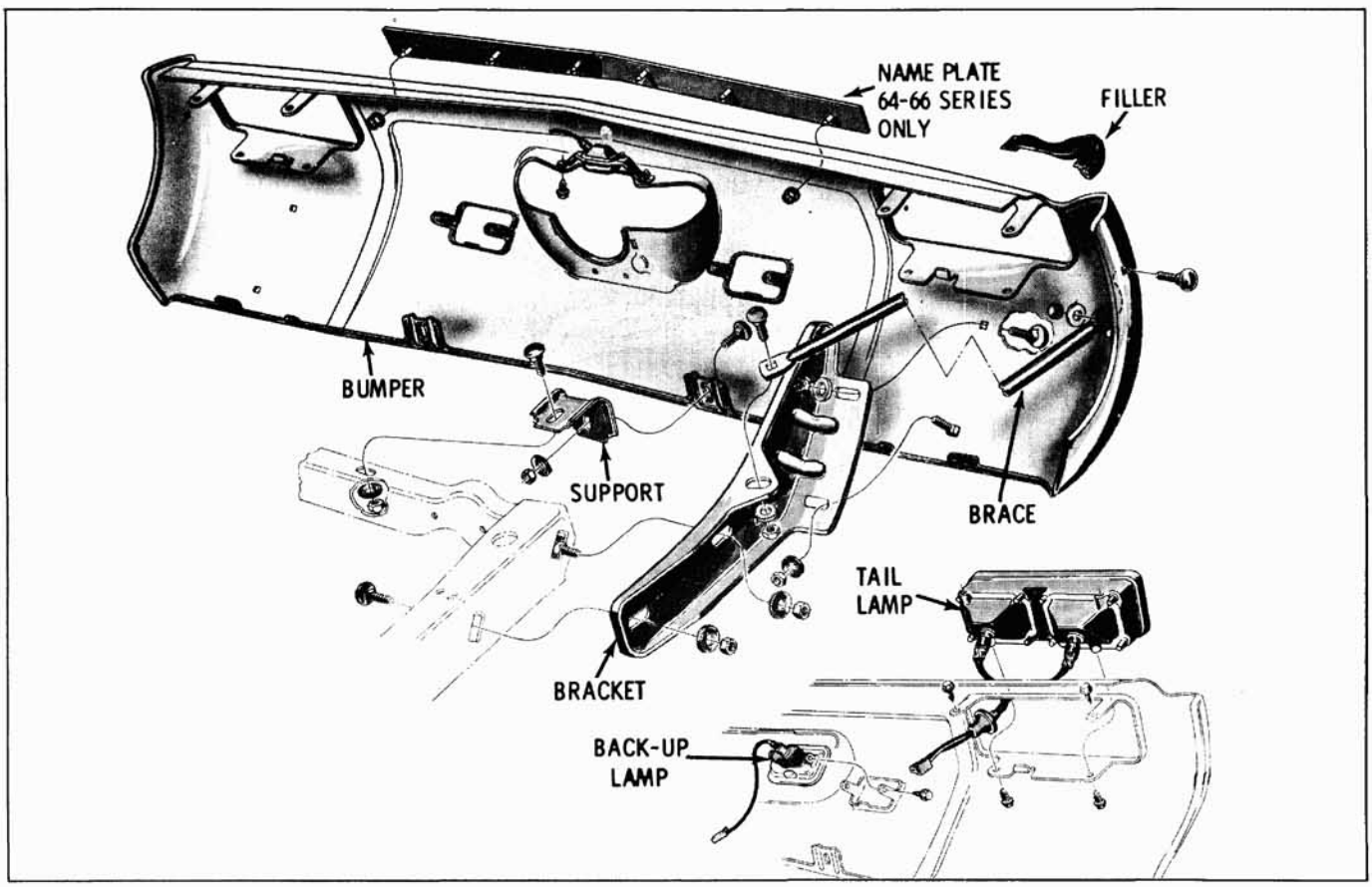


Fig. 14-3—Rear Bumper 54-66 Series

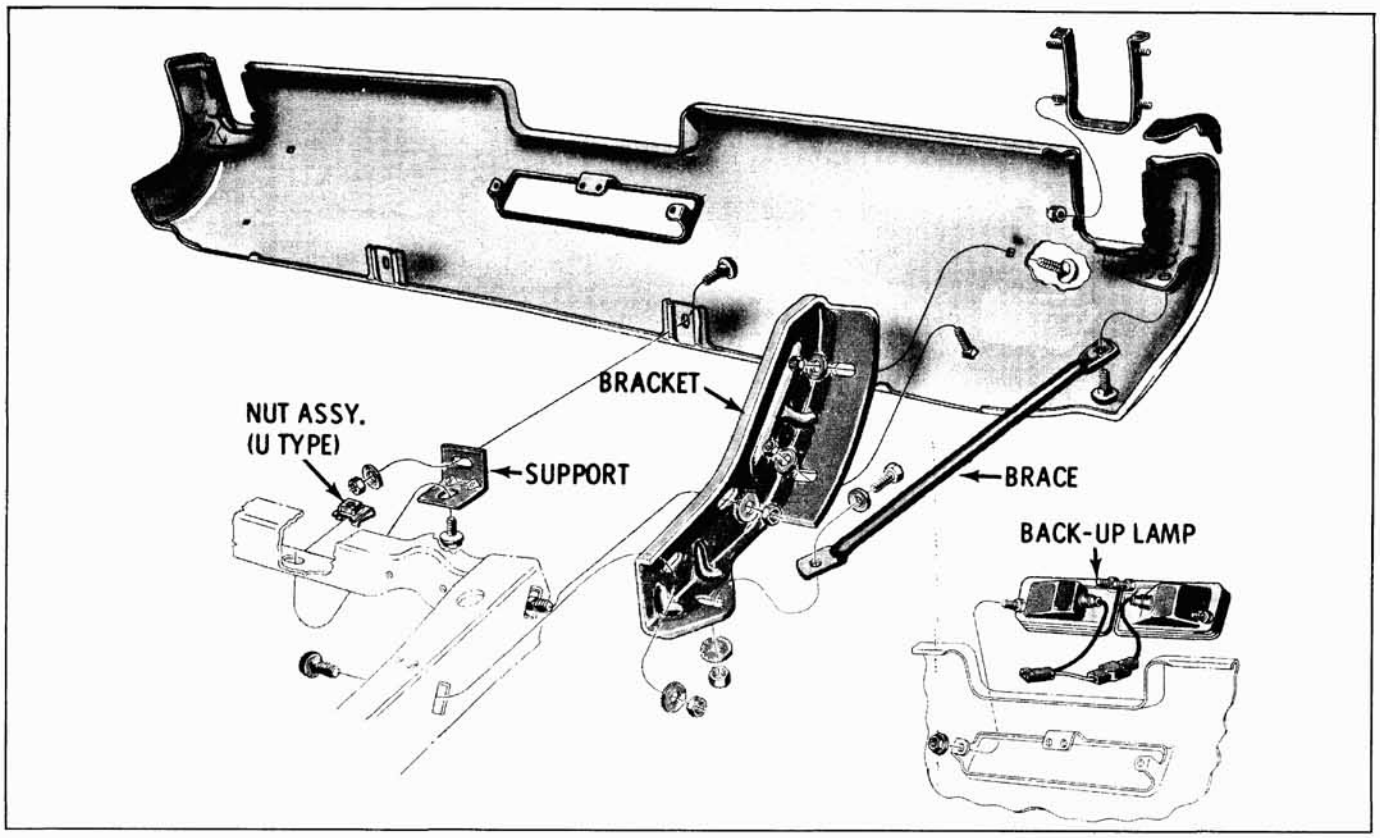


Fig. 14-4—Rear Bumper 84-86 Series

REAR BUMPER (Figs. 14-3, 14-4, 14-5 and 14-6)

Removal

1. Disconnect back-up lamps and license lamp wiring, tail lamp wiring on 54-66 series.
2. Remove bolts securing bumper to frame crossmember supports. Supports are to remain attached to crossmember.
3. Remove bolts securing brackets and braces to bumper and remove bumper.

Installation

To install, reverse the removal procedure. Align the bumper horizontally and laterally so that bumper to body clearance is the same on both ends. The bumper brackets and frame bolt holes are elongated providing a means of alignment. Torque attaching nuts as indicated under TORQUE SPECIFICATIONS.

BUMPER MOLDING

Removal and Installation

It is not necessary to completely remove the bumper to remove the molding.

1. At center of bumper remove the bumper to support attaching bolts.
2. At the bumper bracket to frame attaching bolt location, remove the rear attaching bolts and loosen the front attaching bolt. The bumper will now pivot down. The molding attaching nuts are now accessible.

To install, reverse the removal procedure. Torque all attaching nuts as indicated under TORQUE SPECIFICATIONS.

BACK-UP LAMPS (31-44 Series, Exc. Wagons) (Fig. 14-5)

Back-up lamps can be removed without removing rear bumper. On 4400 Series it may be necessary to loosen the tail pipe for clearance.

BACK-UP LAMPS (4800 Series and Wagons)

Back-up lamps are part of the tail light assembly and can be serviced by removing the lens.

BACK-UP LAMPS (54-86 Series) (Figs. 14-3 and 14-4)

Disconnect the wiring connector. Loosen the bracket to frame attaching bolts and remove bolts from bumper to support. Slide bumper rearward. By pulling rearward on bumper and using a block of wood near center of bumper to frame, back-up lamp can now be removed.

TAIL LAMP ASSEMBLY (31-44 Series, Exc. Wagons)

It will be necessary to remove bumper to bracket bolts and pull rearward on bumper to gain clearance for tail lamp assembly removal. It is only necessary to remove the bolts from bumper to bracket on the side the lamp assembly is being removed.

TAIL LAMP ASSEMBLY (All Wagons)

By removing the tail lamp lens and back-up lamp lens, the tail lamp assembly attaching bolts are now accessible.

TAIL LAMP ASSEMBLY (54-66 Series) (Fig. 14-3)

Tail lamp assembly can be removed by using the same procedures as for back-up lamp removal.

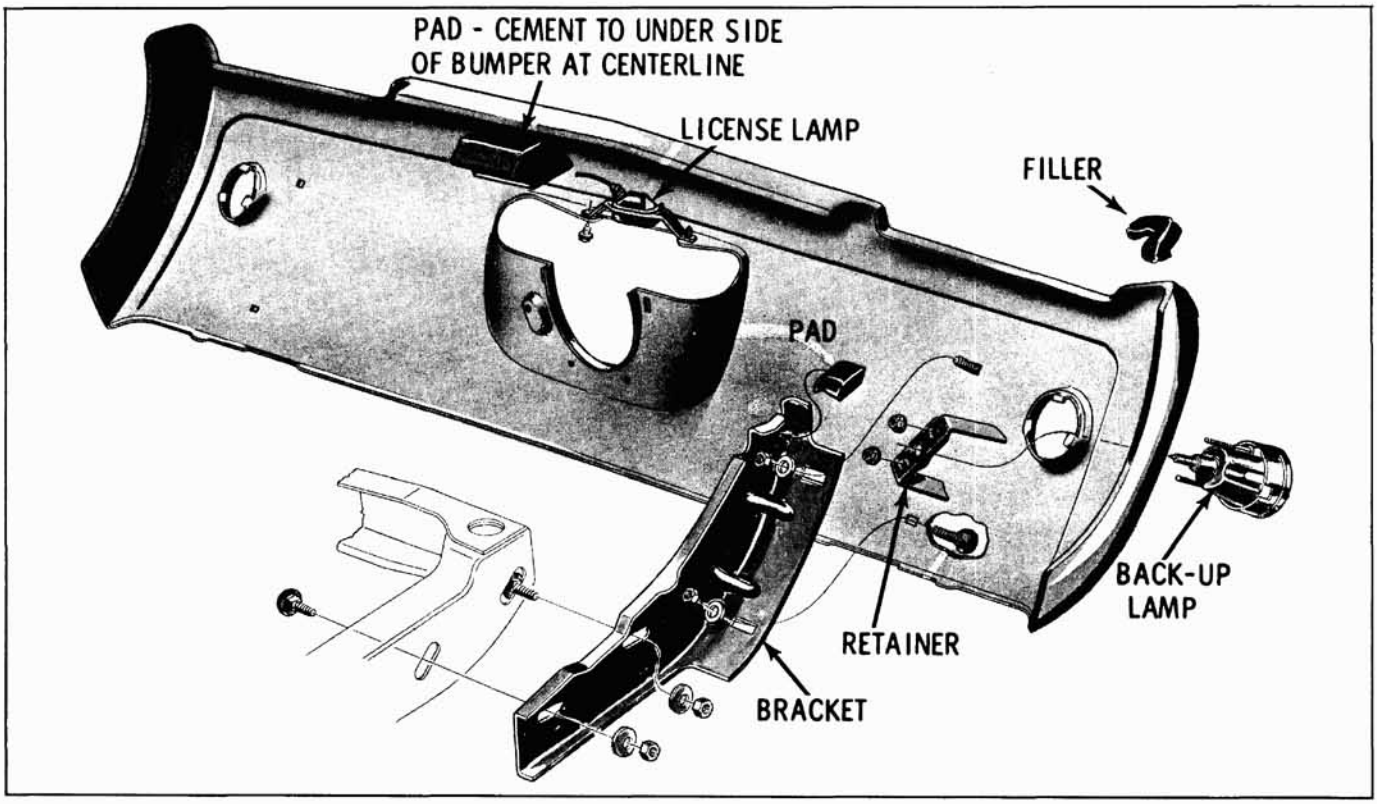


Fig. 14-5—Rear Bumper 31-44 Series (Exc. Wagons)

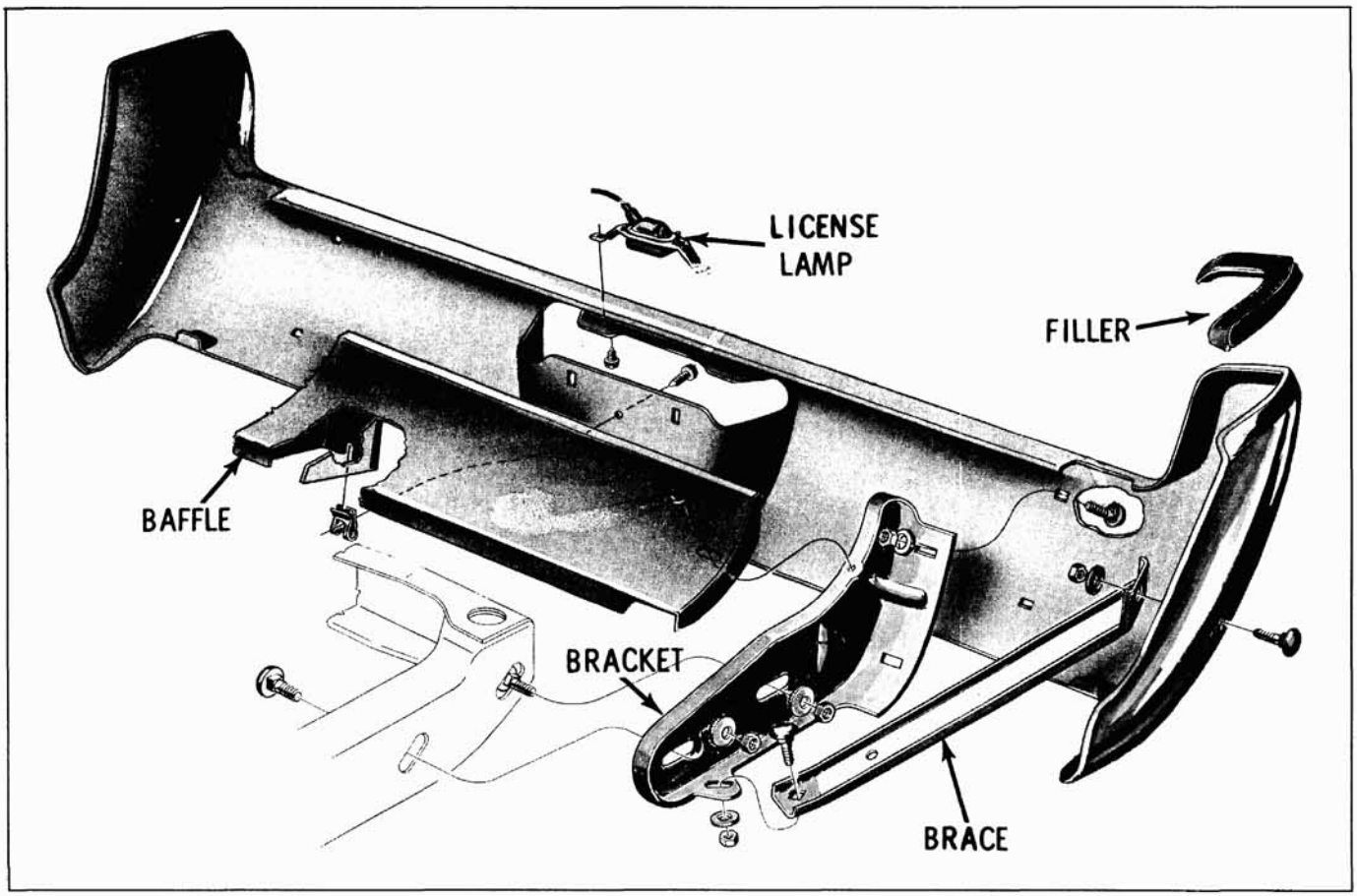


Fig. 14-6—Rear Bumper (Wagons)

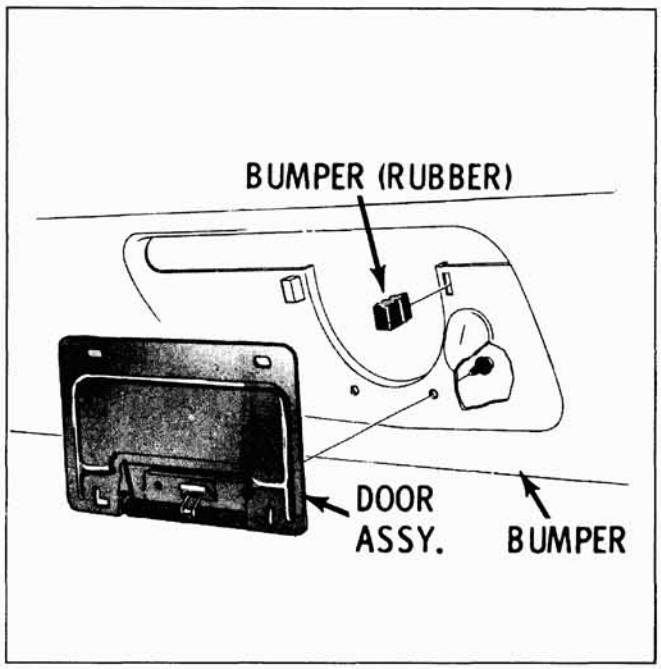


Fig. 14-7—Fuel Filler Door (31-66 Series, Exc. Wagons)

FUEL FILLER DOOR (Fig. 14-7)

(Exc. Wagons and 84-86 Series)

The fuel filler door can be removed by removing the hinge attaching screws from the rear side of the bumper through the filler opening.

LICENSE LAMP

The license lamp assembly, lens or bulb can be removed without loosening or removing the bumper. To remove the bulb, remove the lens and while pushing on the bulb, turn it counterclockwise.

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

APPLICATION	FT. LBS.
FRONT BUMPER	
Bumper Bracket to Frame Nuts	70
Bumper to Bracket Nuts	25
Brace to Center of Bumper Nuts	25
Brace from Center of Bumper to Frame Nuts (31-48 Series)	70
(54-86 Series)	30
Brace from Bumper to Bracket Nuts (31-48 Series)	25
Brace from Bumper to Bracket and Frame Nuts (31-48 Series)	25
Brace from Bumper to Frame at Bumper Nut (54-86 Series)	25
at Frame Nut	50
REAR BUMPER	
Bumper Bracket to Frame Nuts	70
Bumper to Bracket Nuts	25
Brace from Bumper to Bracket Nuts (54-86 Series)	25
Support from Bumper to Frame Nuts (54-86 Series)	25
Support to Bumper Nuts (84-86 Series)	25
Support to Frame Nuts (84-86 Series)	18

ACCESSORIES

31 THROUGH 86 SERIES

CONTENTS OF SECTION 15

Subject	Page
RADIO	15-1
PUSH BUTTON ADJUSTMENT	15-3
AM-FM (STEREO)	15-3
REMOVE AND INSTALL	15-4
RADIO DIAL LAMP	15-4
TRIMMER ADJUSTMENT	15-4
SPEAKERS	15-5
CONVERTIBLES	15-5
STEREO TAPE PLAYER	15-6
ANTENNA	15-9
MANUAL	15-9
POWER	15-9
DISASSEMBLY	15-10
ASSEMBLY	15-10
DIAGNOSIS	15-10
RADIO SYSTEM TESTER	15-11
RADIO DIAGNOSIS	15-11
CRUISE CONTROL 54-86 SERIES	15-12
CRUISE CONTROL SELECTOR ASSEMBLY AND/OR CONTROL CABLE	15-17
CONTROL CABLE ADJUSTMENT	15-17
LINKAGE ADJUSTMENT	
BRAKE RELEASE SWITCH ADJUSTMENT	15-18
MOTOR FEED POINTS ADJUSTMENT (ON CAR)	15-17
LIMIT SWITCH AND THROTTLE SWITCH POINTS ADJUSTMENTS (ON CAR)	15-18
CHECKING MOTOR OPERATION	15-19
MOTOR STALL TEST	15-19
CHECKING FOR DAMAGED CABLES AND GEARS	15-19
REGULATOR	15-19
DISASSEMBLY	15-21
ASSEMBLY	15-21
DIAGNOSIS CHART	15-24
CRUISE CONTROL 32-48 SERIES (EXC. 3500)	15-25
PRELIMINARY ELECTRICAL CHECKS	15-26
VACUUM CHECKS	15-26
ENGAGING SWITCH TEST PROCEDURE	15-26
SERVO ROD LINKAGE ADJUSTMENT	15-26
CHECKING FOR DAMAGED CABLES AND GEARS	15-26
CENTERING SPRING ADJUSTMENT	15-27
VACUUM RESTRICTION ADJUSTMENT	15-27
VACUUM SERVO	15-27
REGULATOR	15-27
DISASSEMBLY	15-27
ASSEMBLY	15-28
REPLACING VALVE BODY AND MAGNET ASSEMBLY	15-29
REPLACING GOVERNOR ASSEMBLY	15-29
DIAGNOSIS CHART	15-30
SAFETY SENTINEL	15-31
CHECKING SAFETY SENTINEL	15-32
RALLY-PACK	15-32
INSTRUMENT CLUSTER	15-32
TACHOMETER	15-32
INOPERATIVE TACHOMETER	15-32
CLOCK TACHOMETER PRINTED CIRCUIT	15-34
CLOCK	15-34
CORNERING LAMPS	15-35
BACK-UP LAMP SWITCH (AUTOMATIC TRANSMISSION)	15-35

RADIO (Figs. 15-1, 15-2, 15-3, 15-4 and 15-5)

Three types of radios are available: AM Deluxe, AM/FM Wonder Bar and AM/FM Stereo. The outer left knob operates the on-off switch and volume control while the inner left knob operates the tone control. The right hand outer knob controls manual tuning.

On cars equipped with a rear seat speaker, a variable type control located behind the manual tuning knob modulates both the front and rear speakers simultaneously. As the control is turned counterclockwise, the volume of the front speaker increases while the volume of the rear speaker decreases. As the control is turned clockwise, the volume of the front speaker diminishes while the volume of the rear speaker increases. After the desired speaker modulation is obtained, the volume of both speakers can be regulated by the volume control knob.

All radios have five pushbuttons for touch tuning, which mechanically tunes the radio to pre-selected stations, and a control knob for manual selection of stations.

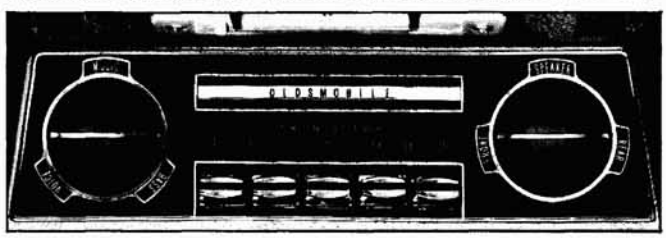


Fig. 15-1—Deluxe Radio (31-48 Series)

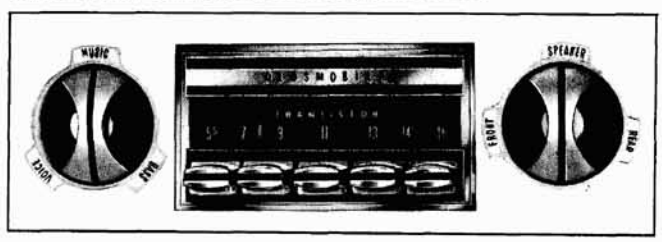


Fig. 15-2—Deluxe Radio (54-48 Series)

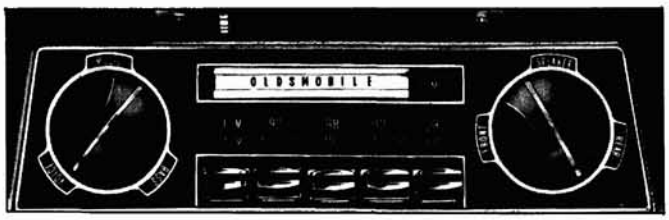


Fig. 15-3—AM-FM (31-48 Series)

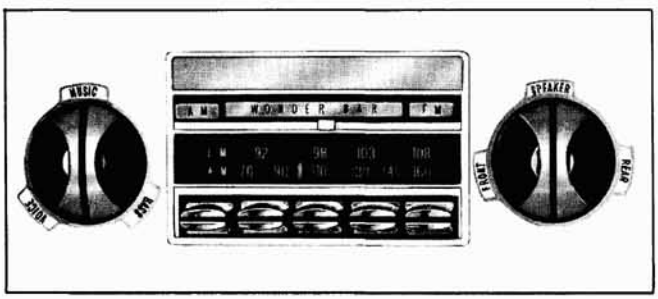


Fig. 15-4—AM-FM Wonder Bar

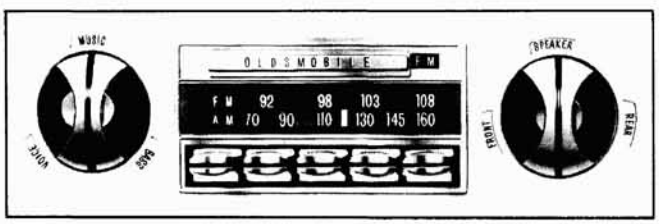


Fig. 15-5—AM-FM Stereo

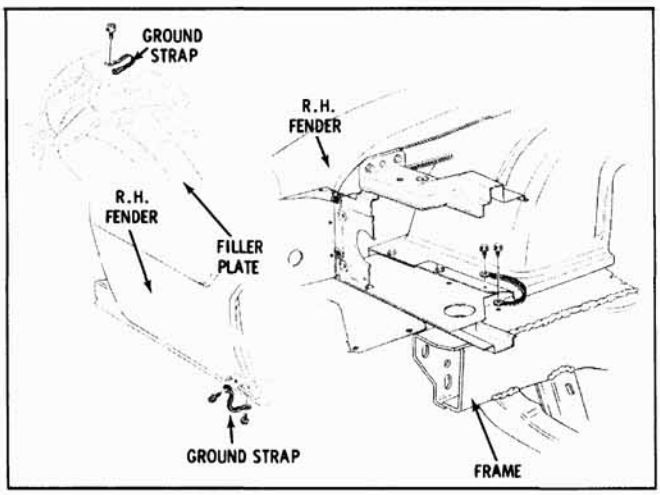


Fig. 15-6—Stereo Radio Ground Straps

In addition to pushbutton tuning, the AM/FM Wonder Bar features automatic tuning. Depressing the center push bar rejects any station previously selected and automatically selects and tunes the next available station.

On cars equipped with stereo radios, the inner right knob controls the relative volume from the front and rear speakers. This control should be adjusted for the most pleasing stereo separation between the front and rear speaker. Fig. 15-6 shows the ground straps used when the car is equipped with FM Stereo.

The sensitivity of the automatic tuning mechanism can be increased or decreased by the sliding lever located under the

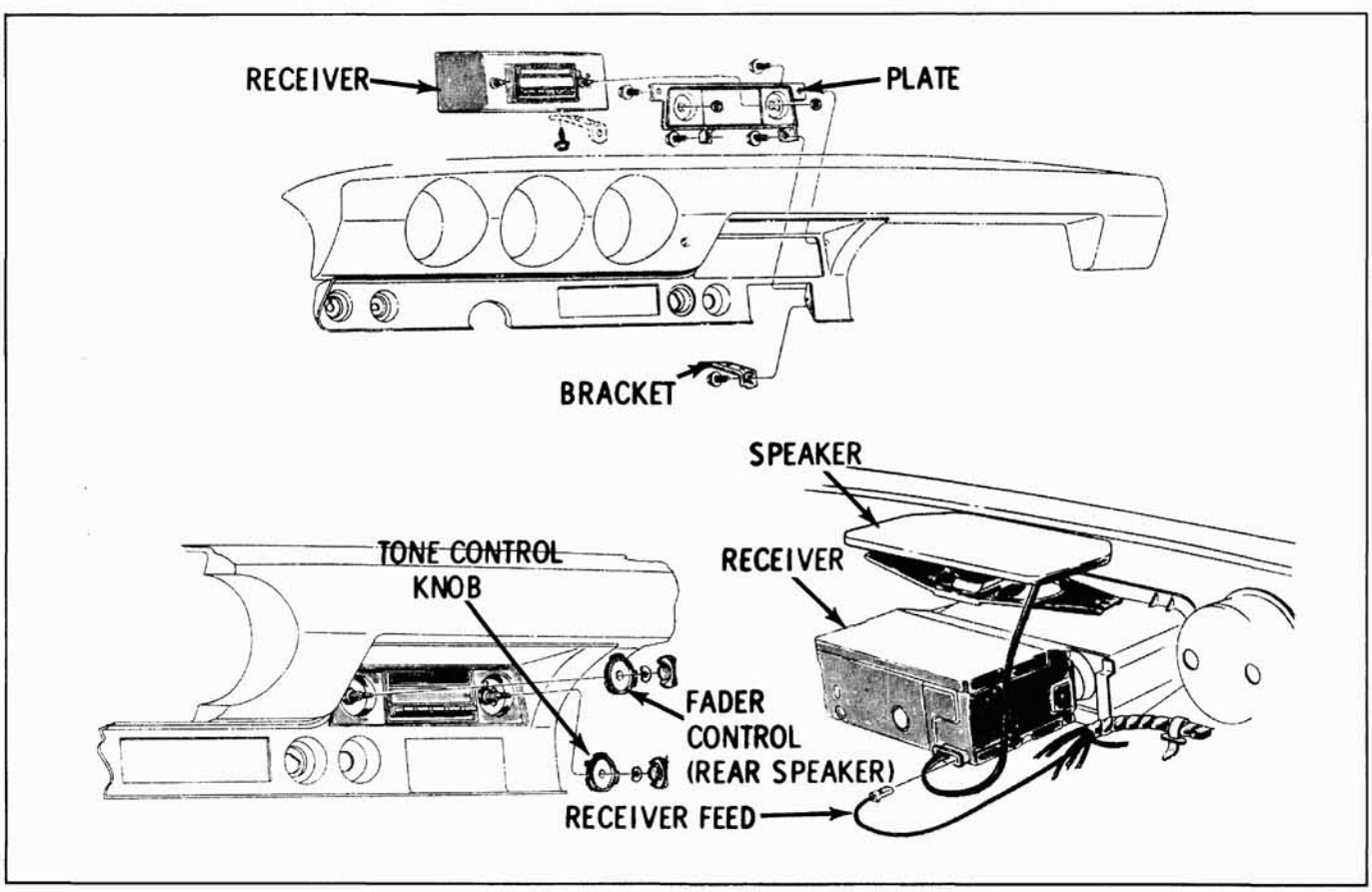


Fig. 15-7—Radio and Speaker Installation (31-48 Series)

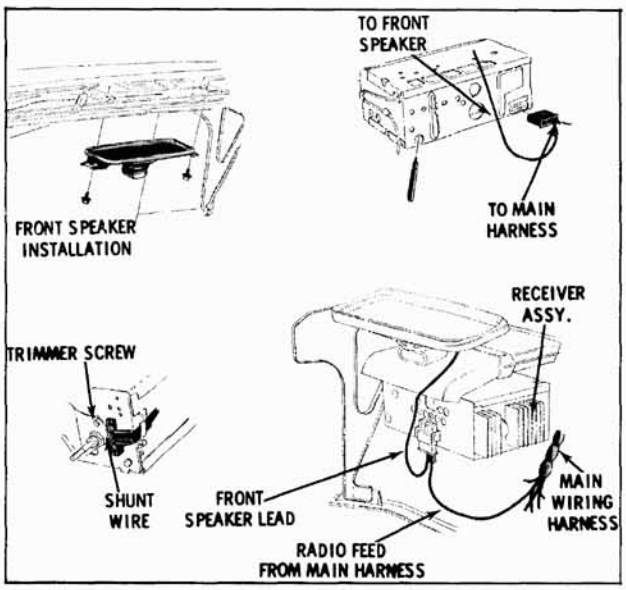


Fig. 15-8—Radio and Speaker Installation (54-86 Series)

bar. The lever has three positions. When the lever is to the left, only the stronger or local stations will be received. The sensitivity can be increased by moving the lever to the middle or extreme right position.

A stereo tape player is also available. This player uses standard eight-track tape cartridges and may be operated with or without an AM/FM Stereo radio.

PUSHBUTTON ADJUSTMENT

Adjustment of the mechanical pushbutton tuning system on the Deluxe, AM-FM Wonder Bar, and AM-FM Stereo models is the same.

1. Turn on the receiver.
2. Select a pushbutton for desired station. Pull the button slightly to the left and then out as far as it will go.
3. Tune in the desired station manually.
4. Push the selected button to its maximum in position. This is the locking operation.
5. Proceed in the same manner for the remaining stations.
6. After all the buttons have been adjusted, recheck the settings. Push each button, then see if the station can be tuned in more accurately manually. If so, repeat Step 2 and reset the station manually.

Any single pushbutton on the AM-FM radio may be adjusted for either AM or FM reception. When a push button is adjusted for FM, it cannot be used for selecting a station on AM without first readjusting the pushbutton for AM.

AM-FM STEREO RADIO

AM or FM radio broadcasts may be selected by sliding the control switch located above the radio dial, to the right or left. The letters AM or FM will appear in the upper left or right corners of the control panel, indicating the type of broadcast being received.

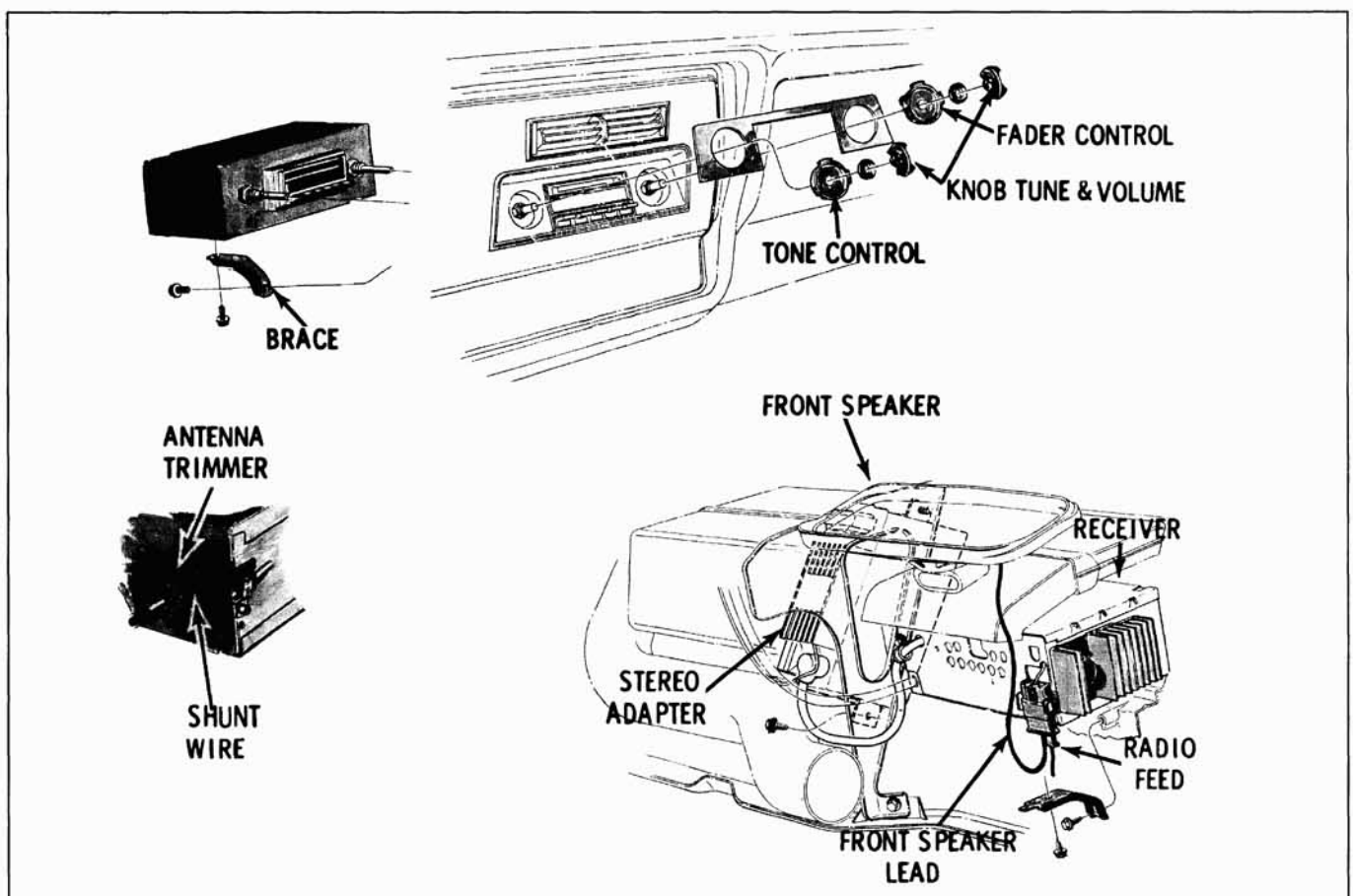


Fig. 15-9—Radio and Speaker Installation - Stereo (54-86 Series)

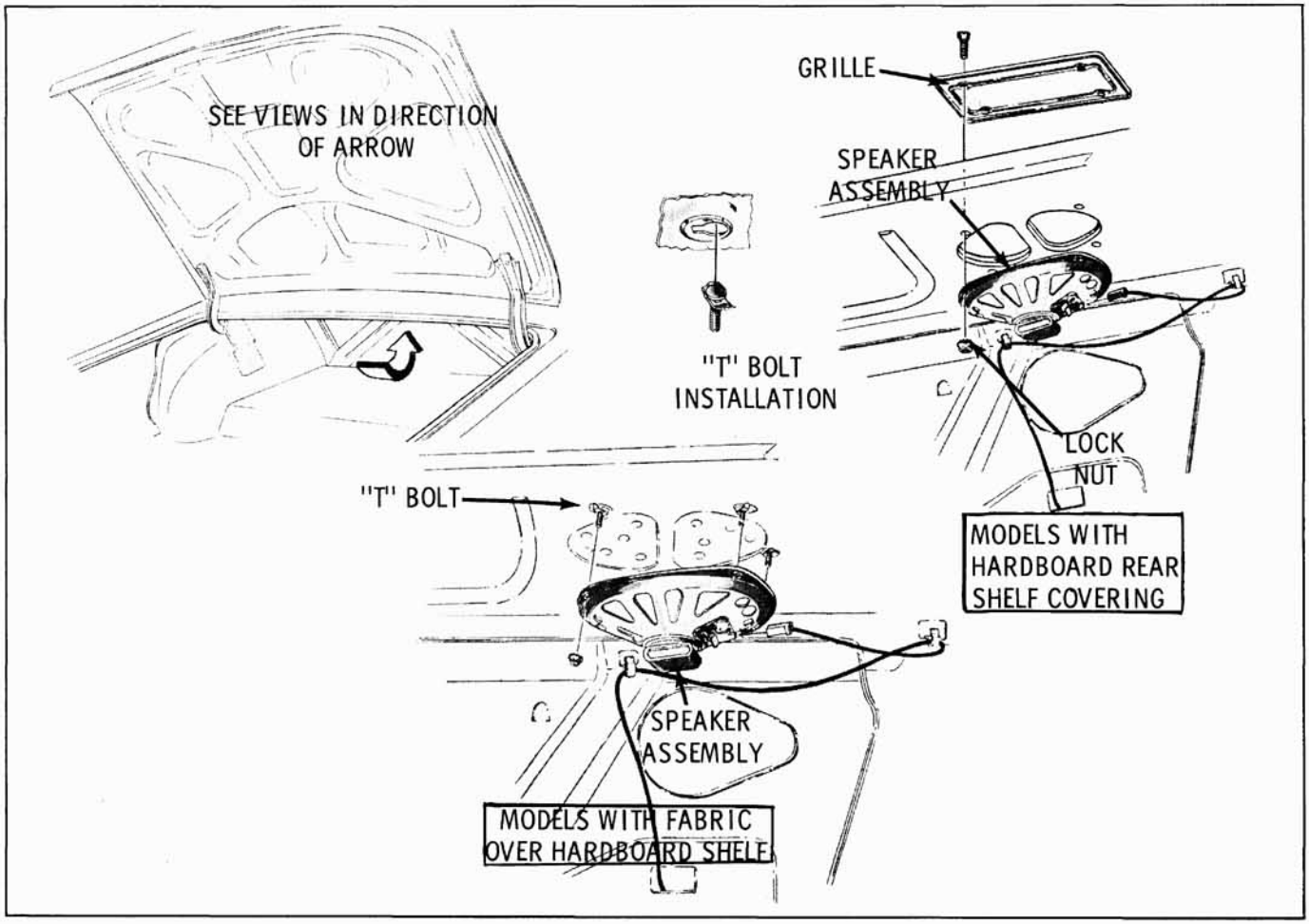


Fig. 15-10—Rear Seat Speaker (31 through 44 Series)

Normal FM reception will be almost noise-free unless the radio is tuned to a weak station in a fringe area. It may be necessary, while driving, to manually retune FM stations slightly to maintain peak reception. The average FM station coverage is approximately 20 to 30 miles.

Maximum FM reception is obtained with the antenna extended approximately 31 inches.

FM Stereo offers all the advantages of FM plus the realism of stereo. The AM/FM stereo radio will operate in the same manner as the AM/FM radio. When a FM station is capable of transmitting in stereo, the stereo indicator lamp will light. The illumination of this lamp, however, does not always mean the station is transmitting stereo at that particular moment. The bulb will not light on any AM station, since stereo programs are not broadcast on this band.

The reception area for good FM stereo reception will be generally less than 25 miles. Beyond this limit the station will be subject to flutter, fading and ignition interference from the automobile ignition system.

Flutter, fading and ignition interference can be reduced by careful, fine tuning of the radio and also by adjustment of the antenna height to thirty one inches.

REMOVAL AND INSTALLATION (Figs. 15-7, 15-8 and 15-9)

1. Disconnect negative battery cable.
2. Remove radio knobs, washers or rear seat speaker control.
3. Remove radio attaching nuts and escutcheons.
4. Disconnect all wiring and antenna lead in.
5. Remove lower radio support bracket attaching screw.
6. Remove radio from the rear of the instrument panel.

To install, reverse removal procedure.

STEREO ADAPTER REMOVAL (Fig. 15-9)

The Stereo Receiver and Adapter have identical serial numbers and the units must be kept together for service and installation.

1. Disconnect negative battery cable.
2. Disconnect all wiring from adapter.
3. Remove adapter retaining screws and remove adapter.

RADIO DIAL LAMP (54 through 86 Series)

The radio dial light on the Deluxe, AM-FM, and Super Deluxe radios is located on top of the receiver and can be removed after removing the radio.

RADIO DIAL LAMP (31 through 48 Series)

The radio dial lamp plugs into the top side of the receiver. It is not necessary to remove the receiver to replace the bulb, however, if car is equipped with air conditioning, it will be necessary to remove the glove box to gain access.

TRIMMER ADJUSTMENT

1. Extend antenna to approximately 31 inches.

AM-FM radio must be set on the AM band.

2. Remove the manual tuning knob and escutcheon or rear seat speaker fader control, if so equipped.

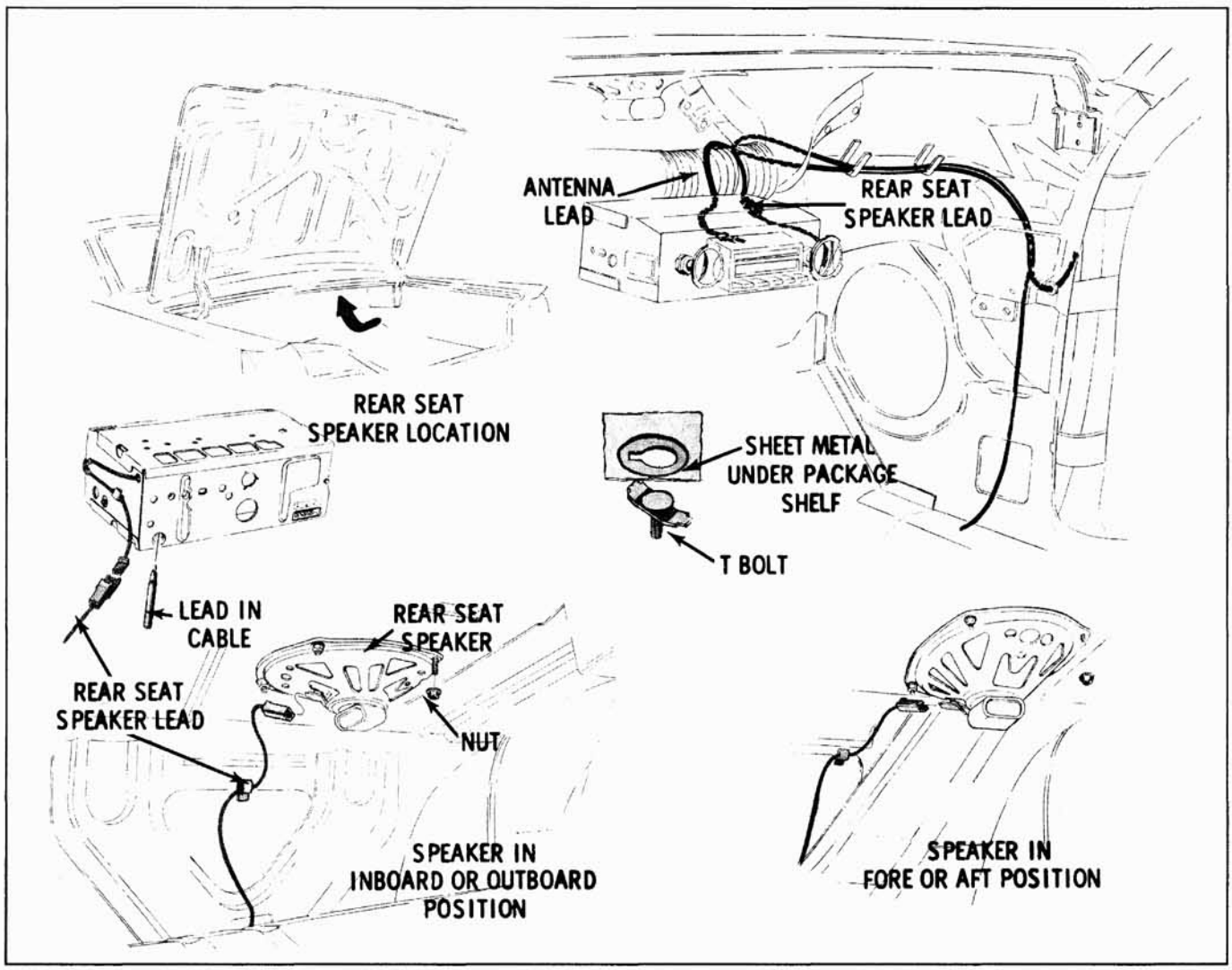


Fig. 15-11—Rear Seat Speaker (54 through 86 Series)

3. If car is equipped with a rear seat speaker, insert a shunt wire as shown in Fig. 15-7 or Fig. 15-8.

Do not turn on radio unless shunt wire is installed.

4. Turn the volume control full on and tune the receiver to a weak station at approximately 1400 kilocycles.
5. With a small screwdriver, adjust the antenna trimmer until loudest signal is received.
6. Turn off radio. Remove shunt wire, if equipped with a rear seat speaker.

FRONT SPEAKER REMOVAL

The speaker is attached to the instrument panel as illustrated in Figs. 15-7, 15-8 and 15-9.

31-48 Series speaker can be removed for service without removing the receiver.

REAR SPEAKER REMOVAL

The rear seat speaker is mounted under the parcel shelf and is accessible through the rear compartment. To remove speaker:

1. Disconnect lead from terminal.
2. Remove four mounting locknuts while supporting speaker to prevent it from dropping (Figs. 15-10 and 15-11).

To install, reverse removal procedure, being careful to avoid damaging the speaker cone while aligning the speaker assembly over the mounting screws.

CONVERTIBLES

The rear seat speaker on convertibles is mounted on the rear seat back. To remove speaker, proceed as follows:

1. Remove rear seat cushion.
2. Remove the upper two body to seat back attaching screws, accessible from the rear compartment.
3. Remove the two lower seat back attaching screws and tip seat back forward.

Place protective covering on floor panel to prevent soiling of seat back.

4. Remove four speaker assembly to seat back attaching screws.
5. Disconnect lead wire from speaker. Remove the four speaker attaching screws and remove speaker (Fig. 15-12).
6. If speaker grille is to be replaced, it can be removed by removing the four self-threading attaching nuts.
7. To install, reverse removal procedure.

STATION WAGON AND VISTA CRUISER (Fig. 15-13)

Removal

1. Remove four speaker grille retaining screws and remove grille.

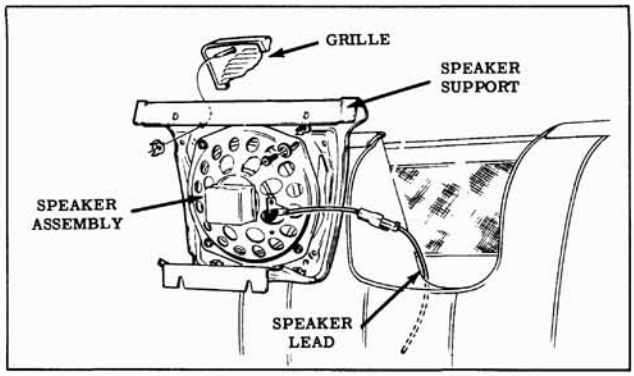


Fig. 15-12—Rear Seat Speaker (67 Style)

2. The speaker may be removed through the opening in rear quarter trim panel.
3. Disconnect wires from speaker.

Install

1. Connect wires to speaker and insert speaker through opening in quarter trim panel.
2. Hold speaker and start one retaining screw into cage nut on speaker.

Leave retaining screw in speaker loose.

3. Insert an awl or small drift punch through grille and into cage nut on speaker. Take caution not to damage speaker.
4. Install two retaining screws and tighten.
5. Remove awl and install remaining retaining screw.

TAPE PLAYER STEREO

With the stereo tape player, the owner may make his own selection of pre-recorded music. To operate the tape player, completely insert a cartridge into the unit. This turns on the player, and automatically removes power from the radio and switches the speakers from the radio to the tape player. This feature prevents accidental damage to the radio should the owner attempt to operate it while the tape player is in use.

After the tape player is in operation, the front panel controls of the player are then adjusted for the most pleasant stereo listening.

Tape cartridges should be handled carefully and should be kept clean. A cartridge should not be left inserted fully in the player. This may cause permanent damage to the cartridge.

TAPE PLAYER—PERIODIC MAINTENANCE

The only required maintenance is cleaning of the tape player head. This service should be performed every 100 hours of operation. The head cleaning is done by swabbing the head (unit still installed in car) with a cotton swab that has been dipped in alcohol.

No service is performed on the tapes and warranty on these tapes is handled by the cartridge manufacturer and not by the dealer. The test tape used by the dealer should be stored in its container to keep the tape clean.

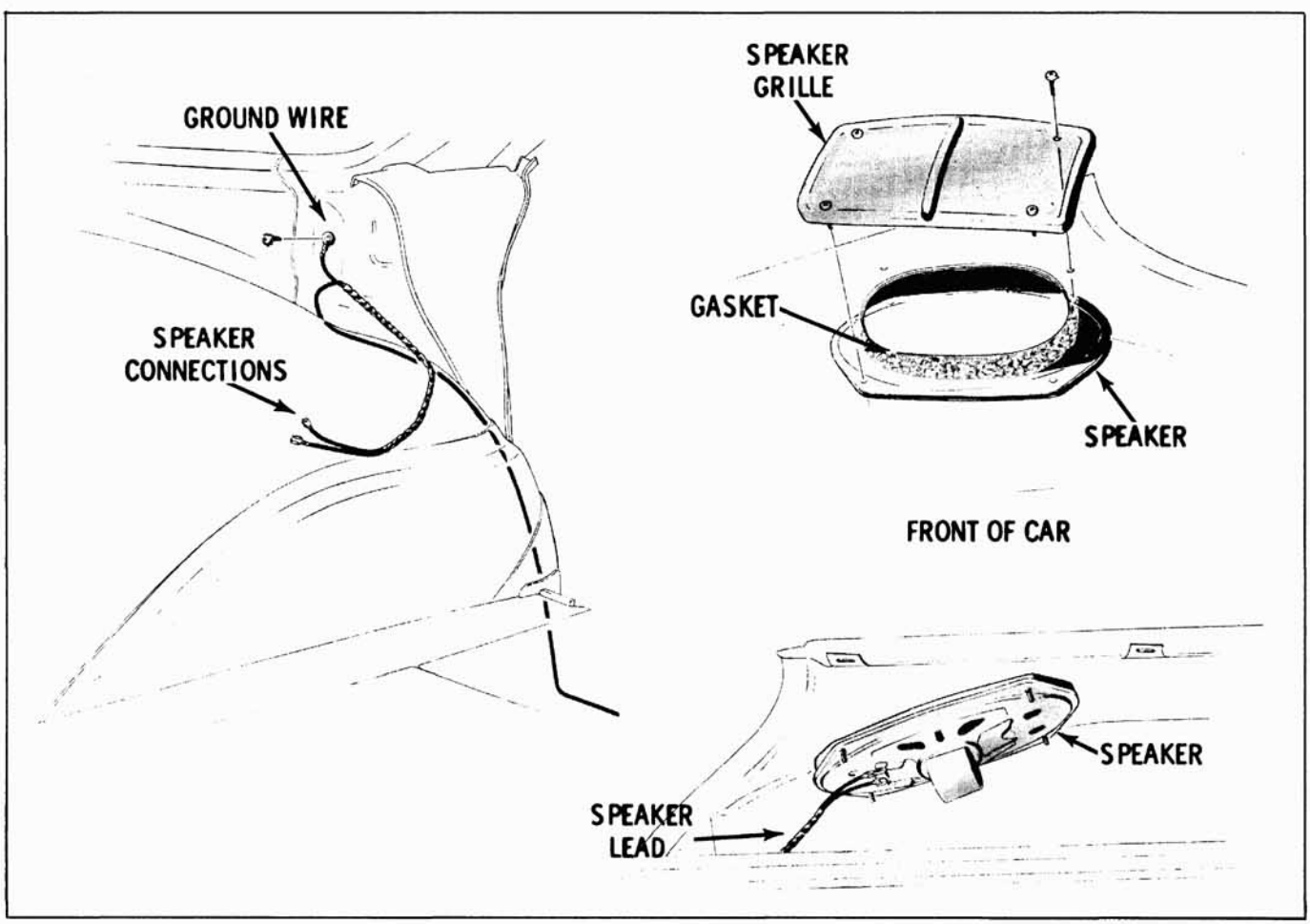


Fig. 15-13—Rear Speaker (Station Wagon)

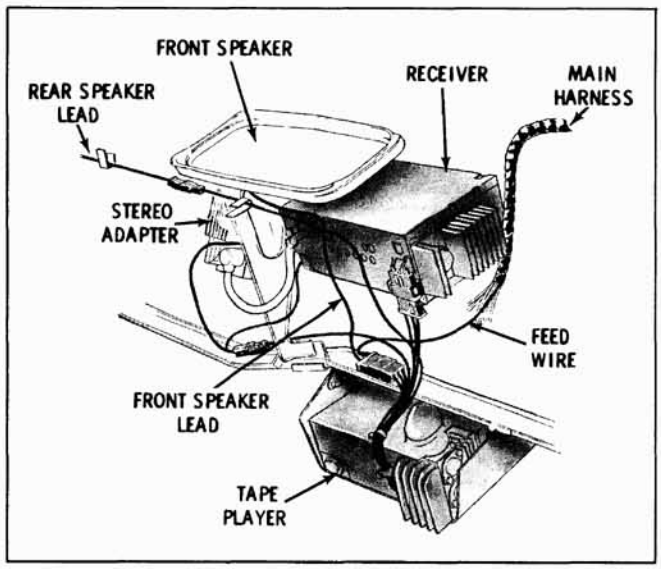


Fig. 15-14—Stereo Tape Play Wire Routing

TAPE PLAYER CHECKS

Refer to Figs. 15-14 and 15-15 when performing the following checks.

A. Insert a known good cartridge and listen for a "thump" in the speakers which should be heard as current builds up through the power transistors.

(a) If "thump" is heard in all speakers, go to check (C).

(b) If no "thump" is heard, check the fuse. If a "thump" was not heard from one speaker, check that speaker and its interconnecting cable.

(c) If fuse is okay, check all tape player interconnecting cables. If still no "thump", remove tape player for repair.

B. One channel is dead:

Insert known good cartridge and listen for "thump" from dead speaker.

(a) If "thump" is heard, remove player for repair.

(b) If no "thump", check dead speaker and its interconnecting cable. If this channel is still dead, remove player for repair.

C. Player is noisy:

Try known good cartridge. If still noisy, remove player for repair.

D. Player has constant change in pitch of music or seems to run too slow or too fast:

Try known good cartridge. If condition still persists, remove player for repair.

TAPE PLAYER—REMOVE AND INSTALL (Figs. 15-14 and 15-15)

1. Disconnect negative battery cable.
2. Disconnect all wiring at connectors.
3. Remove attaching nut at rear bracket.
4. Remove two retaining screws at instrument panel reinforcement and remove player assembly.

To install, reverse removal procedure.

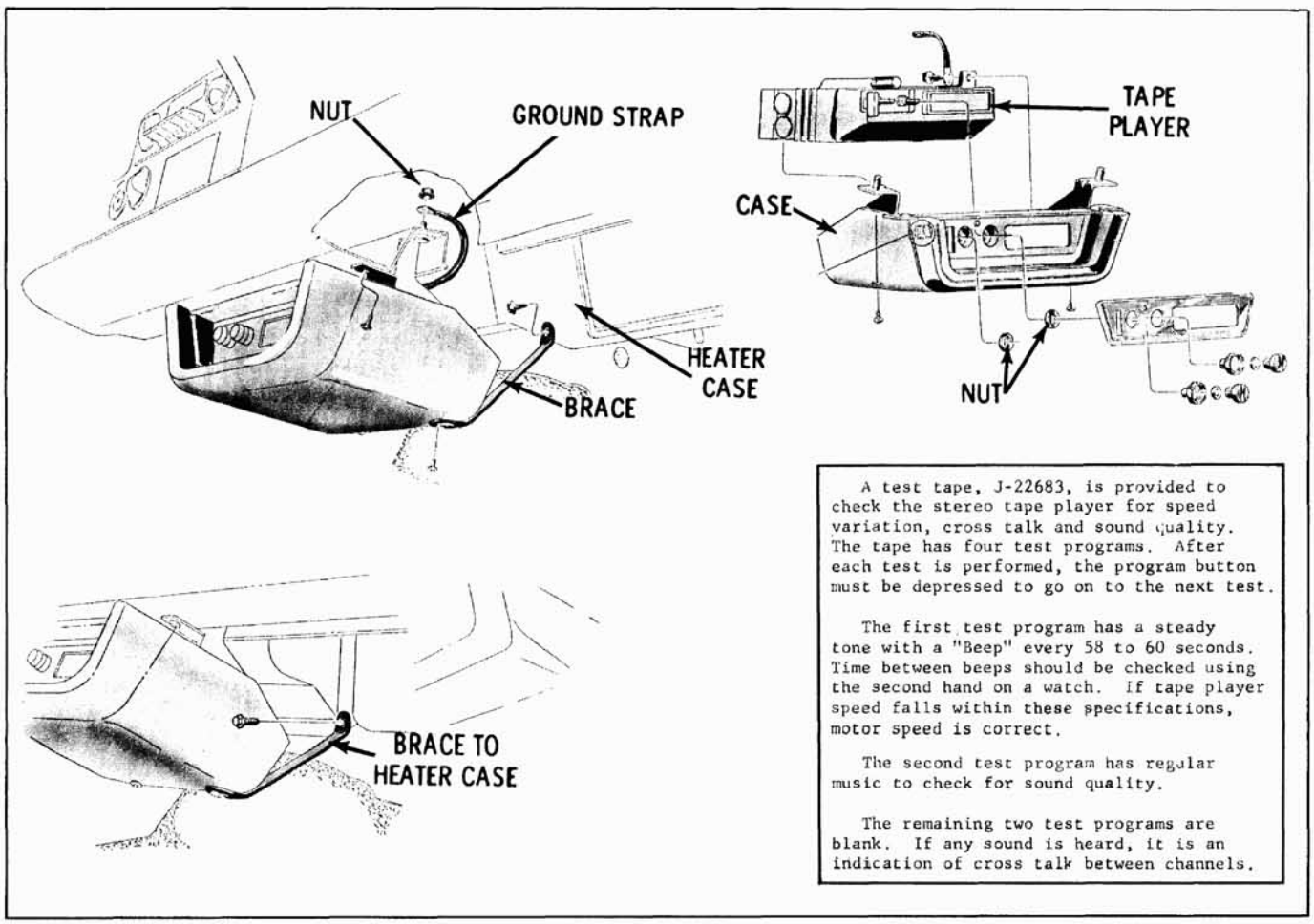


Fig. 15-15—Stereo Tape Player Installation

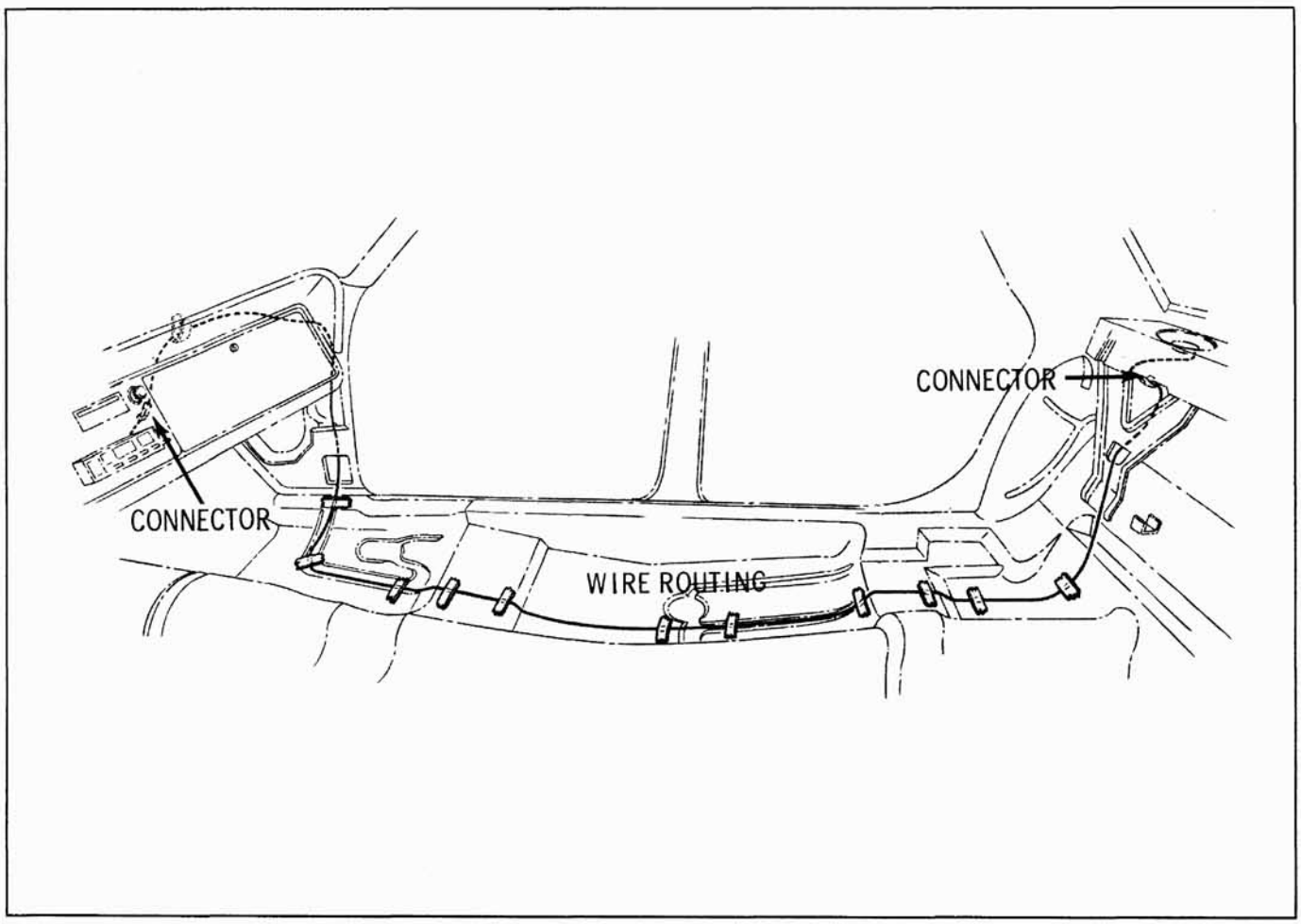


Fig. 15-16—Rear Seat Speaker Lead Routing (54 through 86 Series)

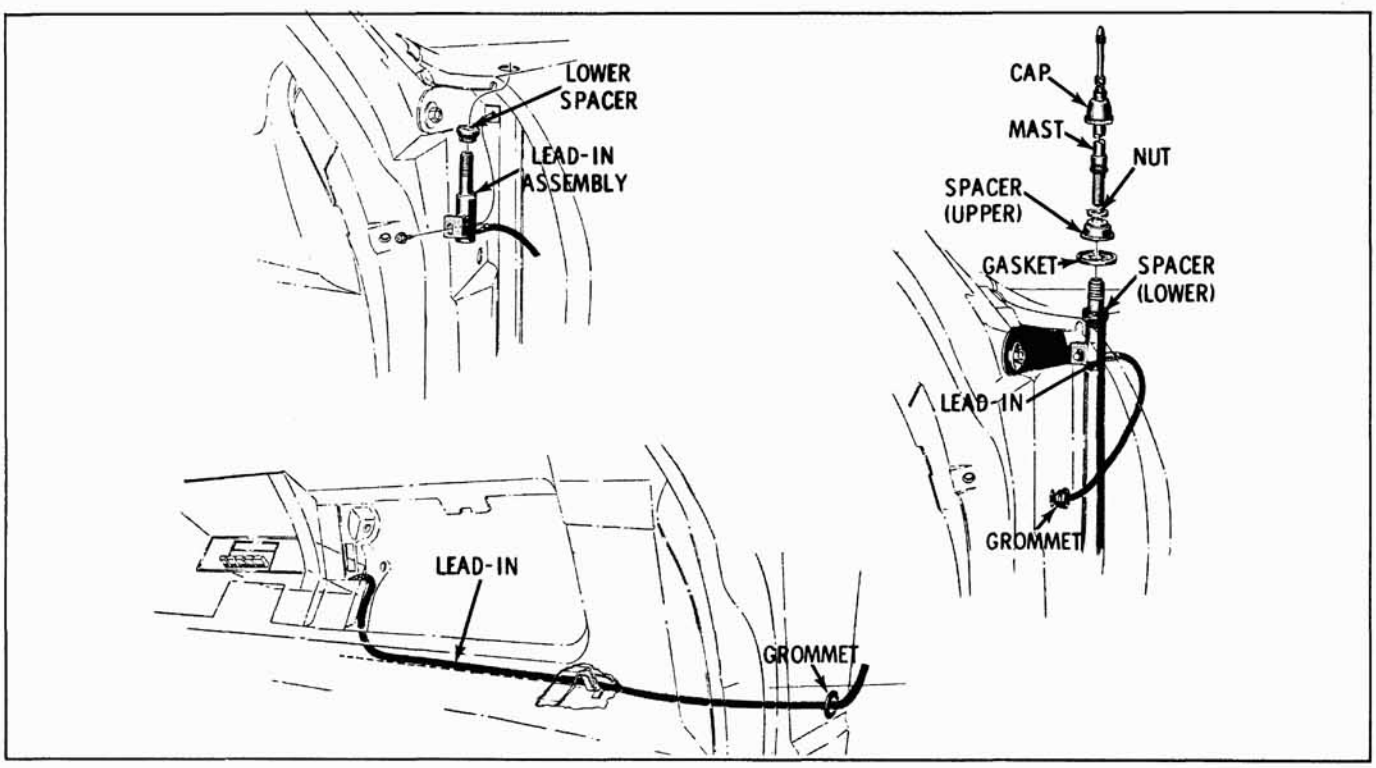


Fig. 15-17—Manual Antenna Mounting (31 through 48 Series)

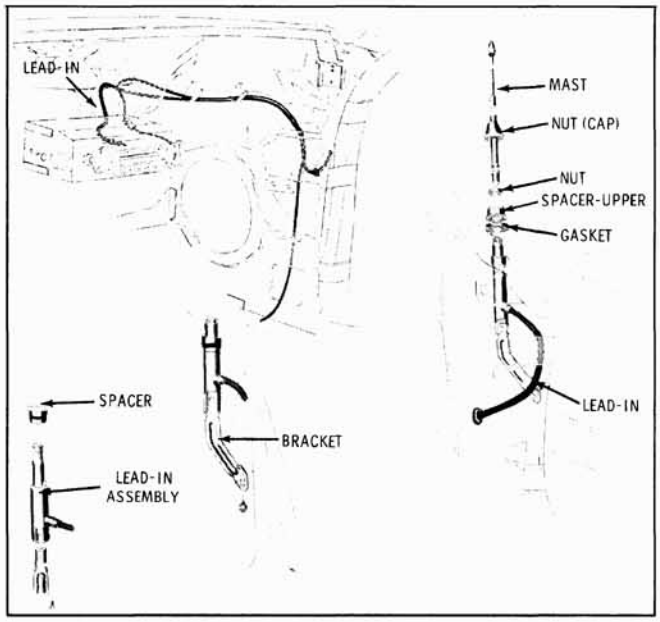


Fig. 15-18—Manual Antenna Mounting (54 through 86 Series)

ANTENNA

MANUAL

The manual antenna is installed as shown in Figs. 15-17 and 15-18. The manual antenna can be removed without removing the cowl trim pad.

Removal—Power

Power antennas are installed as illustrated in Figs. 15-19 and 15-20.

DISASSEMBLY (Fig. 15-21)

The following parts of the power antenna are serviceable: Drive Assembly, Mast Assembly and Support Tube Assembly. To service any of these parts, proceed as follows:

1. Remove the two connector-to-support tube screws and remove connector.
2. Unsolder hook-up wire at pin and remove pin and insulator assembly.

Do not overheat pin by slow soldering as the pin insulator will be destroyed.

3. Remove the three support tube-to-drive assembly screws.
4. While applying a back and forth rotary motion, pull until support tube is removed from antenna.
5. If the drive assembly or mast assembly is to be replaced, proceed as follows:
   a. While applying a rocking motion, pull on mast until insulator bushing is removed from the drive assembly tubular fitting.
   b. Energize motor until entire length of nylon cord is expelled from the drive assembly. To prevent a kink or bend in nylon cord, keep it taut by pulling on mast.

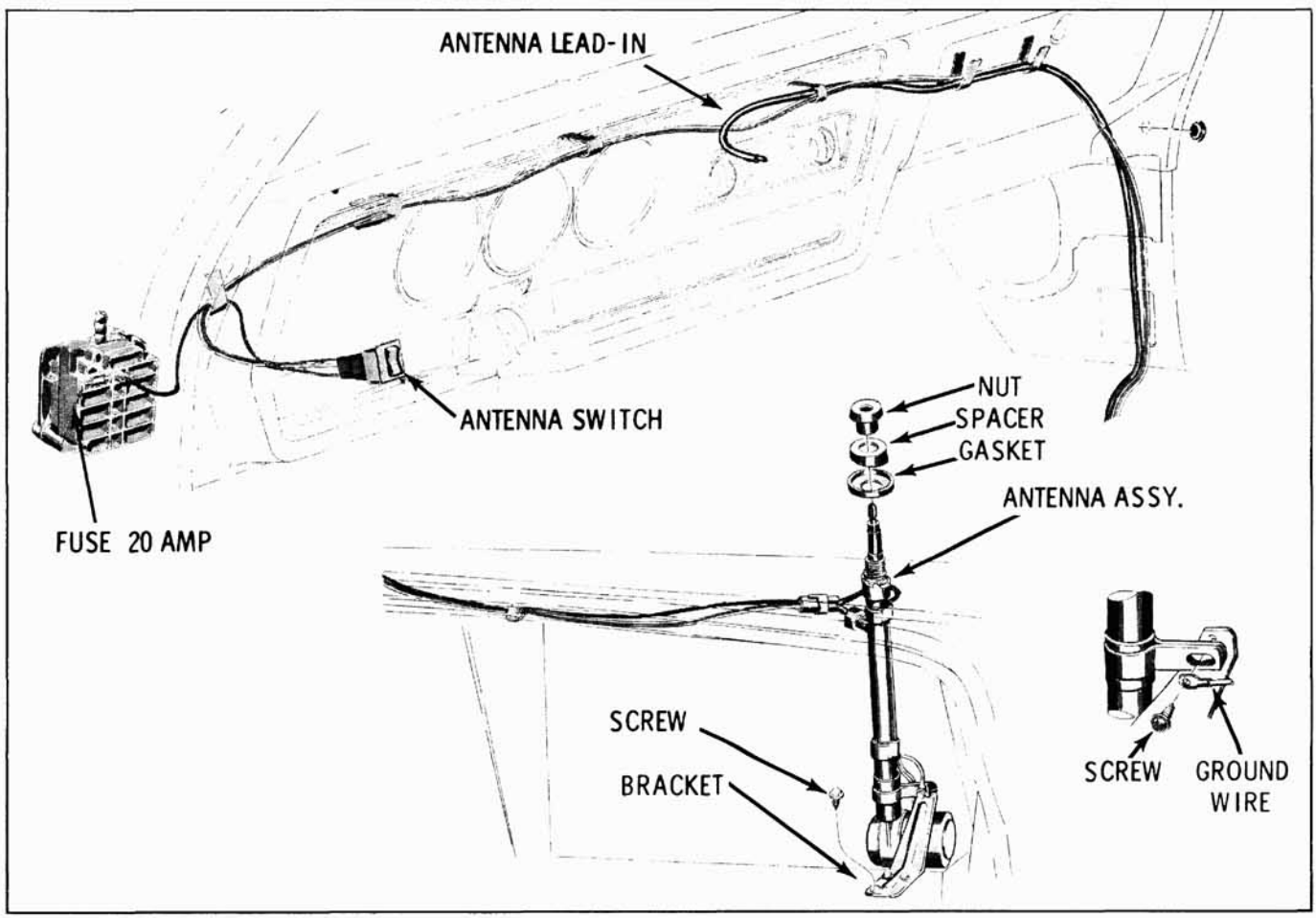


Fig. 15-19—Power Antenna (54 through 86 Series)

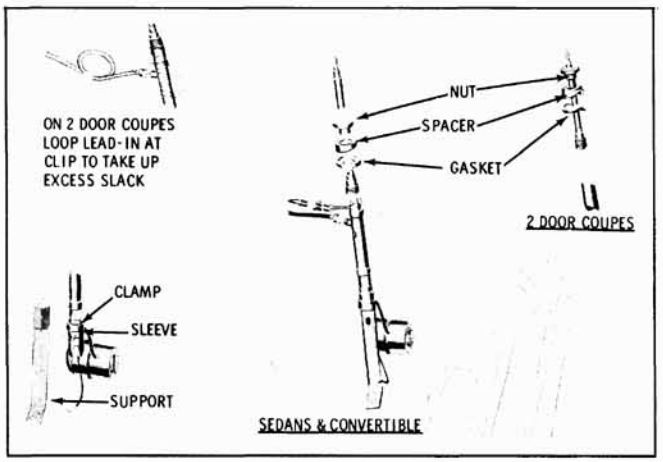


Fig. 15-20—Power Antenna (31 through 44 Series)

If motor is inoperative, it will be necessary to manually remove the nylon cord from the drive assembly as follows:

c. Place the assembly in a vise so that the normal plane of the nylon cord is parallel with the floor.

d. Pull on nylon cord until it is completely expelled from the drive assembly.

No attempt should be made to disassemble antenna further than Step 5-d.

ASSEMBLY

1. Thread nylon cord through bottom insulator, (small diameter end down) and water seal washer.

2. Energize motor and feed nylon cord into drive assembly. Do not allow nylon cord to bend or kink.

Push water seal washer and bottom insulator all the way down into tubular fitting (make sure that keyways in bottom insulator are rotated to key position) before nylon cord completely disappears into drive assembly.

3. Push mast assembly into tubular fitting (Guide Keyways into key position) making sure that the upper edge of the insulator bushing is below the center of the three support tube to drive assembly screw holes.

4. Install support tube over mast assembly, making sure hook-up wire is extended through connector hole in support tube and install the three screws.

5. Solder hook-up wire to pin and insulator assembly, being careful not to overheat.

6. Install connector over pin and insulator assembly and install two screws.

Diagnosis

If antenna fails to operate properly, check the following possible sources of trouble.

1. Excessive tightening of cap nut on quarter panel will result in excessive operating noise in the car.

2. A stalled or slowly operating mast may be caused by bent or dirty mast sections. If dirty, wipe with oily cloth.

3. See that fuse is not burned out.

4. See that ground wire is tight.

5. To determine whether fault is in the antenna or the control circuit, disconnect the leads coming from antenna. Connect a jumper wire from a known hot source and touch jump-

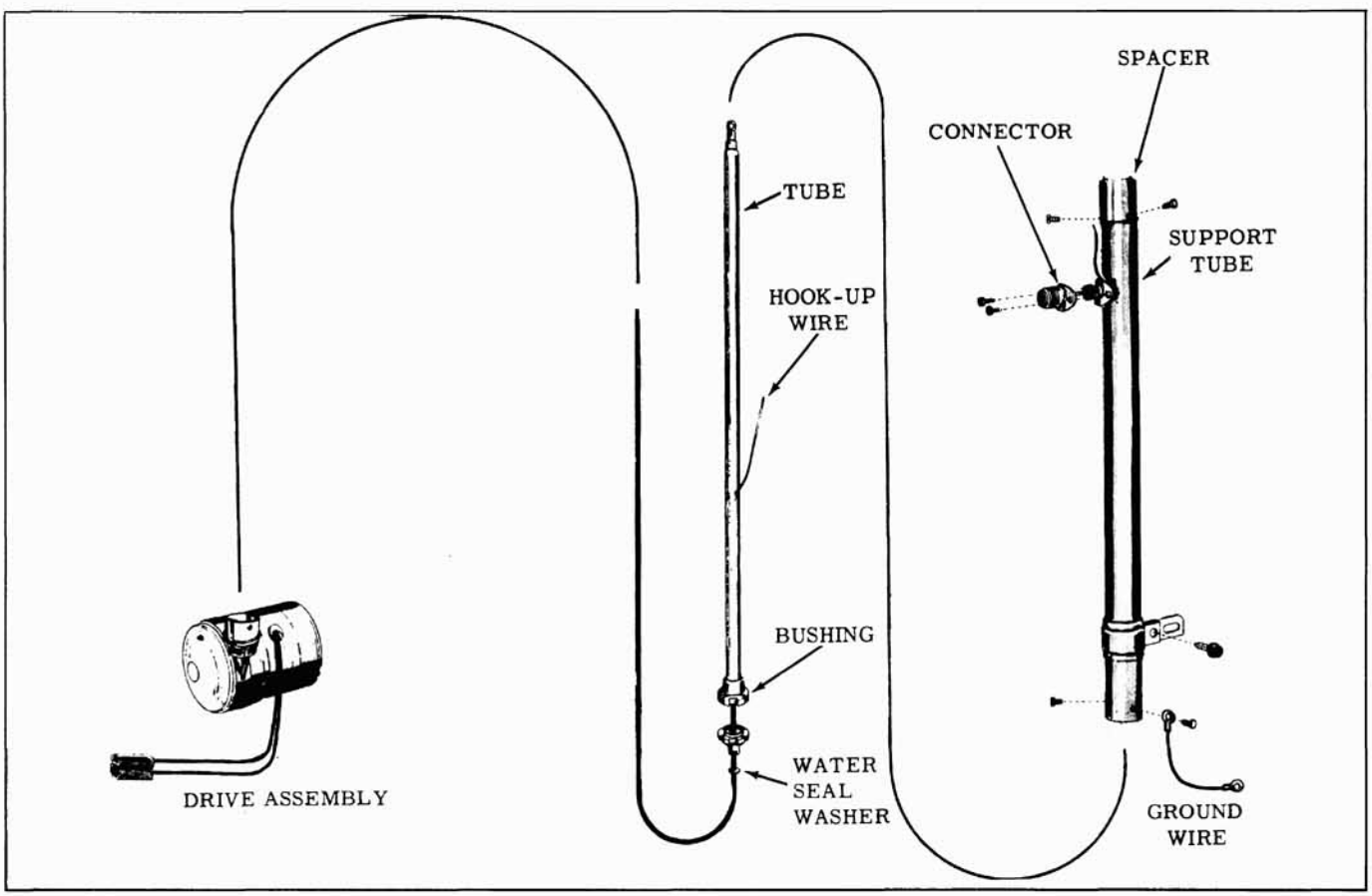


Fig. 15-21—Power Antenna Disassembled

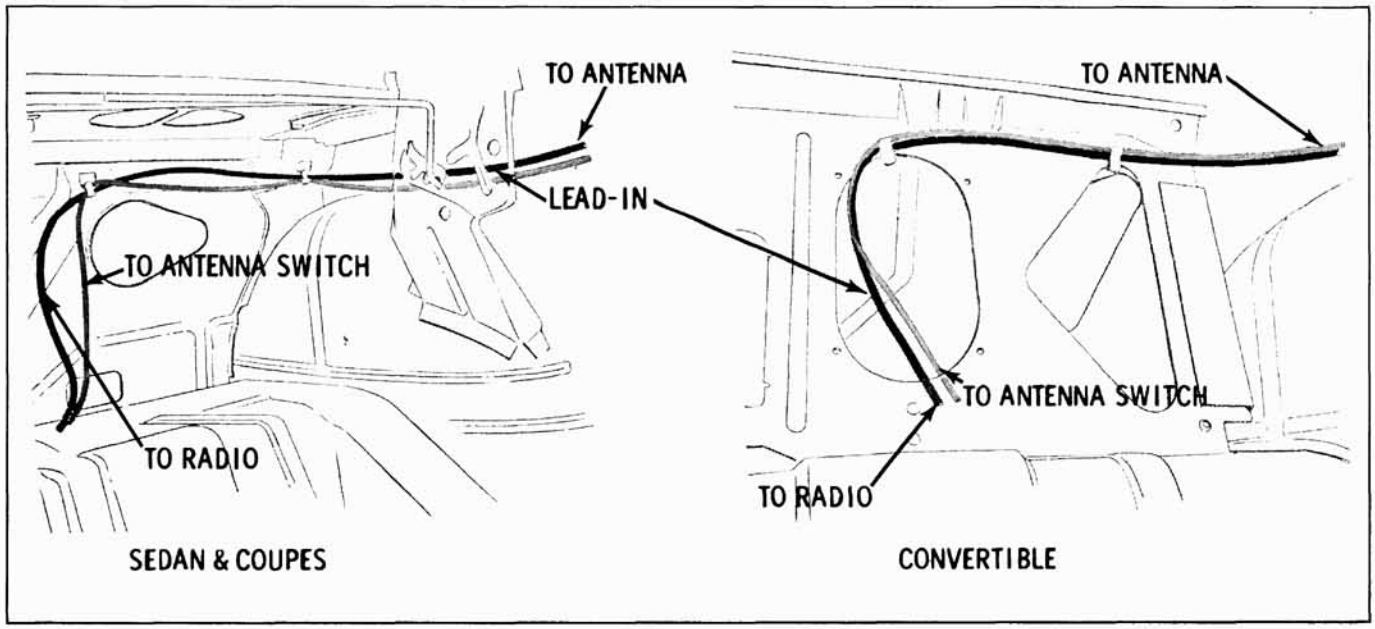


Fig. 15-22—Power Antenna Lead-in Routing (31 through 44 Series)

er wire to each of the terminals of the wires coming from the drive assembly. If antenna does not operate, the fault is in the antenna drive assembly. If antenna does operate, the fault is in the control circuit.

If antenna lead-in is suspected of being bad, check radio operation using an antenna lead-in known to be good.

If excessive static is encountered, check suppressors and static eliminators for proper installation. (Fig. 15-24)

6. If trouble is in the control circuit:

a. Examine electrical connections at switch, making sure they are securely connected.

b. Check wiring at switch with lamp or motor.

RADIO SYSTEM TESTER

With the radio system tester, service personnel can quickly determine if the radio system problem is in the antenna, antenna lead-in, the speaker or the receiver without removing the components.

Complete testing instructions are printed on the face of the tester. (Fig. 15-25)

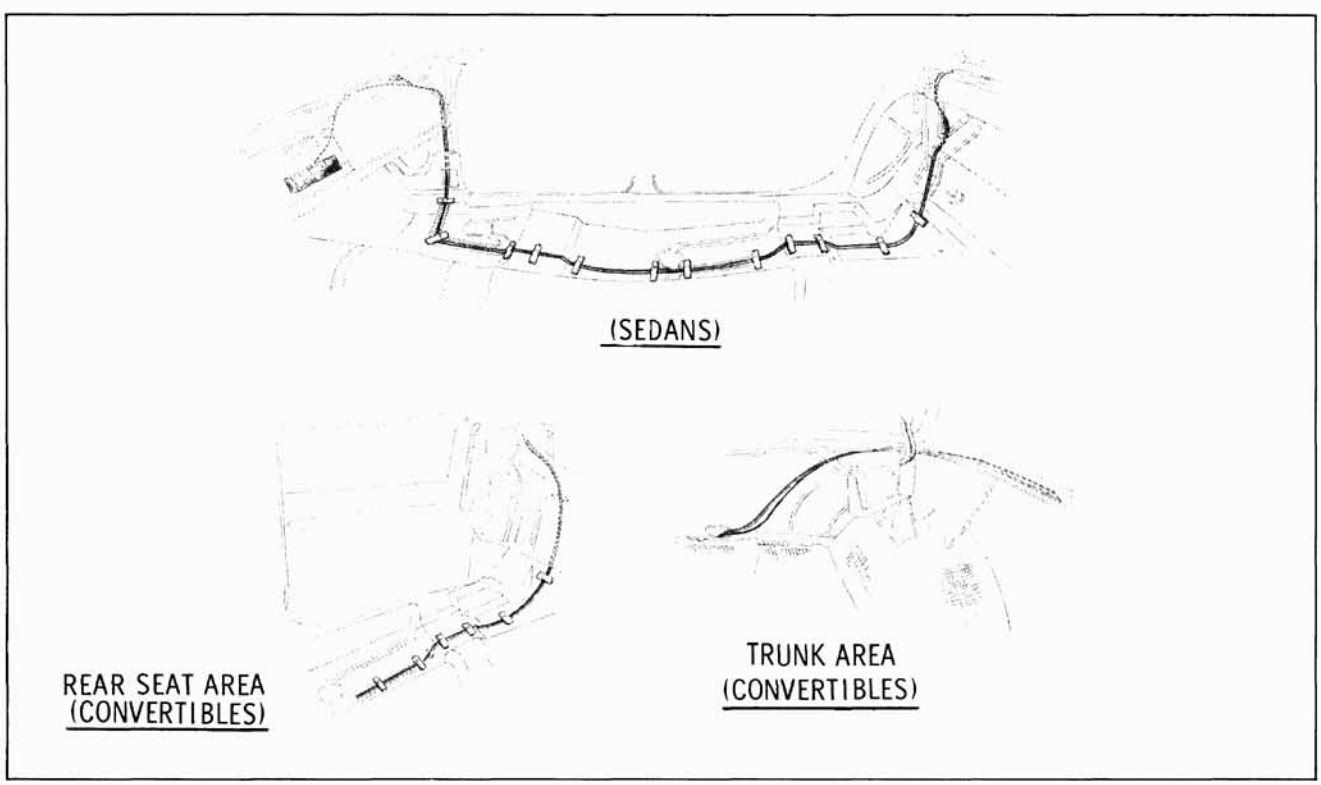


Fig. 15-23—Power Antenna Lead-in Routing (54 through 86 Series)

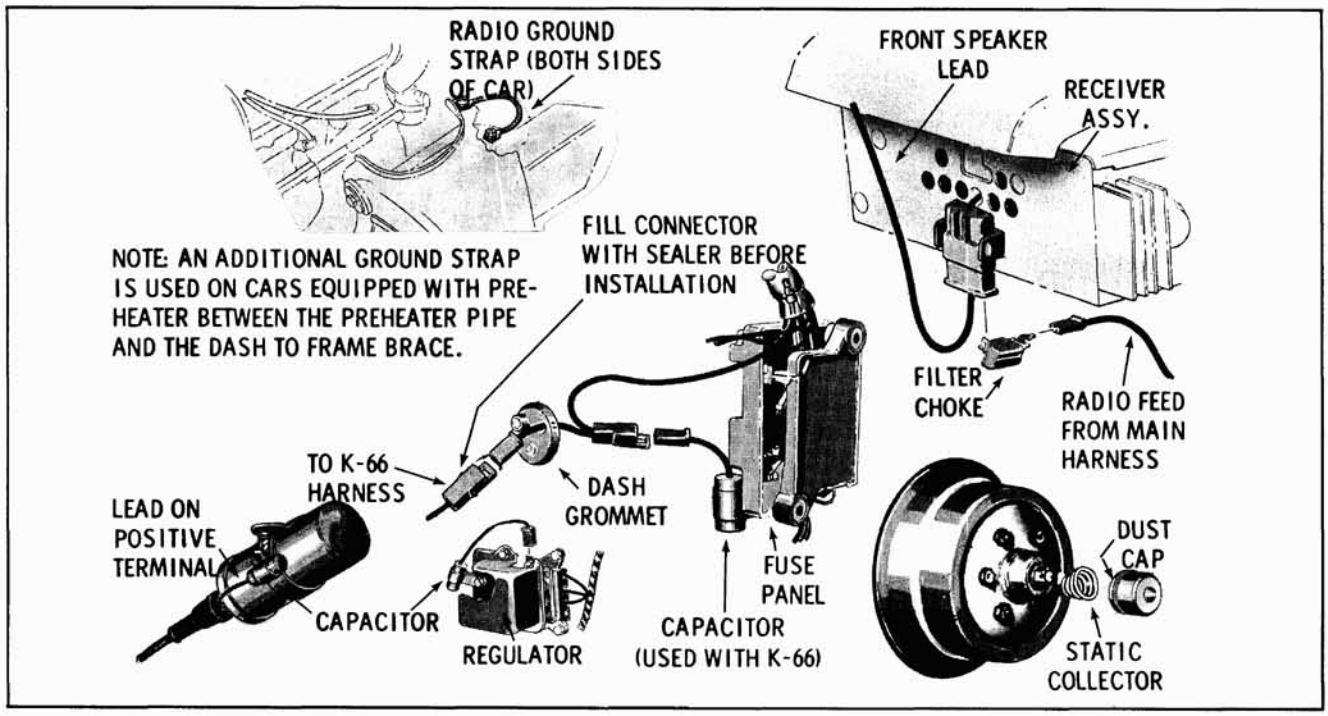


Fig. 15-24—Static Eliminators and Suppressors

DIAGNOSING RADIO PROBLEMS (Fig. 15-26)

Because radio service problems are mainly corrected by authorized Warranty Repair Stations, the tendency for many dealer servicemen is to remove the set when a problem is reported, without any preliminary diagnosis. A large number of sets are being reported to be standard when received by the Warranty Repair Stations. This indicates that the trouble is frequently correctable without removal of the radio.

The inconvenience to an owner of having to drive without a radio while his set is being serviced at a Warranty Station can frequently be avoided if the following quick checks are used to eliminate "outside" conditions before removing the set for repairs.

If possible, attempt to determine from the owner the exact nature of the radio problem as an aid to diagnosis. Knowing whether the condition is intermittent or constant, whether it occurs with engine off or running, with car stationary or moving, will help to pinpoint the problem.

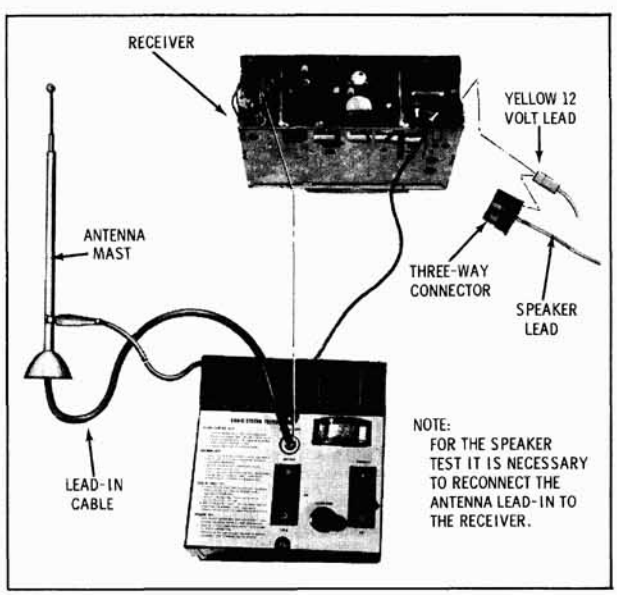


Fig. 15-25—Radio System Tester

CRUISE CONTROL 54-86 SERIES

DESCRIPTION

The automatic lock-in Cruise Control is a driver-operated speed regulating device that may be used either as a speed reminder or as an automatic speed control for any car speed between 25 mph and 85 mph.

The major components of the automatic lock-in Cruise Control are the regulator, mounted in the engine compartment, and the selector control assembly, located on the right side of the instrument cluster.

The regulator is driven by a flexible drive cable (Fig. 15-27). The drive cable also drives the speedometer cable that runs from the regulator to the speedometer. The selector control assembly is connected to the regulator by means of a bowden cable. Mechanical linkage connects the regulator to the accelerator and carburetor throttle rod.

The selector control assembly is shown in Fig. 15-28. Speed settings are secured by use of a calibrated thumb wheel. The selector dial is numbered with speed markings from 30 mph to 80 mph, in increments of 10 mph. An arrow on the selector control assembly indicates the speed on the selector dial for which the unit is set when in the ON position. The numbers on the dial are illuminated whenever the parking lights or headlights are on.

The sliding switch located on the top of the selector dial bezel turns the unit off and on, and activates the unit for automatic control. The sliding switch is in the OFF position at the top, ON position in the center, just at the point where spring tension is felt, and AUTO position when moved down to the bottom limit of its travel against spring tension.

When the switch lever is in the OFF position, the unit has no effect at any car speed. Once the switch lever has been

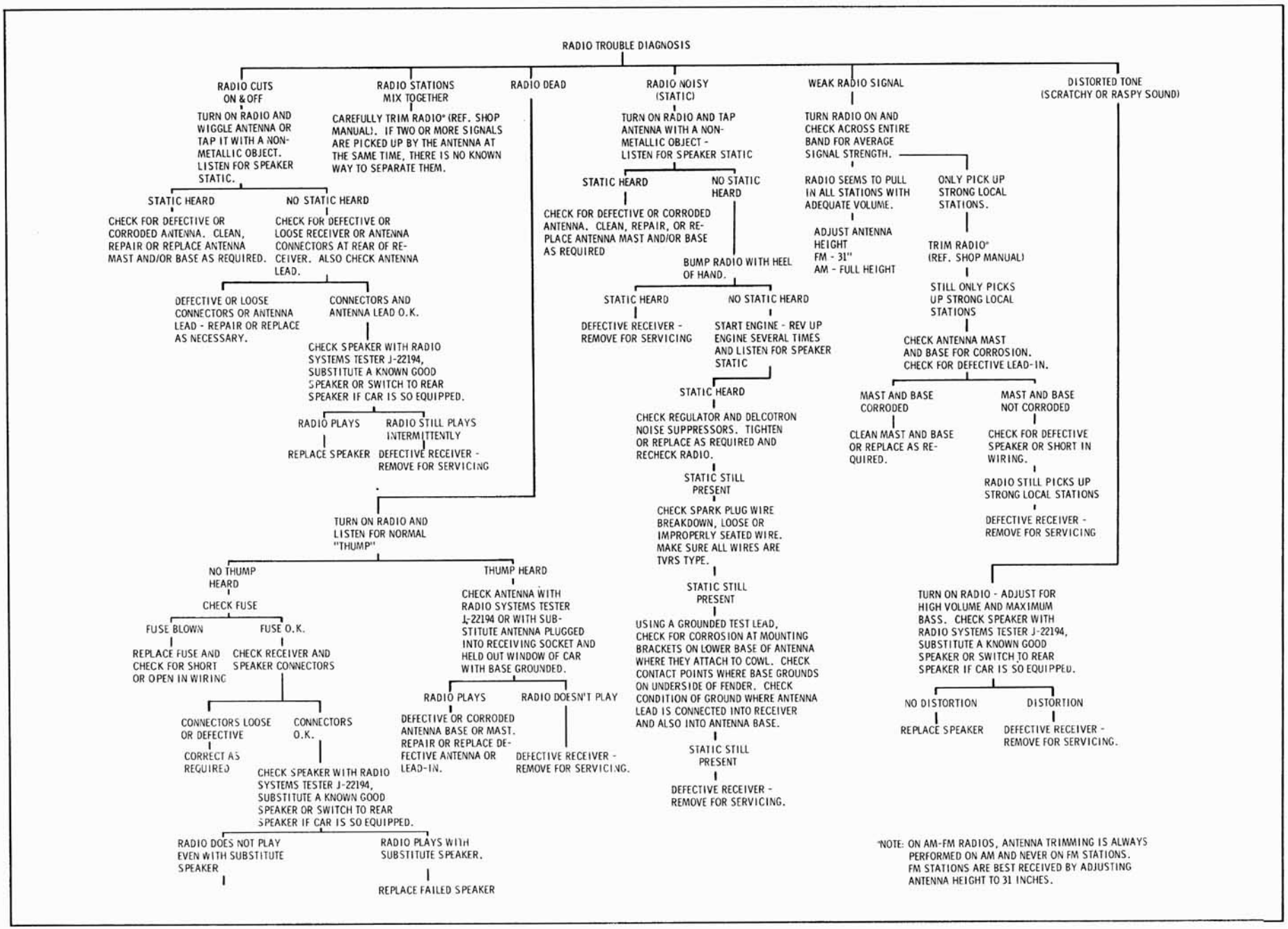


Fig. 15-26—Radio System Diagnosis

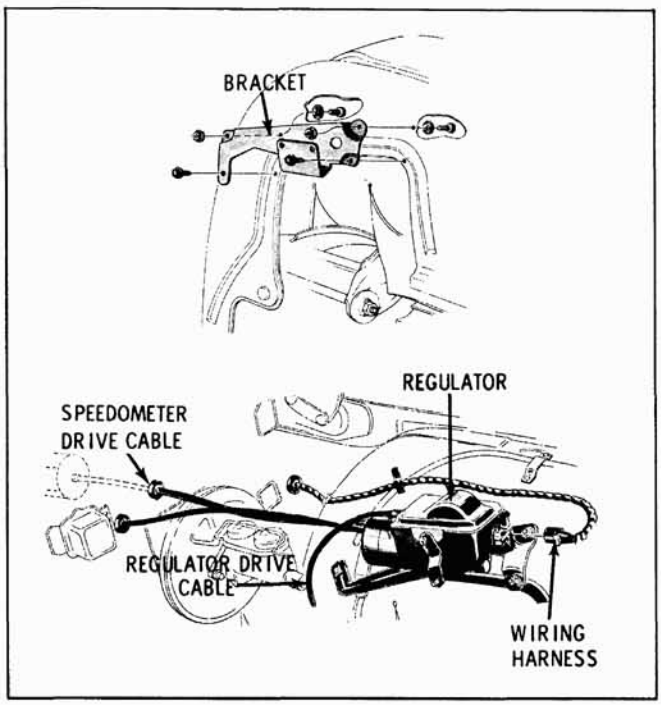


Fig. 15-27—Regulator Installation

moved to the ON position, the unit is on and accelerator back pressure will be felt as a warning at the speed for which the selector dial is set. Moving the switch lever momentarily to the AUTO position activates an automatic relay switch in the regulator engaging the unit for automatic control. The switch, which is spring loaded, will return to the ON position. Once the unit is set for automatic control, the unit will lock-in automatically whenever back pressure is felt on the accelerator pedal at the selected speed.

A reversible electric motor in the regulator actuates the mechanical linkage between the power unit and the carburetor. Motor feed points for forward and reverse energizing of the motor are closed and opened by a governor, under control of a governor spring that is compressed or relaxed to calibrated positions, corresponding to selected speeds, by the bowden cable leading to the selector control. The complete electrical circuit for the Cruise Control is shown in Fig. 15-29.

SPEED REMINDER OPERATION

Move the switch lever to ON or center position and rotate the selector dial to the desired speed setting. The Cruise Control will then function as a speed reminder by exerting back pressure on the accelerator pedal whenever the speed setting is reached. The unit will function in the same way whenever the speed setting is changed. Cruise Control does not interfere with normal acceleration up to the selected speed setting. Further acceleration may be obtained above that speed by pressing the accelerator pedal past the warning back pressure position.

AUTOMATIC SPEED CONTROL OPERATION

For automatic speed control, move sliding switch down momentarily to AUTO position. Then rotate selector dial to the desired speed setting. The unit is now set for automatic control and will lock-in automatically when back pressure is felt on the accelerator at the selected speed. The car will now maintain the selected speed automatically and the driver

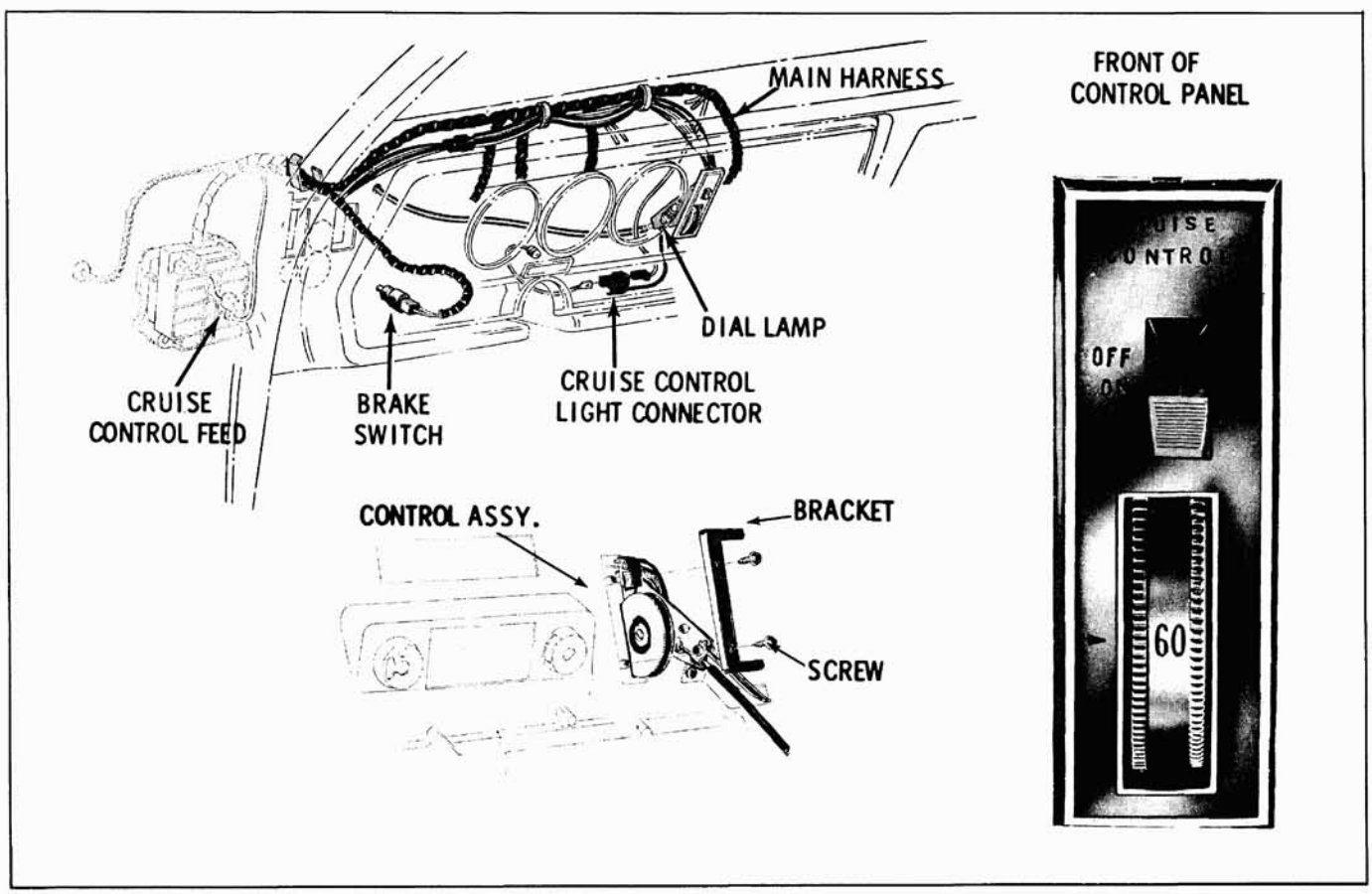


Fig. 15-28—Speed Selector Control

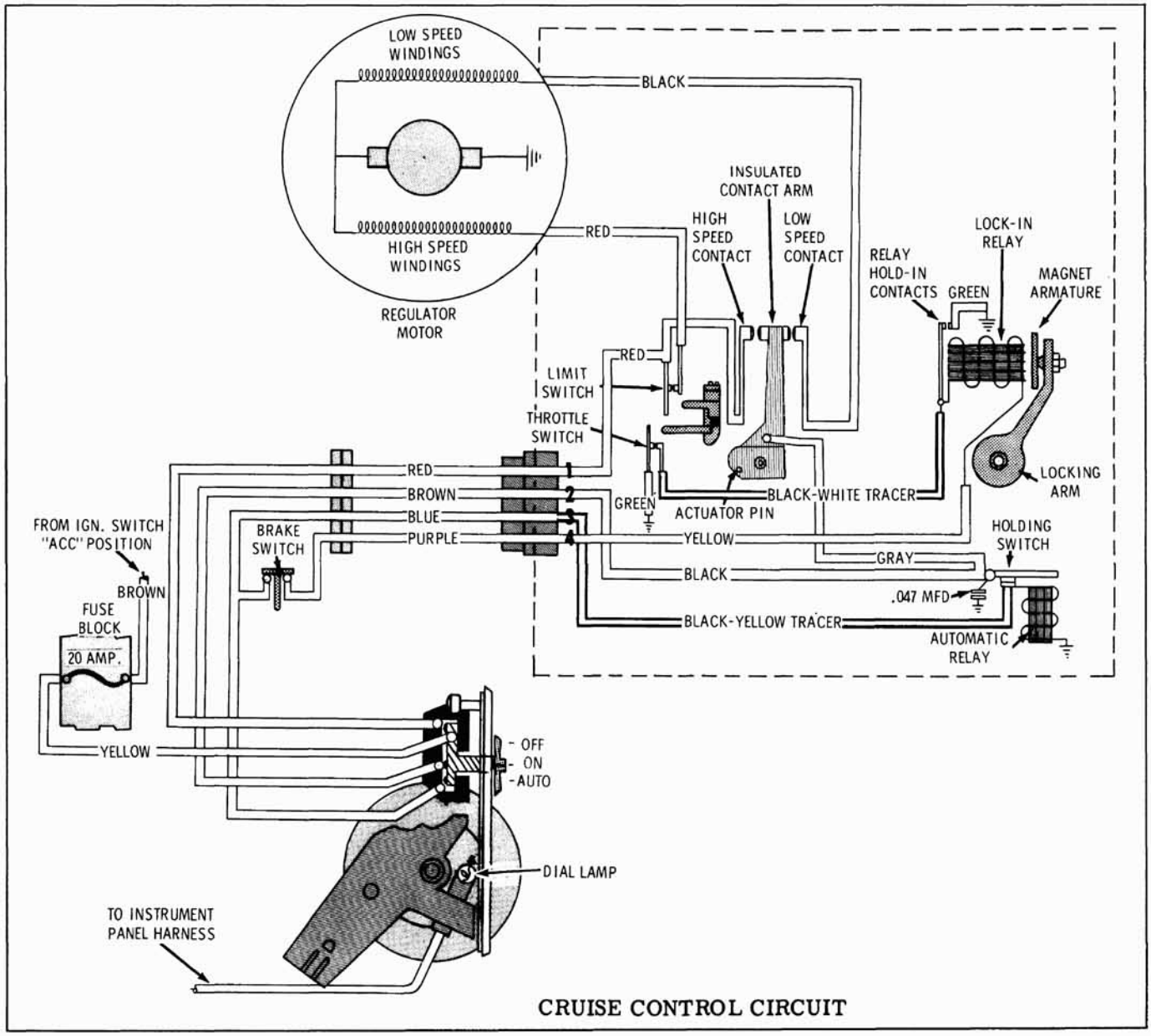


Fig. 15-29—Cruise Control Schematic

may remove his foot from the accelerator pedal if desired. Selected speed will be maintained regardless of road terrain, within limits of engine performance.

When the unit is on automatic control, car speed can be changed by slowly rotating the selector dial forward (down) to increase speed or rearward (up) to decrease speed. Also, car speed can be increased at any time by pushing the accelerator pedal through the back pressure. When the accelerator is released, the car will return automatically to the selected speed.

When using selector dial to increase car speed during automatic control, always rotate dial slowly, to prevent sudden acceleration.

Automatic control is disengaged when the brake pedal is depressed. It can be re-engaged by simply accelerating until back pressure is felt. It is not necessary to push the sliding switch to AUTO position to re-engage automatic control. The unit can be canceled by moving the slide switch to the OFF position, without touching the speed setting.

The ignition switch should never be turned off when the Cruise Control is engaged except in an emergency since this may cause permanent damage to the engine.

When the switch is in the OFF position, the unit has no effect at any car speed. Once the switch lever has been moved to the ON position, the unit is on and accelerator back pressure will be felt as a warning at the speed for which the selector dial is set. Moving the switch lever momentarily to the AUTO position activates an automatic relay switch engaging the unit for automatic control. The switch, which is spring loaded, will return to the ON position. Once the unit is set for automatic control the unit will lock-in automatically whenever back pressure is felt on the accelerator pedal at the selected speed.

A reversible electric motor in the regulator actuates the mechanical linkage between the power unit and the carburetor. Motor feed points for forward and reverse energizing of the motor are closed and opened by a governor, under control of a governor spring that is compressed or relaxed to calibrated positions, corresponding to selected speeds, by the bowden cable leading to the selector control.

It is not always necessary to remove and disassemble the regulator in cases of an inoperative Cruise Control. The following checks should be performed as part of your diagnosis to determine the cause and correction of the Cruise Control trouble and to eliminate unnecessary service work on the power unit.

1. Ground one test lamp lead and touch other lead to terminal No. 3 (NOTE: Ignition switch must be on for these tests). Push switch lever to AUTO position and allow switch to come back to ON position. Test lamp should light when slide switch reaches AUTO position and then go out when slide switch returns to ON position. If test lamp fails to operate as described above, check for defective wiring in selector control assembly.

2. Ground one test lamp lead and touch other lead to terminal No. 4. Push switch lever to AUTO position and manually hold switch lever in AUTO position. Depress brake pedal. Test lamp should go out and then come on when brake pedal is released. If lamp fails to operate as described above, check for improperly adjusted brake switch or defective wiring in selector control assembly. Allow switch lever to return to ON position.

3. Connect multiple connector to power unit.

4. Ground one test lamp lead and touch other lead to terminal No. 3 (white with black stripe wire) at power unit. Push switch lever to AUTO position and allow switch to come back to ON position. Test lamp should light when switch lever reaches AUTO position, and remain lit when slide switch returns to ON position. If test lamp fails to operate as

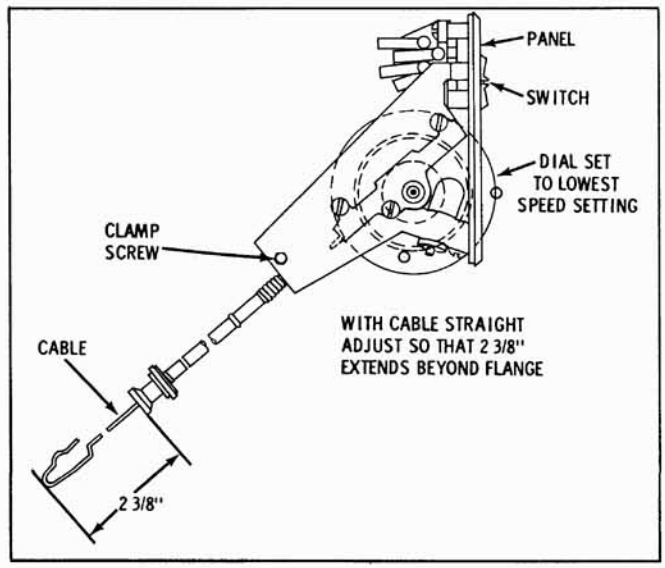


Fig. 15-30—Control Cable Adjustment

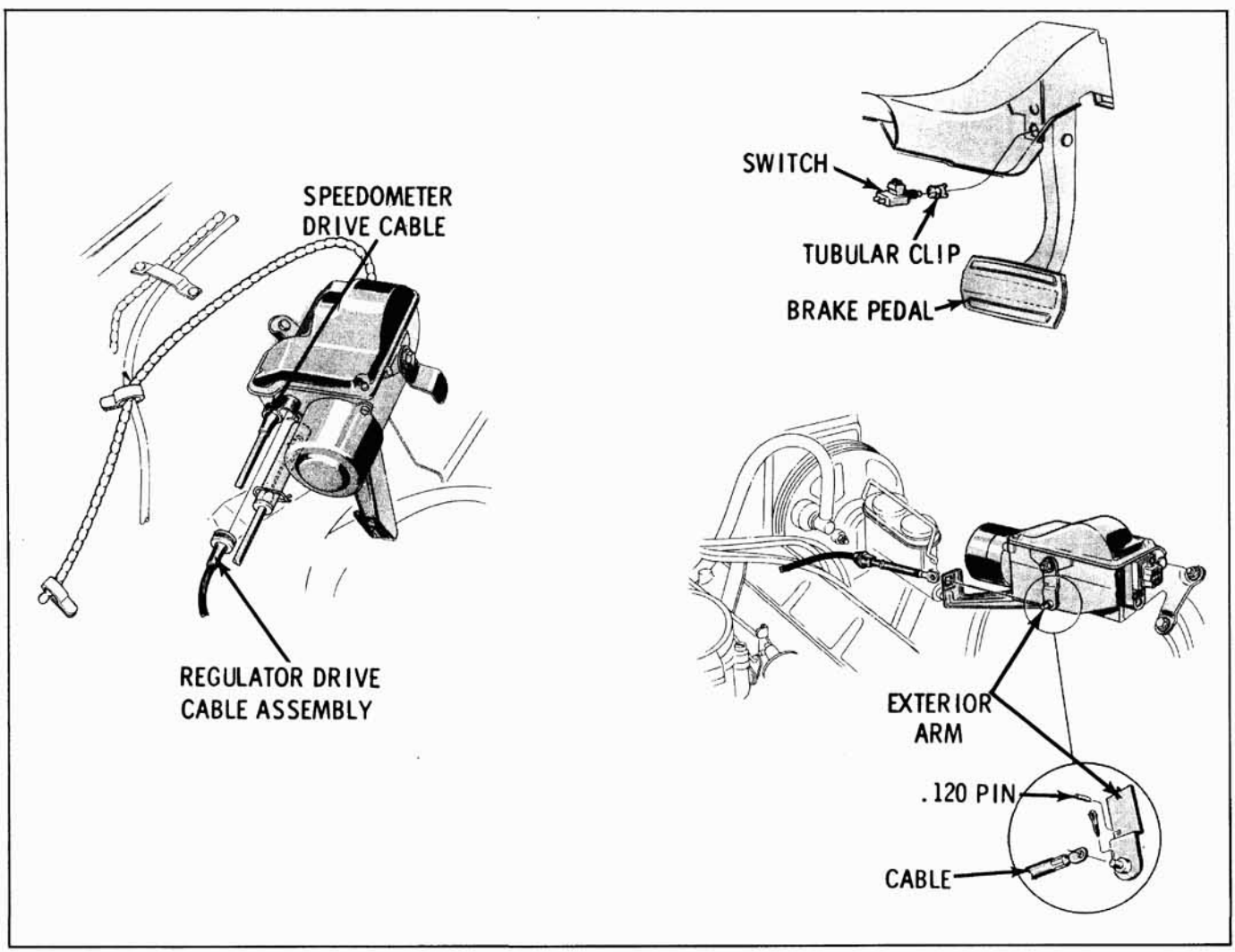


Fig. 15-31—Cable Installation

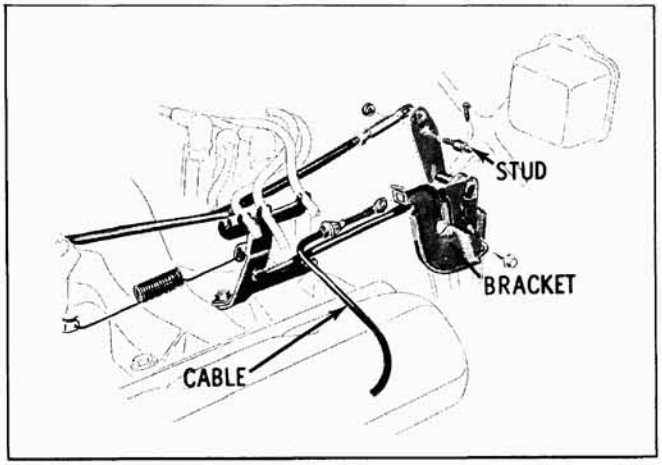


Fig. 15-32—Cable Adjustment

described above, check for loose connections at relay switch or a defective relay switch.

5. Remove four screws securing power unit cover to power unit and remove cover.

6. Turn ignition switch on and momentarily move slide switch to AUTO position to set unit for automatic control. Do not start engine.

7. Move locking arm against magnet and move contact arm against motor feed point on locking arm side of magnet. Unit should lock-in when throttle switch closes and magnet is moved to low speed position. Move slide switch to OFF position. Unit should disengage and magnet will move to wide open throttle position, opening the throttle switch.

SELECTOR DIAL ADJUSTMENT

1. Rotate selector dial downward to high speed position against its stop.

2. Push switch lever to ON position.

3. Operate car at a steady speed of 50 mph, as indicated on speedometer.

This adjustment must be performed on highway. Do not perform on hoist or jack stands in shop area.

4. Rotate selector dial upward until back pressure is felt on accelerator pedal, then lock in Cruise Control by momentarily pushing switch lever to AUTO position.

5. With car speed at 50 mph, as indicated on speedometer, the numeral 50 on selector dial should be lined up with arrow on selector control assembly. Observe reading on dial then move switch to OFF position. Do not rotate selector dial.

6. If reading on selector dial agrees with reading on speedometer, selector dial is properly adjusted.

7. If readings do not agree, adjust selector dial as follows:

a. With switch lever in OFF position, rotate selector dial either downward (if dial reading is on the low side) or upward (if dial reading is on the high side) against its stop. Then rotate dial by hand beyond its stop the necessary amount of travel as observed in Step 5 to correct the selector dial setting.

b. Repeat adjustment procedure until reading on selector dial agrees with reading on speedometer.

SELECTOR CONTROL CABLE ADJUSTMENT

The control cable is pre-set at the factory and normally should not require adjustment unless a new cable is installed. This adjustment must be performed off the car. Adjust control cable as follows:

1. Remove cruise control selector assembly.

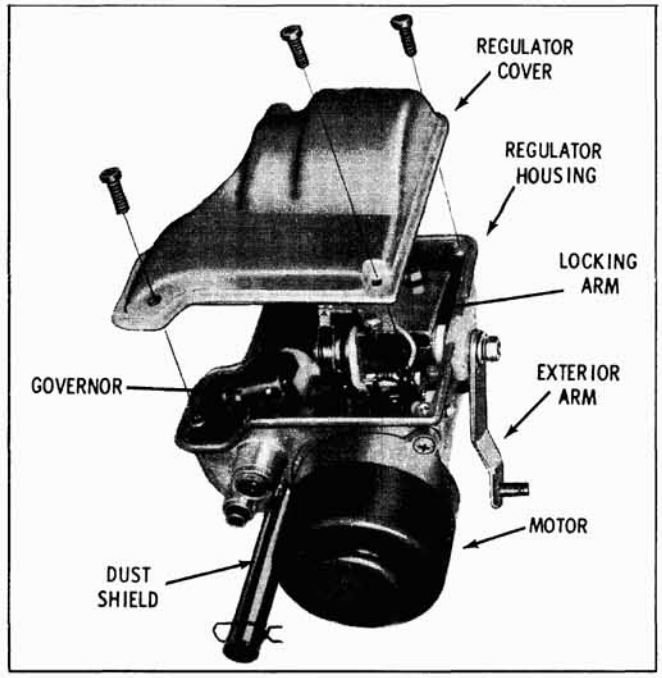


Fig. 15-33—Cover Removal

2. Rotate selector dial to low speed position against stop.

3. Position assembly flat on work bench. Make certain there are no kinks in cable.

4. Using a steel scale, measure the distance shown in Fig. 15-30 and after adjusting screw is loosened, adjust cable to 2 3/8" as shown.

5. Tighten adjusting screw and reinstall as shown in Fig. 15-31.

THROTTLE CABLE ADJUSTMENT (Fig. 15-32)

1. With throttle cable and cotter pin installed on regulator assembly exterior arm, align hole in exterior arm with hole in regulator case and insert .120 dia. gage pin. (Fig. 15-31)

2. Loose assemble stud and nut to bellcrank assembly.

3. Install throttle cable and cotter pin.

4. With carburetor in slow idle position, tighten nut on stud to bellcrank assembly.

5. Remove gage pin from regulator assembly and check operation.

MOTOR FEED POINTS ADJUSTMENT

1. If working on car, disconnect terminal board connector at power unit housing.

2. Remove three screws that secure cover to housing. (Fig. 15-33)

3. Connect negative lead of a 12-volt power source to housing.

4. Connect positive lead to close throttle motor feed point (black wire). Magnet assembly will move to close throttle position. Disconnect positive lead.

5. Measure gap between either motor feed point and center contact arm. This gap should be .070" ± .010". Bend either motor feed point to adjust and recheck gap (Fig. 15-34).

A blackened condition of motor feed points does not mean they should be replaced. Points need never be replaced unless broken.

6. Touch positive lead to open throttle motor feed point (red wire). This will run magnet assembly to wide open throttle position. Disconnect positive lead.

7. Insert a 1/8" drill into exterior arm hole and hole in

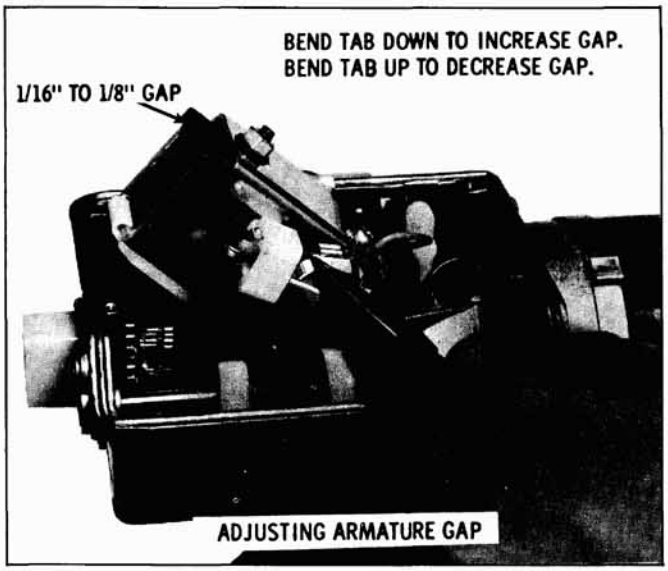


Fig. 15-34—Feed Point Adjustment

housing.

8. Spread governor weights to the limits of their travel with fingers.

9. Touch positive lead to center contact arm terminal (gray wire). Magnet assembly will move toward close throttle position. Disconnect positive lead when magnet assembly stops moving. There should be 1/16" to 1/8" between locking arm and outer casting of magnet assembly.

10. If magnet assembly is less than 1/16" from locking arm, adjust contact arm by bending curved tab down, slightly. If magnet assembly is more than 1/8" from locking arm, bend tab upward slightly. After each bend, check magnet assembly to locking arm gap by repeating Steps 6, 8 and 9.

11. Remove power source leads.

12. Remove 1/8" drill from exterior arm and hole in housing.

13. Install cover on housing and secure with three screws.

14. If working on car, connect terminal board connector at housing.

LIMIT SWITCH AND THROTTLE SWITCH POINT ADJUSTMENT (Fig. 15-35)

Adjusting the limit switch points will also adjust the throttle switch points.

1. If working on car, turn ignition switch to ON position but do not start engine.

2. If working off car, connect the negative lead of a 12-volt power source to the power unit housing and connect the positive lead to the No. 1 terminal at the terminal board.

Terminal board is numbered on inside with respective terminal numbers.

3. Loosen screw securing striker to housing and move striker up until motor stops running. Then slowly move striker down until motor just starts running. Move striker down an additional .020" to .030" and tighten screw to perform adjustment. (Fig. 15-36)

4. If working on car, turn ignition switch off.

5. If working off car, disconnect power source leads.

BRAKE RELEASE SWITCH ADJUSTMENT (Fig. 15-31)

1. Insert switch into tubular clip until switch body seats

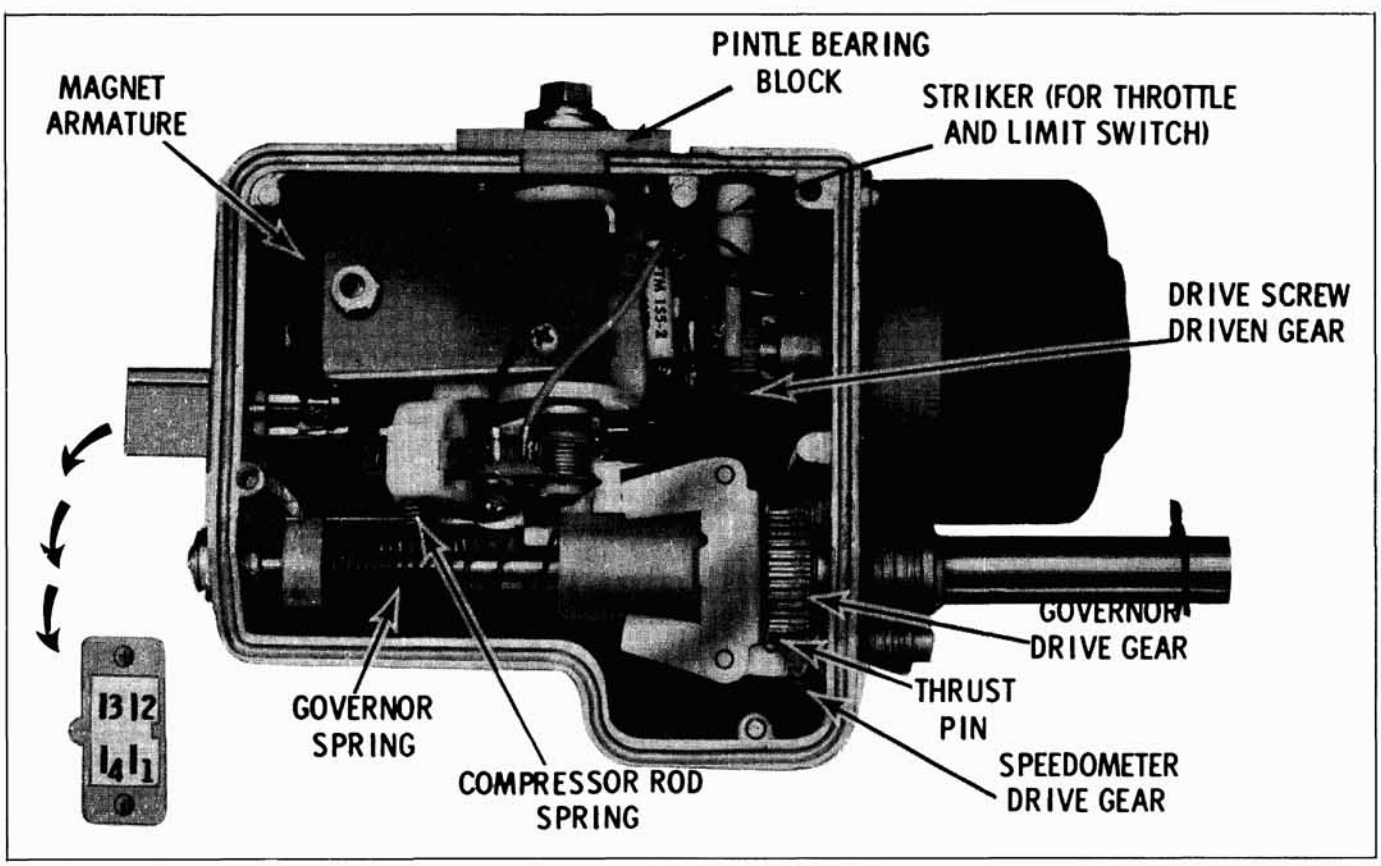


Fig. 15-35—Regulator Assembly

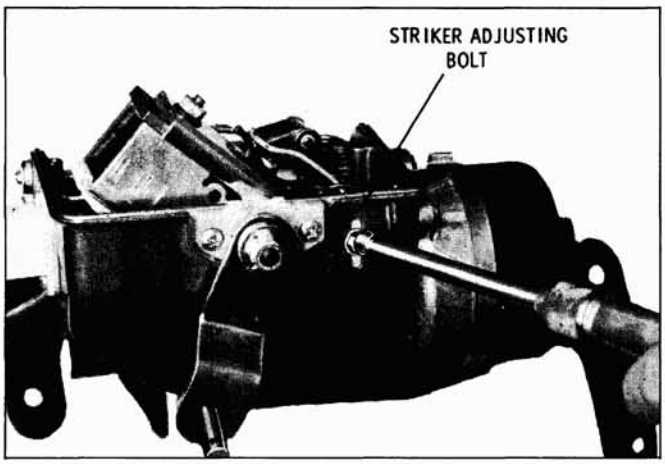


Fig. 15-36—Limit Switch and Throttle Switch Point Adjustment

on tubular clip.

2. Pull brake pedal rearward against internal pedal stop. Switch will be moved in tubular clip providing proper adjustment.

CHECKING MOTOR OPERATION

1. Remove three screws securing power unit cover and remove cover.
2. Check accelerator linkage adjustment, as previously described.
3. Turn ignition switch ON. Do not start engine.
4. Momentarily move slide switch to AUTO position to set unit for automatic control.
5. Move locking arm against magnet, simulating automatic control.
6. Move contact arm to touch motor feed point on locking arm side of magnet. Motor should rotate drive screw and close the throttle through the accelerator linkage. Motor should move magnet to wide open throttle position when contact arm is released.
7. If motor will not open or close throttle through accelerator linkage, motor may be binding. Check alignment of motor with housing. To check motor for binding loosen motor from housing without disconnecting motor leads and disengage motor shaft from drive screw. Move contact arm against motor feed point on motor side of magnet assembly to check reverse operation, and against motor feed point on locking arm side of magnet assembly to check forward operation. If motor does not run free, replace motor. If motor runs free, then make motor stall test.
8. The drive screw or carburetor linkage may also be binding. After making certain motor runs free, check drive screw for binding by turning plastic gear on drive screw with finger to check for free rotation. If drive screw does not rotate freely, it is defective and should be replaced. If motor and drive screw operate satisfactorily, then adjust carburetor linkage.
9. Turn ignition switch OFF, move switch lever to OFF position, and replace power unit cover.

MOTOR STALL TEST

1. Disconnect multiple electric connector at power unit.
2. Remove three screws securing power unit cover to housing and remove cover.
3. Connect positive lead of an ammeter tester to positive battery terminal.
4. Insert 1/8" drill into hole of power unit housing to limit travel of locking arm and prevent rotation of drive screw.
5. Connect negative lead of tester to terminal No. 2 on front of power unit.
6. Hold contact arm against motor feed point on locking arm side of magnet and observe reading on ammeter. If reading on ammeter indicates more than 7 amps, motor is drawing too much current and should be replaced.
7. Disconnect tester leads, remove drill, install cover, and connect multiple connector.

CHECKING FOR DAMAGED CABLES AND GEARS

1. Raise left front wheel of car.
2. Remove speedometer cable at regulator, rotate wheel and check to see if nylon gear is turning. This will determine if cable from wheel to regulator is turning and if gear is operating.
3. If nylon gear is turning, cable to speedometer is broken or speedometer is inoperative.
4. If nylon gear is not turning, disconnect cable at the regulator.
5. If cable is turning, gears are stripped inside the regulator.
6. If cable is not turning, check for a broken cable or stripped speedometer drive mechanism.
7. Replace parts as required.

POWER UNIT

Removal (Fig. 15-27)

1. Disconnect multiple electric connector at power unit.
2. Disconnect drive cable and speedometer cable at power unit.
3. Remove retainer spring and pull bowden cable to remove from power unit.
4. Remove cotter pin at exterior arm and separate Cruise Control cable and washer from exterior arm.
5. Remove two screws securing power unit to mounting bracket and remove power unit, leaving mounting bracket attached.

Installation

1. Position power unit on mounting bracket and secure to bracket with two screws.
2. Install Cruise Control cable and washer at exterior arm and secure with cotter pin.
3. Push bowden cable into dust shield and secure with retainer spring.
4. Rotate selector dial to low speed stop to secure control cable into adjustable coupling.

This step must be performed or unit will control in "ON" position or lock in "AUTO" position at low speed regardless of selected setting.

5. Connect drive cable and speedometer cable at power unit.
6. Connect multiple electrical connector at power unit.

POWER UNIT DISASSEMBLY

It is not necessary to disassemble and assemble the complete power unit to service individual components. Instructions on how to service the five basic components are given: the magnet assembly, the motor, the drive screw assembly, the governor assembly and speedometer gear, and the compressor rod and dust shield.

MAGNET ASSEMBLY

Removal

1. Remove three screws that secure cover to housing and remove cover.
2. Using a 12-volt power source, attach negative lead to housing. Manually move contact point to close throttle position and touch positive lead to terminal No. 2 on termi-

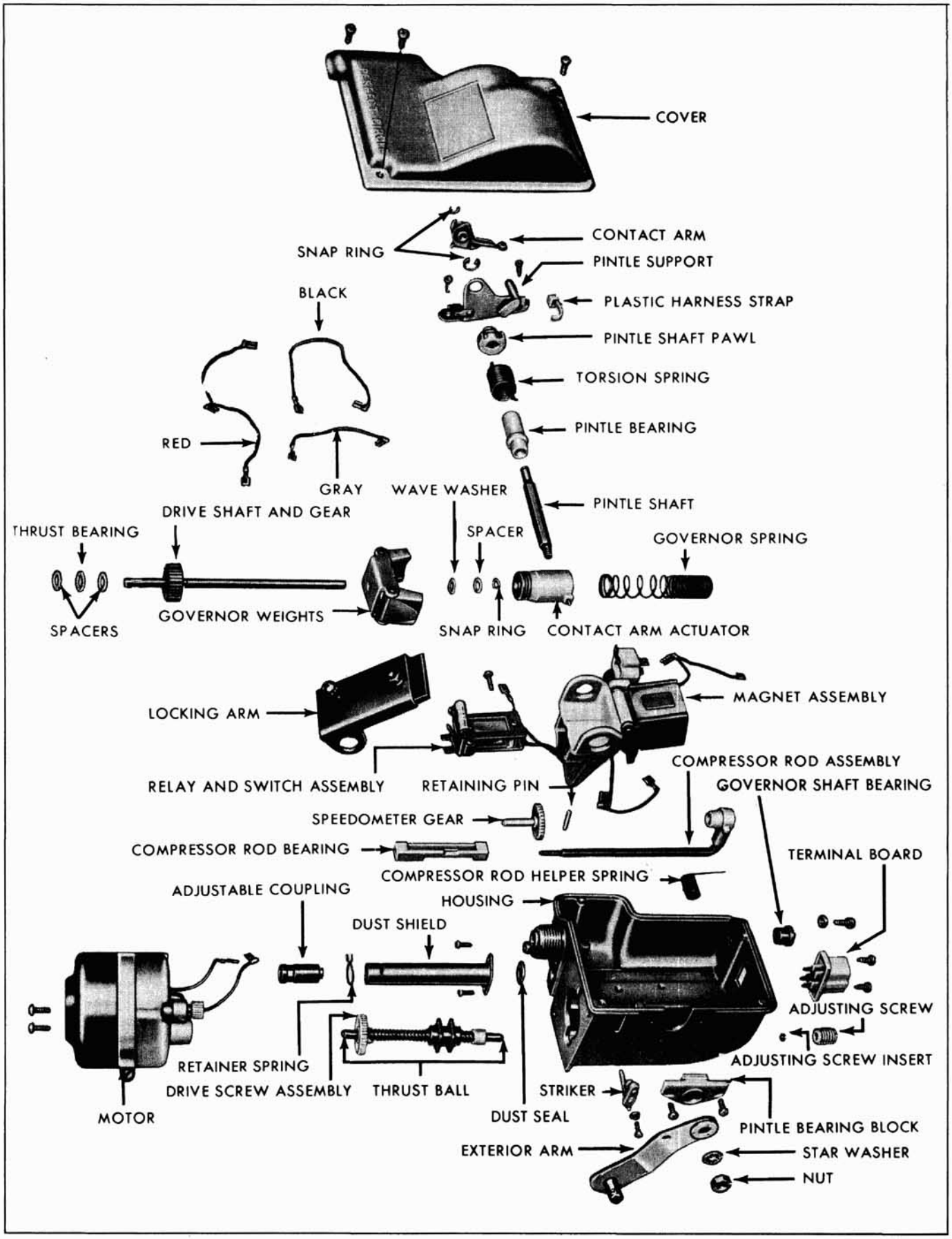


Fig. 15-37—Regulator Assembly Exploded

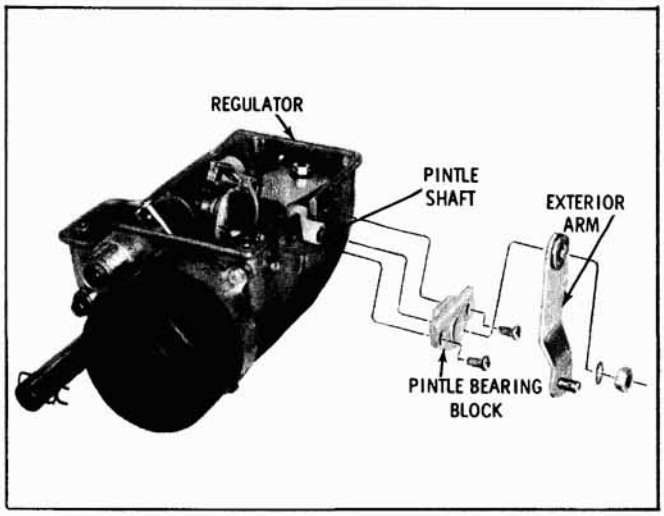


Fig. 15-38—Removing Bearing Block

nal board. This will move magnet assembly to close throttle position.

Board is numbered inside by respective terminals. Refer to Fig. 15-37 for the following steps.

3. Remove power source leads.
4. Remove red motor wire from limit switch point terminal.
5. Disconnect black motor wire at close throttle motor point.
6. Unhook compressor rod helper spring.
7. Remove nut, starwasher and exterior arm from pintle shaft.
8. Remove two screws securing pintle bearing block to housing and remove pintle bearing block (Fig. 15-38).

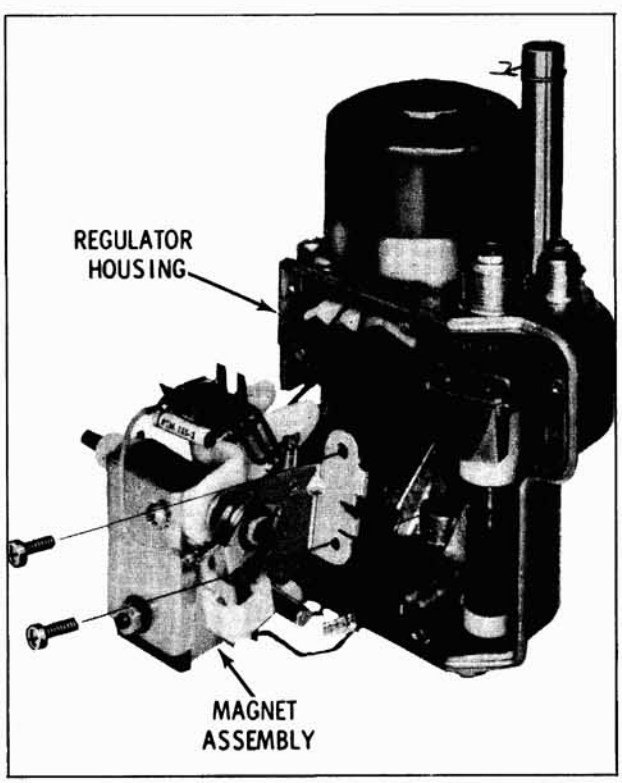


Fig. 15-39—Removing Magnet Assembly

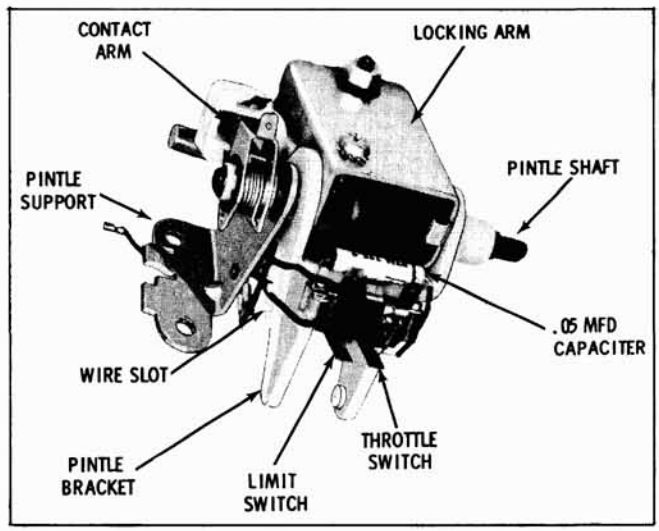


Fig. 15-40—Magnet Assembly

9. Remove two screws holding pintle support to housing (Fig. 15-39).
10. Swing assembly clockwise as viewed from motor side and free pin of contact arm actuator from contact arm.
11. Disconnect red, black, black with yellow stripe and yellow wires from terminal board and remove assembly.

MAGNET DISASSEMBLY

See Fig. 15-37, 15-40 and 15-41 when performing the following steps. Wires must be routed exactly as illustrated.

1. Disconnect green wire at lower outboard terminal of auto relay switch (capacitor side) and at pintle support.
2. Disconnect gray wire from terminal on contact arm and at upper outboard terminal of auto relay switch (capacitor side).
3. Disconnect black wire at upper inboard terminal of auto relay switch (capacitor side) and remove from lower slot on pintle bracket. Cut plastic harness strap at pintle support.
4. Disconnect red wire from inboard terminal of auto relay switch (magnet side) and at open throttle motor feed point.
5. Disconnect black with white stripe wire at outboard terminal of auto relay switch (magnet side) and at holding switch.
6. Remove screw securing auto relay switch to magnet assembly and slide auto relay switch from pintle bracket.
7. Remove small snap ring from end of pintle shaft.
8. Remove larger snap ring from pintle shaft.
9. Mount magnet assembly in a vise. Position exterior arm on pintle shaft and take up torsion spring tension. Hold in this position and loosen screw at locking arm until screw clears pintle shaft pawl. Slowly release and then remove exterior arm.
10. Loosen set screw on pintle shaft pawl with an Allen wrench.
11. Remove pintle shaft from magnet assembly, and catch contact arm. Remove pintle support.
12. Remove pintle bearing and torsion spring from magnet assembly.
13. Remove pintle shaft pawl and locking arm from magnet assembly.

MAGNET ASSEMBLY

1. Slide auto relay switch on magnet assembly and secure with one screw.
2. Position locking arm on pintle bracket and insert pintle

shaft pawl so that notch in pawl is visible. Position torsion spring and pintle bearing.

3. Install pintle support on pintle shaft pawl.

4. Position contact arm between points and insert pintle shaft into assembly.

5. Install large snap ring on inner groove of pintle shaft between contact arm and pintle shaft pawl.

6. Install small snap ring on end of pintle shaft.

7. Turn pintle shaft until set screw in pintle shaft pawl is visible. Tighten set screw with an Allen wrench.

8. Mount magnet assembly in a vise. Position exterior arm on pintle shaft and rotate exterior arm clockwise until screw in locking arm can engage notch in pintle shaft pawl. Tighten screw.

Wires must be routed exactly as illustrated.

9. Connect black with white stripe single lead at outboard terminal of auto relay switch (magnet side) and double lead at holding switch.

10. Connect single lead red wire at inboard terminal of auto relay switch (magnet side) and connect double lead at open throttle motor feed point.

11. Connect black wire at upper inboard terminal of auto relay switch (capacitor side) and position wire in lower slot on pintle bracket.

12. Position black with yellow stripe wire under red wire terminal connector. Secure black with yellow stripe, yellow and black wires at pintle support with new plastic harness strap. Position wires so there is approximately 2 1/8" extending from strap. Cut off excess strap.

13. Connect gray wire at terminal on contact arm and at upper outboard terminal of auto relay switch (capacitor side).

14. Route green wire from holding switch over red wire and black with yellow stripe, yellow and black wires and position in center slot of pintle bracket. Then route green wire over black wire and connect double lead to lower outboard terminal of auto relay switch (capacitor side) and single lead to pintle support.

MAGNET ASSEMBLY

Installation (Refer to Figs. 15-37, 15-40 and 15-41 when performing the following steps)

1. Position compressor rod helper spring with shorter end positioned against tang.

2. Install magnet assembly into housing, engaging pin of contact arm actuator with hole in contact arm. Align bracket tangs on bottom of magnet assembly with grooves in drive screw nut. Tang on pintle support must engage notch in compressor rod bearing.

3. Install pintle bearing block and secure with two screws.

4. Install two screws that secure pintle support to housing.

5. Using a pair of needle nose pliers, hook compressor rod helper spring under tab on plastic compressor rod cap.

6. Install exterior arm so that when on pintle shaft the hole in the exterior arm can be aligned with hole in housing. Secure with starwasher and nut.

7. Connect black motor wire at close throttle motor feed point routing under black wire at relay and gray wire at contact arm.

8. Connect rod motor wire at limit switch point terminal (lower inboard terminal of relay switch).

9. Install cover on housing and secure with three screws.

10. Perform limit switch and throttle switch points adjustment as previously outlined.

11. Perform motor feed points adjustment as previously outlined.

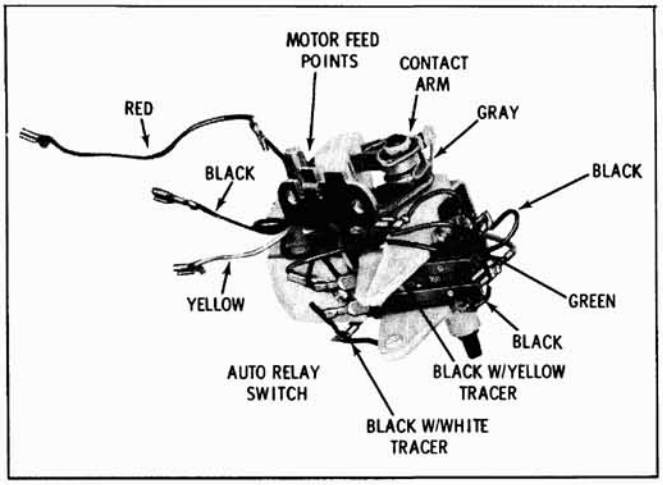


Fig. 15-41—Magnet Assembly

MOTOR

Removal

1. Remove three screws that secure cover to housing and remove cover.

2. Disconnect red motor wire from limit switch point terminal.

3. Disconnect black motor wire at close throttle motor point.

4. Remove two screws that secure motor to housing and remove motor (Fig. 15-42).

MOTOR

Installation

1. Install motor on housing, aligning drive shaft screw with hole in motor and bracket tangs on bottom of magnet assembly with grooves in drive screw nut. Install two screws that secure motor to housing.

2. Check drive screw to see if it will turn. If not, adjust as described in Step 4.

3. Turn adjusting screw until it is tight. Do not force. Then back off screw 1/4 turn.

4. Connect black motor wire at motor feed point routing under black wire at relay and gray wire at contact arm.

5. Connect red motor wire at limit switch point terminal (lower inboard terminal of relay switch).

6. Install cover on housing and secure with three screws.

DRIVE SCREW ASSEMBLY

Removal

1. Remove magnet assembly as described in previous part of this section.

2. Remove two screws that secure motor to housing and remove motor.

3. Remove drive screw assembly (Fig. 15-43).

COMPRESSOR ROD AND DUST SHIELD

Removal

1. Remove governor assembly as previously described.

2. Loosen two screws that secure pintle bearing block to housing and two screws that secure pintle support to housing enough to free compressor rod bearing.

3. Pull up compressor rod against its stop and measure gap between compressor rod plastic cap and housing using a feeler gauge. Record measurements (Fig. 15-44).

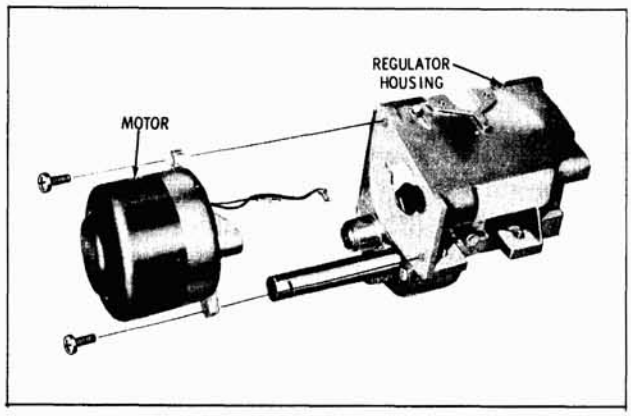


Fig. 15-42—Motor Removal

This measurement is necessary for installation purposes.

4. Push compressor rod down and remove adjustable coupling with a screwdriver.
5. Remove compressor rod assembly from housing and slide off compressor rod bearing.
6. Remove two screws that secure dust shield to housing and remove felt dust seal.

COMPRESSOR ROD AND DUST SHIELD

Installation

1. Lubricate compressor rod with cam and bearing lubricant and slide compressor rod bearing on compressor rod with notch on inboard side.
2. Position compressor rod in housing so that a portion of the rod extends from housing. Hold compressor rod in this position and install dust seal on rod so that square hole in dust seal will align with square section of compressor rod and dust seal as positioned in housing.
3. With dust seal correctly positioned, install dust shield with two screws.
4. Insert adjustable coupling into dust shield and screw onto compressor rod.
5. Using a feeler gauge, position compressor rod plastic cap with same gap between housing and cap as during removal and screw adjustable coupling on rod until same gap is obtained.
6. Tighten two screws that secure pintle support to housing, aligning notch in compressor rod bearing with tang on pintle support.
7. Tighten two screws that secure pintle bearing block to housing.

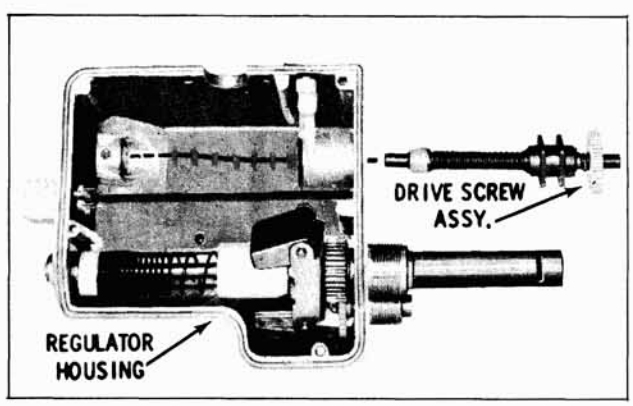


Fig. 15-43—Drive Screw Assembly

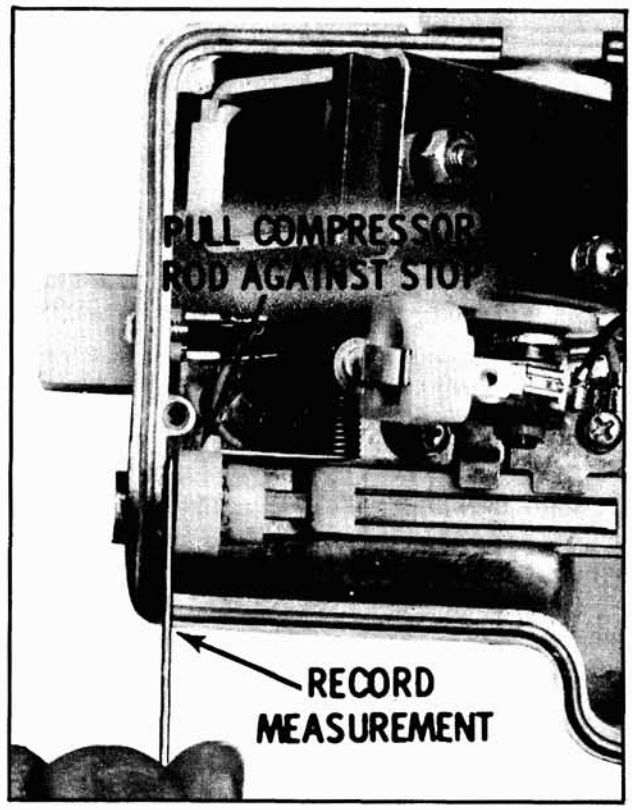


Fig. 15-44—Compressor Rod Clearance

8. Install governor assembly as previously described.

DRIVE SCREW ASSEMBLY

Installation

1. Lubricate drive screw assembly sparingly with cam and bearing lubricant and position drive screw assembly in housing aligning shaft with adjusting screw.
2. Install motor on housing, aligning drive screw shaft with hole in motor. Install two screws that secure motor to housing.
3. Check drive screw to see if it will turn. If not, adjust as outlined in Step 4.
4. Turn adjusting screw until it is tight. Do not force. Then back off screw 1/4 turn.
5. Install magnet assembly as outlined previously.

SPEEDOMETER GEAR REMOVAL, GOVERNOR DISASSEMBLY

1. Remove three screws that secure cover to housing and remove cover.
2. Using a 12-volt power source, attach negative lead to housing. Manually move center contact arm to close throttle position and touch positive lead to terminal No. 2 on terminal board.

Terminal board is numbered on inside with respective terminal numbers.

3. Remove screw and flatwasher securing governor shaft bearing and remove bearing.
4. Disconnect pin on contact arm actuator from contact arm by inserting a screwdriver and carefully prying free.
5. Turn governor weights so they are parallel with sides of housing. Push weights toward governor spring until gear end of governor drive shaft and gear is free of governor shaft bushing.

6. Raise governor weights and pull governor assembly from housing.

Do not lose two spacers and thrust bearing from gear end of governor drive shaft and gear.

7. Remove two spacers and thrust bearing.
8. Remove governor spring from governor drive shaft and gear.

Do not stretch or damage spring.

9. Remove contact arm actuator from governor drive shaft and gear.
10. Remove snap ring, spacer and wave washer and governor weights from governor drive shaft and gear.
11. Remove compressor rod helper spring.
12. Drive out retaining pin from inside of housing and remove speedometer gear.

Same pin will be used upon installation.

SPEEDOMETER GEAR INSTALLATION. GOVERNOR ASSEMBLY AND INSTALLATION

1. Lubricate speedometer gear with cam and bearing lubricant, and install speedometer gear in speedometer gear bushing. Retain by driving in speedometer retaining pin from outside of housing.
2. Slide governor weights, wave washer, spacer and gear on governor drive shaft and secure with a snap ring.
3. Install contact arm actuator and governor spring on governor drive shaft and gear.

Governor spring must be installed so that wide coil spacing is toward contact arm actuator.

4. Install spacer, thrust bearing and second spacer on gear end of governor drive shaft and gear.
5. Install governor assembly into housing by inserting spring end of governor drive shaft and gear into compressor rod plastic cap and hole in housing. Then install gear end of governor drive shaft and gear into governor shaft bushing.
6. Insert pin on contact arm actuator into hole in contact arm by prying against contact arm with a screwdriver.
7. Install governor shaft bearing and secure with flatwasher and screw. Flatwasher must not ride on center ridge of bearing.
8. Install cover on housing and secure with three screws.
9. Perform limit switch arm throttle switch points adjustment as outlined.
10. Perform motor feed points adjustment as outlined.

CRUISE CONTROL DIAGNOSIS CHART

CONDITION	CAUSE	REMEDY
Speedometer noise	Cables bent or kinked Lack of cable lubrication Noisy speedometer head assembly	Straighten or replace cables Lubricate Repair
Blowing fuses	Short or ground in wiring circuit Defective motor Locked drive screw	Perform electrical checks Check operation of motor Check drive screw for binding
Carburetor does not return to normal idle.	Improper carburetor or accelerator linkage adjustment Weak or disconnected throttle return spring	Adjust throttle control cable and accelerator linkage Connect or replace spring
Unit does not control at selected speed	Improper selector dial adjustment Improper accelerator linkage adjustment Improper control cable adjustment	Adjust selector dial Adjust accelerator linkage Adjust control cable
Unit controls in "ON" position or locks in "AUTO" position at low speed regardless of selected setting	Control cable not secured to adjustable coupling	Rotate selector dial to low speed stop to secure
Speedometer does not register	Speedometer drive gear in transmission defective Broken drive cable from transmission to power unit Damaged drive gear or nylon gear in power unit Broken speedometer cable	Replace gear Replace drive cable Replace nylon gear or drive shaft and gear assembly Replace speedometer cable
No Cruise Control response	Accelerator linkage broken or disconnected Drive cables broken or disconnected Blown fuse Loose connections or broken wires (internal or external).	Connect or replace linkage and adjust Connect or replace cables Perform electrical checks Perform electrical checks

CRUISE CONTROL DIAGNOSIS CHART (Cont'd)

CONDITION	CAUSE	REMEDY
No Automatic Control when unit is set for automatic lock-in	Driver riding the brake pedal or driver does not accelerate to selected speed No current at No. 2 terminal Improper throttle switch adjustment Foreign material on proximity switch.	Instruct owner Perform electrical checks Adjust limit and throttle switch Clean switch
Constant pressure on accelerator pedal regardless of dial setting	Blown fuse No current at No. 1 terminal Control cable defective Inoperative motor or locked drive screw Improper limit switch adjustment Control cable improperly adjusted	Perform electrical checks Perform electrical checks Replace selector control cable Check operation of motor and/or drive screw Adjust limit switch and throttle switch Adjust control cable
Automatic control engages at selected speed without unit set for automatic lock-in	Shorted automatic relay switch	Perform electrical checks
Unit does not remain inoperative in the "OFF" position.	Limit switch not properly adjusted	Adjust limit switch and throttle switch
Pulsating accelerator pedal	Speedometer cable or drive cable kinked or lack of lubrication Improper accelerator linkage adjustment Improper motor feed points adjustment	Lubricate or replace cables if necessary Adjust accelerator linkage Adjust motor feed points

CRUISE CONTROL

32 AND 36 THROUGH 48 SERIES

DESCRIPTION

The main components of the automatic cruise control are the regulator assembly and the vacuum servo, mounted in the engine compartment, and the engaging switch located in the turn signal lever. (Figs. 15-45, 15-46)

The regulator is driven by a flexible drive cable from the transmission. The speedometer is driven by another flexible drive cable from the regulator. The engaging switch electrically controls the vacuum from the intake manifold to the regulator. The governor assembly controls the vacuum to the vacuum servo, which in turn regulates the throttle. A brake release switch is also provided to disengage the unit.

A complete electrical and vacuum diagram is shown in Fig. 15-47. The automatic Cruise Control maintains the drivers selected speed automatically with the drivers foot off of the accelerator between 30 mph and 90 mph. To operate, accelerate the car to the desired speed and push the engage button approximately one-half way in and release. The car will maintain this speed whether going up hill, down hill or on the level. To disengage Cruise Control, depress the brake pedal. To re-engage Cruise Control, depress the brake pedal. To re-engage Cruise Control, again attain desired cruising speed and push engage button approximately one-half way in and release.

If a higher cruising speed is desired, push the engage button until the detent is felt. The car will gain speed slowly and when the desired speed is obtained, release the engage button.

If a lower cruising speed is desired, push the engage button in fully and hold in until desired cruising speed is reached and release engage button.

The car speed can be increased at anytime by pushing the accelerator. When the pressure on the accelerator pedal is released the car will return to the selected speed.

PRELIMINARY ELECTRICAL CHECKS

It is not always necessary to remove and disassemble the regulator in cases of inoperative Cruise Control. The following checks should be performed as part of the diagnosis to determine the cause and correction of Cruise Control trouble and to eliminate unnecessary service work on the regulator.

1. Disconnect multiple connector at regulator.
2. Turn ignition switch to the accessory position.
3. Using a test lamp, ground one test lamp lead and touch

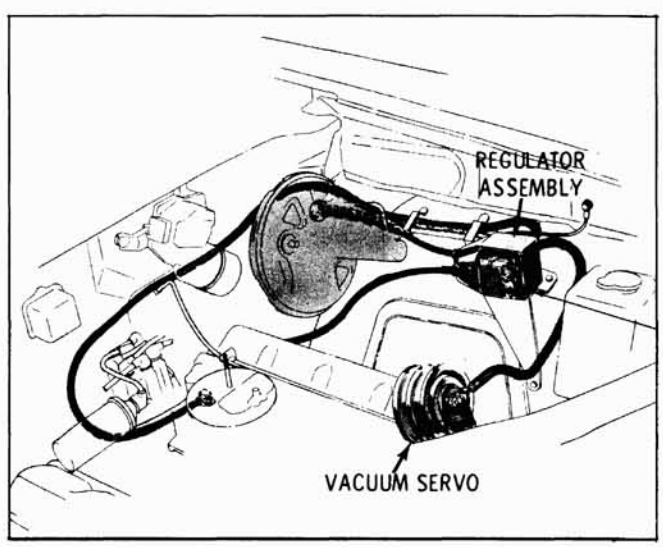


Fig. 15-45—Vacuum Servo and Regulator Assembly

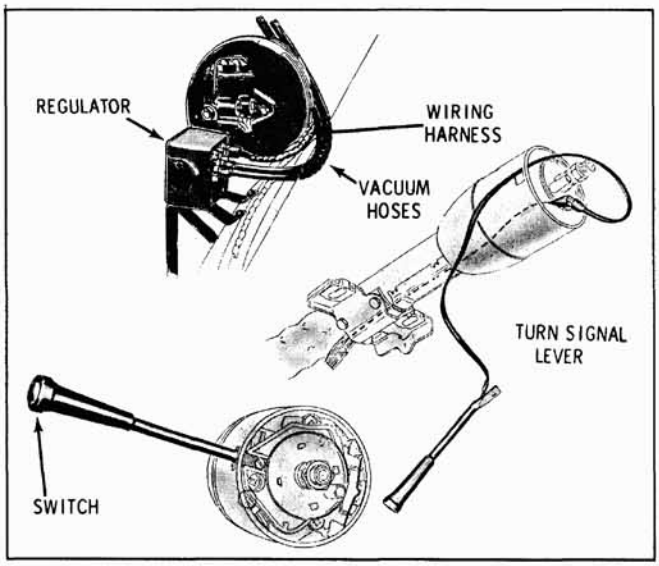


Fig. 15-46—Cruise Control Harness Routing

other lead to terminal No. 1 (Fig. 15-47). Test lamp should not light. If test lamp lights, the wiring harness or the engaging switch is defective.

4. Ground test lamp lead and touch the other lead to terminal No. 2. Test lamp should light. If test lamp doesn"t light, check fuse, brake switch adjustment, and engaging switch.

VACUUM CHECKS

Make sure vacuum hoses are properly connected and are not collapsed.

BRAKE RELEASE SWITCH ADJUSTMENT (Fig. 15-47A)

1. Insert switch into tubular clip until switch body seats on tubular clip.
2. Pull brake pedal rearward against internal pedal stop. Switch will be moved in tubular clip providing proper adjustment.

ENGAGING SWITCH TEST PROCEDURE

If the engaging switch needs replacement, refer to Section 9 for procedure.

1. Turn ignition switch to accessory position.
2. Using test lamp, touch one test lamp lead to terminal No. 2 and the other to ground. Lamp should light.
3. Push engaging switch button all the way in and light should go out. If light does not go out, replace the switch.
4. Touch one test lamp lead to terminal No. 1 and ground the other lead. Lamp should not light. If lamp lights, replace switch.
5. Push engaging switch button in slowly. Light should come on when first depressed and go out when the button is fully depressed. If this sequence fails, replace switch.

SERVO ROD ADJUSTMENT

With carburetor set at slow idle and in slow idle position, adjust servo rod to get .030" clearance as shown in Fig. 15-48.

CHECKING FOR DAMAGED CABLES AND GEARS

1. Raise rear end of car.
2. Remove cover from cruise control.

Engagement Switch

Switch Position	Wires Connected
Released	Brown-Blue
Engaging	Brown-Blue-Black
Locked In	Brown-Blue
Advance (Detent)	Brown-Blue-Black
Fully Depressed	None

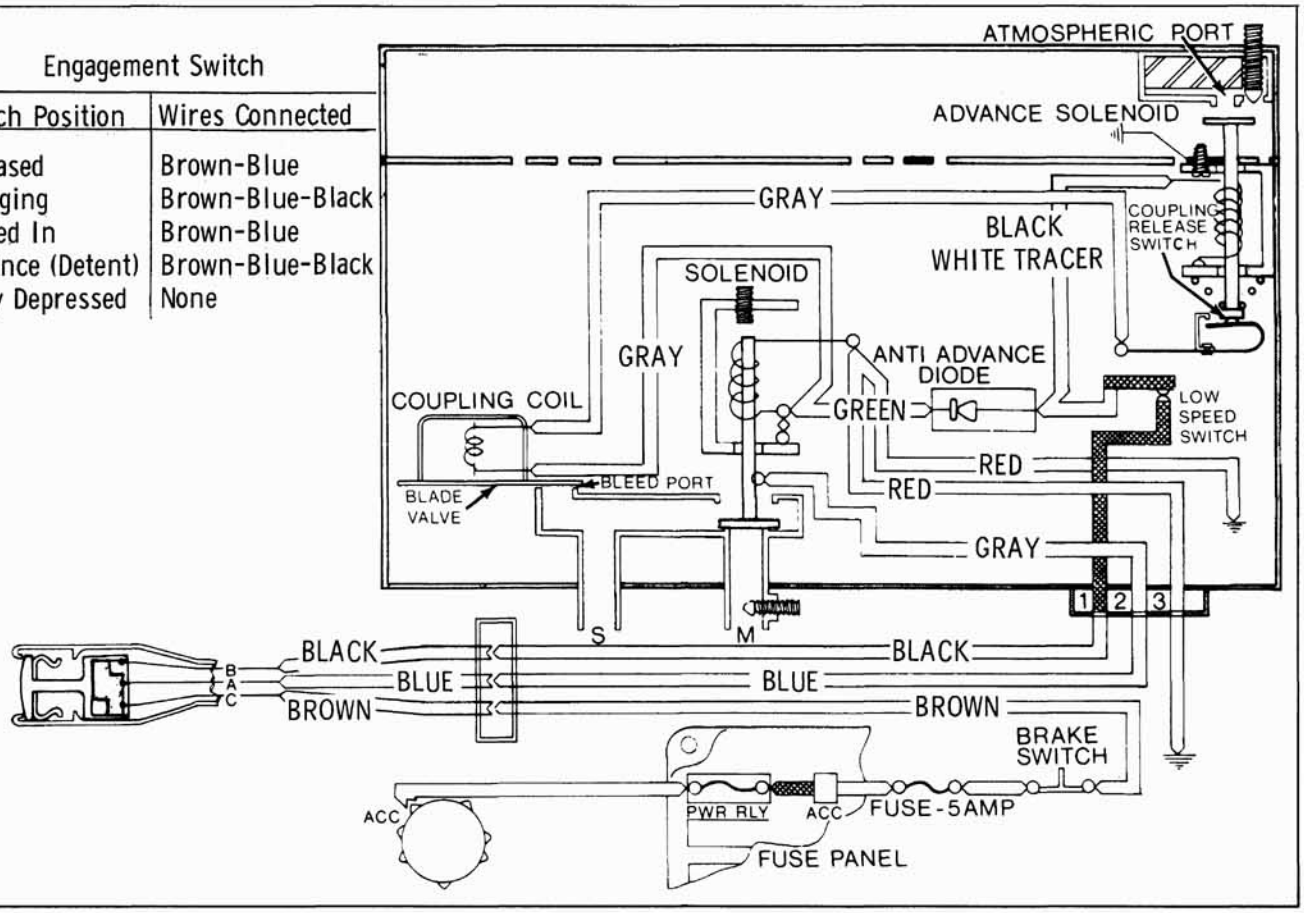


Fig. 15-47—Cruise Control Electrical Circuit

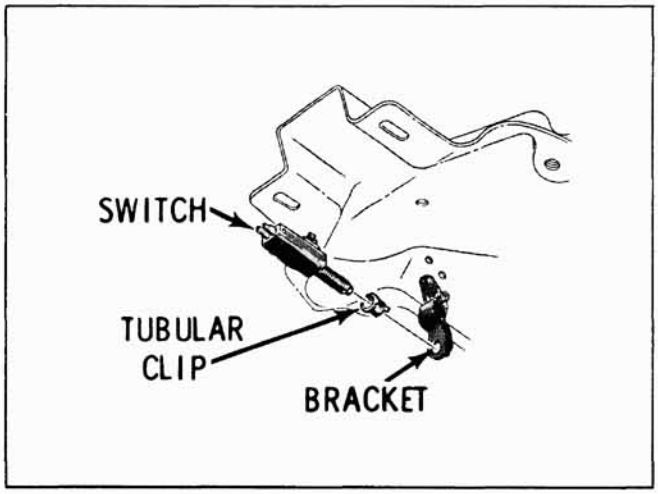


Fig. 15-47A—Brake Release Switch

3. Slowly rotate rear wheel and check to see if governor weights are turning. This will determine if cable from transmission to regulator and drive gear in transmission is operating.
4. If weights are rotating, the speedometer drive gear, cable or speedometer is defective.
5. Replace parts as required and lower car.

CENTERING SPRING ADJUSTMENT

1. If Cruise Control holds speed, three or more mph higher than selected speed, turn centering spring adjusting screw (c), Fig. 15-49, towards S 1/32" or less.
2. If Cruise Control holds speed, three or more mph below selected speed, turn centering spring adjusting screw (c), Figure 15-49 toward F 1/32" or less.

VACUUM RESTRICTION ADJUSTMENT

This screw should not be tampered with. Fig. 15-49 (R). If it is inadvertently moved, turn it in until it stops and then back off 1 1/2 turns.

Do not apply excessive pressure when turning screw in.

VACUUM SERVO—SERVICE PROCEDURE

Disassembly of Servo (Fig. 15-50)

1. Remove end plates by removing from groove in bellows.
2. Remove spring.
3. If bellows is to be replaced, remove the bellows reinforcing ring from the center groove in bellows.

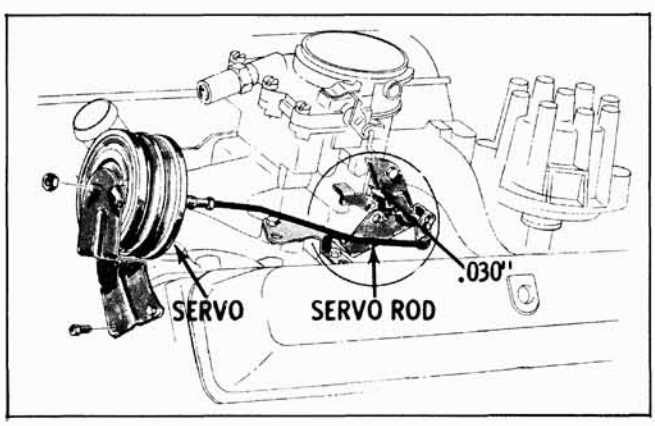


Fig. 15-48—Servo Rod Adjustment

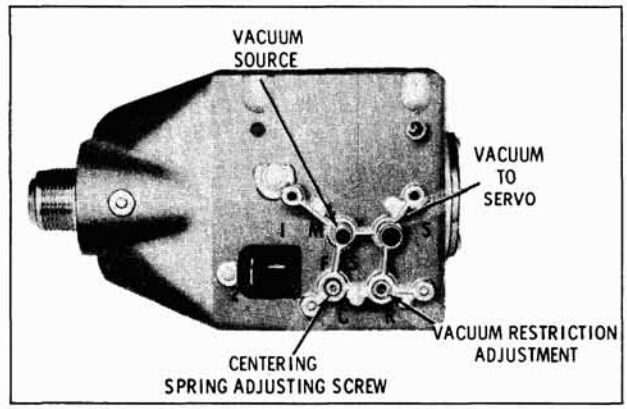


Fig. 15-49—Adjustment Screw Identification

Assembly of Servo

1. Install the bellows reinforcing ring in center groove of bellows.
2. Install spring and both end plates in end groove of bellows.

REGULATOR—SERVICE PROCEDURE (Fig. 15-50A)

Disassembly of Regulator

1. Remove six screws and cover assembly.

Disconnect advance solenoid lead (black w/white tracer).

2. Remove two (2) external screws from bearing support assembly and rotate the assembly 180° and slide out (Fig. 15-51).

Do not tamper with the screw on the speedometer drive adapter assembly. This screw positions the governor spring and should not be loosened.

3. Remove the governor spring. (Fig. 15-51)
4. Disconnect wires from terminal board and remove terminal board.
5. Remove the actuator pin spring using needle nose pliers. (Fig. 15-52)
6. While spreading weights, pry up on the actuator rod and disengage actuator rod from the pin. Rotate actuator and rod 180° and hook the actuator rod over the top of the regulator housing. (Fig. 15-53)
7. Move the governor assembly away from the regulator drive end of the housing until the shaft is free of the bearing and remove the governor assembly.
8. Remove four (4) screws holding the valve body and

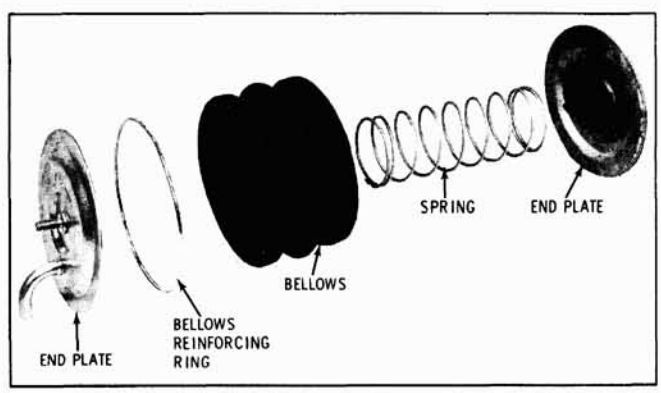


Fig. 15-50—Power Servo Assembly (Exploded)

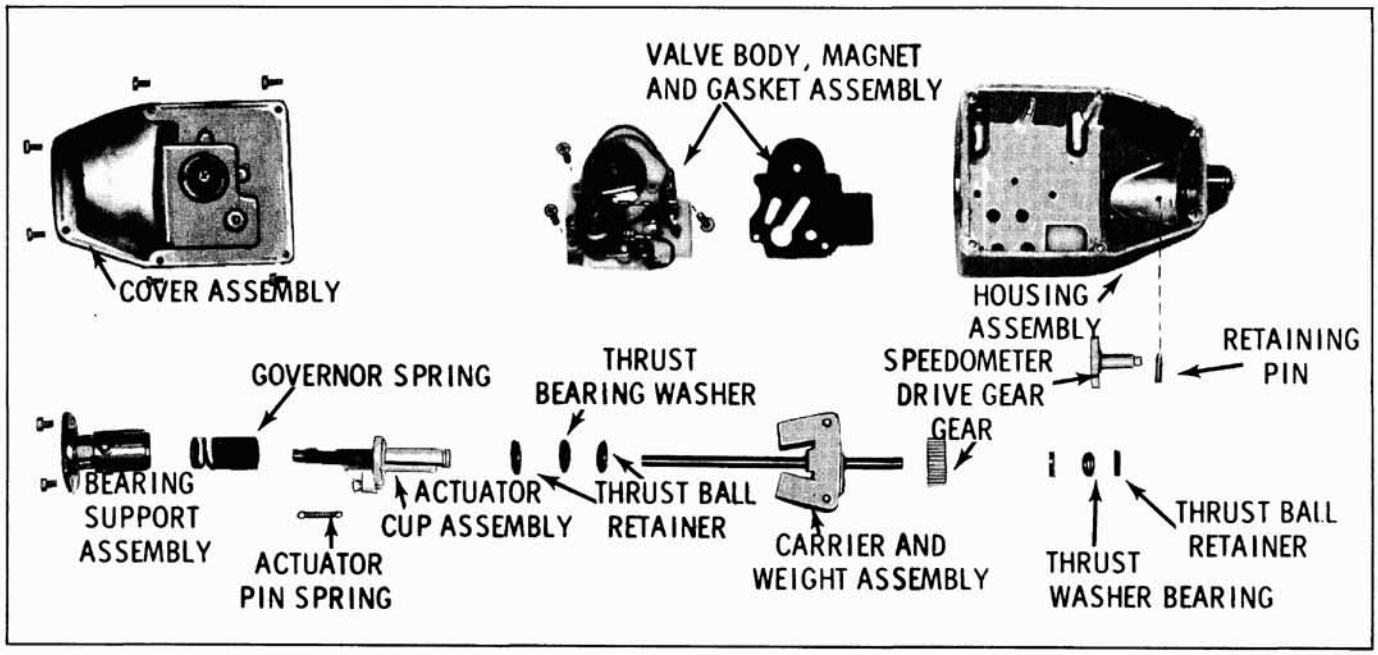


Fig. 15-50A—Regulator Assembly (Exploded)

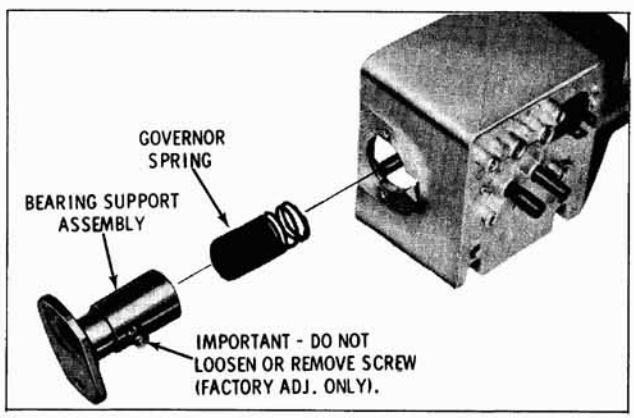


Fig. 15-51—Bearing Support Assembly - Removal

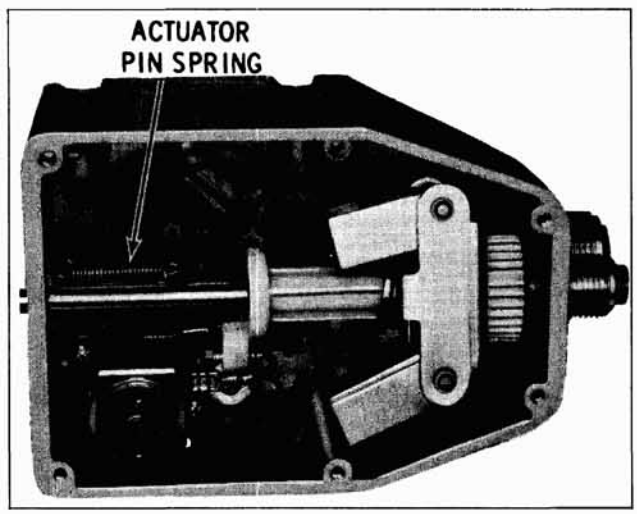


Fig. 15-52—Actuator Pin Spring Removal

magnet assembly. Remove valve body and magnet assembly from the regulator housing. (Fig. 15-54)

Adjustment on Governor Spring

If screw is accidentally loosened, it may be adjusted as follows:

Move collar so it just touches the governor spring and then collapse spring 1/16". Then tighten screw. Road test car to be sure Cruise Control locks in at 30 mph ± 2 mph.

If lock in speed is too low, loosen screw and compress spring slightly.

If lock in speed is too high, loosen screw and move collar away from spring slightly. Road test car again.

ASSEMBLY OF REGULATOR

1. Insert valve body and magnet assembly into the regulator housing and install four screws, two from the back. (Fig. 15-54)

Make sure the rubber gasket on the bottom of the valve body and magnet assembly lies flat against the regulator housing. Under no circumstances should this gasket be glued to the valve body and magnet assembly.

2. Insert the long end of the governor shaft assembly through the bearing support mounting hole making sure that the actuator rod is above the edge of the regulator housing assembly. Insert the shaft, with weights positioned vertical, far enough to allow the short end of the governor assembly to be inserted into the bearing. Slide the governor assembly toward the bearing until it bottoms.

Gray wire from solenoid to coupling coil must be above governor shaft.

3. Move the actuator cup down the shaft until it bottoms and rotate 180°. Using a screwdriver, pry the actuator coupling up and rotate the magnet counterclockwise until the pin engages the lower actuator coupling slot.

4. Using needle nose pliers, install actuator pin spring.

5. Install governor spring over governor shaft with closed end of spring toward the actuator cup.

6. Install bearing support assembly.

7. Replace terminal board in housing and connect wiring (green on bottom terminal of terminal board). (Fig. 15-55)

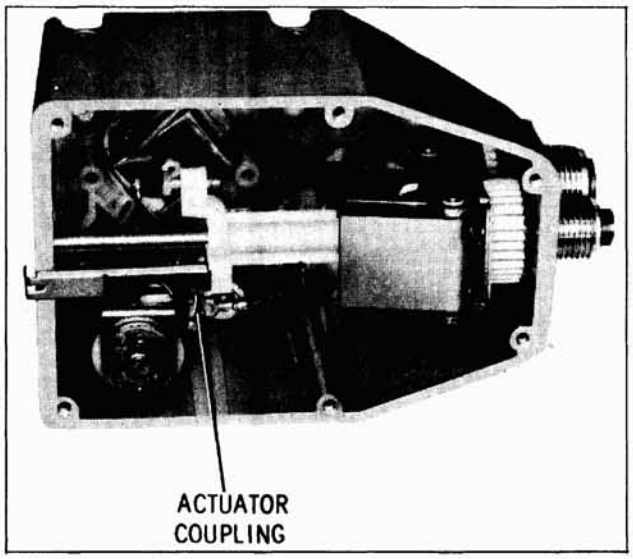


Fig. 15-53—Carrier and Weight Assembly Removal

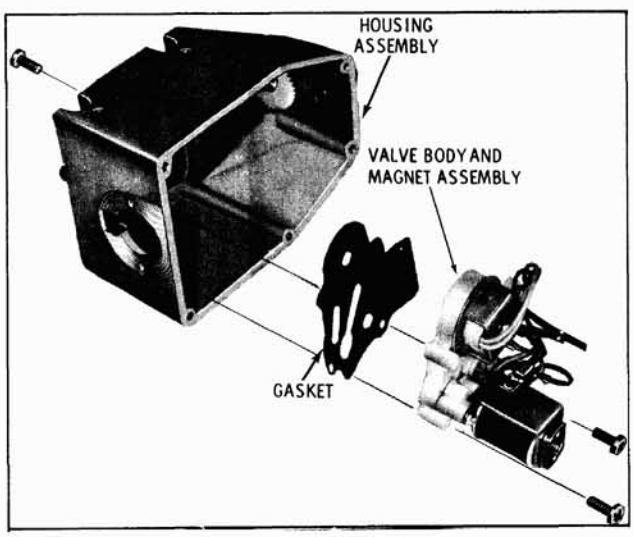


Fig. 15-54—Valve Body and Magnet Assembly Removal

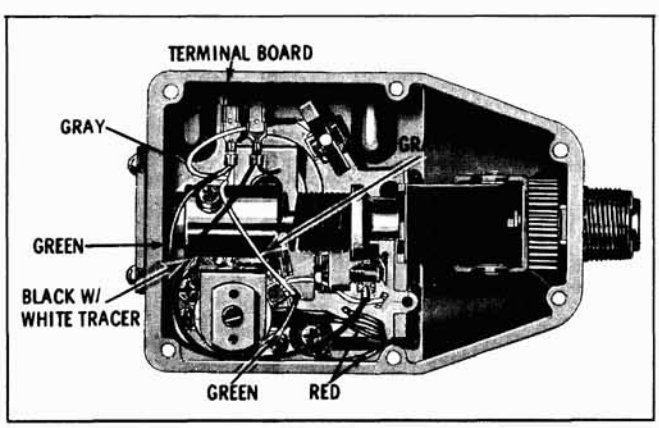


Fig. 15-55—Cruise Control Wiring

8. Connect advance solenoid lead and replace cover using new gasket.
9. If filter is to be replaced, remove advance solenoid and plate assembly with seals. A new gasket must be used when plate assembly is removed. (Fig. 15-56) If either seal is damaged or leaking, the plate assembly must be replaced as an assembly.

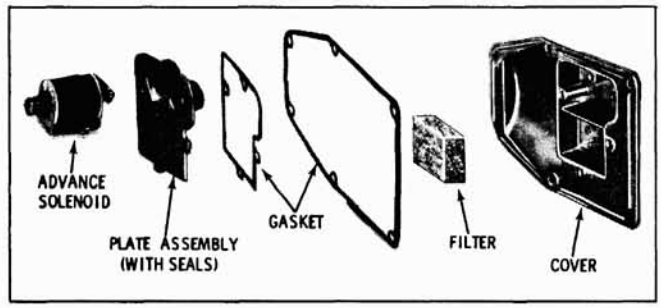


Fig. 15-56—Cover Assembly (Exploded)

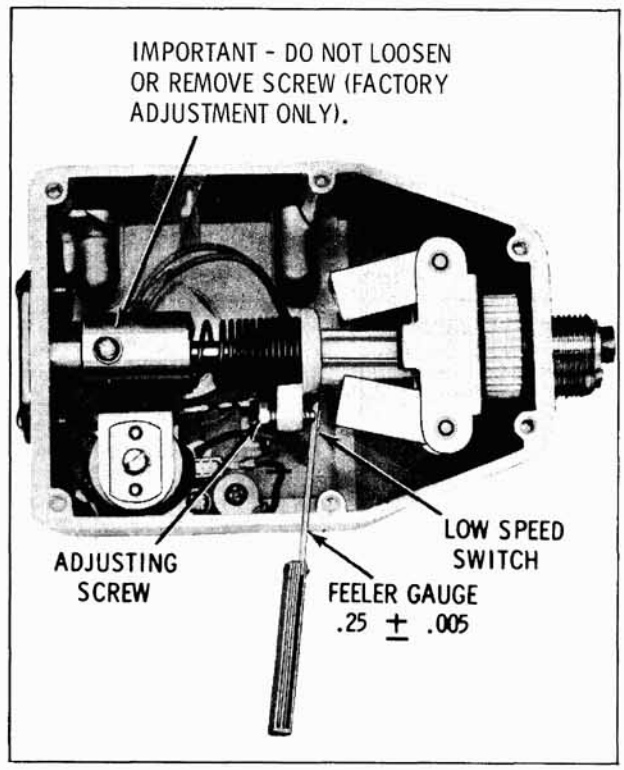


Fig. 15-57—Checking Low Speed Switch Points

Do not disassemble the plate assembly unless diagnosis indicates service is needed.

ADVANCE RELAY ADJUSTMENT

The advance relay adjustment screw is located in the cover assembly. If the advance is too slow, the screw should be turned in 1/6 of a turn only and then road test car. If the advance is too fast, the screw should be turned out 1/6 of a turn only and then road test the car.

REPLACING VALVE BODY AND MAGNET ASSEMBLY

When the valve body and magnet assembly is replaced, the Low Speed Switch will have to be adjusted. With the actuator cup held in the lowest speed position (governor weights in) turn point adjusting screw until the gap between the switch points are .025±.005. (Fig. 15-57).

REPLACING GOVERNOR ASSEMBLY

When the governor assembly is replaced, the Low Speed

Switch will have to be adjusted. With the actuator cup held in the lowest speed position (governor weights in) turn point adjusting screw until the gap between the switch points is .025+.005. (Fig. 15-57).

CRUISE CONTROL DIAGNOSIS

CONDITION	POSSIBLE CAUSE	REMEDY
Blowing fuses	Short or ground in wiring circuit	Perform electrical checks
Cruise Control does not engage	Fuse blown No ground on Terminal No. 3 Brake switch out of adjustment Wire unplugged on advance solenoid No current to terminal No. 2 Faulty diode Engaging switch inoperative Faulty valve body and magnet assembly Faulty low speed switch	Replace fuse Ground Terminal No. 3 Adjust brake switch Connect wire Repair wiring harness Replace diode board Replace engaging switch Replace valve body and magnet assembly Refer to low speed switch adjustment
Cruise Control does not disengage when brake is applied	Improper brake release switch adjustment Defective brake release switch Faulty valve body and magnet assembly	Adjust brake release switch Replace brake release switch Replace valve body and magnet assembly
Cruise Control re-engages when brake released	Faulty engaging switch	Replace engaging switch
Carburetor does not return to normal idle	Improper Cruise Control Linkage Rod adjustment Improper accelerator linkage adjustment Weak or disconnected throttle return spring	Adjust vacuum servo rod Adjust accelerator linkage Connect or replace spring
Pulsating accelerator pedal	Speedometer cable or drive cable kinked or lack of lubrication	Lubricate or replace cables if necessary
Cruise Control does not control at selected speed	Improper Cruise Control Linkage Rod adjustment Faulty vacuum servo or vacuum hose Faulty governor assembly	Adjust vacuum servo rod Replace vacuum servo or vacuum hose Replace governor assembly
Cruise Control controls speed 3 or more mph above selected speed	Improper centering spring adjustment	Adjust centering spring (c)
Cruise Control controls speed 3 or more mph below selected speed	Improper centering spring adjustment	Adjust centering spring (c)
Cruise Control "hunts" for correct speed (not pulsation of accelerator pedal)	Vacuum restriction adjusting screw (R) is in too far	Adjust vacuum restriction adjusting screw (R)
Cruise Control goes 4 mph or more over selected speed when going over a hill	Vacuum restriction adjusting screw (R) is out too far	Adjust vacuum restriction adjusting screw (R)
Cruise Control does not advance	Defective advance solenoid Vacuum leak Defective engagement switch	Replace solenoid Replace cover gasket Replace engagement switch
Advance rate too slow	Advance relay out of adjustment	Refer to advance relay adjustment
Advance rate too fast	Advance relay out of adjustment	Refer to advance relay adjustment

Refer to Fig. 15-49 for adjustment locations.

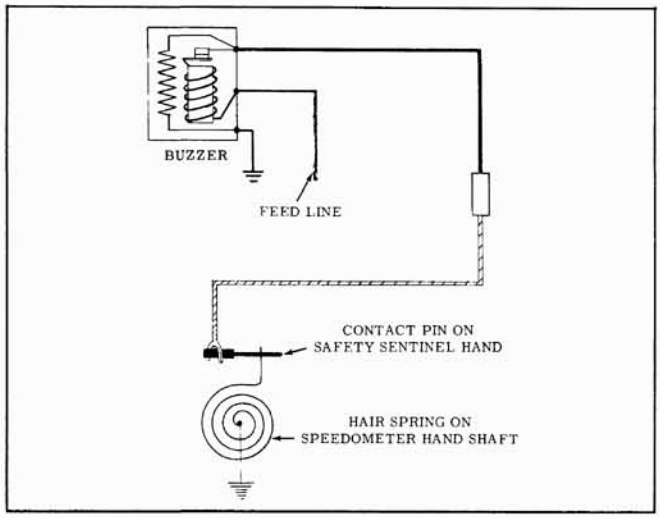


Fig. 15-58—Safety Sentinel

SAFETY SENTINEL (Fig. 15-58)

A speed warning device (Safety Sentinel), is available as factory installed optional equipment. A knob on the instrument panel can be turned by the driver to adjust the sentinel dial in the cluster face to any desired speed setting between 25 and 100 mph. When car speed is equal to, or exceeds the setting on the sentinel dial, a buzzer warns the driver that he is exceeding his desired speed.

The circuit is complete when a hair spring on the speedometer hand shaft contacts an insulated pin on the Safety Sentinel hand. The hair spring is grounded and the insulated pin is connected to the buzzer. If speed is increased further, the hair spring remains in contact with the pin on the Safety Sentinel hand and is wound up by the speedometer hand.

Check Safety Sentinel

1. Check the ten ampere fuse in the fuse block. The parking brake lamp, back-up lamps, temperature, generator and oil pressure warning lamps, and fuel gauge are also on this fuse.
2. Raise the car so that the left front wheel is off the floor.

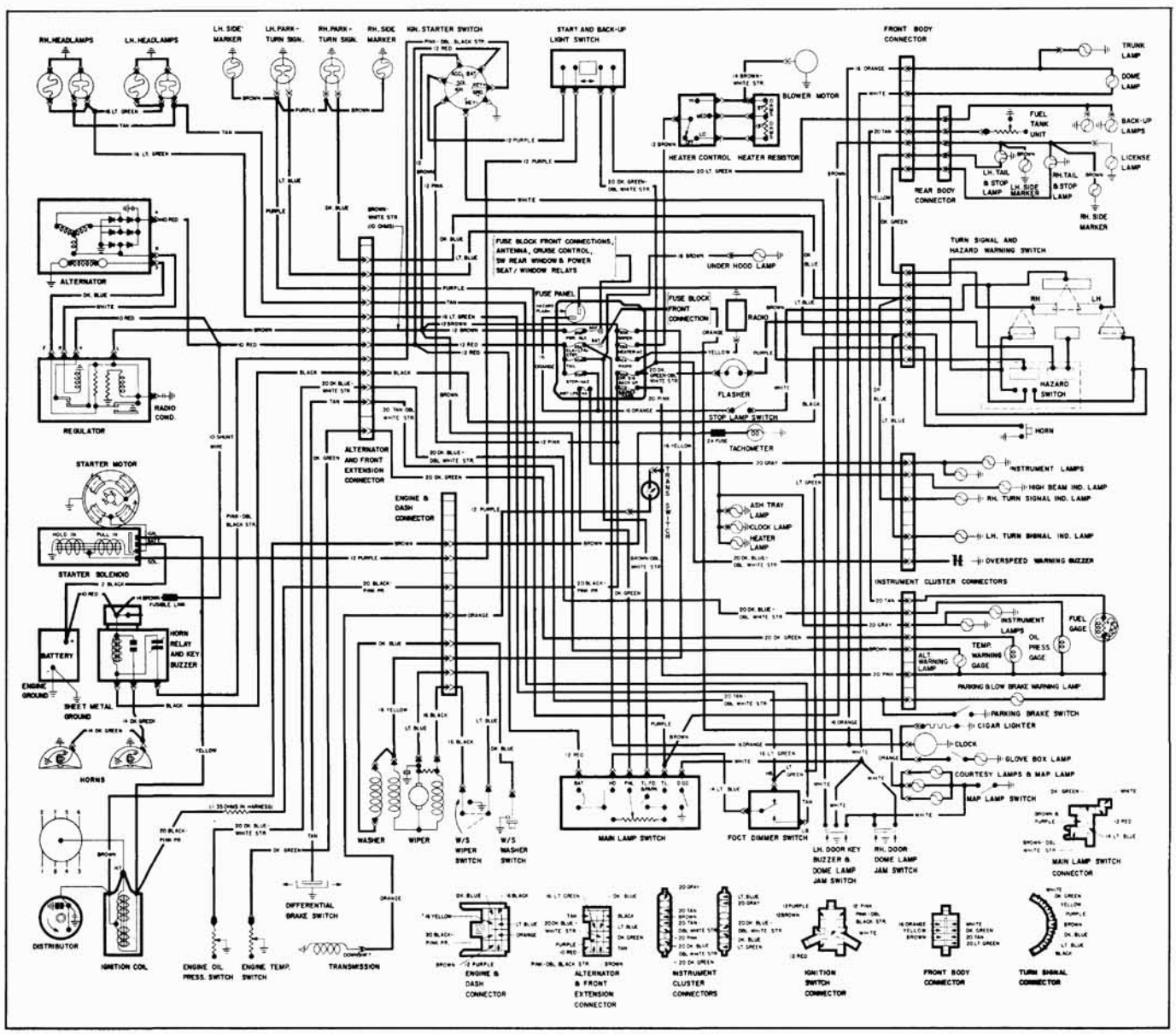


Fig. 15-59—Rally Pack Wiring Diagram

Fig. 15-60—Rally Pack

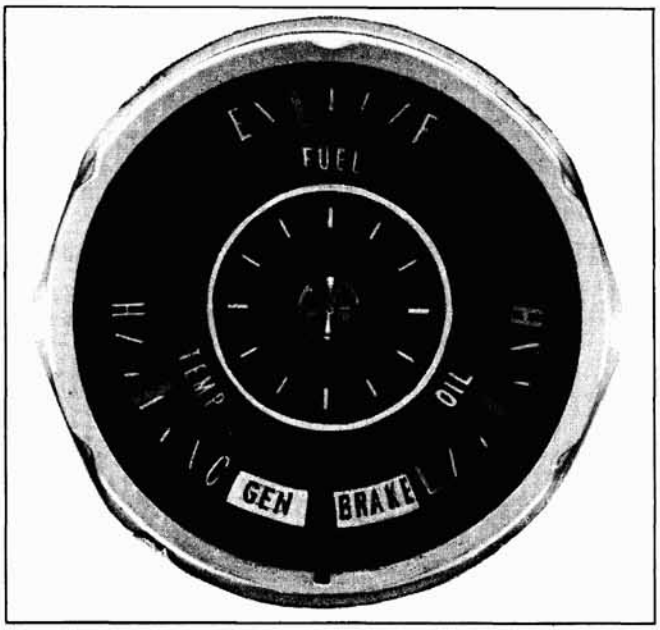


Fig. 15-61—Instrument Cluster

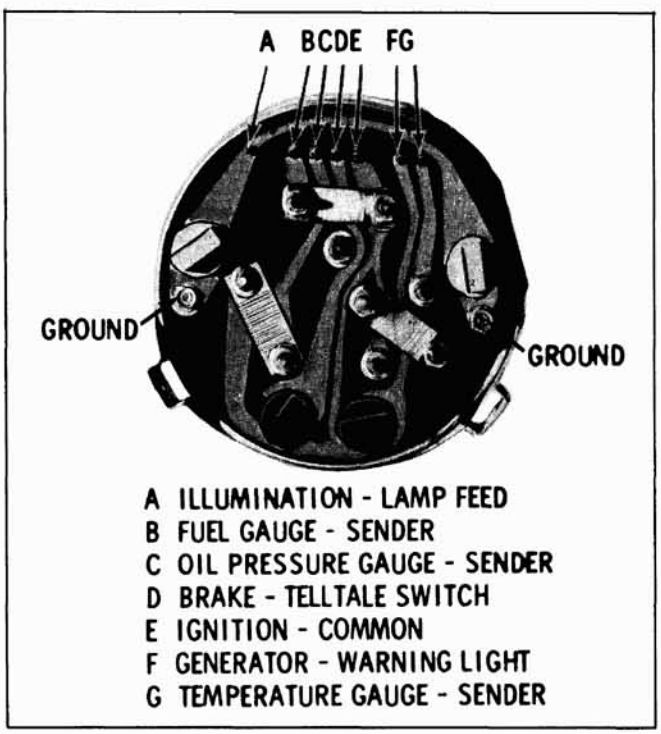


Fig. 15-62—Instrument Cluster

Rear wheels on 31 through 48 Series.

3. Adjust the Safety Sentinel to 30 mph.
4. Using a wheel spinner, rotate the wheel until speedometer reads approximately 32 mph, and the buzzer should operate.
5. If the buzzer does not sound, remove the buzzer and replace with one known to be working.
6. If the buzzer does not operate, check Safety Sentinel circuit connection to the printed circuit. If connection is good, remove speedometer head for repair by an authorized warranty repair dealer.

RALLY PACK (Figs. 15-59 and 15-60)

The Rally Pack instrument cluster is equipped with a fuel gauge, oil pressure gauge, temperature gauge, brake tell tale light and generator warning light. A clock tachometer combination is also used with Rally Pack.

INSTRUMENT CLUSTER (Fig. 15-61 and 15-62)

For removal and installation of cluster and clock tachometer, refer to Section 12AA, INSTRUMENT PANEL.

REMOVAL OF PRINTED CIRCUIT FROM INSTRUMENT CLUSTER

1. Remove cluster. Refer to Section 12AA, INSTRUMENT PANEL.
2. Remove the bulbs and sockets from printed circuit.
161 bulbs for brake tell tale and generator warning lights.
168 bulbs for illumination lights.
3. Remove two ground screws from printed circuit.
4. Remove protectors from resistors and remove resistors. Make note of position of resistors for assembly.
5. Remove protectors and nuts from studs above and below temperature gauge resistor and remove printed circuit.

To install, reverse removal procedure.

If any one of the gauges are defective it will be necessary to replace the cluster assembly.

CLOCK TACHOMETER—(Figs. 15-63 and 15-64)

Inoperative Tachometer

1. Check the tachometer ground connection by connecting

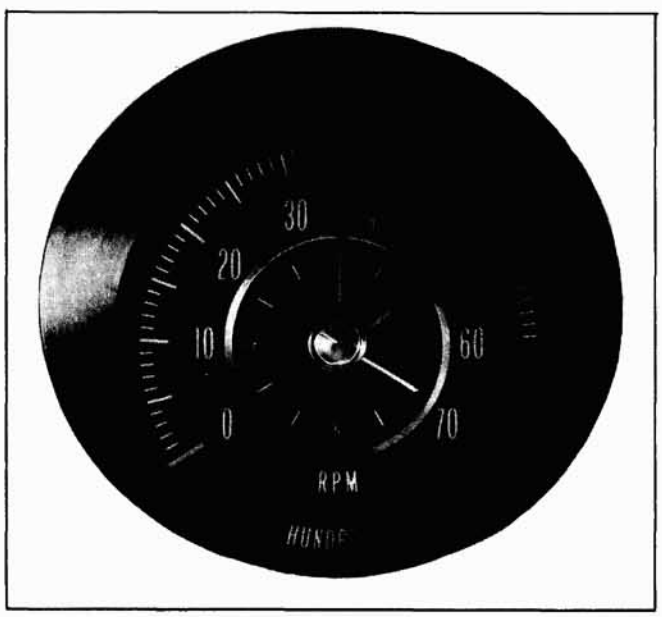


Fig. 15-63—Clock Tachometer

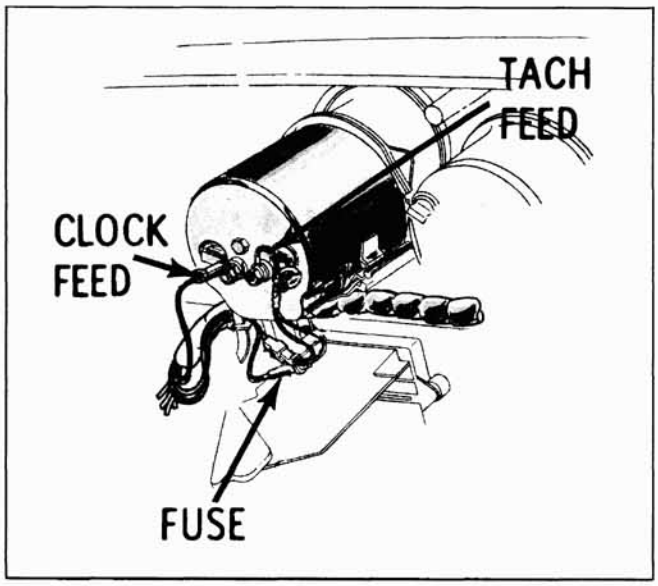


Fig. 15-64—Wiring to Clock Tachometer

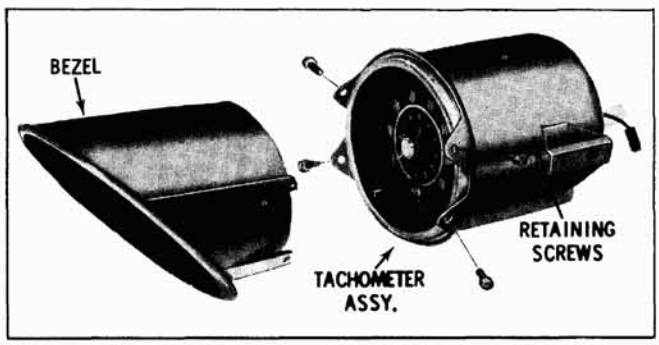


Fig. 15-65—Bezel Removal

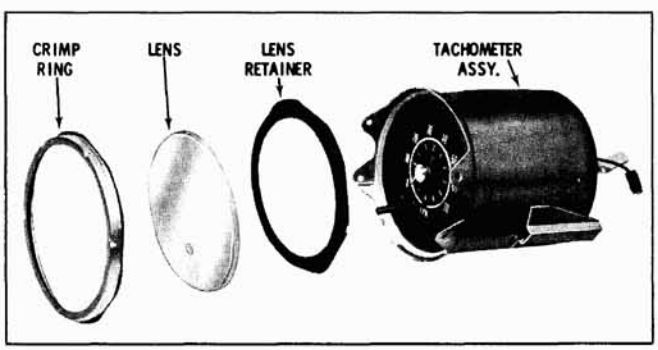


Fig. 15-66—Lens Removal

a jumper wire to a good ground and holding the other end against the tachometer bezel. If the tachometer will now operate, a defective ground is indicated and must be corrected.

2. Check for loose connections or broken wire from the ignition coil to the tachometer. Repair if necessary.

3. Check the tachometer fuse located under the instrument panel. (Fig. 15-64)

4. If the tachometer is still inoperative, remove it from instrument panel. After removal, inspect the connector and ground wire at the back of the tachometer for loose connections. Repair if necessary.

