

1962

TEMPEST

**CHASSIS
SHOP MANUAL**

PONTIAC MOTOR DIVISION

1962 PONTIAC TEMPEST SHOP MANUAL

GENERAL

This shop manual applies to 1962 Pontiac Tempest models. It contains information on all components of the car with the exception of the air conditioning, heating and ventilation systems and body information which will be covered in separate manuals. All pertinent information available at time of preparation is included.

CONTENTS

Arrangement of the material is shown by the table of contents on the right-hand side of this page. Black tabs on the first page of each section can be seen on the edge of the book below the section title. More detailed table of contents precedes each section, and an index is included in the back of the manual.

AIR CONDITIONING CAUTION

It is extremely important that proper methods and precautions be observed when disconnecting any refrigerant lines or units. Check information published concerning air conditioning prior to performing operations of this nature. Failure to observe this caution may result in injury to personnel or cause extensive damage to the air conditioning system.

**PONTIAC MOTOR DIVISION
GENERAL MOTORS CORPORATION
PONTIAC 11, MICHIGAN**

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GENERAL INFORMATION

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GENERAL INFORMATION

General information and general specifications appear in this section. Detailed specifications are given on major units at the end of each section of this manual.

VEHICLE IDENTIFICATION PLATE

Serial, assembly plant and model year identification can be made from the Manufacturer's Motor Vehicle Identification Number Plate. This plate is a

metal strip which is fastened to the left front hinge pillar post, visible when the left front door is open. The plate has embossed numerals as shown in Fig. 1-1.

BODY IDENTIFICATION PLATE

Identification as to body style, body number, trim and paint is carried on a plate (Fig. 1-2) attached to the left side of the cowl just under the rear edge of the hood.

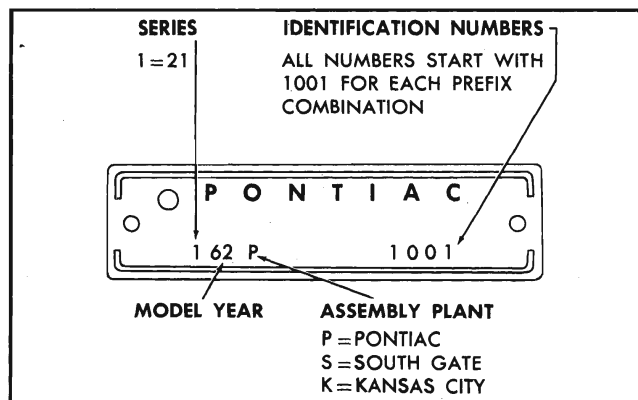


Fig. 1-1 Vehicle Identification Plate

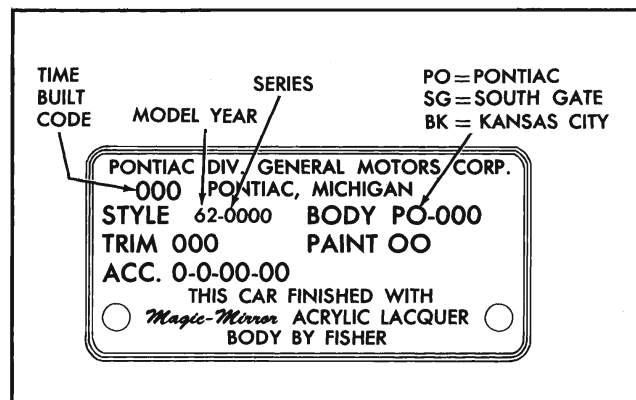
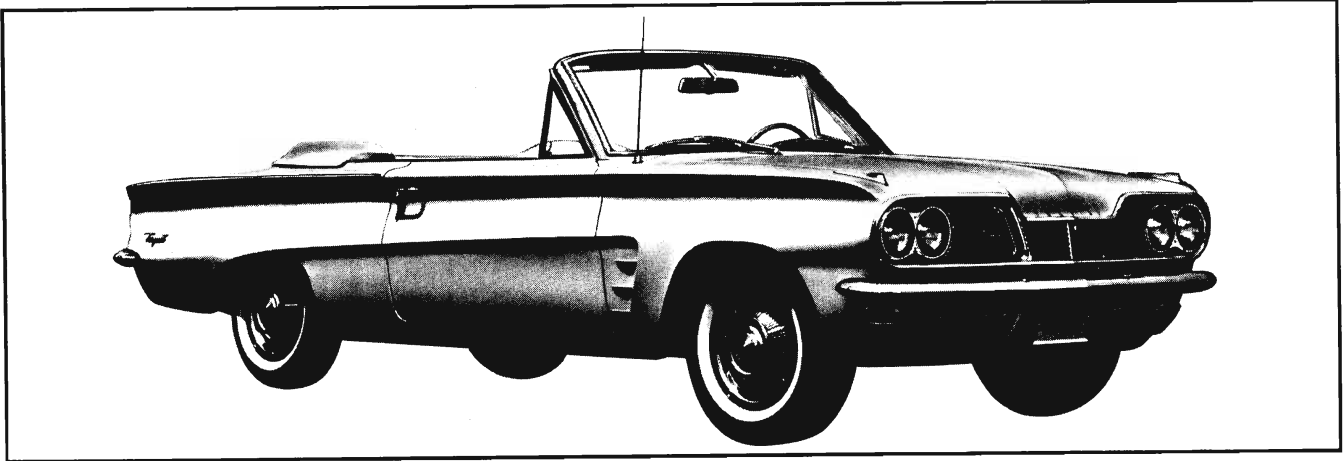


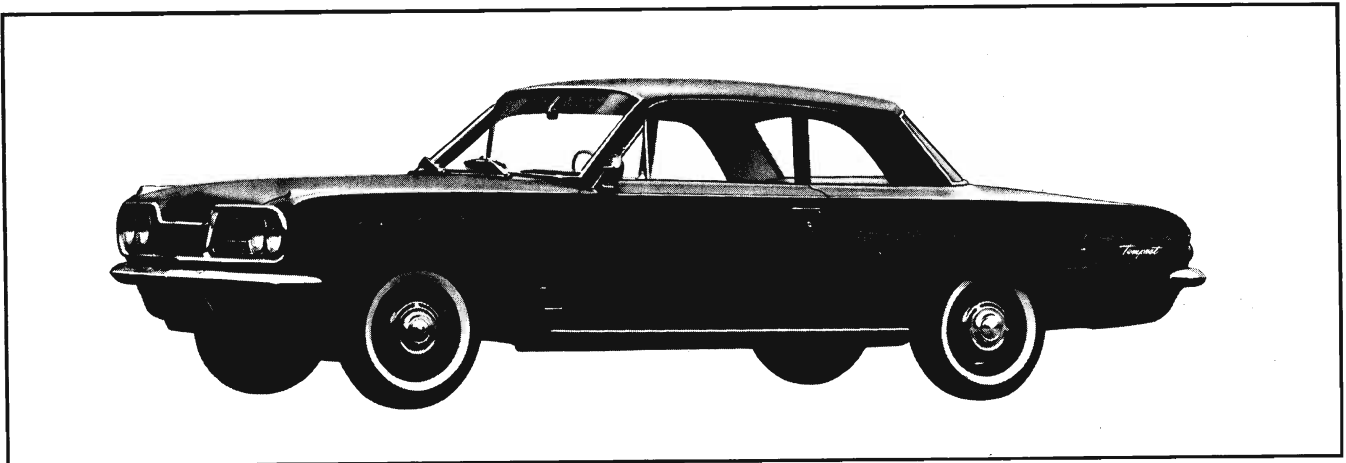
Fig. 1-2 Body Identification Plate



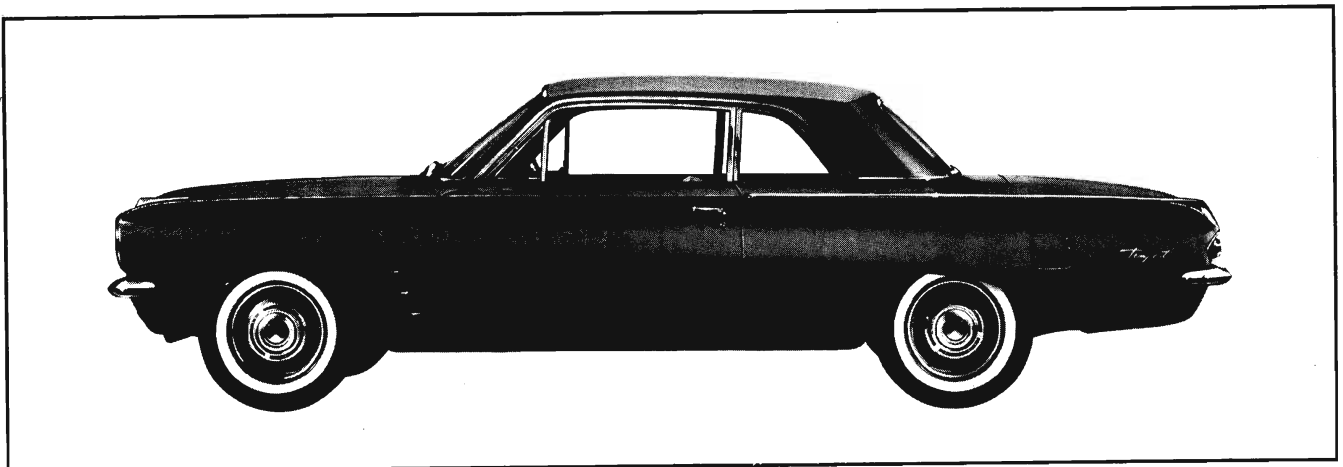
Pontiac Tempest Station Wagon, Series 2135



Pontiac Tempest Convertible Coupe 2167



Pontiac Tempest 2 Door Coupe 2127



Pontiac Tempest 2 Door Sports Coupe 2117



Pontiac Tempest Sedan, Series 2119

RELATION OF CAR SPEED TO ENGINE RPM

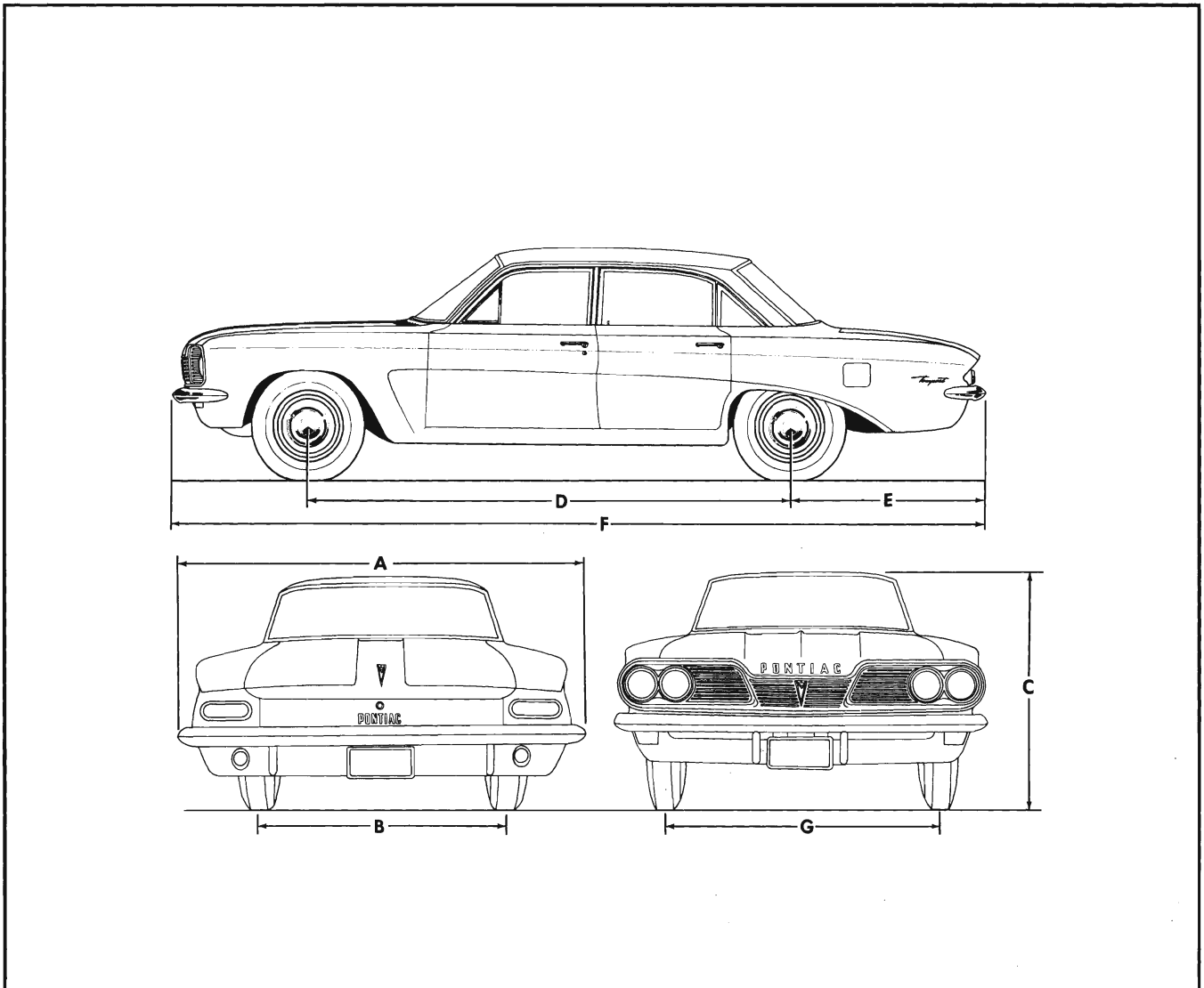
CAR SPEED M.P.H.	REAR WHEEL R.P.M.		ENGINE R.P.M. FOR GIVEN AXLE RATIOS AND TIRES									
			3.08		3.31		3.55		3.73		3.90	
	6.00	6.50	6.00	6.50	6.00	6.50	6.00	6.50	6.00	6.50	6.00	6.50
10	132	130	408	399	438	428	470	459	494	483	517	505
20	265	259	816	798	877	857	940	918	988	965	1034	1010
30	398	388	1224	1197	1315	1285	1409	1377	1482	1448	1550	1515
40	530	518	1632	1596	1753	1713	1879	1837	1975	1931	2067	2020
50	662	648	2040	1995	2191	2142	2349	2296	2469	2413	2584	2525
60	795	777	2448	2394	2630	2570	2819	2755	2963	2896	3101	3030
70	928	906	2856	2793	3068	2998	3288	3214	3457	3379	3617	3535
80	1060	1036	3264	3192	3506	3427	3758	3673	3951	3861	4134	4040
90	1192	1166	3672	3591	3944	3855	4228	4132	4445	4344	4651	4545
100	1325	1295	4080	3990	4383	4283	4698	4591	4939	4827	5168	5050

AXLE RATIO	N V RATIO*	
	TIRE SIZE	
	6.00 x 15	6.50 x 15
3.08	40.8	39.9
3.31	43.8	42.8
3.55	47.0	45.9
3.73	49.4	48.3
3.90	51.7	50.5

*N = Engine R.P.M. V = Car Speed M.P.H.

GENERAL SPECIFICATIONS

DIMENSION	KEY	2119—Sedan	2117—2 Dr. Cpe.	2127—2 Dr. Cpe.	2167—Conv.	2135—Safari
Over-all length	F	189.3	189.3	189.3	189.3	189.3
Width	A	72.2	72.2	72.2	72.2	72.2
Height (with Passengers)	C	53.0	52.7	52.7	53.1	54.0
Wheelbase	D	112	112	112	112	112
Tread						
Front	B	56.8	56.8	56.8	56.8	56.8
Rear	G	56.8	56.8	56.8	56.8	56.8
Turning Circle Curb to Curb	—	37.7	37.7	37.7	37.7	37.7
Road Clearance	—	6.0	6.0	6.0	6.0	6.0
Overhang (rear)	E	45.7	45.7	45.7	45.7	45.7
Tire Size	—	6.00 x 15	6.00 x 15	6.00 x 15	6.00 x 15	6.50 x 15
Ramp Angle	—	12.9°	12.9°	12.9°	12.9°	13.6°



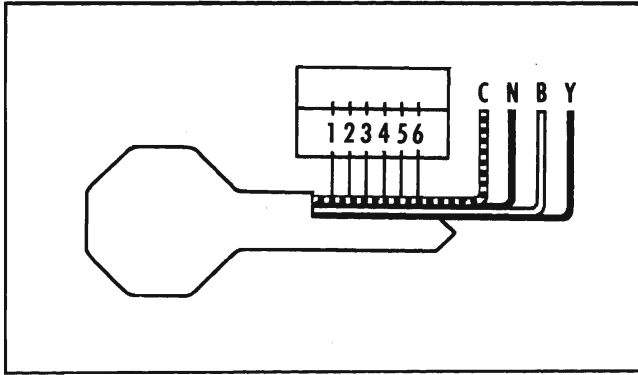


Fig. 1-3 Key Coding Diagram

CODING SIDE BAR LOCK

The side bar lock is used on the ignition, front door and rear deck lid lock. Uncoded side bar locks may be coded to match the keys used on the car. Locks are received without tumblers, springs or retainers which are available separately. Four different tumblers are available, only approved parts should be used.

Before the lock may be coded the code of the key must be determined. If the numbered blank surrounding the hole in the key head has not been removed the code may be determined by consulting lock manufacturers code book. Should the blank be missing from the key the coding sequence may be readily determined as follows:

1. Place key on diagram (Fig. 1-3) with bottom, head and point aligned.
2. Starting at the head of the key, code each of six cuts either C-N-B or Y by recording which area the bottom of the cut leaves exposed. Example: If the first line from the top is the only line exposed the cut would be coded C.

After the key code has been determined the correct tumblers should be installed as follows:

1. The letters determined from coding the key indicate different colored tumblers to be installed in slots of the lock (Fig. 1-4).

LETTER	COLOR	DEPTH SET AT
C	Copper	.000
N	Nickel	.025
B	Black	.050
Y	Yellow	.075

Fig. 1-4 Tumbler Color Chart

2. Beginning with slot next to head (number one position) install tumbler of color coinciding with letter determined from key code. Install correct tumblers in remaining five slots.

3. Insert spring in each round cavity in each tumbler lock between slots.

NOTE: Do not pull springs apart, twist them apart.

4. Install spring retainer over springs with ends inserted in slots.

5. Side bar will now drop in place when key is inserted if correct tumblers have been installed.

6. Stake spring retainer in place using screwdriver and light hammer.

LIFTING AND TOWING

LIFTING

Fig. 1-5 shows the Tempest may be lifted at any accessible point on the body-frame rail. It can also be lifted at the front crossmember or at either the front or rear lower control arms. When lifting on the lower control arms, use care to avoid the lower shock absorber brackets.

Under no circumstances should lift adapters be used on the bumpers, torque tube, axle shafts, trans-axle or engine.

The torque tube and the exhaust system are lower than the side rails. Lift adapters must provide adequate clearance height for these parts.

TOWING

For normal over-the-road towing, use only the front or rear crossmembers as chain attaching points. There are holes in the end of the frame rails which can be engaged with a small hook for moving the car from mud, ditches, etc.

The bumpers, axle shafts or steering linkage should NOT be used for towing of any kind. Protection must be provided for bumpers, front end sheet metal and fuel tank when the hook-up is made.

Following are general towing instructions:

1. Place transmission in neutral.
2. If transmission or differential malfunction is suspected, tow from rear with rear wheels approximately six inches off ground.
3. Never tow over 30 mph. Do not raise car to height that would cause opposite end to be damaged by dragging.

CAUTION: Power steering equipped cars should be towed with caution, since there is no power assist with the engine off.

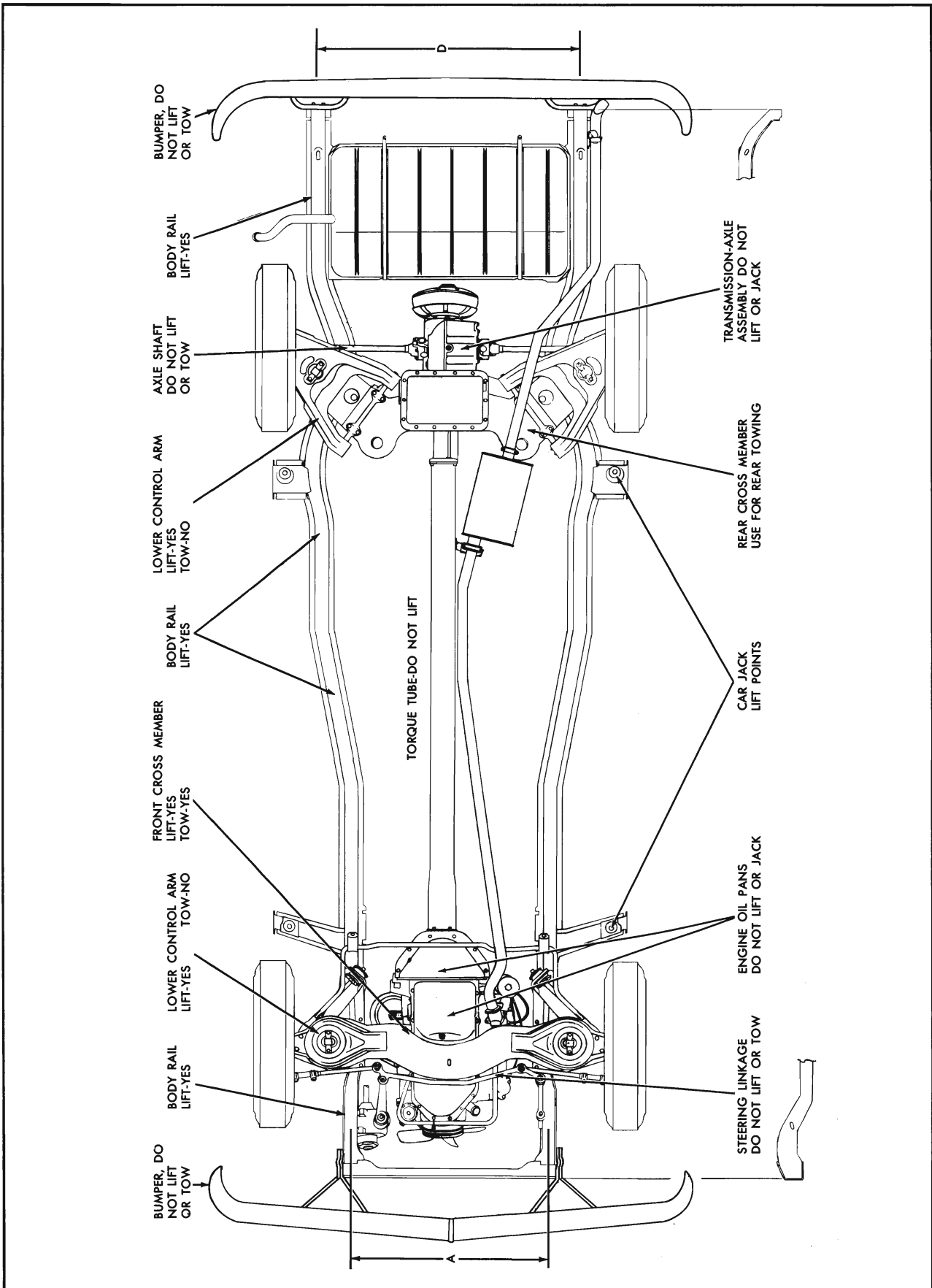


Fig. 1-5 Tempest Lift Points

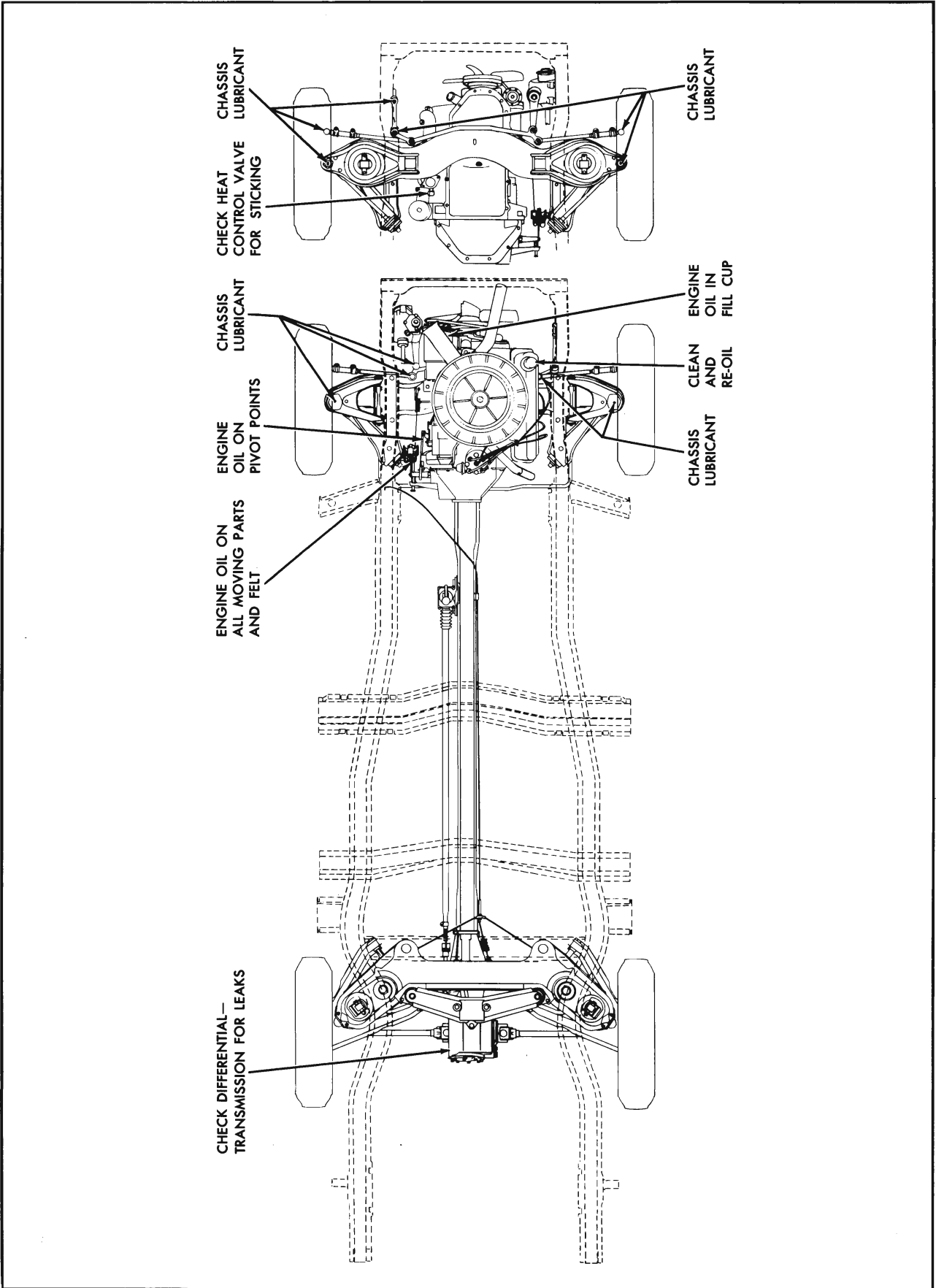


Fig. 2-1 Pontiac Tempest Lubrication Chart

GENERAL LUBRICATION

SUBJECT	PAGE	SUBJECT	PAGE
4,000 Mile Service		Hood Latch and Safety Hook	2-4
Chassis and Body Lubrication	2-1	Hood Hinge Pivots	2-4
When to Lubricate Chassis	2-1	Fuel Tank Door Hinge	2-4
Engine Crankcase	2-2	Rear Deck Lid Lock Bolt	2-4
Oil Filter	2-2	Tail Gate Hinges	2-4
Ball Joints	2-3	Station Wagon Folding Seat	2-4
Transmission	2-3	Service At Special Intervals	
Clutch Linkage	2-3	Battery	2-4
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Steering Gear	2-3	Front Wheel Bearings	2-5
Power Steering	2-3	Speedometer Drive Cable	2-5
Brake Master Cylinder	2-3	Polyurethane Air Cleaner	2-6
Brake System	2-3	Fuel Filter (Disposable Type)	2-6
8,000 Mile Service		Fuel Filter (Integral)	2-6
Generator	2-3	Brake Pedal Pivots	2-6
Crankcase Ventilator	2-3	Items Not Normally Requiring Service	
Standard Air Cleaner	2-4	Starting Motor	2-6
Accelerator Linkage	2-4	Distributor	2-6
Door Lock and Striker	2-4	Clutch Release Bearing	2-6
Door Hinge Hold Opens	2-4	Gearshift Control	2-6
Door Hinge Pins	2-4	Shock Absorbers	2-6
Door and Rear Deck Locks	2-4	Rear Wheel Bearings	2-6

4,000 MILE SERVICE

CHASSIS AND BODY LUBRICATION

Pontiac Tempest cars should be lubricated periodically (see Figures 2-1 and 2-2) to retain all the built-in value. Experience has shown that the need for this vital service varies according to the conditions under which the car is driven.

WHEN TO LUBRICATE CHASSIS

For normal driving conditions, lubrication is recommended every 4,000 miles. This applies to all models with the exception of those driven under the conditions described below.

DRIVING OVER ROUGH AND DUSTY ROADS

When the car is driven over rough or dusty roads, more frequent lubrication might be necessary.

DRIVING IN SLUSH, WATER OR MUDDY ROADS

Cars driven through slush, water or muddy roads should be lubricated at more frequent intervals, due to the washing effect of the water on the lubricant in front suspension parts and the clutch and brake pedal shafts.

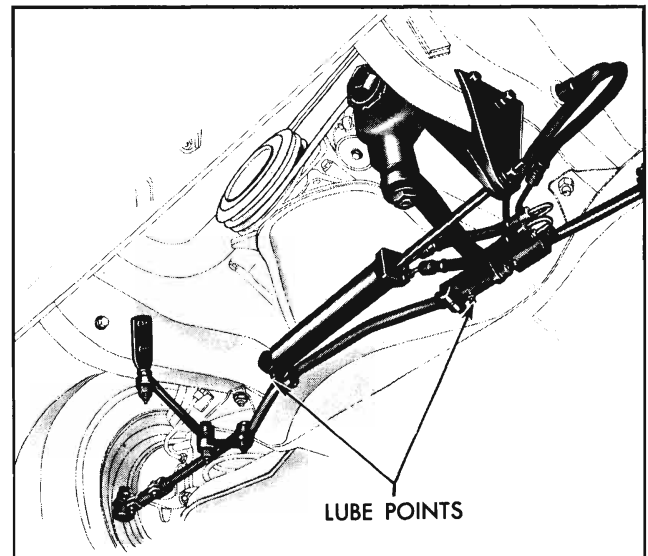


Fig. 2-2 Power Steering Lubrication Points

LOW MILEAGE DRIVING

Some cars are driven very little and accumulate mileage slowly. It is good practice to lubricate these cars every 1,000 miles.

Atmospheric Temperatures Expected	S.A.E. Recommended Single Viscosity	Number Acceptable Alternate
10°F.—110°F.	20W	10W-30
10°F. below zero to 95° above zero	10W	10W-30
10°F. below zero and colder	5W	5W-20

NOTE: Petroleum based oils which are identified as "For Service MS or DG" are recommended for the Pontiac Engine.

Fig. 2-3 Engine Oil Chart

HIGH MILEAGE DRIVING

Cars operated over 500 miles per week under favorable conditions should be lubricated once a month.

ENGINE CRANKCASE

The terms "For Service ML", "For Service MM" and "For Service MS or DG" are used by the oil industry to designate the types of engine oil supplied to meet the requirements of various service conditions.

Petroleum based engine oils of type MS, as supplied by reputable marketers and represented as passing car maker's tests (General Motors Standard, GM 4745M), are suitable for use in Pontiac Tempest engines.

S.A.E. OIL NUMBER SYSTEM

The numerical designations such as 10W, 20W and 20, etc., adopted by the Society of Automotive Engineers, classify lubricating oil only according to Fluidity (viscosity). The oils with the lower numbers are lighter and flow more readily than do the oils with the higher numbers. The letter "W" after the number indicates an oil adapted for cold weather starting. Multi-viscosity type crankcase oils such as 5W-20, 10W-20, and 10W-30 are designed to combine the easy starting characteristics of the low number with the warm weather operating characteristics of the higher number.

SELECTING OIL OF THE PROPER NUMBER

An oil should be used which provides safe lubrication, satisfactory oil economy under warm climatic conditions, and easy starting at the lowest atmospheric temperatures expected during the period the oil is to remain in the engine. Based on these considerations, the numbers of engine oil which are recommended for the Pontiac Tempest engine under various climatic conditions are shown in Fig. 2-3 above.

Prevailing Daylight Temperature	Oil Change Interval
Above 32° F.	Every 60 days or every 4,000 Miles, whichever occurs first.
Below 32° F.	Every 30 days or every 4,000 Miles, whichever occurs first.

Fig. 2-4 Oil Change Intervals

OIL CHANGE RECOMMENDATIONS

Engine oil should be drained from the engine and the crankcase refilled with oil as recommended in Fig. 2-3 and 2-4.

It is always advisable to drain the crankcase only after the engine is thoroughly warmed. The benefit of draining is lost, to a large extent, if the crankcase is drained when the engine is cold as the oil will be thick and will not drain properly.

The crankcase refill capacity is 4 quarts except when the oil filter cartridge is changed. The refill capacity with an oil filter cartridge change is 5 quarts.

ADDING OIL BETWEEN CHANGES

Since the lubrication system in a Pontiac Tempest is a full pressure system, it is not necessary to keep oil level up to the "FULL" mark on the dipstick. It is only necessary to keep oil level above "ADD" mark. It takes one quart to bring the oil level from "ADD" to "FULL" mark. Each time the gas tank is filled, the oil level should be checked. However, it is good economy to let the oil level approach the "ADD" mark before having oil changed.

CAUTION: Do not overfill.

OIL FILTER (DISPOSABLE TYPE)

A full flow oil filter is optional on Pontiac Tempest 4 cylinder engines and standard on the V-8 engines. This filter removes harmful particles of dirt, grit or other foreign materials before they can cause undue engine wear by embedding themselves in bearing surfaces or otherwise harmfully affect engine performance.

The filter cartridge should be replaced after the first 4,000 miles and then each 6 months or 4,000 miles thereafter.

BALL JOINTS

The upper and lower control arm balls should be lubricated every 4,000 miles with chassis lubricant.

MANIFOLD HEAT CONTROL VALVE—4 CYLINDER ENGINE

Check heat valve in right bank manifold for freedom of movement; if sticking, lubricate bushing with graphite in alcohol.

TRANSMISSION

AUTOMATIC TRANSMISSION

Check for leaks. Automatic Transmission Fluid Type "A" with an AQ-ATF-A number is recommended for use in the automatic transmission. However, if this type of fluid is not available, it is permissible to use automatic transmission fluid Type "A" with an AQ-ATF number. Refill capacity is 6 pints.

SYNCHROMESH

Check for leaks. An SAE 80 or 90 "Multi-Purpose" gear lubricant must be used in the Synchromesh transmission.

CAUTION: Straight Mineral Oil gear lubricants or any "active sulphur soap" lubricants must not be used.

The SAE 80 or 90 viscosity grade is recommended for year around use. Refill capacity is 2.8 pints (three-speed) and 3.75 pints (four speed).

CLUTCH LINKAGE

Use engine oil on all moving parts of the clutch linkage. Spherical joint at fork should be lubricated with wheel bearing grease.

DIFFERENTIAL

Check for leaks. An SAE 80 or 90 "Multi-Purpose" gear lubricant must be used in the differential assembly.

GENERATOR

At each 8,000 mile lubrication period, fill the oil cup with engine oil.

CAUTION: Do not oil with engine running.

CAUTION: Straight Mineral Oil gear lubricants or any "active sulphur soap" lubricants must not be used.

The SAE 80 or 90 viscosity grade is recommended for year around use. Refill capacity is 3 pints.

STEERING GEAR

Lubricant change is not necessary unless the unit is disassembled for repair.

At each chassis lubrication, unit should be checked for leaks. If there is evidence of leakage from the steering gear, the leak should be corrected and steering gear lubricant added to bring to proper level.

POWER STEERING

It is not necessary to change fluid unless the unit is disassembled for repairs. However, if there are any leaks in the system they should be corrected and the fluid level checked. Add recommended Hydra-Matic fluid to bring level up to "Full" mark on dip stick.

BRAKE MASTER CYLINDER

If there is evidence of leakage in the brake hydraulic system, the leak should be corrected and fluid added as needed. Otherwise fluid level should be checked at the time of brake adjustment.

When adding fluid, bring level to $\frac{7}{8}$ " from gasket surface of filler neck as instructed in Brake Section of this manual.

NOTE: Always use heavy duty brake fluid which meets the S.A.E. 70R3 specifications.

BRAKE SYSTEM

Check for leaks.

8,000 MILE SERVICE

CRANKCASE VENTILATOR

The crankcase breather element, built into the oil filler cap, should be cleaned at 8,000 mile intervals and after driving through severe dust conditions.

Clean oil filler and ventilator cap filter by plunging it up and down several times in a can of kerosene or other suitable solvent. Re-oil element by dipping in engine oil and allowing to drain thoroughly.

STANDARD AIR CLEANER

The carburetor standard air cleaner should be serviced every 8,000 miles and after driving under extremely dusty conditions.

Following is the correct cleaning procedure:

1. Remove filter element from carburetor air cleaner.
2. Clean element by plunging up and down in a can of gasoline or kerosene.
3. Re-oil element by dipping in engine oil and allowing excess oil to drain off before assembly.
4. Clean dirt out of element seat in silencer body and reassemble.

ACCELERATOR LINKAGE

Use engine oil on linkage pivot points. Do not lubricate carburetor linkage.

DOOR LOCK AND STRIKER

Wipe lock and striker parts clean and apply a light coat of stick-type lubricant to the mating surfaces of the rotary lock bolt and the striker teeth of each door. Clean off excess lubricant.

CAUTION: Do not use oil.

SERVICE AT SPECIAL INTERVALS

BATTERY

Observe liquid level at least every 30 days. If low, add distilled or "demineralized" water to bring level to bottom of vent well. Inspect top of battery and retainer. If damp or corroded, clean with soda solution or diluted ammonia water; dry thoroughly.

Check the specific gravity of the battery. The bat-

DOOR HINGE HOLD OPENS

Coat front door hinge hold opens and friction surface on rear door hold opens with light grease.

DOOR HINGE PINS

Apply light engine oil when dry.

DOOR AND REAR DECK LOCKS

Whenever it becomes difficult to insert the key into the lock, a small amount of powdered graphite should be blown into the lock cylinder.

HOOD LATCH AND SAFETY HOOK

Apply light engine oil to hinge pins, latch, and safety hook friction surfaces.

HOOD HINGE PIVOTS

Apply light engine oil when dry.

FUEL TANK DOOR HINGE

Apply light engine oil to hinge pin.

REAR DECK LID LOCK BOLT

Spring and fall or every 8,000 miles apply light grease to slot in deck lid lock bolt which contacts lock striker.

TAIL GATE HINGES

Apply light engine oil to rear gate hinges.

STATION WAGON FOLDING SEAT

Apply engine oil to the frictional area of the folding rear seat back support assembly. Wipe off all excess lubricant.

tery should be kept at or near a full charge at all times (1.240-1.280 hydrometer reading). This is especially important in cold weather when the demands on the battery are high. A battery can freeze in extreme cold if it is not in a fully charged condition.

CAUTION: Battery fumes are inflammable and toxic.

PARKING BRAKE CABLES

Brake cables should be lubricated when the rear wheels and drums are off to replace brake shoes and linings or to make a major adjustment. Use light grease, chassis lubricant, or equivalent.

Lubricate as follows:

1. Thoroughly clean cable, from conduit to cable equalizer.
2. Remove retainer at forward end of conduits.
3. Unhook parking brake cable at equalizer (Fig. 2-5).
4. Unhook cable from parking brake lever assembly in drum and remove cable from backing plate.
5. Slide the conduit forward on the brake cable.
6. Clean the cable, examine for broken strands, and apply light grease, chassis lubricant to the cable, or equivalent.
7. Inspect cable connections to hand brake actuating lever to be certain cable is seated in lever hook.
8. Slide brake cable conduit back in position and secure at forward end with retainer.
9. Install brake cable in backing plate and secure to lever assembly.
10. Connect parking brake at equalizer and adjust as described in Section 5.

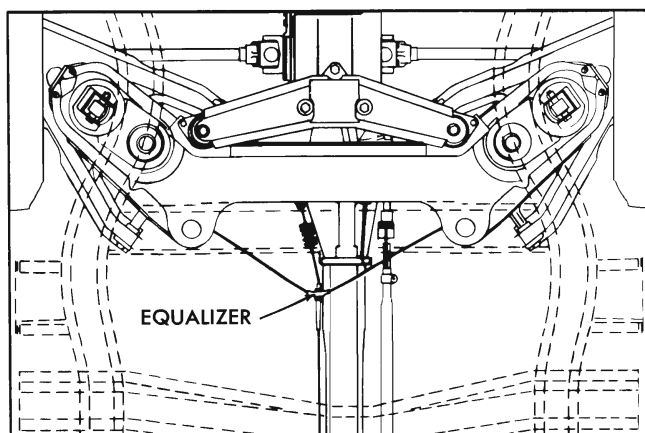


Fig. 2-5 Parking Brake Cable Equalizer

FRONT WHEEL BEARINGS

Front wheel bearings require no periodic lubrication. They should be lubricated only when it is necessary to remove wheels for other work, such as brake relining. The bearings should then be thoroughly cleaned and packed with high melting point water resistant wheel bearing lubricant. The spindle should be coated and the I.D. of the seal. If wheel bearings are found to be discolored—turned blue or straw colored—it does not indicate that they have been overheated due to lack of lubricant. This discoloration is merely a chemical reaction of substances in the lubricant and does not affect the serviceability of the bearing in any manner. Wheel bearings that are not properly adjusted, i.e., too tight or too loose, are usually the cause of wheel bearing failure.

SPEEDOMETER DRIVE CABLE

Lubricate speedometer cable when dry. In some cases the lubricant placed in the conduit at the factory may become dry causing a slight binding of the cable. A dry cable will usually be noticeable by wavering of the speedometer needle. A very dry cable, of course, will be noisy. When lubricating the speedometer cable, first remove it from the top.

To insure quiet cable operation, apply suitable speedometer cable lubricant on lower two-thirds of cable and assemble in casing in the following manner:

- a. Wipe cable clean using lint free cloth. Flush bore of casing with oleum spirits or suitable solvent solution and blow dry with air under pressure.
- b. Place 1" of suitable speedometer cable lubricant in palm of the hand.
- c. Then feed cable through lubricant in hand and into casing until the lubricant has been applied to the lower two-thirds of cable. *Do not over lubricate and do not apply lubricant to upper third of cable*, since operation of cable assures adequate lubrication of the upper third and at the same time prevents lubricant from seeping into the speedometer head.

POLYURETHANE AIR CLEANER

Wash element in kerosene, squeeze dry, dip in S.A.E. 10W-30 oil, squeeze dry to remove excess oil and re-install every 16,000 miles or yearly, **DO NOT WRING DRY**. Clean after driving under severe dust conditions.

FUEL FILTER (DISPOSABLE TYPE)

The disposable type fuel filter assembly should be replaced at 12,000 mile intervals or yearly. If prema-

ture plugging is experienced, change brand of fuel.

FUEL FILTER (INTEGRAL TYPE—ONE BARREL ONLY)

The integral filter, located in the fuel inlet of the carburetor, should be cleaned twice yearly and replaced after 12,000 miles. Replace oftener if flooding or vapor lock occurs.

BRAKE PEDAL PIVOTS

Engine oil, when sticky or dry.

ITEMS NOT NORMALLY REQUIRING SERVICE

STARTING MOTOR

No lubrication required except on overhaul. When overhauling starting motor add a few drops of engine oil to the bronze bushings in both end frames.

DISTRIBUTOR

When replacing contact points add a trace of special Cam and Ball Bearing Lubricant to the breaker cam. No other lubrication is required. Contact points should be completely free of lubricant at all times.

CLUTCH RELEASE BEARING

The clutch release bearing requires no periodic lubrication. It is a ball bearing, lubricated and sealed with enough lubricant for life.

GEARSHIFT CONTROL

The lower cover of the assembly housing the gearshift lever should be removed as necessary and a molybdenum disulphide based grease placed in the socket which holds the lower gearshift lever ball.

SHOCK ABSORBERS

Give visual inspection for leaks. If leaks are found, the unit should be replaced.

REAR WHEEL BEARINGS

The rear wheel bearings require no periodic lubrication.

COIL SPRING SUSPENSION

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Shock Absorbers	3-12	Special Tools	3-24

DESCRIPTION

FRONT SUSPENSION (Fig. 3-1)

The compression strut independent front suspension with stabilizer bar, has an "A" frame type upper control arm and a cantilever type lower control arm with a compression strut. This unitized front suspension assures a consistently high quality in production, alignment being accomplished under closely controlled conditions in manufacturing. Notably from the service standpoint, the front suspension assembly can be built up as a unit, with cross member attachment to the unitized construction body being accomplished by three bolts on each side.

Stamped steel suspension control arms are used with rubber bushed mounting shafts. A strut bolted to the lower control arm is mounted at the rear with rubber bushings while the inner end is threaded so that the front suspension caster angle may be readily adjusted by varying the effective length of the strut. The front coil springs are seated on the lower control arm and the shock absorbers operate within the coils. To completely isolate the body from road noise, the tops of the coiled springs are seated against rubber insulators. Half ball joints with phenolic seats and anti-dive suspension geometry are also features of this system. The front wheel bearings are of the tapered roller type which provides desired capacity in minimum space.

REAR SUSPENSION (Fig. 3-2)

The swing axle independent rear suspension pro-

vides independent action of each rear wheel and reduced unsprung weight as well as positive control of suspension geometry.

In this system, a rear cross member is attached to the integral body in four positions. Attached to the rear cross member is the trans-axle support mounted in rubber for noise and vibration isolation (Fig. 3-3). This is in turn affixed to the differential in a manner to provide fore and aft shimming for toe variation. The differential and final drive gear case is, therefore, mounted to the sprung mass of the car, the axle shafts being driven through a universal joint on either side of the differential.

The swing axle type suspension gets its name from the fact that suspension travel is provided by allowing each wheel to swing through arcs of radius equal to the axle shaft length. With this arrangement, the independent action of each wheel and the reduction in unsprung weight contributes greatly to the Tempest ride. Because the rear wheels are independently suspended, new geometry factors must be considered. Wheel camber for example, is designed to change as the suspension moves up or down from the design height position. Since the outside wheels carry the greatest weight in a turn, camber characteristics of the rear suspension create desirable understeer geometry (i. e. increased weight in a turn causes reduced camber on the outside wheel to give beneficial steering effect).

The lower control arms are "A" frame type arrangement, each having four studs which extend through the brake backing plate for attachment. This

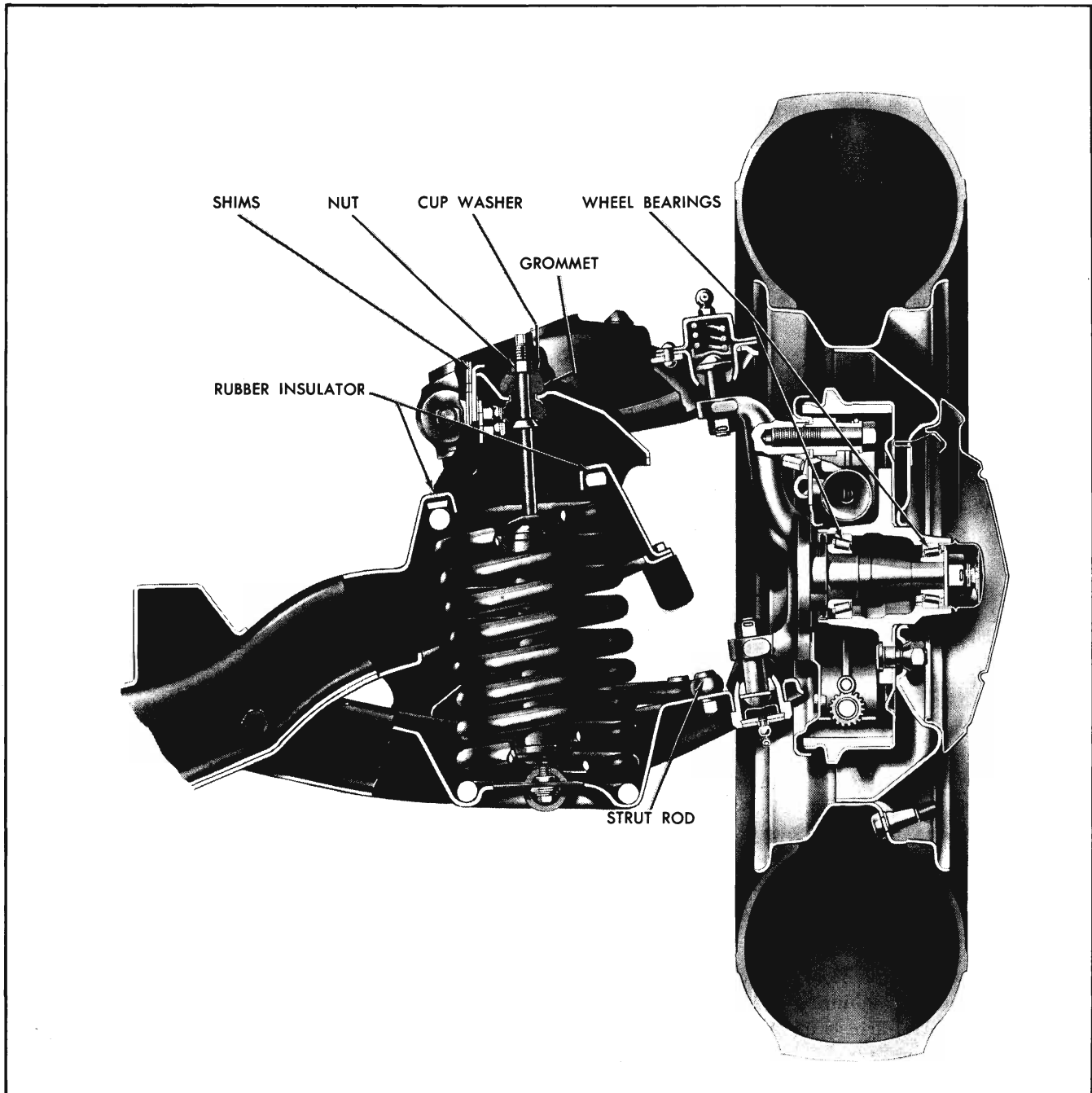


Fig. 3-1 Front Coil Spring Suspension

forms the lower seat for the rear coil springs, while the upper seat is the suspension cross member. Angled shock absorbers operate within the spring coils. Rear axle shafts are attached to the differential with universal joints, having a splined yoke which extends into the side gears of the differential case.

PERIODIC SERVICE

Periodical service of the suspension system consists of regular lubrication as outlined in the General Lubrication Section.

ADJUSTMENTS AND CHECKS ON CAR

- Front wheel bearing (page 3-3)
- Front suspension toe-in (page 3-8)
- Front suspension caster and camber (page 3-8)
- Front suspension toe-out on turns (page 3-9)
- Rear suspension toe-in (page 3-9)
- Wheel and tire run-out (page 3-5)
- Wheel and tire balance (page 3-6)
- Ball joints (page 3-5)
- Curb height (page 3-7)

CHECK AND ADJUST FRONT WHEEL BEARING

The tapered roller bearings used in the Tempest will have a slightly loose feel when properly adjusted. (This differs from ball bearings which may be pre-loaded without adverse effect.) Tapered roller bearings can be damaged by the steady thrust which comes from pre-loading.

1. Place lift or car jack under lower control arm and raise wheel just off floor.

2. Grip tire at top and bottom and rock. If movement of tire at lower outer periphery exceeds $\frac{1}{4}$ " , the wheel bearings, ball joints or both may be worn excessively.

If bearing looseness is excessive, adjustment of

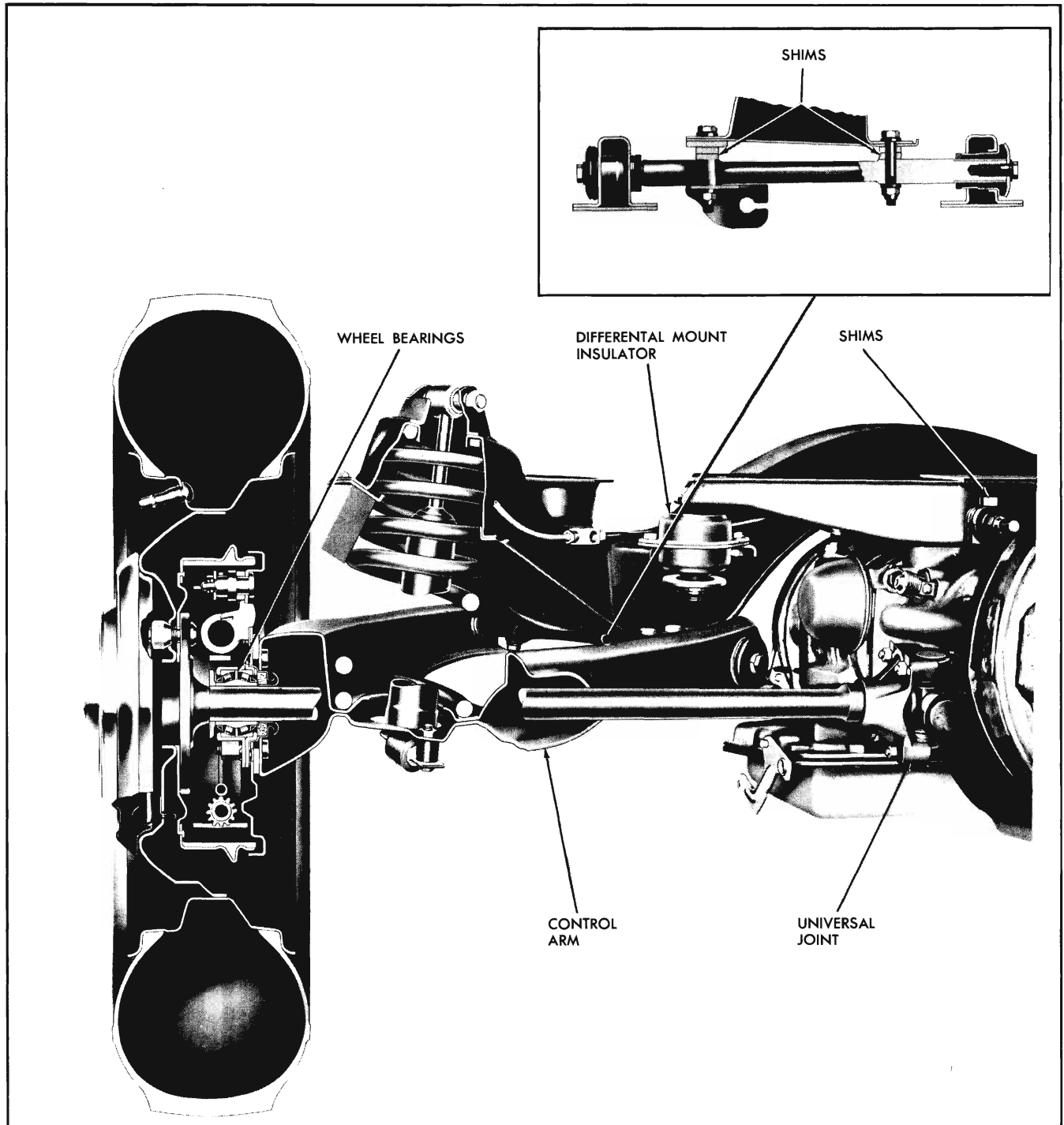


Fig. 3-2 Rear Coil Spring Suspension

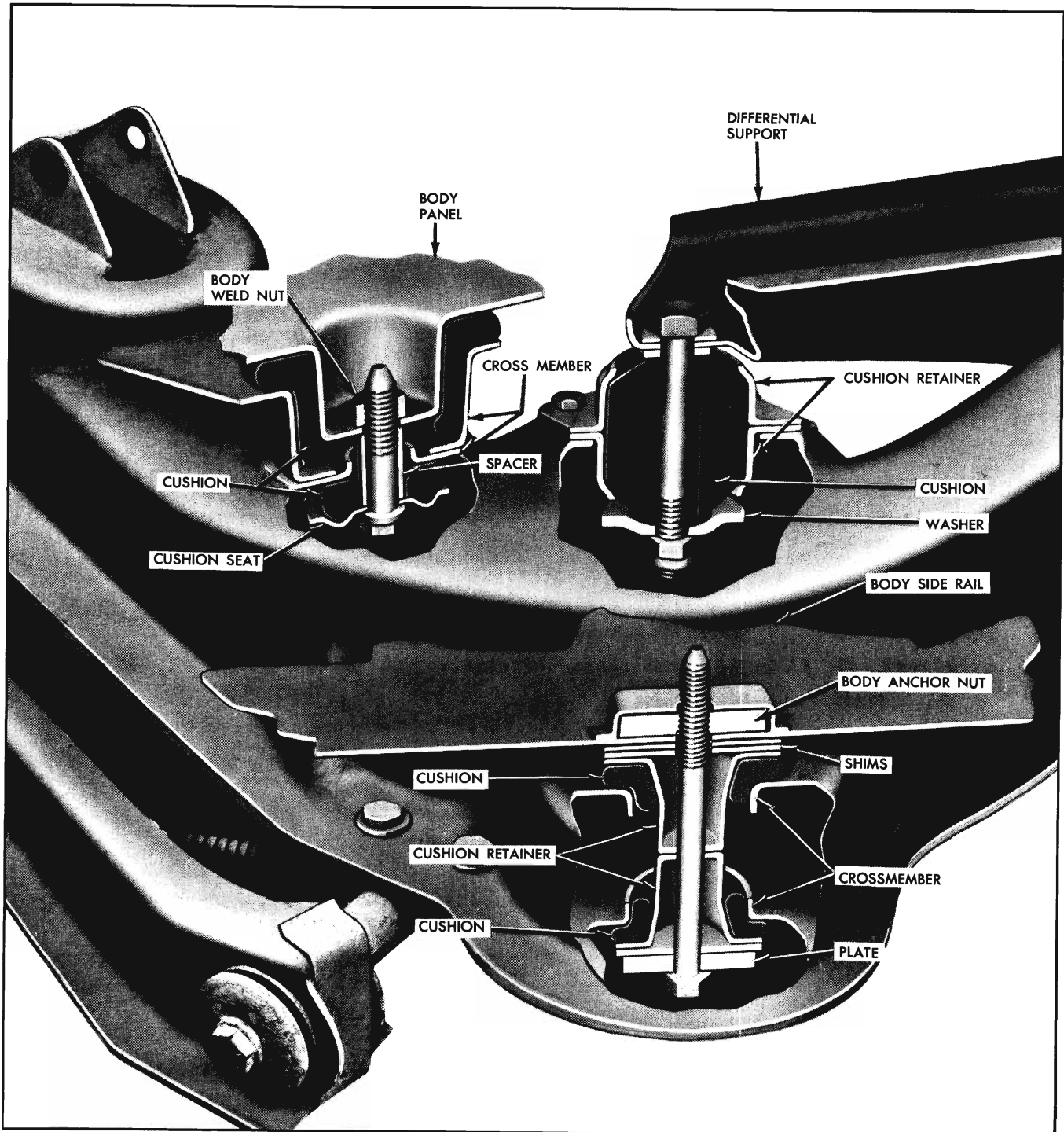


Fig. 3-3 Insulation of Rear Suspension to Body Mounting Components

wheel bearings can be made by the following method:

TORQUE WRENCH METHOD

1. Remove dust cap.
2. Check for slip fit of bearing cones on spindles. Bores of bearing cones should have a light coat of

wheel bearing lubricant to allow cones to creep on spindle.

3. If nuts turn hard on spindle, check for and remove any burrs from spindle threads and cotter pin holes or key slots in nut.
4. With tire off ground adjust bearing:

a. While rotating drum, tighten nut with torque wrench to approximately 10-12 lb. ft. to insure all parts are properly seated.

b. Back off nut one flat (1/6 of a turn). If locking holes line-up, insert cotter pin. If holes do not line-up, continue to back off the adjusting nut to the nearest locking hole. Final adjustment should be one flat to 1½ flats turn, backed off from the initial tightened position. *This should result in the desired limits of .001-.010 end play (required with tapered roller bearings).*

5. Clinch cotter pin and cut off extra length to insure ends will not interfere with static collector or dust cap.

6. Install dust cap and wheel and lower tire to ground.

CHECK BALL JOINTS

If wheel bearing adjustment does not remove excessive movement (exceeds ¼") at lower outer periphery of tire, check ball joints as follows:

1. Check and lubricate all ball joints.

2. Raise car at the lower control arm, supporting outside of the spring seat, so that the upper control arm is not touching rebound rubber bumper, and front wheels are free from contact lift or floor.

3. Remove dust cap, wheel bearing nut cotter pin, and temporarily tighten nut just enough to remove all end play from wheel bearings.

CAUTION: It is imperative that the wheel bearing nut be loosened and the wheel bearing readjusted according to the procedure outlined under "Check and Adjust Front Wheel Bearing," after the ball joint check is completed.

4. Check movement of each front wheel by gripping top and bottom of tire and moving in and out. An excess of ¼" travel (measured at the lower periphery of the tire) indicates worn ball joints. When moving tire, as mentioned above, observe each ball joint for looseness.

5. If necessary, use J-6627 ball stud remover to remove the upper ball stud, and disconnect the upper arm from steering knuckle.

6. Make sure that the upper ball joint is properly lubricated, then install a nut (snug against the upper ball joint) and rotate the ball stud in its socket with a torque wrench. If the torque required is less than ½ lb. ft. or more than 6 lb. ft., the ball joint should be replaced (page 3-15).

7. Install upper ball stud in knuckle and tighten

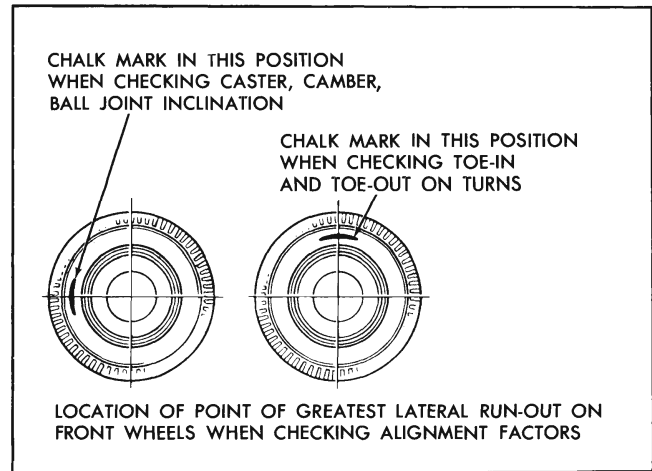


Fig. 3-4 Wheel Position for Checking Alignment

stud nut to 55-80 lb. ft. torque. **NOTE:** Do not back off nut when aligning holes to install cotter pin.

8. If excessive looseness still exists at periphery of tire, then use J-6627 ball stud remover to disconnect lower ball stud from steering arm.

NOTE: It is permissible to support the suspension assembly anywhere on the lower arm.

9. Install nut on lower ball stud and check for excessive wear or looseness by measuring the ball joint end play.

a. When the ball joint is new, it is permissible to have a maximum of .052" end play.

b. When checking a used or worn ball joint, it is permissible to have a maximum of .060" end play.

10. Replace lower ball joint in control arm, if necessary (page 3-13).

11. Install lower ball stud in steering arm and tighten stud nut to 55-80 lb. ft. torque. **NOTE:** Do not back off nut when aligning holes to install cotter pin.

12. Readjust wheel bearings according to procedure outlined under "Check and Adjust Front Wheel Bearing."

13. Nuts on end of upper control arm shaft must be torqued to 55-80 lb. ft. after vehicle is lowered to floor and jounced.

CHECK WHEEL AND TIRE RUN-OUT

Check run-out of each front wheel and tire using dial indicator against rim felloe band. If run-out exceeds allowable ⅛", correction may be made by rotating tire on wheel.

When minimum run-out has been obtained, mark

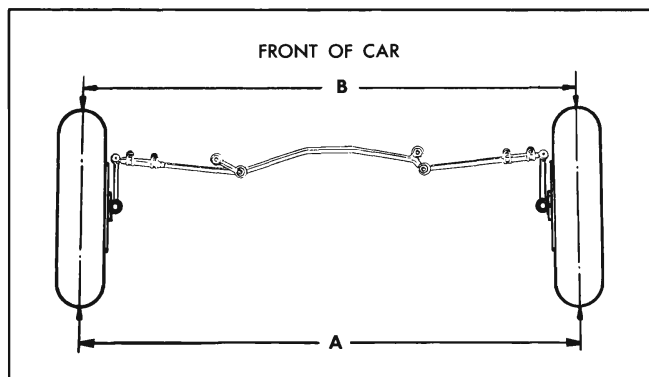


Fig. 3-5 Toe-in

point of greatest run-out so wheels can be positioned as shown in Fig. 3-4 when checking front end alignment. Hold a piece of chalk near wheel rim or tire sidewall while spinning wheel. Chalk can be moved inward to mark rim or tire at point of greatest run-out.

CHECK WHEEL AND TIRE BALANCE

During tire break-in or after tires have been repaired they may lose their original static balance—equal distribution of weight of a wheel and tire about its axis of rotation—resulting in pounding action or “tramp”.

Correct static unbalance with special equipment if available otherwise use following method:

1. Clamp clean steering knuckle in bench vise.
2. Remove wheel, hub and tire assembly from car and mount on knuckle.
3. Adjust bearings so that wheel will rotate with minimum friction.

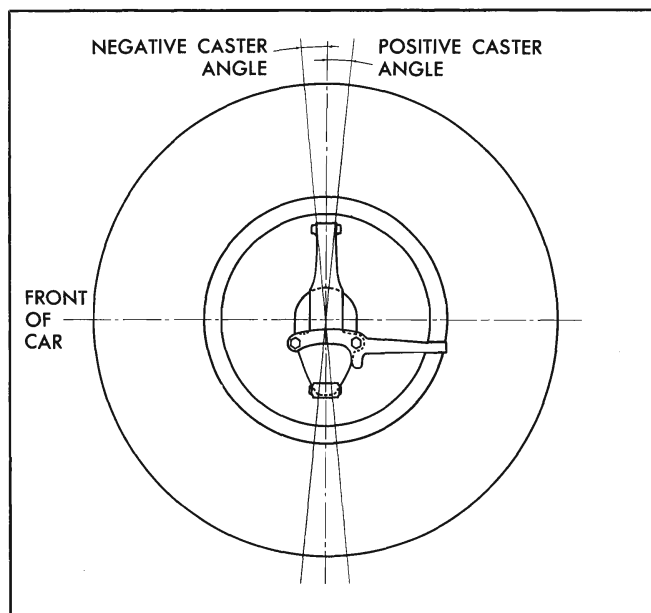


Fig. 3-6 Caster Angle

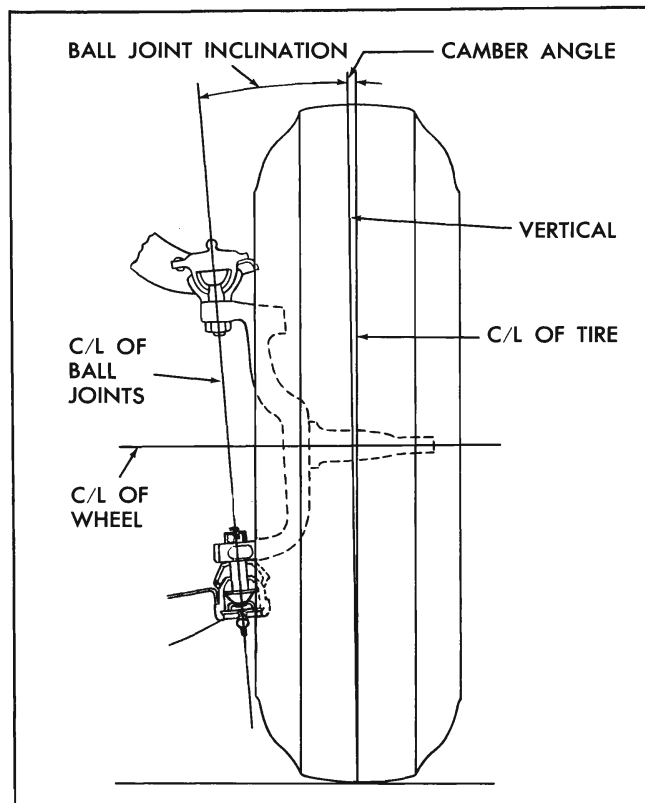


Fig. 3-7 Camber Angle and Ball Joint Inclination

4. Check tire for correct pressure and remove stones from thread grooves.
5. Start wheel several times allowing it to stop by itself. If stop position is always the same, wheel assembly is not in static balance.
6. Mark low (heavy) and high (light) points.
7. Install weight on rim felloe at light point to compensate for unbalance.
8. If only slight unbalance exists, install weights at opposite sides of rim inner felloe 90° from light point. Then move these weights toward light point until wheel is in balance.
9. Repack bearing and install wheel assembly. Adjust wheel bearing (see page 3-3).

WHEEL ALIGNMENT—DEFINITIONS

TOE-IN

Toe-in is the drawing together of the wheels so that they are closer at the front “B” than at the back “A” as shown in Fig. 3-5.

CASTER AND CAMBER

Forward tilt of the front ball joints relative to the true vertical is negative caster; backward tilt is positive caster (Fig. 3-6). Camber is the outward tilt of the wheels at top; ball joint inclination is the inward tilt (Fig. 3-7).

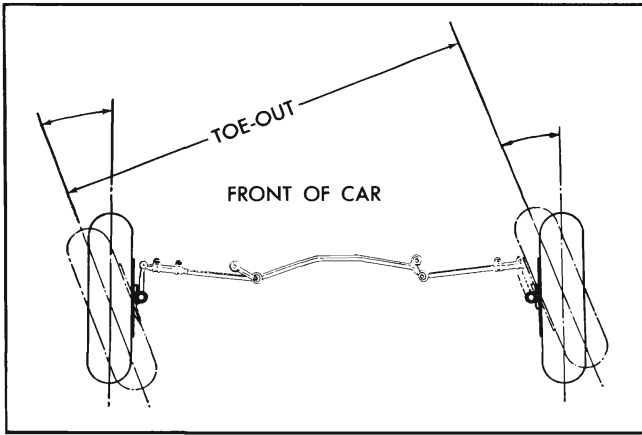


Fig. 3-8 Toe-out on Turns

TOE-OUT ON TURNS

Toe-out on turns is the relationship between front wheels on turns (Fig. 3-8). Since the front wheels must turn on different radius circles, the steering arms are inclined inward at the back to provide the correct turning angles in degrees.

INSPECTION BEFORE CHECKING FRONT WHEEL ALIGNMENT

Before any checking or corrective work is started on wheel alignment elements, including toe-in, caster, camber, steering axis inclination, and toe-out on turns, the following items which will affect steering should be considered.

1. Check tire inflation and bring to recommended pressure (see specifications in Section 3A).
2. Check front wheel bearing adjustment and correct if necessary (page 3-3).
3. Check wheel and tire-run-out (page 3-5).
4. Check wheel and tire for excessive unbalance which would affect steering (page 3-6).
5. Check ball joints (page 3-5).
6. Check steering linkage for looseness. Replace or tighten parts.
7. Check shock absorbers for leaks or lack of control.
8. Check for extraordinary load in car. Remove load or compensate by setting height. (Samples, tools, etc., carried regularly should not be considered extraordinary load).
9. Check steering gear adjustment (see Section 9).

FRONT SUSPENSION ALIGNMENT

Whenever performing a front wheel alignment or inspection, it is necessary that the front end be properly lubricated, and that there is no excessive play in the wheel bearings or ball joints. Before performing the procedure outlined below, check front suspension ball joints.

CURB HEIGHT

The suspension parts must be at normal curb height position when checking wheel alignment. This can be obtained by jouncing front and rear of the car up and down, decreasing the amount of movement until the parts reach normal curb height position.

To determine whether height front and rear of suspension is normal, compare measurement on the car in question with others of the same body type and having comparable equipment. Measurements should be taken as follows:

1. In front, measure height at a point directly in front of spring (Fig. 3-9).
2. At rear, measure height at a point directly behind spring (Fig. 3-10).

The tendency to remain upward and downward will be more noticeable on new cars on which the suspension joints have not yet become burnished and completely free. For this reason, checking of caster and

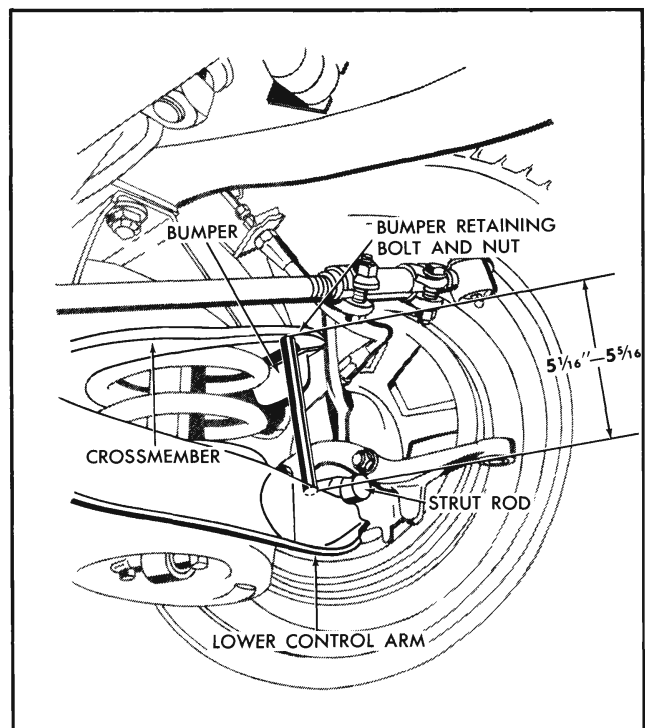


Fig. 3-9 Measuring Front Suspension Curb Height

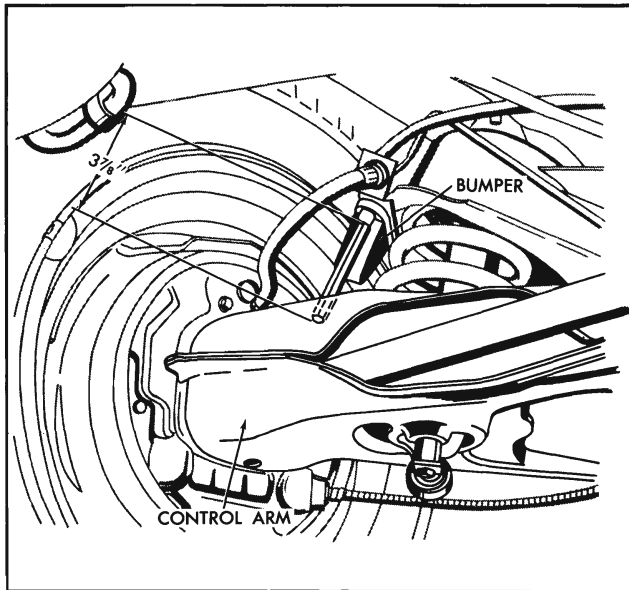


Fig. 3-10 Measuring Rear Suspension Curb Height

camber on new cars should not be done unless the height is set to correspond with the height of the front end of a similar model which has freed up after usage. Blocks or spacers made of rod or tubing will be useful in positioning parts.

ADJUST CASTER

Caster adjustment is made, with equal shimming front and rear on the upper control arm, by adjusting the length of the strut rod (Fig. 3-11) to give negative $1^{\circ} 40' \pm 30'$. Lengthening this rod by turning the nut increases caster. Shortening this rod by turning the nut decreases caster.

NOTE: Proper strut rod adjustment is necessary to prevent misalignment of lower control arm and bushing in front crossmember.

After adjustment, tighten nut at rear of strut to 70-85 lb. ft. torque and bend overlocking tab on two sides of nut. Be sure all strut nuts are tight before making final adjustment reading.

ADJUST CAMBER

The camber adjustment is made by means of shims between the upper control arm inner shaft and the front crossmember (Fig. 3-1). Although shims can be changed at either the front or rear attachment, it is important that the shimming be done equally so as to have no effect on caster. Adding shims at both front

and rear of support shaft will decrease positive camber. The procedure for adjustment is to loosen the upper support shaft to crossmember bolts, add or remove shims (equally) as required and retighten the bolts. It may be necessary to remove the wheel to secure these bolts. Camber should be positive $0^{\circ} 8'$ plus or minus $30'$. After adjustment tighten nuts and bolts securing cross shaft to crossmember to 55-70 lb. ft. torque.

NOTE: To compensate for drift to the right, induced by road surface camber, it is desirable that the left camber be set $0^{\circ} 15'$ greater than the right camber.

TOE-IN

Check and set toe-in to specifications (see page 3-9) with a trammel or with other reputable front end alignment equipment, measuring from sidewall of tire or wheel felloes using methods given below. **NOTE:** Front suspension toe-in should be checked at pre-delivery and 2,000 mile inspection intervals and set, if required.

MEASURING BY TRAMMEL

1. After moving car forward on level floor, chalk tread on both front tires at a point 9" above floor.
2. With trammel set at center to center distance of front tires, make mark in chalk on each front tire exactly trammel width apart.
3. Push car forward (never backward) until chalk with trammel marks is 9" above floor at rear of wheels.
4. Measure difference from trammel marks made when chalk was in front of wheel; if trammel marks

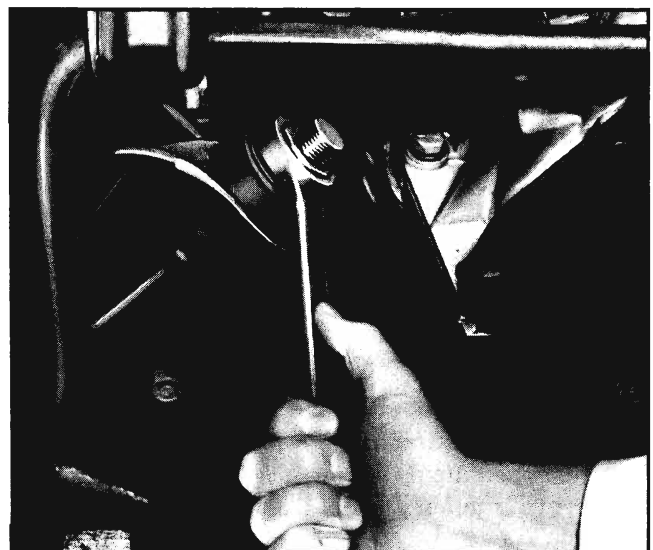


Fig. 3-11 Strut Rod Rear Adjusting Nut

are now greater than when marked at front, wheels toe-in by this amount (see specifications).

EQUIPMENT MEASURING FROM SIDEWALL OR WHEEL FELLOES

When using this type of equipment, wheel run-out will have a very direct bearing on the readings. Since the allowable run-out is $\frac{1}{8}$ " the readings could possibly be off as far as $\frac{1}{8}$ " on each wheel if the effect of run-out is not cancelled. By taking the average of three readings with the wheel rotated 120° for each reading, the error due to wheel run-out can be cancelled. This should be done as follows:

1. After moving the car forward on level floor, take first reading.
2. Mark sidewall of both tires with the number "1" at rear of tire where instrument bears.
3. At 120° intervals (i.e. $\frac{1}{3}$ and $\frac{2}{3}$ distance around the tire) mark the numbers "2" and "3" on both tires.
4. Jack up and turn wheels until the number "2" is in the position which number "1" occupied when the first reading was taken.
5. Push car back one foot and bring forward to position and take second reading. This reading will then be taken with the instrument bearing 120° around the wheel from where the first reading was taken.
6. Use the same procedure for taking the third reading.
7. Average the three readings to find the actual toe-in.

SET TOE-IN

1. Remove horn button and set gear on high point of worm by turning steering wheel until mark on shaft is exactly at top. This mark locates the high point, or middle of gear travel.
2. Loosen tie rod end clamp bolts and turn tie rod tubes an equal amount until toe-in is $0\text{-}\frac{1}{8}$ ". Turn right tie rod in direction of rotation of wheels, when car moves forward, to increase toe-in; turn left tie rod in opposite direction to increase toe-in.
3. Make sure front wheels are straight ahead by measuring from a reference point at same place on each side of frame center to front of wheel rims. If measurements are not equal, turn both tie rod tubes in same direction (so as not to change toe-in) until measurements become equal. Re-check toe-in since toe-in measurement is accurate only with wheels in straight ahead position.

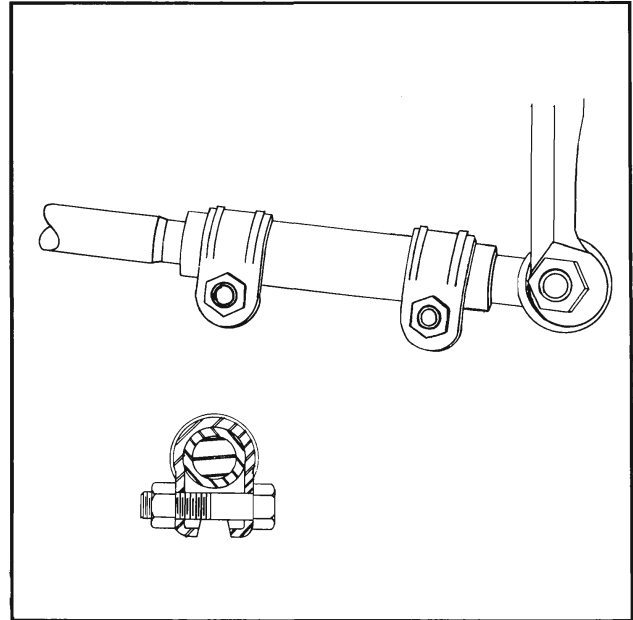


Fig. 3-12 Position for Tie-rod Adjuster Sleeve Bolts (Viewed from Top)

4. Tighten tie rod adjuster sleeve bolts to 14-20 lb. ft. torque, making sure bolts are positioned as shown in Fig. 3-12.

CHECK TOE-OUT ON TURNS

Check toe-out after any necessary corrections to camber, caster and toe-in have been made.

1. Check with any reputable front end aligning equipment using full floating turn tables. With front wheels resting on turn tables turn wheels to left until left wheel has been turned 20° from straight ahead. The right wheel should then be turned 18° to 19° .
2. Turn wheels to right until right wheel has been turned 20° from straight ahead. Left wheel should now be turned 18° to 19° .
3. Incorrect toe-out on turns may be caused by other incorrect front end adjustments but generally indicates bent steering arms which must be replaced.

Replacement of one or both steering arms should be followed by a complete front end check.

REAR SUSPENSION ALIGNMENT

TOE-IN

Rear suspension toe-in should be checked at pre-delivery and 2,000 mile inspection intervals and set, if required.

Suspension parts must be at curb height (see page 3-7).

If the rear wheels are notably tilted just after vehicle has been lowered to floor, roll car back and forth a few feet to bring wheels back to normal position.

If drive-on type of equipment is used, reverse the vehicle and back it into position. Toe-in (overall) will be read as toe-out when the vehicle is backwards, because readings will be taken from the rear of the tire rather than the front. A trammel or side wall of tire (Page 3-8) may also be used in a procedure similar to that used on the front wheels, except that both sides will be adjusted at the same time. It must be pointed out, however, that since the wheels are adjusted by adding or removing shims at the front edge of the differential (Fig. 3-3), both wheels are adjusted at the same time. With the design of this suspension, it will be impossible to adjust one wheel at a time as shims must be added or taken away equally from each side.

A shim added to each side will increase toe-in. Removal of a shim from each side will decrease toe-in. Shims must be added or removed in pairs. Toe-in should be 0"- $\frac{1}{4}$ " total toe-in. After shimming is completed, loosen engine mount bolts, run engine to permit it to seek its natural position, and retighten engine mount bolts.

NOTE: Due to manufacturing tolerance and parts stack up, it is possible to have toe-out on one wheel and toe-in on the opposite wheel. In this instance, adjust the suspension to bring the wheel with the toe-out as close to specifications as possible, but not letting the opposite wheel go out of specifications. If, for example one wheel toes out by $\frac{1}{4}$ " then opposite wheel must toe-in enough to give 0"- $\frac{3}{8}$ " overall toe-in.

SERVICE OPERATIONS

FRONT SUSPENSION

To overhaul the front suspension or to perform various major service operations, it will be desirable to raise car on a hoist. The suspension should be allowed to swing free. If a twin post hoist or similar equipment is used, it will be necessary to support the front of the vehicle at the forward end of the body side rail extension (each side) with jack stands and lower front of hoist.

FRONT HUB AND DRUM ASSEMBLY

REMOVE

1. Remove hub caps, break loose (less than one full turn) the five wheel to hub bolt nuts, raise vehicle from floor, place on jack stands and remove wheels.

2. Remove hub dust cap, cotter pin, spindle nut, spindle washer and remove hub and drum assembly. Do not allow roller bearing to fall out onto floor and become damaged.

NOTE: In some cases it may be necessary to back off brake adjustment because of scored drums.

3. Remove outer bearing from hub. The inner bearing will remain in the hub and may be removed by prying out the inner bearing seal assembly. Discard old seal.

4. Wash bearing parts thoroughly in cleaning solvent. Do not spin bearings, when dry, with air hose.

INSPECT

1. Check all bearings for cracked bearing separators or worn or pitted rollers.

2. Check bearing outer races for cracks or pitting.

3. Check brake drum for out of round or scored condition.

4. Check bearing outer race for looseness in hub.

REPAIRS

Replacement of Bearing Races:

1. Insert a brass drift through hub, indexing end of drift with notches in hub shoulder behind bearing cup.

2. Tap lightly on cup, alternating through each notch, to remove cup from hub.

3. Install new bearing cup in hub using Tool J-8849 (Fig. 3-13) on the outer race and Tool J-8914 (Fig. 3-14) on the inner race. Tool J-8092 Driver Handle must be used with the above installers.

4. Make certain that the cup is not cocked and that it is fully seated against shoulder in hub.

INSTALL

1. Hand pack both inner and outer bearings, using a high melting point wheel bearing lubricant.

2. Place inner bearing in hub, and install a new inner bearing seal assembly with Tool J-5154-A (Fig. 3-15). Side of seal with ridge should be down as installed, or away from center of the vehicle. Apply

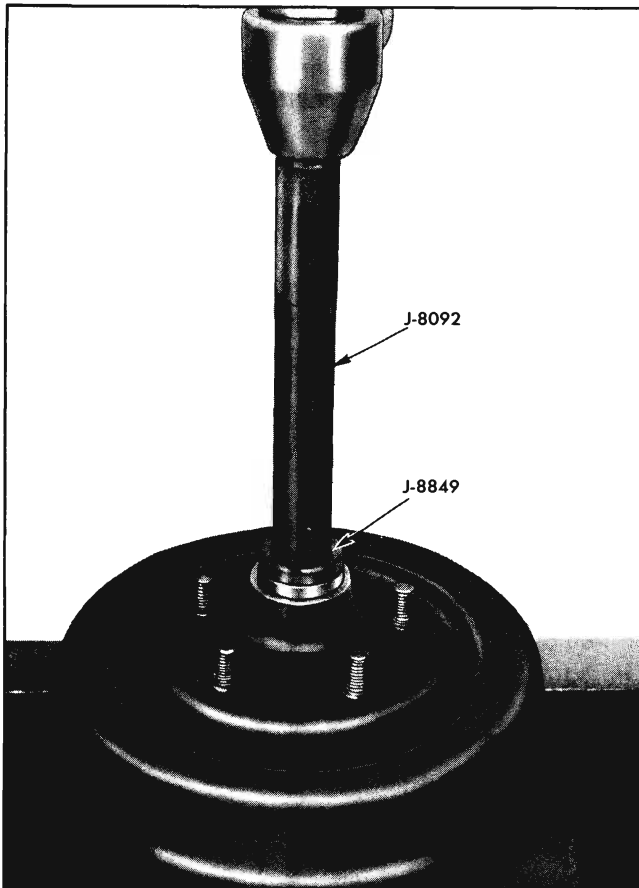


Fig. 3-13 Installing Outer Race in Hub

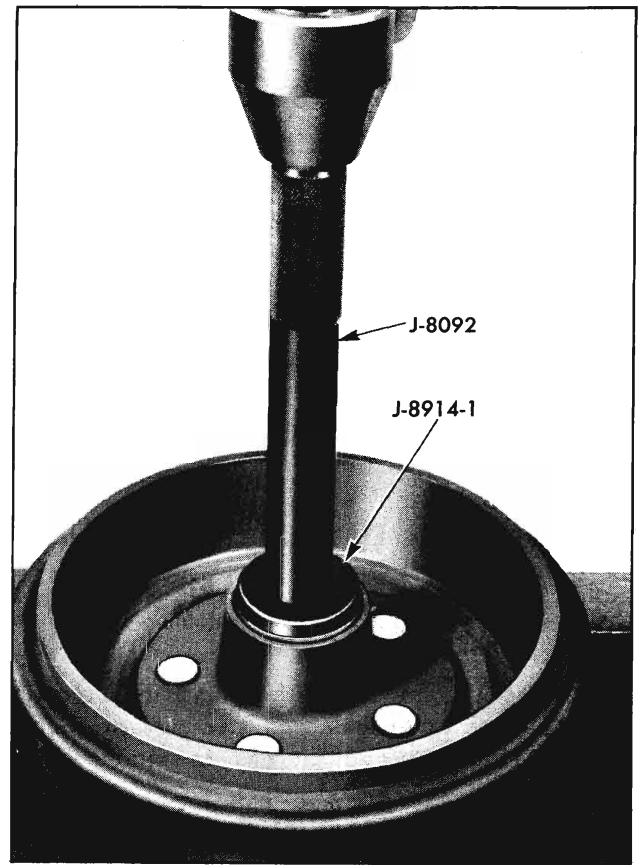


Fig. 3-14 Installing Inner Race in Hub

light coat of wheel bearing grease to inner diameter of seal, which contacts spindle.

3. Wipe out drum finishing with clean solvent on a clean cloth. If there is any doubt, use sandpaper followed by compressed air. Tape over hub opening before using sandpaper or air.

NOTE: Since lining dust in a brake has a definite affect on friction, do not blow dust off shoes or wipe linings of one brake, while drum is off, unless both brakes are to be cleaned. This precaution will help prevent brake pull.

4. Carefully position hub on spindle.

5. Install outer bearing, pressing it firmly into the hub by hand.

6. Install spindle washer and spindle nut. Adjust bearings as outlined on page 3-3.

STEERING KNUCKLE AND SPINDLE

REMOVE

1. Remove hub and drum assembly as outlined above and support lower control with stand or hoist.

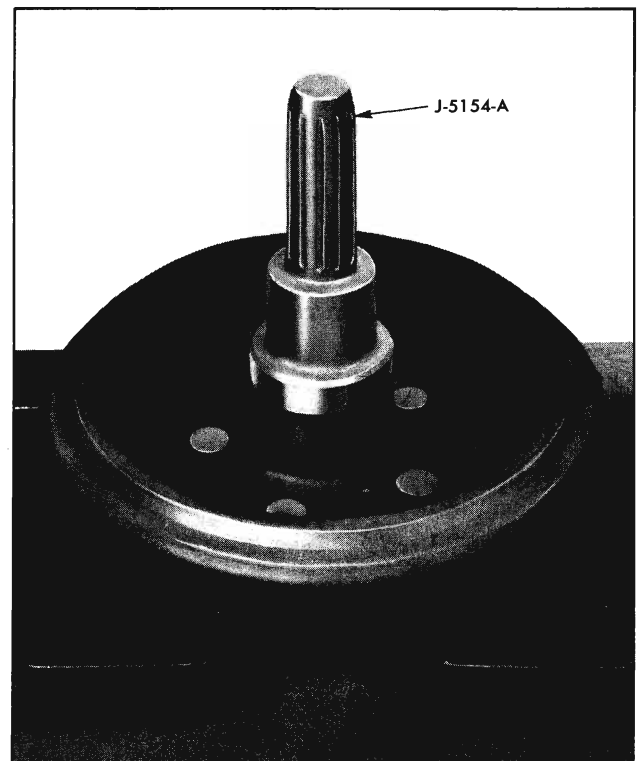


Fig. 3-15 Installing Inner Bearing Seal



Fig. 3-16 Strut Rod Front Retaining Nuts

2. Remove bolts, lockwashers and nuts securing backing plate to knuckle and steering arm. Secure backing plate to bumper hanger with suitable wire.

3. Remove upper and lower ball studs from knuckle with Tool J-6627.

INSTALL

1. Install upper and lower ball studs through steering knuckle and tighten nuts to 55-80 lb. ft. torque.

NOTE: Do not back off nut when aligning holes to install cotter pins.

2. Secure backing plate to knuckle and steering arm with bolts, lockwashers and nuts. Tighten two lower bolts to 45-65 lb. ft. torque and upper bolt to 135-165 lb. ft. torque.

3. Install hub and drum assembly as outlined above.

FRONT SHOCK ABSORBER

REMOVE

1. Properly support vehicle at side rails so that front suspension hangs free and so that clearance is sufficient on front lower control arms to allow removal of shock absorber.

2. Holding flat part of stud, remove upper retaining nut, cup washer and grommet (Fig. 3-1).

3. Remove the two shock absorber lower attaching bolts and lockwashers.

4. Withdraw shock absorber and remove cup washer and grommet from upper end of shock absorber shaft.

INSTALL

1. Install cup washer and new grommet on shaft. Pull out shock absorber shaft to extend it to its full length.

2. Install shock absorber up through lower control arm and through coil spring. Be certain shaft protrudes out of small hole in top of spring tower.

3. Install both lower attaching lockwashers and bolts. Tighten to 15-25 lb. ft. torque.

4. Install upper grommet, cup washer, and retaining nut. Tighten nut to 5-10 lb. ft. torque. **NOTE:** Nut must be bottomed at end of thread.

5. Lower vehicle to floor.

FRONT COIL SPRINGS, LOWER CONTROL ARMS, SPHERICAL JOINTS AND/OR BUSHINGS

See "Curb Height," page 3-7. If in doubt as to condition of ball joints, proceed as outlined under "Check Ball Joints," page 3-5.

REMOVE COIL SPRING

1. Place vehicle on suitable hoist which supports car at side rails. The front control arms must be allowed to swing free and positioned so that they (the control arms) may be raised or lowered with the hoist.

2. Remove shock absorber.

3. Remove the two strut rod to control arm nuts and lockwashers (Fig. 3-16). The studs are pressed into the end of the strut rod.

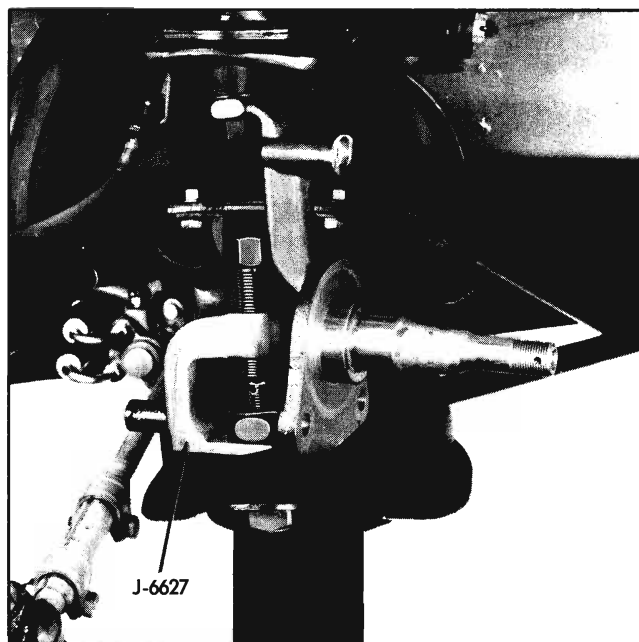


Fig. 3-17 Removing Lower Ball Stud

NOTE: The strut rod is under slight tension from the rubber grommet on opposite end.

4. Place stand under control arm (Fig. 3-17). Take up slightly on spring compression.

5. Remove lower ball stud from steering knuckle with J-6627 (Fig. 3-17).

6. Carefully raise hoist until spring is free. Withdraw spring.

NOTE: A bar placed through control arm and into spring tower will retain spring and keep it from slipping until free. Otherwise, keep clear of suspension until all compression is removed from spring.

7. Remove lower control arm inner pivot nut, flat washer, and bolt and remove arm. To move steering linkage out of way, turn steering wheel to right.

REMOVE LOWER CONTROL ARM BALL JOINT

To remove the control arm ball joint and/or bushing, perform steps 1-7 as shown above. Then proceed with the following:

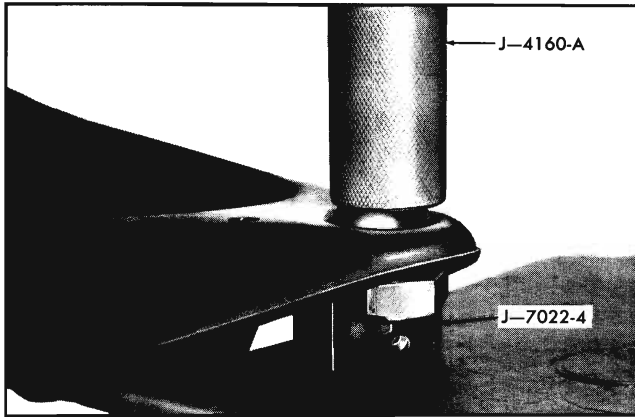


Fig. 3-18 Removing Lower Control Arm Ball Joint

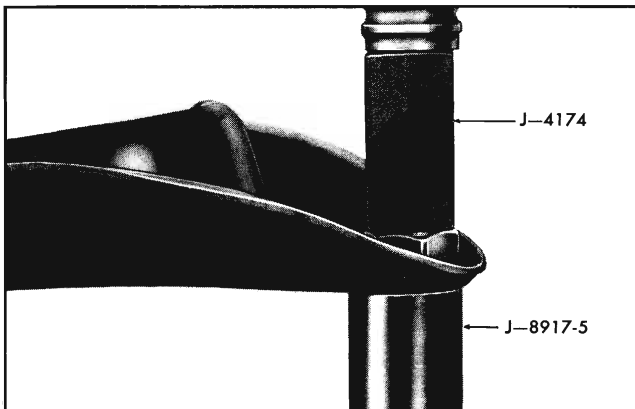


Fig. 3-19 Installing Lower Control Arm Ball Joint

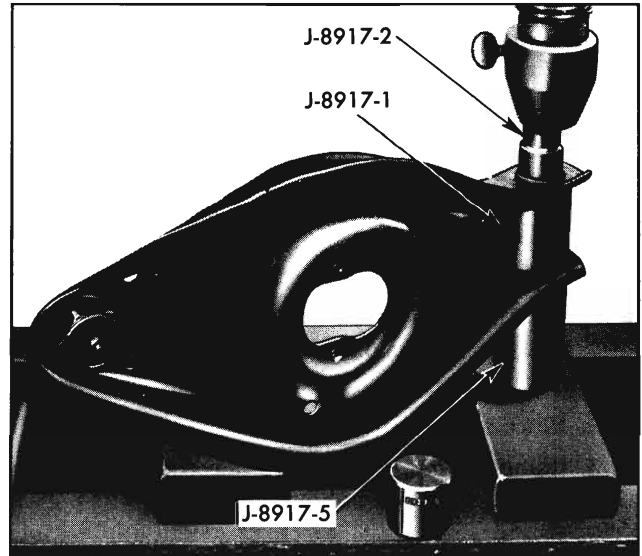


Fig. 3-20 Removing Control Arm Bushing

Using Tool J-4160-A or other suitable tool, press ball joint out of arm (Fig. 3-18).

REMOVE CONTROL ARM BUSHINGS

To remove the bushing set up the tools as shown in Fig. 3-20. The bushing may be pressed out. Be certain to press on the end of the bushing that does not have the large collar on outer shell.

INSTALL CONTROL ARM BUSHINGS

If lower arm bushing was removed, replace as shown in Fig. 3-21. The bushing must enter the control arm on the front side of arm.

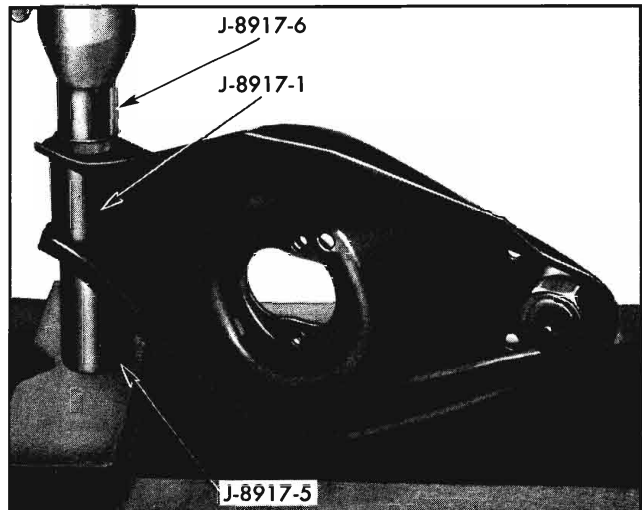


Fig. 3-21 Installing Control Arm Bushing

INSTALL CONTROL ARM AND BALL JOINT

1. With Tool J-4174 or other suitable tool, press ball joint into place (Fig. 3-19). Install lube fitting in bottom of joint and lubricate with chassis lube. Place rubber cap over stud.

2. Set control arm in place and install bolt, washer, and nut. Do not tighten bolt at this time.

INSTALL FRONT COIL SPRING

1. Set rubber insulator in place in crossmember spring tower.

2. Place spring on control arm.

3. Using jack stand under outer end of arm, raise control arm by lowering hoist.

4. Install ball stud into steering knuckle. Tighten nut to 55-70 lb. ft. torque.

NOTE: Do not back off nut when aligning holes to install cotter pin.

5. Attach strut rod to control arm with two attaching nuts and lock washers. Tighten nuts to 40-55 lb. ft. torque. The studs are pressed into end of strut rod.

NOTE: The tension in this rod is due to the rubber grommet at the opposite end of rod. Do not touch the large nuts at the grommet end as these control caster adjustment.

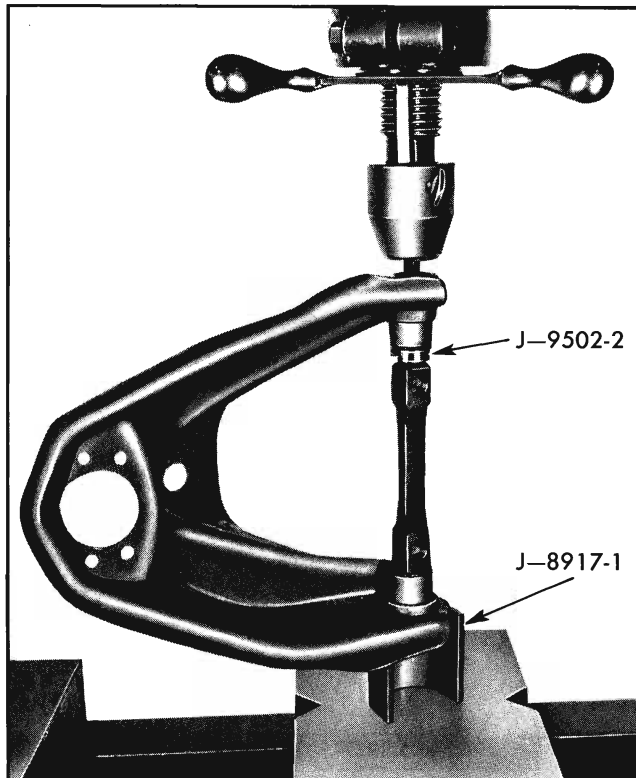


Fig. 3-22 Spacer J-9502-2 Installed

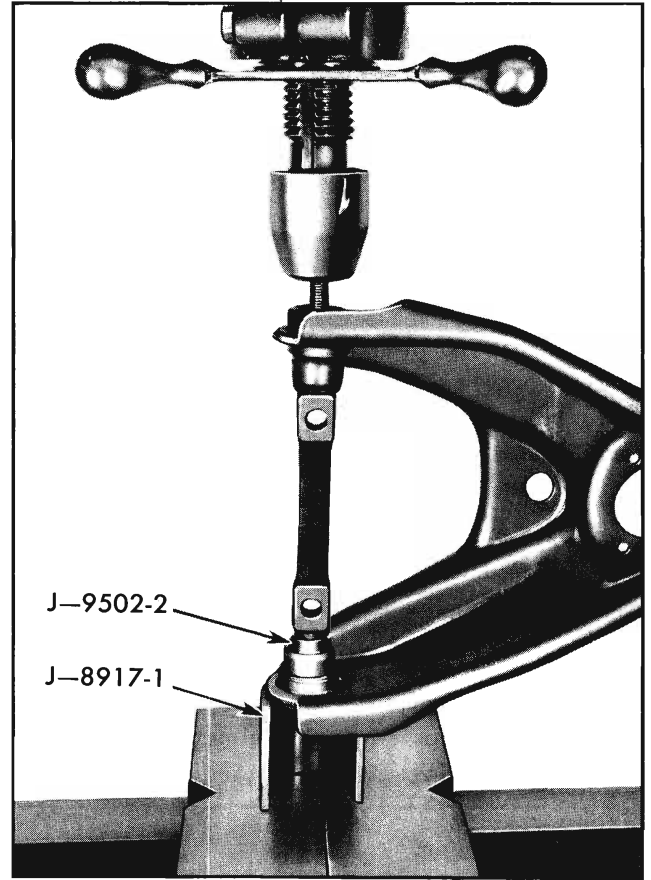


Fig. 3-23 Removing Bushing

6. Install shock absorber as outlined previously.

7. Lower vehicle to floor, jounce front end several times and tighten lower control arm pivot bolt and nut to 75-90 lb. ft. torque, at curb height position (Fig. 3-9).

UPPER CONTROL ARM, BALL JOINT, CROSS SHAFT AND/OR BUSHINGS

REMOVE CONTROL ARM

1. Support vehicle weight at outer end of lower control arm.

2. Remove wheel and tire assembly.

3. Remove cotter pin and nut from upper control arm ball stud.

4. Remove the stud from the knuckle with Tool J-6627.

5. Remove two nuts retaining upper control arm cross shaft to front cross member. Note number of shims at each bolt.

6. Remove control arm retaining bolts.

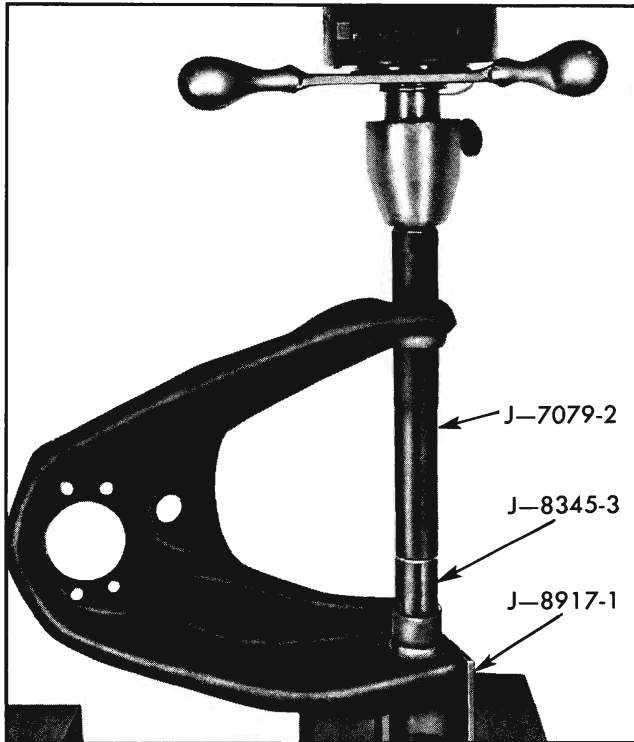


Fig. 3-24 Removing Control Arm Bushing

REMOVE BALL JOINT

1. Prick punch the center of the four rivets.
2. Drill through the heads of these rivets.
3. Using a sharp cold chisel cut off rivets, being careful not to enlarge holes in control arm.
4. Tap out rivets with a punch and remove joint from control arm.

REMOVE CROSS SHAFT AND BUSHINGS

1. Remove nuts and collars from both ends of cross shaft.
2. Support control arm, press on cross shaft and install spacer J-9502-2 (Fig. 3-22).
3. Invert control arm and press out bushing (Fig. 3-23).
4. Remove cross shaft, support control arm, and press out remaining bushing (Fig. 3-24).

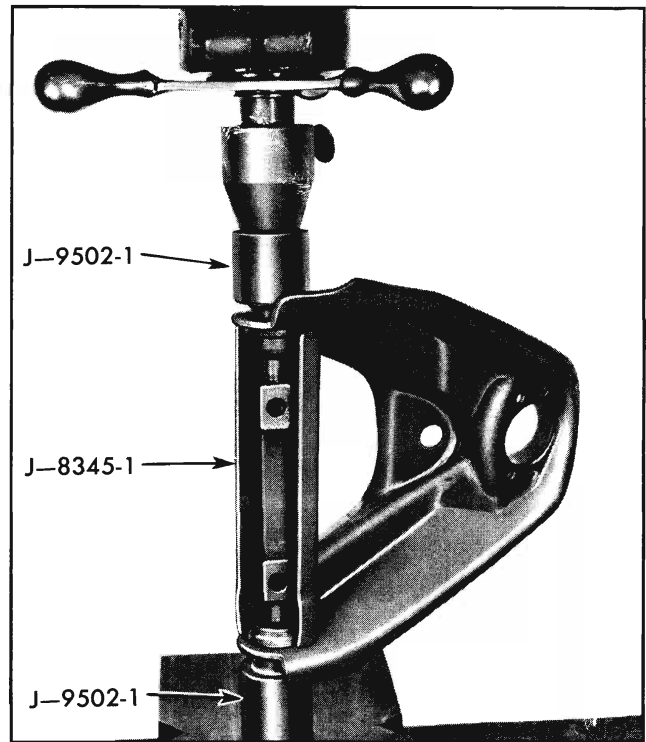


Fig. 3-25 Installing Cross Shaft and Bushing

INSTALL CROSS SHAFT AND BUSHINGS

1. Install cross shaft and bushings and press bushing into arm using J-8345-1 to prevent collapse of control arm (Fig. 3-25).
2. Install collars and nuts on both ends of cross shaft. Do not tighten nuts at this time.

INSTALL BALL JOINT

1. Install new ball joint against top side of upper control arm. Secure joint to control arm with the four special alloy nuts and bolts furnished with replacement part.

CAUTION: Use only alloy bolts supplied for this operation.

2. Tighten these nuts to 10-12 lb. ft. torque.

INSTALL CONTROL ARM ASSEMBLY

1. Install bolts and upper control arm to crossmember.
2. Install two nuts and washers to the bolts retaining upper control arm shaft to front crossmember. Install same number of shims as removed at each bolt. Tighten nuts and bolts to 55-70 lb. ft. torque.
3. Install new rubber seal on ball joint stud and lubricate ball with chassis lubricant.
4. Install ball joint stud through knuckle, install nut and tighten to 55-70 lb. ft. torque.

NOTE: Do not back off nut when aligning holes to install cotter pin.

5. Install wheel and tire assembly.
6. Lower vehicle to floor.
7. Jounce front end of vehicle to centralize bushings and tighten cross shaft nuts to 55-80 lb. ft.
8. If ball joint was replaced or if proper number of shims were not reinstalled, recheck caster and camber.

STABILIZER BAR

REMOVE

1. Remove two body rail to stabilizer bar supports.
2. Remove bolts at each bar to strut rod clamp.
3. Remove bar.

INSTALL

1. Install bar.
2. Install bar into each strut rod clamp and install bolt and nut. **NOTE:** Bolt must have head facing outside of car.
3. Install two body rail to stabilizer bar supports and bolts. Torque bolts to 20-35 lb. ft.
4. Torque bar to strut rod clamp nuts to 20-30 lb. ft.

STRUT ROD

REMOVE

NOTE: The vehicle need not be raised, but for working clearance it may be desirable.

1. Remove the two nuts and lockwashers that secure the front end of strut rod to lower control arm. (Fig. 3-16).

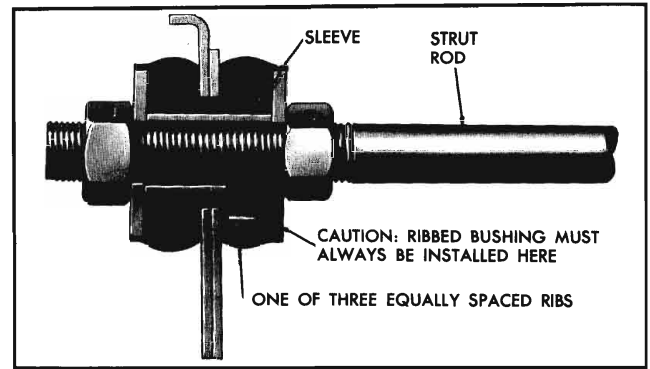


Fig. 3-26 Strut Rod Bushing Stack-up

NOTE: There is slight tension on the rod caused by the rubber bushings at rear of strut rod.

2. Remove the nut and rubber bushing from rear end of strut rod.
3. Withdraw strut rod from crossmember bracket. Remove rubber bushing, spacer, and nut from rod. The studs in the rod are replaceable by driving them in or out.

INSTALL

1. Install the forward nut onto the rod. Position it about 1" from front end of threads. Install the spacer and rubber bushing with three equally spaced ribs. (Fig. 3-26).
2. Set strut rod in place in crossmember bracket. Install the remaining rubber bushing and nut. Snug up the rear nut.

CAUTION: Do not interchange ribbed and smooth surfaced bushings.

3. Install the rod to the lower control arm with the two attaching lock washers and nuts. Tighten nuts to 40-55 lb. ft. torque.
4. Lower vehicle to floor (if raised) and reset caster as outlined earlier in this section. Tighten nut at rear of strut to 70-85 lb. ft. torque (Fig. 3-11).

FRONT SUSPENSION CROSSMEMBER

This crossmember may be removed as either a complete front suspension system, including wheels and brake assemblies, or after all components have been removed. Individual item removal and installation (bench overhaul) on a complete front suspension are handled in a similar manner as outlined under the respective headings for each component, with one notable exception: the coil springs should be removed while the crossmember is still attached to the car. This way, the weight of the car helps to keep the

spring compressed after the lower control arm ball stud is removed from the steering knuckle. The torque tube must be attached to the engine if the front suspension crossmember is removed.

REPLACE

1. Raise front end of car and install blocks or jack stands under front crossmember assembly in such a manner that crossmember will be supported when free of car.
2. Install suitable engine support.
3. Remove wheels.
4. Disconnect steering linkage at tie rod ends with J-6627.
5. Disconnect engine mounts at crossmember.
6. Remove ground straps from crossmember on both sides (Fig. 3-27).
7. Disconnect brake lines at junction block on crossmember (Fig. 3-27).
8. Disconnect fuel line from crossmember clip.
9. Remove three crossmember retaining bolts, washers, and nuts on each side of crossmember (Fig. 3-28).
10. Raise car to allow removal of crossmember assembly.
11. To reinstall, reverse above procedure plus bleeding brakes upon completion of installation. Tighten the three crossmember retaining bolts to 70-85 lb. ft. torque, the engine mount bolts to 30-45 lb. ft. torque, and the tie rod end nuts to 55-70 lb. ft. torque.

NOTE: Do not back off nut when aligning holes to install cotter pin.

REAR SUSPENSION

REAR SHOCK ABSORBER

REMOVE

The rear shock absorber holds all of the rear spring compression. For this reason, the weight of the vehicle must be resting on the tires. If an attempt is made to support the vehicle on the rear suspension lower control arms, and unless caution is used and proper support is given to control arm, it is possible that when the shock absorbers are removed, the control arms may be forced downward and inward, causing vehicle to slip from its support. If the vehicle is supported at the body side rails and no support is given to the wheels and control arm, and the shock absorber

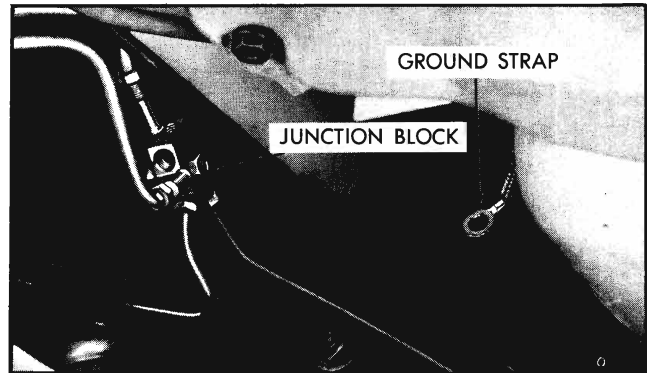


Fig. 3-27 Components to Disconnect From Crossmember

is removed, the spring pressure will force the control arms downward and inward with extreme force.

1. Place car on a "drive-on" (ramp) type hoist, frame contact hoist or place jack stands under the body at each side rail, just forward of the rear wheel openings. The body should be raised high enough so that the wheels hang free and a floor jack can be placed under tire. Raise tire so that it is in its normal position. This will allow shock absorber to be removed without interfering with the floor.

2. Remove upper attaching nut, lock washer, and bolt.

3. Remove lower attaching bolts, washers, and spacers.

4. Withdraw shock absorber.

INSTALL

1. Pull out shock absorber shaft to extend it to its full length.

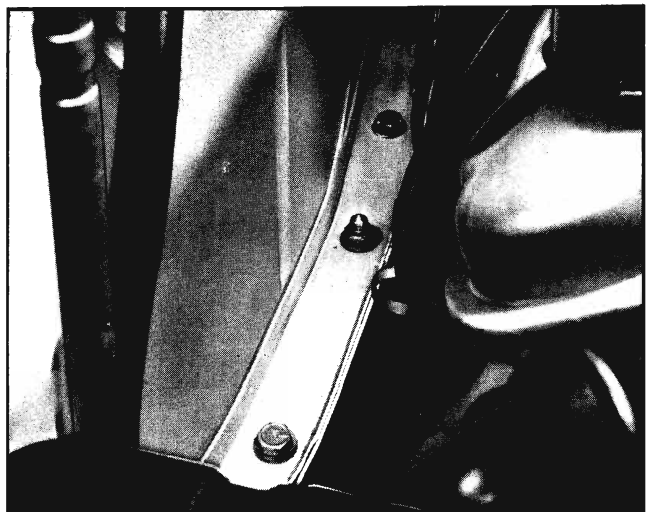


Fig. 3-28 Crossmember to Body Retaining Bolts

2. Install shock absorber up through lower control arm and through coil spring.
3. Install lower attaching spacers, lock washers, and bolts. Torque bolts to 15-25 lb. ft.
4. Install upper attaching bolt, lock washer, and nut. Torque bolt to 45-60 lb. ft.
5. Lower vehicle to floor.

COIL SPRING

REMOVE

1. Raise vehicle by body side rails so that the control arms may swing free. The vehicle must be raised far enough so that a rolling floor jack may be placed under the drum.
2. Loosen the control arm cross shaft bolts (in ends of shaft). Disconnect brake hose from brake line at junction point (Fig. 3-29). Remove the wheel and tire assembly. Replace the nut onto the studs to hold the drum in place.
3. Remove tail pipe (see Section 8).
4. Position the axle shaft U-joint as shown in Fig. 3-30. This must be done to allow the axle shaft and control arm to swing down far enough to remove spring. This will keep the yoke on universal joint from hitting the axle case or the side bearing adjusting nut.

5. Place a rolling floor jack under the drum and brake flange.

6. Raise the jack slightly to place a slight load on the coil spring. Remove shock absorber (see "Rear Shock Absorber").

7. Index coil spring with spring seat (Fig. 3-31).

8. Carefully lower floor jack until spring is free and pry spring out. Do not remove or lower the jack too far as this places too much strain on axle shaft.

NOTE: If both rear springs are removed, be sure to mark which side each spring goes on.

INSTALL

1. Set spring into crossmember spring tower and pry into place in lower control arm. If same spring is used, be sure that index marks line up (Fig. 3-31).
2. Extend shock absorber shaft. Place up through control arm and spring and attach bottom of shock absorber to control arm with spacers, lock washers, and bolts. Torque bolts to 15-25 lb. ft. Installing the shock absorber at this time will provide safe working conditions.
3. Raise control arm so shock absorber top attaching bolt, lock washer, and nut may be installed. Torque bolt to 45-60 lb. ft.
4. Connect the brake line at the junction point.

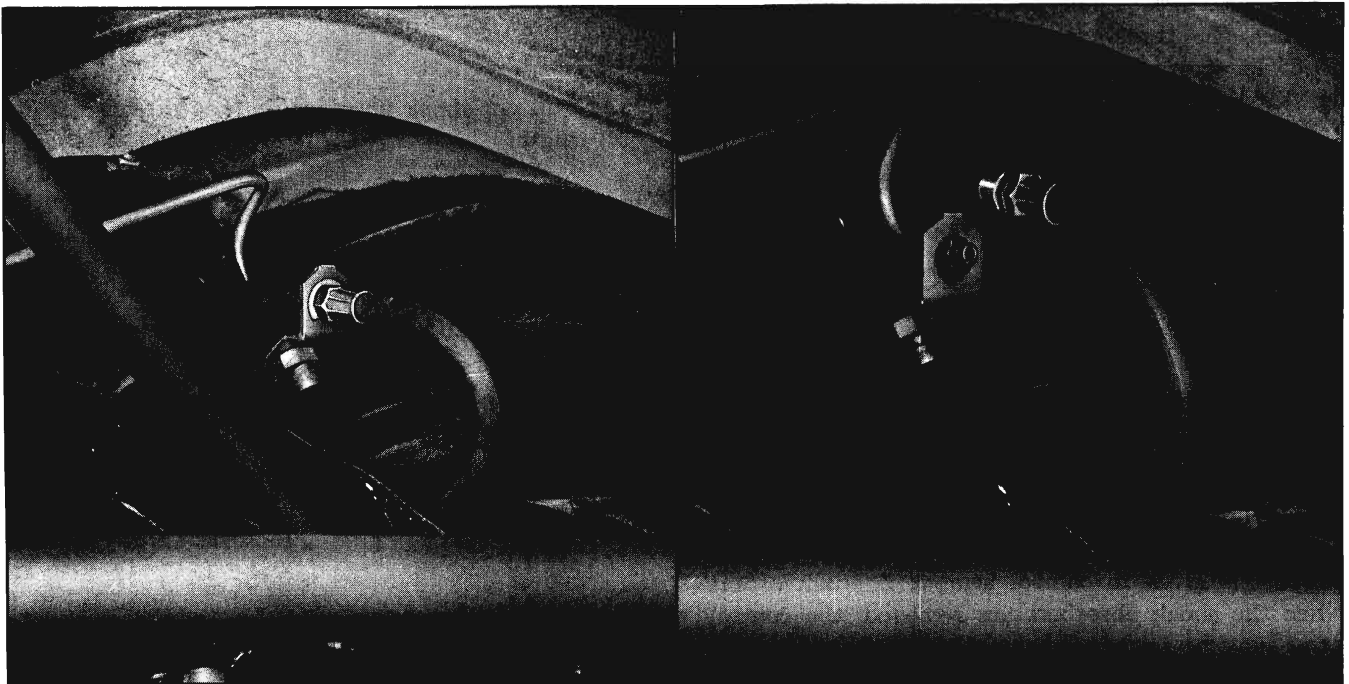


Fig. 3-29 Disconnecting Brake Hose from Brake Line

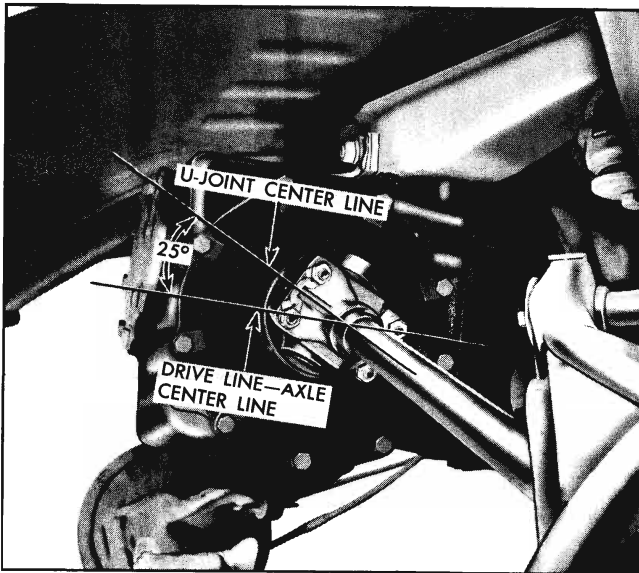


Fig. 3-30 Position of U-Joint for Spring Removal

Remove the floor jack and install the wheel and tire assembly.

5. Lower vehicle to floor. Jounce rear end several times and with full weight on suspension control arms, tighten the cross shaft bolts to 30-40 lb. ft.

6. Bleed and adjust brakes (see Section 5).

REAR SUSPENSION LOWER CONTROL ARM

REMOVE

1. Remove the shock absorber and coil spring as outlined above.

2. Before removing floor jack from under drum, support control arm with a suitable jack stand.

3. Remove the wheel nuts from the axle shaft and remove the drum.

4. Line up the hole in axle shaft flange with the nuts retaining backing plate to the lower control arm. Remove these four nuts and lock washers (Fig. 3-32).

5. Pull the brake backing plate outboard slightly then push it back onto the control arm studs to break backing plate away from bearing retainer.

6. Remove the four nuts and lock tabs that secure the universal joint U-Bolts.

7. Pull axle shaft outward sufficiently to separate yoke for U-Bolts.

8. Remove U-Bolts.

9. Remove the bolt, lock washer and flat spacer securing yoke to axle shaft.

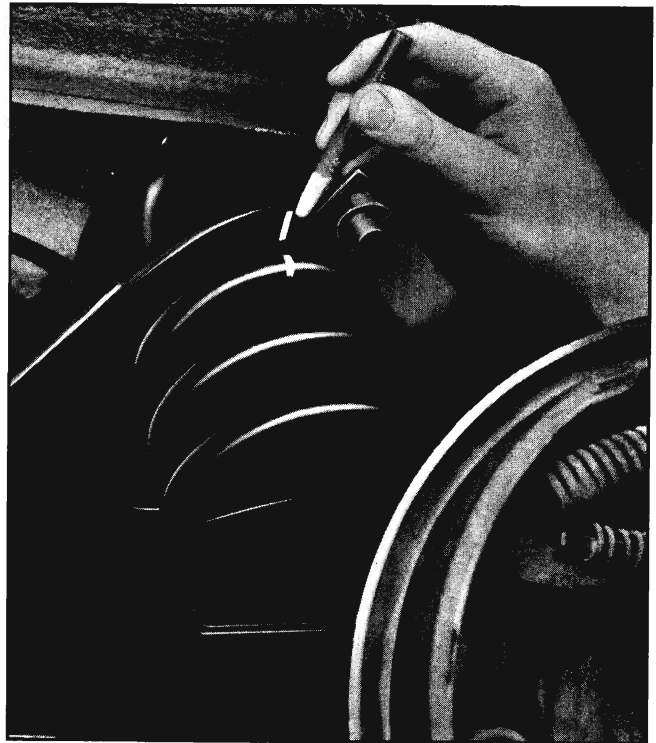


Fig. 3-31 Indexing Coil Spring

10. Remove the universal joint yoke by using Tool J-8614 (Fig. 3-33).

11. Withdraw axle shaft.

12. Remove backing plate from lower control arm

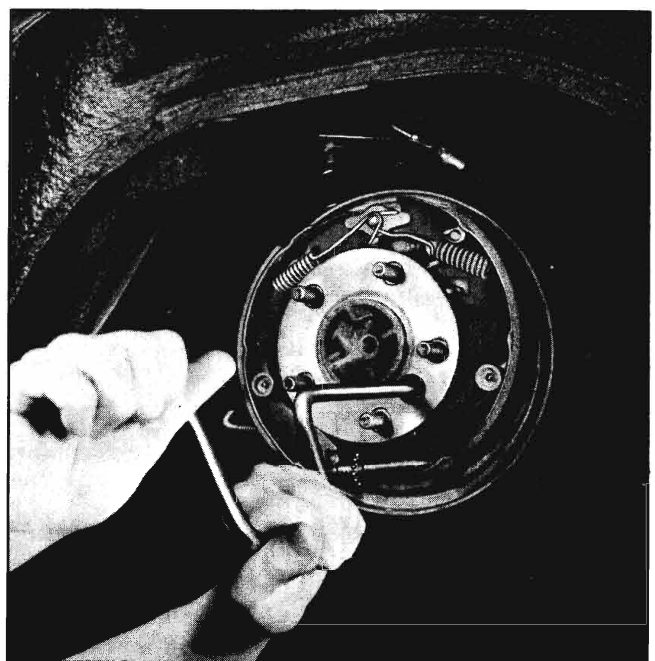


Fig. 3-32 Axle Shaft Flange Holes

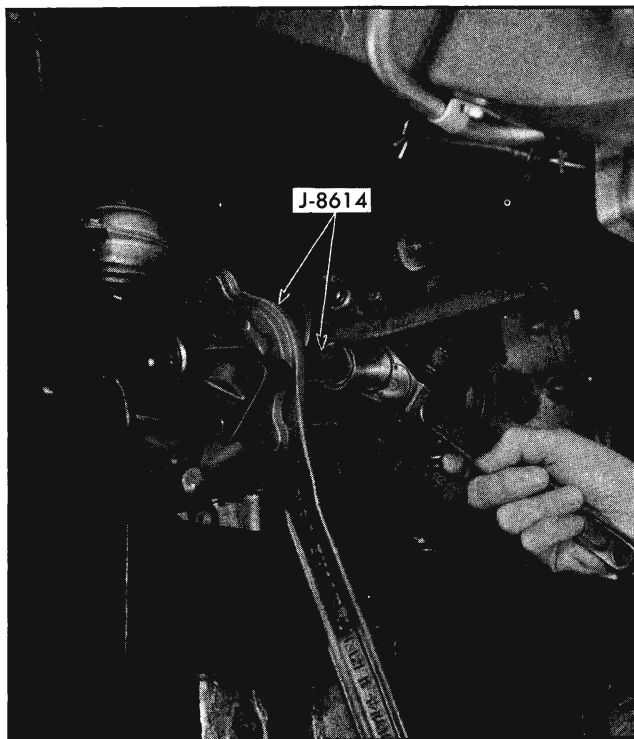


Fig. 3-33 Removing Yoke from Axle Shaft

studs. Tie backing plate up to the crossmember with wire.

13. Remove the four bolts, nuts and washers that attach the control arm to the crossmember. A parking brake cable bracket is retained by two of these four attaching bolts. On the right side a tail pipe support is retained by two of the four attaching bolts. Withdraw control arm from under vehicle. Note installation of shims and use care not to lose them.

REMOVE CROSS SHAFT AND BUSHINGS

1. Remove bolt, lock washer and collar from each end of cross shaft.

2. Thread the large bolt (furnished with Tool J-8347) to the bottom of the threads in one end of the cross shaft.

3. Support control arm in a press on Tool J-8917-5 as shown in Fig. 3-34.

NOTE: Be certain bushing flange does not contact support.

4. Press on bolt until bushing is free of control arm. Discard bushing.

5. Remove bolt from end of cross shaft. Insert it in opposite end. Invert control arm on support (J-8917-5). Again, be certain bushing does not contact support.

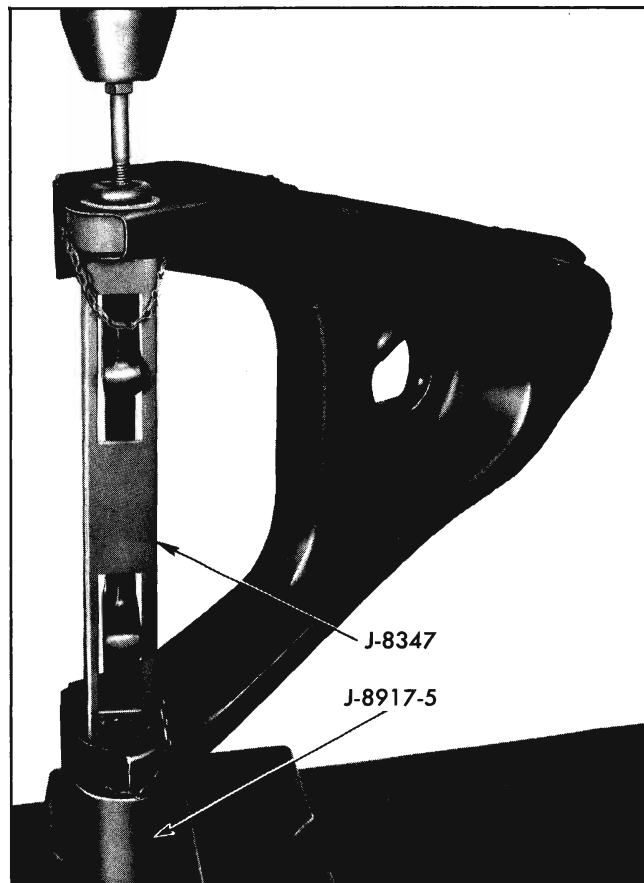


Fig. 3-34 Removing Cross Shaft and Bushings

6. Press on bolt until bushing is free of control arm. Discard bushing. Remove cross shaft from control arm.

INSTALL CROSS SHAFT AND BUSHINGS

1. With cross shaft in control arm and Tool J-8347 in position, place control arm on Tool J-8917-5. Hand start bushing into control arm and over end of cross shaft.

2. Install Tool J-7052-5 over bushing.

CAUTION: Be certain three-piece spacer is not overlapping bushing holes in control arm.

3. Press bushing into control arm until flange contacts control arm (Fig. 3-35).

NOTE: In extreme cases, due to manufacturing tolerances, it may be necessary to shim under Tool J-8347 to assure proper contact with both flanges of control arm.

4. Invert arm in press and repeat the process on the opposite bushing. After installation, cross shaft should be free enough to be rotated by hand.

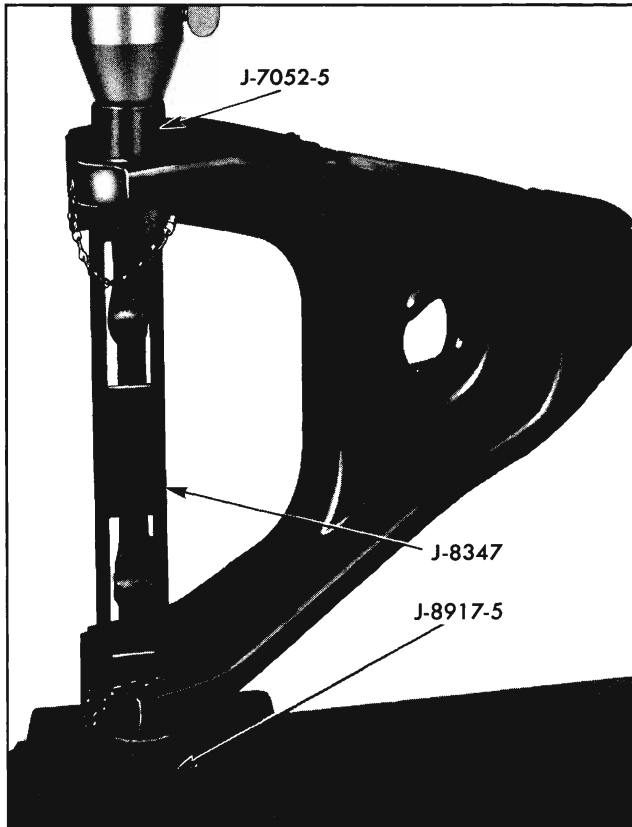


Fig. 3-35 Installing Cross Shaft and Bushings

5. Install collar, lock washer and bolt in each end of cross shaft. *Do not tighten.*

INSTALL CONTROL ARM

1. Set control arm assembly in place (up to cross-member) with shims properly installed (Fig. 3-2). Install the four attaching bolts (from the top), washers and nuts and torque to 40-55 lb. ft. Be certain to attach the parking brake bracket (also tail pipe support) to the front two attaching bolts before installing nuts and washers. Replace jack stand under control arm.

2. Remove wire retaining backing plate to cross-member and install backing plate onto studs in end of control arm. Temporarily install two nuts onto studs.

3. Install axle shaft through backing plate and lower control arm. Install yoke on end of axle shaft. Install flat spacer, lock washer and bolt that retains yoke to shaft. Torque bolt to 20-35 lb. ft.

4. Install U-Bolts (Fig. 3-36).

5. Remove the two nuts installed in step 2. Line up holes in axle bearing flange plate with studs on end of control arm and push axle shaft inward until

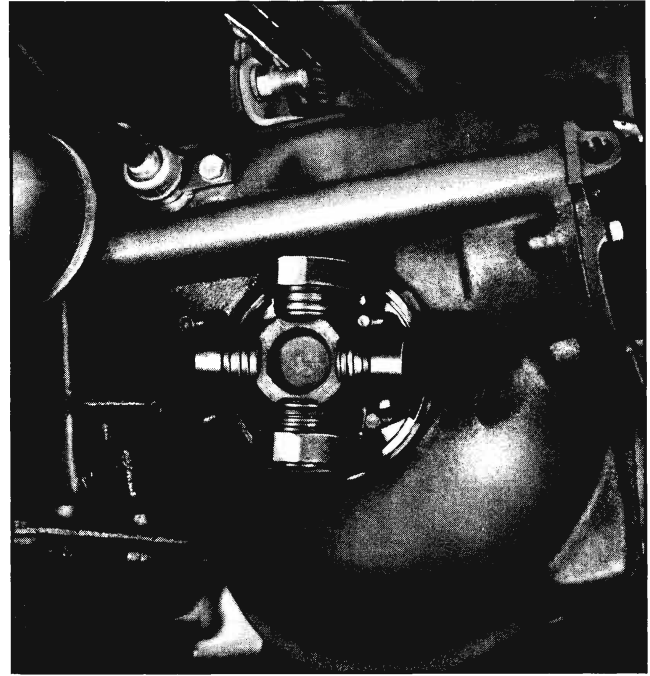


Fig. 3-36 U-Bolts Installed

yoke is fully attached to U-Bolts. Install U-Bolt nuts and lock tabs. Torque nuts to 14-20 lb. ft. Install the lock washers and nuts through hole in axle shaft flange (Fig. 3-32). Torque nuts to 30-45 lb. ft.

6. Install drum onto axle flange being certain that holes (not stud holes, but machine holes) in drum *do not* line up with hole in axle flange or dirt and other foreign matter may get into brake assembly.

7. Temporarily install wheel nuts to hold drum in place.

8. Install shock absorber and coil spring.

9. Bleed and adjust brakes.

10. Lower car and torque control arm cross shaft bolts to 30-40 lb. ft.

REAR SUSPENSION CROSSMEMBER

REMOVE

1. Raise car off ground and remove transmission and differential assembly as outlined in Section 4.

2. Remove both shock absorbers and coil springs as outlined previously. Support control arms with jack stands.

3. Disconnect parking brake cable at rear equalizer (Fig. 2-6).

4. Remove fuel line and brake line from clip on top of crossmember.

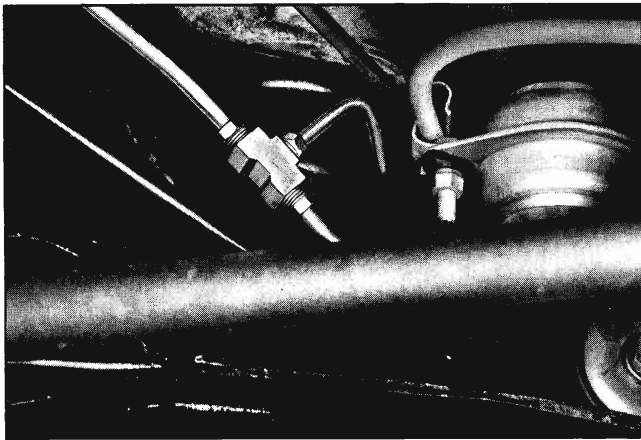


Fig. 3-37 Junction For Brake Lines

5. Disconnect brake lines at junction block (Fig. 3-37).

6. Remove two bolts on each side, connecting crossmember to body (Figures 3-38 and 3-39).

7. Lower crossmember away from car.

CAUTION: Be sure that the crossmember is properly supported prior to lowering. This will prevent it from losing balance and possibly falling off hoist.

8. Disassembly of components attached to crossmember are outlined earlier in this section.

INSTALL

1. Raise crossmember into car.

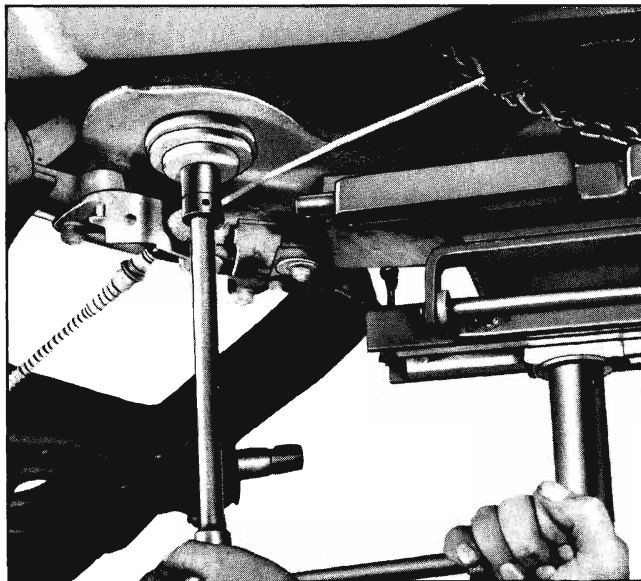


Fig. 3-38 Removing Rear Crossmember Mounting Bolt (Forward)

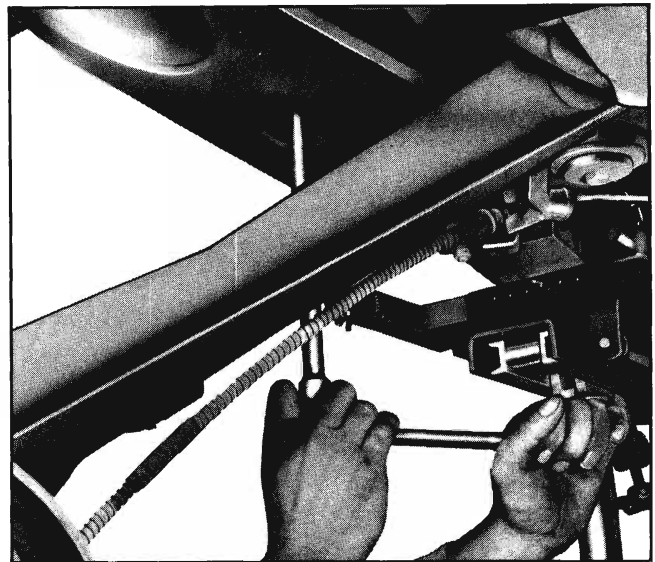


Fig. 3-39 Removing Rear Crossmember Mounting Bolt (Rearward)

2. Install four bolts connecting crossmember to body. Torque bolts as shown in Fig. 3-40.

3. Connect brake line at junction block.

4. Hook fuel line and brake line to clip on top of crossmember.

5. Connect parking brake cable at rear equalizer.

6. Install coil springs and shock absorbers as outlined previously.

7. Install transmission-differential as outlined in Section 4.

8. Lower vehicle.

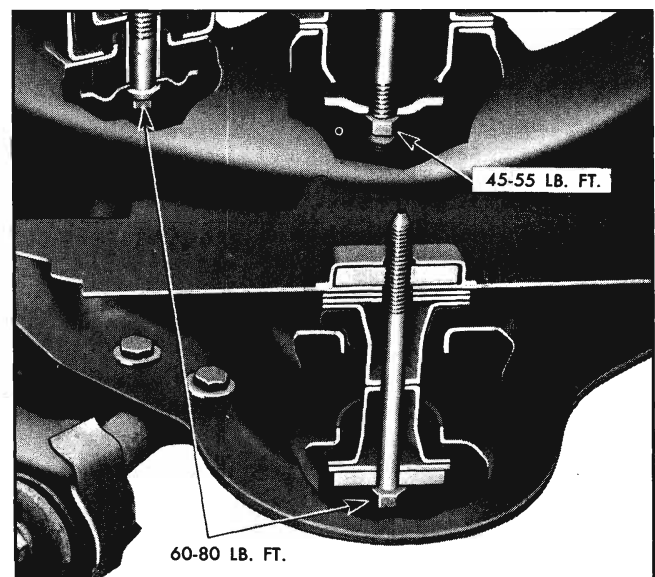


Fig. 3-40 Cross Member Bolt Torques

TORQUE SPECIFICATIONS**FRONT SUSPENSION**

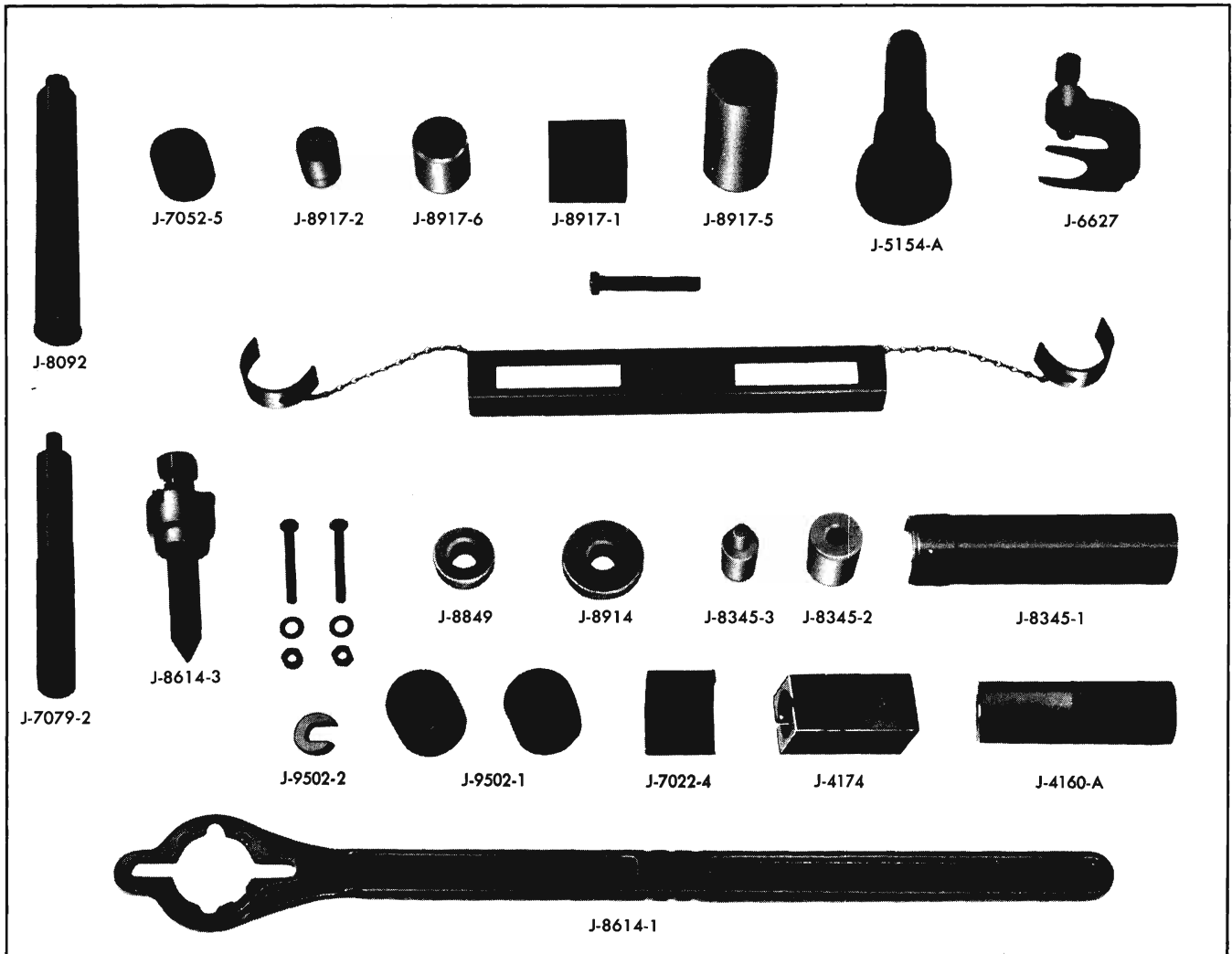
LB. FT.

	LB. FT.
Front crossmember to body mounting bolt and nut.....	70-85
Front upper control arm shaft nut.....	55-80
Steering knuckle to ball stud assembly (upper and lower).....	55-80
Front lower control arm pivot bolt and nut.....	75-90
Front upper control arm to front crossmember bolt and nut.....	55-70
Strut rod to lower control arm nut.....	40-55
Lower control arm strut bushing nut.....	70-85
Stabilizer bar to body rail support bolt.....	20-35
Stabilizer bar to strut rod clamp nut.....	20-30
Front brake backing plate to steering knuckle lower nut and bolt.....	45-65
Front brake backing plate to steering knuckle upper bolt.....	135-165
Tie-rod adjuster sleeve nut and bolt.....	14-20

Front wheel bearing adjustment.....	See page 3-5
Front shock absorber to mounting bracket nut.....	See page 3-12
Front shock absorber to lower control arm bolt.....	15-25

REAR SUSPENSION

Rear shock absorber to upper mounting bracket bolt and nut.....	45-60
Rear shock absorber to control arm bolt and nut.....	15-25
Rear control arm to crossmember bolt and nut.....	40-55
Rear control arm shaft bolt.....	30-40
Yoke to axle shaft bolt.....	20-35
U-joint yoke clamp nut.....	14-20
Rear brake backing plate to control arm bolt and nut.....	30-45
Rear crossmember to body bolts.....	See page 3-22

SPECIAL TOOLS

J-8092	Driver Handle	J-8849	Front Wheel Outer Bearing Cup Installer
J-7052-5	Rear Control Arm Bushing Installer	J-8914	Front Wheel Inner Bearing Cup Installer
J-8917	Front Suspension Lower Control Arm Remover and Replacer Set	J-8345	Front Upper Control Arm Bushing Set
J-5154-A	Front Wheel Inner Bearing Seal Installer	J-9502-2	Spacer
J-6627	Ball Stud Remover	J-9502-1	Bushing Installer
J-8347	Rear Control Arm Bushing Remover and Replacer	J-7022-4	Ball Joint Remover Support
J-7079-2	Handle	J-4174	Ball Joint Installer
J-8614-3	Companion Flange Puller	J-4160-A	Ball Joint Remover
		J-8614-1	Companion Flange Puller Holder

WHEELS AND TIRES

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
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Periodic Service	3A-2	Tire and Wheel Balancing	3A-4
Tire Inflation	3A-2	Trouble Diagnosis and Testing	3A-4
Tire Rotation	3A-2	Tire Inspection	3A-4
Minor Repairs	3A-3	Testing for Tire Noises	3A-6
Test for Leaks	3A-3	Specifications	3A-7

GENERAL DESCRIPTION

Drop center rim steel wheels secured by left hand thread nuts on left side of car and right hand thread nuts on right side of car are used on all models. The rim width is 4.5" and wheel diameter 15". Low pres-

sure 6.00 x 15 4 ply tires are standard equipment on all models except station wagons and air conditioned cars. Station wagons and air conditioned cars are equipped with 6.50 x 15 4 ply tires. All tires are of tubeless construction.

TIRE PRESSURE CHART			
TIRE SIZE	COLD PRESSURE After Car Has Been Standing Three or More Hours	CITY PRESSURE After Driving Car Three Miles or More Below 40 M.P.H.	HIGHWAY PRESSURE After Driving Car Ten Miles or More Above 40 M.P.H.
6.00 x 15-4 Ply Front and Rear	22 Lbs.	24 Lbs.	26 Lbs.
6.50 x 15-4 Ply (Station Wagon) Front Rear	22 Lbs. 26 Lbs.	24 Lbs. 28 Lbs.	26 Lbs. 30 Lbs.
6.50 x 15-4 Ply (Air Conditioned equipped cars Front and Rear)	22 Lbs.	24 Lbs.	26 Lbs.

Fig. 3A-1 Tire Pressure Chart

PERIODIC SERVICE

INFLATION OF TIRES:

Maintenance of correct inflation pressure is one of the most important elements of tire care. The inflation pressure recommended for any model of car is carefully worked out as the best pressure to give a correct balance of those factors in good car performance which are affected by inflation pressure. Some of these factors are: satisfactory ride, stability, steering, tread wear, cord life and resistance to stone bruises.

Tire pressure, with tires cold, should be checked once a month. Pressure should be changed if necessary, to conform to specifications on chart (Fig. 3A-1). It is normal for air pressure in tires to increase as temperature of tires increases due to car being driven.

When it is not possible to check air pressure when tire is cold, it may be checked with tires warm using pressure recommended for city and highway driving given in specifications. It must be recognized that this method is not as accurate as checking pressure when tires are cold. One driver's tires may get warmer than another driver due to difference in speed, acceleration and braking.

NOTE: Always check tires with accurate gauge.

Tire valve caps should always be reinstalled on the valve and tightened finger tight. They assist in keeping air in the tire in case of a valve leak, and keep dust and water out of the valve.

Higher than recommended inflation pressure will give:

1. A harder riding car.
2. A tire carcass more susceptible to bruising or carcass damage directly under the tread.
3. Poorer traction at rear wheels resulting in uneven wear.

4. Fast tread wear at center of tire.

Lower inflation pressures than recommended will give:

1. Increased tire squeal on turns.
2. Harder steering.
3. Rapid and uneven wear on the edges of tire tread.
4. A tire more susceptible to rim bruises and various types of rupture.

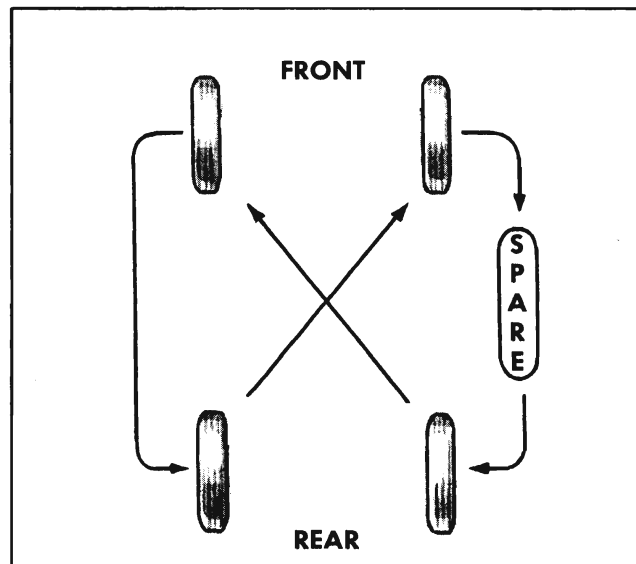


Fig. 3A-2 Diagram for Switching Tires

5. Increased cord fatigue or broken tire cords.
6. Increased tramp and shimmy troubles.
7. Higher tire temperatures.
8. Increased car roll when turning a corner or making a sharp swerve in traffic.

TIRE ROTATION:

Uneven tire wear is frequently the cause of tire noises which are attributed to rear axle gears, bearings, wheels, etc., and at times unnecessary work has been done on rear axle assemblies in an endeavor to correct this noise.

To minimize the possibility of tire noise and equalize wear, it is recommended that tires be rotated as shown in (Fig. 3A-2), approximately each 4000 miles. They should be rotated more frequently when tires are subjected to extremely hard use. This will prevent undue wear on any particular tire which might cause excessive noise. More important from the owner's viewpoint, will be equalization of wear on all tires and the saving made through getting some use from the spare tire which all too often is allowed to remain as a spare until the other tires are worn out. When this occurs, the spare tire, while appearing to be new will actually have deteriorated through disuse. If the rotating of tires is followed each 4,000 miles in accordance with (Fig. 3A-2), all tires will have had the same number of miles in each wheel position at the end of the fourth change or when ready to interchange tires for the fifth time. The car will have been driven

20,000 miles, but each tire will have only 16,000 miles of use.

CAUTION: *Hub caps are made of brass and care should be used not to damage them when removing or installing them.*

Each time tires are switched they should be inspected for signs of abnormal wear, bulging, etc. and all stones, nails, glass, etc., removed before reinstalling tire and wheel on car.

MINOR REPAIRS

TEST FOR LEAKS:

1. Use soapy water to check valve for leaks. In many cases air loss can be corrected by simply tightening the valve core.
2. If the reason for air loss is not immediately discernible, submerge the complete wheel assembly in a tank of water.
3. Mark the tire and rim at the point where air is escaping.

Tire Mounting and Dismounting Instructions:

The wheel assembly has a hump-type bead seat on the outboard (valve hole) side of rim (Fig. 3A-3). This design provides a tight tire fit making it necessary to use a rubber lubricant or a vegetable oil soap solution for tire mounting and dismounting. This design also makes it mandatory that tire mounting and dismounting are done with the outboard (valve hole) side of the wheel up.

REMOVE TIRE FROM WHEEL:

1. Remove valve cap and valve core. Let out all the air.
2. With valve hole side of tire up, break beads away from rim. Use only conventional bead-breaker type machine.

CAUTION: *Do not use hammer or tire irons.*

3. Apply a liberal amount of rubber lubricant or thin vegetable oil soap solution to both beads and remove the first bead, using the machine method.

CAUTION: *During the entire operation of breaking beads away from rim and removing tire from rim, special care should be taken not to damage the sealing ridges along the tire beads.*

PUNCTURE REPAIRS:

Puncture repairs may be quickly and permanently performed using one of several kits available through tire manufacturer's dealer outlets.

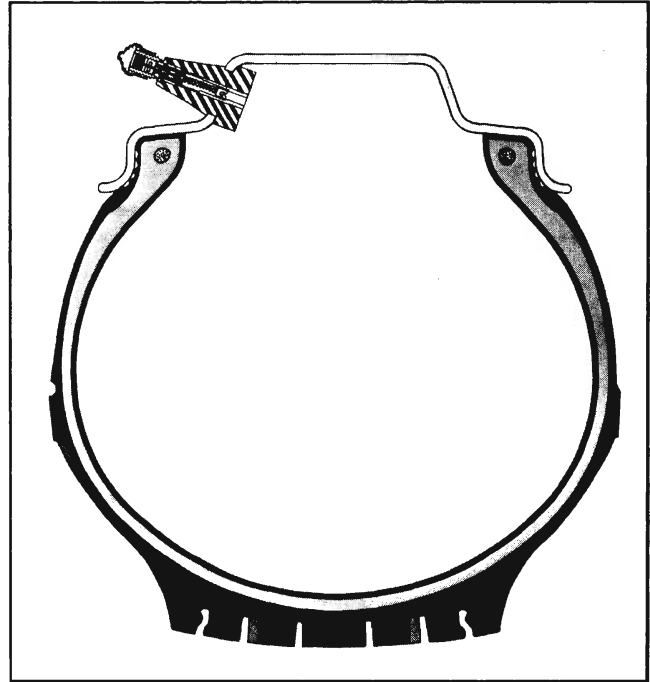


Fig. 3A-3 Cross Section of Typical Tubeless Tire

WHEEL LEAKS:

Examine rim flanges for sharp dents. Any dent visible to the eye should be straightened.

CAUTION: *Under no circumstance should wheels be brazed, welded or peened.*

PREPARATION OF TIRE:

Remove excess "strings" of rubber hanging from tire bead.

PREPARATION OF RIM:

1. Clean the rim flanges using a small piece of No. 3 coarse steel wool or emery cloth removing all oxidized rubber, soap solution, rust, etc. If rim is badly pitted a file can be used.
2. Straighten or replace rim if it is bent or damaged.

MOUNTING TIRE ON WHEEL:

1. Install valve if valve was removed. Always install valve recommended by car manufacturer.
2. Apply liberal amounts of vegetable oil soap solution or approved rubber lubricant to rim edges and tire beads.

3. Mount the tire on the wheel with valve hole side up using the machine method.

4. Remove valve core from stem to increase flow of air.

5. With casing on the rim so that the beads are resting uniformly on the bead ledge and quickly apply a large volume of air. This forces the bead over the bead seat and against the flanges where the air seal for the tire is obtained. Inflate tire until beads are completely forced against rim flanges.

CAUTION: Do not stand over tire when inflating. Bead wire may brake when bead snaps over safety bump. Do not exceed 40 lb. air pressure when inflating. If 40 lbs. pressure will not seat beads properly, deflate, lubricate, and reinflate.

6. Once the beads are seated against the rim flanges, the air pressure can be released.

7. Install valve core and inflate to proper specifications.

8. General precautions in mounting tires:

A. Use tire mounting and dismounting machine.

B. Do not use hammer or tire irons.

C. Work over rim flange so that the section nearest the valve stem will be applied last.

TIRE BALANCING

Factory specifications call for wheel and tire assemblies to be in balance within 6 inch ounces maximum. Under certain circumstances it may be necessary to use weights greater than maximum to obtain satisfactory balance. When greater than 3 ounces of weight are used, split weights between inside and outside of rim. Use heavier weight on the inside if weights added are not equal. When total weights used exceed 6 ounces, this is an indication of a bad tire.

Wheels on new cars are statically balanced at the factory to less than 6 oz. which is well within requirements for smooth operation on the car.

Shimmy or tramp may be caused by radial runout or eccentricity of the tire and/or wheel assembly as well as out of balance. This will be seen as a variation in the radius of the tire and wheel assembly when revolving the wheel with the car jacked up. Radial runout may be caused by a variation in tire tread surface caused by skidding, a damaged tire, a bent or distorted wheel, or an improperly mounted tire.

NOTE: Shimmy is always aggravated by worn front tires. When shimmy is a problem, use best tires on front of car.

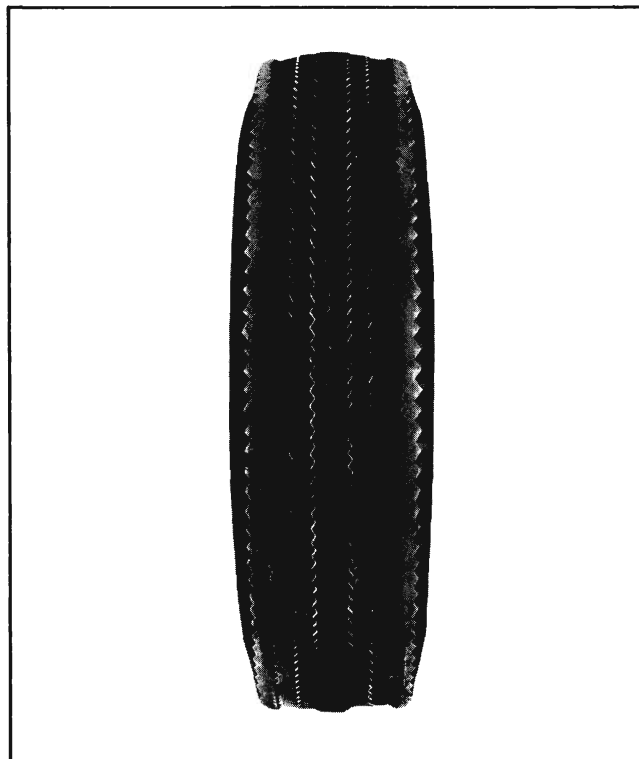


Fig. 3A-4 Wear from Underinflation

TROUBLE DIAGNOSIS AND TESTING

TIRE INSPECTION

Upon careful inspection of tires, it may be found that improper wheel alignment, grabbing brakes, poor driving habits, fast cornering or other conditions are the cause of wear, such conditions should be corrected. Listed below are common types of irregular tire wear and possible causes.

UNDERINFLATION

The result of underinflation is shown (Fig. 3A-4). Car weight distorts the normal contour of the tire body and the tire bulges or "bellies out" with an extreme flexing action. This wears the tread at the edges more than the center and generates excessive internal heat weakening the cords and resulting in bruises, broken cords or ply separation. Underinflation also leads to rim bruises as insufficient resistance is provided to prevent the tire from being jammed against the rim and crushed or cut when the tire strikes a curb, rock, or rut.

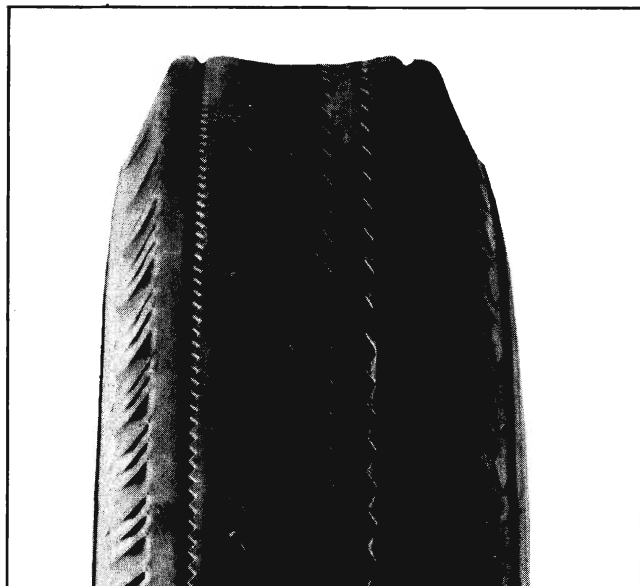


Fig. 3A-5 Wear from Overinflation

OVERINFLATION

The result of overinflation is shown in Fig. 3A-5. When a tire is overinflated, increased tension caused by excessive pressure prevents proper deflection of the sidewalls. This results in wear in the center of the tread and the tire also loses its ability to absorb road shocks. Under this increased strain, cords in the tread area eventually snap under impact, causing either a characteristic X-break or diagonal break.

SIDE WEAR (CAMBERING OR CORNERING WEAR):

There are three reasons why tires wear more rapidly on one side of the tread than on the other.

1. Wheel camber causes the tires to run at a certain angle from the perpendicular, resulting in side wear.
2. Side thrust when rounding turns causes wear on the sides of the treads. In making a turn to the left, especially at high speeds, the outside shoulder of the right tire and the inside shoulder of the left tire take most of the wear. When making a right-hand turn, the opposite shoulders of the tires are worn.
3. High crowned roads cause increased wear on the side of the right front tire. This is particularly true when there is too much toe-in on front wheels or when positive camber of right front wheel is greater than the left.

Cornering wear can usually be differentiated from

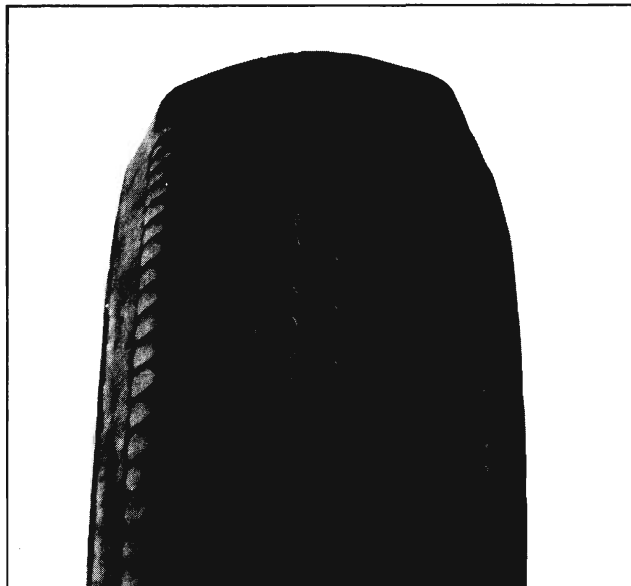


Fig. 3A-6 Cornering Wear

camber wear because cornering wear affects both sides of the tire giving it a very round appearance (Fig. 3A-6). When camber is incorrect it will cause excessive wear only on one side of the tire tread. Camber wear does not leave the tread rounded as cornering wear does.

When cornering wear is encountered, the owner should be shown, by the rough tire surface and rounded shoulders, that he is severely abrading his tires by fast or sharp turns, and told that he could greatly prolong the useful life of his tires by taking the turns a little slower. The tires and wheels should be switched (Fig. 3A-2) and continued in service the same as with normal camber wear.

TOE-IN OR TOE-OUT MISALIGNMENT WEAR

Front wheels should be straight ahead or toe-in slightly. When there is excessive toe-in or toe-out, tires will revolve with a side motion and scrape the tread rubber off. If the misalignment is severe, the rubber on both tires will be scuffed off, but if the misalignment is slight, the rubber on only one tire will be scuffed off.

In general, if right front tire shows most wear, toe-in or right camber is excessive. If left front shows most wear, toe-out or left camber is excessive.

The scuffing action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread design. This feather edge is the evidence of irregularity, as shown in Fig. 3A-7.

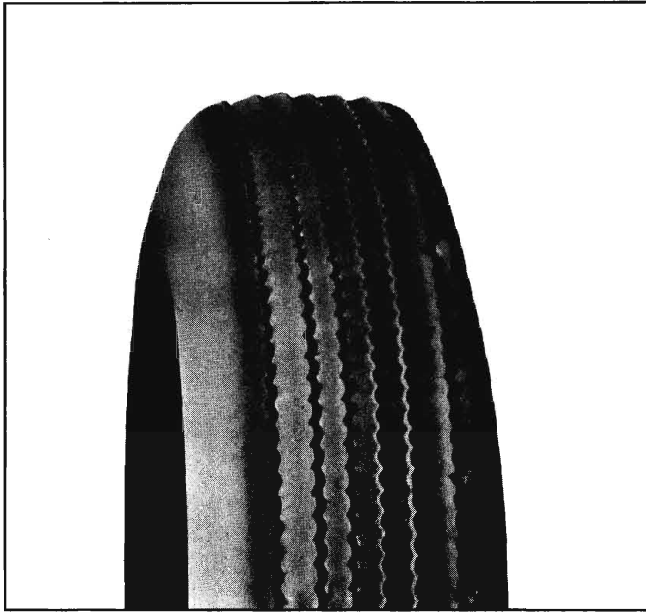


Fig. 3A-7 Toe-in or Toe-out Misalignment Wear

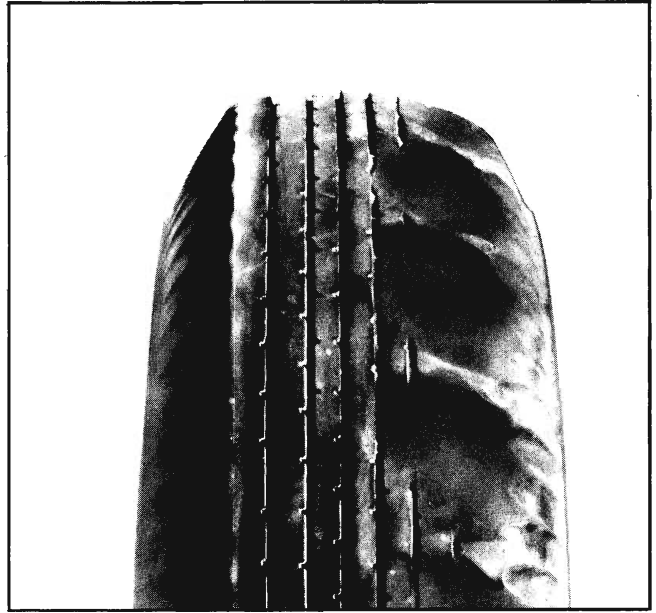


Fig. 3A-8 Spot Wear

UNEVEN TIRE WEAR

Other types of uneven tread wear such as a single spot or series of cuppings around the tire circumference (Fig. 3A-8) may also be noted on some tires. Such uneven wear may be due to excess toe-in or toe-out with underinflation, uneven camber, or such irregularities as bent or worn suspension, wobbly wheels, out of round brake drums, and unequally adjusted brakes.

TREAD WEAR

Tread wear is affected by wheel alignment, cornering, inflation pressure, etc., as mentioned previously. There are several factors which must be considered in analyzing tread wear.

A careful driver may obtain many times the mileage from his tires as would be obtained by a severe driver. Also, tires wear much faster in some localities depending on the type of road (some are more abrasive than others), condition of road (rain or snow), the number of sharp turns, hills or mountains the car must go up or down, and the prevailing temperature. Fast driving, quick starting, and hard stopping are generally recognized as a definite cause of rapid tread wear. Temperature is often not considered to be as great a factor in tire life as it actually is. By actual test an increase of 40°F in temperature reduces tread mileage by 33%.

TESTING FOR TIRE NOISES

To determine whether tires are causing the noise complained of, use the following procedure:

Check car to see if it is equipped with snow tires. These tires produce a noise which the owner will have to ignore or overlook. If not equipped with snow tires, drive the car at various speeds and note the effect of acceleration and deceleration on noise. Axle and exhaust noise show definite variations under these conditions while tire noise will remain constant. Tire noise generally is most pronounced on smooth black top roads at speeds between 15 and 40 miles per hour.

Tire thump is the periodic noise with each revolution of the wheel. It is prominent only on smooth black top pavement that is free of surface irregularities. Tire thump may be checked by driving the car over a smooth black top pavement with tires at recommended inflation pressure, and again over the same stretch of road with the tires inflated to 50 lbs. and dropping the pressure in one tire at a time to normal.

CAUTION: Be careful not to strike any obstructions or rocks in road with tire at 50 lbs. pressure as this will lead to a rupture in the casing. Operate car with higher than recommended inflation only while testing. Do not operate car over 50 M.P.H. with high tire pressure.

Carefully inspect the tire making the noise for bulges, irregular wear, low air pressure, toe and heel (saw tooth) wear, and unusual tread design (ribbed tread gives less noise than some all weather treads;

mud and snow treads are very noisy). Checking wheel alignment and rotating tires will usually cure tire noises unless caused by tire tread design, heavy irregular tread wear, or tire bulges.

SPECIFICATIONS

WHEELS

- MaterialSteel
- TypeDrop Center
- Diameter15"
- Width4.5"

TIRES

- Size (Standard)6.00 x 15
- Size (Station Wagons and
Air Conditioned Cars)6.50 x 15
- TypeTubeless
- Ply4

TORQUE SPECIFICATIONS

LB. FT.

- Wheel to Drum Nut—Front and Rear70-85

REAR AXLE AND PROPELLER SHAFT

CONTENTS OF THIS SECTION

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Major Repairs			
Remove and Replace Trans-Axle, Synchro-Mesh Transmission	4-14		
Remove and Replace Trans-Axle, Automatic Transmission	4-15		

GENERAL DESCRIPTION

The differential and carrier assembly (Fig. 4-1) is a component of the transmission and differential assembly. This design combines the transmission with the differential and carrier and is commonly referred to as a trans-axle. The differential and carrier design utilizes a hypoid ring and drive pinion set with the pinion shaft above the center of the ring gear. The remaining components of the differential and carrier are conventional. The differential and carrier are mounted on the rear suspension crossmember and are sprung with the body weight.

Each axle shaft is independently suspended and is free to move in a vertical plane in an arc. The axle shaft is attached to universal joints, which in turn are splined into the differential side gears. The driving force is transmitted by the lower control arm and lateral forces are absorbed by self-aligning wheel bearings and rubber bushings at the lower control arm attachment to the rear crossmember. Details on rear suspension are given in Section 3.

Axle ratio letter code is stamped on the right side of the carrier housing on the flat surface next to the side cover (Fig. 4-2). The available axle ratios are shown on chart (Fig. 4-3).

DIFFERENTIAL AND CARRIER ASSEMBLY

The differential and carrier assembly is basically the same for both synchro-mesh transmissions and the automatic transmission. Modifications are made to the various components to accommodate the respective transmissions.

The synchro-mesh transmission drive pinion shaft is hollow and is splined internally to receive the transmission main shaft. The rear pinion bearing retainer on the synchro-mesh application supports the drive pinion shaft rear bearing. The front pinion bearing adjusting nut supports the front pinion bearing. The lubricant used in the differential and carrier is the same as in the transmission. The drive pinion shaft used with automatic transmission is also hollow but is splined externally so that the drive pinion shaft may

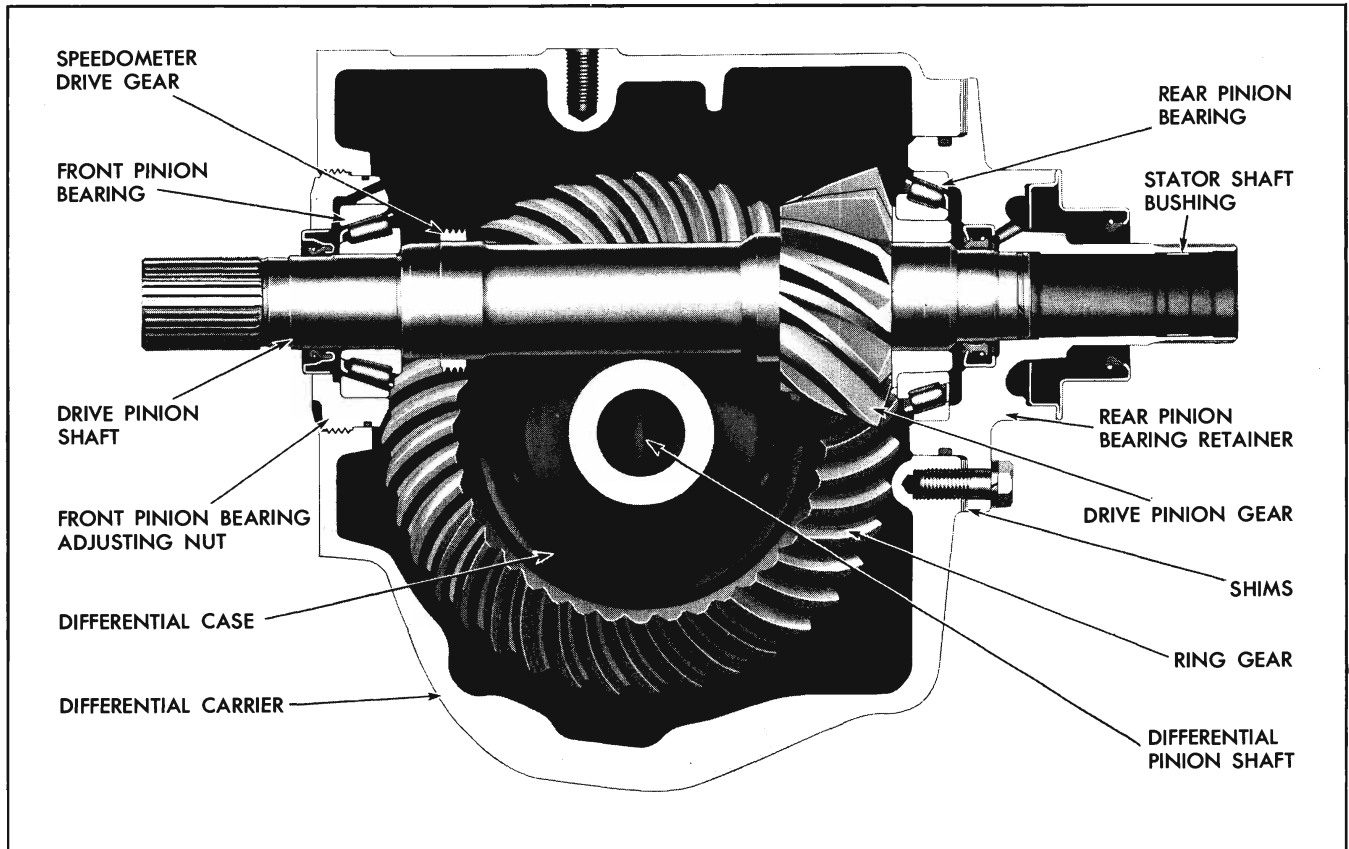


Fig. 4-1 Cross Section of Differential and Carrier

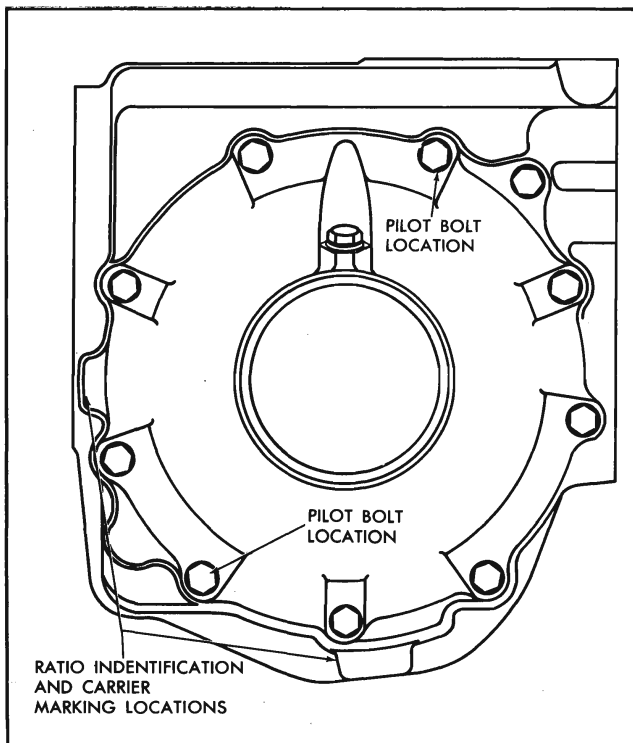


Fig. 4-2 Ratio Identification Locations.

be inserted in the transmission planet carrier hub. On automatic transmission application the turbine shaft passes through the drive pinion shaft to connect the turbine with the transmission. The rear pinion bearing retainer used with the automatic transmission supports the rear pinion bearing and also acts as a turbine or stator support. An oil seal is used on the rear pinion bearing retainer to separate the transmission fluid in the turbine from the hypoid oil in the axle.

A passage in the carrier and rear pinion bearing retainer is provided to relieve any pressure against rear pinion bearing seal due to leakage past pinion shaft ring by returning automatic transmission fluid to transmission.

The front pinion bearing adjusting nut used with automatic transmission application is similar to the nut used with synchro-mesh transmission but contains an oil seal and "O" ring seal as the fluid used in automatic transmission and differential and carrier is different and must not be allowed to mix. This could result in damage to either the transmission, differential and carrier, or both.

Rear Axle Gear		Transmission			Ratio			Code		2117 2119 2127 Exc. Taxi	2119 Taxi	2135	2167	Air Cond.		Engine				
Comb.	Ratio	3-Speed SM	4-Speed SM	Auto.	Econ.	Std.	Perf.	Color	Letter				Without	With	1-bbl.	4-bbl.	215			
37:12	3.08			X		X		Blue	H	X	X		X		X					
				X	X					X						X				
				X		X					X								X	
43:13	3.31	X				X		Green	E	X			X	X	X					
		X			X						X	X	X							
					X		X			B			X	X		X	X			
					X		X						X	X					X	
39:11	3.55					X		Yellow	D		X	X	X	X	X	X				
		X					X					X	X	X						
		X					X					X	X		X					
		X					X					X	X	X	X					
				X					X		M	X	X	X	X	X	X	X		
						X			X					X		X	X			
						X			X		A		X		X		X	X		
						X			X			X	X		X			X		
						X			X			X	X	X	X		X	X		
						X			X			X	X		X		X			
						X			X					X	X		X	X		X
						X			X				X	X	X		X			X
		41:11	3.73	X					Special Order		Red	F	X	X	X	X	X	X	X	
				X						X				X	X		X			
						X		X		C		X	X		X	X		X		
						X		X						X	X	X	X			
						X		Special Order				X	X			X	X	X		
						X		Special Order							X	X	X	X		
						X		X							X	X				X
						X		Special Order				X	X		X	X	X			X
39:10	3.90	X				Special Order		Brown	G	X	X	X	X	X	X	X				
						X				Special Order		X	X	X	X	X	X			
						X			Special Order		J	X	X	X	X	X	X	X		

Fig. 4-3 Differential and Carrier Ratio and Usage Chart

The drive pinion shaft is carried in press fit tapered roller bearings which support the shaft at the front and rear of the carrier housing. The speedometer drive gear is pressed on the pinion drive shaft.

The ring gear is attached to the differential case, which is of two-piece construction, by eight special bolts. The differential pinion gears are mounted on a solid shaft which is held in place by a pin. Pinion gears mesh with side gears which are splined to universal joints. Both pinion and side gears have

thrust washers behind them to prevent scoring of thrust surfaces.

The differential and carrier assembly used with the four speed synchro-mesh transmission has four pinion gears in the differential case. The carrier is modified in design to accept the four speed transmission. All other components of the differential and carrier assembly are the same as the three speed synchro-mesh, differential and carrier assembly.

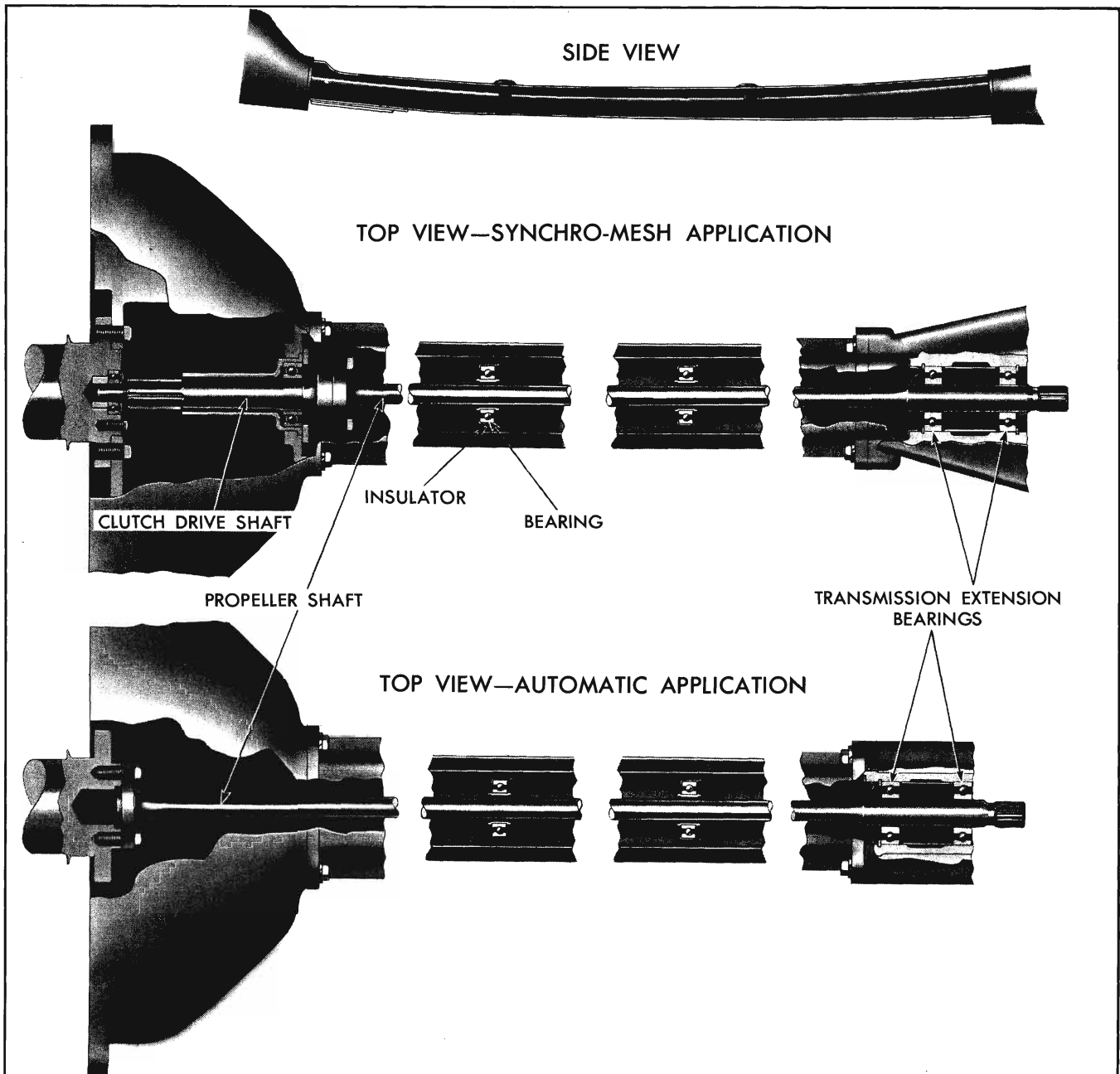


Fig. 4-4 Cross Section of Propeller Shaft and Torque Tube

AXLE SHAFT

The axle shaft is bolted to the universal joint which is splined to the differential side gears. The axle bearing retainer is secured to the rear lower control arm with four nuts. The self-aligning bearing is permanently sealed to protect it from dirt and water and requires no service.

PROPELLER SHAFT AND TORQUE TUBE (Fig. 4-4)

The propeller shaft transmits torque from the engine to the transmission. The shaft has a flanged front

end which is attached to the flywheel on automatic and clutch drive shaft on synchro-mesh with six bolts. The rear of the propeller shaft is splined to the transmission. The shaft is constructed of special quality triple alloy forged steel. It is heat treated and shot peened for high fatigue life. A special protective coating is applied which greatly increases the durability of the shaft.

The torque tube rigidly joins the engine and transmission and forms a housing for the propeller shaft. The flexible propeller shaft permits a curved torque

tube so that the center tunnel in the body floor is virtually eliminated. Hat sectioned steel is used in the construction of the torque tube.

The shaft is supported by ball bearings, sealed and lubricated for life, which are press fitted over plastic lined steel sleeves. Rubber insulator assemblies are retained by a press fit on the ball bearing O.D. The sleeves and the inner race of the ball bearings are affixed to the propeller shaft and rotate with it. Ball bearings in the transmission extension provide additional support for the propeller shaft.

PERIODIC SERVICE

See Lubrication Section.

MINOR REPAIRS

REPLACE DIFFERENTIAL SIDE BEARING OIL SEALS

1. Drain lubricant from differential and carrier assembly.

2. Remove five nuts securing wheel and remove wheel and brake drum.

3. Remove four nuts securing axle bearing retainer to brake backing plate (Fig. 4-5). Nuts are accessible through hole in axle shaft flange.

4. Pull axle shaft and universal joint outward far enough to remove universal joint from differential and carrier assembly.

5. Remove side bearing oil seals by prying out with small chisel or screwdriver.

6. Clean seal seat area to remove old sealer.

7. Apply uniform bead of sealer to case of new seal.

8. Install new side bearing oil seal using tool J-8889 installed (Fig. 4-6) Coat lip of seal and splines with hypoid oil to help prevent damage to seal by splines of the U-joint yoke.

9. With bearing retainer and brake backing plate holes aligned with control arm studs, insert U-joint splined yoke through seal at side bearing and index with splines of side gear.

10. Install four nuts to secure bearing retainer to brake backing plate via access hole in axle flange. Tighten all nuts to 30-45 lb. ft. of torque.

11. Position brake drum on rear axle shaft studs, install wheel, and secure wheel and drum with five wheel mounting nuts. Tighten to 70-85 lb. ft. of torque.



Fig. 4-5 Removing Nuts from Axle Shaft Bearing Retainer

12. Fill differential assembly to proper level with lubricant. (Check synchro-mesh transmission level and add lubricant if necessary.)

REMOVE AND REPLACE AXLE SHAFT OR BEARING

REMOVE AXLE SHAFT

1. Remove five nuts securing wheel and remove wheel and brake drum.

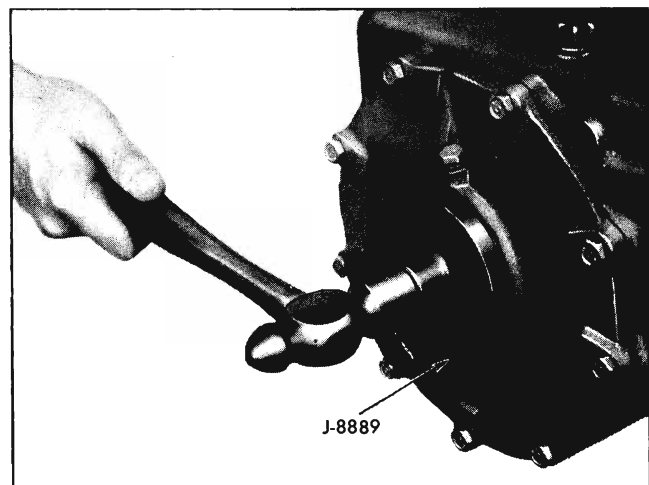


Fig. 4-6 Installing Side Bearing Oil Seal

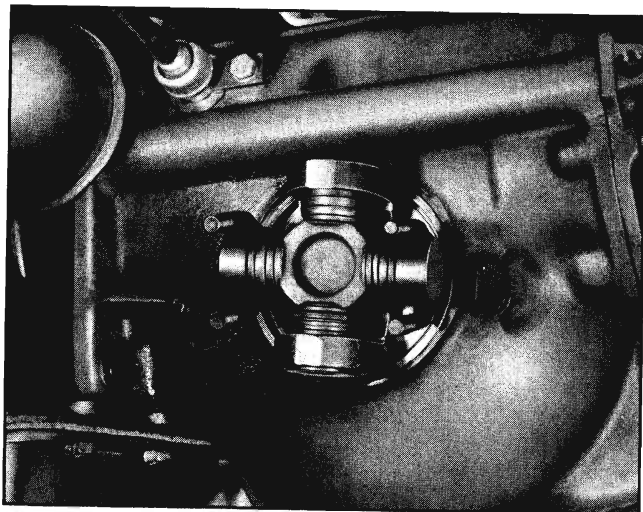


Fig. 4-7 Flange Separated from U-Bolts

2. Remove four nuts securing axle bearing retainer to brake backing plate (Fig. 4-5). Nuts are accessible through hole in axle shaft flange.

3. Pull the brake backing plate outboard slightly then push it back on the control arm studs to break backing plate away from bearing retainer.

4. Remove four nuts and lock tabs from U-Bolts, attaching U-Joint assembly to rear axle flange.

5. Pull axle shaft outward sufficiently to separate flange from U-Bolts (Fig. 4-7).

6. Remove capscrew, lock washer, and flat washer, securing flange to axle shaft. Using tool J-8614 to hold flange.

7. Remove flange from axle shaft using J-8614 (Fig. 4-8).

8. Remove axle shaft from lower control arm.

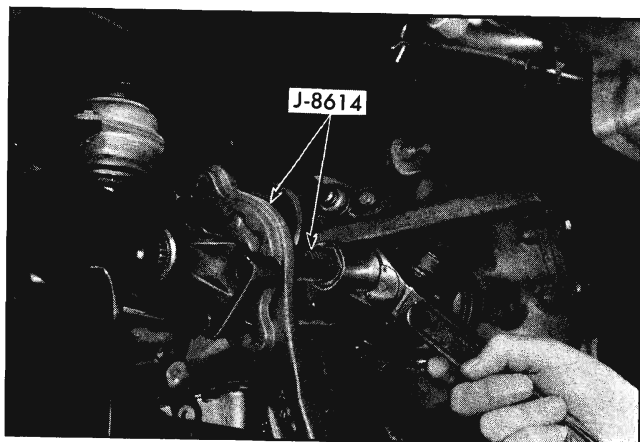


Fig. 4-8 Removing Flange from Axle Shaft

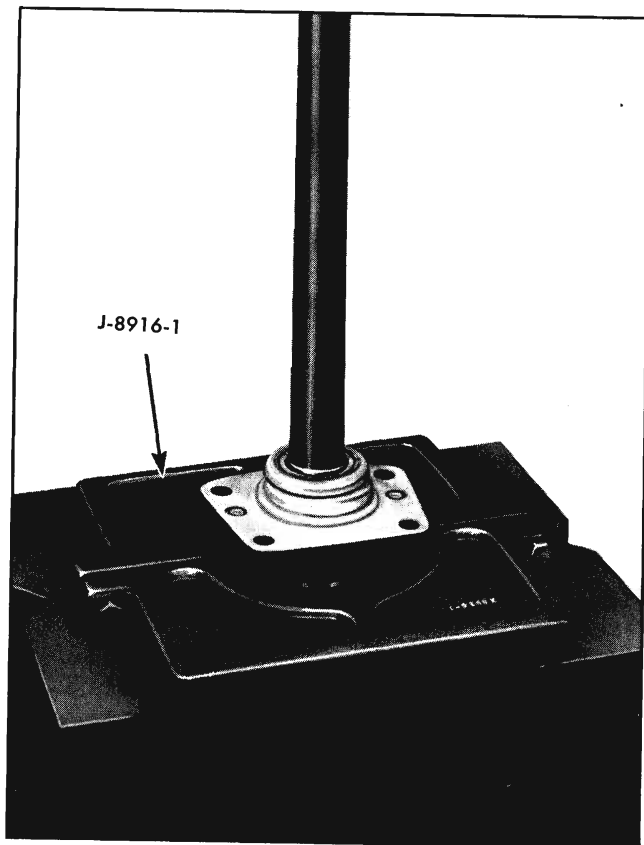


Fig. 4-9 Removing Axle Shaft Bearing

AXLE BEARING REPLACEMENT

1. Place axle shaft in press (Fig. 4-9) with J-8916-1 puller plate below the puller ring, then remove oil deflector shield, bearing, and puller ring.

2. To install the new bearing assembly, place a new puller ring and bearing assembly on axle shaft.

3. To prevent damaging the bearing assembly during installation, place old puller ring saved in Step 1 with its flat side against the bearing inner race and then press (Fig. 4-10) the puller ring and bearing assembly onto the axle using J-8916-2. Remove old puller ring.

4. Pack shield with approximately $\frac{1}{2}$ oz. wheel bearing grease (ES-29). Install shield over bearing assembly tapping carefully on flange of shield.

5. Install oil deflector, using J-8916-2. A very light press is required.

REPLACE AXLE SHAFT

1. Insert axle shaft through the lower control arm. Install flange on splines of axle shaft. It may be neces-

sary to lightly tap flange to start splines if original pieces are being installed.

2. Secure installation of flange to axle shaft with bolt, washer, and lock washer.

3. Attach U-Joint to flange on axle shaft with U-Bolts and nuts. Tighten to 14-20 lb. ft. of torque.

4. With bearing retainer and brake backing plate holes aligned with control arm studs, insert U-Joint splined yoke through seal at side bearing and index with splines of side gears. **NOTE:** Coat lip of seal and splines with hypoid oil to help prevent damage to seal from splines of the U-Joint yoke.

5. Install four nuts to secure bearing retainer to brake backing plate via access hole in axle flange. Tighten all nuts to 30-45 lb. ft. of torque.

6. Position brake drum on rear axle studs, install wheel, and secure wheel and drum with five wheel mounting nuts. Tighten to 70-85 lb. ft. of torque.

CAUTION: *With this design of independent rear suspension, it is very important that U-Joint snap rings are properly installed and that U-Bolts are tightened to 14-20 lb. ft. of torque.*

REMOVE, REPACK AND REPLACE UNIVERSAL JOINT

REMOVE UNIVERSAL JOINT

1. Remove five nuts securing wheel and remove wheel and brake drum.

2. Remove four nuts securing axle bearing retainer to brake backing plate (Fig. 4-5). Nuts are accessible through hole in axle shaft flange.

3. Pull the brake backing plate outboard slightly, then push it back onto the control arm studs to break backing plate away from bearing retainer.

4. Remove four nuts and lock tabs from U-Bolts, attaching U-Joint assembly to rear axle flange.

5. Pull axle shaft outward sufficiently to separate flange from U-Bolts (Fig. 4-7).

6. Remove bolt, lock washer and flat washer securing flange to axle shaft. Hold flange using tool J-8614.

7. Remove flange from axle shaft using tool J-8614 (Fig. 4-0).

8. Remove universal joint from differential and carrier.

DISASSEMBLE UNIVERSAL JOINT

1. Remove bearings from journal (spider) not held in yoke. If bearings are connected with wire, cut wire

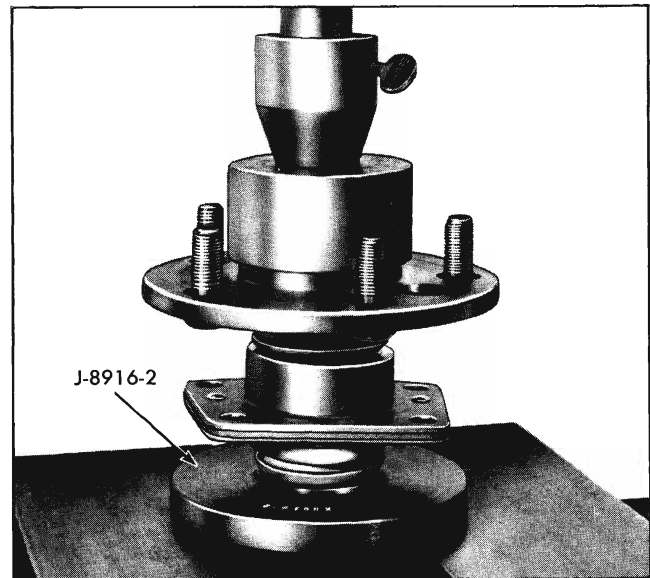


Fig. 4-10 Replace Axle Shaft Bearing

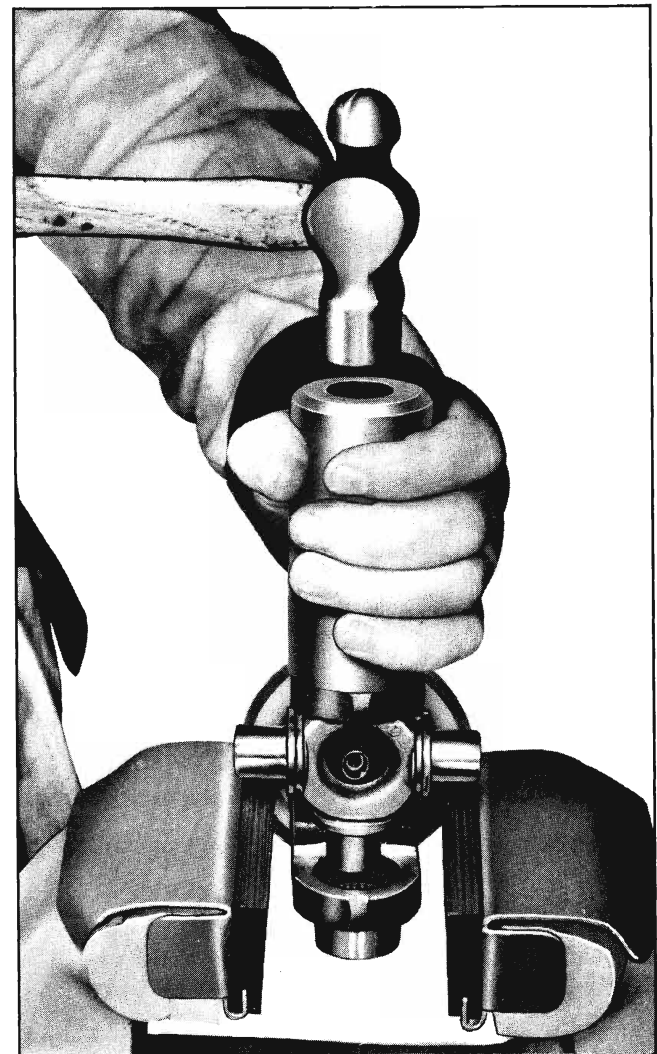


Fig. 4-11 Removing Bearing from Yoke

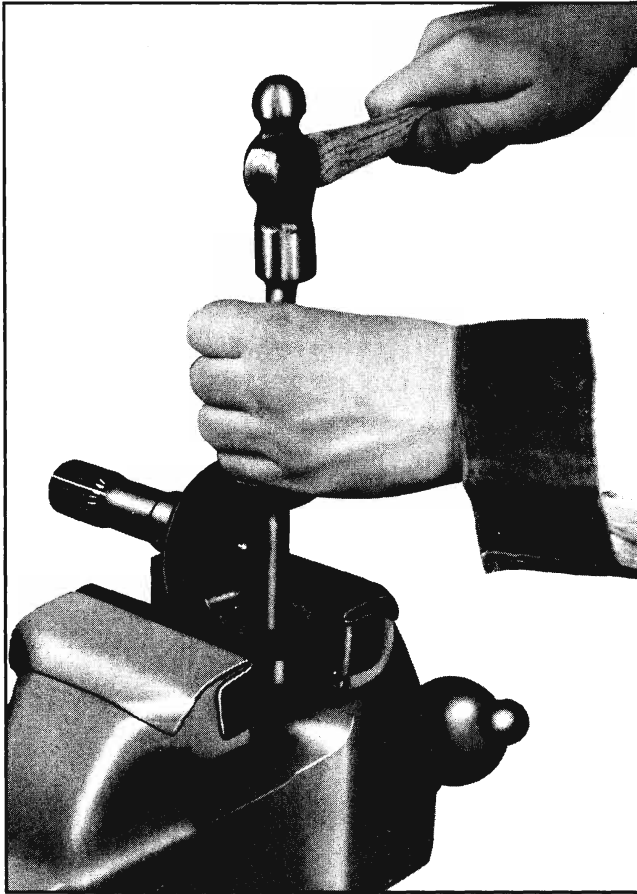


Fig. 4-12 Removing Bearing

and remove bearings.