5. Connect a jumper wire between the terminal of the tachometer and the negative side of the coil. Connect another jumper between the tachometer ground and a good ground on the car. Start the engine and observe tachometer operation. If

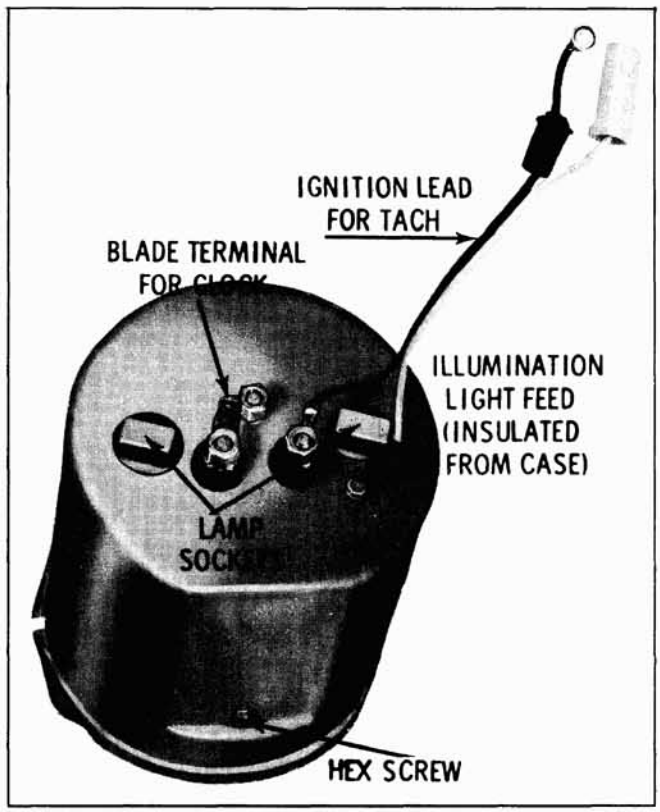


Fig. 15-67—Case Removal

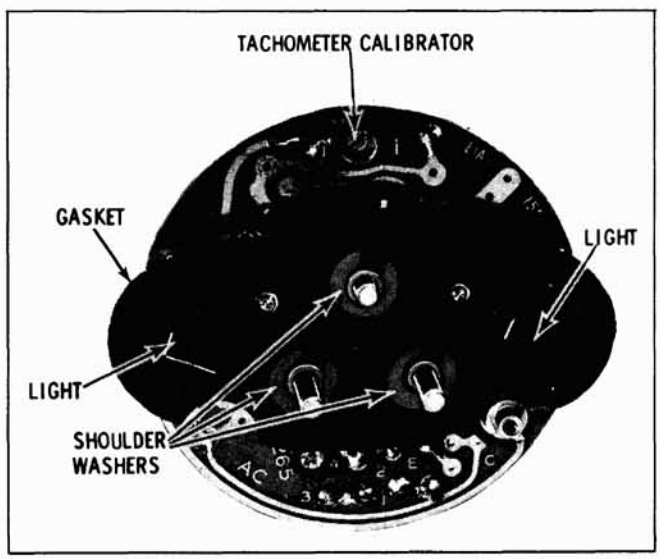


Fig. 15-68—Shoulder Washer and Gasket

the tachometer now operates, the trouble is not in the tachometer assembly and Steps 1 through 3 must be rechecked to locate the trouble.

CLOCK TACHOMETER DISASSEMBLY

1. Remove four retaining screws and remove bezel (Fig. 15-65).

2. Unscrew clock knob, holding clock stem with long nose pliers to keep it from turning.

3. Uncrimp crimp ring and remove ring, lens, retainer, and clock setting shaft seal (Fig. 15-66).

4. Remove all nuts and one hex screw from rear of assembly (Fig. 15-67).

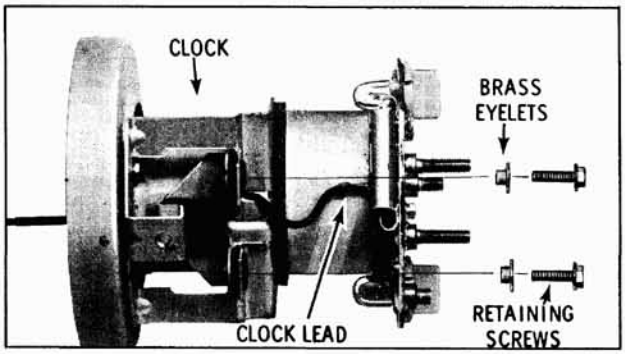


Fig. 15-69—Clock Removal

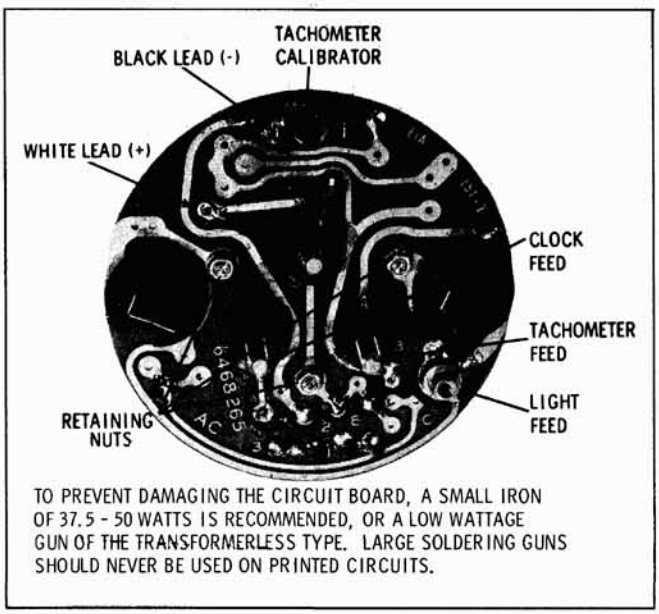


Fig. 15-70—Printed Circuit

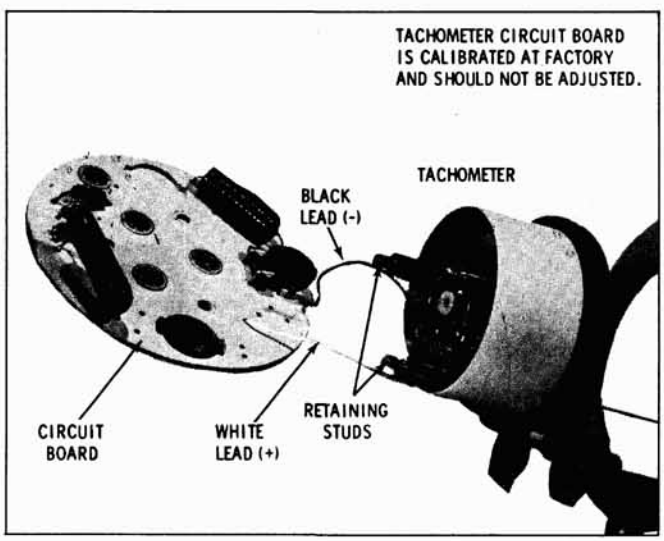


Fig. 15-71—Printed Circuit

5. Remove hex screw from bottom of case.
6. Slide out complete clock tachometer assembly from case. (Note position of three shoulder washers in back of case for assistance in reassembly.) Fig. 15-68

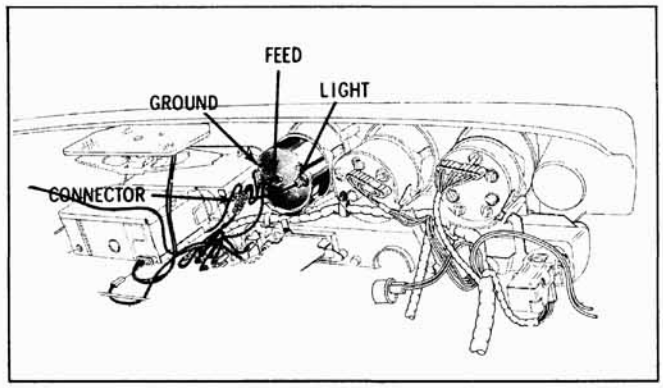


Fig. 15-72—Clock Installation (31 through 48 Series)

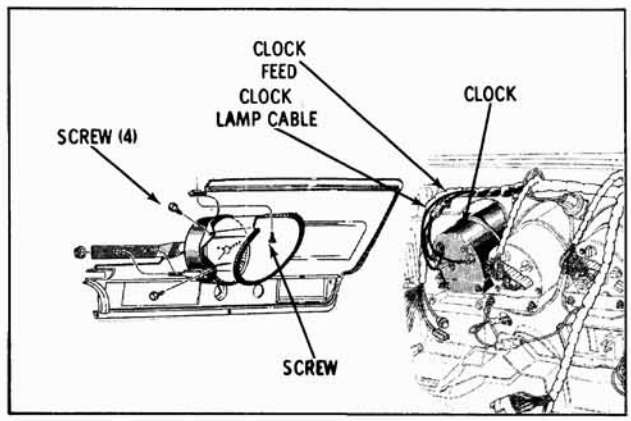


Fig. 15-73—Clock Installation (54 through 86 Series)

7. Remove two hex screws which hold the clock in position (Fig. 15-69). (Note position of brass eyelets for assistance in reassembly.)
8. Disconnect clock lead in wire at circuit board. (Note its location for assistance in reassembly.)
9. Lift out clock assembly being careful not to damage tachometer pointer.
10. Have defective unit(s) sent to authorized repair station.
11. To assemble, reverse above procedure.

CLOCK TACHOMETER PRINTED CIRCUIT

Remove and Install

With clock tachometer removed from dash, perform Steps 1 through 6 of CLOCK TACHOMETER DISASSEMBLY.

1. Remove three retaining nuts and remove printed circuit board from studs.
2. Unsolder black (-) and white (+) leads from circuit board.
3. Using low voltage soldering gun, solder black (-) and white (+) lead to new circuit board using rosin core solder. (Figs. 15-70 and 15-71)
4. Install circuit board on studs with tachometer calibrator to the top and tighten retaining nuts.

To assemble, reverse Steps 1 through 6 of CLOCK TACHOMETER DISASSEMBLY.

Do not attempt to calibrate tachometer as circuit board is calibrated at the factory and requires no adjustment.

CLOCK (Figs. 15-72 and 15-73)

Removal and Installation

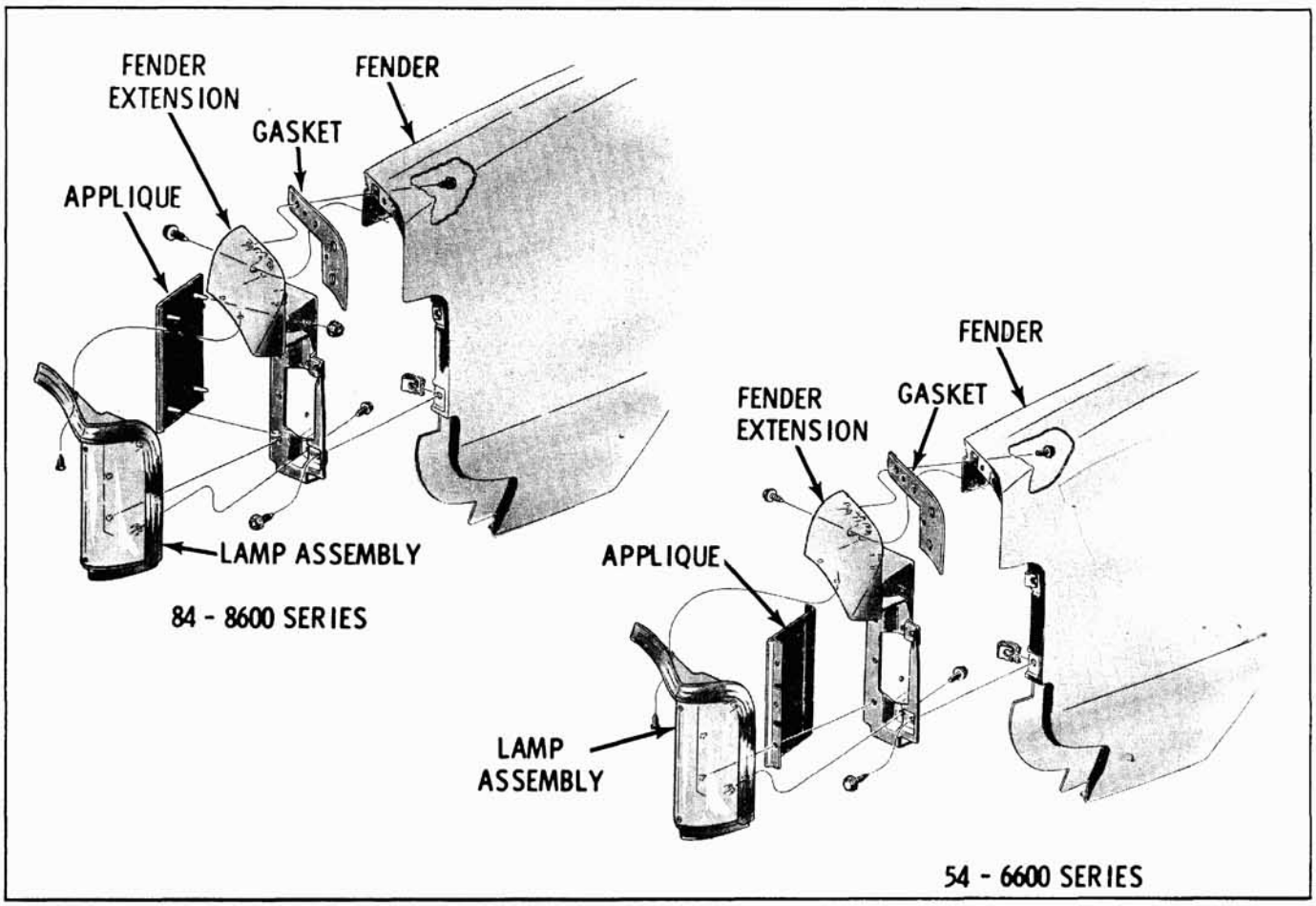


Fig. 15-74—Side Marker Lamps

1. Disconnect battery negative cable.
2. Disconnect wiring harness from rear of clock.
3. Remove attaching nuts and bezel attaching screw.
4. To install, reverse removal procedure.

CORNERING LAMPS (Fig. 15-74)

The cornering lamps are located in the side of the front fenders. The switch that operates the cornering lamp is integral with the directional signal switch. When either turn signal is operating with the headlamps or parking lamps ON, the corresponding cornering lamp will light continuously. After the turn is completed, the return of the steering wheel to the straight ahead position automatically turns off the cornering lamps.

BACK-UP LAMP SWITCH (Fig. 15-75) (Automatic Transmission)

ADJUSTMENT (All Except Console Equipped)

1. Place transmission in drive detent with switch installed and drive lug engaged in shift tube.
2. Adjust switch so gauge pin hole will align between contact support and switch bracket permitting insertion of a .090" pin.

ADJUSTMENT (Console Equipped)

1. If console equipped, remove console.
2. Place shift lever against neutral stop.
3. Adjust switch to dimension shown in Fig. 15-75.

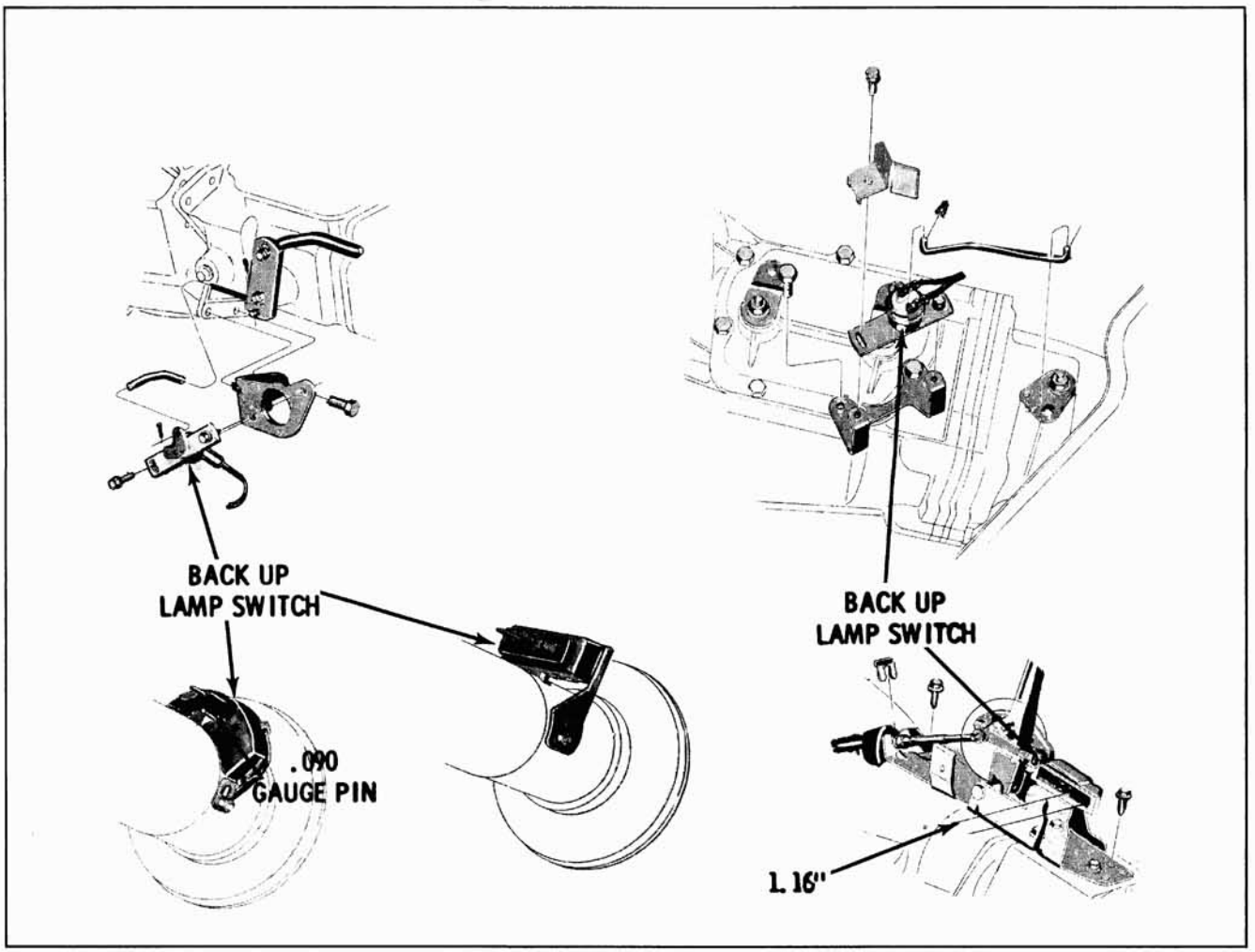


Fig. 15-75—Back-Up Lamp Switch

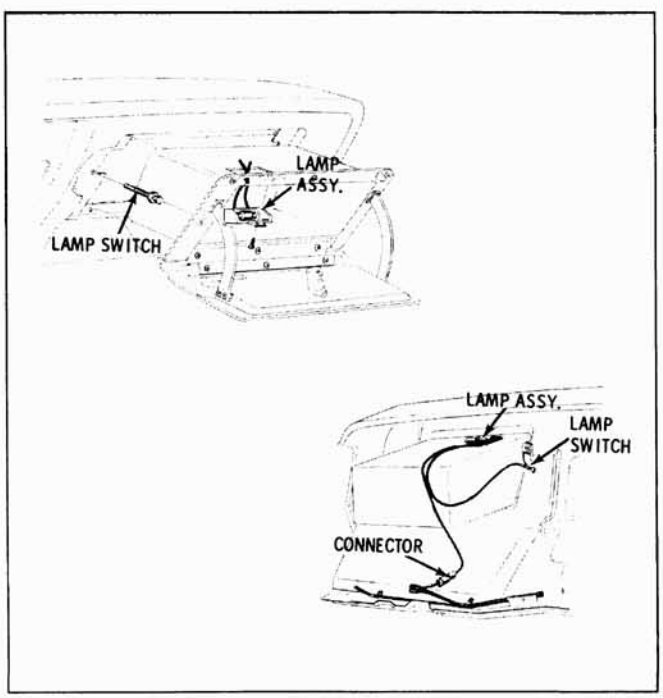


Fig. 15-76—Glove Box Lamp Installation (54 through 86 Series)

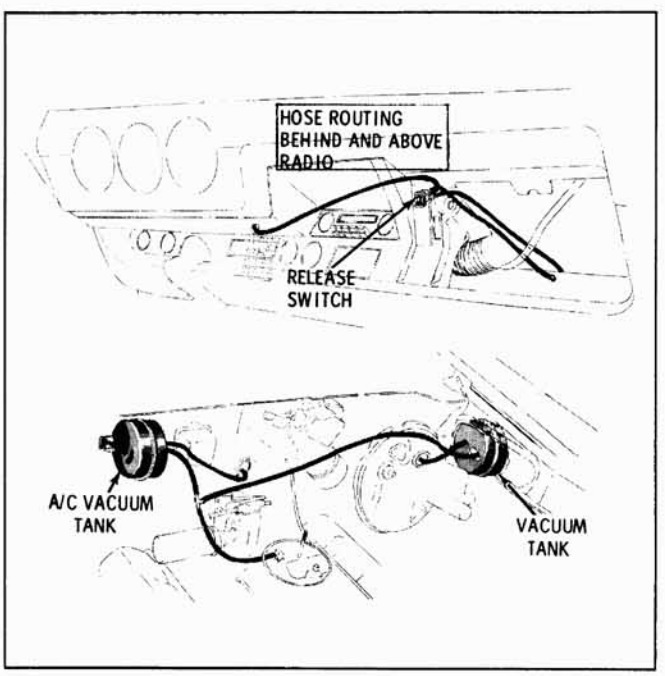


Fig. 15-77—Trunk Release Vacuum Hose Routing (31 through 44 Series)

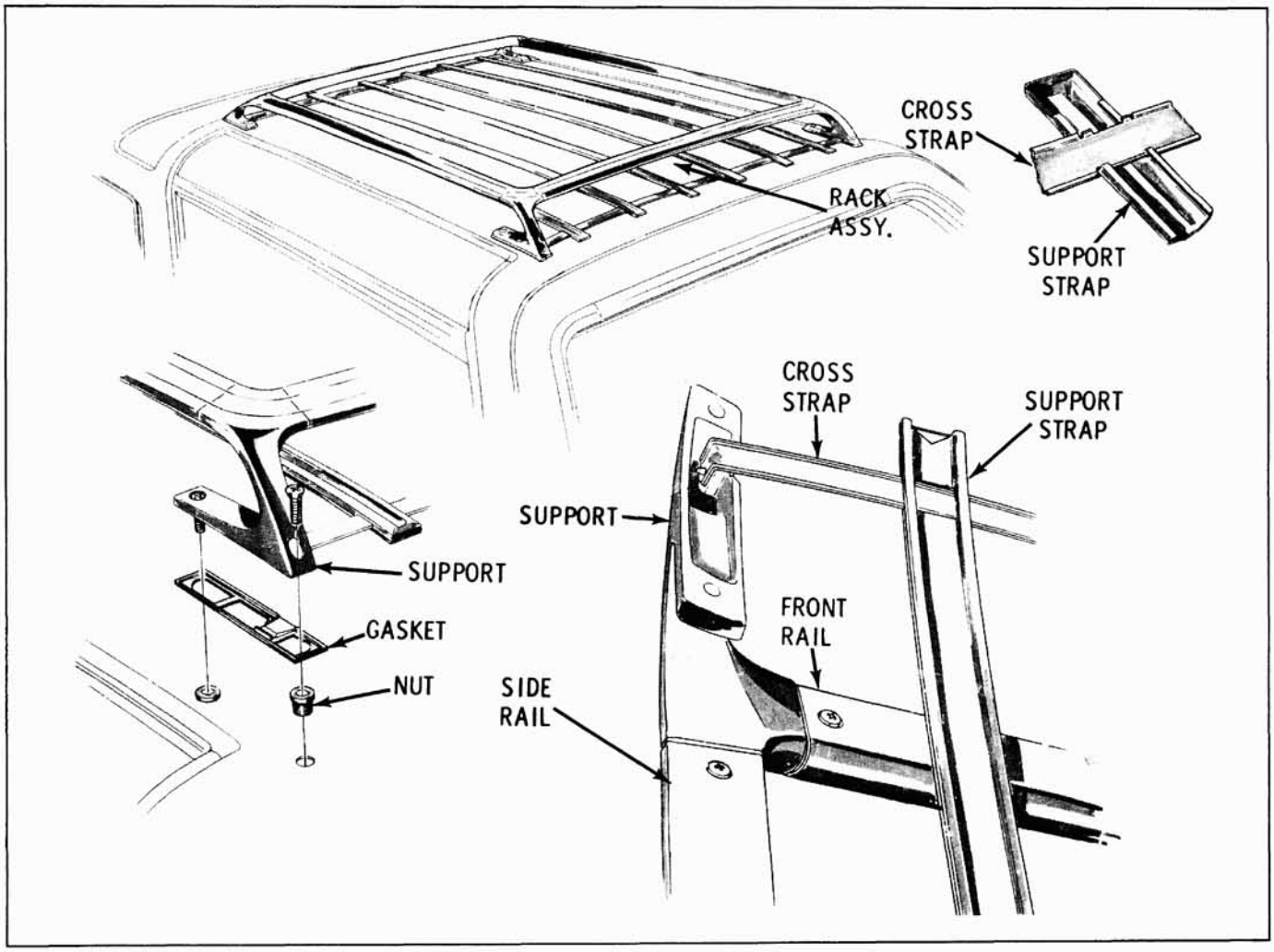


Fig. 15-78—Station Wagon Luggage Carrier

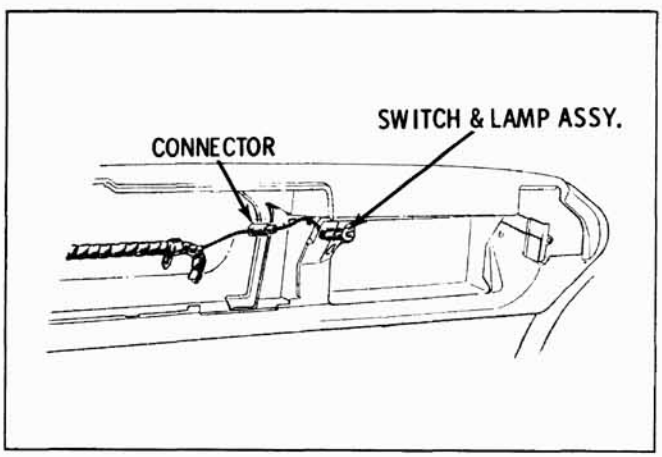


Fig. 15-79—Glove Box Lamp Installation (31 through 48 Series)

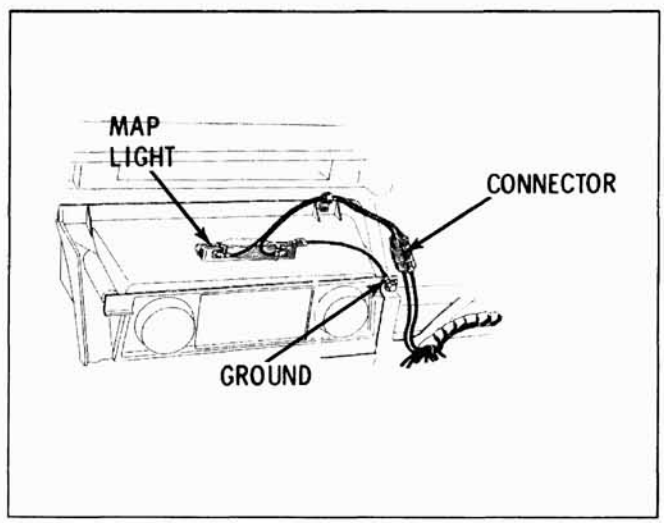


Fig. 15-80—Map Light Installation (31 through 48 Series)

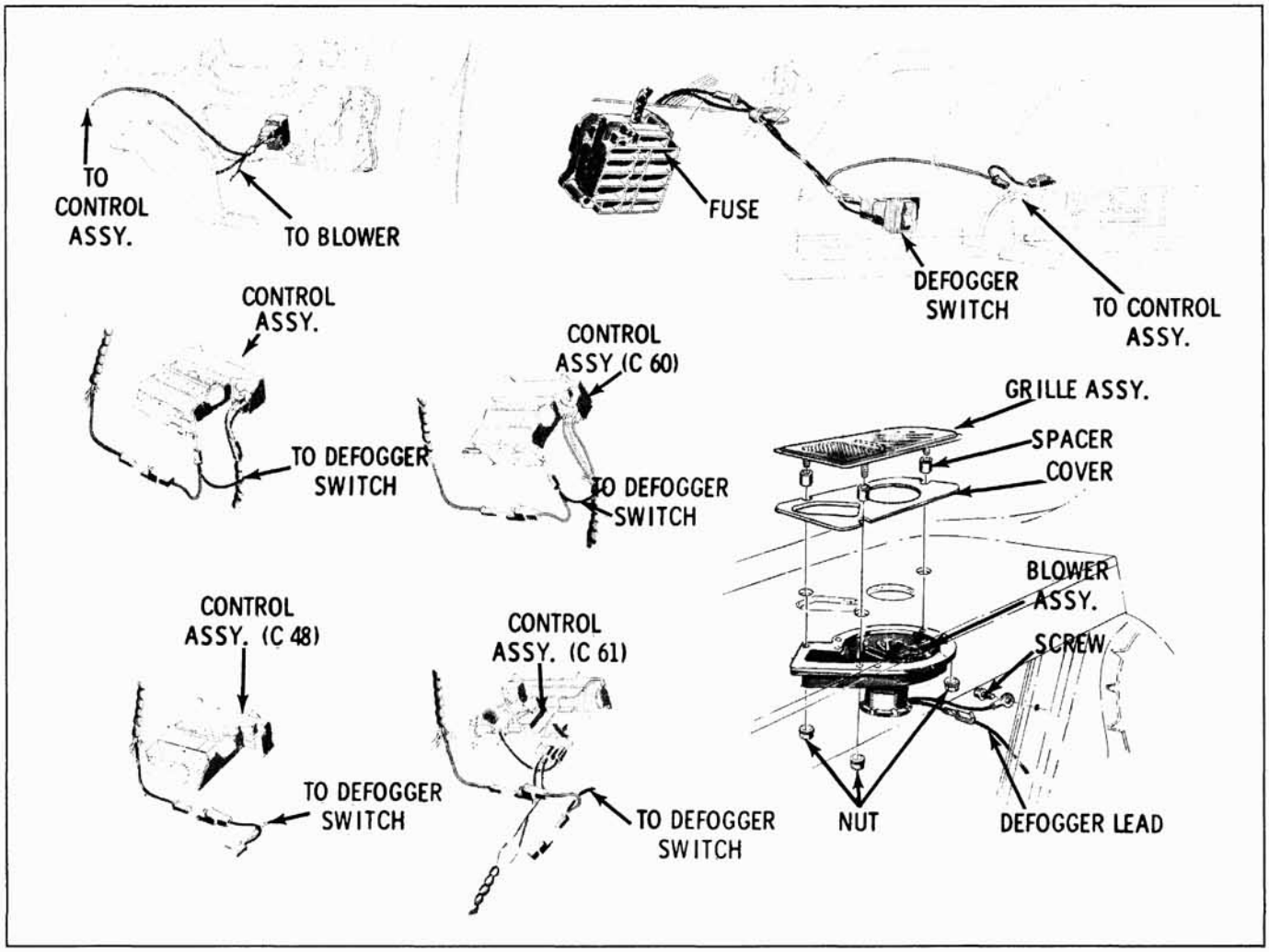


Fig. 15-81—Rear Window Defogger Wiring

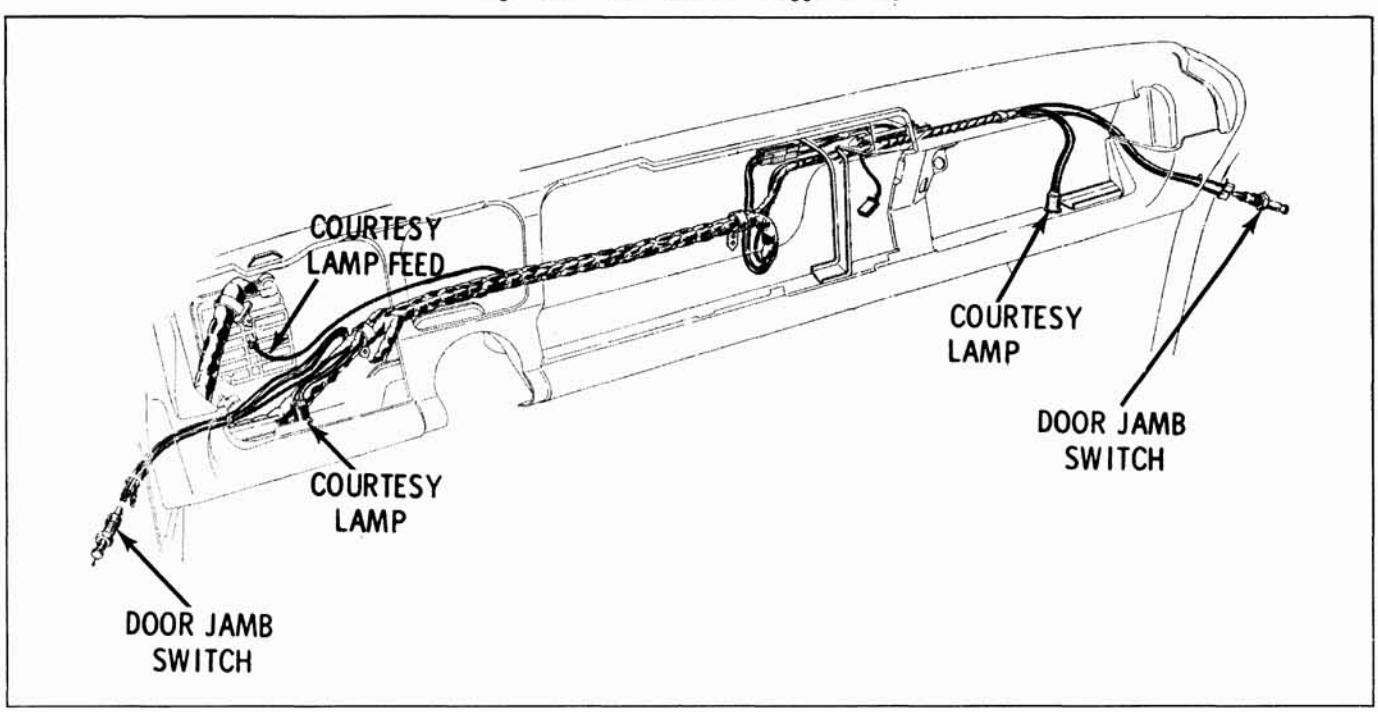


Fig. 15-82—Courtesy Lamps (31 through 48 Series)

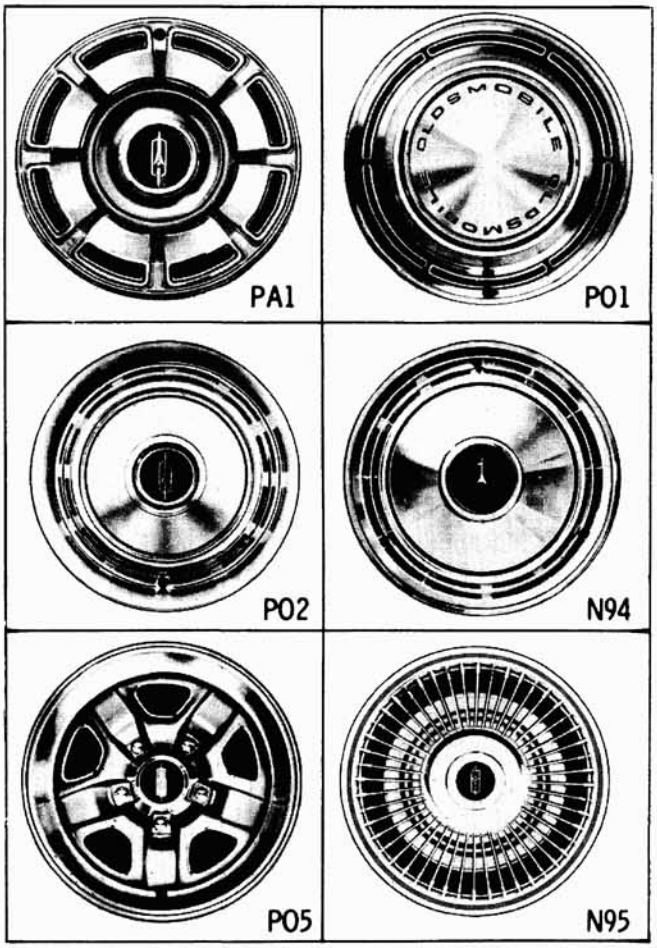


Fig. 15-83—Wheel Disc (31 through 86 Series)

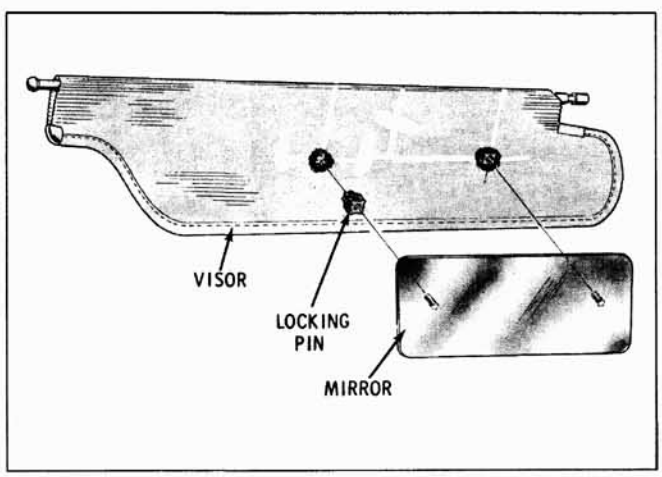


Fig. 15-84—Sunshade Vanity Mirror

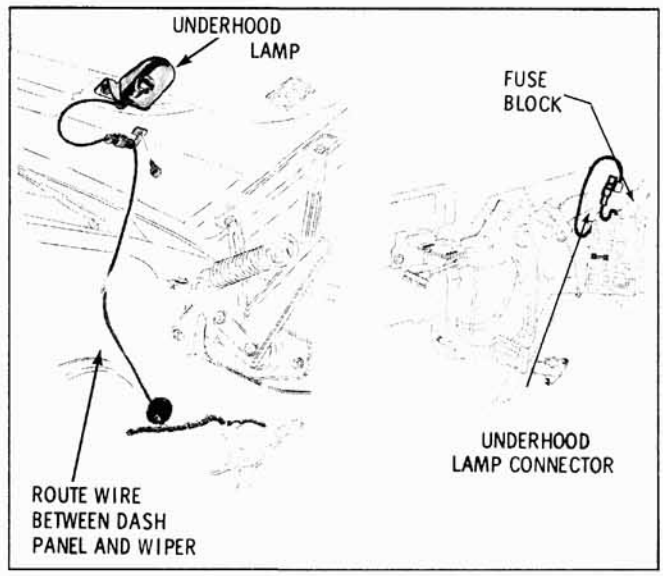


Fig. 15-85—Under Hood Lamp Installation (54 through 86 Series)

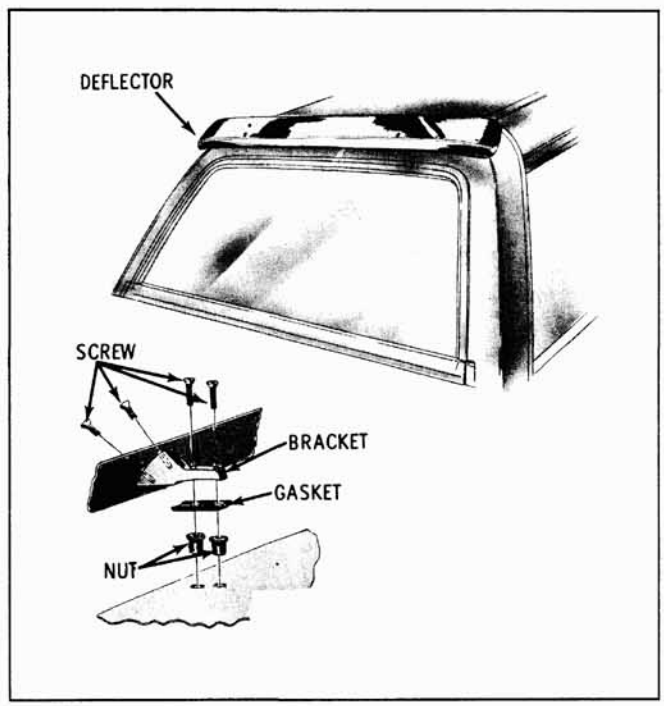


Fig. 15-86—Air Deflector (Station Wagon)

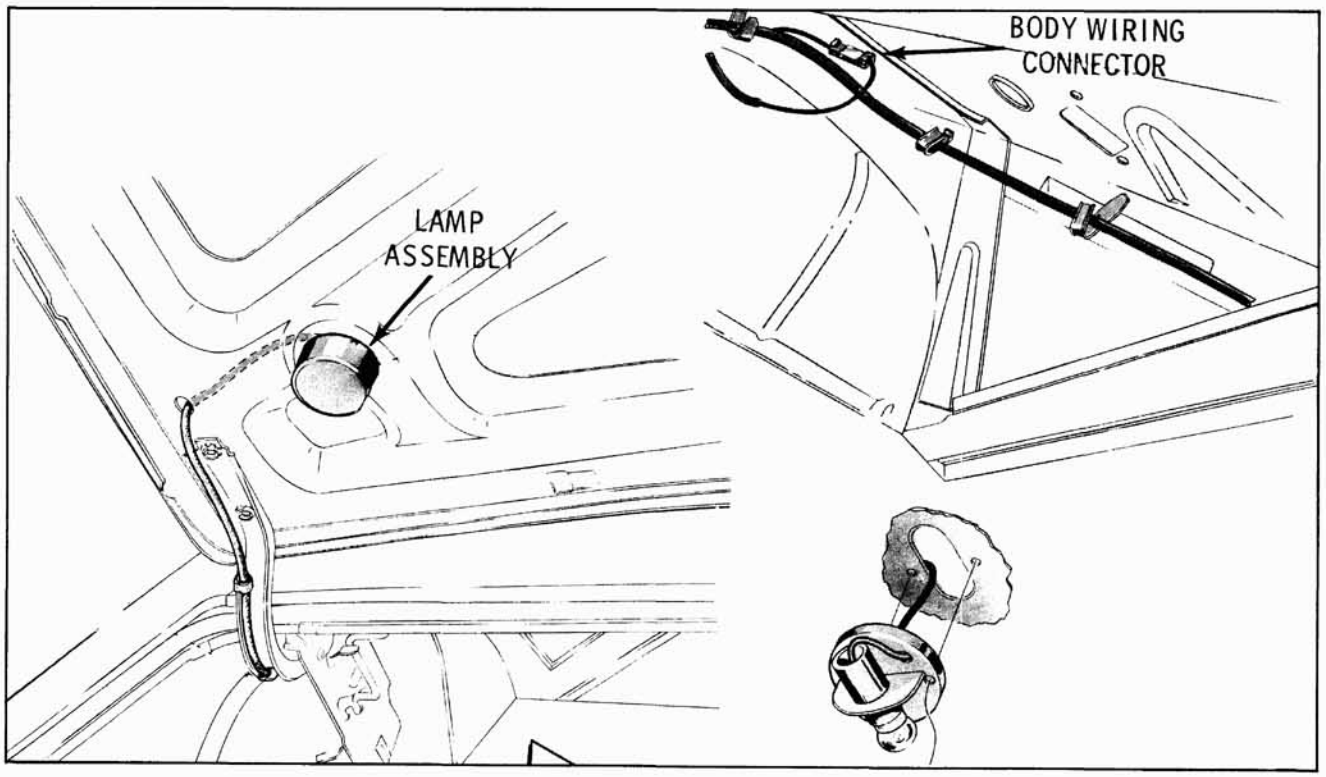


Fig. 15-87—Trunk Lamp Installation (31 through 44 Series)

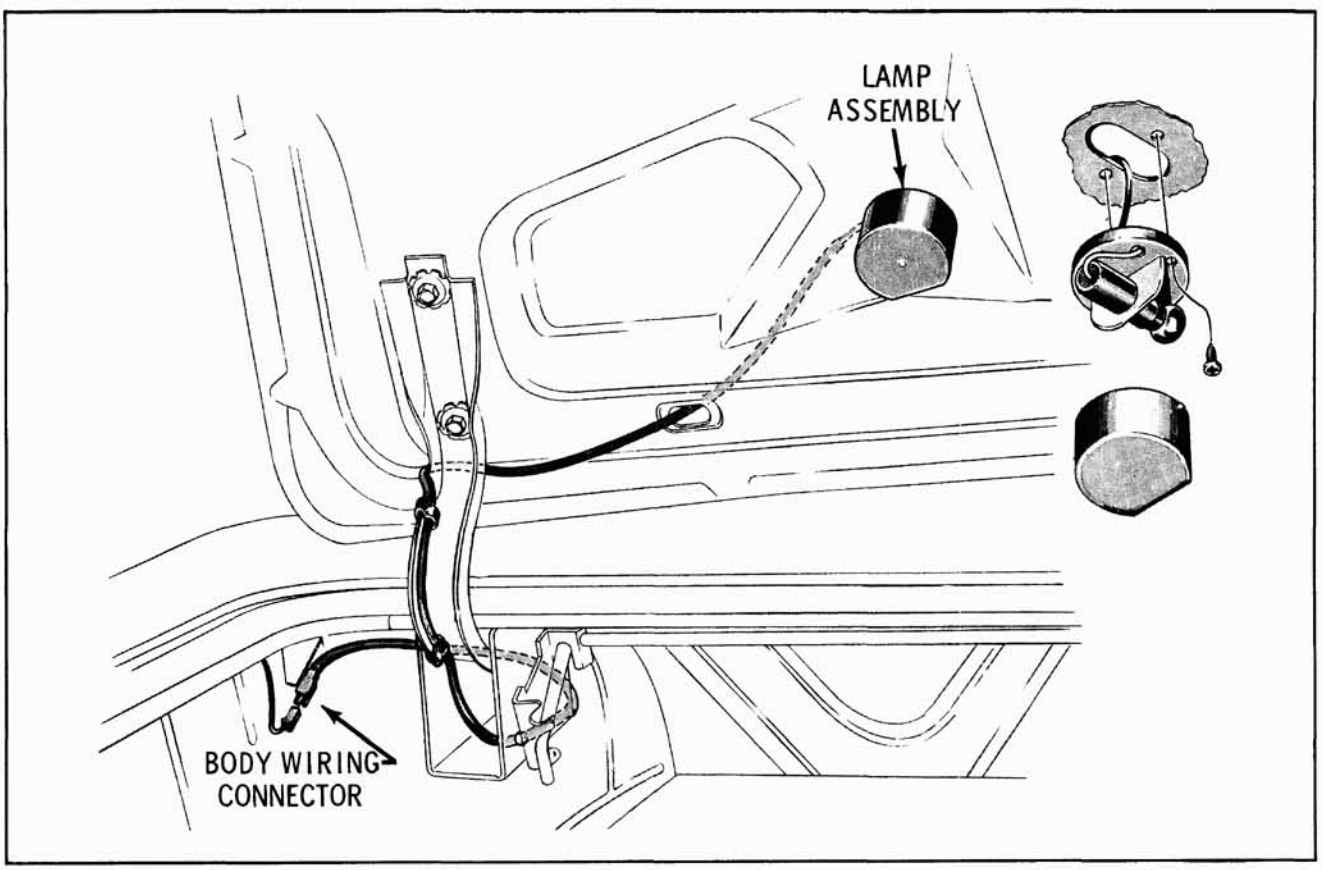


Fig. 15-88—Trunk Lamp Installation (54 through 86 Series)

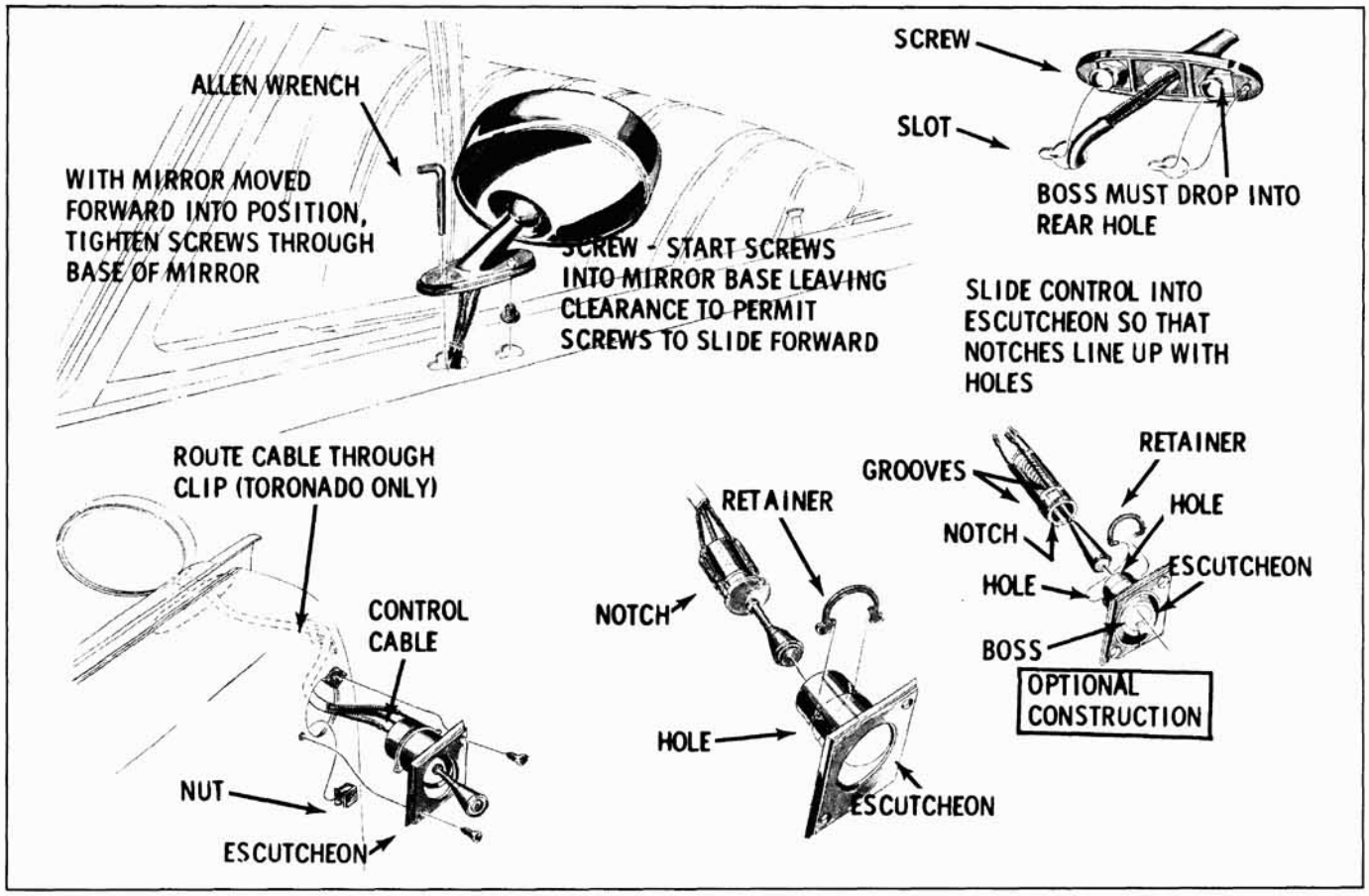


Fig. 15-89—Remote Control Mirror Installation

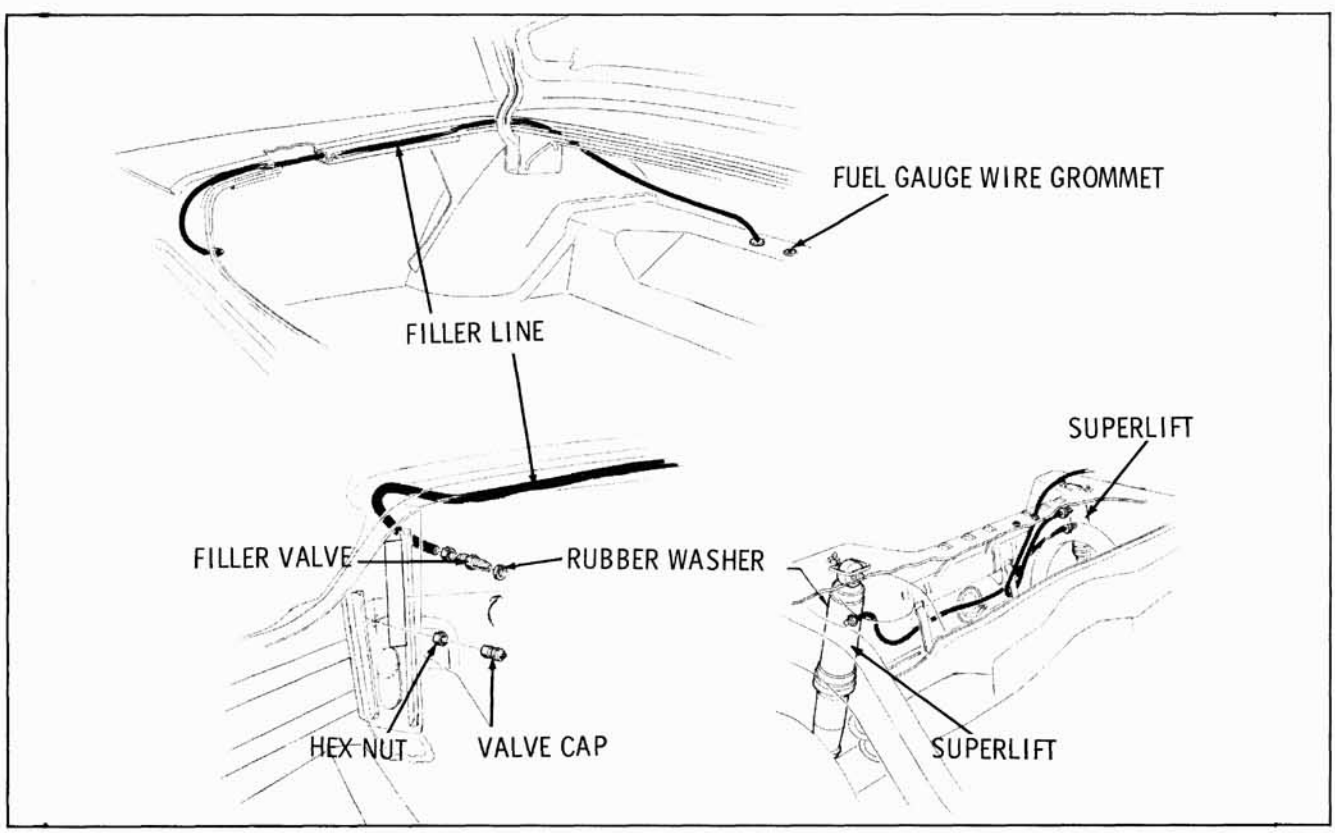


Fig. 15-90—Superlift Shock Absorber Installation (54 through 86 Series)

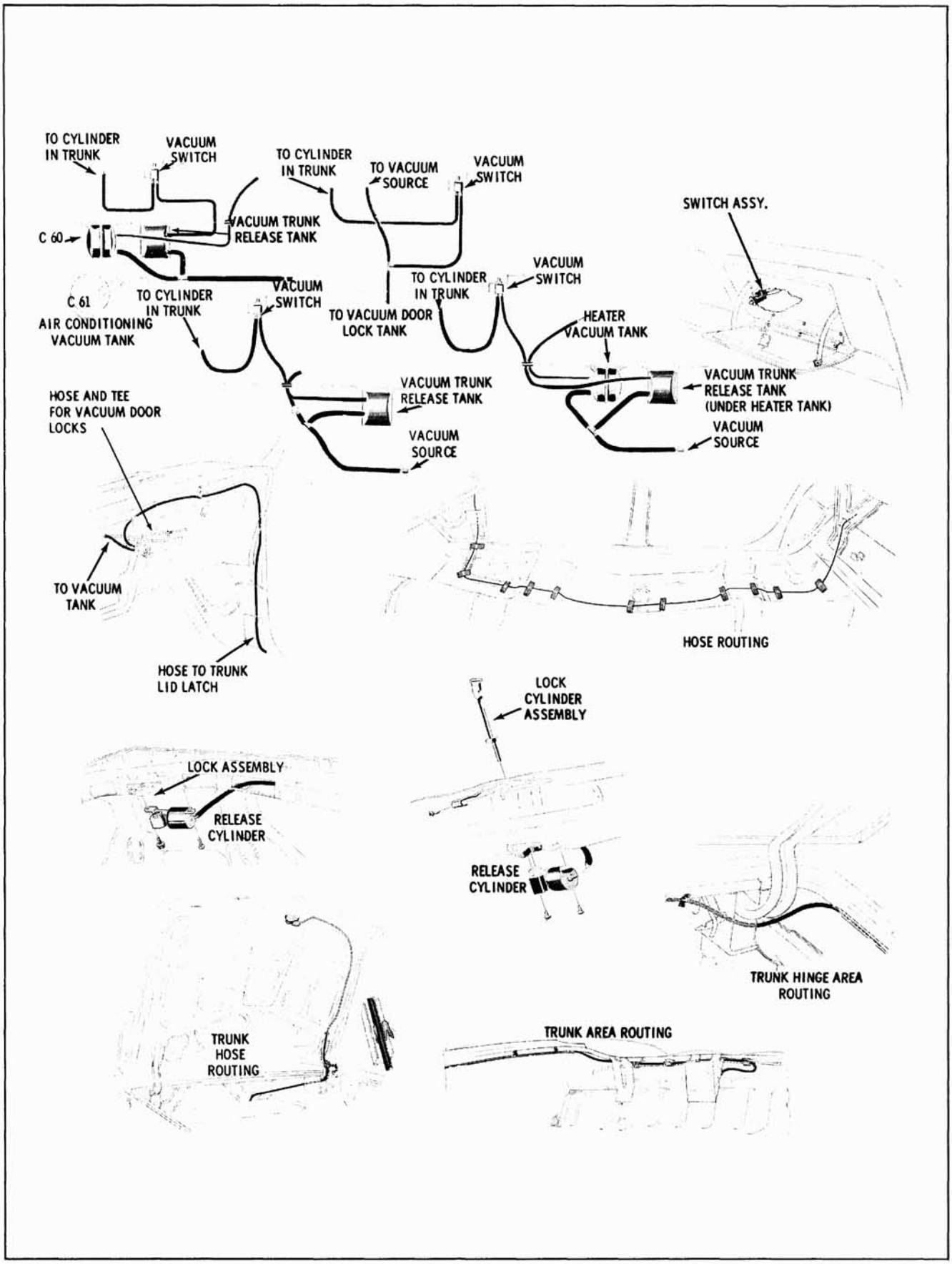


Fig. 15-91—Vacuum Trunk Release (54 through 86 Series)

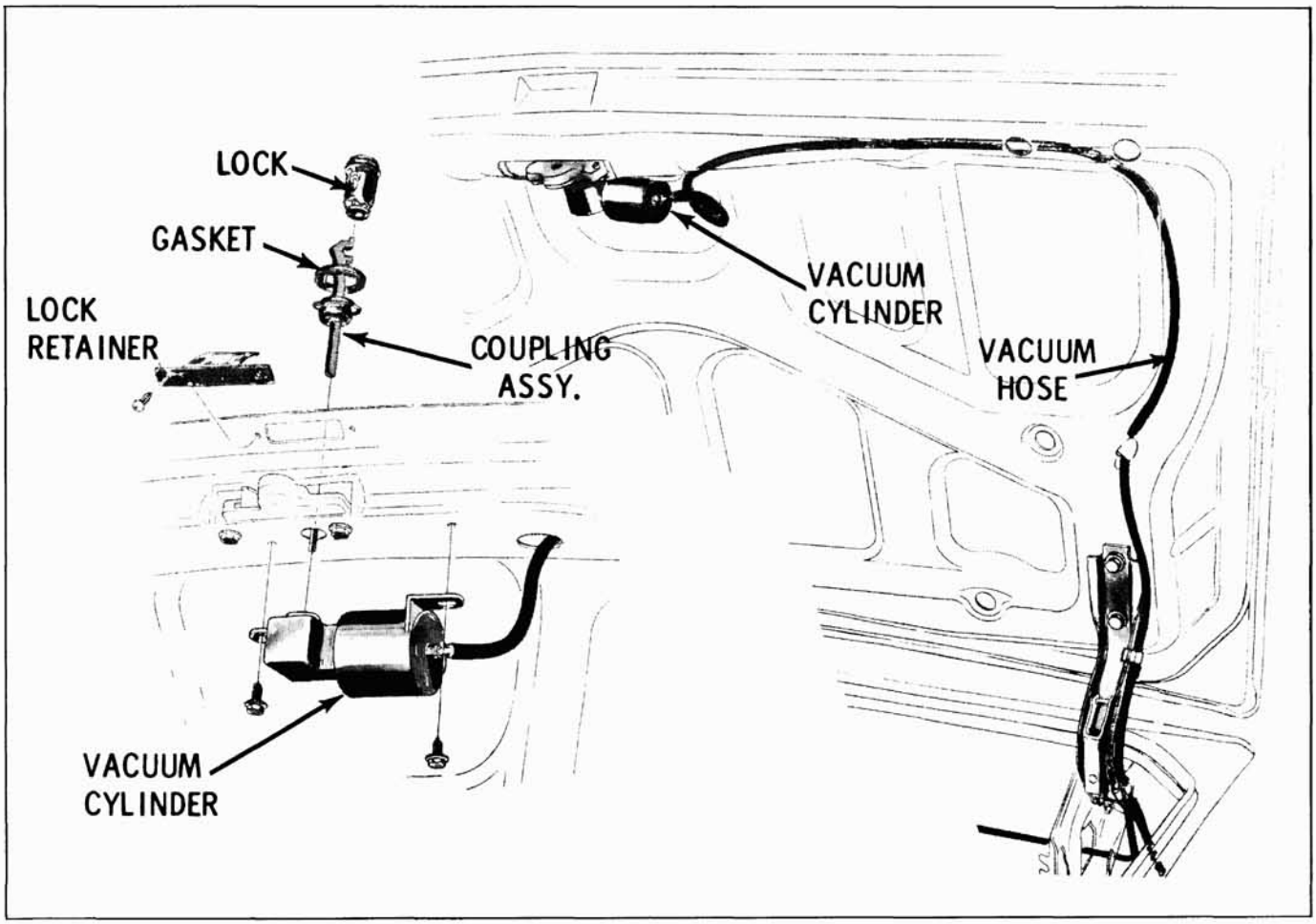


Fig. 15-92—Release and Lock Installation

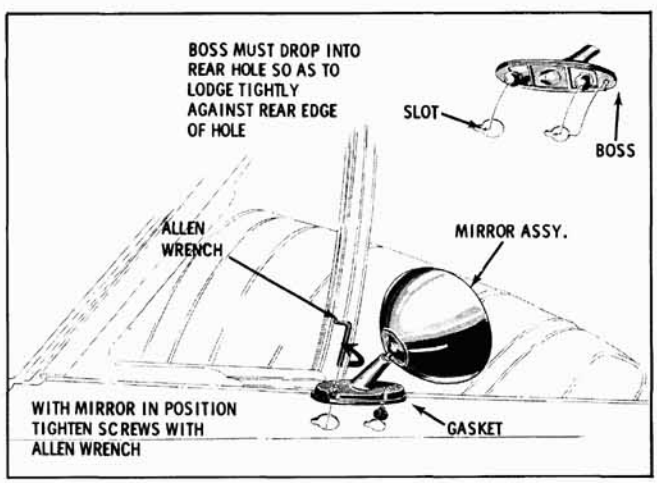


Fig. 15-93—Outside Mirror Installation

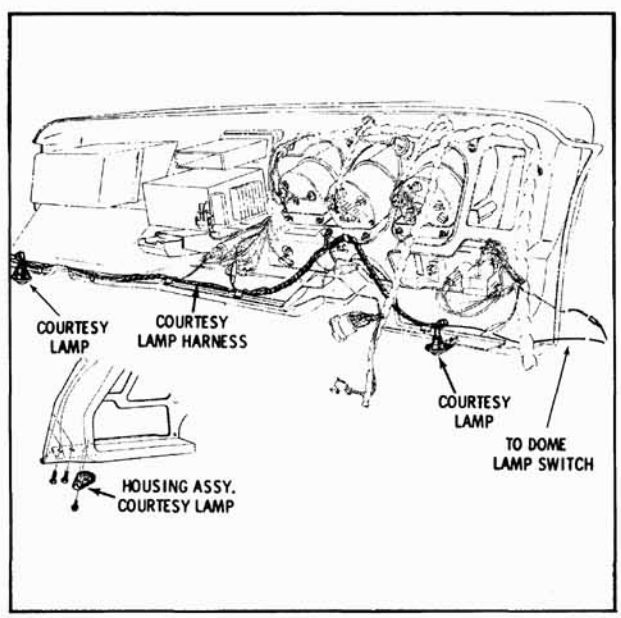
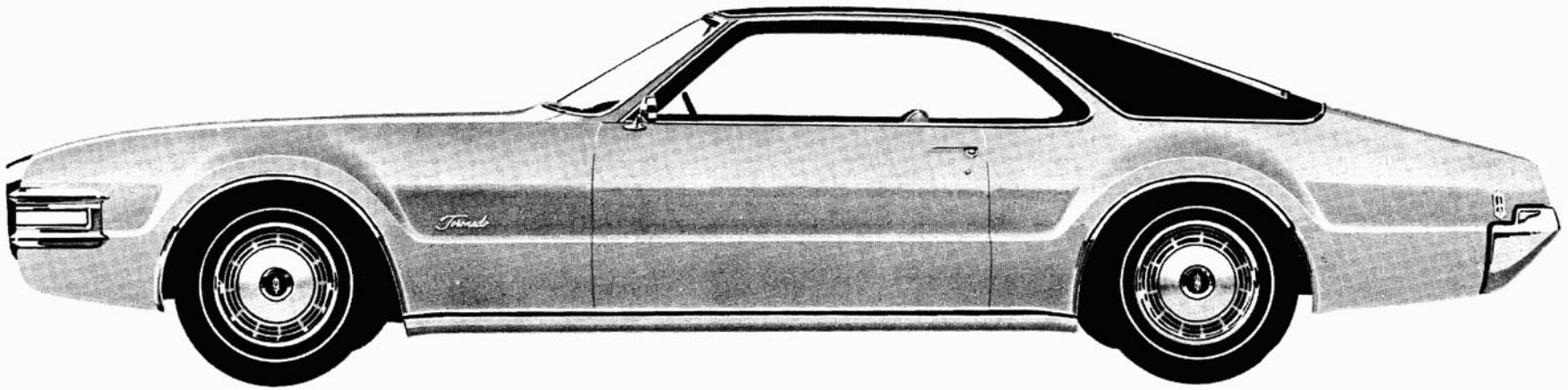


Fig. 15-94—Courtesy Lamps (54 through 86 Series)

1968
OLDSMOBILE TORONADO
(94 SERIES)

For service procedures and recommendations not listed within this section, refer to the appropriate section in the forward part of this manual as the service procedures are similar to the 31 through 86 series.

SECTION	SUBJECT	PAGE
1E	HEATER AND AIR CONDITIONER	1E-1
2E	FRAME AND BODY MOUNTINGS	2E-1
3E	FRONT SUSPENSION, DRIVE AXLES AND FINAL DRIVE	3E-1
4E	REAR SUSPENSION	4E-1
5E	BRAKES	5E-1
6E	ENGINE	6E-1
7E	TRANSMISSION	7E-1
8E	FUEL TANK AND EXHAUST	8E-1
9E	STEERING	9E-1
10E	WHEELS AND TIRES	10E-1
11E	CHASSIS SHEET METAL	11E-1
12E	CHASSIS ELECTRICAL, INSTRUMENT PANEL AND WIPERS	12E-1
13E	RADIATOR AND GRILLE	13E-1
14E	BUMPERS	14E-1
15E	ACCESSORIES	15E-1


Firebird

HEATER AND AIR CONDITIONER

TORONADO

CONTENTS OF SECTION 1E

Subject	Page	Subject	Page
GENERAL DESCRIPTION	1E-1	VENTILATION AND HEATER CONTROL	1E-4
OPERATION	1E-2	REMOVE AND INSTALL	1E-4
VENTILATION	1E-2	BLOWER RESISTOR	1E-4
HEATER	1E-2	REMOVE AND INSTALL	1E-4
ADJUSTMENTS	1E-2	HEATER DISTRIBUTOR	1E-5
TEMPERATURE CONTROL CABLE	1E-2	VENT DUCTS	1E-5
AIR INLET DOOR	1E-2	HEATER HOSES	1E-5
HEATER AND BLOWER ASSEMBLY	1E-3	VACUUM HOSES	1E-5
REMOVE AND INSTALL	1E-3		

HEATER

GENERAL DESCRIPTION (Fig. 1E-1)

Air enters the ventilation and heater system at the cowl vent grille, travels through the plenum chamber and into the cowl air chamber. Air can now be directed into the passenger compartment by opening the right and left side cowl doors or by opening the heater inlet door. The doors are operated by vacuum diaphragms, actuated by pushbuttons in one direction and closed by spring force in the other direction.

The ventilation and heater control pushbuttons are in a single control unit located in the instrument panel on the left side of the steering column. The control also contains the blower speed switch and the temperature control slide lever.

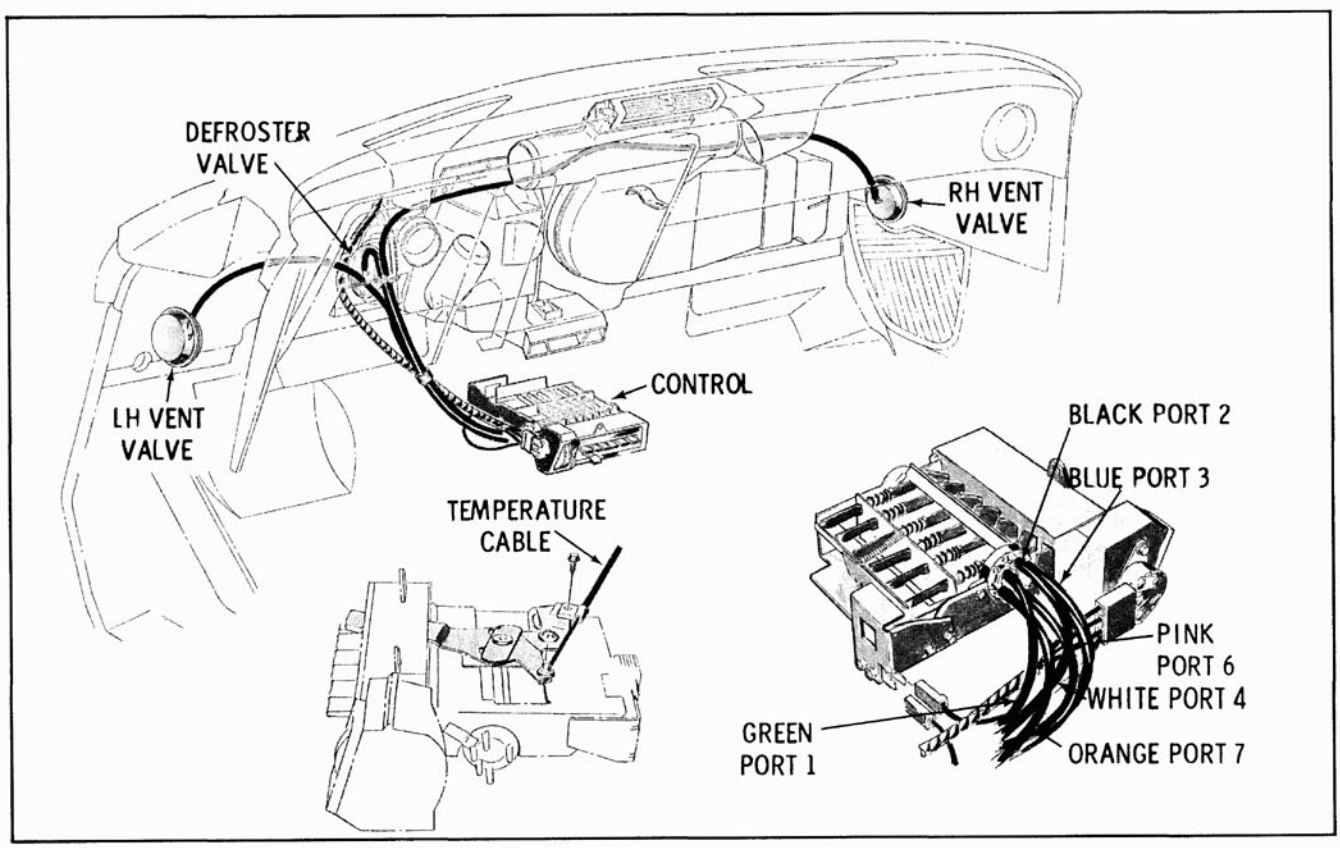


Fig. 1E-1—Heater Layout

OPERATION

Ventilation

When the MIN button is depressed the outside air and forced ventilation valve diaphragms are vented. This allows spring force to open the outside air door and move the forced ventilation valve to allow air to flow into the passenger compartment through the vent outlets in the instrument panel. Air velocity is controlled by the blower speed switch.

When the MED button is depressed, the operation is the same as when the MIN button is depressed, however the left cowl air inlet valve is also opened. Air enters the passenger compartment through the vent outlets in the instrument panel and through the left cowl air inlet.

Air velocity through the vent outlets, in the instrument panel, is controlled by the blower speed switch. Air velocity from the left cowl air inlet is controlled by forward motion of the car only.

When the MAX button is depressed, the operation is the same as when the MED button is depressed, however the right cowl inlet valve is also opened. Air enters the passenger compartment through the vent outlets in the instrument panel and through the right and left cowl air inlets.

Air velocity through the vent outlets, in the instrument panel, is controlled by the blower speed switch. Air velocity from the left and right cowl air inlets is controlled by forward motion of the car only.

Heater

When the HEAT button is depressed, vacuum is applied to the defroster and the forced ventilation valve diaphragms. This moves the defroster door to allow approximately 80% of the air to flow into the heater case and 20% to flow onto the windshield. The forced ventilation valve is moved to seal off air to the vent outlets in the instrument panel.

Outside air is drawn through the cowl air intake grille and into the heater blower and air inlet assembly. The heater blower then forces a portion of the outside air through the heater core and into the ducting system. The remaining air is forced directly into the ducting system. To obtain the desired discharge air temperature, the heater air then mixes with the unheated air in the necessary proportions.

The temperature lever operates the temperature door which controls the temperature of the discharged air by regulating the mixing of heated and unheated air. In the full left position, the flow from the heater core is completely blocked. As the lever is moved to the right, the temperature door opens, allowing more air to flow through the core and progressively decreases the amount of unheated air. In the extreme right position, the flow of unheated air is completely blocked directing all the air through the heater core, for maximum heating.

When the DEF button is depressed, the operation is the same as when the HEAT button is depressed, however the defroster diaphragm is vented and the spring moves the valve to allow approximately 80% of the air to flow onto the windshield and 20% to flow out of the heater outlets.

Rate of air flow on HEAT and DEF can be controlled by the blower speed switch.

ADJUSTMENTS

Temperature Control Cable (Fig. 1E-2)

The temperature control cable is adjusted at the heater case under the hood. To adjust hold temperature door closed at heater case and adjust turnbuckle on cable to obtain 1/8" springback of control lever from end of slot in heater control.

Air Inlet Door

Adjustment of the air inlet door and diaphragm is provided for at the diaphragm (Fig. 1E-3).

1. With the air inlet body removed, loosen set screw.

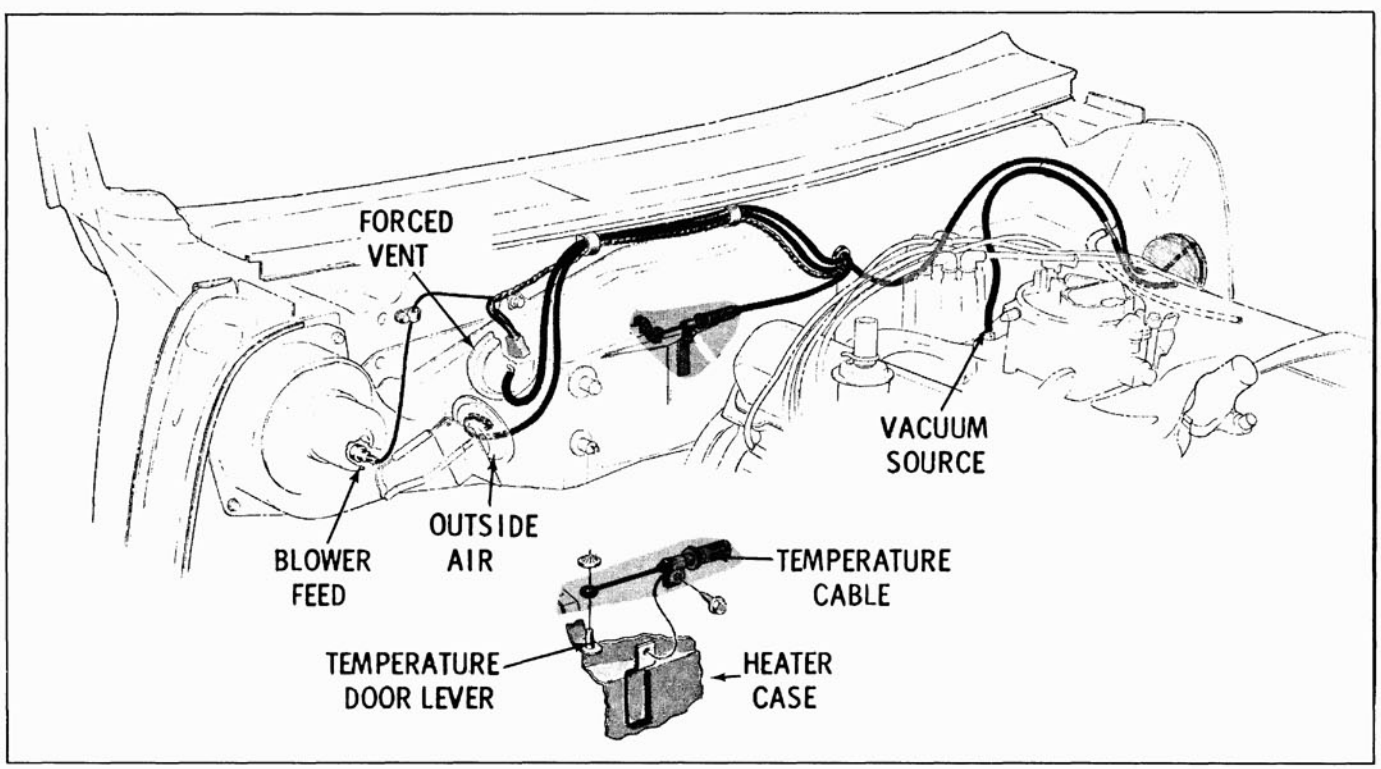


Fig. 1E-2—Temperature Control Cable Location

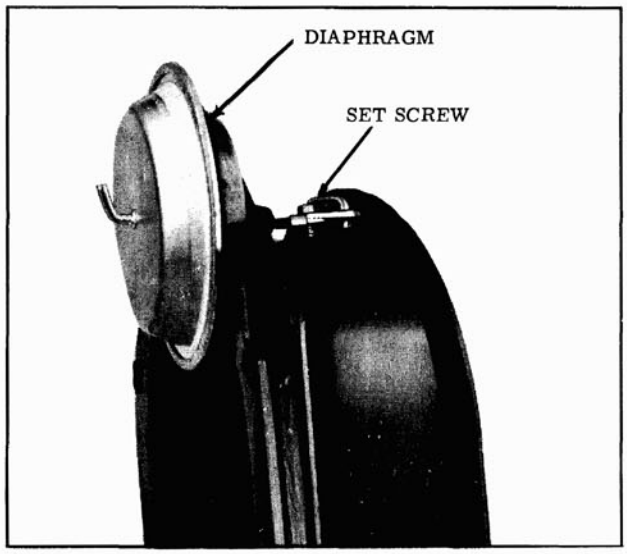


Fig. 1E-3—Air Inlet Diaphragm Adjustment

2. Pull diaphragm lever to its extreme stop, then push back 1/16".
3. While holding door closed, tighten set screw.

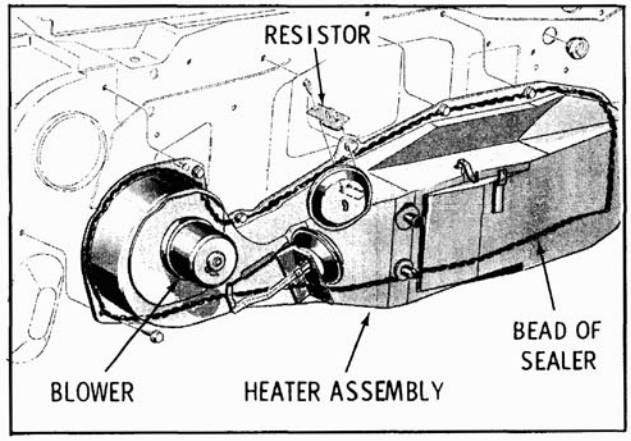


Fig. 1E-4—Heater Assembly

HEATER ASSEMBLY

Remove and Install (Fig. 1E-4)

1. Disconnect blower feed and resistor wiring.
2. Disconnect vacuum hoses from the air inlet and forced vent diaphragms.
3. Disconnect temperature cable from temperature door lever.

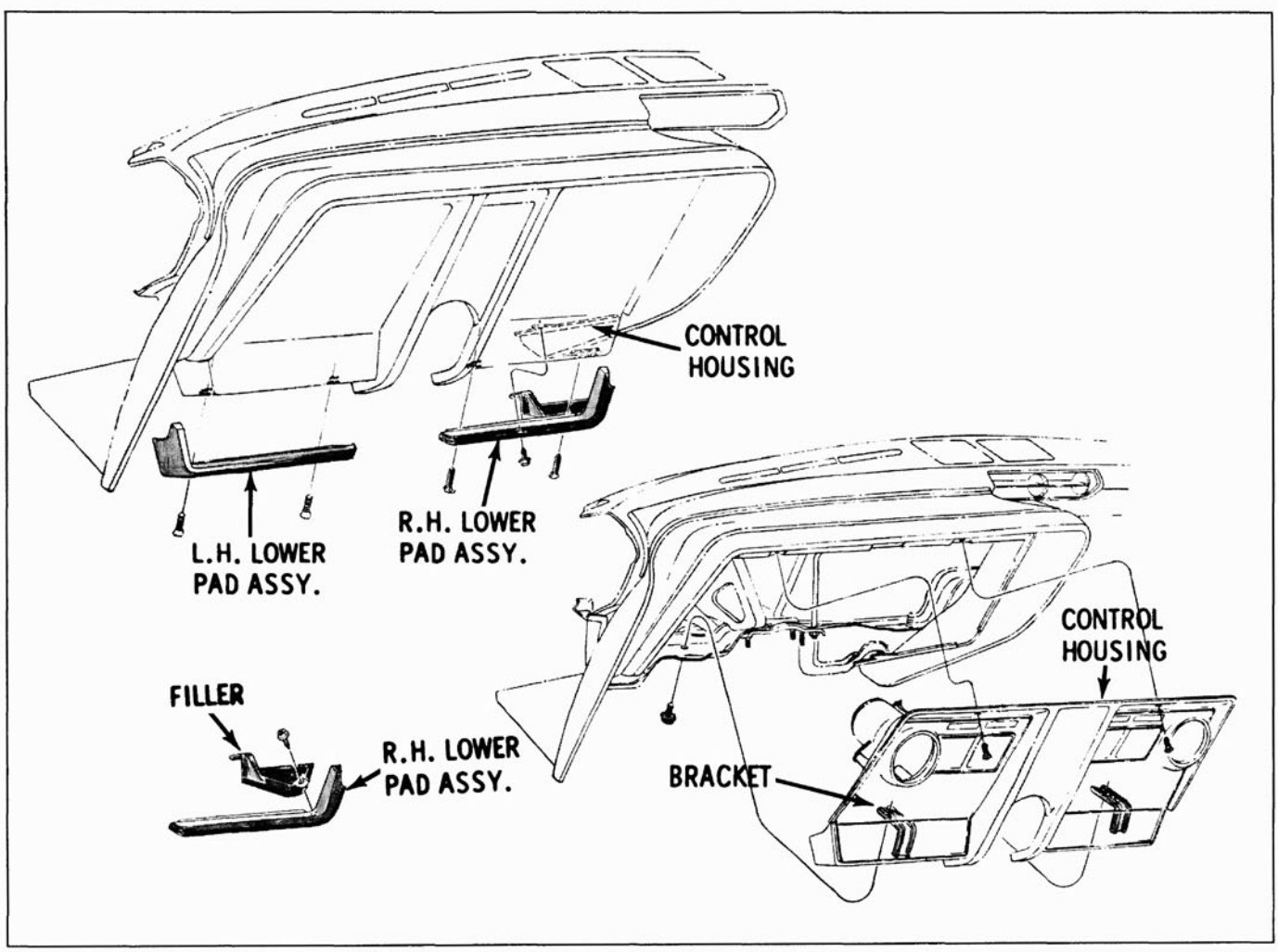


Fig. 1E-5—Trim And Filler Panel Removal

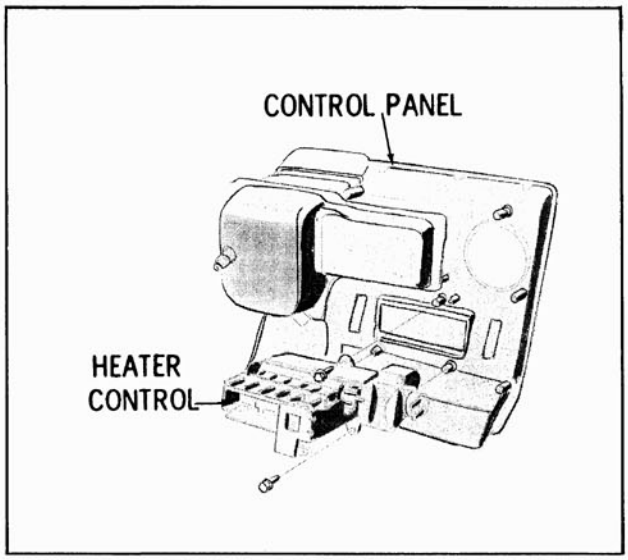


Fig. 1E-6—Control Attachment

4. Disconnect heater hoses. Keep open ends of hoses above engine coolant level to prevent loss of coolant.
5. Remove the heater assembly attaching screws.
6. Remove the heater assembly from the cowl.
7. If the heater core is to be removed, it can be removed at this time.

To install, reverse the removal procedure. Apply sealer to the mounting face of the heater assembly.

VENTILATION AND HEATER CONTROL

Remove and Install

1. Disconnect battery.
2. Remove the RH lower trim panel. (Fig. 1E-5).
3. Disconnect steering column as outlined under STEERING COLUMN, Section 9E.

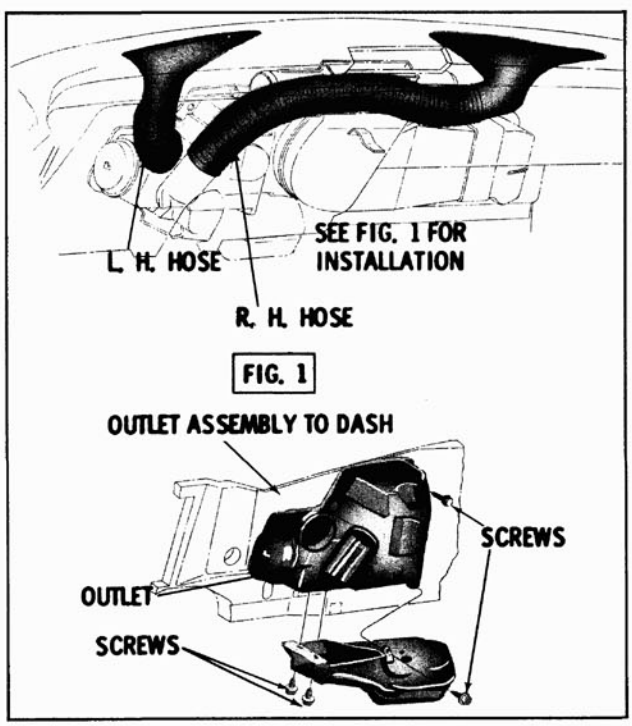


Fig. 1E-7—Heater Distributor

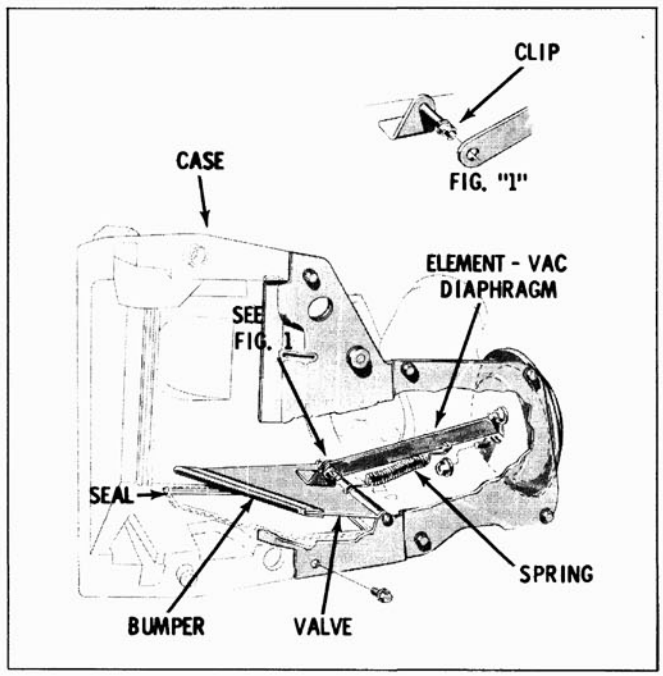


Fig. 1E-8—Heater Distributor (Rear View)

4. Loosen the two lower control panel attaching bolts and remove the two upper bolts. (Fig. 1E-5)
5. Disconnect speedometer cable from transmission. Tip control panel toward seat.
6. Disconnect the vacuum hoses, electrical connections and the temperature cable from the control.
7. Remove the three control attaching screws and remove control from control panel. (Fig. 1E-6)

To install, reverse the removal procedure.

BLOWER RESISTOR

Removal and Installation

The blower resistor is mounted on the heater case. To

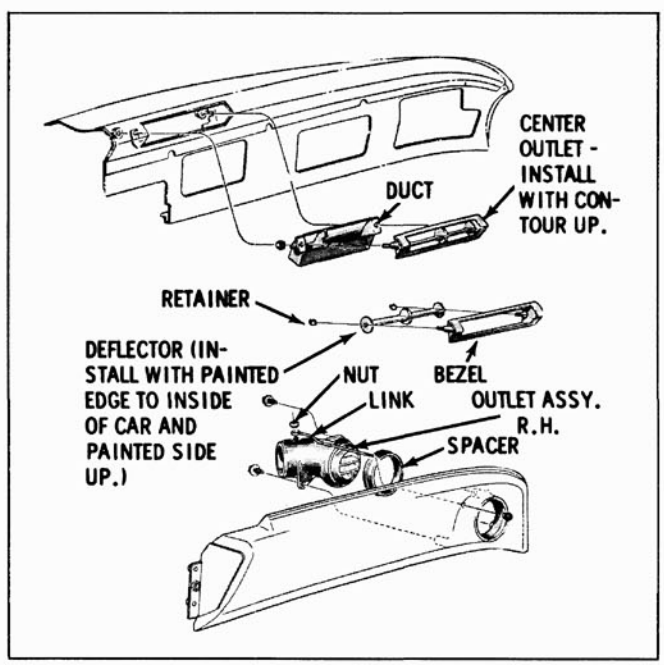


Fig. 1E-9—Vent Outlets

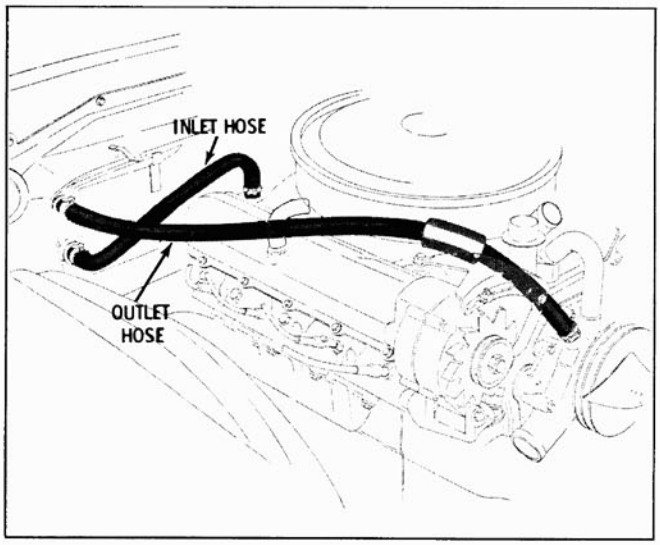


Fig. 1E-10—Heater Hose Routing

remove, disconnect the wiring connector and remove the attaching screws. (Fig. 1E-4)

To install, reverse removal procedure.

HEATER DISTRIBUTOR

The heater distributor, outlet and defroster hoses are installed as shown in Fig. 1E-7. Fig. 1E-8 illustrates the distributor removed from the car.

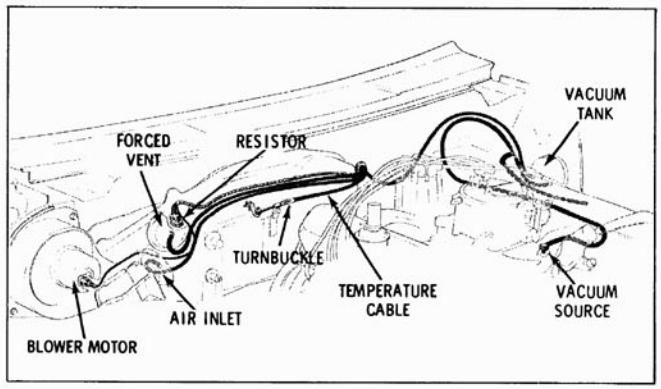


Fig. 1E-11—Electrical Connections

VENT DUCTS

The vent ducts are attached as shown in Fig. 1E-9. Air from the duct assembly is distributed to the vent center outlet and to the right and left side vent outlets. For removal of outlets refer to TORONADO INSTRUMENT PANEL Section 12EA.

HEATER HOSES

The heater hoses are routed as shown in Fig. 1E-10. A water valve is not used on cars equipped with a heater.

VACUUM HOSES

The routing of the vacuum hoses, electrical wiring and temperature cable is shown in Fig. 1E-11.

The vacuum hose and wiring connections and routing inside the car are shown in Fig. 1E-12.

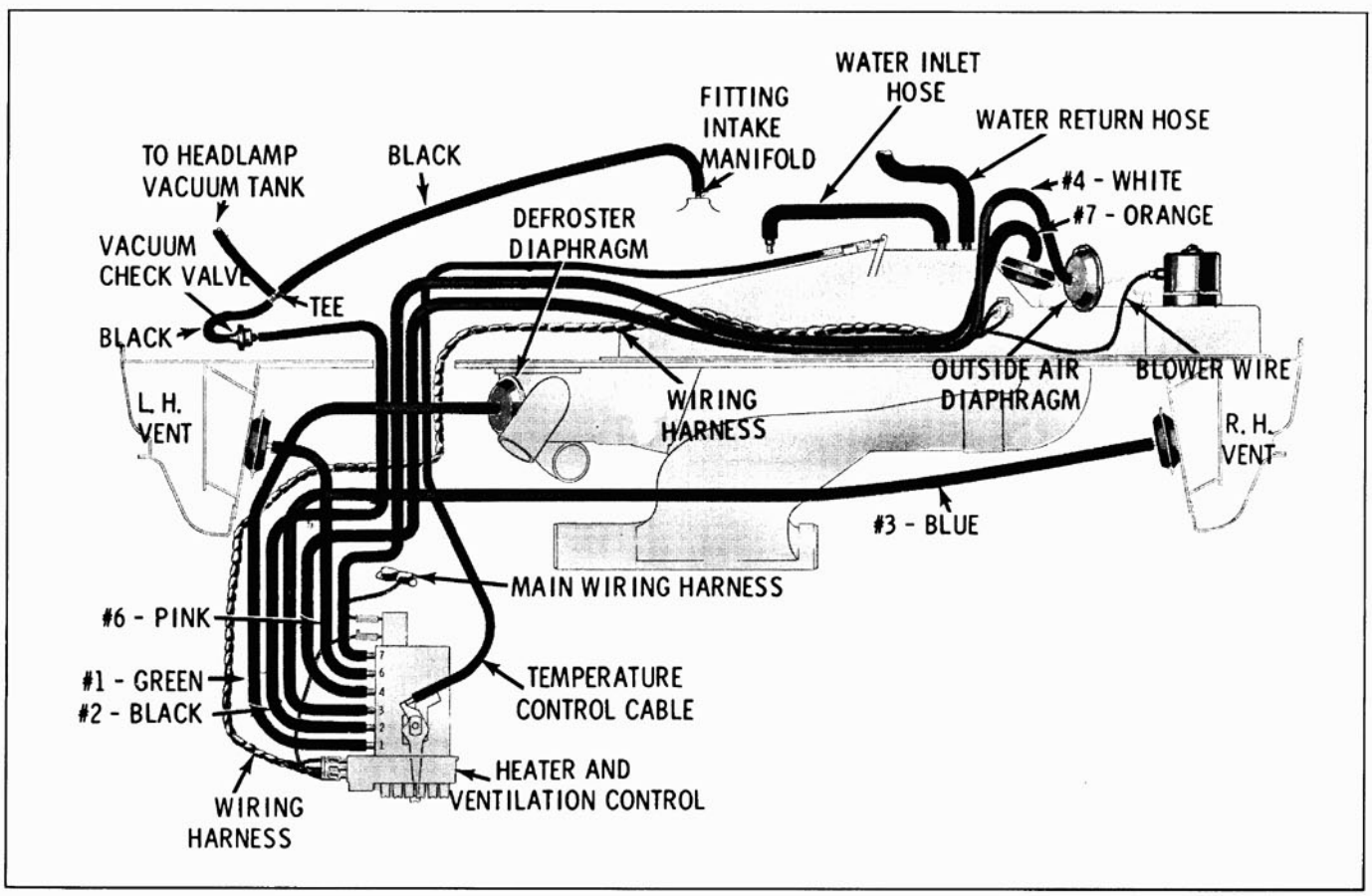


Fig. 1E-12—Vacuum Hose Connections

CUSTOM AIR CONDITIONER (MANUAL, VACUUM CONTROL)

TORONADO

GENERAL DESCRIPTION

Two types of air conditioner systems are used on the Toronado.

Custom (Manual, Vacuum Control)

Comfortron (Automatic Control)

Service information on the air conditioner systems will be covered in order as follows:

1EA Custom Air Conditioner (Manual Vacuum Control)

1EB Comfortron (Automatic Control)

For service information on General Air Conditioning items such as Compressor Servicing, Evacuating and Charging, etc., refer to GENERAL AIR CONDITIONING INFORMATION Page 1A-1.

CONTENTS OF SECTION 1EA

Subject	Page
PERIODIC MAINTENANCE	1EA-1
GENERAL DESCRIPTION	1EA-2
OPERATION	1EA-2
AIR OUTLETS	1EA-2
A.C. CONTROL	
REMOVE AND INSTALL	1EA-3
BLOWER MOTOR	
REMOVE AND INSTALL	1EA-4
HEATER CASE AND CORE	
REMOVE AND INSTALL	1EA-6
EVAPORATOR	
REMOVE AND INSTALL	1EA-6
AIR INLET ASSEMBLY	
REMOVE AND INSTALL	1EA-6
AIR DISTRIBUTION DUCTS	1EA-7
CONDENSER AND RECEIVER	1EA-7
REFRIGERANT LINES	1EA-7
COMPRESSOR	
BELT ADJUSTMENT	1EA-7
REMOVAL	1EA-7
INSTALLATION	1EA-9
HEATER HOSE	1EA-9
BLOWER RESISTOR	1EA-9
DIAGNOSIS	1EA-9
PERFORMANCE TEST	1EA-10
PERFORMANCE CHART	1EA-11
PERFORMANCE TEST RESULTS	1EA-12

PERIODIC MAINTENANCE

Remove road accumulation from condenser at every engine oil change interval or as necessary.

Check and adjust compressor belt tension at each engine oil change interval.

The system should be operated for at least five minutes every two weeks.

Check refrigerant level and replenish as necessary at the start of every cooling season.

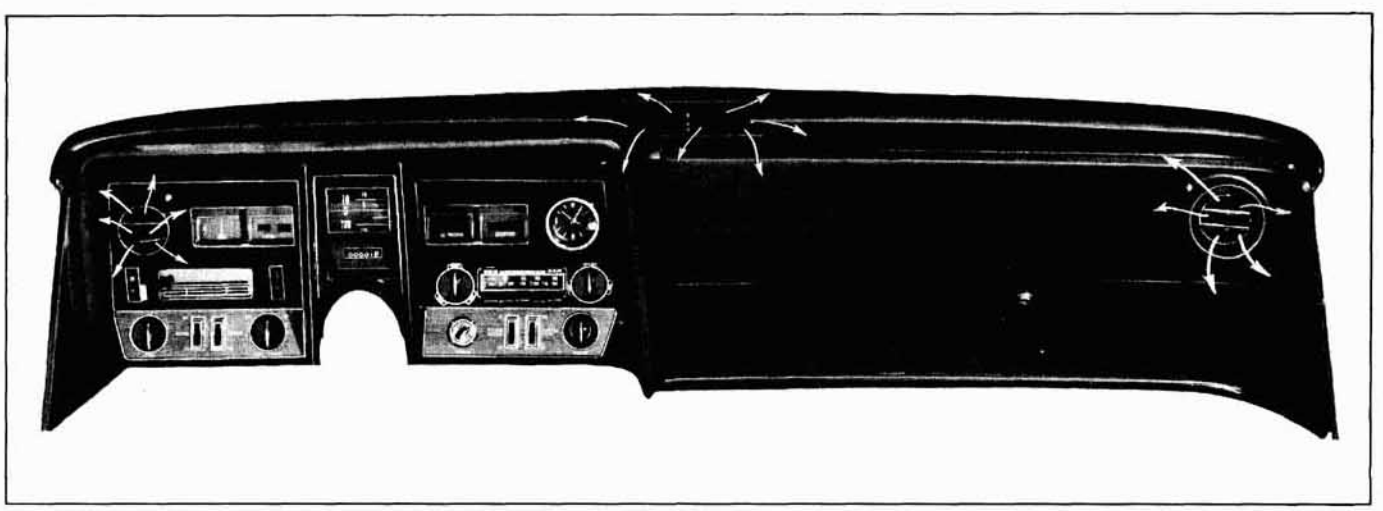


Fig. 1EA-1—Air Outlets

GENERAL DESCRIPTION

The air conditioning system provides refrigerated and dehumidified air to cool the car interior. The system uses both outside and recirculated air.

For normal cooling, A.C. control set for NORMAL, 100% outside air passes through the evaporator core. For maximum cooling, A.C. control set for RECIRC, approximately 80% recirculated air and 20% outside air is directed through the evaporator core.

AIR OUTLETS (Fig. 1EA-1)

Adjustable air outlets are located on either side of the instrument panel. The left and right air outlets may be adjusted to direct the air as desired. In addition, a center outlet is provided to allow additional upper level cooling. The sides are equipped with shut-off valves. The center outlet can be rotated to shut off air flow.

The air condition control assembly is mounted in the instrument panel. A four-speed blower switch is located in the control assembly.

FAST COOL DOWN

To rapidly cool a car which has been standing for a period of time in the sun, open the outlets, set A.C. control on NORMAL, slide temperature lever to the extreme left position and rotate blower speed switch on HI. Open car windows just long enough to expel hot air. After car has cooled, adjust temperature control lever position to suit individual comfort. Air flow can be directed by adjusting the outlets. The recommended position of the air outlets, for best over-all front and rear seat cooling, is when the side outlets are adjusted to direct the air flow along the inside roof line, and the side and center outlets are open.

DRIVING CONDITIONS

For normal driving conditions, the driver may adjust the temperature of cool air by moving the control lever to suit individual comfort. Selection of blower speeds should be regulated according to the amount of air forced into the passenger compartment by the forward motion of the car.

When driving in heavy traffic, it may be desirable to set the blower speed switch on "HI". At higher speeds, air will be forced by the forward motion of the car into the passenger compartment in greater volume, lessening the speed requirements of the blower motor. It then may be desirable to set the blower speed switch to suit individual comfort.

OPERATION

Heat Button Depressed

When HEAT button is depressed vacuum is applied to both parts of the outside air door and to the defroster door. This positions the defroster door to allow approximately 80% of the air to flow out of the heater outlet and 20% to flow onto the windshield. The outside air door is positioned to allow 100% outside air to enter the heater assembly.

When the temperature lever is moved toward the warm position, vacuum is directed to the water valve allowing engine coolant to flow through the heater core. Air flowing through the heater assembly is now warmed and flows out of the heater outlets. Temperature of heater outlet air is controlled by moving the temperature lever which is connected to the temperature door with a cable. This mixes outside air with heated air to temper the discharge air.

Air velocity is controlled by a four-speed blower switch. When the DEF button is depressed the operation is identical to HEAT except the defroster door diaphragm is vented to direct air flow to the windshield.

Vent Button Depressed

When the VENT button is depressed, vacuum is applied to both ports of the outside air door, and to the mode door. This positions the outside air door to allow 100% outside air to enter the heater assembly. With vacuum applied to the mode door, the mode door is in the A.C. position, allowing discharge air to flow out of the A.C. outlets. With the temperature lever moved to the full cool position 100% outside ambient air flows out of the A.C. outlets. When the temperature lever is moved toward the warm position, vacuum is directed to the water valve allowing engine coolant to flow through the heater core. Some of the air is now directed through the heater core by movement of the temperature door where it is warmed and mixes with the outside air to temper the discharge air from the A.C. outlets.

Air velocity is controlled by a four-speed blower switch.

Normal Button Depressed

When the NORMAL button is depressed an electrical switch is closed to start the compressor and vacuum is applied to both ports of the outside air door. This positions the outside air door to allow 100% outside air to enter the heater assembly. With vacuum applied to the mode door the door is in the A.C. position.

Air flowing through the heater assembly is cooled by the evaporator.

With the temperature lever in the full cool position all the cooled air is directed out of the A.C. outlets.

As the temperature lever is moved toward the warm position, vacuum is directed to the water valve allowing engine coolant to flow through the heater core. Some of the air is now directed through the heater core by movement of the temperature door, where it is warmed and mixes with the A.C. air to temper the discharge air from the A.C. outlets. If the temperature lever is moved to the full warm position all the air coming out of the A.C. outlets will be heated.

Air velocity is controlled by a four-speed blower switch.

Recirc Button Depressed

When the RECIRC button is depressed, an electrical switch is closed to start the compressor and vacuum is applied to one port of the outside air door. This positions the outside air door to allow 20% outside air and 80% inside air to enter the heater assembly. With vacuum applied to the mode door, the mode door is in the A.C. position.

Air flowing through the heater assembly is cooled by the evaporator.

With the temperature lever in the full cool position all the cooled air is directed out of the A.C. outlets.

As the temperature lever is moved toward the warm position vacuum is directed to the water valve allowing engine coolant to flow through the heater core. Some of the air is now directed through the heater core where it is warmed and mixes with the A.C. air to temper the discharge air from the A.C. outlets. If the temperature lever is moved to the full warm position, all the air coming out of the A.C. outlets will be heated.

Air velocity is controlled by a four-speed blower switch.

Air Outlets

The air outlets are installed as shown in Fig. 1EA-2.

SIDE OUTLETS

Adjustment

The side outlet nozzles should be free to rotate but tight enough to remain in a set position. If adjustment is required, refer to Fig. 1EA-3.

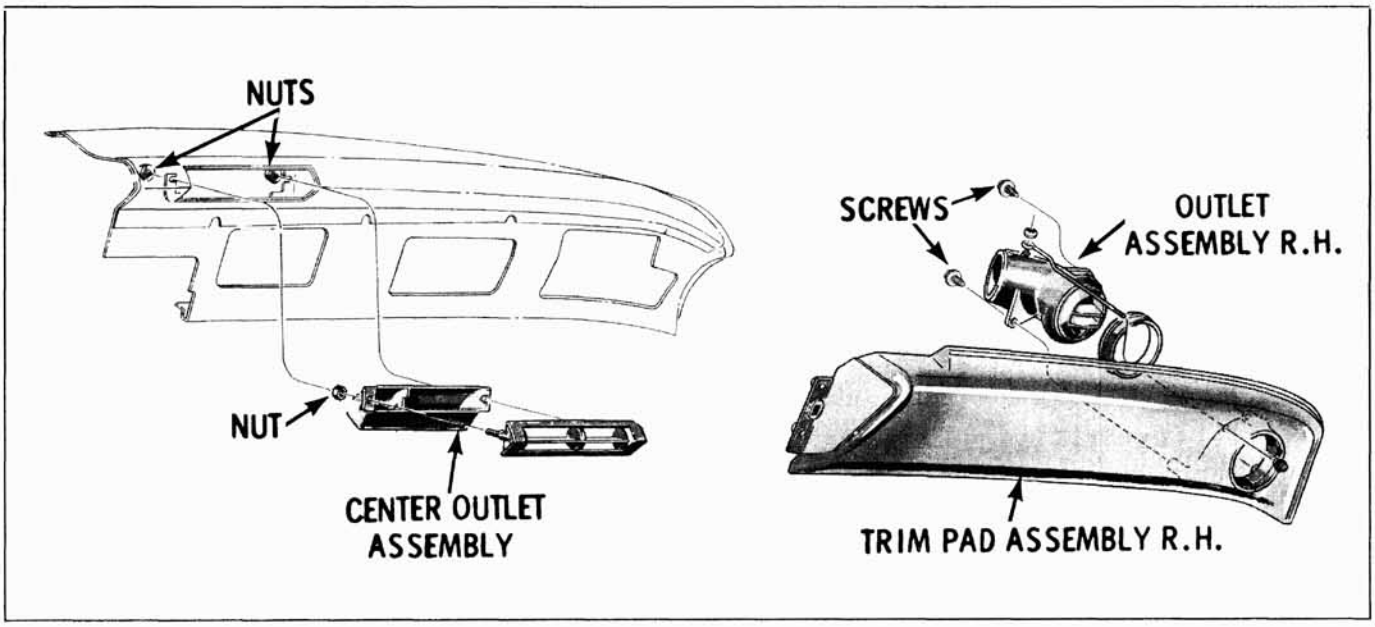


Fig. 1EA-2—Air Outlet Installation

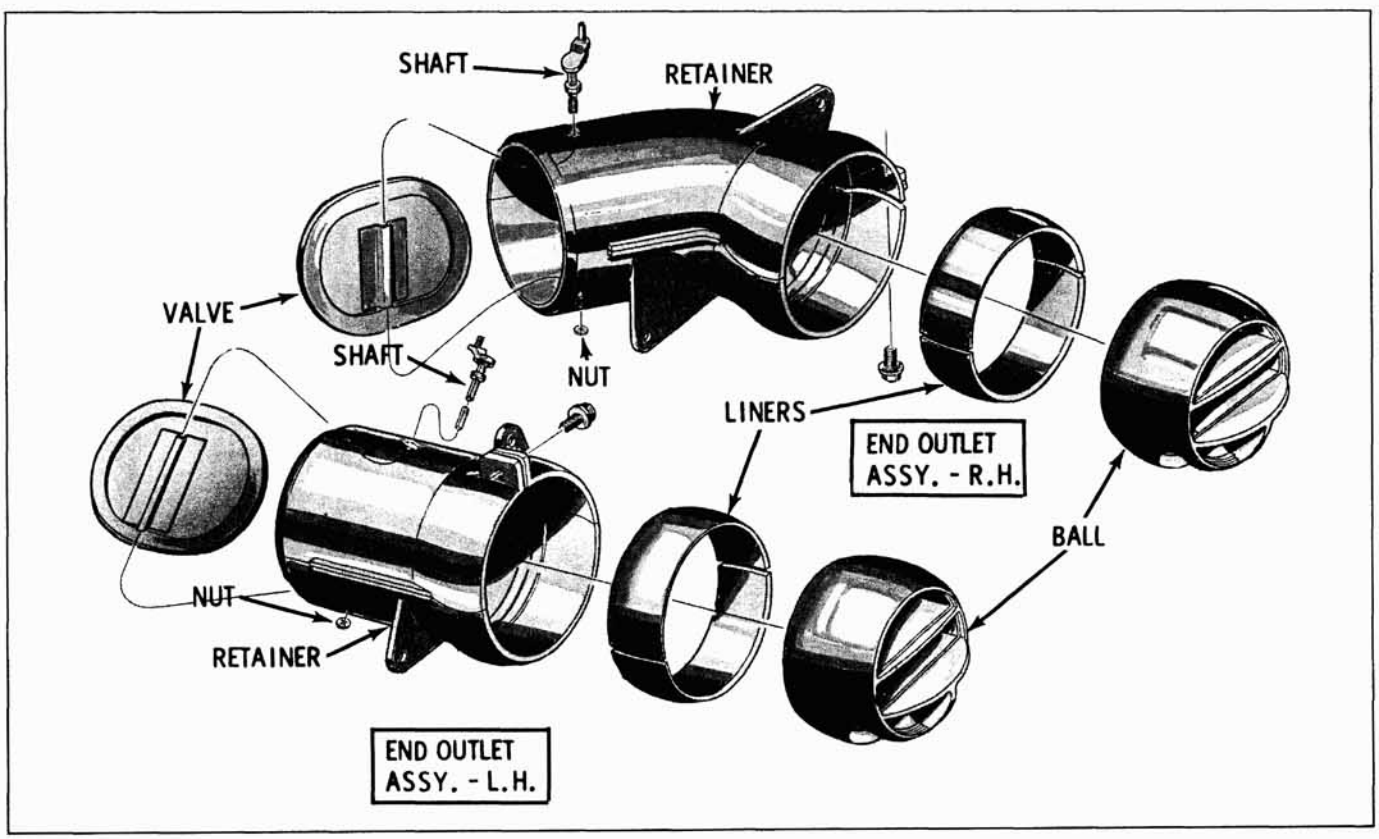


Fig. 1EA-3—Side Outlets

CONTROL

Remove and Install

1. Disconnect battery.
2. Remove the RH lower trim panel. (Fig. 1EA-4)
3. Disconnect steering column as outlined under Steering Column Section 9E.
4. Loosen the two lower control panel attaching bolts and remove the two upper bolts. (Fig. 1EA-5)
5. Tip control panel toward seat. Disconnect speedometer cable from transmission to obtain more clearance.
6. Disconnect the vacuum hoses, electrical connections and the temperature cable from the control.
7. Remove the three control attaching screws and remove control from control panel.

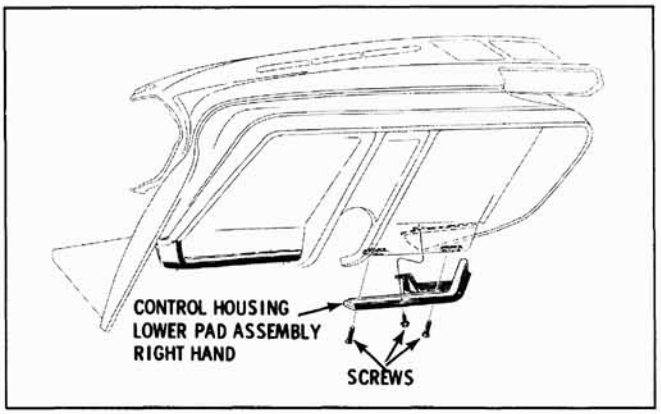


Fig. 1EA-4—Lower Trim Panel Removal

To install, reverse the removal procedure. Refer to Figs. 1EA-6 and 1EA-7 for vacuum hose and wiring connections.

BLOWER MOTOR

Remove and Install

1. Disconnect battery.
2. Disconnect wiring as necessary for accessibility.
3. Remove antenna assembly, if so equipped.
4. Remove blower motor attaching screws.
5. Rotate blower motor inside of fender and remove fan.

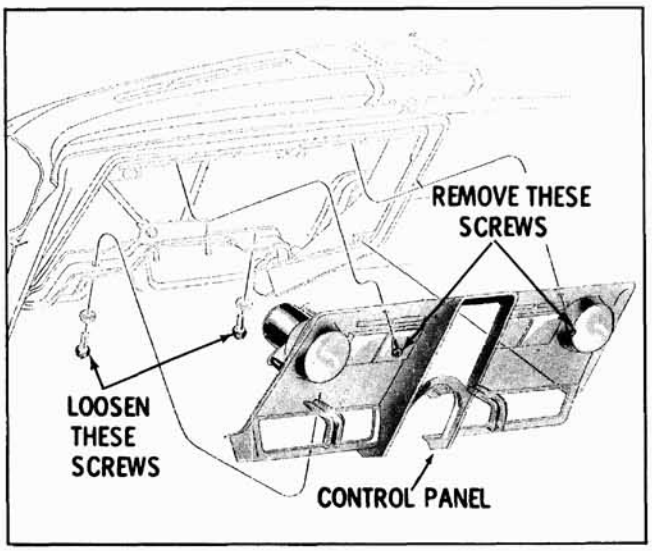


Fig. 1EA-5—Disconnecting Control Panel

6. Remove motor and blower separately, between the fender and filler plate and out through the top of the engine compartment.

To install, reverse the removal procedure.

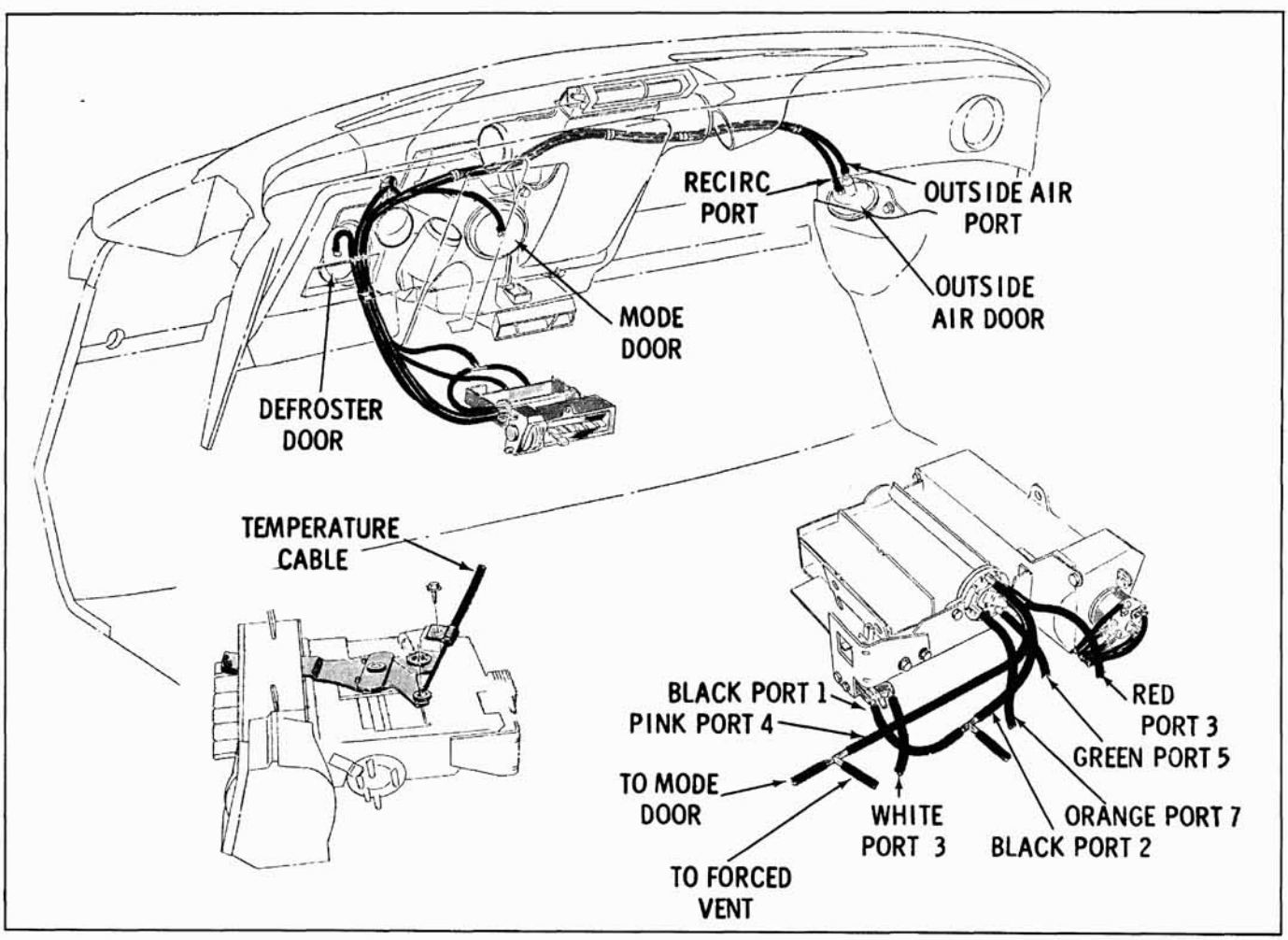


Fig. 1EA-6—Vacuum Hose Routing

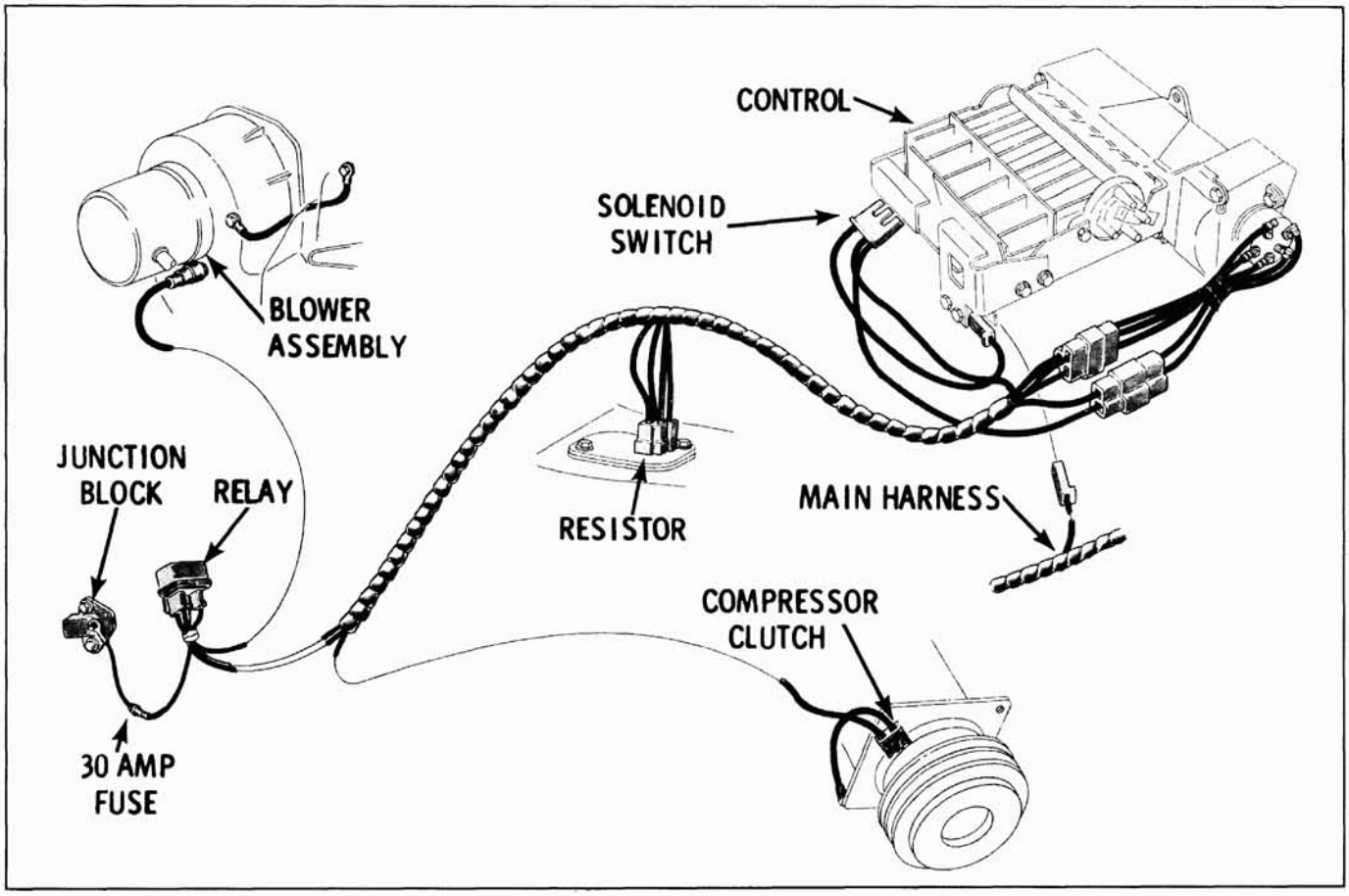


Fig. 1EA-7—Wiring Connections

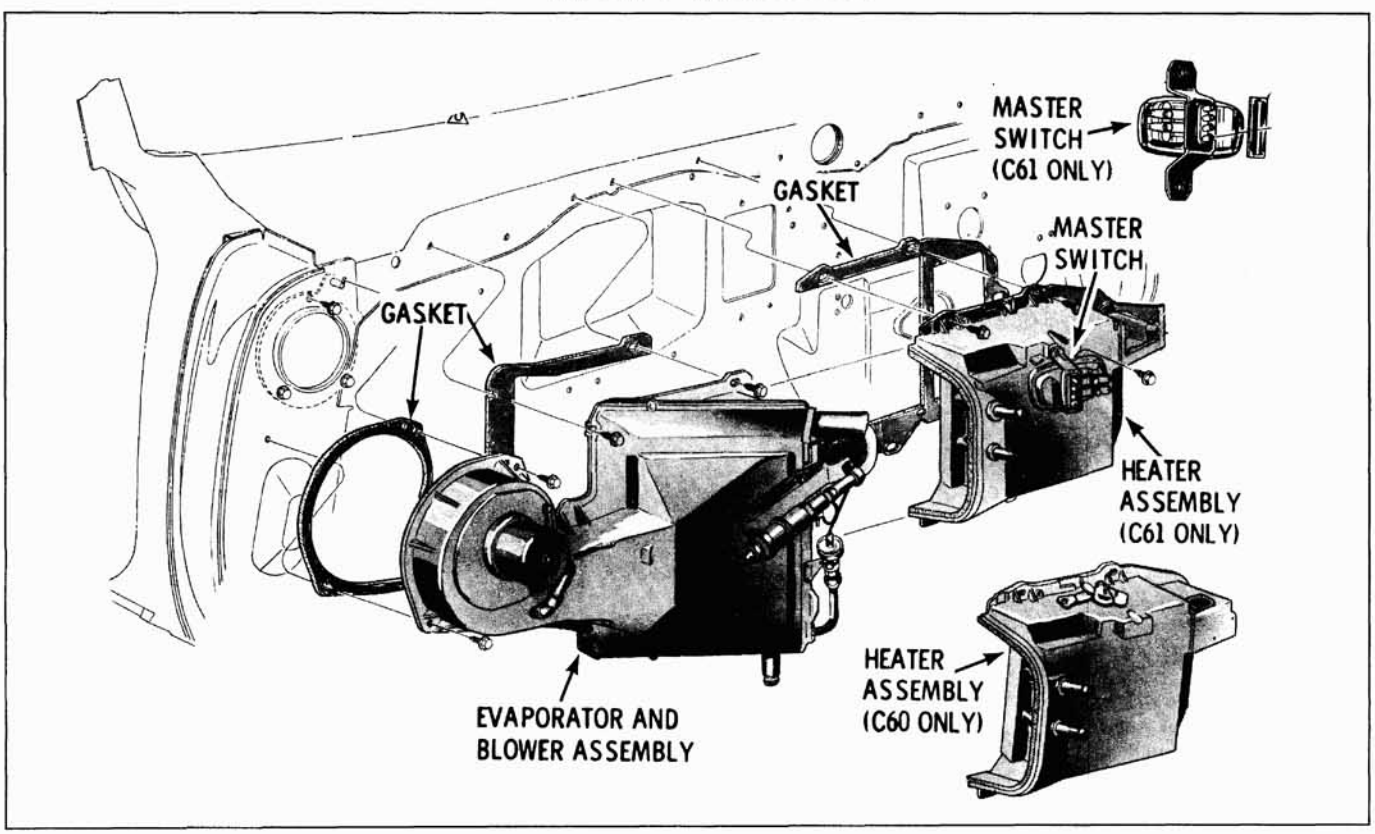


Fig. 1EA-8—Evaporator and Heater Installation

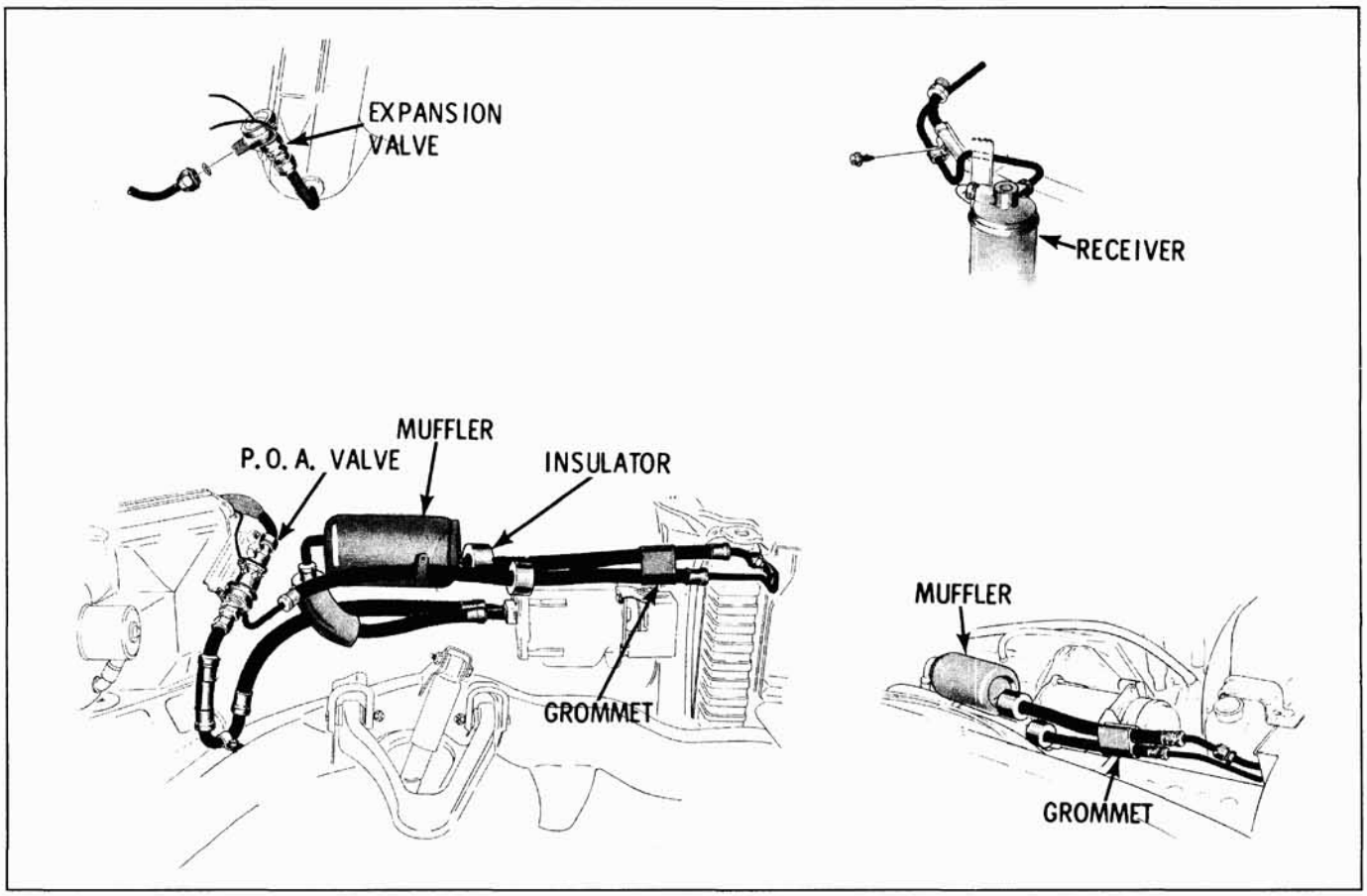


Fig. 1EA-9—Refrigerant Line Routing

HEATER CASE AND CORE

Remove and Install (Fig. 1EA-8)

1. Disconnect battery.
2. Disconnect hood from hinges and remove.
3. Disconnect vacuum hoses, electrical connections and temperature cable.
4. Remove heater hoses and suspend above engine coolant level.
5. Remove the heater case to cowl attaching screws.
6. Remove heater assembly.
7. If the heater core is to be serviced, it can be removed at this time.

To install, reverse removal procedure. Be sure all gaskets are in place. Refill radiator and check for coolant leaks.

EVAPORATOR

Remove and Install (Fig. 1EA-8)

1. Disconnect battery.
2. Disconnect hoodlight wiring.
3. Remove hood and RH hinge as an assembly.
4. Discharge system, then disconnect muffler hose at P.O.A. valve and plug fittings. (Fig. 1EA-9)
5. Disconnect vacuum hoses and wiring as necessary.
6. Remove blower motor assembly from evaporator housing and tie motor back against fender inner panel.
7. Disconnect high pressure hose at condenser and plug fittings.
8. Remove muffler clamp attaching bolt and slide muffler assembly forward out of the way.
9. Remove line at expansion valve and plug fittings.
10. Remove evaporator housing attaching bolts.
11. Loosen heater assembly attaching screws until duct can be moved to the left of elongated holes.
12. Remove top right attaching screw in heater duct.
13. Remove evaporator assembly.

To install reverse removal procedure. Evacuate and charge the system.

AIR INLET VALVE ASSEMBLY

Remove and Install

1. Remove evaporator assembly.
2. Remove the three screws holding the air inlet valve assembly to the cowl. (Fig. 1EA-8)
3. Remove cowl trim pad.
4. Remove the five screws securing the inlet valve to the cowl. (Fig. 1EA-10)
5. Remove the vacuum hoses.

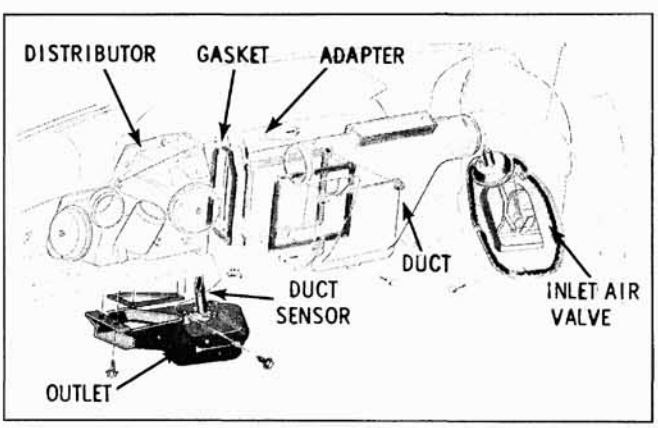


Fig. 1EA-10—Air Distribution Ducts

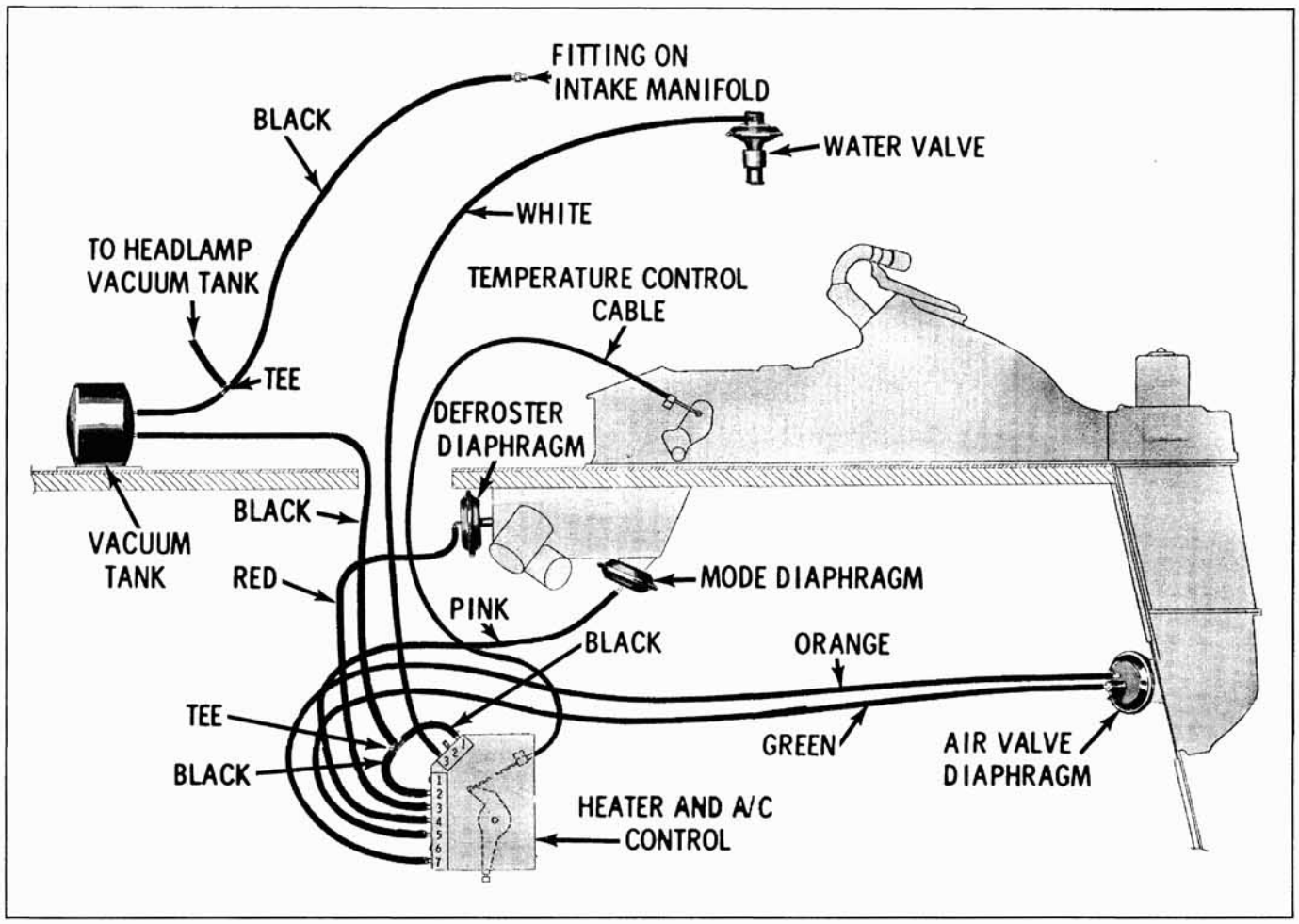


Fig. 1EA-11—Vacuum Hose Identification

6. Remove the air inlet valve assembly.

To install, reverse the removal procedure. Be sure that the alignment pin on the air inlet assembly enters the hole in the cowl. Refer to Fig. 1EA-11 for correct valve hose installation.

AIR DISTRIBUTION DUCTS

The air distribution ducts, distributor assembly and heater outlet are attached as shown in Fig. 1EA-10.

TEMPERATURE CABLE

Adjustment (Fig. 1EA-12)

The cable is connected to a cam lock device that assures positive closing of the temperature door. The cable must be adjusted so there is 1/16" to 1/8" springback with the valve fully closed (Fig. 1EA-12).

CONDENSER AND RECEIVER

The condenser is mounted in front of the radiator, and is attached as shown in Fig. 1EA-13. The condenser and receiver are serviced as an assembly.

REFRIGERANT LINES

The refrigerant lines are attached and routed as shown in Fig. 1EA-9.

The suction line, high pressure line, and high pressure muffler are of one piece construction and are serviced as an assembly.

COMPRESSOR

Belt Adjustment (Fig. 1EA-14)

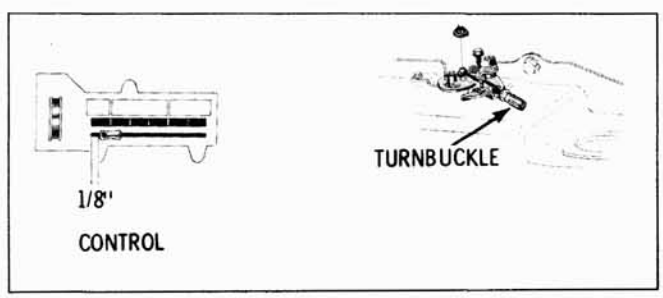


Fig. 1EA-12—Temperature Cable Adjustment

Tool 33-70M is used to check the compressor belt tension.

If belts require adjustment:

1. At rear of compressor, loosen link to compressor bolt.
2. At front of compressor, loosen link to compressor strut bolts.
3. Loosen compressor upper pivot bolts.
4. Pivot the compressor evenly at the front and rear until correct belt tension is obtained.

Check belt alignment and torque all bolts loosened.

Bolt Size	Torque Ft. Lbs.
5/16"	26
3/8"	35
7/16"	50

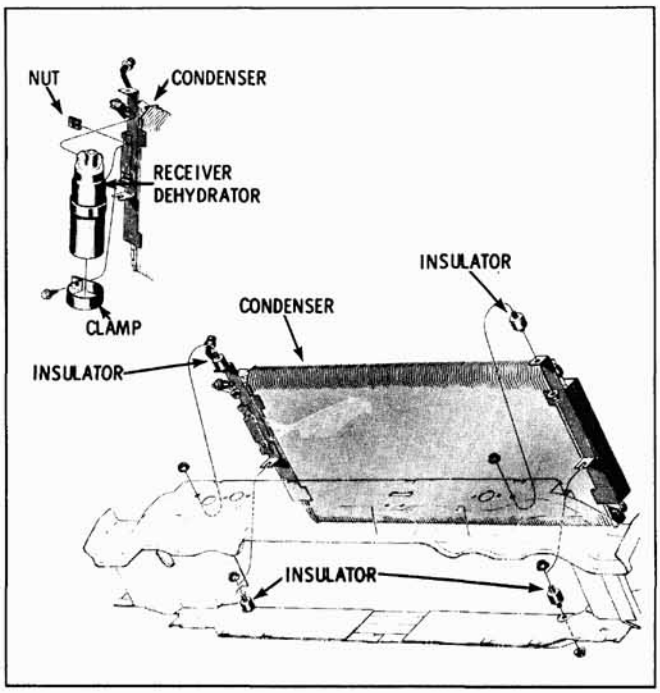


Fig. 1EA-13—Condenser Mounting

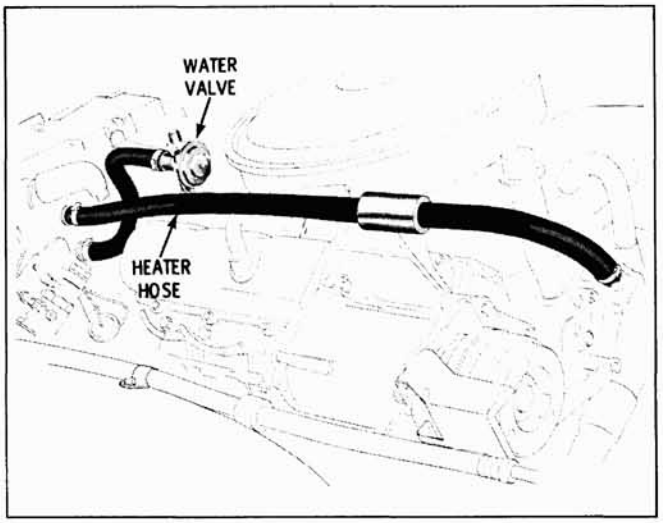


Fig. 1EA-15—Water Valve and Heater Hose Installation

Removal

1. Discharge the refrigerant system.
2. Disconnect compressor clutch wire at compressor connector.
3. Remove belt from compressor pulley.

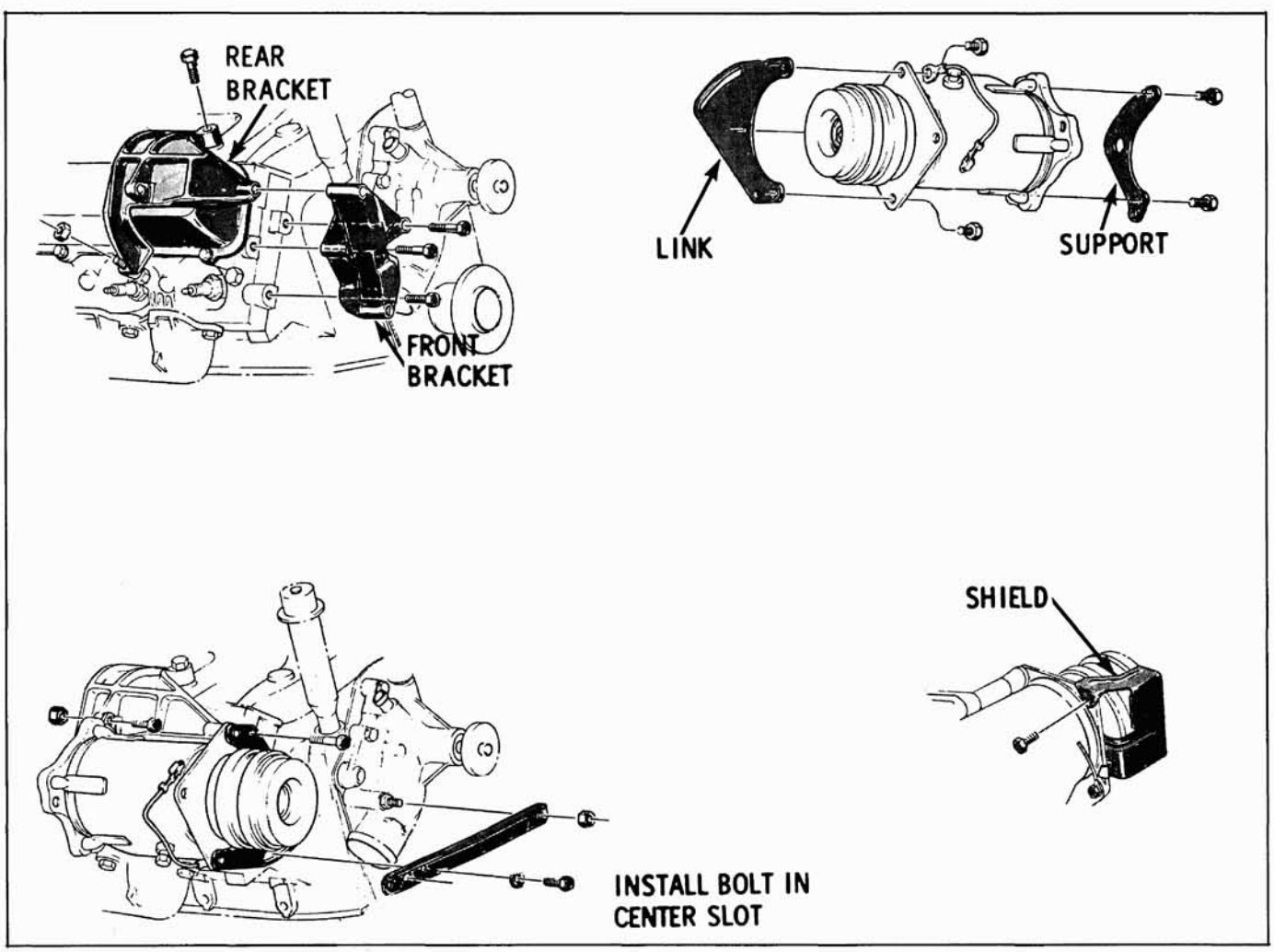


Fig. 1EA-14—Compressor Mounting Brackets

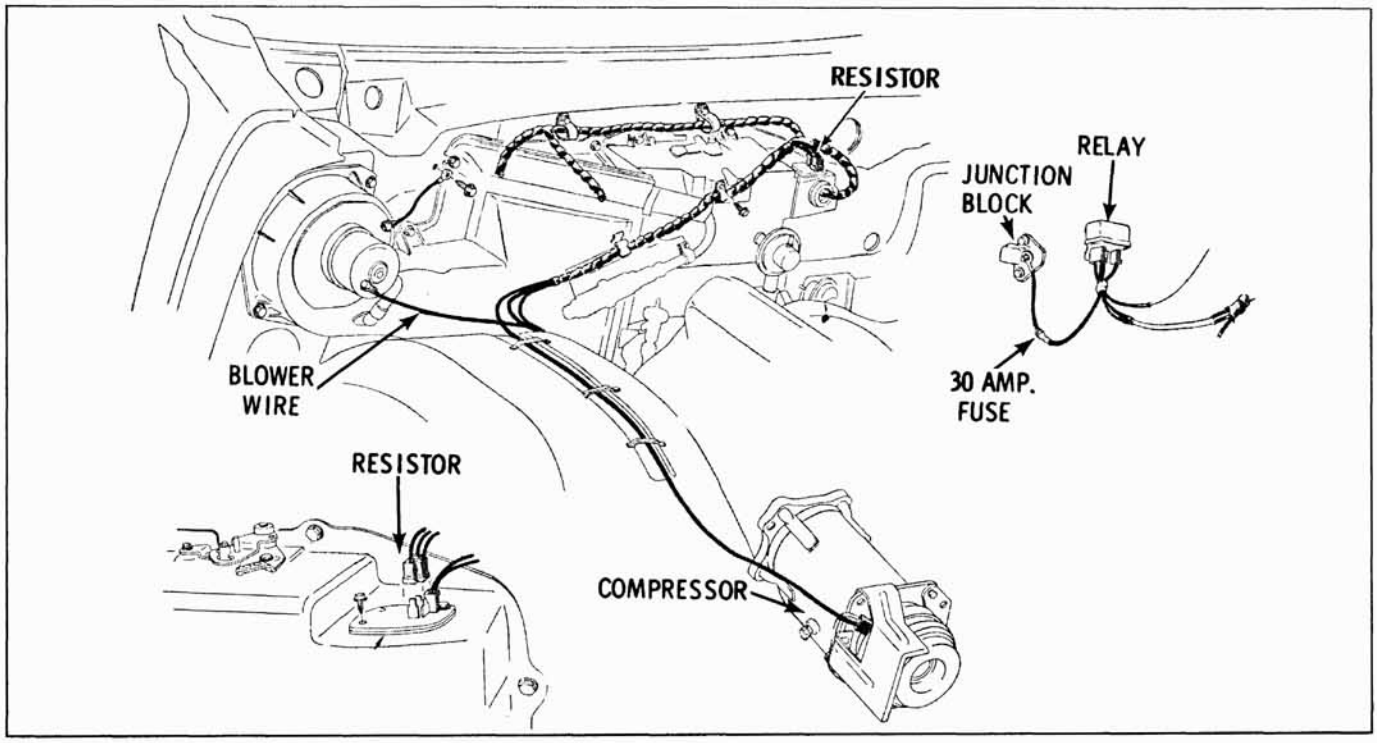


Fig. 1EA-16—Electrical Wire Routing

4. Remove the bolt holding the fittings connector to the compressor, then remove the assembly from the compressor. Tape lines and fittings to prevent entry of dirt and moisture.

5. Remove the compressor to bracket bolts, then remove the compressor assembly.

Installation

1. Position the compressor on the mounting bracket, then install and tighten the compressor to bracket bolts.

2. Connect compressor clutch wire.

3. Install two new "O" rings on the valve port openings and position the fittings connector on the compressor. Install the mounting bolts and tighten to 22 ft. lbs. torque.

4. Install belt and adjust tension using Tool 33-70M.

5. If compressor was removed for some internal malfunction and foreign material has circulated throughout the system, proceed as follows:

a. Install a charging line to the compressor discharge Schrader valve and to a drum of refrigerant 12.

b. Disconnect the liquid line from the dehydrator receiver assembly on the inlet side, and cap the dehydrator receiver immediately.

c. Open the refrigerant drum valve and turn the drum upside down to allow liquid refrigerant to flush through the condenser and out the line. Use approximately 2 lbs. of refrigerant for this operation.

d. Close the drum valve and connect the dehydrator receiver assembly.

e. Remove the expansion valve screen and clean or replace as necessary.

f. Remove the charging line from the compressor, install the gauge set, and evacuate the entire system.

g. Recharge the system.

HEATER HOSE

The heater hose and water valve installation is shown in Fig. 1EA-15.

BLOWER RESISTOR

The blower resistor is installed in the heater assembly and can be removed by disconnecting the electrical connections and removing the two attaching screws. (Fig. 1EA-16)

WIRING

For wiring location and routing in the engine compartment, refer to Fig. 1EA-16. For wiring connections at individual air conditioner components, refer to Fig. 1EA-17.

AIR CONDITIONING DIAGNOSIS

If a car is in for service with a complaint of high outlet temperatures on the road but appears to operate normally during tests, a quick check to determine which unit is at fault can be made using the following procedure.

VISUAL CHECKS

1. Check temperature door to make sure that it seals in the cool position. Adjust if necessary.

2. Check air hoses and ducts for proper connection.

3. Check vacuum hoses for correct routing and connection.

A leaking engine water valve could cause a slight rise in outlet temperature.

4. Check sight glass for "clear" condition.

5. Check compressor clutch to make sure that it engages.

6. Check compressor belt, adjust if necessary.

OPERATIONAL TEST

Install air conditioning gauge set, operate the engine at 1500 rpm in Neutral. Set control on Recirculate with blower at low speed.

1. Check evaporator pressure. If pressure is 30 psi or less and outlet air temperature is too warm, check to see that the expansion valve is clamped tightly to the evaporator outlet pipe and that the insulation is in place.

If the feeler bulb installation and insulation are satisfactory, a leak in the bulb is indicated and the expansion valve should be replaced.

2. If the evaporator pressure is above 30 psi, even with

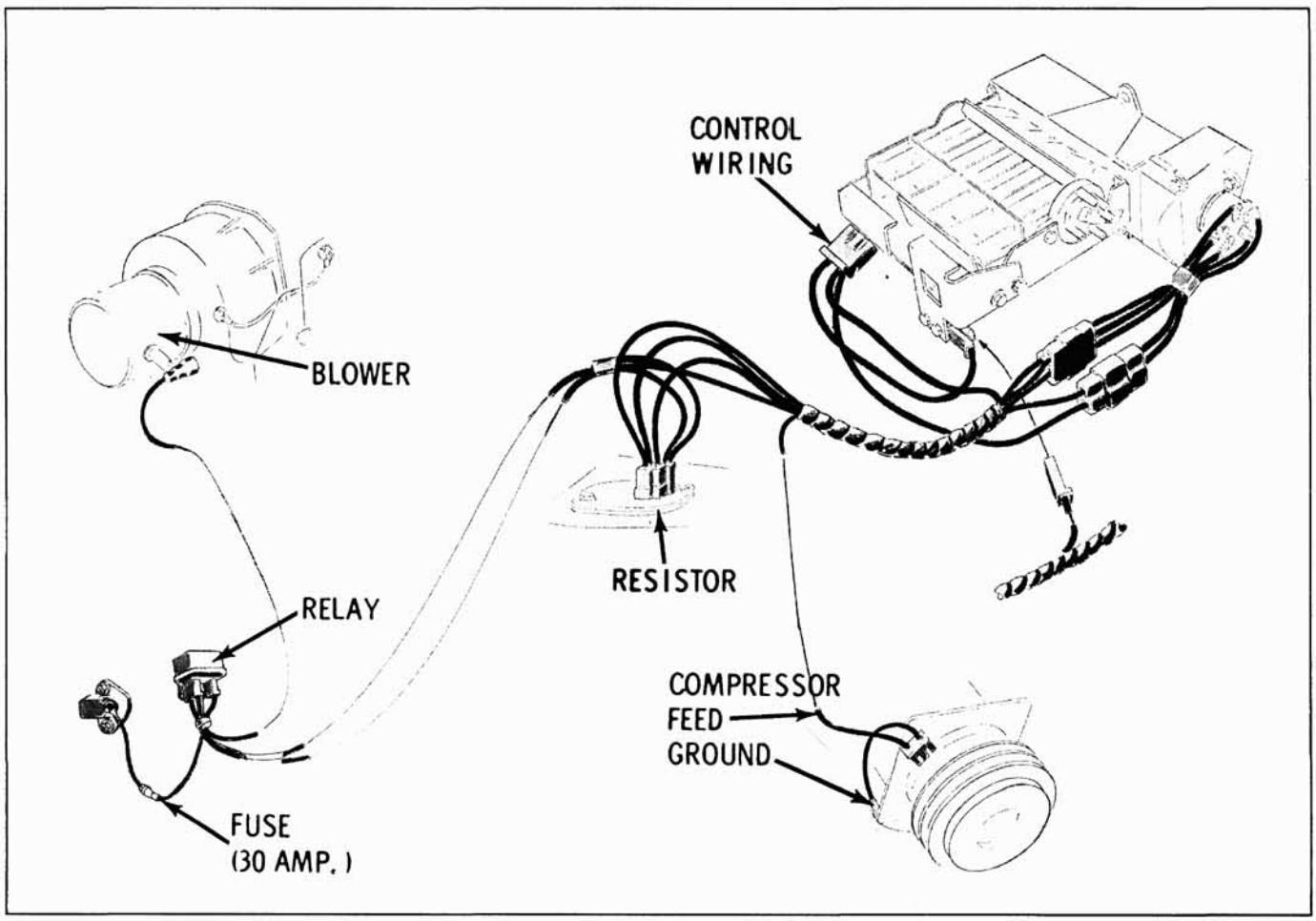


Fig. 1EA-17—Electrical Connections

blower motor wire disconnected, replace the P.O.A. valve.

3. If evaporator pressure is 29 psi ± 1 psi and the outlet air temperature is normal, partially cover the condenser to obtain head pressure of 300 psi. If evaporator pressure rises above 30 psi, replace the expansion valve. If evaporator pressure remains at 29 psi during test, there is a possibility of water or moisture in the system which could freeze under certain conditions, and a new receiver dehydrator may be required.

PERFORMANCE TEST

The Performance Test should be made with the car doors open, the temperature control lever fully to the left, A/C control set at NORMAL, blower speed switch on "HI", all air outlets open, an auxiliary fan in front of the radiator, and the car hood partially down.

1. Remove Schrader valve fitting cap at the suction throttling valve.

2. Install Adapter J-5420 on the low pressure gauge hose, and connect the adapter to the Schrader valve fitting on the suction throttling valve, then momentarily open low pressure gauge valve to purge gauge hose.

3. Remove the high pressure Schrader valve protective cap from the back side of the high pressure muffler and install high pressure gauge hose with Adapter J-5420. Be sure high pressure gauge valve is closed.

4. Momentarily open high pressure gauge to purge the gauge and hose.

5. With transmission in PARK or NEUTRAL and parking brake applied, adjust engine speed to 2000 rpm.

6. After temperature and humidity have been determined, compare test results with the PERFORMANCE CHART.

7. When test is completed, disconnect gauge hoses, and install protective caps.

8. Install Schrader valve fitting cap at the suction throttling valve, and high pressure muffler.

PERFORMANCE CHART
TORONADO

In Front of Condenser		Evaporator Pressure At Suction Throttling Valve ± 1 psi	Engine rpm	Discharge Air Temp. R.H. Nozzle ± 2°F.	Pressure High (Discharge) ± 20 psi
Relative Humidity	Air Temp. °F.				
20	70	29	2000	39	170
	80	29		39	197
	90	29		41	242
	100	29		42.5	298
	110	32		46	357
30	70	29	2000	39	177
	80	29		41	205
	90	29		45	265
	100	30		47.5	316
	110	37		57.5	377
40	70	29	2000	40	183
	80	29		42.5	213
	90	29.5		47.5	277
	100	33		54	335
	110	42		63	390
50	70	29	2000	40	190
	80	29.5		44	222
	90	30		50	292
	100	38		60	354
	110	47		75	420
60	70	29	2000	40.5	198
	80	30		45	230
	90	32		52.5	305
	100	42		65	373
70	70	29.5	2000	41	205
	80	30		46	240
	90	33		55	319
	100	47		70	392
80	70	30	2000	42	212
	80	31		47.5	248
	90	35		57.5	332
	100	51		75	405
90	70	30	2000	42	220
	80	33		48	256
	90	36		60	344
	100	55		78	420

DIAGNOSIS OF PERFORMANCE TEST RESULTS

CONDITION AND CAUSE	CORRECTION
EVAPORATOR PRESSURE TOO HIGH	
A. Defective suction throttle valve.	A. Replace.
B. Loose compressor drive belt.	B. Adjust as outlined.
C. Defective clutch or coil.	C. Check or replace as necessary.
D. Defective expansion valve.	D. Replace as necessary.
E. Expansion valve capillary tube not tight to evaporator suction line.	E. Check clamp for tightness.
F. Clutch slippage.	F. Refer to CLUTCH SLIPPAGE.
HIGH PRESSURE SIDE OF SYSTEM TOO HIGH	
A. Restricted air flow through condenser.	A. Remove foreign material from engine radiator and condenser.
B. Air in system or overcharge of refrigerant.	B. Momentarily discharge system on discharge side with engine not running; then, operate system and recheck pressure. Repeat as necessary. Check sight glass with system under load.
C. Restriction in condenser, dehydrator receiver assembly, discharge or liquid line.	C. Remove parts, inspect for restricted passage, and clean or replace.
NOZZLE DISCHARGE AIR TOO WARM (With other readings OK)	
A. Low refrigerant charge.	A. Check and add refrigerant as necessary.
B. Poor seal-Evaporator to cowl.	B. Correct sealing.
C. Temperature Control Cable misadjusted.	C. Adjust.
CLUTCH SLIPPAGE	
A. Head pressure too high.	A. Discharge system until bubbles appear in sight glass and then add one pound of refrigerant.
B. Pulley wobbles.	B. Check and replace, if necessary, the pulley bearing. If pulley has been worn by bearing, replace pulley.
EVAPORATOR PRESSURE TOO LOW	
A. Insufficient Refrigerant charge.	A. Add refrigerant.
B. Defective suction throttling valve.	B. Replace.
C. Defective expansion valve.	C. Replace.
VELOCITY OF AIR AT DISCHARGE NOZZLES TOO LOW	
A. Restricted evaporator core in evaporator assembly.	A. Wash evaporator core. Restricted evaporator core caused by freezing. Adjust suction throttling valve.
B. Restricted air hoses.	B. Inspect and replace if necessary.
C. Defective blower motor.	C. Check and replace if necessary.
D. Defective switches, relay or resistor.	D. Check and replace if necessary.
E. Poor wiring connection (Low voltage at blower.) Poor ground at blower.	E. Correct wiring.
WATER BLOWING OUT AIR DISCHARGE NOZZLE	
A. Plugged or kinked evaporator drain hose.	A. Clean or align as necessary.
INOPERATIVE CONTROLS	
A. Inadequate vacuum.	A. Check vacuum. All controls should move with 10" Hg. Check hoses.
B. Temperature cable improperly adjusted.	B. Adjust cable.

COMFORTRON AIR CONDITIONING

(AUTOMATIC CONTROL)

CONTENTS OF SECTION 1EB

Subject	Page
INTRODUCTION	1EB-1
GENERAL DESCRIPTION	1EB-1
SENSORS	1EB-1
CONTROL PANEL	1EB-2
TRANSDUCER	1EB-2
POWER SERVO	1EB-3
THERMOSTATIC VACUUM VALVE	1EB-3
VACUUM MASTER SWITCH	1EB-3
AMBIENT SWITCH	1EB-3
RANGE RELAY	1EB-3
VACUUM RELAY	1EB-3
VACUUM TANK	1EB-4
VACUUM CHECK VALVE	1EB-4
MODE DOOR	1EB-4
TEMPERATURE DOOR	1EB-4
DEFROSTER DOOR	1EB-4
OPERATION	1EB-4
SERVICE PROCEDURES	1EB-4
POWER SERVO	1EB-4
IN-CAR SENSOR	1EB-5
DUCT SENSOR	1EB-5
AMBIENT SENSOR	1EB-6
MASTER SWITCH	1EB-6
COMFORTRON CONTROL	1EB-6
TRANSDUCER	1EB-6
VACUUM TANK	1EB-7
WATER VALVE	1EB-7
VACUUM HOSES	1EB-8
WIRING	1EB-8
CHARGING THE SYSTEM	1EB-8
CHECKING COMFORTRON SYSTEM	1EB-8
CHECKING SENSOR CIRCUIT FOR AN OPEN	1EB-11
AMPLIFIER AND TEMPERATURE DIAL TEST	1EB-11
TEMPERATURE CONTROL DIAL ADJUSTMENT	1EB-11
FUNCTION CHECK	1EB-11

INTRODUCTION

The Comfortron air conditioning uses an automatic temperature control system which allows the driver to preset a desired temperature, between 65 and 85 degrees, which is then automatically maintained regardless of changes in ambient air temperatures.

Outside of the automatic control system, which is covered in this section, the basic air conditioning components are similar to the procedures outlined in Custom Air Conditioning Section 1EA. Service procedures pertaining only to the Comfortron system are covered in this section.

GENERAL DESCRIPTION

The Comfortron system consists of four major components:

1. Temperature Sensors
   a. In-car
   b. Ambient
   c. Duct
2. Control Panel
3. Transducer
4. Power Servo

In addition to the four major components, an electrical and vacuum system is used to control the complete system.

Sensors

The sensors consist of a special type of resistor (Thermistor) which varies inversely to temperature change. As the temperature rises, the resistance decreases; as the temperature falls, the resistance increases. The three sensors are connected in series.

The in-car sensor, located at the bottom of the control, Fig. 1EB-1 is positioned so that it senses the temperature of the interior of the car.

The ambient sensor, Fig. 1EB-2, mounted in the blower inlet duct senses the temperature of the air entering the system.

The duct sensor, mounted on the air outlet, Fig. 1EB-3, is positioned so that it senses discharge air temperature for the full range from heating to air conditioning.

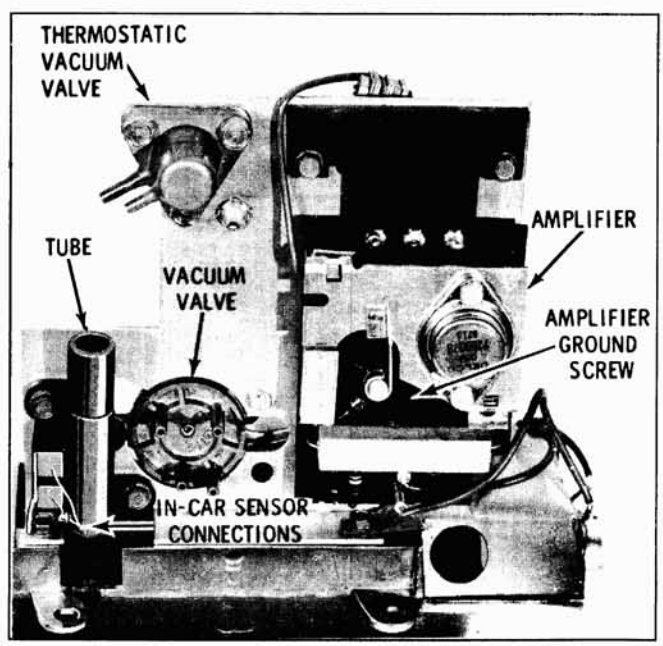


Fig. 1EB-1—In-Car Sensor Location

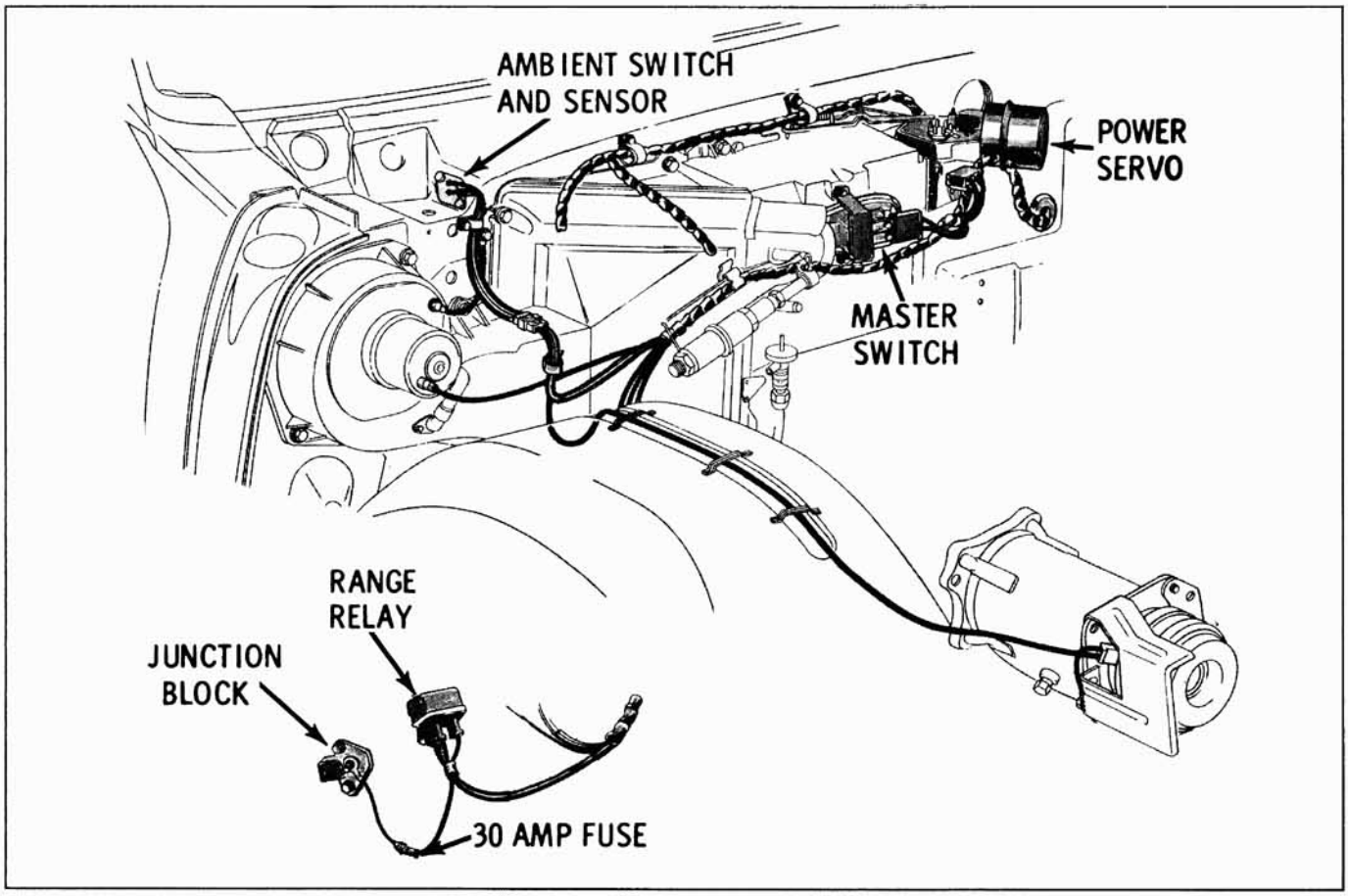


Fig. 1EB-2—Ambient Sensor Location

Control Panel (Fig. 1EB-4)

The control panel located in the instrument panel contains the Amplifier, Temperature Dial and In Car Sensor.

The amplifier is a two stage DC amplifier which provides a voltage output proportional to the input signal from the sensors to control the transducer.

The amplifier is serviced only as an assembly.

The temperature dial is graduated in 5° divisions between 65° and 85° allowing the driver to select any desired temperature within this range.

The temperature dial operates a rheostat. Setting the dial sets the resistance valve of the rheostat. This resistance, in series with the resistances of the three sensors, forms a voltage divider network supplying a voltage signal to the amplifier. If any of the sensors detect a change in temperature, or the driver changes the temperature dial rheostat setting, the resultant resistance change causes the voltage signal to the amplifier to vary accordingly.

Transducer (Fig. 1EB-5)

The transducer, mounted on the lower center of the cowl, below the instrument panel, is an electro-mechanical device that converts the DC voltage signal from the amplifier to a proportionate vacuum output that controls the power servo unit.

The transducer is constructed of four major parts; the vacuum regulator valve, wire element, production adjusting

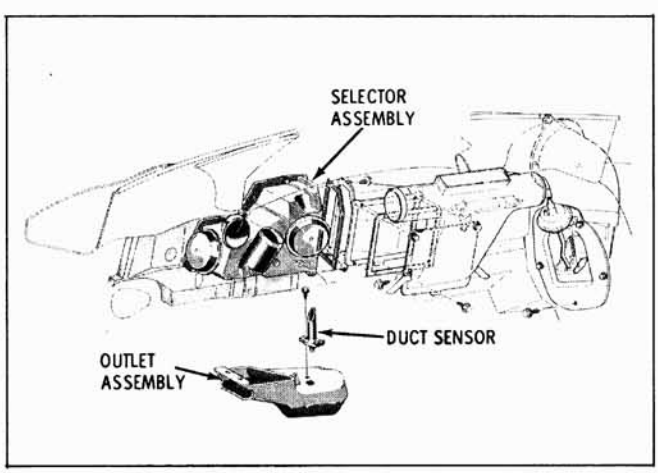


Fig. 1EB-3—Duct Sensor Location

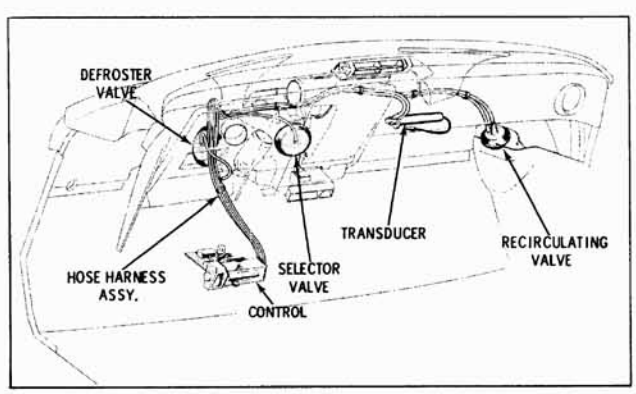


Fig. 1EB-4—Control Panel

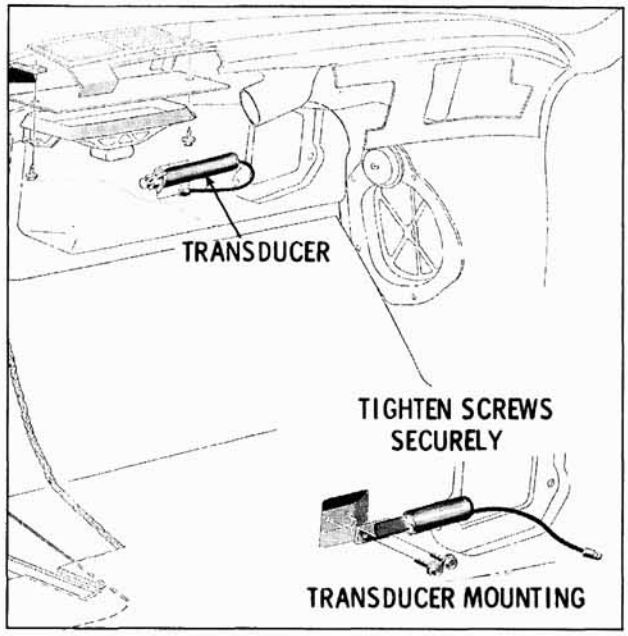


Fig. 1EB-5—Transducer

mechanism, and housing. The valve is a force actuated type where the output is proportioned to the force applied by the wire element. The wire element is enclosed in a steel tube housing that provides rigidity as well as protection from air currents.

During periods when the amplifier is supplying a weak, or no electrical signal, the wire element contracts, allowing a large amount of vacuum flow to the power servo unit. When the amplifier emits a stronger signal, the wire element is heated and expands, thereby diminishing the vacuum flow to the power servo unit. No attempt should be made to adjust the transducer during any service operation.

Power Servo (Fig. 1EB-6)

The power servo is mounted on the left top side of the heater case assembly in the engine compartment. It is composed of four basic parts; a vacuum diaphragm assembly, an electrical circuit board (blower speed switch), a rotary vacuum valve and a door link attached to the temperature door.

The vacuum diaphragm is connected to a pivot arm, and positions the pivot arm in response to the regulated vacuum output from the transducer. The pivot arm actuates the temperature door, the rotary vacuum valve and the blower speed switch.

The temperature door controls the proportions of cooled and heated air that are mixed to provide the proper discharge air temperature.

The rotary vacuum valve provides the necessary control for the operation of the mode door and the outside air door diaphragm.

The electrical circuit board controls the blower speeds through the use of resistors.

The following components are also used to operate the Comfortron system.

Thermostatic Vacuum Valve (Engine Compartment)

A valve mounted on the water valve which prevents the system from operating until the engine coolant reaches 120°F.

Thermostatic Vacuum Valve (Inside Car)

A valve mounted on the control panel which allows vacuum to pass through it whenever the in-car temperature is above 70°F.

Vacuum Master Switch

This switch located on the heater assembly turns on the blower motor whenever vacuum is applied to it.

Ambient Switch

The ambient switch located in the blower inlet duct, energizes the compressor clutch whenever the ambient temperature rises above approximately 35°F. The ambient switch and the ambient sensor are assembled as one unit.

Range Relay

The range relay is located in the engine compartment on the right fender filler plate. When the sliding lever on the instrument panel control is moved to HI, a switch on the control is closed and energizes the range relay. The range relay allows voltage from the junction block to by-pass a fixed resistor permitting the blower to operate in one of the five high range speeds.

Vacuum Relay

The vacuum relay located in the engine compartment, allows vacuum to pass from the transducer to the Power Servo

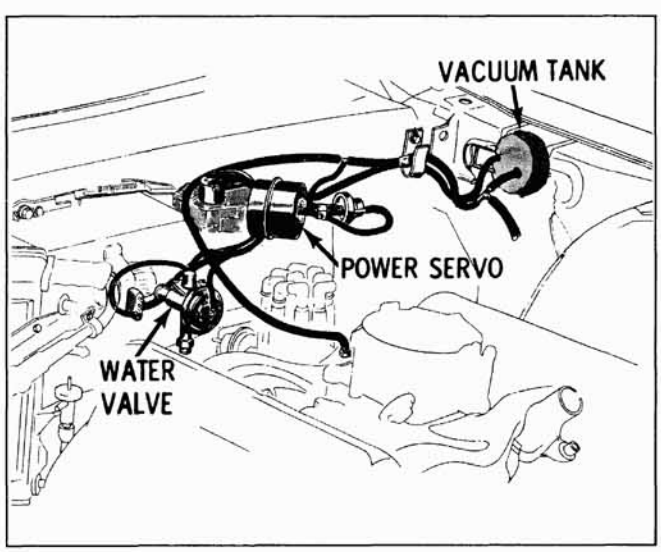


Fig. 1EB-6—Power Servo

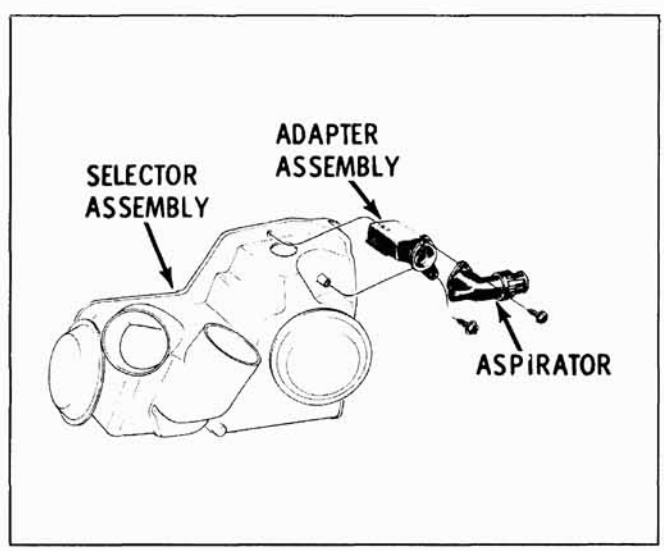


Fig. 1EB-7—Aspirator

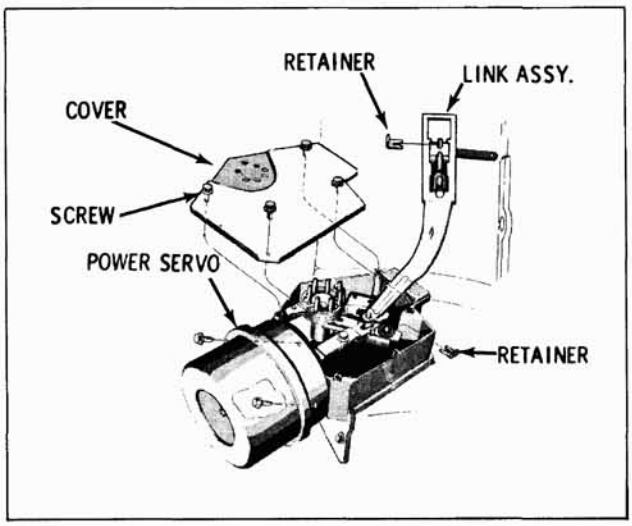


Fig. 1EB-8—Power Servo Removal

as long as vacuum is present from the engine. If engine vacuum drops, the vacuum relay closes, sealing off the vacuum line to the Power Servo, locking it in position.

Vacuum Tank

The vacuum tank, located in the engine compartment below the left front fender, is used to store engine vacuum so that the system can continue to operate even though engine vacuum is low.

Vacuum Check Valve

The vacuum check valve is an integral part of the tank and prevents loss of vacuum stored in the vacuum tank whenever engine vacuum drops.

ASPIRATOR (Fig. 1EB-7)

The aspirator is attached to the top of the selector assembly. Air is passing through the aspirator whenever the blower motor is operating. When air passes through the aspirator, it causes a low pressure area on the inside tube of the aspirator. A hose connects the aspirator to the in-car sensor tube. Due to low pressure in the tube, the in-car air is drawn over the in-car sensor through the grille on the front of the control panel.

Mode Door

A door in the distributor assembly that directs air flow either out of the air conditioning or heater ducts.

Temperature Door

A door in the heater assembly, controlled by the Power Servo, that controls the temperature of the air that comes out of the air outlets.

Defroster Door

A door in the selector assembly that directs air onto the windshield whenever the sliding lever is moved to DEFROST or DE-ICE. The door is controlled by a vacuum diaphragm.

OPERATION

While Comfortron is regulating, warm air can come from the A/C outlets (approx. 95°). This will occur just before the system changes from A/C mode to heat mode.

The operation of the Comfortron A.C. system is controlled at the control panel. The sliding lever can be positioned in five positions.

OFF-With the sliding lever in the OFF position, vacuum is shut off from the system and the system is inoperative. Voltage to the temperature control system remains on until the ignition key is turned off.

HI-With sliding lever in the HI position, engine coolant above 120°F., inside car temperature above 70°F., vacuum is supplied to the system. Movement of the sliding lever activates a switch on the control which energizes the range relay. With the range relay energized, the fixed resistor is by-passed and the blower operates in one of the five speeds in high range. The system is on automatic control.

LO-With the sliding lever in the LO position, engine coolant above 120°F., inside car temperature above 70°F., vacuum is supplied by the system. Current to the blower motor must pass through a fixed resistor and blower operates in one of the five speeds in low range. The system is on automatic control.

DEFROST

With the sliding lever in the DEFROST position, operation of the system is identical to the HI position except that approximately 80% of the air is directed to the windshield. The other 20% flows out of the heater outlets. The temperature of the air coming out of the defroster outlets can be either warm or cold as the system is on automatic control. The defroster air temperature is dependent on the temperature dial setting on the control, the temperature inside the car and outside temperature.

DE-ICE

With the sliding lever in the DE-ICE position, the thermal and temperature vacuum valves are by-passed. Vacuum is supplied to the system regardless of in-car or engine coolant temperature. The sensors are by-passed so the system is no longer on automatic control. Movement of the temperature dial has no effect on the system.

In the DE-ICE position, the defroster door directs the air to the windshield. The system is in maximum heat and maximum blower speed position, however temperature of DE-ICE air will be dependent on engine coolant temperature.

SERVICE PROCEDURES

Service procedures listed in this section pertain to the Comfortron system only. For procedures not listed refer to Section 1EA.

ASPIRATOR (Fig. 1EB-7)

Remove and Install

1. Remove aspirator hose from aspirator.
2. Remove screw holding aspirator to adapter.

To install, reverse removal procedure.

POWER SERVO

Remove and Install

1. Open hood, disconnect battery.
2. Disconnect vacuum hose and wiring connector from power servo.
3. Remove the four cover attaching screws, then remove cover. (Fig. 1EB-8)
4. Remove the retainer then disconnect link assembly from power servo.
5. Remove the power servo to heater case attaching screws then remove power servo.

To install, reverse removal procedure, making sure that the vacuum and electrical connectors are installed tightly.

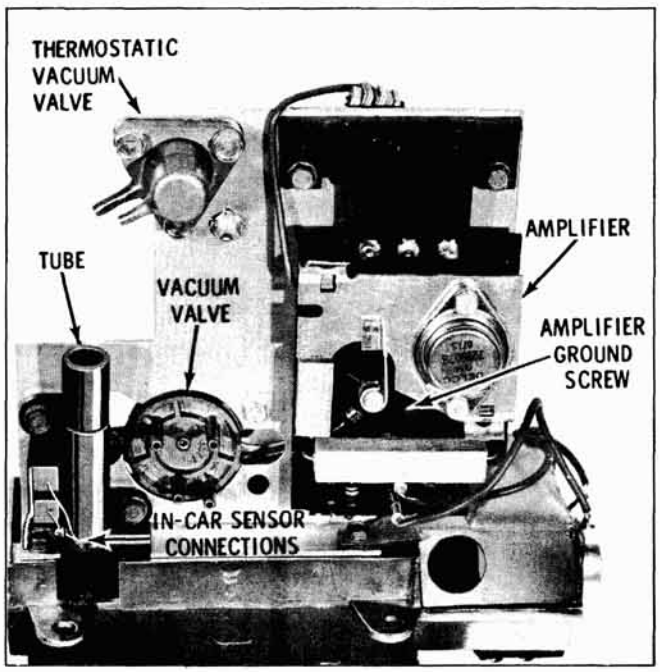


Fig. 1EB-9—In Car Sensor Removal

IN-CAR SENSOR

Remove and Install

1. Remove Comfortron control from instrument panel. (Refer to Section 1EA)

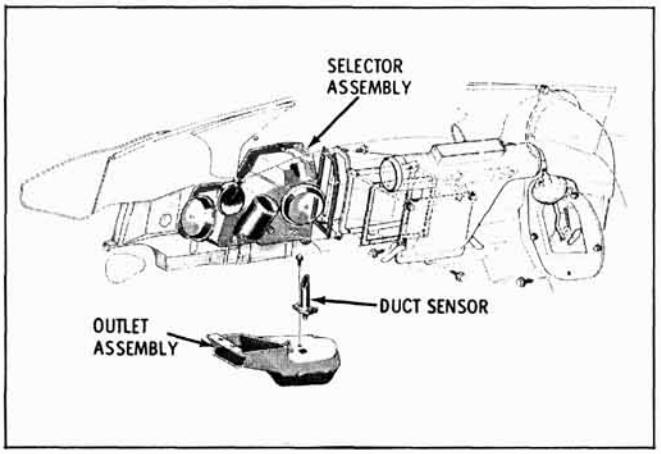


Fig. 1EB-10—Duct Sensor

2. Remove two sensor to control attaching screws. (Fig. 1EB-9)

To install, reverse removal procedure.

DUCT SENSOR

Remove and Install

1. Disconnect wiring connector from duct sensor.
2. Remove the heater outlet from the selector assembly. (Fig. 1EB-10)
3. Remove the sensor from the heater outlet.

To install, reverse the removal procedure, making sure the electrical connector is installed securely.

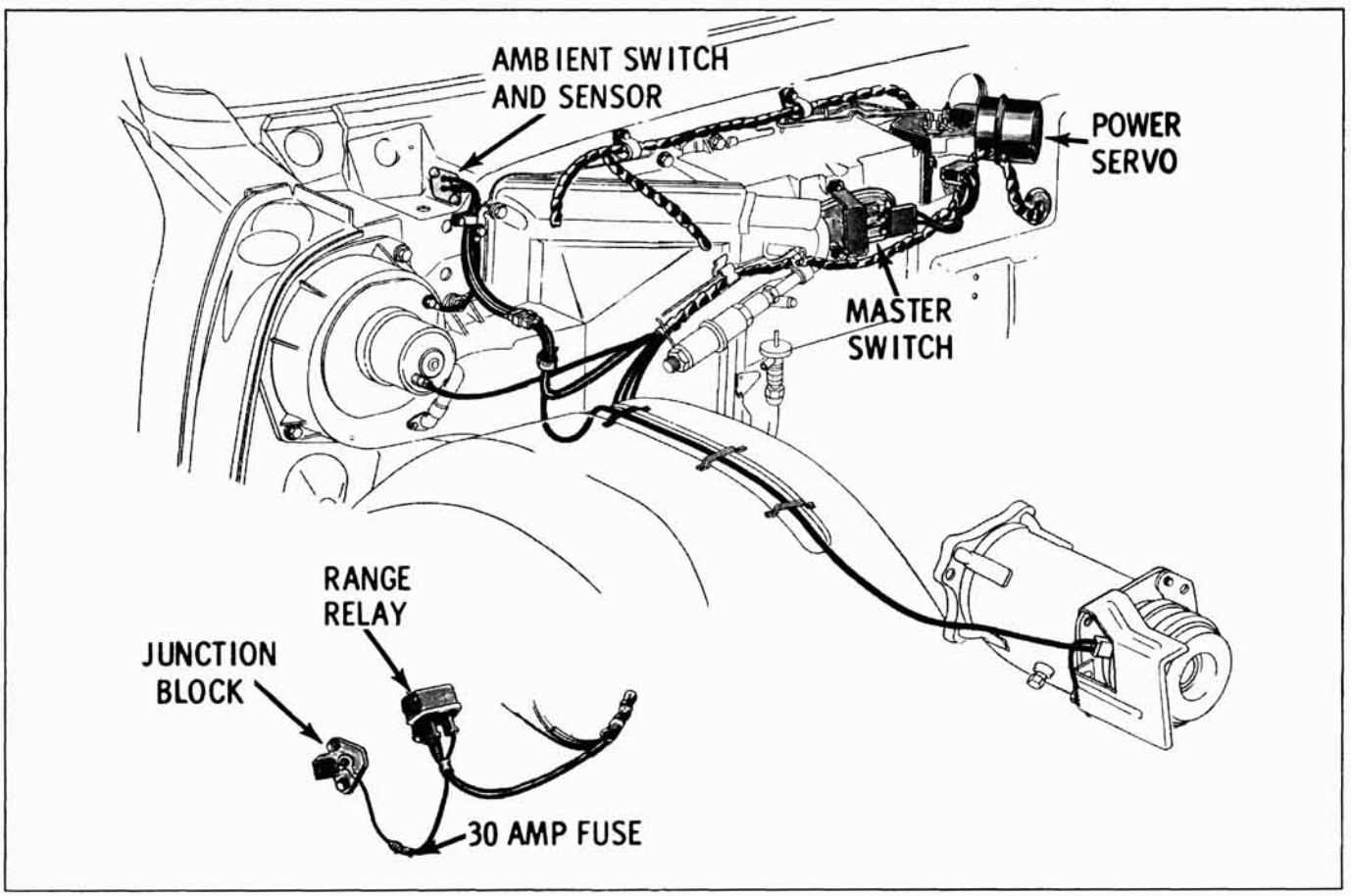


Fig. 1EB-11—Ambient Sensor and Switch

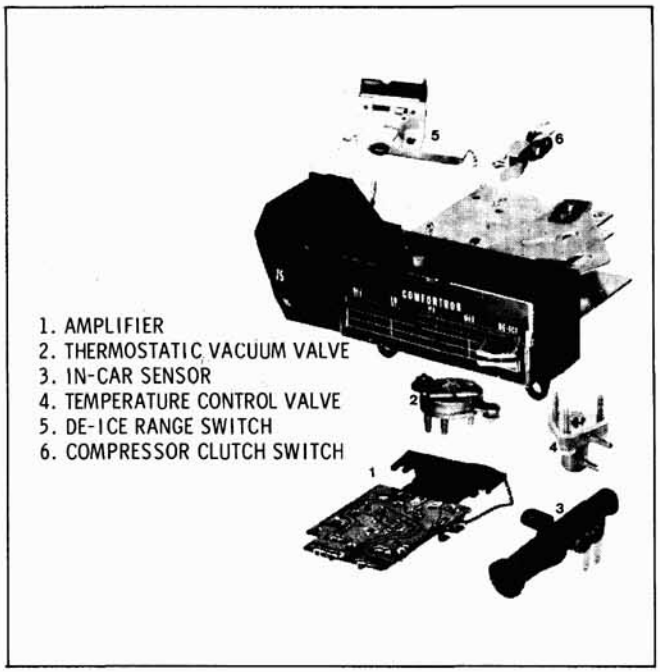


Fig. 1EB-12—Control Components

AMBIENT SENSOR AND SWITCH

The ambient sensor and switch assembly, located in the blower inlet duct can be removed by disconnecting the electrical connector, then removing the two attaching screws. (Fig. 1EB-11)

MASTER SWITCH

Remove and Install

1. Disconnect vacuum hoses and electrical connector.
2. Remove the two master switch attaching screws and remove master switch from the heater. (Fig. 1EB-11)

To install, reverse removal procedure. Vacuum hoses can be reinstalled on any connector.

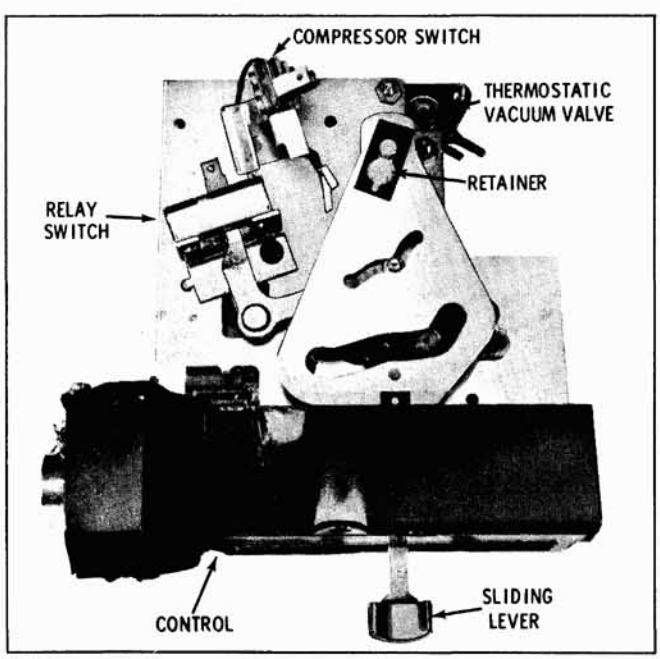


Fig. 1EB-13—Control Components

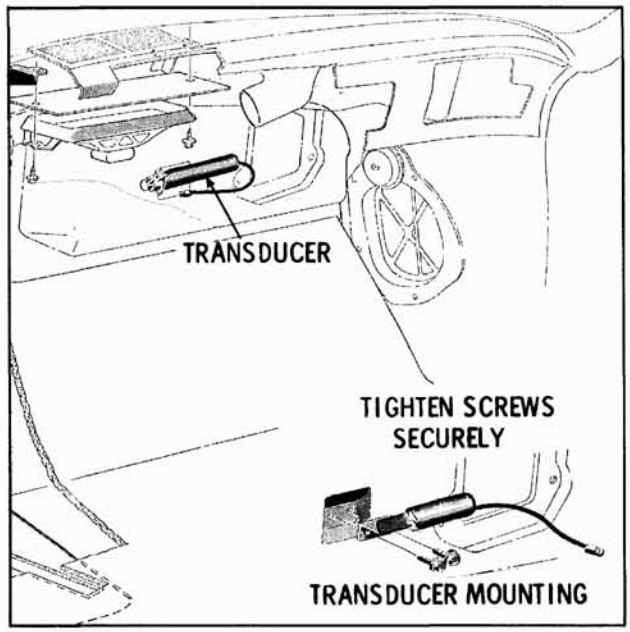


Fig. 1EB-14—Transducer Mounting

COMFORTRON CONTROL (Fig. 1EB-12)

The amplifier, range switch, temperature vacuum valve, vacuum control valve, rheostat and compressor switch can be serviced after removing the control from the instrument panel, then removing the control cover. To remove control refer to Control Remove and Install - Section 1EA.

If component parts of the control are to be serviced they can be replaced as follows: (Fig. 1EB-12 and 1EB-13)

AMPLIFIER

The amplifier is attached with three screws. Connections to the amplifier are of the plug-in type.

RANGE SWITCH

The range switch can be removed by removing the attaching screw and disconnecting the actuating arm from the sliding lever.

THERMOSTATIC VACUUM VALVE

The thermostatic vacuum valve is attached with two screws.

COMPRESSOR SWITCH

The compressor switch is attached with one screw. When replacing the compressor switch, it must be adjusted so it will be off when the sliding lever is in the "OFF" position. With the sliding lever in any of the other positions, the compressor switch must be on.

VACUUM CONTROL VALVE

The vacuum control valve can be removed by removing the attaching screw and the push-on spring nut, then disconnecting the valve from the sliding lever.

RHEOSTAT AND TEMPERATURE DIAL

The rheostat and temperature dial can be removed by disconnecting the electrical wires and removing the attaching screws.

TRANSDUCER

Remove

1. Disconnect electrical connector. (Fig. 1EB-14)

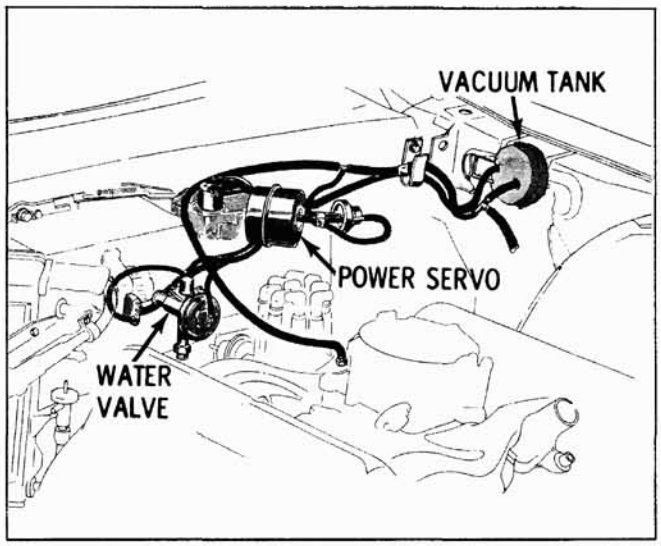


Fig. 1EB-15—Vacuum Hose and Tank Location

2. Remove the transducer attaching screws.
3. Lower transducer and remove the two vacuum hoses.

Install

1. Install vacuum hoses on the transducer. Note that the hoses and connectors are of different size and must be installed in proper order.
2. Install the attaching screws.

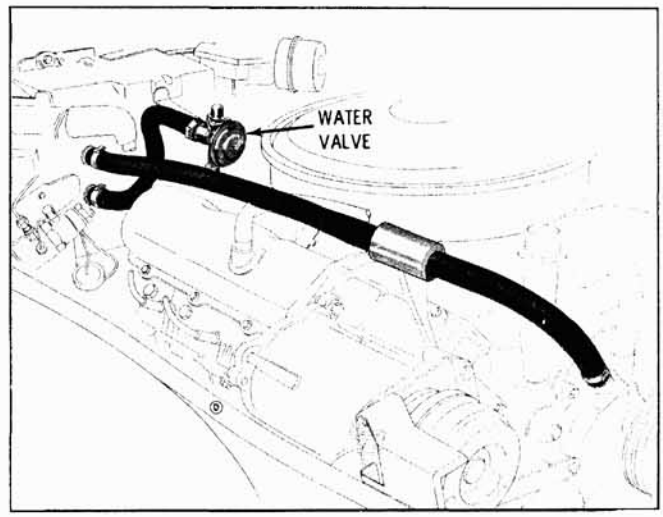


Fig. 1EB-16—Water Valve Installation

The transducer attaching screws must be tightened securely as proper operation of the complete system is dependent on a good ground at the transducer.

VACUUM TANK

The vacuum tank is installed as shown in Fig. 1EB-15.

WATER VALVE

The water valve and thermostatic vacuum switch is in-

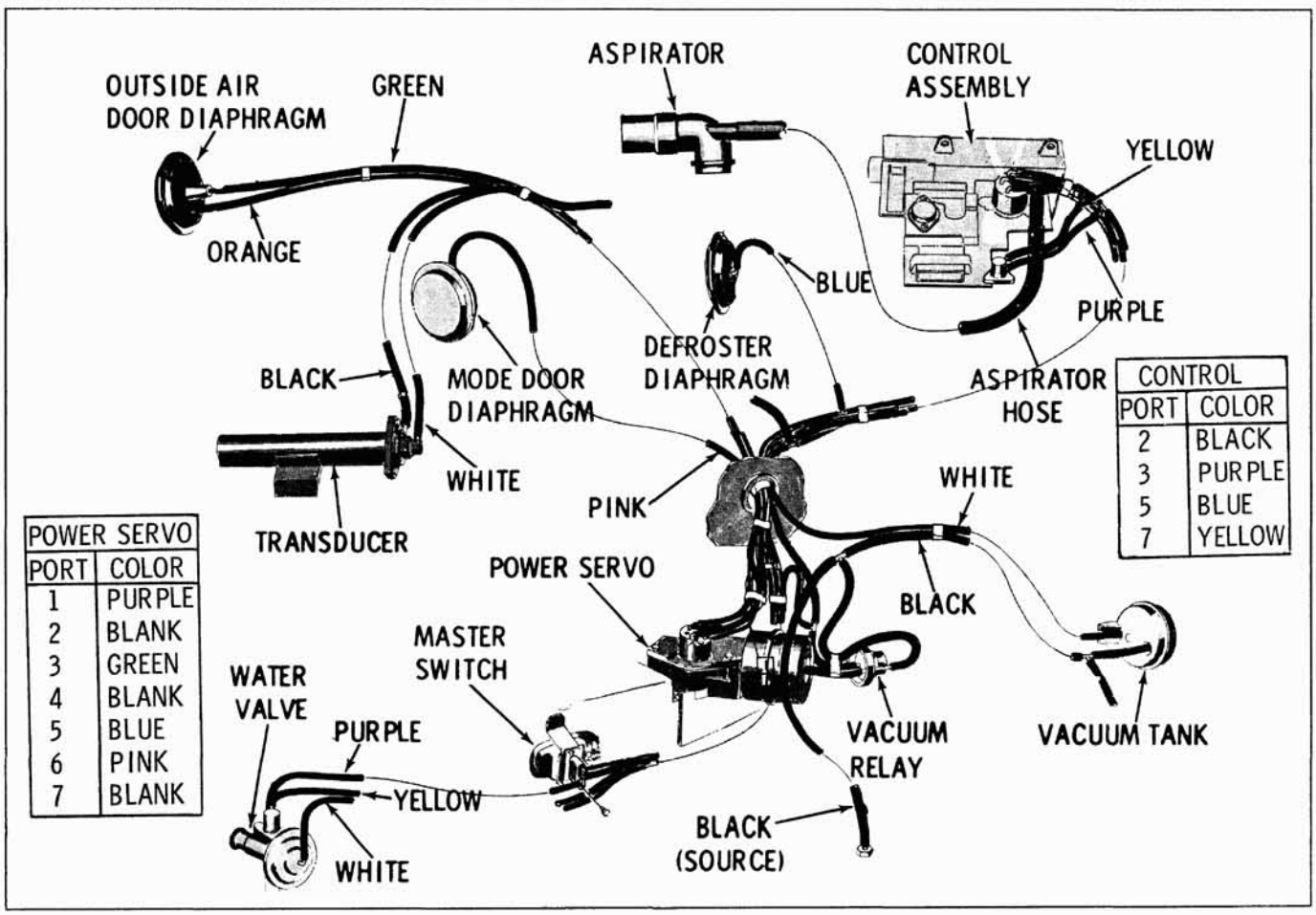


Fig. 1EB-17—Vacuum Hose Routing

stalled in the heater inlet hose. The valve installation and heater hose routing is shown in Fig. 1EB-16.

VACUUM HOSES

Vacuum hoses used in the Comfortron system are color coded to assist in correct routing of the hoses.

Whenever any of the vacuum hoses or connections are disconnected be sure the hoses and connectors are installed securely. Vacuum hose routing is shown in Fig. 1EB-17.

A restrictor is used in the end of the purple hose that attaches to the water valve. When replacing the vacuum hose harness, the restrictor must be removed from the old harness and placed in the new harness.

WIRING

Wiring used on the Comfortron system is shown in Figs. 1EB-18 and 1EB-19. Whenever wiring connectors are removed, be sure that the connectors are fully seated on their terminals and that the terminals are clean and fit tightly. Due to the low current used in some of the circuits, a poor connection could cause a malfunction in the Comfortron system.

REFRIGERATION SYSTEM

The refrigeration system used with the Comfortron system is basically the same as used on the custom air conditioning. For repairs to the refrigeration system or components, refer to Section 1A and 1B. When making a performance test on comfortron equipped cars, the sliding lever should be on high blower speed and the vacuum line must be disconnected from the power servo and plugged.

CHARGING THE SYSTEM

The system can be charged by the refrigerant drum, disposable can or charging station method only after being evacuated as outlined in Section 1A. When charging the Comfortron System, follow the procedures as outlined in Section 1A. However, the control must be set on automatic.

CHECKING COMFORTRON SYSTEM

Before checking the Comfortron system, it is essential that the function and operation of each unit in the system is understood and that the engine is running and the coolant is warm, it is important to remember that at the transducer, the lower the voltage, the higher the vacuum, the higher the voltage, the lower the vacuum. If Tester J-22368 is not available, many of the FUNCTION CHECKS, Pages 1EB-12 through 1EB-18 can still be made without the use of the tester.

Tester J-22368 (Fig. 1EB-21) is available to assist in locating malfunctions in the system. Operating instructions are attached to the back of the tester.