CAUTION: When removing bearings from journal (spider) use extreme care not to lose needle rollers from bearing.

2. Remove snap rings from yoke assembly.
3. Place ends of journal (spider) on vise jaws so that splined yoke shaft is horizontal. Yoke member must be free to move vertically between jaws of vise.
4. Using a piece of pipe $1\frac{1}{8}$ " I.D. or tool J-4774, drive yoke down causing journal (spider) to force bearing partially out of yoke (Fig. 4-11).
5. Rotate yoke 180° and repeat above operations.
6. When using pipe, drive yoke down as far as possible. Place one or more flat washers $\frac{9}{16}$ " O.D. inside of lower bearing.

NOTE: Total thickness of washer should be $\frac{1}{8}$ " - $\frac{3}{16}$ ".

7. Rotate yoke 180° and again apply force around bearing in which washers were installed. This will completely remove bearing from yoke.

8. Remove journal (spider) from yoke.

9. Remove remaining bearing from yoke with drift (Fig. 4-12).

10. Remove washers.

CLEANING AND INSPECTION

1. Wash all parts thoroughly in cleaning fluid.
2. Inspect roller bearing surfaces of journal (spider), inner bearing surfaces of outer races, and rollers for wear, scores, flat spots, or other damage. Replace damaged or worn parts.
3. Inspect packings (cork washers) and journal dust shields for wear or injury. Replace if necessary. Packing should be flexible; if brittle or hard, replace with new packing.

REASSEMBLE UNIVERSAL JOINT

1. Repack roller bearings and fill holes in ends of journal (spider) with high melting point wheel bearing lubricant.

NOTE: 25 rollers are used in each bearing.

2. Press cork washer into position in recess of bearing. Install bearing about one quarter of the way into yoke using soft faced hammer.

3. Position journal (spider) with dust shields installed, between arms of yoke. Insert journal (spider) into partially installed bearing.

4. Hold journal in bearing and complete installation of bearing into yoke.

5. Install opposite bearing with cork packing in place on journal, being sure that bearing rollers do not bind on journal (spider).

6. Press bearings into yokes far enough to install lock rings.

7. Install remaining bearings with lock rings on journal (spider) shaft and hold in place with C-clamp or other suitable device.

REPLACE UNIVERSAL JOINT

1. Install flange on end of axle shaft and secure with flat washer, lock washer and bolt. Using tool J-8614 installed on flange tighten bolt to 20-35 lb. ft. of torque.

2. Install universal joint to flange with U-Bolts and secure with four nuts and lock tabs. Tighten nuts to 14-20 lb. ft. of torque.

3. With bearing retainer and brake backing plate holes aligned with control arm studs, insert U-Joint splined yoke through seal at side bearing and index with splines of side gears. Coat lip of seal with hypoid oil to help prevent damage to seal by splines of the U-Joint yoke.

4. Install four nuts to secure bearing retainer to brake backing plate via access hole in axle flange. Tighten all nuts to 30-45 lb. ft. of torque.

5. Position brake drum on rear axle studs, install wheel and secure wheel and drum with five wheel mounting nuts. Tighten to 70-85 lb. ft. of torque.

CAUTION: *With this design of independent rear suspension, it is very important that U-Joint snap rings are properly installed and that U-Bolts are tightened to 14-20 lb. ft. of torque.*

REMOVE AND REPLACE PROPELLER SHAFT AND TORQUE TUBE (SYNCHRO-MESH TRANSMISSION)

REMOVE

1. Remove parking brake cable from torque tube.
2. Remove exhaust system. Break at engine and slide entire system off.
3. Remove three bolts from gearshift lever housing and remove gearshift housing.
4. Remove flywheel housing bottom cover.
5. Remove eight screws from torque tube access hole cover and remove cover
6. Remove six bolts from propeller shaft flange (Fig. 4-13).
7. Place a short piece of rubber hose or rag between propeller shaft and torque tube.
8. Loosen six bolts connecting torque tube to flywheel housing.
9. Support torque tube so it will not fall down.
10. Remove six bolts connecting torque tube to flywheel housing.
11. Pry torque tube and propeller shaft away and down from flywheel housing (Fig. 4-14).
12. Place block of wood approximately 2" square between transmission extension and floor of car to position transmission for reassembly. Support torque tube with stand.
13. Remove six bolts connecting torque tube to transmission (Fig. 4-15).

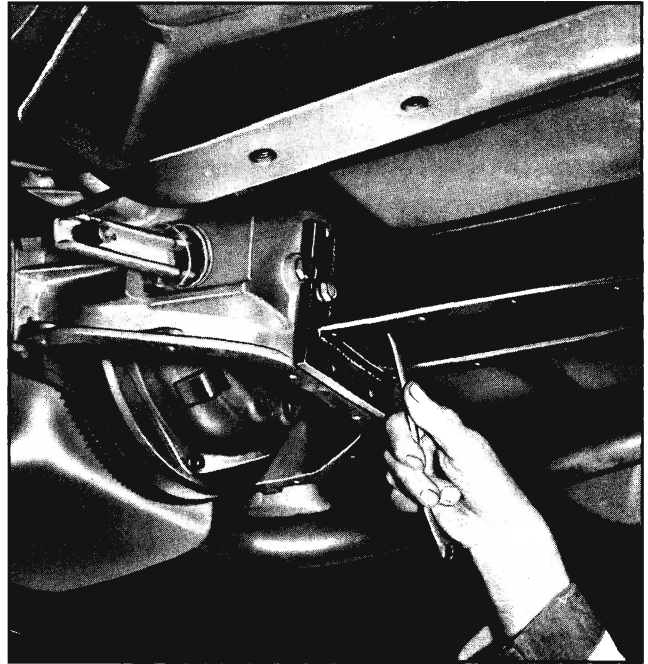


Fig. 4-13 Removing Bolts from Propeller Shaft Flange

CAUTION: *Propeller shaft and torque tube are now held in place only by the bearings in transmission extension and must be supported to prevent bearing or bar damage.*

14. Remove propeller shaft and torque tube as a unit by pulling on propeller shaft flange.



Fig. 4-14 Removing Torque Tube and Propeller Shaft from Flywheel Housing

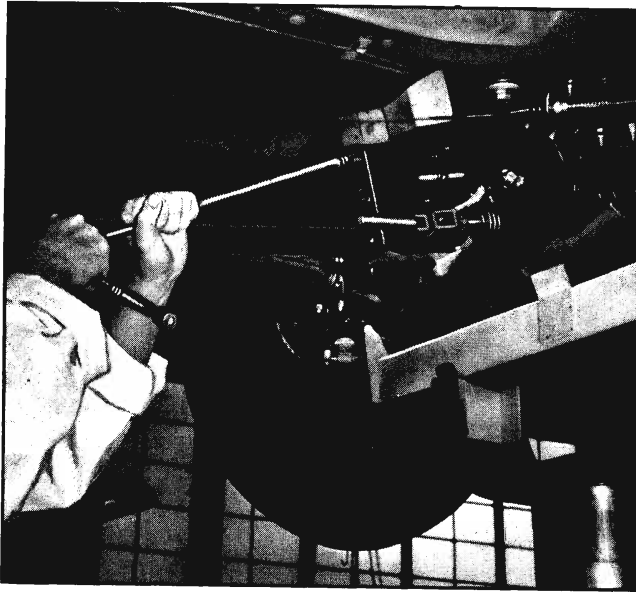


Fig. 4-15 Removing Bolts Connecting Torque Tube to Transmission

CAUTION: Pull propeller shaft straight out of transmission so that shaft will not bind in transmission or transmission extension.

15. Place torque tube and propeller shaft on bench and pull propeller shaft out of torque tube. Pull slowly, do not pull insulator and bearing over sleeves.

CAUTION: Extreme care should be exercised not to damage the coating on the propeller shaft. Damage to this coating will shorten the life of the drive line.

REPLACE

1. Assemble propeller shaft in torque tube and place a short piece of rubber hose or rag between front of propeller shaft and torque tube so that coating on propeller shaft will not be damaged.

CAUTION: When installing propeller shaft in torque tube, you should be able to install propeller shaft without using force.

CAUTION: Extreme care should be exercised not to damage the coating on the propeller shaft. Damage to this coating will shorten the life of the drive line.

2. Coat spline generously with axle oil and take care introducing shaft into extension seal. Never allow weight of shaft to rest on seal. Install propeller shaft into transmission. Care must be used to engage spline of propeller shaft into transmission and journal diameter into transmission extension bearings so as not to damage journal surface. Visual check of propeller shaft alignment into transmission extension is required and if absolutely necessary, tap front flange lightly

with a soft rubber hammer. **BE SURE SPLINES ARE COMPLETELY ENGAGED IN TRANSMISSION.**

3. Install the six bolts that connect the torque tube to transmission extension and tighten to 30-45 lb. ft. of torque.

4. Remove block of wood from between transmission and floor.

5. Secure torque tube to flywheel housing with six bolts; tighten finger tight.

6. Insert propeller shaft in place on clutch drive shaft and secure with six bolts. Tighten bolts finger tight.

7. Remove rag or short piece of rubber hose from inside of torque tube.

8. Tighten bolts securing propeller shaft flange to clutch drive shaft and torque tube to flywheel housing to 30-45 lb. ft. of torque.

9. Install eight screws in torque tube access cover and tighten to 40-80 lb. in.

10. Install gearshift housing.

11. Reinstall exhaust system.

REMOVE AND REPLACE PROPELLER SHAFT AND TORQUE TUBE (AUTOMATIC TRANSMISSION)

REMOVE

1. Remove parking brake cable and vacuum line from torque tube. Remove stabilizer bar.

2. Remove exhaust system. Break at engine and slide entire system off.

3. Remove flywheel bottom cover from engine.

4. Remove six bolts connecting propeller shaft flange to flywheel.

5. Back out, about half way, bolts that connect torque tube to flywheel housing.

6. Place short piece of rubber hose or rag between propeller shaft and torque tube to prevent damage to coating on drive line.

7. Using a screwdriver or other suitable tool, pry propeller shaft flange (while holding with hand) to the rear far enough for pilot to clear recess in flywheel (Fig. 4-16).

8. Remove six bolts connecting torque tube to flywheel housing.

9. Pull torque tube and propeller shaft down and away from flywheel housing (Fig. 4-17).

10. Place 2" block of wood between transmission extension and floor of car to position transmission extension for reassembly.

11. While supporting torque tube, remove six bolts connecting torque tube to transmission.

CAUTION: Propeller shaft and torque tube are now held in place only by the bearings in transmission extension and may drop down.

12. Remove propeller shaft and torque tube as a unit by pulling on propeller shaft flange.

CAUTION: Pull propeller shaft straight out of transmission so that shaft will not bind in transmission or transmission extension.

13. Place torque tube and propeller shaft on bench and pull propeller shaft out of torque tube.

CAUTION: When removing or replacing propeller shaft in torque tube, you should be able to remove propeller shaft without using force.

CAUTION: Extreme care should be exercised not to damage the coating on the propeller shaft. Damage to this coating will shorten the life of the drive line.

REPLACE

1. Install propeller shaft in torque tube and place a short piece of rubber hose or rag between front of propeller shaft and torque tube so that coating on propeller shaft will not be damaged.

2. Install propeller shaft into transmission. Care must be used to engage spline into transmission and journal diameter into transmission extension bearings so as not to damage journal surface. Visual check of propeller shaft alignment into transmission extension is required and, if absolutely necessary, use of a soft rubber hammer to apply additional force to the front flange of propeller shaft is permissible. Be sure splines are completely engaged in transmission.

3. Install the six bolts that connect the torque tube to transmission housing and tighten to 30-45 lb. ft. of torque.

4. Remove block of wood from between transmission and floor.

5. Secure torque tube to flywheel housing with six bolts, tighten finger tight.

6. Install propeller shaft in place on flywheel and secure front flange of propeller shaft to flywheel with six bolts. Tighten bolts finger tight.

7. Remove hose or cloth from inside of torque tube.

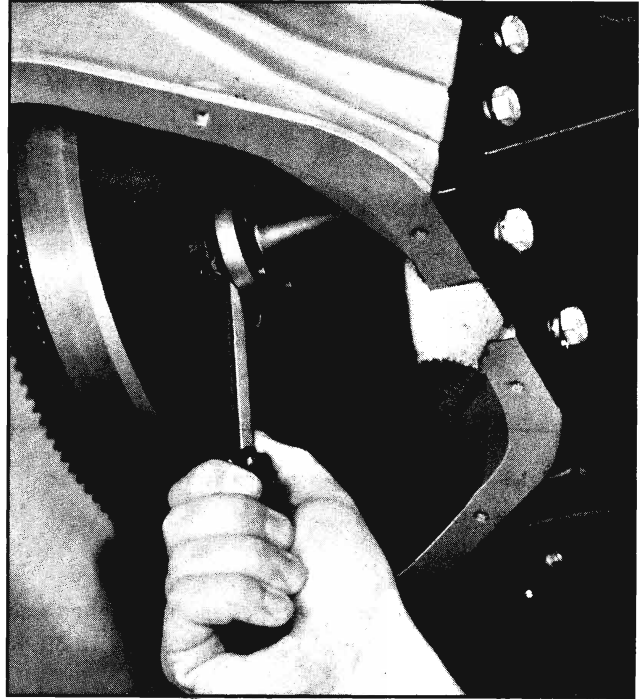


Fig. 4-16 Removing Propeller Shaft from Flywheel

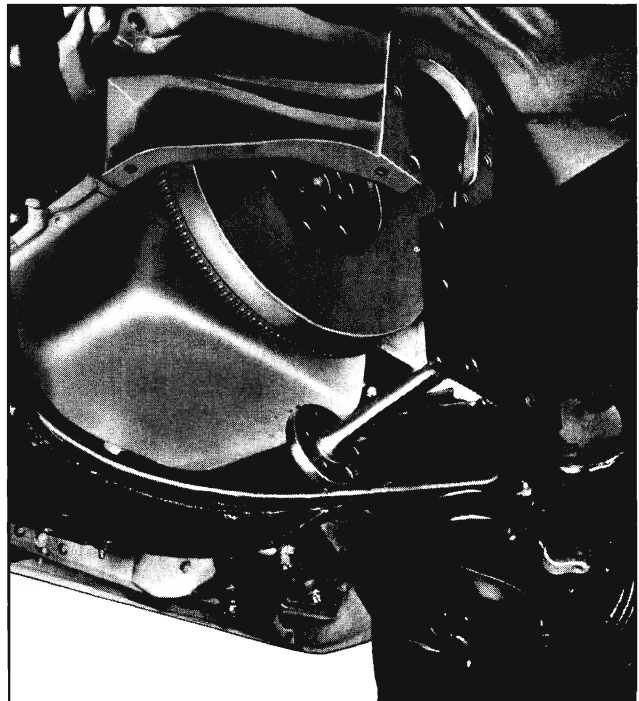


Fig. 4-17 Lowering Torque Tube and Propeller Shaft from Flywheel Housing

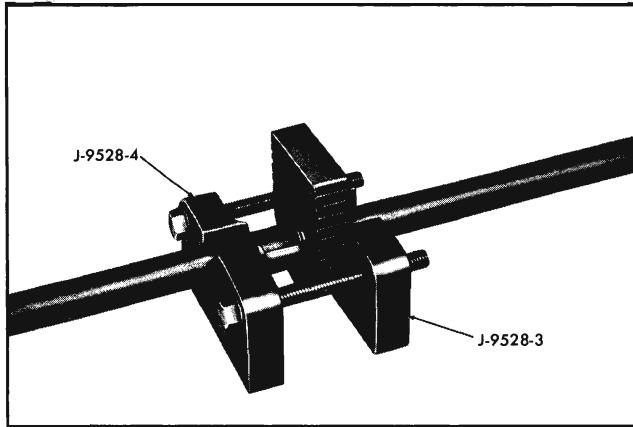


Fig. 4-18 Tools J-9528-3 and J-9528-4 Installed

8. Tighten bolts securing propeller shaft flange and torque tube to flywheel and flywheel housing to 30-45 lb. ft. of torque.

9. Install flywheel cover.

10. Install stabilizer bar. Tighten to 20-35 lb. ft. of torque.

11. Install exhaust system.

12. Install parking brake cable and vacuum line. Adjust parking brake cable as described in Section 5.

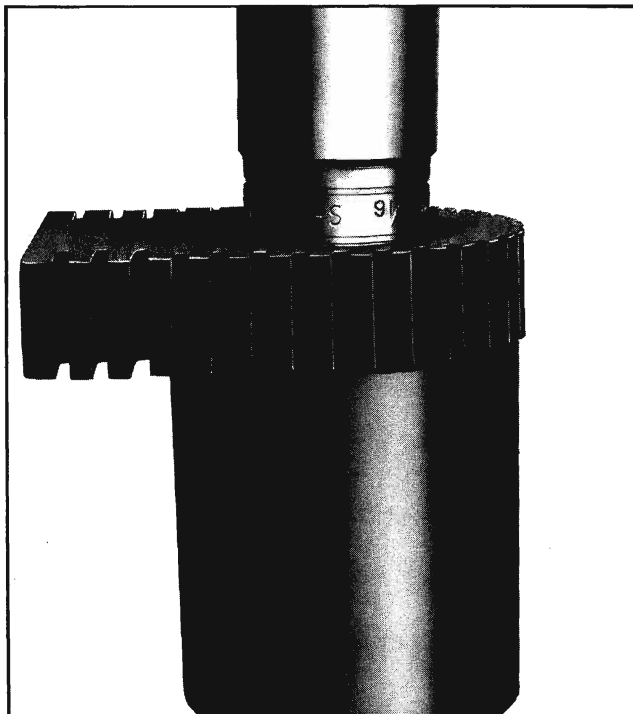


Fig. 4-19 Removing Bearing from Insulator

REMOVE AND REPLACE PROPELLER SHAFT BEARINGS

REMOVE

1. Position tools J-9528-3 and J-9528-4 on propeller shaft (Fig. 4-18).
2. Tighten bolts evenly until bearing is pulled off half-shell.
3. Carefully remove half-shells from propeller shaft.

REMOVE BEARING FROM INSULATOR

1. While supporting insulator with J-7022-3 or other suitable tool (Fig. 4-19) press bearing from insulator using socket. Use inner race to press out bearing.

INSTALL BEARING IN INSULATOR

1. Using socket (Fig. 4-20), press bearing into insulator. Press on outside diameter only.

REPLACE BEARING AND INSULATOR

1. Position bearings and insulators on shaft, as shown (Fig. 4-21).
2. Position half-shells on shaft and secure with J-9528-1 & 2 (Fig. 4-22). Tighten bolts securely.
3. Locate bearing between arrows on J-9528-1 & 2 and J-9528-3.

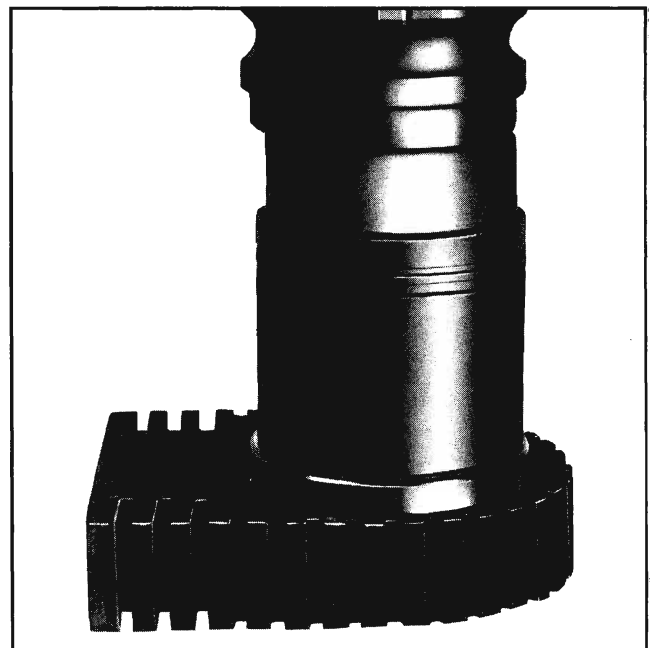


Fig. 4-20 Installing Bearing in Insulator

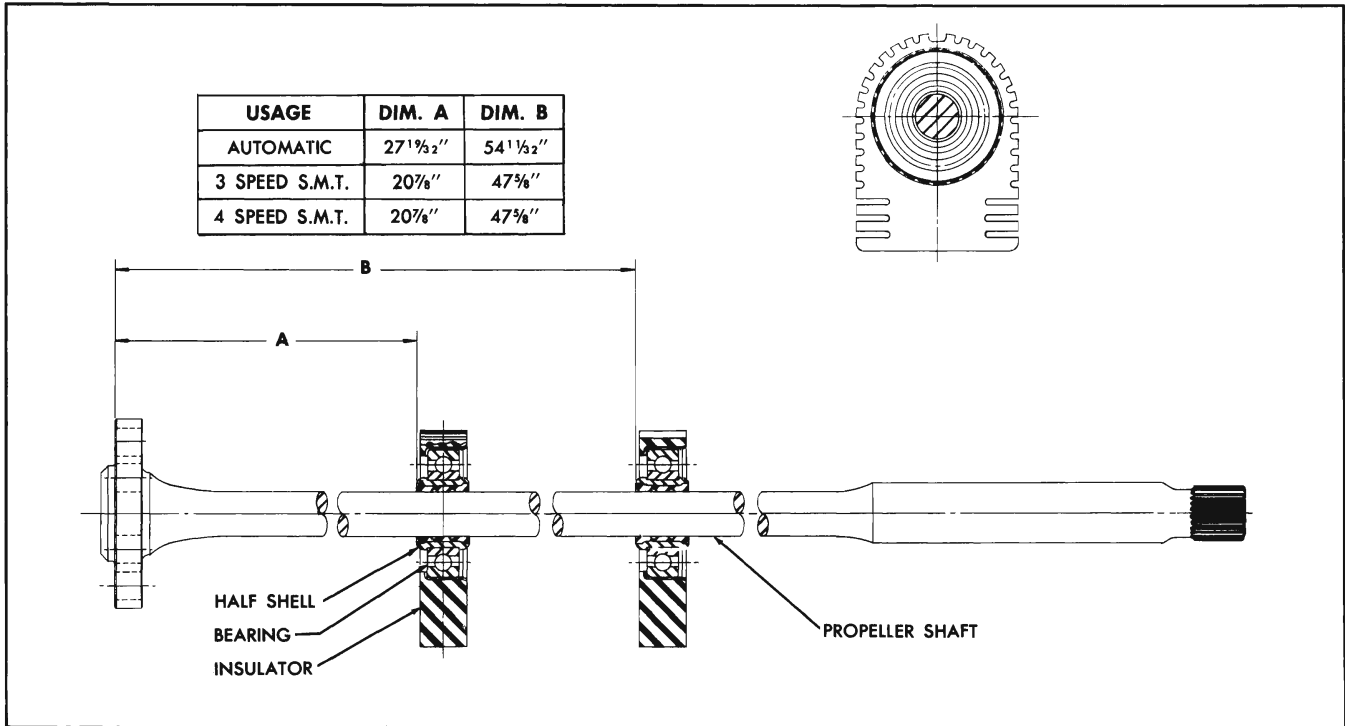


Fig. 4-21 Location of Bearings on Shaft

4. Position J-9528-4 in place and install bolts through J-9528-1 & 2 and into J-9528-3 (Fig. 4-23).

5. Tighten bolts evenly so that tool does not become cocked. Continue to tighten bolts evenly until tool is completely closed. This will locate bearing on half-shell.

6. Carefully remove tool from propeller shaft. Inspect for centering (nibs on each side of I.D.). Make certain shells are not cocked or edge damaged (failing rubber bond to metal).

REMOVE AND REPLACE DIFFERENTIAL AND CARRIER ASSEMBLY (SYNCHRO-MESH)

REMOVE

1. Raise car so that rear wheels hang free and place support under transmission.

2. Drain both differential and carrier and transmission.

3. Remove wheel and brake drum from each side in rear.

4. Remove four nuts securing axle bearing retainer to brake backing plate (Fig. 4-5).

5. Pull axle shafts outward far enough to remove universal joint from differential and carrier assembly. Do not drag splines on lip of oil seal on side of differential and carrier.

6. Disconnect speedometer cable from differential and carrier assembly.

7. Remove four bolts connecting differential and carrier to transmission.

8. Remove two bolts securing differential and carrier to rear crossmember. Remove bolt bracket (Fig. 4-24).

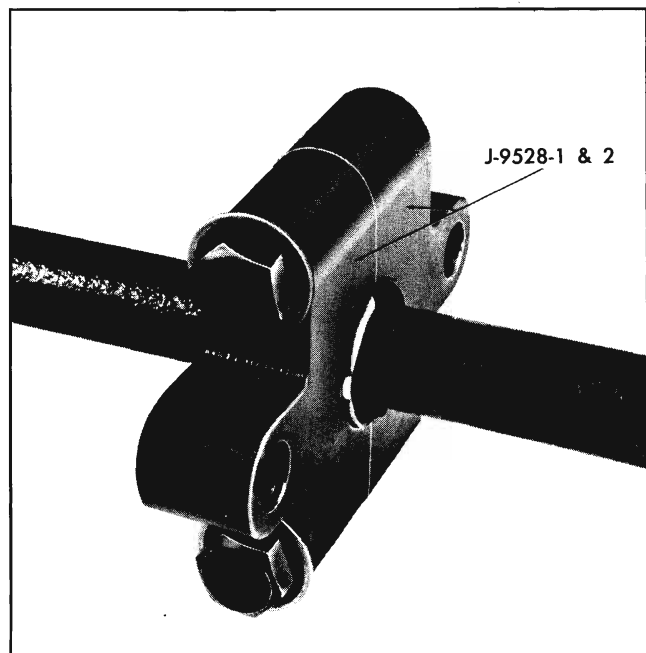


Fig. 4-22 J-9528-1 & 2 Installed on Shaft

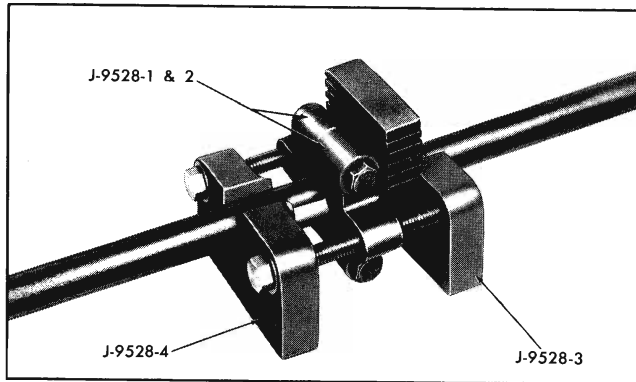


Fig. 4-23 Tool Positioned to Install Bearing

9. Separate transmission from differential and carrier assembly.

10. Carefully lower differential and carrier assembly from car.

INSTALL

1. With new gasket in place install differential and carrier on transmission.

2. Install four differential and carrier to transmission bolts and tighten to 30-35 lb. ft. torque.

3. Install bolt securing transmission and differential assembly to bracket. Install two bolts securing transmission and differential assembly to rear cross-member. Tighten all bolts to 65-85 lb. ft. torque.

4. Install speedometer cable in differential and carrier assembly.

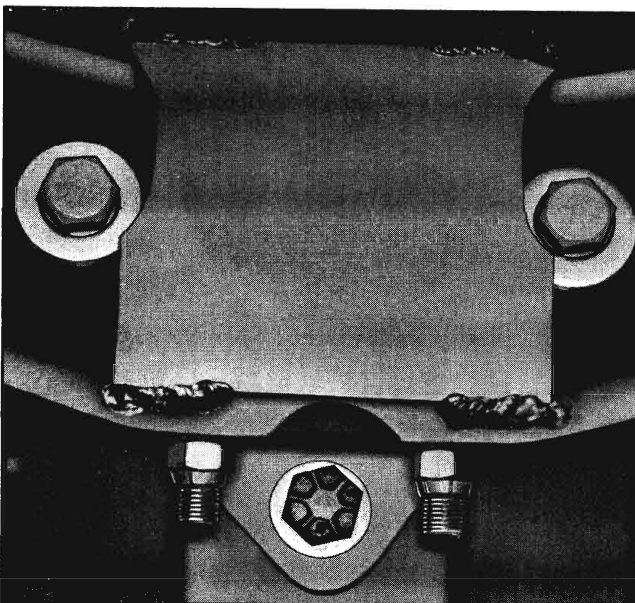


Fig. 4-24 Location of Mounting Bolts

5. Install axle shaft universal joint splines in differential and carrier using extreme care not to damage side cover of oil seal.

NOTE: Coat lip of seal and splines with hypoid oil to prevent damage to seal.

6. Place rear axle bearing retainer in position on brake backing plate and secure with four nuts. Tighten to 30-45 lb. ft. torque.

7. Install wheels and brake drums and secure with five nuts. Tighten to 70-85 lb. ft. torque.

8. Fill both transmission and differential assembly with proper amount of recommended lubricant.

9. Remove all stands and supports and lower car.

MAJOR REPAIRS

REMOVE AND REPLACE TRANS-AXLE ASSEMBLY (SYNCHRO-MESH)

REMOVE

1. Raise car so that rear wheels hang free. Support torque tube and transmission-differential assembly separately.

2. Drain both differential and carrier assembly and transmission.

3. Remove wheel and brake drum from each side in rear.

4. Remove four nuts securing axle shaft bearing retainer to brake backing plate (Fig. 4-5).

5. Pull axle shafts outward far enough to remove universal joint from differential and carrier assembly. Do not drag splines on lip of oil seal on side of differential and carrier.

CAUTION: Cover universal joint splines to protect them from damage.

6. Disconnect speedometer cable and parking brake spring from differential and carrier assembly.

7. Remove six bolts connecting torque tube to transmission extension.

8. Remove two bolts securing differential and carrier assembly to rear crossmember. Remove bolt from bracket (Fig. 4-24).

9. Remove muffler support bracket from torque tube.

10. Separate trans-axle assembly from torque tube and propeller shaft.

CAUTION: Pull trans-axle assembly straight off propeller shaft so that propeller shaft will not bind in transmission.

- Carefully lower trans-axle assembly from car.

REPLACE

- Carefully install trans-axle assembly on propeller shaft and torque tube.
 - Install six bolts connecting torque tube to transmission extension and tighten to 30-45 lb. ft. torque.
 - Install bolt securing transmission and differential assembly to bracket. Install two bolts securing transmission and differential assembly to rear crossmember. Tighten all bolts to 65-85 lb. ft. torque.
 - Install muffler support bracket to torque tube.
 - Install speedometer cable in differential and carrier assembly.
 - Install axle shaft universal joint splines in differential and carrier assembly using extreme care so as not to damage side cover oil seal.
- NOTE:** Coat lip of seal and splines with hypoid oil to prevent damage to seal.
- Place rear axle bearing retainer in position on brake backing plate and secure with four nuts. Tighten to 30-45 lb. ft. torque.
 - Install wheels and brake drums and secure with five nuts. Tighten to 70-85 lb. ft. torque.
 - Fill both transmission and differential assembly with proper amount of lubricant.
 - Remove all stands and supports.

REMOVE AND REPLACE TRANS-AXLE ASSEMBLY (AUTOMATIC TRANSMISSION)

REMOVE

- Raise car so that rear wheels hang free. Support trans-axle assembly and torque tube separately.
- Drain lubricant from both differential and carrier assembly and transmission.
- Remove wheel and brake drum assembly from each side in rear.
- Remove four nuts securing axle shaft bearing retainer to brake backing plate (Fig. 4-5).
- Pull axle shafts outward far enough to remove universal joint splines from differential and carrier assembly. Do not drag splines on lip of oil seals on side of differential and carrier assembly.

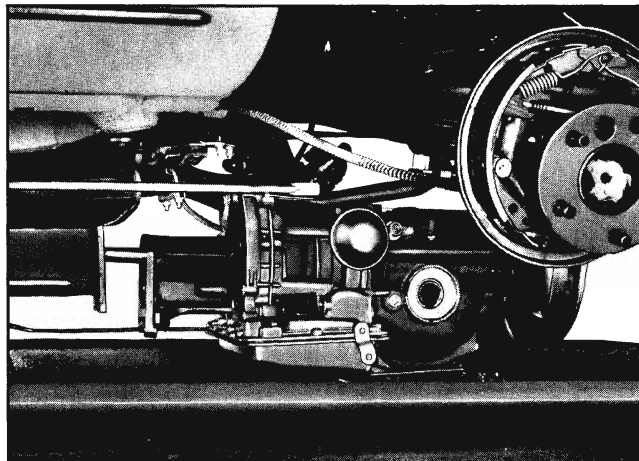


Fig. 4-25 Separating Trans-Axle from Torque Tube

CAUTION: Cover universal joint splines to protect them from damage.

- Disconnect vacuum line, parking brake return spring, TV rod, transmission control cable and speedometer cable.
- Remove two bolts holding transmission filler tube to differential and carrier assembly and remove filler tube.
- Remove two bolts securing differential and carrier assembly to rear crossmember. Remove bolt from bracket (Fig. 4-24).
- Remove six bolts connecting transmission extension to torque tube.
- Separate trans-axle assembly from torque tube (Fig. 4-25).
- Carefully lower trans-axle assembly from car.

REPLACE

- Carefully install trans-axle assembly on propeller shaft and torque tube.
- Install six bolts and tighten to 30-45 lb. ft. torque.
- Install bolt securing differential and carrier assembly to bracket. Install two bolts securing transmission and differential assembly to rear crossmember. Tighten all bolts to 65-85 lb. ft. torque.
- Install speedometer cable in differential and carrier assembly.
- Connect vacuum line, parking brake return spring T.V. rod and transmission control cable.

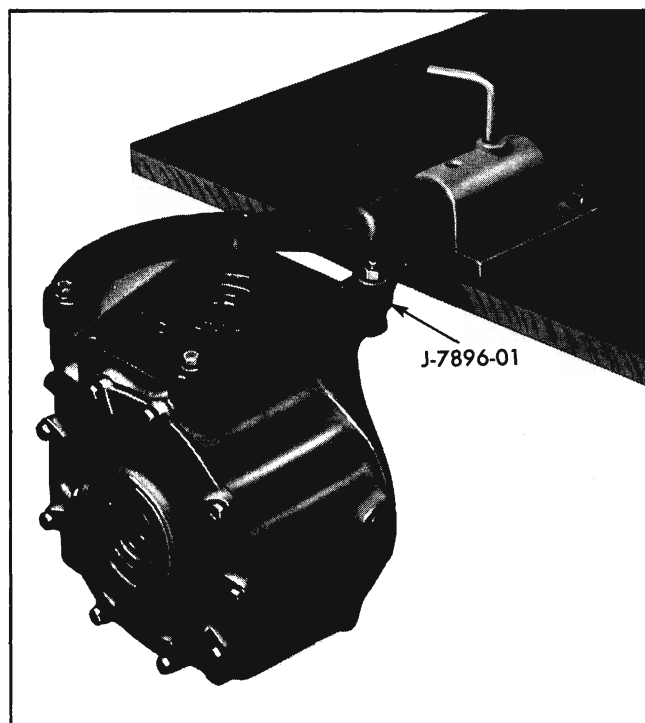


Fig. 4-26 Carrier Assembly Mounted on Fixture

6. Install axle shaft universal joint splines in differential and carrier assembly using extreme care not to damage oil seal on side of differential and carrier.

NOTE: Coat lip of seal and splines with hypoid oil to prevent damage to seal.

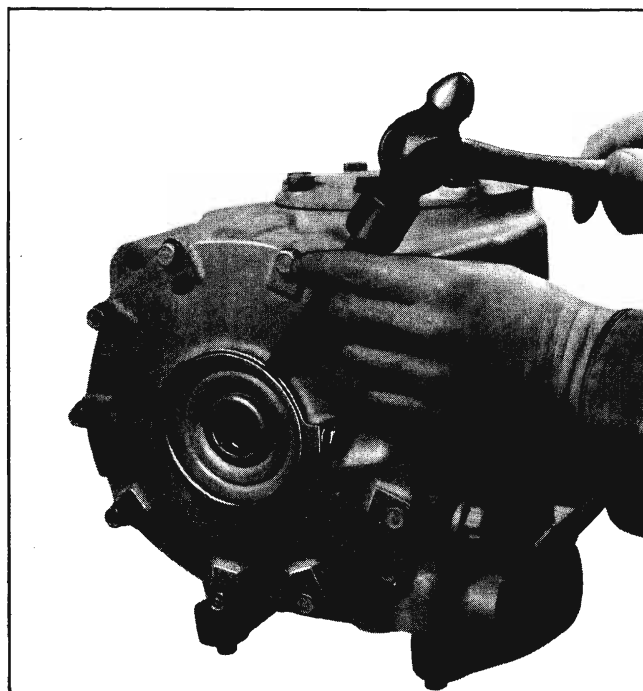


Fig. 4-27 Removing Side Bearing Oil Seal

7. Place rear axle bearing retainer in position on brake backing plate and secure with four nuts. Tighten to 30-45 lb. ft. torque.

8. Install wheels and brake drums and secure with five nuts. Tighten to 70-85 lb. ft. torque.

9. Fill both transmission and differential assembly with respective and proper amount of lubricant.

10. Remove all stands and supports.

DISASSEMBLY OF DIFFERENTIAL AND CARRIER ASSEMBLY

1. Separate differential and transmission.

2. Pull off governor drive gear and spacers (automatic transmission only).

3. Mount differential on holding fixture J-7896-01 (Fig. 4-26).

4. Remove differential side bearing oil seals (Fig. 4-27.)

5. Remove differential carrier side cover from carrier.

CAUTION: Differential case and ring gear assembly are held in position by side cover and will be free when cover is removed.

6. Remove differential case and ring gear assembly from carrier.

7. In order to provide complete diagnosis, a red lead test should be made as described on page 4-26.

8. Remove front pinion bearing adjusting nut lock.

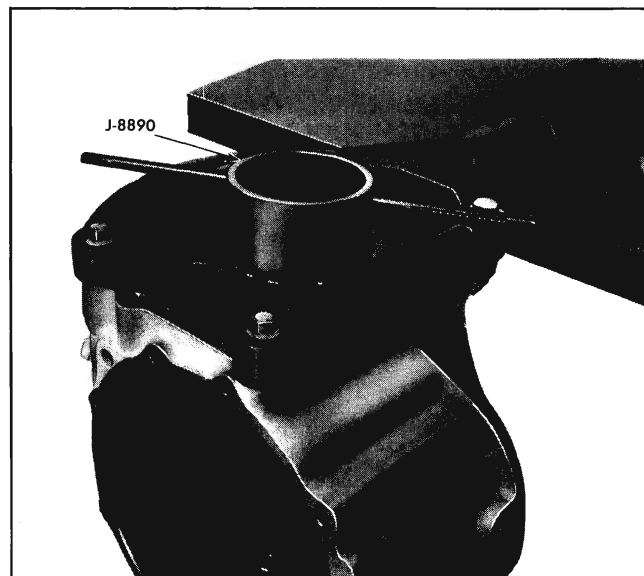


Fig. 4-28 Tool Positioned to Remove Front Pinion Bearing Adjusting Nut

9. Remove front pinion bearing adjusting nut using J-8890 (Fig. 4-28).

10. Remove pinion and shaft assembly from carrier.

11. Remove pinion rear bearing retainer and shim pack. Remove rubber oil passage seal (automatic only). (If difficulty should arise tap retainer out from front of case.)

12. Remove side bearing adjusting nut lock screw.

13. Remove side bearing adjusting nut from carrier.

14. Remove side bearing race from carrier. (If race is difficult to remove, screw in adjusting nut until race is pushed out into carrier housing. Remove adjusting nut from carrier.)

15. Remove drain and filler plugs from carrier housing.

16. Remove adjusting nut lock screw, adjusting nut, bearing race, and "O" ring seal from side cover.

OVERHAUL: DIFFERENTIAL CASE AND RING GEAR ASSEMBLY (EXCEPT FOUR SPEED SYNCHRO-MESH TRANSMISSION)

DISASSEMBLE

1. If side bearing or case is to be replaced, remove bearings using J-8900 and J-8614 (Fig. 4-29).

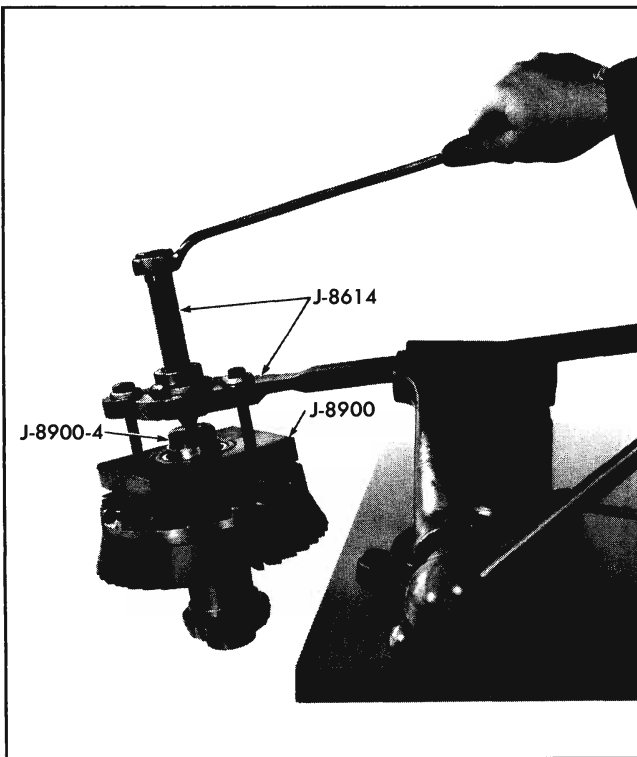


Fig. 4-29 Removing Side Bearing

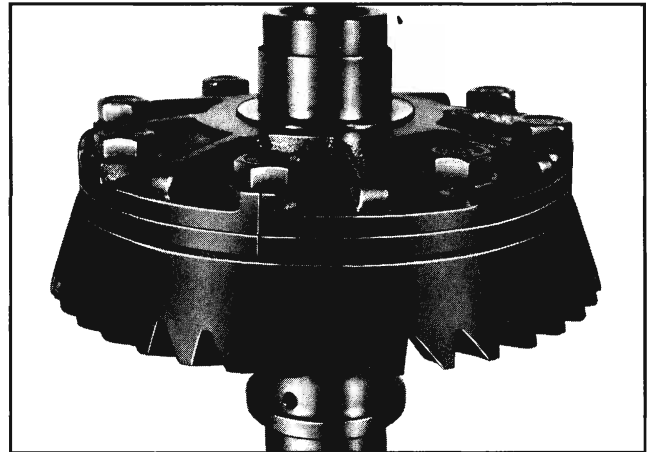


Fig. 4-30 Scribe Mark on Differential

2. A mark is scribed across parting line of differential case and cover to aid in alignment on reassembly (Fig. 4-30).

3. Place differential case in soft jawed vise and remove 8 ring gear retaining bolts.

4. Install two ring gear attaching bolts partially into ring gear.

5. Using ball peen hammer, tap ring gear off of case (Fig. 4-31).

6. Separate cover and case (Fig. 4-32).

7. Remove side gear and thrust washer from cover half.

8. Drive out roll pin which retains cross shaft (Fig. 4-33).

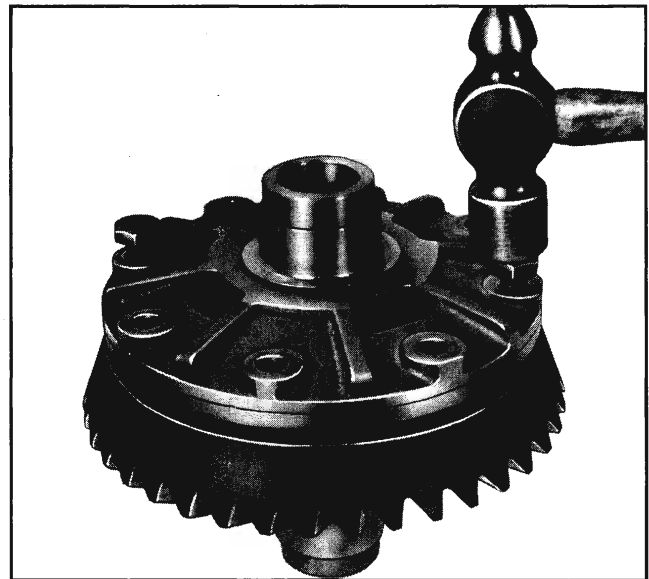


Fig. 4-31 Removing Ring Gear from Case



Fig. 4-32 Separating Cover and Case

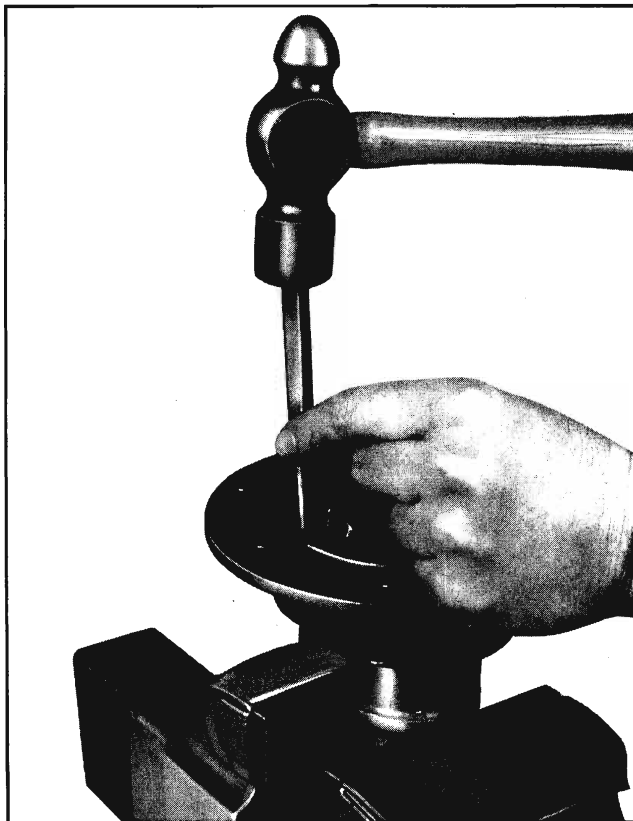


Fig. 4-33 Removing Roll Pin

9. Drive out cross shaft.

10. Remove pinions, thrust washers, and side gear from case.

INSPECT

1. Clean all parts of assembly with cleaning fluid.
2. Inspect all castings for cracks or other damage.
3. Inspect all bearings for loose rollers, flaked or pitted rollers, and locking of bearings.
4. Inspect gears for nicks and scoring.
5. Replace all excessively worn or damaged parts.

ASSEMBLE

1. Install side gear and thrust washer in case.
2. Install two pinion gears and thrust washers in case.
3. Drive cross shaft into case being sure to align holes for pin.
4. Install pin through cross shaft.
5. Install side gear and thrust washer in cover.
6. Install cover on case being sure to align scribe marks.
7. Install bolts through case into ring gear. Tighten to 55-60 lb. ft. torque.

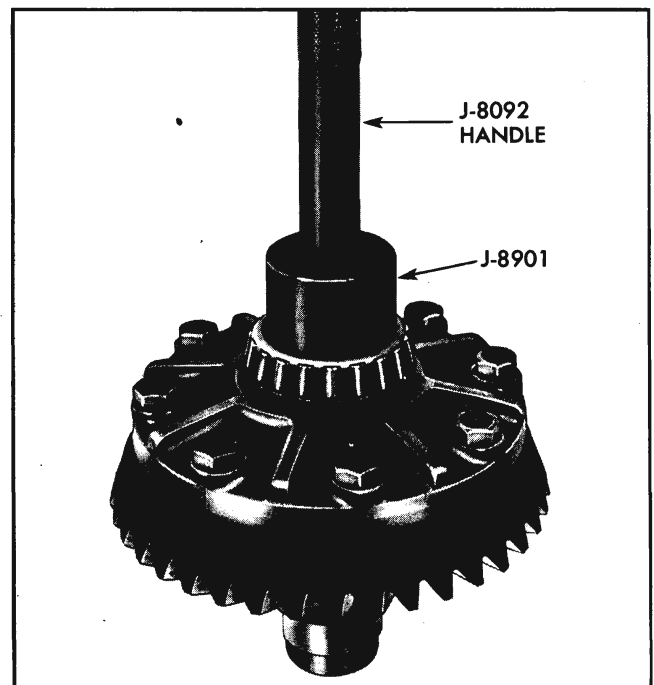


Fig. 4-34 Installing Differential Side Bearing

8. Press on side bearings using J-8901 and J-8092 handle (Fig. 4-34).

OVERHAUL: DIFFERENTIAL CASE AND RING GEAR (FOUR SPEED SYNCHRO-MESH TRANSMISSION)

DISASSEMBLE

1. If side bearing or case is to be replaced, remove bearings using J-8900 and J-8614 (Fig. 4-29).
2. A mark is scribed across parting line of differential case and cover to aid in alignment on reassembly (Fig. 4-30).
3. Place differential case in soft jawed vise and remove 8 ring gear retaining bolts.
4. Install two ring gear attaching bolts partially into ring gear.
5. Using ball peen hammer, tap ring gear off of case (Fig. 4-31).
6. Separate cover and case.
7. Remove side gear and thrust washer from cover half.
8. Drive out roll pins which retain cross shafts.
9. Drive out cross shafts.
10. Remove differential pinion shaft ring from case (Fig. 4-35).
11. Remove pinions and thrust washers from case.
12. Remove side gear from case.

INSPECT

1. Clean all parts of assembly with cleaning fluid.
2. Inspect all castings for cracks or other damage.
3. Inspect all bearings for loose rollers, flaked or pitted rollers, and locking of bearings.
4. Inspect gears for nicks and scoring.
5. Replace all excessively worn or damaged parts.

ASSEMBLE

1. Install side gear and thrust washer in case.
2. Install pinion gears and thrust washers in case.
3. Install differential shaft ring in case.
4. Drive cross shafts into case being sure to align hole for pin.
5. Install pins through cross shafts.

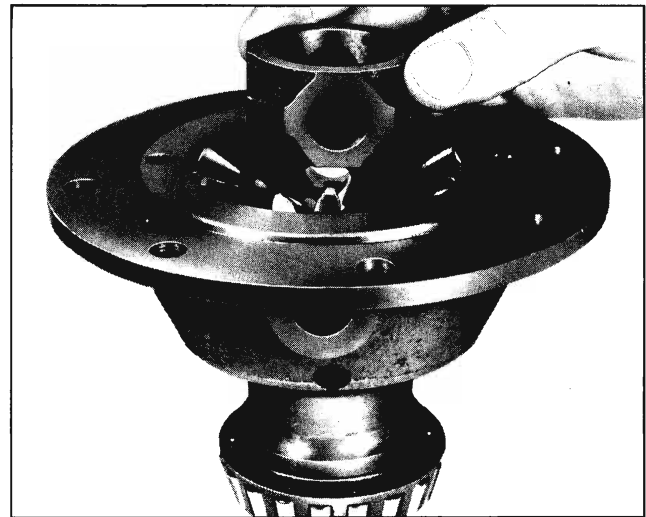


Fig. 4-35 Removing Differential Ring from Case

6. Install side gear and thrust washer in cover.
7. Install cover on case being sure to align scribe marks.
8. Install bolts through case into ring gear. Tighten to 55-65 lb. ft. torque.
9. Press on side bearings, if removed, using J-8901 and J-8092 handle (Fig. 4-34).

OVERHAUL: PINION AND SHAFT ASSEMBLY

DISASSEMBLE

1. Remove oil ring from pinion shaft (automatic only).

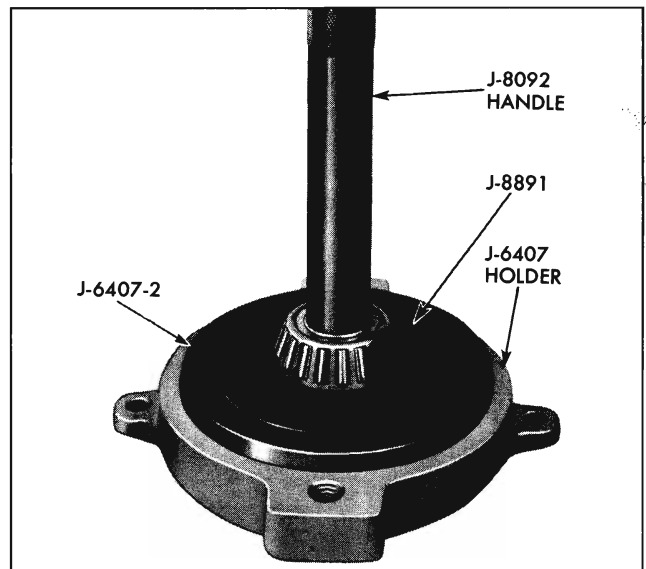


Fig. 4-36 Removing Front Pinion Bearing

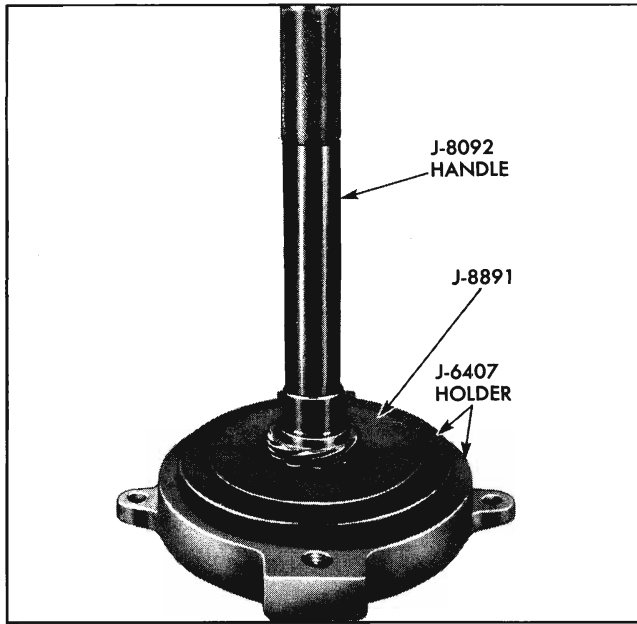


Fig. 4-37 Removing Speedometer Drive Gear

2. Remove front pinion bearing—press off using J-8891 in J-6407 holder and J-8092 handle (Fig. 4-36).

CAUTION: Be sure speedometer drive gear is clear of yoke of press.

3. Press off speedometer gear using J-8891 held in J-6407 holder and J-8092 handle (Fig. 4-37).

4. Press off rear pinion bearing using tool J-8893 in J-6407 holder. Press on pinion shaft using J-8901 synchro-mesh, use J-8887 (Fig. 4-38) on automatic.

5. Place rear pinion bearing in rear pinion bearing

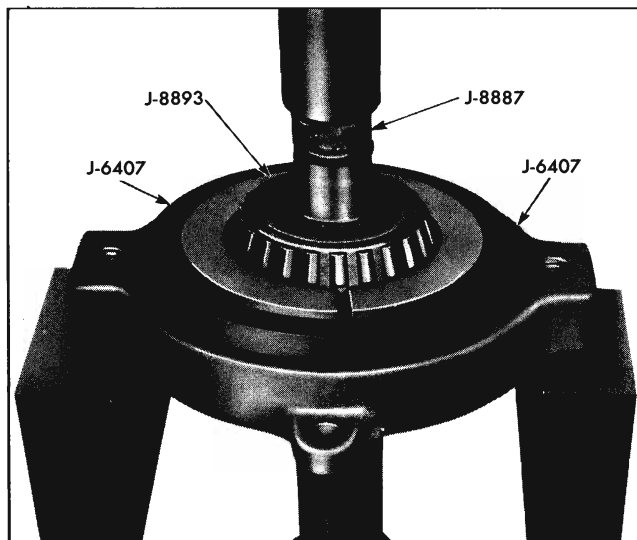


Fig. 4-38 Removing Rear Pinion Bearing

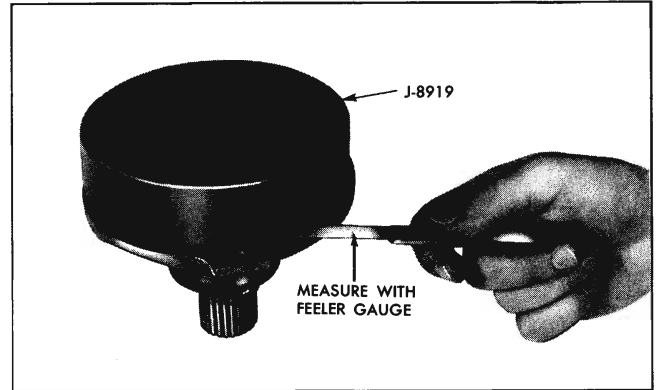


Fig. 4-39 Determining Shim Thickness Required

retainer. Place tool J-8919 on retainer as shown (Fig. 4-39). Use feeler gauge as shown to determine correct shim thickness required for reassembly. Use chart (Fig. 4-40) to convert feeler gauge readings to shim specifications. If pinion shaft is marked on end of shaft use chart (Fig. 4-41) for correction.

CAUTION: If bearing race is to be replaced, replace before attempting to determine shim requirements.

Demension Determined With Feeler Gauge	MARK ON CARRIER						
	4.583	4.582	4.581	4.580	4.579	4.578	4.577
	-3	-2	-1	NO MARK	+1	+2	+3
.038	.030	.031	.032	.033	.034	.035	.036
.037	.029	.030	.031	.032	.033	.034	.035
.036	.028	.029	.030	.031	.032	.033	.034
.035	.027	.028	.029	.030	.031	.032	.033
.034	.026	.027	.028	.029	.030	.031	.032
.033	.025	.026	.027	.028	.029	.030	.031
.032	.024	.025	.026	.027	.028	.029	.030
.031	.023	.024	.025	.026	.027	.028	.029
.030	.022	.023	.024	.025	.026	.027	.028
.029	.021	.022	.023	.024	.025	.026	.027
.028	.020	.021	.022	.023	.024	.025	.026
.027	.019	.020	.021	.022	.023	.024	.025
.026	.018	.019	.020	.021	.022	.023	.024
.025	.017	.018	.019	.020	.021	.022	.023
.024	.016	.017	.018	.019	.020	.021	.022
.023	.015	.016	.017	.018	.019	.020	.021
.022	.014	.015	.016	.017	.018	.019	.020
.021	.013	.014	.015	.016	.017	.018	.019
.020	.012	.013	.014	.015	.016	.017	.018

Fig. 4-40 Shim Chart

PINION CORRECTION CHART	
MARK	CORRECTION TO BE APPLIED TO SHIM STACK WHEN PINION IS MARKED
-4	ADD .004 TO SHIM STACK
-3	ADD .003 TO SHIM STACK
-2	ADD .002 TO SHIM STACK
-1	ADD .001 TO SHIM STACK
NO MARK	MAKE NO CORRECTION
+1	SUBTRACT .001 FROM SHIM STACK
+2	SUBTRACT .002 FROM SHIM STACK
+3	SUBTRACT .003 FROM SHIM STACK
+4	SUBTRACT .004 FROM SHIM STACK

Fig. 4-41 Pinion Correction Chart

ASSEMBLE

1. Press on rear pinion bearing use J-8894 and J-8092 handle (Fig. 4-42).

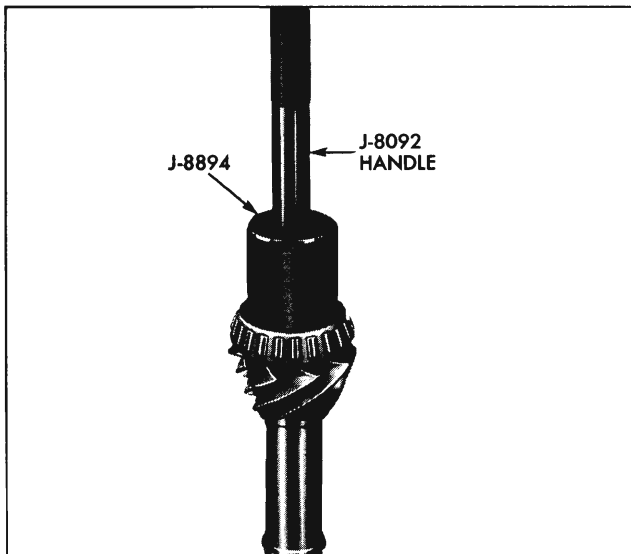


Fig. 4-42 Tool Positioned to Install Rear Pinion Bearing

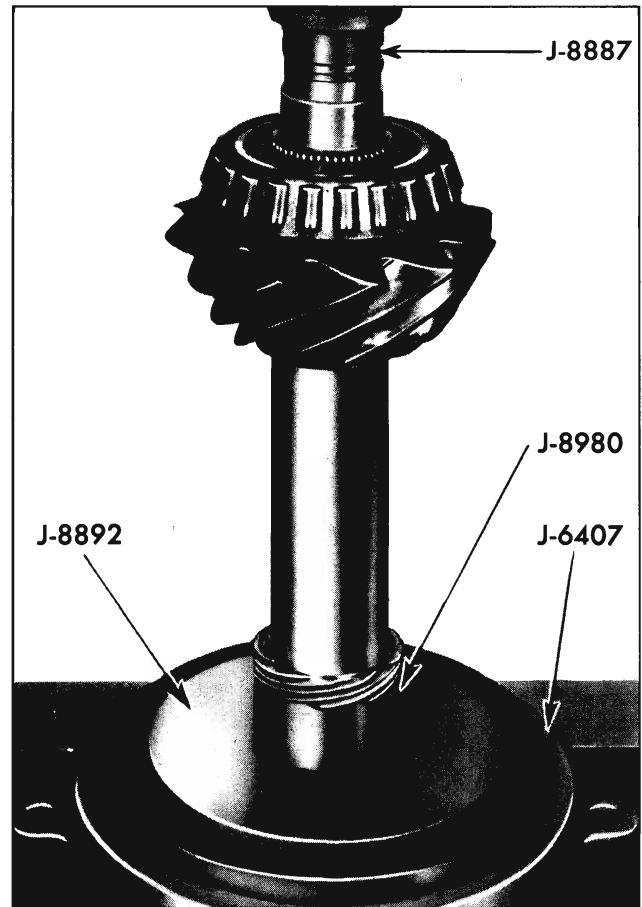


Fig. 4-43 Installing Speedometer Drive Gear

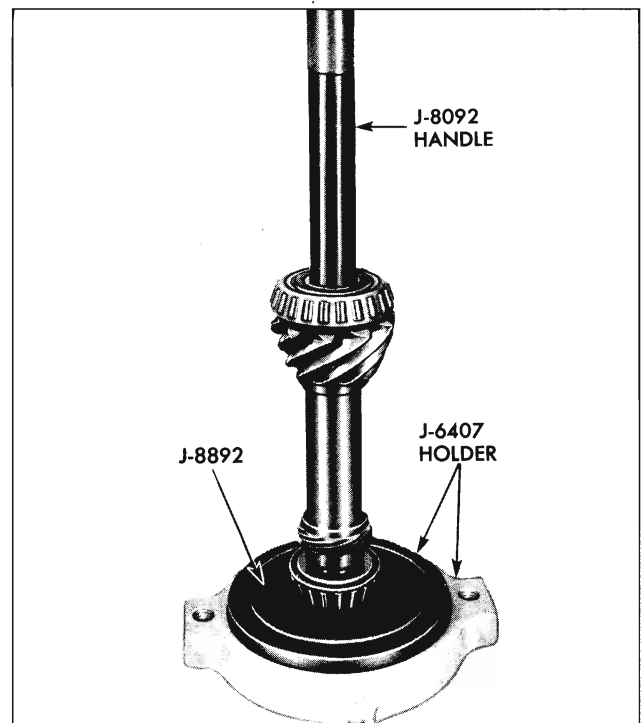


Fig. 4-44 Installing Front Pinion Bearing

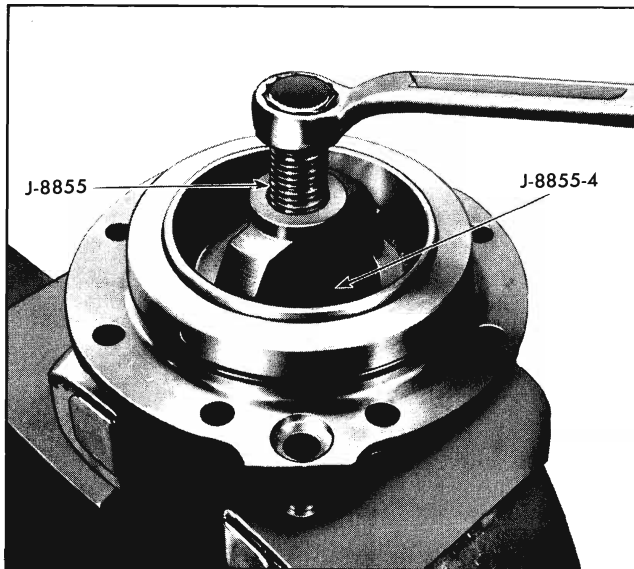


Fig. 4-45 Removing Rear Pinion Bearing Outer Race

2. Press on speedometer drive gear using J-8980 spacer with J-8892 in J-6407 holder. Use J-8887 installed on end of pinion shaft (Fig. 4-43) on automatic only.

3. Press on front pinion bearing using J-8892 in J-6407 holder and J-8092 handle (Fig. 4-44).

4. Replace oil ring on shaft (automatic only).

OVERHAUL: REAR PINION BEARING RETAINER (SYNCHRO-MESH TRANSMISSION)

DISASSEMBLE

1. Remove "O" ring seal from retainer.

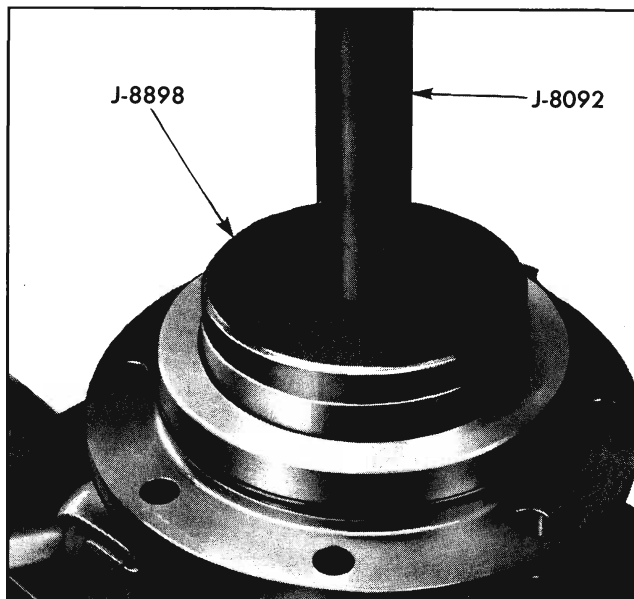


Fig. 4-46 Installing Rear Pinion Bearing Outer Race



Fig. 4-47 Removing Rear Pinion Oil Seal

2. Remove rear pinion bearing outer race using J-8855 and button J-8855 (Fig. 4-45).

ASSEMBLE

1. Install rear pinion bearing outer race using J-8898 with J-8092 handle (Fig. 4-46).

2. Install new "O" ring seal.

OVERHAUL: REAR PINION BEARING RETAINER (AUTOMATIC TRANSMISSION)

DISASSEMBLE

1. Remove "O" ring seal from rear pinion bearing retainer.

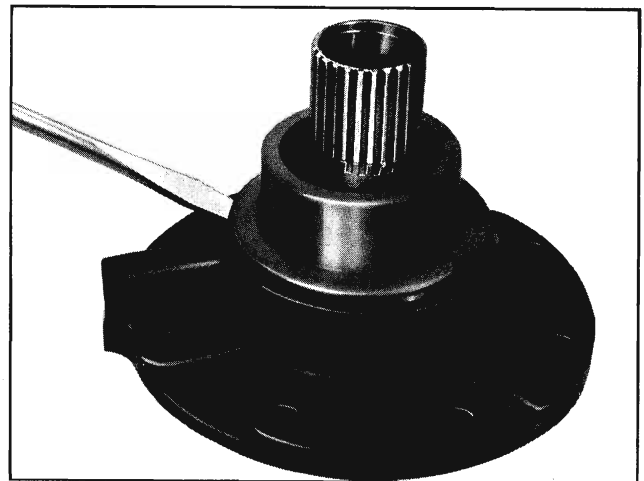


Fig. 4-48 Removing Rear Flange and Stator Seal

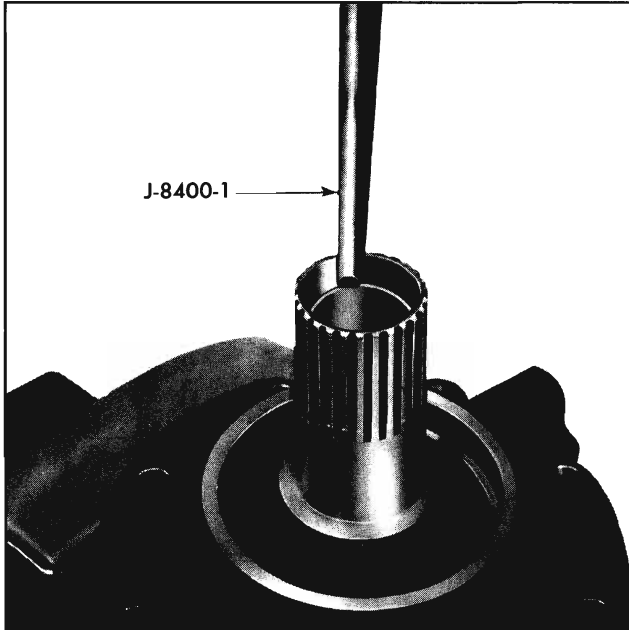


Fig. 4-49 Removing Stator Shaft Bushing

2. Secure rear bearing retainer in soft jawed vise being careful not to damage splined shaft.

CAUTION: Clamp on O.D. of retainer or on flange that supports stator oil seal. Do not clamp on splined stem that supports the turbine.

3. Remove rear oil seal from retainer using small chisel or other suitable tool (Fig. 4-47).

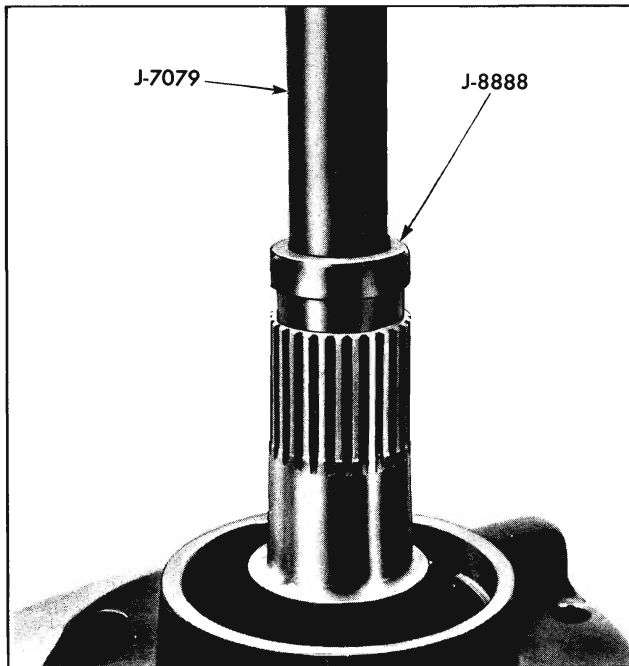


Fig. 4-50 Installing New Bushing

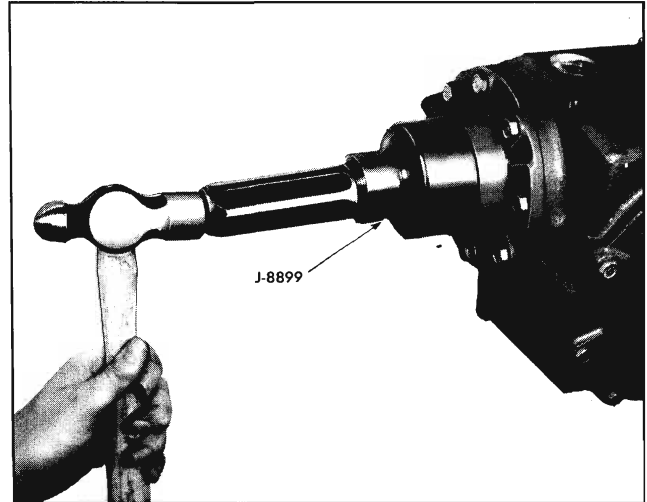


Fig. 4-51 Installing Rear Flange and Oil Seal

4. Remove rear pinion bearing outer race from retainer using tool J-8855 with J-8855-4 adapter (Fig. 4-45).

5. Pry off rear flange and stator seal as shown (Fig. 4-48).

6. Remove stator shaft bushing using tool J-8400-1 (Fig. 4-49).

ASSEMBLE

1. Install new bushing using tool J-8888 with J-7079 handle (Fig. 4-50).

2. Apply uniform bead of sealer and install new rear flange and oil seal using J-8899 (Fig. 4-51).

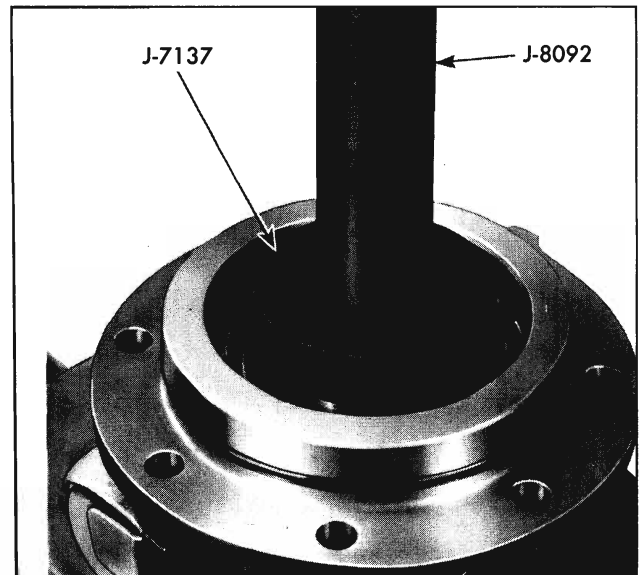


Fig. 4-52 Installing Rear Pinion Oil Seal

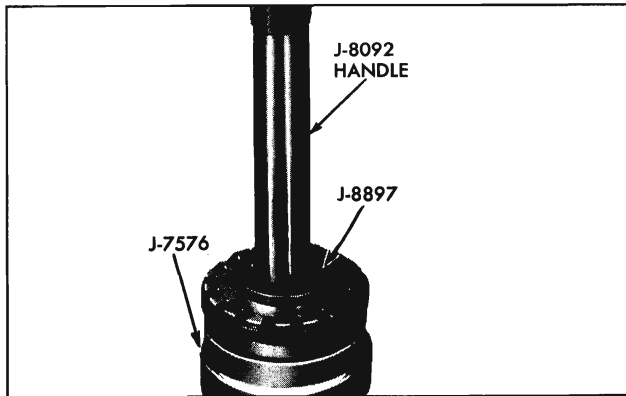


Fig. 4-53 Tool Positioned to Remove Front Pinion Bearing Outer Race (Synchro-mesh)

3. Install new seal using suitable flat surface tool such as J-7137 with J-8092 handle (Fig. 4-51).

4. Install rear pinion bearing outer race using tool J-8898 with J-8092 handle (Fig. 4-52).

5. Install new "O" ring seal on rear pinion bearing retainer.

OVERHAUL: FRONT PINION BEARING ADJUSTING NUT

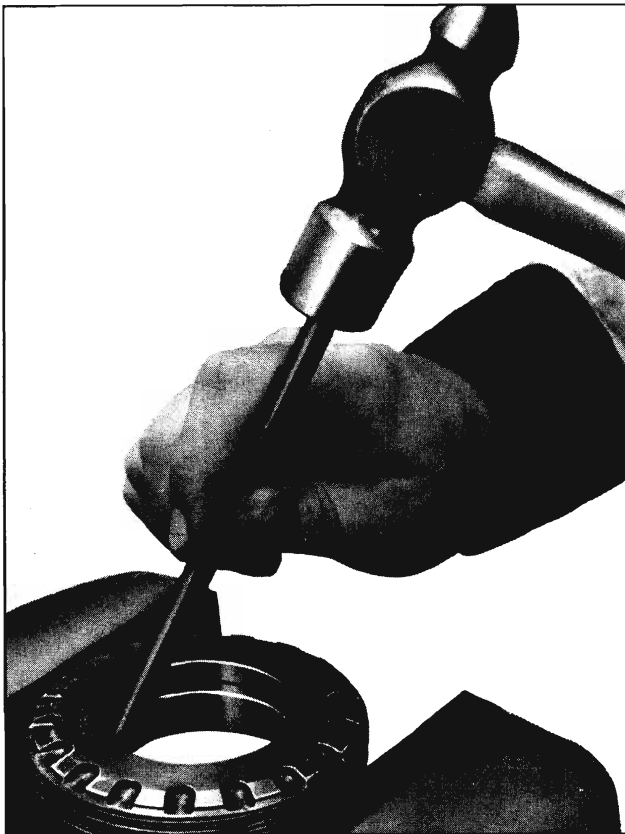


Fig. 4-54 Removing Front Pinion Bearing Outer Race (Automatic)

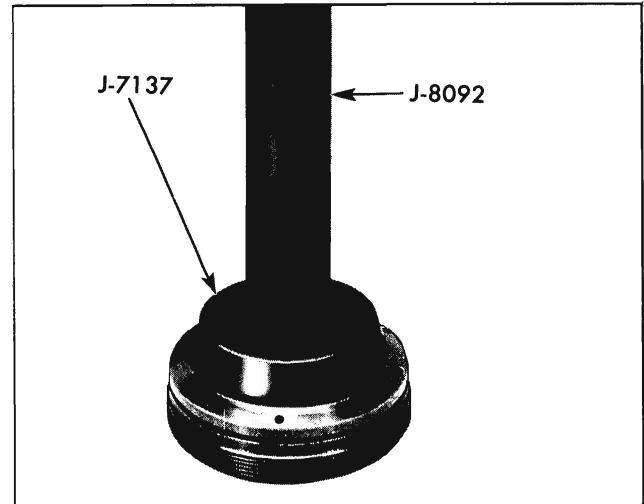


Fig. 4-55 Tool Positioned to Install Front Pinion Bearing Outer Race

DISASSEMBLE

1. Remove "O" ring seal from nut (automatic only).

2. Remove oil seal from nut by tapping out from rear of nut (automatic only).

3. Remove front pinion bearing race:

STANDARD TRANSMISSION: Supporting nut on tool J-7576 using J-8897 with J-8092 handle, press out race on arbor press (Fig. 4-53).

AUTOMATIC TRANSMISSION: Holding nut in soft jawed vise, drive race out of nut using drift and ball peen hammer (Fig. 4-54).

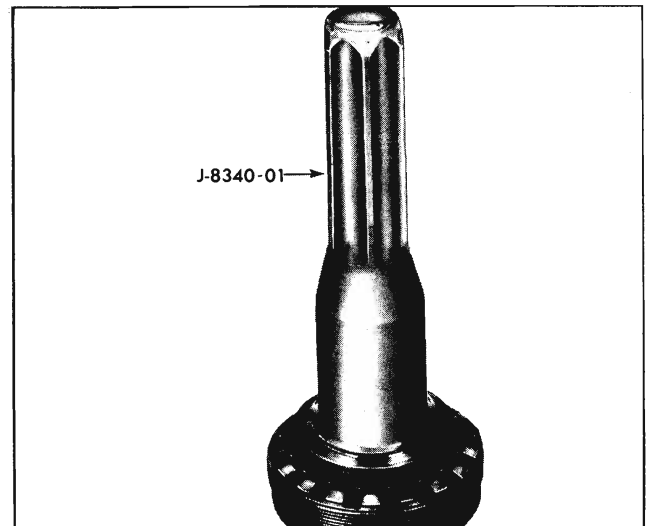


Fig. 4-56 Tool Positioned to Install Front Oil Seal (Automatic only)

REASSEMBLE

1. Install front bearing race in nut using tool J-7137 with J-8092 handle (Fig. 4-55).
2. Apply uniform bead of sealer and replace front oil seal (automatic transmission only) using tool J-8340 (Fig. 4-56).
3. Install new "O" ring seal (automatic transmission only).

ASSEMBLE AND ADJUST DIFFERENTIAL AND CARRIER

1. Install side bearing race in carrier casting.
2. Start side bearing adjusting nut in carrier casting. Five turns in at this time.
3. Position side bearing race in side cover and start side bearing adjusting nut.
4. Position ring gear and differential case in carrier casting.
5. With oil seal removed, place side cover on case and retain with four bolts. Be sure the two aligning bolts are installed in the correct holes.
6. Turn side bearing adjusting nut in cover casting finger tight.
7. Install J-8903 in end of differential cross shaft through side cover.
8. Adjust side bearing preload to 10-20 lb. in. by turning side bearing adjusting nut in carrier using tool J-8902 (Fig. 4-57). Check side bearing preload using J-8903 in shaft and J-7754 torque wrench (Fig. 4-58).
9. Install adjusting nut lock screws and washers in carrier and cover.

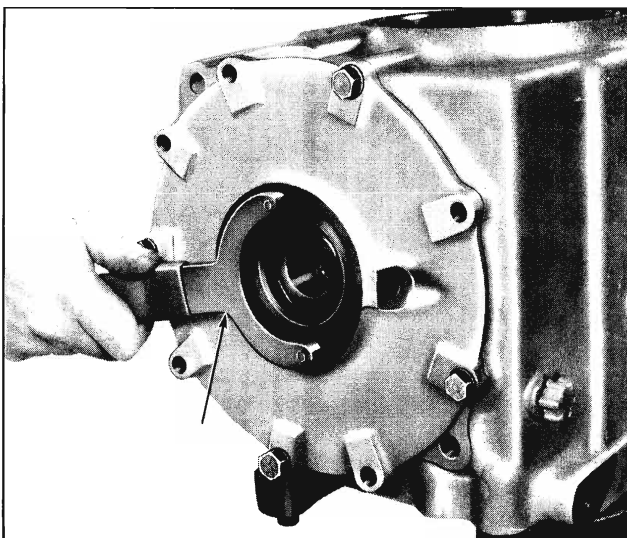


Fig. 4-57 Adjusting Side Bearing Preload

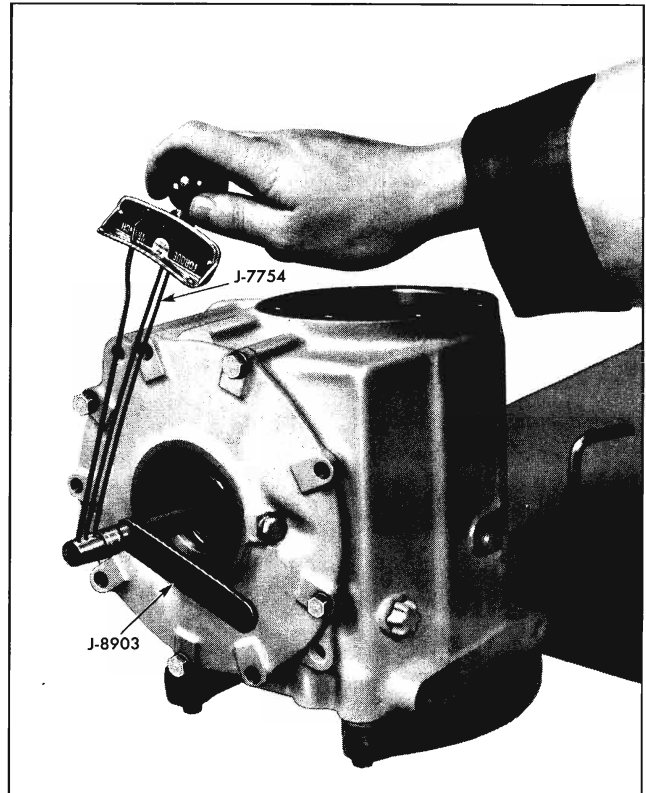


Fig. 4-58 Checking Side Bearing Preload

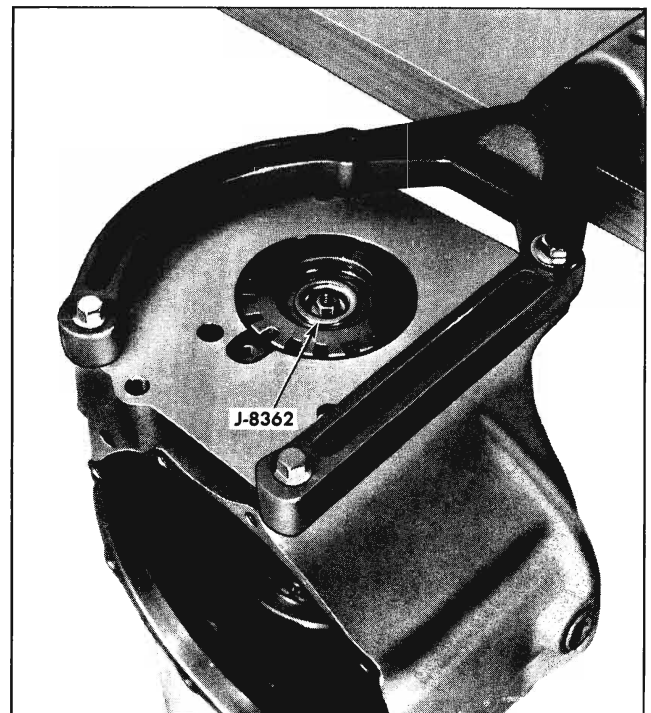


Fig. 4-59 J-8362 Installed in Pinion Shaft

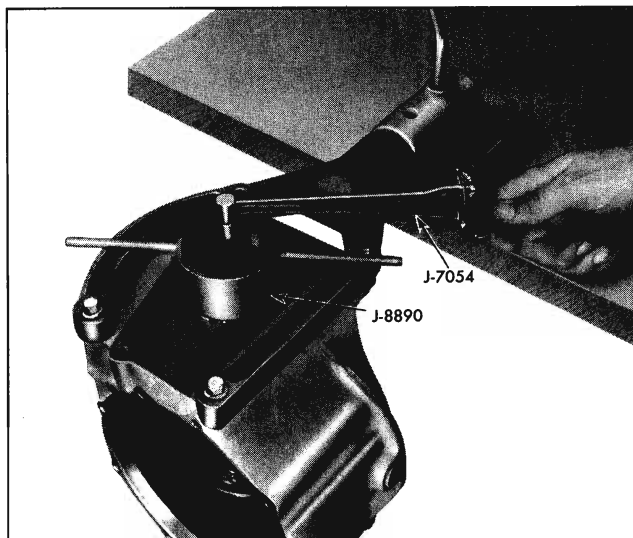


Fig. 4-60 Adjusting Pinion Bearing Preload

10. Remove tool J-8903 from shaft.

11. Remove side cover from carrier.

CAUTION: Differential case and ring gear assembly are held in position by side cover and will be free when cover is removed.

12. Remove differential case and ring gear assembly from carrier housing.

13. Install shim pack thickness as determined, page 4-20, step 5. Install new rubber oil passage seal (automatic transmission only). Install new "O" ring on rear pinion bearing retainer. Install retainer on housing using 8 bolts.

14. Tighten bolts to 25-40 lb. ft. of torque.

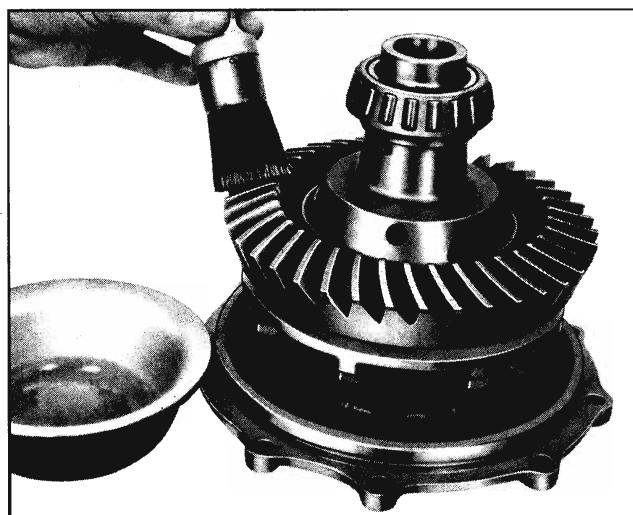


Fig. 4-61 Painting Ring Gear

15. Invert carrier and position pinion shaft assembly in carrier. Care should be used so as not to damage oil ring on shaft or seal on automatic transmission.

16. Install pinion adjusting nut assembly two turns. Install new "O" ring seal on automatic transmission.

17. Tighten nut until play of pinion shaft is eliminated with tool J-8890.

18. Install J-8362 inside pinion shaft and tighten nut (Fig. 4-59). Adjust pinion bearing preload to 10-16 lb. in. of torque (Fig. 4-60).

19. Paint ring gear with red lead as described on page 4-27 (Fig. 4-61).

20. Position ring gear and differential assembly in carrier.

21. Install side cover without "O" ring seal and retain with four bolts.

22. Remove side bearing adjusting nut lock screws.

23. Install tool J-8903 inside of differential shaft and set up dial indicator J-8001 on support J-3387-3 as illustrated (Fig. 4-62). Dial indicator should rest squarely on line scribed on handle of J-8903.

24. Insert large screwdriver in other end of differential shaft.

25. Adjust ring gear and pinion back lash to .004"-.009" by loosening one adjustment nut and tightening the other one notch at a time. Move ring gear toward pinion to decrease backlash and away from pinion to increase backlash.

CAUTION: Do not rotate pinion.

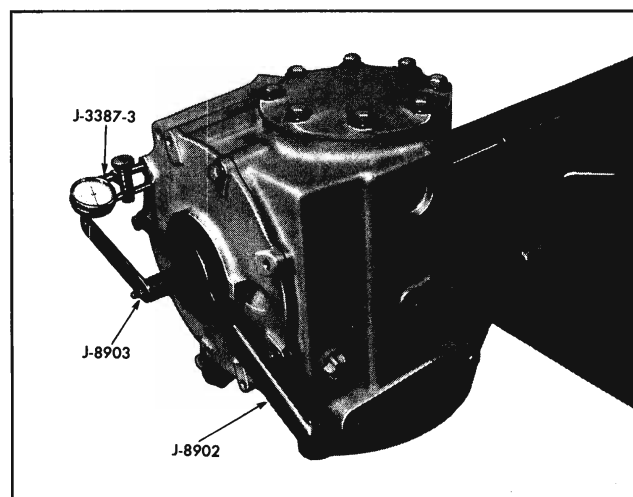


Fig. 4-62 Tools in Position for Adjusting Backlash

26. Remove dial indicator J-8001 and support rod J-3387.

27. Reinstall side bearing adjusting nut lock screws (10-20 lb. in. torque).

28. Rotate pinion shaft clockwise 4 turns and counterclockwise 4 turns while creating a drag on tool J-8903.

29. Remove side cover and ring gear assembly.

30. Analyze tooth patterns and make corrections as described in section on red lead test, page 4-27.

CAUTION: Any change in shim pack will require new pinion bearing preload and side bearing backlash adjustment. If no corrections are necessary proceed with reassembly.

31. Reinstall ring gear and differential assembly.

32. Install side cover using new "O" ring seal.

33. Tighten side cover attaching bolts to 15-25 lb. ft. of torque.

34. Apply bead of sealer and install new differential side bearing seals using tool J-8889 (Fig. 4-6).

35. Install drain and filler plug in carrier housing. Coat threads with white lead or suitable sealer.

36. Install governor drive gear and spacers on automatic transmission model as described in Section 7-A.

37. Assemble transmission and differential and carrier assembly. Refer to section 7-A for automatic transmission.

ANALYSIS OF RED LEAD TEST

NOTE: The red lead test should be performed as described on page 4-26 steps 19-30.

The purpose of a red lead test is to show the area and position where the teeth of the pinion gear contact the teeth of the ring gear. This may be changed by an increase or decrease in the shim pack or a change in the backlash. Improper tooth contact will result in excessive gear noise.

The equipment needed to perform the test is a small quantity of powdered red lead, a round stiff bristled stencil brush, a small quantity of clean engine oil, and a small dish or pan. The red lead and stencil brush may be obtained from most paint supply stores. The red lead is mixed with a small quantity of clean engine oil. Several drops of oil and a very small quantity of red lead will provide enough for many applications.

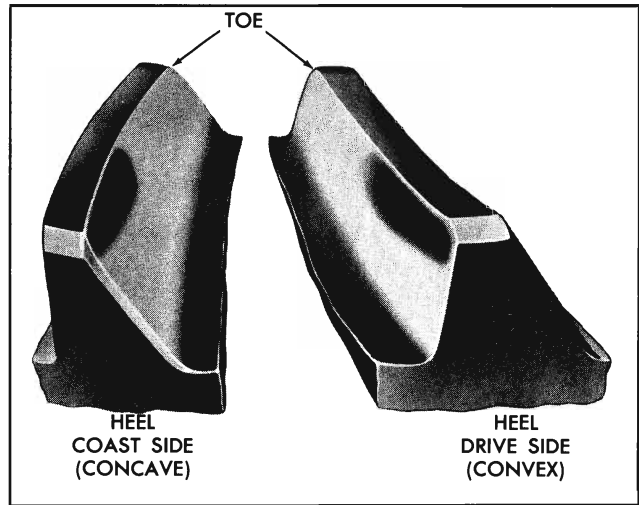


Fig. 4-63 Tooth Pattern—Excess Backlash

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect tooth contact pattern: backlash and position of drive pinion in carrier. The effects of bearing preload are not readily apparent on (hand loaded) red lead tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

BACKLASH is adjusted by means of the side bearing adjusting nuts which move the ring gear assembly closer to or farther from the drive pinion (the adjusting nuts are also used to set side bearing preload).

The **POSITION OF THE DRIVE PINION** is adjusted by increasing or decreasing the shim pack

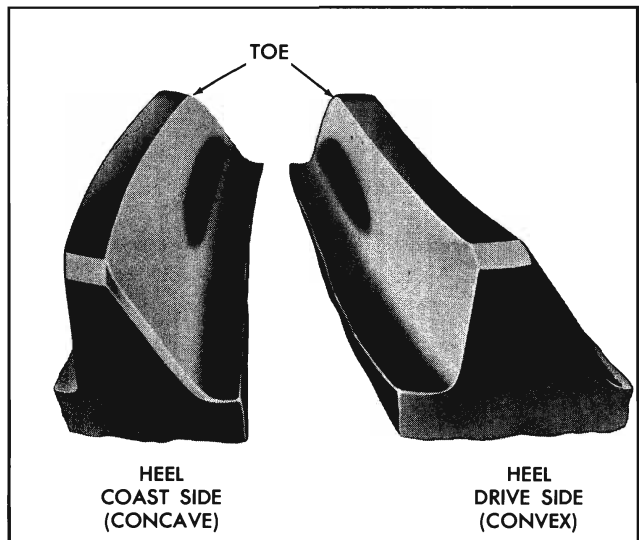


Fig. 4-64 Tooth Pattern—Insufficient Backlash

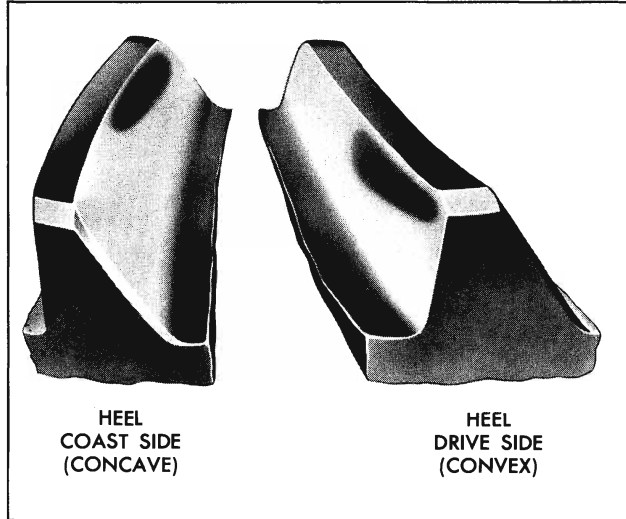


Fig. 4-65 Tooth Pattern—Pinion Too Far Away from Ring Gear

between the rear pinion bearing retainer and the carrier housing. Increasing shim pack thickness will move the pinion farther away from the center line of the ring gear, decreasing shim pack thickness will move pinion closer to the center line of ring gear.

ANALYSIS OF TOOTH CONTACT PATTERNS

Tooth contact pattern is revealed by observing teeth on ring gear after conducting a red lead test (page 4-26). The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side; concave side is the "coast" side. The end of the tooth nearest the center of ring gear is referred to as the "Toe" end; end of tooth farthest away from center is "Heel" end.

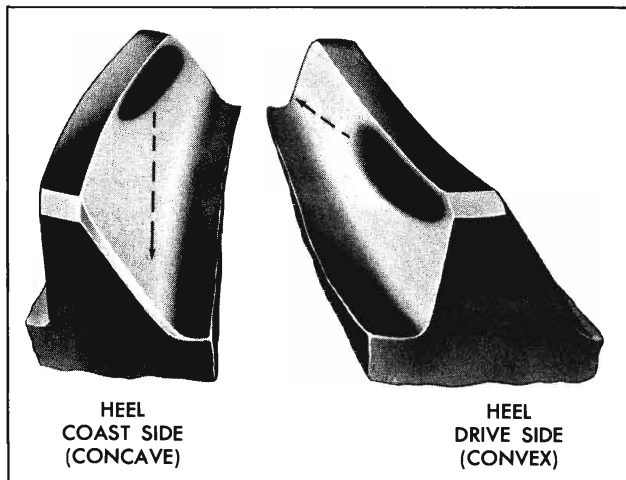


Fig. 4-66 Direction of Tooth Contact Movement—Decreasing Shim Pack

EFFECTS OF BACKLASH ON TOOTH PATTERN

Excess backlash, provided pinion is properly positioned, will give a heel pattern on both drive and coast sides (Fig. 4-63). Decreasing backlash by moving ring gear assembly closer to pinion will cause pattern to move toward the toe and toward the top of teeth on both drive and coast sides.

Insufficient backlash, provided pinion is properly positioned, will give a low toe pattern on both drive and coast sides (Fig. 4-64). Increasing backlash will cause pattern to move toward heel end and up toward top of teeth on both drive and coast sides.

EFFECTS OF PINION POSITION ON TOOTH PATTERN

When drive pinion is too far away from center line of ring gear, the pattern will be a high heel contact on drive side and a high toe contact on coast side (Fig. 4-65) provided backlash is within specifications of .004"-.009". Moving pinion closer to center line of the ring gear by decreasing shim pack thickness will cause the high heel contact on drive side to lower and move toward toe; the high toe contact on coast side will lower and move toward the heel (Fig. 4-66).

When pinion is too close to ring gear the pattern will be a low toe contact on drive side, and a low heel contact on coast (Fig. 4-67), provided backlash is within specifications of .004"-.009". Moving pinion farther away from the ring gear by increasing shim pack thickness will cause the low toe contact on drive side to raise and move toward heel; the low heel contact on coast will raise and move toward toe (Fig. 4-68).

TROUBLE DIAGNOSIS

Many noises reported as coming from the differential actually result from other sources such as tires, body drumming, muffler roar, transmission, engine, speedometer gears, universal joint noise, wheel bearing, torsion bar bearings, etc. A careful check should be made to ensure that the noise in question is in the differential before disassembling. It should be remembered that rear axle gears, like any other mechanical device, are not absolutely quiet and should be accepted as being commercially quiet unless some abnormal noise is present.

To make a systematic check for axle noise under standard conditions, observe the following:

1. Select a level tarvia or asphalt road to reduce tire noise and body drumming.

2. Drive car far enough to thoroughly warm up rear axle lubricant.

3. If noise is present, note speed at which it occurs. With car standing and clutch disengaged, or automatic transmission in neutral, accelerate engine to approximate speed where noise was noticed to determine if it is caused by exhaust or muffler roar or other engine condition. Repeat while engaging and disengaging clutch, transmission in neutral, to see if noise is in transmission.

4. Distinguish between tire noise and differential noise by noting if noise varies with various speeds, sudden acceleration and deceleration; exhaust and axle noise show variations under these conditions while tire noise remains constant and is more pronounced at speeds of 20-30 miles per hour. Further check for tire noise by driving car over smooth pavements or dirt roads (not gravel) with tires at normal pressure. If noise is caused by tires, it will noticeably change or disappear and reappear with changes in road surface.

5. Rear suspension rubber bushings and coil spring insulators dampen out rear axle noise when correctly installed. Check to see that no metal to metal contact exists between rear suspension components or rear suspension and body. Metal to metal contact may result in "telegraphing" road noise and normal axle noise which would not be objectionable if dampened by bushings.

AXLE NOISE

GEAR NOISE

After the noise has been determined as being in the rear axle by following the above appraisal procedure, the type of axle noise should be determined to aid in making repairs if necessary.

Gear noise (whine) is audible from 20 to 65 mph under four driving conditions:

1. Drive—acceleration or heavy pull.
2. Road load—car driving load or constant speed.
3. Float—using enough throttle to keep the car from driving the engine—car slows down gradually but engine still pulls slightly.

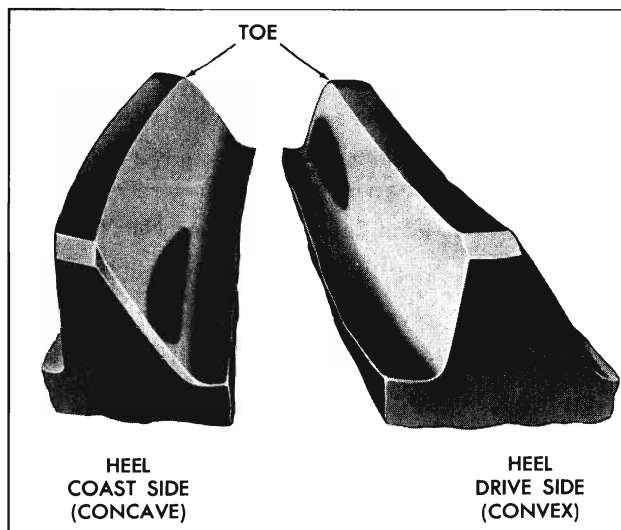


Fig. 4-67 Tooth Pattern—Pinion Too Close to Ring Gear

4. Coast—throttle closed and car in gear.

Gear noise most frequently has periods where noise is more prominent.

When objectionable axle noise is encountered, the driving condition and speed range should be noted and then differential removed for a red lead check following procedure on page 4-27. Shim and adjust to obtain best possible tooth pattern. If noise still persists, replace gear set.

BEARING NOISE

Bad bearings generally produce a rough growl or grating sound rather than the whine typical of gear noise.

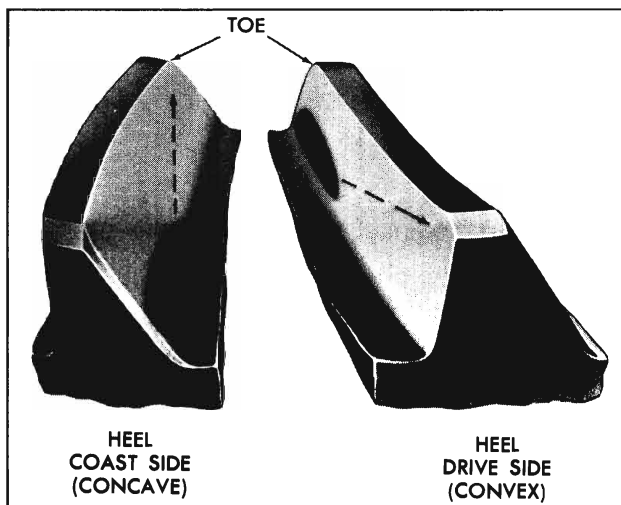
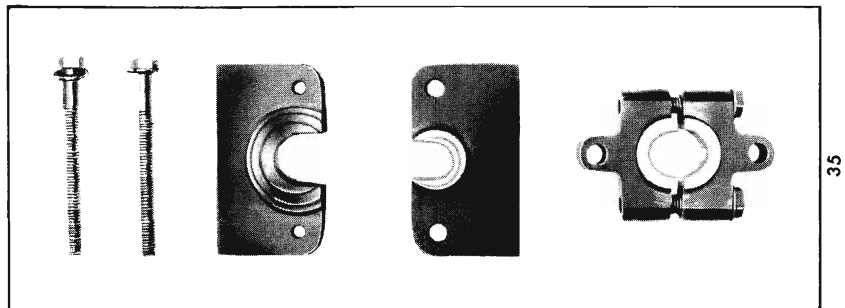
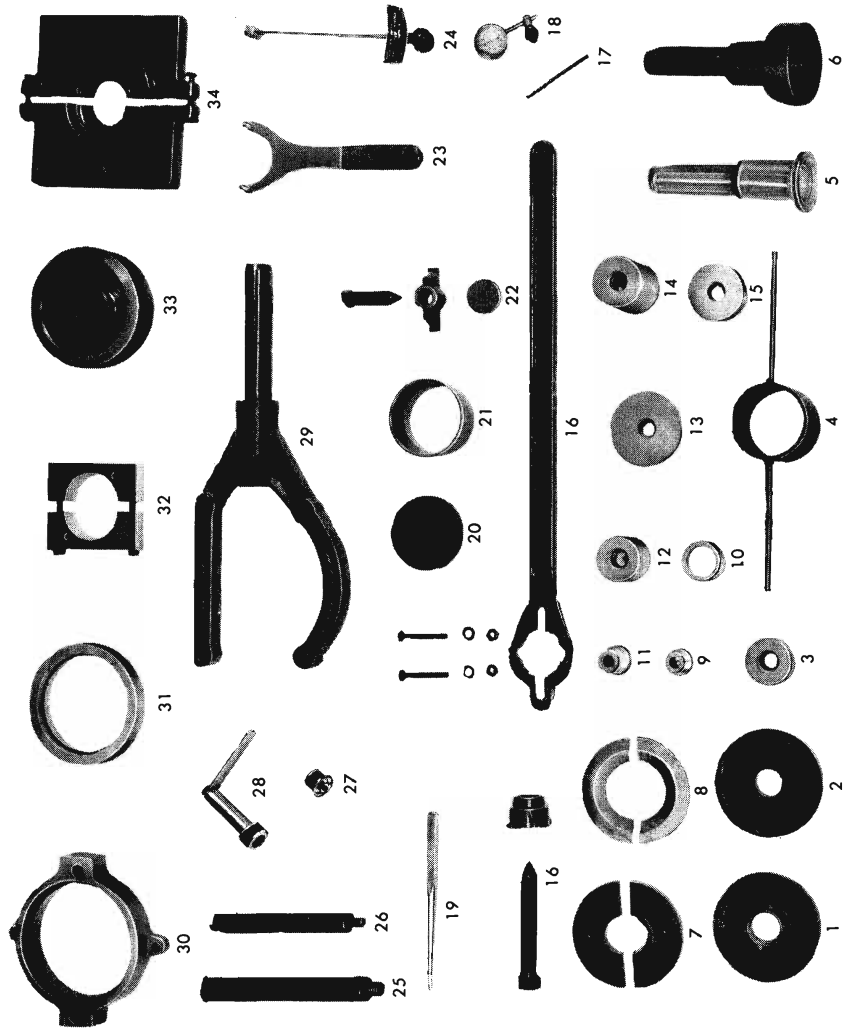


Fig. 4-68 Direction of Tooth Contact Movement—Increasing Shim Pack

SPECIAL TOOLS

1. J-8892	Front Pinion Bearing Installer	19. J-8400-1	Bushing Chisel
2. J-8916	Rear Axle Shaft Bearing Installer	20. J-8889	Companion Flange Oil Seal Installer
3. J-8897	Pinion Bearing Adjusting Nut Outer Race Remover	21. J-7576	Piston Installer
4. J-8890	Pinion Bearing Adjusting Nut Wrench	22. J-8855	Pinion Bearing Race Remover
5. J-8340-01	Front Pinion Bearing Oil Seal Installer	23. J-8902	Side Bearing Adjusting Nut Wrench
6. J-8899	Torus Hub Oil Seal Installer	24. J-7754	Inch Pound Torque Wrench
7. J-8891	Front Pinion Bearing and Speedo Gear Remover	25. J-8092	Handle
8. J-8893	Rear Pinion Bearing Remover	26. J-7079-2	Handle
9. J-8887	Bushing Installer (Pinion Shaft)	27. J-8362	Pinion Turning Adapter
10. J-8980	Speedometer Gear Installer	28. J-8903	Side Bearing Preload and Backlash Checking Fixture
11. J-8888	Drive Pinion Rear Bushing Installer	29. J-7896-01	Holding Fixture
12. J-8901	Differential Side Bearing Installer	30. J-6407	Press Plate Holder
13. J-8898	Rear Pinion Bearing Race Installer	31. J-6407-2	Press Plate Holder Adapter
14. J-8894	Rear Pinion Bearing Installer	32. J-8900	Differential Side Bearing Remover
15. J-7137	Front Pinion Bearing Installer	33. J-8919	Pinion Shim Gauge
16. J-8614	Companion Flange Holder and Puller	34. J-8916	Rear Axle Bearing Remover
17. J-3387-3	Stud	35. J-9528	Propeller Shaft Bearing Remover and Installer
18. J-8801	Dial Indicator		



SPECIFICATIONS

REAR AXLE

Type of Suspension	Swing Axle Independent Rear Suspension
Drive Final	Hypoid Gear
Lubricant Capacity	3.0 Pints
Lubricant Level	Bottom of Filler Plug
Lubricant	See Lubrication Section

RING AND PINION GEAR

Backlash	.004"-.009"
Ratios	See Fig. 4-3, Page 4-3

PROPELLER SHAFT AND TORQUE TUBE

Type of Drive	Torsion Bar
Length of Propeller Shaft	
Automatic	87.59"
3 Speed S/M	82.29"
4 Speed S/M	80.63"
Outside Diameter of Shaft	
Automatic	.650"
Synchro-Mesh	.750"
Length of Torque Tube	
Automatic	76.18"
3 Speed S/M	76.18"
4 Speed S/M	75.14"
Tube Wall Thickness	.054"

TORQUE SPECIFICATIONS

	Lb. Ft.		Lb. Ft.
Differential carrier side cover to carrier bolt	15-25	Ring gear retaining bolt	55-60
Differential bearing adjusting nut lock screw	10-20	Propeller shaft and bearing assembly to drive shaft bolt	20-35
Differential rear pinion bearing retainer to differential bolt	25-40	Differential assembly to bracket bolt	65-85
Rear axle universal joint yoke clamp nut	14-20	Differential support assembly to differential carrier bolt	65-85
Rear axle to universal joint yoke bolt	20-35	Transmission control lever housing to torque tube bolt	5-10
Rear brake assembly to lower control arm nut	30-45	Stabilizer bar to body side rail bolt	20-35
Torque tube to transmission extension bolt	30-45	Stabilizer bar to strut rod bolt and nut	20-30
Torque tube to flywheel housing bolt	30-45		

BRAKES

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
General Description	5-1	Adjustment of pedal and stop light switch ..	5-5
Periodic service	5-2	Major repairs	5-6
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Minor brake adjustment	5-3	Wheel cylinder: overhaul	5-7
Parking brake adjustment	5-3	Master cylinder: overhaul	5-8
Major brake adjustment	5-4	Trouble diagnosing and testing	5-9
Bleeding brakes	5-5	Specifications	5-14
Flushing hydraulic system	5-5	Special Tools	5-15

GENERAL DESCRIPTION (Fig. 5-1)

All models are equipped with Duo-Servo self-energizing hydraulic brakes.

The brake and clutch pedal mounting bracket is attached to the instrument panel and cowl. The pedals are suspended with Nylon bushings at the pivot points.

The brake master cylinder is attached to the engine side of the cowl. A push rod connects the brake pedal to the master cylinder. The brake light switch is mounted on a bracket under the dash.

Effective brake cooling and water sealing have been achieved with the backing plate. It combines one piece construction with the multi-seal design. Brak-

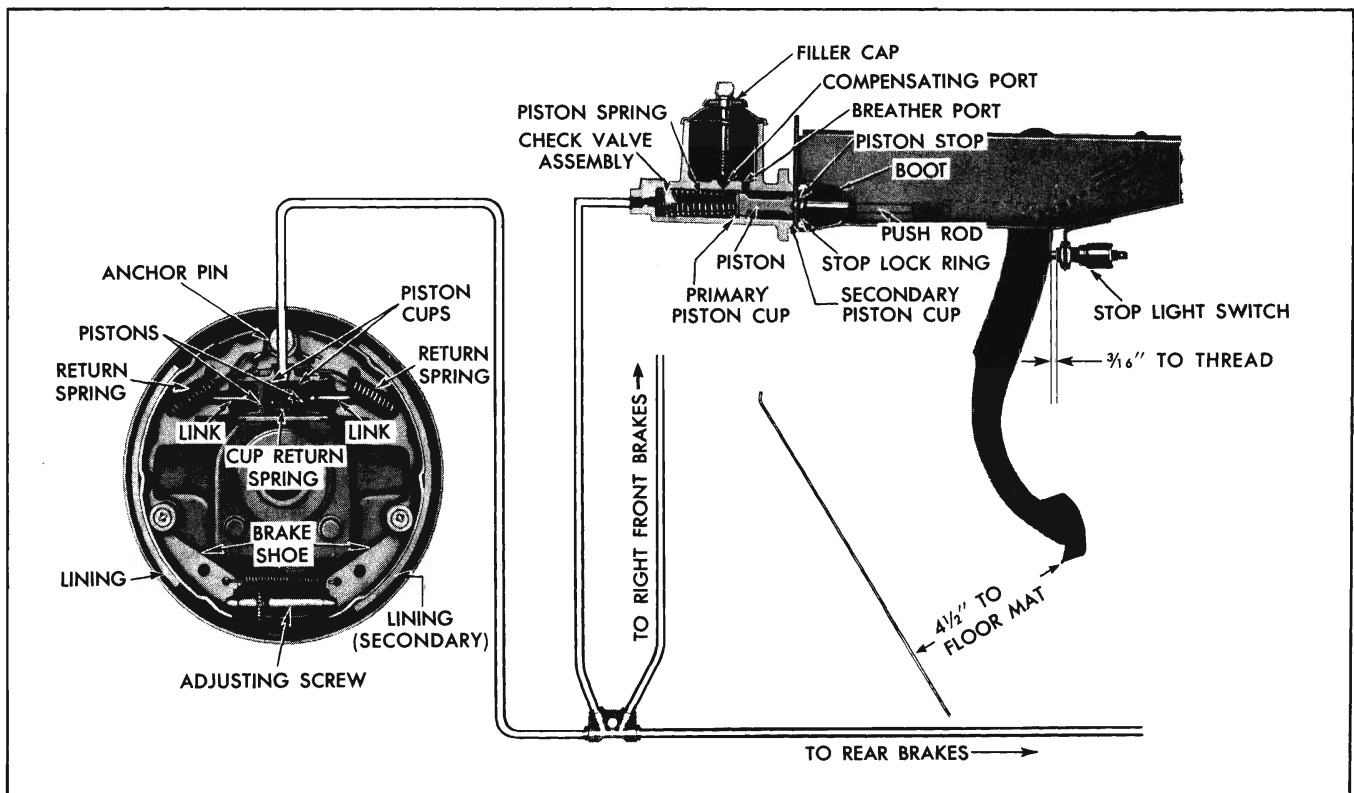


Fig. 5-1 Schematic Diagram of Hydraulic System

ing surface of the brake drums is cast iron in a steel shell.

In the unique design of the Tempest rear suspension, the control arm and axle pivot at slightly different points and swing in arcs of different radii. Because of this, the drum and shoes are not parallel to each other through all degrees of axle travel. In some cases this may result in unusual wear at the corners of the secondary linings. This is a normal condition having no effect on performance. Brake shoes and linings should not be replaced because of this type of wear.

Brake shoe web contour provides precise conformity of brake linings to drums for true contour effect. This brake shoe flexibility requires less pedal effort because of its ability to exert uniform pressure on linings and follow-up wear.

The parking brake (Fig. 5-2) operates through a system of cables. The parking brake is foot operated and is mounted under the left side of the instrument panel.

OPERATION OF HYDRAULIC SYSTEM

Depressing the brake pedal moves the master cylinder push rod and piston, forcing hydraulic fluid out

through a check valve (Fig. 5-1). This fluid flows through the hydraulic lines into the wheel cylinders. Forcing the wheel cylinder pistons outward from the center of the cylinder and expanding the brake shoes and linings against the brake drums.

When the brake pedal is released quickly, the master cylinder piston returns to the released position, faster than fluid returns from the lines. Holes in the piston head allow fluid to pass from the rear to front of the piston head, past the primary cup to fill in this space.

At the same time (when the pedal is released) the brake shoe return springs force the wheel cylinder pistons to return toward the center of the wheel cylinder (released position). Fluid forced out of the wheel cylinders by this action returns to the master cylinder by overcoming the pressure of the master cylinder piston spring which holds the check valve closed. As this fluid returns, the excess portion will return to the reservoir through the compensating port which must be uncovered when the master cylinder piston is in the released position. The piston spring will close the check valve when the pressure in the lines is reduced to 8-12 pounds per square inch, maintaining a slight pressure in the lines at all times. The purpose of this pressure is to keep wheel cylinder cups from leaking fluid and to reduce the possibility of air entering the system.

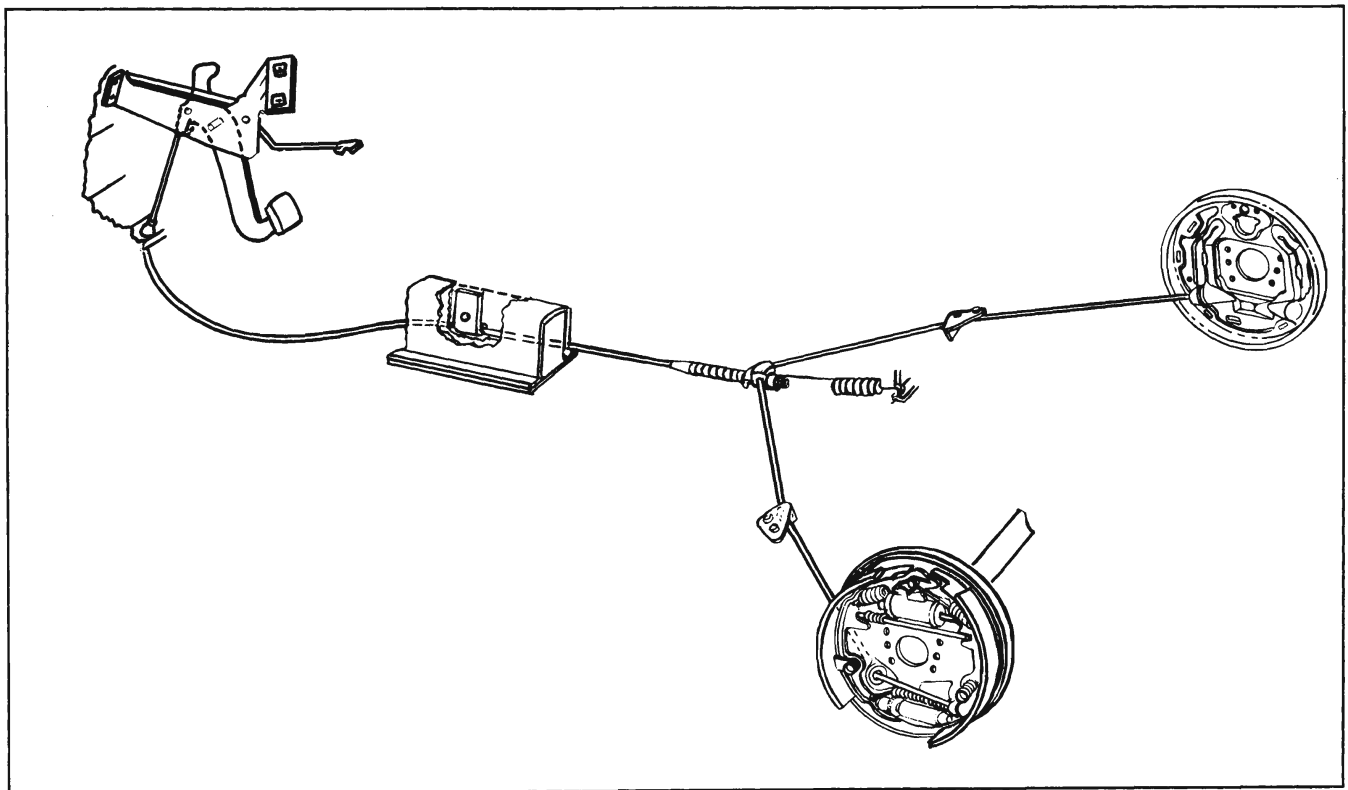


Fig. 5-2 Schematic Diagram of Parking Brake System

PERIODIC SERVICE

The brake system should be checked each time the car is lubricated. When the car is raised on a lift for lubrication, **brake lines, hoses, and cables** should be inspected for signs of chafing, deterioration, or other damage. A careful check for leaks should be made. Repairs as necessary should be performed as outlined in this section.

Each time the car is serviced there is an opportunity to check the operation of the brake system. If the brake pedal can be depressed to within less than 2" of floor mat when brakes are applied, a need for brake service exists. Corrections should be made as outlined in this section.

The parking brake cables must be lubricated yearly or when brakes are relined. The procedure for lubricating cables is outlined in LUBRICATION SECTION.

MINOR BRAKE ADJUSTMENT

ADJUST FRONT BRAKES AS FOLLOWS:

1. Remove adjusting hole cover from backing plate.
2. Using tool J-8915 or equivalent expand adjusting screw to produce 5-8 lb. drag on outside of tire (Fig. 5-3).
3. Back off ten notches.
4. After adjustment, drum rotation should be free from brake drag.
5. Install adjusting hole covers.

Rear service brakes cannot be correctly adjusted if the parking brake is too tight and the parking brake cable cannot be adjusted if service brakes are too loose. In either case, shoes are held off the anchor pins by the parking brake and produce a clunking noise during application. Under this condition, brakes tend to become hotter and have shorter life.

ADJUST REAR BRAKES AS FOLLOWS:

1. Raise car so rear wheels hang down.
2. Loosen parking brake cable or disconnect anchor from side of torque tube.
3. Remove adjusting hole cover from backing plate.
4. Expand adjusting screw to produce 5-8 lb. drag on outside of tire.
5. Back off 12 notches with shock absorbers fully extended (Back off 14 notches if hoist supports rear suspension near ends of control arms and prevents rear wheels from hanging down.)

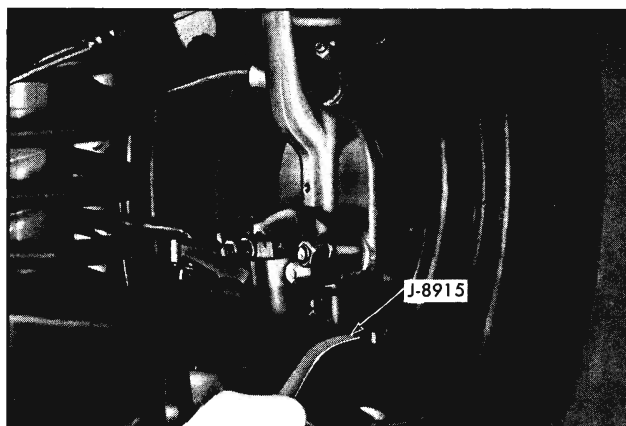


Fig. 5-3 Expanding Adjusting Screw

6. After adjustment, drum rotation should be free from brake drag.

7. Install adjusting hole covers.

Items 1 and 5 accommodate the special characteristics of the Tempest rear suspension to be certain brakes will not drag under conditions of unusual loading or cornering.

8. Reconnect and adjust parking brake cable as outlined under parking brake adjustment.

9. While applying pressure to brake pedal, check entire system for leaks and correct where necessary.

10. Check level of fluid in master cylinder and if necessary, add sufficient fluid to bring level within $\frac{7}{8}$ " from top of gasket surface on filler neck.

PARKING BRAKE ADJUSTMENT

Parking brake cable is properly adjusted when a 30 lb. pull downward on the cable 49" from front of torque tube places cable $2\frac{1}{4}$ " below bottom of torque tube (Fig. 5-4). (Parking brake lever should be fully released).

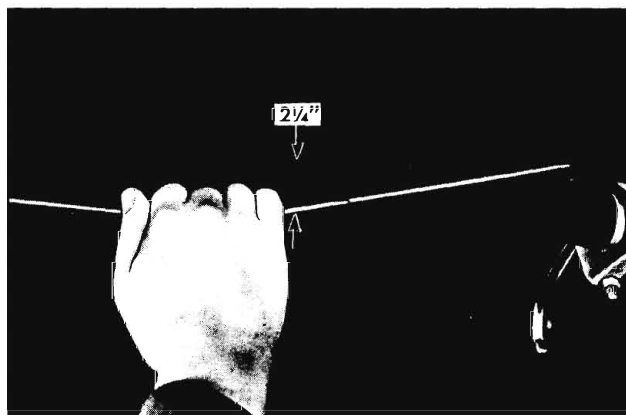


Fig. 5-4 Correct Cable Tension

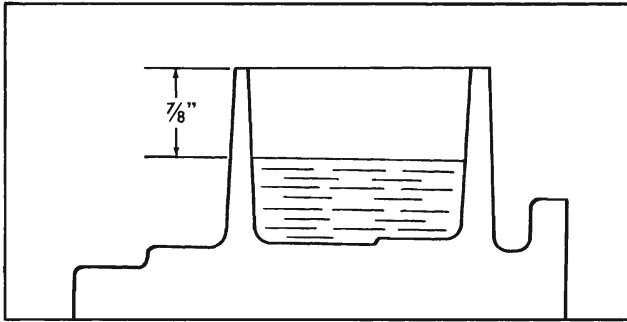


Fig. 5-5 Correct Level in Master Cylinder

1. Adjust parking brake cable at equalizer as required to obtain proper tension.
2. Tighten lock nut to 5-10 lb. ft. torque.
3. Be sure cable slides freely in equalizer.
4. Check to make sure wheels turn freely without drag.

MAJOR BRAKE ADJUSTMENT

Remove all four wheels and brake drums and blow out dust from all drums and brake assemblies.

INSPECTION

1. Inspect drums for scoring. Road dirt frequently cuts grooves in drums which do not impair operation of brakes unless grooving is extremely severe. When drums are badly scored, inspect lining carefully for imbedded foreign material. Replace or recondition drums only when drums are badly scored.

CAUTION: Removing material from brake drum reduces strength of drum and also the ability of drum to absorb heat.

2. Inspect front wheel bearings and oil seals and replace as necessary.
3. Carefully pull edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Excessive amounts of fluid at this point indicates leakage past piston cups.

NOTE: A slight amount of fluid is nearly always present and acts as lubricant for the piston.

4. If an excessive amount of fluid is present, overhaul wheel cylinder as outlined on page 5-7.
5. Inspect hoses and hydraulic lines for wear or damage and replace as necessary.

Pull all shoe assemblies away from backing plate and apply a small amount of petroleum base lubricant to pads where brake shoes contact backing

plates. Remove adjusting hole covers from backing plates.

6. Reinstall brake drums and wheels (see section 3 for front wheel bearing adjustment).

ADJUST FRONT BRAKES AS FOLLOWS:

1. Using tool J-8915 expand adjusting screw to produce 5-8 lb. drag on outside of tire (Fig. 5-3).
2. Back off ten notches.
3. After adjustment, drum rotation should be free from brake drag.
4. Install adjusting hole covers.

ADJUST REAR BRAKES AS FOLLOWS:

Rear service brakes cannot be correctly adjusted if the parking brake is too tight and the parking brake cable cannot be adjusted if service brakes are too loose. In either case, shoes are held off the anchor pins by the parking brake and produce a clunking noise during application. Under this condition, brakes tend to become hotter and have shorter life.

1. Raise car so rear wheels hang down.
2. Loosen parking brake cable or disconnect anchor from side of torque tube.
3. Expand adjusting screw to produce 5-8 lb. drag on outside of tire.
4. Back off 12 notches with shock absorbers fully extended. (Back off 14 notches if hoist supports rear suspension near ends of control arms and prevents rear wheels from hanging down.)
5. After adjustment, drum rotation should be free from brake drag.

6. Install adjusting hole covers.

Items 1 and 4 accommodate the special characteristics of the Tempest rear suspension to be certain brakes will not drag under conditions of unusual loading or cornering.

7. Reconnect and adjust parking brake cable.

Parking brake cable is properly adjusted when a 30 lb. pull downward on the cable 49" from front of torque tube locates cage $2\frac{1}{4}$ " below bottom of torque tube (Fig. 5-4). Parking brake lever should be fully released.

1. Adjust parking brake cable at equalizer as required to obtain proper tension.
2. Tighten lock nut to 5-10 lb. ft. torque.
3. Be sure cable slides freely in equalizer.

4. While applying pressure to brake pedal, check entire system for leaks where necessary.

5. Check to make sure wheels turn freely without drag.

Fluid level in master cylinder should be $\frac{7}{8}$ " below cap sealing surface.

Road test car to check brake operation.

BLEEDING BRAKES

Depressing the pedal with a low fluid level in master cylinder reservoir or disconnecting any part of the hydraulic system permits air to enter the system. Air may also enter the system occasionally when brake shoes are replaced. This air must be removed by bleeding.

Bleeding may either be done by operating the brake pedal using bleeder tube as outlined below, or by using pressure bleeding equipment.

When using pressure bleeding equipment follow instructions of the equipment manufacturer and always use bleeder tube attached to wheel cylinder to prevent brake fluid from running down backing plate.

When bleeding by operating pedal proceed as outlined below:

1. Fill master cylinder reservoir with recommended brake fluid.

CAUTION: Always clean away any dirt from around master cylinder filler cap before removing cap for any reason. Never depress pedal while any brake drum is off unless bleeder valve is open.

Never use a cheap or reclaimed brake fluid as this will positively result in brake trouble. Even though reclaimed fluid may look clear, tests have shown such fluid to be corrosive. If there is doubt as to the grade of fluid in the system, flush out system and fill with recommended brake fluid complying with SAE 70R3 specifications.

2. Starting at left front wheel, attach bleeder tube allowing tube to hang submerged in brake fluid in a clean quart jar. Unscrew bleeder valve three quarters of a turn, depress pedal a full stroke and allow it to return slowly making sure end of bleeder tube is under the surface of liquid in container. Continue operating pedal, refilling reservoir after each five strokes (unless an automatic filling device is used), until liquid containing no air bubbles emerges from bleeder tube.

3. Close bleeder valve securely and remove bleeder

tube; proceed bleeding one brake at a time as described above, right front, left rear and right rear.

4. When bleeding operation is completed, refill reservoir to within $\frac{7}{8}$ " of top of master cylinder filler neck gasket surface (Fig. 5-5) and then replace filler cap.

FLUSHING HYDRAULIC SYSTEM

It may sometime become necessary to flush out the brake hydraulic system due to the presence of mineral oil, kerosene, gasoline, carbon tetrachloride, etc., which will cause swelling of rubber piston cups and valves so they become inoperative.

To flush the hydraulic system, proceed as follows:

1. Attach bleeder tube and open bleeder valve at left front wheel.

2. Flush out system thoroughly with clean denatured alcohol or recommended hydraulic system cleaning fluid, pumping the fluid from master cylinder reservoir and out of wheel cylinder bleeder valve.

3. Repeat steps 1 and 2 at remaining wheel cylinders. To ensure thorough flushing approximately $\frac{1}{2}$ pint of alcohol should be bled through each wheel cylinder.

4. Replace all rubber parts in master and wheel cylinders. Thoroughly clean cylinders and pistons in alcohol before installing new parts.

5. After installing parts, fill system with recommended brake fluid and follow steps 2 through 4 under bleeding brakes to flush system of cleaning solution and to bleed brakes. In doing this, pump brake fluid from wheel cylinder bleeder valves until brake fluid flows from bleeder tube and then, if necessary, continue until no air bubbles emerge from bleeder tube.

ADJUSTMENT OF PEDAL AND STOP LIGHT SWITCH (Fig. 5-1)

Specified pedal height for normal usage may be changed to accommodate special owner requirements. The pedal may be raised or lowered by moving clevis toward or away from the master cylinder. If pedal is moved it is essential to reset stop light switch. Do not lower pedal to less than $3\frac{1}{2}$ " as insufficient brake pedal travel may result when used at high speed with worn linings.

After changing pedal height or stoplight switch adjust stop light switch, tighten push rod locknut securely and check pedal for freedom of movement.

CAUTION: If stop light switch or pedal bracket prevents full return of brake pedal and master cylinder push rod, the master cylinder piston may be prevented from returning to its internal stop. This can block off the compensating port which prevents brake shoes from returning fully when the pedal is released (see Fig. 5-1). A further complication which follows a blocked compensating port, bottom of conical pit, is lining drag and complete brake burn-up on the first prolonged drive. It is necessary that in the released position the primary cup be entirely clear of the compensating port to provide a safety factor against normal rubber swell and expansion and deflection of body parts and pedal linkage.

MAJOR REPAIRS

REMOVAL AND REPLACEMENT OF BRAKE SHOES

REMOVAL:

1. Raise all four wheels off ground. Remove front wheels, front hub and drum assemblies, rear wheels and rear drums.

CAUTION: Extreme care must be taken to prevent oil, grease, or brake fluid from getting on linings. Even oily finger prints on linings may affect the operation of brakes.

2. Inspect linings for wear. Clean brake shoes, drums and backing plates, removing any foreign particles that may have become imbedded in lining surface. Examine shoes for loose rivets which must be replaced. Install new shoes or reline if linings are badly burned or worn nearly flush with rivets or if linings show evidence of oil, grease or brake fluid on the surface.

CAUTION: In case of severe brake usage it is possible for shoes to take the shape of worn linings permanently. Before relining a shoe, particularly if it is discolored, check for distortion by laying it against a new shoe. Discard the shoe if its radius has opened up more than the thickness of the rim metal.

3. Loosen parking brake cable sufficiently to remove all tension from brake cable.

4. Remove brake shoe pull back springs (Fig. 5-1) using tool J-8049 or equivalent.

5. Remove brake shoe hold down cup and spring assemblies.

6. Spread brake shoes apart to clear wheel cylinder boots and connecting links and remove shoes from backing plate.

7. Install clamp or large rubber band on wheel cylinder to hold wheel cylinder piston in place.

8. Separate the brake shoes by removing adjusting screw and spring.

9. Remove parking brake lever from secondary brake shoe (rear only).

INSPECTION

1. Inspect drums for scoring. Road dirt frequently cuts grooves in drums which do not impair operation of brakes unless grooving is extremely severe. When drums are badly scored, inspect lining carefully for imbedded foreign material. When drums are badly scored, replace or recondition as necessary.

CAUTION: Removing material from brake drum reduces strength of drum and also the ability of drum to absorb heat.

2. Inspect front wheel bearings and oil seals and replace as necessary.

3. Carefully pull edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Excessive amounts of fluid at this point indicates leakage past piston cups.

NOTE: A slight amount of fluid is nearly always present and acts as lubricant for the piston.

4. If an excessive amount of fluid is present, overhaul wheel cylinder as outlined on page 5-7.

5. Inspect hoses and hydraulic lines for wear or damage and replace as necessary.

6. Check and make sure all bolts and nuts securing backing plate to suspension are tightened as follows: Front Backing Plate to Knuckle.

Upper 80-110 lb. ft. torque
(Bolt Lubricated)

Lower 45-65 lb. ft. torque
Rear Backing Plate to Control Arm.

All 30-45 lb. ft. torque

REPLACE BRAKE SHOES

1. Inspect new linings and make sure there are no nicks or burrs on shoe edge, where contact is made with backing plate.

2. Use a file, hand grinder, or emery cloth to remove grooves from brake shoe ledges on backing plates. Apply a small amount of brake lubricant on shoe ledges.

3. Nuts and threads of all adjusting screws should be lubricated with a small amount of petroleum base lubricant.

4. On rear brakes lubricate parking brake lever fulcrum, link, and cable ramp with petroleum base lubricant or grease (Front wheel bearing grease).

CAUTION: Do not apply too much lubricant as it may get on linings. This will result in unequalized brakes and necessitate replacement of linings.

5. Connect brake shoes together with adjusting screw spring, then place adjusting screw in position.

6. When replacing shoes, always be certain to assemble secondary shoes to the rear and primary shoes to the front. Note that linings of primary shoes are shorter than secondary linings.

CAUTION: Do not permit oil or grease to come in contact with linings.

7. On rear brakes, connect parking brake lever to secondary shoe and install strut between lever and primary shoe.

8. Attach brake shoes to backing plate with hold down nails and cup and spring assemblies. At the same time engage shoes with wheel cylinder connecting links.

9. Install brake shoe return springs. New brake shoe return springs should be installed if old springs have been overheated or strength is doubtful. Overheated springs may be indicated by ends of coils opened up or failure of shoes to return to anchor pin.

10. Sand linings lightly to remove any trace of oil.

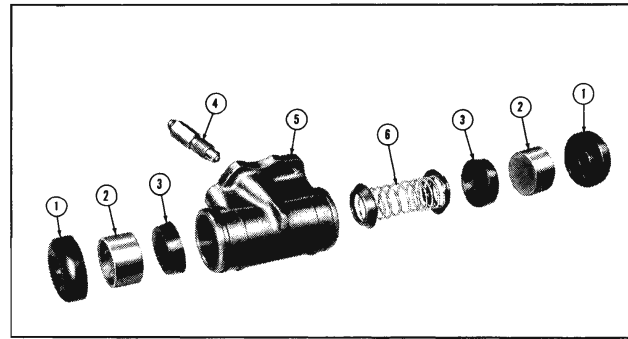
11. When new shoes or linings have been installed release adjusting screw until drum will slide freely over shoes.

12. Install drums, observing instructions for front wheel bearing lubrication and adjustment.

13. Adjust brake shoes as described on page 5-3.

14. If wheel cylinder has been replaced or repaired, or hydraulic line has been replaced, bleed brakes as described in section on bleeding brakes. Apply pressure to pedal and check entire system for leaks.

CAUTION: New linings must be protected from severe usage for several hundred miles. Stops from high speeds or repeated stops from low speed may permanently injure new linings. This information should be conveyed to owner.



- | | |
|----------------|-------------------------------------|
| 1. Boot | 4. Bleeder Screw |
| 2. Piston | 5. Wheel Cylinder Housing |
| 3. Piston Cups | 6. Cup Return Spring with Expanders |

Fig. 5-6 Wheel Cylinder Exploded View

WHEEL CYLINDER OVERHAUL

REMOVE

1. Raise wheels of vehicle.
2. Back off brake adjustment and remove drum.
3. Disconnect hose from wheel cylinder.
4. Remove brake shoe return springs.
5. Remove screws and lock washers which hold cylinder to backing plate and remove wheel cylinder.

DISASSEMBLE

1. Remove wheel cylinder connecting link.
2. Remove rubber boots.
3. Remove pistons, rubber cups, and spring.

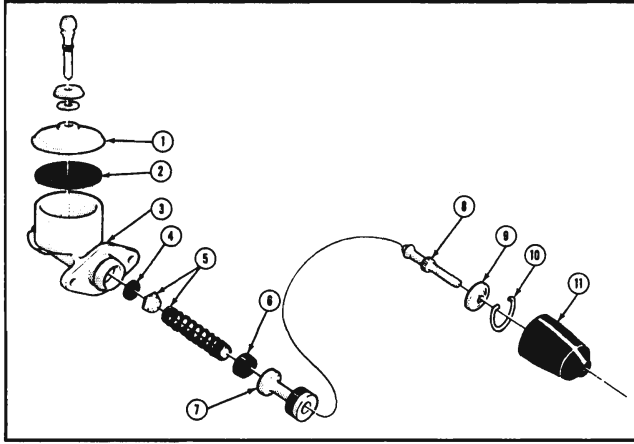
CAUTION: Before cleaning parts, clean hands. Do not wash hands in gasoline or fuel oil before cleaning parts. Use soap and water to clean hands.

4. Wash all parts in clean alcohol.
5. Place clean parts on clean piece of paper.
6. Protect parts from dirt until reassembly.

INSPECT

1. Inspect piston rubber cups for softening, distortion, or swelling. This condition indicates oil, gasoline, carbon tetrachloride, etc., in hydraulic system which would require flushing of system, and replacing of rubber parts in wheel cylinders as well as in master cylinder.

2. See that rubber cups are flared so they will have tension against the cylinder bore. Loss of flare may be caused by overheating.



- | | |
|----------------------------|-----------------------------|
| 1. Filler Cap | 6. Primary Cup |
| 2. Filler Cap Gasket | 7. Piston and Secondary Cup |
| 3. Master Cylinder Housing | 8. Push Rod |
| 4. Valve Seal Washer | 9. Piston Stop Plate |
| 5. Check Valve and Spring | 10. Stop Plate Lock Ring |
| | 11. Boot |

Fig. 5-7 Master Cylinder Exploded View

3. Examine spring, cylinder bore, and pistons for signs of scoring, rust, pitting or etching. Any of these require replacement of wheel cylinder.

NOTE: A new brake cylinder has a "bearingized" surface. This is accomplished by diamond boring the cylinder then rolling it under heavy pressure to obtain a highly polished hard surface. Honing this surface destroys the "skin" and leaves a softer and rougher surface which will cause more rapid piston wear than the "bearingized" surface. Honing also enlarges the bore and oversize pistons are not available.

ASSEMBLE

1. Apply clean brake fluid to cylinder bore, pistons, and rubber cups before assembly.
2. Place a boot over one end of cylinder.
3. Place a piston in cylinder so that flat side will be toward center of completed assembly.
4. Insert a rubber cup with flat side against piston.
5. Insert spring and expander assembly.
6. Insert a rubber cup with flat side toward opening.
7. Install piston with flat side against cup.
8. Place rubber boot over end of cylinder.

REPLACE

1. Install wheel cylinder on backing plate with screws and lock washers. Tighten to 60-90 pound inches of torque.
2. Replace wheel cylinder connecting links.
3. Install brake shoe return springs.
4. Connect hose to wheel cylinder using new gasket.
5. Install brake drums, adjust wheel bearings if front drum was removed as described in **Front Suspension** section.
6. Bleed all brake lines as described on page 5-5 of this section.
7. Adjust and test brakes as previously described on page 5-3 of this section.

MASTER CYLINDER OVERHAUL

REMOVE

1. Disconnect brake pedal return spring.
2. Disconnect stop light switch.
3. Remove cotter pin and clevis pin from clevis.
4. Remove hydraulic brake line from end of master cylinder.
5. Remove four nuts, holding master cylinder to cowl.
6. Remove master cylinder from automobile.

DISASSEMBLE

1. Remove reservoir cover from top of master cylinder and dump fluid.
2. Remove boot from master cylinder.
3. Carefully remove push rod stop plate lock ring from end of cylinder.

NOTE: Ring is under high tension, use eye protection.

CAUTION: When lock ring is removed piston spring will force piston and stop plate out of cylinder with great force.

4. Remove piston, piston cups, piston spring, and check valve assembly from cylinder.

CAUTION: Before cleaning parts, clean hands. Do not wash hands in gasoline or fuel oil before cleaning parts. Use soap and water to clean hands.

5. Wash all parts in clean alcohol.
6. Place clean parts on clean paper.
7. Prevent parts from becoming dirty.

INSPECT

1. Inspect piston rubber cups and check valve for softening, distortion or swelling. They indicate oil, gasoline, carbon tetrachloride, etc. in hydraulic system which would require flushing of entire system and replacing of rubber parts in wheel cylinders as well as in master cylinder.

2. Inspect master cylinder bore for signs of scoring, rust, pitting, or etching. Any of these will require replacement of master cylinder. Presence of pitting, rust, or deep etching in master cylinder calls for replacement and careful inspection for similar condition in all wheel cylinders. Stains may be removed with crocus cloth.

CAUTION: A new brake cylinder has a "bearingized" surface. This is accomplished by diamond boring the cylinder then rolling it under heavy pressure to obtain a hard surface. Honing this surface destroys the "skin" and leaves a softer and rougher surface which will cause more rapid piston and cup wear than the "bearingized" surface. Honing also enlarges the bore and oversize pistons are not available.

ASSEMBLE

1. Install check valve and spring in cylinder.
2. Coat primary cup with clean brake fluid and install in cylinder with flat side toward opening, make certain cup seats over end of spring.
3. Coat secondary cup with clean brake fluid and install on piston.

4. Install secondary cup and piston in cylinder so that flat end of piston is toward front of cylinder.
5. Install push rod and stop plate in cylinder.
6. Install push rod stop plate lock ring in cylinder.

CAUTION: Use eye protection.

NOTE: Inspect piston stop washer in end of master cylinder to see that it is held firmly in place by lock ring bottoming fully in groove seat in master cylinder.

7. Place rubber boot on end of cylinder.
8. Fill and bleed reservoir.
9. Install reservoir cover.

REPLACE

1. Install master cylinder on dash and secure with two nuts. Tighten to 15-25 lb. ft. torque.
2. Connect master cylinder push rod and clevis to brake pedal with clevis pin and secure with cotter pin.
3. Connect brake pedal return spring.
4. Connect stop light switch wires.
5. Check stop light switch adjustment.
6. Connect hydraulic line to master cylinder.
7. Check level after working pedal several times. Fill master cylinder with recommended fluid to within $\frac{1}{8}$ " of top of cylinder (Fig. 5-5) and replace filler cap.
8. Brake system may be bled as described in section on bleeding brakes if necessary.
9. Test operation of stop light switch.
10. Adjust and test brakes as outlined previously in this section.

TROUBLE DIAGNOSIS AND TESTING**TESTING FOR LEAK IN HYDRAULIC SYSTEM**

NOTE: If there is any evidence of air in system, brakes must be bled before making this test.

1. Apply brakes manually, holding as steady a force as possible.
2. If pedal sinks slowly toward floor, a leak is indicated. Check for location of the leak by examining all lines, connections, wheel cylinders and inside of

master cylinder boot. If external leak is not found, remove master cylinder, disassemble and inspect parts. Leak will usually be past primary piston cup due to defective cup or cylinder bore.

NOTE: If leak at wheel cylinder has allowed fluid to reach linings, they must be replaced.

The following is a list of common troubles occurring in the brake system with possible causes and remedies:

PEDAL GOES TO TOE BOARD**CAUSE**

Normal wear of lining.
Low fluid level in master cylinder reservoir.

REMEDY

Readjust or replace lining.
Low fluid level in reservoir will permit air to be pumped into hydraulic lines. This necessitates refilling reservoir and bleeding lines. Find cause of low fluid and correct.

CAUSE	REMEDY
External leak in hydraulic system, or leak past master cylinder primary piston cup.	Check for leak in system as outlined above.
Air trapped in hydraulic system.	Air trapped in hydraulic system gives pedal a spongy feeling when depressed. Bleed lines.

ALL BRAKES DRAG AFTER BRAKE ADJUSTMENT IS CHECKED AND FOUND TO BE CORRECT OR PEDAL BUILDS UP WITH USE

CAUSE	REMEDY
Mineral oil, etc, in system.	The presence in the hydraulic system of any mineral oil, kerosene, gasoline, shock absorber or transmission fluid or carbon tetrachloride will cause swelling of rubber piston cups and valves, so they become inoperative. This is first noticed in the master cylinder. Brakes will not release freely if master cylinder primary piston cup has swollen sufficiently to obstruct the compensating port. Flush system thoroughly with a good grade of clean denatured alcohol and replace all internal rubber parts in brake system.
Master cylinder piston does not return to stop or push rod is adjusted too long.	See that pedal return spring has not lost its tension and promptly returns pedal.
Compensating port of master cylinder closed.	The compensating port in master cylinder must be completely clear when pedal is in released position. <ol style="list-style-type: none"> 1. See that pedal returns freely. 2. See that push rod is not adjusted too long. 3. See that compensating port is not plugged by dirt. To check compensator port, remove master cylinder reservoir cover and watch the fluid in the cylinder as the brake pedal is moved. A "geyser" should be seen as the pedal is first depressed. If no geyser is seen, the compensating port is blocked. 4. Inspect master cylinder piston cup and if found to be swollen or elongated, flush system and replace damaged parts.

ONE WHEEL DRAGS

CAUSE	REMEDY
Improperly adjusted parking brake cables (rear wheels only) or stuck cable.	Adjust parking brake cables and lubricate.
Weak or broken brake shoe return springs.	Replace defective brake shoe springs and lubricate brake shoe ledges and shoe contact at anchor pin with grease.

CAUSE	REMEDY
Brake shoe or drum clearance too small.	Readjust brakes to secure complete freedom from drag.
Loose or incorrect front wheel bearings.	Adjust front wheel bearings or replace as described in section 3.
Wheel cylinder piston cups swollen or distorted or piston stuck.	Replace defective or damaged parts. Look for evidence of dirt in hydraulic system which could cause damage to the cylinders or cups. See first item under ALL BRAKES DRAG . . .
Obstruction in line.	Obstruction in line may be caused by foreign material in line or flattened or kinked tube. If dirt is found in line, remove obstruction and flush hydraulic system with fresh brake fluid. If tube is flattened or kinked, replace damaged parts.
Support assembly shoe ledges grooved.	Grind or file ledges on backing plate smooth and lubricate.
Incorrect brake shoe radius.	Replace defective brake shoe.

CAR PULLS TO ONE SIDE

CAUSE	REMEDY
Grease or fluid on lining.	Replace with new linings. See BRAKE CAUTIONS on page 5-15. Linings with even a slight trace of grease or fluid will cause trouble, and can seldom be salvaged by cleaning. Correct cause of grease or fluid reaching linings.
Loose wheel bearings.	Adjust wheel bearings.
Loose backing plate at rear axle or front axle.	Tighten backing plate on rear or front axle.
Linings not to specifications, or primary and secondary shoes reversed. New and used linings mixed on one end of car.	Various kinds of linings have different friction effect on the drums. Each wheel must have similar linings. The primary and secondary linings must not be interchanged. Use only factory specified linings.
Tires not properly inflated or unequal wear of tread. Different tread non-skid design.	Inflate tires to specified pressures. Rearrange tires so that a pair with non-skid tread surfaces of similar design and equal wear will be installed on front wheels and another pair with like tread will be installed on rear wheels.
Linings charred or drums scored.	Sand surfaces of linings and drums. Remove particles of metal that have become embedded in surfaces of linings. See COMPLETE BRAKE RECONDITIONING , regarding road dirt grooving brake drums. Seriously charred linings should be replaced.
Wheel cylinder link off shoe.	Check boot for holes. Check for burrs on wheel cylinder piston.
Water, mud, etc., in brakes.	Remove any foreign material from all brake parts and the inside of drums. Lubricate shoe ledges and rear brake cable ramps with grease. Examine support assembly for damage.

CAUSE	REMEDY
Weak chassis springs, loose steering gear, etc.	Replace springs, adjust steering gear, etc.
Incorrect geometry setting of suspension.	Adjust geometry so that car does not have a tendency to "lead" when driven on a level road.
Rigid and flexible shoes intermixed.	Use only approved type parts.

SPONGY PEDAL

CAUSE	REMEDY
Air trapped in hydraulic system.	Remove air by bleeding (if bleeding is not effective check for closed compensating port).
Brake adjustment not correct.	Adjust brakes.
Bent shoes.	Replace.
Compensating port closed.	See ALL BRAKES DRAG .

EXCESSIVE PEDAL PRESSURE REQUIRED TO STOP CAR

CAUSE	REMEDY
Brake adjustment not correct.	Adjust brakes.
Improper lining.	Install factory specified lining.
Improper shoes.	Install factory specified shoes.
Grease or fluid soaked linings.	Correct cause and replace linings. See BRAKE CAUTIONS page 5-14.
Rusted wheel cylinder.	Replace necessary parts.
Wheel cylinder link incorrectly aligned.	Check wheel cylinder piston and boot for damage. Install link.
Brake pedal set too high.	Set to specified height.
Compensating port not cleared.	Check pedal linkage, stop lite switch adjustment, etc. See also "Compensating Port" under "All Brakes Drag . . .".

LIGHT PEDAL PRESSURE—BRAKES TOO SEVERE

CAUSE	REMEDY
Brake adjustment not correct.	Adjust brakes.
Loose support assembly on rear axle or front spindle.	Adjust front wheel bearings and tighten front backing plates. Tighten rear backing plates. Adjust brakes.
Small amount of grease or fluid on linings.	Correct cause and replace linings.
Charred linings or scored drums.	Sand surfaces of linings and drums. Clean loose dust from brakes and drums. In severe cases replace shoes. Warn owner regarding abuse of brakes.
	Remove all particles of metal that have become embedded in surfaces of linings. Slightly scored drums do not require replacing.
Improper linings.	Install factory specified linings.

BRAKE NOISES

NOISE	CAUSE	REMEDY
1. *Squeak in brake with car stationary (sometimes mistaken for pedal squeak).	Shoe pads on backing plates dry and rusty.	Pry shoes out with screwdriver—apply grease sparingly to shoe pads with feeler stock.
2. *Snaps in brakes as pedal is applied, car stationary.	Hold down nail heads dry.	Lubricate.
3. Pedal squeak.	Return spring or stoplight switch rubbing pedal nylon bushing.	Lubricate.
4. Crunch or groan, holding car on hill.	Brake dust and possibly linings which have been overheated.	Sand and de-dust linings.
5. High pitch squeak while brakes operate.	A. New linings not yet fully burnished.	Let run or sand off high spots of linings.
	B. Persistent squeak—no apparent cause.	Sand linings for temporary cure of mild cases. Install drum springs for stubborn cases of high pitch squeak.
	C. Bonded linings.	
	D. Rigid brake shoes.	Install factory specified shoes.
6. Low pitch squeal at end of high rate stop.	A. New linings not fully burnished.	Check adjustment. Sand lining high spots.
	B. Incorrect adjustment.	Adjust.
	C. Bent backing plate (top of shoe webs should be in line with each other looking down on them. Check after pushing shoes toward backing plate at top).	Straighten or replace. NOTE: Drum springs not effective against low pitch squeal or howl.
7. Clicks during high rate stops, usually once per wheel revolution in one wheel only.	Threaded drum.	Disappears with usage as drum surface is conditioned by lining wear.
8. Chatter at high speed.	Drum out of round with 2 or more distinct high spots in circumference.	Sometimes corrects with usage. Turn drum.
9. Pedal throb at light applications at low speed.	Drum out of round simply off center, remove.	Turn drum.
10. "Rough feel" during high rate stops from moderate speed.	Tool chatter. Look for faint light and darker stripes running across the braking surface.	Usually corrects with usage.
11. Loud clank as foot is slipped off depressed manual brake.	Normal for design.	For special complaints stretch pedal return spring (make sure pedal returns fully even when pedal is eased back slowly).

NOISE	CAUSE	REMEDY
12. *Click, first application after reversing	Shoes holding out from anchor pins.	File shoe pads on backing plates; lubricate.
	Incorrect parking brake adjustment.	Check parking brake adjustment.

*Although adjusting brakes temporarily changes these noises, lubrication is the only long term fix.

BRAKE CAUTIONS

1. Do not use a substitute for recommended brake fluid (see below) or reclaimed brake fluid.
2. Do not allow grease, paint, oil or brake fluid to come in contact with brake lining.
3. Do not handle brake shoes or drums with greasy hands.
4. Do not clean rubber parts or inside of cylinders with anything but clean alcohol, or clean brake fluid.
5. Do not use any linings other than those specified by the factory.
6. Do not allow master cylinder reservoir to become less than half full of brake fluid.

7. Under no circumstances should brakes be severely used after new shoes are installed. They should be given moderate use for several hundred miles until linings become well burnished. Repeated severe applications will cause erratic brake action and may permanently injure brake linings. Under no circumstances should severe testing be done that will burn the linings.

8. When linings of one brake require replacement, the linings should also be replaced on the other brake at the same end of the car (except on very low mileage new cars on which the brakes have not been abused.)

SPECIFICATIONS

NEW DRUMS

Inside diameter—Front	9"
—Rear	9"
Out of Round including taper for full width (max.)	
—Front .....	.005"
—Rear .....	.006"

Indicator shall not change more than .0005" in any inch of circumference.

FLUID

Fluid that complies with heavy duty standards of S.A.E. 70R3 Specifications.

LINING

Width—Primary	13/4"
—Secondary	13/4"
Thickness (Front and Rear)222"

MASTER CYLINDER BORE

.....	1"
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PEDAL HEIGHT

Underside of Pedal Pad to floor mat	4 1/2" + 1/4" - 0"
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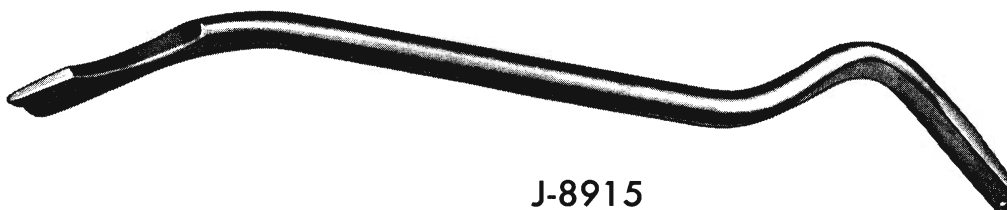
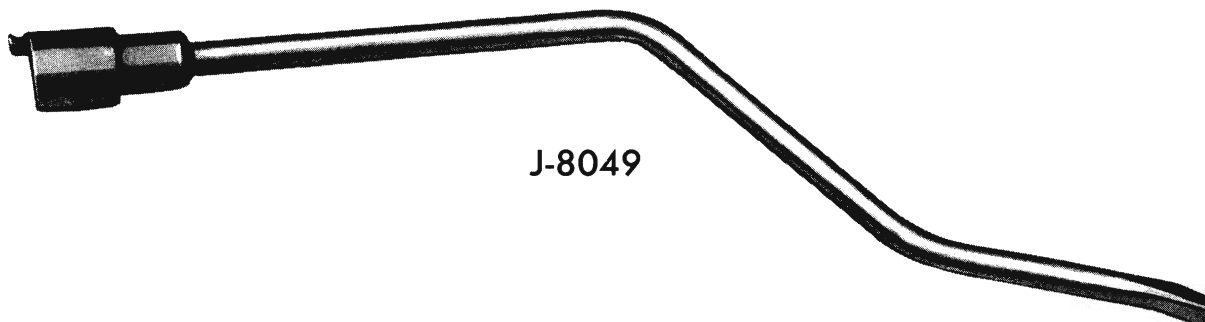
WHEEL CYLINDER BORE

—Front	1 1/16"
—Rear	1 5/16"

TORQUE SPECIFICATIONS

	LB. FT.		LB. FT.
Front brake assembly to steering knuckle—lower Bolt and Nut	45-65	Brake and clutch pedal pivot Bolt and Nut	20-35
Front brake assembly to steering knuckle—upper Bolt	80-110	Wheel cylinder to backing plate Screw	5-7
(Bolt Lubricated)		Wheel brake cylinder bleeder Screw	5-10
Rear brake assembly to control arm Bolt and Nut	30-45	Parking brake lever assembly to dash Nut	10-20
Brake master cylinder assembly to dash Nut	20-35	Parking brake lever assembly to reinforcement Bolt	10-25
		Parking brake front cable to equalizer Nut	5-10

SPECIAL TOOLS



ENGINE MECHANICAL

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TEMPEST FOUR CYLINDER ENGINE

GENERAL DESCRIPTION

The Pontiac Tempest uses a 195 cubic inch 45° inclined, four cylinder engine as standard equipment. This engine has a 4 $\frac{1}{16}$ " bore and 3 $\frac{3}{4}$ " stroke. Two compression ratios are available, an 8.6:1 ratio as standard equipment and a 10.25:1 ratio available on special order. In addition a 7.6:1 compression ratio is used for export.

An optional aluminum V-8 engine with 215 cubic inches displacement and a 10.25:1 compression ratio is also available on special order.

Twelve different engine combinations are available; these combinations and their usage are shown in the engine chart Fig. 6-1.

Engine identification is facilitated by a number-letter code stamped below the production engine number. By referring to the identification code and Fig. 6-1 each engine may be readily identified.

The four cylinder engine (Fig. 6-2) features completely machined combustion chambers, overhead valves, ball pivot rocker arm construction, harmonic balancer, hydraulic lifters, aluminum pistons, straight valve guides, superior crankcase ventilation and lubrication systems, and large displacement combined with high compression ratio for utmost performance and economy.

Detailed descriptions of cooling, crankcase ventila-

tion, and the lubrication system are given in **ENGINE COOLING AND LUBRICATION**, page 6A-1.

The following detailed description covers only the four cylinder engine; description and service procedure on the eight cylinder starts on page 6-38.

CYLINDER BLOCK

The cylinder block has one bank of four cylinders inclined at 45° to the right. Cylinders are numbered from the front 1-2-3-4.

The 45° inclination of the engine permits installation of the intake manifold, carburetor, fuel pump, starter and generator on the left side of the engine. This provides the best possible use of engine compartment space and maximum serviceability.

Engine rigidity is maintained by the cast iron block which has three main bearing bulk heads and five main bearings for the crankshaft. All main bearing caps are doweled to the cylinder block to insure accurate alignment and facilitate assembly.

CYLINDER HEAD

The same head is used on 8.6:1 and 10.25:1 compression ratio engines.

Valve seats are completely surrounded by water and the head has an oil gallery which feeds oil to the rocker arm studs to provide lubrication of the upper valve train parts.

Cylinder head casting date is located at the right front corner of the head.

Code	Model	Trans.	Usage	COMP. RATIO			CARB.		VALVE SPRG.		CAMSHAFT			Spec. Valve Lifter
				7.6	8.6	10.25	1 Bbl.	4 Bbl.	Sgl.	Dbl.	995	099	155	
89Z	195	SM	Standard		X		X		X		X			
88Z	195	SM	Export	X			X		X		X			
87Z	195	SM	Spec. Order			X		X		X		X		X
86Z	195	SM	Spec. Order			X	X		X		X			
85Z	195	SM	Spec. Taxi		X		X		X		X			
79Y	195	Auto.	Standard		X		X		X				X	X
78Y	195	Auto.	Export	X			X		X		X			
77Y	195	Auto.	Spec. Order			X		X		X		X		X
76Y	195	Auto.	Spec. Order			X	X			X		X		X
97Y	215	Auto.	Spec. Order			X		X	X		-	-		X

Fig. 6-1 Engine Identification Chart

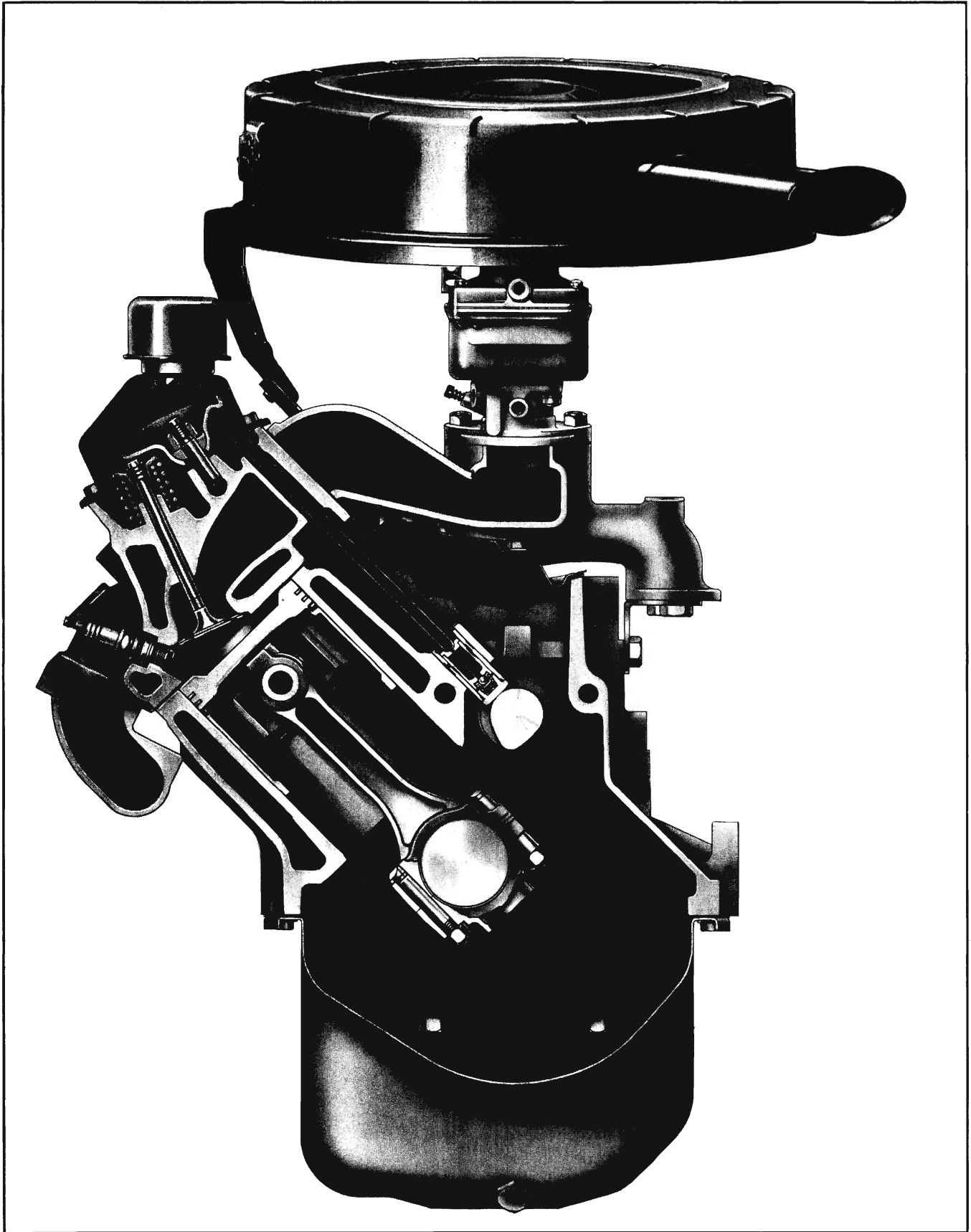


Fig. 6-2 Transverse Cross Section of Engine

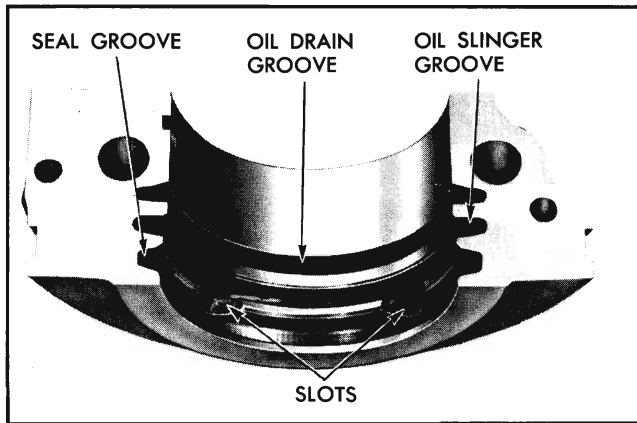


Fig. 6-3 Rear Main Bearing Cap

CRANKSHAFT AND BEARINGS

The crankshaft is cast pearlitic malleable iron and is supported by five main bearings. The rear main bearing shells have two oil grooves (Fig. 6-3). The rear oil groove has three oil drain holes evenly spaced. The first four upper and lower shells are interchangeable. The rear is not. Torsional vibration is dampened by the harmonic balancer mounted on the front end of the crankshaft.

The rear main bearing is sealed by a packing seated in a chamfered groove in the block and bearing cap. A slinger on the crankshaft in front of the seal and the drain groove in the rear main bearing prevent an excess of oil from getting to the seal.

Slots are cast in the cylinder block and cap seal groove to prevent seal rotation.

CAMSHAFT AND DRIVE

Three different camshafts are used as shown in Figs. 6-4 through 6-6.

The camshafts are cast from alloy iron. Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes valve lifters to rotate. The camshaft is supported by five bearings.

A $\frac{7}{8}$ " wide, 60 link timing chain is used to drive the camshaft. The timing chain, by means of cambered double bushing construction at each link, has built-in friction to provide quiet operation. To further assure quiet operation the timing chain is contained by two rubber bumpers. The pivotal bumper on the right hand side (slack side) is connected by a spring to the fixed position bumper on the left hand side (tension side) to absorb slack which develops in the chain. The 42 tooth camshaft drive sprocket is made from cyanide hardened, cast alloy iron, while the 21

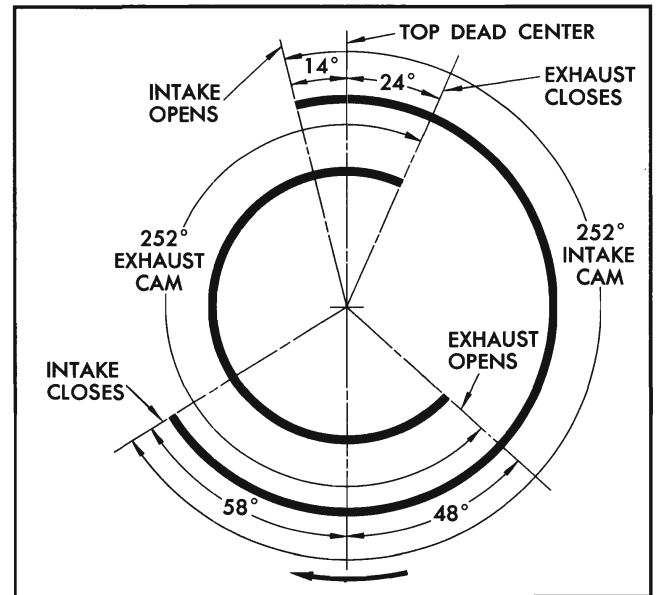


Fig. 6-4 Valve Timing Diagram—Engines Coded 89Z, 88Z, 86Z, 85Z and 78Y

tooth crankshaft sprocket is made from case hardened steel.

PISTONS

The pistons are aluminum alloy, tin plated, with steel struts to control expansion and give added strength. Pistons are cam ground so that the diameter across the thrust faces is larger than the diameter fore and aft of the engine. The steel struts force expansion and contraction to occur to the front and

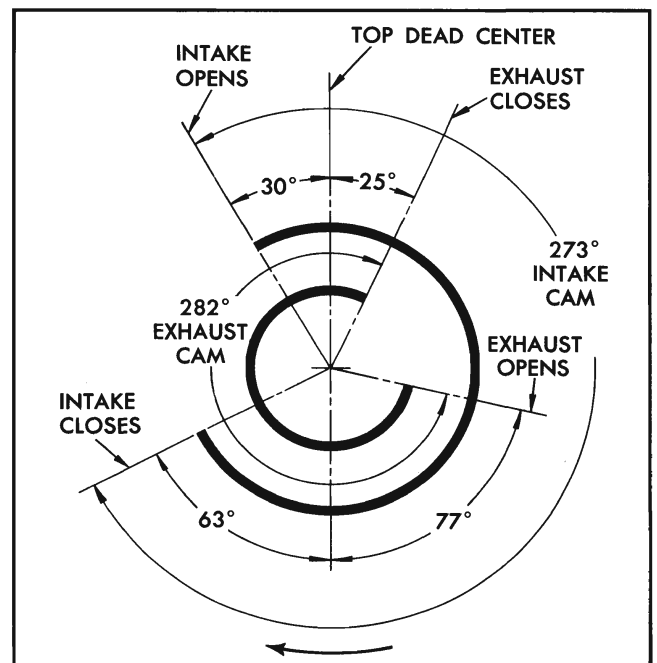


Fig. 6-5 Valve Timing Diagram—Engines Coded 87Z, 77Y and 76Y

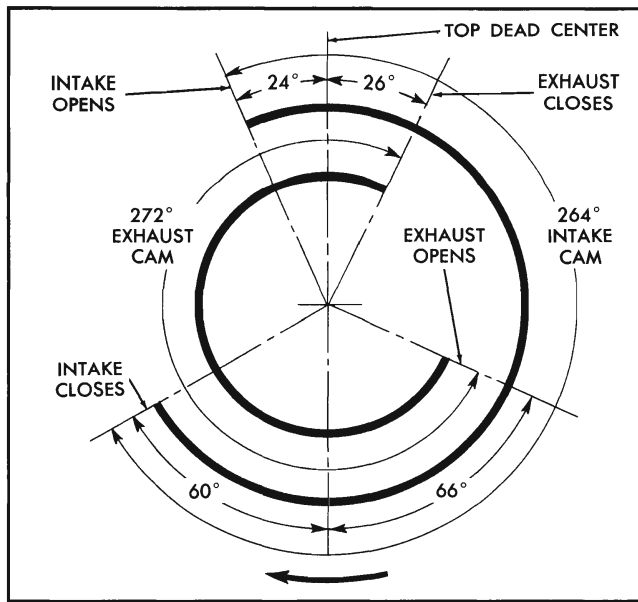


Fig. 6-6 Valve Timing Diagram
Engine Coded 79Y

rear and thus provides a constant diameter across the thrust faces. Two compression rings and one oil control ring are used, all of which are located above the piston pin.

The pistons used in the 10.25:1 compression ratio engines are flat on top as shown in Fig. 6-7. Pistons used in the 8.6:1 compression ratio engine are dished as shown in the illustration and also have an "L" cast on the back side. Dishing provides the larger combustion chamber volume required for the lower compression ratio.

The high compression piston has a relief machined into the head of the piston for valve clearance.

Piston pins are offset $\frac{1}{16}$ " toward thrust side (right hand side) to provide a gradual change in thrust

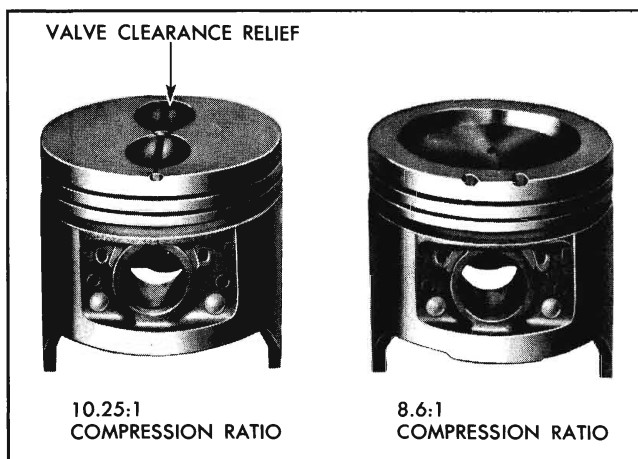


Fig. 6-7 Standard and High Compression Pistons

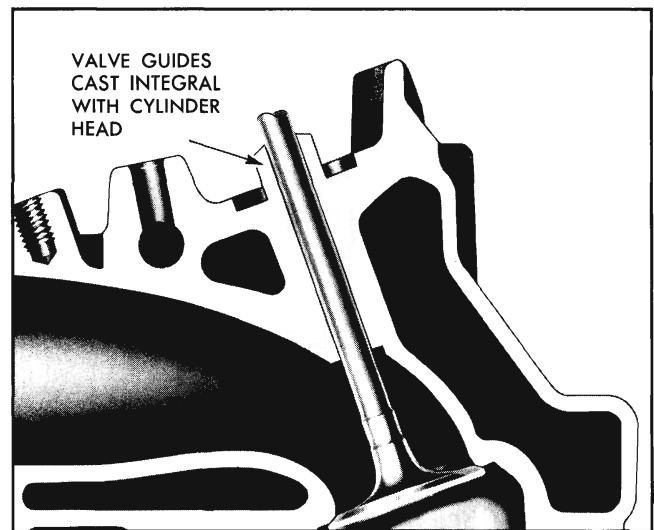


Fig. 6-8 Cross Section at Intake Valve

pressure against the cylinder wall as the piston travels its path. This feature provides quieter engine operation. Pins are hardened steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

VALVE TRAIN

A very simple ball pivot type valve train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball is retained by a nut which locks against a chamfer on the stud.

The maximum in durability is assured by the use of cyanide hardened stamped steel rocker arms. In addition all friction points to the valve train are positively lubricated.

The cylinder head has straight valve guides cast integrally (Fig. 6-8). External shields are used on both intake and exhaust valves to reduce the amount of oil splashed against stems. Valve stem seals are used on exhaust as well as intake valves to prevent oil from entering the valve guides.

Inner and outer valve springs are used on all four barrel engines and the 10.25:1 ratio automatic transmission equipped one barrel. The balance use single valve springs.

HYDRAULIC VALVE LIFTERS

Hydraulic lifters are used to keep all parts of the valve train in constant contact. In other words each lifter is an automatic adjuster maintaining zero lash under all conditions. This insures precision valve tim-

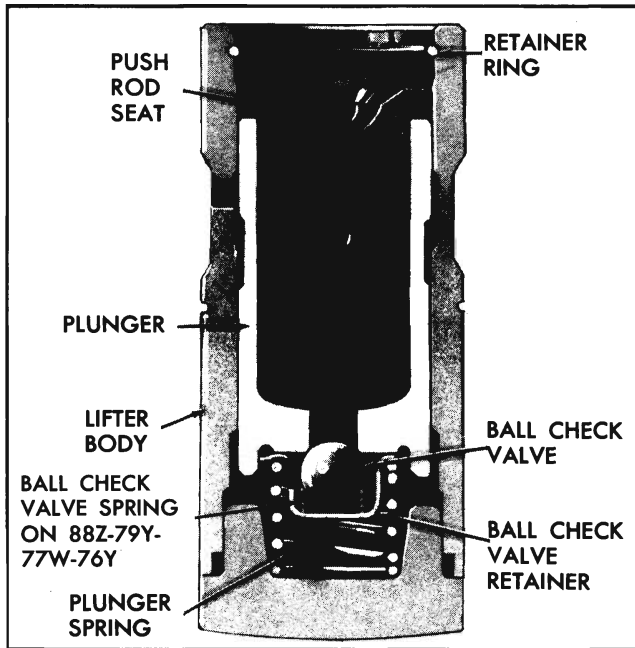


Fig. 6-9 Hydraulic Valve Lifter Assembly

ing and silent operation, increases valve life, and eliminates the need for tappet adjustment.

The hydraulic lifter assembly (Fig. 6-9) includes: the cast iron body which rides in the cylinder block boss, the plunger, push rod seat, plunger spring, ball check valve, ball check valve retainer, and retainor ring.

The hydraulic valve lifter functions as follows: when the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

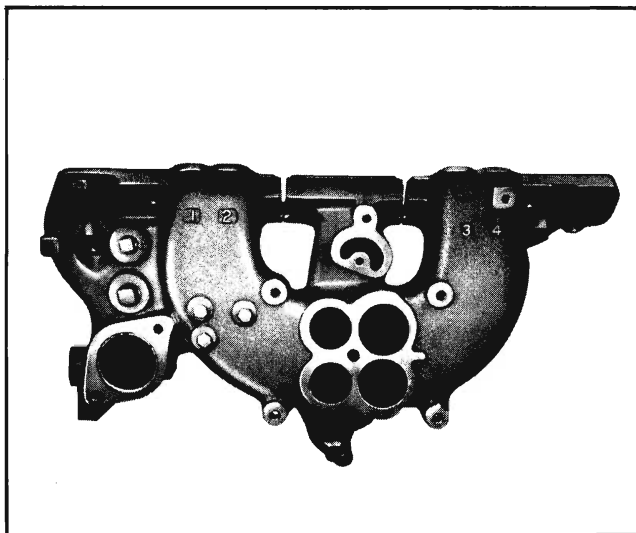


Fig. 6-10 Intake Manifold—4 Barrel Carburetor

When the lifter body begins to ride up the cam lobe, the ball check valve cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full. On some engines a special valve lifter is used (Fig. 6-1 and 6-9). This lifter incorporates a spring under the check ball to ensure satisfactory low speed operation with the longer ball travel.

During operation a small amount of oil leaks out of the lifter between the plunger and body. A controlled amount of leakage is important to provide continuous adjustment of the plunger position within the lifter. This leakage is called "leak down" and must be within certain limits to provide correct operation (see page 6-14).

Oil is supplied to the lifter by the cylinder block oil gallery to replace that lost through leak down. The annular groove around the outside of the lifter body indexes with the passage drilled from the gallery to the lifter boss. Oil then enters the lifter from this groove and passes into the plunger cavity. From the plunger cavity, oil under pressure is also fed up the push rod to lubricate the friction area between the upper end of the push rod and the rocker arm.

FUEL DISTRIBUTION SYSTEM

The intake manifold is designed to provide fuel passages which are short and practically equal in length. On the single barrel carburetor all cylinders feed off a single carburetor throat. On the four barrel manifold (Fig. 6-10) the front two openings feed the number 2 and 3 cylinders and the rear openings feed number 1 and 4 cylinders.

A stove is included in the intake manifold surrounding the heat risers which lead to the carburetor. When the engine is cold exhaust gases are diverted through a passage in the intake manifold to circulate around and heat the risers. The fuel-air mixture is thereby pre-heated to the desired temperature for proper combustion.

EXHAUST MANIFOLD

A cast iron manifold is used. A thermostatically

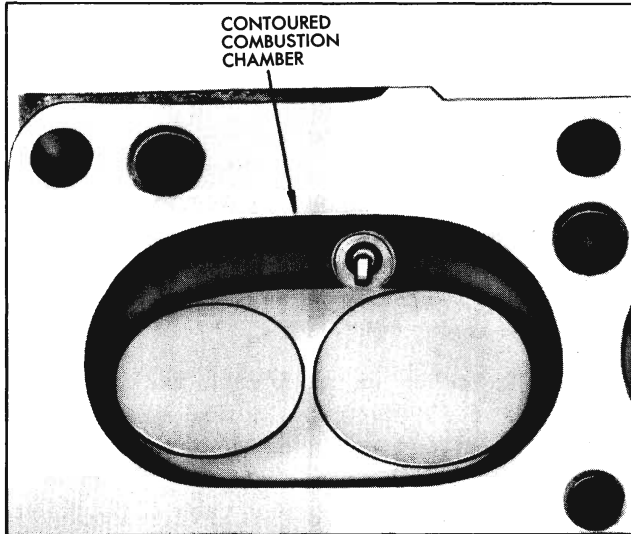


Fig. 6-11 Cylinder Head Combustion Chamber

controlled valve in the outlet of the manifold blocks the passage of exhaust out of the manifold when the engine is cold. Exhaust gases will then pass through the intake manifold exhaust crossover passage and into the exhaust system through the crossover pipe.

In passing through the crossover passage, the hot gases serve to heat the intake manifold stove and the choke heat tube.

COMBUSTION CHAMBERS

Combustion chambers are completely machined to insure accurate volume control and uniform shape for

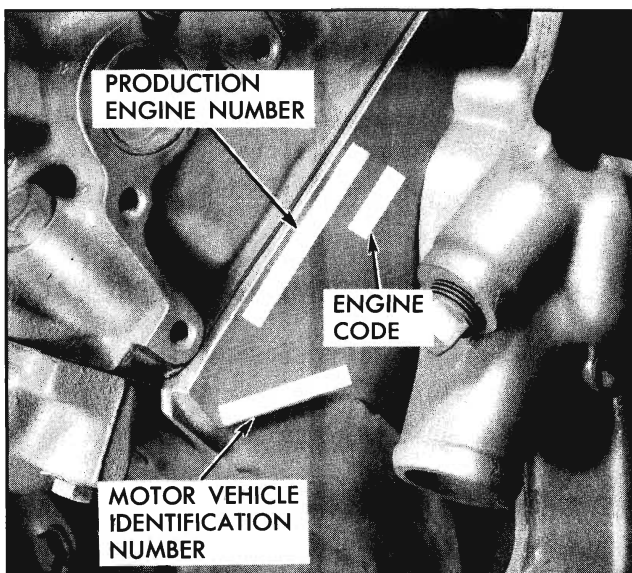


Fig. 6-12 Serial Number Location

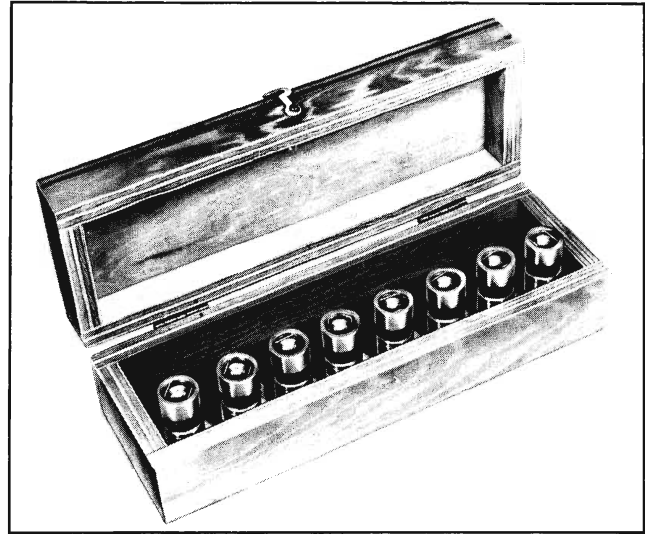


Fig. 6-13 Valve Lifter Storage Box

all cylinders. Spark plugs are located near intake valves for maximum power and to properly fire economically lean mixtures.

The contoured wedge shape of the combustion chamber (Fig. 6-11) minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

Intake valves are large and have 30° seat angles to further provide easy breathing for high combustion efficiency. Exhaust valve seat angle is 45°.

SERIAL NUMBERS

The manufacturer's motor vehicle identification number is located on a machined pad on the front, right-hand side of the block.

The production engine number will also be found in the same area (Fig. 6-12). This number is used for production control purposes during manufacture. The production engine number should be included on AFA's or P.I. Reports concerning the engine.

GENERAL INFORMATION ON ENGINE SERVICE

Cleanliness is a primary factor when servicing the engine. The slightest particle of dirt that finds its way into a hydraulic lifter may cause a malfunction.

Since any dirt which may enter the oil galleries or passages in the engine could eventually get to a lifter, cleanliness should be exercised when any part

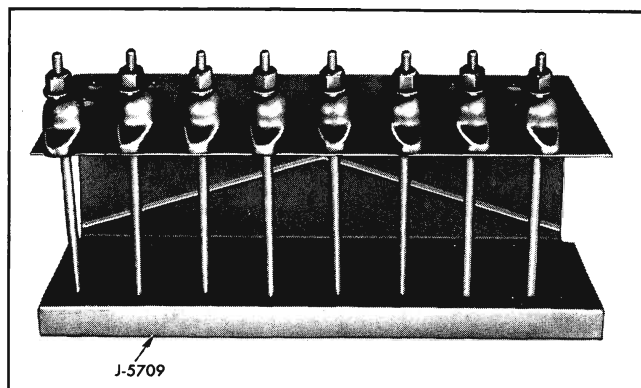


Fig. 6-14 Valve and Valve Train Holding Stand

of the engine is removed or disassembled. When a cylinder head is removed for any purpose, it is necessary to remove the push rod cover. This exposes the lifters to any dirt which may fall from the upper portion of the block or which may be carried in the air. Thus, it is wise to cover the lifter galleries until ready to reassemble the engine.

When lifters are removed for any reason, they should immediately be placed in order in Valve Lifter Storage Box J-5763 (Fig. 6-13). This is important for two reasons. First, it is the easiest way to keep lifters clean. Second, lifters should always be replaced in the same bosses from which they were removed.

Valves, valve lifters, push rods, rocker arms, rocker arm balls, and rocker arm ball nuts should always be kept in sets and returned to their original positions. These parts will tend to mate as the engine operates and will provide more satisfactory operation when kept together. By storing lifters in Storage Box J-5763 and valves, push rods, rocker arms, balls and nuts in Holding Stand J-5709 (Fig. 6-14), whenever they are removed, they can easily be kept in sets for identification during assembly. In addition to keeping the parts in sets, the push rods should be replaced with the same end up. In other words, the same end will contact the rocker arm as before the engine was disassembled. The upper end can usually be identified by the polished surface which contacts the rocker arm. Push rods will also be polished somewhat in the area where the rod passes through the head.

When hydraulic valve lifters are disassembled, the various parts of each lifter must be kept together. This is especially important since the lifter body and plunger are selectively fitted. The use of the special tray included with Cleaning Tank J-5821 will aid in keeping the parts of each lifter together when lifters are being serviced.

Cylinder head screws should be installed without thread sealer of any kind.

When raising or supporting the engine for any reason, do not use a jack under the oil pan or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump, jacking against the oil pan may cause it to be bent against the pump. The result would be a telegraphed noise which would be difficult to trace. The crankshaft pulley is sheet steel and will not support engine weight.

It should be kept in mind, while working on the engine, that the twelve volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

In the mechanical procedures described in this section generally no references will be made to the removal of optional equipment such as power steering pump, air conditioning compressor, etc.

Should it become necessary to remove any such item to perform other service refer to the appropriate section of the manual for specific information.

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, fuel filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this book.

ENGINE ASSEMBLY REMOVE AND REPLACE

REMOVE

1. Remove hood.
2. Drain and remove radiator.
3. Disconnect heater hoses at engine.
4. Disconnect wiring harness at generator, ignition coil, starter solenoid, heater blower, thermogauge and oil pressure switch.

5. Disconnect engine ground strap at both sides of engine.
6. Disconnect fuel line at fuel pump.
7. Disconnect vacuum modulator line on automatic transmission equipped unit.
8. Remove front fender cross brace.
9. Remove fan and fan pulley.
10. Disconnect accelerator rod at engine lever.
11. Raise front of car.
12. Disconnect exhaust pipe at manifold.
13. Disconnect clutch linkage on Synchro-Mesh.
14. Position wooden block at rear of engine to prevent damage to distributor if engine rocks to the rear. Disconnect propeller shaft and torque tube from rear of engine by following first 11 steps of removal procedure given in Section 4.
15. Disconnect engine support at crossmember.
16. Carefully raise engine with chainfall or overhead hoist. Move forward to clear firewall and heater.

REPLACE

The replacement procedure is essentially a reversal of removal. Follow instructions given in Section 4 for the installation of propeller shaft and torque tube. Failure to follow procedure may result in drive-line damage.

MANIFOLDS—VALVE TRAIN—CYLINDER HEAD

EXHAUST MANIFOLD OR GASKET REPLACE

REMOVE

1. Remove bolts from exhaust crossover pipe at exhaust manifold.
2. Straighten tabs on manifold front and rear screw locks and remove manifold attaching bolts, manifold and gasket.
3. Remove old gasket from exhaust crossover pipe connector.

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold. Check condition of heat control valve and related parts.
2. Place new gasket on exhaust crossover pipe connector.

3. Replace exhaust manifold and new gasket. Use new individual manifold bolt locks on front and rear pairs of bolts. **NOTE:** Place manifold outlet in position over end of crossover pipe, but do not permit weight of manifold to rest on crossover pipe. Since the end holes of the gasket are slotted, installation of gasket may be simplified by first installing the manifold using only the front and rear bolts to retain manifold. Allow clearance of about $\frac{3}{16}$ " between cylinder head and exhaust manifold. After inserting the gasket between head and manifold the remaining bolts may be installed.

4. Tighten all bolts evenly and securely (30 lb. ft. torque). Bend tabs of bolt locks against bolt heads. **NOTE:** Be sure tabs are bent against sides of bolt heads, not on top of bolt heads.

INTAKE MANIFOLD ASSEMBLY AND/OR GASKET REPLACE

REMOVE

1. Drain radiator.
2. Remove air cleaner assembly.
3. Disconnect exhaust crossover pipe at manifold.
4. Disconnect carburetor linkage at carburetor.
5. Disconnect fuel line at carburetor.
6. Disconnect temperature gauge wire at thermogauge.
7. Disconnect upper radiator hose at thermostat housing.
8. Disconnect vacuum advance hose at manifold.
9. Disconnect heater hose at manifold.
10. Remove high tension wires from bracket on coil.
11. Disconnect coil high tension wire at coil.
12. Loosen manifold to timing cover draw bolt (Fig. 6-15).
13. Remove manifold attaching screws (Fig. 6-15).
14. Remove manifold using care not to lose locating sleeves in head.
15. Remove manifold gasket.

REPLACE

NOTE: If new manifold is to be installed all parts and assemblies from old manifold must be transferred. Use new gaskets on those units requiring gaskets.

1. Position new gasket over locating sleeves in cylinder head (Fig. 6-16). Replace "O" ring seal in recess at front of manifold.

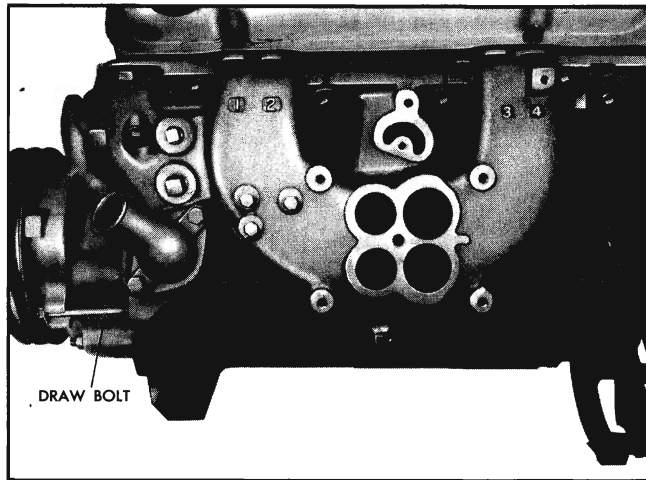


Fig. 6-15 Location of Manifold Attaching Screws

2. Position intake manifold assembly on cylinder head. Install screws finger tight.

3. Tighten manifold to timing cover draw bolt to obtain metal to metal contact between parts (10-20 lb. ft. torque). Be sure "O" ring is in place.

4. Tighten manifold attaching screws to 40 lb. ft. torque.

5. Connect coil high tension wire at coil.

6. Position high tension wires in coil bracket.

7. Connect heater hose.

8. Connect vacuum advance hose.

9. Connect upper radiator hose.

10. Connect wires to thermogauge.

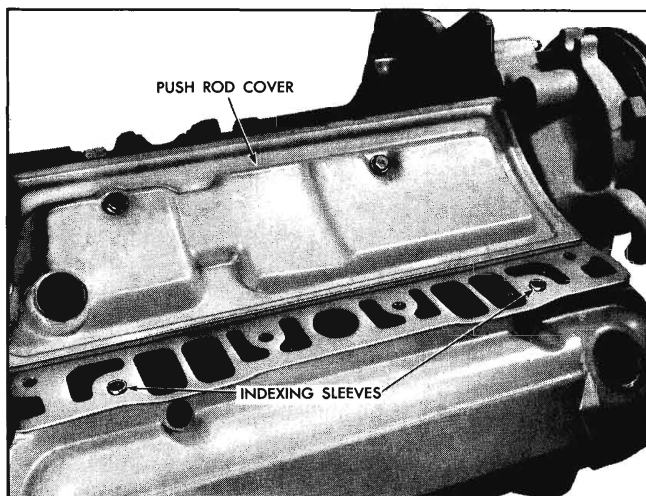


Fig. 6-16 Manifold Gasket Indexing Sleeves

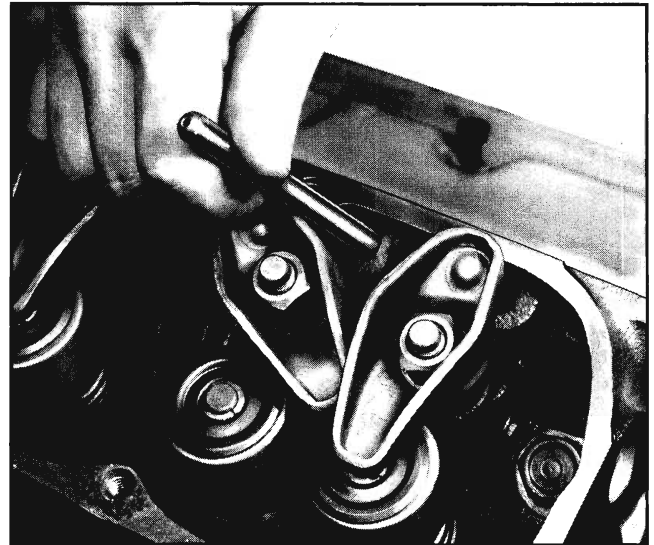


Fig. 6-17 Removing Push Rod

11. Connect carburetor linkage.

12. Connect fuel line at carburetor.

13. Connect exhaust crossover pipe.

14. Install air cleaner assembly.

15. Fill radiator.

PUSH ROD REPLACE

REMOVE

1. Remove rocker arm cover.

2. Loosen rocker arm nuts and rotate rocker arms to allow removal of push rods (Fig. 6-17).

3. Remove push rods and store in such a manner as to allow installation in original position.

REPLACE

1. Install push rod in original location with same end toward valve lifter.

2. Position rocker arms and tighten rocker arm nuts to 15-25 lb. ft. torque (Fig. 6-18).

3. Install rocker arm cover.

VALVE SPRINGS, SHIELDS OR SEALS REPLACE

1. Remove rocker arm cover.

2. Remove rocker arm.

3. After removing rocker arm, thread valve spring compressor stud J-8929-1 on rocker arm stud and

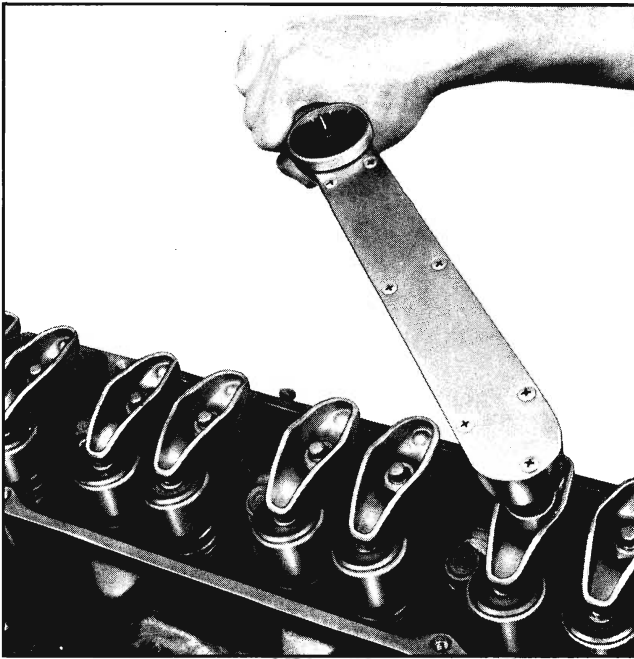


Fig. 6-18 Torqueing Rocker Arm Nut

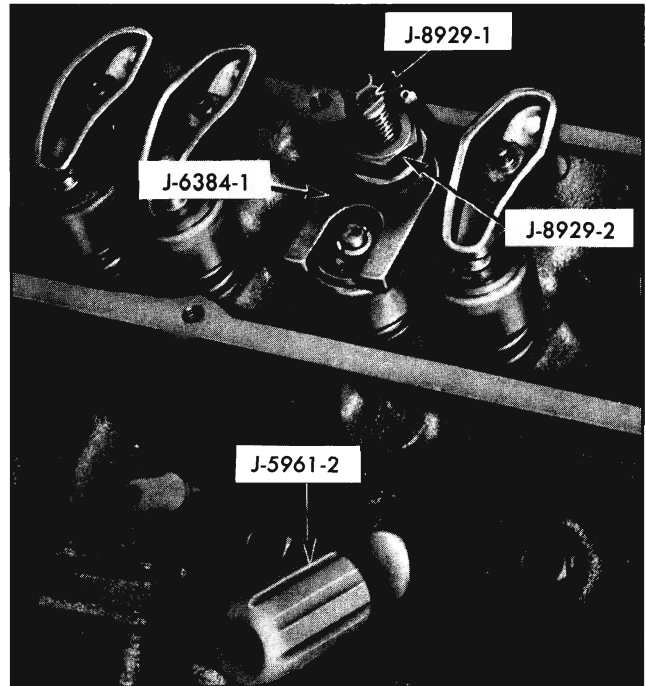


Fig. 6-19 Valve Spring Compressed

compress valve spring using compressor J-6384-1 and nut J-8929-2 while holding valve up with Valve Holder J-5961-2 (Fig. 6-19). Remove valve spring retainer cup locks and then remove valve spring compressor, valve spring retainer cup shield and valve stem seal.

4. Remove valve springs.

5. Install new part or parts, compress springs with Valve Spring Compressor J-6384-1 and Nut J-8929-2 (while holding valve up with Holder J-5961-2), install valve stem seal, and install retainer cup locks. Remove spring compressor and valve holder, then test valve stem seal using suction cup end of tool J-5751.

6. Install rocker arm. Tighten rocker arm ball retaining nut to 15-25 lb. ft. torque.

7. Replace rocker arm cover.

VALVE LIFTER REPLACE

REMOVE

1. Remove intake manifold (Page 6-9).
2. Disconnect crankcase ventilator outlet and remove push rod cover.
3. Remove rocker arm cover.

4. Loosen rocker arm nuts and rotate rocker arms to allow removal of push rods.

5. Remove push rods and store in such a manner as to allow installation in original position.

6. Before removing lifter that is suspected of having a stuck plunger, it can be tested using unloader J-5097. To check lifter insert pin of unloader tool through hole in push rod seat and push down on tool. Pin will unseat ball and tool will move push rod seat and plunger down. If lifter plunger is stuck, it will be impossible to move push rod seat down.

7. Remove lifter. Hydraulic Valve Lifter Remover J-3049 may facilitate removal of lifter. Store lifters so that they can be installed in exactly the same location.

REPLACE

NOTE: If new lifter is to be installed be sure to remove all sealer coating from inside of new lifter and check leak down rate, page 6-14.

1. Place lifter in original lifter boss.
2. Replace push rod exactly as removed.
3. Position rocker arm on push rod and tighten rocker arm ball retaining nut to 15-25 lb. ft. torque.
4. Install rocker arm cover.

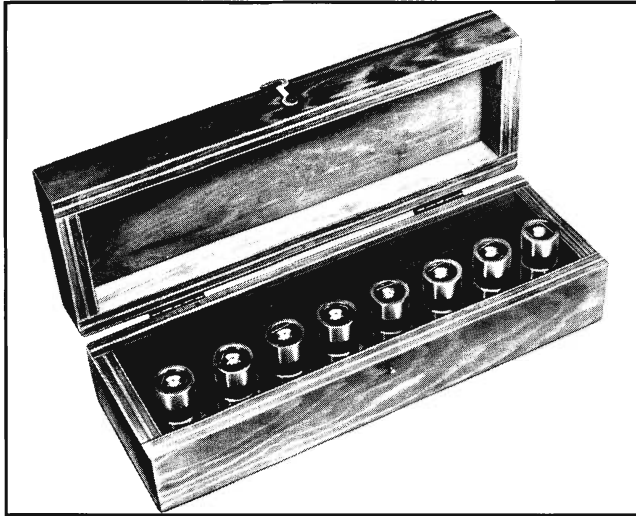


Fig. 6-20 Valve Lifter Storage Box

5. Install push rod cover and connect crankcase ventilator outlet pipe.
6. Install intake manifold.

RECONDITION HYDRAULIC VALVE LIFTERS

NOTE: Because of the important part hydraulic valve lifters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, cleanliness, cannot be overstressed when servicing these parts.

New lifters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leak down rate. It is not necessary to remove the oil from new lifters prior to checking leak down rate since special leak down oil is already in new lifters.

Wash Tank and Tray J-5821 is recommended for

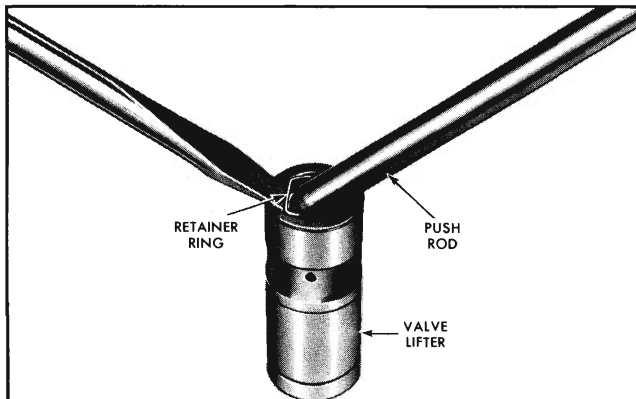


Fig. 6-21 Removing Push Rod Seat Retainer Ring

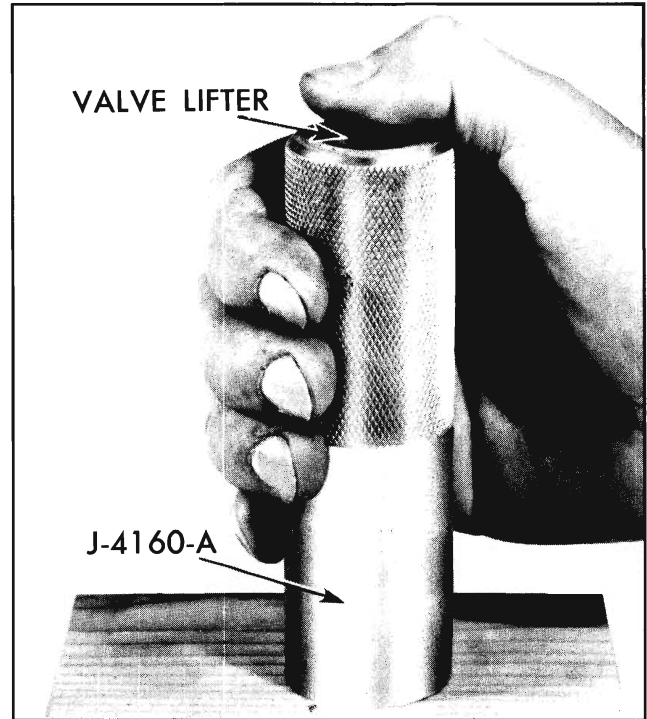


Fig. 6-22 Removing Stuck Plunger

cleaning valve lifters. This tank should be used only for valve lifters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Lifters should at all times be stored in a covered box (Fig. 6-20) which will aid in keeping them clean. The lifter box should be kept dry and as free of oil as possible.

DISASSEMBLE VALVE LIFTER

1. Remove push rod seat retainer ring by holding seat down with push rod while dislodging spring from lifter body with a pointed tool (Fig. 6-21). **NOTE:** It may be necessary to unseat lifter ball, using plunger unloader J-5097, before plunger can be pushed down.

2. Invert lifter and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place lifter in large end of Hydraulic Valve Lifter Plunger Remover, J-4160-A, with push rod end of lifter downward. Hold tool firmly in hand with thumb over lifter body and sharply strike tool against a block of wood (Fig. 6-22) until plunger falls out.

NOTE: It may be necessary to soak a lifter having a stuck plunger in cleaning solvent for several min-

utes in order to remove the plunger.

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from Wash Tank J-5821 (Fig. 6-23).

CAUTION: Valve lifter body and plunger are selectively fitted and must not be interchanged with parts of other lifters. (Keeping all parts of lifters together will also aid in trouble diagnosis.)

CLEAN AND INSPECT VALVE LIFTER

Wash Tank J-5821 is recommended for cleaning valve lifter parts. This tank consists of two chambers, a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be closed.

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Wipe out tank cover and place tray of parts on cover in front of tank. A shop towel under tray and clean paper on remainder of cover will ensure cleanliness.

6. Working on one lifter at a time and using clean, lint-free cloths, thoroughly wipe off lifter parts. Clean plunger and external and internal surfaces of body with a hard wiping action. A bristle brush may be used to clean internal surface of lifter body.

CAUTION: Do not use wire brush or sand paper, as these may damage machined surfaces.

NOTE: Absolute cleanliness can be assured if each lifter is inspected and assembled after cleaning, but before proceeding to the next lifter.

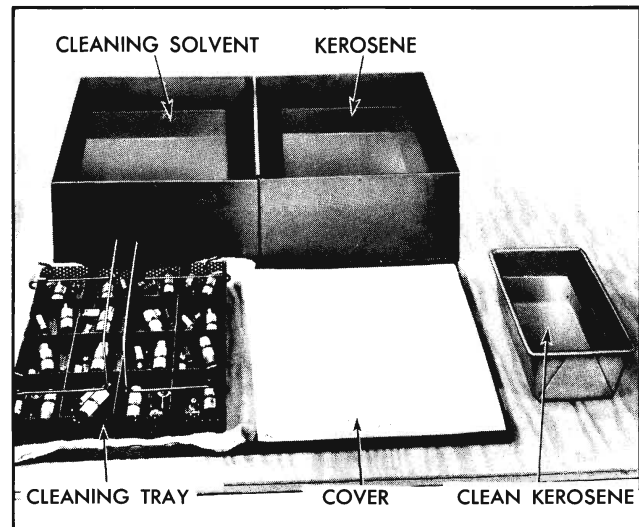


Fig. 6-23 Lifter Wash Tank and Tray

7. Inspect lifter body. Both inner and outer surfaces of lifter body should be inspected for scoring. Lifter assembly should be replaced if body is roughly scored, grooved, or galled. Inspect cam contact surface on lower end of lifter body. Replace lifter assembly if this surface is excessively worn, galled or otherwise damaged.

8. Inspect lifter plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

A blackened appearance is not a defective condition. Sometimes the discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect push rod seat. Inspect push rod seat for roughness and to insure that hole in center is open.

10. Inspect valve lifter ball. Carefully examine ball for nicks, embedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy lifter operation. Also inspect plunger face of ball retainer for excessive wear.

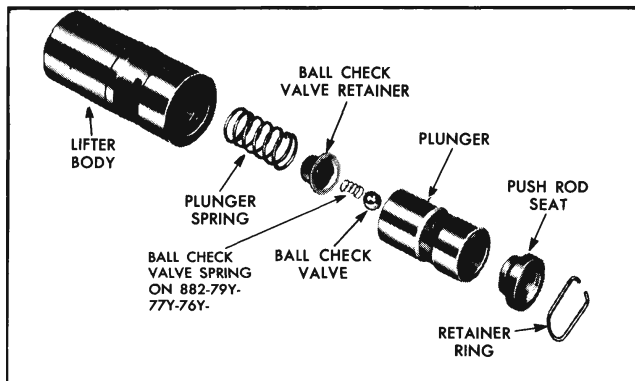


Fig. 6-24 Exploded View of Valve Lifter

ASSEMBLE VALVE LIFTER

NOTE: All parts must be absolutely clean when assembling a hydraulic lifter. Since lint and dust may adhere to parts they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of lifters being overhauled.

Figure 6-24 shows the relative position of component parts of valve lifters. The recommended procedure for assembly is given in the following steps.

1. Rinse plunger spring and ball retainer and position retainer in spring.

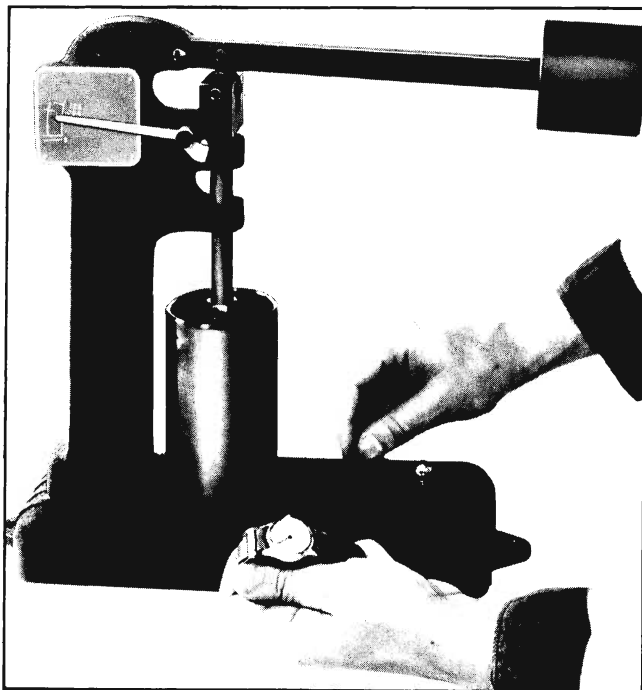


Fig. 6-25 Testing Leak Down Rate

2. Rinse lifter ball and place in retainer.
3. Rinse plunger and place on retainer so that seat on plunger mates with ball.
4. Invert plunger with parts assembled thus far and, after rinsing lifter body, install body over spring and plunger.
5. Place lifter body on clean paper, rinse and install push rod seat and retainer ring.
6. After lifter has been assembled, place in lifter box and close lid to preserve cleanliness.

TEST VALVE LIFTER LEAK DOWN RATE

After all lifters have been assembled, the leak down rate must be checked before they are installed in the engine. Valve Lifter Leak Down Tester J-5790 (Fig. 6-25) is designed to test leak down rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is paramount. The tester cup, and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

1. Fill tester cup to approximately one inch from top with special fluid which is available from tester manufacturer.
2. Swing weight arm up out of the way, raise ram, and position lifter into boss in center of tester cup.
3. Adjust ram (with weight arm clear of ram) so that the pointer is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.
4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and force out air. (Lifter must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.
5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds). Time indicator travel from lower line (first line above set line) to line marked $.125''$ or $\frac{1}{8}''$, while still rotating cup with crank (Fig. 6-25). Lifter is satisfactory if rate is between 12 and 60 seconds.

A doubtful lifter should be tested three or four times. Disassemble, inspect, and re-test doubtful lifters. If leak down still is not within specifications, replace lifter.

6. After each lifter is tested, replace in lifter box to insure cleanliness. Leave lifters in box until ready for installation in cylinder block.

7. When all lifters have been tested, empty cup, clean, and place cover over tester to maintain its cleanliness.

REMOVE AND REPLACE CYLINDER HEAD AND/OR GASKET

REMOVE

1. Remove intake manifold assembly.
2. Disconnect breather pipe or hose from vent valve and remove push rod cover.
3. Remove bolts attaching exhaust manifold to cylinder head.
4. Remove rocker arm cover assembly.
5. Loosen rocker arm nuts and rotate rocker arms so push rods can be removed.
6. Remove push rods and store so that they can be installed in original position.
7. Disconnect spark plug wires.
8. Remove cylinder head attaching bolts.
9. Remove cylinder head using lifting hooks J-4266.
10. Remove cylinder head gasket.

REPLACE

1. Thoroughly clean gasket surfaces of block and head, position new cylinder head gasket over locating dowels.

2. Place cylinder head in position on locating dowels (Fig. 6-26).

NOTE: Three different length bolts are used. When installed in their proper position, they will project an equal amount from their bosses. Do not use sealer on threads.

3. Install cylinder head attaching bolts. Torque to 95 lb. ft.

4. Install push rods in original location and position.

5. Position rocker arms and tighten rocker arm nuts

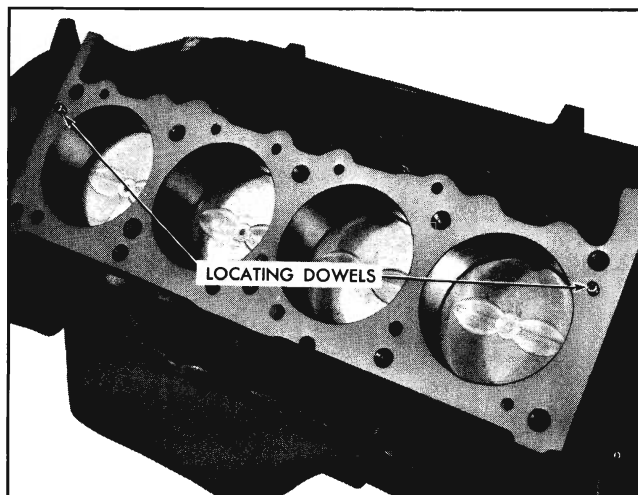


Fig. 6-26 Cylinder Head Locating Dowels

to 15-25 lb. ft. torque.

6. Install rocker arm cover.

7. Install bolts attaching exhaust manifold to cylinder head and lock in position. Torque bolts to 30 lb. ft.

8. Install push rod cover and crankcase breather outlet pipe or reinstall vent valve hose.

9. Install intake manifold.

10. Connect spark plug wires.

ROCKER ARM STUD REPLACE

Rocker arm studs are replaceable providing a press of two tons capacity or more is available.

NOTE: Both standard and .003" oversize studs are available. If replacing stud which has become loose, measure stud diameter with micrometer. Standard size stud should measure .4340"-.4345". If stud is loose because it is undersize, replace with standard stud. If loose because hole is oversize, replace with .003" oversize stud. No reaming operation is necessary.

1. Remove cylinder head from engine (page 6-15).

2. With rocker arm removed, file two slots $\frac{3}{32}$ " to $\frac{1}{8}$ " deep on opposite sides of rocker arm stud (Fig. 6-27). Top of slots should be $\frac{1}{4}$ " to $\frac{3}{8}$ " below thread travel.

3. Place washer J-8934-3 at bottom of rocker arm stud.

4. Position Rocker Arm Stud Remover J-8934-1 on rocker arm stud and tighten screws securely with $\frac{5}{32}$ " allen wrench.

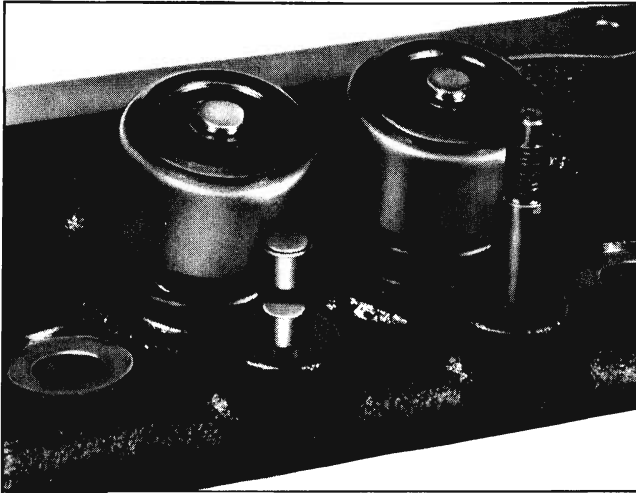


Fig. 6-27 Slots Filed in Rocker Arm Stud

5. Place spacer J-8934-2 over Stud Remover J-8934-1.

6. Thread $\frac{7}{8}$ " standard nut on stud remover and turn nut until rocker arm stud is out of cylinder head (Fig. 6-28).

7. Remove plugs (Fig. 6-29) from ends of cylinder head oil gallery and thoroughly clean out metal deposits and foreign matter from oil gallery (head must be right side up so foreign material will not lodge in or around studs).

8. Position rocker arm on new rocker arm stud and place Rocker Arm Stud Installer J-8927 on stud in place of rocker arm ball.

9. Coat rocker arm stud with white lead and oil and with cylinder head mounted in press so studs are

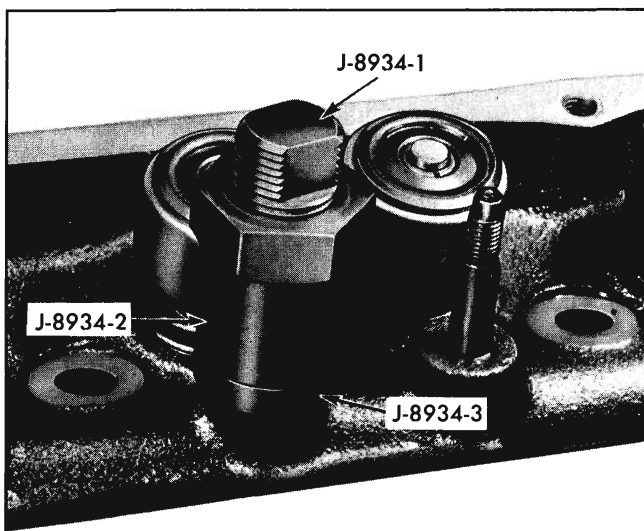


Fig. 6-28 Tools Positioned to Remove Rocker Arm Stud

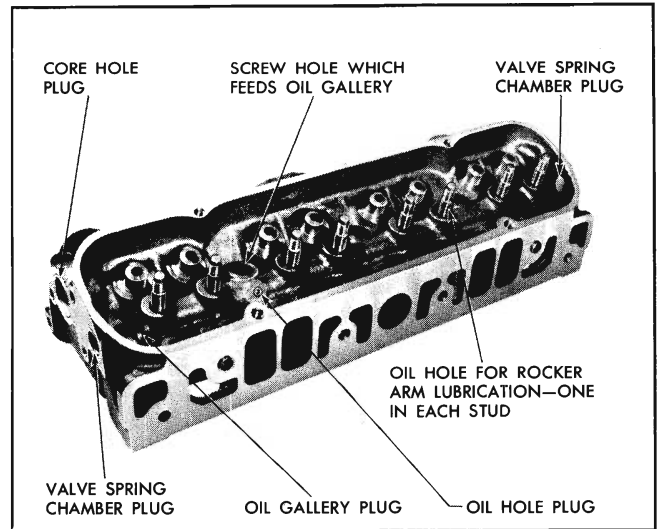


Fig. 6-29 Location of Oil Gallery Plugs

vertical, position new stud with rocker arm and rocker arm stud installer over hole in head (Fig. 6-30).

10. Carefully press stud into head until it is in about half way ($\frac{7}{16}$ ").

11. Position Valve Train Gauge J-8928 in push rod hole so that it seats properly in the rocker arm.

12. With valve seated, slowly press rocker arm stud into cylinder head until gauge projects about midway between the end of the gauge and the step with respect to the gasket surface of the cylinder head.

NOTE: It will be necessary to clamp a straight edge along the edge of the cylinder head as shown in Fig. 6-31 to simulate this gasket surface.

13. Remove Rocker Arm Stud Installer, rocker arm and ball.

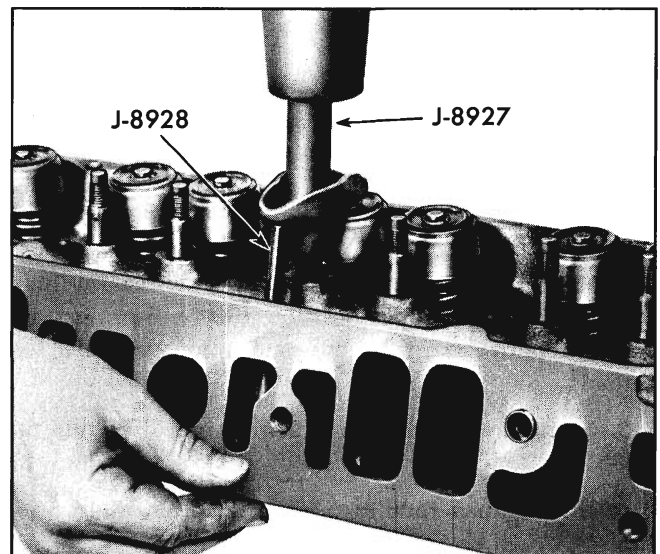


Fig. 6-30 Positioning Rocker Arm Stud

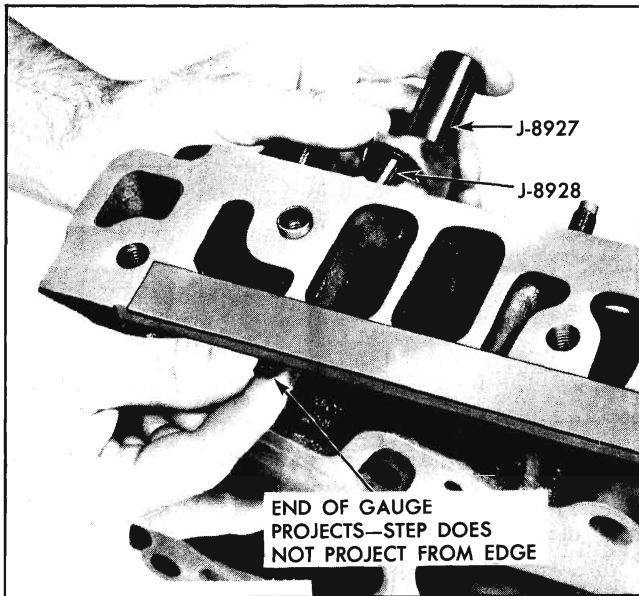


Fig. 6-31 Checking Stud Height

14. Blow air through hole in new stud to insure that the passage is not restricted.
15. Blow air through oil gallery to remove any foreign matter.
16. Replace plugs in ends of oil gallery.
17. Check oil passages from oil gallery to all studs. (See step 3c, **CLEAN AND INSPECT CYLINDER HEAD AND VALVES**.)
18. Install rocker arm and ball and install nut loosely.
19. Replace cylinder head (page 6-15).

RECONDITION CYLINDER HEAD AND VALVES

DISASSEMBLE CYLINDER HEAD AND VALVES

Remove valve spring retainer cup locks (keepers), valve stem oil seals, valve spring retainer cups, valve stem shields, valve springs, and valves, using valve spring compressor. Valve stem oil seals must be discarded and replaced with new seals any time they are removed. Place valves in Valve and Valve Train Holding Stand J-5709.

CLEAN AND INSPECT CYLINDER HEAD AND VALVES

1. Inspect valves and seats to determine condition

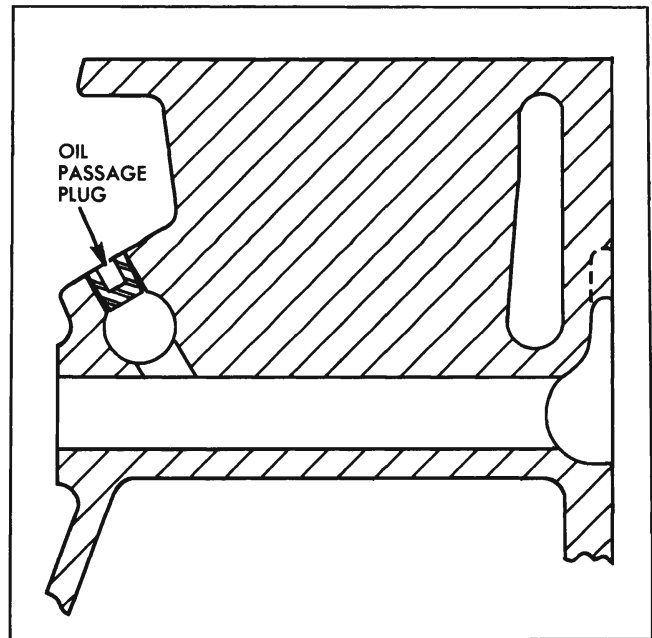


Fig. 6-32 Cylinder Head Oil Passage Plug

before cleaning. Also check oil and water passage plugs for evidence of leakage (Fig. 6-32).

2. Clean valves thoroughly to remove deposits from head and stem.
3. Clean and inspect cylinder head as follows:
 - a. Clean carbon deposits from combustion chambers and all sludge or foreign matter from other areas of cylinder head. If a scraper or wire brush is used for cleaning, use care to prevent damage to valve seats.

CAUTION: To prevent damage to valve seat it is good practice to keep wire brush well away from seat.

- b. Clean cylinder head thoroughly using suitable cleaning equipment.

- c. Check oil passages from oil gallery through rocker arm studs. A simple test can be made using a rubber hose and smoke. Block lower end of cylinder head screw hole which feeds oil gallery (Fig. 6-29) and blow smoke in top end of hole through rubber hose. Smoke should come out hole in each stud.

4. Clean valve guides thoroughly using Valve Guide Cleaner J-8101 (Fig. 6-33).

5. Visually inspect valve guides for evidence of wear, especially the end toward the spring seat. If a guide is scored or galled, install valve with proper oversize stem according to procedure on page 6-19.

6. Clean valve springs and inspect to see that they meet specifications.

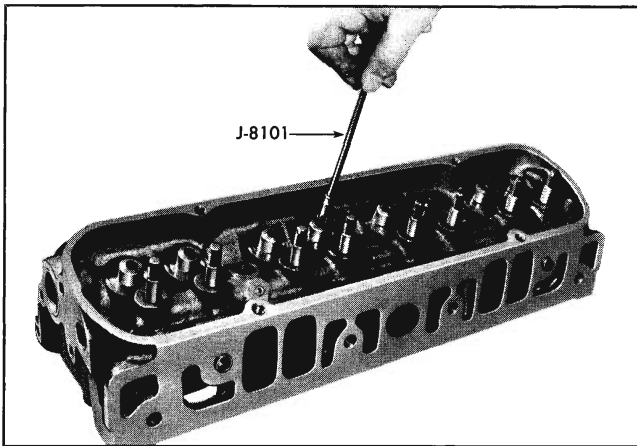


Fig. 6-33 Cleaning Valve Guide

7. Clean push rods and thoroughly clean out oil passage through center of rod. Inspect to see that the rod is straight.
8. Clean rocker arms and rocker arm balls, and visually inspect for evidence of wear.
9. Clean spark plugs as outlined in section 12.
10. Clean and inspect valve lifters.

RECONDITION VALVES AND SEATS

1. Reface valves and seats as follows:

Valves should be ground on a special bench grinder designed specifically for this purpose and built by a reputable manufacturer. Valve seats should be ground with reputable power grinding equipment having stones of the correct seat angle and a suitable pilot which pilots in the valve stem guide. To ensure positive sealing of the valve face to its seat, the grinding

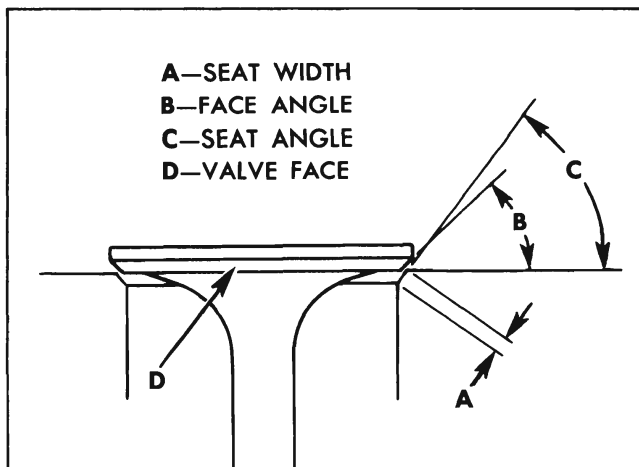


Fig. 6-34 Valve Seat and Face Angles

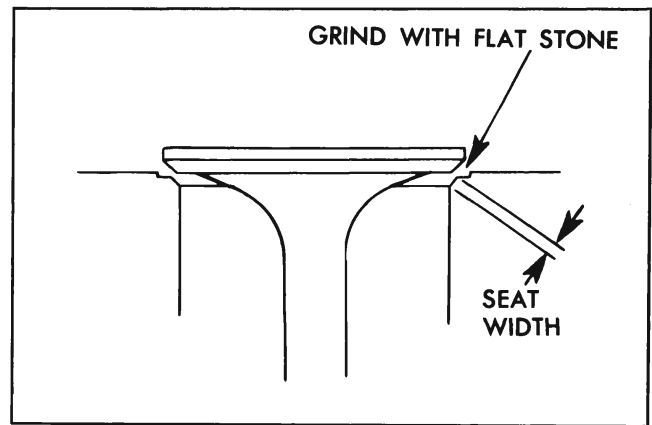


Fig. 6-35 Valve Seat after Grinding with Flat Stone

stones should be carefully refaced before any grinding is done. Intake valve seat angle is 30° , exhaust valve seat angle is 45° . Intake valve face angle is 29° and exhaust valve face angle is 44° . This will provide hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces (Fig. 6-34).

DO NOT USE REFACING EQUIPMENT EXCESSIVELY; only enough material should be removed to true up surfaces and remove pits. The valve head will run hotter as its thickness is diminished; therefore, if valve face cannot be cleaned up without grinding to point where outside diameter of valve has a sharp edge, the valve should be replaced. Whenever it is necessary to replace a valve, the new valve should be of the same stem diameter as the valve removed (unless the valve guide is reamed to provide proper fit).

Width of valve seats should be $\frac{1}{16}$ " (.048"—.070"). If seat width is excessive it should be narrowed by grinding with a flat stone (Fig. 6-35). This is the only method that should be used to narrow the seat. **NOTE:** Lapping of valve seats is not required or recommended.

2. Check concentricity of valve seat and valve guide. Concentricity of valve seat and valve guide can be checked by using a suitable dial indicator or prussian blue. When using a dial indicator, total runout should not exceed .002".

When prussian blue is used, a light coat should be applied to the face of the valve only and the valve rotated in its seat. If blue appears all the way around the valve seat, the valve seat and the valve guide are concentric with one another.

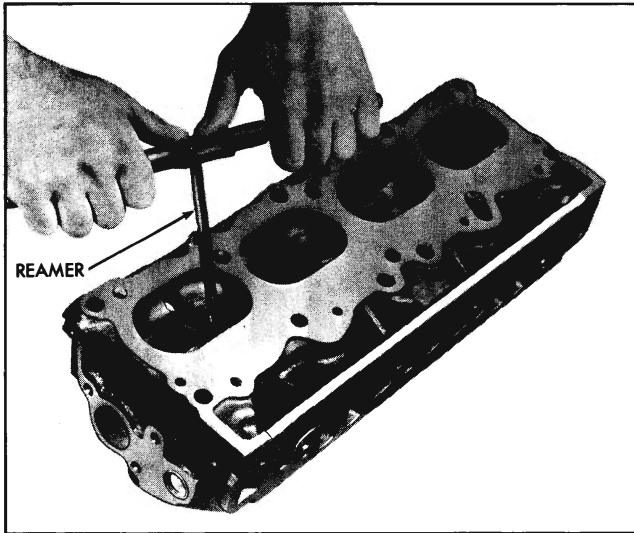


Fig. 6-36 Reaming Valve Guide

3. Check concentricity of valve stem and face of valve. After cleaning prussian blue from valve and seat from preceding check, lightly coat valve seat with prussian blue and rotate valve in guide. If blue appears all the way around the valve, the valve stem and valve face are concentric with one another.

NOTE: Both tests in steps 2 and 3 are necessary to insure proper valve seating.

4. Check and correct length of valve stem using Valve Train Gauge J-8928 as follows:

a. Position rocker arm on stud and hold in place using Rocker Arm Stud Installer J-8927. Slip valve into place and hold it against valve seat. While holding rocker arm and valve in position securely, insert Valve Train Gauge through push rod hole and seat snugly in push rod seat of rocker arm (Fig. 6-31). With all parts seated, step end of gauge should be at least flush with gasket face of head, but should not project past the step on the gauge.

b. If gauge projects too far, indicating that the valve stem is too long, grind the tip of the valve stem as necessary to make the gauge index properly.

CAUTION: When grinding valve stem be very careful not to overheat it. Overheating will soften the hardened stem causing rapid wear.

FITTING VALVE STEMS TO GUIDES

Correct valve stem clearance for valve guides is .0021" to .0038" for the intake valve and .0026" to .0043" for the exhaust valve.

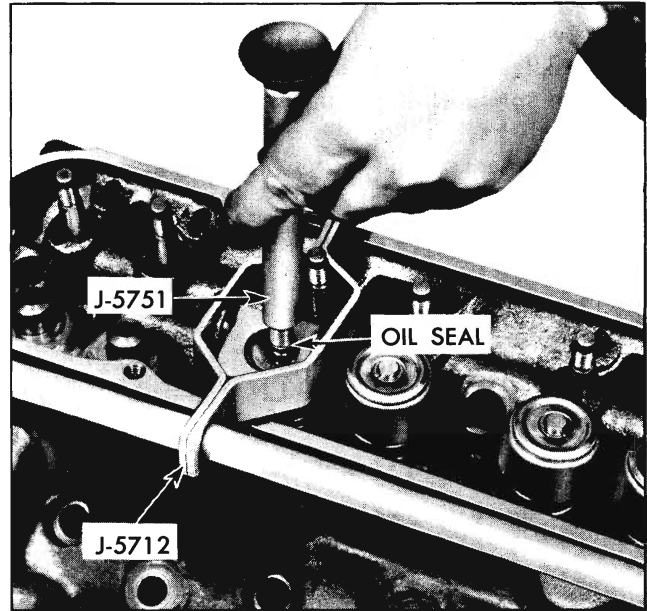


Fig. 6-37 Installing Valve Stem Shield

Valves with oversize stems are available in .001", .003" and .005" larger than standard. The same valve stem to guide clearance applies for oversize stems.

Oversize reamers are required to enlarge valve guide holes to fit the oversize stems. When the reamer is turned through the valve guide it will size the hole to fit the valve stem according to the above limits.

Carefully ream the valve guide using Valve Guide Reamer J-5830-1 for .003" oversize stems and Valve Guide Reamer J-6621 for .005" oversize stems (Fig. 6-36). For best results when installing .005" oversize valve stem use the .003" oversize reamer first and then ream to .005" oversize. Always reface the valve and valve seat after reaming valve guide. **NOTE:** Valves are marked .001, .003 or .005 with colored ink.

ASSEMBLE CYLINDER HEAD AND VALVES

1. Install valves, valve springs, valve stem shields, valve spring retainer cups, valve stem seals and retainer cup locks using suitable spring compressor. The valve stem seals must be installed in the second groove (from end of stem). Valve Stem Seal Installer and Tester J-5751 can be used to install this seal (Fig. 6-37).

After the valves have been installed, the suction cup end of special tool J-5751 should be used to test for leaks between the valve spring retainer cup and

valve stem seal. The suction cup will tend to be held to the valve spring retainer cup by suction when the seal is satisfactory. If a leak is detected, replace seal or valve spring retainer cup as necessary. It is important to have a positive seal between the valve spring retainer cup and the valve stem seal to prevent excessive amounts of oil from being drawn down the valve stem which will cause exhaust smoke and oil consumption.

2. Install spark plugs.

TIMING COVER—TIMING CHAIN—CAMSHAFT

HARMONIC BALANCER REPLACE

1. Remove generator and accessory drive belts.
2. Position fan so wide angles will be at top and bottom allowing access to balancer.
3. Remove harmonic balancer attaching bolt and retainer washer.
4. Remove harmonic balancer by sliding it off end of crankshaft.
5. Install new harmonic balancer by reversing above steps. Tighten to 160 lb. ft. torque.

NOTE: Remove flywheel cover and lock flywheel before tightening balancer.

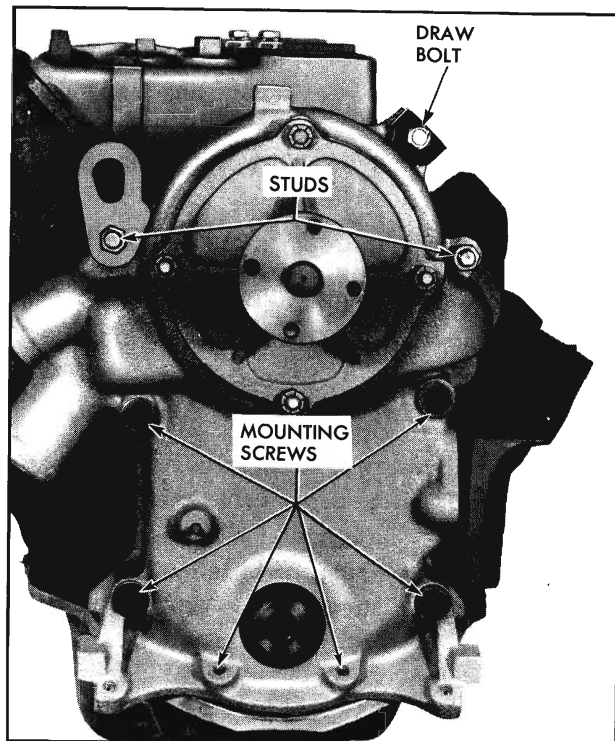


Fig. 6-38 Timing Cover Mounting Bolts

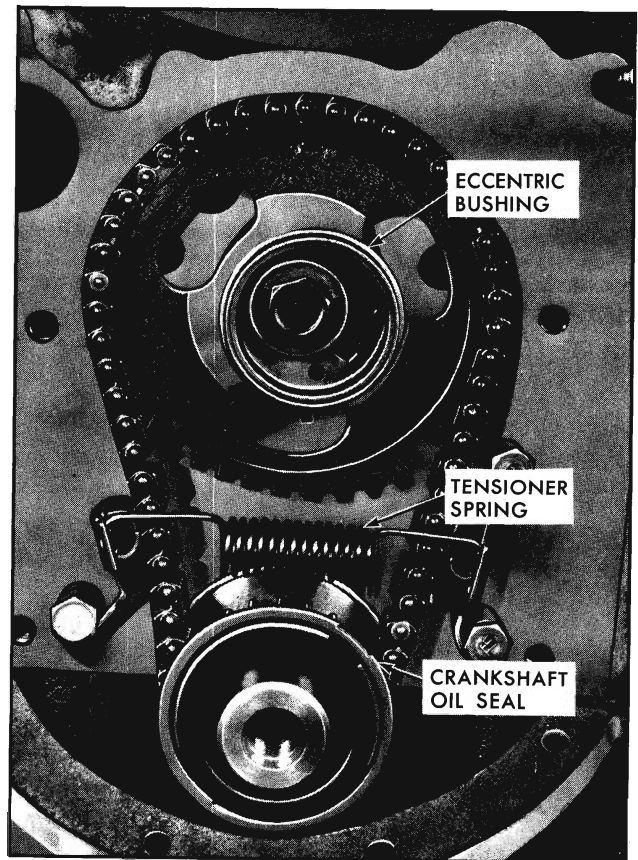


Fig. 6-39 Front of Engine with Timing Cover Removed

TIMING CHAIN COVER, GASKET, AND/OR FUEL PUMP ECCENTRIC AND CRANKSHAFT OIL SEAL REPLACE

REMOVE

1. Drain radiator.
2. Loosen generator fan drive belt and remove generator, mounting brackets and adjusting strap.
3. Remove harmonic balancer.
4. Remove fuel pump.
5. Disconnect lower radiator hose and heater hose at cover.
6. Remove timing cover attaching bolts (Fig. 6-38).
7. Loosen timing cover to intake manifold draw bolt and remove cover.
8. Remove fuel pump eccentric bushing and crankshaft oil seal (Fig. 6-39).
9. Remove fuel pump eccentric.

REPLACE

1. Inspect oil pan gasket at front of pan and replace gasket if necessary.
2. Coat face of new crankshaft oil seal with graphite lubricant and replace seal. Sealing surface faces towards timing cover.
3. Install fuel pump eccentric, indexing tang on eccentric with hole in camshaft sprocket.
4. Install bushing over eccentric with flange against sprocket.
5. Clean gasket surfaces of cover and block, and position new cover gasket on block over studs.
6. Position timing chain cover assembly over studs, install attaching bolts and tighten bolts and manifold to cover draw bolt securely.
7. Install oil pan to timing cover screws and tighten to 15 lb. ft. torque.
8. Connect lower radiator hose and heater hose to timing cover.
9. Install harmonic balancer.
10. Install generator brackets and fan belt.
11. Fill radiator.

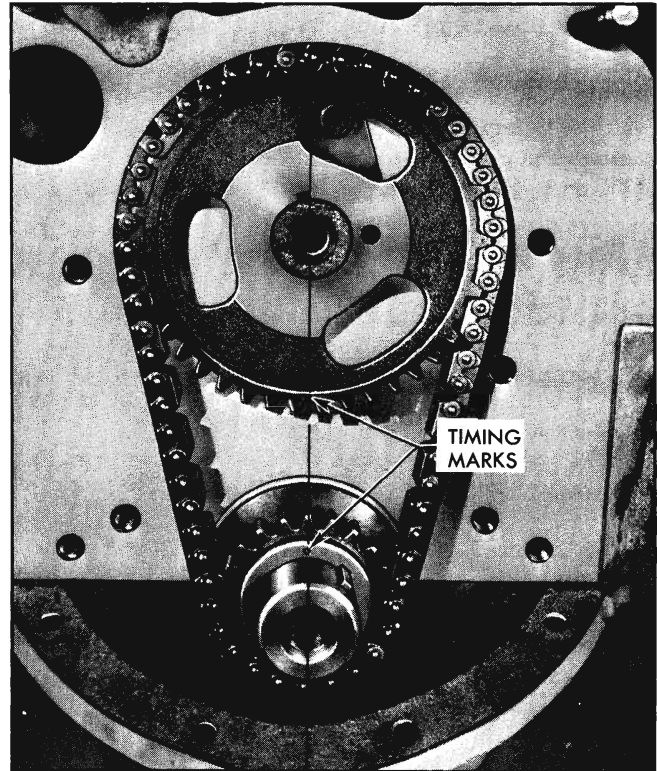


Fig. 6-40 Valve Timing Marks

TIMING CHAIN AND SPROCKETS REPLACE

1. Remove timing cover, fuel pump eccentric and crankshaft oil seal. (Page 6-20).
 2. Remove timing chain tensioner spring and bumper (Fig. 6-39).
- NOTE:** Right hand bumper must be removed before spring can be removed. This is because of hook in end of spring. Do not attempt to remove spring by stretching or twisting as this may damage spring.
3. Align timing marks on sprockets to simplify proper positioning on reassembly.
 4. Slide timing chain and sprockets off ends of crankshaft and camshaft.
 5. Install new timing chain and/or sprockets making sure marks on timing sprockets are aligned exactly on a straight line passing through the shaft centers (Fig. 6-40). Camshaft should extend through sprocket so that hole in fuel pump eccentric will locate on shaft.
 6. Inspect tensioner bumpers; if worn excessively replace. Install timing chain tensioner assembly.
 7. Install crankshaft oil seal, fuel pump eccentric,

eccentric bushing and timing cover assembly.

CAMSHAFT REPLACE**REMOVE**

1. Remove radiator grille lower panel, grille and hood latch as an assembly.
2. Remove front bumper assembly.
3. Drain and remove radiator.
4. Remove intake manifold, page 6-9.
5. Remove timing cover, page 6-20.
6. Remove distributor assembly.
7. Remove timing chain and sprockets page 6-21.
8. Remove valve lifters, page 6-11.
9. Remove camshaft thrust plate.
10. Carefully pull out camshaft using care not to damage camshaft bearings.

REPLACE

1. Install camshaft using care not to damage bearings.
2. Install camshaft thrust plate indexing slot in plate with slot in block.
3. Install timing chain and sprockets.
4. Install distributor following procedure outlined on page 6-33 to set ignition timing.
5. Install timing cover.
6. Install intake manifold.
7. Install radiator.
8. Install radiator grille lower panel, grille and hood latch.
9. Install front bumper assembly.
10. Fill radiator.

CAMSHAFT BEARING—REPLACE

Camshaft bearings can be replaced while the engine is disassembled for overhaul, or without completely disassembling the engine. To replace bearing without completely disassembling engine, remove the camshaft.

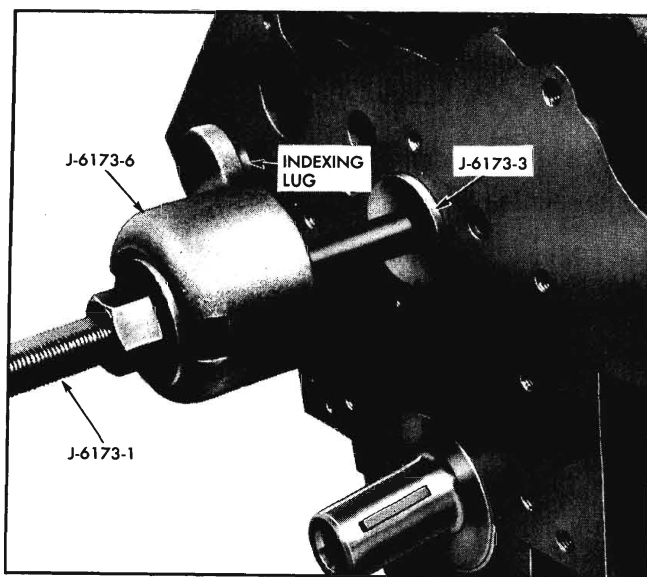


Fig. 6-41 Positioning Indexing Collar

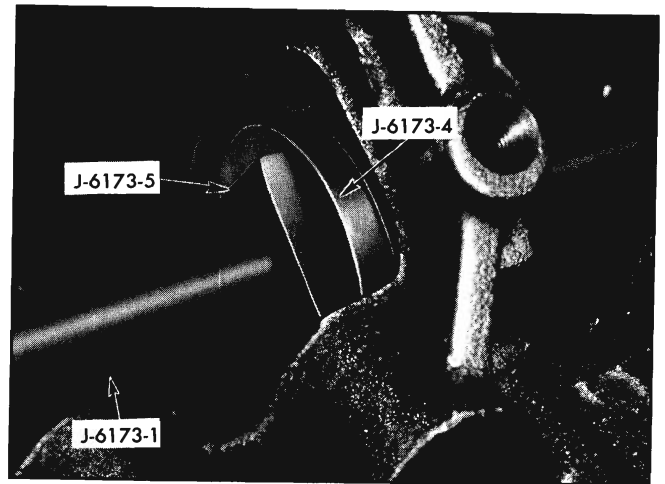


Fig. 6-42 Tools Positioned for Bearing Removal

REMOVE BEARING

1. Insert Replacer Adapter J-6173-3 into front bearing to act as a support for Shaft J-6173-1.

NOTE: If front bearing is to be replaced, insert Installer Adapter in center bearing to act as support for shaft.

2. Insert Remover Adapter J-6173-4 into rear of bearing to be removed so that shoulder on Remover bears against rear edge of bearing.

NOTE: If rear bearing is to be removed, it will be necessary to remove camshaft rear plug.

3. Place Indexing Collar J-6173-6 on threaded end of shaft with open side toward unthreaded end and start thrust washer and nut on shaft.

4. Insert shaft and Indexing Collar through Remover and Replacer Adapters and position lug on Indexing Collar in ventilator hole in front of block (Fig. 6-41). This indexes the shaft so that it cannot rotate.

5. Slip Key J-6173-5 into notches in shaft behind bearing to be removed (Fig. 6-42).

6. Turn nut on front of shaft to pull key against Remover J-6173-4, then continue to turn nut until bearing is pulled out of its hole.

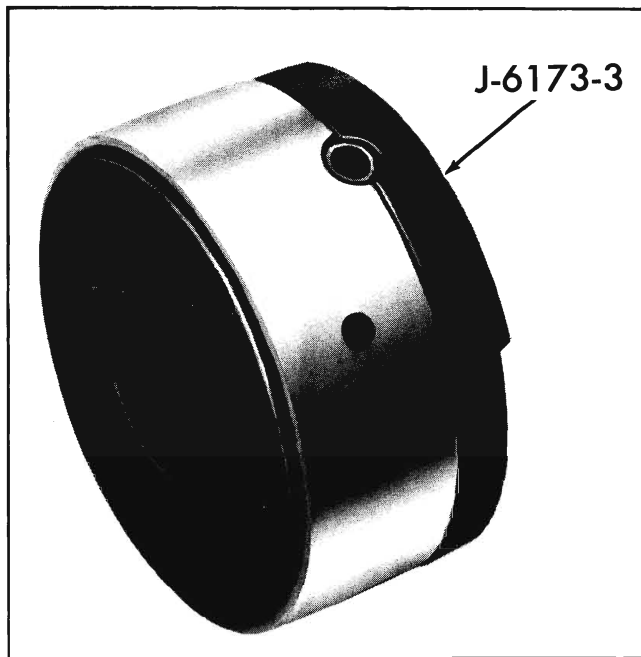


Fig. 6-43 Bearing Installed on Replacer Adapter

INSTALL BEARING

1. Place a rag against each side of the transverse member just below the bearing hole to catch any shavings and carefully clean up the hole. All scratches or nicks in the cast iron should be smoothed with a scraper or file, being careful not to get any chips in cylinder head gallery feed hole. Chamfer the rear edge of the hole slightly to reduce the possibility of shavings down the outer diameter of the bearing when it is installed.

2. Insert Remover Adapter J-6173-4 into front bearing to act as a support for the shaft. **NOTE:** If front bearing is being replaced, insert Remover Adapter in center bearing to act as support for the shaft.

3. Insert pilot J-6173-7 into hole in which bushing is to be installed.

4. Coat outside of new bearing with oil and place it over Replacer Adapter J-6173-3, indexing notch in edge of bearing with pin on Replacer Adapter (Fig. 6-43).

NOTE: The notch in the edge of the bearing is used to properly position the bearing, with respect to the oil holes, when it is installed. When bearings are installed in production, the notches all face the front except the one in the rear bearing. In the field it is necessary to install bearings with the notch facing the rear.

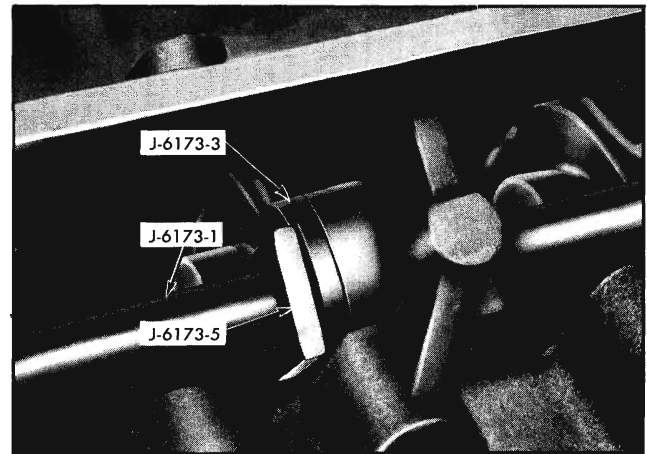


Fig. 6-44 Tools Positioned for Bearing Installation

5. Position Replacer Adapter J-6173-3, with bearing in position against shoulder, against rear of hole in which bearing is to be installed (Fig. 6-44). Index mark on shoulder of Replacer must point toward crankshaft to properly position bearing.

6. Insert Shaft with Indexing Collar, thrust washer, and nut through Remover, pilot and Replacer Adapters and index lug on Collar with ventilation hole in front of block (Fig. 6-41).

7. Slip key J-6173-5 into notches in shaft behind Replacer Adapter J-6173-3 and tighten nut to start bearing into hole (Fig. 6-44). Continue to tighten nut until bearing has been pulled completely into its hole. When properly positioned, it will be approximately flush with both sides of the transverse member.

NOTE: Rear bearing should be pulled in until front edge is flush with block. This will leave shoulder at end of counterbore for camshaft rear plug visible behind bearing.

8. Remove Remover and Replacer J-6173.

9. Visually observe that holes in bearing line up with drillings in block.

10. Carefully remove rags used to catch particles of metal and use magnet or vacuum cleaner to make sure that all metal particles are removed from block surfaces and oil drillings.

11. Coat inner diameters of all camshaft bearings with oil and install camshaft. Rotate camshaft through several revolutions to make sure it is completely free. If any tight spots are found, remove camshaft and very carefully polish down the center

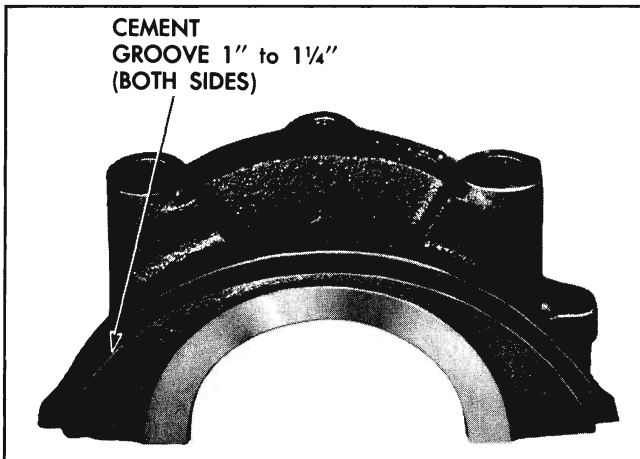


Fig. 6-45 Oil Pan Gasket Positioned in Bearing Cap

journal slightly. If still not free, polish the front and rear journals slightly. If any particular bearing causes binding of the camshaft, replace that bearing also.

NOTE: Front center and rear center journals should not be polished except to remove slight roughness or scratches. Slight warpage of the camshaft is not harmful providing the journals are polished down until the camshaft rotates freely in its bearings.

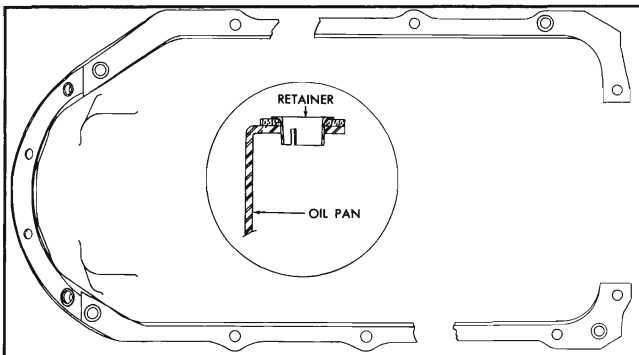


Fig. 6-46 Pan Gasket Retainer Location

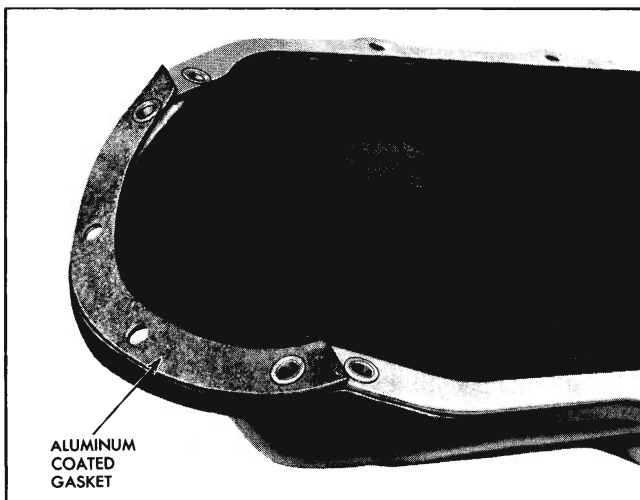


Fig. 6-47 Oil Pan Gaskets Positioned for Installation

OIL PAN—BEARINGS CONNECTING ROD—PISTON—CRANKSHAFT

ENGINE OIL PAN AND/OR GASKET REPLACE

1. Drain oil from crankcase.
2. Remove exhaust crossover pipe.
3. Support engine and remove front crossmember assembly as covered in Section 3.
4. Remove flywheel housing front shield and lower cover.
5. Remove oil pan bolts and remove oil pan.
6. Remove oil pan gaskets from oil pan. Thoroughly clean gasket surfaces of oil pan and block.
7. Remove rear bearing cap gasket from groove in cap and thoroughly clean groove.
8. Apply gasket cement to gasket groove from joint face down 1" to 1 1/4" (Fig. 6-45) and install new gasket.
9. Apply gasket cement to gasket surface of oil pan and position new gaskets on pan using gasket retainers where shown (Fig. 6-46). Make sure front gasket overlaps side gaskets (Fig. 6-47). Retainers should be used to hold gasket in position for installation.
10. Reverse procedure for installing oil pan. Use new oil pan gasket.
11. Refill crankcase.

REAR MAIN BEARING OIL SEAL REPLACE

1. Drain oil from crankcase.
2. Disconnect propeller shaft and torque tube from rear of engine by following procedure given in Section 4.
3. Support engine and remove front crossmember assembly as covered in Section 3.
4. Remove oil pan.
5. Remove oil baffle and cylinder block to oil baffle tube.
6. Remove rear center main bearing cap and upper half of rear center main bearing shell. This will eliminate danger of damaging thrust surfaces of bearing and will also allow crankshaft to be lowered more easily.

NOTE: See steps 4 and 5 under "Main Bearings Replace" page 6-25 for method of removing upper half of bearing insert.

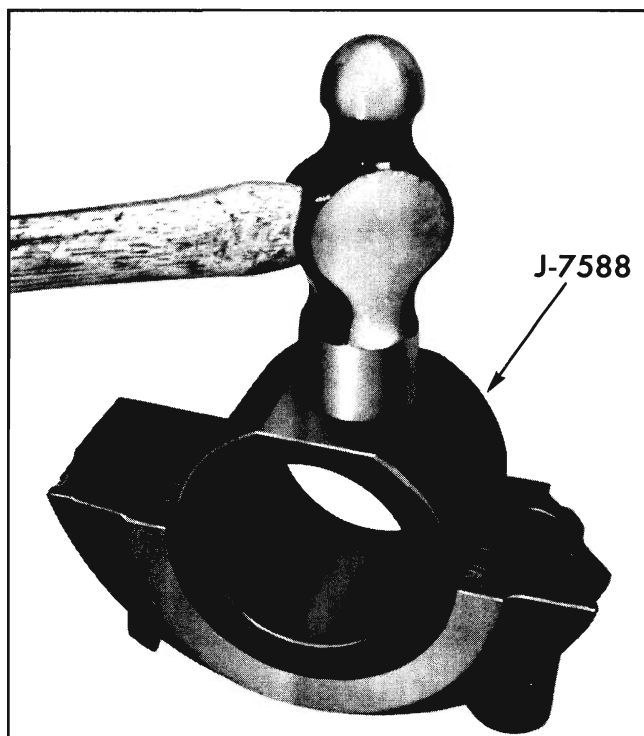


Fig. 6-48 Compressing Seal in Bearing Cap

7. Remove rear main bearing cap and loosen remaining bearing caps sufficiently to allow crankshaft to be lowered approximately $\frac{1}{2}$ " at the rear.

8. With crankshaft lowered to provide clearance, remove upper half of rear main bearing oil seal.

9. With rear main bearing cap on bench, remove oil seal and bearing shell.

10. Install new seal in block as follows:

a. First install seal in cap and compress seal using hammer and Seal Compressor J-7588 (Fig. 6-48).

b. Trim one end of seal flush with cap.

c. Rotate seal slightly and recompress to eliminate "bumps" caused by seal retention slots.

d. Remove seal from cap, and install in block by slipping up over crankshaft into seal cavity of block. Insert end which was flush with cap first.

e. Install rear center main bearing cap with bearing shell and tighten to 95 lb. ft. torque to pull crankshaft up into place against seal.

f. Carefully trim both ends of seal flush with block.

11. Install a new seal in rear main bearing cap using tool J-7588 to pack seal tightly. Be sure to pack seal tightly into groove and trim flush with cap.

12. Install cap with shell and tighten to 120 lb. ft. torque.

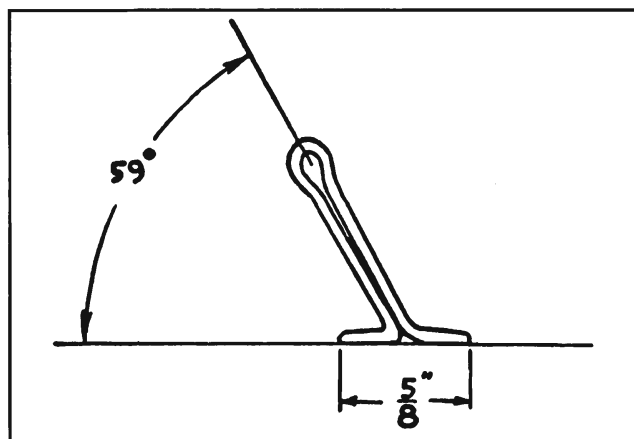


Fig. 6-49 Tool for Removing Upper Half of Main Bearing

13. Remove rear main bearing cap again and inspect split line between cap and block to be certain that none of the seal material has been compressed between the two. If inspection shows material between cap and block surface, scrape it off to insure proper seating of metal surfaces.

14. Clean face of rear main bearing cap with volatile type cleaner to remove all oiliness. Then apply a $\frac{1}{16}$ " diameter bead of sealer on face of the cap from packing groove to external cork groove on both sides. Reinstall cap and tighten to 120 lb. ft. torque.

15. Remove rear center main bearing cap and reinstall upper half of bearing shell. Reinstall rear center main bearing cap and tighten to 95 lb. ft. torque. Tighten remaining main bearing caps to 95 lb. ft. torque.

16. Replace transmission, oil pump, oil baffle, oil pan and flywheel housing lower cover and shield.

17. Reinstall crossmember assembly and refill crankcase.

MAIN BEARINGS REPLACE

1. Drain oil and remove oil pan (page 6-24).

2. To gain access to rear center bearing cap, remove oil baffle. To gain access to rear main, remove oil pump in addition to oil baffle.

3. Remove bearing cap of main bearing to be replaced.

4. Make a tool for removing upper half of bearing shell as shown in Fig. 6-49; J-8080 can also be used.

NOTE: Rear main journal does not have oil hole. To remove upper bearing use screw driver or punch in oil groove to start bearing around to where it can

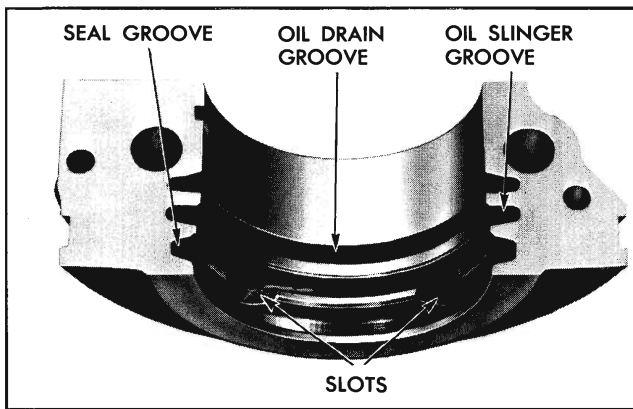


Fig. 6-50 Rear Main Bearing Cap

be rotated free of block.

5. Insert tool in oil hole of crankshaft and rotate crankshaft in usual direction of rotation. This will cause bearing to be moved from between shaft and bearing seat.

6. Oil bearing surface of shell and stall by inserting plain end of bearing shell at indented side of bearing seat and gently rotating shell into place by turning shaft.

NOTE: The rear main bearing cap has three grooves, one for oil drain, one for the oil slinger and the other for the seal (Fig. 6-50). The bearing shells have two oil grooves. The front oil groove in the upper shell has an oil hole in the center while the rear oil groove has three oil drain holes evenly spaced. The upper and lower shells are not interchangeable due to location of tang slots in block and cap. For the front, front center, center, and rear center bearings install the shells with the oil grooves in the cylinder block (upper) position and install the shells without the oil grooves in the cap (lower) position. There will be no oil supply to the bearings if the shells are reversed.

7. Install new bearing lower half by inserting in bearing cap so indentation in shell and cap coincide.

8. Install bearing cap and check fit of bearing using plastigage or shim stock as outlined on page 6-27.

9. Replace oil pump, cylinder-block-to-oil-baffle tube, and oil baffle if they were previously removed.

10. Replace oil pan using new gaskets and fill crankcase with oil.

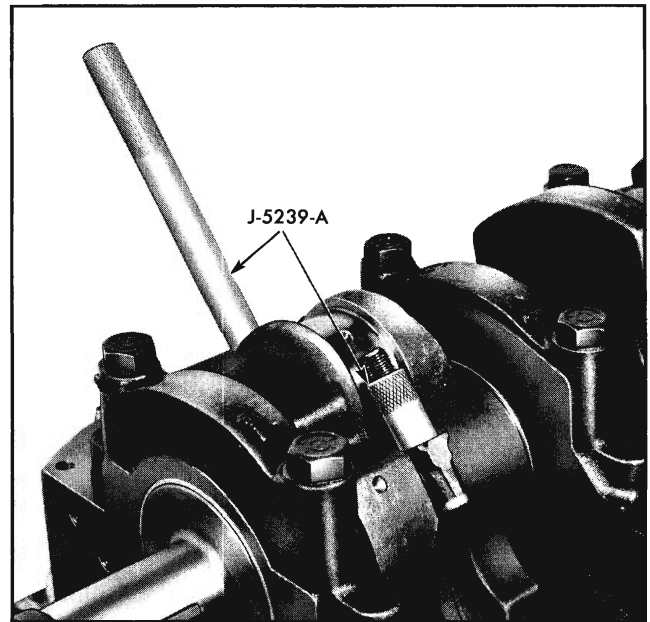


Fig. 6-51 Bolt Guide Set Installed

CONNECTING ROD BEARINGS REPLACE

1. Drain oil and remove oil pan (page 6-24).
2. To gain access to numbers 3 or 4 connecting rod caps it will be necessary to remove oil pump screen and oil baffle.
3. Rotate crankshaft as necessary to bring crank pin carry bearing to be replaced straight down.
4. Remove bearing cap of bearing to be replaced.
5. Install Connecting Rod Bolt Guide Set J-5239 on connecting rod bolts (Fig. 6-51).
6. Push piston and rod assembly up far enough to allow removal of bearing shell. Remove bearing shells from rod and cap.
7. Inspect crank pin for damage, out-of-round, and taper.
8. Reassemble cap and rod with new bearing shells and check fit using plastigage or shim stock as outlined on page 6-27.
9. Replace oil baffle and oil pump screen if they were removed.
10. Replace oil pan (page 6-24) using new gaskets and fill with engine oil.

MAIN BEARING CLEARANCE CHECK

PLASTIGAGE METHOD

1. Place a piece of Plastigage plastic for length of bearing in bearing (bearing must be free of oil); install main bearing and cap and tighten to 95 lb. ft. except rear main torque to 120 lb. ft. **DO NOT TURN CRANKSHAFT WITH PLASTIGAGE IN PLACE.**

When position of engine is such that weight of crankshaft is on bearing caps, all bearing caps must be in place and tightened so crankshaft weight will be properly supported and not give error in reading at bearing being checked. Shim caps on either side of bearing being checked to force crankshaft against upper half of bearing.

2. Remove bearing cap and using Plastigage scale measure width of flattened piece of plastic. If reading is not over $2\frac{1}{2}$, standard size main bearing should be used; if reading is over $2\frac{1}{2}$, use .001" undersize bearing and recheck. Main bearing inserts .002" undersize are available for cases where use of the .001" undersize bearing results in excessive clearance.

3 After determining that the correct bearing insert has been fitted, tighten bearing cap to final tightness of 95 lb. ft. torque except rear main bearing cap which should be tightened to 120 lb. ft. torque. **NOTE:** Before installing rear main bearing cap, apply a $\frac{1}{16}$ " wide bead of sealer on face of rear main bearing cap from packing groove to external cork groove on both sides. Reinstall cap and tighten to 120 lb. ft. torque. **NOTE:** Lock washers are not used on main bearing cap screws.

SHIM STOCK METHOD

1. Place .002" brass shim $\frac{1}{2}$ " wide by 1" long in main bearing cap with new standard bearing and install cap, pulling up bolts 95 lb. ft. except rear main torque to 120 lb. ft. in step 6. Refer to Fig. 6-52 for position of shim in cap.

2. Attempt to rock crankshaft by hand 1" in either direction.

CAUTION: Do not attempt to move crankshaft more than 1" in either direction or shim may damage bearing.

3. Repeat test in step 2 without shim. If crankshaft moves freely without shim in place and locks with .002" shim, the standard bearing is satisfactory. If it is possible to rock the crankshaft freely with the

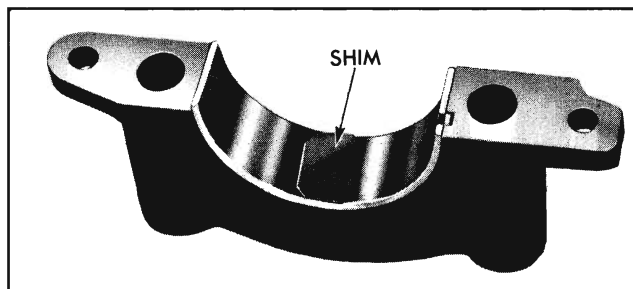


Fig. 6-52 Shim Positioned in Bearing Cap

.002" shim, the .001" undersize bearing should be used and the fit rechecked. If necessary recheck with .002" undersize bearing.

4. After determining that the correct bearing insert has been fitted, tighten bearing cap to final tightness of 95 lb. ft. torque except rear main bearing cap which should be tightened to 120 lb. ft. torque. **NOTE:** Before installing rear main bearing cap, apply a $\frac{1}{16}$ " wide bead of sealer on face of rear main bearing cap from packing groove to external cork groove on both sides. Reinstall cap and tighten to 120 lb. ft. torque. **Note:** Lock washers are not used on main bearing cap screws.

CONNECTING ROD BEARING CLEARANCE CHECK

PLASTIGAGE METHOD

1. Place a piece of Plastigage plastic the length of bearing in bearing (bearing must be free of oil); install bearing and cap and tighten nuts to 45 lb. ft. torque. **DO NOT TURN CRANKSHAFT WITH PLASTIGAGE IN PLACE.**

2. Remove bearing cap. Using Plastigage scale, measure width of flattened piece of plastic. If reading is not over $2\frac{1}{4}$, standard size connecting rod bearing should be used; if over $2\frac{1}{4}$, use .001" undersize bearing and recheck. Connecting rod bearing inserts .002" undersize are available for cases where use of the .001" undersize bearing results in excessive clearance.

3. After determining that the correct bearing insert has been fitted, tighten connecting rod cap nuts to final tightness of 45 lb. ft. torque. Nuts are self-locking and require no lock washers or cotter pins.

SHIM STOCK METHOD

1. Place .0015" brass shim $\frac{1}{2}$ " wide by $\frac{1}{8}$ " long in bearing cap with new standard insert and install cap. Tighten nuts to 45 lb. ft. torque.

2. Attempt to move connecting rod endwise on crankpin by hand and then by a light tap of a hammer.

3. Repeat test to move rod endwise by hand with shim removed. If connecting rod did not move by hand, but moved by tap of hammer in Step 2 and moved freely in this step, the standard bearing should be used. If rod could be moved by hand in Step 2, install .001" undersize bearing. If necessary, recheck with .002" undersize bearing.

4. After determining that the correct bearing insert has been fitted, tighten connecting rod cap nuts to final tightness of 45 lb. ft. torque. Nuts are self-locking and require no lock washers or cotter pins.

PISTON RINGS REPLACE

PISTON AND ROD ASSEMBLY—REMOVE

1. Remove engine and mount in holding fixture.
2. Remove intake manifold (Page 6-9).
3. Remove cylinder head (Page 6-15).
4. Drain oil, invert engine and remove oil pan. If number 3 or 4 rod and piston are to be removed, remove oil baffle and oil pump screen.
5. Rotate crankshaft so crank pin carrying assemblies to be replaced projects straight upward.
6. Remove bearing cap and install connecting Rod Bolt Guide Set J-5239 (Fig. 6-51).
7. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide (J-5239).

PISTON RINGS INSTALL

Two compression rings and one oil control ring, all above the piston pin, are used on pistons for both standard and premium fuel engines. The top compression rings are taper faced and also have either a step or a chamfer on the inside diameter of the top side. The top compression ring is chrome plated. The lower compression ring may have a step or chamfer on the inside. Both rings should always be installed with the mark (letter "T", dot or word "TOP") toward the top.

New rings are serviced for the standard size pistons, and for .005", .010", .020" and .030" oversize pistons. When selecting rings be sure they match the size of the piston on which they are to be installed, i.e. standard rings for standard pistons, .010" over-

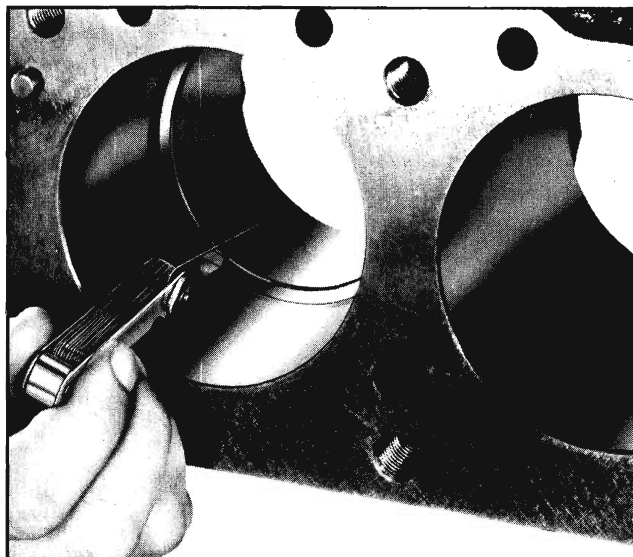


Fig. 6-53 Checking Ring Gap

size rings for .010" oversize pistons, etc. Ring gap and side clearance should be checked while installing rings as follows:

1. Check pistons to see that ring grooves and oil return holes have been properly cleaned.
2. Place ring down at the bottom of the ring traveled part of the cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.
3. Measure gap between ends of ring with feeler gauge (Fig. 6-53). Gaps should be as follows:

Upper Compression Ring	.016"-.026"
Lower Compression Ring	.013"-.025"
Oil Ring	.015"-.035"

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore (standard .005" oversize, etc.) they should have the proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston using good ring installing tool to prevent breakage, or fracture of rings, or damage to pistons.
5. Measure side clearance of rings in ring groove (Fig. 6-54) as each ring is installed. Clearance with new pistons and rings should be as follows:

Upper Compression Ring	.0015"-.0030"
Lower Compression Ring	.0015"-.0035"
Oil Control Ring	.0015"-.0085"

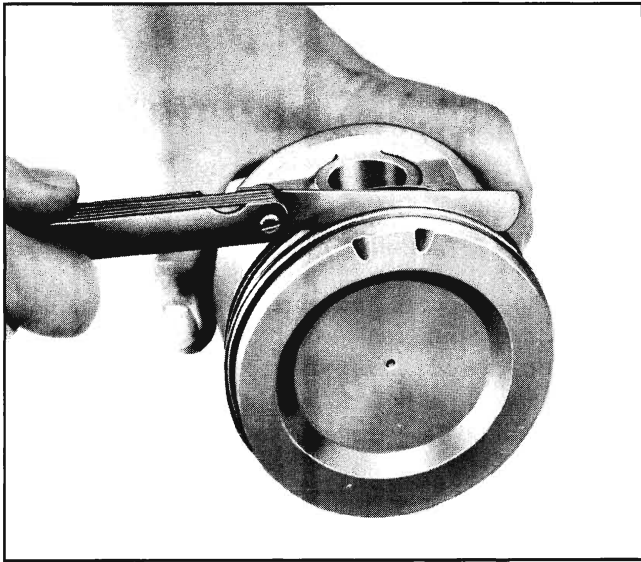


Fig. 6-54 Measuring Side Clearance of Ring in Groove

If side clearance is excessive, piston should be replaced.

PISTON AND ROD ASSEMBLY—INSTALL

1. Install connecting rod bolt guide set on connecting rod bolts with long handle guide on same side as oil groove in rod.
2. Using suitable ring compressor insert piston and connecting rod assembly into cylinder so that "F" on web and notch in top of piston are toward front of engine.
3. From beneath engine, pull connecting rod, with bearing shell in place, into position against crank pin.
4. Remove guide set J-5239. Install bearing cap and cap nuts and tighten to 45 lb. ft. torque.
5. Replace oil pump screen and oil baffle, if they were removed.
6. Replace oil pan using new gaskets. Tighten oil pan screws to 15 lb. ft. torque.
7. Install cylinder head and intake manifold (page 6-33).
8. Install engine (page 6-8).
9. Refill crankcase and cooling system, and check for leaks.

PISTON, PIN OR CONNECTING ROD REPLACE

NOTE: Use care at all times when handling and servicing connecting rods and pistons. To prevent

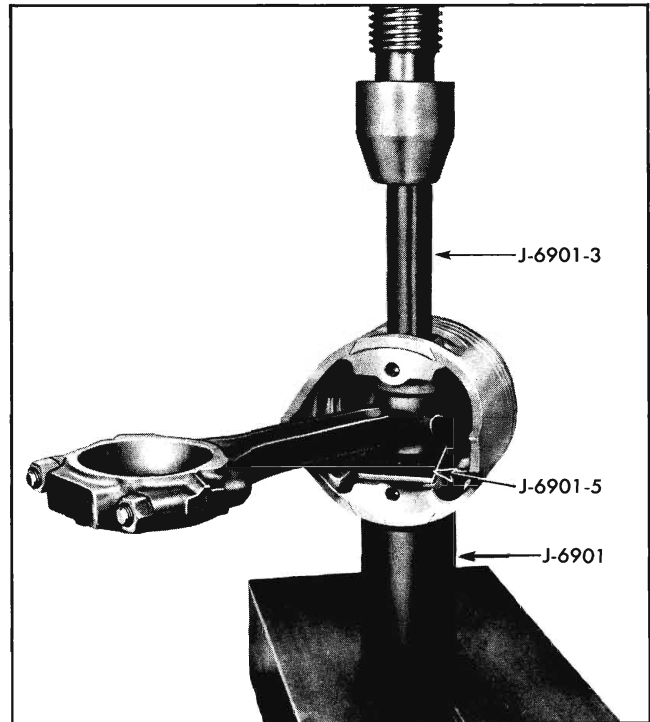


Fig. 6-55 Removal of Piston Pin

possible damage to these units, do not clamp rod or piston in vise since they may become distorted. Do not allow pistons to strike against one another, against hard objects or bench surfaces, since distortion of piston contour or nicks in the soft aluminum material may result.

DISASSEMBLE ROD AND PISTON

1. Remove connecting rod and piston assembly as covered on page 6-28.

2. Remove piston rings using suitable piston ring remover.

NOTE: It is important that rings be removed carefully to prevent scratching or burring of ring grooves and lands.

3. Using a suitable arbor press, place plunger tool J-6901 into piston pin bore and position on arbor press (Fig. 6-55).

4. Place tool J-6901-5 between connecting rod and piston boss (Fig. 6-55).

5. Place tool J-6901-3 (Fig. 6-55) in piston pin and press piston pin down until pin bottoms in tool J-6901.

6. Remove tool J-6901-5 from between connecting rod and piston boss.

7. Remove plunger and spring from tool J-6901 (Fig. 6-55).

8. Place end of piston pin in tool J-6901 and place on arbor press.

9. Using tool J-6901-3 (Fig. 6-55) press pin out of piston and connecting rod.

10. Remove bearing cap and bearings.

CLEAN AND INSPECT CONNECTING ROD AND PISTON

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to assure against subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

NOTE: If piston pin bosses are rough or worn out-of-round and the piston is otherwise serviceable, the pin bosses may be honed for oversize pins. Before fitting oversize pins, however, it is advisable to check fit of piston in bore.

4. Inspect piston pin for scoring, roughness, or uneven wear.

5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.

FIT AND REPLACE PISTON

Pistons should be fitted in the bores by actually measuring the fit. Clearance between the piston and the cylinder bore should be .0007" to .0013".

If cylinder bores have been reconditioned, or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated. If bore has been honed, it should be washed thoroughly with hot, soapy water and stiff bristle brush.

Using a cylinder checking gauge, measure the cylinder bore crosswise of the block to find the smallest diameter. Record the smallest diameter of each bore.

NOTE: When measuring cylinder bores and pistons it is very important that the block and pistons be at room temperature. If any or all of the parts are hotter or colder than normal room temperature, improper fitting will result.

Measure the piston skirt perpendicular to the piston pin boss (piston pin removed) and $1\frac{1}{4}$ " below the oil ring groove. Make sure the micrometer is in full contact (Fig. 6-56).

As pistons are measured they should be marked for size identification and the measurements recorded. If there is excessive clearance between a cylinder bore and the piston which was installed in that bore, a new piston should be used.

New pistons are serviced for both standard and premium fuel engines in standard size and .005", .010", .020" and .030" oversizes.

NOTE: Since these are nominal or basic sizes, it is important that new pistons be measured to ensure proper fit. All new pistons are serviced with selectively fitted piston pins.

After all measurements have been made, match the new pistons with the cylinders where they will fit with proper clearance. Honing of cylinder bore may be necessary to effect a proper fit. When properly mated, mark the pistons with the cylinder numbers they fit so they will not become mixed.

FITTING PIN IN PISTON

The piston pin fit in piston is .0003" to .0005" loose with pin and bosses clean and dry.

NOTE: Piston and pin must be at room temper-



Fig. 6-56 Measuring Piston

ature when checking fit and pin must be able to fall from piston by its own weight.

FITTING OVERSIZE PINS IN PISTONS AND CONNECTING ROD PIN BORES

In case the standard size piston pin does not fit properly in the piston, an oversize piston pin must be fitted. Piston pins are available in .001" and .003" oversize.

When oversize pins are used, the piston pin bosses must be honed to give the required fit. It will also be necessary to hone the connecting rod pin bore to fit the oversize pin using a Sunnen hone or similar accurate equipment.

NOTE: A special grit hone is used for honing the connecting rod pin bore. The piston pin size should be .0008" to .0016" larger than the connecting rod pin bore for the proper press fit. The piston pin should not show any movement under 1500 lb. minimum load after assembly in rod.

ASSEMBLE CONNECTING ROD TO PISTON

All pistons have an "F" cast on the front side. There is also a notch cast in the top of the high compression piston head and two notches cast in top of the low compression piston head at the front to facili-

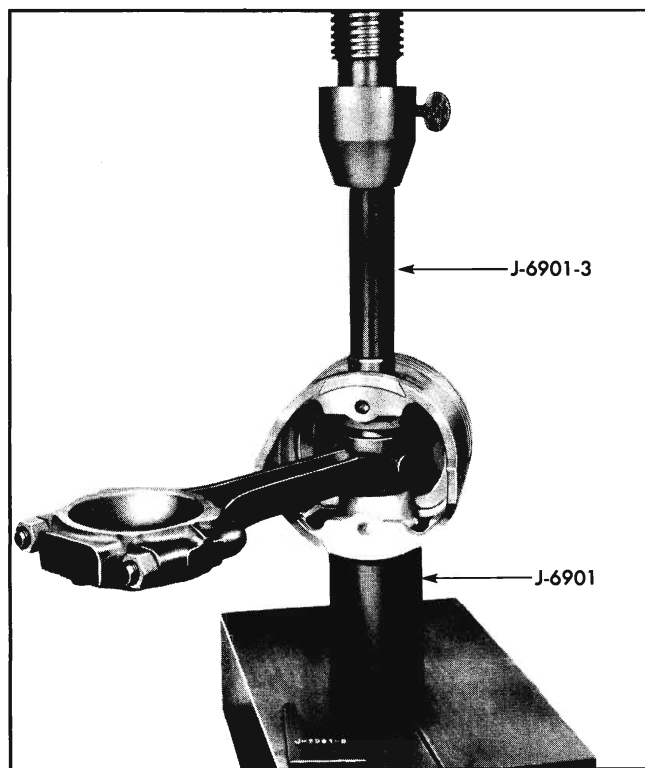


Fig. 6-57 Installation of Piston Pin

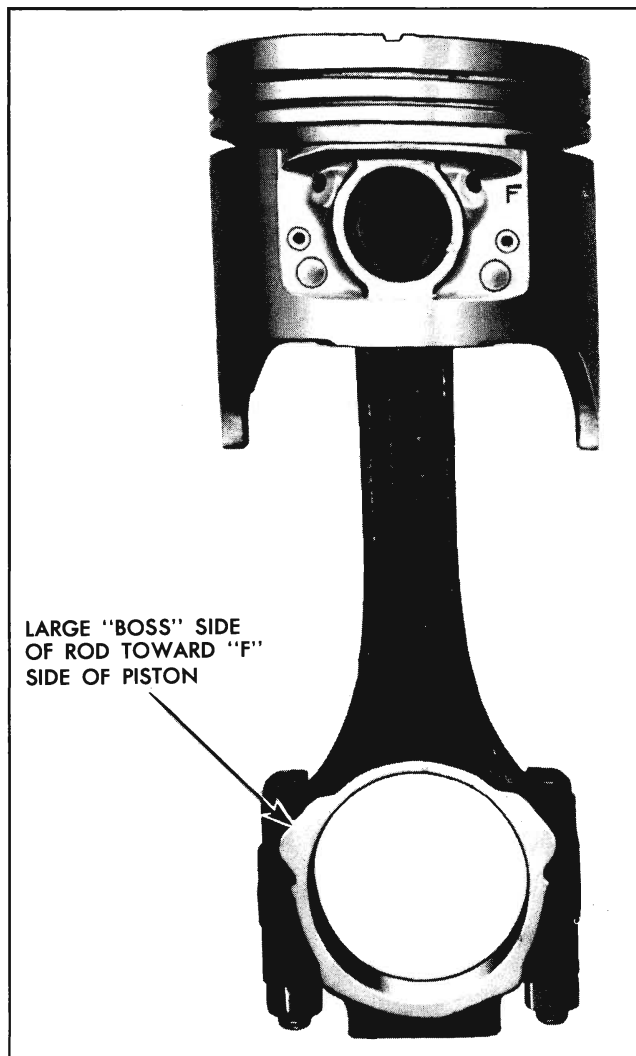


Fig. 6-58 Rod and Piston Assembly

tate proper installation. The piston assemblies should always be installed with the notch or notches toward the front of the engine.

One side of the connecting rod will have large machined bosses (Fig. 6-58). This side of the connecting rod should be installed toward the front of the engine.

REPLACE PISTON PIN

1. Place plunger and spring in tool J-6901 (Fig. 6-57) to be used as a pilot and stop.
2. Place plunger of tool J-6901 in piston pin bore and place on arbor press.
3. Coat piston pin and rod lightly with graphite lubricant.

4. Place tool J-6901-3 in piston pin and press pin into piston and connecting rod (Fig. 6-57) until piston pin bottoms against plunger of tool J-6901. Piston must turn freely on pin. If piston binds on pin, disassemble, hone piston bosses slightly and reassemble.

REPLACE PARTIAL ENGINE ASSEMBLY

DISASSEMBLE

1. Remove flywheel housing and clutch assembly.
2. Remove flywheel and mount engine in holding stand.
3. Remove motor mounts and linkage bracket.
4. Remove generator, front and rear mounting brackets, and adjusting strap.
5. Remove fuel pump.
6. Remove harmonic balancer.
7. Remove timing chain cover, fan and pulley as an assembly. Remove timing cover mounting studs.
8. Remove crankshaft oil seal and fuel pump eccentric bushing.
9. Remove timing chain tensioner bumpers and spring.
10. Remove fuel pump eccentric.
11. Slide timing chain and sprockets off end of camshaft and crankshaft.
12. Remove camshaft thrust plate.
13. Remove exhaust crossover pipe.
14. Remove distributor and high tension wires.
15. Remove starter assembly using straight box end wrench through slot in casting.
16. Remove crankcase ventilator outlet pipe (push neoprene seal up on pipe so it will not be lost).
17. Remove intake manifold using care not to lose locating sleeves in cylinder head.
18. Remove push rod cover.
19. Remove oil level indicator.
20. Remove rocker arm cover.
21. Loosen rocker arm nuts, rotate rocker arms and remove push rods. Store push rods so that they may be reinstalled in the same position as removed.

22. Remove cylinder head and exhaust manifold as an assembly.

23. Remove cylinder head gasket.

24. Remove oil filter assembly.

25. Remove valve lifters; use J-3049 if necessary. Place valve lifters in storage box J-5763 so lifters can be reinstalled in original location.

26. Remove camshaft.

27. Invert engine and remove oil pan and flywheel front cover.

28. Remove oil pump assembly and drive shaft.

29. Remove baffle and oil indicator tube extension.

The complete disassembly for partial engine replacement. Mount new partial engine assembly in holding fixture and proceed with assembly operations. Use new gaskets throughout and pay special attention to torque requirements.

ASSEMBLE

1. Install two timing cover mounting studs.
2. Install camshaft using care not to damage bearings.
3. Install camshaft thrust plate indexing oiling slot in plate with oil groove in block.
4. Make sure keys are in place in crankshaft and camshaft. Install timing chain and sprockets making sure marks in sprockets are aligned exactly on a straight line passing through the shaft centers. Alignment can be simplified by first installing sprockets without chain to align timing marks. If timing chain is excessively loose, new chain or new chain and sprockets should be used.
5. Install fuel pump eccentric on camshaft sprocket, indexing tang on eccentric with hole in camshaft sprocket.
6. Position fuel pump eccentric bushing over eccentric with flange toward camshaft sprocket.
7. Install timing chain tensioner bumpers (replace bumpers if worn) and spring.
8. Coat face of timing chain cover oil seal with graphite lubricant and install seal on end of crankshaft.
9. Position timing cover gasket over mounting studs on block.

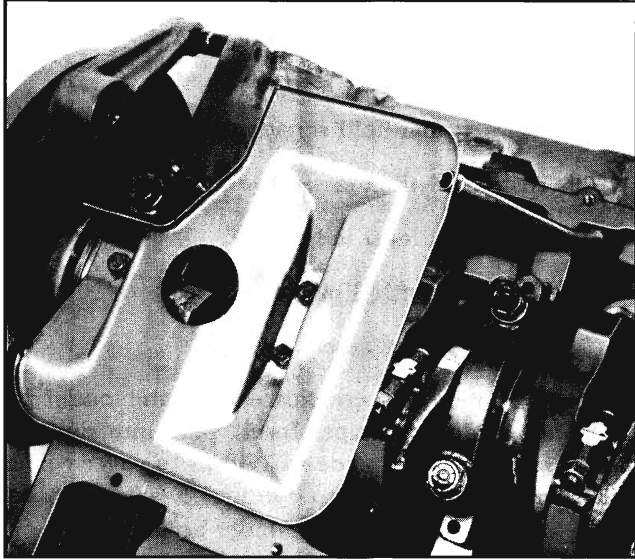


Fig. 6-59 Oil Baffle and Tube Installed

10. Install timing cover, water pump, fan and pulley as an assembly. Do not install stud nuts at this time.

11. Slide harmonic balancer onto crankshaft, and install harmonic balancer to crankshaft bolt and washer. Place hammer handle between block and crankshaft counterweight to keep crankshaft from turning and tighten harmonic balancer to crankshaft bolt 160 lb. ft. torque.

12. Install baffle and oil indicator tube extension (Fig. 6-59).

13. Insert oil pump drive shaft with dimpled end towards block (Fig. 6-60).

14. Install oil pump and gasket.

15. Cement new gaskets to oil pan and rear main bearing cap; use retainers to hold gasket. Install oil pan except for two rear screws. Position flywheel housing front shield and gasket against oil pan and install two rear oil pan bolts.

16. Position new cylinder head gasket on block.

17. Position cylinder head and exhaust manifold assembly on locating pins. Install head bolts and torque to 95 lb. ft.

NOTE: Three different length bolts are used. When inserted on proper holes, all will project an equal amount from their respective bosses.

18. Install lifters in bosses from which they were removed.

19. Install push rods in same location as originally removed and with same end facing valve lifter.

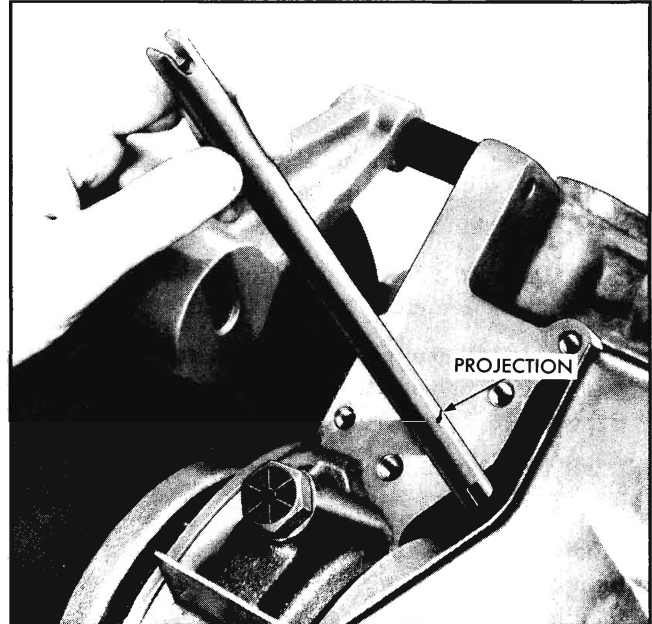


Fig. 6-60 Installing Pump Drive Shaft

20. Tighten rocker arm ball retaining nuts to 15-25 lb. ft. torque.

21. Install distributor as follows:

a. Turn crankshaft to firing position of number one cylinder (number one exhaust and intake valve lifters both on base circles of their cams (Fig. 6-61) and timing mark on harmonic balancer indexed with pointer). **NOTE:** Number one intake must have just closed.

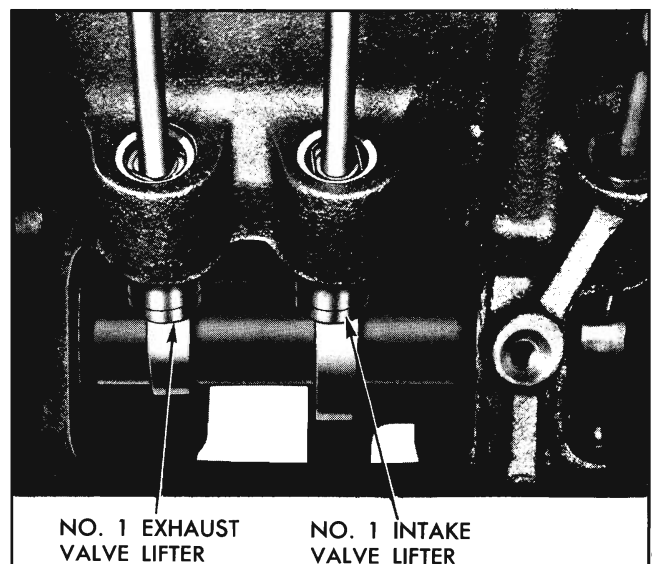


Fig. 6-61 Relationship of Lifters and Cams when Cylinder No. 1 is in Firing Position

- b. Position new distributor to block gasket on block.
- c. Install distributor (without cap and wires) so that vacuum diaphragm faces the left side of the engine and rotor arm points toward contact in cap for number one cylinder. It will also be necessary to turn the oil pump drive shaft so it will index with distributor shaft.
22. Install distributor hold down clamp and special bolt and tighten enough to hold distributor in place.
23. Cement new gaskets to push rod cover. Install push rod cover with two screws and flat washers and tighten to 5 lb. ft. torque.
24. Cement new gaskets to rocker arm cover and install cover.
25. Install intake manifold locating sleeves in cylinder head as shown in Fig. 6-16 and position intake manifold gasket.
26. Start intake manifold to timing cover draw bolt into intake manifold.
27. Position intake manifold and install retaining screws finger tight.
28. Tighten draw bolt to 10-20 lb. ft. torque to obtain metal to metal contact between manifold and timing cover.
29. Tighten manifold screws to 40 lb. ft. torque.
30. Install oil filter assembly and gasket.
31. Install oil level indicator.
32. Install throttle linkage bracket.
33. Install starter assembly.
34. Oil interior of crankcase ventilator outlet pipe seal and slide onto pipe. Insert pipe into flange on push rod cover, and slide seal down to cover connection. Slide outlet pipe to cylinder head clamp onto pipe and attach to rear of cylinder head.
35. Install fuel pump.
36. Install exhaust crossover pipe.
37. Install generator, bracket and adjusting strap.
38. Install fan belt and adjust belt tension as covered in Section 6A.

SPECIFICATIONS

GENERAL

Type	Line 4
Bore and Stroke	4 $\frac{1}{16}$ " x 3 $\frac{3}{4}$ "
Piston Displacement	195 cu. in.
Taxable Horsepower	26.4
Compression Ratio	8.6: or 10.25:1

HORSEPOWER AND TORQUE

	8.6:1 C.R.		10.25:1 C.R.	
	Synchromesh	Automatic	Synchromesh	Automatic
Brake Horsepower 1 bbl. carburetor	110 @ 3800 rpm	115 @ 4000 rpm	120 @ 3800 rpm	140 @ 4400 rpm
Torque (lb. ft.) 1 bbl. carburetor	190 @ 2000 rpm	195 @ 2300 rpm	202 @ 2000 rpm	207 @ 2200 rpm
Brake Horsepower 4 bbl. Carburetor	—	—	166 @ 4800 rpm	166 @ 4800 rpm
Torque (lb. ft.) 4 bbl. Carburetor	—	—	215 @ 2800 rpm	215 @ 2800 rpm

Compression Pressure at Cranking Speed (8.6:1 Compression Ratio)	140-150 psi @ 155-165 rpm
Compression Pressure at Cranking Speed (10.25:1 Compression Ratio)	155-165 psi @ 155-165 rpm
Firing Order	1-3-4-2
Car-Engine Serial No. Location	Front Face of Right Cylinder Bank
Production Engine No. Location	Front Face of Right Cylinder Bank
Cylinder Nos.—Front to Rear	1-2-3-4

CAMSHAFTS

Material	Alloy Cast Iron
Journal Diameter	1.8987"-1.8997"
Bearing—Inside Dia. (after line reaming)	1.9012"-1.9017"
Bearing Length	
Front	1.060"
All Others	.680"
Bearing Clearance	.0015"-.0030"
End Play	.003"-.007"

CONNECTING RODS

Length, center to center	6.625"
Lower end bearing, inside diameter and length	2.25" x .82"
Bearing clearance on crank pin—limits when new	.0005"-.0025"
End Play of connecting rod on crank pin	.0045"-.0085"

CRANKSHAFTS

Material	Pearlitic Malleable Iron
Journal Diameter	3.000"
Bearing Length—bearing shell, including chamfer	
Front	$\frac{15}{16}$ "
Front Center	$\frac{15}{16}$ "
Center	$\frac{15}{16}$ "
Rear Center Including Thrust Flanges	1.133"-1.135"
Rear	1.590"
Thrust Taken On	Rear Center
Crank Pin Diameter	2.25"
Journal and Pin Maximum Out of Round and Taper	.00025"
Thrust Bearing End Play—Limits When New	.0035"-.0085"

Main Bearing Clearance—Limits When New	Front .0005"-.0025"
	Front center, Center, Rear center and Rear .0005"-.003"

FLYWHEEL

Teeth on ring	150
Teeth on starter pinion	9

PISTONS AND CYLINDERS

Cylinder bore out-of-round and taper when new	.001"
Piston material	Aluminum Alloy
Piston clearance in cylinder—STD	.0007" to .0013"

Piston ring gap

Compression rings

Upper	.016"-.026"
Lower	.013"-.025"

Oil Ring Segments	.015"-.035"
-------------------	-------------

Piston ring to groove clearance

Compression rings

Upper	.0015"-.0030"
Lower	.0015"-.0035"

Oil Ring Assembly	.0015"-.0085"
-------------------	---------------

PISTON PINS

Fit in piston	.0003"-.0005" loose with piston and pin at 70°F.
Fit in rod	.0008"-.0016" press
Diameter (selective)	.9800"-.9804"
Length	3.250"

TIMING CHAIN

Camshaft sprocket material	Cyanide hardened cast iron (cylinder iron)
Crankshaft sprocket material	Case hardened steel—SAE 1020 or 1022.
Number of links in chain	60

VALVES

Material

Intake	G. M. Manganese Molybdenum Steel
Exhaust	G. M. T-XCR Steel

Head Diameter

Intake 1.88"
 Exhaust 1.60"

Stem Diameter

Intake3407"- .3414"
 Exhaust3402"- .3409"

Seat Angle

Intake 30°
 Exhaust 45°

Fit of stem in guide (new) Intake .0021"- .0038"
 Exhaust .0026"- .0043"

Valve Lift Engines Coded 87Z, 77Y, 76Y .40"
 Engines Coded 89Z, 88Z, 86Z, 85Z .33"
 Engines Coded 79Y .34"

VALVE LIFTER

Diameter8422"- .8427"
 Clearance in boss0013"- .0028"
 Length-overall 2.000"
 Leakdown rate 12-40 seconds with 50 lbs. load
 Plunger travel (for gauging purposes)125"

VALVE SPRINGS

OUTER	ENGINES CODED 87Z, 77Y, 76Y	ENGINES CODED 89Z, 88Z, 86Z, 85Z, 78Y, 79Y
Spring Pressure	60 @ 1.52"	80 @ 1.53"
and Length	114 @ 1.12"	171 @ 1.20"
INNER		
Spring Pressure	26 @ 1.48"	
and Length	64 @ 1.08"	

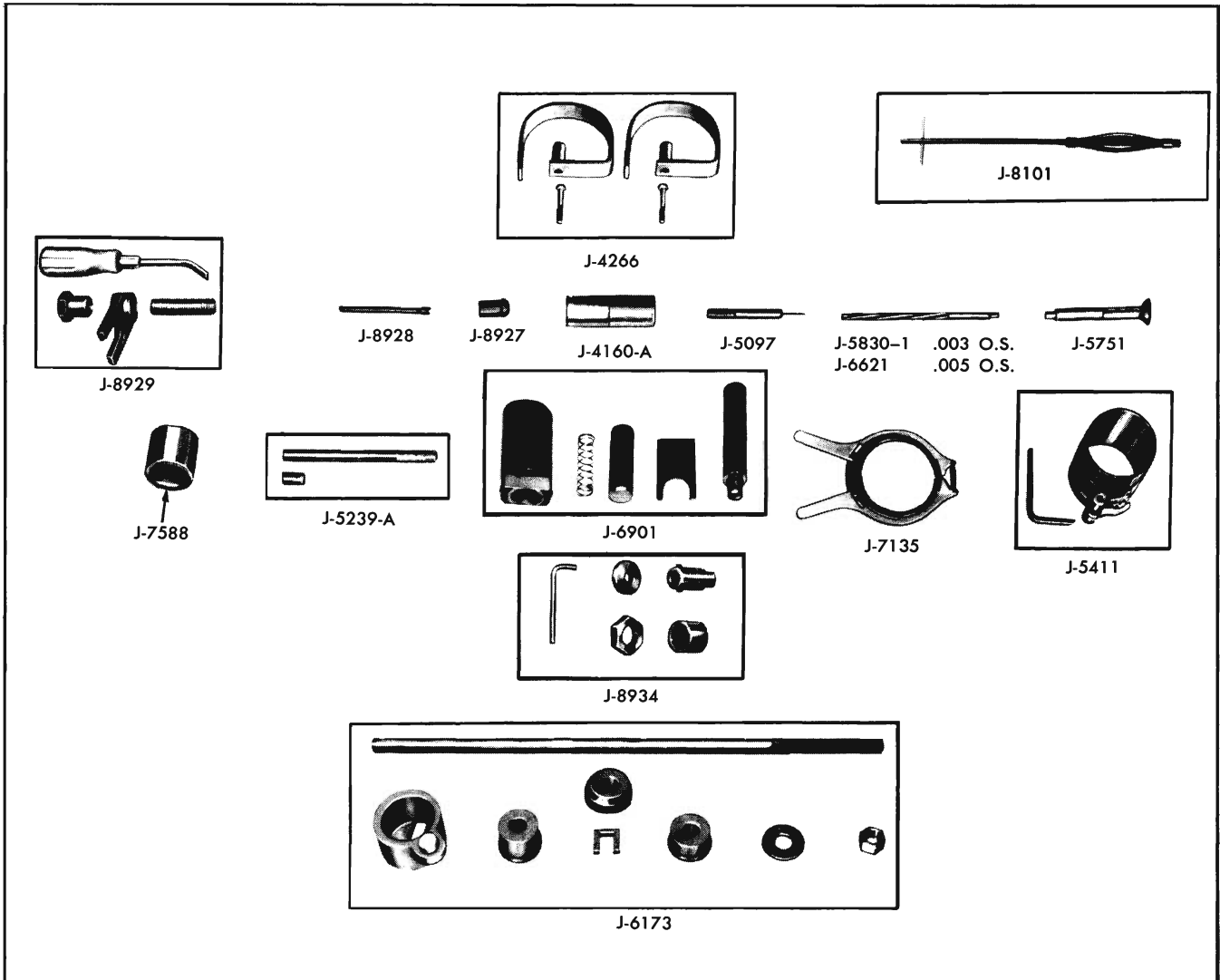
ENGINE TORQUE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed to prevent straining or distorting the parts or possibly damaging the threads. These specifications are for clean and lubricated threads only. Dry or dirty threads produce increased friction which prevents

accurate measurement of tightness. It is important that these torque specifications be strictly observed. Over-tightening to any extent may damage threads, thus preventing proper torque from being attained, requiring replacement or repair of the damaged part.

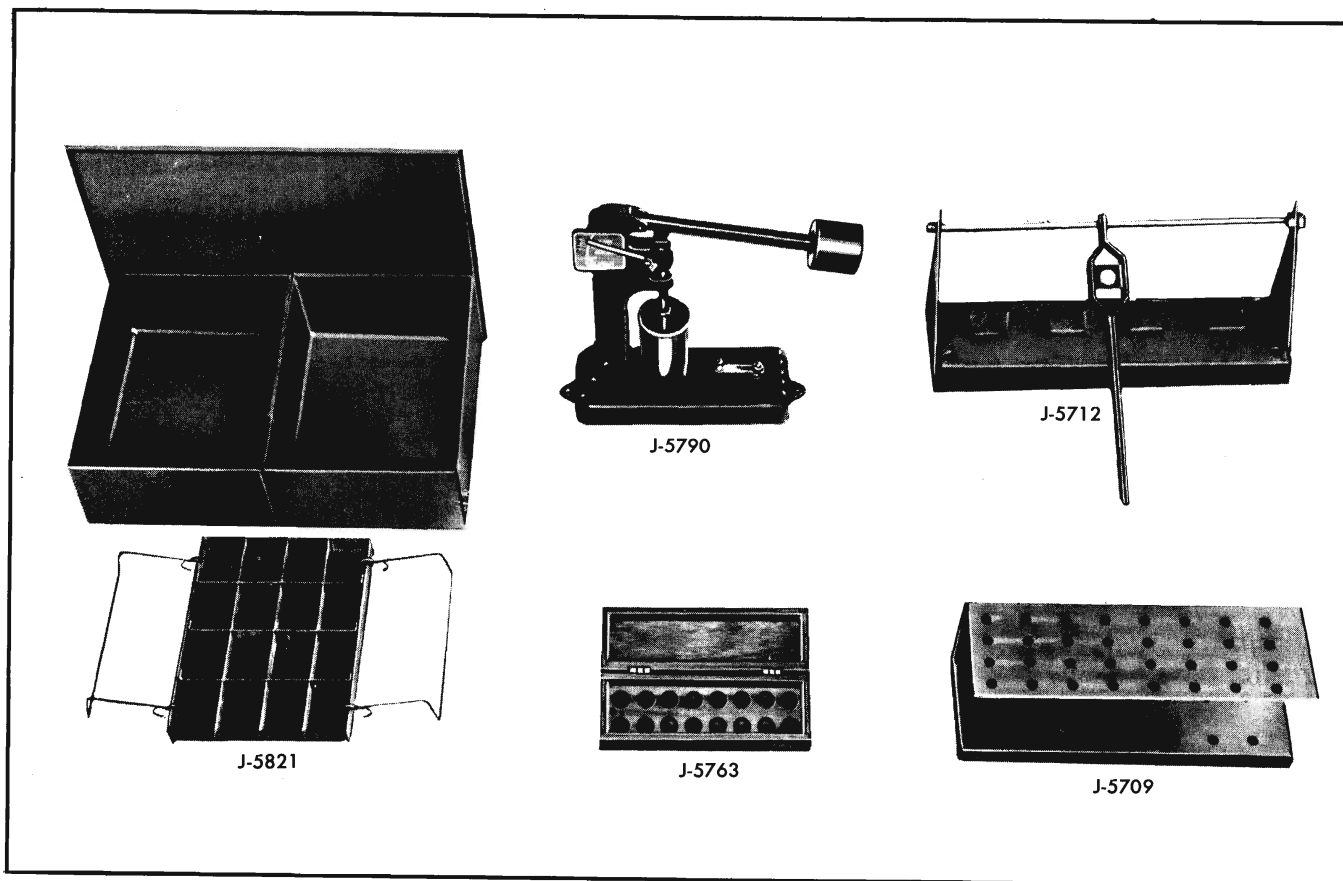
PART	APPLICATION	LB. FT.
Bolt	Main Bearing Cap to Block (Exc. Rear Main)	90-110
Bolt	Rear Main Bearing Cap to Block	110-130
Bolt	Cylinder Head	85-100

PART	APPLICATION	LB. FT.
Bolt	Harmonic Weight to Pulley	15-25
Bolt	Harmonic Balancer to Crankshaft	130-190
Bolt	Flywheel to Crankshaft	85-100
Nut	Connecting Rod & Bushing Cap to Rod	40-46
Bolt	Engine Oil Baffle to Bearing Cap	10-20
Bolt	Oil Pan to Cylinder Block	8-15
Bolt	Engine Oil Pump Cover to Body	10-20
Retainer	Oil Pump Pressure Regulator Spring	8-18
Bolt	Engine Oil Pump Assy. to Block	20-35
Bolt	Timing Chain Cover to Intake Manifold Seal Clamp	10-20
Bolt	Timing Chain Cover to Cyl. Block	20-35
Nut	Timing Chain Cover to Block (Stud)	20-35
Bolt	Fan & Pulley to Water Pump Shaft Flange	15-25
Bolt	Crankshaft Pulley & Hub Assy. to Crankshaft	130-190
Nut	Water Pump to Timing Chain Cover & Stud	10-25
Bolt	Intake Manifold Water Outlet Fitting to Manifold	20-35
Bolt	Intake Manifold to Cyl. Head	30-45
Bolt	Intake Manifold Supp. Brace to Cyl. Block & Manifold	30-45
Bolt	Exhaust Manifold to Cyl. Head	20-35
Bolt	Timing Chain Bumper to Cyl. Block	20-35
Bolt	Valve Push Rod Cover Assy. to Block	25-70 (Lb. In.)
Bolt	Camshaft Thrust Plate to Block	10-25
Bolt	Camshaft Sprocket to Camshaft	30-45
Bolt	Valve Rocker Arm Cover to Head	45-80 (Lb. In.)
Nut	Valve Rocker Arm Ball Retainer	15-25
Bolt	Gen. Mtg. Rear Brkt. to Cyl. Block	20-35
Bolt	Gen. Mtg. Front Brkt. to Cyl. Block & Rear Brkt.	20-35
Bolt	Gen. Adj. Strap to Generator	15-25
Bolt	Gen. Mtg. Rear Brkt. to Cyl. Block	20-35
Bolt & Nut	Gen. & Pulley Assy. to Brackets	20-30
Bolt	Starting Motor to Cylinder Block	20-45
Screw & Lock Washer Assy.	Distributor Hold-Down Clamp to Cyl. Block	15-25
Bolt	Ignition Coil Brkt. to Intake Manifold	10-20
Plug. Assy.	Spark	15-25



SPECIAL TOOLS

- | | | | |
|----------|---|--------|--------------------------------------|
| J-4160-A | Hydraulic Valve Lifter Plunger Remover | J-8927 | Rocker Arm Stud Installer |
| J-4266 | Cylinder Head Lifting Hooks | J-8928 | Valve Train Gauge |
| J-5097 | Hydraulic Valve Lifter Plunger Unloading Tool | J-8929 | Valve Spring Compressor Set |
| J-5239-A | Connecting Rod Bolt Guide Set | J-8934 | Rocker Arm Stud Remover |
| J-5411 | Piston Ring Compressor | J-6621 | Valve Guide Reamer .005 oversize |
| J-5751 | Intake and Exhaust Valve Stem Seal Installer and Tester | J-6901 | Piston Pin Remover and Replacer Set |
| J-5830-1 | Valve Guide Reamer .003 oversize | J-7135 | Piston Ring Remover and Replacer |
| J-6173 | Camshaft Bearing Remover and Replacer | J-7588 | Rear Main Bearing Oil Seal Installer |



SPECIAL TOOLS

- | | | | |
|--------|--|--------|--|
| J-5709 | Valve and Valve Train Holding Stand | J-5790 | Hydraulic Valve Lifter Tester |
| J-5712 | Cylinder Head Holder and Valve Spring Compressor | J-5821 | Hydraulic Valve Lifter Solvent Tank and Tray |
| J-5763 | Hydraulic Valve Lifter Storage Box | | |

TEMPEST EIGHT CYLINDER ENGINE

GENERAL DESCRIPTION

The 215 aluminum V-8 engine (Fig. 6-62) is available on all automatic transmission equipped models of the Tempest series. The engine has a bore of 3.5" and a stroke of 2.8" providing a displacement of 215 cubic inches compression ratio of 10.25 to 1 and a brake horsepower of 185 at 4800 rpm.

CYLINDER BLOCK

The cylinder block is cast aluminum with non-replaceable iron cylinder liners in place. The cylinder block has two banks of four cylinders, cast in 90° to each other. The cylinder block section extends below the center line of the crankshaft to form a continuous flat surface with the rear main bearing cap

and timing chain cover, permitting installation of the oil pan with a one piece gasket (Fig. 6-63, 6-64).

The left bank of cylinders (as viewed from the driver's seat) is set forward of the right bank so connecting rods of opposite pairs of cylinders can be connected to the same crankpin. The cylinders in the left bank 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.

CYLINDER HEADS

Right and left cylinder heads are identical and interchangeable, although in service it is good practice to replace the cylinder heads on the side from which they were removed (Fig. 6-65).

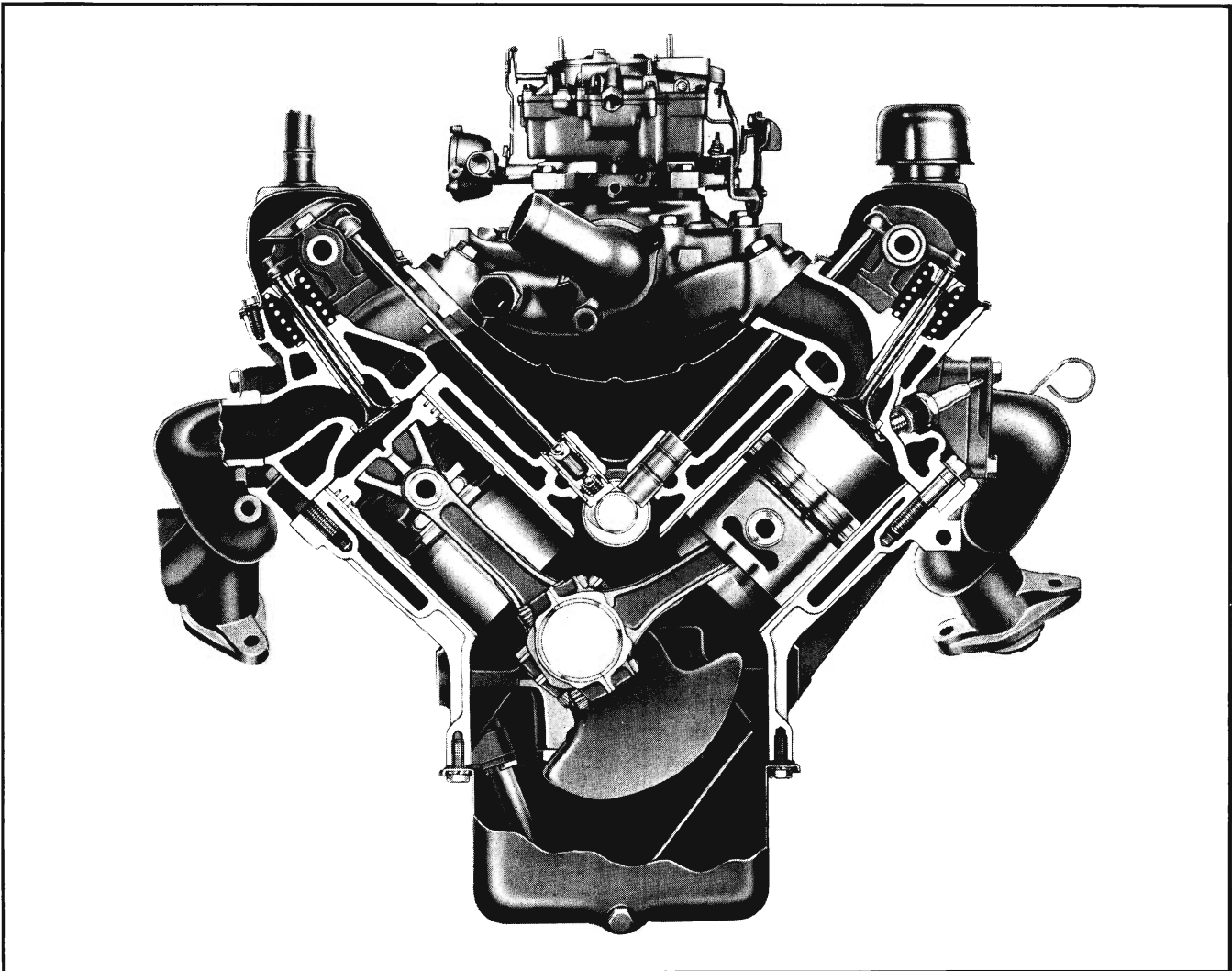


Fig. 6-62A Pontiac Tempest V-8 Engine

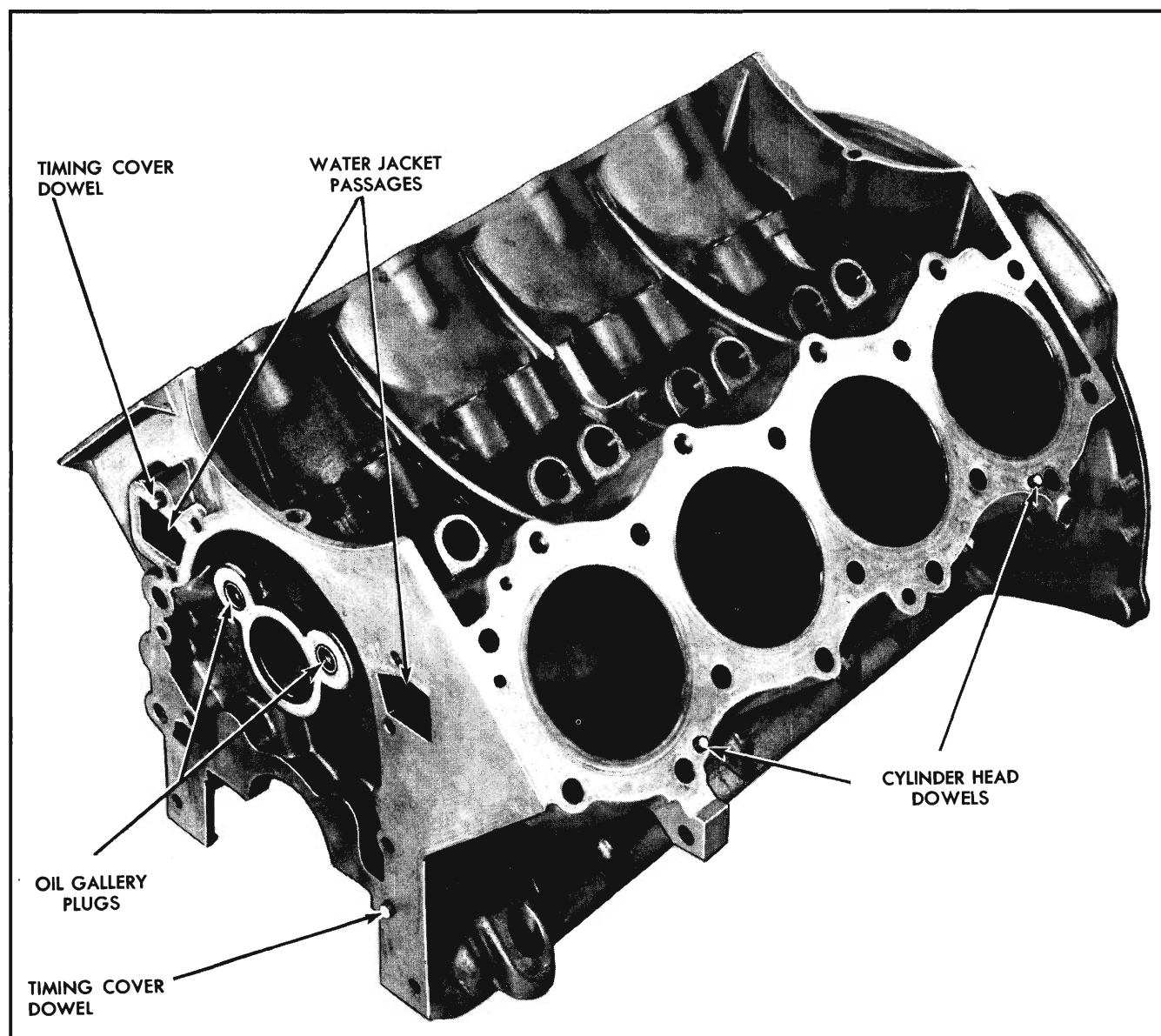


Fig. 6-63 Cylinder Block—View from Top

The cylinder heads are made of cast aluminum with iron valve seat inserts and valve stem guides. The valve stem guides are a press fit and are replaceable while the valve seat inserts are shrunk fit at assembly and are non-replaceable.

The valves are in line in each head and operate at an angle 10° above the center line of the cylinder bore. The spark plug in each cylinder head is located so the point gap is ideally located with respect to the sweep of the incoming charge (Fig. 6-66).

CRANKSHAFT AND BEARINGS

The crankshaft is supported by five steel backed

full precision bearings all having the same nominal diameter. Except for the center crankshaft bearing all bearings are identical. The center bearing takes end thrust and has flanges for that purpose (Fig. 6-67).

The crankshaft is counterbalanced by weights cast integral with the crank cheeks. Maximum counterweighting in the space available is accomplished by precision casting of the counterweights to a contour which allows a minimum uniform clearance with cylinder barrel and piston skirts (Fig. 6-68).

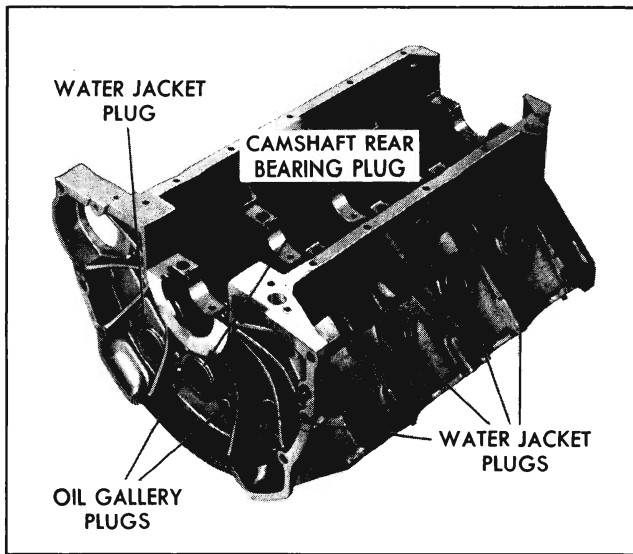


Fig. 6-64 Cylinder Block—View from Bottom

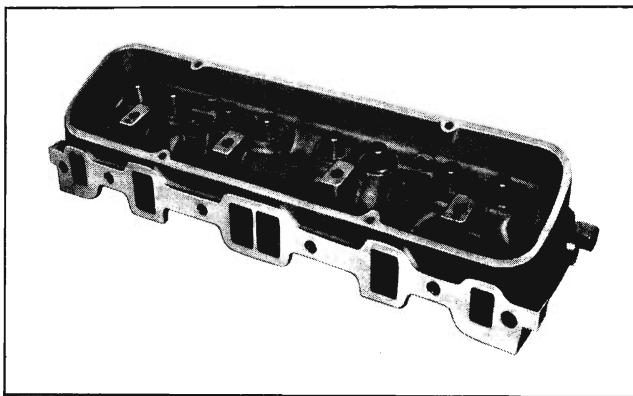


Fig. 6-65 Cylinder Head

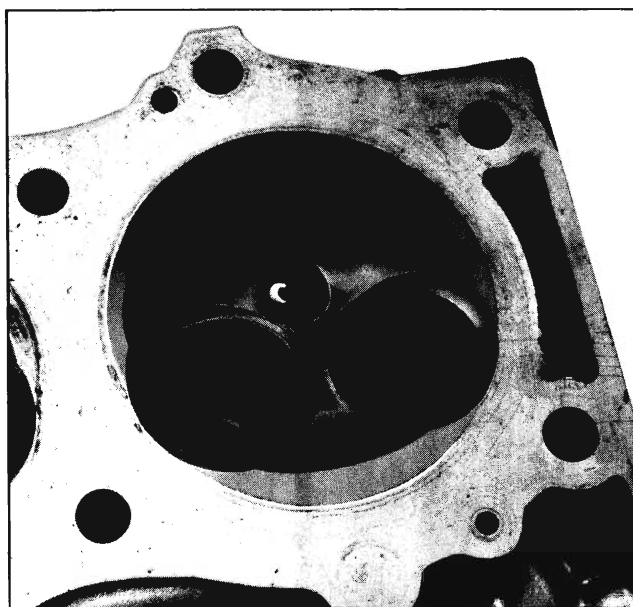


Fig. 6-66 Spark Plug Location

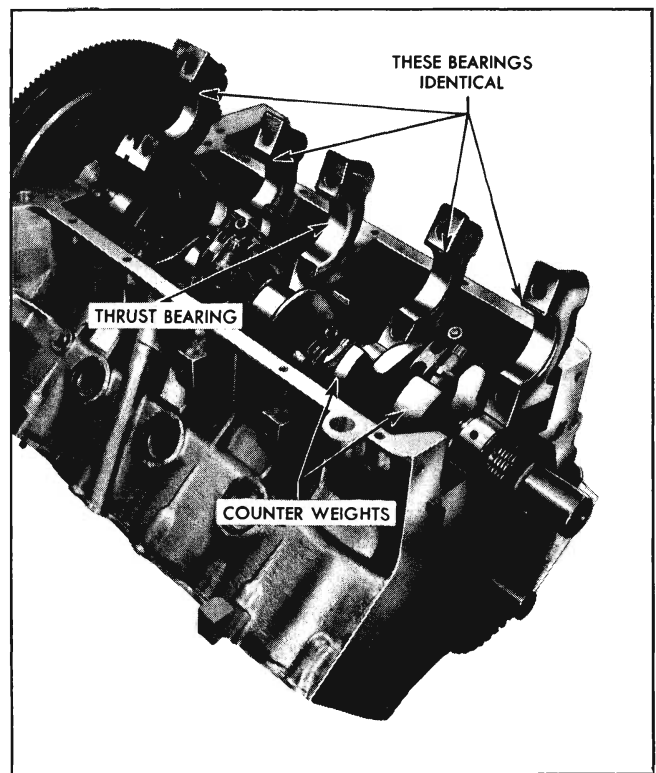


Fig. 6-67 Main Bearing

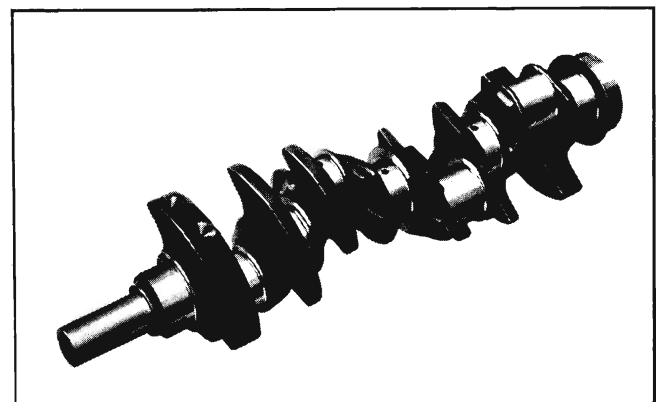


Fig. 6-68 Crankshaft

CONNECTING RODS AND PISTONS

Connecting rods are forged steel of I-beam section with bosses on each side so metal can be removed as required to secure correct weight and balance. The lower end of each rod is fitted with a steel backed full precision type bearing. A lubrication groove between the connecting rod and cap directs a jet of oil onto the opposite cylinder wall to lubricate the piston and rings and to provide splash for lubricating the piston pins. The piston pin is a press fit into the upper end. The outer ends of the piston pins are a slide fit in the piston bosses (Fig. 6-69).

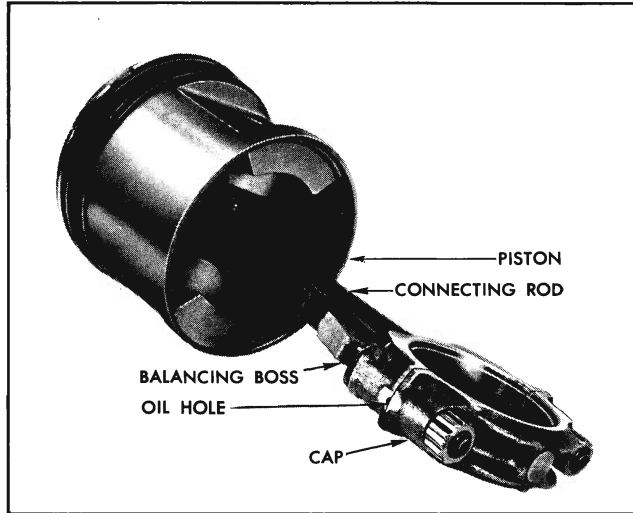


Fig. 6-69 Piston and Rod Assembly

The full skirted aluminum alloy pistons are cam ground and tin plated. Two compression rings and one oil control ring are located above the piston pin. The cast iron compression rings in the two upper grooves of the piston have a groove or bevel cut around the inner edge on one side. The rings are installed with manufacturer's mark up. The oil ring in the lower groove consists of two thin steel rails separated and backed by a combination spacer and expander.

CAMSHAFT AND VALVE MECHANISM

The camshaft is located above the crankshaft between the two banks of cylinders, where it is supported by five steel backed babbitt bearings. It is driven at $\frac{1}{2}$ crankshaft speed by sprockets and a single outside guide type chain (Fig. 6-70).

Hydraulic valve lifters and one piece push rods are used to operate overhead rocker arms and valves of both banks of cylinders from a single camshaft. This system requires no lash adjustment at time of installation or in service.

The eight rocker arms for each bank of cylinders

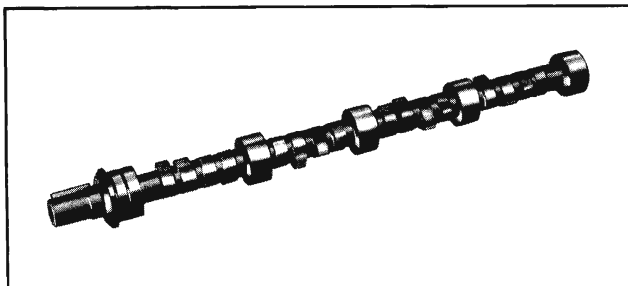


Fig. 6-70 Camshaft

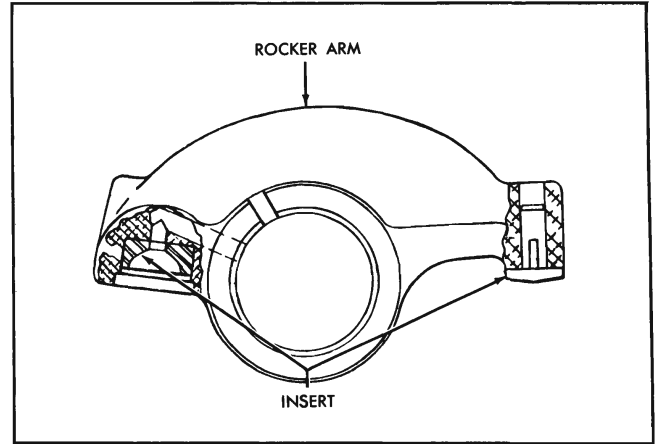


Fig. 6-71 Rocker Arm

are mounted on a tubular steel shaft supported on the cylinder head by four die cast brackets.

The rocker arms are die cast aluminum with steel inserts at the valve stem contact face and iron inserts at the push rod socket. The rocker arms are offset slightly to accommodate the different planes of movement of the valves and the push rods (Fig. 6-71).

The valves operate in guides pressed in the cylinder head. Each valve has a spring of ample capacity to insure positive valve seating throughout the operating speed range of the engine.

Intake valve heads are 1.5" in diameter and exhaust valve heads are 1.3125" in diameter. The valve rocker arm mechanism is protected by a sheet metal cover which seats against a raised surface of the cylinder head and is gasketed to prevent oil leaks.

INTAKE MANIFOLD

The intake manifold (Fig. 6-72) is designed to provide fuel passages which are short and practically equal in length.

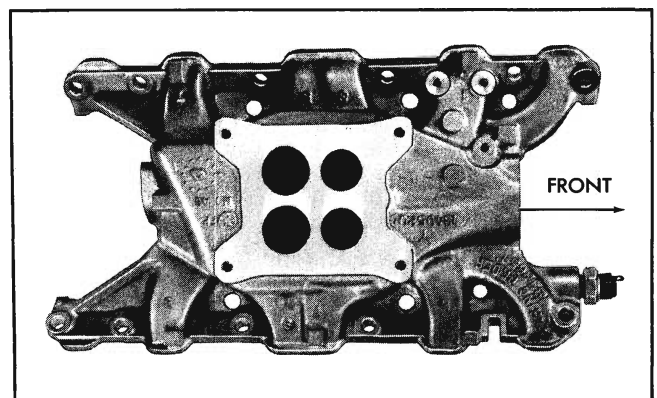


Fig. 6-72 Intake Manifold

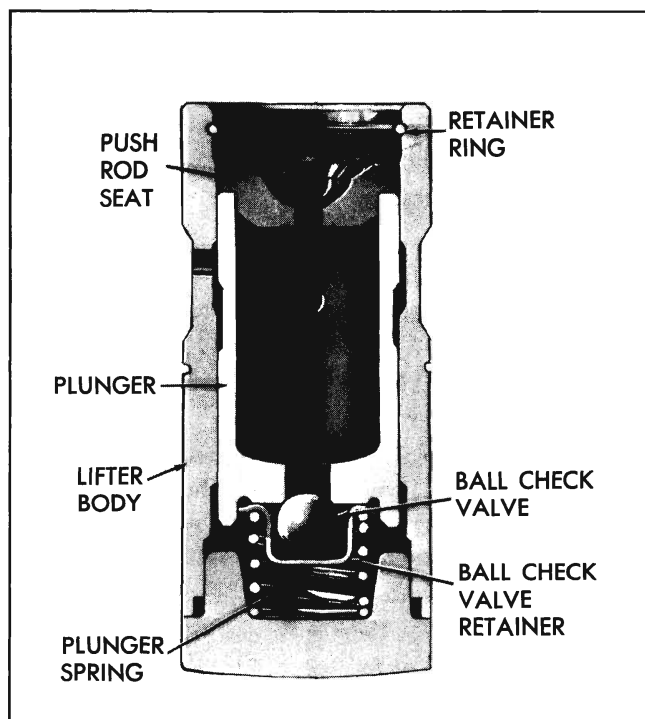


Fig. 6-73 Cross Section of Valve Lifter Assembly

The intake manifold is water cooled cast aluminum. The flow of heated coolant through the intake manifold water jacket warms the manifold evenly to provide good vaporization of the incoming fuel charge.

HYDRAULIC VALVE LIFTERS

Hydraulic lifters are used to keep all parts of the valve train in constant contact. In other words each lifter is an automatic adjuster maintaining zero lash under all conditions. This insures precision valve timing and silent operation, increases valve life, and eliminates the need for tappet adjustment.

The hydraulic lifter assembly (Fig. 6-73) includes: the cast iron body which rides in the cylinder block boss, the plunger, push rod seat, plunger spring, ball check valve, ball check valve spring, ball check valve retainer, and retainer ring.

The hydraulic valve lifter functions as follows: When the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the ball check valve cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

During operation a small amount of oil leaks out of the lifter between the plunger and body. A controlled amount of leakage is important to provide continuous adjustment of the plunger position within the lifter. This leakage is called "leak down" and must be within certain limits to provide correct operation (see page 6-54).

Oil is supplied to the lifter by the cylinder block oil gallery to replace that lost through leak down. The annular groove around the outside of the lifter body indexes with the passage drilled from the gallery to the lifter boss. Oil then enters the lifter from this groove and passes into the plunger cavity.

MOTOR VEHICLE IDENTIFICATION NUMBER

The two numbers stamped on the boss just forward of the right cylinder head on the cylinder block constitute the motor vehicle identification number and the production engine code number. The production engine code number along with the motor vehicle identification number is used on product reports to identify the engine.

GENERAL INFORMATION ON ENGINE SERVICE

Cleanliness is a primary factor when servicing the V-8 engine. The slightest particle of dirt that finds its way into a hydraulic lifter may cause a malfunction.

Since any dirt which may enter the oil galleries or passages in the engine could eventually get to a lifter, cleanliness should be exercised when any part of the engine is removed or disassembled. When the intake manifold is removed for any purpose, it exposes the lifters to any dirt which may fall from the upper portion of the block or which may be carried in the air. Thus, it is wise to cover the lifter galleries until ready to reassemble the engine.

When lifters are removed for any reason, they should immediately be placed in order in Valve Lifter Storage Box J-5763 (Fig. 6-74). This is important for two reasons. First, it is the easiest way to keep lifters clean. Second, lifters should always be replaced in the same bosses from which they were removed.

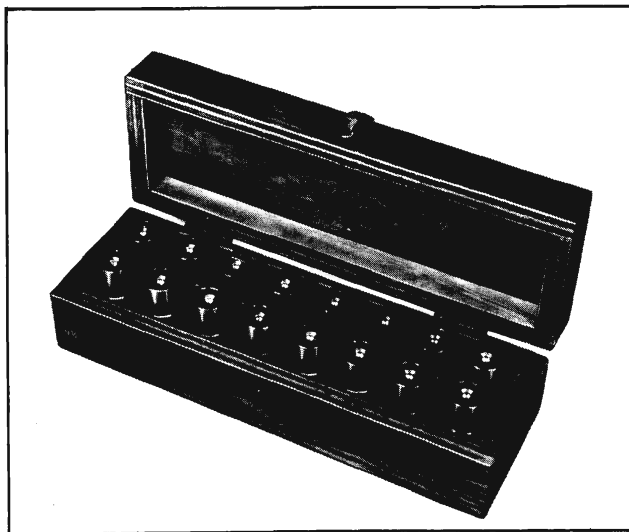


Fig. 6-74 Valve Lifter Storage Box J-5763

Valves, valve lifters, push rods and rocker arms, should always be kept in sets and returned to their original positions. These parts will tend to mate as the engine operates and will provide more satisfactory operation when kept together. By storing lifters in Storage Box J-5763 and valves and push rods in Holding Stand J-5709 (Fig. 6-75), whenever they are removed, they can easily be kept in sets for identification during assembly. In addition to keeping the parts in sets, the push rods should be replaced with the same end up. In other words, the same end will contact the rocker arm as before the engine was disassembled. The upper end can usually be identified by the polished surface which contacts the rocker arm. Push rods will also be polished somewhat in the area where the rod passes through the head.

When hydraulic valve lifters are disassembled, the various parts of each lifter must be kept together. This is especially important since the lifter body and plunger are selectively fitted. The use of the special tray included with Cleaning Tank J-5821 will aid in keeping the parts of each lifter together when lifters are being serviced.

Cylinder head bolts should be installed with non hardening thread sealer such as Perfect Seal #4, Permatex #2 or equivalent.

When raising or supporting the engine for any reason, do not use a jack under the oil pan or crankshaft pulley. The crankshaft pulley is sheet steel and will not support engine weight.

It should be kept in mind, while working on the engine, that the twelve volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

In the mechanical procedures described in this section generally no references will be made to the removal of optional equipment such as power steering pump, air conditioning compressor, etc.

Should it become necessary to remove any such item to perform other service refer to the appropriate section of the manual for specific information.

IMPORTANT: The cylinder block, cylinder heads, intake manifold, timing chain cover and water pump are all cast aluminum.

Aluminum is a soft metal that may be scratched or nicked very easily. It is very important that extreme caution be observed while working on this engine. The main rules to follow are:

1. Maintain a clean working area.
2. Use proper tools.
3. Do not drop or slide machined surfaces on the bench or floor.
4. Do not use gasket cement.
5. Use special lubricant for all bolts.
6. Use special non-hardening sealing compound on cylinder head bolt.

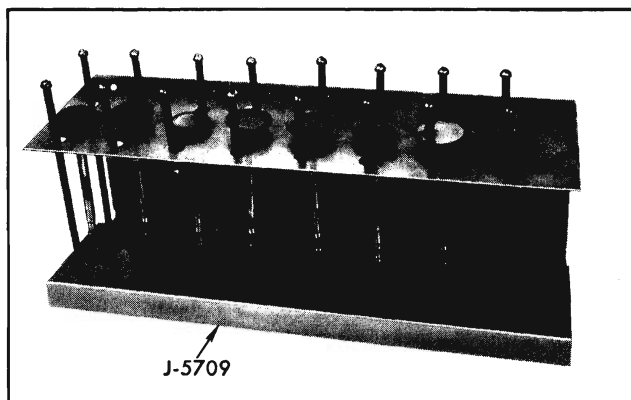


Fig. 6-75 Valve Lifter and Push Rod Holding Stand

7. Follow the torque specifications. *Do not over tighten bolts.*

To help prevent thread damage, all bolts used in aluminum must be free of grit and well lubricated before installation. This note applies in particular to cylinder head and main bearing cap bolts.

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, fuel filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this book.

ADJUSTMENTS ON CAR

ADJUST DRIVE BELTS

Engine fan and accessory drive belts may be adjusted either by the deflection method or by use of the Burroughs 33-73 gauge. Section 6A gives the correct specifications for both methods.

ADJUST IGNITION TIMING

See Section 11.

ADJUST CARBURETOR

See Section 6B.

ENGINE ASSEMBLY REMOVE AND REPLACE

REMOVE

1. Remove hood.
2. Drain and remove radiator.
3. Disconnect heater hoses at engine.
4. Disconnect wiring harness at generator, ignition coil, starter solenoid, heater blower, thermogage.
5. Disconnect fuel line at fuel pump.
6. Disconnect vacuum modulator line (Automatic Transmission only).
7. Disconnect battery ground strap.

8. Remove front fender cross brace.
9. Remove fan and fan pulley.
10. Disconnect accelerator rod at engine.
11. Raise front of car.
12. Disconnect clutch and shifting linkage (Synchro-mesh transmission only).
13. Disconnect propeller shaft and torque tube from rear of engine by following steps as outlined in Section 4.
14. Disconnect engine support at crossmember.
15. Carefully raise engine with chainfall or overhead hoist. Move forward to clear firewall and heater.

REPLACE

The replacement procedure is essentially a reversal of removal. Follow instructions given in Section 4 for the installation of propeller shaft and torque tube. Failure to follow procedure may result in drive-line damage.

MANIFOLDS—VALVE TRAIN—CYLINDER HEAD

EXHAUST MANIFOLD REPLACE

REMOVE

1. Remove bolts attaching exhaust manifold to exhaust pipe assembly.
2. On right side remove generator rear attaching bolt and heat riser tube.
3. Bend tabs of exhaust manifold lock plates back to allow manifold to cylinder head bolts to be removed. Remove bolts and lock plates. Remove manifold.

REPLACE

1. Clean surfaces on manifold and head.
2. Place exhaust manifold in place against cylinder head and install bolts and locking plates as shown in Fig. 6-76.
3. Torque bolts to 10 to 15 lb. ft. Bend one tab of locking plate against a flat surface of each bolt head.
4. Connect generator rear attaching bolt and heat riser tube. Right side.
5. Connect exhaust manifolds to exhaust pipes.

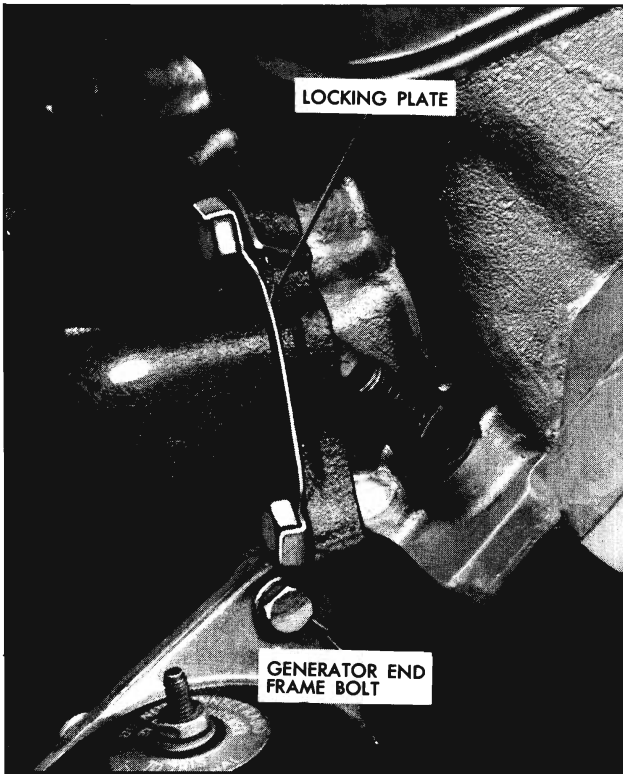


Fig. 6-76 Manifold Locking Plate

INTAKE MANIFOLD OR GASKET REPLACE

REMOVE

1. Drain radiator and cylinder block.
2. Remove air cleaner and silencer assembly.
3. Disconnect fuel lines and vacuum hose from carburetor.
4. Disconnect accelerator and transmission linkage at carburetor.
5. Disconnect temperature gauge wire at thermogauge.
6. Disconnect heater hose at intake manifold fitting. Position hose along fender skirt so that there is no chance of coolant entering the engine when manifold is removed.
7. Slide thermostat by-pass front clamp back on hose.
8. Disconnect upper radiator hose at manifold.
9. Remove coil assembly.
10. Remove 12 bolts attaching intake manifold to cylinder head.

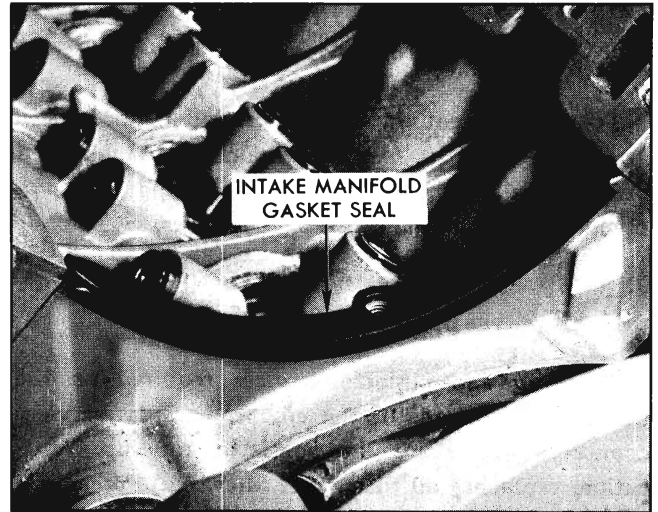


Fig. 6-77 Intake Manifold Gasket Seal

11. Remove intake manifold and carburetor as an assembly by sliding rearward to disengage thermostat by-pass hose from water pump.

12. Remove intake manifold sound absorber, intake manifold gasket clamps and remove gasket.

13. Remove rubber gasket seals (Fig. 6-77).

NOTE: If new manifold is to be installed remove all parts from old manifold assembly and transfer to new manifold.

REPLACE

1. Install new manifold gasket seals as shown in Fig. 6-77. Make sure the ends of the seals fit properly in the notches provided in the block.

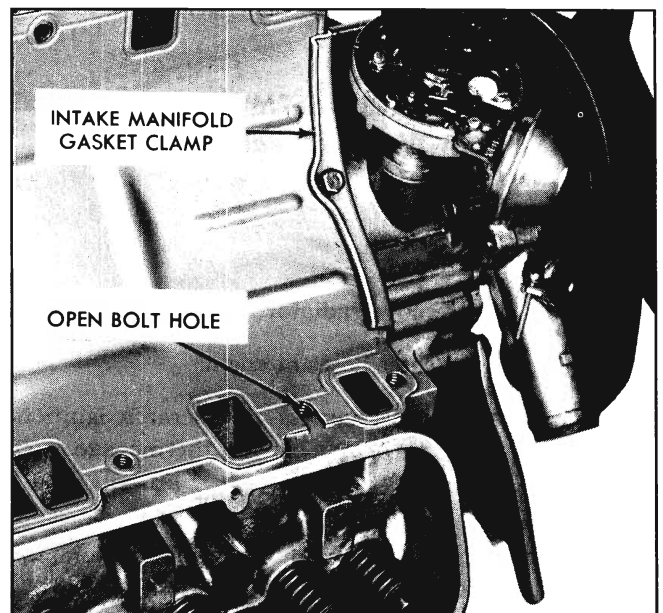


Fig. 6-78 Intake Manifold Gasket

2. Position manifold gasket in position so open bolt hole is located as shown in Fig. 6-78.

3. Install gasket clamps and retaining screws, but do not tighten.

4. Install intake manifold sound absorber.

5. Set intake manifold in position and connect thermostat by-pass hose to water pump with corbin hose clamp.

6. Check to be sure manifold and gasket clamp are properly positioned. Start all attaching bolts into cylinder head. The two longer bolts are installed in forward location on each side (Fig. 6-79).

7. Tighten all manifold to cylinder head bolts a little at a time until all are snug, then torque to 25-30 lb. ft. Do not overtighten. Torque clamp bolts at front and rear to 10-15 lb. ft.

8. Connect upper radiator hose.

9. Install coil assembly. Connect high tension lead and primary lead.

10. Connect heater hose to intake manifold fitting.

11. Connect temperature gauge wire at thermo-gauge.

12. Connect accelerator and transmission linkage at carburetor.

13. Connect fuel and vacuum lines at carburetor.

14. Install air cleaner and silencer.

15. Fill radiator.

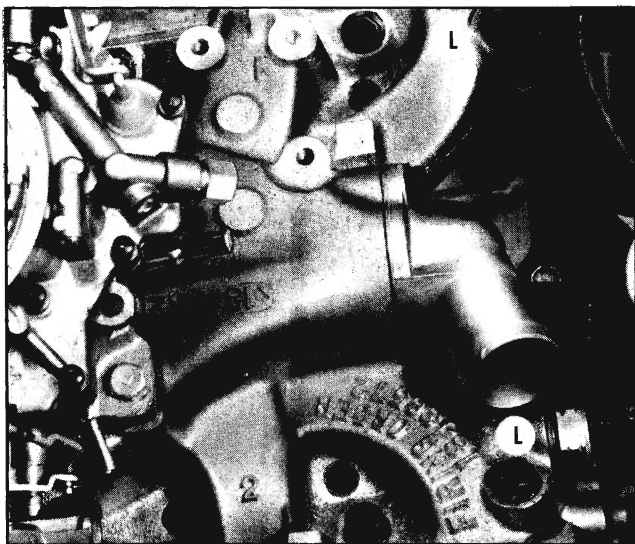


Fig. 6-79 Intake Manifold Bolts

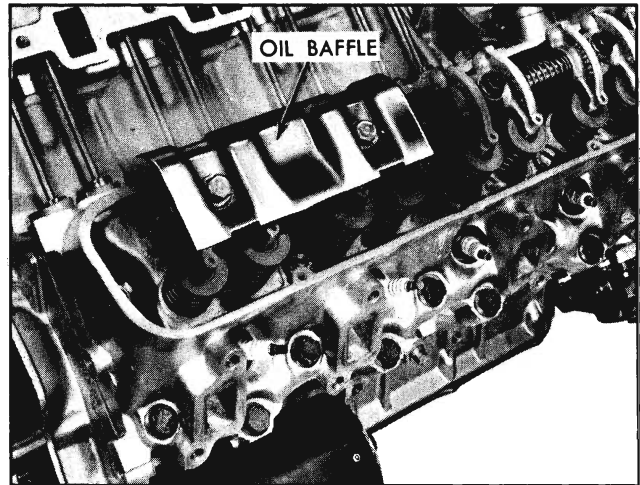


Fig. 6-80 Oil Baffle

REPLACE ROCKER ARMS OR SHAFT

REMOVE

1. Pull spark plug retainers from brackets on rocker arm cover. Disconnect spark plug wires at plugs and swing wires and loom out of way.

2. Remove four screws attaching rocker arm cover to cylinder head. On right side remove vent pipe. Remove rocker arm cover and gasket.

3. Remove rocker arm and shaft assembly. Remove vent pipe oil baffle from right rear rocker arm and shaft assembly (Fig. 6-80).

4. Remove cotter pin, plain washer and spring washer from end of rocker arm shaft.

5. Remove bracket bolts. Slide all rocker arms, springs, brackets and washers off shaft being careful to keep them in correct order so they may be replaced in original order.

6. Clean and inspect all parts, taking particular care to clean out all oil holes. Replace parts that are excessively worn.

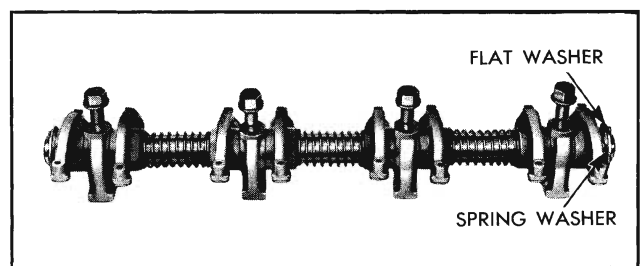


Fig. 6-81 Rocker Arm Shaft Assembly

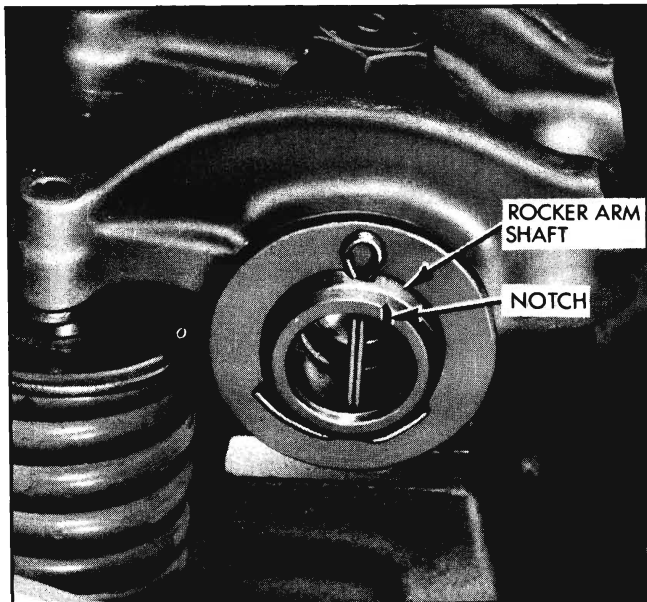


Fig. 6-82 Locating Notch

REPLACE

1. Assemble rocker arm shaft assembly as shown in Fig. 6-81.

NOTE: Two different rocker arms are used. Position rocker arms so they angle away from brackets.

2. Install, in order, spring washer, flat washer, and cotter pin on each end of shaft.

3. Install bolts and plain washers through brackets and shaft so the notch on one end of shaft is "UP" toward the shaft bracket bolt heads (Fig. 6-82).

4. Replace rocker arm shaft assembly. Torque 25-30 lb. ft.

5. Replace valve cover, gasket and wire loom.

PUSH ROD REPLACE

REMOVE

1. Disconnect spark plug wires at plugs and wire retainer from brackets on rocker arm cover.

2. Remove rocker arm cover and gasket. On right side of engine remove vent pipe.

3. Remove rocker arm shaft assembly.

4. Remove push rods. Store in J-5709 so they may be reinstalled in original location and position.

If push rod is broken or has fallen through, it will be necessary to remove intake manifold, page 6-48.

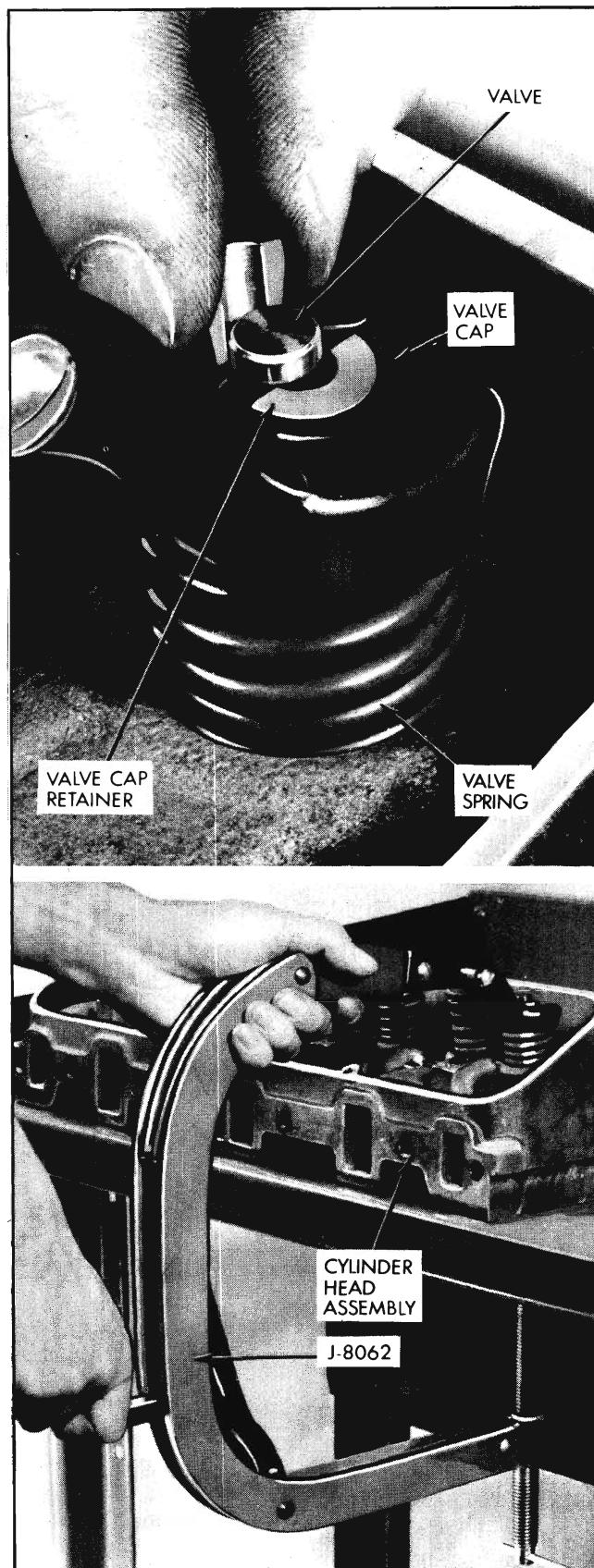


Fig. 6-83 Compressing Valve Spring

REPLACE

1. Install push rods through cylinder head openings so rods are correctly positioned on lifter plungers.

2. Check notch on end of rocker arm shaft to be certain it is "up" (Fig. 6-82). Set rocker arm and shaft assembly in place and start one or two bolts into head.

3. Draw down rocker arm shaft assembly by tightening four bracket bolts a little at a time. Torque bolts to 30-35 lb. ft.

4. Install rocker arm covers and gaskets. On right side, install vent pipe. Torque 3-5 lb. ft.

5. Connect spark plug wires.

VALVE SPRING REPLACE**REMOVE**

1. Remove intake manifold assembly, page 6-48.
2. Remove cylinder head, page 6-55.
3. Place cylinder head on clean smooth surface.
4. Remove rocker arm shaft assembly.
5. Using suitable spring compressor, compress valve spring and remove cap retainers. Release tool and remove spring and cap (See Fig. 6-83).

REPLACE

1. Place new spring and cap over valve and compress with spring compressor. Replace cap retainers and release tool.

NOTE: Install valve spring with closely wound coils toward the cylinder head (Fig. 6-84).

2. Replace rocker arm shaft assembly. Torque bolts 30-35 lb. ft.
3. Replace head assembly, page 6-55.
4. Replace intake manifold assembly, page 6-49.

VALVE LIFTER REPLACE**REMOVE**

1. Remove intake manifold assembly and gasket, page 6-49.
2. Disconnect spark plug wires retainer from sockets on rocker arm cover. Disconnect plug wires at plugs and swing wire loom out of way.

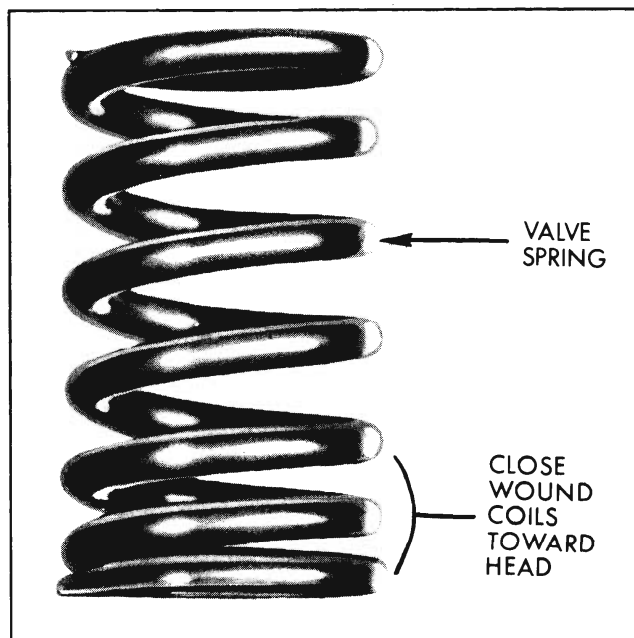


Fig. 6-84 Valve Spring

3. Remove rocker arm cover and gasket.
 4. Remove rocker arm shaft assembly.
 5. Remove push rod or rods. Store in tool J-5709 so they may be reinstalled in correct position and location (Fig. 6-75).
 6. Before removing lifter that is suspected of having a stuck plunger, it can be tested using **Lifter Plunger Unloader J-5097**. To check lifter, insert pin of unloader tool through hole in push rod seat and push down on tool. Pin will unseat ball and tool will move push rod seat and plunger down. If lifter plunger is stuck, it will be impossible to move push rod seat down.
 7. Remove lifter or lifters.
- NOTE:** If more than one lifter is to be replaced, store lifters to be reinstalled in **Lifter Box J-5763** so they can be reinstalled in exactly the same place and position (Fig. 6-74).

REPLACE

NOTE: If new lifter is to be installed, be sure to remove all sealer coating from inside of new lifter and check leakdown rate, page 6-54.

1. Place new lifter in lifter boss.
2. Replace push rod or rods exactly as removed (same end against rocker arm).

3. Replace rocker arm shaft assembly. Torque bolts to 30-35 lb. ft.
4. Replace intake manifold and gasket assembly, page 6-48.
5. Replace rocker arm cover and gasket. Torque 3-5 lb. ft.
6. Connect spark plug wires.

RECONDITION HYDRAULIC VALVE LIFTER

NOTE: Because of the important part hydraulic valve lifters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, *cleanliness*, cannot be overstressed when servicing these parts.

New lifters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leakdown rate. It is not necessary to remove the oil from new lifters prior to checking leakdown rate since special leakdown oil is already in new lifters.

Wash Tank and Tray J-5821 is recommended for cleaning valve lifters. This tank should be used only for valve lifters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Lifters should at all times be stored in a covered box (Fig. 6-79) which will aid in keeping them clean. The lifter box should be kept dry and as free of oil as possible.

DISASSEMBLE VALVE LIFTER

1. Remove push rod seat retainer ring by holding

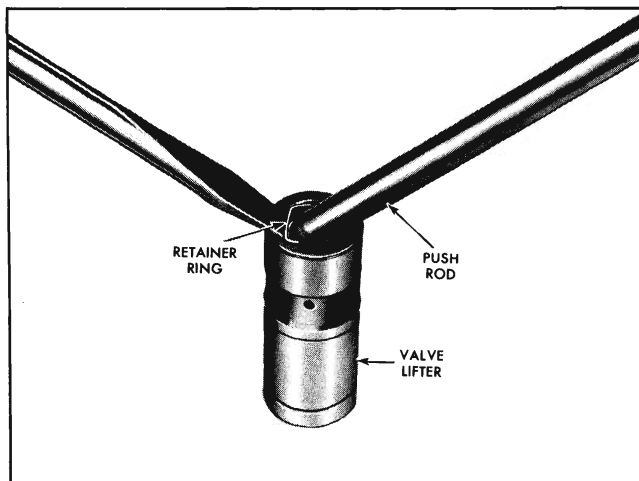


Fig. 6-85 Removing Push Rod Seat Retainer Ring

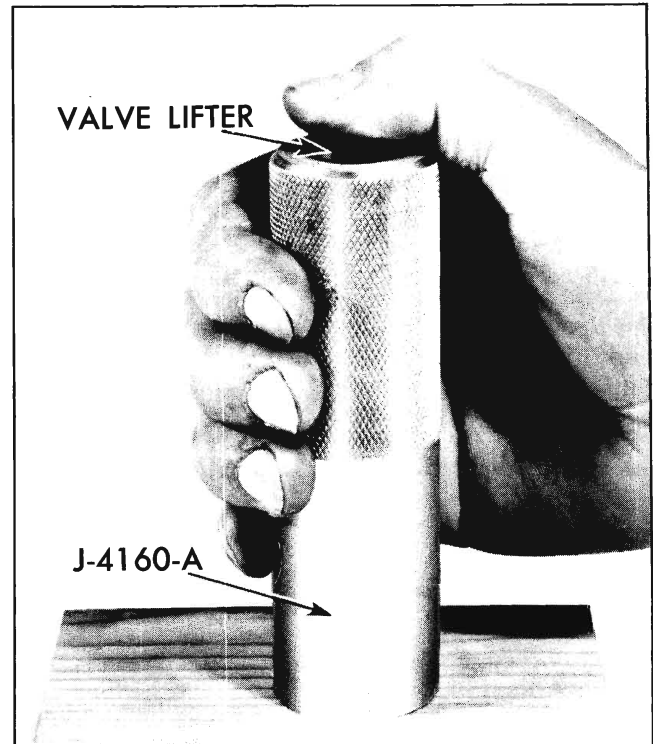


Fig. 6-86 Removing Stuck Plunger

seat down with push rod while dislodging spring from lifter body with a pointed tool (Fig. 6-85). **NOTE:** It may be necessary to unseat lifter ball, using plunger unloader J-5097, before plunger can be pushed down.

2. Invert lifter and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place lifter in large end of Hydraulic Valve Lifter Plunger Remover, J-4160-A, with push rod end of lifter downward. Hold tool firmly in hand with thumb over lifter body and sharply strike the tool against a block of wood (Fig. 6-86) until plunger falls out. **NOTE:** It may be necessary to soak a lifter having a stuck plunger in cleaning solvent for several minutes in order to remove the plunger.

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from Wash Tank J-5821 (Fig. 6-87).

CAUTION: Valve lifter body and plunger are selectively fitted and must not be interchanged with parts of other lifters. (Keeping all parts of lifters together will also aid in trouble diagnosis.)

CLEAN AND INSPECT VALVE LIFTER

Wash Tank J-5821 is recommended for cleaning

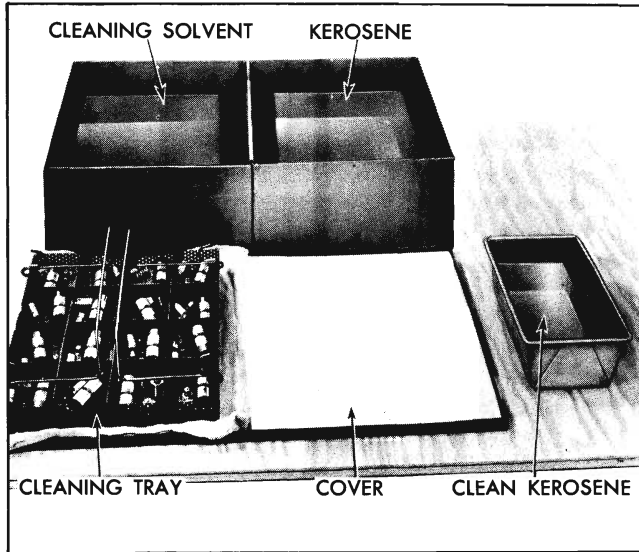


Fig. 6-87 Lifter Wash Tank and Tray J-5821

valve lifter parts. This tank consists of two chambers, a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be closed.

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Wipe out tank cover and place tray of parts on cover in front of tank (Fig. 6-87). A shop towel under tray and clean paper on remainder of cover will enhance cleanliness.

6. Working on one lifter at a time and using *clean, lint-free* cloths, thoroughly wipe off lifter parts. Clean plunger and external and internal surfaces of body with a hard wiping action. A bristle brush may be used to clean internal surface of lifter body.

CAUTION: Do not use wire brush or sand paper, since damage to machined surface is likely.

NOTE: Absolute cleanliness can be assured if each lifter is inspected and assembled after cleaning, but before proceeding to the next lifter.

7. Inspect lifter body. Both inner and outer surfaces of lifter body should be inspected for scoring. Lifter assembly should be replaced if body is roughly scored, grooved, or galled. Inspect cam contact surface on lower end of lifter body. Replace the lifter assembly if this surface is excessively worn, galled or otherwise damaged.

8. Inspect lifter plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

A blackened appearance is not a defective condition. Sometimes the discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect push rod seat. Inspect push rod seat for roughness and to insure that hole in center is open.

10. Inspect valve lifter ball. Carefully examine ball for nicks, embedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy lifter operation. Also inspect plunger face of ball retainer for excessive wear.

ASSEMBLE VALVE LIFTER

NOTE: All parts must be absolutely clean when assembling a hydraulic lifter. Since lint and dust may adhere to parts they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of lifters being overhauled.

Figure 6-88 shows the relative position of component parts of valve lifters. The recommended procedure for assembly is given in the following steps.

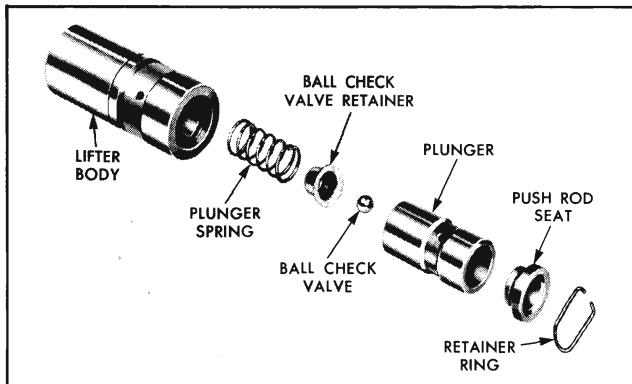


Fig. 6-88 Exploded View of Valve Lifter

1. Rinse plunger spring and ball retainer and position retainer in spring.
2. Rinse lifter ball, check valve and check valve spring and place in retainer.
3. Rinse plunger and place on retainer so that seat on plunger mates with ball.
4. Invert plunger with parts assembled thus far and, after rinsing lifter body, install body over spring and plunger.
5. Place lifter body on clean paper; rinse and install push rod seat and retainer ring.
6. After lifter has been assembled, place in lifter box and close lid to preserve cleanliness.

TEST VALVE LIFTER LEAKDOWN RATE

After all lifters have been assembled, the leakdown rate must be checked before they are installed in the engine. Valve Lifter Leakdown Tester J-5790 (Fig. 6-89) is designed to test leakdown rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is paramount. The tester cup, and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

1. Fill tester cup to approximately one inch from top with special fluid which is available from tester manufacturer.

NOTE: No other type fluid is recommended.

2. Swing weight arm up out of the way, raise ram, and position lifter into boss in center of tester cup.

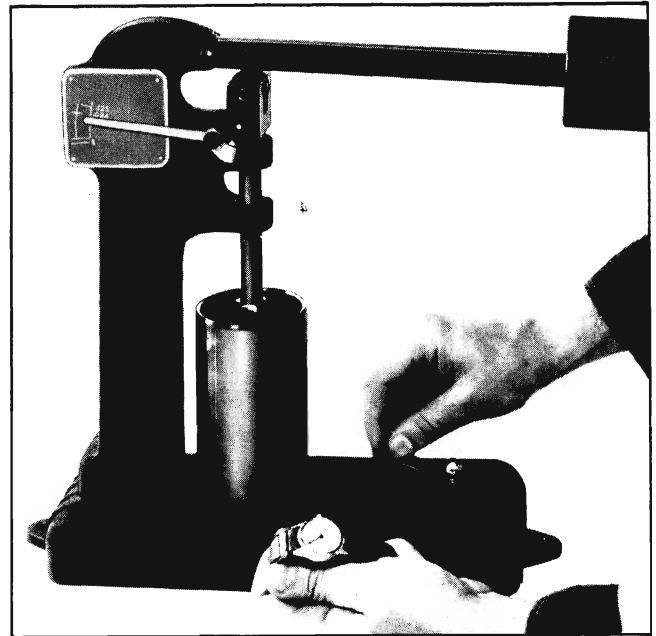


Fig. 6-89 Testing Leak Down Rate

3. Adjust ram (with weight arm clear of ram) so that the pointer is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.

4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and force out air. (Lifter must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds). Time indicator travel from lower line (first line above set line) to line marked .125 or $\frac{1}{8}$ ", while still rotating cup with crank (Fig. 6-89). Lifter is satisfactory if rate is between 12 and 60 seconds.

A doubtful lifter should be tested three or four times. Disassemble, inspect, and re-test doubtful lifters. If leakdown still is not within specifications, replace lifter.

6. After each lifter is tested, replace in lifter box to insure cleanliness. Leave lifters in box until ready for installation in cylinder block.

7. When all lifters have been tested, empty cup, clean, and place cover over tester to maintain its cleanliness.

CYLINDER HEAD OR GASKET REPLACE**REMOVE**

1. Remove intake manifold, page 6-48.
2. Pull spark plug wire retainer from brackets on rocker arm cover. Disconnect plug wire at plugs and swing wires and loom out of way.
3. Remove rocker arm cover and gasket. On right side of engine remove vent pipe.
4. Remove four rocker arm shaft bracket to cylinder head attaching bolts. Remove rocker arm and shaft assembly.
5. Remove push rods. Store in J-5709 so they may be reinstalled in original location and position.
6. Protect lifters and camshaft area from entrance of dirt by covering with clean cloths.
7. Disconnect exhaust manifold at exhaust pipe.
8. Disconnect battery ground strap at front right outer cylinder head bolt stud.
9. Remove 14 cylinder head bolts and rear generator attaching bolt.
10. Remove cylinder head, gasket and exhaust manifold as an assembly.

CAUTION: Aluminum can be dented or nicked if carelessly handled. Use particular care to protect gasket surfaces against damage.

REPLACE

1. Wipe off engine block gasket surface and be certain no foreign material has fallen in cylinder bores or bolt holes. It is good practice to clean out bolt holes with air hose.
2. Install new gasket on block dowels. **DO NOT** use sealer.
3. Clean gasket surface of cylinder head and set in place on block dowel pins.
4. Clean and coat head bolts with special non-hardening sealing compound. **CAUTION:** Failure to coat bolts with sealing compound can result in water seepage into cylinders.
5. Install bolts as shown in Fig. 6-90.
6. Tighten head bolts a little at a time until snug then using Fig. 6-91 as a sequence guide torque to 50-55 lb. ft. Do not overtighten.

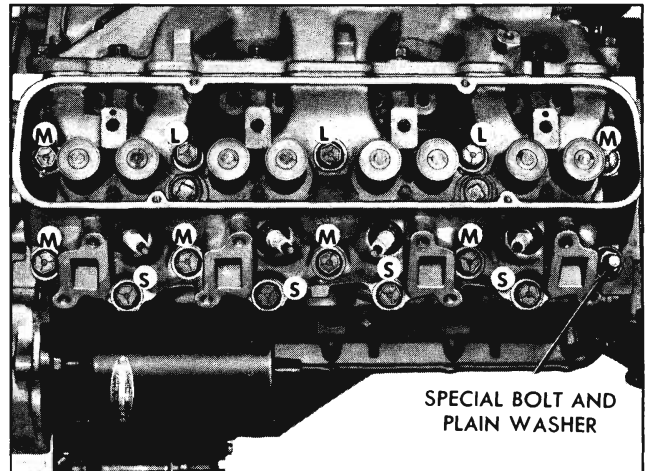


Fig. 6-90 Cylinder Head Bolt Location

7. Install push rods in original location and position through cylinder head opening so rods are correctly positioned on lifter plungers.
8. Wipe bases of rocker arm shaft brackets and bracket bases on cylinder head clean.
9. Check notch on one end of rocker arm shaft to be certain it is "up" (Fig. 6-82). Set rocker arm and shaft assembly in place and start one or two bolts into head.
10. Tilt rocker arms toward push rods and locate top of push rod in its rocker arm seat.
11. Draw down rocker arm and shaft assembly by tightening four bracket bolts a little at a time. Torque bolts to 25-35 lb. ft.
12. Install rocker arm cover and gasket. On right side install vent pipe.
13. Connect spark wires.

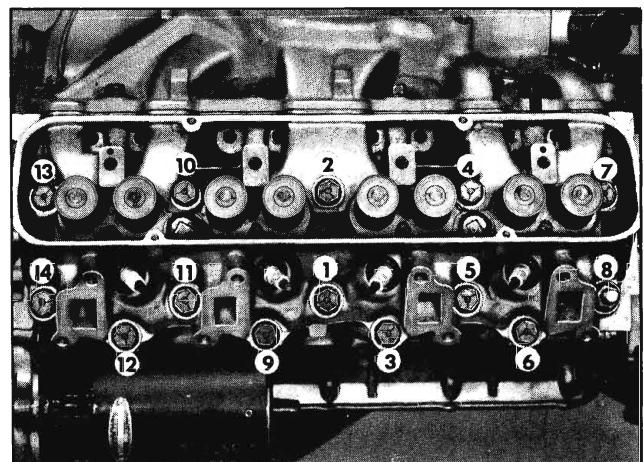


Fig. 6-91 Cylinder Head Bolt Tightening Sequence

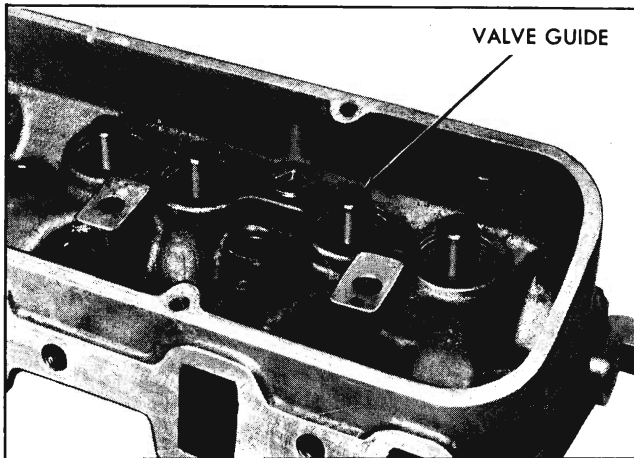


Fig. 6-92 Valve Guide

14. Connect battery ground strap at right front of engine.

CYLINDER HEAD AND VALVES RECONDITION

1. Place cylinder head on clean smooth surface.
2. Using suitable spring compressor, compress valve spring and remove cap retainers. Release tool and remove spring and cap. See Fig. 6-83.
3. Remove valve. Valves should be set aside so they may be reinstalled in original location. Tool J-3049 is handy for this purpose.
4. Remove carbon from combustion chamber of heads using care to avoid scratching the aluminum head or the valve seats. Use a Soft Wire Brush (J-8358) for this purpose.
5. Clean carbon and gum deposits from valve guide bores with Reamer J-8814.
6. Clean valves. Inspect valve faces and seats for pits, burned spots or other evidence of poor seating.
7. Grind or replace valves as necessary. If a valve head must be ground to a knife edge to obtain a true face, the valve should be replaced; as a sharp edge will run too hot. 45° is the correct angle for valve faces.
8. Check fit of valve in valve guide (Fig. 6-92). If clearance is excessive, replace guides as follows:

(a) Drive old guide out from combustion chamber side using tool J-267. See Fig. 6-93.

(b) Install new guide from top of head using tool J-8813, the tool is designed to bottom when the guide is correctly positioned. See Fig. 6-94.

NOTE: New valve guides are not finish reamed to size.

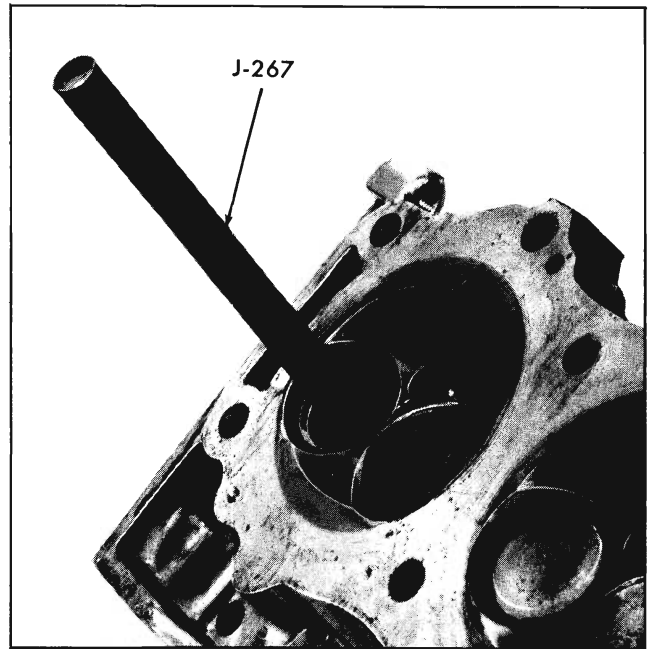


Fig. 6-93 Removing Valve Guide

(c) Finish ream a newly installed valve guide to size with reamer J-8814. Use a tap wrench to turn the reamer clockwise. See Fig. 6-95.

9. True up valve seats to 45° . Cutting a valve seat results in an increase in the width of the seat. The nominal width of the valve seat is $\frac{1}{16}$ ". If a valve seat is over $\frac{5}{64}$ " wide, after truing up it should be

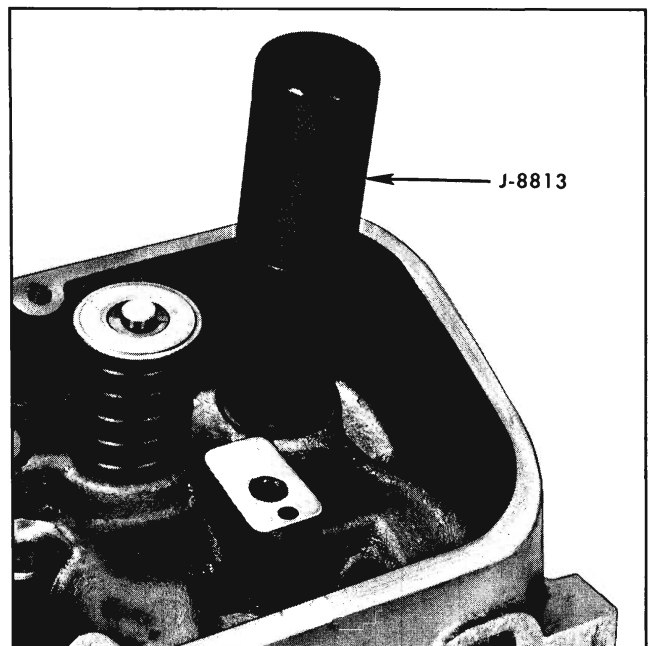


Fig. 6-94 Installing Valve Guide

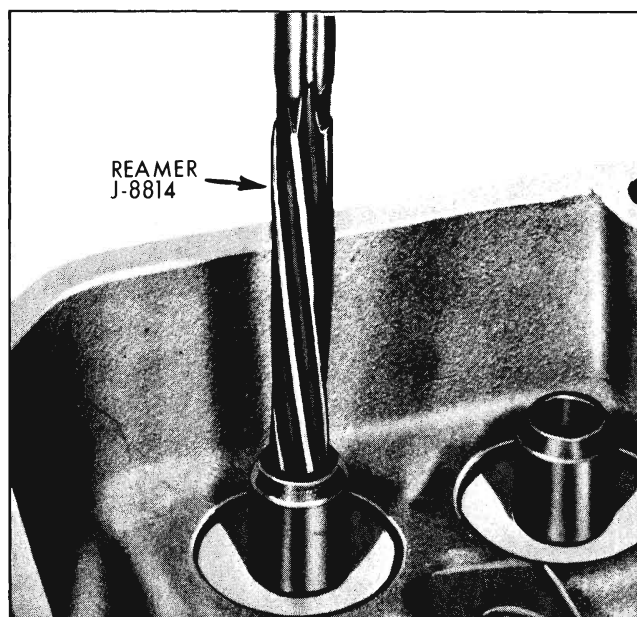


Fig. 6-95 Fitting Valve Stems to Guide

narrowed to specified width by the use of 20° and 70° stones.

Improper hydraulic valve lifter operation may result if valve and seat are refinished to the extent that the valve stem is raised more than .050" above normal height. In this case it will be necessary to grind off the end of the valve stem or replace parts.

The normal height of the valve stem above the valve spring seat surface of the head is 1.82".

10. Test valves for concentricity with seats and for tight seating. The usual test is to coat the valve face lightly with Prussian blue and turn the valve against seat. If the valve seat is concentric with the valve guide a mark will be made all around the seat, while if the seat is not concentric with the guide, a mark will be made on only one side of the seat. Next, coat the valve seat lightly with Prussian blue. Rotate the valve against the seat to determine if the valve face is concentric with the valve stem, and if the valve is seating all the way around. Both of these tests are necessary to prove that a proper seat is being obtained.

11. Reinstall valves, valve springs, caps and cap retainers, using same equipment used for removal. Install valve spring with closely wound coils toward the cylinder head. See Fig. 6-84.

TIMING COVER—TIMING CHAIN—CAMSHAFT

HARMONIC BALANCER REPLACE

REMOVE

1. Remove fan belt, fan and pulley.
2. Remove harmonic balancer to crankshaft bolt and washer. Remove harmonic balancer and pulley assembly. It may be necessary to tap the balancer with a plastic mallet to start it off the crankshaft.

REPLACE

1. Align key way in harmonic balancer with key on crankshaft and install balancer on crankshaft.

NOTE: Be sure to lubricate outside diameter of the harmonic balancer before installation to prevent damage to the timing chain cover oil seal during installation and when the engine is first started.

2. Remove flywheel cover and lock flywheel. Tighten balancer attaching screw to 140-160 lb. ft.
3. Replace pulley and fan. Torque 15-20 lb. ft.
4. Replace fan belt. Adjust to proper specifications given in Section 6A.

TIMING CHAIN COVER AND GASKET REPLACE

REMOVE

1. Drain radiator and block.
2. Disconnect lower radiator hose and heater return hose at water pump.
3. Disconnect oil pressure lead from oil pump.
4. Remove fan, fan pulley and belt(s).
5. Remove harmonic balancer to crankshaft bolt and washer. Remove harmonic balancer. It may be necessary to tap balancer with a plastic mallet to start it off the crankshaft.
6. If car is equipped with power steering, remove steering pump bracket bolts attached to timing chain cover and loosen or remove other bolts to allow brackets and pump to be moved out of the way.
7. Disconnect fuel lines and remove fuel pump.
8. Remove generator and brackets.
9. Remove distributor cap and pull spark plug wire retainers off brackets on rocker arm cover. Swing distributor cap with wire attached out of way. Disconnect primary distributor lead.

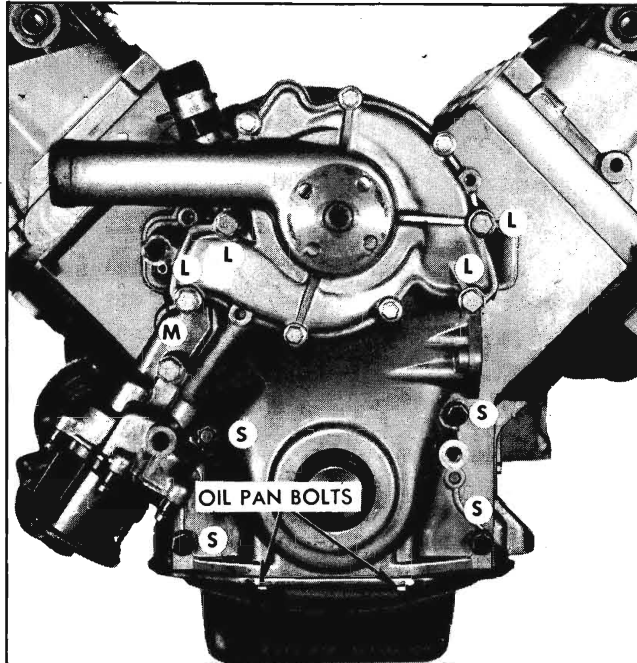


Fig. 6-96 Timing Chain Cover Bolt Location

10. Remove distributor to coil primary lead; remove distributor. *If timing chain and sprockets are not going to be disturbed, note position of distributor rotor for reinstallation in same position.*

11. Loosen and slide front clamp on thermostat bypass hose rearward.



Fig. 6-97 Removing Shedder

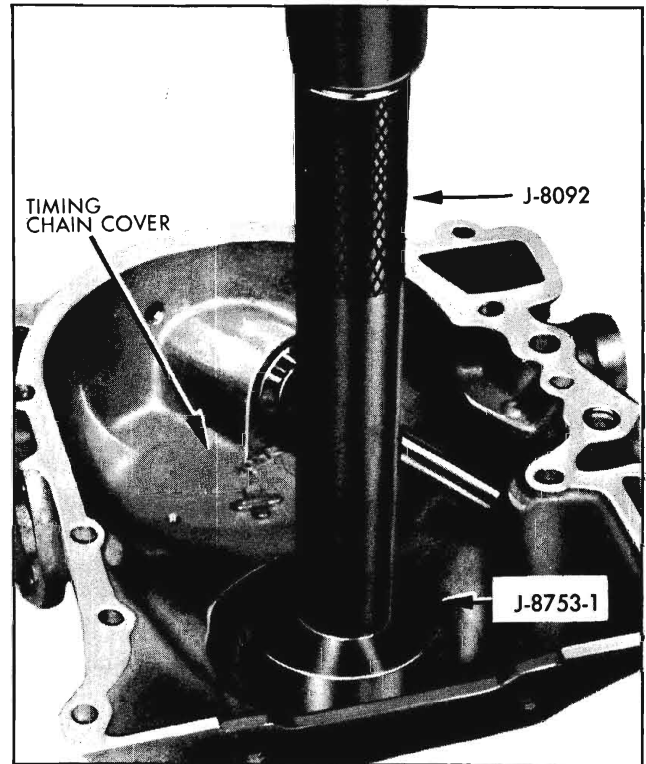


Fig. 6-98 Installing Shedder

12. Remove bolts attaching timing chain cover to cylinder block. Remove two oil pan to timing chain cover bolts. See Fig. 6-96. Remove timing chain cover and gasket. Thoroughly clean cover, taking care to avoid damage to gasket surfaces.

NOTE: If new cover is to be installed transfer all brackets.

REPLACE

1. Install new oil seal and shedder as follows:

a. Remove old oil seal and shedder from timing chain cover (Fig. 6-97).

b. Coil new packing around opening so ends of packing are at top. Drive in new shedder using tool J-8753-1 (Fig. 6-98).

c. Stake shedder in three places (Fig. 6-99).

d. Size the packing by driving tool J-8753-2 through packing from front toward rear (Fig. 6-100).

2. Replace timing chain cover.

NOTE: Remove oil pump cover and pack space around gears completely full of petroleum jelly.

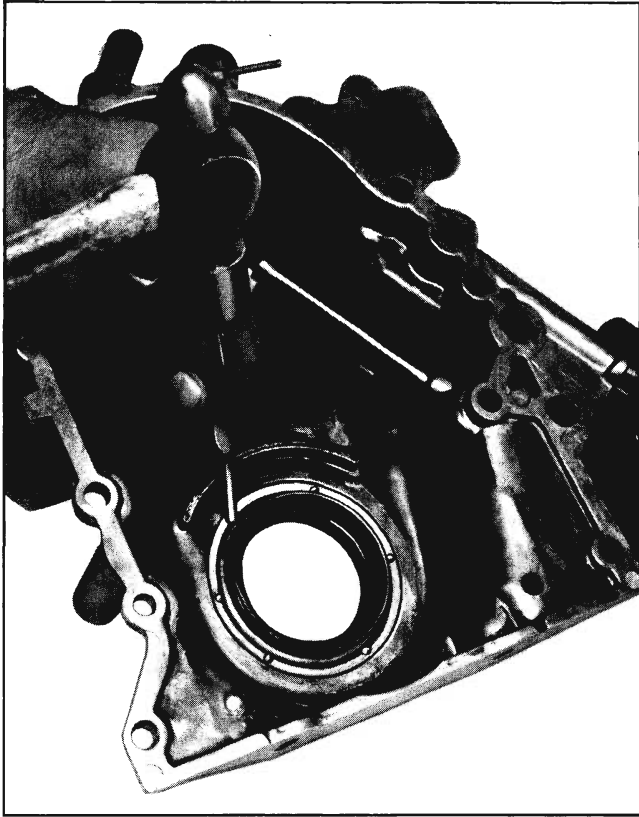


Fig. 6-99 Staking Shedder

There must be no air space left inside pump. Replace pump cover using a new gasket. Sec. 6A. This step is very important as oil pump may "lose its prime" whenever pump cover or timing chain is disturbed. If pump is not packed it may not begin to pump oil as soon as engine is started. The gasket surface of block and timing chain cover must be smooth and clean.

Position timing chain cover against block and be certain dowel pins engage dowel holes before starting bolts. Lubricate bolt threads and install as shown in Fig. 6-96. Torque 20-25 lb. ft.

3. Lubricate outside of harmonic balancer before installation to prevent damage to seal during installation and when engine is first started.

NOTE: Remove flywheel cover and lock flywheel. Tighten harmonic balancer bolt to 140-160 lb. ft. Release flywheel and replace flywheel cover.

4. Replace fuel pump. Torque 20-25 lb. ft.

5. Replace distributor. Torque 25-30 lb. ft.

NOTE: Install distributor so rotor is in same position as removed.

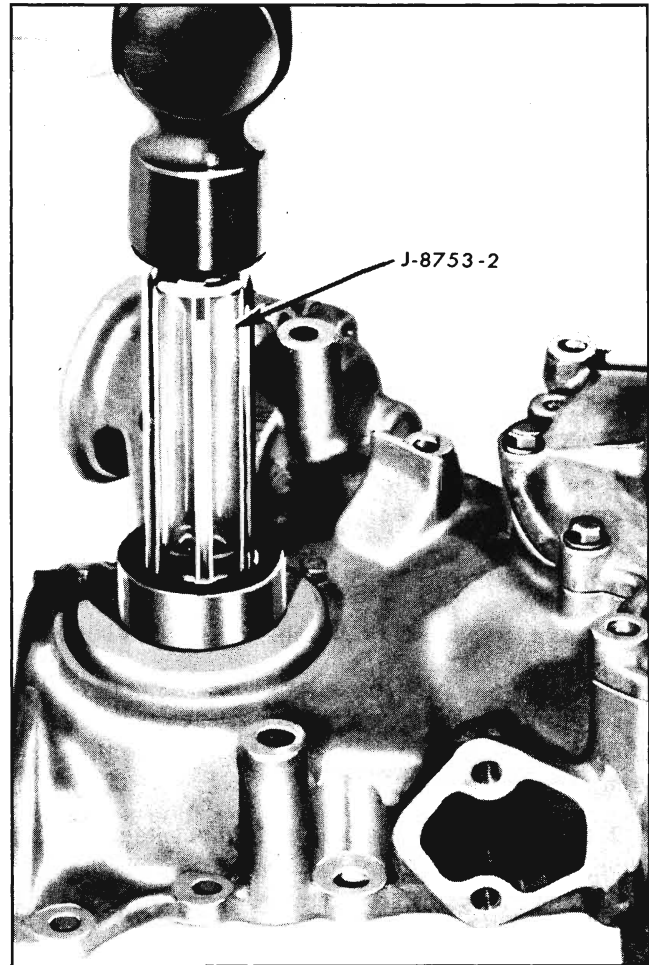


Fig. 6-100 Sizing Shedder

6. Replace pulley and fan. Torque pulley 15-20 lb. ft.

7. Replace distributor cap.

8. Replace generator and fan belt.

9. Replace oil pressure lead.

10. Shut radiator and block drains, connect all hoses and fill cooling system.

TIMING CHAIN AND SPROCKET REPLACE

REMOVE

1. Remove timing chain cover, page 6-53.

2. Remove oil slinger from crankshaft.

3. Temporarily install harmonic balancer bolt and washer in end of crankshaft. Turn crankshaft so sprockets are positioned as in Fig. 6-101. Doing so will make it easier to reinstall parts. Remove harmonic balancer bolt and washer being careful not to change position of sprockets.

NOTE: Valve timing diagram for the engine is shown in Fig. 6-102.

4. Remove bolt and special washer retaining camshaft distributor drive gear and fuel pump eccentric to camshaft forward end. Slide gear and eccentric off camshaft.

5. Use two large screwdrivers to alternately pry camshaft sprocket then crankshaft sprocket forward until camshaft sprocket is free, then remove camshaft sprocket and chain and finish working sprocket off crankshaft.

6. Thoroughly clean timing chain, sprockets, distributor drive gear, fuel pump eccentric and crankshaft oil slinger.

REPLACE

1. Turn crankshaft so number one piston is at top dead center.

2. Turn camshaft with sprocket temporarily installed so "O" mark is straight down (Fig. 6-101). Remove sprocket.

3. Assemble timing chain and sprockets and slide sprocket and chain assembly on shafts with the "O" marks in their closest together position and in line with sprocket hubs (Fig. 6-101).

4. Assemble oil slinger on crankshaft with I.D. against sprocket. (Concave side toward front of engine.)

5. Slide fuel pump eccentric on camshaft and woodruff key with oil groove forward (Fig. 6-103).

6. Install distributor drive gear (Fig. 6-104).

7. Install drive gear and eccentric bolt and retainer washer (Fig. 6-104). Torque to 40-45 lb. ft.

8. Reinstall timing chain cover, page 6-58.

9. Install distributor with rotor in number one firing position.

10. Install harmonic balancer and pulley assembly. Torque 140-160 lb. ft.

11. Install fan belt pulley and fan.

12. Install generator and adjust belts to proper specifications.

CAMSHAFT REPLACE

REMOVE

1. Remove radiator and hood latch support.

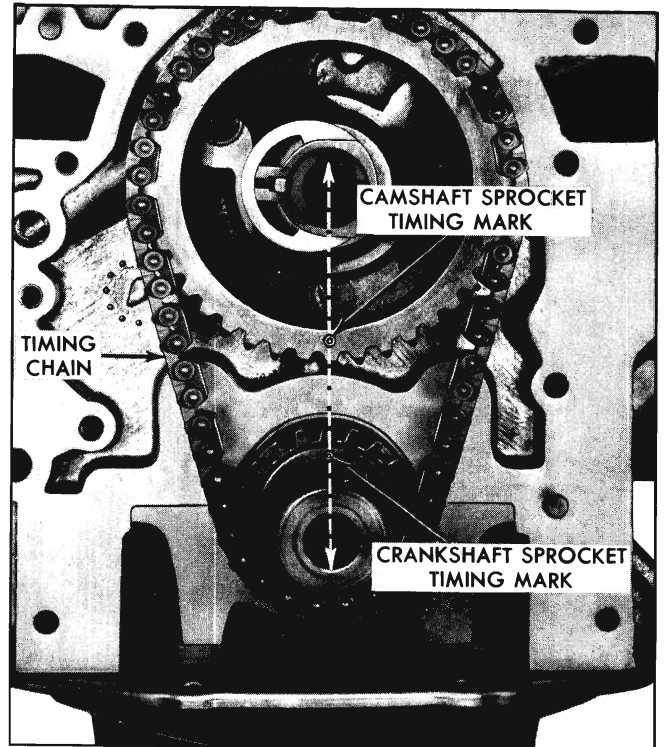


Fig. 6-101 Timing Marks

2. Remove timing chain and cover, page 6-58.
3. Remove timing chain and sprockets, page 6-59.
4. Remove intake manifold, page 6-48.
5. Remove rocker arm covers.
6. Remove rocker arm shaft assemblies.