When using Tester J-22368, Step 2 of the operating instructions states, "Disconnect large vacuum hose from transducer and insert tester tee in vacuum line". However, on 54 through 86 Series cars, remove the vacuum hose from the power servo and insert tester tee in this vacuum line as it is more easily accessible. Under Step 4 of the tester instructions, the only correction listed is a defective transducer. If the diaphragm in the vacuum relay is ruptured, the same problem will be encountered as a defective transducer. To determine which unit is defective, pinch the vacuum hose between the tester and the vacuum relay. If tester still indicates a defective

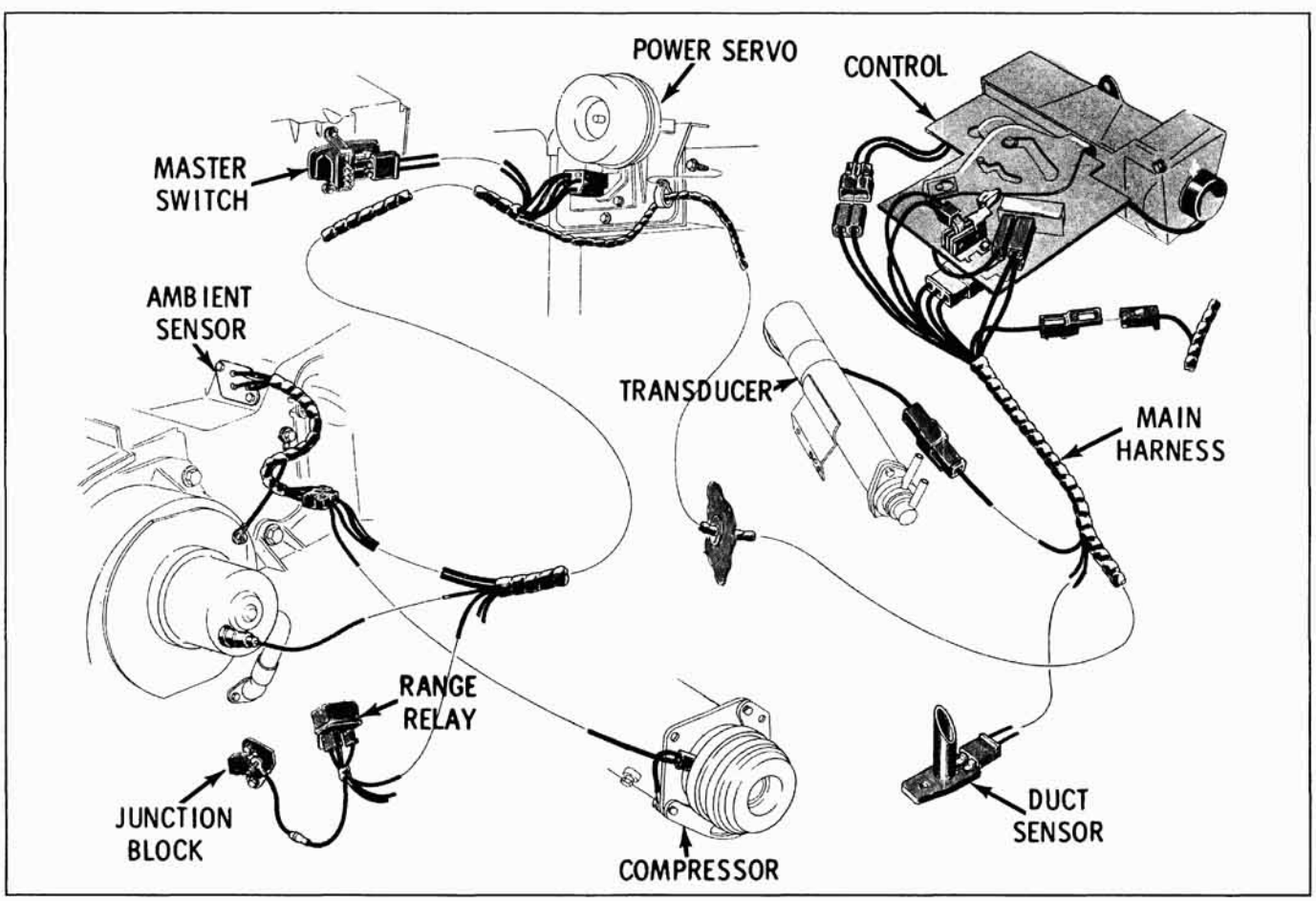


Fig. 1EB-18—Electrical Connections

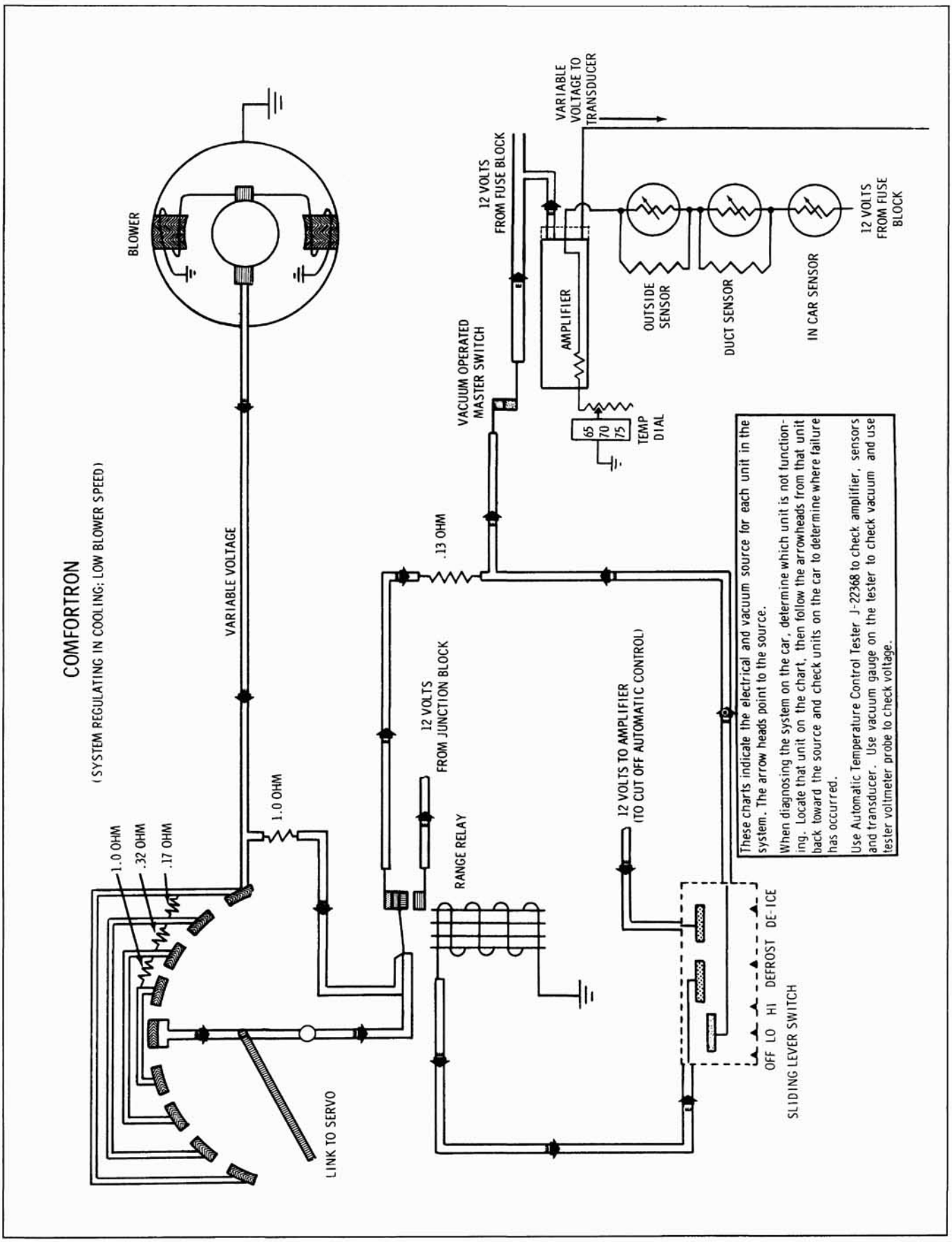


Fig. 1EB-19—Comfortron Check Chart (Electrical)

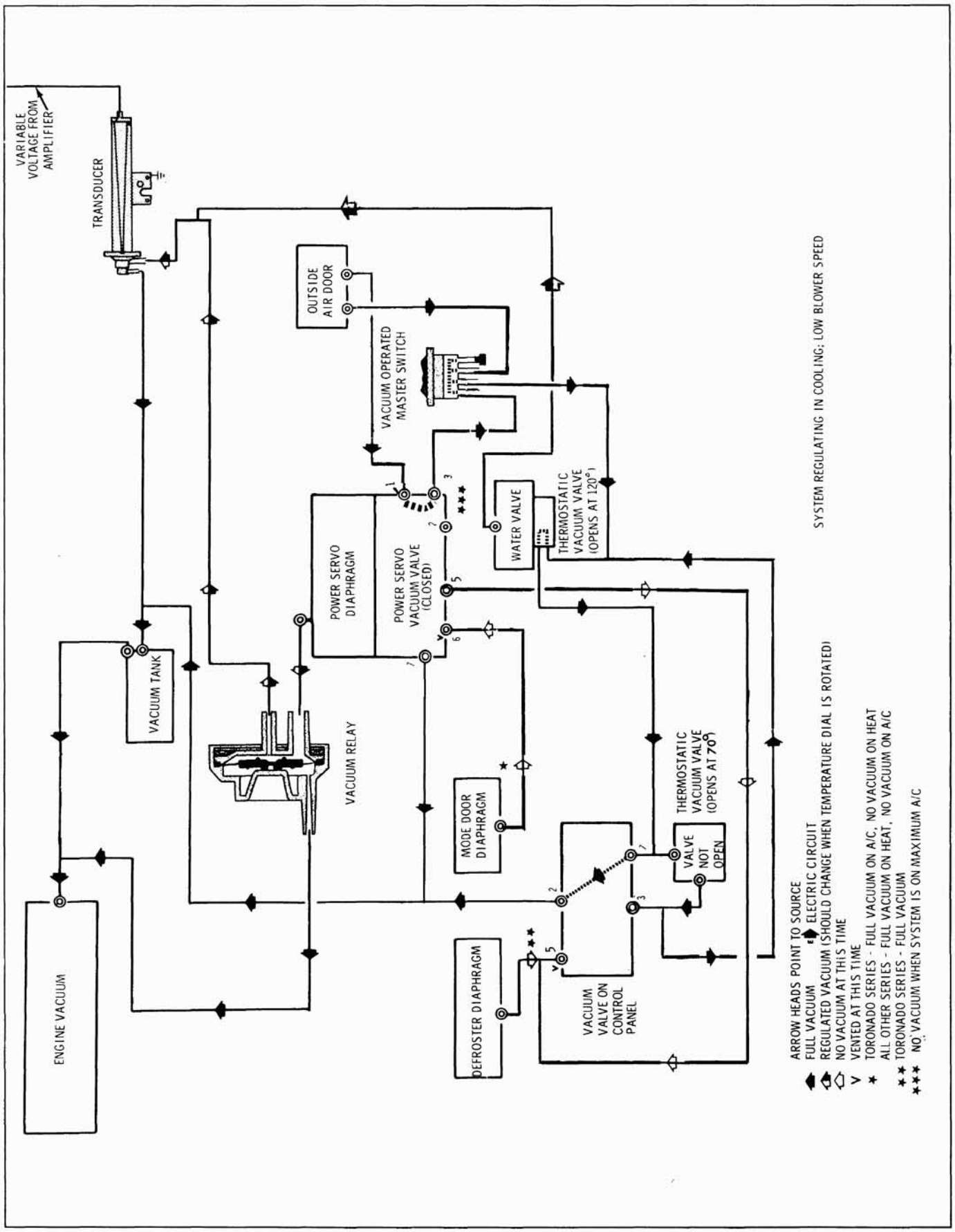


Fig. 1EB-20—Comfortron Check Chart (Vacuum)

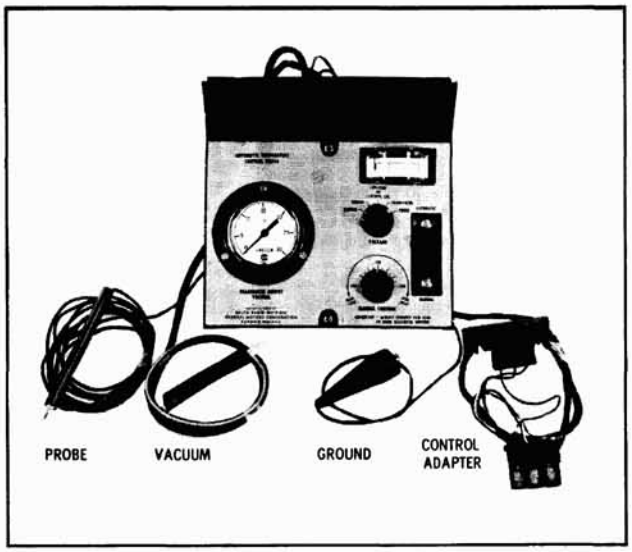


Fig. 1EB-21—Comfortron Tester

transducer, then replace it. If problem is now cured, then replace vacuum relay.

CHECKING SENSOR CIRCUIT FOR A SHORT

1. First indication of a shorted sensor in the Comfortron will be delivery of cold air (max. Air Conditioning) in the "Lo", "High" or "Defrost" position, regardless of temperature dial setting.
   a. Check sensor visually for indication of a short.
   b. Substitute known good sensor in wiring harness to check each sensor individually.

CHECKING SENSOR CIRCUIT FOR AN OPEN

1. Use Tester J-22368 voltmeter probe. Position voltage knob in the probe position. Attach tester ground clip to car. Disconnect amplifier connector.
2. With ignition switch in the ACC position, test for battery voltage at both terminals on all three connectors.
   a. Obtaining a voltage reading at both terminals indicates a good sensor.
   b. Obtaining a voltage reading at one connection only indicates an open circuit in the sensor. Replace sensor.
   c. No voltage at either connection on a sensor indicates the open circuit is at one of the other sensors or the battery feed wire to the sensor circuit is open.

AMPLIFIER AND TEMPERATURE DIAL TEST

(Step 3 on Tester J-22368)

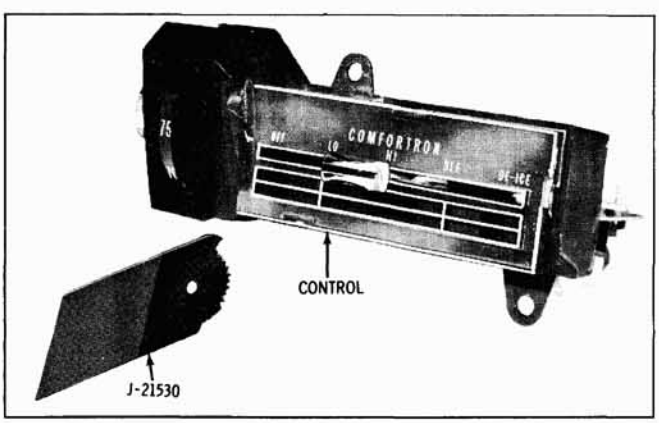


Fig. 1EB-22—Adjusting Temperature Control Dial

1. With tester connected and set as in Step 3, disconnect both wires from amplifier. Voltage should go to 8 to 9 volts minimum and should go to zero when connecting the two terminals on amplifier together with a jumper wire or screwdriver.
2. If voltage is as indicated in Step 1, replace temperature dial and rheostat assembly.
3. If voltage did not change in Step 1, replace amplifier.

TEMPERATURE CONTROL DIAL ADJUSTMENT

1. Connect Tester J-22368 to Comfortron amplifier as outlined by instructions on back of Tester.
2. Follow step 5A of Instructions, setting Manual Control on Tester as follows:

Toronado 150

3. Insert available Tool J-21530 or a 6" steel scale to the left of temperature dial. (Fig. 1EB-20)
4. While holding temperature dial on 75°, rotate Tool J-21530 or 6" steel scale until voltmeter on Tester J-22368 reads 6.5 volts.

Tool J-21530 must contact teeth on side of temperature dial.

FUNCTION CHECK

Normal Operating System

Check to be made with engine operating and coolant warm.

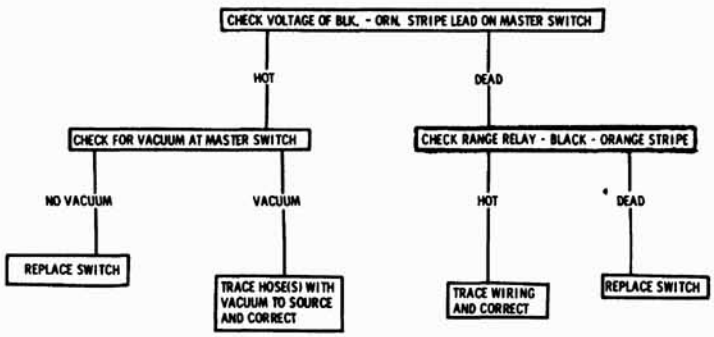
1. Set control lever in OFF position. Rotate temperature dial to max. heat position.
   a. No air flow from any outlets.
2. Move control lever to NORMAL HI position.
   a. Blower speed and air flow increases.
3. Move control lever to NORMAL LO position.
   a. Blower comes on high speed.
   b. Hot air comes chiefly from heater outlet with some air from defroster outlets.
4. Rotate temperature dial to max. cold position. (65°)
   a. Cold air comes from air conditioning outlets.
   b. Blower speed goes from high down through low and up to high.
5. Move control lever to DEFROST position.
   a. Cold air comes chiefly from defroster outlets, with some air from heater outlets.
6. Move control lever to DE-ICE position.
   a. Hot air comes chiefly from defroster outlets, with some air from heater outlet.
   b. Blower operating on high speed.

FUNCTIONAL TEST ITEM 1-A

AIR SHOULD NOT FLOW FROM ANY OUTLET
BUT
AIR DOES FLOW FROM OUTLETS

TEST CONDITIONS:

1. SET CONTROL LEVER IN "OFF" POSITION.
2. SET TEMPERATURE DIAL TO MAX. WARM POSITION (85 OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER IS USED AS A VOLTMETER.



FUNCTIONAL TEST ITEM 2-A

BLOWER SHOULD COME ON HIGH SPEED
BUT
BLOWER DOES NOT COME ON HIGH SPEED

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "LOW" POSITION.
2. ROTATE TEMPERATURE DIAL TO MAX. WARM POSITION (85° F. OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED AS VOLTMETER.

NOTE: IF AMBIENT TEMPERATURE IS HIGH OR THE IN-CAR TEMPERATURE IS HIGH (85° F. OR HIGHER), THE BLOWER WILL NOT STAY ON "HI". TO RUN THIS PROCEDURE UNDER HIGH TEMPERATURE CONDITIONS, REMOVE POWER CYLINDER HOSE FROM POWER SERVO AND SEAL THE HOSE. APPLY 12" HG. OF VACUUM ON THE POWER SERVO SO THAT THE POWER SERVO ARM GOES TO FULL WARM POSITION (DOOR LINK FULL RETRACTED).

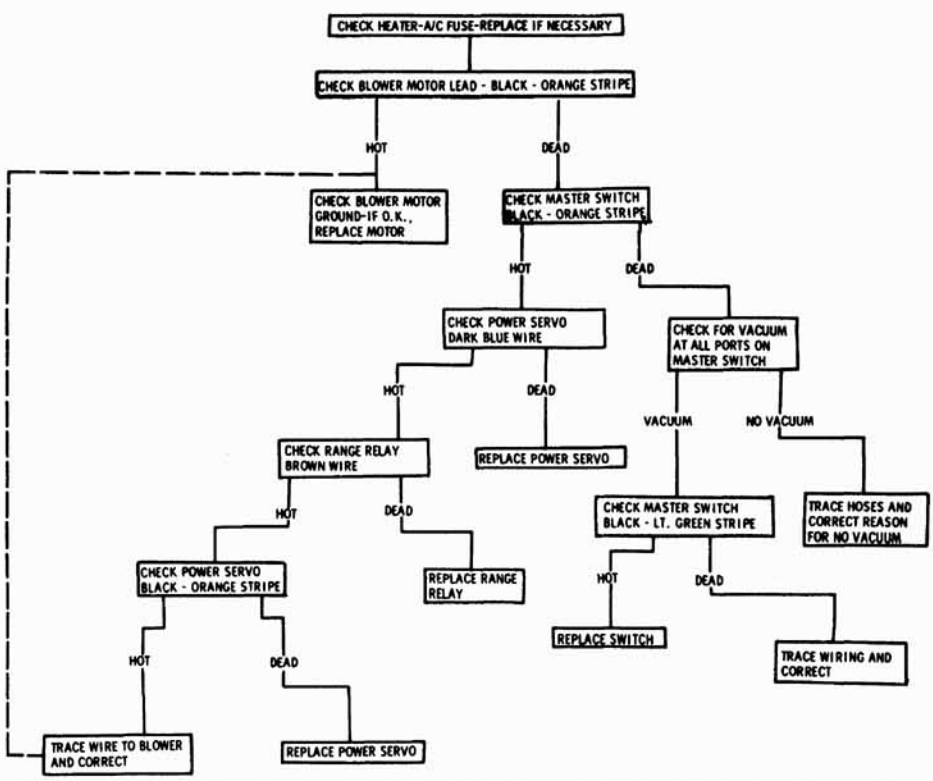


Fig. 1EB-23—Functional Test

FUNCTIONAL TEST ITEM 2-B

HOT AIR SHOULD COME CHIEFLY FROM HEATER OUTLET
BUT
HOT AIR DOES NOT COME FROM HEATER OUTLET

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "LOW" POSITION.
2. ROTATE TEMPERATURE DIAL TO MAX. WARM POSITION (85° F. OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER TO BE USED AT THE AMPLIFIER CONNECTOR.

NOTE: IF AMBIENT TEMPERATURE IS HIGH OR IN-CAR TEMPERATURE IS HIGH (ABOVE 85° F.), SYSTEM WILL NOT PUT OUT MAXIMUM HEAT AND MAY EVEN GO INTO A/C BECAUSE SYSTEM WILL TRY TO MAINTAIN 85° F. INSIDE CAR. THE ONLY WAY TO CHECK THE SYSTEM AS A UNIT WOULD BE TO HAVE THE CAR AMBIENT AT 75° F. AND THE ENGINE SHOULD NOT BE SO HOT THAT EXTREMELY HOT AIR WOULD BE HITTING THE AMBIENT SENSOR.

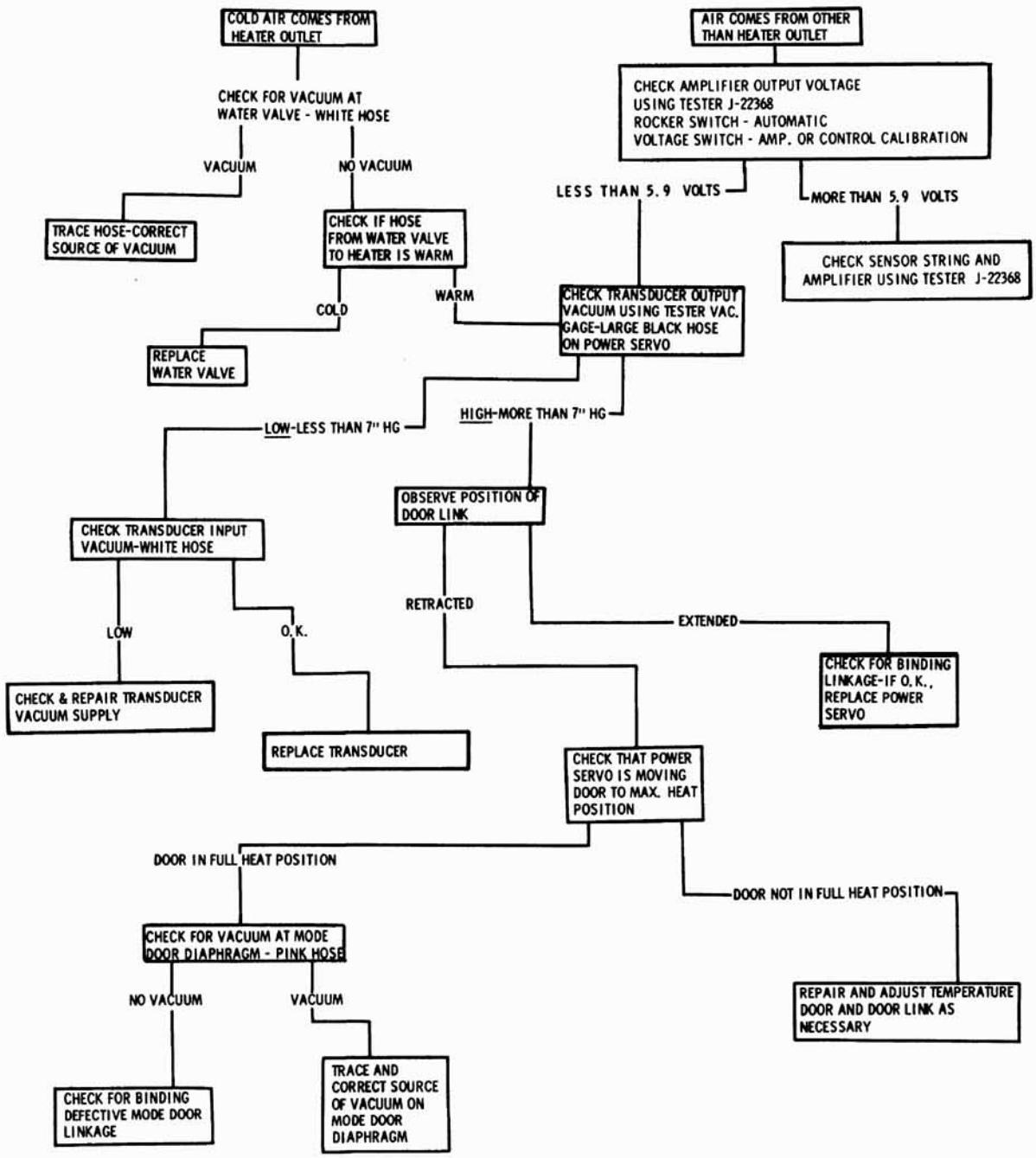


Fig. 1EB-24—Functional Test

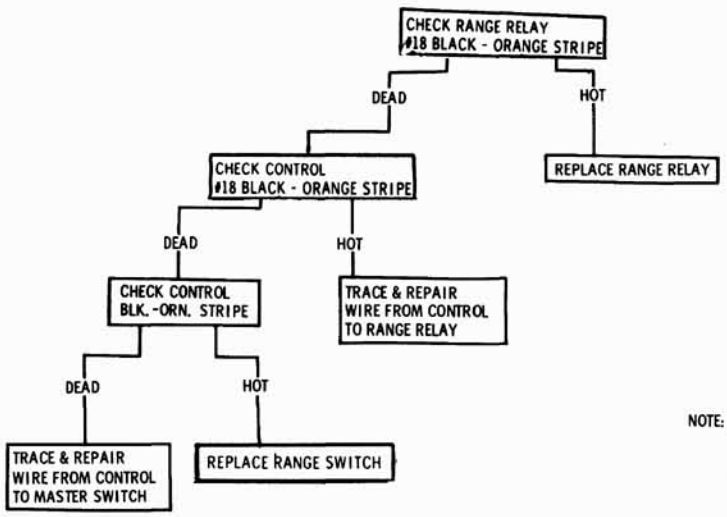
FUNCTIONAL TEST ITEM 3-A

BLOWER SPEED AND AIR FLOW SHOULD INCREASE
BUT
BLOWER SPEED AND AIR FLOW DOES NOT INCREASE

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "HIGH" POSITION.
2. ROTATE TEMPERATURE DIAL TO MAX. WARM POSITION (85 OR HIGHER).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED AS A VOLTMETER.

NOTE: AT HIGH AMBIENT TEMPERATURES, IT MAY BE NECESSARY TO SET THE TEMPERATURE DIAL IN MAX. COLD POSITION (65 OR LESS) TO MAINTAIN HIGH SPEED BLOWER OPERATION.



NOTE: IF BLOWER DOES NOT OPERATE WITH CONTROL IN NORMAL "HIGH" POSITION, CHECK RED WIRE FROM RANGE RELAY TO JUNCTION BLOCK INCLUDING CIRCUIT BREAKER.

VACUUM OPERATION

CONTROL					
		FUNCTION			
			AUTOMATIC		
PORT	CONNECTION	OFF	LOW-HI	DEFROST	DE-ICE
2	INPUT	SEAL	FEED	FEED	FEED
3	DE-ICE OVERRIDE	VENT	SEAL	SEAL	VAC
5	DEFROST DOOR	SEAL	VAC	VENT	VENT
7	THERMAL VAC. VALVES	VENT	VAC	VAC	VAC

POWER SERVO			
		FUNCTION	
PORT	CONNECTION	MAX. A/C	MAX. HEAT
4	BLOCKED	--	--
1	MASTER SWITCH (VAC. INPUT)	SEAL	CONNECT TO #2 & #3
3	OUTSIDE AIR DOOR	REG. VAC./VENT	CONNECT TO #1 & #2
2	BLOCKED		
5	MODE OVERRIDE (VAC. INPUT)	VAC.	SEAL
6	MODE DOOR	VAC.	VENT
7	BLOCKED	--	--

Fig. 1EB-25—Functional Test

FUNCTIONAL TEST ITEM 4-A

COLD AIR SHOULD COME FROM A/C OUTLETS
BUT
COLD AIR DOES NOT COME FROM A/C OUTLETS

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "HIGH" POSITION.
2. ROTATE TEMPERATURE DIAL TO FULL COLD POSITION (65° F. OR LESS).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED TO CHECK AMPLIFIER OR AS A VOLTMETER AS REQUIRED.

NOTE: IF AMBIENT OR IN-CAR TEMPERATURE IS LOW (BELOW 65° F.), SYSTEM WILL TRY TO MAINTAIN 65° F. AND IT WOULD NOT BE UNUSUAL FOR THE SYSTEM NOT TO GO MAX. COLD, ALTHOUGH THE TEMPERATURE DIAL IS SET FULL COLD.

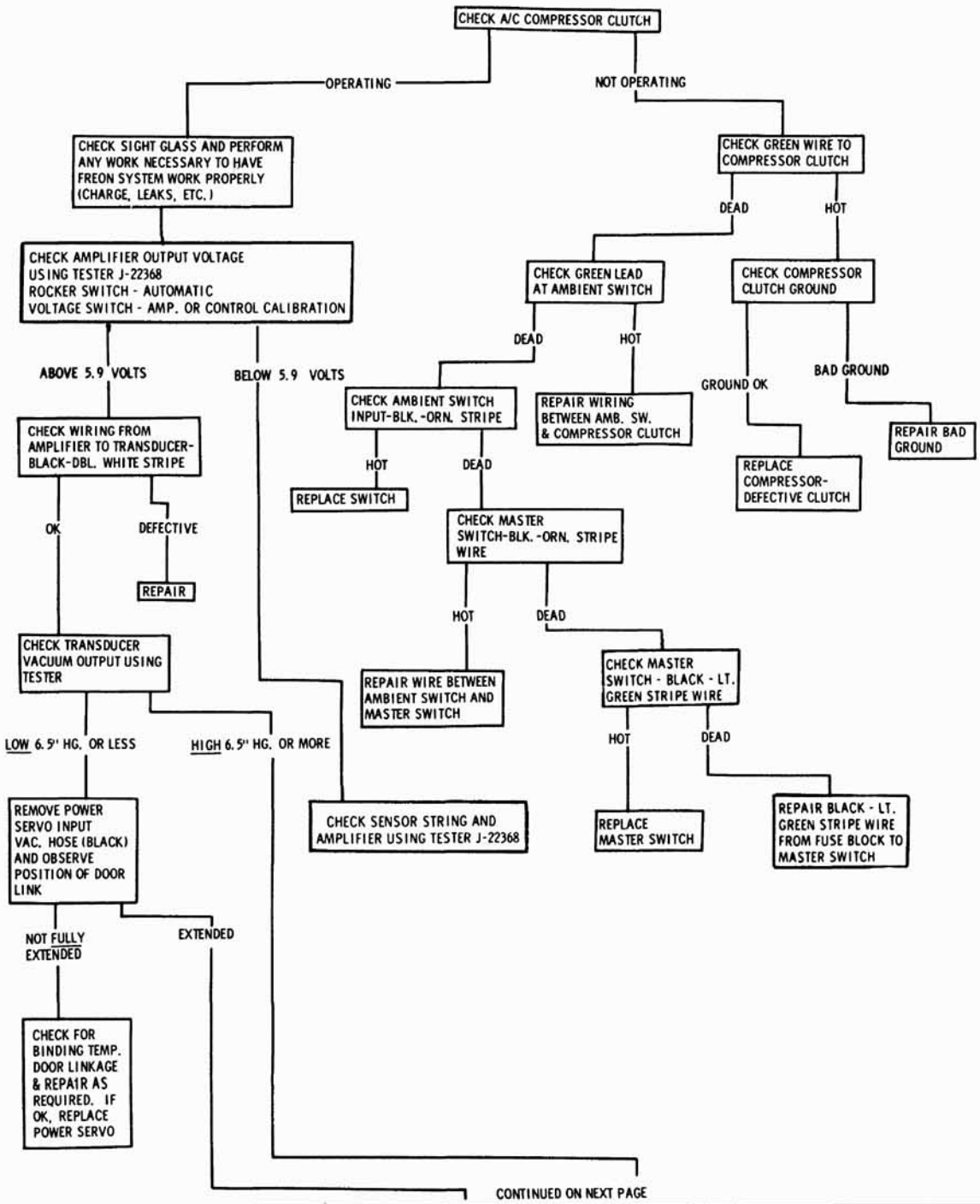


Fig. 1EB-26—Functional Test

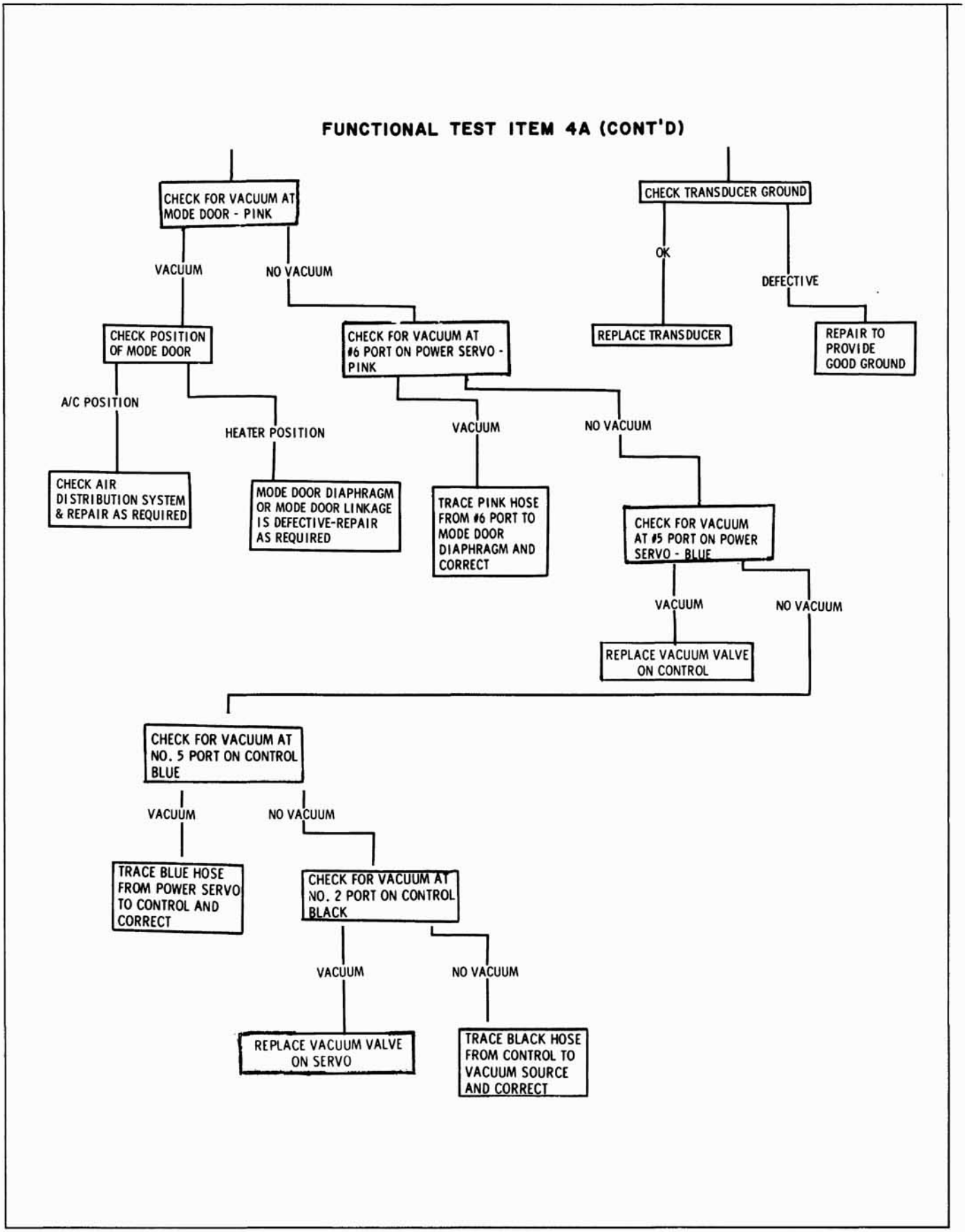


Fig. 1EB-27—Functional Test

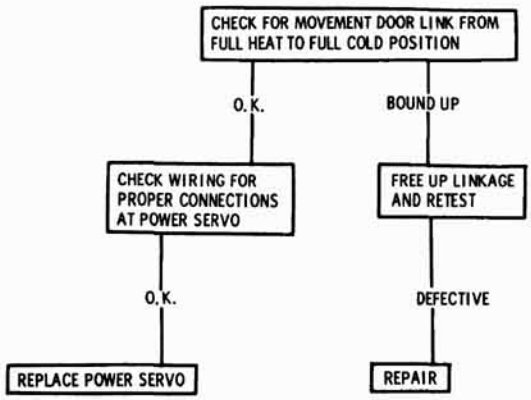
FUNCTIONAL TEST ITEM 4-B

BLOWER SPEED SHOULD GO FROM HIGH DOWN THROUGH LOW AND UP TO HIGH
BUT
BLOWER SPEED DOES NOT GO FROM HIGH DOWN THROUGH LOW AND UP TO HIGH

TEST CONDITIONS:

1. SET CONTROL LEVER IN NORMAL "HIGH" POSITION.
2. SET TEMPERATURE DIAL IN MAX. WARM POSITION (85 OR HIGHER) - FUNCTION TEST IS TO ROTATE DIAL FROM FULL WARM TO FULL COLD.
3. ENGINE OPERATING AND COOLANT WARM.

NOTE: HIGH-LOW-HIGH BLOWER CHANGES ARE ONLY TRANSIENT AS THE POWER SERVO GOES FROM MAXIMUM HEAT TO MAXIMUM COLD IN THE FUNCTION TEST.



FUNCTIONAL TEST ITEM 5-A

COLD AIR SHOULD COME FROM DEFROSTER OUTLETS
BUT
COLD AIR DOES NOT COME FROM DEFROSTER OUTLETS

TEST CONDITIONS:

1. SET CONTROL LEVER IN "DEFROST" POSITION.
2. ROTATE TEMPERATURE DIAL TO MAX. COLD POSITION (65 OR LESS).
3. ENGINE OPERATING AND COOLANT WARM.

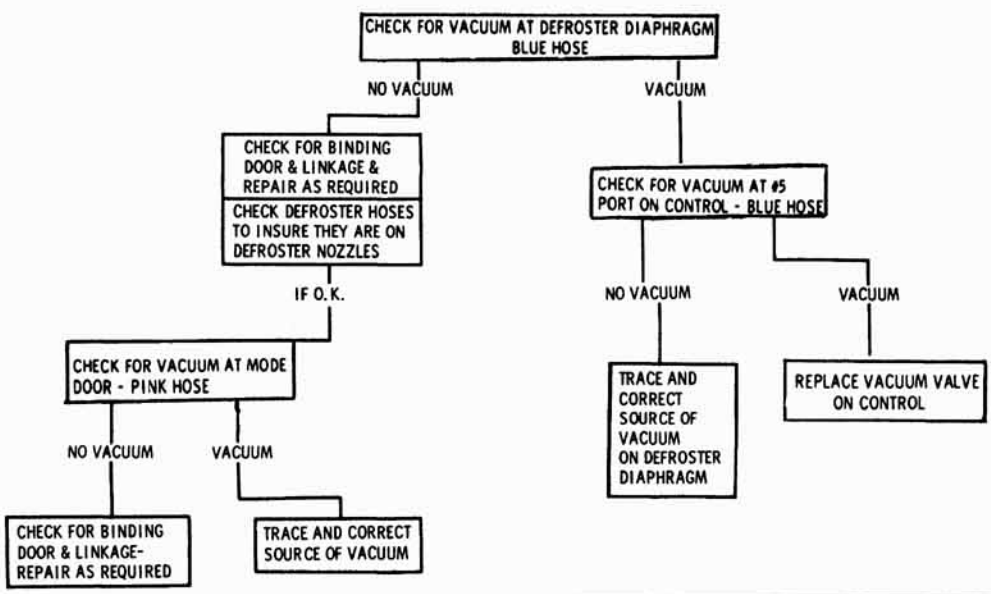


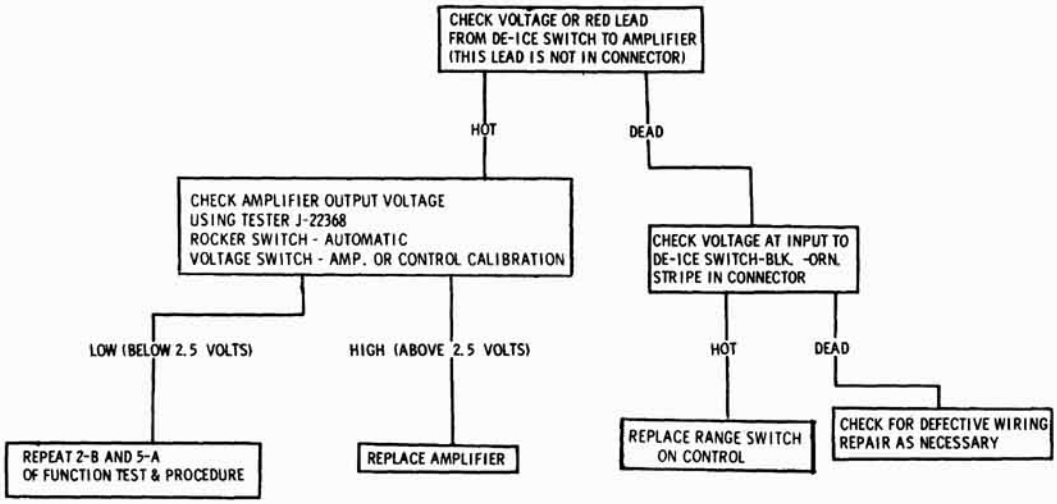
Fig. 1EB-28—Functional Test

FUNCTIONAL TEST ITEM 6-A

HOT AIR SHOULD COME FROM DEFROSTER OUTLETS
BUT
HOT AIR DOES NOT COME FROM DEFROSTER OUTLETS

TEST CONDITIONS:

1. SET CONTROL LEVER IN DE-ICE POSITION.
2. SET TEMPERATURE CONTROL DIAL IN FULL COLD POSITION (65 OR LESS).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER IS USED AS A VOLTMETER AND AT AMPLIFIER AS REQUIRED.



FUNCTIONAL TEST ITEM 6-B

BLOWER SHOULD OPERATE ON HIGH SPEED
BUT
BLOWER DOES NOT OPERATE ON HIGH SPEED

TEST CONDITIONS:

1. SET CONTROL LEVER IN DE-ICE POSITION.
2. ROTATE TEMPERATURE DIAL TO FULL COLD POSITION (65 OR LESS).
3. ENGINE OPERATING AND COOLANT WARM.
4. TESTER USED AS A VOLTMETER, VACUUM GAGE AND AMPLIFIER CHECK.

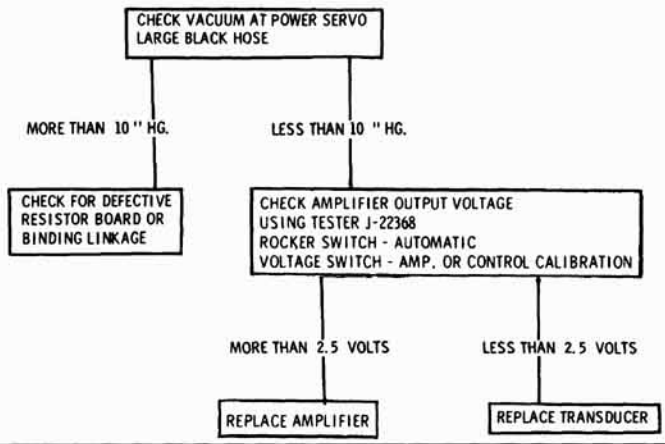


Fig. 1EB-29—Functional Test

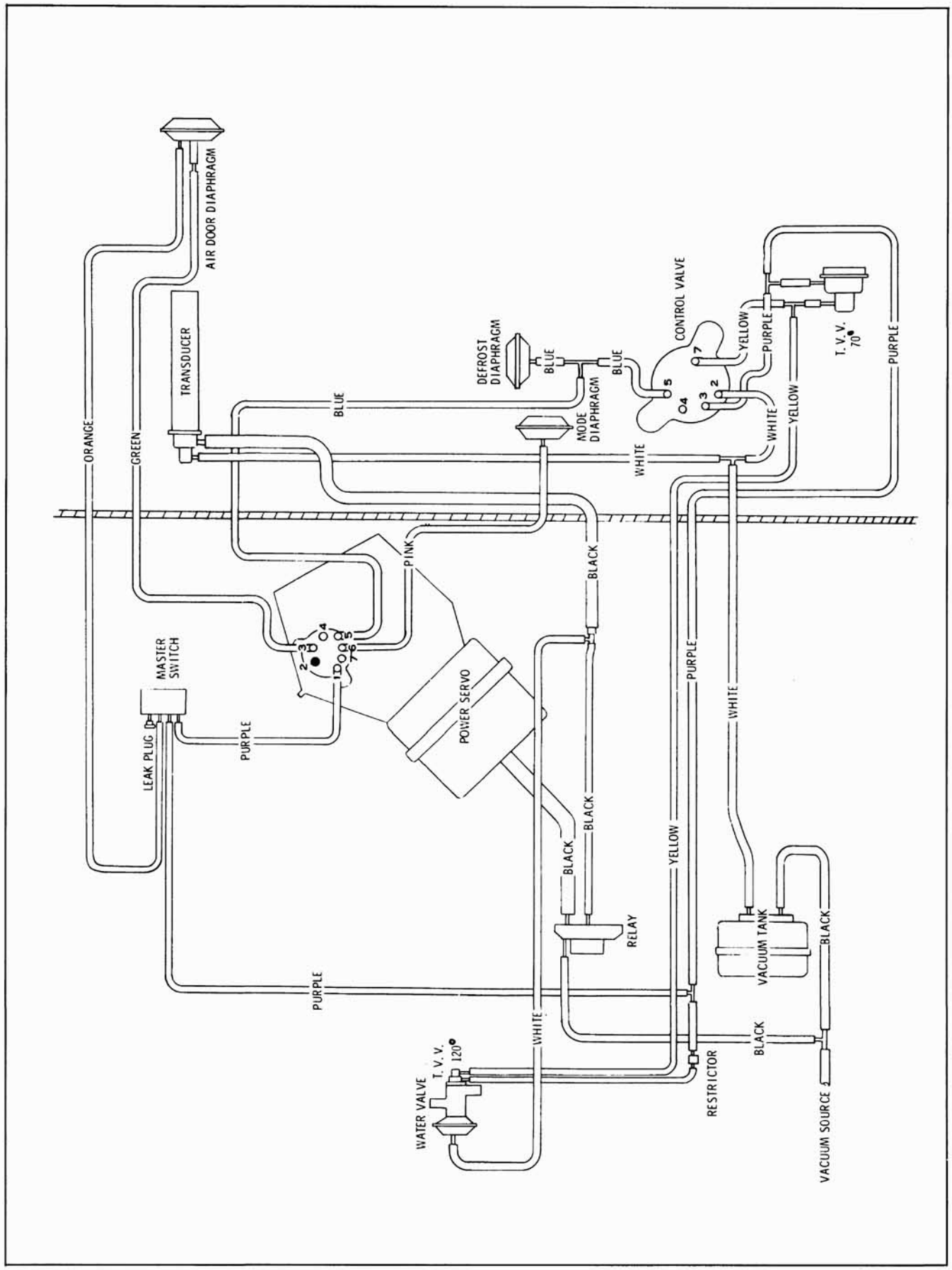
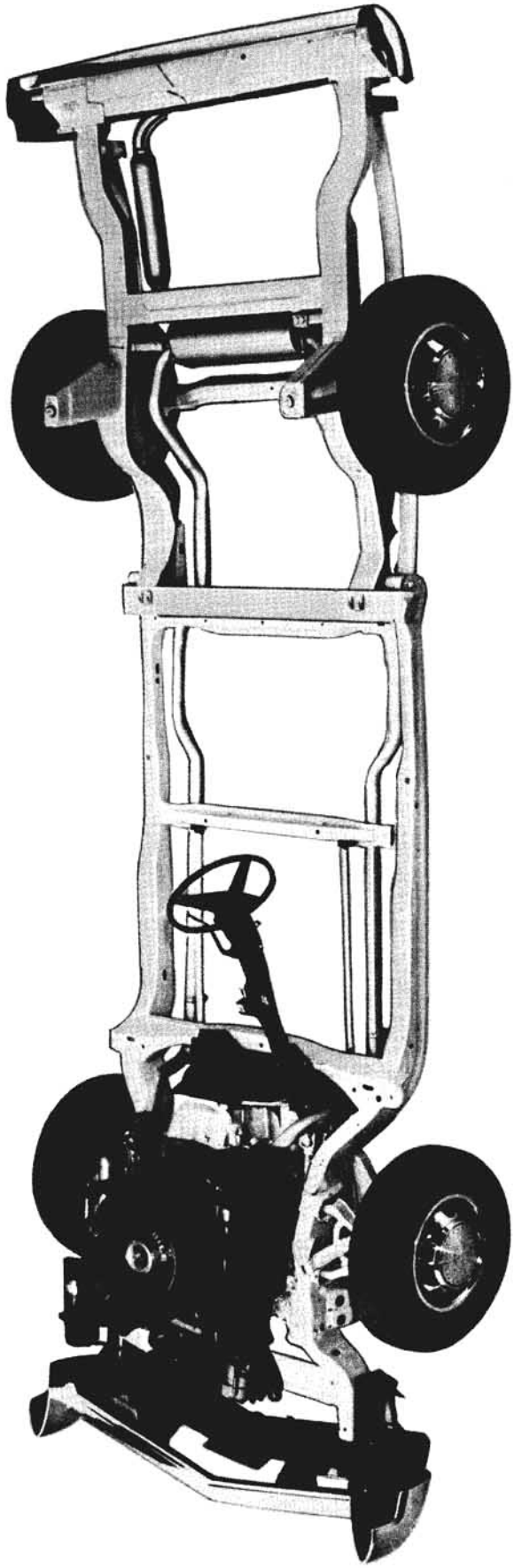


Fig. 1EB-30—Vacuum Hose Routing



FRAME AND BODY MOUNTING

TORONADO

CONTENTS OF SECTION 2E

Subject	Page	Subject	Page
FRAME	2E-1	BODY MOUNTING	2E-2

FRAME

When supporting car on a floor jack or floor stands, the car should be supported at the lift points only. Under no conditions should the car be supported at the extreme ends of frame, at the center of a frame side rail or on the rear crossbar.

FRAME ALIGNMENT

The diagram shown in Fig. 2E-1 can be used to check the alignment of a frame that is suspected of being damaged.

The reference points are to be checked with a tram gauge. The difference in corresponding measurements will indicate where straightening operations are necessary.

Corresponding measurements must be equal within 1/4".

1. Measure A-A. If not equal, rear end of frame or center section is misaligned.
2. Measure B-B. If not equal, then front section of frame is misaligned.

Measurement between the frame horns is given in Fig. 2E-1.

FRAME REPAIR

In case of collision, frame members can often be straightened to the required dimensions. However, some parts of the frame are service parts and can be replaced. The service parts available for the frame are the upper and lower control arm brackets, shock absorber brackets and the radiator support bar. If the front crossmember or the side rails cannot be satisfactorily straightened it will be necessary to replace the complete frame assembly.

BODY MOUNTS

To minimize vibration and noise, the body mounts must be properly torqued. Body mounts which are not tightened sufficiently will cause body "chucking" and damage to the cushions. If body mounts are tightened excessively, the cushioning effect of the cushion is impaired, resulting in squeaks and body "drumming". Torque body mount bolts to 40 ft. lbs.

For installation of body mounts, refer to Fig. 2E-2.

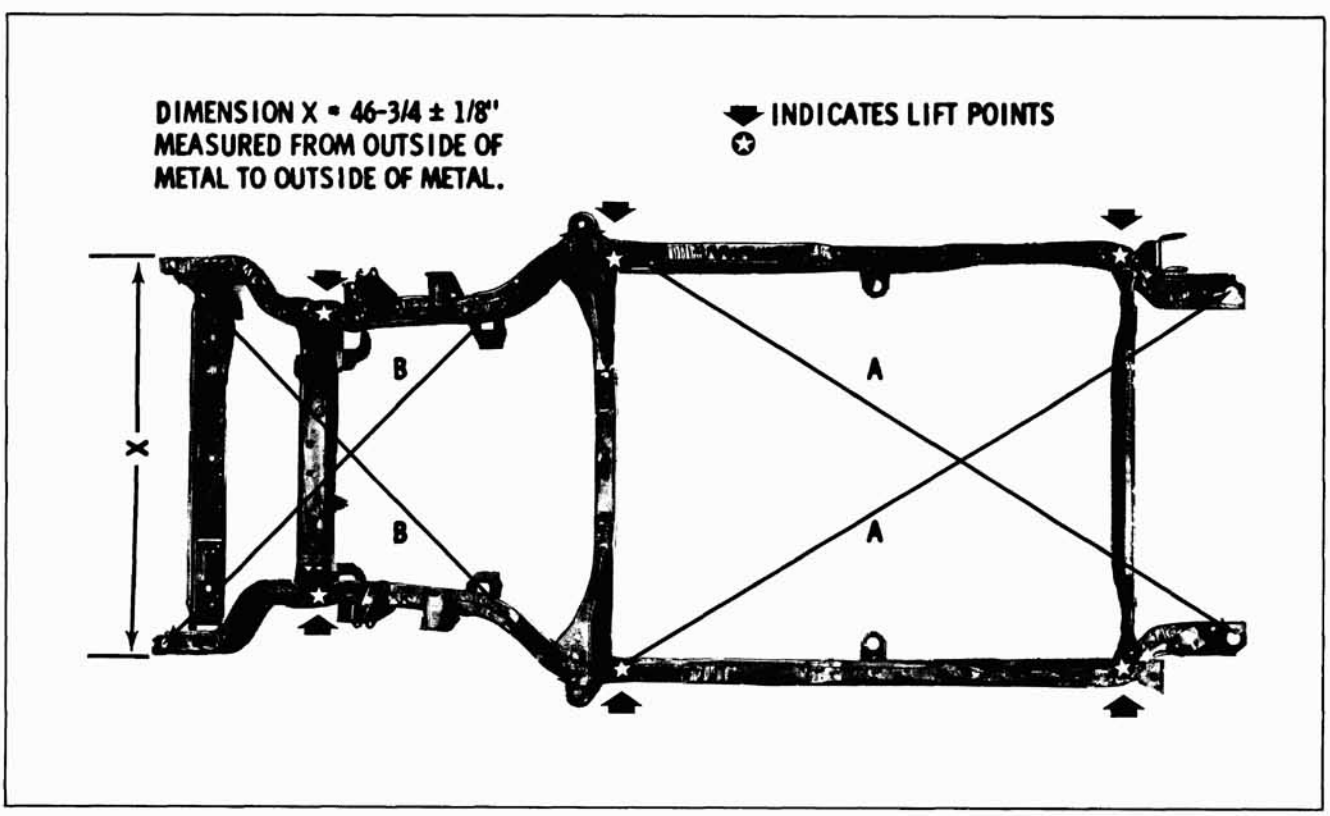


Fig. 2E-1—Frame - Toronado

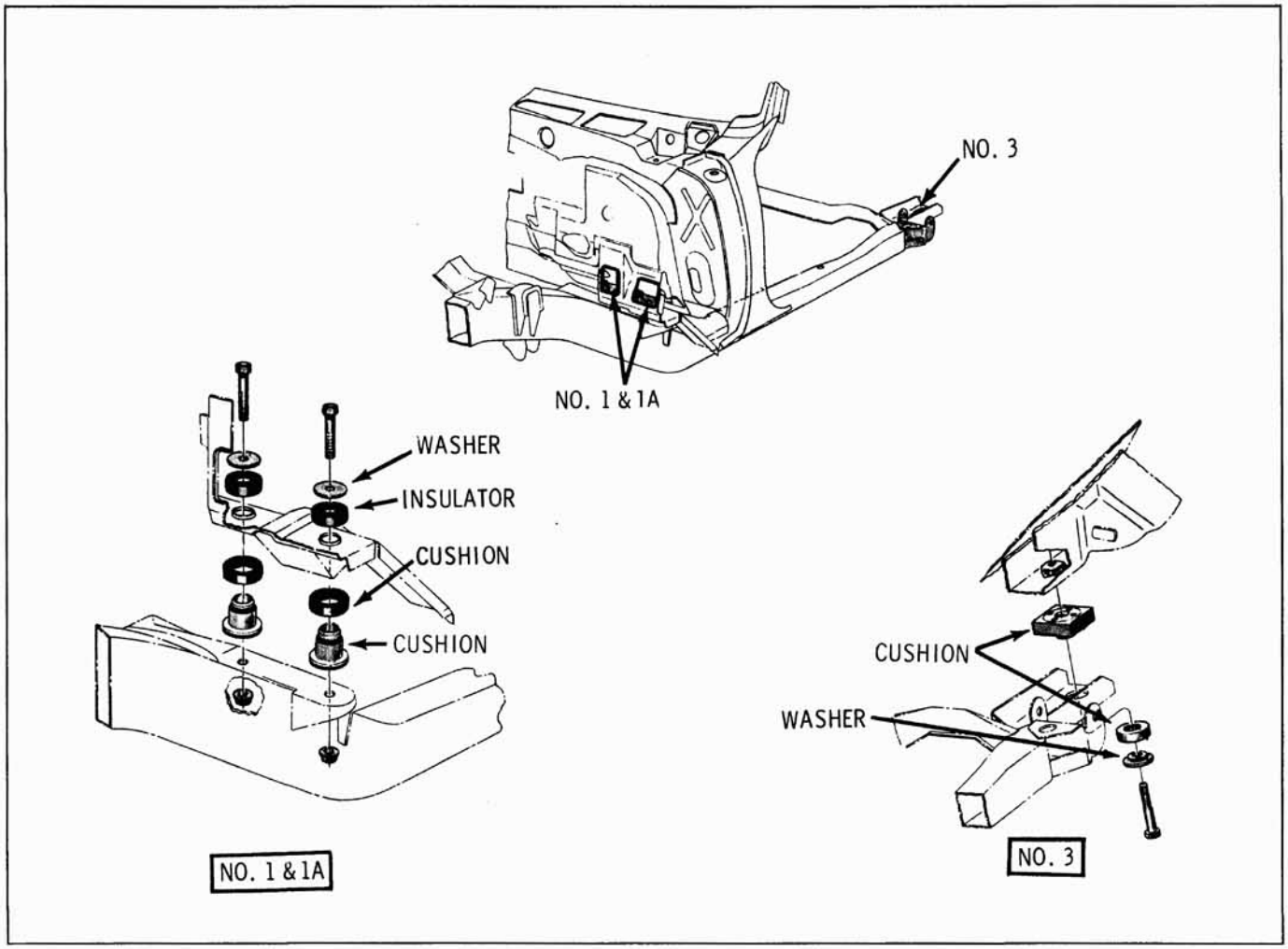


Fig. 2E-2—Body Mounting - Toronado

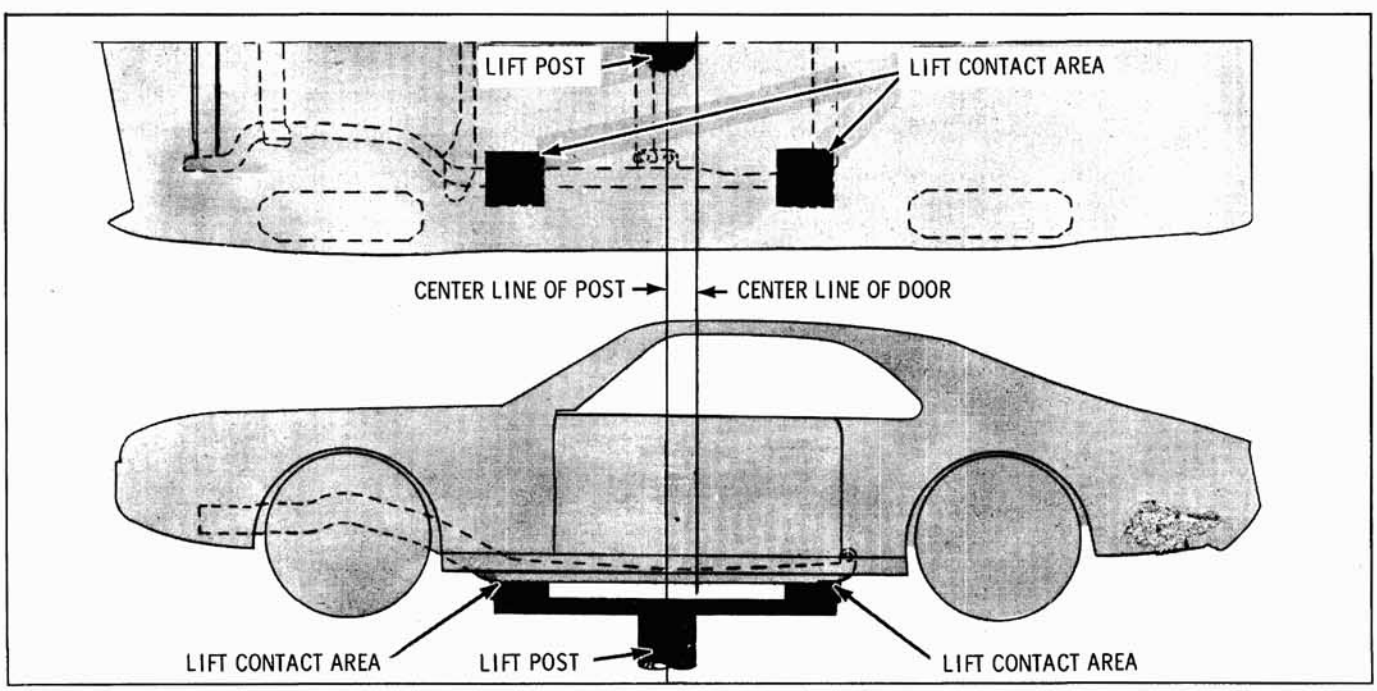


Fig. 2E-3—Lift Point Data

FRONT SUSPENSION
DRIVE AXLE
FINAL DRIVE

If equipped with disc brakes, refer to BRAKE SECTION 5E for the removal of disc brake components in relation to front suspension.

CONTENTS OF SECTION 3EA

FRONT SUSPENSION

Subject	Page
GENERAL DESCRIPTION	3EA-1
HUB ASSEMBLY	
REMOVAL AND INSTALLATION	3EA-1
KNUCKLE "O" RING SEAL	
REMOVAL AND INSTALLATION	3EA-3
KNUCKLE	
REMOVAL	3EA-3
INSTALLATION	3EA-4
TORSION BAR	
REMOVAL	3EA-5
INSPECTION	3EA-5
INSTALLATION	3EA-5
UPPER CONTROL ARM	
REMOVAL	3EA-7
INSTALLATION	3EA-7
UPPER CONTROL ARM BUSHINGS	
REMOVAL	3EA-7
INSTALLATION	3EA-7
LOWER CONTROL ARM R.H.	
REMOVAL	3EA-7
INSTALLATION	3EA-8
LOWER CONTROL ARM L.H.	
REMOVAL	3EA-8
INSTALLATION	3EA-9
LOWER CONTROL ARM BUSHINGS	
REMOVAL	3EA-9
INSTALLATION	3EA-10
BALL JOINT	
LUBRICATION	3EA-10
CHECKS	
VERTICAL	3EA-10
HORIZONTAL	3EA-11
LOWER CONTROL ARM BALL JOINT	
REMOVAL	3EA-11
INSTALLATION	3EA-11
SEALS	
REMOVAL	3EA-12
INSTALLATION	3EA-12
STABILIZER BAR	
REMOVAL AND INSTALLATION	3EA-12
TORSION BAR CROSSMEMBER	
REMOVAL	3EA-13
INSTALLATION	3EA-14
FRONT END ALIGNMENT	3EA-14
CARRYING HEIGHTS	3EA-15
SHOCK ABSORBER	
REMOVAL AND INSTALLATION	3EA-15
SHOCK ABSORBER CHART	3EA-15
TORQUE SPECIFICATIONS	3EA-15
TOOLS	3EA-16
DRIVE AXLE	3EB-
FINAL DRIVE	3EC-

FRONT SUSPENSION

GENERAL DESCRIPTION

The front suspension on the Toronado consists of control arms, stabilizer bar, shock absorbers and a right and left torsion bar. Torsion bars are used instead of the conventional coil springs. The front end of the torsion bar is attached to the lower control arm. The rear of the torsion bar is mounted into an adjustable arm at the torsion bar crossmember. The carrying height of the car is controlled by this adjustment. (Figs. 3EA-1 and 3EA-2)

HUB ASSEMBLY (Fig. 3EA-3)

Removal (Wheel Removed)

1. Carefully pull drum from hub assembly.

It may be necessary to back off the brake shoe adjustment before drum can be removed.

2. Remove drive axle cotter pin, nut and washer.
3. Position access slot in hub assembly so each of the attaching bolts (4) can be removed. (Fig. 3EA-4) It will be necessary to push aside adjuster lever to remove one of the bolts.
4. Position Spacer Tool J-22237 and install Tool J-21579 and Slide Hammer J-2619. (Fig. 3EA-4)
5. Remove hub assembly. It will again be necessary to push aside adjuster lever for clearance.

If bearing is to be replaced, install Tool BT-6702 as shown in Fig. 3EA-5 and remove bearing.

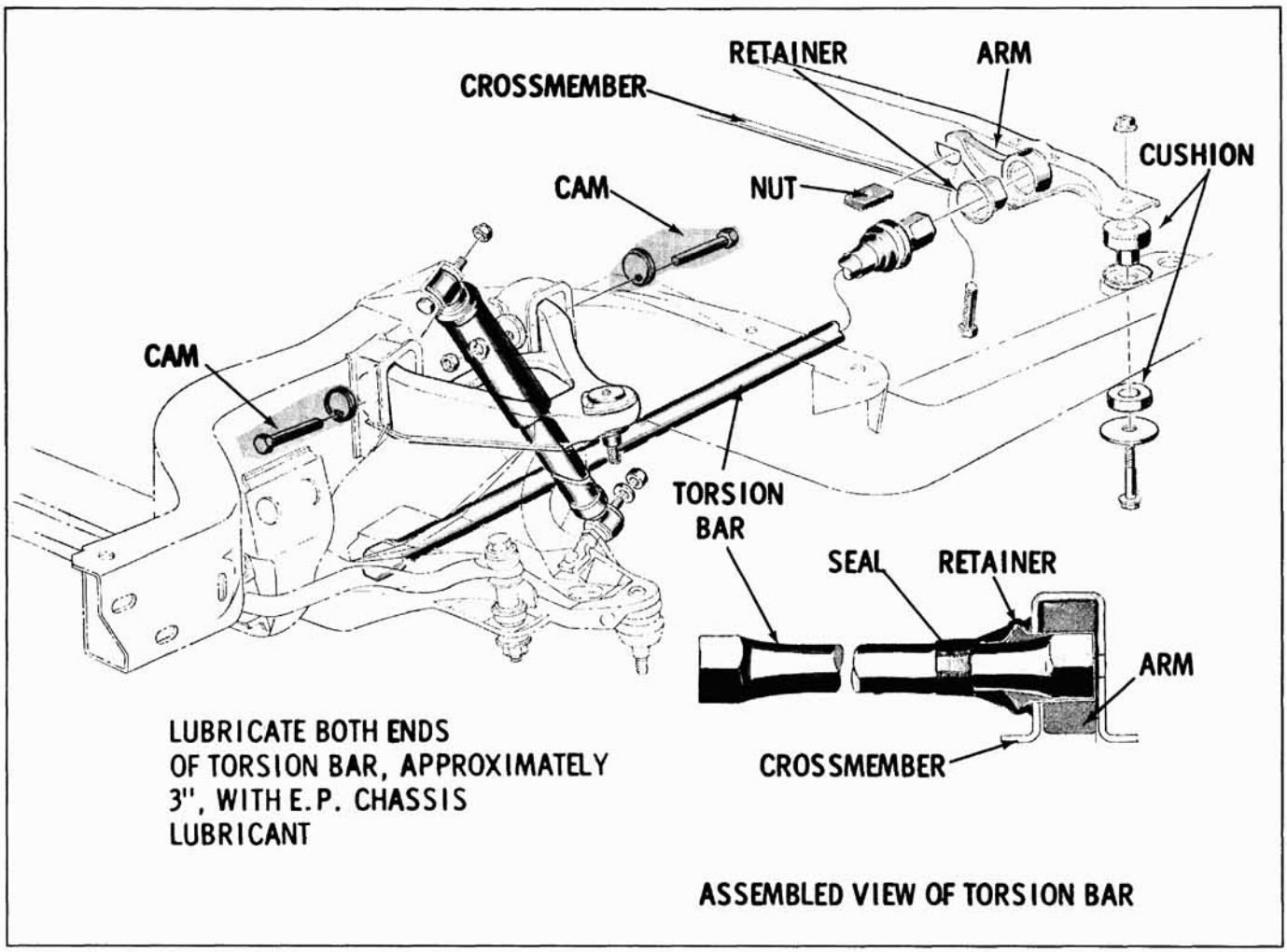


Fig. 3EA-1—Front Suspension

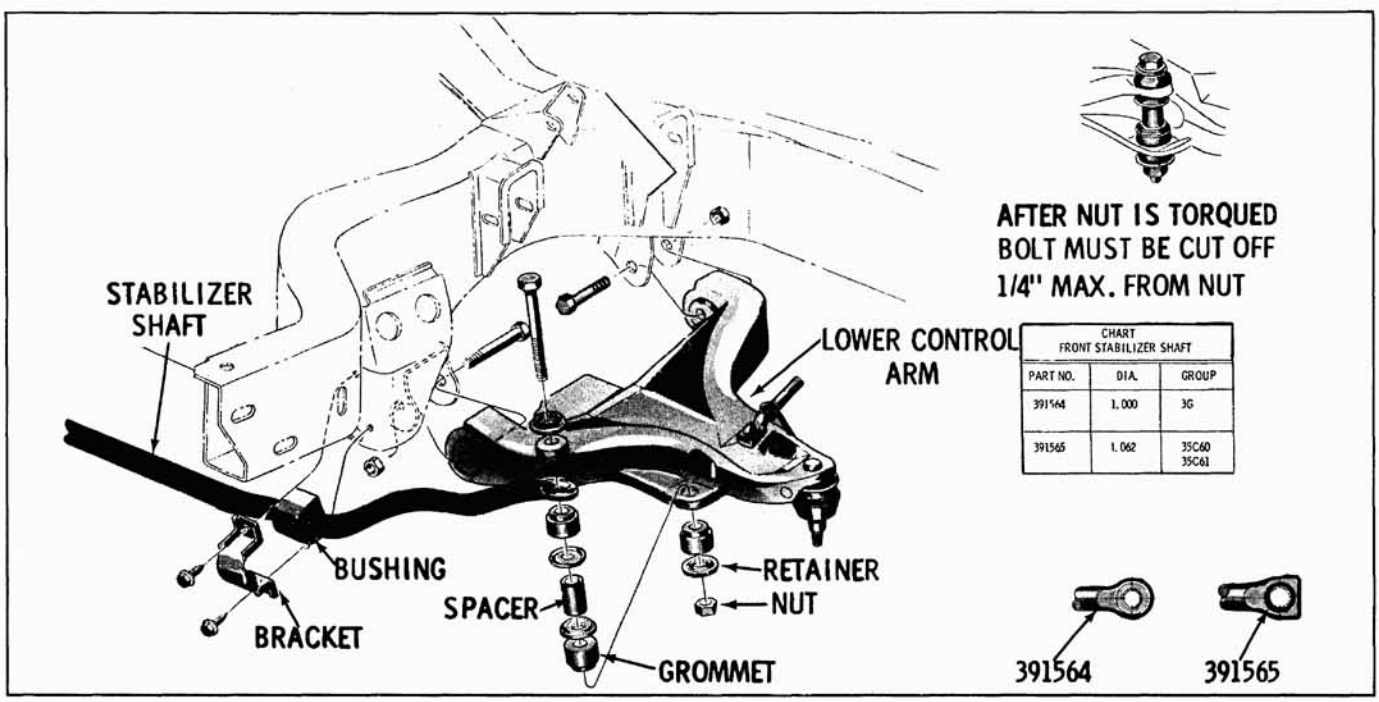


CHART
FRONT STABILIZER SHAFT

PART NO.	DIA.	GROUP
391564	1.000	3G
391565	1.062	3SC60 3SC61

Fig. 3EA-2—Front Suspension

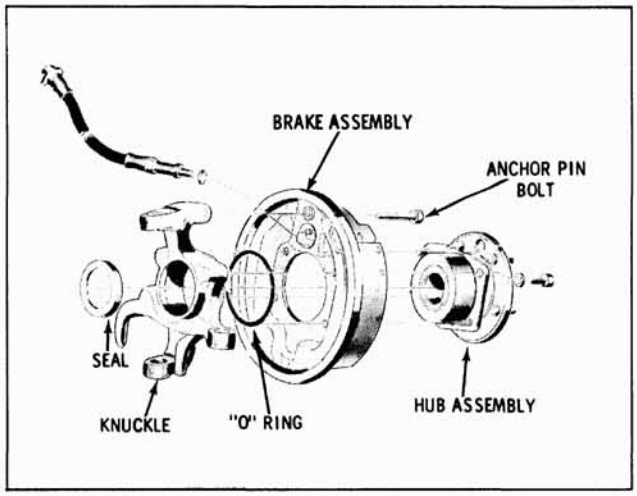


Fig. 3EA-3—Front Hub Assembly

Installation

Install bearing onto hub as shown in Fig. 3EA-6 making sure new bearing retainer is in correct position.

Reverse removal procedure.

OD of bearing must be lubricated with E.P. Chassis Lubricant.

Care must be used when installing hub assembly over drive axle splines so the splines are in correct alignment.

KNUCKLE "O" RING SEAL

Removal (Wheel Removed)

1. Remove hub and drum (refer to HUB ASSEMBLY REMOVAL.)
2. Remove upper ball joint cotter pin and nut.
3. Remove brake line hose clip from ball joint stud.

Do not loosen ball joint stud.

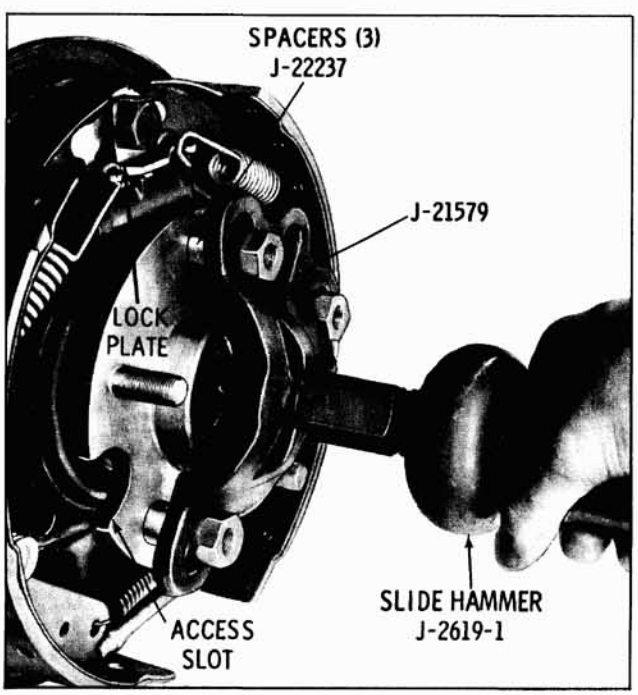


Fig. 3EA-4—Removing Hub Assembly

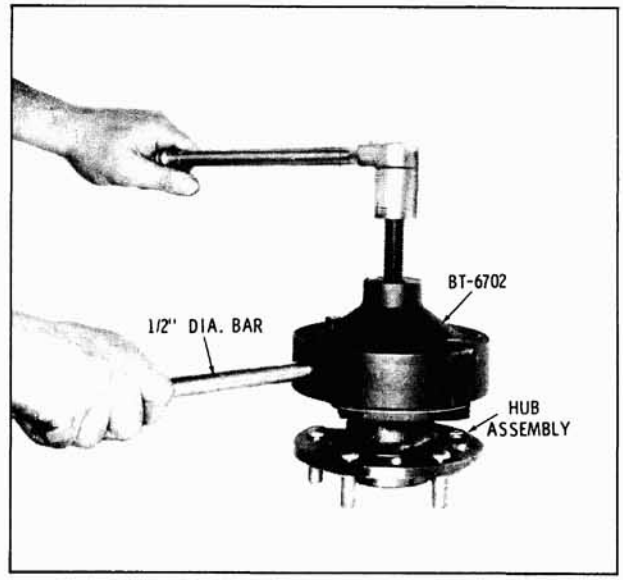


Fig. 3EA-5—Removing Hub Bearing

4. Bend lock plate on anchor bolt up and remove anchor bolt. (Fig. 3EA-4)
5. Carefully lift brake backing plate outboard over end of axle shaft and support so brake hose is not damaged. (Fig. 3EA-7)
6. Remove "O" ring seal. (Fig. 3EA-3)

Installation

To install reverse removal procedure.

KNUCKLE

Removal

1. Raise car and support lower control arm with floor stands.
2. Remove wheel and drum.
3. Remove hub assembly (refer to HUB ASSEMBLY, REMOVAL).

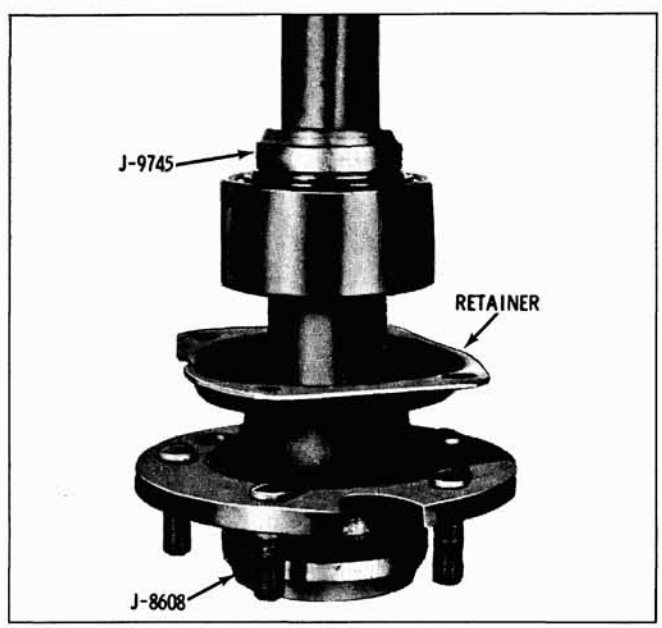


Fig. 3EA-6—Installing Hub Bearing

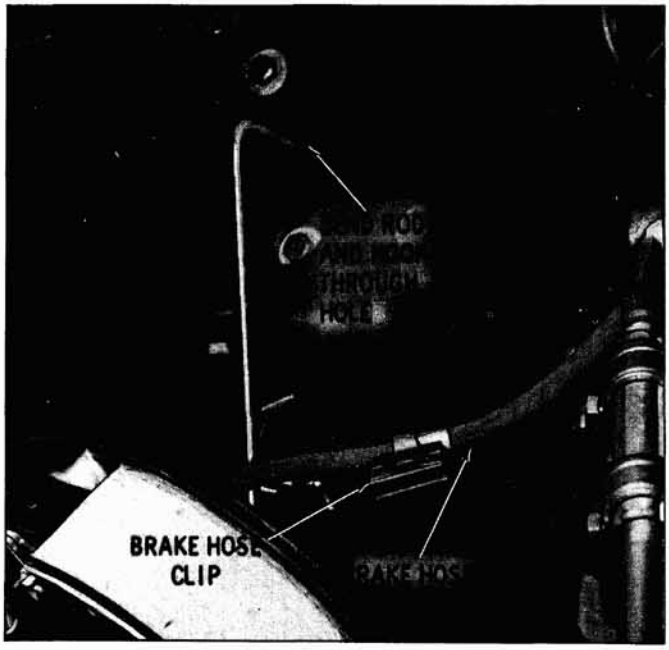


Fig. 3EA-7—Holding Backing Plate Assembly

4. Follow Steps 2 through 6 on KNUCKLE "O" RING, REMOVAL.
5. Place Tool J-22193 Support Block under drive axle to protect C.V. joint seal. (Fig. 3EA-8)
6. Using a brass drift and hammer, Fig. 3EA-9, loosen upper ball joint stud.
7. Remove cotter pin and nut from tie-rod end.
8. Using Brass Drift and Hammer, remove tie-rod end from knuckle. (Fig. 3EA-10)
9. Remove cotter pin and nut from lower ball joint.
10. Using Tool J-22292-3, carefully place between ball joint seal and knuckle.
11. Using Tool J-22292-1 and -2, remove lower ball joint from knuckle. (Fig. 3EA-11)
12. Remove knuckle.
13. Knuckle seal can be pried from knuckle at this time.

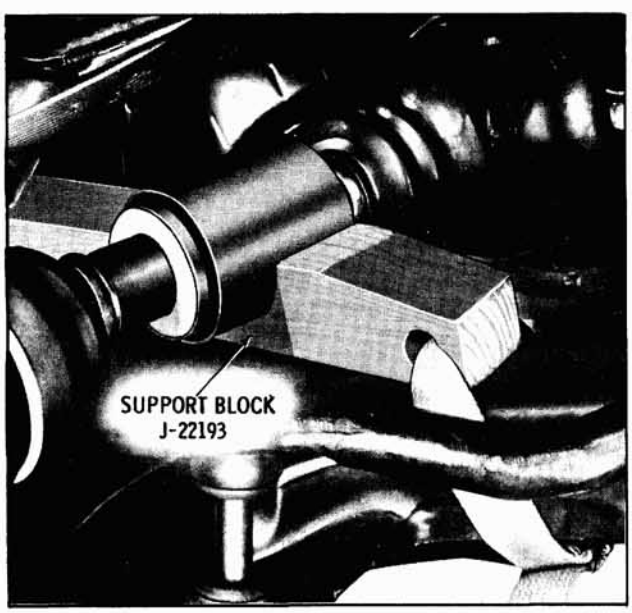


Fig. 3EA-8—Drive Axle Support Block

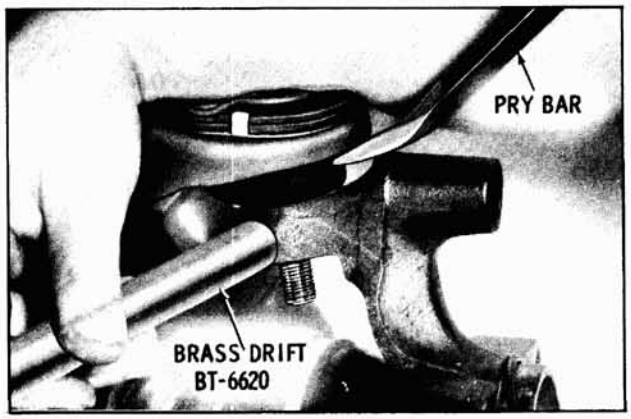


Fig. 3EA-9—Removing Upper Ball Joint

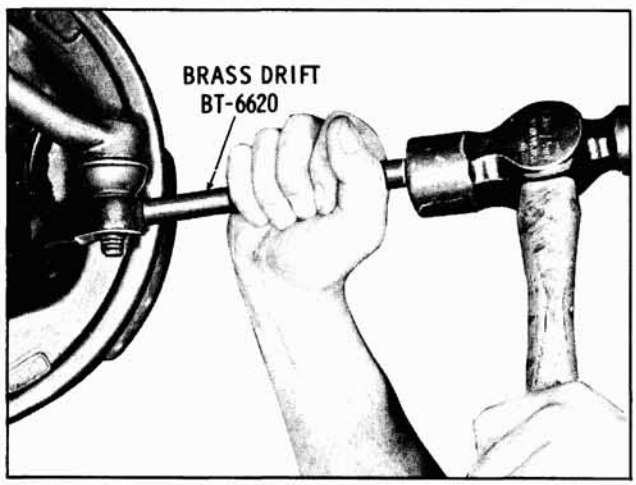


Fig. 3EA-10—Removing Tie-Rod End

Installation

1. Using Tool J-22234, install seal into knuckle. (Fig. 3EA-12)
2. Install lower ball joint stud into knuckle and attach nut. Do not torque.
3. Install tie-rod end stud into knuckle and attach nut. Do not torque.

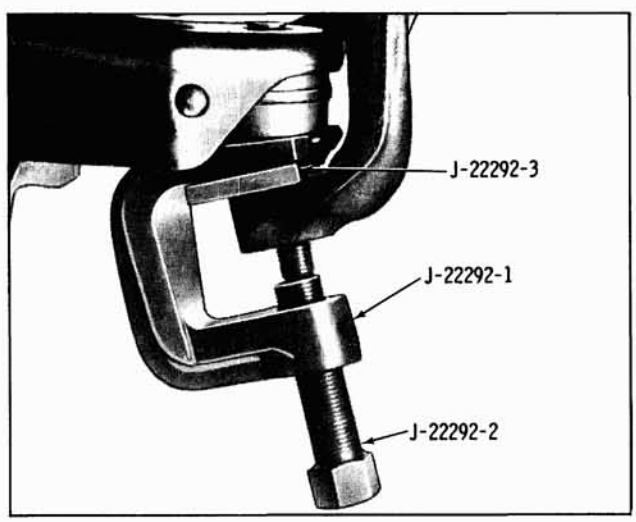


Fig. 3EA-11—Removing Lower Ball Joint

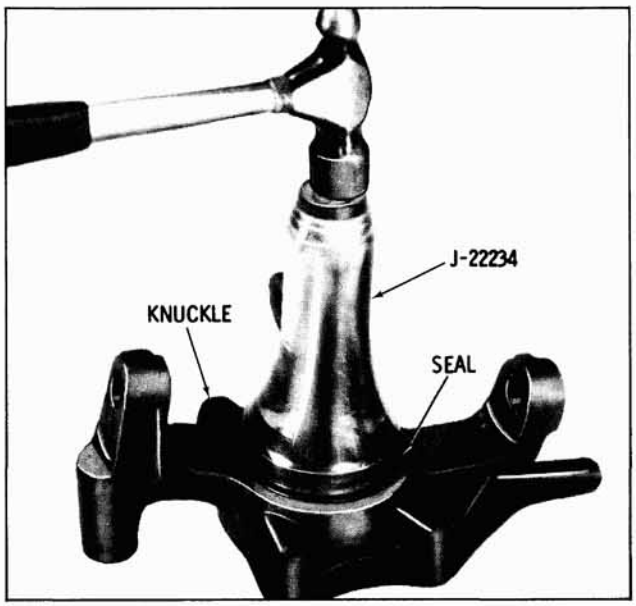


Fig. 3EA-12—Installing Knuckle Seal

4. Install upper ball joint stud into knuckle and attach nut. Do not torque.
5. Install backing plate onto knuckle with anchor bolt and lock plate. Do not torque.
6. Remove upper ball joint attaching nut and install brake line hose clip. Install nut.
7. Torque ball joint nuts to a minimum of 85 ft. lbs. Tighten to install cotter pins.

Cotter pin on upper ball joint must be bent up only to prevent interference with C.V. joint seal.

8. Torque tie-rod end to 50 ft. lbs. and install cotter pin.
9. Torque anchor bolt to 135 ft. lbs. and bend lock plate onto flat of bolt head.
10. Install hub assembly (refer to HUB ASSEMBLY INSTALLATION).
11. Install drum and wheel.
12. Remove floor stand and lower car.

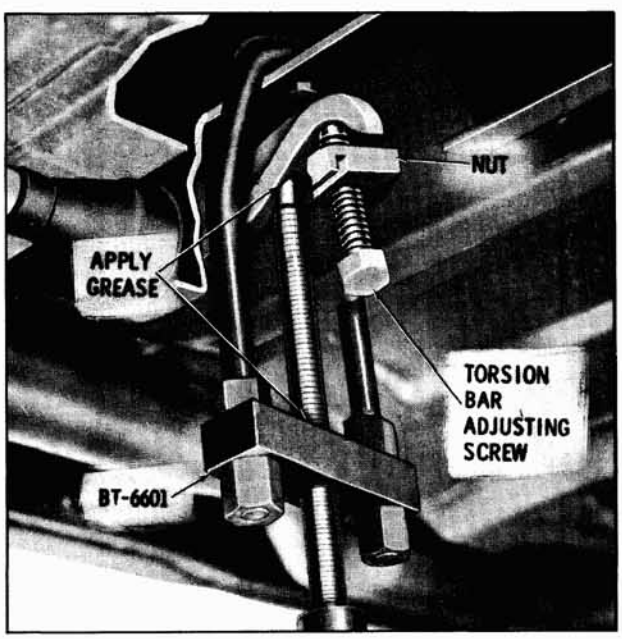


Fig. 3EA-13—Removing Torsion Bar

TORSION BAR

Torsion bar must be reused on the same side of car that it was removed. Right and left torsion bars are available for service replacement and are tagged with a sticker, which designates the front end of the torsion bar.

Removal

1. Hoist car under lower control arms.
2. Slide seal at rear of torsion bar forward.
3. Before using Tool BT-6601, remove the four nuts and center screw; then place tool over crossmember support. Align pin of tool into hole in crossmember. Install two nuts on tool and center screw; then install two remaining nuts to lock center screw. Turn center screw until seated in dimple of torsion adjusting arm. (Fig. 3EA-13)
4. Using a socket on the torsion bar adjusting bolt, turn counterclockwise, counting the number of turns necessary to remove.

The number of turns to remove the adjusting bolt will be used when installing, to obtain an initial carrying height.

5. Remove adjusting bolt and nut.
6. Turn center screw of Tool BT-6601 until torsion bar is completely relaxed.
7. Slide torsion bar forward until it bottoms in lower control arm, adjusting arm will drop out.

Do not mark, scratch or in any way damage torsion bar. Replacement will be necessary if such conditions exist.

8. Remove bolt from crossmember on the side from which torsion bar is being removed.
9. Remove center bolt assembly from Tool BT-6601.
10. Raise crossmember and twist rearward until torsion bar clears member.
11. Place floor stands under frame arms. (Fig. 3EA-22)
12. Lower hoist until the lower control arms are just free.
13. Remove lower control arm rear bushing bolt.
14. Pry lower control arm down, Fig. 3EA-15, and pull rearward on torsion bar until torsion bar is out of lower control arm. It may be necessary to force compressed air into anchor of lower control arm to relieve the vacuum caused by grease.

Inspection

1. Check rubber seal for damage. Replace if necessary.
2. Check retainer for excessive wear. Replace if necessary.

New retainer is required on replacement of torsion bar. Stake as shown in Fig. 3EA-14.

3. Check torsion bar for nicks, scratches or dents due to removal and replace if such conditions exist.

Installation

1. Lubricate both ends of torsion bar for approximately 3" with E.P. Chassis Lubricant.
2. Install torsion bar into lower control arm anchor and push forward until bar bottoms.
3. Pry crossmember back and align torsion bar with hole in crossmember.
4. Position lower control arm and install lower control arm bushing bolt and nut. Do not torque.
5. Raise hoist and remove floor stands.
6. Install torsion bar arm and pull torsion bar rearward until fully seated in arm.
7. Install crossmember bolt through rubber mounting and torque nut to 40 ft. lbs.

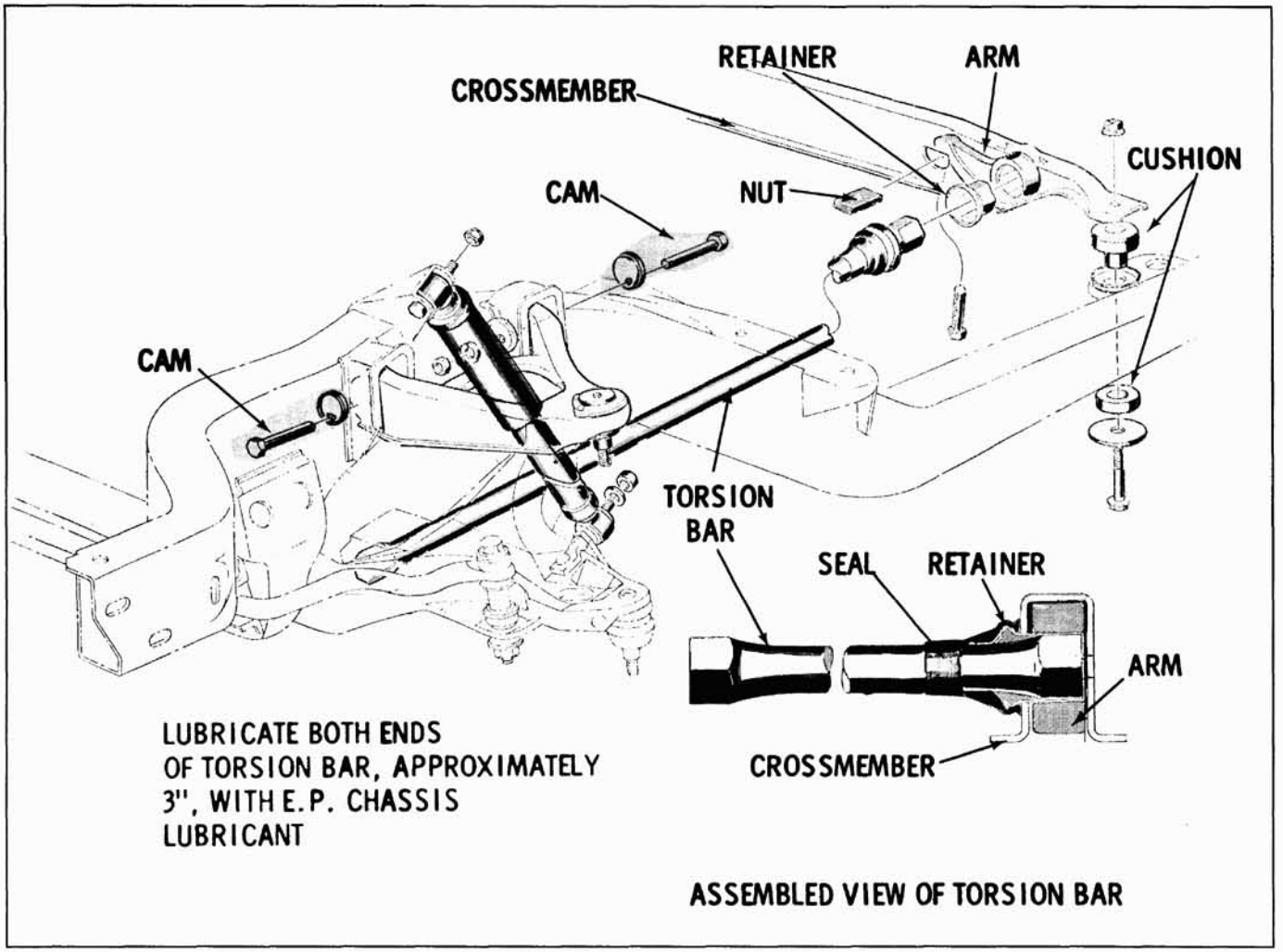


Fig. 3EA-14—Front Suspension

8. Install Tool BT-6601 on crossmember.
9. Using Tool BT-6601, tighten torsion bar arm to install adjusting nut under arm and through crossmember.
10. Lubricate threads of torsion bar adjuster bolt with E.P. Chassis Lubricant and turn into nut the same number of turns used to remove.
11. Remove Tool BT-6601.
12. Lower car to floor.
13. Torque lower control arm bushing nut to 80 ft. lbs.

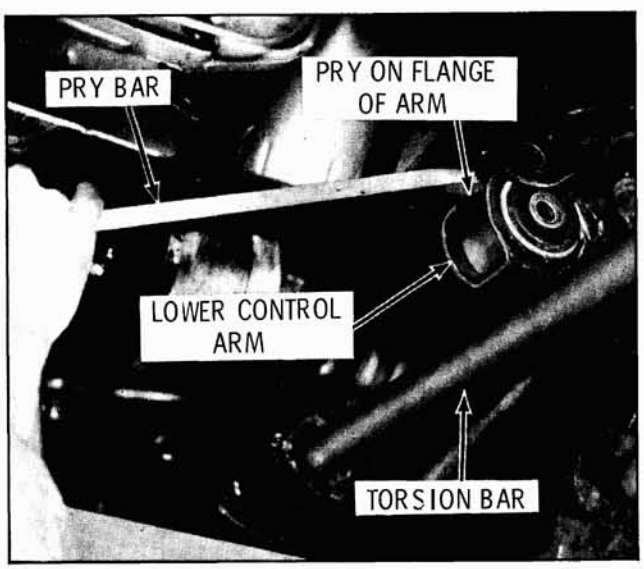


Fig. 3EA-15—Prying Lower Control Arm

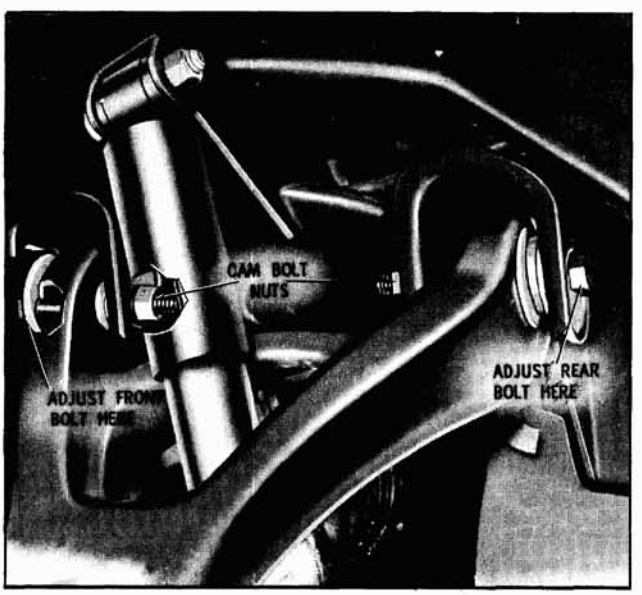


Fig. 3EA-16—Front Wheel Alignment Cams

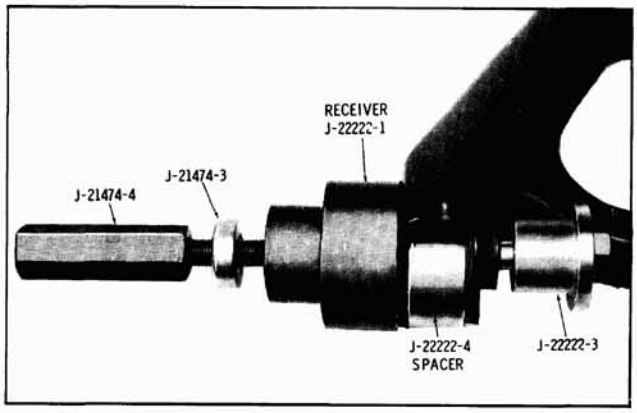


Fig. 3EA-17—Removing Upper Control Arm Bushing

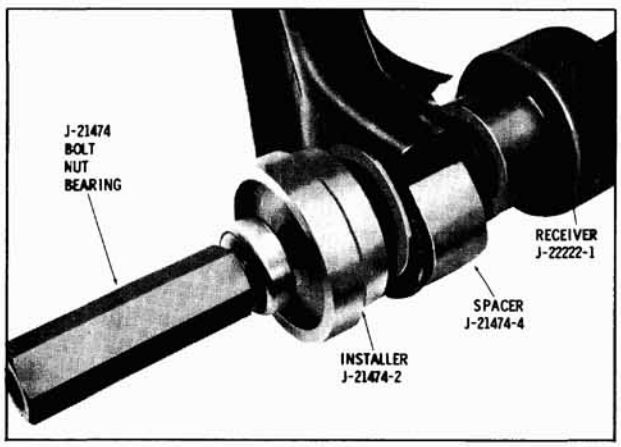


Fig. 3EA-18—Installing Upper Control Arm Bushing

UPPER CONTROL ARM

Removal

Upper control arm is serviced as an assembly less bushings.

1. Hoist car under lower control arms and remove wheel.
2. Remove upper shock attaching bolt.
3. Remove cotter pin and nut from upper ball joint.
4. Disconnect brake hose clamp from ball joint stud.

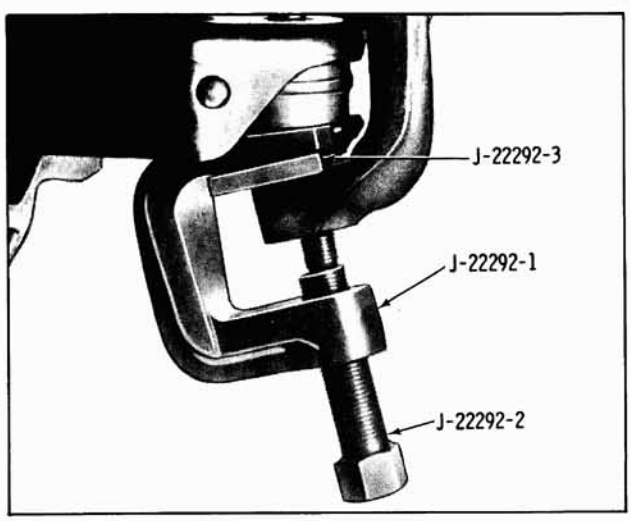


Fig. 3EA-19—Removing Lower Ball Joint

5. Using hammer and a drift, Fig. 3EA-9, drive on spindle until upper ball joint stud is disengaged.
6. Remove upper control arm cam assemblies and remove control arm from car by guiding shock absorber through access hole in arm.

Installation

1. Guide upper control arm over shock absorber and install bushing ends into frame bracket.
2. Install cam assemblies as shown in Fig. 3EA-16.

Front cam is mounted up. Rear cam is mounted down.

3. Install ball joint stud into knuckle.
4. Install brake hose clip on ball joint stud.
5. Install ball joint nut. Torque to 85 ft. lbs. Insert cotter pin and crimp.

Cotter pin must be crimped toward upper control arm to prevent interference with outer C.V. joint seal.

6. Install upper shock attaching bolt and nut. Torque nut to 80 ft. lbs.
7. Install wheel.
8. Lower hoist.
9. Check camber, caster and toe-in and adjust if necessary. Refer to FRONT END ALIGNMENT.

UPPER CONTROL ARM BUSHING (ON THE CAR)

Upper control arm bushings can be removed and installed on or off the car.

Removal

1. Hoist car under lower control arms and remove wheel.
2. Disconnect upper shock absorber attaching bolt.(Fig. 3EA-16)
3. Remove cam assemblies from control arms.
4. Move control arm out of frame brackets and attach bushing removal tools as shown in Fig. 3EA-17.

Installation

1. Install Tools as shown in Fig. 3EA-18 and press bushings into control arm.
2. Move control arm into frame brackets and install cam assemblies. The front cam is installed with the bolt in the lower position. The rear cam is installed with the bolt in the upper position.
3. Connect upper shock attaching bolt. Torque nut to 80 ft. lbs.
4. Replace wheel and lower car.
5. Align front wheels. Refer to FRONT END ALIGNMENT.

LOWER CONTROL ARM (RIGHT HAND)

Removal

1. Remove drive axle assembly. Refer to DRIVE AXLE ASSEMBLY (RIGHT HAND).
2. Hoist car and place floor stands under frame horns. (Fig. 3EA-22)
3. Position Tool BT-6601 on torsion bar. Refer to TORSION BAR REMOVAL, Items 2 through 6.
4. Remove wheel.
5. Remove shock absorber.
6. Disconnect stabilizer bar from lower control arm. Discard bolt.
7. Place Tool J-22193-1 between stabilizer bar and tie-rod.
8. Remove cotter pin and nut from lower ball joint stud.
9. Install Tool J-22292-3 Adapter under ball joint seal and install Tool J-22292-1-2 and remove ball joint stud from knuckle. (Fig. 3EA-19)

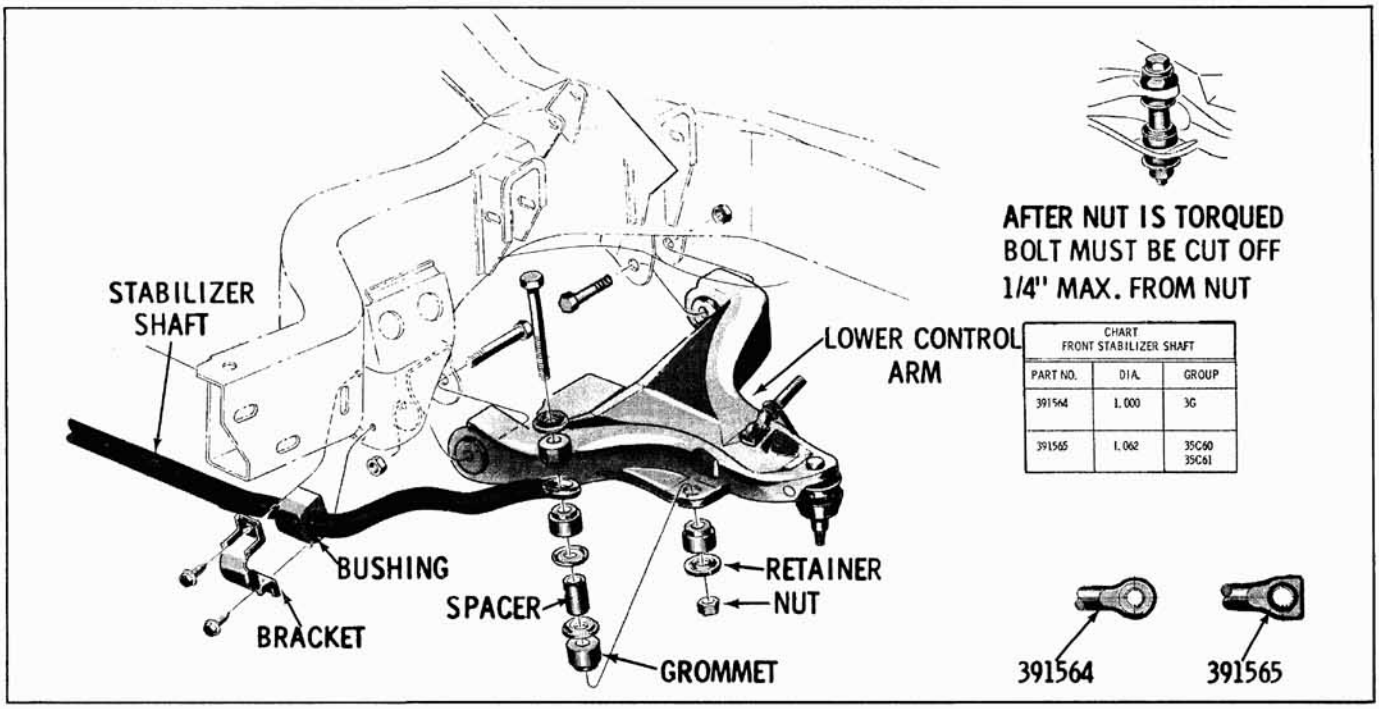


Fig. 3EA-20—Front Suspension

10. Remove lower control arm bushing bolts and with the aid of a helper, remove lower control arm and torsion bar as an assembly. Torsion bar arm will drop out at this time.

11. Carefully slide torsion bar from lower control arm and store in a safe, clean place.

Installation

1. Lubricate both ends of torsion bar for approximately 3" with E.P. Chassis Lubricant.

2. Install torsion bar into anchor of lower control arm.

3. With the aid of a helper, lift torsion bar and lower control arm assembled up until torsion bar will engage arm in crossmember and bushing ends of lower control arm engages frame brackets.

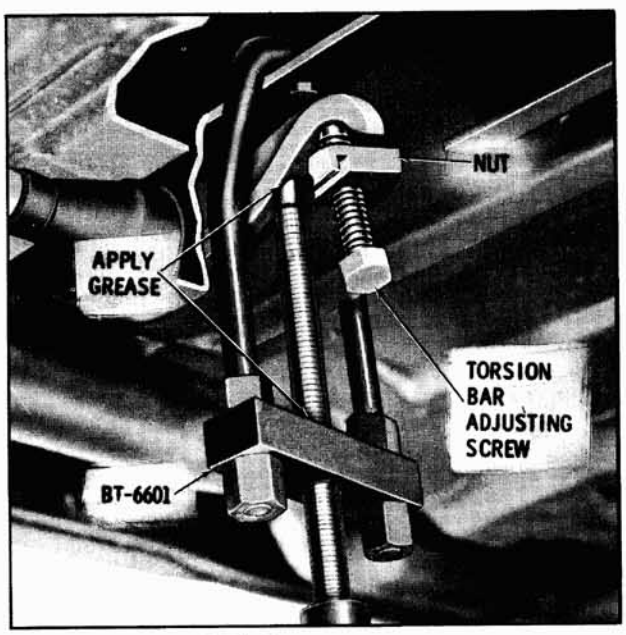


Fig. 3EA-21—Removing Torsion Bar

4. Install lower control arm bushing bolts and nuts. Do not torque.

5. Install lower control arm ball joint stud into knuckle. Install nut. Torque to 50 ft. lbs.

6. Remove Tool J-22193-1 from between stabilizer bar and tie-rod.

7. Using a new bolt, connect stabilizer bar to lower control arm. Refer to Fig. 3EA-20 for correct sequence of grommets, retainers and spacer. Torque nut to 14 ft. lbs. Cut bolt off 1/4" below nut.

8. Install shock absorber. Torque nuts to 80 ft. lbs.

9. Install wheel.

10. Position Tool BT-6601 over torsion bar crossmember, Fig. 3EA-21, and tighten center bolt until nut can be positioned through crossmember. Lubricate adjuster bolt with E.P. Chassis Lubricant and thread into nut the same amount of turns required to remove.

11. Raise hoist under lower control arms and remove floor stands.

12. Install drive axle assembly RH. Refer to DRIVE AXLE ASSEMBLY R.H. - Installation.

13. Torque lower control arm bushing nuts to 80 ft. lbs.

LOWER CONTROL ARM (LEFT HAND)

Removal

1. Remove drive axle assembly. Refer to DRIVE AXLE ASSEMBLY REMOVAL (LEFT HAND).

2. Place floor stands under frame horns. (Fig. 3EA-22)

3. Lower hoist slowly until floor stands are seated and hoist is still under lower control arm.

4. Remove shock absorber and bolt from stabilizer bar to lower control arm. Discard bolt.

5. Install Tool BT-6601 and completely relax torsion bar. For attachment, refer to TORSION BAR REMOVAL, Steps 2 through 6.

6. Lower front hoist to floor.

7. With the aid of a helper, remove lower control arm attaching bolts to frame and carefully lower control arm and torsion bar as an assembly. Torsion bar arm will drop out at this time.

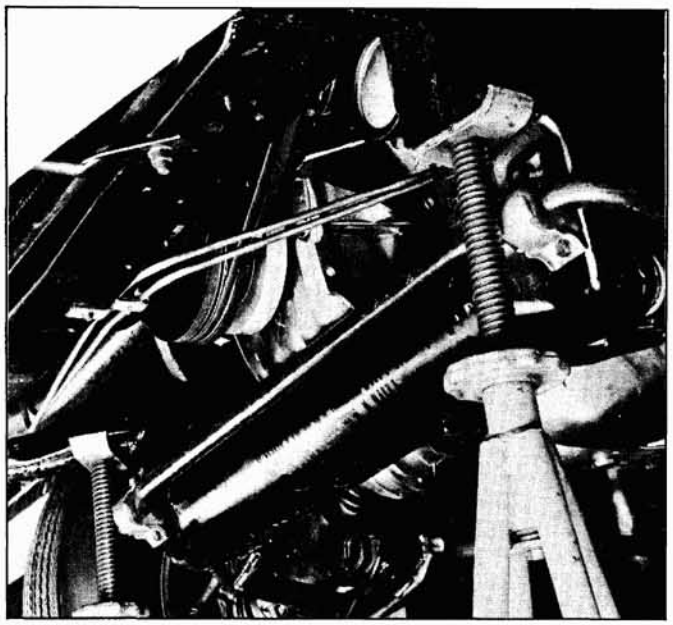


Fig. 3EA-22—Supporting Front of Car

8. Carefully slide torsion bar from lower control arm and store in a safe, clean place.

Installation

1. Lubricate both ends of torsion bar with E.P. Chassis Lubricant for approximately 3".
2. Install torsion bar into anchor of lower control arm.
3. With the aid of a helper, lift torsion bar and lower control arm assembly up until torsion bar will engage arm in crossmember and bushing ends of lower control arm engages frame brackets.
4. Install lower control arm bushing bolts and nuts. Do not torque.
5. Position Tool BT-6601 over torsion bar crossmember, Fig. 3EA-21, and tighten center bolt until lower control arm is in a horizontal plane.
6. Install drive axle. Refer to DRIVE AXLE ASSEMBLY L.H. - INSTALLATION, Steps 1 through 9.
7. Install shock absorber. Torque nuts to 80 ft. lbs.
8. Using a new bolt, connect stabilizer bar to lower control arm. Refer to Fig. 3EA-20 for correct sequence of grommets, retainers and spacer. Torque nut to 14 ft. lbs. Cut bolt off 1/4" below nut.
9. Continue to tighten center bolt of Tool BT-6601 until nut can be positioned through crossmember. Lubricate adjuster bolt with E.P. Chassis Lubricant and thread into nut the same amount of turns required to remove.
10. Install drum and wheel.
11. Remove floor stands and lower hoist.
12. Torque lower control arm bushing nut to 80 ft. lbs.

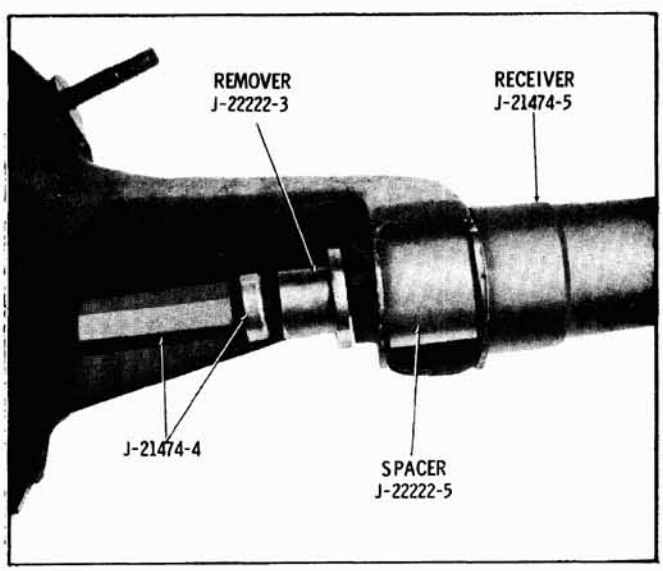


Fig. 3EA-23—Removing Lower Control Arm Rear Bushing

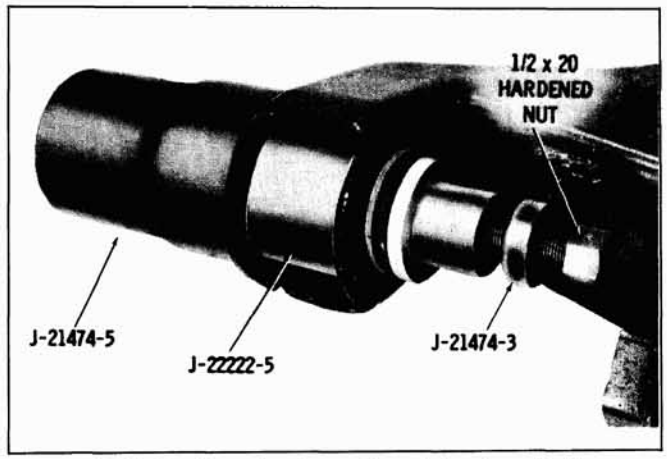


Fig. 3EA-24—Removing Lower Control Arm Front Bushing

LOWER CONTROL ARM BUSHINGS

Removal

1. Hoist car on a two post lift.
2. Remove stabilizer link bolt. Discard bolt.

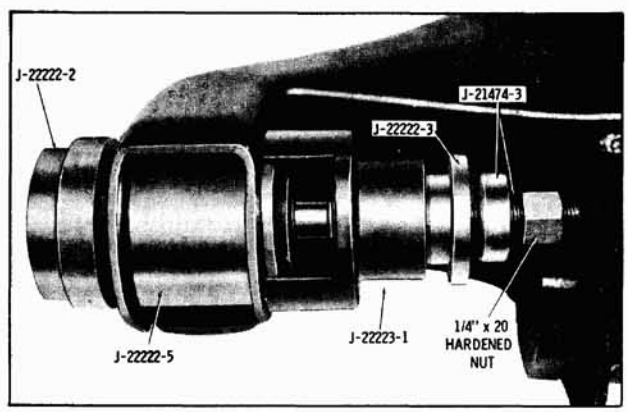


Fig. 3EA-25—Installing Lower Control Arm Rear Bushing

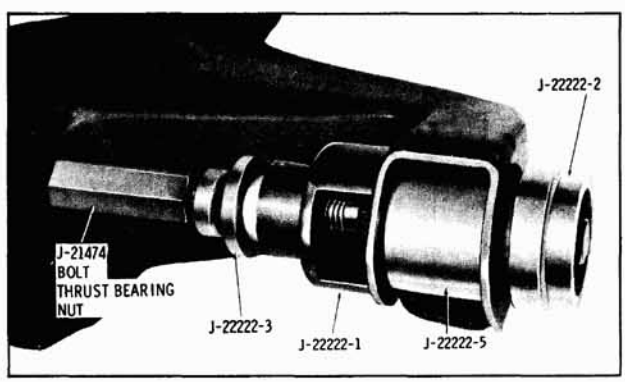


Fig. 3EA-26—Installing Lower Control Arm Front Bushing

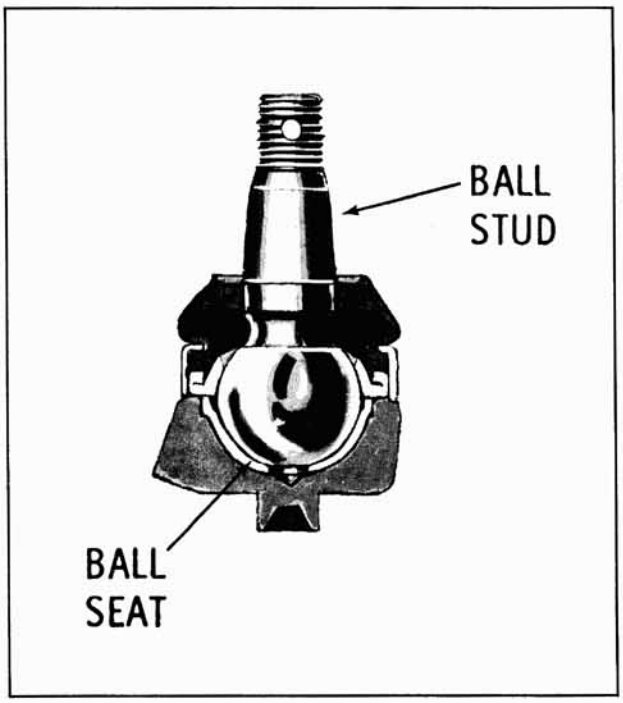


Fig. 3EA-27—Lower Control Arm Ball Joint

3. Place floor stands under frame horns, Fig. 3EA-22. Lower front lift to floor.
4. Install Tool BT-6601. Method for attaching, refer to TORSION BAR REMOVAL, Item 2 through 6.
5. Remove lower control arm bushing bolts and pull control arm down until free of frame brackets.
6. Install Tools through rear bushing and press out bushing as shown in Fig. 3EA-23.

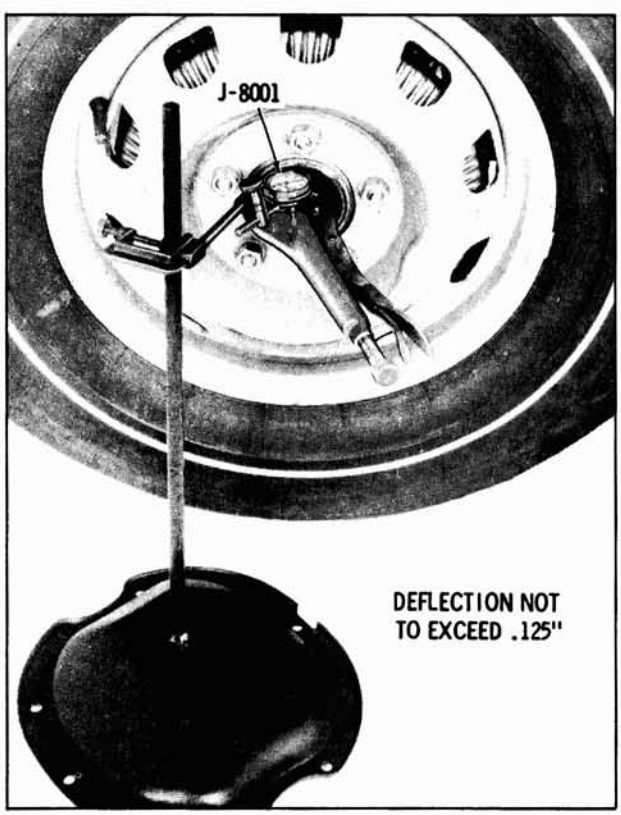


Fig. 3EA-28—Ball Joint Vertical Check

Due to the torsion bar anchor attachment to the lower control arm, it will be necessary to use a hardened 1/2" x 20 nut as shown in Fig. 3EA-24 to remove the front bushing.

Installation

1. Install Tools as shown in Fig. 3EA-25 and press rear bushing into lower control arm.

Due to the torsion bar anchor attachment to the lower control arm, it will be necessary to use a hardened 1/2" x 20 nut as shown in Fig. 3EA-26 to install the front bushing.

2. Raise lower control arm into frame brackets and install bushing bolts and nuts. Do not torque.
3. Using Tool BT-6601 turn center bolt into dimple of torsion bar arm until adjusting nut can be inserted through center frame support. Install and turn adjusting bolt clockwise the same number of turns needed to remove. Remove Tool BT-6601.
4. Raise front lift under lower control arms and remove floor stands.
5. Using a new bolt attach stabilizer link bolt to lower control arm. Torque nut to 14 ft. lbs. Cut bolt off 1/4" below nut.
6. Lower car and torque lower control arm bushing nuts to 80 ft. lbs.

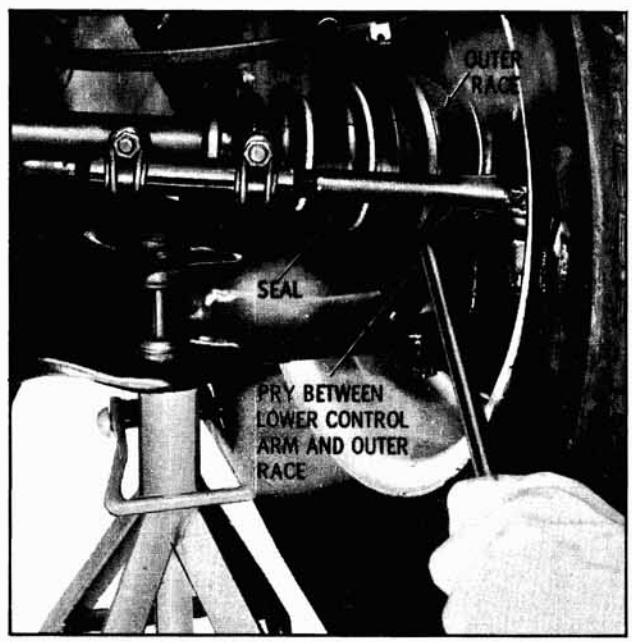


Fig. 3EA-29—Pry Bar Installation

BALL JOINT

Ball Joint Lubrication

For ball joint seal inspection and lubrication interval, refer to PERIODIC MAINTENANCE Section 0E.

BALL JOINT CHECKS

Vertical Checks

1. Raise the car and position floor stands under the left and right lower control arms as near as possible to each lower ball joint. Car must be stable and should not rock on the floor stands.
2. Position dial indicator as shown in Fig. 3EA-28.
3. Place a pry bar as shown in Fig. 3EA-29 and pry down on bar. Care must be used so that drive axle seal is not damaged. Reading must not exceed .125"

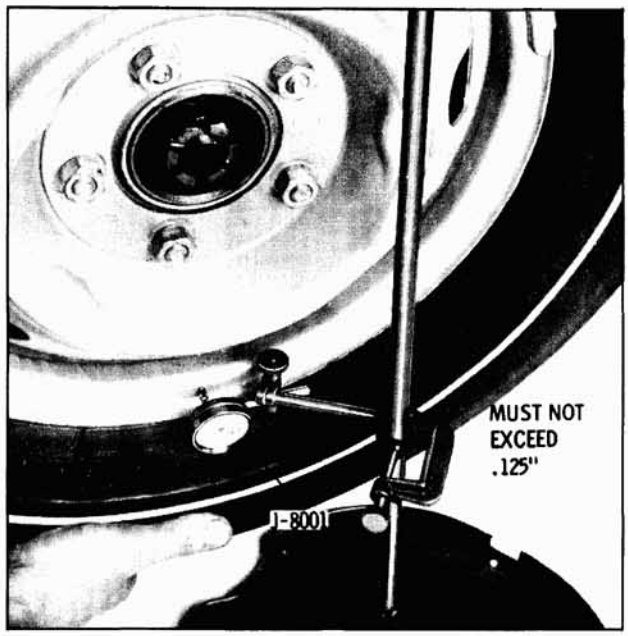


Fig. 3EA-30—Ball Joint Horizontal Check

Horizontal Check

1. Place car on floor stands as outlined in Step 1 of the vertical check.
2. Position dial indicator as shown in Fig. 3EA-30.
3. Grasp front wheel as shown in Fig. 3EA-30 and push in on bottom of tire while pulling out at the top. Read gauge, then reverse the push-pull procedure. Horizontal deflection on the gauge should not exceed .125" at the wheel rim. This procedure checks both the upper and lower ball joints.

LOWER CONTROL ARM BALL JOINT (Fig. 3EA-27)

Removal

1. Remove knuckle. Refer to KNUCKLE REMOVAL.
2. Using hacksaw, saw the two side rivet heads off. Use a grinder to remove the rivet head on the top side of control arm.
3. Using a 7/32" drill bit, drill side rivets 3/16" deep. (Fig. 3EA-31)
4. Using hammer and punch, drive center rivet of joint until joint is out of control arm.

Installation

1. Install service ball joint into control arm and torque bolts and nut as shown in Fig. 3EA-32.

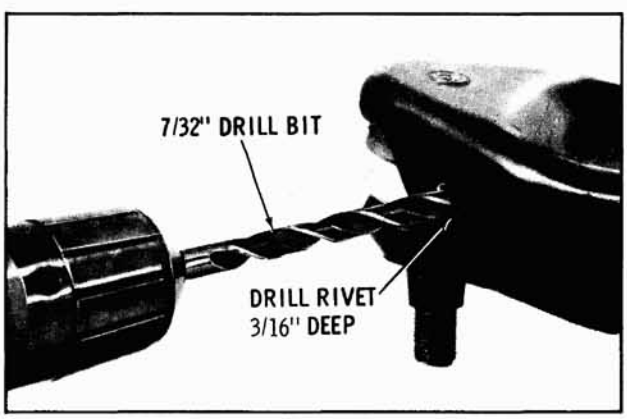


Fig. 3EA-31—Drilling Ball Joint Rivets

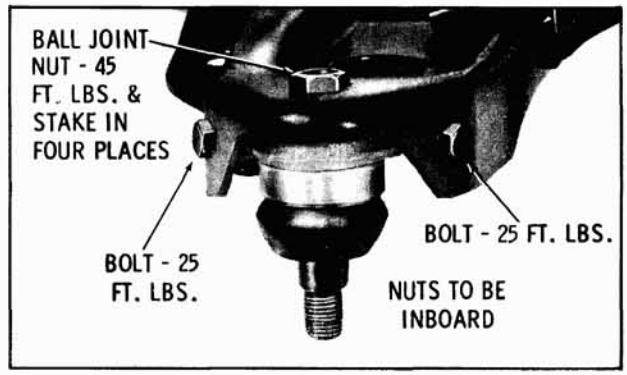


Fig. 3EA-32—Installing Service Ball Joint

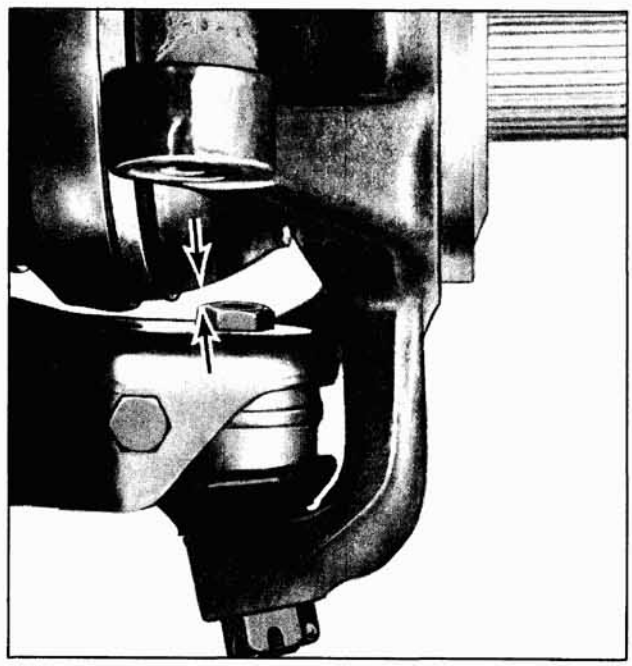


Fig. 3EA-33—Checking Clearance

2. Install knuckle - Refer to KNUCKLE INSTALLATION.
3. Check clearance from ball joint nut to drive axle outer joint as shown in Fig. 3EA-33. If no clearance is obtained, it may be necessary to grind off nut but not more than 1/16".

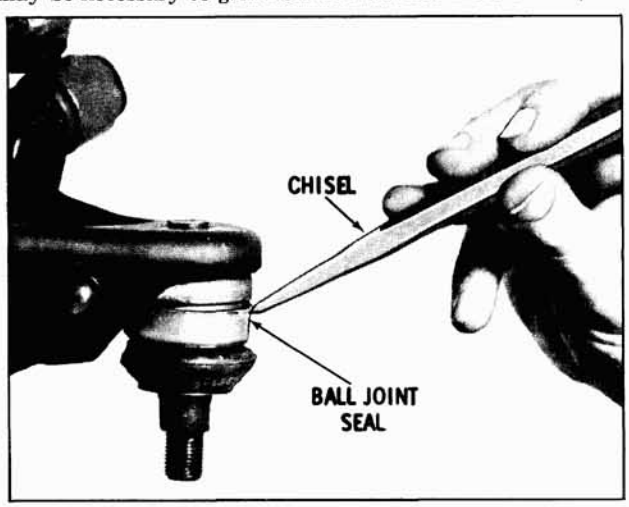


Fig. 3EA-34—Removing Ball Joint Seal

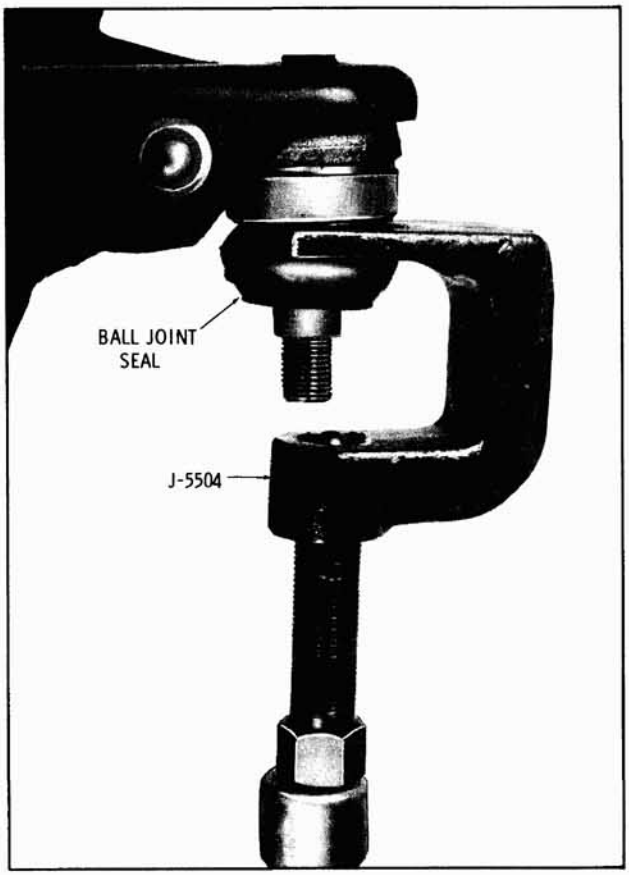


Fig. 3EA-35—Installing Ball Joint Seal

SEAL—LOWER CONTROL ARM BALL JOINT

The lower ball joint seal can be installed with lower control arm either on or off the car.

Removal

1. Remove knuckle. Refer to KNUCKLE REMOVAL, Items 1 through 12.
2. Using hammer and chisel, drive seal from ball joint. (Fig. 3EA-34)
3. Wipe grease from ball joint and stud.

Installation

1. Position new seal over ball joint stud.
2. Lubricate jaws of Tool J-5504 and carefully slide jaw between seal and retainer. (Fig. 3EA-35)
3. Tap lightly with hammer on center bolt of Tool J-5504 until retainer is fully seated.
4. Install knuckle. Refer to KNUCKLE INSTALLATION, Steps 2 through 12.

STABILIZER BAR

Removal

1. Remove link bolts, nuts, grommets, spacers and retainers from lower control arm. Discard bolts.
2. Remove two bolts attaching dust shield to frame (both sides).
3. Remove bracket to frame attaching bolts and remove stabilizer bar from front of car.

Installation

Reverse removal procedure.

New link nuts are torqued to 14 ft. lbs. then cut off 1/4" below nut.

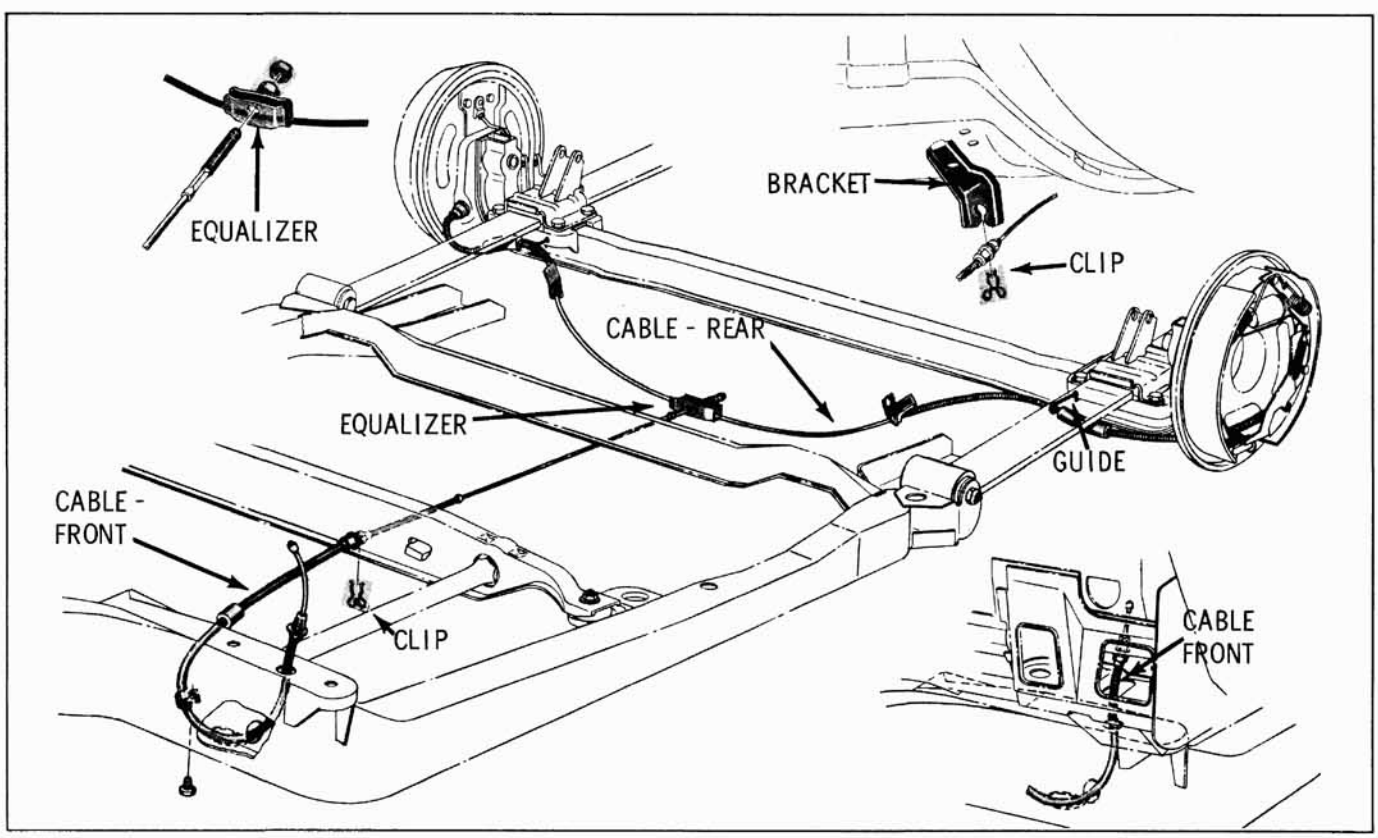


Fig. 3EA-36—Parking Brake Cable Attachment

TORSION BAR CROSSMEMBER

Removal

1. Raise car on a two post hoist and position floor stands under frame torque boxes.

It may be necessary to disconnect side battles.

2. Disconnect parking brake cable at equalizer and clip at torsion bar crossmember. Pull cable through crossmember. (Fig. 3EA-36)
3. Slide torsion bar rear seals forward.
4. Remove the four nuts and center screw from Tool BT-6601.

Position tool over crossmember installing pin of Tool into hole in crossmember. Install two nuts on Tool, install center screw assembly, then install the two remaining nuts and tighten (Fig. 3EA-37)

It may be necessary to pry up on under body and down on crossmember to install Tool.

5. Turn center screw until seated in dimple of torsion bar adjusting arm.
6. Remove torsion bar adjusting bolt and nut. Count the number of turns necessary to remove and record.

The number of turns to remove the adjusting bolt will be used when installing to obtain an initial carrying height.

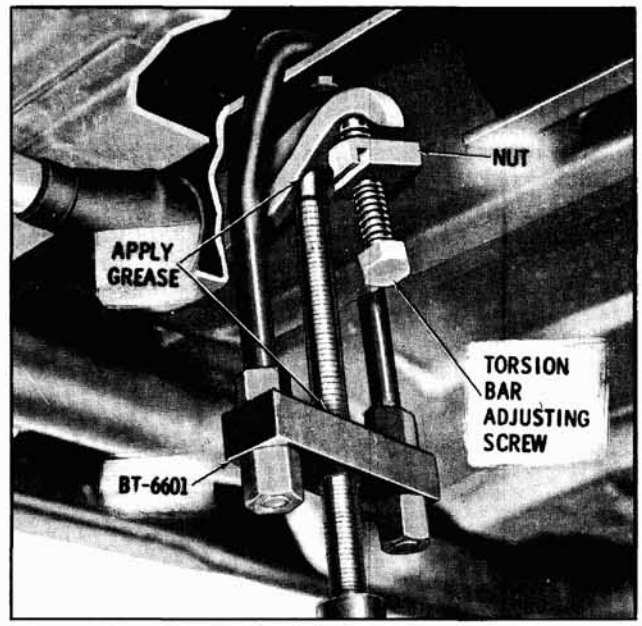


Fig. 3EA-37—Torsion Bar Remover and Installer

7. Turn center screw of Tool BT-6601 until torsion bar is completely relaxed.
8. Remove Tool BT-6601.

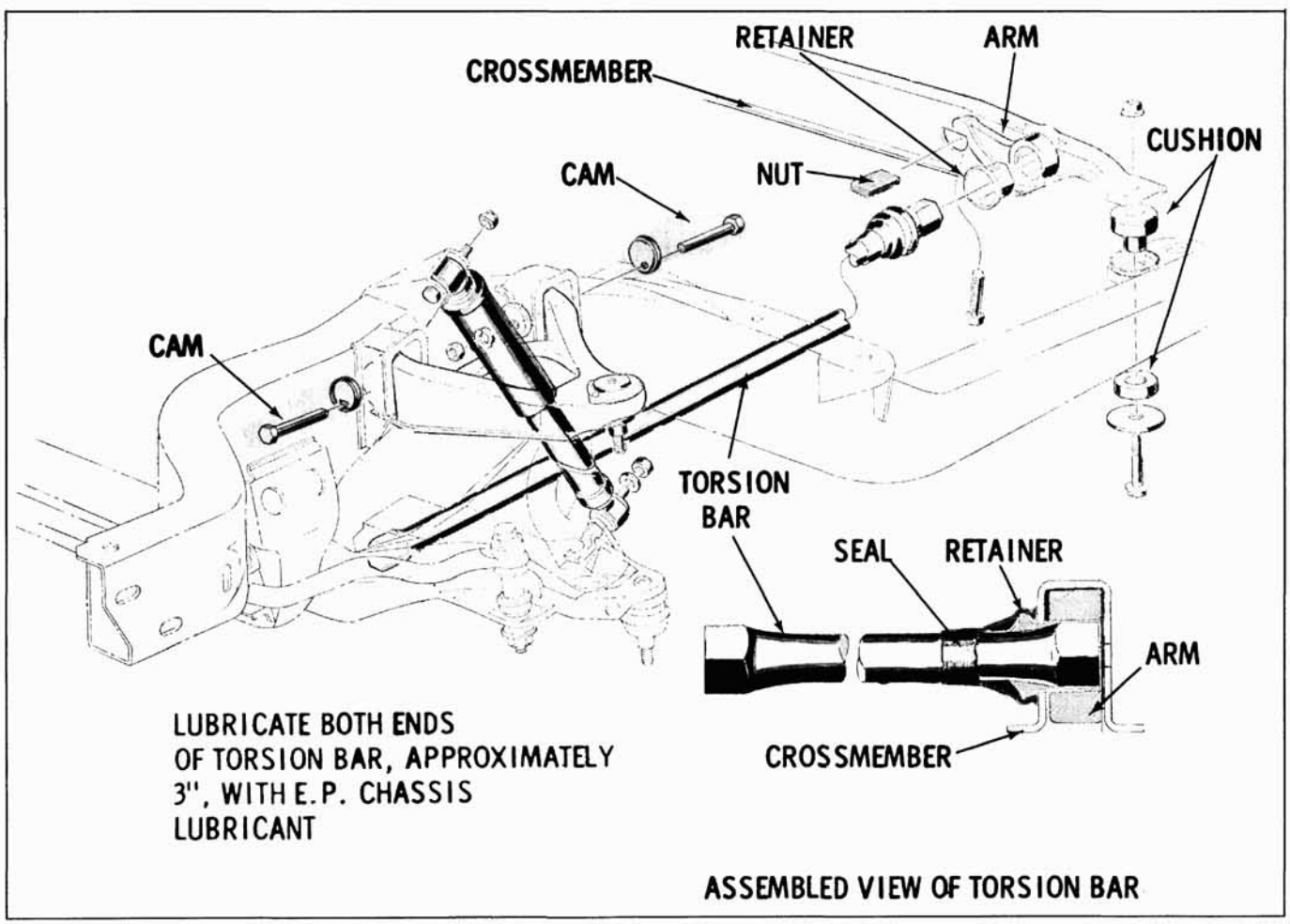


Fig. 3EA-38—Front Suspension

9. Repeat steps 4, 5, 6, 7 and 8 on opposite torsion bar.

10. Remove bolts and cushions from torsion bar crossmember at frame brackets. (Fig. 3EA-38)

11. Move crossmember rearward until torsion bars are free and adjusting arms can be removed.

It may be necessary to slide both torsion bars forward until they bottom in the lower control arm.

12. Disconnect hangers at muffler and tail pipes.

13. Move torsion bar crossmember sideways to the extreme right or left side. It may be necessary to insert a block between the body and frame, then move crossmember upward and outward until opposite end clears crossmember frame bracket. It may also be necessary to block between the intermediate exhaust pipe and the body.

Installation

To install, reverse the removal procedure.

FRONT END ALIGNMENT

Car must be on level surface, gas tank full or a compensating weight added, front seat all the way to the rear and tires, both front and rear, inflated to specifications. All doors must be closed and no passengers or additional weight should be in the car or trunk.

1. Check rocker panel molding to ground dimension. (Fig. 3EA-39)

front reading to ground	8" + 1/2"-1"
rear reading to ground	8-1/4" + 1/2"-1"
front to rear to be within	1"
side to side to be within	5/8"

If not within tolerance, adjust torsion bar.

2. Align car on wheel alignment equipment.

3. Raise up front end and check wheel runout. Set wheels at center of runout and lower car.

4. Loosen nuts on inboard side of upper control arm cam bolts.

5. Check camber, + 1/8° ± (3/8°). If necessary to adjust turn both front and rear cams in the same direction (inboard or outboard) until correct. Camber reading of the right and left wheels should be within 1/2° of each other.

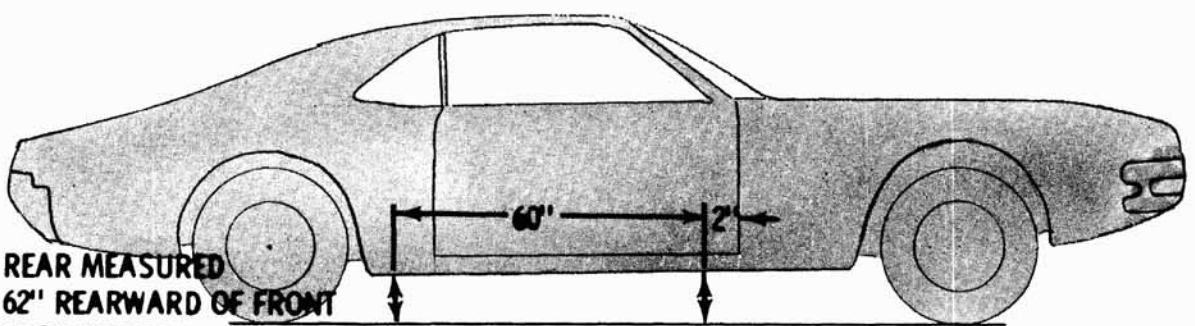
6. Check caster, -2° ± (1/2°). Set caster, if necessary, in two steps as follows:

a. Adjust front cam (nearest front of car) so that the camber changes an amount equal to one-fourth of the desired caster change.

b. Adjust the rear cam (nearest rear of car) in the opposite direction so that the camber setting returns to its corrected position (Step 5).

CAR ON LEVEL SURFACE
FUEL TANK FULL
TRUNK EMPTY
FRONT SEAT REARWARD
DOORS CLOSED
TIRES AT CORRECT PRESSURE

TO ADJUST FRONT CARRYING HEIGHT RAISE CAR AT FRONT CROSSMEMBER TO RELIEVE STRAIN ON ADJUSTING BOLT. LUBRICATE ADJUSTING BOLT BEFORE ATTEMPTING TO CHANGE CARRYING HEIGHT.



REAR MEASURED 62" REARWARD OF FRONT EDGE OF DOOR
SPEC. 8 1/4" + 1/2" OR - 1" ROCKER PANEL TO FLOOR.

FRONT TO REAR TO BE WITHIN 1"
SIDE TO SIDE TO BE WITHIN 5/8"

FRONT MEASURED 2" REARWARD OF FRONT EDGE OF DOOR
SPEC. 8" + 1/2" OR - 1" MEASURED FROM ROCKER PANEL TO FLOOR.

Fig. 3EA-39—Carrying Heights

EXAMPLE: Camber is set at +1/8° and caster setting is -1°. For correct setting the caster must be decreased by 1° to -2°. Therefore, first the front cam is adjusted to decrease camber by one-fourth of 1° or -1/4° to a value of -1/8°. Then the rear cam is adjusted to increase the camber reading back to the original value of +1/8°.

c. Recheck caster reading.

If a problem exists where there is insufficient cam to obtain a correct reading:

1. Turn front cam bolt so high part of cam is pointing up.
2. Turn rear cam bolt so high part of cam is pointing down.

This is a location to start from and a correct setting can be obtained with the above procedure.

Torque upper control arm cam nuts to 95 ft. lbs. Hold head or bolt securely, any movement of the cam will effect the final setting and caster camber adjustment must be rechecked.

7. Toe-in adjustment, 0 to 1/16" toe-in.

a. Center steering wheel - raise car and check wheel runout. Set wheels at center of runout.

b. Loosen tie-rod nuts and adjust to proper setting (0 to 1/16" toe-in).

c. Tighten tie-rod nuts - torque nuts to 20 ft. lbs. Position tie-rod clamps so that opening of clamp is facing up. This is a very necessary setting. Interference and a possible tie up of front end linkage could occur if clamps snag while turning.

CARRYING HEIGHTS

When checking carrying heights, the car should be parked on a known level surface, gas tank full, front seat rearward, doors closed and tire pressure at specified psi.

Measuring must be taken from lower edge of rocker panel molding to floor.

Carrying heights are controlled by the adjustment setting of the torsion bar adjusting bolt. Clockwise rotation of the bolt increases the front height. Counterclockwise decreases front height. Specifications are shown in Fig. 3EA-39.

SHOCK ABSORBER

Removal

1. Remove upper shock attaching bolt.
2. Remove lower shock attaching nut and carefully guide shock through upper control arm.

Installation

Reverse removal procedure.

SHOCK ABSORBER CODE AND USAGE			
Series	Front	Rear	
		Horizontal	Vertical
Toronado	SY	MR	SZ

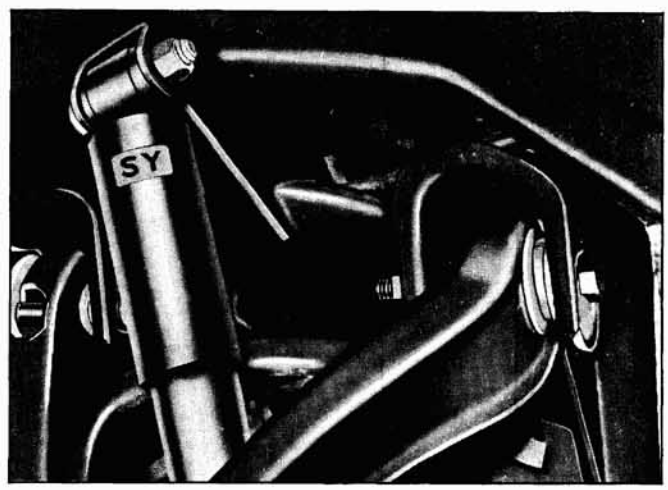
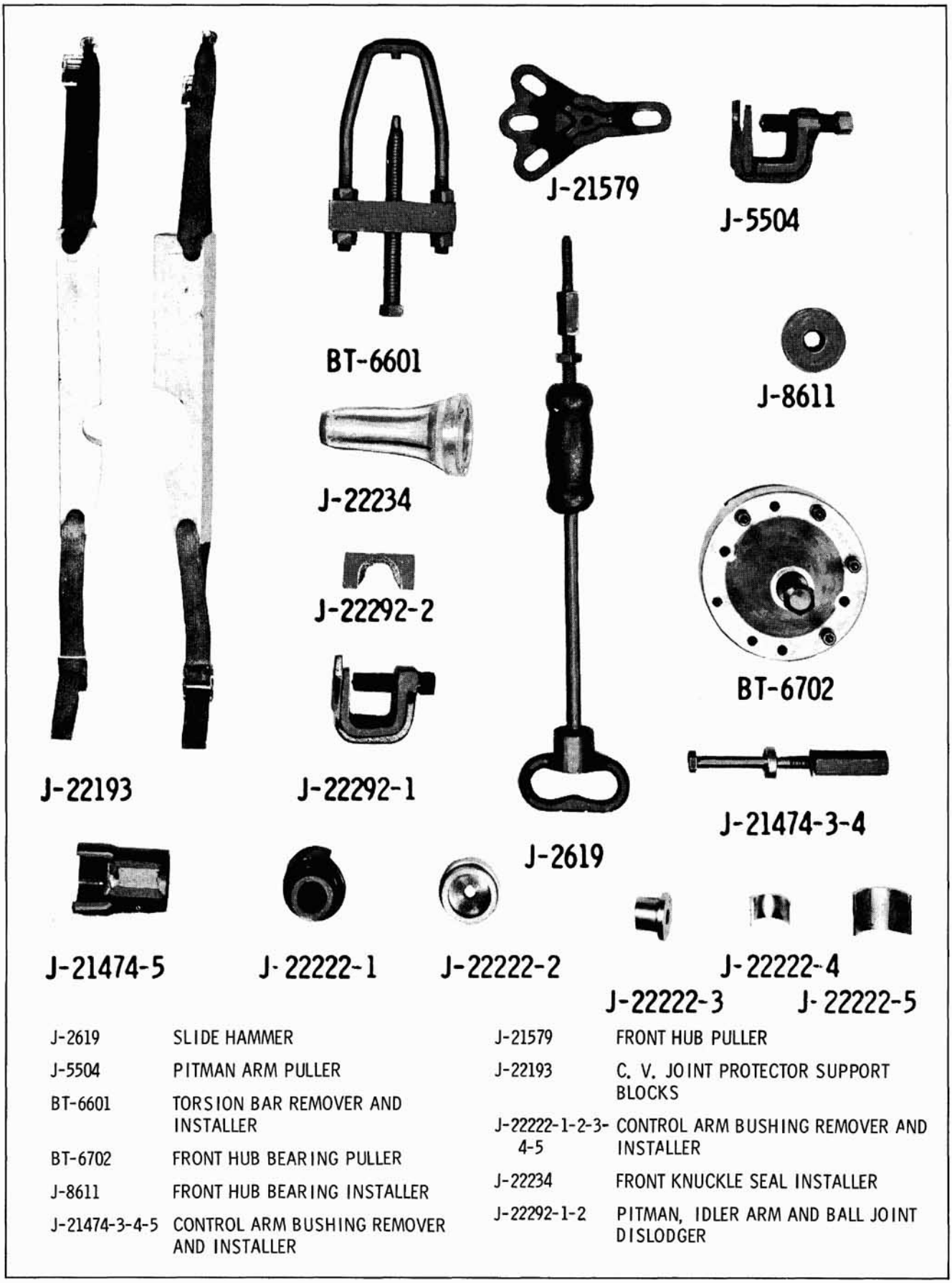


Fig. 3EA-40—Shock Absorber Code Location

TORQUE SPECIFICATIONS

APPLICATION	FT. LBS.
Drive Axle Nut (Nut must be tightened to insert cotter pin)	150
Hub to Knuckle Bolts	65
Anchor Bolt to Backing Plate and Knuckle Bolt	135
Stabilizer Link Nut	14
Stabilizer Bracket to Frame Bolt	14
Torsion Bar Crossmember Nut	40
Shock Absorber	
Upper Nut	80
Lower Nut	80
Lower Control Arm Bushing Nuts	80
Upper Control Arm Bushing Nuts	95
Ball Joint (Nut must be tightened to insert cotter pin)	85
Tie-Rod to Knuckle Nut	50
Inner C.V. Joint to Output Shaft Bolts	65



J-2619	SLIDE HAMMER	J-21579	FRONT HUB PULLER
J-5504	PITMAN ARM PULLER	J-22193	C. V. JOINT PROTECTOR SUPPORT BLOCKS
BT-6601	TORSION BAR REMOVER AND INSTALLER	J-22222-1-2-3-4-5	CONTROL ARM BUSHING REMOVER AND INSTALLER
BT-6702	FRONT HUB BEARING PULLER	J-22234	FRONT KNUCKLE SEAL INSTALLER
J-8611	FRONT HUB BEARING INSTALLER	J-22292-1-2	PITMAN, IDLER ARM AND BALL JOINT DISLODGER
J-21474-3-4-5	CONTROL ARM BUSHING REMOVER AND INSTALLER		

Fig. 3EA-41—Tools

DRIVE AXLES
TORONADO

CONTENTS OF SECTION 3EB

Subject	Page
DESCRIPTION	3EB-1
DRIVE AXLE ASSEMBLY (RIGHT HAND)	
REMOVAL	3EB-1
INSTALLATION	3EB-1
DRIVE AXLE ASSEMBLY (LEFT HAND)	
REMOVAL	3EB-1
INSTALLATION	3EB-2
CONSTANT VELOCITY JOINT	3EB-4
DISASSEMBLY (OUTER)	3EB-4
CLEANING AND INSPECTION	3EB-5
ASSEMBLY (OUTER)	3EB-5
DISASSEMBLY (INNER)	3EB-5
CLEANING AND INSPECTION	3EB-7
ASSEMBLY (INNER)	3EB-7
DRIVE AXLE	3EB-10
DISASSEMBLY	3EB-10
ASSEMBLY	3EB-10
TOOLS	3EB-10

DESCRIPTION

Drive axles on the Toronado are a complete flexible assembly and consist of an axle shaft and an inner and outer constant velocity joint. (Fig. 3EB-1) The right axle shaft has a torsional damper mounted in the center. The inner constant velocity joint has complete flexibility plus inward and outward movement. The outer constant velocity joint has complete flexibility only.

Whenever any operations call for disconnecting, connecting, removal or installation of the drive axles, care must be exercised to prevent damage to constant velocity joint seals. Seals may be wrapped with floor mat rubber or old innertube, etc. Make sure any rubber protective covers that are used are removed before car is started or driven.

DRIVE AXLE ASSEMBLY (RIGHT HAND) (Fig. 3EB-2)

Removal

1. Hoist car under lower control arms.
2. Remove drive axle cotter pin, nut and washer. (Fig. 3EB-3)
3. Remove oil filter element.
4. Remove inner C.V. joint attaching bolts. (Fig. 3EB-3)
5. Push inner C.V. joint outward enough to disengage from R.H. final drive output shaft and move rearward.
6. Remove R.H. output shaft support bolts to engine and final drive. (Fig. 3EB-3)
7. Remove R.H. output shaft.
8. Remove drive axle assembly.

Care must be exercised so that C.V. joints do not turn to full extremes and that seals are not damaged against shock absorber or stabilizer bar.

Installation

1. Carefully place R.H. drive axle assembly into lower control arm and enter outer race splines into knuckle.
2. Lubricate final drive output shaft seal with Special Seal Lubricant, No. 1050169 or equivalent.
3. Install R.H. output shaft into final drive and attach support bolts to engine and brace.

When attaching the right hand output shaft to the engine bracket, do not let the shaft hang. Assemble bracket bolts loosely, and by moving the flange end of the shaft up and down, and back and forth, find the center location. Hold the shaft in this position and then torque the bolts to 50 ft. lbs. on support and 14 ft. lbs. on brace. Refer to Fig. 3EC-2A.

4. Move R.H. drive axle assembly toward front of car and align with R.H. output shaft. Install attaching bolts and torque to 65 ft. lbs.
5. Install oil filter element.
6. Install washer and nut on drive axle. Torque to 150 ft. lbs. Insert cotter pin and crimp.
7. Remove floor stands and lower hoist.
8. Check engine oil, add if necessary.

DRIVE AXLE ASSEMBLY (LEFT HAND)

Removal

1. Hoist car under lower control arms.
2. Remove wheel and drum.
3. Remove drive axle cotter pin, nut and washer.
4. Position access slot in hub assembly so that each of the attaching bolts (4) can be removed. (Fig. 3EB-4) It will be necessary to push aside adjuster lever to remove one of the bolts.
5. Position Spacers Tool J-22237 and install Tool J-21579 and Slide Hammer J-2619 with Adapter J-2619-1. (Fig. 3EB-4)
6. Remove hub assembly. It will again be necessary to push aside adjuster lever for clearance for hub assembly.
7. Remove tie-rod end cotter pin and nut.
8. Using hammer and brass drift, drive on knuckle until tie-rod end stud is free. (Fig. 3EB-5)
9. Remove bolts from drive axle assembly and left output shaft. Insert Tool J-22193. (Fig. 3EB-6)
10. Remove upper control arm ball joint cotter pin and nut. Remove brake hose clip from ball joint stud.
11. Using hammer and brass drift, drive on knuckle until upper ball joint stud is free. (Fig. 3EB-7)
12. Install Tool J-22292-3 carefully between lower ball

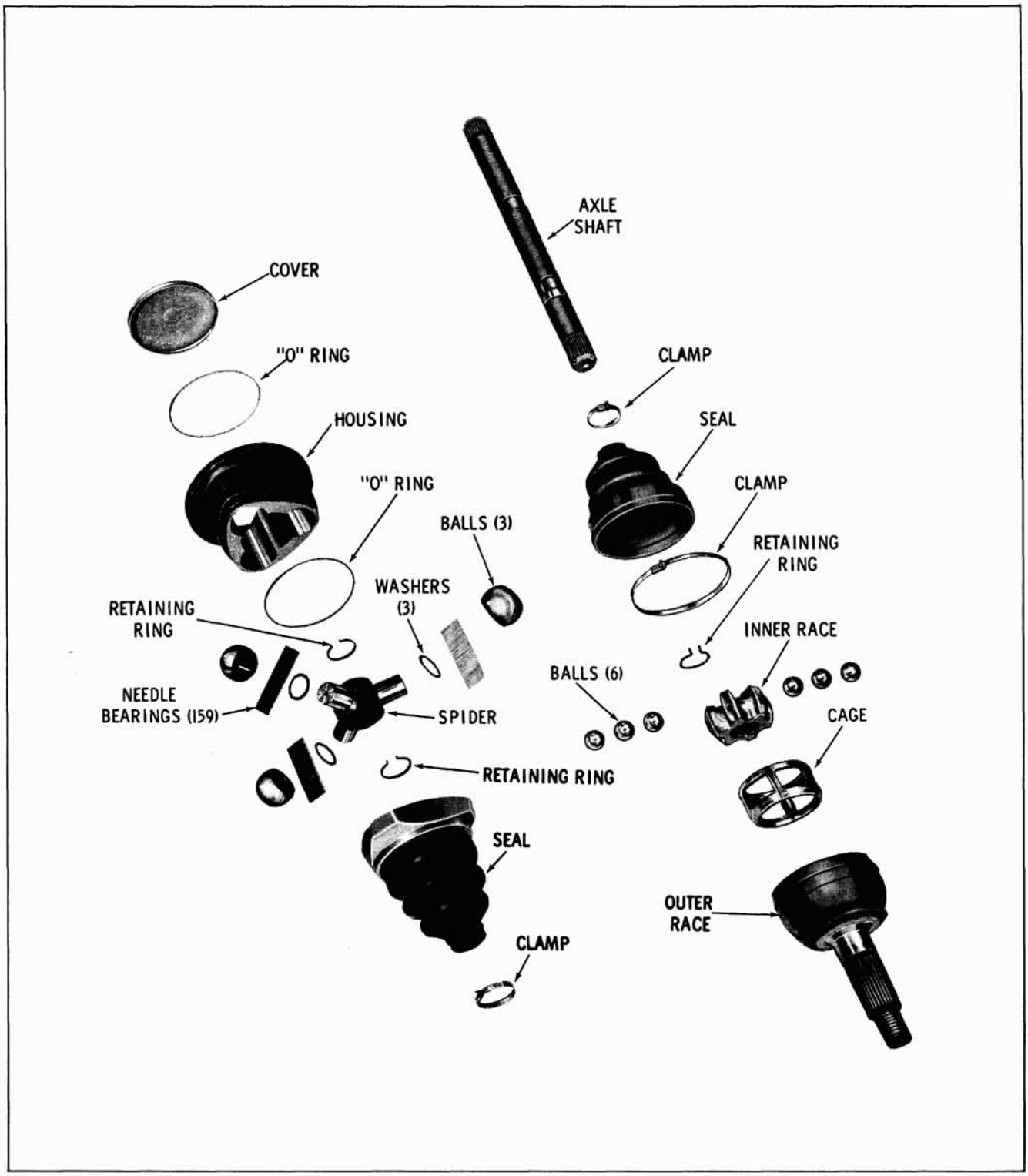


Fig. 3EB-1—Drive Axle Assembly(L.H. Shown)

joint seal and knuckle. (Fig. 3EB-8)

13. Using Tool J-22292-1-2 (Fig. 3EB-8) remove lower ball joint from knuckle. Care must be exercised so that ball joint doesn't damage drive axle seal.

14. Remove knuckle. Support backing plate so that brake hose is not damaged.

15. Carefully guide drive axle assembly outboard.

Care must be exercised so that C.V. joints do not turn to full extremes and that seals are not damaged against shock absorber or stabilizer bar.

Installation

1. Carefully guide L.H. drive axle assembly onto lower control arm in position on Tool J-22193.

2. Insert lower control ball joint stud into knuckle and attach nut. Do not torque.

3. Center L.H. drive axle assembly in opening of knuckle

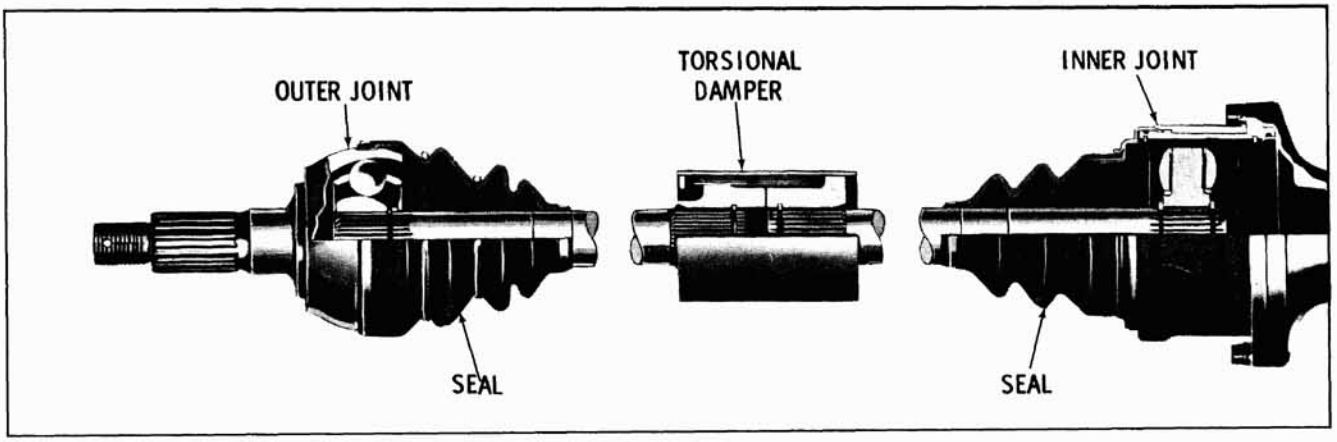


Fig. 3EB-2—Drive Axle Assembly (R.H. Shown)

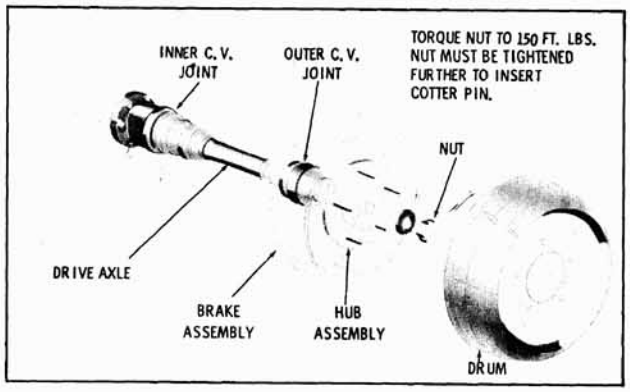


Fig. 3EB-3—Drive Axle Installed

and insert upper ball joint stud.

4. Place brake hose clip over upper ball joint stud and install nut. Do not torque.

5. Insert tie-rod end stud into knuckle and attach nut. Torque to 50 ft. lbs. Install cotter pin and crimp.

6. Lubricate hub assembly bearing OD with E.P. Grease and install. Torque to 65 ft. lbs.

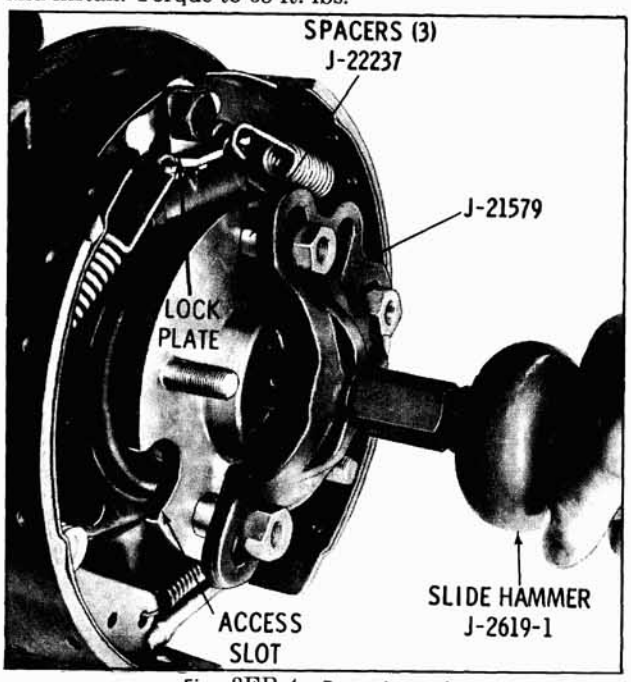


Fig. 3EB-4—Removing Hub

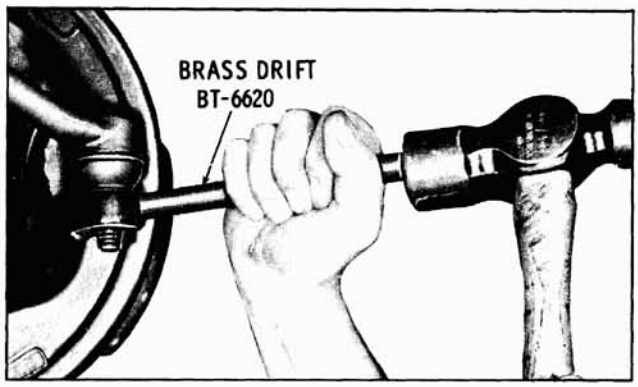


Fig. 3EB-5—Removing Tie Rod End

7. Align inner C.V. joint with output shaft and install attaching bolts. Torque to 65 ft. lbs.

8. Torque upper and lower ball joint stud nuts to 85 ft. lbs. min. Tighten to align cotter pins.

Upper ball joint cotter pin must be crimped toward upper control arm to prevent interference with outer C.V. joint seal.

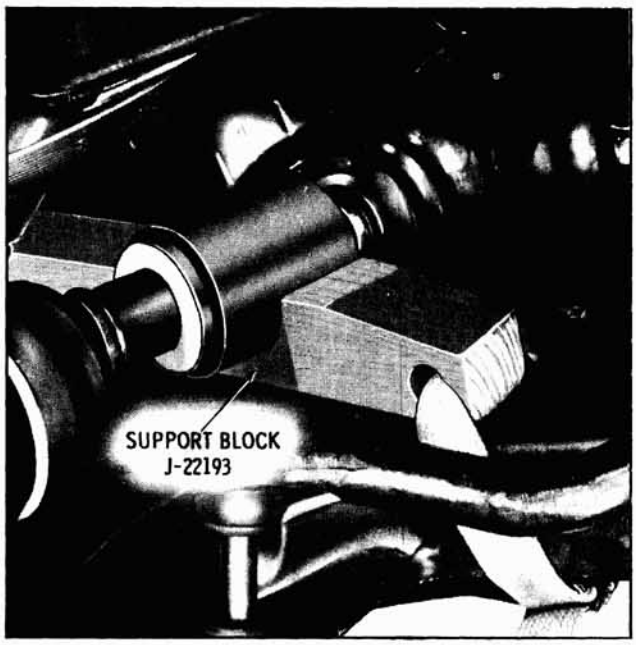


Fig. 3EB-6—Installing Support Block

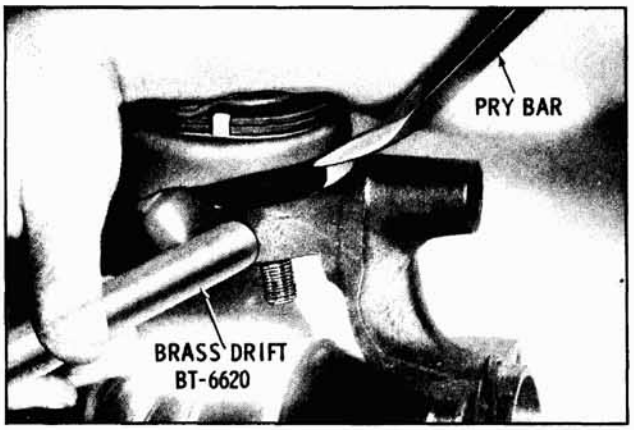


Fig. 3EB-7—Removing Upper Ball Joint

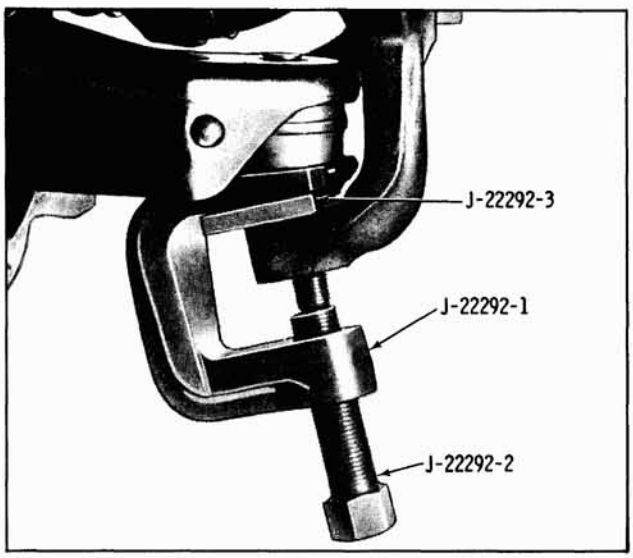


Fig. 3EB-8—Removing Lower Ball Joint

9. Install drive axle washer and nut. Torque to 150 ft. lbs. Install cotter pin and crimp.
10. Install drum and wheel.
11. Remove floor stands and lower hoist.

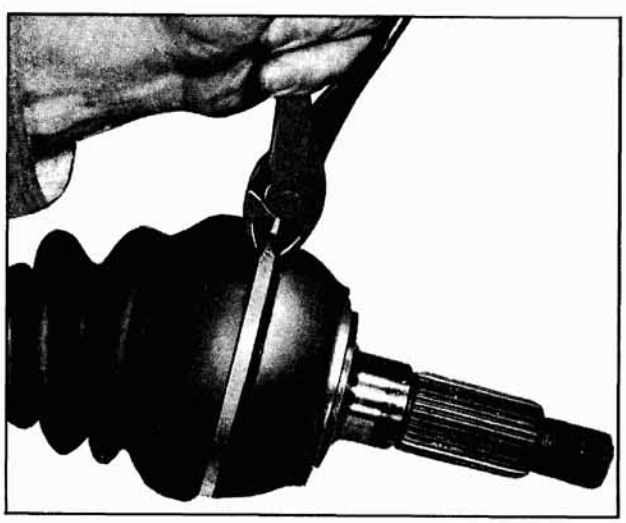


Fig. 3EB-9—Cutting Seal Clamp

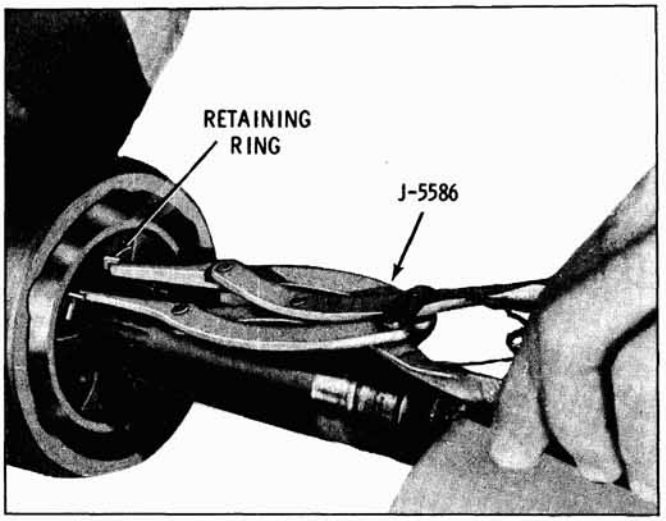


Fig. 3EB-10—Removing Retaining Ring

CONSTANT VELOCITY JOINT (C.V. JOINT OUT OF CAR)

The C.V. joints are to be replaced as a unit and are only disassembled for repacking and replacement of damaged seals.

Disassembly (Outer C.V. Joint)

1. Insert axle assembly in vise. Clamp on mid-portion of axle shaft.
2. Remove inner and outer seal clamps. (Fig. 3EB-9)
3. Slide seal down axle shaft to gain access to C.V. joint.
4. Using Tool J-5586, spread retaining ring until C.V. joint can be removed from axle spline. (Fig. 3EB-10)
5. Remove retaining ring. (Fig. 3EB-17)
6. Slide seal from axle shaft.
7. Remove grease from C.V. joint.
8. Holding C.V. joint with one hand, tilt cage and inner race so that one ball can be removed. Continue until all (6) balls are removed. (Fig. 3EB-11)
9. Turn cage 90° and with slot in cage aligned with land in outer race lift out inner race and cage. (Fig. 3EB-12)
10. While holding cage and inner race, turn inner race 90°. Line up short land of inner race with slot in cage. Move short land through cage and turn inner race up and out of cage. (Fig. 3EB-13)

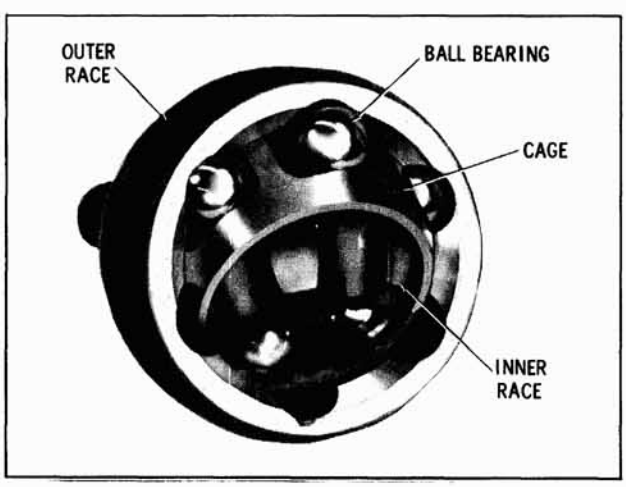


Fig. 3EB-11—Removing Balls From Outer Race

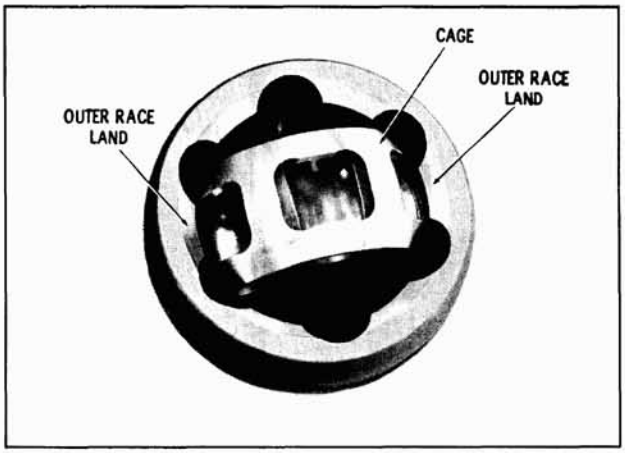


Fig. 3EB-12—Positioning Cage For Removal

CLEANING AND INSPECTION (OUTER)

Wash all metallic parts thoroughly in a cleaning solvent. Dry with compressed air. Rubber seal should be replaced whenever C.V. joint is disassembled for service.

Outer and inner race may show a definite wear pattern where the balls travel. The C.V. Joint should not be replaced for this reason. However, if this wear pattern is suspected to be the cause of a noisy or vibrating C.V. Joint, the joint should be replaced.

1. Inspect outer race for excessive wear or scoring in the ball splines. Inspect shaft splines and threads for any damage.
2. Inspect balls (six) for nicks, cracks, breaks or scores.
3. Inspect cage for cracks or breaks.
4. Inspect inner race for excessive wear, scores or breaks.
5. Inspect retaining ring for being broken.

If any of the above defects, except Item 5 are found, the C.V. joint assembly will have to be replaced as a unit. Retaining ring may be replaced separately.

Assembly

1. Insert short land of inner race into hole in cage and pivot to install in cage. (Fig. 3EB-13)
2. Align inner race and cage as shown in Fig. 3EB-12 and pivot inner race and cage 90° to align in outer race as shown in Fig. 3EB-14.
3. Insert balls into outer race one at a time until all six balls are installed. (Fig. 3EB-14) Inner race and cage will have to be tilted as shown so that each ball can be inserted.

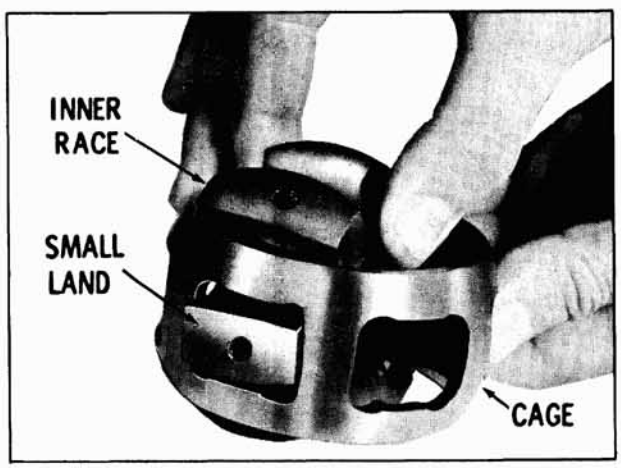


Fig. 3EB-13—Removing or Installing Inner Race From Cage

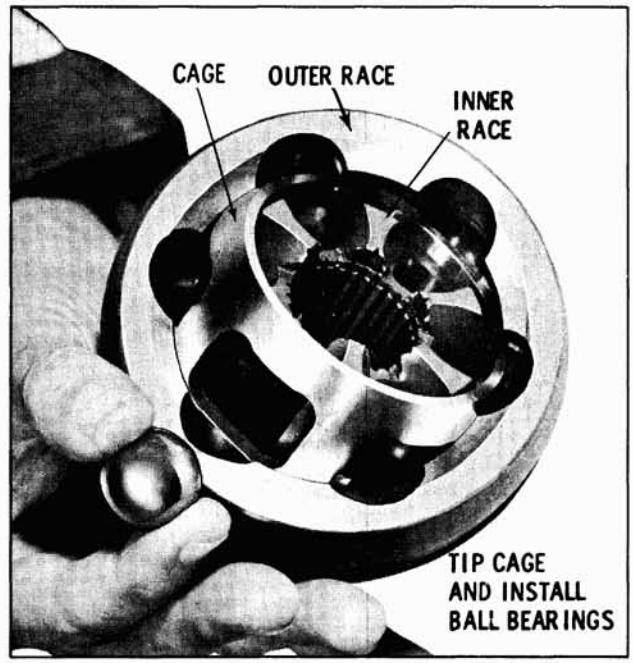


Fig. 3EB-14—Installing Balls in Outer Race

4. Pack C.V. joint full of Lubricant No. 1050530 or equivalent.
5. Pack inside of seal with Lubricant No. 1050530 or equivalent until folds of seal are full.
6. Place service clamp on axle shaft.
7. Install seal onto axle shaft.
8. Install retaining ring into inner race. (Fig. 3EB-17)
9. Insert axle shaft into splines of outer C.V. joint until retaining ring secures shaft.
10. Position seal in slot of outer race. (Fig. 3EB-15)
11. With service clamps over seal in correct position, follow procedures listed on Figs. 3EB-16A-B-C-D-E. This procedure will apply to both small clamps on axle shaft and large clamp on outer C.V. joint.

Disassembly (Inner C.V. Joint)

1. Insert axle assembly in vise. Clamp on mid-portion of axle shaft.

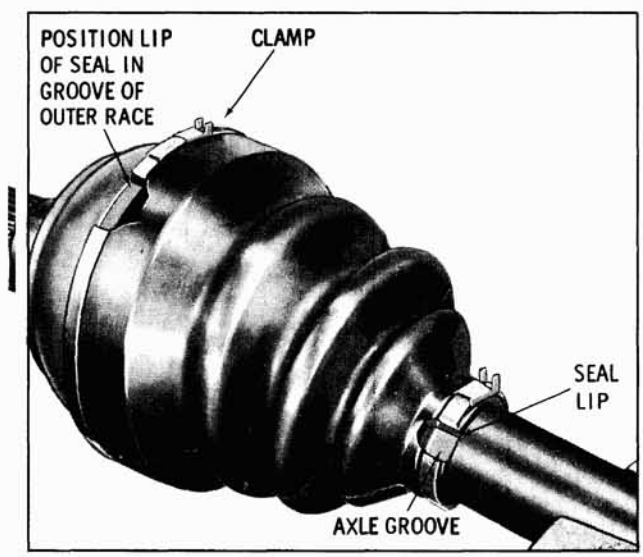


Fig. 3EB-15—Positioning Seal

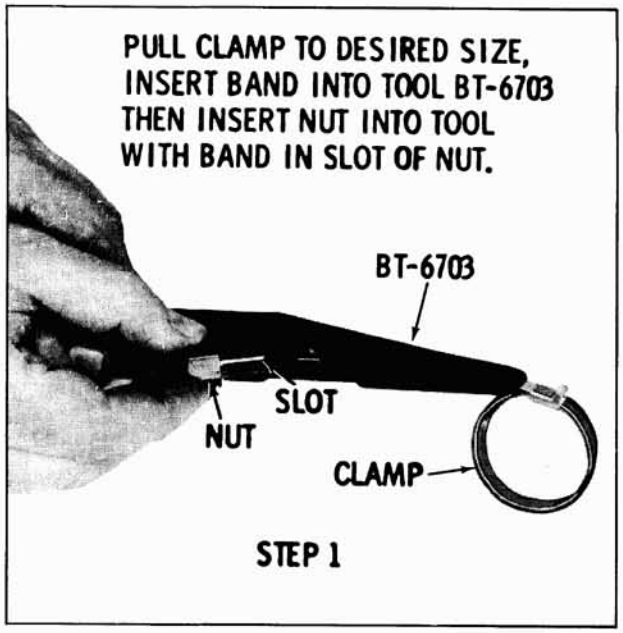


Fig. 3EB-16A—Clamp Procedure (Step 1)

2. Remove small seal clamp.
3. Remove large end of seal from C.V. joint by prying out peened spots and driving off C.V. joint with hammer and chisel. (Fig. 3EB-18)
4. Carefully slide seal down axle shaft.
5. Carefully lift housing assembly from spider assembly (Fig. 3EB-19) and remove "O" ring from housing outer surface.

Place a rubber band over ends of spider to retain the three balls and needle bearings. Wipe all excess grease from C.V. Joint.

6. Using Tool J-5586, remove retaining ring from end of axle shaft.
7. Slide spider assembly from axle shaft. (Fig. 3EB-21)
8. Remove retaining ring (inner) from axle shaft, using Tool J-5586. (Fig. 3EB-20)

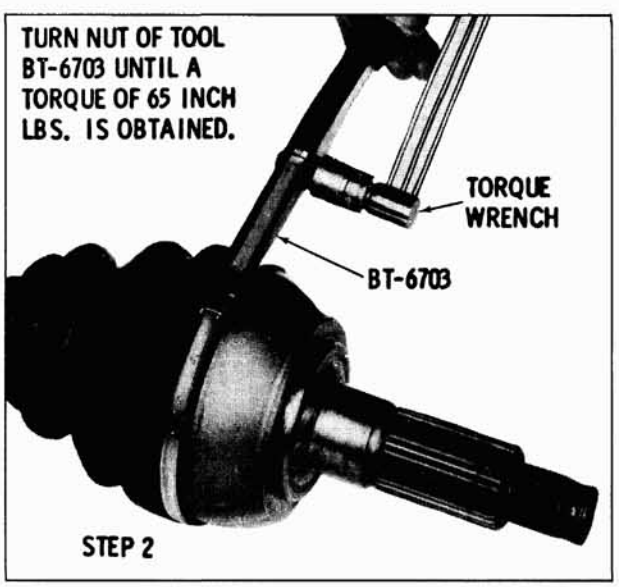


Fig. 3EB-16B—Clamp Procedure (Step 2)

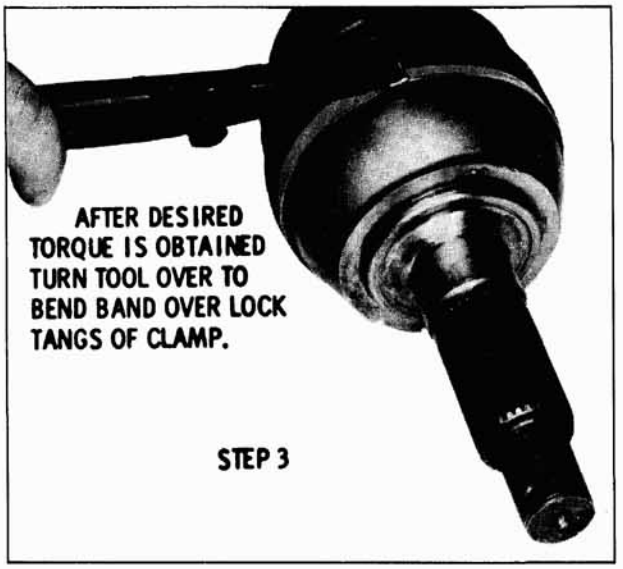


Fig. 3EB-16C—Clamp Procedure (Step 3)

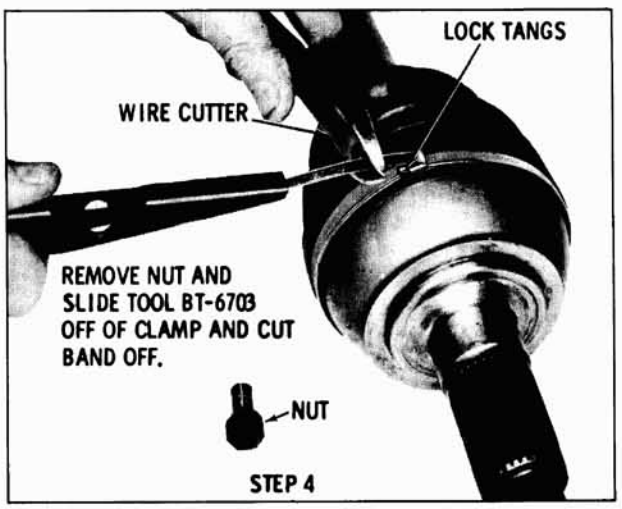


Fig. 3EB-16D—Clamp Procedure (Step 4)

9. Slide seal off axle shaft.
10. Remove cover from housing as shown in Fig. 3EB-22.
11. Remove "O" ring from housing.

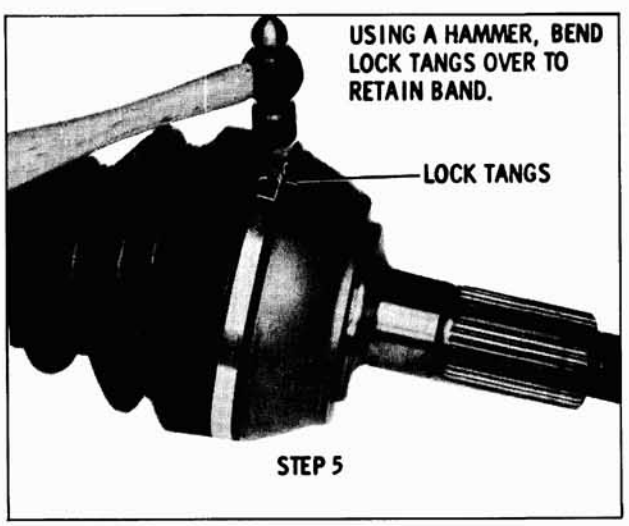


Fig. 3EB-16E—Clamp Procedure (Step 5)

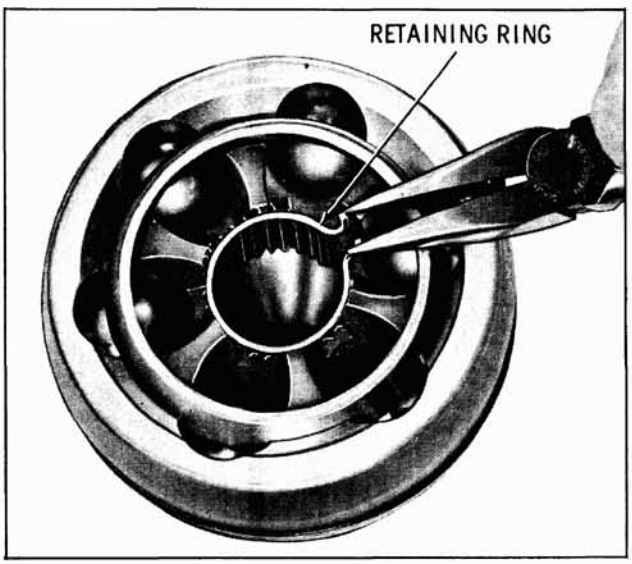


Fig. 3EB-17—Removing Or Installing Retaining Ring

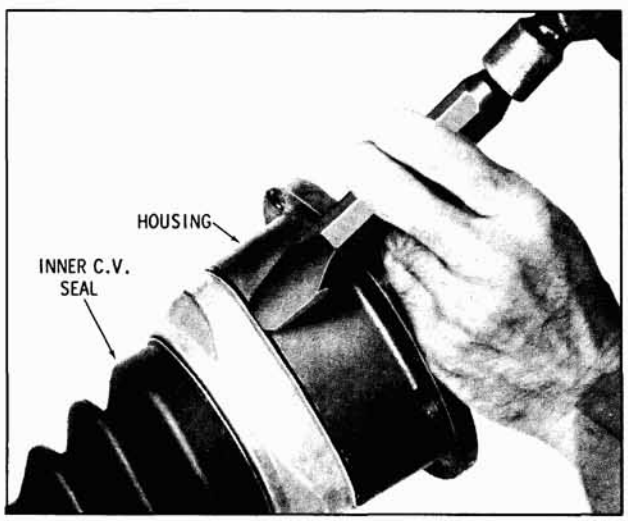


Fig. 3EB-18—Removing Inner C.V. Joint Seal

12. Remove balls (three) from spider, being careful not to lose any of the (53) needle bearings in each of the balls. (Fig. 3EB-23)

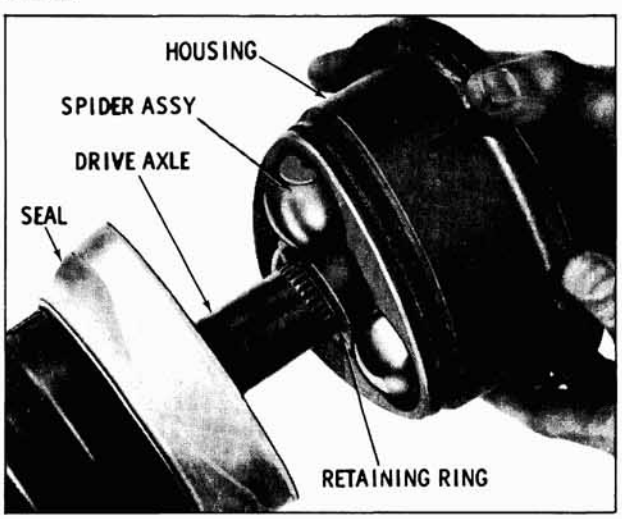


Fig. 3EB-19—Removing Housing Assembly

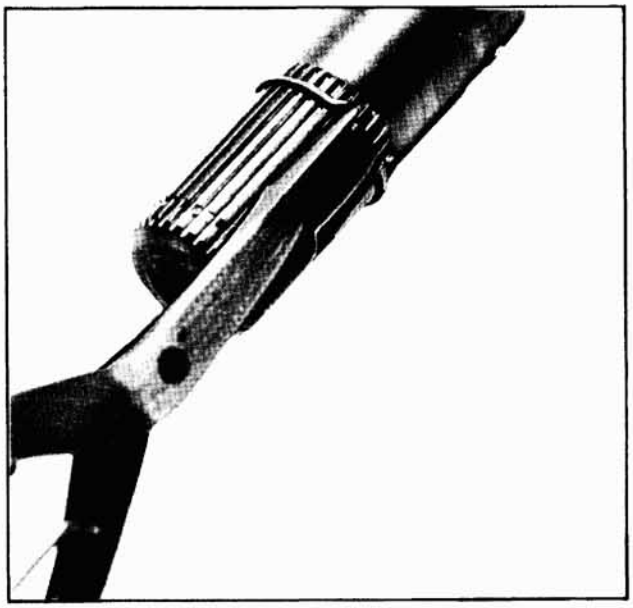


Fig. 3EB-20—Removing Retaining Ring

13. Remove washers from spider journals. (Fig. 3EB-24)

CLEANING AND INSPECTION

Wash all metallic parts thoroughly in a cleaning solvent. Dry with compressed air.

Rubber seal, "O" rings and clamp should be replaced whenever C.V. joint is disassembled for service.

Housing may show smooth shiny spots where balls travel; this is considered NORMAL.

A housing that has brinelling will appear as small depressions in the metal approximately .002" to 003" and can be felt, should be replaced.

1. Inspect housing for excessive wear, cracks or chips in ball grooves.
2. Inspect retaining rings for being bent or broken.
3. Inspect balls (three) for excessive wear, cracks, nicks, scores or broken.
4. Inspect needle bearings for wear, broken or bent.
5. Inspect washers for wear or bent.
6. Inspect spider for excessive wear, chips or cracks.

Assembly

1. Slide new clamp on axle shaft, to be used after seal positioning.

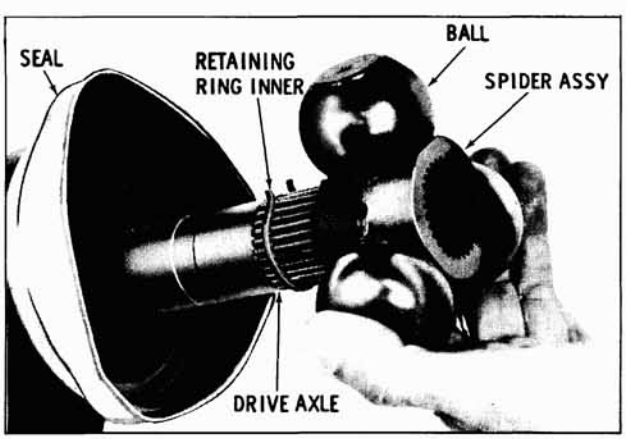


Fig. 3EB-21—Removing Spider Assembly

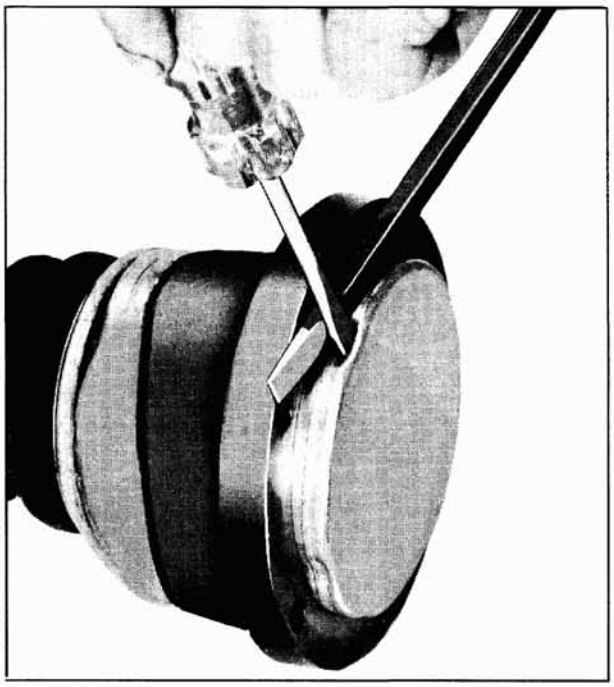


Fig. 3EB-22—Removing Cover From Housing

2. Pack new seal with Lubricant, No. 1050649 or equivalent until folds in seal are full.
3. Position retaining ring on axle shaft in the inner slot. (Fig. 3EB-25)
4. Using Lubricant, No. 1050649, or equivalent load balls (three) with the needle bearings (53 to each ball). (Fig. 3EB-26)
5. Position one washer on each of the spider journals. (Fig. 3EB-24)

Groove in washer must face toward center of spider.

6. Carefully install balls on each of the spider journals. (Fig. 3EB-23)

A rubber band may be used to retain balls in position until spider assembly is installed in housing.

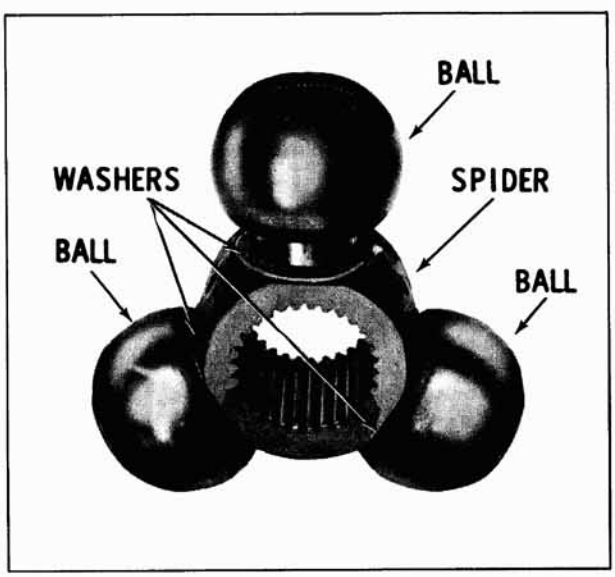


Fig. 3EB-23—Spider Assembly

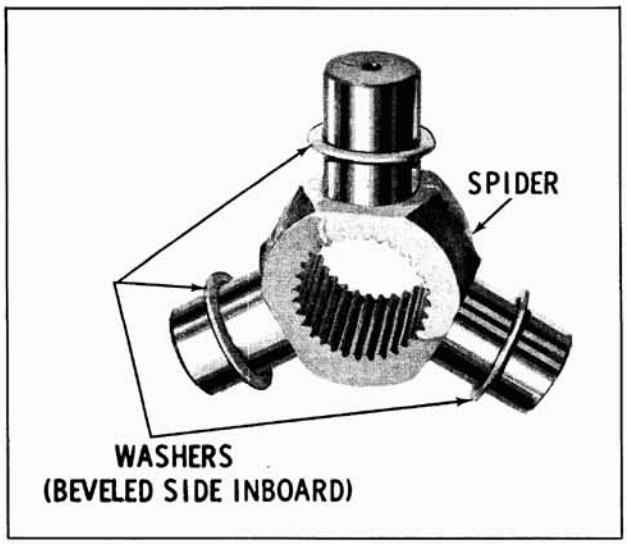


Fig. 3EB-24—Removing Or Installing Washers

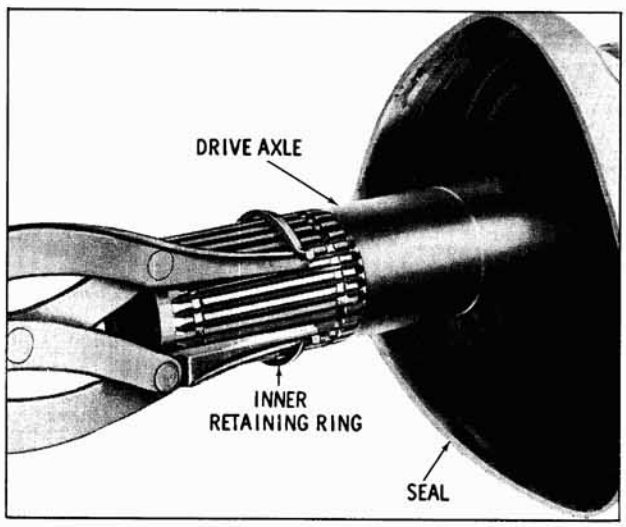


Fig. 3EB-25—Removing Or Installing Inner Retaining Ring

7. Position spider assembly on axle shaft and retain with retaining ring.
8. Install new "O" ring in outer groove in housing. (Fig. 3EB-29)

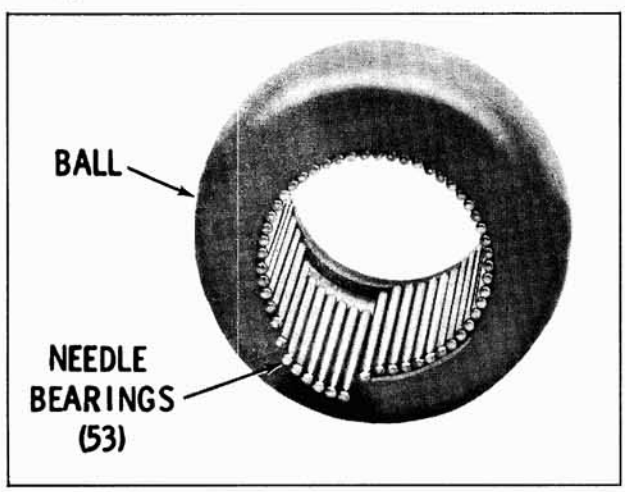


Fig. 3EB-26—Loading Ball With Needle Bearings

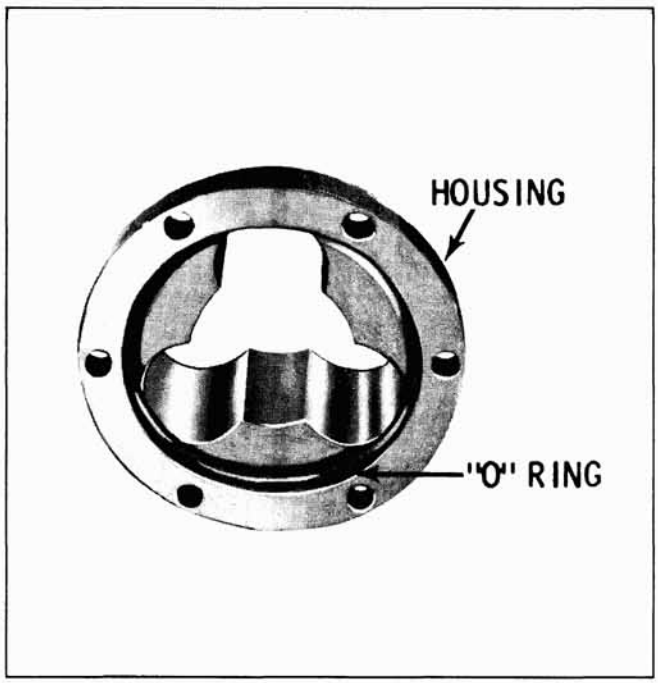


Fig. 3EB-27—Installing "O" Ring In Housing

9. Remove rubber band, if used, from spider assembly.
10. Position spider assembly in line with housing assembly and push into housing. (Fig. 3EB-30)
11. Lubricate housing outer groove "O" ring with Special Seal Lubricant, No. 1050169, or equivalent.
12. With housing positioned as shown in Fig. 3EB-31, slide seal into position and stake in six places, evenly spaced.

Care must be taken so that "O" ring is not cut by metal portion of seal.

13. Position seal into groove in axle shaft and install clamp following procedure listed on Figs. 3EB-16A-B-C-D-E.
14. Extend axle shaft until seal is at maximum length.
15. Using Lubricant, No. 1050649, or equivalent fill housing level full.
16. Install new "O" ring housing and lubricate "O" ring with Special Seal Lubricant No. 1050169 or equivalent. (Fig. 3EB-27)
17. Install cover into housing using existing A/C Tool No. J-9397-2. Attach two machine bolts (2 1/4" x 1/4") as shown in Fig. 3EB-28 and tighten bolts alternately while tapping lightly with hammer until cover bottoms.