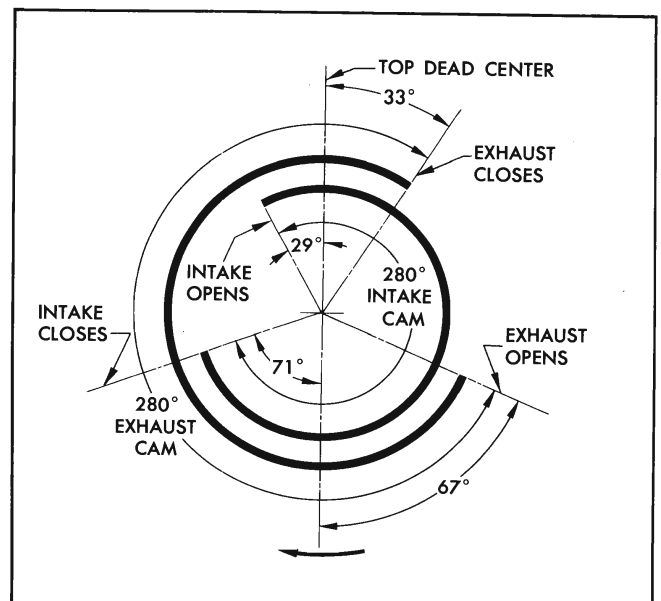


Fig. 6-102 Valve Timing Diagram

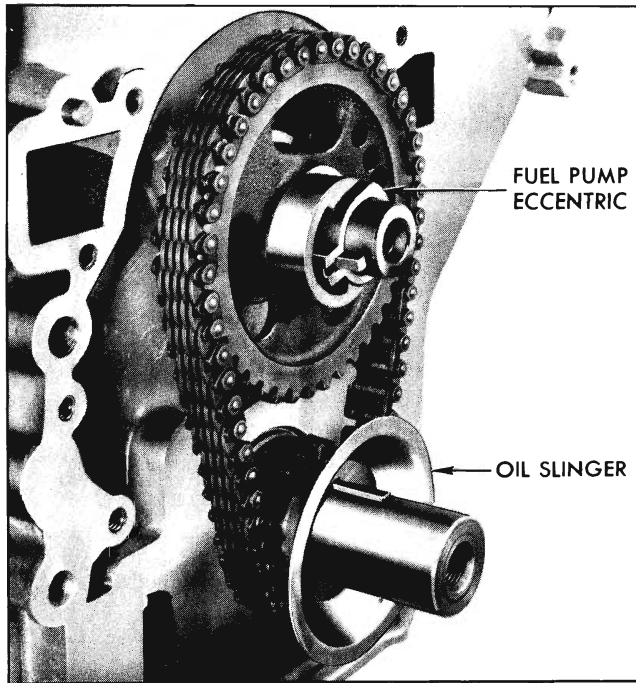


Fig. 6-103 Fuel Pump Eccentric and Oil Slinger Location

7. Remove push rods. Store in tool J-5709 so they may be reinstalled in correct position and location.

8. Remove valve lifters. Hydraulic Valve Lifter Remover J-3049 may facilitate removal of lifters.

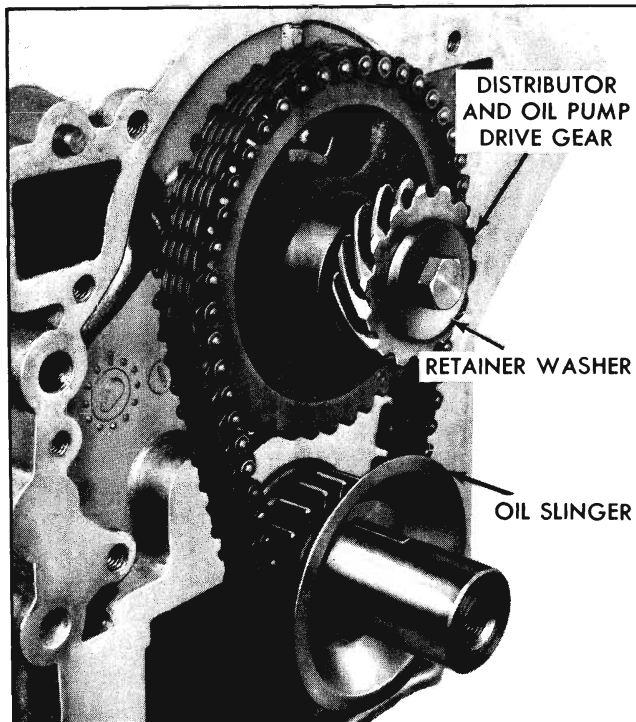


Fig. 6-104 Front of Engine with Timing Chain Cover Removed

NOTE: Store lifters in Lifter Box J-5763 so they can be reinstalled in exactly same location.

9. Slide camshaft forward out of bearing bores carefully to avoid marring bearing surfaces.

REPLACE

1. Replace camshaft being careful not to damage camshaft bearings.

2. Replace timing chain and sprockets, page 6-59.

3. Replace fuel pump eccentric, woodruff key with oil groove forward and distributor drive gear, (Fig. 6-103).

4. Replace oil slinger, (Fig. 6-104).

5. Replace timing chain cover assembly, page 6-60.

NOTE: Be sure to pack oil pump gears as outlined on page 6-58.

6. Replace distributor with rotor in number one firing position with number one piston in firing position.

7. Replace harmonic balancer and pulley assembly. Torque 140-160 lb. ft.

8. Replace fan belt pulley, fan and belt. Torque 15-20 lb. ft.

9. Replace valve lifters and push rods in original order.

10. Replace rocker arm shaft assembly. Torque 25-30 lb. ft.

NOTE: Lubricate bolts first with lubricant.

11. Replace intake manifold gasket. Torque 10-15 lb. ft.

12. Replace intake manifold assembly. Torque 25-30 lb. ft.

13. Replace radiator, connect hose connections and fill cooling system.

14. Replace hood latch support.

CAMSHAFT BEARINGS

The five steel-backed babbitt-lined camshaft bearings are pressed into crankcase. Going from front to rear, each bearing is bored .030" smaller than preceding bearing, and each camshaft journal is correspondingly reduced in diameter.

Camshaft bearings must be line reamed to size after being pressed into crankcase. Since this operation requires special reaming equipment original bearings should be retained unless severely damaged. Slightly scored camshaft bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within clearance limits of .0015" to .004".

OIL PAN—BEARINGS—CONNECTING ROD—PISTON—CRANKSHAFT

OIL PAN OR GASKET REPLACE

REMOVE

1. Raise car.
2. Drain oil.
3. Remove flywheel pan.
4. Remove 16 oil pan bolts.
5. Remove oil pick up pipe bolts and remove pan.

NOTE: If necessary the engine may be raised slightly.

6. Clean block gasket surface.
7. Clean oil pan.

REPLACE

1. Install new gasket and pan assembly. Torque 6-15 lb. ft.

NOTE: Be sure to use special lubricant on bolts.

REAR MAIN BEARING OIL SEAL REPLACE

REMOVE

1. Remove oil pan, page 6-62.
2. Remove oil pump pipe and screen assembly.
3. Remove rear main bearing cap and seal.

NOTE: Braided fabric seals are pressed into grooves formed in crankcase and rear bearing cap, to rear of oil collecting groove. Crankcase seal may be replaced only with removal of crankshaft.

Neoprene composition seals are placed in grooves in sides of bearing cap to seal against leakage in the joints between cap and crankcase. Neoprene composition swells in presence of oil and heat. Seals are undersize when newly installed and may even leak a short time until seals have had time to swell and seal opening (Fig. 6-105).

REPLACE

1. Install new rear main bearing braided oil seal.

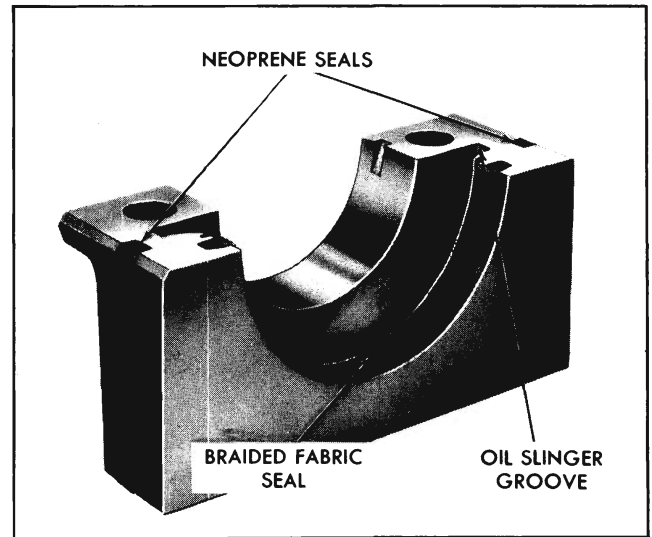


Fig. 6-105 Rear Main Bearing Cap

NOTE: Force seal in so it projects above the groove by not more than $\frac{1}{16}$ ". Use special tool J-8807 (Fig. 6-106). Cut ends off flush with surface.

2. Before installation of bearing cap in crankcase, lightly lubricate neoprene seals and install in bearing cap with upper ends protruding approximately $\frac{1}{16}$ ".

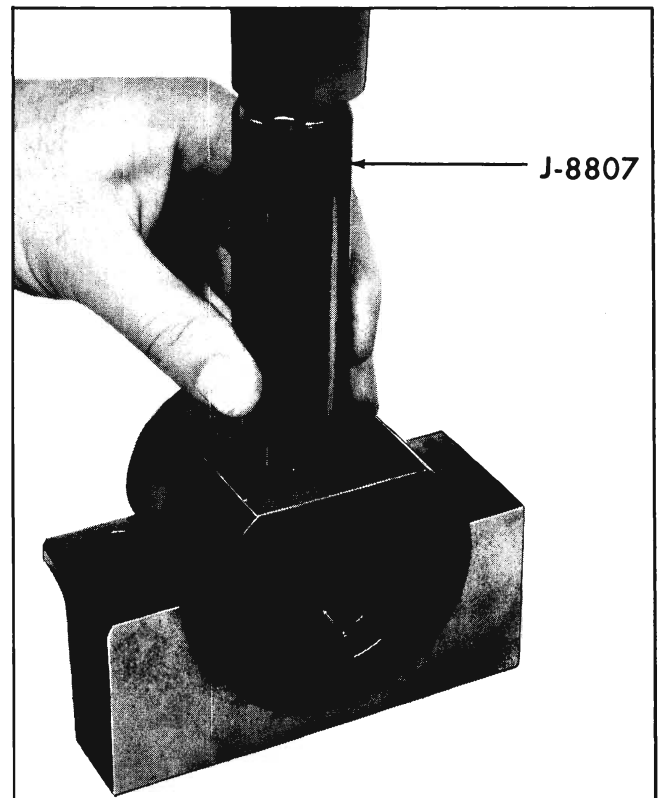


Fig. 6-106 Compressing Seal in Bearing Cap



Fig. 6-107 Connecting Rod Bolt Set

3. Install bearing cap; force seals up into cap with a blunt instrument to be sure of a seal at upper parting line between cap and crankcase.

NOTE: Seals will leak until neoprene swells due to contact with oil and heat. Torque 65-70 lb. ft.

CAUTION: Engine must be operated at slow speed when first started after new braided seal is installed.

4. Replace oil pump pipe and screen.

5. Replace oil pan and gasket. Torque 6-15 lb. ft. page 6-62.

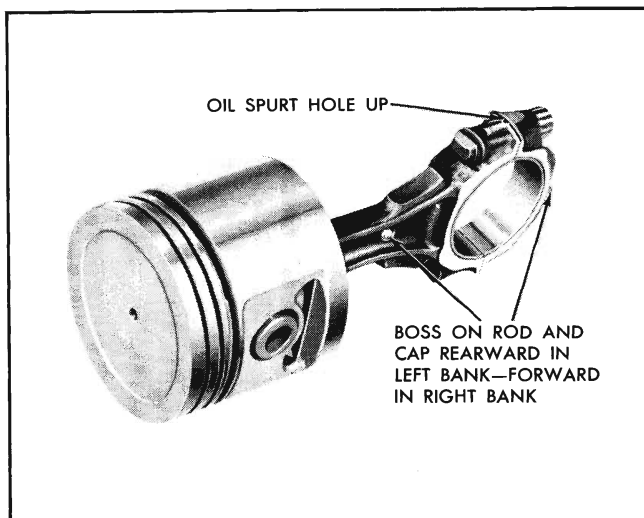


Fig. 6-108 Piston and Rod Assembly

CONNECTING ROD BEARINGS REPLACE

REMOVE

1. Remove oil pan, page 6-62.
2. Remove oil pump screen and baffle.
3. Rotate crankshaft as necessary to bring crank-pin carrying bearing to be replaced straight down.
4. Remove bearing cap to be replaced.
5. Install connecting rod bolt guide set J-5239 on connecting rod bolts (Fig. 6-107).
6. Push piston and rod assembly up far enough to allow removal of bearing shell. Remove bearing shells from rod and cap.
7. With outside micrometer check crankpins for out-of-round.

NOTE: If more than .0015" out, satisfactory life of new bearing cannot be expected. If crankpins are scored, ridged or out-of-round crankshaft must be replaced. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil. Burrs may be honed off with a fine oil stone.

REPLACE

1. Reassemble cap and rod with new bearing shells and check fit using plastigage or shim stock, page 6-60.

NOTE: The rib on edge of cap and the conical boss on web of rod must be toward rear of engine on all rods in left bank or toward front of engine in right bank (Fig. 6-108).

2. Replace oil pump screen and baffle.
3. Replace oil pan and gaskets.

MAIN BEARINGS REPLACE

REMOVE

1. Remove oil pan.
2. Remove oil pump screen.
3. Loosen all bearing cap bolts $\frac{1}{2}$ turn.
4. Remove bearing cap of bearing to be replaced.
5. Make a tool for removing upper bearing shell as shown in Fig. 6-109. KMO 734 can also be used.

6. Insert tool in oil hole of crankshaft and rotate crankshaft in usual direction of rotation. This will cause bearing to be moved from between shaft and bearing seat.

7. Check journal for out-of-round; if more than .0015" out, replace.

REPLACE

1. Install new bearing lower half by inserting in bearing cap so indentation in shell and cap coincide.

2. Oil bearing surface of upper shell and install by inserting plain end of bearing shell at indented side of bearing seat and gently rotating shell into place by turning shaft.

CAUTION: If hard turning, do not force; shell may be in a bind.

NOTE: Upper bearing shells have an oil groove in their center, while lower shells are plain. They must not be interchanged.

3. Install bearing cap and check fit of bearing using plastigage or shim as outlined on page 6-63.

4. If the thrust center bearing is disturbed or replaced, it is necessary to line up thrust surfaces of bearing shell before cap bolts are tightened. To do this move crankshaft fore and aft the limit of its travel several times with thrust bearing cap bolts finger tight.

5. When all bearings have been installed and tested, tighten all bearing caps to 65-70 lb. ft. torque.

6. Replace oil pump screen.

7. Replace oil pan.

CONNECTING ROD BEARING CLEARANCE CHECK

PLASTIGAGE METHOD

1. Place a piece of plastigage plastic the length of bearing in bearing (bearing must be free of oil), install bearing and cap and tighten to 30-35 lb. ft. torque. **DO NOT TURN CRANKSHAFT WITH PLASTIGAGE IN PLACE.**

2. Remove bearing cap. Using Plastigage scale measure width of flattened piece of plastic (Fig. 6-110). If reading is not over $2\frac{1}{4}$, standard size connecting rod bearing should be used; if over $2\frac{1}{4}$, use .001" undersize bearing and recheck. Connecting rod bearing inserts .002" undersize are available for cases where use of .001" undersize bearing results in excessive clearance.

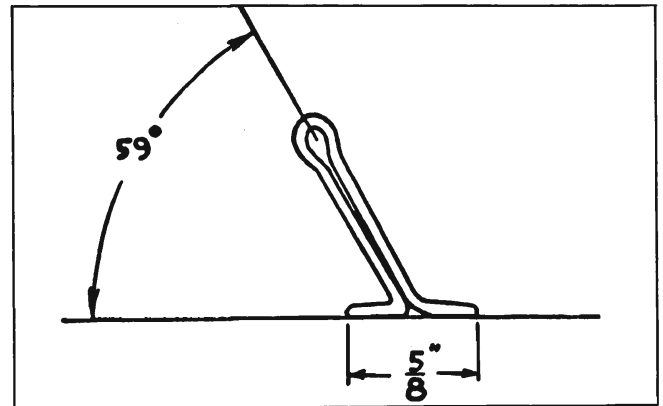


Fig. 6-109 Tool for Removing Upper Half of Main Bearing

3. After determining that correct bearing insert has been fitted, tighten connecting rod cap nuts to final tightness of 30-35 lb. ft. torque. Nuts are self-locking and require no lock washers or cotter pins.

SHIM STOCK METHOD

1. Place .0015" brass shim $\frac{1}{2}$ " wide by $\frac{7}{8}$ " long in bearing cap with new standard insert and install cap. Tighten nuts to 30-35 lb. ft. torque.

2. Attempt to move connecting rod endwise on crankpin by hand and then by a light tap of a hammer.

3. Repeat test to move rod endwise by hand with shim removed. If connecting rod did not move by hand, but moved by tap of hammer in step "2" and moved freely in this step, standard bearing should be used. If rod could be moved by hand in step "2", install .001" undersize bearing. If necessary, recheck with .002" undersize bearing.

4. After determining that the correct bearing insert has been fitted, tighten connecting rod cap nuts to final tightness of 30-35 lb. ft. torque. Nuts are self-locking and require no lock washers or cotter pin.

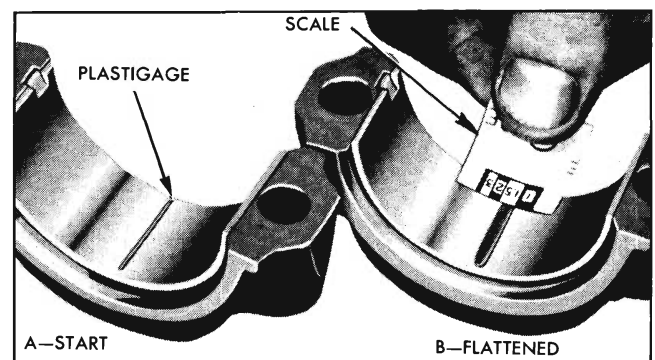


Fig. 6-110 Plastigage Position in Cap for Checking Bearing Clearance



Fig. 6-111 Checking Ring Gap

MAIN BEARING CLEARANCE CHECK

PLASTIGAGE METHOD

1. Remove bearing cap.
2. Turn crankshaft so oil hole is up to avoid oil dripping in plastigage.
3. Place shims in lower half of adjacent bearings and tighten cap bolts to take weight of crankshaft off lower shell of bearing being checked.

NOTE: Arrow on cap must point to front of engine.

4. Place a piece of plastigage plastic the length of bearing in bearing (bearing must be free of oil), install bearing and cap. Torque 65-70 lb. ft.

DO NOT TURN CRANKSHAFT WITH PLASTIGAGE IN PLACE.

5. Remove bearing cap. Using plastigage scale, measure width of flattened piece of plastic (Fig. 6-110). If bearing clearance exceeds .003", it is advisable to install a new bearing. Desired new bearing clearance .0005" to .0025".
6. After determining that correct bearing insert has been fitted, insert both bearing shells, remove shims from nearby main caps and torque caps 65 to 70 lb. ft.

CRANKSHAFT STRAIGHTNESS CHECK

1. Place crankshaft on "veeblocks" at number one and number five main bearing journals.

2. Check indicator run out at number 2, 3, and 4 main bearing journals. Total readings should not exceed .003".

3. While checking run out of each journal note relation of "high" spot (or maximum eccentricity) on each journal.

NOTE: High spot on all journals should come at same angular location. If high spots do not come at nearly same angular location, crankshaft has a "crook" or "dog leg" and is unsatisfactory for service.

PISTON RINGS REPLACE

PISTON AND ROD ASSEMBLY REMOVE

1. Remove engine and mount in holding fixture J-8690-1.
2. Remove intake manifold, page 6-48.
3. Remove cylinder heads, page 6-55.
4. Remove oil pan. If number 5, 6, 7 or 8 rod and piston are to be removed, remove oil pump screen.
5. Rotate crankshaft so crankpin carrying assemblies to be replaced project straight down.
6. Examine cylinder bores above ring travel. If bores are worn so a ridge exists at this point, remove the ridges with ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal.
7. Remove bearing cap and install connecting rod Bolt Guide Set J-5239, (Fig. 6-107).
8. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of a long guide J-5239.

PISTON RINGS INSTALL

There are two compression rings and one oil control ring, all situated above piston pin. The top compression ring is beveled on both upper and lower outer edges and has a 30° bevel on the lower inner edge. The second compression ring has two sharp edges on the outer edges and inner upper edge has a 30° bevel.

The oil ring in the lower groove consists of two thin steel rails separated by a combination spacer and expander. The top compression ring is chrome plated. Rings should be installed with the mark (letter "T", "Dot" or word "Top") toward the top.

New rings are serviced for the standard size pistons, and for .010" oversize pistons. When selecting rings be sure they match the size of piston on which they

are to be installed, i.e. standard size rings for standard piston, .010" oversize rings for .010" oversize piston.

1. Check pistons to see that ring grooves and oil return holes have been properly cleaned.

2. Place ring down at the bottom of ring traveled part of cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.

3. Measure gap between ends of compression rings with feeler gauge (Fig. 6-111). Gaps should be .010"-.020".

NOTE: Flexible oil rings are not checked for gap.

Incorrect gap indicates that wrong size rings are being used. If rings are selected by size of bore, they should have proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston using ring installing tool J-7135 to prevent breakage, or fracture of rings, or damage to pistons.

5. Install oil ring combination spacer and expander in lower ring groove. Position ends of expander above piston pin and where groove is not slotted. Thread lower rail into place over expander and locate gap approximately 90° from ends of expander. Install upper rail with gap 180° from lower rail.

6. Install compression rings in top and center groove.

NOTE: Be sure right side is up. Manufacturers identification is always on the top side.

7. Measure side clearance of rings in ring groove (Fig. 6-112), as each ring is installed. Clearance with new pistons and rings should be as follows:

Compression rings	.003" to .005"
Oil Ring	.0035" to .0095"

NOTE: If piston grooves have worn to extent that relatively high steps exist on lower lands, the piston should be replaced because the steps will interfere with operation of new rings and ring clearance will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

8. Before installation of piston and rod assembly check to see that cylinder, piston, rod bearing and crankshaft journal are absolutely clean, then coat all surfaces with engine oil. Position crankpin straight down.

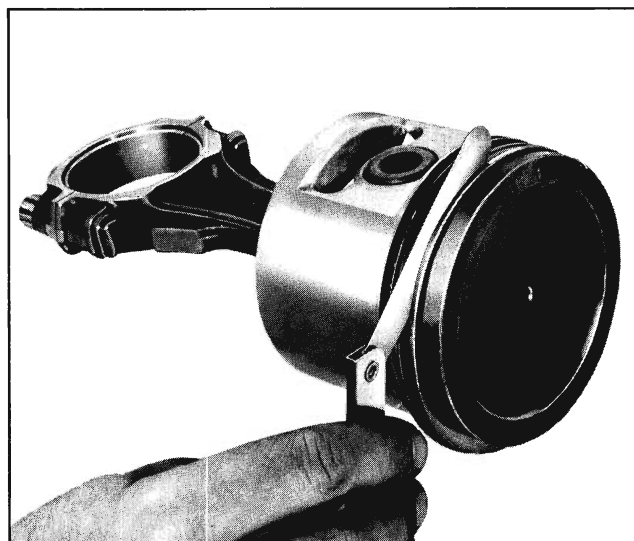


Fig. 6-112 Measuring Side Clearance of Ring in Groove

9. Remove bearing cap with upper bearing shell in place and install bolt guides J-5239.

10. Lubricate the piston and rings and install in bore by compressing the rings with suitable ring compressor (Fig. 6-113).

11. Replace matching connecting rod cap and bearings. If new bearings are necessary select them as described on page 6-64.

12. Install all other piston and rod assemblies in same manner. When piston and rod assemblies are properly installed, the oil spurt hole in connecting rods will be "up" toward the camshaft, rib on

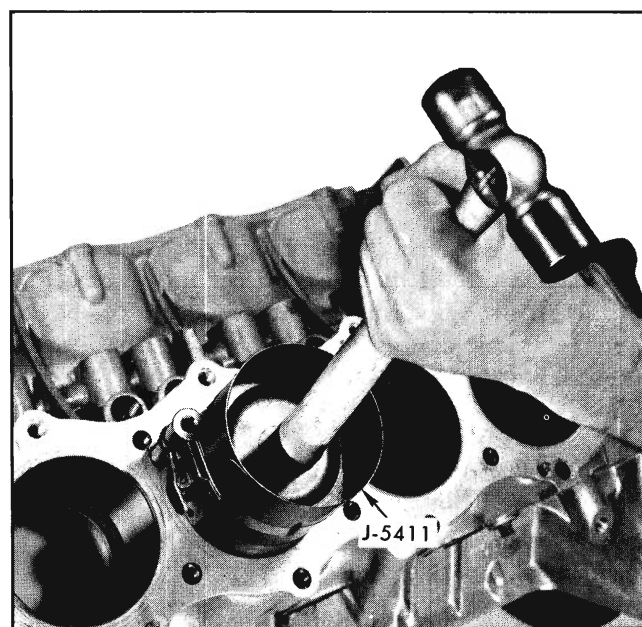


Fig. 6-113 Installing Piston



Fig. 6-114 Measuring Side Clearance Between Connecting Rod Bearing Caps

edge of rod cap will be on same side as conical boss on connecting rod web, and these marks, (ribs and boss) will be toward other connecting rod on same crankpin (Fig. 6-108).

13. Check end clearance between connecting rods on each crankpin using feeler gauges (Fig. 6-114). Clearance should be between .005" and .012".

14. Replace oil pump screen.

15. Replace oil pan.

16. Replace cylinder head, page 6-55.

17. Replace valve lifters and push rods in original location.

18. Replace rocker arm assembly, page 6-49.

19. Replace intake manifold and gasket, page 6-48.

21. Remove engine from stand and install in car, page 6-47.

PISTON, PIN OR CONNECTING ROD REPLACE

NOTE: Use care at all times when handling and servicing connecting rods and pistons. To prevent possible damage to these units, do not allow pistons to strike against one another, against hard objects or bench surfaces, since distortion of piston contour or nick in soft aluminum material may result. Do not clamp rod or piston in vise since they may become distorted.

1. Remove connecting rod and piston assembly, page 6-62.

NOTE: Be sure to remove bearing shells and maintain in correct order and sets.

2. Remove piston rings using suitable piston ring remover.

3. Remove pins as follows:

a. Remove pilot and spring from tool J-8754 (Fig. 6-115).

b. Place end of piston pin in tool J-8754-1 and place on arbor press.

c. Using driver J-8355-3 (Fig. 6-115), press pin out of piston and connecting rod.

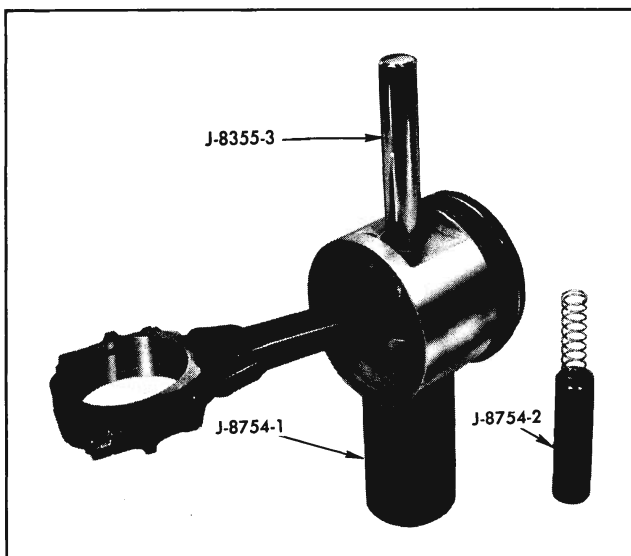


Fig. 6-115 Removing Piston Pin

INSPECTION OF CYLINDER BORES

Inspect cylinder walls for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-of-round with an accurate cylinder gauge at top middle and bottom of bore, both parallel and at right angles to the center line of the engine. The diameter of the cylinder bores at any point may be measured with an inside micrometer (Fig. 6-116, 6-117) or by setting the cylinder gauge dial at "0" and measuring across the gauge contact points with outside micrometer while the gauge is at same "0" setting.

If a cylinder bore is moderately rough or slightly scored but is not out-of-round or tapered, it is usually possible to remedy the situation by honing the bore to fit a standard service piston since standard service pistons are high limit production pistons. If cylinder

bore is very rough or deeply scored, however, it may be necessary to rebores the cylinder to fit an oversize piston in order to insure satisfactory results.

If cylinder bore is tapered .005" or more or is out-of-round .003" or more, it is advisable to rebores for the smallest possible oversize piston and rings.

INSPECTION OF PISTONS, PINS AND RODS

Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clear ring grooves, and oil holes in ring grooves, using suitable cleaning solvent and tools.

Carefully examine pistons for rough or scored bearing surfaces, cracks in skirt or head, cracked or broken ring lands, chipping or uneven wear which would cause rings to seat improperly or have excessive clearance in ring grooves. Damaged or faulty pistons should be replaced.

Pistons are cam ground, which means diameter at a right angle to piston pin is greater than diameter parallel to piston pin. When a piston is checked for size, it must be measured with micrometers applied to the skirt at points 90° to piston pin. See Fig. 6-118. The piston should be measured (for fitting purpose) ¼" below the bottom of oil ring groove.

Inspect bearing surfaces of piston pins and check for wear by measuring worn and unworn surfaces with micrometers. Rough or worn pins should be replaced. Test fit of piston pins in piston bosses. Occasionally pins will be found tight due to gum or varnish deposits. This may be corrected by removing the deposit with a suitable solvent. If piston bosses are worn out-of-round or oversize, the piston and pin assembly must be replaced. Piston pins must fit the piston with an easy finger push at 70°F (.00005" to .0001" clearance).

FITTING NEW PISTONS

Standard size service pistons are high limit or maximum diameter; therefore, they can usually be used with a slight amount of honing to correct slight scoring or excessive clearances in engines having relatively low mileage. Service pistons are also furnished in standard and .010" oversizes. All service pistons are diamond bored and selectively fitted with piston pins; pistons are not furnished without pins.

No attempt should be made to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight. The smallest possible oversize service pistons should be used and

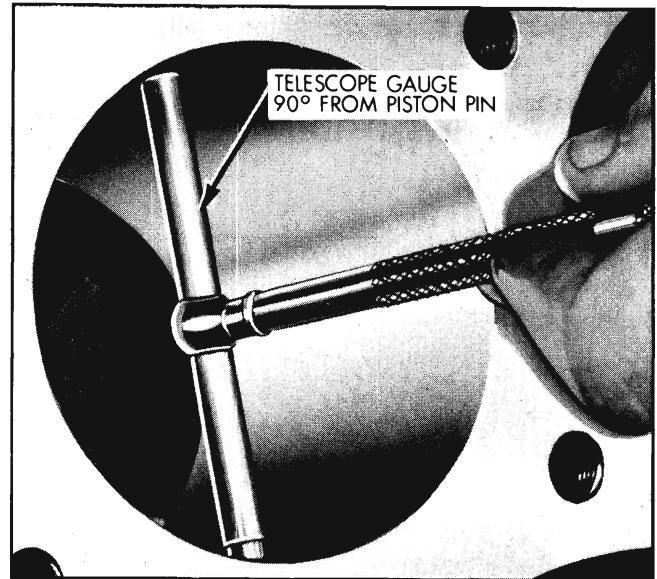


Fig. 6-116 Measuring Cylinder Bore

the cylinder bores should be honed to size for proper clearances.

When reboring cylinders, all crankshaft bearing caps must be in place and tightened to proper torque to avoid distortion of bores in final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. When taking the final cut with boring bar leave .001" on the diameter for finish honing to give the required clearance specified below.

After final honing and before the piston is checked for fit, each cylinder bore must be thoroughly washed to remove all traces of abrasive and then dried thoroughly. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result.

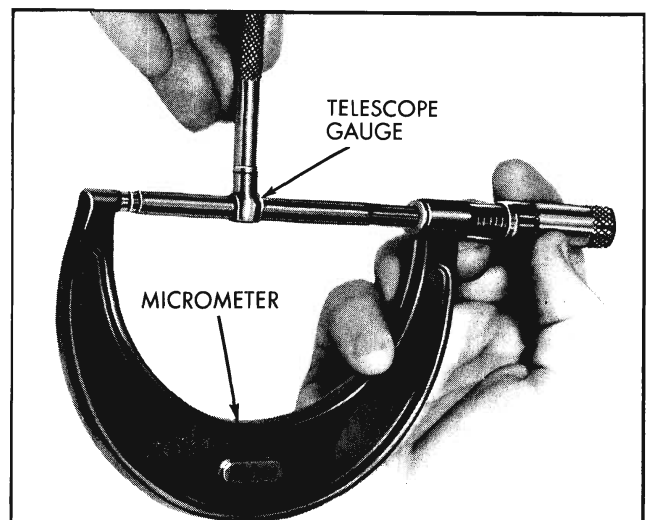


Fig. 6-117 Measuring Telescope Gauge

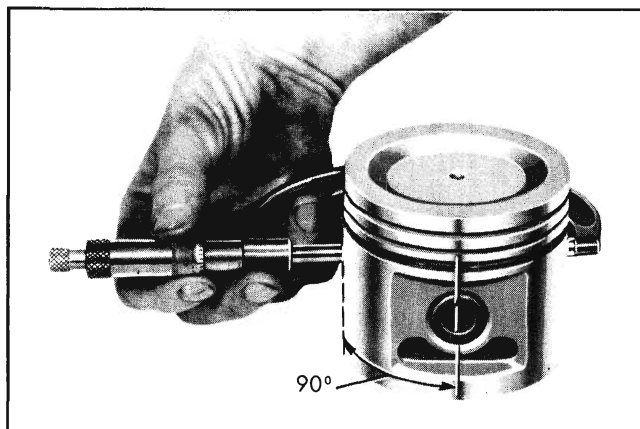


Fig. 6-118 Measuring Piston

A satisfactory method of fitting pistons is as follows:

1. Expand a telescope gauge to fit the cylinder bore at right angles to the piston pin and between $1\frac{1}{2}$ " and 2" from the top. See Fig. 6-116.

2. Measure the telescope gauge. See Fig. 6-117.

3. Measure the piston to be installed. See Fig. 6-118. The piston must be measured at right angles to the piston pin $\frac{1}{4}$ " below the oil ring groove. The piston must be between .001" and .0015" smaller than the cylinder bore.

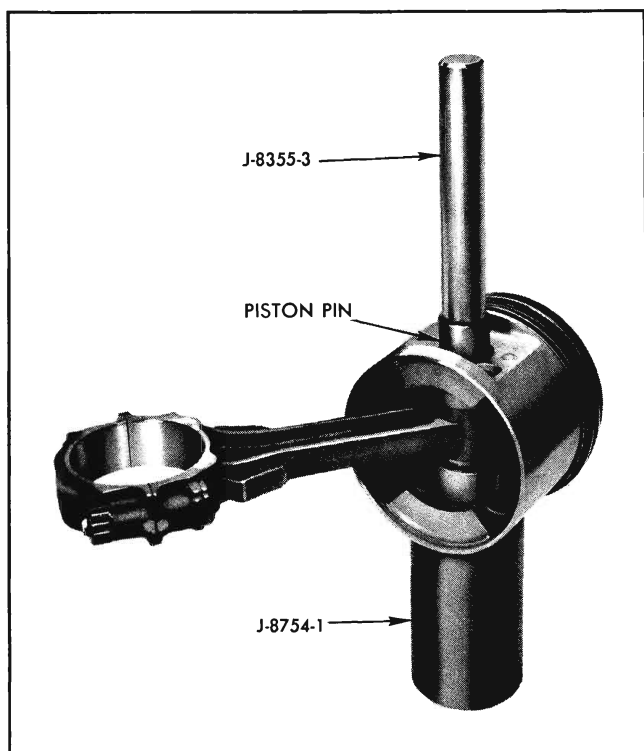


Fig. 6-119 Installing Piston Pin

NOTE: Both block and piston must be at very nearly the same temperature when measurements are made or errors due to expansion will occur. A difference of 10°F between parts is sufficient to produce a variation of .0005".

ASSEMBLY AND INSTALLATION OF PISTON AND CONNECTING ROD ASSEMBLIES

1. Place pilot J-8754-2 and spring in cup J-8754-1 (Fig. 6-119).

2. Position piston over cup so pilot J-8754-2 is located in piston pin bore and place on arbor press.

3. Coat piston pin and rod lightly with graphite lubricant.

4. Place driver J-8355-3 in piston pin and press pin into piston and connecting rod (Fig. 6-119) until piston pin bottoms against tool J-8754-2.

5. Remove piston and rod assembly from press. Rotate piston on pin to be sure pin was not damaged during the pressing operation.

6. Check rings for correct size, page 6-65.

7. Install rings on piston, page 6-65.

8. Clean and lightly oil cylinder and piston and rod assembly.

9. Install piston and rod assembly, page 6-66.

10. Select new connecting rod bearing, if necessary, as described on page 6-64. Otherwise, install bearings removed and torque bolt nuts to 30-35 lb. ft.

11. Replace oil screen and pipe.

12. Replace oil pan.

13. Replace cylinder heads, page 6-55.

14. Replace valve lifters and push rods in original order.

15. Replace rocker arm assemblies, page 6-50.

16. Replace intake manifold and gasket, page 6-48.

17. Remove engine from stand and install in car.

CRANKSHAFT REPLACE

REMOVE

1. Remove engine and mount in holding fixture J-8690-1, page 6-47.

2. Remove oil pan and oil pump screen and pipe.

3. Remove timing chain and sprockets, page 6-59.

4. Remove connecting rod caps and bearing shells.

NOTE: Keep caps and bearing shells in correct order.

5. Remove connecting rod bolts and push piston and connecting rod assembly to top of its stroke.

6. Remove flywheel.

7. Remove main bearing caps.

NOTE: Keep in correct order.

8. Remove crankshaft.

9. Remove upper rear main oil seal.

REPLACE

1. Replace new upper rear main oil seal.

2. Replace new crankshaft.

3. Replace new main bearings using plastigage method, page 6-65.

4. Replace new connecting rod bearings.

5. Replace flywheel. Torque 50-60 lb. ft.

6. Replace timing chain and sprockets, page 6-60.

7. Replace fuel pump eccentric and distributor and oil pump drive gear.

8. Replace oil slinger on crankshaft.

9. Replace new oil seal and shedder, page 6-58.

10. Replace timing chain cover assembly, page 6-58.

11. Replace fuel pump.

12. Replace distributor, Section 11.

13. Replace harmonic balancer. Torque 140-160 lb. ft.

14. Replace upper pulley and fan. Torque 15-20 lb. ft.

15. Remove engine from fixture and replace in car, page 6-47.

FITTED BLOCK INSTALLATION

1. Remove engine assembly (Page 6-47).

2. Remove flywheel housing and clutch assembly.

3. Mount engine in holding fixture J-5856-02.

4. Remove rocker arm covers.

5. Remove push rod cover.

6. Remove intake manifold assembly (Page 6-48).

7. Remove rocker arm shaft assemblies.

8. Remove push rods. Store in J-5709 so that they may be returned to original position and location.

9. Remove cylinder head assemblies (Page 6-55).

10. Remove valve lifters and store in J-5763, so that they may be reinstalled in original location.

11. Remove timing cover assembly (Page 6-60).

12. Remove oil slinger from crankshaft.

13. Remove distributor and oil pump drive gear and fuel pump eccentric.

14. Remove timing chain and sprockets.

15. Remove camshaft.

16. Remove starting motor assembly.

17. Remove oil pan assembly.

18. Remove oil pick up screen.

19. Remove rod and piston assemblies.

20. Remove crankshaft and flywheel assembly.

21. Using pin remover J-8355-3, remove connecting rods from pistons. Mark rods so they may be installed in original locations.

22. Remove old block from holding fixture J-5856-02.

23. Install new fitted block in holding fixture.

24. Remove pistons, pins and bearing caps and bearing shell from new block and store so they may be installed in original location.

REPLACE

1. Using tool J-8355-3, assemble new pistons to connecting rods.

2. Install new rear main bearing oil seal.

- NOTE: Force seal in so it projects above the groove by not more than $\frac{1}{16}$ ". Use special tool J-8807 (Fig. 6-106). Cut ends off flush with surface (braided seal).

3. Install neoprene seals in grooves on side of rear main cap.

NOTE: Before installation of bearing cap in crankcase, lightly lubricate seals and install in bearing cup with upper end protruding approximately $\frac{1}{16}$ ". After installation of cap, force seals up into cap with a blunt instrument to be sure of a seal between cap and case. It will leak until neoprene seal swells.

4. Measure crankshaft journals for bearing size using plastigage method (Page 6-64).

5. Install upper main bearing shells in block and lower main bearing shells in caps in original and proper order.

6. Install crankshaft and flywheel assembly.

NOTE: Lube bolts with special lube. Torque evenly 65-70 lb. ft.

7. Using tool J-5239, install connecting rod and piston assemblies in original order. Torque 30-35 lb. ft.

8. Replace oil pick up pipe and screen.

9. Replace camshaft.

CAUTION: Be careful not to mar the camshaft bearings.

10. Replace timing chain and sprockets, page 6-60.

11. Replace fuel pump eccentric, distributor and oil pump drive gear, special washer and bolt on camshaft (Fig. 6-104). Torque 40-45 lb. ft.

12. Replace oil slinger on crankshaft (Fig. 6-104).

13. Pack oil pump gears, page 6-58.

14. Replace timing chain cover assembly. Torque 20-25 lb. ft.

15. Replace fuel pump. Torque 20-25 lb. ft.

16. Replace distributor with rotor in number one firing position. Torque 25-30 lb. ft.

17. Replace harmonic balancer assembly (Page 6-57). Torque 140-160 lb. ft.

18. Replace fan belt pulley and fan. Torque 15-20 lb. ft.

19. Replace starter motor.

20. Replace oil pan and flywheel cover.

NOTE: Use new gaskets. Torque 6-15 lb. ft.

21. Replace head gaskets and head assemblies. Torque 50-55 lb. ft.

NOTE: Lube bolts with special lube.

22. Replace valve lifters and push rods in original positions.

23. Replace rocker arm shaft assemblies. Torque evenly 25-30 lb. ft.

NOTE: Lube bolts with special lube.

24. Replace intake manifold gasket, seals, sound absorber and intake manifold assembly. Connect carburetor linkage.

NOTE: Lube bolts with special lube. Torque seal clamps 10-15 lb. ft., manifold 25-30 lb. ft.

25. Replace rocker arm cover and gasket.

26. Replace generator.

NOTE: Set bolts to proper specifications.

27. Replace distributor cap.

28. Remove from stand and replace flywheel housing and clutch assembly.

29. Replace engine assembly (Page 6-47).

SPECIFICATIONS

GENERAL

Type—No. of Cylinders	90° V-8
Valve Arrangement	In Head
Bore and Stroke	3.5" x 2.80"
Piston Displacement	215 cu. in.
Compression Ratio	10.25:1
Brake Horsepower at RPM	185 @ 4800
Pound Feet Torque at RPM	230 @ 2800
Taxable Horsepower	39.2
Cylinder Numbers Front to Rear	
Right Bank	2-4-6-8
Left Bank	1-3-5-7
Firing Order	1-8-4-3-6-5-7-2
Compression Pressure at Cranking Speed (Min.)	160 lbs. sq. in.

CYLINDER BLOCK AND CRANKSHAFT

Cylinder block material	Aluminum
Cylinder liners	Non-replaceable cast iron
Crankshaft bearings Number and Type	5 Replaceable liners
Material	Durex 100-A
Bearing which takes end thrust	Center
Crankshaft journal diameter	2.2983"
Crankshaft journal to bearing clearance .....	.0005"-.0021"
Crankshaft end play at thrust bearing .....	.004"-.008"
Crankshaft bearing effective length	
No. 1 .....	.802"
No. 2 .....	.802"
No. 3 .....	.965"
No. 4 .....	.802"
No. 5 .....	.802"
Crankpin journal diameter	2.000"
Crankpin journal to bearing clearance .....	.002"-.0022"

CONNECTING ROD AND PISTON

Connecting rod bearings, type	Replaceable liners
Material	Durex 100-A

CONNECTING ROD AND PISTON—Continued

Piston material and surface treatment	Aluminum alloy Tin Plated
Compression rings—No. per piston—Material	2 cast iron
Oil rings—No. per piston	One
Type	3 piece—expander
Location of all piston rings	Above piston pin
Connecting rod end play on crankpin	.006"—.014" (Total both rods)
Connecting rod bearing length	.737"
Piston clearance in bore	.0005"—.0011"
Piston pin diameter	.8747"—.8750'
Piston pin length	2.870"
Piston pin fit at 70°F. in piston (Finger Push)	.00005"—.0001"
Piston pin fit in connecting rod	.0005"—.0013" Press
Piston ring side clearance in groove	
Compression ring	.003"—.005"
Oil ring	.0035"—.0095"
Piston ring gap, compression ring in bore	.010"—.020"
Oil ring in bore	.015"—.035"

CAMSHAFT AND VALVES

Camshaft, type and material	Cast iron alloy
Camshaft drive	Chain
Number and type of camshaft bearings	5 steel back babbitt
Valve lifter type	Hydraulic
Valve spring type	Single helicoil
Camshaft bearing journal diameter	
No. 1	1.785"—1.786"
No. 2	1.755"—1.756"
No. 3	1.725"—1.726"
No. 4	1.695"—1.696"
No. 5	1.665"—1.666"
Camshaft journal clearance in bearings	.0005"—.0035"
Valve lifter diameter	.8422"—.8427"

CAMSHAFT AND VALVES—Continued

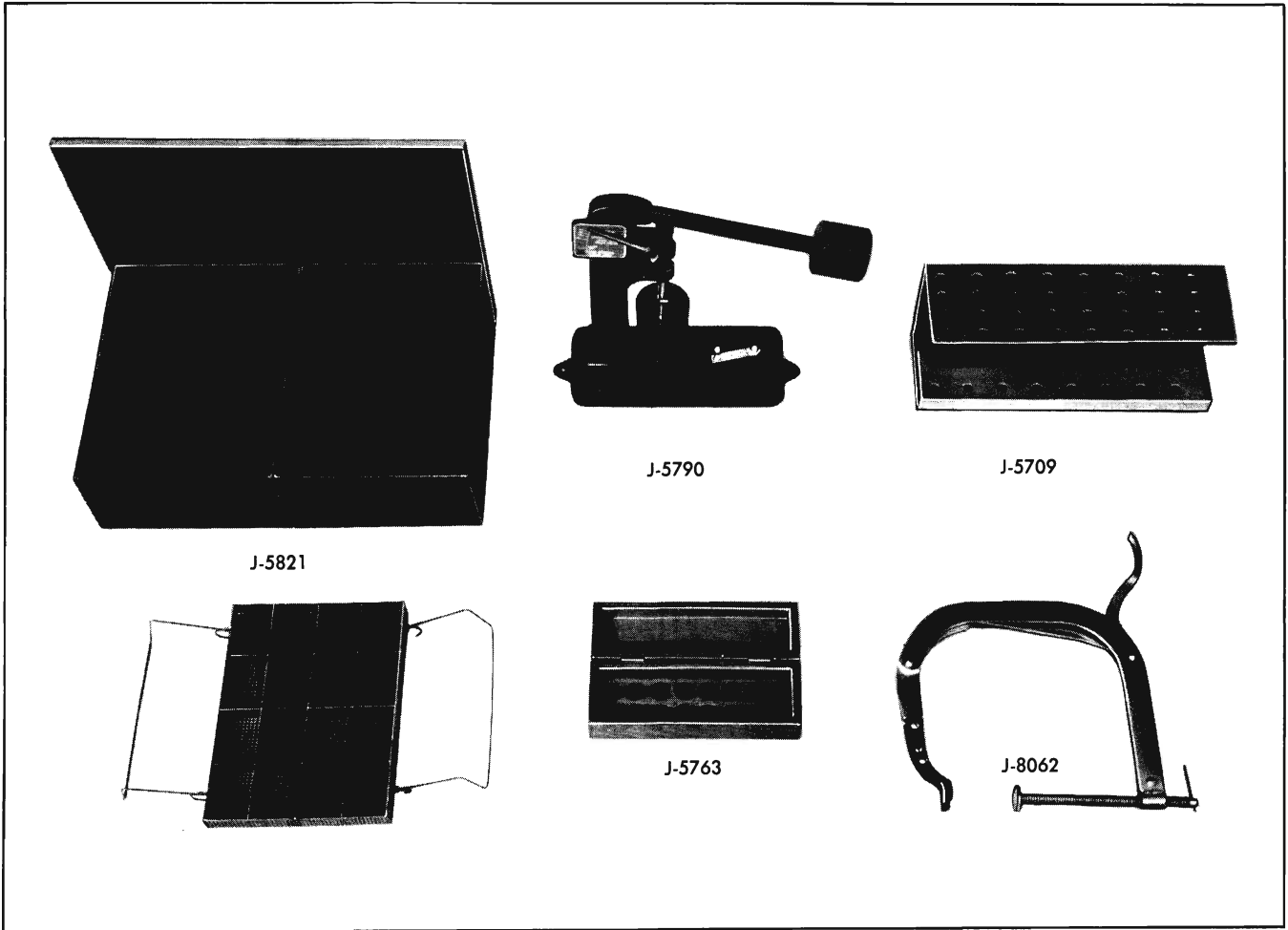
Valve lifter clearance in crankcase .....	.0015"-.0030"
Valve lifter leakdown ratio, in test fixture	12 to 60 Sec.
Rocker arm ratio	1.6 to 1
Rocker arm clearance on shaft .....	.0027"-.0042"
Valve head diameter inlet	1.500"
Valve head diameter exhaust	1.3125"
Valve seat angle inlet and exhaust	45°
Valve stem diameter inlet .....	.3412" top .3407" bottom
Valve stem diameter exhaust .....	.3407" top .3397" bottom
Valve stem clearance in guide inlet	top .0005"-.0025" bottom .0010"-.0030"
exhaust	top .001"-.003" bottom .0015"-.0035"
Valve Spring	
Valve closed pounds @ length	64 @ 1.640"
Valve open pounds @ length	164 @ 1.260"

ENGINE TORQUE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed to prevent straining or distorting the parts or possibly damaging the threads. These specifications are for clean and lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurement of tightness. It is important that these torque specifications be strictly observed. Over-tightening to any extent may damage threads, thus preventing proper torque from being attained, requiring replacement or repair of the damaged part.

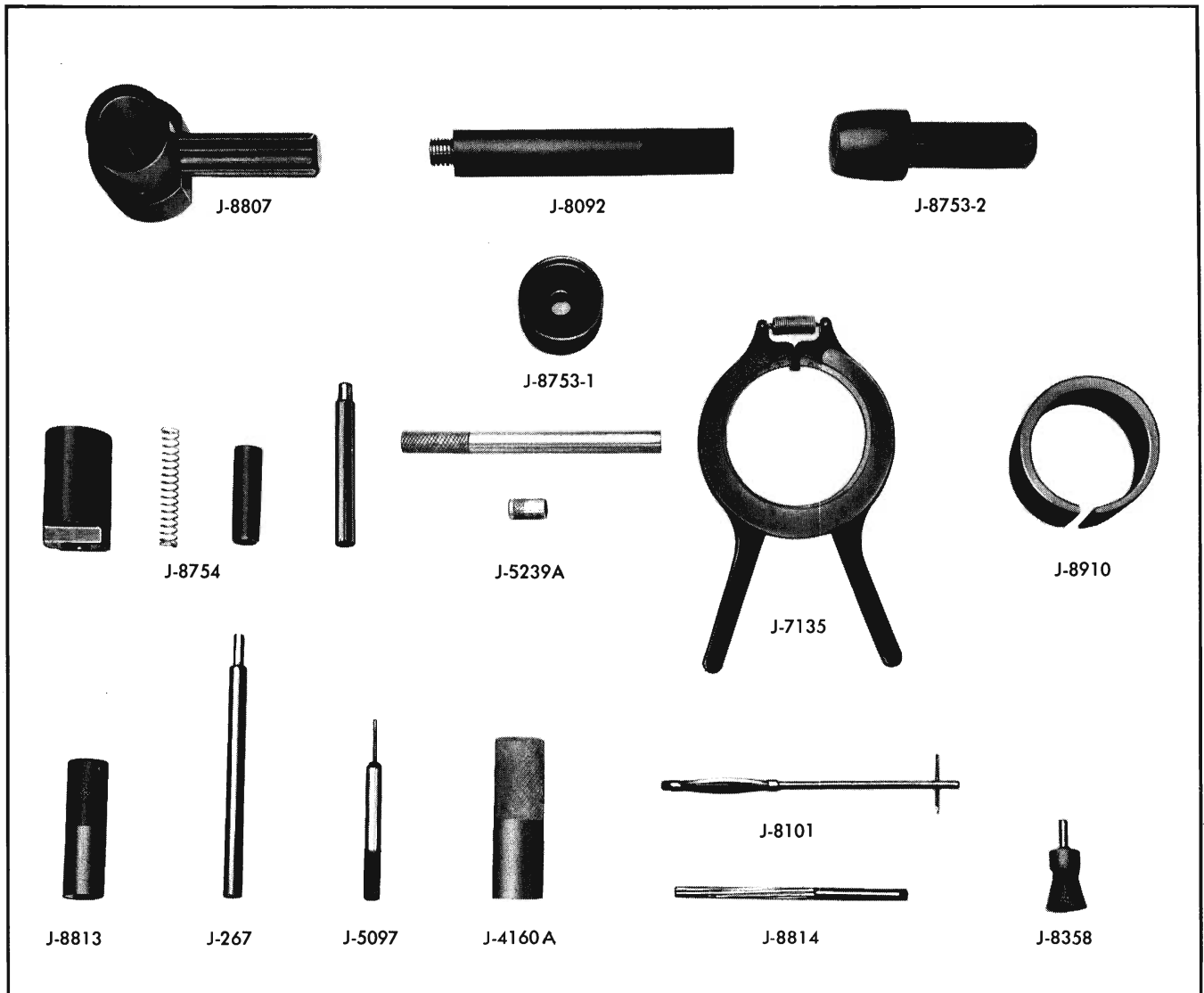
PART	APPLICATION	LB. FT.	PART	APPLICATION	LB. FT.
			Bolt	Water outlet to intake manifold	20-25
			Bolt	Intake manifold gasket clamp to block	10-15
			Bolt	Intake manifold to cylinder head	25-30
			Bolt	Exhaust manifold to cylinder head	10-15
			Bolt	Carburetor to intake manifold	12-15
			Bolt	Fuel Pump to timing chain cover	20-25
			Bolt	Camshaft sprocket to camshaft	40-45
			Bolt	Rocker Arm shaft bracket to cylinder head	25-30
Plug	Spark	15-20	Screw	Rocker Arm cover to cylinder head	3-5
Plug	Crankcase drain	20-25	Bolt	Cranking Motor to cylinder block	30-35
Bolt	Water pump and timing chain cover to block	20-25	Bolt	Distributor clamp to timing chain cover	25-30
Bolt	Water pump cover to timing chain cover	6-8			

PART	APPLICATION	LB. FT.	PART	APPLICATION	LB. FT.
Bolt	Generator bracket to timing chain cover	30-35	Bolt	Upper flywheel housing to cylinder block	30-35
Bolt	Generator brace to timing chain cover	30-35	Bolt	Lower flywheel housing to block and upper flywheel housing	20-25
Bolt	Generator to mounting bracket	25-35	Bolt	Flywheel to crankshaft	50-60
Bolt	Generator rear end frame to exhaust manifold	14-17	Bolt	Harmonic balancer to crankshaft	140-160
Bolt	Generator brace to generator	14-17	Nut	Connecting rod bolt	30-35
Bolt	Crankshaft bearing cap to crankcase	65-70	Bolt	Ignition coil to intake manifold	20-25
Plug	Cylinder block water drain	15-20	Bolt	Oil pan to block	6-15
Bolt	Cylinder head to block	50-55	Bolt	Oil screen housing pipe and flange assembly to block	10-15



SPECIAL TOOLS

- | | | | |
|--------|------------------------------------|--------|--|
| J-8062 | Valve Spring Compressor | J-5790 | Hydraulic Valve Lifter Tester |
| J-5709 | Valve and Push Rod Stand | J-5821 | Hydraulic Valve Lifter Solvent Tank and Tray |
| J-5763 | Hydraulic Valve Lifter Storage Bar | | |



SPECIAL TOOLS

J-8813	Valve Guide Installer	J-5239-A	Connecting Rod Bolt Guide Set
J-267	Valve Guide Remover	J-7135	Piston Ring Remover and Replacer
J-5097	Hydraulic Valve Lifter Plunger Unloading Tool	J-8910	Piston Ring Compressor
J-4160-A	Hydraulic Valve Lifter Plunger Remover	J-8807	Rear Main Bearing Oil Sealer Installer
J-8814	Valve Guide Reamer	J-8753-1	Front Shedder Installer
J-8101	Valve Guide Cleaner	J-8092	Handle
J-8358	Carbon Brush	J-8753-2	Shedder Sizer
J-8754	Piston Pin Remover and Replacer Set		

ENGINE COOLING AND LUBRICATION

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COOLING SYSTEM DESCRIPTION

The cooling system consists of the radiator core, cooling fan, pellet type thermostat, water pump and suitable passages for water circulation through the engine.

RADIATOR

Four Radiators are Used:

4 Cylinder Engine	V-8 Engine
Standard Radiator	Standard Radiator
Air Conditioning Radiator	Air Conditioning Radiator

The radiator is of the down-flow tube and center type and is constructed of copper. A drain cock is located at the inside lower left corner of the radiator.

A pressure-vent type cap is used on the radiator to allow a build-up of 15 psi of pressure in the cooling system. This pressure raises the boiling point of water 38°.

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the normal boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while the engine is hot and the pressure is high will cause the solution to

boil instantaneously and possibly with explosive force, spewing the solution over the engine, fenders, and the person removing the cap. If the solution contains inflammable anti-freeze (not recommended), such as alcohol, there is also the possibility of causing a serious fire. When removing filler cap, rotate cap toward left very slowly; if hissing of vapor is encountered, tighten cap immediately and wait for system to cool sufficiently to allow removal of cap. After pressure in the system has been relieved, turn cap more forcibly to left and remove. Turn cap all the way to the right when installing. It should not be necessary to check coolant level unless temperature gauge shows over-heating, and then not until engine is stopped and allowed to cool to normal.

FAN

The fan is used to increase the air flow through the radiator at low speeds. In addition it forces air into the crankcase ventilator inlet on top of the rocker arm cover to provide air flow for crankcase ventilation.

The standard fan has four blades. A seven bladed fan is used on cars with air conditioners and has curled tips to provide minimum noise.

A fan shroud is used on 4 cylinder engine air con-

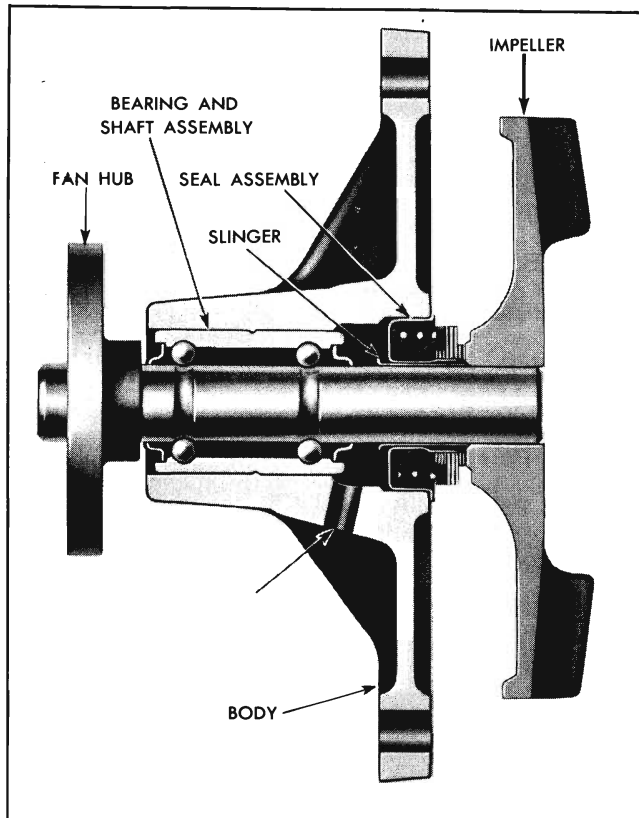


Fig. 6A-1 Water Pump for 4 Cylinder Engine

ditioned cars to prevent recirculation of air around the fan.

THERMOSTAT

A pellet type thermostat is used in the water outlet passage in the intake manifold. The thermostat controls the flow of coolant to provide rapid engine warm up and regulate coolant temperature. A thermostat is installed as standard equipment.

WATER PUMP—4 CYLINDER ENGINE

A centrifugal type water pump is used to circulate the water through the system. The water pump impeller turns on a steel shaft mounted on a double-row permanently lubricated, sealed ball bearing (Fig. 6A-1). A bellows type seal is seated in the water pump body between the bearing and the impeller. The seal surface is a phenolic washer which is held by the spring loaded bellows against a machined surface on the impeller.

The inlet side of the pump is connected to the lower radiator tank by means of a hose. A water leg in the intake manifold connects to the timing chain

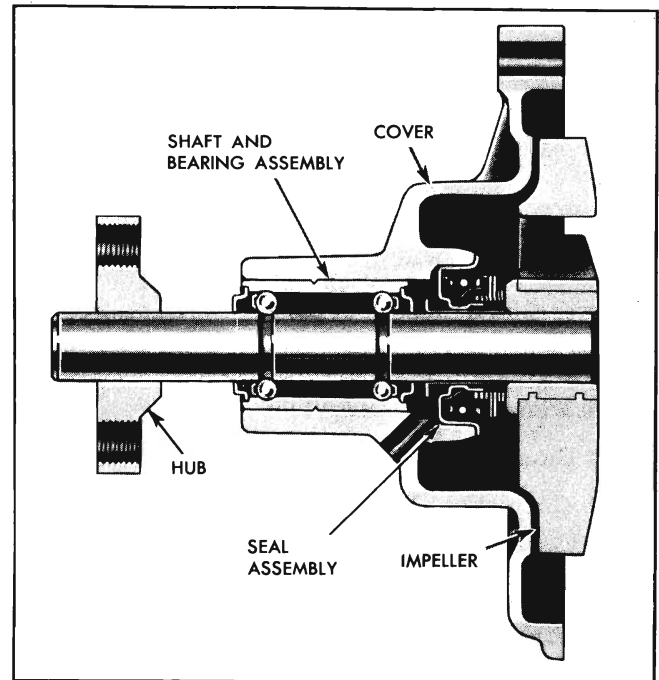


Fig. 6A-2—Water Pump for V-8 Engine

cover (which acts as the pump body) to provide recirculation of water when the thermostat is closed. The timing chain cover also has a heater water return connection.

WATER PUMP—V-8 ENGINE (Fig. 6A-2)

The coolant is circulated by a centrifugal pump mounted on the timing chain cover which forms the outlet side of the pump. The pump shaft and bearing assembly is pressed in the aluminum 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 timing chain cover. These passages deliver an equal quantity of coolant to each cylinder bank water jacket pocket.

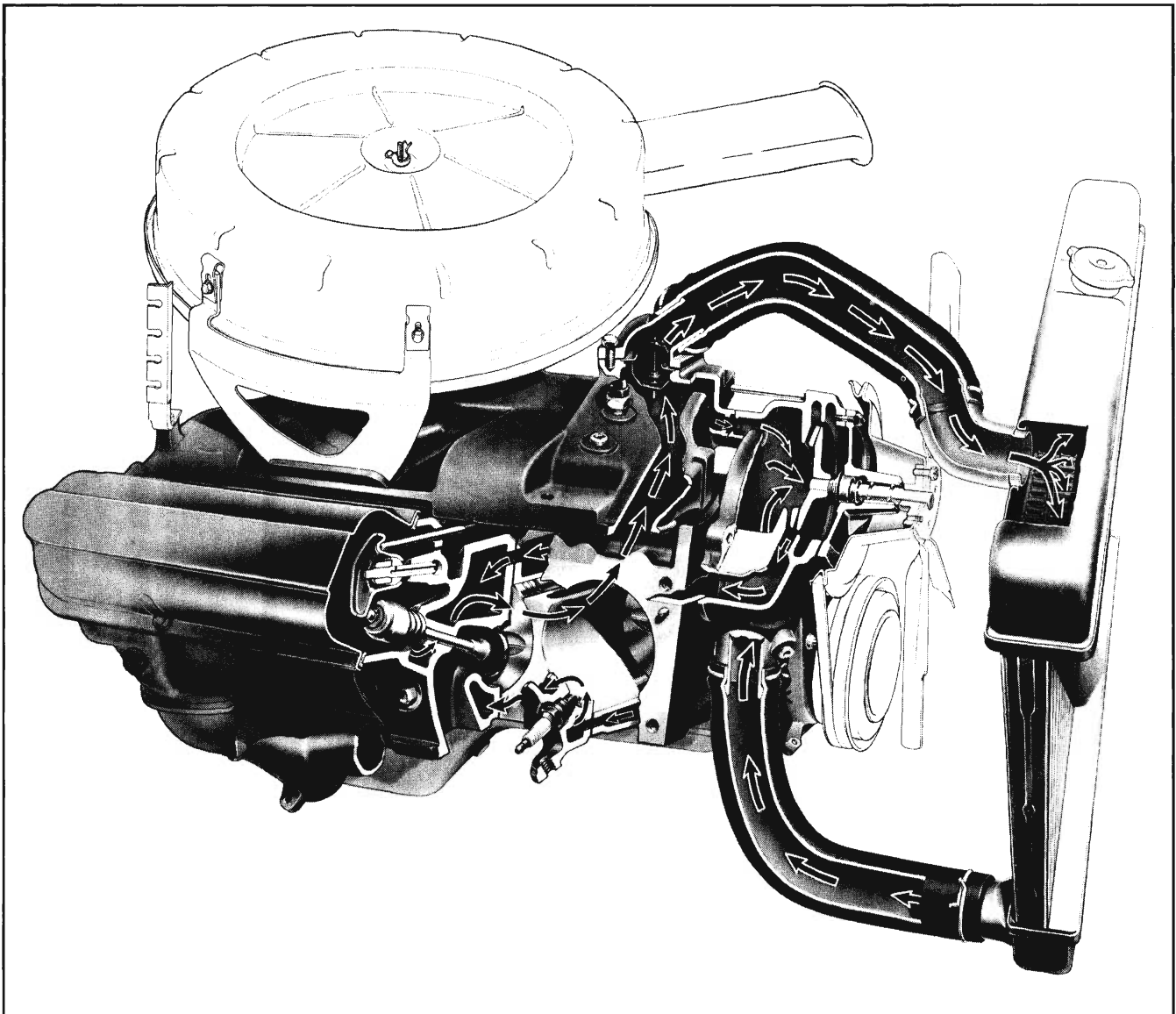


Fig. 6A-3 Cooling System Circulation—4 Cylinder Engine

COOLING SYSTEM CIRCULATION— 4 CYLINDER ENGINE

Water circulation (Fig. 6A-3) is provided by a single impeller, specially designed water pump which provides flow of water into the cylinder block.

Water circulation during warm-up (thermostat closed) is from the pump to the cylinder block, up into the cylinder head, into the front of the intake manifold, and back to the inlet of the pump, via the timing chain cover, which acts as a pump body. The inlet side of the pump has a heater water return connection.

After normal operating temperatures are reached (thermostat open), part of the water will recirculate as outlined above. A major portion of the water, however, will pass into the radiator via the outlet passage and hose above the thermostat. It will then circulate back to the pump inlet. The water pump and the water transfer holes between the block and cylinder head have been designed to provide the proper flow of coolant to provide temperature balance within the engine bank and its cylinder head.

COOLING SYSTEM CIRCULATION—V-8 ENGINE

Fig. 6A-4 shows V-8 engine cooling circulation.

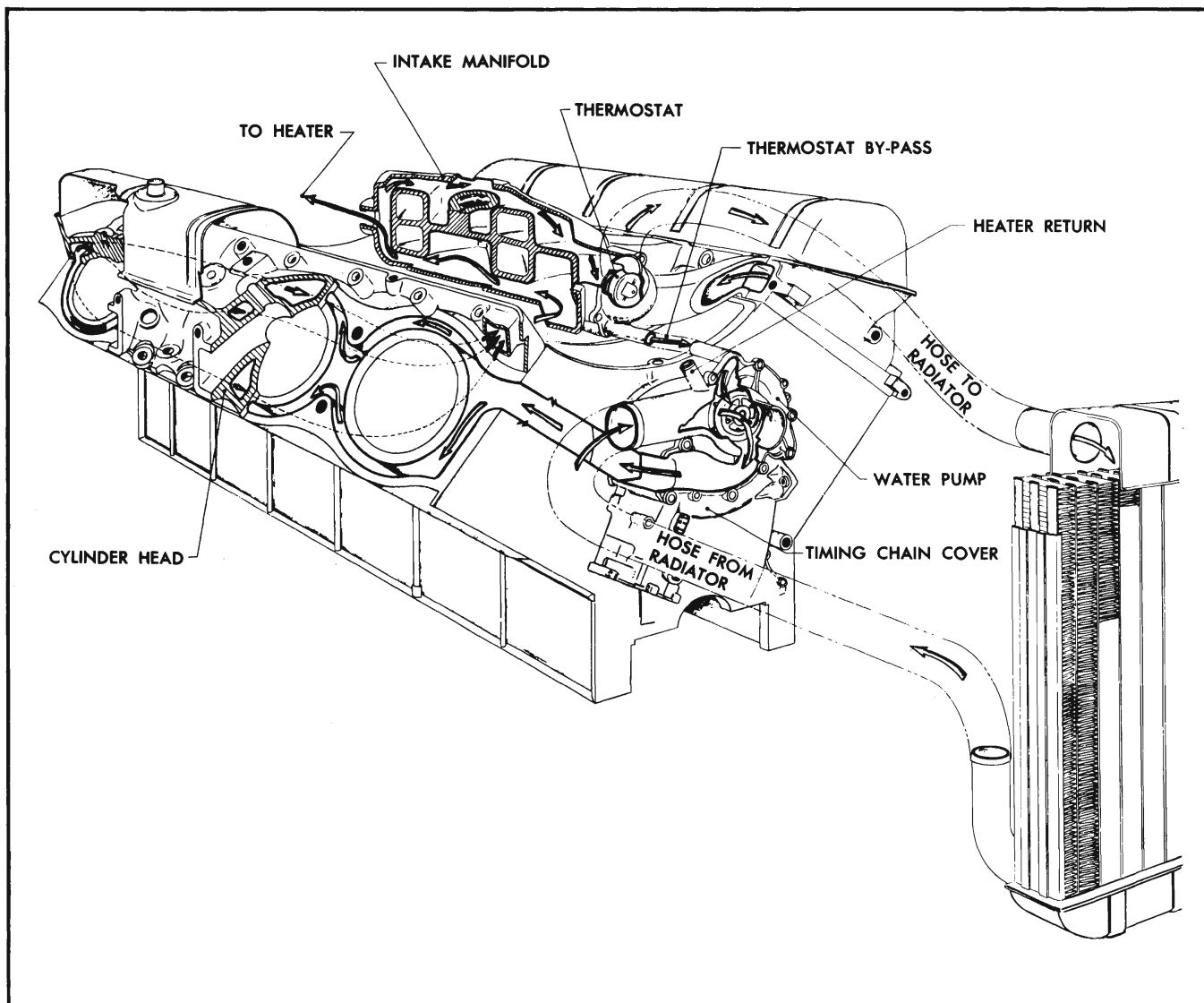


Fig. 6A-4 Cooling System Circulation—V-8 Engine

The coolant from the pump 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 water jacket. The coolant flows to the rear in the lower portion of the intake manifold and then forward in the upper portion to the thermostat housing and thermostat by-pass. The flow of heated coolant through the intake manifold water jacket warms the manifold evenly to provide good vaporiza-

tion of the incoming fuel charge. During cold engine operation when the thermostat is closed, a thermostat by-pass, open at all times, allows recirculation of coolant through the engine to provide rapid warm up. When the thermostat opens, coolant is directed to the upper tank of the radiator and thence through the radiator core, lower tank to water pump inlet where the cycle is repeated.

LUBRICATION SYSTEM DESCRIPTION

OIL FILTER—4 CYLINDER ENGINE

A full flow oil filter is optional equipment on the engine. The filter is mounted on a machined boss on the right rear side of the engine block.

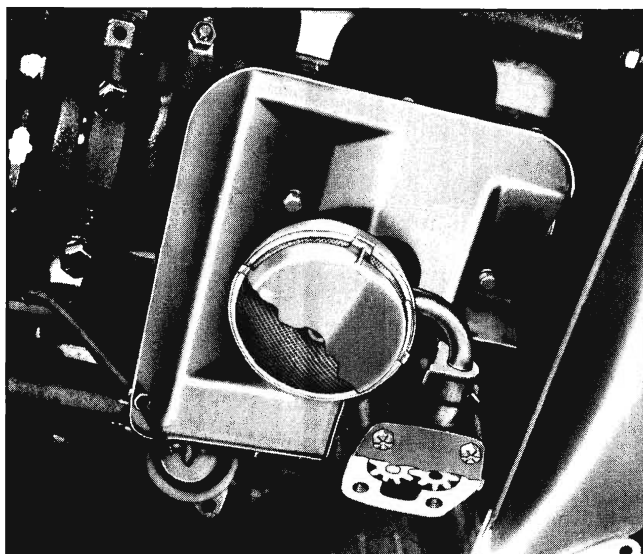


Fig. 6A-5 Oil Pump and Intake for 4 Cylinder Engine

All oil from the pump passes through the filter before going to the engine oil galleries. In the filter, the oil passes through a filtering element where all dirt and foreign particles are removed.

A by-pass valve is located in the filter base casting to insure ample lubrication in case the filter element becomes restricted. Thus, if required, oil will flow directly from the inlet through the spring loaded by-pass valve to the outlet without any possibility of washing accumulated dirt off the filter element.

OIL PUMP—4 CYLINDER ENGINE

Oil is circulated under pressure by a spur gear type pump. The pump is mounted on the right rear lower face of the cylinder block (Fig. 6A-5) and is driven by the distributor drive gear. Maximum oil pressure is regulated by a spring loaded, ball type, pressure regulator valve. No adjustment of the pressure regulator valve is provided.

Oil is taken into the pump through a floating type oil intake. By allowing the intake to float, only the cleanest oil near the surface is pumped through the engine. All oil entering the floating intake passes through a screen. As a safety precaution a large hole is provided in the middle of the screen. During normal operation no oil can pass through this hole since the grommet around the hole is seated against the baffle. If the screen should become plugged, however, pump suction will cause the screen to move away from the baffle, and oil will flow through the large center hole.

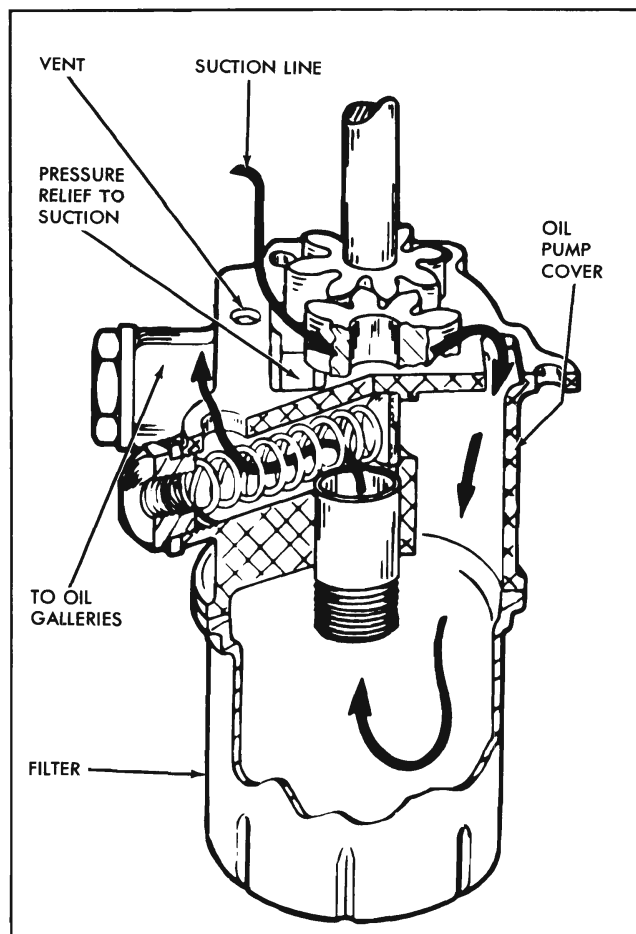


Fig. 6A-6 V-8 Oil Pump and Filter

OIL PUMP AND FILTER—V-8 ENGINE (FIG. 6A-6)

The oil pump is located in the timing chain cover where it is connected by a drilled passage in the cylinder crankcase to an oil screen housing and pipe assembly. The screen is submerged in the oil supply and has ample area for all operating conditions. If the screen should become clogged for any reason, oil may be drawn into the system over the top edge of the screen which is held clear of the sheet metal screen housing.

Oil is drawn into the pump through the screen and pipe assembly and a drilled passage in the crankcase which connects to drilled passages in the timing chain cover. All oil is discharged from the pump to the oil pump cover assembly. The cover assembly consists of an oil pressure relief valve, an oil filter by-pass valve and a nipple for installation of an oil filter. The spring loaded oil pressure relief valve limits the oil pump pressure to a maximum of 40 pounds per square inch while the oil filter by-pass

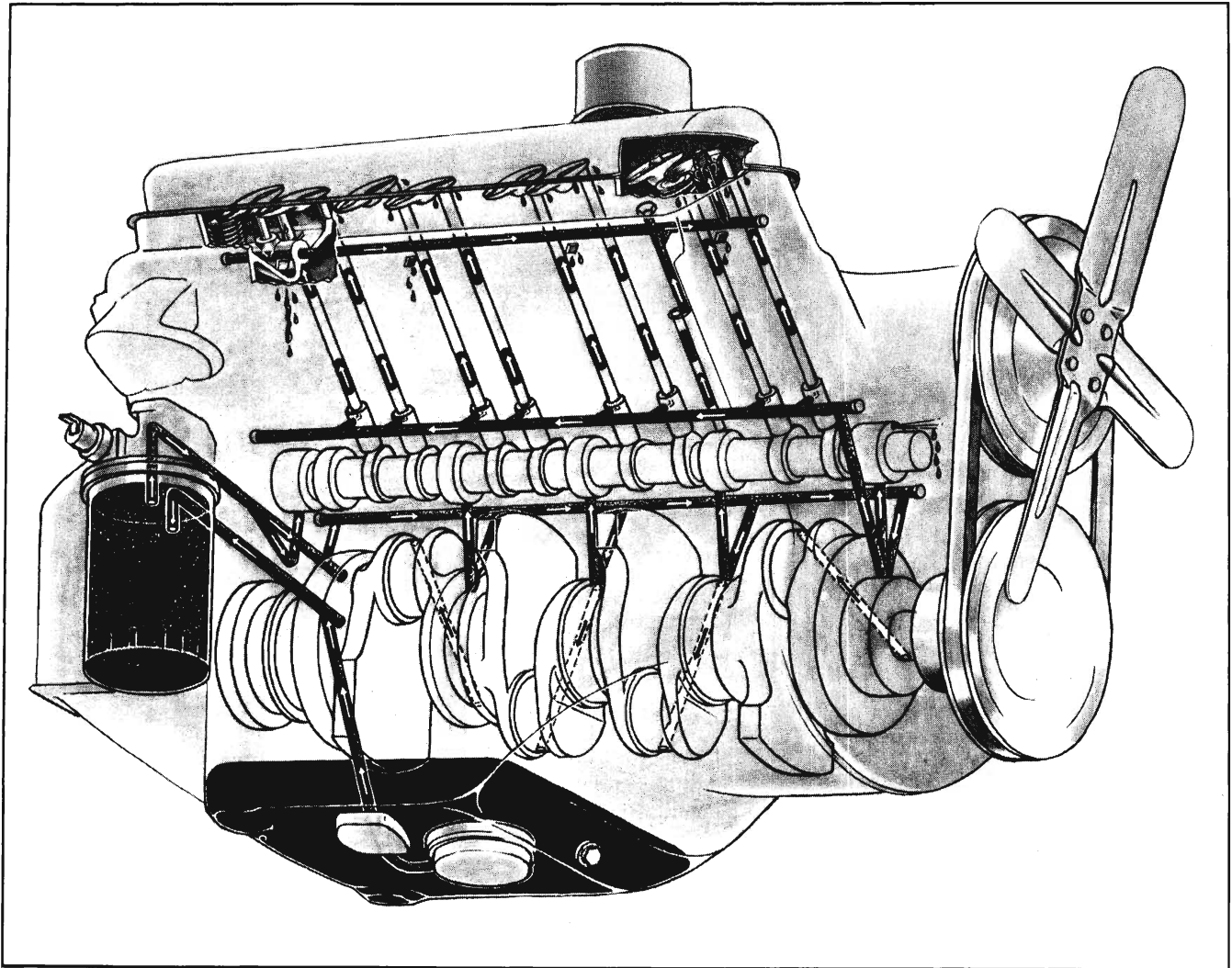


Fig. 6A-7 Oil Circulation for 4 Cylinder Engine

valve opens when the filter has become clogged to the extent that $4\frac{1}{2}$ to 5 pounds difference exists between the filter inlet and exhaust, to by-pass the oil filter and channel unfiltered oil directly to the main oil gallery of the engine.

An A.C. full flow oil filter (optional) is externally mounted to the oil filter cover nipple on the right side of the engine just below the generator. Normally, all engine oil passes through the filter element. However, if the element becomes restricted, the spring loaded by-pass valve opens as mentioned above.

OIL CIRCULATION—4 CYLINDER ENGINE (FIG 6A-7)

The positive pressure system delivers oil under pressure to the crankshaft, connecting rod, and cam-

shaft bearings and to the valve train parts. Spray from main and connecting rod bearings lubricates the cylinder walls, piston pins and bushings. Timing chain and sprockets receive metered jet lubrication as do the fuel pump eccentric and rocker arm. A hole in the block from the push rod gallery through the distributor boss lubricates the distributor shaft and bushings.

Oil flow through the engine is as follows: Oil is first supplied by the pump and filter to two parallel oil galleries drilled in the block on each side of the camshaft. Oil travels from rear to front in the left gallery and from front to rear in the right gallery. The rear crankshaft and camshaft bearings receive oil from a hole drilled through the passage connecting the filter to the left gallery. All other crankshaft bearings receive oil from holes drilled to the left hand gallery.

The remaining four camshaft bearings are supplied by a hole drilled vertically from each crankshaft bearing journal to camshaft bearing journal.

Hydraulic valve lifters are fed by holes drilled from each lifter boss to the oil gallery. Oil is fed under pressure from a hole in the push rod seat of the valve lifter up through the hollow push rod to provide pressure lubrication of both ends of the push rod.

Oil is also positively fed to the cylinder head to lubricate all valve train surfaces. An oil gallery in the head is fed from the front center camshaft journal. Oil from cylinder head gallery flows up holes in each rocker arm ball stud and out through a $\frac{1}{16}$ " hole drilled into the side of the stud to index with the ball. This oil lubricates the ball seat and also flows out through grooves in the top of the ball to fill the rocker arm with oil. Overflow from the rocker arm passes over the end onto the valve stem to lubricate the contact area between the rocker arm and the end of the valve stem.

Lubrication of the camshaft thrust plate, timing chain and sprockets, and fuel pump eccentric and rocker arm is provided for by a passage in the front of the camshaft. A lateral hole in the front bearing journal indexes with the camshaft bearing oil supply hole in the block once each revolution.

An oil jet then squirts out of the horizontal hole in the end of the camshaft toward the front of the engine. Part of this oil is projected straight forward, against the camshaft thrust plate. Another part of the oil is projected downward through the grooves in the block and thrust plate to the crankshaft timing chain sprocket (Fig. 6A-8). Oil passing down the groove also is forced out the hole in the thrust plate. The jet of oil from this hole is timed to pass through one of the openings in the camshaft sprocket and strike the fuel pump eccentric and rocker arm.

The oil pan has been made as deep as possible to provide the maximum depth of oil. This minimizes splashing and foaming which would be detrimental to the operation of hydraulic lifters. It also insures a constant supply of oil during rapid acceleration and sharp turns. Additional protection against splashing and foaming is provided by the oil pan baffle. The baffle extends across the entire sump area of the oil pan preventing oil which is thrown off the crankshaft from churning that in the sump.

OIL CIRCULATION—V-8 ENGINE (FIG. 6A-9)

The engine lubrication system is the force feed type in which oil is supplied under pressure to the

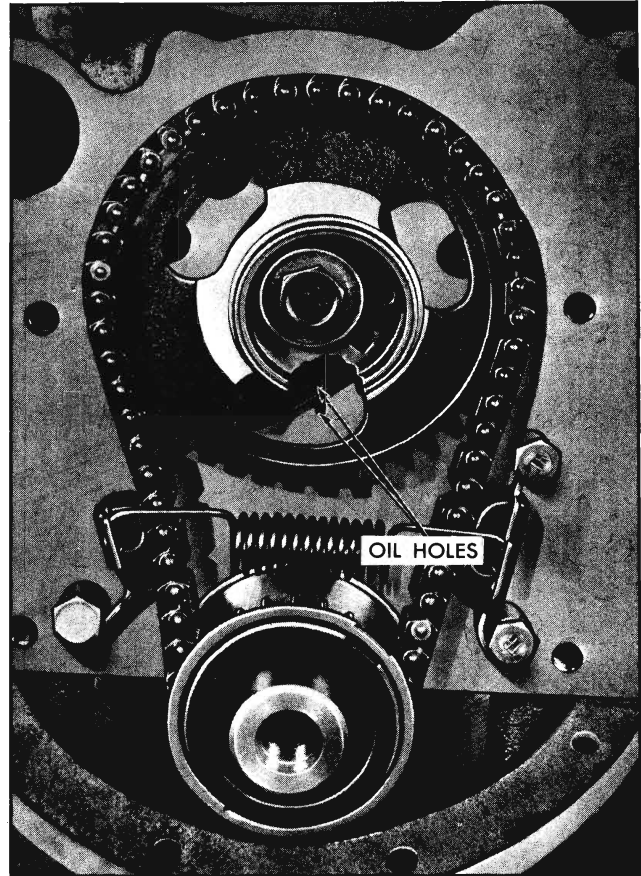


Fig. 6A-8 Timing Chain and Sprocket, Camshaft Thrust Plate and Fuel Pump Eccentric and Rocker Arm Lubrication Oil Holes

crankshaft, connecting rods, camshaft bearings and valve lifters and is supplied under controlled volume to the valve lifters, rocker arm bearings and push rods. All other moving parts are lubricated by gravity flow or splash.

The supply of oil is carried in the lower crankcase (oil pan) which is filled through a filler opening in the left rocker arm cover. The filler opening is covered by a combination filler and ventilating cap which contains a metal gauze to exclude dust. An oil level indicator on the left side of the crankcase is provided to check oil level.

The main oil galleries run the full length of the crankcase and cut into the valve lifter guide holes to supply oil at full pressure to the lifters. Connecting passages drilled in the crankcase permit delivery of oil at full pressure to all crankshaft and camshaft bearings.

Holes drilled in the crankshaft carry oil from the crankshaft bearings to the connecting rod bearings.

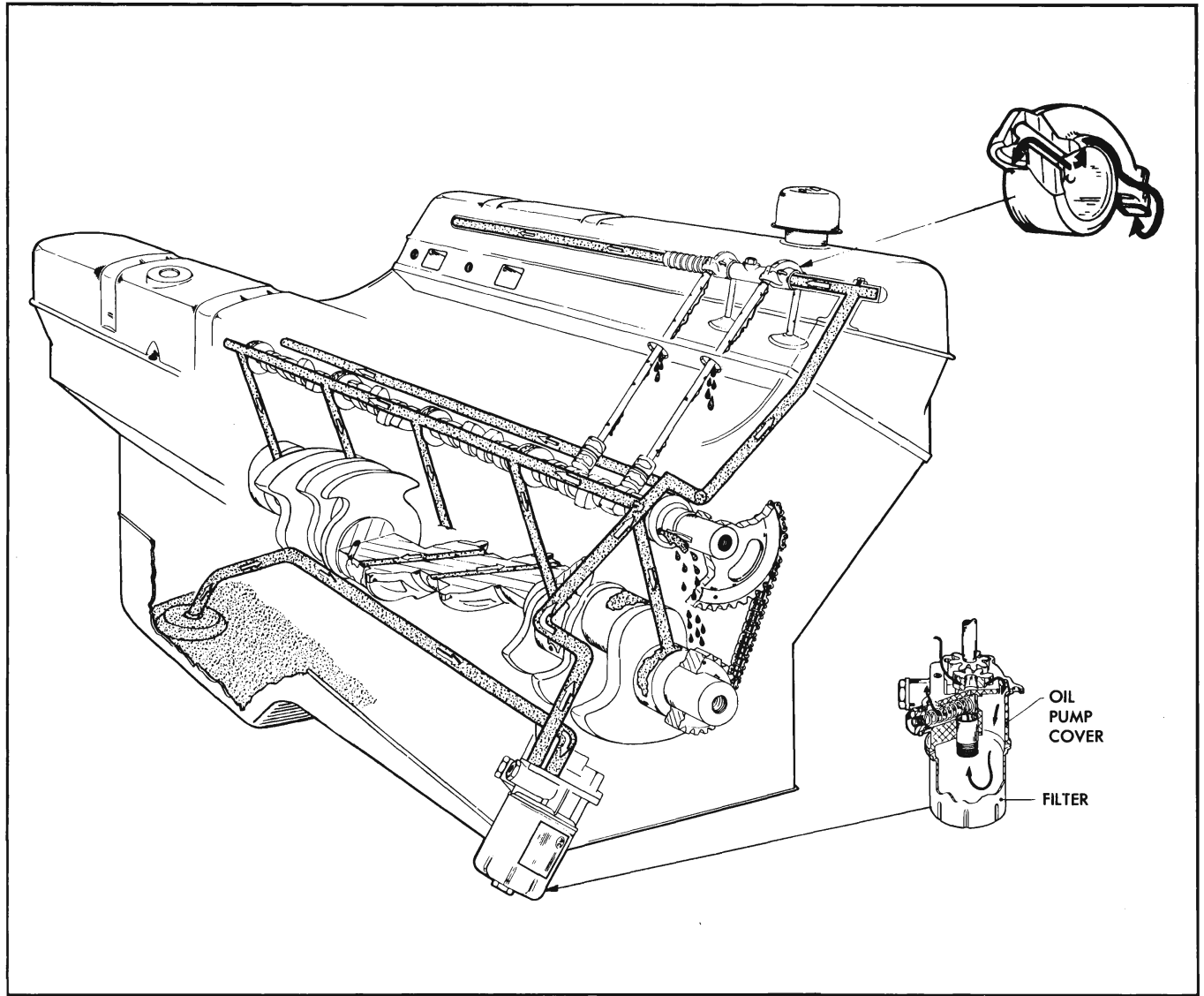


Fig. 6A-9 Oil Circulation for V-8 Engine

Pistons and cylinder walls are lubricated by oil forced through a small notch in the bearing parting surface on the connecting rod, which registers with the hole in the crankpin once in every revolution. Piston pins are lubricated by splash.

Drilled holes in the camshaft connect the front camshaft bearing journal to the keyslot in the front of the camshaft. Oil flows from the journal into the keyslot over the woodruff key in the space between the key and the camshaft sprocket and fuel pump eccentric.

The forward end of the fuel pump eccentric incorporates a relief which allows the oil to escape between the fuel pump eccentric and the camshaft distributor gear. The oil stream strikes the distributor shaft gear once each camshaft revolution and provides ample

lubrication of the timing chain and sprockets by splash.

The rocker arms and valves on each cylinder head are supplied with oil from the oil galleries through holes drilled in the front of the cylinder block and cylinder head. The hole drilled in the cylinder head ends beneath the front rocker arm shaft bracket. A notch cast in the base of the rocker arm shaft bracket allows the oil to flow up inside the bracket in the space between the bracket and bolt to the hollow rocker arm shaft which is plugged at both ends. Each rocker arm receives oil through a hole in the underside of the shaft. Grooves in the rocker arm provide lubrication of the bearing surface. Oil is metered to the push rod seat and valve stem through holes drilled in the rocker arm. Excess oil drains off and returns

to the oil pan through passages in the cylinder head and block.

CRANKCASE VENTILATION

When gasoline is burned in the cylinders of any internal combustion engine, one of the by-products is water vapor. Actually, more than one gallon of water is produced for every gallon of gasoline burned. Most of this water vapor is blown out through the exhaust system. Some of it, however, leaks down into the crankcase where it can have very destructive effects through the formation of sludge and acid. The acid is formed when the water combines with sulphur dioxide which is another by-product of combustion.

Adequate crankcase ventilation evaporates the moisture and carries it, as well as the combustion gases, out of the engine. Pontiac Tempest crankcase ventilation system provides positive ventilation of the complete engine, even during idling. This system functions as follows:

4 CYLINDER ENGINE

Air is forced into the engine through an air inlet in the rocker arm cover. The inlet, which also serves as an oil filler cap, is located at the front of the rocker arm cover where it receives direct blasts of air from the fan. A filter element in the air inlet ensures the circulation of clean air through the engine.

The flow of air through the crankcase is aided by the suction type air outlet which exhausts vapors and fumes beneath the car.

Air entering the inlet circulates along the top of the cylinder head inside the rocker arm cover. A cast opening at the front and rear of the cylinder head allows air to be forced down into the area of the block below the push rod cover.

Air passing down into the block at the front circulates into the timing chain cover through a hole near the top of the block. The ventilating air then circulates down around the timing chain and sprockets and into the crankcase.

An oil separator or baffle chamber inside the push rod cover insures against excessive oil being carried out of the engine with the ventilating air.

V-8 ENGINE

The crankcase is ventilated by suction provided by a ventilator pipe which projects down into the air

stream passing beneath the car. Air passing the open end of the pipe creates a suction when the car is moving forward. Air is drawn in through a ventilating cap in the left rocker arm cover, passes over the rocker arms, down through the push rod holes and through the crankcase. Air is then pulled up through the right cylinder head push rod holes to the right rocker arm area. The air is drawn out of the right rocker arm cover past a baffle that acts to prevent oil from being exhausted with the air through the vent pipe.

SERVICE OPERATIONS

CHECKING AND FILLING COOLING SYSTEM

The Pontiac Tempest cooling system requires little care, except for maintaining an adequate coolant level, checking the coolant level whenever the car is serviced, and use of ethylene glycol type anti-freeze with soluble oil corrosion inhibitor for winter months.

For summer months, the cooling system containing anti-freeze should be drained, flushed, and refilled with water.

The coolant level should be considered correct as long as the temperature gauge does not indicate overheating.

Always allow the cooling system to cool to normal before removing the cap. When removing filler cap, rotate cap toward left very slowly; if there is pressure in the system, tighten cap immediately and wait for system to cool sufficiently to allow removal of cap. See "Caution," page 6A-1.

When filling radiator, do not bring level above three inches from the top of the filler neck. This air space is required for expansion and contraction and if the space is not left, coolant will be lost out the overflow. **NOTE:** The water in the radiator should be kept at the proper level by filling it when the heater "Temp." lever on the instrument panel is fully depressed.

FLUSHING COOLING SYSTEM

It is especially important to flush and check the cooling system for leaks when anti-freeze is used, because of the possibility of damage to engine parts should it reach the interior of the engine.

1. Drain radiator and block by opening drain cock on radiator lower tank and removing plug on right side of 4 cylinder engine block and on both sides of V-8 engine block.

2. After system is empty, with drains open, run water into radiator. Engine should be running and occasionally accelerated to aid in circulating water and dislodge rust and scale.

CAUTION: *Do not introduce cold water into a hot engine or block may be cracked. Allow engine to cool, then add water with engine running.*

3. Where there is difficulty in getting water to run clear or there is an excessive amount of rust and scale, the cooling system should be cleaned with a cleanser (reputable source) supplied for that purpose. If force flushing equipment is used it should be used on the *radiator only* (engine to radiator inlet and outlet hoses removed) as any reverse flushing of the block with the water pump in place may cause the water pump seal to leak, if flushing pressure is excessive.

PREPARING COOLING SYSTEM FOR ANTI-FREEZE

The cooling system should be properly prepared for the addition of anti-freeze each fall.

To properly prepare cooling system:

1. Bring engine up to operating temperature.
2. Flush out cooling system as instructed previously.
3. Tighten all hose connections on radiator, heater and defroster. Replace any deteriorated hose. Check to see that radiator hold down bolts are tightened properly.
4. Fill system with water (*with heater TEMP fully depressed*) and operate engine, checking for water leaks at radiator core, hose connections, water pump seal and gaskets, heater and defroster connections, and head to block joint.
5. Drain sufficient water to allow addition of proper quantity of anti-freeze.

ADDING ANTI-FREEZE TO COOLING SYSTEM

In selecting anti-freeze for winter operations, the local conditions and type of service should be considered. Pontiac recommends the use of glycol type anti-freeze in its cooling system.

Glycol type anti-freeze is non-evaporating. For this reason it will not be boiled away by the higher temperatures resulting from hard drives on warm days or from use of the high opening thermostat.

Glycol type anti-freeze, although not subject to loss by evaporation, should not be left in the cooling system indefinitely, since the corrosion inhibitor in the anti-freeze will become exhausted and corrosion in the cooling system will result.

USE OF ANTI-FREEZE IN ENGINES WITH ALUMINUM COMPONENTS

ADDITIVES

In general, aluminum is easily destroyed by caustic solutions. No cooling system compound should be added to an aluminum system unless it is specifically recommended for use with aluminum by a reliable manufacturer.

ANTI-FREEZES

Most well-known brand commercially available anti-freezes are acceptable. However, general rules for the selection of anti-freeze are: avoid the use of salt-base inhibited anti-freezes and use an anti-freeze with a soluble oil inhibitor where possible. No well-known brand of anti-freeze uses a salt base inhibitor and most use soluble oils. Occasionally, an off-brand anti-freeze will be found with a salt-base inhibitor.

INHIBITORS

When no anti-freeze is in the system, a cooling system corrosion inhibitor is recommended to prevent corrosion of the cooling system. This is particularly recommended in areas in southwest United States where native water contains chemical salts which accelerate corrosion.

TESTING ANTI-FREEZE

In using a hydrometer to determine the freezing point of radiator solution, make sure the correct hydrometer markings are read. Unless hydrometer is provided with means for temperature correction, test should be made at the temperature at which hydrometer is calibrated, for if the solution is warmer or colder large errors may result (in some cases as much as 30° F.). Most good hydrometers are equipped with a thermometer and temperature correction scale which allows an accurate test of freezing point over a range of temperatures.

ENGINE OIL

See General Lubrication Section.

OIL FILTER CARTRIDGE

Install a new oil filter at 4,000 miles and then each six months or each 4,000 miles thereafter, whichever occurs first.

1. Turn hex nut on bottom of filter counterclockwise to unscrew filter from base.
2. Wipe filter base with clean cloth and make sure filter base attaching screws are tight.
3. Apply light grease or oil on new gasket furnished in filter package and place gasket firmly in groove at open end of filter base.
4. *Hand-tighten* (Figures 6A-10 and 6A-11) filter on hollow center stud until gasket contacts filter base, then complete tightening with additional $\frac{2}{3}$ turn of filter but *do not over tighten*. Use care when tightening to prevent "bunching" of gasket. *Do not use wrench to tighten cartridge to base.*
5. Add oil to bring to "FULL" mark on dipstick.
6. Run engine and check for leaks at filter to base gasket. Recheck crankcase oil level. If necessary, add oil to bring level to "FULL" mark on dipstick.

OIL FILTER BASE—4 CYLINDER ENGINE

1. Remove oil pressure warning light wire from terminal on filter base and remove filter assembly and gasket.
2. If new filter base is to be installed, transfer fittings from old to new base.
3. Install gasket and filter assembly on engine (replace gasket if damaged). Torque bolts to 20-35 lb. ft.
4. Attach oil pressure warning light wire.

CRANKCASE VENTILATOR INLET AND OUTLET

See General Lubrication Section.

THERMOSTAT

1. Drain radiator, disconnect upper hose and remove water outlet assembly from intake manifold.
2. Remove thermostat. Unless obviously defective, test the thermostat as follows, before replacing with new one:

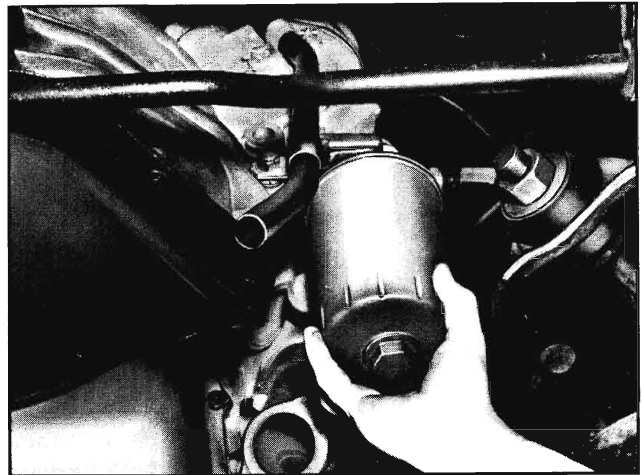


Fig. 6A-10 Installing Oil Filter on 4 Cylinder Engine

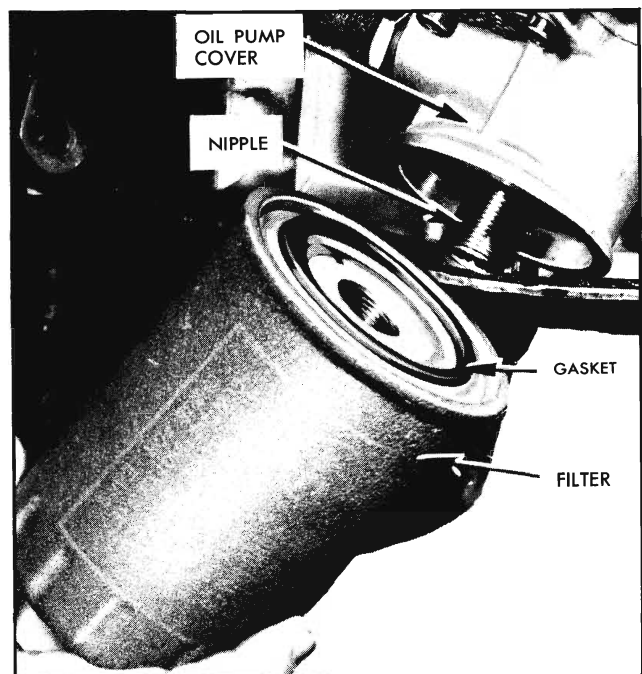


Fig. 6A-11 Installing Oil Filter on V-8 Engine

a. Immerse the unit and a thermometer in a container of water over a heater. While heating the water do not rest either the thermometer or thermostat on bottom of container as this will cause them to be at higher temperature than the water.

b. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

The thermostat (180°) valve should start to open at a temperature of 177°F. to 182°F. , and should be fully open at a temperature not in excess of 202°F. If thermostat does not operate at specified tempera-

tures it should be replaced as it cannot be adjusted.

3. Install thermostat with pellet or cartridge projecting down into water passage in intake manifold.

4. Using new gasket, install water outlet fitting. Torque bolts to 20-35 lb. ft.

5. Connect upper radiator hose.

6. Refill radiator to approximately three inches from top and check for leaks.

OIL PUMP—4 CYLINDER ENGINE

REMOVE

1. Remove engine oil pan (see section 6).

2. Remove oil pump attaching screws while holding oil pump in place. Carefully lower oil pump away from block with one hand while removing oil pump drive shaft with other hand.

3. Recondition oil pump if necessary (see below).

DISASSEMBLE

1. Remove cotter pin which retains floating screen to oil pump inlet, and remove screen (Fig. 6A-12).

2. Remove pressure regulator spring retainer, spring, and pressure regulator ball.

3. Remove oil pump body cover.

4. Remove driven gear and drive gear with shaft.

CAUTION: Mark gears before removing, so they have the same relationship when they are installed again.

CLEAN AND INSPECT

1. Clean all parts thoroughly. Screen must be thoroughly cleaned by using a fluid such as used for carburetor cleaning.

2. Inspect pressure regulator spring (Fig. 6A-12) for distortion, cracks, and wear on sides.

3. Inspect pressure regulator ball to see that it is not nicked or otherwise damaged.

4. Inspect pump body, drive gear shaft and cover for evidence of wear.

5. Inspect pump gears and end of drive gear shaft for wear.

6. Inspect oil pump drive shaft (distributor to pump shaft) for evidence of wear and cracks.

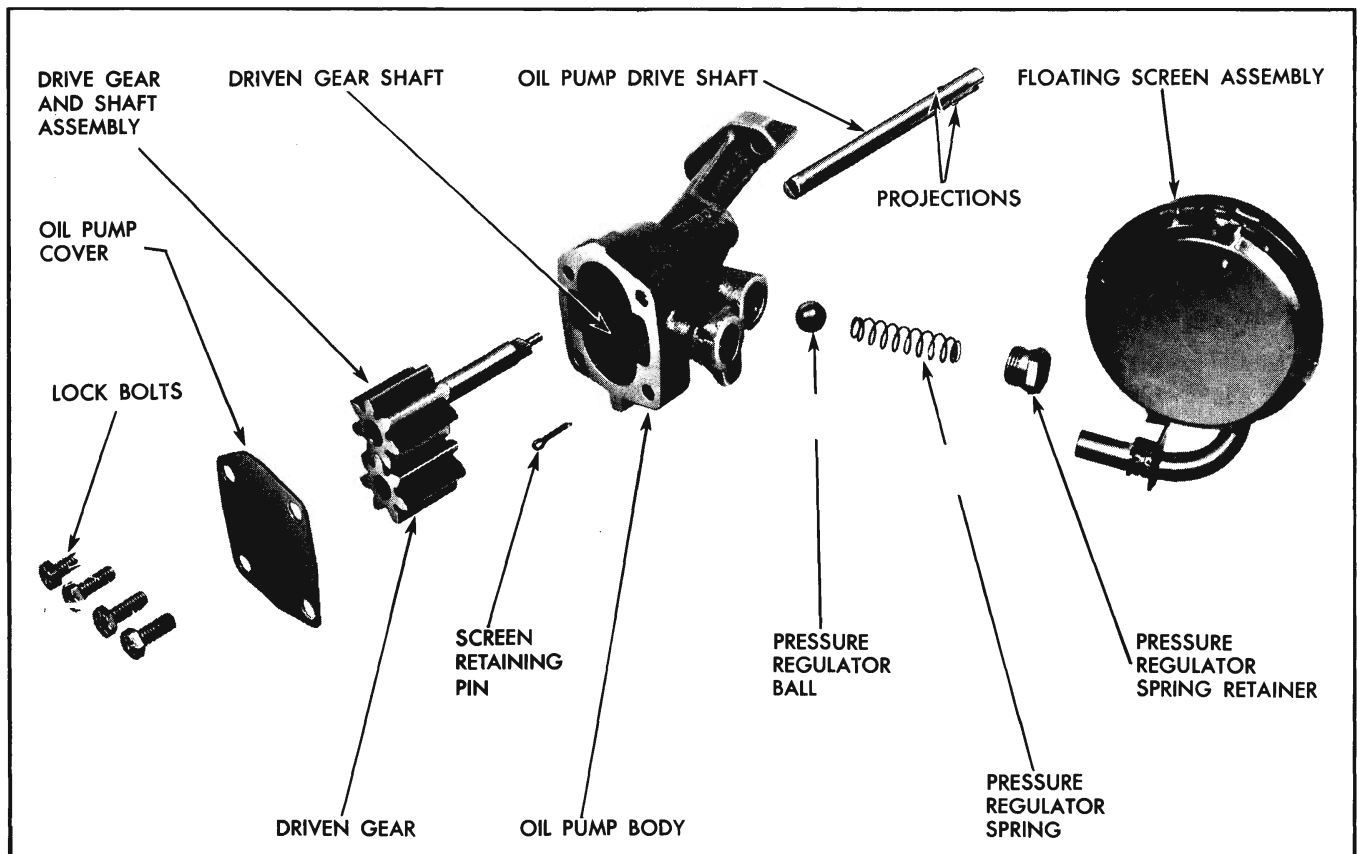


Fig. 6A-12 Oil Pump for 4 Cylinder Engine

ASSEMBLE

1. Install drive and driven gear in proper relationship.

2. Install cover and turn driveshaft by hand to insure that it turns freely and has a slight amount of end play. Torque bolts 10-20 lb. ft.

3. Install pressure regulator ball, spring and retainer. Torque retainer 8-18 lb. ft.

CAUTION: Do not attempt to change oil pressure by varying length of pressure regulator valve spring.

4. Install screen assembly on oil pump and install new cotter pin retainer. Bend both ends of cotter pin to avoid contact with oil pan.

INSTALL

1. Position drive shaft in distributor and oil pump drive gears (Fig. 6A-13).

2. Place pump against block using new gasket between pump and block.

3. Index drive shaft with pump drive gear shaft.

4. Install two attaching bolts with lock washers and torque to 20-35 lb. ft.

NOTE: Removal and installation of pump does not affect ignition timing, since the oil pump and distributor drive gear is mounted on the distributor shaft.



Fig. 6A-13 Positioning 4 Cylinder Engine Pump Drive Shaft

5. Install oil pan (see section 6).

OIL PUMP—V-8 ENGINE**REMOVE**

1. Remove oil filter cartridge.

2. Disconnect wire from oil pressure indicator switch in filter by-pass valve cap.

3. Remove screws attaching oil pump cover assembly to timing chain cover. Remove cover assembly and slide out oil pump gears.

CLEAN AND INSPECT

1. Wash off gears and inspect for wear, scoring, etc. Replace any gears not found serviceable.

2. Remove the oil pressure relief valve cap, spring and valve (see Fig. 6A-14). Remove the oil filter by-pass valve cap, spring, and valve.

3. Wash the parts thoroughly and inspect the relief valve for wear or scoring. Check the relief valve spring to see that it is not worn on its side or collapsed. Replace any relief valve spring that is questionable.

4. Check the valve in its bore in the cover. The valve should have no more clearance than an easy slip fit. If any perceptible side shake can be felt the valve and/or the cover should be replaced.

5. Check filter by-pass valve for cracks, nicks, or warping. The valve should be flat and free of nicks or scratches.

ASSEMBLE

1. Lubricate and install pressure relief valve and spring in bore of oil pump cover (see Fig. 6A-14).

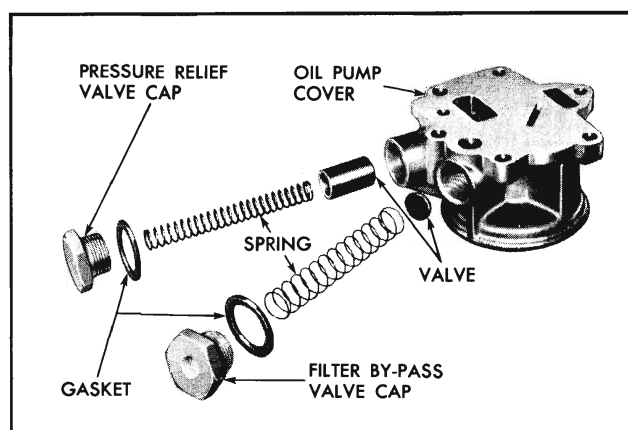


Fig. 6A-14 Oil Pump Cover Assembly for V-8 Engine

Install cap and gasket; torque cap to 30-35 lb. ft. with a reliable torque wrench. Do not over tighten.

2. Install filter by-pass valve flat in its seat in cover. Install spring, cap and gasket. Torque cap to 30-35 lb. ft. using a reliable torque wrench.

3. Install oil pump gears and shaft in oil pump body section of timing chain cover to check gear end clearance.

4. Place a straight edge over the gears and measure the clearance between the straight edge and the gasket surface (Fig. 6A-15). Clearance should be between .005" and .010". If clearance is less than .005" check timing chain cover gear pocket for evidence of wear.

5. If gear and clearance is satisfactory, remove gears and pack gear pocket full of petroleum jelly. *Do not use Chassis lube!*

6. Reinstall gears so petroleum jelly is forced into every cavity of the gear pocket and between the teeth of the gears. Place new gasket in position (see Fig. 6A-16).

NOTE: This step is very important. Unless the pump is packed with petroleum jelly, it may not prime itself when the engine is started.

7. Install cover assembly screws. Tighten alternately and evenly. The torque specification is 10-15 lb. ft.

8. Install filter cartridge (see p. 6A-11).

9. Install oil pressure switch in pump.

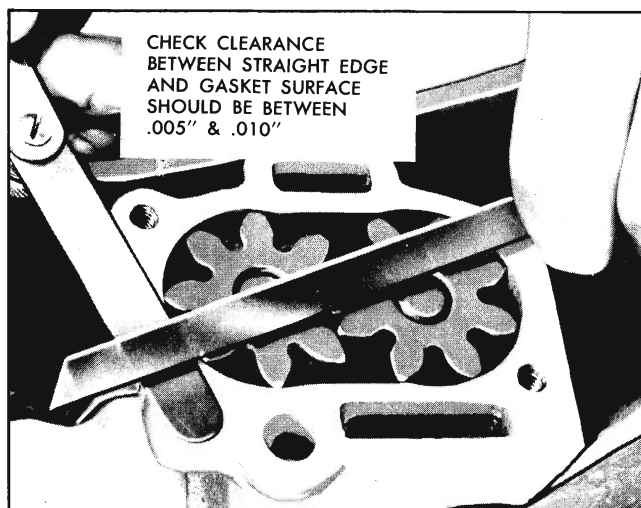


Fig. 6A-15 Measuring Gear to Cover Clearance

OIL PUMP PIPE AND SCREEN—V-8 ENGINE

REMOVE

1. Drain oil and remove oil pan.

2. Remove two screws attaching oil pump pipe and screen assembly to cylinder block.

3. Pry screen out of housing and examine for evidence of clogging due to deposit of sludge or other foreign material.

4. Clean the screen and housing thoroughly in solvent and blow dry with air cleaner hose.

5. Snap screen into housing.

INSTALL

1. Make sure gasket surface of block is smooth and free of dirt.

2. Place new gasket in position and install pipe and screen assembly with two bolts.

3. Torque bolts to 10-15 lb. ft. Do not overtighten.

WATER PUMP—4 CYLINDER ENGINE

NOTE: Water pump is serviced only as an assembly.

1. Drain radiator and engine block.

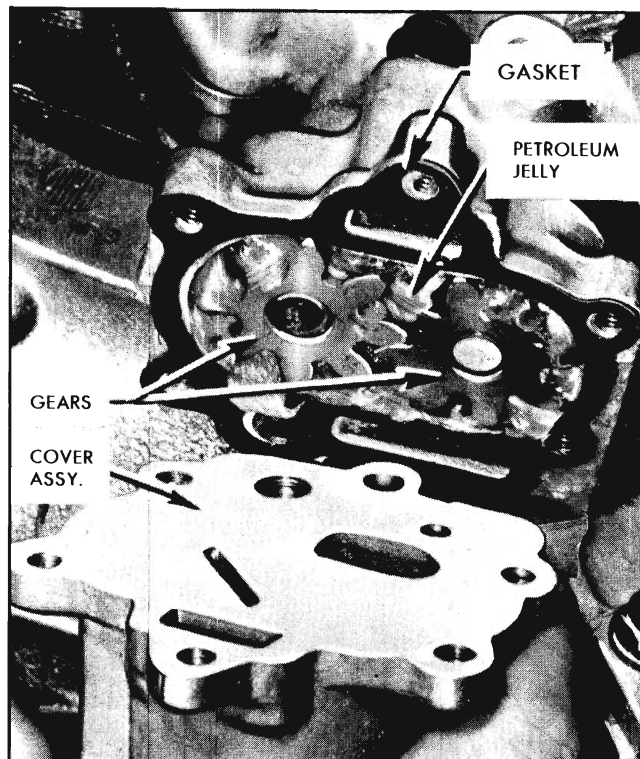


Fig. 6A-16 Installing Pump Gears and Gasket

2. Loosen generator at adjusting strap and remove fan belt from fan pulley.
3. Remove fan and pulley.
4. Remove pump.
5. Install pump by reversing above steps. When pump is installed on engine, drain hole will be at bottom. Tighten water pump attaching nuts to 15 lb. ft. torque. Adjust belt for proper tension as shown on chart, page 6A-17.

WATER PUMP—V-8 ENGINE

The water pump cover is die cast aluminum into which the water pump bearing outer race is shrunk fit. For this reason the cover, shaft bearing and hub are not replaceable. The shaft seal and impeller are the only replaceable parts of the water pump.

REMOVE

1. Drain cooling system being sure to drain into a clean container if anti-freeze solution is to be saved.
2. Remove fan blade, and pulley or pulleys from hub on water pump shaft.
3. Disconnect hose from water pump inlet and heater hose from nipple. Remove pump assembly and gasket from timing chain cover.
4. Check pump shaft bearings for end play or roughness in operation. If bearings are not in serviceable condition, the assembly must be replaced.

SEAL REPLACEMENT

1. Pull impeller from pump shaft using care to avoid any end thrust on bearings (Fig. 6A-17).
2. Remove carbon washer, rubber bellows and spring from the brass sleeve that is pressed into the pump housing. It is not necessary to remove the brass sleeve if it is in good condition. If necessary to remove brass sleeve, drive out with punch inserted through vent hole in pump body.
3. Clean pump cover to remove seals, old gasket, etc. Do not use cleaning solvent as solvent may leak into bearings and destroy the lubricant.

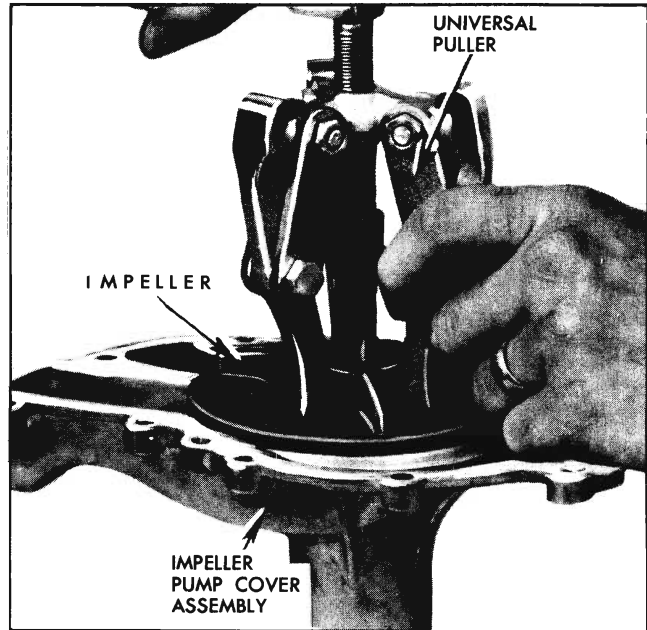


Fig. 6A-17 Pulling V-8 Water Pump Impeller

4. a. If the old brass seal sleeve was removed from pump body, carefully press new seal assembly into body, using thick walled tube of suitable diameter.
- b. If old sleeve was not removed, separate the new seal sleeve from seal bellows by soaking in hot water to soften cement used to hold seal parts together for ease of handling. Install the carbon washer bellows and spring in the old sleeve being careful to engage notches of washer with driving dents of brass sleeve.
5. Coat face of carbon washer and impeller hub with rust preventative and press impeller on shaft until rear face of impeller hub is flush with end of shaft.

CAUTION: Avoid any pressing technique that is likely to impose thrust loads on water pump bearings. Pump must be supported on forward end of shaft only while pressing on impeller.

INSTALL

1. Make sure the gasket surfaces on pump and timing chain covers are clean. Install pump assembly with new gasket. Bolts with lock washers must be tightened uniformly.

2. Connect radiator hose to pump inlet and heater hose to nipple, then fill cooling system and check for leaks at pump and hose joints.

3. Install fan pulley or pulleys and fan blade, tighten attaching bolts securely. Adjust belt for proper tension as shown on chart page 6A-17.

RADIATOR—REMOVE AND REPLACE

1. Drain radiator
2. Disconnect overflow, upper and lower radiator hoses.
3. Remove radiator fan shield (Fig. 6A-18).
4. Remove radiator.
5. To install radiator, reverse above procedure.

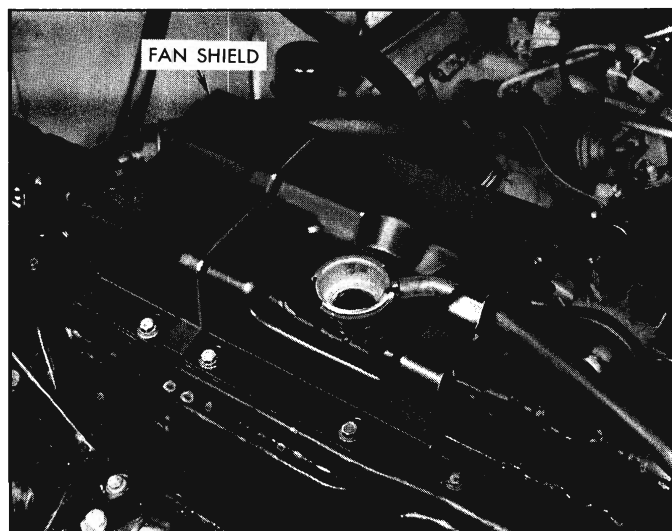


Fig. 6A-18 Radiator Fan Shield

TROUBLE DIAGNOSIS

SYMPTOM	CAUSE
Cooling system loses water.	<ol style="list-style-type: none"> 1. Make sure owner is not trying to keep radiator filled to top, and is not filling while cold. The expansion and contraction of water during operation will cause level to drop to several inches below the top of the filler neck. Once the level becomes stabilized it will not change appreciably during operation. 2. If cooling system has excess soluble oil, drain and refill. 3. Check for leaks from radiator or hose connections, including heater. 4. Check for crack in block. Pull engine oil dipstick to check for water in crankcase. 5. Remove rocker arm cover and check for cracked cylinder head. 6. Remove cylinder head and check gasket. While head is off, check for crack in head or block.
Buzzing noise from radiator cap.	This is caused by the relieving of excessive pressure when radiator boils. Check causes of overheating.
Overheating (coolant actually boils)	<ol style="list-style-type: none"> 1. Check engine thermostat. 2. Check for driving conditions which may cause overheating. Prolonged idling, start and stop driving in long lines of traffic on hot days, climbing steep grades on hot days, etc. will occasionally cause coolant to boil. 3. Check engine operation to make sure tune-up is not needed. Timing retarded past TDC may cause overheating. NOTE: Timing must be set with vacuum advance line disconnected.

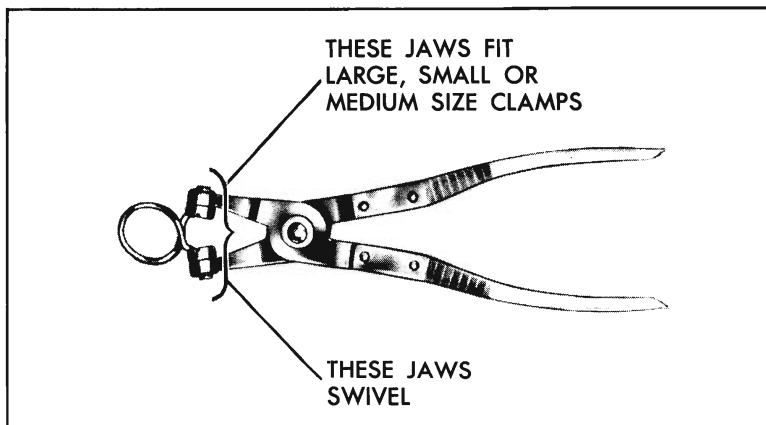
SYMPTOM

CAUSE

4. Check fan belt for excessive looseness.
5. Clean debris from radiator.
6. Clean cooling system.
7. Remove cylinder head and check water passages in head and block for obstructions.

DRIVE BELTS FOR PONTIAC TEMPEST ENGINE AND ACCESSORY DRIVE COMBINATIONS

Belt Width	Belt Name	Borroughs Gauge
3/8"	Water Pump and Generator Belt (4 Cylinder Engine)	70-75 lbs.
3/8"	Water Pump and Generator Belt (V-8 Engine)	70-75 lbs.
3/8"	Power Steering Pump Belt (4 Cylinder and V-8 Engines)	70-75 lbs.
3/8"	Air Conditioning Comp. Drive Belt (4 Cylinder Engine)	70-75 lbs.
3/8"	Air Conditioning Comp. Drive Belt (V-8 Engine)	70-75 lbs.



SPECIAL TOOL

J-8404 Universal Hose Clamp Pliers

SPECIFICATIONS

COOLING SYSTEM

Type	Pressure with vent
Operating Pressure	15 psi
Pump Type	Centrifugal
Pump and Fan Drive	V-Belt
Pump Bearings	Sealed Ball Bearings
Radiator	Tube and Center
Core Area	309.7 sq. in.
Thermostat	180°
Fan Diameter—Standard	17"
Fan Diameter—w/Air Conditioning	
4 Cylinder Engine	17"
V-8 Engine	18"
Number of Blades—Standard Fan	4
Number of Blades—Air Conditioning Fan	7
Cooling System Capacity	
Without Heater	11½ qts.
With Heater	12½ qts.
With Air Conditioning	add ½ qt.

LUBRICATION

Type	Pressure
Oil Pressure at 2600 r.p.m.	30-40 psi
Lubricant Capacity When Refilling	4 qts.
	(5 qts. if filter element is changed)
Oil Pump Type	Spur Gear

ENGINE FUEL

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
Carburetor Air Cleaner and Silencer	6B-1	Adjustments on car	
Heat Control Valve	6B-1	Four Cylinder	6B-25
Throttle Return Check and Dash Pot	6B-2	Eight Cylinder	6B-27
Carburetor Linkage	6B-2	Overhaul and adjustment	6B-27
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Rochester B and BC Model 7019061 and 7019062		Carburetor General	6B-38
Description	6B-7	Trouble Diagnosis	6B-38
Adjustments on car	6B-11	Fuel Pump	
Overhaul and adjustment	6B-12	Description	6B-39
Rochester 4 GC Model 7019079, 7019066 and		Overhaul and adjustment	6B-39
7020078		Trouble Diagnosis and Testing	6B-41
Description	6B-20		

CARBURETOR AIR CLEANER AND SILENCER

A combined air cleaner-silencer is used on all models. These units filter air entering the carburetor to keep abrasive dust from being carried into the engine, and reduce air induction noises.

Two types of air cleaners are available:

Standard and heavy duty. The heavy duty filter is intended for areas where the standard air cleaner is inadequate.

The standard air cleaner used on one barrel, four cylinder engine contains an oil moistened aluminum mesh filter element which catches dust particles as the air passes through.

The heavy duty type of filter is used on the remainder of the applications. This filter contains an oiled polyurethane filter element.

For service instruction see lubrication Section 2.

HEAT CONTROL VALVE (FIG. 6B-1)

A thermostatically controlled valve in the outlet of the exhaust manifold on the four cylinder engine blocks the passage of exhaust gases out of the manifold when the engine is cold (Fig. 6B-2). Exhaust gases will then pass through to crossover passage in the intake manifold heating the manifold stove. From

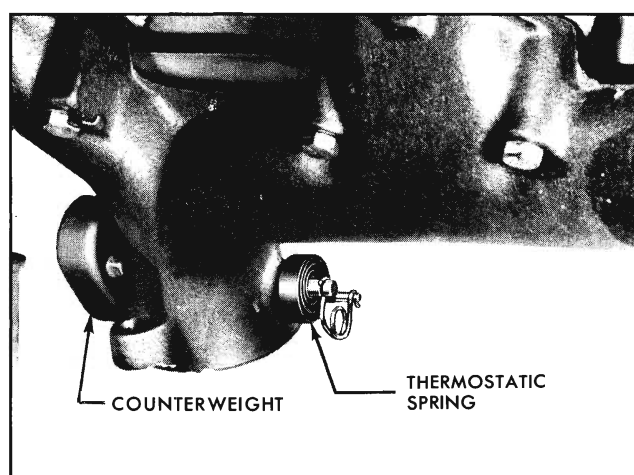


Fig. 6B-1 Thermostatic Heat Control Valve

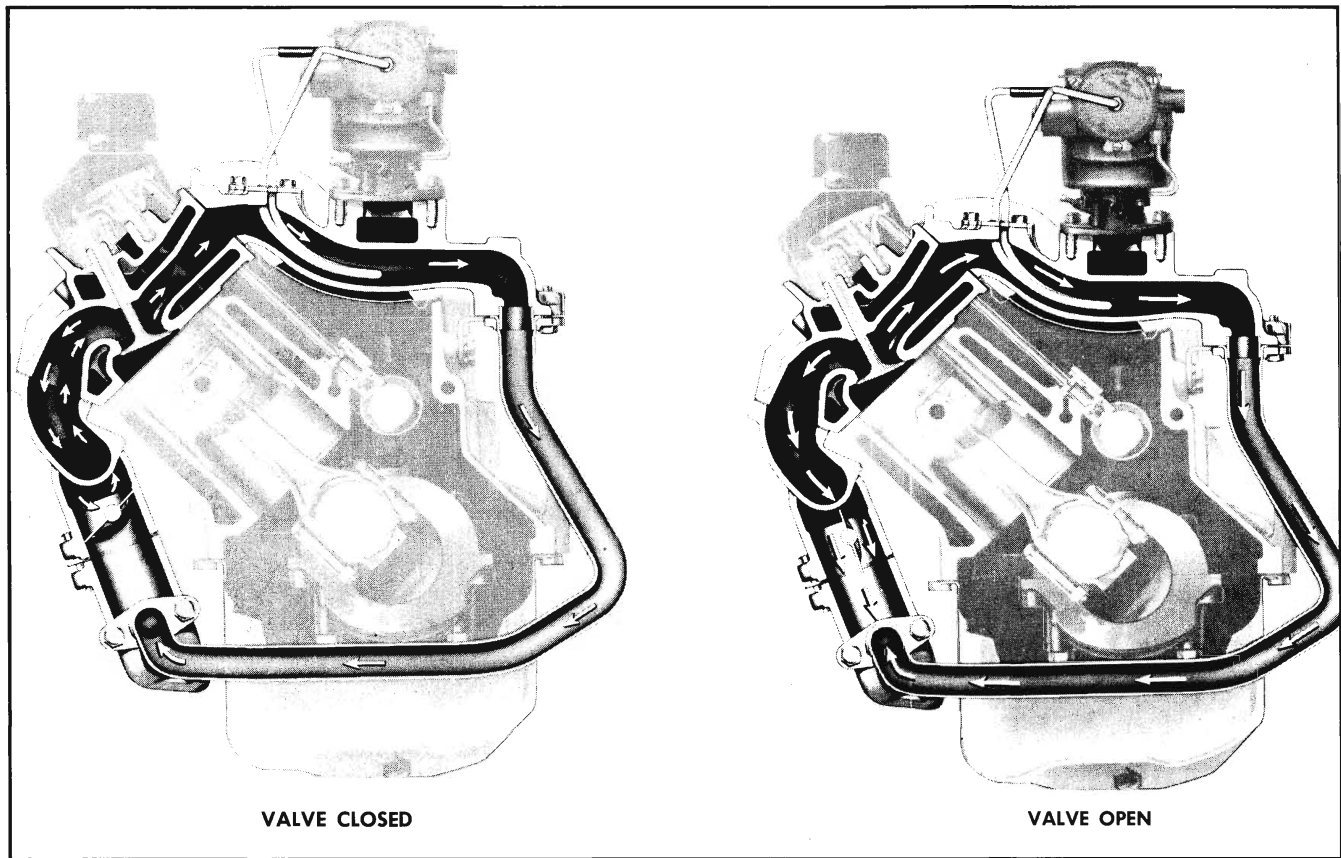


Fig. 6B-2 Operation Heat Control Valve

the intake manifold the gases pass through the exhaust crossover pipe and into the exhaust system. As the engine warms up, the thermostatic valve opens allowing a greater amount of the exhaust gases to pass directly out the exhaust manifold and gas to pass through the crossover pipe.

THROTTLE RETURN CHECK AND DASH POT

THROTTLE RETURN CHECK

DESCRIPTION

All Tempest four cylinder engines with automatic transmissions are equipped with a throttle return check device which is mounted on the carburetor. The throttle return check is designed to open the throttle valves to increase engine speed slightly and prevent stalling when engine vacuum drops. It also acts to retard throttle closing when the driver suddenly takes his foot off the accelerator pedal.

DASH POT

DESCRIPTION

All eight cylinder engines with automatic transmission are equipped with a dash pot which is mounted on the engine. The dash pot acts to retard throttle closing when the driver suddenly takes his foot off the accelerator pedal.

ACCELERATOR LINKAGE ADJUSTMENT

1. Check accelerator pedal height. If necessary, adjust linkage (Fig. 6B-3-4-5) to obtain correct height.
2. Depress accelerator to floor and check to see that carburetor throttle valves are wide open.

NOTE: Disconnect automatic transmission T.V. cable from carburetor.

3. For adjustment of transmission T.V. cable see Section 7A.

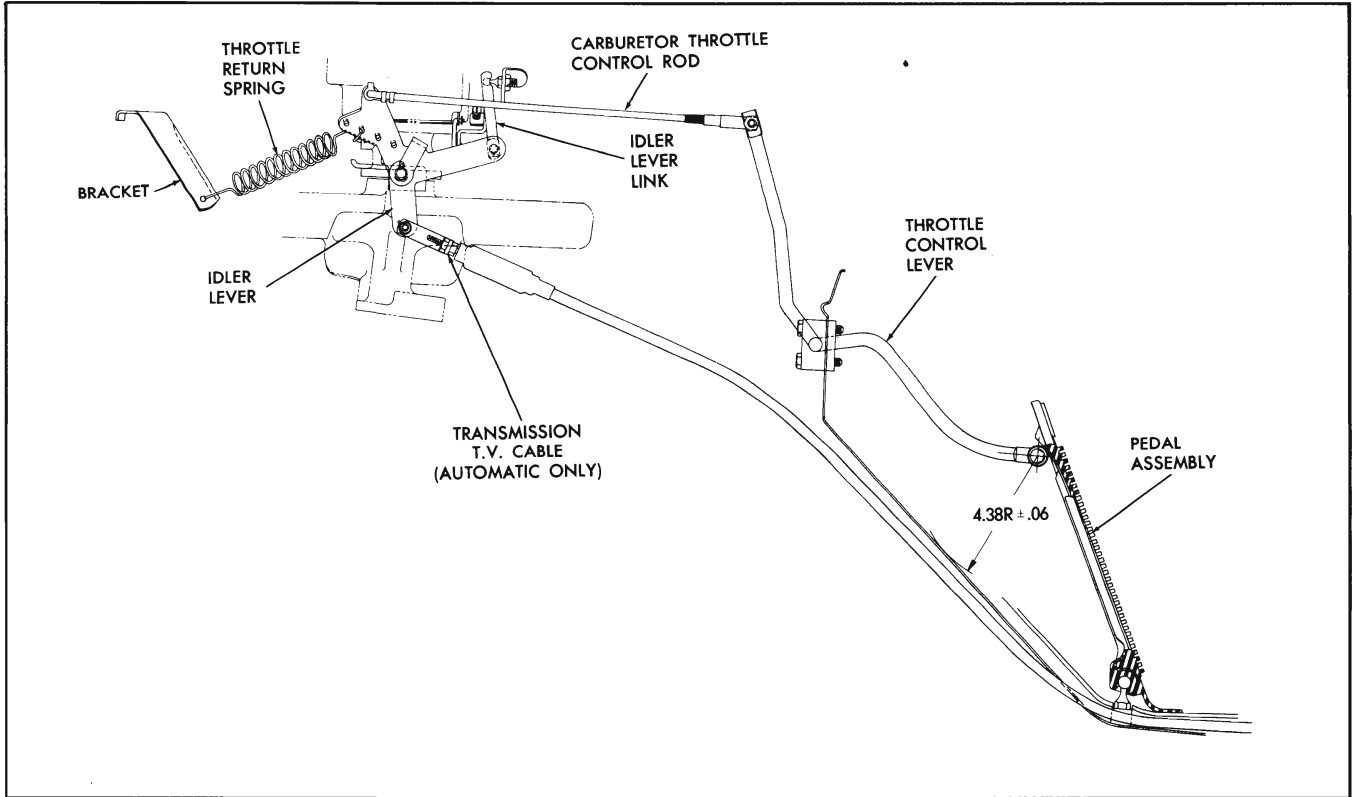


Fig. 6B-3 Four Cylinder—One Barrel—Accelerator Linkage

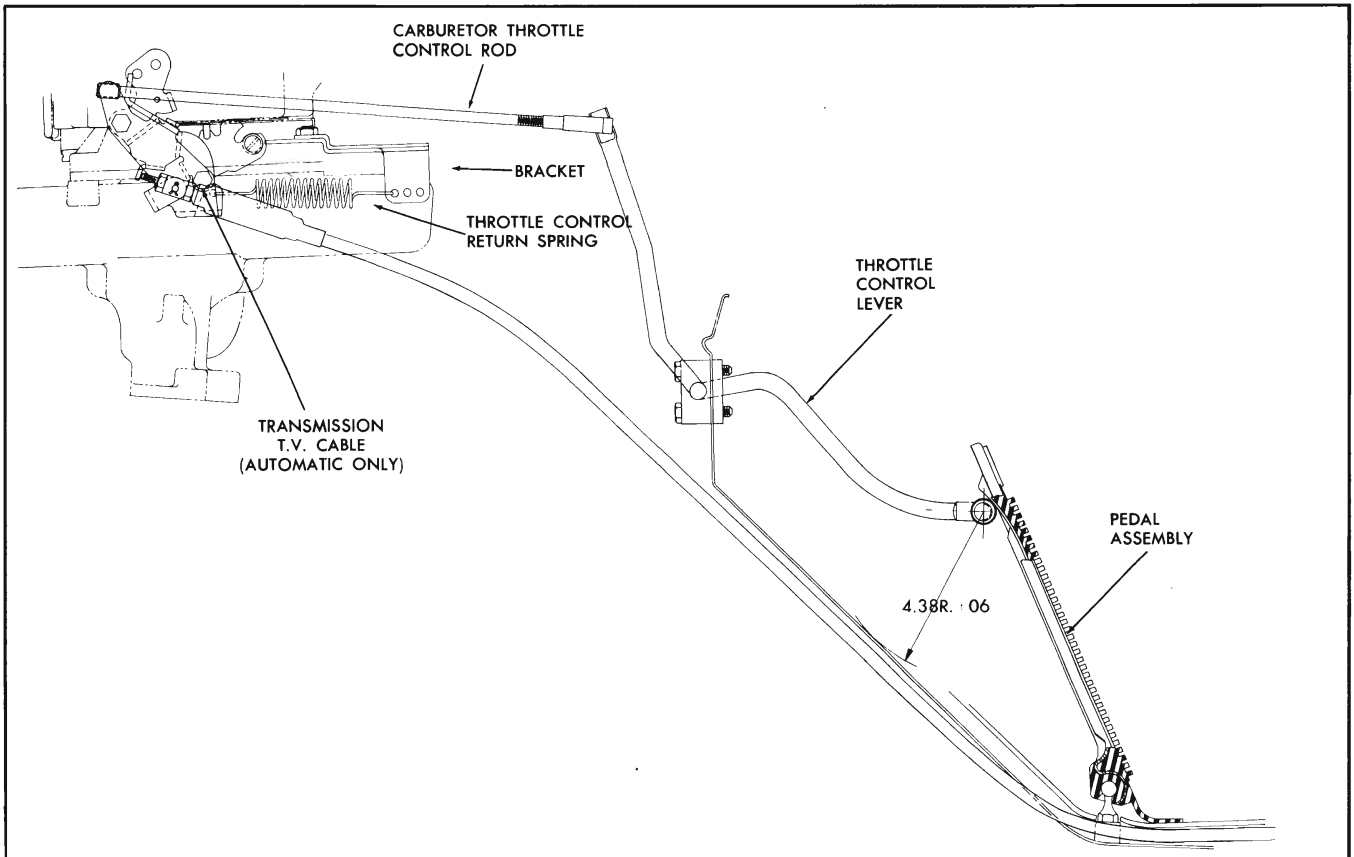


Fig. 6B-4 Four Cylinder—Four Barrel—Accelerator Linkage

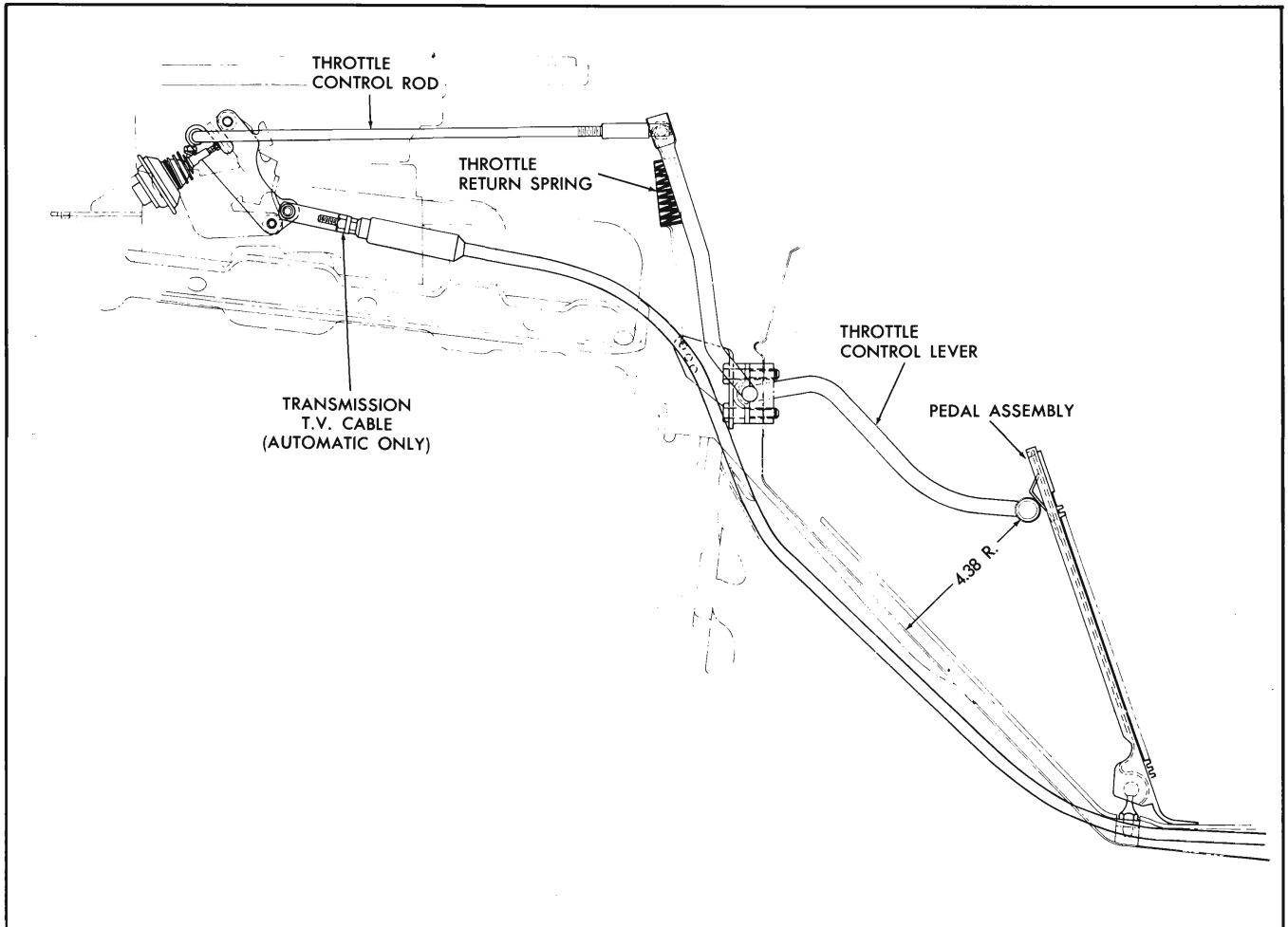


Fig. 6B-5 Eight Cylinder Accelerator Linkage

POSITIVE CRANKCASE VENTILATION SYSTEM

GENERAL DESCRIPTION

The function of the positive crankcase ventilation system is to reclaim unburned fuel, prevent dilution and contamination of lubricating oils, and reduce the amount of harmful and irritating gases discharged into the atmosphere. The positive crankcase ventilation system utilizes the vacuum in the intake manifold to remove blow by gases from the crankcase and return them to the combustion chambers to be burned. The crankcase vent pipe is replaced by a valve and rubber hose, which carry the gases from the crankcase to the intake manifold.

The valve automatically meters the flow of gases so that the normal operation of the engine is not

disturbed. Valve is designed to maintain an almost constant rate of flow, regardless of manifold vacuum. Should the engine backfire, the valve is automatically held closed by the reverse air flow to prevent fuel vapor from entering crankcase.

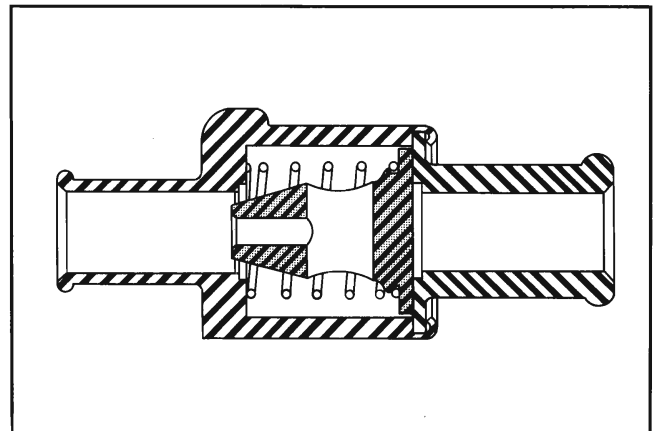


Fig. 6B-6 Crimped Type Valve

PERIODIC SERVICE

Once a year or 12,000 miles the positive crankcase ventilation system should be serviced as follows:

1. Disconnect both ends of the hose and blow it out with compressed air. If the hose cannot be freed of obstructions, replace with new hose.

2. Remove crankcase ventilation valve assembly from rubber grommet.

3. The Tempest four cylinder engine is equipped with a crimped type valve (Fig. 6B-6), no further disassembly is possible and a new valve should be installed.

4. The Tempest eight cylinder engine is equipped with a take-apart type valve (Fig. 6B-7), proceed as follows:

- a. Disassemble valve, clean parts in solvent and blow dry.

- b. Inspect parts of valve for damage or excessive wear and replace if necessary.

- c. Install spring on valve by pushing valve, tapered end first, into the spring until the end of spring is seated in the groove just under the head of the valve. Unless the spring and valve are properly assembled, the valve will not contact the seat squarely and will not close properly.

- d. Place valve in valve body, tapered end first, install male threaded end of body and tighten securely.

5. Clean crankcase and intake manifold connectors using care not to allow dirt to enter openings.

6. Remove crankcase oil filler cap. Clean cap in solvent, blow dry, and re-oil.

7. Reinstall positive crankcase ventilation system.

8. Adjust carburetor idle to manufacturer's specifications.

INSTALLATION INSTRUCTIONS

TEMPEST FOUR CYLINDER, SINGLE BARREL CARBURETOR (Fig. 6B-8)

1. Remove air cleaner.
2. Remove entire existing ventilator outlet.
3. Remove plug on intake manifold.
4. Assemble valve and grommet.

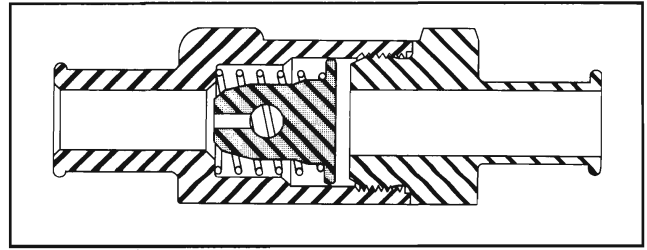


Fig. 6B-7 Take-Apart Type Valve

5. Apply soap or rubber lubricant to tapered surface of grommet and install in push rod cover at the same hole old outlet pipe and seal were removed.

6. Install fitting into hole in manifold.

7. Assemble hose to fittings, using a thin coat of soap or rubber lubricant if necessary.

8. Attach bracket with intake manifold bolt and secure hose.

9. Readjust carburetor idle speed and mixture setting.

10. Check carburetor and transmission throttle control linkage adjustment.

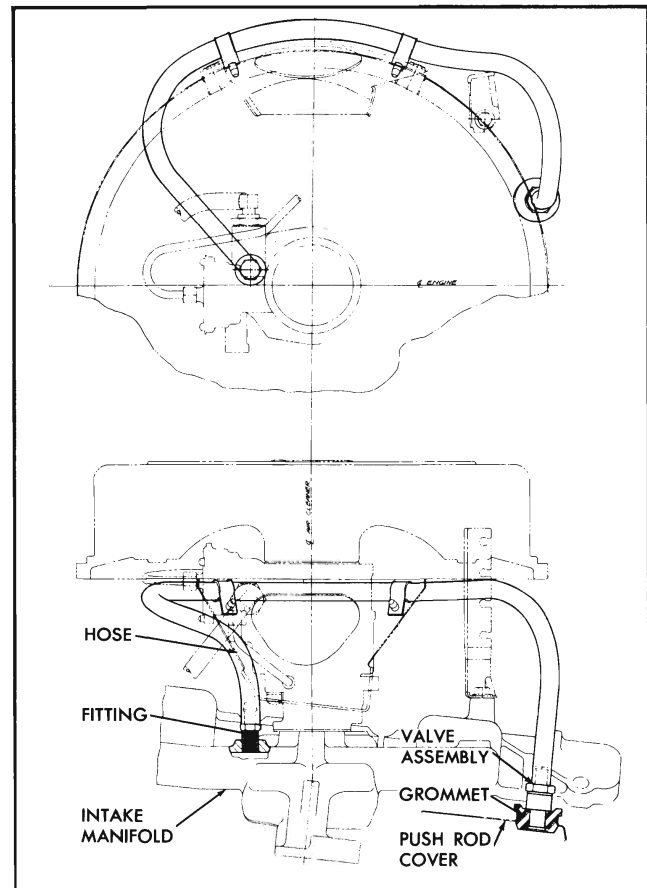


Fig. 6B-8 Installation Drawing Tempest Four Cylinder One Barrel Carburetor

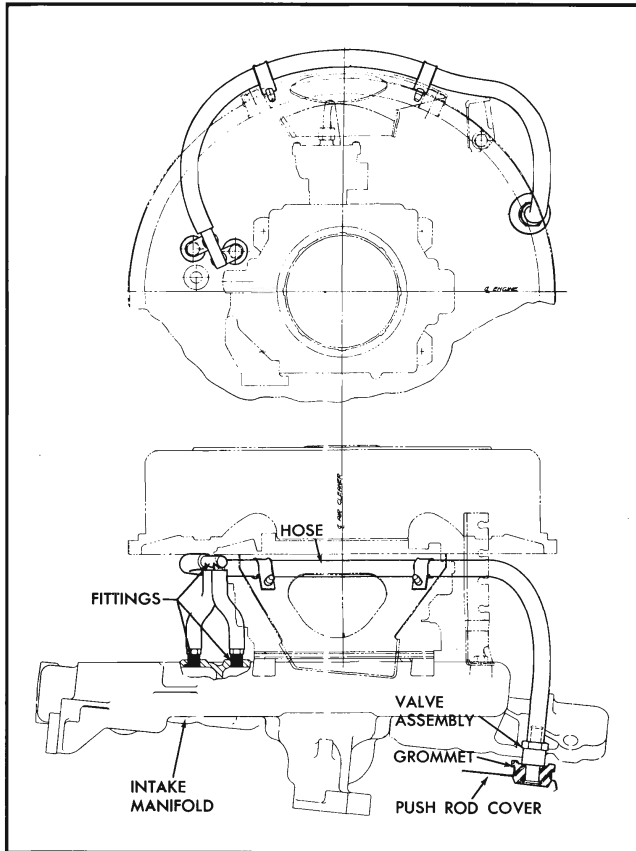


Fig. 6B-9 Installation Drawing Tempest Four Cylinder Four Barrel Carburetor

TEMPEST FOUR CYLINDER, FOUR BARREL CARBURETOR (Fig. 6B-9)

1. Remove air cleaner and (2) plugs on intake manifold.
2. Remove entire existing ventilator outlet.
3. Assemble valve and grommet.
4. Apply soap or rubber lubricant to tapered surface of grommet and assemble to push rod cover at the same opening from which outlet pipe and seal were removed.
5. Assemble elbow and fittings into holes in manifold.
6. Assemble hoses to fittings, using a thin coat of soap or rubber lubricant if necessary.
7. Assemble connector to hoses as shown.
8. Attach bracket with intake manifold bolt and insert hose.
9. Readjust carburetor idle speed and mixture setting.
10. Check carburetor and transmission throttle control linkage adjustment.

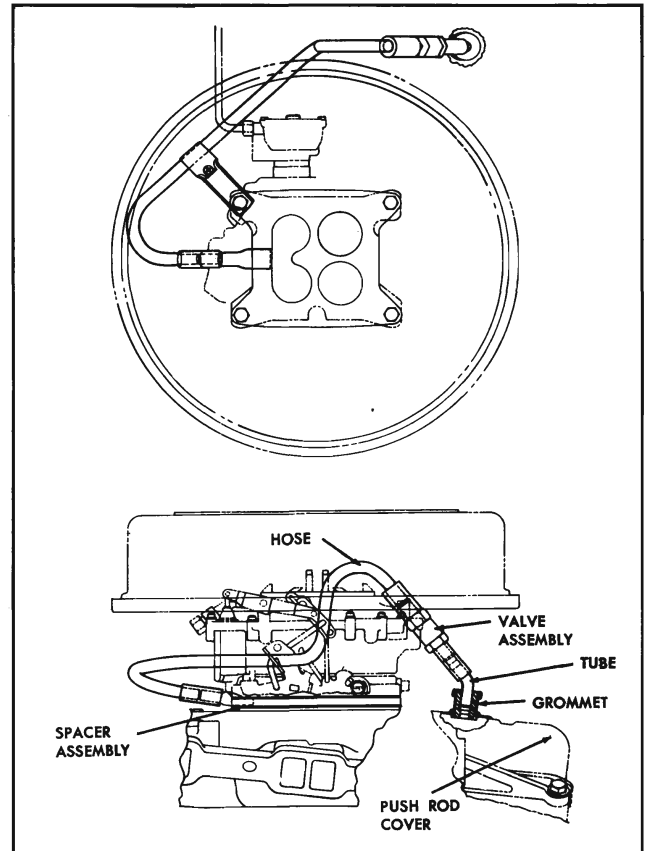


Fig. 6B-10 Installation Drawing Tempest Eight Cylinder Four Barrel Carburetor

TEMPEST V-8, FOUR BARREL CARBURETOR (Fig. 6B-10)

1. Remove entire existing ventilator outlet.
2. Remove air cleaner, carburetor and gasket.
3. Assemble tube and grommet.
4. Apply soap or lubricant to outer surface of grommet and install in rocker arm cover at the same opening from which the old outlet pipe and seal were removed.
5. Assemble (2) gaskets, adapter, carburetor and air cleaner. Secure with four bolts.
6. Assemble short hose and valve to tube then assemble hose to adapter and valve using a thin coat of soap or rubber lubricant if necessary.
7. Bend existing choke heat tube, fuel lines and vacuum lines as required.
8. Readjust carburetor idle speed and mixture setting.
9. Check carburetor adjustment and throttle control linkage adjustment.

ROCHESTER B AND BC CARBURETORS

The model B and BC carburetors are used on the four cylinder engine, model B on Synchro-Mesh transmission applications, and BC on automatic transmission applications. The model B is a manual choke carburetor.

Model BC incorporates a Rochester-GM automatic choke.

The two models are identical except for the choke system, distributor vacuum take off system and the throttle return check assembly.

CARBURETOR MODEL NO.	USED ON	THROTTLE BORE SIZE
7020061	Synchro-Mesh Transmission Four Cylinder Engine	1 $\frac{9}{16}$ "
7020066	Automatic Transmission Four Cylinder Engine	1 $\frac{9}{16}$ "

DESCRIPTION

Both B and BC model carburetors incorporate several distinct features. The carburetor features a concentric float bowl, which completely surrounds the main bore of the carburetor. The design of the float bowl in conjunction with the centrally located discharge nozzle prevents fuel loss on inclined roads. Regardless of the angle the car assumes, the fuel level is below the nozzle spill point at all times.

A second feature of this carburetor is the unique design of the main well assembly. This assembly contains the main metering jet and power valve. It is attached to the carburetor air horn and is suspended in the float bowl with the suspension of the main well in the bowl. Engine heat cannot be directly transmitted to the main passageway through the main metering jet.

On the model BC carburetor the choke housing is located on the air horn and is connected to the manifold vacuum by an external steel tube. Clean, hot air is supplied to the choke from the air horn located below the air cleaner, from here it is drawn through the heat stove in the manifold to the choke through steel tubing.

Both the model B and BC carburetor incorporates the six systems of carburetion: float, idle, part throttle, pump, power, and choke.

FLOAT SYSTEM (Fig. 6B-11)

The model B and BC carburetors employ the conventional float needle and seat to control fuel level in the float bowl. With the concentric float bowl design, dual floats are used to maintain a constant fuel level throughout all operating ranges and engine

angles. The float bowl is designed so that the fuel is centrally located around the main well, so the efficient carburetor metering may be maintained under all engine operating conditions.

Fuel entering the carburetor first passes through the inlet filter located behind the fuel inlet nut. The fuel inlet filter is cylindrical in shape and it is held in place against the fuel inlet nut by a small pressure release spring. The filter element can be easily removed for periodic cleaning by removing the fuel inlet line and nut. Should the filter become clogged, fuel flow will not be restricted because the filter element will be pushed off its seat, against the pressure release spring, allowing fuel to temporarily by-pass the filter element. A small fibre gasket seals the fuel filter element against the inside of the fuel inlet nut.

As the fuel level drops in the carburetor bowl, the twin floats also drop, thus moving the fuel inlet needle off its seat. The pressure from the fuel pump, forces fuel through the filter element into the fuel

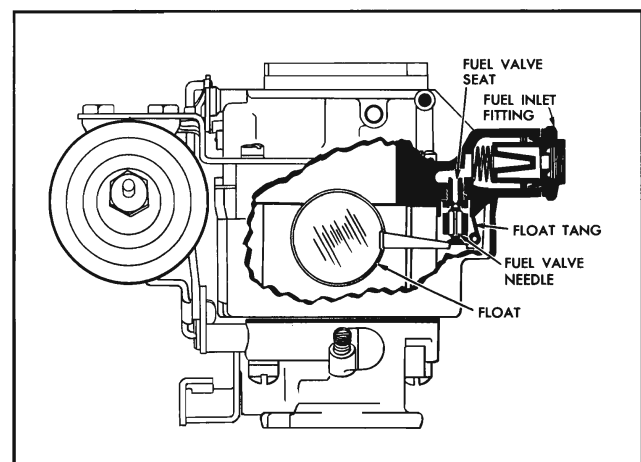


Fig. 6B-11 Float System

inlet passage, past the float needle seat, into the fuel bowl. As the fuel level rises, the floats rise and when the correct fuel level is reached the fuel is shut off at the float needle seat, thereby keeping the fuel level constant. The float tang prevents the float from moving too far downward into the float bowl. This tang also prevents the float needle from dropping out of the seat during disassembly and assembly operations.

A vent transmits air pressure from beneath the air cleaner to the fuel in the float bowl. The amount of fuel metered by the carburetor is dependent upon the pressure in the float causing fuel to flow. By locating the vents below the air cleaner, or internally, the carburetor automatically compensates for the air cleaner restriction, since the same pressure causing air to flow will also be causing fuel to flow.

The external idle vent, located in the top of the float bowl, vents the bowl to the atmosphere. In this way any fuel vapors which may form in the bowl during hot operation, will be vented to the outside.

IDLE SYSTEM (Fig. 6B-12)

The idle system consists of the idle tube, idle passages, idle air bleeds, idle mixture adjustment needle, idle discharge holes, and an idle speed adjustment screw.

A fixed air bleed in the throttle valve acts as a deterrent to stalling due to gum formation in the throttle valve. The fixed idle air bleed maintains a constant idle air flow for part of the idle air requirement, while the idle speed adjusting screw regulates the remainder of the idle air. The engine idle speed can be adjusted by the idle speed adjusting screw.

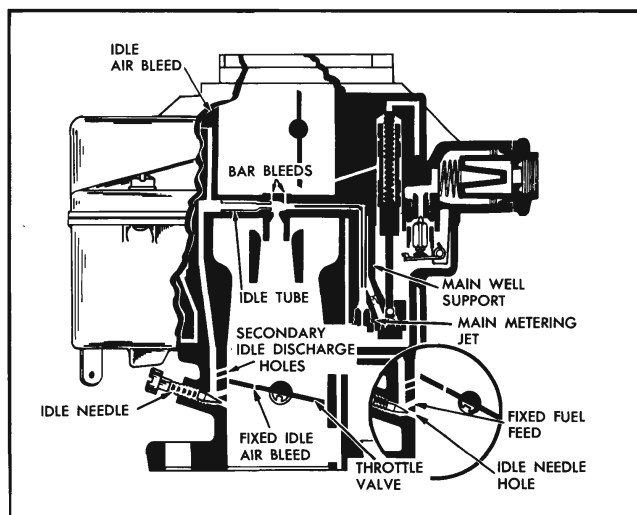


Fig. 6B-12 Idle System

The idle mixture needle hole is in the high vacuum area below the throttle valve while the fuel bowl is vented to atmospheric pressure. Vacuum can be called lack of pressure, so a high vacuum area can be spoken of as an area of low pressure. There is considerable pressure difference between the normal atmospheric pressure on the fuel in the bowl and the low pressure (or high vacuum) at the idle mixture needle hole. The fuel/air mixture will be forced by atmospheric pressure to occupy any low pressure area. Due to the difference in pressure the fuel will flow from fuel bowl to the engine manifold.

The atmospheric pressure, acting on the fuel in the bowl, forces fuel through the main metering jet into the main well. The fuel travels first through the primary idle tube and vertical channel and then through the horizontal cross bar in the air horn. The secondary idle tube which controls idle quantity is in the cross bar and is located beyond the nozzle opening. Air mixes with the fuel at the air bleeds in the center of the cross bar and the idle air bleed at the top of the vertical idle channel.

The fuel/air mixture then travels through the vertical passage in the fuel bowl to the throttle valve surface. The fuel/air mixture then travels part way around the throttle bore through a horizontal passage in the bowl and starts down the vertical passage in the throttle body. Here more air is added to the mixture from the idle discharge holes. The fuel/air mixture then passes around the idle adjustment needle which regulates the amount of fuel/air mixture admitted to the carburetor bore. The mixture then travels through the idle needle hole where more air is added to the mixture. It then travels into the intake manifold.

Except for the variable of the idle mixture adjustment needle the idle system is specifically calibrated for low engine speeds.

The model BC carburetor will be equipped with a vacuum operated throttle return check which will be attached to the air horn with screws. The return check is designed to open the throttle valve to increase engine speed slightly and prevent stalling when engine vacuum drops suddenly. It also acts as a retard to throttle closing when the driver suddenly takes his foot off the accelerator pedal.

PART THROTTLE SYSTEM (Fig. 6B-13)

When the throttle valve is opened, there is a change in pressure differential points. Opening of the throttle valve progressively exposes the idle discharge holes

to manifold vacuum and the air stream with the result that they deliver additional fuel/air mixture for fast idle engine requirements.

Further opening of the throttle valve increases the speed of the air stream passing through the venturi, lowering the pressure (or raising the vacuum) in the small venturi area of the carburetor bore. At the same time, the throttle valve is moved away from the wall of the bore, progressively reducing the vacuum and thus the mixture flow at the idle discharge holes.

Since the low pressure point is now in the small venturi area, fuel and fuel/air mixture will be forced from the fuel bowl through the main metering system into the venturi as follows:

The fuel passes through the main metering jet into the main well, where it rises in the main well tube. The fuel continues up the main well tube to the horizontal cross-bar in the air horn and across the cross-bar to the main nozzle. At this point air is bled into the fuel and the mixture is discharged through the main discharge nozzle into the small venturi. Here the air/fuel mixture mixes with additional air and moves on to the bore of the carburetor and into the intake manifold.

The calibration of the main metering jet and air bleeds in the cross-bar maintain economical fuel/air ratios through the part throttle or cruising range. Therefore, no adjustments are necessary on the part throttle system of the B and BC carburetors.

POWER SYSTEM (Fig. 6B-14)

A vacuum operated power system is used on the carburetor to provide additional fuel for sustained high speed operation or increased road load power. A direct manifold vacuum passage within the carburetor to the engine intake manifold operates this system. At any manifold vacuum below approximately 5" of mercury, it forces the power actuating piston down.

The end of the power piston unseats the spring loaded ball in the power valve. Fuel passes around the ball into the base of the main well support. The calibrated power restriction meters the fuel prior to joining the fuel from the main metering jet. Conversely as the manifold vacuum rises above 5" of mercury, the power piston is drawn up immediately to the up position and the spring loaded ball of the power valve closes returning the carburetor to the economical part throttle "mixture". There is no adjustment required for the power system.

The relief passage which is drilled from the bore of the air horn to the power piston passage serves to

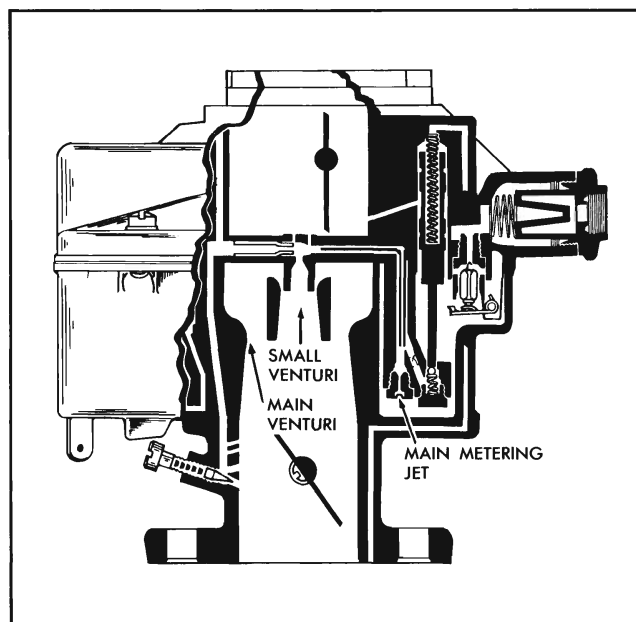


Fig. 6B-13 Part Throttle System

relieve any vacuum built up around the piston diameter. This vacuum, if unrelieved, will draw fuel past the piston and down the vacuum passage into the manifold, resulting in an overly rich condition.

PUMP SYSTEM (Fig. 6B-15)

Extra fuel for smooth, quick acceleration is supplied by a double spring pump plunger. Rapid opening of the throttle valve, as in the case where accelerating from low speeds, causes an immediate increase in air velocity. Since fuel is heavier than air, it requires a short period of time to "catch up" with the air flow. To avoid a leanness during this momentary lag, the accelerator pump furnishes a quantity of

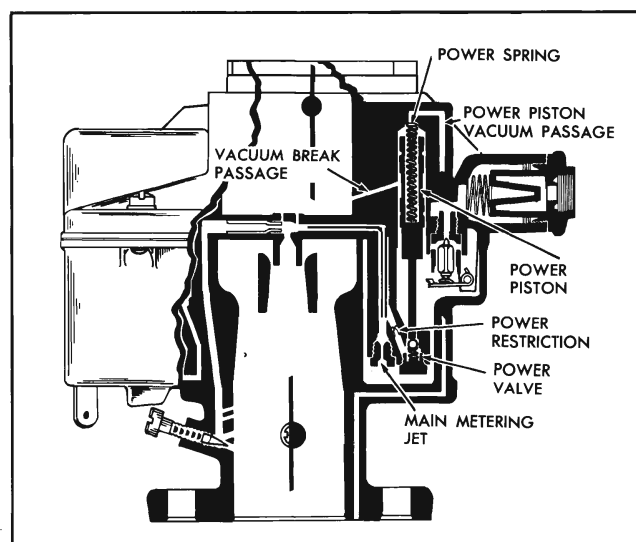


Fig. 6B-14 Power System

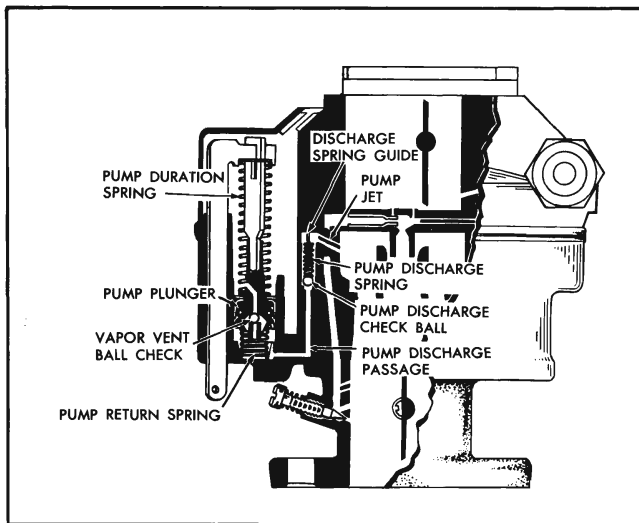


Fig. 6B-15 Pump System

liquid fuel sprayed into the air stream to mix with the incoming air and maintain the proper fuel/air mixture.

The pump is operated by the combined action of two springs which are calibrated to move the plunger in such a manner that a sustained charge of fuel is delivered for smooth acceleration. The pump is attached by linkage to the accelerator. When the throttle valves are closed, the pump plunger moves upward in its cylinder, creating a low pressure area (partial vacuum) in the cylinder below the plunger. Atmospheric pressure acting on the fuel in the bowl forces fuel into the cylinder through the anti-percolator ball in the pump plunger head. The discharge ball is seated at this time to prevent air being forced into the cylinder.

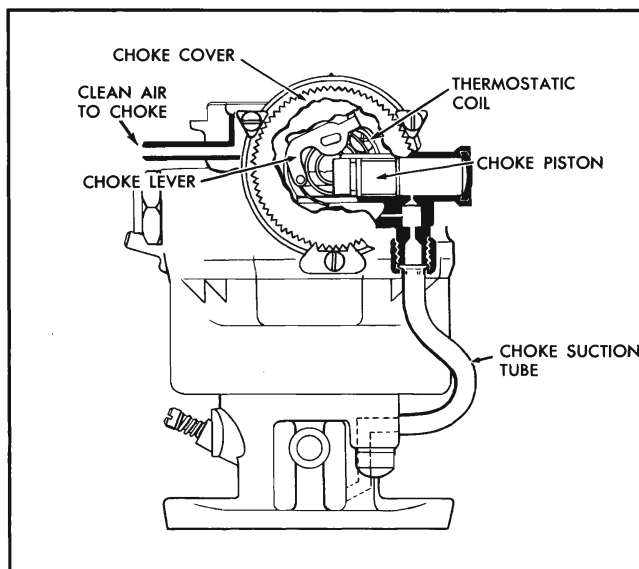


Fig. 6B-16 Choke System

When the plunger is moved downward for acceleration, the force of the stroke seats the anti-percolator ball check to prevent fuel flow into the bowl. The fuel is forced up the pump discharge passage. The pressure of the fuel lifts the pump outlet ball check from its seat and the fuel passes on through the pump jets in the bowl where it is sprayed into the venturi and delivered to the engine.

At higher speeds pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a predetermined amount, the pump plunger bottoms in the cylinder eliminating pump discharge.

The "anti-percolator" check valve, contained inside the plunger provides relief for any vapors which might form during hot idle or when a hot engine is not operating. The ball check is designed so that it can move up and down in its passage. Throughout the above periods it is seated by gravity and vapors in the pump will rise and by-pass the ball check through small holes in the plunger head.

CHOKE SYSTEM

MODEL BC (FIG. 6B-16)

The purpose of the choke system is to provide a rich mixture for cold engine operation. It is necessary to have an extra rich mixture, because fuel vapor has a tendency to condense on cold engine parts, thus decreasing the amount of combustible mixture available at the combustion chamber.

The choke system includes a thermostatic coil, housing, choke piston, choke valve, and fast idle cam and linkage. It is controlled by a combination of manifold vacuum, air velocity against the offset choke valve, and tension of the thermostatic spring.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. Starting the engine causes air velocity to strike the offset choke valve. This tends to open it along with the action of the intake manifold vacuum on the choke piston. After a slight opening of the choke valve, the tension of the thermostatic coil spring balances the force of air on the valve and the pull of vacuum at the piston.

As the engine warms up, manifold vacuum exists in the choke housing. Hot air from the choke stove is forced into this low pressure area through a passage in the side of the choke housing to heat the thermostatic coil.

A secondary baffle plate serves to distribute heat from its entering point at the side of the coil evenly throughout the choke housing, to prevent a hot spot in the coil center, which would cause a rapid opening of the choke valve. The thermostatic coil relaxes gradually until the choke is fully open.

As the engine is accelerated during warm-up the corresponding drop in manifold vacuum on the piston allows the thermostatic coil to momentarily close the choke, providing a richer mixture.

During warm-up it is necessary to provide a fast idle to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke shaft. The idle screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to the idle position until the choke valve is fully opened.

If the engine becomes flooded during the starting period, the choke valve can be partially opened manually to allow increased air flow to carburetor. This is accomplished by depressing the accelerator pedal to the floor. The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke valve.

To insure trouble free operation of the choke system and minimize wear, Teflon bushings, on the choke shaft, choke collar, and air horn bushings are being used on the BC carburetor.

MODEL B

The model B carburetor is essentially identical to the BC carburetor with the exceptions being the choke system and the distributor vacuum take off system.

The model B has a manually controlled choke and has the necessary linkage to accept the manual control cable. Fast idle is controlled during cold and closed choke operations by means of a cam on the choke shaft driving a fast idle lever which holds the throttle valve partially open to allow higher engine R.P.M.

The throttle body on the model B carburetor is drilled and tapped to receive a fitting so that vacuum may be supplied to the distributor. The model BC carburetor has no vacuum take off hole in the throttle body. The vacuum for the distributor is obtained from the intake manifold.

The model B is not equipped with vacuum operated throttle return check.

ADJUSTMENTS ON CAR—ROCHESTER B AND BC CARBURETOR

All Rochester B and BC adjustments can be performed on the car. With the exception of the idle speed and mixture adjustment and the unloader adjustment, all adjustments are included in the "Overhaul and Adjustments" procedure. Following are the idle speed and mixture adjustments and the unloader adjustment.

IDLE SPEED AND MIXTURE ADJUSTMENT ROCHESTER B OR BC

With the engine at operating temperature, adjust idle speed to the following specifications:

Synchro-Mesh	680-700 R.P.M.
Automatic (In Drive)	580-600 R.P.M.

Air Conditioned:

(Automatic Drive Position—

Air Conditioning off) 630-650 R.P.M.

(S/M Neutral—

Air Conditioning off) 680-700 R.P.M.

1. As a preliminary setting, turn idle mixture screw out $1\frac{1}{2}$ turns from lightly seated position and speed screw in $\frac{1}{2}$ to one turn from throttle closed position.

2. Set hand brake securely, place transmission in neutral and connect tachometer to engine.

3. Start engine and warm up thoroughly. Be sure choke is fully open and carburetor is completely off fast idle.

4. Place automatic in "drive" and adjust idle speed screw to obtain specified idle speed.

5. Turn mixture screw to best quality (highest R.P.M.) idle.

6. Reset idle speed screw to specified idle speed if mixture adjustment changed setting.

7. Recheck mixture adjustment to insure smoothest possible idle.

NOTE: Always recheck idle mixture setting after making idle R.P.M. adjustment with idle speed screw.

THROTTLE RETURN CHECK ADJUSTMENT

1. Set hot idle and mixture adjustment to specifications.

2. Place transmission in neutral.

3. With engine running, disconnect vacuum hose from throttle return check and plug open end of vacuum hose.

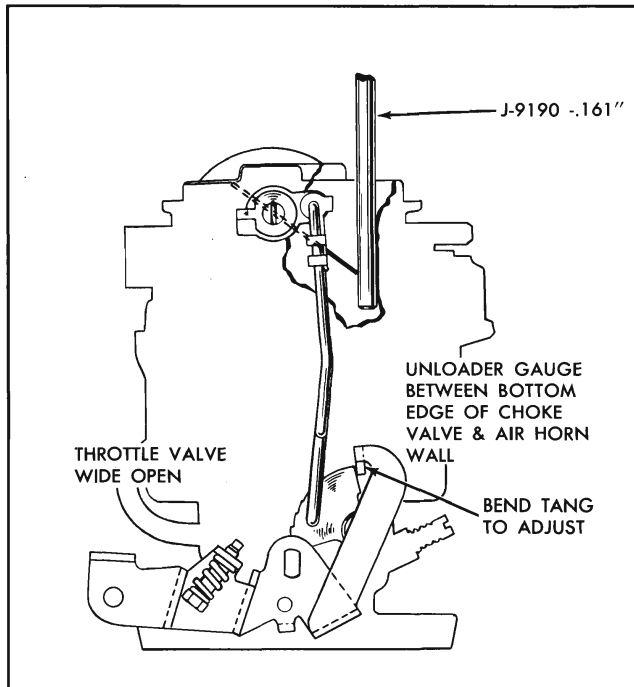


Fig. 6B-17 Unloader Adjustment

4. Adjust the contact screw of the throttle return check to obtain speed of 1175 R.P.M.

NOTE: Hold sleeve next to diaphragm from turning while adjusting contact screw.

UNLOADER ADJUSTMENT—(Fig. 6B-17) (AUTOMATIC CHOKE ONLY)

NOTE: Unloader adjustment cannot be made correctly unless linkage is properly adjusted.

1. Remove carburetor air cleaner assembly.

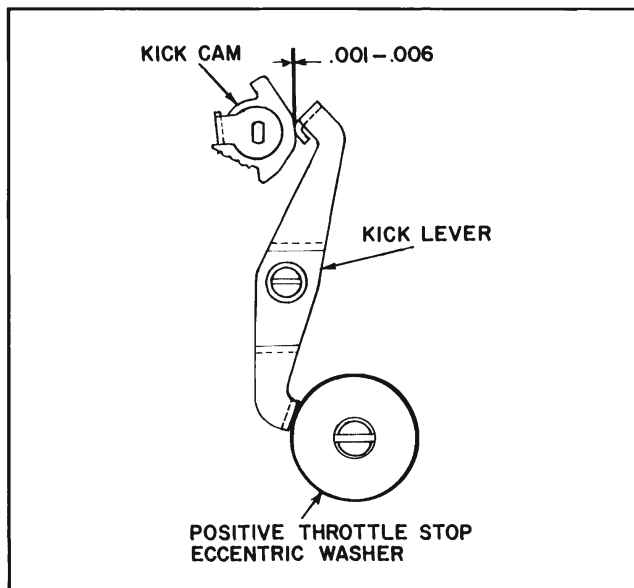


Fig. 6B-18 Throttle Stop Adjustment

2. Depress accelerator pedal to pedal stop on floor. (This should be done by person sitting in driver's seat of car to simulate driving conditions.)

3. With accelerator pedal depressed as in above step, bend tang on throttle lever to give a clearance of .161" tool J-9190 between the choke valve and the inside of the air horn.

4. Replace air cleaner assembly.

The above procedure will eliminate variance in linkage, pedal location, etc., and should ensure correct unloader action.

THROTTLE STOP ADJUSTMENT (Fig. 6B-18) (MANUAL CHOKE ONLY)

When servicing a Tempest model B carburetor it is not necessary to remove the positive idle stop eccentric washer. However, should this washer become loose or be removed, it may be adjusted as follows:

With the choke valve wide open, rotate the eccentric washer to a position where a clearance of .001"-.006" is maintained between the upper end of the kick lever and the kick cam as shown in Fig. 6B-18. Lock the eccentric washer in place with the screw.

OVERHAUL AND ADJUSTMENT

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the contents of the fuel bowl should be examined for contamination as the carburetor is disassembled.

DISASSEMBLY OF CHOKE

1. Loosen $\frac{1}{2}$ " fitting on choke vacuum tube.
2. Remove three choke cover attaching screws and retainers, remove choke cover, cover gasket, and thermostatic coil assembly from carburetor (Fig. 6B-19).
3. Remove baffle plate.
4. Remove pin spring and clip from respective ends of choke rod and remove rod (Fig. 6B-20).
5. Remove throttle return check valve and mounting bracket (automatic choke only).
6. Remove retaining screw at end of choke shaft and carefully pry off choke trip lever, spacing washer, and choke counterweight.

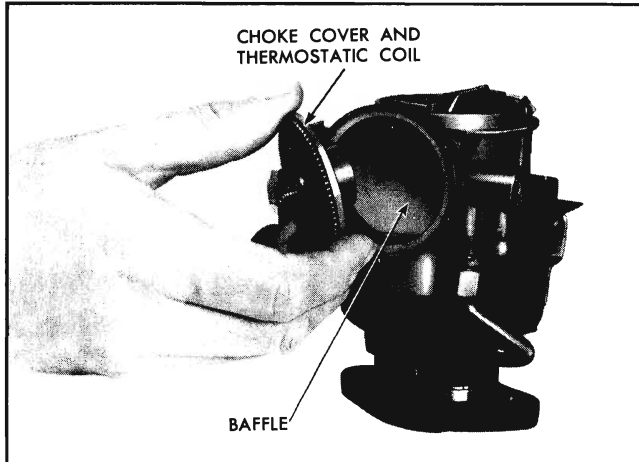


Fig. 6B-19 Removing Choke Cover

7. Remove two choke valve screws and remove choke valve.

8. Rotate choke shaft clockwise to remove choke piston from housing, then remove piston and choke shaft from carburetor (Fig. 6B-21).

9. Remove choke piston pin and piston from choke shaft.

10. Remove two choke housing attaching screws. Choke housing and gasket may now be removed from air horn.

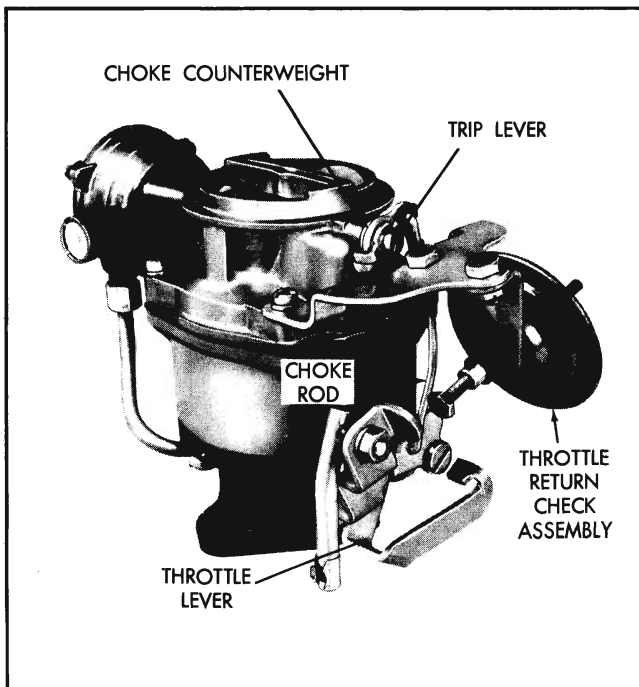


Fig. 6B-20 Rochester BC Carburetor

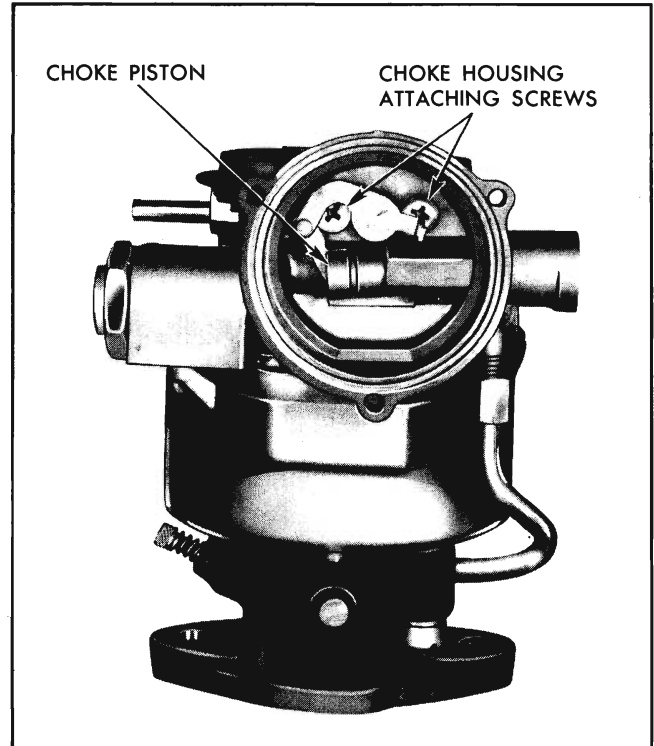


Fig. 6B-21 Location of Choke Piston

AIR HORN DISASSEMBLY

1. Remove filter retainer nut and gasket with 1" wrench. Remove filter, spring and gasket (Fig. 6B-22).

2. Remove four screws and throttle return check (automatic only). Lift air horn straight up from bowl so as not to damage floats (Fig. 6B-23). Place air horn float side up on flat surface.

3. Remove float hinge pin (Fig. 6B-24) and lift float assembly from air horn. Float needle may now be removed.

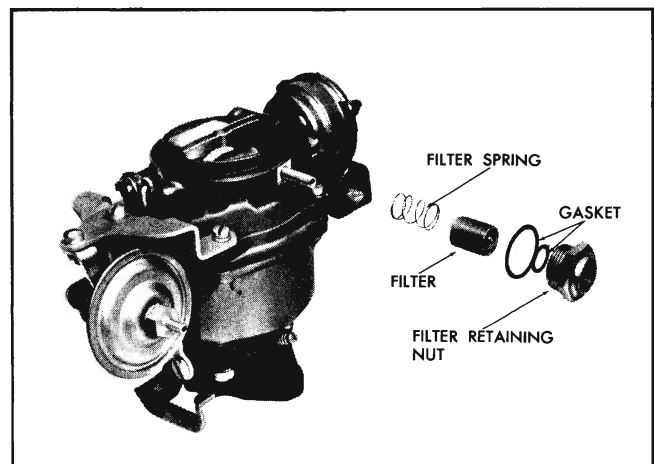


Fig. 6B-22 Removing Fuel Filter

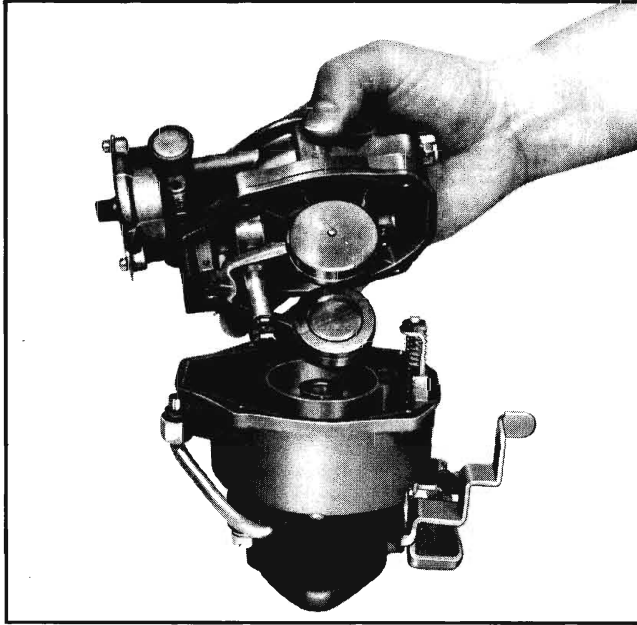


Fig. 6B-23 Removing Air Horn from Bowl

4. Remove float seat and gasket with $\frac{1}{2}$ " bit screwdriver (Fig. 6B-25).

5. Remove main metering jet from main well support (Fig. 6B-26).

6. Remove power check valve ball retainer, spring and ball (Fig. 6B-27).

7. Remove main well support.

8. Remove power piston and spring (Fig. 6B-28).

NOTE: Do not remove primary idle tube from air horn.

9. Air horn gasket may now be removed.

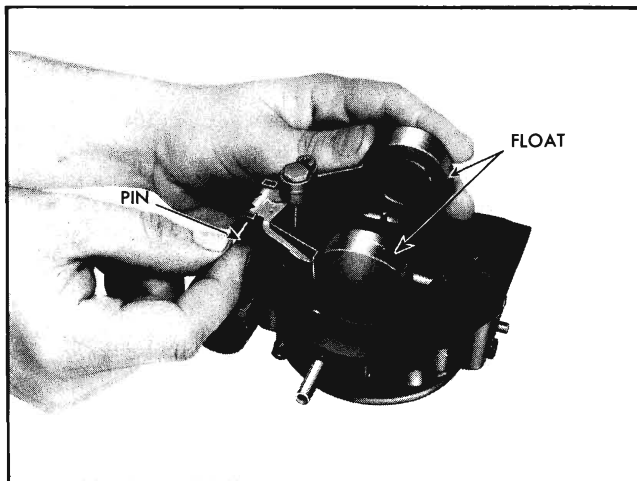


Fig. 6B-24 Removing Float Hinge Pin

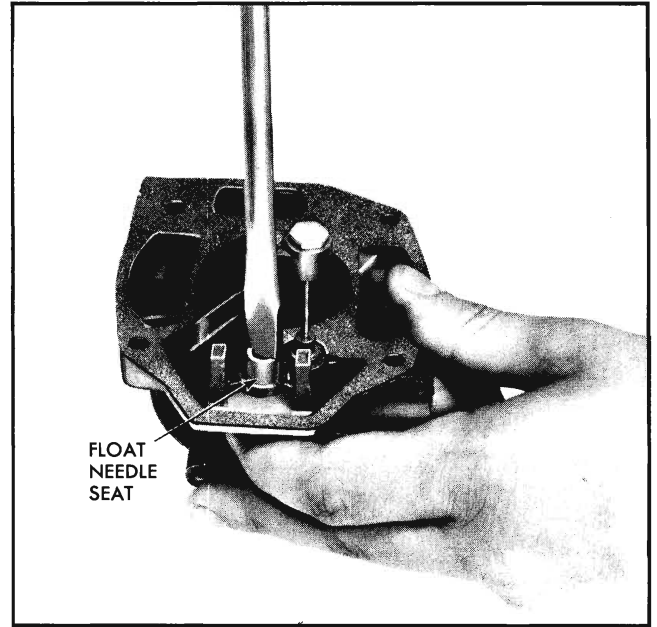


Fig. 6B-25 Removing Float Needle Seat

BOWL DISASSEMBLY

1. Using a pair of long nose pliers, remove pump discharge guide, spring and ball (Fig. 6B-29).

2. Remove two pin springs from pump link and remove pump link from throttle lever. Remove pump plunger arm.

3. Remove pump plunger from bowl (Fig. 6B-30).

4. Remove pump return spring (Fig. 6B-31).

NOTE: Do not remove choke suction tube from throttle body.

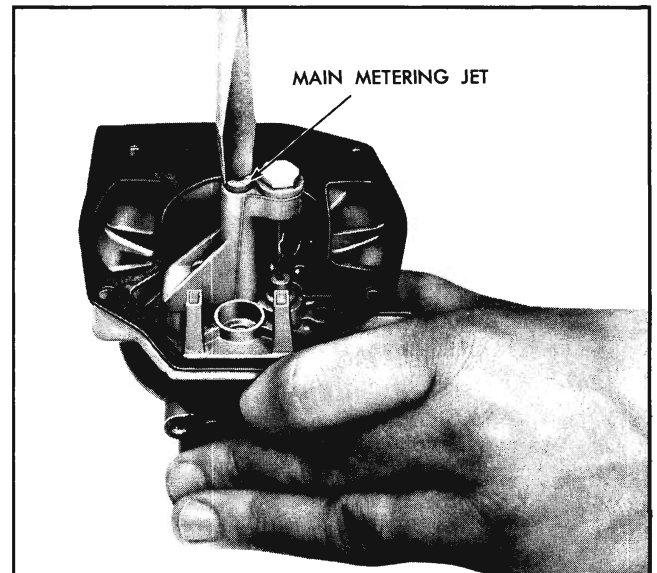


Fig. 6B-26 Removing Main Metering Jet

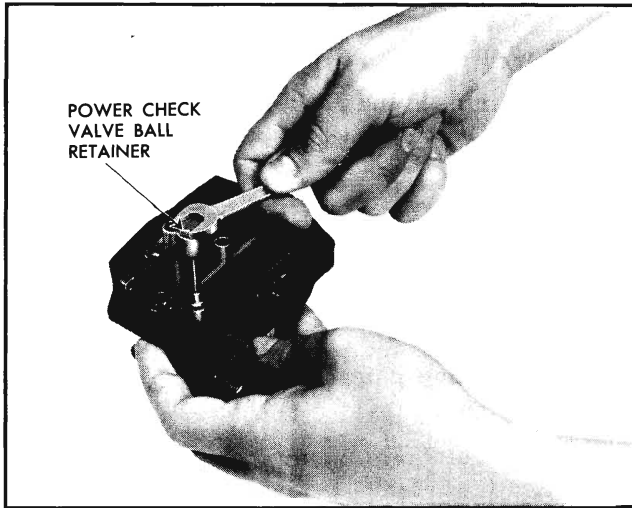


Fig. 6B-27 Removing Power Check Valve Ball Retainer

5. Place carburetor bowl with suction tube projected over edge of flat surface and remove two throttle body attaching screws. Throttle body and gasket may now be removed.

THROTTLE BODY DISASSEMBLY

1. Remove idle adjusting needle and spring.
2. Remove idle screw from throttle lever.

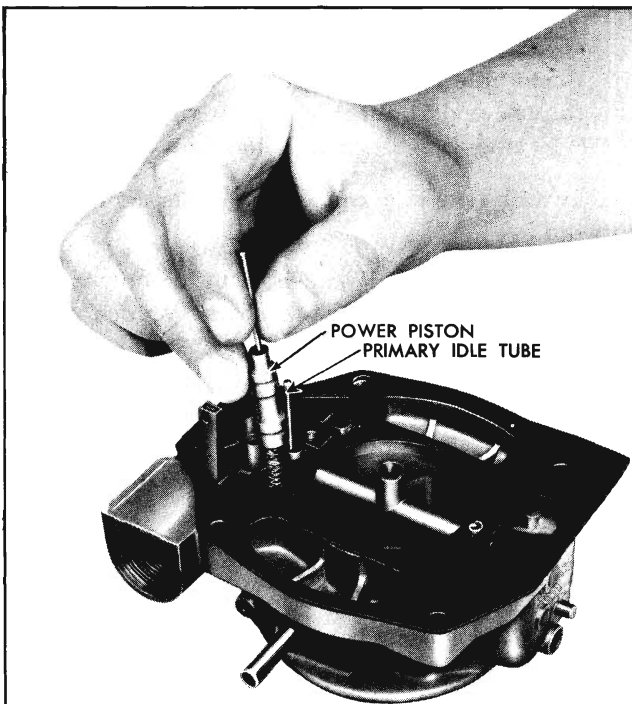


Fig. 6B-28 Removing Power Piston

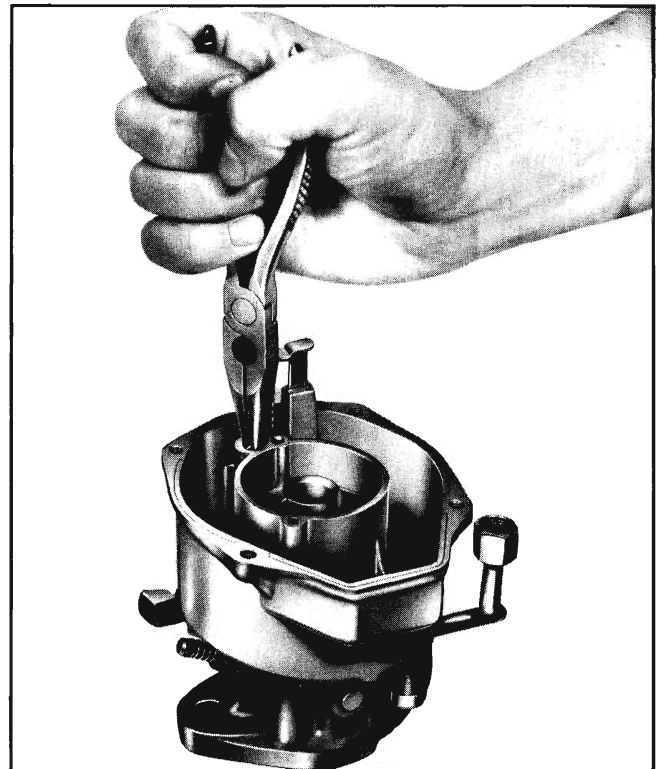


Fig. 6B-29 Removing Pump Discharge Guide

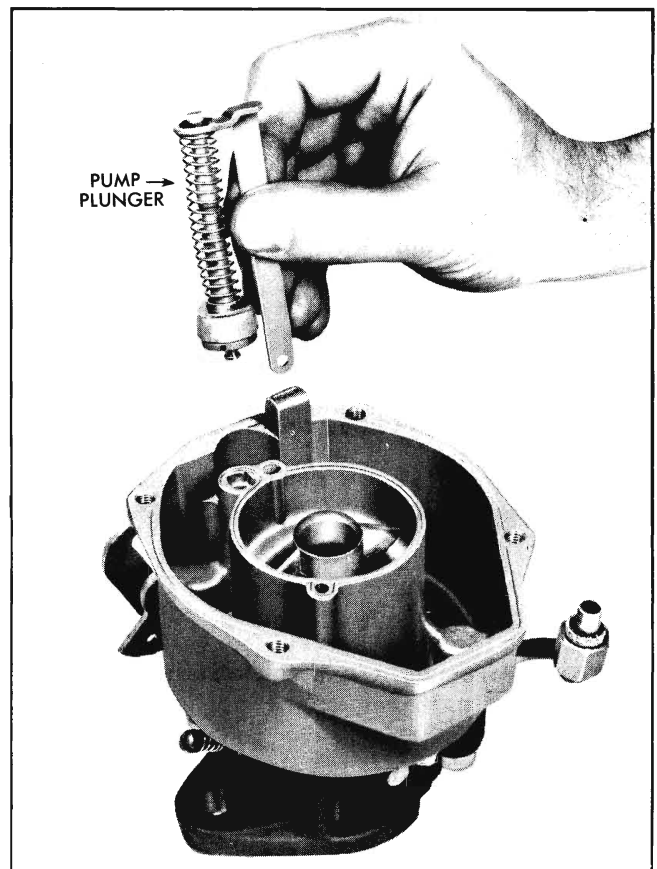


Fig. 6B-30 Removing Pump Plunger

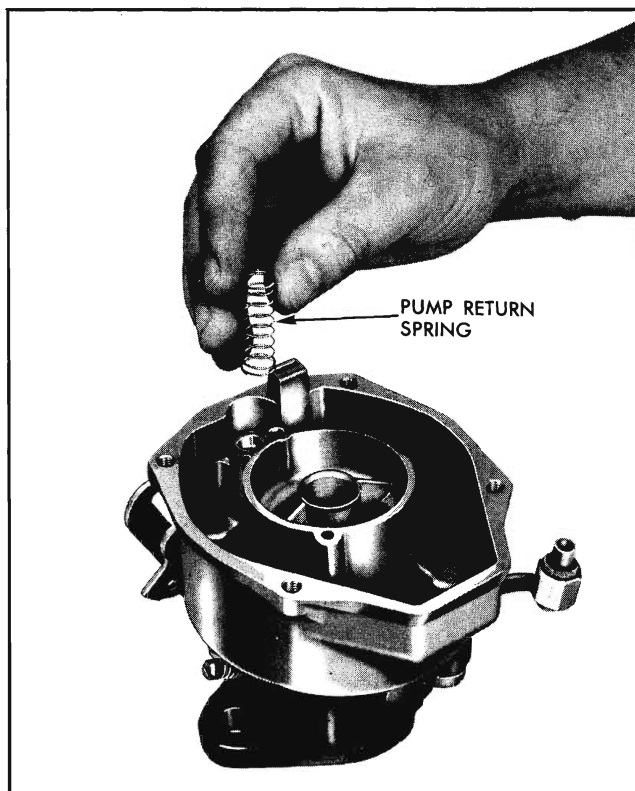


Fig. 6B-31 Removing Pump Return Spring

3. Remove fast idle cam.

NOTE: Due to close tolerance fit of the throttle valve in the bore of the throttle body do not remove the throttle valve or shaft from the throttle body.

4. Remove vacuum take off fitting. (Synchro-Mesh transmission application only.)

CLEANING AND INSPECTION

1. Thoroughly clean carburetor castings and metal parts in carburetor cleaning solvent.

CAUTION: Choke coil and pump plunger should not be immersed in solvent. Clean pump plunger in clean gasoline only.

2. Blow all passages in castings dry with compressed air and blow off all parts until they are dry.

CAUTION: Do not pass drills or wires through calibrated jets or passages as this may enlarge orifice and seriously affect carburetor calibration.

3. Check all parts for wear. If wear is noted, defective part must be replaced.

NOTE: Especially the following:

a. Check float needle and seat for wear.

b. Check float button for wear and float for dents. Check floats for leaks by shaking.

c. Check throttle and choke shaft bores in throttle body and air horn castings for wear or out of round.

d. Inspect idle mixture adjusting needle for burrs or ridges.

e. If wear is noted on steps of fast idle cam it should be replaced as it may upset engine idle during the choke period.

f. Inspect pump plunger leather. Replace plunger if leather is damaged.

g. Inspect for burrs on the power piston or distorted or bent power piston nail or spring.

4. Always use new gaskets in reassembling.

5. Check to see that lower end of choke vacuum tube is tight in throttle body seal.

6. Inspect choke vacuum tube hex nut packing. If packing is unduly compressed or out of round, it should be replaced.

7. Clean all dirt or lint out of inlet filter. If filter remains plugged, replace it. Check spring for distortion, replace it if necessary.

ASSEMBLY AND ADJUSTMENT

THROTTLE BODY

1. Install idle stop screw in throttle lever.

2. Screw idle mixture adjusting needle and spring into throttle body until it is finger tight. Back needle out $1\frac{1}{2}$ turns as a temporary idle adjustment.

3. Install fast idle cam with letters R P facing outward.

4. Using new gasket, attach throttle body to bowl using two screws and lock washers. Tighten screws evenly and securely.

NOTE: If needed, a new vacuum seal will be installed after carburetor is completely assembled.

5. Install vacuum take off fitting (Synchro-Mesh application only).

BOWL ASSEMBLY

1. Install large steel ball in pump discharge cavity. Insert spring and guide on top of ball. Tap spring guide lightly to seat in casting.

2. Place pump return spring in pump well.

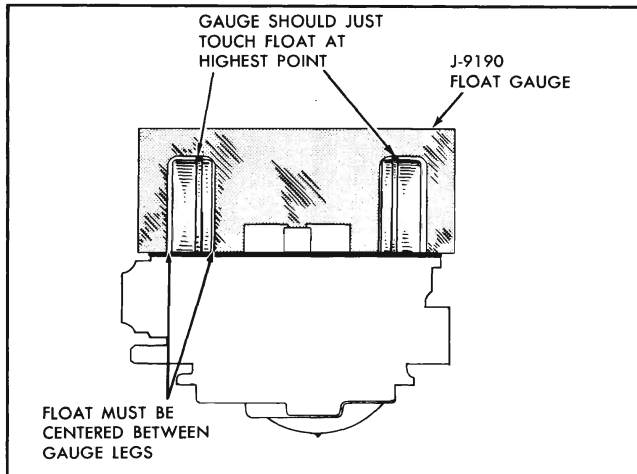


Fig. 6B-32 Float Level Adjustment

3. Install pump plunger assembly in bowl.

4. Attach pump link to pump plunger arm and throttle lever.

NOTE: Dog leg in the pump link must face away from the throttle shaft.

AIR HORN ASSEMBLY

1. Install float needle seat and gasket using screw driver with $\frac{1}{2}$ " bit.

2. Install power piston spring and power piston in vacuum cavity.

NOTE: Piston should ride free in cavity.

3. Place new gasket atop air horn, check to be sure that all air horn and gasket holes are in line.

4. Assemble power valve ball, spring, and retainer in main well support.

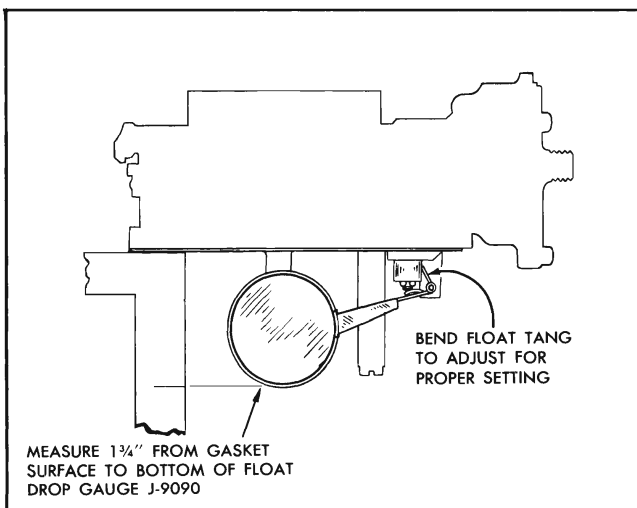


Fig. 6B-33 Float Drop Adjustment

5. Attach main well support to air horn securely.

NOTE: Check for free motion of power piston.

6. Install main metering jet in main well support.

7. Place float needle in float needle seat.

8. Place float carefully in position and install float hinge pin.

FLOAT LEVEL ADJUSTMENT (Fig. 6B-32)

With air horn inverted and gasket in place, position gauge J-9190 $1\frac{9}{32}$ " over the float with the gauge tang inserted in the discharge nozzle. Bend the float arms as necessary so that the top of each float just touches the gauge and the float is centered between the gauge legs.

FLOAT DROP ADJUSTMENT (Fig. 6B-33)

Bend float as necessary to obtain a distance of $1\frac{3}{4}$ " from the gasket surface to the bottom of float with the air horn held in the upright position and the float hanging free. Measure with scale or tool J-9190.

9. Attach air horn to bowl with attaching screw.

10. Install filter gasket, filter spring, and filter retainer nut and gasket.

ASSEMBLY OF CHOKE

1. Place new gasket into position and attach choke housing to air horn with two screws. Tighten screws securely.

2. Place new hex fitting packing on choke suction tube. Tighten fitting on choke housing sufficiently to prevent loss of vacuum (Fig. 6B-34).

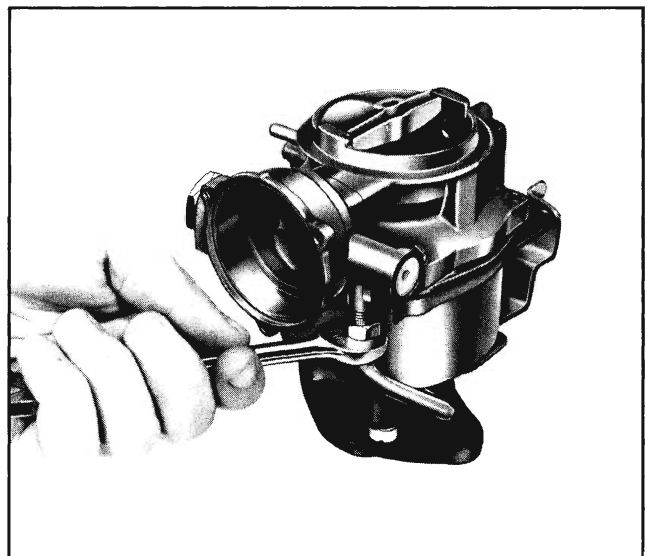


Fig. 6B-34 Tightening Choke Suction Tube Fitting

3. Assemble choke piston to shaft with pin and place choke shaft into choke housing. Rotate choke shaft counterclockwise so that the piston rides in housing cavity.

4. Install choke valve on choke shaft with letters **R P** facing upward. Center choke valve before tightening screws.

5. Place baffle and choke cover gasket into position, install choke coil and cover.

6. Rotate cover counterclockwise until index mark on housing is located one notch rich on model **B** carburetor and two notches rich on **BC** carburetor (Fig. 6B-35).

7. Attach three retainers and screws to choke housing and tighten securely. Recheck to see that adjustment previously made has not moved.

NOTE: Choke valve should be lightly closed at room temperature 75°F. when index mark on cover and housing are aligned.

8. Place choke counterweight on end of choke shaft with tang facing choke housing. Install spacing washer and trip lever so that tang of trip lever is atop counterweight tang, when choke is full open.

9. Install choke rod to counterweight and fast idle cam and secure with clip and spring. The dog leg of

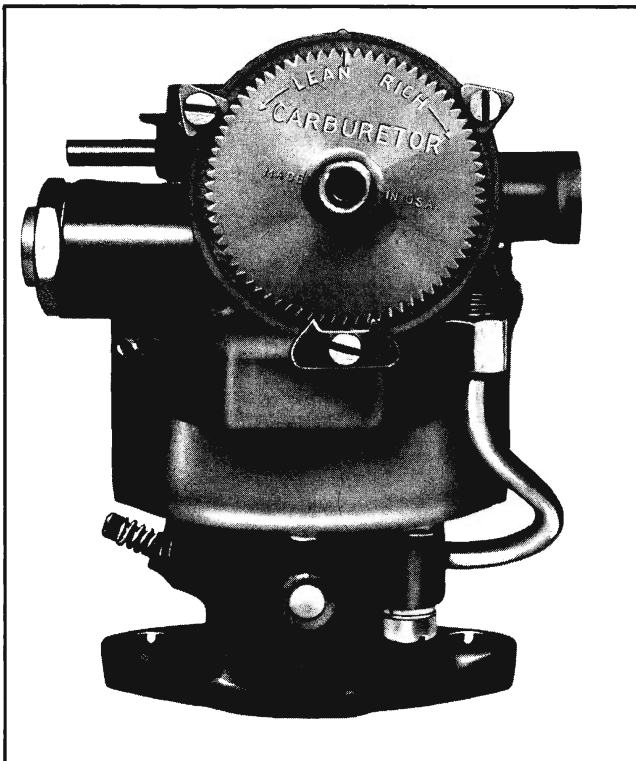


Fig. 6B-35 Location of Index Mark on Choke Cover

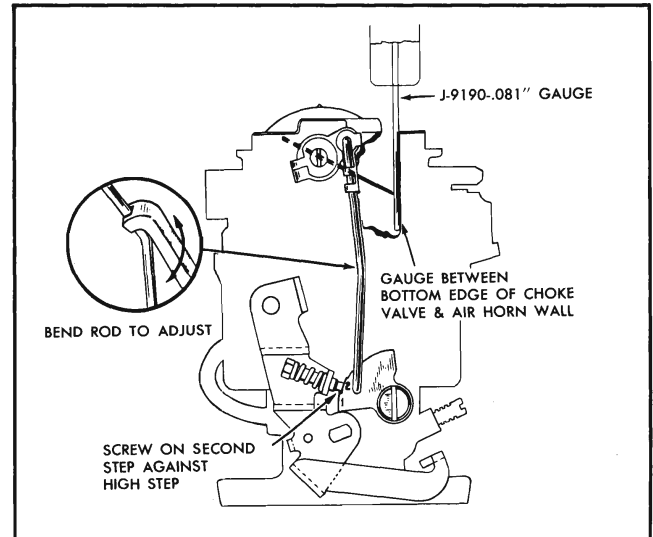


Fig. 6B-36 Choke Rod Adjustment

the rod must face idle mixture adjusting needle. Check valve for free movement.

CHOKE ROD SETTING (AUTOMATIC TRANSMISSION ONLY) Fig. 6B-36)

With idle screw on the second step and against the high step of the cam, bend choke rod as necessary with tool J-9190-.081" to obtain specified clearance between the lower edge of the choke valve and air horn wall.

10. If the choke suction tube and seal assembly in the throttle body requires replacement, proceed as follows:

This operation must be performed after the carburetor is completely assembled.

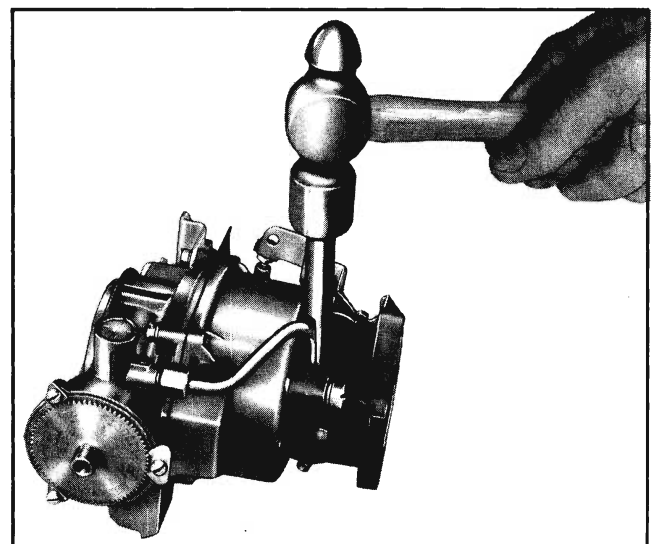


Fig. 6B-37 Installing Choke Tube Seal in Throttle Body

a. Loosen throttle body to bowl attaching screws.

b. Place flared end of tube with seal into throttle body. Using seal punch J-4551, tap lightly to hold seal in throttle body. Rotate tube while tapping seal so that it is started uniformly and evenly into the throttle body (Fig. 6B-37).

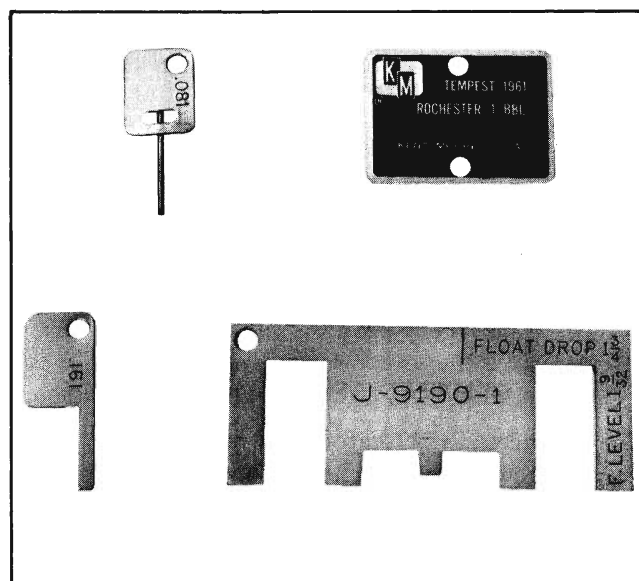
c. Install hex fitting and new packing on upper end of tube and fasten tube to choke housing by turning hex nut up "finger" tight.

d. Using seal punch tool J-4551 and hammer, spread seal into throttle body securely.

e. Completely loosen hex nut and check that tube is tight in throttle body. (Will not turn.) Then tighten hex nut to choke housing securely.

f. Tighten throttle body to bowl screws evenly and securely.

g. After installing carburetor on car, run idling to warm up engine, check packing joint with gasoline. If there is any leak, engine will stall or roll.



SPECIAL TOOLS—J-9190

1. .161" unloader gauge
2. Float drop and level gauge
3. .081" choke rod gauge

ROCHESTER 4GC CARBURETOR

Carburetor Model Number

7020079
7020066
7020078

Used On

Four Cylinder Synchro-Mesh
Four Cylinder—Automatic
Eight Cylinder—Automatic

GENERAL DESCRIPTION

The Rochester 4GC carburetor is essentially two 2-jet carburetors in a single casting. The "primary side" contains all six carburetor systems—float, idle, part throttle, power, pump, and choke; the "secondary side" supplements the "primary side" with separate float and power systems.

This carburetor uses the Rochester calibrated cluster design, which places in a removable assembly the main well tubes, idle tubes, mixture passages, air bleeds, and pump jets.

When the cluster is removed for service purposes, all of these vital parts can be readily seen, cleaned and examined because the main well tubes and idle tubes are permanently installed in the cluster body by means of a precision pressed fit.

The cluster fits on a platform provided in the body casting of the carburetor so that the main well and idle tubes and main well inserts are suspended in the fuel. A gasket is used between the cluster casting and body platform.

This method of design and assembly serves to insulate the main well tubes and idle tubes from engine heat thus preventing heat expansion and percolation spill-over during hot idle periods of operation and during the time the hot engine is not operating.

Four vertical vent tubes are located in the air horn in addition to four pitot tubes. The vertical vent stacks provide space for the fuel to go during severe stop and start maneuvers, preventing fuel spillage from the pitot tubes.

FLOAT SYSTEM (Fig. 6B-38)

The primary and secondary sections of the carburetor have separate bowls, floats, needles and seats.

All fuel enters the carburetor through a common inlet fitting. From this point the fuel flows through separate passages to the respective float bowls.

As the fuel level in the bowl drops, the twin floats also drop, allowing the needle to move off its seat. Pressure from the fuel pump forces fuel through the filter screen into the inlet passage, through the small filter screen under the needle seat and then into the float bowl. As the fuel level in the bowl rises, the floats rise and once again shut off the inlet needle.

The four cylinder engine carburetor has a torsion spring, located on the float hinge pin, which acts as an assist in closing the inlet needle on its seat by exerting pressure against the float hanger. A slight amount of pressure is exerted by the torsion spring when the needle valve is in its closed position. The spring pressure increases slightly as the torsion spring is wound up further.

The eight cylinder engine carburetor has balance springs at the rear tangs of the floats. The spring tension against the float tang determines float drop and also helps to determine fuel level. The spring also provides for more positive closing of the needle valve.

A passage in the float bowls, slightly above the normal fuel level, connects the primary and secondary float bowls. With this design any abnormal rise in level on one side will be absorbed by the other, without disrupting engine operation.

Both sides of the carburetor are individually and internally vented. These vents transmit the air pressure from beneath the air cleaner to the fuel in the float bowl. The amount of fuel metered by the carburetor is dependent upon the pressure in the float bowl causing fuel to flow. By locating the vents below the air cleaner, or internally, the carburetor is automatically balanced with the air cleaner, since the same pressure causing air to flow will also be causing fuel to flow. The four vertical vent stacks, which are in addition to the standard pilot tubes, are pressed into the air horn casting and care should be used to avoid damage to them.

On the four cylinder engine to minimize difficult hot weather starting or rough idling due to fuel vapor formation in the float bowl, the carburetor incorpor-

ates an external idle vent valve which functions when the throttle valves are in the closed position.

This valve is located in the center of the carburetor air horn on the primary (pump side) of the carburetor. The valve consists of an actuating lever integral with the pump lever, which operates a rubber valve mounted over the vent hole. The rubber vent valve is attached to a spring arm which holds the valve closed.

When the throttle valves are closed, the actuating lever contacts the spring arm to which the rubber vent is attached, and holds the valve open. This permits vapors from the fuel bowl to vent themselves to the atmosphere. As the throttle valves are opened, the spring arm closes the vent valve, eliminating the atmospheric vent and returning the carburetor to an internal balance. A guard is installed over the vent valve to prevent damage during air cleaner removal.

IDLE SYSTEM (FOUR CYLINDER) (Fig. 6B-39)

An adjustable idle system is provided on the primary side of the carburetor only. An idle circuit is incorporated in the secondary side of the carburetor which supplies supplementary fuel discharged through lower idle air bleeds to the primary side for part throttle operation.

In the normal idle speed position, the throttle valves are completely closed. Idle air is taken from above the secondary valves, adjusted by an air-adjustment screw at the rear of the throttle body, and discharged into the primary bores below the throttle valve. Thus the idle air adjusting screw controls idle R.P.M.

The idle mixture needle hole is in the high vacuum area below the throttle valves, while the fuel bowl is vented to atmospheric pressure. Vacuum can be called a lack of pressure, so a high vacuum area can be spoken of as an area of low pressure. Thus it can be said that there is considerable pressure difference between the normal atmospheric pressure on the fuel in the bowl and the low pressure (or high vacuum) at the idle mixture needle hole.

Incorporated in the idle system are secondary lower idle air bleed tubes, located in the venturi wall of the primary side, and fed by the idle tubes in the secondary cluster. These lower idle air bleed tubes provide an additional source of fuel to maintain a constant mixture ratio at wide primary throttle openings. The tubes act as nozzles and supplement the fuel discharge of the main system to fill the gap between late part throttle and pre-power system operation.

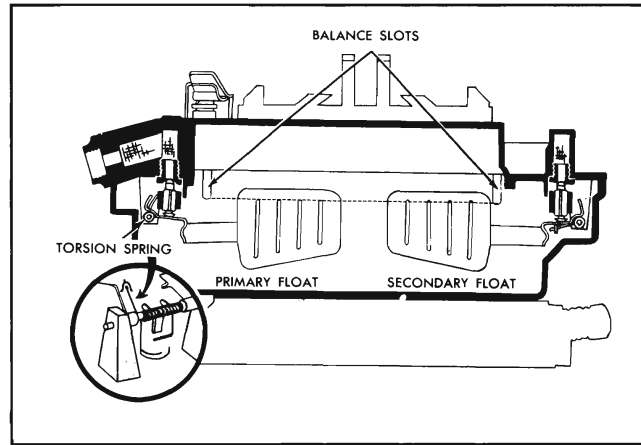


Fig. 6B-38 Float System

No fuel is discharged until the primary throttles are open sufficiently to allow enough air flow to create a low pressure area at the tube. Fuel then flows and continues to do so as long as the low pressure is maintained throughout part throttle and wide open throttle operation.

The fuel and fuel/air mixture will be forced by atmospheric pressure to occupy the low pressure area. Atmospheric pressure acting on the fuel in the bowl forces fuel through the main metering jets into the main well area. The fuel travels up the idle tube after passing through the idle metering orifice at the lower tip of the tube. Air joins the fuel at the primary idle air bleeds. This mixture then passes through the idle restrictions which tend to mix thoroughly the fuel and air. More air enters the mixture at the secondary idle air bleeds. This mixture then passes down the vertical idle channel. At the lower end of the channel, additional air is bled into the mixture through the idle slots. The resultant mixture is then discharged into the throttle bore from the idle needle holes.

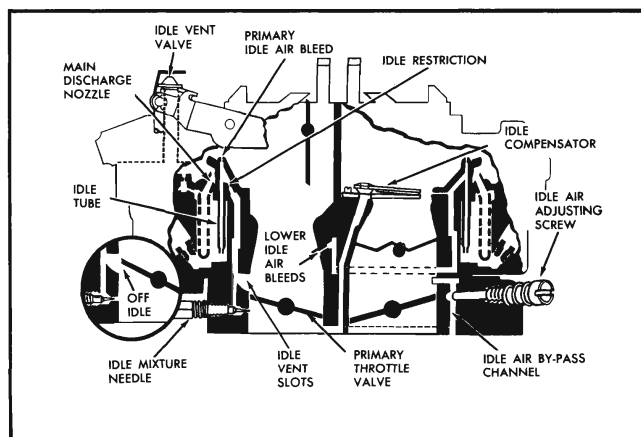


Fig. 6B-39 Idle System (Four Cylinder)

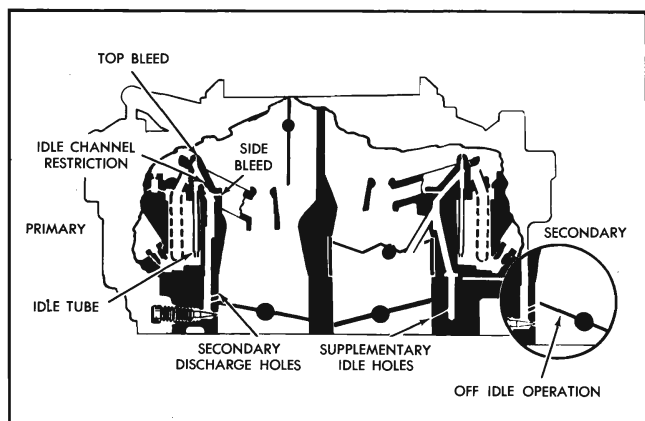


Fig. 6B-40 Idle System (Eight Cylinder)

In addition to this mixture of fuel and air, there is air entering the bore from the idle air by-pass channel; for smooth operation, the air from the by-pass channel, the fixed air bleeds and the fuel/air mixture from the idle needle hole must combine to form the correct final mixture for normal idle engine speed.

As the throttle valves are opened, the bleed effect of the idle discharge slots gradually diminishes. When these slots become exposed to manifold vacuum they become fuel discharge openings to meet the increased fuel demand.

The idle mixture adjusting screws govern the amount of fuel/air mixture admitted to the carburetor bore at idle.

Also included in the idle system is the idle compensator. This consists of a bi-metal strip, a valve, and a mounting bracket. It is mounted between the large venturi on the secondary side. The valve seats on a drilled channel which leads into the center throttle body attaching bolt hole.

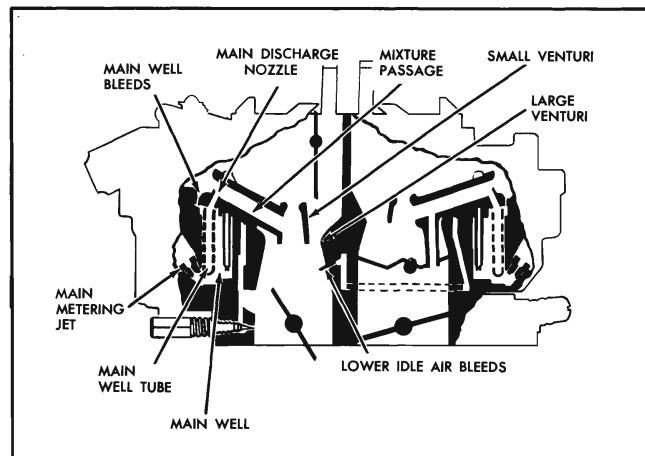


Fig. 6B-41 Part Throttle

From there the passage goes to the underside of the primary throttle valves. In operation, when idling hot for long periods, the bi-metal strip will become heated, bending up and forcing the valve off its seat. This allows additional idle air (under the influence of manifold vacuum) to be drawn in below the throttle valves, offsetting the enriching effects of the high temperatures. When underhood temperatures are lowered, the valve closes and idle operation returns to normal.

IDLE SYSTEM (EIGHT CYLINDER) (Fig. 6B-40)

When vacuum is present at the idle discharge holes the atmospheric pressure in the float bowl causes fuel to flow through the main metering jets and upward into the idle tube which meters the fuel. Calibrated bleed holes permit air to enter at the top and side of the idle passage in the cluster and mix with the fuel. The fuel/air mixture then passes down the idle passage. Additional air is drawn in the idle channel through the lower idle air bleeds. The fuel/air mixture is then discharged through the idle discharge holes.

When the throttle valve is closed, the fuel/air mixture is supplied through the lower idle discharge holes only, since the upper holes are above the valve and are not affected by vacuum. As the throttle valve is opened, vacuum is also placed on the upper idle discharge holes which then feed additional fuel/air mixture into the engine. With continued opening of the throttle valve the suction on the idle discharge holes tapers off until a point is reached where the idle system no longer supplies fuel/air mixture. Before this point is reached, however, the main metering system has begun to supply fuel, as described later.

In the *primary* section, the quantity of fuel/air mixture supplied through the lower idle discharge holes is controlled by the idle needles, which may be adjusted to provide smooth engine idle operation. In the *secondary* section, the quantity of idle fuel/air mixture is controlled by the fixed size of discharge holes located in the rear of the secondary throttle bores.

On the secondary side of the float bowl, a thermostatic valve allows additional air to enter the primary bores under extreme hot idle conditions. This valve, called the "idle compensator," is operated by a bi-metal strip which senses temperature. In a prolonged hot idle, the bi-metal strip bends, raising the valve and uncovering a hole leading to the underside of the primary throttle valves. The additional air drawn into the engine in this manner is sufficient to offset the enriching effects of high temperatures and prevent hot

idle stalling. When underhood temperatures are lowered, the valve closes and operation returns to normal. This valve cannot be repaired, so a defective valve must be replaced.

PART THROTTLE SYSTEM (Fig. 6B-41)

As the throttle valves are opened to a greater degree and more air is drawn through the carburetor, it is necessary to provide means, other than the idle systems, for supplying additional fuel to meet the engine requirements. The primary side of the carburetor meets the increased demand for fuel in the following manner.

The increased air flow through the venturi during part throttle operation lowers the pressure at the tip of the main discharge nozzles. This differential in pressure forces fuel from the float bowl, through the main metering jets and into the main well tubes. After passing through the main well tubes the mixture passes from the tip of the nozzle through the mixture passage to the venturi and on into the intake manifold.

As the throttle opening is progressively increased and more fuel is drawn through the main well tubes, the fuel level in the main well drops. Calibrated holes in the main well tubes are proportionately exposed to the air in the upper well area. When this occurs, they become air bleeds, mixing progressively more air with fuel passing through main well tubes. Thus, although the nozzle suction is increased by increasing the throttle opening, the fuel mixture to the engine remains constant throughout the part throttle range.

On the four cylinder engine, as throttle opening increases, the secondary lower idle air bleed tubes become part throttle feed nozzles in the main bore below the primary venturi.

POWER SYSTEM (Fig. 6B-42)

As the primary throttle valves are opened to a point where more air and fuel are needed for increased power, mechanical linkage between the primary and secondary throttle valves starts to open the secondary valves. The ratio of motion is such that by the time the primary valves have reached wide open, the secondary valves are also wide open. With both the primary and secondary throttle valves open, the venturi systems in both sides feed fuel-air mixture through their respective main metering systems.

Spring loaded, auxiliary throttle valves are located in the secondary bores above the regular secondary throttle valves. When the throttle valves are moved to their wide open positions and engine speed is low,

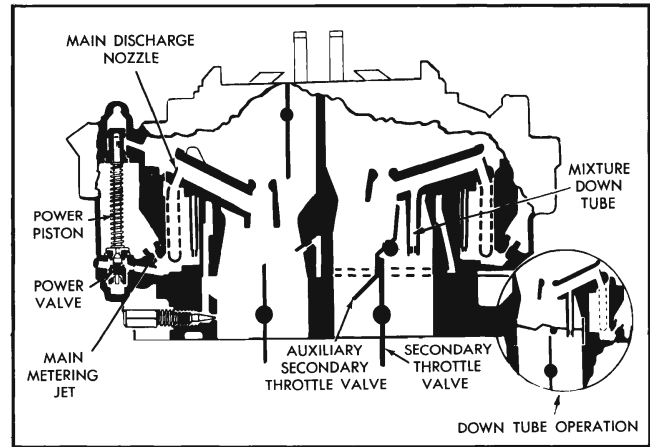


Fig. 6B-42 Power System

there is insufficient air flow through the secondary bores to force the spring loaded auxiliary valves open. This will concentrate all air flow through the primary throttle bores for improved metering of fuel and air. In this condition the carburetor is functioning as a 2-barrel carburetor. As the engine speed increases, the force of the air acting on the auxiliary valves increases to the point where the auxiliary valves are forced to open. The calibration of auxiliary valve spring tension is such that valve opening occurs when greatest metering efficiency is possible.

The mixture down tube supplies additional fuel air mixture while the auxiliary valves are opening. For maximum power under load, a richer mixture is required than that necessary for normal throttle opening. This additional fuel is provided by one power system connected to the main metering systems in the primary section of the carburetor.

The power piston cylinder in the air horn of the carburetor is connected by a channel to the face of the mounting flange so it is subject to intake manifold vacuum. At part throttle position the vacuum is sufficient to hold the power piston in its "up" position

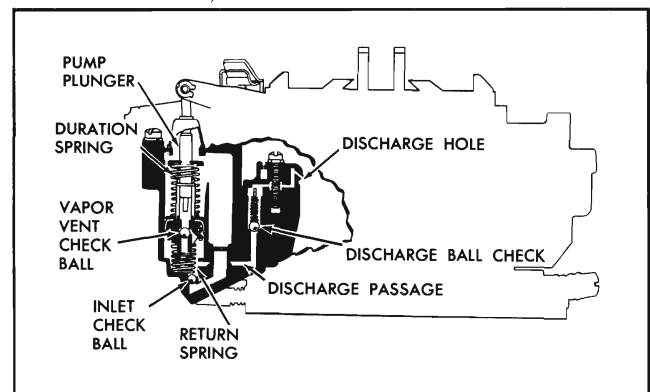


Fig. 6B-43 Pump System

against the tension of the piston spring. When the throttle valves are opened to a point where manifold vacuum drops to approximately 9 to 5 inches of mercury and additional fuel is required for satisfactory operation, the piston spring moves the power piston down to open the power valve. This allows additional fuel to enter the main discharge nozzles in the primary section through calibrated restrictions located below the main metering jets.

PUMP SYSTEM (Fig. 6B-43)

Extra fuel for smooth, quick acceleration is supplied by a double spring pump plunger. A rapid opening of the throttle valves, as is the case when accelerating from low speeds, causes an immediate increase in air velocity. Since fuel is heavier than air it requires a short period of time for it to "catch up" with the air flow. To avoid a leanness during this momentary lag, the accelerator pump furnishes a quantity of liquid fuel, sprayed into the air stream to mix with incoming air and maintain the proper fuel/air mixture.

Since the secondary throttle valves remain closed during part throttle operation, only the primary side needs the extra boost; hence the primary side only contains the pump system.

The pump is operated by the combined action of two springs which are calibrated to move the plunger in such a manner that a sustained charge of fuel is delivered for smooth acceleration.

The pump is attached by linkage to the accelerator so that when the throttle valves are closed the pump plunger moves upward in its cylinder, creating a low pressure area (partial vacuum) in the cylinder below the plunger. Atmospheric pressure acting on the fuel in the bowl forces fuel into the cylinder through the inlet ball check. The discharge ball check is seated at this time to prevent air being forced into the cylinder.

When the plunger is moved downward for acceleration, the force of the stroke seats the inlet ball check to prevent flow to the fuel bowl, and the fuel is forced up the pump discharge passage. The pressure of the fuel lifts the pump discharge ball check from its seat and the fuel passes on through the pump jets in the cluster, where it is sprayed into the venturi and delivered to the engine.

At higher speeds, pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a predetermined amount, the pump plunger bottoms in the cylinder eliminating pump discharge.

The "anti-percolator" check ball, contained inside the plunger, provides relief for any vapors which might form during hot idle or when a hot engine is not operating. The ball check is designed so that it can move up and down in its passage. Throughout the above periods it is seated by gravity, and vapors in the pump well rise and by-pass the ball check through small holes in the plunger head. The "anti-perc" ball check also acts as an extra inlet during the upstroke of the pump plunger, but is seated by fuel pressure when the plunger moves down.

CHOKE SYSTEM (Fig. 6B-44)

The purpose of the choke system is to provide a very rich mixture for cold engine operation. It is necessary to have an extra rich mixture because fuel vapor has a tendency to condense on the cold engine parts, thus decreasing the amount of combustible mixture available at the combustion chamber.

The choke system subjects all fuel outlets in the bore of the carburetor to manifold vacuum while restricting the intake of air.

The choke system includes a thermostatic coil, a choke housing, a choke piston, choke valve, and fast idle cam and linkage. It is controlled by a combination of manifold vacuum, air velocity against the offset choke valve, and tension of the thermostatic coil spring.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. Starting the engine causes air velocity to strike the offset choke valve. This tends to open it along with the action of the intake manifold vacuum on the choke piston. After a slight opening of the choke valve, the tension of the thermostatic coil spring balances the force of air on the valve and the pull of vacuum at the piston.

As the engine warms up, manifold vacuum exists in the choke housing. Filtered air from just beneath the air cleaner is taken through a tube in the air horn, down to the manifold, to the choke stove. The cleaned air is heated and then drawn up to the choke housing to heat the thermostatic coil.

A baffle plate serves to evenly distribute the heat throughout the choke housing, to prevent a "hot spot" in the coil center, which would cause a rapid opening of the choke valve. The thermostatic coil relaxes gradually until the choke is fully open. The hot air, after having been drawn past the thermostatic coil, is drawn into the throttle body and deposited in a cavity on the primary half of the throttle body flange on the underside. This cavity is directly adjacent to the idle mixture adjusting needles and in

this way heat is supplied to the throttle body for better warm up characteristics. A small slot from one end of the cavity into one primary bore deposits this heated air into the intake manifold.

If the engine is accelerated during warm-up, the corresponding drop in manifold vacuum allows the thermostatic coil to momentarily close the choke, providing a richer mixture.

During warm-up it is necessary to provide a fast idle to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke shaft. The idle screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to a normal warm engine idle position until the choke is open.

Since the secondary throttle valves remain closed, only the primary side requires a choke system. When the choke is closed, the fast idle cam is raised; the raised position of the fast idle cam "locks out" any opening of the secondary throttle valve by means of a lockout lever, which is free to move only when the cam is fully lowered.

If the engine becomes flooded during the starting period, the choke valve can be partially opened manually to allow increased air flow through the carburetor. This is accomplished by depressing the accelerator pedal to the floor and engaging the starter.

The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke valve.

ADJUSTMENTS ON CAR FOUR CYLINDER ROCHESTER 4GC CARBURETOR

IDLE SPEED AND MIXTURE ADJUSTMENT

With the engine at operating temperature adjust idle speed to the following specifications:

Synchro-Mesh	680-700 R.P.M.
Automatic (In Drive)	580-600 R.P.M.

Air Conditioned:

(Auto-Drive Range—

Air Conditioning off)	630-650 R.P.M.
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(S/M-Neutral—

Air Conditioning off)	680-700 R.P.M.
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1. As a preliminary setting turn air screw out one turn from lightly seated position and mixture screws out $1\frac{1}{2}$ turns.
2. Set hand brake securely. Place transmission in neutral and connect tachometer to engine.

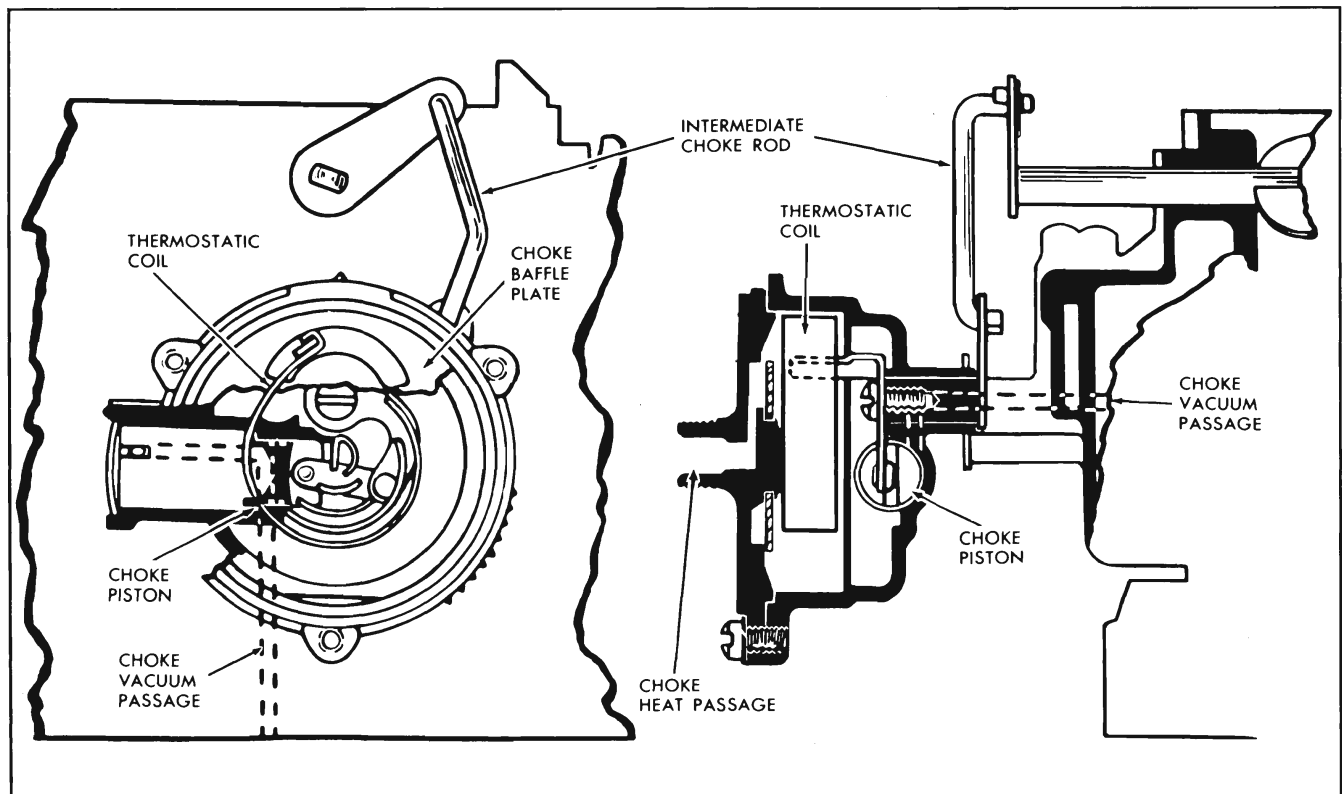


Fig. 6B-44 Choke System

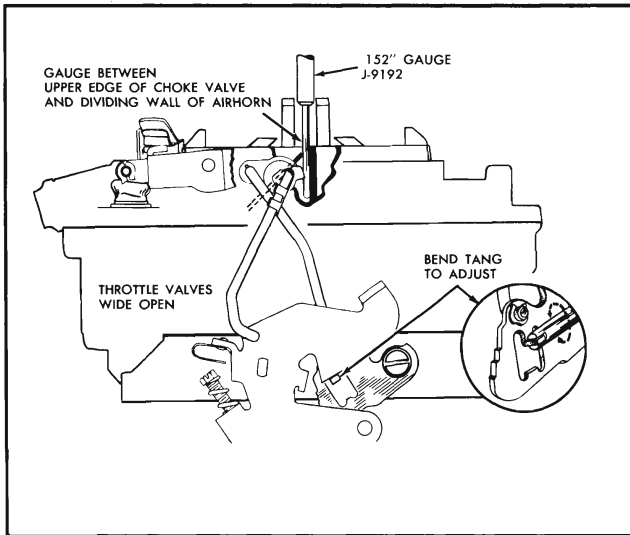


Fig. 6B-45 Unloader Adjustment (Shown off Car for Photographic Purposes)

3. Start engine and warm up thoroughly. Be sure choke is fully open and carburetor is completely off fast idle.

4. Place automatic transmission in "drive" and adjust air screw to obtain specified idle speed.

5. Adjust mixture screws to best quality (highest R.P.M.) idle.

6. Reset air screw to specified idle speed if mixture adjustment changed setting.

7. Recheck mixture adjustment to insure smoothest possible idle.

NOTE: Always recheck idle mixture setting after making idle R.P.M. adjustment with air screw.

8. Check idle speed after installation of air cleaner and reset idle if a difference in idle speed is noted.

FAST IDLE ADJUSTMENT

1. Perform normal idle speed and mixture adjustment procedure as outlined above.

2. Place transmission in neutral, move fast idle cam so that fast idle screw is on top step of the cam.

3. Observing tachometer, adjust fast idle screw to give an engine speed of 3000 R.P.M. (auto), 2800 R.P.M. (s/m).

THROTTLE RETURN CHECK ADJUSTMENT

1. Set hot idle and mixture adjustment to specifications.

2. Place transmission in neutral.

3. With engine running, disconnect vacuum hose from throttle return check and plug open end of vacuum hose.

4. Adjust the contact screw of the throttle return check to obtain speed of 1050 R.P.M.

NOTE: Hold sleeve next to diaphragm from turning while adjusting contact screw.

UNLOADER ADJUSTMENT (Fig. 6B-45)

1. Remove carburetor air cleaner assembly.

2. Depress accelerator pedal. (This should be done by person sitting in driver's seat of car to simulate actual driving conditions.)

3. With accelerator pedal depressed as in step 2, bend tang on fast idle cam to give a clearance of .152" (gauge J-9192) between top of choke valve and inside of the air horn.

4. Replace air cleaner assembly.

The above procedure will eliminate variance in linkage, floor mat, pedal location, etc. and should ensure correct unloader action.

SECONDARY THROTTLE LEVER ADJUSTMENT (Fig. 6B-46)

1. Adjust carburetor idle speed and mixture. (Be sure secondary valves are closed during this adjustment.)

2. Shut off engine and manually close choke valve.

3. Position idle speed screw on the second step of the fast idle cam.

4. Measure clearance between the secondary lock spring and the secondary throttle operating lever (Fig. 6B-46). This clearance should be .038". Bend lock spring to adjust.

It is important that this adjustment be made accurately. .038" clearance ensures the proper amount of tension when car is on hot idle. Too much tension (less than .038" clearance) could interfere with the idle speed adjustment.

**ADJUSTMENTS ON CAR
EIGHT CYLINDER ENGINE
ROCHESTER 4GC CARBURETOR**

IDLE SPEED AND MIXTURE ADJUSTMENT

With engine at operating temperature, adjust idle speed to the following specifications:

Automatic (In Drive) 580-600 R.P.M.

Air Conditioned (Auto-Drive
Range-Air Conditioning off) . 580-600 R.P.M.

FAST IDLE ADJUSTMENT

1. Perform normal idle speed and mixture adjustment procedure as outlined above.
2. Place transmission in neutral, move fast idle cam so that fast idle screw is on highest step of the cam.
3. Observing tachometer adjust fast idle screw to give an engine speed of 2800 R.P.M.

DASH POT ADJUSTMENT

1. No attempt should be made to adjust dash pot until carburetor and transmission linkage are properly adjusted, carburetor idle speed is properly adjusted and engine has reached operating temperature.
2. Place idle speed adjusting screw on high step of fast idle cam.
3. Adjust Dash Pot until there is a clearance of .000 to .010 between Dash Pot and throttle lever. Be sure Dash Pot is properly aligned with throttle lever.
4. Place transmission in drive and, with brakes firmly applied, jab accelerator pedal and release rapidly. Note engine operation as throttle closes.

UNLOADER ADJUSTMENT (Fig. 6B-45)

1. Remove carburetor air cleaner assembly.
2. Depress accelerator pedal. (This should be done by person sitting in driver's seat to simulate actual driving condition.)
3. With accelerator pedal depressed, bend tang on fast idle cam to give clearance of .129" (gauge J-9384-01) between top of choke valve and inside of the air horn.
4. Replace air cleaner assembly.

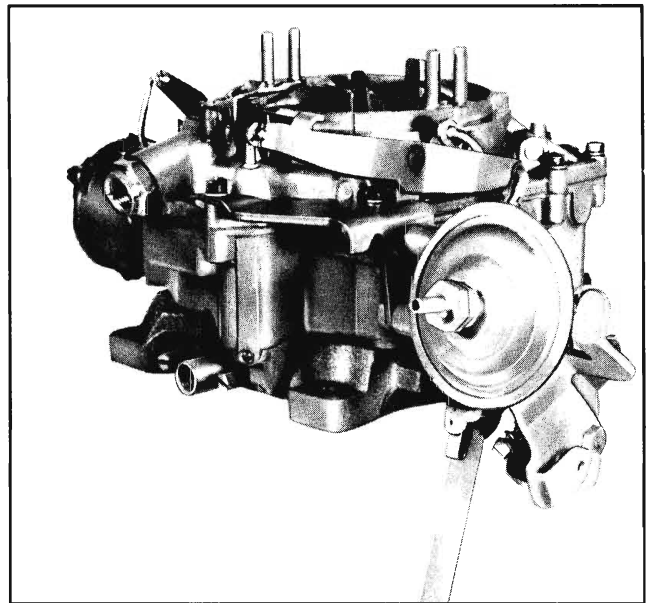


Fig. 6B-46 Secondary Throttle Lever Adjustment (Shown off Car for Photographic Purposes)

OVERHAUL AND ADJUSTMENT

NOTE: For illustration purposes four cylinder engine carburetor will be shown.

DISASSEMBLY OF AIR HORN

1. Mount carburetor on legs J-8328.
2. Remove fuel inlet fitting and gasket; strainer on four cylinder only.
3. Remove idle vent valve guard and vent valve assembly (Fig. 6B-47) (four cylinder only).

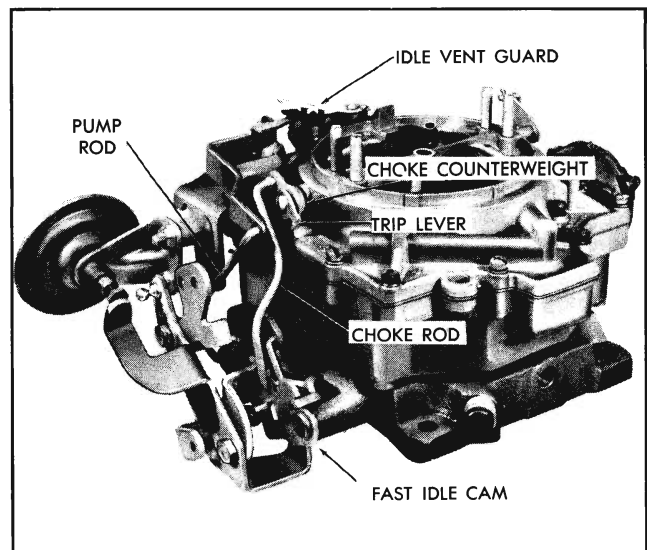


Fig. 6B-47 Rochester 4GC Carburetor

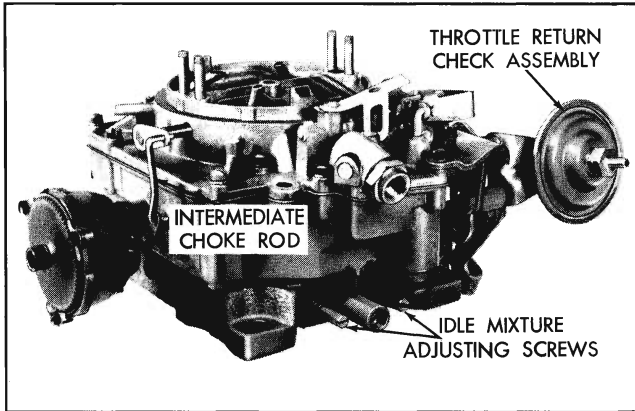


Fig. 6B-48 Rochester 4GC Carburetor

4. Remove clip from upper end of pump rod and remove rod (Fig. 6B-47).

5. Remove trip lever retaining screw at end of choke shaft and remove trip lever (Fig. 6B-47).

6. Remove fast idle cam attaching screw and remove choke counterweight rod and fast idle cam as assembly (Fig. 6B-47).

7. Remove clip at upper end of intermediate choke rod (remove clip from lower end of rod, eight cylinder carburetor) and remove intermediate rod (Fig. 6B-48).

8. If choke valve or choke shaft is to be replaced, remove two choke valve retaining screws and slide choke valve from slot in choke shaft. Remove choke shaft.

9. Remove throttle return check assembly from air horn (four cylinder carburetor only).

10. Remove 13 air horn attaching screws (Fig. 6B-49).

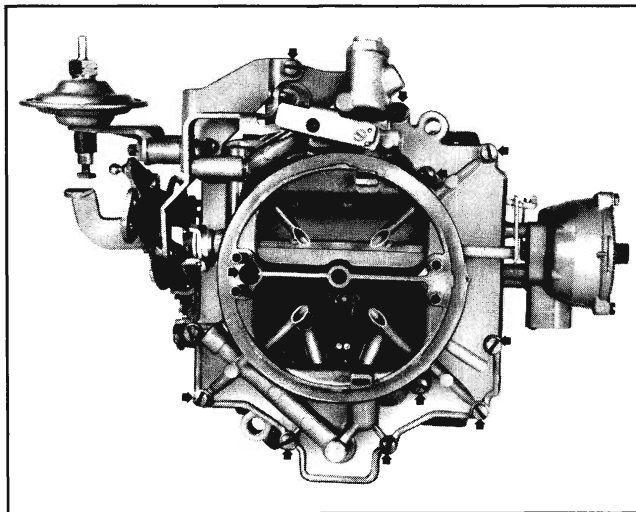


Fig. 6B-49 Location of Air Horn Attaching Screws

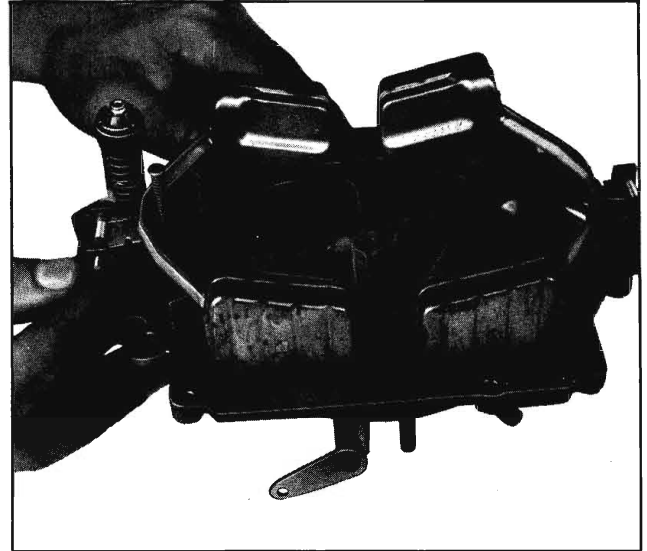


Fig. 6B-50 Removing Float Hinge Pin

11. Carefully remove air horn by lifting straight up.

12. Place air horn on clean surface float side up.

13. Remove hinge pin, spring, and float assembly primary side (Fig. 6B-50).

NOTE: Method by which spring is installed (Fig. 6B-51).

14. Remove float needle, seat gasket and strainer from primary side.

CAUTION: Group and keep together all parts of the primary side. Never mix primary and secondary parts.

15. Remove and group hinge pin, spring, float, needle and seat, gasket and strainer screen from secondary side.

16. Remove air horn gasket.

17. Remove power piston.

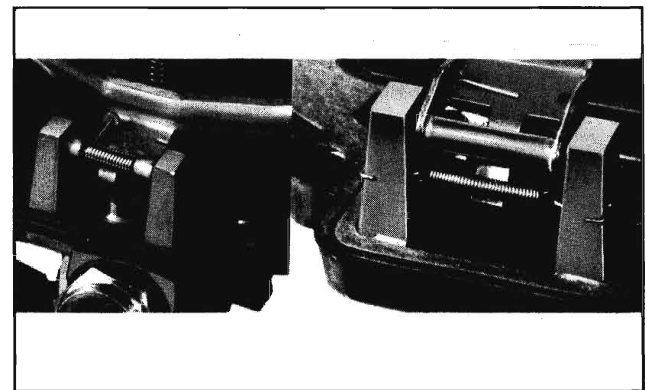


Fig. 6B-51 Float Spring Installation

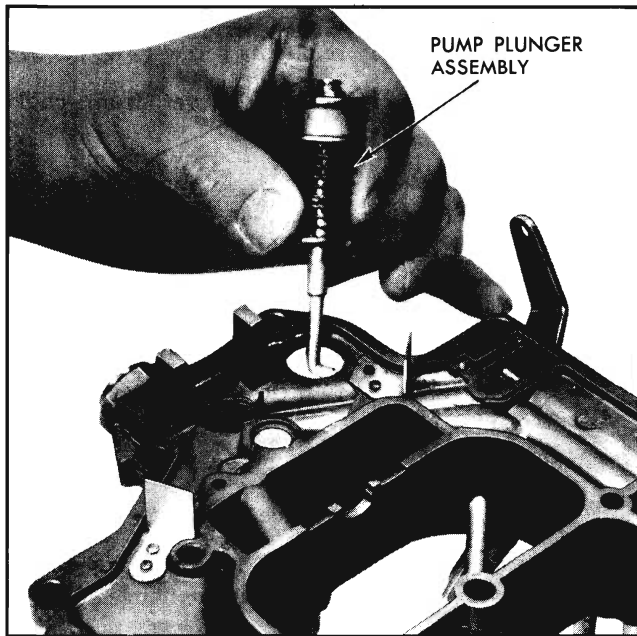


Fig. 6B-52 Removing Pump Plunger

18. Remove horseshoe retainer from pump plunger shaft.

19. Remove rubber seat and pump plunger assembly from air horn (Fig. 6B-52).

DISASSEMBLY OF BOWL

1. Remove three attaching screws and lock washers from venturi cluster on primary side and carefully remove cluster and gasket (Fig. 6B-53).

NOTE: The primary venturi cluster contains the pump discharge nozzle and idle tubes in addition to main well tubes and must always be installed on the primary side. The venturi clusters are serviced as an assembly.

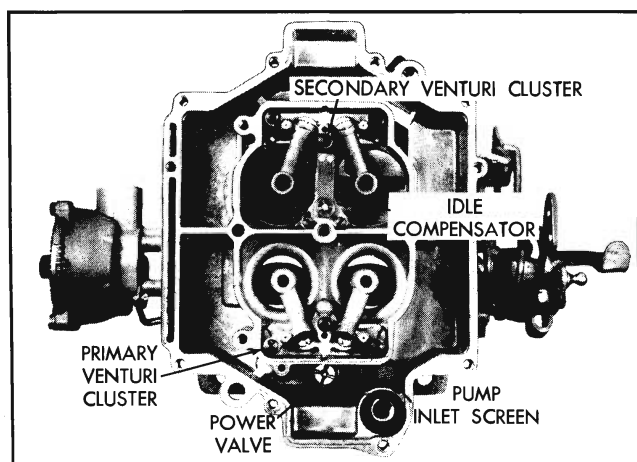


Fig. 6B-53 Fuel Bowl

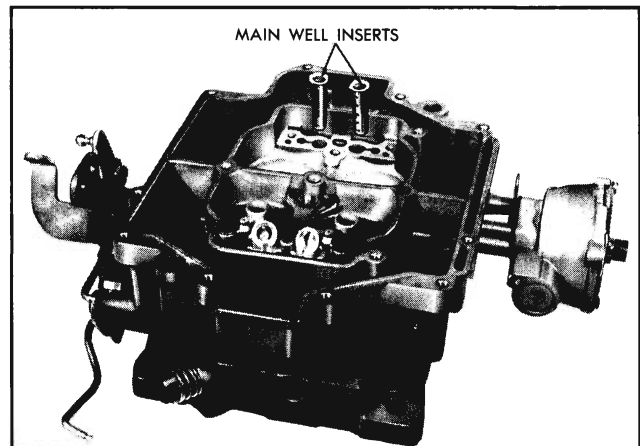


Fig. 6B-54 Main Well Inserts (Four Cylinder)

2. Remove main well inserts four cylinder, baffle eight cylinder engine.

3. Remove main metering jets from primary side.

CAUTION: Do not mix primary and secondary jets.

4. Remove power valve.

5. Remove three screws and lock washers from secondary venturi cluster. Remove cluster and gasket.

6. Remove main metering jets from secondary side of bowl.

CAUTION: Keep secondary jets separate from primary jets.

7. Remove pump return spring from pump well.

8. Carefully invert bowl and remove aluminum pump inlet ball.

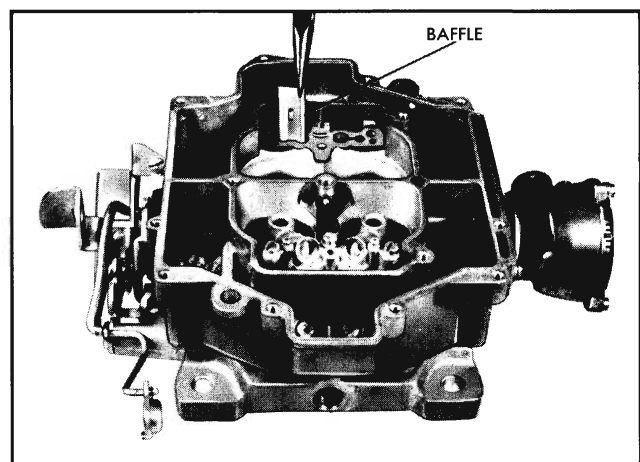


Fig. 6B-55 Baffle (Eight Cylinder)



Fig. 6B-56 Removing Pump Discharge Spring

9. Using needle nose pliers, remove pump discharge spring guide, spring and steel ball (Fig. 6B-56).

10. If pump inlet screen is damaged or plugged, it should be replaced by prying up ring with pointed tool.

11. Remove three choke cover attaching screws.
12. Remove choke cover and gasket.
13. Remove choke baffle plate.

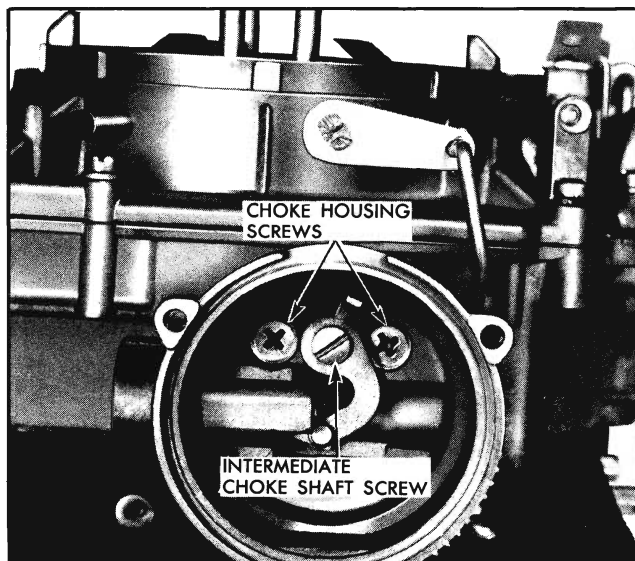


Fig. 6B-57 Location of Choke Housing Screws

14. Detach piston and link assembly from intermediate choke shaft by removing screw (Fig. 6B-57).

15. Remove piston, link and lever from choke housing.

16. Detach choke housing by removing two attaching screws (Fig. 6B-57).

17. Remove intermediate choke shaft from choke housing.

18. Remove choke housing gasket.

19. Remove bowl and throttle body from legs.

DISASSEMBLY OF THROTTLE BODY

1. Invert bowl on flat surface.

2. Remove four throttle body attaching screws and lock washers and remove throttle flange (6B-58).

3. Remove throttle body gasket.

4. Remove idle mixture adjusting needles.

5. Remove idle by-pass air screw (four cylinder only).

NOTE: The throttle body and throttle valves are serviced as a unit. No further disassembly of the throttle body should be attempted. It may be impossible to again reassemble throttle valves correctly in relation to vacuum and idle discharge orifices.

DISASSEMBLY OF AUXILIARY THROTTLE BODY

As soon as the throttle body has been removed from the fuel bowl, the auxiliary throttle valve assembly (Fig. 6B-59) can be easily removed from its

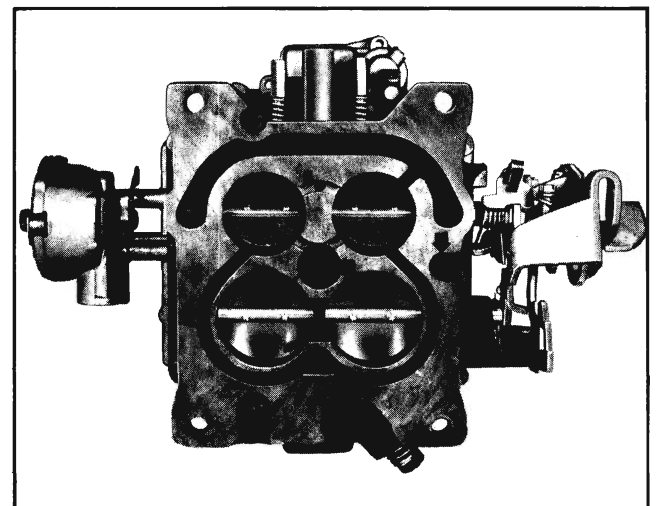


Fig. 6B-58 Location of Throttle Body Attaching Screws

recess in the float bowl by simply lifting it out. If it should stick in the carburetor body, hold the bowl upright and tap the auxiliary throttle valve casting at both ends with a long punch from above.

NOTE: Do not attempt any further disassembly of the auxiliary throttle valve assembly. The spring tension is exactly calibrated and any change will completely upset the operation of the secondary side of the carburetor.

CLEANING AND INSPECTION OF PARTS

Dirt, gum, water or carbon contamination in the carburetor or on the exterior moving parts of the carburetor are often responsible for unsatisfactory performance. Efficient carburetion depends upon careful cleaning and inspection while servicing.

1. Thoroughly clean all metal parts of carburetor in clean carburetor cleaning solution.

CAUTION: *Composition and plastic parts such as pump plunger, rubber valve and gaskets should not be immersed in cleaner.*

2. Blow out all passages in castings with compressed air and blow off all parts so they are free of cleaner. Be sure to follow instructions furnished with cleaning solution.

CAUTION: *Do not use drills or wire to clean out jets, ports or slots as this may enlarge the opening and affect carburetor operation.*

3. Carefully inspect parts for wear and replace those which are worn. Check the following specific points:

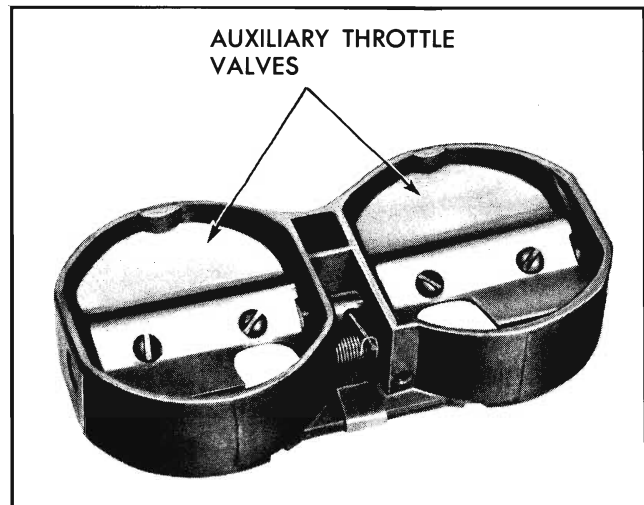
a. Inspect choke piston and choke piston housing for carbon. If necessary to clean choke piston housing, remove welch plug in the bottom of the housing. Plug can be removed by piercing center with a small pointed instrument and prying outward. Care should be used not to damage casting when removing plug. Before installing new plug, carbon present in piston and cylinder slots should be removed and welch plug seat should be carefully cleaned.

b. Remove carbon from bores of throttle flange with sandpaper; never use emery cloth.

c. Inspect float needles and seats for wear; if worn, replace both needle and seat.

d. Inspect float hinge pins for excessive wear.

e. Inspect floats for dents and excessive wear on lip. Check for fluid inside floats by shaking. Replace float if any of above are present.



6B-59 Auxiliary Throttle Body

f. Inspect throttle shaft for excessive wear (looseness or rattle in body flange casting).

g. Inspect idle mixture adjusting air screws for burrs. Replace if burred.

h. Inspect pump plunger assembly. If leather is not in good condition, replace plunger.

i. Inspect gasket surfaces between fuel bowl assembly and air horn, and between bowl assembly and throttle body. Small nicks or burrs should be smoothed down to eliminate air or fuel leakage. Be especially careful when inspecting choke vacuum passages and the top surface of the inner wall of the fuel bowl.

j. 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 causing improper carburetor operation, the part should be replaced.

k. Inspect fast idle cam, if excessive wear is noted on cam, it should be replaced to ensure proper engine operation during warm up.

l. Check all filter screens for lint or dirt. Clean or replace as necessary.

m. Check venturi clusters for loose or damaged parts. If damage or looseness exists, replace cluster assembly.

ASSEMBLY AND ADJUSTMENT

ASSEMBLY OF THROTTLE BODY

1. Install auxiliary throttle valve assembly in float bowl.

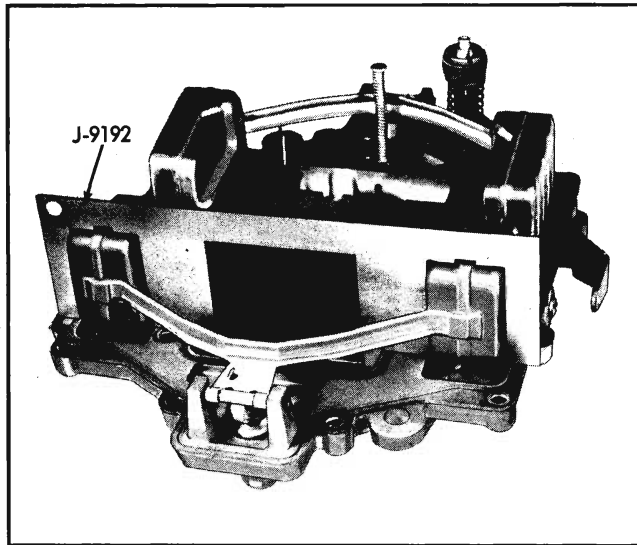


Fig. 6B-60 Float Level Adjustment (Four Cylinder)

2. Position new throttle body to bowl gasket on bowl making sure all holes are aligned.

3. Place throttle body on bowl and install four attaching screws and lock washers. Tighten screws evenly and securely.

4. Install idle mixture adjusting needles and springs. Tighten finger tight and back off $1\frac{1}{2}$ turns for approximate adjustment.

5. Install air screw on four cylinder carburetor only, back out one turn for approximate adjustment.

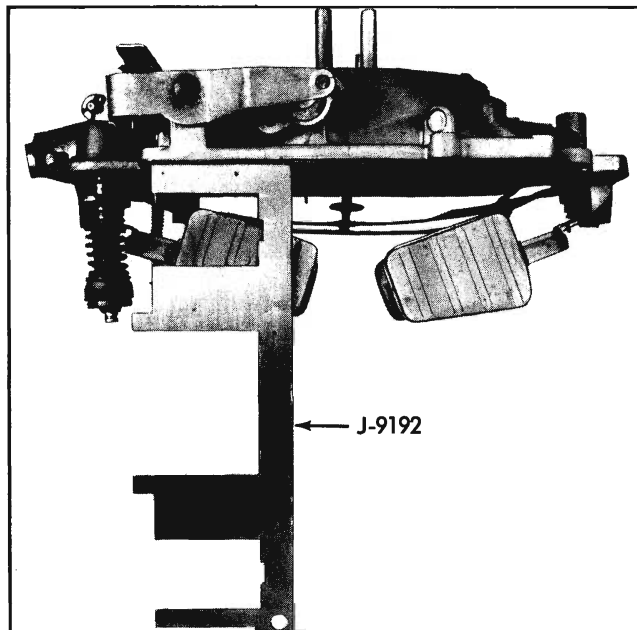


Fig. 6B-61 Float Drop Adjustment (Four Cylinder)

ASSEMBLY OF BOWL

1. Place throttle body and bowl assembly on legs J-8328.

2. Install steel pump outlet ball, discharge spring and guide.

3. Install aluminum inlet ball and pump return spring.

4. Replace pump inlet screen and retainer if removed in disassembly.

5. Install primary and secondary main metering jets in their respective sides.

NOTE: Secondary jets have larger orifice.

6. Install power valve and gasket.

7. Install idle compensator and gasket using two small self-tapping screws.

8. Install secondary venturi cluster and gasket using three attaching screws and lock washers.

9. Install main well inserts four cylinder, baffles eight cylinder.

10. Install primary venturi cluster and gasket using three attaching screws and lock washers.

11. Place new choke housing gasket on choke housing.

12. Insert intermediate choke in choke housing.

13. Assemble choke housing to bowl four cylinder, to throttle body eight cylinder.

14. Assemble choke piston and lever with small pin.

15. Install choke piston in cylinder of choke housing and attach lever to intermediate choke shaft with attaching screw.

16. Choke baffle plate and cover should not be installed until carburetor is assembled and the intermediate choke rod is adjusted at a later point in the procedure.

ASSEMBLY OF AIR HORN

1. Install rubber seal on pump plunger shaft.

2. Install pump plunger assembly in air horn making certain that the seal is properly located.

3. Assemble pump shaft into operating lever and install retainer.

4. Position new gasket on air horn.
5. Install power piston in place. Lightly stake re-tainer in place.
6. Install primary and secondary float needle seats, gaskets, and inlet screens in air horn.

CAUTION: Primary and secondary needle seat orifices are of different size and must be installed in their respective sides.

7. Install float, needle, hinge pin and spring on primary side.

NOTE: Be sure springs are properly installed.

8. Install float, needle pin and spring on secondary side.

FLOAT ADJUSTMENT PROCEDURE (FOUR CYLINDER)

FLOAT LEVEL ADJUSTMENT (FIG. 6B-60)

1. With air horn gasket in place, position float level gauge J-9192 over floats so that gauge is located at the highest point on float (Fig. 6B-60).
2. Bend float arms at center so floats just contact gauge as shown in Fig. 6B-60. The vertical height should be $1\frac{21}{64}$ ".
3. If necessary, bend float arm horizontally until each float pontoon is centered between gauge legs.
4. Repeat same adjustment on the opposite float assembly.

NOTE: With air horn inverted, lower tip of float should clear air horn casting. This ensures needle valve will fully close.

FLOAT DROP ADJUSTMENT (FIG. 6B-61)

1. Check the distance between air horn and bottom of float with air horn held in upright position (Fig. 6B-61) with gauge J-9192. The distance between air horn, with gasket installed, and the bottom of the float at the lowest point is $1\frac{3}{4}$ " minimum.
2. If adjustment is necessary, bend float tang toward float needle seat to lessen drop and away from seat to increase drop.

If necessary to adjust, bend the tang at the rear of the float hanger towards needle seat to decrease drop and away from needle seat to increase drop. Use care to avoid damage to torsion spring.

PRIMARY AND SECONDARY FLOAT ALIGNMENT

Float alignment should be checked each time float level and drop adjustments are made to be sure pontoons do not rub on sides of bowl. Invert air horn and align screw holes in gasket with screw holes in air horn. Then make sure float pontoons are centered in the cut-out sections of gasket and the sides of pontoons are parallel with the adjacent edges of the gasket as viewed from directly above. Bend the float arms to align.

Move float assembly from side to side at hinge pin to make sure pontoons do not extend over edges of cut-out sections of gasket.

FLOAT ADJUSTMENT PROCEDURE (EIGHT CYLINDER)

ADJUST PRIMARY FLOAT LEVEL

1. With air horn inverted and gasket in place, slide gauge J-9384-01 .140" back and forth, making sure pontoon just touches (Fig. 6B-62). If only one pontoon needs adjusting, bend float; if both are out of adjustment, bend arm.
2. With gauge J-9587-1 in place check alignment of primary float assembly. Each pontoon should be centered in gauge cut-out. Move float assembly from side to side making sure pontoons do not touch gauge.

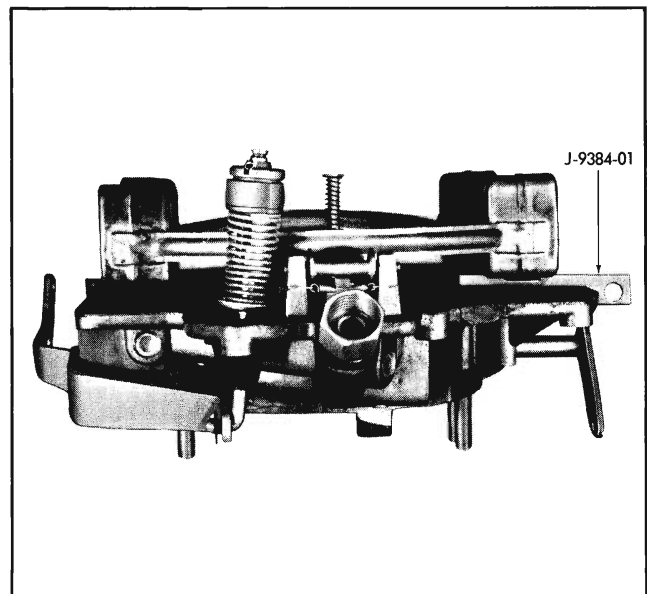


Fig. 6B-62 Primary Float Level Adjustment

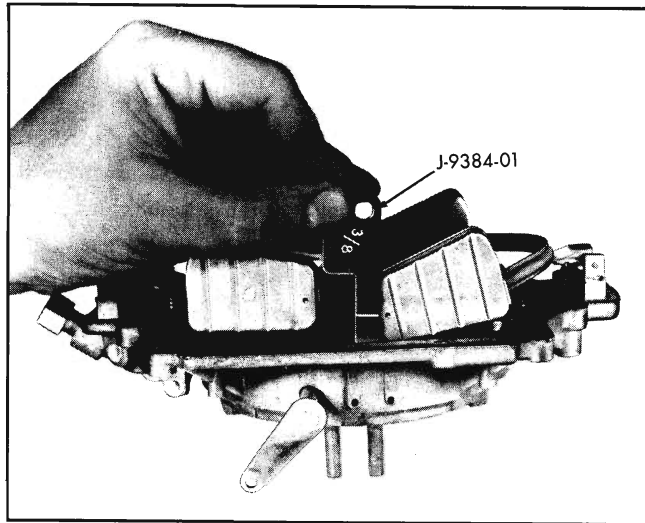


Fig. 6B-63 Secondary Float Level Adjustment

ADJUST SECONDARY FLOAT LEVEL

1. With air horn inverted and gasket in place, position gauge J-9384-01-1 (Fig. 6B-63) vertically over float assembly. Highest point on each pontoon should just touch gauge.

2. Using gauge J-9384-01- $\frac{3}{8}$ "—measure distance at toe of secondary float to dimple at side of each pontoon (Fig. 6B-63).

Recheck float alignment by aligning air horn gasket with screw holes in cover, and make sure all float pontoons are centered and aligned with gasket cut-outs. If float setting is changed, always recheck all other adjustments and alignment of floats.

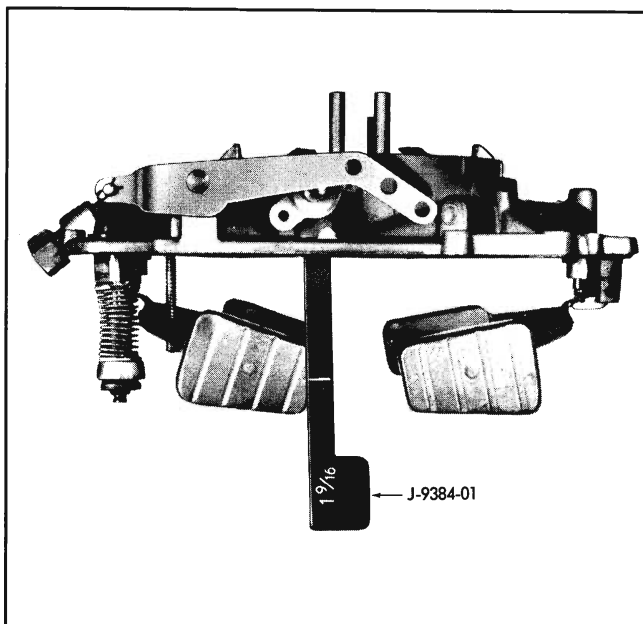


Fig. 6B-64 Float Drop Adjustment

ADJUST FLOAT DROP

NOTE: Float drop must be adjusted accurately because it affects float balance spring tension, which in turn affects fuel level in bowl.

1. With gasket in place and air horn held upright and level, bounce floats lightly to make sure they assume normal drop.

2. On the primary side measure distance from air horn gasket to dimple using gauge J-9384-01- $1\frac{9}{16}$ " (Fig. 6B-64). Bend tang toward balance spring to reduce drop, away to increase float drop.

3. On the secondary side measure distance from air horn gasket to dimple using gauge J-9384-01- $1\frac{7}{16}$ ". Bend tang as necessary to adjust.

ASSEMBLE AIR HORN TO BOWL

1. Install air horn assembly on fuel bowl being careful to guide pump plunger into pump well. Check to see that floats are lined up correctly so they will not bend.

2. Align holes in air horn, gasket and fuel bowl.

3. Start, but do not tighten, 13 air horn attaching screws.

4. Tighten evenly and securely all inner attaching screws, then tighten outer screws.

5. Install choke shaft in air horn if removed.

6. Install choke valve through choke shaft with letters R/P facing up when choke valve is closed.

7. Start, but do not tighten, choke valve attaching screws.

8. Install choke counterweight, trip lever and fast idle cam.

9. To provide correct fit of choke valve in air horn, push lightly on choke shaft to obtain a minimum clearance of .020" between trip lever and counterweight lever. While holding in this position, tighten choke valve retaining screws and stake lightly.

10. Install intermediate choke rod and retaining clip.

INTERMEDIATE CHOKE ROD ADJUSTMENT (Fig. 6B-65)

Holding choke valve completely closed, bend intermediate link, if necessary, so that the end of the choke piston is flush with the upper end of the choke piston bore.

COMPLETION OF CARBURETOR ASSEMBLY

1. Place baffle plate in position in choke housing.
2. Install thermostatic coil and cover assembly, gasket, screws and retainers. Leave screws loose.
3. Rotate cover counterclockwise until the coil begins to close the choke valve. Set cover at index four cylinder synchro-mesh; eight cylinder and four cylinder automatic one notch rich.
4. Install pump rod to pump lever and throttle lever with retainers.
5. Install fuel inlet fitting and gasket in air horn. Install screen four cylinder only.
6. Install idle vent valve and guard using the self-tapping screw on four cylinder only.

FINAL ADJUSTMENTS

The remaining adjustments should be made in the following sequence.

**PUMP ROD ADJUSTMENT (Fig. 6B-66)
FOUR CYLINDER ENGINE**

1. Hold throttle valves closed and measure, using gauge J-9192- $1\frac{5}{16}$ " , from the top of air horn casting to the bottom of pump plunger rod. Bend pump rod to adjust.
2. Operate pump several times to be sure it is free.

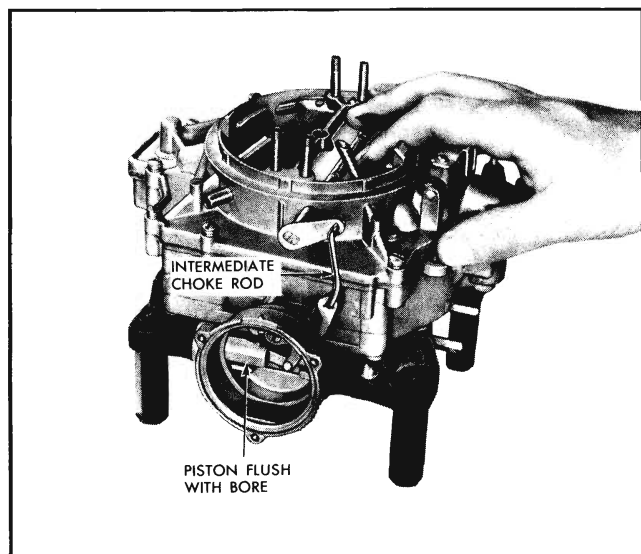


Fig. 6B-65 Intermediate Choke Rod Adjustment

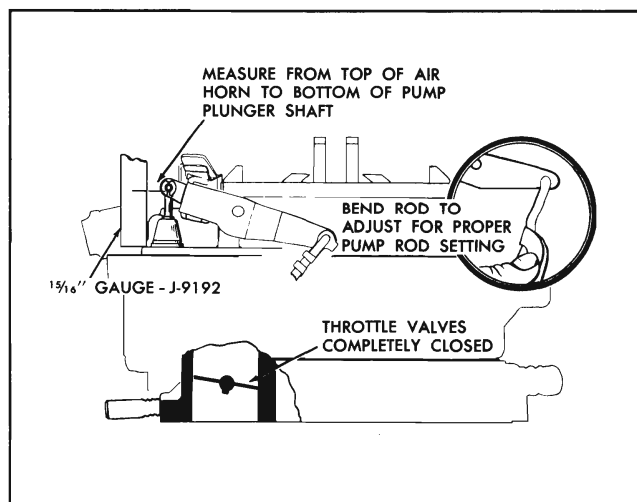


Fig. 6B-66 Pump Rod Adjustment

**PUMP ROD ADJUSTMENT
EIGHT CYLINDER ENGINE**

1. Back off fast idle and idle stop screws so that throttle valves are completely closed.
2. With pump rod in center hole of lever, measure using gauge J-9384-01- $6\frac{1}{4}$ " from top of air horn casting to bottom of pump plunger rod. Bend rod to adjust.
3. Operate pump several times to be sure it is free.

**ATMOSPHERIC IDLE VENT ADJUSTMENT
(FOUR CYLINDER) (Fig. 6B-67)**

1. Open primary throttle valve to a point where the idle vent valve just closes.
2. With gauge J-9192- $5\frac{3}{64}$ " measure the distance between top of air horn casting and bottom of pump.

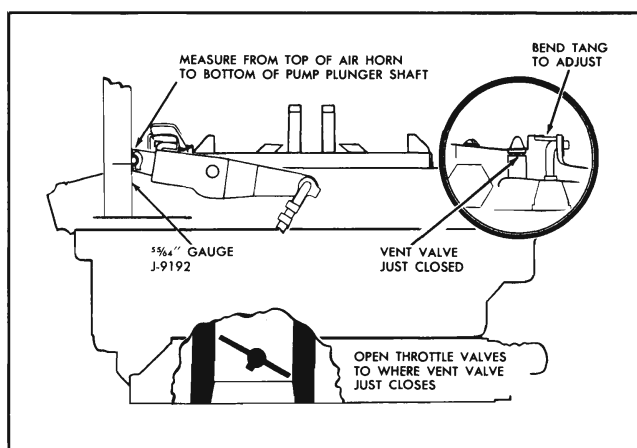


Fig. 6B-67 Atmospheric Idle Vent Adjustment

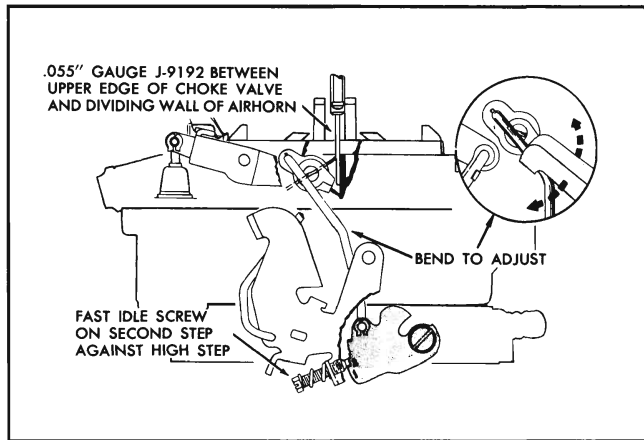


Fig. 6B-68 Choke Rod Adjustment

CHOKE ROD ADJUSTMENT (Fig. 6B-68)

1. Adjust fast idle screw so that it just contacts the second step (against shoulder of high step) of the fast idle cam.
2. Be sure that choke trip lever is contacting choke counterweight lever.
3. With gauge J-9192-.028" four cylinder, J-9384-01-.045" eight cylinder, measure clearance between the top edge of the choke valve and the dividing wall of the air horn. Bend choke rod at lower angle to adjust.

SECONDARY THROTTLE LOCKOUT ADJUSTMENT (Fig. 6B-69)

1. With the choke valve closed so that the secondary lockout tang is in the fast idle cam slot, using a .015" feeler gauge check the clearance between the cam and the tang.
2. Bend tang horizontally to adjust.

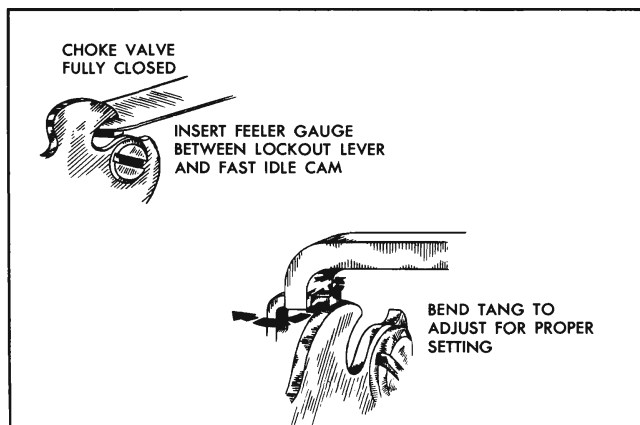


Fig. 6B-69 Secondary Throttle Lockout Adjustment

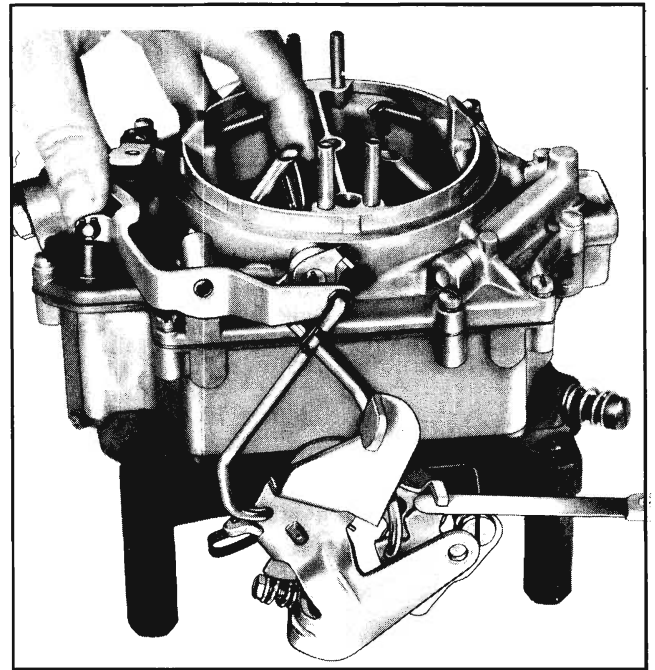
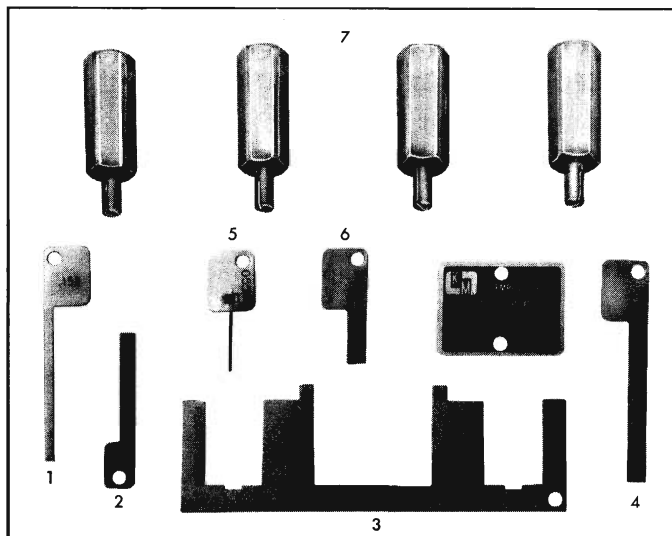


Fig. 6B-70 Secondary Throttle Contour Clearance Adjustment

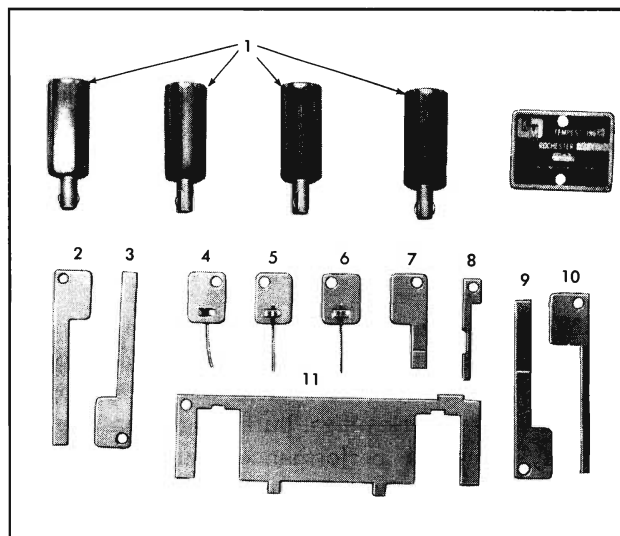
SECONDARY THROTTLE CONTOUR CLEARANCE ADJUSTMENT

1. With the choke valve held wide open and the fast idle cam and secondary lockout tang positioned as shown (Fig. 6B-70), there should be a clearance of .015" between the cam and the tang four cylinder, .030" eight cylinder.
2. Bend the tang vertically to adjust.



SPECIAL TOOLS—J-9192

1. .152" unloader gauge
2. .038" secondary throttle lever gauge
3. Float drop and level gauge
4. 5/16" pump rod gauge
5. .028" choke rod gauge
6. Idle vent gauge
7. J-8328 legs



SPECIAL TOOLS—J-9384-01

1. J-8328 legs
2. 1 1/8" float drop gauge (primary)
3. 1 7/16" float drop gauge (secondary)
4. .015" secondary throttle lockout gauge
5. .030" secondary throttle contour clearance gauge
6. .045" choke rod gauge
7. 3/8" float toe gauge (secondary)
8. Float level gauge (primary)
9. 6/64" pump rod gauge
10. .129" unloader gauge
11. Float level gauge (secondary)

SERVICE SPECIFICATIONS

Carburetor Model	Float Level		Float Drop		Float Toe Adjustment	Choke Rod	Unloader	Stat Setting	Pump Rod	Idle Vent	Secondary Throttle Lever
Rochester B & BC 7020061 7002062	1 9/32"		1 3/4" min.		—	.081" model BC only	.161" model BC only	Index	—	—	—
Rochester 4GC 7020079 7020066	1 21/64"		1 3/4" min.		—	.028"	.152"	s/m— Index auto— one notch rich	15/16"	53/64"	.015"
7020078	P 9/64"	S 13/8"	P 19/16"	S 17/16"	Secondary 3/8"	.045"	.129"	Index	61/64"	—	.030"

CARBURETOR—GENERAL

TROUBLE DIAGNOSIS AND TESTING

When carburetor troubles are encountered they can usually be corrected by making the adjustments outlined under **ADJUSTMENTS ON CAR**. The following list of common troubles and their causes will frequently save considerable time in locating the cause of the difficulty.

NOTE: Before any work is performed on the carburetor, make sure trouble is not due to poor compression, or in the ignition system due to improper timing, defective spark plugs, burned ignition points, etc. Always diagnose performance trouble by using the Pontiac Tune-N-Test Guide before adjusting or repairing the carburetor.

When the cause of trouble is not located by the Tune-N-Test, check for trouble in the carburetor system as follows:

POOR FUEL ECONOMY

NOTE: Before any attempt is made to improve fuel economy the actual gasoline mileage should be determined using a tenth of a gallon tester. If the mileage obtained during this test compares favorably with that found on other normal cars, the poor mileage must be attributed to the driving conditions or driving habits of the owner. Also consider factors such as dragging brakes, soft tires, improper tire size, and improper speedometer driven gear.

1. Check automatic choke, if used, to see that it operates properly and that it is correctly indexed.
2. On four cylinder engine inspect manifold heat valve to see that it operates freely and thermostat is installed properly.
3. Check for leaks in fuel line fittings, at fuel tank, or at fuel pump bowl.
4. Check for dirty or restricted air cleaner.
5. Test for high fuel pump pressure.
6. Disassemble carburetor and check for evidence of vacuum leaks.
7. Check float level.

SURGING CONDITION WITH HOT ENGINE

1. Lean carburetor adjustment. Check idle mixture setting.
2. Check fuel pump pressure and output.
3. Check needle and seat on leak down tester.
4. Check float adjustment.
5. Check for dirty or obstructed jets or fuel passages.
6. Check for loose cluster or jets.

FLAT SPOT OR POOR ACCELERATION

1. Check manifold heat control valve on four-cylinder engine thermostat for correct operation.
2. Check accelerator pump output visually to see if operating.
3. Check accelerator pump adjustment.
4. Check accelerator pump inlet and outlet valves for leakage.
5. Check for seating of accelerator pump plunger vent ball.
6. Check accelerator pump passages for dirt or obstructions.

ROUGH IDLE

1. Check speed and mixture adjustment.
2. Check mixture screws for wear or burrs.
3. Check for manifold gasket leaks.
4. Check vacuum and choke heat connection.
5. Check operation and setting of choke system.
6. Check idle passage and throttle bore for carbon and dirt.
7. Check float adjustment.
8. Check for secondary throttle sticking (4 barrel).
9. Check engine compression.
10. Check spark plug gaps.

IMPROPER HIGH SPEED PERFORMANCE

1. Check spark plugs for correct gap and condition.
2. Check distributor points.
3. Check fuel pump output and pressure.
4. Check filter for restriction or plugging.
5. Check carburetor for evidence of internal vacuum leaks.
6. Check float level adjustment.
7. Check high speed passages for dirt or obstruction.

FLOODING OR LEAKING

1. Check for foreign material in needle and seat area.
2. Check needle and seat on leak down tester.
3. Check float adjustment (make sure float is not binding or rubbing).
4. Check for leaking or collapsed float.
5. Check for cracked bowl or loose passage plugs.

FUEL PUMP

DESCRIPTION (Fig. 6B-71)

The fuel pump transfers gasoline from the tank to the carburetor in sufficient quantity to meet engine requirements at any speed or load.

The rocker arm spring keeps the rocker arm in constant engagement with the eccentric on the engine camshaft so that the rocker arm moves downward and upward as the camshaft rotates. As the rocker arm is moved downward, it bears against a link which is also pivoted on the rocker arm pin. The link is hooked to the diaphragm pull rod so that the diaphragm is moved away from the fuel chamber and the diaphragm spring is compressed. The enlarging fuel chamber moves gasoline from the tank through the tubing inlet valve and into the space below the diaphragm.

As the rotating eccentric permits the rocker arm to move away from contact with the link, the compressed diaphragm spring is free to move the diaphragm downward to expel the fuel through the outlet valve to the carburetor bowl.

Because the diaphragm is moved downward only by the diaphragm spring, 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. Fuel is delivered to the carburetor only when the needle valve is open. When the needle valve is closed by pressure of fuel on the float, the

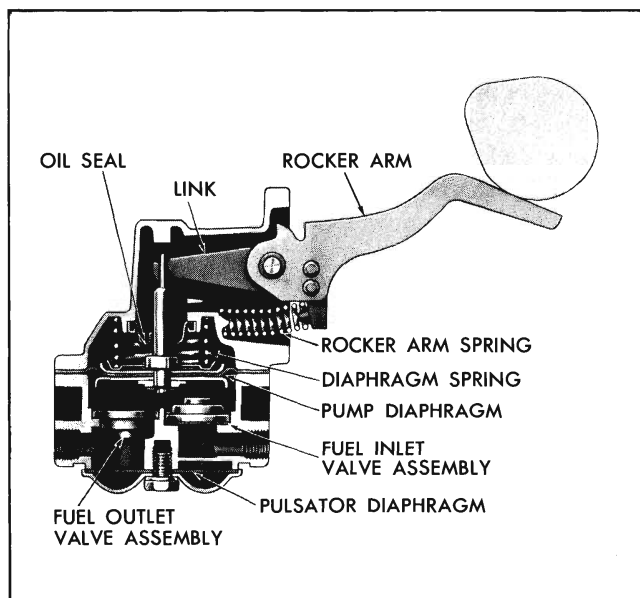


Fig. 6B-71 Schematic Fuel Pump

pump builds up pressure in the space below the diaphragm and in the outlet tube until the diaphragm spring is compressed. The diaphragm then remains stationary until more fuel is required.

OVERHAUL AND ADJUSTMENT

DISASSEMBLY

1. Scratch locating marks on fuel cover and pump body so that inlets and outlets will be properly located when pump is reassembled.
2. Place pump in soft jawed vise (Fig. 6B-72).
3. Remove bolt and washer from pulsator cover plate. Remove pulsator cover and diaphragm from pump cover.
4. Remove pump cover screws except any two that are diametrically opposite.
5. Press down firmly on the cover to hold the diaphragm spring compressed and remove the remaining two screws. Release the cover slowly and remove cover assembly.
6. Drive out rocker arm pin with a tapered drift after removing sufficient staked metal from the pin. Be sure to leave sufficient metal for restaking.
7. Remove rocker arm, rocker arm spring and link.
8. Remove diaphragm assembly and diaphragm spring.
9. Using a small chisel, round file or small grinding wheel, remove metal from around oil seal retainer which was displaced by staking during assembly. Pull out seal and seal retainer using a hooked shaped tool.

CAUTION: Use care not to damage oil seal seats.

10. Remove metal displaced by staking around inlet and outlet valves. Pry valves and cages out with screwdriver blade. Lift out gaskets.

CLEANING AND INSPECTION

1. Clean and rinse all metal parts in solvent. Blow out all passages with compressed air.
2. Inspect pump body, cover and pulsator cover for cracks, breakage or distorted flanges. Examine all screw holes for stripped or crossed threads. If any of these three parts are damaged, the pump should be replaced.
3. Inspect rocker arm, link and pin for wear.

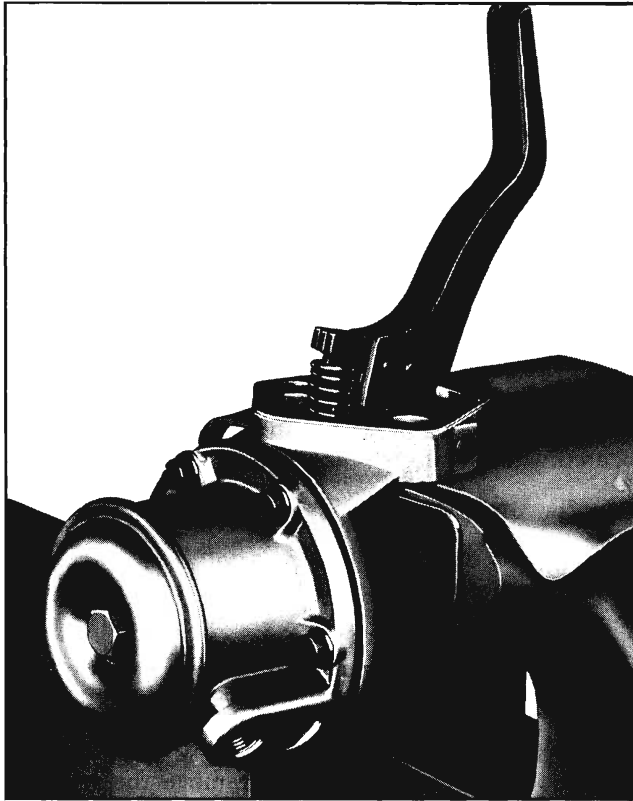


Fig. 6B-72 Fuel Pump Positioned in Vise

ASSEMBLY

1. Install new oil seal and retainer in pump body and press firmly in place.
2. Stake die cast lip in four places to retain seals.
3. Position link and rocker arm in pump body with hook of link pointing toward top of pump.
4. Align holes and drive rocker arm pin through rocker arm.
5. Install small washer on rocker arm pin and re-stake pin securely.
6. Install inlet and outlet gaskets and valves in pump cover. Press valve and cage assembly against gasket and stake in position.
7. Soak pump diaphragm in clean kerosene. Fuel oil may be used, but do not use shellac or sealing compound.
8. Place pump body in soft jawed vise.
9. Place diaphragm on bench with pull rod pointing up. Position spring over pull rod.

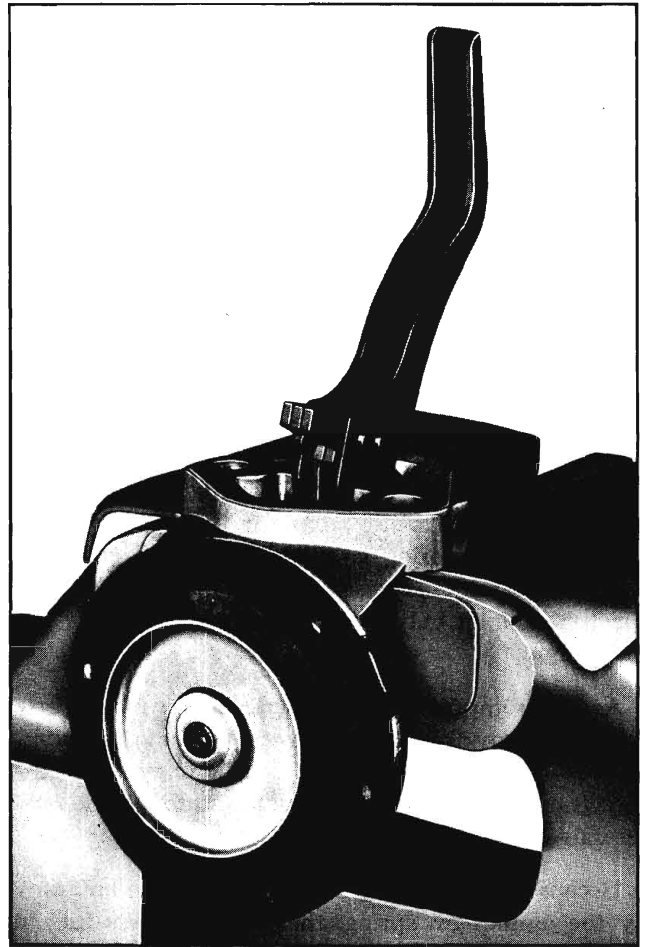


Fig. 6B-73 Diaphragm Assembly Installed

10. Pick up diaphragm and spring as an assembly and push pull rod through oil seal into body. Be sure diaphragm spring is seated in body. Have flat of pull rod parallel to flat of link with the diaphragm flush with the body. With palm of hand, turn the diaphragm 90°, or until flat of pull rod is perpendicular to pump link. This motion should engage the pull rod "eye" with the link hook. If not, repeat this procedure until the connection is made (Fig. 6B-73).

CAUTION: Extreme care should be used to avoid damaging oil seal.

11. Position rocker arm spring between projection on rocker arm and conical projection on body.
12. Install pump cover on body making sure that scratch marks on cover and body line up. Push on rocker arm until diaphragm is flat across body flange. Install cover screws and lockwashers loosely until screws just engage lockwashers. Push rocker arm through its full stroke and hold in that position while tightening cover screws securely.

NOTE: Diaphragm must be flexed before tightening cover screw or pump will deliver too much pressure.

13. Place new pulsator diaphragm on pump body. Install pulsator cover with bolt and lockwasher.

TROUBLE DIAGNOSIS AND TESTING

Always check fuel pump while it is mounted on the engine and be sure there is gasoline in the tank.

The line from the tank to the pump is the suction side of the system. The line from the pump to the carburetor is the pressure side of the system. A leak on the pressure side of system would be visible because of dripping fuel. A leak on the suction side would not be apparent except for its effect of reducing the volume of fuel on the pressure side.

1. Tighten any loose line connections and look for bends or kinks in lines which could reduce the flow of fuel.

2. Tighten diaphragm flange screws.

3. Disconnect fuel pipe at carburetor. Disconnect distributor to coil primary wire so that the engine

can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If little or no gasoline flows from open end of pipe, then fuel pipe is clogged or pump is inoperative. Before removing pump, disconnect fuel pipe at inlet of pump and at gas tank outlet pipe and blow through them with an air hose to make sure they are clear. Reconnect pipes to pump and retest while cranking engine.

4. If fuel flows from pump in good volume from pipe at carburetor, check fuel delivery pressure to be certain that fuel pump is operating within specified limits as follows:

a. Attach a fuel pump pressure test gauge to disconnected end of pump to carburetor pipe.

b. Run engine at approximately 1,800 RPM on gasoline in carburetor bowl and note reading on pressure gauge.

c. If pump is operating properly, the pressure will be between 4 PSI to $5\frac{1}{4}$ PSI at 1,800 RPM. If pressure is too low or too high, or varies materially at different speeds, the pump should be removed for repair.

ENGINE TUNE-UP

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
General Description	6C-1	Additional Procedures	
Basic Procedure	6C-1	Clean Battery	6C-2
Connect Tune-up Equipment	6C-1	Check Compression	6C-2
Test Battery Voltage	6C-1	Clean Air Cleaner	6C-3
Remove and Recondition Spark Plugs	6C-2	Clean and Inspect Secondary Wiring	6C-3
Clean and Adjust Distributor Points	6C-2	Check Choke and Unloader	6C-3
Set Ignition Timing	6C-2	Tighten Intake Manifold	6C-4
Adjust Idle Speed and Mixture	6C-2	Inspection	6C-4
Adjust Fast Idle Speed	6C-2	Road Test	
Check Manifold Heat Valve	6C-2	Performance	6C-4
		Operation	6C-4

GENERAL DESCRIPTION

A minor tune and test consists of testing battery, cleaning, regapping or replacing, if required, spark plugs and distributor points; adjusting distributor dwell angle, ignition timing, carburetor idle mixture, hot idle speed and fast idle speed, and checking manifold heat control valve.

The complete or major tune and test procedure consists of these basic items plus other ignition, compression, electrical and carburetor checks, and a final road test to ensure continued trouble free operation.

BASIC PROCEDURE

CONNECT TUNE-UP EQUIPMENT

Follow manufacturer recommendations for the use of testing equipment. Fig. 6C-1 shows a basic schematic for instrumentation which will apply to many types of test equipment and may be used as a rough guide if equipment manufacturers instructions are not available.

Connections shown in Fig. 6C-1 are made as follows:

1. Voltmeter
 - a. Positive lead to resistor side of coil.
 - b. Negative lead to ground.
2. Timing Light
 - a. Positive lead to positive battery terminal.

- b. Negative lead to ground.
- c. Trigger lead to number 1 spark plug.

3. Tachometer

- a. Positive lead to distributor side of coil.
- b. Negative lead to ground.

4. Dwell Meter

- a. Positive lead to distributor side of coil.
- b. Negative lead to ground.

TEST BATTERY VOLTAGE BEFORE AND WHILE CRANKING ENGINE

NOTE: Disconnect distributor to coil primary wire during this test to prevent engine from firing.

Terminal voltage while cranking must not be less than 9.0 volts. Engine cranking speed (approximately 180 RPM) should also be observed during this check to see that it is satisfactory. If cranking speed is low, check starting circuit to locate cause of low speed. If battery voltage is low while cranking, further tests of battery and/or starting motor circuit should be made to locate trouble.

To insure proper electrical operation, the battery should be in good condition and be adequately charged. Check cell to cell voltage as outlined in section 11 and recharge or replace as necessary.

REMOVE AND RECONDITION SPARK PLUGS

See that correct spark plugs are used. Spark plug insulators should be thoroughly cleaned to prevent possible flash-over. Thoroughly clean lower insulator and cavity by sand blasting. File both electrodes flat (rounded surfaces increase voltage required to fire plugs) and set gap to .035". When plugs are reinstalled, use new gaskets and tighten plugs to 25 lb. ft. torque (4 Cylinder Engine) or 15-20 lb. ft. torque (V-8 Engine). NOTE: Use thread lubricant on V-8 Engine.

CLEAN AND ADJUST DISTRIBUTOR POINTS

Remove distributor cap and inspect points for excessive burning or pitting. Replace points if necessary. Use a point file to clean contact area and remove scale from points. Filing is for cleaning purposes only. Do not attempt to remove all roughness. Apply a trace of bearing lubricant to the breaker cam. Adjust distributor dwell angle to 75 degrees on four cylinder models and 30 degrees on eight cylinder models following procedure outlined in Section 11.

SET IGNITION TIMING

With distributor vacuum line disconnected and car operating at normal idle speed or below, set ignition timing. Follow procedure outlined in Section 11 of this manual. Correct settings are 6° BTDC for the four cylinder engine and 5° BTDC for the eight cylinder engine.

ADJUST HOT IDLE SPEED AND MIXTURE

Following adjustment procedure outlined in section 6B, adjust carburetor idle speed and mixture to the following specifications:

	4 CYL.	8CYL.
S. M. Transmission	680-700	580-600 RPM
Auto. Transmission w/o Air Conditioning*	580-600	580-600 RPM
Auto. Transmission with Air Conditioning*	630-650	580-600 RPM

*NOTE: Set idle speed with transmission in drive.
Air Conditioning Off.

ADJUST FAST IDLE SPEED

Following procedures outlined in Section 6-B, adjust fast idle speed to the following:

4 Cylinder, 4 bbl., Auto Trans.	3000 RPM
4 Cylinder, 4 bbl., S.M. Trans.	2800 RPM
8 Cylinder, 4 bbl., A/M Trans.	2800 RPM

NOTE: There is no fast idle adjustment on one barrel equipped units.

SEE THAT EXHAUST MANIFOLD HEAT VALVE OPERATES FREELY (4 CYL. ONLY)

Manifold heat valve must operate freely. If stuck open, it can cause sluggish operation of the engine, especially during warm-up. If stuck closed, engine performance when hot will be unsatisfactory.

ADDITIONAL PROCEDURES

For diagnosis purposes, it is sometimes necessary to proceed further than the basic tune-up procedure. The following steps plus a road test are included in a complete or major tune and test procedure.

CLEAN TOP OF BATTERY, TIGHTEN TERMINALS AND HOLD DOWN CLAMP

Clean top of battery and terminals with a solution of baking soda and water. Rinse off and dry with compressed air. The top of the battery must be clean to prevent current leakage between the terminals and from the positive terminal to the hold down clamp.

In addition to current leakage, prolonged accumulation of acid and dirt on top battery may cause blistering of the material covering the connector straps and corrosion of the straps. After tightening terminals, coat them with petrolatum to protect them from corrosion. Hold down clamp should be tightened to 22-27 lb. in. torque.

CAUTION: Excessive tightening of the hold down clamp can crack the battery case.

TEST COMPRESSION PRESSURE OF EACH CYLINDER

NOTE: If this test is to be performed, it should be done when plugs are removed for service during the basic tune-up procedure.

Unless checking for worn rings or for the cause of low speed miss, compression check should not be necessary.

Test compression with engine warm, all spark plugs removed and throttle and choke open. No cylinder should be less than 80% of the highest cylinder (see examples). Excessive variation between cylinders, accompanied by low speed missing of the cylinder or cylinders which are low, usually indicates a valve not properly seating or a broken piston ring. Low pressures, even though uniform, may indicate worn rings. This may be accompanied by excessive oil consumption.

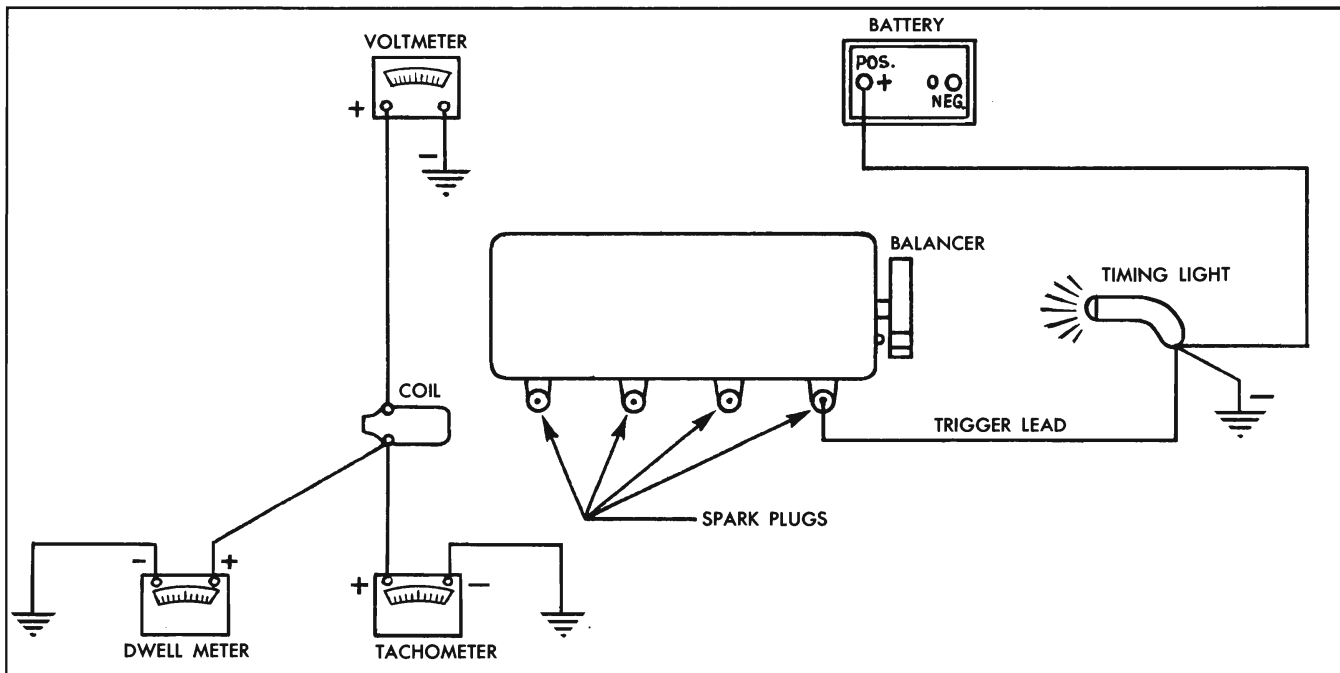


Fig. 6C-1 Basic Instrumentation for Tune-up

EXAMPLE 1

Cyl.	1	2	3	4
Press.	136	102	135	144

80% of 144 (highest) is 115. Thus cylinder No. 2 is less than 80% of No. 4. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

EXAMPLE 2

Cyl.	1	2	3	4
Press.	85	96	90	87

80% of 96 is 77. While all cylinders are well above 77, they are all excessively low. This indicates all poor valves or, if accompanied by oil consumption, worn rings. If compression is subnormal, the tune-up will probably not be satisfactory.

CLEAN CARBURETOR AIR CLEANER AND CRANKCASE VENTILATOR AIR CLEANERS

The entire air cleaner should be removed from the car for cleaning. The metal cover and shell of the air cleaner should be cleaned on the inside surfaces.

Remove filter element from standard carburetor air cleaner. Wash dirt from filter element and from crankcase ventilator inlet by plunging up and down several

times in suitable solvent. Drain dry and re-oil.

The heavy duty air cleaner element should be washed in kerosene, squeezed dry and dipped in SAE 10W-30 oil. Squeeze dry again to remove excess oil. **DO NOT WRING DRY.**

CLEAN AND INSPECT HIGH TENSION WIRES, DISTRIBUTOR CAP AND ROTOR

NOTE: This operation is to be performed while checking distributor points during the basic tune-up procedure. Inspect distributor cap for cracks and flash over.

External surfaces of all parts of the secondary system must be cleaned to reduce the possibility of voltage loss. All wires should be removed from the distributor cap and coil so that terminals can be inspected and cleaned. Burned or corroded terminals indicate that wires were not fully seated, causing arcing between the end of the wire and the terminal. When replacing wires in terminal, be sure they are fully seated before pushing rubber nipple down over tower. Check distributor rotor for damage.

CHECK CARBURETOR CHOKE AND UNLOADER OPERATION AND ADJUSTMENT

The specified choke setting provides ideal choke operation in all climates. No seasonal changes are necessary.

Settings are center index on all automatic choke equipped units.

The choke should just close at 75°F. when set at index. In rare cases, it may be necessary to change slightly (never more than two notches) from the standard setting to properly calibrate the choke. Excess carbon in choke housing may indicate a leaking choke heat tube.

Choke linkage and fast idle cam must operate freely. Do not lubricate linkage since this will collect dust and cause sticking.

Check unloader action. Inoperative unloader can cause complaints of difficult hot starting. Adjust as outlined in Section 6B.

TIGHTEN INTAKE MANIFOLD AND CARBURETOR ATTACHING NUTS

Intake manifold attaching screws and nuts on engines should be tightened to 40 lb. ft. torque. Carburetor attaching nuts should be tightened securely. Leaks at these areas can cause rough idle, surging, deceleration popping, or deceleration whistle.

INSPECTION

Inspect for oil and/or coolant leaks. Check radiator hoses. Check and adjust engine fan and accessory drive belt tension. Clean steering wheel.

ROAD TEST

TEST PERFORMANCE OF CAR

Observe performance of engine at low speed, during acceleration, and at constant speed. Check for missing, stalling, surging, poor acceleration or flat

spots on acceleration. If any irregularity is found, refer to the appropriate section of the manual for repair procedures.

TEST OPERATION OF:

BRAKES—Pedal should not go closer than 2" from floor mat and car should not pull to either side.

PARKING BRAKE—Should hold the car without excessive movement of parking brake pedal.

AUTOMATIC TRANSMISSION—Observe shift at minimum, medium, and full throttle and test part throttle and forced downshift. Watch for slipping or unusual shift characteristics that may indicate need for adjustment.

STEERING GEAR—See that steering operates normally and that steering wheel does not have excessive play. Also observe for alignment of steering wheel, pull, wander, or other irregularity that might indicate need for front end alignment.

WINDSHIELD WIPER—Wiper operation should be tested with windshield wet in order to properly judge the action.

CLUTCH—See that clutch engages smoothly and that pedal has approximately 3/4" of free travel. "Hard" pedal or lack of pedal return may indicate need for linkage adjustment.

LIGHTS AND HORNS—Test operation and aim of headlights, operation of all lights and horn.

INSTRUMENTS—Observe operation of all instruments. Observe especially for possible abnormal readings which may indicate trouble.

ACCESSORIES—Test operation of radio, heater, defroster, cigar lighter, other accessories.

ENGINE CLUTCH

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
Description	6D-1	Replace Clutch Drive Shaft Bearing	6D-7
Periodic Service	6D-3	Replace Drive Shaft Pilot Bearing	6D-8
Clutch Pedal Adjustment	6D-3	Install Clutch	6D-8
Replace Clutch Linkage	6D-4	Torque Specifications	6D-9
Remove Clutch	6D-5	Special Tools	6D-10
Inspect Clutch	6D-5		

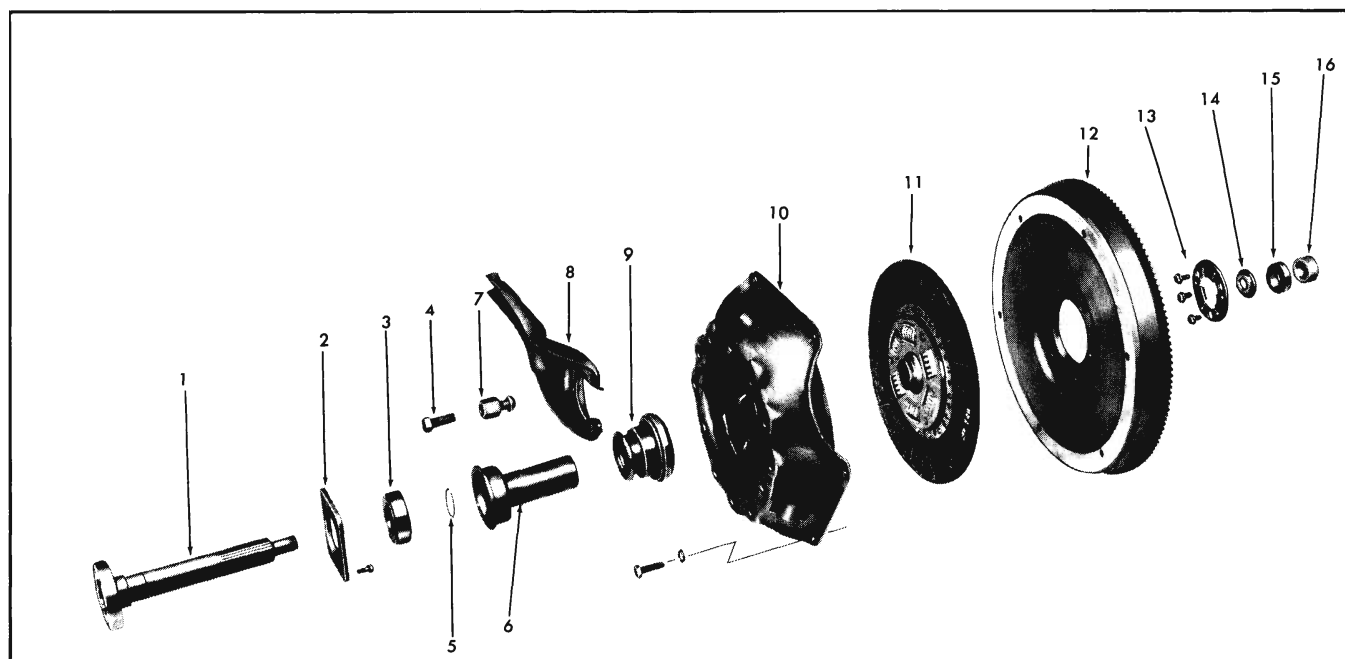
DESCRIPTION

A single plate, dry disc type clutch is used on all Tempest cars with synchro-mesh transmissions. The clutch assembly consists of the clutch driven plate assembly, the clutch cover and pressure plate assembly, and the clutch release mechanism (Fig. 6D-1).

The 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 cover and pressure plate assembly (Fig. 6D-1) is made up of the cover, pressure plate, nine clutch thrust springs, three clutch release levers, three eyebolts, three anti-rattle springs, three struts and three special adjusting nuts. The clutch thrust springs act on the pressure plate and force the driven plate against the flywheel, thereby coupling the engine to



- | | | |
|--|-------------------------------------|--------------------------------------|
| 1. Clutch Drive Shaft | 7. Clutch Release Fork Ball Nut | 13. Pilot Bearing Retainer |
| 2. Retaining Plate | 8. Clutch Release Fork | 14. Pilot Bearing Oil Seal |
| 3. Clutch Drive Shaft Bearing | 9. Clutch Release Bearing | 15. Clutch Drive Shaft Pilot Bearing |
| 4. Clutch Fork Ball Nut Support Bolt | 10. Clutch Cover and Pressure Plate | 16. Clutch Drive Shaft Oiling Felt |
| 5. Clutch Drive Shaft Bearing Retainer | 11. Clutch Driven Plate | |
| 6. Clutch Release Bearing Support | 12. Flywheel | |

Fig. 6D-1 Engine Flywheel and Clutch

the transmission. The clutch eyebolts connect the pressure plate to the clutch cover and the release levers disengage the pressure plate when force is applied against the clutch release bearing.

The clutch release mechanism consists of a ball thrust bearing, appropriate levers and linkage to manually control the action of the bearing. The ball thrust bearing is piloted on a tubular support. When pressure is applied to the clutch pedal to release the clutch, the clutch fork 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 (Fig. 6D-1). Pedal effort is transmitted by the pedal to the lever assembly and thence through the clutch fork.

The lever assembly is equipped with an overcenter spring so that when the clutch pedal is depressed beyond a certain point, the overcenter spring partially balances the clutch springs, thus reducing the pedal effort exerted by the driver in disengaging the clutch.

PERIODIC SERVICE

See "General Lubrication" Section.

CLUTCH PEDAL ADJUSTMENT

CAUTION: Do not attempt to adjust pressure plate release levers as they are adjusted at the factory with a special fixture, and cannot be adjusted correctly unless a fixture is used.

Due to design of clutch linkage, the Tempest requires a slightly different adjustment procedure than used on other Pontiac models. The main difference is that prior to adjusting clutch lash, the pedal height must be adjusted at the stop bracket. Setting the pedal height provides the correct overcenter adjustment and makes it possible to achieve good pedal feel and correct lash at the same time.

1. Back off silencer bumper so it does not touch pedal.

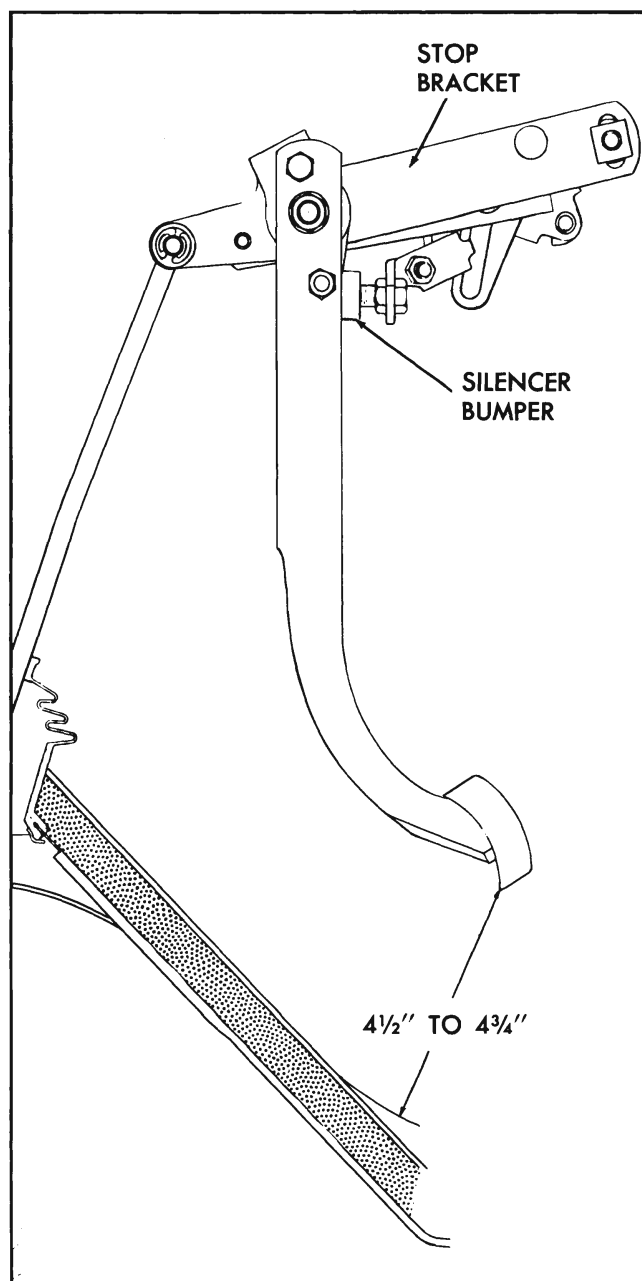


Fig. 6D-3. Clutch Pedal Clearance

2. Adjust position of stop bracket assembly to established correct pedal height (Fig. 6D-3).

3. Adjust silencer bumper so that it just contacts clutch pedal on pedal return.

4. Loosen lock nut on clutch rod and adjust clutch lash as follows:

a. Remove spring, washer and cotter pin from rear end of clutch fork rod.

b. Pull end of clutch fork toward rear of car until release bearing is in solid contact with fingers on pressure plate. This is the zero lash position.

c. With fork held back as described above, run adjusting nut back against fork assembly. Then adjust lash by turning $3\frac{1}{2}$ turns forward for a used driven plate or $4\frac{1}{4}$ turns for a new driven plate.

d. Tighten lock nut.

e. Reinstall washer, cotter pin and spring.

As a final check, observe clearance between release bearing and fingers with clutch released. This should be a minimum of .060". Check clutch pedal feel and return action.

6. Install flywheel housing lower cover.

LOWER CLUTCH LINKAGE ASSEMBLY

REMOVE AND REPLACE

1. Remove anti-rattle spring.
2. Remove clutch rod rear cotter pin, washer, and spring.
3. Remove clutch rod front retaining ring and washer.
4. Remove clutch rod.
5. Remove clutch pedal linkage rod retaining ring and washer and remove from lever assembly.
6. Remove clutch link to clutch housing stud retaining ring.
7. Remove support plate to body rail bolts.
8. Remove clutch lever and link assembly.
9. To install assembly, reverse above procedure.

NOTE: Make certain lever assembly is installed as shown in Fig. 6D-4, or incorrect clutch pedal operation will result.

10. Adjust clutch pedal as described on page 6D-3.

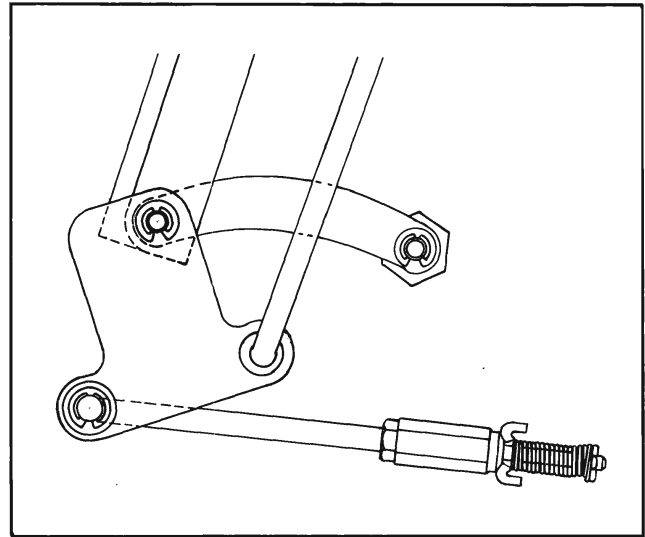


Fig. 6D-4. Clutch Lever Assembly

UPPER CLUTCH LINKAGE ASSEMBLY

REMOVE

1. Remove overcenter spring.
2. Remove clutch pedal silencer bumper.
3. Remove clutch pedal.
4. Remove pivot bolt.
5. Remove two bolts securing overcenter lever.
6. Remove retaining ring securing link to stop bracket.
7. Remove overcenter lever and assembly.
8. Remove bolt to rear slot of stop bracket and remove stop bracket.
9. Disconnect pedal linkage rod from lever assembly.
10. Remove lever assembly.

REPLACE

1. Install lever assembly.
2. Install stop bracket, overcenter lever, and pivot bolt; install link to stop bracket.
3. Connect pedal linkage rod to lever assembly and secure with retaining ring.
4. Install nut and secure pivot bolt. Torque nut to 20-35 lb. ft.

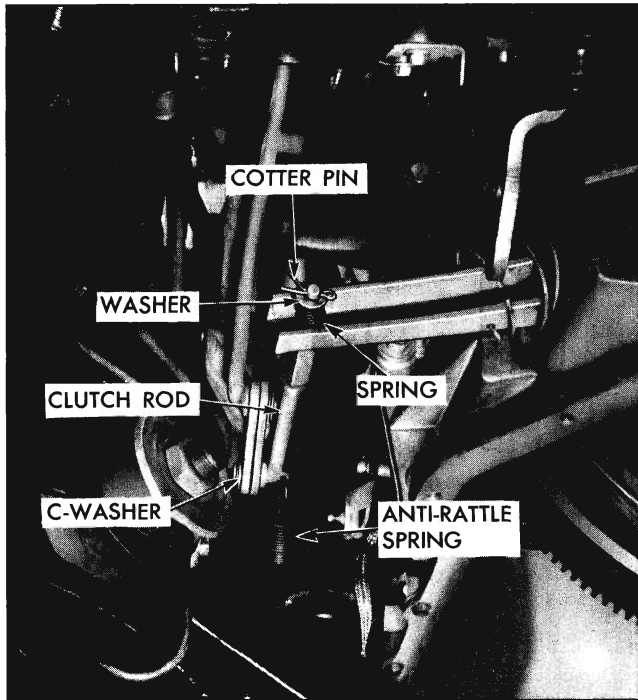


Fig. 6D-5 4 Cylinder Engine Lower Clutch Linkage

CAUTION: Over-tightening of nut will cause a bind in the linkage assembly.

5. Install and secure clutch pedal with two bolts.
6. Install bolt securing stop bracket at rear slot.
7. Install two bolts securing overcenter lever.
8. Secure link to stop bracket with retaining ring.
9. Install overcenter spring.
10. Install clutch pedal silencer bumper.
11. Adjust clutch pedal as described on page 6D-3.

CLUTCH ASSEMBLY

REMOVE

1. Raise car.
2. Disconnect stabilizer bar at body frame rail.
3. Disconnect exhaust pipe.
4. Disconnect front of torque tube from clutch housing as outlined in Section 4. Support torque tube at front after dropping front of tube enough to permit sufficient access to the clutch assembly.

5. Disconnect clutch rod from fork.
6. Disconnect clutch linkage link from clutch housing stud.
7. Remove clutch housing assembly with components intact.
8. Remove clutch pressure plate and cover assembly and clutch driven plate.

CAUTION: Index the pressure plate and cover to flywheel prior to disassembly.

9. Remove fork spring.
10. Remove fork cover plates.
11. Remove fork ball nut support bolt, fork, and release bearing.
12. Remove retaining plate bolts (Fig. 6D-6).
13. Remove clutch drive shaft and retaining plate.
14. Remove clutch release bearing support.

INSPECT

1. Inspect clutch driven plate for broken or distorted torsion springs, worn or loose facings, oil on facings, and damaged spline which could cause bind-

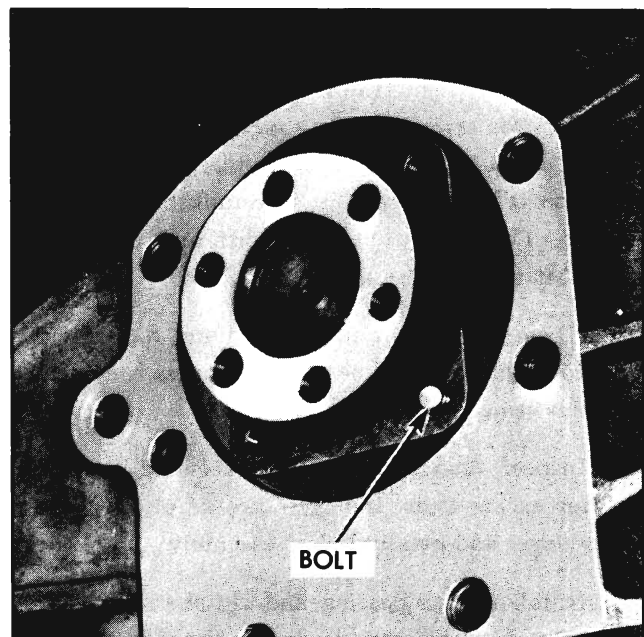


Fig. 6D-6 Retaining Plate Bolt

ing. If any of the above defects are present, replace driven plate with new assembly.

NOTE: Servicing of clutch driven plate should be by replacement of plate assembly only.

2. Inspect pressure plate and cover assembly to see that it is free of oil and grease. Check pressure plate for scores or cracked surface.

NOTE: Servicing of clutch driven plate or pressure plate and cover assembly should be made by replacement of assemblies only.

3. Examine clutch release bearing support carefully to be certain there are no burrs on outer surface which pilots clutch release bearing. Make sure there is a light coat of molybdenum disulphide grease in inner groove of clutch release bearing assembly.

4. Try release bearing on support to make sure no binding exists.

5. Check release bearing by placing thrust load on bearing by hand and turning bearing race. Replace if bearing feels rough when turning.

6. Clean flywheel face with carbon tetrachloride, sandpaper or steel wool.

7. Check clutch pilot bearing for looseness in crankshaft counterbore.

8. If bearing is loose, remove from crankshaft and inspect bore for wear. If bearing has been run loose in crankshaft for some time, a noticeable ridge will be found in counterbore. If diameter of bore is more than .005" oversize (spec. 1.379"), the crankshaft must be replaced. Thoroughly clean all dirt and rust from crankshaft counterbore area.

9. If bearing is tight in counterbore, rotate with finger to check for roughness. If roughness is evident, replace bearing.

10. Inspect fingers on clutch cover and pressure plate for excess wear. If fingers are deeply grooved, replace cover and pressure plate assembly.

11. Install release bearing and clutch release fork ball in clutch release fork as shown, Fig. 6D-7.

12. Inspect fork assembly as follows:

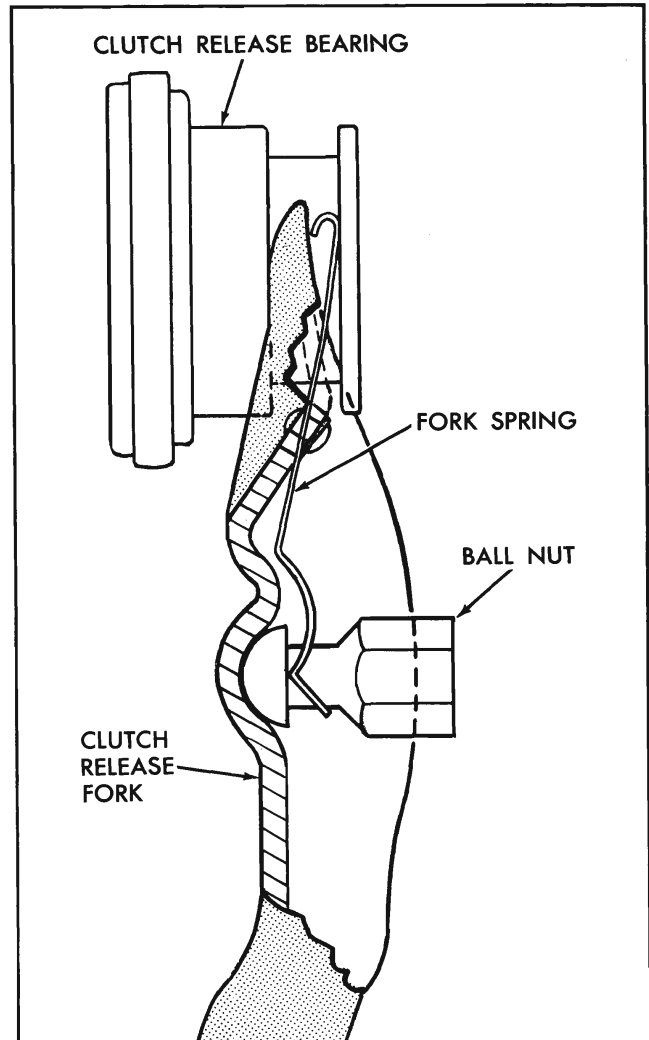


Fig. 6D-7 Fork Installed in Release Bearing

a. End of fork assembly and spring must completely fill groove in release bearing as shown. Spring should be under enough tension so that if fork is held with release bearing down, bearing will not fall out of fork.

b. With release bearing installed in fork, the end of spring retaining fork ball must have tension on ball so that there is no possible end play of ball.

NOTE: If fork assembly does not meet requirements outlined in (a.) above, it is permissible to attempt correction by bending ends of fork spring. However, after bending, the spring still must meet the requirements of step (b.). In many instances, bending of the spring ends will cause tension on the

stud ball to be reduced. If fork assembly cannot be corrected by bending spring, discard and check new fork assembly.

13. Apply a light coating of special molybdenum disulphide grease to face surface of release bearing, fingers on pressure plate, and pilot end of clutch shaft.

CLUTCH DRIVE SHAFT BEARING

REMOVE

1. Remove retaining ring (Fig. 6D-8).



Fig. 6D-8 Removing Drive Shaft Bearing Retainer

2. Set shaft in press (Fig. 6D-9) and press bearing off.

INSTALL

1. Set shaft in press as shown in (Fig. 6D-10) and press new bearing onto shaft.
2. Install retaining ring.

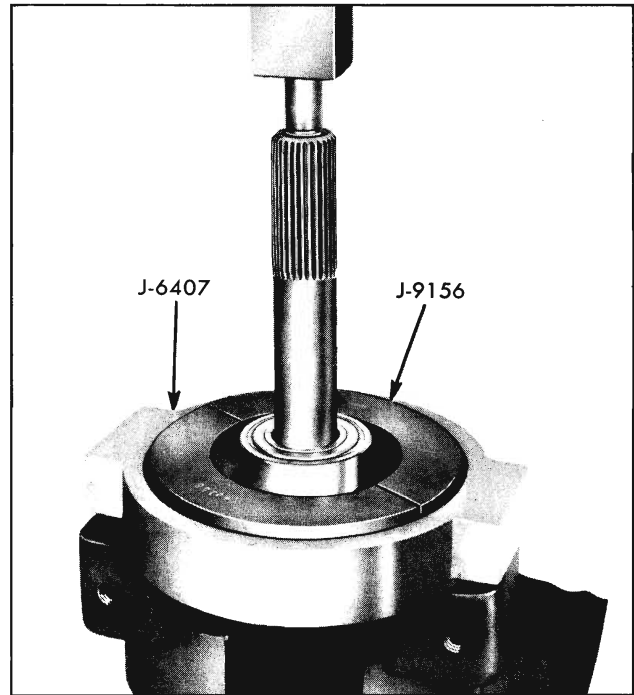


Fig. 6D-9 Removing Drive Shaft Bearing

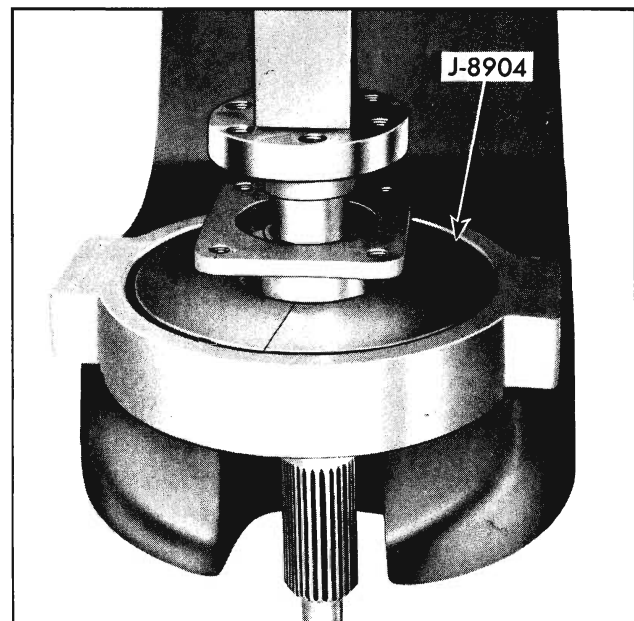


Fig. 6D-10 Installing Drive Shaft Bearing

FLYWHEEL CLUTCH DRIVE SHAFT PILOT BEARING**REMOVE**

1. Remove retainer plate and oil seal.
2. Install tool J-4383 (Fig. 6D-11) and remove pilot bearing.
3. Remove oiling felt.

INSTALL

1. Fill bore in crankshaft $\frac{1}{3}$ full of molybdenum disulphide grease.
2. Install oiling felt which has had molybdenum disulphide grease worked into it.
3. Install new bearing with tool J-5736 (Fig. 6D-12).
4. Install oil seal and retainer plate. Torque bolts to 35 lb. ft.

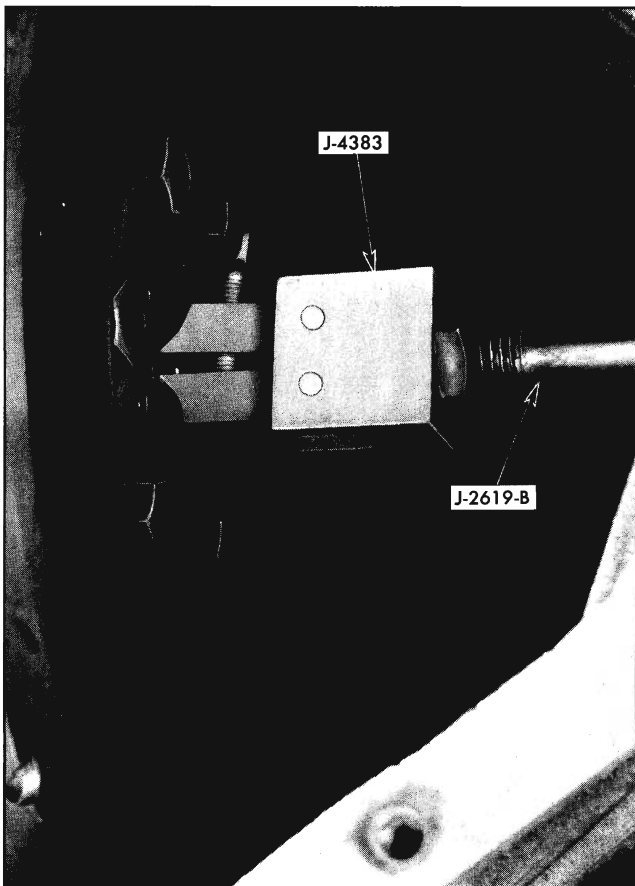


Fig. 6D-11 Removing Drive Shaft Pilot Bearing

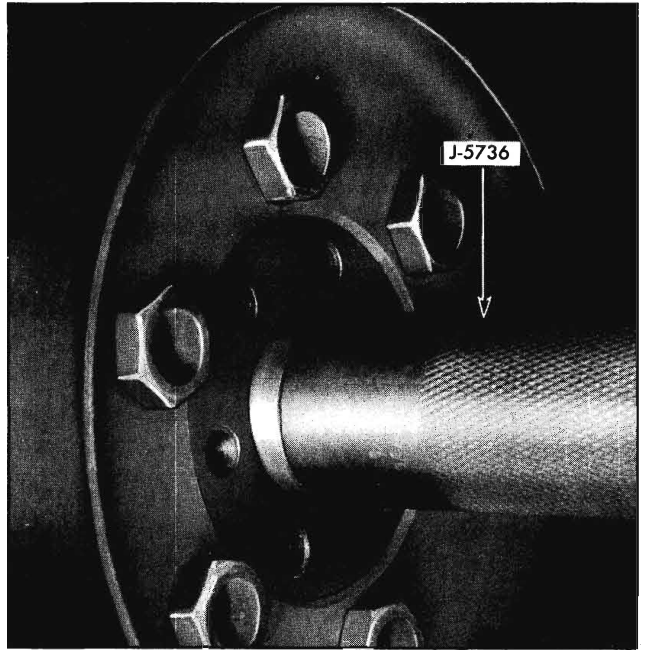


Fig. 6D-12 Installing Drive Shaft Pilot Bearing

INSTALL

1. Install driven plate (as shown in Fig. 6D-1) and pressure plate and cover assembly, making sure index mark lines up with one on flywheel.

NOTE: Use clutch drive shaft to align clutch driven plate. Remove shaft after all pressure plate bolts are tightened to 20-35 lb. ft. torque.

2. Install clutch release bearing support on drive shaft.
3. Install drive shaft and retaining plate in housing and tighten bolts to 10-25 lb. ft. torque.
4. Install clutch release bearing on clutch release bearing support. Make sure surface of support has a light coat of molybdenum disulphide grease.
5. Coat ball nut with molybdenum disulphide grease and install in fork.
6. Install fork with ball nut facing to rear of car, hook clutch fork in groove of release bearing (Fig. 6D-7), and install ball nut support bolt.
7. Install dust shields together (with a light coat of wheel bearing grease between them) as shown in Fig. 6D-13.
8. Install clutch fork spring.

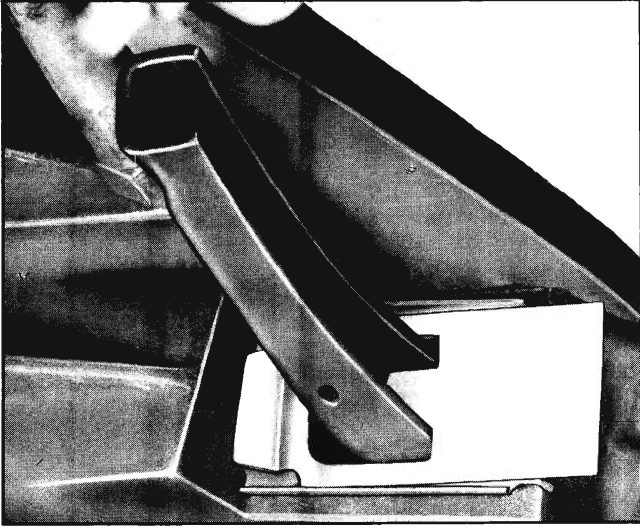


Fig. 6D-13 Dust Shields Installed

9. Tighten clutch ball nut support bolt to 30-45 lb. ft. torque.

10. Coat drive shaft splines lightly with molybdenum disulphide grease and install clutch housing as-

sembly and components, installing clutch rod in fork at same time. Torque clutch housing to engine block bolts to 40-60 lb. ft. Be sure face of release bearing and release fingers are coated with molybdenum disulphide grease.

NOTE: Coat contact area of clutch rod at fork end with wheel bearing grease.

11. Connect clutch linkage link to clutch housing stud.

12. Install clutch rod spring, washer, and cotter pin at fork end.

13. Install front of torque tube to clutch housing as outlined in Section 4.

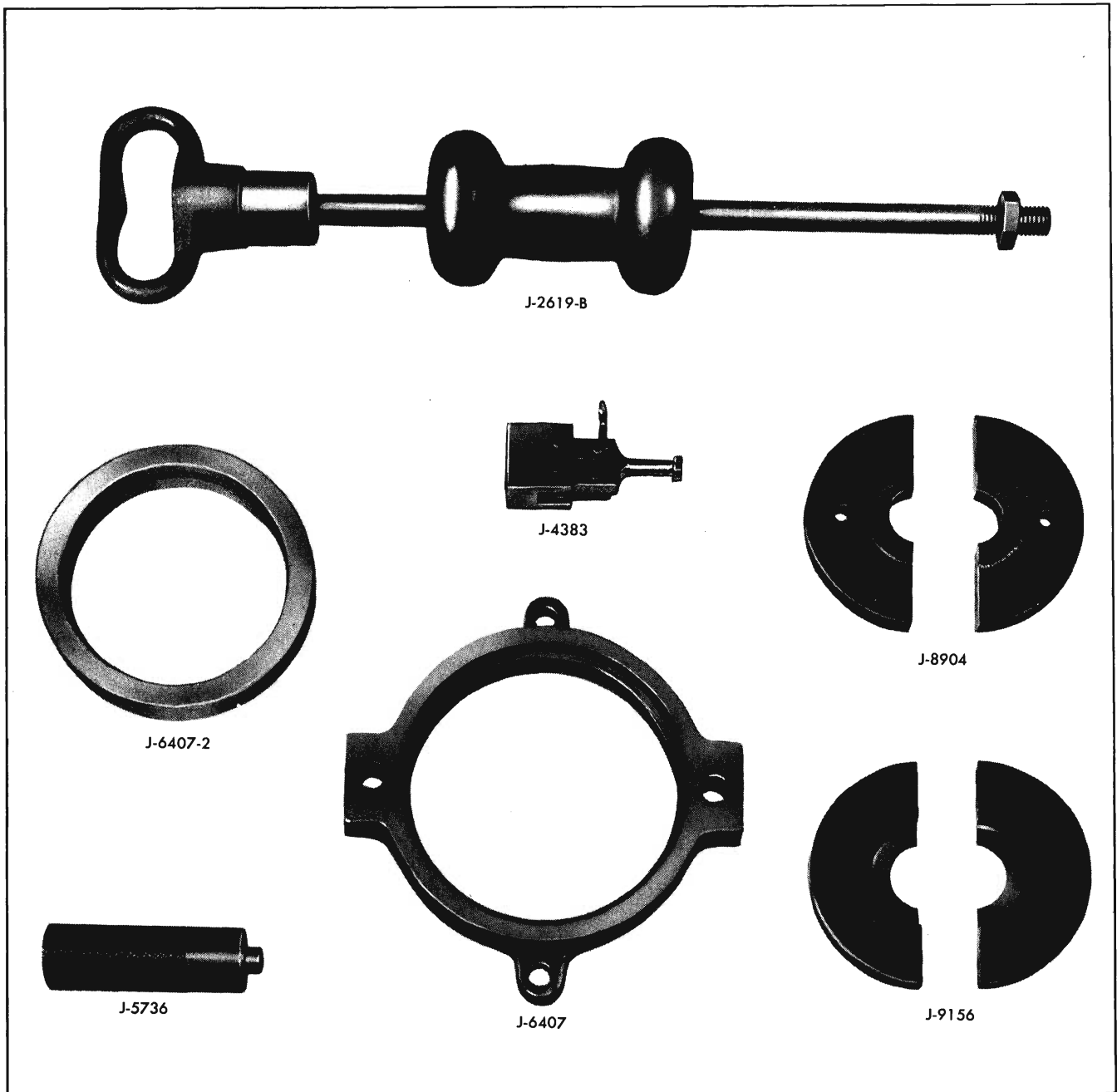
14. Connect exhaust pipe.

15. Connect stabilizer bar at body frame rail. Torque bolts to 20-35 lb. ft.

16. Make clutch pedal adjustment as outlined on page 6D-3.

TORQUE SPECIFICATIONS

	LB. FT.
Upper clutch linkage pivot bolt nut	20-35
Pressure plate and cover assembly to flywheel bolts	20-35
Drive shaft retaining plate bolts	10-25
Ball nut support bolt	30-45
Clutch housing to engine block bolts	
4 cylinder engine	40-60
Stabilizer bar to body frame rail bolts	20-35



SPECIAL TOOLS

J-2619-B Slide Hammer

J-4383 Clutch Pilot Bearing Remover

J-8904 Clutch Drive Shaft Bearing Installer

J-5736 Clutch Pilot Bearing Installer

J-6407 Press Plate Holder

J-9156 Clutch Drive Shaft Bearing Remover

SYNCHRO-MESH TRANSMISSION

CONTENTS OF THIS SECTION

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Operation	7-2	Inspection and Repair	7-14
Gearshift Control	7-7	Assemble Transmission	7-17
Gearshift Lever and Housing	7-8	Torque Specifications	7-21
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Replace Transmission	7-12		

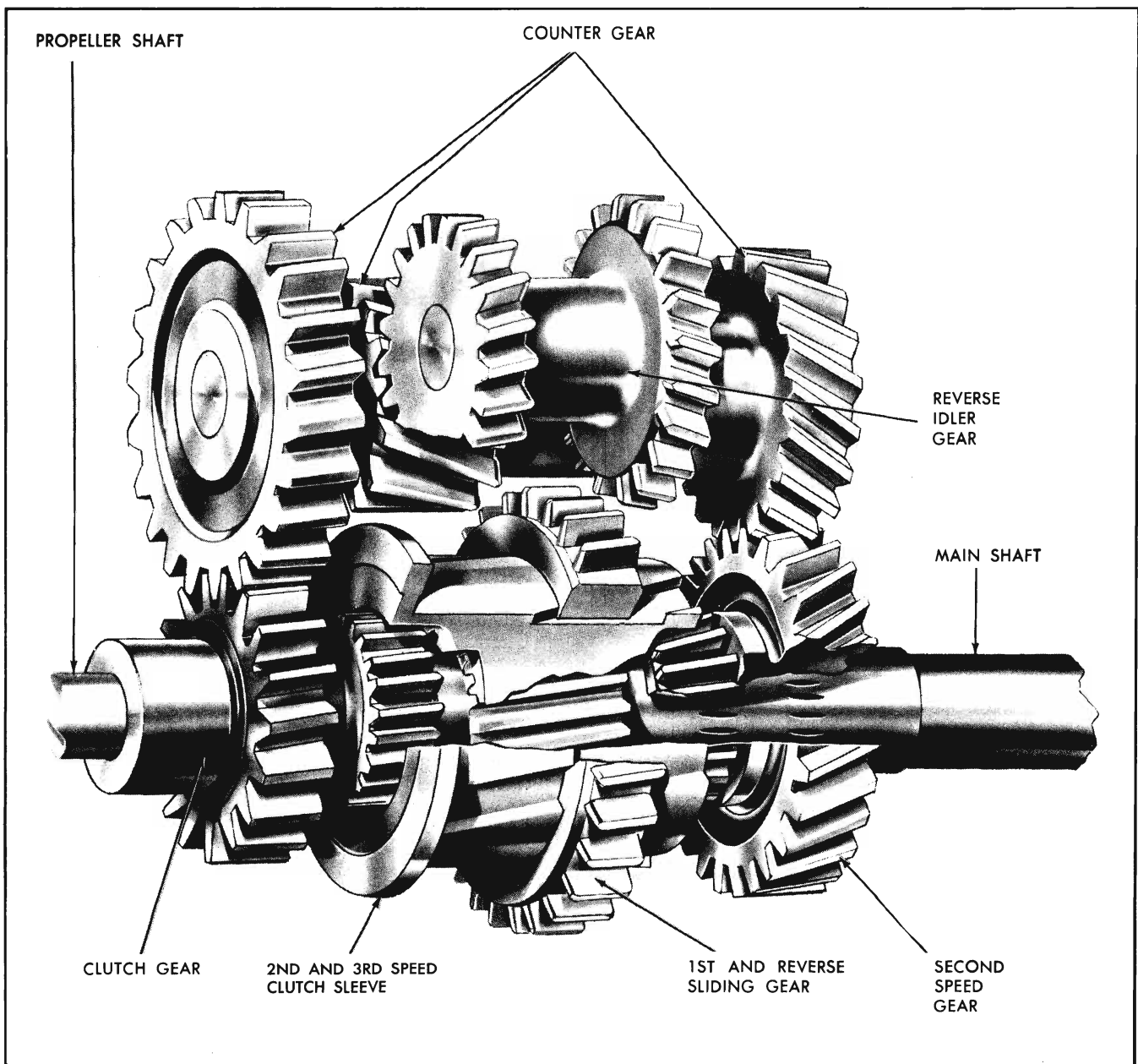


Fig. 7-1 Cut-away of Synchro-Mesh Transmission Gears (Viewed through top of case)

DESCRIPTION

The Tempest manual three speed synchro-mesh transmission (Fig. 7-1) mounts on the differential carrier at the rear of the car. This light weight and compact transmission shares a common lubrication system with the differential. This is possible because of the inter-connecting holes between the two housings which permit the common lubricant to circulate through both units.

The gearshift lever and control are located at the center just forward of the front seat. A shift control rod connects the gearshift lever and control to the transmission manual shift shaft at the rear of the car.

In the transmission, the manual shift shaft carries a finger which extends upward to engage either the first and reverse fork or the second and third fork, depending on shift lever position. As the two forks are parallel to each other, a slight rotational motion

of the shift shaft places the actuating finger in the proper fork and permits the desired shift. An inter-lock between the two fork shafts holds the fork not being actuated in the neutral crossover position.

The transmission gear ratios are: 2.94-1 in first; 1.68-1 in second; 1.00-1 in third, and 3.32-1 in reverse.

The location of first and reverse sliding gear and clutch sleeve determine the different drive ratios in the transmission.

The clutch gear, counter gear, reverse idler gear, and the second speed gear are in constant mesh. No power is transmitted to the mainshaft unless the first and reverse sliding gear or the clutch sleeve is engaged.

The synchronizer rings in the clutch sleeve bring the clutch sleeve up to the speed of the gear to be engaged. This feature permits smooth engagement when shifting into 2nd and 3rd speeds.

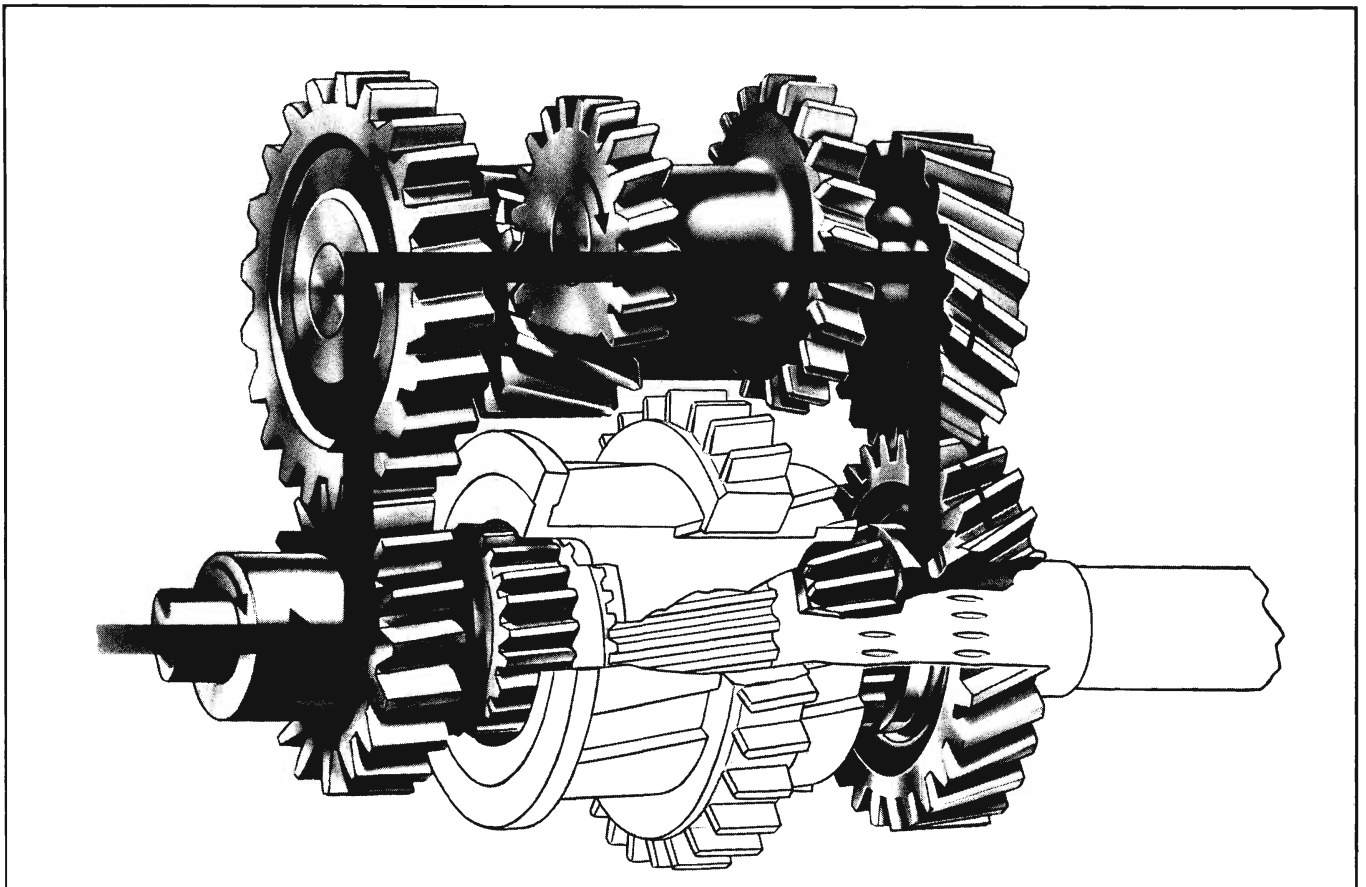


Fig. 7-2 Power Flow with Transmission Gears in Neutral Position

NEUTRAL (FIG. 7-2)

The clutch sleeve and the first and reverse sliding gear are not engaged with the clutch gear, counter

gear, reverse idler gear, or the second speed gear. Therefore, there is no transmission of power to the mainshaft.

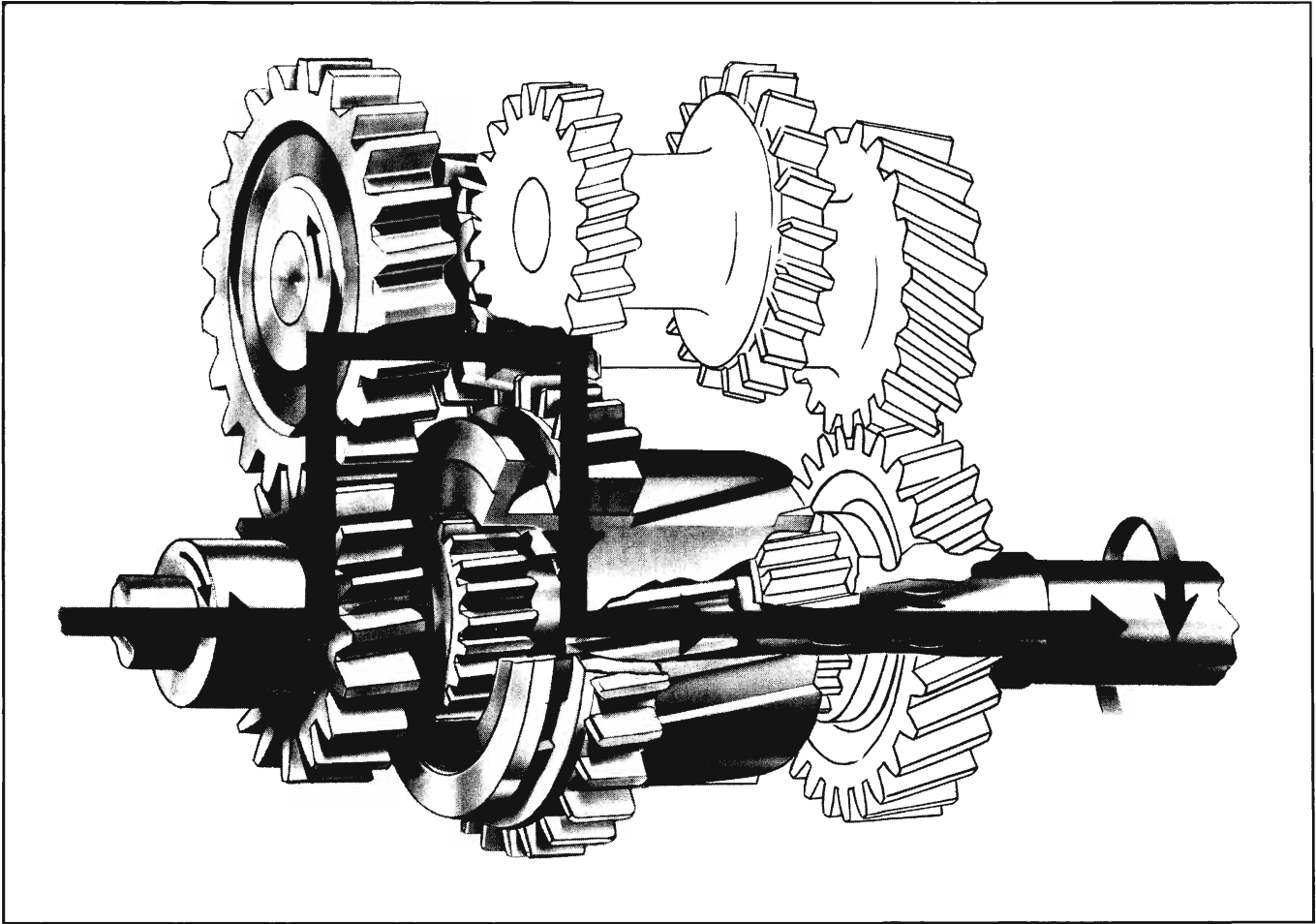


Fig. 7-3 Power Flow with Transmission Gears in First Gear Position

FIRST (FIG. 7-3)

The first and reverse sliding gear is positioned forward on the clutch sleeve to engage the counter gear. Power is transmitted to the mainshaft via the clutch gear, counter gear, first and reverse sliding gear, and clutch sleeve.

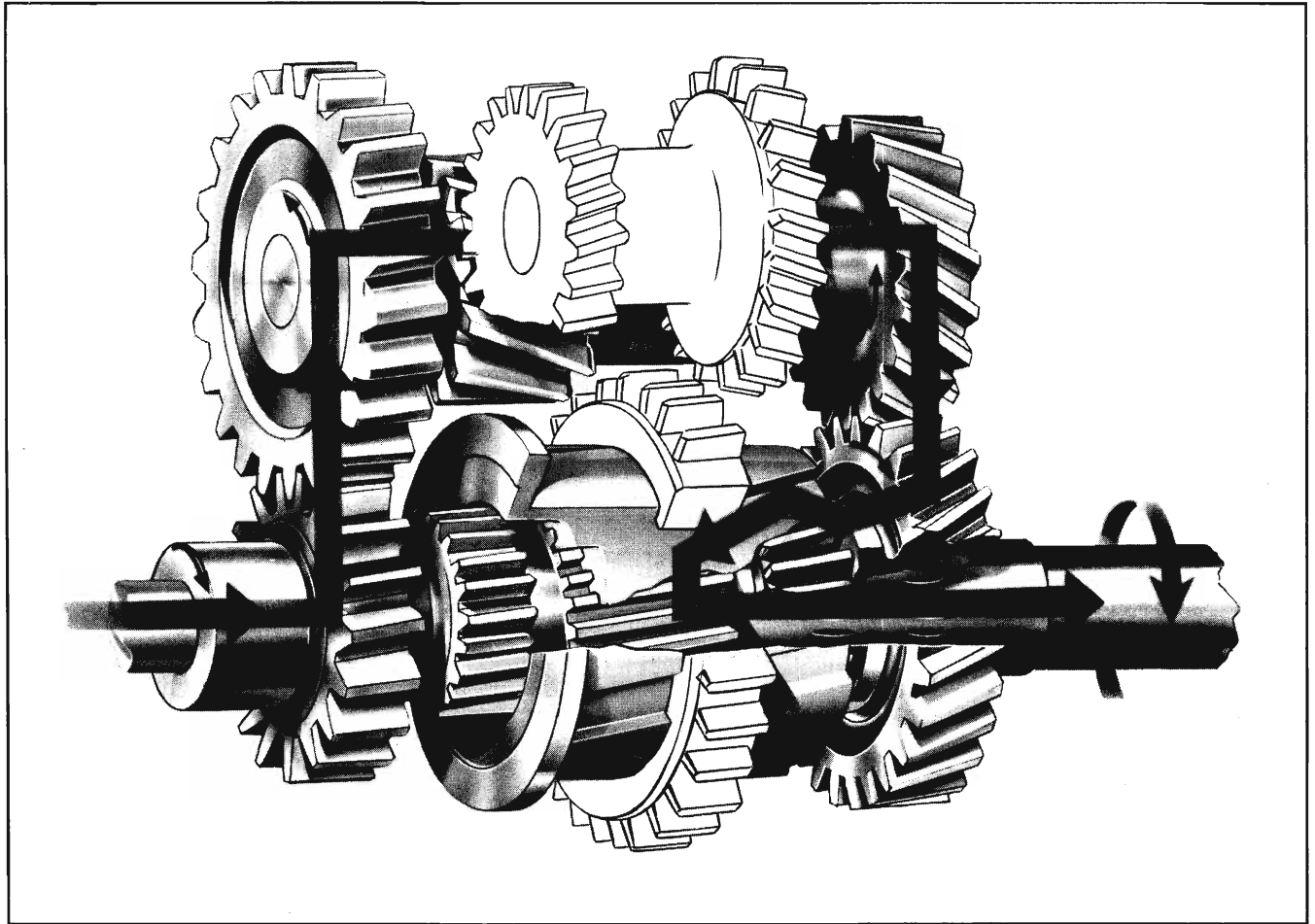


Fig. 7-4 Power Flow with Transmission Gears in Second Gear Position

SECOND (FIG. 7-4)

The first and reverse sliding gear is disengaged from the counter gear and the clutch sleeve is positioned rearward to engage the second speed gear. Power is transmitted to the mainshaft via the clutch gear, counter gear, second speed gear and clutch sleeve.

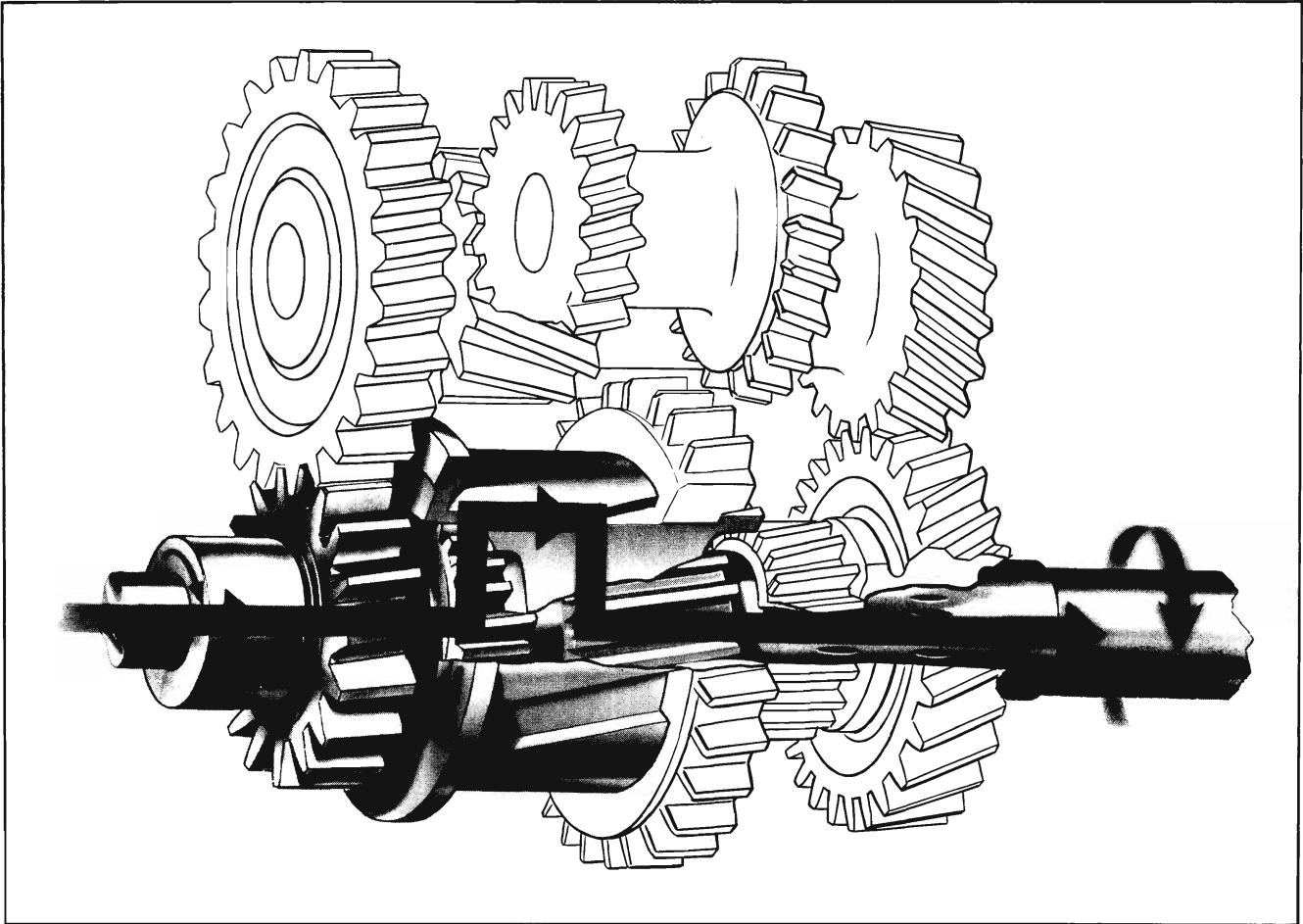


Fig. 7-5 Power Flow with Transmission Gears in Third Gear Position

THIRD (FIG. 7-5)

The clutch sleeve is repositioned forward, disengaging the second speed gear and engaging the clutch gear. Power is transmitted to the mainshaft via the clutch gear and clutch sleeve.

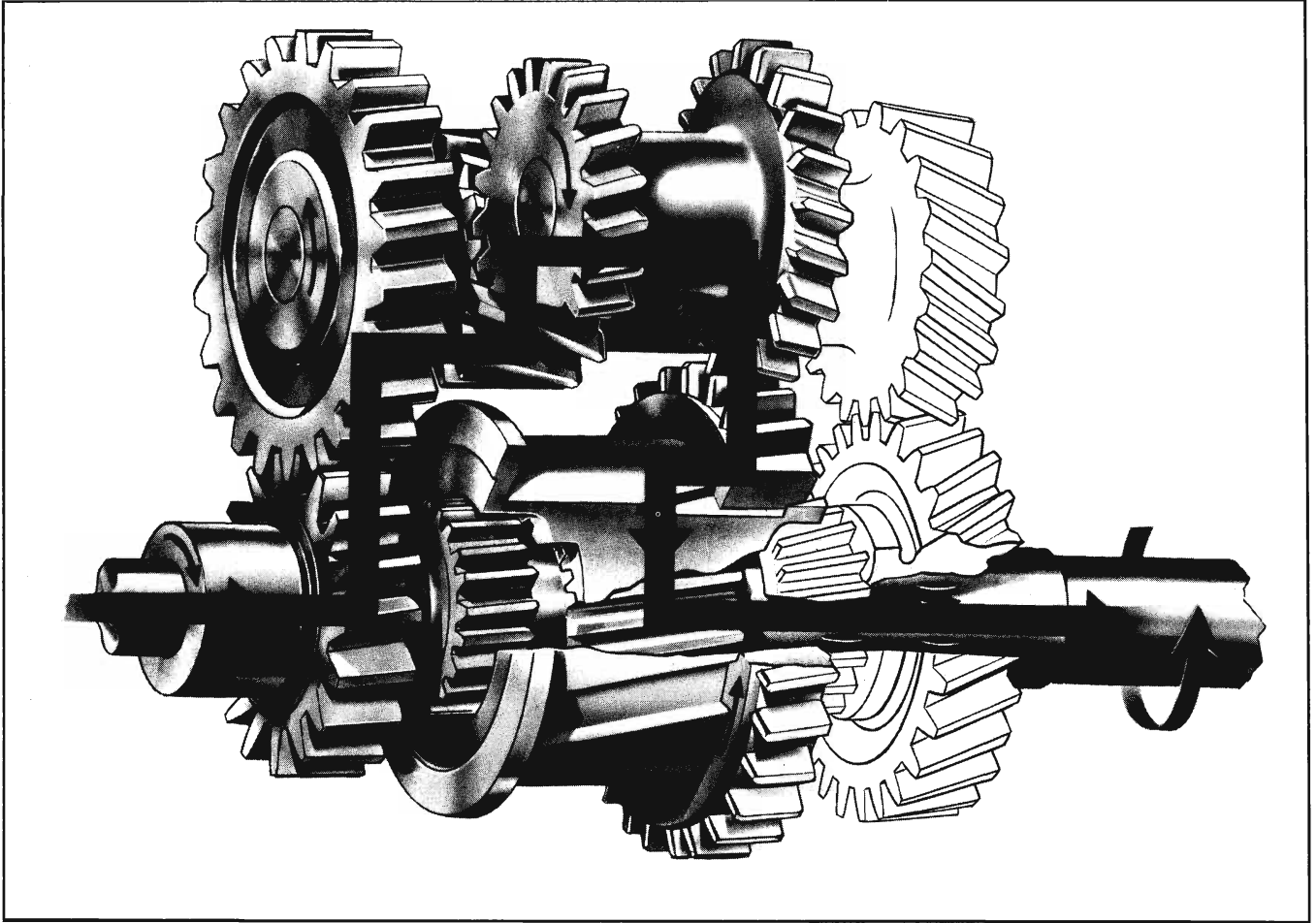


Fig. 7-6 Power Flow with Transmission Gears in Reverse Position

REVERSE (FIG. 7-6)

The first and reverse sliding gear is positioned rearward to engage the reverse idler gear, with the clutch sleeve disengaged from the clutch gear and second speed gear. Power is transmitted to the mainshaft via the clutch gear, counter gear, reverse idler gear, first and reverse sliding gear, and clutch sleeve.

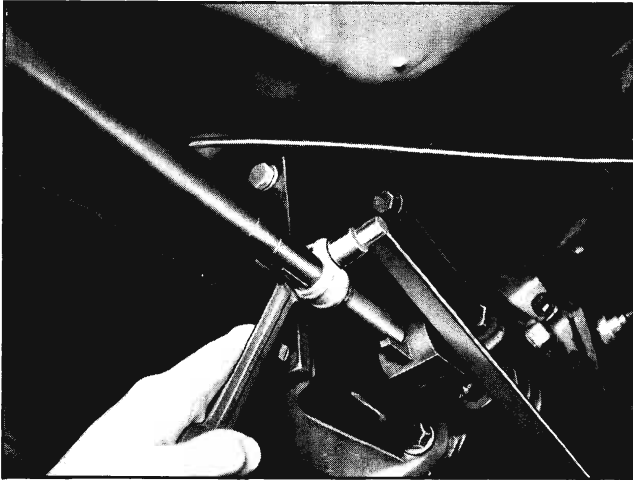


Fig. 7-7 Control Rod Clamp Nut

GEARSHIFT CONTROL ASSEMBLY

REMOVE

1. Loosen clamp nut securing control rod to control rod coupling. (Fig. 7-7).
2. Remove bolts securing transmission gearshift lever and housing to torque tube.
3. Move gearshift lever and housing assembly toward front of car, removing control rod from control rod coupling.
4. Remove cotter pin and clevis pin securing control rod coupling to manual shift shaft (Fig. 7-8).
5. Remove coupling from shaft.
6. Remove boot.

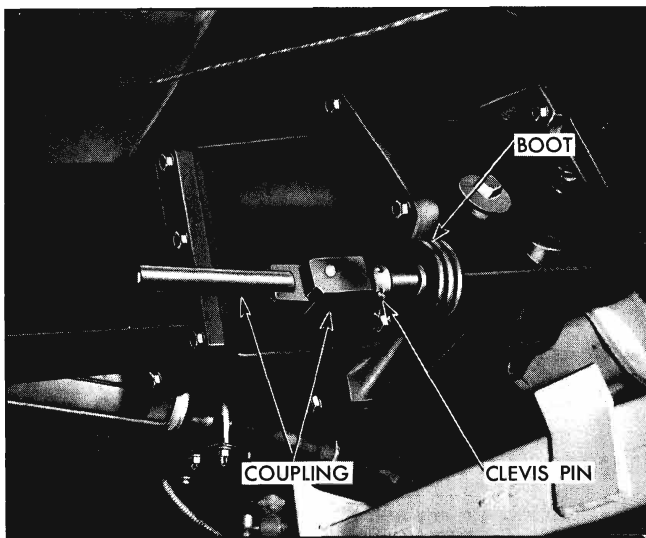


Fig. 7-8 Control Rod Coupling Assembly

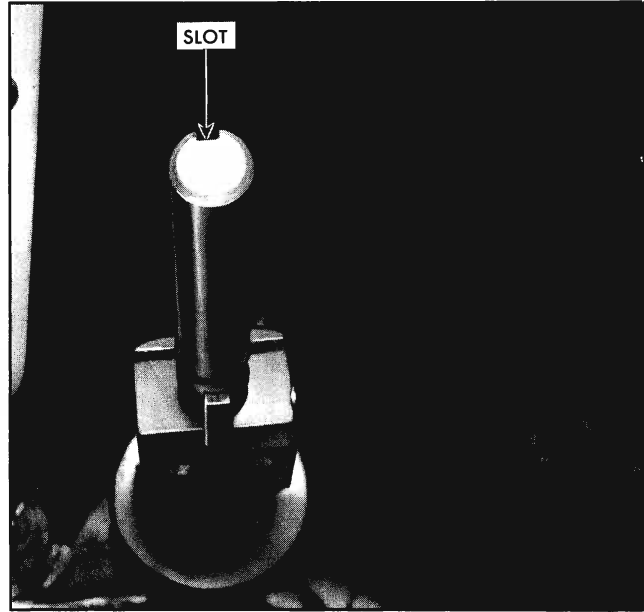


Fig. 7-9 Control Rod Coupling Slot

INSTALL

1. Position transmission manual shift shaft in first gear position on the three speed synchro-mesh transmission or in second gear position on the four speed synchro-mesh transmission.
2. Install manual shift shaft and control rod coupling boot (Fig. 7-8).
3. Install control rod coupling on manual shift shaft and secure with clevis pin and cotter pin (Fig. 7-8).

NOTE: Slot in control rod coupling should be in up position (Fig. 7-9).

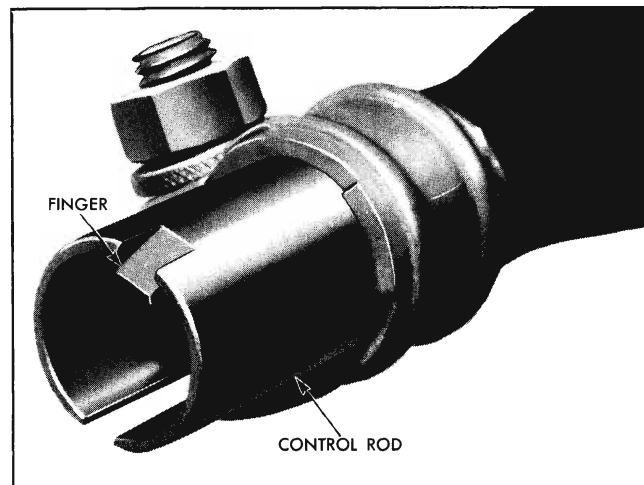


Fig. 7-10 Control Rod Coupling Finger

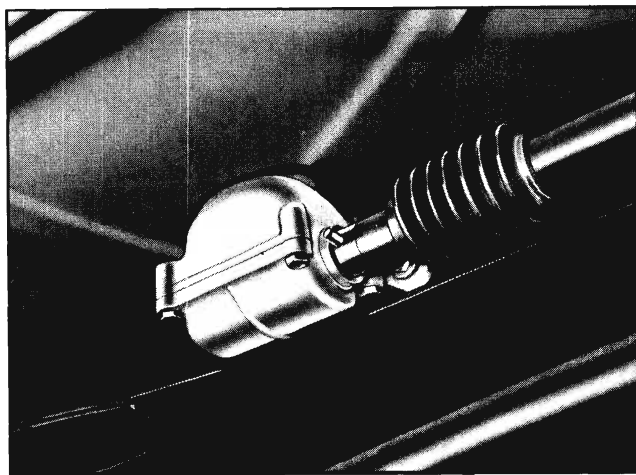
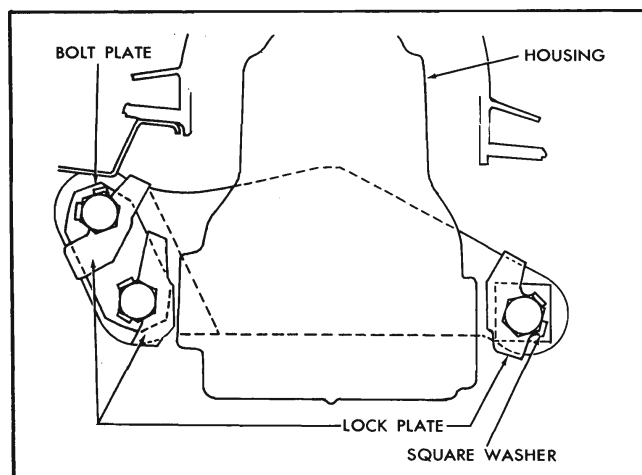


Fig. 7-11 Gearshift Lever and Housing Location

4. Slide control rod on control rod coupling, with control rod finger (Fig. 7-10) in coupling slot (Fig. 7-9).

5. Secure transmission gear shift lever and housing to torque tube (Fig. 7-11). Torque bolts to 10-15 lb. ft.

6. Install pin in control rod alignment hole and push control rod forward into gearshift lever and housing, until pin hits flange of housing (Fig. 7-12).

7. Secure control rod to coupling by tightening clamp nut to 10-20 lb. ft. torque (Fig. 7-7).

8. Remove pin from control rod alignment hole and position control rod boot over housing shoulder.

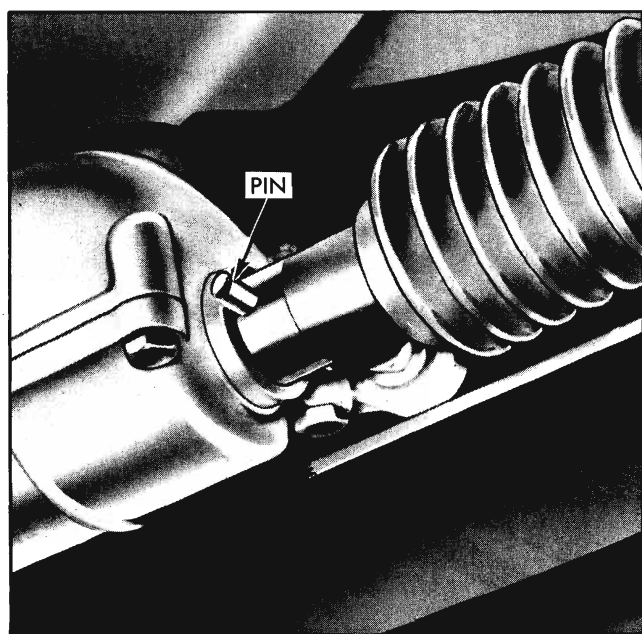


Fig. 7-12 Control Rod Alignment Pin

GEARSHIFT LEVER AND HOUSING

DISASSEMBLE

1. Remove housing lower cover bolts and washers (Fig. 7-13) and remove cover.

2. Remove (2) half diameter bushings and transmission control rod. Use wire to support front of control rod.

3. Screw control lever ball from lever and remove shift control assembly from torque tube.

4. Mount shift control in vise (Fig. 7-14).

5. Depressing spring cup, rotate spring cup seat to disengage it from housing.

6. Remove spring cup seat, spring cup, and spring.

7. Remove control lever and control lever spring seat.

ASSEMBLE

1. Mount housing in vise.

2. Lightly coat all bearing surfaces with molybdenum disulphide grease.

3. Install control lever spring seat in control lever as shown in Fig. 7-15.

NOTE: It is important that the seat be installed with tab as shown, so that spring tension will position lever towards 2nd and high position.

4. Install control lever in housing as shown in Fig. 7-16.

5. Install spring and spring cup. Notches in spring cup must line up with control lever as shown in Fig. 7-17.

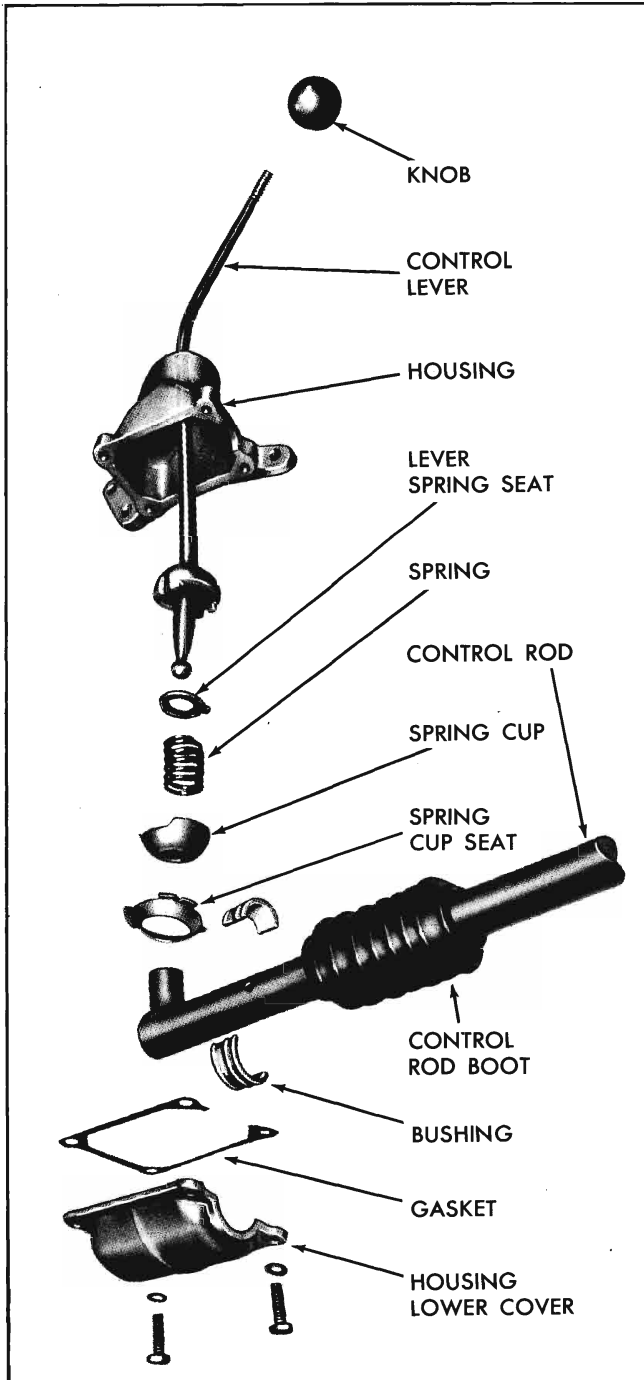


Fig. 7-13 Gearshift Lever and Housing

6. Install spring cup seat with seat detent aligned to engage housing notch (Fig. 7-18). Depress spring cup and rotate spring cup seat until three seat extensions fully engage three housing shoulders.

NOTE: It is important that the seat is fully engaged or an inoperative control lever may result.

7. Install shift control assembly on torque tube.

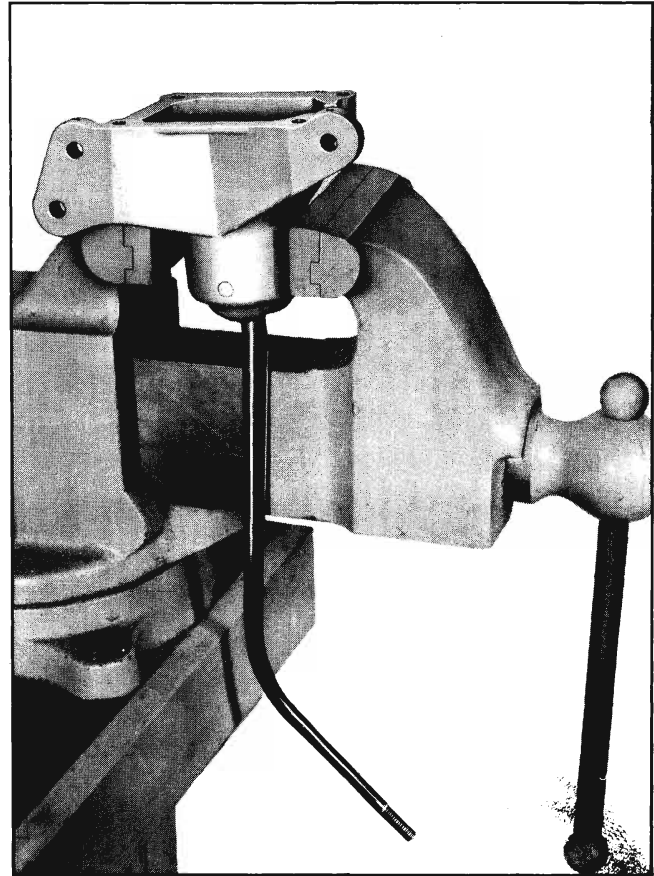


Fig. 7-14 Housing in Vise

8. Install transmission control rod and bushings.

NOTE: Place molybdenum disulphide grease into control rod socket prior to connecting control rod to control lever ball.