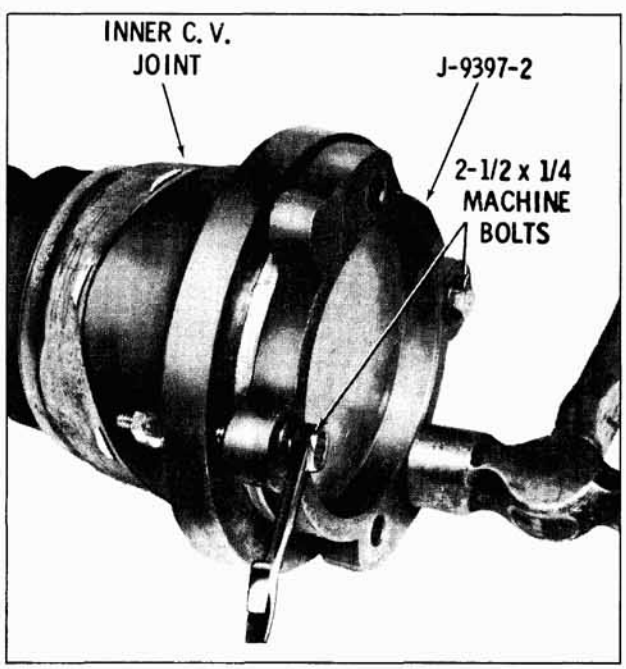


Fig. 3EB-28—Installing Cover Into Housing

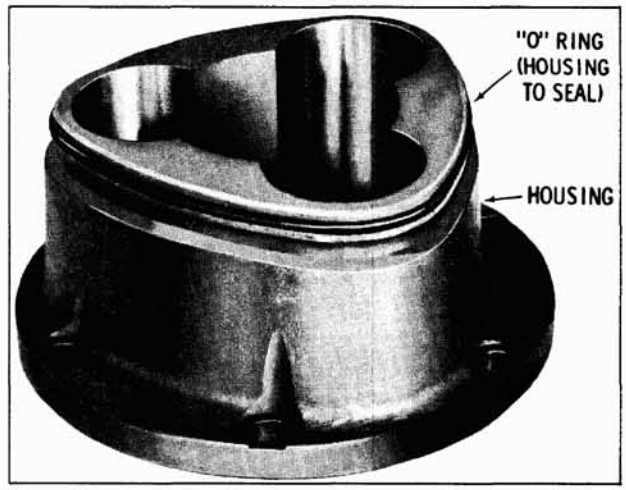


Fig. 3EB-29—Installing "O" Ring On Housing

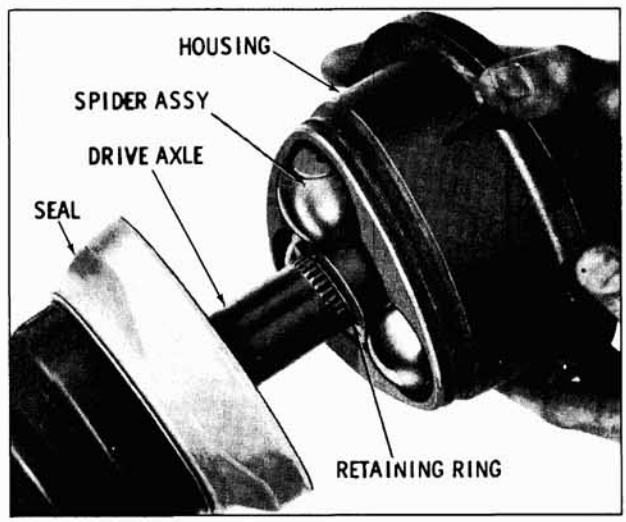


Fig. 3EB-30—Installing Spider Assembly To Housing

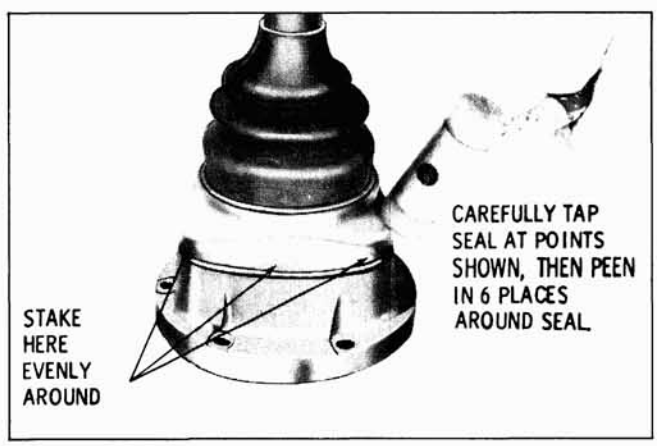


Fig. 3EB-31—Installing Seal To Housing

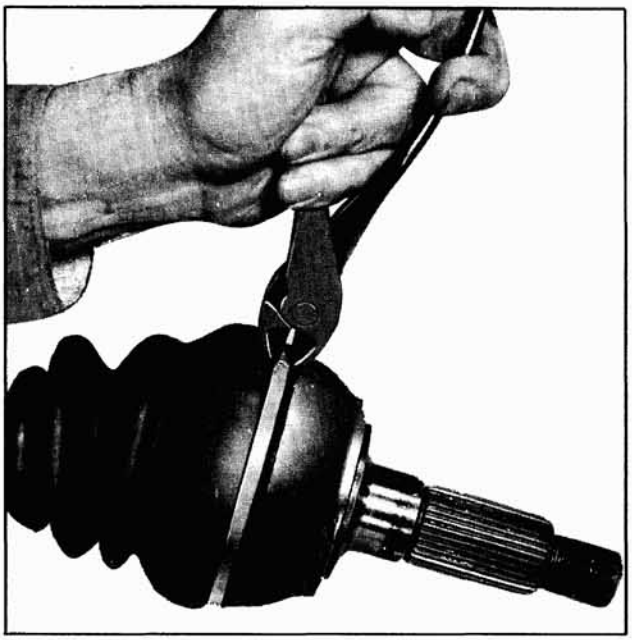


Fig. 3EB-32—Removing Seal Clamps

Be careful that seal is positioned correctly so that "O" ring is not cut.

DRIVE AXLE

Disassembly

1. Remove drive axle assembly. (Refer to DRIVE AXLE ASSEMBLY - R. or L. Removal).
2. Remove outer C.V. joint seal clamps. (Fig. 3EB-32)
3. Remove inner C.V. joint small clamp and pry out peened spots of seal to housing. Slide seal down shaft.
4. Slide seal inboard on shaft.
5. Remove retaining ring from inner C.V. joint. (Fig. 3EB-20)
6. Remove spider assembly.

A rubber band may be used around spider journals to retain balls and needle bearings.

7. Remove inner retaining ring from axle shaft. (Fig. 3EB-25)
8. Remove seals from shaft.
9. Remove "O" ring from housing.

Assembly

1. Pack folds of outer seal full of Lubricant, No. 1050530 or equivalent. Inner seal with No. 1050649 or equivalent.
2. Insert new service clamp on shaft.
3. Slide new outer seal onto shaft.
4. Using Tool J-5586, spread retaining ring of outer C.V. joint until axle shaft can be inserted into outer C.V. joint.

Make sure retaining ring is in proper position.

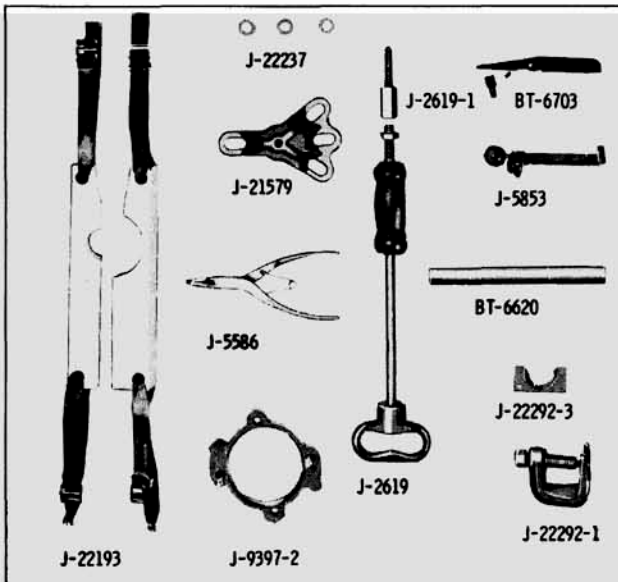
5. Position inner seal into groove of axle and outer C.V. joint and install clamps and secure. (Fig. 3EB-16A-B-C-D-E)
6. Install new clamp on shaft.

For clamp installation procedures, follow Figs. 3EB-16A-B-C-D-E.

7. Slide new inner C.V. joint seal onto shaft.
8. Install inner retaining ring on shaft. (Fig. 3EB-33)
9. Install spider assembly on shaft and retain with retaining ring. (Fig. 3EB-30)
10. Install new "O" ring on housing and lubricate with Special Seal Lubricant, No. 1050169 or equivalent. (Fig. 3EB-31)
11. Remove rubber band, if used, from spider assembly.
12. Position spider assembly in line with housing assembly and push into housing until bottomed.
13. Using Lubricant, No. 1050649 or equivalent, fill housing level full.
14. With housing positioned as shown in Fig. 3EB-31, slide seal into position and stake in six places, evenly spaced.

Care must be taken so that "O" ring is not cut by metal portion of seal.

15. Prior to installation of the seal clamp, extend the assembly to its maximum length and equalize the pressure in the seal by lifting the lip at the axle shaft. Hold joint in extended position and install seal clamp. (Figs. 3EB-16A-B-C-D-E)
16. Install drive assembly. (Refer to DRIVE AXLE ASSEMBLY - RIGHT OR LEFT INSTALLATION.



J-2619	SLIDE HAMMER
J-2619-1	ADAPTER
J-5586	SNAP RING PLIERS
J-5853	IN. LBS. TORQUE WRENCH
BT-6620	BRASS DRIFT
BT-6703	C. V. JOINT BOOT CLAMP TOOL
J-21579	AXLE AND HUB PULLER
J-22193	C. V. JOINT SUPPORT BLOCKS
J-22237	FRONT HUB PULLING SPACERS
J-9397-2	C. V. JOINT COVER INSTALLER
J-22292-1	LOWER BALL JOINT REMOVER PLATE
J-22292-3	LOWER BALL JOINT REMOVER PLATE

Fig. 3EB-33—Tools

FINAL DRIVE

TORONADO

CONTENTS OF SECTION 3EC

Subject	Page
PERIODIC MAINTENANCE	3EC-1
RATIO CODE	3EC-1
GENERAL DESCRIPTION	3EC-1
R.H. OUTPUT SHAFT, BEARING AND SEAL	
REMOVAL	3EC-1
INSTALLATION	3EC-1
L.H. OUTPUT SHAFT AND SEAL	
REMOVAL	3EC-3
INSTALLATION	3EC-4
TRANSMISSION FILLER TUBE	
REMOVAL AND INSTALLATION	3EC-5
FINAL DRIVE	
REMOVAL	3EC-6
INSTALLATION	3EC-7
DISASSEMBLY	3EC-8
PINION BEARINGS	
REMOVAL	3EC-9
FINAL DRIVE CASE	
DISASSEMBLY	3EC-9
CLEANING AND INSPECTION	3EC-9
PINION DEPTH	3EC-11
PINION BEARING PRE-LOAD	3EC-12
FINAL DRIVE CASE	
ASSEMBLY	3EC-13
SIDE BEARING INSTALLATION	3EC-13
SIDE AND PINION GEAR	
INSTALLATION	3EC-13
RING GEAR INSTALLATION	3EC-14
SIDE BEARING PRE-LOAD	3EC-15
BACKLASH ADJUSTMENT	3EC-16
TORQUE SPECIFICATIONS	3EC-16
FINAL DRIVE SPECIFICATIONS	3EC-17
TOOLS	3EC-18

FINAL DRIVE

PERIODIC MAINTENANCE

Check lubricant level at each engine oil change period. Maintain lubricant level to filler plug hole in cover. Use only Gear Lubricant, No. 1050081 or equivalent.

Always clean dirt or foreign material from around plug opening before removing filler plug.

Periodic or seasonal changes are not recommended.

RATIO CODE

Ratio codes are located as shown on Fig. 3EC-2. "T" for 3:07:1.

GENERAL DESCRIPTION (Fig. 3EC-1)

The final drive assembly, mounted and splined directly to the automatic transmission, consists of a pinion drive gear, a ring gear (bolted to the case), case assembly with two side gears and two pinion gears which are retained to the case with a pinion shaft. A lock pin is used instead of a bolt to lock the pinion shaft to the case. There are thrust washers used behind the side gears and shims behind the pinion gears the same as the conventional differential. The left side gear is different than the right side in the respect that it has a threaded retainer plate that the left output shaft bolts to. The two side bearings are the same and the pre-load shims are identical for the right and left side. The carrier is identical in external appearance and mounts to the transmission the same as in the past models.

The output shafts remain identical in external appearance as in the past. The left output shaft has the retainer bolt going through the shaft to the side gear.

RH OUTPUT SHAFT, BEARING AND SEAL

Removal

1. Disconnect battery.
2. Hoist car.
3. Remove engine oil filter element.
4. Remove attaching bolts, R.H. drive axle to R.H. output shaft. Then move drive axle rearward until free from output shaft.
5. Disconnect support from engine and brace. (Fig. 3EC-2)
6. Remove output shaft assembly.
7. If output shaft seal is to be replaced, install Seal Remover BT-6629 and BT-6229-2 into seal and drive seal out with a hammer. (Fig. 3EC-3)
8. If output shaft bearing is to be replaced, it can be removed with a press as shown in Fig. 3EC-4.

Installation

1. If output shaft bearing was removed, assemble parts as shown in Fig. 3EC-5.
2. Position assembly in a press and install bearing until seated as shown in Fig. 3EC-6.
3. Pack area between bearing and retainer with wheel bearing grease, then install slinger as shown in Fig. 3EC-7.

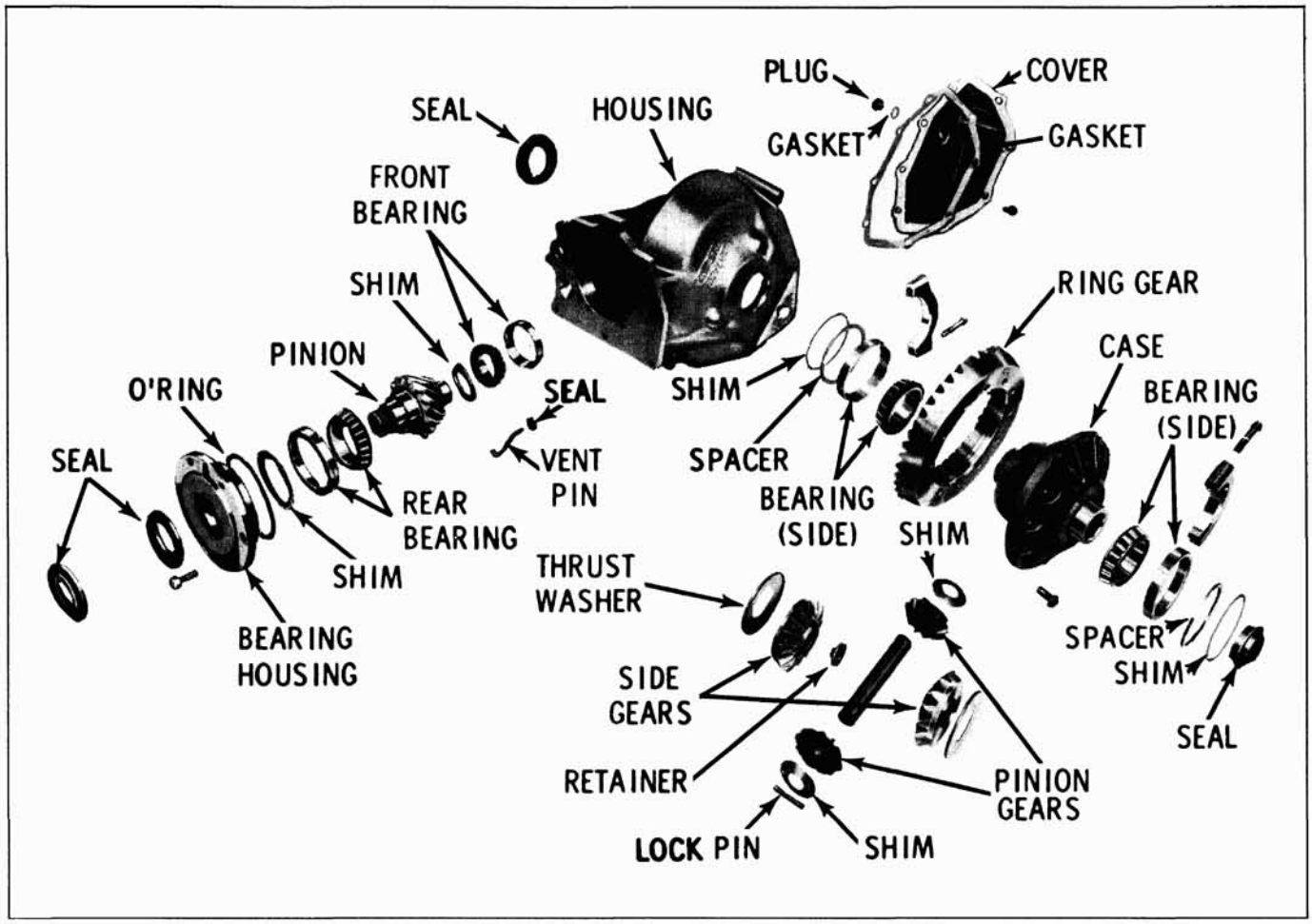


Fig. 3EC-1—Final Drive Assembly

4. If output shaft seal was removed, new seal can be installed as shown in Fig. 3EC-8.

5. Apply Special Seal Lubricant No. 1050169 or equivalent to output shaft seal, then install output shaft into final drive indexing splines of output shaft with splines in side gear.

6. Install support to engine and brace. (Fig. 3EC-2)

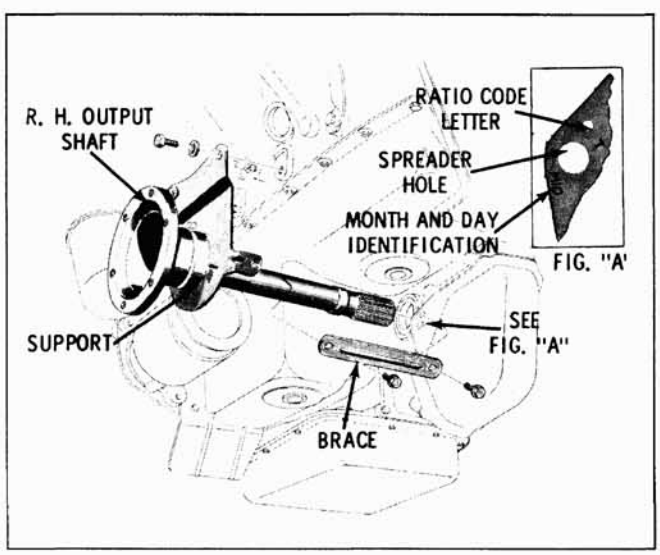


Fig. 3EC-2—R.H. Output Shaft Attachment

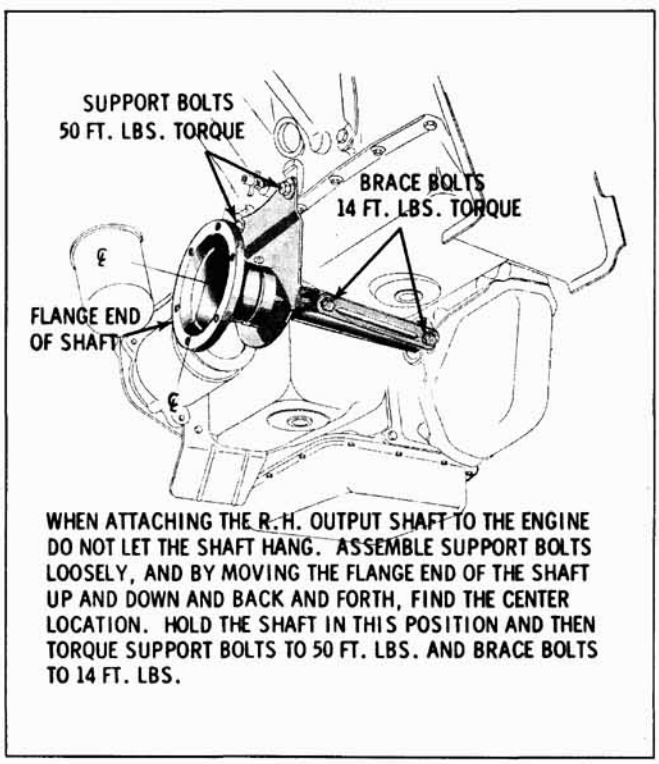


Fig. 3EC-2A—Aligning R.H. Output Shaft

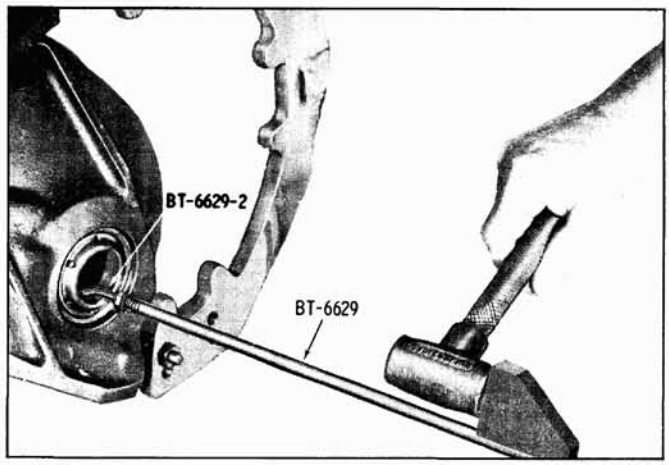


Fig. 3EC-3—Removing R.H. Output Shaft Seal

When attaching the right hand output shaft to the engine, do not let the shaft hang. Assemble support bolts loosely, and by moving the flange end of the shaft up and down, and back and forth, find the center location. Hold the shaft in this position and then torque the bolts to 50 ft. lbs. on support and 14 ft. lbs. on brace. (Fig. 3EC-2A)

7. Move drive axle forward until alignment with output shaft is obtained. Install attaching bolts. Torque to 65 ft. lbs.

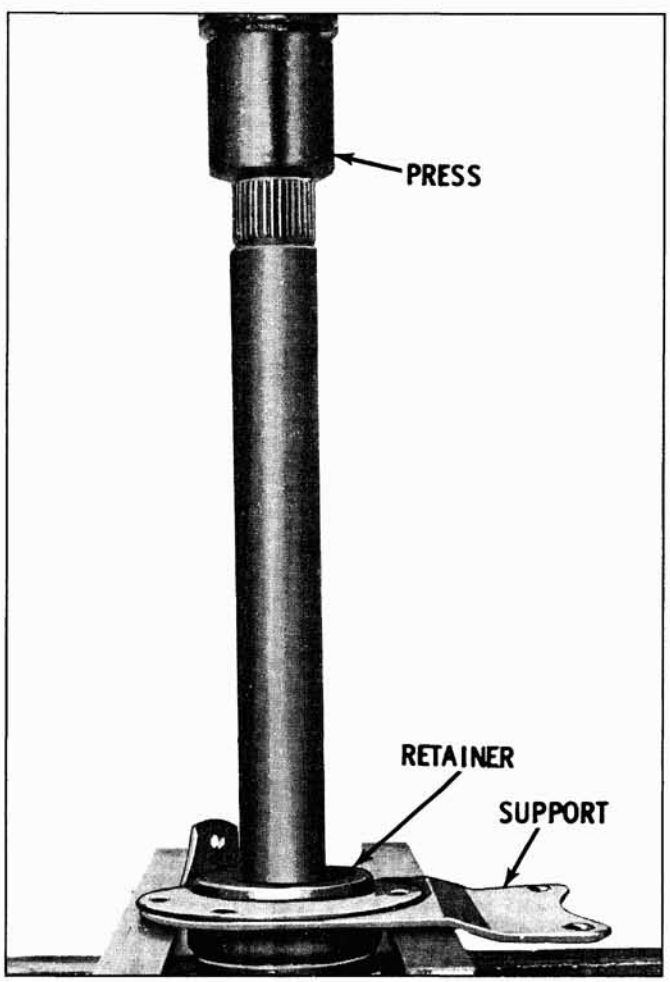


Fig. 3EC-4—Removing R.H. Output Shaft Bearing

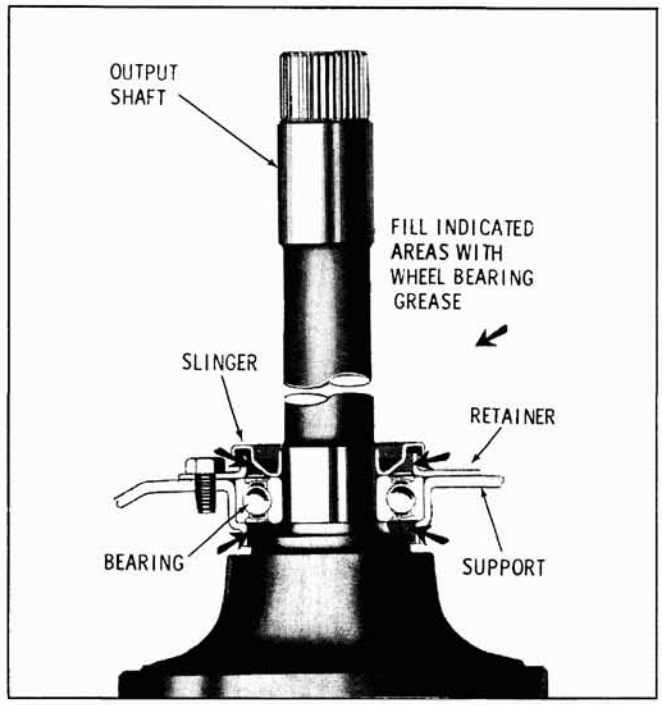


Fig. 3EC-5—R.H. Output Shaft Assembly

8. Install engine oil filter element.
9. Connect battery.
10. Check engine oil level and final drive oil level and check for oil leaks.

LH OUTPUT SHAFT AND SEAL

Removal

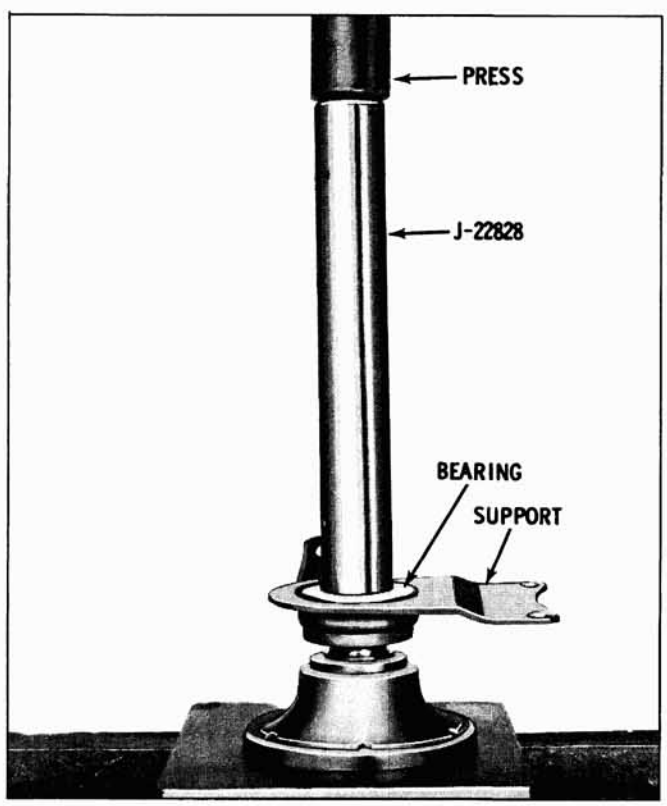


Fig. 3EC-6—Installing R.H. Output Shaft Bearing

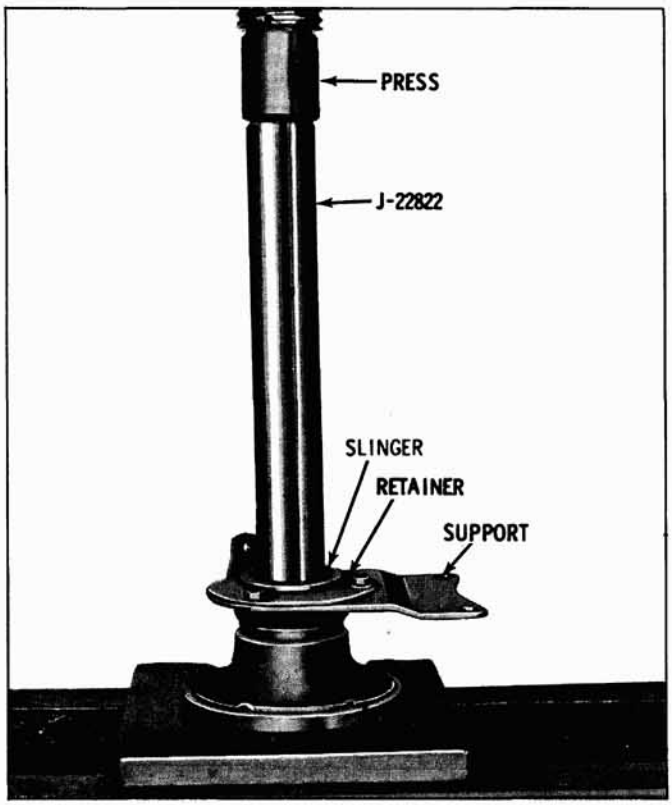


Fig. 3EC-7—Installing Slinger

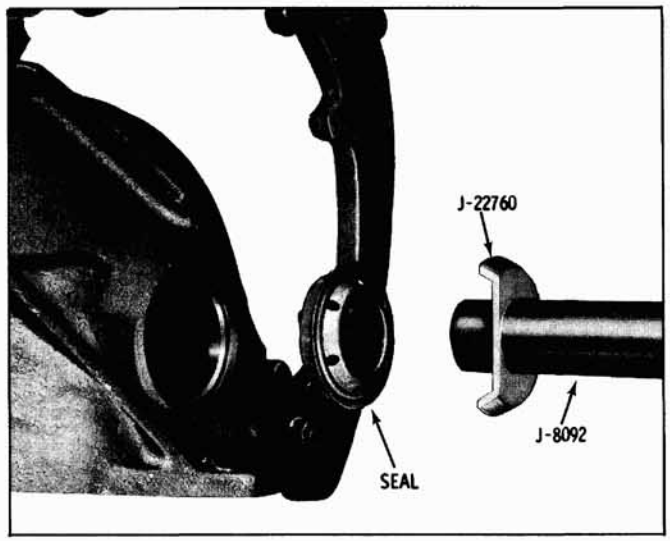


Fig. 3EC-8—Installing R.H. Output Shaft Seal

1. Remove L.H. drive axle. Refer to Section 3EB, DRIVE AXLE ASSEMBLY (LEFT HAND), Steps 1 through 15 under REMOVAL.
2. Using a 9/16" socket remove L.H. output shaft retaining bolt and remove L.H. output shaft. (Fig. 3EC-19)

If output shaft seal is to be replaced, insert Tool BT-6629 and BT-6629-3 into seal and drive out with a hammer. (Fig. 3EC-10)

Installation

1. If output shaft seal was removed, install new seal as shown in Fig. 3EC-11.

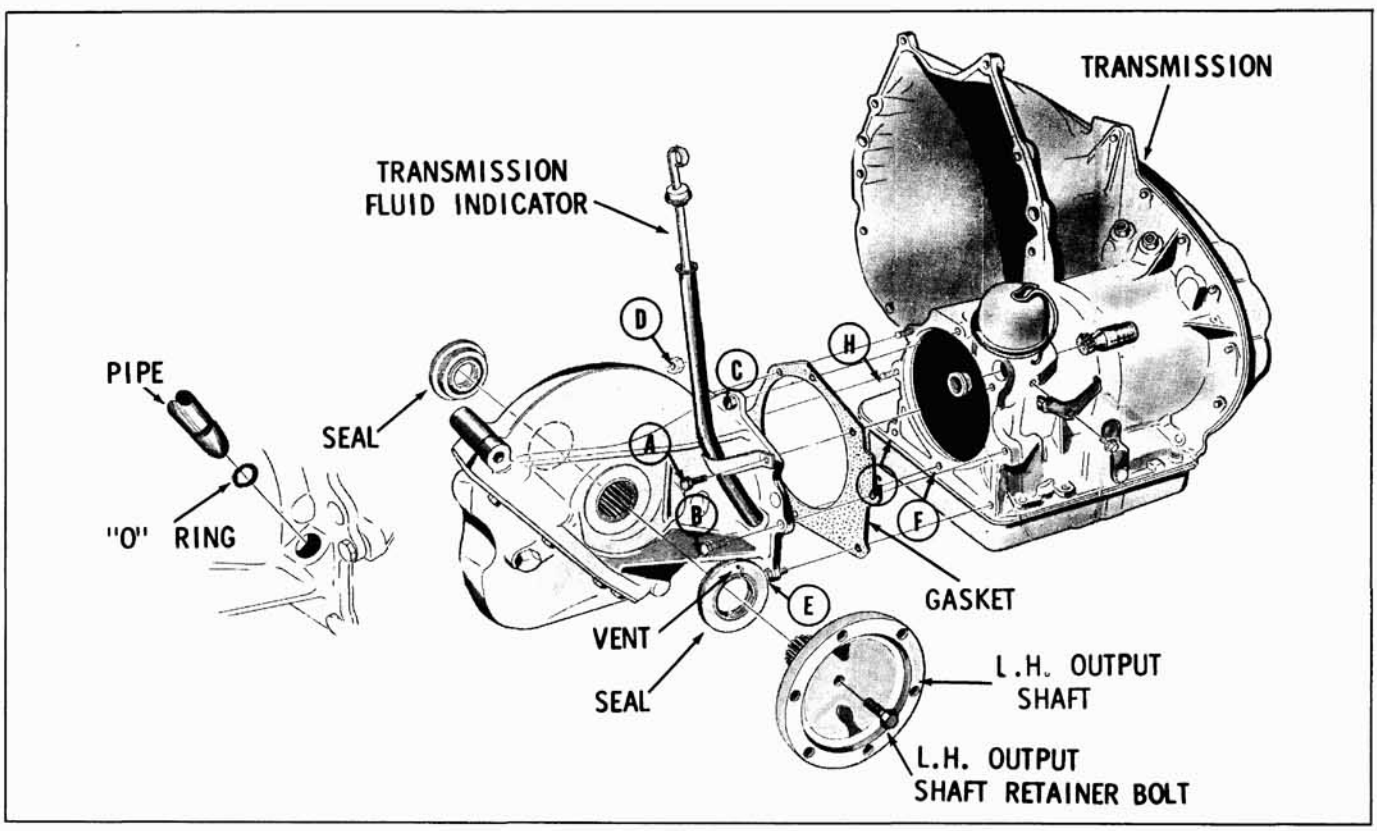


Fig. 3EC-9—Final Drive Attachment

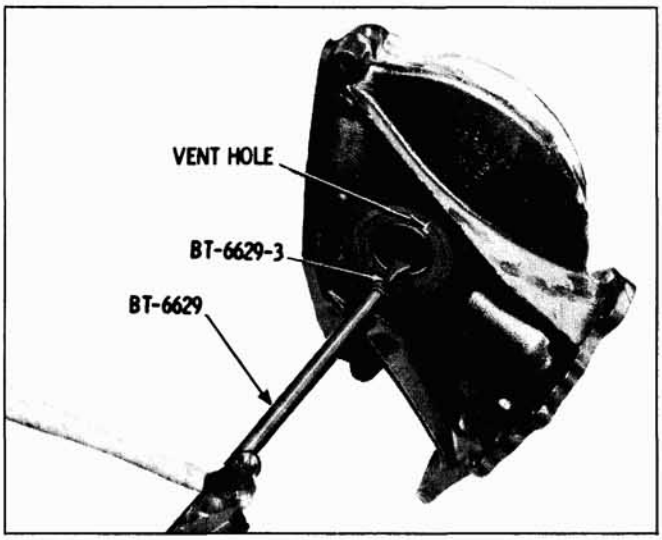


Fig. 3EC-10—Removing L.H. Output Shaft Seal

Left output shaft seal is installed with vent hole toward top of final drive housing in the in car position.

2. Apply Special Seal Lubricant No. 1050169 or equivalent to the seal; then, insert output shaft into final drive assembly, indexing splines of output shaft with splines in side gear.
3. Install L.H. output shaft retaining bolt and torque to 40 ft. lbs. (Fig. 3EC-9)
4. Install L.H. drive axle. Refer to Section 3EB, DRIVE AXLE ASSEMBLY (LEFT HAND), Steps 1 through 10 under INSTALLATION.

TRANSMISSION FILLER TUBE

Removal and Installation

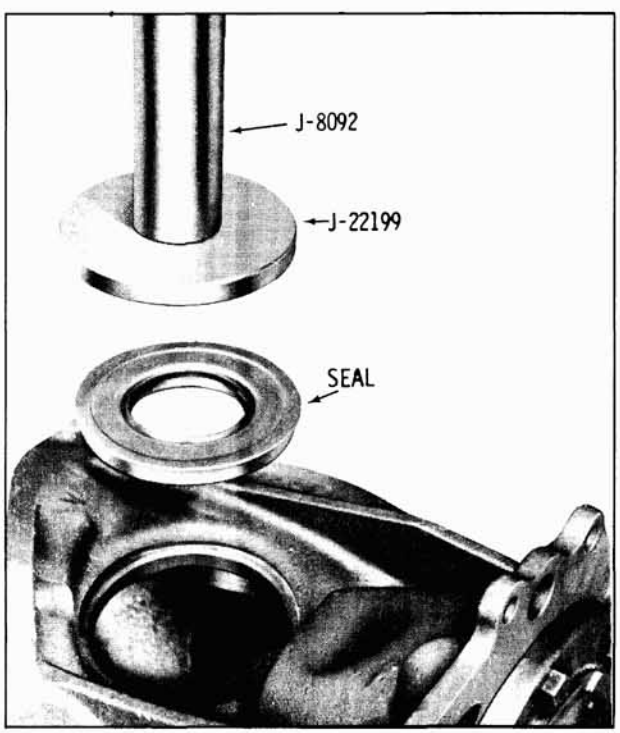


Fig. 3EC-11—Installing L.H. Output Shaft Seal

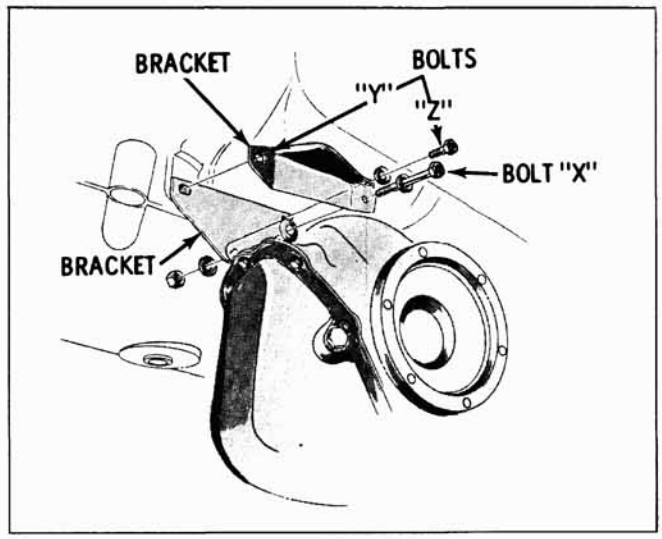


Fig. 3EC-12—Disconnecting Final Drive From Engine

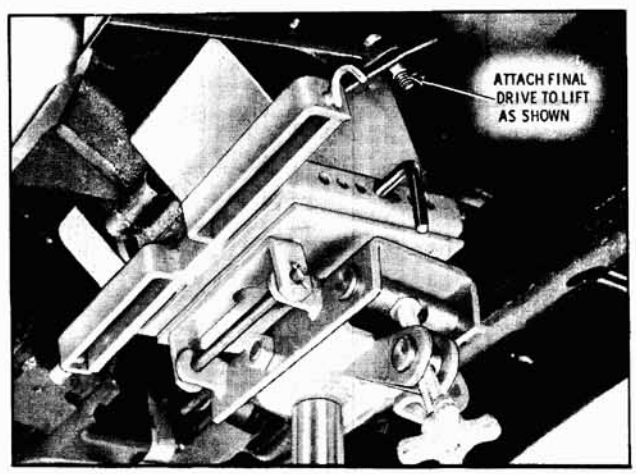


Fig. 3EC-13—Connecting Lift to Final Drive

The automatic transmission filler tube is located on the final drive. The filler tube can be removed by removing bolt "A", Fig. 3EC-9 and then pulling the filler tube out of the

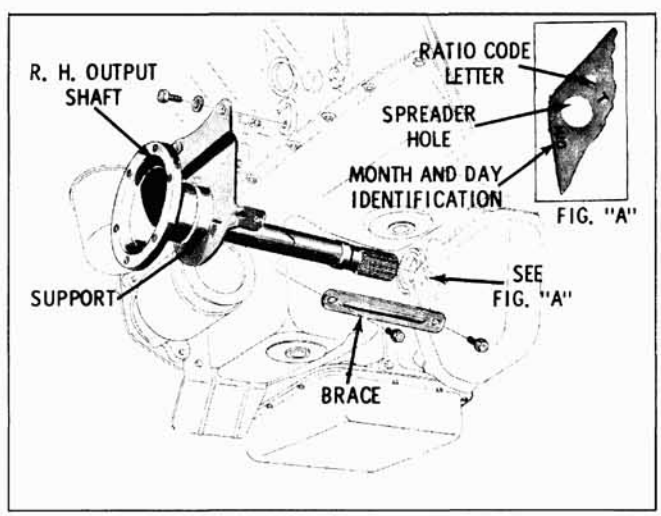


Fig. 3EC-14—R.H. Output Shaft Attachment

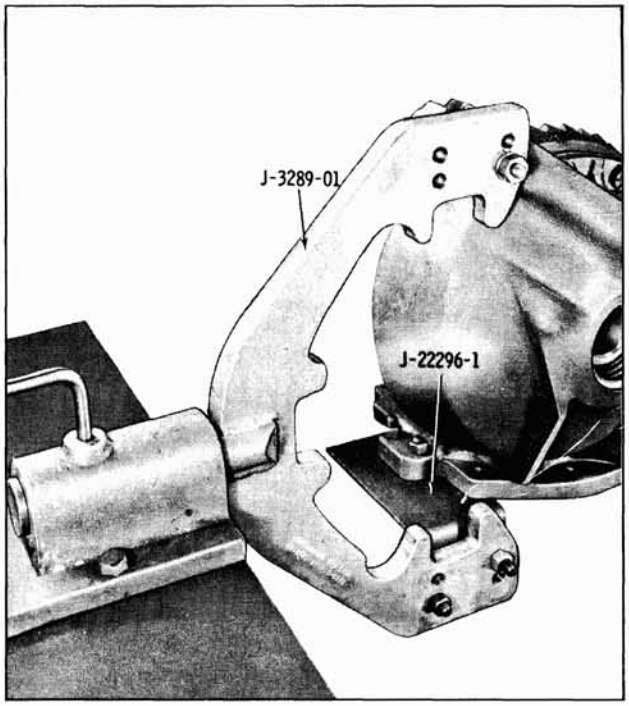


Fig. 3EC-15—Final Drive In Holding Fixture

housing. To install, position a new "O" ring seal on the filler tube. Coat seal with Special Seal Lubricant No. 1050169 or equivalent and install filler tube into housing. Install bolt "A" and torque to 25 ft. lbs.

FINAL DRIVE

Removal

1. Disconnect battery.
2. Remove bolts "A", "B", and "C" and nut "D". Nut "D" must be removed with a special wrench, such as MAC S-147. (Fig. 3EC-9)

It may be necessary to remove the transmission filler tube to obtain clearance.

3. Hoist car. If a two post hoist is used, the car must be supported with floor stands at the front frame rails and the front post lowered.
4. Disconnect right and left drive axles from the output shafts.

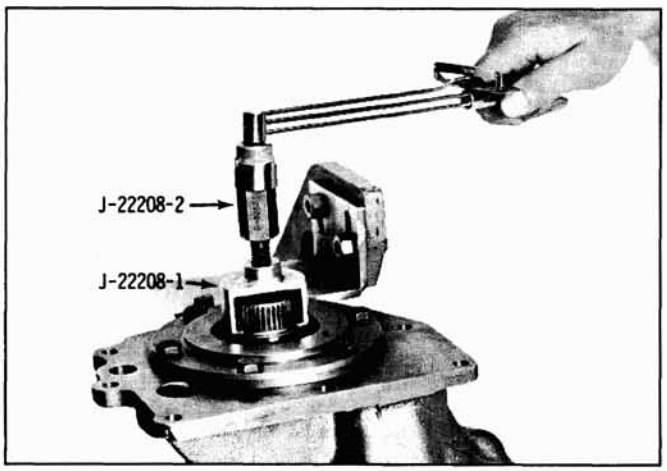


Fig. 3EC-16—Checking Pinion and Side Bearing Pre-Load

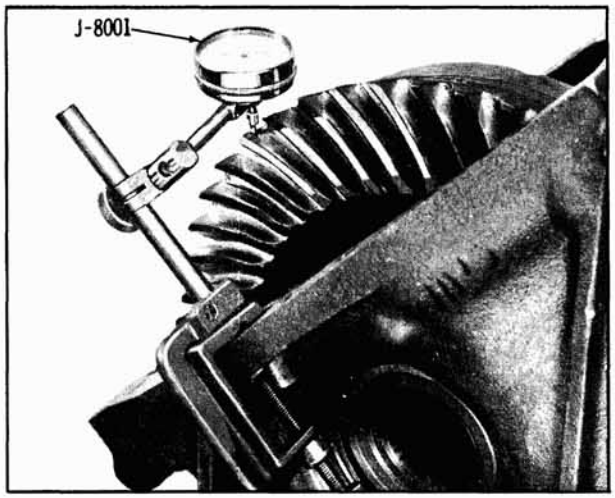


Fig. 3EC-17—Checking Ring Gear to Pinion Gear Backlash

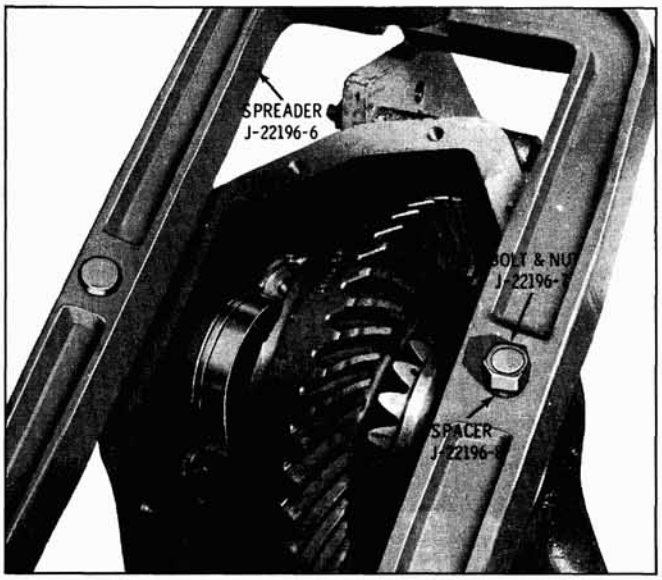


Fig. 3EC-18—Spreader Installation

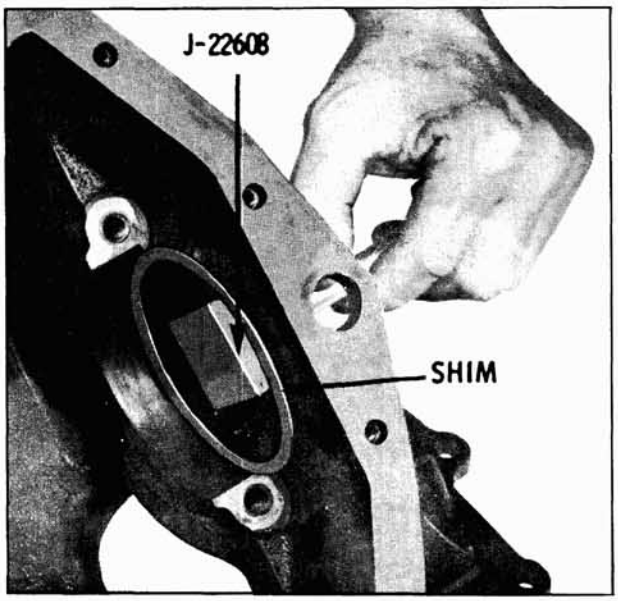


Fig. 3EC-19—Removing Shims

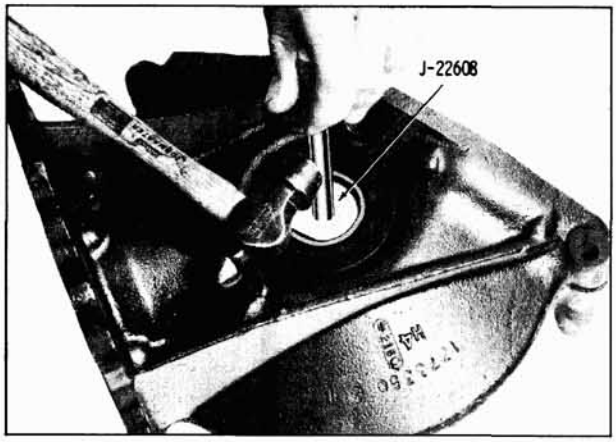


Fig. 3EC-20—Positioning of Tool J-22608

5. Remove engine oil filter element.
6. Disconnect brace from final drive, then disconnect R.H. output shaft support from engine. (Fig. 3EC-14)
7. Move R.H. drive axle rearward until R.H. output shaft can be removed from final drive.
8. Remove bolt "X" and loosen bolts "Y" and "Z". (Fig. 3EC-12)
9. Remove final drive cover and allow lubricant to drain.
10. Position transmission lift with adapter for final drive as shown in Fig. 3EC-13. Install an anchor bolt through final drive housing and lift pad.
11. Remove bolts "E", "F", and "G" and nut "H". (Fig. 3EC-9)
12. Move transmission lift toward front of car to disengage final drive splines from transmission.

As the final drive is disengaged from transmission, some transmission fluid will be lost. Provide a container to prevent oil from running on floor.

13. Lower transmission lift and remove final drive from lift.
14. Using a 9/16" socket remove the left output shaft retainer bolt, then pull output shaft from final drive. (Fig. 3EC-9)
15. Remove transmission to final drive gasket.

Installation

1. Apply Special Seal Lubricant No. 1050169 or equivalent to both output shaft seals.

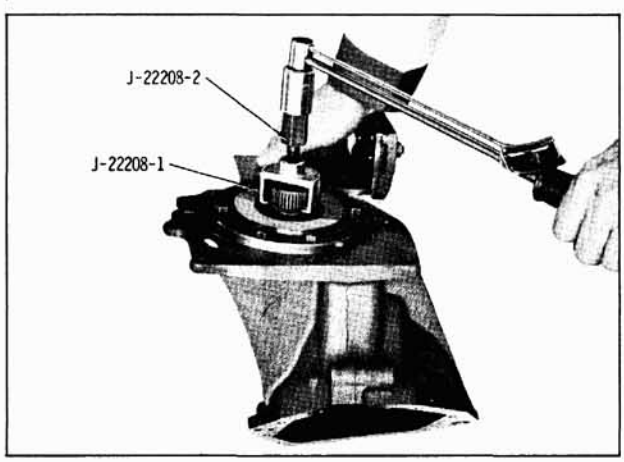


Fig. 3EC-21—Check Pinion Pre-Load

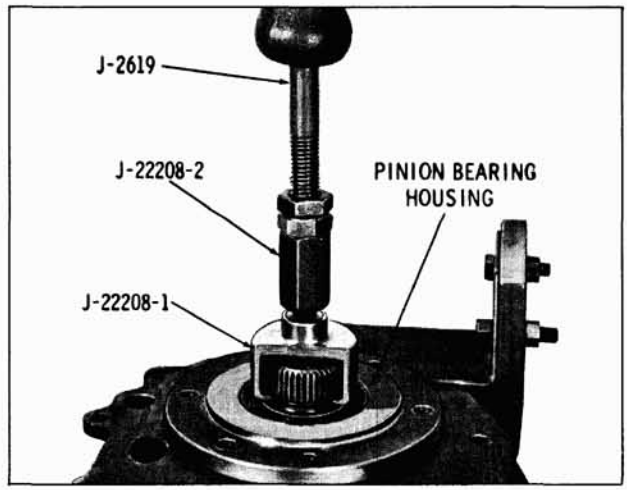


Fig. 3EC-22—Removing Pinion and Bearing Housing

2. Install the left output shaft into the final drive. Retain with bolt. Torque bolt to 40 ft. lbs. (Fig. 3EC-9)
3. Position final drive on transmission lift and install an anchor bolt through housing and lift pad. (Fig. 3EC-13)
4. Apply a thin film of Special Seal Lubricant No. 1050169 or equivalent on the transmission side of a new final drive to transmission gasket, then position gasket on transmission.
5. Raise transmission lift. Align the two bolt studs "D" and "H" on the transmission with their mating holes in the final drive. Move final drive until it mates with the transmission. (Fig. 3EC-9)

It may be necessary to rotate the left output shaft so that the splines of the final drive pinion engage the splines of the transmission output shaft. Do not allow gasket to become mispositioned while engaging splines.

6. Install bolts "E", "F" and "G" and nut "H" (Fig. 3EC-9). Install bolts "A", "B", and "C" and nut "D". (Fig. 3EC-9) Torque all final drive to transmission bolts to 25 ft. lbs. Torque nuts to an approximate 25 ft. lbs.
7. Install bolt "X" and torque to 105 ft. lbs. Tighten and torque bolts "Y" and "Z" to 50 ft. lbs. (Fig. 3EC-12)
8. Loosen and remove lift from final drive.
9. Position a new cover gasket on the final drive, then install cover. Torque cover bolts to 25 ft. lbs.

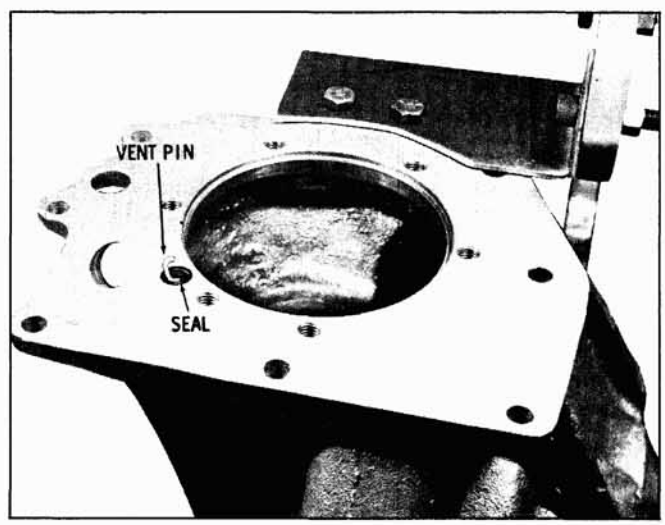


Fig. 3EC-23—Removing Vent Pin and Seal

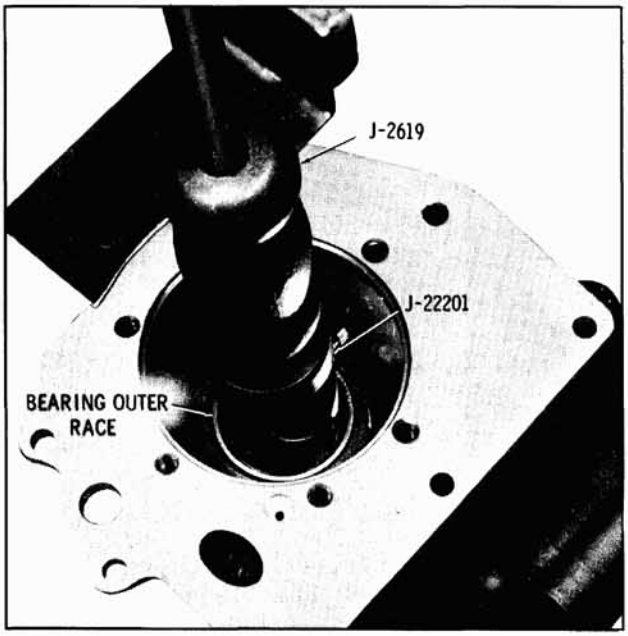


Fig. 3EC-24—Removing Front Pinion Bearing Outer Race

10. Install right output shaft into final drive indexing splines of output shaft with splines of side gear. Install support and brace bolts. (Fig. 3EC-14)

When attaching the right hand output shaft to the engine, do not let the shaft hang. Assemble support bolts loosely, and by moving the flange end of the shaft up and down, and back and forth, find the center location. Hold the shaft in this position and then torque the bolts to 50 ft. lbs. on support and 14 ft. lbs. on brace. (Fig. 3EC-2A)

11. Connect drive axles to output shafts. Torque bolts to 65 ft. lbs.
12. Install engine oil filter element.
13. Raise hoist, remove floor stands and lower car.
14. If filler tube was removed, install a new "O" ring and install filler tube.
15. Connect battery.
16. Fill final drive with 4-1/2 pints of Lubricant No. 1050081 or equivalent.
17. Check engine oil level, start engine and check transmission fluid level. Add fluid as necessary.
18. Check for any oil leaks.

FINAL DRIVE (REMOVED FROM CAR)

Disassembly

1. Install adapter J-22296-1 on Differential Holding Fixture J-3289. Mount final drive in holding fixture as shown in Fig. 3EC-15.
2. Rotate housing so that pinion is up. Install tools as shown in Fig. 3EC-16, and turn torque wrench several turns and record torque reading. This combined pinion and side bearing pre-load reading will be helpful in determining cause of final drive failure. Remove tools and rotate carrier so that pinion is down.
3. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Fig. 3EC-17. Use a small button on the indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is in line as nearly as possible with gear rotation and perpendicular to tooth angle for accurate backlash reading.

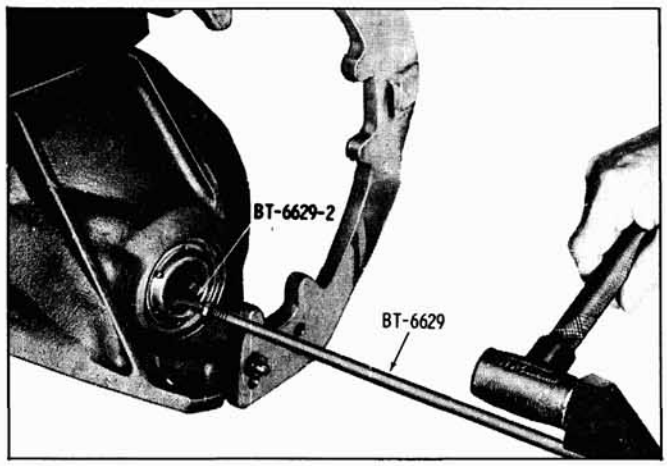


Fig. 3EC-25—Removing R.H. Output Shaft Seal

4. Check backlash at three or four points around ring gear. Lash must not vary over .002" around ring gear.

Pinion must be held stationary when checking backlash. If variation is over .002" check for burrs, uneven bolting conditions or distorted case and make corrections as necessary.

5. Remove side bearing cap bolts.

Bearing caps are of same size and must be installed in their original position. Mark right and left bearing caps to identify for reassembling. Keep the original bearing outer races with their corresponding caps.

6. Install Spreader on Housing as shown in Fig. 3EC-18.

Spreader must be modified with Tools J-22196-7-8.

7. Turn the Spreader screw to expand Spreader until the spacer and shim(s) can be removed from between the right side bearing and the housing. Retain spacers and shims for reassembly.

Spread housing only enough to relieve tension on the spacer and shims. The shims may be removed with Tool J-22608 as shown in Figs. 3EC-19 and 20.

8. Remove spreader from housing.

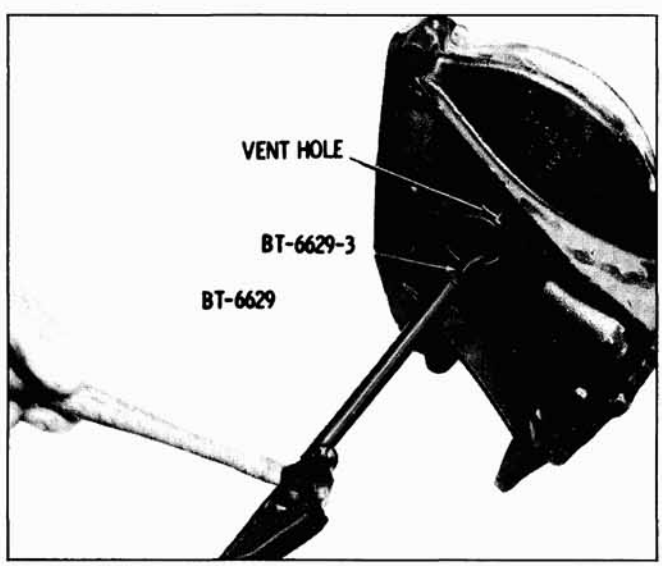


Fig. 3EC-26—Removing L.H. Output Shaft Seal

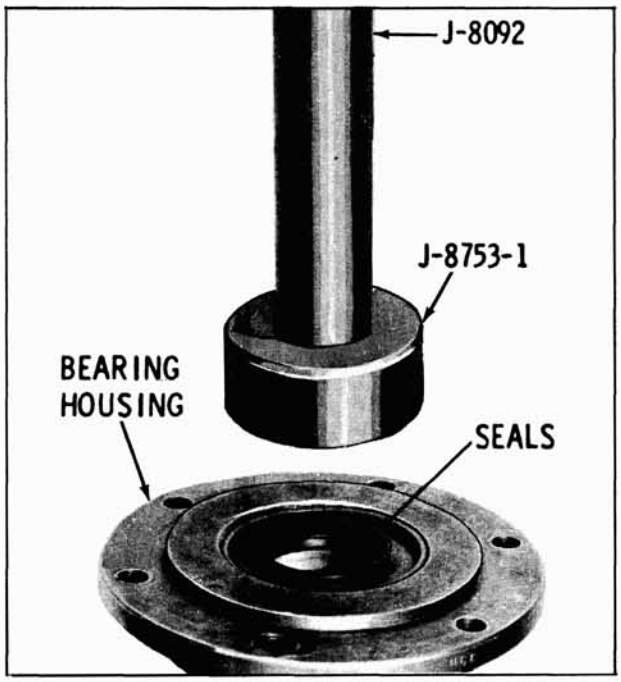


Fig. 3EC-27—Removing Oil Seals from Pinion Bearing Housing

9. Remove the spacer and shims, then slide the case assembly to the left, away from the pinion gear. Remove case assembly from housing.

10. Rotate housing so that the pinion is up. Check pinion bearing pre-load as shown in Fig. 3EC-21. Record the pinion bearing pre-load.

11. Remove the bearing housing bolts. Remove the drive pinion and housing as shown in Fig. 3EC-22. Remove housing from drive pinion. Remove "O" ring seal from bearing housing.

12. Remove seal and vent pin from housing. (Fig. 3EC-23)

13. Install Tool J-22201 on Slide Hammer J-2619. Position Tool J-22201 as shown in Fig. 3EC-24 and tighten screw. Remove pinion front bearing outer race.

14. Remove the output shaft oil seals as shown in Fig. 3EC-25 and 3EC-26.

15. Remove the two oil seals from the pinion bearing housing as shown in Fig. 3EC-27.

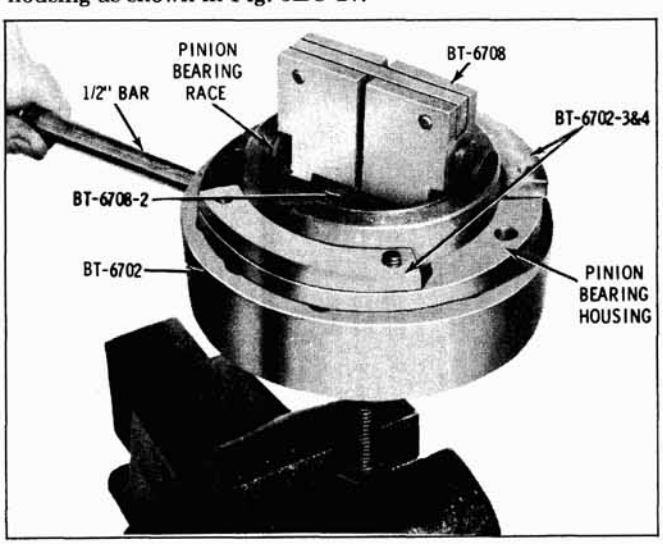


Fig. 3EC-28—Removing Rear Pinion Bearing Outer Race

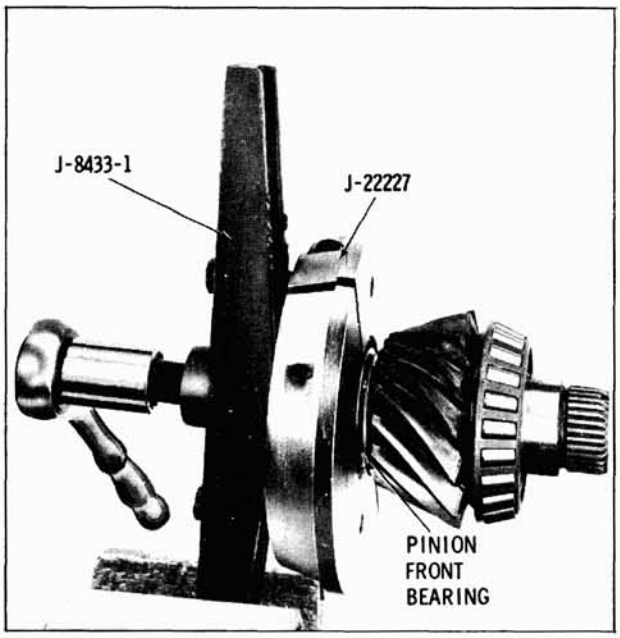


Fig. 3EC-29—Removing Pinion Front Bearing

16. If necessary to remove the pinion rear outer race, it can be removed as shown in Fig. 3EC-28.

PINION BEARINGS

Removal

1. Remove the pinion front bearing and selective shim as shown in Fig. 3EC-29. Bearing can be removed without Tool J-8433-1 if a press is available.

2. Remove the pinion rear bearing as shown in Fig. 3EC-30.

FINAL DRIVE CASE

Disassembly

1. If the side bearings are to be removed, they can be removed as shown in Fig. 3EC-31 and 3EC-32.

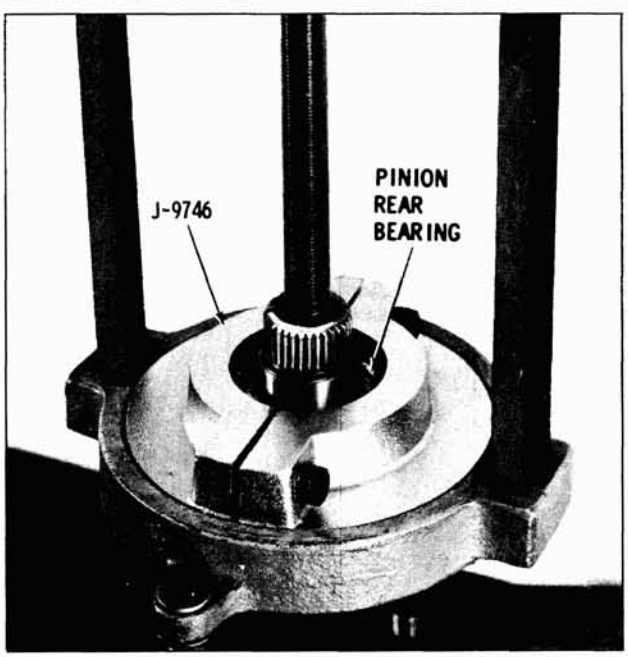


Fig. 3EC-30—Removing Pinion Rear Bearing

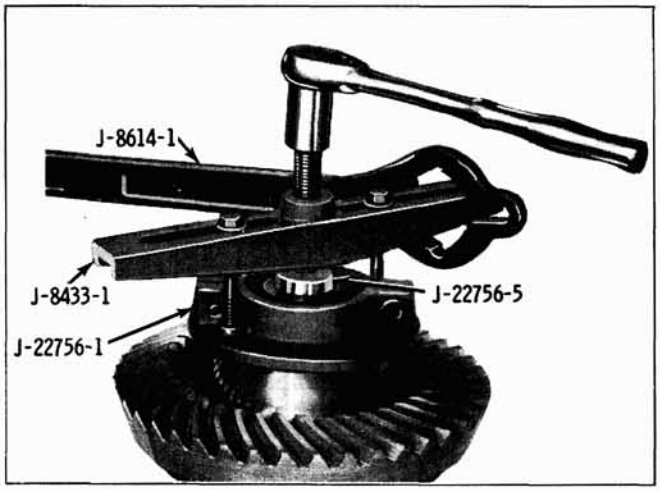


Fig. 3EC-31—Removing Left Side Bearing

2. Mark ring gear and case, then remove all but two of the case to ring gear bolts. Leave two of the bolts, 180° apart, loose.

Ring gear must be removed to remove pinion and side gears.

3. Position case as shown in Fig. 3EC-33 and tap lightly on a bench to separate the case from ring gear.
4. Remove the two remaining ring gear bolts and separate ring gear from case.
5. Drive lock pin from pinion shaft with a 3/16" punch. (Fig. 3EC-34)
6. Push pinion shaft out of case.
7. Rotate one pinion gear and shim towards access hole in case and remove.

Keep the corresponding shims and pinion gear together for correct assembly.

8. Remove the other pinion gear and shim.
9. Remove side gears keeping the same thrust washer with the side gear it is mated with. Inspect thrust washers and shims for wear and replace as necessary.

The left side gear has the threaded retainer that retains the (short) left output shaft. If threaded retainer is to be removed, use a brass drift and hammer to remove from left side gear.

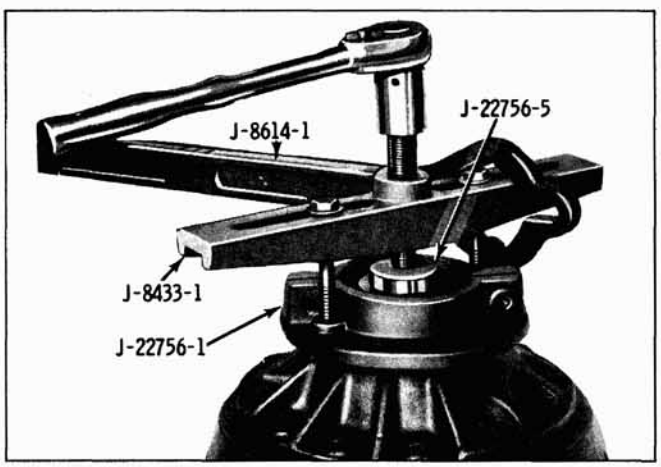


Fig. 3EC-32—Removing Right Side Bearing

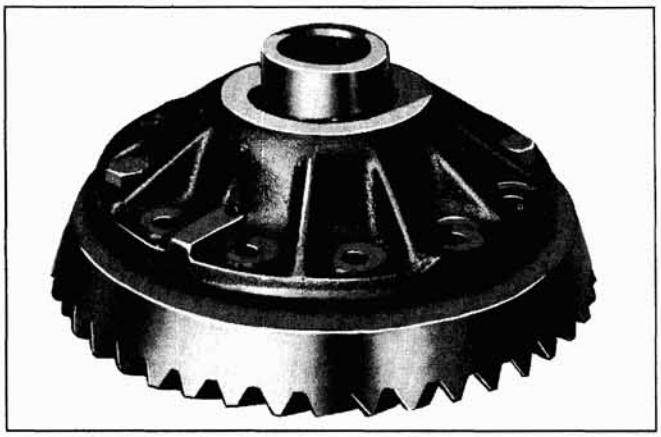


Fig. 3EC-33—Separating Ring Gear From Case

CLEANING AND INSPECTION

1. Clean all bearings thoroughly in clean solvent (Do not use a brush). Examine bearings visually and by feel. All bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.

Minute scratches and pits that appear on rollers and races at low mileage are due to the initial pre-load, and bearings having these marks should not be rejected.

2. Examine the ring gear and drive pinion teeth for excessive wear and scoring. Any of these conditions will require replacement of the gear set.

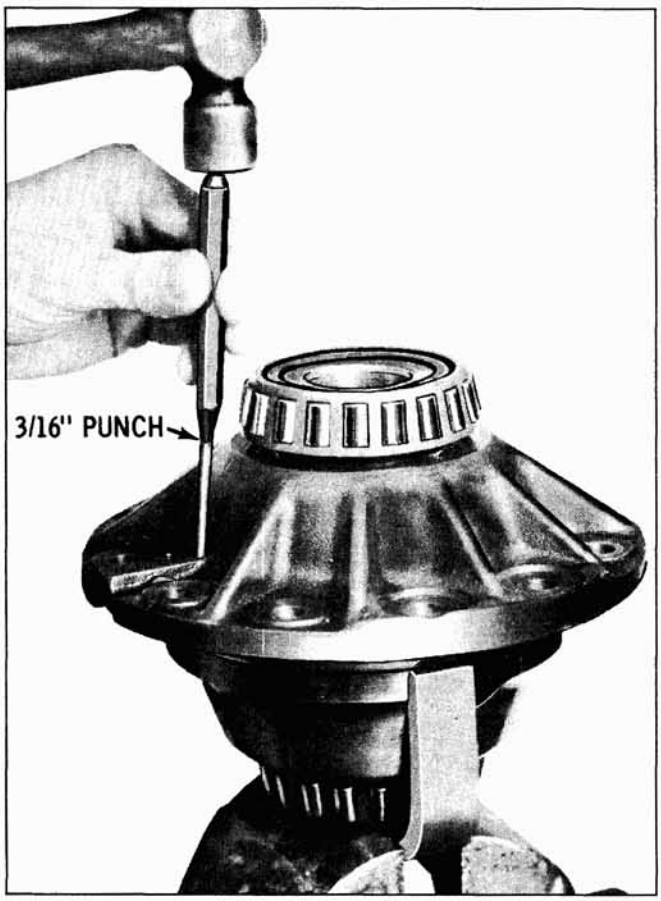


Fig. 3EC-34—Removing Lock Pin From Pinion Shaft

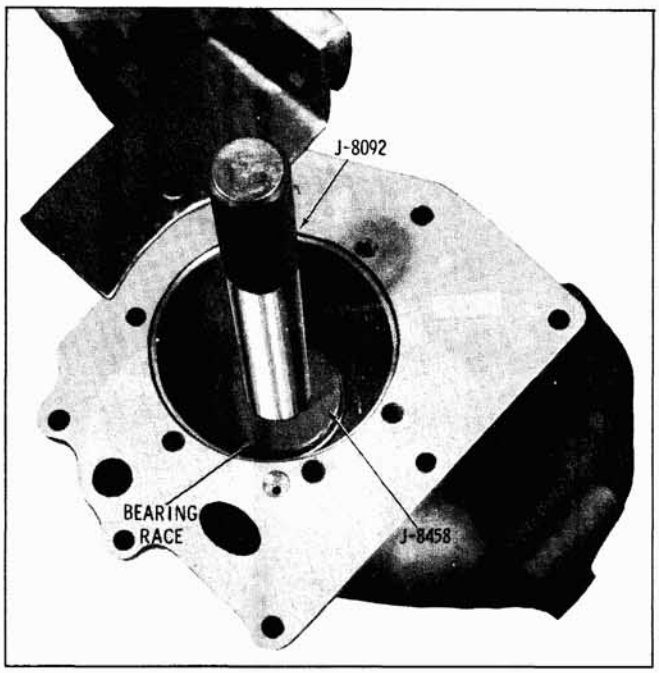


Fig. 3EC-35—Installing Pinion Front Bearing Outer Race

3. Examine housing bores and remove any burrs that might cause leaks around the OD of the seal.

4. Inspect the differential pinion shaft for unusual wear; also check the pinion and side gears and thrust washers.

5. Side bearings must be a tight press fit on the hub.

6. Diagnosis of a differential failure such as chipped bearings, loose (lapped-in) bearings, chipped gears etc. is a warning that some foreign material is present; therefore, the housing must be thoroughly cleaned and inspected.

CHECKING PINION DEPTH

1. Install pinion front outer race as shown in Fig. 3EC-35. Drive race until it bottoms.

2. Lubricate front bearing with final drive lubricant and install into front outer race.

3. Position Tool J-21777-10 on front bearing. Install Tool J-21579 on final drive housing and retain with two bolts. Thread screw J-21777-13 into J-21579 until tip of screw engages Tool J-21777-10. Torque screw J-21777-13 to 20 in. lbs. to pre-load bearing. (Fig. 3EC-36)

4. Remove dial indicator post from Tool J-21777-1 and install Discs J-21777-22 as shown in Fig. 3EC-37. Reinstall dial indicator post.

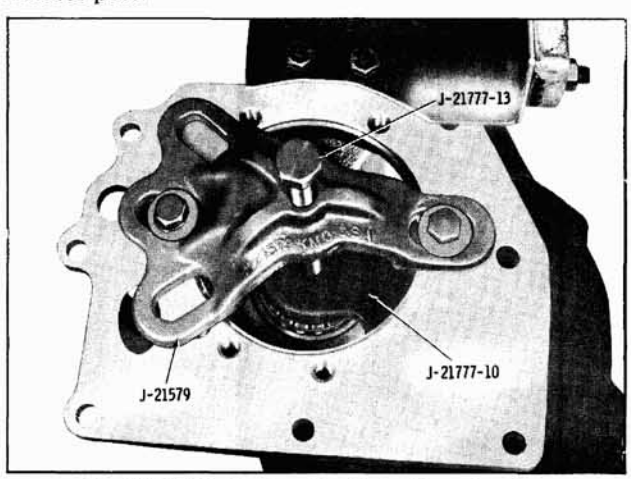


Fig. 3EC-36—Pre-Loading Pinion Front Bearing

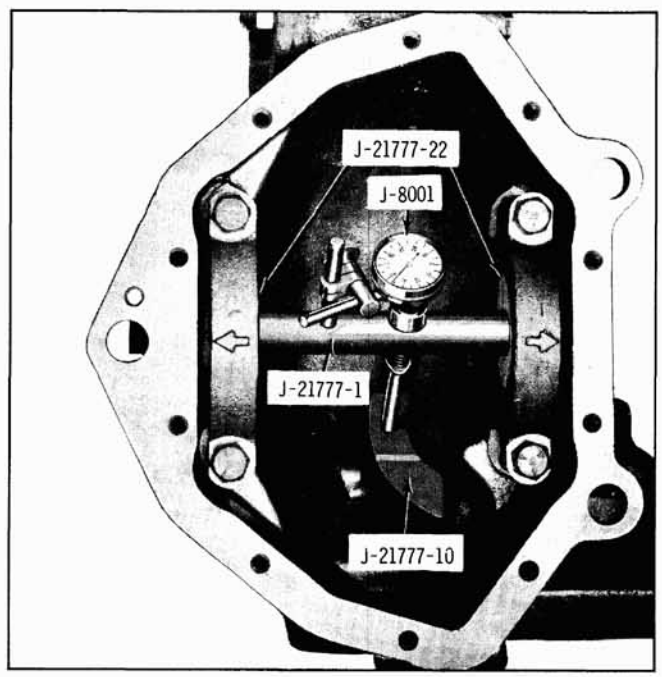


Fig. 3EC-37—Pinion Depth Gauge Installation

5. Place the gauging discs in the side bearing bores and install the side bearing caps.

6. Position the dial indicator, J-8001 on the mounting post of the gauge shaft and with the contact rod OFF the gauging area of J-21777-10. Set dial indicator on ZERO, then depress the dial indicator until the needle rotates 3/4 turn clockwise. Tighten the dial indicator in this position. RESET DIAL INDICATOR ON ZERO.

7. Position the gauge shaft assembly in the housing so that the dial indicator contact rod is directly in line with the gauging area BUT NOT ON and the discs seated fully in the side bearing bores.

8. Rotate the gauge shaft assembly until the dial indicator rod contacts the gauging area of J-21777-10. Rotate gauge shaft slowly back and forth until the dial indicator reads the greatest deflection.

9. At the point of greatest deflection, read the dial indicator directly for pinion depth.

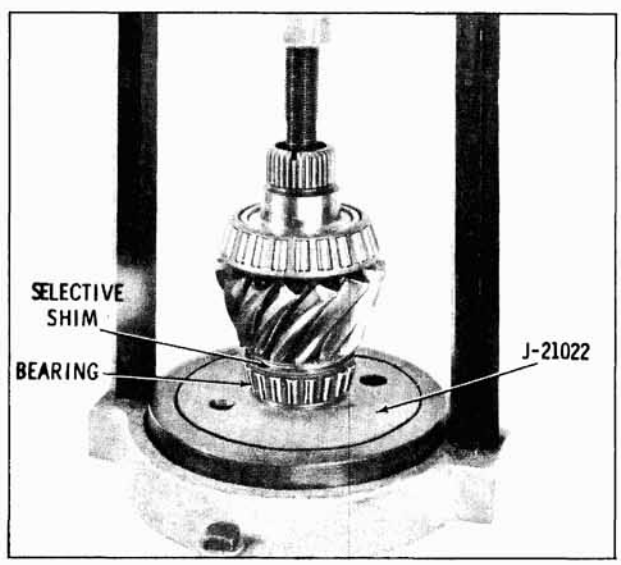


Fig. 3EC-38—Installing Pinion Front Bearing and Shim

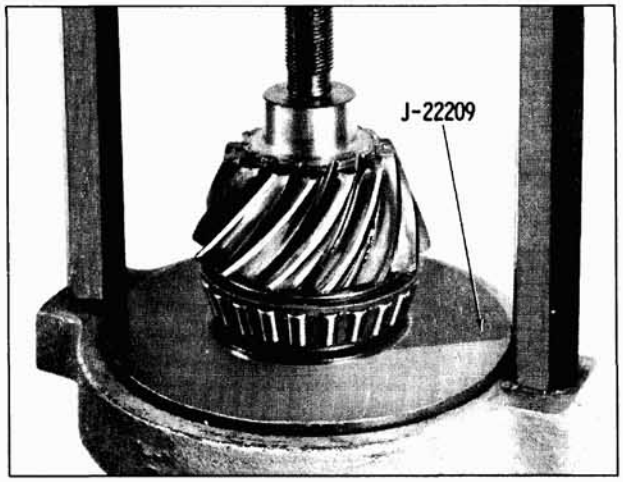


Fig. 3EC-39—Installing Pinion Rear Bearing

10. Select the correct pinion shim to be used during pinion reassembly on the following basis:

a. If a service pinion is being used, or a production pinion with no marking, the correct shim will have a thickness equal to the indicator gauge reading found in Step 9.

b. If a production pinion is being used and it is marked "+" or "–", the correct shim will be determined as follows:

Pinions marked "+" (plus) the shim thickness indicated by the dial indicator on the pinion setting gauge must be INCREASED by the amount etched on the pinion.

If the pinion is marked "-" (minus) the shim thickness indicated by the dial indicator on the pinion setting gauge must be DECREASED by the amount etched on the pinion.

11. Remove pinion depth checking tools and front bearing from housing.

12. Position correct shim on drive pinion and install the drive pinion front bearing as shown in Fig. 3EC-38.

Shims are available from .040" to .070" in increments of .002".

13. Install rear pinion bearing as shown in Fig. 3EC-39.

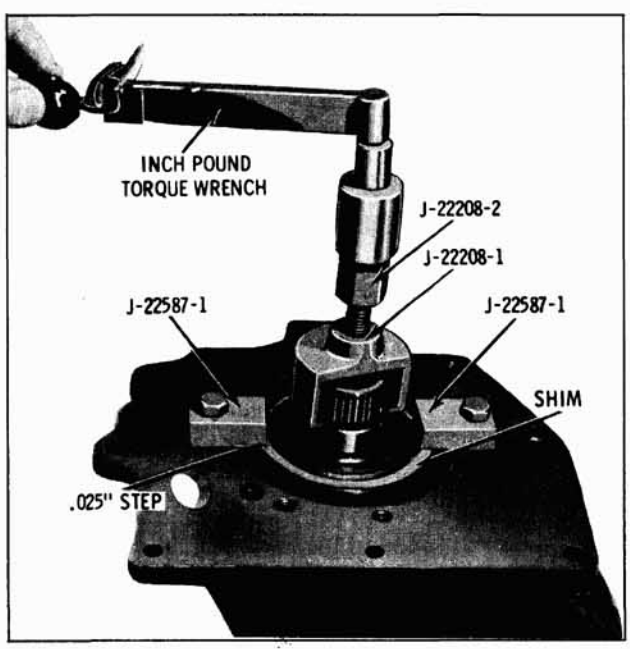


Fig. 3EC-40—Checking Shim Thickness for Pre-Load

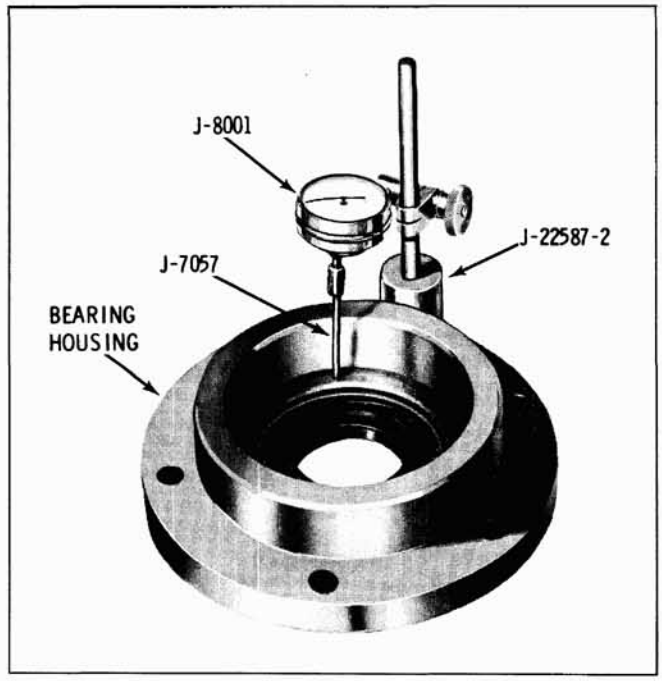


Fig. 3EC-41—Checking Inner Flange of Housing

PINION BEARING PRE-LOAD ADJUSTMENT

1. The pre-load shim will have to be changed or checked any time the following parts have been replaced:

a. Ring gear and pinion.
b. Pinion bearings (front or rear).
c. Rear bearing retainer.
d. Final drive housing.

2. Position pinion bearing race on pinion bearing and install Tool J-22587-1 as shown in Fig. 3EC-40. Using a feeler gauge check thickness between bearing race and Tool J-22587-1. Loosen bolts holding Tool J-22587-1 so that pinion bearing shim can be installed. Shims are available in sizes from .036" to .070" in increments of .002". Add shims until a pre-load of 2 to 5 in. lbs. is obtained. RECORD FINAL SHIM THICKNESS.

3. Remove Tool J-22587-1.

4. With dial indicator J-8001 and extension J-7057, attach existing dial indicator post to Tool J-22587-2. (Fig. 3EC-41). While holding contact studs (three) of Tool J-22587-2 firmly against shoulder of bearing housing, position dial indicator as shown in Fig. 3E-41 and rotate dial to ZERO.

5. Carefully lift dial indicator assembly over flange of bearing housing and position assembly as shown in Fig. 3EC-42. With the three contact studs held firmly against shoulder of bearing housing, read the dial indicator deflection. RECORD THIS DEFLECTION.

The following is an example of finding the correct pinion bearing pre-load with information obtained above.

.053"	(Shims recorded in Step 2)
+.024"	(Diff. in housing - Step 5)
.077"	
–.025"	(Built in step in Tool J-22587-1)
.052"	
–.002"	(To compensate for increase in pre-load when installing housing)
.050"	(Actual pinion bearing pre-load shim required)

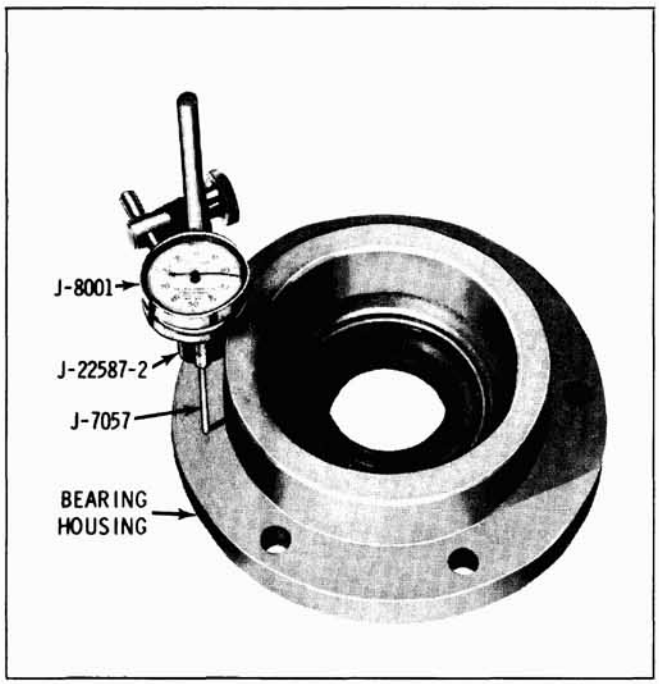


Fig. 3EC-42—Checking Outer Flange of Housing

6. Position shim into bearing housing and install pinion rear bearing outer race as shown in Fig. 3EC-43.
7. Install seals into bearing housing as shown in Fig. 3EC-44.
8. Install a new "O" ring seal on the bearing, housing.
9. Install seal and vent pin on face of housing. (Fig. 3EC-45)
10. Install seal protector J-22236 over drive pinion and install bearing housing over seal protector into position on the housing. Torque the attaching bolts to 35 ft. lbs. (Fig. 3EC-46)
11. Reinstall Tool J-22587-1 and recheck pinion pre-load. Must be within 2 to 5 in. lbs.

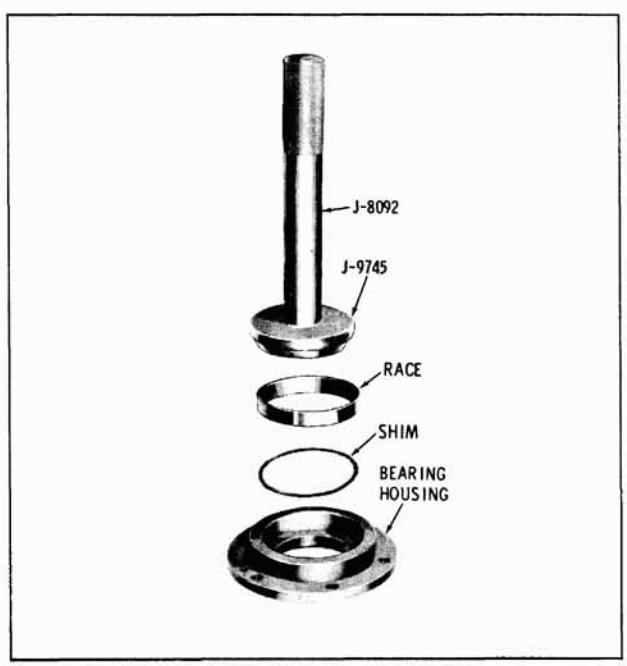


Fig. 3EC-43—Installing Rear Pinion Bearing Outer Race

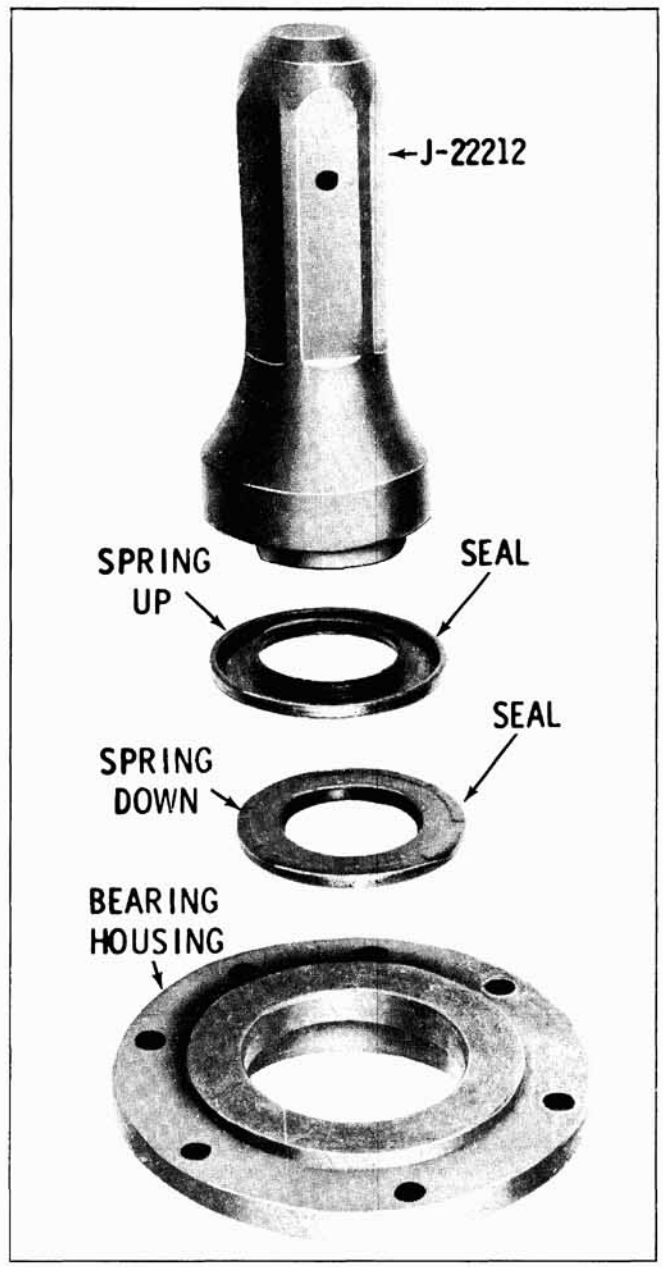


Fig. 3EC-44—Installing Seals into Bearing Housing

CASE ASSEMBLY

SIDE BEARING

Installation

1. Install the side bearings as shown in Figs. 3EC-47 and 48. Drive evenly until seated.

Do not let the bearing cock as it is being driven on. Excess metal could be wiped off the mounting surfaces and the bearing could become loose on the case.

SIDE AND PINION GEARS

Installation

Before assembling the differential case, lubricate all parts with Lubricant No. 1050081 or equivalent.

1. Place side gear thrust washers over side gear hubs and install side gears in case. If same parts are reused, install in original sides.

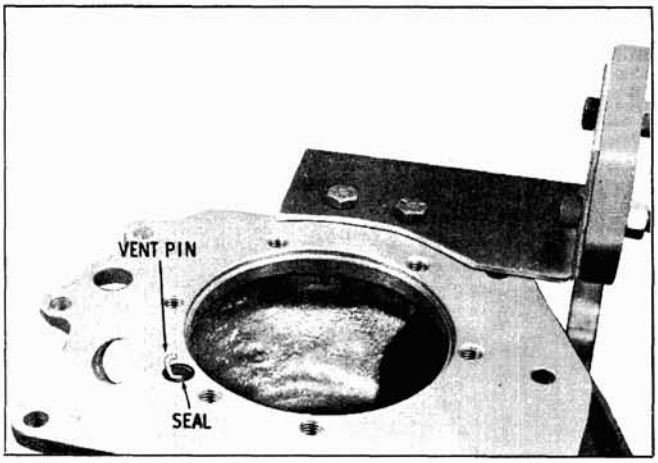


Fig. 3EC-45—Installing Seal and Vent Pin

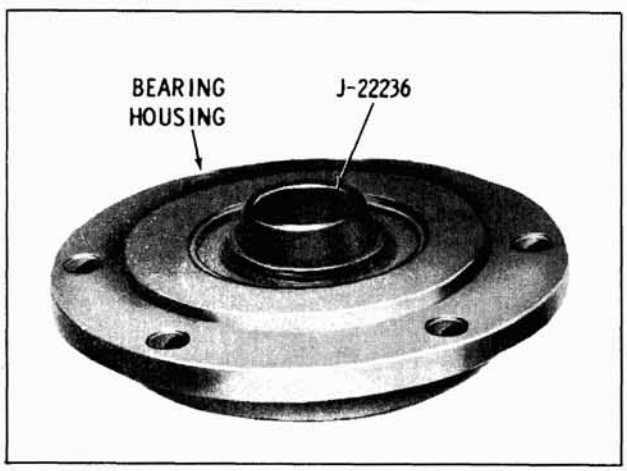


Fig. 3EC-46—Installing Bearing Housing to Housing

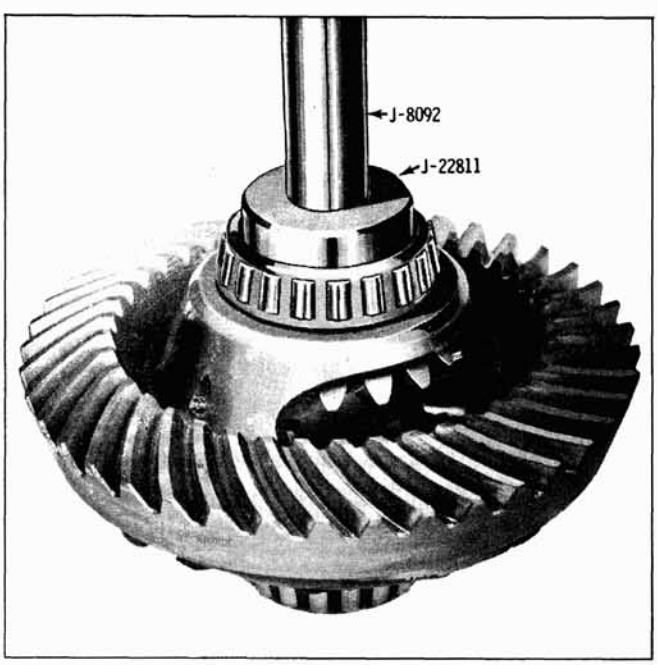


Fig. 3EC-47—Installing Left Side Bearing

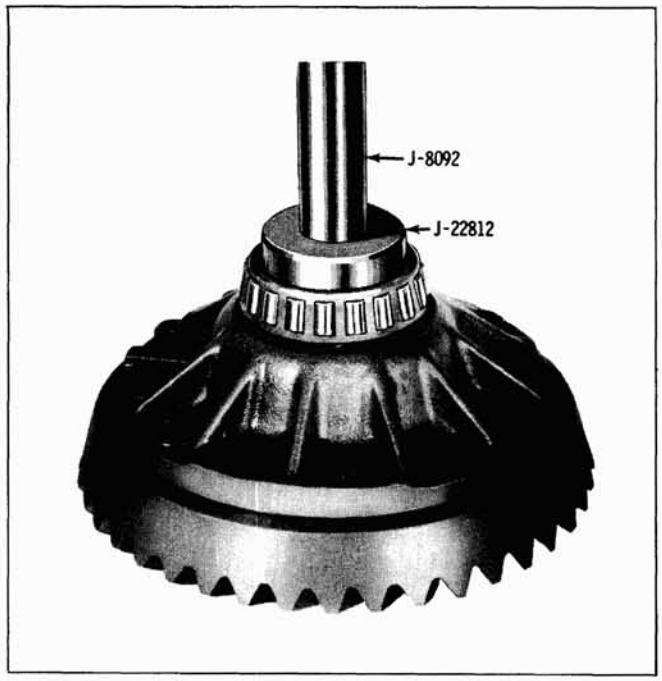


Fig. 3EC-48—Installing Right Side Bearing

Position side gear with threaded retainer on left side of case.

2. Position one pinion (without shims) between side gears and rotate gears until pinion is directly opposite from loading opening in case. Place other pinion between side gears so that pinion shaft holes are in line; then rotate gears to make sure holes in pinions will line up with holes in case.

3. If holes line up, rotate pinions back toward loading opening just enough to permit sliding in pinion gear shims.

4. Install pinion shaft. Drive pinion shaft retaining lock pin into position. (Fig. 3EC-49)

RING GEAR

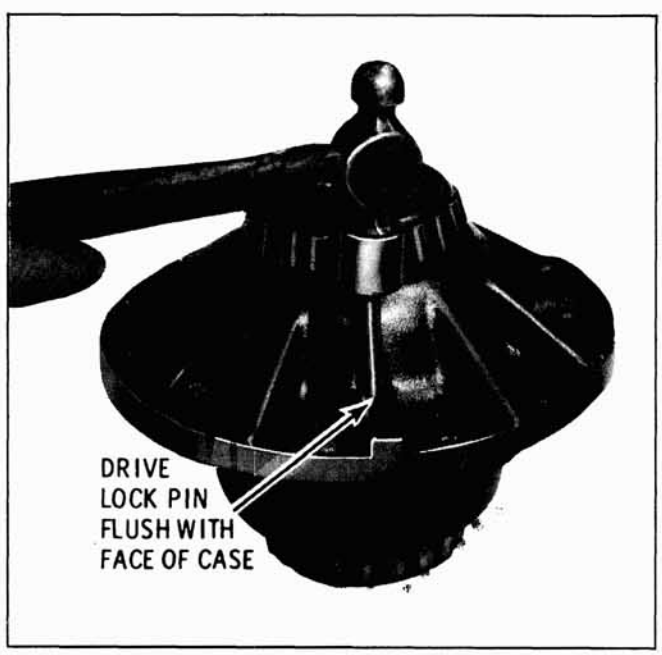


Fig. 3EC-49—Installing Lock Pin

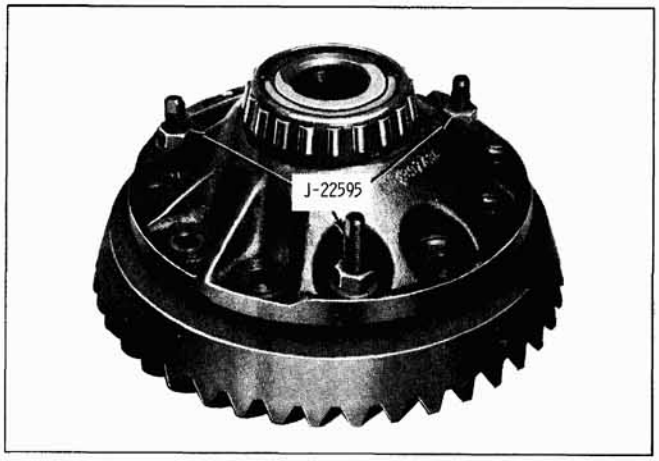


Fig. 3EC-50—Installing Ring Gear to Case

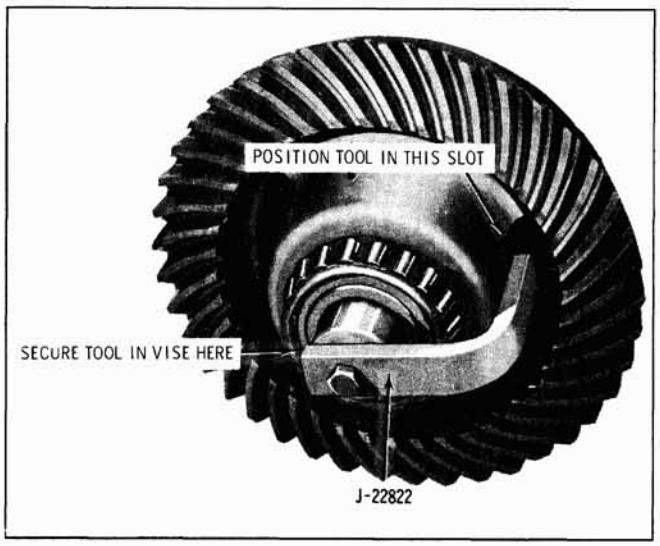


Fig. 3EC-50A—Installing Tool J-22822

Installation

1. After making certain that mating surfaces of case and ring gear are clean and free of burrs, install Tool J-22595 as shown in Fig. 3EC-50 to correctly position ring gear.

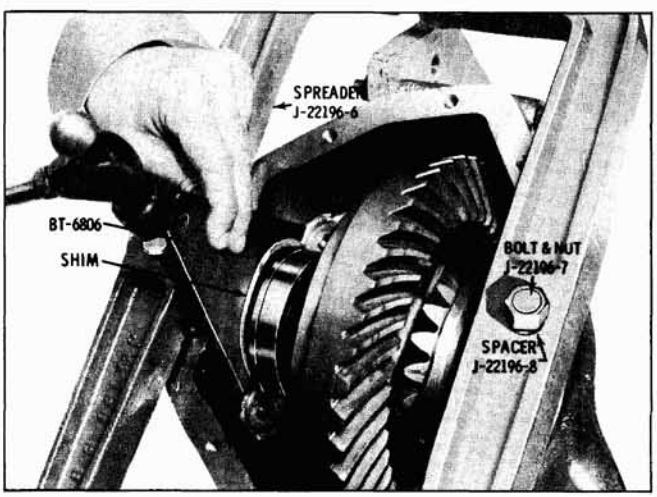


Fig. 3EC-51—Spreading Housing for Shim Installation

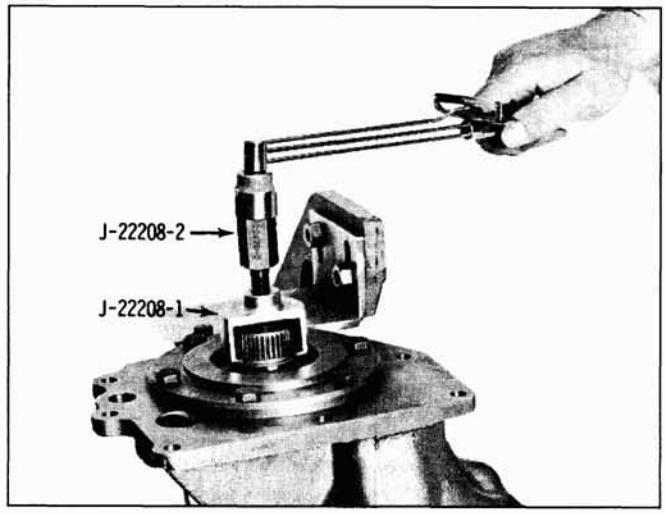


Fig. 3EC-52—Checking Pinion and Side Bearing Pre-Load

2. Install Tool J-22822 into a vise and place case assembly over tool as shown in Fig. 3EC-50A. Install new ring gear attaching bolts in remaining holes and then remove Tool J-22595. Install remaining three new bolts into ring gear and torque bolts alternately in progressive stages to 85 ft. lbs.

Tool J-22822 must be used to correctly torque ring gear bolts.

SIDE BEARING PRE-LOAD ADJUSTMENT

Differential side bearing pre-load is adjusted by means of shims placed between the side bearing and housing. Shims are used on both sides and 19 shims are available in increments of .002" from .038" to .074". Two spacers, .140" ±.005", are used, one on the right side and one on the left side. By adding or subtracting the same amount of shims from both sides, the ring gear to pinion backlash will not change.

1. Before installing the case assembly, make sure that side bearing surfaces in the housing are clean and free of burrs. Side bearings must be oiled with Lubricant No. 1050081 or equivalent. Turn fixture and housing so cover side is up.
2. Place differential case and bearing assemblies in position in housing.
3. Install the original spacers on left and right side. If the recorded side bearing pre-load was correct on disassembly. the original shims may be used.

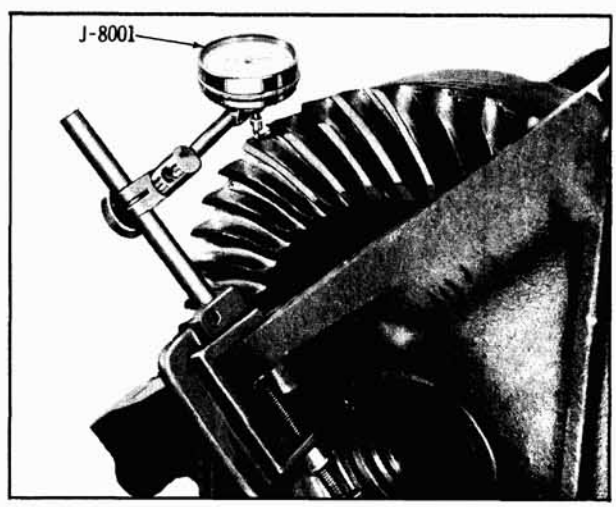


Fig. 3EC-53—Checking Ring Gear to Pinion Gear Backlash

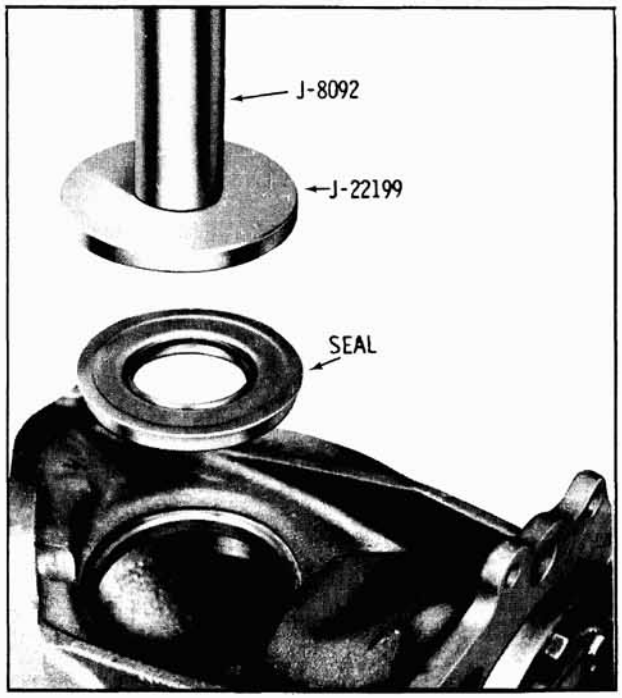


Fig. 3EC-54—Installing L.H. Output Shaft Seal

4. Install Spreader J-22196 on housing and spread housing just enough so that shim can be inserted between the spacer and the housing. (Fig. 3EC-51)

5. Release tension on spreader tool, install side bearing caps, then check pre-load as shown in Fig. 3EC-52. Pre-load should be 10 to 15 in. lbs. for new bearings, 5 to 7 in. lbs. for old bearings over the pinion bearing pre-load.

6. If pre-load is not within specifications, obtain proper combination of shims, either thicker or thinner, until side bearing pre-load is 10 to 15 in. lbs. for new bearings, 5 to 7 in. lbs. for old bearings over the pinion bearing pre-load.

BACKLASH ADJUSTMENT

1. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Fig. 3EC-53. Use a small button on the indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is in line as nearly as possible with gear rotation and perpendicular to tooth angle for accurate backlash reading.

2. Check backlash at three or four points around ring gear. Lash must not vary over .002" around ring gear.

Pinion must be held stationary when checking backlash. If variation is over .002" check for burrs, uneven bolting conditions or distorted case and make corrections as necessary.

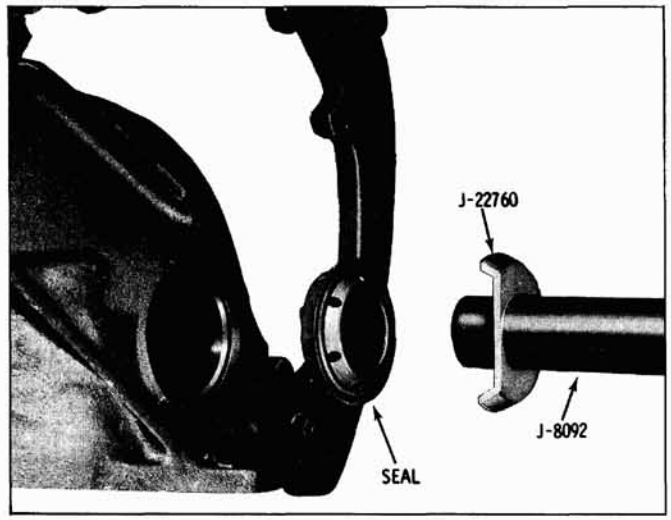


Fig. 3EC-55—Installing R.H. Output Shaft Seal

3. Backlash at the point of minimum lash should be between .005" and .009" for all new gears. If original ring gear and pinion was installed, backlash should be set at the same reading obtained in Step 4 of the Final Drive Disassembly procedure, provided reading was within specifications.

4. If backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. This will maintain correct differential side bearing pre-load.

For each .001" change in backlash desired, transfer .002" in shim thickness. To decrease backlash .001", decrease thickness of right shim .002" and increase thickness of left .002". To increase backlash .002" increase thickness of right shim .004" and decrease thickness of left shim .004".

5. When backlash is correctly adjusted, remove spreader. Install the bearing caps and bolts. Torque to 65 ft. lbs.

6. Install new output shaft seals as shown in Fig. 3EC-54 and 3EC-55.

Left output shaft seal is installed with vent hole toward top of final drive housing in the in car position.

7. Install new gasket on housing. Install cover, torque cover bolts to 25 ft. lbs. Fill final drive to proper level with the specified lubricant.

If final drive was removed without removing the transmission, do not install gasket, cover or lubricant until final drive has been installed in car.

TORQUE SPECIFICATIONS

APPLICATION	FT. LBS.
Final Drive Cover Bolts	25
Side Bearing Cap Bolts	65
Bearing Housing Bolts	35
Ring Gear Bolts	85
Drive Axle to Output Shaft Bolts	65
Final Drive Support Bracket to Engine Bolt	50
Final Drive to Support Bolt	105
RH Output Shaft Support to Engine Bolts	50
RH Output Shaft Brace to Final Drive and Support Bolts	14
LH Output Shaft Retainer Bolt	40
Final Drive to Transmission Bolts and Nuts	25

FINAL DRIVE SPECIFICATIONS

LUBRICATION	
Capacity	4-1/2 Pints
Replenish	Special Lubricant, No. 1050081 or equivalent
ADJUSTMENTS	
Backlash	.005" to .009"
Pinion Bearing Pre-load	
New Bearings	2 to 5 in. lbs.
Old Bearings	2 to 3 in. lbs.
Side Bearing Pre-load	
New Bearings	10 to 15 in. lbs. over Pinion Bearing Pre-load
Old Bearings	5 to 7 in. lbs. over Pinion Bearing Pre-load
GEAR RATIO	**43:14—3.07**

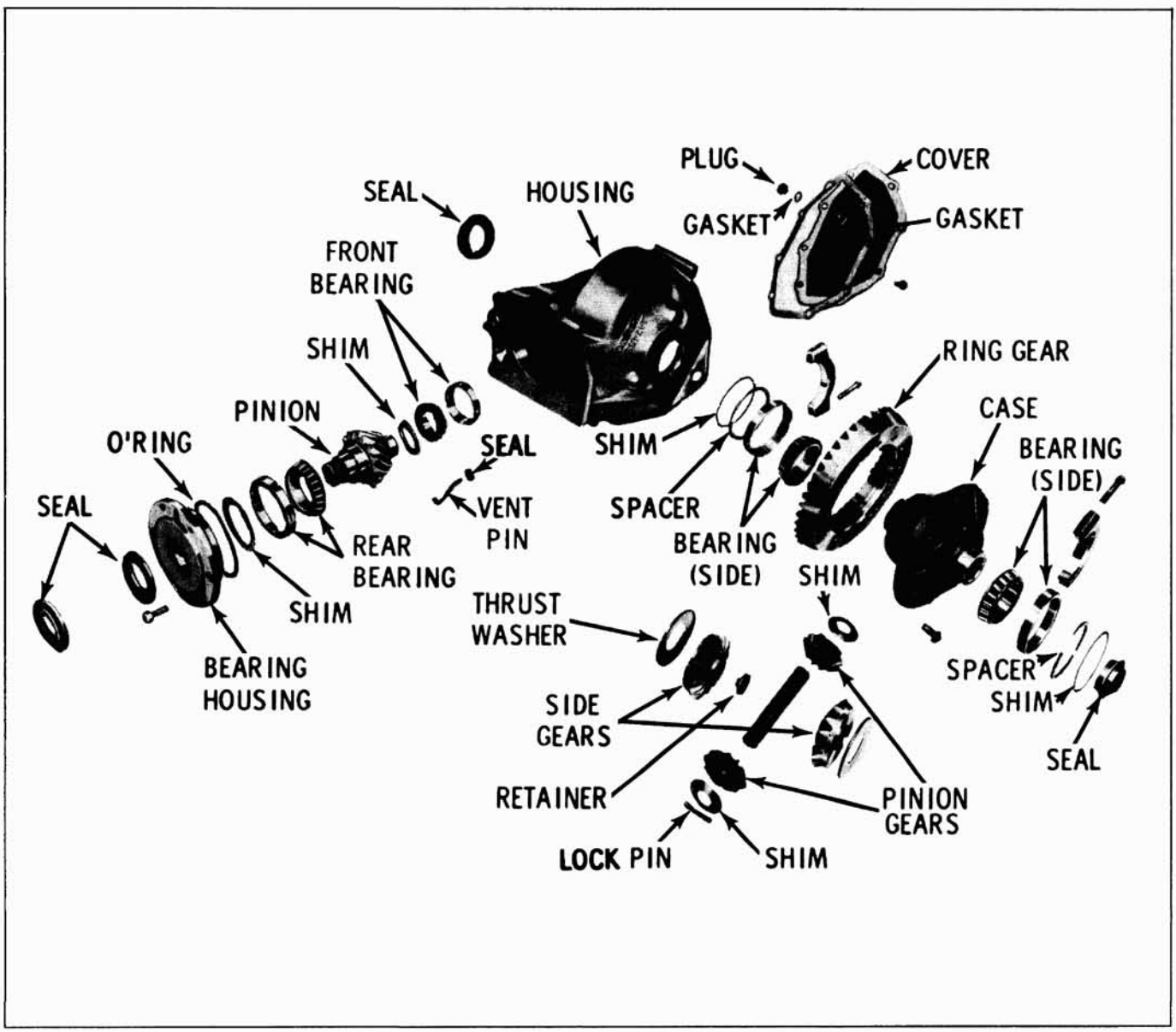
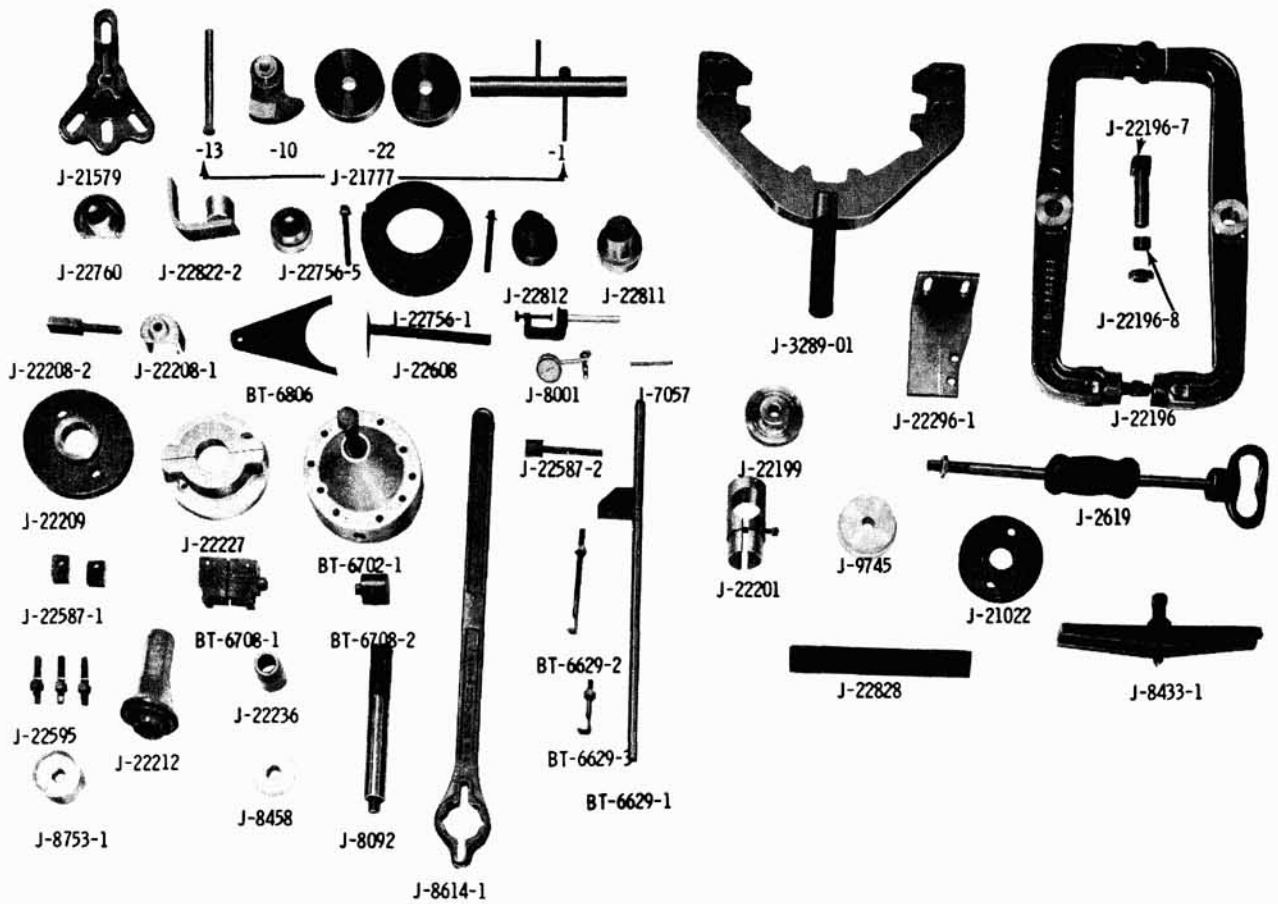


Fig. 3EC-56—Final Drive Assembly



J-2619	SLIDE HAMMER	J-22196-7-8	HOUSING SPREADER
J-3289-01	HOLDING FIXTURE	J-22199	LEFT OUTPUT SHAFT SEAL INSTALLER
BT-6629-1-2-3	SEAL REMOVER	J-22201	FRONT PINION BEARING RACE REMOVER
BT-6702	FRONT HUB BEARING PULLER SET	J-22208-1-2	ADAPTER
BT-6708-1	PINION BEARING CUP REMOVER	J-22209	PINION BEARING INST.
BT-6708-2	PINION BEARING CUP REMOVER	J-22212	PINION SEAL INST.
BT-6806	SIDE BEARING SHIM INST.	J-22227	FRONT PINION BEARING REMOVER
J-7057	EXTENSION	J-22236	PINION OIL SEAL PROTECTOR
J-8001	DIAL INDICATOR	J-22296-1	HOLDING FIXTURE ADAPTER
J-8092	DRIVER HANDLE	J-22587-1-2	PINION BEARING PRELOAD GAUGE SET
J-8433-1	PULLER	J-22595	RING GEAR INSTALLER STUDS
J-8458	RACE INSTALLER	J-22608	SIDE BEARING SHIM REMOVER
J-8614-1	COMPANION FLANGE HOLDER	J-22756-1-5	SIDE BEARING REMOVER
J-8753-1	TIMING CASE COVER SEAL INSTALLER	J-22760	R.H. OUTPUT SHAFT SEAL INST.
J-9745	RACE INSTALLER	J-22811	R.H. SIDE BEARING INST.
J-21022	FRONT PINION BEARING INSTALLER	J-22812	L.H. SIDE BEARING INST.
J-21579	PINION BEARING PRELOAD TOOL	J-22822-2	CARRIER HOLDER
J-21777-1-10-13-22	PINION SETTING TOOLS	J-22828	AXLE BRG. AND SLINGER INST.

Fig. 3EC-57—Tools

REAR SUSPENSION

TORONADO

CONTENTS OF SECTION 4E

Subject	Page	Subject	Page
PERIODIC MAINTENANCE	4E-2	INSTALLATION	4E-4
WHEEL BEARING ADJUSTMENT	4E-2	HORIZONTAL SHOCK	4E-4
HUB AND DRUM ASSEMBLY	4E-2	REMOVAL	4E-4
REMOVAL (WHEEL REMOVED)	4E-2	INSTALLATION	4E-4
BEARING AND SEAL REMOVAL	4E-2	LEAF SPRING	4E-4
CLEANING AND INSPECTION	4E-2	REMOVAL	4E-4
BEARING AND SEAL INSTALLATION	4E-2	INSTALLATION	4E-4
HUB AND DRUM INSTALLATION	4E-2	BUSHING - FRONT	4E-4
HUB BOLT REPLACEMENT	4E-3	REMOVAL	4E-4
REAR WHEEL SPINDLE (ON THE CAR)	4E-3	INSTALLATION	4E-4
REMOVAL	4E-3	REAR AXLE	4E-4
INSTALLATION	4E-3	REMOVAL	4E-4
VERTICAL SHOCK	4E-3	INSTALLATION	4E-4
REMOVAL	4E-6	TORQUE SPECIFICATIONS	4E-5

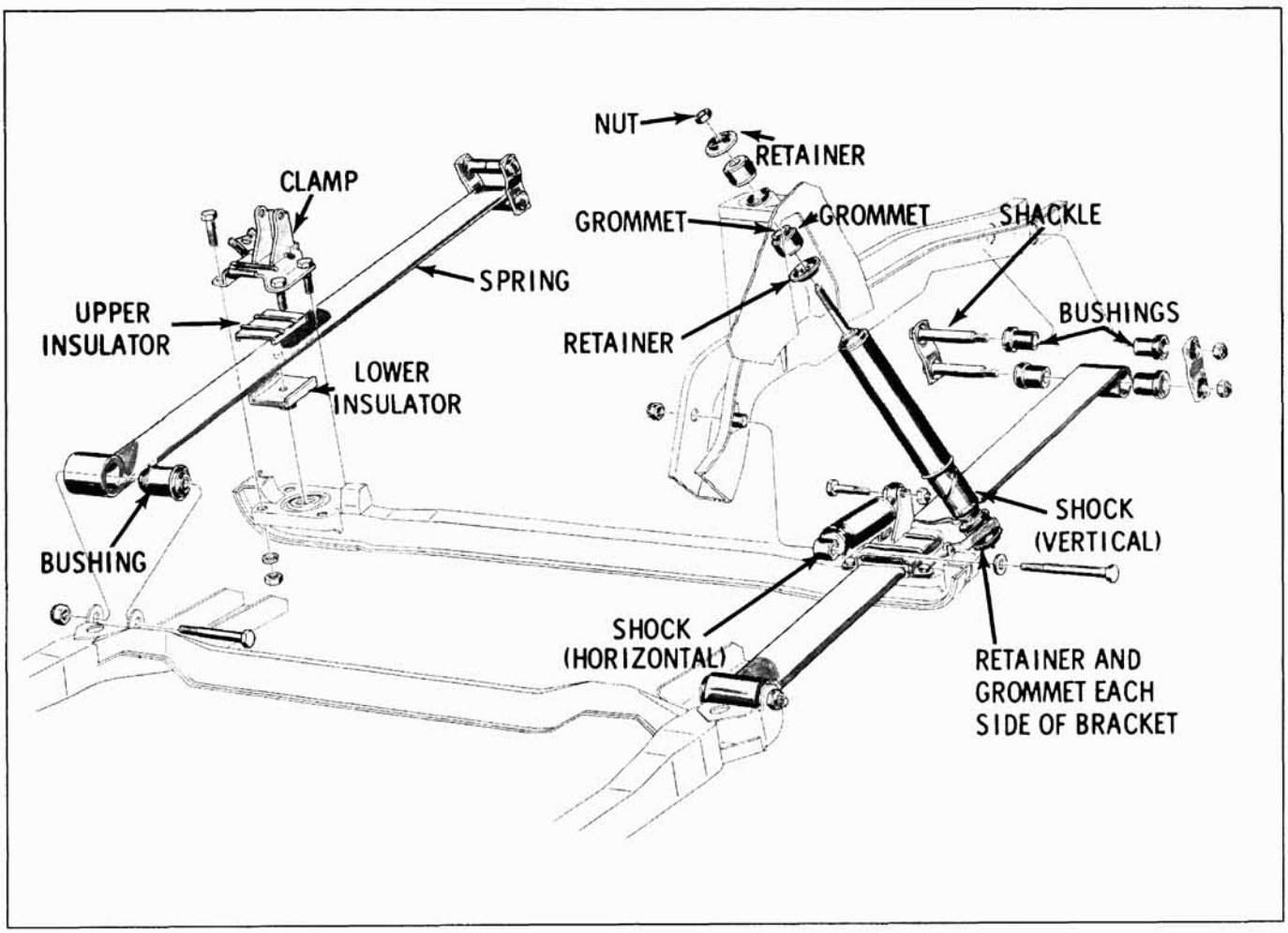


Fig. 4E-1—Rear Suspension - Toronado

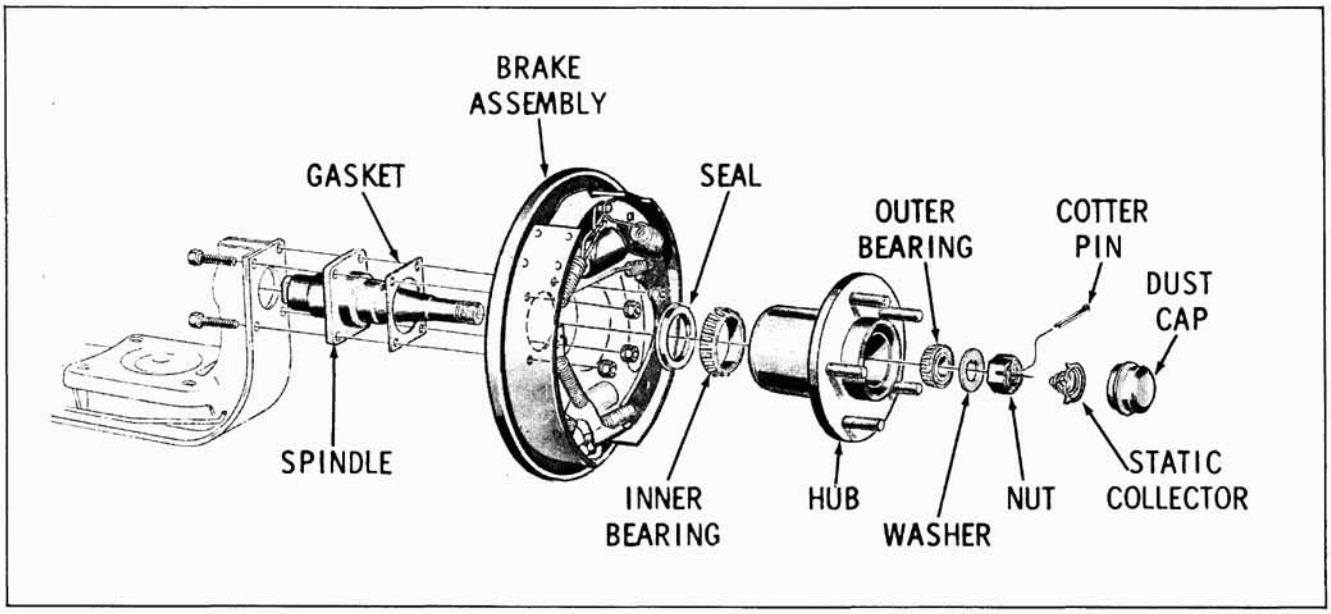


Fig. 4E-2—Rear Hub and Spindle - Toronado

REAR SUSPENSION

PERIODIC MAINTENANCE

A periodic rear wheel bearing repack is not required. However, when major brake service is being performed, it is recommended that the rear wheel bearings be cleaned and repacked with a Lithium E.P. grease.

WHEEL BEARINGS

The proper functioning of the rear suspension cannot be maintained unless the rear wheel taper roller bearings are correctly adjusted. Cones must be a slip fit on the spindle and the inside diameter of the cones should be lubricated to insure that the cones will creep. Spindle nut must be a free-running fit on threads.

Adjustment

The adjustment of the rear wheel bearings should be made WHILE REVOLVING THE WHEEL AT LEAST THREE TIMES THE SPEED OF NUT ROTATION when making the torque readings as follows:

1. Tighten adjusting nut with a torque wrench 25 to 30 ft. lbs. to insure that all parts are properly seated and threads are free.
2. Back off nut 1/2 turn. Retighten nut finger tight.
3. If unable to install cotter pin at finger tight position, back off to first securing position.

HUB AND DRUM ASSEMBLY

Removal (Wheel Removed)

1. Remove dust cap from hub.
2. Remove cotter pin, nut and washer from spindle.
3. Reinstall dust cap and carefully pull hub and drum assembly from spindle.

It may be necessary to back off the brake shoe adjustment before the hub and drum can be removed.

BEARING AND SEAL

Removal

1. Remove dust cap and remove the outer bearing inner race and the roller and separator assembly from hub.
2. Pry seal from hub; then remove inner bearing inner race and roller and separator assembly from hub.
3. If necessary to remove outer races, insert a brass drift into hub, indexing end of drift into notches in hub behind bearing outer race and tap with a hammer. Tap alternately on each side of bearing race. (Fig. 4E-4)

CLEANING AND INSPECTION

For inspection of rear drums, refer to BRAKE DRUMS, Section 5.

1. Wash all parts in clean solvent with the exception of the roller and separator assemblies and races and air dry. Roller and separator assemblies and races should be washed in gasoline.
2. Check bearings for cracked separators and worn or pitted rollers.
3. Check bearing races for cracks, scores or a brinelled condition.

BEARING AND SEAL

Installation

1. If the outer races were removed, drive or press the races into the hub as shown in Fig. 4E-6.
2. Lubricate the bores of the inner races and fully pack the roller and separator assemblies with a Lithium E.P. grease.
3. Install inner bearing roller and separator assembly into outer race; then install inner bearing into race.
4. Carefully tap seal into hub. (Fig. 4E-6)
5. Clean any traces of grease from brake lining and drum with fine sandpaper. If necessary to adjust brake linings, refer to BRAKE LINING - Adjust, Section 5.

HUB AND DRUM

Installation

1. Position hub and drum assembly over spindle.
2. Install outer bearing roller and separator into hub.
3. Install outer bearing inner race over spindle; then install the washer and spindle nut. Draw spindle nut up snug

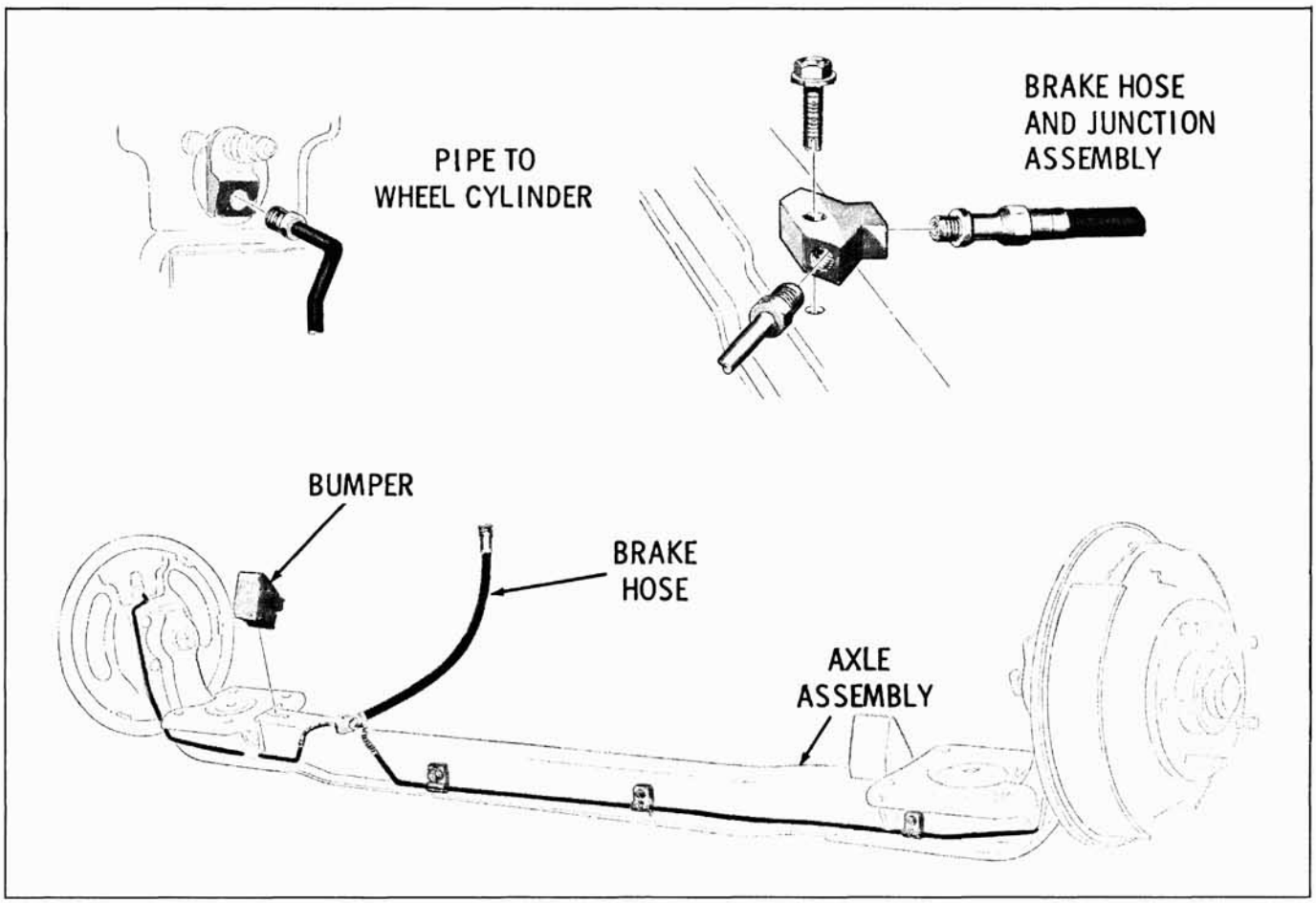


Fig. 4E-3—Rear Axle Brake Line Routing - Toronado

and adjust bearing as outlined under WHEEL BEARING ADJUSTMENT.

HUB BOLT REPLACEMENT

1. With the hub and drum removed, drill a 5/8" hole 1/4" deep into the head of the hub bolt.
2. Support hub and drive or press hub bolt out through the front of the hub.
3. Press a new hub bolt into the hub.
4. While supporting hub bolt, peen hub bolt with the use of Peening Tool J-554-13. (Fig. 4E-5)

REAR WHEEL SPINDLE (ON THE CAR)

Removal

1. Hoist rear of car and support with floor stand under frame pad.
2. Remove wheel and drum.
3. Remove hub assembly.
4. Disconnect brake line fitting at wheel cylinder. (Fig. 4E-3)
5. Remove four attaching bolts, backing plate to spindle. (Fig. 4E-2)
6. Place backing plate out of the way.
7. Place hydraulic jack under axle.
8. Remove four attaching bolts from center spring clamp assembly. (Fig. 4E-1)
9. Remove rubber insulator from spring.
10. Lower hydraulic jack until spindle is clear of spring and spindle is accessible for removal.
11. Drive spindle out of axle, with a hammer.

Installation

1. Start new spindle, with keyway up, into axle and install the four bolts (backing plate to spindle). Tighten bolts progressively one turn each until spindle is fully seated.
2. Remove bolts.
3. Position insulators on spring. Tape if necessary to secure.
4. Raise rear axle until spring aligning pin locates into axle.
5. Replace four attaching bolts into center spring clamp assembly. Torque nuts to 30 ft. lbs.
6. Install backing plate on spindle. Torque nuts to 35 ft. lbs.
7. Connect brake line to wheel cylinder.
8. Install hub assembly. For correct torque, refer to REAR WHEEL BEARING ADJUSTMENT.
9. Install drum and wheel. Torque wheel nuts to 115 ft. lbs.
10. Bleed wheel cylinder and add fluid as necessary. Check for Leaks.
11. Remove floor stands.

VERTICAL SHOCK

Removal

1. Using Tool BT-6515, remove upper attaching nut (inside of trunk). (Fig. 4E-1)

Before removing shocks the rear axle must be supported to prevent stretching of brake hose. Raise car and remove wheel.

2. Remove lower nut, retainer and grommet, Fig. 4E-1, and remove shock.
3. Remove grommet and retainer from shock.

Installation

Reverse removal procedure. Torque upper and lower nuts to 10 ft. lbs.

HORIZONTAL SHOCK

Refer to Front Suspension, Section 3EA, for code and usage.

Removal

1. Raise car and remove wheel.
2. Remove two attaching bolts, front and rear. (Fig. 4E-1)

Installation

Reverse removal procedure. Torque nuts to 40 ft. lbs.

LEAF SPRING

Removal

1. Raise car and support with floor stand on frame pad.
2. Using hydraulic jack under axle, remove wheel.
3. Remove nut only from front of rear spring. (Fig. 4E-1)
4. Remove two attaching nuts on rear shackle (outer). (Fig. 4E-1)
5. Remove rear shackle (outer).
6. Remove four attaching bolts on center clamp assembly. (Fig. 4E-1)
7. Lift center clamp assembly up, shock will retain it in position.
8. Remove resonator bracket attaching bolts to frame and allow resonator to hang loose.
9. Lower hydraulic jack until axle is free from spring.
10. Remove shackle assembly from spring and body.
11. Remove bolt from front of rear spring and remove spring.
12. Remove bushing and replace if worn or damaged. Refer to Bushing - Front-Removal, Step 5.

Installation

1. Install rear bushings in spring and frame.

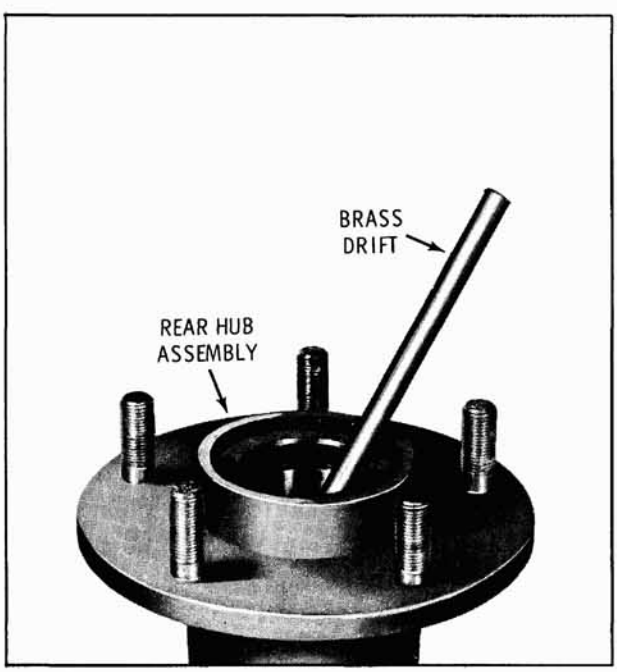


Fig. 4E-4—Rear Hub Assembly

2. Install front bushings. Refer to Bushing - Front (Removal, Step 5 for Procedure for Expanding Spring Loop so that Bushing can be Driven into Position.)
3. Place spring into position at front attachment and install bolt and nut. Do not torque.
4. Position rear of spring so that shackle assembly can be inserted.
5. Install shackle (outer) and nuts. Do not torque.
6. Install resonator bracket attaching bolts. Torque to 10 ft. lbs.
7. Attach insulators to each side of spring, tape together if necessary.
8. Raise hydraulic jack under axle until aligning tang on spring enters hole in axle.
9. Pull center clamp assembly down towards axle until the four attaching bolts can be inserted. Torque nuts to 30 ft. lbs.
10. Install wheel. Torque nuts to 115 ft. lbs.
11. Remove floor stands and hydraulic jack.

With weight of car on the wheels, torque nuts as specified below.

Rear Shackle Nuts	40 ft. lbs.
Front of Spring Nut	80 ft. lbs.

BUSHING-FRONT (IN CAR)

Removal

1. Raise car and support with floor stand on frame pad. Leave hoist under axle.
2. Disconnect vertical shock at lower attachment.
3. Remove front bushing attaching bolt.
4. Lower hoist until spring is below frame attaching bracket.

Care must be exercised when lowering hoist so that brake hose is not stretched or damaged.

5. Using small chisels or screwdrivers, wedge between edge of spring and outside of loop expanding loop so that bushing can be driven out with a hammer.

It may be necessary to block spring loop down with a block of wood to gain clearance for bushing.

Installation

To install, reverse removal procedure.

REAR AXLE

Removal

1. Lift car and use floorstands at both rear frame pads ahead of wheel opening.
2. Remove wheels, drum and hub assemblies.
3. Disconnect brake lines at wheel cylinders.
4. Disconnect parking brake cable at equalizer.
5. Remove backing plate attaching bolts and let backing plates rest on floor.
6. With hydraulic jack under center of axle, remove eight attaching bolts from center spring clamp assemblies.
7. Disconnect rubber brake hose at underbody bracket.
8. Lower jack and remove axle assembly from rear of car.
9. Remove brake line assembly and bumpers from axle.
10. Spindles can be driven from axle at this time. Brace axle end being driven to reduce bounce.

Installation

1. Insert spindle, with keyway up, into axle. (Fig. 4E-2) Using backing plate attaching bolts, progressively tighten until spindle is fully seated. Remove bolts for use later.
2. Install bumpers.

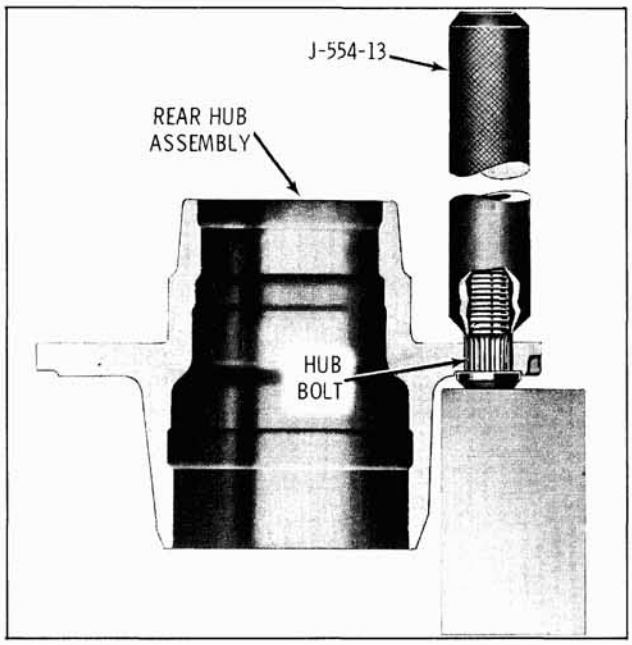


Fig. 4E-5—Hub Bolt Replacement

3. Install brake line assembly and torque junction bolt to 14 ft. lbs.
4. Place axle assembly on hydraulic jack and position axle under spring until spring aligning tangs engage. Raise jack slightly to hold axle in alignment.
5. Install center spring clamp assembly. Torque eight attaching nuts to 30 ft. lbs.
6. Install backing plates. Torque nuts to 35 ft. lbs.
7. Install brake lines to wheel cylinders.
8. Install rubber brake hose at Underbody Connector.
9. Install equalizer on parking brake cable and secure.
10. Install hub and drum assemblies. Refer to WHEEL BEARING ADJUSTMENT.
11. Bleed both wheel cylinders. Add brake fluid as necessary.
12. Install wheel. Torque wheel nuts to 115 ft. lbs.

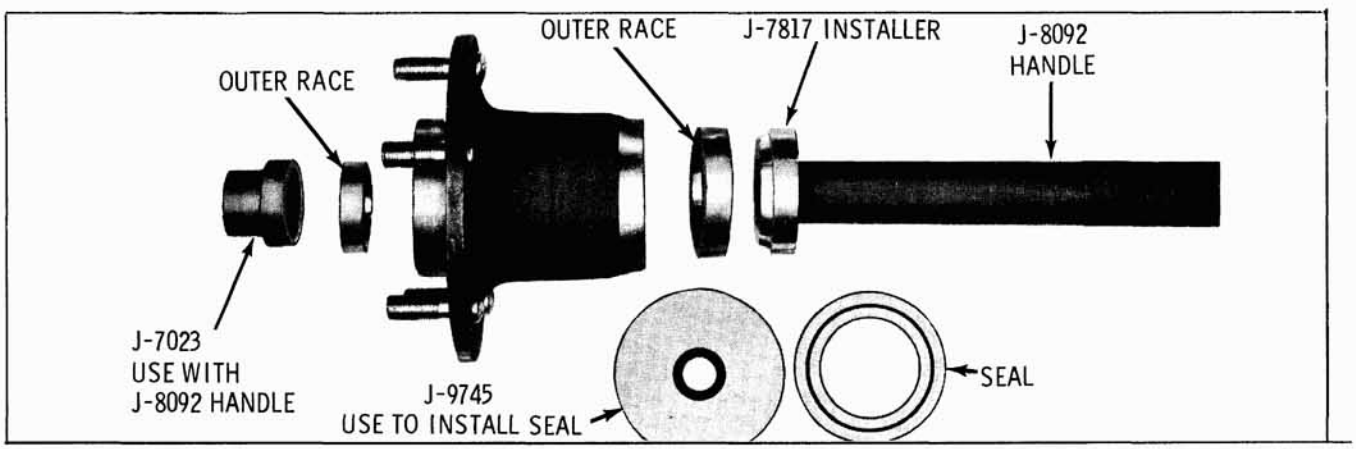


Fig. 4E-6—Installing Outer Races or Seal

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

APPLICATION	FT. LBS.
Center Spring Clamp to Axle	30
Backing Plate to Spindle	35
Brake Line to Wheel Cylinder	14
Brake Hose Assembly to Axle	14
Wheel Nuts	115
Vertical Shock Absorber Nuts	10
Horizontal Shock Absorber Nuts	40
Resonator Bracket to Frame	14
Rear Shackle Bolts	40
Front Spring Bolt	75

BRAKES

ITEMS LISTED IN THE TABLE OF CONTENTS ARE FOR TORONADO. FOR SERVICE PROCEDURES AND RECOMMENDATIONS NOT LISTED REFER TO SECTION 5, 31-86 SERIES.

CONTENTS OF SECTION 5E

Subject	Page	Subject	Page
PARKING BRAKE CABLE, REAR	5E-1	CALIPER DISASSEMBLY	5E-6
FRONT BACKING PLATE	5E-1	ASSEMBLING CALIPER	5E-8
REAR BACKING PLATE	5E-4	DISC REMOVAL	5E-10
ADJUSTER IDENTIFICATION	5E-4	DISC INSTALLATION	5E-10
REMOVING BRAKE SHOES (DISC BRAKES)	5E-4	DISC SHIELD	5E-10
INSTALLING BRAKE SHOES	5E-5	GENERAL SPECIFICATIONS	5E-11
REMOVING CALIPER	5E-6	TORQUE SPECIFICATIONS	5E-11

PARKING BRAKE CABLE

The rear parking brake cable can be removed as follows:

1. Disconnect the cable at the equalizer.
2. Remove the retainers which hold the conduit to the brackets.
3. Remove the rear wheels and brake drums.
4. Disconnect the cable from the operating levers.
5. Install a corbin-type hose clamp over the conduit retainer fingers as shown in Fig. 5-24, Section 5, 31-86 Series.
6. Tap the conduit lightly to remove from the backing plate.

To install, reverse the removal procedure. Adjust the parking brake.

FRONT BACKING PLATE

If the front backing plate is to be removed, proceed as follows:

1. Remove brake drum.

It may be necessary to back off the brake shoe adjustment before the brake drum can be removed. To back off the brake shoe adjustment, refer to Fig. 5E-2.

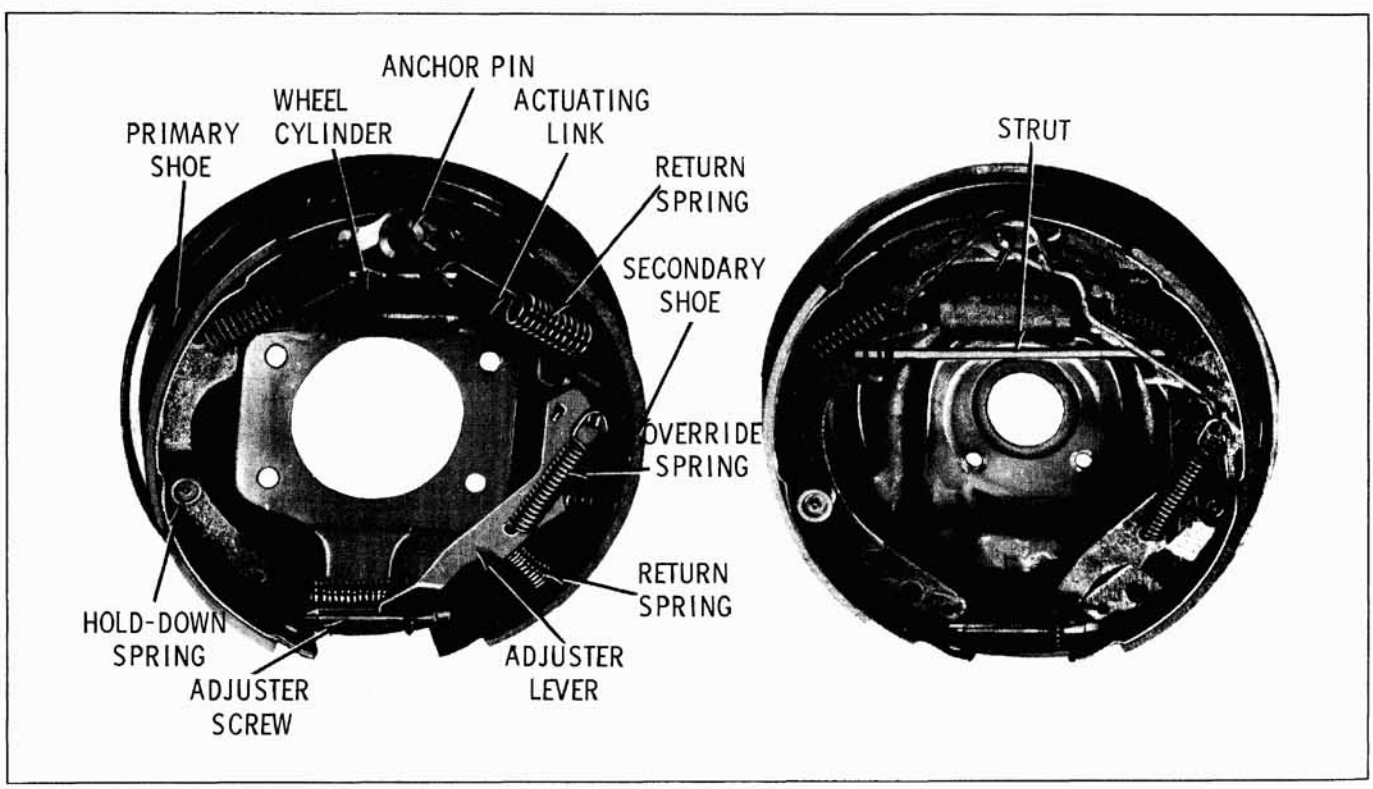


Fig. 5E-1—Brake Assemblies (Toronado)

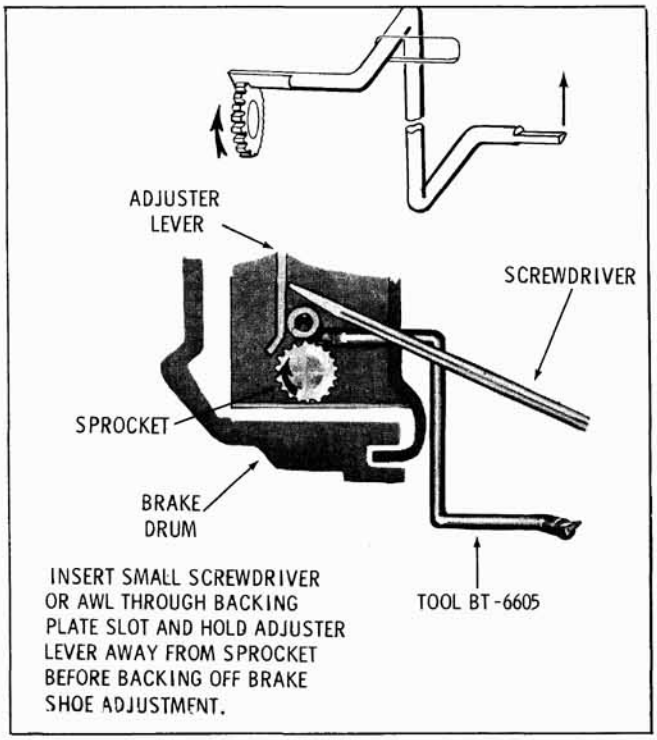


Fig. 5E-2—Backing Off Brake Shoe Adjustment

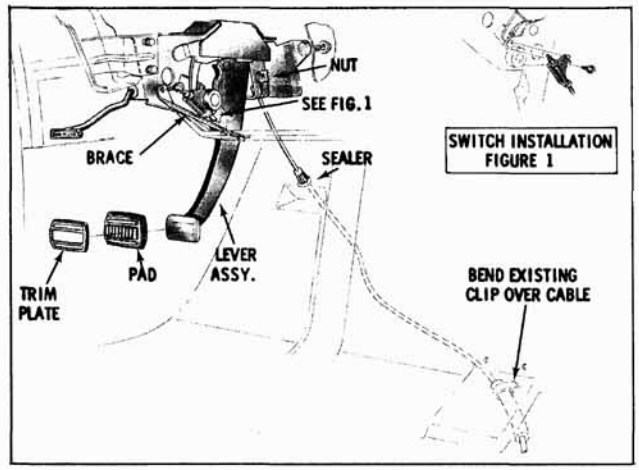


Fig. 5E-3—Parking Brake

2. Remove lining as described in Section 5, 31-86 Series.
3. Loosen lock tab from anchor pin, then remove the anchor pin bolt.
4. Loosen the brake hose at the wheel cylinder.
5. Remove the wheel cylinder attaching bolts and turn cylinder off brake hose.
6. Remove the steering knuckle to hub assembly bolts and nuts. Remove axle nut. Remove hub assembly and backing plate.

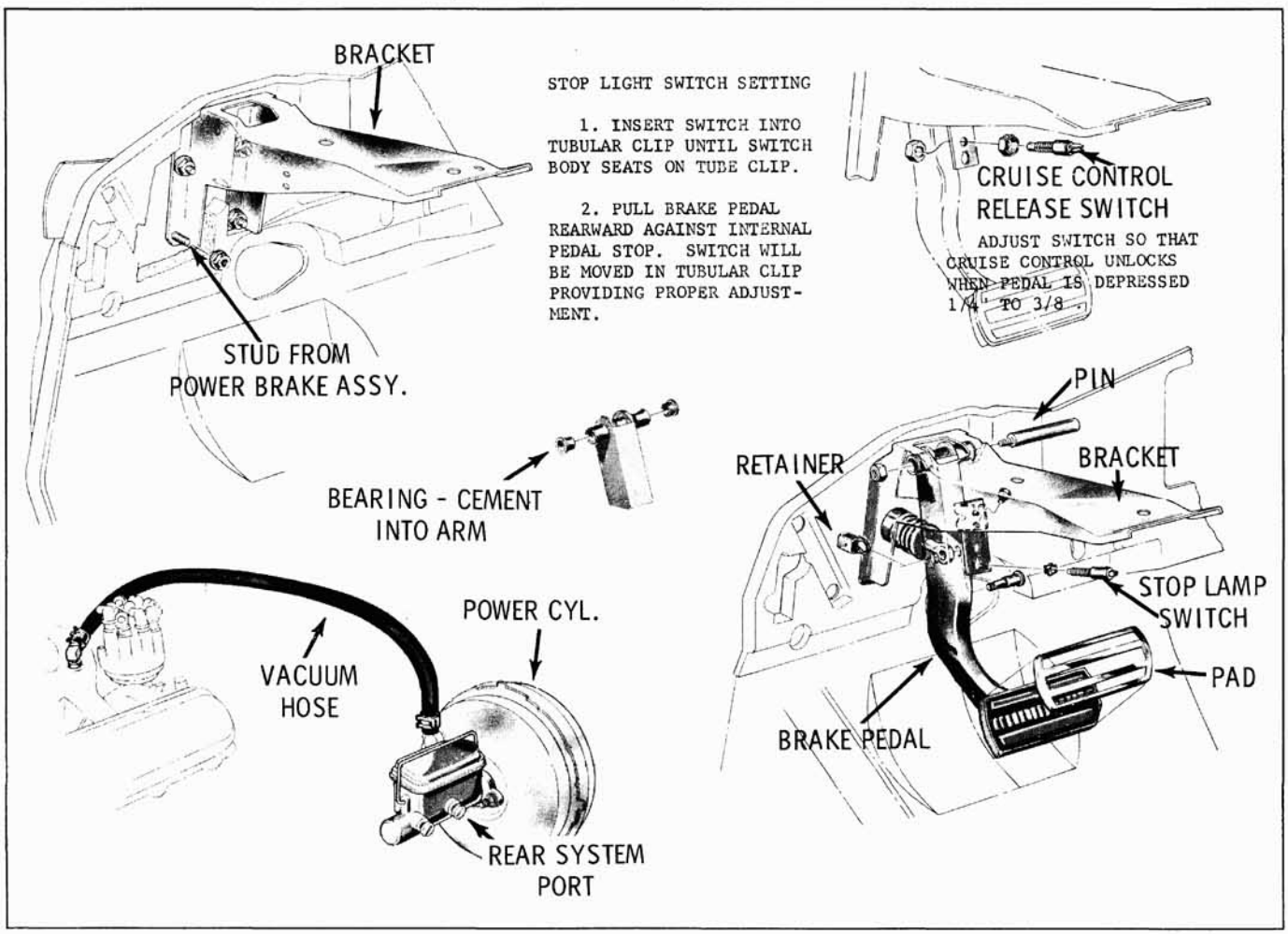


Fig. 5E-4—Brake Pedal Mounting

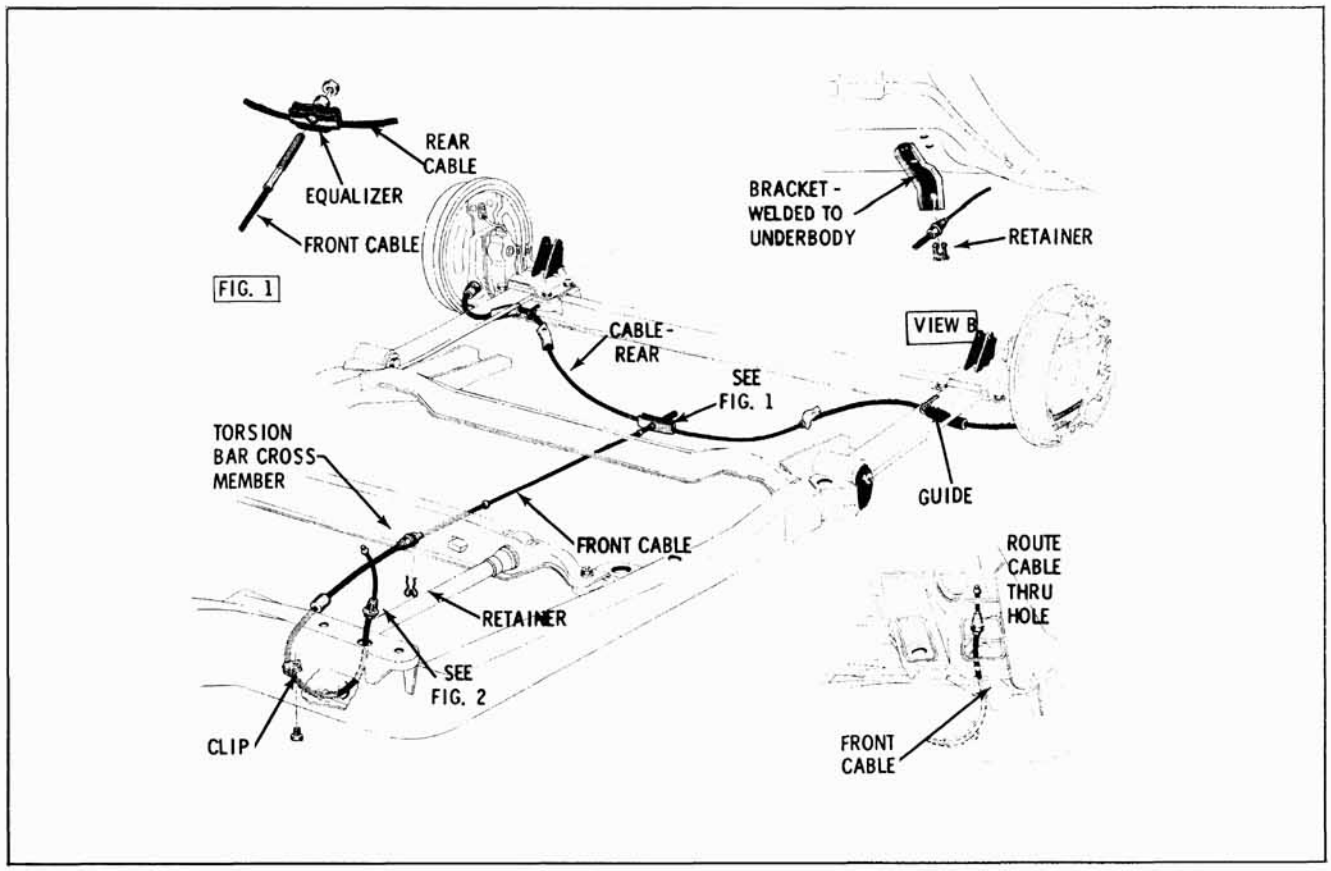


Fig. 5E-5—Parking Brake Layout

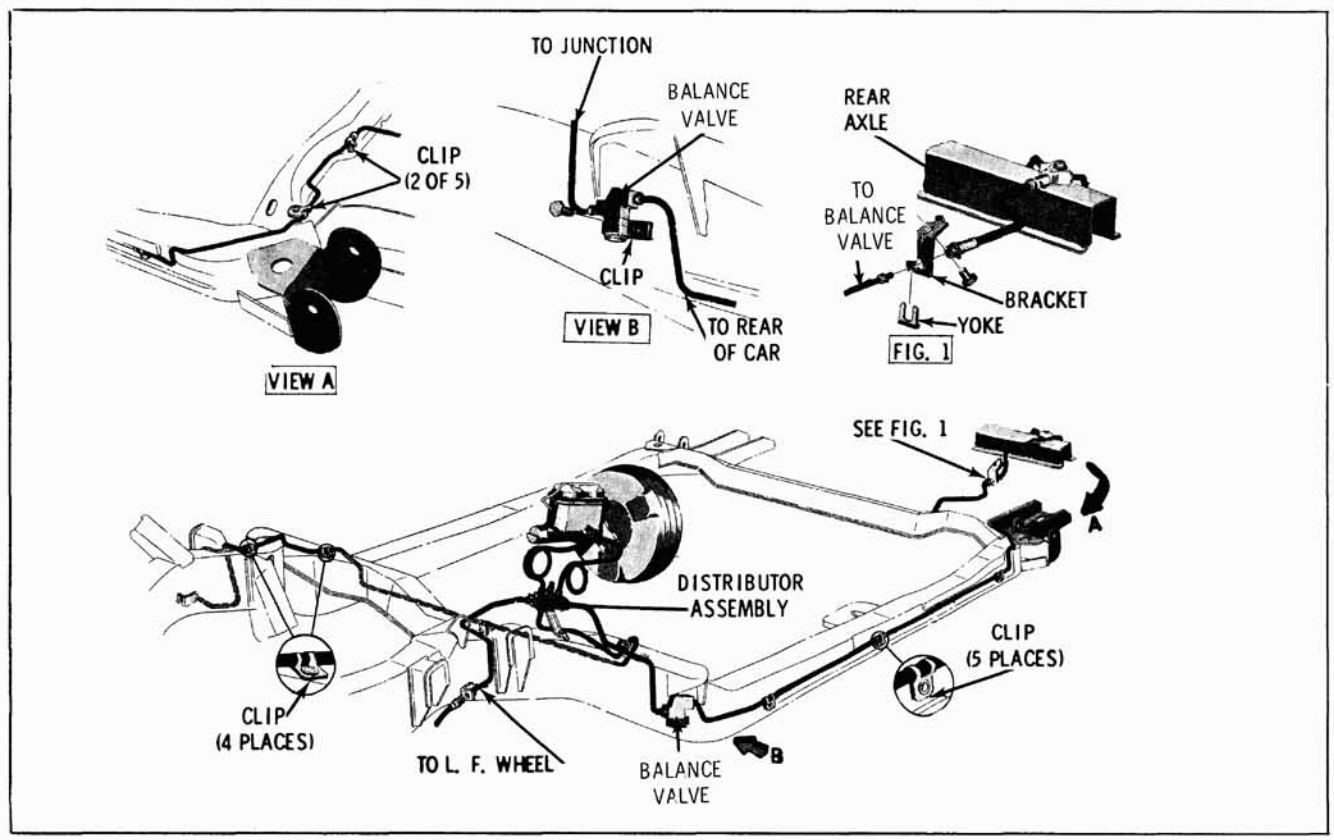


Fig. 5E-6—Hydraulic Brake Lines

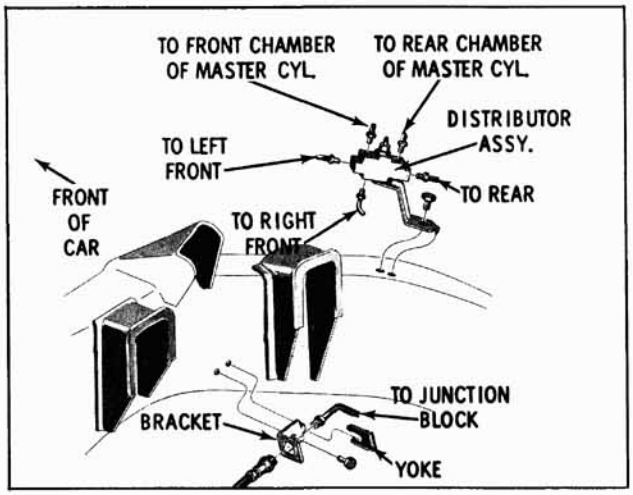


Fig. 5E-7—Distributor (Exploded)

REAR BACKING PLATE

If necessary to remove the rear backing plate, proceed as follows:

1. Remove brake drum.

It may be necessary to back off the brake shoe adjustment before the brake drum can be removed. To back off the brake shoe adjustment, refer to Fig. 5E-2

2. Remove lining as described in Section 5, 31-86 Series.
3. Remove the hub assembly and the inner bearing race from the spindle.
4. Remove brake line from wheel cylinder and remove wheel cylinder from backing plate.
5. Disconnect the parking brake cable from the backing plate.
6. Remove the backing plate.

REMOVING BRAKE SHOES (DISC BRAKE)

1. With car raised evenly on a hoist or jackstands, remove the front wheels.
2. Remove the bolts retaining the caliper splash shield, then remove the shield and anti-rattle spring assembly. (Fig. 5E-9).
3. Using two pairs of pliers, grasp the tabs on the outer ends of one of the shoes and remove the shoe and lining by pulling straight out. Repeat this operation for the second shoe. (Fig. 5E-11)

A ridge of rust may have built up on the edge of the disc surface outside of the lining contact area. If this has occurred, it will be necessary to force the pistons back slightly into their cylinders to provide clearance for the shoe removal. Do this by forcing the shoe back with a pair of water pump pliers gripped on the corner of the shoe and on the caliper housing. (Fig. 5E-12)

CLEANING AND INSPECTING THE CALIPER ASSEMBLY

1. Check the caliper seal for leaks (indicated by fluid moisture around the cavity).
2. Check for any damage to the piston dust boot.
3. Wipe the caliper cavity clean with a shop towel.
4. Check the piston dust boot for proper seating in the piston groove and on the caliper housing. If excessive fluid moisture is evident, it will be necessary to install a new piston seal and piston dust boot.

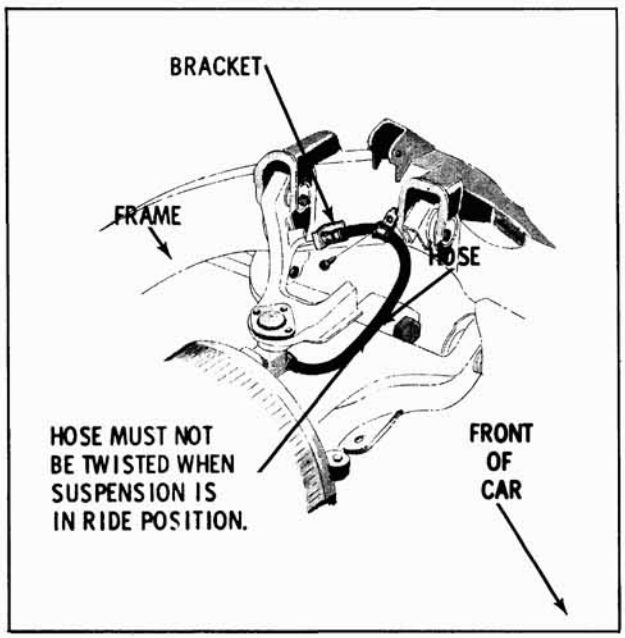


Fig. 5E-8—Front Brake Hose Installation

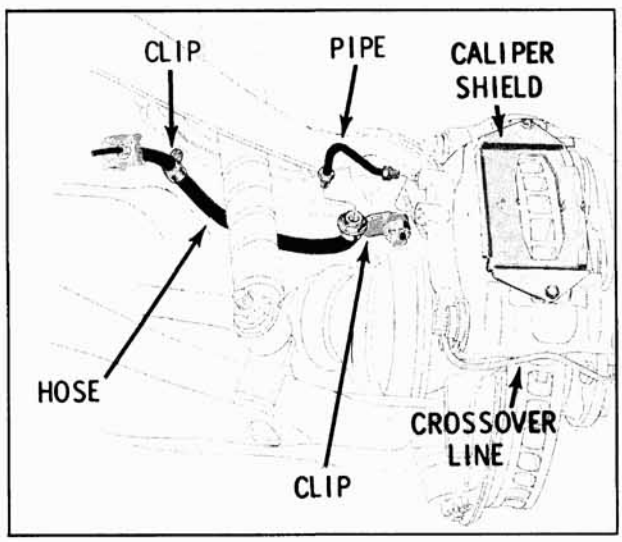


Fig. 5E-9—Caliper Shield Removal

BRAKE ADJUSTER CHART

WHEEL	IDENTIFICATION	THREAD
RIGHT FRONT	3 FLAT GROOVES	LEFT HAND
LEFT FRONT	3 "V" GROOVES	RIGHT HAND
RIGHT REAR	3 FLAT GROOVES	LEFT HAND
LEFT REAR	3 "V" GROOVES	RIGHT HAND

Fig. 5E-10—Adjusting Screw Identification

Fig. 5E-11—Removing Brake Shoes

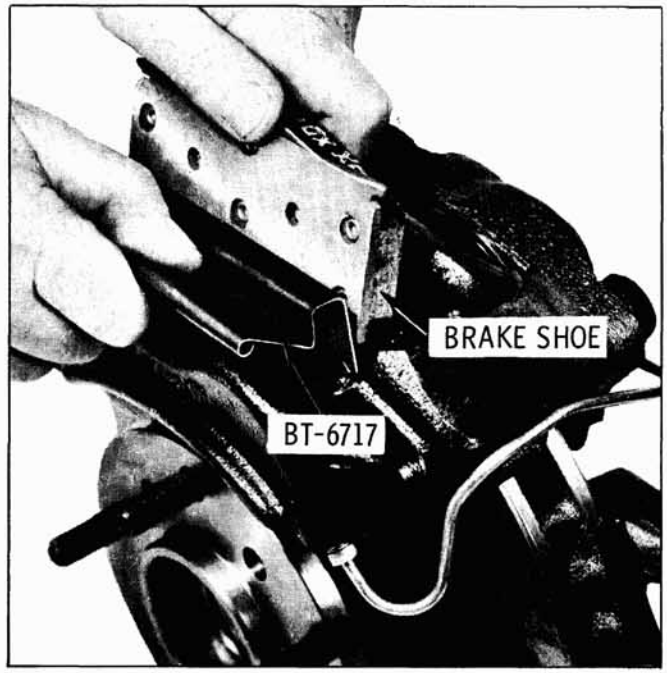


Fig. 5E-13—Installing Brake Shoes

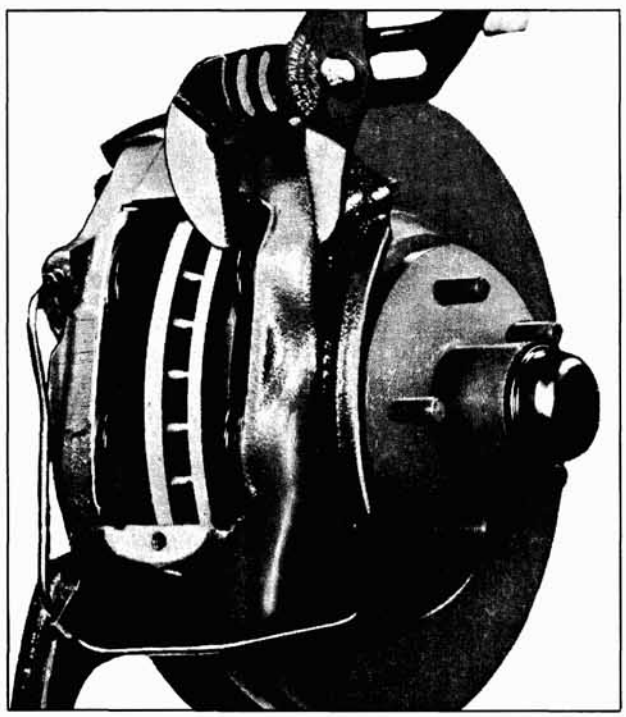


Fig. 5E-12—Forcing Pistons Back in Cylinders

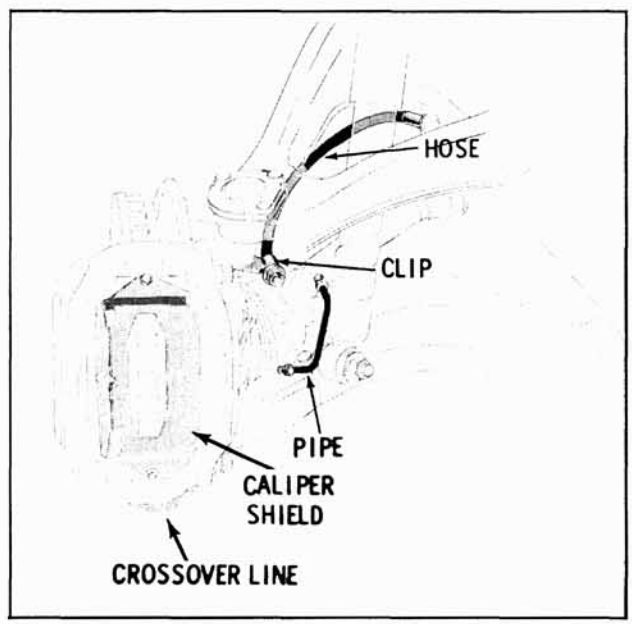


Fig. 5E-14—Disconnecting Brake Hose

INSTALLING BRAKE SHOES

1. Push all four pistons back into their cylinders until bottomed to make room for installation of new (thicker) shoes. Do this by placing a flat metal bar or tool against the piston and exerting a steady force until bottomed.

2. Slide a new shoe and lining assembly into the caliper on each side of the disc using tool BT-6717 with the ears of each shoe resting on the bridges of the caliper. Be sure the shoe is fully seated and lining is facing disc. (Fig. 5E-13)

3. Place the caliper splash shield and anti-rattle spring assembly in position on the caliper and install the attaching bolts. Tighten securely.

4. Repeat steps 1, 2 and 3 on the second disc brake.

5. Pump the brake several times until a firm pedal is obtained and the shoes and linings are properly seated.

6. Install the wheels.

7. Check and refill the master cylinder reservoir with brake fluid as required.

8. Road test the car and make several heavy 40 m.p.h. stops to wear off any foreign material on the brakes and to seat the shoes. The brakes may tend to "pull" if this is not done.

It should not be necessary to bleed the system if only

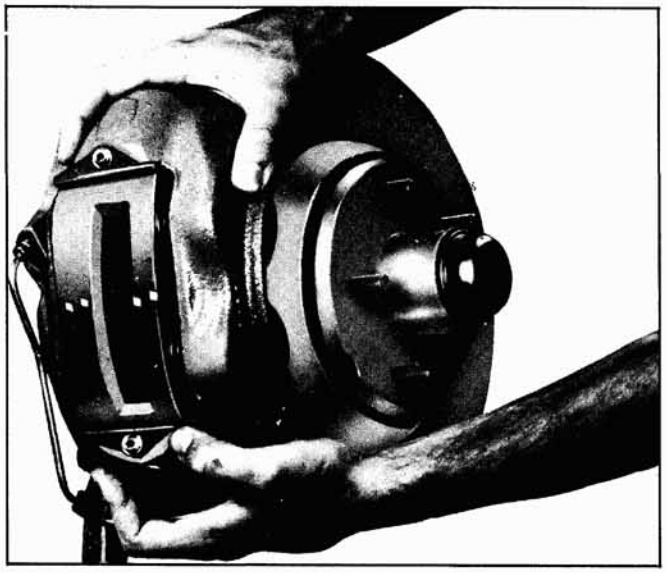


Fig. 5E-15—Removing Caliper

shoe and lining assemblies have been replaced.

REMOVING THE CALIPER

It is necessary to remove the caliper for installation of a new piston seal or boot. Proceed as follows:

1. Raise the car evenly on hoist or jackstands and remove the wheel, dust shield and shoes.
2. Disconnect the front brake tube at the frame mounting bracket and plug the brake tube to prevent loss of fluid. (Fig. 5E-14)
3. Remove the bolts which attach the caliper assembly to the steering knuckle.
4. Slide the caliper assembly up and away from the disc. (Fig. 5E-15)

DISASSEMBLING THE CALIPER (Fig. 5E-16)

1. Prepare a clean bench area.
2. Remove the caliper splash shield attaching bolts, then remove the splash shield and anti-rattle spring assembly, if not previously removed. (Fig. 5E-17)
3. Mount the caliper assembly in a vise equipped with padded jaws, clamping on the caliper mounting lugs. Remove the crossover line.
4. Remove the shoe and lining assemblies, if not previously removed.

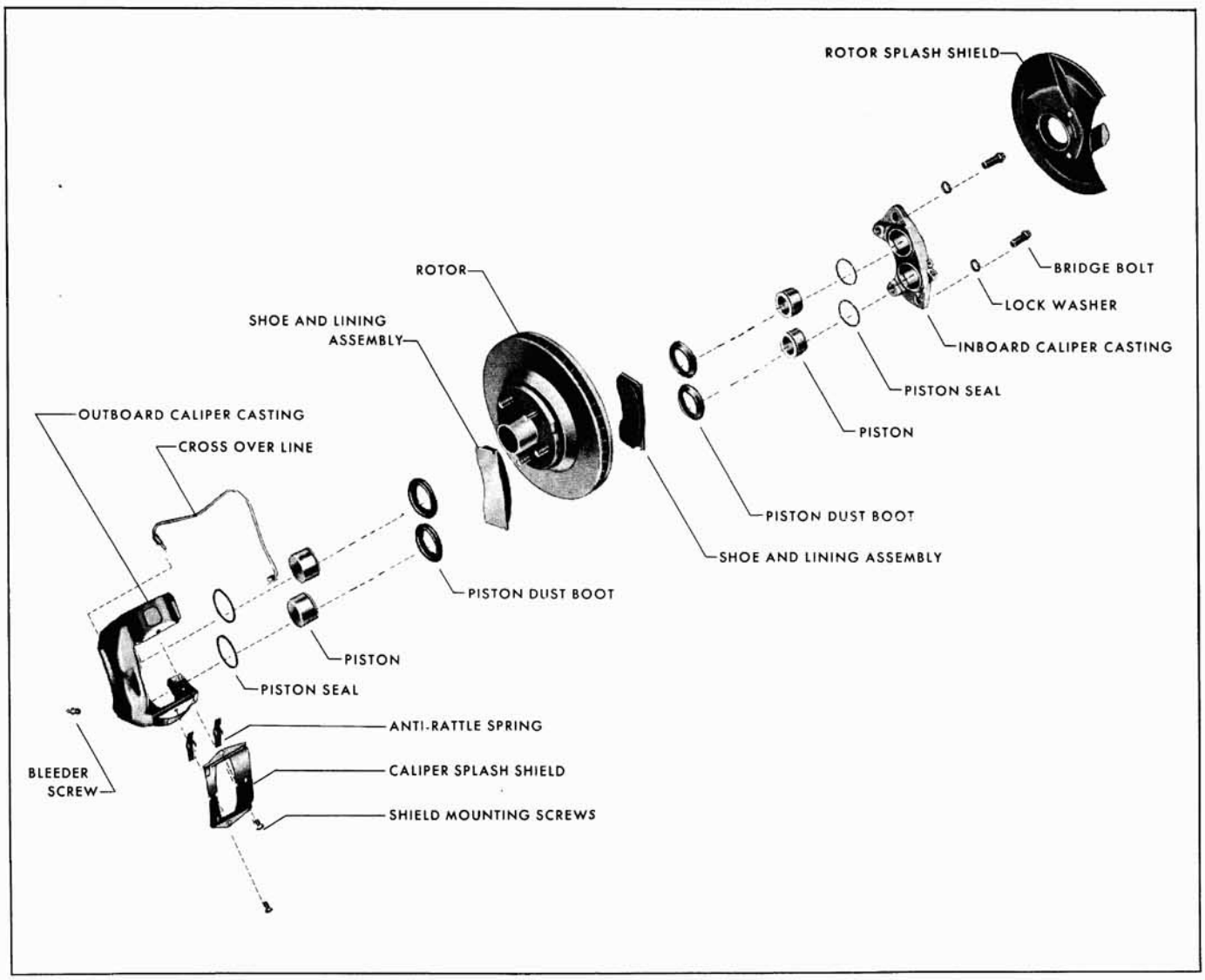


Fig. 5E-16—Caliper Disassembly

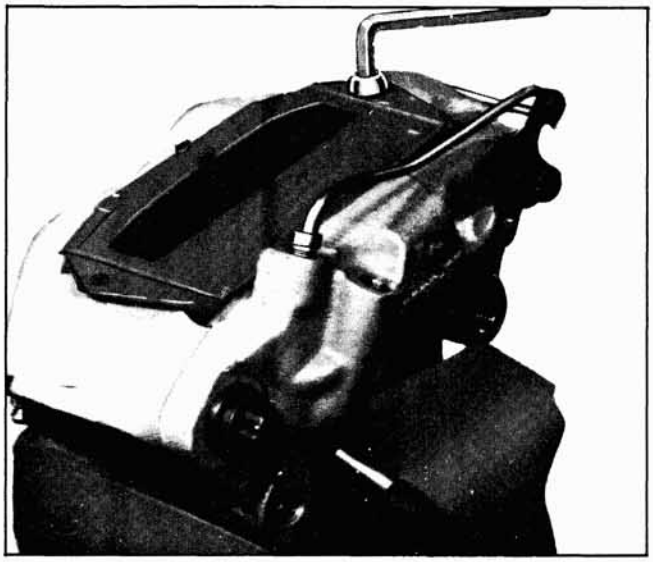


Fig. 5E-17—Removing Splash Shield

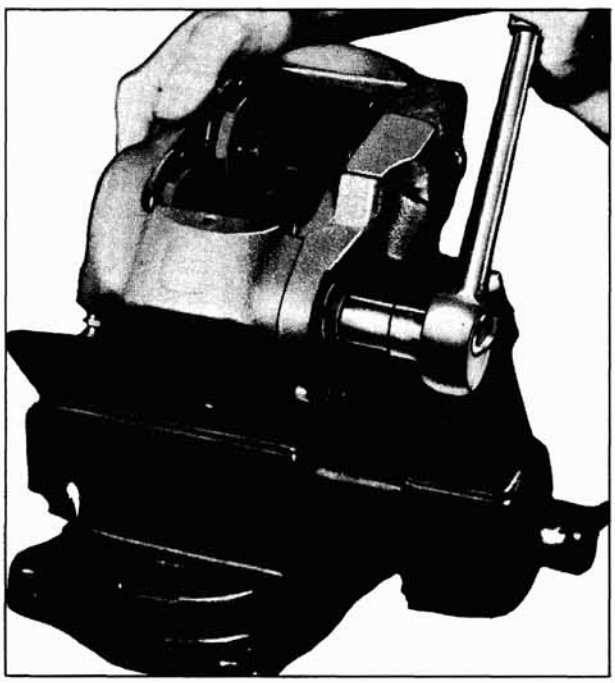


Fig. 5E-18—Removing Bridge Bolts

5. Remove the bridge bolts that hold the two halves of the caliper together. Separate the assemblies. (Fig. 5E-18)

Be sure at reassembly that these two bolts are used and tightened to the correct torque.

6. Remove each piston. Care must be used not to scratch, burr or otherwise damage the piston on its outside diameter or boot groove. Draw the piston straight out of its cylinder bore. Available tool BT-6712 may be used. (Fig. 5E-19)

7. Remove dust boot from caliper bores.

8. Using a small pointed wood or plastic tool, remove the piston seals from the grooves in the cylinder bores. Discard the old seals. Do not scratch the cylinder bores or the seal grooves. (Fig. 5E-20)

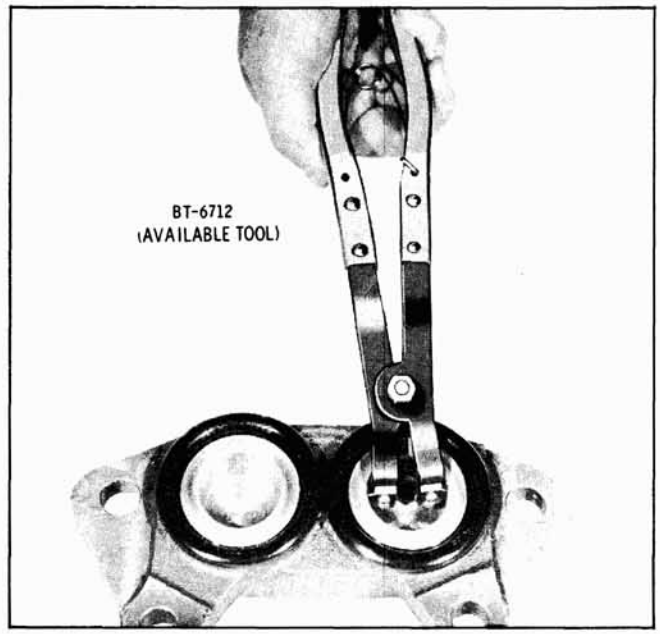


Fig. 5E-19—Removing Pistons

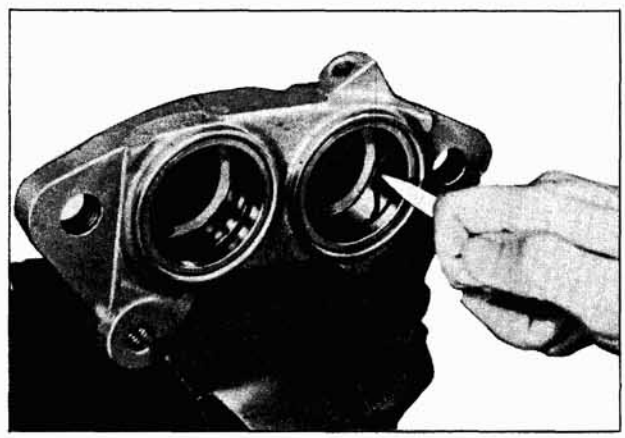


Fig. 5E-20—Removing Piston Seal

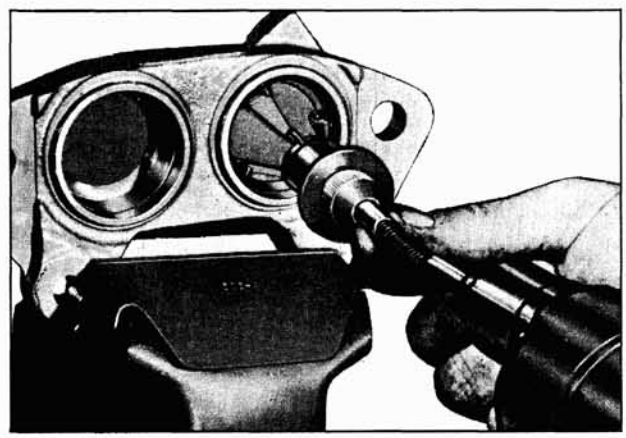


Fig. 5E-21—Honing Cylinder Bore

CLEANING AND INSPECTING THE CALIPER ASSEMBLY

1. Clean all parts with brake fluid and wipe dry, using a clean, lint free cloth. Using an air hose, blow out the drilled

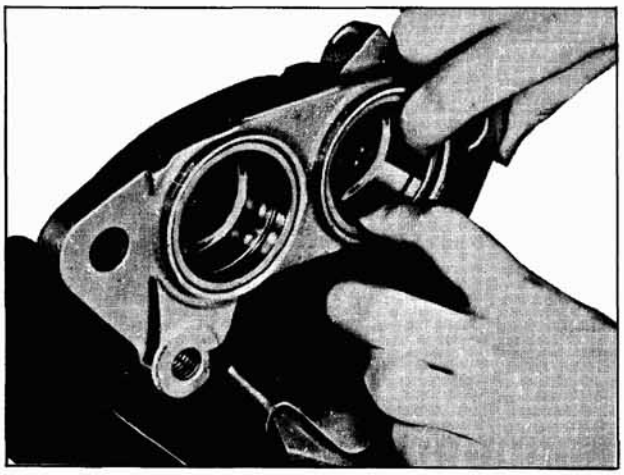


Fig. 5E-22—Installing Piston Seals

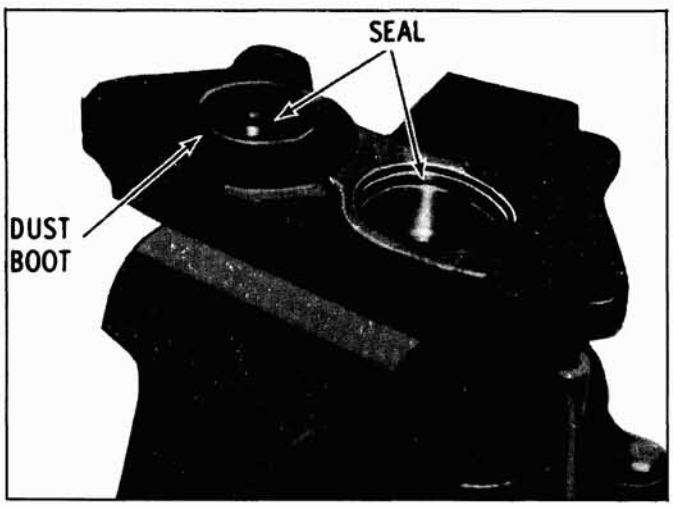


Fig. 5E-23—Installing Dust Boot

passages and bores.

2. Inspect the cylinder bores in both housing castings for scoring or pitting. Bores which show light scratches or corrosion can usually be cleaned up with crocus cloth. However, bores which have deep scratches or scoring may be honed, providing the diameter of the bore is not increased more than .002 inch. If the bore does not clean up within this specification, replace caliper housing.

Black stains on the bore wall are caused by the piston seals and will do no harm.

When using hone, be sure to install the hone baffle before honing cylinder bore. The baffle is used to protect the hone stones from damage. After honing the bore carefully, clean the seal groove with a stiff non-metallic rotary brush. (Fig. 5E-21)

3. Check each piston to see if it is pitted, scored or the chrome plating is worn off. If any of these conditions exist, discard and replace the defective piston.

Use extreme care in cleaning the caliper after honing. Remove all dust and grit by flushing the caliper with brake fluid; wipe dry with a clean lint-free cloth and then clean a second time in the same manner.

CALIPER ASSEMBLY

When reassembling caliper assembly, use only the special lubricant provided in the service repair kit.

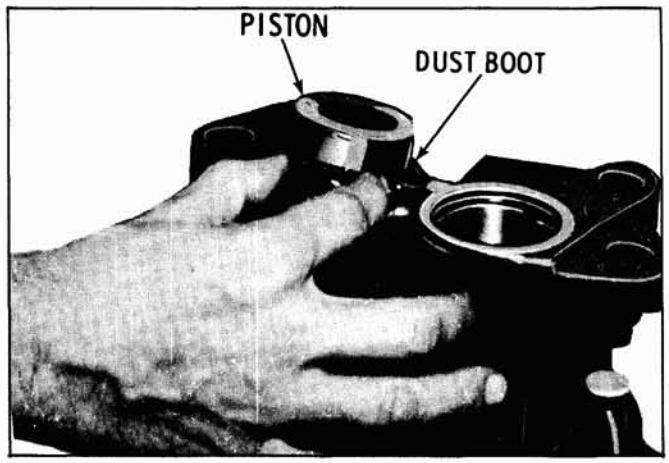


Fig. 5E-24—Installing Piston in Dust Boot

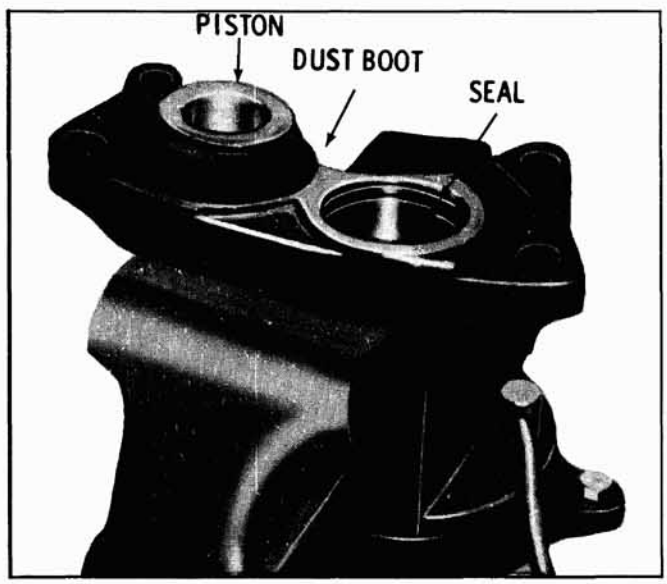


Fig. 5E-25—Piston Installed in Dust Boot

1. Clamp the inner caliper housing in a vise having brass jaws.

2. Lubricate bore in caliper housing with lubricant provided.

3. Lubricate piston seal and install in the second groove in the housing bore, being sure the seal is not twisted or rolled. (Fig. 5E-22)

4. Lubricate lips of dust boot and install dust boot in upper groove of housing bore. Make certain that dust boot is properly seated in bore groove. (Fig. 5E-23)

5. Lubricate piston and start piston inside of dust boot, working dust boot around piston until piston is installed in dust boot. (Fig. 5E-24)

6. Reposition piston as necessary. Slowly force piston into housing bore. As piston moves downward, dust boot lip will seat in groove on piston. (Fig. 5E-25)

When piston is fully seated, trapped air under dust boot may cause dust boot lip to disengage from piston groove. If this occurs, reinstall lip of dust boot in piston groove.

7. Repeat Steps 2 - 6 to install remaining pistons in hous-

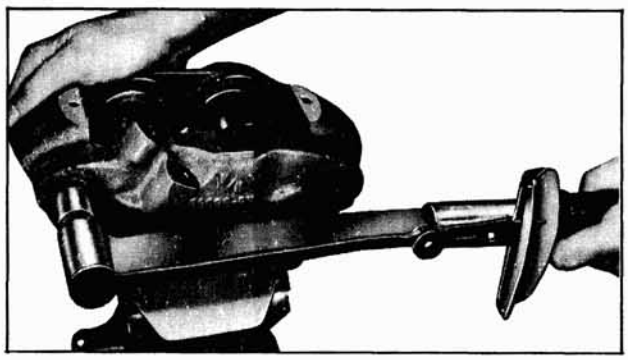


Fig. 5E-26—Tightening Bridge Bolts

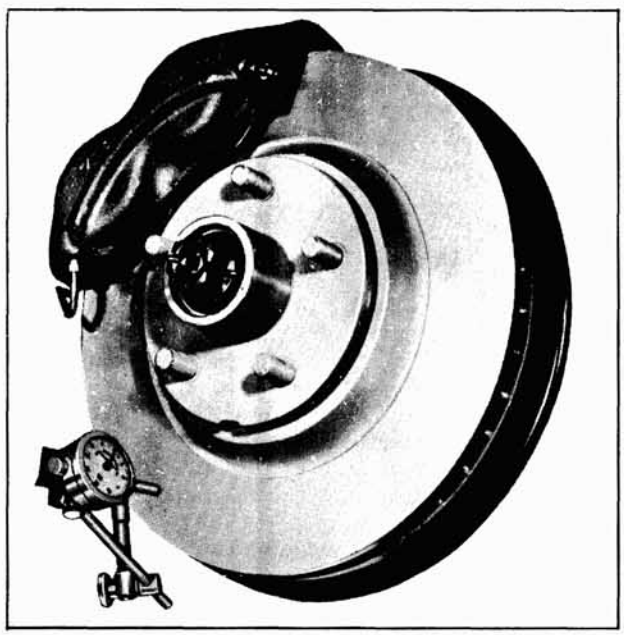


Fig. 5E-27—Checking Disc Runout

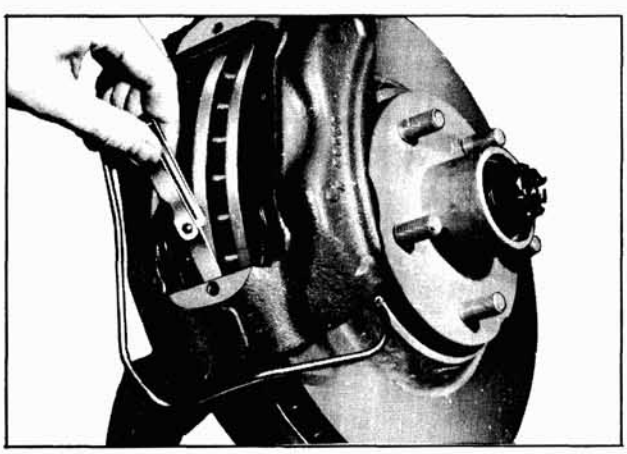


Fig. 5E-28—Checking Clearance Between Disc and Caliper

ing bore.

8. Assemble outer caliper housing to the one clamped in the vise then install the bridge bolts and tighten to 85 ft. lbs. (Fig. 5E-26)

Bridge bolts are special high tensile steel. If replacement is necessary, use only factory authorized replacement bolts. Do not use ordinary bolts.

9. Install the crossover line and tighten to 25 ft. lbs.

INSTALLING THE CALIPER

Before installing the caliper assembly over the brake disc, check the disc for runout. Mount a dial indicator to check lateral runout of both surfaces. Runout should not exceed .004 inch. If runout exceeds this amount, remove the disc and install a new one. Be sure the wheel bearings are adjusted to zero end play during this check. Readjust wheel bearings after check. (Fig. 5E-27)

1. Install the caliper assembly over the disc and align the mounting holes. Install the mounting bolts and tighten to 165 foot pounds. A check should be made to be sure that the disc runs squarely and centrally within the caliper opening. There should be approximately .090 to .120 inch clearance between the outside diameter of the braking disc and the caliper. There should also be a minimum of .050 inch from either disc face to the machined groove in the outboard caliper. (Fig. 5E-28)
2. Install the shoe and lining assemblies between the caliper and disc.
3. Place the caliper splash shield in position on the caliper and install the attaching bolts. Be sure that opening in caliper splash shield is centered over disc. Tighten securely, with a torque of 8 foot pounds.
4. Be sure that bleeder screw is open, then reconnect the brake line at the caliper housing. Bleed the system. Allow the caliper to fill with brake fluid. After all air bubbles have escaped, and fluid runs clear from bleeder, close the bleeder screw. Replenish the brake fluid in the master cylinder.
5. "Pump" the brake pedal several times to actuate the piston seals and position the shoe and lining assemblies.
6. Check for fluid leakage at all connections under maximum pedal pressures. Refill master cylinder reservoir as necessary.
7. Install wheel and torque wheel stud nuts to 115 ft. lb.
8. Remove jackstands or lower hoist.

Road test the car and make several heavy 40 m.p.h. stops to wear off any foreign material on the brakes and to seat the shoes. (The car may pull to one side

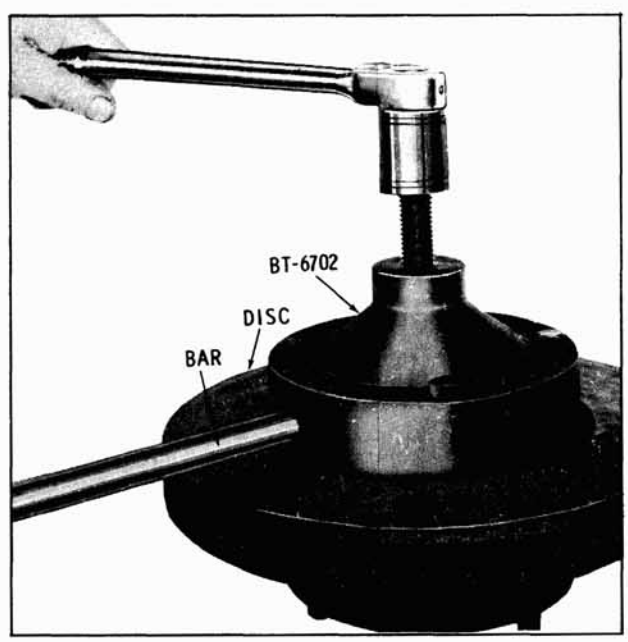


Fig. 5E-29—Removing Hub Bearing

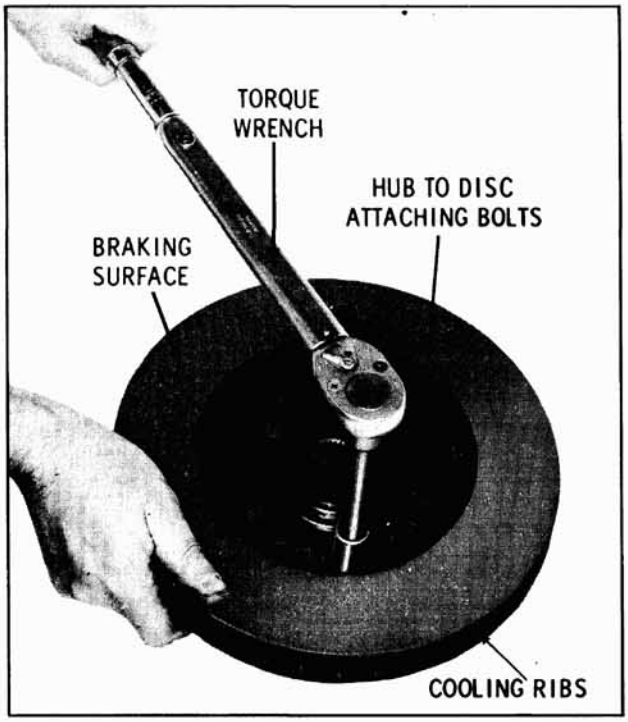


Fig. 5E-30—Installing Disc Attaching Bolts

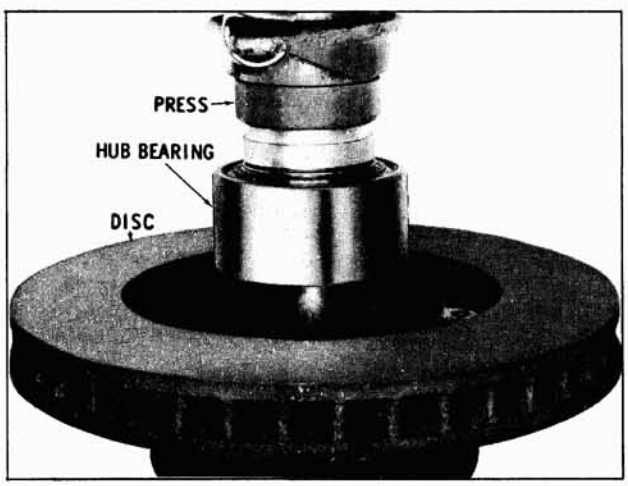


Fig. 5E-31—Installing Hub Bearing

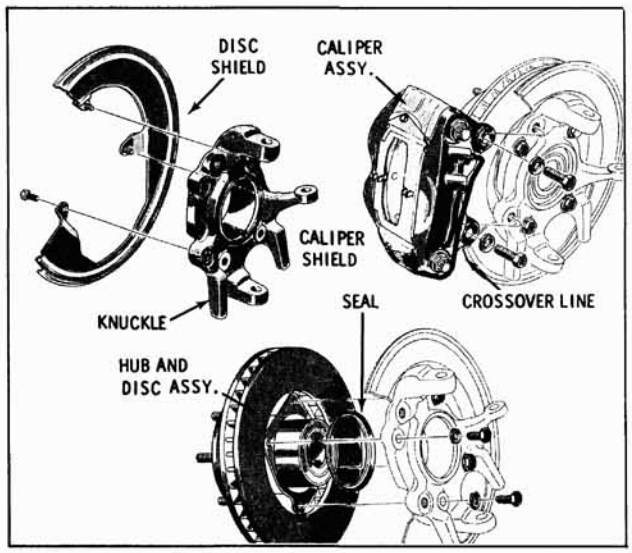


Fig. 5E-32—Disc Shield Removal

on the first application after service. This is normal until shoes are seated.)