9. Install housing lower cover gasket and cover and torque bolts to 4-5 lb. ft.

10. Install control lever knob.

TRANSMISSION EXTENSION ASSEMBLY

DISASSEMBLE ON CAR

1. Remove transmission extension bearing seal (Fig. 7-20).

2. Remove bearing retainer ring (Fig. 7-21).

3. Install Tool J-8918 to remove front bearing.

4. With slide hammer (Fig. 7-22) remove bearing.

5. Remove spacer.

6. Install Tool J-8918 and remove rear bearing.

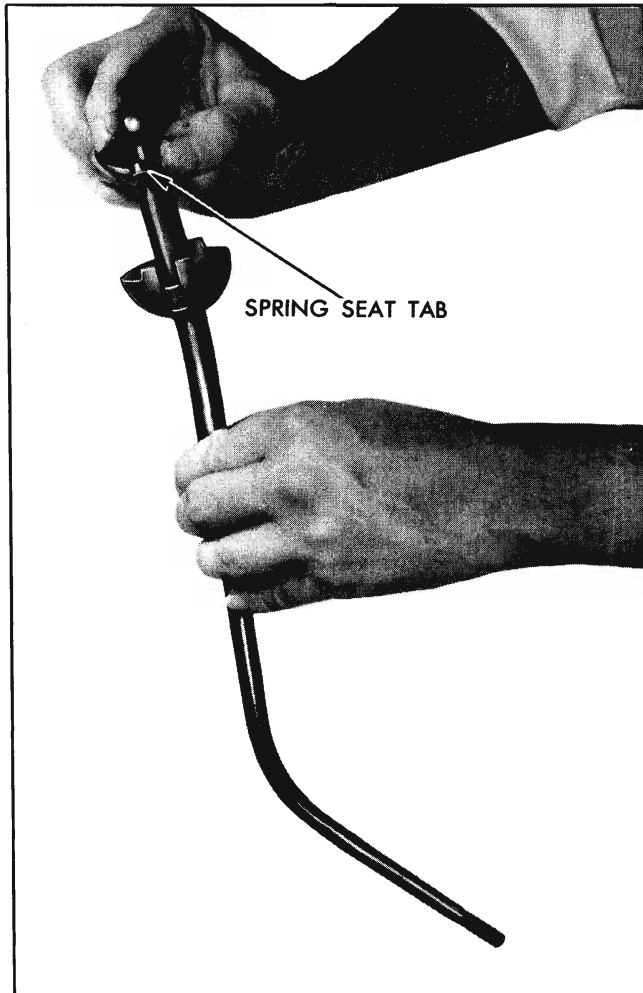


Fig. 7-15 Installing Spring Seat

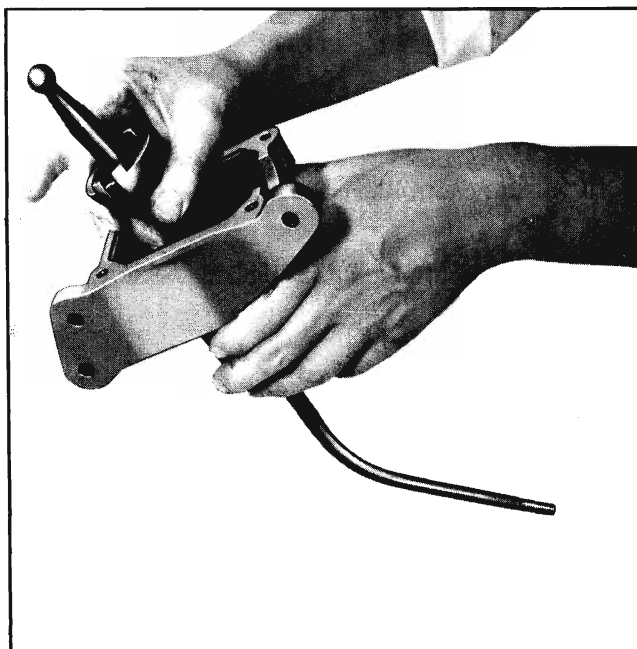


Fig. 7-16 Installing Shift Lever

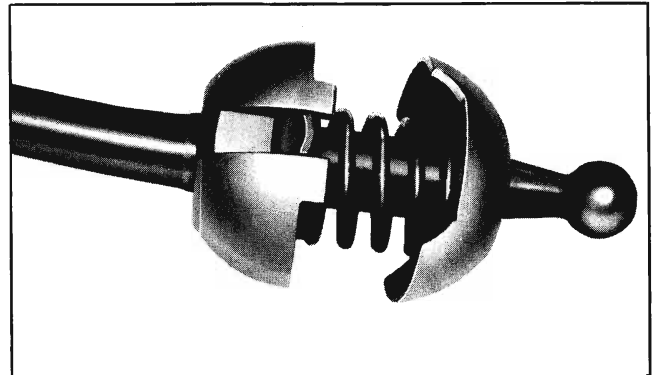


Fig. 7-17 Lining-up Spring Cup

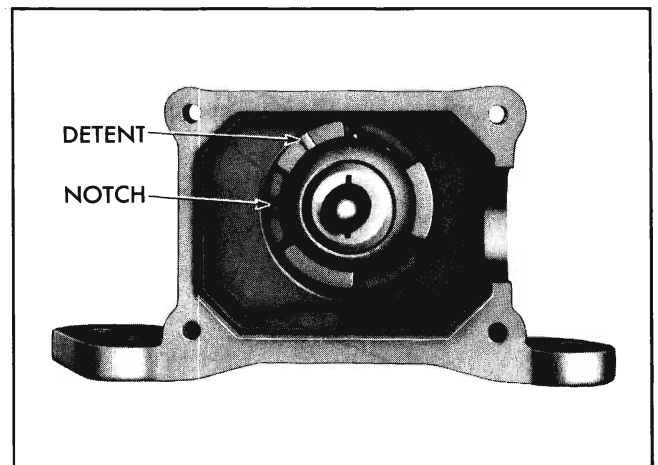
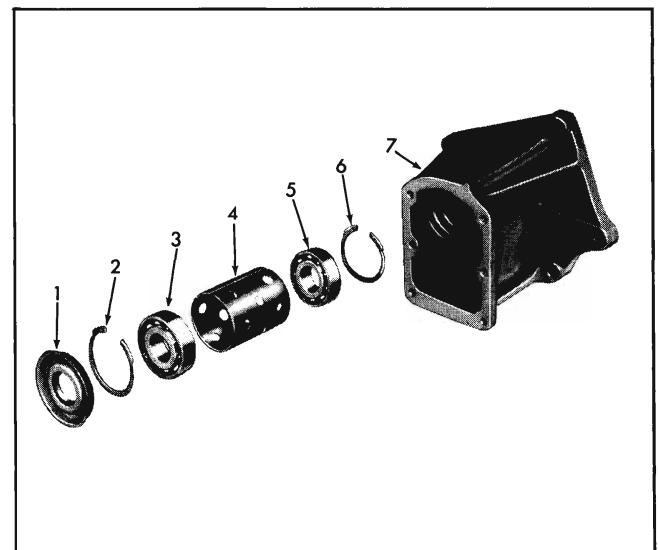


Fig. 7-18 Installing Spring Cup Seat



- | | |
|-------------------|----------------------|
| 1. Seal | 5. Bearing |
| 2. Retaining Ring | 6. Retaining Ring |
| 3. Bearing | 7. Extension Housing |
| 4. Spacer | |

Fig. 7-19 Transmission Extension Assembly

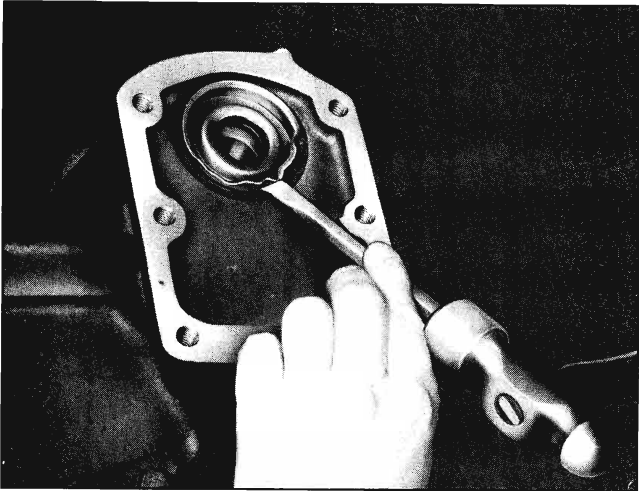


Fig. 7-20 Removing Extension Seal

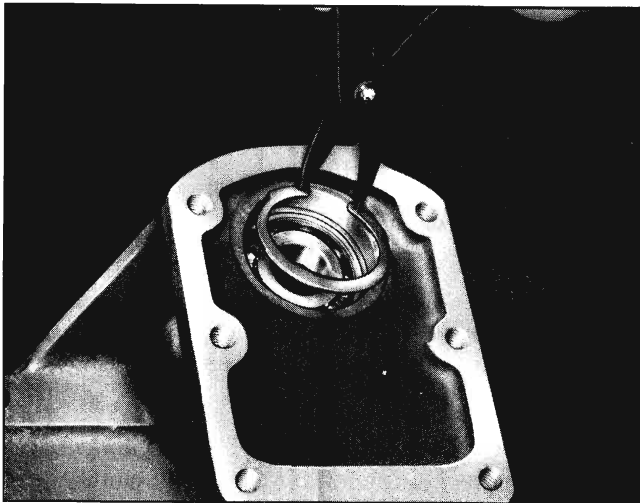


Fig. 7-21 Removing Retaining Ring

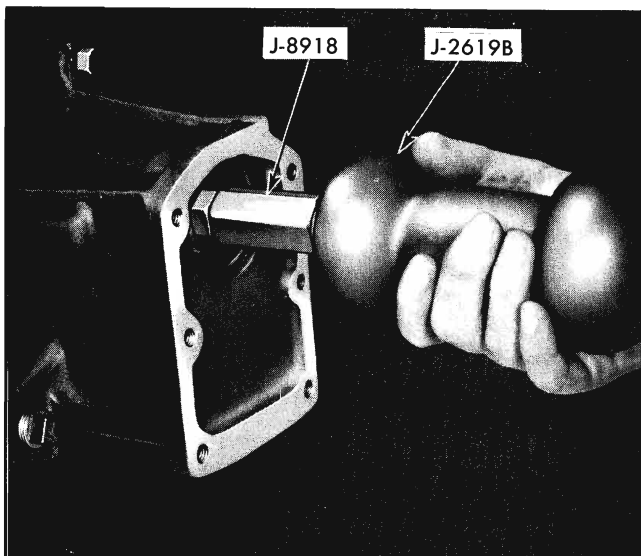


Fig. 7-22 Removing Bearing

ASSEMBLE ON CAR

1. Install rear bearing with suitable socket (rides on outer race) and extension (Fig. 7-23).
2. Install spacer and front bearing (Fig. 7-24) in same manner.
3. Install bearing retainer ring.
4. Install new bearing seal with suitable tool (Fig. 7-25).

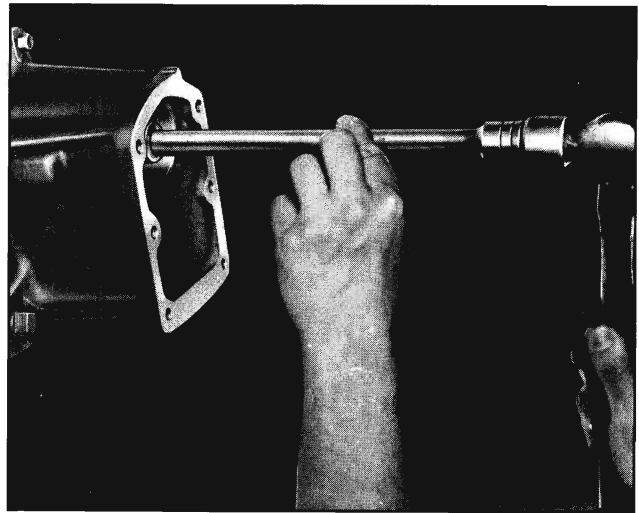


Fig. 7-23 Installing Rear Bearing

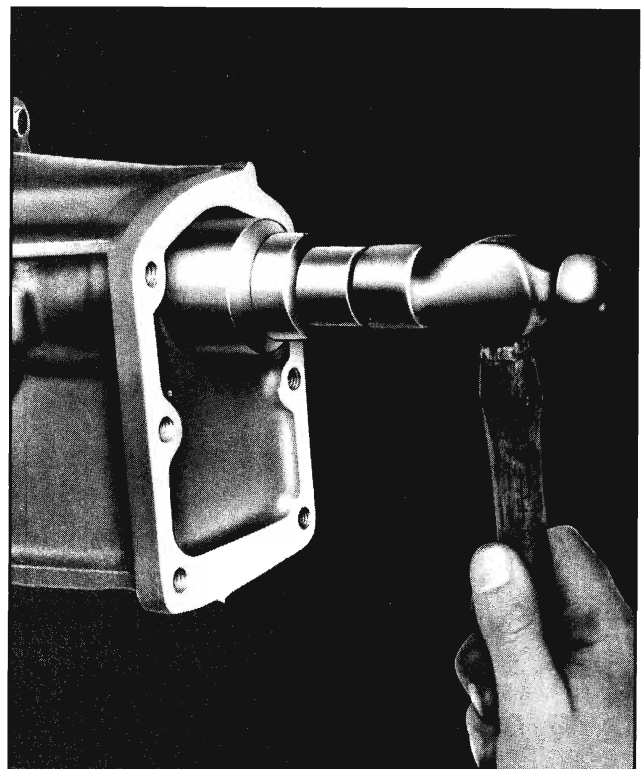


Fig. 7-24 Installing Front Bearing

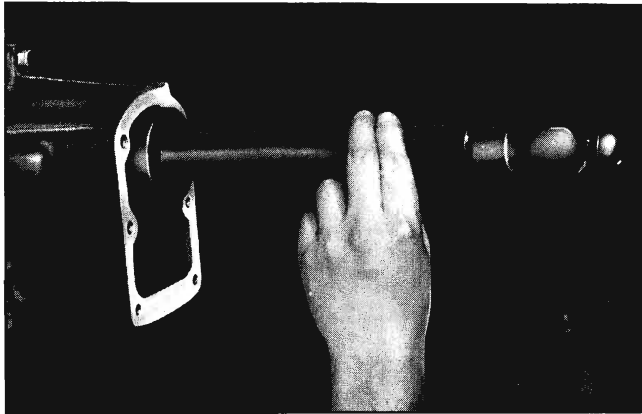


Fig. 7-25 Installing New Seal

NOTE: If rear retainer ring must be removed for any reason, the extension must be separated from the transmission to make the ring accessible.

REPLACE TRANSMISSION ASSEMBLY

To remove and replace transmission, differential, propeller shaft, and torque tube from car, see Section 4.

DISASSEMBLE TRANSMISSION

1. Mount transmission on holding fixture J-7896-01 (Fig. 7-26) and remove extension assembly. Do not scratch or dent mounting surface.
2. Remove filler plug.
3. Remove transmission case top cover and gasket.
4. Remove snap ring from mainshaft groove at rear of case. Snap ring is immediately behind mainshaft bearing as shown in Fig. 7-27.
5. Drive out clutch gear bearing and clutch gear

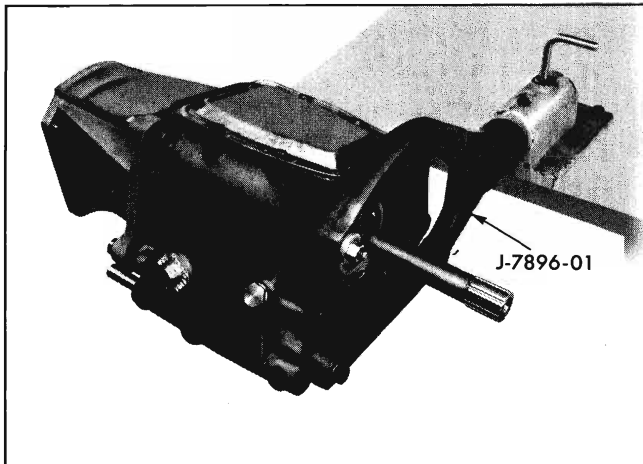


Fig. 7-26 Transmission on Holding Fixture

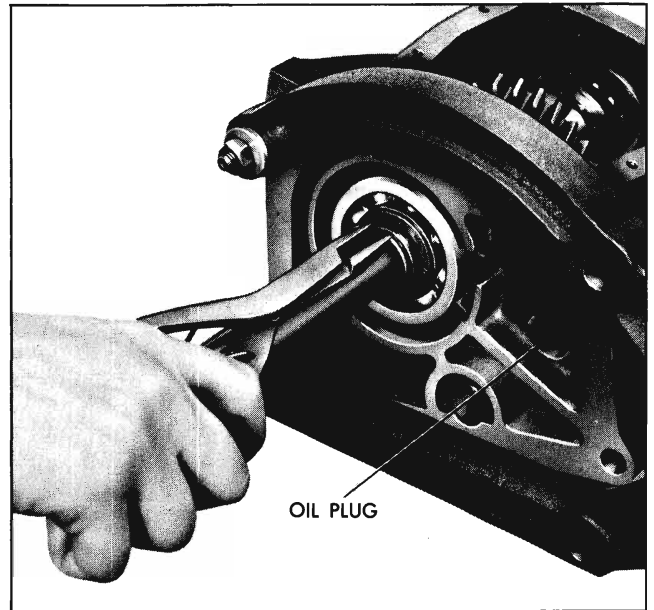


Fig. 7-27 Removing Mainshaft Snap Ring

by driving on mainshaft (Fig. 7-28). Remove clutch gear and bearing.

6. Continue to drive or press mainshaft out of transmission and remove thrust washer.

CAUTION: Be sure synchronizer ring tangs are lined with the mainshaft splines (Fig. 7-29) prior to driving out shaft, otherwise damage to ring and shaft splines will occur.

7. Remove second speed gear, first and reverse sliding gear, and second and third speed clutch sleeve from case by lifting out through top cover hole. Remove second speed gear from clutch sleeve.

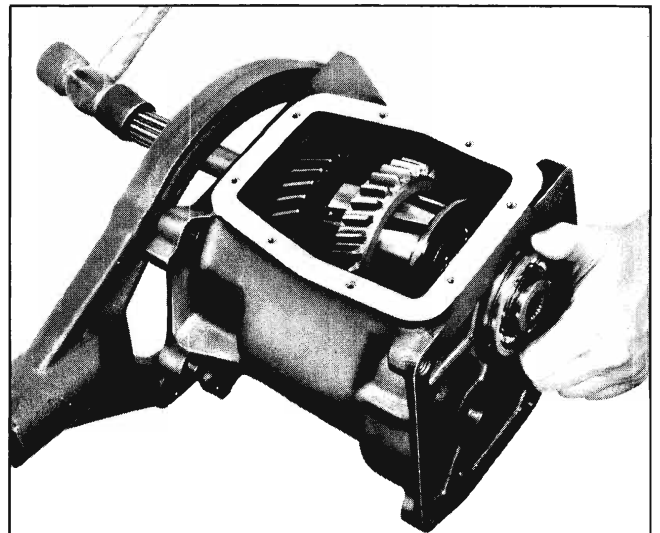


Fig. 7-28 Driving out Clutch Gear and Bearing

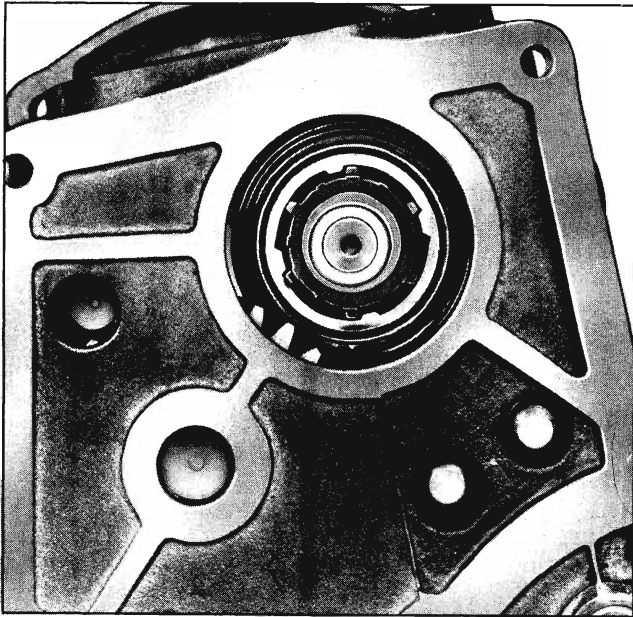


Fig. 7-29 Synchronizer Tangs Aligned with Mainshaft Splines

8. To remove the mainshaft bearing from the case, fully expand retaining ring and start bearing out by tapping on outer race (Fig. 7-30). Then drive bearing out of case.

9. Remove detent cover plug and remove second and third gear detent spring and ball.

10. With suitable punch, drive out roll pin securing second and third shift fork (Fig. 7-31) to shaft. Then tap shaft toward front of case with a drift and remove fork, shaft, and roll pin.

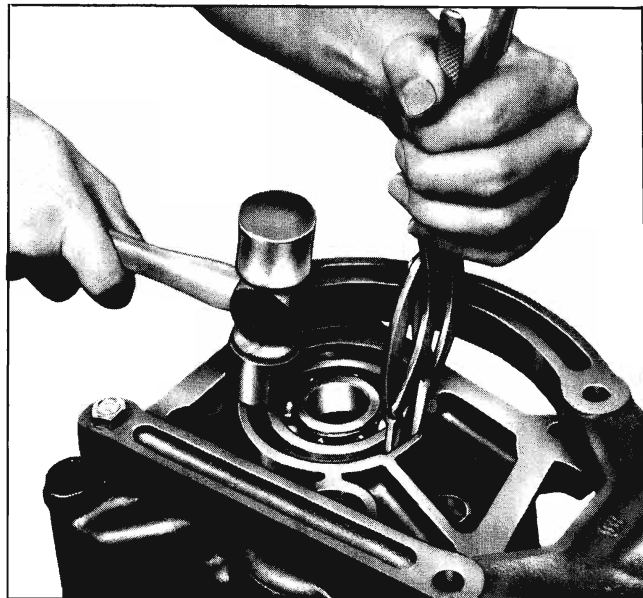


Fig. 7-30 Removing Mainshaft Bearing

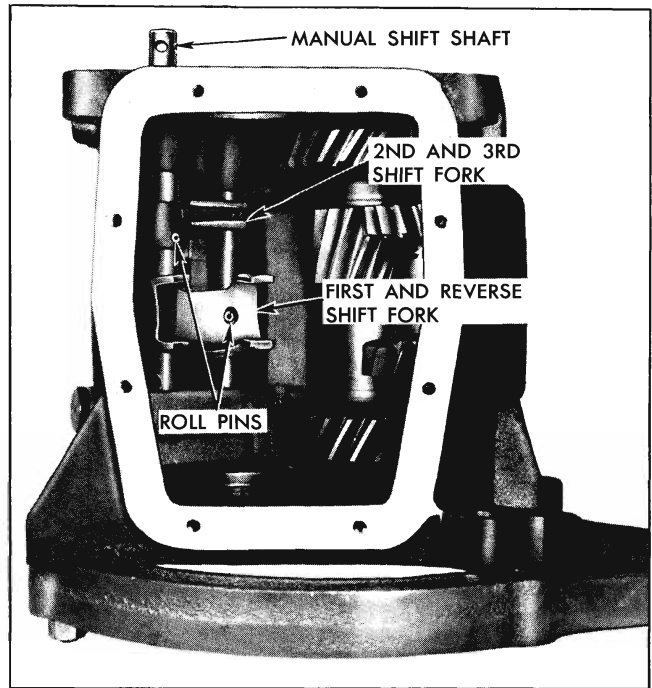


Fig. 7-31 Transmission Shift Forks

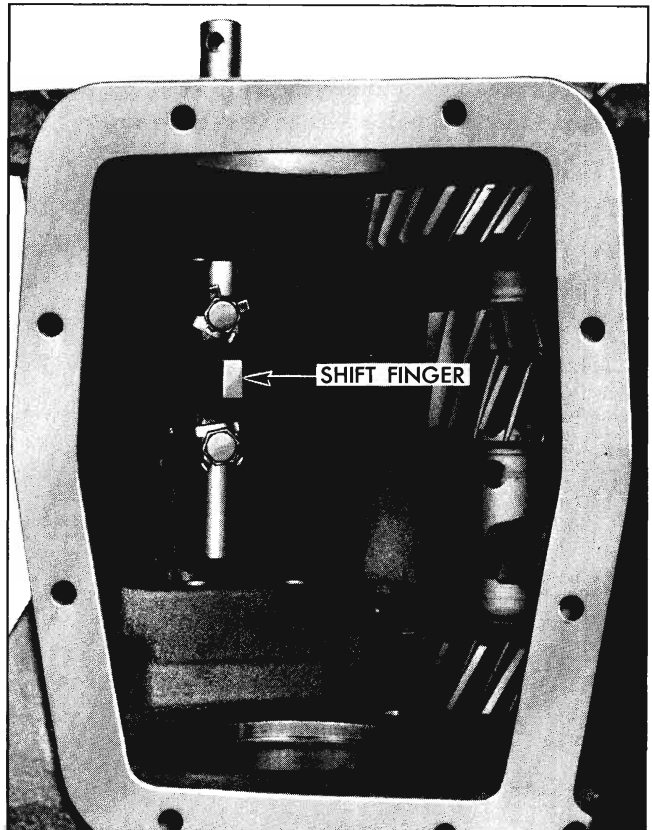


Fig. 7-32 Transmission Shift Finger

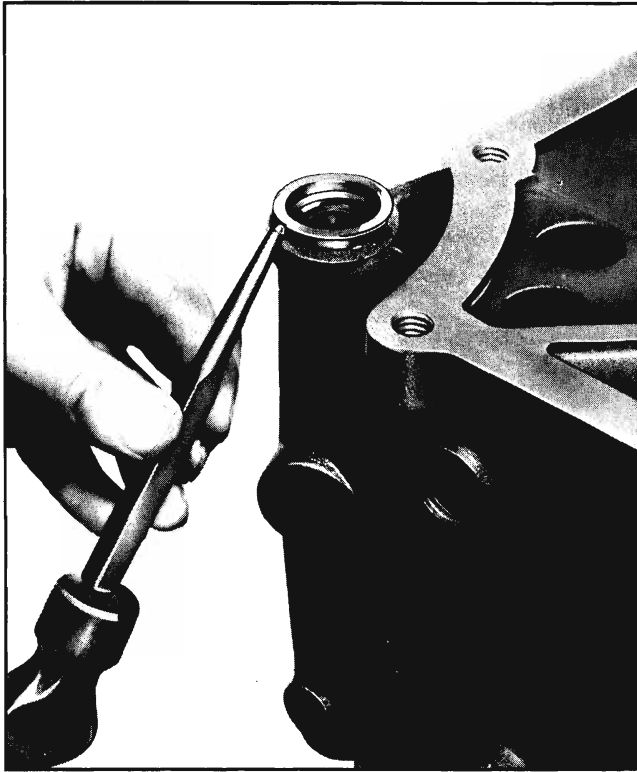


Fig. 7-33 Removing Seal

11. Remove interlock from detent cavity.
12. Remove first and reverse shift fork and shaft in the same manner as the second and third fork.
13. Remove first and reverse gear detent ball and spring.
14. Remove two cap screws and lock tabs securing shift finger (Fig. 7-32) to manual shift shaft and pull shaft from case.
15. Remove manual shift shaft seal (Fig. 7-33).

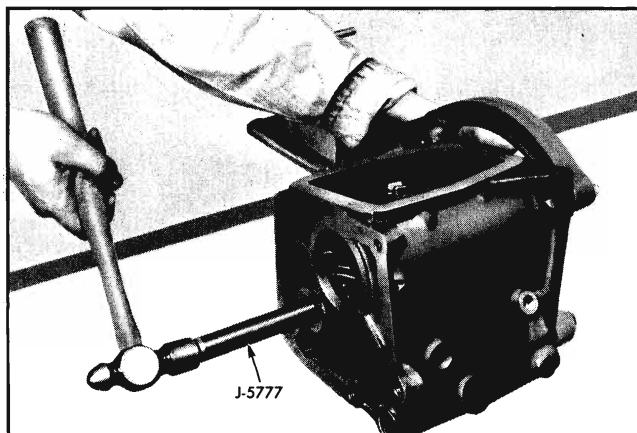


Fig. 7-34 Removing Countergear Shaft

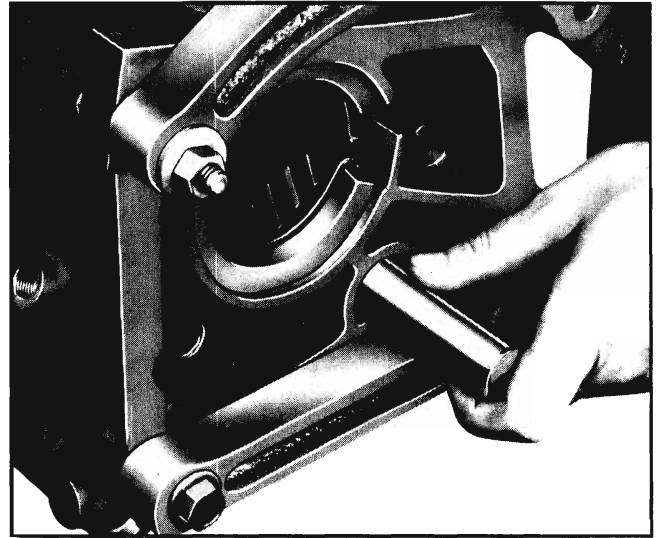


Fig. 7-35 Removing Countergear Shaft

16. Remove countergear and thrust washers by driving countergear shaft out from front of case with tool J-5777 (Fig. 7-34).

CAUTION: Hold countergear shaft while driving out to insure it is flush with tool J-5777 at all times (Fig. 7-35). This will prevent displacement of any needle bearings. Be sure tool is free from burrs.

17. If replacement is anticipated, remove reverse idler gear. To remove, first drive the reverse idler shaft lock pin into the shaft, then drive the reverse idler shaft out of case with a drift from the through hole at the rear of the case. Remove the caged needle bearing and the thrust washer used at the rear of the reverse idler gear.

18. Remove mainshaft bearing retaining ring from case.

All transmission on components are shown in Fig. 7-36.

INSPECTION AND REPAIR

BEARINGS

1. Wash the bearings thoroughly in a cleaning solvent.

2. Blow out the bearings with compressed air.

CAUTION: Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the race and balls.

3. After making sure the bearings are clean, lubri-

cate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

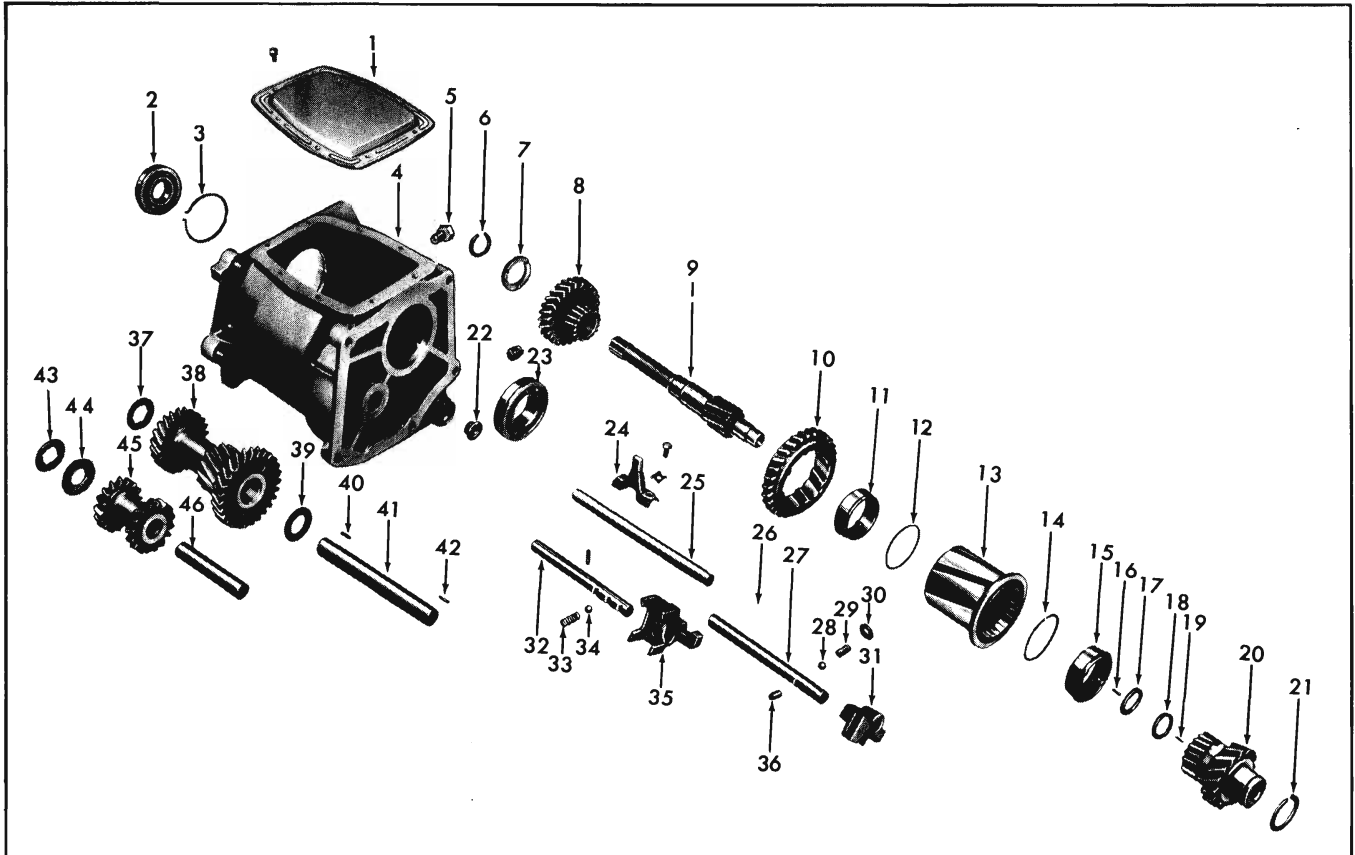
faces for burrs and if any are present, dress them off with a fine cut mill file.

TRANSMISSION CASE

Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the

GEARS

1. Inspect all gears and, if necessary, replace any that are worn or damaged.
2. Check the first and reverse sliding gear to make sure it slides freely on clutch sleeve.



- | | | | |
|------------------------------------|------------------------------------|------------------------------------|------------------------------|
| 1. Top Cover | 13. Second and Third Clutch Sleeve | 23. Clutch Gear Bearing | 35. 1st & Reverse Shift Fork |
| 2. Mainshaft Bearing | 14. Synchronizer Ring Retainer | 24. Shift Finger | 36. Interlock |
| 3. Bearing Retainer | 15. Synchronizer Ring | 25. Manual Shift Shaft | 37. Thrust Washer |
| 4. Transmission Case | 16. Needle Bearing | 26. Roll Pin | 38. Countergear |
| 5. Detent Cap | 17. Spacer | 27. 2nd & 3rd Shift Fork Shaft | 39. Thrust Washer |
| 6. Snap Ring (Selective) | 18. Spacer | 28. Detent Ball | 40. Needle Bearing |
| 7. Thrust Washer | 19. Needle Bearing | 29. Detent Spring | 41. Countergear Shaft |
| 8. Second Speed Gear | 20. Clutch Gear | 30. Detent Cap Gasket | 42. Needle Bearing |
| 9. Mainshaft | 21. Clutch Gear Bearing Snap Ring | 31. 2nd & 3rd Shift Fork | 43. Thrust Washer |
| 10. First and Reverse Sliding Gear | 22. Manual Shift Shaft Seal | 32. 1st & Reverse Shift Fork Shaft | 44. Caged Needle Bearings |
| 11. Synchronizer Ring | | 33. Detent Spring | 45. Reverse Idler Gear |
| 12. Synchronizer Ring Retainer | | 34. Detent Ball | 46. Idler Gear Shaft |

Fig. 7-36 Synchro-mesh Transmission Exploded View

3. Check the clutch sleeve to see that it slides freely on mainshaft.

REVERSE IDLER GEAR BUSHINGS

The bushings used in the idler gear are pressed into the gear then peened into holes in the bores to lock them into place, and are accurately bored with special diamond boring tools. 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.

Check bushings for excessive wear by using a narrow feeler gauge between the shaft and the bushing. The proper clearance is from .002" to .004".

COUNTERGEAR NEEDLE BEARINGS

All countergear needle bearings should be inspected closely and if excessive wear shows, they should all be replaced as well as the shaft.

To replace the countergear shaft needle bearings:

1. Place some cup grease in the needle bearing area at each end of the countergear and install the 25 needle bearings in each end. The grease will hold the needle bearings in place while installing (Fig. 7-37).
2. Insert tool J-5777 in countergear.
3. Apply grease to countergear thrust washers.

CLUTCH GEAR BEARING REPLACEMENT

As the clutch gear and bearing are removed as a unit, it will be necessary to drive the clutch gear out

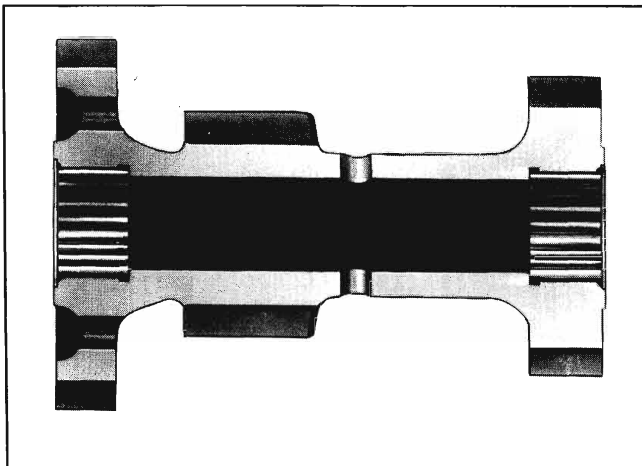


Fig. 7-37 Counter Needle Bearings Installed

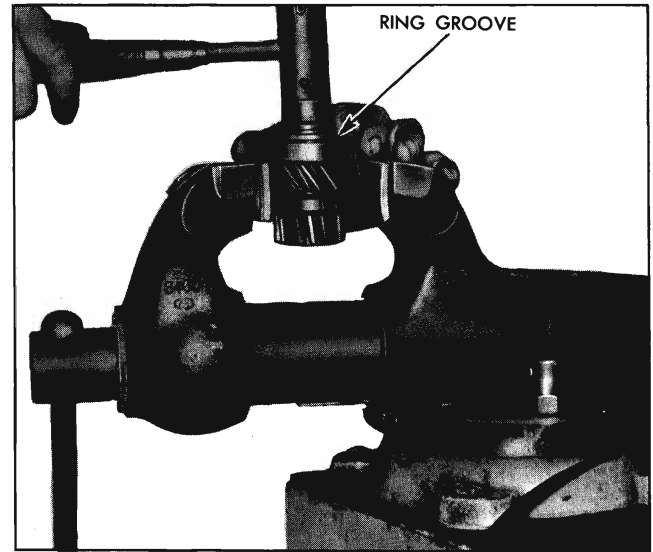


Fig. 7-38 Removing Clutch Gear Bearing

of the bearing if replacement of either the gear or the bearing is required.

TO REMOVE:

1. Remove all needle bearings.
2. Remove snap ring.
3. Place outer race of bearing on top of vise, and tap out clutch gear with a soft hammer (Fig. 7-38).

Installation of new bearing can be accomplished by tapping or pressing new bearing onto clutch gear with a suitable tool (such as J-6133) used on the bearing inner race. Ring groove should be away from gear (Fig. 7-38).

Place some cup grease in the mainshaft pilot hole of the clutch gear and install 26 needle bearings and small spacer. Then install the large spacer and 28 needle bearings (Fig. 7-39).

CLUTCH SLEEVE AND SYNCHRONIZER RINGS

1. Remove the first and reverse sliding gear.
2. Turn the synchronizer ring in the clutch sleeve until the ends of the synchronizer ring retainer can be seen through the slot in the clutch sleeve.
3. Using Tool J-932, expand the retainer into the counterbore in the clutch sleeve. This raises the retainer from the groove in the ring so ring may be easily slipped out (Fig. 7-40).
4. Check the synchronizing cones for wear or for being loose in the clutch sleeve. If cones are damaged

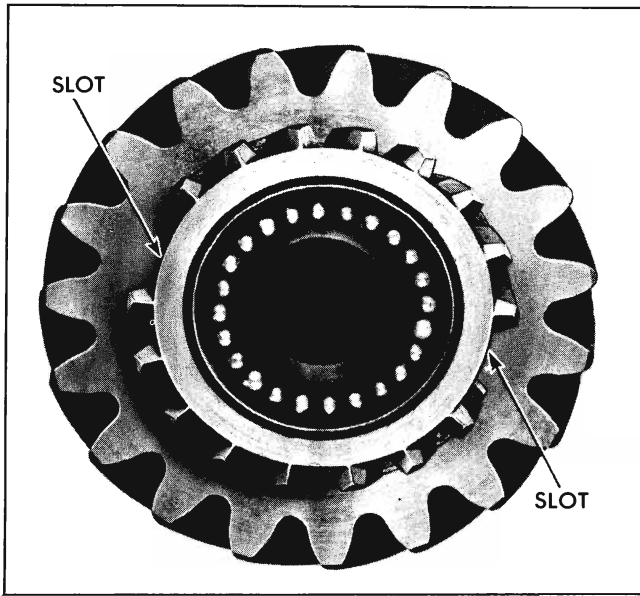


Fig. 7-39 Clutch Gear Needle Bearings

in any way, it will be necessary to replace the clutch sleeve assembly and both synchronizer rings. Clutch sleeve should be replaced if there is more than .030" end play between cone and synchronizer ring.

5. Inspect the synchronizer rings for smoothness.
6. Place the synchronizer rings in the synchronizing cones and check with thumbs to see that rings do not rock. Excessive rocking indicates a poor fit between the rings and cone, which will not permit proper synchronizing of gears during shifting.
7. Install the synchronizer ring retainers in the counterbores in the ends of the clutch sleeves.
8. Using Tool J-932 in slot in clutch sleeve, expand each retainer in the counterbore, lubricate each

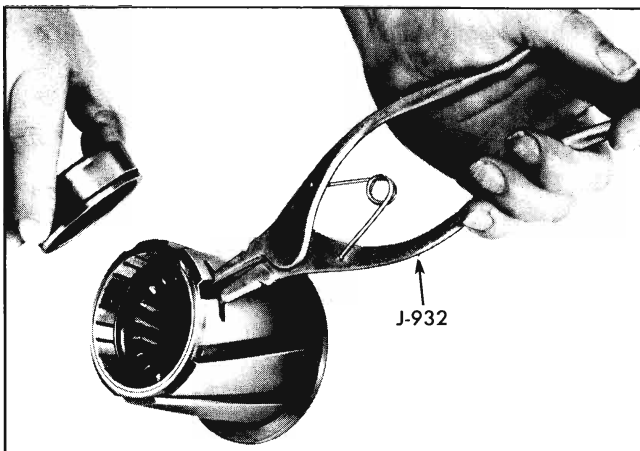


Fig. 7-40 Removing Synchronizer Ring

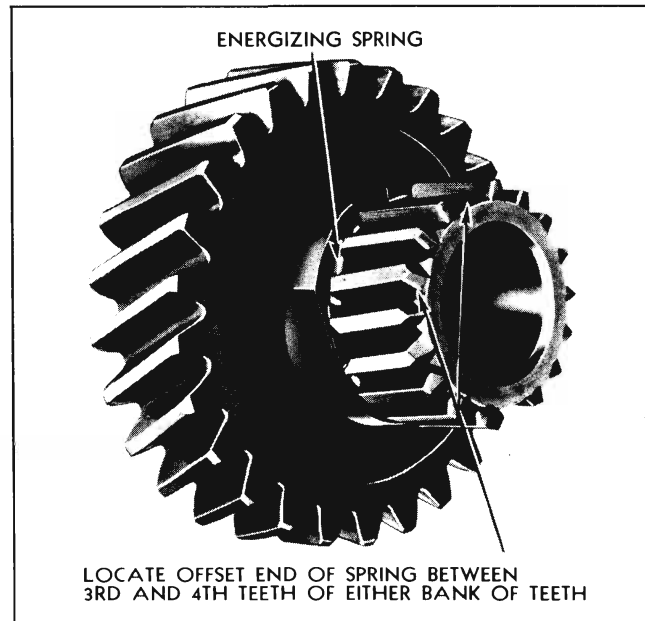


Fig. 7-41 Position of Energizing Spring

synchronizer ring with light oil and install in clutch sleeve.

NOTE: Look through slot and make sure retainers seat in groove all the way around the rings so they will turn freely.

9. Install the first and reverse sliding gear on the clutch sleeve.

SYNCHRONIZER ENERGIZING SPRINGS

1. It will be noticed upon examining these springs that one of the ends is slightly offset. Each spring must be assembled in its groove in the clutch gear and the second speed gear with the offset or locking end between the third and fourth teeth of either of the two banks of teeth on these gears, thus keeping the spring from turning in its groove (Fig. 7-41).

2. Under normal operation it should never be necessary to replace the energizing springs. However, should an energizing spring be removed for any reason, a new spring should be installed. The spring may be removed by slipping a thin blade under the spring and raising it sufficiently to slide it off over the clutch gear teeth.

CAUTION: Spring must be carefully installed so as not to expand it greater than the diameter of the clutch gear teeth as the spring will set.

ASSEMBLE TRANSMISSION

1. Mount transmission case on J-7896-01.

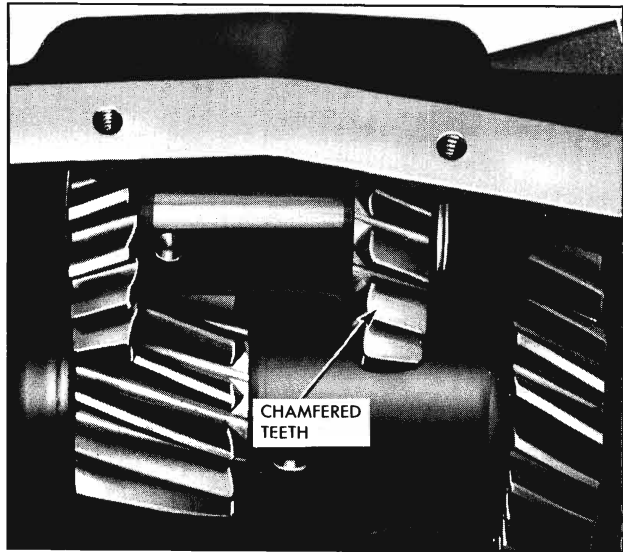


Fig. 7-42 Reverse Idler Gear Installed

2. Install manual shift shaft seal.
3. With tab facing out, place thrust washer on same end as larger countergear and rest countergear on bottom of case (larger gear toward front of case). Raise countergear and engage tool J-5777 through thrust washer and into case front hole just enough to hold countergear in place. Be sure thrust washer tab engages notch in case.
4. With tab facing out, insert rear thrust washer (tab engaging notch), insert countergear shaft at rear of case, and drive out J-5777 with countergear

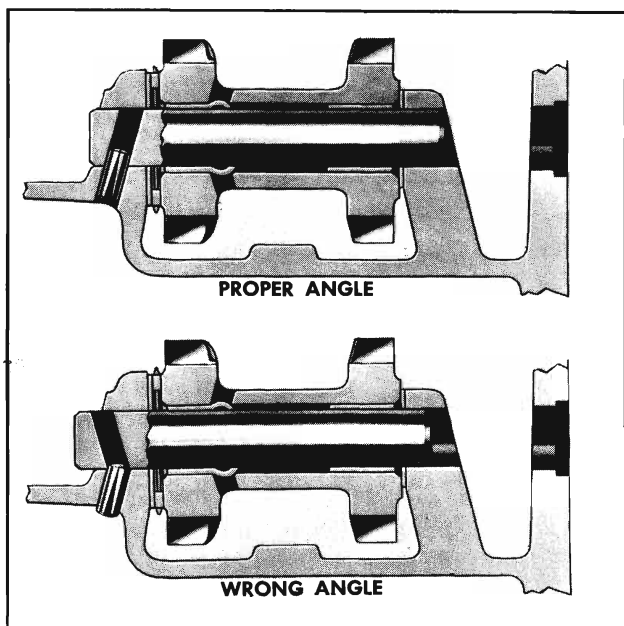


Fig. 7-43 Proper Lock Pin Installation

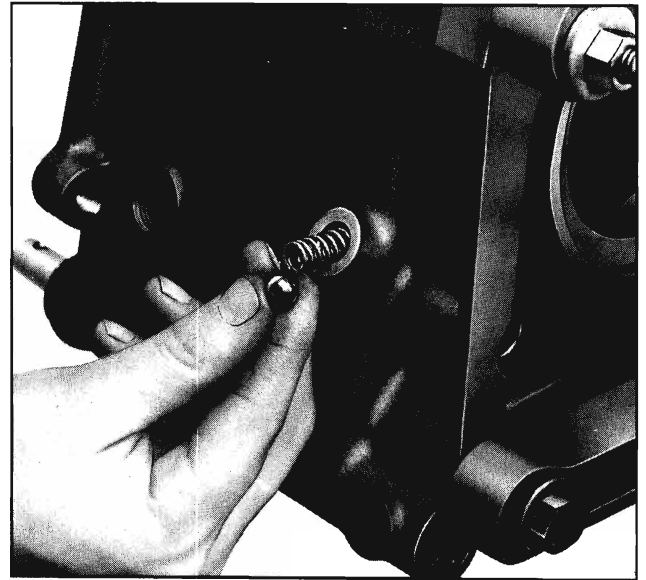


Fig. 7-44 Installing Detent Spring and Ball

shaft (notched end facing rear of case). The shaft is a slight press fit at front of case.

CAUTION: Hold tool J-5777 against countergear shaft while driving out to insure it is flush with shaft at all times. This will prevent displacement of any needle bearings. Be sure shaft is free from burrs.

5. If reverse idler gear was removed, coat the needle thrust bearing and thrust washer with grease and position them on reverse idler gear in that order. The needle bearing must be against end with chamfered gear teeth (Fig. 7-42). Coat bushings with transmission lubricant.

6. Place reverse idler gear assembly in position in case so thrust bearing is toward rear of case.

7. Install the reverse idler shaft from rear, making sure the lock pin hole in the shaft lines up with the hole in the case at the same angle (Fig. 7-43).

8. Use a new idler shaft lock pin and drive it in approximately $\frac{1}{16}$ " beyond flush with case. Use Permatex No. 2 or equivalent to seal pin when installed.

9. Lubricate manual shift shaft with oil, then insert through seal into case. Position shift finger and secure to shaft with two lock tabs and capscrews. Tighten capscrews to 5-7 lb. ft. torque. Bend lock tabs onto heads of screws.

10. Install detent spring and ball (Fig. 7-44), in that order, in detent cavity. Tap ball and spring to insure the spring is resting on bottom of cavity.

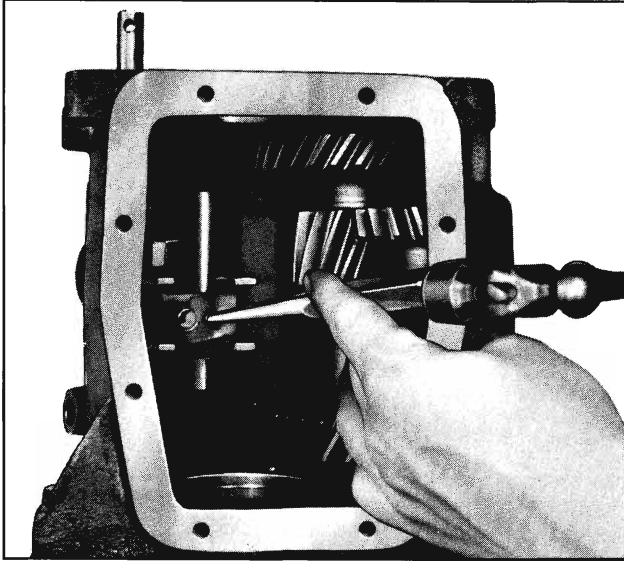


Fig. 7-45 Installing Roll Pin

11. Start roll pin into first and reverse fork. Start first and reverse shift fork shaft (shorter than second and third fork shaft) through lower hole at front of case with three detents facing detent ball and slip fork on shaft. Depressing detent ball, press shaft over ball to the center detent position. Secure fork to shaft with roll pin (Fig. 7-45).

12. Coat interlock lightly with oil and install in detent cavity. (Fig. 7-46).

13. **NOTE:** Be sure manual shift lever shift finger is engaged with first and reverse shift fork prior to installing second and third shift fork.

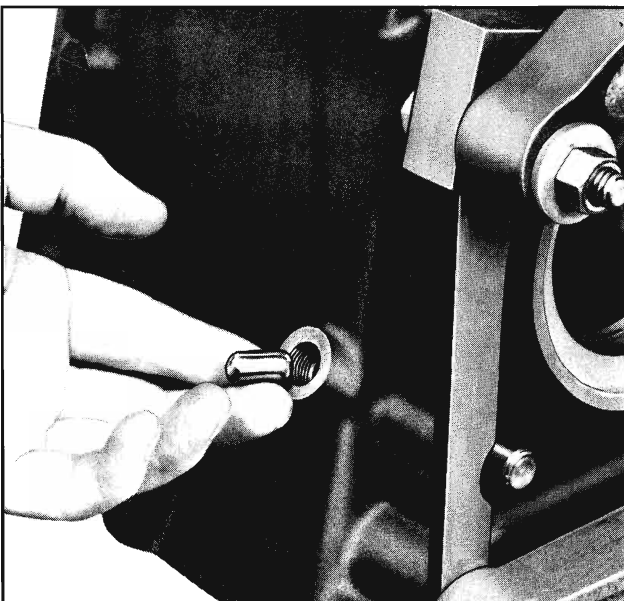


Fig. 7-46 Installing Interlock

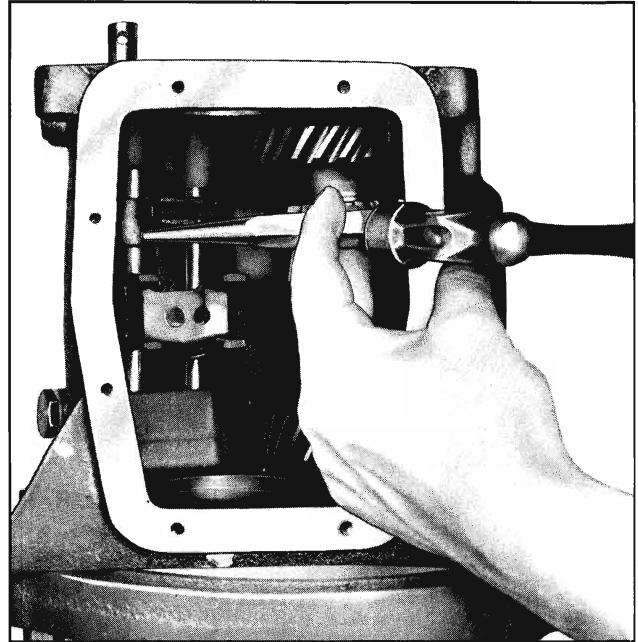


Fig. 7-47 Installing Roll Pin

Start roll pin into fork. Insert second and third shift fork shaft through front of case with three detents facing away from interlock, and slip fork onto shaft. Secure shift fork to shaft with roll pin (Fig. 7-47).

14. Move second and third shift fork shaft to center detent position and insert detent ball and spring (in that order). Install detent cavity cover and gasket and torque to 25-35 lb. ft.

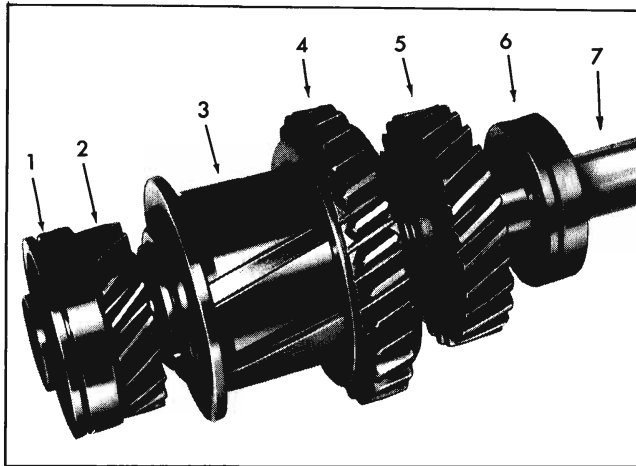
NOTE: Check for free movement of manual shift shaft in all gear positions after installing detent plug.

15. Check synchronizer rings to be sure they turn freely.

16. Indexing properly with synchronizer ring tangs, install second speed gear (5, Fig. 7-48) in clutch sleeve.

17. Place assembled clutch sleeve, first and reverse sliding gear, and second speed gear in case (with second speed gear at rear of case). Make sure first and reverse sliding gear and shoulder on clutch sleeve are in proper forks.

18. Place the mainshaft in clutch gear and, from the front of the case, insert the mainshaft through the bores of the clutch sleeve and second speed gear (Fig. 7-49).



- | | |
|-----------------------------------|-----------------------------------|
| 1. Clutch Gear Bearing | 4. First and Reverse Sliding Gear |
| 2. Clutch Gear | 5. Second Speed Gear |
| 3. Second and Third Clutch Sleeve | 6. Mainshaft Bearing |
| | 7. Mainshaft |

Fig. 7-48 Stack-up of Components on Mainshaft

CAUTION: Be sure that the tangs of the synchronizer ring are aligned with the mainshaft splines (Fig. 7-29) before installing mainshaft and that the clutch gear slots (Fig. 7-39) are properly aligned with the larger tangs on the synchronizer ring.

19. Drive clutch gear bearing into place (Fig. 7-50).

20. Place transmission and fixture on the bench. Install thrust washer on mainshaft with its oil grooves toward the second speed gear.

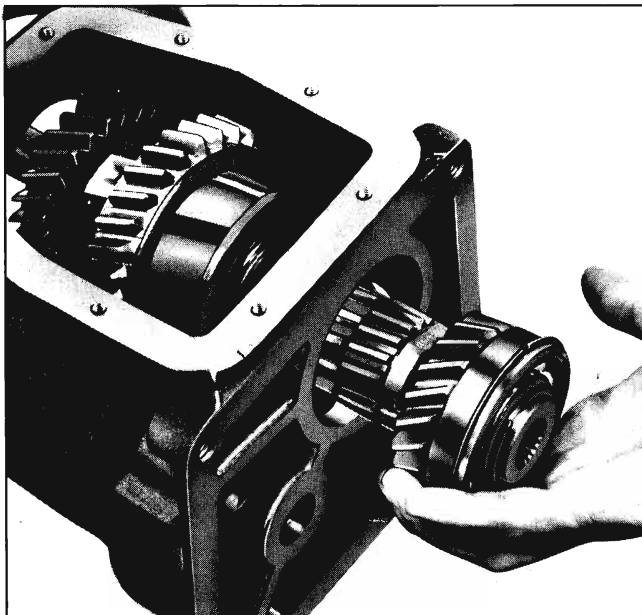


Fig. 7-49 Installing Mainshaft and Clutch Gear

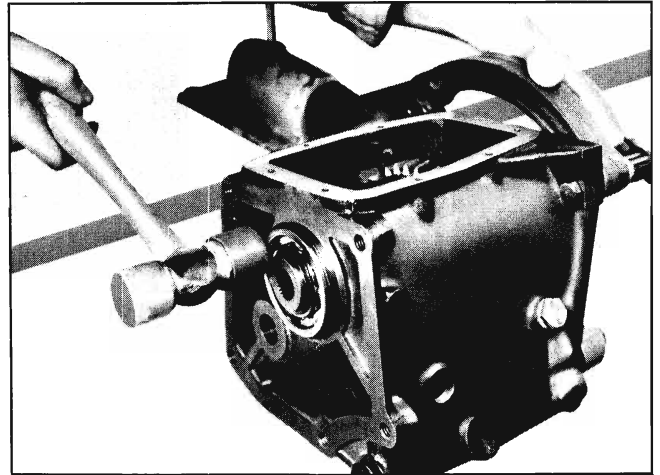


Fig. 7-50 Installing Clutch Gear Bearing

21. Install mainshaft bearing retainer ring.

22. Install mainshaft bearing with ring groove toward case and, with the retainer ring expanded, drive the bearing onto mainshaft with tool J-6133 (Fig. 7-51).



Fig. 7-51 Installing Mainshaft Bearing

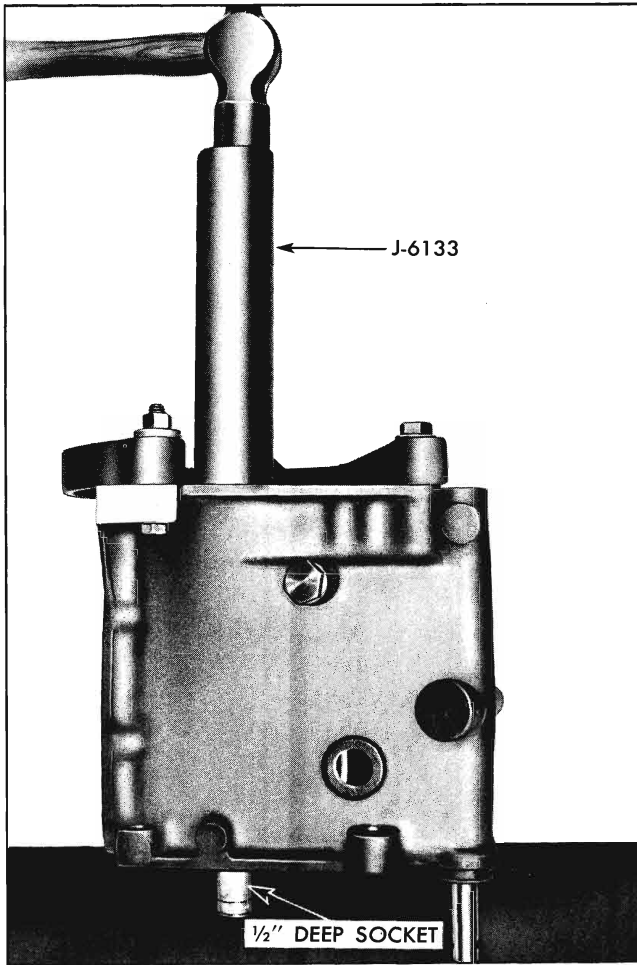


Fig. 7-52 Making Snap Ring Groove Accessible

23. Install $\frac{1}{2}$ " deep socket in clutch gear and continue to drive on mainshaft bearing until the snap ring groove on mainshaft is accessible (Fig. 7-52). Remove $\frac{1}{2}$ " deep socket.

24. Install snap ring. Check end play of mainshaft by inserting feeler gauge between snap ring and bearing inner race. Final end clearance must be .004" maximum. Change to applicable thickness snap ring if original does not meet this limit. Snap rings are available in four (4) thicknesses, ranging from .086" to .097". NOTE: After making this check, drive mainshaft forward into case until snap ring contacts bearing inner race.

25. Check for free movement of manual shift shaft to be sure each gear position may be easily obtained.

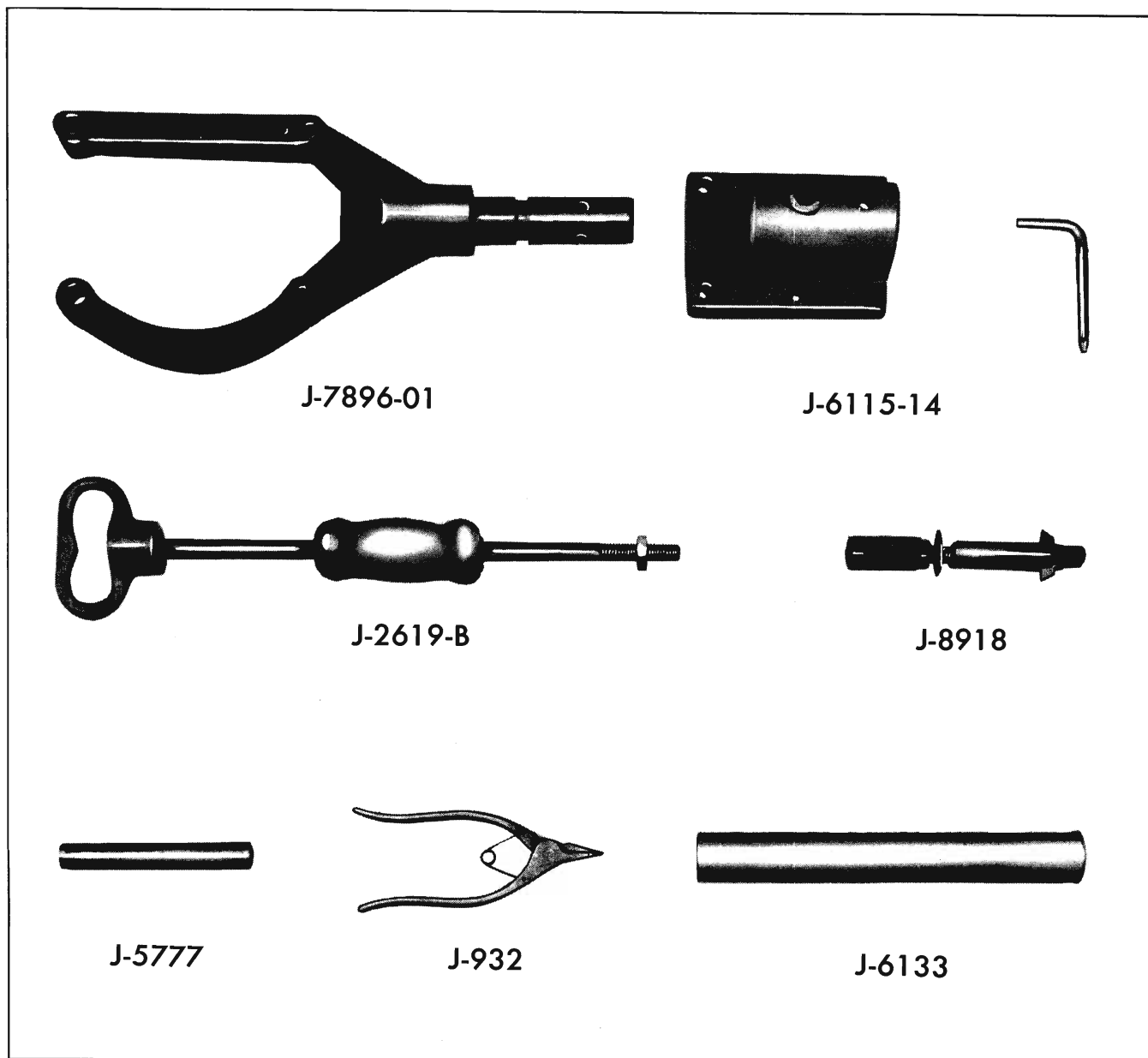
26. Install top cover and gasket. Tighten top cover bolts to 3-4 lb. ft.

27. Install extension assembly. Torque bolts to 35-40 lb. ft.

28. Make sure oil plug is properly installed (Fig. 7-27).

TORQUE SPECIFICATIONS

	Lb. Ft.
Gearshift lever housing to torque tube bolts	10-15
Control rod to coupling clamp nut	10-20
Shift lever housing cover bolts	4-5
Shift finger to shift shaft cap screws	5-7
Detent cavity cover	25-35
Top cover bolts	3-4
Extension to transmission bolts	35-40



SPECIAL TOOLS

- J-7896-01 Transmission Holding Fixture
- J-6115-14 Holding Fixture Base
- J-2619-B Slide Hammer
- J-8918 Extension Housing Bearing Remover
- J-5777 Countershaft Needle Bearing Loader
- J-932 Synchronizer Ring Retainer Pliers
- J-6133 Mainshaft Bearing Installer

AUTOMATIC TRANSMISSION

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GENERAL DESCRIPTION

The automatic transmission used in the Pontiac Tempest consists of an air cooled, three element torque converter and a two speed planetary transmission.

The transmission is attached to the differential carrier assembly to form a transmission-axle assembly. As a result the converter is mounted on the opposite side of the carrier from the transmission. Two shafts run axially through the differential pinion shaft, transmitting torque from the engine to the converter and back to the transmission assembly.

Torque multiplication is obtained both hydraulically through the converter and mechanically through

a planetary gear set. The transmission provides neutral, low range, direct drive and reverse. Gear ratios are 1.82:1 in low and reverse and 1:1 in direct drive. The components of the transmission are shown schematically in Fig. 7A-1.

The transmission used with the 215 V-8 engine is of a different calibration than that used with the four cylinder engine. Under no circumstances should the 215 engine transmission or transmission axle assembly be interchanged with the four cylinder.

Identification of the two transmissions can be made by the white stripe found on the governor assembly of the 215 engine transmission. The primary differences found in these two units are in the governor assembly, TV spring, pressure regulator spring and

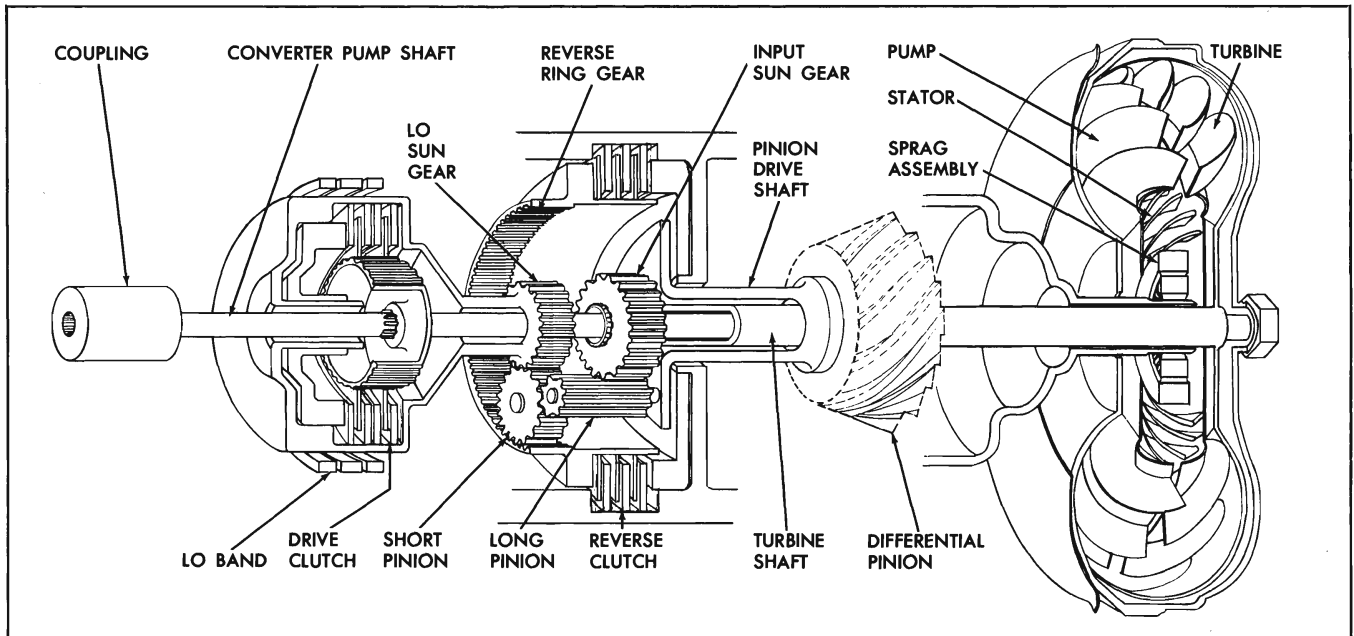


Fig. 7A-1 Transmission—Axle Schematic

the downshift timing valve. See the Master Parts Catalog for complete part number information.

TORQUE CONVERTER OPERATION

The torque converter is a device which multiplies engine torque when required. The converter assembly has three members; a driving member called the converter pump, a driven member called the turbine, and a stator located between the pump and turbine. The three components are immersed in oil. The converter pump is mechanically connected, through the converter pump and propeller shafts, to the engine. When the engine is running oil within the converter cavity is maintained under pressure by the front oil pump. Oil is then picked up at the inner section of the converter pump and directed to its outer edges where it is thrown against the curved blades in the turbine. This causes the turbine to rotate, driving the turbine shaft. As the oil leaves the turbine blades it is traveling in a direction opposite to the pump rotation. The blades of the stator (curved in the opposite direction to those in the turbine) change the direction of oil

flow so that the oil strikes the back side of the converter pump blades helping to drive the pump. Therefore, the total torque transmitted to the drive line is the combination of engine torque plus the additional torque supplied by the redirected oil striking the back side of the converter pump blades.

The stator is mounted on a sprag clutch, which holds the stator from moving in a reverse direction when the unit is acting to multiply torque. As the turbine speed approaches pump speed there is progressively less torque multiplication. The stator, which in the beginning was standing still, is picked up by the rapidly rotating oil and accelerates until the pump, turbine and stator are turning at almost the same speed. When the stator rotates, interference in the oil flow between the turbine and pump is minimized. When all three members are turning together there is no torque multiplication in the converter and it is acting as a fluid coupling.

Following is a description of the power flow in each of the transmission ranges.

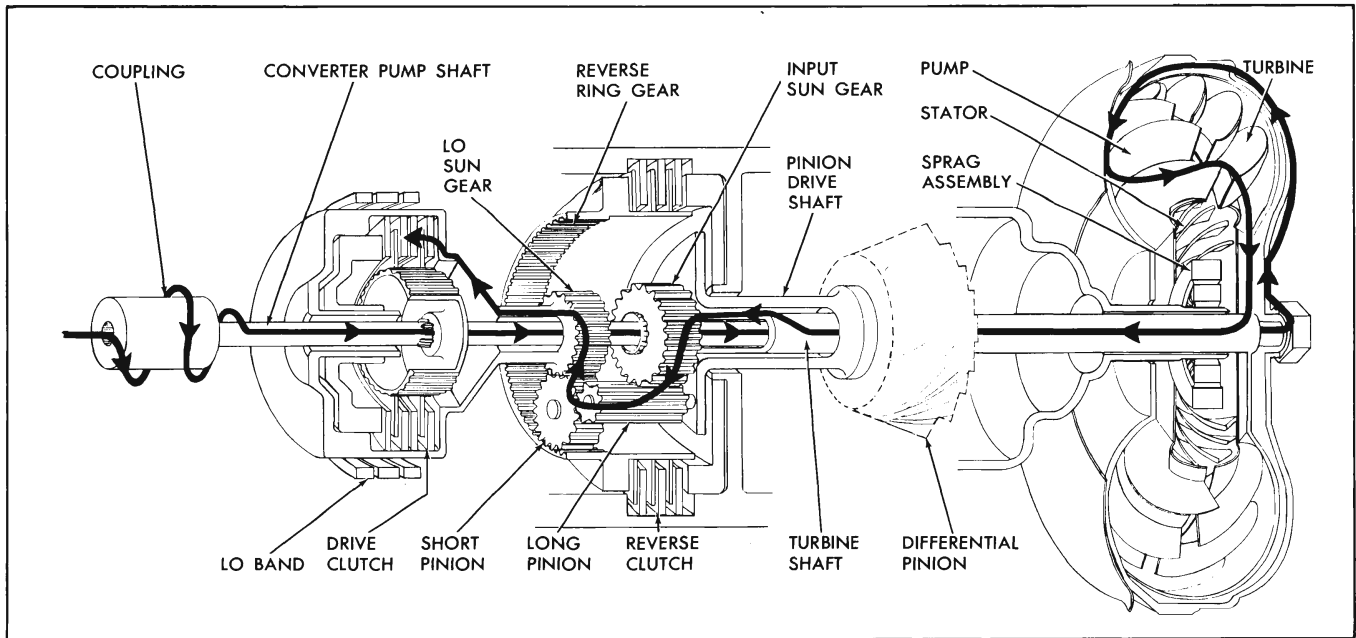


Fig. 7A-2 Power Flow—Neutral

POWER FLOW

POWER FLOW NEUTRAL (FIG. 7A-2)

Engine torque is transmitted by the propeller shaft through the coupling to converter pump shaft. This shaft extends through the entire transmission and differential assembly to the torque converter where it drives the converter pump. The converter pump in turn drives the turbine which is connected to the turbine shaft. The input sun gear driven by the turbine shaft drives the long pinions which are engaged with the short pinions. The short pinions in turn drive the Lo sun gear. Since the reverse clutch, lo band and drive clutch are in a released position no power can be further transmitted and the unit is in neutral.

SUMMARY NEUTRAL

- Low Band — Released
- Drive Clutch — Released
- Reverse Clutch — Released

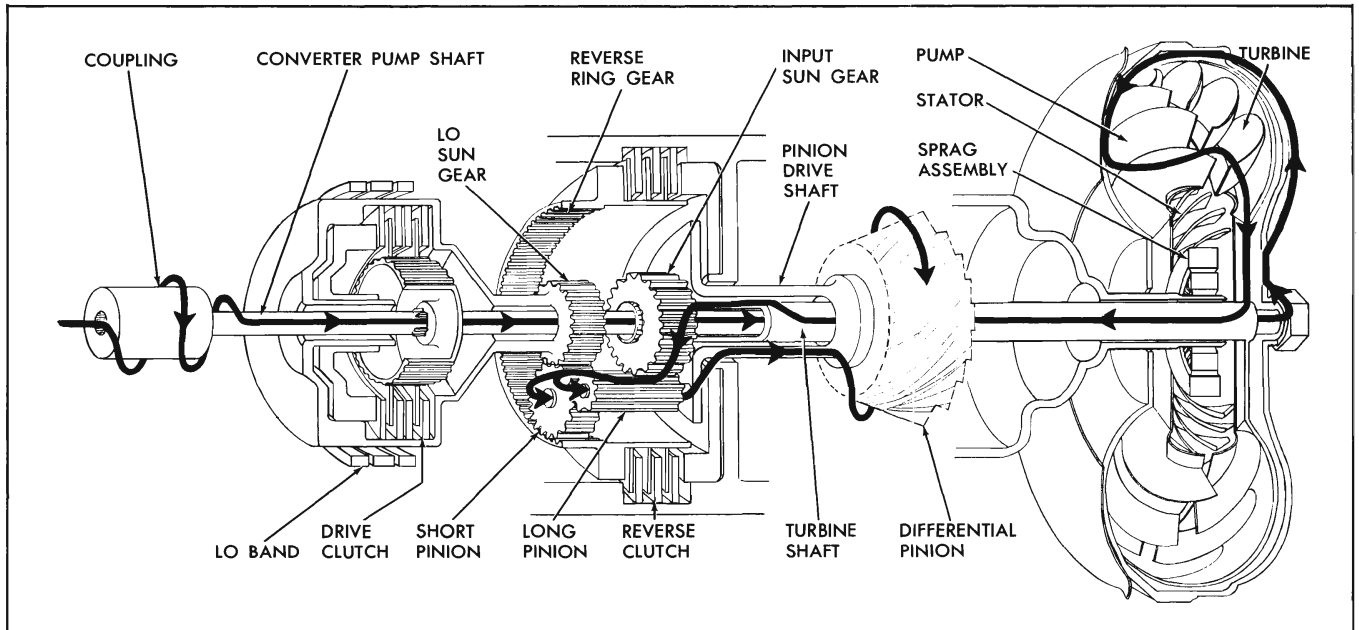


Fig. 7A-3 Power Flow—Low

POWER FLOW—LOW (FIG. 7A-3)

Engine torque is transmitted by the propeller shaft through the coupling to converter pump shaft. This shaft extends through the entire transmission and differential assembly to the torque converter where it drives the converter pump. The converter pump in turn drives the turbine which is connected to the turbine shaft. The input sun gear driven by the turbine shaft drives the long pinions which are engaged with the short pinions.

With the low band applied the low sun gear is held stationary, this causes the planet carrier to rotate around the low sun gear in the same direction as engine rotation and in reduction.

The planet carrier in turn drives the differential pinion.

SUMMARY LOW

- Low Band — Applied
- Drive Clutch — Released
- Reverse Clutch — Released

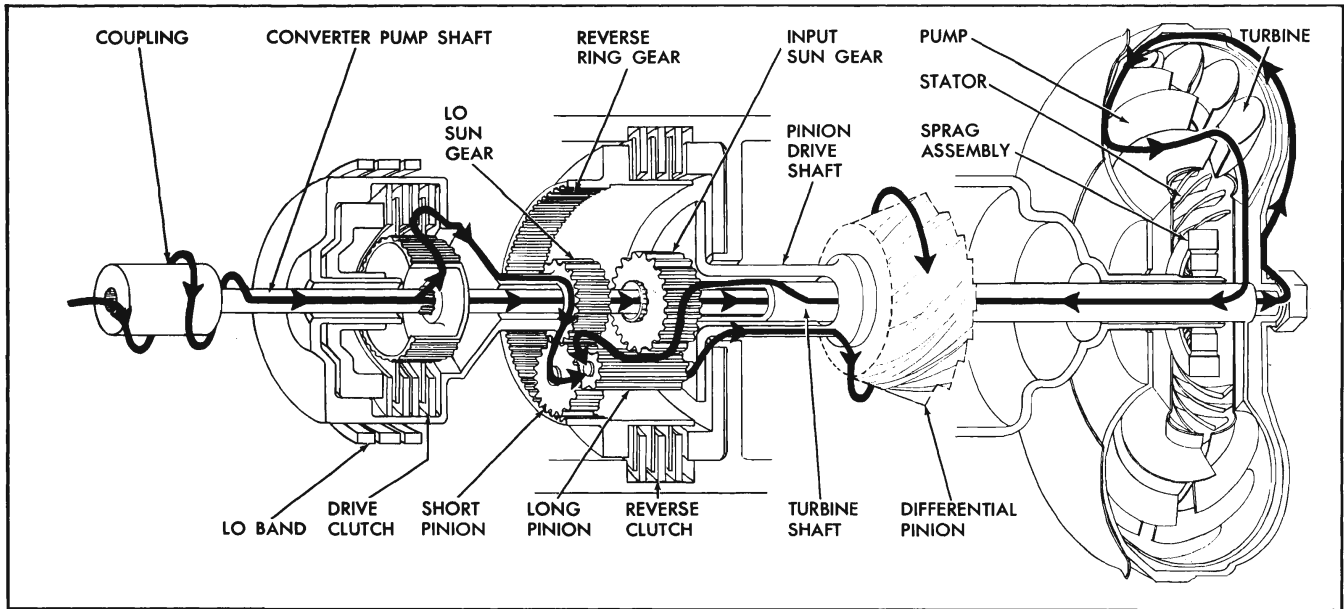


Fig. 7A-4 Power Flow—Direct Drive

POWER FLOW—DIRECT DRIVE (FIG. 7A-4)

Engine torque is transmitted by the propeller shaft to the converter pump shaft. In direct drive the drive clutch is applied. This allows the torque to "split". Part of the torque goes through the splines on the converter pump shaft to the drive clutch and from the clutch directly to the low sun gear. The low sun gear drives the short pinions which are in mesh with the long pinions. The remainder of the torque is transmitted by the converter pump shaft to the converter pump. The converter pump in turn drives the turbine which is connected to the turbine shaft. The input sun gear, splined to the turbine shaft, drives the long pinion.

The torque thus "joins" at the planetary gear set. The planet carrier is driven by both pinions and transmits torque to the differential pinion.

This split torque principle, therefore, combines the efficiency of a direct mechanical drive with the advantages of hydraulic drive provided by the torque converter.

SUMMARY DIRECT DRIVE

- Low Band — Released
- Drive Clutch — Applied
- Reverse Clutch — Released

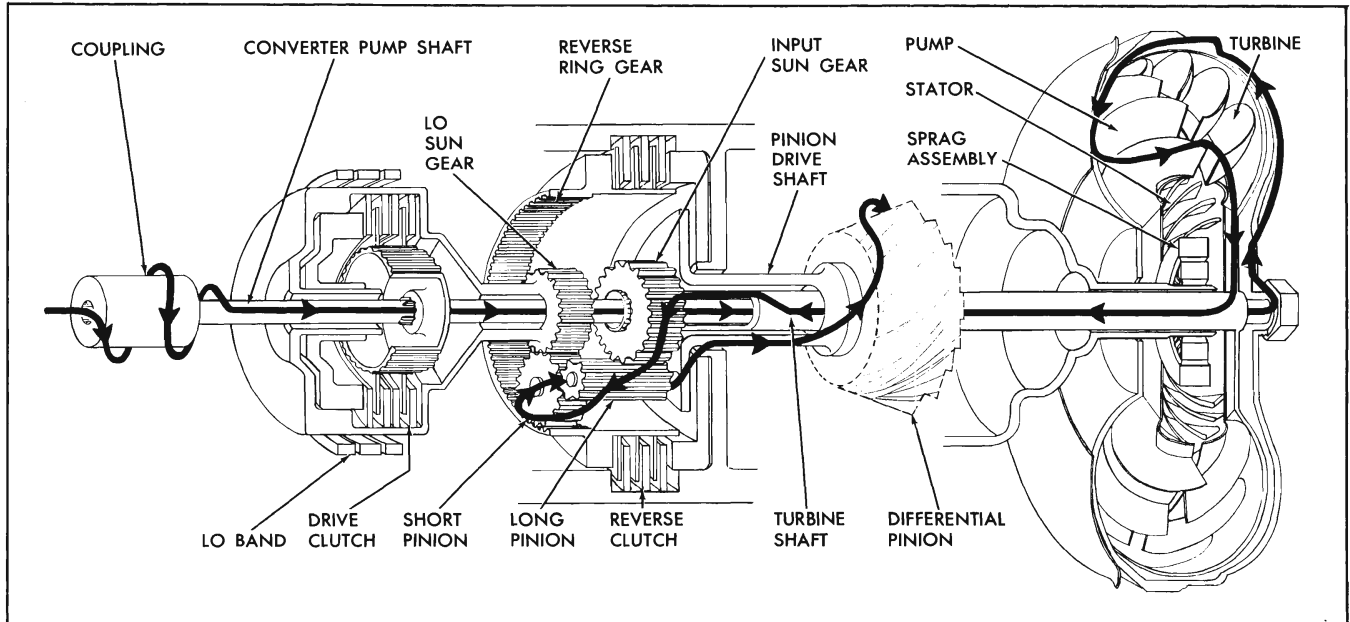


Fig. 7A-5 Power Flow—Reverse

POWER FLOW—REVERSE (FIG. 7A-5)

Engine torque is transmitted by the propeller shaft through the coupling to converter pump shaft. This shaft extends through the entire transmission and differential assembly to the torque converter where it drives the converter pump. The converter pump in turn drives the turbine which is connected to the turbine shaft. The input sun gear driven by the turbine shaft drives the long pinions which are engaged with the short pinions.

In reverse the reverse clutch is applied holding the reverse ring gear stationary. Therefore the short pinion rotating clockwise carries the planet carrier in a counterclockwise direction and in deduction.

Summary	—Reverse
Low Band	—Released
Drive Clutch	—Released
Reverse Clutch	—Applied

Following is a summary of the hydraulic operation required for the foregoing power flows.

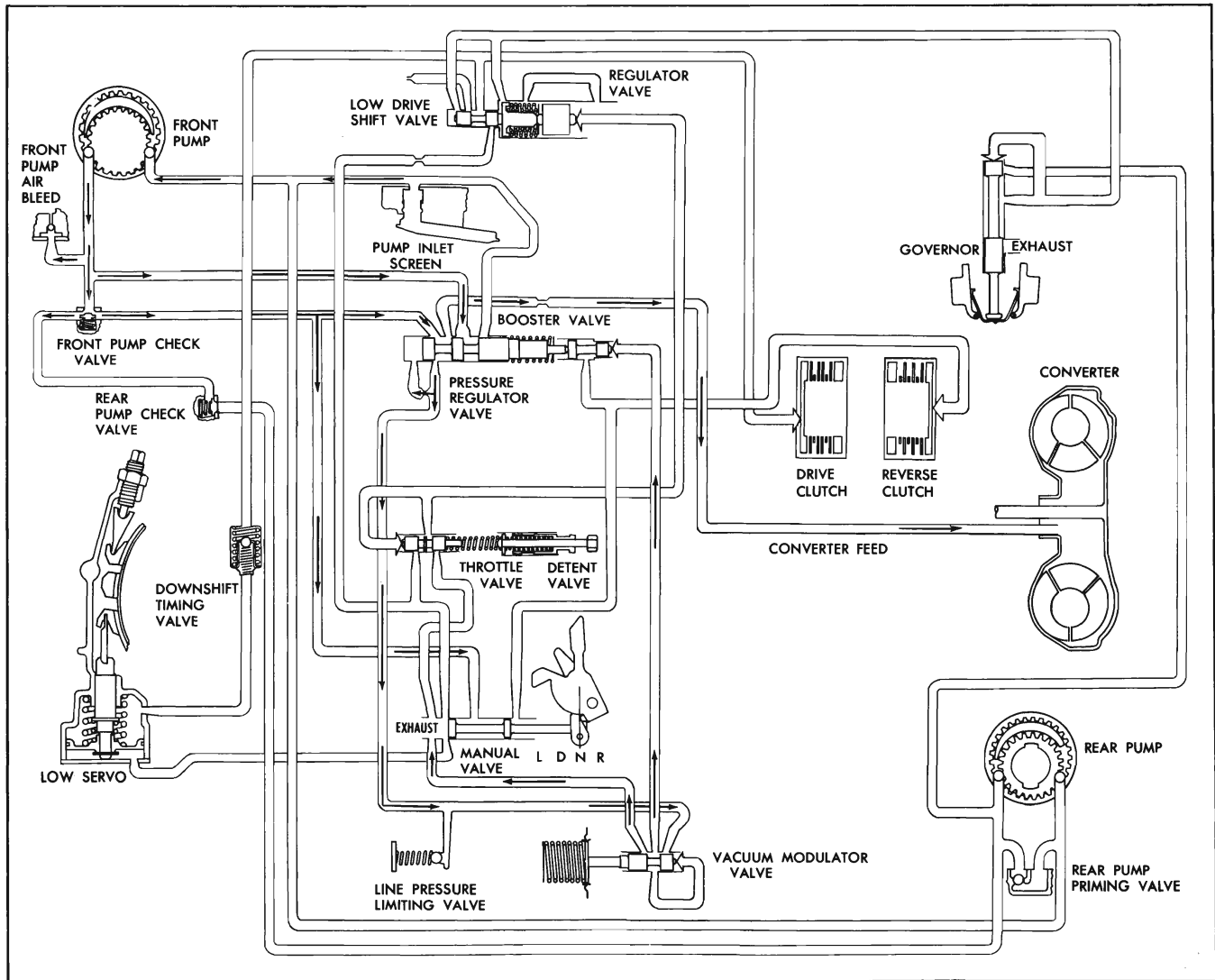


Fig. 7A-6 Oil Circuits—Neutral

HYDRAULIC OPERATION

HYDRAULIC OPERATION—NEUTRAL (FIG. 7A-6)

FRONT PUMP

The engine drives the propeller shaft which is splined through the coupling to the converter pump drive shaft. A drive plate mounted on the front end of the shaft drives the transmission front pump. As the engine is started, the front pump picks up oil from the sump through the pump inlet screen. Any air in the front pump passes out through the front pump air bleed. As pressure begins to build up, it seats the air bleed ball to prevent oil leakage. Oil flows from the front pump to the pressure regulator valve in the area between the second and third lands. Oil also passes from the front pump, unseating the lightly

sprung front pump check valve, and flows to the pressure regulator valve in the area between the first and second lands.

The oil from the front pump also seats the rear pump check valve to prevent any loss of pressure through the rear pump which pumps only when car is in motion.

Oil from the front pump pressure cavity is also sent to the manual valve. In neutral, the manual control valve is positioned so that no oil is permitted to flow to the clutches or band.

PRESSURE REGULATOR

Oil also flows through small opening in the valve body gasket into a cavity at the left end of the pres-

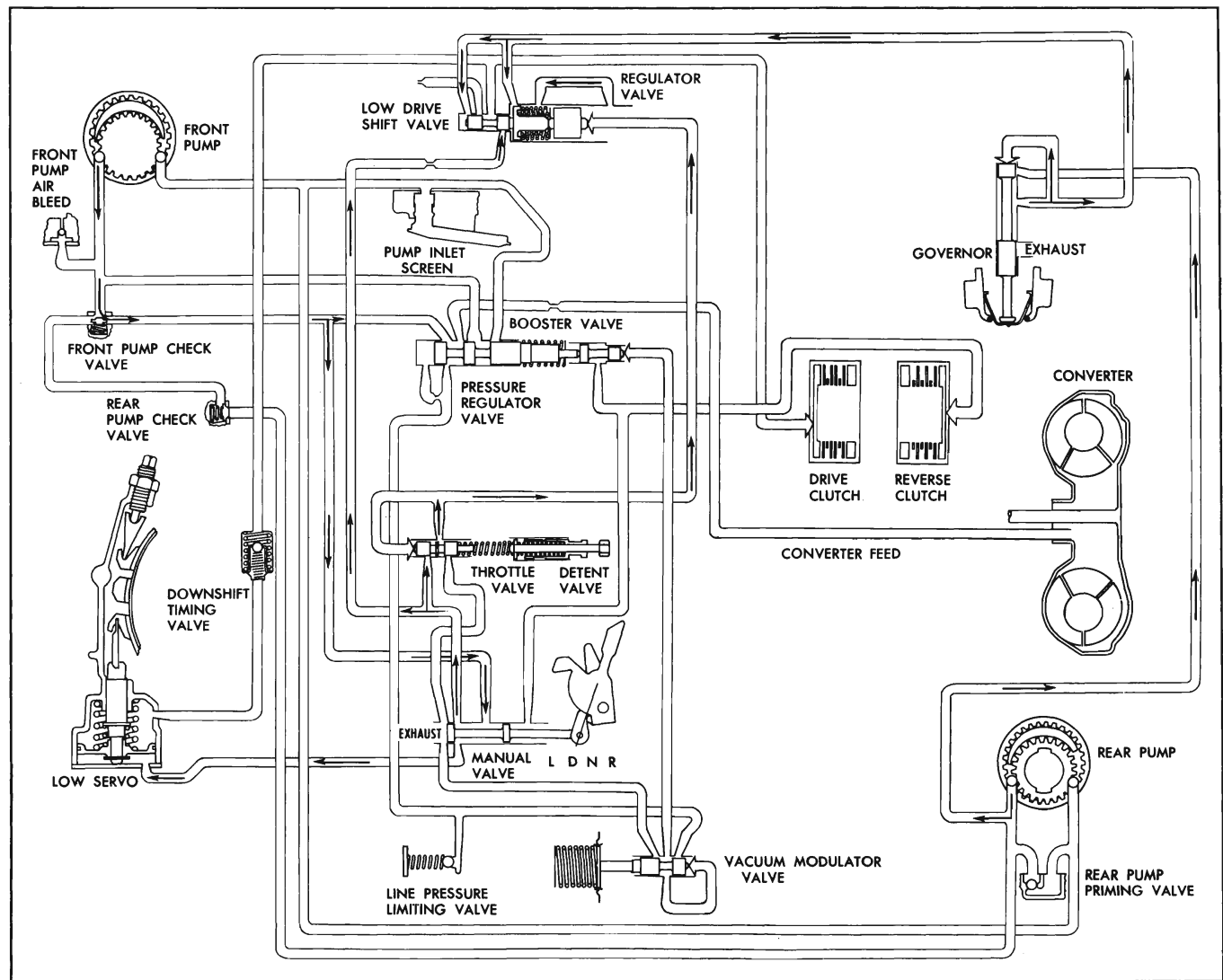


Fig. 7A-7 Oil Circuits—Automatic Low

sure regulator valve. As pressure begins to build up against the valve, the valve starts moving against the spring and booster valve and opens the converter feed orifice. This occurs at approximately 60 psi.

When the converter circuit is under pressure, the valve continues to move against its spring and booster valve until the area between the second and third lands is opened to pump inlet. When the exhaust port or channel is opened, pressure begins to fall, and the pressure regulator valve spring forces the valve to move back, shutting off the exhaust port. The valve balances at a point where the hydraulic and spring forces are equal, maintaining an even mainline pressure.

Oil is also sent from the pressure regulator valve to the modulator valve. Oil, at mainline pressure enters

the modulator bore at the first port from the right and passes through a gasket slot to a chamber to the right of the valve.

The vacuum modulator valve produces a modified pressure as explained under "Vacuum Modulation."

The vacuum modulator pressure is directed to the right hand, smaller diameter of the pressure booster valve. This valve is in contact with the right end of the pressure regulator valve. Any force to the left on the pressure regulator valve, due to the modulator pressure, is added to the force of the pressure regulator valve spring.

When the desired pressure is reached, the force on the left of the pressure regulator valve acting to the right balances the spring and booster valve force on the right of the pressure regulator valve acting to the

left, and any excess oil capacity is exhausted or dumped back into the pump inlet circuit. The pressure thus established is normal, modulated mainline pressure.

A line pressure limiting valve is installed in the circuit from the pressure regulator valve to the vacuum modulator valve. This is a simple spring-loaded ball valve that bleeds to sump if mainline pressure exceeds 225 psi.

VACUUM MODULATION

Engine vacuum is utilized to control mainline pressure in accordance with engine power output in "N," "D" and "R" positions. Engine vacuum is applied to a vacuum modulator diaphragm. The diaphragm is spring-loaded, the spring force acting to push the diaphragm against the end of the vacuum modulator valve.

Oil from the pressure regulator valve is sent to the mainline port of the modulator valve. When engine vacuum is low it passes through a gasket slot and goes behind the modulator valve. The modulated pressure at which the valve balances in Drive Range is determined by the force due to the vacuum modulator diaphragm and spring, and the force due to modulated main line pressure acting on the right hand end of the valve. Any oil pressure in excess of that called for by the modulator action is exhausted to sump at the manual valve. Low engine vacuum tends to increase the modulator pressure. This results in mainline pressure varying in accordance with load.

In manual low range, the exhaust passage at the manual valve is closed and main line pressure is introduced into the exhaust passage. This produces maximum line pressure for holding the low band under the extreme driving conditions for which this range is normally used.

CONVERTER CIRCUIT AND LUBRICATION

At the time that the pressure regulator valve described above began moving from the rest or bottomed position in its bore, it uncovered a port in the valve body called the converter feed port. When this port is uncovered, oil from the mainline pressure cavity is permitted to flow into the converter circuit. The oil is directed through the hollow converter pump drive shaft, and is delivered to the converter between the turbine and the converter housing.

Oil leaves the converter and flows back to transmission between the turbine shaft and pinion shaft. This lubricates the shaft bushings. Some oil also flows

between the converter pump shaft and the turbine shaft.

With the exception of vacuum modulation, which is not present in manual low range the above pressure regulation and converter feed circuits are unaffected by the position of the manual valve, and function in a similar manner for each operating range of the transmission.

HYDRAULIC OPERATION— AUTOMATIC LOW (FIG. 7A-7)

GOVERNOR

The governor supplies a pressure, variable with car speed, to a shift valve. Oil from the rear pump is directed to a land on the governor valve. As car speed increases centrifugal force causes the governor weights to move the governor valve in, directing rear pump pressure to the end of the governor valve and to the low drive shift valve. The pressure on the end of the governor valve balances the force of the centrifugal weights. The faster the governor spins, the greater is the oil pressure required to hold the governor weights in equilibrium. Therefore, as car speed varies, the centrifugal force varies, regulating the pressure accordingly. As car speed increases, the hydraulic pressure from the governor to the shifter valve will increase.

LOW-DRIVE SHIFT CIRCUIT

The low-drive shift valve circuit includes a throttle valve, throttle valve spring regulator, detent valve, regulator valve, shifter valve and shifter valve springs.

OPERATION—THROTTLE VALVE

Oil at main line pressure flows to the throttle valve. Throttle valve spring force holds the throttle valve bottomed to the left. Oil flows into the cavity between the two lands and flows through a drilled passage in the valve to the left of the throttle valve. This exerts a force on the throttle valve opposing the spring force, and the throttle valve moves to the right, closing off the main line supply port. The hydraulic and spring forces balance out, creating a throttle valve pressure proportional to the linkage-controlled throttle valve spring.

OPERATION—SHIFTER VALVE

The shifter valve controls the flow of oil to or from the high clutch and release side of the low servo piston. The position of the shifter valve is controlled by governor pressure opposing shifter valve springs

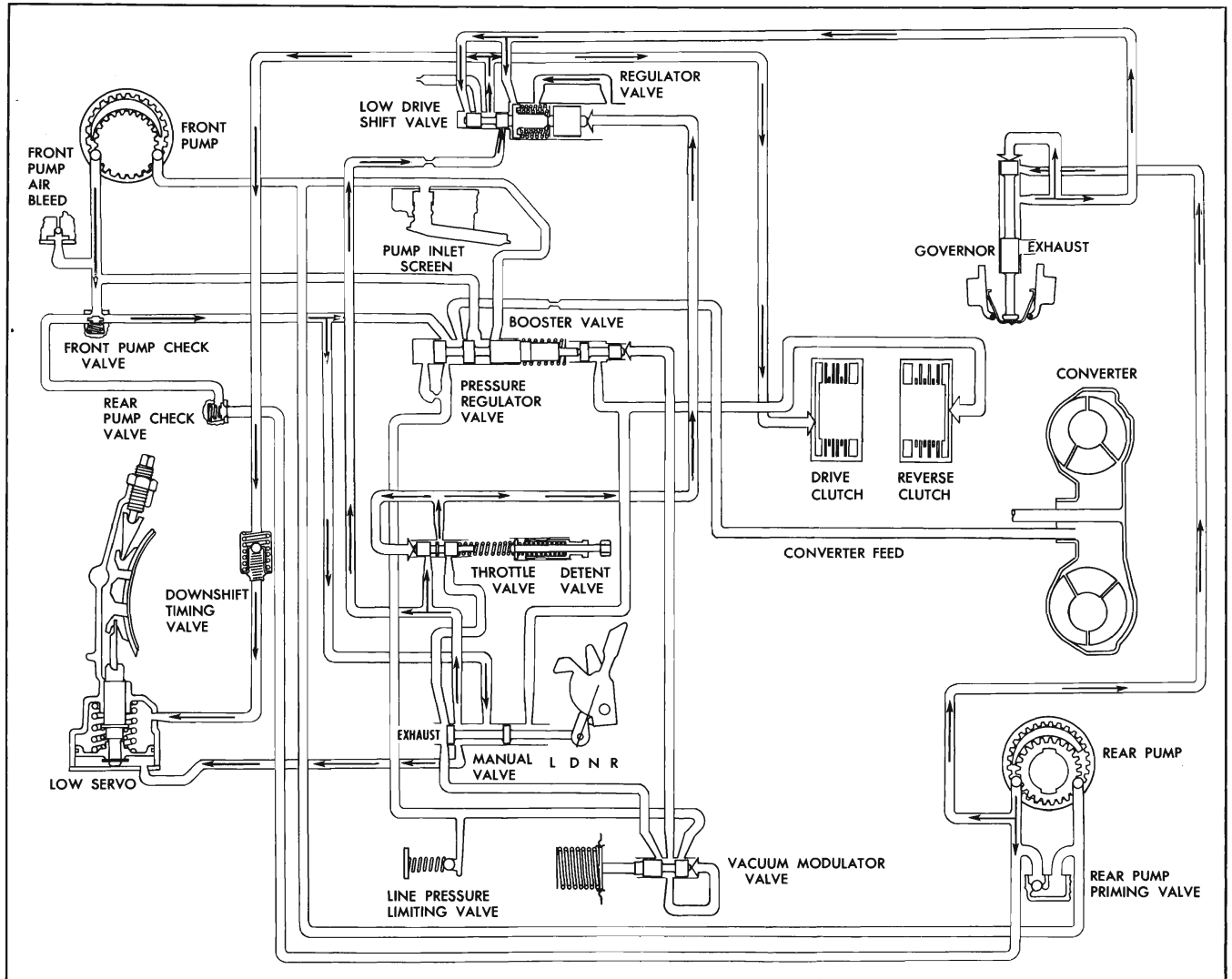


Fig. 7A-8 Oil Circuits—Automatic High

plus throttle valve pressure.

The shifter valve has three different diameter lands. The two smaller diameter surfaces open and close off passages according to the position of the shifter valve.

When the manual valve is shifted to "D" range main line pressure is supplied to the throttle valve and the shifter valve. The throttle valve pressure that is developed is applied to the outer end of the low-drive regulator valve. This pressure moves the low drive regulator valve against the shifter valve opening a passage that allows throttle valve pressure to be imposed on the large diameter area of the shifter valve. Throttle valve pressure on this surface plus the force of the shifter valve springs keeps the valve in low range. The second small land of this valve blocks off main line pressure to the clutch and to the release side of the low servo piston. Main line pressure from the manual valve to the apply side of

the low servo piston applies the low band and places the transmission in low range.

The shifter valve springs help keep the shifter valve in low range position during light throttle operation to obtain desired acceleration or car performance. They also move the shifter valve from the high to the low position on a closed throttle downshift, so the transmission is in low range to provide good acceleration performance at any speed below 12 mph.

HYDRAULIC OPERATION— AUTOMATIC HIGH (FIG. 7A-8)

As car speed increases, governor pressure, which is applied to the small land and the left side of the large spool of the shifter valve, increases. When the pressure is great enough, it moves the shifter valve, closing the exhaust passage and opening the clutch apply and low band release circuit to mainline pressure.

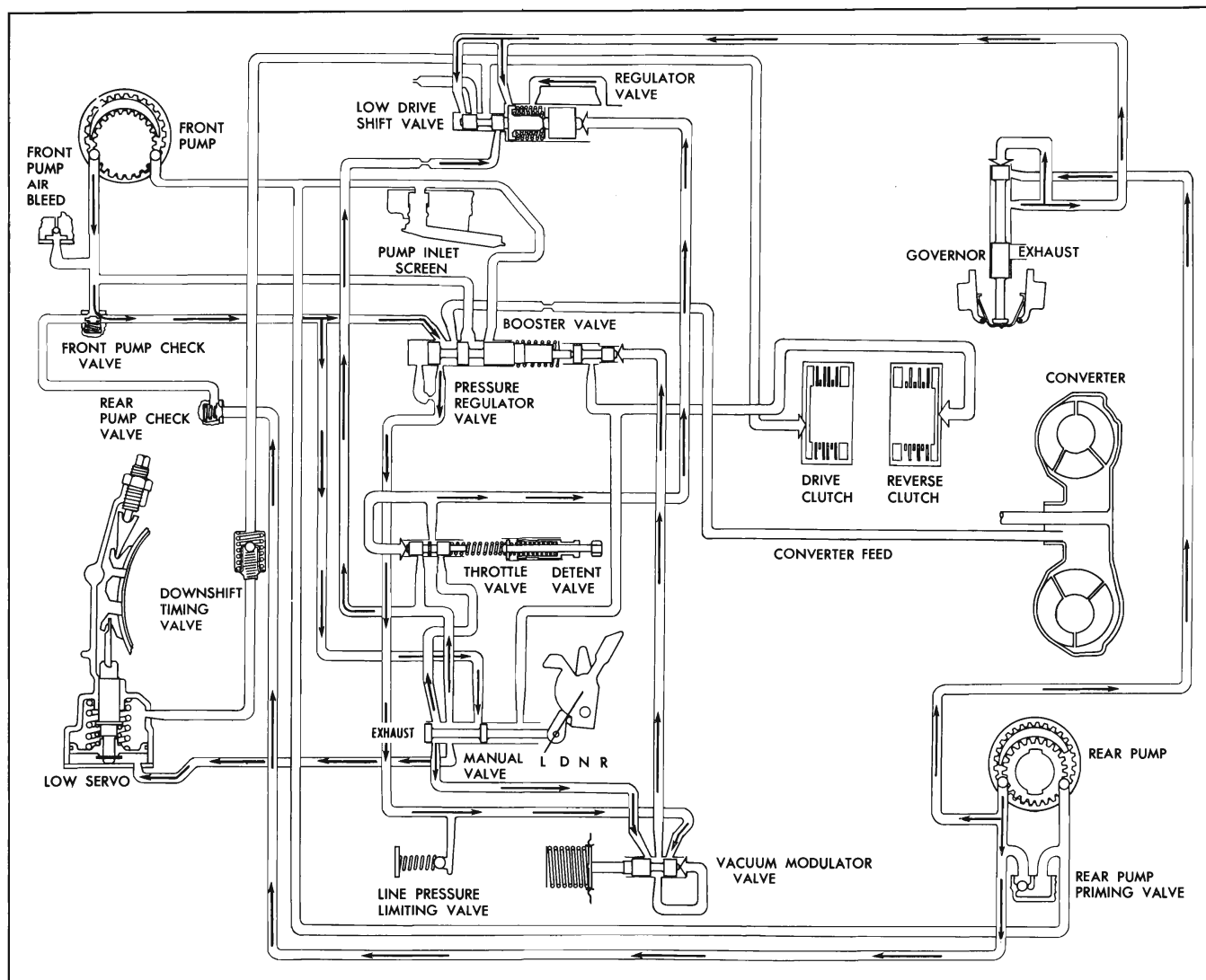


Fig. 7A-9 Oil Circuits—Manual Low

The clutch is applied, the low band is released and the transmission shifted into high range. The shifter valve also moves the low-drive regulator valve against its stop cutting off throttle pressure against the large diameter of the shifter valve.

This feature assures that the shifter valve will not "hunt," that is, move back and forth, when the transmission is at a shifting point.

When a reduction in speed causes governor pressure to drop off sufficiently, throttle and spring forces opposing the governor pressure move the shifter valve, closing off main line pressure to the high clutch and to the release side of the low servo piston and opens the high clutch line to an exhaust port. This disengages the high clutch and allows main line pressure from the manual valve to apply the low band placing

the transmission in low range. As soon as the valve moves, the clutch and the release side of the low servo line are opened to sump and the pressure between the two small lands is dissipated. This has the effect of a sudden increase of the net force tending to move the valve to its new (low) position. Part throttle downshifts are possible up to about 33 mph.

FORCED DOWNSHIFT

When the accelerator pedal is depressed almost to the floor, there is a definite resistance to further movement of the pedal, this resistance is furnished by a detent spring located behind the detent valve in the shifter valve body. Further movement of the accelerator pedal against the resistance of the detent spring moves the detent valve and allows maximum throttle valve pressure to be imposed directly on the large

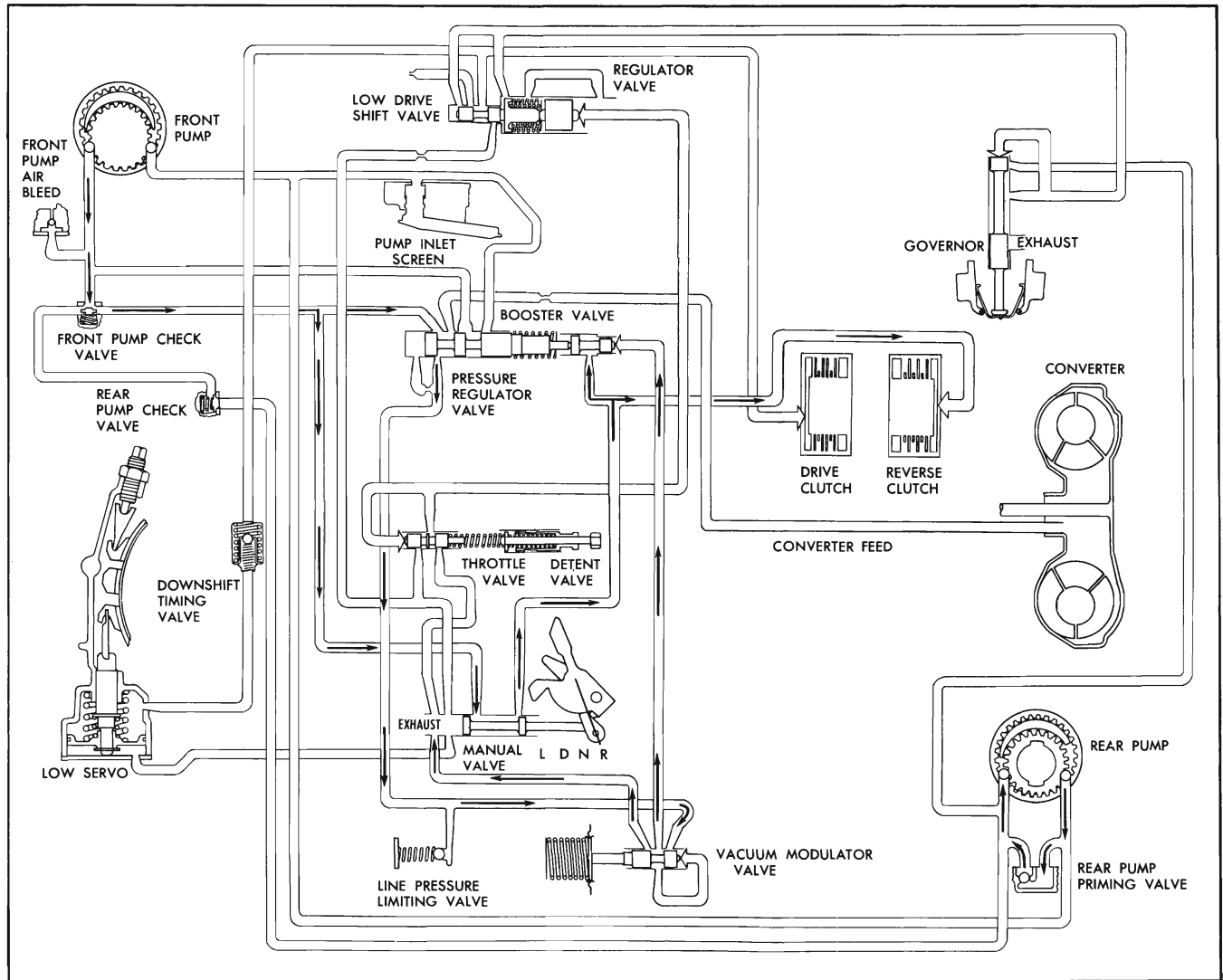


Fig. 7A-10 Oil Circuits—Reverse

diameter of the shifter valve. The force of this higher pressure on the large diameter enables the shifter valve to overcome governor pressure shifting the transmission to low range. Downshifts above 39-46 mph are prevented because the force due to governor pressure has increased to a point greater than the force created by maximum TV pressure and the spring.

To aid in producing a smooth low band application on a forced downshift a downshift timing valve is installed in the low servo release circuit. This spring loaded ball check valve has the effect of delaying the "bleed off" servo release oil and thereby avoids a severe band application.

The transmission will automatically upshift at 43-50 mph at wide open throttle.

HYDRAULIC OPERATION— MANUAL LOW (FIG. 7A-9)

In manual low, the manual valve is so positioned that two passages that are normally exhaust passages, are blocked from exhaust and charged with main line pressure.

One of these passages is the exhaust line for the throttle valve. By blocking the throttle valve exhaust with mainline pressure, the throttle valve pressure becomes mainline pressure. This full mainline pressure is then applied to the throttle valve pressure areas of the low-drive shifter valve.

This holds the shifter valve in the "L" drive position.

The other exhaust passage that is blocked off and

charged with mainline pressure is the vacuum modulator valve exhaust. This produces full mainline pressure in the modulator pressure circuit to the pressure booster valve. This prevents any modulation, and the transmission operates at maximum pressure. No up-shift can occur in manual low. If the transmission is shifted to manual low position at any car speed downshifting of the transmission will occur.

HYDRAULIC OPERATION—

REVERSE RANGE (FIG. 7A-10)

In Reverse Range, the manual valve is positioned to direct oil under main line pressure to the apply side of the reverse clutch and to the reverse apply sensitive area of the pressure booster valve. With the reverse pressure-sensitive area of the pressure booster valve supplied with full main line pressure, the pressure regulator valve will regulate at 106 to 222 psi to produce the required reverse clutch apply forces, depending upon engine manifold vacuum.

There is no reverse inhibitor, it is possible to shift to reverse at any car speed, however reverse should not be engaged while car is in motion.

MAINTENANCE AND ADJUSTMENTS

OIL RECOMMENDATIONS

It is important to use only Automatic Transmission Fluid (Type A). This is an all-season fluid, ideal for year-round operation. No special additives to these fluids are required or recommended.

Instructions for checking fluid level and for draining and refilling transmission follow:

OIL LEVEL

The transmission oil level should be checked every 4000 miles. Oil should be added only when the level is near the "ADD" mark on the indicator (Fig. 7A-11) with oil at normal operating temperature. The oil level indicator is located under a plate in the right front of the luggage compartment (Fig. 7A-12).

NOTE: The difference in oil level between Full and Add is one (1) pint.

In order to check oil level accurately, the engine should be idled with the transmission oil at normal temperature and the control lever in neutral (N) position.

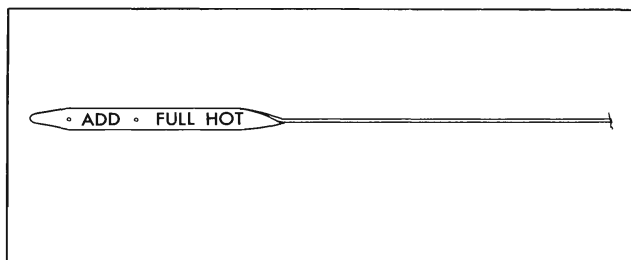


Fig. 7A-11 Oil Level Indicator

It is important that the oil level be maintained no higher than the "FULL" mark on the transmission oil level indicator. **DO NOT OVERFILL**, for when the oil level is at the full mark on the dip stick, it is just slightly below the planetary gear unit. If oil is added which brings the oil level above the full mark, the planetary unit will run in the oil, foaming and aerating the oil. This will cause malfunction of the transmission assembly due to improper application of the band or clutches and excessive temperature.

If the transmission is found consistently low on oil, a thorough inspection should be made to find and correct all external oil leaks.

All mating surfaces such as the front pump, oil pan rail, filler tube, governor, and the attachment to the differential carrier should be carefully examined for signs of leakage. The vacuum modulator must also be checked to insure that the diaphragm has not ruptured as this would allow transmission oil to be drawn into the intake manifold. Usually, the exhaust

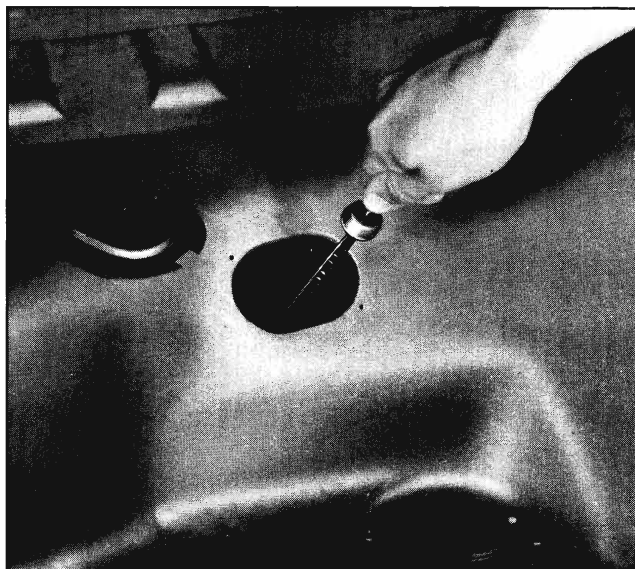


Fig. 7A-12 Location of Oil Level Indicator

will be excessively smoky, if the diaphragm ruptures due to the transmission oil drawn into the combustion chamber. Also check level in differential to be certain oil is not leaking from transmission to carrier assembly.

DRAINING AND REFILLING

No periodic draining of the transmission oil is recommended.

When the transmission requires repair, drain the oil by loosening the filler tube attaching nut in the oil pan and allow oil to drain; no drain plug is provided.

To refill the transmission, tighten the filler tube attaching nut and add four (4) pints transmission fluid using filler tube and funnel. Start engine and allow engine to idle in Neutral 3-5 minutes to warm oil, then check oil and add as required to raise to the level of the "FULL" mark. Assuming that the converter was not drained (since it is welded) and allowing for a nominal spillage or draindown, approximately six (6) pints of oil will be required for refill.

CAUTION: Do not over-fill!

The dry capacity of the transmission, including converter, is 12 pints. Normal refills require 6 pints.

NEUTRALIZER SWITCH ADJUSTMENT

The starter neutralizer switch is located on the rear of the gearshift control and indicator assembly.

Properly adjusted the switch should prevent engine cranking with the selector lever in any position other than "N" (Neutral). If engine cranks in any other position adjust the switch by loosening the two switch mounting screws and repositioning as required.

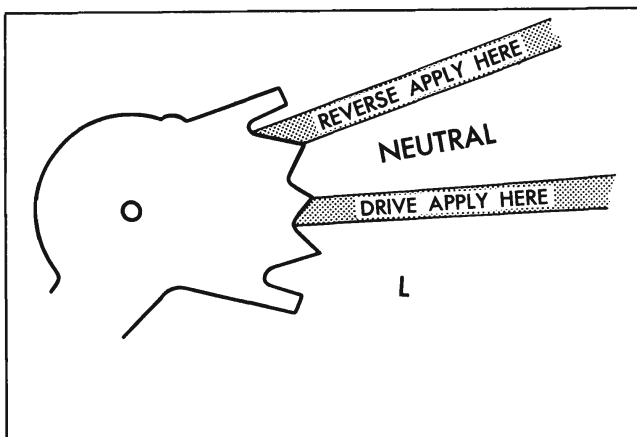


Fig. 7A-13 Shift Linkage Check Diagram

SHIFT LINKAGE CHECK AND ADJUST

CHECK

If improper shift linkage adjustment is suspected, a check can be made quickly without any disassembly as described below:

1. Start engine. If cold, allow 2-3 minutes for transmission fluid to warm-up.
2. With engine at normal idle speed slowly move the range selector lever up from "N" toward "R" and note by feel point at which reverse clutch applies. Properly adjusted, reverse clutch should apply within band from tooth peak to full Reverse detent (Fig. 7A-13).
3. Make same check as in step 2 above while moving selector lever from "N" toward "D". Properly adjusted, the low band should apply as selector lever indicator is felt to be between tooth peak separating Neutral from Drive and full Drive detent.
4. Unless shifts are obtained at points illustrated in Fig. 7A-13, the shift linkage should be adjusted with gauge J-8365.

ADJUSTMENT

Adjustment of the manual valve linkage should be checked after any transmission overhaul or control cable, or range selector control assembly replacement, as described below:

1. Drain oil from transmission by unscrewing filler tube nut, then remove oil pan.
2. Place range selector lever in driving compartment in "D" (Drive).
3. Insert J-8365 into manual valve bore as shown (Fig. 7A-14) with tab of gauge upward so it engages to forward port of the valve body.
4. With J-8365 in place, push forward on manual

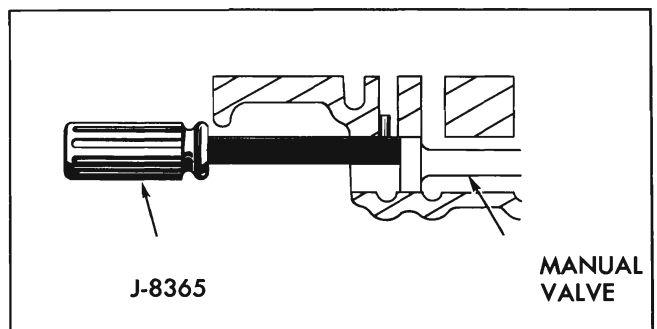


Fig. 7A-14 Gauging Manual Valve

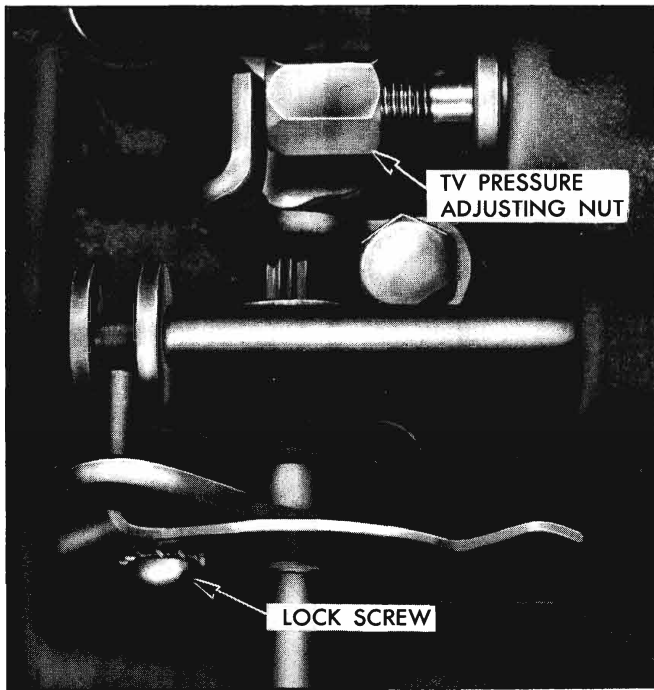


Fig. 7A-15 Manual Valve Lever Lock Screw

valve levers. Properly adjusted J-8365 will be held in place horizontally without being supported.

5. If readjustment is required, loosen lock screw (Fig. 7A-15), push the manual valve levers forward so that J-8365 is held in position. Retighten lock screw.

6. When satisfactory adjustment is obtained, install oil pan and filler tube, then refill transmission with oil.

**TRANSMISSION THROTTLE VALVE
CABLE ADJUSTMENT**

The following procedure is to be used for obtaining the correct relationship between the carburetor, accelerator pedal and transmission throttle valve shaft. The procedure must be rechecked anytime the transmission or engine position is disturbed in other service.

Incorrect adjustment will cause poorly timed shifts and other out of line operating conditions.

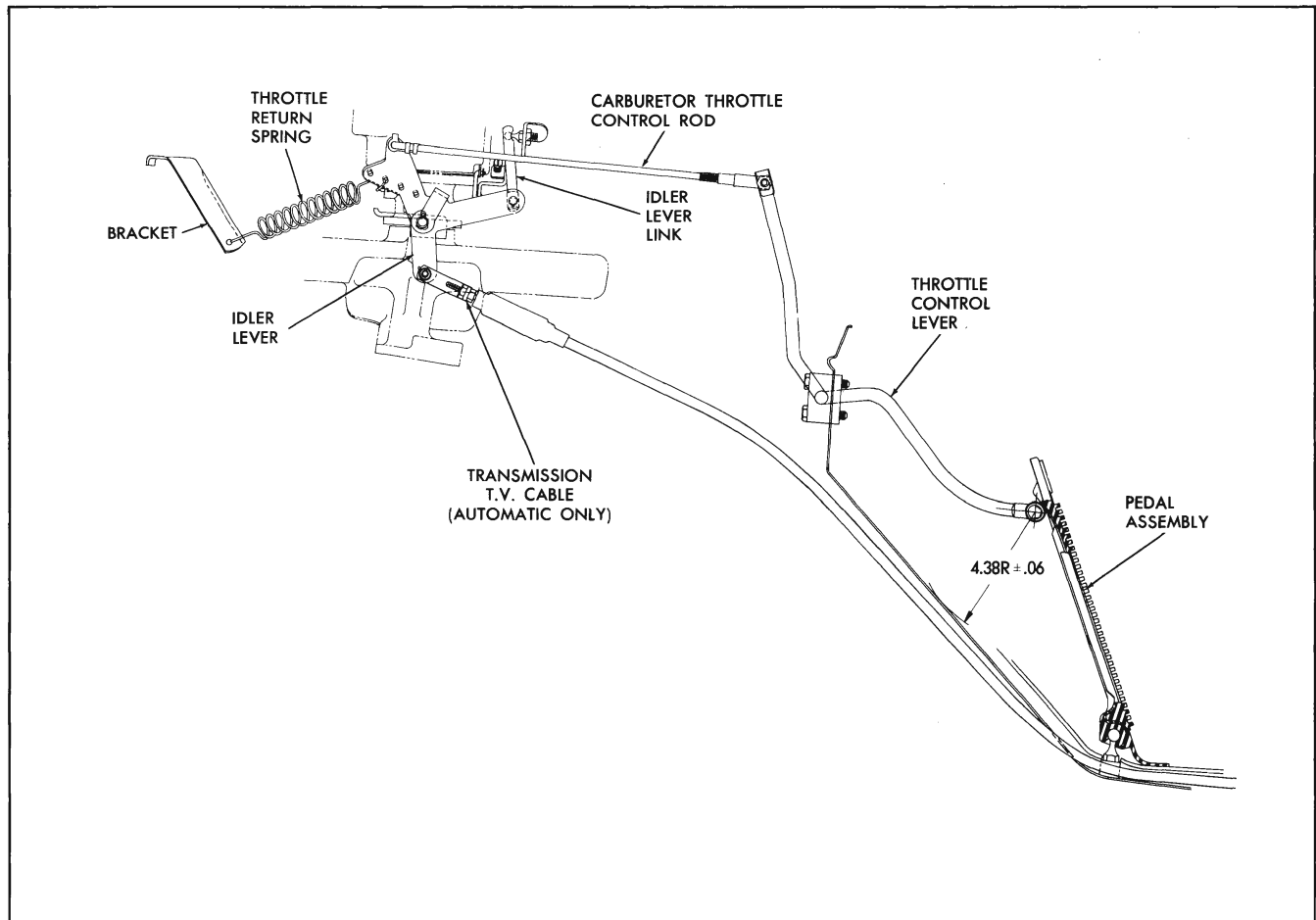


Fig. 7A-16 Throttle Linkage—Four Cylinder

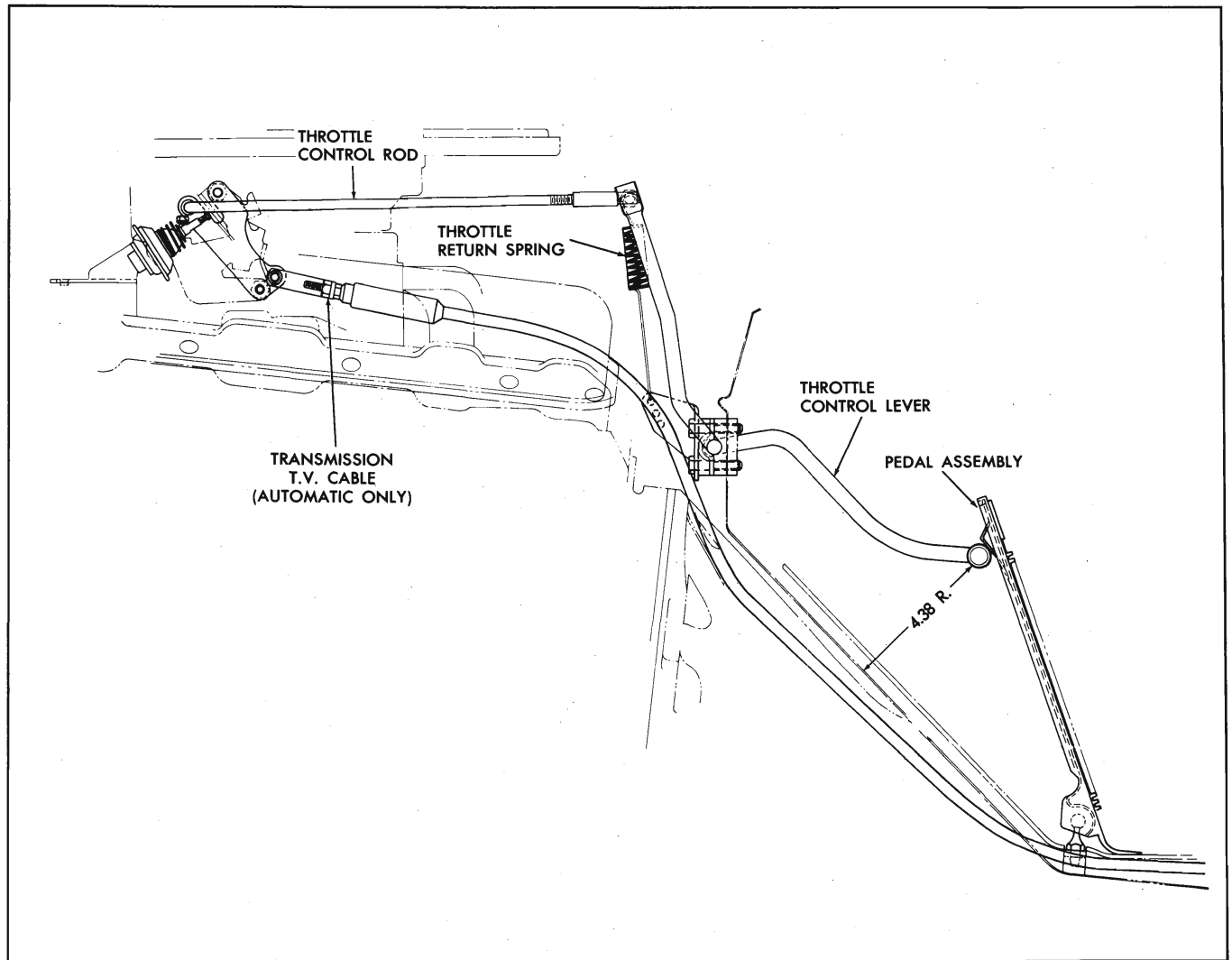


Fig. 7A-17 Throttle Linkage—Eight Cylinder

1. Check and adjust carburetor throttle rod as covered in section 6B.

2. Disconnect throttle valve cable at carburetor throttle lever (Figs. 7A-16 and 7A-17).

3. Block carburetor in wide open throttle position.

4. Pull throttle valve cable fully forward until T.V. lever is against stop in transmission.

CAUTION: Do not confuse transmission detent feel with lever stop contact.

5. Adjust position of front connector at trunnion so it may be slipped freely into carburetor adapter lever.

6. Tighten lock nuts.

7. Recheck adjustment after connecting cable, by holding carburetor at wide open and checking to be sure T.V. lever is against stop.

8. Road test car and note shift points. They should correspond with those listed in the specifications page 7A-40.

9. Should shift points not correspond, it may be necessary to lengthen cable to raise shift points or shorten to lower shift points in order to obtain correct pattern.

CAUTION: Do not adjust cable more than two turns of trunnion from standard position. If this does not obtain correct shift points, perform T.V. pressure check and adjustment procedure as outlined on page 7A-39.

LOW BAND ADJUSTMENT

No periodic adjustment of the low band is recommended, however, if necessary it may be performed as follows:

1. Lower transmission to allow access to adjusting screw.
2. To adjust, loosen lock nut and tighten adjusting screws to 40 ± 5 lb. in. torque, then back off four (4) full turns exactly. While holding adjusting screw stationary, tighten adjusting screw lock nut securely.

SERVICE OPERATIONS—TRANSMISSION IN CAR

The service operations on the Tempest automatic transmission which can be performed on the car are covered in this section. It is important that further transmission disassembly not be performed in the vehicle as any work which changes the transmission end play requires a new shim pack in front of the governor drive gear as covered on page 7A-00. Failure to observe this precaution could result in extensive transmission damage.

SHIFT CONTROL CABLE REPLACE

1. Disconnect T.V. cable from transmission throttle lever.
2. Remove bolt securing shift control cable housing to transmission case (Fig. 7A-18).
3. Remove cable from body clips and body grommet.
4. Disconnect cable at range selector assembly.
5. Complete disconnection of cable by rotating transmission TV lever its full limit counterclockwise to free cable ball from inner manual valve slot in transmission and withdraw cable.
6. Remove cable from car.
7. Install "O" ring seal on new cable.
8. Locate cable in approximate position in car as shown in Fig. 7A-19.
9. With TV lever rotated fully counterclockwise insert cable ball into slot of manual valve lever.
10. Seat "O" ring and secure installation by installing bolt and lockwasher.
11. Complete cable installation as shown in Fig. 7A-19 working from rear of car forward. Keep slack in cable at front of car.

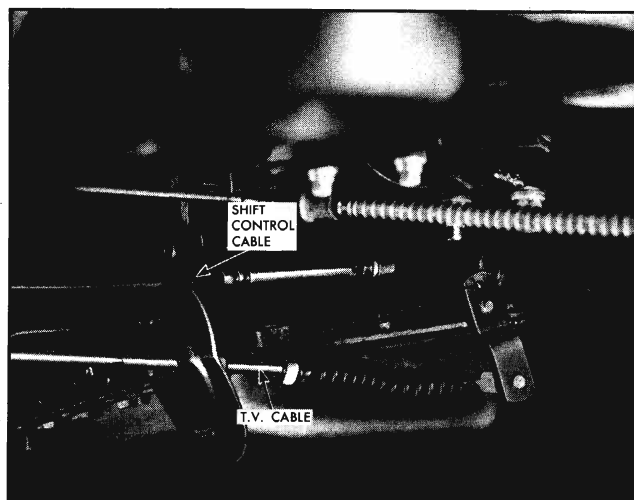


Fig. 7A-18 Shift Control Cable and Throttle Valve Cable

10. Connect TV cable to TV lever.
11. Check linkage and cable adjustment as outlined on page 7A-14.

EXTENSION HOUSING OIL SEAL REPLACE

1. Remove torque tube and propeller shaft as covered in Section 4.
2. Pry out old oil seal.
3. Tap new oil seal into position.
4. Install torque tube and propeller shaft.

EXTENSION HOUSING BEARINGS REPLACE

1. Remove torque tube and propeller shaft as covered in Section 4.
2. Remove oil seal.
3. Using Truarc pliers remove bearing retaining ring.
4. Insert tool J-8918 into extension housing so that it picks up inner race of rear bearing (Fig. 7A-20).
5. Using slide hammer J-2619-B tap out front bearing, spacer sleeve and rear bearing.
6. Using suitable socket, tap new rear bearing into position. Do not tap on inner race.
7. Install spacer sleeve.
8. Tap in new front bearing.
9. Install bearing retaining ring.
10. Install new oil seal.
11. Install torque tube and propeller shaft.

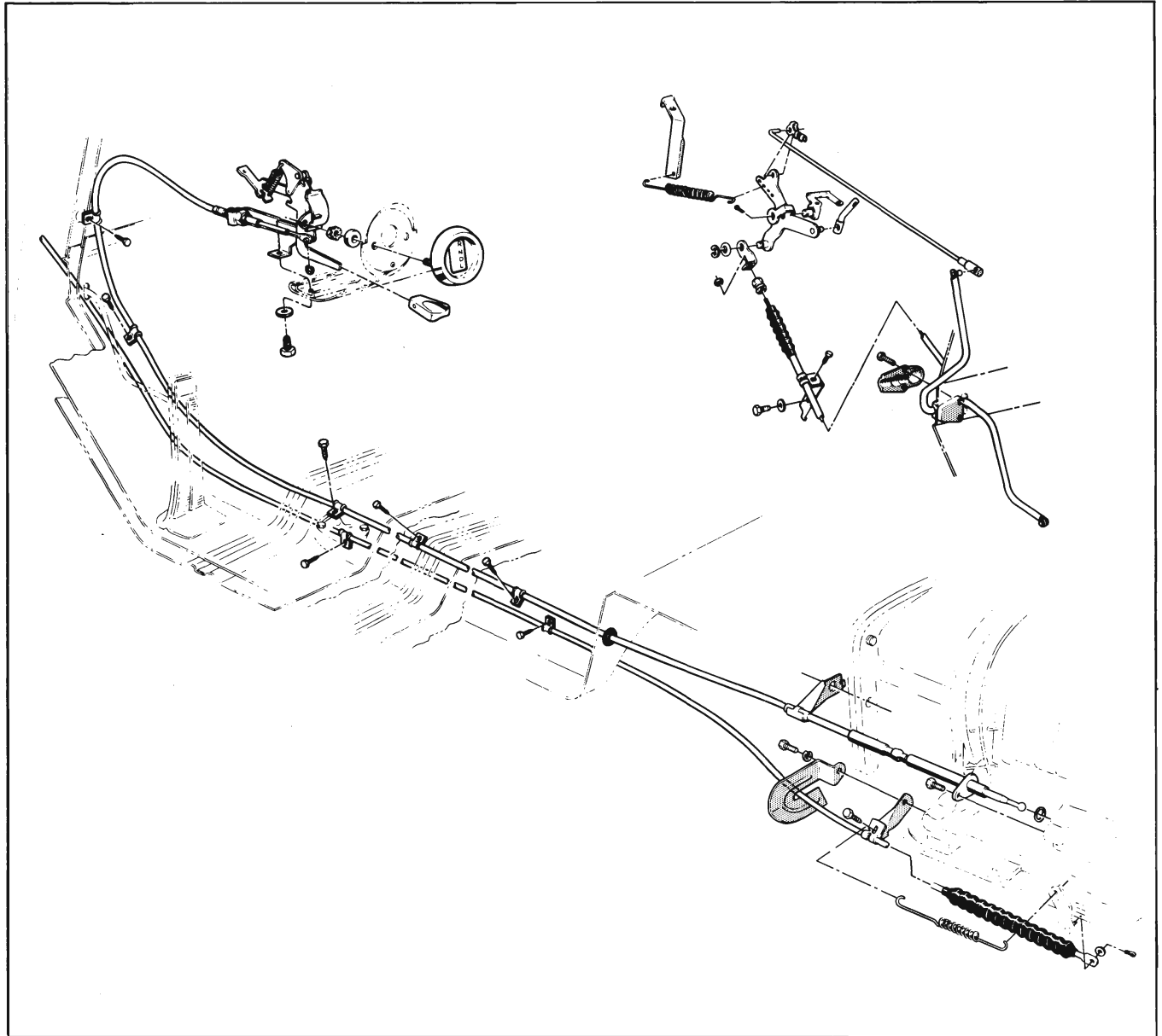


Fig. 7A-19 Shift Control Cable and Throttle Linkage Installation

VACUUM MODULATOR

The vacuum modulator is mounted on the right side of the transmission (Fig. 7A-21) and can be serviced from beneath the vehicle.

REMOVAL

1. Remove vacuum hose at vacuum modulator.
2. Unscrew vacuum modulator from transmission using channel lock pliers or a thin 1" wrench, if available.
3. Remove vacuum modulator valve from transmission case.

INSPECTION AND REPAIRS

Check the vacuum modulator valve for nicks and burrs. If such cannot be repaired with a slip stone, replace the valve.

The vacuum modulator can be checked with a vacuum source for leakage. However, leakage normally results in transmission oil pull-over, oil smoky exhaust and continually low transmission oil. No vacuum modulator repairs are possible; replace as an assembly.

INSTALLATION

1. Install vacuum modulator valve in bore in transmission.

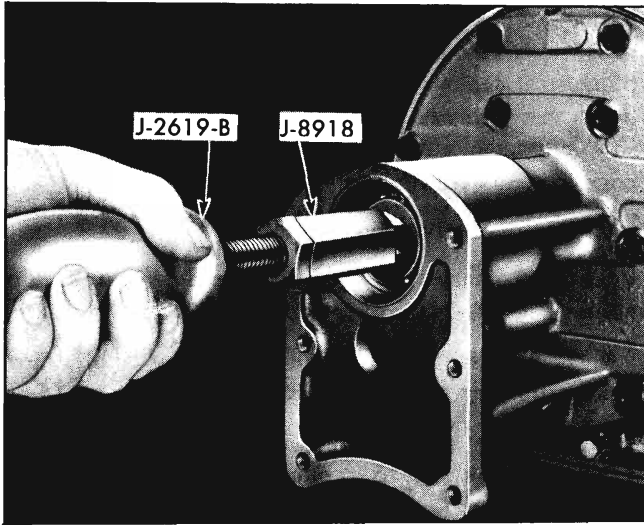


Fig. 7A-20 Removing Extension Housing Bearings

2. Place a new gasket on vacuum modulator and hold gasket centered with petroleum jelly. It is important that gasket be held centered during installation to prevent a transmission external oil leak.

3. Install vacuum modulator, tighten firmly, and install vacuum hose.

GOVERNOR

The governor is accessible from beneath the vehicle and is mounted on the left side (Fig. 7A-22).

REMOVAL

Remove speedometer driven gear.

Unscrew the lock screw securing the governor tab to the case, then pull the governor from the transmission.

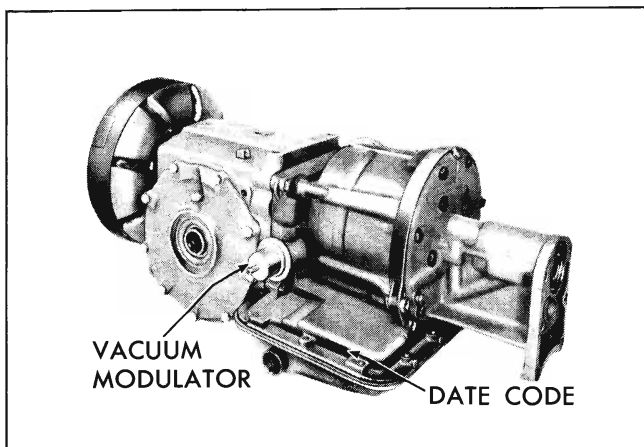


Fig. 7A-21 Location of Vacuum Modulator

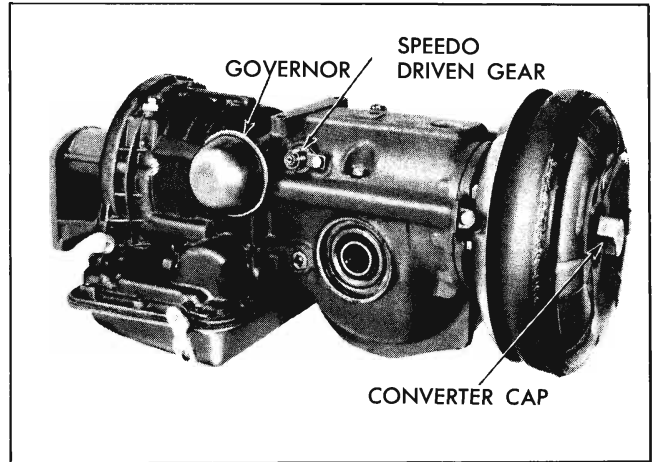


Fig. 7A-22 Transmission—Axle Assembly

REPAIRS

The only part replaceable on the governor is the driven gear. To remove, drive out roll pin with a punch and pull out old gear. Drill a new hole in the governor 90 degrees from the original. Insert new gear and reinstall roll pin.

INSTALLATION

Install new "O" ring seal on governor. Insert governor into transmission with a slight twist to engage gear teeth. Secure installation with lock bolt.

VALVE BODY AND LOW SERVO

REMOVAL

1. Loosen oil filler nut in order to drain transmission oil. Remove filler pipe from oil pan.

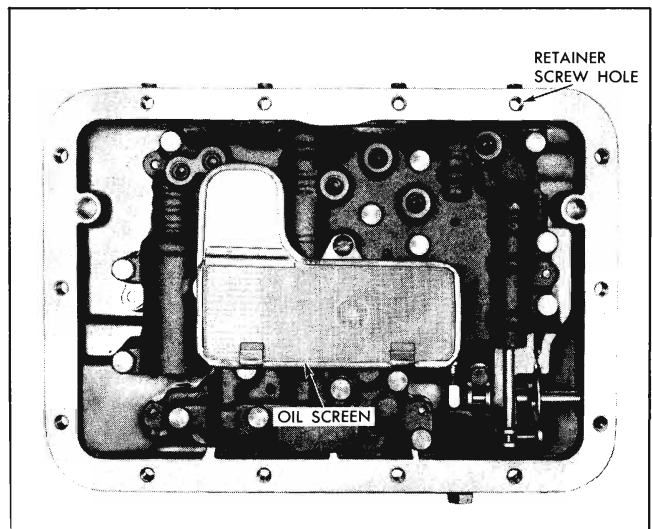


Fig. 7A-23 Transmission—Oil Pan Removed

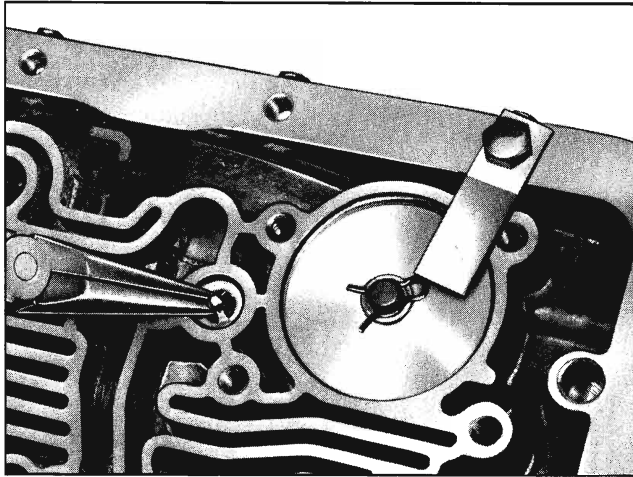


Fig. 7A-24 Servo Piston Retainer—Downshift Timing Valve

2. Disconnect throttle valve rods from TV lever on transmission.
3. Remove 14 screws and lock washers securing oil pan and remove oil pan and gasket.
4. Remove retainer screw, oil screen and "O" ring seal (Fig. 7A-23).
5. Loosely install retainer (Fig. 7A-24) in pan screw hole illustrated in Fig. 7A-23.

NOTE: Retainer can be made from piece of sheet metal or other suitable material.

6. Remove screws securing valve body to transmission, tap valve body lightly with a soft hammer to



Fig. 7A-25 Removing Front Pump Air Bleed Ball

loosen from its dowels in transmission case, then carefully lower valve body about $\frac{1}{16}$ ". Rotate retainer into place so it secures servo piston hub and tighten with pan screw. This eliminates possibility of servo piston slipping down out of its bore and loss of low band engagement with its apply components.

7. Remove valve body and gasket.
8. If necessary to replace remove downshift timing valve (Fig. 7A-24) and install new valve.
9. If necessary to remove low servo, tighten low band adjusting screw fully. Remove retainer and pull downward on piston shaft with screwdriver.
10. If necessary to replace, the front pump air bleed ball can be removed by removing retainer with needle nose pliers (Fig. 7A-25).

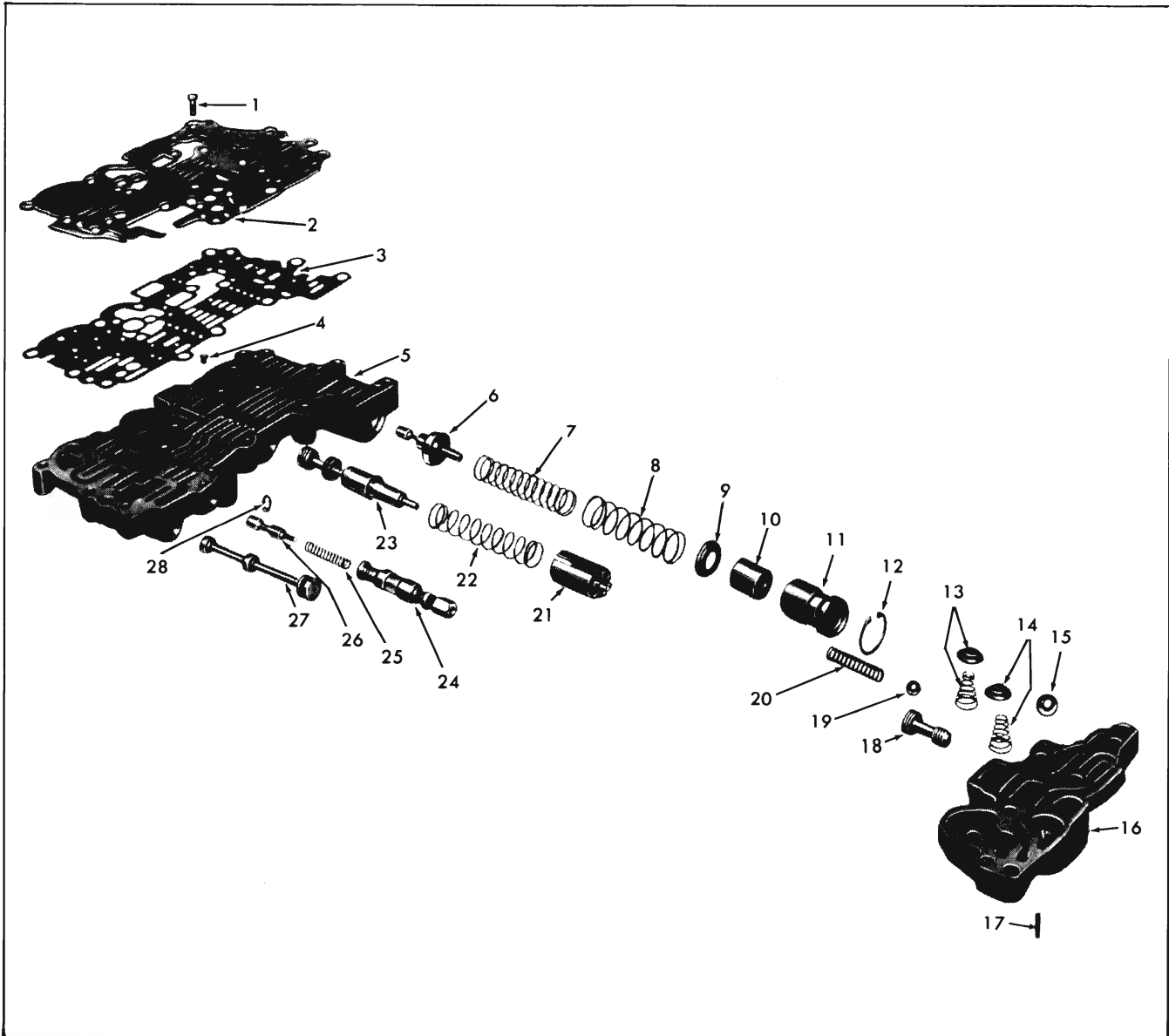
DISASSEMBLY—VALVE BODY (FIG. 7A-26)

1. Remove manual valve.
 2. Remove two clutch head screws attaching hydraulic modulator valve body and separate modulator body from main valve body.
- CAUTION: Modulator body should be held during removal of screws as it is under spring pressure from pressure regulator valve spring.**
3. Remove pressure regulator valve spring retainer, spring, and pressure regulator valve.
 4. From hydraulic modulator body, remove rear pump priming ball and front and rear pump check valves and springs. Remove hydraulic modulator valve.
 5. To remove line pressure limiting valve, drive roll pin from hydraulic modulator valve body with a pin punch and remove line pressure limiting valve spring and valve from their bore in modulator valve body.

6. Remove two remaining clutch head screws. Separate transfer plate and gasket from main valve body.

7. To remove low drive shift valve components, remove retainer ring with Truarc pliers while exerting a downward force, then release pressure and remove low drive sleeve, spring seat, and inner and outer springs. Lightly tap main valve body with a plastic hammer to remove low drive shift valve from its bore.

8. To remove TV valve components, remove retaining pin by wedging a thin screwdriver between its head and surface of main valve body. Remove detent valve assembly and throttle valve spring. Complete disassembly of valve body by removing "E" ring from



1. Valve Body-to-Transfer Plate
Attaching Screws (4)

2. Transfer Plate

3. Transfer Plate-to-Main Valve
Body Gasket

4. Throttle Valve Assembly
Retaining Pin

5. Main Valve Body

6. Low-Drive Shift Valve

7. Low-Drive Valve Inner Spring

8. Low-Drive Valve Outer Spring

9. Spring Seat

10. Low-Drive Regulator Valve

11. Low-Drive Sleeve

12. Retainer Ring

13. Front Pump Check Valve and
Spring

14. Rear Pump Check Valve and
Spring

15. Rear Pump Priming Ball

16. Hydraulic Modulator Valve
Body

17. Roll Pin (Line Pressure Limiting
Valve)

18. Hydraulic Modulator (Booster)
Valve

19. Line Pressure Limiting Valve

20. Line Pressure Limiting Valve
Spring

21. Pressure Regulator Valve
Spring Retainer

22. Pressure Regulator Valve
Spring

23. Pressure Regulator Valve

24. Detent Valve Assembly

25. Throttle Valve Spring

26. Throttle Valve

27. Manual Valve

28. Throttle Valve Locating Ring

Fig. 7A-26 Exploded View of Valve Body

throttle valve and removing throttle valve from main valve body by tapping valve body with plastic hammer.

INSPECTION—VALVE BODY

As most valve body failures are initially caused by dirt or other foreign material preventing a valve to function properly, a thorough cleaning of all parts in *clean* solvent is mandatory. Check all valves and their operating bores for burrs or other deformities which could result in valve "hang-up".

ASSEMBLY—VALVE BODY (FIG. 7A-26)

1. Drop line pressure limiting valve into bore of hydraulic modulator, then install spring. Compress spring slightly. Secure by installing roll pin.

2. Install hydraulic modulator valve in its bore in modulator valve body.

3. Place rear pump priming ball into hydraulic modulator valve body, then place front and rear pump check valves and springs into modulator body.

4. Carefully lower transfer plate onto assembled components in hydraulic modulator valve body so as not to knock front and rear pump check valves from their springs. Secure transfer plate to modulator valve body with two clutch head screws. Tighten screws to 38-50 pounds inch.

5. Install low drive shift valve components in main valve body. Place low drive shift valve into its main valve body bore, then assemble inner and outer low drive springs and place them in bore. Place spring seat over open end of sleeve, and insert this assembly into bore in main valve body, compressing inner and outer springs and secure by installing retainer ring with Truarc pliers.

6. Install throttle valve into its bore in main valve body, then install locating ring in groove in throttle valve. Be sure throttle valve is fully seated in its bore as locating ring must be installed in throttle valve via third port from left of valve body.

7. Place throttle valve spring and detent valve assembly in throttle valve bore. Depress detent valve assembly and secure to valve body by tapping retaining pin into main valve body.

8. Using a new transfer plate-to-main valve body gasket apply a light coat of petroleum jelly to main valve body and install gasket onto valve body. The purpose of petroleum jelly is to retain valve body and gasket alignment when transfer plate is installed.

9. Install pressure regulator valve in main valve body with spring and spring retainer. Fully compress pressure regulator valve spring so that spring retainer enters bore of main valve body. Position main valve body onto assembled transfer plate-hydraulic modulator body, align mounting screw holes in transfer plate and main valve body, and secure with two remaining clutch head screws. Tighten screws to 38-50 lb. in.

10. Install manual valve in main valve body.

INSPECTION AND REPAIRS— LOW SERVO PISTON

To disassemble the low servo piston, remove the hairpin retainer securing the piston to the piston rod and separate all components. The cushion spring tension on this piston is relatively slight; no press is required.

Remove piston ring from the piston and install it in the low servo bore and measure the ring gap. If within limits ring gap will be .002"-.012".

Assemble ring to piston. Measure clearance between ring and one wall of the piston groove. Clearance should be .0005"-.005".

To assemble low servo, place spring seat on piston shaft. Install cushion spring. Complete assembly by compressing cushion spring slightly with piston and secure piston to shaft with hairpin retainer.

VALVE BODY AND LOW SERVO— INSTALLATION

1. Install low servo piston and return spring in bore in transmission (Fig. 7A-27) and engage notch in piston shaft with low band apply strut, loosening low band screw slightly to permit piston ring to seat in case bore and allow installation of valve body.

2. Install retainer to hold servo piston in bore.

3. Position new gasket on valve body.

4. Position valve body in transmission indexing on dowels and remove retainer. Be sure manual valve indexes properly with pin on inner shaft lever.

5. Secure valve body with 20 screws. Torque screws to 9-11 lb. ft.

6. Install oil pick-up screen and "O" ring in valve body and secure with screw.

7. Position manual valve lever in full reverse position so it is held securely by wedging device in transfer plate. Engage shift control cable and secure.

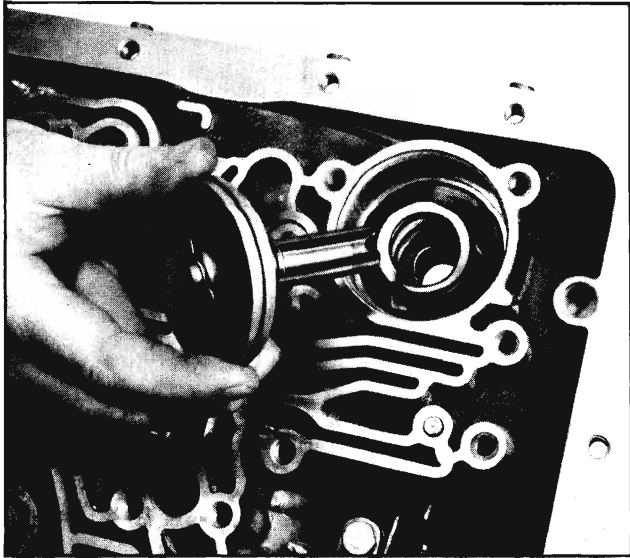


Fig. 7A-27 Low Servo Piston and Return Spring

8. Using a new pan gasket install transmission oil pan and torque pan attaching bolts to 3-4 lb. ft. It is important that an even torque be applied to the pan bolts to prevent leakage between oil pan and transmission case pan rail.

9. Tighten filler tube attaching nut, then refill transmission with oil as described on page 7A-14.

10. Readjust low bands as covered on page 7A-17.

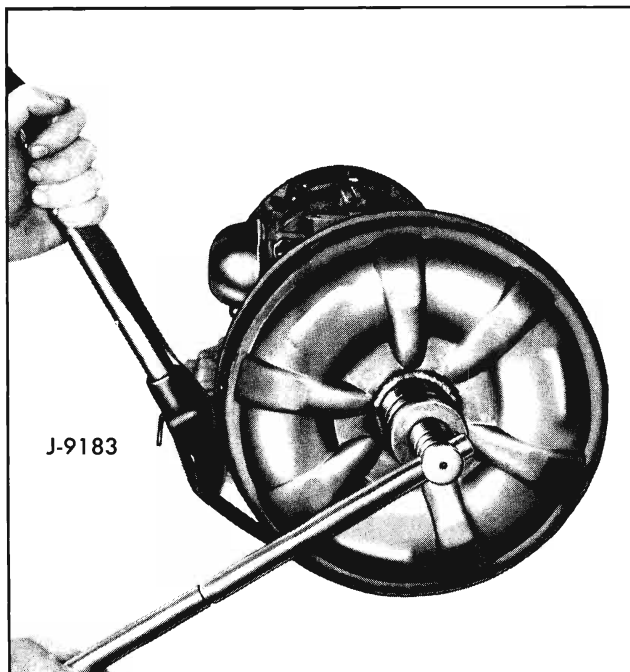


Fig. 7A-28 Removing Converter Cap

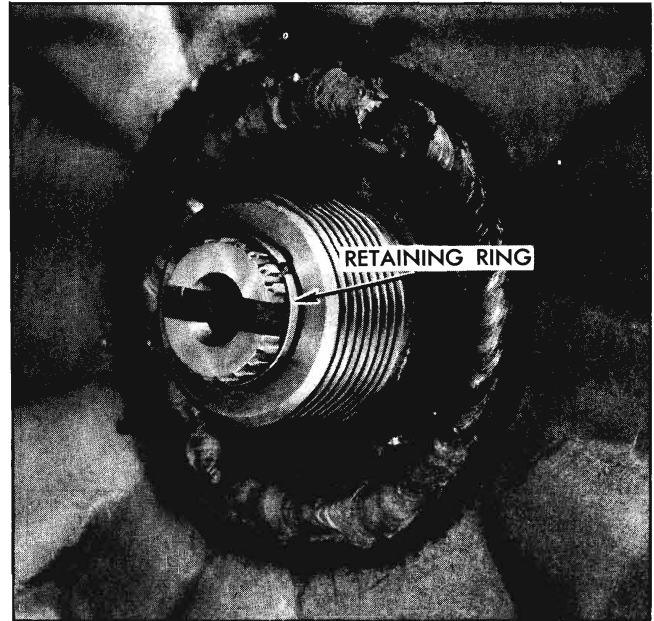


Fig. 7A-29 Converter Retaining Ring

TRANSMISSION REMOVAL

Removal of transmission is covered in Section 4.

TRANSMISSION DISASSEMBLY

1. Remove converter cover cap assembly using J-9183 wrench to hold converter (Fig. 7A-28) Remove retaining ring (Fig. 7A-29) and converter assembly.

NOTE: Reinstall cap on converter after removal and place cap side down to retain oil.

2. Remove speedometer driven gear.

3. Remove governor assembly and "O" ring (Fig. 7A-30).

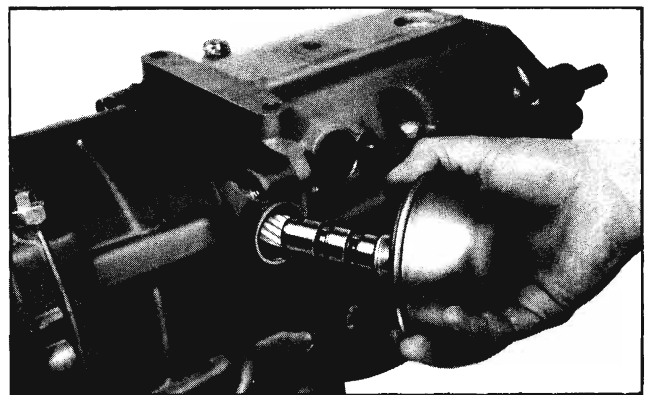


Fig. 7A-30 Removing Governor

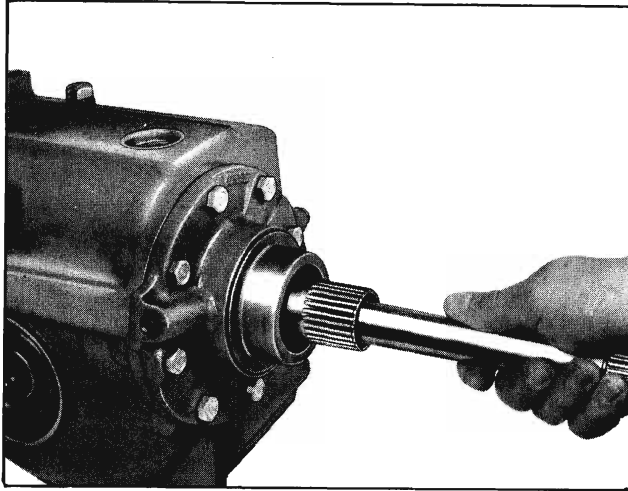


Fig. 7A-31 Removing Turbine Shaft

4. Remove turbine drive shaft (Fig. 7A-31).
5. Remove remaining screws retaining transmission to differential carrier assembly.
6. Separate transmission and differential carrier.
7. Remove vacuum modulator and modulator valve.
8. Mount transmission in holding fixture J-7896-01 (Fig. 7A-32).
9. Loosen low band adjusting screw jam nut and fully tighten low band adjusting screw (Fig. 7A-32).
10. Remove twelve housing attaching screws.
11. Using a soft hammer tap off extension housing.

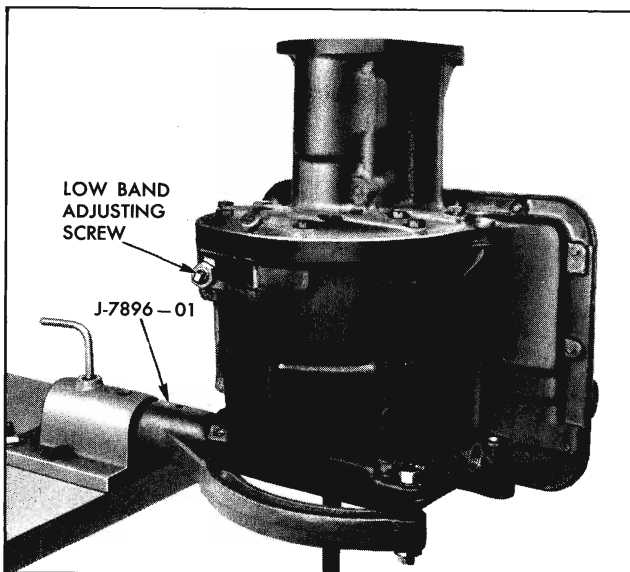


Fig. 7A-32 Transmission Mounted in Holding Fixture

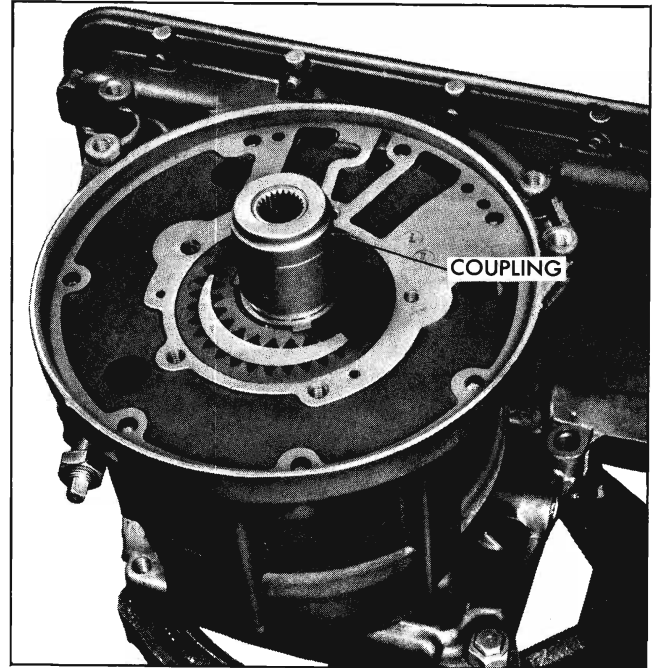


Fig. 7A-33 Coupling Assembly

12. Remove thrust washer and coupling (Fig. 7A-33).
13. Remove converter pump drive shaft (Fig. 7A-34). It is not necessary to remove drive key unless it is to be replaced.
14. Remove thrust washer from pump body (Fig. 7A-34).

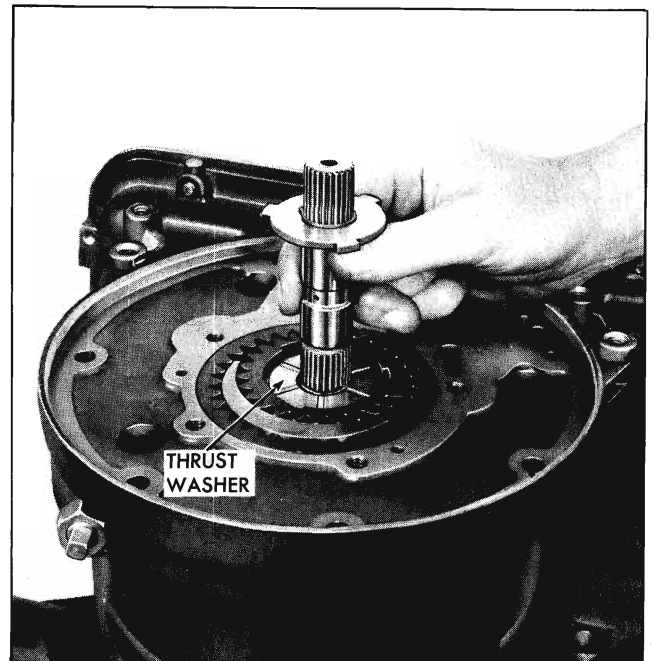


Fig. 7A-34 Removing Converter Pump Shaft



Fig. 7A-35 Removing Pump Body

15. Remove pump gears. Stack so they may be re-assembled with same face up. NOTE: The front pump bushing between internal gear and body (Fig. 7A-35) is not replaceable.

16. Remove pump body and gasket (Fig. 7A-35).



Fig. 7A-36 Removing Clutch Drum Thrust Washer

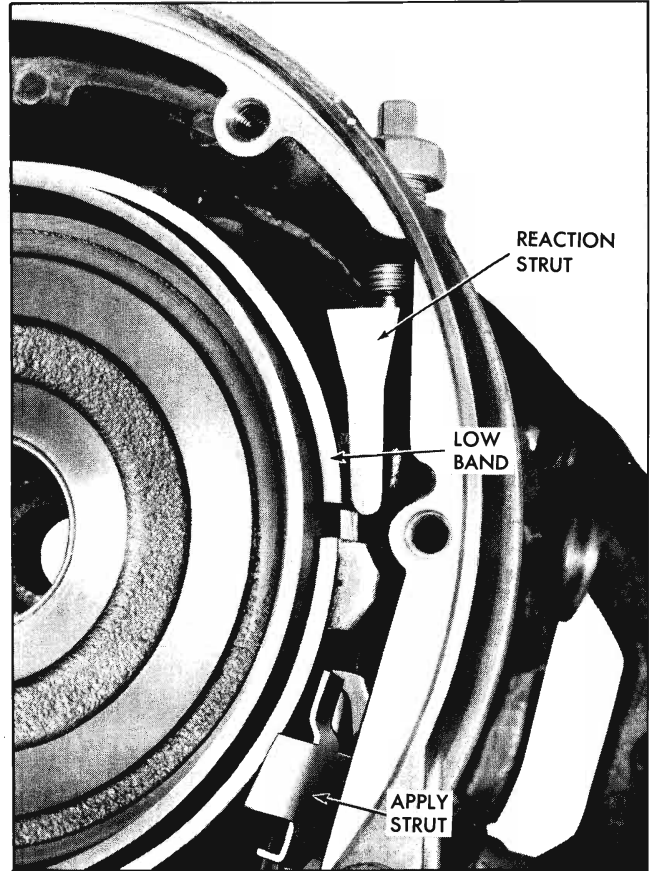


Fig. 7A-37 Location of Apply and Reaction Struts

17. Remove pump body to clutch drum thrust washer (Fig. 7A-36).

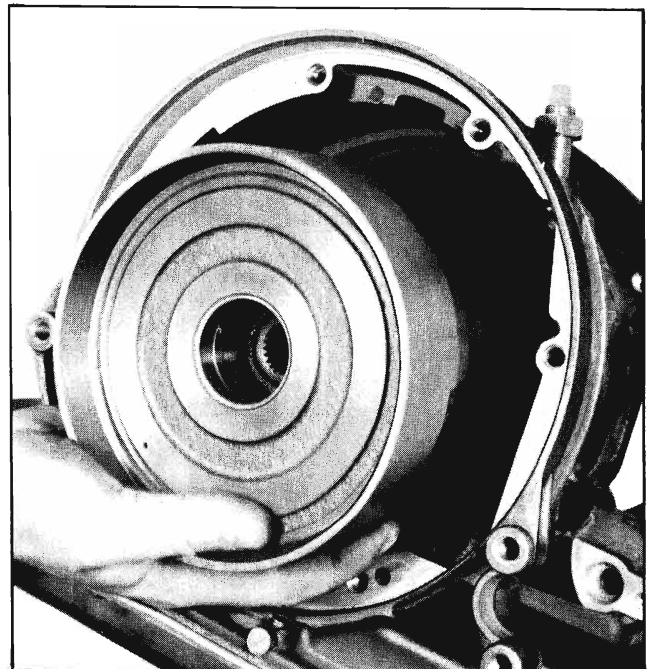


Fig. 7A-38 Removing Clutch Drum Assembly

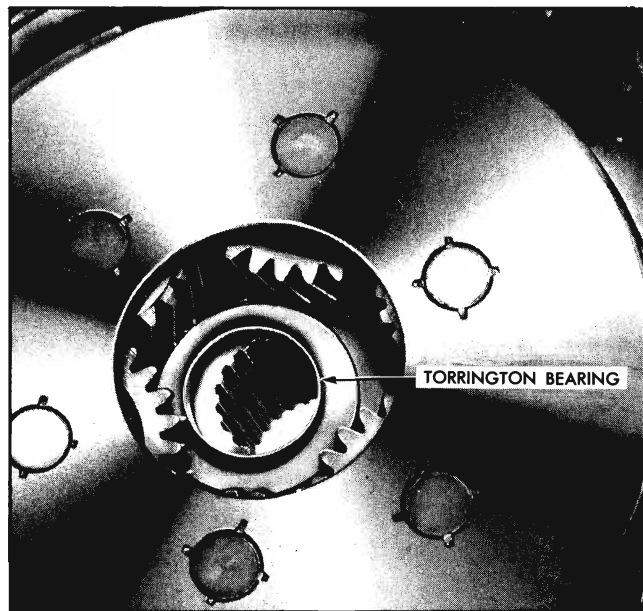


Fig. 7A-39 Torrington Bearing

18. Loosen low band adjusting screw and remove low band, apply strut and reaction strut (Fig. 7A-37).

19. Remove clutch drum assembly (Fig. 7A-38).

20. A torrington bearing (Fig. 7A-39) is used in the planet carrier. This bearing is non-replaceable.

21. Remove planet carrier assembly from ring gear (Fig. 7A-40).

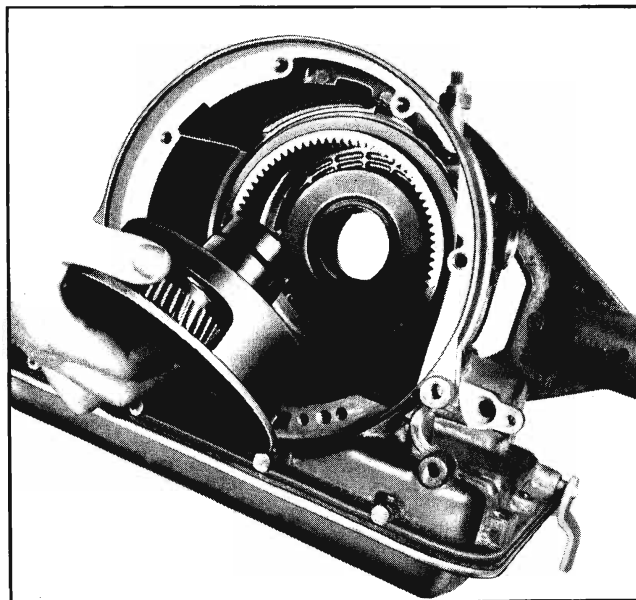


Fig. 7A-40 Removing Planet Carrier Assembly

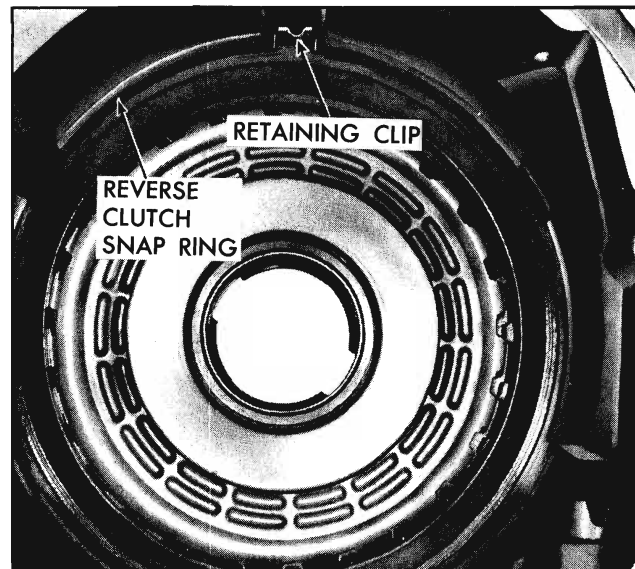


Fig. 7A-41 Reverse Snap Ring Retaining Clip Installed

22. Remove ring gear from engagement with reverse clutch plates.

23. Remove clip mounted on thick reverse reaction plate between the ends of reverse clutch snap ring and remove snap ring (Fig. 7A-41).

24. Remove thick reverse reaction plate, three drive plates (faced) and three reaction plates (steel).

25. Rotate transmission to a horizontal position and remove rear pump and reverse piston mounting bolts at rear of case (Fig. 7A-42).

26. Remove rear pump and reverse piston assembly.

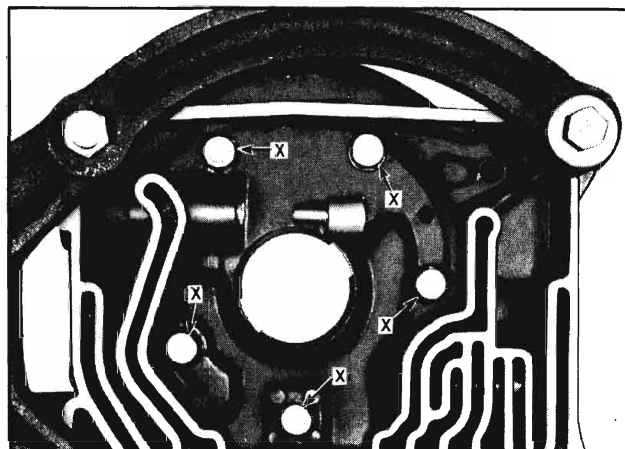


Fig. 7A-42 Rear Pump Mounting Bolts

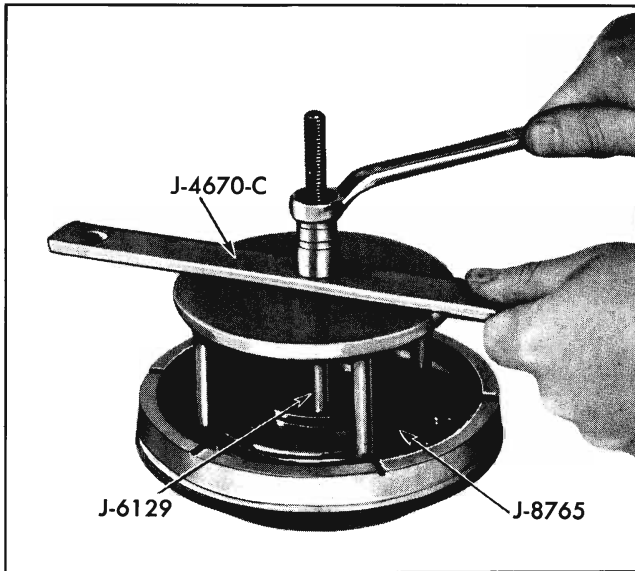


Fig. 7A-43 Compressing Reverse Piston Springs

27. Remove rear pump wear plate.

This completes disassembly of the transmission.

INSPECTION AND OVERHAUL OF INDIVIDUAL TRANSMISSION COMPONENTS

REAR PUMP AND REVERSE PISTON ASSEMBLY DISASSEMBLY

1. Remove drive gear and driven gear from rear pump body. Stack so they may be reassembled with same face up.

2. Compress spring retainer with J-6129, J-4670-C and J-8765 as illustrated in Fig. 7A-43.

3. With spring retainer compressed until springs bottom, remove snap ring. Carefully release pressure. Remove spring retainer and return springs.

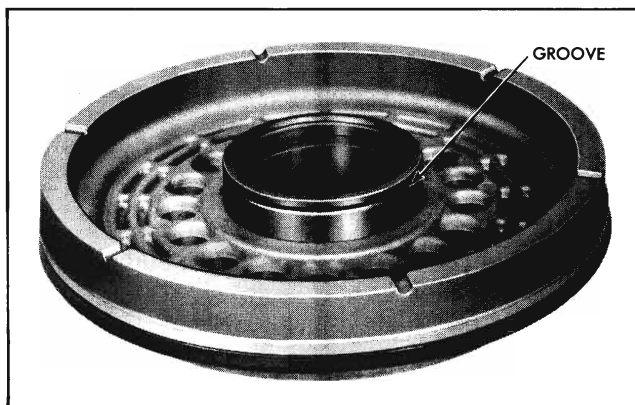
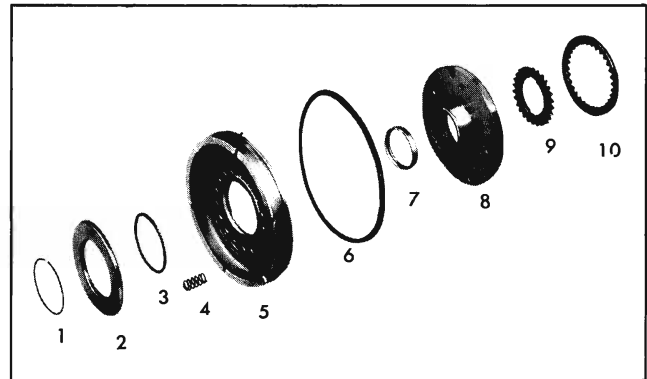


Fig. 7A-44 Reverse Piston Ring Groove



- | | |
|--|---|
| 1. Spring Retainer Snap Ring | 6. Reverse Piston Outer Seal (Lip Type) |
| 2. Spring Retainer | 7. Rear Pump Body Bushing |
| 3. Reverse Piston Inner Seal | 8. Rear Pump Body |
| 4. Reverse Piston Return Springs (17 Used) | 9. Rear Pump Drive Gear |
| 5. Reverse Piston | 10. Rear Pump Driven Gear |

Fig. 7A-45 Exploded View of Rear Pump and Reverse Piston

4. In order to remove reverse piston, it is necessary to fill groove for snap ring in the hub of rear pump body (Fig. 7A-44) with string, a small rubber band or a similar size "O" ring. Once groove is filled, rear pump body can be pushed out of reverse piston bore.

5. Remove square cut piston inner seal and piston outer seal. Seals should be discarded and new seals installed at reassembly.

INSPECTION (FIG. 7A-45)

1. Wash all parts in clean solvent and dry with compressed air.

2. Check fit of rear pump drive and driven gear. With parts clean and dry, check following clearances:

a. Clearance between 'OD of driven gear and body should be .0025"-.005" (Fig. 7A-46).

b. Clearance between driven gear and crescent should be .003"-.009" (Fig. 7A-47).

c. Gear end clearance, checked with straight edge and feeler gauge, should be .0005 to .0015" (Fig. 7A-48).

3. Inspect pump body for leaks and scoring. Check hub of pump body for smoothness. Any burrs on this surface would cause leakage and could result in a jammed reverse piston.

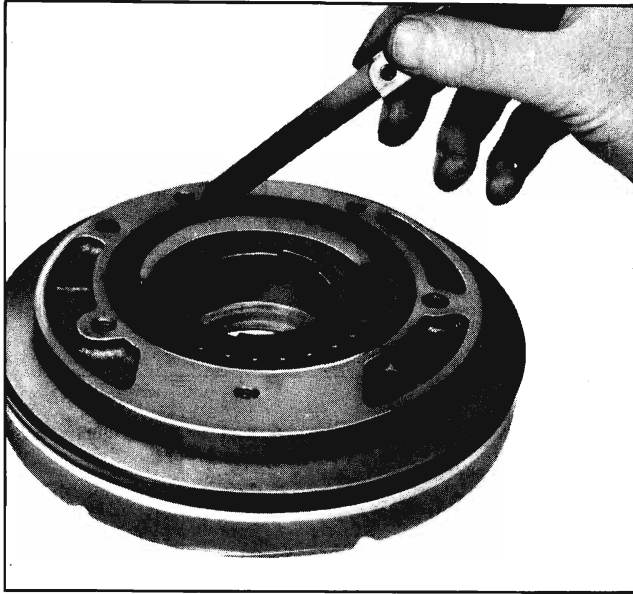


Fig. 7A-46 Checking Gear to Body Clearance

4. Check for broken piston return springs and make a comparative check of spring heights by standing all of the springs in a row. If appreciable variance in spring height is noticed, replace springs.

5. Check condition of rear pump body bushing. If scored or worn, replace.

REAR PUMP BODY BUSHING REPLACEMENT

1. Remove old bushing with chisel J-8400-1 using care not to damage pump body bore.

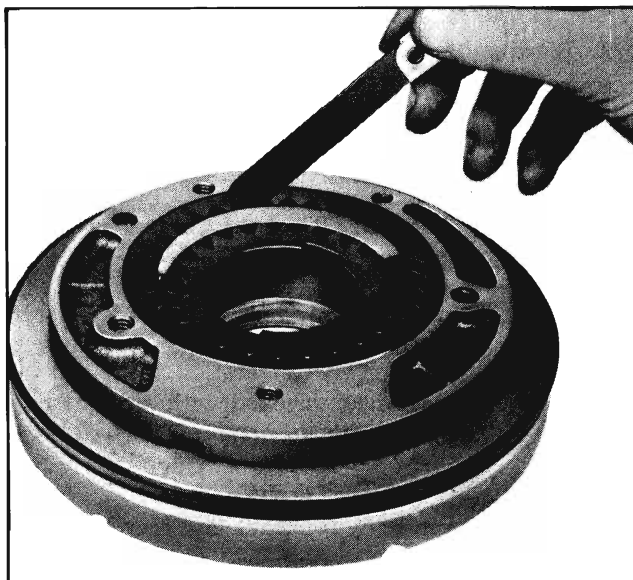


Fig. 7A-47 Checking Gear to Crescent Clearance

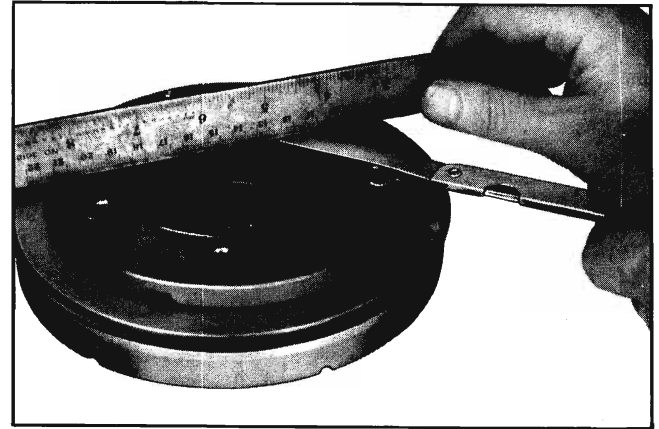


Fig. 7A-48 Checking Gear End Clearance

2. Install new bushing as illustrated in Fig. 7A-49, using tool J-8360-4.

ASSEMBLY

1. Install piston inner seal in reverse piston.

2. Install piston outer seal in piston with lip of seal toward pump body (opposite from spring seats in piston).

3. Install reverse piston on rear pump body. It is not necessary to fill snap ring groove on pump body hub for installation of piston. Pitch of groove for snap ring is favorable for installation.

4. Position 17 return springs in their seats on reverse piston, then place spring retainer on springs.

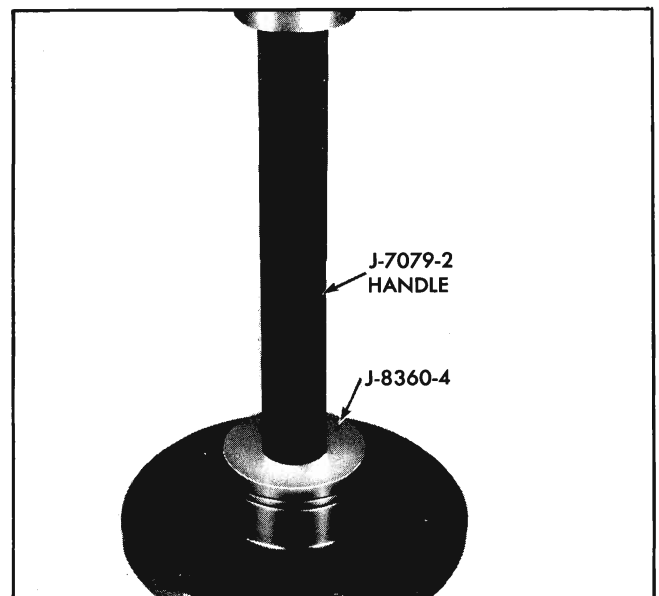


Fig. 7A-49 Installing Rear Pump Body Bushing

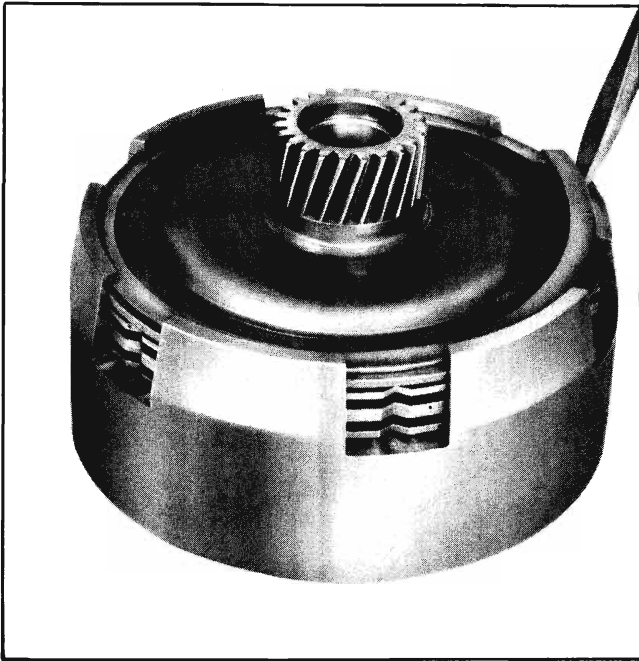


Fig. 7A-50 Removing Clutch Drum Retainer Ring

5. Compress springs using as illustrated in Fig. 7A-43.

6. With springs fully compressed install snap ring in its groove in rear pump body.

7. Complete assembly by installing drive gear and driven gear in their respective bores in pump body. It is advisable to apply a small amount of petroleum jelly to gears to prevent their being dropped from pump body.

CLUTCH DRUM

DISASSEMBLY

1. Remove retainer ring (securing low sun gear and clutch flange assembly to clutch drum) (Fig. 7A-50).

2. Remove low sun gear clutch flange and hub to flange thrust washer.

3. Lift out clutch hub (Fig. 7A-51), then remove nested drive and reaction plates and hub thrust washer.

4. To remove spring retainer, compress the springs using J-8765 adapter ring, J-4670C and J-6129 as shown (Fig. 7A-52). Remove snap ring.

5. Carefully release pressure, then remove spring retainer and return springs.

6. To remove clutch piston, pull upward with a twisting motion on center. Remove piston seal.

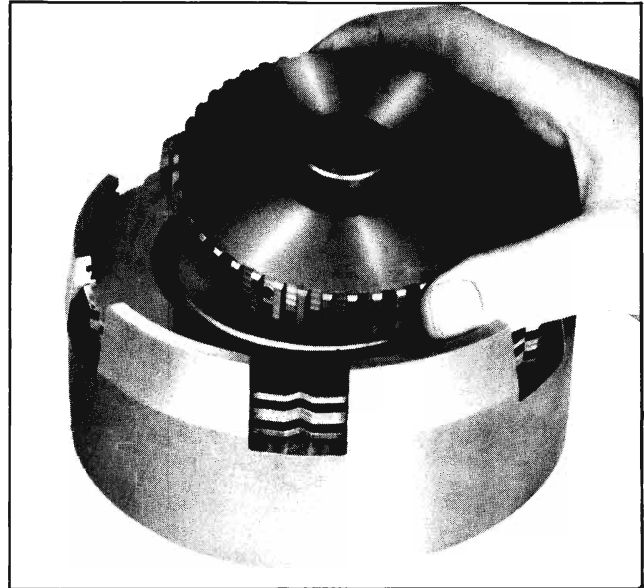


Fig. 7A-51 Removing Clutch Hub

7. To complete disassembly, remove piston inner seal from hub of clutch drum.

INSPECTION (FIG. 7A-53)

1. Wash all parts in cleaning solvent (air dry).

CAUTION: Do not use rags to dry parts.

2. Inspect drum brake band surface for excessive scoring or burning. Also, check drum bushing for scoring or excessive wear.

3. Check steel ball in clutch drum that acts as a relief valve (Fig. 7A-54). Be sure that it is free to move in hole and that the orifice leading to front of

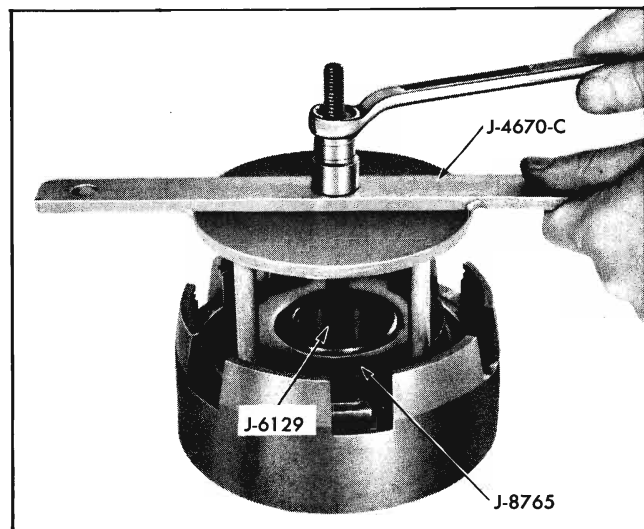
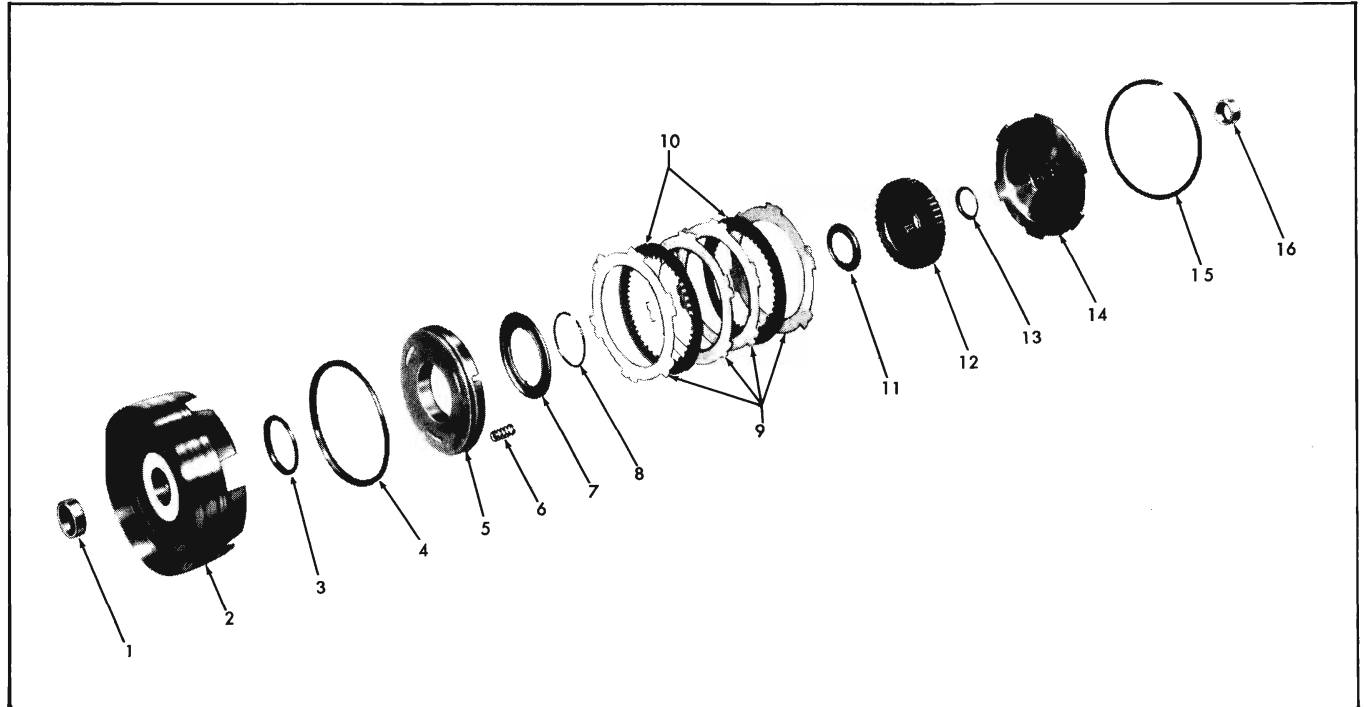


Fig. 7A-52 Compressing Clutch Springs



- | | | |
|--|-------------------------------------|---|
| 1. Clutch Drum Bushing | 7. Return Spring Retainer | 12. Clutch Hub |
| 2. Clutch Drum | 8. Return Spring Retainer Snap Ring | 13. Clutch Hub-to-Clutch Flange Thrust Washer |
| 3. Clutch Drum Hub Seal (Lip Type) | 9. Reaction Plates (4 Used) | 14. Clutch Flange and Low Sun Gear Assembly |
| 4. Clutch Piston Seal (Lip Type) | 10. Face Plates (2 Used) | 15. Clutch Flange Retaining Ring |
| 5. Clutch Piston | 11. Clutch Hub Thrust Washer | 16. Low Sun Gear Bushing |
| 6. Clutch Piston Return Spring (15 Used) | | |

Fig. 7A-53 Exploded View of Clutch Drum

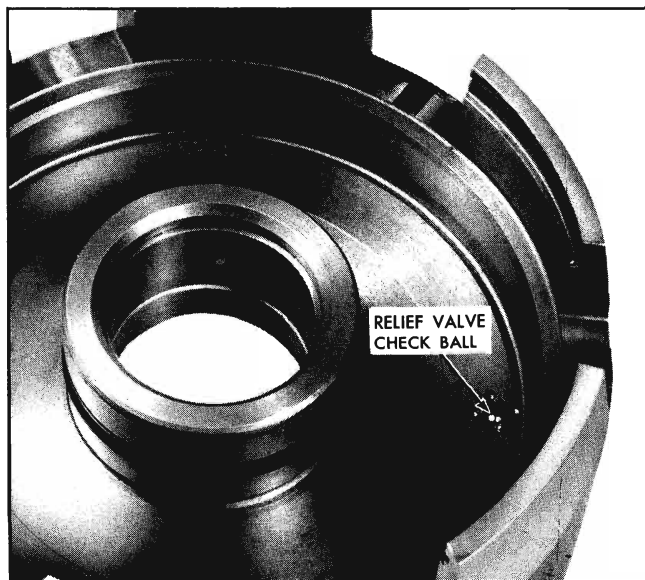


Fig. 7A-54 Relief Check Ball

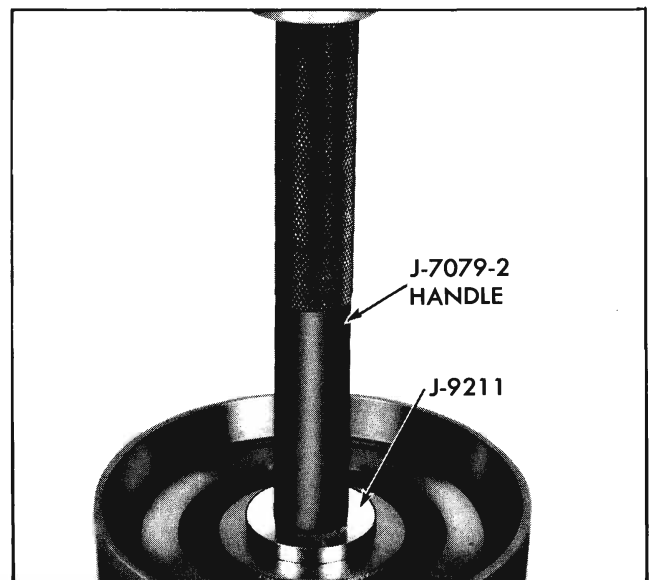


Fig. 7A-55 Installing Clutch Drum Bushing

drum is open. If clutch relief valve check ball in the clutch drum is loose enough to come out or not loose enough to rattle, replace clutch drum as an assembly. Replacement or restaking of ball should not be attempted.

4. Check fit of clutch flange in drum slots. There should be no appreciable radial play between these two parts. Also check low sun gear for nicks or burrs and bushing for wear.

5. Check clutch plates for burning, pitting or metal pick up. Also check to see that faced plates are a free fit over clutch hub and that steel plates are a free fit in clutch flange. Check for excessive wear on friction facing of drive plate teeth. Check condition of clutch hub splines and mating splines on faced plates.

CLUTCH DRUM BUSHING REPLACEMENT

1. Remove old bushing with J-8400-1 chisel using care not to damage bushing bore.

2. Install new bushing with tool J-9211 (Fig. 7A-55).

LOW SUN GEAR BUSHING REPLACEMENT

1. Remove old bushing with chisel or other suitable tool using care not to damage bushing bore.

2. Install new bushing with tool J-8360-3 (Fig. 7A-56).

ASSEMBLY

1. Install piston inner seal in hub of clutch drum. Be sure seal lips are downward (or toward the front of transmission).

2. Install a new piston seal in clutch piston. Be sure seal lips are toward front of transmission (clutch drum) when installed. Lubricate both piston inner seal and the piston seal, then install clutch piston in clutch drum with a twisting motion.

3. Place the 15 return springs in position on clutch piston. Place spring retainer on springs.

4. Compress springs, as illustrated in Fig. 7A-52. With springs fully compressed, install snap ring in groove on clutch drum hub.

5. Install hub front thrust washer with its lip toward clutch drum. Install clutch hub.

6. Install steel reaction plate, faced drive plate, two steel plates, faced plate then steel plate.

7. Install hub rear thrust with its flange toward low sun gear, then install low sun gear and clutch

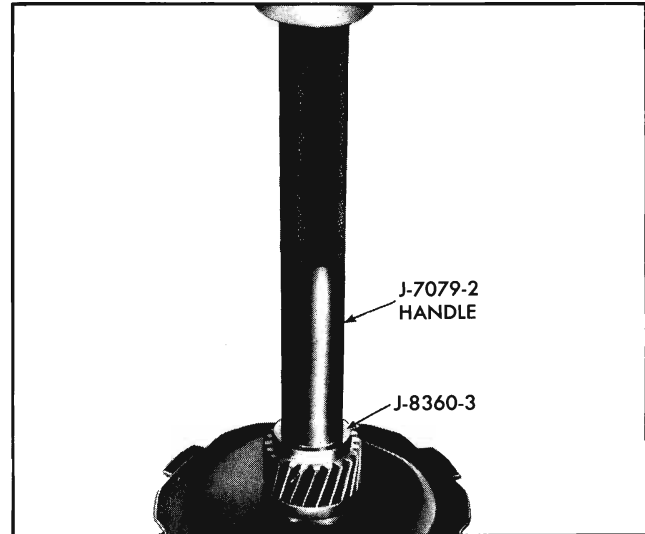


Fig. 7A-56 Installing Low Sun Gear Bushing

flange assembly and secure with retainer ring. Openings of retainer ring should be adjacent to one of lands of clutch drum.

8. Check assembly by turning clutch hub to insure it is free to rotate.

FRONT PUMP AND EXTENSION HOUSING

NOTE: Front pump body and extension housing were separated during disassembly of components from case.