DISC (WITH CALIPER REMOVED)

Removal

1. Remove drive axle cotter pin, nut and washer.
2. Remove bolts (four) from inboard side of knuckle from bearing retainer.
3. Position spacers, Tool J-22237 and install Tool J-21579 and slide hammer J-2619 on hub assembly and remove hub assembly. Remove tools.
4. Position Tool BT-6702 over bearing and remove bearing as shown in Fig. 5E-29.
5. Remove bolts that secure disc to hub and remove disc.

Installation

1. Install bolts through disc into hub. Torque to 70 ft. lbs. (Fig. 5E-30)
2. Position a new bearing retainer onto hub.
3. Lubricate O.D. of bearing with E.P. Chassis Lubricant and press bearing into place as shown in Fig. 5E-31.
4. Install hub assembly over drive axle splines being careful to align splines correctly.
5. Install drive axle washer and nut. Torque to 150 ft. lbs. Tighten nut to insert cotter pin.

DISC SHIELD

Disc shield can be removed only after hub and disc assy. has been removed. (Fig. 5E-32)

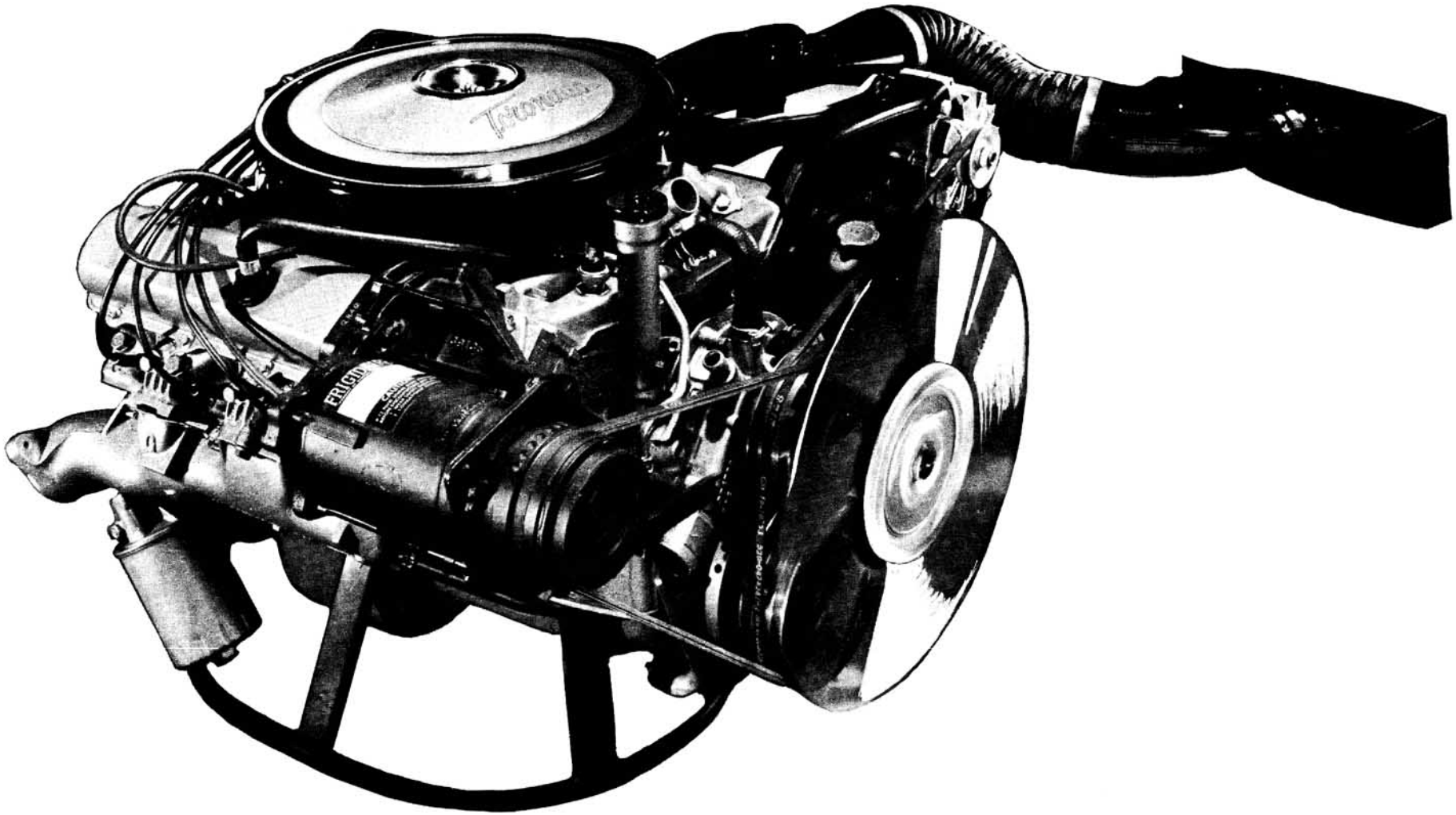
TORONADO GENERAL SPECIFICATIONS

LINING AREA	
Drum Brake	216 Sq. In.
Disc Brake	124.8 Sq. In.
RATIO (Percentage of Braking Effect)	
A. Front	67%
B. Rear	33%
DRUMS	
A. Inside Diameter	11.00"
B. Out-of-Round (Total Indicator Reading) Front and Rear	.005"
DISC	
A. Outside Diameter	11-1/4"
B. Lateral Runout	.004"
C. Parallelism	.0005"
D. Disc Thickness	
1. Maximum	1-1/4"
2. Minimum	1.215"
LININGS (Drum Brake)	
A. Length - Primary (Front)	12"
B. Length - Primary (Rear)	9"
C. Length - Secondary (Both)	12"
D. Width - Front	2-3/4"
E. Width - Rear	2"
LININGS (Disc Brake)	
A. Length	6"
B. Thickness	19/32"
WHEEL CYLINDER BORE (Disc Brake)	
A. Front	1.94"
B. Rear	.88"
MASTER CYLINDER BORE	1"

TORONADO TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

Application	Ft. Lbs.
Anchor Pin to Steering Knuckle Bolt	135
Steering Knuckle to Backing Plate Nuts	65
Backing Plate to Axle Nuts	35
Wheel Cylinder to Backing Plate Cap Screws (Front)	7
Wheel Cylinder to Backing Plate Cap Screws (Rear)	14
Wheel Nuts	115
Parking Brake Lever to Cowl	14
Parking Brake Lever to Instrument Panel Cap Screws	10
Pedal Mounting Bracket to Instrument Panel Cap Screws	6
Pedal Mounting Bracket and Master Cylinder Bolts to Cowl	24
Pedal Pivot Bolt Nut	12
Master Cylinder to Front Housing	24
Rear Housing to Cowl	24
Master Cylinder to Cowl	24
Bridge Bolts (Caliper Assembly)	85
Caliper Mounting Bolts	165
Caliper Shield Bolts	8
Splash Shield Bolts	10
Disc to Hub	70



TORONADO ENGINE - WITH W-34 OPTION

ENGINE

ITEMS LISTED IN THE TABLE OF CONTENTS ARE FOR TORONADO SERIES. FOR SERVICE PROCEDURES AND RECOMMENDATIONS NOT LISTED, REFER TO SECTION 6, 6B, V-8 ENGINE.

CONTENTS OF SECTION 6EB

Subject	Page	Subject	Page
ENGINE ASSEMBLY		FRONT COVER	
REMOVAL	6EB-2	REMOVAL	6EB-4
INSTALLATION	6EB-3	INSTALLATION	6EB-4
VALVE IDENTIFICATION	6EB-3	OIL PAN	
THROTTLE CONTROLS	6EB-4	REMOVAL	6EB-4
THERMOSTATIC VACUUM SWITCH	6EB-4	INSTALLATION	6EB-4
		SPECIFICATIONS	6EB-5

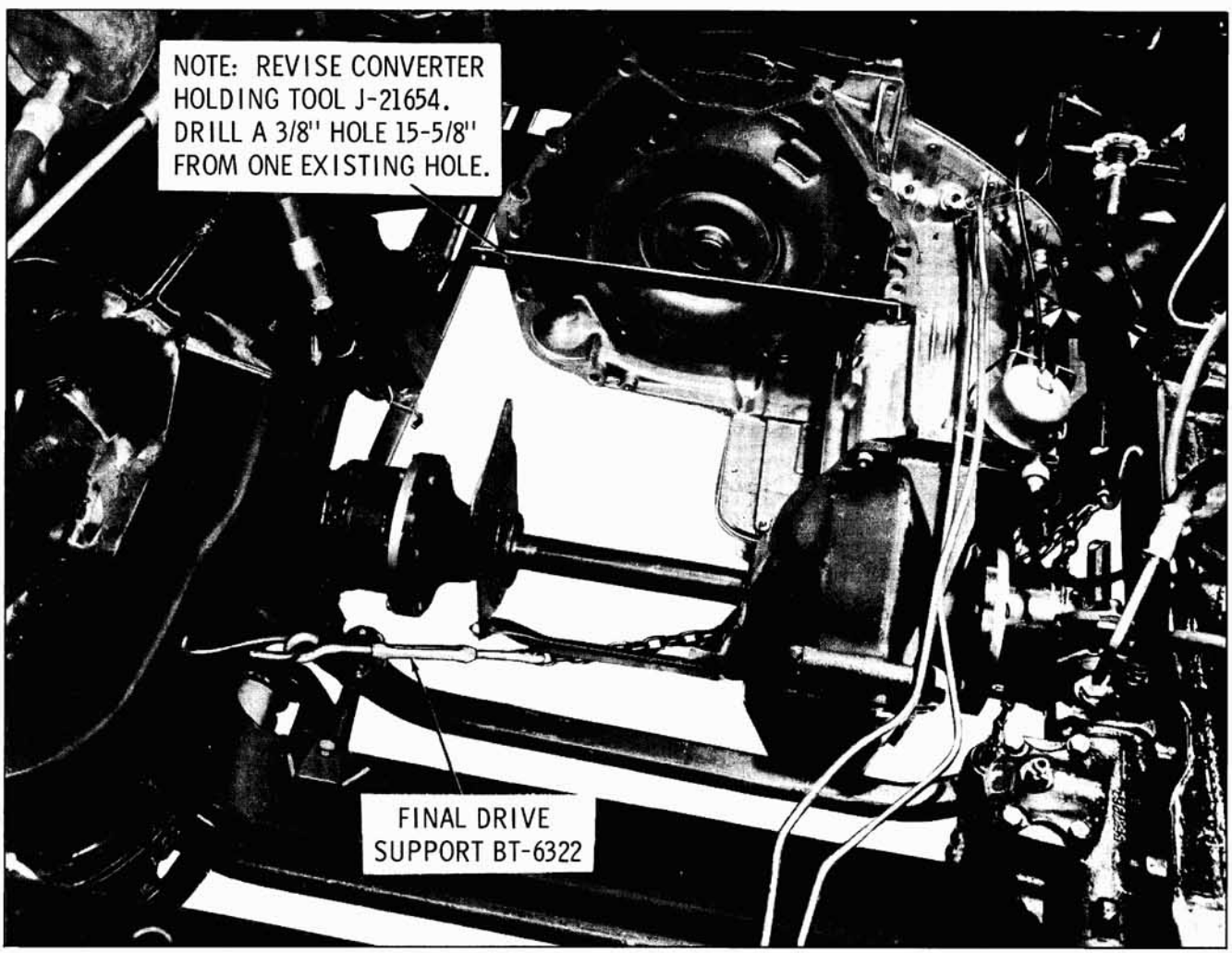


Fig. 6EB-1—Final Drive Supporting Tool

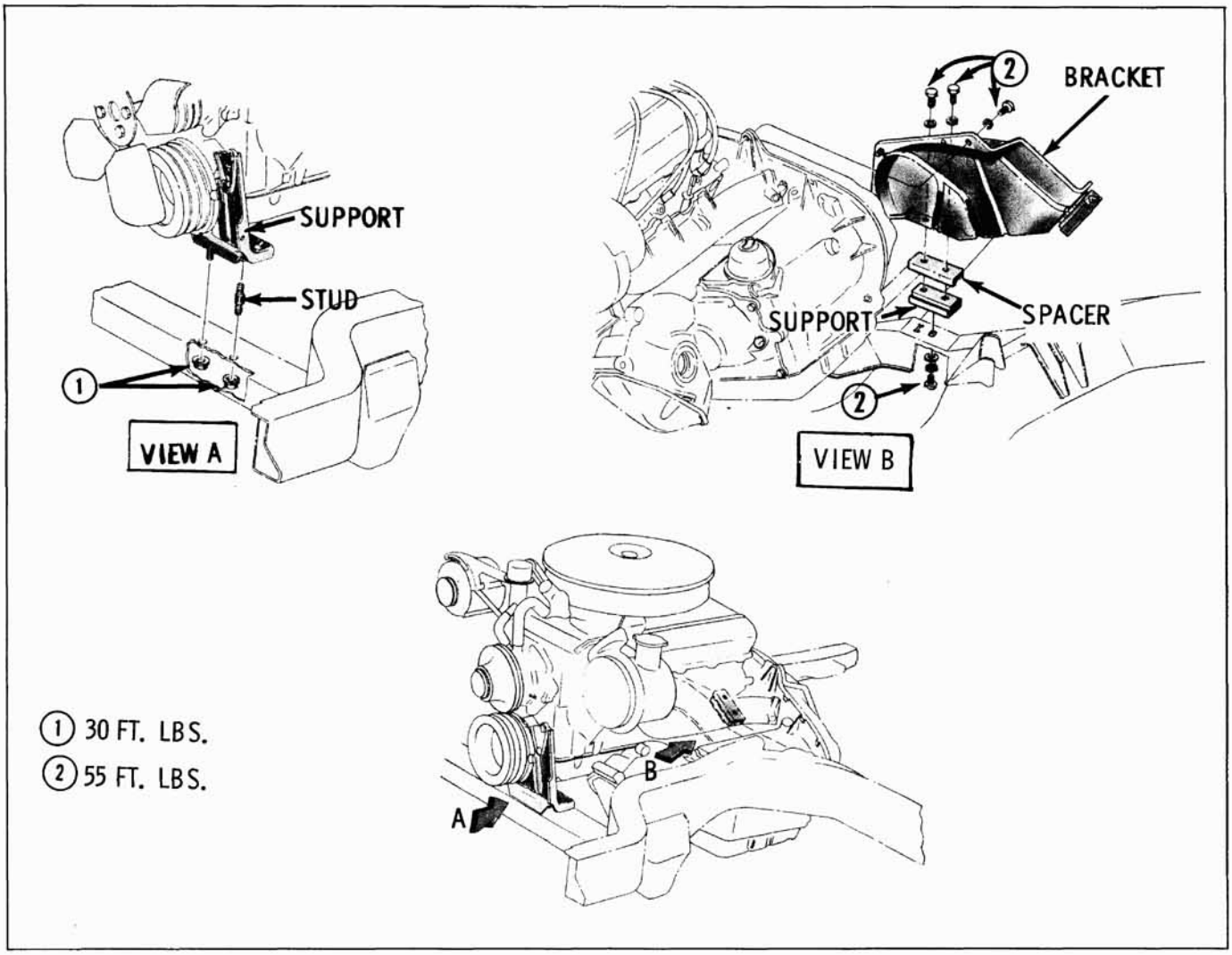


Fig. 6EB-2—Engine Mounting

ENGINE ASSEMBLY

Removal

1. Drain radiator.
2. Remove hood, marking hinge for reassembly.
3. Disconnect battery.
4. Disconnect radiator hoses and cooler lines, heater hoses, vacuum hoses, power steering pump hoses, engine to body ground strap, fuel hose from fuel lines, wiring and accelerator cable.
5. Remove coil, radiator support and radiator.
6. Raise car.
7. Disconnect exhaust pipes at manifold.
8. Disconnect wires and remove starter.
9. Remove torque converter cover and remove three bolts securing converter to flywheel.
10. Attach Tool BT-6322 supporting final drive assembly as shown in Fig. 6EB-1.
11. Remove two attaching bolts from right output shaft support bracket and one thru bolt attaching final drive to engine block, left side.
12. Remove engine mount to crossmember nuts (Fig. 6EB-2).
13. Lower car.
14. Support engine using Lift Fixture BT-6606 as shown in Fig. 6EB-3.

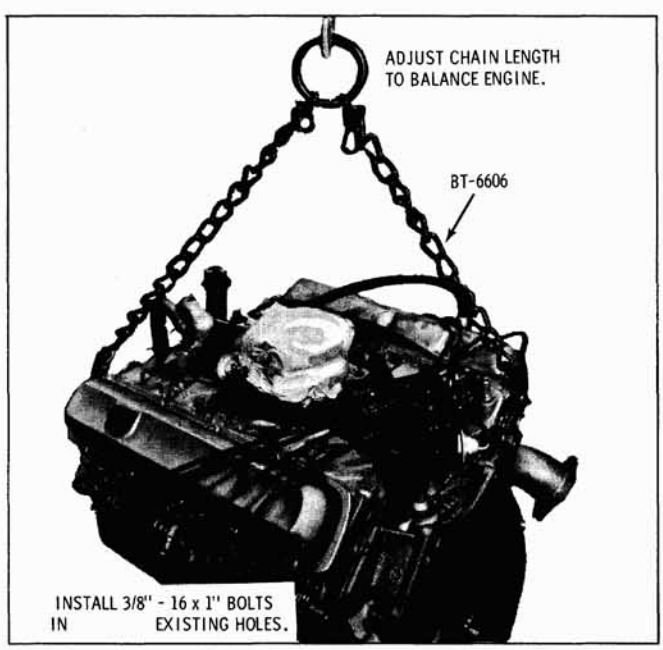


Fig. 6EB-3—Engine Lift Fixture

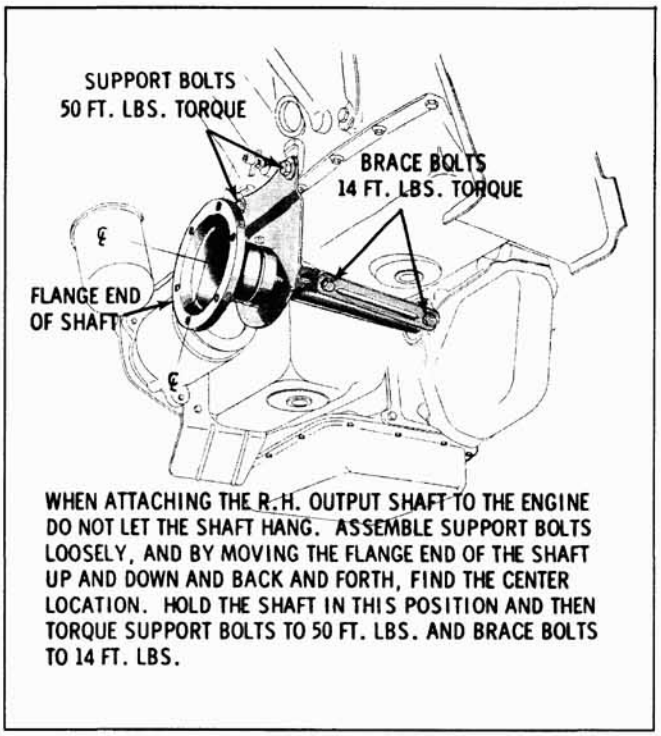


Fig. 6EB-4—Aligning R.H. Output Shaft

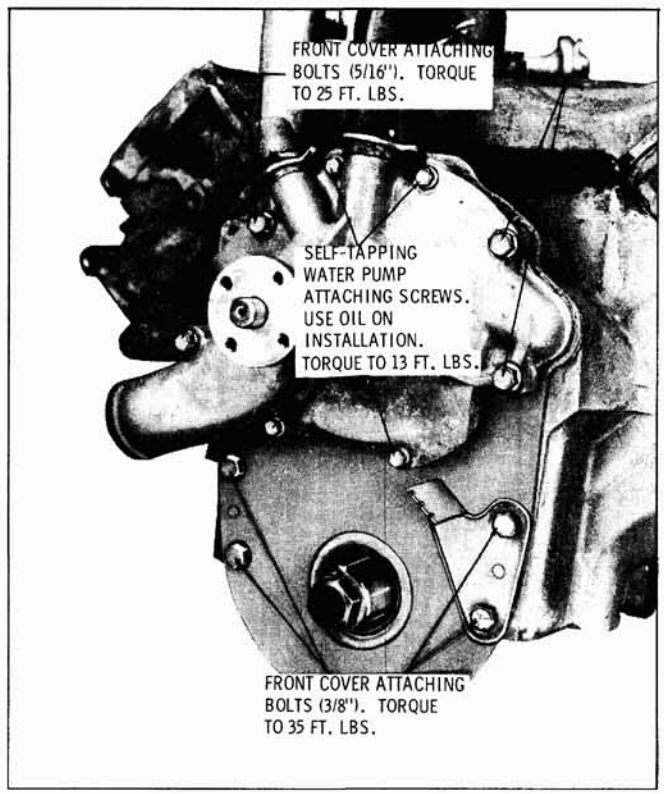


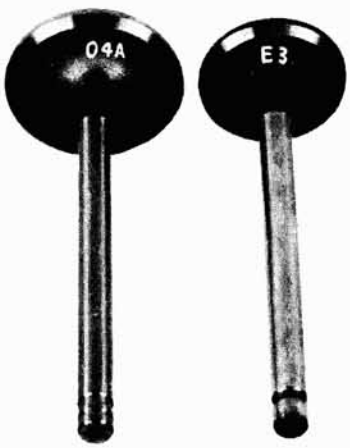
Fig. 6EB-5—Engine Front Cover Bolts

15. Remove six bolts, transmission to engine.
16. Using suitable lifting device, lift engine from car.

If car is to be moved install Converter Holding Tool J-21654.

Installation

1. Attach Lift Fixture BT-6606 (Fig. 6EB-3) and lower engine into position.
2. Locate engine dowels into transmission and position mount studs into front crossmember.
3. Reinstall six bolts, transmission to engine.
4. Remove Lift Fixture BT-6606 and raise car.
5. Replace torque converter to flywheel bolts.
6. Install engine mount nuts.
7. Install torque converter cover and starter.
8. When attaching the right hand output shaft to the engine support bracket, do not let the shaft hang. Assemble bracket bolts loosely, and by moving the flange end of the shaft up and down, and back and forth, find the center location. Hold the shaft in this position and then tighten the bolts. See Fig. 6EB-4. Reinstall the one thru bolt attaching final drive to engine block, left side.
9. Remove Tool BT-6322 supporting final drive assembly.
10. Connect exhaust pipes.
11. Lower car.
12. Install coil, radiator and radiator support.
13. Reconnect accelerator cable, wiring, fuel hoses, engine to body ground strap, power steering pump hoses, vacuum lines, heater hoses, cooler lines and radiator hoses.
14. Install and align hood (refer to Chassis Sheet Metal Section).
15. Fill radiator.
16. Connect battery.



TYPE	ENGINE USAGE	PAINT CODE	FORGED LETTER	HEAD DIAMETER	LENGTH	SEAT ANGLE
INTAKE	TORONADO	RED	"04A" "S4A"	2.062	4.593	30°
EXHAUST	TORONADO	BLACK	"E3" "T3"	1.625	4.587	45°

Fig. 6EB-6—Valve Identification

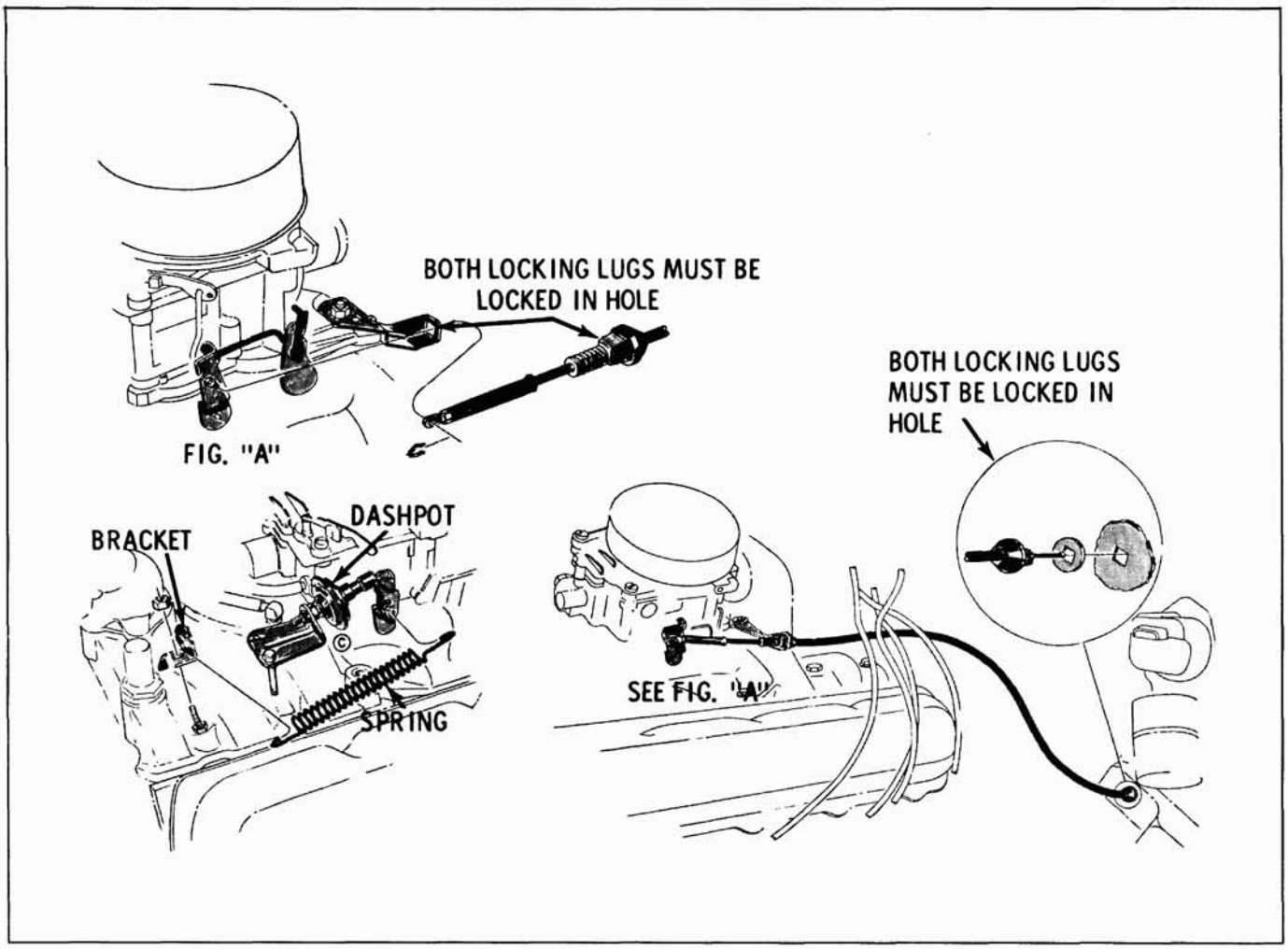


Fig. 6EB-7—Throttle Control

FRONT COVER
(With Engine and Oil Pan Removed)

Removal

1. Disconnect bypass hose from water pump.
2. Remove cover to block attaching bolts and remove cover, timing indicator and water pump assembly. (Fig. 6EB-5)

Installation

1. Install new cover gasket. Apply 1050026 Sealer or equivalent to gasket around water holes and place on block.
2. Install front cover and torque as shown in Fig. 6EB-5.

OIL PAN

Removal

1. Remove engine assembly as previously outlined.
2. Remove dip sticks.
3. Drain oil.
4. Remove mount from front cover.
5. Remove oil pan attaching bolts and remove oil pan.

Installation

1. Apply 1050026 Sealer or equivalent to both sides of pan gaskets (cork) and install on block.
2. Install front and rear seal (rubber).
3. Wipe lube 1050169 or equivalent on seal area and install pan. Torque 5/16" bolts to 15 ft. lbs. and 1/4" bolts to 10 ft. lbs.
4. Reinstall mount to front cover.
5. Reinstall engine and fill crankcase.

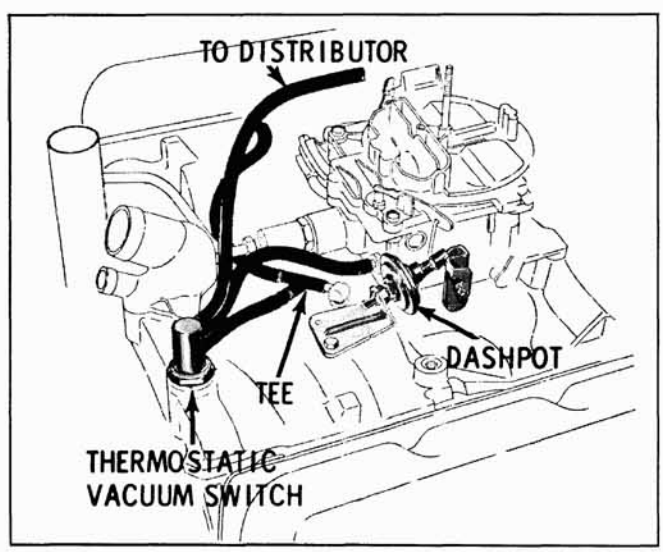


Fig. 6EB-8—Thermostatic Switch and Hoses

TORONADO ENGINE SPECIFICATIONS

CYLINDER BLOCK	
Engine Type	90° V-Type
No. of Cylinders	8
Bore and Stroke (all)	4.126" x 4.250"
Piston Displacement (all)	455 Cu. In.
Compression Ratio	10.25:1
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (I.D.)	3.188"-3.189"
CRANKSHAFT	
Diameter-Main Bearing Journal (all)	3.0003"-2.9993"
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 and 4	1.156"-1.166"
No. 3	1.199"-1.201"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.4998"-2.4988"
Width-Connecting Rod Bearing (with fillets)	1.877"-1.880"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	.201"-.209"
Clearance - Crankshaft End Thrust	.004"-.008"
MAIN BEARINGS	
Oil Clearance-Crankshaft Vertical 1, 2, 3 and 4	.0005"-.0021"
Oil Clearance Crankshaft Vertical 5	.0020"-.0034"
Width-Bearing Shell	
No. 1, 2, and 4	.970"-.980"
No. 3	1.193"-1.195"
No. 5	1.624"
CONNECTING RODS	
Length-Center to Center	6.733"-6.737"
Diameter-Connecting Rod Bore	2.6243"-2.6250"
Diameter-Pin Bore	.9789"-.9795"
Bearing Clearance - Crankshaft (vertical)	.0004"-.0033"
Side Clearance - Crankshaft End	.002"-.011"
PISTON	
Diameter Nominal Outside	4.125"
Length Overall	3.490"
Top of Piston to Center of Pin	1.740"
Clearance at Thrust Surface (selective)	.00075"-.00125"
Weight Less Pin and Rings (all)	24.057 oz.
Skirt Taper	.0000"-.0010" Larger at Bottom
Ring Width (2 compression)	.0798"-.0808"
(1 oil)	.1881"-.1891"
PISTON PINS	
Diameter	.9803"-.9807"
Length Overall	2.980"
Pin to Piston Clearance	.0003"-.0005" Loose
Pin to Rod Clearance	.0008"-.0018" Press
PISTON RINGS	
No. of Compression Rings (per piston)	2
Width of Compression Rings (top and bottom)	.0770"-.0780"
Gap Clearance Compression Rings	.013"-.023"
Clearance in Groove Compression Rings - Upper	.002"-.004"
Lower	.002"-.004"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015"-.055"
Clearance in Groove - Oil Ring	.002"-.008"
CAMSHAFT	
Bearing Journal Diameters	
No. 1	2.0365"-2.0357"
No. 2	2.0165"-2.0157"
No. 3	1.9965"-1.9957"
No. 4	1.9765"-1.9757"
No. 5	1.9565"-1.9557"

TORONADO ENGINE SPECIFICATIONS (Cont'd.)

CAMSHAFT (Cont 'd.)	
Width (including chamfers)	
No. 1	.810"
No. 2, 3, and 4	.761"
No. 5	.788"
Journal Clearance in Bearing (all)	.0020"-.0058"
End Thrust	.011"-.077"
VALVE - INTAKE	
Diameter - Head	2.067"-2.077"
Diameter - Stem	.3425"-.3432"
Angle - Valve	30°
Angle - Valve Seat	30°
Width - Valve Seat (on Cylinder Head)	.030"-.045"
Overall Length	4.703"
Clearance in Guide	.0010"-.0027"
Lash	Hydraulic
VALVE EXHAUST	
Diameter - Head	1.629"-1.619"
Diameter - Stem	.3420"-.3427"
Angle - Valve	45°
Angle - Valve Seat	46°
Width - Valve Seat (on Cylinder Head)	.037"-.075"
Overall Length	4.695"
Clearance in Guide	.0015"-.0032"
Lash	Hydraulic
PUSH ROD - Length	9.556"
VALVE GUIDES	
Inside Diameter (intake and exhaust)	.3442"-.3452"
VALVE SPRINGS	
Length	1.96"
Diameter - Wire	.192"
Inside Diameter	1.065"-1.041"
Load @ 1.670"	76-84 Lbs.
Load @ 1.270"	180-194 Lbs.
VALVE LIFTERS	
Diameter - Body	.8422"-.8427"
Length - Overall	2.000"
Clearance in Boss (selective)	.0005"-.0020"
CAMSHAFT SPROCKET	
Width of Sprocket	.529"-.521"
Pitch	.500"
No. of Teeth	36
Overall Width of Gear Hub	.471"-.461"
CRANKSHAFT SPROCKET	
Width of Sprocket	.530"-.520"
Overall Width of Gear	1.001"-.991"
Pitch	.500"
No. of Teeth	18
TIMING CHAIN	
Width	.875"-Morse, .844"-Linkbelt
No. of Links	48
Pitch	.500"

TURBO HYDRA-MATIC TRANSMISSION

TORONADO

CONTENTS OF SECTION 7E

Subject	Page
PERIODIC MAINTENANCE	7E-1
GENERAL DESCRIPTION	7E-2
VALVES AND THEIR FUNCTIONS	7E-4
POWER FLOW	7E-4
DRIVE RANGE-FIRST GEAR	7E-4
DRIVE RANGE-SECOND GEAR	7E-5
DRIVE RANGE-THIRD GEAR	7E-6
SUPER RANGE-SECOND GEAR	7E-7
LO RANGE-FIRST GEAR	7E-8
REVERSE	7E-9
OIL FLOW CIRCUITS	7E-10
OPERATIONS NOT REQUIRING TRANSMISSION REMOVAL	7E-10
UNITS THAT CAN BE SERVICED AFTER REMOVAL OF OIL PAN	7E-10
GENERAL SERVICE NOTES	7E-10
PARTS CLEANING AND INSPECTION	7E-11
TRANSMISSION REMOVAL AND INSTALLATION	7E-13
TRANSMISSION DISASSEMBLY	7E-16
CONVERTER, MODULATOR AND SPEEDOMETER DRIVE GEAR	7E-16
BOTTOM PAN, STRAINER AND INTAKE PIPE "O" RING SEAL	7E-18
PRESSURE REGULATOR AND BOOST VALVE, CONTROL VALVE ASSEMBLY, GOVERNOR PIPES, DETENT SPRING ASSEMBLY, REAR SERVO, MANUAL AND PARKING LINKAGE AND CASE CONNECTOR	7E-19
COVER AND PLATE ASSEMBLY SPROCKET HOUSING, LINK ASSEMBLY DRIVE AND DRIVEN SPROCKETS	7E-22
DRIVE SPROCKET AND TURBINE SHAFT, AND LINK ASSEMBLY	7E-24
DRIVEN SPROCKET AND INPUT SHAFT	7E-24
SPROCKET BEARINGS	7E-24
FRONT UNIT END PLAY CHECK	7E-25
OIL PUMP	7E-25
PUMP COVER PLATE, DRIVE AND DRIVEN SPROCKET SUPPORT HOUSING ASSEMBLIES	7E-25
FORWARD CLUTCH, DIRECT CLUTCH, FRONT BAND ASSEMBLIES AND SUN GEAR SHAFT	7E-27
REAR UNIT END PLAY CHECK	7E-27
CENTER SUPPORT, GEAR UNIT ASSEMBLY, REAR BAND ASSEMBLY AND REAR UNIT SELECTIVE WASHER	7E-28
DISASSEMBLY AND ASSEMBLY OF INDIVIDUAL UNITS	7E-30
SUPPORT AND GEAR UNIT	7E-30
CASE CENTER SUPPORT	7E-33
REACTION CARRIER, ROLLER CLUTCH AND OUTPUT CARRIER	7E-34
PINION GEARS	7E-35
OUTPUT FLANGE	7E-36
GEAR UNIT	7E-36
VACUUM MODULATOR DIAGNOSIS	7E-40
REAR SERVO	7E-40
FRONT SERVO	7E-41
GOVERNOR ASSEMBLY	7E-42
CONTROL VALVE	7E-42
OIL PUMP	7E-44
FORWARD CLUTCH	7E-46
DIRECT CLUTCH AND INTERMEDIATE SPRAG	7E-50
ASSEMBLY OF UNITS INTO CASE	7E-54
INSTALLING FRONT PUMP	7E-57
REAR SERVO	7E-58
FRONT SERVO	7E-59
CONTROL VALVE	7E-60
PRESSURE REGULATOR	7E-60
MODULATOR	7E-61
GOVERNOR	7E-62
LUBRICATION CHART	7E-63
DIAGNOSIS	7E-63
OIL LEAKS	7E-69
TOOLS	7E-70
INFORMATION CHART	7E-70
TORQUE SPECIFICATIONS	7E-70
BUSHING SERVICE	7E-71

PERIODIC MAINTENANCE

The fluid level should be checked at each oil change. The fluid and strainer should be replaced every 24 months. If more than 24,000 miles are driven in a 24 month period, change the fluid every 24,000 miles. Under heavy duty operating conditions or excessive stop and go driving, replace fluid and strainer every 12,000 miles.

Use only automatic transmission fluid identified with the mark DEXRON. This type fluid has been especially formulated and tested for use in automatic transmissions. Dexron fluid is available from many lubricant suppliers.

DEXRON type automatic transmission fluid is also preferred for use in all pre 1968 model GM automatic transmissions. Type A, Suffix A fluids identified by the mark "AQ-ATF" and a number followed by the suffix letter A (AQ-

ATF-XXXXA) continue to be satisfactory for use in pre 1968 GM automatic transmissions.

CHECKING AND ADDING FLUID (Transmission at Operating Temperature)

The automatic transmission is designed to operate at the full mark on the dip stick at normal operating temperature (170°F.) and should be checked under these conditions. The normal operating temperature is obtained only after at least 15 miles of highway type driving or the equivalent of city driving.

To determine proper level, proceed as follows:

1. Apply parking brake.
2. With the selector lever in the PARK position, start engine. DO NOT RACE ENGINE. Move selector lever through each range.
3. Immediately check fluid with the selector lever in PARK, engine running at SLOW IDLE and the car on a LEVEL surface. The fluid level on the dip stick should be at the "FULL" mark.
4. If additional fluid is required, add sufficient fluid to bring it to the "FULL" mark on the dip stick.

CHECKING AND ADDING FLUID (Transmission at Room Temperature)

If the car has not been driven sufficiently to bring the transmission to operating temperature and it becomes necessary to check the fluid level, the transmission may be checked at room temperature (80°F.) as follows:

1. With parking brake applied, selector lever in PARK position, start engine. DO NOT RACE ENGINE. Move selector lever through each range.
2. Immediately check fluid level with selector lever in park, engine running at SLOW IDLE and vehicle on a LEVEL surface. The fluid level on the dip stick should be 1" below the "FULL" mark.
3. If additional fluid is required, add sufficient fluid to bring level to 1" below the "FULL" mark on the dip stick.

If transmission fluid level is correctly established at 80°F., it will appear at the "FULL" mark on the dip stick when the transmission reaches normal operating temperature (170°F.). The fluid level is set 1" below the "FULL" mark on the dip stick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature of 170°F.

Do not overfill as foaming and loss of fluid through the vent pipe might occur as the fluid expands. If fluid is too low, especially when cold, complete loss of drive may result which can cause transmission failure.

CHECKING AND ADDING FLUID (After Transmission Service)

If work has been performed on the transmission, add the following quantity of fluid, then check fluid as outlined in Steps 1, 2 and 3 under CHECKING AND ADDING FLUID (Transmission at Room Temperature).

1. Pan Removal - 4 quarts
2. Converter Changed - 2 quarts
3. Overhaul - 12 quarts

A point to remember when adding fluid to the transmission is that the quantity of fluid alone is not important. The important factor is the relation of the fluid level to the "FULL" mark, dependent on temperature, on the dip stick.

The end result of the checking and adding procedure is to assure that the fluid level is at the "FULL" mark when the transmission is at operating temperature.

GENERAL DESCRIPTION

The Turbo Hydra-Matic transmission used on the Toronado Series is a fully automatic transmission used for front wheel drive applications. It consists primarily of a three-element hydraulic torque converter, dual sprocket and link belt, compound planetary gear set, three multiple-disc clutches, a sprag clutch, a roller clutch, two band assemblies, and a hydraulic control system.

The three-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator or reaction member.

The stator assembly is mounted on a one-way roller clutch which allows the stator to overrun when not used as a reaction member.

The torque converter couples the engine to the planetary gear set through the use of a drive sprocket, a link belt and a driven sprocket. Clockwise engine torque turns the drive sprocket clockwise. This, in turn, drives the driven sprocket in a clockwise direction. This in effect is a reverse in the direction of engine torque due to the side mounting of the gear unit. (Fig. 7E-1)

The planetary gear set provides three forward ratios and reverse. The approximate gear ratios are as follows:

	First	- 2.5 gear ratio x 2. Converter stall ratio equals 5:1.
*	Second	- 1.5 gear ratio.
*	Third	- 1.1 gear ratio.
*	Reverse	- 2.1 gear ratio x 2. Converter stall ratio equals 4:1.

* Second and third are also multiplied to a lesser degree.

The three multiple-disc clutches, the sprag and roller clutch assemblies, and the two band assemblies provide the friction elements required to obtain the desired function of the compound planetary gear set.

The hydraulic control system automatically selects the proper gear ratio depending upon vehicle load and speeds. It also provides the working pressures required to operate the friction elements of the transmission.

External control connections to the transmission are:
Engine Vacuum
12 Volt Electrical Signals
Manual Linkage Control

Engine vacuum is used to operate the vacuum modulator assembly. The vacuum modulator automatically senses any change in torque input to the transmission that the driver induces through a change in accelerator position.

The 12 volt electrical signal is used to operate the electrical detent solenoid. The detent solenoid is activated by an electrical switch in the throttle linkage. When the throttle is fully opened the switch in the throttle linkage is closed, activating the detent solenoid and causing the transmission to downshift at speeds below approximately 70 mph.

The manual linkage is used to select the desired operating ranges, reverse, neutral and park.

The selector quadrant has six positions: P, R, N, D, S, L.

P — Park position positively locks the output carrier to the transmission case by means of a locking pawl to prevent vehicle from rolling in either direction. This position should be selected whenever the driver leaves the vehicle. The engine may be started in Park position.

R — Reverse enables the vehicle to be operated in a Reverse direction.

N — Neutral position enables the engine to be started and run without driving the vehicle.

D — Drive range is used for all normal driving conditions and maximum economy.

Drive range has three gear ratios, from the starting ratio to direct drive. Detent downshifts are available for passing by depressing the accelerator to the floor.

S — Super range adds performance for congested traffic or hilly terrain. Super range has the same starting ratio as Drive range, but prevents the transmission from shifting above second gear to retain second gear acceleration when extra performance is desired. Super range can also be used for engine braking.

Super range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in second until the vehicle speed or the throttle are changed to obtain first gear operation in the same manner as in Drive range.

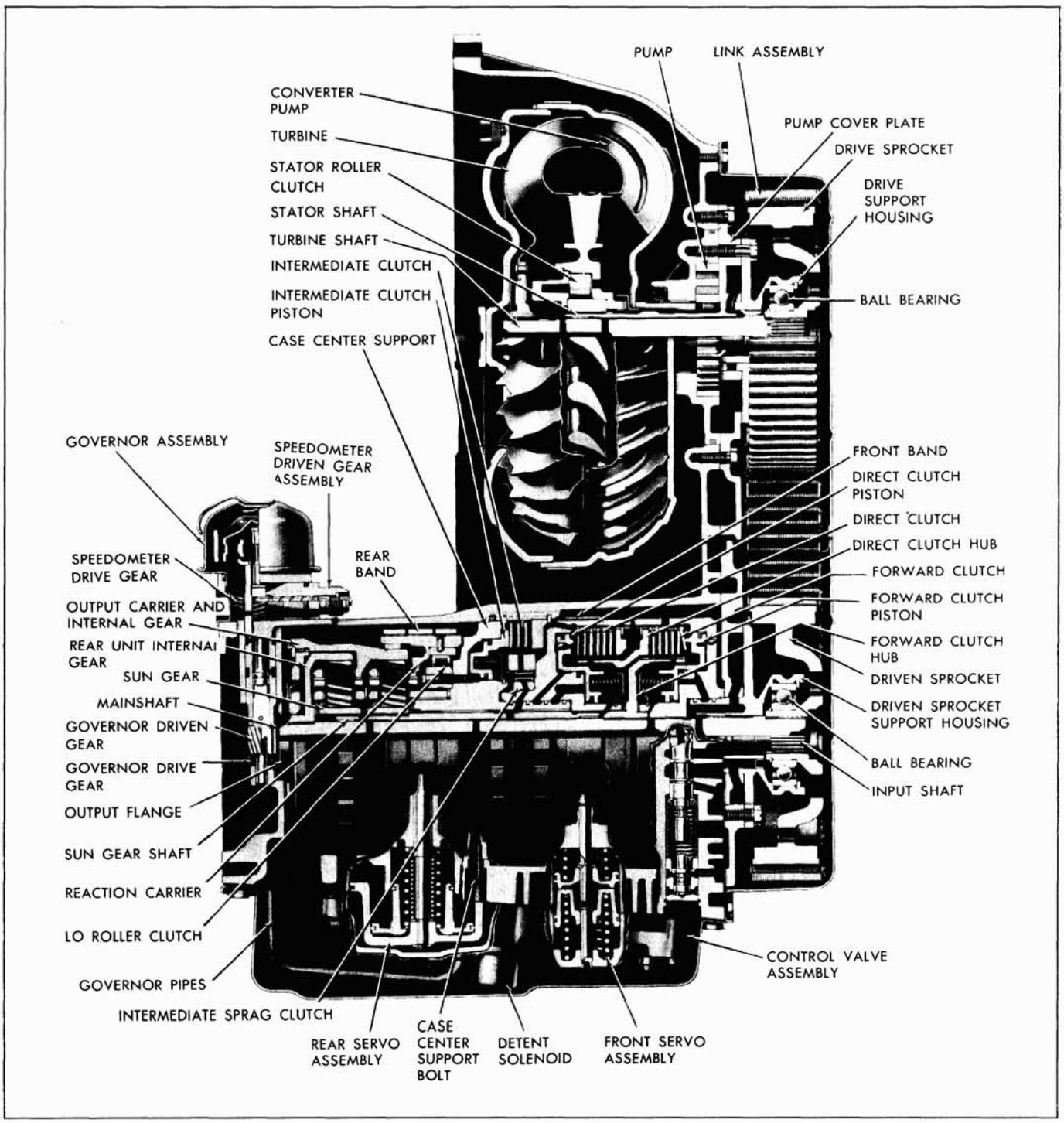


Fig. 7E-1—Turbo Hydra-Matic Transmission

L — Lo range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in second until vehicle speed is reduced to approximately 40 mph, depending on axle ratio.

Lo range position prevents the transmission from shifting out of first gear. This is particularly beneficial for maintaining maximum engine braking when continuous first gear operation is desirable.

VALVES AND THEIR FUNCTIONS

The valves in the Turbo Hydra-Matic transmission used on the Toronado Series function identically to their corresponding valves in the regular Turbo Hydra-Matic transmission with the following exceptions:

1. The pressure regulator valve is located in the transmission case. The valve functions as a regulator of line pressure. The bottom pan must be removed to service this valve located in the right rear corner of the case valve body mounting pad.

2. The modulator valve has a case to valve bushing in which it operates.

3. The governor is mounted with a clip, an external stamped housing, and a square cut "O" ring seal.

POWER FLOW (Fig. 7E-2)

DRIVE RANGE - FIRST GEAR

FORWARD CLUTCH - APPLIED
ROLLER CLUTCH - EFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - RELEASED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - RELEASED
INTERMEDIATE SPRAG - INEFFECTIVE

With the selector lever in "D" range, the forward clutch is applied. This delivers turbine torque to the drive sprocket, through the link belt to the driven sprocket and mainshaft and turns the rear internal gear in a counterclockwise direction. (Converter torque ratio equals approximately 2:1 at stall.)

Counterclockwise motion of the rear internal gear causes the rear pinions to turn counterclockwise to drive the sun gear clockwise. In turn, the sun gear drives the front pinions counterclockwise, turning the front internal gear, output carrier, and output flange counterclockwise in a reduction ratio of approximately 2.5:1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and roller clutch assembly to the transmission case. (Approximate stall ratio equals 5:1.)

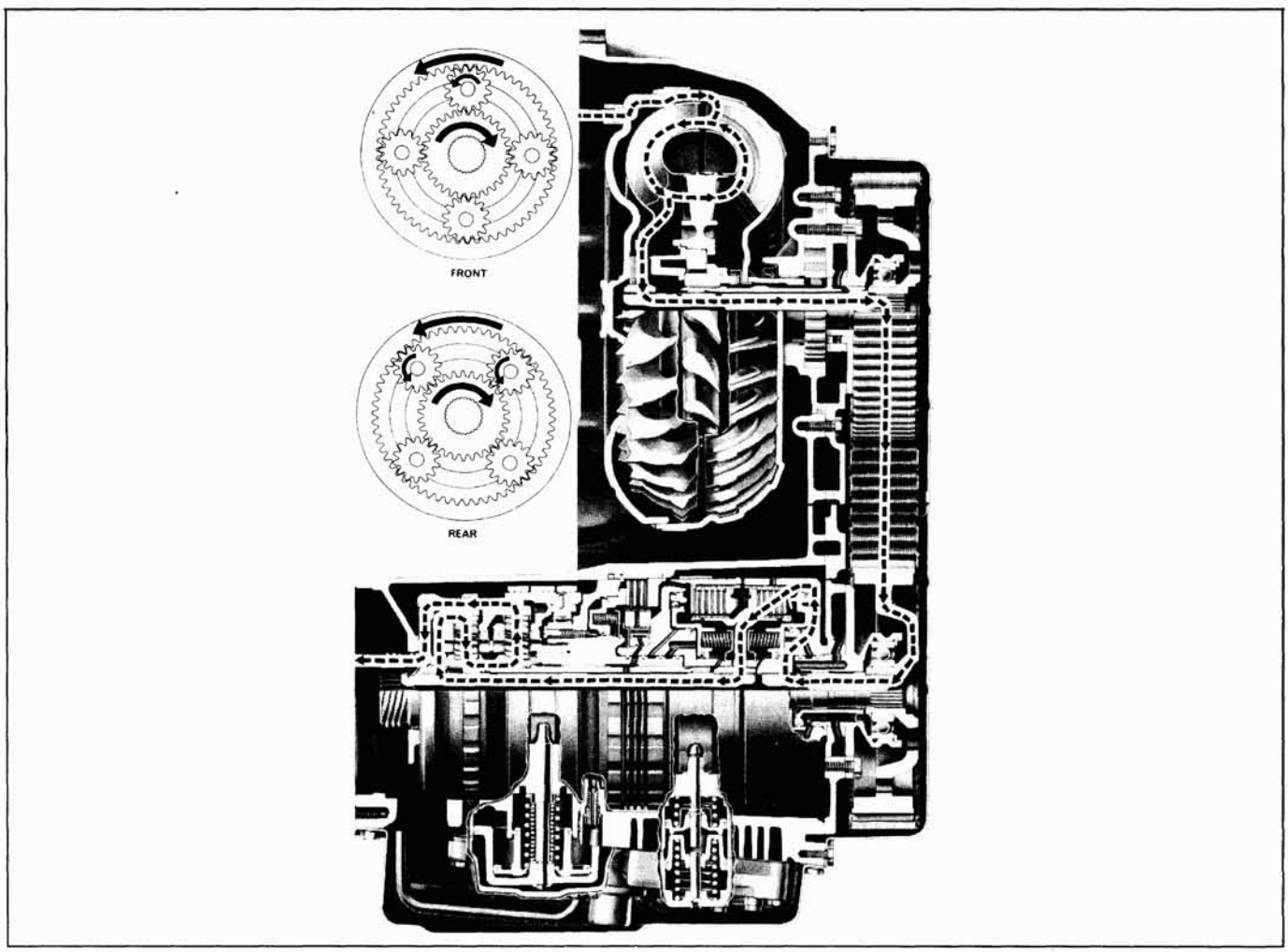


Fig. 7E-2—Drive Range - First Gear

DRIVE RANGE - SECOND GEAR
(Fig. 7E-3)

FORWARD CLUTCH - APPLIED
ROLLER CLUTCH - INEFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - RELEASED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - APPLIED
INTERMEDIATE SPRAG - EFFECTIVE

In second gear, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against clockwise rotation. Turbine torque, through the forward clutch, is now applied through the mainshaft to the rear internal gear in a counterclockwise direction.

Counterclockwise rotation of the rear internal gear turns the rear pinions counterclockwise against the stationary sun gear. This causes the output carrier and output flange to turn counterclockwise in a reduction ratio of approximately 1.5:1.

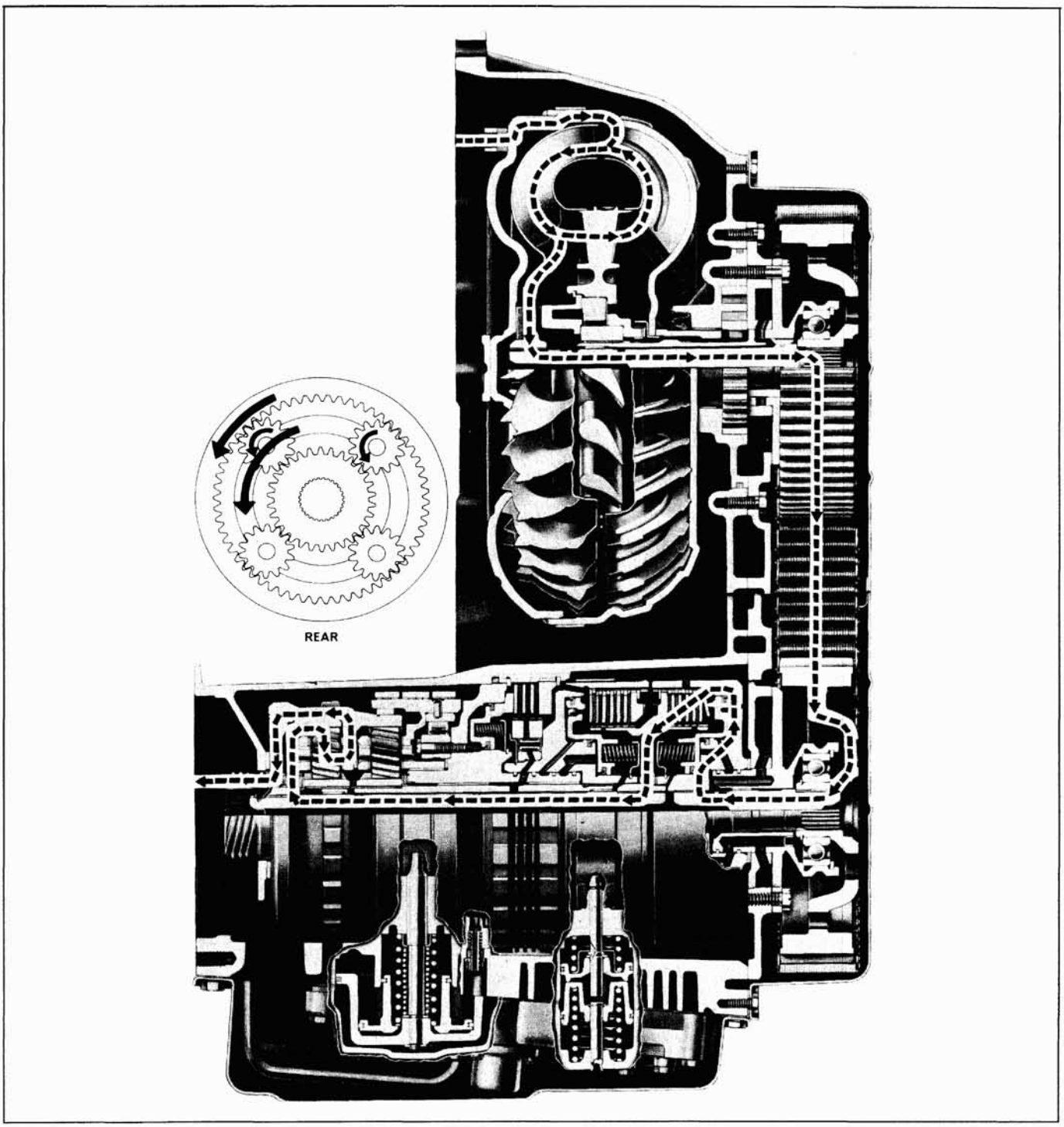


Fig. 7E-3—Drive Range - Second Gear

DRIVE RANGE-THIRD GEAR
(Fig. 7E-4)

FORWARD CLUTCH - APPLIED
ROLLER CLUTCH - INEFFECTIVE

DIRECT CLUTCH - APPLIED
FRONT BAND - RELEASED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - APPLIED
INTERMEDIATE SPRAG - INEFFECTIVE

In direct drive, engine torque is transmitted to the converter to the drive sprocket, through the link belt, to the driven sprocket and through the forward clutch to the mainshaft and rear internal gear. Because the direct clutch is applied, equal power is also transmitted to the sun gear shaft and the sun gear. Since both the sun gear and internal gears are now turning at the same speed, the planetary gear set is essentially locked and turns as one unit in direct drive, or a ratio of 1:1.

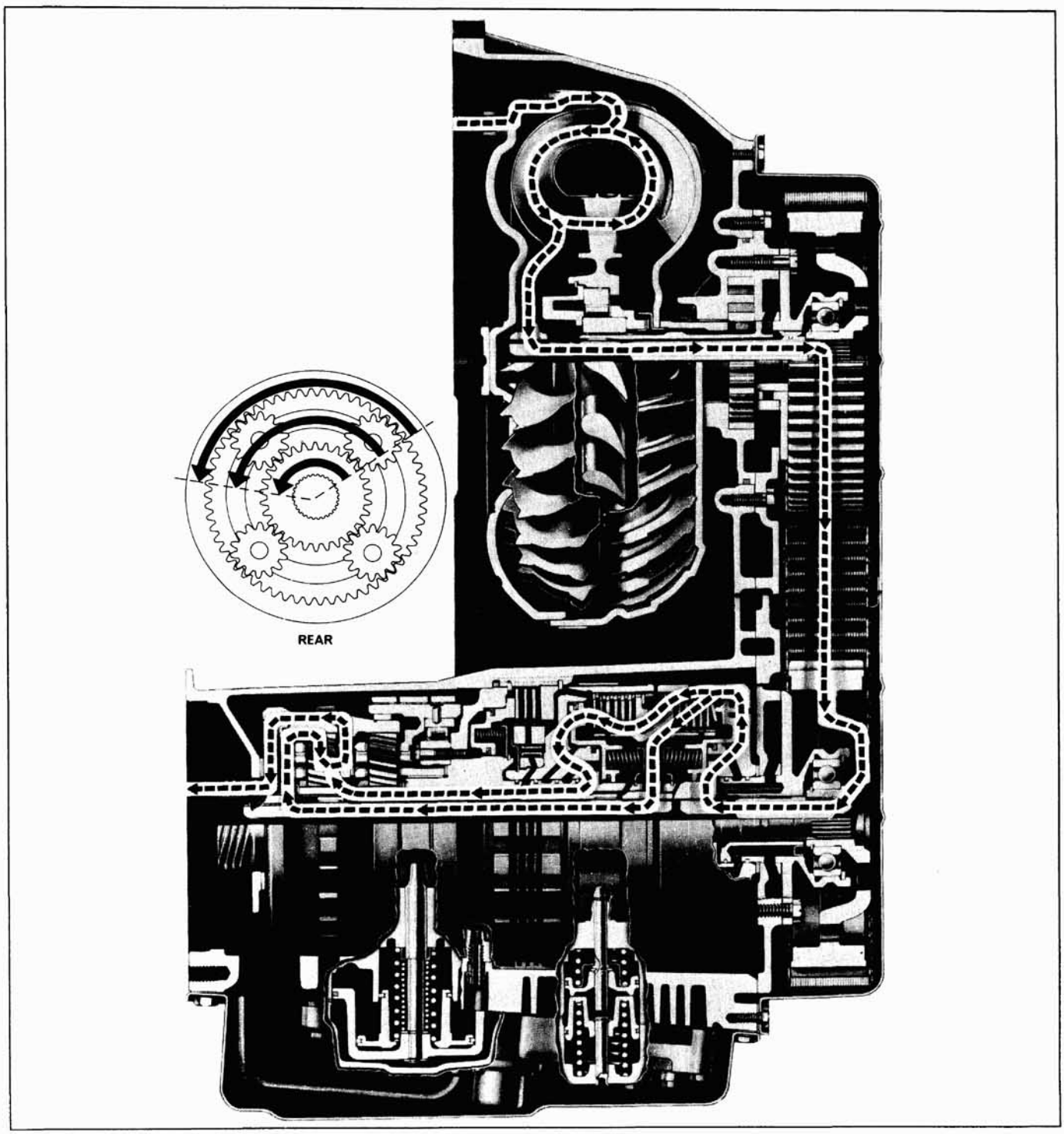


Fig. 7E-4—Drive Range - Third Gear

SUPER RANGE-SECOND GEAR
(Fig. 7E-5)

FORWARD CLUTCH - APPLIED
ROLLER CLUTCH - INEFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - APPLIED
REAR BAND - RELEASED

INTERMEDIATE CLUTCH - APPLIED
INTERMEDIATE SPRAG - EFFECTIVE

In second gear, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against clockwise rotation. Turbine torque through the forward clutch is now applied through the mainshaft to the rear internal gear in a counterclockwise direction.

Counterclockwise rotation of the rear internal gear turns the rear pinions counterclockwise against the stationary sun gear. This causes the output carrier and output flange to turn counterclockwise in a reduction ratio of approximately 1.5:1.

In second gear, overrun braking is provided by the front band as it holds the sun gear fixed. Without the band applied, the sun gear would overrun the intermediate sprag.

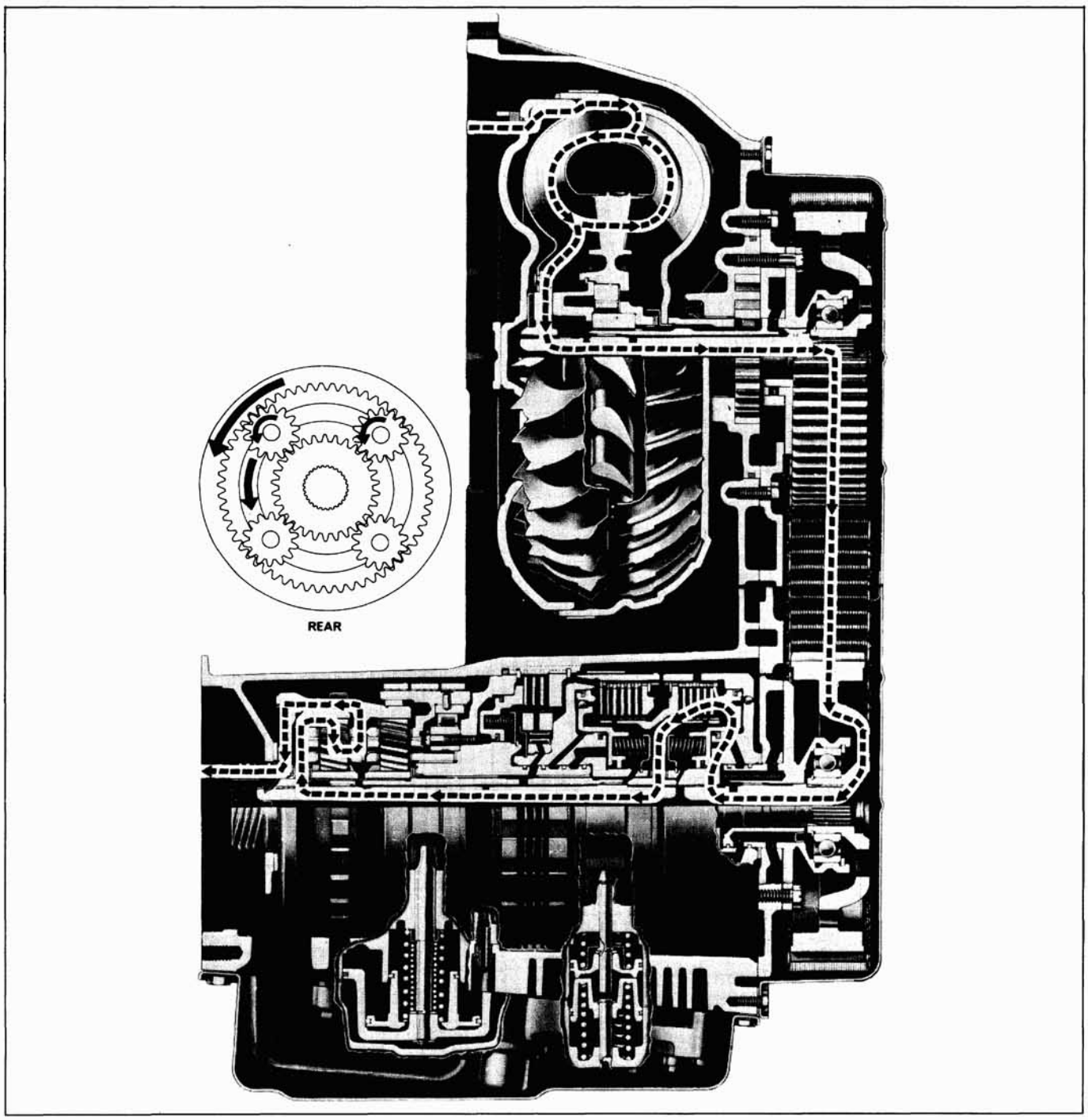


Fig. 7E-5—Super Range - Second Gear

LO RANGE-FIRST GEAR
(Fig. 7E-6)

FORWARD CLUTCH - APPLIED
ROLLER CLUTCH - EFFECTIVE

DIRECT CLUTCH - RELEASED
FRONT BAND - RELEASED
REAR BAND - APPLIED

INTERMEDIATE CLUTCH - RELEASED
INTERMEDIATE SPRAG - INEFFECTIVE

With the selector lever in "L" range, the forward clutch is applied. This delivers turbine torque through the drive sprocket, link belt, and driven sprocket to the mainshaft and turns the rear internal gear in a counterclockwise direction. (Converter torque ratio equals approximately 2:1 at stall.)

Counterclockwise motion of the rear internal gear causes the rear pinions to turn counterclockwise to drive the sun gear clockwise. In turn, the sun gear drives the front pinions counterclockwise, turning the front internal gear, output carrier, and output flange, counterclockwise in a reduction ratio of approximately 2.5:1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and roller clutch assembly to the transmission case. (Total stall ratio equals approximately 5:1.)

Downhill or overrun braking is provided in "L" range by applying the rear band as this prevents the reaction carrier from overrunning the roller clutch.

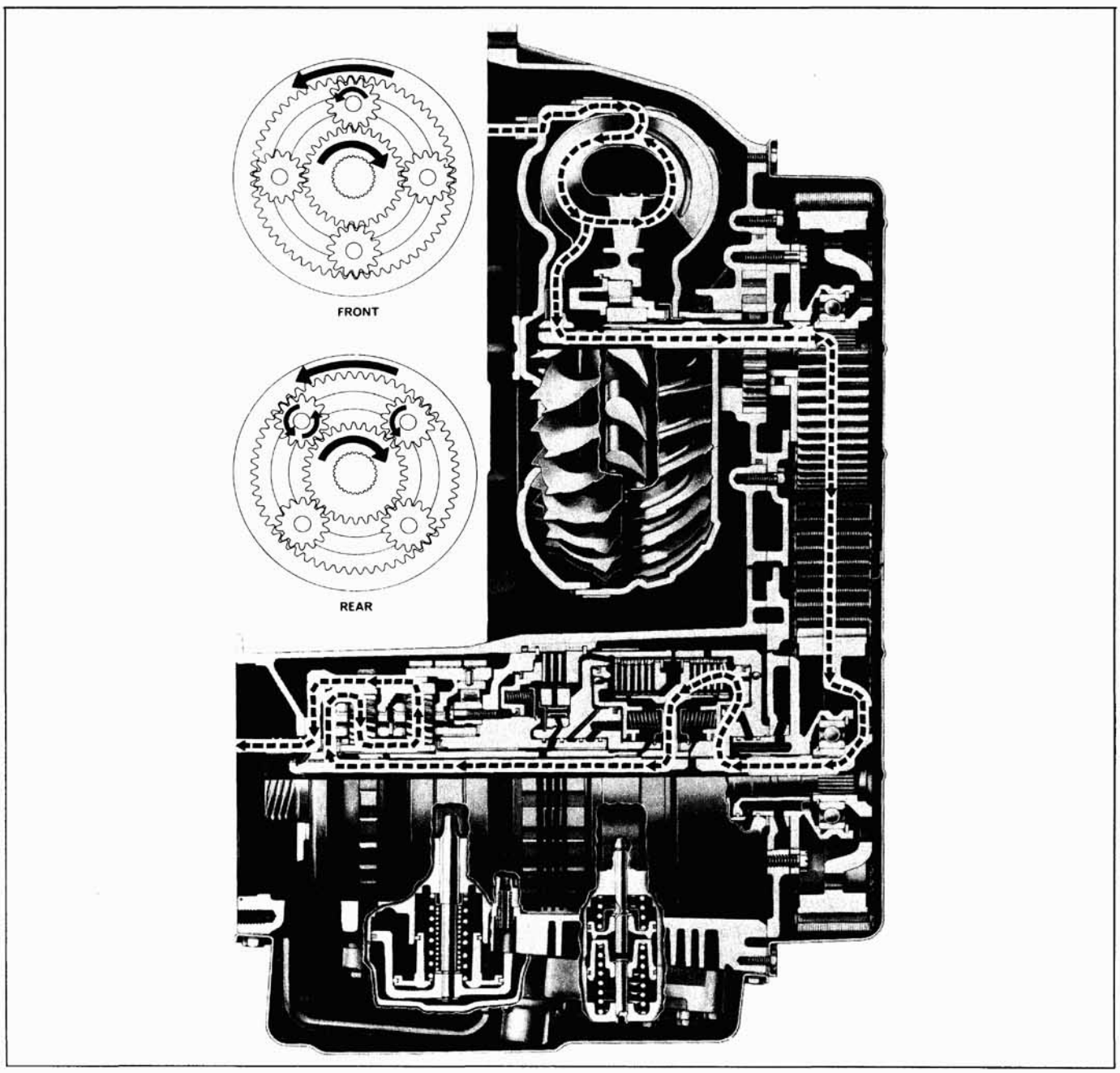


Fig. 7E-6—Low Range - First Gear

REVERSE
(Fig. 7E-7)

FORWARD CLUTCH - RELEASED
LO SPRAG - INEFFECTIVE

DIRECT CLUTCH - APPLIED
FRONT BAND - RELEASED
REAR BAND - APPLIED

INTERMEDIATE CLUTCH - RELEASED
INTERMEDIATE SPRAG - INEFFECTIVE

In reverse, the direct clutch is applied to direct turbine torque, through the drive sprocket, link belt and driven sprocket, to the sun gear shaft and sun gear. The rear band is also applied, holding the reaction carrier.

Counterclockwise torque to the sun gear causes the front pinions and front internal gear to turn clockwise in reduction. The front internal gear is connected directly to the output shaft, thus providing the reverse output gear ratio of approximately 2:1. The reverse torque multiplication at stall (converter and gear ratios) is approximately 4:1.

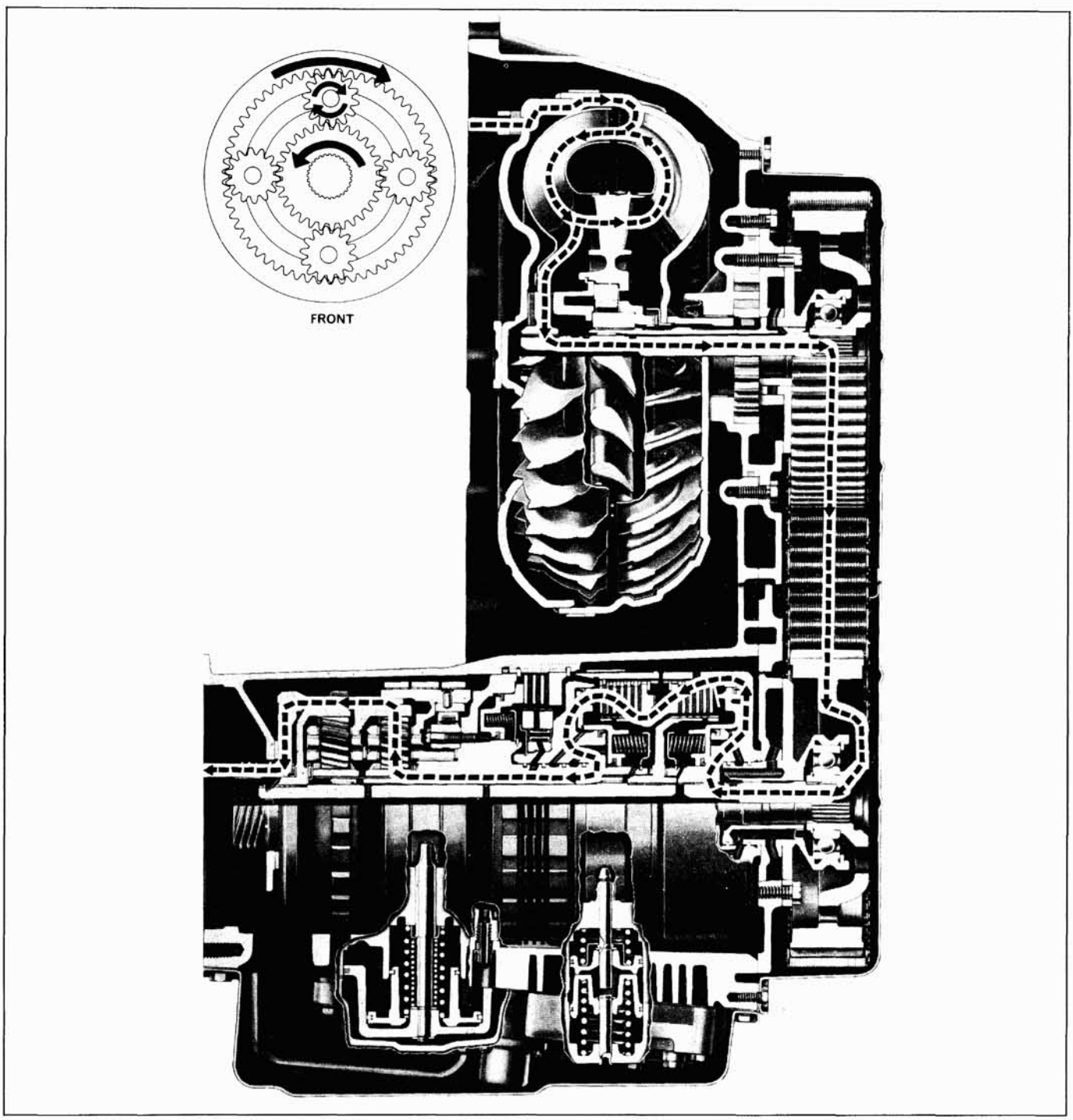


Fig. 7E-7—Reverse

OIL FLOW CIRCUITS

The oil flow circuits are similar to the oil flow circuits used in the regular Turbo Hydra-Matic transmission. When tracing oil circuits refer to Figs. 7-14 through 7-21 in the TURBO HYDRA-MATIC TRANSMISSION, Section 7.

OPERATIONS NOT REQUIRING TRANSMISSION REMOVAL

1. Oil cooler fitting replacement or adjustment.
2. Governor assembly service.
3. Vacuum modulator, and valve service.
4. Speedometer driven gear service.
5. Oil level check.
6. Oil pressure check with oil pressure gauge.

UNITS THAT CAN BE SERVICED AFTER REMOVAL OF OIL PAN

(Fig. 7E-8)

1. Oil pan and pan to case gasket.
2. Pressure regulator valve assembly.
3. Valve body assembly.
4. Rear servo and accumulator assembly.
5. Front servo and accumulator assembly.
6. Governor pipes.
7. Detent solenoid.
8. Solenoid connector.
9. Manual linkage.
10. Parking linkage.
11. Valve body to case spacers and gaskets.
12. Check balls (7). See Fig. 7E-9 for proper location.
13. Detent roller and spring assembly.
14. Strainer assembly.

General disassembly and assembly instructions should be followed whenever service is performed with the transmission remaining in the vehicle.

GENERAL SERVICE NOTES

When servicing the transmission, it is recommended that upon disassembly of a unit, all parts should be cleaned and inspected as outlined under CLEANING AND INSPECTION, then the unit should be reassembled before disassembly of other units to avoid confusion and interchanging of parts.

1. Before disassembly of a unit, thoroughly clean the exterior.

2. Disassembly and assembly of the unit and sub assemblies must be made on a clean work bench. As in repairing any hydraulically operated unit, cleanliness is of the utmost importance; therefore, the work bench, tools, and parts must be kept clean at all times.

3. Before installing screws or bolts into aluminum parts, ALWAYS DIP SCREWS OR BOLTS INTO HYDRA-MATIC OIL to prevent screws or bolts from galling the aluminum threads and also to prevent the screws or bolts from seizing.

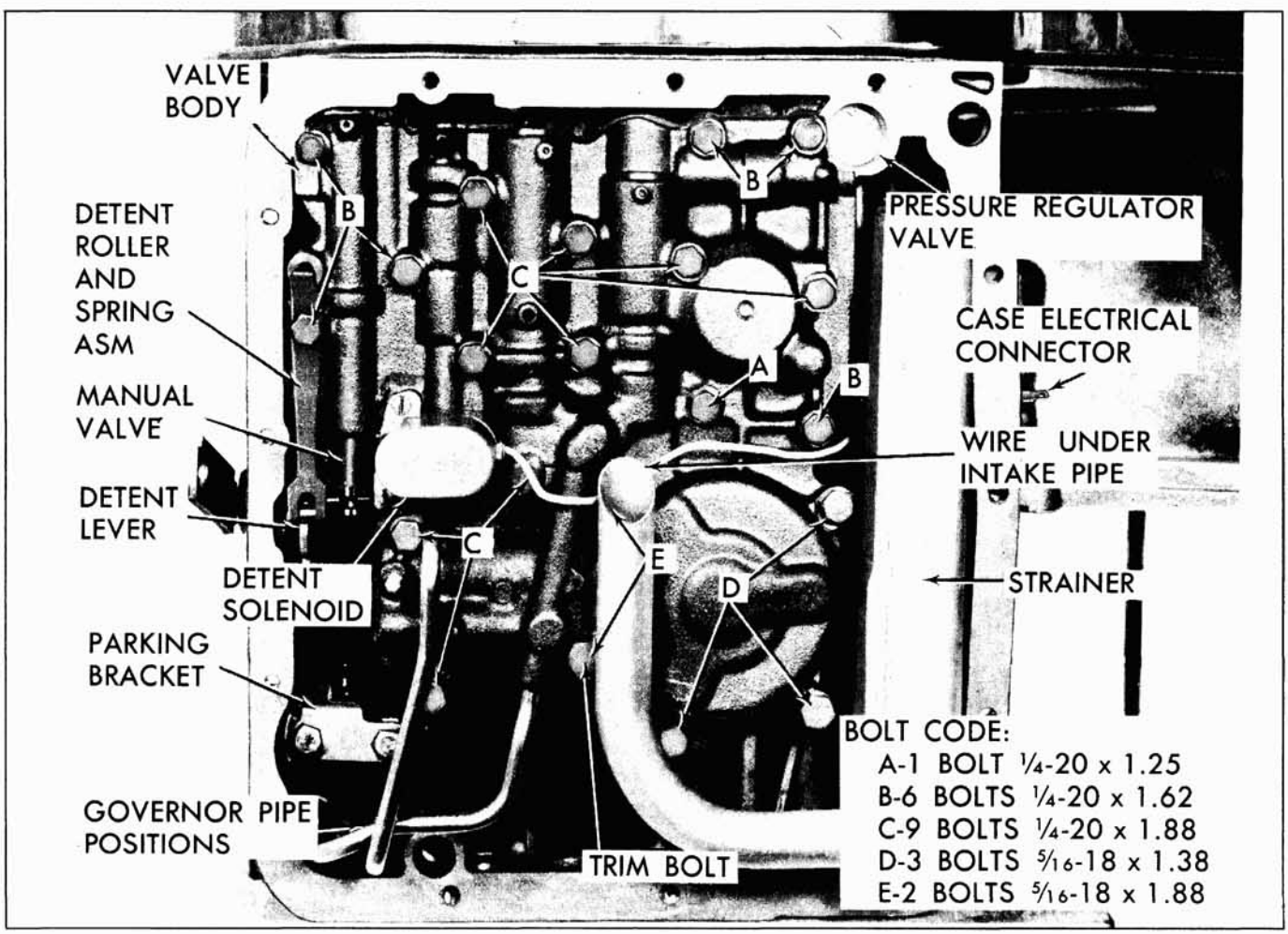


Fig. 7E-8—Oil Pan Removed

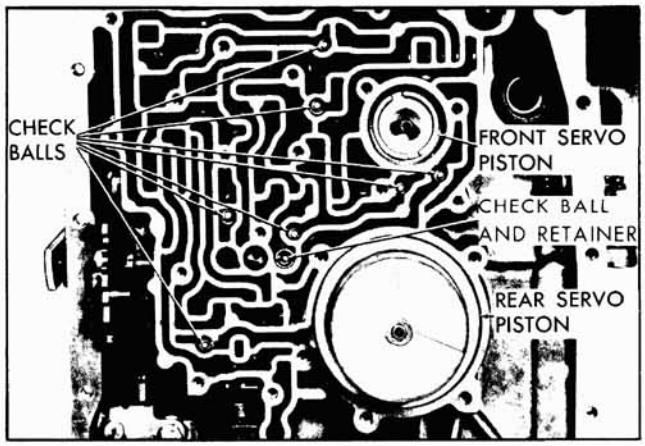


Fig. 7E-9—Location of Check Balls

4. Always use a torque wrench and tighten bolts to the recommended torque specifications when installing bolts into aluminum parts to prevent the possibility of stripping the aluminum threads.

5. If tapped threads in aluminum parts are stripped or damaged, the part can, in most cases, be made serviceable by the careful use of Heli-coils.

6. Seal protecting tools must be used when assembling the units to prevent damage to the seals. Hydra-Matic oil should be applied to all seals before they are assembled into sealed units. The slightest flaw in the sealing surface of the seal can cause an oil leak.

7. All aluminum castings and valve body parts are very susceptible to nicks, burrs and handling damage, so extreme care should be used in handling these parts.

8. The internal snap rings should be expanded and external snap rings compressed if they are to be reused. This will insure proper seating when they are reinstalled into the unit.

9. Replace all "O" rings, gaskets and oil seals that are removed. Complete overhaul service packages are available for these items.

10. During reassembly of each unit, all internal parts must be lubricated with Hydra-Matic oil.

11. Always refer to the lubrication chart (Fig. 7E-232) for the location of all oil and lubrication holes and passages. Lubrication holes are all shown in the chart.

PARTS CLEANING AND INSPECTION

After complete disassembly of a unit, all metal parts should be washed in a clean solvent and dried with compressed air. All oil passages should be blown out and checked to make sure that they are open and not obstructed. Small passages should be checked with tag wire. All parts should be inspected to determine which parts are to be replaced.

The various inspections of parts are as follows:

1. Inspect linkage and pivot joints for excessive wear.

2. Bearing and thrust surfaces of all parts should be checked for excessive wear or scoring.

3. Check for broken seal rings, damaged ring lands and damaged threads.

4. Inspect seals and "O" rings. (Check these for damage, even though they will be replaced, to determine if they are part of the transmission problem.)

5. Mating surfaces of castings and end plates should be checked for burrs and irregularities. If a good seal is not apparent, burrs or irregularities may be removed by lapping the surface with crocus cloth. The crocus cloth should be held on a flat surface, such as a piece of plate glass.

6. Castings should be checked for cracks and sand holes.

7. Gear teeth should be examined for chipping, scoring, and excessive wear.

8. Valves should be free of burrs, nicks, and chips and the shoulders of the valves must be square. Any burrs or irregularities may be removed by honing. Valves should be free to slide in their respective bores.

9. Inspect composition clutch plates for damaged surfaces and loose facings. If flakes of the facing material can be removed with the thumbnail, the plates should be replaced; however, composition clutch plate discoloration is not an

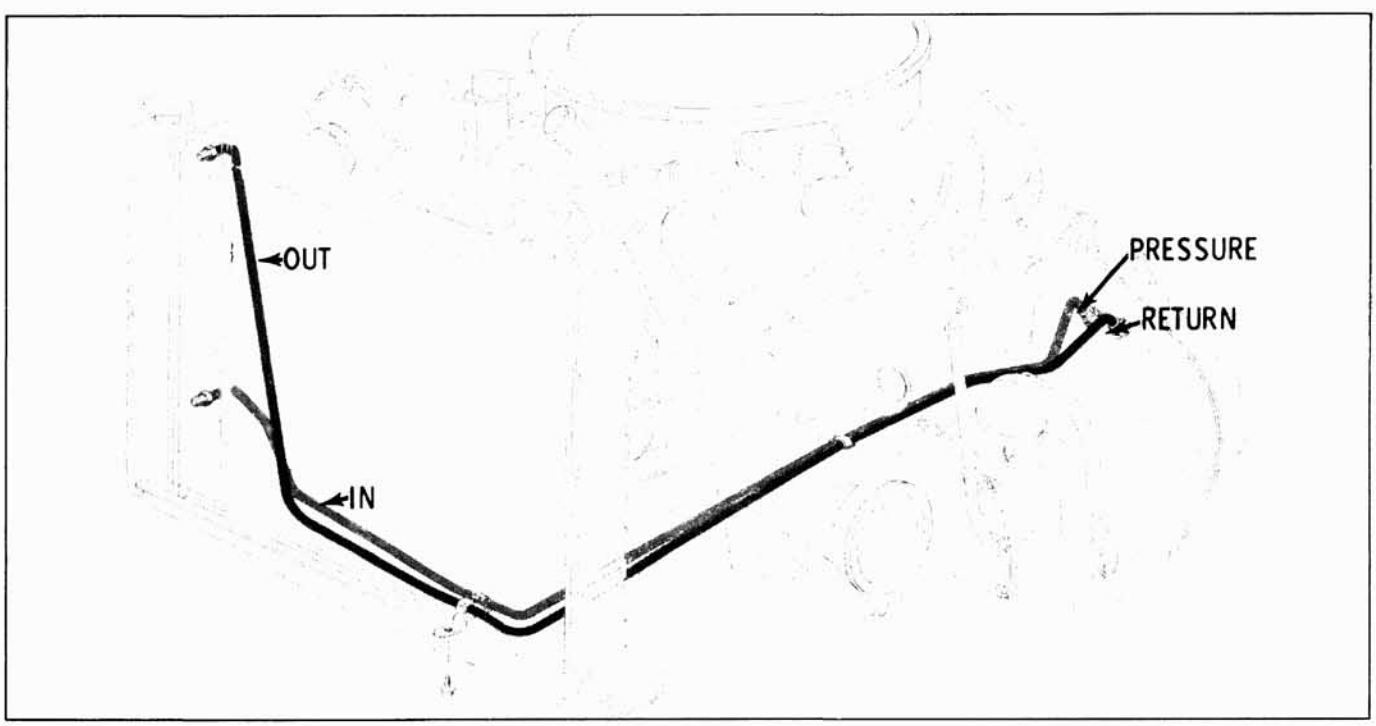


Fig. 7E-10—Oil Cooler Lines

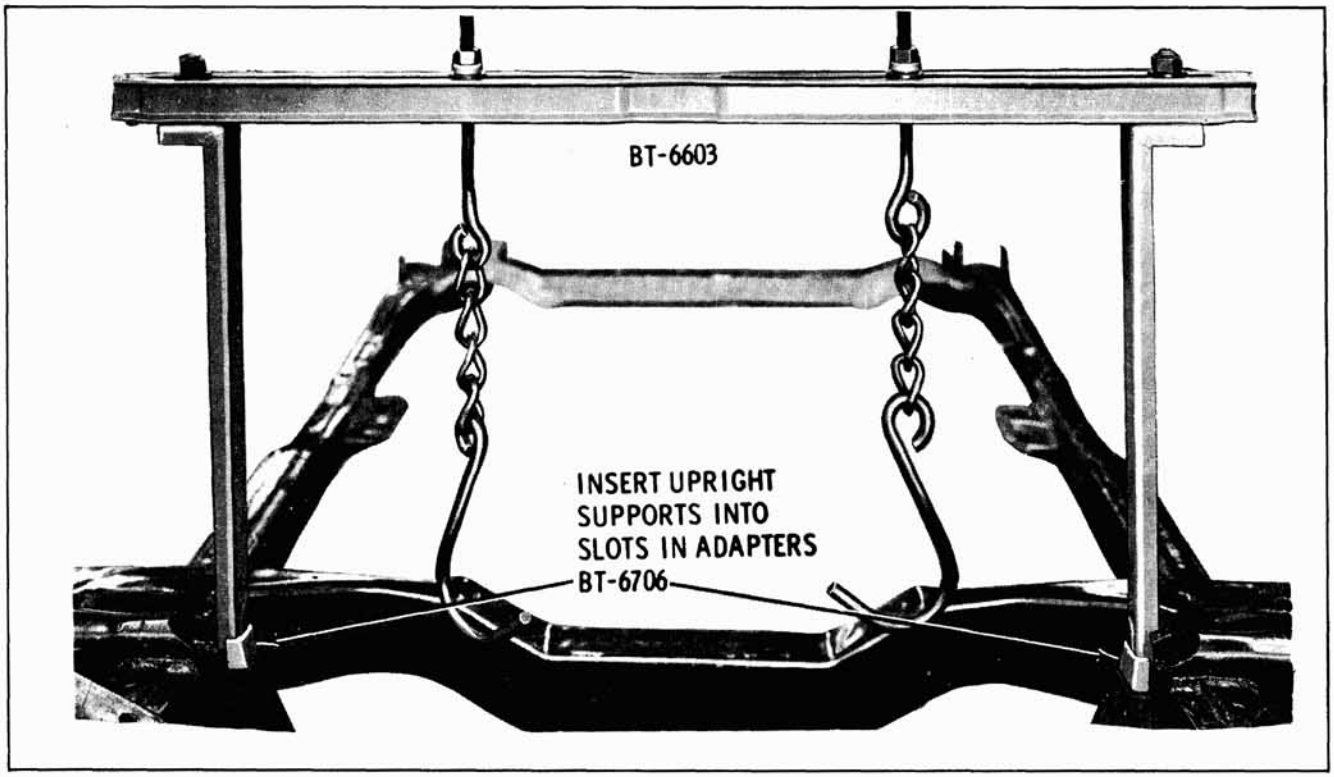


Fig. 7E-11—Installing Support Bars

indication of composition clutch plate failure. Discoloration is natural for these parts.

10. Inspect steel clutch plates for scored or damaged surfaces.

11. Inspect springs for distortion or collapsed coils. Slight wear (bright spots) on the sides of the springs is permissible.

12. When inspecting bushings, fit the mating part into the bushing and observe the amount of looseness. Bushing clearance is excessive if more than .008" exists when checked with a wire feeler gauge.

13. If the transmission shows evidence that foreign material has circulated throughout the transmission or if the oil strainer is dirty, the oil strainer should be discarded and a new one installed upon reassembly of the transmission. (A

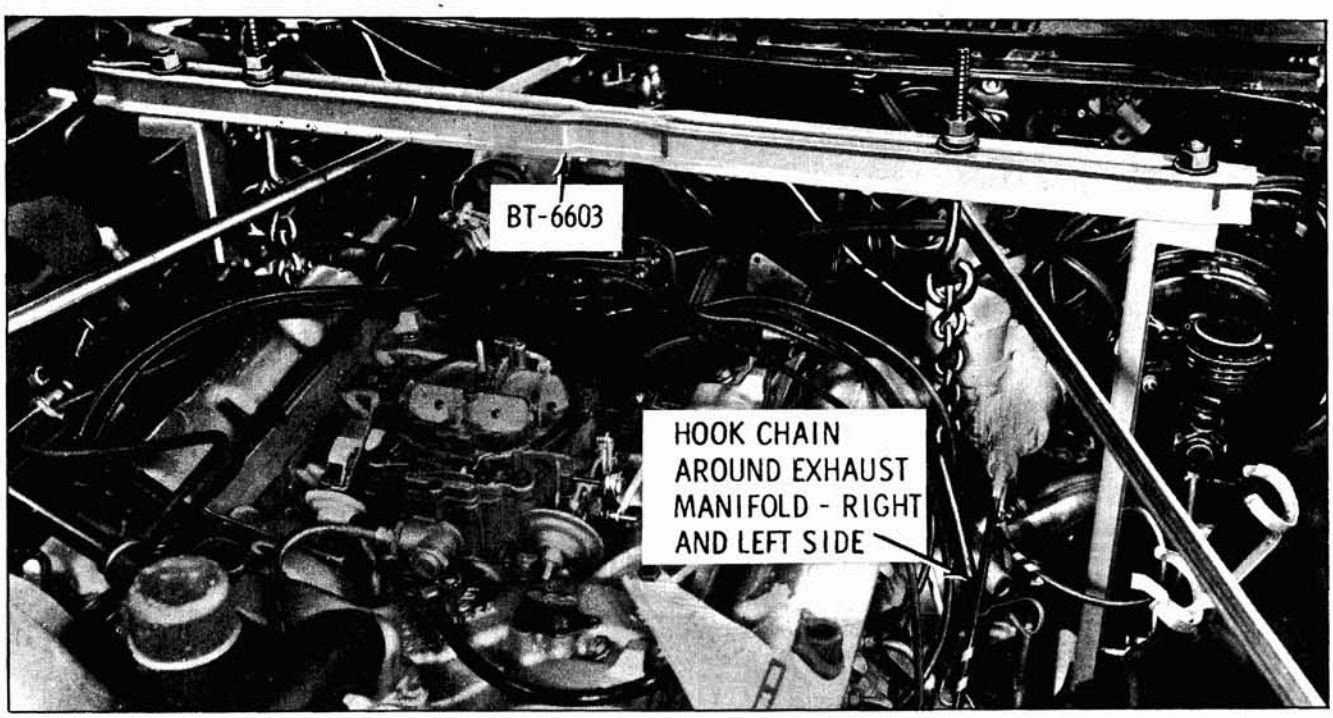


Fig. 7E-12—Supporting Engine

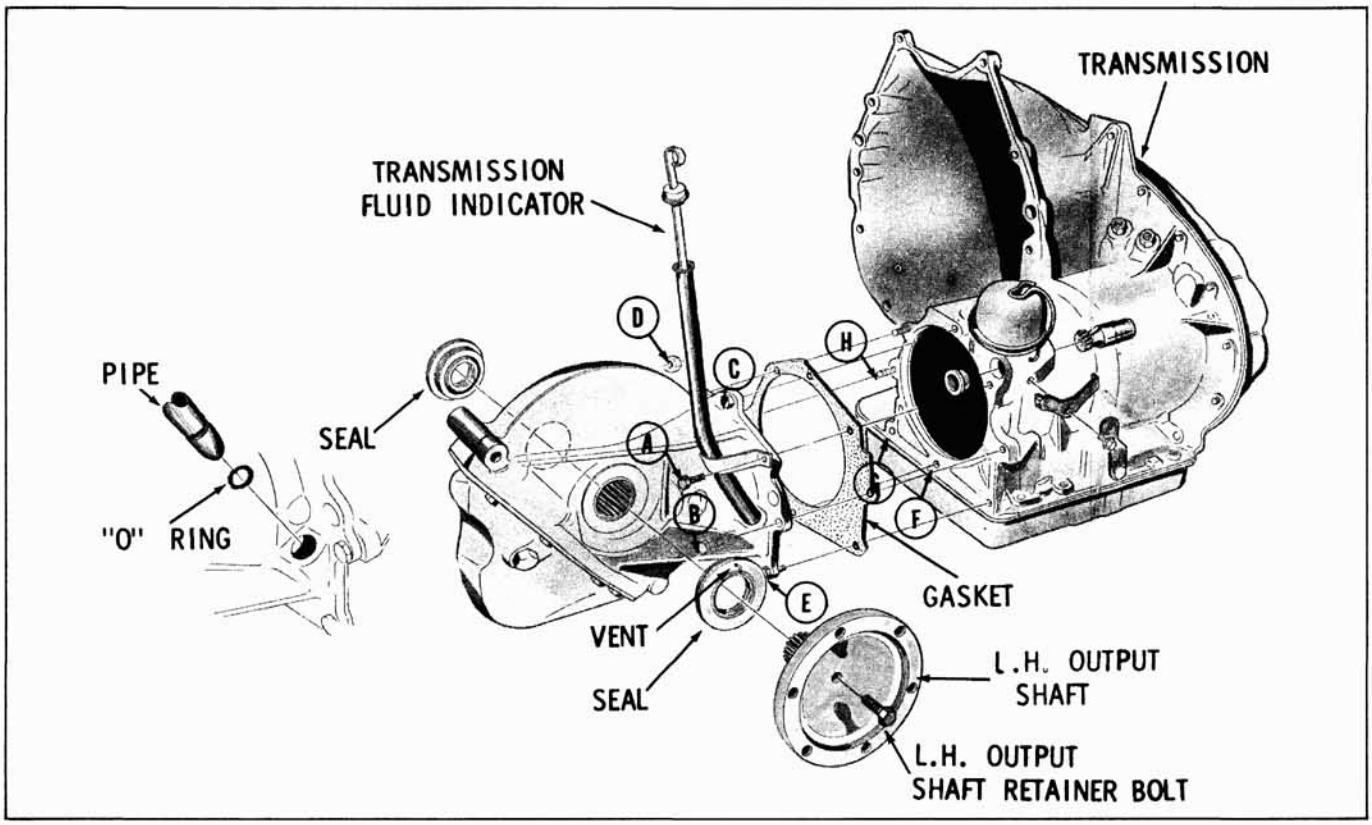


Fig. 7E-13—Transmission Attachment

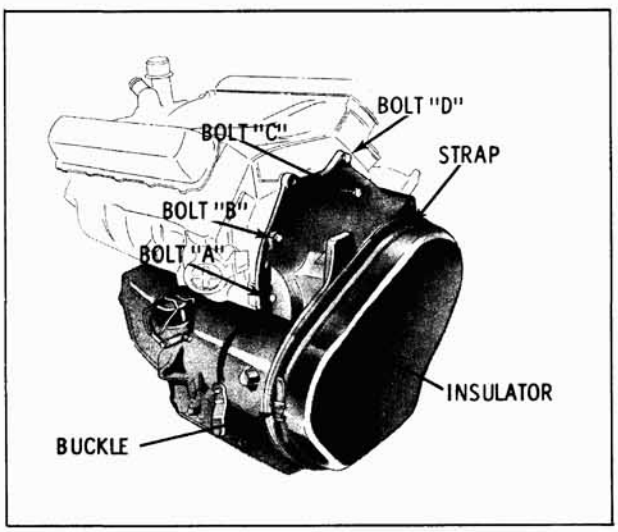


Fig. 7E-14—Transmission to Engine Attachment

NEW STRAINER SHOULD ALWAYS BE INSTALLED FOR A CONVERTER, CLUTCH, OR PUMP FAILURE.)

14. Transmission oil cooler lines should always be flushed and reverse flushed whenever foreign material has circulated throughout the transmission.

15. Always refer to the lubrication chart (Fig. 7E-232) when inspecting the oil passages and holes, for the location of oil passages and lubrication holes.

TRANSMISSION

Remove (less final drive)

1. Disconnect battery.

2. Disconnect oil cooler lines at transmission (Fig. 7E-10) and speedometer cable at governor.

3. Install engine support bar as shown in Figs. 7E-11 and 7E-12.

4. Remove nut "D" and bolts "A", "B" and "C". (Fig. 7E-13) A special wrench such as MAC S-147 must be used on nut "D".

5. Remove bolts "A", "B", "C" and "D". (Fig. 7E-14)

6. Remove flywheel cover plate bolt "A". (Fig. 7E-15)

7. Hoist car.

8. Disconnect starter wiring, then remove starter. (Fig. 7E-15)

9. Remove bolts "B", "C" and "D" from flywheel cover plate. (Fig. 7E-15)

10. Remove flywheel to converter bolt "E". (Fig. 7E-15) Rotate flywheel until all bolts are removed.

11. Disconnect vacuum modulator line and detent wire. (Fig. 7E-16)

12. Install transmission lift. (Fig. 7E-17, 7E-18 and 7E-19)

13. Remove shift linkage.

14. Remove bolts "E", "F", "G" and nut "H". (Fig. 7E-13)

When the last three transmission to final drive bolts are removed, a quantity of oil will be lost.

15. Remove bolts "A" and "B". (Fig. 7E-20)

16. Remove the two upper engine mount bracket to transmission bolts "A" and "B". (Fig. 7E-21)

17. Remove the four bracket to engine mount bolts. (Fig. 7E-21)

18. Slide transmission rearward and down. Engine mount bracket will follow transmission down. Install Converter Holding Tool J-21654 as shown in Fig. 6EB-1.

19. After transmission is removed from car, the link belt cover insulator can be removed or installed. (Fig. 7E-14)

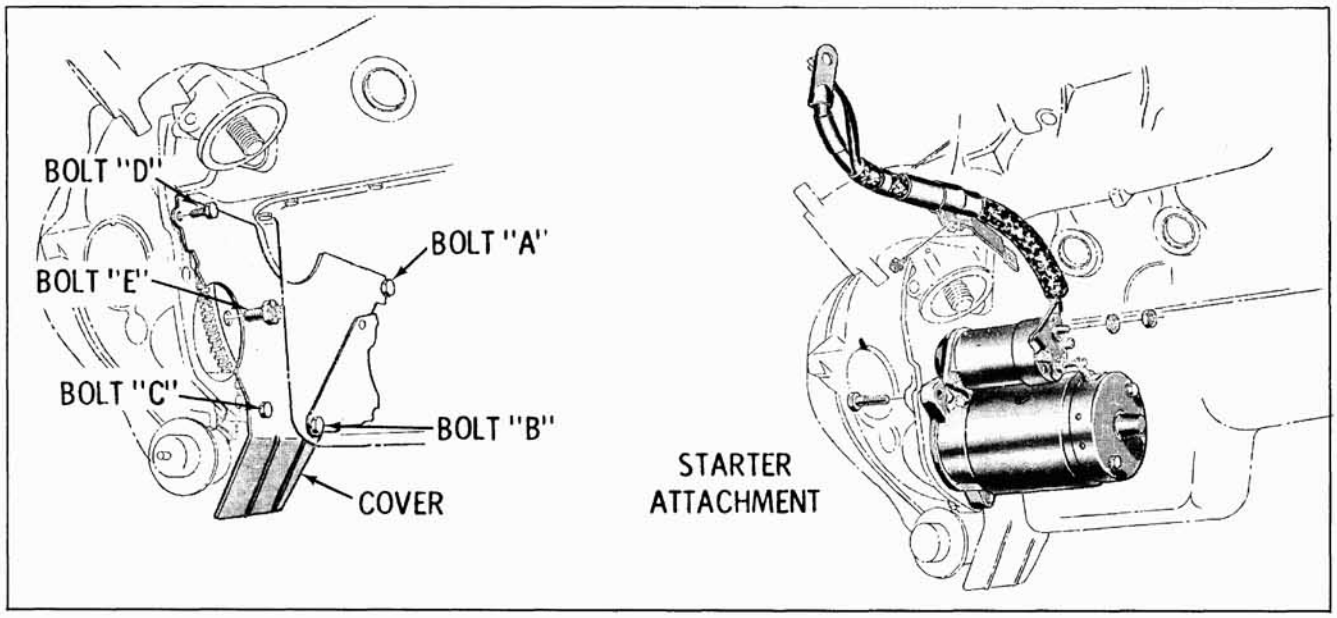


Fig. 7E-15—Starter and Converter Attachment

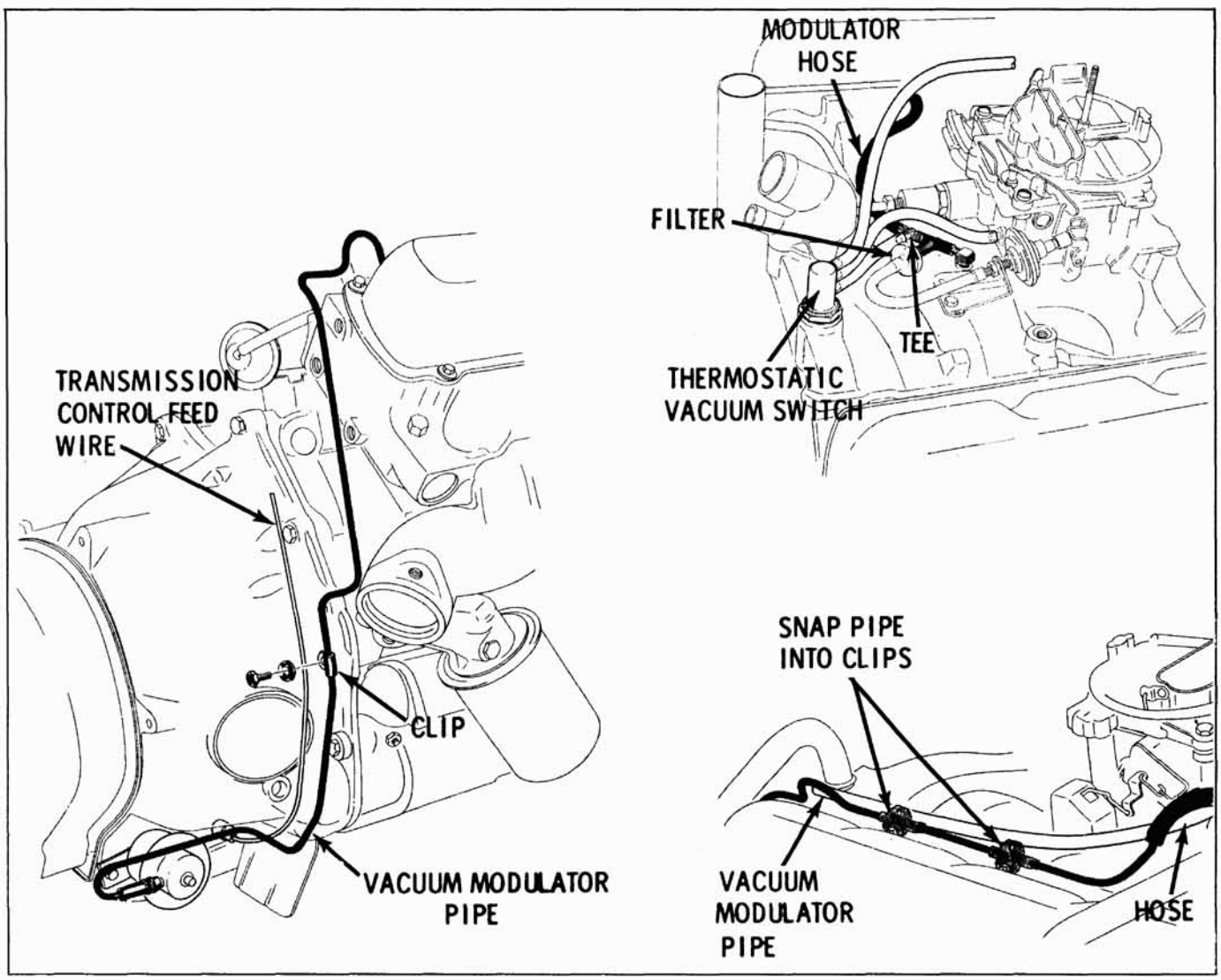


Fig. 7E-16—Modulator Line

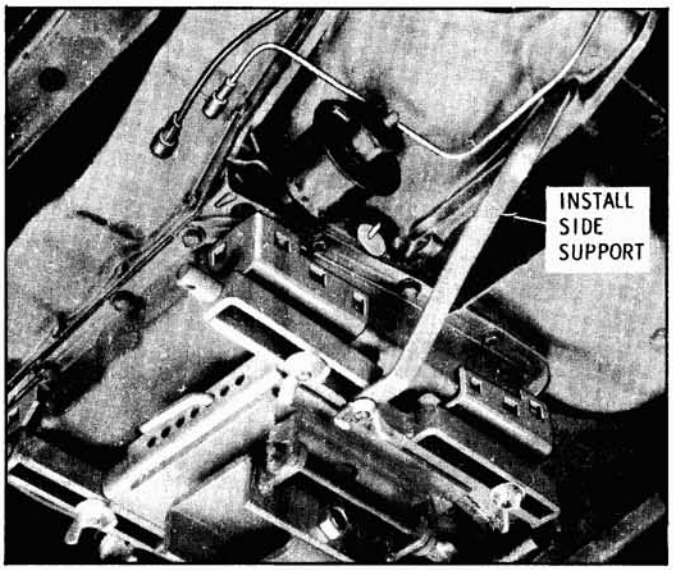


Fig. 7E-17—Transmission Lift in Position

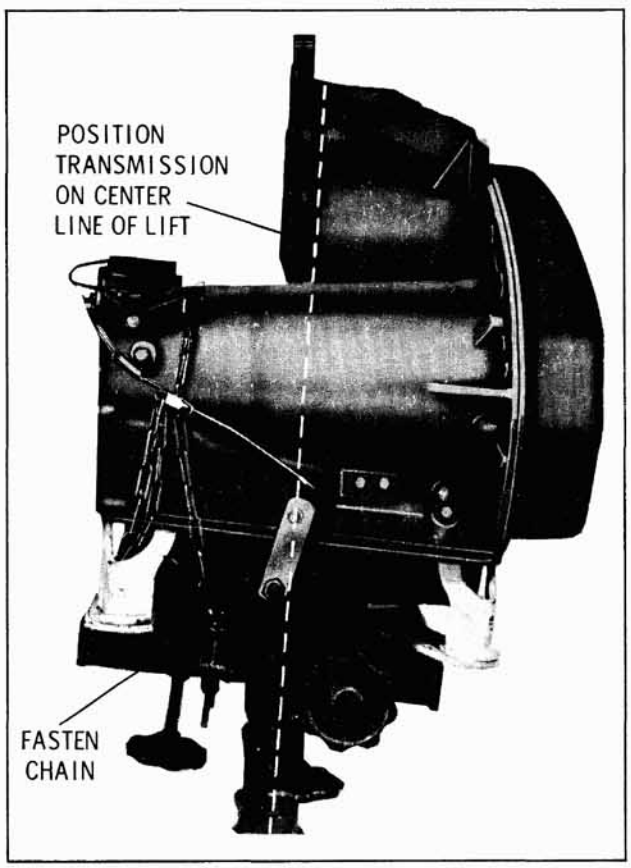


Fig. 7E-18—Transmission on Lift

Install

When installing the transmission, the motor mount bracket must be positioned loosely on the link belt cover until the transmission is in place; then, reverse removal procedure. Torque bolts as follows:

Before installing the flex plate to converter bolts, make certain that the weld nuts on the converter are flush with the flex plate and the converter rotates freely by hand in this position. Then hand start all three bolts and tighten finger tight. Torque to specifications. This will insure proper converter alignment.

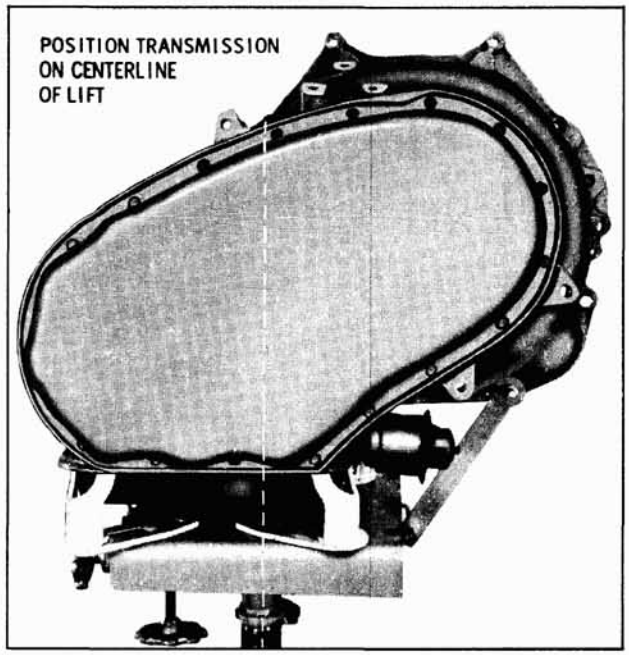


Fig. 7E-19—Transmission on Lift

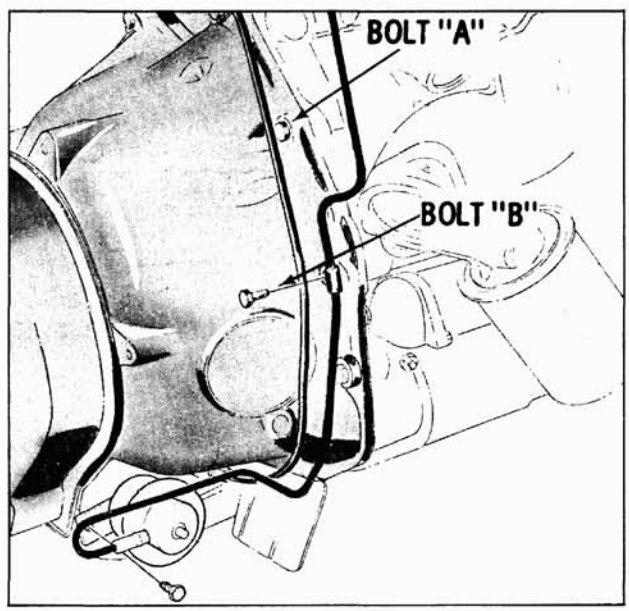


Fig. 7E-20—Transmission to Engine Attachment

Engine to Torque Converter Housing	25 ft. lbs.
Engine Bracket to Transmission	55 ft. lbs.
Engine Bracket to Rubber Mount	55 ft. lbs.
Oil Cooler Lines to Transmission	25 ft. lbs.
Final Drive to Transmission Nuts and Bolts	25 ft. lbs.
Torque Converter to Flywheel Bolts	30 ft. lbs.
Flywheel Housing Cover	5 ft. lbs.
Starter to Transmission	30 ft. lbs.

Apply sealer to bolts "E", "F" and "G" (Fig. 7E-13)

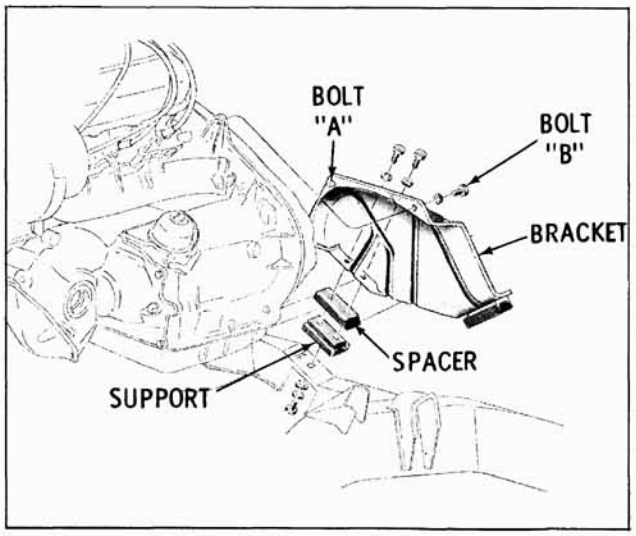


Fig. 7E-21—Engine Mount Attachment

After transmission is installed, check transmission oil level. Refer to PERIODIC MAINTENANCE at the front of this section. Adjust manual control shift linkage.

MINOR SERVICE OPERATIONS

SERVICING THE OIL COOLER

The oil cooler is located in the side tank of the radiator and its purpose is to cool the oil in the event excessive temperature tends to develop. (Fig. 7E-10)

In a major transmission failure, where particles of metal have been carried with the oil throughout the units of the transmission, it will be necessary to flush out the oil cooler and connecting lines. The oil cooler is a sealed container providing a passage for oil to flow from the inlet to the outlet. Clean solvent can be flushed through the cooler with air pressure. (An engine desludge gun may be used.) The cooler should be back-flushed first through the return line to remove all foreign material possible. Then flush through the inlet line and finish by flushing through the return line. Clean remaining solvent from cooler with compressed air applied to the return line and flush with Hydra-Matic oil.

THROTTLE LINKAGE ADJUSTMENTS (Refer to ENGINE, Section 6)

MANUAL LEVER ADJUSTMENT

The manual lever adjustment provides proper clearance between the "D" detent in the transmission and the stop for the manual shift lever. The adjustment is made as outlined in Figs. 7E-22 and 7E-23.

TRANSMISSION DISASSEMBLY

CONVERTER, MODULATOR, AND SPEEDOMETER DRIVE GEAR

Remove

1. With the transmission in cradle or portable jack, remove the torque converter assembly by pulling straight out from the transmission housing.

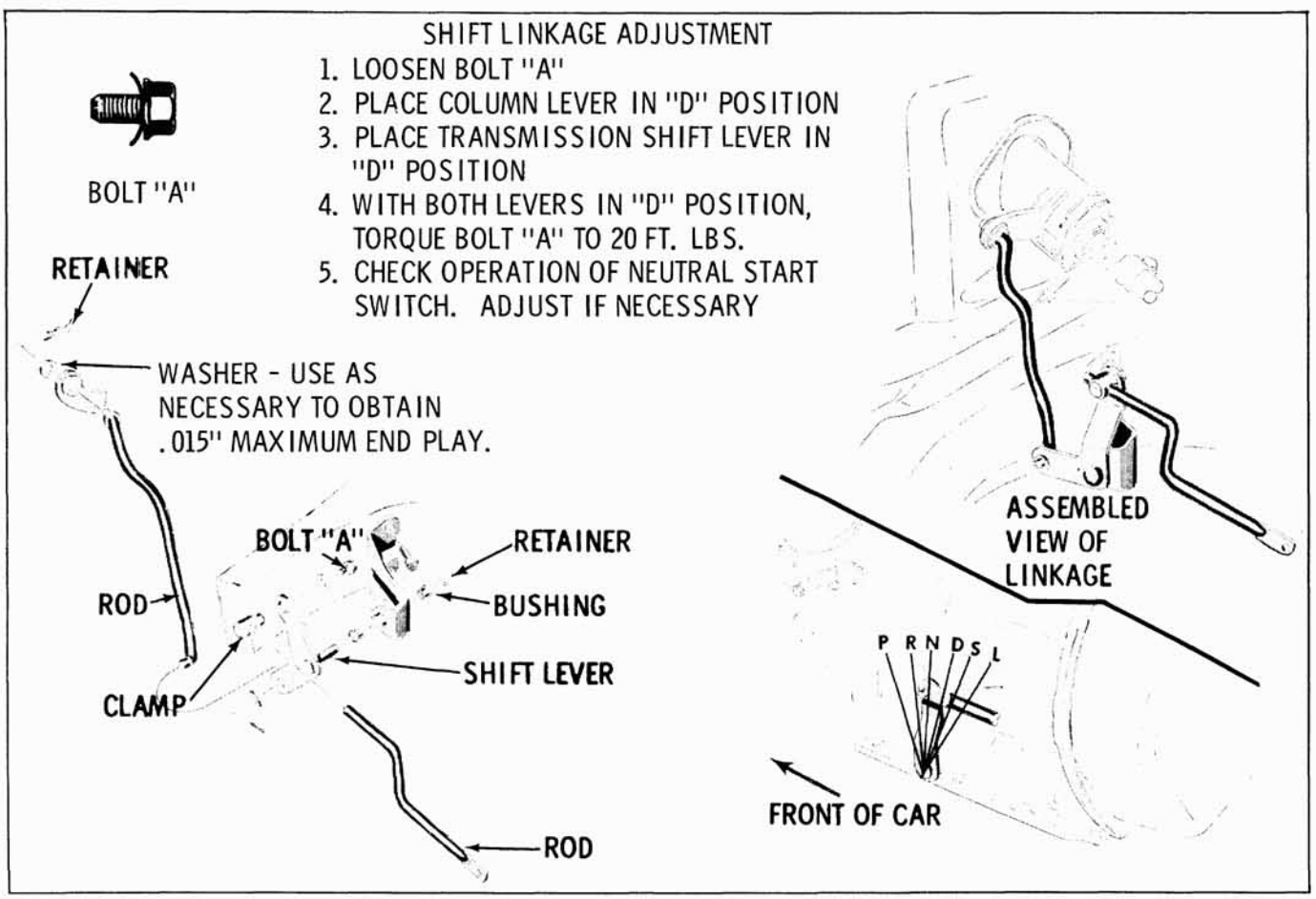


Fig. 7E-22—Column Shift Linkage

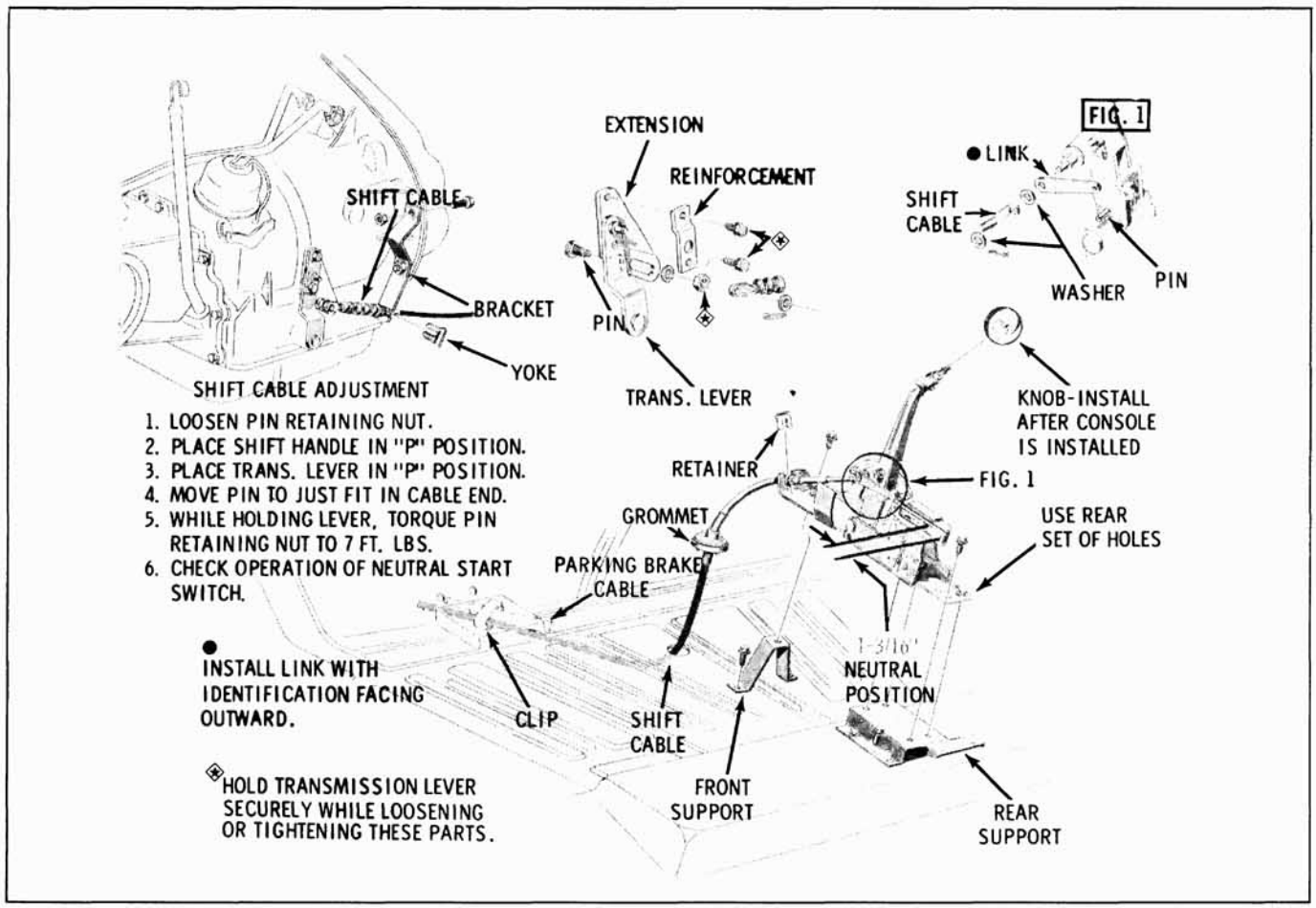


Fig. 7E-23—Console Shift Cable

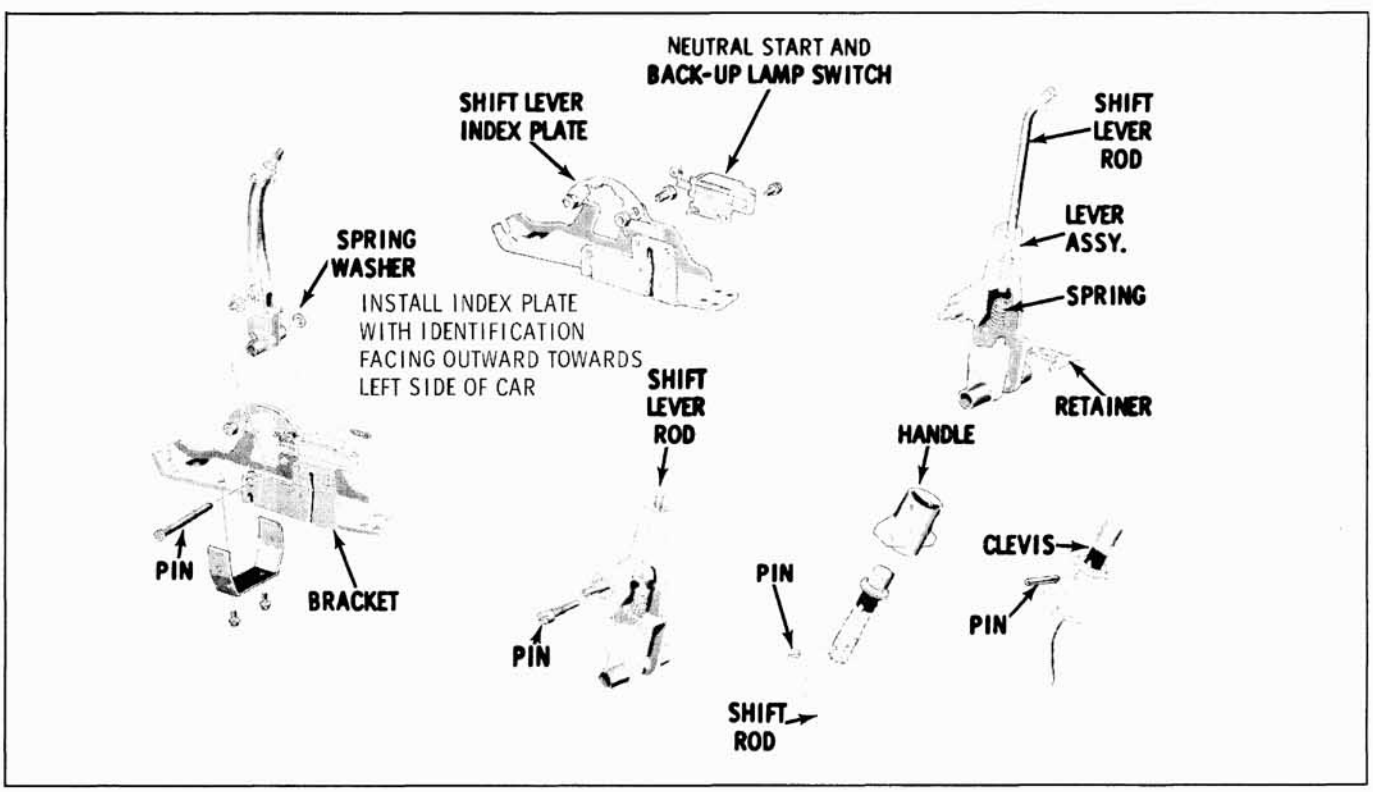


Fig. 7E-24—Console Shift Bracket

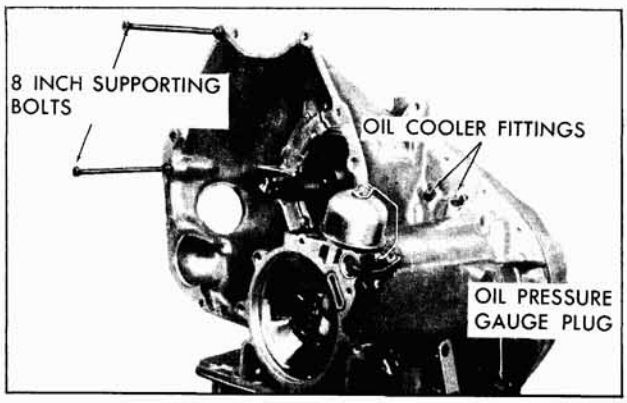


Fig. 7E-25—Supporting Bolt Installation

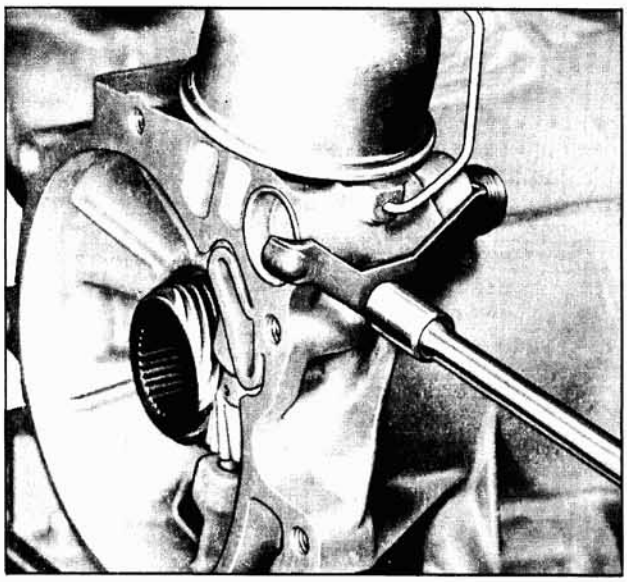


Fig. 7E-26—Removing Retainer

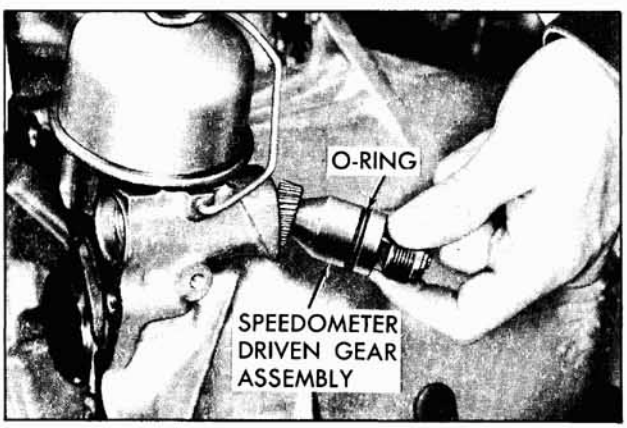


Fig. 7E-27—Removing Speedometer Driven Gear

The torque converter is heavy due to the large amount of oil that it contains.

2. Install two 3/8 x 8 inch bolts into the case to engine mounting face. (Fig. 7E-25)

3. Remove the speedometer driven gear attaching screw and retainer clip. (Fig. 7E-26)

4. Withdraw speedometer driven gear assembly from case bore. Remove and discard "O" ring seal. (Fig. 7E-27)

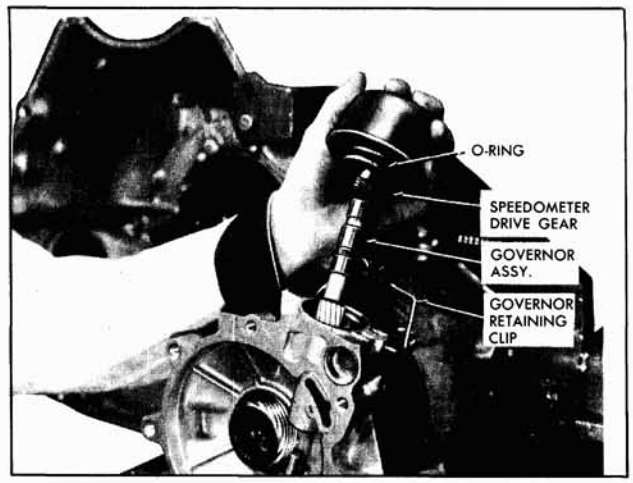


Fig. 7E-28—Removing Governor

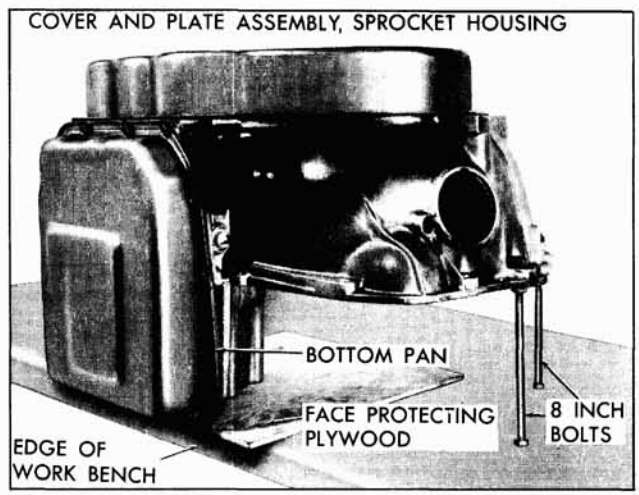


Fig. 7E-29—Transmission on Bench

5. Remove the governor attaching clip.

6. Withdraw governor assembly and "O" ring seal from case bore. (Fig. 7E-28)

7. Remove two studs from output end of case and place a piece of plywood under output end of case, place transmission on work bench with bottom pan facing the outside edge of work bench. (Let pan overhang edge of bench.) Stand transmission on the two eight inch bolts and the output flange end of the transmission case. (Fig. 7E-29)

8. Remove vacuum modulator assembly attaching screw and retainer clip. (Fig. 7E-30)

9. Remove vacuum modulator assembly and "O" ring seal from case bore. (Fig. 7E-31)

10. Remove vacuum modulator valve from bushing in case. (Fig. 7E-32)

Modulator bushing may be press fit in case bore and should not be removed with force.

BOTTOM PAN, STRAINER, AND INTAKE PIPE "O" RING SEAL

Removal

1. Remove thirteen bottom pan attaching screws.
2. Remove bottom pan and discard gasket.
3. Remove oil strainer assembly. (Fig. 7E-34)
4. Remove and discard the intake pipe to case "O" ring seal from the oil strainer assembly or from the case counterbore.

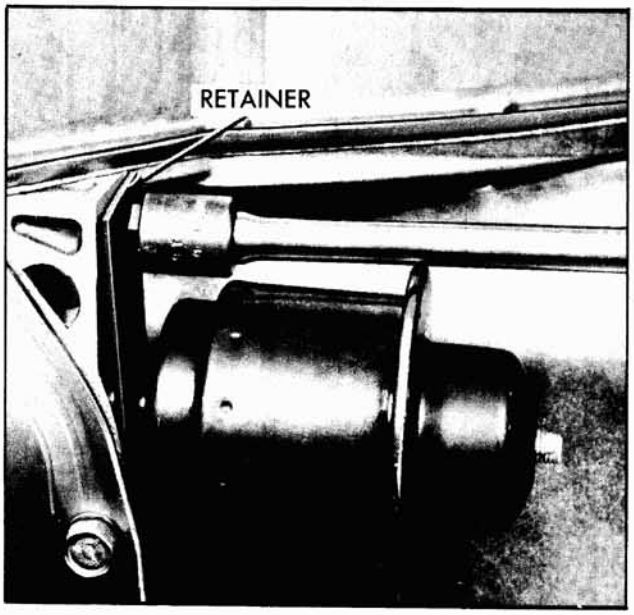


Fig. 7E-30—Removing Modulator Attaching Bolt

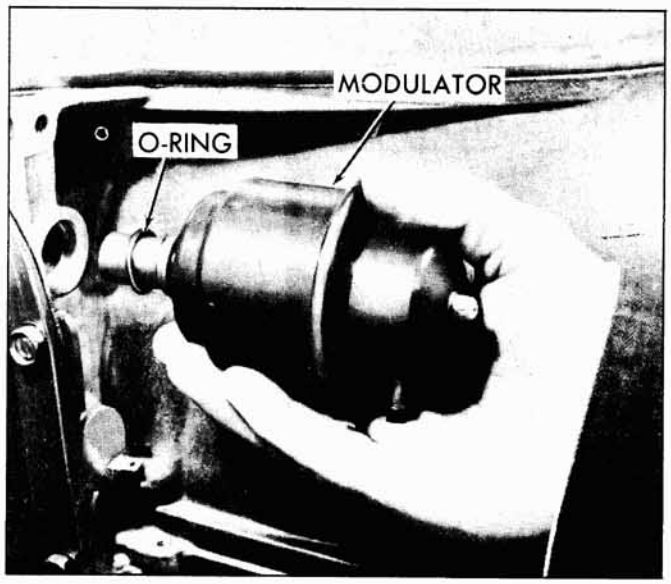


Fig. 7E-31—Removing Modulator

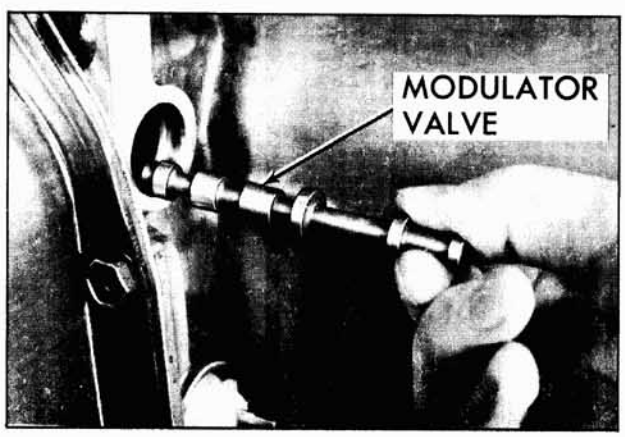


Fig. 7E-32—Removing Modulator Valve

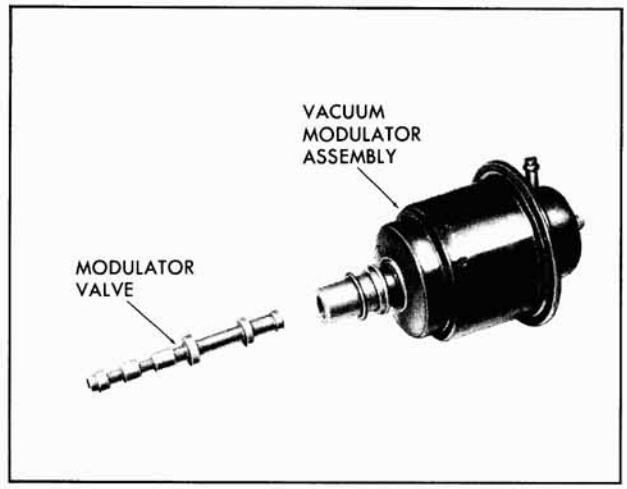


Fig. 7E-33—Modulator and Valve

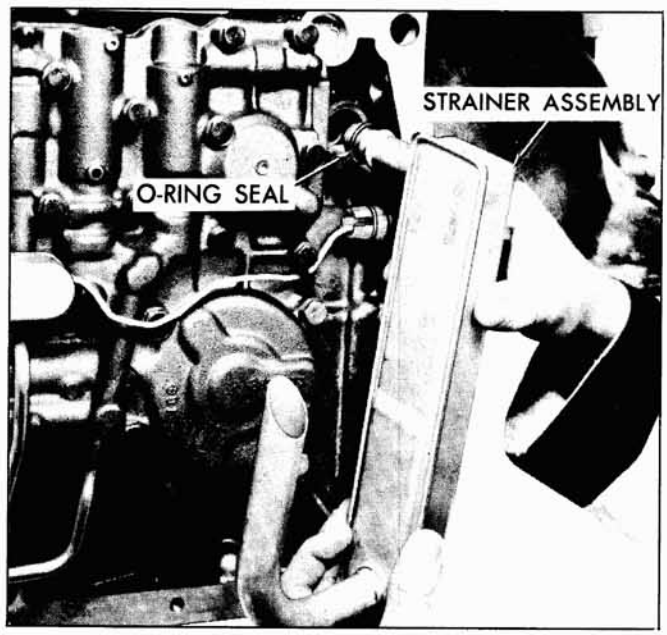


Fig. 7E-34—Removing Oil Strainer

PRESSURE REGULATOR AND BOOST VALVE, CONTROL VALVE ASSEMBLY, GOVERNOR PIPES, DETENT SPRING ASSEMBLY, REAR SERVO, MANUAL AND PARKING LINKAGE, AND CASE CONNECTOR

Removal

1. Compress the pressure boost valve bushing against the pressure regulator spring and remove the retaining snap ring from the case, using J-5403 pliers. (Fig. 7E-35)
2. Remove the pressure boost valve bushing and valve from the case bore. (Fig. 7E-36)
3. Remove the pressure regulator spring from the case bore.
4. Remove pressure regulator valve, spring retainer, and spacer(s) if present, from the case bore.
5. Disconnect detent solenoid connector from case connector. Disconnect detent solenoid wire from inside connector. (Fig. 7E-37)
6. Remove governor feed pipe by pulling straight out. (Fig. 7E-38)

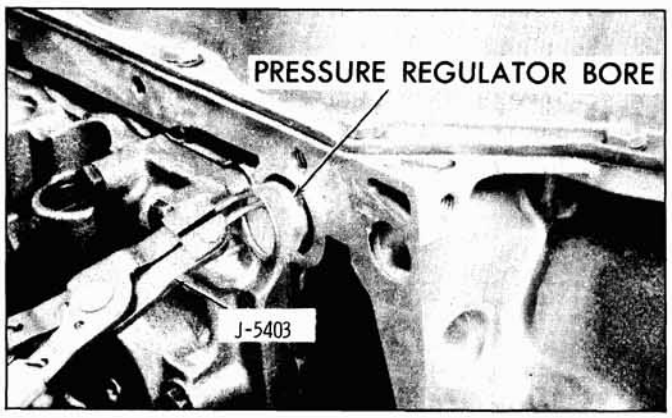


Fig. 7E-35—Removing Retaining Ring

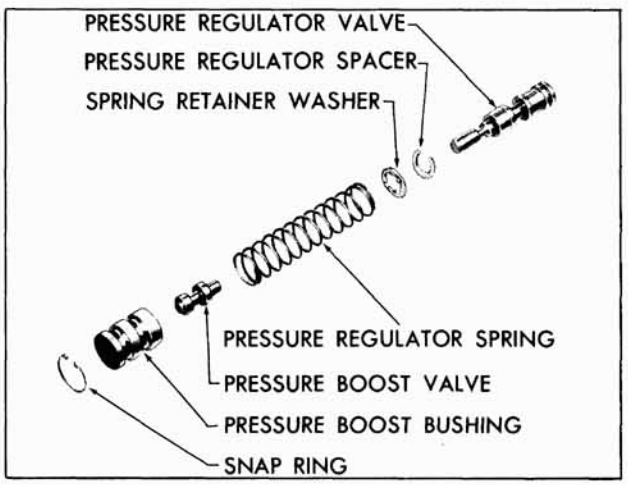


Fig. 7E-36—Pressure Regulator Valve

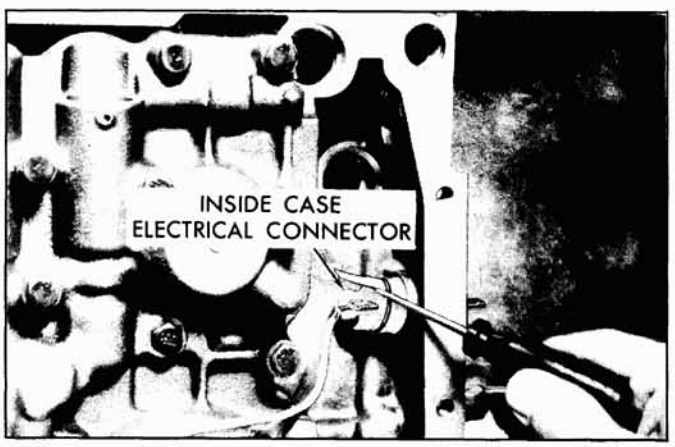


Fig. 7E-37—Removing Connector

7. Remove control valve body to case attaching screws, detent roller spring and assembly. Leave two top bolts in until all other bolts are removed.

Do not remove detent solenoid attaching screws.

8. Remove control valve body assembly, gasket, and remaining governor pipe. (Fig. 7E-39)

Do not allow manual valve to fall out of control valve assembly during removal of control valve assembly.

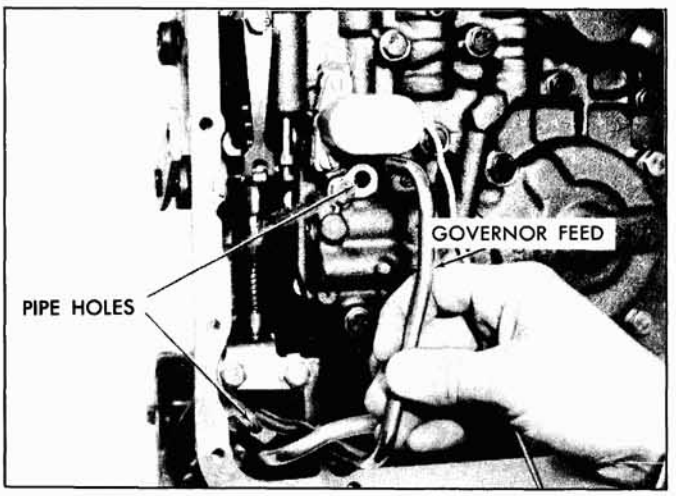


Fig. 7E-38—Removing Governor Feed Pipe

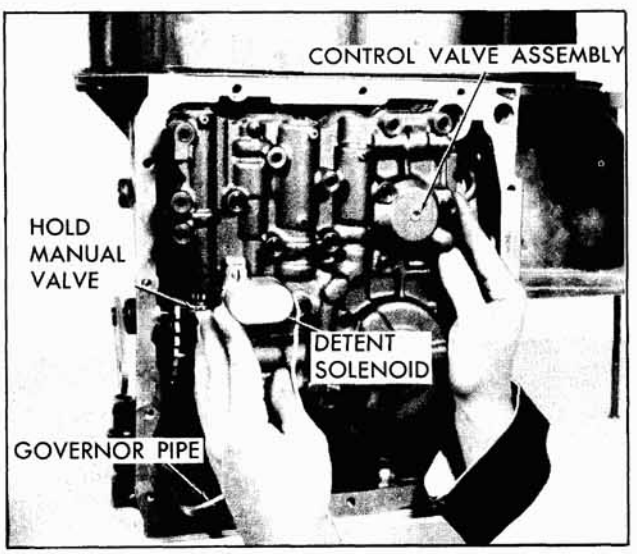


Fig. 7E-39—Removing Control Valve

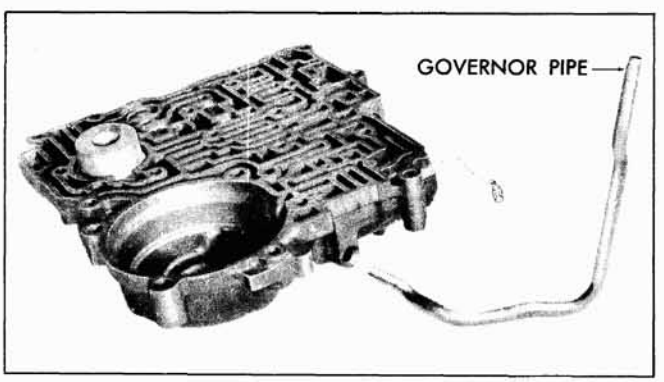


Fig. 7E-40—Removing Governor Pipe

9. Remove the remaining governor pipe from control valve assembly. (Fig. 7E-40)

10. Remove the control valve assembly spacer plate and gasket. (Fig. 7E-41)

11. Remove the seven check balls from the cored passages in transmission case. (Fig. 7E-42)

The eighth check ball is held in by a retainer and should not be removed unless replacement is required.

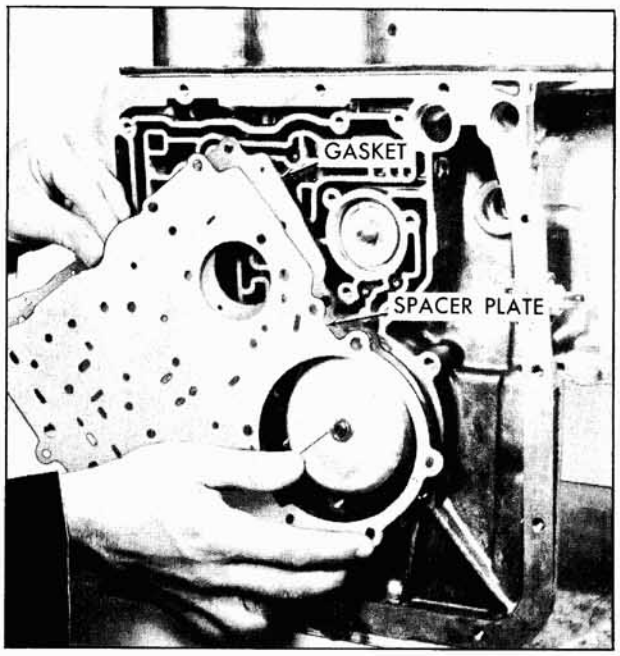


Fig. E-41—Removing Gasket and Spacer Plate

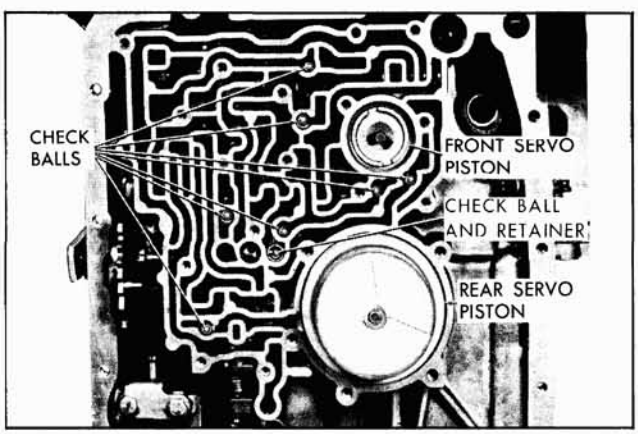


Fig. 7E-42—Check Ball Location

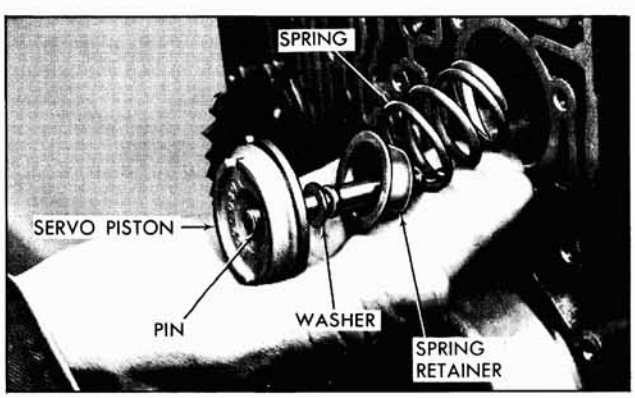


Fig. 7E-43—Removing Front Servo

12. Remove the front servo piston, washer, pin, retainer, and spring from transmission case. (Fig. 7E-43)
13. Remove the rear servo piston assembly from the case. (Fig. 7E-44)

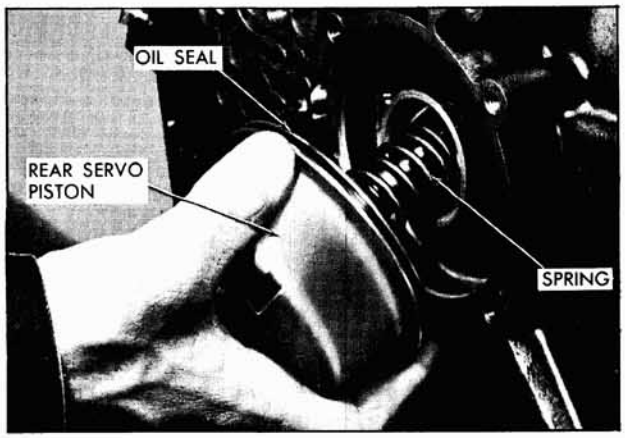


Fig. 7E-44—Removing Rear Servo

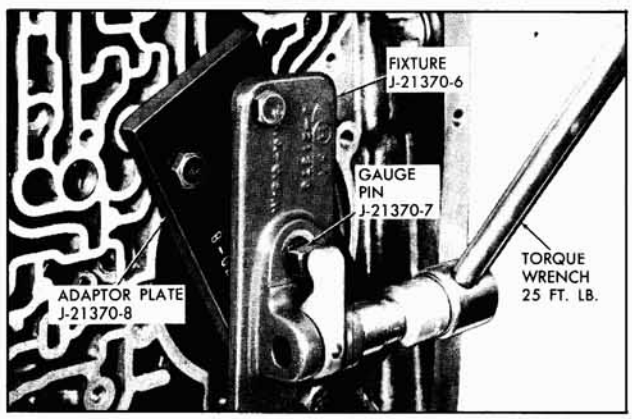


Fig. 7E-45—Checking Band Apply Pin

14. Remove rear servo accumulator spring from case.
15. Make band apply pin selection check. (Fig. 7E-45)

Band Apply Pin Selection

a. Attach Adapter Plate J-21370-8 to case valve body face and torque to 18 ft. lbs. Install fixture Gauge J-21370-6 to J-21370-8 Adapter Plate with two bolts and insert J-21370-7 Gauge Pin. Be sure the pin does not bind when tightening bolts to adapter plate and to case face.

b. Apply 25 ft. lb. torque and note position of step on gauge pin. Below first step requires short pin. Above top step requires long pin, and between steps requires medium length pin. (Fig. 7E-46)

The three selective pins are identified as follows:

PIN IDENTIFICATION	PIN LENGTH
3 Rings	Long
2 Rings	Medium
1 Ring	Short

The identification ring is located near the shoulder end of the pin. Selecting the proper pin length is the equivalent of adjusting the band.

16. If necessary, remove the manual linkage as follows:

a. Loosen the jam nut holding detent lever to manual shaft. (Fig. 7E-47)

b. Remove manual shaft retaining pin from case. Pull straight out. (Fig. 7E-48)

c. Loosen detent lever from machined flats on manual shaft.

STEP LOCATION	PIN IDENT.	SIZE
TOP STEP OR ABOVE	THREE RINGS	LONG
THIS AREA	TWO RINGS	MED.
LOWER STEP OR BELOW	ONE RING	SHORT

J-21370-7

Fig. 7E-46—Pin Selection Chart

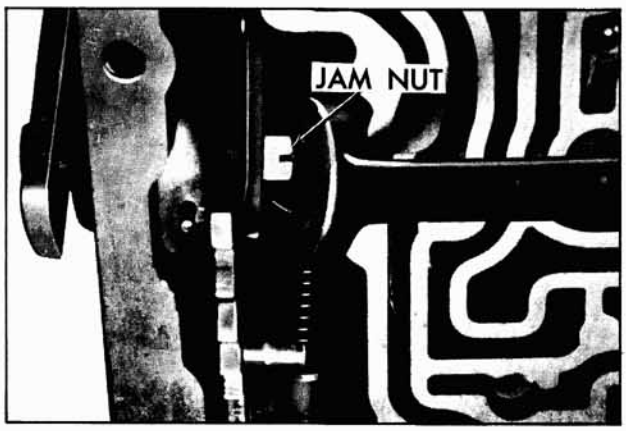


Fig. 7E-47—Removing Jam Nut

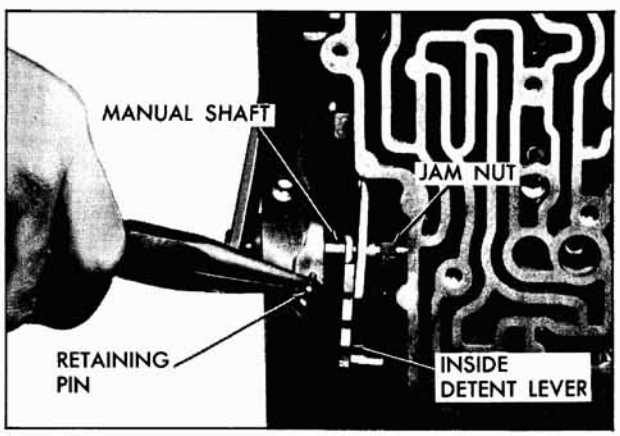


Fig. 7E-48—Removing Retaining Pin

d. Withdraw manual shaft from case bore and remove and discard "O" ring seal from manual shaft. (Fig. 7E-49)

Be careful not to drop jam nut inside case.

e. Remove detent lever, parking brake actuator rod, and jam nut from case.

17. Remove two attaching screws and parking bracket. (Fig. 7E-50)

18. Remove parking pawl shaft retaining pin from case. Pull straight out. (Fig. 7E-51)

19. Remove parking pawl shaft, parking pawl, and return spring from case. (Fig. 7E-52)

20. Remove detent electrical connector sleeve from case. (Fig. 7E-53)

21. Remove and discard "O" ring seal from connector sleeve.

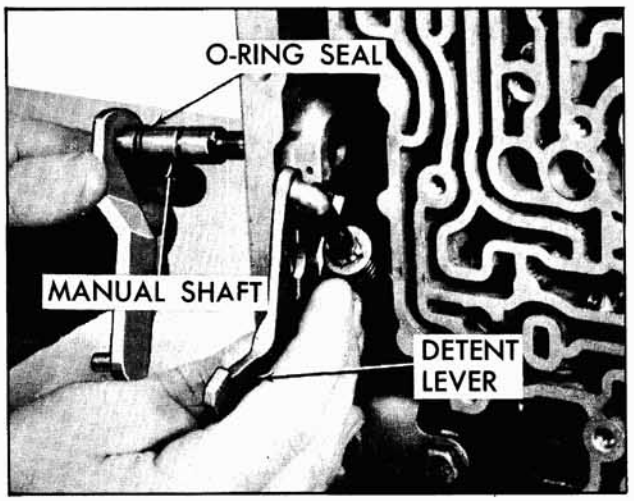


Fig. 7E-49—Removing Manual Shaft and Detent Lever

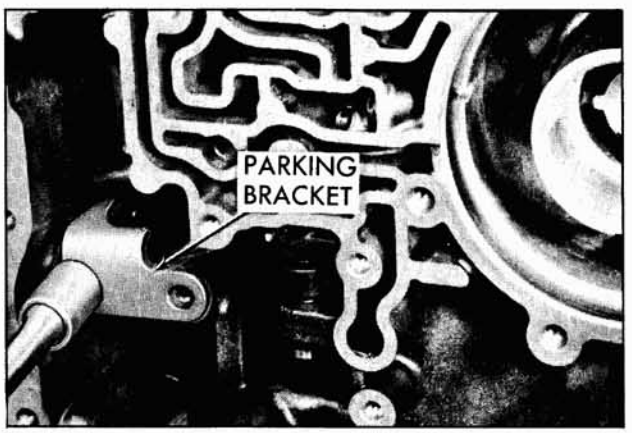


Fig. 7E-50—Removing Parking Bracket

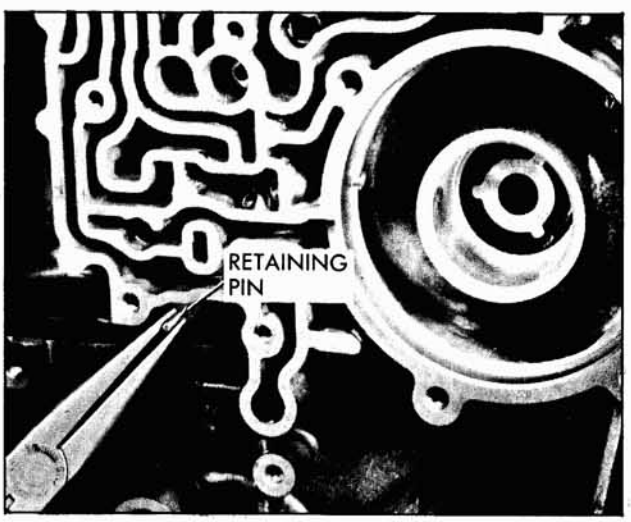


Fig. 7E-51—Removing Retaing Pin

SPROCKET HOUSING COVER AND PLATE ASSEMBLY, LINK BELT DRIVE AND DRIVEN SPROCKETS

Removal

1. Remove sprocket housing cover attaching bolts.
2. Remove cover and gasket. Discard gasket.

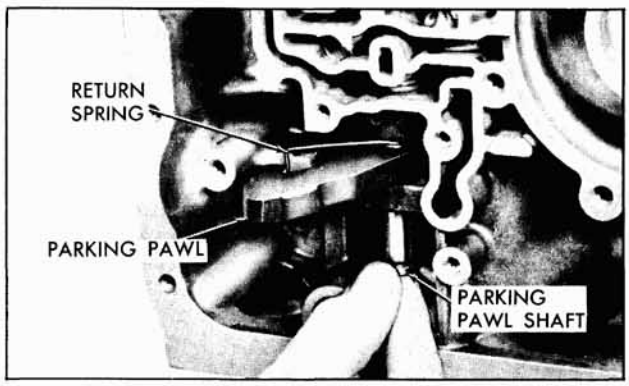


Fig. 7E-52—Removing Parking Pawl, Spring and Shaft

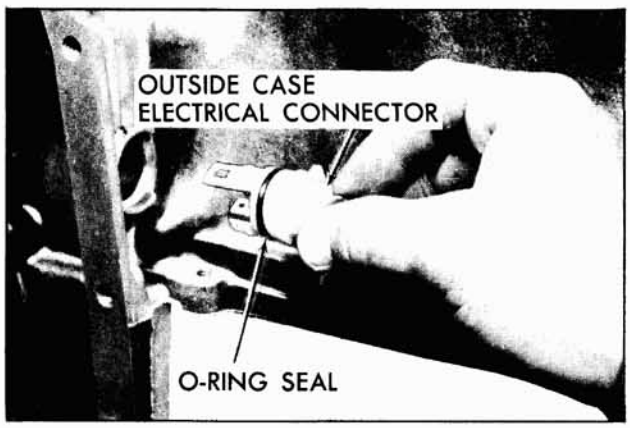


Fig. 7E-53—Removing Electrical Connector

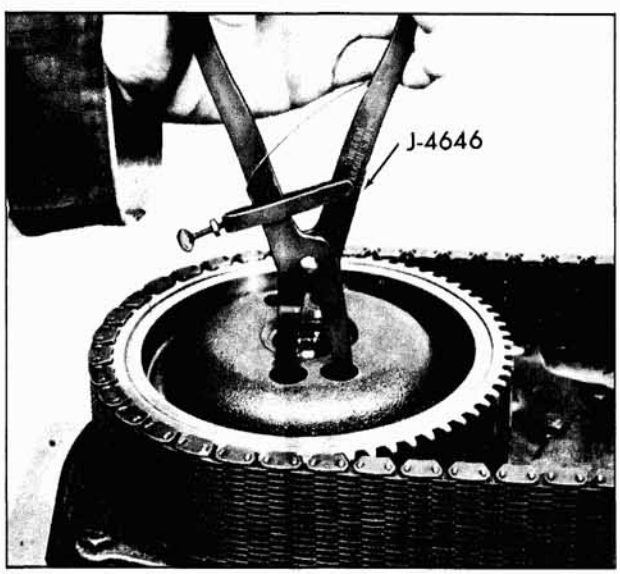


Fig. 7E-54—Removing Retaining Rings

3. Install J-4646 snap ring pliers into sprocket bearing retaining snap rings located under the drive and driven sprockets, and remove snap rings from retaining grooves in support housing. (Fig. 7E-54)

Do not remove snap rings from beneath the sprockets, leave them in a loose position between the sprockets and the bearing assemblies.

4. Remove drive and driven sprockets, link belt, bearings,

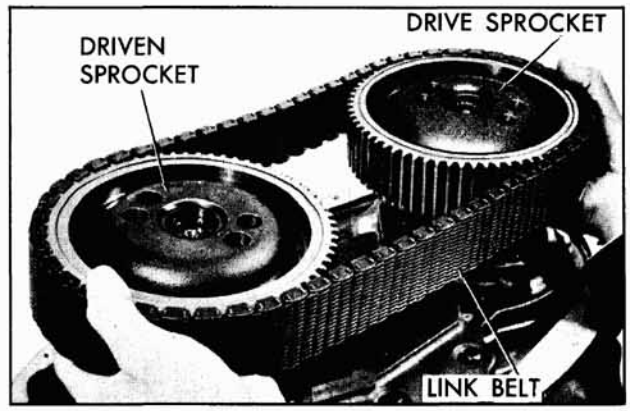


Fig. 7E-55—Removing Sprackets and Link Assembly

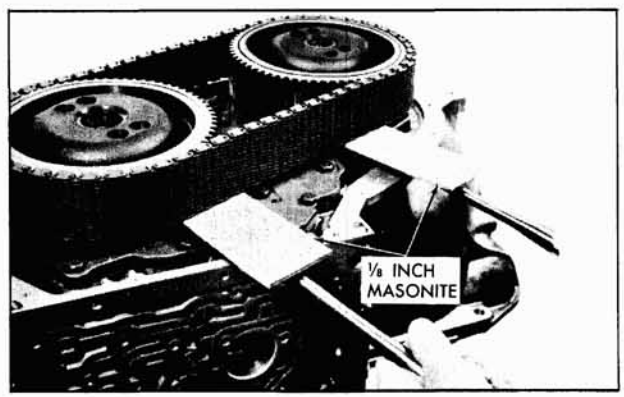


Fig. 7E-56—Removing Tight Sprackets

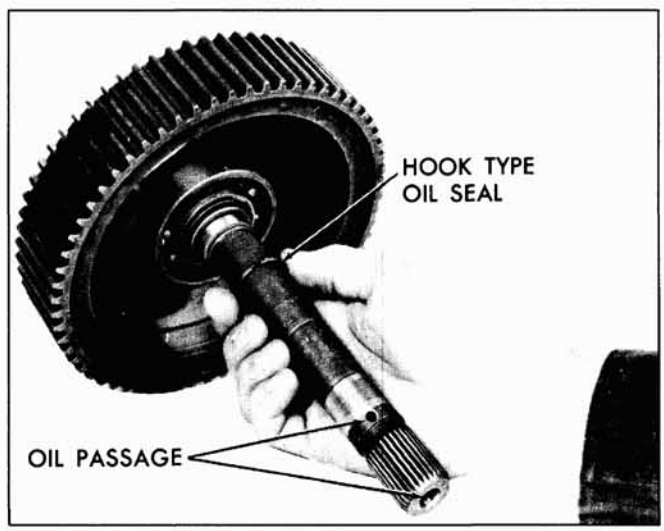


Fig. 7E-57—Oil Seal Rings

and shafts simultaneously by alternately pulling upwards on the drive and driven sprockets until the bearings are out of the drive and driven support housings. (Fig. 7E-55)

If the sprockets are difficult to remove, place a small piece of masonite, or similar material between the sprocket and 1/2 x 9 inch pry bar, and alternately pry upward under each sprocket. Do not pry on the links or the aluminum case. Pry only on the sprockets. (Fig. 7E-56)

5. Remove link belt from drive and driven sprockets.

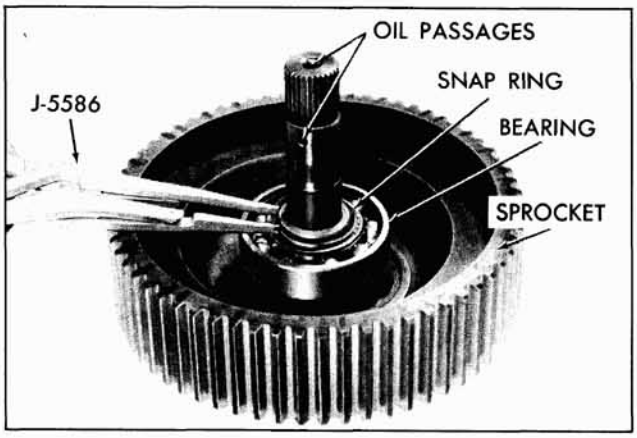


Fig. 7E-58—Removing Retaining Rings

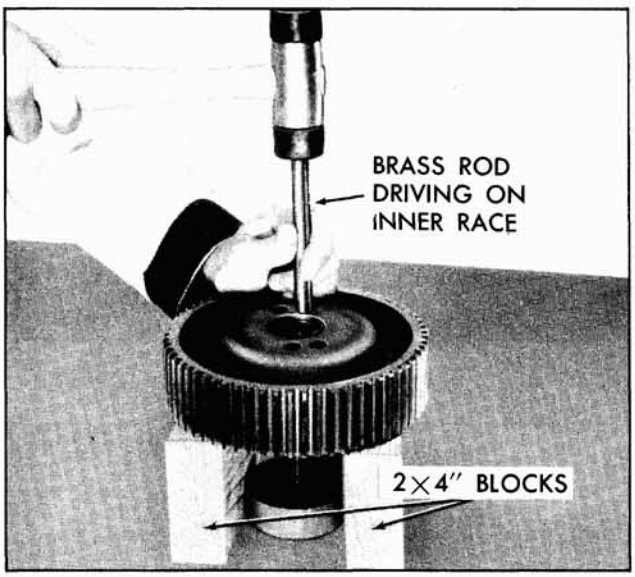


Fig. 7E-59—Removing Bearing

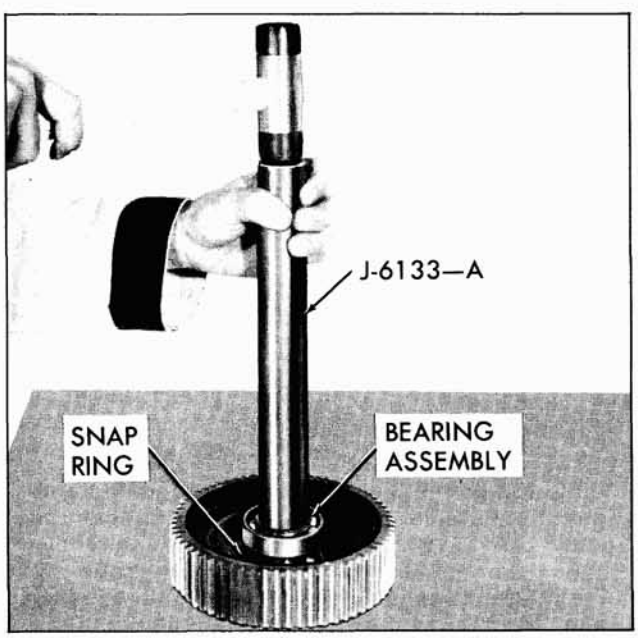


Fig. 7E-60—Installing Bearing

6. Remove the hook type oil seal ring from turbine shaft. (Fig. 7E-57)

7. Inspect drive and driven sprocket bearing assemblies for rough or defective bearings.

Do not remove bearing assemblies from drive and driven sprockets unless they need replacement.

8. If removal of bearing assembly from drive and/or driven sprockets is necessary, proceed as follows:

a. Remove sprocket to bearing assembly retaining snap ring using J-5586, snap ring pliers. (Fig. 7E-58)

b. Mount sprocket, with turbine or input shaft placed in hole in work bench, on two 2" x 4" x 10" pieces of wood.

c. With a hammer and brass rod, drive the inner race, alternately through each of the access openings, until the bearing assembly is removed from the sprocket hub. (Fig. 7E-59)

DRIVE SPROCKET AND TURBINE SHAFT, AND LINK BELT

Inspection

1. Inspect drive sprocket teeth for nicks, burrs, scoring, galling, and excessive wear.

Wear pattern at bottom of teeth is normal.

2. Inspect drive sprocket to ball bearing retaining snap ring for damage.

3. Inspect drive sprocket ball bearing inner race mounting surface for damage.

4. Inspect turbine shaft for open lubrication passages. Run a tag wire through the passages to be sure they are open. See lubrication chart for passage location. (Fig. 7E-232)

5. Inspect spline for damage.

6. Inspect the bushing journals for damage.

7. Inspect the hook type oil seal groove for damage or excessive wear.

8. Inspect the turbine shaft for cracks or distortion.

9. Inspect the link belt for damage or loose links.

Check the guide links. Guide links are the wide outside links on each side of the link belt.

DRIVEN SPROCKET AND INPUT SHAFT

Inspection

1. Inspect driven sprocket teeth for nicks, burrs, scoring, galling, and escessive wear.

Wear pattern at bottom of teeth is normal.

2. Inspect sprocket to ball bearing retaining snap ring for damage.

3. Inspect ball bearing inner race mounting surface for damage.

4. Inspect input shaft for open lubrication holes. Run a tag wire through the holes to be sure they are open. See lubrication chart for location of holes. (Fig. 7E-232)

5. Inspect spline for damage.

6. Inspect bushing journal for damage.

SPROCKET BEARINGS

Install

1. Turn sprocket so that turbine or input shaft is pointing upward.

2. Install new sprocket bearing as follows:

a. Install support snap ring, letter side down, onto shaft.

b. Assemble bearing assembly on turbine or input shaft.

c. Using J-6133-A, drive the bearing assembly onto the

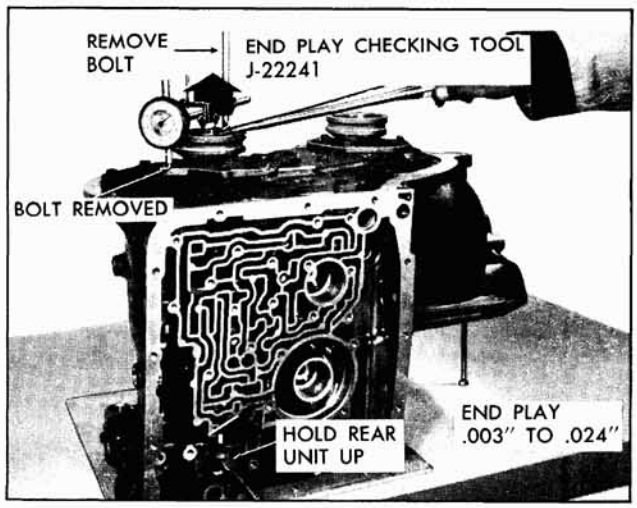


Fig. 7E-61—Checking Front Unit End Play

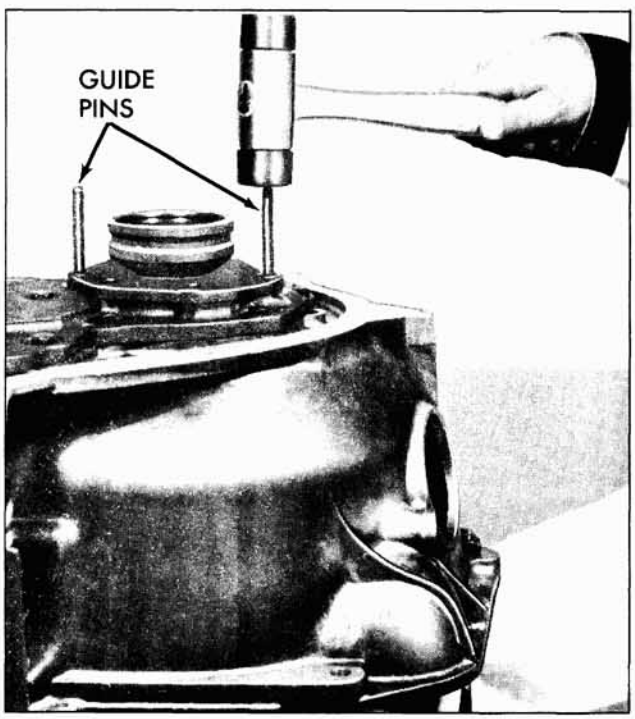


Fig. 7E-62—Oil Pump Removal

hub of the sprocket until it is resting on the bearing seat of the sprocket. (Fig. 7E-60)

d. Install sprocket to bearing assembly retaining snap ring into groove in sprocket hub.

3. Install hook type oil seal ring on turbine shaft. (Fig. 7E-57)

Turbine and/or input shaft may appear not to be pressed fully into the sprockets. DO NOT attempt pressing shaft into sprocket further as a specific length dimension is held during initial assembly.

FRONT UNIT END PLAY CHECK

1. Make front unit end play check as follows:

a. Install front unit end play checking tool J-22241 into driven sprocket housing so that the soft plastic on the tool can engage the splines in the forward clutch housing. Let the tool bottom on the mainshaft and then withdraw it approximately 1/16 to 1/8 of an inch and tighten wing nut. (Fig. 7E-61)

b. Remove two of the 5/16" bolts from the driven support housing.

c. Install 5/16" threaded slide hammer bolt with jam nut into one bolt hole in driven support housing.

Do not thread slide hammer bolt deep enough to interfere with forward clutch housing travel.

d. Mount dial indicator on rod and index indicator to register with the forward clutch drum that can be reached through second bolt removed from driven support housing.

e. Push end play tool down to remove slack.

f. Push and hold output flange upward. Place a screwdriver in case opening at parking pawl area and push upward on output carrier.

g. Place another screwdriver between the metal lip of the end play tool and the driven sprocket housing, now push upward on the metal lip of the end play tool and read the resulting end play, which should be between .003" and .024".

The selective washer controlling this end play is the thrust washer located between the driven support housing and the forward clutch housing. If more or less washer thickness is required to bring the end play within specifications, select the proper washer from the chart below.

Thickness	Color
.060" to .064"	Yellow
.071" to .075"	Blue
.082" to .086"	Red
.093" to .097"	Brown
.104" to .108"	Green
.115" to .119"	Black
.126" to .130"	Purple

An oil soaked washer may tend to discolor so that it will be necessary to measure the washer with micrometers to determine its actual thickness.

OIL PUMP

Removal

1. Remove two opposite pump attaching bolts from the drive support housing.

2. Install two 5/16" x 4" guide pins or bolts. (Fig. 7E-62)

3. Remove the remaining pump attaching bolts from the drive support housing.

4. With one hand, hold the under side of the pump, gently tap the guide pin until the pump is removed from the case.

PUMP COVER PLATE AND DRIVE AND DRIVEN SUPPORT HOUSING ASSEMBLIES

Removal

1. Remove the pump cover plate to case attaching screws. Do not remove sprocket support housing bolts at this time.

2. Remove pump cover plate and plate to case face gasket. Discard gasket. (Fig. 7E-63)

3. Remove two hook type oil seal rings from the driven support housing. (Fig. 7E-64)

4. Remove the front unit end play selective thrust washer from the hub of the driven support housing.

Drive and driven support housing assemblies are pressed into and removed with the pump cover plate. Do not remove them unless it is necessary.

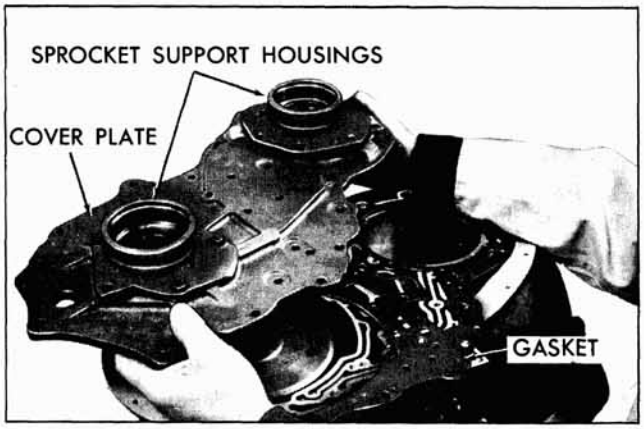


Fig. 7E-63—Removing Support Housings and Cover Plate

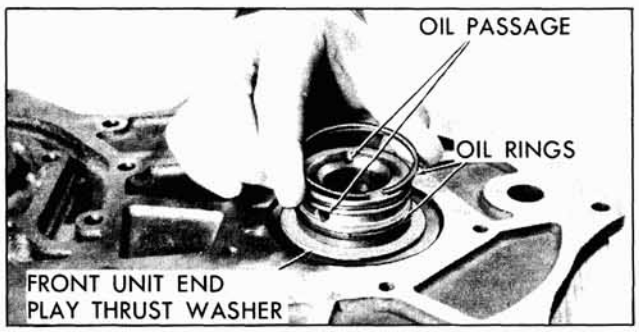


Fig. 7E-64—Removing or Installing Oil Rings and Thrust Washer

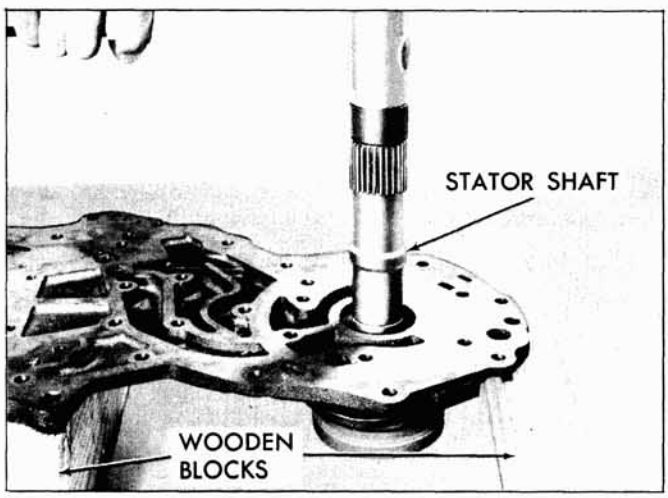


Fig. 7E-65—Removing Drive Sprocket Support

5. If necessary to remove the drive and driven sprocket support housing assemblies, proceed as follows:

a. Remove the remaining sprocket support to pump cover plate attaching bolts.

b. Using a plastic mallet, vigorously strike the stator shaft of the drive sprocket support (Fig. 7E-65) and the hub of the driven sprocket support (Fig. 7E-66) until they are removed from their pump cover plate bores.

When driving the housings out of the pump cover plate avoid damaging or distorting the stator shaft or the ring grooves in the hub of the driven housing.

c. Remove and discard housing to pump cover plate gaskets.

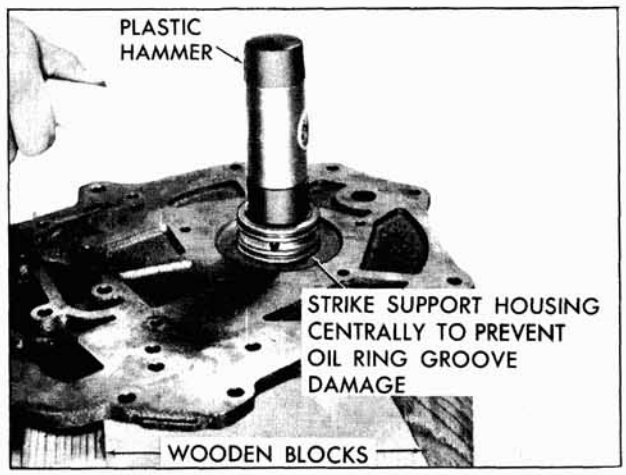


Fig. 7E-66—Removing Driven Sprocket Support

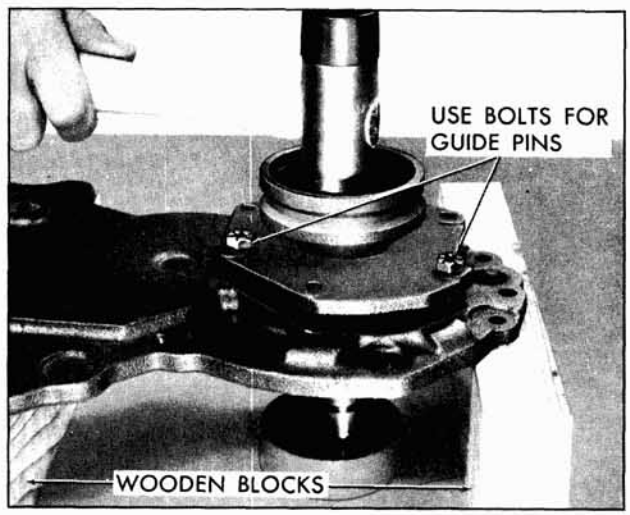


Fig. 7E-67—Installing Drive Sprocket

DRIVE AND DRIVEN SPROCKET

Assembly

Steps 1 through 6 can be omitted if parts were not disassembled.

1. Install drive sprocket support housing to pump cover plate gasket.
2. Install drive sprocket support housing into pump cover plate by using a plastic mallet to seat the housing. Use bolts for guides. (Fig. 7E-67)
3. Install driven sprocket support housing to pump cover plate gasket.
4. Install driven sprocket support housing to pump cover plate attaching bolts for gasket guides.
5. Install driven sprocket support housing into pump cover plate by using a plastic mallet to seat the housing.
6. Install all but two driven support housing to pump cover plate attaching bolts. Torque to 20 ft. lbs.
7. Install proper front unit end play selective thrust washer on the hub of the driven sprocket support housing. Use micrometers to determine the actual thickness of the thrust washer. (Fig. 7E-63)
8. Install two hook type oil seal rings into the grooves in the hub of the driven sprocket support housing.

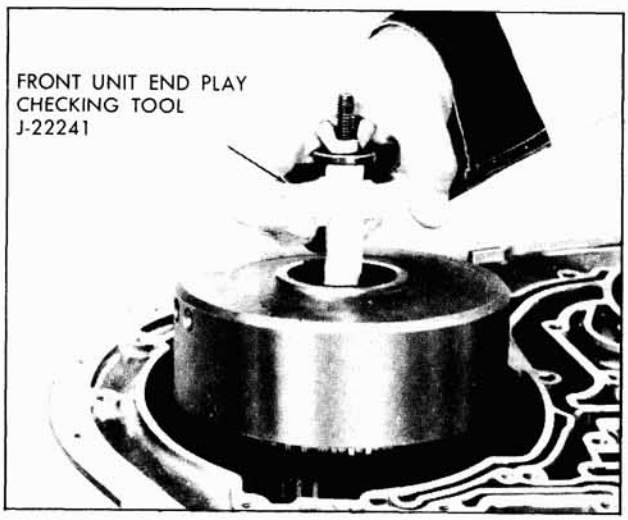


Fig. 7E-68—Removing Forward Clutch Housing

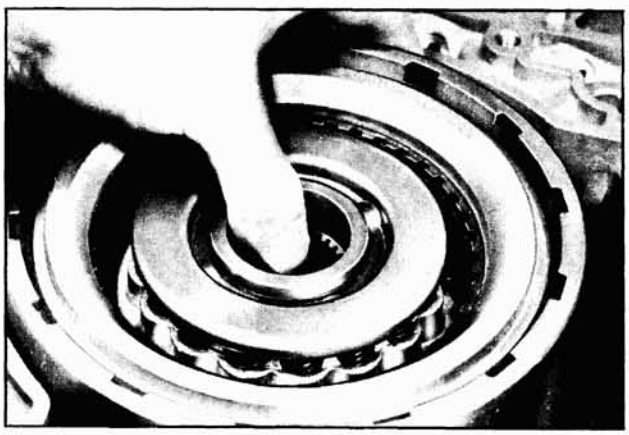


Fig. 7E-69—Removing Direct Clutch

FORWARD CLUTCH, DIRECT CLUTCH, FRONT BAND ASSEMBLY AND SUN GEAR SHAFT

Removal

1. Remove forward clutch housing assembly, using Tool J-22241. (Fig. 7E-68)
2. Remove forward clutch hub to direct clutch housing thrust washer if it did not come out with the forward clutch housing assembly.
3. Remove direct clutch housing assembly. (Fig. 7E-69)
4. Remove the front band. (Fig. 7E-70)
5. Remove sun gear shaft from gear unit assembly. (Fig. 7E-71)

GEAR UNIT END PLAY CHECK

1. Make rear unit end play check as follows:

a. Install 3/8" bolt for slide hammer into one of the final drive attaching bolt holes. Allow end of case to hang over edge of bench. (Fig. 7E-72)

b. Mount dial indicator on the bolt and index with end of output flange.

c. Move the output flange in and out to read the end play. End play should read .003" to .019". The selective washer controlling this end play is the steel washer having three lugs that is located between the output flange thrust washer and the rear face of the transmission case.

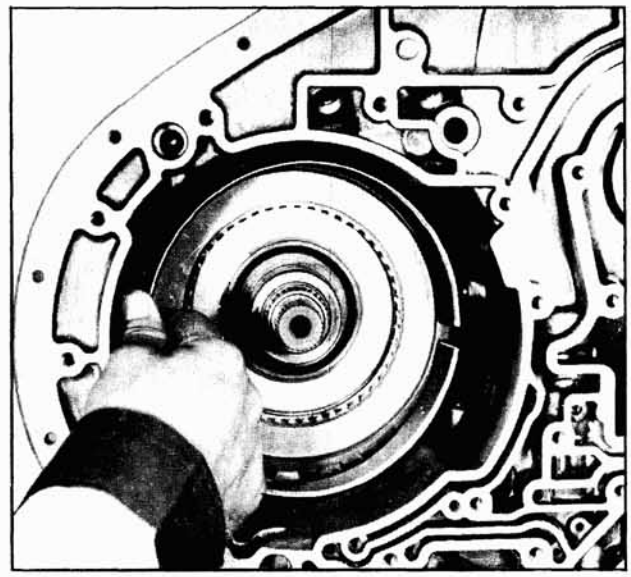


Fig. 7E-70—Removing Front Band

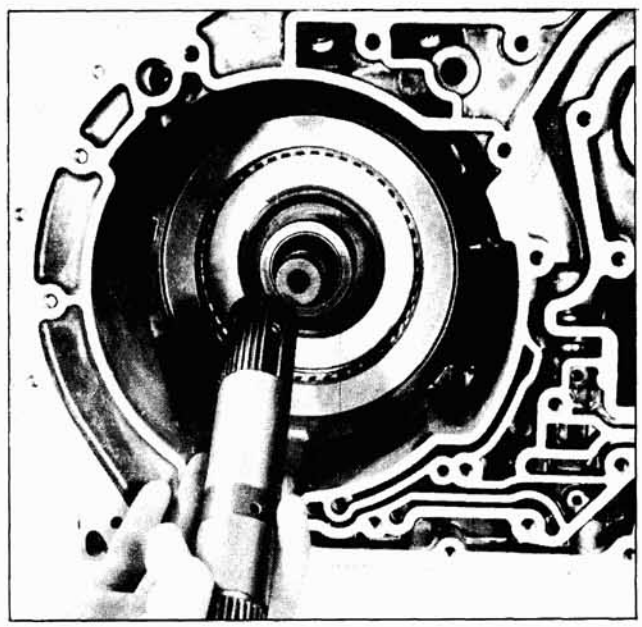


Fig. 7E-71—Removing Sun Gear Shaft

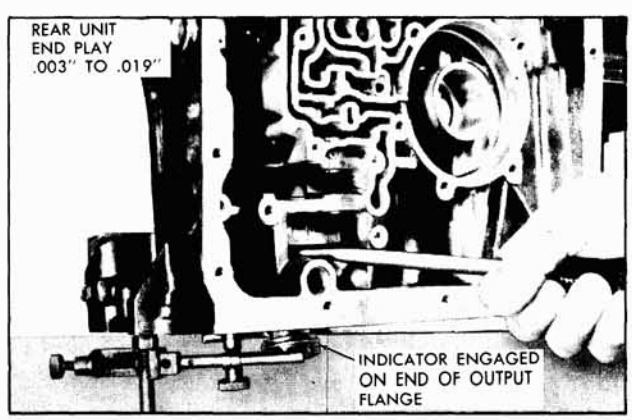


Fig. 7E-72—Checking Rear Unit End Play

If a different washer thickness is required to bring the end play within specifications, it can be selected from the following chart:

Thickness	Notches or Numeral
.074" to .078"	None 1
.082" to .086"	1 Tab Side 2
.090" to .094"	2 Tab Side 3
.098" to .102"	1 Tab O.D. 4
.106" to .110"	2 Tabs O.D. 5
.114" to .118"	3 Tabs O.D. 6

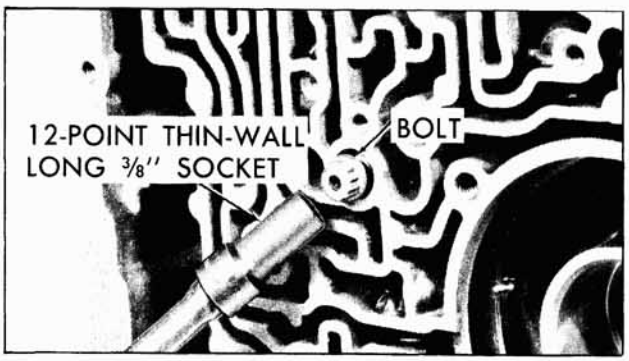


Fig. 7E-73—Removing Case Center Support Bolt

CENTER SUPPORT, GEAR UNIT ASSEMBLY, REAR BAND ASSEMBLY, AND REAR UNIT SELECTIVE WASHER

Removal

1. Remove the case center support to case bolt, using a 3/8" 12-point thin wall socket. (Fig. 7E-73)
2. Remove the intermediate clutch backing plate to case snap ring. (Fig. 7E-74)
3. Remove the intermediate clutch backing plate, three composition and three steel clutch plates. (Fig. 7E-75)
4. Remove the center support to case retaining snap ring. (Fig. 7E-76)
5. Install Tool J-21795 with J-6125 slide hammer onto mainshaft. Tool should tighten against shaft. Using the slide hammer as a handle, lift entire support and gear unit assembly from case. (Fig. 7E-77)

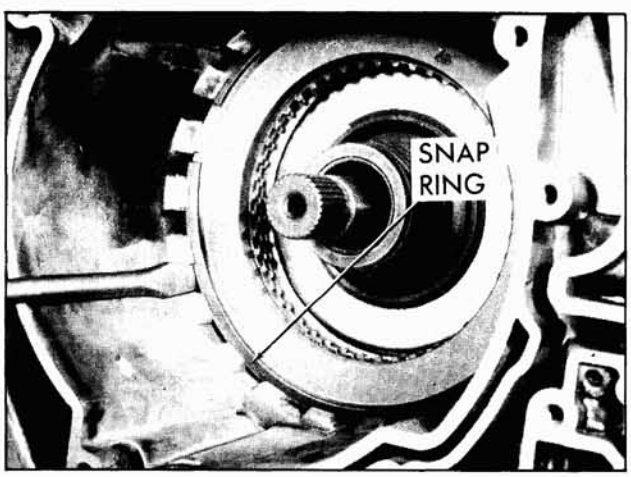


Fig. 7E-74—Removing Intermediate Clutch Snap Ring

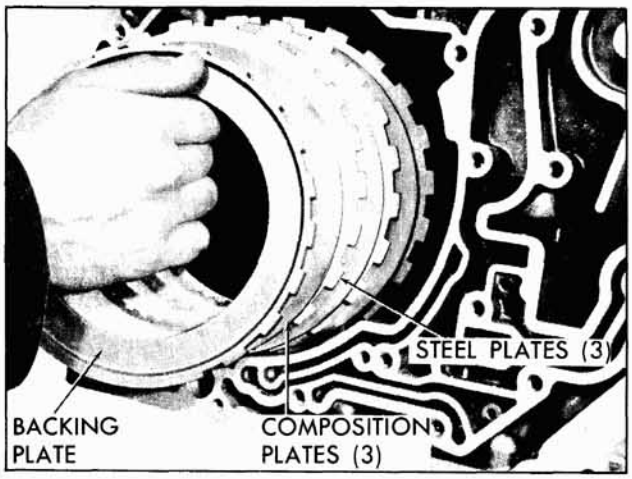


Fig. 7E-75—Removing Backing and Clutch Plates

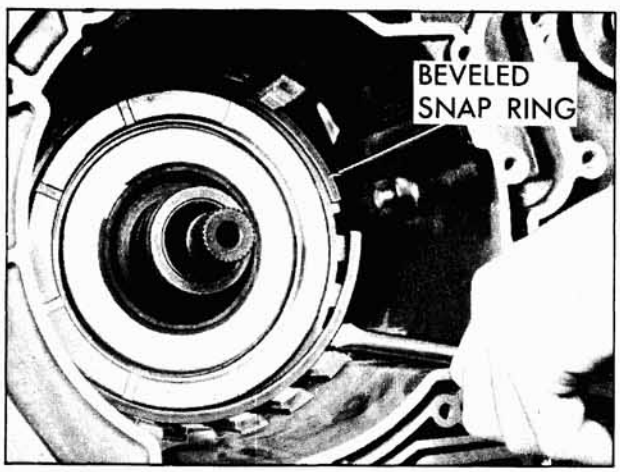


Fig. 7E-76—Removing Case Center Support Snap Ring

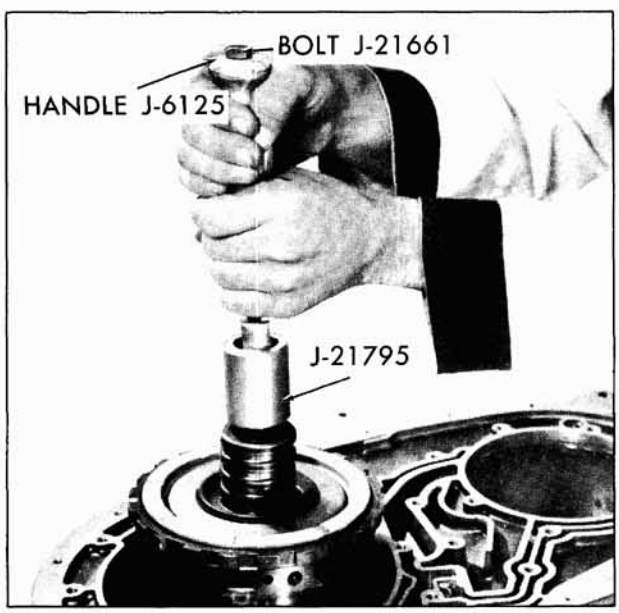


Fig. 7E-77—Removing Gear Unit

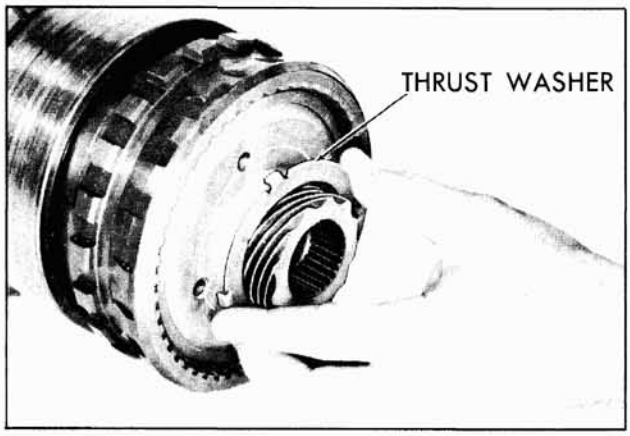


Fig. 7E-78—Removing Thrust Washer

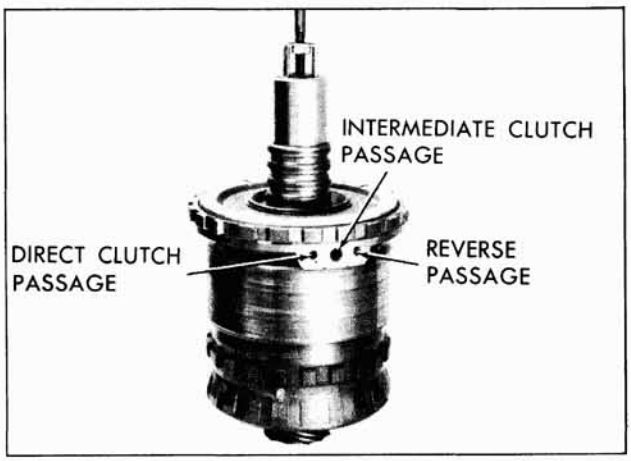


Fig. 7E-79—Gear Unit Positioned on Bench

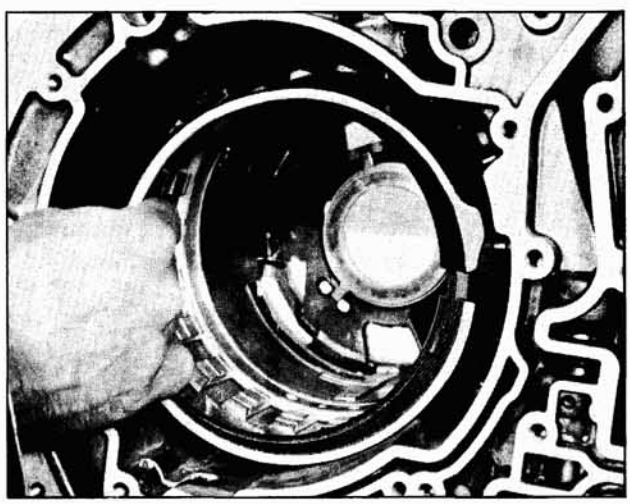


Fig. 7E-80—Removing Rear Band

6. Remove the output flange to case thrust washer from the rear of the output flange or inside the case. (Fig. 7E-78)
7. Place the gear unit assembly with output flange facing down on work bench. (Fig. 7E-79)
8. Remove the rear band assembly. (Fig. 7E-80)
9. Remove the rear unit selective washer from the transmission case. (Fig. 7E-81)

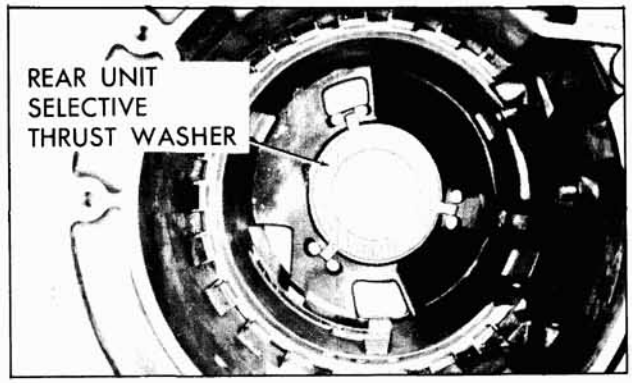


Fig. 7E-81—Removing Selector Washer

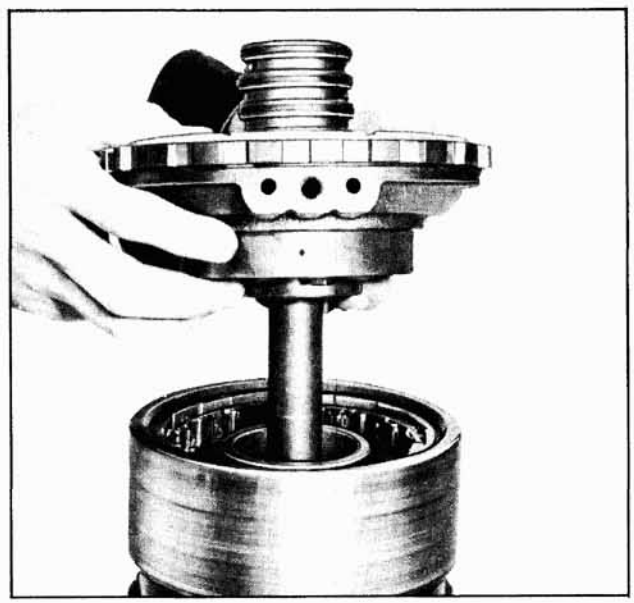


Fig. 7E-82—Removing Center Support

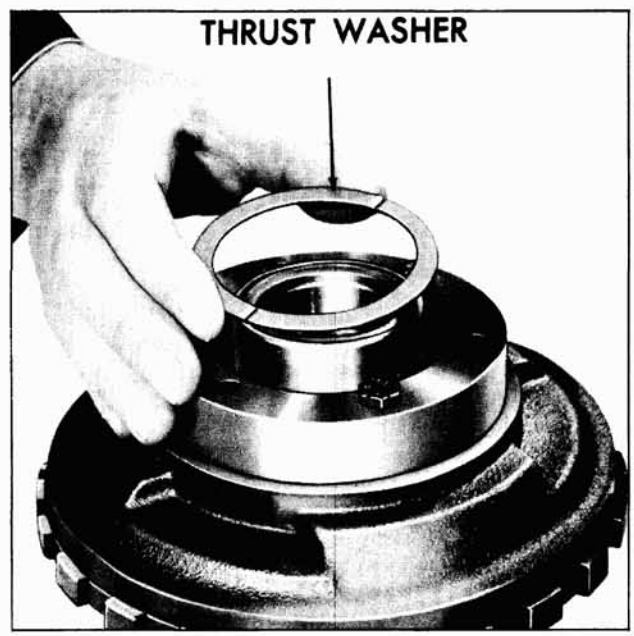


Fig. 7E-83—Removing Thrust Washer

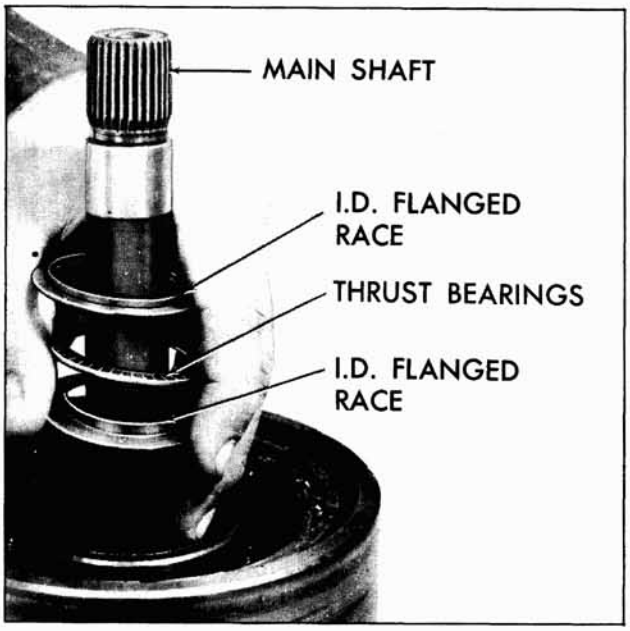


Fig. 7E-84—Removing Sun Gear Races and Bearings

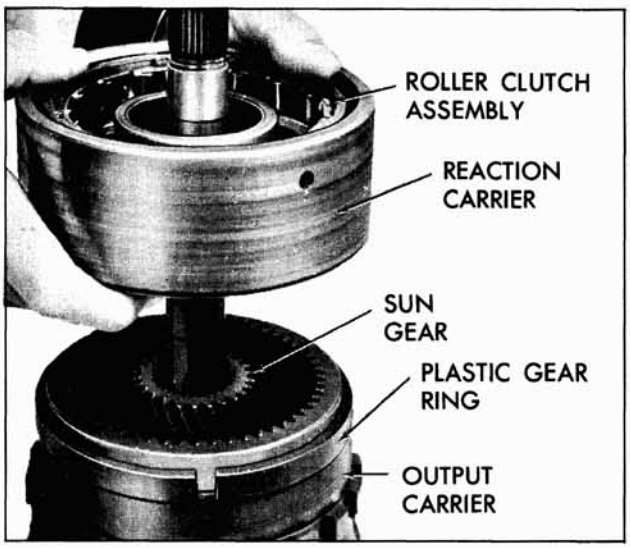


Fig. 7E-85—Removing Reaction Carrier

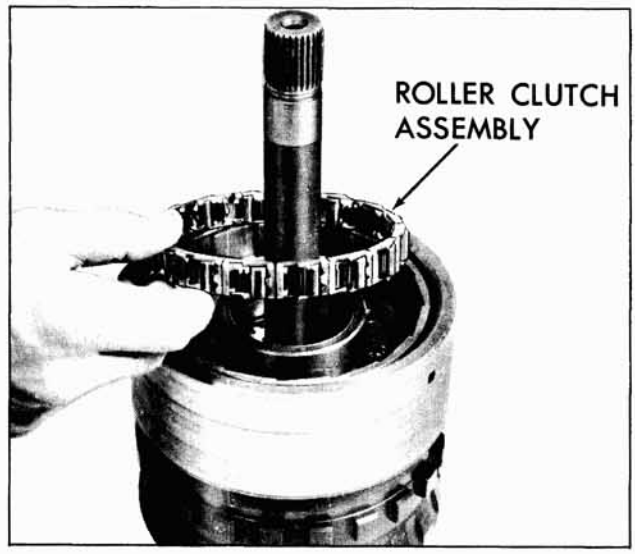


Fig. 7E-86—Removing Roller Clutch

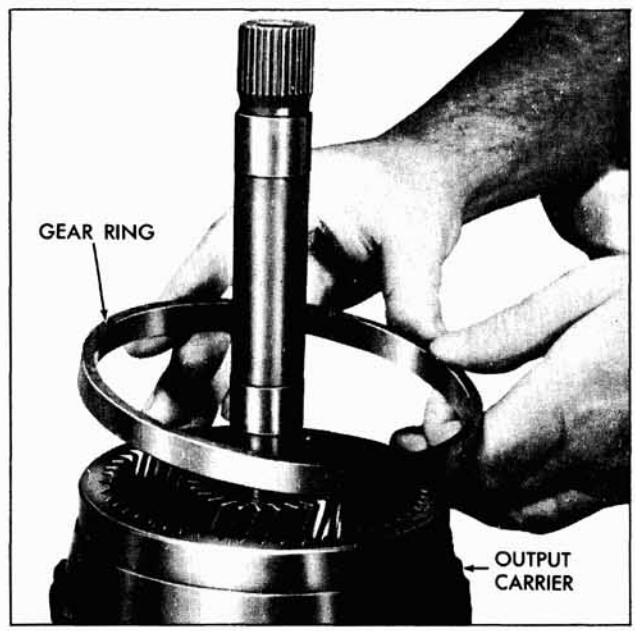


Fig. 7E-87—Removing Front Internal Gear Ring

DISASSEMBLY AND ASSEMBLY OF INDIVIDUAL UNITS

SUPPORT AND GEAR UNIT

Disassembly

1. Remove the case center support assembly. (Fig. 7E-82)
2. Remove the center support to reaction carrier thrust washer. (Fig. 7E-83)
3. Remove the center support to sun gear races and thrust bearing. (Fig. 7E-84)

One of the races may have been removed with the center support.

4. Remove the reaction carrier and roller clutch assembly. (Fig. 7E-85)
5. Remove roller clutch assembly from reaction carrier. (Fig. 7E-86)
6. Remove front internal gear ring from output carrier assembly. (Fig. 7E-87)
7. Remove sun gear. (Fig. 7E-88)
8. Remove reaction carrier to output carrier thrust washer. (Fig. 7E-89)
9. Turn assembly over.
10. Remove output flange to output carrier snap ring. (Fig. 7E-90)
11. Remove output flange. (Fig. 7E-91)
12. Remove output flange to rear internal gear thrust bearing and two races. (Fig. 7E-92)

Do not drop roller thrust bearings.

13. Remove rear internal gear and mainshaft. (Fig. 7E-93)
14. Remove the rear internal gear to sun gear thrust bearing and two races. (Fig. 7E-94)
15. If necessary, remove the rear internal gear to mainshaft snap ring to remove mainshaft. (Fig. 7E-95)

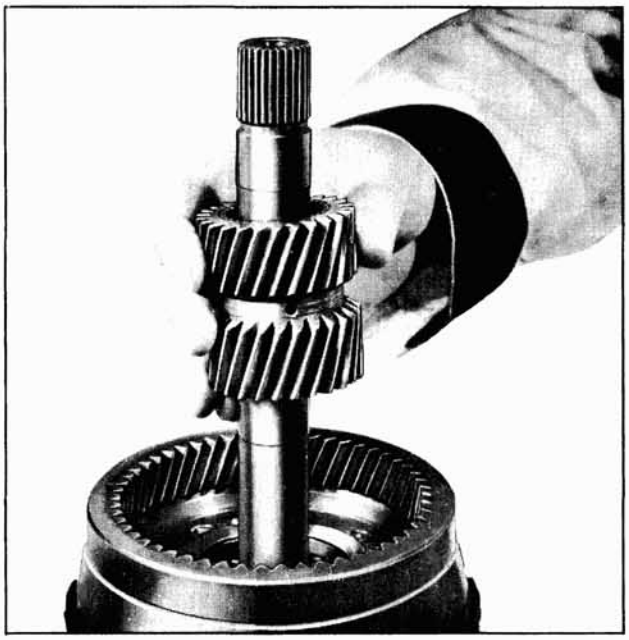


Fig. 7E-88—Removing Sun Gear

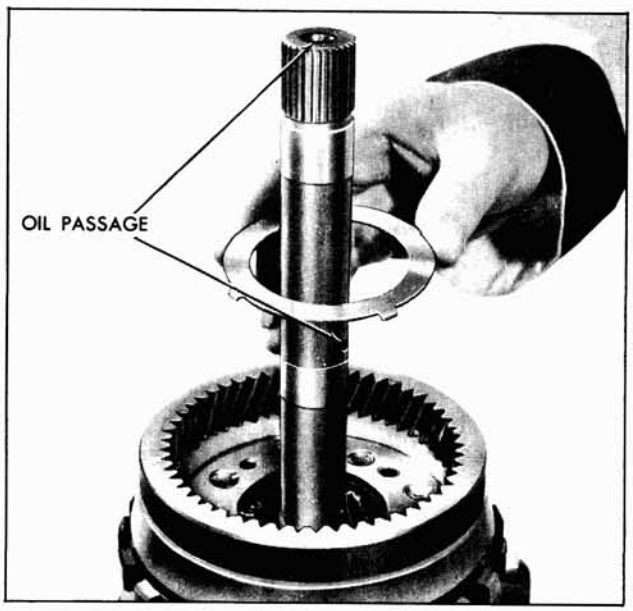


Fig. 7E-89—Removing Output Carrier Thrust Washer

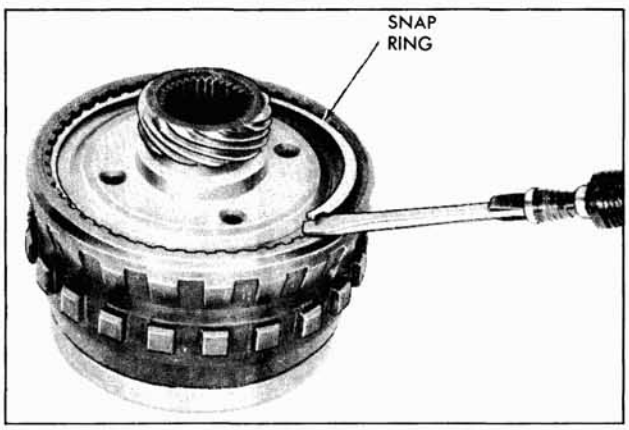


Fig. 7E-90—Removing Output Carrier Snap Ring

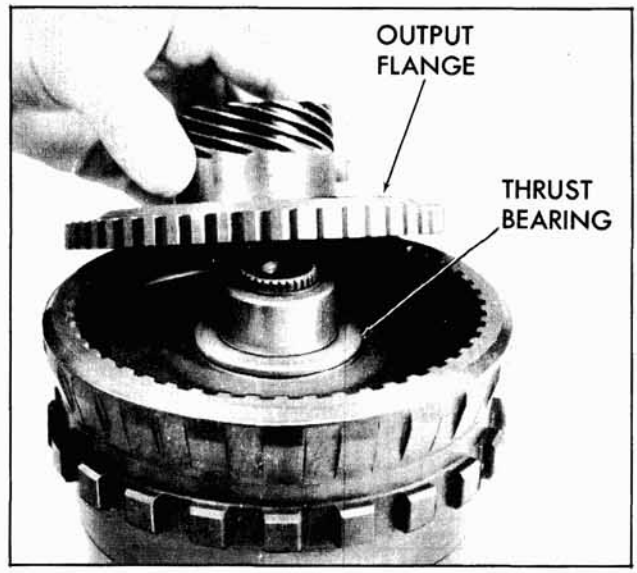


Fig. 7E-91—Removing Output Flange

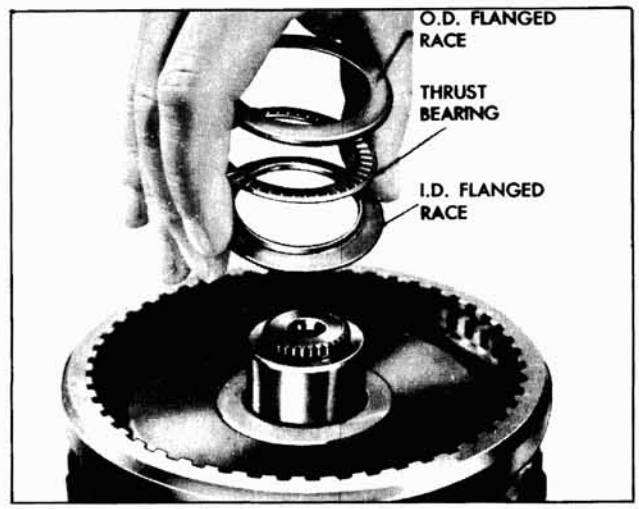


Fig. 7E-92—Removing Thrust Bearing and Races

Fig. 7E-93—Removing Rear Internal Gear and Mainshaft

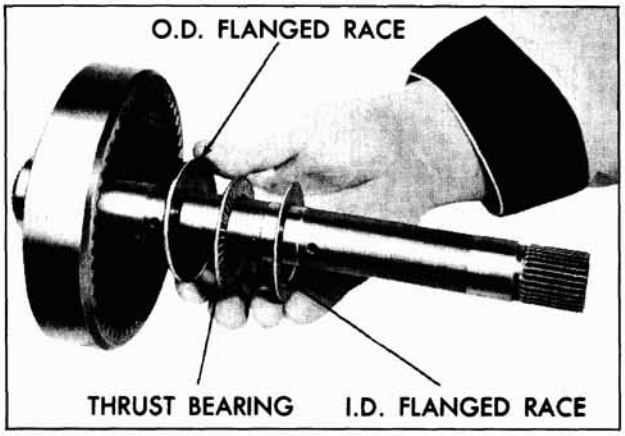


Fig. 7E-94—Removing Thrust Bearing and Races

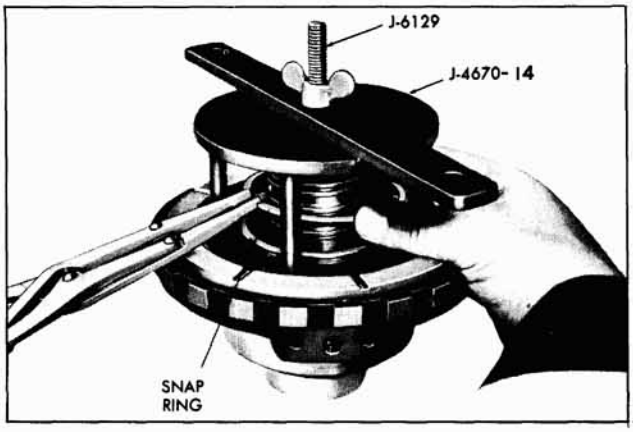


Fig. 7E-97—Removing Snap Ring

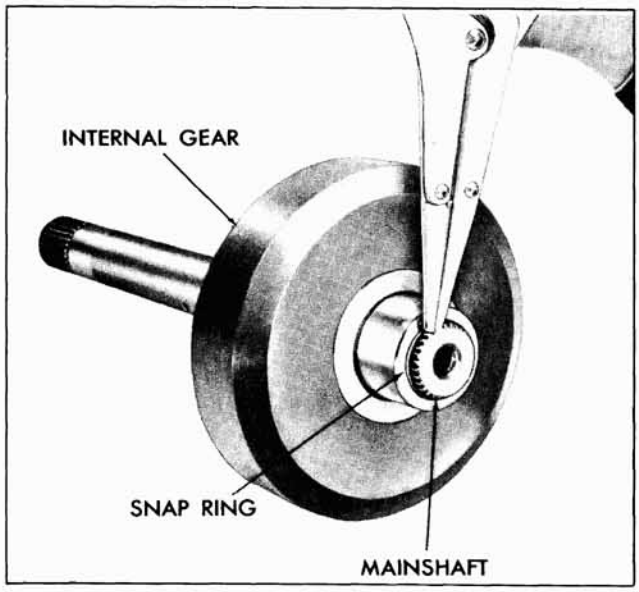


Fig. 7E-95—Removing Snap Ring

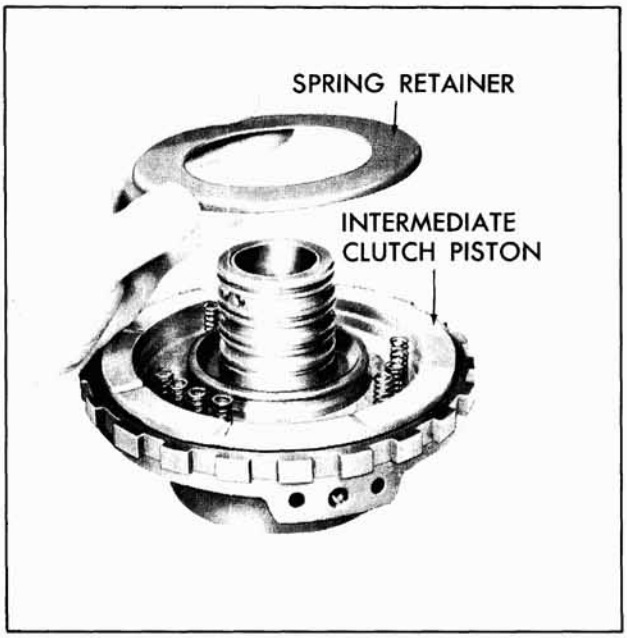


Fig. 7E-98—Removing Spring Retainer

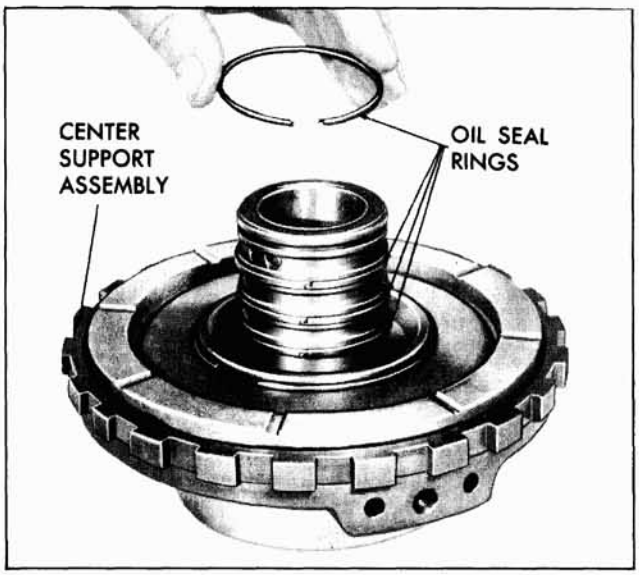


Fig. 7E-96—Removing Oil Seal Rings

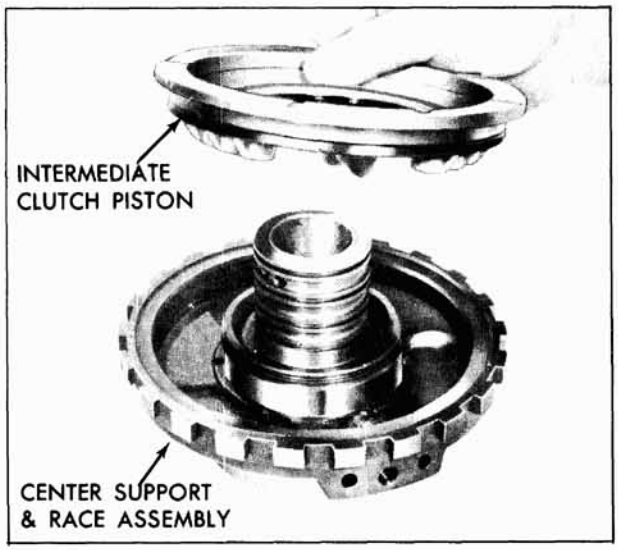


Fig. 7E-99—Removing Intermediate Clutch Piston

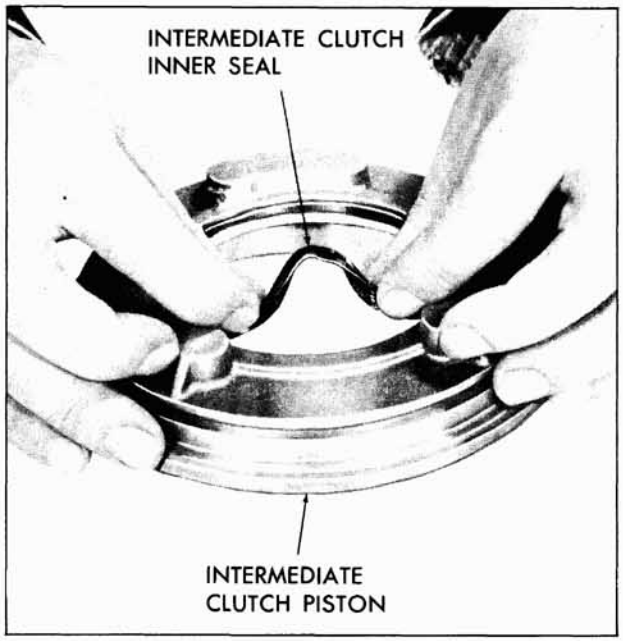


Fig. 7E-100—Removing or Installing Inner Seal

CASE CENTER SUPPORT

Disassembly

1. Remove four hook type oil seal rings from center support. (Fig. 7E-96)
2. Using clutch compressor or tools J-6129 and J-4670-14, compress the spring retainer and remove snap ring. (Fig. 7E-97)
3. Remove the spring retainer and twelve clutch release springs. (Fig. 7E-98)
4. Remove the intermediate clutch piston. (Fig. 7E-99)
5. Remove and discard the inner piston seal. (Fig. 7E-100)

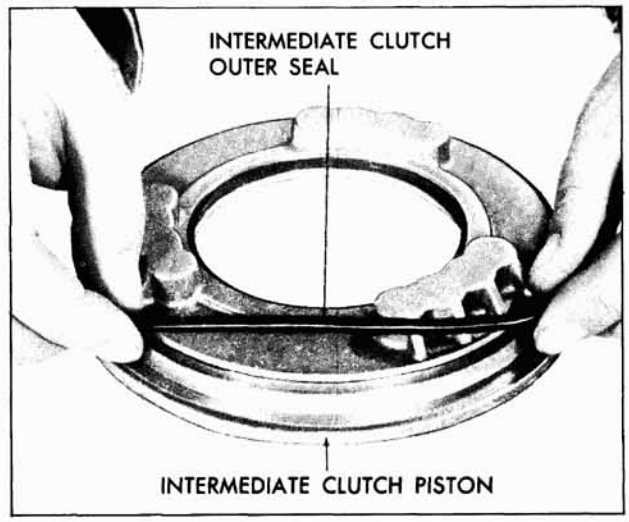


Fig. 7E-101—Removing or Installing Outer Seal

6. Remove and discard the outer piston seal. (Fig. 7E-101)

Do not remove the three screws retaining the roller clutch inner race to the center support.

Inspection

1. Inspect the roller clutch inner race for scratches or indentations. Be sure the lubrication hole is open by running a tag wire through this hole. See lubrication chart (Fig. 7E-232) for location of holes.
2. Inspect the bushing for scoring, wear, or galling.
3. Check oil ring grooves for damage or excessive wear.
4. Air check the oil passages to be sure they are open and are not interconnected. See lubrication chart for location of holes. (Fig. 7E-232)
5. Inspect the piston sealing surfaces for scratches.
6. Inspect the piston seal grooves for nicks and other damage.

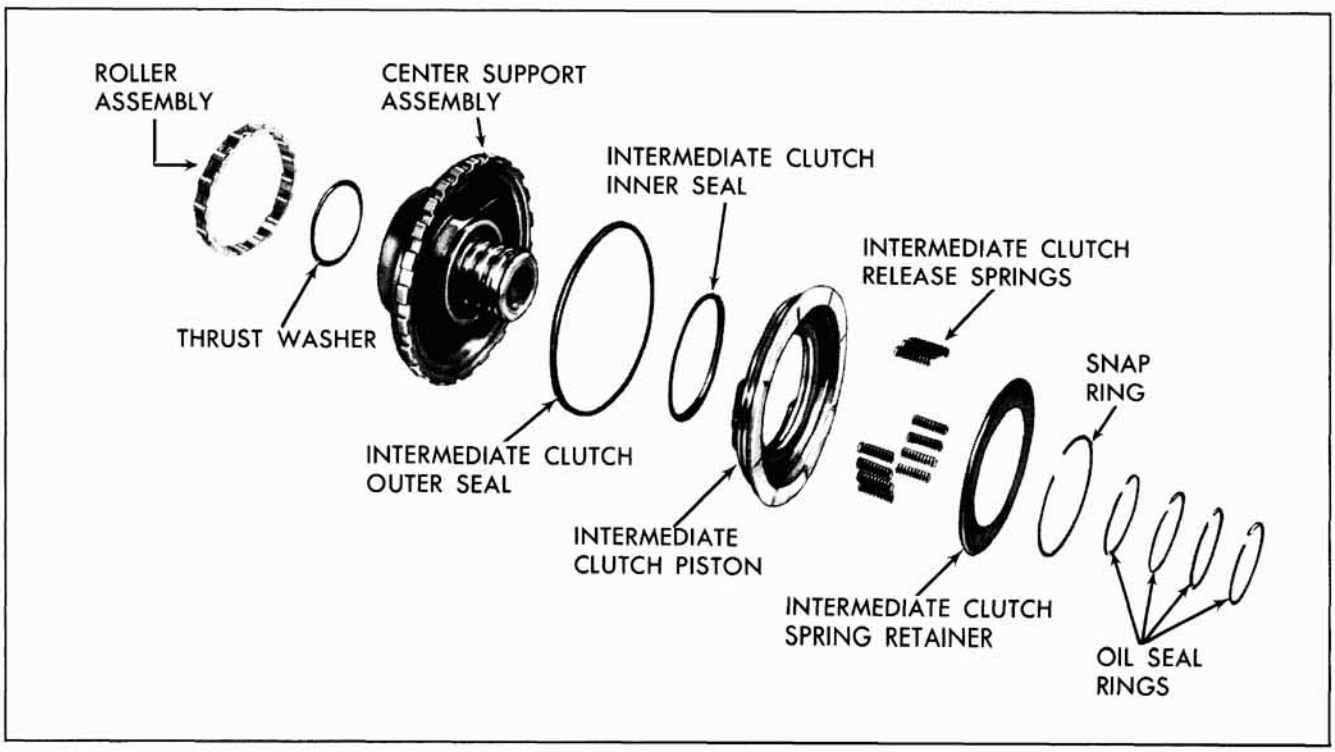


Fig. 7E-102—Center Support Assembly

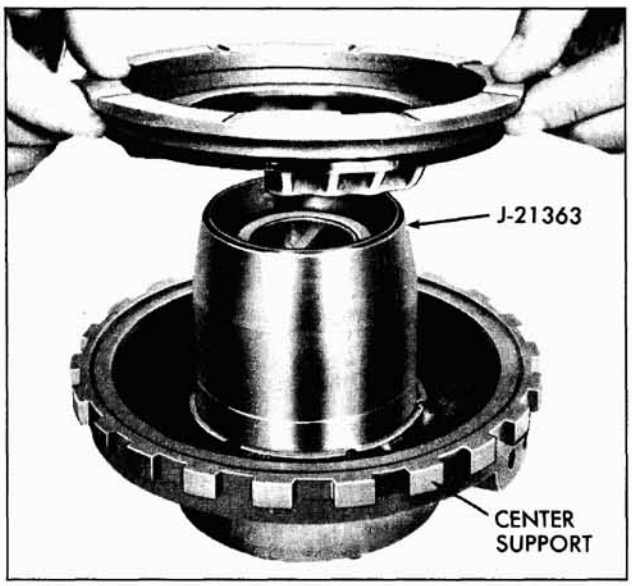


Fig. 7E-103—Installing Intermediate Clutch Piston

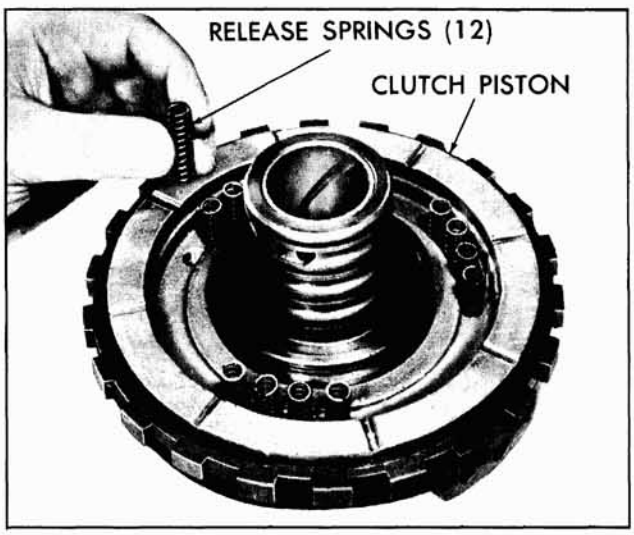


Fig. 7E-104—Installing Release Springs

7. Inspect the piston for cracks or porosity.
8. Inspect the release springs for distortion or collapsed coils.

Assembly (Fig. 7E-102)

1. Install new inner seal on the piston with lip of the seal facing away from the spring pockets. (Fig. 7E-100)
2. Install new outer seal with lip of seal facing away from the spring pockets. (Fig. 7E-101)

Apply Hydra-Matic oil to all seals before installing piston.

3. Install inner seal protector, Tool J-21363, on the center support hub. Install the piston, indexing spring pockets in the piston with cast pockets in center support. (Fig. 7E-103)

Spring pocket recesses in the piston must match cast pocket in center support.

4. Install twelve release springs into the piston. (Fig. 7E-104)

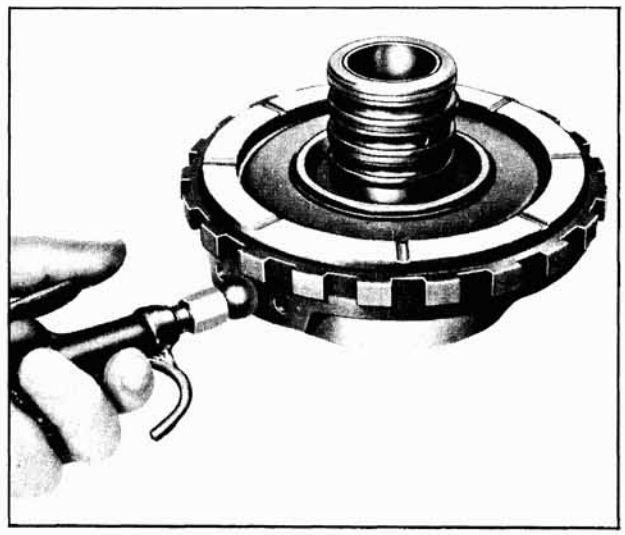


Fig. 7E-105—Air Checking Intermediate Clutch and Piston

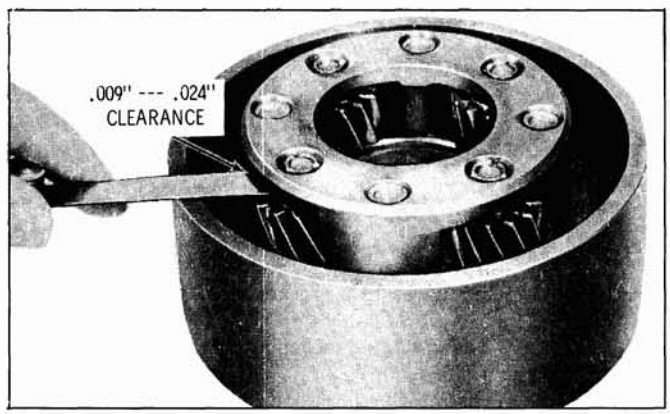


Fig. 7E-106—Checking Pinion End Play

5. Place the spring retainer and snap ring over the springs. (Fig. 7E-98)
6. Using clutch compressor tools J-6129 and J-4670-14, compress the springs and install the snap ring. (Fig. 7E-97)
7. Install four hook type oil rings. (Fig. 7E-96)
8. Air check operation of intermediate clutch and piston. (Fig. 7E-105)

REACTION CARRIER, ROLLER CLUTCH, AND OUTPUT CARRIER

Inspection

1. Inspect band surface on reaction carrier for signs of burning or scoring.
2. Inspect the roller clutch outer race for scoring or wear.
3. Inspect the thrust washer surfaces for signs of scoring or wear.
4. Inspect the bushing for damage. If bushing is damaged, the reaction carrier must be replaced.
5. Inspect the pinions for damage, rough bearings, or excessive tilt.
6. Check pinion end play. Pinion end play should be .009" to .024". (Fig. 7E-106)
7. Inspect the roller clutch for damage.
8. Inspect the roller cage and retaining springs for damage.
9. Inspect the front internal gear in output carrier assembly for damaged teeth.
10. Inspect the output carrier pinions for damage, rough bearings, or excessive tilt.

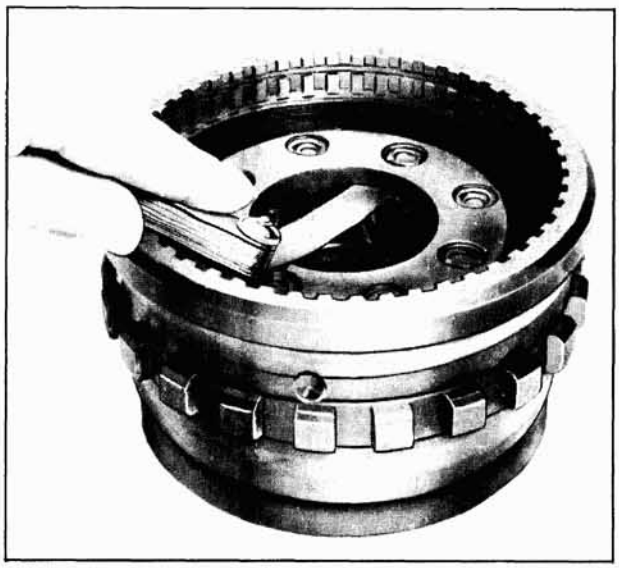


Fig. 7E-107—Checking Output Carrier Pinion End Play

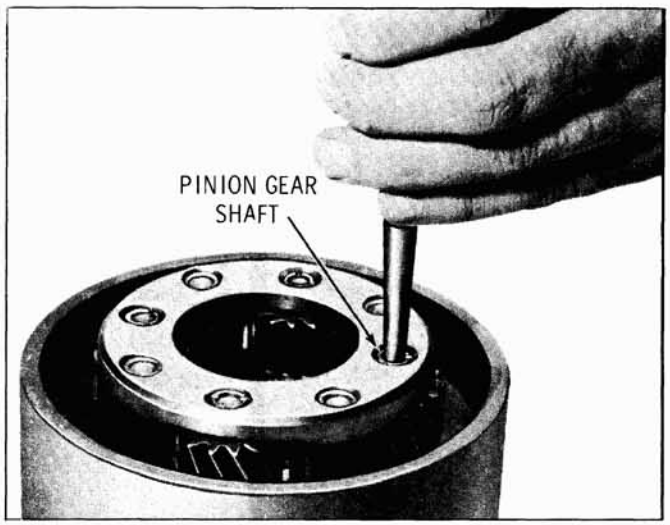


Fig. 7E-108—Removing Pinion Pins

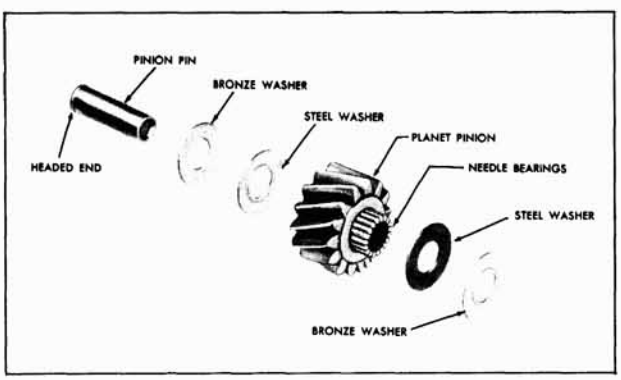


Fig. 7E-109—Planet Pinion Gears

11. Check pinion end play. Pinion end play should be .009" to .024". (Fig. 7E-107)
12. Inspect the parking pawl lugs for cracks or damage.
13. Inspect the output locating splines for damage.
14. Inspect the front internal plastic gear ring for flaking or cracks.

Fig. 7E-110—Installing Pinion Pin

Fig. 7E-111—Staking Pinion Pin

PINION GEARS

Remove and Install

1. Support the carrier assembly on its front face.
2. Using a 1/2" drill, remove the stake marks from the end of the pinion pin, or pins, to be replaced. This will reduce the possibility of cracking the carrier when the pinion pins are pressed out.

Do not allow drill to remove any stock from the carrier as this will weaken the part.

3. Remove the pinions, thrust washers, and roller needle bearings. (Fig. 7E-108)
4. Inspect the pinion pocket thrust faces for burrs and remove if present.
5. Install eighteen needle bearings into each pinion, using petrolatum to hold the bearings in place. Use a pinion pin as a

guide. (Fig. 7E-109)

6. Place a steel and bronze washer on each side of pinion so steel washer is against pinion. Hold in place with petrolatum.

7. Place the pinion assembly in position in the carrier and install a pilot shaft through the rear face of the assembly to hold the parts in place.

8. Drive a new pinion pin into place while rotating pinion from the front. Be sure that the headed end is flush or below the face of the carrier. (Fig. 7E-110)

9. Place a large punch in a bench vise to be used as an anvil while staking the opposite end of the pinion pin in three places. (Fig. 7E-111)

Both ends of the pinion pins must lie below the face of the carrier or interference may occur.

OUTPUT FLANGE

Inspection

1. Inspect the bushing for wear or galling.
2. Inspect the governor drive gear for rough or damaged teeth.
3. Inspect the drive lugs for damage.
4. Inspect lubrication passages.

Rear Internal Gear

1. Inspect the gear teeth for damage or wear.
2. Inspect the splines for damage.
3. Inspect the gear for cracks.
4. Inspect bearing and thrust surfaces for wear or galling.

Sun Gear

1. Inspect the gear teeth for damage or wear.
2. Inspect splines for damage.
3. Be sure oil lubrication hole is open. See lubrication chart (Fig. 7E-232) for location of holes.

Sun Gear Shaft

1. Inspect shaft for cracks or splits.
2. Inspect splines for damage.
3. Inspect bushings for scoring or galling.
4. Inspect the bushing journals for damage.
5. Be sure the oil lubrication holes are open. See lubrication chart (Fig. 7E-232) for location of holes.

Mainshaft

1. Inspect the shaft for cracks or distortion.
2. Inspect the splines for damage.
3. Inspect the bushing journals for damage.
4. Inspect the snap ring groove for damage.
5. Inspect the orificed cup plug pressed into one end of mainshaft. Be sure it is not plugged by running a tag wire through the orifice hole.
6. Inspect for open lubrication passages.

If mainshaft replacement is required, it is necessary to use a shaft with a "V" identification groove on the machined journal at the rear internal gear end of the shaft. Because of a spline change, the current model mainshaft is not interchangeable with past model parts.

GEAR UNIT (Fig. 7E-112)

Assembly

1. Install rear internal gear on end of mainshaft and install snap ring. (Fig. 7E-113)
2. Install the sun gear to internal gear thrust races and bearings against the inner face of the rear internal gear as follows: (Retain with petrolatum). (Fig. 7E-114)
   a. Place the large race against the internal gear with O.D. flange facing rearward or up.
   b. Place the thrust bearing against the race.
   c. Place the small race against the bearing with the inner flange facing into the bearing or down.
4. Install the output carrier over the mainshaft so that the pinions mesh with the rear internal gear. (Fig. 7E-115)
5. Place the above portion of the build-up through hole in bench so that the mainshaft hangs downward.

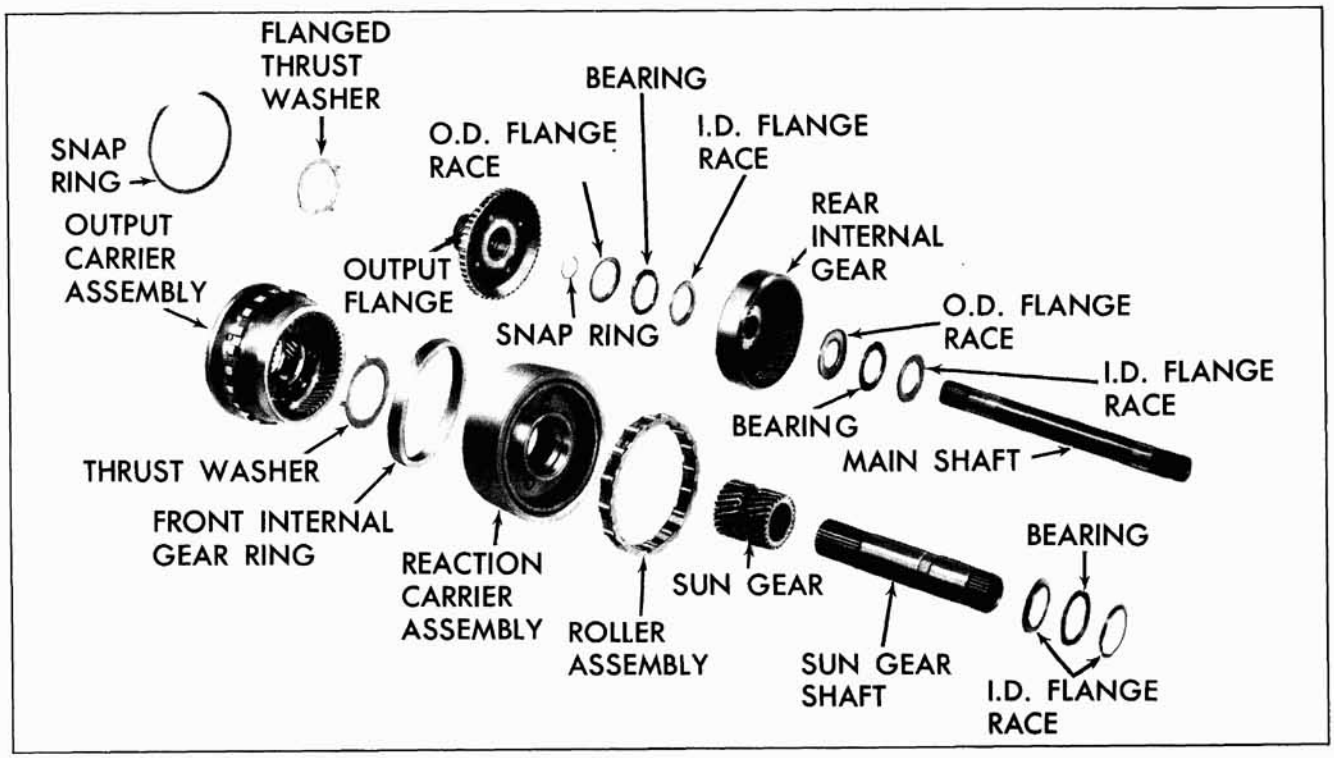


Fig. 7E-112—Gear Unit

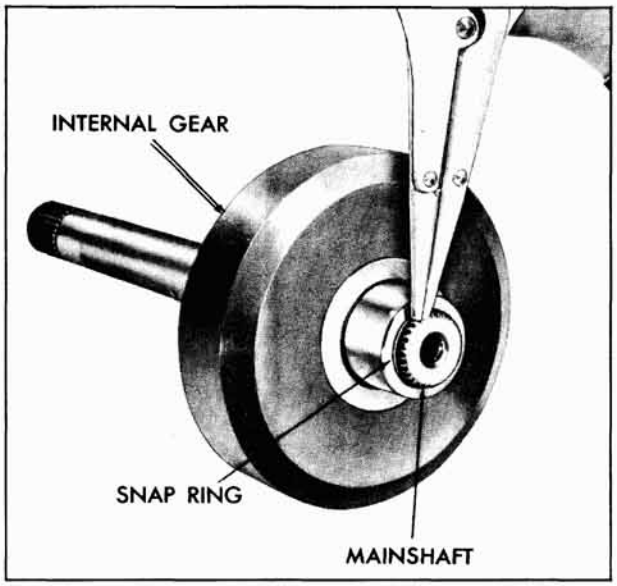


Fig. 7E-113—Installing Snap Ring

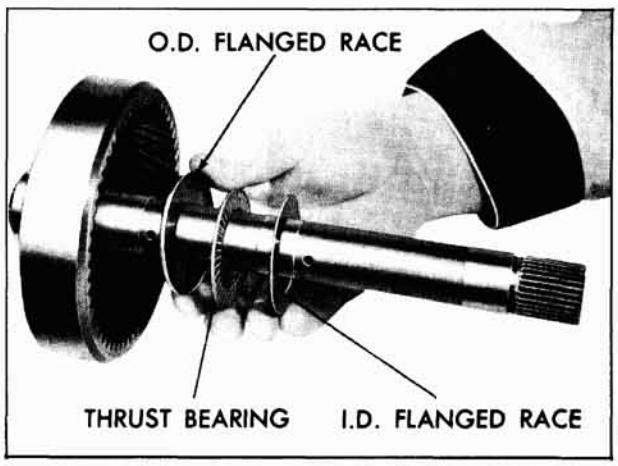


Fig. 7E-114—Installing Thrust Bearing and Races

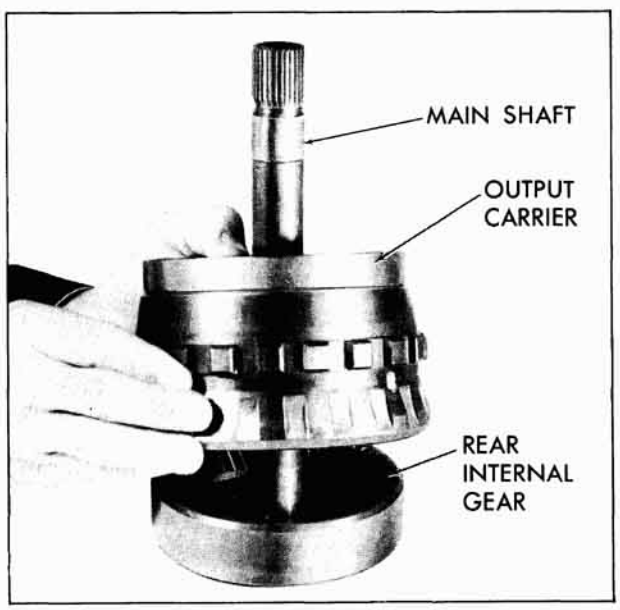


Fig. 7E-115—Installing Output Carrier

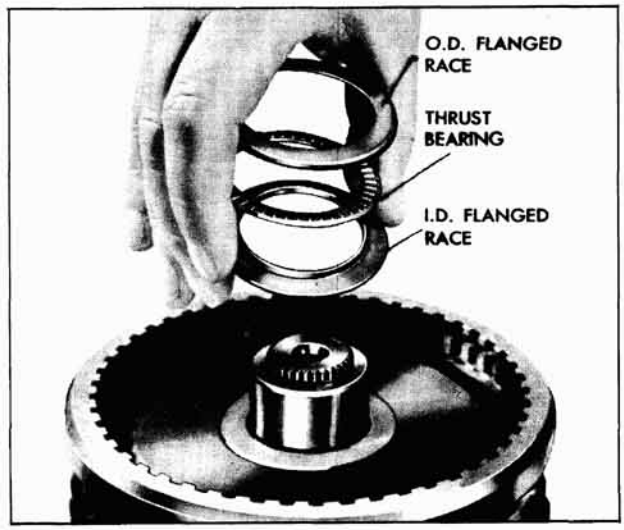


Fig. 7E-116—Installing Thrust Bearing and Races

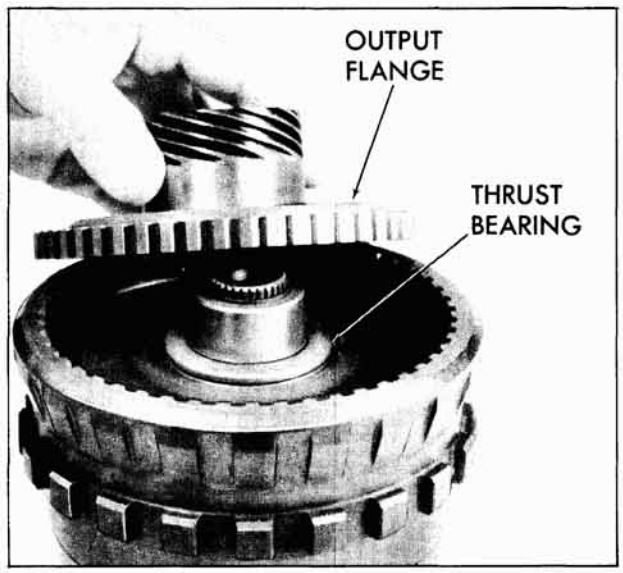


Fig. 7E-117—Installing Output Flange

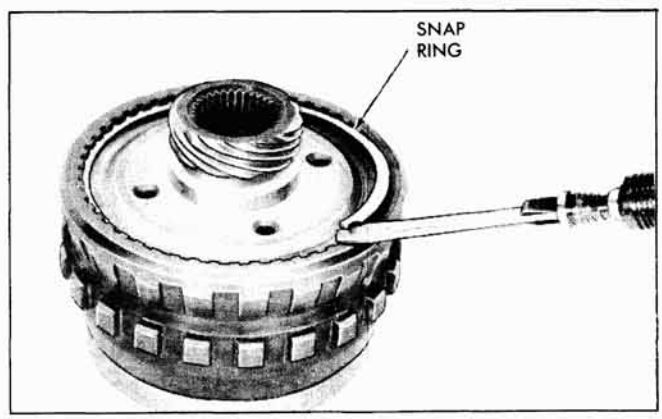


Fig. 7E-118—Installing Snap Ring

6. Install the rear internal gear to output flange thrust races and bearings as follows: (Retain with petrolatum). (Fig. 7E-116)

a. Place the small diameter race against the internal gear

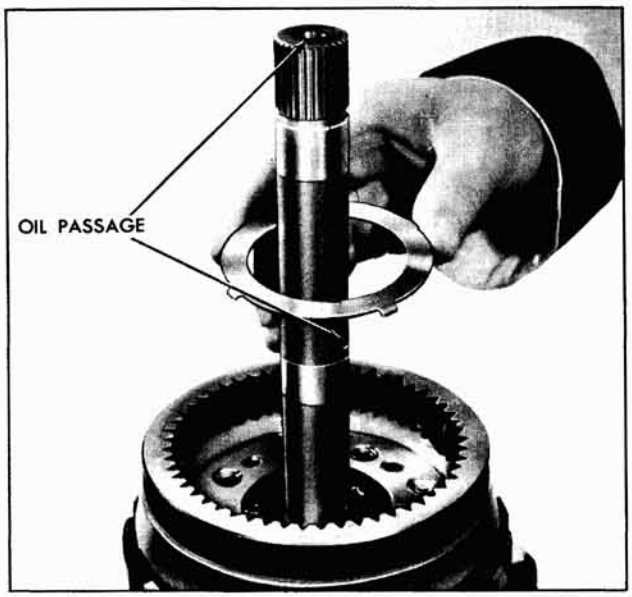


Fig. 7E-119—Installing Thrust Washer

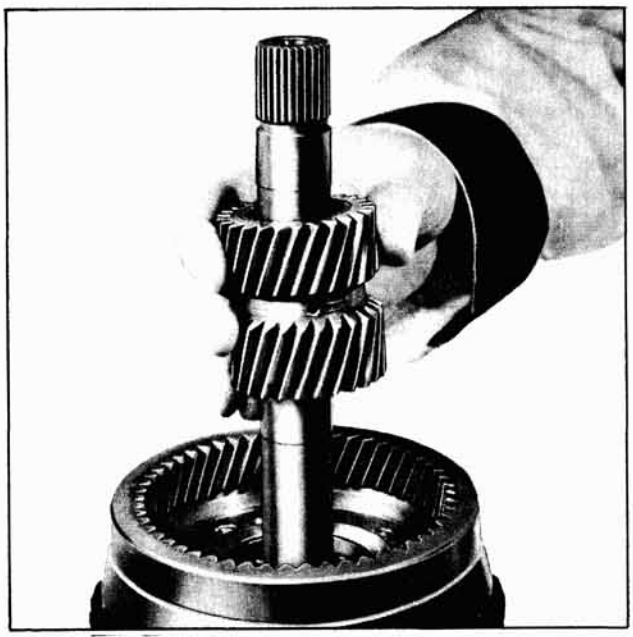


Fig. 7E-120—Installing Sun Gear

with the center flange facing up.

b. Place the bearing on the race.

c. Place the second race on the bearing with the outer flange cupped over the bearing.

7. Install the output flange into the output carrier assembly. (Fig. 7E-117)

8. Install the output flange to the output carrier snap ring bevel side up. (Fig. 7E-118)

9. Turn assembly over and support so that the output flange faces downward.

10. Lubricate and install the reaction carrier to output carrier plastic thrust washer with the tabs facing down into pockets. (Fig. 7E-119)

11. Install the sun gear with I.D. chamfer end down. (Fig. 7E-120)

12. Install the plastic gear ring over the output carrier. (Fig. 7E-121)

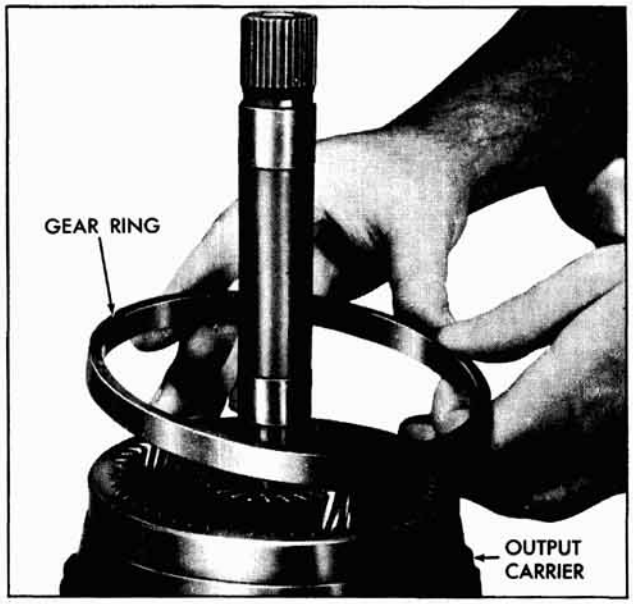


Fig. 7E-121—Installing Gear Ring

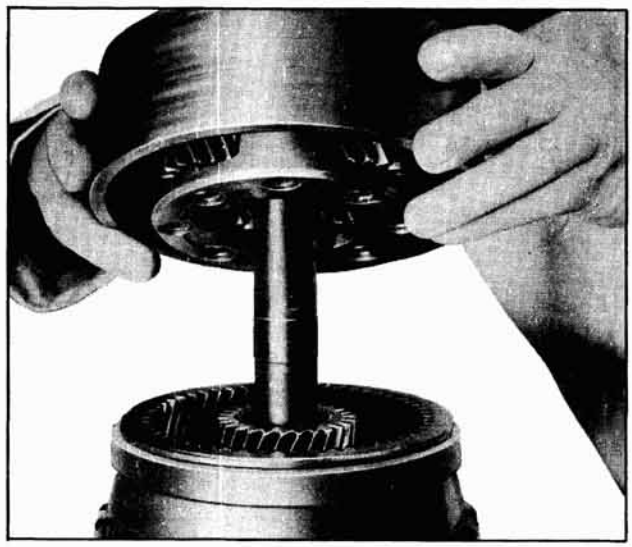


Fig. 7E-122—Installing Reaction Carrier

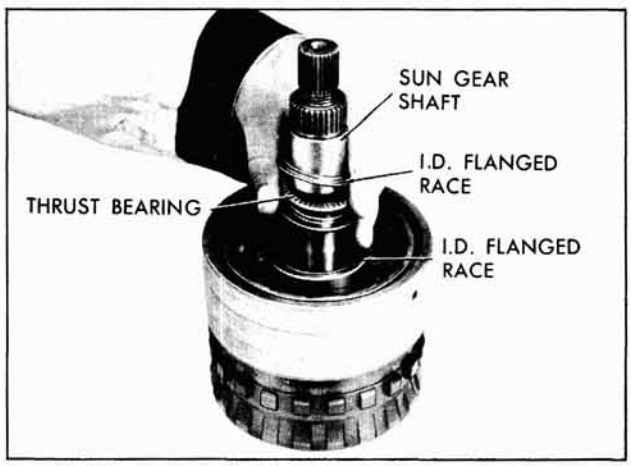


Fig. 7E-123—Installing Sun Gear Thrust Washers

Fig. 7E-124—Installing Thrust Washers

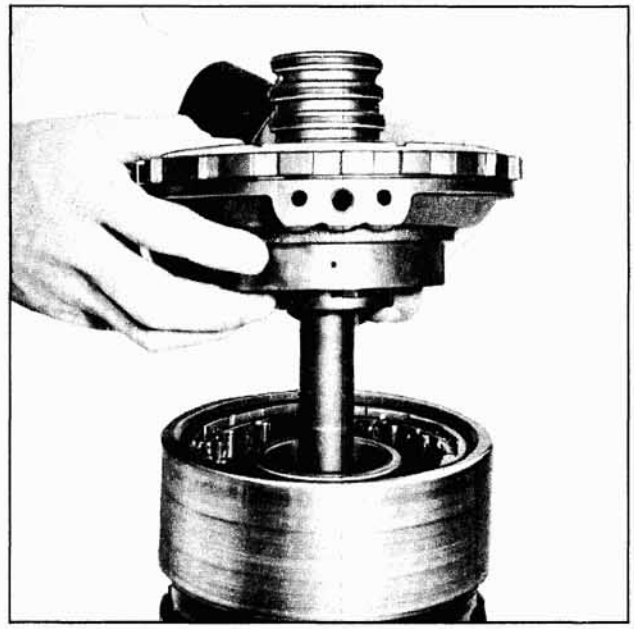


Fig. 7E-126—Installing Center Support

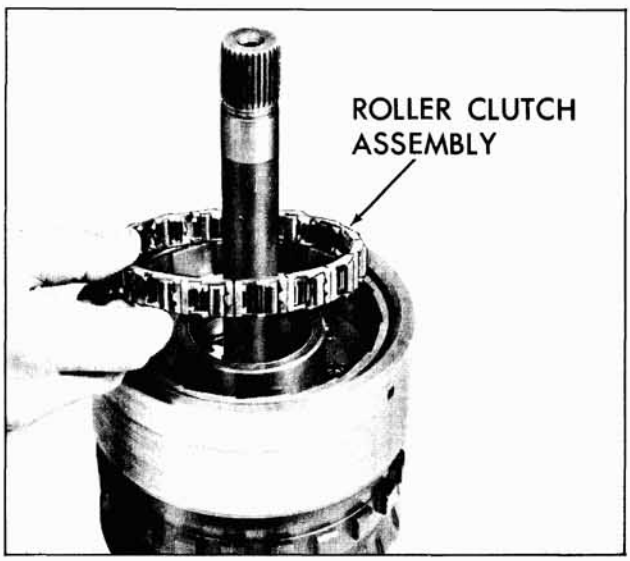


Fig. 7E-125—Installing Roller Clutch

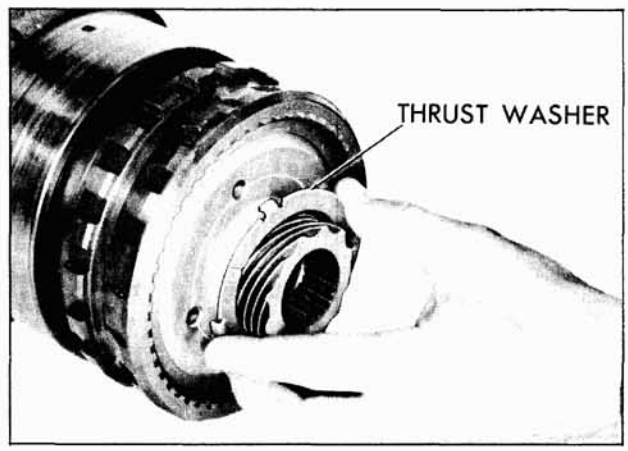


Fig. 7E-127—Installing Thrust Washer

13. Install the reaction carrier. (Fig. 7E-122)
14. Install sun gear shaft.
15. Install the center support to sun gear thrust races and bearings as follows: (Fig. 7E-123)
    a. Install the large race, center flange up over the sun gear shaft.
    b. Install the thrust bearing against the race.
    c. Install the second race, center flange up.
16. Install the center support to reaction carrier thrust washer into the recess in the center support. Retain with petrolatum. (Fig. 7E-124)
17. Install the roller clutch assembly into reaction carrier. (Fig. 7E-125)
18. Install the case center support into roller clutch assembly. (Fig. 7E-126)

With reaction carrier held, case support should only turn clockwise.

19. Install output flange to case selective thrust washer, tabs in pockets. Retain with petrolatum. (Fig. 7E-127)

INSPECTION

Front and Rear Bands

1. Inspect the lining for cracks, flaking, burning, or looseness.
2. Inspect the bands for cracks or distortion.
3. Inspect the end for damage at the anchor lugs or apply lugs.

Modulator and Valve

1. Inspect the modulator assembly for any signs of bending, distortion, or presence of water or oil.
2. Inspect the "O" ring seal seat for damage.
3. Apply suction to the vacuum tube and check for diaphragm leaks.
4. Inspect the modulator valve for nicks or damage.
5. Inspect case bushing for nicks or scoring.
6. Check freeness of valve operation in case bushing bore.
7. Check modulator bellows, modulator plunger is under pressure (16 lbs.). If bellows are damaged the plunger will have very little pressure.

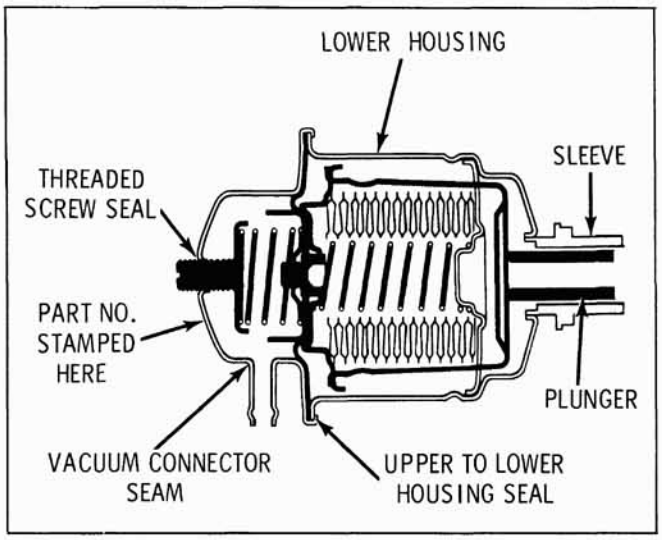


Fig. 7E-128—Vacuum Modulator

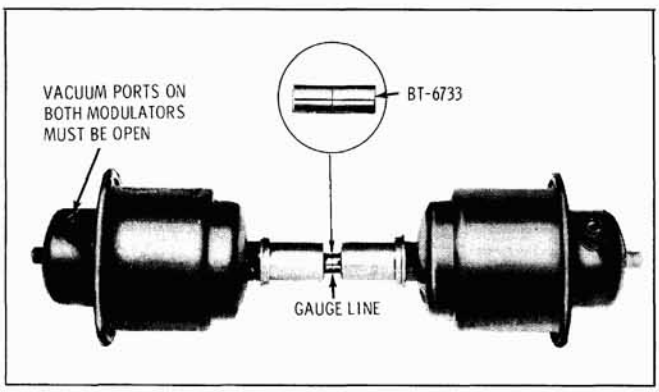


Fig. 7E-129—Checking Vacuum Modulator

VACUUM MODULATOR DIAGNOSIS

Vacuum Diaphragm Check

Insert a pipe cleaner as far as possible into the vacuum connector pipe and check for the presence of transmission fluid. If transmission fluid is found, the modulator should be replaced.

Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of oil, proceed to the next check.

Atmospheric Leak Check

1. Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, the crimped upper to lower housing seam, and the threaded screw seal. (Fig. 7-128)
2. Using a short piece of rubber hose, apply air pressure to the vacuum pipe by blowing into the tube and observing for bubbles. If bubbles appear, replace the modulator.

Do not use any method other than human lung power for applying air pressure, as pressures over 6 psi may damage the modulator.

Bellows Comparison Check

This check is made using an available tool, BT-6733. The gauge compares the load of a known good modulator with a modulator being checked.

1. Install the modulator that is known to be acceptable on either end of the gauge.
2. Install the modulator in question on the opposite end of the gauge. (Fig. 7-129)
3. Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gauge. The gap between the opposite modulator sleeve end and the gauge line should be 1/16" or less. If the distance is greater than this amount, the modulator in question should be replaced.

When making the comparison, make sure that both modulators are of the same type. The part numbers are stamped on the dome of the modulator.

Sleeve Alignment Check

Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

If the vacuum modulator assembly passes all of the above checks, it is an acceptable part and should be reused.

Manual and Parking Linkage

1. Inspect the parking actuator rod for cracks, damage, or broken spring retainer lugs.
2. Inspect the actuator spring for damage.
3. Inspect actuator for a free fit on the actuator rod.
4. Inspect the parking pawl for cracks or wear.
5. Inspect the manual shaft for damaged threads, rough oil seal groove or loose lever.
6. Inspect the inside detent lever for cracks or a loose pin.
7. Inspect the parking pawl shaft for damaged retainer grooves, or rough surface.
8. Inspect the parking pawl return spring for deformed coils or ends.
9. Inspect the parking bracket for cracks or wear.
10. Inspect the detent roller and spring assembly.

Case

1. Inspect case assembly for cracks, porosity, or interconnected passages. Air can be blown through passages to determine if they are interconnected. See lubrication chart (Fig. 7E-232) for location of passages.
2. Check for good retention of band anchor pins.
3. Inspect all threaded holes for thread damage.
4. Inspect the intermediate clutch driven plate lugs for damage or brinelling.
5. Inspect the snap ring grooves for damage.
6. Inspect the bore of the governor assembly for scratches or scoring.
7. Inspect the modulator bushing bore for scoring or damage.
8. Inspect the pressure regulator bore for scoring or damage.

Converter

1. Check converter for cracks or broken welds.
2. Check converter hub surfaces for signs of scoring or wear.
3. Check converter for leaks as outlined in Section 7.

REAR SERVO

Disassembly

1. Remove the rear accumulator piston from rear servo piston. (Fig. 7E-130)
2. Remove E-ring retaining rear servo piston to band apply pin. (Fig. 7E-131)
3. Remove rear servo piston and seal from band apply pin.
4. Remove washer, spring and retainer.

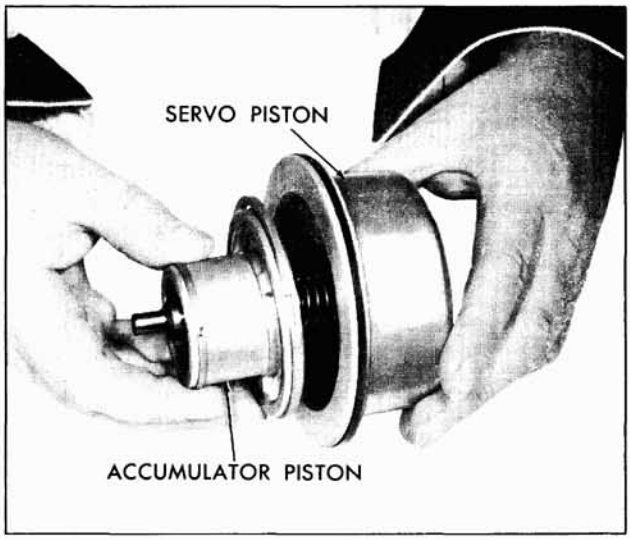


Fig. 7E-130—Removing Accumulator Piston

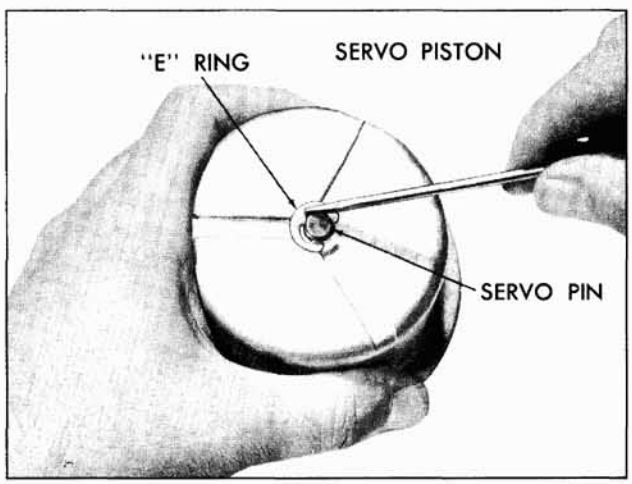


Fig. 7E-131—Removing "E" Ring

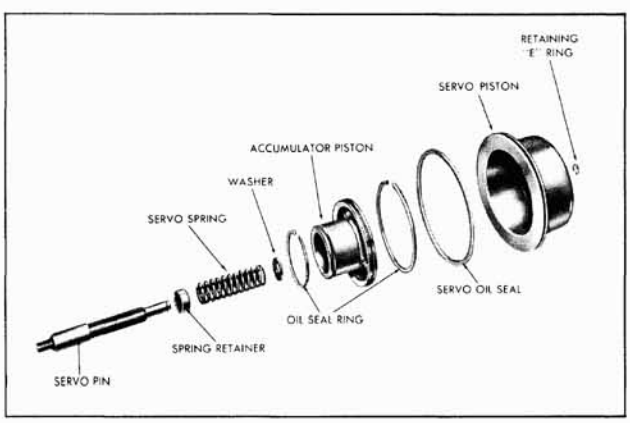


Fig. 7E-132—Rear Servo and Accumulator

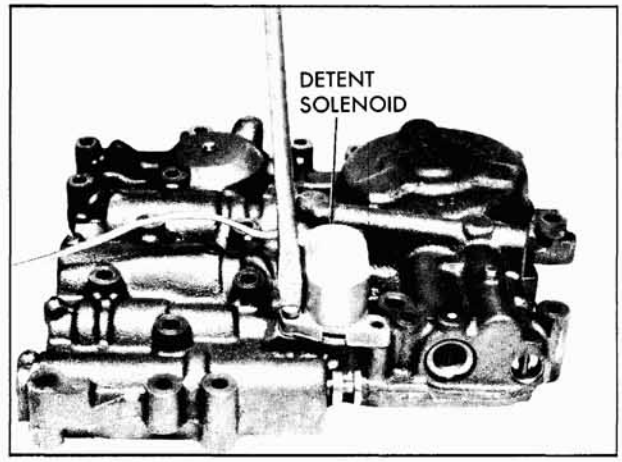


Fig. 7E-133—Removing Detent Solenoid

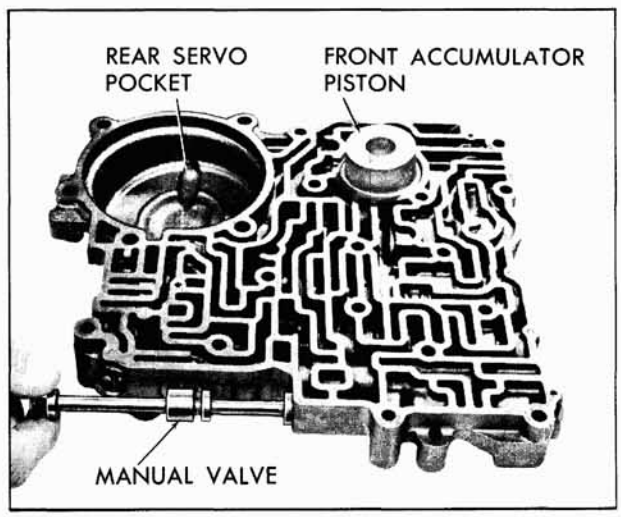


Fig. 7E-134—Removing Manual Valve

Inspection

1. Inspect freeness of accumulator ring in piston.
2. Pick up proper band apply pin determined by band apply pin selection check.
3. Inspect fit of band apply pin in servo piston.
4. Inspect band apply pin and servo piston for scores and cracks.

Assembly

1. Install spring retainer, cup end first, spring and washer on band apply pin. (Fig. 7E-132)
2. Install band apply piston and secure with E-ring. (Fig. 7E-131)
3. If removed, install oil seal ring on servo piston.
4. If removed, install outer and inner oil rings on accumulator piston. Assemble into bore of servo piston.

FRONT SERVO

Inspection

1. Inspect servo pin for damage. Roll pin on a flat surface to determine the straightness of pin.
2. Inspect piston for damaged oil ring groove. Check freeness of ring in groove.
3. Inspect piston for cracks or porosity.
4. Check fit of servo pin in piston.

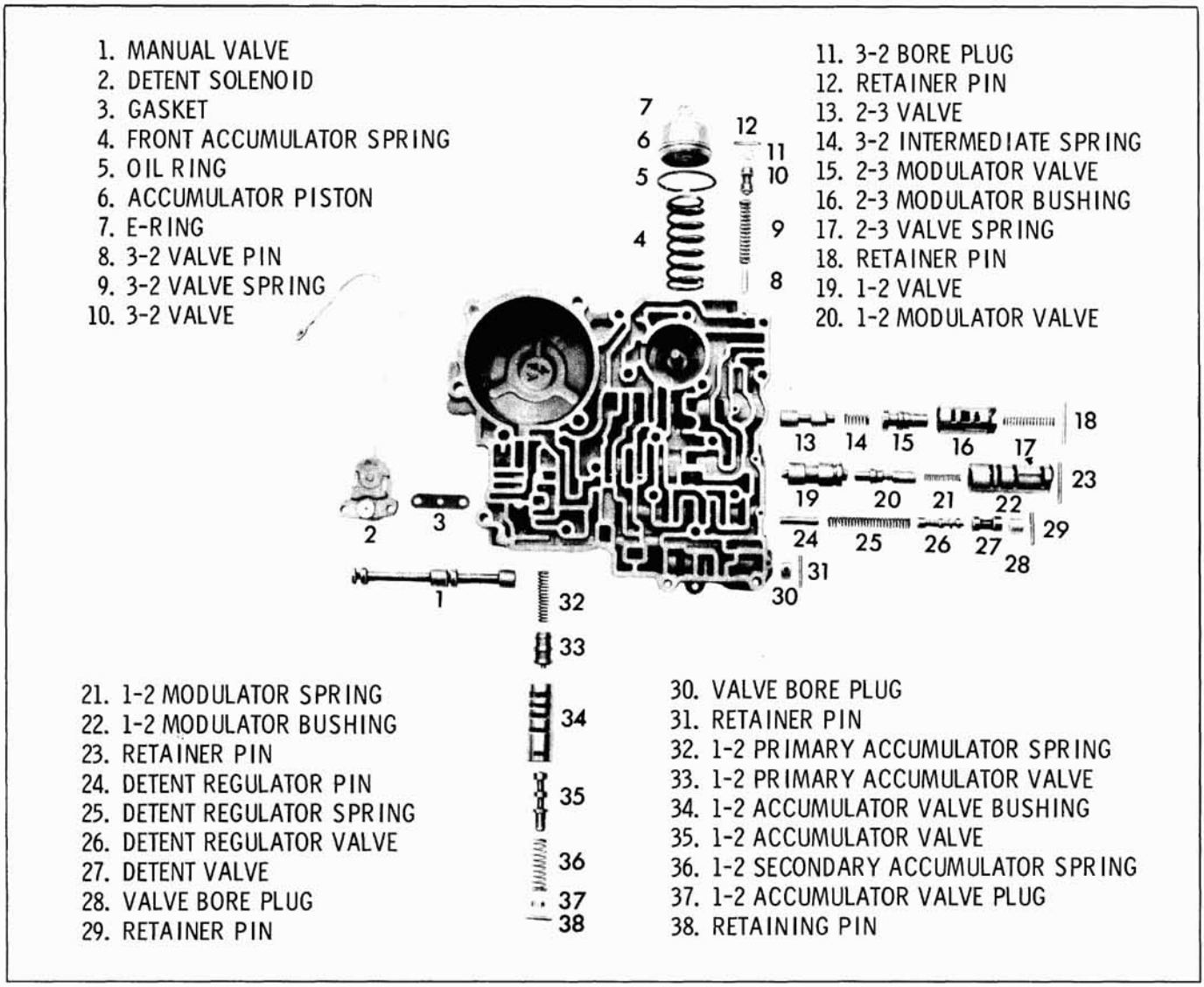


Fig. 7E-137—Valve Body Assembly

GOVERNOR ASSEMBLY

All components of the governor assembly, with the exception of the driven gear, are select fit. Each assembly is factory calibrated. The governor, including the driven gear and cover is serviced as a complete assembly.

Governor Inspection

1. Wash all parts in cleaning solvent, air dry and blow out all passages.
2. Inspect governor sleeve for nicks, burrs, scoring or galling.
3. Check governor sleeve for free operation in bore of transmission case.
4. Inspect governor valve for nicks, burrs, scoring or galling.
5. Check governor valve for free operation in bore of governor sleeve.
6. Inspect governor driven gear for nicks, burrs, or damage.
7. Check governor driven gear for looseness on governor sleeve.
8. Inspect governor springs for distortion or damage.
9. Check governor weights for free operation in their retainers.
10. Check valve opening at entry and exhaust (.020" minimum).

CONTROL VALVE (Fig. 7E-137)

Disassembly

As each valve train is removed, place the individual valve train in a separate location relative to its position in the valve body. Also, place each part of each valve train in the order that it is removed from the valve bore. None of the valves or springs are interchangeable. Keep them in the proper valve train.

1. Remove two detent solenoid to valve assembly attaching screws. (Fig. 7E-133)
2. Remove detent solenoid and solenoid gasket. Discard gasket.
3. Position valve assembly with lapped face up so that the servo bore and the front accumulator piston are positioned as shown in Fig. 7E-134.
4. Remove manual valve from bore. (Fig. 7E-134)
5. Use a No. 1 easy-out and remove retaining pin and plug from manual bore.

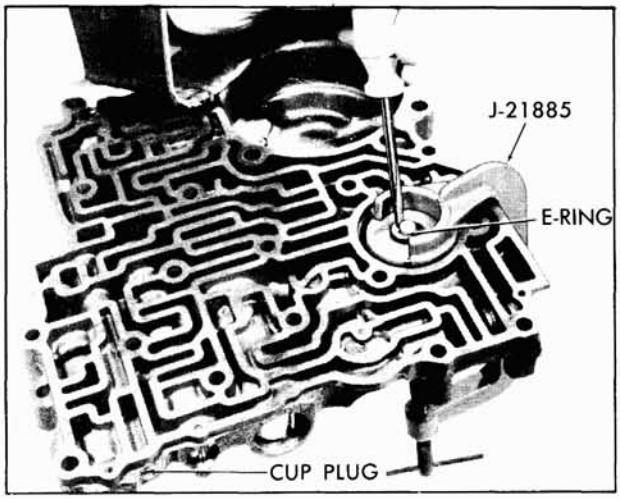


Fig. 7E-135—Removing Front Accumulator Piston

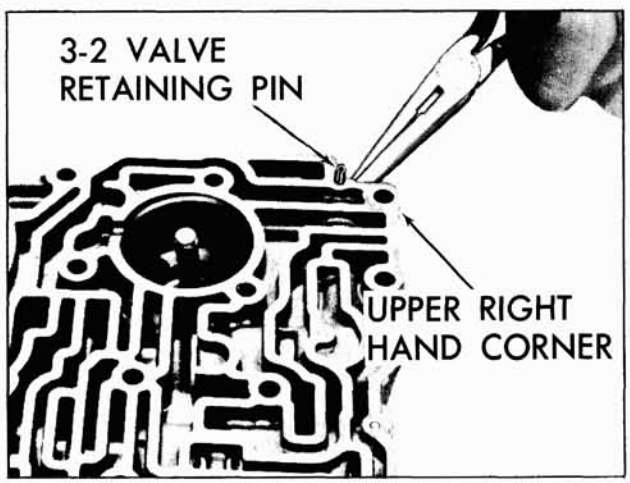


Fig. 7E-136—Removing 3-2 Valve Retaining Pin

6. Install available compressor Tool J-21885 on front accumulator piston and remove retaining E-ring. (Fig. 7E-135)

7. Release Tool J-21885 and remove the tool, the front accumulator piston, and spring from valve assembly.

8. Using a pair of needle nose pliers, compress the bore plug and remove the retaining pin from the 3-2 valve bore located in the extreme upper right hand corner of the valve assembly. (Fig. 7E-136)

9. Remove the bore plug, 3-2 valve and spring from the valve assembly.

10. Remove the retaining pin from the 2-3 valve train bore located directly below and at a right angle to the 3-2 valve.

11. Remove the 2-3 modulator bushing, 2-3 modulator valve and spring, the 3-2 intermediate spring, and the 2-3 valve.

12. Remove the retaining pin from the 1-2 valve bore located directly below the 2-3 valve train bore.

13. Remove the 1-2 modulator valve bushing, 1-2 regulator valve and spring, 1-2 detent valve, and the 1-2 valve.

14. Remove the retaining pin from the detent regulator bore located directly below the 1-2 valve bore.

15. Remove the bore plug, detent valve, detent regulator valve, detent regulator pin and spring.

16. Remove the 1-2 accumulator bushing retaining pin and bore plug from the hole located to the right of the stator valve.

17. Remove 1-2 accumulator valve bushing, 1-2 accumulator valve and secondary spring, 1-2 accumulator primary valve, and spring.

Inspection (Fig. 7E-137)

1. Thoroughly wash and clean valve body in a clean solvent to remove the oil.

2. Inspect valve body for cracked lands in the valve port areas, scratches or porosity in bores, nicks on the machined face, and cracks, scratches, nicks or distortion in the servo bores.

3. Inspect front servo pin for scoring, cracks, and damage to the E-ring groove.

4. Inspect the valves for scoring, cracks, and squareness of corner shoulders.

Valve corners should be sharp and square.

5. Inspect bushings for galling, scratches, or distortion.

6. Check all springs for distortion or collapsed coils.

Assembly (Fig. 7E-137)

1. Install the 1-2 accumulator primary spring in the 1-2 primary valve and install both, spring first, into bore, using a retaining pin as a temporary retainer to hold the spring and valve in its operating position until the bushing assembly is installed. Pin goes into first drilled hole in port. (Fig. 7E-138)

2. Install the 1-2 accumulator secondary valve (wide land first) into the 1-2 accumulator bushing.

3. Install the 1-2 accumulator valve bushing into the bore, align the square port on the end of the bushing with the hole for the retaining pin.

4. Install the 1-2 secondary accumulator valve spring and 1-2 accumulator plug into the bushing.

5. Install grooved retaining pin, with the grooves entering the pin hole last, and tap with a hammer until flush with cast surface of the valve body.

6. Install spring, detent regulator pin, detent regulator valve (flat end first), detent valve (flat end first), bore plug, and retaining pin into detent bore. (Compress spring with screwdriver to aid installation of detent valve into the valve body).

7. Install 1-2 valve into 1-2 valve bore, long stem end first.

8. Install 1-2 modulator valve spring, and 1-2 modulator valve into 1-2 modulator valve bushing.

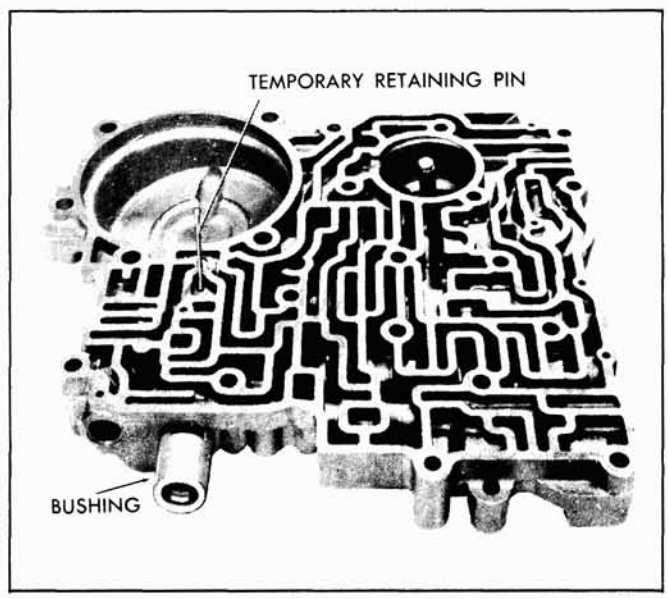


Fig. 7E-138—Temporary Retaining Pin Installation

9. Install 1-2 modulator valve bushing assembly into 1-2 valve bore and install retaining pin into valve body.
10. Install the 2-3 valve (flat end first) into 2-3 bore. Install 3-2 intermediate spring on stem end of 2-3 valve.
11. Install 2-3 modulator valve into 2-3 modulator bushing and install 2-3 modulator bushing (large diameter hole first) into valve body.
12. Install 2-3 valve spring and retaining pin into valve bore.
13. Install 3-2 valve spring, spacer and 3-2 valve (either end first) into 3-2 valve bore.
14. Install valve bore plug and retaining pin into valve body.
15. Using Tool J-21885, install front servo spring, front servo piston, and retaining E-ring into front accumulator piston pocket.
16. Install detent solenoid gasket, detent solenoid, and attaching screws on reverse side of valve body assembly.
17. Check all valve trains to see that they are operating freely by compressing the valves on the springs.
18. Install manual bore plug and retaining pin.
19. Install manual valve into manual bore.

OIL PUMP

Disassembly

1. Mark gears for reassembly and remove drive gear from pump body. (Fig. 7E-139)

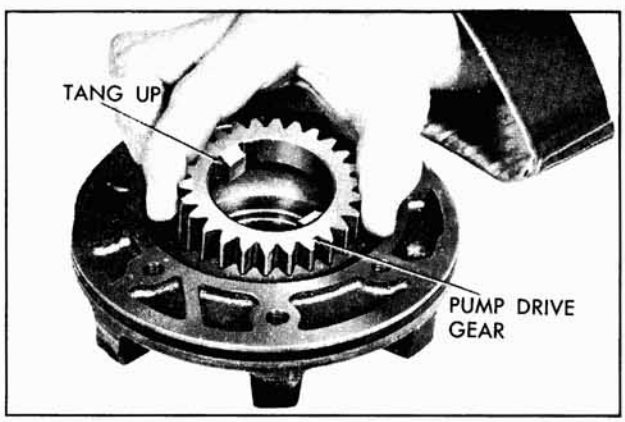


Fig. 7E-139—Removing or Installing Pump Drive Gear

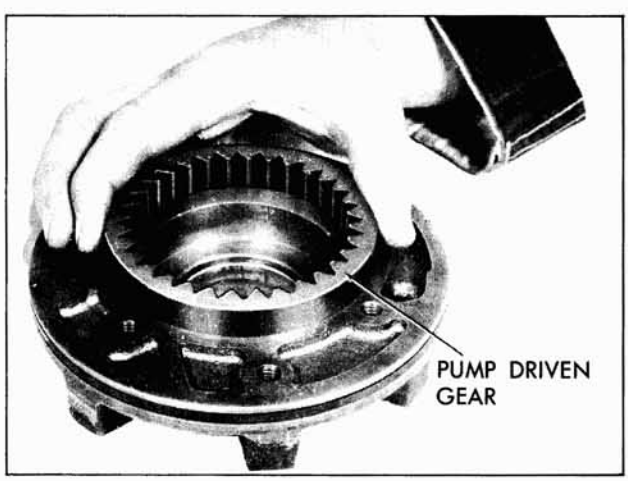


Fig. 7E-140—Removing or Installing Pump Driven Gear

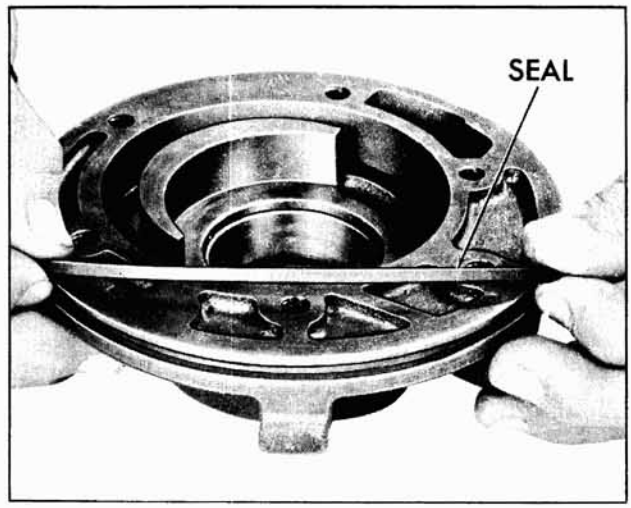


Fig. 7E-141—Removing or Installing Pump to Case Seal

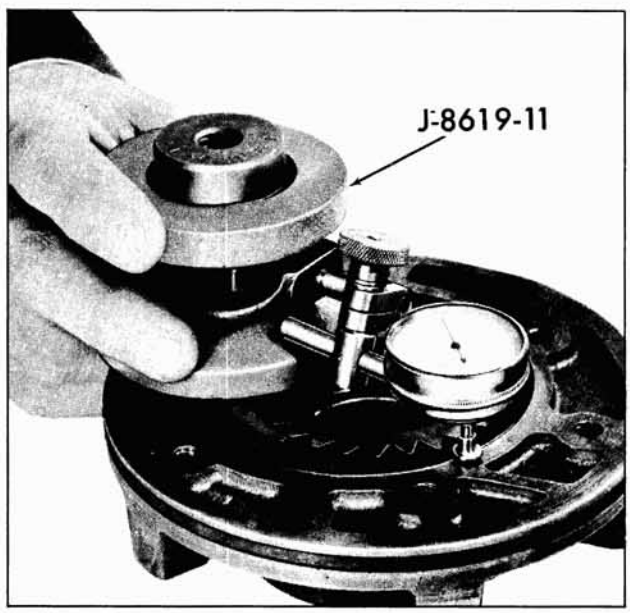


Fig. 7E-142—Checking End Clearance

2. Remove driven gear from pump body. (Fig. 7E-140)
3. Remove and discard pump body to case "O" ring seal. (Fig. 7E-141)

Inspection

1. Using tip of finger, inspect gear pocket and crescent for nicks, burrs, scoring or galling.
2. Inspect drive gear for nicks, burrs, scoring, or galling.
3. Inspect driven gear for nicks, burrs, scoring, or galling.
4. Place pump gears in pump body and check the following gear face to pump face clearances.
   a. Pump body face to gear face can be checked by placing a dial indicator on the J-8619-11 gauge and reading the flatness between the pump face and the pump gears. End clearance should be .0008" to .0015". (Fig. 7E-142)
5. Check face of pump body for nicks, burrs, scoring, or galling.
6. Check pump body face flatness. Overall flatness should be .000" to .002". Use J-8619-11.
7. Inspect bushing for nicks, burrs, scoring, galling, out-of-round, or excessive wear.

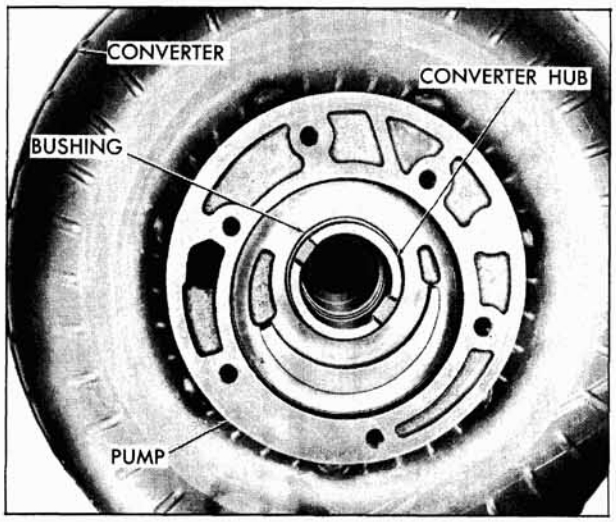


Fig. 7E-143—Checking Bushing Runout

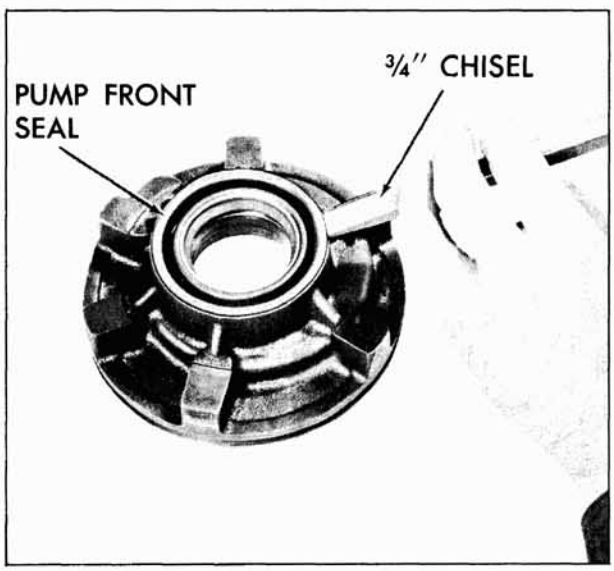


Fig. 7E-144—Removing Front Seal

a. To check for out-of-round, install pump body on the converter hub and look for eccentricity between pump bushing and converter hub. (Fig. 7E-143)

8. Check for damaged pump cover plate bolt holes.

9. Inspect front seal for damage. If replacement of front seal is necessary, use a standard 3/4" cold chisel and pry front seal from pump body. (Fig. 7E-144)

Assembly

1. If necessary, install a new front seal, using Tool J-21359 to drive the seal in place. Use Sealer No. 1050026 or equivalent on outside of seal before installing into pump. (Fig. 7E-145)

2. Install the driven gear into the pump body. (Fig. 7E-140)

3. Install the drive gear into the pump body with drive tangs up. (Fig. 7E-139)

The drive gear should always be installed with the counterbore down.

4. Install the new pump to case "O" ring seal. (Fig. 7E-141)

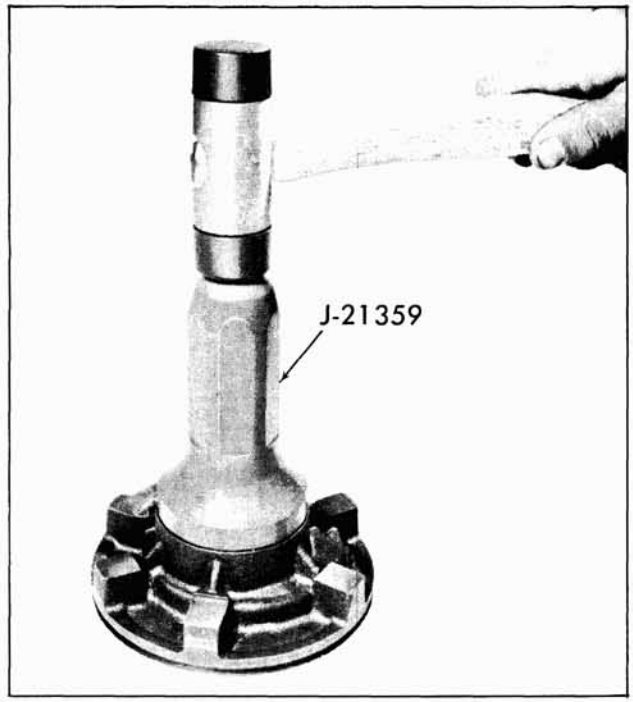


Fig. 7E-145—Installing Front Seal

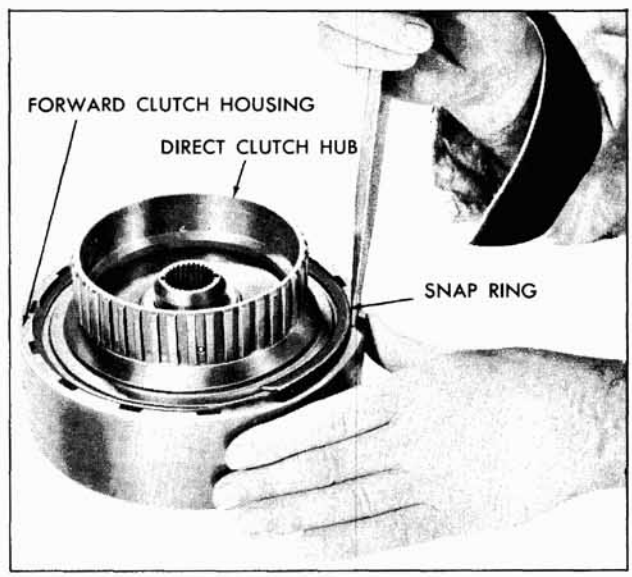


Fig. 7E-146—Removing Snap Ring

FORWARD CLUTCH

Disassembly

1. Place forward clutch on bench. Remove the forward clutch housing to direct clutch hub snap ring. (Fig. 7E-146)

2. Remove the direct clutch hub. (Fig. 7E-147)

3. Remove the forward clutch hub and thrust washers. (Fig. 7E-148)

4. Remove five composition, five steel clutch plates, and one dished steel plate. (Fig. 7E-149)

5. Using J-6129 clutch spring compressor, with Adapters J-4670-14 and J-8765, compress the spring retainer and remove the snap ring. (Fig. 7E-150)

6. Remove the tools, snap ring, spring retainer, and sixteen clutch release springs. (Fig. 7E-151)

7. Remove the forward clutch piston. (Fig. 7E-152)

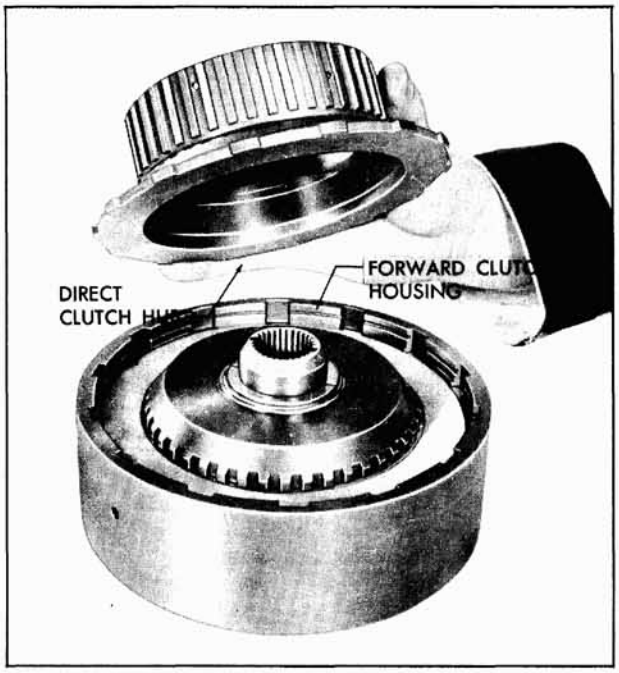


Fig. 7E-147—Removing Direct Clutch Hub

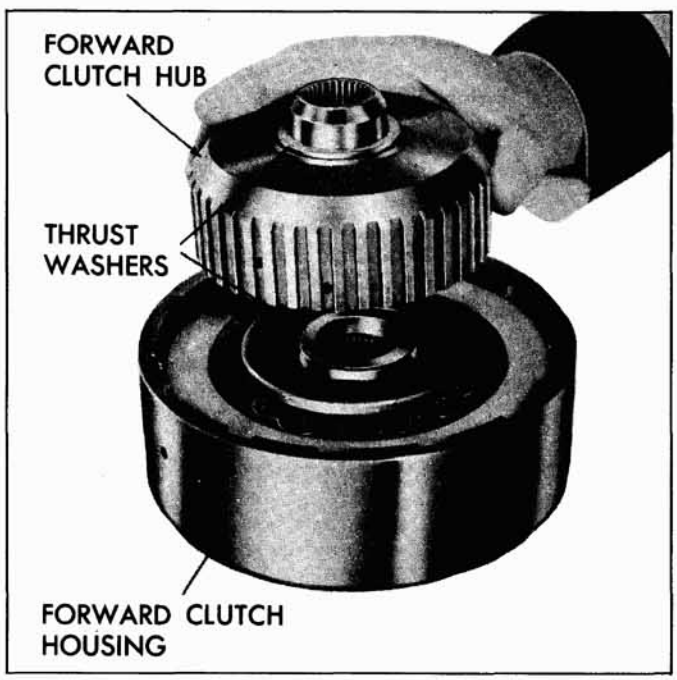


Fig. 7E-148—Removing Forward Clutch Hub and Thrust Washers

8. Remove and discard inner and outer clutch piston seals. (Figs. 7E-153 and 7E-154)

9. Remove and discard the center piston seal from the forward clutch housing. (Fig. 7E-155)

Inspection

1. Inspect the drive and driven clutch plates for signs of burning, scoring, or wear.

2. Inspect the sixteen springs for collapsed coils or signs of distortion.

3. Inspect the clutch hubs for worn splines, thrust faces and open lubrication holes. Run a tag wire through each lubrication hole. See lubrication chart (Fig. 7E-232) for location of holes.

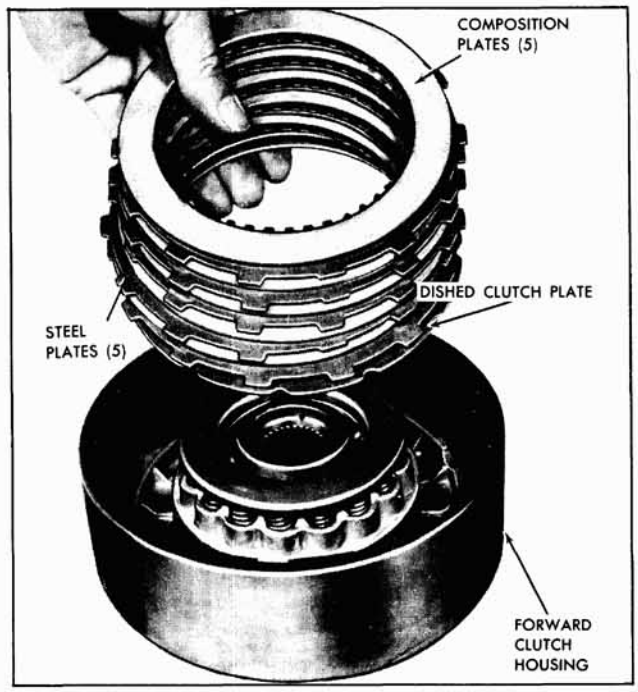


Fig. 7E-149—Removing Forward Clutch Plates

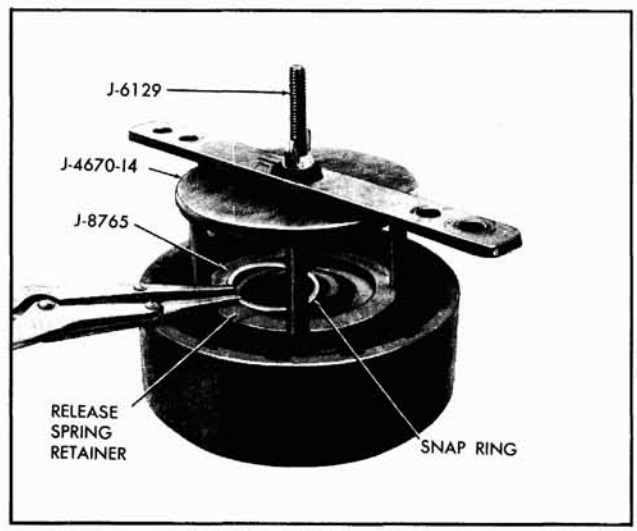


Fig. 7E-150—Removing Forward Clutch Snap Ring

4. Inspect the piston for cracks or excessive porosity on sealing surfaces.

5. Inspect the clutch housing for wear, scoring, open oil passages, and free operation of the ball check. Run a tag wire through lubrication holes. See lubrication chart for location of holes.

Assembly (Fig. 7E-156)

Apply Hydra-Matic oil to all seals before reassembly.

1. Place new inner and outer seals on clutch piston, lips away from spring pockets. (Figs. 7E-153 and 7E-154)

Make certain piston has blind hole. Piston with ball check is for direct clutch.

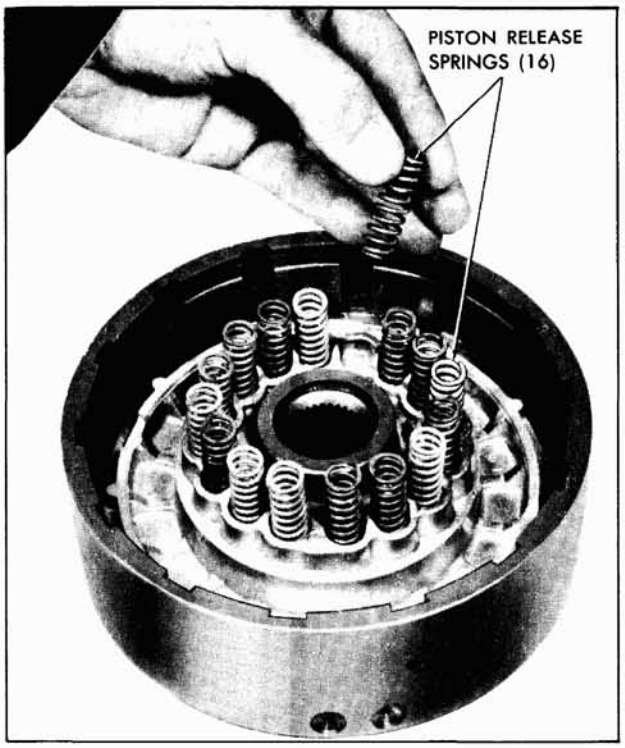


Fig. 7E-151—Removing Release Springs

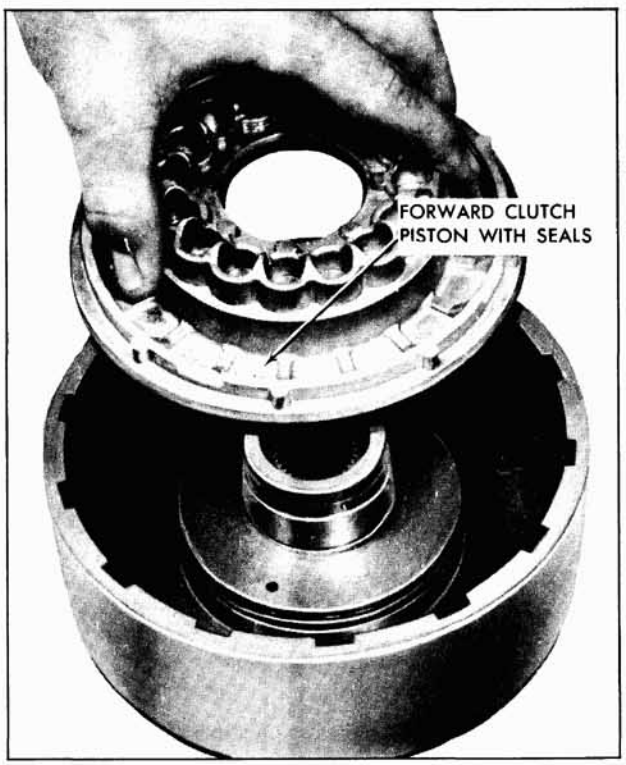


Fig. 7E-152—Removing Forward Clutch Piston

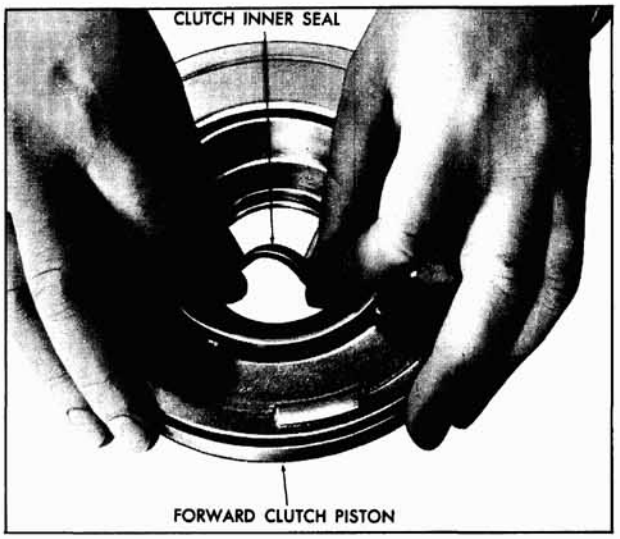


Fig. 7E-153—Removing or Installing Inner Oil Seal

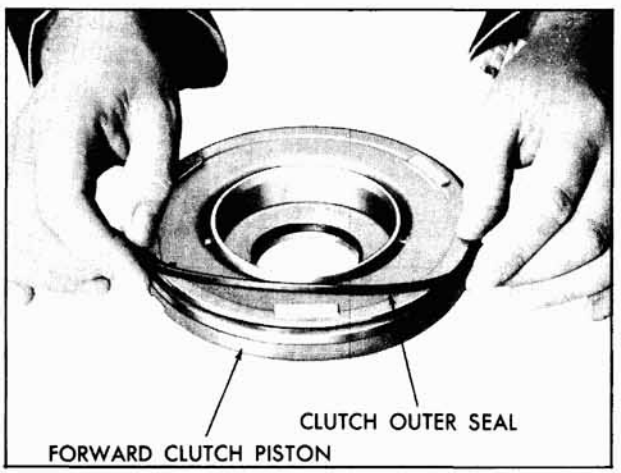


Fig. 7E-154—Removing or Installing Outer Oil Seal

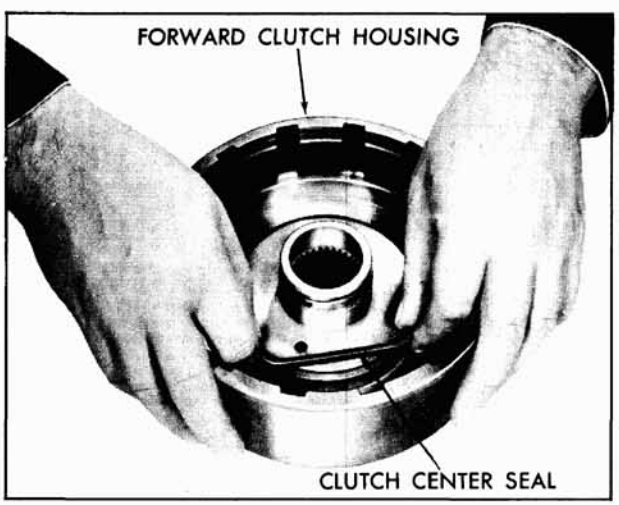


Fig. 7E-155—Removing or Installing Center Oil Seal

2. Place a new center seal on the clutch housing, lip faces up. (Fig. 7E-155)

3. Place seal protector Tool J-21362 over clutch hub. Install outer clutch piston seal protector J-21409 into clutch drum and install piston, rotating the piston on the drum until seated. (Fig. 7E-158)

4. Install sixteen release springs into pockets in piston. (Fig. 7E-159)

5. Place spring retainer and snap ring on springs.

6. Compress springs using clutch compressor Tools J-6129,

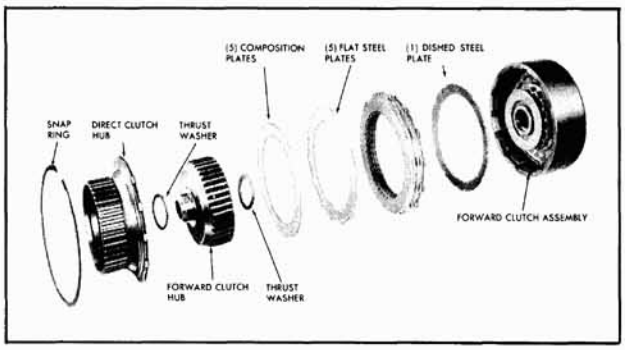


Fig. 7E-156—Forward Clutch Assembly

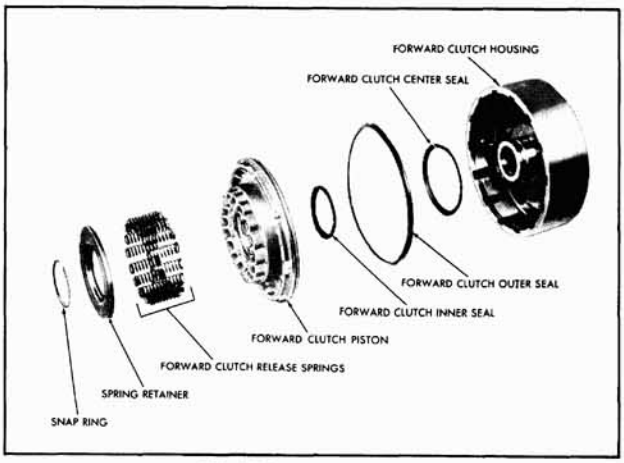


Fig. 7E-157—Forward Clutch Assembly

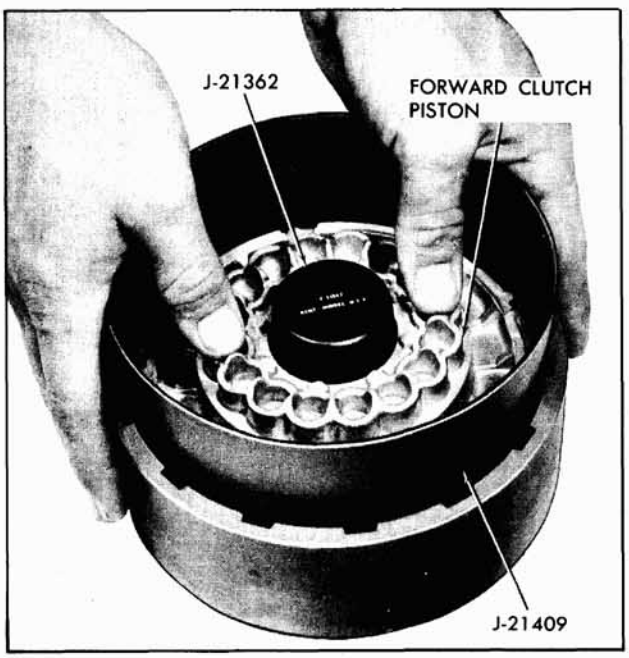


Fig. 7E-158—Installing Forward Clutch

J-4670-14, and J-8765 and install snap ring. (Fig. 7E-160)

7. Install the forward clutch hub washers on forward clutch hub. Retain with petrolatum.

The forward clutch hub, identified by a machined groove on the front, or hub side, is NOT interchangeable with past model pre 1968 parts. Due to a spline change, if replacement of either the forward clutch hub or mainshaft is required, ONLY current model parts must be used. The mainshaft is identified by a "V" groove on the front, or internal gear, end of the shaft.

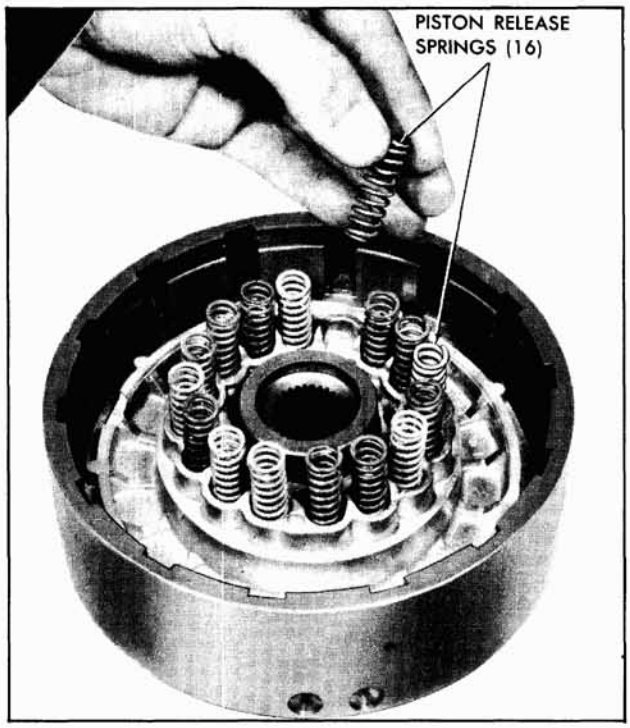


Fig. 7E-159—Installing Piston Release Springs

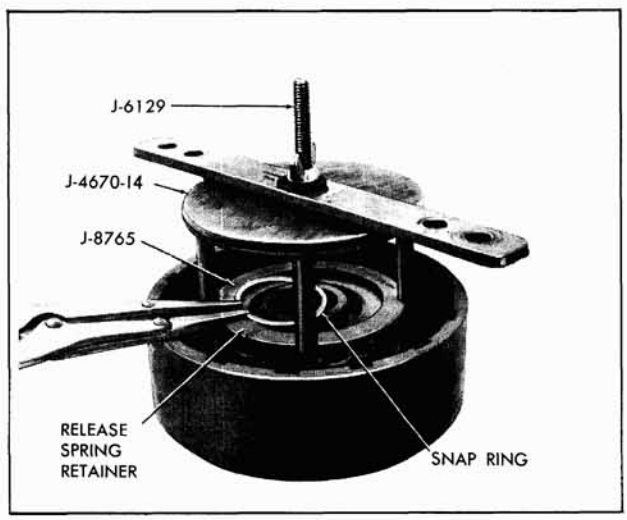


Fig. 7E-160—Installing Snap Ring

8. Place forward clutch hub into forward clutch housing. (Fig. 7E-161)

9. Oil and install five composition and five flat steel and one dished steel clutch plate, starting with the dished plate, placed so that the outside diameter contacts the first flat steel plate and then alternating composition and steel. (Fig. 7E-162)

10. Install the direct clutch hub and retaining snap ring. (Figs. 7E-163 and 7E-164)

A new direct clutch hub is used in the 1968 models. It is identified by a machined groove on the front face,

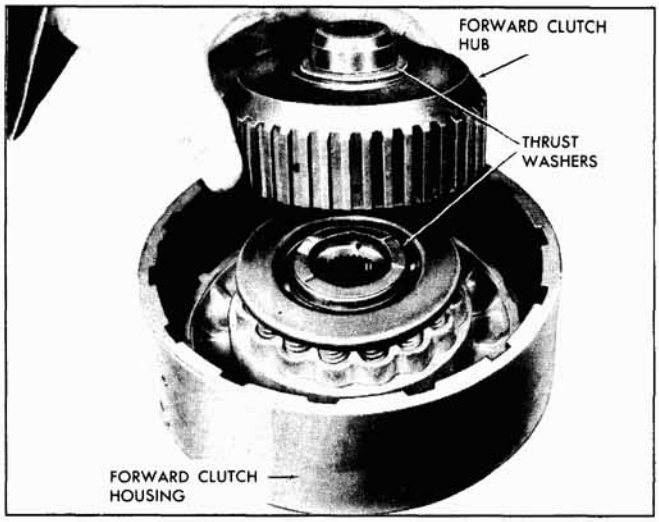


Fig. 7E-161—Installing Forward Clutch Hub

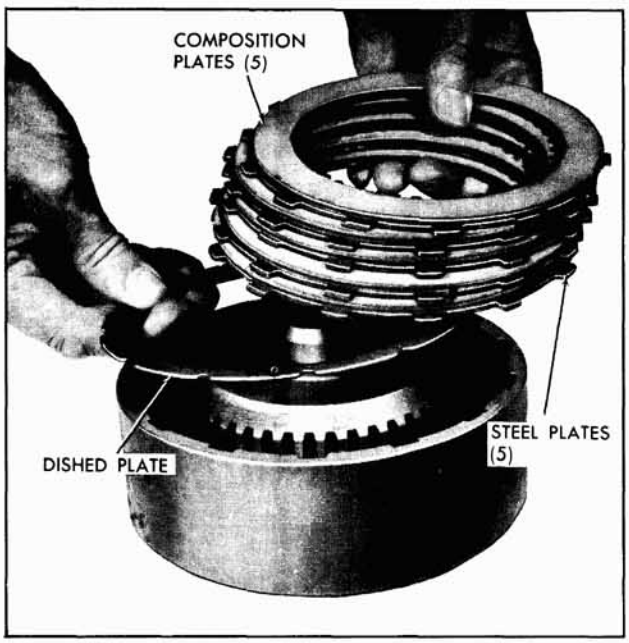


Fig. 7E-162—Installing Forward Clutch Plates

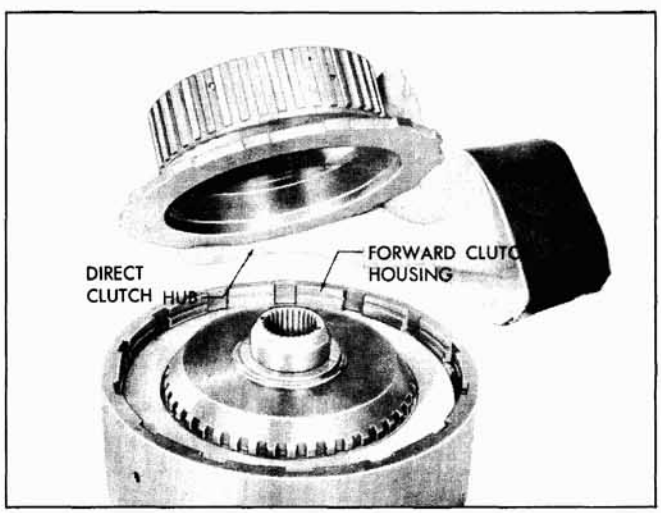


Fig. 7E-163—Installing Direct Clutch Hub

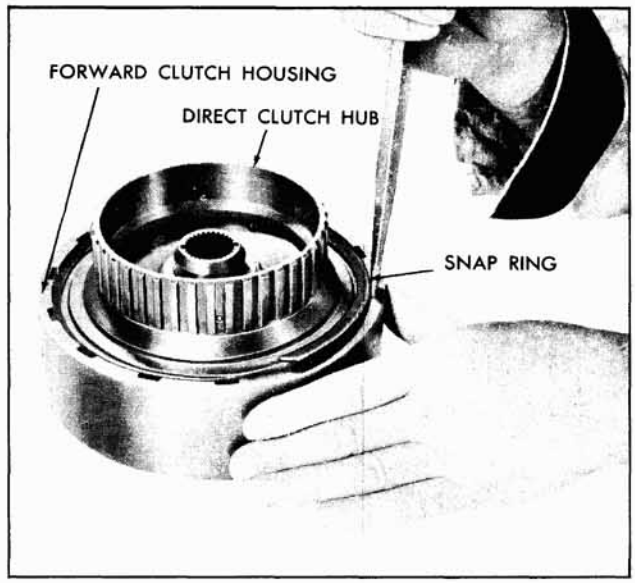


Fig. 7E-164—Installing Snap Ring

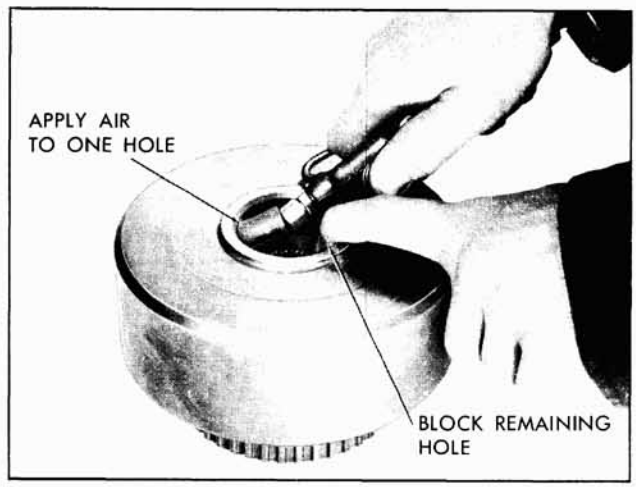


Fig. 7E-165—Air Checking Clutch and Piston

Fig. 7E-166—Removing Snap Ring

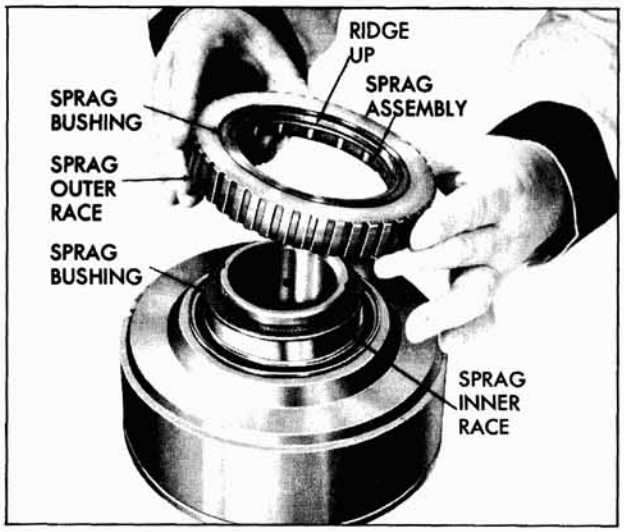


Fig. 7E-167—Removing Sprag, Race and Bushings

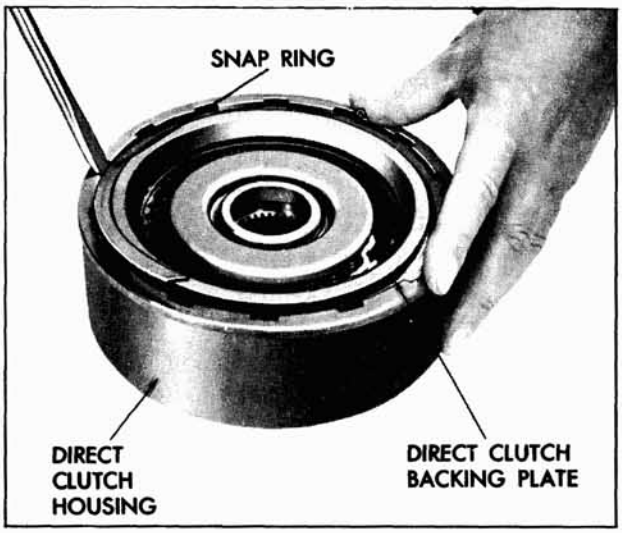


Fig. 7E-168—Removing Snap Ring

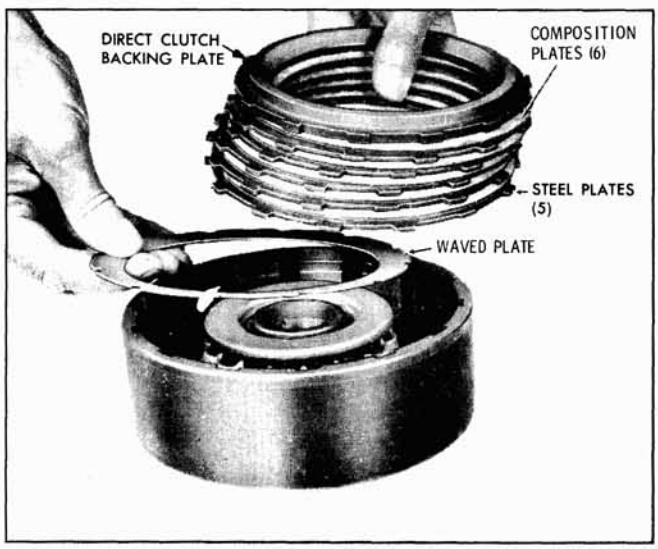


Fig. 7E-169—Removing Clutch Plates

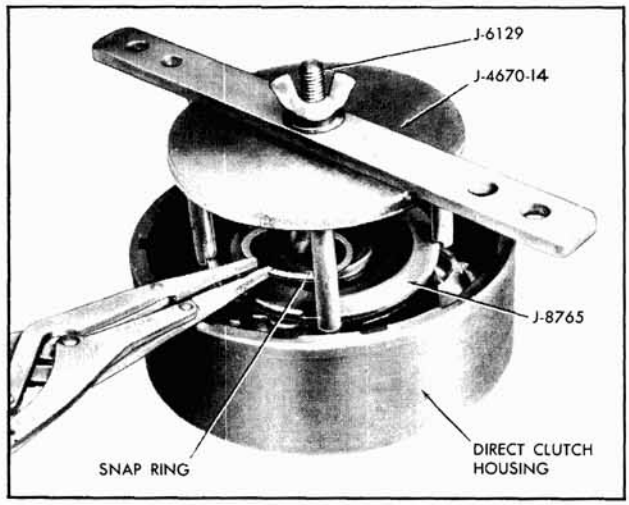


Fig. 7E-170—Removing Snap Ring

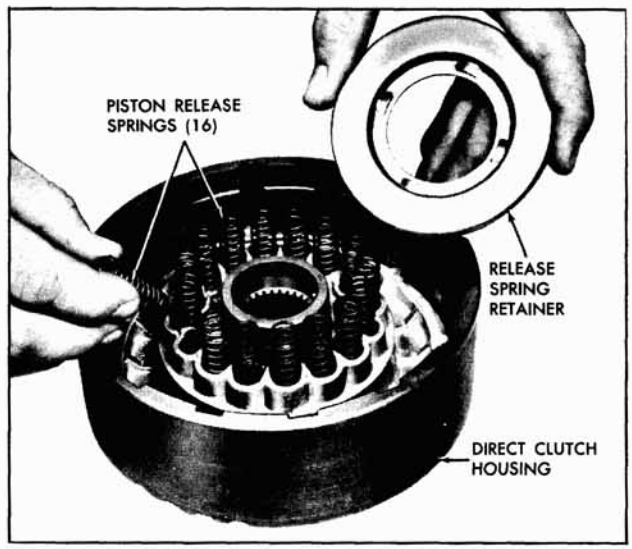


Fig. 7E-171—Removing Piston Release Springs

or long spline side, of the hub. This part change, because of the 6 plate direct clutch assembly, necessitates use of ONLY the 1968 part if replacement is required. Past model parts must NOT be used with the 6 plate direct clutch assembly.

11. Air check clutch and piston operation. (Fig. 7E-165)

DIRECT CLUTCH AND INTERMEDIATE SPRAG

Disassembly

1. Remove sprag retainer snap ring and retainer. (Fig. 7E-166)
2. Remove sprag outer race, bushings, and sprag assembly. (Fig. 7E-167)
3. Turn unit over and remove backing plate to direct clutch housing snap ring. (Fig. 7E-168)
4. Remove direct clutch backing plate, six composition, five steel clutch plates and waved steel plate. (Fig. 7E-169)
5. Using Clutch Compressor Tools J-6129, J-4670-14, and J-8765, compress springs and remove snap ring. (Fig. 7E-170)
6. Remove retainer and sixteen piston release springs. (Fig. 7E-171)
7. Remove the direct clutch piston. (Fig. 7E-172)

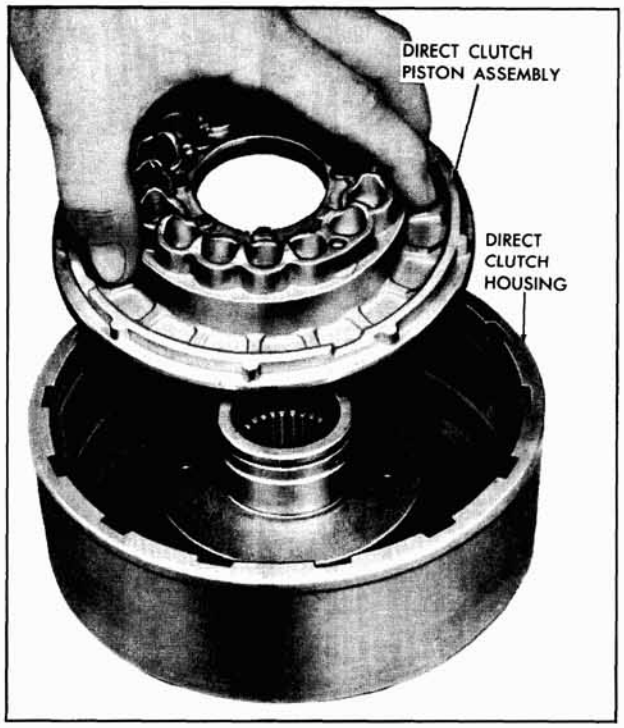


Fig. 7E-172—Removing Direct Clutch Piston

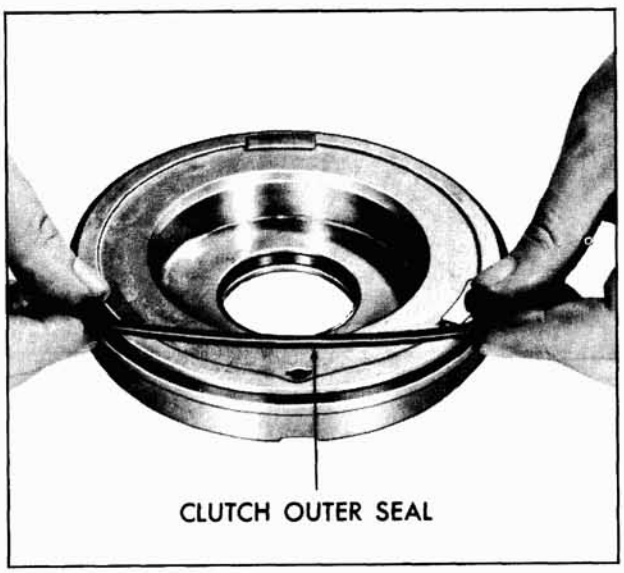


Fig. 7E-173—Removing or Installing Clutch Outer Seal

8. Remove and discard the outer seal from the piston. (Fig. 7E-173)

9. Remove and discard the inner seal from the piston. (Fig. 7E-174)

10. Remove and discard the center piston seal from the direct clutch housing. (Fig. 7E-175)

Inspection

1. Inspect sprag assembly for damage.

2. Inspect sprag bushings for wear or distortion.

3. Inspect the inner and outer races for scratches or wear that can be felt with finger nail.

4. Inspect the clutch housing for cracks, wear, proper opening of oil passages, or wear on clutch plate drive lugs. Probe oil passages with a tag wire to see that hole is open. See oil chart (Fig. 7E-232) for location of oil lubrication passages.

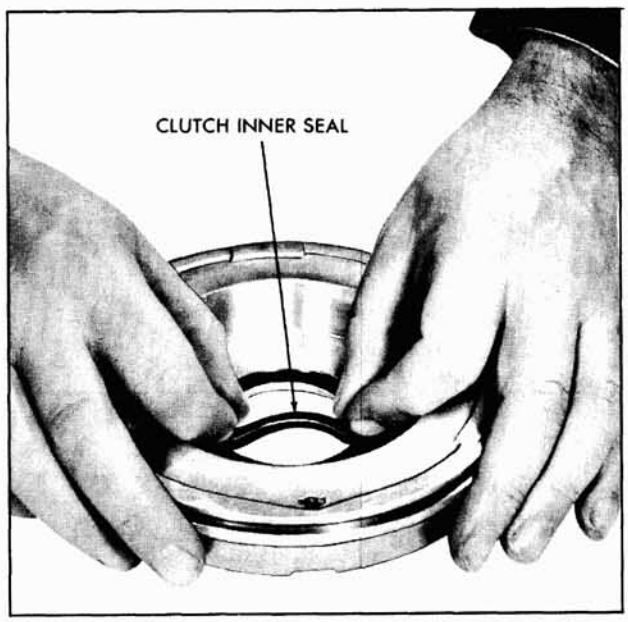


Fig. 7E-174—Removing or Installing Clutch Inner Seal

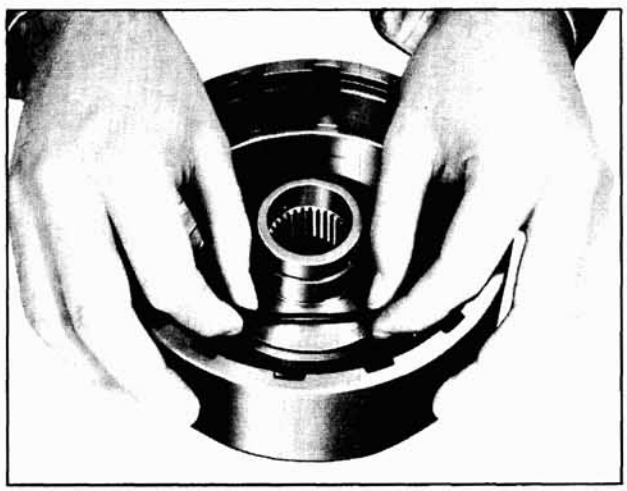


Fig. 7E-175—Removing or Installing Clutch Center Seal

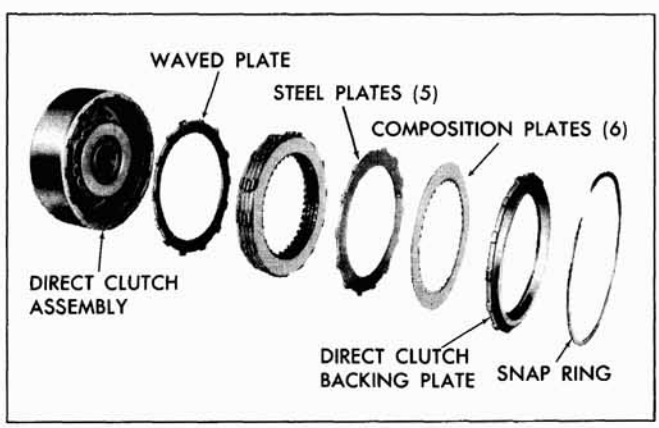


Fig. 7E-176—Direct Clutch Assembly

5. Inspect the drive and driven clutch plates for sign of wear or burning.

6. Inspect the backing plate for scratches or other damage.

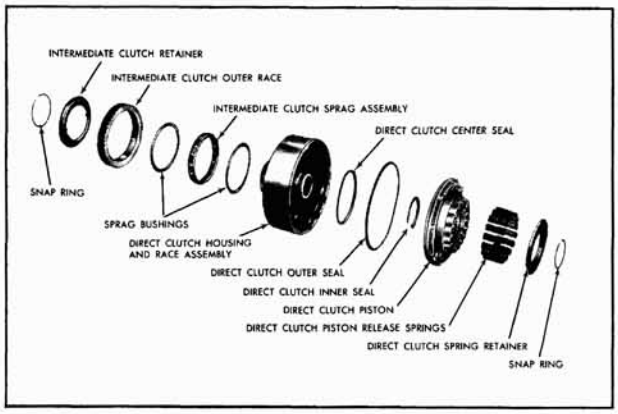


Fig. 7E-177—Direct Clutch Assembly

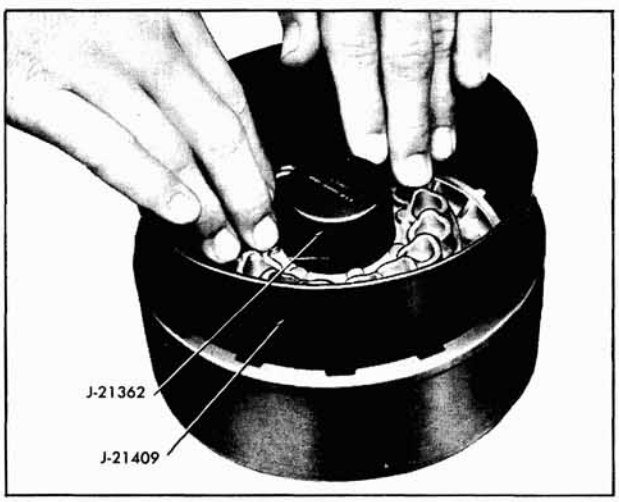


Fig. 7E-178—Installing Clutch Piston

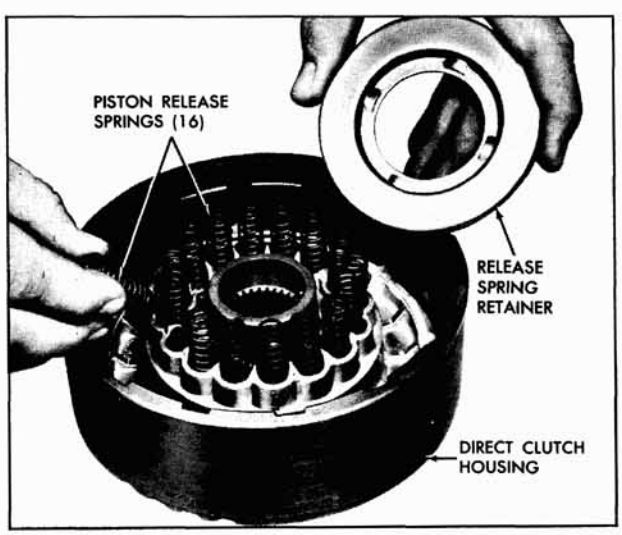


Fig. 7E-179—Installing Release Springs

7. Inspect the clutch piston for cracks, porosity on sealing surfaces, and free operation of the ball check.

Assembly (Figs. 7E-176 and 7E-177)

Apply Hydra-Matic oil to all seals.

1. Install a new inner clutch piston seal on piston with lip facing away from spring pockets. (Fig. 7E-174)

Make certain piston with ball check is used in direct clutch. Piston with blind hole is used in forward clutch.

2. Install a new outer clutch piston seal with lip facing away from spring pockets. (Fig. 7E-173)
3. Install a new center seal on clutch housing with lip of seal facing up. (Fig. 7E-175)

The direct clutch housing has been changed to accommodate the six plate clutch assembly. Therefore, past model parts are NOT interchangeable with current models.

The six plate housing can be identified by the elimination of the I.D. chamfer on the rear, or clutch plate, end of the housing.

4. Place Seal Protectors, Tool J-21362-Inner, J-21409-Outer, over hub and clutch housing and install clutch piston with a rotating motion. (Fig. 7E-178)
5. Install sixteen springs into the piston. (Fig. 7E-179)
6. Place spring retainer and snap ring on springs.

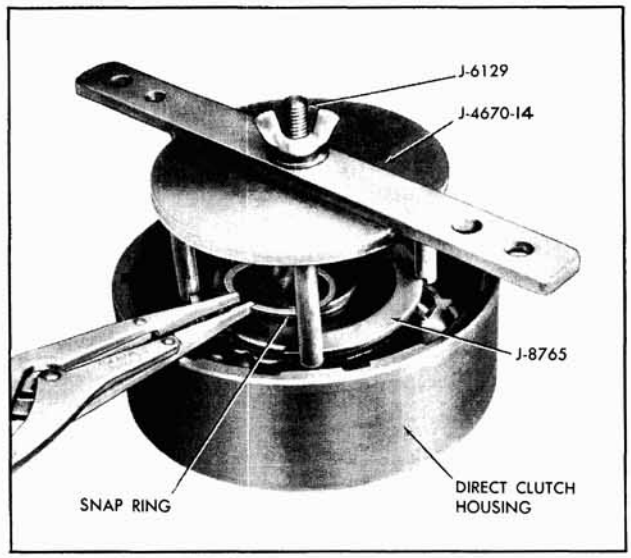


Fig. 7E-180—Installing Snap Ring

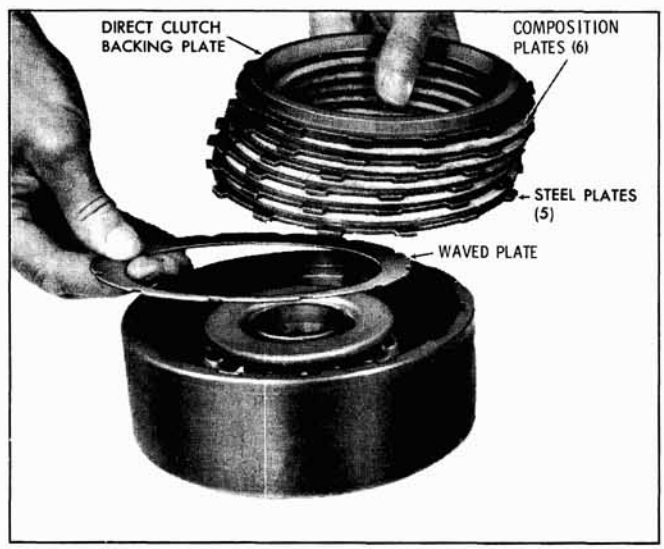


Fig. 7E-181—Installing Clutch Plates

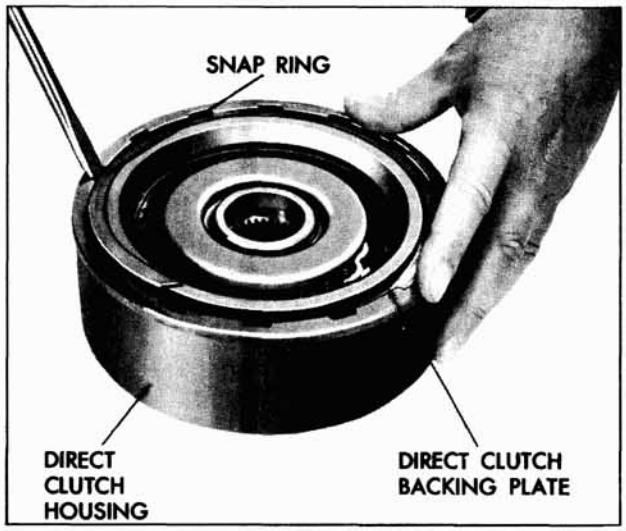


Fig. 7E-182—Installing Snap Ring

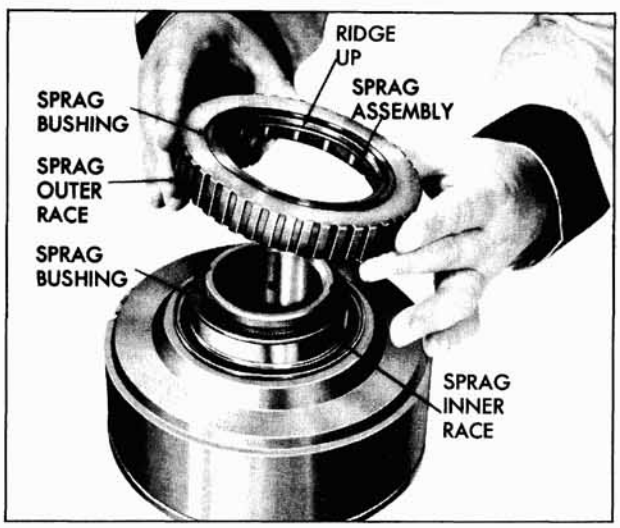


Fig. 7E-183—Installing Sprag

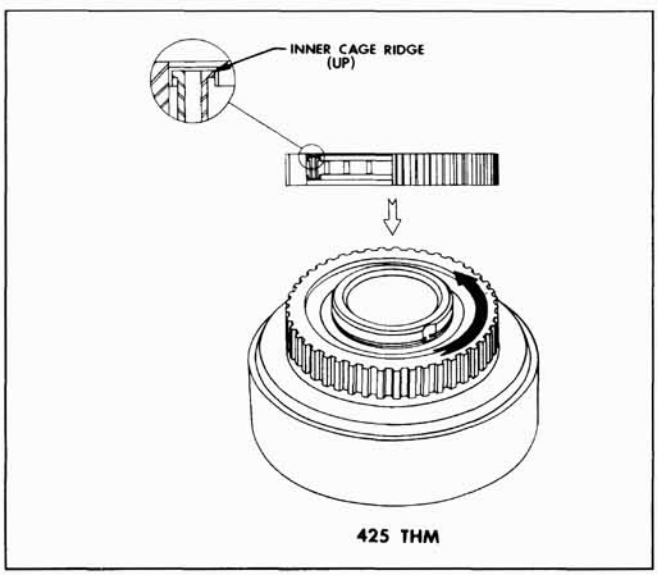


Fig. 7E-184—Sprag Rotation

Fig. 7E-185—Installing Sprag Retainer and Snap Ring

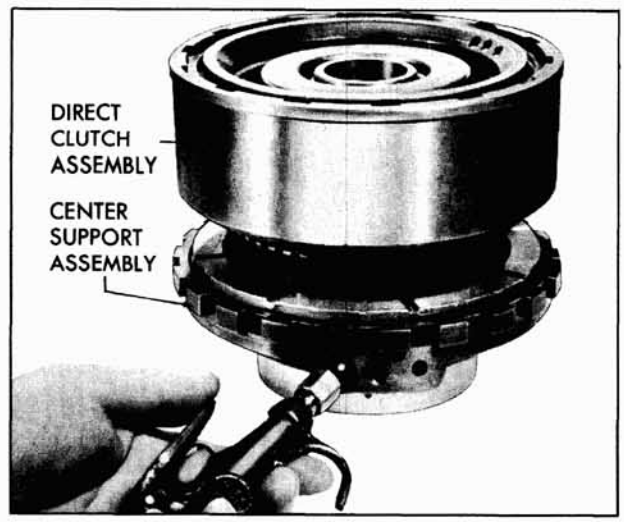


Fig. 7E-186—Air Checking Direct Clutch

7. Using Clutch Compressor Tools J-6129, J-4670-14, and J-8765, install snap ring. (Fig. 7E-180)

8. Oil and install six composition, five flat steel, and one waved steel plate starting with the waved plate and then alternating composition and steel. (Fig. 7E-181)

9. Install the clutch backing plate.

10. Install the backing plate retaining snap ring. (Fig. 7E-182)

11. Turn unit over and install one sprag bushing, cup side up, over inner race.

12. Install sprag assembly into outer race.

13. With ridge or shoulder on inner cage up, start sprag and outer race over inner race with counterclockwise motion. (Fig. 7E-183)

Outer race should turn only counterclockwise. (Fig. 7E-184)

14. Install sprag bushing over sprag, cup side down.

15. Install sprag retainer and snap ring. (Fig. 7E-185)

16. Place direct clutch assembly over center support and air check operation of direct clutch and piston. (Fig. 7E-186)

If air is applied through reverse passage it will escape from the direct clutch passage. This is normal.

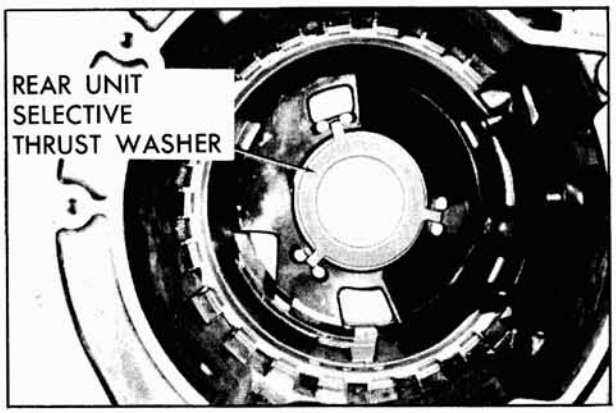


Fig. 7E-187—Installing Rear Unit Thrust Washer

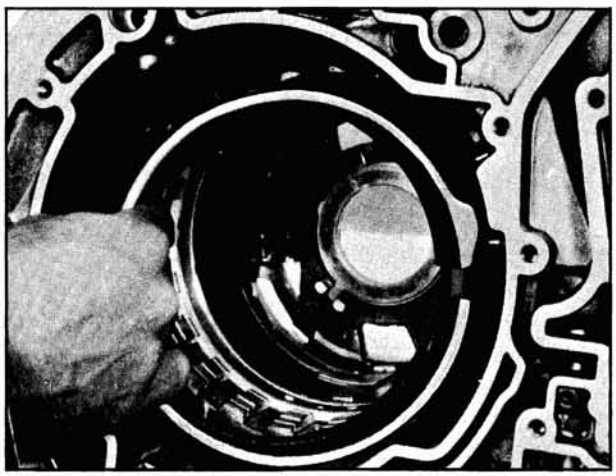


Fig. 7E-188—Installing Rear Band

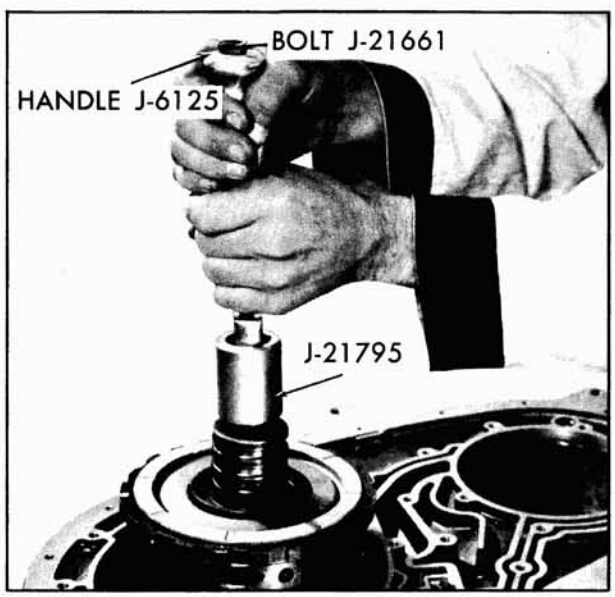


Fig. 7E-189—Installing Gear Unit into Case

ASSEMBLY OF UNITS INTO TRANSMISSION CASE

1. Install the proper rear selective washer (proper washer determined by previous rear end play check) into slots provided inside front of transmission case. (Fig. 7E-187)

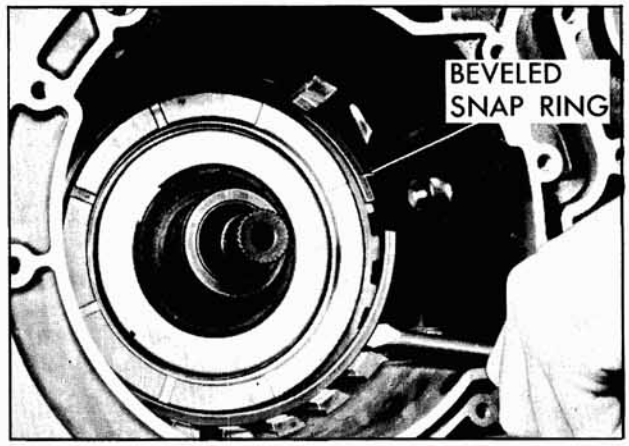


Fig. 7E-190—Installing Center Support Snap Ring

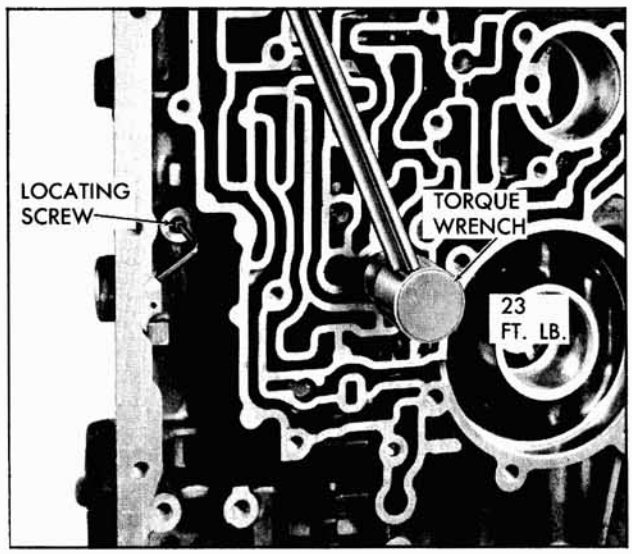


Fig. 7E-191—Installing Case Center Support Bolt

2. Install the rear band assembly so that two lugs index with the two anchor pins. Check band to be sure band ends are seated on lugs by inserting small screwdriver into servo pin hole in case and pushing on band. (Fig. 7E-188)

3. Install the complete gear unit assembly into the case using Tool J-21795 with J-6125 slide hammer. Be sure locating bolt hole in center support lines up with case hole. (Fig. 7E-189)

4. Oil and install center support to case retaining snap ring with the bevel side up. Locate gap adjacent to band anchor pin. Make certain ring is properly seated in case. (Fig. 7E-190)

5. Install and tighten center support locating screw. Torque to 2 ft. lbs.

It may be necessary to shorten dog point end of locating screw by 1/4" to assure proper location of center support.

6. Install case to center support bolt. Torque to 23 ft. lbs. Remove center support locating screw. (Fig. 7E-191)

7. Install three steel and three composition intermediate clutch plates. Start with steel, alternate the plates.

8. Install the intermediate clutch backing plate, ridge up. (Fig. 7E-192)

9. Install the backing plate to case snap ring, locating gap opposite band anchor pin. (Fig. 7E-193)

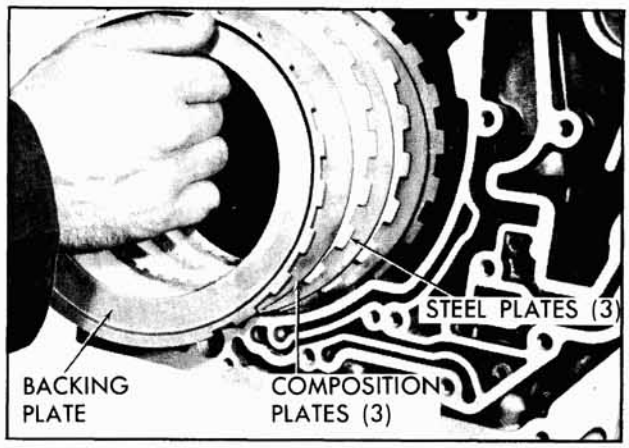


Fig. 7E-192—Installing Backing and Clutch Plates

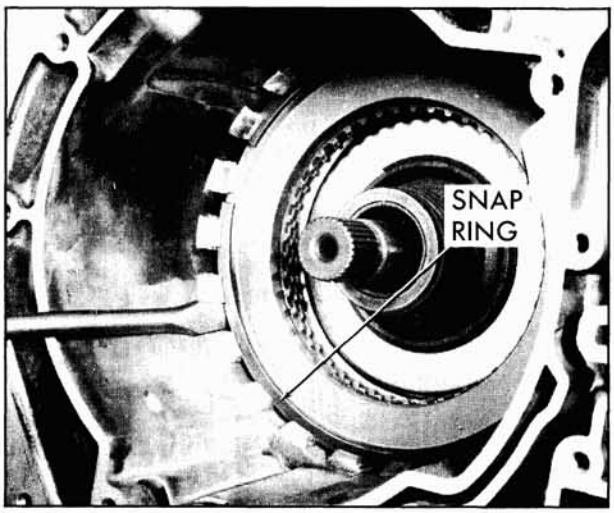


Fig. 7E-193—Installing Snap Ring

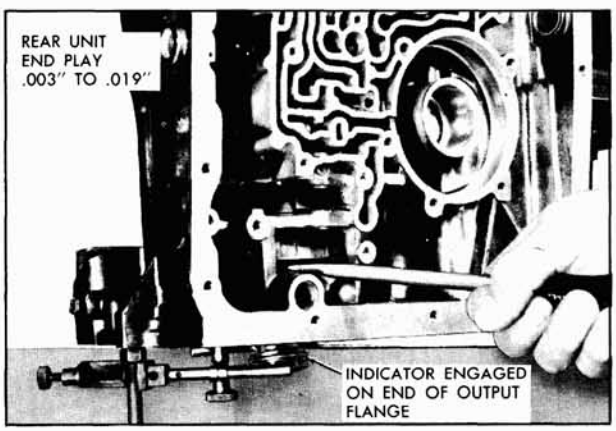


Fig. 7E-194—Checing Rear Unit Ene-Play

10. Check rear end play as follows: (Fig. 7E-194)

a. Install 3/8" bolt into final drive attaching bolt hole. Allow end of transmission to hang over edge of bench.

b. Mount the dial indicator on the bolt and index with the end of the output flange.

c. Move the output flange in and out to read the end play. End play should be from .003" to .019". The selective washer controlling this end play is the steel washer having three lugs that is located between the thrust washer and the rear face of the transmission case.

If a different washer thickness is required to bring the end play within specification, it can be selected from the following chart:

Thickness	Notches or Numeral
.074" to .078"	None 1
.082" to .086"	1 Tab Side 2
.090" to .094"	2 Tab Side 3
.098" to .102"	1 Tab O.D. 4
.106" to .110"	2 Tabs O.D. 5
.114" to .118"	3 Tabs O.D. 6

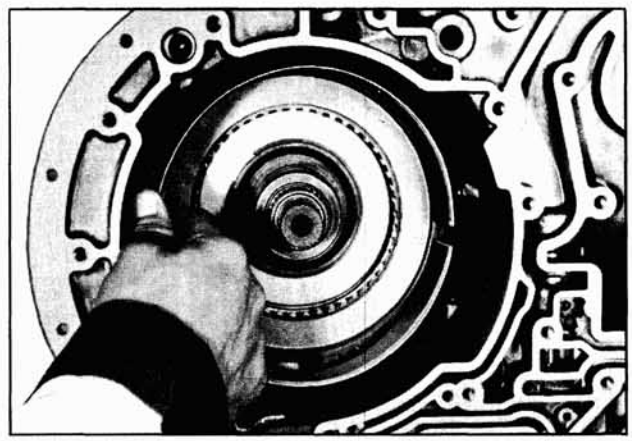


Fig. 7E-195—Installing Front Band

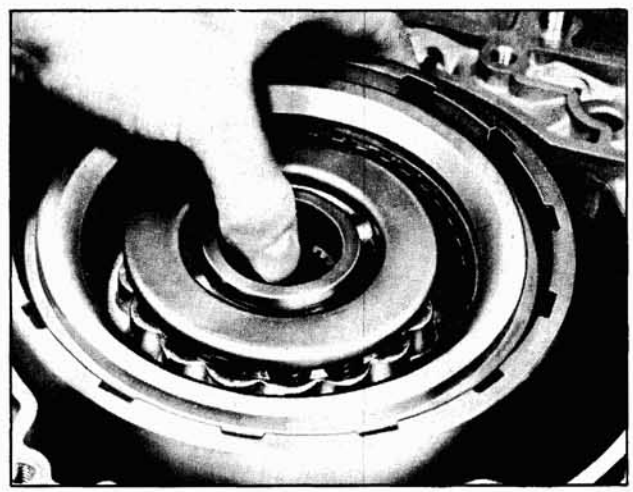


Fig. 7E-196—Installing Direct Clutch and Sprag

11. If a different selective washer thickness is required it will be necessary to disassemble the transmission back to this washer so that the correct washer can be installed.

12. Install front band with anchor hole placed over the band anchor pin and apply lug facing servo hole. (Fig. 7E-195)

13. Be sure center support oil rings are hooked and centered, then install the direct clutch and intermediate sprag assembly. It will be necessary to twist the housing to allow the sprag outer race to index with the clutch drive plates. The sun gear shaft splines will be flush with housing splines. (Fig. 7E-196)

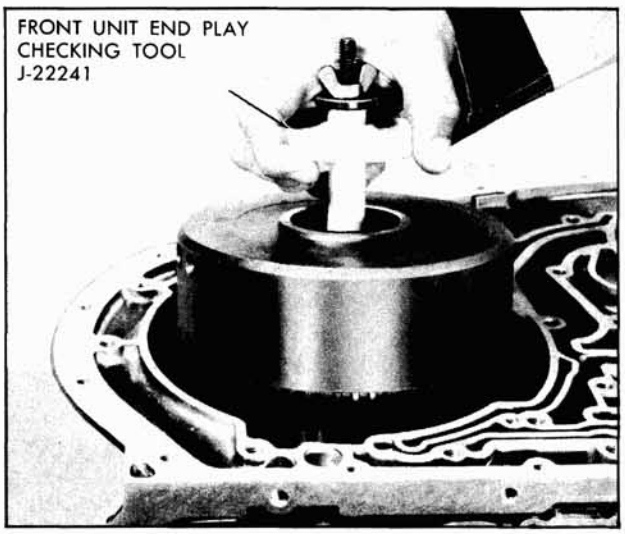


Fig. 7E-197—Installing Forward Clutch

Fig. 7E-198—Installing Pump Cover Plate

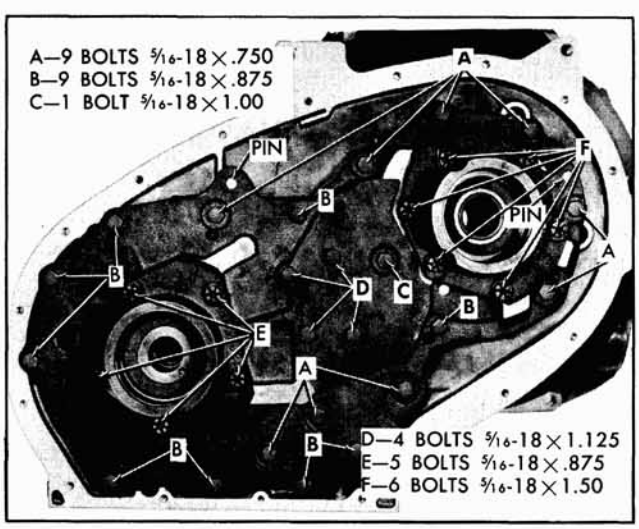


Fig. 7E-199—Pump Cover Plate Attaching Screws

Removal of direct clutch drive and driven plates may be helpful.

14. Install the forward clutch hub to direct clutch housing thrust washer on the forward clutch hub. Retain with petrolatum.

15. Install the forward clutch assembly, indexing the direct clutch hub so end of the mainshaft will bottom on end of the forward clutch. If seated it will be approximately flush - 1/4" below pump cover plate face in case. (Fig. 7E-197)

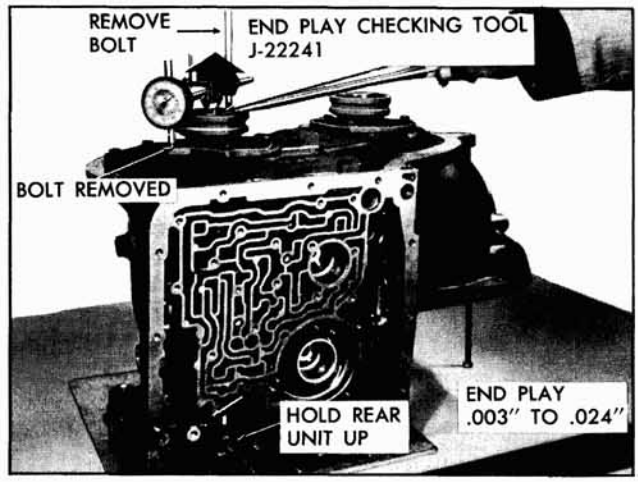


Fig. 7E-200—Checking Front Unit Endplay

16. Install pump cover plate assembly and gasket. (Fig. 7E-198)

17. Install pump cover plate attaching bolts. Torque bolts to 20 ft. lbs. (Fig. 7E-199)

If the forward clutch housing cannot be rotated (using the driven sprocket as a driver) as the pump cover plate is being pulled into place, the forward or direct clutch housings have not been properly installed to index with all the clutch plates. This condition must be corrected before the pump cover plate is pulled fully into place.

18. Check front unit end play as follows: (Fig. 7E-200)

a. Install a 5/16" threaded slide hammer bolt or J-6126 into bolt hole in pump cover plate. (Install End Play Checking Tool J-22241 into pump cover plate and forward clutch housing.)

b. Mount a dial indicator on the bolt. Index indicator to register with the forward clutch drum that can be reached through second bolt omitted from cover plate.

c. Push End Play Tool J-22241 down to remove slack.

d. Push and hold output flange upward. Place screwdriver in case opening at parking pawl area and push upward on output carrier.

e. Set dial indicator to zero.

f. Pull end play checking tool upward by placing another screwdriver between metal lip of end play tool and the driven sprocket housing.

Read the resulting travel or end play which should be .003" to .024". The selective washer controlling this end play is the washer located between the driven support housing and the forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select the proper washer from the chart below.:

THICKNESS	COLOR
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black
.126 - .130	Purple

An oil soaked washer may tend to discolor so that it will be necessary to measure the washer for its actual thickness.

19. Install the remaining pump cover plate attaching bolts. Torque bolts to 20 ft. lbs.

INSTALLATION OF FRONT PUMP

1. Mount two 5/16" x 4" guide pins in pump attaching screw holes.
2. Align guide pins with matching holes in pump cover plate and insert bolts into open holes in pump body. (Keep the crescent to the outside of the case.)
3. Tighten bolts, remove guide pins, and insert remaining attaching bolts and tighten to 18 ft. lbs.

LINK BELT, DRIVE AND DRIVEN SPROCKET COVER PLATE AND SPROCKET HOUSING

Assembly

1. Place link belt around the drive and driven sprockets so that the links engage the teeth of the sprockets, colored guide link facing link cover.
2. Simultaneously place link belt, drive and driven sprockets into support housing. (Fig. 7E-201)

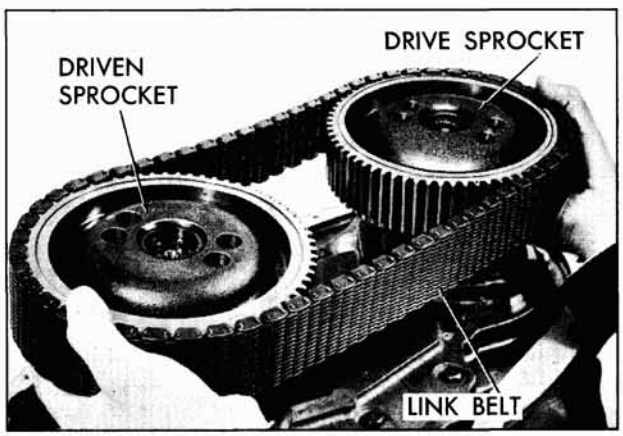


Fig. 7E-201—Removing Sprackets and Link Assembly

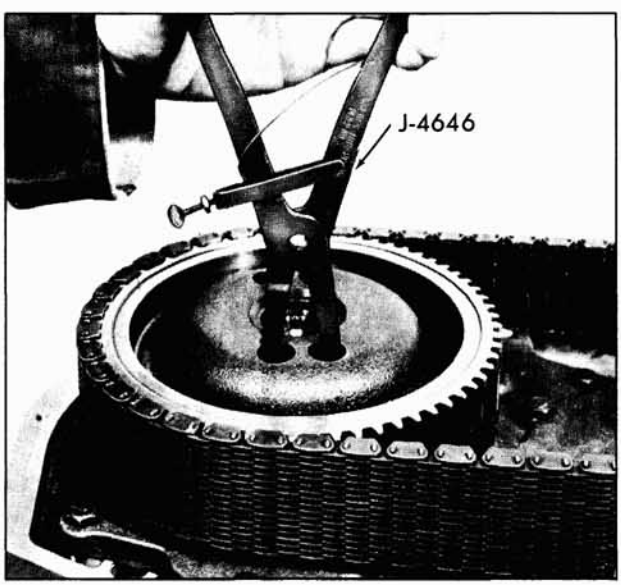


Fig. 7E-202—Installing Snap Rings

3. Using a plastic mallet, gently seat the sprocket bearing assemblies into the support housings.
4. Install sprocket assembly to support housing snap rings using J-4646 snap ring pliers. (Fig. 7E-202)
5. Install new case to cover and plate assembly sprocket housing gasket.
6. Install sprocket housing cover and plate assembly and eighteen attaching bolts. Torque bolts to 8 ft. lbs.

One sprocket cover housing attaching bolt is 1/4 inch longer. This bolt must be installed in the tapped hole located directly over the cooler fittings on the transmission case.

PARKING PAWL, BRACKET AND MANUAL LINKAGE (Fig. 7E-203)

Install

1. Install parking pawl (tooth toward the inside of case), pawl return spring and parking pawl shaft into case. (Fig. 7E-204)

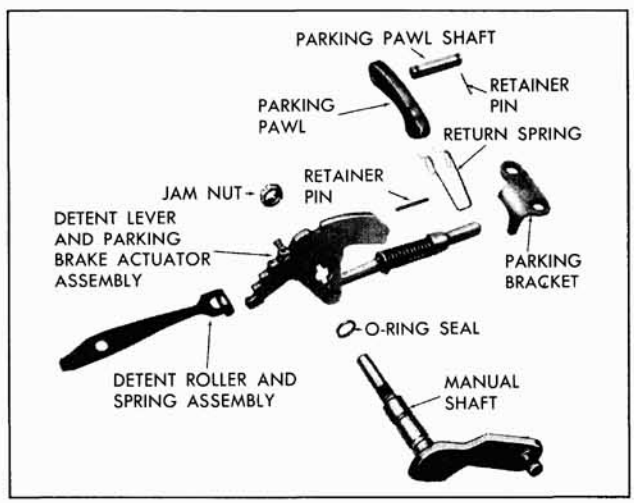


Fig. 7E-203—Manual and Parking Linkage

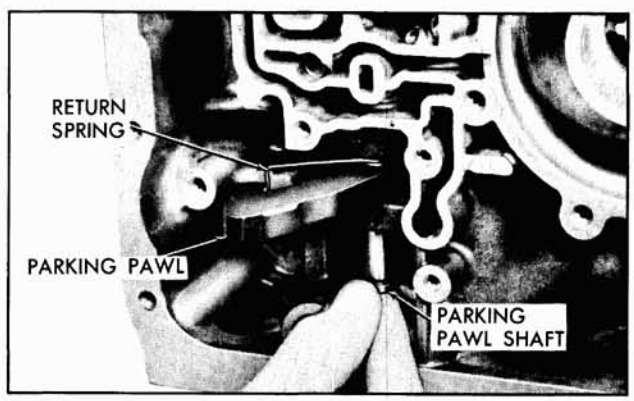


Fig. 7E-204—Installing Parking Pawl Shaft

2. Install the parking pawl shaft retaining pin. (Fig. 7E-205)
3. Install the parking bracket into case (pawl below finger on bracket). Torque the attaching bolts to 18 ft. lbs. (Fig. 7E-206)
4. Install a new manual shaft "O" ring seal on manual shaft.
5. Install the actuator rod plunger under the parking

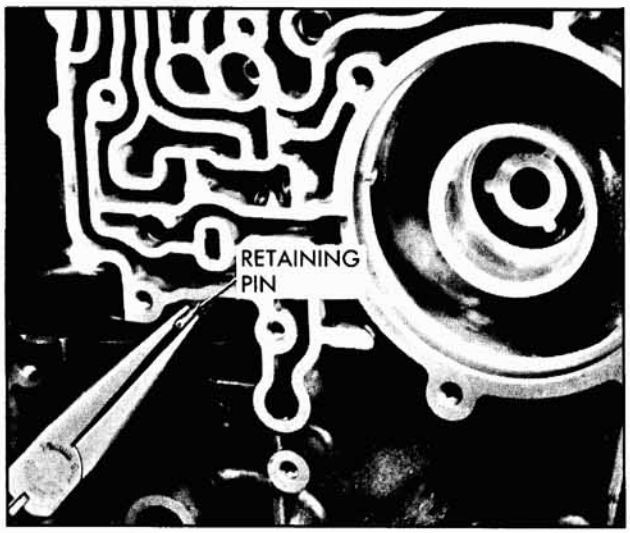


Fig. 7E-205—Installing Retaining Pin

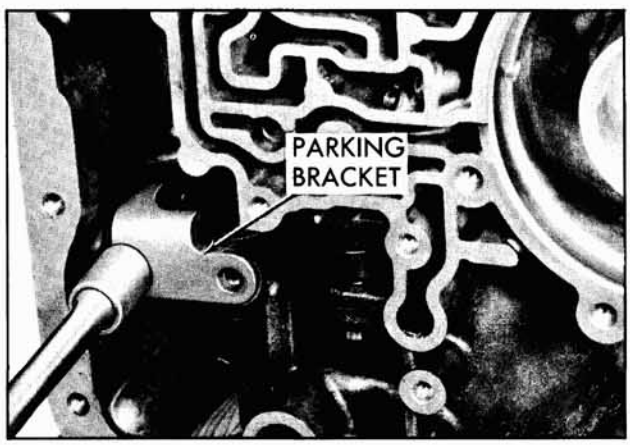


Fig. 7E-206—Installing Parking Bracket

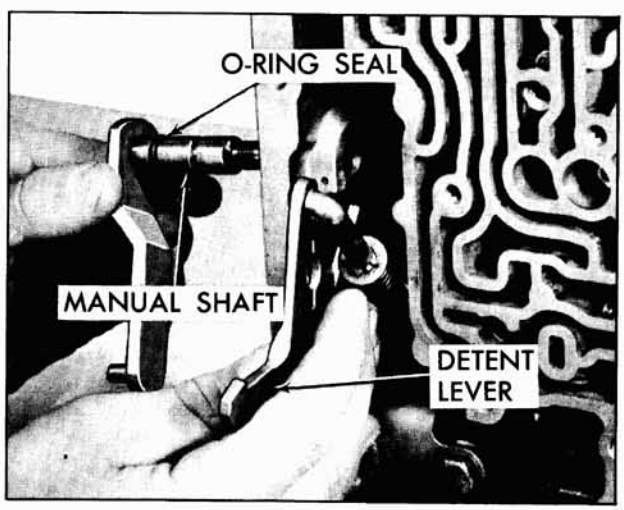


Fig. 7E-207—Installing Manual Shaft

bracket and over the parking pawl and through hole in detent lever.

6. Install the manual shaft assembly through the case and detent lever. Install the retaining hex-lock nut on the manual shaft. Lever points away from oil pan. (Fig. 7E-207)

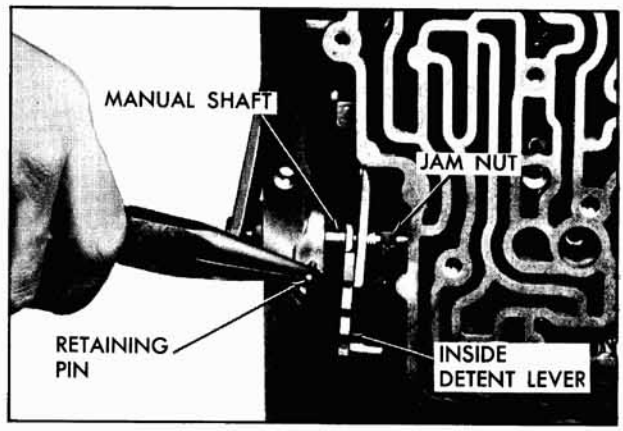


Fig. 7E-208—Installing Retaining Pin

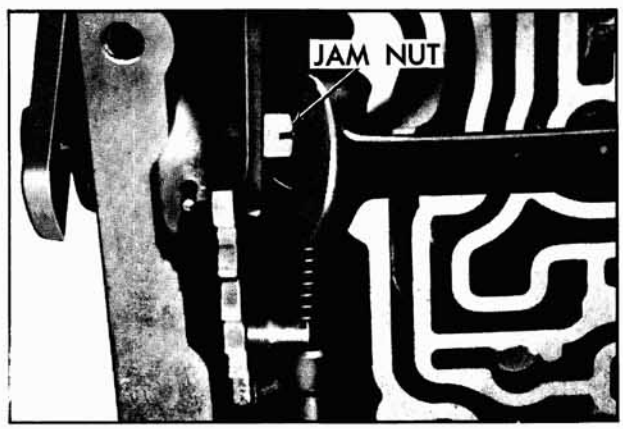


Fig. 7E-209—Installing Locknut

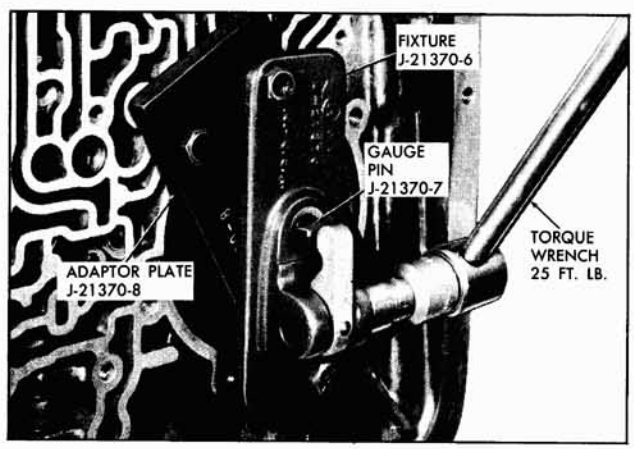


Fig. 7E-210—Checking Band Apply Pin

7. Install manual shaft retaining pin into case. Install the long, smooth end into case first. (Fig. 7E-208)

8. Torque jam nut to 18 ft. lb. (Fig. 7E-206)

REAR SERVO

Install

Before installing the rear servo assembly check band apply pin using Tool J-21370 as follows:

A. Attach the band apply pin selection gauge adaptor plate J-21370-8, J-21370-6 and J-21370-7 to the transmission case with attaching bolts as shown. (Fig. 7E-210)

STEP LOCATION	PIN IDENT.	SIZE
TOP STEP OR ABOVE	THREE RINGS	LONG
THIS AREA	TWO RINGS	MED.
LOWER STEP OR BELOW	ONE RING	SHORT

J-21370-7

Fig. 7E-211—Pin Selection Chart

Install tool attaching bolts finger tight and check freeness of selective pin. Torque attaching bolts and recheck pin to make certain it does not bind.

B. Apply 25 ft. lb. torque and select proper servo pin to be used from scale on tool.

C. Remove the tool and make note of the proper pin to be used during assembly of the transmission. (Fig. 7E-211)

There are three selective pins identified as follows:

PIN IDENTIFICATION	PIN LENGTH
3 Rings	Long
2 Rings	Medium
1 Ring	Short

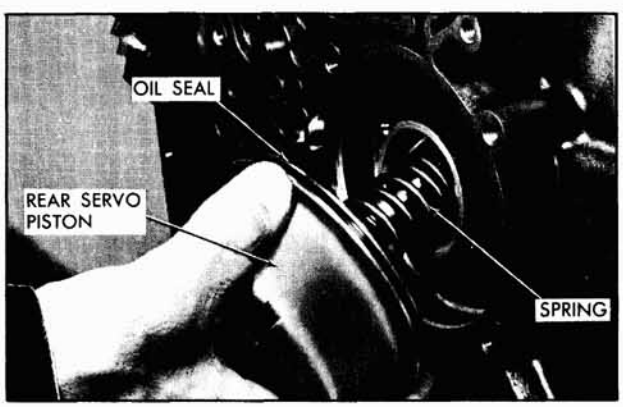


Fig. 7E-212—Installing Rear Servo

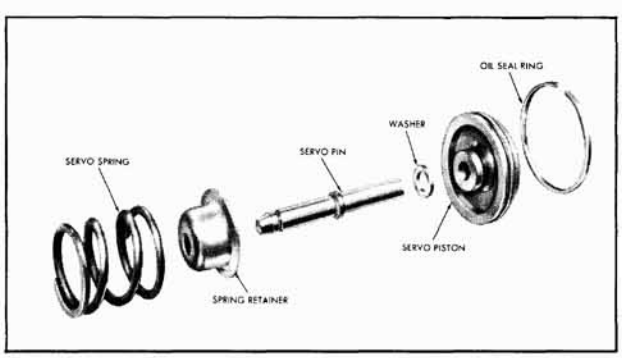


Fig. 7E-213—Front Servo

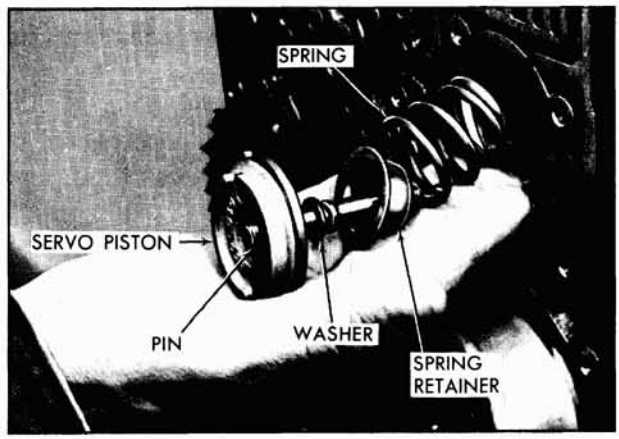


Fig. 7E-214—Install Front Servo

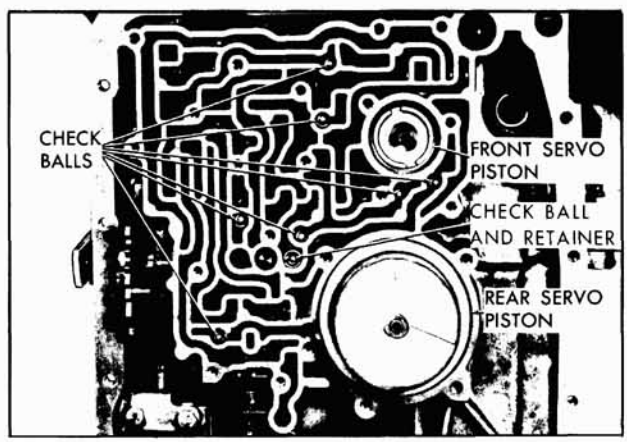


Fig. 7E-215—Check Ball Location

The identification rings are located on the band lug end of the pin. Selecting the proper pin is the equivalent of adjusting the band.

1. Install rear accumulator spring into case.
2. Lubricate and install the rear servo assembly into case. (Fig. 7E-212)

FRONT SERVO, CHECK BALLS, GASKETS, SPACER, AND SOLENOID

Installation

1. Install front servo spring and retainer on front servo pin. (Fig. 7E-213)
2. Install flat washer on front servo pin on end opposite taper.
3. If removed, install oil seal ring on front servo piston. Install piston on apply pin so that part number faces away from spring.
4. Install piston into case so that tapered end of pin is contacting band. (Fig. 7E-214)
5. Check freeness of piston by stroking piston in bore.
6. Install seven check balls into the transmission case pockets. (Use petrolatum to retain balls in case.) (Fig. 7E-215)
7. Install the valve body spacer to case gasket and spacer plate, install guide pins for alignment. (Fig. 7E-216)

Valve body spacer to case gasket should extend approximately 1/8" beyond the spacer plate over the void case channel. (Fig. 7E-217)

If service gaskets are being installed, the valve body spacer to case gasket has an extension which will cover the void case channel.

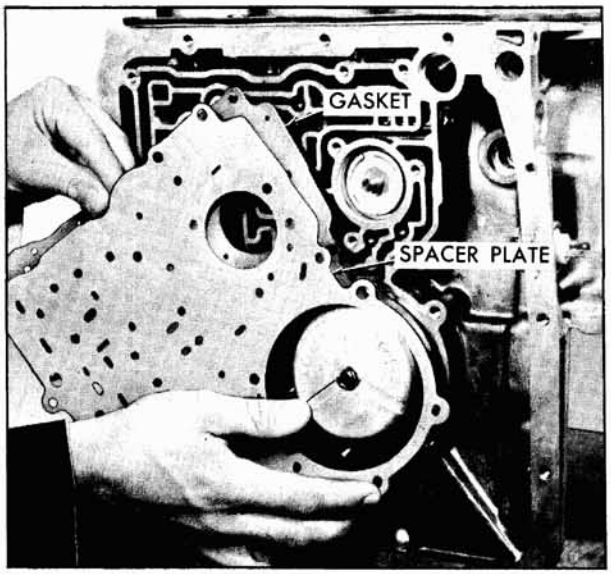


Fig. 7E-216—Installing Spacer Plate

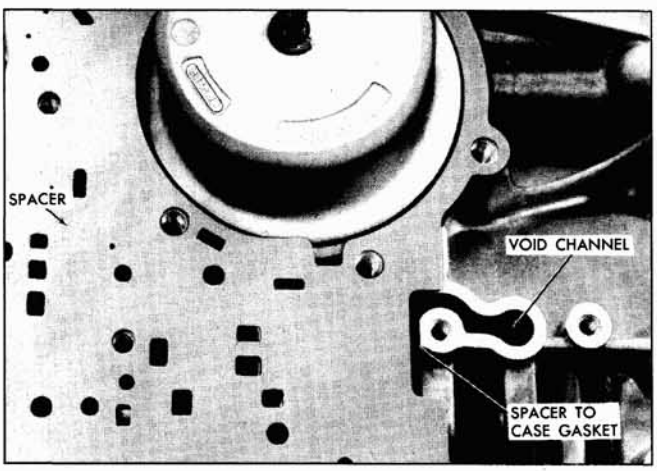


Fig. 7E-217—Valve Body Spacer to Case gasket Identification

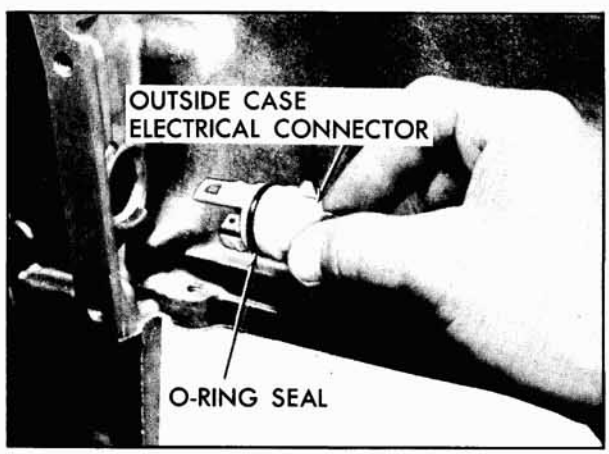


Fig. 7E-218—Installing Connector

8. Install the "O" ring seal on the case solenoid connector.
9. Lubricate and install case connector with lock tabs facing into case, positioning locater tabs up on side of case. (Fig. 7E-218)

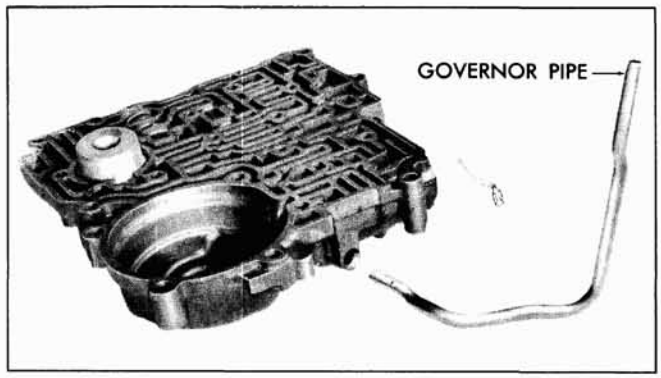


Fig. 7E-219—Installing Governor Pipe

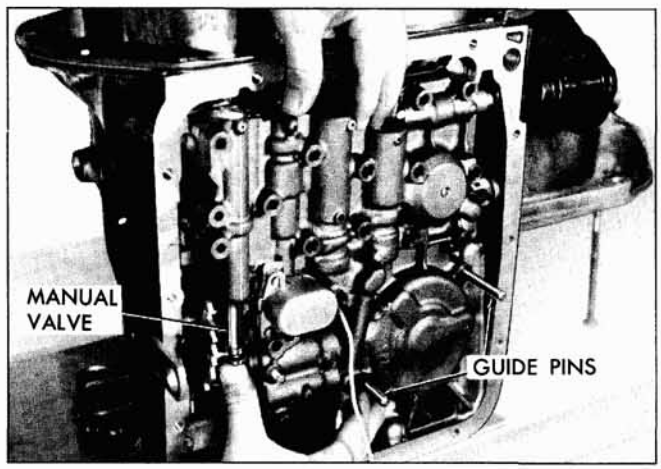


Fig. 7E-220—Installing Control Valve

CONTROL VALVE ASSEMBLY AND GOVERNOR PIPES

Installation

1. Install the control valve assembly to spacer gasket.
2. Install governor screens into case governor pipe holes if removed.
3. Install governor pipe into valve body. (Fig. 7E-219)
4. Install control valve assembly and governor pipe into the transmission. Engage manual valve with detent lever. (Fig. 7E-220)

Be sure manual valve is properly indexed with the pin on the manual detent lever.

5. Install the control valve assembly attaching bolts, and manual detent and roller assembly. (Fig. 7E-221)
6. Torque control valve assembly attaching bolts to 8 ft. lbs.
7. Install governor feed pipe into case and control valve assembly. (Fig. 7E-222)
8. Install detent connector terminal into case electrical connector pushing inward so that detent terminal connections are locked. (Fig. 7E-223)

PRESSURE REGULATOR VALVE

Install (Fig. 7E-224)

1. Install regulator valve, spring retainer, and spacer, if present, into case bore.
2. Install pressure regulator spring into bore.
3. Install pressure boost valve bushing and boost valve into case bore.
4. Compress the pressure boost valve bushing against the

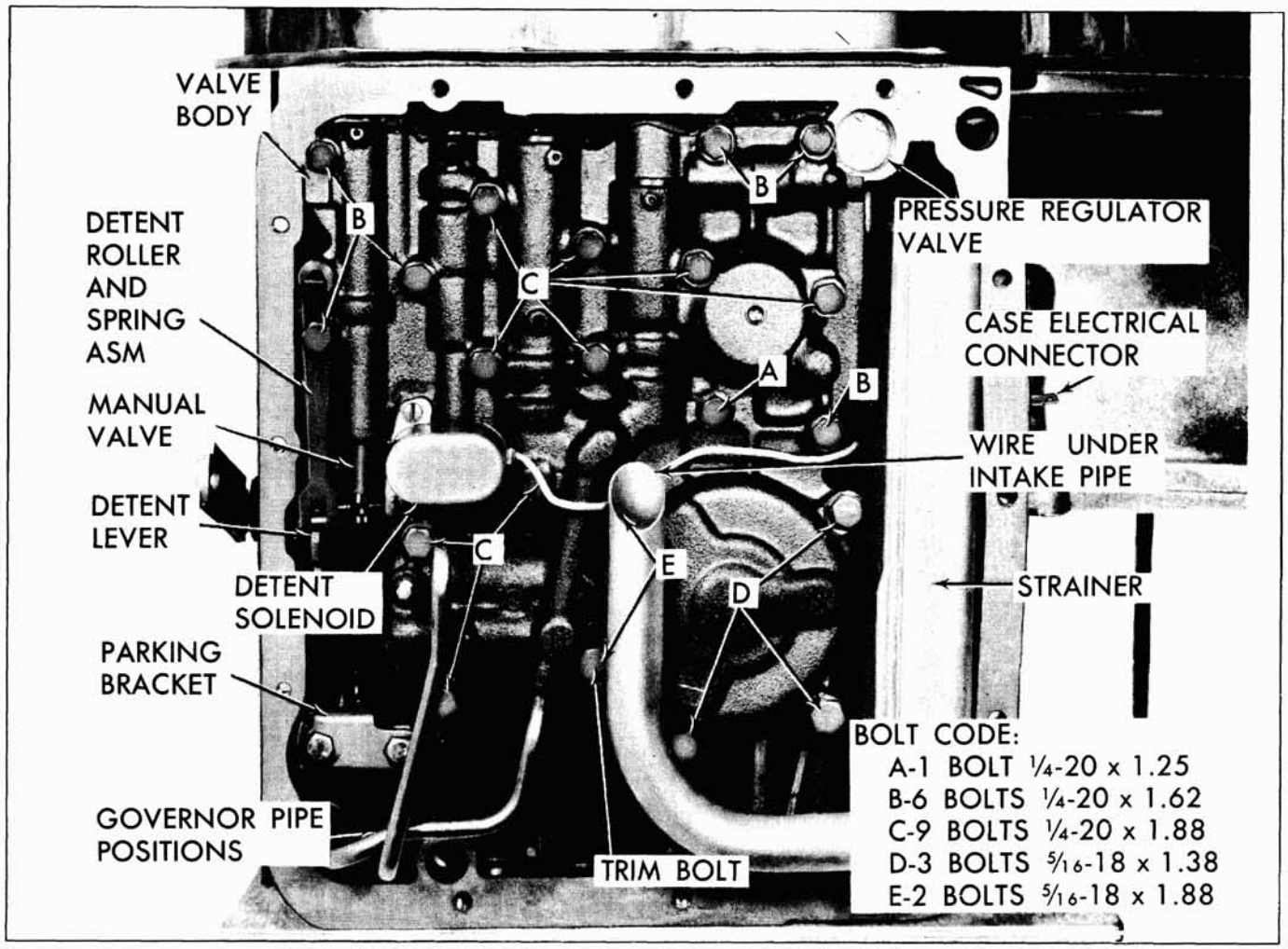


Fig. 7E-221—Attaching Bolt Location

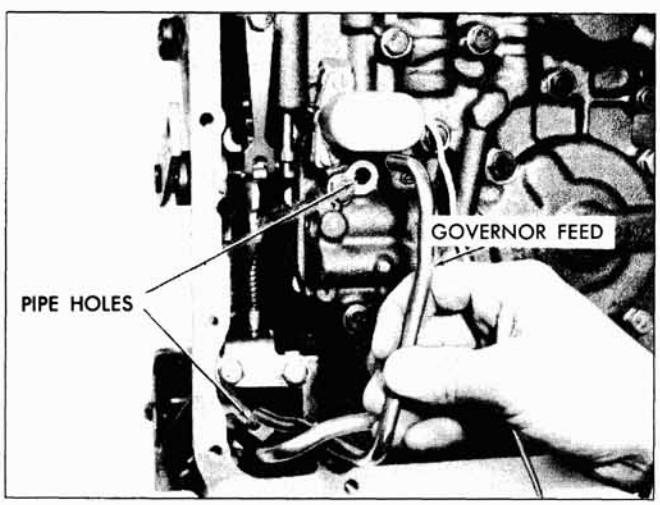


Fig. 7E-222—Installing Governor Feed Pipe

pressure regulator spring and install the retaining snap ring into the case, using J-5403 pliers. (Fig. 7E-225)

STRAINER AND INTAKE PIPE

Install

1. Install the case to intake pipe "O" ring seal on strainer and intake pipe assembly. (Fig. 7E-226)

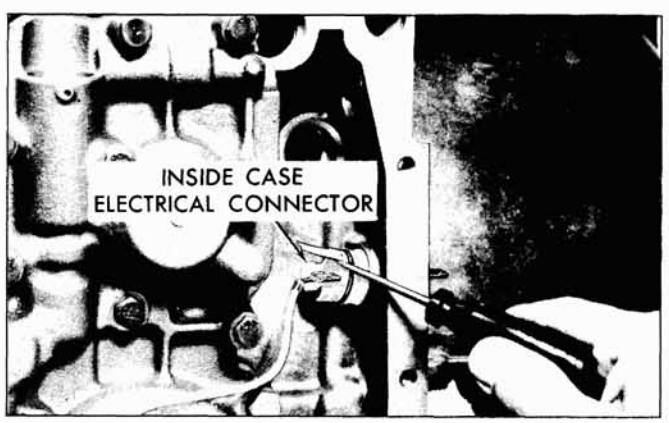


Fig. 7E-223—Installing Detent Connector

2. Install the strainer and intake pipe assembly. (Wire under strainer intake pipe.)
3. Using a new bottom pan gasket, install pan. Torque attaching screws to 10 ft. lbs.

MODULATOR VALVE AND VACUUM MODULATOR

Install

1. Install the modulator valve into the case bushing bore with stem end out.

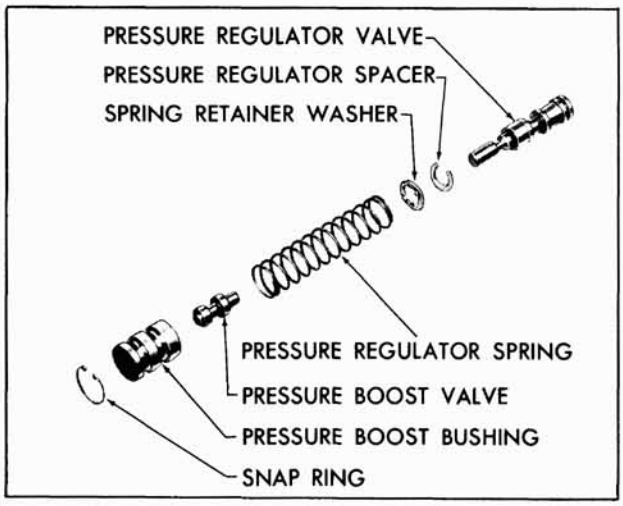


Fig. 7E-224—Pressure Regulator Valve

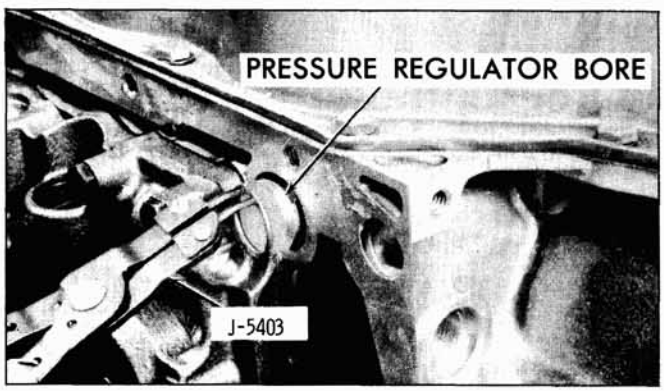


Fig. 7E-225—Installing Pressure Regulator Valve

Fig. 7E-226—Installing "O" Ring Seal

2. Install the "O" ring seal on vacuum modulator.
3. Install the vacuum modulator into the case. (Fig. 7E-227)
4. Install the modulator retainer and attaching bolt. Torque bolt to 14 ft. lbs. (Fig. 7E-228)

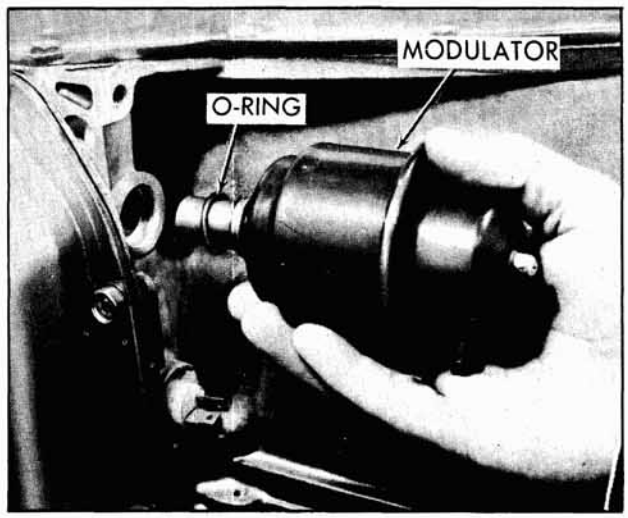


Fig. 7E-227—Installing Vacuum Modulator

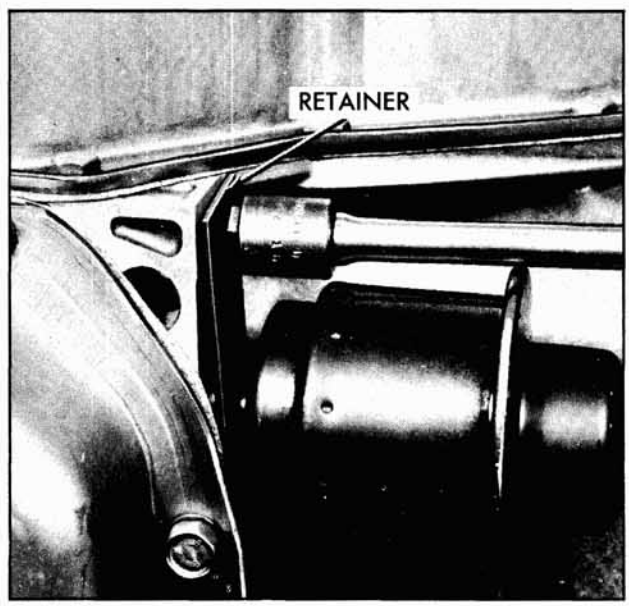


Fig. 7E-228—Installing Modulator Retainer Bolt

GOVERNOR

Install

1. Lay the transmission on the oil pan.
2. Position new "O" ring seal on governor assembly then install into the case. (Fig. 7E-229)
3. Attach the governor with the retaining clip.

INSTALL SPEEDOMETER DRIVEN GEAR

1. Install new "O" ring seal on speedometer driven gear assembly.
2. Install speedometer driven gear assembly into transmission. (Fig. 7E-230)
3. Install retainer clip and screw, torque to 3 ft. lbs. (Fig. 7E-231)

INSTALL CONVERTER ASSEMBLY

1. With transmission in cradle or portable jack, install converter into pump, making certain the converter hub slots engage the pump drive gear tangs.

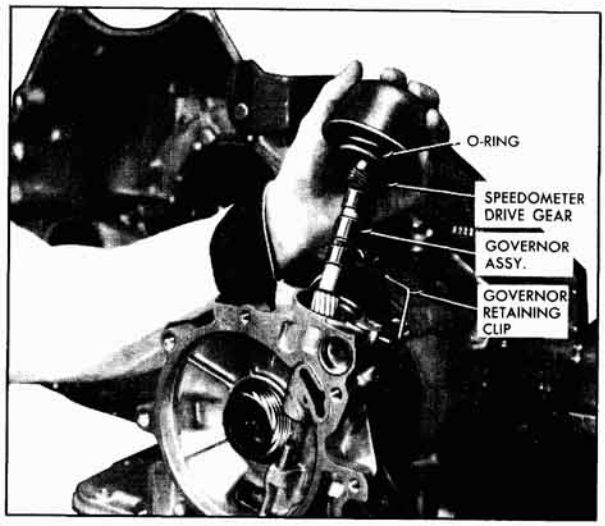


Fig. 7E-229—Installing Governor

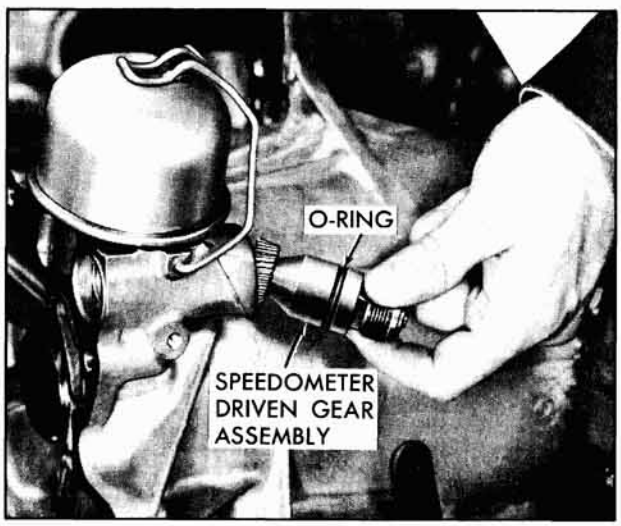


Fig. 7E-230—Installing Speedometer Driven Gear

LUBRICATION CHART (Fig. 7E-232)

The lubrication chart illustrates the lubricating oil flow from the oil pan through the transmission. The chart can be used to assist in location areas of possible oil flow restrictions.

DIAGNOSIS GUIDE

In many of the following diagnosis procedures, it is recommended that air pressure be applied. The purpose of this is to help determine if seal, rings or pistons are stuck, missing or damaged. Therefore, when air is applied, it is important to listen carefully for escaping air and piston action as air is applied to a particular area.

For additional diagnosis information refer to pages 7-77 through 7-81 found in Section 7.

All passages can be located by referring to Fig. 7E-232 through Fig. 7E-237.

NO DRIVE IN "D" RANGE

Possible Causes

A. Low Oil Level

Correct level-check for external leaks or vacuum modulator diaphragm leaking.

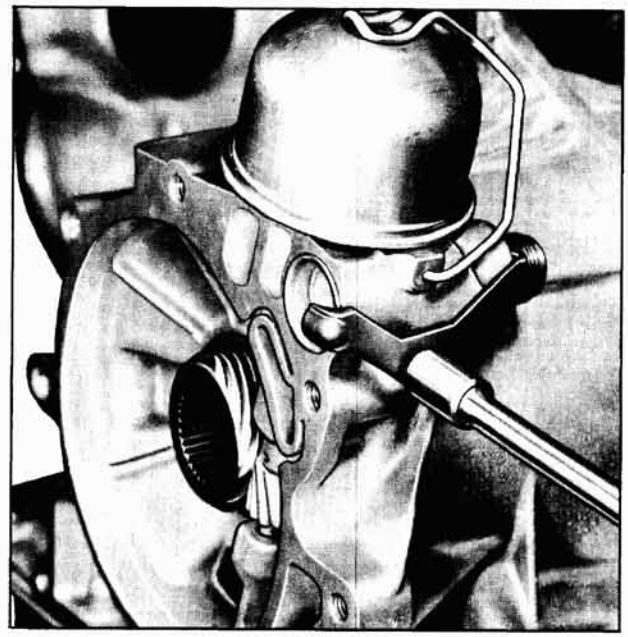


Fig. 7E-231—Installing Retainer Clip

B. Manual Linkage

Maladjusted; correct alignment in manual lever shift quadrant.

C. Low Oil Pressure - Refer to oil pressure chart Fig. 7E-239 and connect oil pressure gauge to transmission.

1. Strainer Assembly - "O" ring missing or damaged, neck weld leaking, strainer blocked.
2. Pump Assembly - Pressure regulator stuck or inoperative (located in case); pump drive gear - tangs damaged by converter.
3. Case - Porosity in intake bore.

D. Control Valve Assembly

Manual valve disconnected from manual lever pin. (Other shift lever positions would also be affected.)

E. Forward Clutch

Forward clutch does not apply - piston cracked; seals missing or damaged (these defects can be checked by removing the valve body and applying air pressure to the drive cavity in the case valve body face. Missing, damaged, or worn oil rings on the driven support housing can also be checked in this manner at the same time because they can also cause the forward clutch not to apply); clutch plates burned.

F. Roller Clutch Assembly

Roller clutch inoperative. Rollers worn, damaged springs, or damaged races. May be checked by placing selector lever in "L" range.