DISASSEMBLY

1. Pry out oil seal (Fig. 7A-57).

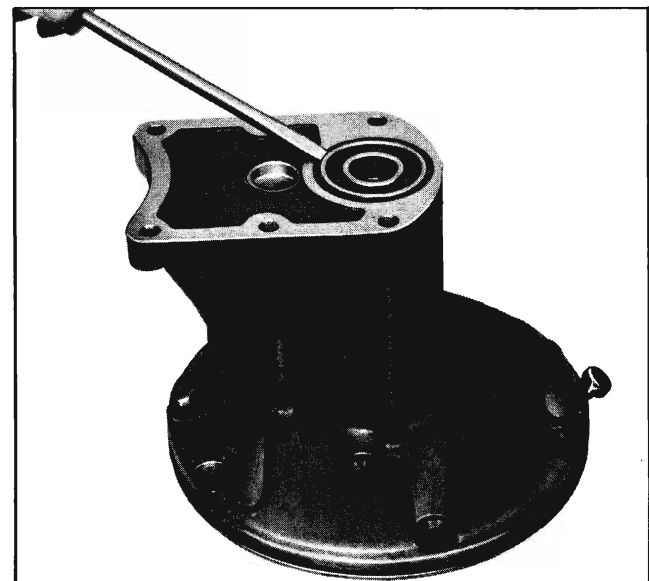


Fig. 7A-57 Removing Extension Housing Oil Seal

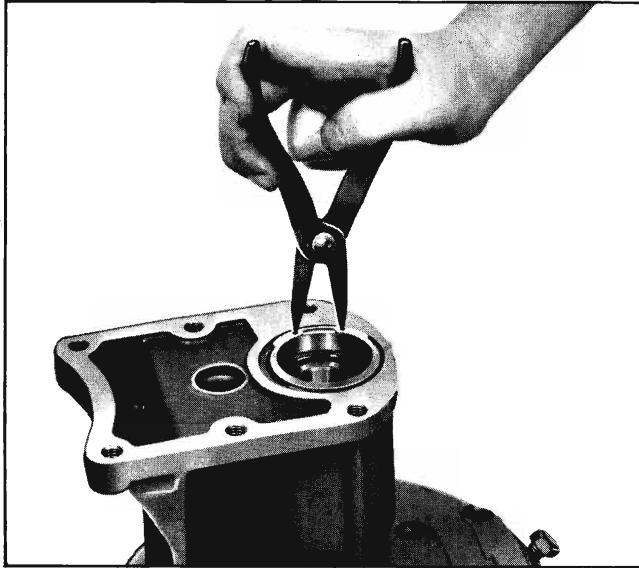


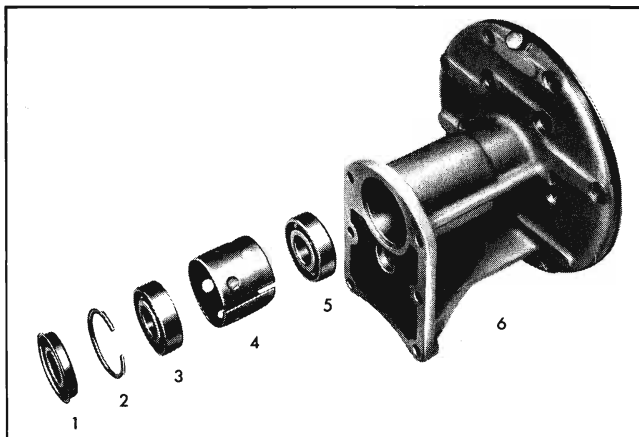
Fig. 7A-58 Removing Bearing Retainer Ring

2. Using Truarc Pliers, remove bearing retainer ring (Fig. 7A-58).

3. Invert extension housing. Using suitable socket as driver, tap out front bearing, spacer sleeve, and rear bearing.

INSPECTION (FIG. 7A-59)

1. Wash all parts in cleaning solvent and blow out oil passages.
2. Inspect pump gears for nicks or damage.
3. Inspect cover face for nicks or scoring.



- | | |
|---------------------|----------------------|
| 1. Seal | 4. Bearing Spacer |
| 2. Retainer Ring | 5. Bearing Assembly |
| 3. Bearing Assembly | 6. Extension Housing |

Fig. 7A-59 Exploded View of Extension Assembly

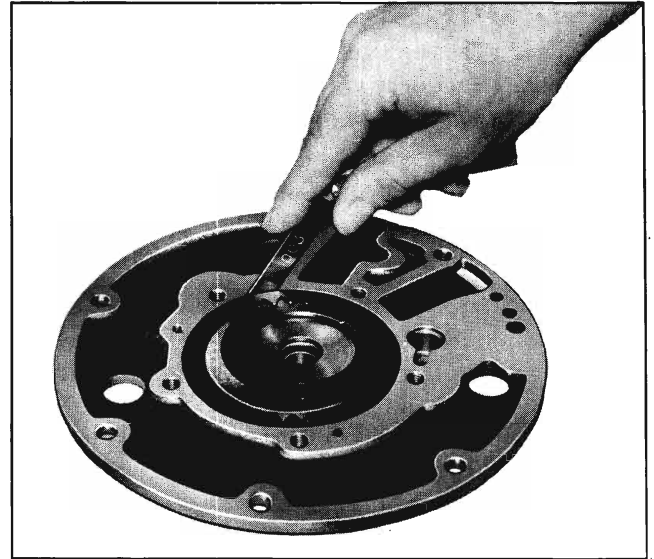


Fig. 7A-60 Checking Gear To Body Clearance

4. Inspect pump body for nicks or scoring.
5. Check oil control rings on pump body.
6. Check condition of bushing in front pump body, if damaged, replace as outlined below.
7. With parts clean and dry install pump gears and check:
 - a. Clearance between OD of driven gear and body, should be .0025"-.005" (Fig. 7A-60).
 - b. Clearance between driven gear and crescent should be .0025"-.005" (Fig. 7A-61).
 - c. With scale and feeler gauge check gear end

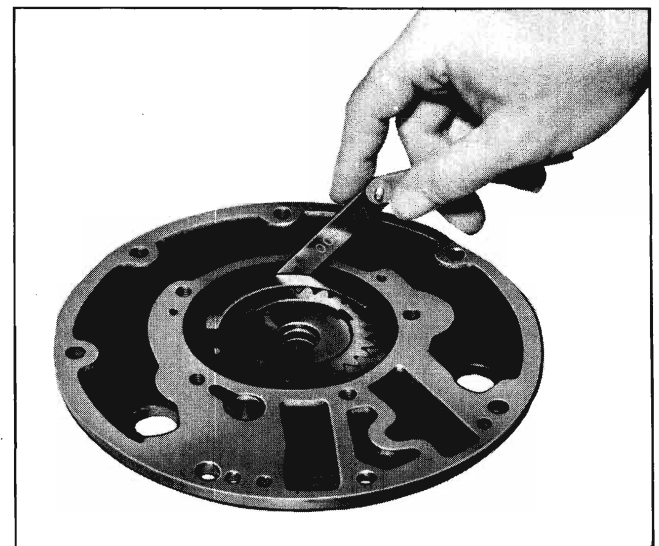


Fig. 7A-61 Checking Gear to Crescent Clearance

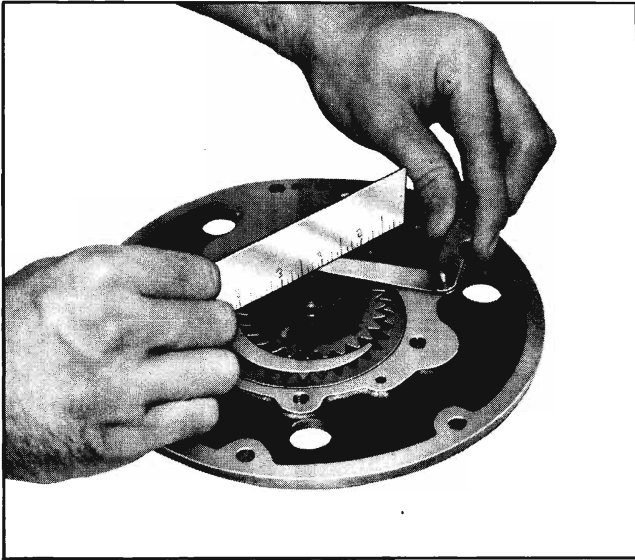


Fig. 7A-62 Checking Gear End Clearance

clearance. This clearance should be .0005"-.0015" (Fig. 7A-62).

8. Inspect front and rear propeller shaft bearings for damage

FRONT PUMP BODY BUSHING REPLACEMENT

1. Press out old bushing assembly using tool J-8885 (Fig. 7A-63).

2. Install new bushing using tool J-8884 (Fig. 7A-64).

ASSEMBLY

1. Install rear drive line bearing in pump cover using suitable socket as installer. Do not tap on inner race.

2. Install spacer sleeve.

3. Install front drive line bearing using suitable socket as installer.

4. Install retaining ring with Truarc pliers.

5. Using soft hammer, tap in new drive line oil seal.

6. Install new square cut oil ring on OD of pump cover.

Balance of pump assembly will be performed under assembly of transmission. If front pump only was removed and disassembled, proceed to step 13, page 7A-36 for balance of assembly operations.

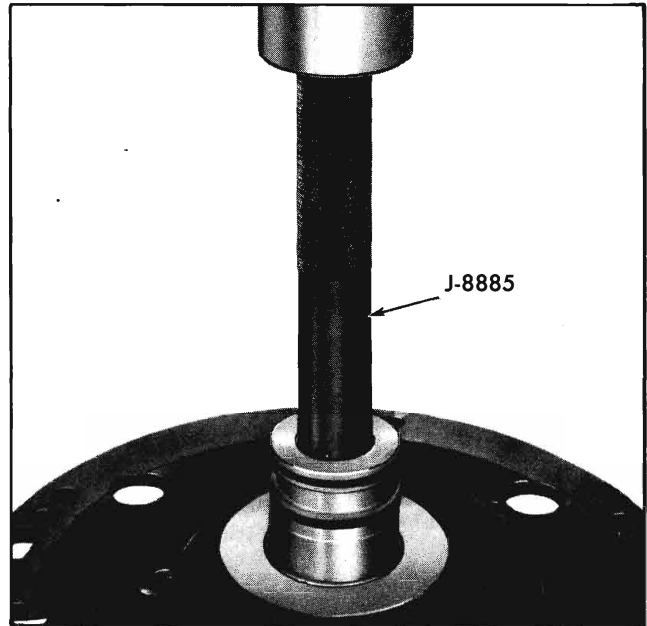


Fig. 7A-63 Removing Front Pump Body Bushing

PLANET CARRIER

No service operations. If a component of the planet carrier fails, replace the carrier as an assembly.

TURBINE SHAFT

INSPECTION

Inspect splined areas for wear or damage. Check lubrication holes to be sure they are open. Inspect bushings for wear or damage. If bushings are damaged, replace as described below.

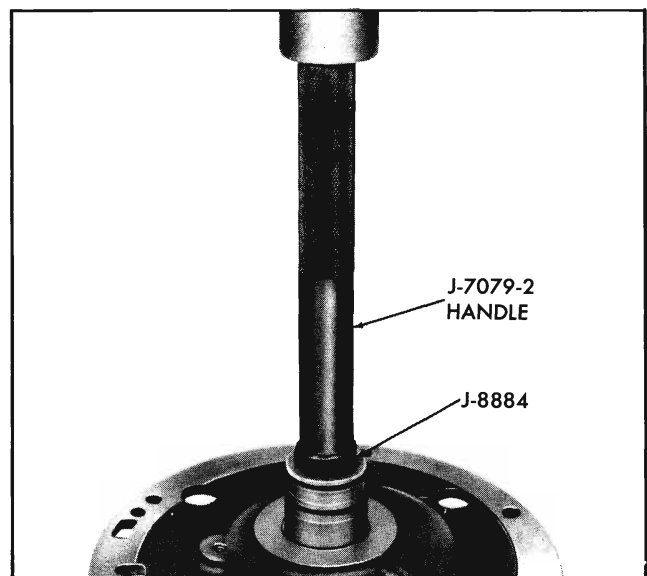


Fig. 7A-64 Installing Front Pump Body Bushing

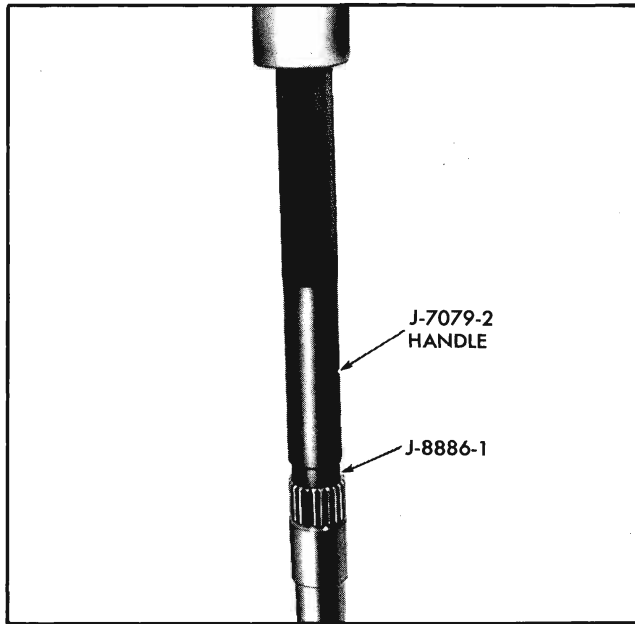


Fig. 7A-65 Installing Front Turbine Shaft Bushing

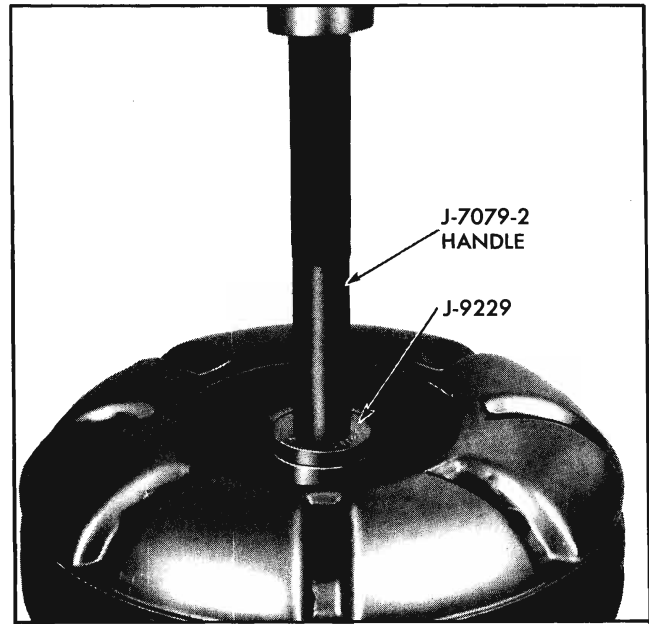


Fig. 7A-67 Installing Converter Bushing

BUSHING REPLACEMENT

The two bushings used in the turbine shaft are identical, however, the rear bushing is installed deeper than the front.

1. To remove old bushing cut out with chisel J-8400-1. Use care not to damage the bore.
2. Install new bushing as illustrated in Figs. 7A-65 and 7A-66 using tool J-8886-1 on front bushing and tool J-8886-2 on rear bushing.

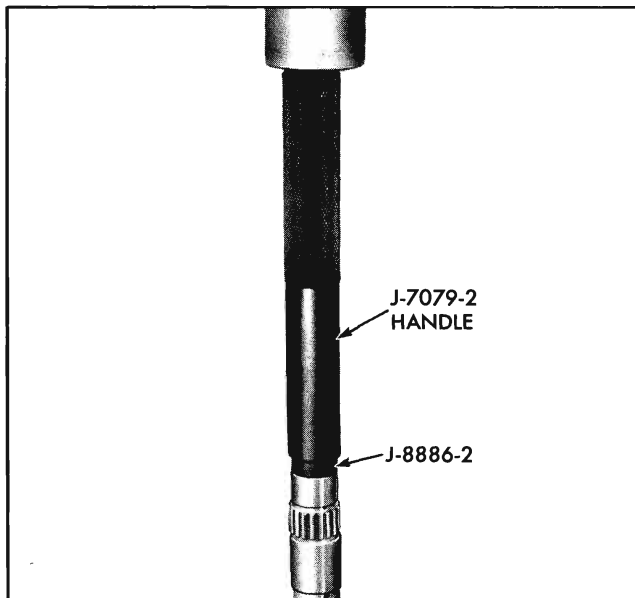


Fig. 7A-66 Installing Rear Turbine Shaft Bushing

PUMP DRIVE SHAFT

Inspect splines for wear or damage. Inspect drive lugs for wear or peened edges.

CONVERTER

NOTE: It is unnecessary to drain converter as it is welded and no internal repairs can be made.

INSPECTION

Check converter seams for stress or breaks and either replace converter or repair welds as required. If welds are repaired, keep added material to a minimum by chipping off scale and filing away excess weld to retain converter balance. Check converter hub bushing for wear or damage.

CONVERTER BUSHING REPLACEMENT

1. Remove old bushing with chisel J-8400-1, using care not to damage converter bore.
2. Install new bushing using J-9229 as shown in Fig. 7A-67.

ASSEMBLY OF TRANSMISSION

1. Install transmission case in holding fixture J-7896-01 if removed.
2. Install two J-3387-2 guide pins in rear pump bolt holes, then install rear pump wear plate on guide pins, using a small amount of petroleum jelly to hold wear plate in place.

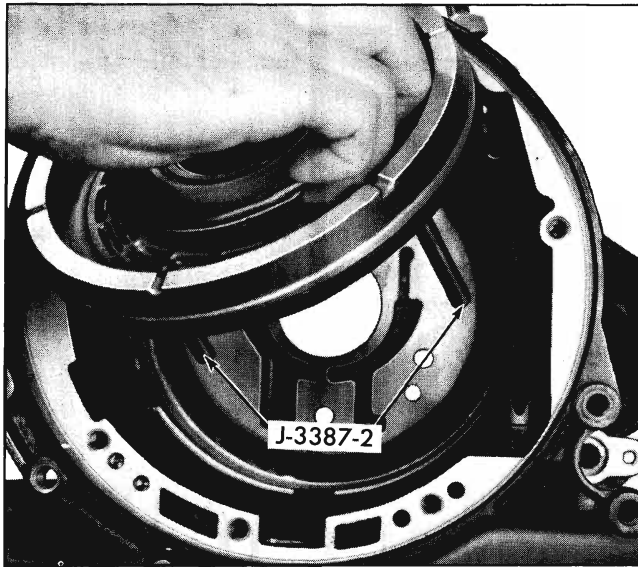


Fig. 7A-68 Installing Rear Pump and Reverse Piston

3. Insert rear pump and reverse piston with guide pins into case (Fig. 7A-68). Insert a length of .010"-.015" shim stock between piston outer seal and case. Run shim stock around entire diameter of seal to seat the seal.

Remove the guide pins and install five rear pump mounting bolts securing to 9-11 lb. ft.

NOTE: Check rear pump for freeness before proceeding.

4. Install reverse clutch drive and reaction plates alternately starting with reaction plate (steel) and finishing with drive plate (faced). Notched lug in each steel reaction plate is installed so it is at top of groove at 4 o'clock position in case (Fig. 7A-69). Install the thick reaction plate. It has a rectangular "dimple" on its lug which engages 4 o'clock case groove.

5. Install reverse clutch plate retainer ring in such a manner that open ends of ring are at 12 o'clock position, then install retainer ring clip (Fig. 7A-70) on thick reaction plate between the ends of snap ring.

6. With the rear of transmission case downward, align internal lands and grooves of reverse face plates.

7. Engage ring gear to reverse drive plates. Engagement must be made by "feel" while moving drive plates laterally.

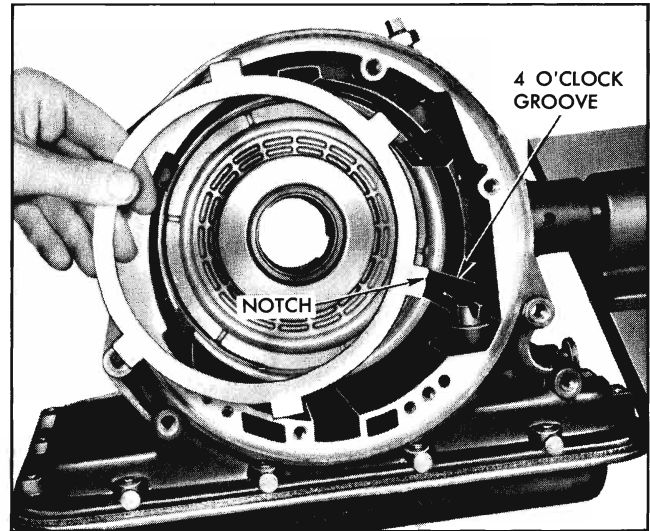


Fig. 7A-69 Installing Reverse Clutch Reaction Plates

8. Install planetary unit with a slight twist to engage planet gears with ring gear. Be sure to engage two rear pump drive lugs on planet hub with grooves in rear pump drive gear.

9. Install the clutch drum assembly, using a slight twist to engage low sun gear to the planet gears in planetary gear set.

10. Turn transmission to a horizontal position, then install the low band, apply strut, and reaction strut (Fig. 7A-71). When low band linkage is all installed, tighten low band adjusting screw to prevent struts from falling out of place. Then shake clutch drum slightly to center band and linkage.

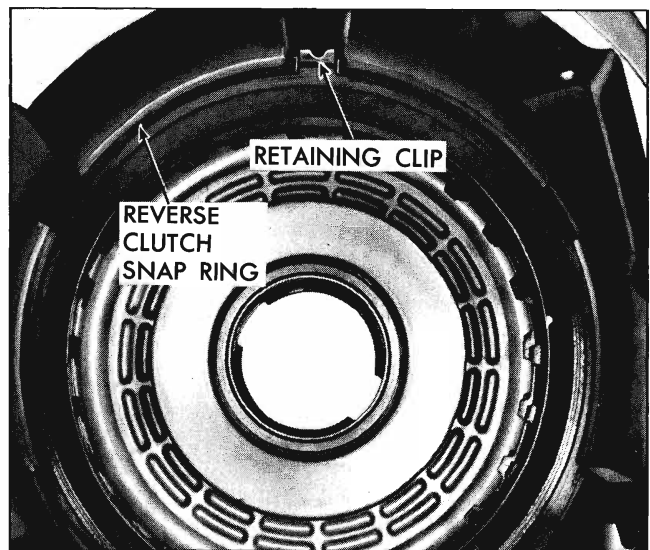


Fig. 7A-70 Reverse Snap Ring Retaining Clip Installed

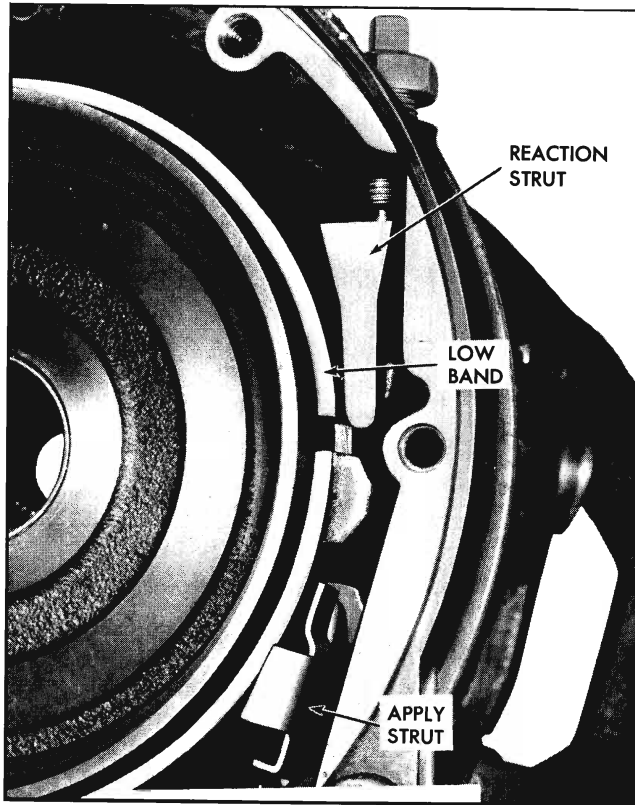


Fig. 7A-71 Location of Apply and Reaction Struts

11. Replace original thrust washer or new washer of same size if original is damaged. Final end play adjustment will be performed at governor drive gear prior to assembly of transmission to carrier assembly.

12. Install a new front pump gasket, then locate and install front pump body, being careful not to break cast iron oil rings on pump body hub when they are indexed to clutch drum.

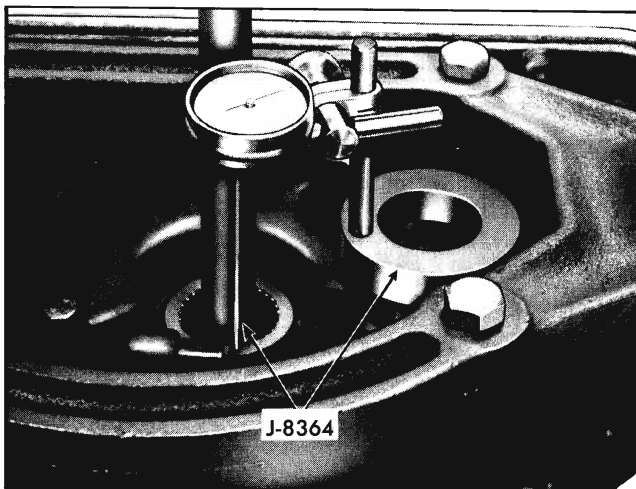


Fig. 7A-72 Zeroing Indicator on Planet Carrier Hub

13. Install inner and outer pump gears with drive notches on inner gear facing up, and outer gear with same face up as removed.

14. Install thrust washer in pump body (see Fig. 7A-35).

15. Install converter pump drive shaft. Use care when inserting pump shaft not to damage bushings of transmission components already installed.

16. Position coupling on end of pump drive shaft.

17. Position coupling thrust washer in extension housing. Washer is retained by light press fit.

18. Install a new square cut seal ring in extension housing, then position extension housing, dip bolt heads in oil impervious sealer and install mounting bolts loosely. Tighten outer bolts in a crisscross pattern to 15-20 lb. ft. torque, then tighten five inner bolts to same torque. By using this sequence, chance of cocking front pump which would bind the pump is virtually eliminated. Check pump for freeness before proceeding.

19. Adjust low band by first tightening adjusting screw to 40 ± 5 inch-lbs., then back off four (4) full turns exactly. Hold adjusting screw and lock adjustment by fully tightening lock nut.

NOTE: J-8938 guide pins may be used to help position cover.

ASSEMBLE TRANSMISSION TO DIFFERENTIAL CARRIER ASSEMBLY

1. Prior to reassembly of carrier and transmission it is necessary to determine required thickness of shim pack to be installed at front face of governor drive gear.

Following is the correct procedure:

a. Install dial indicator on support J-8364 and install 3" indicator extension provided.

b. Without gasket, place support on rear pump cavity surface of transmission case with transmission on front end as illustrated (Fig. 7A-72) so that dial indicator tip rests on planet carrier hub. Adjust indicator on J-8364 as required to permit maximum indicator travel and set indicator dial to zero.

NOTE: Front end of transmission must face downward when indicator is zeroed.

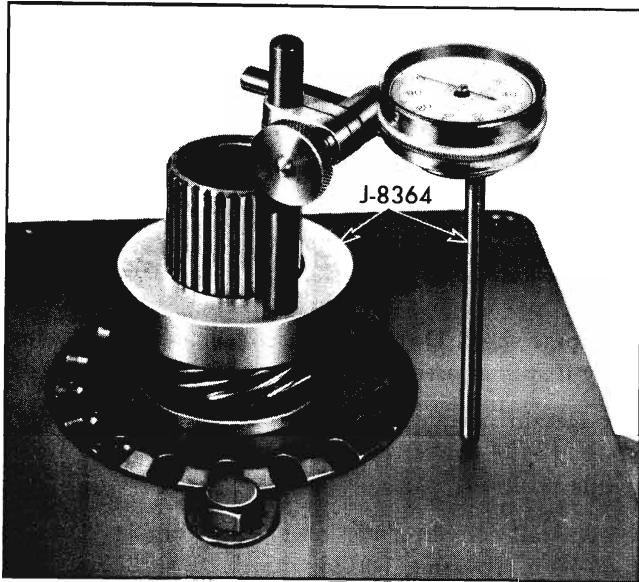


Fig. 7A-73 Measuring for Shim Determination

c. Slowly lift support J-8364 and indicator off transmission rear pump cavity and note its range of needle deflection from zero position. Properly positioned on support, indicator should not deflect more

Indicator Reading	Spacer No. 6256827	
	Number	Thickness
.025 - .046	None	—
.047 - .062	1	.016 ± .001
.063 - .078	2	.032 ± .002
.079 - .094	3	.048 ± .003
.095 - .110	4	.064 ± .004
.111 - .126	5	.080 ± .005
.127 - .142	6	.096 ± .006
.143 - .155	7	.112 ± .007

Fig. 7A-74 Spacer Chart

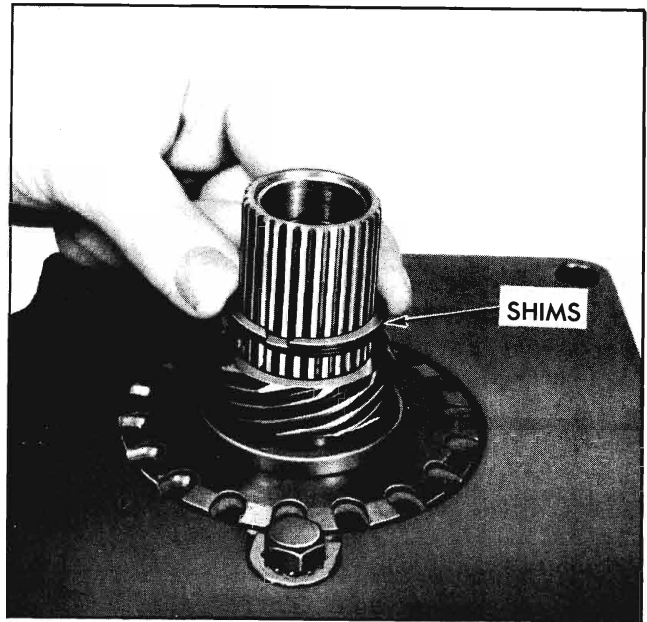


Fig. 7A-75 Installing Spacers

than .050" (one-half turn) when removed; otherwise raise or lower dial indicator on support post as required and again zero gauge as described in step b.

d. Place J-8364 and dial indicator on governor gear without spacers on the differential carrier pinion shaft as illustrated (Fig. 7A-73) and lower support slowly so that revolutions of indicator needle can be counted. Measurement starts once indicator needle again reaches zero. Fully depress support on governor gear, note indicator reading and refer to chart (Fig. 7A-74) for spacers to be installed on governor gear.

e. Install spacers selected on governor gear (Fig. 7A-75), then check that proper total thickness has been installed by again measuring with J-8364 as described in step d. If shim stack is correct, indicator reading will now be between .025"-.038"; otherwise

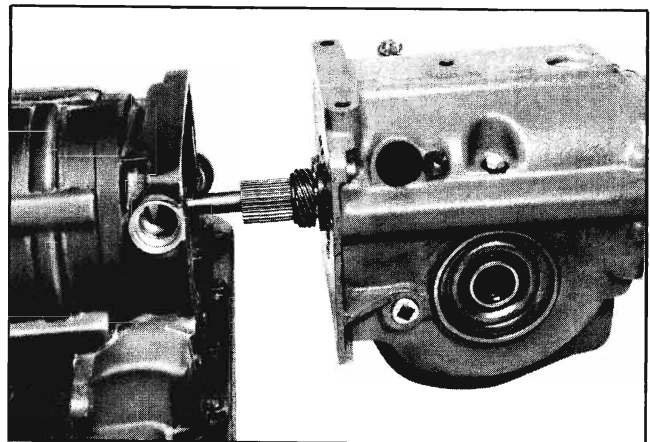


Fig. 7A-76 Assembling Transmission to Carrier

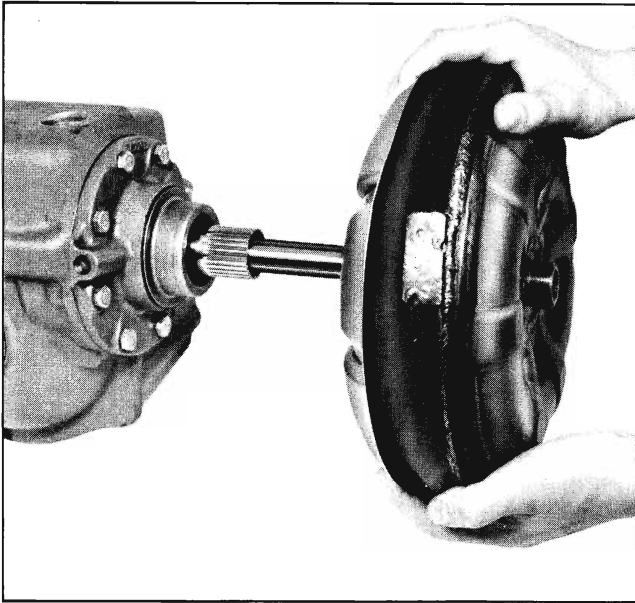


Fig. 7A-77 Installing Converter and Turbine Shaft

add or remove spacers until reading is within this range.

2. Apply a new gasket to either carrier or rear face of transmission with petroleum jelly.

3. Remove transmission from holding fixture and align carrier and transmission on a flat surface and carefully guide pump shaft through the differential carrier so as not to damage bushing in pinion. Then engage splines of the pinion shaft with planet carrier internal splines in transmission (Fig. 7A-76).

4. Install governor and "O" ring seal and secure

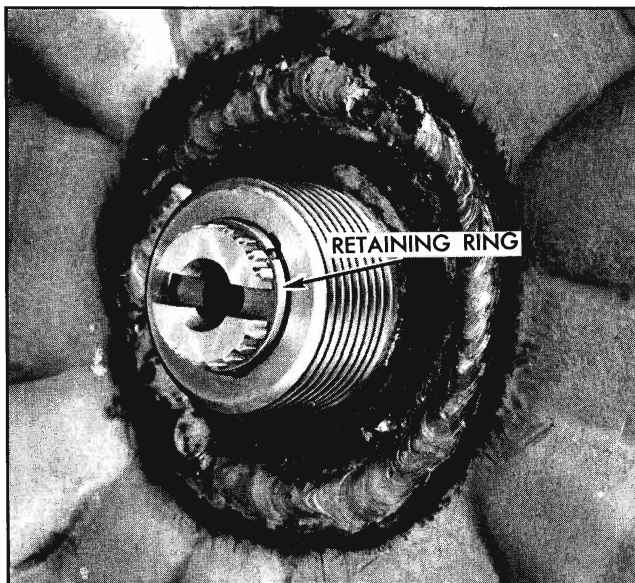


Fig. 7A-78 Converter Retaining Ring

transmission to carrier with four screws. Drive two screws from the carrier side first to minimize chance of cocking mating surfaces of the transmission and carrier. Tighten screws to 30-35 lb. ft.

5. Install turbine shaft into converter and then install converter and turbine shaft (Fig. 7A-77) using care not to damage turbine shaft bushings when sliding over converter pump shaft. It is necessary to use caution in engaging splines in converter and at end of turbine shaft. Do not force, engagement will occur easily if splines are correctly aligned.

6. Retain converter with retaining ring (Fig. 7A-78). Pull converter rearward to trap ring. Hold in this position.

7. Install converter cap and seal assembly. Torque to 60-70 lb. ft. using J-9183 wrench to hold converter.

8. Install modulator valve and vacuum modulator assembly.

9. Install transmission and axle assembly as covered in Section 4.

TROUBLE DIAGNOSIS

HYDRAULIC PRESSURE DATA

PRESSURE TAP LOCATIONS

Two pressure tap plugs in the extension housing are accessible, front pump pressure is at the 6 o'clock position and throttle valve (TV) pressure is at the 8 o'clock position (Fig. 7A-79).

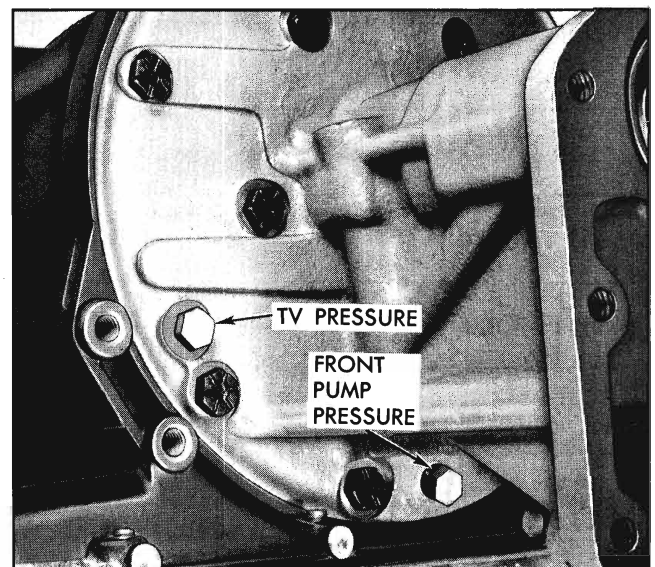


Fig. 7A-79 Pressure Tap Locations

TEST PREPARATION

All tests can be made without driving the vehicle by simply raising the wheels 3-5 inches from the floor on jack stands. With pressure gauges installed, perform the following preliminary steps.

- Establish pressure gauge indicator needle rest positions at zero pressure.
- Thoroughly warm-up transmission.
- Check transmission oil level.
- Check linkage adjustment.

Absence of front pump pressures results in no drive in any range as this pressure is required to apply the applicable clutch for a given range. Common causes would be stuck pressure regulator valve, broken or disengaged front pump drive lugs, or missing plug from front end of converter pump shaft.

Failure of pressure to raise when disconnecting the vacuum hose (or high pressures with the hose connected) would indicate a stuck vacuum modulator valve, defective vacuum modulator, or collapsed hose.

REAR PUMP CHECK

With the rear wheels raised, place the selector in "D" and accelerate the engine. Front pump pressure should drop to approximately 0-5 psi at approximately 20 mph. If pressure does not drop, rear pump is disengaged or clogged, or rear pump check ball not seating.

Throttle valve pressure tests are of value in cases where the transmission shift points are not in accord-

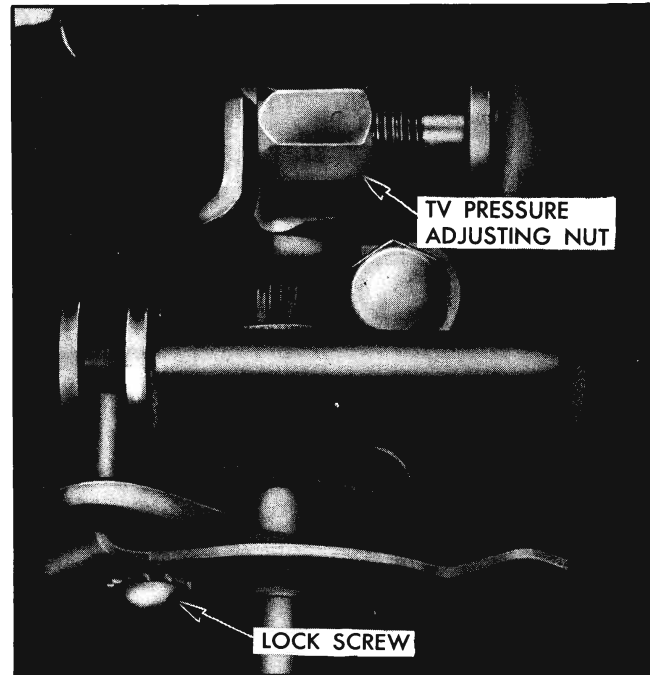


Fig. 7A-80 TV Pressure Adjusting Nut

ance with the "Shift Point-MPH Chart." If pressures are not as prescribed, they may be raised or lowered by adjusting the position of the jam nut on the throttle valve assembly (Fig. 7A-80). To raise TV pressure 3 psi, back off the jam nut one (1) full turn. This increases the dimension from the jam nut to the throttle valve assembly stop. Conversely, tightening the jam nut one (1) full turn lowers TV pressure 3 psi. Smaller pressure adjustments can be made by partial turns of the jam nut. The end of TV adjusting screw has an Allen head so the screw may be held stationary while the jam nut is moved.

FRONT PUMP PRESSURES (PSI)					
CONDITION	Eng. Type	R	N	D	L
At Idle (16" Hg)	4 Cyl.	106-130	55-67	55-67	124-137
	8 Cyl.	110-139	59-73	59-73	130-151
At 1000 RPM with Vacuum Hose Disconnected	4 Cyl.	198-222	101-114	101-114	124-137
	8 Cyl.	202-231	105-120	105-120	130-151

THROTTLE VALVE (TV) PRESSURE (PSI)					
CONDITION	Eng. Type	R	N	D	L
Disconnect TV cable at Transmission and Vacuum Hose at Modulator.	4 Cyl.	0	0	50-52	119-132
	8 Cyl.	0	0	48-50	125-146
Hold TV Lever forward against stop— Engine at 1000 RPM					

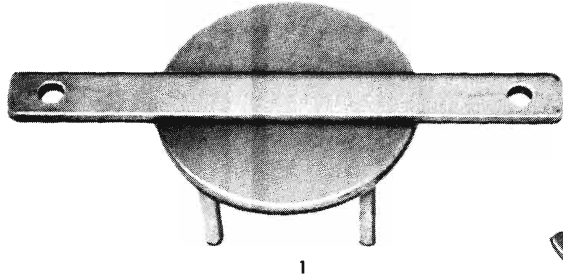
**TEMPEST AUTOMATIC TRANSMISSION
SHIFT POINT*—MPH CHART**

UPSHIFTS	M.P.H.		DOWNSHIFTS	M.P.H.	
	4 Cyl.	8 Cyl.		4 Cyl.	8 Cyl.
Minimum Throttle	12-15	17-21	Closed Throttle	9-15	14-18
Full Throttle	43-50	49-55	Full Throttle	39-46	45-51
Part Throttle (Detent Touch)	35-45	40-49	Part Throttle (Detent Touch)	21-33	28-37

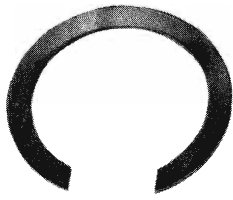
*Above shift points are with 3.55:1 axle ratio. To convert for other ratios multiply MPH x 3.55 and divide result by desired ratio.

SPECIAL TOOLS

- | | |
|--|--|
| 1. J-4670C Clutch Spring Compressor | 11. J-8886-1 Front Turbine Shaft Bushing Installer |
| 2. J-8765 Adapter | 12. J-8886-2 Rear Turbine Shaft Bushing Installer |
| 3. J-6129 Clutch Spring Compressor | 13. J-9211 Clutch Drum Bushing Installer |
| 4. J-8918 Extension Bearing Remover | 14. J-9229 Converter Bushing Installer |
| 5. J-7079-2 Handle | 15. J-8938 Guide Pins (Two J-3387-2 Pins) |
| 6. J-8400-1 Bushing Chisel | 16. J-8364 Dial Indicator Support and Extension |
| 7. J-8835 Front Pump Body Bushing Remover | 17. J-8365 Manual Valve Lever Gauge |
| 8. J-8360-3 Low Sun Gear Bushing Installer | 18. J-7896-01 Holding Fixture |
| 9. J-8360-4 Rear Pump Body Bushing Installer | 19. J-9183 Strap Wrench |
| 10. J-8884 Front Pump Body Bushing Installer | |



1



2



3



4



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7



8



9



10



11



12



13



14



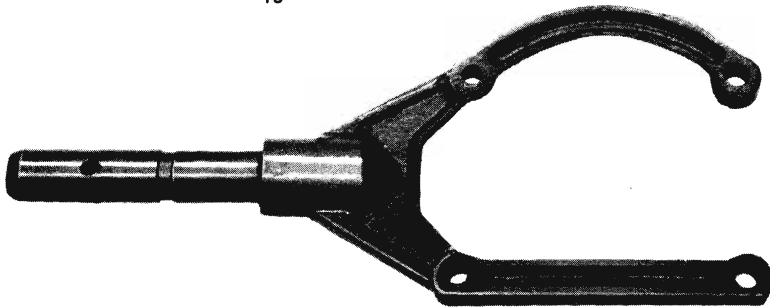
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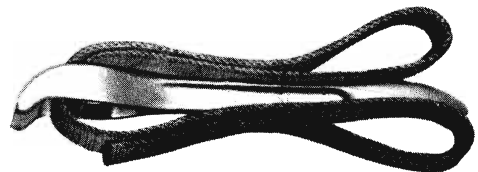
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19

FOUR-SPEED SYNCHROMESH TRANSMISSION

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
Description	7B-1	Assemble Mainshaft	7B-7
Service Procedures	7B-1	Assemble Transmission	7B-8
Disassemble Transmission	7B-1	Torque Specifications	7B-12
Disassemble Mainshaft	7B-4	Special Tools	7B-13
Inspection and Repair	7B-4		

DESCRIPTION

The Tempest four-speed transmission (Fig. 7B-25) is of the helical gear, constant mesh type to provide full synchronization in all forward gears. Spur gears on the mainshaft and countershaft are engaged by a small sliding spur gear to provide reverse. Reverse is not synchronized.

Like the Tempest three-speed, the mainshaft is supported at the front in a double row of needle bearings carried by the clutch gear and at the rear by a ball bearing race. In turn, the clutch gear is carried in the front of the case by an identical ball bearing race.

The countergear is of single piece construction and is carried on double rows of needle bearings at each end. Thrust washers are used both front and rear between the countergear and the transmission case. A slight press fit is used at the front of the countershaft to retain the shaft and to prevent lubrication loss at this point.

Vehicle shift components are comparable to those used with the Tempest three-speed transmission (See Section 7).

In the transmission, three shift fork shafts are mounted parallel above the transmission selector shaft which is attached to the tunnel shift tube. The transmission selector shaft carries a finger which extends upward to engage the shift forks. As the three forks are mounted on parallel shafts, a slight rotation of the selector shaft moves the shift finger from the 1-2 fork in the center to the 3-4 fork which is outboard. To engage the reverse shifter head, which is mounted on the inboard shaft, the shift finger must be moved laterally against a spring-loaded plunger at the neutral cross-over point. The plunger is required to prevent accidental shifting into reverse while in motion, as the 1-2 fork has a gate to permit passage of the shift finger through it to reach reverse.

Gear ratios are 3.65:1 in first, 2.35:1 in second, 1.44:1 in third, and 1.00:1 in fourth. Reverse is 3.66:1.

SERVICE PROCEDURES

For information concerning service procedures for the gearshift control, the transmission extension assembly, and transmission replacement, see pages 7-7 to 7-12 in Section 7.

DISASSEMBLE TRANSMISSION

1. Remove side cover from case.
2. Remove plug, detent spring, and ball from 3-4 detent channel (Fig. 7B-1) at the left-rear of the case.
3. Drive roll pin from 3-4 shift fork with a pin punch (Fig. 7B-2). Remove 3-4 shift shaft with a drift and remove fork. Shaft can be driven from case in either direction.
4. Remove plug, spring, and detent ball from 1-2 detent channel at front of case adjacent to shifter shaft (Fig. 7B-3).

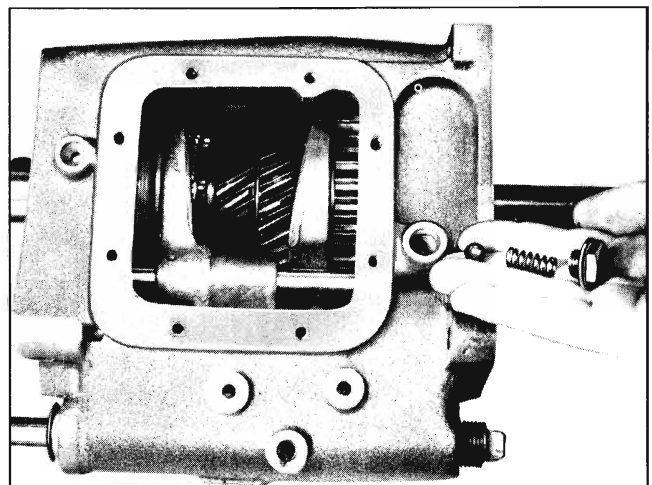


Fig. 7B-1 Detent Ball, Spring and Plug

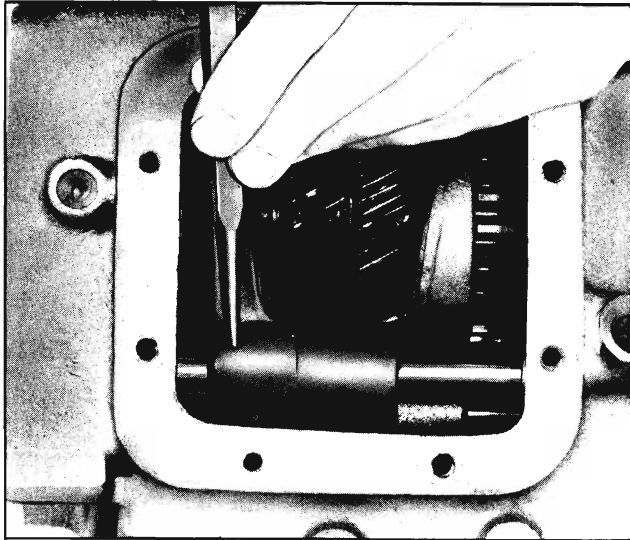


Fig. 7B-2 Removing Roll Pin

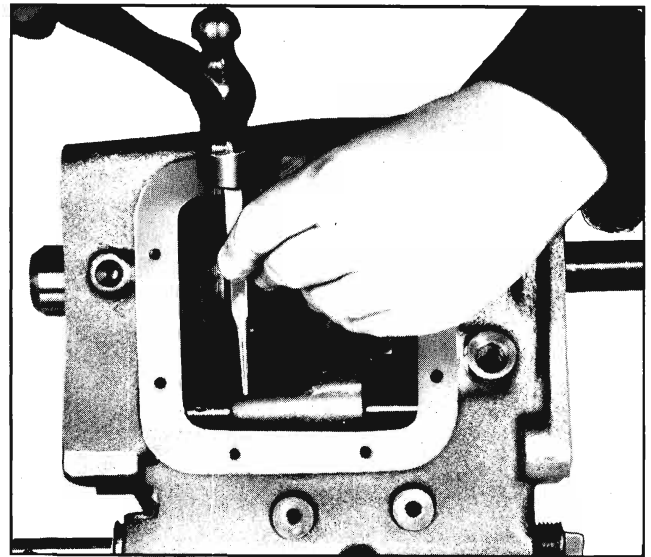


Fig. 7B-4 Removing Roll Pin

5. Move 1-2 shift fork (Fig. 7B-4) into second gear, then remove roll pin securing fork to shaft with a pin punch. Remove shift fork and shaft by tapping shaft out of case in either direction. Don't lose interlock pin from shaft or case.

6. Remove the snap rings located at the clutch gear, between the clutch gear and bearing, and between the clutch gear bearing and case (Fig. 7B-5).

7. Install clutch bearing puller J-8880 as follows:

a. Assemble puller plates J-8880-1 (Fig. 7B-6) onto clutch gear bearing by inserting plates into the bearing groove, then secure puller plates together with two screws.

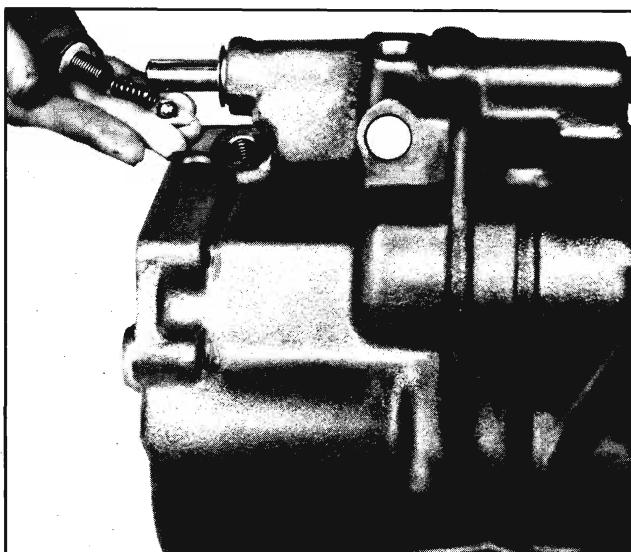


Fig. 7B-3 Detent Channel (1-2)

b. Insert adapter plug J-8880-2 into bore of clutch gear.

c. Attach body J-8111-23 to puller plates with two $\frac{1}{2}$ "-13 x $2\frac{1}{2}$ " screws and two $\frac{1}{2}$ " flat washers. Back out large puller screw in body as required to permit attachment of body to puller plates with these screws.

d. Remove the clutch gear bearing by turning puller screw in J-8880 as shown (Fig. 7B-6). Separate puller plates from bearing.

8. Remove two snap rings securing rear main shaft bearing retainer in place (Fig. 7B-7).

9. Remove mainshaft with assembled gears and rear bearing retainer as shown in Fig. 7B-8, with

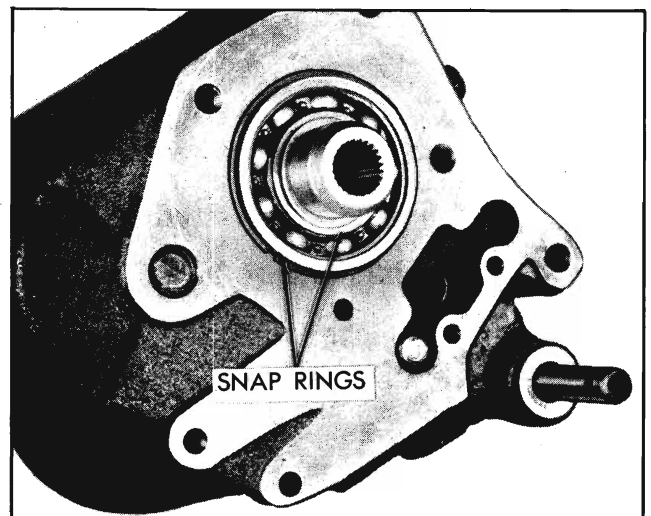


Fig. 7B-5 Clutch Gear Bearing Retained

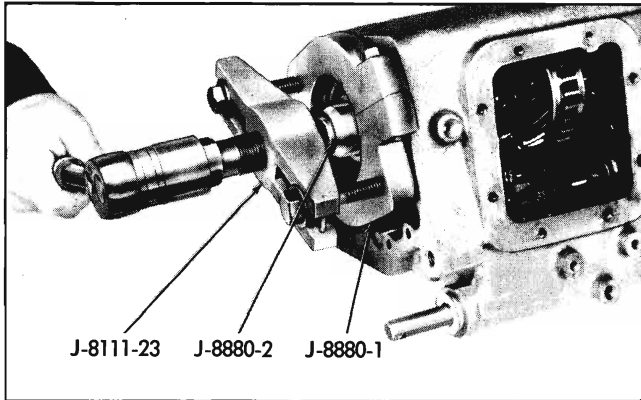


Fig. 7B-6 Removing Clutch Gear Bearing

sliding sleeve full forward. It may be necessary to jiggle the output shaft, making sure the clutch gear does not separate from mainshaft.

10. Using a pin punch, drive roll pin from reverse shifter head (Fig. 7B-9), then remove shifter head and shaft from case by tapping shaft out in either direction with a drift.

11. Drive out reverse idler gear and reverse shifter fork shafts from the case by driving rearward with a drift. Use care not to lose Woodruff key used in reverse idler gear shaft. Remove idler gear and reverse shifter fork (Fig. 7B-10) from case.

12. Remove reverse shifter lever (Fig. 7B-10) by lifting off its pin in the case.

13. To remove the countergear, use tool J-9563. Drive countershaft rearward until the countershaft is fully disengaged from the case and J-9563 is fully within the countergear (Fig. 7B-11). Remove one

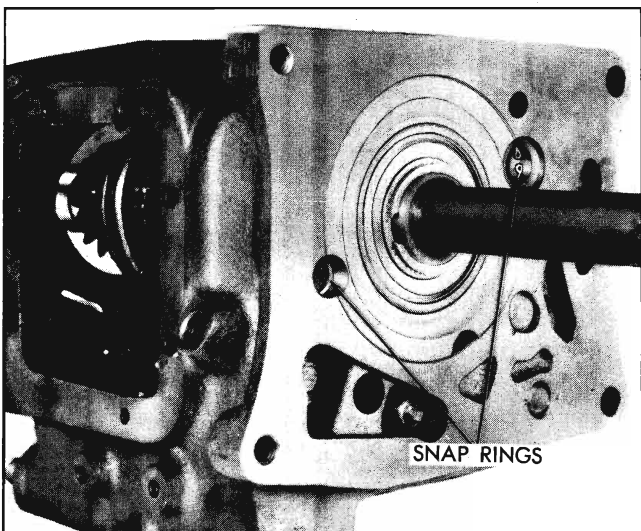


Fig. 7B-7 Bearing Retainer Snap Rings

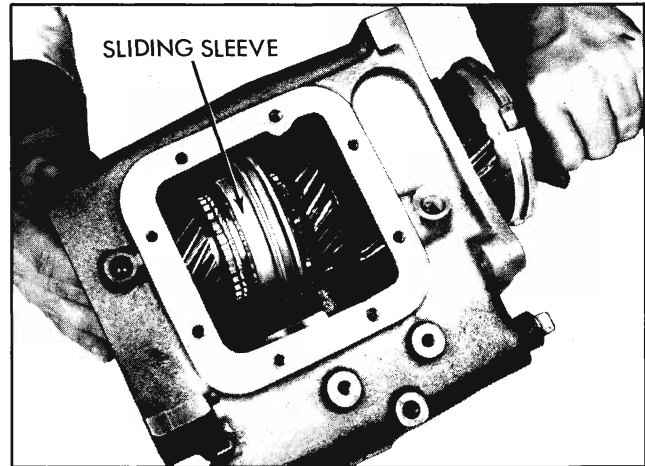


Fig. 7B-8 Removing Mainshaft Assembly

thrust washer and carefully remove the countergear from the case, using care not to tip countergear to prevent needle bearings from falling out.

14. Remove two countergear thrust washers from case.

15. Using a magnet or by tipping the case, remove the two interlocks and the detent ball and spring remaining in the 3-4 detent channel.

16. Remove shift finger from selector shaft by first flattening lock tabs securing the two retaining screws, then remove shifter shaft plug in rear of case. Tap shaft rearward from case out through hole with a drift.

17. With suitable tool, remove reverse inhibitor plug, spring, ball seat and ball (Fig. 7B-12). Remove

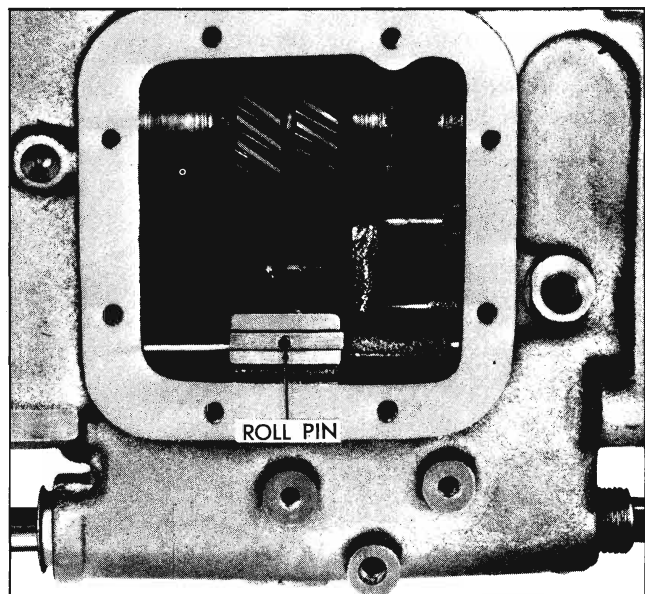


Fig. 7B-9 Reverse Shifter Head

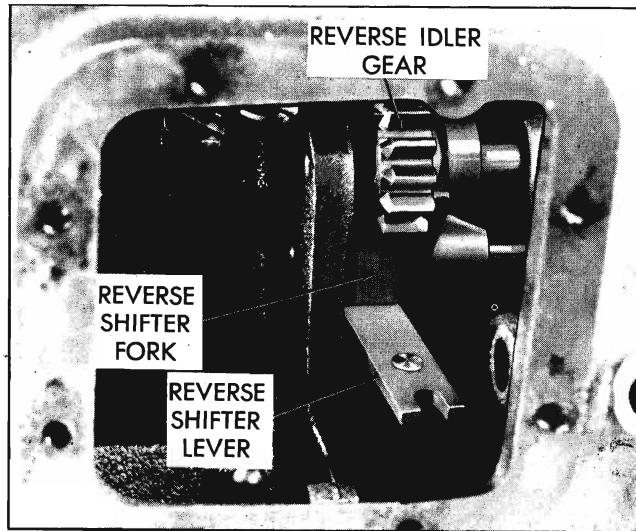


Fig. 7B-10 Reverse Shifter Assembly

other plug, spring, and reverse inhibitor plunger (Fig. 7B-13).

DISASSEMBLE MAINSHAFT

1. Place clutch gear downward against table top and carefully lift mainshaft out of clutch gear to prevent disturbing clutch gear roller bearings.

CAUTION: Be sure to keep needle retainer washer with clutch gear.

2. Remove special snap ring from front of mainshaft, then slide or press with J-8893 in J-6407 press plate holder (Fig. 7B-14) 3-4 synchronizer unit with blocker rings, third speed gear, radial needle bearing, and second speed gear from mainshaft. Remove 1-2 synchronizer from hub and do not lose keys.

3. Remove rear bearing selective snap ring, then remove rear bearing and retainer and first speed gear

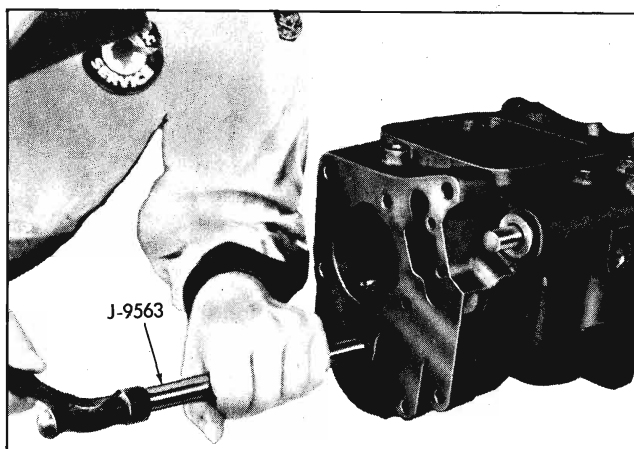


Fig. 7B-11 Removing Countergear

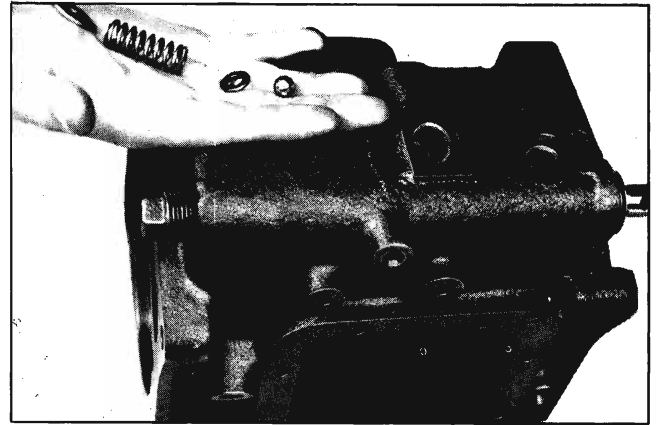


Fig. 7B-12 Reverse Inhibitor Detent

as an assembly, using press with J-8893 in J-6407 press plate holder (Fig. 7B-15). Be careful not to lose first speed gear thrust washer.

4. Remove 1-2 blocker rings.

5. Press mainshaft out of 1-2 synchronizer unit and first speed gear sleeve with J-6547 in J-6407 (Fig. 7B-16). This completes disassembly of mainshaft.

INSPECTION AND REPAIR

TRANSMISSION CASE

Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the rear face which fits against differential carrier for burrs and if any are present, dress them off with a fine mill file.

Also check the condition of the shifter shaft seal and replace if necessary.

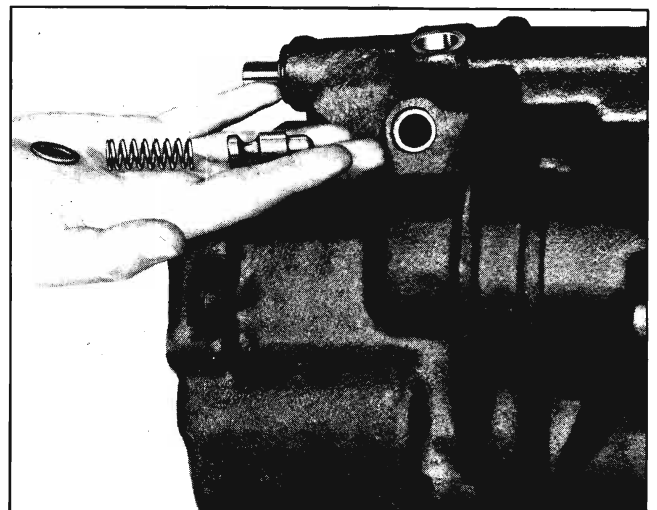


Fig. 7B-13 Reverse Inhibitor

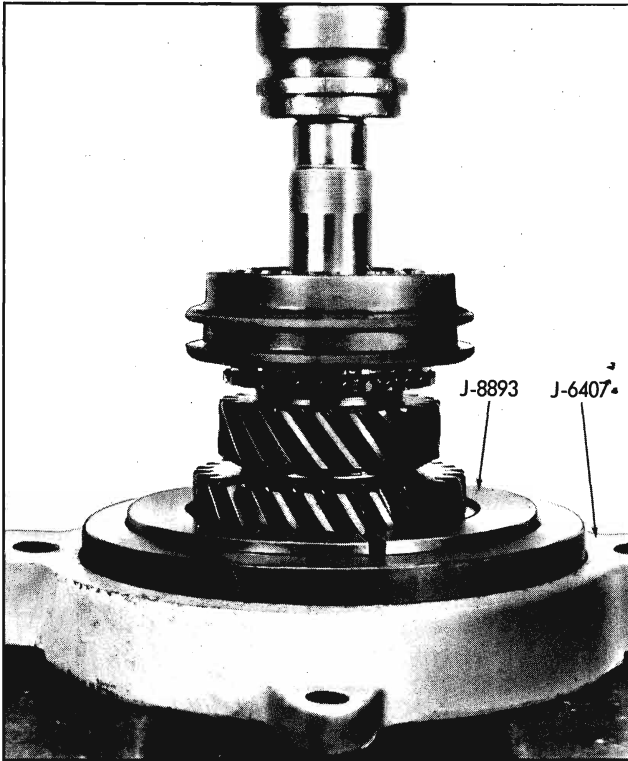


Fig. 7B-14 Disassembly of Mainshaft

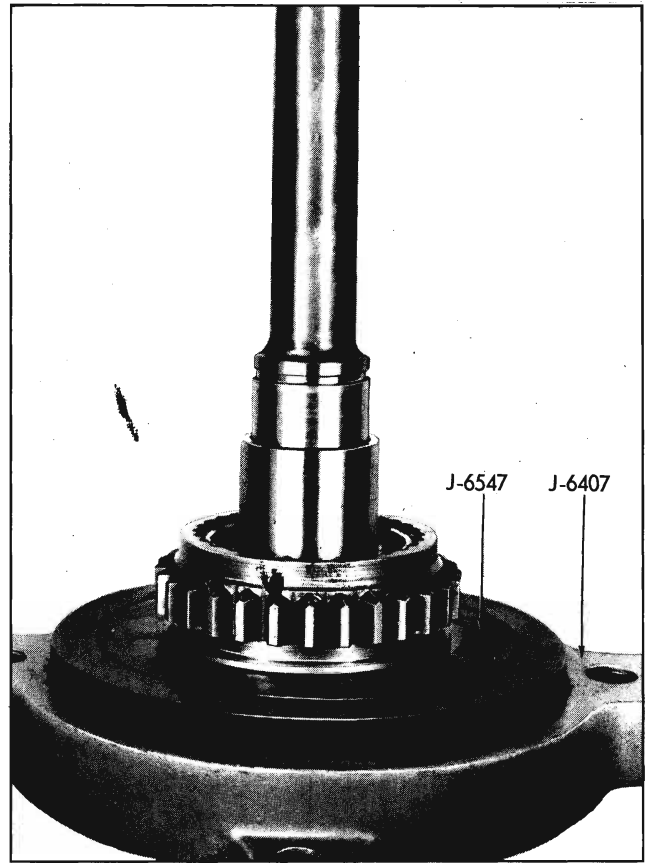


Fig. 7B-16 Disassembly of Mainshaft

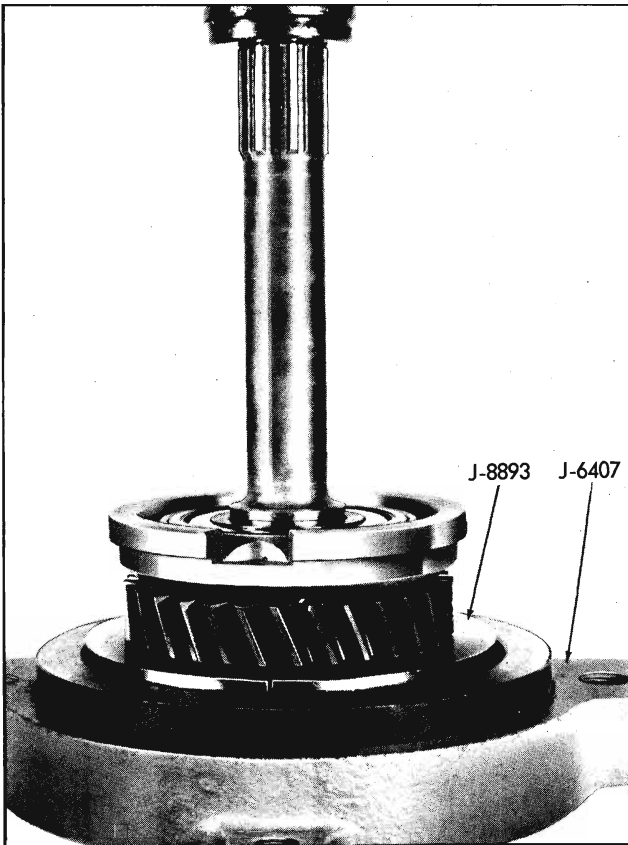


Fig. 7B-15 Disassembly of Mainshaft

FRONT AND REAR BEARINGS

1. Wash the front and rear bearings thoroughly in a cleaning solvent.
2. Blow out bearings with compressed air.

CAUTION: Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the race and balls.

3. Make sure the bearings are clean, then lubricate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

SHIFTER SHAFT SEAL

If shifter shaft seal needs replacing, it can be replaced in same manner as 3-speed transmission seal is replaced (Fig. 7-33) in Section 7.

BEARING ROLLERS AND SPACERS

All clutch gear and countergear bearing rollers should be inspected closely and replaced if worn. Inspect countershaft at the same time and replace if necessary. Replace all worn spacers.

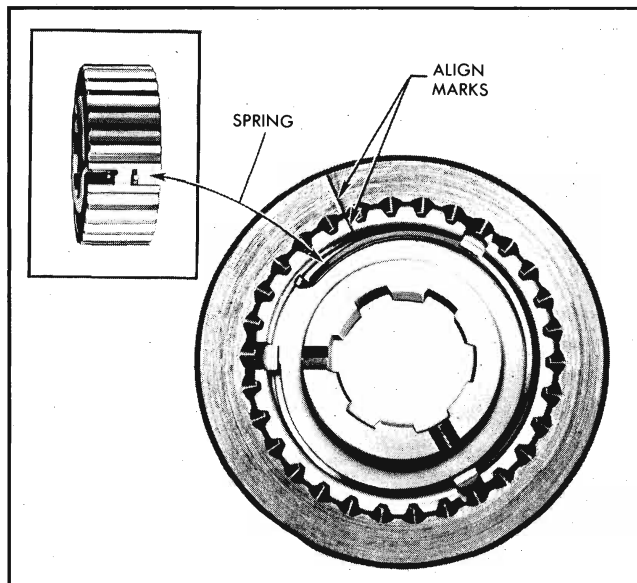


Fig. 7B-17 Synchronizer Spring and Hub Installed

GEARS AND THRUST WASHERS

Inspect all gears and thrust washers and, if necessary, replace all that are worn or damaged.

CLUTCH KEYS AND SPRINGS

NOTE: The clutch hubs and sliding synchronizer sleeves are a matched assembly and should be kept together as originally assembled, but the three keys and two springs may be replaced if worn or broken.

REPLACEMENT

1. Push the hub from the sliding sleeve. The keys will fall free and the springs may be easily removed.

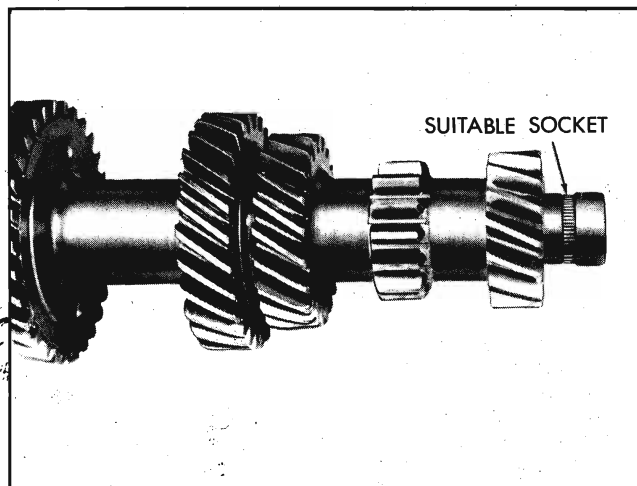


Fig. 7B-18 Suitable Socket Installed

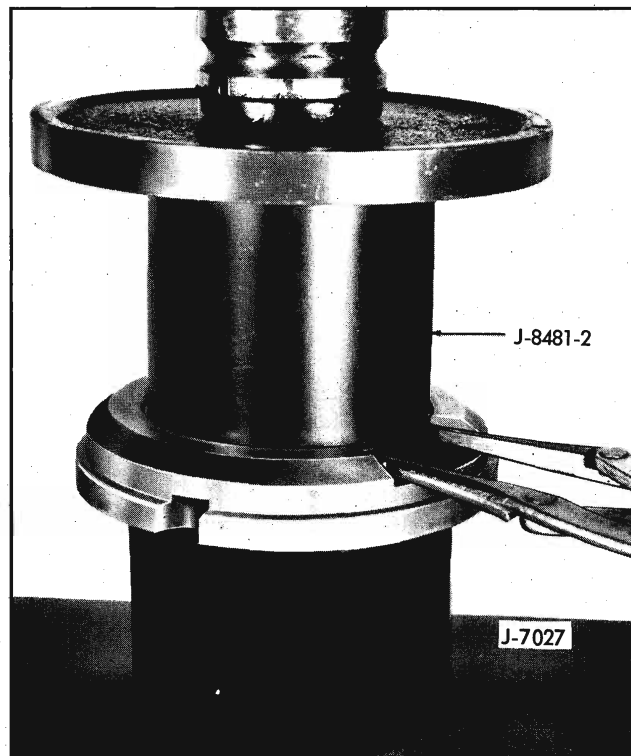


Fig. 7B-19 Removing Rear Bearing

2. Place the two springs in position (one on each side of the hub), so a tanged end of each spring falls into the same keyway in the hub (inset, Fig. 7B-17). Holding keys in position, align etched marks (Fig. 7B-17), in hub and sleeve, then slide hub into sleeve. *Be sure etched marks align after assembly.*

COUNTERGEAR NEEDLE BEARING REPLACEMENT

1. Install J-9563 and then install spacer just deep enough at one end to serve as seat for needle bearings.

2. Install 23 needle bearings.

3. Install retainer and move spacer and needle bearings back enough to accommodate outside row of 23 needle bearings.

4. Install needle bearings and retainer.

5. With suitable socket, move needle bearings and spacer toward opposite end of countergear, just enough to serve as seat for needle bearings at opposite end (Fig. 7B-18).

6. Install 23 needle bearings and retainer.

7. Move needle bearing and retainer inward to accommodate outer row of needle bearings.

8. Install 23 needle bearings and retainer.

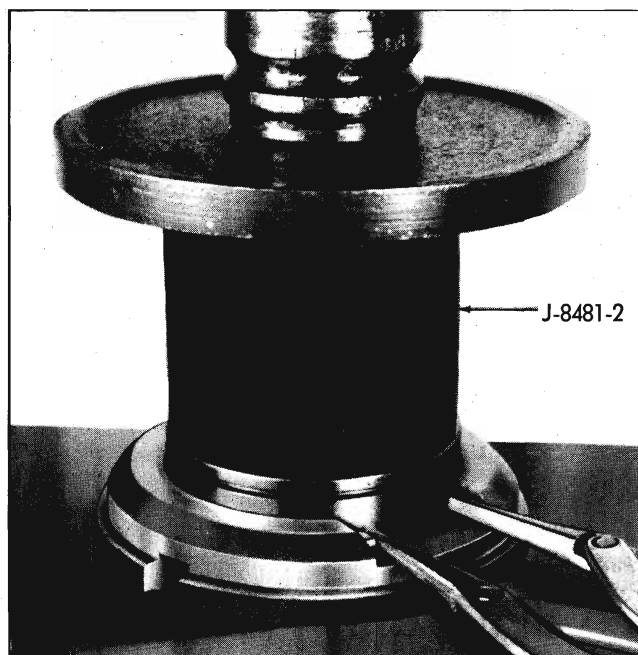


Fig. 7B-20 Installing Rear Bearing

REAR BEARING RACE REPLACEMENT

If inspection reveals the necessity to replace the rear bearing, place the bearing and retainer in a press. Expand retainer ring and press out bearing using J-8481-2 and J-7027 (Fig. 7B-19). Install a new bearing by reversing this procedure (Fig. 7B-20).

ASSEMBLE MAINSHAFT

1. Install 1-2 synchronizer hub onto mainshaft with shift fork groove of hub downward, then place first gear sleeve on mainshaft. Press both first gear sleeve and synchronizer hub onto mainshaft until they bottom, using J-6133 or other suitable tool (Fig. 7B-21).

2. Install blocker ring in rear of 1-2 synchronizer, being sure that notches in blocker ring engage keys in synchronizer unit. It should be noted that blocker rings used in the 1-2 synchronizer have slightly longer hubs (Fig. 7B-22) than those used in the 3-4 synchronizer. Then slide first speed gear (Fig. 7B-26) and its thrust washer onto mainshaft.

3. Press assembled rear bearing retainer and rear bearing onto mainshaft using J-6133 (Fig. 7B-23) and secure with selective fit snap ring. With the proper snap ring installed (three thicknesses available), maximum end play between rear face of rear bearing and snap ring will be .005".

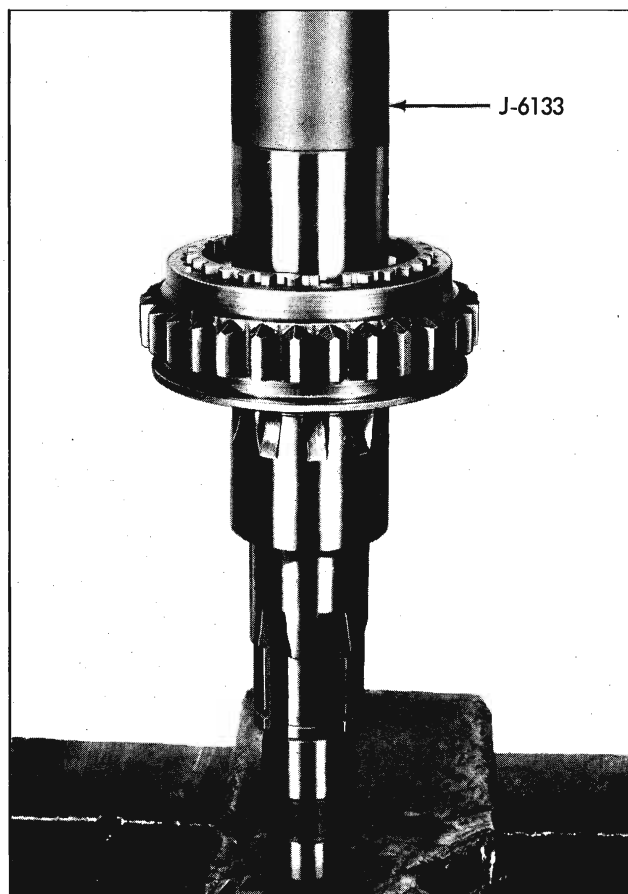


Fig. 7B-21 Installing 1-2 Synchronizer Hub

4. Invert mainshaft, then install the second blocker ring (long hub) in front side of 1-2 synchronizer, again being sure to engage blocker ring notches with keys in synchronizer unit.

5. Install second speed gear (Fig. 7B-26) with clutching teeth toward 1-2 synchronizer, then place radial needle bearing on second speed gear.

6. Install third speed gear, clutching teeth upward, onto mainshaft and seat it against the radial needle bearing (Fig. 7B-26).

7. Place 3-4 blocker ring on cone surface of third speed gear, then press 3-4 synchronizer unit onto

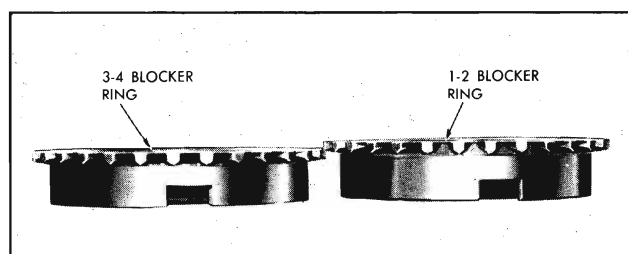


Fig. 7B-22 Blocker Rings

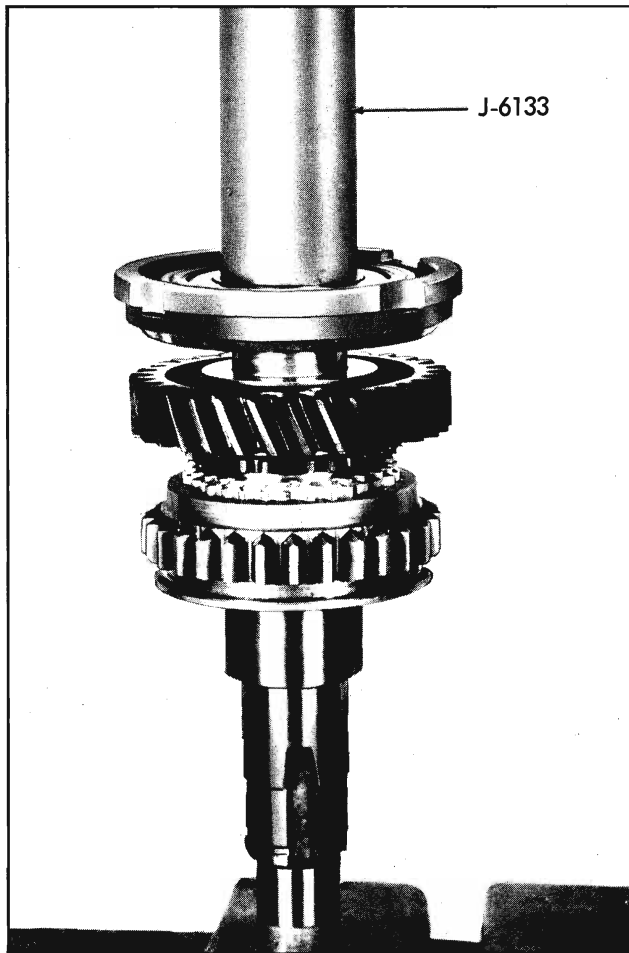


Fig. 7B-23 Installing Rear Bearing Retainer

blocker ring, with extended neck toward 3rd gear (Fig. 7B-24). Be sure notches in blocker ring engage clutch keys in synchronizer unit. Install second blocker ring onto 3-4 synchronizer unit. Install snap ring.

8. If clutch gear roller bearings have become displaced, load 33 needle bearings into innermost diameter and 37 needle bearings into outermost diameter, using a generous amount of petroleum jelly to prevent roller bearings from becoming displaced.

9. Carefully slide clutch gear onto mainshaft. It is good practice to place the clutch gear on a bench with its pilot bore upward, needle bearing retainer in place, and insert the mainshaft into the clutch gear. This prevents accidentally dislodging the clutch gear roller bearings. Set assembled mainshaft (Fig. 7B-26) aside for later installation into transmission.

ASSEMBLE TRANSMISSION

(See Fig. 7B-25 for transmission exploded view.)

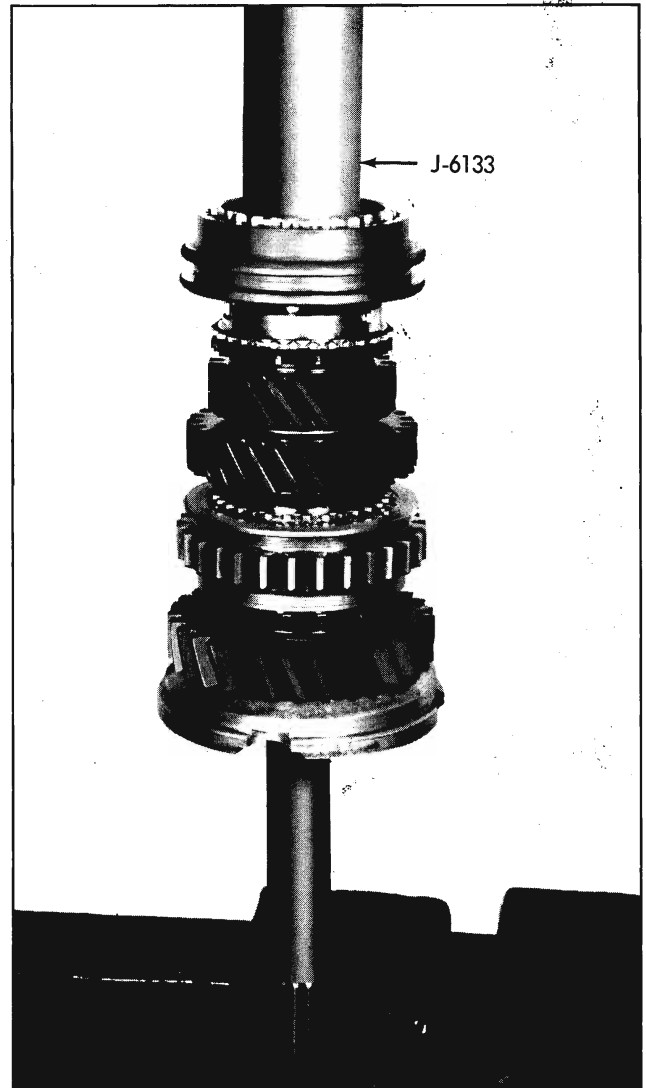


Fig. 7B-24 Installing 3-4 Synchronizer Unit

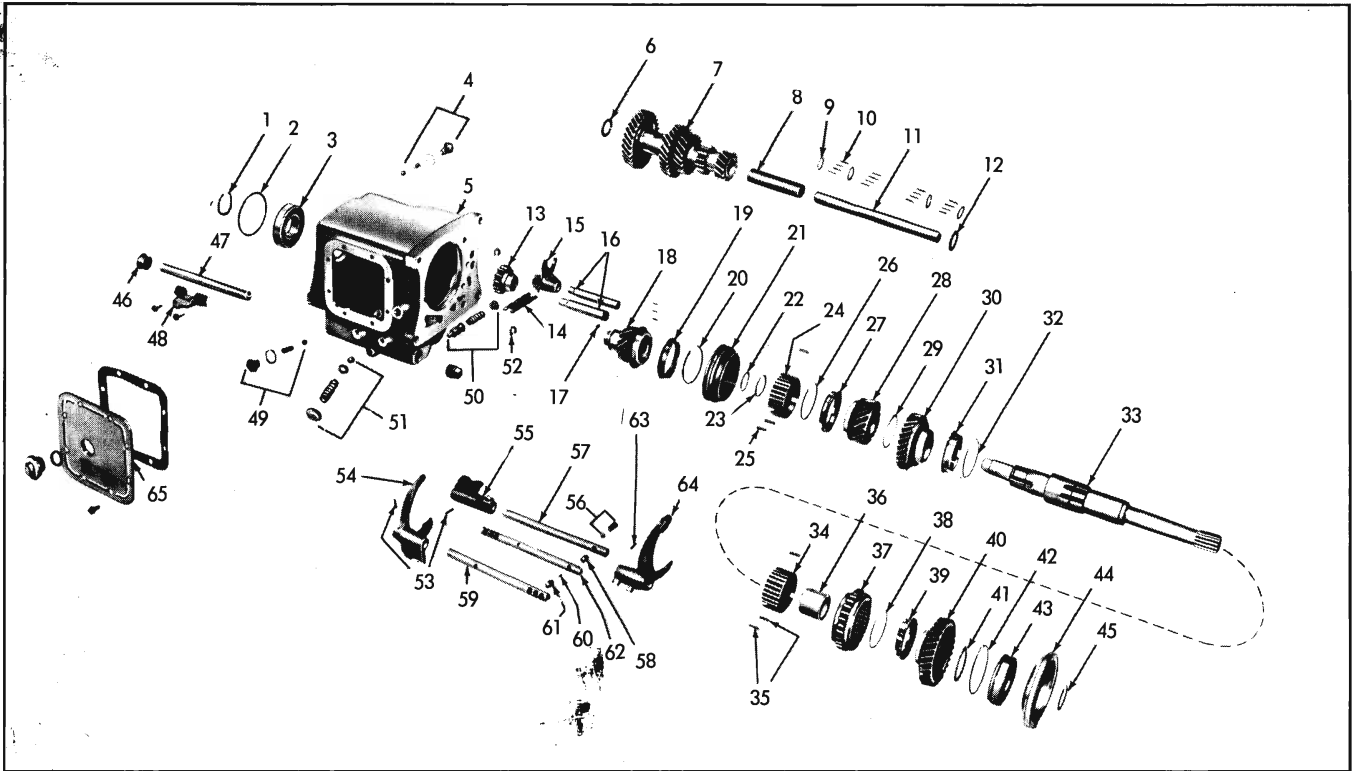
1. Install reverse inhibitor plug, then spring and reverse inhibitor plunger (Fig. 7B-13).

2. Install reverse inhibitor detent ball, ball seat, spring, and plug (Fig. 7B-12).

3. Coat selector shaft with grease, then insert through seal from the inside of the case. Do not install shaft from front of case as notches in selector shaft will damage seal lips.

4. Attach shift finger to selector shaft using two bolts and lock tabs. Bend tabs onto bolt heads after tightening bolts, then install drain plug in case at rear of selector shaft.

5. With tab facing out, place thrust washer on same end as larger countergear and rest countergear on



- | | | | |
|------------------------------------|----------------------------|---|---|
| 1. Snap Ring | 18. Clutch Gear | 35. Keys | 51. Reverse Inhibitor Detent Ball, Ball Seat, Spring and Plug |
| 2. Retainer Ring | 19. Blocker Ring | 36. Sleeve | 52. Snap Rings |
| 3. Clutch Gear Bearing | 20. Ring | 37. 1-2 Sliding Sleeve | 53. Roll Pins |
| 4. 1-2 Detent Ball, Spring and Cap | 21. 3-4 Sliding Sleeve | 38. Ring | 54. 3-4 Shift Fork |
| 5. Case | 22. Washer | 39. Blocker Ring | 55. Reverse Shifter Head |
| 6. Thrust Washer | 23. Snap Ring | 40. First Speed Gear | 56. Detent Spring and Ball |
| 7. Countergear | 24. 3-4 Clutch Hub | 41. Thrust Washer | 57. Reverse Shifter Head Shaft |
| 8. Sleeve | 25. Key | 42. Retaining Ring | 58. Interlock |
| 9. Spacer | 26. Ring | 43. Bearing | 59. 3-4 Shift Fork Shaft |
| 10. Needle Bearing | 27. Blocker Ring | 44. Bearing Retainer | 60. Interlock Pin |
| 11. Shaft | 28. Third Speed Gear | 45. Snap Ring | 61. Interlock |
| 12. Thrust Washer | 29. Radial Needle Bearings | 46. Seal | 62. 1-2 Shift Fork Shaft |
| 13. Reverse Idler Gear | 30. Second Speed Gear | 47. Selector Shaft | 63. Roll Pin |
| 14. Shifter Lever | 31. Blocker Ring | 48. Selector Finger | 64. 1-2 Shift Fork |
| 15. Shifter Fork | 32. Ring | 49. 3-4 Detent Ball, Spring and Cap | 65. Cover |
| 16. Shafts | 33. Main Shaft | 50. Reverse Inhibitor Plunger, Spring, and Plug | |
| 17. Woodruff Key | 34. 1-2 Clutch Hub | | |

Fig. 7B-25 Transmission Exploded View

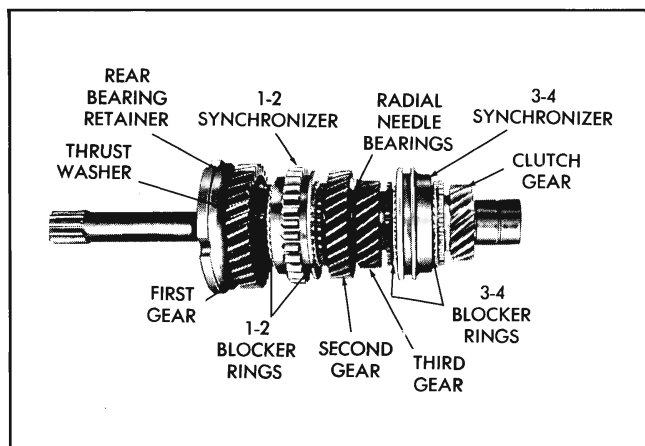


Fig. 7B-26 Assembled Mainshaft

bottom of case (larger gear toward front of case). Raise countergear and engage tool J-9563 through thrust washer and into case front hole just enough to hold countergear in place. Be sure thrust washer tab engages notch in case.

6. With tab facing out, insert rear thrust washer (tab engaging notch), insert countergear shaft at rear of case, and drive out J-9563 with countergear shaft. Tap countershaft until it is flush with the rear face of the case. The shaft is a slight press fit at front of case.

CAUTION: Hold tool J-9563 against countergear shaft while driving out to insure it is flush with shaft at all times. This will prevent displacement of any needle bearings. Be sure shaft is free from burrs.

7. Place reverse shifter lever (Fig. 7B-10) on pin in case with tapered end away from the reverse inhibitor.

8. Place the reverse idler gear shift fork in the case with its pin toward the front (Fig. 7B-10). Engage the fork pin with the reverse shifter lever, then insert the shift fork shaft.

9. With the reverse idler gear shift fork fully rearward, engage the reverse idler gear to the shift fork (Fig. 7B-10). Then align the Woodruff key groove in the idler gear shaft with the keyway in the rear face of the case and slide the shaft almost fully into the case, install Woodruff key in shaft, then fully bottom shaft.

10. Tap both reverse idler and shift fork shafts to insure full seating, then stake each shaft bore in two places below the rear face of the case adjacent to the shaft chamfer. Be sure stakes do not protrude above the rear face as this would disrupt the mating surface for the axle.

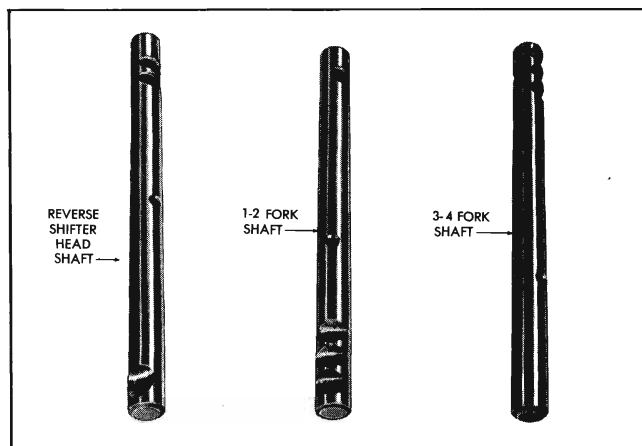


Fig. 7B-27 Shift Fork Shafts

11. Insert a detent spring and ball in the 3-4 detent channel, checking that the spring goes fully to the bottom of the channel and that the detent ball does not roll out the reverse shifter head shaft hole in the detent channel.

12. Lay out the shift fork shafts as illustrated in Fig. 7B-27 to prevent mixing the shafts during installation. With the interlock notches aligned, the reverse shifter head shaft can be identified as its pin hole is approximately centered on the shaft. The 1-2 fork shaft is most easily recognized as it has two interlock notches in the shaft and these notches are connected by a drilled hole which houses the interlock pin. Finally, the 3-4 fork shaft roll pin hole is closest to the end of the shaft opposite the detent notched end.

13. Depress the detent ball and spring in the 3-4 detent channel slightly with a small drift and insert the reverse shifter head shaft (Fig. 7B-28) partially into the case to compress the detent. Then engage the

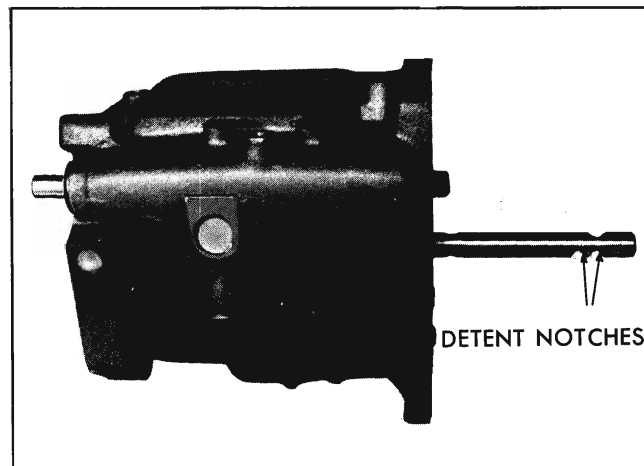


Fig. 7B-28 Reverse Shifter Head Shaft

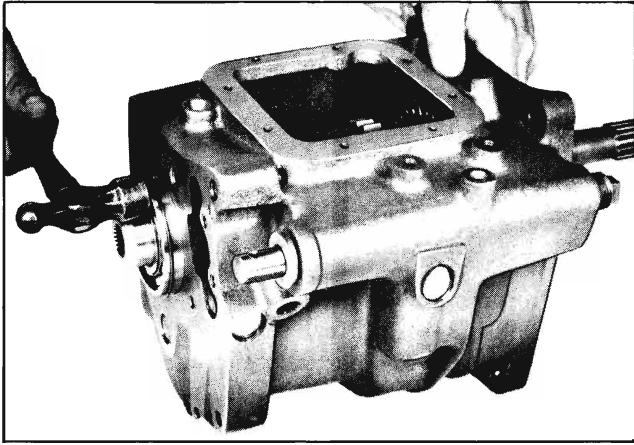


Fig. 7B-29 Installing Bearing

pin of the reverse shifter head with the yoke of the reverse shift lever. Check that the shaft pin hole is aligned with the pin hole in the shifter head and push the shaft through until the pin holes in the head and shaft align. Secure shifter head to shaft with roll pin (Fig. 7B-9); place in neutral.

14. To install the assembled mainshaft in the case, shift the synchronizers into second and fourth simultaneously (both full forward) to provide clearance to pass the countergear. Insert the mainshaft through the rear bearing bore into the case. Align rear bearing retainer snap ring cut outs, with snap ring cut outs, in rear face of case, then tap rear bearing retainer into case until flush with the rear face.

CAUTION: Make sure clutch gear stays securely in place.

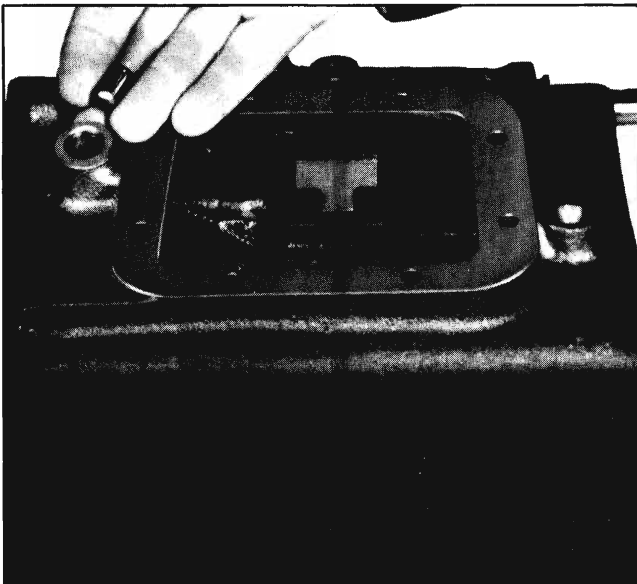


Fig. 7B-30 Installing Interlock

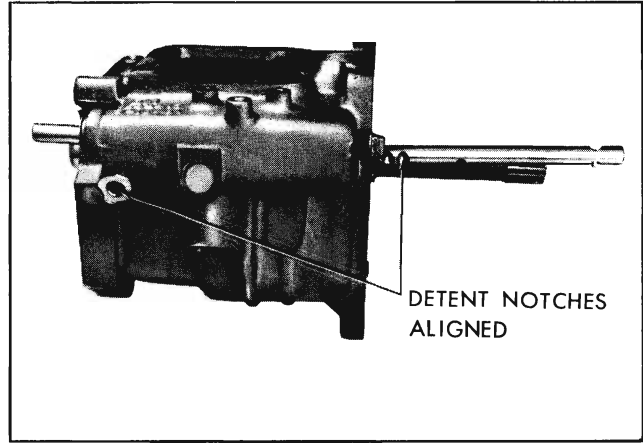


Fig. 7B-31 Fork Shaft Partially Installed

15. With large snap ring installed in outer diameter of front bearing, tap bearing into front of case and over clutch gear hub until large snap ring seats against front of case.

CAUTION: Hold rear bearing retainer while tapping clutch gear bearing, to prevent retainer from working out of case (Fig. 7B-29).

16. Retain clutch gear in bearing with selective snap ring (Fig. 7B-5). With proper snap ring installed, maximum end play between bearing and snap ring will be .005".

17. Install two rear bearing retainer rings (Fig. 7B-7).

18. Prior to installing the 1-2 shift fork, shift the 1-2 synchronizer and the 3-4 synchronizer to neutral.

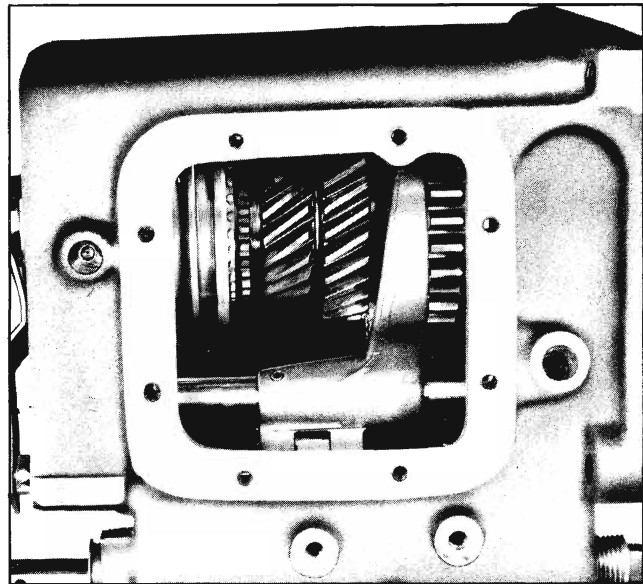


Fig. 7B-32 Fork (1-2) Installed

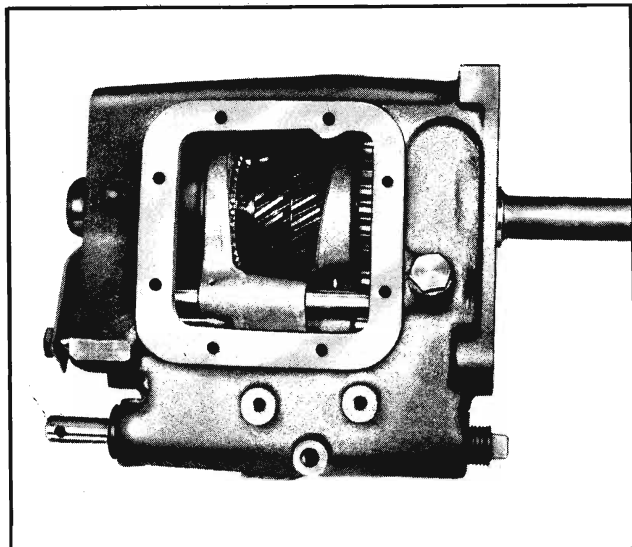


Fig. 7B-33 Fork (3-4) Installed

Then install one interlock in the 3-4 detent channel (Fig. 7B-30).

19. With the interlock pin in the hole in the interlock notch end, push the 1-2 shift fork shaft partially into the case (Fig. 7B-31). The interlock end (two op-

posite notches) of the shaft goes to the rear of the case. Engage 1-2 shift fork which is identified by the thru gate at the shift location, with the 1-2 synchronizer. Align the pin holes in the shaft and fork, and secure fork to shaft with roll pin (Fig. 7B-32).

20. Install detent ball, spring, gasket, and cap in 1-2 detent channel (Fig. 7B-3). Cap used at this location has the longer shank.

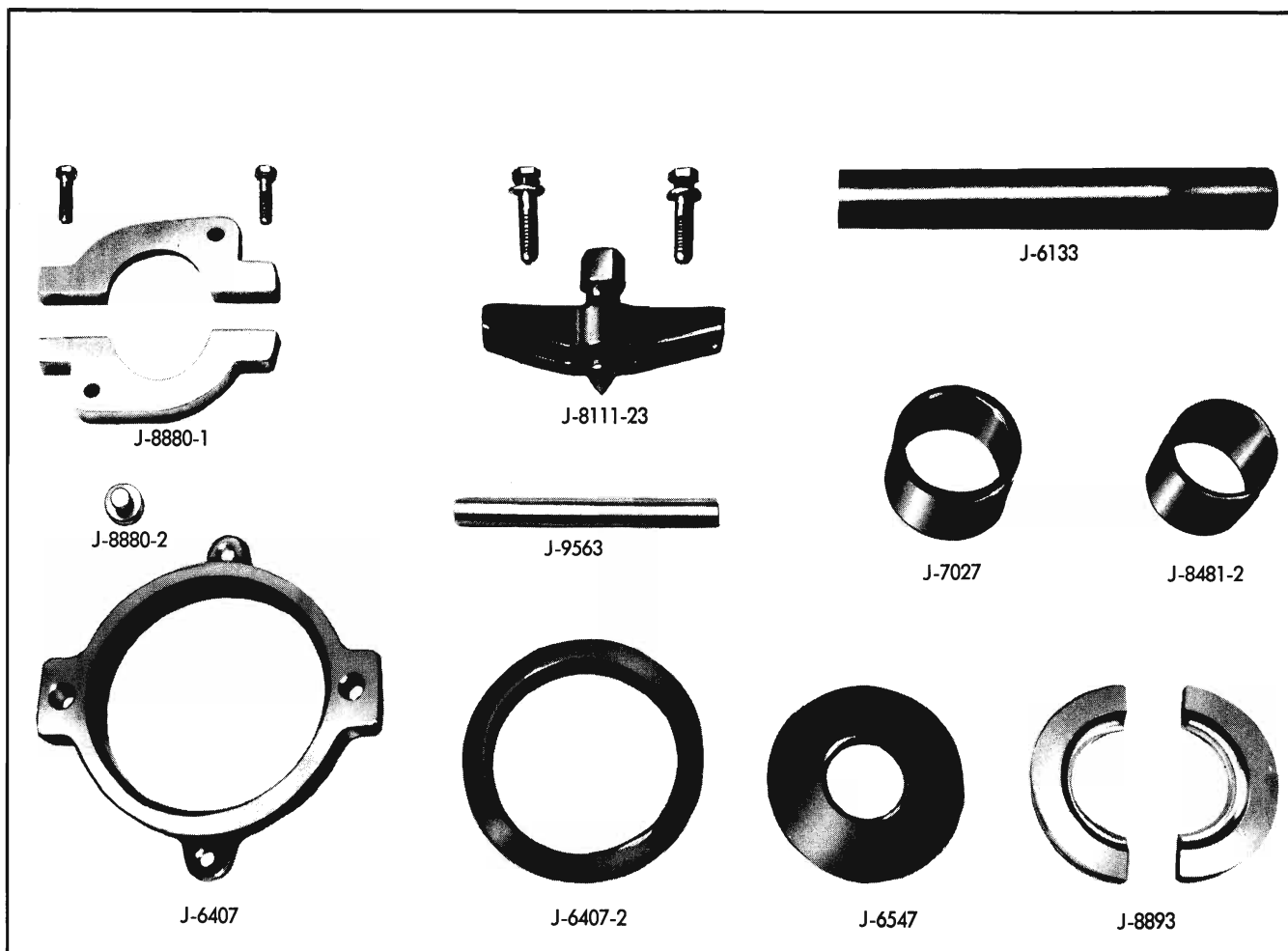
21. Drop remaining interlock into 3-4 detent channel, then push 3-4 shift fork shaft (with three detents away from interlock) partially through hole in front of case. Engage 3-4 shift fork in 3-4 synchronizer, align pin hole in shift fork and shaft. Secure shift fork shaft with roll pin (Fig. 7B-33).

22. Install remaining detent ball, spring, nylon washer, and cap in 3-4 detent channel at left rear of case.

23. Prior to installing side cover, test operation of shift forks by actuating the shift selector lever with a small pin punch inserted in the hole in the shifter shaft. If the transmission shifts satisfactorily, install side cover with new gasket and secure with eight bolts tightened 3-4 ft. lb.

TORQUE SPECIFICATIONS

	Lb. Ft.
Gearshift lever housing to torque tube bolts	10-15
Control rod to coupling clamp nut	10-20
Shift lever housing cover bolts	4-5
Shift finger to shift shaft cap screws	7-10
Detent cavity covers	10-20
Top cover bolts	3-4
Extension to transmission bolts	35-40



SPECIAL TOOLS

J-8880-1	Clutch Gear Bearing Puller Plates	J-7027	Support
J-8111-23	Clutch Gear Bearing Puller Body	J-8481-2	Rear Bearing Remover and Installer
J-6133	Installer	J-6407	Press Plate Holder
J-8880-2	Adapter Plug	J-6547	Support
J-9563	Countergear Needle Bearing Loader	J-8893	Support

FUEL TANK AND EXHAUST

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
FUEL TANK			
Description	8-1	Remove and Replace Connector Four Cylinder Engine	8-4
Service Procedures	8-1	Remove and Replace Exhaust Pipe Four Cylinder Engine	8-4
Draining Fuel Tank	8-1	Remove and Replace Exhaust Crossover Pipe— V-8 Engine	8-4
Remove and Replace Fuel Tank	8-1	Remove and Replace Exhaust Pipe— V-8 Engine	8-5
Trouble Diagnosis	8-3	Remove and Replace Muffler	8-5
EXHAUST SYSTEM			
Description	8-3	Remove and Replace Tail Pipe	8-5
Service Procedures	8-4	Remove and Replace Muffler Support Assembly	8-5
Remove and Replace Exhaust System Four Cylinder Engine	8-4	Remove and Replace Tail Pipe Support	8-5
Remove and Replace Exhaust System V-8 Engine	8-4	Specifications	8-5
Remove and Replace Exhaust Crossover Pipe Four Cylinder Engine	8-4		

FUEL TANK

DESCRIPTION

The fuel tank is constructed of two sheet metal sections welded together. This filler pipe is permanently attached to the tank, which is secured to the underside of the body by two metal straps. They are held in place with a pin on one end and a bolt on the other.

The tank filler pipe is located on the left side of the car and is accessible through a spring hinged door. A vented filler cap is used on all models.

The fuel gauge and filter assembly are located in the tank and are accessible only with fuel tank removed from car. The filter is of double wrap plastic construction. The filter has a sufficiently fine mesh to prevent water or particles large enough to damage fuel pump from passing through.

The fuel line runs under the car and is connected to the tank with a piece of hose and two corbin clamps.

SERVICE PROCEDURES

TO DRAIN FUEL TANK

1. Insert a length of hose (Fig. 8-1 for details) into the gas tank, pipe nipple end first, until weighted end of hose rests on bottom of tank.

2. With chuck of air hose inserted into hose slit, a short blast of air will cause the gas to flow.

NOTE: The tank can be drained rapidly by raising the car several feet off the floor when performing the above operation.

REMOVE AND REPLACE FUEL TANK

REMOVE

1. Disconnect wire from tank gauge unit inside of trunk and force wire through grommet in floor of trunk.
2. Raise car and support fuel tank.
3. Drain fuel tank as described, page 8-1.
4. Remove corbin clamp connecting fuel line to tank.

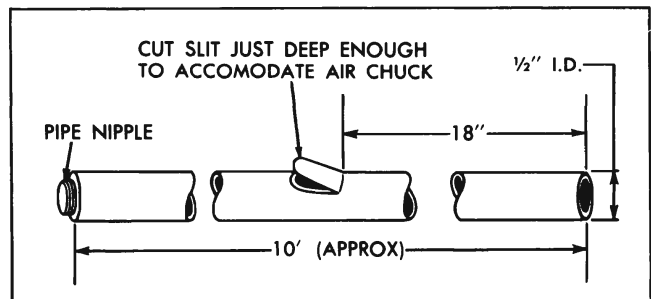


Fig 8-1 Typical Drain Hose

5. Remove two screws connecting fuel filler pipe to splash shield. (Early model only).

6. Remove screws connecting vent pipe to side rail.

7. Remove two screws connecting splash shield to body.

8. Remove two nuts securing straps that hold fuel tank to body.

9. Lower fuel tank from car.

2. Install two straps and secure with nuts.

3. Push fuel tank gauge unit wire through grommet under car into trunk.

4. Install corbin clamp connecting fuel line to tank.

5. Install two screws connecting fuel filler pipe to splash shield. (Early model only).

6. Install two screws connecting splash shield to body.

7. Install screw connecting vent pipe to side rail.

8. Connect connector inside of trunk.

REPLACE

1. Raise fuel tank into position under car.

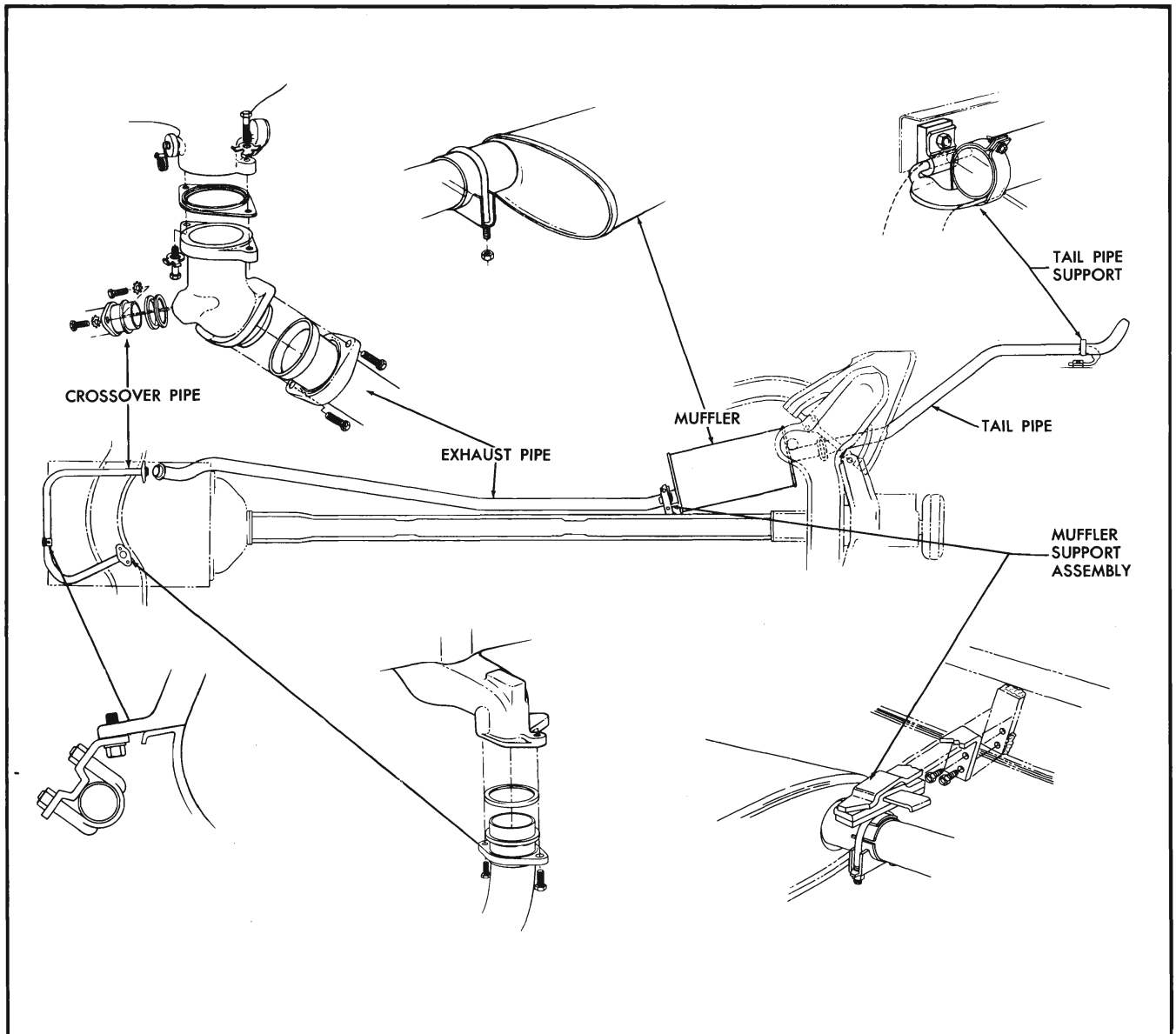


Fig. 8-2 Exhaust System—Four Cylinder Engine

TROUBLE DIAGNOSIS

LEAKS

Before removing fuel tank to correct a leak, a careful inspection of the tank should be made to determine as accurately as possible the source of the leak. So called "seam leaks" very often turn out to be loose screws at the fuel gauge tank unit. In this case the gasoline runs down on the flange of the seam and drips off at points along the seam giving the false indication of leaking seams.

NOISES

Stones on top of the tank may be the cause and should be removed.

TANK UNIT

Diagnosis for the fuel tank gauge unit appears in Section 11.

EXHAUST SYSTEM

DESCRIPTION

The major units of the exhaust system of the Four Cylinder Engine (Fig. 8-2) are the exhaust crossover pipe, exhaust pipe, muffler and tail pipe. The gases formed as fuel is burned in the combustion chamber of the engine pass into the exhaust manifold. Here if the engine is cold a thermostatically controlled valve in the outlet of the exhaust manifold blocks the pass-

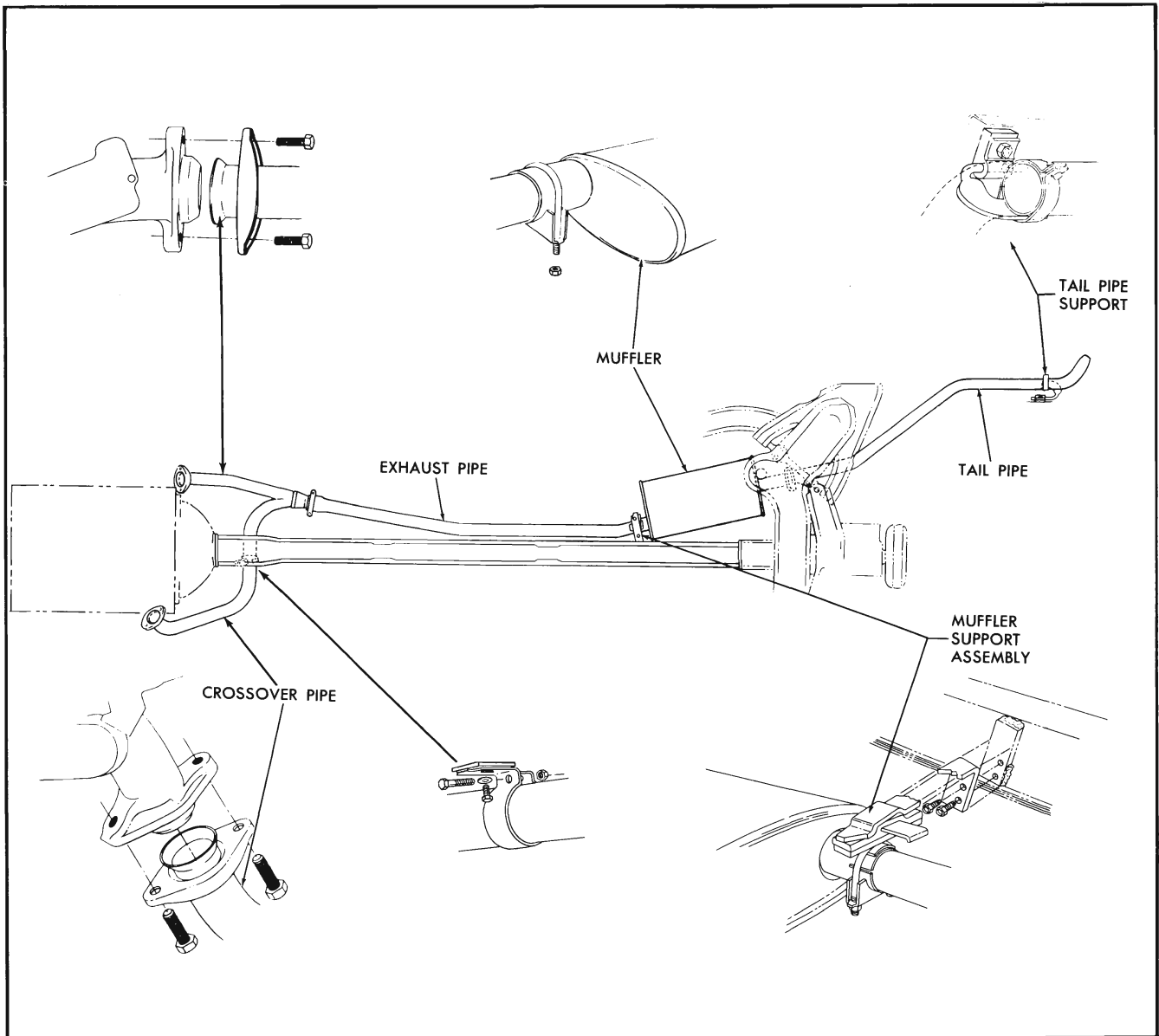


Fig. 8-3 Exhaust System—Eight Cylinder Engine

age of exhaust gases out of the manifold. Exhaust gases then pass through the crossover passage in the intake manifold heating the manifold stove. From the intake manifold the gases pass through the exhaust crossover pipe and into the connector. When the engine warms up the thermostatic valve opens and the exhaust gases pass directly into the connector. From here they are carried into the exhaust pipe through the muffler assembly and out the tail pipe.

The major units of the V-8 exhaust system (Fig. 8-3) are the exhaust crossover pipe, exhaust pipe, muffler and tail pipe. The fuel burned in the combustion chamber of the engine passes into the exhaust manifolds of the engine. A heat riser pipe in the right hand manifold supplies heated air to the carburetor choke assembly. The crossover pipe connects both exhaust manifolds to the exhaust pipe. From the exhaust pipe the gases pass through the muffler and out the tail pipe.

SERVICE PROCEDURES

REMOVE AND REPLACE EXHAUST SYSTEM FOUR CYLINDER ENGINE

REMOVE

1. Remove two bolts connecting exhaust pipe to connector.
2. Remove entire exhaust system by moving rearward to remove hooks from insulators.

REPLACE

1. Position exhaust system and slide hooks through insulators.
2. Secure exhaust pipe to connector.

REMOVE AND REPLACE EXHAUST SYSTEM EIGHT CYLINDER ENGINE

REMOVE

1. Remove bolts connecting crossover pipe to exhaust manifold. Remove exhaust crossover pipe support to torque tube bolt.
2. Remove entire exhaust system by moving rearward to remove hooks from insulators.

REPLACE

1. Position exhaust system and slide hooks through insulators.
2. Secure exhaust crossover pipe to exhaust manifolds. Secure crossover pipe support to torque tube.

REMOVE AND REPLACE EXHAUST CROSSOVER PIPE FOUR CYLINDER ENGINE

1. Disconnect crossover pipe from intake manifold.
2. Remove two nuts from U-bolt and remove U-bolt from clamp.
3. Disconnect and remove exhaust crossover pipe from connector.
4. Replace crossover pipe, using new gaskets, by reversing above steps. Tighten bolts at each end of crossover pipe to 15-25 lb. ft. torque.

REMOVE AND REPLACE CONNECTOR FOUR CYLINDER ENGINE

1. Remove two bolts attaching crossover pipe to connector.
2. Remove two bolts attaching exhaust pipe to connector.
3. Remove two bolts attaching connector to exhaust manifold.
4. Replace connector, using new gaskets, by reversing above steps. Tighten bolts to 15-25 lb. ft. torque.

REMOVE AND REPLACE EXHAUST PIPE FOUR CYLINDER ENGINE

1. Remove two bolts connecting exhaust pipe to connector.
2. Remove clamp securing exhaust pipe to muffler.
3. Remove exhaust pipe from car.
4. Replace exhaust pipe, using new gaskets, by reversing above steps. Tighten exhaust pipe to connector bolts to 15-25 lb. ft. torque, clamp, U-bolt nuts to 10-15 lb. ft. torque.

REMOVE AND REPLACE EXHAUST CROSSOVER PIPE V-8 ENGINE

1. Remove four bolts connecting exhaust crossover pipe to exhaust manifold.
2. Remove support strap connecting crossover pipe to torque tube.
3. Remove clamp connecting exhaust crossover pipe to exhaust pipe.
4. Remove exhaust crossover pipe from car.
5. Replace exhaust crossover pipe by reversing above steps. Tighten bolts connecting crossover pipe to manifold to 15-25 lb. ft. torque. Tighten nuts on clamp to 10-15 lb. ft. torque.

REMOVE AND REPLACE EXHAUST PIPE V-8 ENGINE

1. Remove clamps at both ends of exhaust pipe.
2. Remove exhaust pipe from car.
3. Replace exhaust pipe by reversing above procedure. Tighten nuts to 10-15 lb. ft. torque.

REMOVE AND REPLACE MUFFLER

1. Remove clamp from support assembly and from front of muffler.
2. Remove muffler from car.
3. Replace muffler by reversing above steps. Tighten nuts on clamp to 10-15 lb. ft. torque.

REMOVE AND REPLACE TAIL PIPE

1. Remove U-bolt connecting muffler and tail pipe to support assembly.
2. Remove clamp securing hook to tail pipe.
3. Remove tail pipe from car.
4. Replace by reversing above steps. Tighten U-bolt nuts to 10-15 lb. ft. torque. Tighten screw on clamp to 15-45 lb. in. torque.

REMOVE AND REPLACE MUFFLER SUPPORT ASSEMBLY

1. Remove two nuts from U-bolt and remove clamp.

2. Remove two bolts, nuts and washers from control arm.

3. Remove muffler support assembly from car.

4. Replace muffler support assembly by reversing above steps. Tighten control arm bolts to 40-55 lb. ft. torque. Tighten U-bolt nuts to 10-15 lb. ft. torque.

REMOVE AND REPLACE TAIL PIPE SUPPORT

1. Remove screws from clamp on tail pipe.

2. Remove hook from support.

3. Remove screw from washer and insulator.

4. Replace tail pipe support by reversing above steps. Tighten screw securing insulator to 30-40 lb. in. torque. Clamp screw tighten to 15-45 lb. in. torque.

SPECIFICATIONS

Fuel Tank Capacity 16 Gal.

Exhaust crossover pipe diameter
(Four Cylinder) 1 $\frac{1}{8}$ "

Exhaust crossover pipe diameter (V-8) 1 $\frac{5}{8}$ "

Exhaust pipe diameter (Four Cylinder 1 bbl) 1 $\frac{3}{4}$ "

Exhaust pipe diameter (V-8 and 4 bbl.) 2 $\frac{1}{4}$ "

Tail pipe diameter (1 bbl, 4 cyl.) 1 $\frac{1}{2}$ "

Tail pipe diameter (4 bbl., 4 cyl.) 2"

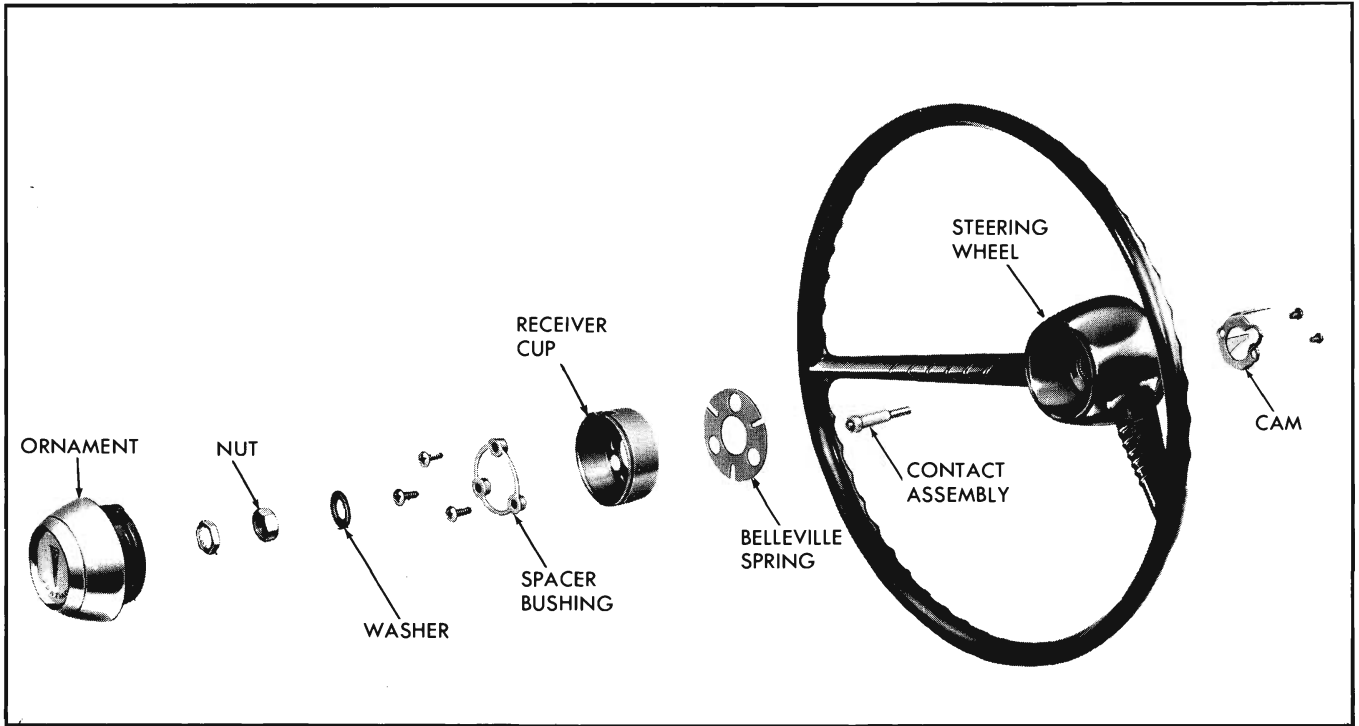


Fig. 9-1 Standard Steering Wheel Assembly

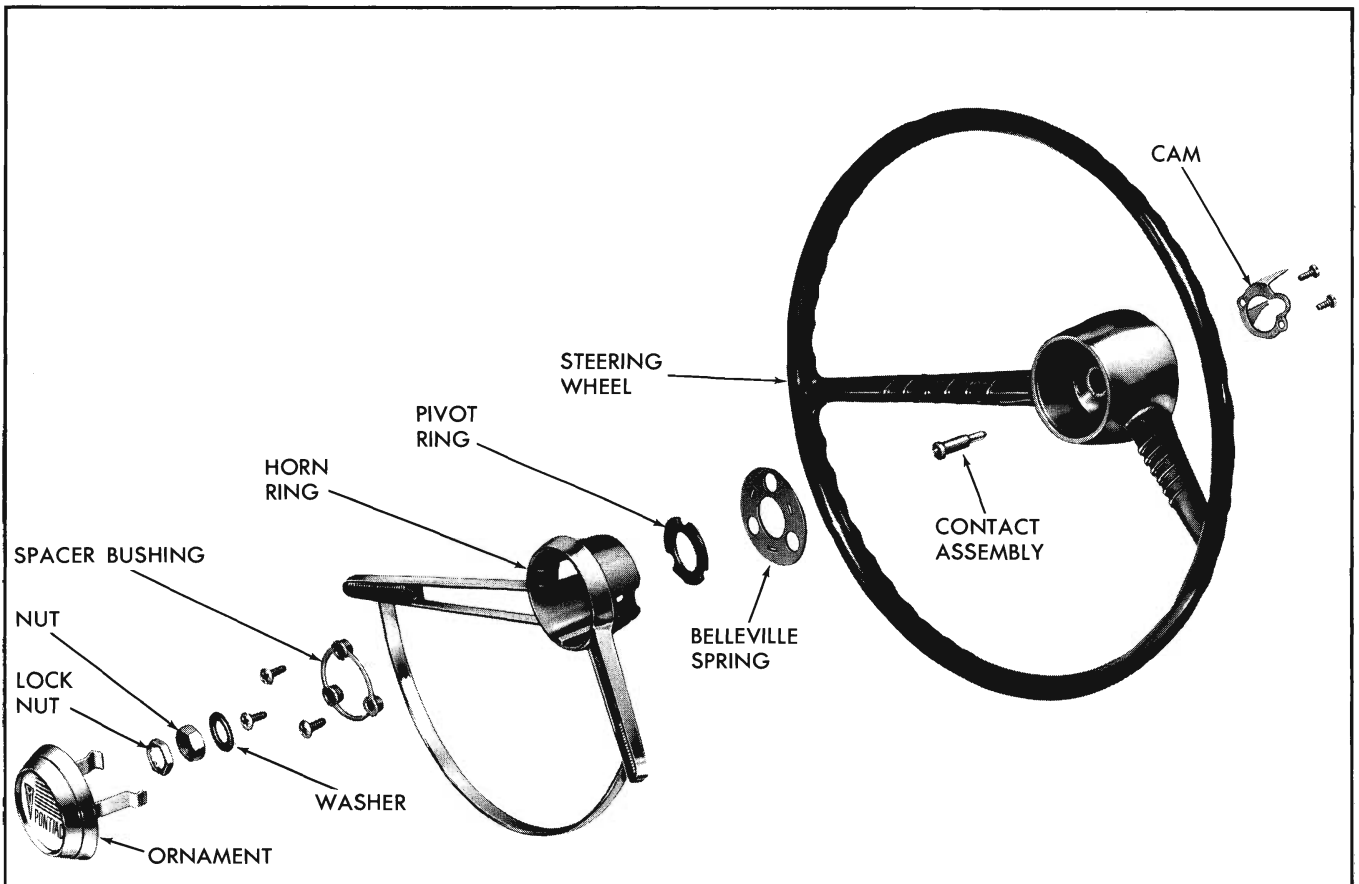


Fig. 9-2 Deluxe Steering Wheel Assembly

STEERING

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SUBJECT	PAGE	SUBJECT	PAGE
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Assemble Steering Linkage	9-3	Disassemble	9-8
Steering Column Jacket	9-3	Cleaning and Inspection	9-9
Steering Gear	9-4	Assemble	9-11
Description	9-4	Torque Specifications	9-12
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REPLACE STEERING WHEEL

1. Lift to remove ornament (Figs. 9-3 and 9-4).
2. Remove two nuts and washer from the shaft.
3. Remove spacer bushing.
4. Remove horn ring (deluxe wheel) or receiver cup (standard wheel).
5. Remove pivot ring (deluxe wheel) and belleville spring.
6. Remove contact assembly.



Fig. 9-3 Standard Horn Button

7. Remove steering wheel using Puller J-3044-01 (Fig. 9-5).

8. To replace, reverse the above procedure, making sure steering wheel is in straight ahead position (Fig. 9-6). Tighten steering wheel nut to $2\frac{1}{2}$ lb. ft. torque.

STEERING LINKAGE

REMOVE

1. Raise car.

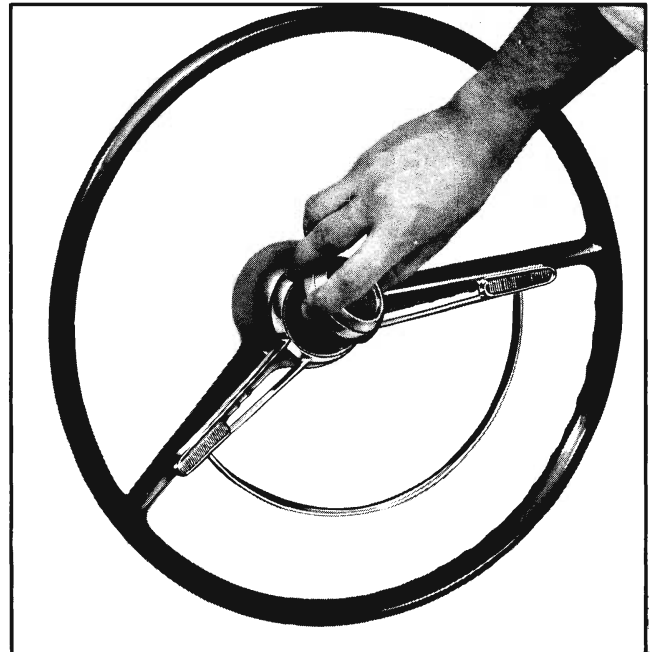


Fig. 9-4 Deluxe Horn Button

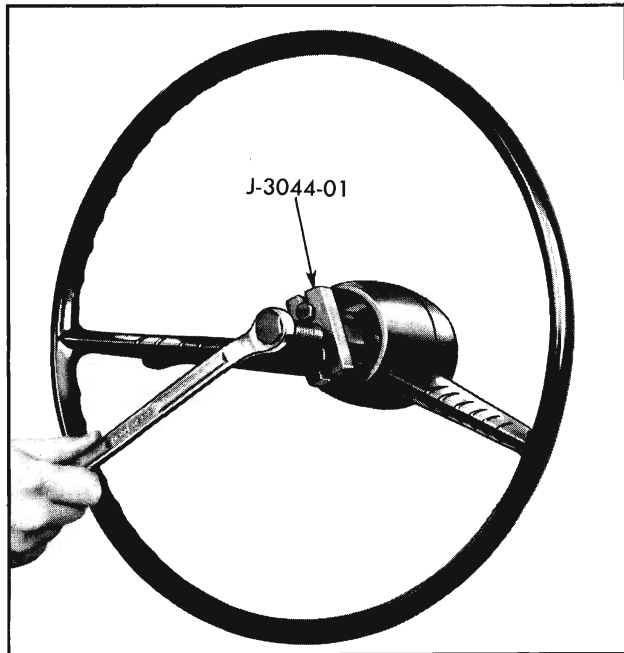


Fig. 9-5 Pulling Steering Wheel

2. Remove cotter pin and nut and remove tie-rod end stud from steering arm at each front wheel with tool J-6627.

3. Remove nut and lock washer and remove pitman arm from pitman arm shaft with tool J-5504-B.

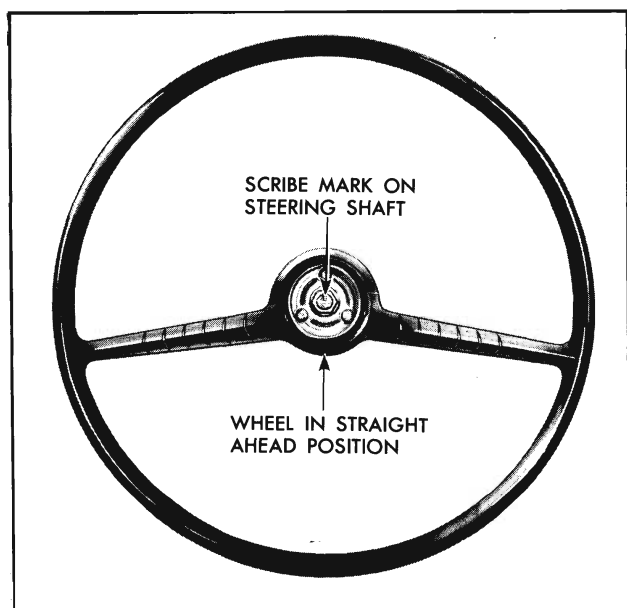


Fig. 9-6 Steering Wheel Installed

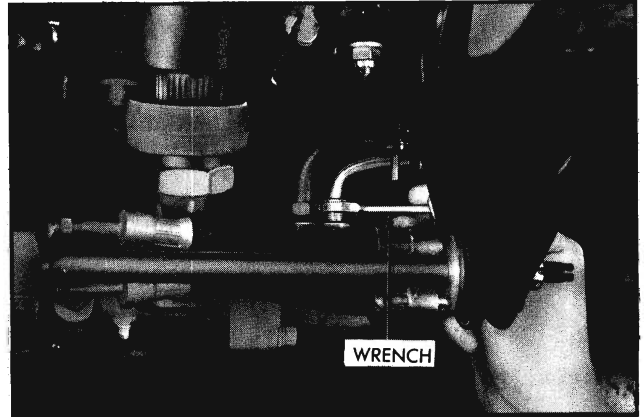


Fig. 9-7 Removing Inlet and Outlet Hoses

4. Remove idler arm nuts and remove idler arm and steering linkage from car.

INSTALL

1. Install idler arm and steering linkage into car, securing idler arm with bolts, lock washers and nuts. Tighten to 20-30 lb. ft. torque.

2. Install pitman arm on pitman shaft. Make sure steering gear is at high point with wheels straight ahead before installing arm on shaft.

3. Install pitman arm lock washer and nut. Torque to 100-125 lb. ft.

4. Install tie-rod end into steering arm at each front wheel and torque nut to 60-95 lb. ft. Install cotter pin.

STEERING LINKAGE

DISASSEMBLE

1. Thread idler support from bushing, then idler arm from bushing.

2. Tie-rod ends and idler arm may be disconnected from steering linkage by removing cotter pins and nuts and using Tool J-6627. Use Tool J-5504-B to disconnect pitman arm from pitman shaft.

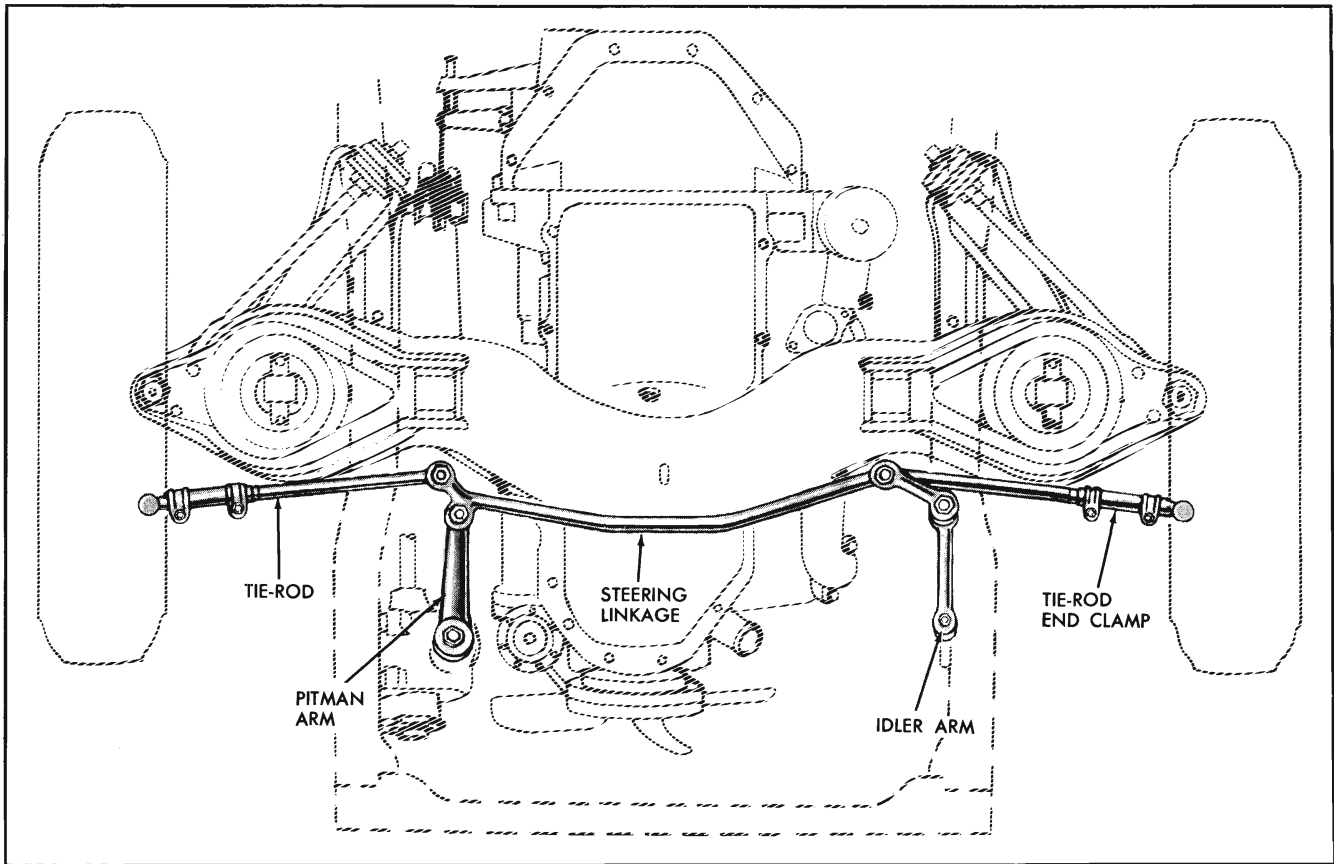


Fig. 9-8 Standard Steering Linkage

ASSEMBLE

1. Connect pitman arm, idler arm, and tie rod ends to steering linkage and torque nuts to 50 lb. ft. **NOTE:** Do not back off nuts to insert cotter pins.

2. Thread idler arm onto bushing, then idler support onto bushing. Torque bushing to 110-115 lb. ft. **NOTE:** Distance between upper face of idler arm and shoulder at thread end of idler support should be approximately $1\frac{1}{16}$ ".

STEERING COLUMN JACKET

REMOVE

1. Remove steering wheel (page 9-1).
2. Loosen lower steering column jacket clamp (Fig. 9-9).
3. Remove steering column jacket directional signal switch from jacket (Fig. 9-10).

4. Disconnect directional signal switch control cable from switch and disconnect horn contact terminal (Figs. 9-10 and 9-11).

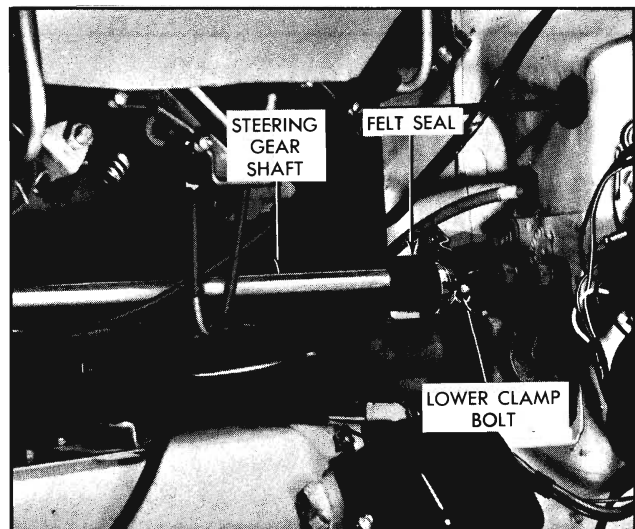


Fig. 9-9—Steering Shaft and Jacket

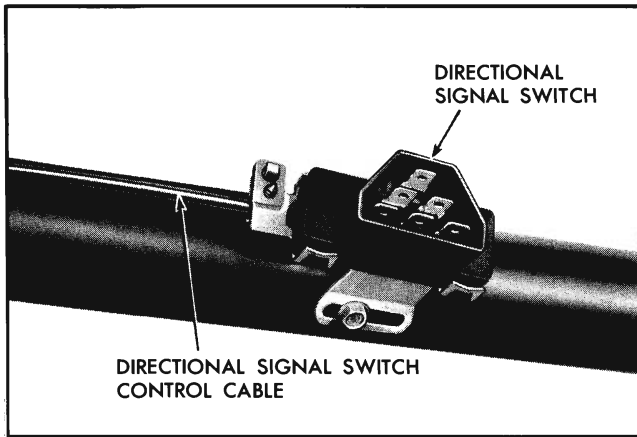


Fig. 9-10 Directional Signal Switch Assembly

5. Remove upper steering column jacket bezel screws (Fig. 9-12) and upper steering column jacket clamp, located just under front edge of instrument panel.

6. Pull steering column jacket out.

INSTALL

1. Install steering column jacket into lower retainer (line up key-way).

2. Torque lower clamp nut to 4-5 lb. ft.

3. Install upper clamp and torque bolts to 4-5 lb. ft.

4. Install upper bearing and horn contact (Fig. 9-12).

5. Connect directional signal control cable to switch and connect horn contact terminal.

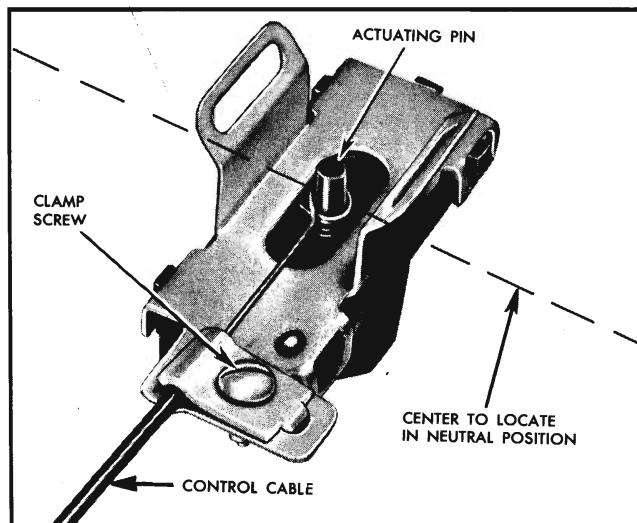


Fig. 9-11 Control Cable Wire

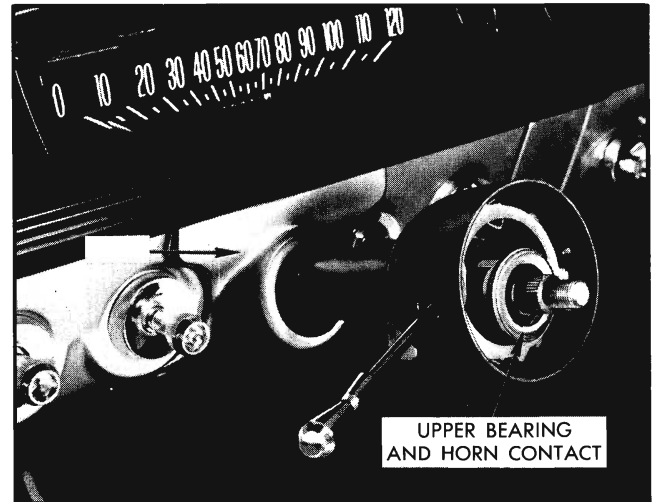


Fig. 9-12 Upper Steering Column Assembly

6. Attach directional signal switch to steering column jacket and adjust as outlined in Section 11.

7. Install steering wheel (page 9-1).

8. Install bezel attaching screws.

STEERING GEAR

DESCRIPTION

The steering gear (Fig. 9-13) is the recirculating ball nut type having a gear and overall ratio of 24-1. The ball nut, mounted on the worm, is driven through steel balls which circulate in helical grooves in both the worm and nut. Ball return guides, attached to the nut, serve to recirculate the two sets of twenty-five balls each in the grooves.

As the steering wheel is turned to the right, the nut moves upward. When the wheel is turned to the left the nut moves downward.

The teeth on the sector (which are forged as part of the pitman shaft) and the ball nut are so designed that a tighter fit exists between the two when the front wheels are straight ahead. Proper engagement between the sector and the ball nut is obtained by an adjusting screw which moves the pitman shaft endwise, permitting desired engagement of the tapered teeth of the ball nut and sector gear. The worm bearing adjuster can be turned to provide proper pre-loading of the upper and lower bearings.

PERIODIC SERVICE

Periodic service consists of periodical lubrication as outlined in General Lubrication section.

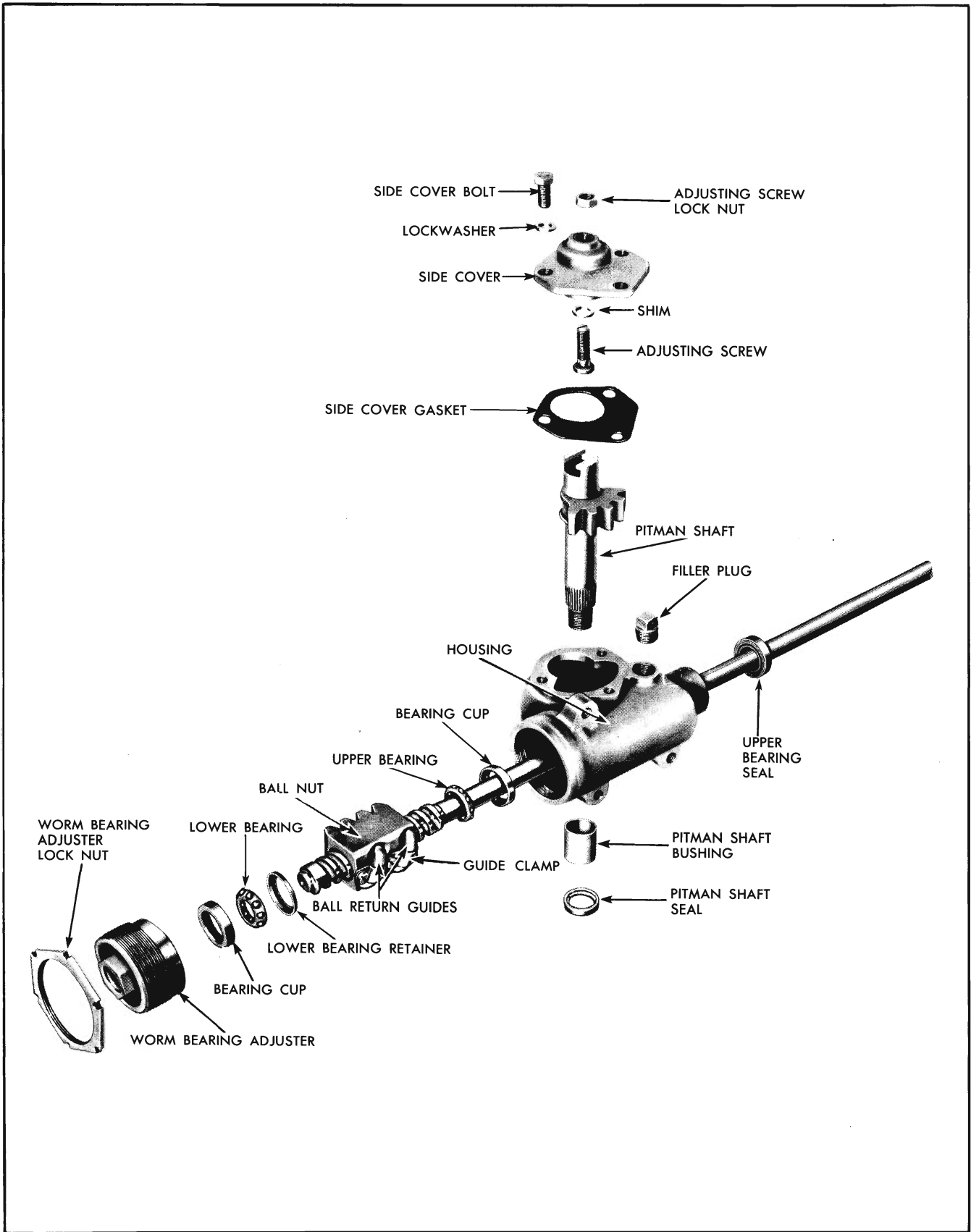


Fig. 9-13 Steering Gear Exploded View

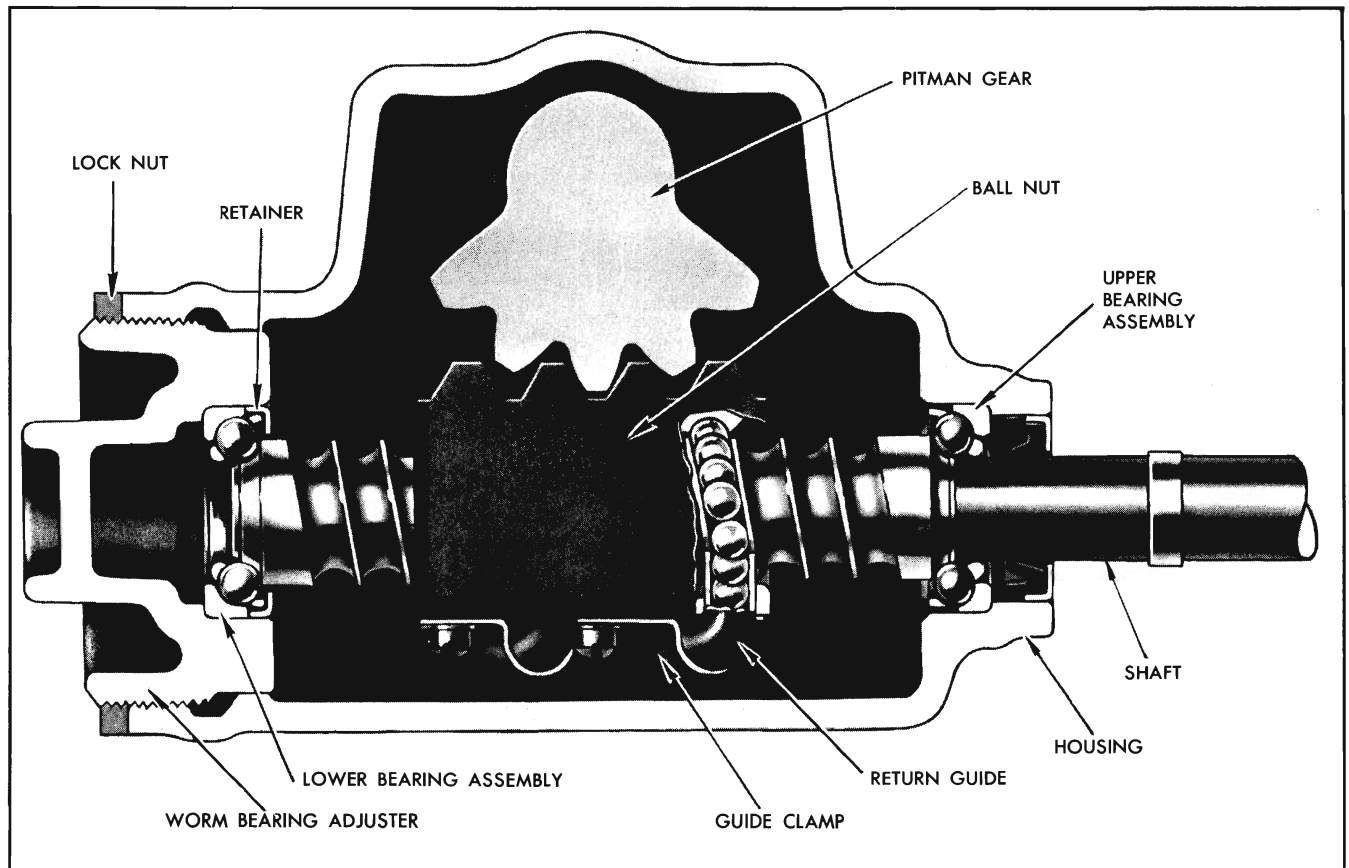


Fig. 9-14 Steering Gear Cut-away View

ADJUSTMENTS ON CAR

Correct adjustment of the steering gear is extremely important and can only be obtained by following the correct procedure. Before any adjustments are made to the steering gear, in an attempt to correct such conditions as shimmy, hard or loose steering and road shocks, careful check should be made to determine that front suspension alignment, shock absorbers, wheel balance and tire pressure are correctly adjusted and/or are operating satisfactorily.

There are two adjustments on the recirculating ball type steering gear:

1. Worm bearing preload adjustment.
2. Sector and ball nut backlash adjustment.

CAUTION: It is very important when adjusting the steering gear, that the adjustment be made in the above sequence. Failure to do so will result in damage to the steering gear.

Service adjustment is not required until:

1. Worm bearing load falls below 2 in. lbs. and or
2. Total overcenter load falls below worm bearing load plus 2 in. lbs.

ADJUST WORM BEARING PRELOAD

1. Disconnect steering linkage from pitman arm (Fig. 9-8) by removing cotter pin and nut and using Tool J-6627.
2. Tighten pitman arm nut to 100-125 lb. ft. torque.
3. Loosen steering column bracket to make certain column is not sprung due to misalignment. If misaligned, shim at steering gear housing to frame bolts and tighten bracket (Fig. 9-16).
4. Remove horn button.
5. Loosen pitman shaft adjusting screw lock nut and back off adjusting screw a few turns (Fig. 9-17).
6. With a inch pound torque wrench at steering wheel, measure pull required to keep wheel in motion when off high point, at least 30° off center (Fig. 9-18).
Pull required should be 6-10 in. lbs. (Standard Steering) or 1½-5½ in. lbs. (Power Steering). To correct, loosen worm bearing adjuster lock nut (Fig. 9-13) with brass drift and turn adjuster to bring pull within limits.
7. Retighten worm bearing adjuster lock nut to

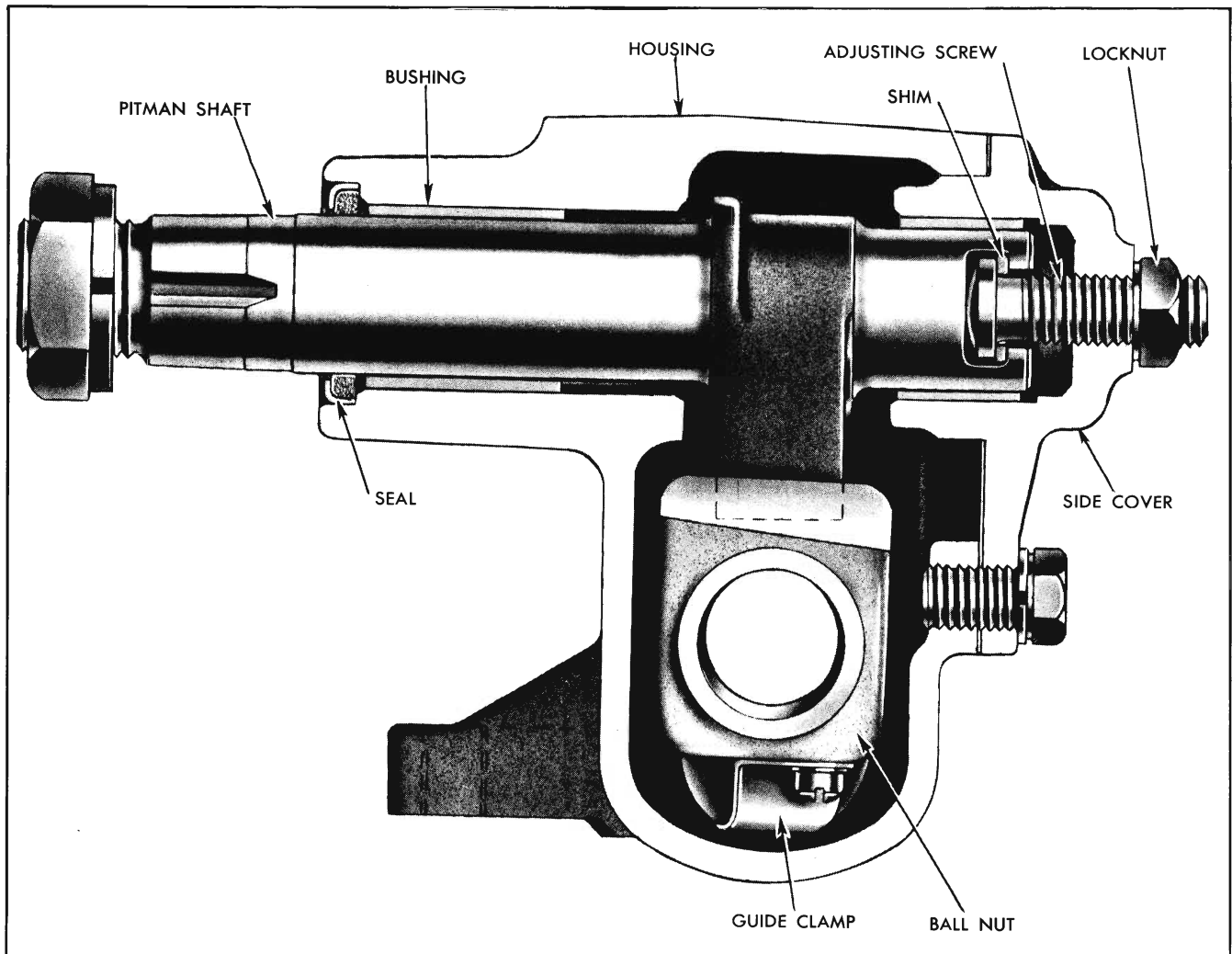


Fig. 9-15 Steering Gear Cut-away View

70-100 lb. ft. torque when adjustment is correct and recheck as in step 5.

ADJUST SECTOR AND BALL NUT BACKLASH

1. When worm bearing preload has been adjusted correctly, pitman shaft adjusting screw should be turned clockwise until a pull of worm bearing load plus 2-6 in. lbs. (Standard Steering) or 3-7 in. lbs. (Power Steering) at the steering wheel is required to turn the wheel through high point. This load should not exceed 17 in. lbs. (Standard Steering) or 11 in. lbs. (Power Steering).

2. Tighten pitman shaft adjusting screw lock nut to 18-27 lb. ft. torque and recheck adjustment.

3. Reassemble steering connecting linkage to pitman arm. Set spokes of steering wheel in straight ahead position (mark on steering shaft up, Fig. 9-6). If road wheels are not straight ahead, adjust steering tie rods.

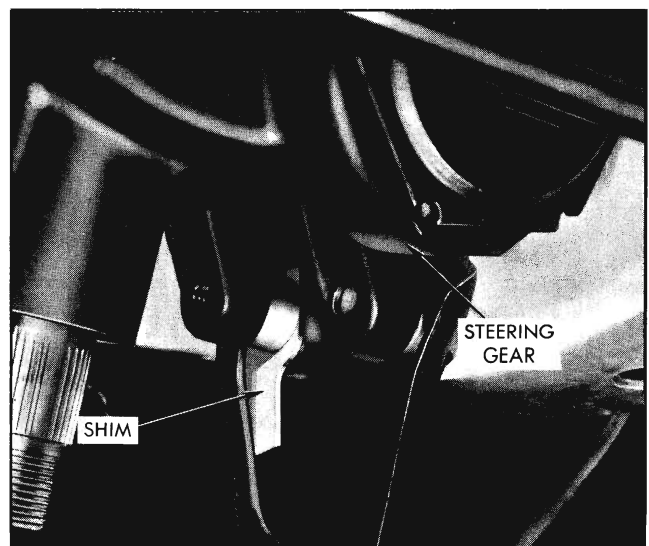


Fig. 9-16 Steering Gear Housing Shim

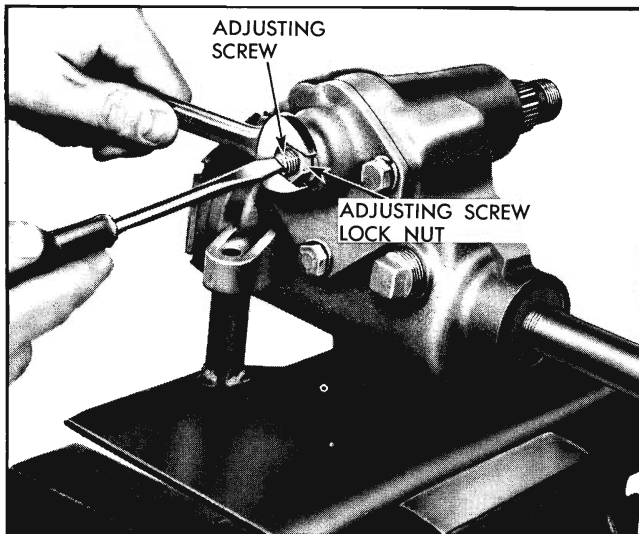


Fig. 9-17 Adjusting Pitman and Ball Nut Backlash

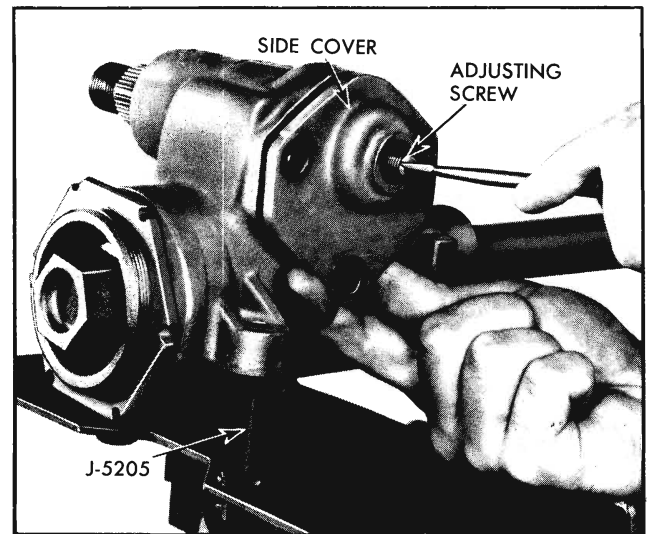


Fig. 9-19 Removing or Replacing Side Cover

STEERING GEAR

REMOVE

1. Remove steering wheel as outlined on page 9-1.
2. Remove bolts retaining steering gear housing to side rail and remove gear and shaft from car.
3. Remove plastic collar and felt seal from steering column.

INSTALL

1. Install shaft, with felt seal and plastic collar, (Fig. 9-9) into steering column and secure gear to side rail with three bolts and spacers. Torque bolts



Fig. 9-18 Checking Pull at Wheel

to 70-90 lb. ft. Use shims as necessary to align shaft with steering column jacket (Fig. 9-16).

NOTE: On power steering cars be sure to secure booster cylinder shaft bracket with two lower steering gear housing to side rail bolts. Install as shown in Fig. 9A-7.

2. Install felt seal and plastic collar into steering gear column jacket.

NOTE: Install steering column upper bearing prior to installing seal and collar (Fig. 9-12).

DISASSEMBLE

1. Mount steering gear assembly on holding fixture J-5205.
2. Rotate wormshaft with steering wheel, until wheel is in center of travel. Remove pitman adjusting screw lock nut.
3. Remove side cover and gasket by turning adjusting screw clockwise through cover (Fig. 9-19).
4. Remove adjusting screw from slot in end of pitman shaft. Make sure shim found on adjusting screw remains with screw (Fig. 9-20).

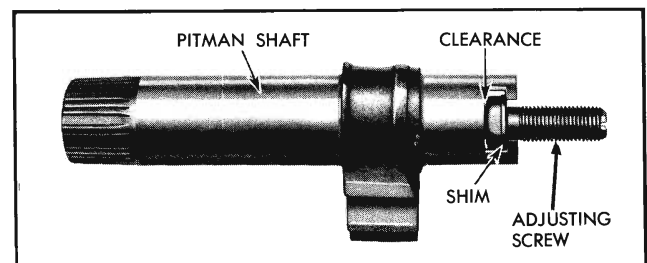


Fig. 9-20 Pitman Shaft and Adjusting Screw

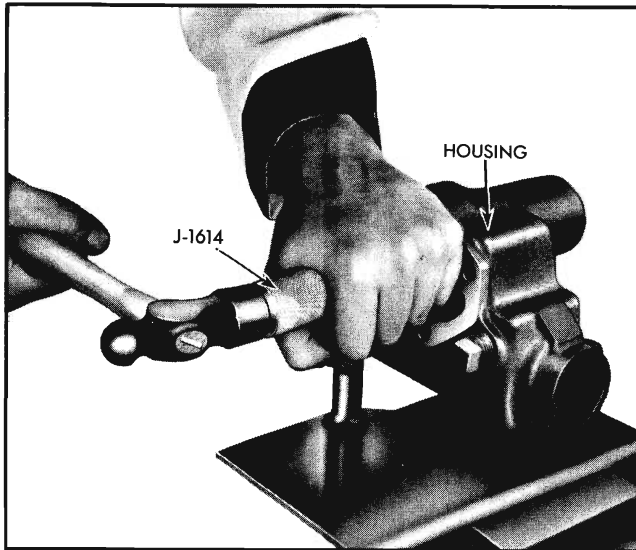


Fig. 9-21 Removing or Replacing Pitman Shaft Bushing

5. Remove pitman shaft from housing using care that threads do not damage seal in housing.

6. Loosen worm bearing adjuster lock nut with brass drift and remove adjuster and lower bearing.

7. Push worm and shaft assembly, with ball nut assembly, through bottom of housing and remove upper bearing.

8. Remove ball nut return guide clamp, remove guides, turn ball nut over and remove balls. Rotating shaft slowly from side to side will aid in removing balls.

9. Remove ball nut from worm. **NOTE:** Unless all balls are removed nut cannot be removed.

CLEANING AND INSPECTION

1. Wash all parts in clean kerosene or other suitable solvent.

2. Inspect all bearings, bearing cups, worm groove, bushings, seals, teeth for scoring, wear, pitting, etc. which would necessitate replacement.

3. Inspect housing and cover for sandholes or cracks.

If pitman shaft bushing, seal, upper and lower bearing cups, upper bearing seal, steering gear housing, or column jacket are worn excessively or damaged, replace parts.

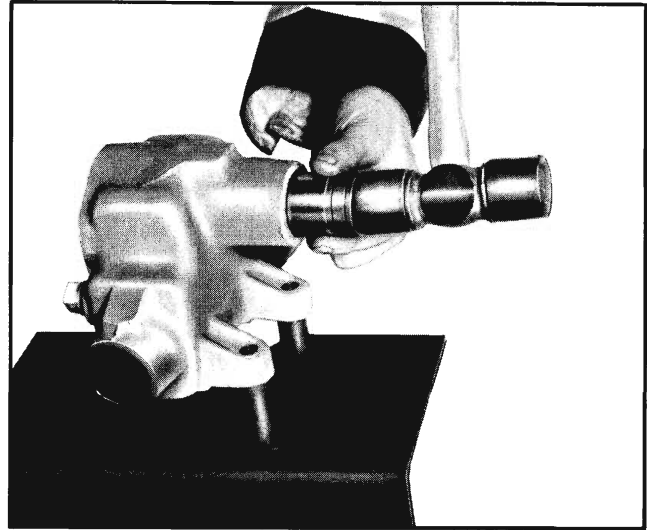


Fig. 9-22 Installing Pitman Shaft Seal

REMOVE AND REPLACE PITMAN SHAFT SEAL AND/OR BUSHING

1. Pry pitman shaft seal out with suitable screwdriver.

2. Drive out bushing with Tool J-1614 (Fig. 9-21).

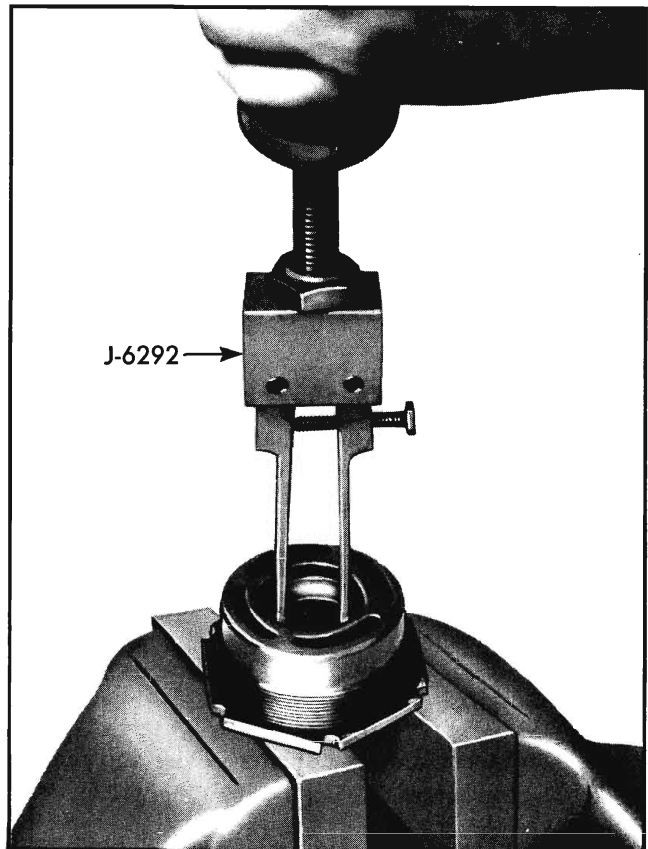


Fig. 9-23 Removing Lower Bearing Cup

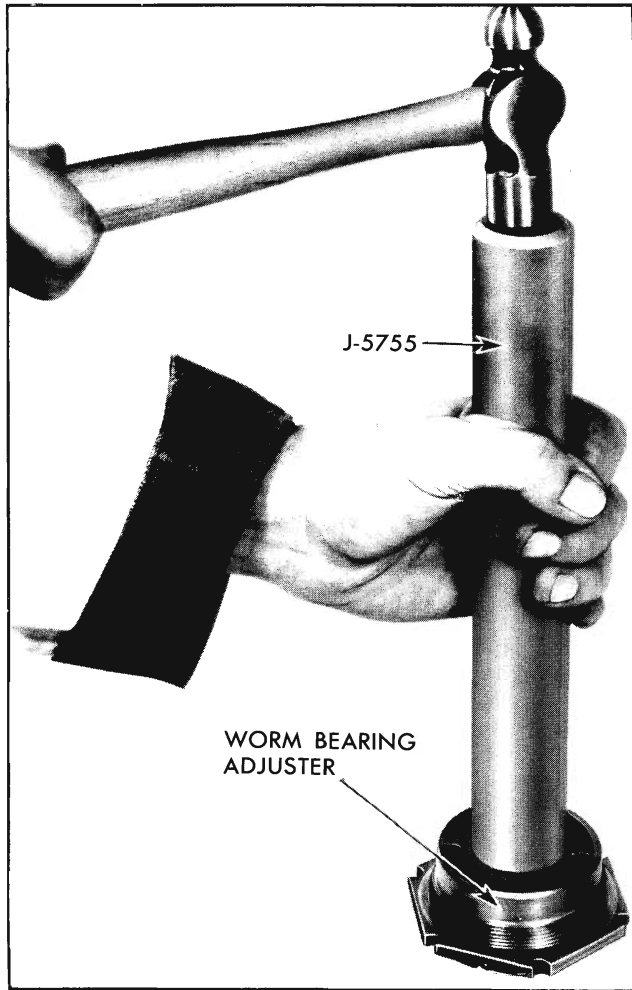


Fig. 9-24 Installing Lower Bearing Cup

3. Install bushing with Tool J-1614, making sure bushing is flush with inner surface of housing (Fig. 9-15).

4. Install pitman shaft seal. A suitable socket which presses on outer diameter of seal may be used. (Fig. 9-22).

REPLACE LOWER BEARING CUP

1. Pry bearing retainer off with suitable screwdriver.

2. Remove lower bearing.

3. Place worm bearing adjuster in vise and remove lower bearing cup with Tool J-6292 (Fig. 9-23).

4. Install lower bearing cup with Tool J-5755 (Fig. 9-24).



Fig. 9-25 Removing Upper Bearing Seal

5. Install lower bearing.

6. Install lower bearing retainer.

REPLACE UPPER BEARING CUP AND/OR SEAL

1. Remove upper bearing seal by driving out with suitable punch (Fig. 9-25).

2. Remove upper bearing cup with punch (Fig. 9-26).

3. Install upper bearing cup using tool J-5755 (Fig. 9-27).

4. Install new upper bearing seal (Fig. 9-28).

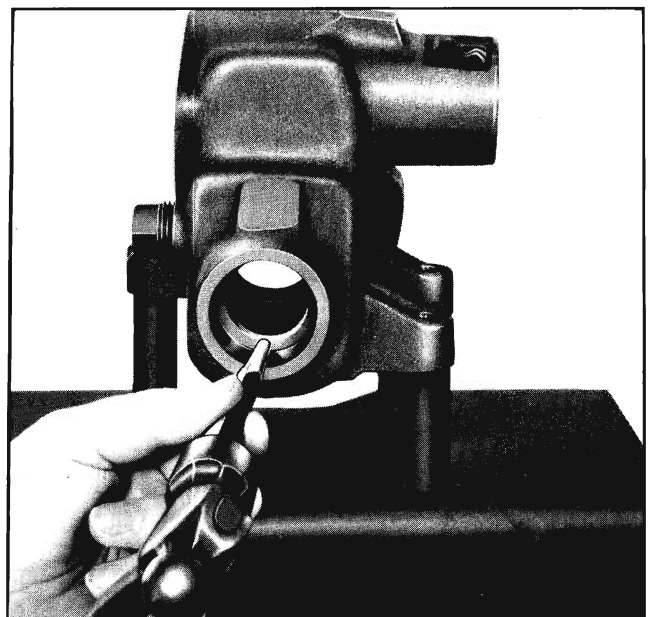


Fig. 9-26 Removing Upper Bearing Cup

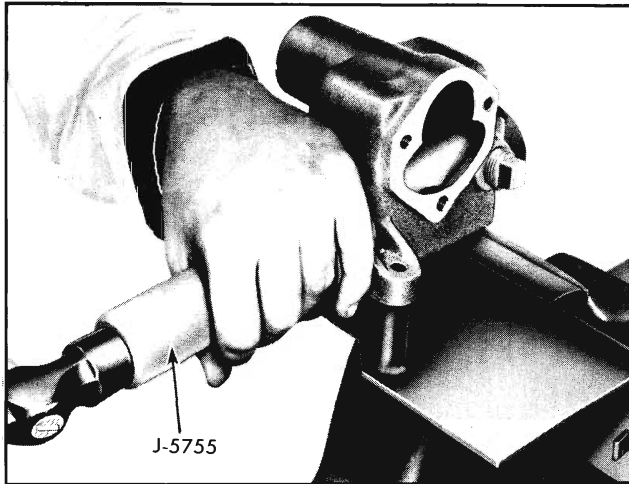


Fig. 9-27 Installing Upper Bearing Cup

ASSEMBLE

NOTE: All seals, bushings and bearings should be prelubricated before assembly.

1. Position ball nut on shaft so that deep side of teeth are located as shown in Fig. 9-29.

2. Install 20 balls in each circuit (one circuit at a time) of ball nut (rotate steering shaft slightly to aid in installing balls) and insert 5 balls in each return guide using petrolatum to hold balls in place. Install return guide clamp and screw.

CAUTION: Be careful that rotation of shaft does not cause balls to enter crossover passage between circuits. This will cause improper operation of ball nut.

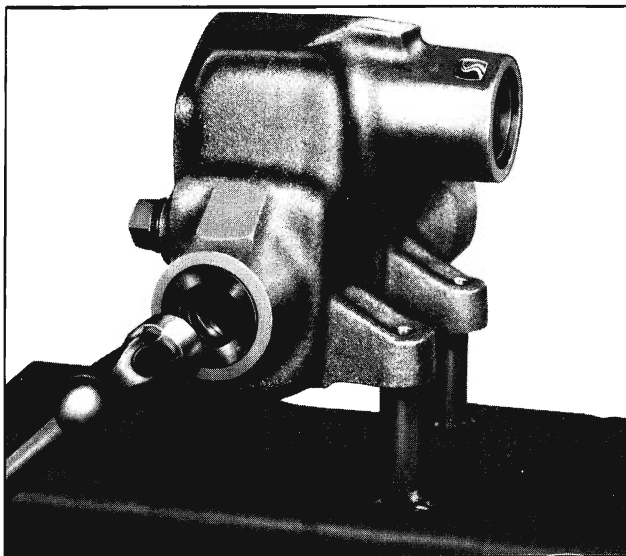


Fig. 9-28 Installing Upper Bearing Seal

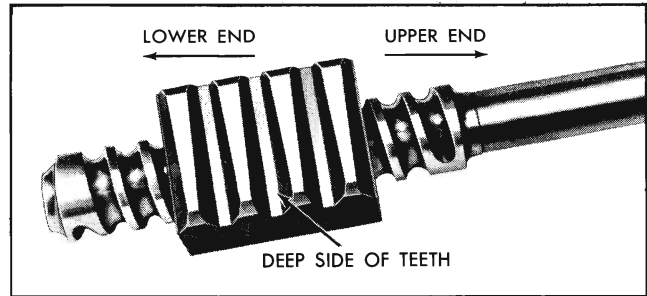


Fig. 9-29 Ball Nut Properly Installed on Shaft

3. Place upper bearing on shaft. Center ball nut on worm, then slide steering shaft, bearing and nut into housing.

4. Install worm adjuster in housing. **NOTE:** Adjuster should be installed just tight enough to hold bearing races in place. Final adjustment will be made later.

5. Install pitman shaft adjusting screw and selective shim in pitman shaft (Fig. 9-20). **NOTE:** Screw must be free to turn, but have no more than .002" end play. If end play of screw in slot is too tight or too loose, select new shim to give proper clearance. Shims are furnished in four thicknesses: .063", .065", .067", and .069".

6. Install pitman shaft and adjusting screw with sector and ball nut teeth positioned as shown in Fig. 9-30.

7. Install side cover and gasket on adjusting screw, turning screw counterclockwise until it projects through cover $\frac{5}{8}$ " to $\frac{3}{4}$ ".

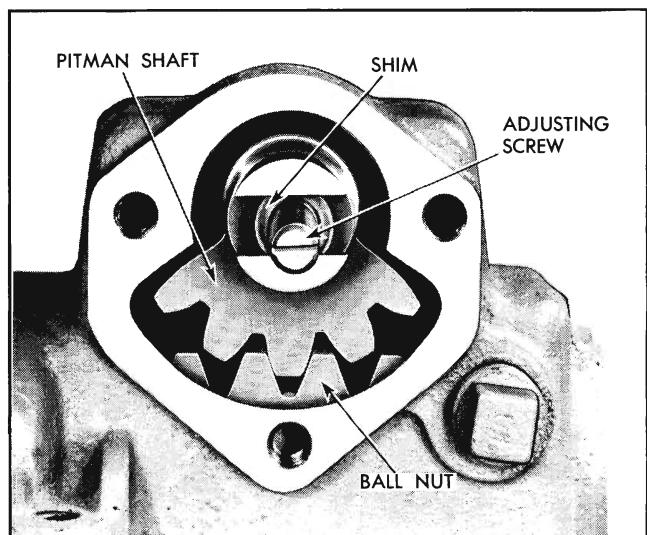


Fig. 9-30 Adjusting Worm Bearing Preload

8. Install three side cover attaching bolts and torque to 25-35 lb. ft.

9. Tighten pitman shaft adjusting screw so that teeth on shaft and ball nut engage but do not bind. Final adjustment will be made later.

10. Fill steering gear with all-season steering gear lubricant.

11. Place steering wheel on shaft and turn steering

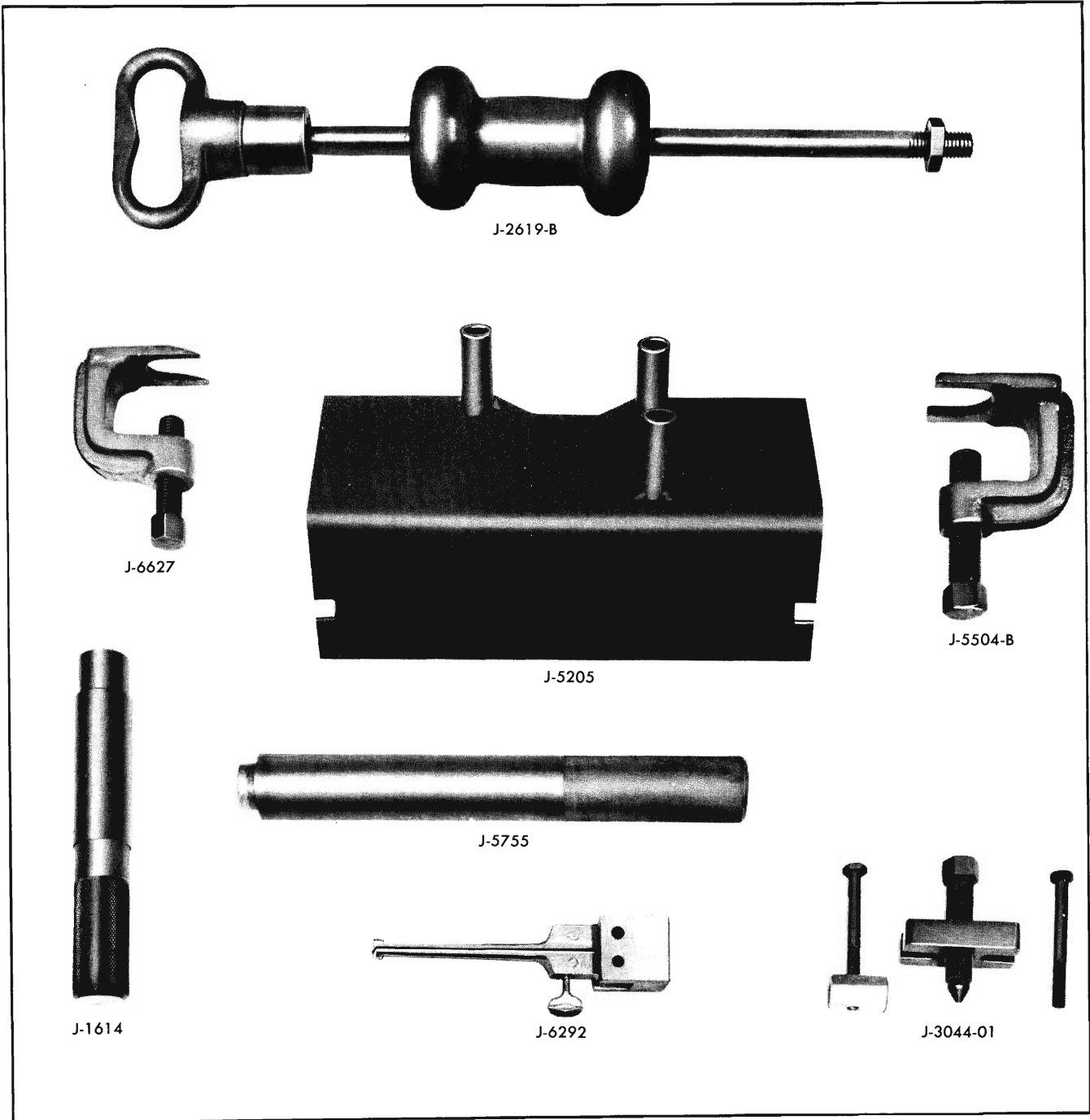
gear from one extreme to the opposite to make certain there are no unusual binds.

NOTE: Never allow ball nut to strike the ends of the ball races in worm, due to the possibility of damage to ball guides. Steering gear is now ready for final adjustment of worm bearing preload and sector and ball nut backlash.

12. Adjust steering gear according to procedure outlined on page 9-6.

TORQUE SPECIFICATIONS

	LB. FT.
Steering wheel nut	2½
Idler arm bolts and nuts	20-30
Pitman arm nut	100-125
Tie-rod end to steering arm nut	60-95
Pitman arm, idler arm, and tie-rod ends to steering linkage retaining nuts	50
Idler arm bushing	110-115
Steering column jacket lower clamp nut	4-5
Steering column jacket upper clamp bolts ..	4-5
Worm bearing adjuster screw lock nut	70-100
Pitman shaft adjusting screw lock nut	18-27
Steering gear to side rail bolts	70-90
Side cover attaching bolts	25-35



SPECIAL TOOLS

- | | | | |
|----------|-------------------------------|-----------|---|
| J-2619-B | Slide Hammer | J-1614 | Pitman Shaft Bushing Remover and Replacer |
| J-6627 | Ball Stud Remover | J-5755 | Steering Shaft Worm Bearing Cup Installer |
| J-5205 | Steering Gear Holding Fixture | J-3044-01 | Steering Wheel Puller |
| J-5504-B | Pitman Arm Puller | J-6292 | Steering Shaft Worm Bearing Cup Remover |

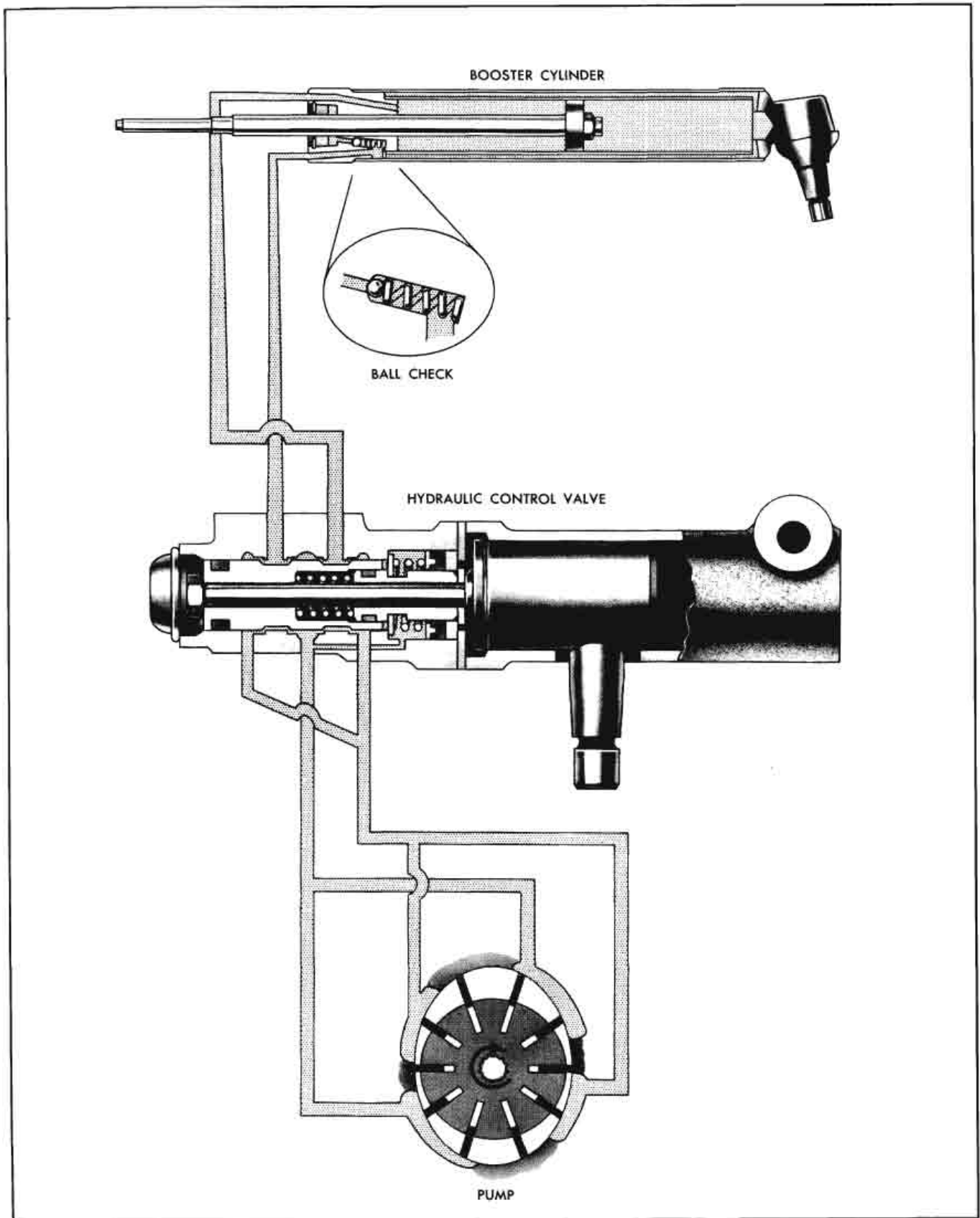


Fig. 9A-1 Power Steering System

POWER STEERING

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Description	9A-1	Disassemble	9A-20
Power Steering Pump		Cleaning and Inspection	9A-22
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POWER STEERING SYSTEM

DESCRIPTION

The hydraulic power steering system consists of a pulley driven vane type pump, an oil reservoir which is part of the pump assembly, a double-acting hydraulic power booster cylinder, and a hydraulic control valve (Fig. 9A-1).

The power steering pump is the source of hydraulic power which assists the driver in steering the car. It is pulley driven by means of the crankshaft pulley.

The hydraulic power booster cylinder converts hydraulic power into mechanical output. The cylinder is double acting which permits it to drive the steering linkage in either direction as desired by the driver when he turns the steering wheel.

The hydraulic control valve ports oil to the power cylinder according to the direction the steering wheel is turned. It is an open center valve which permits oil to be routed back to the reservoir when the system is not assisting the driver in steering. When the steering wheel is turned and steering assistance is necessary, the valve ports pressure oil to the cylinder according to the assistance required.

POWER STEERING

VANE TYPE PUMP

DESCRIPTION

The power steering pump has an outlet capacity of 1.25 gallons per minute at idle. It is mounted on the engine and driven by a belt from the crankshaft harmonic balancer.

The component parts of the power steering pump are encased in a reservoir (Fig. 9A-2) filled with oil, which is used for the control valve (valve and adapter assembly) and the booster cylinder. The reservoir has a filler neck with a cap and is fastened to the pump housing. Only the housing face and shaft hub are exposed.

A pump housing within the reservoir houses a bab-bitt bushing and a shaft seal, and has two openings from the rear side. The larger of these openings has two dowel pins in the pump inner face that hold the functional parts of the pump: the thrust plate, rotor ring (which contains the rotor and vanes) and the pressure plate. The smaller opening houses a flow control valve and spring.

THRUST PLATE

The thrust plate is located adjacent to the inner

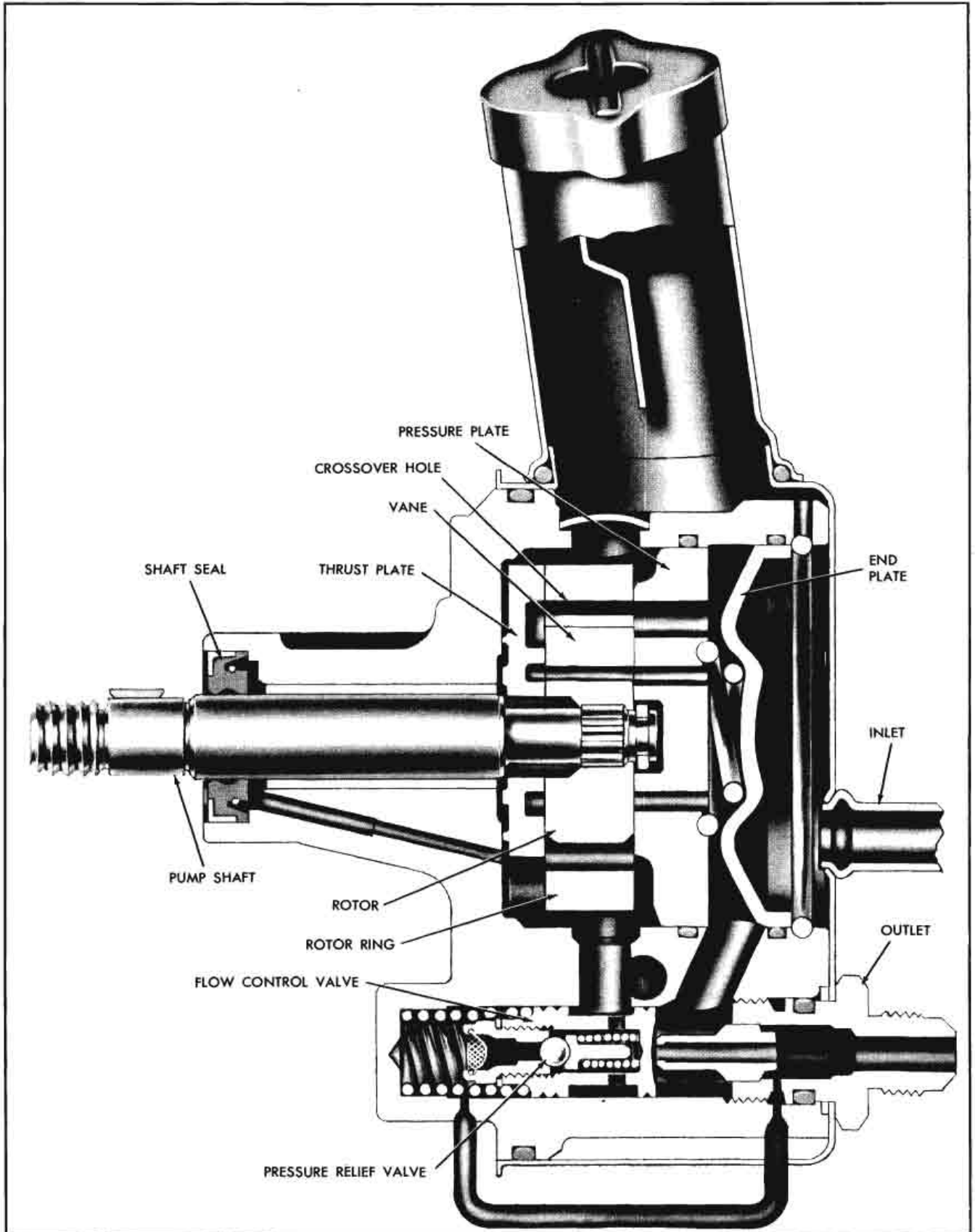


Fig. 9A-2 Power Steering Pump

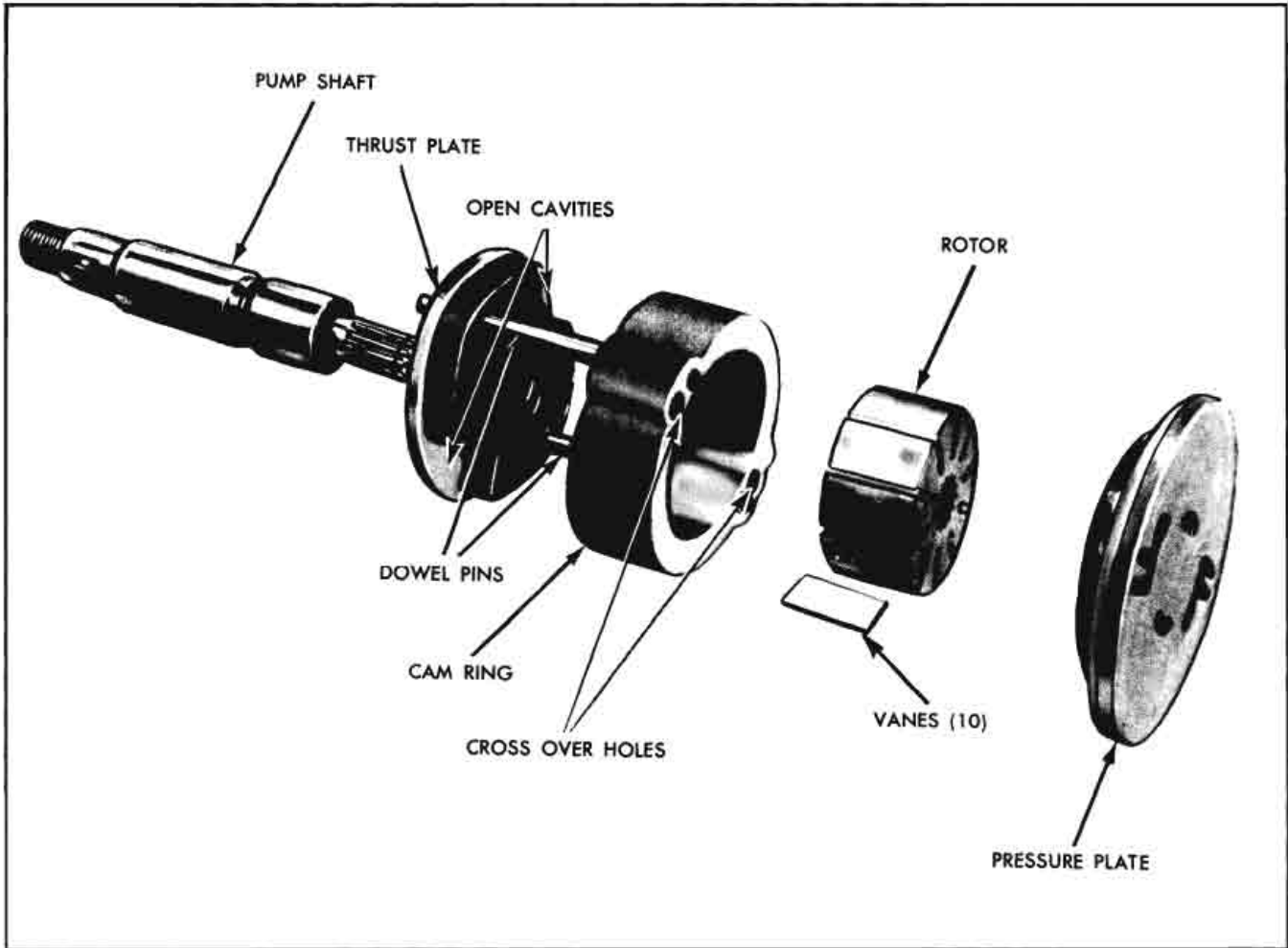


Fig. 9A-3 Power Steering Pump Components

face of the pump housing. One side of the thrust plate performs the function of taking the rearward shaft thrust. The other side consists of six crescent or kidney shaped cavities and two openings at the plate sides and opposite each other (Fig. 9A-3).