NO DRIVE IN "R" OR SLIPS IN REVERSE

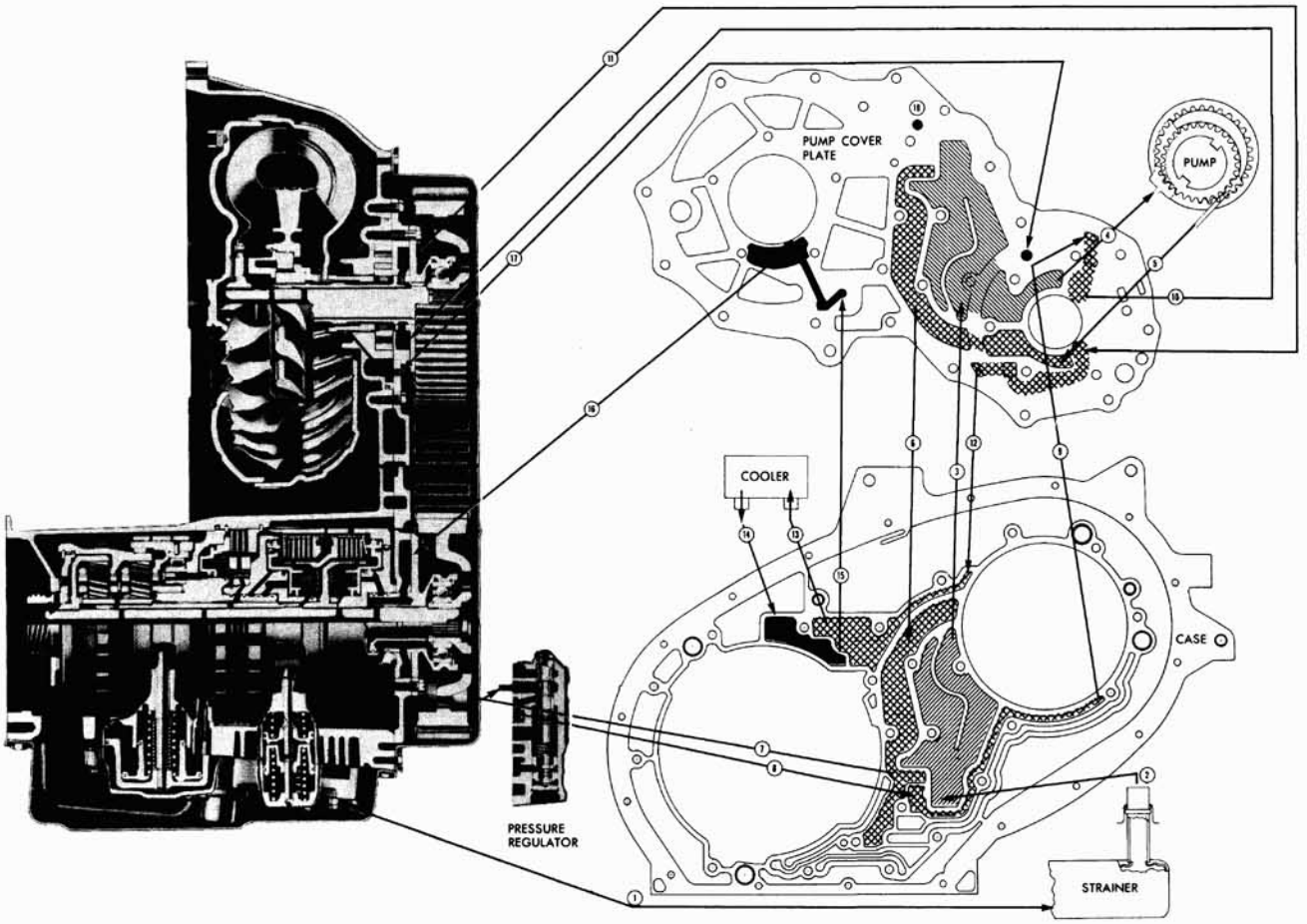
Possible Causes

A. Low Oil Level

B. Manual Linkage

C. Oil Pressure - Refer to Oil Pressure Chart Fig. 7E-239 for specifications.

1. Vacuum modulator assembly defective.
2. Vacuum modulator valve sticking.



1. OIL FROM SUMP TO STRAINER
2. STRAINER TO CASE PASSAGE
3. CASE PASSAGE TO PUMP COVER PLATE PASSAGE
4. PUMP COVER PLATE PASSAGE TO PUMP
5. PUMP TO PUMP COVER PLATE PASSAGE
6. PUMP COVER PLATE PASSAGE TO CASE PASSAGE
7. CASE PASSAGE TO PRESSURE REGULATOR VALVE
8. PRESSURE REGULATOR VALVE TO CASE PASSAGE
9. CASE PASSAGE TO PUMP COVER PLATE PASSAGE
10. PUMP COVER PLATE PASSAGE TO CONVERTER
11. CONVERTER TO PUMP COVER PLATE PASSAGE
12. PUMP COVER PLATE PASSAGE TO CASE PASSAGE
13. CASE PASSAGE TO COOLER
14. COOLER RETURN TO CASE PASSAGE
15. CASE PASSAGE TO PUMP COVER PLATE PASSAGE
16. PUMP COVER PLATE PASSAGE TO TRANSMISSION POWER TRAIN (ALL INTERNAL LUBRICATION)

    NOTE: THE NUMBERS IN THE CROSS SECTION INDICATE THAT THERE ARE ADDITIONAL LUBRICATION HOLES IN THIS AREA THAT ARE NOT SHOWN IN THE CROSS SECTION

17. FRONT SEAL DRAIN BACK HOLE
18. PRESSURE REGULATOR VENT HOLE

Fig. 7E-232—Lubrication Chart

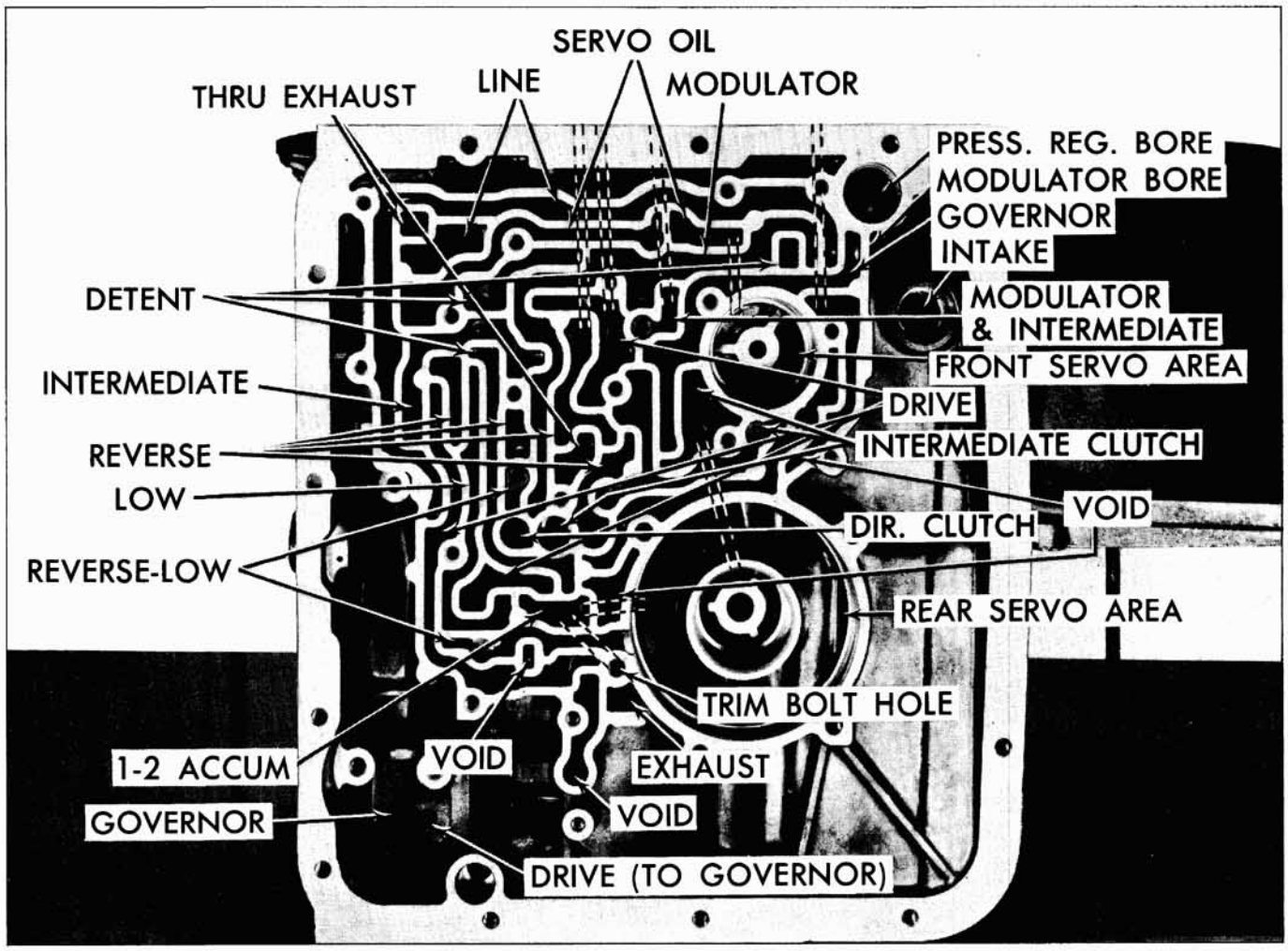


Fig. 7E-233—Case - Oil Passages

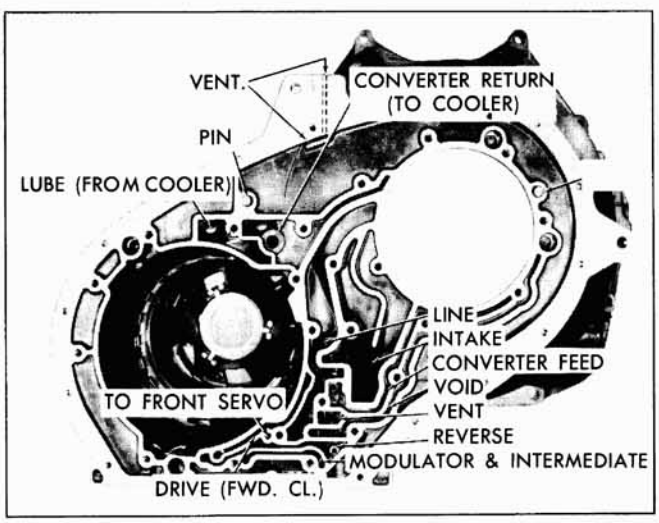


Fig. 7E-234—Oil Passages

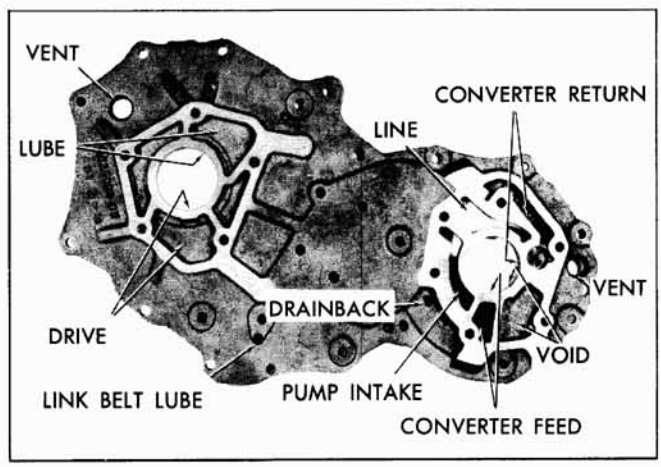


Fig. 7E-235—Oil Passages

3. Restricted strainer, leak at intake pipe, or "O" ring seal.
4. Pump Assembly - Regulator or boost valve sticking.

D. Control Valve Assembly
1. Valve body gaskets - leaking or damaged. (Other malfunctions may also be indicated.)
2. Low reverse check ball - missing from case (this will cause no overrun braking in low range.)
3. 2-3 valve train stuck open (this will also cause 1-3 upshifts in drive range.)
4. Reverse feed passage - not drilled - also check case passages. Apply air to reverse passage in case valve body face.

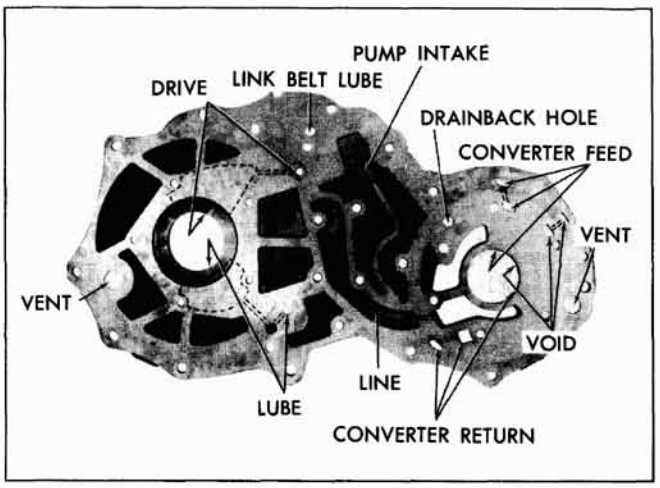


Fig. 7E-236—Oil Passages

E. Rear Servo and Accumulator
1. Servo piston seal ring broken or missing. Apply air pressure to drilled hole in the intermediate clutch passage of the case valve body face to check for piston operation and excessive leakage.
2. Band apply pin too short (this may also cause no overrun braking or slip in overrun braking in low range.)

F. Rear Band
Burned, loose lining, apply pin or anchor pins not engaged, band broken.

G. Direct Clutch
1. Outer seal damaged or missing.
2. Clutch plates burned - may be caused by stuck ball-check in piston.

H. Forward Clutch
Clutch does not release (will also cause drive in Neutral Range).

DRIVE IN NEUTRAL

Possible Causes

A. Manual Linkage - Maladjusted

B. Forward Clutch
Clutch does not release (this condition will also cause No Reverse).

FIRST SPEED ONLY—NO 1-2 SHIFT

Possible Causes

A. Governor Assembly
1. Governor valve sticking.
2. Driven gear loose, damaged or worn.
If driven gear shows signs of wear or damage, check output flange drive gear for nicks or rough finish.

B. Control Valve Assembly
1. 1-2 shift valve train stuck closed. Dirt, chips, or damaged valve in 1-2 shift valve train.
2. Governor feed channels blocked, or leaking; pipes out of position.
3. Valve body gaskets - leaking, damaged or incorrectly installed.

C. Case
1. Porosity between oil channels.
2. Governor feed passage blocked, governor bore scored or worn allowing cross pressure leak.

D. Intermediate Clutch
1. Case center support - oil rings missing, broken, defective, Apply air to intermediate clutch passage in case valve body face to check this defect.
2. Clutch piston seals - missing, improperly assembled, cut or damaged. Apply air to the intermediate clutch passage located in case valve body face to check for this defect.

1-2 SHIFT CAN ONLY BE OBTAINED AT FULL THROTTLE

Possible Causes

A. Detent Switch
Sticking or defective - can be detected by pulling electrical connector at transmission and obtaining normal upshifts.

B. Detent Solenoid
1. Loose.
2. Gasket leaking.
3. Sticks open.
4. Electrical wire pinched between cover and casting.

C. Control Valve Assembly
1. Valve body gasket - leaking, damaged or incorrectly installed.
2. Detent valve train stuck - dirt or foreign material.

D. Case Assembly
1. Porosity

FIRST AND SECOND SPEEDS ONLY— NO 2-3 SHIFT

Possible Causes

A. Detent Solenoid
Stuck open (the 2-3 would occur only at very high speeds) may be diagnosed as no 2-3 shift.

B. Detent Switch - Sticking or defective.

C. Control Valve Assembly
1. 2-3 valve train stuck - dirt or foreign material in valve train.
2. Valve body gaskets - leaking, damaged or incorrectly installed.

D. Direct Clutch
1. Case center support - oil rings missing, broken. Apply air to direct clutch passage in case valve body face to check this area.
2. Clutch piston seals - missing, improperly assembled, cut or damaged; piston ball check stuck or missing. Apply air to direct clutch passage in case valve body face to check this condition.

SLIPS IN ALL RANGES

Possible Causes

A. Oil Level Incorrect - check oil level.

B. Oil Pressure Low - Refer to Oil Pressure Chart Fig. 7E-239 for specifications.
1. Vacuum modulator defective.
2. Vacuum modulator valve sticking.

3. Oil strainer assembly - plugged or leaks at neck; "O" ring, case to strainer, missing or damaged.
4. Pressure regulator or boost valve sticking.
5. Pump gears damaged or worn, cover plate loose or gasket leaking.

C. Case - Cross channel leaks - porosity.

D. Forward, Intermediate, and Direct Clutches Slipping - composition and steel clutch plates burned. (Burned clutch plates are usually resultant defects; always look for a primary defect that would cause the clutch plates to burn.) Missing feed holes, seals and oil rings, etc., are primary defects.

E. Roller Clutch Assembly - Rollers worn, springs or cage damaged, and worn or damaged races; (operates normally in low and reverse ranges).

SLIPS 1-2 SHIFT

Possible Causes

A. Oil Level Incorrect - Check oil level.

B. Oil Pressure Low - Refer to chart Fig. 7E-239 for pressure specifications.
1. Vacuum modulator assembly - defective.
2. Vacuum modulator valve sticking.
3. Pump pressure regulator valve stuck.

C. Front Servo Accumulator.
1. Piston-cracked or porosity.
2. Oil ring damaged or missing.

D. Control Valve Assembly
1. 1-2 accumulator valve train (may cause a slip-bump shift.)
2. Porosity in valve body or case valve body face.

E. Rear Servo Accumulator - Oil ring missing or damaged; case bore damaged; piston cracked or damaged.

F. Case - Porosity between oil passages. Raised ridge around center support bolt hole-does not allow control valve assembly to seat properly.

G. Intermediate Clutch
1. Piston seals missing, cut, or damaged. Apply air pressure to the intermediate clutch passage in the case valve body face to check.
2. Clutch plates burned. (Burned clutch plates are usually the result of some other defect. Always look for other defects when clutch plates are found burned.)
3. Case Center Support.
a. Leaks in feed circuits (oil rings damaged or grooves damaged) or excessive leak between tower and bushing.
b. Center support bolt not seated properly in case.
4. Waved steel plate in intermediate clutch pack - All should be flat.

ROUGH 1-2 SHIFT

Possible Causes

A. Oil Pressure - Refer to Oil Pressure Chart Fig. 7E-239 for specifications.
1. Vacuum modulator - check for loose fittings; restrictions in line; modulator assembly defective.
2. Modulator valve stuck.
3. Pump - regulator boost valve stuck - cover plate loose or gasket leak.

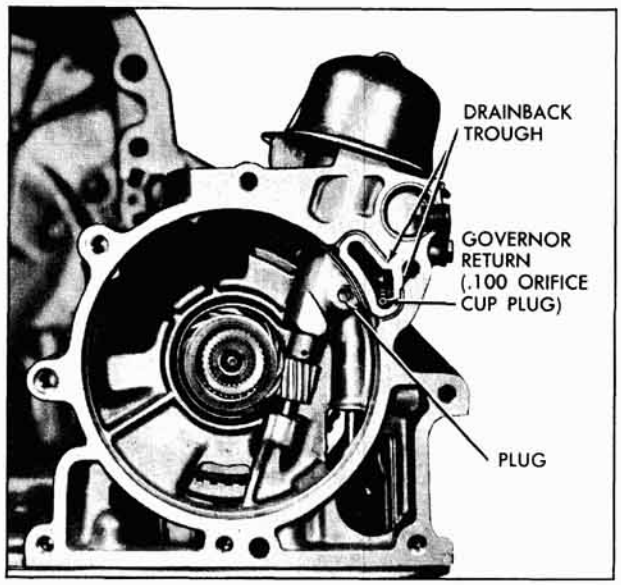


Fig. 7E-237—Oil Passages

B. Control Valve Assembly
1. 1-2 accumulator valve train.
2. Valve body to case bolts loose.
3. Gaskets inverted, off location, or damaged.

C. Case
1. Intermediate clutch passage check ball missing or not sealing.
2. Porosity between channels.

D. Rear Servo Accumulator Assembly
1. Oil rings damaged.
2. Piston stuck. Apply air pressure to the 1-2 accumulator passage in the case valve body face. (You should hear the servo piston move.)
3. Broken or missing spring.
4. Bore scored or damaged.

E. Intermediate clutch
1. Waved steel plate in clutch pack - should all be flat.

SLIPS 2-3 SHIFT

Possible Causes

A. Oil Level - high or low.

B. Oil Pressure Low - Refer to Oil Pressure Chart Fig. 7E-239 for specifications.
1. Modulator assembly defective.
2. Modulator valve sticking.
3. Pump pressure regulator valve or boost valve sticking.

C. Control Valve Assembly
Accumulator piston pin - leak at valve body end.

D. Direct Clutch
1. Piston seals or ball check leaking. Apply air to the direct clutch passage in the case valve body face.
2. Case center support - oil seal rings damaged, excessive leak between tower and bushing. Apply air to the direct clutch passage in the case valve body face. If air comes out the intermediate passage, center support is defective.
3. Extra waved steel plate - should have only one waved plate.

SHIFT SPEED CHART

DRIVE RANGE	LIGHT THROTTLE	THRU DETENT
1-2	6 to 11 mph	35 to 51.5 mph
2-3	15.5 to 29.5 mph	70 to 85 mph
3-2	16.5 to 11.5 mph	78 to 61.5 mph
2-1	10 to 3.5 mph	35 to 17 mph
LO RANGE		
2-1	51 to 40 mph	

N/V = 38.15 with 3.21:1 axle; 8.85 Tire Size
Wheel Rev/mile = 713

Fig. 7E-238—Shift Speed Chart

ROUGH 2-3 SHIFT

Possible Causes

A. Oil Pressure High - Refer to Oil Pressure Chart Fig. 7E-239 for specifications.
1. Vacuum modulator assembly defective.
2. Vacuum modulator valve sticking.
3. Pump - pressure regulator or boost valve stuck or inoperative.

B. Front Servo Accumulator Assembly
1. Front accumulator spring missing or broken.
2. Accumulator piston stuck.

C. Direct Clutch
1. Extra waved steel plate.

SHIFTS OCCUR AT TOO HIGH OR TOO LOW CAR SPEED

Possible Causes

A. Oil Pressure - Refer to Oil Pressure Chart Fig. 7E-239 for specifications.
1. Engine vacuum - check at transmission end of modulator pipe.
2. Vacuum modulator assembly defective.
3. Modulator valve sticking.
4. Leak in vacuum line, engine to transmission.
5. Vacuum modulator line fitting on the carburetor blocked.
6. Pump - pressure regulator and boost valve train stuck.

B. Governor
1. Valve stuck or sticking.
2. Feed holes restricted or leaking; pipes damaged or mispositioned.

C. Detent Solenoid
1. Stuck open.
2. Loose on valve body (will cause late shifts).
3. Feed line screens plugged.

D. Control Valve Assembly
1. Detent valve train sticking.
2. 3-2 valve train sticking.
3. 1-2 shift valve train.
a. 1-2 regulator valve stuck - will cause 1-2 shift point to remain the same regardless of throttle opening.
b. 1-2 detent valve sticking open (will probably cause early 2-3 shift).

E. Spacer Plate Gaskets
1. Inverted or mispositioned.
2. Spacer plate orifice holes missing or blocked.
3. Check balls missing or mislocated.

F. Case
1. Porosity in channels.
2. Foreign material blocking channels.

NO PART THROTTLE DOWNSHIFT—(INSTALL PRESSURE GAUGE)

A. Oil pressure - (refer to table for oil pressure specifications)
1. Vacuum modulator assembly, modulator valve, pressure regulator valve train. (Other malfunctions may also be noticed).

B. Control valve assembly
1. 3-2 valve stuck, spring missing or broken.

NO DETENT DOWNSHIFTS

Possible Causes

A. Detent Switch
1. Mispositioned.
2. Electrical connections loose.

B. Solenoid
1. Defective.
2. Electrical connections loose.

C. Control Valve Assembly
1. Detent valve train stuck.
2. 3-2 valve stuck - spring missing or broken.

NO ENGINE BRAKING—SUPER RANGE—SECOND SPEED

Possible Causes

A. Front Servo Accumulator Assembly
1. Servo or accumulator piston rings broken or missing.
2. Case or valve body bores worn oversize causing excessive leakage.
3. Servo piston stuck.

B. Front Band
1. Band worn or burned. (Check for cause).
2. Band end lugs broken or damaged.
3. Band lugs not engaged on anchor pins or servo apply pin. (Check for cause).

NO ENGINE BRAKING—LOW RANGE—FIRST SPEED

Possible Causes

A. Control Valve Assembly
Low-reverse check ball missing from case.

B. Rear Servo
1. Oil seal ring damaged or missing.
2. Piston damaged or porous causing a leak in apply pressure.
3. Rear band apply pin short.

RANGE	GEAR	PUMP PRESS.	FORWARD CLUTCH	INTER-MEDIATE CLUTCH	DIRECT CLUTCH	FRONT BAND	REAR BAND
PARK		60-150	OFF	OFF	OFF	OFF	OFF
REV		95-230	OFF	OFF	ON	OFF	ON
NEUT		60-150	OFF	OFF	OFF	OFF	OFF
DRIVE	FIRST	60-150	ON	OFF	OFF	OFF	OFF
	SECOND	60-150	ON	ON	OFF	OFF	OFF
	THIRD	60-150	ON	ON	ON	OFF	OFF
SUPER	FIRST	150	ON	OFF	OFF	OFF	OFF
	SECOND	150	ON	ON	OFF	ON	OFF
LOW	FIRST	150	ON	OFF	OFF	OFF	ON
	SECOND	150	ON	ON	OFF	ON	OFF

Fig. 7E-239—Oil Pressure Chart

C. Rear Band
1. Band lining worn or burned (check for cause).
2. Band end lugs broken.
3. Band ends not engaged on anchor pin or servo apply pin.

Items A, B and C will also cause slip in reverse or No Reverse.

WILL NOT HOLD CAR IN PARK POSITION

Possible Causes

A. Manual Linkage - Maladjusted - external.

B. Internal Linkage
1. Parking brake lever and actuator rod assembly defective (check for proper actuator spring action).
2. Parking pawl broken or inoperative.

TRANSMISSION NOISE

Possible Causes

A. Pump Noise
1. Oil level high or low.
2. Water in oil.
3. Driving gear assembled upside down.
4. Driving or driven gear teeth damaged.
5. Cavitation due to plugged strainer or damaged "O" ring.

B. Gear Noise - (First Gear Drive Range)
1. Check pinions in planetary gear set for tooth finish or damage.
2. Check sun gear and both front and rear internal gears for tooth finish or damage.
3. Transmission grounded to body.

C. Clutch Noise - During Application
1. Forward Clutch - (Neutral to drive, park to drive). Check clutch plates.
2. Intermediate Clutch - (1-2 in Super and Drive Range). Check clutch plates.
3. Direct Clutch - (2-3 shift in drive range and neutral to Reverse, park to reverse). Check clutch plates.

D. Sprocket and Link Belt Noise
1. Link belt too long. Sounds similar to pop corn popping. (There will be a rough burr along the teeth of the drive sprocket if the link belt is too long). Replace link belt and drive sprocket.
2. Drive or Driven sprocket teeth damaged.
3. Engine mounts worn or damaged.

OIL LEAKS

The suspected area should be wiped clean of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission. The use of a "black light '* to identify the oil at the source of the leak is also helpful. Comparing the oil from the leak to that on the engine or transmission dip stick (when viewed by black light) will determine the source of the leak.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by the air stream. For example, a transmission "oil filler tube to case leak" will sometimes appear as a leak at the rear of transmission. In determining the source of an oil leak, it is most helpful to keep the engine running.

Possible Points of Oil Leaks

A. Transmission Oil Pan
1. Attaching bolts not correctly torqued.
2. Pan gasket improperly installed or damaged.
3. Oil pan case mounting face not flat.

B. Cover and Plate Assembly Sprocket Housing Leak
1. Attaching bolts not correctly torqued.

* A "black light" testing unit such as J-6640 may be obtained from service tool suppliers.

2. Housing to case gasket improperly installed or damaged.
3. Housing to case gasket face not flat.

C. Final Drive to Transmission Leak
1. Attaching bolts not correctly torqued.
2. Final drive to transmission gasket improperly installed or damaged.
3. Mounting surfaces not flat.

D. Case Leaks
1. Filler pipe "O" ring seal damaged or missing. (Filler pipe is located in the final drive housing).
2. Mispositioning of filler pipe mounting bracket - loading one side of "O" ring seal.
3. Modulator assembly "O" ring seal damaged or improperly installed.
4. Governor cam, "O" ring and bracket damaged or loose.
5. Manual shaft "O" ring seal damaged or improperly installed.
6. Line pressure tap plug loose or stripped.
7. Cooler connectors loose, cracked, or stripped.
8. Porosity in case.
9. Speedometer driven gear housing "O" ring or lip seal damaged.

E. Front End Leaks
1. Front seal in pump damaged (check converter neck for nicks, etc., also for pump bushing moved forward).
2. Garter spring missing or loose on front seal.
3. Converter weld leaks.
4. Pump to case "O" ring cut or damaged.
5. Vent fitting damaged.

F. Oil Comes Out Vent Pipe
1. Transmission overfilled.
2. Water in oil.
3. Cooler lines blocked causing excessive heat.

TOOLS

J-22241 - Forward Clutch End Play Checking Tool
J-21370-7 Band Apply Selector Pin
J-21370-8 Band Apply Selector Pin Adapter Plate

For usage of additional tools, refer to Figs. 7-256 and 7-257 of the TURBO HYDRA-MATIC TRANSMISSION, Section 7.

TURBO HYDRA-MATIC INFORMATION CHART

For additional specification information refer to Information Chart, Section 7, Page 7-84.

TORQUE CHART

APPLICATION	FT. LBS.
Transmission to Engine Bolts	25
Torque Converter to Flywheel	30
Flywheel Housing Cover	5
Oil Cooler Lines to Radiator and Transmission	25
Final Drive to Transmission	25
Starter Motor to Transmission	25
Solenoid to Valve Body	3
Line Pressure Plug	13
Vacuum Modulator Retainer	18
Valve Body to Case	8
Center Support to Case	23
Manual Shaft to Inside Lever	18
Pump Body to Cover Plate	18
Parking Brake Bracket to Case	18
Oil Pan to Case	12
Sprocket Housing	8
Support Housing to Cover Plate	18
Speedometer Drive Gear Retainer	3

TURBO HYDRA-MATIC BUSHING SERVICE 1966-1968 TORONADO

Bushings are available and can be replaced in the following units. Service bushings do not require reaming.

1. Output Flange
2. Sun Gear Shaft - Front and Rear
3. Case Support
4. Pump Body
5. Stator Shaft 1966 and 1967
6. Stator Shaft 1968

Tools required are J-21465, -1, -3, -5, -6, -15, -16, -17, -19, J-2619, -4, J-8092, J-8647-1. (Fig. 7E-259)

OUTPUT FLANGE BUSHING

With output flange properly supported using Tool J-21465-16, with Slide Hammer J-2619 and Adapter Tool J-2619-4, remove bushing. (Fig. 7E-250)

Using Tool J-21465-1, with Driver Handle J-8092, press or drive replacement bushing into place until tool bottoms. (Fig. 7E-251)

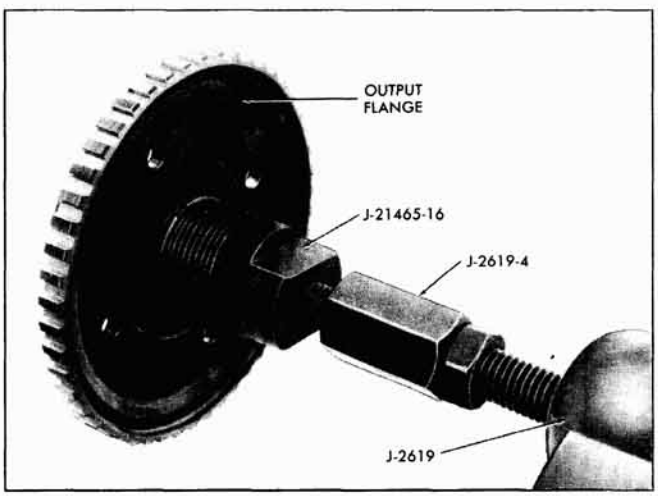


Fig. 7E-250—Output Flange Bushing Removal

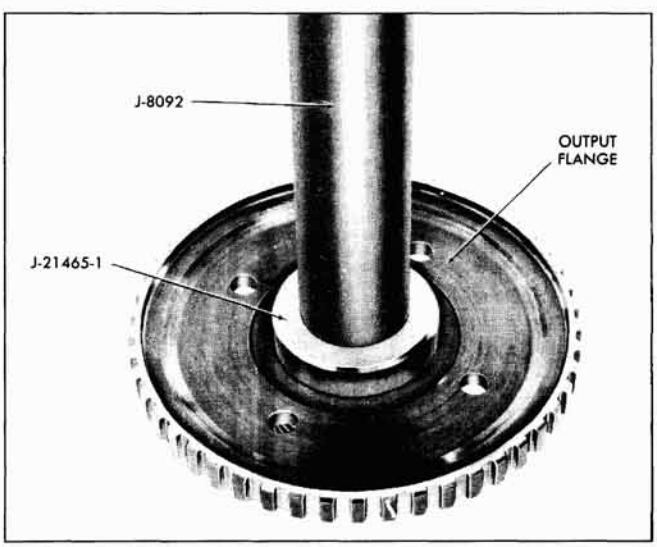


Fig. 7E-251—Output Flange Bushing Installation

SUN GEAR SHAFT BUSHING - FRONT AND REAR

With sun gear shaft properly supported, using Tool J-21465-15, with Slide Hammer Tool J-2619 and Adapter J-2619-4, remove bushing. (Fig. 7E-252)

Using Tool J-21465-5 with Driver Handle J-8092, press or drive replacement bushing into place until tool bottoms. (Fig. 7E-253)

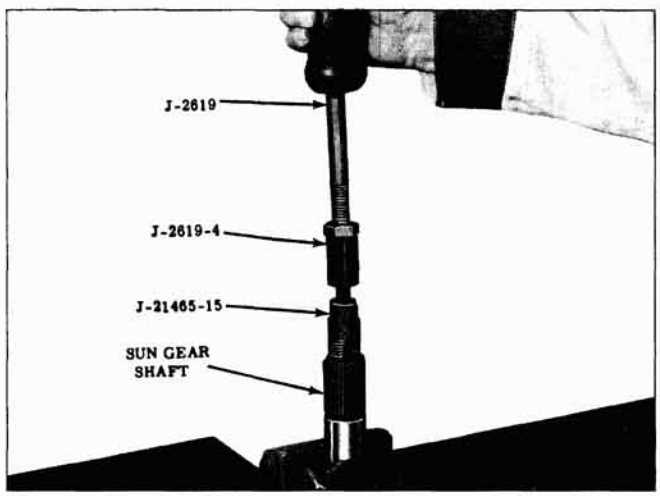


Fig. 7E-252—Sun Gear Shaft Bushing Removal

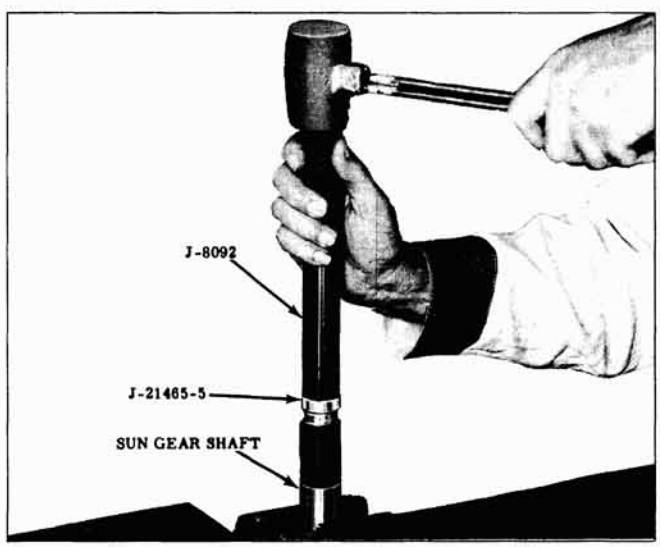


Fig. 7E-253—Sun Gear Shaft Bushing Installation

CASE SUPPORT BUSHING

With case support properly supported on wood blocks, using Tool J-21465-6 with Driver Handle J-8092, remove bushing. (Fig. 7E-254)

Using Tool J-21465-6 with Driver Handle J-8092, press or drive replacement bushing into place, aligning elongated slot in bushing with the drilled hole in the delivery sleeve closest to the piston. Bushing should be .010" below to flush with oil delivery sleeve. (This oil passage port is lubrication to low sprag or roller clutch.) (Fig. 7E-255)

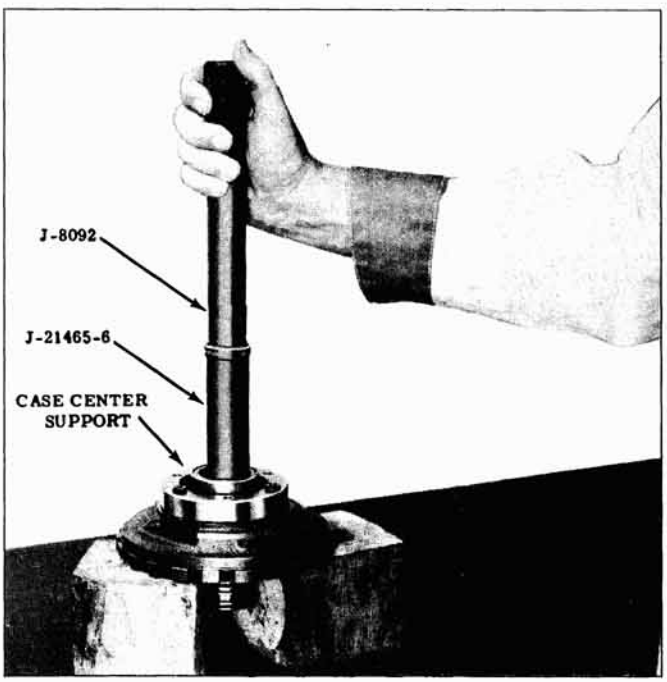


Fig. 7E-254—Case Support Bushing Removal

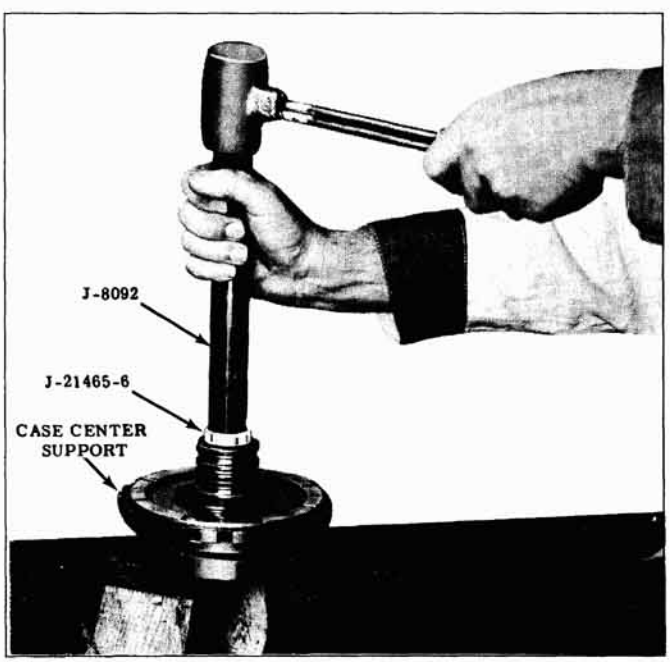


Fig. 7E-255—Case Support Bushing Installation

PUMP BODY BUSHING

With pump body properly supported and front seal removed, using Tool J-21465-17, with Driver Handle J-8092, remove bushing.

Using Tool J-21465-17, with Driver Handle J-8092, press or drive replacement bushing in place, flush to .010" below the gear pocket face.

Do not allow the bushing to protrude into gear pocket as it will interfere with the rotating gears. Also, use care to prevent damage to the gear pocket face. (Fig. 7E-256)

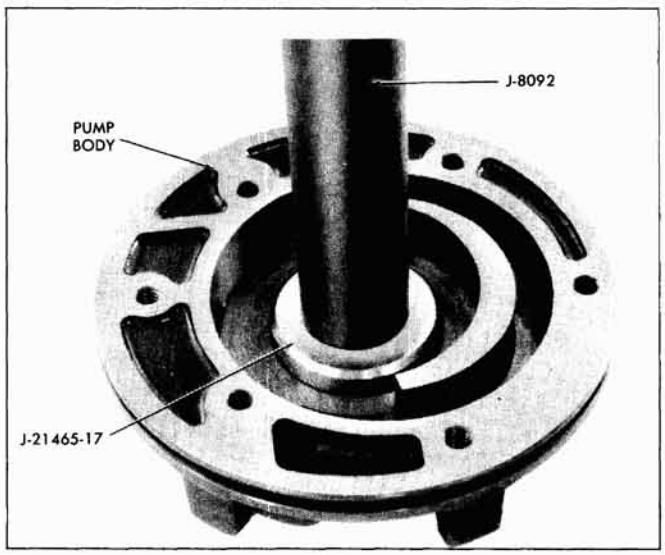


Fig. 7E-256—Pump Body Bushing Installation

STATOR SHAFT BUSHING - 1966 and 1967

With drive sprocket support and stator shaft properly supported, using Tool J-21465-15 or J-8647-1, with Slide Hammer Tool J-2619 and Adapter Tool J-2619-4, remove bushing.

Using Tool J-21465-19, with Driver Handle J-8092, press or drive replacement bushing into place until tool bottoms.

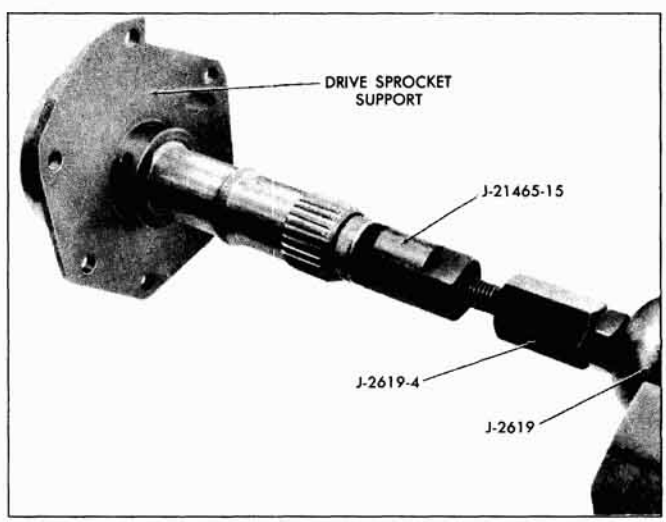


Fig. 7E-257—Stator Shaft Bushing Removal

STATOR SHAFT BUSHING - 1968

With drive sprocket support and stator shaft properly supported, using Tool J-21465-15 or J-8647-1, with Slide Hammer J-2619 and Adapter Tool J-2619-4, remove bushing. (Fig. 7E-257)

Using Tool J-21465-3 with Driver Handle J-8092, press or drive replacement bushing into place until tool bottoms. (Fig. 7E-258)

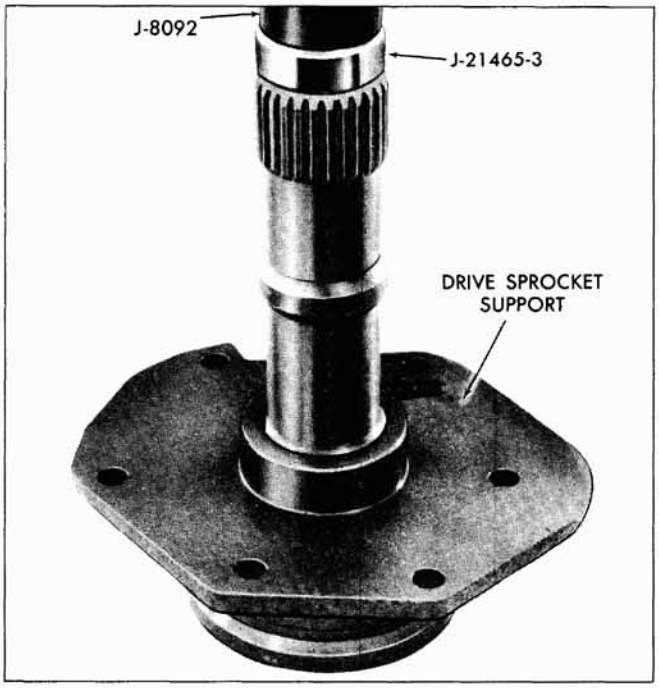


Fig. 7E-258—Stator Shaft Bushing Installation

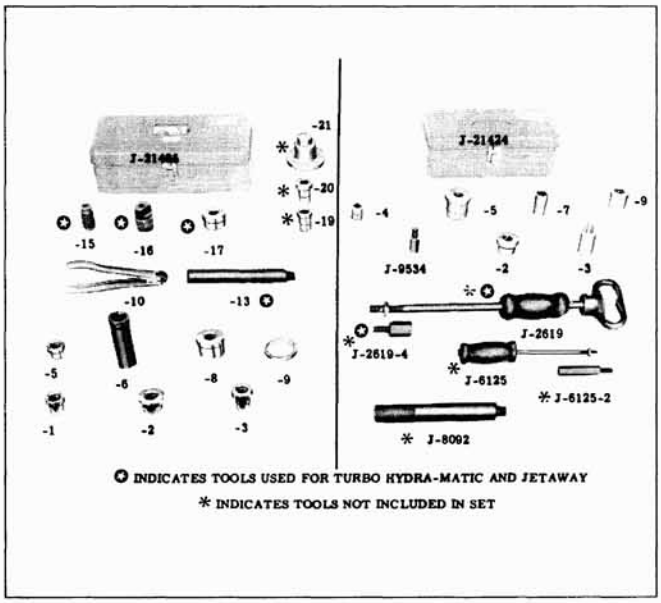


Fig. 7E-259—Tools

J-21424-2	Transmission Case Bushing Installer
J-21424-3	Output Shaft Bushing Installer
J-21424-4	Sun Gear and Flange Bushing Remover and Installer
J-21424-5	Forward Clutch Drum Bushing Remover and Installer
J-21424-7	Stator Shaft Bushing Installer
J-21424-9	Extension Housing Bushing Remover and Installer
J-9534	Output Shaft Bushing Remover
J-2619	Slide Hammer (Large)
J-2619-4	Slide Hammer (Thread Reducer Adapter)
J-6125	Slide Hammer (Small)
J-6125-2	Slide Hammer (Thread Reducer Adapter)
J-8092	Driver Handle (Universal)
J-21465-1	Output Shaft Bushing Installer
J-21465-5	Sun Gear Shaft Bushing Installer
J-21465-6	Case Center Support Bushing Remover and Installer
J-21465-8	Transmission Case Bushing Remover and Installer
J-21465-9	Transmission Case Bushing Installer Adapter Ring
J-21465-10	Transmission Case and Extension Housing Bushing Staking Pliers
J-21465-13	Transmission Case Bushing Extension Handle
J-21465-15	Sun Gear Shaft and Stator Shaft Bushing Remover
J-21465-16	Output Shaft Bushing Remover
J-21465-17	Pump Body Bushing and Extension Housing Bushing Remover and Installer
J-21465-19	Stator Shaft Front Bushing Installer
J-21465-20	Stator Shaft Rear Bushing Installer
J-21465-21	Pump Cover Support

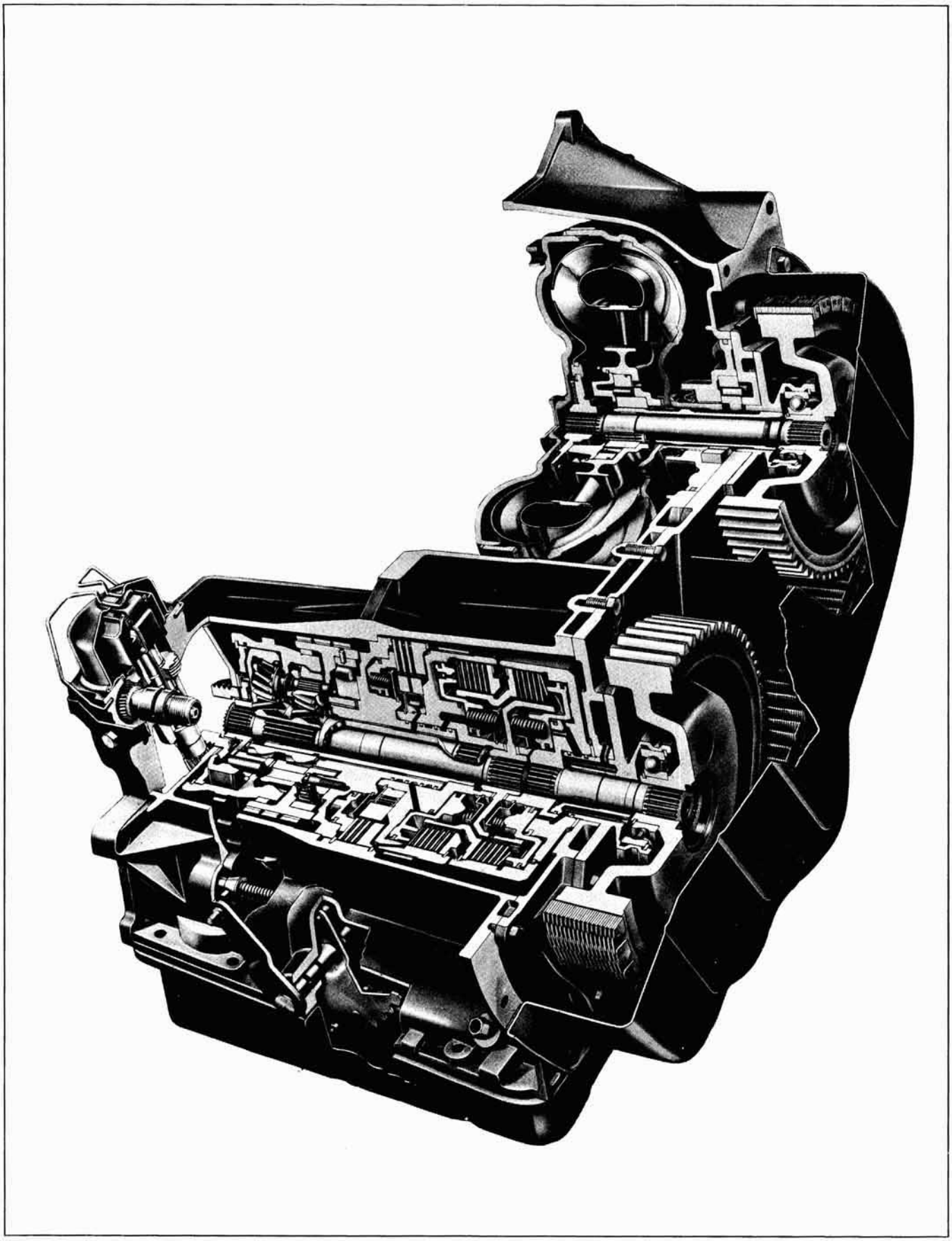


Fig. 7E-260—Toronado Hydra-Matic Transmission Assembly

FUEL TANK AND EXHAUST

CONTENTS OF SECTION 8E

Subject	Page
FUEL SYSTEM	8E-1
DESCRIPTION	8E-1
FUEL GAUGE TANK UNIT	8E-1
EXHAUST SYSTEM	8E-3
DESCRIPTION	8E-3
TORQUE SPECIFICATIONS	8E-4

FUEL SYSTEM

DESCRIPTION (Figs. 8E-1 through 8E-3)

The fuel tank used on the Toronado has a capacity of 24 gallons with the fuel filler pipe located behind the license plate. Venting of the fuel tank is provided by two hoses located at the rear of the tank and on the right side of the filler pipe. The hoses are retained by a clip as shown in Fig. 8E-1 and end behind the filler door. A baffle is positioned laterally in the tank to stabilize fuel level and minimize noise.

The gas tank fuel filter is located on the fuel pickup pipe which is part of the tank unit and is not replaceable except by replacing the tank unit. A non-vented gas cap must be used. Use only premium or super premium fuel.

If equipped with air conditioning, a fuel return system is incorporated. The fuel return consists of a pipe clipped to the frame side rail and a hose on each end routed through holes in the frame. The fuel return hose connects to the right front corner of the fuel tank.

The Toronado has a top mounted tank gauge unit. The same gauge is used for air conditioning and non air conditioning equipped cars.

FUEL GAUGE TANK UNIT

Removal

1. Remove fuel tank. (See tank Removal)
2. Remove tank unit retaining cam using Tool J-22554.
3. Remove tank unit from tank.

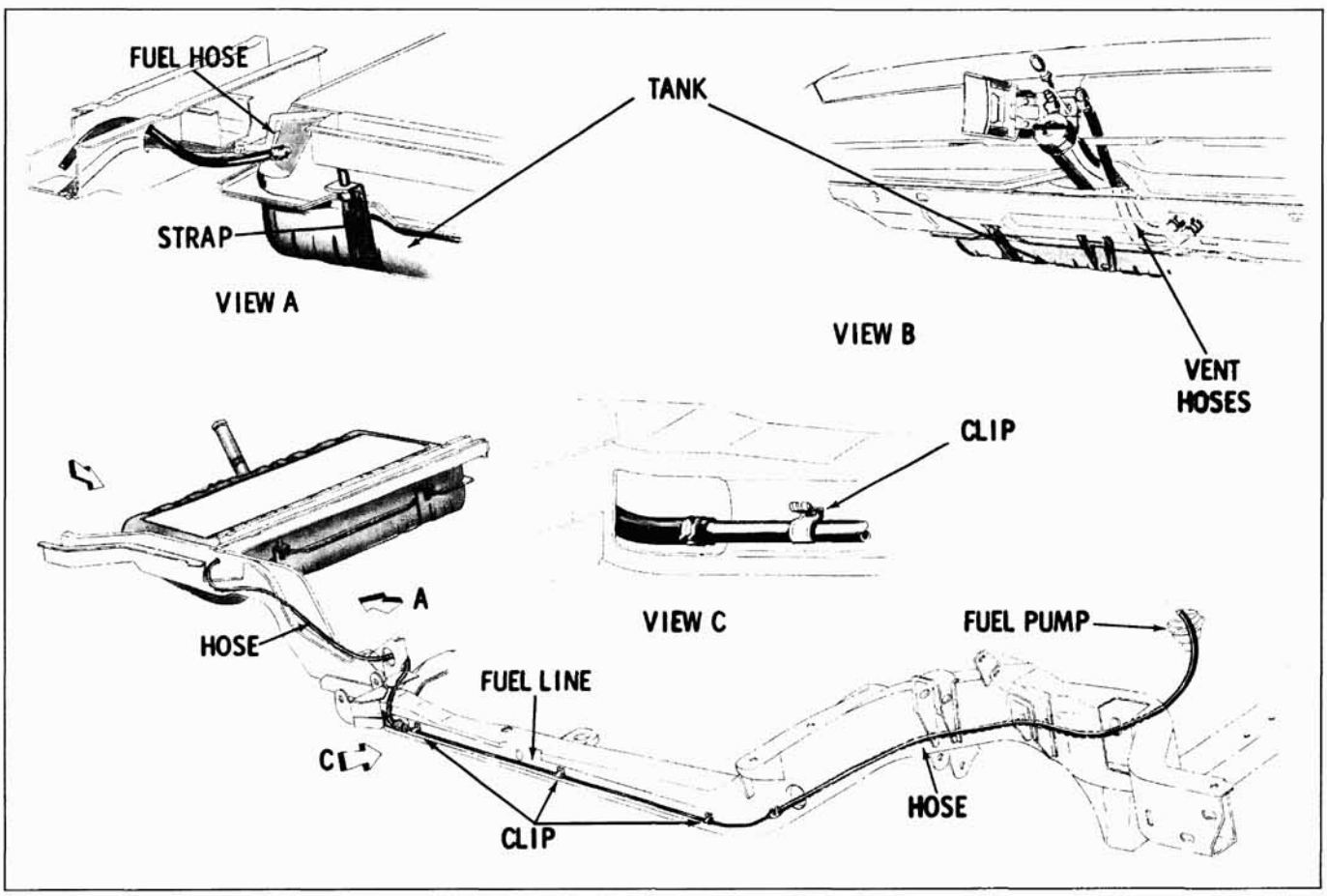


Fig. 8E-1—Fuel System - Toronado

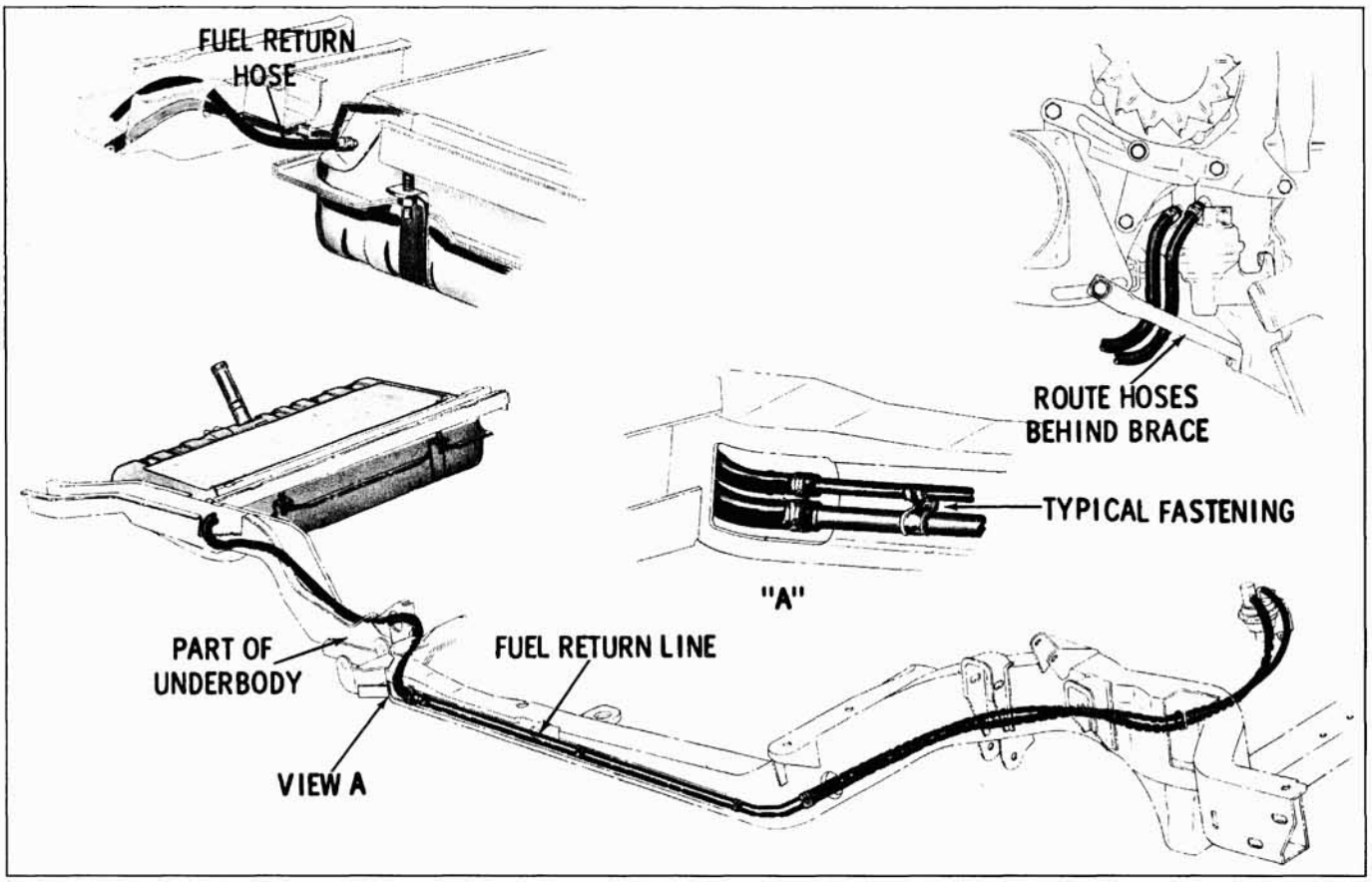


Fig. 8E-2—Fuel Return System - Toronado

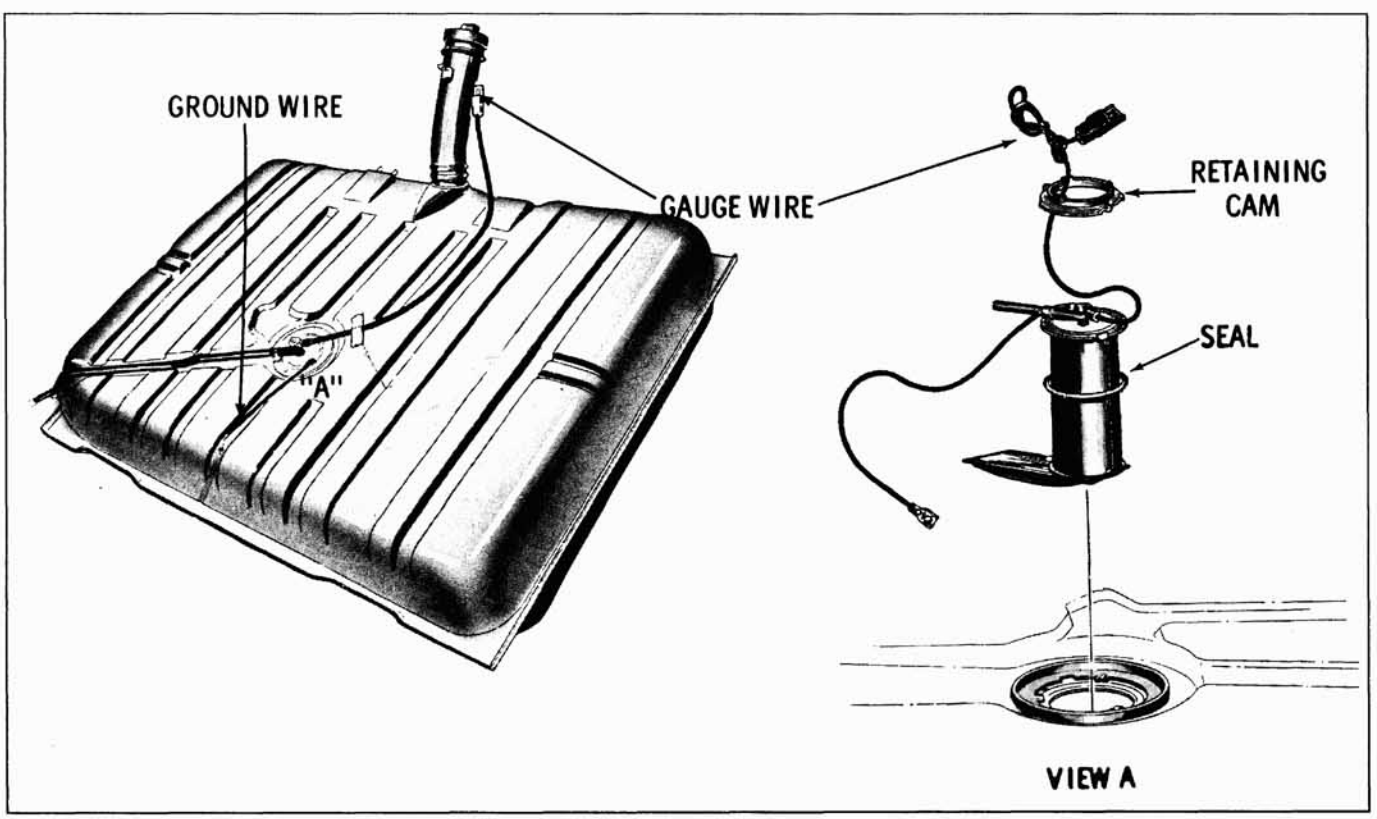


Fig. 8E-3—Tank Unit Installation - Toronado

Installation

1. Position tank unit in tank. (Fig. 8E-3)
2. Install tank unit retaining cam using Tool J-22554.
3. Install fuel tank. (See fuel tank installation)

FUEL TANK

Removal

1. Drain fuel tank.
2. Disconnect tank unit wire from connector in rear compartment.
3. Remove vent hoses from retaining clip. (Fig. 8E-1)
4. Remove ground wire retaining screw from underbody at front of tank.
5. Disconnect fuel hose from tank. (Fig. 8E-2)
6. Support fuel tank and disconnect the two fuel tank retaining straps.
7. Remove tank from car.

Installation

1. Connect tank unit wires. (Fig. 8E-3)
2. Reverse removal procedure.
3. Tighten fuel tank retaining strap nuts to 9 ft. lbs.

EXHAUST SYSTEM (TORONADO)

DESCRIPTION (Figs. 8E-4 AND 8E-5)

Periodic maintenance of the exhaust system is not required; however, if the car is raised for other service, it is advisable to check that the drain holes in the muffler and resonators are in the down position and open to prolong their life.

The muffler supports and the extension insulator brackets are attached to the frame with self-tapping screws. If a screw hole should strip out, it is impossible to use a bolt and nut because of the boxed frame design; therefore, self-tapping hex head 3/8"-16 x 1-1/8" screws should be used.

Annoying rattles and noise vibrations in the exhaust system are usually caused by misalignment of parts.

Aligning the system should be done only when the system is cold, as heat causes the complete system to expand rearward, sometimes as much as 3/4". When servicing any components of the exhaust system, it is important that the exhaust system hang freely in its hangers without binding. If using a single post hoist, it is necessary to use wood blocks to avoid contact between the lift pads and the exhaust system.

For servicing the exhaust manifold heat valve, refer to ENGINE, Section 6.

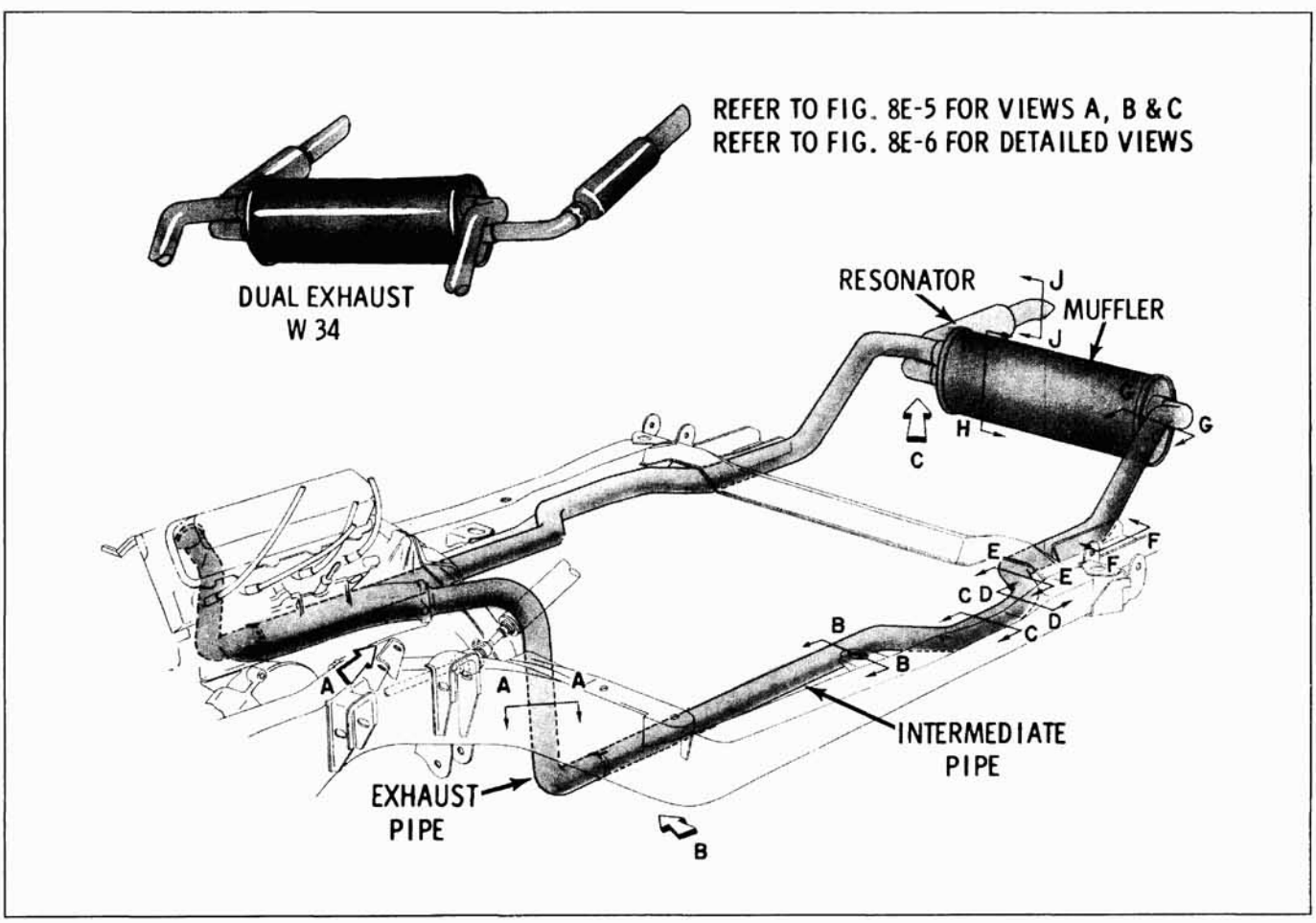


Fig. 8E-4—Exhaust System - Toronado

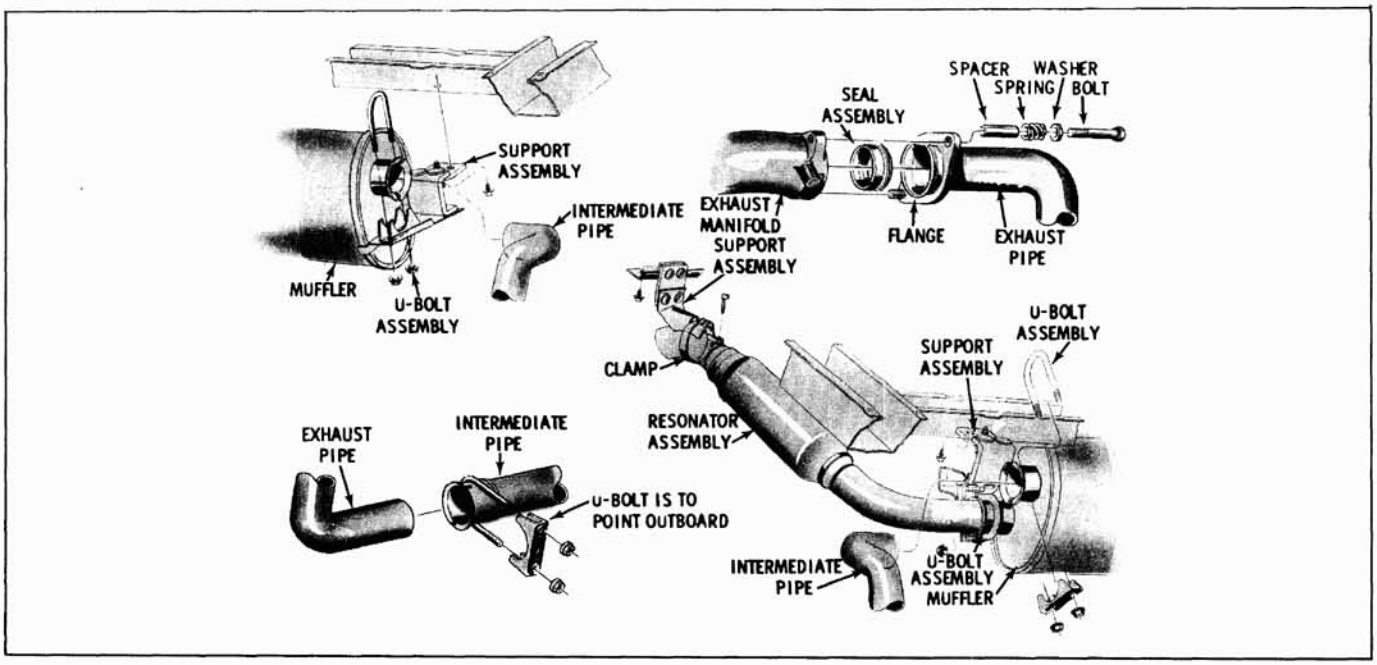


Fig. 8E-5—Exhaust System Connections-Toronado

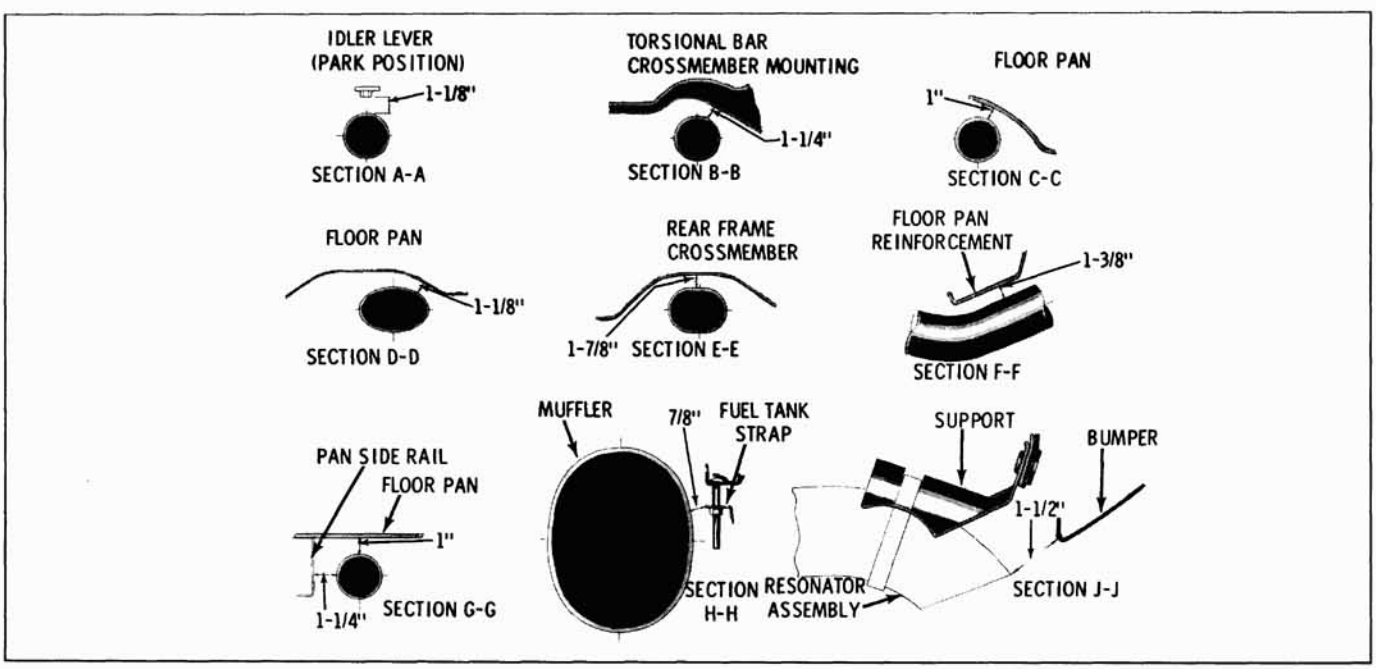


Fig. 8E-6—Exhaust System Connections

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below that specified.

APPLICATION	TORQUE
Fuel Tank Attaching Nuts	18 ft. lbs.
Exhaust Extension to Resonator Attaching Screws	18 in. lbs.
Clamp Attaching Nuts	13 ft. lbs.
Exhaust Pipe to Exhaust Manifold Attaching Bolts	14 ft. lbs.
Exhaust Extension Insulator to Frame Attaching Screws	13 ft. lbs.
Muffler Support to Frame Attaching Screws	13 ft. lbs.

STEERING

TORONADO

CONTENTS OF SECTION 9E

Subject	Page	Subject	Page
STEERING LINKAGE	9E-1	REMOVAL AND INSTALLATION	9E-3
PITMAN ARM	9E-1	COOLER ASSEMBLY	9E-3
IDLER ARM	9E-1	POWER STEERING PUMP	9E-4
TORQUE ADAPTER FORMULA	9E-2	STEERING WHEEL	9E-4
TIE ROD	9E-2	HORN CONTACT	9E-7
STEERING GEAR	9E-2	STEERING COLUMN	9E-7
OVER CENTER ADJUSTMENT	9E-2	TORQUE SPECIFICATIONS	9E-8

REPLACEMENT OF STEERING LINKAGE PARTS (Fig. 9E-1)

PITMAN ARM

Removal

1. Loosen the pitman arm nut on the pitman shaft using Tool BT-6704.
2. Remove the flexible coupling bolt at the gear side of the coupling.
3. Disconnect the pitman arm from the relay rod by removing the cotter pin, nut and using Tool J-22292.
4. Remove the three steering gear to frame attaching bolts and raise the steering gear to clear the pitman arm stud from the relay rod and position the steering gear forward enough to allow access to the pitman arm shaft nut.
5. Remove the loosened pitman arm shaft nut and remove the pitman arm using Tool J-5504.

Installation

1. Loosely position the new pitman arm onto the pitman shaft and snug up the pitman arm nut onto the pitman shaft.

Before installing the gear to the frame, lubricate the frame pads where the gear bolts to frame with a light coating of sodium soap fine fiber grease to prevent squeaks between the gear and frame.

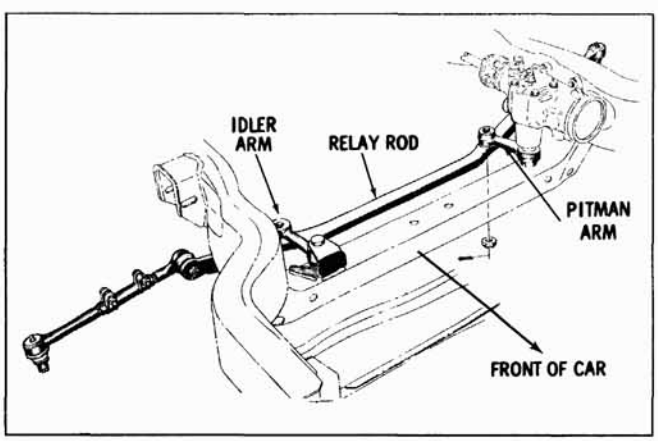


Fig. 9E-1—Steering Linkage

2. Slide the gear rearward and index the gear into the flexible coupling and install one gear to frame attaching bolt.
3. Install the pitman arm stud into the relay rod. Install the remaining gear to frame bolts and torque to 70 ft. lbs.
4. Torque the pitman arm shaft nut to 200 ft. lbs. using Adapter BT-6704 with wheels turned to the right. Refer to Torque Adapter Formula.
5. Install the pitman arm stud to relay rod nut and torque to 45 ft. lbs. Install cotter pin.
6. Reset toe in and steering wheel spoke alignment.

IDLER ARM

Removal

1. Disconnect the idler arm from the relay rod using Tool J-22292. (Fig. 9E-3)
2. Remove the idler arm to frame bracket attaching bolt and remove idler arm.

If using a backing wrench on the head of the bolt, be sure to position it in such a manner as to prevent any damage to the radiator core.

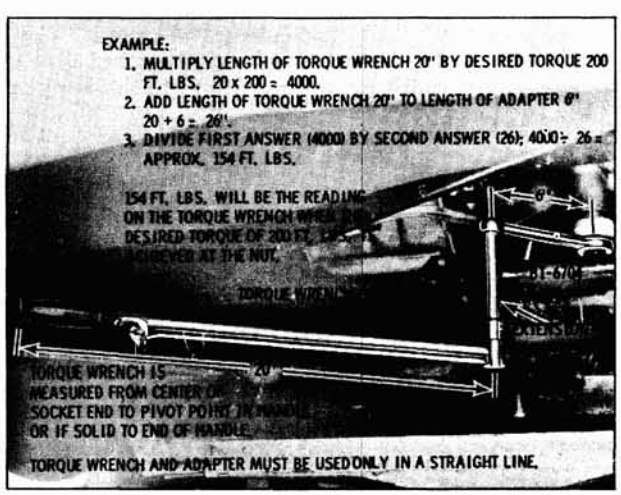


Fig. 9E-2—Torque Wrench with an Adapter Formula

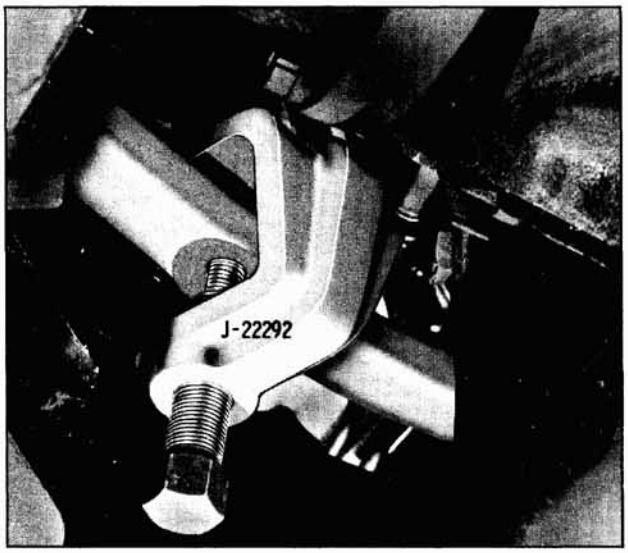


Fig. 9E-3—Disconnecting Relay Joint

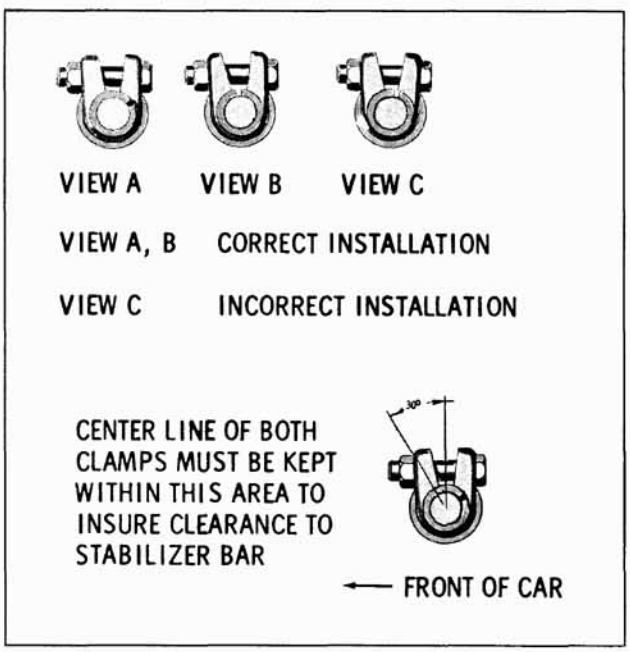


Fig. 9E-4—Tie-Rod Clamp Positioning

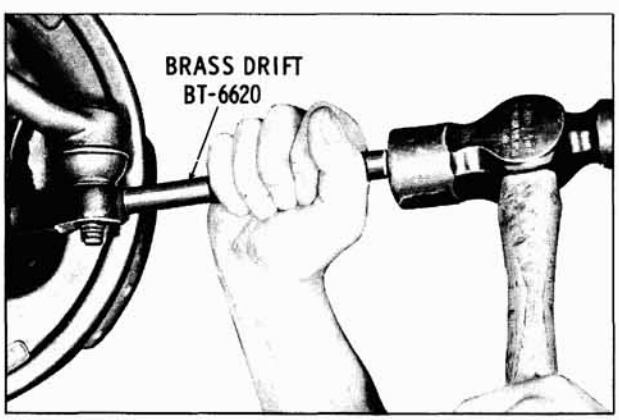


Fig. 9E-5—Removing Tie-Rod End

1. Install idler arm to frame and torque nut to 95 ft. lbs.
2. Reconnect the idler arm to the relay rod and torque nut to 45 ft. lbs. Install a new cotter pin.
3. Reset toe in and steering wheel spoke alignment.

TORQUE ADAPTER FORMULA (Fig. 9E-2)

When using a torque wrench with an adapter the reading on the torque wrench will not reflect the actual torque of the bolt because of the extra length of the combined torque wrench and adapter. To obtain the correct torque reading in these cases, use the following formula:

1. Multiply the length of the torque wrench by the number of pounds of the desired torque.
2. Add the length of the torque wrench to the length of the adapter.
3. Divide the first answer by the second answer. The result will be the corrected torque reading.

For example, if you have a 20" torque wrench and a 6" torque adapter and the specified torque is 200 ft. lbs., you would use the above formula as follows:

1. Multiply length of torque wrench (20") by the desired torque, 200 ft. lbs. 20 x 200 = 4000.
2. Add length of torque wrench (20") to length of adapter (6") 20 + 6 = 26.
3. Divide first answer (4000) by second answer (26) 4000 ÷ 26 = 154.

154 ft. lbs. will be the reading on the torque wrench when the desired torque of 200 ft. lbs. is achieved at the bolt.

TIE RODS

Remove and Install

Whenever the tie rod end is assembled to the tie rod and prior to assembling the tie rod end to the steering knuckle, make certain that an equal number of the tie rod and tie rod end threads are exposed at each end of the tie rod sleeve. Tie rod adjuster sleeve clamps must be kept within 30° of the vertical center line to insure clearance to stabilizer bar. (Fig. 9E-4)

Tie rod end joint to knuckle may be removed as shown in Fig. 9E-5. On installation torque to 45 ft. lbs.

STEERING GEAR

ADJUSTMENT (On Car)

OVER-CENTER ADJUSTMENT

The over-center adjustment is the only power steering gear adjustment which can be made on the car; however, in order to make this adjustment, it is also necessary to check the combined ball and thrust bearing pre-load.

1. Remove pitman arm from relay rod using Tool J-22292.
2. Loosen the pitman shaft adjusting screw locknut and thread the adjusting screw out to the limit of its travel through the pitman shaft side cover.
3. Disconnect the horn wire at the relay, then remove the horn button or ornament from the steering wheel.
4. Count the number of turns of the steering wheel through its full travel to locate the steering wheel at its center of travel.
5. Check the combined ball and thrust bearing pre-load with an inch-pound torque wrench on the steering shaft nut by rotating through the center of travel. Note the highest reading.
6. Tighten the pitman shaft adjusting screw until the torque wrench reads 4 to 8 in. lbs. higher than the previous reading on the steering shaft. The total over-center pre-load should not exceed 16 in. lbs.
7. While holding the pitman shaft adjusting screw, tighten the locknut and recheck the adjustment.

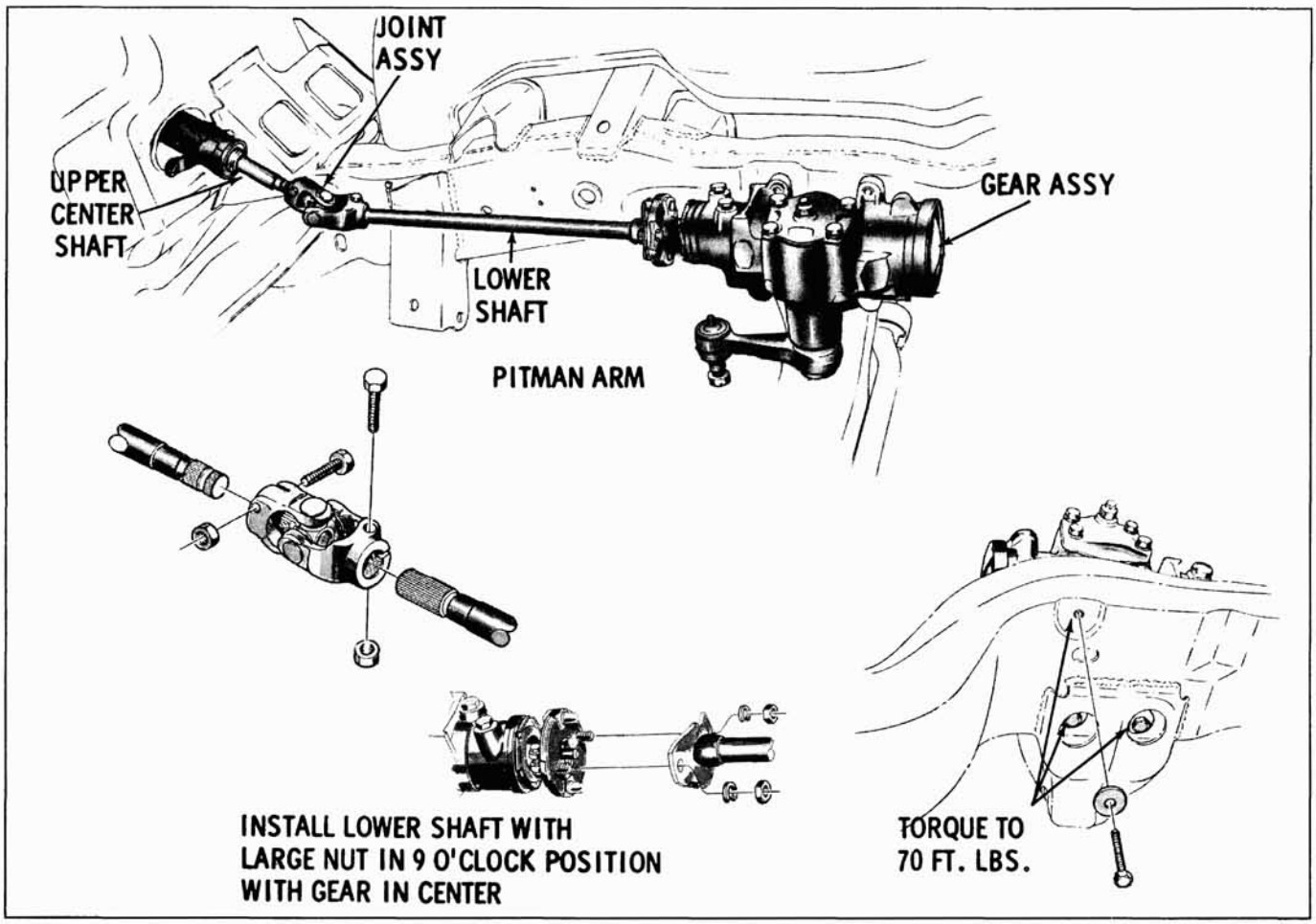


Fig. 9E-6—Steering Gear and Shaft Installation

8. Install the horn button or ornament and connect the horn wire. Connect the pitman arm to the relay rod. Torque pitman arm nut to 45 ft. lbs.

STEERING GEAR (Fig. 9E-6)

Removal and Installation

1. Remove the coupling flange hub bolt.
2. Disconnect the hoses from the pump and cap the pump and hose fittings.

On cars equipped with a cooler assembly disconnect the return hose at the inlet pipe of the cooler assembly.

3. Hoist the car.
4. Remove the pitman arm from the relay rod using Tool J-22292.
5. Remove the three bolts attaching the gear to the frame side rail, permit the lower shaft to slide free of the coupling flange, then remove the gear with the hoses attached.

Before installing the steering gear, apply a sodium soap fine fiber grease to the gear mounting pads to prevent squeaks between the gear housing and the frame. Make certain there is a minimum of .040" clearance between coupling hub and steering gear upper seal. Install the coupling flange hub bolt and torque to 18 ft. lbs. Before tightening the steering gear to frame bolts, shift the steering gear as necessary to place it in the same plane as the steering shaft so that the flexible coupling is not distorted. Tighten the steering gear to frame bolts to 70 ft. lbs. Install pitman arm to relay rod. Torque nut to 45 ft. lbs. Install cotter pin.

After the hoses are connected to the pump, add power steering fluid as necessary to bring the fluid level to the full mark. Run engine at idle for 30 seconds, then run at fast idle for one minute before turning steering wheel. With the engine running, turn the steering wheel through its full travel two or three times to bleed air from the system. Recheck the oil level and add oil if necessary.

COOLER ASSEMBLY

Removal

1. Remove vacuum reserve tank. (Fig. 9E-7)
2. Remove three attaching screws, cooler to L.H. Filler Plate and lower radiator support. (Fig. 9E-8)
3. Remove return hoses from cooler pipes and cap return hoses.
4. Remove cooler assembly through L.H. filler plate opening.

Installation

1. Install cooler assembly through L.H. filler plate opening and install three attaching screws to L.H. filler plate and lower radiator support. (Fig. 9E-8)
2. Remove protective caps and install return hoses to cooler pipes using new clamps.
3. Fill pump reservoir with fluid No. 1050017 or equivalent and start engine. Add additional fluid as needed to retain fluid level at the full mark.
4. Check for leaks. Repair as necessary.
5. Stop engine.

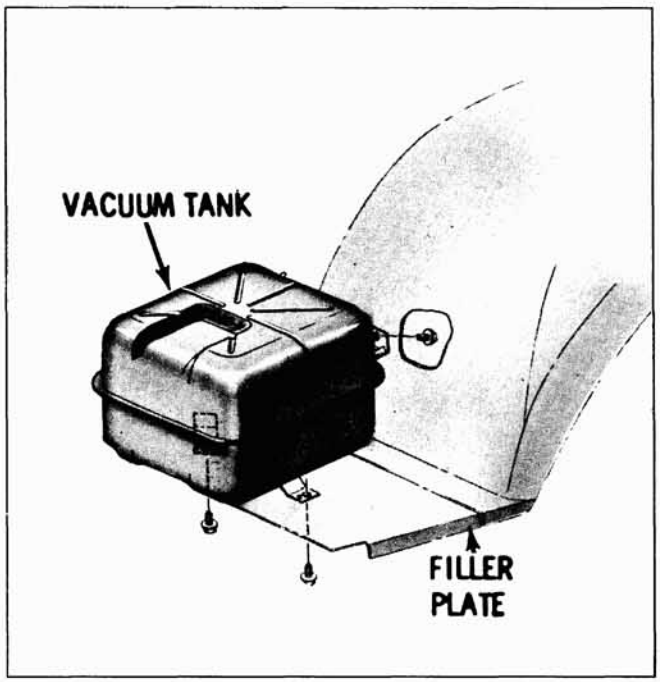


Fig. 9E-7—Vacuum Reserve Tank Mounting

6. Install vacuum reserve tank. (Fig. 9E-7)

POWER STEERING PUMP

Removal

1. Loosen power steering pump pulley nut. Do not loosen belt tension as tension will aid in holding pulley.
2. Remove power steering pump belt.

On A.C. equipped cars, generator belt will have to be loosened first.

3. Remove pump pulley nut and pulley.
4. Remove nuts "A", "B" and screw "C", then remove bolt and nut "D". (Fig. 9E-9)
5. Move pump away from engine and disconnect hoses from pump. Plug the hoses so that no impurities will contaminate fluid. Cap the pump fittings.

Installation

To install, reverse removal procedures.

Torque - Nuts "A" and "D" and screw "C" to 20 ft. lbs. Nut "B" to 30 ft. lbs. Pump pulley nut to 60 ft. lbs.

Fill reservoir with fluid No. 1050017 or equivalent, then bleed pump by turning pulley counterclockwise until air bubbles cease to appear. Refill reservoir to proper level. Adjust pump belt as outlined under PUMP BELT ADJUSTMENTS, Section 9.

STEERING WHEEL (Figs. 9E-10 and 9E-11)

Removal

1. Pry emblem up to disengage locking tang.

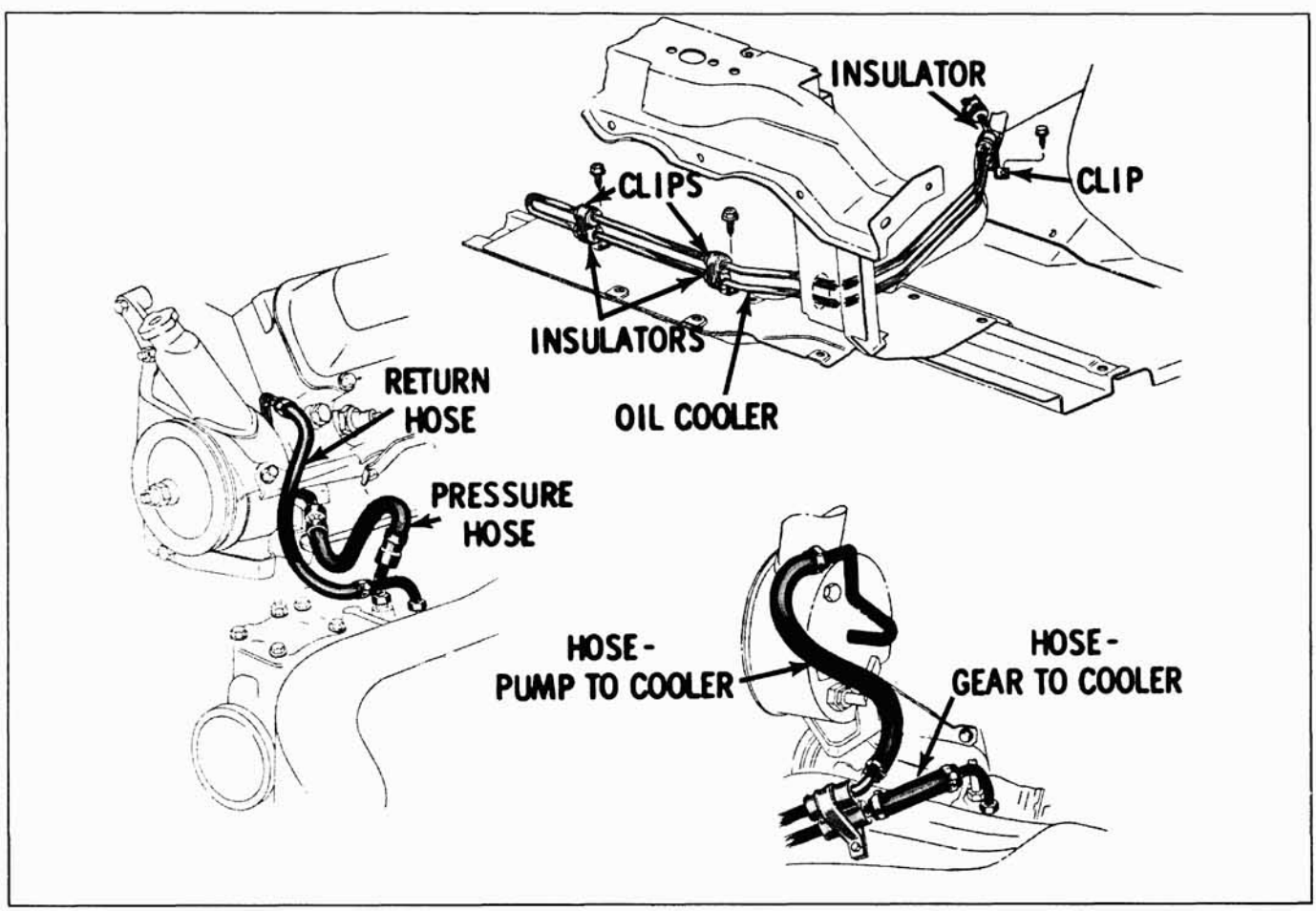


Fig. 9E-8—Power Steering Pump and Cooler Hose Routing

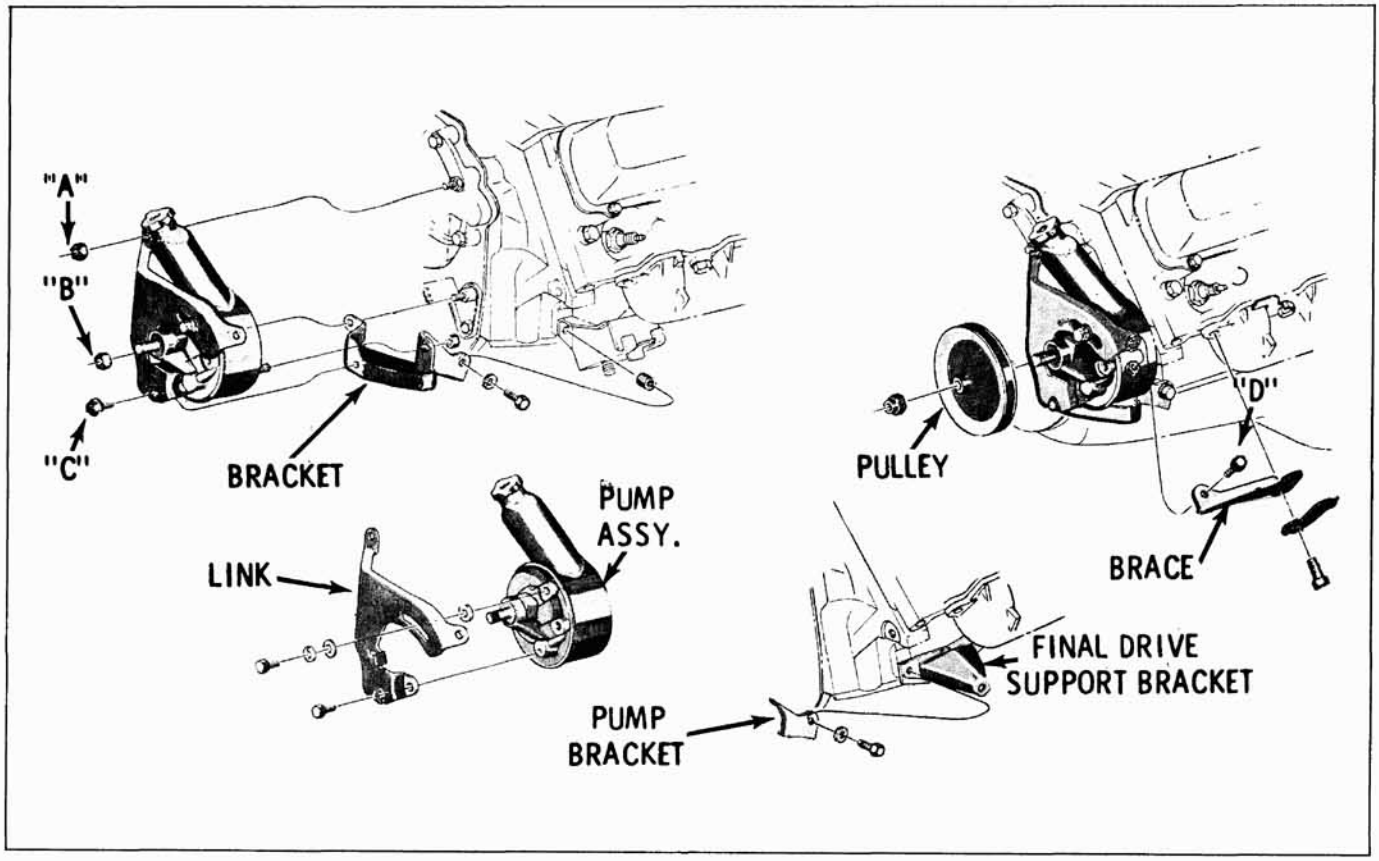


Fig. 9E-9—Power Steering Bracket Mountings

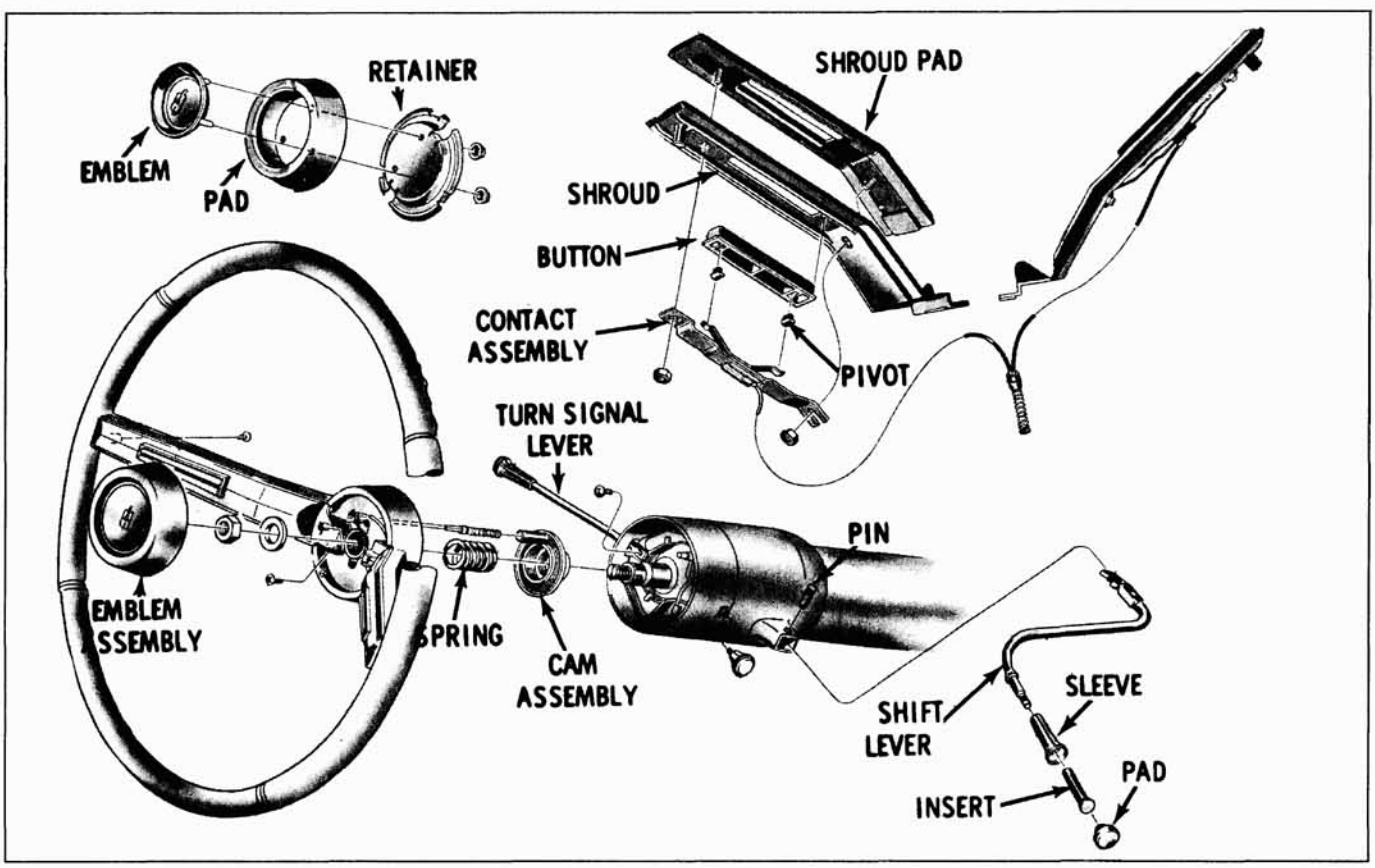


Fig. 9E-10—Deluxe Steering Wheel

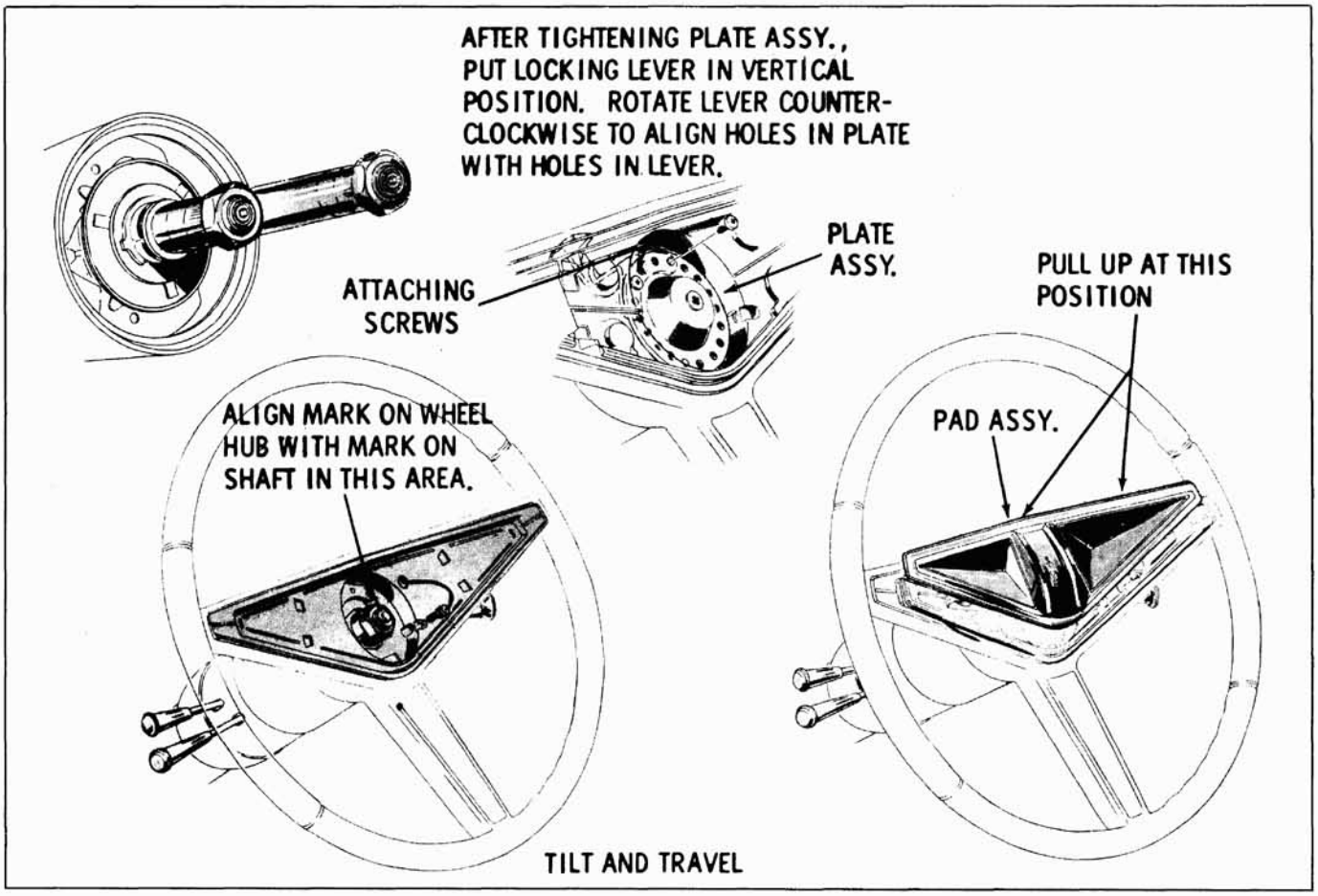


Fig. 9E-11—Tilt and Travel Steering Wheel

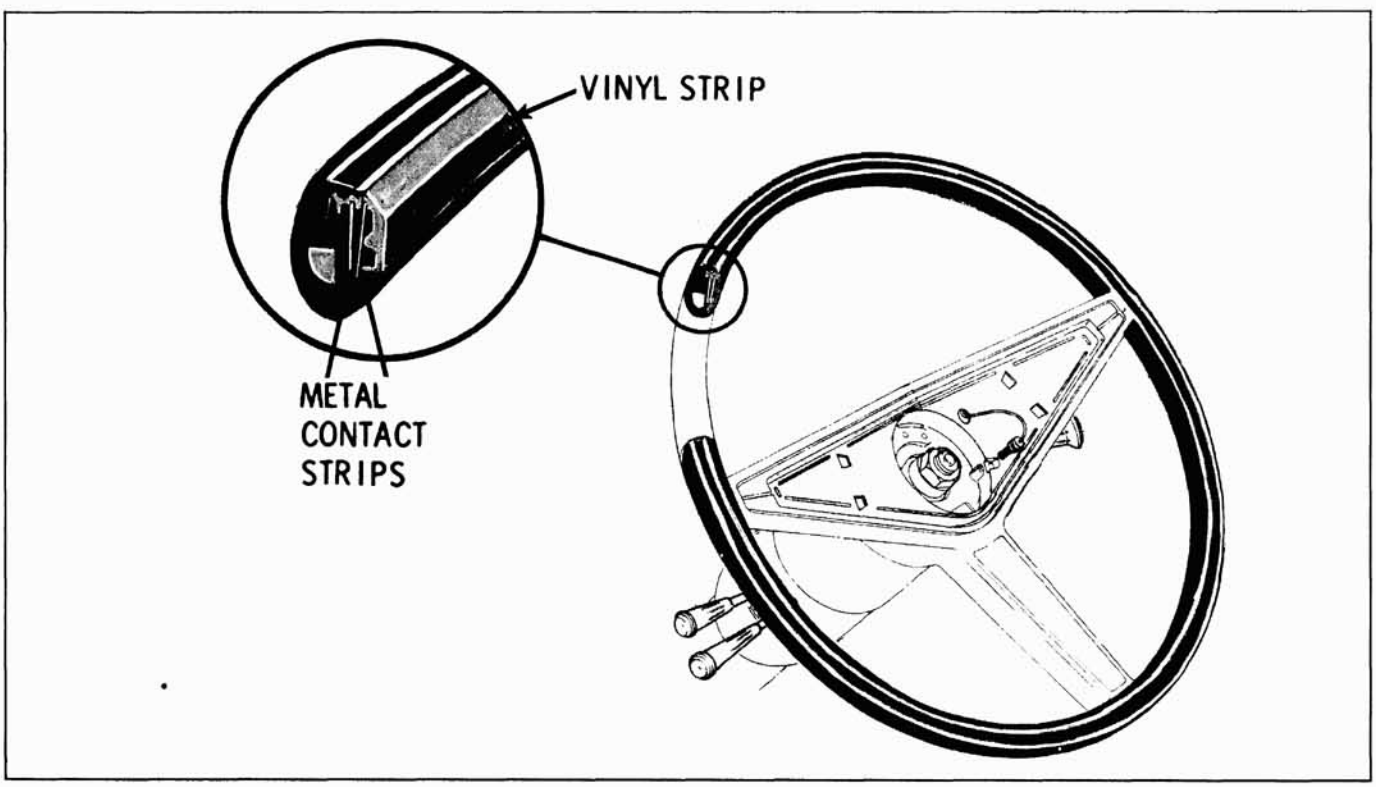


Fig. 9E-12—Horn Contact - Tilt and Travel

2. Remove steering wheel attaching nut and washer, then using a puller such as BT-61-9, remove the steering wheel from the steering shaft. Remove puller from steering wheel.

Installation

1. With the marks on the steering wheel and steering shaft aligned, install the wheel, flat washer and nut.

When mark on steering wheel hub and shaft are lined up, wheel spokes should be horizontal as car is driven straight ahead.

If spokes are not horizontal, it will be necessary to adjust the tie rod ends until steering wheel assumes its proper position. When a new steering gear is installed, it may be necessary to adjust steering wheel spoke alignment even though spoke alignment had been correct for the old gear.

2. Torque the nut to 35 ft. lbs.
3. Align tangs of emblem with contact hole in wheel assembly. Push in to lock.

HORN CONTACT

The horn contact for deluxe wheel is installed as shown in Fig. 9E-10.

The horn contact on the tilt and travel wheel is not serviced. (Fig. 9E-12)

STEERING COLUMN (Fig. 9E-13)

Removal

1. Disconnect negative battery cable.
2. Remove steering wheel.
   Deluxe-Refer to Steering Wheel-Section 9E.
   Tilt and Travel-Refer to Steering Wheel-Section 9.
3. Disconnect shift levers from lower end of column.
4. Place daub of paint on steering shaft at slot in joint assembly and then remove bolt from joint assembly.
5. Disconnect turn signal and cornering light wiring connectors.
6. Disconnect neutral start and back-up wiring connectors.
7. Remove shift indicator needle.
8. Remove bolts from inner and outer covers at floor pan (Fig. 9E-13)
9. Remove four bolts "Z" from clamp assy. (Fig. 9E-13)
10. Remove nut "C" (Fig. 9E-13)
11. Remove nuts "A" and "B" (Fig. 9E-13) Remove clamp assy. and wedge.
12. Carefully lift steering column from inside of car.

All elements of energy absorbing steering columns are sensitive to damage and MUST BE HANDLED WITH CARE.

13. Install column in vise using holding fixture J-22573.

Installation

1. Remove column from holding fixture and carefully position through toe-pan. With the aid of a helper at lower end of column, align paint mark on joint assy. onto shaft from gear. Attach bolt loosely. Torque to 80 ft. lbs.
2. Loosely attach clamp assy. to support with wedge and install nuts "A" and "B" (Fig. 9E-13) loosely.
3. Install 4 bolts "Z" to bracket. Torque to 15 ft. lbs.
4. With the aid of a helper, align flex coupling and torque nuts "A" and "B" to 20 ft. lbs.
5. Position wedge rearward until finger tight and install nut "C" and torque to 20 ft. lbs.
6. Install toe pan screws ("1") and torque to 4 ft. lbs. (Fig. 9E-13)
7. Install toe pan clamp screws ("2") and torque to 4 ft. lbs.
8. Install remaining toe pan screws ("3") and torque to 4 ft. lbs.
9. Connect neutral start and back-up wiring connector.

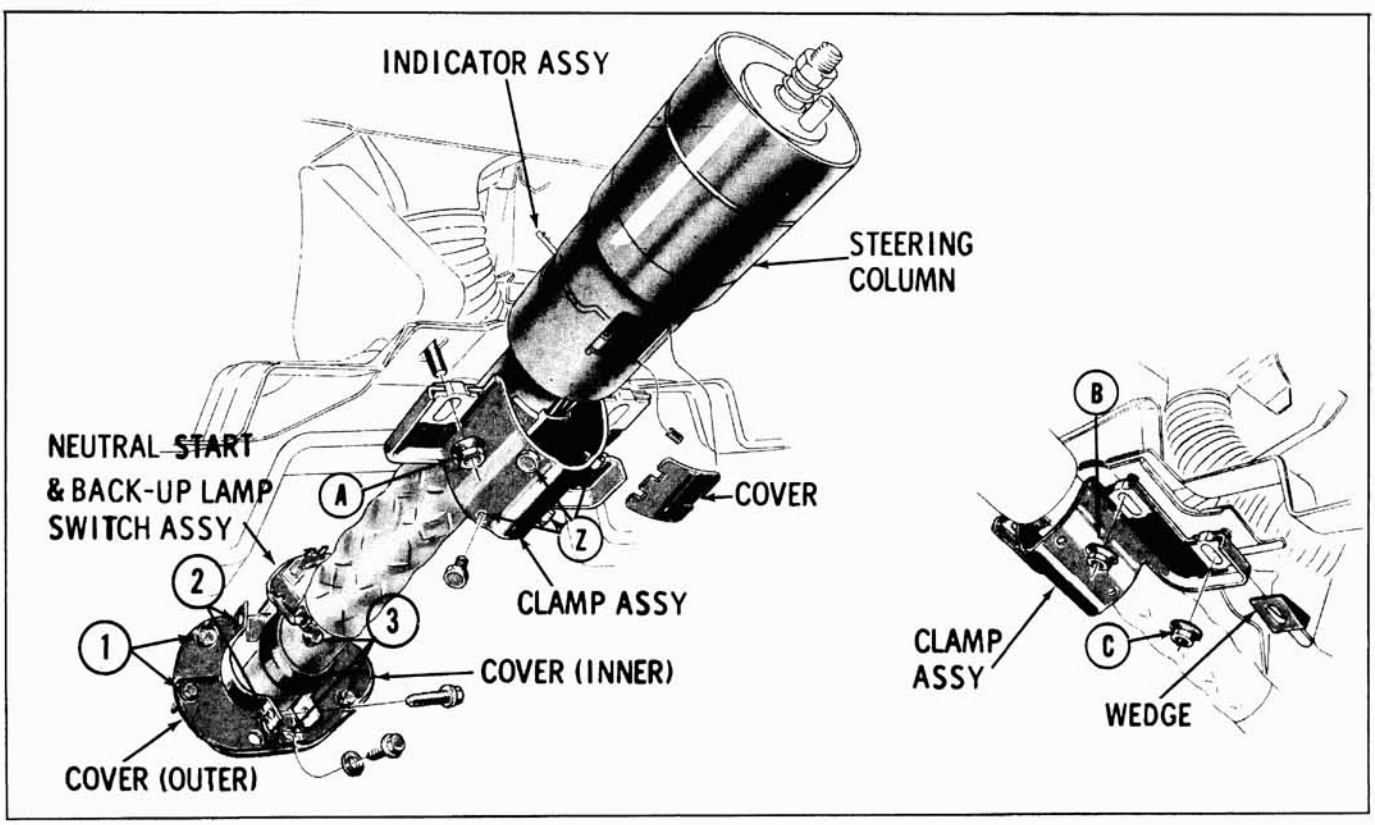


Fig. 9E-13—Steering Column

10. Connect turn signal and cornering light wiring connectors.
11. Install shift indicator needle.
12. Connect shift levers at lower end of column.
13. If neutral start and or back-up switch was removed, refer to Section 9A, Fig. 9A-105 for adjustment procedures.
14. Install steering wheel. Torque nut to 35 ft. lbs.
15. Connect negative battery cable.

TORQUE SPECIFICATIONS

APPLICATION	FT. LBS.
Pitman Shaft Nut	200
Pitman Arm to Relay Rod Nut	45 Min.
Idler Arm to Relay Rod Nut	45
Idler Arm to Bracket Nuts	95
Tie-Rod End to Knuckle Nut	45
Companion Flange Nuts	18
Steering Gear to Frame Bolts	70
Steering Wheel Nut	35
Lower Center Shaft to Joint Bolt	60
Lower Shaft to Joint Bolt	60

WHEELS AND TIRES

TORONADO

CONTENTS OF SECTION 10E

Subject	Page	Subject	Page
GENERAL DESCRIPTION	10E-1	SPARE TIRE STORAGE	10E-1
MAINTENANCE RECOMMENDATIONS	10E-1	TIRE SIZES	10E-1
TIRE ROTATION	10E-1	TIRE RUNOUT	10E-1
TIRE INFLATION	10E-1		

GENERAL DESCRIPTION

The factory installed tires are engineered specifically for the Toronado. These tires are designed to operate satisfactorily with loads up to and including the full rated load capacity, when inflated to the recommended pressures.

Correct tire pressures and driving technique have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear. When replacement is necessary, the original equipment type tire should be used.

MAINTENANCE RECOMMENDATIONS

Tire Rotation

To equalize wear it is recommended that the four road tires be rotated at least every 6,000 miles as shown in Fig. 10E-1. It is not necessary to rotate the spare.

Tire Inflation

Recommended inflation pressure is 24 lbs. front and 22 lbs. rear when tires are cool. When the car is driven a few miles, tires warm up causing pressure increase. If pressures are checked when tires are warm, they may be up to 6 lbs. higher. Tires should be properly inflated, and inflation pressures checked regularly, including the spare tire.

Spare Tire Storage

The spare tire, jack assembly and wrench are stored as shown in Fig. 10E-2.

Tire Size

The standard tire size for Toronado with or without air conditioning is 8.85 x 15. A 235R15 radial ply is available as an option.

TIRE AND WHEEL RUNOUT

Inflate tires to recommended pressure. Tires should be checked immediately after car has been driven to avoid false readings due to the tendency of tires to take a temporary "set" after standing for a period of time.

Wheels and tires can be checked for runout at points indicated and should not exceed the following limits. (Fig. 10E-3)

Tire and Wheel Assembly	- Radial - Lateral	.060" .085"
Wheel	- Radial - Lateral	.035" .045"

TIRE INFORMATION

The factory installed tires are selected to provide the best all around tire performance for normal operation. They are also designed to operate satisfactorily with loads up to and including the full rated load capacity when inflated to the recommended pressure.

The over-all tire wear is about the same as on rear wheel drive cars of comparable weight. However, correct tire pressures and driving technique have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear. When replacement is necessary, the original equipment type tire should be used.

TIRE ROTATION

As on any vehicle, traction can be adversely affected by lack of tire tread, so worn tires should be replaced before the tread is completely gone.

Factory installed tires incorporate built-in tread wear indicators to assist in determining when the tires have been worn to the point of needing replacement. These indicators are molded into the bottom of the thread grooves and will appear as 1/2-inch wide bands when the tire tread depth becomes 1/16th of an inch. When the indicators appear in two or more adjacent grooves, tire replacement due to tread wear is recommended.

So that tires are exposed to equal and balanced wear, it is recommended that the four road tires be rotated at least every 6,000 miles, in accordance with the Fig. 10E-1. It is not necessary to rotate the spare. Torque wheel nuts to 115 ft. lbs.

INFLATION PRESSURES

To insure the proper tire inflation follow the recommendations in the tire inflation pressures table. Keep tires properly

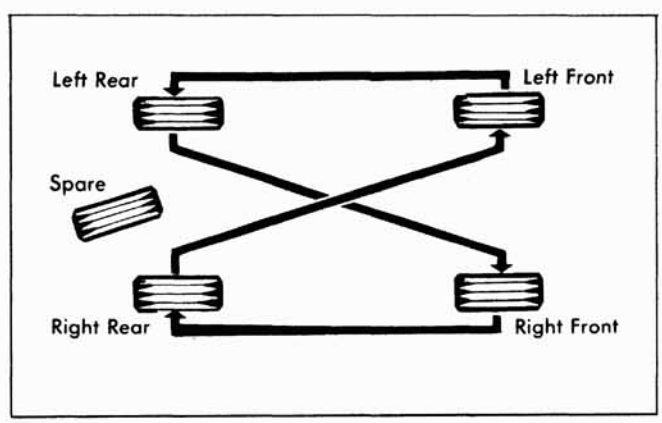


Fig. 10E-1—Tire Rotation

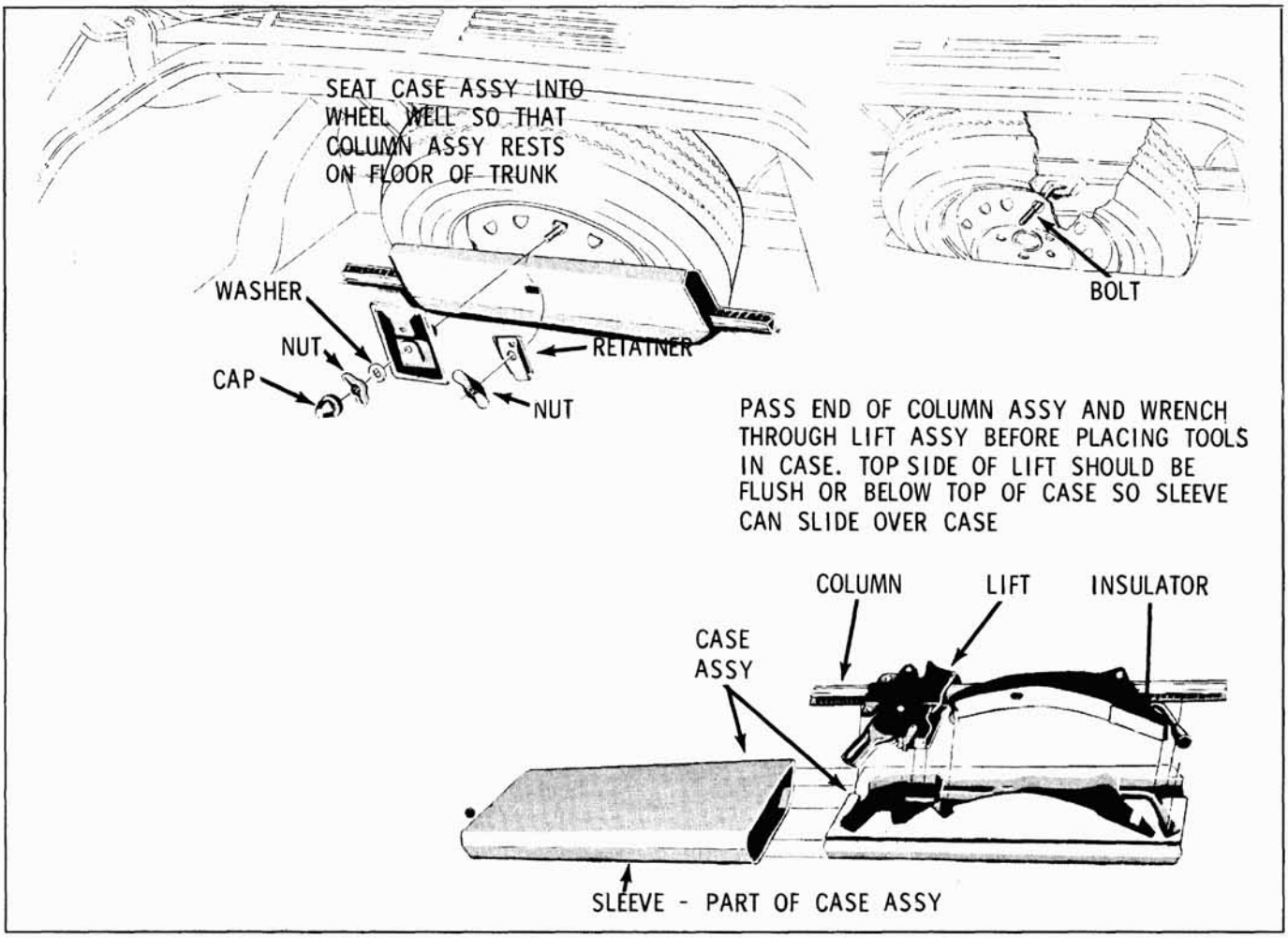


Fig. 10E-2—Spare Tire and Jack Storage

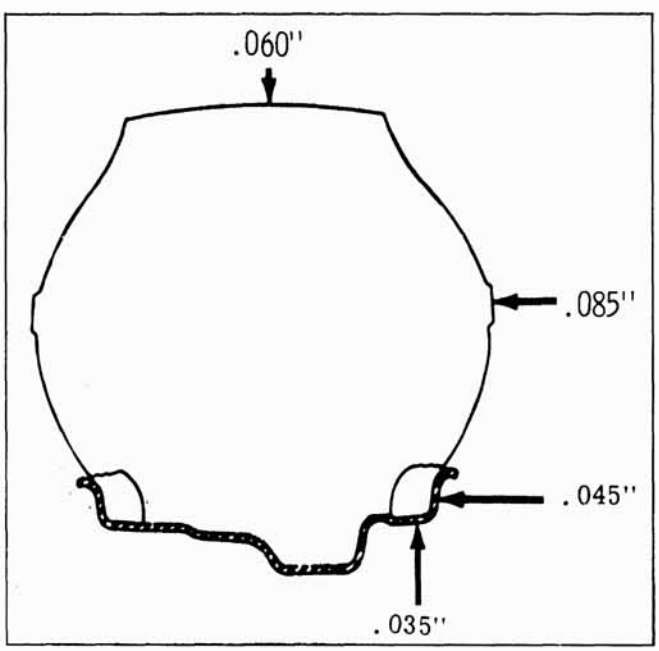


Fig. 10E-3—Tire and Wheel Runout

inflated, and check inflation pressures periodically. This will insure the best tire life and riding comfort, over the full range of driving conditions.

RECOMMENDED COOL TIRE INFLATION PRESSURES - POUNDS PER SQUARE INCH			
		* Normal Inflation All Loads	
SERIES	TIRE PLY	Front	Rear
Toronado	2 (4-Ply Rating) & Radial Ply	24 Lbs.	22 Lbs.

*When the car is driven a few miles, tires warm up causing pressure increase. If tire pressures are checked when tires are warm they may be up to 6 pounds higher than the pressures shown on the chart.

For continuous high speed operation (over 75 mph) increase tire pressure (cool) 4 pounds over the above recommended inflation pressures up to a maximum of 32 psi for 4 ply rating tires.

Over inflation at light loads will have an adverse effect on the car ride and tire tread wear pattern. Under inflation will promote heat and abnormal wear.

VEHICLE LOAD CAPACITY AND DISTRIBUTION

Full load capacity is:		
SERIES Toronado	1100 Lbs. Total:	3 Passengers Front Seat 3 Passengers Rear Seat 200 Pounds Luggage
When towing trailers, the allowable passenger and cargo load must be reduced by an amount equivalent to the trailer tongue load on the trailer hitch.		

FRONT WHEEL BALANCING

Balancing front wheels on the Toronado using on-car balancing equipment and using engine power to spin the wheels requires the following:

1. Set parking brake.
2. Block opposite wheel being balanced.

Do not exceed a speedometer reading of 35 mph while spinning the wheel.

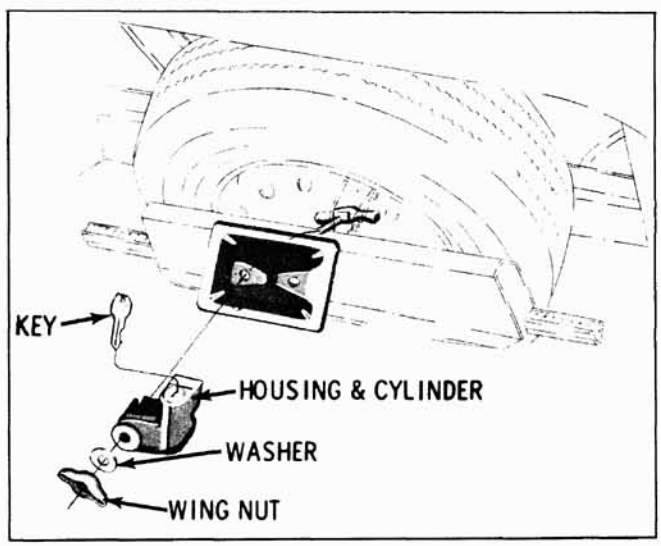


Fig. 10E-4—Spare Wheel Lock

CHASSIS SHEET METAL

TORONADO

CONTENTS OF SECTION 11E

Subject	Page
HOOD ASSEMBLY	11E-1
HOOD HINGE SPRING	11E-1
HOOD HINGE	11E-2
HOOD LATCH ASSEMBLY	11E-2
RADIATOR SUPPORT ASSEMBLY	11E-2
HOOD MOLDINGS	11E-3
REMOVAL	11E-4
INSTALLATION	11E-5
FILLER PLATE	11E-6
MOLDINGS	11E-6
HEADLAMP ACTUATOR DOOR	11E-6
HEADLAMP ASSEMBLY	11E-7
HEADLAMP VACUUM ACTUATOR ASSEMBLY	
OPERATION (EXC. W-34)	11E-7
OPERATION (W-34 ONLY)	11E-7

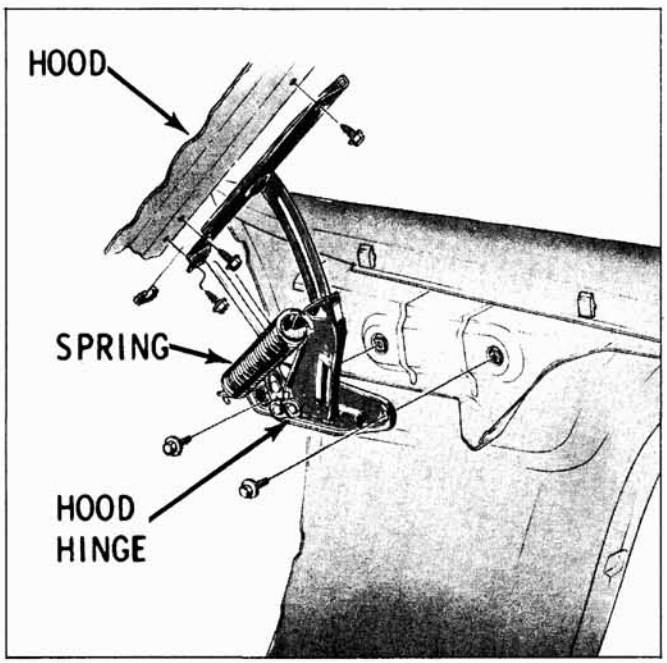


Fig. 11E-1—Hood Hinge Attachment

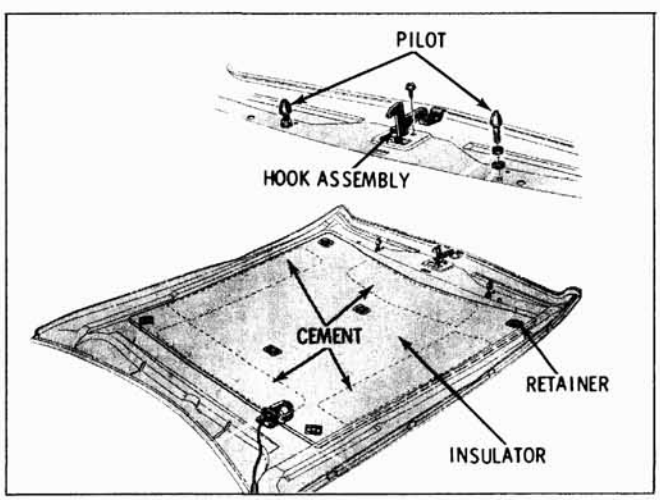


Fig. 11E-2—Hood Insulator

HOOD ASSEMBLY

Removal and Installation

Prior to removal of the hood, it is suggested that adjoining areas be covered to prevent damage.

With the hood supported, scribe the hinge position on the hood reinforcement and remove the two hinge to hood screws from each hinge. (Fig. 11E-1)

When installing hood, position the hood to the scribed lines, torque screws to 25 ft. lbs. The hinge is provided with elongated holes for alignment and if necessary, shift hood to properly align. If necessary to install a new hood insulator, refer to Fig. 11E-2.

HOOD HINGE SPRING

Removal and Installation

To remove the spring from the hood hinge, raise hood approximately 12" and place Tool BT-6813 over the spring. (Fig. 11E-3) Raise hood and the spring will unhook. Block hood in this position and remove spring.

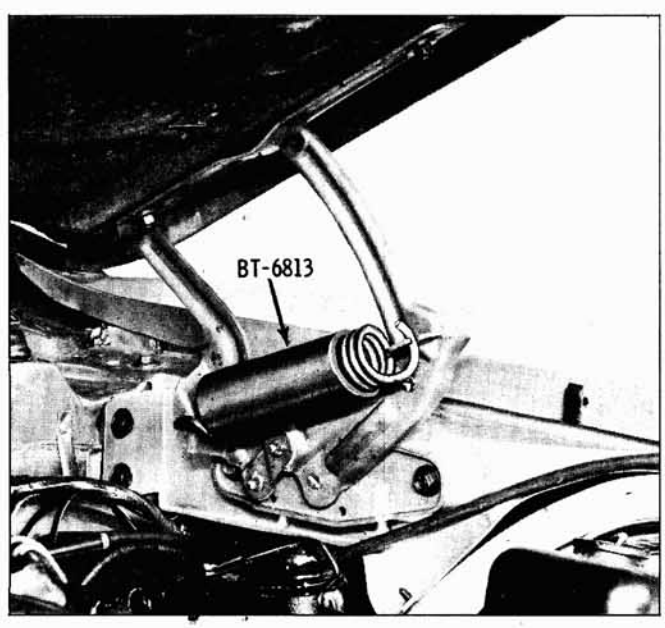


Fig. 11E-3—Hinge Spring Tool in Position

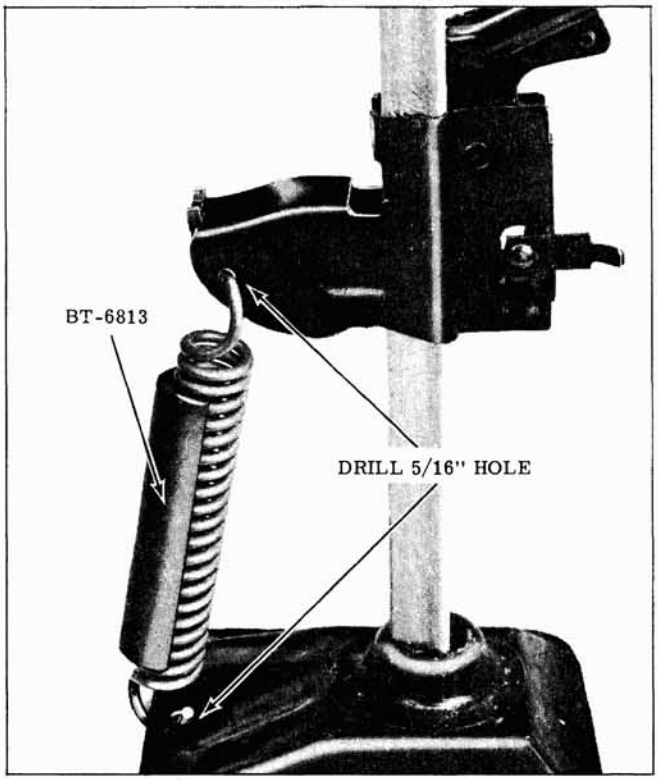


Fig. 11E-4—Installing Hinge Spring Tool

When installing a new spring, stretch the spring (Fig. 11E-4) and place Tool BT-6813 over the spring. Position spring (with tool in place) on hinge. Lower hood slightly to expand spring, then remove tool.

HOOD HINGE

Removal and Installation (With Spring Removed)

Place protective covers on fender at hinge area. Mark the hinge outline on fender and hood to facilitate alignment. (Fig. 11E-1) Support the hood at front and rear and remove the two hinge-to-hood screws, then remove the hinge-to-fender screws.

Using the scribe marks as a guide, install the hinge screws and torque to 25 ft. lbs. Check hood alignment after hinge installation. The hinge is provided with elongated holes for alignment and if necessary, shift hood to properly align.

HOOD LATCH ASSEMBLY (Fig. 11E-5)

The hood latch assembly is bolted to the radiator support assembly. Four bolts retaining the latch assembly to the radiator support are accessible from the top side. Remove the clip from rod. Remove attaching bolts and remove latch assembly through opening between top of front bumper and radiator support. The bolt holes are oversize for alignment purposes. The assembly should be lubricated periodically with lubriplate. Torque screws to 20 ft. lbs.

RADIATOR SUPPORT ASSEMBLY (Fig. 11E-5)

The radiator support assembly is a welded assembly and will be serviced as a complete assembly.

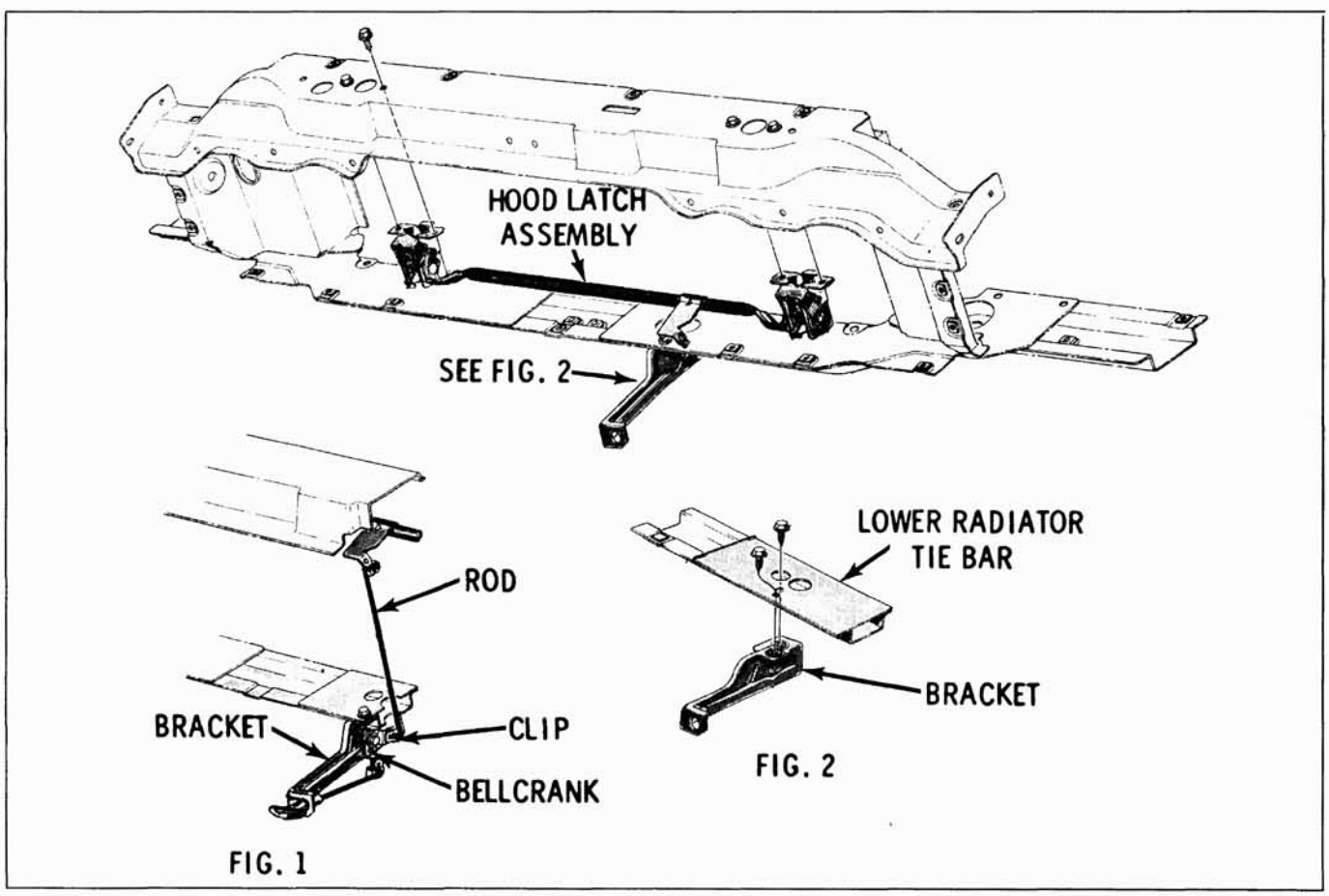


Fig. 11E-5—Hood Latch and Radiator Support Assembly

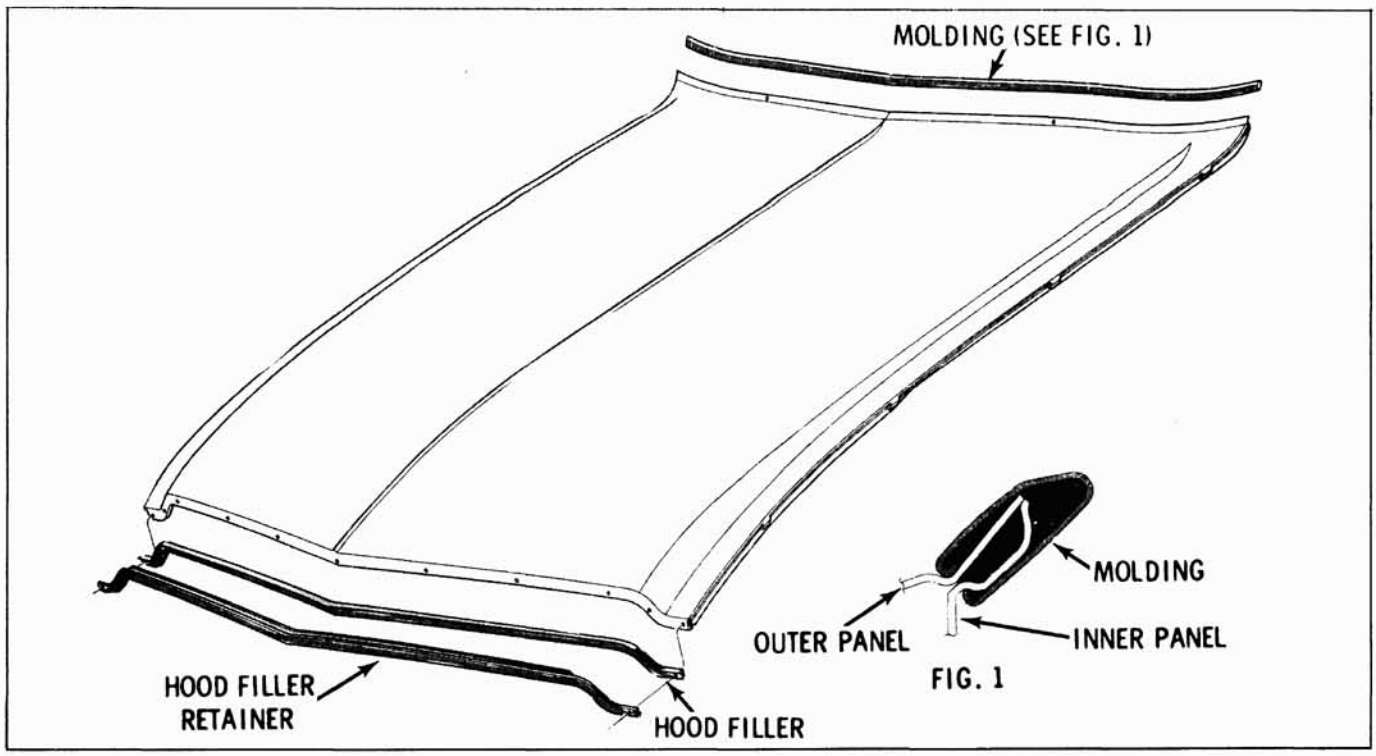


Fig. 11E-6—Hood Moldings

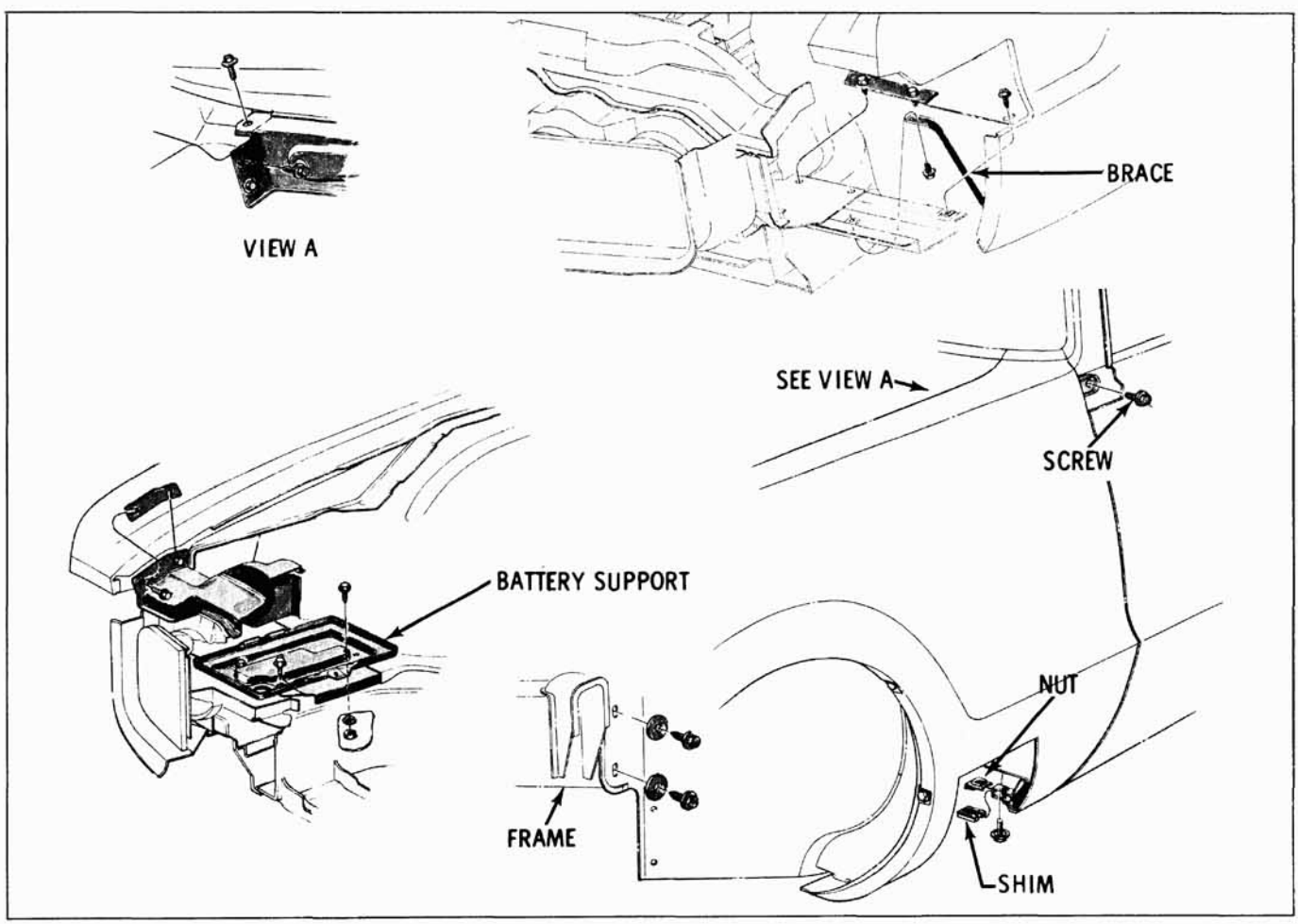


Fig. 11E-7—Fender Installation

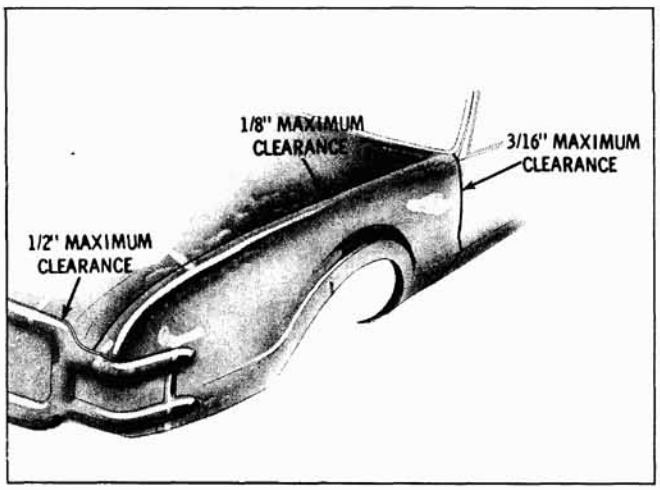


Fig. 11E-8—Sheet Metal Clearance

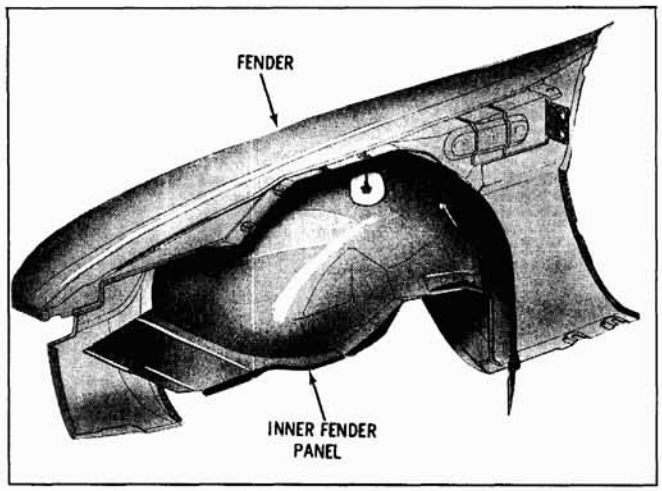


Fig. 11E-9—Fender Filler Plate Attachment

FENDER ASSEMBLY

Removal

1. Remove bumper (refer to Bumper Section).
2. Remove the screws indicated in Fig. 11E-7.
3. Remove the 4 screws at valance panel.
4. Remove two attaching bolts from lower fender brace.
5. Remove hood hinge to fender attaching screws and support hood.
6. For right fender, if equipped with antenna, it will be necessary to:
   a. Loosen plastic nut and remove mast assembly.
   b. Remove the lead-in assembly mounting nut, upper spacer and gasket.
   c. Push the lead-in assembly down through the fender and body.

It will be necessary to remove battery (right side) and vacuum tank and headlamp remote control valve. (left side).

7. Along inner fender flange, remove five screws securing fender filler to fender. (Fig. 11E-9)
8. Remove wheel opening molding.
9. Along edge of wheel opening, remove six screws securing fender filler to fender. (Fig. 11E-10)

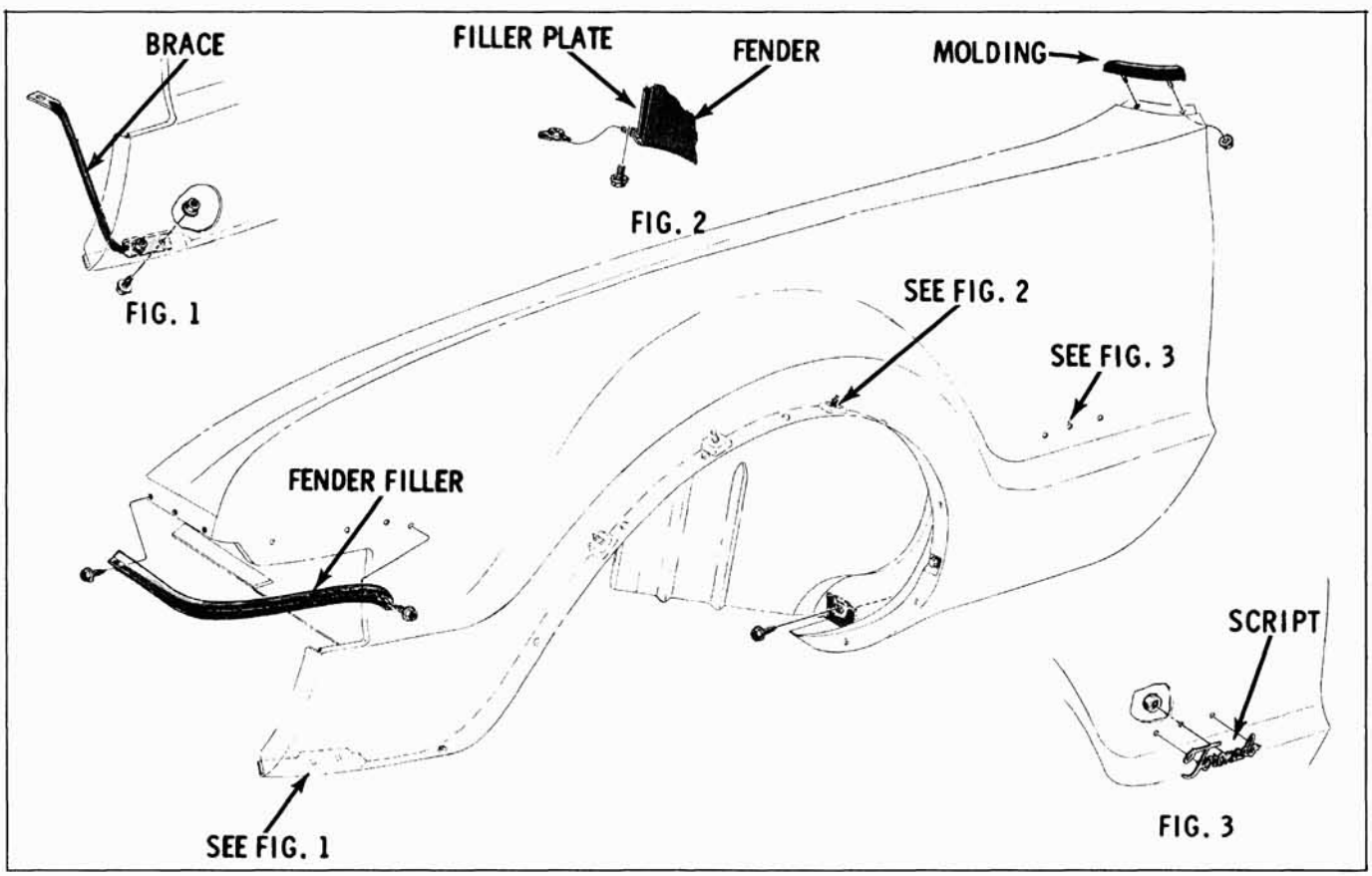


Fig. 11E-10—Fender Filler Plate and Moldings

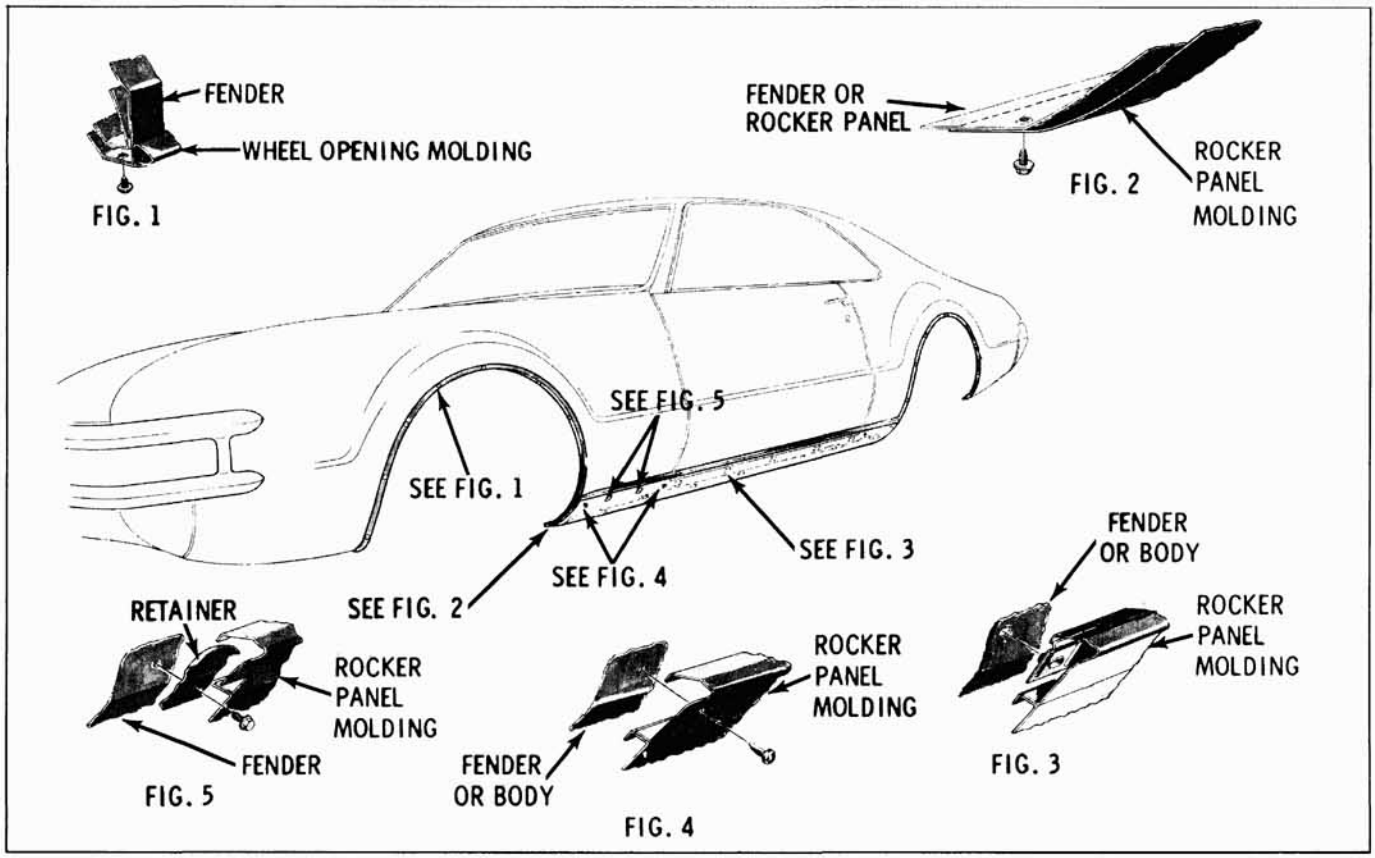


Fig. 11E-11—Wheel Opening and Rocker Moldings

10. Remove rocker panel molding.
11. Remove fender.

Installation

To install the fender, reverse the removal procedure. Refer to ACCESSORIES Section for antenna installation. The fender attaching bolt holes are elongated to permit adjustment and, in addition, there are shims available to be used at proper locations. Shim locations are used to obtain alignment of the fender to the door. (Fig. 11E-8)

When installing a fender, tighten the attaching bolts just enough to permit shifting as required. After proper alignment is obtained, tighten all attaching screws and bolts. Torque

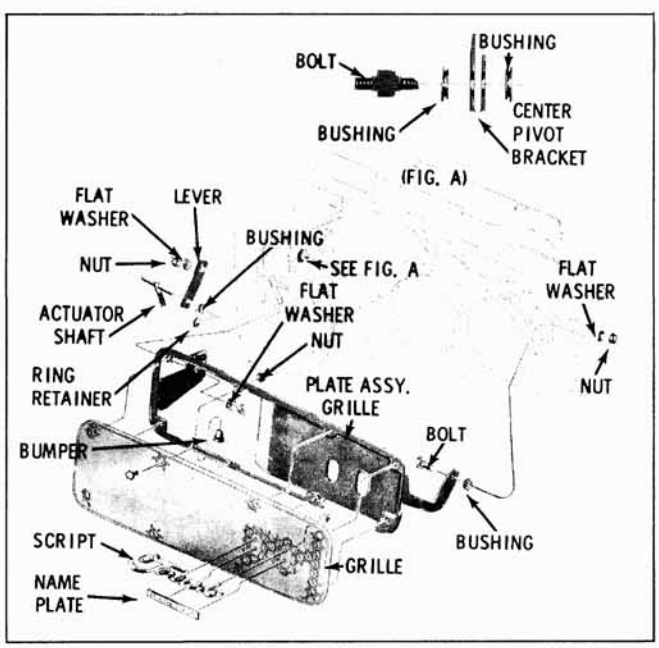


Fig. 11E-12—Headlamp Actuator Door

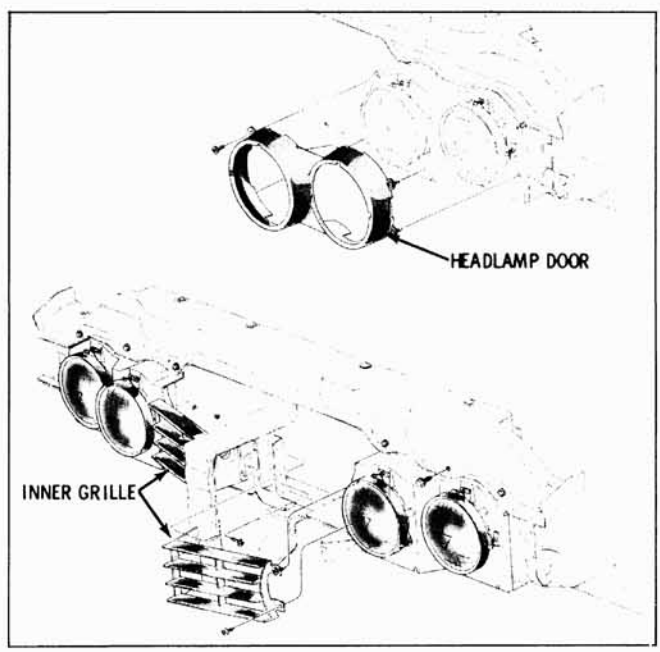


Fig. 11E-13—Headlamp Assembly

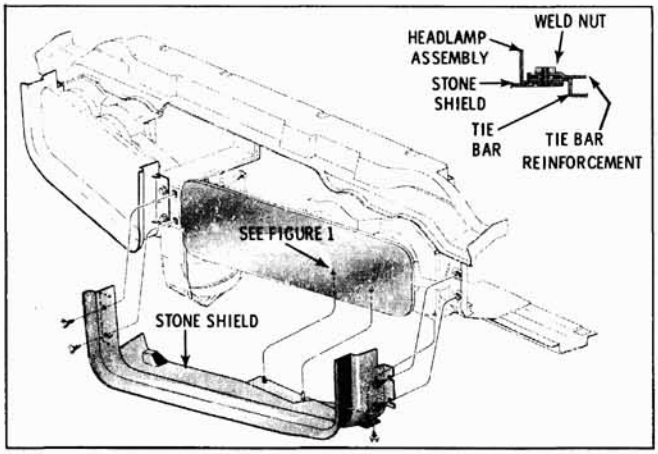


Fig. 11E-14—Stone Shield

fender-to-body bolts to 25 ft. lbs. Torque remaining screws to 20 ft. lbs. Refer to Bumper Section for bumper alignment.

FILLER PLATE (Fig. 11E-9 and 11E-10)

Removal

1. Raise car, support on floor stands, remove wheel assembly.
2. Remove fender as outlined.
3. If side being serviced has battery support attached, remove battery support.
4. For left side, remove windshield washer jar and power steering line bracket.
5. Disengage wiring harness clips from filler plate.
6. For right side, disconnect wiring from horn relay junction block, buzzer assembly and disconnect ground wire.
7. Remove filler plate to radiator support bolt.
8. Remove filler plate to frame bolts.
9. Remove filler plate.

If equipped with comfortron for right side, remove range relay. If equipped with U.H.V. ignition system, remove amplifier. Torque all attaching screws to 20 ft. lbs.

To install, reverse removal procedure.

MOLDINGS

Fender moldings, script, and rocker panel moldings:

To remove moldings and script refer to Figs. 11E-10 and 11E-11.

Brush a thick application of sealer over studs and nuts of moldings and scripts after assembly.

HEADLAMP ACTUATOR DOOR

Remove and Replace (Fig. 11-12)

1. On left side, remove three attaching bolts on vacuum tank. Slide vacuum tank over and remove bolt and nut from outer end of door. On right side, it will be necessary to remove battery.
2. Remove retainer from actuator pin and disconnect pin from actuator door.
3. Remove two screws from end of inner grille.
4. Remove nut from inner end of actuator door.
5. Open actuator door to full open position and remove actuator door.

To install, reverse removal procedure.

When installing actuator door, tape bushing to brackets to prevent loss of bushing during assembly.

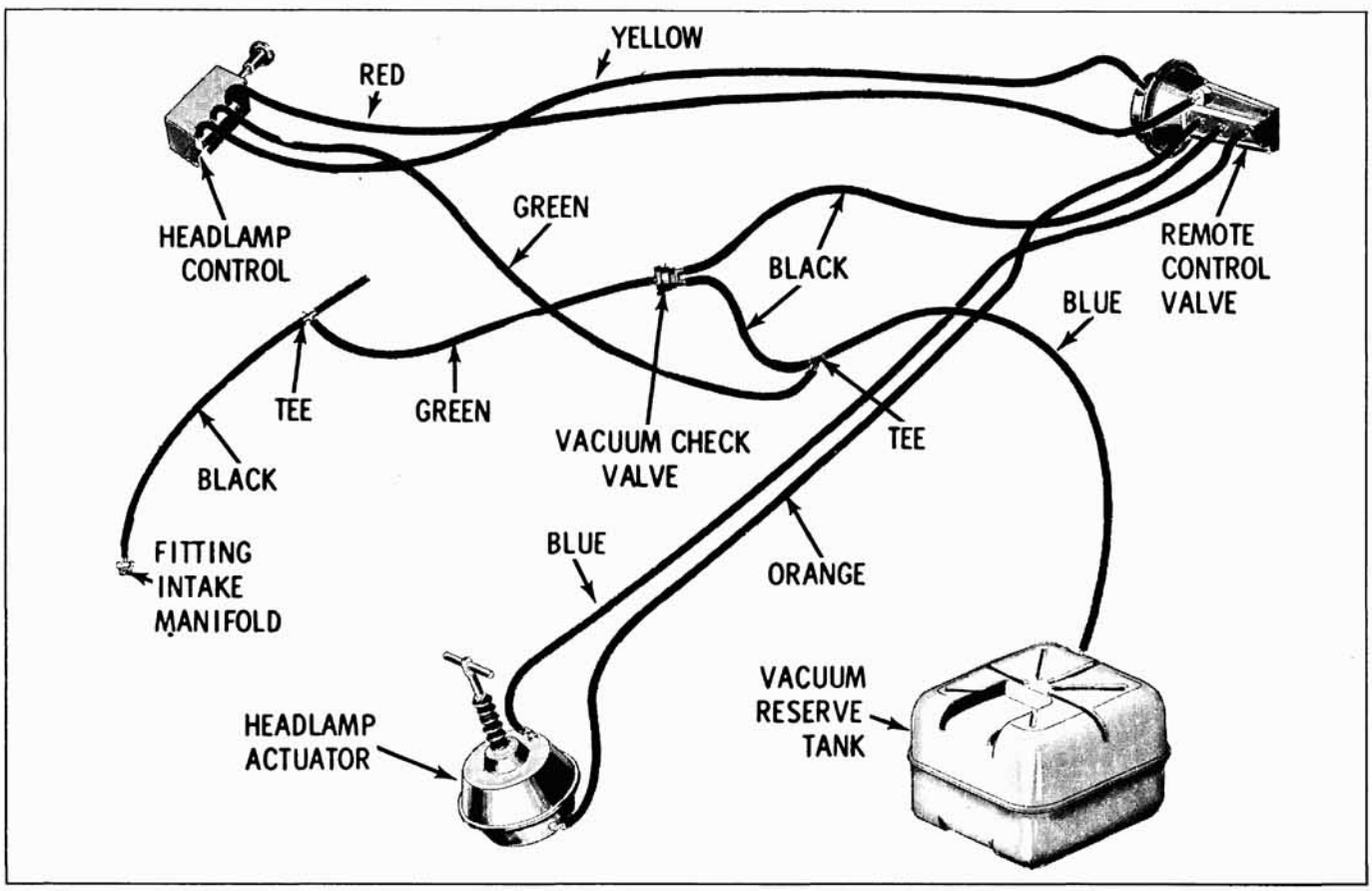


Fig. 11E-15—Headlamp Vacuum Hose Routing (Except W-34)

HEADLAMP ASSEMBLY

Removal (Fig. 11E-13 and 11E-14)

Open headlamp grille assembly and remove headlamp door and inner grille. Close headlamp grille assembly and disconnect headlamp wire connection. Remove the three upper attaching bolts. Remove the three lower attaching bolts (two are removed through opening in front bumper and one is removed from the rear of the bumper).

Slide headlamp assembly to center of car and remove through opening between upper bumper and upper radiator support.

To install reverse removal procedure.

TORONADO VACUUM OPERATED HEADLAMPS

OPERATION EXCEPT W-34 (Fig. 11E-15)

Engine operation will create a reserve supply of vacuum in the reserve tank. Vacuum will also be directed through the green hose to the center port of the headlamp control and to the center port of the remote control valve through the black hose.

With the light switch in the off position, vacuum is connected to the "OFF" port of the switch through the yellow hose to the "OFF" side of the remote control valve diaphragm. With the remote control valve in the "OFF" position, the vacuum source at the center port of the valve is connected to the "CLOSE" side of the actuator through the orange hose. The vacuum holds the actuator shaft down to keep the headlamp grilles in the closed position.

When the headlamp switch is pulled out, to turn on the lights, vacuum to the yellow hose is cut off at the switch and the "ON" port is connected to the source vacuum. This vacuum through the red hose causes the remote control diaphragm to move the valve to the "ON" position. Movement of the valve cuts off vacuum to the "OFF" port opening it to atmosphere and connects the "ON" port to vacuum. Since this port is connected to the "OPEN" side of the actuator by the blue hose, the diaphragm moves up causing the shaft to rise and open the headlamp grilles by means of the connecting levers.

In the event of a vacuum failure, the grilles may be raised manually by lifting upward on the lower edge of both grilles at the same time and holding both units in the full "UP" position for a moment to allow the catch to lock them in the "UP" position until the vacuum operation can be restored.

If the grilles do not raise and there is no vacuum failure or loss of vacuum, it will be necessary to disconnect the vacuum hose at the vacuum tank before manually lifting the grilles.

OPERATION (W-34 Only Fig. 11E-15A)

Toronados equipped with the W-34 option use a thermostatic vacuum switch in the vacuum operated headlamp system. The purpose of this switch is to open the headlamp grilles when engine coolant reaches 220°F which allows more air to pass through the radiator. The thermostatic vacuum switch is located in the left side of the radiator.

Vacuum for the entire system is provided from the intake manifold through a vacuum hose to a green hose that leads to a check valve. The vacuum splits at the check valve through

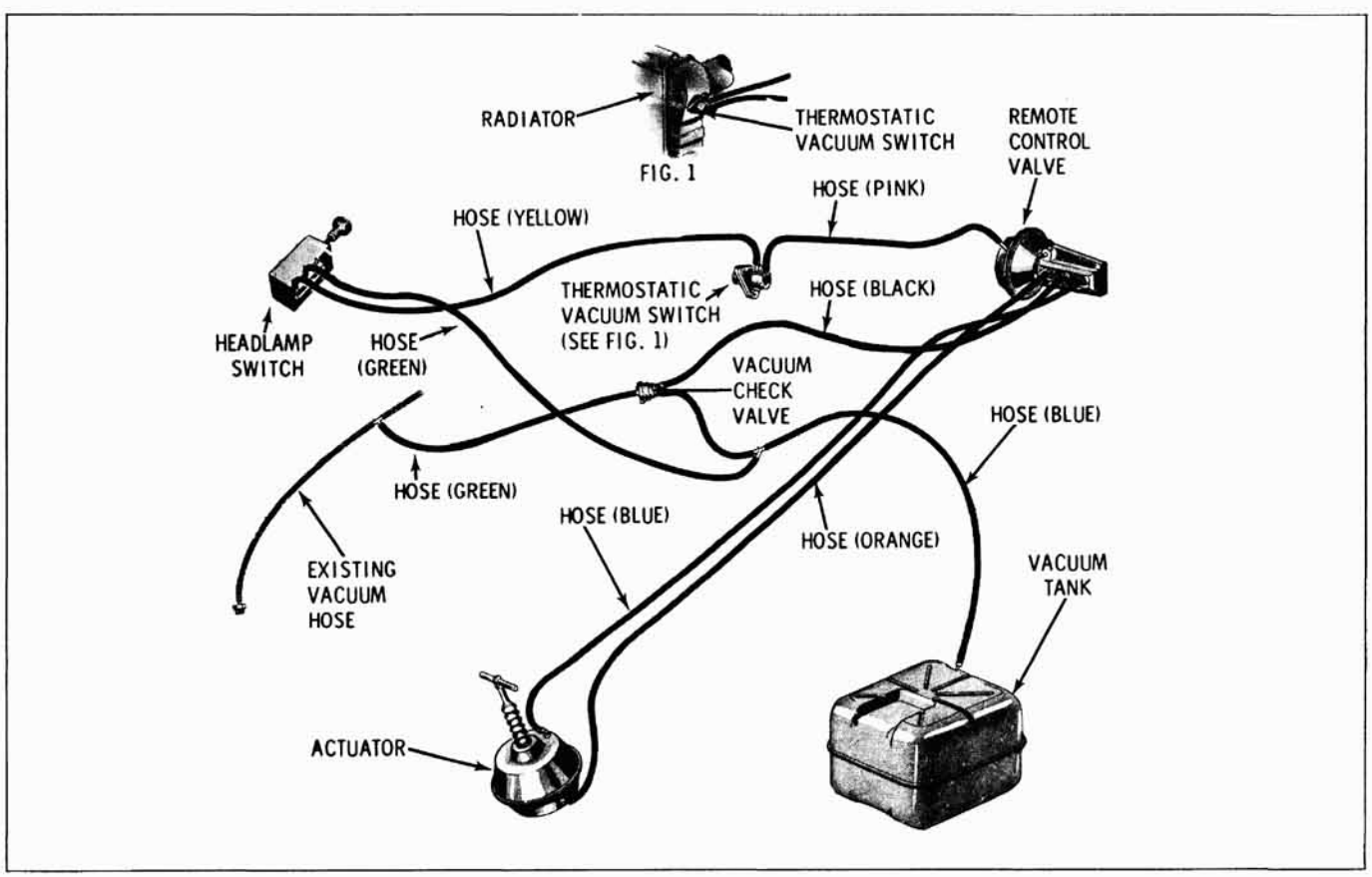


Fig. 11E-15A—Headlamp Vacuum Hose Routing (W-34 Only)

a black hose to the remote control valve. The other branch from the check valve leads to a tee through another black hose. At the tee a blue hose connects to the vacuum reserve tank and a green hose to the headlamp switch.

With the headlamp switch in the "off" position, vacuum is directed through the headlamp switch through the yellow hose to the thermostatic vacuum switch. With the engine coolant below 220°F., vacuum is directed through the thermostatic vacuum switch and through the pink hose to the closed side of the remote control valve diaphragm. With the remote control valve in the closed position, the vacuum source at the center port of the valve is connected to the closed side of the actuator through the orange hose. Vacuum holds the actuator shaft down to keep the headlamp grilles in the closed position.

With the headlamp switch in the "on" position, vacuum is cut off at the headlamp switch, depleting the vacuum in the yellow hose, thermostatic vacuum switch, pink hose and to the closed side of the remote control valve. Spring pressure inside the remote control valve moves the valve to the open position. With the remote control valve in the open position, the vacuum source at the center port of the valve is connected to the open side of the actuator through the blue hose. Vacuum holds the actuator shaft up to keep the headlamp grilles in the up position.

THERMOSTATIC VACUUM SWITCH (Fig. 11E-15A)

When the engine coolant temperature is below 220°F., the thermostatic vacuum switch is open. With the thermostatic vacuum switch open, the vacuum operated headlamp system operates in the normal way.

When the engine coolant temperature is above 220°F., the thermostatic vacuum switch closes, vacuum no longer holds the remote control valve in the closed position. Spring tension moves the valve to the open position and vacuum is directed to the actuator to the open side of the diaphragm. This moves the grilles up to allow more air for cooling to pass through the radiator. The headlamps will not come on.

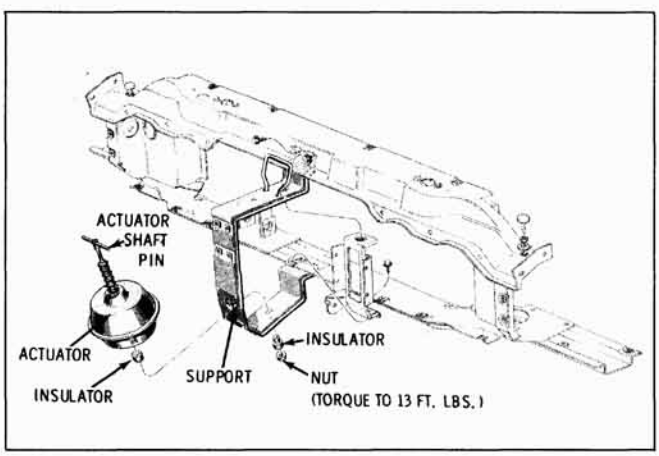


Fig. 11E-16—Headlamp Actuator Removal

HEADLAMP VACUUM ACTUATOR ASSEMBLY

Remove (Figs. 11-16 and 11-17)

1. Remove retaining clips from actuator shaft pin.
2. Disconnect actuator shaft pin from actuator door arms.
3. Remove lower radiator deflector.
4. Remove vertical center brace.
5. Remove the actuator attaching nut and insulator. Disconnect vacuum hoses from actuator.
6. Remove two bolts from actuator support to lower support.
7. Pull down on actuator support only far enough to remove actuator from the right side of actuator support.

Upper insulator may come off at this time. Note position of insulator for assembly.

8. Remove the center bolt from the valance panel and pull down on valance panel only enough to remove actuator assembly from car.

Installation

For installation, reverse removal procedure.

Torque actuator attaching nut to 13 ft. lb. and make sure actuator is free to move in lower insulator after tightening attaching nut.

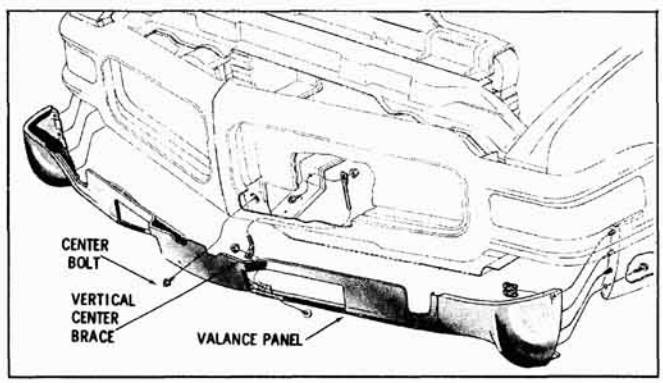


Fig. 11E-17—Valance Panel and Vertical Brace

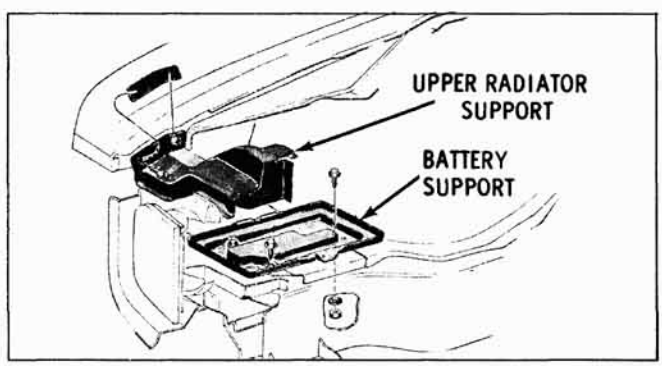


Fig. 11E-18—Battery Support

CHASSIS ELECTRICAL, INSTRUMENTS AND WIPERS

TORONADO

CONTENTS OF SECTION 12E

ITEMS LISTED IN THE TABLE OF CONTENTS ARE FOR TORONADO. FOR SERVICE PROCEDURES AND RECOMMENDATIONS NOT LISTED, REFER TO SECTION 12, 31-86 SERIES.

Subject	Page	Subject	Page
BATTERY	12E-1	LICENSE LAMP ASSEMBLY	12E-1
WIRING CIRCUIT	12E-1	BRAKE SWITCH TESTING	12E-1
CAPACITOR DISCHARGE IGNITION SYSTEM	12E-1	TAIL LAMP ASSEMBLY AND LENS	12E-6
TEMPERATURE GAUGE	12E-1	FUSE SPECIFICATIONS	12E-7
HORNS	12E-1	LAMP BULB SPECIFICATIONS	12E-8
KEY WARNING SYSTEM	12E-5	INSTRUMENTS	12EA
		WINDSHIELD WIPER	12EB

CHASSIS ELECTRICAL

BATTERY (ENERGIZER)

Refer to Section 12 for periodic maintenance and test procedure.

WIRING CIRCUIT

A combination junction and fuse block is mounted on the cowl under the instrument panel. Each wire from the fuse panel is color coded to simplify servicing. (Fig. 12E-1)

The wiring harness installation under the instrument panel is shown in Figs. 12E-2 and 12E-3.

The wiring harness installation in the engine compartment is shown in Figs. 12E-4, 12E-5 and 12E-7.

The fuse block, fuse size and location are shown in Fig. 12E-8.

CAPACITOR DISCHARGE IGNITION SYSTEM

Service procedure for the C. D. Ignition System used on the Toronado is the same as the procedure listed for the 31-86 Series. The only difference is in removal of the amplifier assembly.

Removal C. D. Amplifier (Fig. 12E-6)

1. Disconnect negative battery cable.
2. Disconnect the following leads from the amplifier harness assembly.
   - A. Tachometer Pickup
   - B. Harness Ground
   - C. +and - Coil Wires
   - D. Distributor Connector
   - E. Connectors at Fuse Panel
   - F. Connector at Junction Block
3. Remove vacuum tank.
4. Remove three retaining nuts from amplifier assembly and remove amplifier.

To install, reverse removal procedure.

CHARGING CIRCUIT (Fig. 12E-9)

The charging circuit consists of a battery, Delcotron generator, regulator and generator warning light. Cars without air conditioning are equipped with a 42 amp. generator. Cars with factory installed air conditioning are equipped with a 55 amp. generator.

TEMPERATURE GAUGES (Fig. 12E-5)

The Toronado is equipped with both a HOT light and STOP ENGINE light mounted in the instrument panel. The HOT light has an amber lens and is electrically controlled by the engine temperature switch in the intake manifold. The STOP ENGINE light has a red lens and flashing bulb and is electrically controlled by a temperature switch mounted in the head bolt between No. 5 and No. 7 cylinder.

HORNS

The horns are mounted as shown in Fig. 12E-10. Horns can be removed from the under side of car between bumper and lower tie bar.

LICENSE LAMP ASSEMBLY

In order to change either the lamp or the lens, it will be necessary to remove the license lamp assembly from the bumper. (Fig. 12E-11)

HYDRAULIC BRAKE SWITCH TESTING

For service procedures on this switch, refer to Periodic Service Chart in General Information Section.

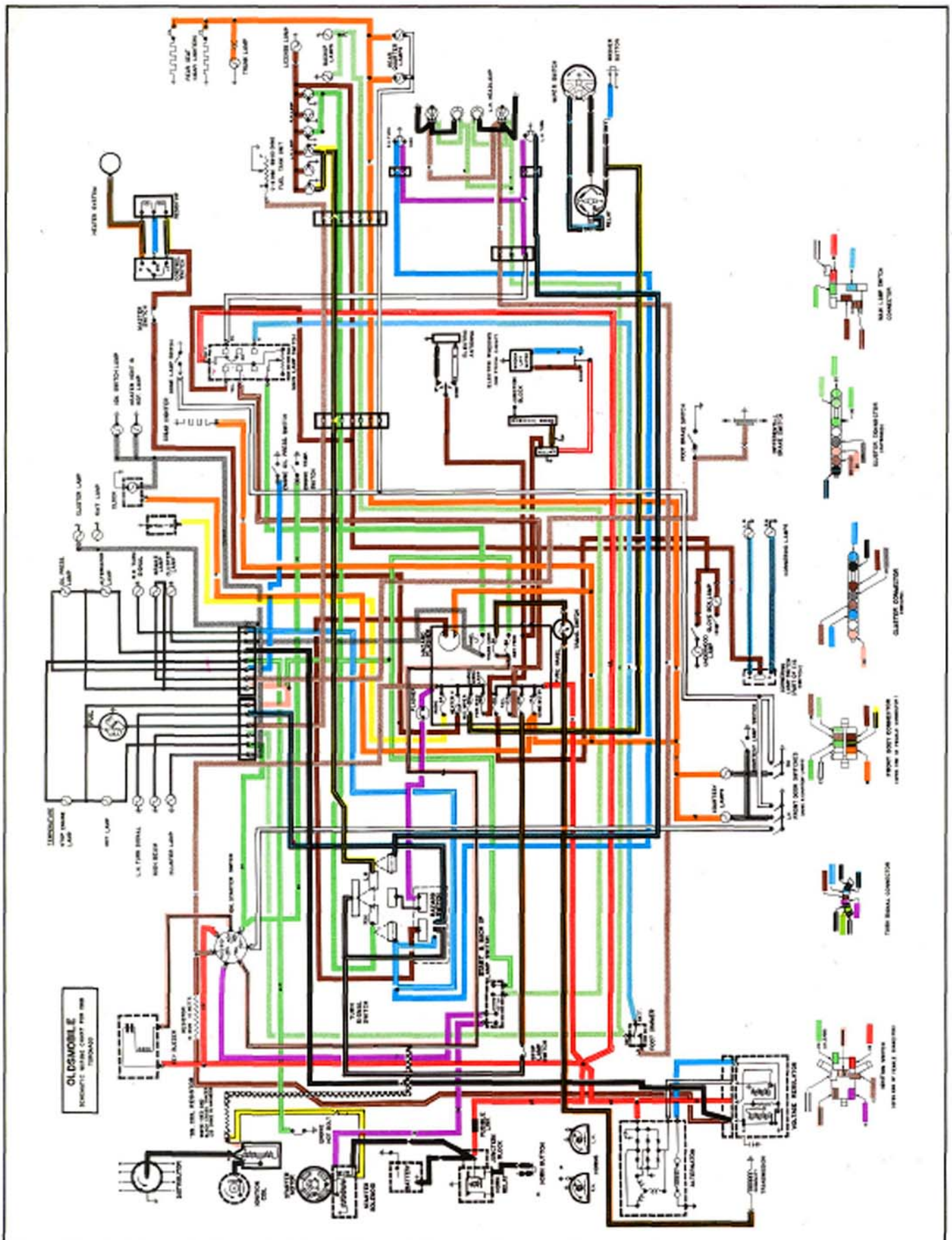


Fig. 12E-1—Wiring Diagram

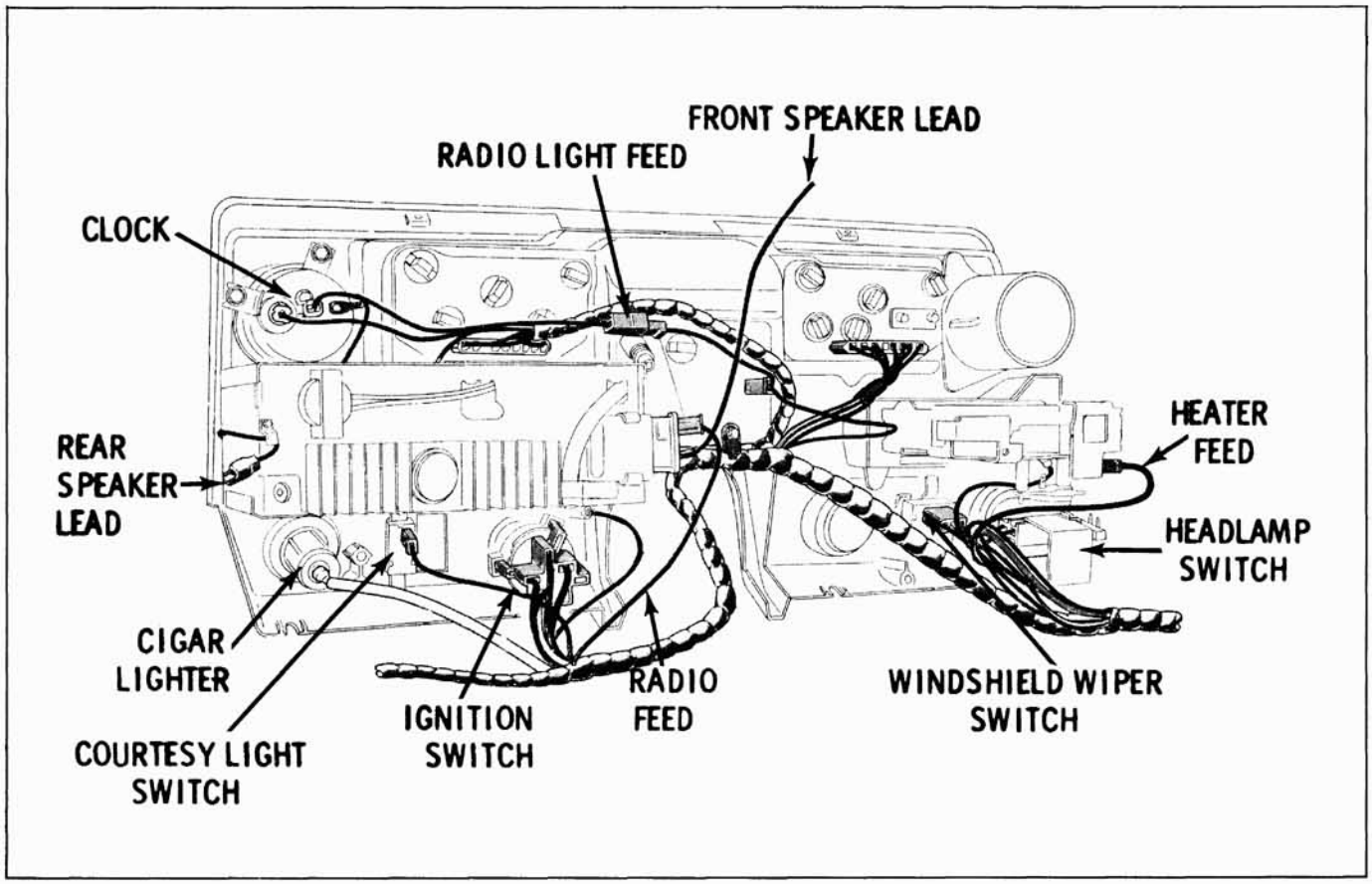


Fig. 12E-2—Instrument Panel Wiring

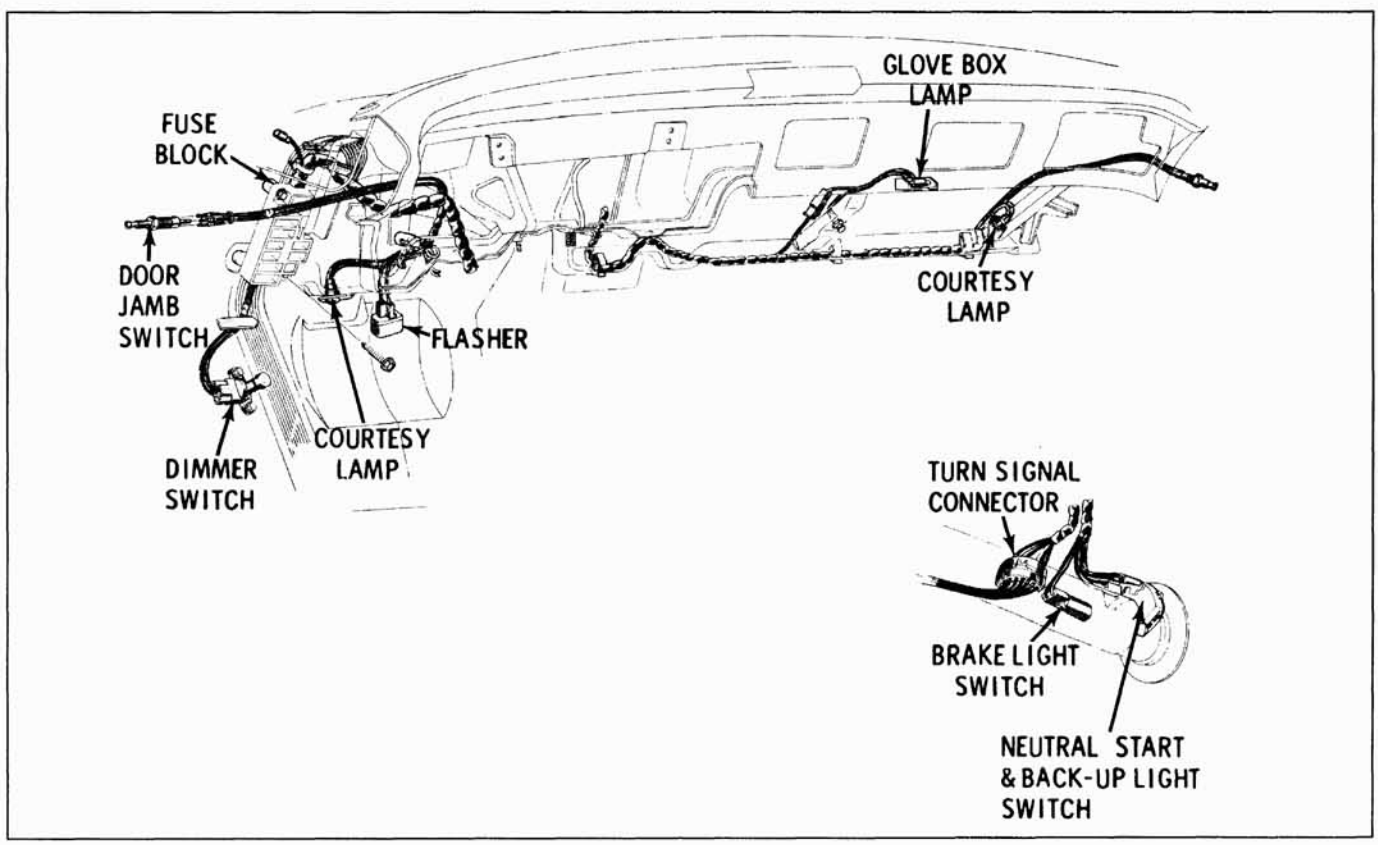


Fig. 12E-3—Instrument Panel Wiring Harness

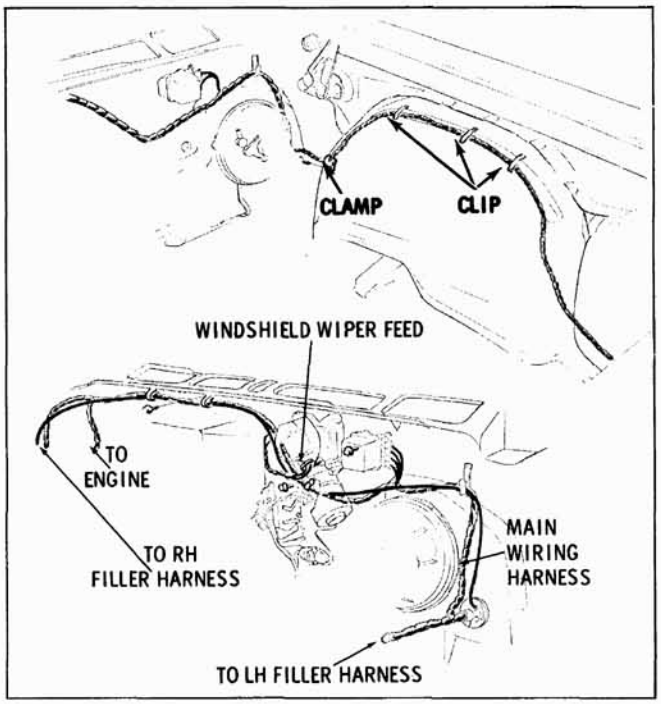


Fig. 12E-4—Chassis Wiring Harness

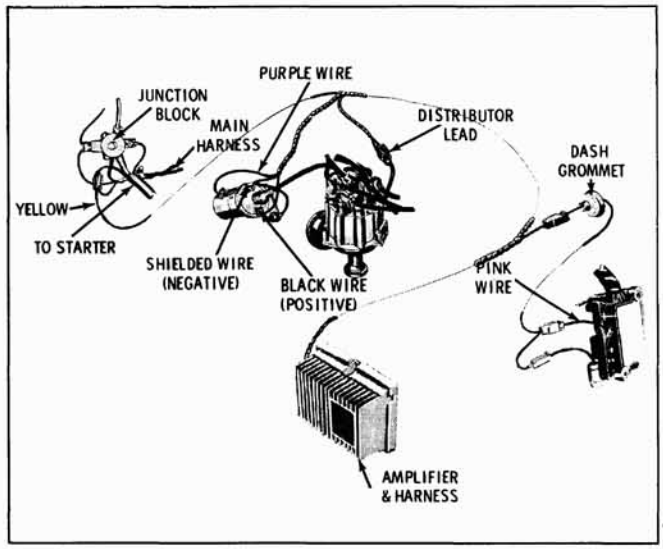


Fig. 12E-6—C.D. Pictorial Diagram

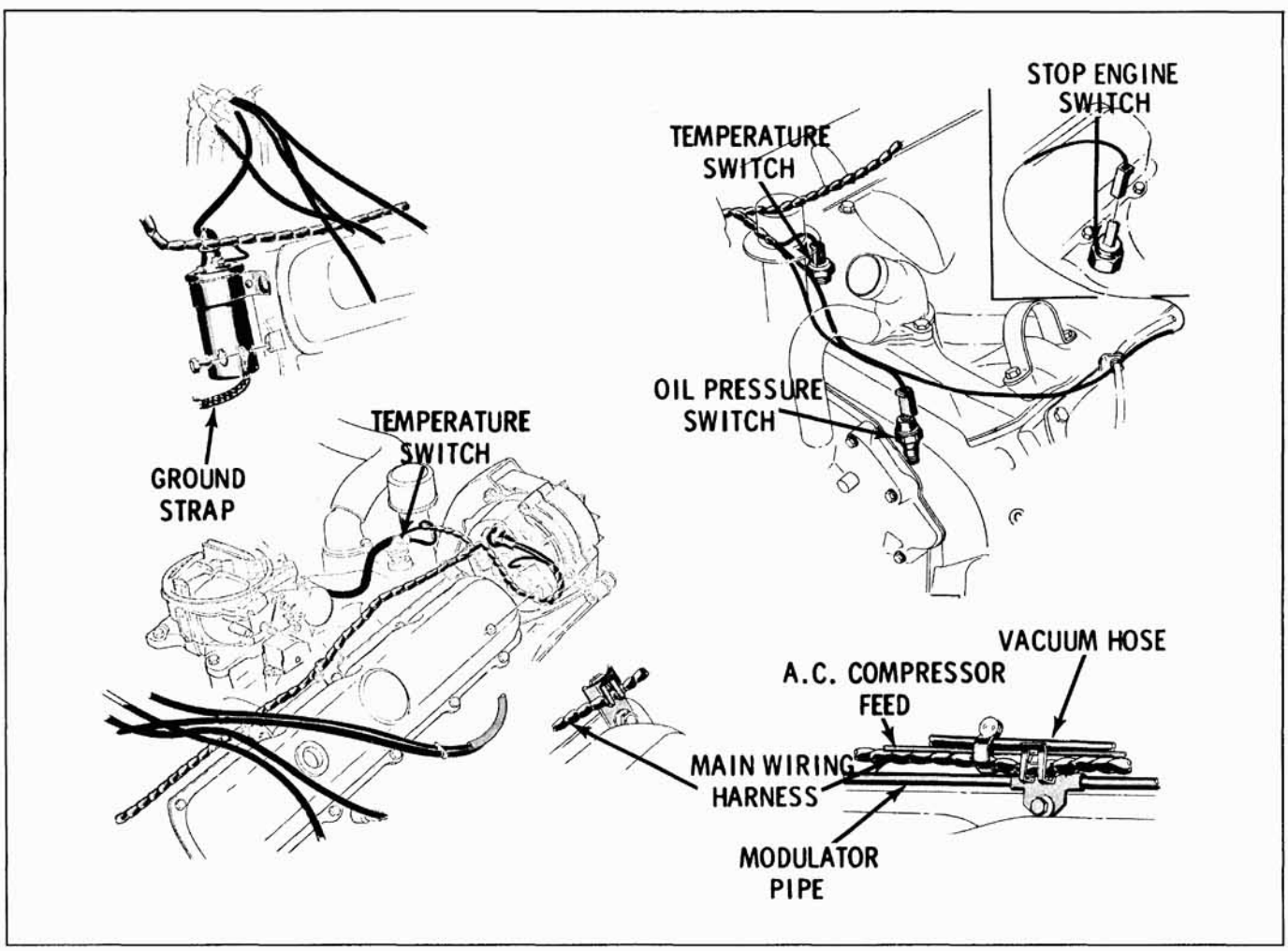


Fig. 12E-5—Engine Wiring

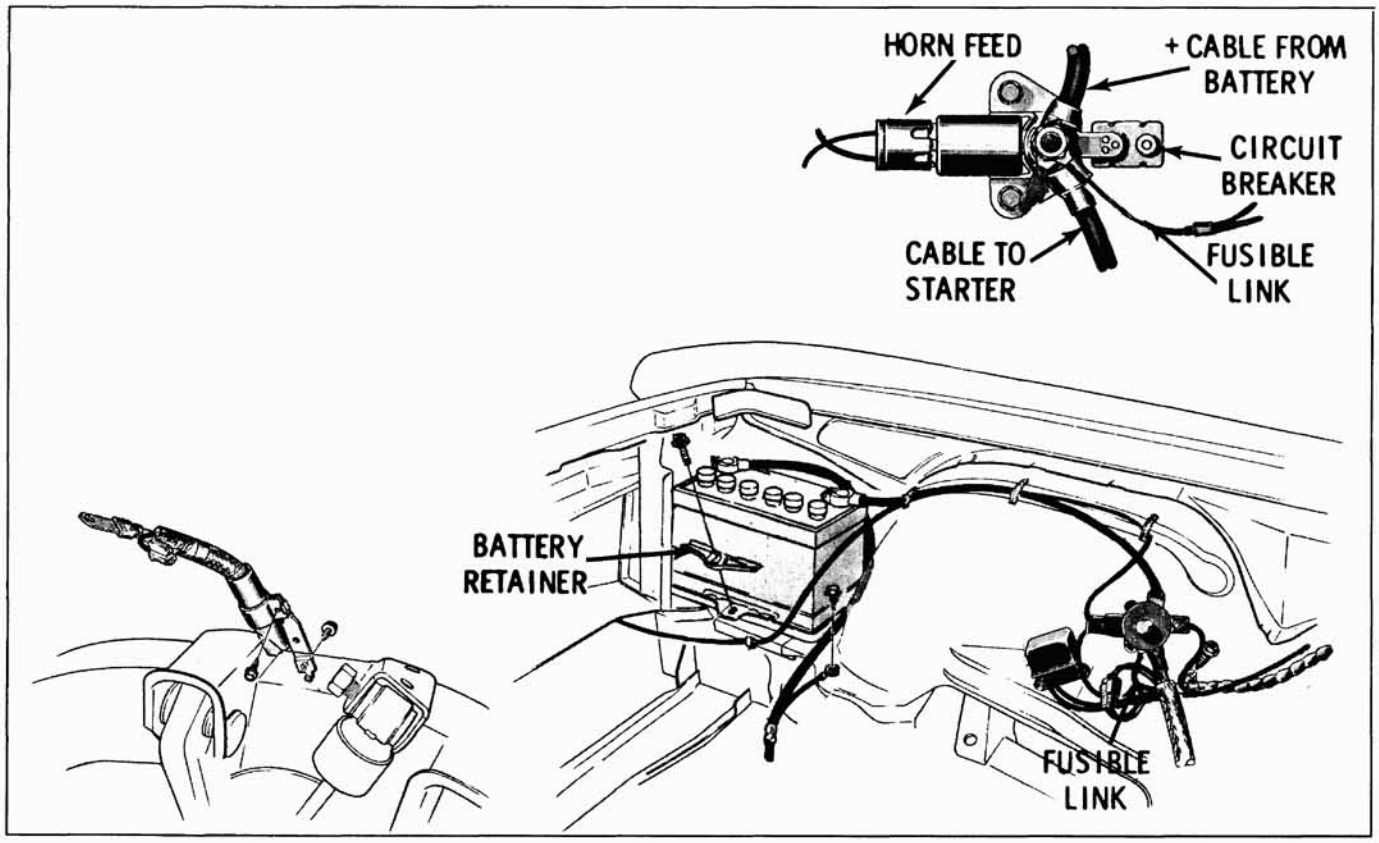


Fig. 12E-7—Battery and Cable Installation

TORONADO HORN RELAY-BUZZER (ANTI-THEFT KEY WARNING SYSTEM)

DESCRIPTION

The horn relay-buzzer operates when the driver's door is opened to remind the driver that the ignition key has been left in the ignition switch.

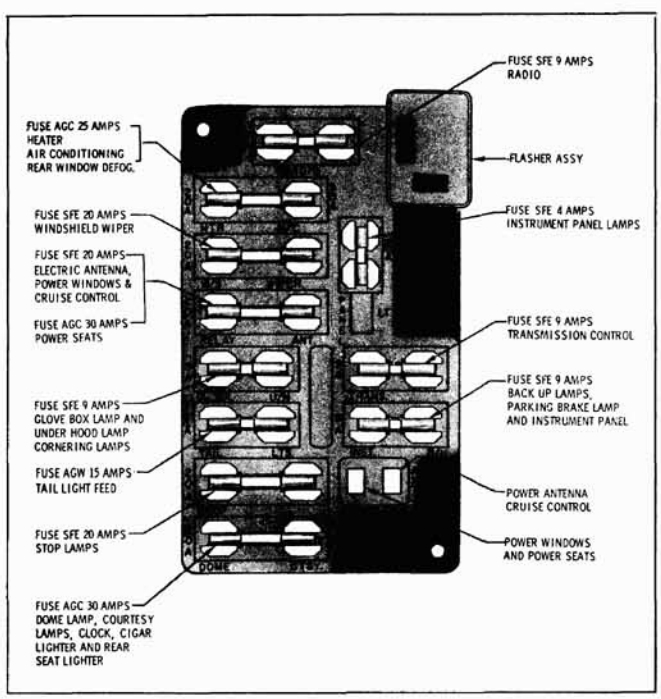


Fig. 12E-8—Fuse Block

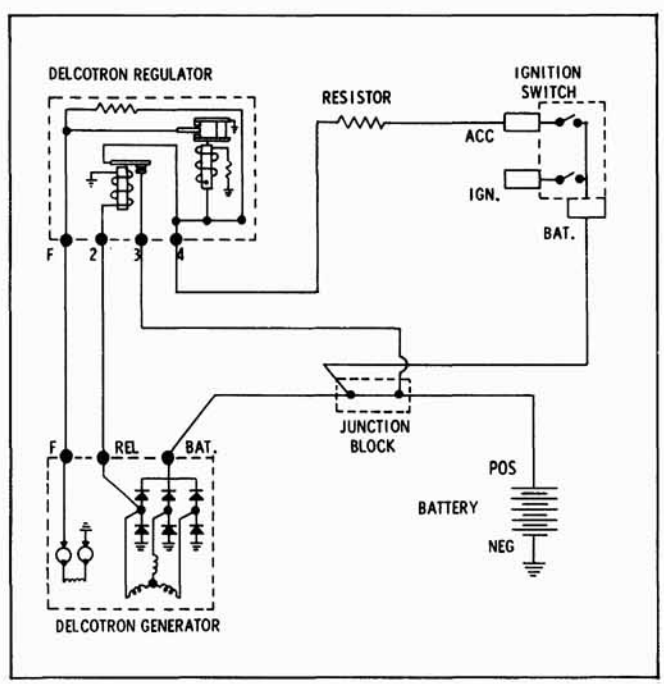


Fig. 12E-9—Charging Circuit

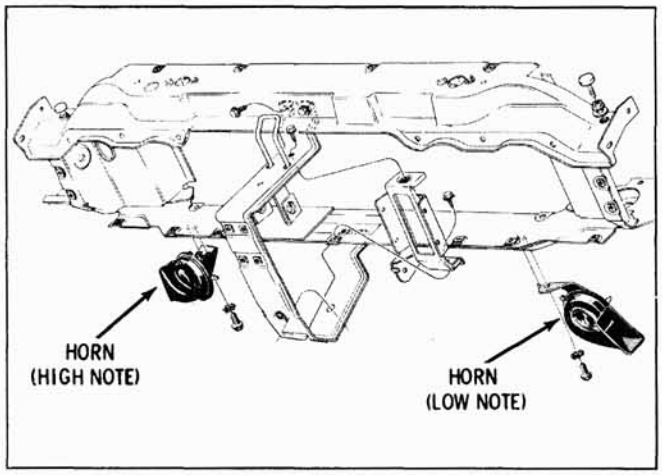


Fig. 12E-10—Horn Installation

BUZZER OPERATION (Fig. 12E-12)

With the key in the off position and fully inserted into the ignition switch, the No. 2 terminal on buzzer is connected to ground through the door switch when the driver's door is opened. Current then flows from the battery, energizing the coil, then through the buzzer contacts, the ignition switch and door switch to ground. The energized coil causes the buzzer contacts to open, which de-energizes the coil, and the buzzer contacts then reclose. This cycle then repeats many times per second to give the buzzing sound. Closing the door, or removing the key will stop the buzzing action.

BUZZER CHECK

1. Make sure the key is fully inserted into the ignition switch and in the "off" position.
2. Open the driver's door, and observe the dome lamp.
3. If both the dome lamp and buzzer fail to operate, check the door switch for defects.
4. If the dome lamp is on, but the buzzer fails to operate, remove the buzzer from its mounting.
5. Connect a jumper lead from the No. 2 terminal to ground.
6. If the buzzer operates, check the ignition switch wiring and ignition switch.
7. If the buzzer does not operate, connect a voltmeter from No. 3 terminal to ground.
8. If the reading is zero, the circuit is open between this point and the battery.
9. If a voltage reading is obtained, replace the buzzer.

The No. 1 terminal on the buzzer is not used.

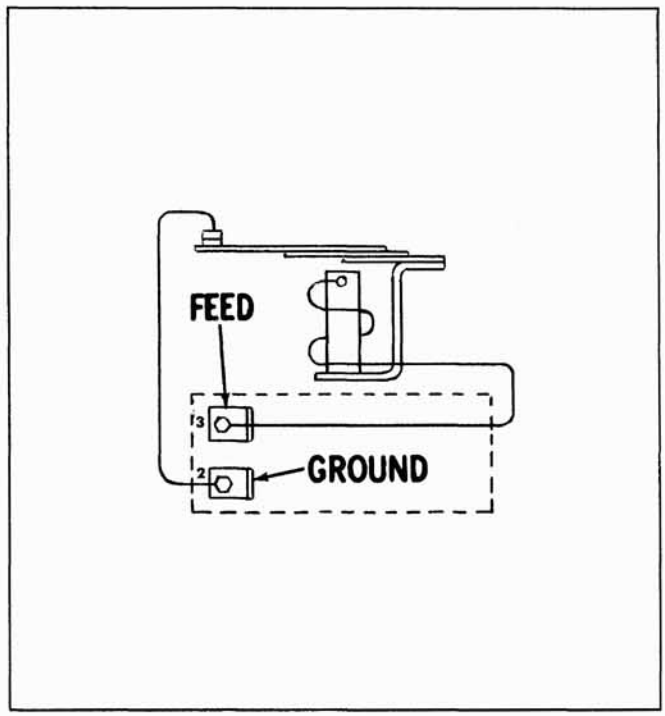


Fig. 12E-12—Buzzer Diagram

TAIL LAMP AND LENS (Fig. 12E-11)

REMOVE AND INSTALL (LENS OR BULB)

1. Remove the two lens retaining screws.
2. Remove the lens and gasket.
3. Bulbs may be removed if necessary.

To install, reverse removal procedure.

REMOVE AND INSTALL (LAMP ASSEMBLY)

1. Lift up rear compartment trim and disconnect wiring.
2. Remove bolts and lower rear bumper. Refer to REAR BUMPER REMOVAL, Section 14E.
3. Remove five retaining bolts from lamp assembly and remove lamp.

To install, reverse removal procedure.

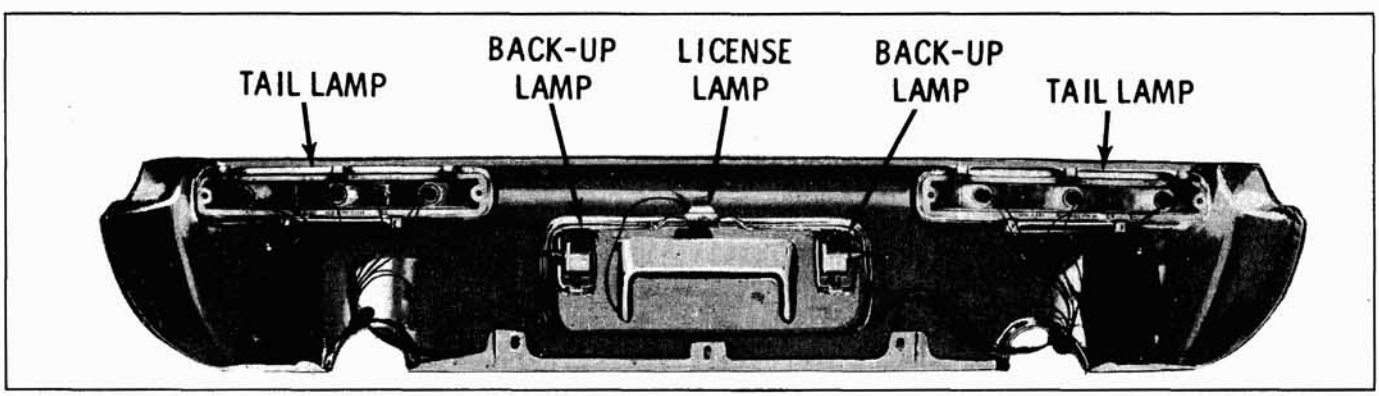


Fig. 12E-11—Tail Lamp and License Lamp

1968 LAMP USAGE
TORONADO

BULB NO.	USAGE
194	Speedometer, Odometer and Shift Indicator
194	High Beam Indicator
194	Fuel, Temperature, Ammeter and Oil Gauge
194	Turn Signal Indicator
194	Brake Warning Lamps
194	Generator Warning
194	Engine Temperature Indicator-Hot (Amber Lens)
168	Oil Pressure Warning
1895	Heater, Ventilation & Air Conditioning Control
1895	Console Compartment
1895	HMT Shift Indicator - Console Only
257	Stop Engine Warning
1445	Ignition Switch
1445	Cruise Control
1816	Electric Clock
1893	Radio Dial
631	Underhood
631	Trunk
90	Courtesy
97	Courtesy Light-Console
68	Front Seat Back
212	Rear Quarter Lamps
212	Door Lamps
212	Glove Box and Map
	EXTERNAL LAMPS
97	License
1157A	Parking & Turn Signal
1157	Tail and Stop
97A	Side Marker-Front
194	Side Marker-Rear
1156	Back-Up
1195	Cornering Lamp
L-4001	Headlamp-Upper Beam
L-4002	Headlamp-Upper & Lower Beam

FUSE SPECIFICATION AND LOCATION

APPLICATION	NAME OF FUSE CIRCUIT ON FUSE BLOCK	FUSE TYPE AND AMPERES
Heater Air Conditioning Rear Window Defogger	HTR-A/C	AGC 25
Windshield Wiper	W/S Wiper	SFE 20
Electric Antenna Power Windows & Cruise Control	RELAY ANT	SFE 20
Power Seats	RELAY ANT	AGC 30
Glove Box Lamp Underhood Lamp	GL BX U/H	SFE 9
Tail Lamp Feed Cornering Lamps Side Marker Lamps	TAIL LTS	AGW 15
Stop Lamps	STOP	SFE 20
Dome Lamp, Courtesy Lamps, Clock, Cigar Lighter and Rear Seat Lighter	DOME CTSY	AGC 30
Radio	RADIO	SFE 9
Panel Lamps	PANEL LT	SFE 4
Transmission Control	TRANS	SFE 9
Back-Up Lamps Parking Brake Lamp and Instrument Panel	INST B/U	SFE 9

The following circuits either employ circuit breakers or have fuses located as indicated.

APPLICATION	TYPE	LOCATION
Head Lamps	Circuit Breaker	In light switch
Electric Seat and/or Window Motor	Circuit Breaker	On horn relay junction
Directional Signal Flasher	3 Lamp-Yellow Cover	In clip behind instrument panel
Air Conditioner	In-Line Fuse 30 amp	In wire between junction block and high blower relay
Hazard Warning Flasher	2-8 Lamp-Green Cover	In fuse block

INSTRUMENT PANEL

TORONADO

CONTENTS OF SECTION 12EA

Subject	Page
CONTROL PANEL	12EA-1
RADIO	12EA-1
CLOCK	12EA-1
IGNITION SWITCH	12EA-2
WINDSHIELD WIPER AND WASHER SWITCH	12EA-2
HEADLAMP SWITCH	12EA-3
CRUISE CONTROL SWITCH	12EA-3
ACCESSORY SWITCHES	12EA-3
CIGAR LIGHTER	12EA-3
HEATER AND/OR A/C CONTROL ASSEMBLY	12EA-3
SPEEDOMETER CABLE	12EA-3
SPEEDOMETER	12EA-4
OUTLET L.H.—VENT	12EA-5
CRUISE CONTROL DIAL ASSEMBLY	12EA-5
OIL AND GENERATOR PRINTED CIRCUIT	12EA-5
FUEL GAUGE AND PRINTED CIRCUIT	12EA-5
PRINTED CIRCUIT--SPEEDOMETER LAMPS	12EA-7
APPLIQUE PANELS--L.H. AND R.H.	12EA-7
PAD ASSEMBLY--CONTROL HOUSING	12EA-7
PAD ASSEMBLY R.H.	12EA-7
PAD ASSEMBLY--INSTRUMENT PANEL UPPER TRIM	12EA-8
MOLDING--LOWER L.H.	12EA-9
MOLDING--LOWER R.H.	12EA-9
GLOVE BOX	12EA-9
GLOVE BOX DOOR	12EA-9
OUTLET R.H.	12EA-9
CENTER OUTLET	12EA-9
CENTER TRIM PANEL	12EA-9
CONSOLE	12EA-9

CONTROL PANEL (Fig. 12EA-1)

Removal

1. Disconnect negative battery cable.
2. If equipped with cruise control, disconnect control cable at regulator.
3. Disconnect speedometer cable at transmission.
4. Remove screws from R.H. lower pad assembly and filler. (Fig. 12EA-2)
5. Remove nuts "A", "B" and "C" as shown in Fig. 12EA-3 and retain wedge for use when installing.
6. If equipped with tilt and travel, tilt down to lowest position and let steering wheel rest on seat cushion. With a standard column, use a 4" x 4" block of wood between steering wheel and seat. This will help to prevent accidental disconnecting of hoses and wiring when tilting control panel out to perform service repairs.
7. Loosen bolt "A" and "B" approximately 1/4". (Fig. 12EA-2)
8. Disconnect radio lead-in.
9. Remove screws "C" and "D" (Fig. 12EA-2) and tilt control panel outward from the top.
10. Disconnect the following electrical connectors:
    a. All printed circuit multiple connectors.
    b. Radio.
    c. Clock.
    d. Ignition switch.
    e. Lighter.
    f. Headlight switch.
    g. Wiper and washer switch.
    h. Accessory switches.
11. Disconnect L.H. air outlet hose.
12. Remove the 3 attaching bolts from A/C or heater control and remove from control panel without disconnecting hoses or wiring.
13. Remove bolts "A" and "B" (Fig. 12EA-2) and remove control panel.
14. To install, reverse removal procedures. For steering column attachment refer to Section 9EA.

SERVICING INDIVIDUAL UNITS

RADIO

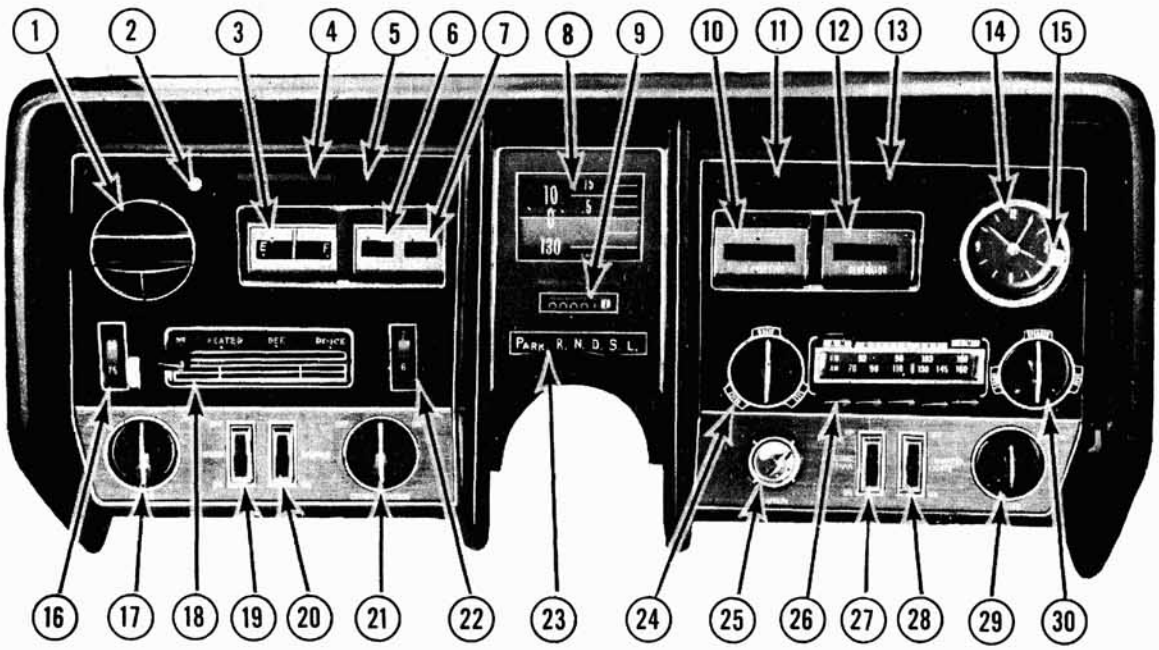
Removal (Fig. 12EA-5)

1. Disconnect control knobs and nuts from front of dash.
2. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
3. Disconnect radio feed wire.
4. Disconnect dial lamp.
5. Remove attaching nut from support to radio.
6. Remove radio from rear of control panel.

CLOCK

Removal (Fig. 12EA-6)

1. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
2. Disconnect clock feed and lamp.
3. Remove three attaching bolts.



1. OUTLET L.H.
2. OUTLET KNOB L.H.
3. FUEL GAUGE
4. L.H. DIRECTIONAL INDICATOR
5. HIGH BEAM INDICATOR
6. HOT TEMPERATURE INDICATOR
7. "STOP ENGINE" WARNING LIGHT
8. SPEEDOMETER
9. ODOMETER
10. OIL PRESSURE INDICATOR
11. BRAKE WARNING LIGHT
12. CHARGING SYSTEM INDICATOR
13. R.H. DIRECTIONAL INDICATOR
14. CLOCK
15. CLOCK SETTING KNOB
16. TEMPERATURE DIAL
17. LIGHT SWITCH
18. HEATER OR A/C CONTROL
19. WINDSHIELD WIPER SWITCH
20. WINDSHIELD WASHER SWITCH
21. CRUISE CONTROL SWITCH
22. CRUISE CONTROL SPEED SELECTOR
23. TRANSMISSION INDICATOR
24. RADIO VOLUME AND TONE CONTROL
25. IGNITION SWITCH
26. RADIO
27. ELECTRIC ANTENNA SWITCH
28. COURTESY LIGHT SWITCH
29. CIGAR LIGHTER
30. MANUAL STATION SELECTOR

Fig. 12EA-1—Control Panel

4. Remove clock from rear of control panel.

IGNITION SWITCH (Fig. 12EA-7)

Removal

1. Disconnect negative battery cable.
2. Turn switch to ACC. position.
3. Insert a paper clip into the small hole in the front side of the switch, while turning the key counterclockwise the lock will pop out.
4. Remove the escutcheon using Tool BT-6817-1.
5. Remove switch from back side of control panel and remove wiring connector.

WINDSHIELD WIPER AND WASHER SWITCH (Fig. 12EA-7)

Removal

1. Disconnect negative battery cable.
2. Disconnect wiring at switch.

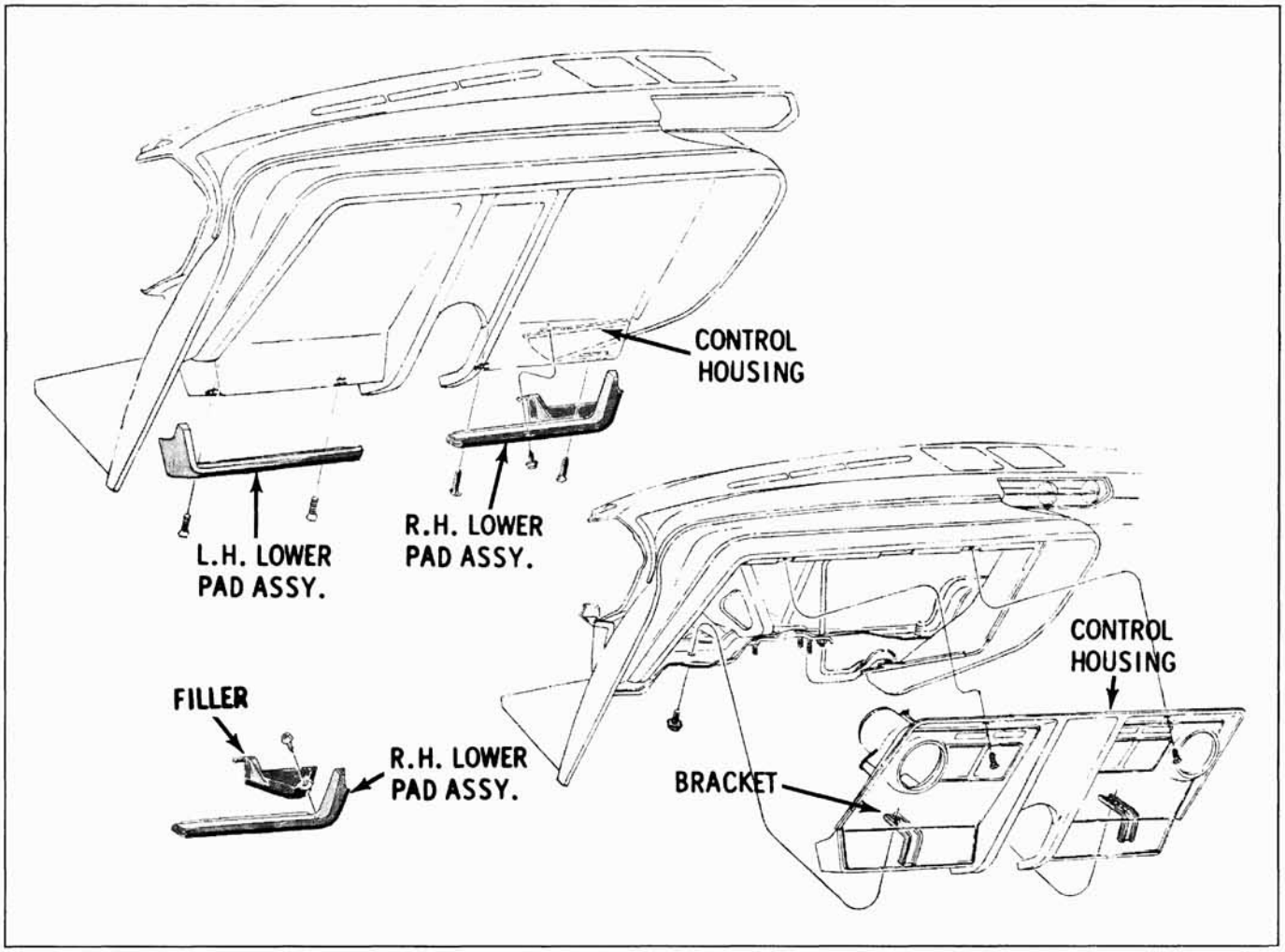


Fig. 12EA-2—Control Panel Attachment

3. Remove attaching bolts and remove from rear of control panel.

HEADLAMP SWITCH (Fig. 12EA-7)

Removal

1. Disconnect negative battery cable.
2. Remove knob by first pulling knob out to the HEADLIGHT position, then depress the spring loaded button on switch body and pull knob out of switch assembly.
3. Remove escutcheon nut using Tool BT-6817-2.
4. Remove headlamp switch from rear of control panel.
5. Disconnect wiring and vacuum hoses.

Carefully disconnect vacuum hoses and note the color coding of each.

CRUISE CONTROL SWITCH (Fig. 12EA-8)

Removal

1. Disconnect negative battery cable.
2. Remove knob and using Tool BT-6817-2 remove escutcheon.
3. Remove switch from rear of control panel.
4. Disconnect wiring harness at connector.
5. Remove switch.

ACCESSORY SWITCHES (Fig. 12EA-7)

Removal

1. Disconnect negative battery cable.
2. Disconnect wiring at switches.
3. Remove attaching bolts.

CIGAR LIGHTER (Fig. 12EA-7)

Removal

1. Disconnect negative battery cable.
2. Disconnect feed wire from lighter.
3. Unscrew retainer from rear of control panel while holding lighter case and escutcheon.
4. Remove case and escutcheon from front of control panel.

HEATER AND/OR A/C CONTROL ASSEMBLY (Fig. 12EA-9)

Removal

1. Remove control panel, refer to CONTROL PANEL, Items 1 through 9.
2. Disconnect wiring connectors.
3. Disconnect vacuum hoses.
4. Remove three attaching bolts and remove control assembly.

SPEEDOMETER CABLE

Removal

1. Remove control panel, Steps 1 through 9.

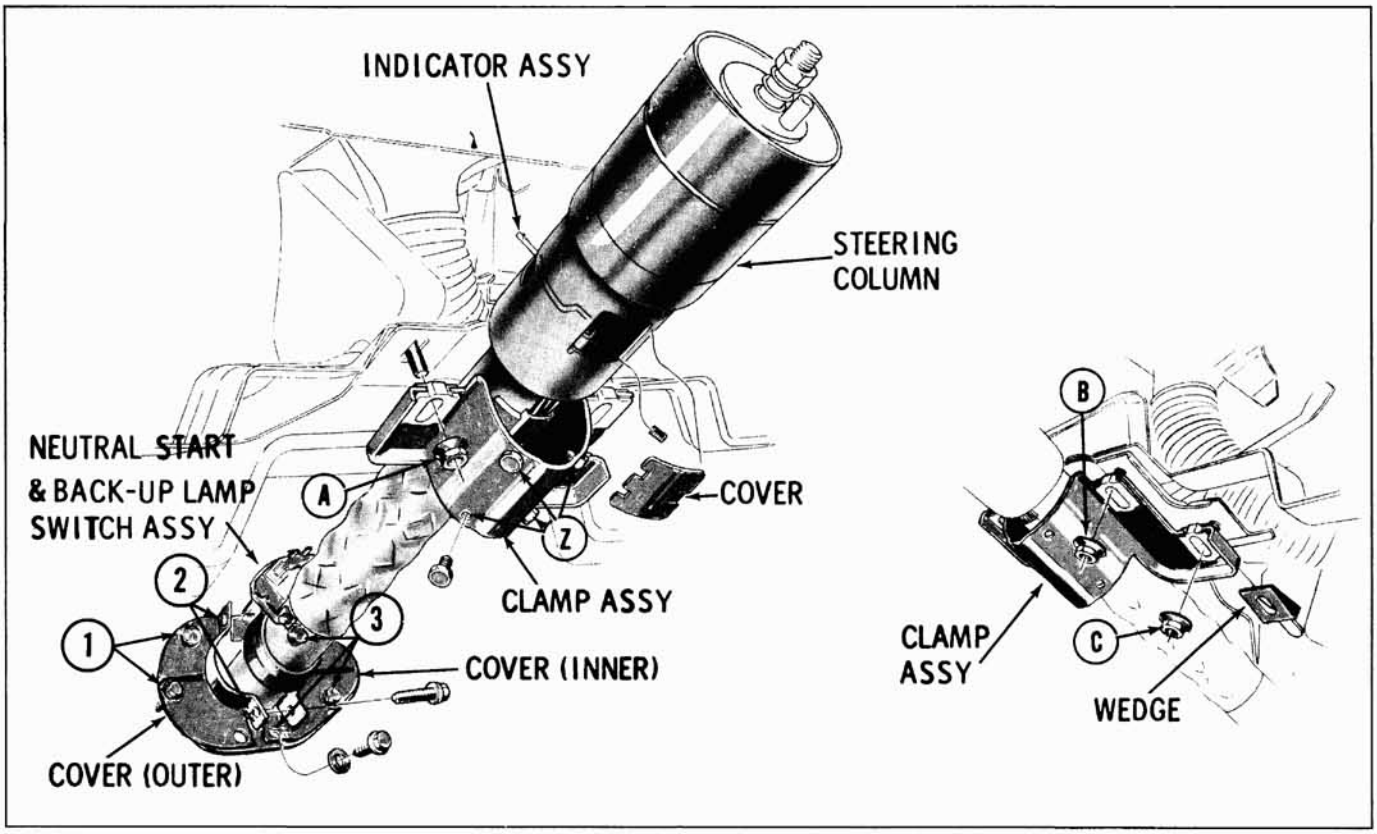


Fig. 12EA-3—Steering Column Attachment

2. Disconnect cable at speedometer.
3. Remove cable.

SPEEDOMETER

Removal

1. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
2. Disconnect printed circuit connectors.
3. Remove radio. Refer to Radio Removal.
4. Remove eight attaching screws, cover to cluster.

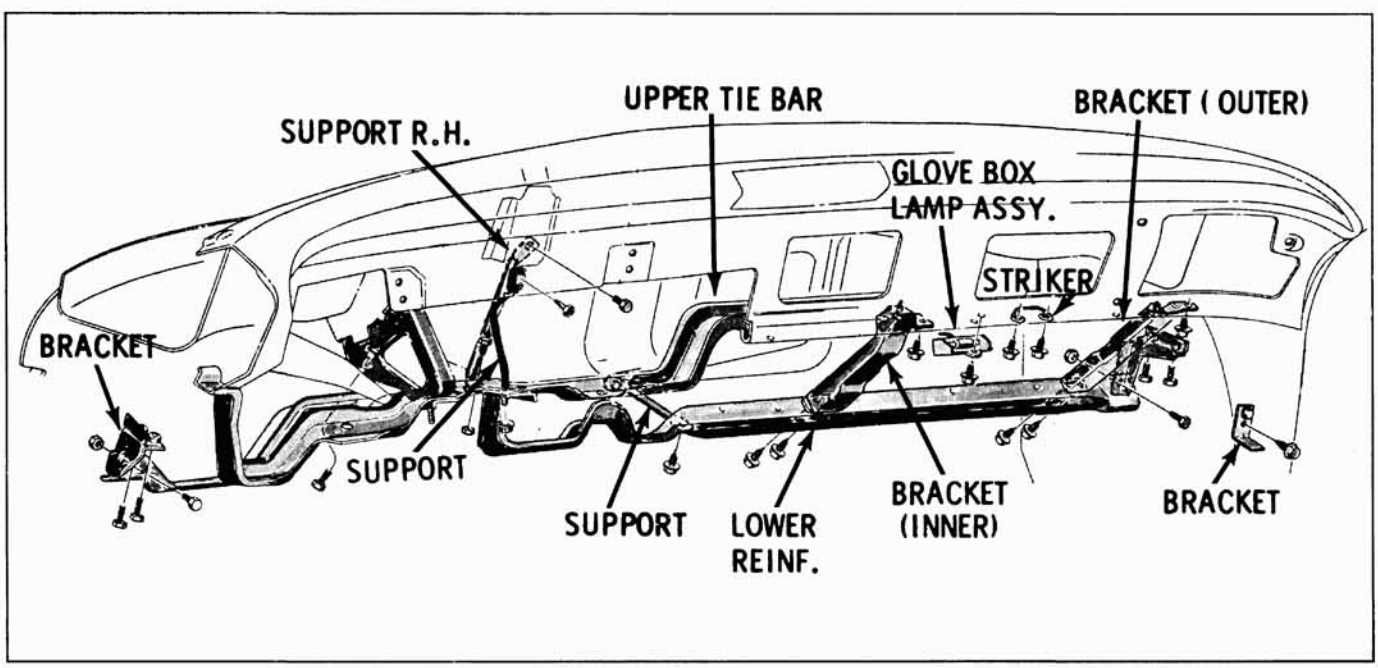


Fig. 12EA-4—Instrument Panel Supports

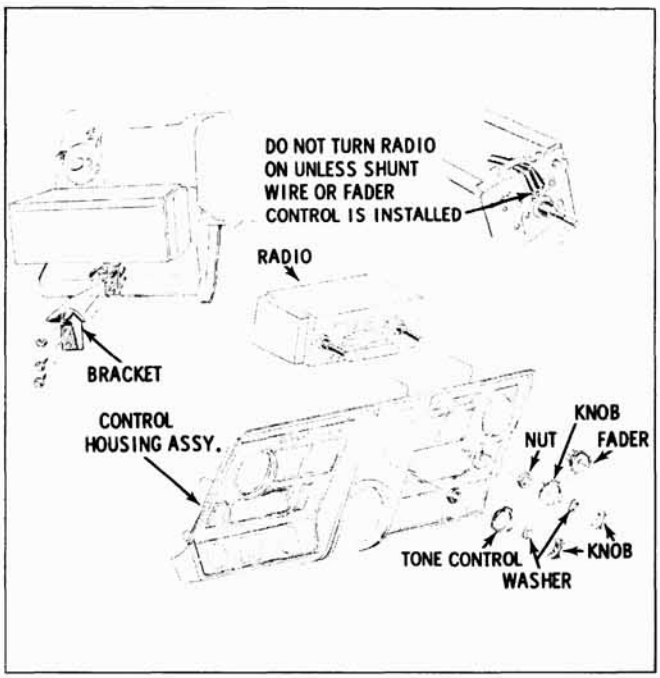


Fig. 12EA-5—Radio Mounting

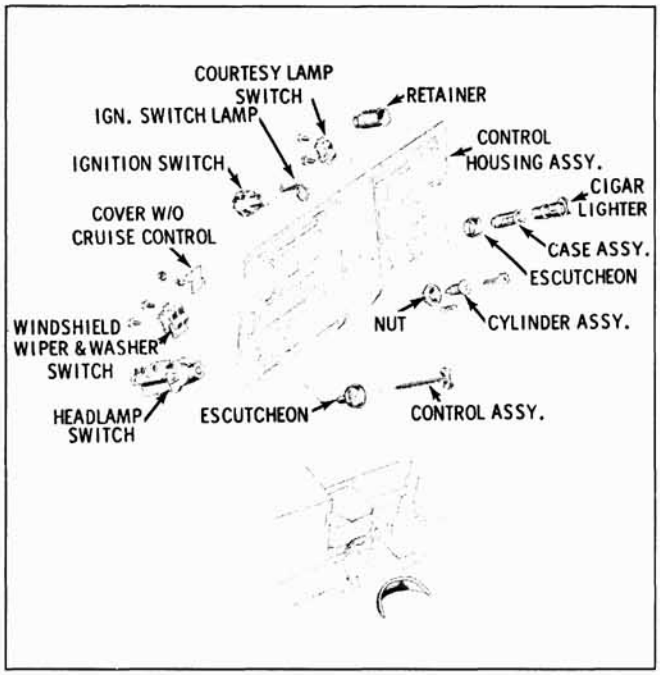


Fig. 12EA-7—Switch Attachments

5. Remove four attaching bolts, cover to speedometer head.

OUTLET L.H. (Fig. 12EA-6)

Removal

1. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
2. Remove shut off knob from front of panel.
3. Remove three attaching bolts.

CRUISE CONTROL DIAL ASSEMBLY (Fig. 12EA-10)

Removal

1. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
2. Disconnect dial lamp.
3. Remove two attaching bolts.

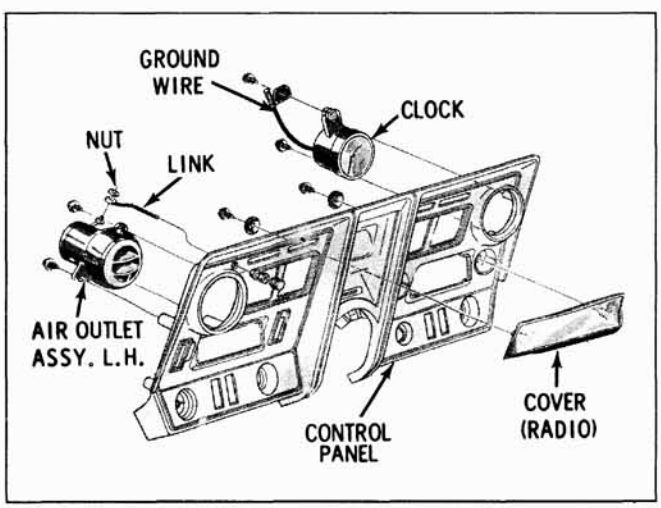


Fig. 12EA-6—Clock Mounting

4. Remove dial assembly from rear of control panel.

OIL AND GENERATOR PRINTED CIRCUIT

Removal

1. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
2. Disconnect wiring connectors.
3. Remove four screws, printed circuit to control housing.
4. Remove lamp sockets.
5. Printed circuit can be replaced at this time.

FUEL GAUGE AND PRINTED CIRCUIT

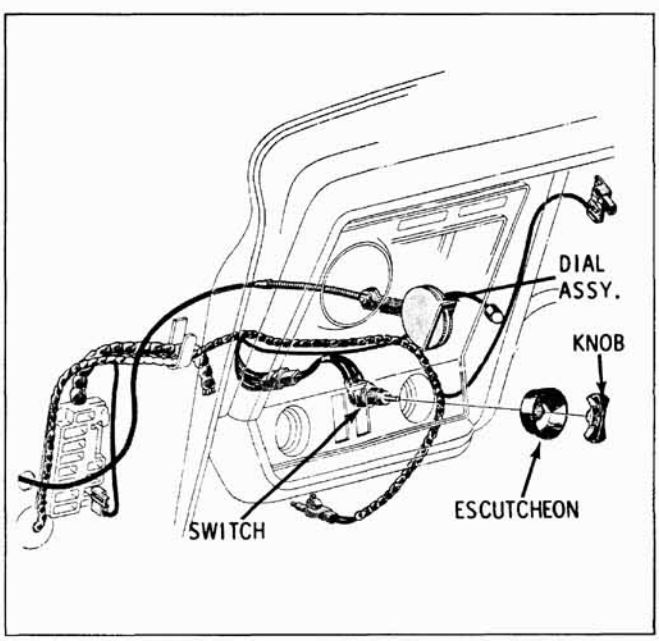


Fig. 12EA-8—Cruise Control Switch

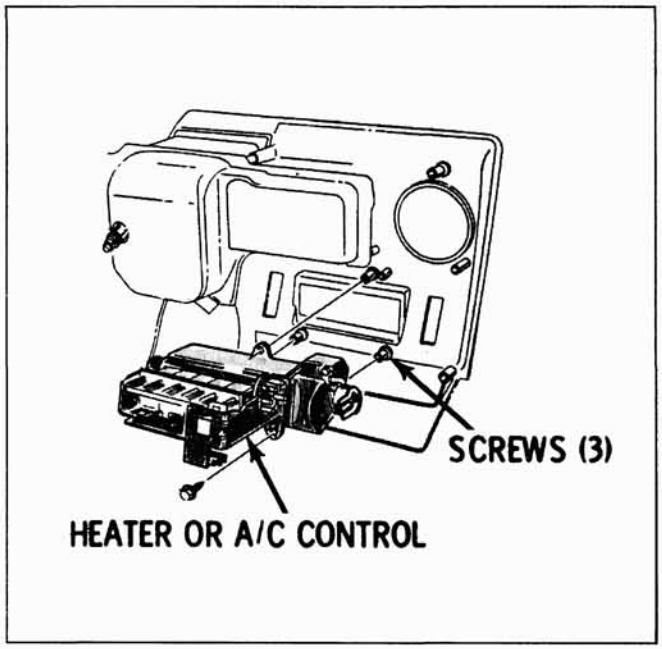


Fig. 12EA-9—Heater or A.C. Control Attachment

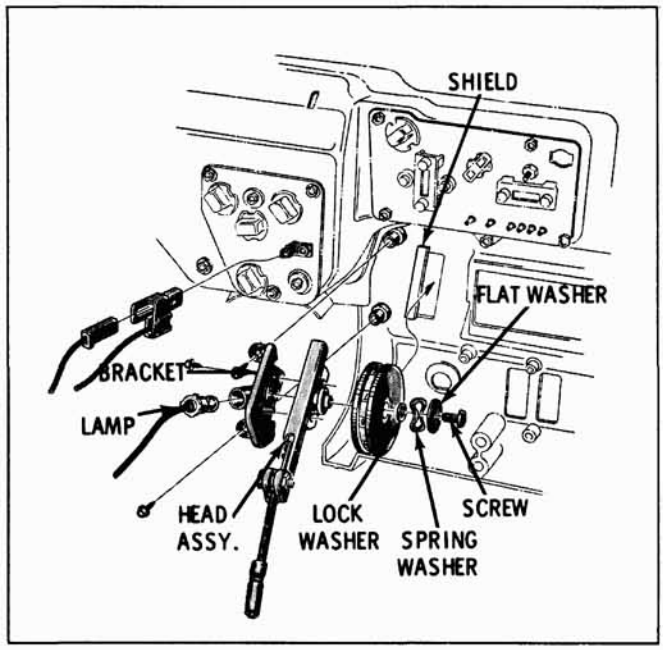


Fig. 12EA-10—Cruise Control Head Attachment

Removal

1. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
2. Disconnect wiring harness connector.
3. Remove four attaching bolts (printed circuit to control housing) and remove assembly.

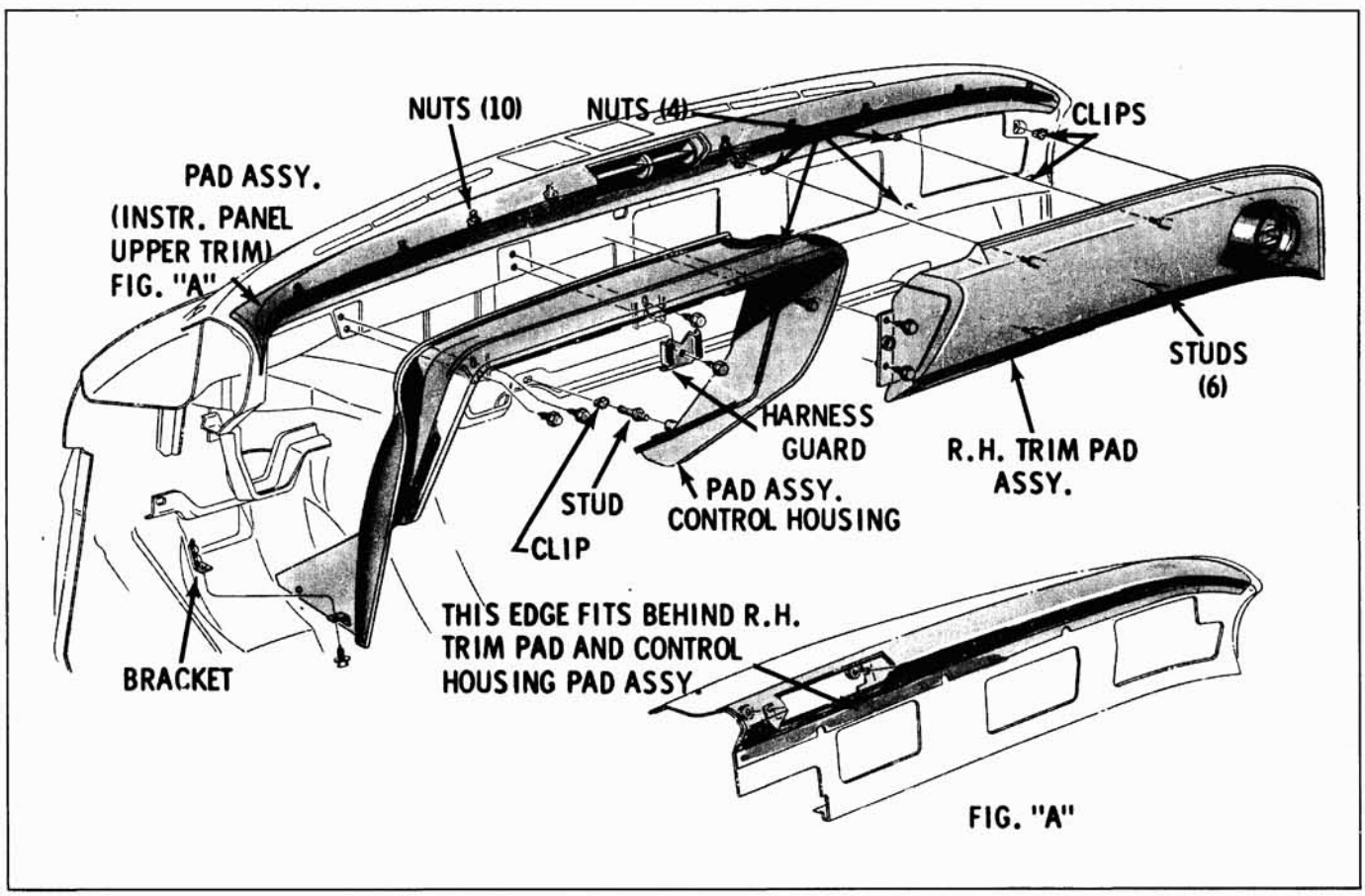


Fig. 12EA-11—Instrument Panel Pad Attachment

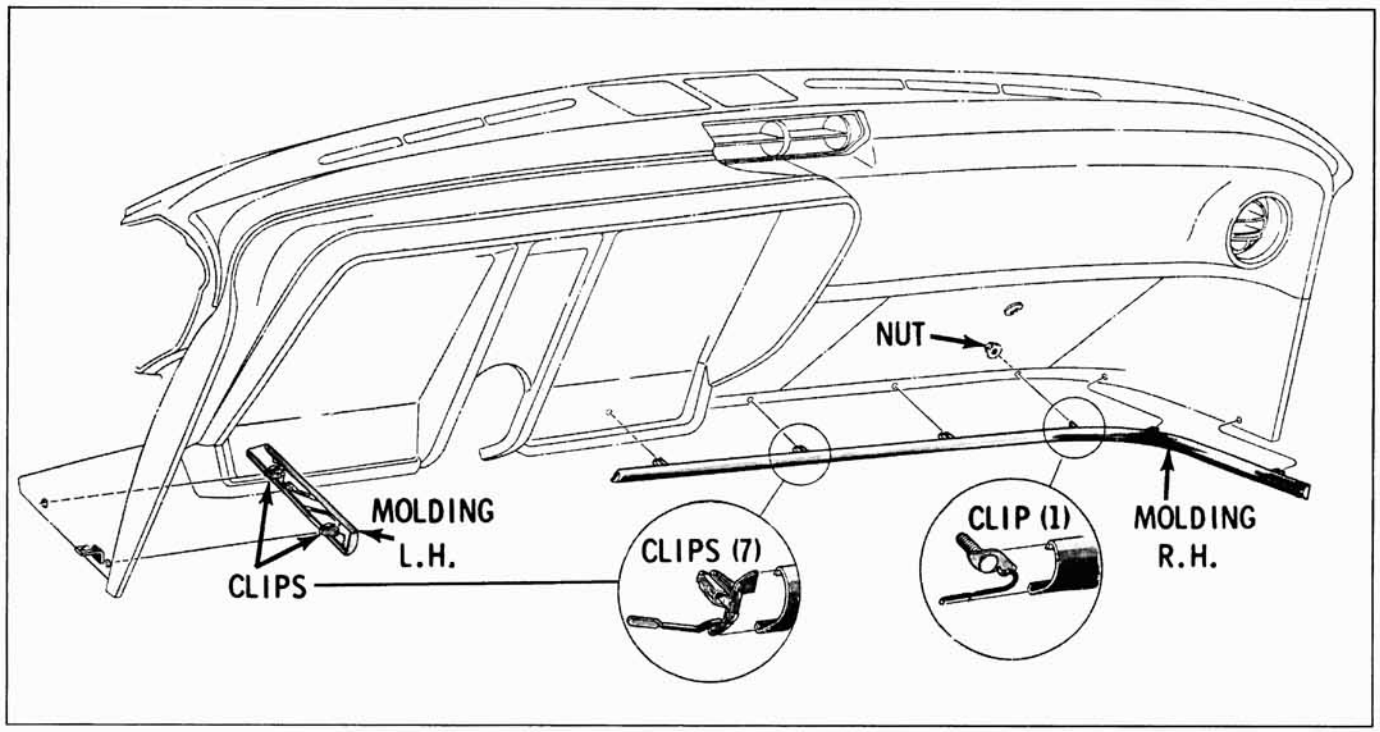


Fig. 12EA-12—Molding Attachment

4. Fuel gauge: Remove three nuts and remove gauge.
5. Printed circuit: Remove fuel gauge and lamps to replace.

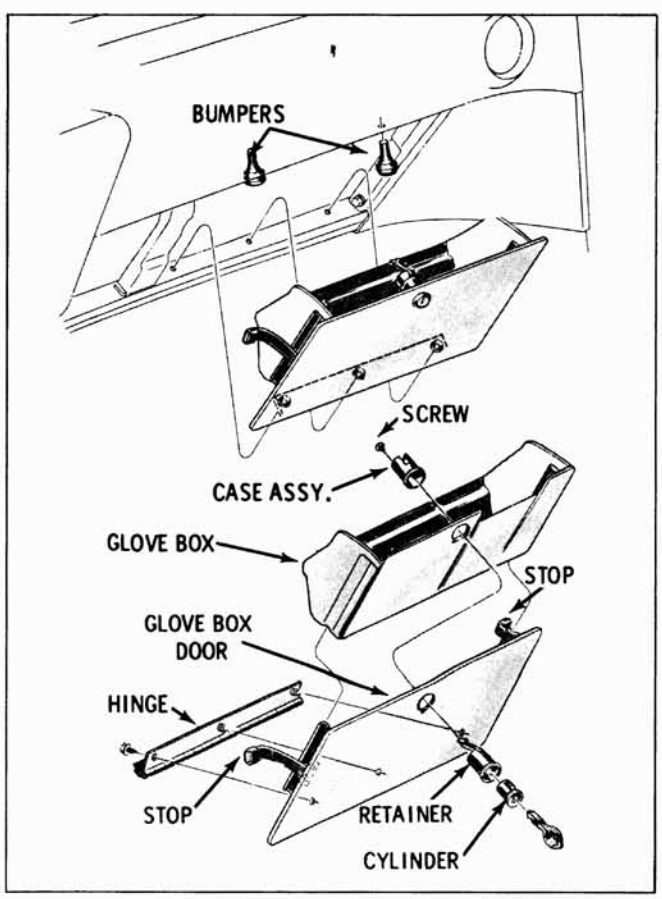


Fig. 12EA-13—Glove Box Attachment

PRINTED CIRCUIT—SPEEDOMETER LAMPS

Removal

1. Remove control panel. Refer to CONTROL PANEL, Items 1 through 9.
2. Disconnect wiring connector.
3. Remove lamp sockets.
4. Remove three attaching bolts and remove printed circuit.

APPLIQUE PANELS—L.H. AND R.H.

Removal

L.H. applique panel can be replaced without removing any of the controls, by lifting edge of applique panel and peeling panel from control panel.

R.H. applique panel will require removing the escutcheon from the ignition switch and then removing applique as described for L.H. applique.

PAD ASSEMBLY—CONTROL HOUSING (Fig. 12EA-11)

Removal

1. Remove control panel. Refer to CONTROL PANEL REMOVAL, Steps 1 through 9.
2. Remove the (7) attaching screws (pad to instrument panel).
3. Pulling pad assembly at lower R.H. corner will pull stud from clip and pad assembly can be removed.

PAD ASSEMBLY R.H. (Fig. 12EA-11)

Removal

1. Remove pad assembly—control housing and glove box. Refer to PAD ASSEMBLY—CONTROL HOUSING and GLOVE BOX REMOVAL.
2. Disconnect R.H. vent outlet hose.
3. Remove two screws and four nuts and remove pad. Extreme R.H. attaching studs will pull out of clips.

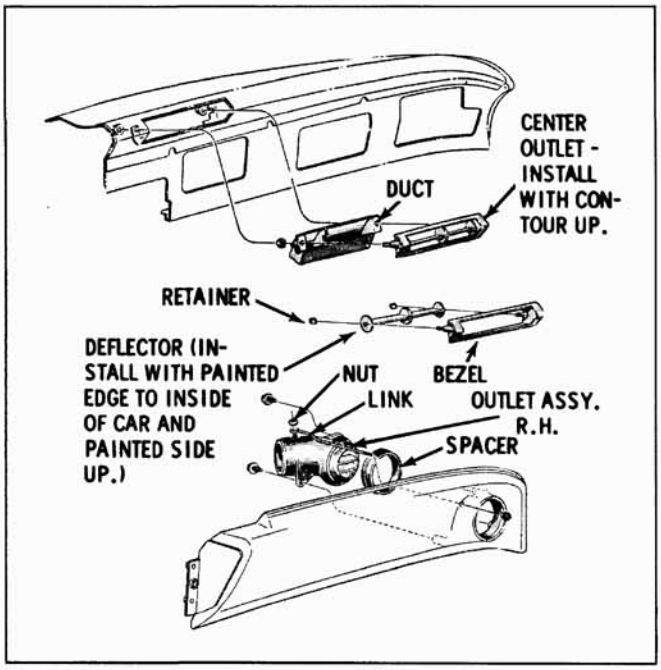


Fig. 12EA-14—Center and R.H. Outlets

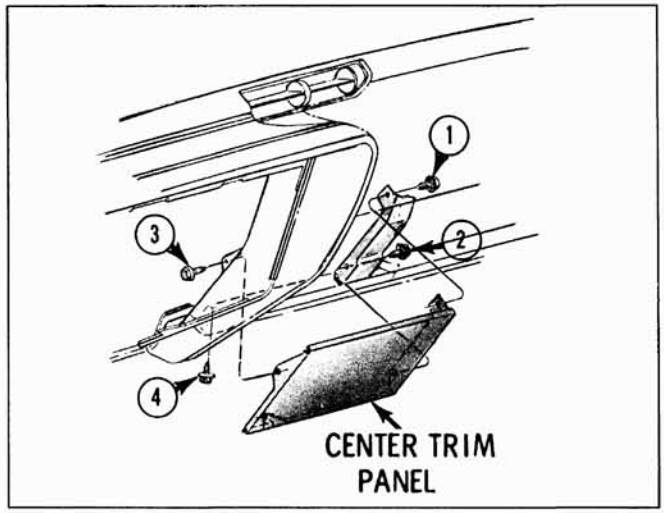


Fig. 12EA-15—Center Trim Panel

PAD ASSEMBLY—INSTRUMENT PANEL UPPER TRIM (Fig. 12EA-11)

Removal

1. Remove pad assembly R.H., Refer to PAD ASSEMBLY R.H. REMOVAL.

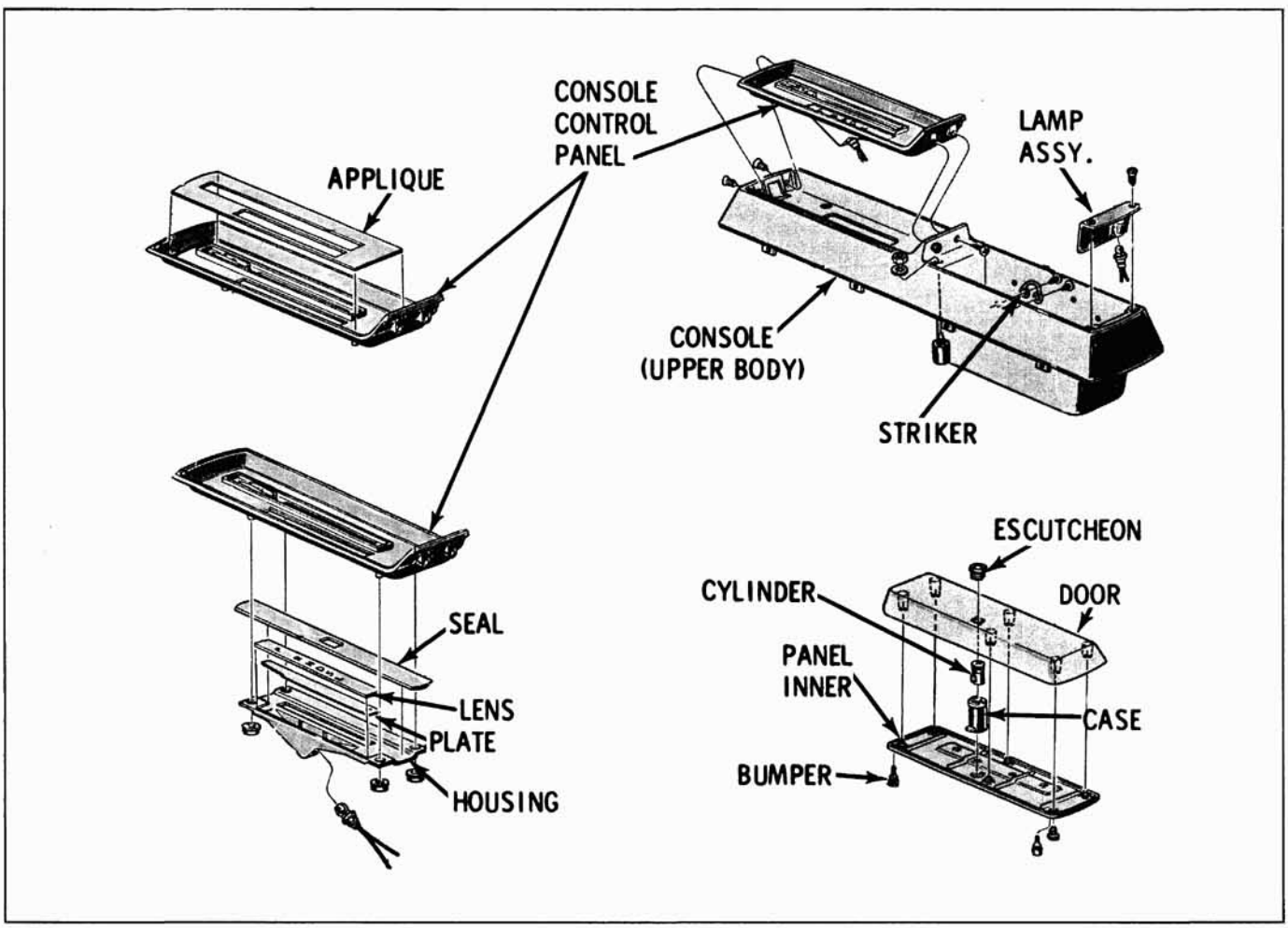


Fig. 12EA-16—Console Attachment

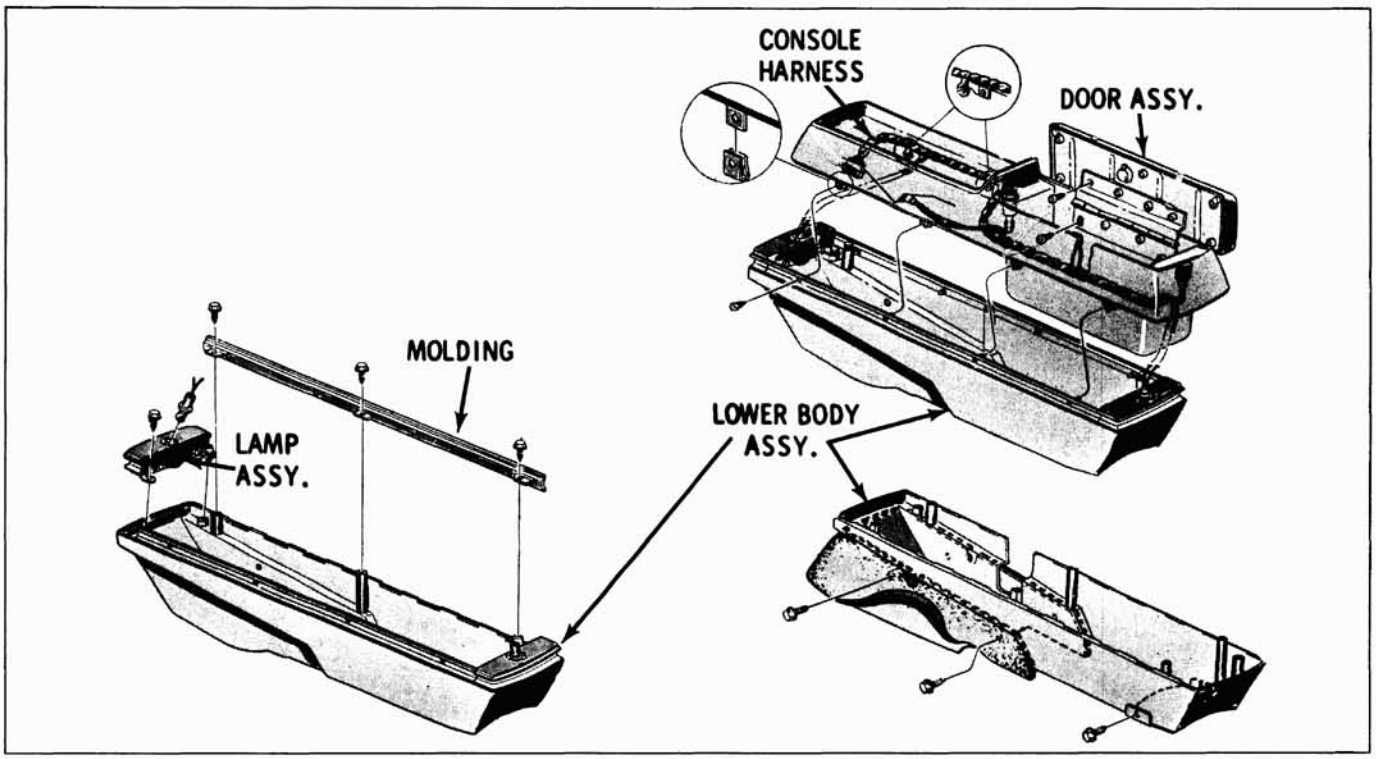


Fig. 12EA-17—Console Attachment

2. Remove the ten attaching nuts as shown in Fig. 12EA-11.
3. Remove pad assembly.

MOLDING—LOWER L.H. (Fig. 12EA-12)

Removal

By carefully prying, molding clips will unsnap and molding can be removed.

MOLDING—LOWER R.H. (Fig. 12EA-12)

Removal

Remove nut from clip bolt as shown in Fig. 12EA-12 and carefully pry molding at clips and remove.

GLOVE BOX (Fig. 12EA-13)

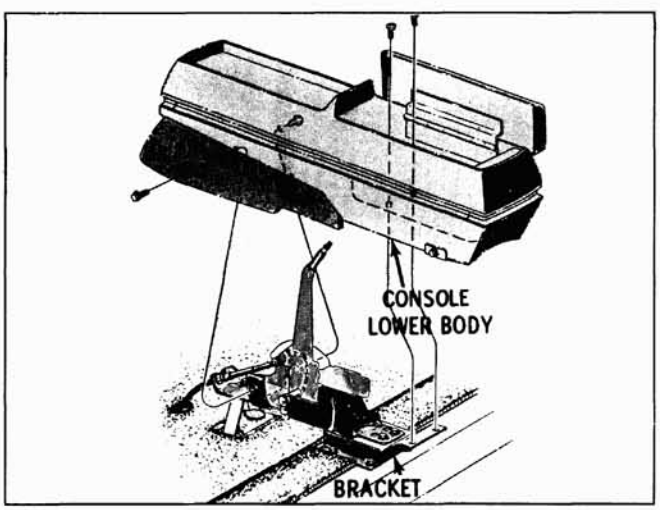


Fig. 12EA-18—Console Attachment

Removal

1. Remove glove box lock assembly.
2. Pull up on glove box to remove.

GLOVE BOX DOOR (Fig. 12EA-13)

Removal

1. Remove glove box.
2. Remove three attaching screws, hinge to glove box door.

OUTLET R.H. (Fig. 12EA-14)

Removal

1. Remove knob from shut off control rod.
2. Remove glove box. Refer to GLOVE BOX, REMOVAL.
3. Remove hose from outlet.
4. Remove three attaching screws and remove from rear of R.H. trim pad assembly.

CENTER OUTLET

Removal

1. Remove pad assembly (Instrument Panel Upper Trim). Refer to PAD ASSEMBLY (Instrument Panel Upper Trim).
2. Remove nuts from center outlet and remove from front of instrument panel.

CENTER TRIM PANEL (Fig. 12EA-15)

Removal

1. Open glove box and remove screw No. 1.
2. Remove screws 2, 3 and 4 from behind dash.
3. Remove panel from front of dash.

CONSOLE (Figs. 12EA-16-17-18)

For console attachment, refer to Figs. 12EA-16-17-18.

WINDSHIELD WIPER SYSTEM

TORONADO

DESCRIPTION (Figs. 12EB-1 and 12EB-2)

The wiper system used on the Toronado consists of the transmission assembly and a round two-speed depressed park motor, very similar to that used on 54 through 86 Series. For servicing the gear and motor section, refer to Section 12B, ROUND MOTOR.

The motor has two external leads with an external over-all measurement of 4-1/2" long. The motor has a gray colored drive gear with a gear ratio of 51:1. The motor crankarm is identified by the letter G.

A windshield washer system is used on all motors and the servicing of the pump is covered in Section 12B. Refer to Fig. 12EB-3 for hose routing and nozzle fastening.

For additional specifications, refer to Section 12B, ROUND MOTOR.

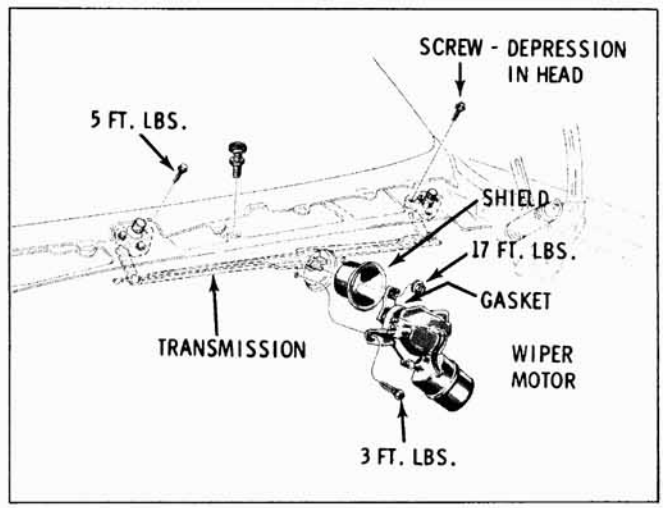


Fig. 12EB-1—Wiper Motor Attachment

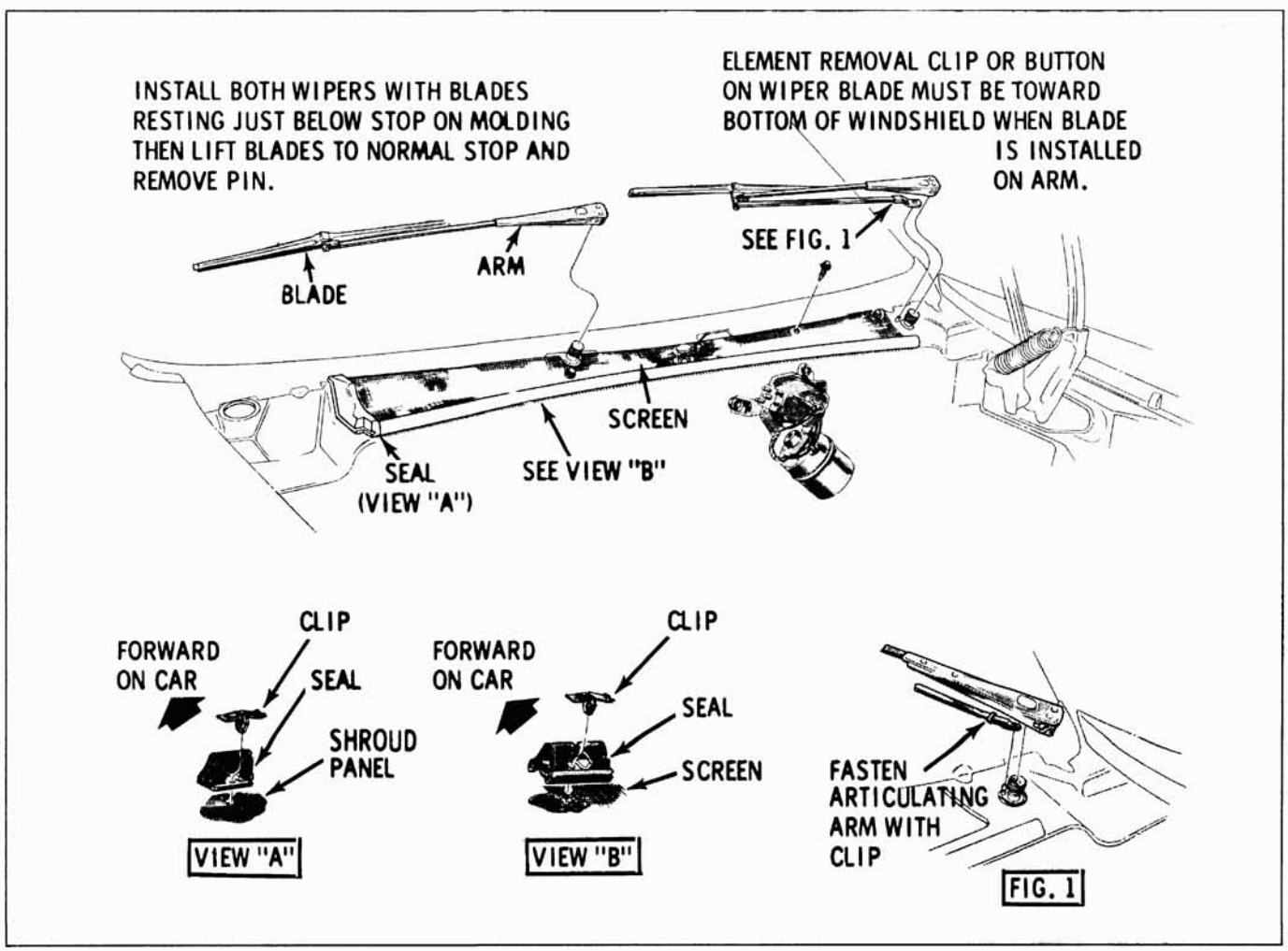


Fig. 12EB-2—Wiper Blade Adjustment

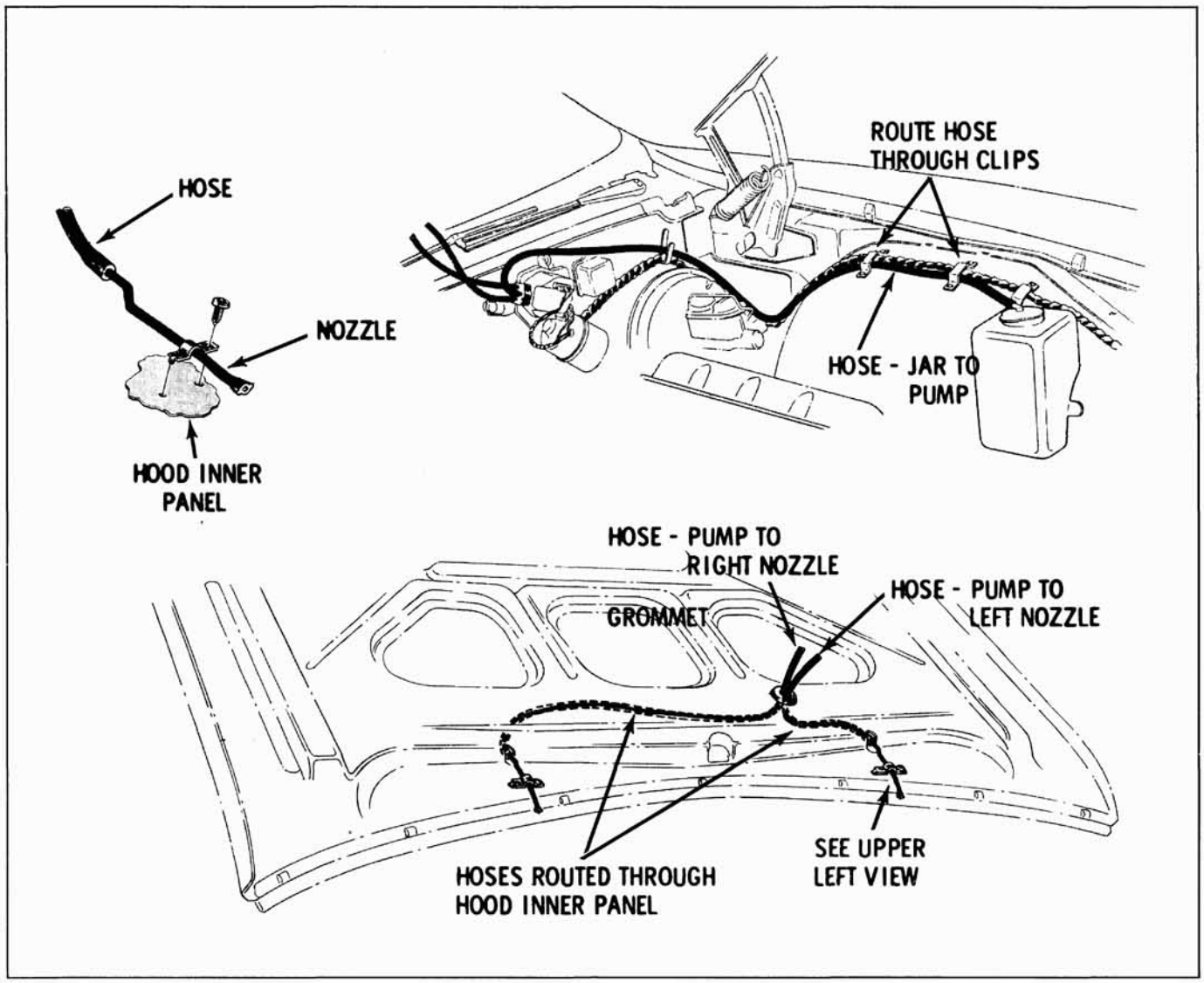


Fig. 12EB-3—Windshield Washer Hose Routing

RADIATOR AND GRILLE

ITEMS LISTED IN THE TABLE OF CONTENTS ARE DIFFERENT FOR TORONADO SERIES. FOR SERVICE PROCEDURES AND RECOMMENDATIONS NOT LISTED, REFER TO SECTION 13, 31-86 SERIES.

CONTENTS OF SECTION 13E

Subject	Page	Subject	Page
RADIATOR	13E-1	GRILLE	13E-2

MAINTENANCE RECOMMENDATIONS

For maintenance recommendations, refer to Section 6K, ENGINE COOLING SYSTEM. For cooling system capacities, refer to Section 0, GENERAL INFORMATION AND PERIODIC MAINTENANCE.

RADIATOR (Figs. 13E-1 and 13E-2)

Removal

1. Drain radiator.
2. Remove upper radiator baffle. Detach the fan shroud and slide back over fan.

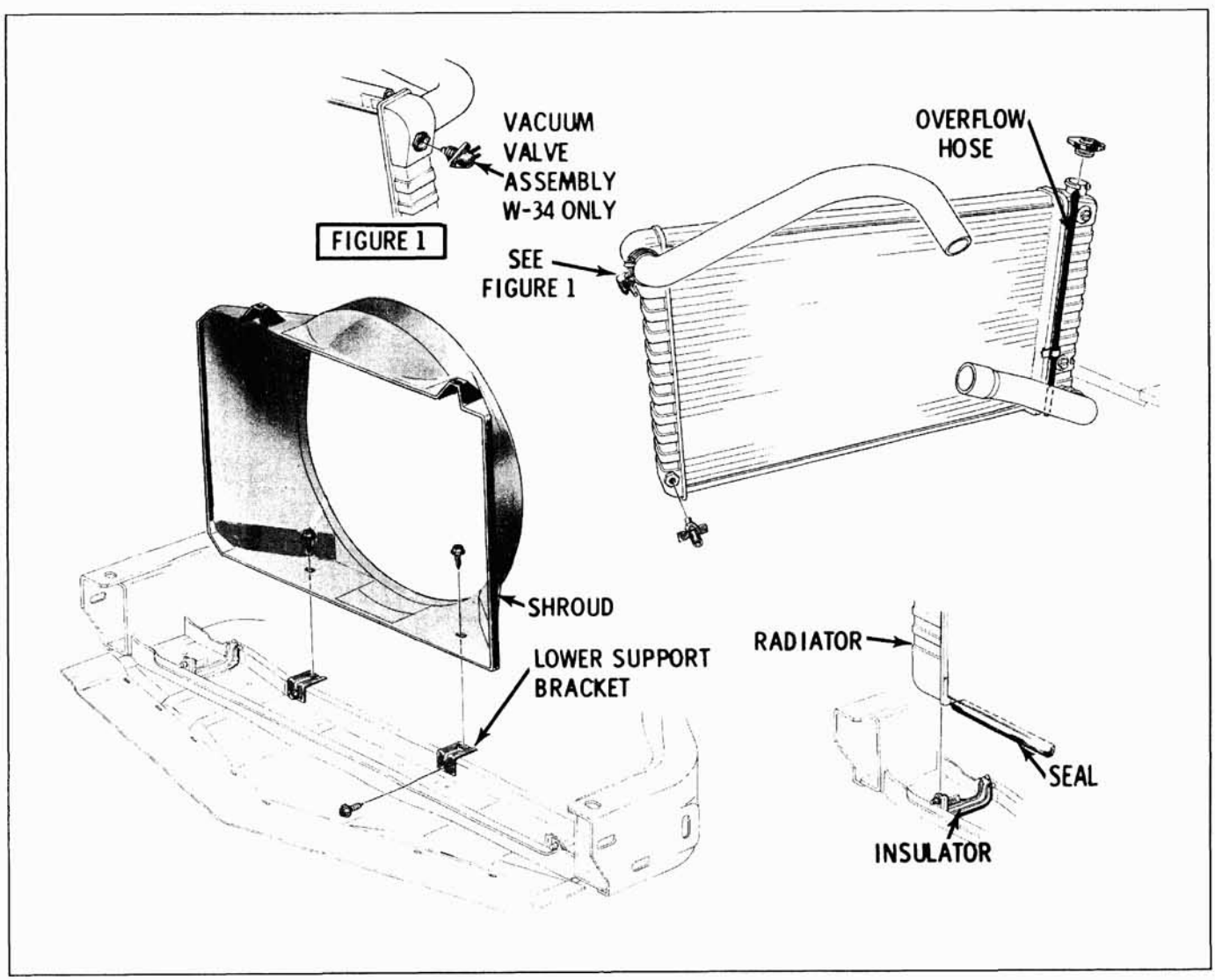


Fig. 13E-1—Radiator, Overflow Hose and Fan Shroud

3. Disconnect upper and lower radiator hose and overflow hose.
4. Disconnect and cap automatic transmission cooler lines.
5. Lift radiator upward to disengage from lower supports and remove from car.

Installation

1. Install radiator in lower support being sure seals are correctly positioned.
2. Connect automatic transmission cooler lines, upper and lower radiator hoses and overflow hose.
3. Install fan shroud and upper radiator baffle.
4. Fill radiator using existing coolant or new coolant as recommended in GENERAL INFORMATION, Section 0.

GRILLE ASSEMBLY (Figs. 13E-3 and 13E-4)

Grille Removal

1. Remove nuts holding grille to grille plate.
2. Remove nuts holding script and name plate to grille.

Grille Installation

1. Install script and name plate to grille.
2. Install grille to grille plate.

Grille Plate Removal

1. Remove vacuum hose at vacuum tank and raise grille assembly to open position.
2. Remove retainer ring and lever from actuator.
3. Remove nut and bushing from center pivot bolt.
4. Loosen and slide rearward, battery or vacuum tank, to gain access to outer pivot nut and bushing.

Grille Plate Installation

1. Tape bushings to grille plate.
2. Install grille plate into position and install outer pivot bolt and nut.
3. Raise grille and install inner pivot nut.
4. Install lever and retaining ring.
5. Connect vacuum hose at vacuum tank.
6. Reposition and install either the vacuum tank or battery.

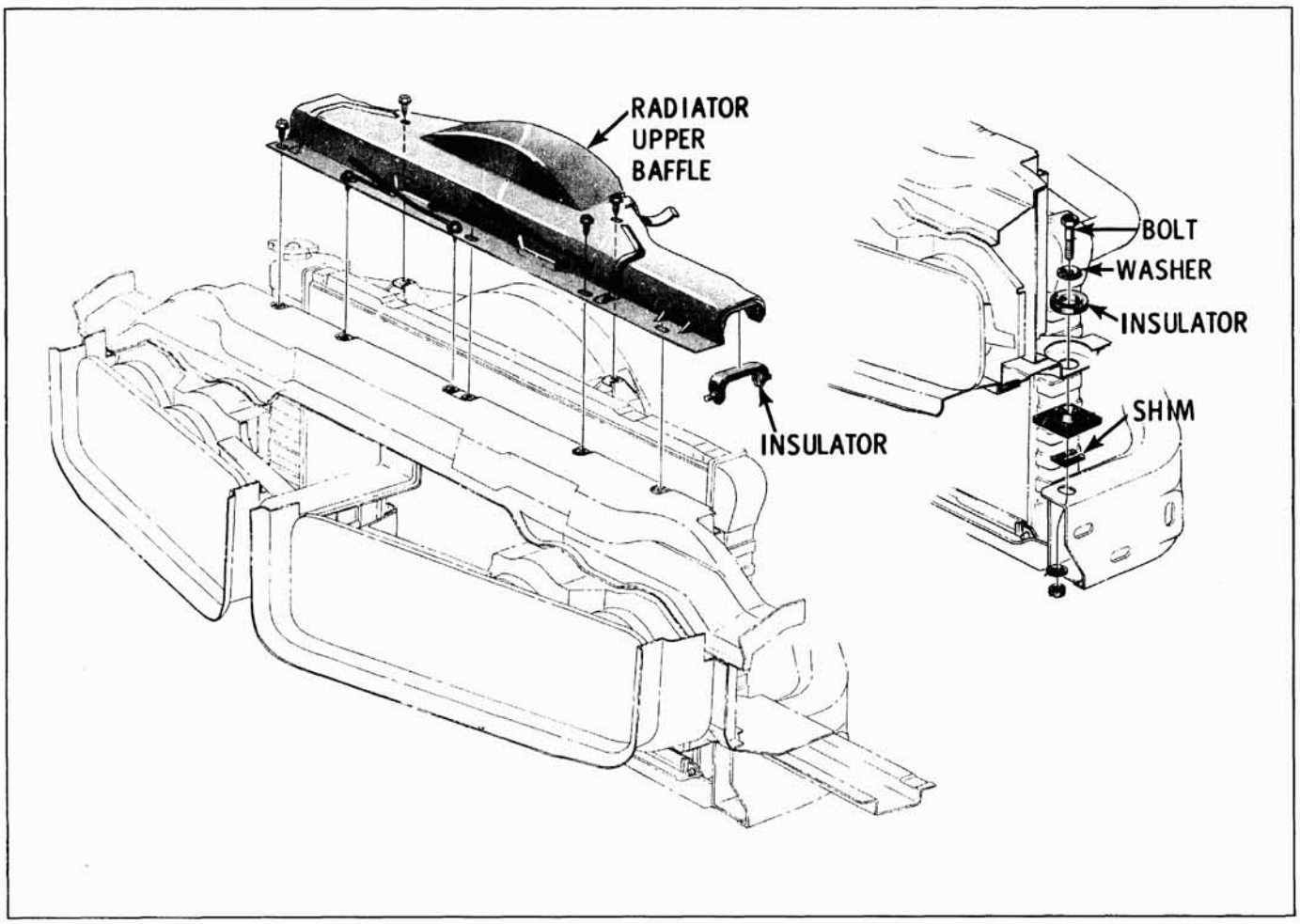


Fig. 13E-2—Radiator Upper Baffle

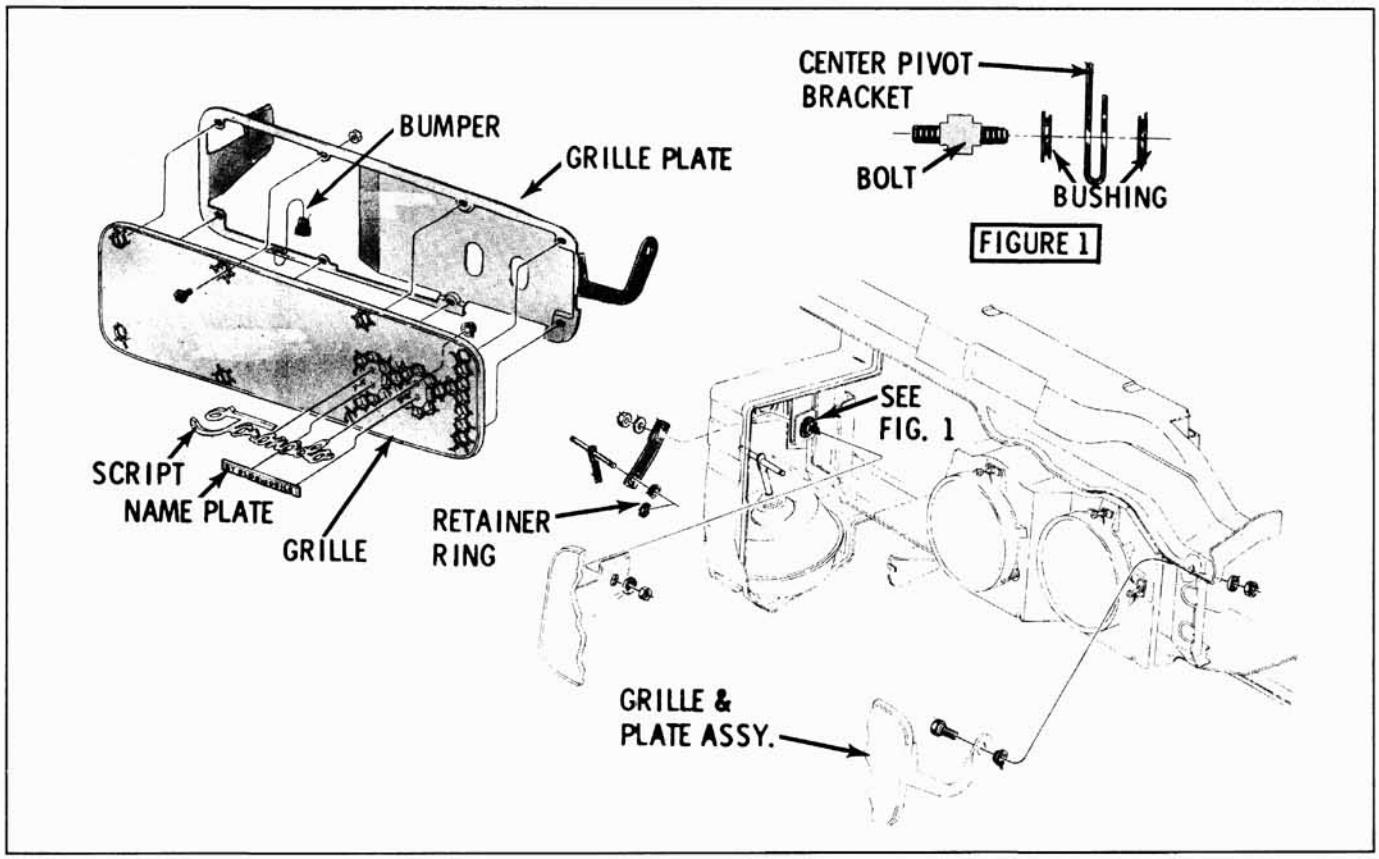


Fig. 13E-3—Grille Assembly

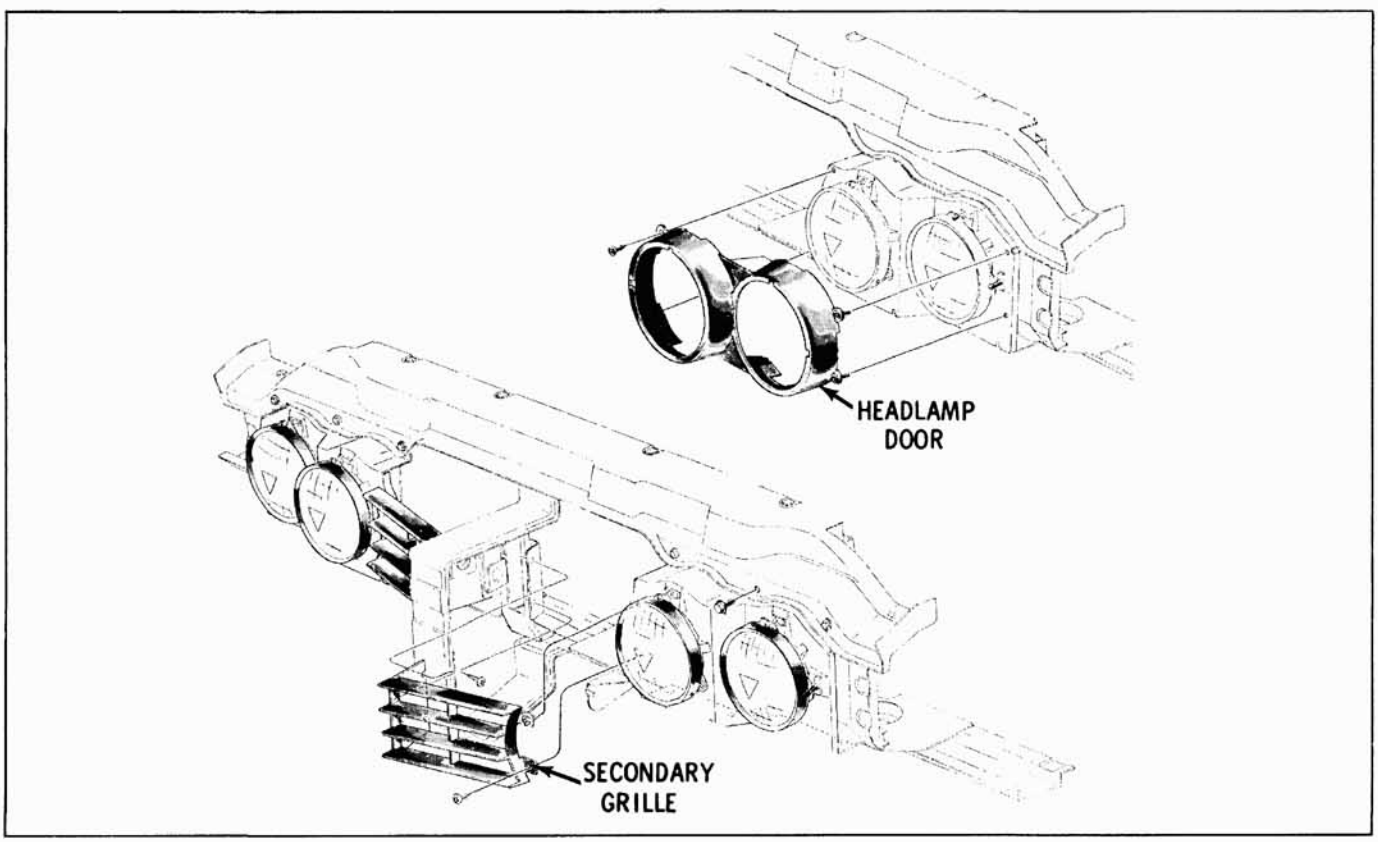


Fig. 13E-4—Secondary Grille Assembly

BUMPERS

TORONADO

CONTENTS OF SECTION 14E

Subject	Page	Subject	Page
FRONT BUMPER	14E-1	TAIL, BACK-UP AND LICENSE LENS OR BULBS	14E-2
REAR BUMPER	14E-1	PARK, TURN AND MARKER LAMP ASSEMBLY (FRONT)	14E-2
BACK-UP LAMP ASSEMBLY	14E-1	TORQUE SPECIFICATIONS	14E-2
TAIL LAMP ASSEMBLY	14E-1		

FRONT BUMPER (Fig. 14E-1)

Removal

1. Disconnect both lamp assembly wiring.
2. Loosen outer brace to frame attaching bolt.
3. Remove bolt from brace at center of bumper.
4. Remove the 4 bracket to bumper attaching bolts and remove bumper

To install, reverse removal procedures. Align bumper horizontally and bumper to fender clearance should be the same on both ends. The braces are elongated for alignment purposes. Torque as indicated under TORQUE SPECIFICATIONS.

REAR BUMPER (Fig. 14E-2)

Removal

1. From under car, remove bracket to frame attaching bolts. Note number of shims used.
2. Remove bumper to center brace attaching bolt.
3. From inside of trunk, disconnect wiring to back-up lamps, tail lamps and license lamp.
4. Lift rear compartment trim to gain access to bracket attaching bolts and remove bolts, then remove bumper assembly.

To install, reverse the removal procedures. Bumper alignment is obtained by using shims as shown on Fig. 14E-2.

BACK-UP LAMP ASSEMBLY

Either back-up lamp assembly can be removed from the bumper through the opening at the license plate bracket.

TAIL LAMP ASSEMBLY

Removal

1. Disconnect tail lamp wiring.
2. Remove bracket to frame bolt. (Inside rear compartment).
3. Remove bracket to frame bolt. (From under car).

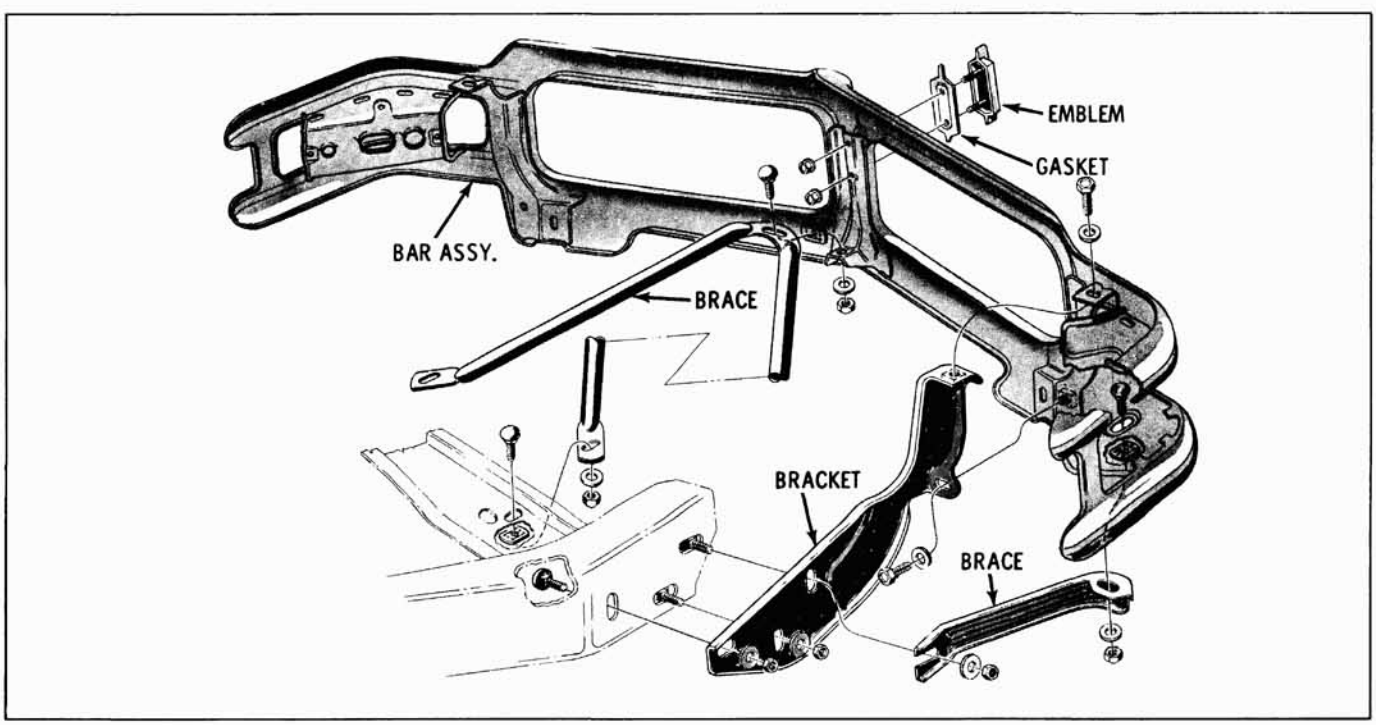


Fig. 14E-1—Front Bumper

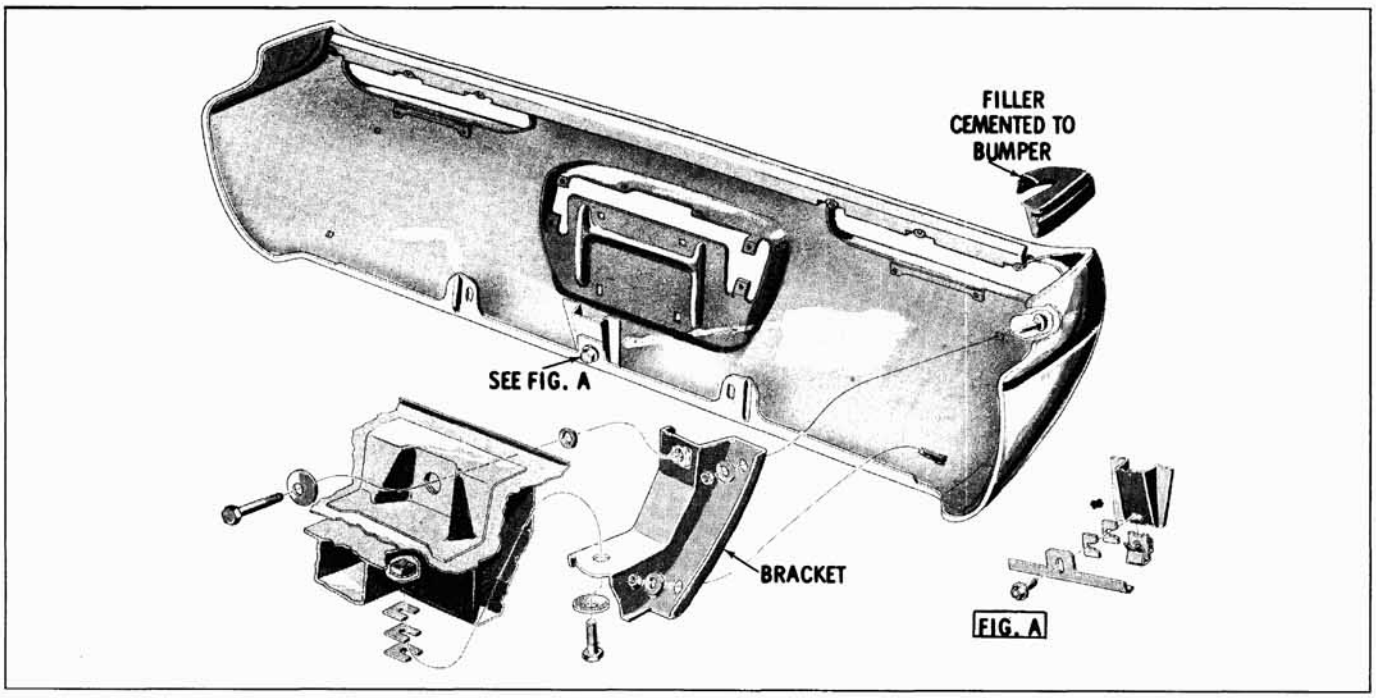


Fig. 14E-2—Rear Bumper

4. Remove the center brace to bumper attaching bolt.
5. Carefully pull bumper end rearward until tail lamp assembly attaching nuts can be removed.

To install, reverse removal procedure.

TAIL, BACK-UP AND LICENSE LENS OR BULBS

All lens or bulbs can be removed from rear of bumper by removing the attaching bolts.

PARK, TURN AND MARKER LAMP ASSEMBLY (FRONT)

Removal

1. For R.H. remove battery. For L.H. remove vacuum reserve tank.
2. Remove attaching bolts and remove lamp assembly from front of bumper.

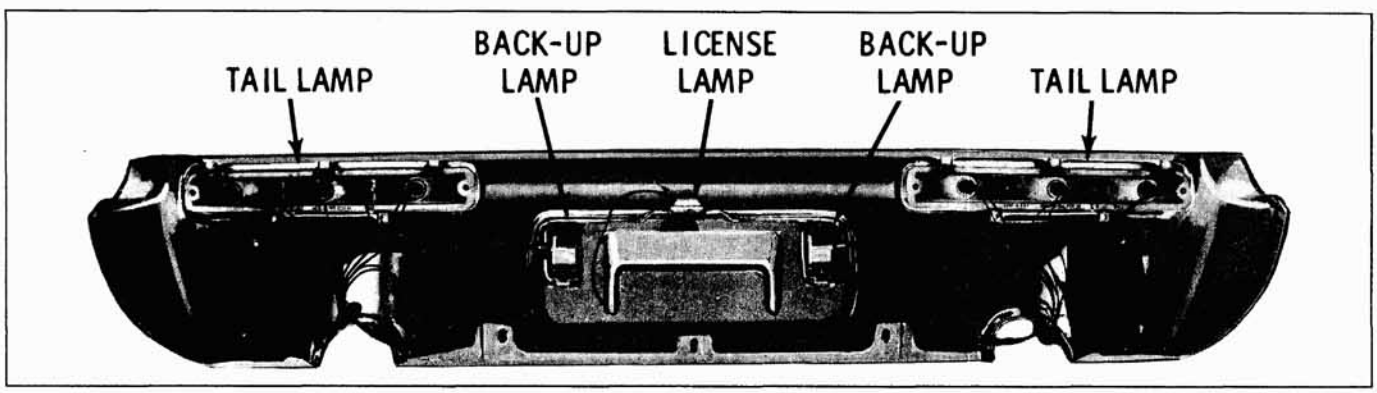


Fig. 14E-3—Rear Bumper Lamp Mountings

TORQUE SPECIFICATIONS

APPLICATION	FT. LBS.
FRONT BUMPER	
Center Brace to Bumper Nut	45
Center Brace to Frame Nuts	45
Bracket to Bumper Nuts	45
Bracket to Frame Nuts	70
Outer Brace to Bumper Nut	45
REAR BUMPER	
Bracket to Frame Bolts	60
Bracket to Bumper Nuts	25
Brace to Bumper Bolt	18

ACCESSORIES

TORONADO

CONTENTS OF SECTION 15E

Subject	Page
RADIO	15E-1
AM-FM WONDER BAR	15E-1
AM-FM STEREO	15E-1
REMOVE AND INSTALL	15E-1
STEREO ADAPTER REMOVAL	15E-1
RADIO DIAL LAMP	15E-3
TRIMMER ADJUSTMENT	15E-3
FRONT SPEAKER REMOVAL	15E-3
STEREO TAPE PLAYER REMOVAL	15E-4
CRUISE CONTROL	15E-5
CRUISE CONTROL SELECTOR ASSEMBLY AND/OR CABLE	15E-6
BRAKE RELEASE SWITCH ADJUSTMENT	15E-6
REGULATOR	15E-7
REMOVAL AND INSTALLATION	15E-7
UNDER HOOD LAMP	15E-7
REAR WINDOW DEFOGGER	15E-7
VACUUM TRUNK RELEASE	15E-8
REMOTE CONTROL MIRROR	15E-9
OUTSIDE MIRROR	15E-9
TRUNK LAMP	15E-10
TRANSMISSION OIL AUXILIARY COOLER	15E-10
LUGGAGE CARRIER	15E-11
VACUUM DOOR LOCK	15E-11
SUPER LIFT SHOCK ABSORBER	15E-12
WHEEL DISCS	15E-12

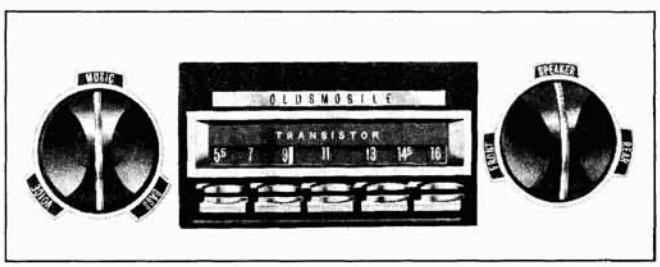


Fig. 15E-1—Deluxe Radio

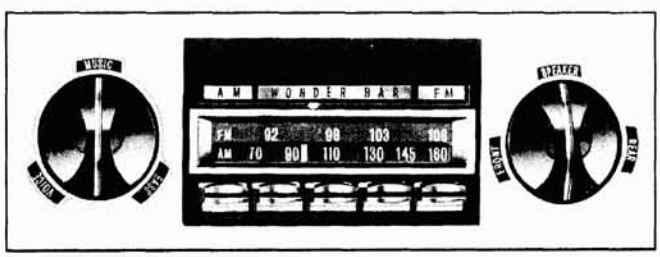


Fig. 15E-2—AM-FM Wonder Bar

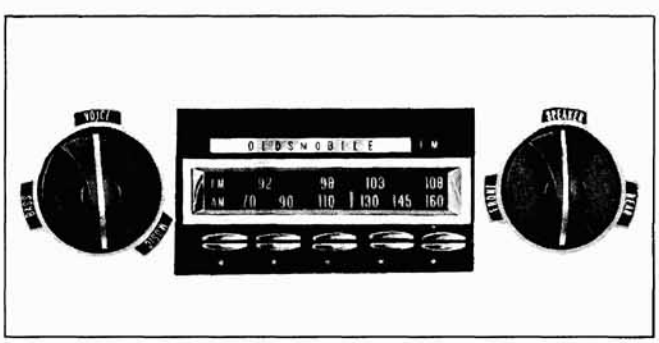


Fig. 15E-3—AM-FM Stereo

RADIO (Figs. 15E-1, 15E-2 and 15E-3)

Radio service procedures not listed in this section can be found in Section 15.

Remove and Install (Fig. 15E-4)

1. Disconnect negative battery cable.
2. Remove right hand filler to control housing pad assembly.
3. Remove shift indicator needle.
4. Remove steering column attaching nuts and lower bracket.
5. Disconnect speedometer cable at transmission.
6. Remove attaching nuts from cluster lower brackets, leaving brackets attached to the instrument panel.
7. Remove two upper instrument panel screws and lay cluster assembly on steering column.

A protective covering must be used to protect steering column.

8. Remove radio knobs, washers or rear seat speaker control.
9. Remove radio attaching nuts and escutcheons.
10. Disconnect all wiring and antenna lead-in.
11. Remove lower radio support bracket attaching nut.
12. Remove radio from instrument panel.

To install, reverse the removal procedure.

STEREO ADAPTER REMOVAL

Refer to Fig. 15E-5 when performing the following.

1. Disconnect negative battery cable.
2. Disconnect cables to rear seat speaker and to receiver assembly.
3. Remove two retaining screws and remove adapter assembly.

To install reverse removal procedure.

The Stereo Receiver and Adapter have identical serial numbers and the units must be kept together for service and installation.

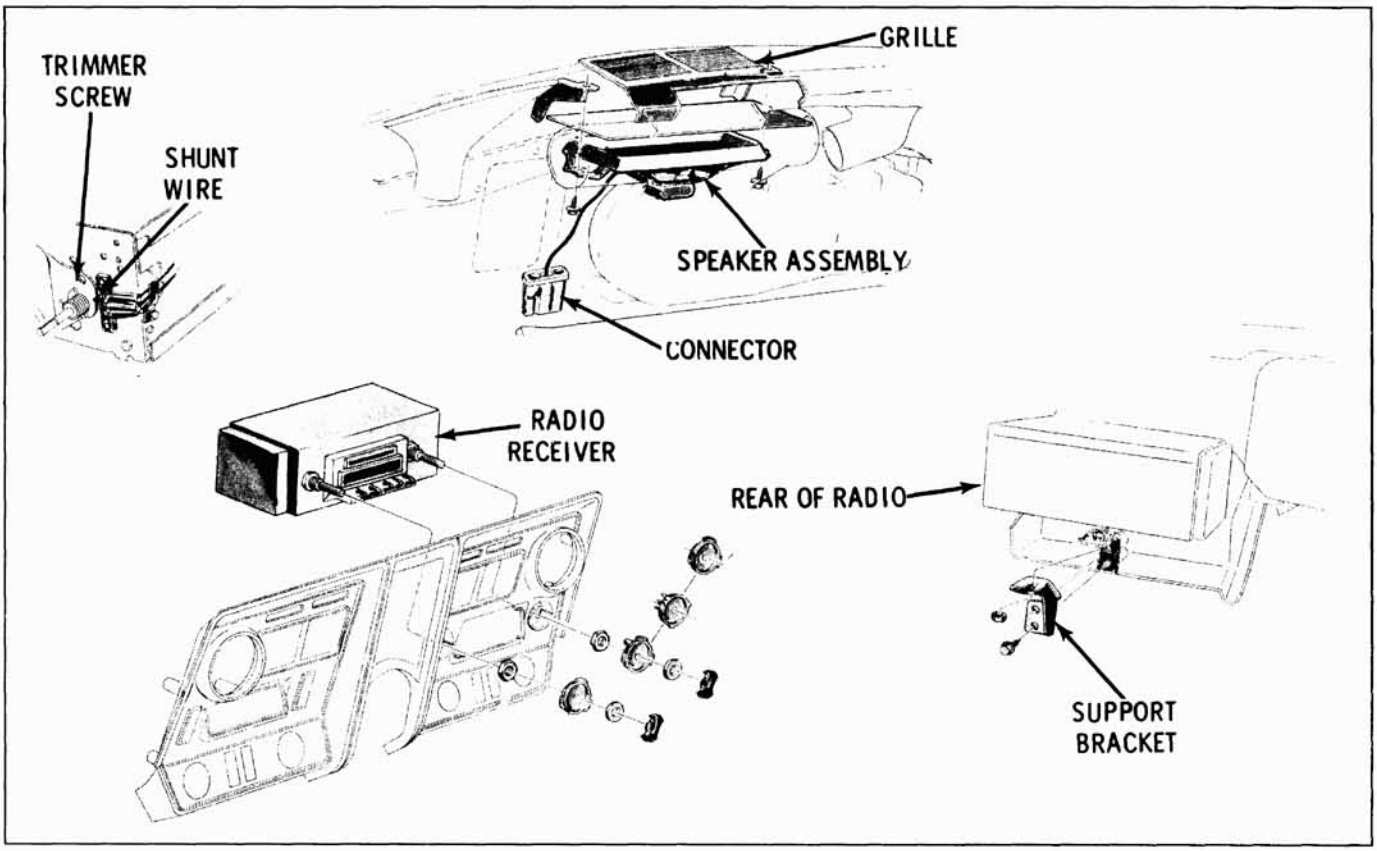


Fig. 15E-4—Radio and Speaker Installation

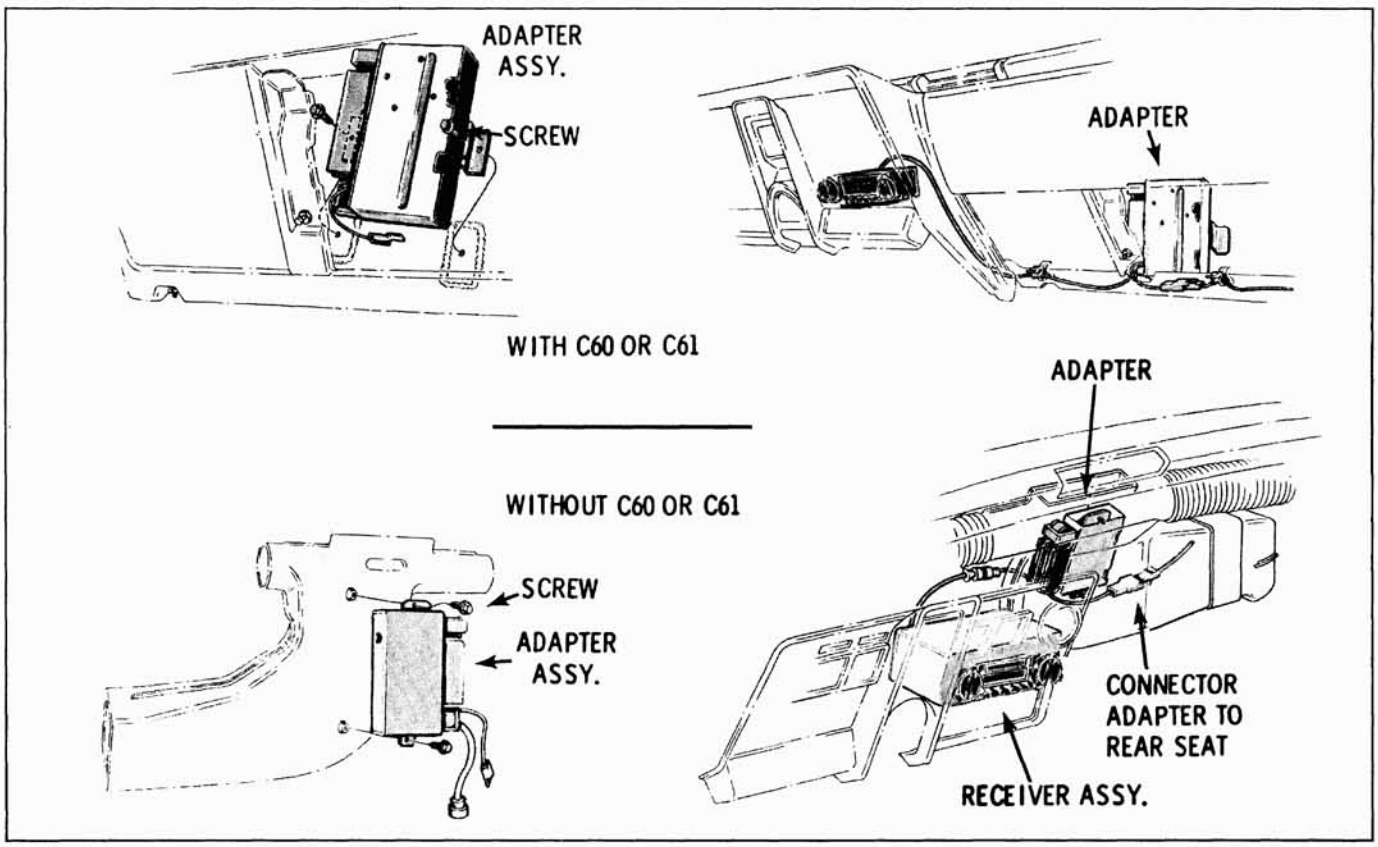


Fig. 15E-5—Radio Installation - Stereo

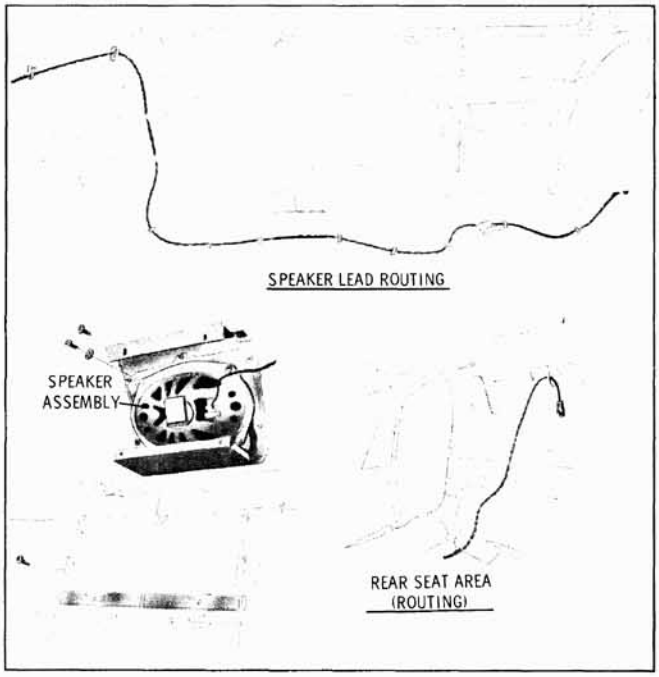


Fig. 15E-6—Rear Seat Speaker Installation

RADIO DIAL LAMP

The radio lamp plugs into the top side of the receiver. It is not necessary to remove the receiver to replace the bulb.

TRIMMER ADJUSTMENT (Fig. 15E-4)

1. Extend antenna to approximately 31 inches.

AM-FM radio must be set on the AM band.

2. Remove the manual tuning knob and escutcheon or rear seat speaker fader control, if so equipped.
3. If car is equipped with a rear seat speaker, insert a shunt wire as shown in Fig. 15E-4.

Do not turn on radio unless shunt wire is installed.

4. Turn the volume control full on and tune the receiver to a weak station at approximately 1400 kilocycles.
5. With a small screwdriver, adjust the antenna trimmer until loudest signal is received.
6. Turn off radio. Remove shunt wire, if equipped with a rear seat speaker.

FRONT SPEAKER REMOVAL (Fig. 15E-4)

1. Disconnect battery, remove glove box and remove stereo tape player if equipped.
2. If non A.C., remove right trim panel and disconnect lower instrument panel reinforcement to the right corner of control housing. Loosen control panel and lay cluster assemblies on steering column as outlined in Radio R and R. Remove heater outlet, ventilator air duct adapter, and duct.
4. Remove right hand defroster duct and hose (A.C. only).
5. Disconnect lead from receiver and remove two speaker attaching screws and remove speaker.

TAPE PLAYER—STEREO

For test procedures refer to Section 15.

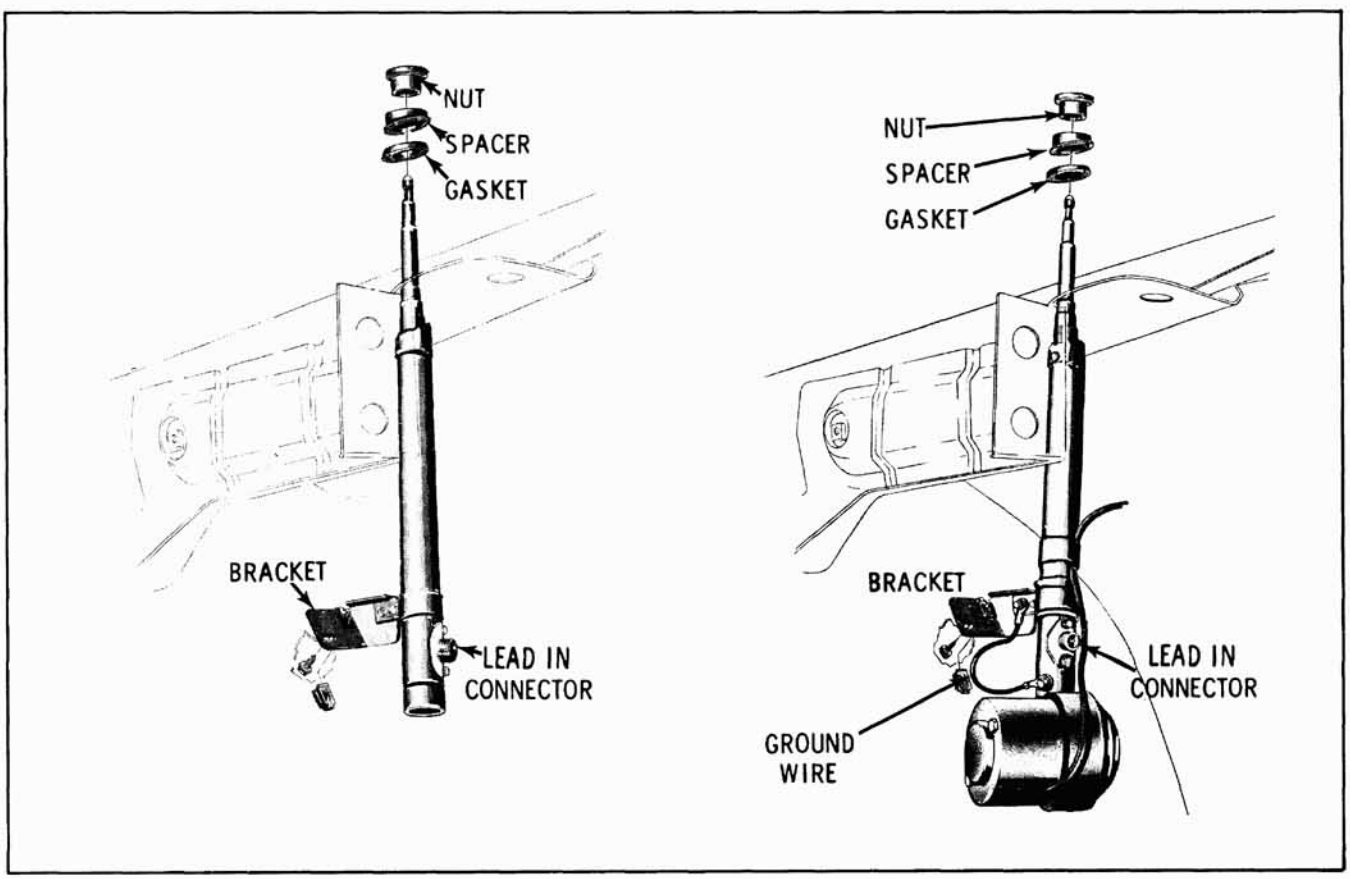


Fig. 15E-7—Antenna Installation

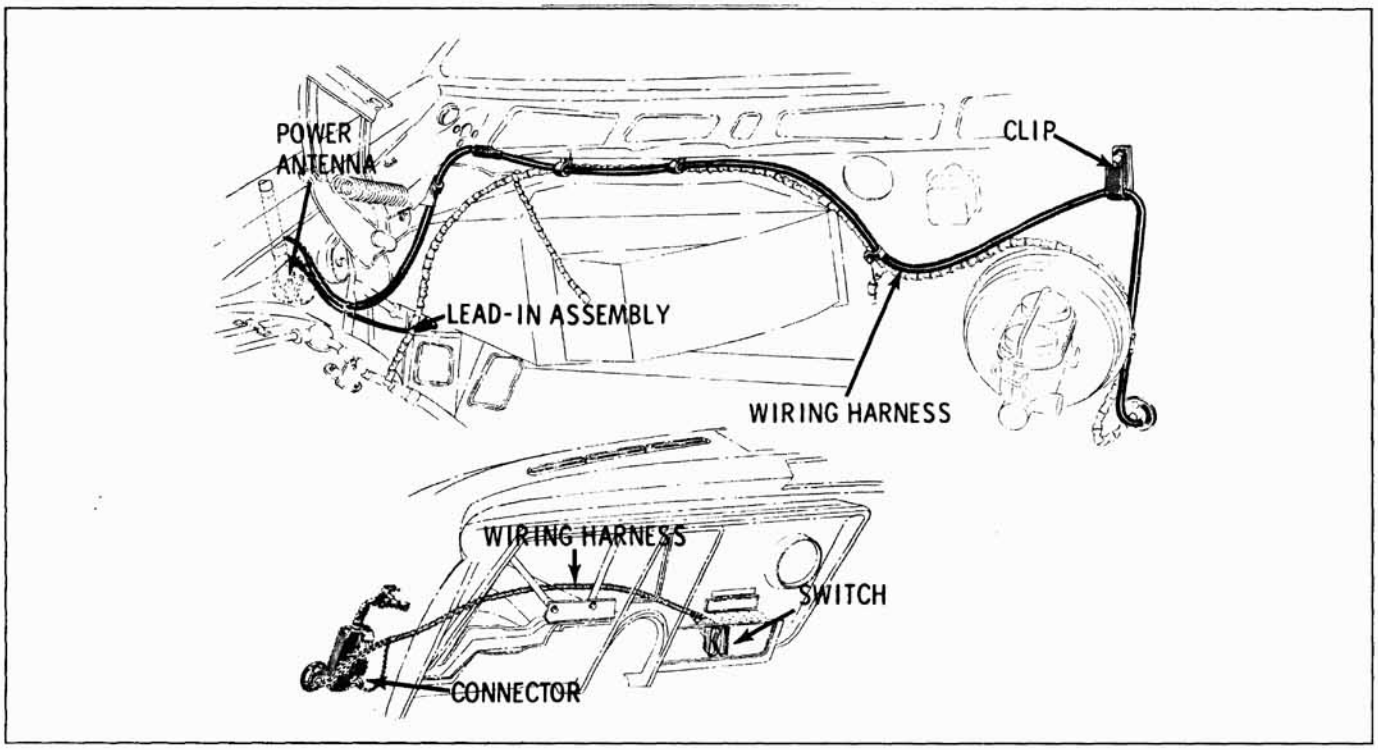


Fig. 15E-8—Power Antenna Lead In Routing

TAPE PLAYER REMOVAL

Refer to Figs. 15E-9, 15E-10 when performing the following steps.)

1. Disconnect negative battery cable.
2. Remove four attaching screws and remove player assembly.
3. Disconnect all wiring at connectors.

To install, reverse removal procedure.

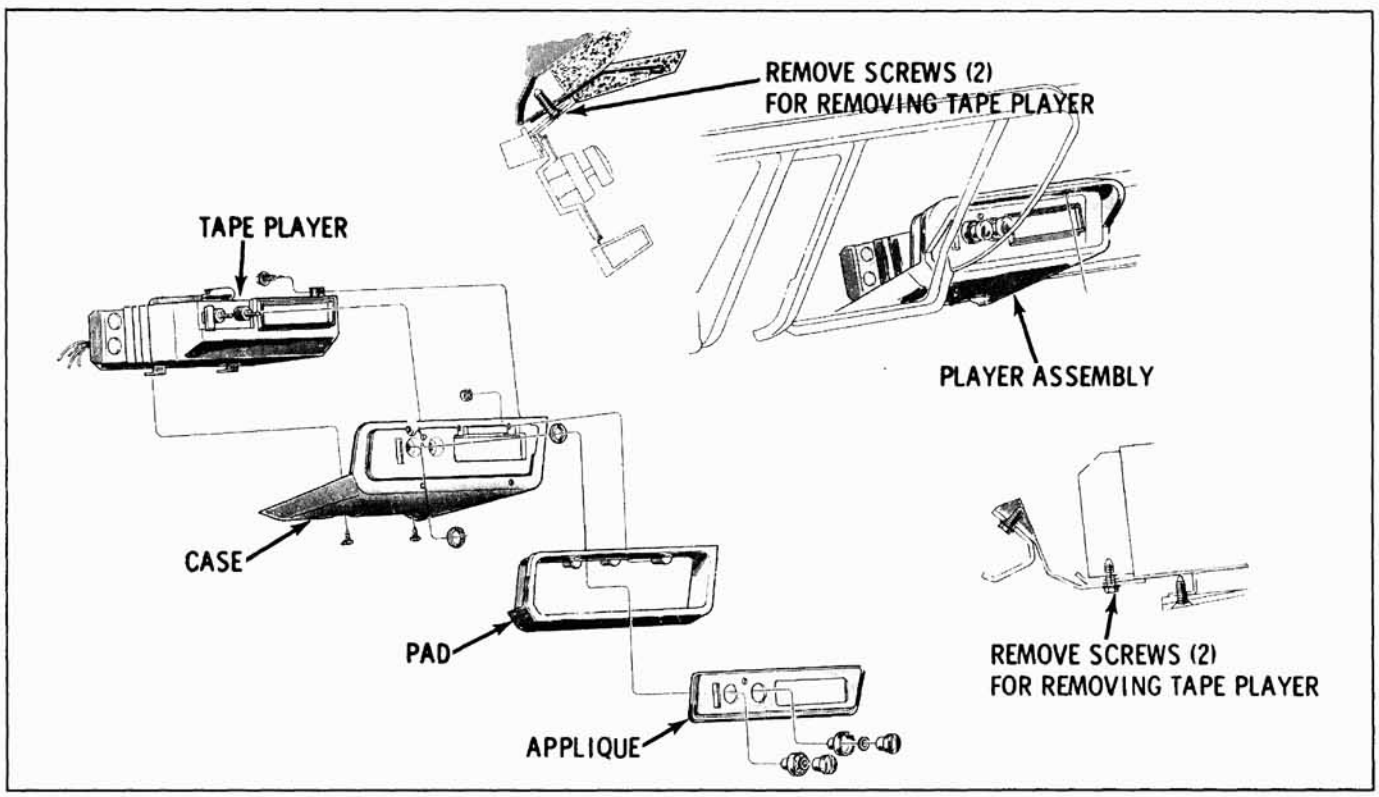


Fig. 15E-9—Stereo Tape Player Installation

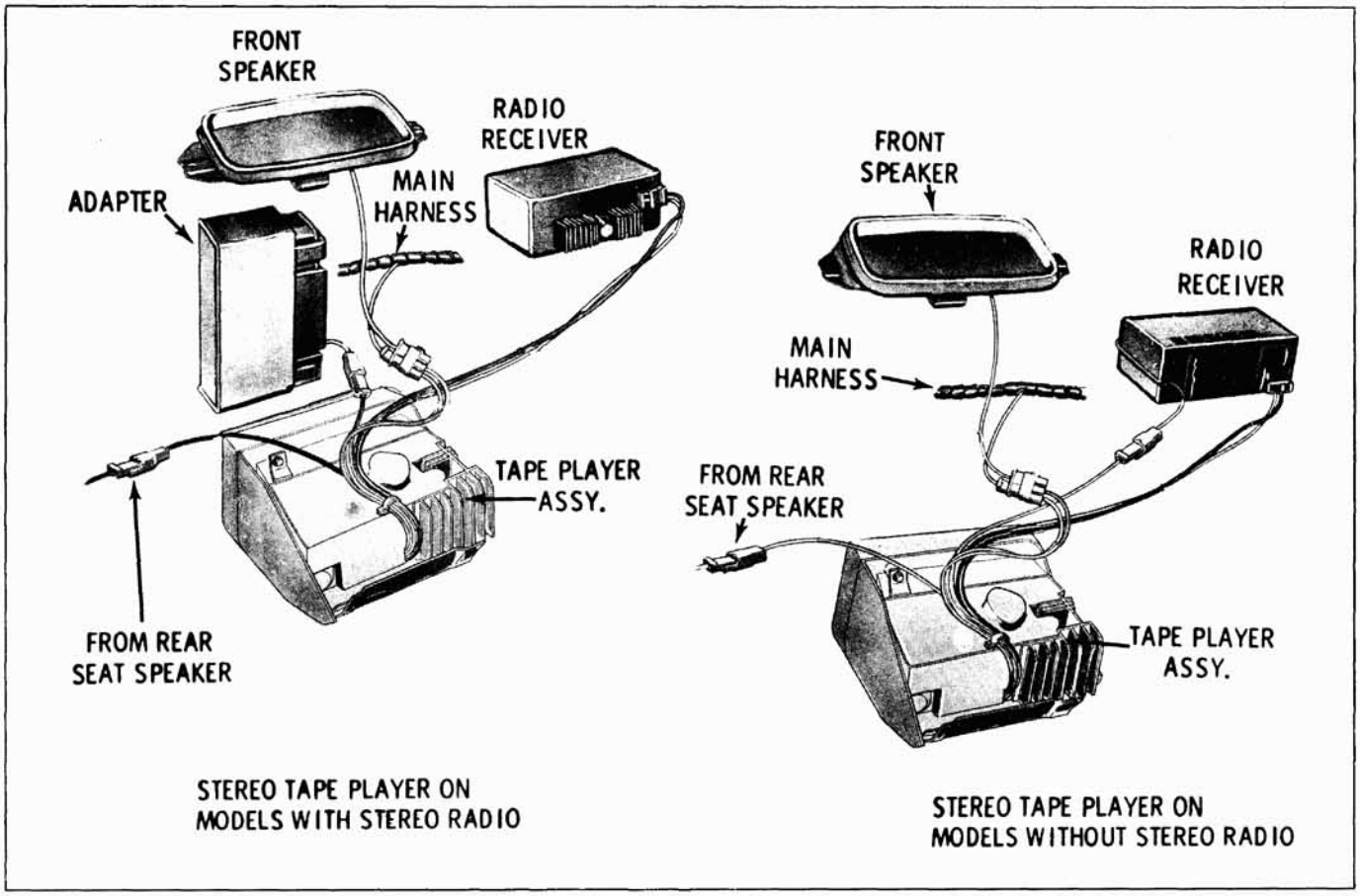


Fig. 15E-10—Stereo Tape Player Wiring

CRUISE CONTROL

For service procedures not listed in this section, refer to Section 15.

DESCRIPTION

The automatic lock-in Cruise Control is a driver-operated speed regulation device that may be used either as a speed reminder or as an automatic speed control for any car speed between 25 mph and 85 mph.

The major components of the automatic lock-in Cruise Control are: the regulator assembly mounted in the engine compartment and the selector control assembly, located on the lower left side of the instrument panel.

The regulator is driven by a flexible drive cable from the transmission. The drive cable also drives the speedometer cable that runs from the regulator to the speedometer. The selector control assembly is connected to the regulator by means of a bowden cable. A rod connects the regulator to the accelerator and carburetor throttle rod.

The selector control assembly is shown in Fig. 15E-11. Speed settings are secured by use of a calibrated thumb wheel. The selector dial is numbered with speed markings from 30 mph to 80 mph, in increments of 5 mph. The numbers on the dial are illuminated for night driving. The switch located below selector dial turns the unit on and off, and activates the unit for automatic control.

When the switch is in the OFF position, the unit has no effect at any car speed. Once the switch has been moved to the ON position, the unit is on and accelerator back pressure will be felt as a warning at the speed the selector dial is set for. Depressing the pushbutton momentarily activates an automatic relay switch in the regulator indicating the unit is set for automatic control. Once the unit is set for automatic control, the unit will lock in automatically, whenever back pressure is felt on the accelerator pedal at the speed the selector dial is set for.

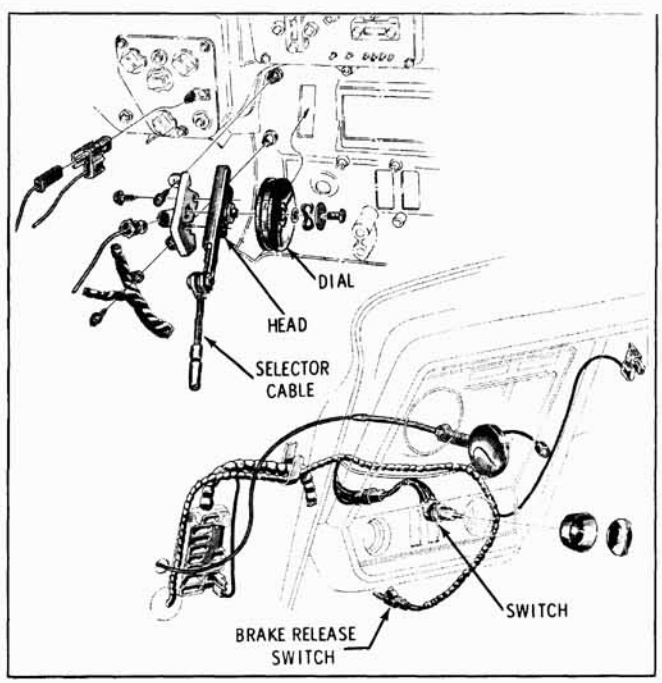


Fig. 15E-11—Speed Selector Control

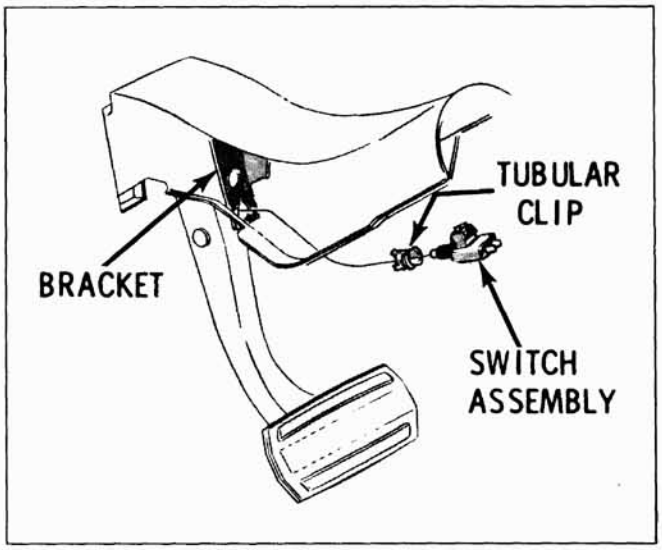


Fig. 15E-11A—Brake Release Switch

The complete electrical circuit for the Cruise Control is shown in Fig. 15E-12. A reversible electric motor in the regulator actuates the rod between the regulator and the carburetor. Motor feed points for forward and reverse energizing of the motor are closed and opened by a governor, under control of a governor spring that is compressed or relaxed to calibrated positions, corresponding to selected speeds by the bowden cable leading to the selector control.

SPEED SELECTOR CONTROL AND/OR CABLE REMOVAL AND INSTALLATION (Fig. 15E-11)

1. Disconnect battery.
2. Remove retainer spring and pull bowden cable to remove from regulator.
3. Attach a five-foot piece of wire or heavy string to disconnected end of control cable. If necessary, rotate selector dial to low speed position to facilitate attachment of wire.

Attaching the wire or string to end of control cable will insure cable being routed properly when selector control assembly is reinstalled.

4. Remove steering column attaching nuts and lower bracket.
5. Remove shift indicator needle.
6. Disconnect speedometer cable at transmission.
7. Remove attaching nuts from cluster lower brackets, leaving brackets attached to the instrument panel.
8. Remove two upper instrument panel screws and lay cluster assembly on steering column.

A protective covering must be used to protect steering column.

9. Remove two screws attaching control to instrument panel and remove control assembly and cable.

Refer to "Cable Adjustment" (Section 15) and reverse removal procedure.

BRAKE RELEASE SWITCH ADJUSTMENT (Fig. 15E-11A)

1. Insert switch into tubular clip until switch body seats on tubular clip.

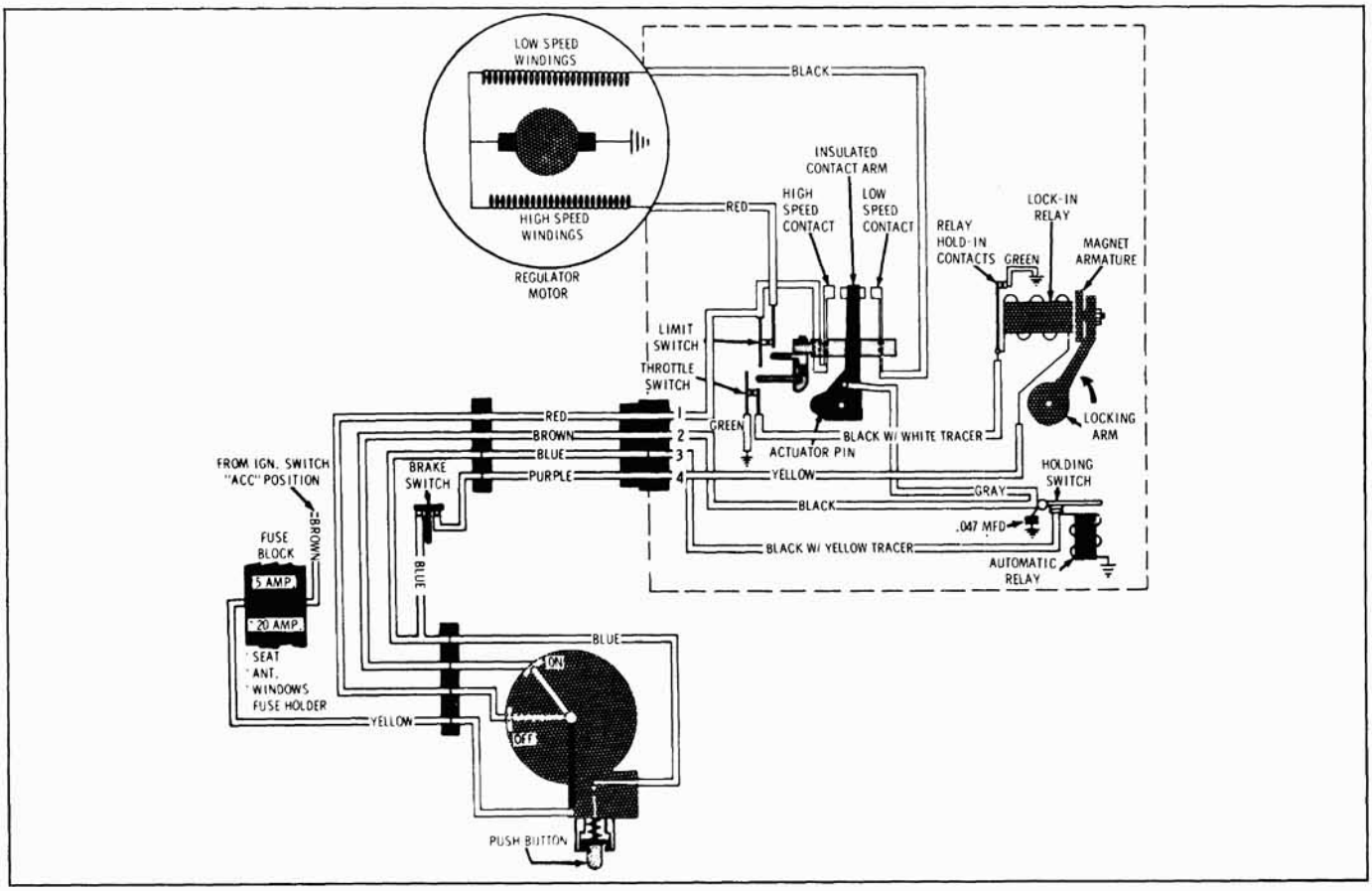


Fig. 15E-12—Cruise Control Schematic

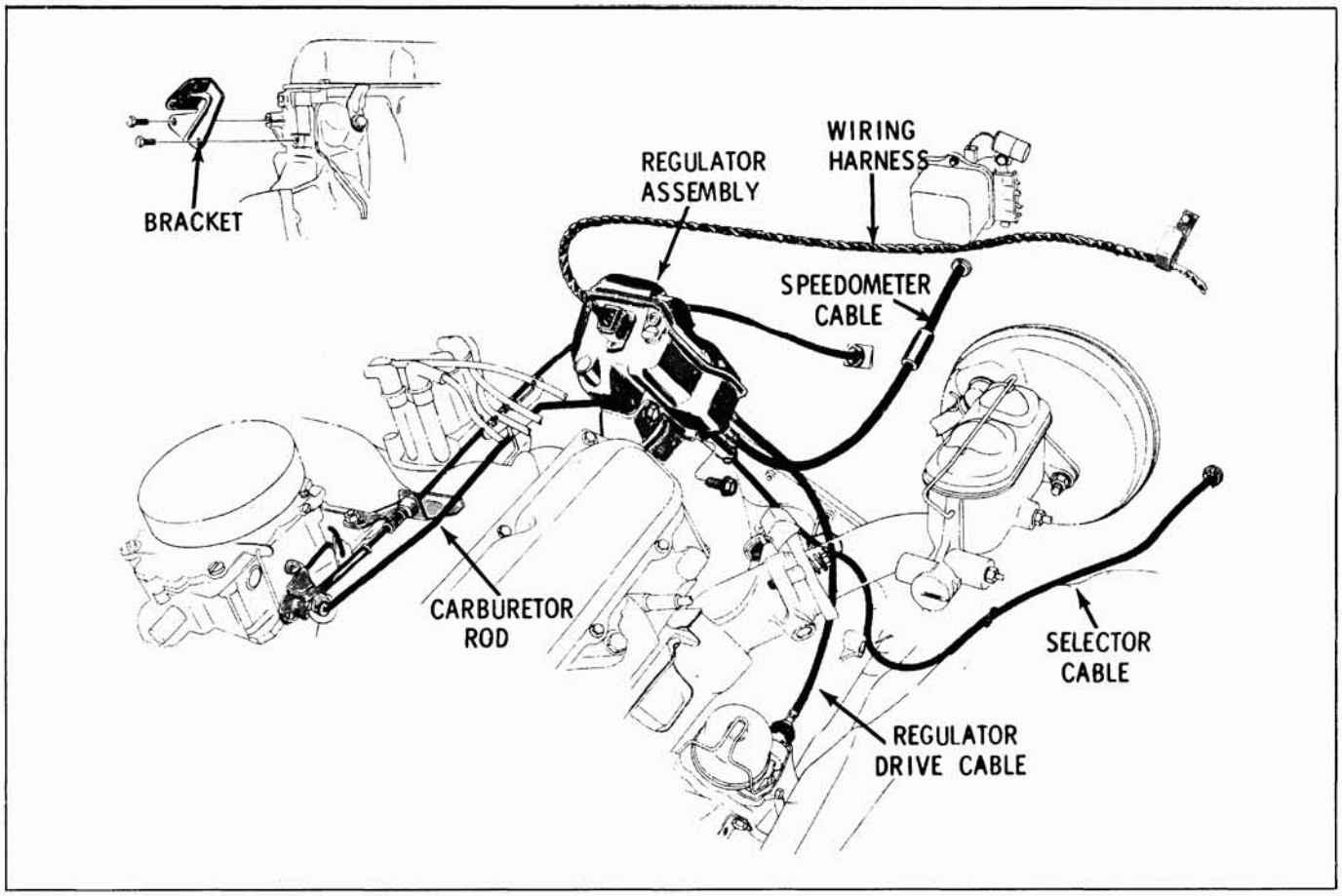


Fig. 15E-13—Regulator Mounting - Cable Routing

2. Pull brake pedal rearward against internal pedal stop. Switch will be moved in tubular clip providing proper adjustment.

REGULATOR (Fig. 15E-13)

Removal

Whenever a regulator is removed, the car can be driven with the speedometer operating by removing the regulator cables from the speedometer and installing a standard speedometer cable and housing assembly.

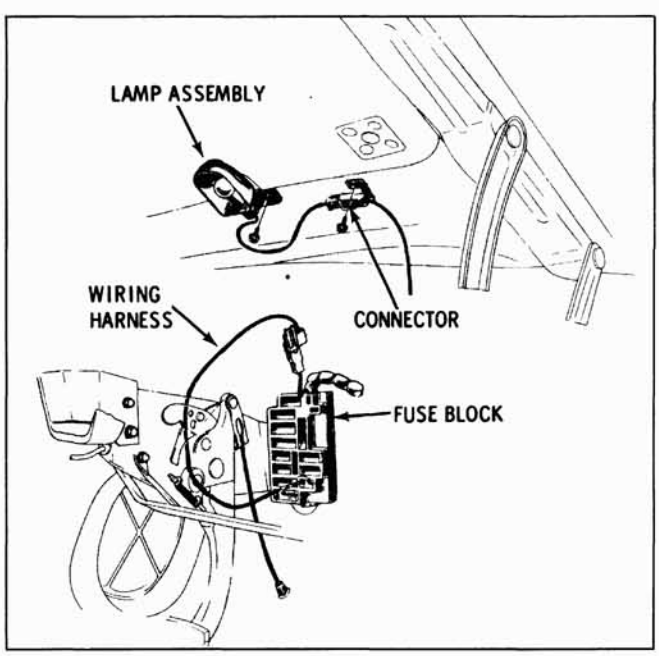


Fig. 15E-14—Under Hood Lamp Installation

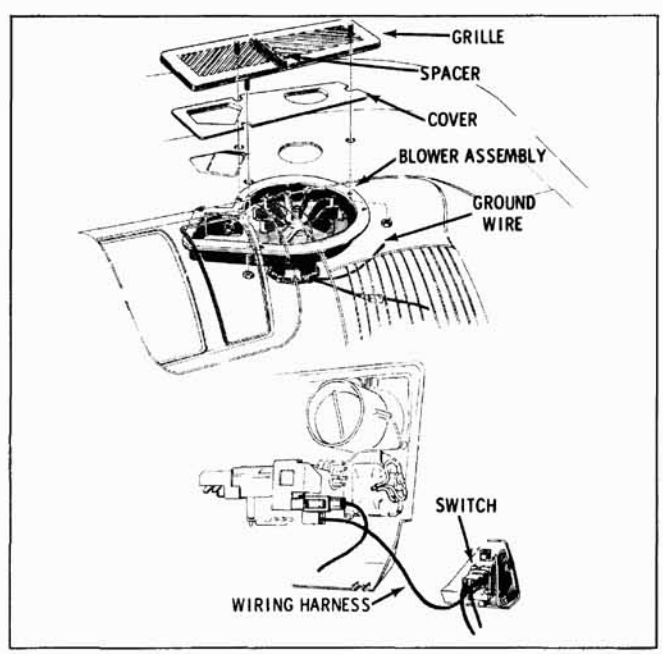


Fig. 15E-15—Rear Window Defogger

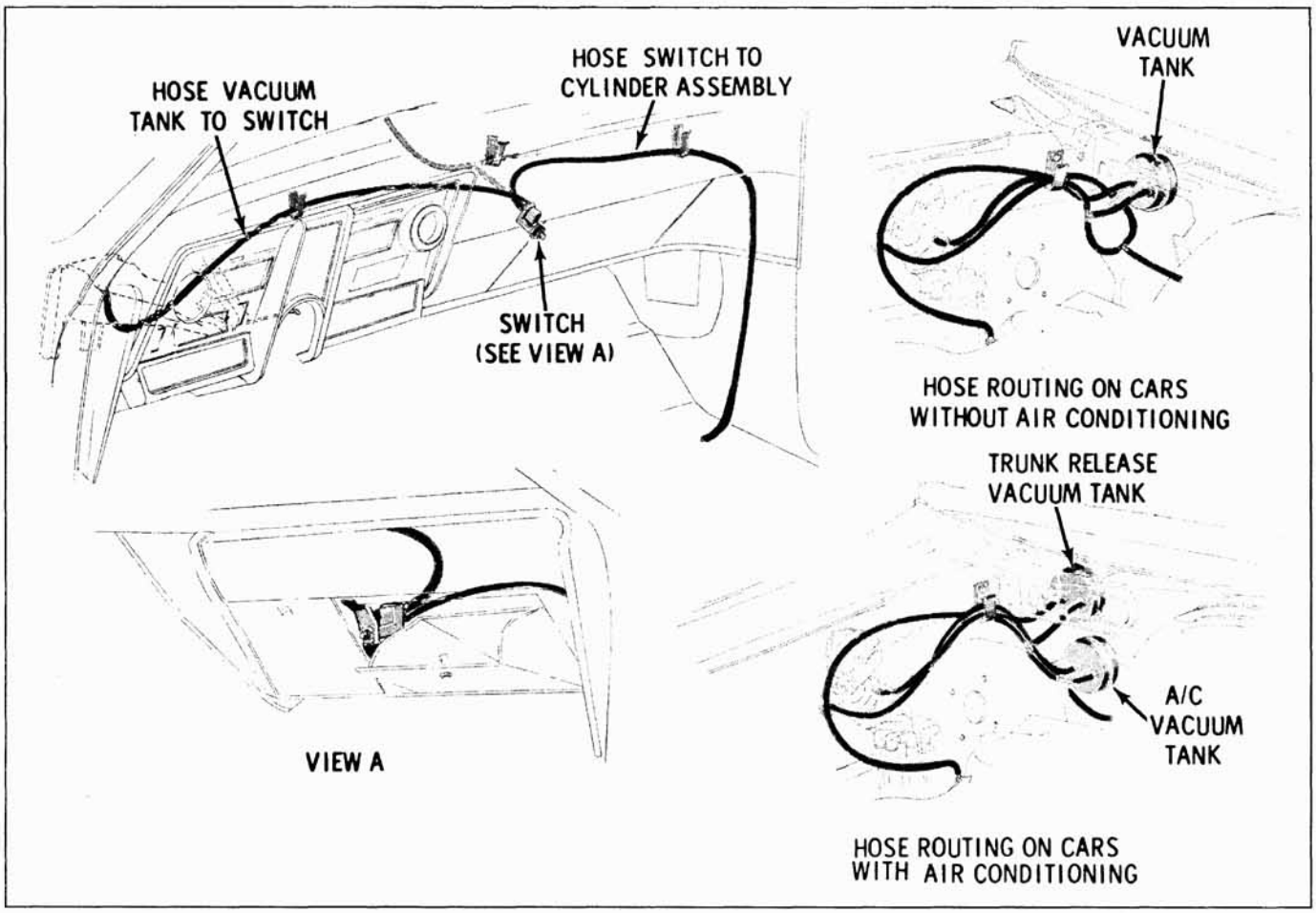


Fig. 15E-16—Vacuum Trunk Release

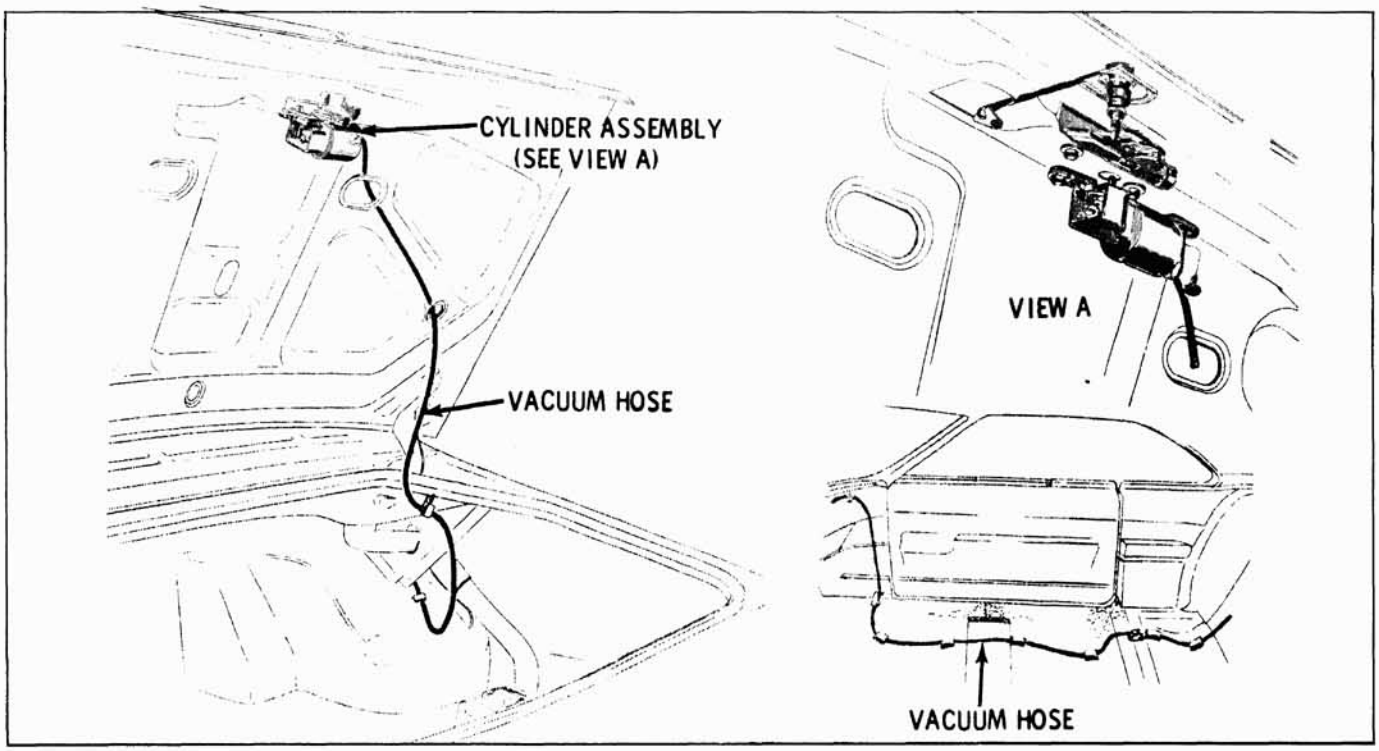


Fig. 15E-17—Vacuum Trunk Release

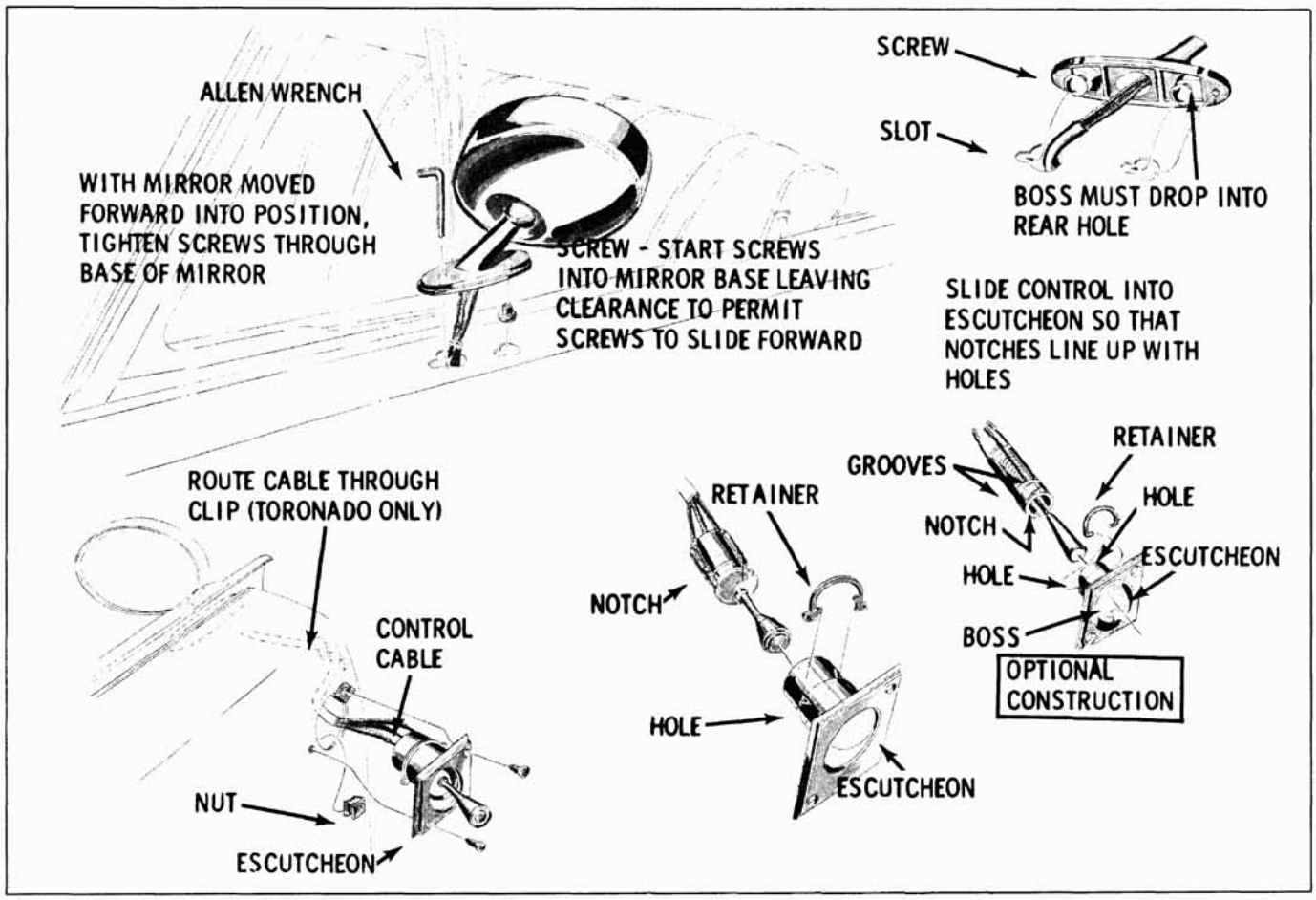


Fig. 15E-18—Remote Control Mirror

1. Disconnect multiple electrical connector at regulator.
2. Disconnect drive cable and speedometer cable at regulator.
3. Remove retainer spring and pull bowden cable to remove from regulator.
4. Disconnect accelerator rod at exterior arm on regulator.
5. Remove two bolts securing regulator to mounting bracket and remove regulator, leaving mounting bracket attached to the engine.

Installation

1. Position regulator on mounting bracket and secure to bracket with two bolts.
2. Connect accelerator rod to exterior arm.
3. Push bowden cable into dust shield and secure with retainer spring.
4. Rotate selector dial to low speed stop to secure control cable into adjusting coupling.

This step must be performed or unit will control in "ON" position or lock in "AUTO." position at low speed, regardless of selected setting.

5. Connect drive cable and speedometer cable to regulator.
6. Connect multiple electrical connector at regulator.

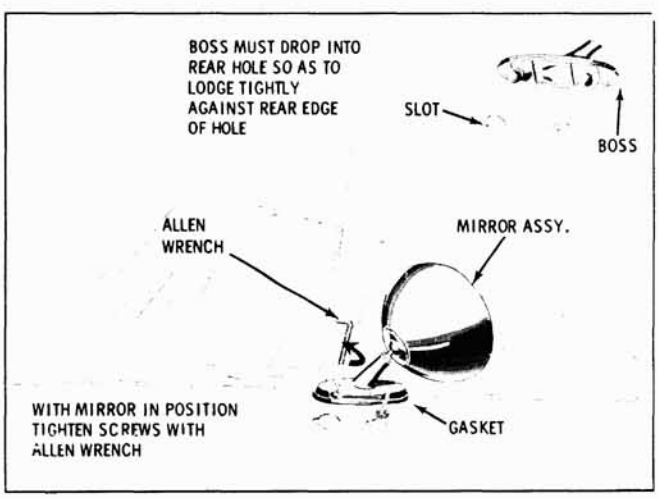


Fig. 15E-19—Outside Mirror

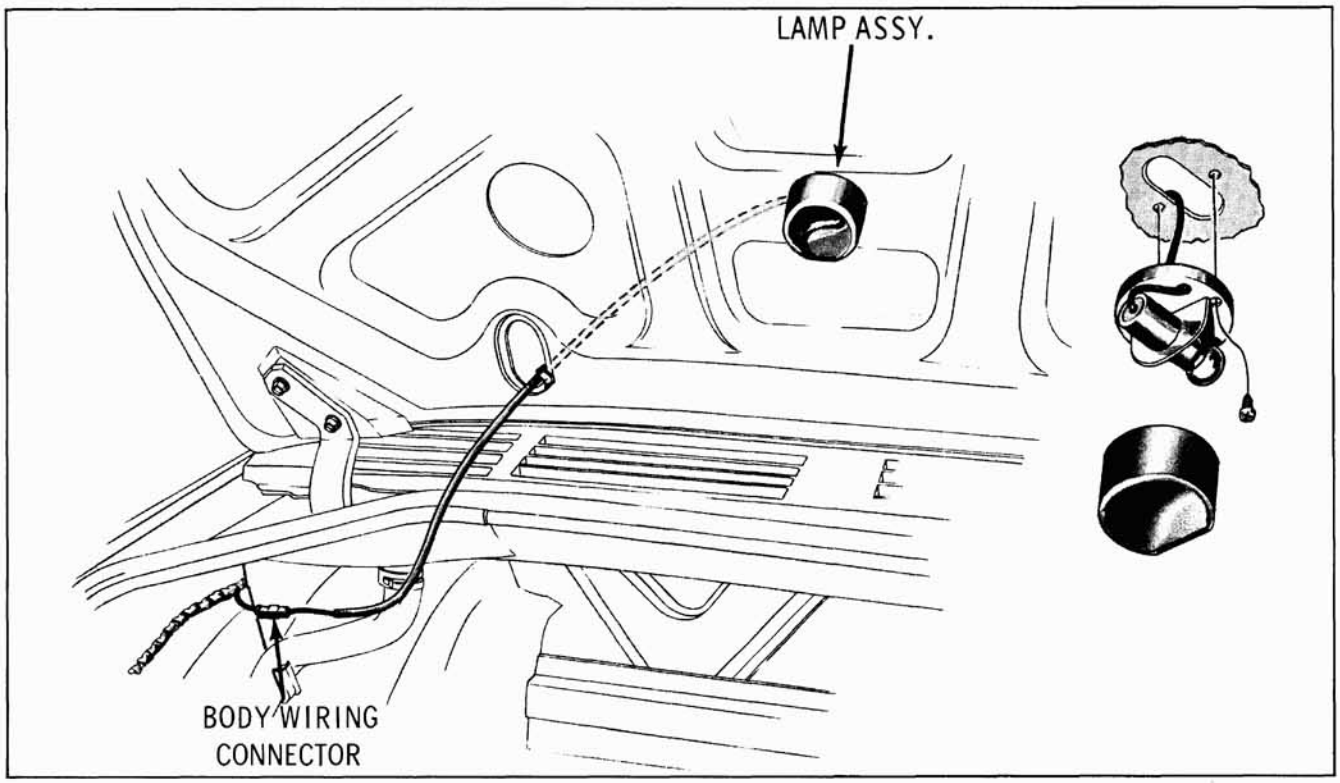


Fig. 15E-20—Trunk Lamp Installation

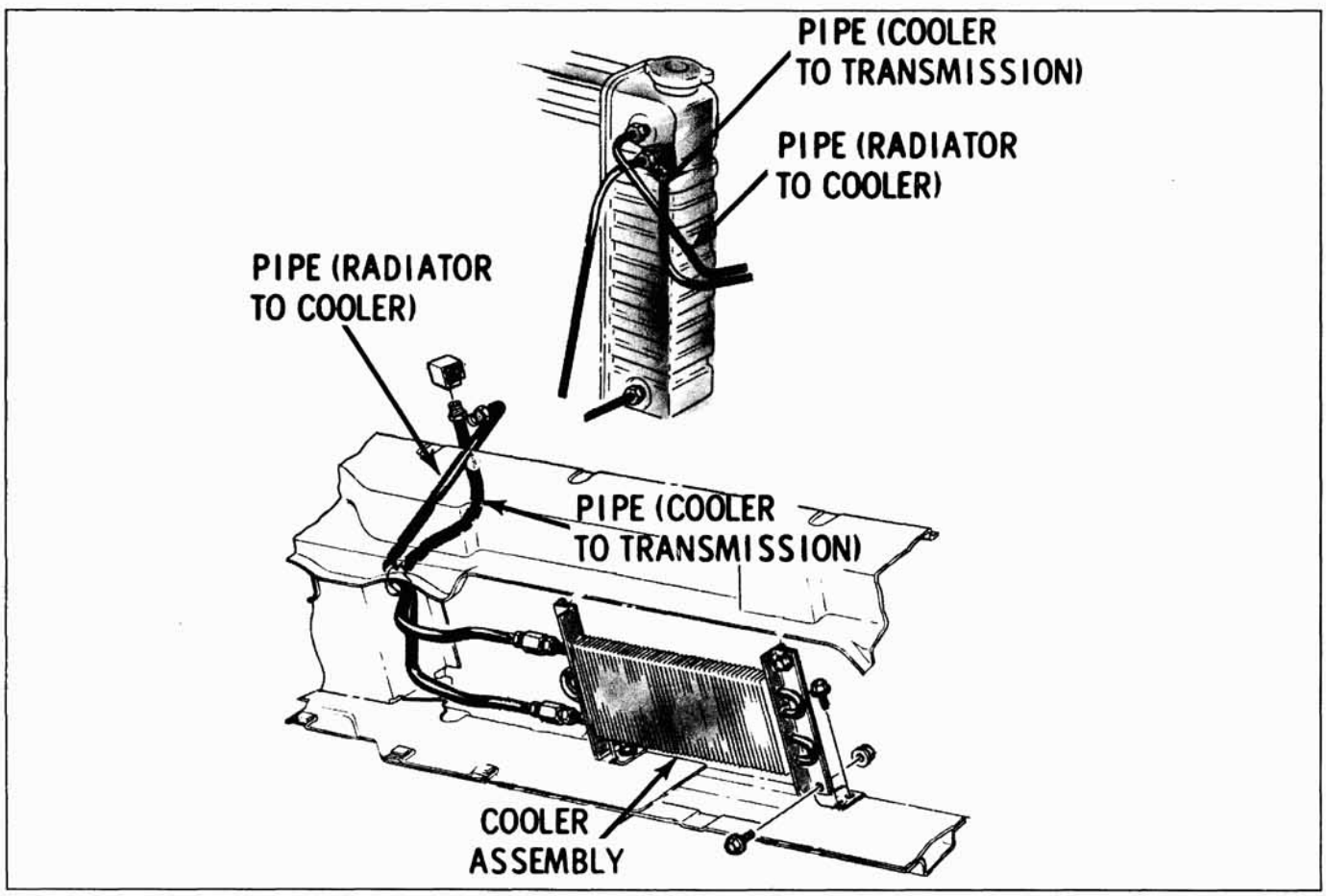


Fig. 15E-21—Transmission Oil Auxiliary Cooler

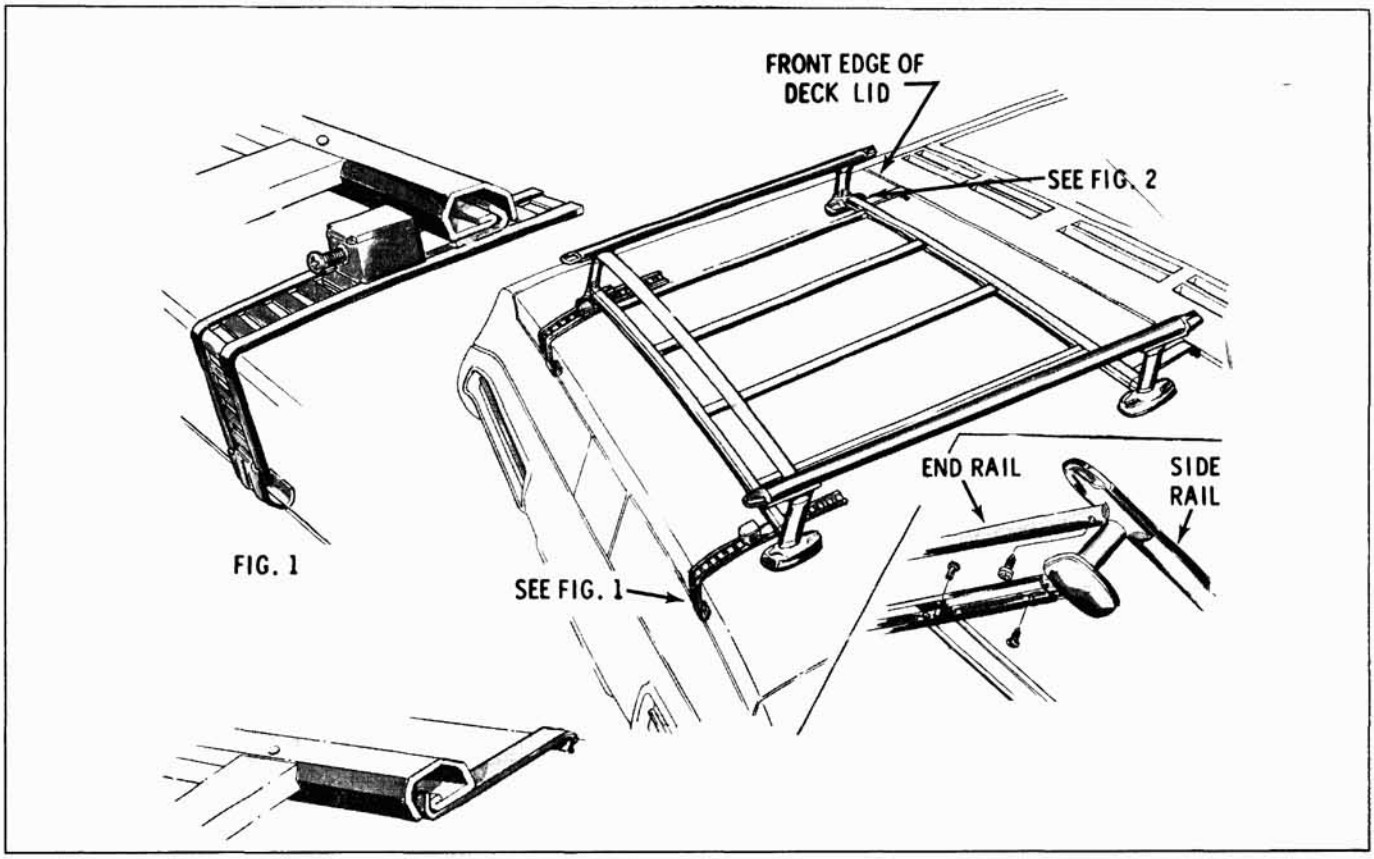


Fig. 15E-22—Luggage Carrier

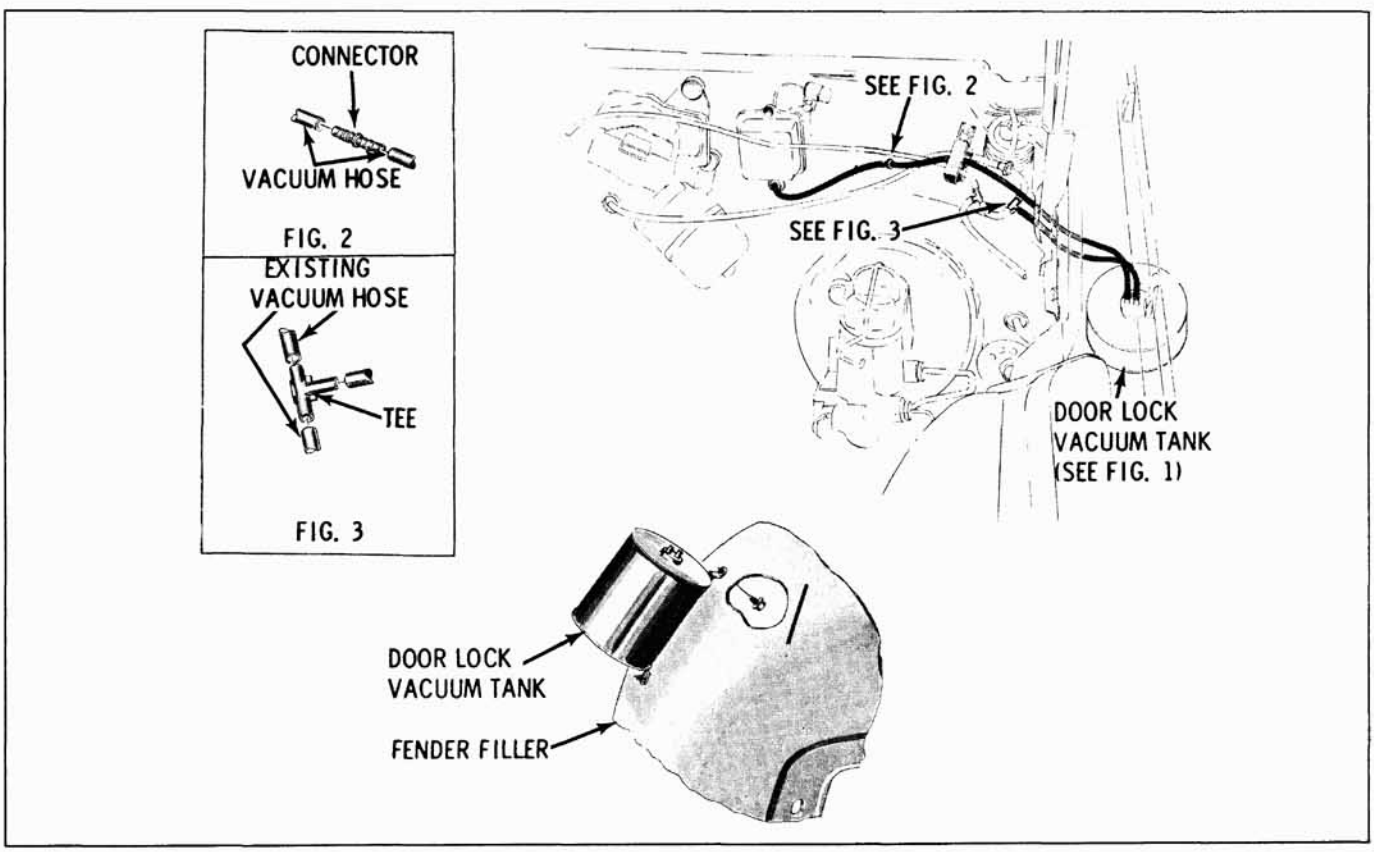


Fig. 15E-23—Vacuum Door Lock Hose Routing

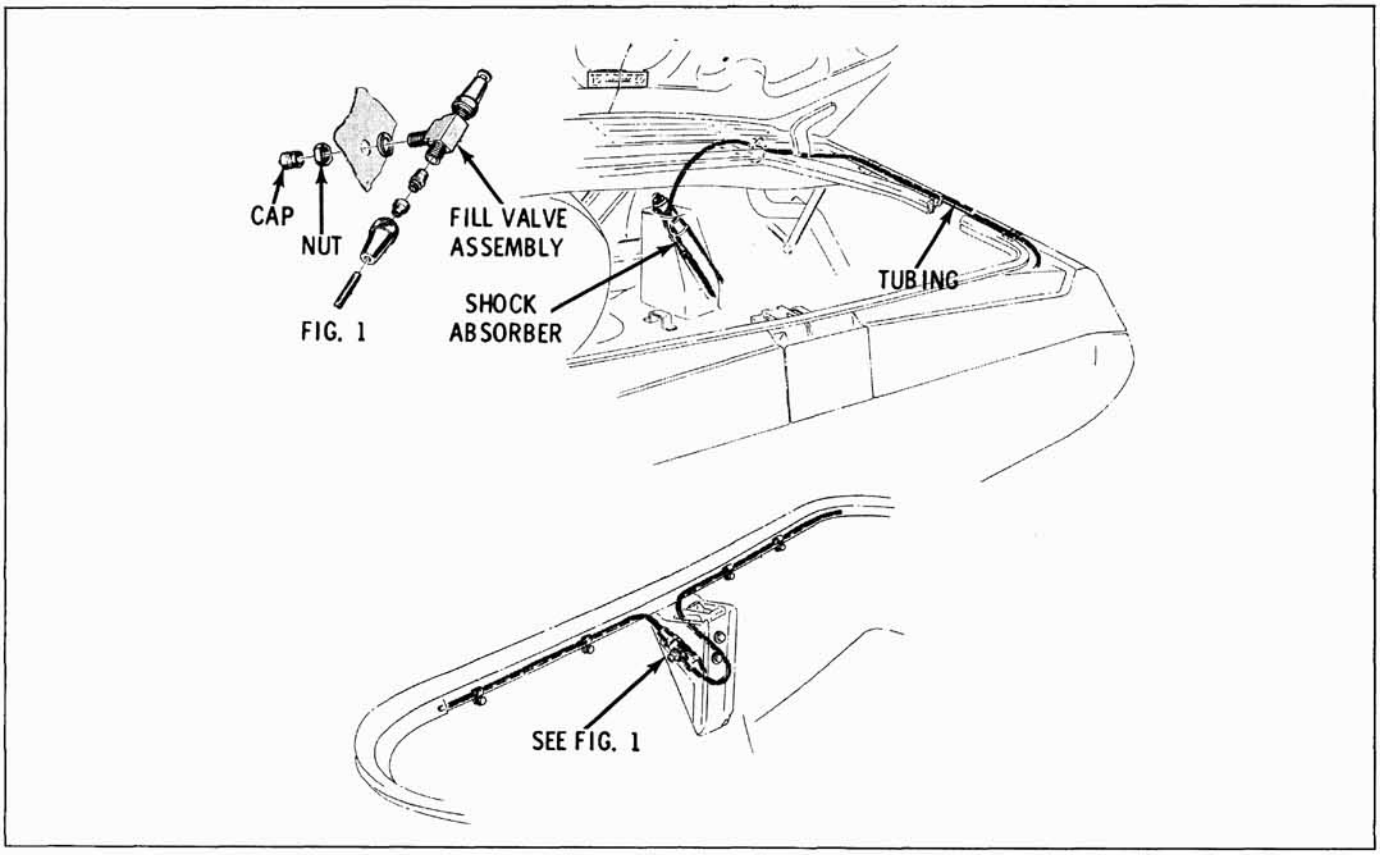


Fig. 15E-24—Superlift Shock Absorber Installation

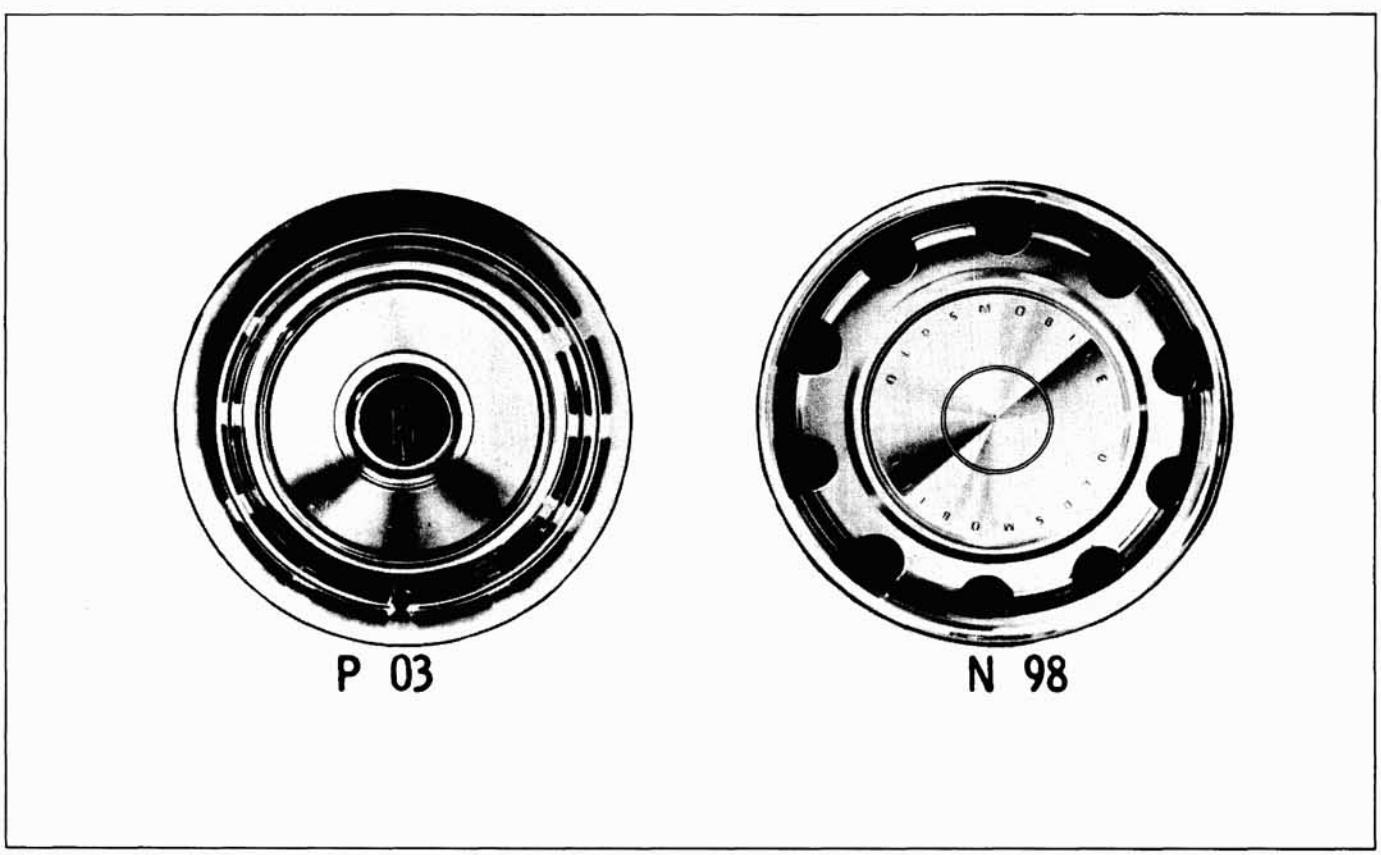


Fig. 15E-25—Wheel Discs

INDEX

A

ACCESSORIES
Exc. Toronado 15-1
Toronado 15E-1
ACCESSORY CODE LETTERS 0-10
AIR CLEANER 0-12
AIR CONDITIONER
Comfortron A.C.
54-86 Series 1D-16
Toronado 1EB-1
Custom A.C.
31-48 Series 1C-1
54-86 Series 1B-23
Toronado 1EA-1
General A.C. Information 1A-1
Performance Chart
31-48 Series 1C-12
54-86 Series 1B-36
Toronado 1EA-11
ALIGNMENT
Axle Housing
31-86 Series 4-4
Drive Line
31-86 Series 4A-6
Frame
31-86 Series 2-1
Toronado 2E-1
Front Wheel
31-86 Series 3-17
Toronado 3EA-14
ANTENNA—RADIO
31-86 Series 15-9
Toronado 15E-3
ANTI-SPIN DIFFERENTIAL
31-86 Series - Type "O" 4B-27
31-44 Series - Type "C" 4B-30
AXLE ASSEMBLY—REAR
Toronado 4F-4
AXLE—DRIVE
Toronado 3EB-1
AXLE—HOUSING
31-86 Series 4B-18
AXLE RATIOS
All Series 0-6
AXLE
Shaft
31-86 Series - Type "O" 4B-4
31-44 Series - Type "C" 4B-6
Bearing
31-86 Series - Type "O" 4B-4
31-44 Series - Type "C" 4B-6
Seal
31-86 Series - Type "O" 4B-5
31-44 Series - Type "C" 4B-6
Bearing and Seal
Toronado 4E-2
Spindle—Rear
Toronado 4E-3

B

BACK-UP LAMPS
31-86 Series ..... 14-3 and 15-35
Toronado 14E-1
BACK-UP LAMPS AND SWITCH
31-48 Series 15-35
54-86 Series 15-35
BALANCE—WHEEL AND TIRE
31-86 Series 10-1
Toronado 10E-3
BALL JOINT
31-86 Series 3-8
Toronado 3EA-10
Seals
31-86 Series 3-10
Toronado 3EA-12
BAR—TORSION 3EA-5
BATTERY
31-86 Series 12-13
Toronado 12E-1
Maintenance
All Series 0-9
BODY MOUNTS
31-86 Series 2-3
Toronado 2E-1
BRAKES
31-86 Series 5-1
Toronado 5E-1
Light Check
All Series 0-10
Fluid Recommendations
All Series 0-8
Master Cylinder
All Series 5-7
Parking Brake
31-86 Series 5-2
Toronado 5E-1
Parking Warning Lamp Switch
All Series 5-4
Power Cylinder
MORAINE 5-21
BENDIX 5-29
Stop Lamp Switch
All Series 5-4
Wheel Cylinder
All Series 5-10
Disc
31-86 Series 5-16
Toronado 5E-4
BREAKER POINTS
All Series ..... 6C-2 and 12-25
BULBS
Specifications
31-48 Series 12-48
54-86 Series 12-49
Toronado 12E-8
BUMPERS
31-86 Series 14-1
Toronado 14E-1
BUTTON
Horn
31-48 Series - w/o - Tilt 9A-4
54-86 Series - w/o - Tilt and Travel 9A-4
Toronado 9E-5
Radio—Setting
All Series 15-3
BUSHING—SERVICE
Turbo-Hydra-Matic
Exc. Toronado 7-85

Toronado 7E-71
Jetaway 7-377

C

CABLE—SPEEDOMETER
31-48 Series 12AA-11
54-86 Series 12A-10
Toronado 12EA-3
CAMSHAFT AND BEARINGS
Engine
L-6 ..... 6A-15
V-8 ..... 6B-23
CAPACITIES
All Series 0-13
CAPACITOR DISCHARGE—IGNITION
All Series 12-31
CARBURETOR
Model - MV 6M-1
Model - 2GC 6M-15
Model - 4MV 6M-25
Adiustment Chart
Model - MV 6M-12
Model - 2GC 6M-22
Model - 4MV 6M-38
Usage Chart 6M-14
Diagnosis Chart
Model - MV 6M-11
Model - 2GC 6M-21
Model - 4MV 6M-37
CAR MODEL IDENTIFICATION
All Series 0-1
CARRYING HEIGHTS
31-86 Series 3-19
Toronado 3EA-14
CHARGE INDICATOR
31-48 Series 12AA-5
54-86 Series 12A-5
Toronado 12EA-5
CHARGING CIRCUIT 12-13
CHASSIS LUBRICATION
All Series 0-12
CHASSIS SHEET METAL
31-48 Series 11-10
54-86 Series 11-1
Toronado 11E-1
CHASSIS SPRINGS
Front
31-86 Series 3-14
Rear
31-86 Series 4-3
Toronado 4E-4
CIRCUIT DIAGRAMS—WIRING
31 and 35 Series 12-4
32-36-42-44 and 48 Series 12-3
54-86 Series 12-2
Toronado 12E-2
CIRCUIT, IGNITION 12-11
CIRCUIT WIRING
31-86 Series 12-4
Toronado 12E-1
CLOCK
31-48 Series 12AA-7
54-86 Series 12A-6
Toronado 12EA-1
CLUSTER—SPEEDOMETER
31-48 Series 12AA-5
54-86 Series 12A-6
Toronado 12EA-1
CLUTCH 7-634
COIL—IGNITION 12-36
COMFORTRON A.C.
54-86 Series 1D-16
Toronado 1EB-1
CONNECTING ROD AND BEARINGS
L-6 Engine 6A-21
V-8 Engine 6B-15
CONSOLE
31-48 Series 12AA-9
54-86 Series 12A-10
Toronado 12EA-8
CONSTANT VELOCITY JOINT
Toronado 3EB-4
CONTACT POINTS, DISTRIBUTOR 6C-2
CONTROL ARM
Upper
31-86 Series 3-11
Toronado 3EA-7
Lower
31-86 Series 3-14
Toronado 3EA-7
CONTROLLED COMBUSTION SYSTEM 6N-1
COOLING FLOW
L-6 Engine 6K-3
V-8 Engine 6K-1
COOLING SYSTEM
31-86 Series 13-1
Toronado 13E-2
CORNERING LAMPS 15-35
CRANKCASE VENTILATION 6H-1
CRANKSHAFT
L-6 Engine 6A-24
V-8 Engine 6B-25
CRUISE CONTROL
31-48 Series 15-25
54-86 Series 15-12
Toronado 15E-5

D

DASHPOT
Adjustment
Model 2GC 6M-24
Model 4MV 6M-41
DEFOGGER—REAR
54-86 Series 15-38
Toronado 15E-7
DEFROSTER—WINDSHIELD
31-48 Series 1-6
54-86 Series 1-2
Toronado 1E-2
DELCOTRON GENERATOR 12-4
DIAGNOSIS
A.C. System
54-86 Series 1B-37
31-48 Series 1C-12
Toronado 1EA-9
Comfortron
54-86 Series 1D-25
Toronado 1EB-12
Front Suspension
31-86 Series 3-20
Rear Suspension
31-86 Series 4-5
Propeller Shaft
31-86 Series 4A-6
Differential
31-86 Series 4B-33

Brakes
All Series 5-38
Tune-Up
All Series 6C-5
Crankcase Ventilation
All Series 6H-3
Cooling System
All Series 6K-1
Carburetion
Model MV 6M-11
Model 2GC 6M-21
Model 4MV 6M-37
Transmission—Turbo
Exc. Toronado 7-74
Toronado 7E-63
Transmission—Jetaway 7-370
Transmission—Manual 7-631
Clutch 7-637
Steering
All Series 9-28
Electrical
All Series 12-46
Windshield Wipers
RECTANGULAR MOTOR 12B-3
ROUND MOTOR 12B-14
WASHER ASSEMBLY 12B-27
Accessories
RADIO 15-11
ANTENNA 15-10
Cruise Control
32-48 Series - Exc. 35 15-30
54-86 Series 15-24
Toronado 15E-5
DIFFERENTIAL
31-86 Series - Type "O" 4B-1
31-44 Series - Type "C" 4B-19
Toronado 3EC-1
DIFFERENTIAL RATIOS
All Series 0-6
DIMMER SWITCH 12-46
DISTRIBUTOR, IGNITION 12-4
Contact Points ..... 6C-2 and 12-29
Dwell Angle Adjustment 6C-2
Timing 6C-2
DRIVE AXLE 3EB-1

E

ELECTRICAL, CHASSIS
31-86 Series 12-1
Toronado 12E-1
EMISSION CONTROL (CCS SYSTEM) 6N-1
ENGINE
Cooling System 6K-1
Fuel and Exhaust System 8-1
Identification 0-4
Oil Recommendations 0-12
Tune-Up Chart 6C-6
Exhaust Emission Control 6N-1
Crankcase Ventilation 6L-1
Mounting
L-6 Engine 6A-27
V-8 Engine 6B-3
Exhaust Manifold
L-6 Engine 6A-2
V-8 Engine 6B-5
Exhaust System
31-86 Series 8-5
Toronado 8E-3

F

FAN BLADE IDENTIFICATION 6K-8
FENDER ASSEMBLY
31-48 Series 11-11
54-86 Series 11-3
Toronado 11E-3
FINAL DRIVE
Output Shaft Seal 3EC-1
FRAME
31-86 Series 2-1
Toronado 2E-1
FRONT SUSPENSION
31-86 Series 3-1
Toronado 3EA-1
FRONT WHEEL ALIGNMENT
31-86 Series 3-17
Toronado 3EA-14
FRONT WHEEL BEARING
31-86 Series 3-2
Toronado 3EA-1
FUEL FILLER DOOR 14-5
FUEL GAUGES
Dash Unit
31-48 Series 12AA-5
54-86 Series 12A-5
Tank Unit
31-86 Series 8-3
Toronado 8E-1
Testing 12-43
FUEL PUMP
L-6 Engine 6B-31
V-8 Engine 6B-31
FUEL SYSTEM
31-86 Series 8-1
Toronado 8E-1
FUSE BLOCK
31-86 Series 12-7
Toronado 12E-5
FUSE SPECIFICATIONS
31-86 Series 12-47
Toronado 12E-8

G

GASOLINE GAUGE
Dash Unit
31-48 Series 12AA-5
54-86 Series 12A-5
Toronado 12EA-5
Tank Unit
31-86 Series 8-3
Toronado 8E-1
Testing 12-44
GENERAL SPECIFICATIONS 0-8
GENERATOR, DELCOTRON 12-8
GRILLE ASSEMBLY
31-48 Series 13-3
54-86 Series 13-3
Toronado 13E-2
GUARDIAN MAINTENANCE SCHEDULE 0-11

H

HAZARD WARNING SYSTEM 12-43
HEADLAMPS
Aiming 12-45
Housing
31-48 Series 11-15

54-86 Series 13-4
Toronado 11E-7
Switch
31-48 Series 12AA-5
54-86 Series 12A-6
Toronado 12EA-3
HEAT CONTROL VALVE, MANIFOLD
L-6 Engine 6A-2
V-8 Engine 6B-6
HEATER
31-48 Series 1-5
54-86 Series 1-1
Toronado 1E-1
HOOD ASSEMBLY
31-48 Series 11-10
54-86 Series 11-1
Toronado 11E-1
Hinge
31-48 Series 11-10
54-86 Series 11-3
Toronado 11E-2
HORN
31-86 Series 12-40
Toronado 12E-1
HORN RELAY 12-41
HUB BOLT 3-4
HYDRAULIC VALVE LIFTER
L-6 Engine 6A-5
V-8 Engine 6B-7

I

IDENTIFICATION NO., VEHICLE
All Series 0-3
IDLE SPEED SPECIFICATIONS
Model MV ..... 6M-13 and 6M-14
Model 2GC ..... 6M-23 and 6M-24
Model 4MV ..... 6M-40 and 6M-41
IGNITION CIRCUIT 12-24
IGNITION COIL 12-36
IGNITION SWITCH
31-48 Series 12AA-4
54-86 Series 12A-7
IGNITION TIMING 6C-2
IGNITION TRANSISTOR 12-31
INFLATION PRESSURES, TIRES
31-86 Series 10-7
Toronado 10E-2
INFORMATION CHARTS
Turbo-Hydra-Matic 7-84
Jetaway 7-375
Fan Blades 6K-8
Throttle Closing Solenoid 6C-8
Carburetor Dashpot 6C-8
Tune-Up 6C-6
Distributor 6C-7
INSTRUMENTS
31-48 Series 12AA-1
54-86 Series 12A-1
INSTRUMENT PANEL
31-48 Series 12AA-1
54-86 Series 12A-1
Toronado 12EA-1
INSTRUMENT PANEL PAD
31-48 Series 12AA-2
54-86 Series 12A-2
Toronado 12EA-7
INTAKE MANIFOLD
L-6 Engine 6A-2
V-8 Engine 6B-4

J

JETAWAY TRANSMISSION 7-301
Model and Parts Identification Chart 7-375
Pressure Charts
TURBO HYDRA-MATIC (EXC. TORONADO) 7-77
TURBO HYDRA-MATIC (TORONADO) 7E-69
JETAWAY 7-374
JOINT BALL
31-86 Series 3-7
Toronado 3EB-4

K

KNUCKLE, STEERING
31-86 Series 3-16
Toronado 3EA-3

L

LAMP BULB SPECIFICATIONS
31-48 Series 12-48
54-86 Series 12-49
Toronado 12E-8
LICENSE LAMP
31-86 Series 14-5
Toronado 12E-1
LIGHTS
Back-Up
31-86 Series 14-3
Toronado 14E-2
Cornering Lamps 15-35
Headlamps
31-86 Series 12-45
Toronado 11E-7
License Lamp
31-86 Series 14-5
Toronado 12E-1
Parking
31-86 Series 12-45
Toronado 14E-2
Tail Lamp
31-86 Series 12-45
Toronado 12E-6
LINKAGE, STEERING
31-86 Series 9-1
Toronado 9E-1
LOAD CAPACITIES
31-86 Series 10-7
Toronado 10E-3
LOWER CONTROL ARM
31-86 Series 3-14
Toronado 3EA-7
LUBRICATION 0-12
LUBRICATION SYSTEM
L-6 Engine 6A-3
V-8 Engine 6B-1

M

MAINTENANCE CHART 0-11
MANIFOLD
Intake
V-8 ..... 6B-4
L-6 ..... 6A-2
Exhaust
V-8 ..... 6B-5
L-6 ..... 6A-2

MANIFOLD HEAT CONTROL
V-8 ..... 6A-2
L-6 ..... 6B-6
MASTER CYLINDER, BRAKE
All Series 5-7
MIRROR, REMOTE CONTROL
31-86 Series 15-41
Toronado 15E-9
MODEL DESIGNATION
All Series 0-2
MOLDINGS
Hood
31-48 Series 11-11
54-86 Series 11-3
Body Side
31-48 Series 11-15
54-86 Series 11-5
Toronado 11E-6
MOUNTINGS
Engine
L-6 ..... 6A-27
V-8 ..... 6B-4
Body
31-86 Series 2-3
Toronado 2E-2
MUFFLER
31-86 Series 8-5
Toronado 8E-3

N

NEUTRAL START AND BACK-UP LAMP,
Switch 12-46

O

OIL FILTER, ENGINE
All Series 0-12
OIL PRESSURE INDICATOR LIGHT
31-48 Series 12AA-5
54-86 Series 12A-5
Toronado 12EA-5
OIL PUMP
L-6 Engine 6A-11
V-8 Engine 6B-15
OIL PUMP, POWER STEERING
All Series 9-8
OIL RECOMMENDATIONS
Engine
All Series 0-12
Transmission
All Series 0-12
Checking Level 0-12
OPTIONAL EQUIPMENT CODES 0-10
OIL SEAL, PINION 4B-2

P

PAINT SERVICE NUMBERS
All Series 0-9
PARKING BRAKE CONTROLS
31-86 Series 5-3
Toronado 5E-1
PERIODIC MAINTENANCE
All Series 0-12
POINTS, IGNITION
Cleaning and Replacement 6C-2
Dwell Adjustment 6C-6
PILOT BEARING (V-8) 6B-29
PILOT BUSHING (L-6) 7-635
PINION OIL SEAL 4B-2
PISTONS, PINS, RINGS
L-6 Engine 6A-21
V-8 Engine 6B-17
POWER BRAKE CYLINDER
Bendix 5-29
Moraine 5-21
PROPELLER SHAFT 4A-1
PUMP, FUEL 6B-31
PUMP, OIL
L-6 Engine 6A-11
V-8 Engine 6B-15
PUMP, POWER STEERING
All Series 9-8
Toronado 9E-4
PUSHBUTTON SETTING, RADIO
All Series 15-3

R

RADIATOR
31-86 Series 13-1
Toronado 13E-1
RADIO
AM and FM Stereo 15-3
Diagnosis
31-86 Series 15-11
Toronado 15E-1
RALLY PACK 15-32
REAR AXLE—TYPE "O"
31-86 Series
BEARING 4B-4
SHAFT 4B-4
SEAL 4B-5
REAR AXLE—TYPE "C"
31-44 Series
BEARING 4B-6
SHAFT 4B-6
SEAL 4B-6
REAR AXLE
Toronado
BEARING 4E-2
SEAL 4E-2
SPINDLE 4E-3
REAR SUSPENSION
31-86 Series 4-1
Toronado 4E-1
REGULATOR, VOLTAGE 12-10
RELAY, HORN 12-41
RELEASE BEARING—CLUTCH 7-635
RINGS, PISTON
L-6 Engine 6A-23
V-8 Engine 6B-18

S

SAFETY SENTINEL 15-31
SEAL SERVICE
Differential
Pinion 4B-2
Wheel Bearing ..... 4B-5 and 4B-6
Final Drive
Housing 3EC-13
Output Shafts 3EC-1
A/C Compressor
Shaft 1A-12

Engine
L-6
VALVES 6A-7
FRONT COVER 6A-14
REAR MAIN 6A-12
V-8
VALVES 6B-11
FRONT COVER 6B-22
REAR MAIN 6B-28
Turbo Hydra-Matic Transmission
Exc. Toronado
FRONT ..... 7-32 and 7-69
REAR 7-30
MANUAL SHAFT ..... 7-33 and 7-67
Toronado
FRONT 7E-45
MANUAL SHAFT ..... 7E-29 and 7E-57
Jetaway Transmission
Front 7-334
Rear 7-355
Manual Shaft 7-340
Manual Transmission
Front 7-607
Rear 7-602
Power Steering Pump
Shaft 9-9
Flow Control Valve 9-8
SHEET METAL, CHASSIS
31-48 Series 11-10
54-86 Series 11-1
Toronado 11E-1
SHOCK ABSORBERS
Front
31-86 Series 3-5
Toronado 3EA-15
Rear
31-86 Series 4-1
Toronado 4E-3
SHOCKS, SUPERLIFT
31-48 Series 15-41
54-86 Series 15-41
Toronado 15E-12
SOLENOID SWITCH, STARTER 12-21
SPARK PLUGS 6C-1
SPARK TIMING CONTROL 12-27
SPEAKER, RADIO
31-86 Series 15-5
Toronado 15E-3
SPECIFICATIONS
Air Conditioner
31-48 Series 1C-13
54-86 Series 1B-38
Battery
31-86 Series 12-1
Toronado 12E-1
Brakes
31-86 Series 5-39
Toronado 5E-11
Carburetion
Model MV 6M-12, 13, 14
Model 2GC 6M-22, 23, 24
Model 4MV 6M-38, 39, 40, 41
Car, General Specifications
All Series 0-8
Clutch 7-638
Cranking System 12-51
Differential 4B-34
Distributor 6C-7
Electrical 12-51
Engine
L-6 ..... 6A-28
V-8 ..... 6B-34
Final Drive 3EC-17
Front Wheel Alignment
31-86 Series 3-17
Toronado 3EA-14
Fuse
31-48 Series 12-48
54-86 Series 12-49
Toronado 12E-8
Generator System 12-51
Idle
Model MV 6M-13, 14
Model 2GC 6M-23, 24
Model 4MV 6M-40, 41
Ignition System 12-47
Lamp Bulb
31-48 Series 12-48
54-86 Series 12-49
Toronado 12E-8
Propeller Shaft 4A-8
Steering 9-31
Suspension, Front
31-86 Series 3-22
Toronado 3EA-14
Transmission—Manual
3-Speed 7-601
3-Speed, H.D. 7-610
4-Speed 7-619
Windshield Wiper 12B-32
SPEEDOMETER CLUSTER
31-48 Series 12AA-5
54-86 Series 12A-6
Toronado 12EA-4
SPEEDOMETER, CABLE
31-48 Series 12AA-11
54-86 Series 12A-10
Toronado 12EA-3
SPEEDOMETER RATIO INFORMATION
31-48 Series 4B-34
SPRING, FRONT SUSPENSION
31-86 Series 3-14
SPRING, USAGE CHART—FRONT 3-21
SPRING, HOOD HINGE
31-48 Series 11-10
54-86 Series 11-3
Toronado 11E-2
SPRING, REAR SUSPENSION
31-86 Series 4-5
Toronado 4E-4
SPRING, USAGE CHART—REAR 4-5
STABILIZER SHAFT
Front
31-86 Series 3-6
Toronado 3EA-12
Rear 4-4
STARTER MOTOR 12-18
STEERING
Arm, Idler 9-3
Arm, Pitman 9-1
Column 9A-1
Diagnosis 9-28
Gear, Manual 9-4
Gear, Power 9-15
Geometry—Turning Angles 3-19
Knuckle
31-86 Series 3-16
Toronado 3EA-3

Linkage
31-86 Series 9-1
Toronado 9E-1
Pump 9-8
Tilt-Away 9A-16
Tilt and Travel 9A-17
Wheel
Exc. T and T 9A-2
Tilt and Travel 9A-4
STOP LAMP SWITCH
31-86 Series 5-4
Toronado 5E-2
SUSPENSION
Front
31-86 Series 3-1
Toronado 3EA-1
Rear
31-86 Series 4-1
Toronado 4E-1
SWITCH
Back-Up 15-35
Dimmer Switch 12-46
Downshift—Throttle
Model - MV 6M-14
Model - 2GC 6M-24
Model - 4MV 6M-41
Headlamp
31-48 Series 12AA-5
54-86 Series 12A-6
Toronado 12EA-3
Ignition
31-48 Series 12AA-5
54-86 Series 12A-7
Toronado 12EA-2
Neutral Start 12-46
Stereo Tape Player
31-86 Series 15-6
Toronado 15E-4
Stop Light 5-4
Turn Signal 9A-11

T

TACHOMETER 15-32
TAIL LAMP
31-86 Series 12-45
Toronado 12E-6
TANK—GASOLINE
31-86 Series 8-1
Toronado 8E-1
TEMPERATURE
Indicator
31-86 Series 12-43
Gauge
Toronado 12E-1
THERMOSTAT—ENGINE 6K-6
THERMOSTATIC VACUUM 6K-7
Switch
THROTTLE CLOSING SOLENOID
Model - MV Carb. 6M-13
Model - 2GC Carb. 6M-24
TIMING
Ignition 6C-2
TIRES
31-86 Series ..... 0-7 and 10-7
Toronado ..... 0-7 and 10E-1
Rotation
31-86 Series ..... 0-7 and 10-7
Toronado ..... 0-7 and 10E-1
Inflation
31-86 Series ..... 0-7 and 10-7
Toronado ..... 0-7 and 10E-2
TORSION BAR 3EA-5
TOWING DATA
31-86 Series 0-8
Toronado 0-8
TRANSDUCER
Oil Pressure 15-32
TRANSMISSION
Turbo-Hydra-Matic
Exc. Toronado 7-1
Toronado 7E-1
Jetaway 7-301
Manual—Three-Speed
31-48 Series - Exc. 44 7-601
32-66 Series - Exc. 35 and 48 7-610
Four Speed 7-619
Serial Numbers
All Series 0-3
TUNE-UP 6C-1
TURN SIGNAL 12-42

U

UNIVERSAL JOINTS
31-86 Series 4A-2
Toronado 3EB-4

V

VACUUM ADVANCE, DISTRIBUTOR 12-25
VACUUM CONTROLLED HEADLAMPS 11E-7
VACUUM DOOR LOCK 15E-11
VACUUM TRUNK RELEASE
31-44 Series 15-36
54-86 Series 15-42
Toronado 15E-8
VEHICLE IDENTIFICATION 0-3
VENTILATION, CRANKCASE 6H-1
VOLTAGE REGULATOR 12-14

W

WATER PUMP 6K-6
WHEELS
31-86 Series 10-1
Toronado 10E-1
Alignment
31-86 Series 3-17
Toronado 3EA-14
Balance
31-86 Series 10-1
Toronado 10E-3
WHEEL BEARING
Front
31-86 Series 3A-2
Toronado 3EA-1
Rear
31-86 Series - Type "O" 4B-11
31-44 Series - Type "C" 4B-6
Toronado 4E-2
WHEEL CYLINDER, BRAKE 5-10
WHEEL, STEERING
31-86 Series ..... 9A-2 and 9A-4
Toronado 9E-4
WINDSHIELD
Defroster
31-48 Series 1-6

54-86 Series 1-2
Toronado 1E-2
Wiper
Rectangular Motor 12B-1
Round Motor 12B-10
Toronado 12EB-1
Washer
Rectangular Motor 12B-24
Round Motor 12B-28
WIRING CIRCUIT
31-86 Series 12-4
Toronado 12E-1
WIRING CIRCUIT DIAGRAMS
32, 36, 42, 44 and 48 Series (V-8) 12-3
31 and 35 Series (L-6) 12-5
54-86 Series 12-2
Toronado 12E-2
WONDER BAR RADIO 15-2