Four of the crescent shaped cavities are located around the drive shaft hole (but are not connected with each other) and are for undervane oil pressure. The other two cavities are for discharging the oil under pressure into a high pressure area that provides oil for the control valve and the booster cylinder. These two cavities are in line with the two crossover holes in the pump ring which feed high pressure (discharging) oil through the pressure plate into the high pressure area to provide oil requirements as called for by the control valve and booster cylinder.

The two openings diametrically opposite from each other, are for intake of oil from the suction part of the pump.

PUMP RING

The pump ring is a flat plate with a cam surface center opening. This ring encompasses the rotor and vanes and is located adjacent to the face of the thrust plate on the same two dowel pins that retain the thrust plate. The rotor is loosely splined to the pump drive shaft and turns with the shaft. Ten slots for vanes are evenly spaced around the rotor and extend from the rotor outer diameter inward to the center approximately $1\frac{3}{32}$ " deep.

PRESSURE PLATE

The pressure plate contains six holes that extend through the plate and two cavities. Four of the holes around the drive shaft hole are connected to high pressure oil. This oil is used to supply oil pressure to the vanes to insure their following the cam surface in the pump ring. The other two holes are for discharging the oil under pressure to the high pressure area for control valve and booster cylinder use.

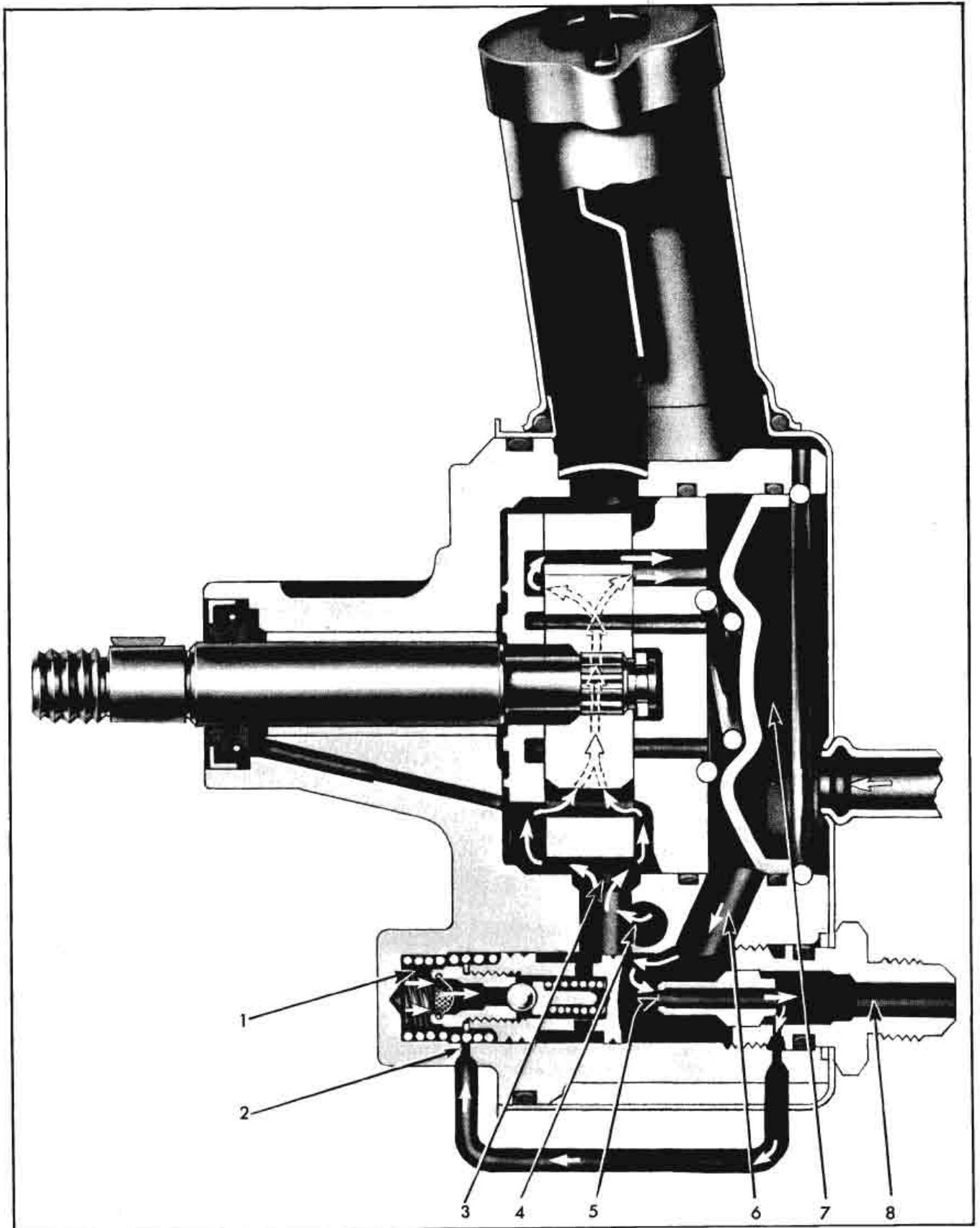


Fig. 9A-4 Oil Flow—Low Speed or Partial Turn

The two cavities are radially open to the suction part of the pump and intake oil flows through these openings.

RESERVOIR

The reservoir is an oil storage space and provides a means of directing the return oil back to the pump.

DRIVE SHAFT

The pump drive shaft is belt-driven by the crankshaft harmonic balancer and extends through all the major parts mentioned above except the pressure plate. The pump shaft rotates at a pump to engine ratio of 1.24.

OPERATION

FILLING THE PUMP AND SYSTEM (FIG. 9A-4)

When the pump, control valve, and booster cylinder are completely void of oil, adding oil to the reservoir will completely envelop the pump housing assembly which is inside the reservoir. The weight of the oil will cause it to flow through a drilled passage in the lower portion of the housing (4) and to another drilled hole leading to a groove around the rotor ring (3). This tends to fill this area and also the two "openings" on the surface of the thrust plate. Oil fills the lower openings in the thrust plate to feed the rising portion of the rotor ring. Some air is forced out of the pump through openings and clearances of parts in the pump housing.

Since the rotor is splined to the drive shaft, it turns with the shaft and the vanes follow the cam surface machined in the pump ring. The cam is designed with two vane rising and two falling areas and, therefore, causes a complete pumping cycle to occur every 180 degrees of pump drive shaft rotation. Centrifugal force throws the vanes against the ring to pick up a little oil to be forced into the high pressure area.

Some oil will leak along the pump drive shaft to the shaft seal and to the area behind the thrust plate (via drilled passages in the housing). As more and more oil is picked up by the vanes, more oil will be forced into the cavities of the thrust plate. From here it will flow through the two crossover holes in the rotor ring and the pressure plate, and empty into the high pressure area of the pump, between the pressure plate and the housing end plate (7).

As the high pressure area fills, some oil returns through two holes drilled through the crescent shaped slots in the pressure plate. It is directed behind the vanes to force them to follow the cam surface of the

pump ring. Eventually most of the air will be bled from the pump and displaced by oil.

The control valve and booster cylinder may be filled by turning through the full right and left turns a few times.

OIL FLOW—LOW SPEED OR PARTIAL TURN (FIG. 9A-4)

From the high pressure chamber, the oil flows through a drilled passage (6) leading to a passage drilled through the outlet union (5). Oil is directed to the control valve through this outlet union (8). The outlet union passage also connects to the area that houses the flow control valve spring. The connecting passage is drilled in the housing and is directed to a pressure sensing orifice (2) which leads to the spring chamber behind the flow control valve (1).

Oil to the control valve is supplied until all air has been forced out of the control valve and booster cylinder via the pump return line.

The quantity of oil displaced by the pump exceeds the predetermined steering system requirements. A pressure drop occurs as oil flows through the outlet union passage. This pressure drop is communicated to the flow control valve spring chamber. With this pressure opposing the high pressure on the face of the flow control valve and outlet union, the valve opens slightly to provide oil pressure control or relief. The external surface still allows some oil to flow through the system.

OIL FLOW—HIGH SPEED, NO TURN, STRAIGHT AHEAD (FIG. 9A-5)

When operating at moderate and high speeds it is desirable to keep oil flow to a minimum in order to limit temperature rise. Therefore, the flow control valve opens wider (due to increased oil pressure) to allow more oil to be by-passed within the pump.

The pressure unbalance between the valve spring chamber and the outlet union increases as the engine speed increases. The greater pressure on the outlet union side then pushes the flow control valve back further to open the by-pass hole wider, thereby diverting more oil into the intake chamber (3). Supercharging of the intake chamber occurs under these conditions. Oil at high velocity discharging past the valve into the intake chamber picks up make-up oil from the reservoir on the jet pump principle. Then by reduction of velocity, velocity energy is converted into supercharge pressure.

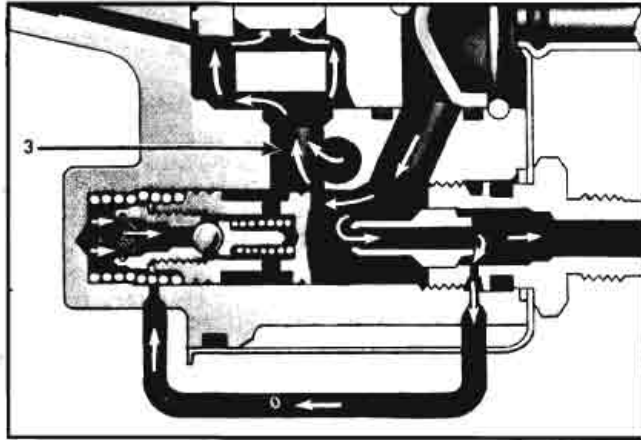


Fig. 9A-5 Oil Flow—High Speed, No Turn, Straight Ahead

OIL FLOW—TURN AGAINST RESISTANCE (FIG. 9A-6)

During a turn, resistance is offered to the pitman shaft and rack-piston nut, and extends to the pump high pressure chamber. It also extends through the pressure sensing orifice to the flow control valve spring chamber. Pressure in the chamber continues to build up until it overcomes the opposing spring pressure on the ball check in the flow control valve. If this pressure is slight, the ball check is sufficient to bleed off any excess pressure.

When the pressure is high, the flow control valve spring chamber pressure reduces below the opposing high pressure on the face of the outlet union and flow control valve plunger. The valve opens wide to provide oil pressure control for the control valve and

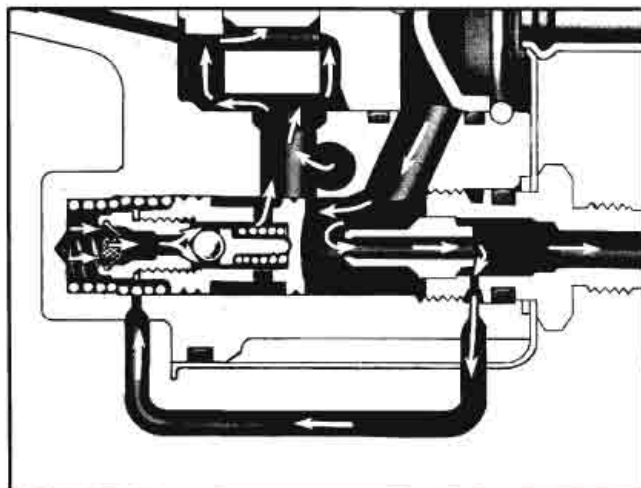


Fig. 9A-6 Oil Flow—Turn Against Resistance

booster cylinder. Oil flows through the passage leading to the suction or intake part of the pump.

Supercharging occurs when pressure oil in the area around the outlet union and flow control valve plunger discharges into the suction passage at high velocity.

REPLACE POWER STEERING PUMP

REMOVE

1. Drain power steering by removing inlet hose.
2. Disconnect outlet hose and connector (Fig. 9A-7).
3. Remove pulley nut.
4. Loosen generator to bracket adjusting bolt (4 cylinder engine) or remove power steering pump to bracket adjusting nut (V-8 engine).
5. Remove pulley belt from pump pulley and remove pulley.
6. Remove rear pump to bracket nut (Fig. 9A-7).
7. Remove bolts (4 cylinder engine) or nuts (V-8 engine) securing pump to bracket and remove pump from car.

INSTALL

1. Install pump on bracket and torque nuts or bolts to 25-35 lb. ft.
2. Secure pump to rear bracket and torque nut to 20-35 lb. ft.
3. Install pulley on pump.
4. Install belt on pump pulley and adjust as outlined in table in Section 6A. Torque pump to bracket adjusting nut or generator to bracket adjusting bolt to 20-35 lb. ft.
5. Torque pulley nut to 70-85 lb. ft.
6. Connect outlet and inlet hoses.
7. Fill pump with Hydra-Matic fluid, run pump at 1000 rpm for 30 seconds.
8. Refill pump before turning steering wheel.
9. Bleed system after filling pump reservoir by running pump and turning steering wheel through entire travel to expel air.
10. Check oil level.
11. Test for leaks in system with front wheels beside obstruction to prevent turning gear to limit. Apply 3 to 8 lb. load at rim of steering wheel, with

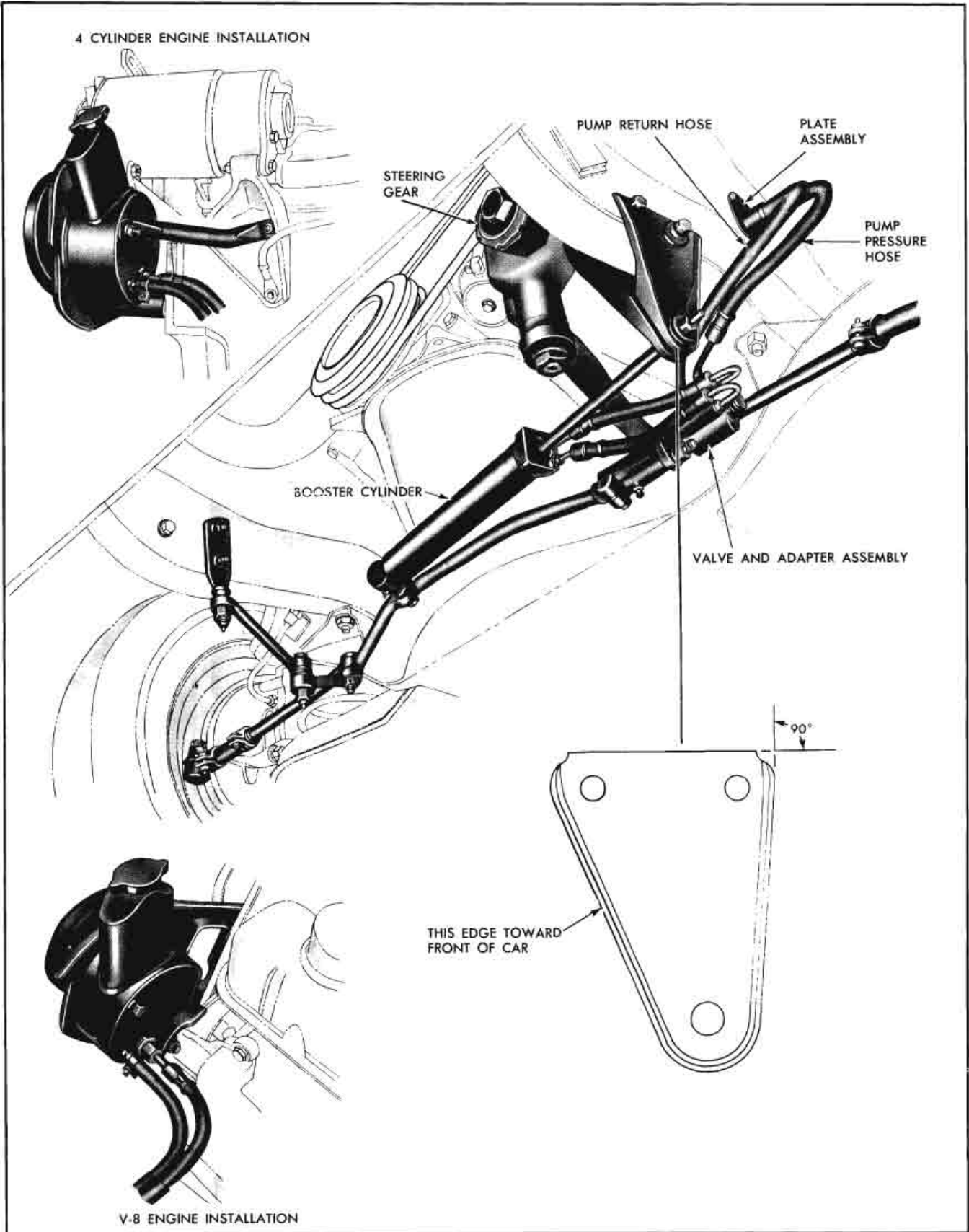


Fig. 9A-7 Power Steering Installation

engine running at 1000-1200 rpm to obtain maximum operating pressure.

12. Check hoses and fittings for leaks.

13. Fill reservoir to oil level full, as indicated on pump dip stick.

14. If oil is still foamy, allow vehicle to stand a few minutes with the engine off and repeat bleeding.

If bracket is removed, torque all bolts when re-installing to 20-35 lb. ft.

PERIODIC SERVICE

See General Lubrication section.

STEERING LINKAGE

REMOVE

1. Raise car.

2. Disconnect valve and adapter assembly inlet and outlet lines.

3. Remove booster cylinder shaft nut, spacer, and grommet and remove shaft from support bracket by pushing shaft into cylinder.

4. Remove cotter pin and nut and remove tie-rod end stud from steering arm at each front wheel with tool J-6627.

5. Remove nut and lock washer and remove pitman arm from pitman arm shaft with tool J-5504-B.

6. Remove idler arm nuts and remove idler arm and steering linkage from car.

INSTALL

1. Install idler arm and steering linkage into car, securing idler arm with bolts, lock washers and nuts. Tighten to 20-30 lb. ft. torque.

2. Install pitman arm on pitman shaft. Make sure steering gear is at high point with wheels straight ahead before installing arm on shaft.

3. Install pitman arm lock washer and nut. Torque to 100-125 lb. ft.

4. Install tie-rod end into steering arm at each front wheel and torque nut to 60-95 lb. ft. Install cotter pin.

5. With retainer grommet and spacer on shaft, install booster cylinder shaft into bracket. Install grommet retainer and nut. Torque nut to 18-30 lb. ft. and install cotter pin.

6. Connect valve and adapter assembly inlet and outlet hoses.

STEERING LINKAGE

DISASSEMBLE

1. Thread idler support from bushing, then idler arm from bushing.

2. Tie-rod ends, idler arm, and booster cylinder may be disconnected from steering linkage by removing cotter pins and nuts and using Tool J-6627. Use Tool J-5504-B to disconnect pitman arm from pitman shaft.

3. Unscrew valve and adapter assembly from steering linkage after loosening retaining bolt.

ASSEMBLE

1. Thread valve and adapter assembly onto steering linkage and tighten retaining bolt to 12-15 lb. ft. torque.

2. Connect booster cylinder, pitman arm, idler arm, and tie rod ends to steering linkage and torque nuts to 50 lb. ft. **NOTE:** Do not back off nuts to insert cotter pins.

3. Thread idler arm onto bushing, then idler support onto bushing. Torque bushing to 110-115 lb. ft. **NOTE:** Distance between upper face of idler arm and shoulder at thread end of idler support should be approximately $1\frac{1}{16}$ ".

DISASSEMBLE

CAUTION: In clamping pump in vise, be careful not to exert excessive force on front hub of pump as this may distort the bushing.

1. Remove union and seal.

2. Remove pump rear mounting bolts.

3. Lift reservoir from housing by tapping reservoir at flange, rocking back and forth.

4. Remove mounting bolt "O" rings and union "O" rings.

5. Remove end plate retaining ring. Push end plate retaining ring out of groove using a punch through $\frac{1}{8}$ " diameter hole in pump housing (Fig. 9A-8), and remove with screwdriver. End of retaining ring should be next to hole to ease removal.

6. Remove end plate and spring. End plate is spring-loaded and will generally sit above the housing

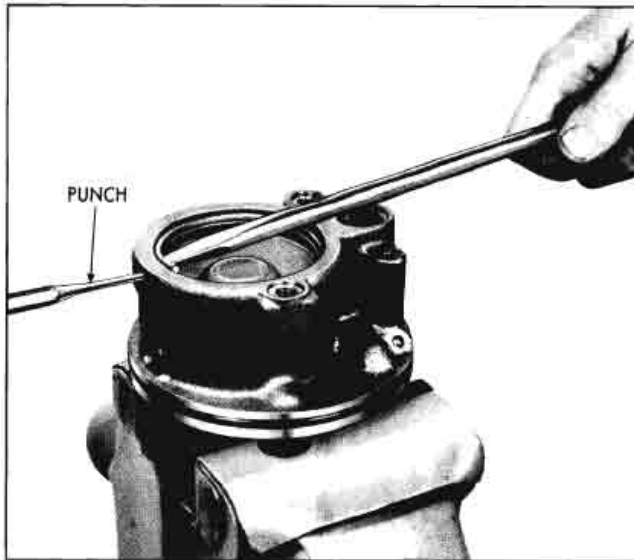


Fig. 9A-8 Removing Retaining Ring

level. If sticking should occur, a slight tapping action will free the plate (Fig. 9A-9).

7. Remove end plate "O" ring.

8. With pump housing turned over remove flow control valve and spring (Fig. 9A-10) and tap housing on wood block until pressure plate falls free (Fig. 9A-11).

9. Remove pressure plate, pump ring and vanes, being careful not to drop parts (Fig. 9A-12).

10. Remount housing in vise. Using a suitable tool, remove shaft retainer on end of drive shaft.



Fig. 9A-9 Removing End Plate



Fig. 9A-10 Removing Flow Control Valve

11. Remove rotor and thrust plate.

12. Remove shaft through front of housing (Fig. 9A-13).

CLEAN PARTS

Carefully clean all parts, except "O" ring seals which are to be replaced and should not be immersed in cleaning solvent. Lubricate all "O" ring seals and the drive shaft seal with vaseline and install in proper location. Be sure not to immerse the drive shaft seal in the cleaning solvent as this could damage it. Fig. 9A-14 shows an exploded view of the pump.

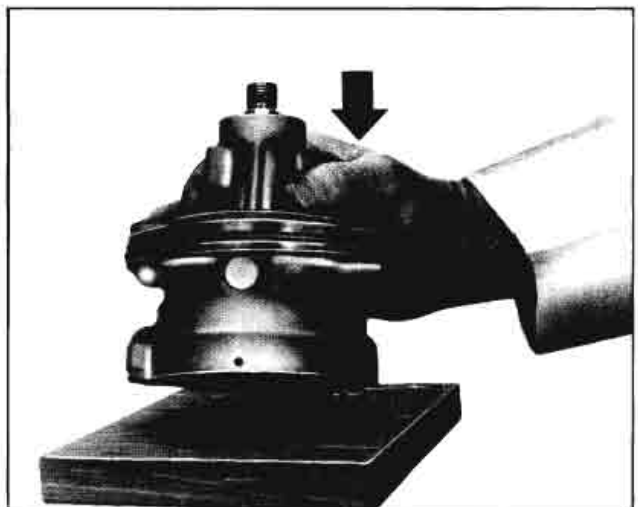


Fig. 9A-11 Removing Pressure Plate

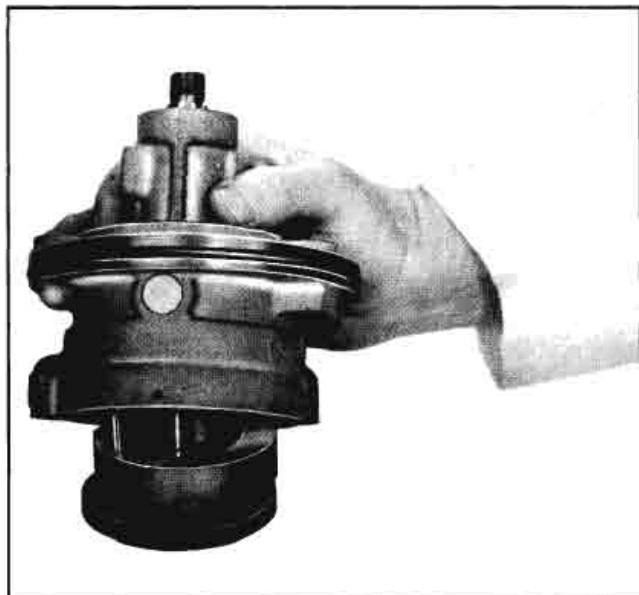


Fig. 9A-12 Pressure Plate and Rotor Ring Removed



Fig. 9A-13 Removing Pump Shaft

ASSEMBLE

Be sure all parts are clean during reassembly.

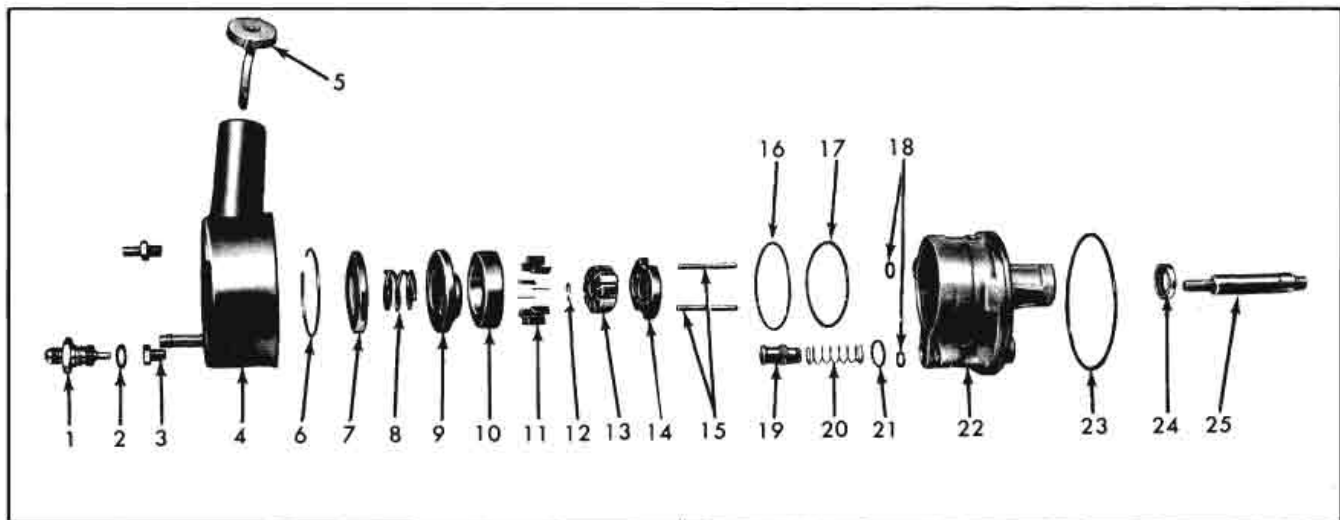
1. Insert shaft at hub end of housing, spline end entering mounting face side (Fig 9A-15).

2. Install thrust plate on dowel pins with ported

face to rear of pump housing (Fig. 9A-16).

3. Install rotor (must be free on splines) on pump shaft at splined end.

NOTE: Assemble rotor with flat side toward rear of pump (Fig. 9A-17).



- | | | | |
|-----------------------------|-------------------|--------------------------------------|-----------------------------|
| 1. Union | 8. Spring | 15. Dowel Pins | 22. Pump Housing |
| 2. Seal | 9. Pressure Plate | 16. End Plate "O" Ring | 23. Reservoir "O" Ring Seal |
| 3. Mounting Bolts | 10. Pump Ring | 17. Pressure Plate "O" Ring | 24. Shaft Seal |
| 4. Reservoir | 11. Vanes | 18. Mounting Bolt "O" Ring Seals | 25. Drive Shaft |
| 5. Dip Stick and Cover | 12. C-Washer | 19. Flow Control Valve | |
| 6. End Plate Retaining Ring | 13. Rotor | 20. Flow Control Valve Spring | |
| 7. End Plate | 14. Thrust Plate | 21. Flow Control Valve "O" Ring Seal | |

Fig. 9A-14 Power Steering Pump Exploded View

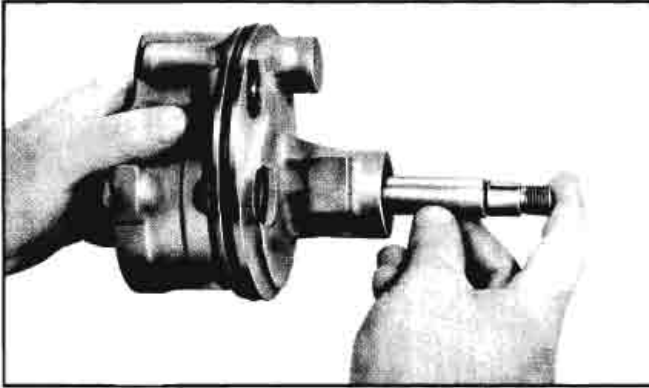


Fig. 9A-15 Installing Pump Shaft

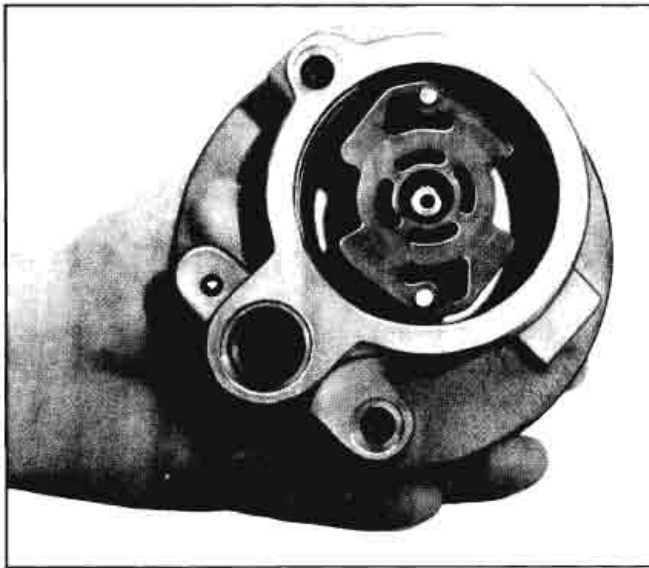


Fig. 9A-16 Thrust Plate Installed



Fig. 9A-17 Installing Rotor

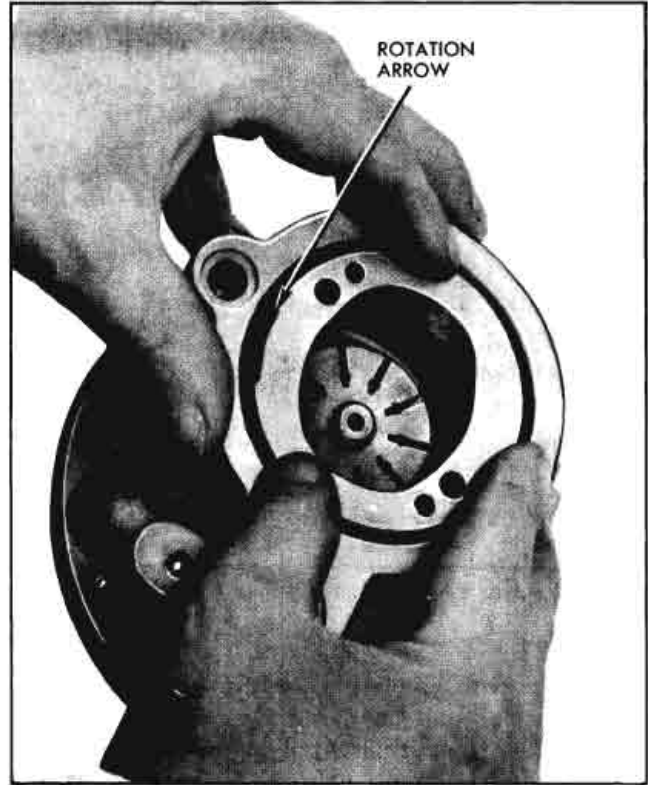


Fig. 9A-18 Installing Pump Ring

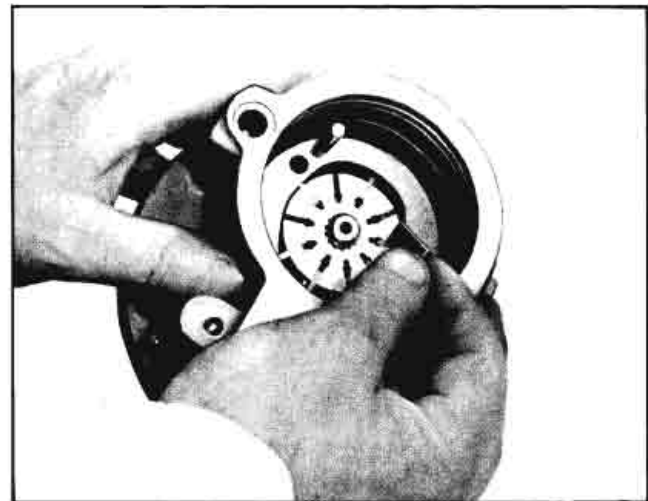


Fig. 9A-19 Installing Pump Vanes

4. Using suitable tool, install shaft retainer.
5. Install pump ring on dowel pins with rotation arrow facing to the rear of the pump housing (Fig. 9A-18).
6. Install vanes in rotor slots with radius edge towards outside (Figs. 9A-19 and 9A-20).
7. Lubricate outside diameter and chamfer of pres-

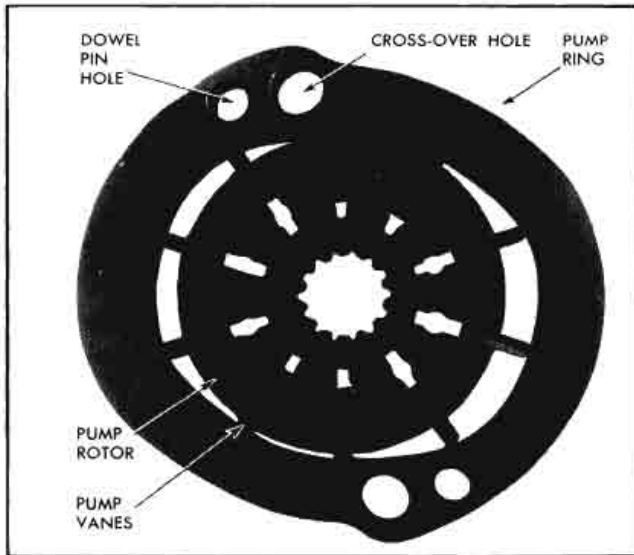


Fig. 9A-20 Pump Vanes Installed

sure plate with vaseline to insure against damaging O-ring and install on dowel pins with ported face toward the pump ring. Applying pressure to outer edge only, seat pressure plate. Never press or hammer on the center of the pressure plate as this will cause permanent distortion with resulting pump failure. (Pressure plate will travel about $\frac{1}{16}$ " to seat).

8. Install end plate "O" ring.



Fig. 9A-21 Installing Pressure Plate Spring

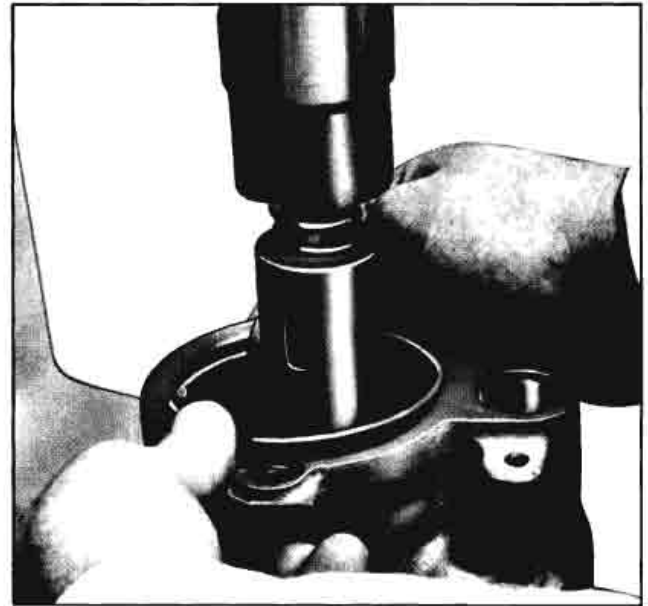


Fig. 9A-22 Installing End Plate

9. Install pressure plate spring in center groove of pressure plate (Fig. 9A-21).

10. Lubricate outside diameter of end plate with vaseline to insure against damaging "O" ring and install in housing using an arbor press.

11. Install end plate retaining ring while pump is in arbor press. Be sure it is completely seated in the groove of the housing (Fig. 9A-22).

12. Install flow control spring and flow control plunger. Be sure end with screen goes into bore first.

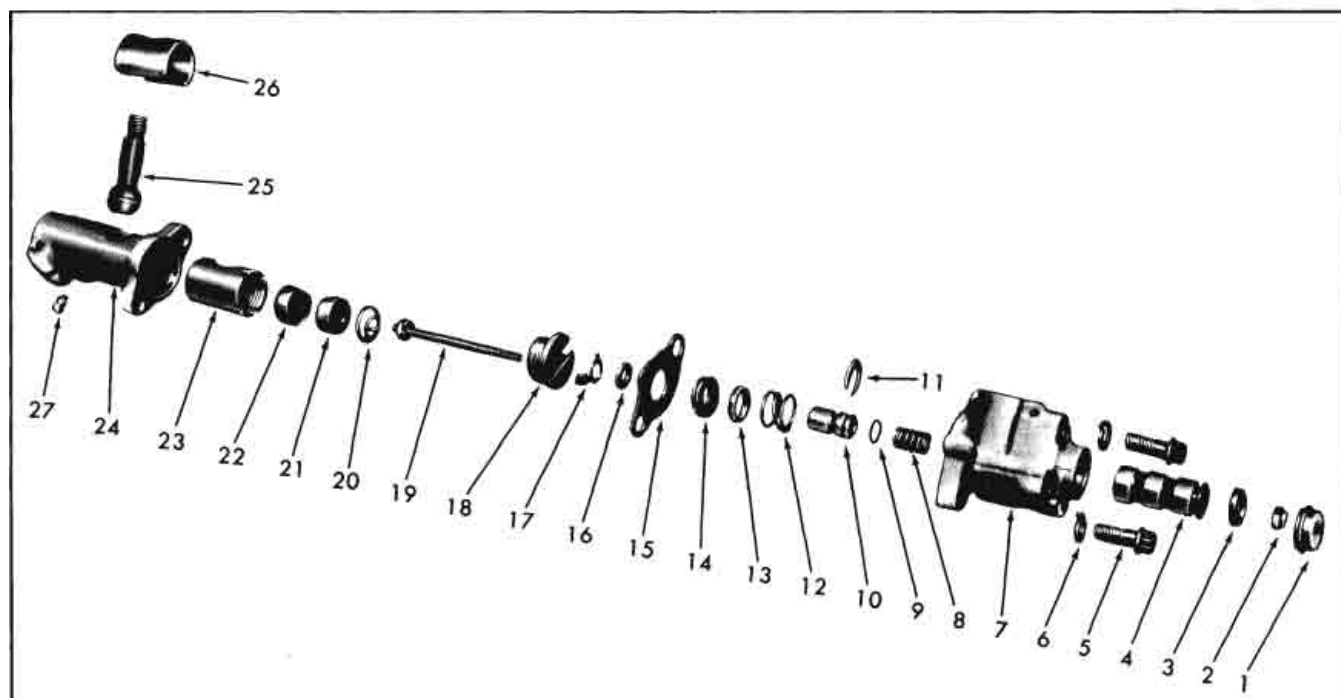
13. Install mounting bolt "O" rings and union "O" rings.

14. Drop reservoir into place and press down until reservoir seats on housing.

15. Install studs, torque to 25-35 lb. ft., and outlet union, and torque to 25-35 lb. ft. Install drive shaft key. Support the shaft on the opposite side of key when installing key.

HYDRAULIC CONTROL VALVE DESCRIPTION

The hydraulic control valve consists of two major sub-assemblies, the adapter assembly and the valve assembly. The valve housing and the adapter housing are bolted together. The inner parts of the valve and the inner parts of the adapter are held together as a unit by a valve shaft (Fig. 9A-23).



- | | | | |
|-------------------------|-----------------------------|------------------------|---------------------|
| 1. Dust Cover | 8. Valve Adjustment Spring | 15. Annulus Spacer | 22. Ball Seat |
| 2. Adjusting Nut | 9. "O" Ring Seal | 16. Valve Shaft Washer | 23. Sleeve Bearing |
| 3. Seal | 10. Valve Reaction Spool | 17. Plug to Sleeve Key | 24. Adapter Housing |
| 4. Valve Spool | 11. Spring Thrust Washer | 18. Ball Adjuster Plug | 25. Ball Stud |
| 5. Valve Mounting Bolts | 12. Reaction Chamber Spring | 19. Valve Shaft | 26. Dust Shield |
| 6. Lock Washer | 13. Spring Retainer | 20. Ball Seat Spring | 27. Lube Fitting |
| 7. Valve Housing | 14. Annulus Seal | 21. Ball Seat | |

Fig. 9A-23 Hydraulic Control Valve Exploded View

The major parts of the adapter assembly are the adapter housing which is fixed to the steering linkage, the ball stud which is fixed to pitman arm, the bearing sleeve, ball seats, spring, and adjuster plug which all contribute to hold the ball stud in the adapter housing.

The major parts of the valve assembly are the valve housing which contains the four oil ports, the valve spool, reaction spool and valve adjustment spring (which act as a unit inside the adapter assembly), the reaction chamber spring which preloads the valve spool, and the three different seals which contain the oil in the valve housing.

Another part which is not part of either of the two major sub-assemblies is the adjusting nut (Fig. 9A-23). It is used to adjust the valve on the hydraulic center.

OPERATION

The hydraulic control valve (or valve and adapter assembly) is attached to the left end of the steering

linkage (Fig. 9A-7) and is actuated by the steering gear pitman arm in the following manner:

The ball stud is retained in the bearing sleeve which is an inner part of the adapter assembly. Protruding from the slot in the adjuster plug is the valve shaft. The adjuster plug is threaded into the bearing sleeve and is held from turning by a small key. The valve shaft is held in the adjuster plug and is prevented from turning by the flats on the head of the shaft (Fig. 9A-23).

The valve spool is attached to the other end of the valve shaft so that any movement of the ball stud with respect to the adapter housing is positively transmitted to the valve spool. The spool is restricted to a movement of .050" travel to the right and left from its centered position by the depth of a counterbore in the adapter housing (Fig. 9A-23) and the thickness of the flange on the adjuster plug.

The valve spool has two annular grooves which connect with three annular grooves inside of the valve housing (Fig. 9A-23). The middle annular groove in

the housing connects with the pressure line from the pump. The two outside annular grooves in the housing connect with the return line to the pump.

When the spool is shifted off center, oil is restricted from passing into the outside grooves and is forced into one of the cylinder line passages in the housing. The more the spool is shifted in either direction the greater the restriction becomes and, therefore, the greater the assisting oil pressure becomes.

The valve spool is preloaded by means of the reaction chamber spring in the housing counterbore which restrains the spool from actuation. It is necessary to overcome the preload of this spring before the valve spool can be moved in either direction. When there is sufficient resistance to rotation of the pitman arm developed at the front wheels, continued turning of the hand wheel will result in movement of the valve shaft, which overcomes the preload of the spring.

NO TURN POSITION (FIG. 9A-24)

In the no turn position, the valve spool is centered in the housing by the valve adjustment spring. Oil is pumped through the middle groove in the valve housing and flows through the two outside grooves which communicate with the return line to the pump.

Since the oil is not blocked at any point, there is low pressure in the system and no steering assist.

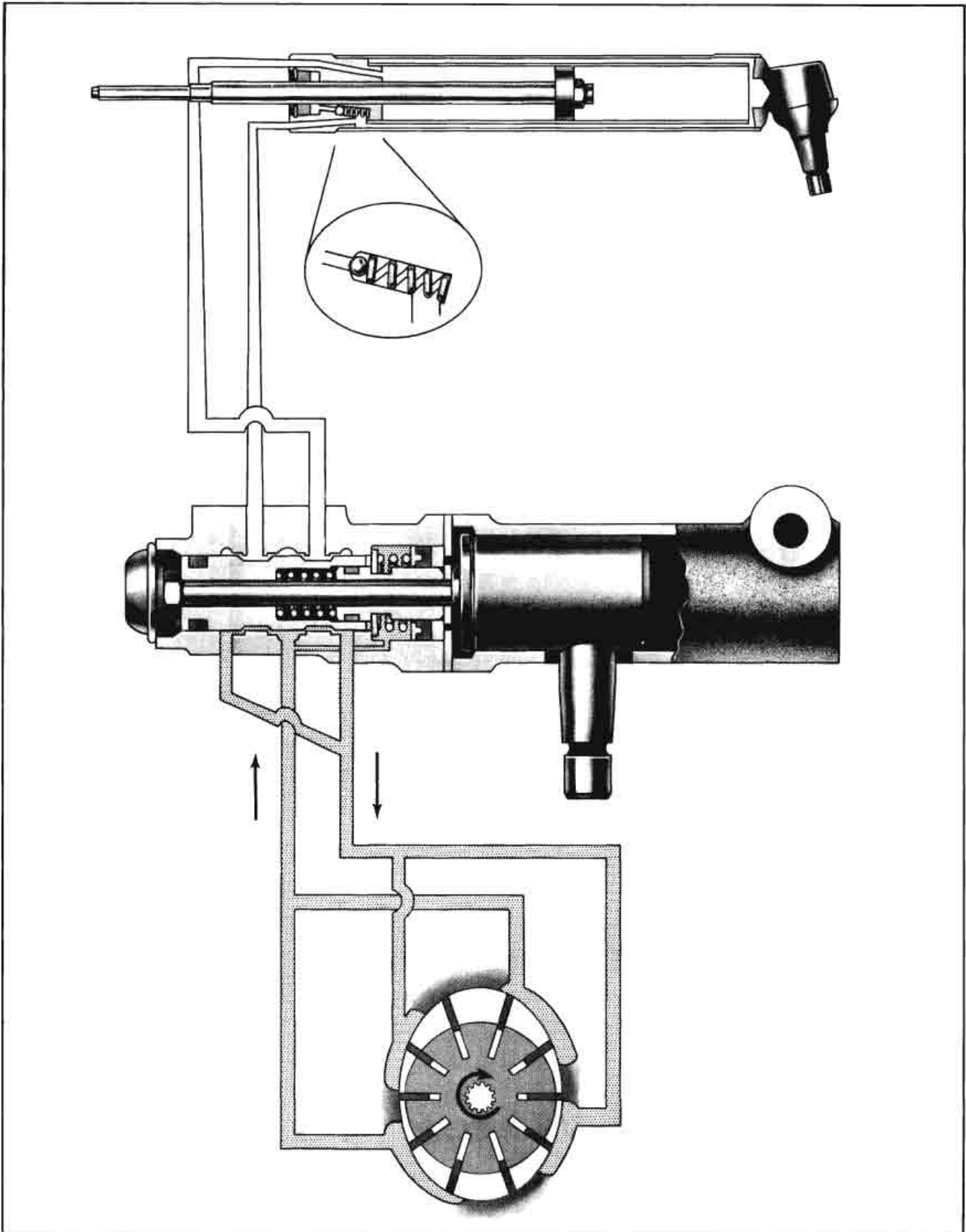


Fig. 9A-24 Operation in No Turn Position

RIGHT TURN POSITION (FIG. 9A-25)

When a right turn is started, movement from the steering gear pitman arm moves the ball stud, bearing sleeve, adjuster plug, valve shaft, valve spool, and valve reaction spool to the right.

Oil from the pump is cut off from the two outside grooves which communicate with the return line to the pump and the right groove to the booster cylinder.

Pressure, therefore, builds up and is communicated through the left groove which communicates with the line to the right booster cylinder chamber.

Since the pressure in the right chamber exceeds that in the left chamber, the cylinder is pushed to the right to supply the right turn assist.

Pressure in the line keeps the pressure relief valve closed. Oil forced out of the left chamber returns to the valve housing and back to the pump via the return line from the valve housing.

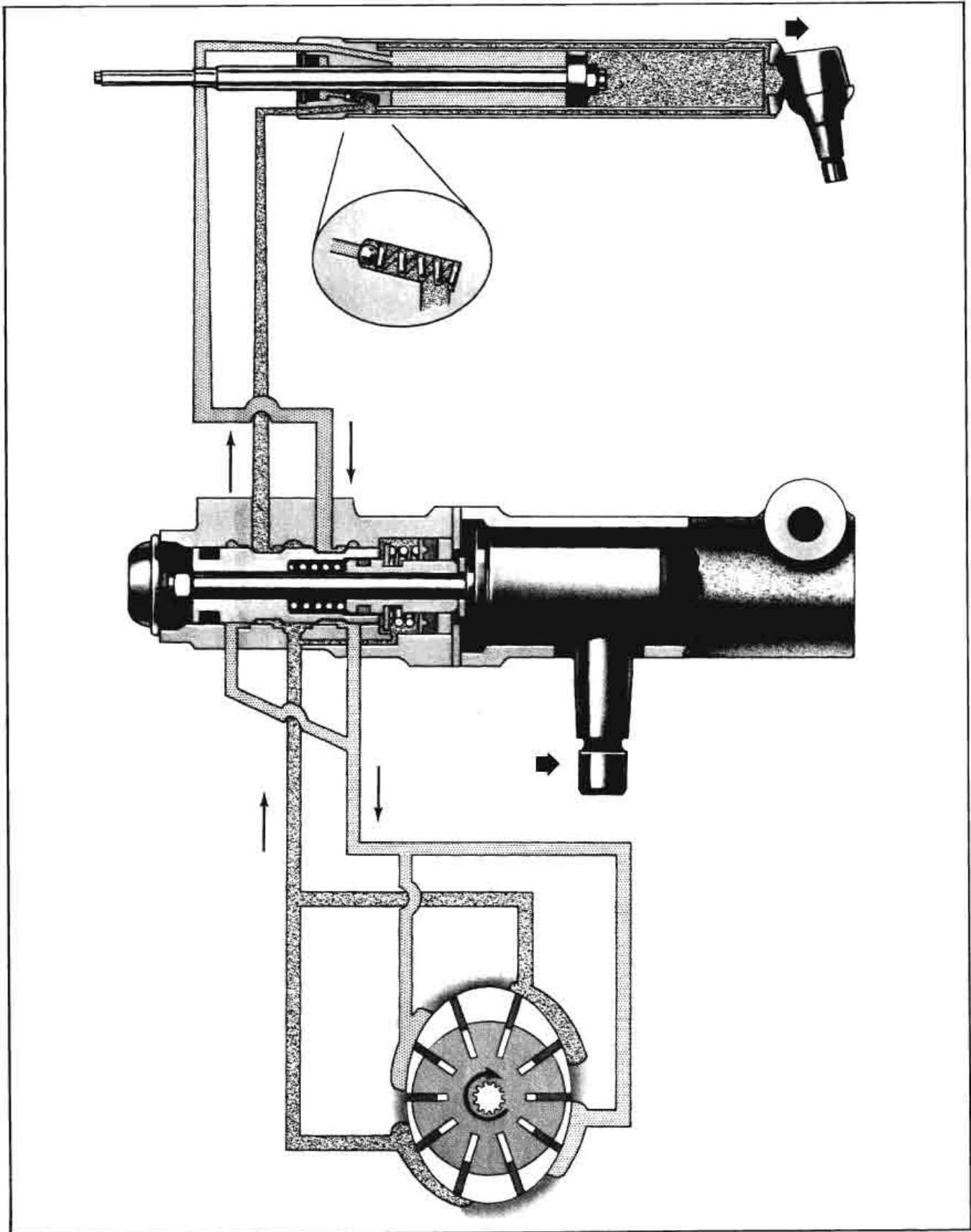


Fig. 9A-25 Operation in Right Turn Position

LEFT TURN POSITION (FIG. 9A-26)

When a left turn is started, movement from the steering gear pitman arm moves the ball stud, bearing sleeve, adjuster plug, valve shaft, valve spool, and valve reaction spool to the left.

Oil from the pump is cut off from the two outside grooves which communicate with the return line to pump, and the left groove to the booster cylinder.

Pressure, therefore, builds up and is communicated through the right groove which communicates with the line to the left booster cylinder chamber.

Since pressure in the left chamber exceeds that in the right chamber, the cylinder is pushed to the left to supply the left turn assist.

Oil is forced out of the right chamber and returns to the valve housing and back to the pump via the return line from the valve housing.

The ball check provides an escape for oil trapped in area A, when excess pressure builds up from leak-by around shaft B.

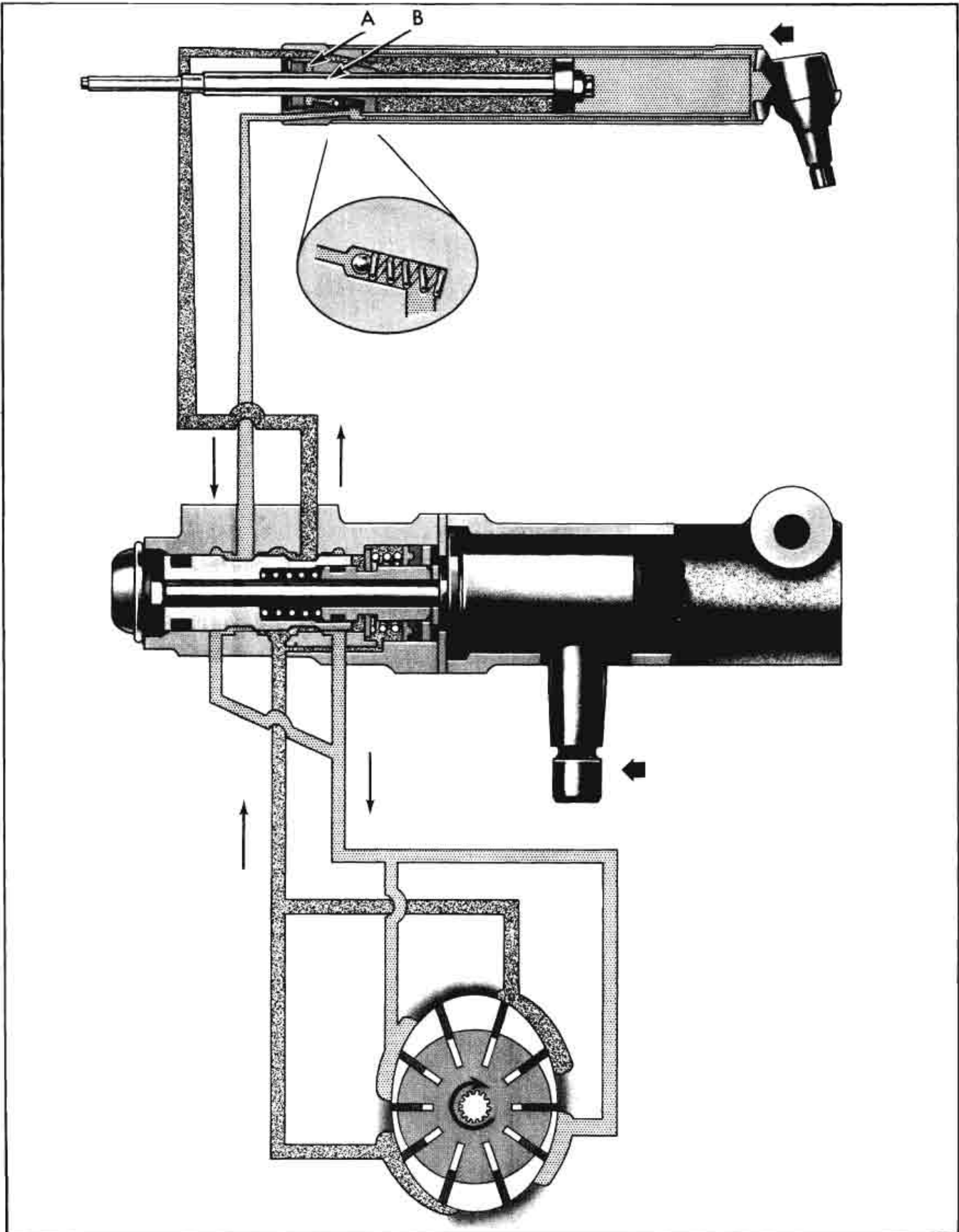


Fig. 9A-26 Operation in Left Turn Position

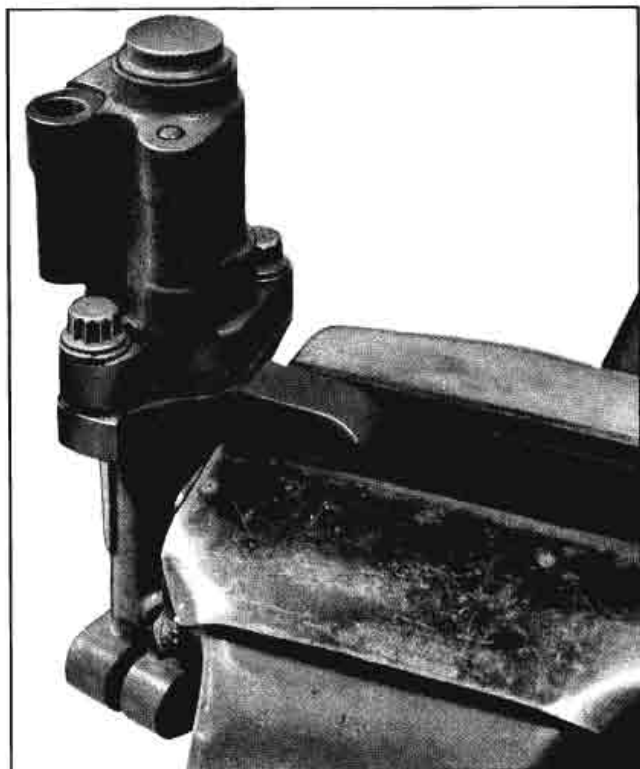


Fig. 9A-27 Holding Control Valve



Fig. 9A-29 Removing Adjusting Nut

DISASSEMBLE

1. Place the valve in a vise as shown (Fig. 9A-27) and remove dust cover (Fig. 9A-28).

2. Remove adjusting nut (Fig. 9A-29).

3. Remove valve to adapter bolts (Fig. 9A-30) and remove valve housing and spool from adapter (Fig. 9A-31).

4. Remove spool from housing (Fig. 9A-32).

5. Remove spring, reaction spool, washer, reaction spring, spring retainer, and seal (Fig. 9A-33). "O" ring may now be removed from the reaction spool.

6. Remove the annulus spacer (Fig. 9A-34).

7. Remove valve shaft washer (Fig. 9A-35).

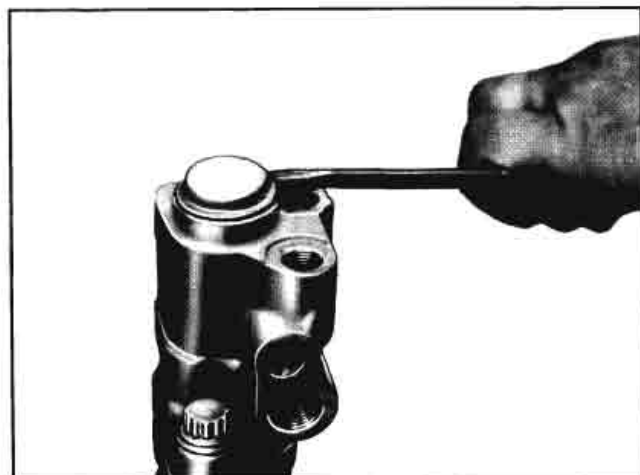


Fig. 9A-28 Removing Dust Cover



Fig. 9A-30 Removing Valve to Adapter Bolts

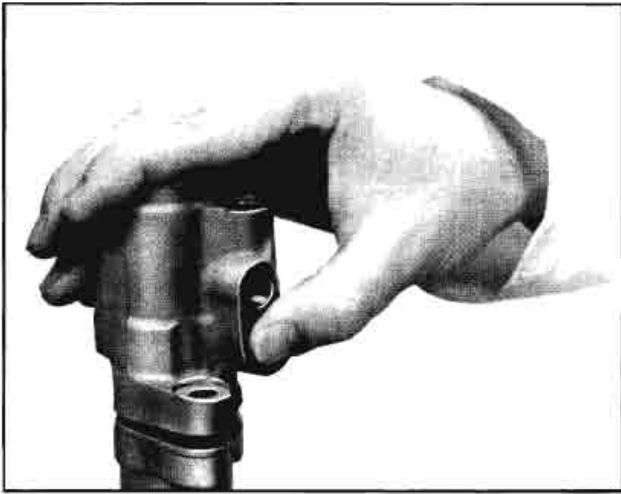


Fig. 9A-31 Removing Valve Housing and Spool

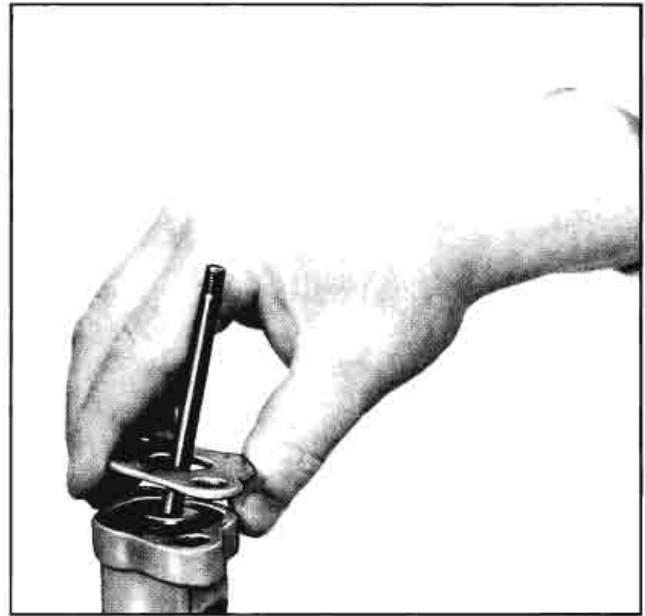


Fig. 9A-34 Removing Annulus Spacer

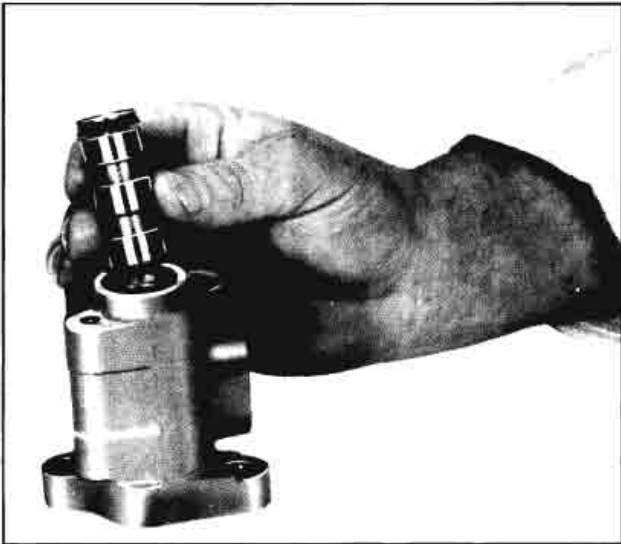


Fig. 9A-32 Removing Valve Spool

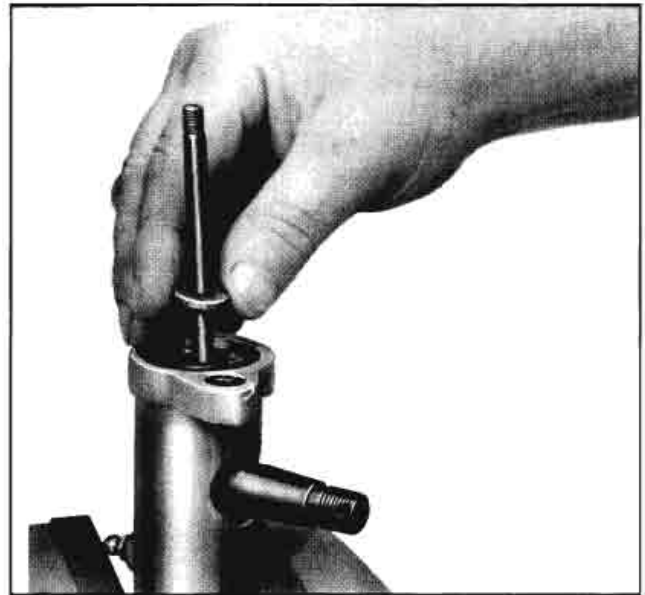


Fig. 9A-35 Removing Valve Shaft Washer



Fig. 9A-33 Removing Reaction Components

8. Remove plug to sleeve key (Fig 9A-36).
9. So as not to nick the top surface, turn adjuster plug out of sleeve carefully (Fig. 9A-37).
10. Remove the adapter from the vise and invert, permitting the spring and one of the two ball seats to fall free (Fig. 9A-38).
11. Remove the ball stud and the other ball seat and the sleeve will fall free (Fig. 9A-39).



Fig. 9A-36 Removing Plug to Sleeve Key

CLEANING AND INSPECTION

1. Wash all metal parts in solvent cleaner and dry them with a lint free cloth.
2. Inspect all parts for scratches, burrs, distortion, evidence of wear and replace all worn or damaged parts, including mating parts where necessary.
3. Replace all seals, gaskets, covers with approved service parts.

If valve ports are to be removed:

1. Tap threads in holes of valve ports (Fig. 9A-40).
2. Remove ports by using suitable size bolt into



Fig. 9A-37 Removing Adjuster Plug

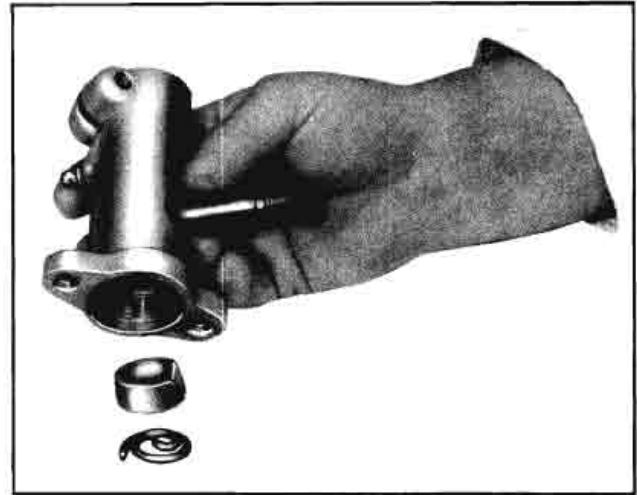


Fig. 9A-38 Removing Spring and Ball Seat

threaded hole, with washer and nut as extractor (Fig. 9A-41).

3. Install new ports with Tool J-6217 (Fig. 9A-42).

ASSEMBLE

1. Replace the sleeve and ball seat in the adapter, then the ball stud.
2. Replace the other ball seat and the spring with the small coil down (Fig. 9A-43).
3. Clamp the adapter in vise, put the shaft through the seat in the adjuster plug and screw adjuster plug in sleeve (Fig. 9A-44).

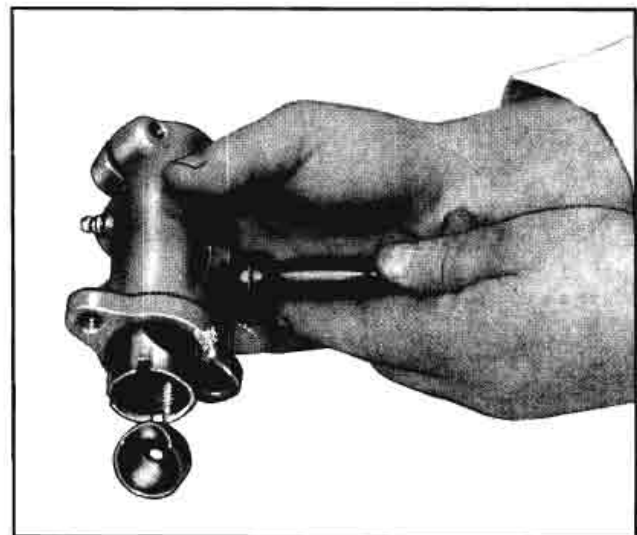


Fig. 9A-39 Removing Ball Seat, Sleeve, and Ball Stud

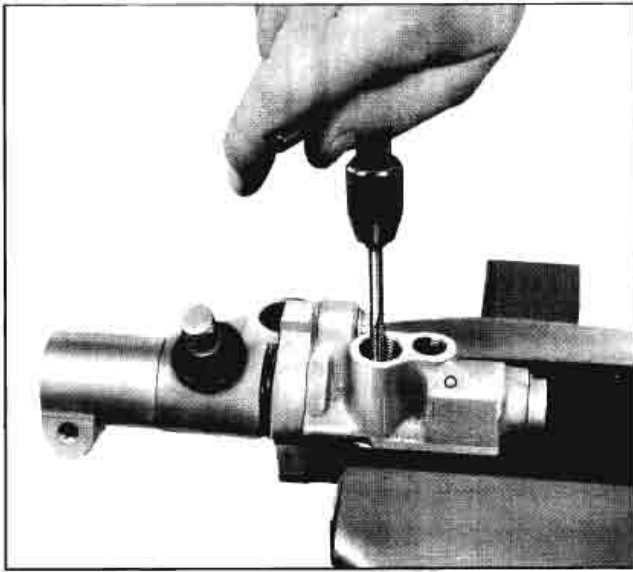


Fig. 9A-40 Tapping Valve Ports

4. Turn the plug in until it is tight, then back it off until the slot lines up with notches in the sleeve.

5. Insert the key, making sure that the small tangs on the ends of the key fit into the notches in the sleeve (Fig. 9A-45).

6. Install "O" ring seal on reaction spool.

7. Install the valve shaft washer, annulus spacer, reaction seal (lip up), spring retainer, reaction spring and spool, and washer and adjustment spring. Install the washer with the chamfer "up".

8. Install the seal on the valve spool (lip down), then install spool in housing (Fig. 9A-32) being careful not to jam spool in housing.

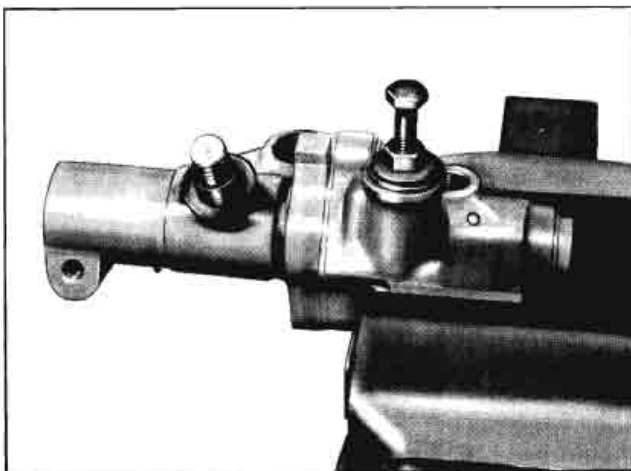


Fig. 9A-41 Installation to Remove Valve Port

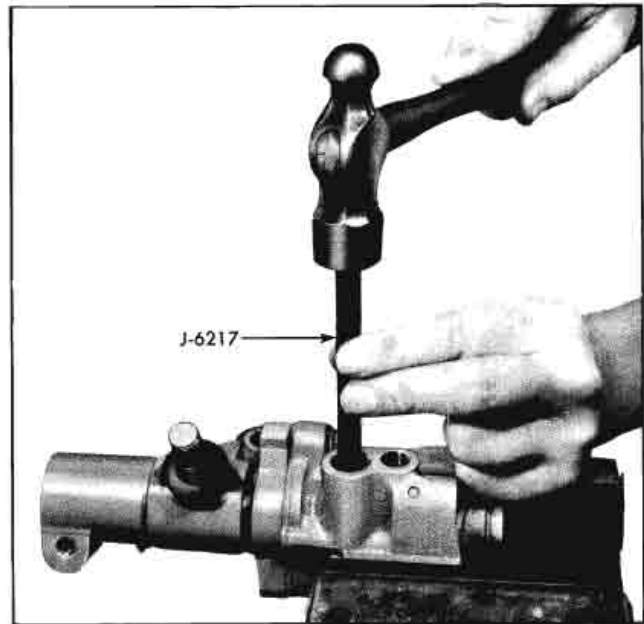


Fig. 9A-42 Installing New Valve Port

9. Install housing and spool onto adapter. The side ports should be on the same side as the ball stud. Bolt the housing to the adapter. Torque bolts to 25-30 lb. ft.

10. Depress the valve spool and turn the lock nut onto the shaft about four turns.

NOTE: Always use a new nut.



Fig. 9A-43 Ball Seat Spring Installed



Fig. 9A-44 Installing Adjuster Plug

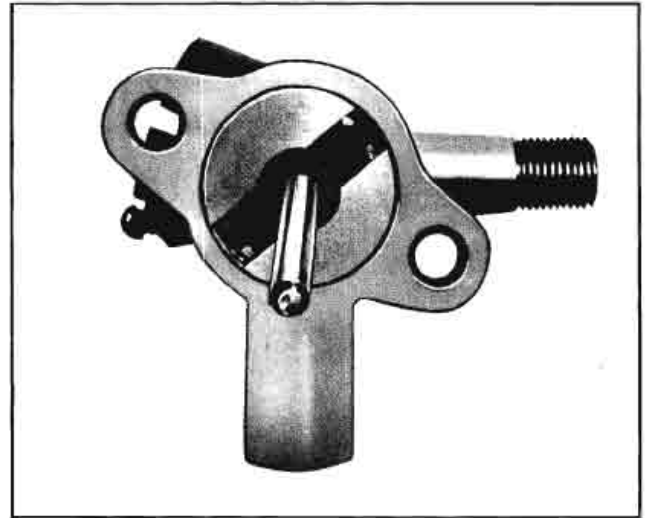


Fig. 9A-45 Installing Key in Sleeve Notches

BOOSTER CYLINDER

DISASSEMBLE

(See Fig. 9A-46).

1. To remove the piston rod seal, remove the snap ring and pull out the rod, being careful not to spray oil out of the ports.
2. Remove the piston rod scraper, scraper element, backup washer and piston rod seal from the rod.
3. To remove the ball stud, depress the end plug and remove the snap ring. Push on the end of the ball stud and remove the end plug, spring, spring seat, and ball stud. If the ball seat is to be removed it must be pressed out, using Tool J-8937 (Fig. 9A-47).

ASSEMBLE

1. Reassemble the piston rod seal components by reversing the disassembly procedure. Apply a thin coating of lubriplate on the inner surfaces of the seal and scraper element before assembly.
2. Reverse the disassembly procedure when reassembling the ball stud. Fill the area beneath the end plug with chassis lubricant. **NOTE:** If the ball seat was removed, press new seat into place using Tool J-8937 (Fig. 9A-48).
3. In each case, be sure that the snap ring is securely seated in the ring groove.

INSTALLATION BALANCING

Because this is an adjustable valve, it must be adjusted after being disassembled.

The following steps should be followed in balancing a control valve. The same procedure may be followed to correct a complaint of harder steering effort required in one direction than the other.

1. Install valve in vehicle. Connect all hoses and fill the pump reservoir with oil. Do not connect the cylinder rod to the frame bracket. If the vehicle is already in operation, it will be necessary to detach the cylinder rod from the frame bracket.

2. With all hoses attached and the proper amount of oil added to the system, the engine should be started with the car on the hoist. One of the two following conditions will exist:

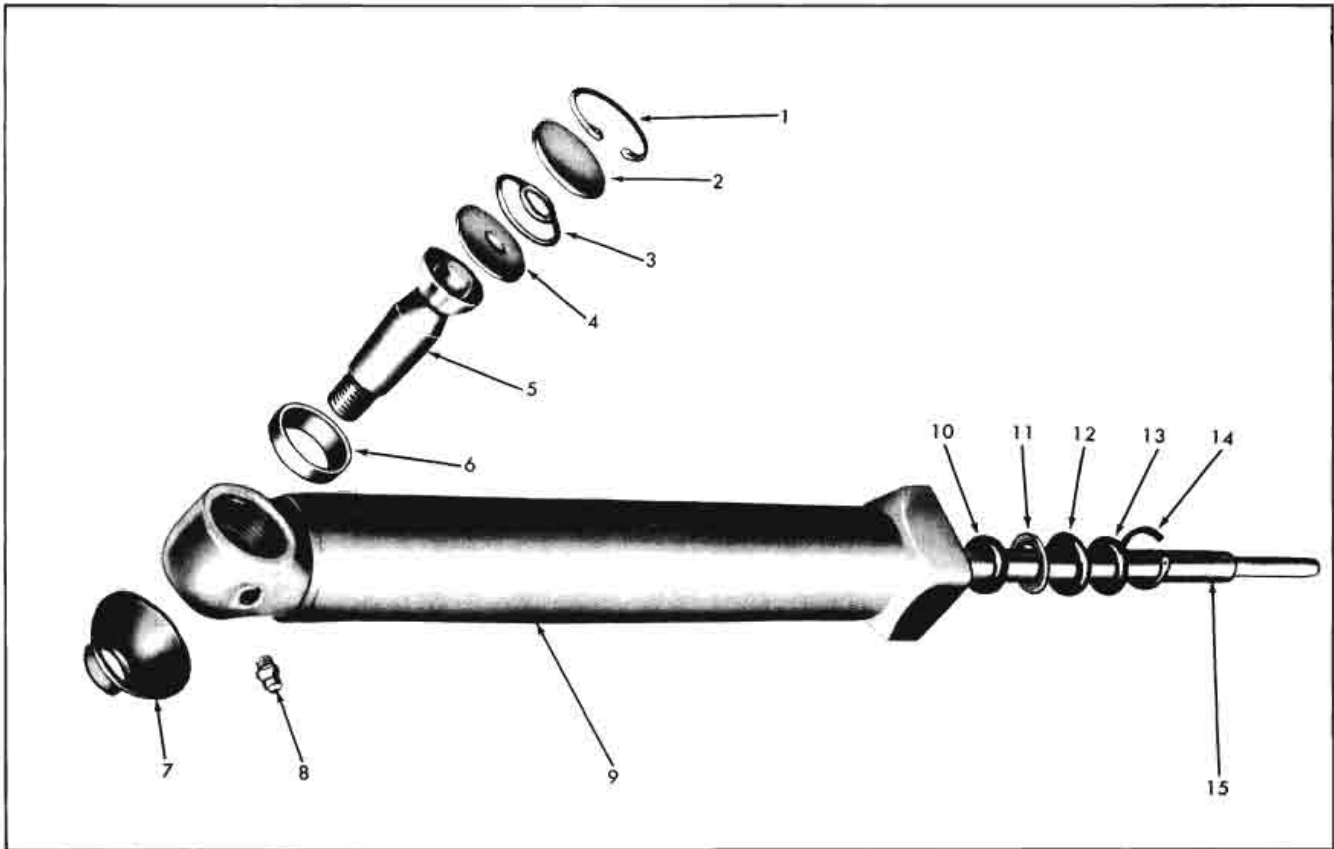
- a. If the piston rod remains retracted, the lock nut should be advanced until the rod starts to move out. The nut should then be backed off until the rod starts to move in. Reposition the nut to exactly $\frac{1}{2}$ the rotation required to change the direction of shaft movement.

- b. If the piston rod extends upon starting the pump, the lock nut should be retarded until the rod starts to move in. The nut should then be advanced until the rod starts to move out. Reposition the nut to exactly $\frac{1}{2}$ the rotation required to change the direction of shaft movement.

CAUTION: Do not turn the nut back and forth more than is necessary to balance the valve.

3. When the valve is balanced, the piston rod should be able to be moved in and out manually.

4. The engine should then be turned off and the



- | | | | |
|----------------|---------------------|---------------------|------------------------|
| 1. Snap Ring | 5. Ball Stud | 9. Piston Body | 13. Piston Rod Scraper |
| 2. End Plug | 6. Ball Seat | 10. Piston Rod Seal | 14. Snap Ring |
| 3. Spring | 7. Ball Stud Shield | 11. Back-up Washer | 15. Piston Rod |
| 4. Spring Seat | 8. Lube Fitting | 12. Scraper Element | |

Fig. 9A-46 Booster Cylinder Exploded View

cylinder rod connected to the frame bracket.

5. As a check, the engine should be started again with the car on the hoist. If the front wheels do not

turn in either direction from center, the valve has been properly balanced.

6. Install the dust cap on the end of the valve.

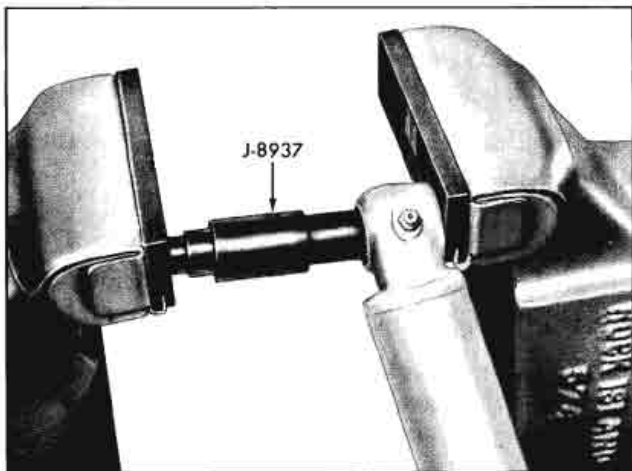


Fig. 9A-47 Removing Ball Seat

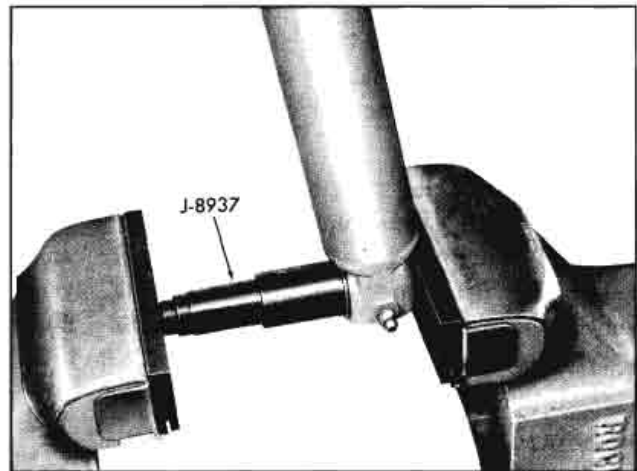


Fig. 9A-48 Installing Ball Seat

TROUBLE DIAGNOSIS

POWER STEERING SYSTEM

Cleanliness is a highly important factor in the service of the power steering system. If dirt enters the hydraulic system, it will cause noise, leaks, or faulty operation. When working on a power steering unit, be sure to completely clean the outside before disassembly. Careful thought to cleanliness while disassembling and reassembling the power unit is essential.

LEAKS

If the complaint is oil loss in the power steering system, the following steps should be performed. First, wipe the complete system dry. This includes the pump, control valve, booster cylinder, and four hoses. Then fill the pump reservoir, start the engine, operate the steering system and observe where leakage is occurring. The position of the leak will then indicate the cause of the leak. If the leakage is at the hose connection, the fitting should be tightened and then rechecked to determine if that stopped the leakage. If the oil leak is from one of the units, it should be removed from the car. Improperly installed seals is a major cause of leaks. Damage to seal will cause leaks if the housings have sharp edges which will cut the seal. Sharp edges should be removed with a fine stone and new seals installed.

NOISE

When the complaint is excessive noise, it is sometimes difficult to isolate the sound. Following is a quick check to determine whether or not the steering system is at fault. Disconnect the pump drive belt and operate the car. If the noise is no longer present, then make the power steering system the next check.

Another good thing to remember is never diagnose a power steering complaint without first checking fluid level and drive belt tension. Either may cause noises and malfunctions which could conceivably be blamed on the steering unit. When checking fluid level, be sure bubbles are not present in the fluid. If bubbles are found, the system should be bled.

Obstructions in the hydraulic system will also cause noise. For instance, a slight burr on the edge of the valve spool lands or a hose restriction will cause noise on turns. Removal of the burr with a fine

stone or replacement of the hose will be necessary for correction.

If belt noise (possibly accompanied by a knock or steering wheel oscillation) is present on extreme turns, improper pump belt tension may be the cause.

HARD STEERING

Dirt in the system can cause hard steering, since greater effort is required to reposition the spool and bring the power steering into operation. The repair is to completely clean the hydraulic system. If dirt is not the cause, usually the pump or cylinder are responsible.

POWER STEERING PUMP

NOISE

The power steering pump is not completely noiseless. Some noise may be present whenever the wheels are against the wheel stops. This noise usually becomes greater as the engine speed is increased as in making a full cramped U-turn. The noise is caused by the system relief valve and is normal. Momentary aeration of the oil is sometimes noticeable under these conditions.

Some noise may also be present under standstill parking conditions.

Power steering pump noise can be confused with many other things such as transmission, rear axle, generator, etc.

If excessive noise is present, remove the pump drive belt, to be sure the pump is at fault.

If the pump is excessively noisy, the following steps should be taken:

1. Check belt tightness and check for bent pulley.
2. Check oil level and fill to level if necessary and follow good bleeding procedure.
3. Check to make sure hoses are not touching any other parts of the car, particularly the sheet metal.
4. Check for air in the oil. Air will show as bubbles or the oil will appear milky. Small amounts of air cause extremely noisy operation. If air is present:
 - a. Tighten all fittings and bolts.
 - b. Check the entire system for source of air leak.

Air can leak into the system at any place. Air leaks usually occur at joints in the system where oil passes through at high velocity, such as hose connections or at the drive shaft seal.

The pump should be operated for a few minutes at idle speed after each step in attempting to eliminate air. Occasionally turn the steering wheel between extreme turns to allow the air to bleed out of the oil.

5. Check the pressure plate, thrust plate, and rotor for scoring.

NOTE: A high polish is always present on the face as a result of normal wear. Do not confuse this with scoring. Light scoring can be cleaned up by carefully lapping on a flat surface. Be sure to thoroughly wash away all lapping compound.

6. Check the vanes to insure that the radius edge is toward the outside and that they operate freely in the rotor slots.

7. Check the contour surface of the pump ring for extreme wear. Normally there may be some scuff marks and uniform wear. This is not detrimental to pump noise or function. However, if the wear con-

sists of chatter marks or gouges that can be felt with the finger, both the ring and vanes should be replaced. The vanes should be replaced because if the ring is worn sufficiently to be felt with the finger, the vanes usually are worn too.

8. Check the face of the thrust plate and rotor for scoring or metal pick up. Light scoring or pick up can be cleaned up by lapping (see 5 above).

9. Check bushing and shaft. If worn heavily or failed, noise may result.

10. Cases of pump noise caused by the flow control plunger have been known to exist. If other measures fail, try a new plunger and spring.

11. Check for burrs on valve hole and supercharge hole intersection and remove burrs.

LEAKS

1. Tighten all fittings and bolts.
2. Try to determine source of leak by wiping off pump assembly.
3. Possible sources of pump leakage are:

SOURCE OF LEAK	CAUSE	REMEDY
Top of reservoir	Reservoir too full.	Fill to proper level.
	Excessive air pressure in oil.	Proceed as in 4 above to determine cause of air.
	Welch plug missing from housing.	Install welch plug.
At reservoir	O-ring cut or improperly installed.	Replace O-ring or install properly.
	Reservoir damaged.	Replace reservoir.
At the pressure fitting or studs on control valve, cylinder or pump.	Not tightened sufficiently.	See page 9A-6.
	Cross threaded. Defective seal on fittings or hose. Damaged seals.	Correct as necessary.
At shaft seal of pump.	Defective seal or damaged shaft.	Replace seal without disassembling pump. Replace shaft if seal surface is scratched or nicked.
Leaks in metal parts.	Defective castings.	Replace.
At cylinder rod seal.		Replace seal.
At control valve.		Replace seals.

INOPERATIVE, POOR, OR NO ASSIST

1. Check for loose drive belt.
2. Check and fill reservoir. Bleed system.
3. Air in the oil. Locate source of air leak and correct.
4. Defective hoses as determined by inspection. Correct.
5. Extreme wear of pump ring. Replace part.
6. Dirt in relief valve. Clean and replace.
7. Piston seal leak. Replace cylinder.
8. Self steering. Balance control valve (Page 9A-24).
9. If steering gear is at fault, see Section 9.
10. Determine the source of trouble; that is pump, control valve cylinder or hoses as outlined below.

TEST NO. 1—OIL CIRCUIT OPEN:

- a. Install a pressure gauge in the pressure line between the pump and control valve. Be sure to check and identify the pressure lines.
- b. Turn the steering wheel from one end to the other end and note the pressure on the gauge while holding the wheel momentarily against each end. This maximum pressure reading should not be less than 775 psi with the engine idling (see Section 6B), the oil temperature in the reservoir between 150 to 170 degrees Fahrenheit as measured with a thermometer.

NOTE: To obtain temperatures of 150 degrees to 170 degrees desired for testing, turn wheels through normal operating range several times.

CAUTION: Do not hold the steering wheel against the stop for any extended period of time.

If the maximum pressure is below 775 psi, it indicates there is some trouble in the hydraulic circuit. However, it does not indicate whether the pump or the control valve is at fault. To determine if the pump alone or the control valve alone, or if both are at fault, proceed with Test No. 2. It will not be necessary to proceed with Test No. 2 if the pressure as read for each end is more than 40 psi different, since the control valve is at fault.

TEST NO. 2—OIL CIRCUIT CLOSED:

- a. Set engine idle (see Section 6B).
- b. Turn the shut-off valve of gauge to the closed position.

NOTE: Shut-off valve must be located between the gauge and the control valve.

- c. Observe and compare the maximum pump pressure at idle. It should not be less than 775 psi.

NOTE: By comparing this reading with Test No. 1 (testing complete circuit), it is possible to determine whether the fault is with the pump or the control valve or both.

DIAGNOSIS OF ABOVE TESTS

- a. First test below 775 psi, second test more than 50 psi greater—control valve is at fault.
- b. First test below 775 psi, second test not more than 50 psi greater—pump at fault.

If pump is determined to be at fault, proceed as follows:

- a. Remove reservoir and flow control plunger. Be sure the flow control plunger operates freely in the pump housing bore. If stuck, dislodge. Check for burrs or dirt that may cause a sticky valve.
- b. Check the small screw in the end of the flow control valve for looseness. If loose, tighten, being careful not to damage machined surfaces.
- c. Insure that the pressure plate and thrust plate are flat against the pump ring.
- d. Check the pressure plate, thrust plate, and rotor for scoring.

NOTE: A high polish is always present on the face as a result of normal wear. Do not confuse this with scoring.

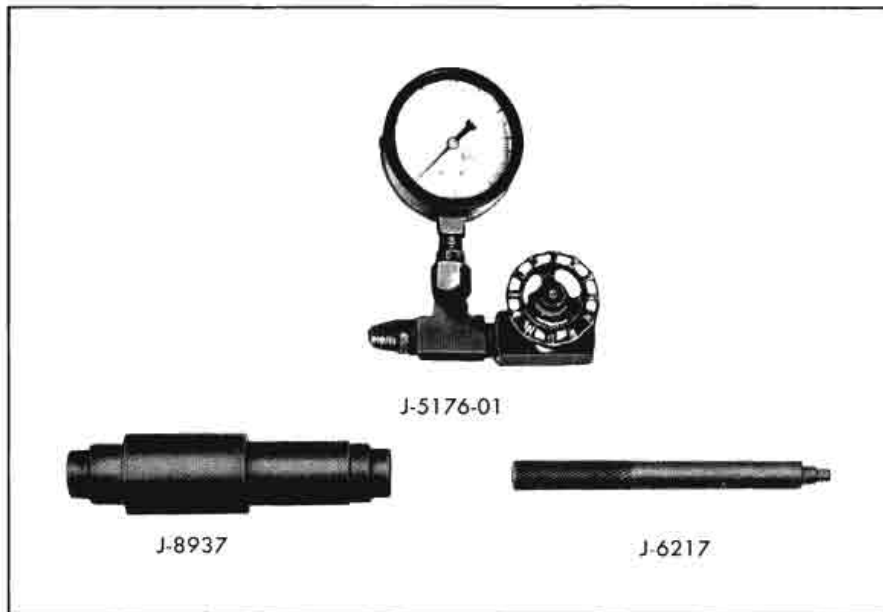
- e. Check the vanes to insure that the radius edge is toward the outside and that they operate freely in the rotor slots.
- f. The internal parts of the flow control plunger may be at fault. Try a new assembly. Do not attempt to service parts, as this assembly is properly calibrated at the factory.
- g. Check for broken drive shaft.

TORQUE SPECIFICATIONS

	LB. FT.
Pump to support retaining nuts or bolts	25-35
Pump to rear bracket support nut	20-35
Belt tension adjusting bolt or nut	20-35
Pulley nut	70-85
Cover retaining stud or bolt	25-35
Outlet union	25-35
Valve to adapter bolts	25-30

SPECIAL TOOLS

J-5176-01	Pressure Checking Gauge
J-8937	Booster Cylinder Ball Seat Remover and Installer
J-6217	Valve Port Installer



CHASSIS SHEET METAL

CONTENTS OF THIS SECTION

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Hood Latch	10-2	Lower Grille Panel Assembly	10-6
Hood Latch Adjustment	10-2	Hood Spring	10-6
Hood Hinges	10-3	Hood Hinge	10-6
Bumper	10-3	Hood	10-6
		Front Fender Cross Brace Assembly	10-7

SHEET METAL ALIGNMENT

Proper alignment of the front end sheet metal will provide proper relationship of adjoining sheet metal parts, ease of hood operation and eliminate squeaks, rattles and vibration.

FRONT FENDER ALIGNMENT

Vertical and fore and aft adjustment is provided at rear of fenders by enlarged holes in the fender bracket or body at the attaching points (Fig. 10-1, 10-2).

Fenders can be moved closer to or farther from the cowl by adding or removing shims between fender and body. Fenders can also be adjusted vertically by shifting the fender on the enlarged bolt holes (Fig. 10-1, 10-2).

1. Check the space between the front door to fender rear edge and adjust as necessary to obtain a parallel space.

2. Check to insure that all connections at the fender attaching bolts are tight.

HOOD

The hood is of rigid sheet metal construction with the outer panel of single sheet metal with a rugged inner panel reinforcement frame. Further rigidity is given by reinforcement diagonal braces strategically located so as to give extra strength at stress points.

1. Slotted holes in the hinge bracket to hood are provided to align hood fore and aft (Fig. 10-3).

2. The parallel space between hood sides and fender is accomplished by the rubber wedges mounted to each fender.



Fig. 10-1 Upper Fender Adjusting Bolt

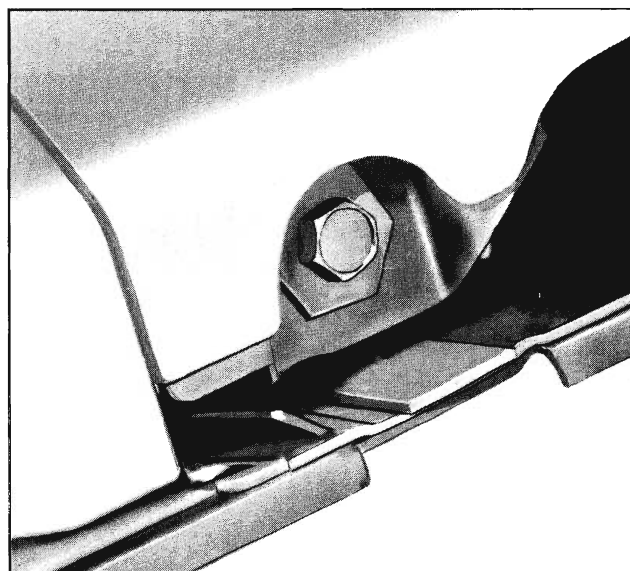


Fig. 10-2 Lower Fender Adjusting Bolt

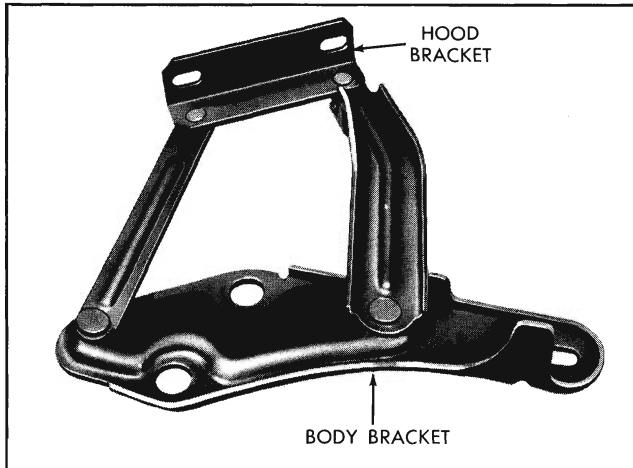


Fig. 10-3 Hood Hinge

3. The rear corners of the hood should be held down against the hood lacing to keep rear of hood from dancing or vibrating. The rear hood height is adjustable by moving hood hinge at body mount. The hinge bolt holes are enlarged giving room for adjustment.

HOOD LATCH

A positive locking hood latch is used consisting of two assemblies, a safety hood latch assembly (Fig. 10-5) that fastens to front fender cross brace and front frame crossmember, and a pilot assembly that fastens to the hood (Fig. 10-4).

The hood is opened by pulling release handle under the bumper (Fig. 10-6) which in turn opens the latch. The safety hook is attached to the hood.

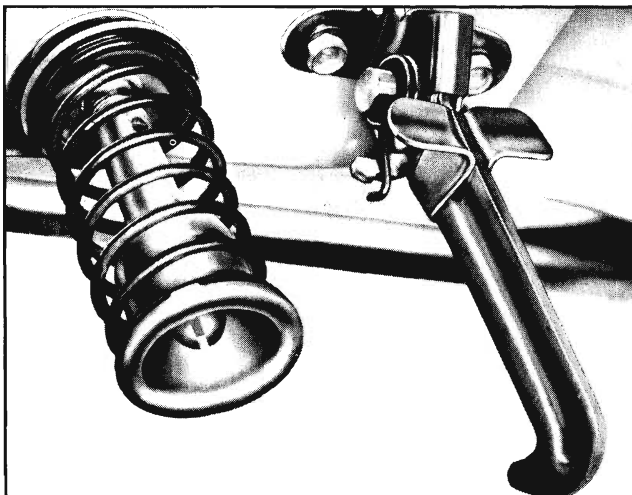


Fig. 10-4 Pilot Assembly

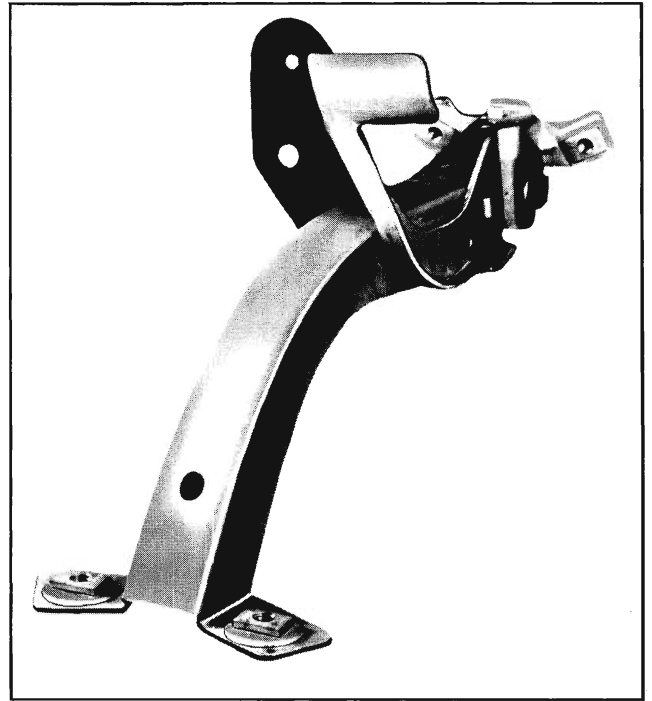


Fig. 10-5 Hood Latch Assembly

The pilot assembly attached to the hood assembly may be adjusted longitudinally for alignment purposes and can be vertically adjusted to obtain a tight hood to fender relationship.

HOOD LATCH ADJUSTMENT

Should the hood be difficult or even fail to release or close, there are 3 adjustments that can be made.

1. Move safety latch either fore or aft in elongated holes at fender cross brace.
2. Fore and aft adjustment of pilot assembly.

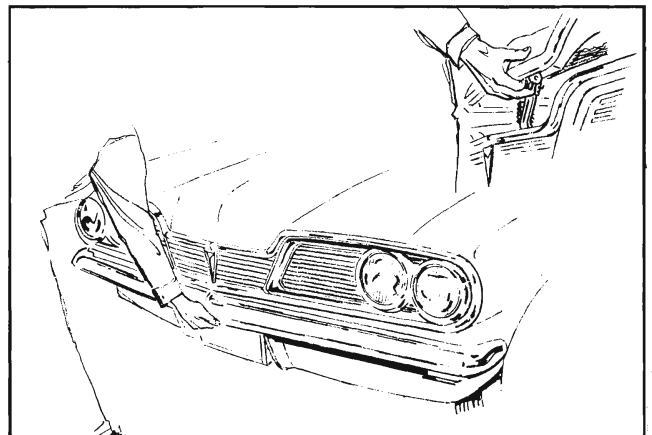


Fig. 10-6 Hood Release

3. Adjustment of pilot bolt.

Proper adjustment of hood latch to provide for easy hood closing is as follows:

1. Check tightness of hood latch bolts.
2. Raise or lower hood bumpers on front fender cross brace (Fig. 10-7).
3. Press down on nose of hood.
 - a. If some give or looseness is noticed, hood is not tight and will vibrate and raise up on corners at high speeds. In this case, shorten latch bolt and recheck.
 - b. If hood is tight with no give, the hood could be properly adjusted or could be too tight.

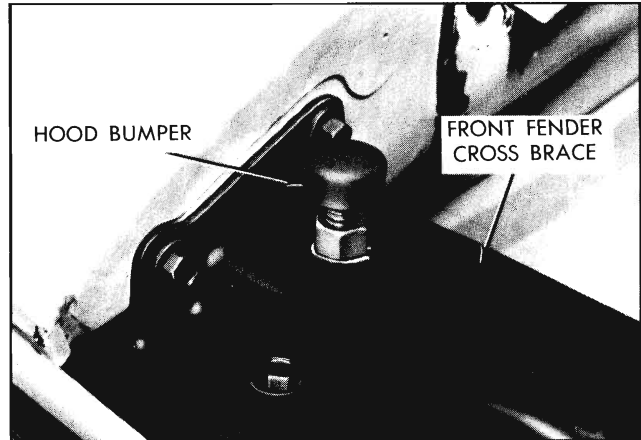


Fig. 10-7 Hood Bumper

CHECK AS FOLLOWS:

1. Close hood.
2. Release latch and raise hood 10"-12".
3. Let hood fall of own weight.
4. Adjust hood latch assembly and latch bolt to permit hood to close easily when it drops of its own weight from 10"-12" above closed position.

HOOD HINGES

The hood is mounted on hinges (Fig. 10-3) mounted to wheel house. Double assist over center springs are used, (one at each hood hinge) both ends of which are fastened to the arms of the hinge. This construction provides hold-open power.

A hood to hinge reinforcement bracket which has two points of attachment is used. Fore and aft adjustment of the hood is provided for by slotted holes in the bracket.

BUMPER ALIGNMENT

FRONT

The bumper mounting bracket is the only adjusting point for the front bumper. This adjusting point is used for both fore and aft and vertical adjustments (Fig. 10-8).

REAR

The rear bumper may only be adjusted longitudinally through the use of the elongated holes in the bumper mounting bracket (Fig. 10-9).

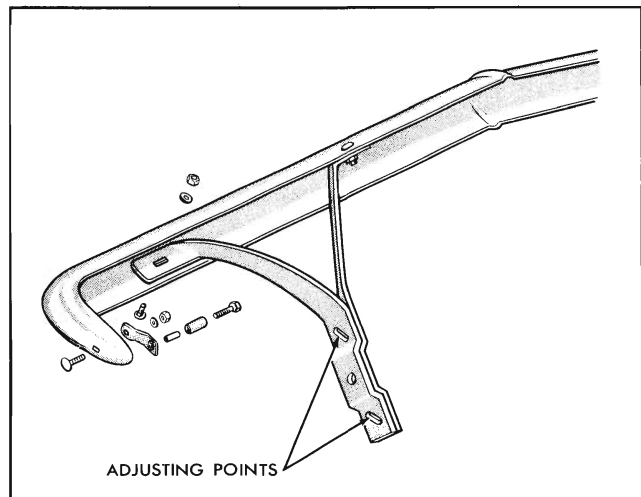


Fig. 10-8 Front Bumper

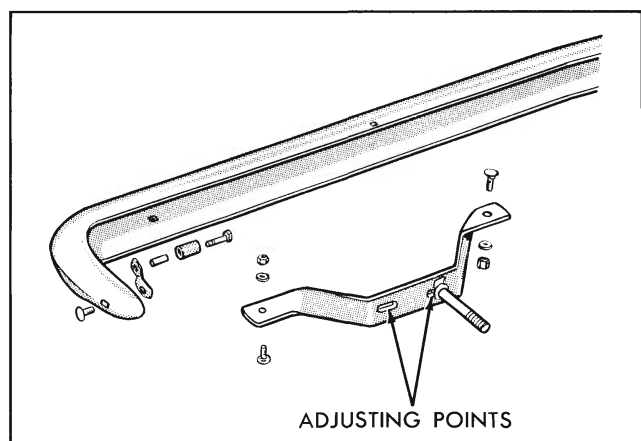
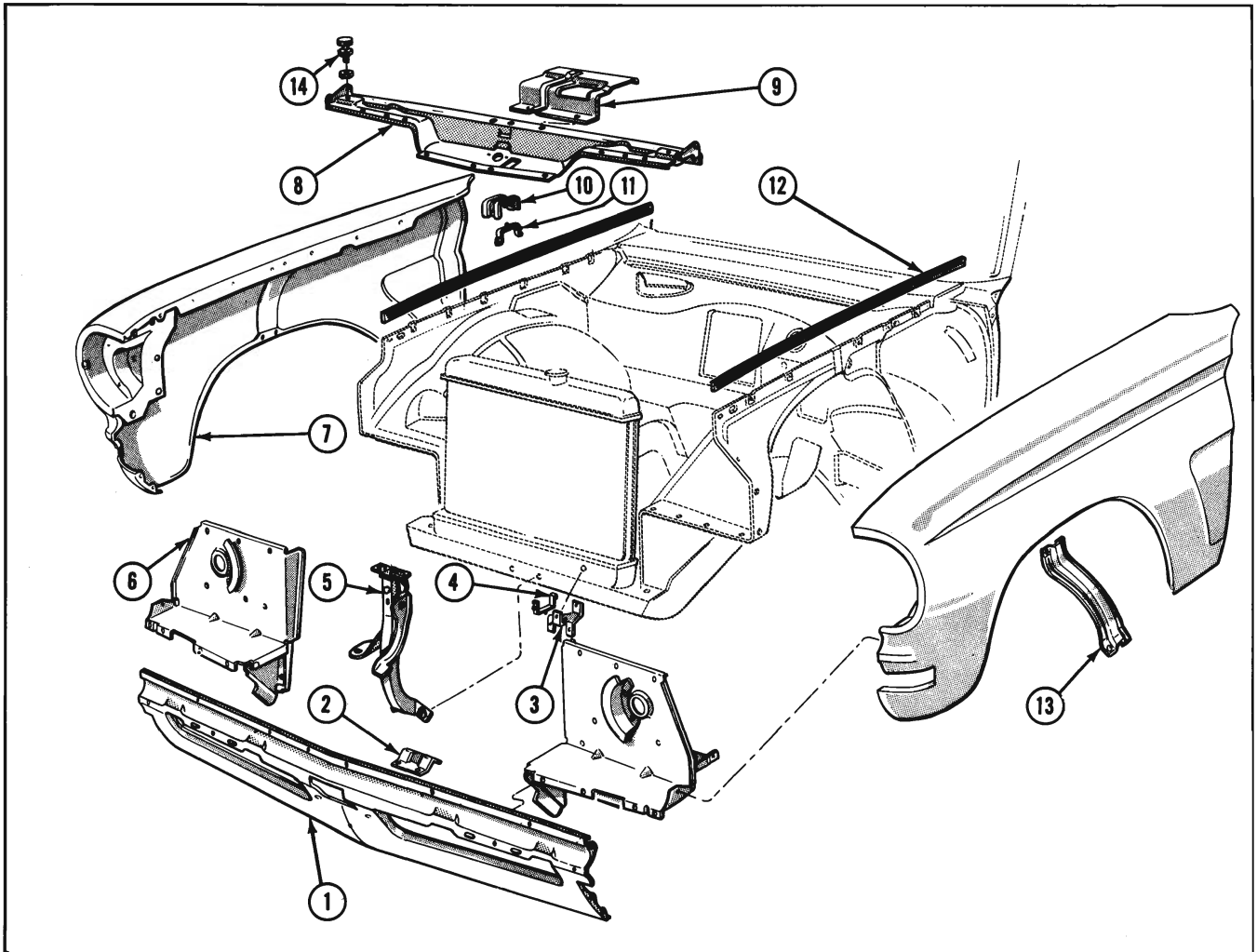


Fig. 10-9 Rear Bumper



- | | |
|---|--|
| 1 Panel, Radiator Grille—Lower | 8 Brace Ass'y. Front Fender Cross |
| 2 Bracket, Rad. Grille—Lower Panel Mounting | 9 Shield Ass'y. Radiator Fan |
| 3 Bracket, Radiator Support—Lower | 10 Bracket, Rad. Support—Upper—Part of Shield Ass'y. |
| 4 Insulator, Radiator Support Bracket—Lower | 11 Insulator, Rad. Support Bracket—Upper |
| 5 Hood Latch and Safety Catch—Ass'y. | 12 Strip, Front Fender to Body Sealing |
| 6 Baffle Ass'y. Radiator | 13 Brace, Front Fender to Wheel House Panel |
| 7 Fender Ass'y. Front | 14 Hood Bumper |

Fig. 10-10 Exploded View—Front End Sheet Metal

SHEET METAL REPLACEMENT

FRONT FENDER—REMOVE AND REPLACE

REMOVE

1. Remove front bumper.
2. Remove headlamp door and No. 2 seal beam unit.

3. Remove screws between headlamp body and fender.

4. Remove four screws between fender and grille assembly.

5. Remove parking lamp assembly.

6. Remove upper and lower rear fender bolts. **Note:** If same fender is to be replaced, note position, location and number of alignment shims used.

7. Remove hood spring. Page 10-6.

8. Remove all screws holding fender to front wheelhouse.

9. Remove fender.

REPLACE

1. Replace all screws holding fender to front wheelhouse.

2. Replace front fender cross brace screws.

3. Replace headlamp body to fender screws.

4. Replace four screws between fender and grille assembly.

5. Replace seal beam unit and headlamp door.

6. Replace upper and lower rear fender bolts.

NOTE: Be sure fender is aligned with door.

7. Replace hood spring, page 10-6.

8. Replace parking lamp assembly.

9. Replace front bumper.

GRILLE ASSEMBLY REMOVE AND REPLACE (FIG. 10-11)

REMOVE

1. Remove both headlamp bezel mouldings.

2. Remove grille to fender screws at each end of grille.

3. Remove battery from car.

4. Remove four radiator to grille brackets.

5. Remove radiator fan shield assembly.

6. Remove front fender cross brace assembly.

NOTE: Disconnect horn while removing cross brace assembly.

7. Remove six nuts from lower clips on grille.

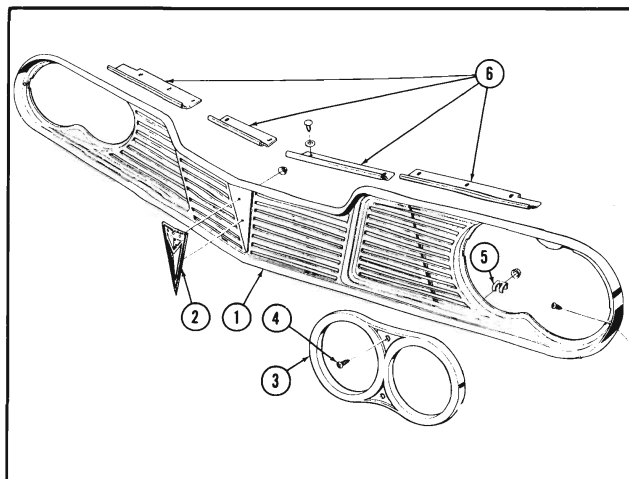
8. Remove grille from car (Fig. 10-12).

REPLACE

1. Install six clips in position on lower grille.

2. Install grille and secure with six nuts.

3. Install two screws securing grille to front fender.



- 1 Grille
- 2 Emblem
- 3 Bezel, Headlamp
- 4 Screw, Headlamp Bezel Retainer
- 5 Clip, Grille to Lower Panel
- 6 Radiator Grille Bracket

Fig. 10-11 Grille Assembly

4. Install front fender cross brace assembly in car.

NOTE: Connect horn wires while installing cross brace.

5. Install radiator fan shield assembly.

6. Install four radiator to grille brackets.

7. Install headlamp bezel mouldings.

8. Install battery in car.

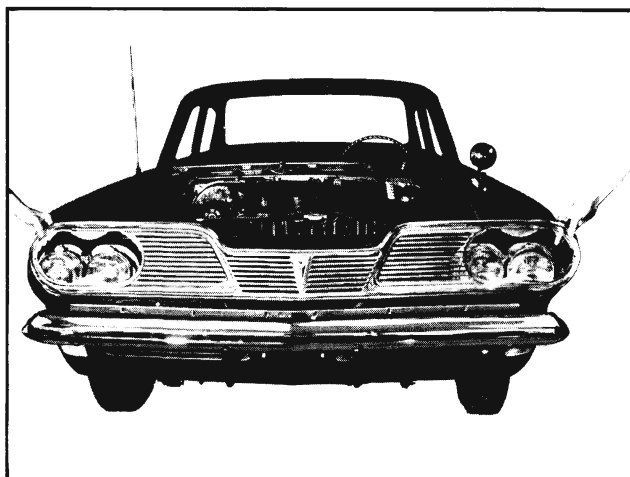


Fig. 10-12 Removing Grille Assembly

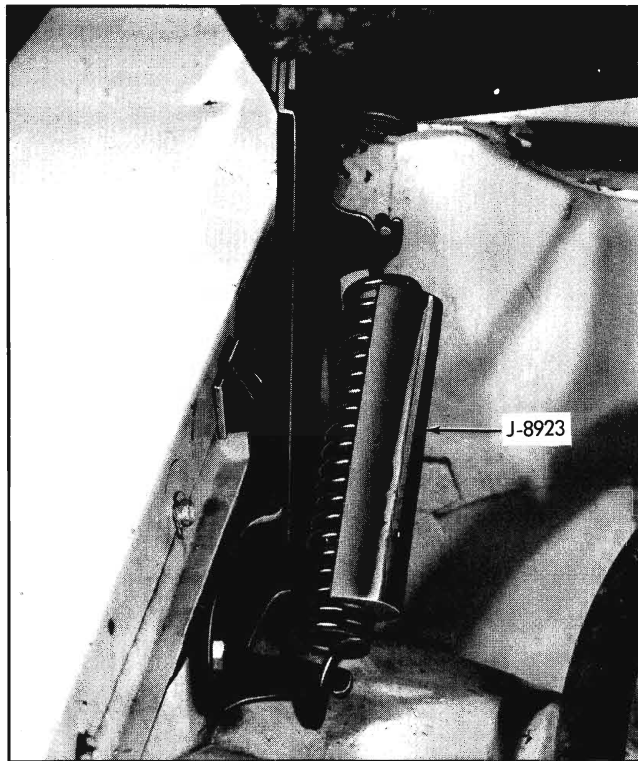


Fig. 10-13 Hood Spring Tool J-8923

LOWER GRILLE PANEL ASSEMBLY— REMOVE AND REPLACE

1. Remove grille.
2. Remove front bumper and bracket.
3. Remove screws between lower grille and fenders.
4. Remove hood latch assembly.
5. Remove screws holding lower grille panel to radiator baffle assembly.
6. Remove lower grille panel.
7. To replace, reverse the above procedure.

HOOD SPRING—REMOVE AND REPLACE

REMOVE

1. Close hood a little to expand spring.
2. Insert tool J-8923 on spring (Fig. 10-13).
3. Open hood all the way so spring can be removed.

REPLACE

1. If new spring is to be installed, insert J-8923 in spring once it is expanded.

2. Open hood until spring can be put in place on hinge.

3. Close hood a little and remove J-8923.

HOOD HINGE—REMOVE AND REPLACE

REMOVE

1. Open hood.
2. Remove hood spring. Page 10-6.
3. Remove screws holding hood to hinge.
4. Remove screws holding hinge to wheelhouse assembly.

REPLACE

1. Position hinge to wheelhouse assembly and tighten attaching screws.
2. Position hinge to hood and tighten attaching screws.
3. Replace hood hinge spring. Page 10-6.
4. Close hood and check hood alignment.
5. If hood is misaligned, measure amount of misalignment.
 - a. Open hood, mark position of hinge relative to hood.
 - b. Loosen hinge and move hinge the amount it was off.
 - c. Tighten securely and recheck alignment.

NOTE: The hood may be aligned vertically and fore and aft. Vertical adjustment is made between hinge and wheelhouse assembly. Fore and aft adjustment between hood and hinge (Fig. 10-3).

HOOD REPLACEMENT

The hood can be removed by removing the attaching screws between hinges and hood. When replacing the hood, adjust the alignment of one hinge at a time, as outlined in steps 4 and 5 under Hood Hinge—Remove and Replace.

**FRONT FENDER CROSS BRACE ASSEMBLY—
REMOVE AND REPLACE**

1. Remove battery.
2. Remove screws between front fender cross brace and fender.
3. Remove horns.
4. Remove screws between radiator baffle assemblies and front fender cross brace.
5. Remove front fender cross brace.
6. To replace, reverse the above procedure.

ELECTRICAL AND INSTRUMENTS

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The electrical system operates on 12 volts. This section of the manual is subdivided into the following sections:

1. Starting Circuit
2. Charging Circuit
3. Ignition Circuit

4. Lighting Circuit
5. Instruments
6. Windshield Wiper

The complete wiring diagram (less accessories) for all models is shown schematically in Figs. 11-1, 11-2, and 11-3.

STARTING CIRCUIT

The starting circuit includes the starting motor, solenoid, battery, and cables.

included on product information reports or battery correspondence.

BATTERY

DESCRIPTION

The Delco Model 455, 9 plate battery (Fig. 11-4) used in Pontiac Tempest cars is a 12-volt, 42 amp hour capacity unit. The battery is assembled in a hard rubber case with rubber separators, and is fitted with the "visual level fill" cell covers.

CAUTION: Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.

Battery liquid is highly acid. Avoid spilling on clothing or other fabric. This battery has a specific gravity of 1.260-1.280 at full charge at 80°F. The battery date code is located on the second cell cover from the positive post end. This date code should always be

PERIODIC SERVICE

Liquid level in the battery should be checked every 2,000 miles or once a month. In extremely hot weather, the checking should be more frequent. If the liquid level is found to be low, add water to each cell until the liquid level rises to the bottom of the vent well. Do not overfill! Distilled water, or water passed through a "demineralizer" should be used for this purpose in order to eliminate the possibility of harmful impurities being added to the electrolyte. Many common impurities will greatly shorten battery life.

The external condition of the battery and the battery cables should be checked periodically. The

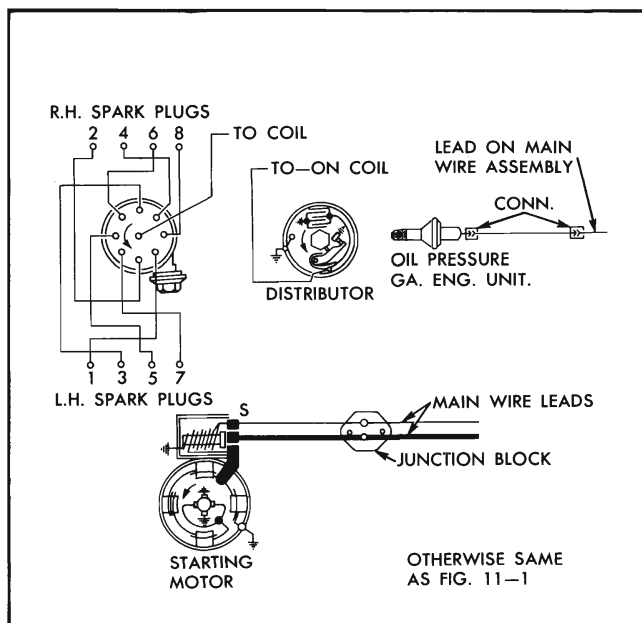


Fig. 11-2 Wiring Circuit Schematic—V-8 Engine

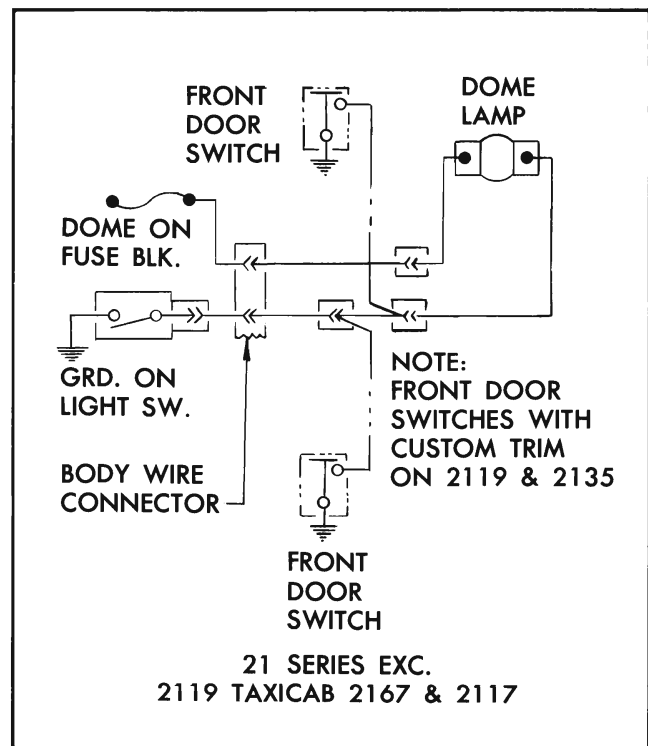


Fig. 11-3 Interior Wiring Schematic

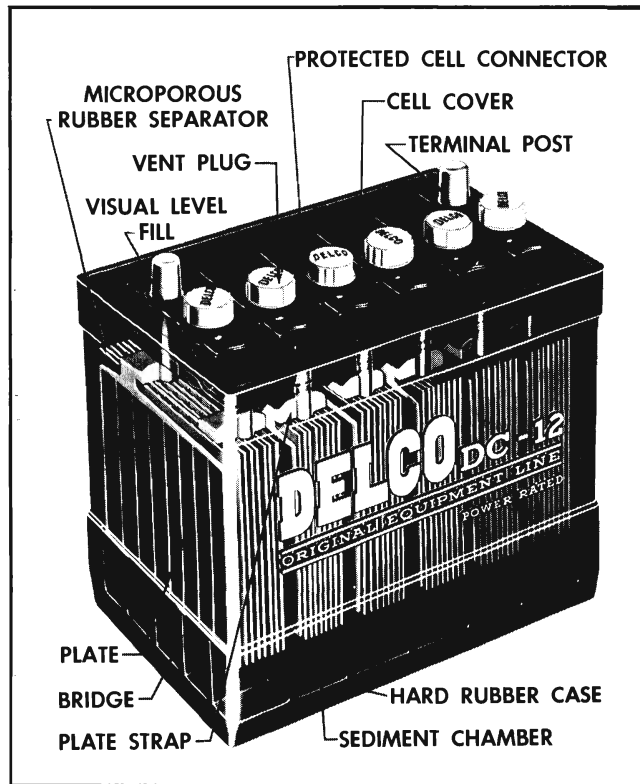


Fig. 11-4 Delco 12 Volt Battery

top of the battery should be kept clean and the battery holddown bolts should be kept properly tightened. Particular care should be taken to see that the top of battery is kept clean of acid film and dirt because of the high voltage between the battery terminals. For best results when cleaning batteries, wash with a dilute ammonia or soda solution to neutralize any acid present and flush off with clean water. Care must be taken to plug vent holes and keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its support so as not to damage the battery case, but they should not be tightened to the point where the battery case will be placed under a severe strain. The torque specification is 2 lb. ft.

To insure good contact, the battery cables should be installed on the battery posts with $\frac{1}{8}$ " of the post showing above cable. If the battery posts or cable terminals are corroded, the cables should be disconnected and the terminals and clamps cleaned separately with a soda solution and a wire brush. After cleaning, apply a thin coating of petrolatum on the posts and cable clamps to help retard corrosion.

REPAIRS

CABLE REPLACEMENT

When replacing battery ground cable be sure the connections are secure.

SUPPORT REPLACEMENT

When replacing the battery support, it is important that the outer edges of the battery bear firmly and evenly against the support. To provide even support, install shims as necessary between the corners of the support and the support bracket. Battery hold down clamp should be tightened to 2 lb. ft. torque.

TESTING, BOOSTING, AND CHARGING

QUICK IN-THE-CAR BATTERY TEST

Inspection

Check outside of battery for damage or signs of serious abuse such as broken case or broken covers. Check inside of battery by removing the vent caps and inspecting for signs of abuse such as electrolyte level too low, or unusual odors. If battery shows signs of serious damage or abuse, it should be replaced. If not, make Light Load Test.

Light Load Test

Check electrical condition of battery cells as follows:

- a. Disconnect high tension lead from coil. Place load on battery by holding starter switch "on" for 3 seconds.
- b. Turn on headlights (low beam). After 1 minute, with lights still "on", read individual cell voltages of battery with voltmeter (.01 volt division). Compare readings with the following:

Uniform Readings

If any cell reads 1.95 volts or more and the difference between the highest and lowest cell is less than .05 volts, battery is good. However, if any cell reads less than 1.95 volts, battery should be fully recharged for good performance (see Charging After Light Load Test).

Non-Uniform Readings

If any cell reads 1.95 volts or more and there is a difference of .05 volts or more between the highest and the lowest cell, the battery should be replaced.

Low Readings

If all cells read less than 1.95 volts, battery is too low to test properly. Failure of the meter to register on all cells does not indicate a defective battery. Boost charge battery and repeat Light Load Test (see Boost Charging for Light Load Test). If battery is found to be good after boosting, it should be fully recharged for good performance.

If none of the cells come up to 1.95 volts after the first boost charge, the battery should be given a second boost. Batteries which do not come up after second boost charge should be replaced.

NOTE: Any battery found to be good by the Light Load Test that does not perform satisfactorily, should be removed from the car and tested as outlined under "Out-of-the-Car Charging and Testing".

IN-THE-CAR BOOSTING AND CHARGING

Boost Charging for the Light Load Test

Boost 12-volt battery at 50 amperes for 20 minutes (50 x 20=1000 ampere minutes). If charger will not give these rates, charge for an equal number of ampere minutes at best rate available. For purposes of this test do not boost battery more than the amount indicated.

Charging After the Light Load Test

For best performance, a good battery should be fully charged before being returned to service.

If batteries are to be fully charged by means of a quick charger, the charge rate must be reduced to a safe limit when the electrolyte temperature reaches 125°F or when gassing becomes excessive. Failure to do so may harm the battery.

OUT-OF-THE-CAR CHARGING AND TESTING

The procedures outlined below under Slow Charging and The Full Charge Hydrometer Test should be used on any battery originally found to be "good" by the Light Load Test, but which does not perform satisfactorily.

Slow Charging

Adjust electrolyte to proper level by adding water, then charge battery at 5 amperes until fully charged. Full charge of the battery is indicated when the specific gravity of each cell has not increased when checked at three hourly intervals and all cells are gassing freely.

Due to the low rate during slow charging, plenty of

time must be allowed. Charge periods of 24 hours or more are often required.

The Full Charge Hydrometer Test

The "Full Charge Hydrometer Test" is not valid unless battery has been tested and found to be good by the Light Load Test.

Make sure battery is fully charged as described above. Hydrometer readings taken on partially charged batteries are unreliable for the test outlined below.

Measure specific gravity of electrolyte in each cell and compare readings with the following:

Normal Reading

If cell readings range between 1.230 and 1.310, the battery is ready for use. Any variation in the specific gravity between cells within this range does not indicate a defective battery.

Low Reading

If any cell reads less than 1.230 and battery has been in service 3 months or less, battery is good, but it has been improperly filled with electrolyte or water and will give poor performance. To correct this condition, empty the electrolyte from any cell reading less than 1.230 and refill with 1.265 specific gravity battery grade electrolyte. The battery is now ready for use.

If any cell reads less than 1.230 and battery has been in service more than 3 months, it should be replaced.

High Reading

If any cell reads above 1.310, battery may be returned to service. However, specific gravities above 1.310 are harmful to the battery and will cause early failure. Such high readings are caused by the improper addition of electrolyte. Adjusting the specific gravity will not correct the damage that has been done by high acid condition.

TROUBLE DIAGNOSIS

If the battery remains undercharged, check for loose generator belt, defective generator, high resistance in the charging circuit, oxidized regulator contact points, or a low voltage setting.

If the battery uses an abnormal amount of water, the voltage regulator setting may be too high.

Measure the terminal voltage of the battery during

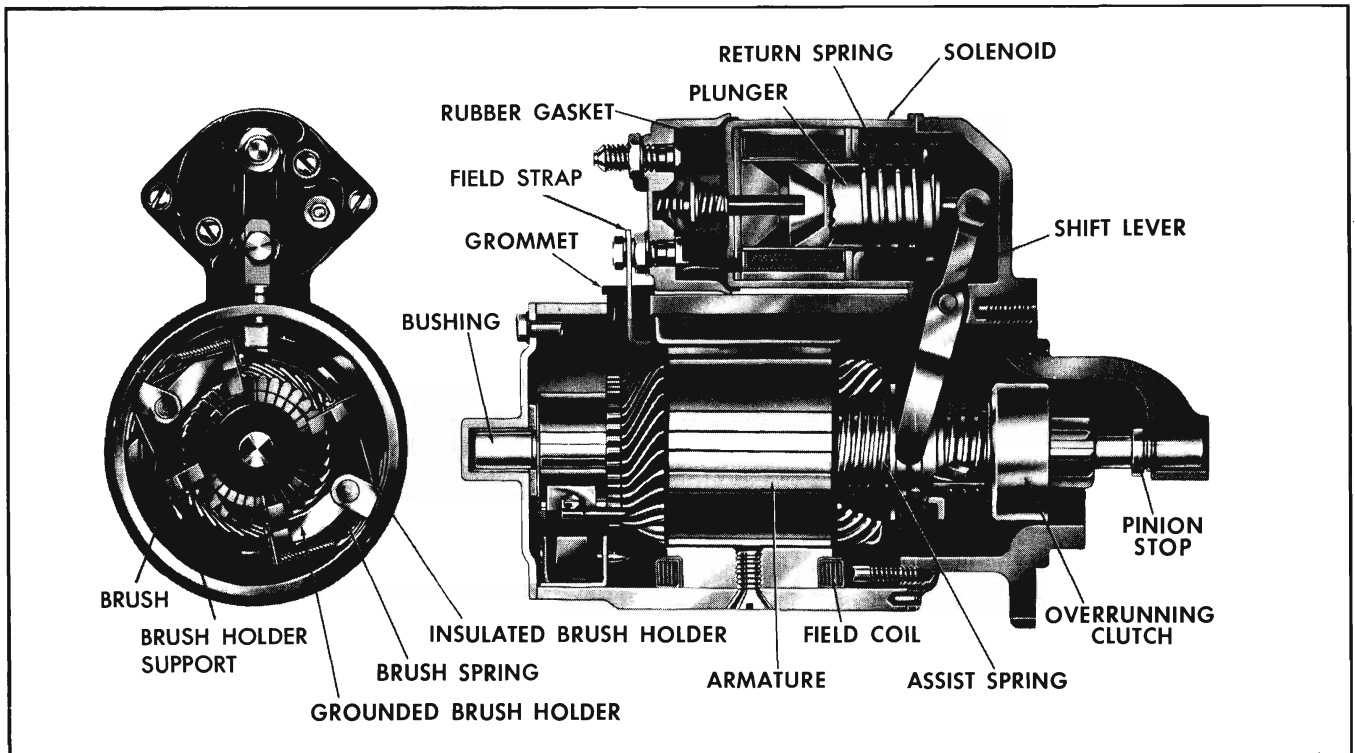


Fig. 11-5 Cross Section of 4 Cylinder Engine Starting Motor

cranking. Disconnect distributor to coil primary wire during this check to prevent engine firing. If the terminal voltage is less than 9.0 volts, remove the battery from service for further checking.

STARTING MOTOR

The procedures that follow in this section apply to both the four cylinder and eight cylinder engines. Although different model starters are used for each engine, they are similar enough that the write-up may apply to both models.

DESCRIPTION

The enclosed shift lever starting motors (Figs. 11-5 and 11-6) are 12-volt extruded frame type units.

The starting motors have the solenoid shift lever mechanism and the solenoid plunger enclosed in the drive housing, thus protecting them from exposure to road dirt, icing conditions and splash. They have an overrunning clutch type of drive. The overrunning clutch is operated by a solenoid switch mounted to a flange on the starting motor drive housing. Instead of a nameplate, lettering and model numbers are rolled into the outside of the field frame, thereby providing a more permanent type of identification.

The starting motor has four poles and four field coils. The field circuit used in this motor is a series field.

The motor has a series field in which all four field coils are connected in series from the motor terminal of the solenoid to the insulated brushes. The end of the field windings extends out through a rubber grommet assembled in an opening in the frame and is attached directly to the "motor" terminal of the solenoid. The rubber grommet insulates the extended end of the field windings from the frame (ground) and prevents dirt, water and oil from entering the motor.

The brush rigging has brush arm supports attached directly to the extruded section of the field frame. One ground brush and one insulated brush are both pivoted from the same brush holder support, thus only two brush holder supports are required. A single ribbon type spring applies tension to each pair of brushes.

An overrunning clutch type of drive is used to engage the cranking motor pinion with the flywheel. The flange mounted solenoid switch operates the overrunning clutch drive by means of a linkage to the shift lever. When the control switch is closed the solenoid is energized, shifting the cranking motor

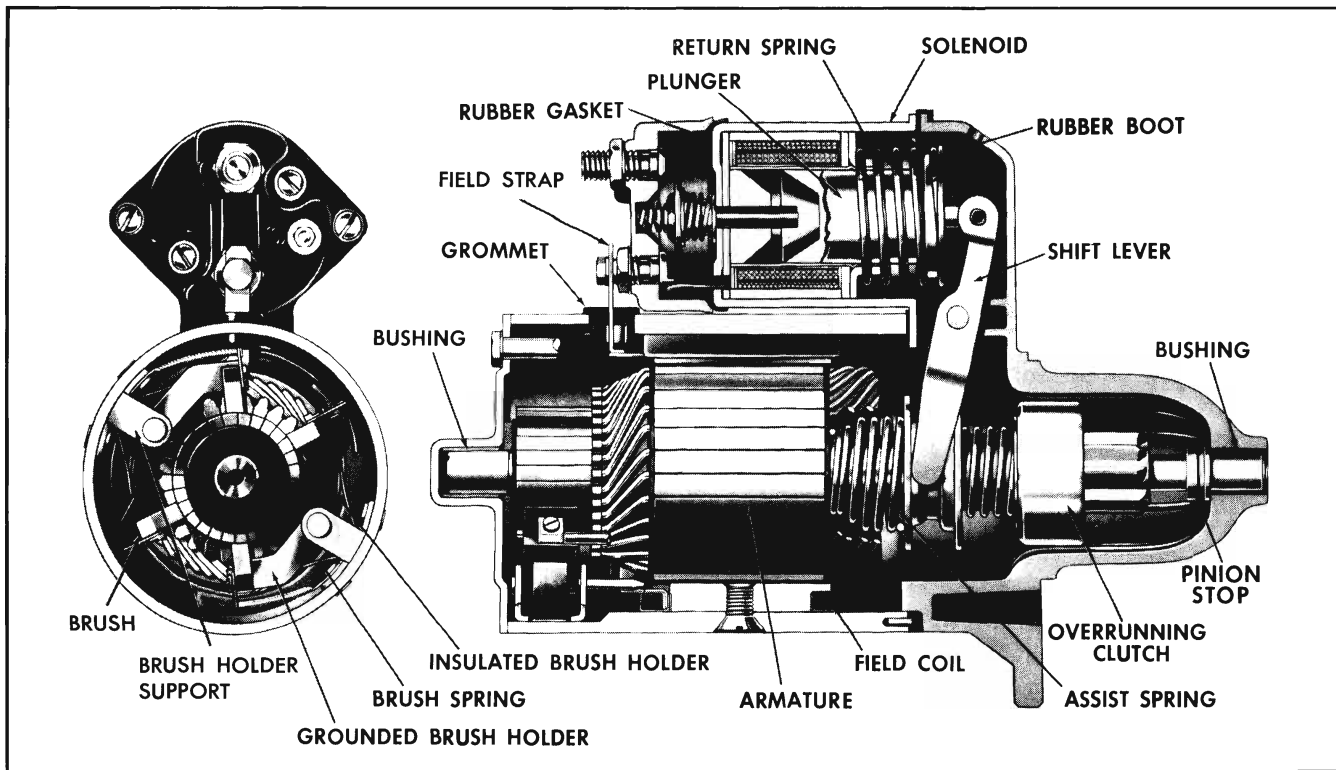


Fig. 11-6 Cross Section of V-8 Engine Starting Motor

pinion into mesh with the flywheel. Battery current is delivered to the motor when the main contacts of the solenoid are then closed. The armature rotates and turns the flywheel. Overrunning action of the clutch protects the cranking motor armature from excessive speed when the engine fires. A compression type spring located inside the solenoid case returns the shift lever and clutch to their normal at-rest position.

The armature shaft and clutch have mating spiral splines which aid in meshing of the gears and thus prevents transmission of cranking power until the clutch pinion is fully engaged in the flywheel ring gear. A special assist spring is located around the armature shaft between the end fiber of the armature and the collar of the clutch drive. This spring aids the solenoid in overcoming the return spring force in the first movement of the clutch along the armature shaft. A pinion stop, consisting of a snap ring and retainer and a thrust collar assembled on the armature shaft, takes all the end thrust.

The solenoid is attached to the drive end housing with two screws. A molded push rod is assembled in the contact assembly. A shoulder molded on the push rod and a cup that can be easily assembled to the rod and locked into position over two molded bosses, holds the contact assembly in place.

PERIODIC SERVICE

No periodic lubrication of the starting motor or solenoid is required. The motor and brushes cannot be inspected without disassembling the unit, so no service is required on the motor or solenoid between overhaul periods.

CHECKS AND ADJUSTMENTS ON CAR

Although the starting motor cannot be checked against specifications on the car, a check can be made for excessive resistance in the cranking circuit. To check for excessive resistance in the cranking circuit, measure:

1. The voltage drop, during cranking, between the insulated battery post and the battery terminal of the solenoid.
2. The voltage drop, during cranking, between the battery terminal of the solenoid and the motor terminal of the solenoid.
3. The voltage drop, during cranking, between the grounded battery post and the starting motor frame.

CAUTION: To prevent the engine from firing during the above checks, disconnect the primary lead to the distributor, either at the distributor or at the coil.

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 cranking circuit being checked. Locate and eliminate the cause for any excessive voltage drop in these circuits in order to obtain maximum efficiency of the cranking system.

When the solenoid fails to pull in, the trouble may be due to excessive voltage drop in the solenoid control circuit. To check for this condition, close the starting switch and measure the voltage drop between the battery terminal of the solenoid and the switch terminal of the solenoid. Excessive resistance in the solenoid control circuit is indicated and should be corrected if this voltage drop exceeds 3.5 volts.

If the voltage drop does not exceed 3.5 volts and the solenoid does not pull in, measure the voltage available at the switch terminal of the solenoid. If the solenoid does not feel warm, it should pull in whenever the voltage available at the switch terminal is 7.7 volts or more (when the solenoid feels warm, it will require a somewhat higher voltage to pull in).

REMOVE FROM CAR

4 CYLINDER ENGINE

1. Disconnect battery ground cable at battery terminal post.
2. Disconnect battery positive cable and wiring harness leads from starting motor solenoid.
3. Disconnect carburetor throttle rod at carburetor end.
4. Disconnect accelerator pedal rod at throttle control lever.
5. Remove starting motor, using straight box end wrench through slot in engine block casting for lower mounting bolt.

V-8 ENGINE

1. Disconnect battery ground cable at battery terminal post.
2. Raise car.
3. Disconnect battery positive cable and wiring harness leads from starting motor solenoid.
4. Remove two bolts securing starting motor.
5. Provide clearance to remove starting motor by repositioning breather pipe and then remove starter.

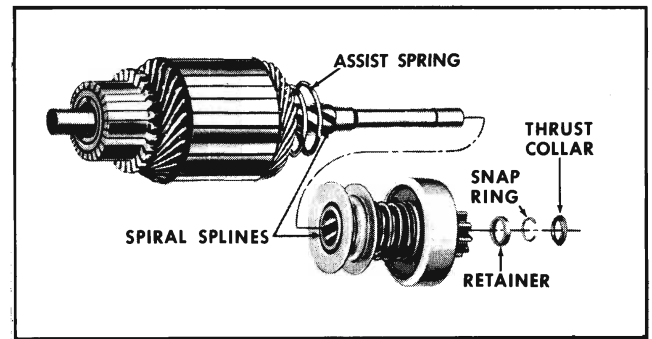


Fig. 11-7 Armature and Overrunning Clutch Assembly

DISASSEMBLE STARTER

1. Disconnect the field strap (Fig. 11-5) from terminal on solenoid.
2. Remove through bolts.
3. On 4 cylinder engine starting motor, remove commutator end frame, leather washer, field frame assembly, and armature assembly from drive housing.

On V-8 engine starting motor, remove commutator end frame, leather washer, and field frame assembly from drive housing. To remove armature assembly from drive housing:

- a. Remove solenoid to drive housing attaching screws and remove solenoid and return spring.
- b. Remove snap ring securing shift lever pivot pin and remove pin.
- c. Remove shift lever and plunger assembly.
- d. Remove armature assembly from drive housing.
4. Remove overrunning clutch from armature shaft as follows:

- a. Slide thrust collar (Fig. 11-7) off end of armature shaft.
- b. Slide a standard half inch pipe coupling or other metal cylinder of suitable size (an old pinion of suitable size can be used if available) onto shaft so end of coupling or cylinder butts against edge of retainer (Fig. 11-8). Tap end of coupling with hammer, driving retainer towards armature and off snap ring.

- c. Remove snap ring from groove in shaft using pliers or other suitable tool. If snap ring is too badly distorted during removal it may be necessary to use



Fig. 11-8 Driving Retainer Off Snap Ring

a new one when reassembling clutch.

- d. Slide retainer and clutch from armature shaft.

REMOVE SOLENOID—4 CYLINDER ENGINE

1. Remove solenoid to drive housing attaching screws and remove solenoid.
2. Remove solenoid return spring.
3. Remove shift lever pivot pin.
4. Remove shift lever and plunger assembly.

DISASSEMBLE SOLENOID

1. Remove nuts from the motor terminal and switch terminal and the two attaching screws.
2. Using care, remove cover.

CAUTION: These terminal studs have welded lead connections. Do not twist during removal of nuts.

CLEAN AND INSPECT

1. If the solenoid contacts are slightly burned or dirty, the contacts should be cleaned. When the contacts are badly burned, the burned parts should be replaced.

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. Badly chipped pinion teeth may indicate chipped teeth on the ring gear. This should be checked under such conditions and replaced if necessary.

3. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.

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. The overrunning clutch, armature and fields should not be cleaned in any degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and would damage the insulation in the armature and field coils. It is suggested that all parts except the clutch, be cleaned with oleum spirits and a brush. The clutch can be wiped with a clean cloth.

If the commutator is dirty it may be cleaned with No. 00 sandpaper. *Never use emery cloth to clean commutator.*

SERVICE

ARMATURE

If the armature commutator is worn, dirty, out of round or has high insulation, the armature should be put in a lathe so the commutator can be turned down. The insulation should then be undercut $\frac{1}{32}$ of an inch wide and $\frac{1}{32}$ of an inch deep, and the slots cleaned out to remove any trace of dirt or copper dust. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

The armature should be checked for opens, short circuits and grounds as follows:

1. **Open**—The most likely place for an open to occur is at the commutator riser bars as a result of excessively long cranking periods. Inspect the points where the conductors are joined to the commutator bars for loose connections. The poor connections cause arcing and burning of the commutator bars as the starting motor is used. If the bars are not too badly burned, repair can often be effected by resoldering the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material. The insulation should then be undercut.

2. **Short Circuit**—Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.

3. **Ground**—Grounds in the armature can be detected by the use of 110-volt test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure which is often brought about by

overheating of the starting motor produced by excessively long cranking periods or by accumulation of brush dust between the commutator bars and the steel commutator ring.

FRAME AND FIELD

The field winding can be checked for an open or a ground by using a test lamp as follows:

1. **Ground**—Touch one lead of the 110-volt test lamp to the grounded brush and the other lead to the field connector strap (Fig. 11-9). If the lamp lights, at least one field coil is grounded and the defective coil will require repair or replacement.

2. **Open**—Touch one test lamp lead to insulated brush and one lead to field connector strap (Fig. 11-10). If lamp does not light, the series field coils are open.

FIELD COIL REMOVE

Field coils can be removed from the field frame assembly most easily by use of a pole shoe screwdriver. A pole shoe spreader should also be used since this prevents distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place. Formed insulators are used to protect the field leads from grounding to the frame. These must be replaced on assembly.

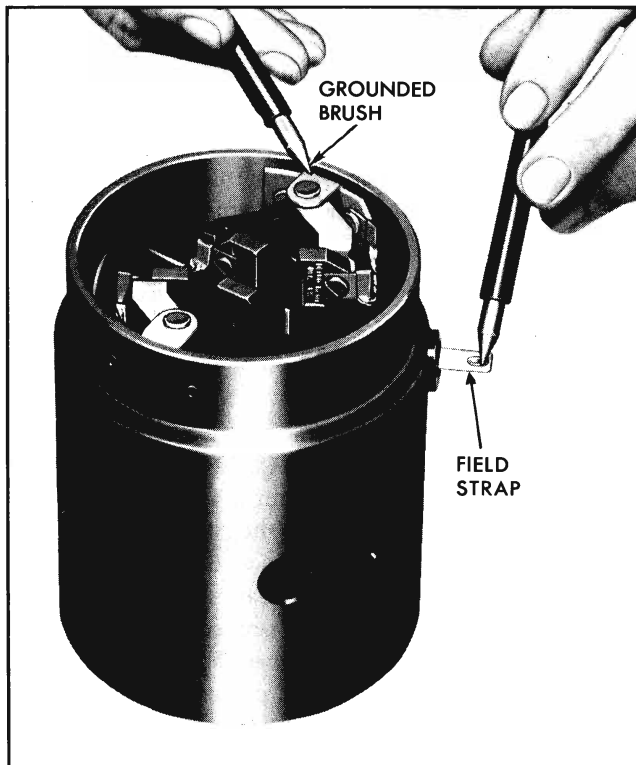


Fig. 11-9 Testing Field Coils for Ground

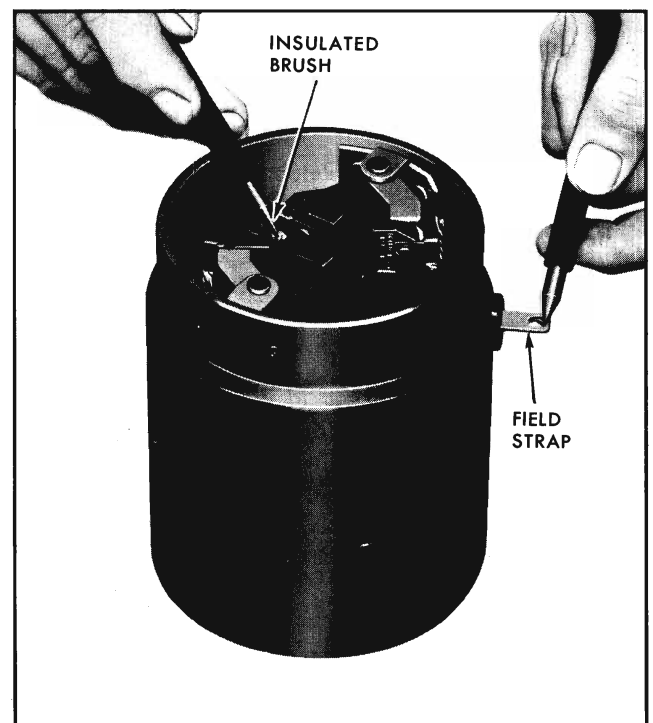


Fig. 11-10 Testing Field Coils for Open Circuit

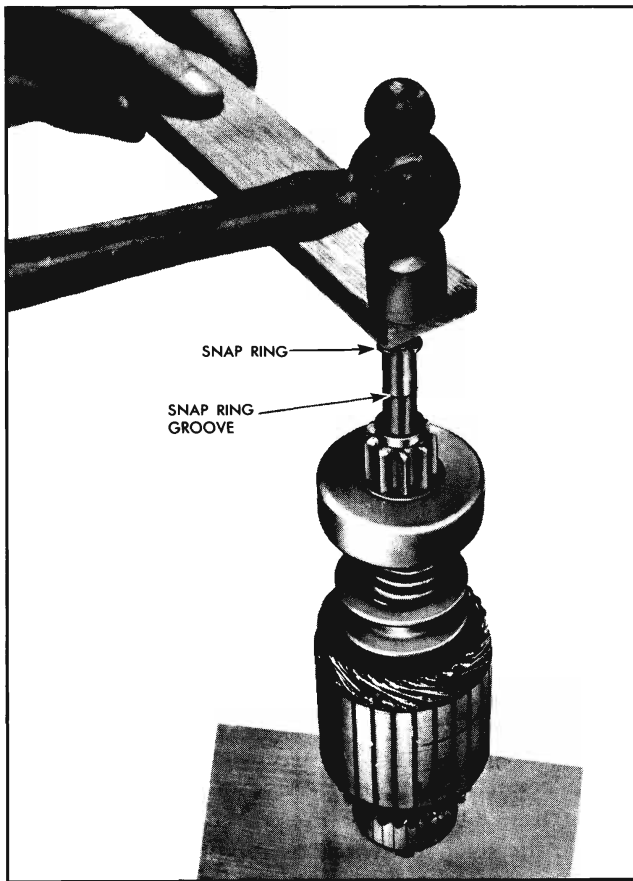


Fig. 11-11 Forcing Snap Ring onto Armature Shaft

REPLACE BRUSHES

1. Remove brush holder pivot pin which positions one insulated and one grounded brush.
2. Remove brush spring.
3. Replace brushes as necessary.

To assemble, reverse above procedure.

ASSEMBLE SOLENOID

1. When reassembling the cover on the solenoid make sure the terminal studs are properly positioned in cover. The cover gasket must be centered under the cover to insure proper sealing.
2. Install cover attaching screws and install nuts on motor and switch terminals.

INSTALL SOLENOID—4 CYLINDER ENGINE

1. Install plunger and lever assembly and pivot pin.
2. Install return spring.
3. Attach solenoid to starter drive housing and secure with two attaching screws.

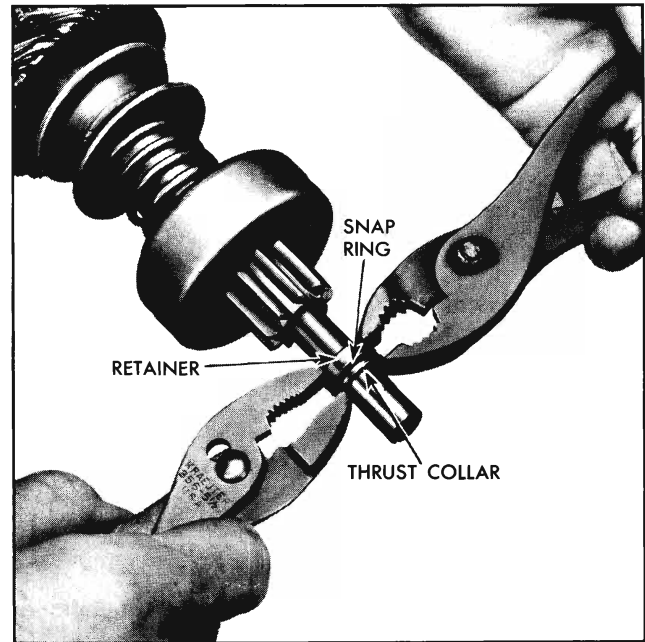


Fig. 11-12 Forcing Retainer Over Snap Ring

ASSEMBLE STARTER

1. Assemble overrunning clutch to armature shaft as follows:

a. Lubricate drive end of armature shaft with light engine oil.

b. Slide clutch assembly onto armature shaft with pinion outward (Fig. 11-8).

c. Slide retainer onto shaft with cupped surface facing end of the shaft (Fig. 11-8).

d. Stand armature on end on wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with a block of wood. Hit wood block a blow with hammer forcing snap ring over end of shaft. Slide snap ring down into groove (Fig. 11-11).

e. Assemble thrust collar on shaft with shoulder next to snap ring (Fig. 11-12).

f. Place armature flat on work bench, and position retainer and thrust collar next to snap ring. Then, using two pairs of pliers at same time (one pair on either side of shaft), grip retainer and thrust collar and squeeze until retainer is forced over snap ring (Fig. 11-12).

2. Place 4 or 5 drops of light engine oil in drive housing bushing. Make sure thrust collar is in place against snap ring and retainer.

On 4 cylinder engine starting motor, slide armature

and clutch assembly into place in drive housing, engaging shift lever with clutch.

On V-8 engine starting motor:

a. Locate shift lever fork in overrunning clutch assembly; install armature and clutch assembly, and shift lever and plunger assembly into drive housing (Fig. 11-13).

CAUTION: Install shift lever with recess toward plunger (Fig. 11-13).

b. Install shift lever pivot pin and secure with snap ring.

c. Install return spring.

d. Install solenoid to drive housing and secure with two attaching screws.

CAUTION: Properly engage lip in pocket of bellows and position in housing for proper sealing.

3. Position field frame over armature, and apply sealing compound between frame and solenoid case



Fig. 11-13 Installing Armature and Plunger

(4 cylinder engine starting motor only). Position frame against drive housing, using care to prevent damage to brushes.

4. Place 4 or 5 drops of light engine oil in bushing in commutator end frame. Place leather thrust washer on armature shaft and slide commutator end frame onto shaft.

5. Install through bolts and tighten securely.

6. Reconnect the field coil lead to the motor solenoid terminal.

PINION CLEARANCE CHECK

There are no provisions for adjusting pinion clearance on the enclosed shift lever cranking motor. When the shift lever mechanism is correctly assembled, the pinion clearance should fall within the specified limits (.010"-.140"). When the clearance is out of these limits it may indicate excessive wear of solenoid linkage or shift lever yoke buttons.

The pinion clearance should be checked after motor has been disassembled and then reassembled. To check, connect a voltage source of approximately 6 volts (three battery cells in series of 6-volt battery) between the solenoid switch terminal and ground.

NOTE: Do not connect the voltage source to the ignition coil terminal "R" of the solenoid. Do not use a 12-volt battery instead of the 6 volts specified as this will cause the motor to operate. As a further precaution to prevent motoring, connect a heavy jumper lead from the solenoid motor terminal to ground.

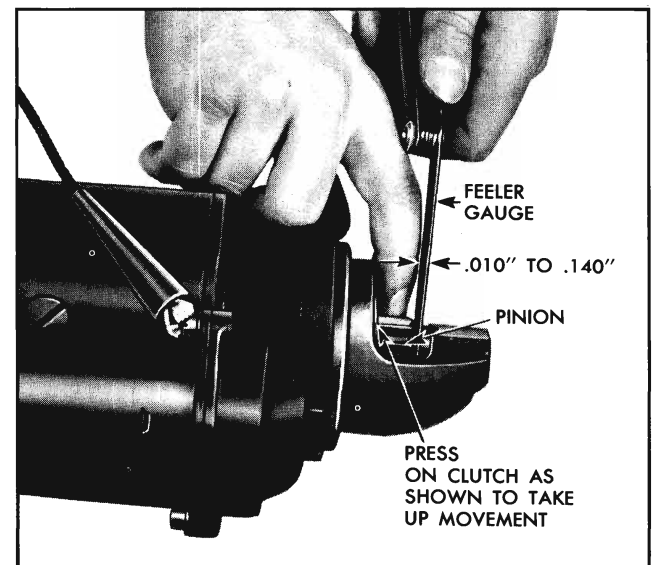


Fig. 11-14 Measuring Pinion Clearance

After energizing the solenoid with the clutch shifted towards the pinion stop retainer, push the pinion back toward the commutator end as far as possible to take up any slack movement, then check the clearance with a feeler gauge (Fig. 11-14).

INSTALL IN CAR

4 CYLINDER ENGINE

1. Install starting motor, using straight box end wrench through slot in engine block casting for lower mounting bolt.

2. Connect accelerator pedal rod at throttle control lever.

3. Connect carburetor throttle rod at carburetor end.

4. Connect battery positive cable and wiring harness leads to starting motor solenoid.

5. Connect battery ground cable at battery terminal post.

V-8 ENGINE

1. Install starting motor and secure with two bolts.

2. Return breather pipe to normal position.

3. Connect battery positive cable and wiring harness leads to starting motor solenoid.

4. Lower car.

5. Connect battery ground cable at terminal post.

TROUBLE DIAGNOSIS

CAUTION: *Specific gravity of battery must be 1.215 or higher before making the following tests:*

1. If the solenoid does not pull in, measure the voltage between the switch S terminal of the solenoid and ground with the starting switch closed.

CAUTION: *If the solenoid feels warm, allow to cool before checking. If the voltage is less than 7.7 volts, check for excessive resistance in the solenoid control circuit. If the voltage exceeds 7.7 volts, remove the starting motor and check (1) solenoid current draw, (2) starting motor pinion clearance, and (3) freedom of shift lever linkage.*

2. If the solenoid "chatters" but does not hold in, check the solenoid for an open "hold-in" winding.

3. If motor engages but does not crank or cranks slowly, check for excessive resistance in the external cranking circuit or within the starting motor.

CHARGING CIRCUIT

The charging circuit consists of the generator, generator regulator, battery and generator warning light (for a complete discussion on the battery see "Starting Circuit").

GENERATOR

The procedures that follow in this section apply to generators used on the four and eight cylinder engines.

Different model 30 amp generators are used on the four and eight cylinder engines. A 35 amp generator is available as special equipment on the four cylinder engine.

DESCRIPTION

The 30 amp generator (Fig. 11-15) is a Delco-Remy 12 volt, two brush unit with shunt windings. The armature is supported at both ends with ball bearings. The drive end has a lubricated bearing with an oiler passage for lubrication while the commutator end is a pre-packed bearing with an oil slinger and no oiler passage. The standard three-unit regulator is used to limit its output.

The 35 amp generator (Fig. 11-16) is a Delco-Remy 12 volt, two brush unit with shunt windings. The armature is supported at both ends with ball bearings. The drive and commutator ends have lubricated bearings with oiler passages for lubrication. A double contact three-unit regulator is used to limit its output.

PERIODIC SERVICE

The hinged cap oiler should be filled with light engine oil once at each vehicle lubrication period.

CAUTION: *Do not fill oil cup with engine running.*

Periodic servicing of the generator should include an inspection of the commutator and brushes for cleanliness and wear. If the commutator is dirty, it should be cleaned. If the brushes are worn down to less than half their original length, replace.

REMOVE FROM CAR

1. Disconnect battery ground strap at battery post.

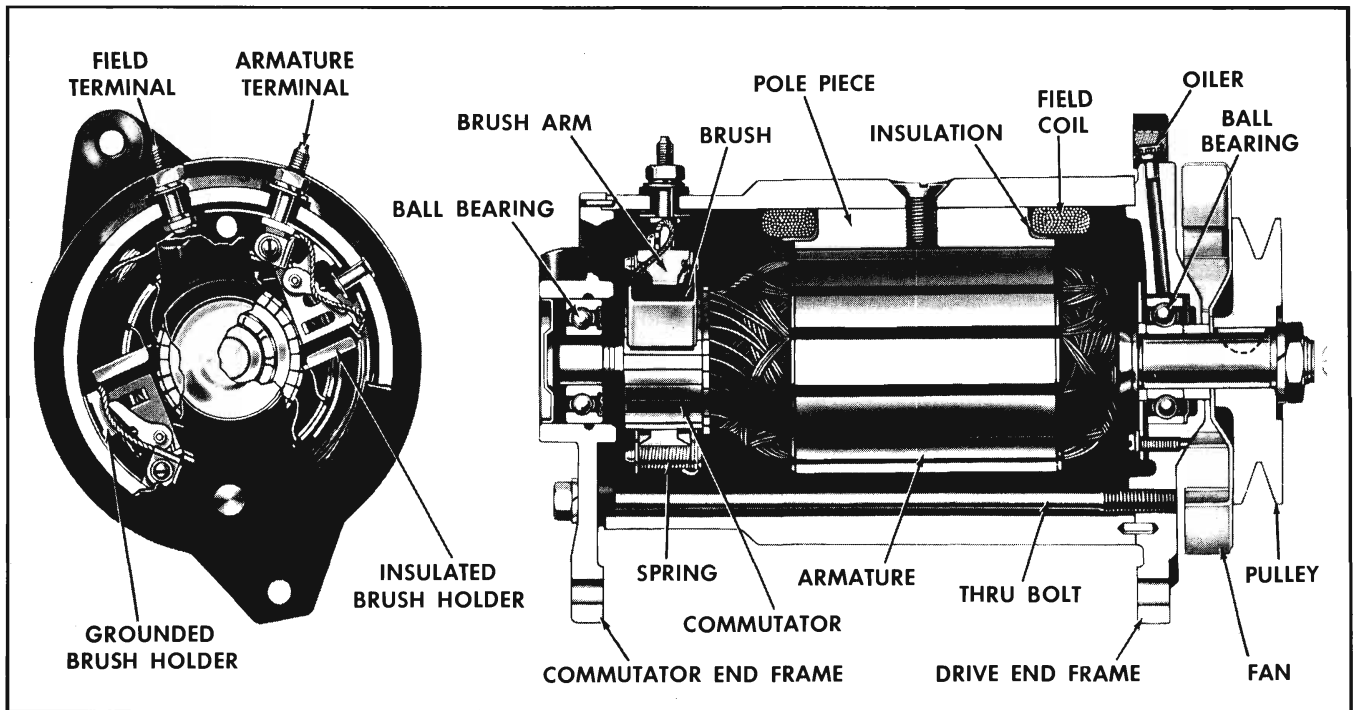


Fig. 11-15 Cross Section of 30 Amp Generator

2. Disconnect armature, field, and ground leads.
3. Remove adjusting strap screw and remove belt from generator pulley.
4. Remove two mounting bolts and nuts and remove generator.

DISASSEMBLE

1. Place generator in bench vise; use vise as holding fixture only and be careful not to distort generator frame.

NOTE: Check brush spring tension before disassembling generator to determine if spring is weak or brush holder is gummy (Figures 11-17 and 11-18). The band must be removed from the frame of the 35 amp generator, prior to check. Proper spring tension is approximately 28 ounces.

2. Remove two through bolts, and remove commutator end frame assembly; disconnect wire from brush holder on 35 amp generator.
3. Remove brush leads and brushes on 30 amp generator.
4. Remove drive end frame assembly, with armature and pulley, from generator frame.
5. Remove drive pulley. A fan belt held tightly in

the pulley groove will aid in holding the armature while removing the nut.

6. Remove drive pulley and key from armature shaft, using tool J-8433 or suitable puller, if necessary.

7. Remove generator fan assembly.

8. Remove spacer collar from armature shaft and then slide drive end frame from armature shaft. Bearing assembly-spacer inside washer will remain on armature shaft and may be lifted off after removing end frame from armature.

9. Remove bearing retainer plate and gasket from drive end frame.

10. Push ball bearing out of drive end frame and put in a clean place where grit or dirt will not enter.

11. Remove steel washer and felt washer from drive end frame.

12. Remove rubber seal from commutator end of armature.

13. Remove ball bearing from commutator end of armature with suitable puller, if replacement is necessary.

CLEAN, INSPECT AND TEST

1. Wash all metal parts except the armature and

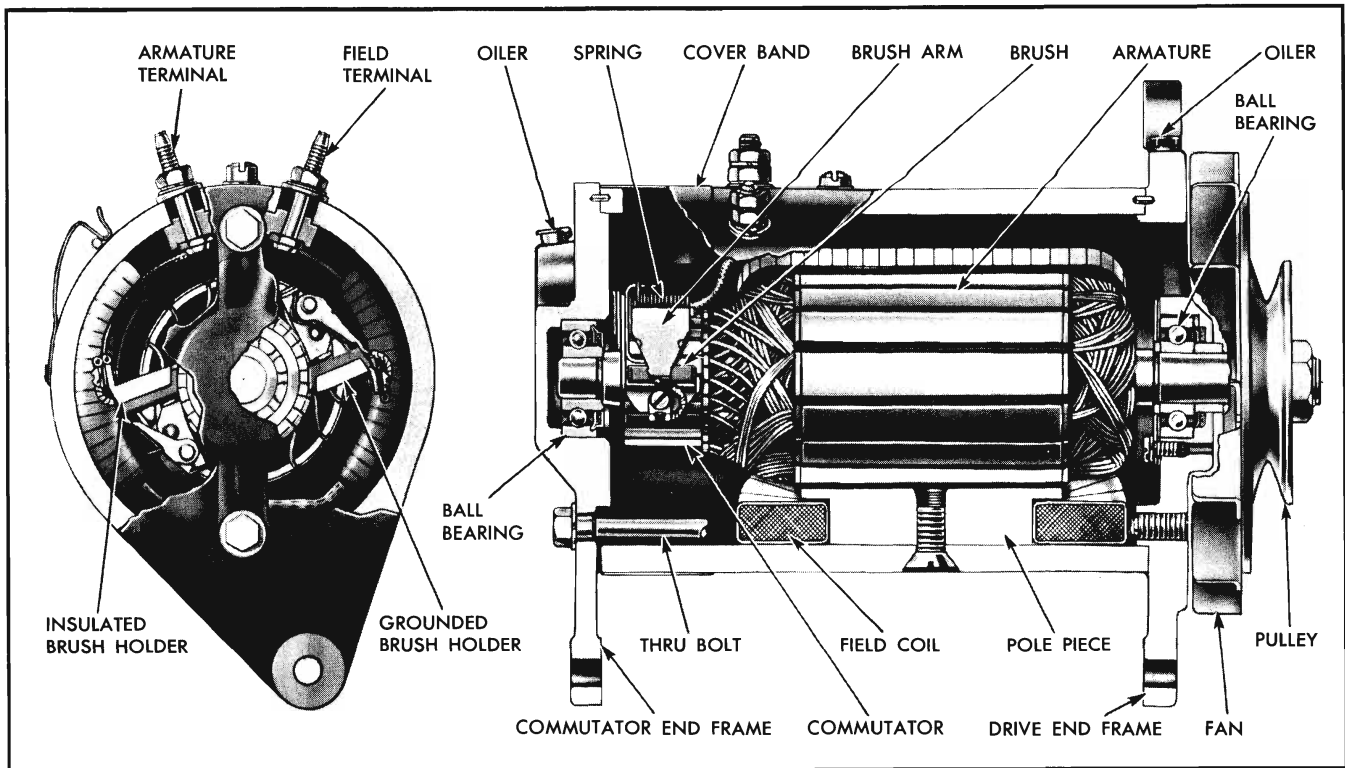


Fig. 11-16 Cross Section of 35 Amp. Generator

fields in cleaning solvent. Fields and armature must never be cleaned with any degreasing solvents since this may damage the insulation.

NOTE: Armature and field coils may be cleaned by brushing with oleum spirits.

2. After a thorough cleaning in solvent, inspect generator ball bearing for roughness, scored races, and deformed balls.

3. Check brush holders to see that they are not deformed or bent so as to interfere with holding brushes properly against commutator.

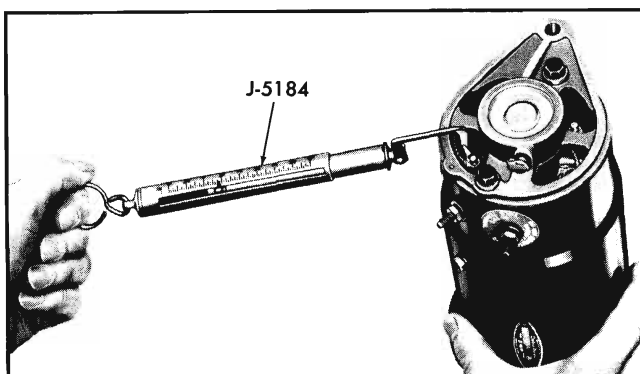


Fig. 11-17 Checking Brush Spring Tension on 30 Amp. Generator

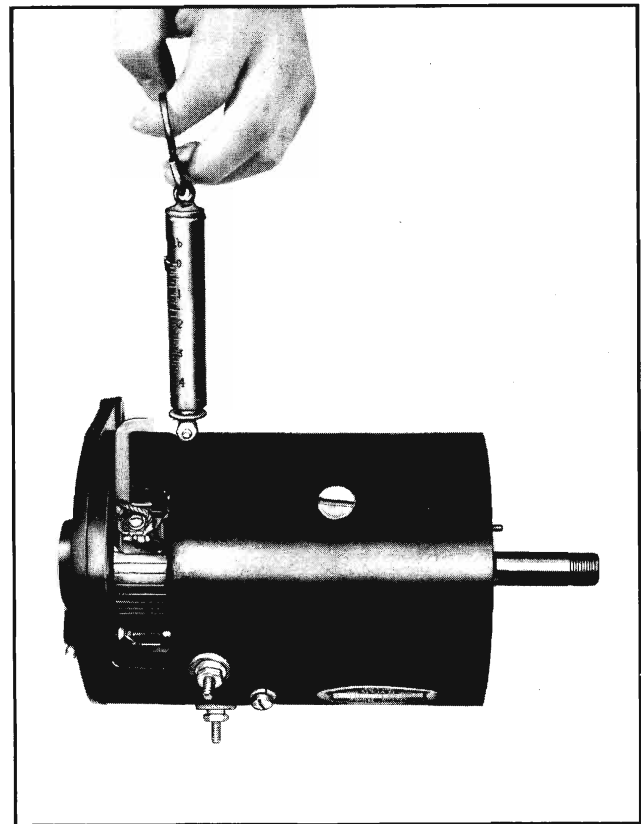


Fig. 11-18 Checking Brush Spring Tension on 35 Amp. Generator



Fig. 11-19 Testing Armature for Shorts

4. Inspect armature commutator; if rough it must be turned down and insulation undercut. Inspect solder at points where armature wires fasten to ends of commutator riser bars to make sure solder is in place to ensure good connections.

5. If test equipment is available:

a. Check armature for shorts by placing on growler and with hack saw blade over armature core, rotate armature (Fig. 11-19). If saw blade vibrates, armature or commutator is shorted. Recheck after cleaning between the commutator bars and if saw blade still vibrates, armature is shorted and must be replaced.

b. Check armature for open circuit by making bar-to-bar check as shown in Fig. 11-20. Inconsistent variation in readings indicates an open armature.

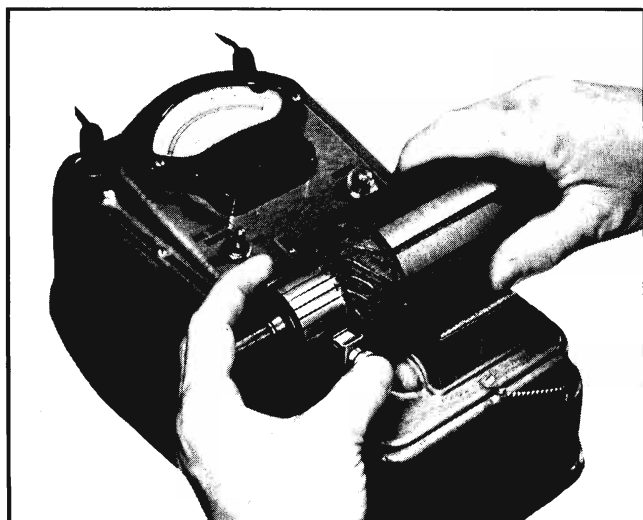


Fig. 11-20 Bar to Bar Test for Open Armature

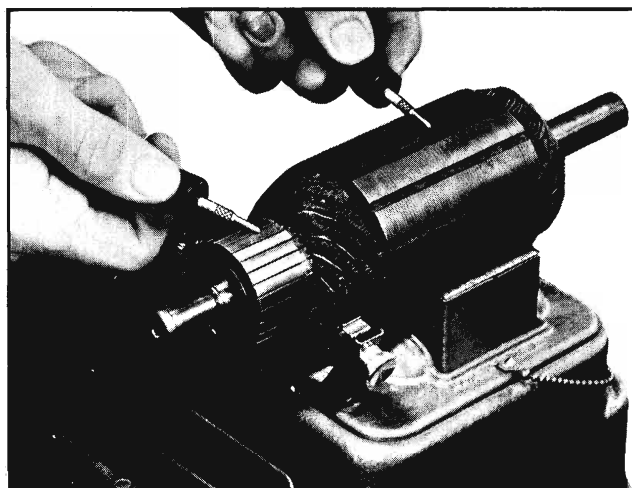


Fig. 11-21 Testing Armature for Ground

c. Using a 110-volt test lamp, place one lead on armature core and other on commutator. If lamp lights, armature is grounded and must be replaced (Fig. 11-21).

d. Using a 110-volt test lamp, place one lead on field terminal on generator frame and the other lead on armature terminal (Figures 11-22 and 11-23). If



Fig. 11-22 Testing Field Coils for Open Circuit on 30 Amp. Generators

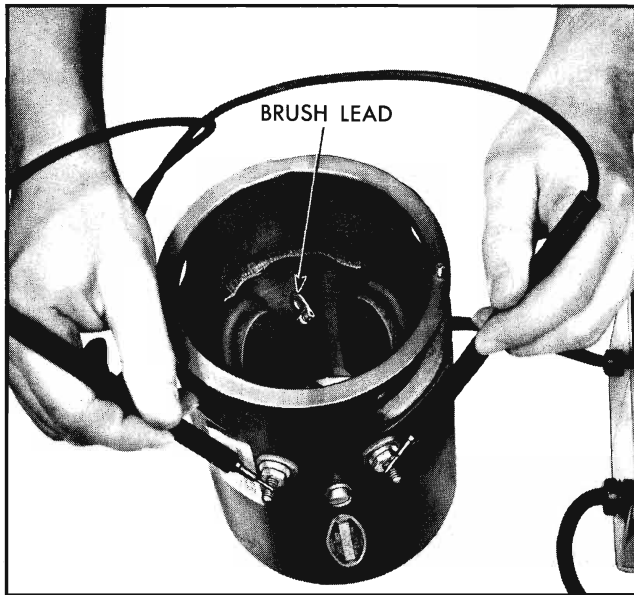


Fig. 11-23 Testing Field Coils for Open Circuit on 35 Amp Generator

lamp does not light, the field coils are open and must be replaced (unless a loose connection is found which can be soldered).

e. Using a 110-volt test lamp, place one lead on ground (touch to generator frame) and other lead on field terminal on generator frame (Figures 11-24 and 11-25). Be sure free end of field wire is not touching ground and field terminal insulation is not broken. On the 35 amp generator, be sure free end of armature terminal brush lead is not touching ground and field terminal insulation is not broken. If lamp lights, the field coils are grounded. If ground in field

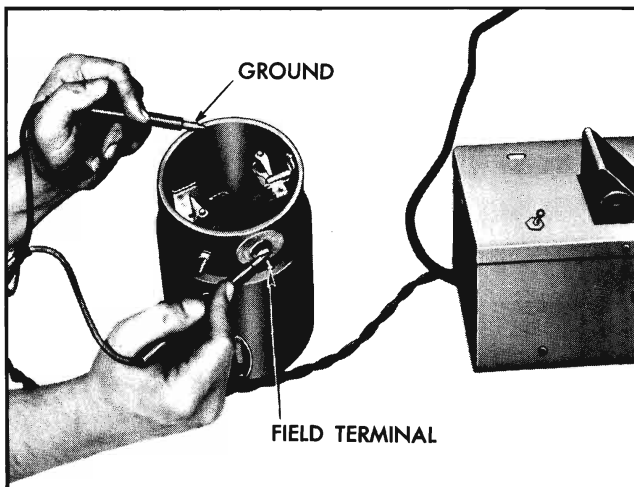


Fig. 11-24 Testing Field Coils for Ground on 30 Amp Generator

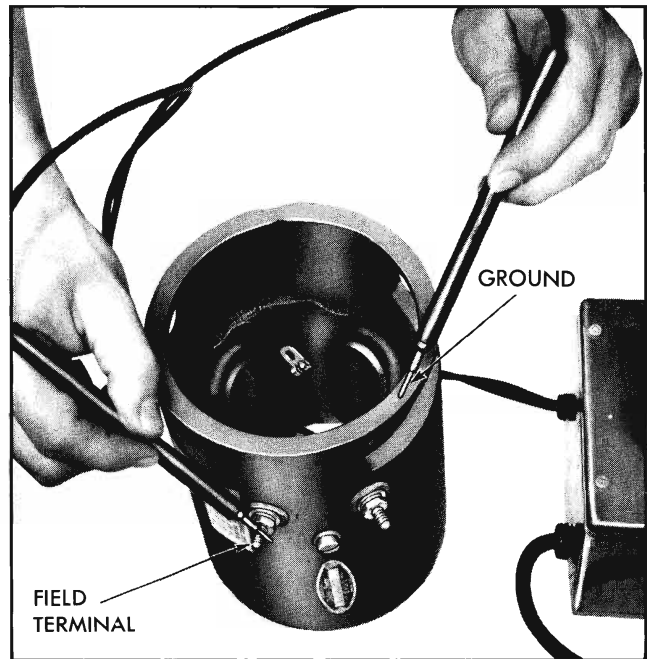


Fig. 11-25 Testing Field Coils for Ground on 35 Amp Generator

coils cannot be located or repaired, coils must be replaced.

f. Using a 110-volt test lamp, place one lead on generator armature terminal on generator frame, and place other lead on ground (touch to generator frame, Figures 11-26 and 11-27). Be sure loose end of armature terminal brush lead is not touching ground and armature terminal insulation is not broken. If lamp lights, armature terminal insulation through

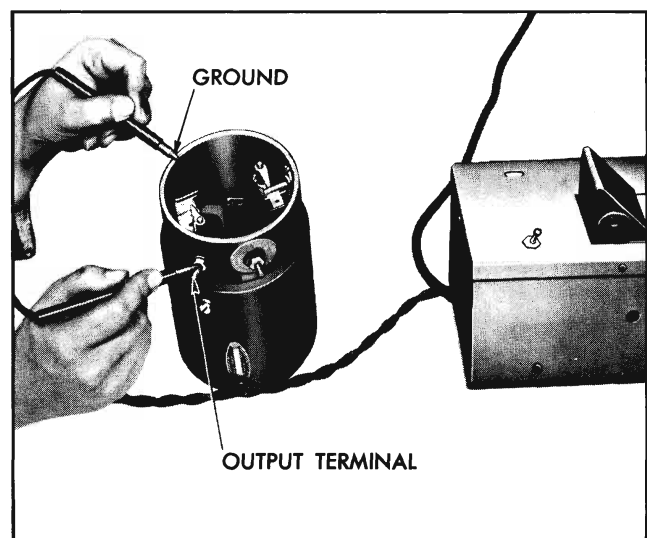


Fig. 11-26 Testing Armature Terminal for Ground on 30 Amp Generator



Fig. 11-27 Testing Armature Terminal for Ground on 35 Amp Generator

generator frame or brush holder insulation on 30 amp generator frame is broken down and must be replaced.

g. Using 110-volt test lamp on the 35 amp generator, place one lead on generator commutator end frame

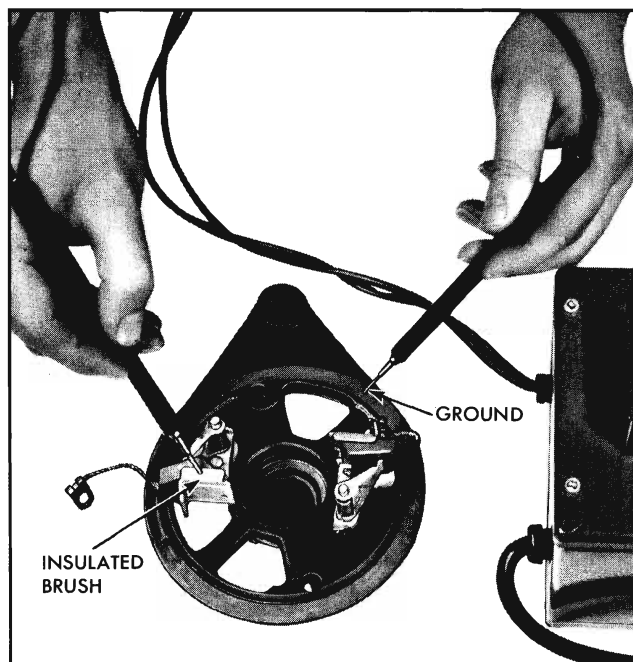


Fig. 11-28 Testing Insulated Brush Holder for Ground on 35 Amp Generator

ground and other lead on insulated brush holder (Fig. 11-28). If lamp lights, the brush holder is grounded and generator end frame must be replaced. Make certain brush leads are not grounded on end frame.

REPAIRS

LOOSE ELECTRICAL CONNECTIONS

When an open soldered connection is found during inspection, it may be resoldered, provided rosin flux is used for soldering.

CAUTION: Acid flux must never be used on electrical connections.

TURNING COMMUTATOR

When inspection shows commutator roughness, it should be cleaned as follows:

1. Turn down commutator in a lathe until it is thoroughly cleaned.

CAUTION: Width of cut should not be beyond section previously turned.

2. Undercut insulation between commutator bars $\frac{1}{32}$ ". This undercut must be the full width of insulation and flat at the bottom; a triangular groove will not be satisfactory. After undercutting, the slots should be cleaned out carefully to remove any dirt and copper dust.

3. Sand the commutator lightly with No. 00 sandpaper to remove any slight burrs left from undercutting.

4. Recheck armature on growler for short circuits.

FIELD ASSEMBLY

REMOVE

1. Disconnect field ground terminal and remove insulator block.

2. Remove two pole piece attaching screws.

NOTE: Use screw to tap pole pieces loose.

3. Remove insulation (on 30 amp generator).

4. Remove fields.

INSTALL

1. Place insulation in each field (30 amp generator only), then pole piece.

2. Install fields and secure with attaching screws.

3. Install field ground terminal. Place insulator

block in position on stud and position in frame. Secure with nut.

ASSEMBLE

1. Pack ball bearing with a good grade of ball bearing grease working the grease well into the bearing.
2. Install felt washer and then steel washer in drive end frame.
3. Install ball bearing in drive end frame and then position gasket and bearing retainer on frame and install three retaining screws.
4. On 30 amp generator, install oil slinger on commutator end of armature with outer lip facing bearing, if bearing was removed.
5. If removed, install new bearing on commutator end of armature, using suitable socket as driver.
6. Place steel washer on drive end of armature shaft and then slip drive end frame assembly onto armature shaft.
7. Install spacer washer on armature shaft and slide it down into place in end frame against bearing inner race.
8. Position drive pulley key in armature shaft and install generator fan assembly on shaft, with blades toward end frame.
9. Install drive pulley (with shoulder toward generator fan), lock washer, and nut. Tighten to 50-60 lb. ft. torque.
10. Place armature and drive end frame assembly in field frame, aligning dowel pin with hole.
11. If commutator end ball bearing was not removed from armature shaft, pack bearing with a good grade of ball bearing grease, working well into bearing.
12. Install new brushes in brush holders by pulling back on brush arm and inserting brush in each holder, making sure that chamfered end of brush will seat correctly on commutator. Brushes will be seated, if necessary, after installing generator in car.
13. Connect brush and field leads to brushes.
14. Install commutator end frame on field frame, aligning dowel pin with hole.
15. Install and tighten two generator through-bolts. Torque to 3-6 lb. ft.
16. Fill reservoir with engine oil.

INSTALL IN CAR

1. Secure generator with two mounting bolts and nuts.
2. Install belt on generator and install adjusting strap screw. Do not tighten screw.
3. Adjust belt tension to specification shown on chart in Section 6A and tighten adjuster screw.
4. Connect armature, field, and ground leads.
5. Connect battery ground strap at battery post.

BELT AND OUTPUT CHECK

1. Check belt tension and adjust as shown on chart in Section 6A.
2. Inspect commutator and, if dirty, clean by holding No. 00 sandpaper or a cleaning stone against it while generator is operating at idle speed.

CAUTION: Do not use emery cloth for cleaning armature.

3. With the engine operating at medium speed, momentarily ground the **F** terminal of the single contact voltage regulator. Generator output should increase. If it does not, make a complete check of the generator.

CAUTION: Do not ground F terminal of double contact voltage regulator.

4. If output is high and is not affected by grounding the **F** terminal of the generator, disconnect the lead from the **F** terminal of the generator. Generator output should fall off. If it does not, remove the generator and check it for a grounded field.

BRUSH NOISE

Generator brush noises can usually be eliminated by seating the brushes with the generator on the car. While brush seating compound will frequently provide satisfactory seating, the use of a brush seating stone as follows has been found to provide a more positive cure:

1. Start engine and run until it reaches normal operating temperature. Brush noise may be more pronounced when generator is hot.
2. Determine engine speed at which brush noise is loudest.
3. While running engine at speed where noise is loudest, very carefully stone commutator until noise disappears.

4. In rare instances, stoning may not eliminate the noise. In this case, remove the armature from the generator, turn down the commutator and undercut the mica. When reassembling generator, install new brushes.

GENERATOR REGULATOR

DESCRIPTION

A Delco-Remy three unit, waterproof 12-volt generator regulator is used on all Tempest models to limit the generator output and system voltage. The regulator is designed for use with a negative grounded battery and a shunt type generator. The regulator contains three units—cutout relay, a voltage regulator and, a current regulator.

A special fuse assembly is attached to the "BAT" terminal of the regulator. This fuse protects the charging circuit wiring, regulator, and the generator armature from battery current, if the cutout relay points stick in the closed position. Check to see if this fuse is blown, if the battery is run down.

SINGLE CONTACT VOLTAGE REGULATOR

A single contact voltage regulator (Fig. 11-29) is used on all models with a 30 ampere generator. Fig. 11-30 shows the single contact voltage regulator in the charging circuit.

CUTOUT RELAY

The purpose of the cutout relay is to close and open the circuit between the generator and battery. When the generator voltage reaches the value for which the cutout relay is adjusted, the contact points

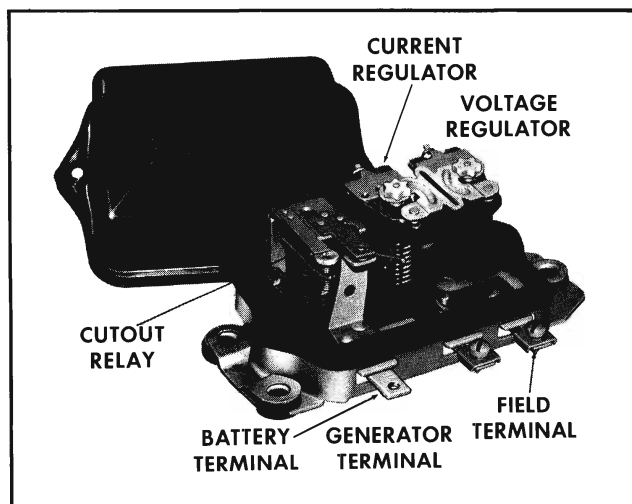


Fig. 11-29 Single Contact Voltage Regulator

close and current flows from the generator toward the battery. When generator voltage falls below battery voltage, the contact points open to prevent battery discharge through the generator while the engine is idling or stopped.

VOLTAGE REGULATOR

The purpose of the voltage regulator is to limit the system voltage to a safe maximum. Vibrating contacts of the voltage regulator limit voltage by intermittently opening the generator field circuit and restricting current flow as required.

With system voltage properly limited, electrical accessories are protected and the battery is not subjected to excessive overcharging.

CURRENT REGULATOR

The purpose of the current regulator is to prevent overheating of the generator armature by limiting generator output. Vibrating contacts of the current regulator limit generator output by intermittently opening the generator field circuit and restricting current flow as required.

DOUBLE CONTACT VOLTAGE REGULATOR

Due to the higher field currents required with the 35 ampere generator, a double contact voltage reg-

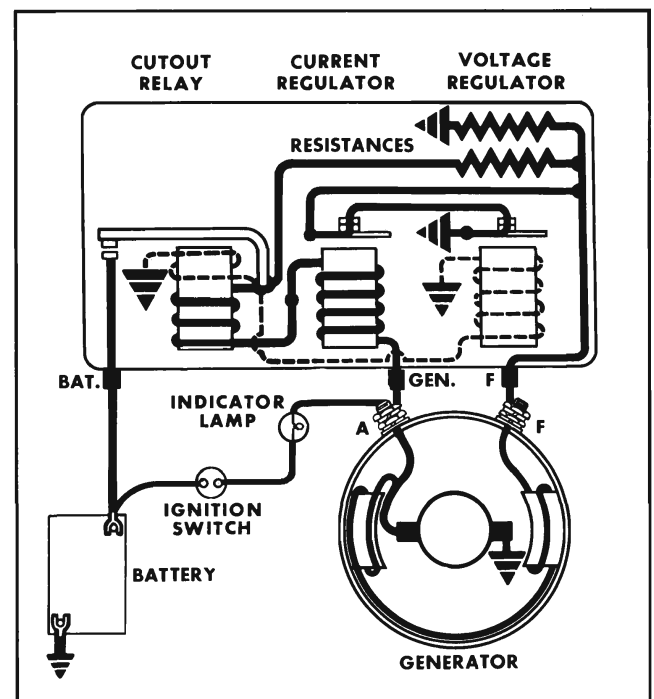


Fig. 11-30 Single Contact Voltage Regulator in Charging Circuit

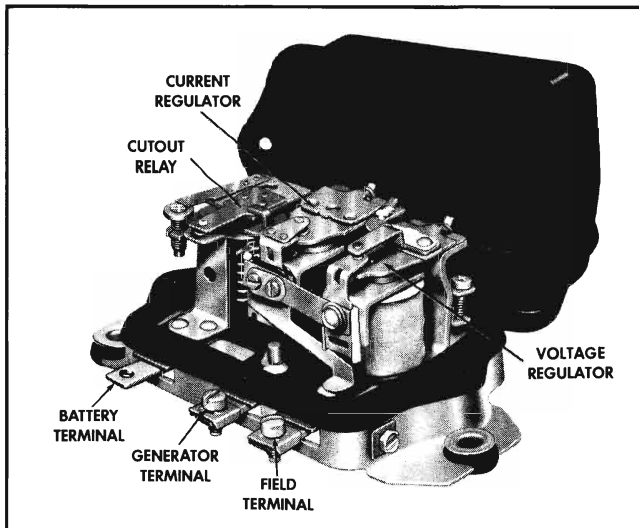


Fig. 11-31 Double Contact Voltage Regulator

ulator (Fig. 11-31) is used. The lower set of contact points is in series with the generator field circuit and the upper set of contact points shorts out the generator field circuit. This unit is checked and adjusted differently than the single contact voltage regulator.

The operation of the lower set of contact points limits generator voltage by opening the generator field circuit and restricting current flow as required. When this series resistance will not control the generator voltage at the predetermined setting, the generator voltage increases slightly causing the upper (shorting) contact points to operate. The upper (shorting) contact points place a short circuit directly across the generator field circuit, limiting the generator voltage to a predetermined value.

This regulator incorporates an external adjustment feature which enables changes in the voltage regulator setting without removing the regulator cover, using electrical meters or warm-up periods to bring the regulator up to operating temperature.

External adjustment is made possible by a plate and resistors located on the side of the regulator. This plate has five positions for an adjustment screw as shown in Fig. 11-32. Any one of these positions can be used to satisfy the voltage requirements of the vehicle. Under normal operating conditions, the external adjustment screw should be in the middle or "O" position. The adjusting screw can be moved to the other positions to raise or lower the voltage setting from the normal or "O" setting.

The external adjustment feature permits quick adjustment of the voltage setting to conform with variations in operating conditions. Unusual driving

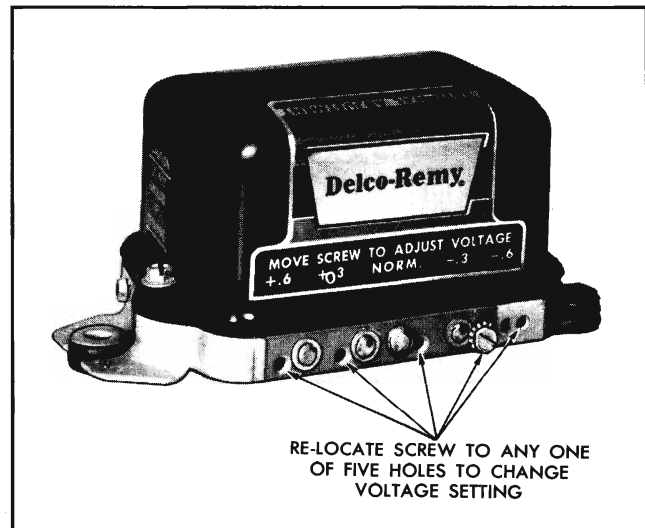


Fig. 11-32 External Adjustment—Double Contact Voltage Regulator

conditions or high battery temperature may result in battery overcharge as evidenced by excessive battery water consumption. Overcharge due to these causes may be experienced even though the voltage regulator setting is within specifications and satisfactory for all normal operating conditions. Under such conditions, overcharged batteries may be avoided if the voltage setting is reduced by moving the external adjustment screw to a lower setting position. Conversely, unusual driving conditions or low battery temperature may be responsible for discharged batteries. In such cases, the voltage regulator setting may be quickly raised by moving the external adjustment screw to a higher setting position.

The ideal voltage setting is the one which will maintain the battery in a fully charged condition with a minimum use of water. This setting can be determined by observing the battery water consumption over a reasonable service period.

Fig. 11-33 shows the charging circuit for the double contact voltage regulator

CAUTION: With the engine running, never ground the generator field with this regulator connected to generator. This can burn up the upper set of contact points of the voltage regulator.

The cutout relay and current regulator are the same as those in the generator regulator with the single contact voltage regulator and are checked and adjusted in the same manner.

PERIODIC SERVICE

Normally, periodic service of the regulator is not

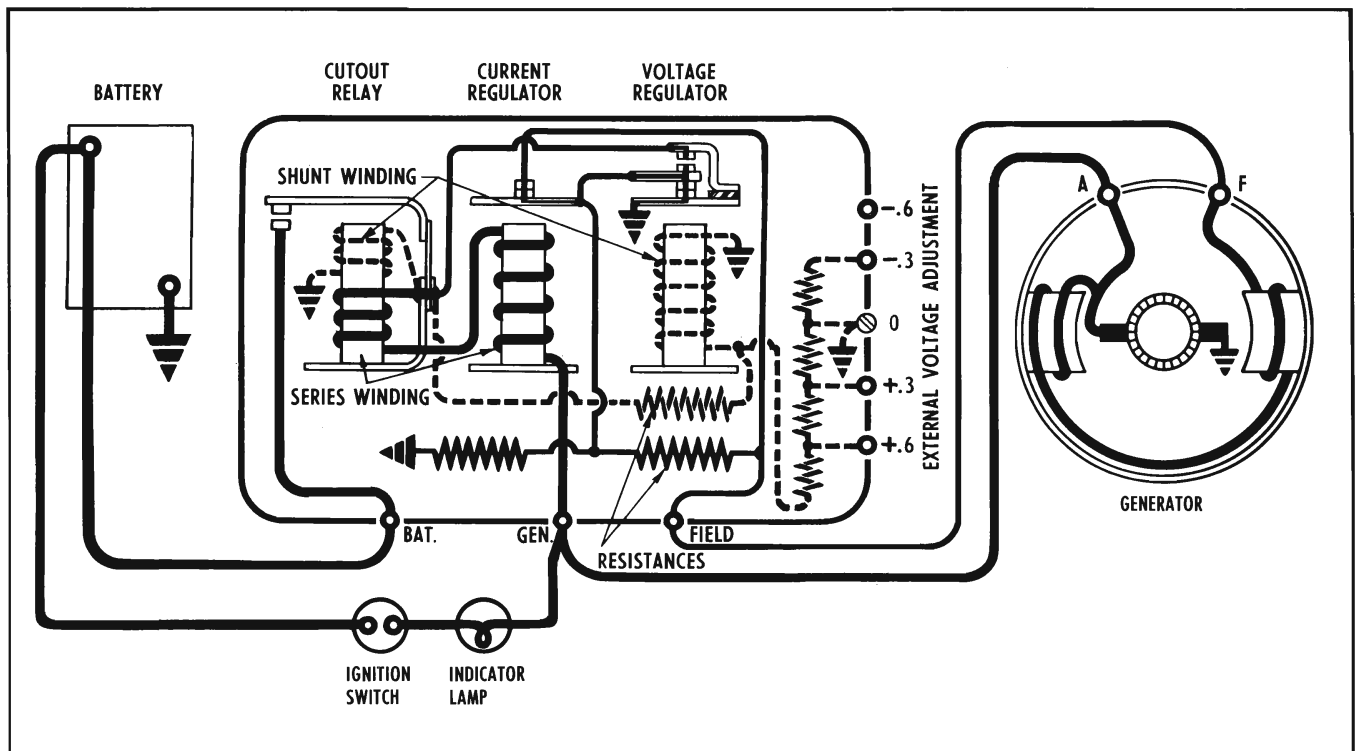


Fig. 11-33 Double Contact Voltage Regulator in Charging Circuit

required. However, it may occasionally be necessary to clean the regulator contact points as outlined under "Check and Adjust Out of Car."

CHECK AND ADJUST ON CAR

Four regulator electrical checks can be made on the car—the settings of the cutout relay, voltage regulator, and current regulator, and a check for oxidized regulator contact points. Mechanical checks and adjustments requiring removal of the regulator from the car are discussed under "Check and Adjust Out of Car."

The regulator cover must be in place and the regulator must be at operating temperature when the electrical settings are checked. For best results, the electrical checks should be made in the following order:

1. Test charging circuit wiring.
2. Voltage regulator setting.
3. Cutout relay closing voltage.
4. Current regulator setting.
5. Check for oxidized contact points.

The procedure required for making each of these checks follows.

NOTE: If special testing equipment is used, follow the manufacturer's instructions.

TEST CHARGING CIRCUIT WIRING

SINGLE CONTACT VOLTAGE REGULATOR

Excessive voltage drop in the charging circuit tends to keep the battery in an undercharged condition. To check for excessive voltage drop (resulting from loose connections or other high resistance) in the charging circuit, make connections as shown in Fig. 11-34 and proceed as follows:

NOTE: Check fuse on battery terminal before proceeding.

1. Ground the "F" terminal of the regulator.
2. Turn off all accessories and operate the generator at a speed which will produce a charge rate of 20 amperes.
3. Measure the voltage drop at V_1 , V_2 , and V_3 . Readings V_1 plus V_2 should not exceed 0.5 volt. Reading V_3 should not exceed 0.3 volt. If the voltage drop exceeds these limits, excessive resistance is indicated in the circuit checked.
4. With the engine stopped, turn on the full lighting and accessory load (approximately 20 amperes).

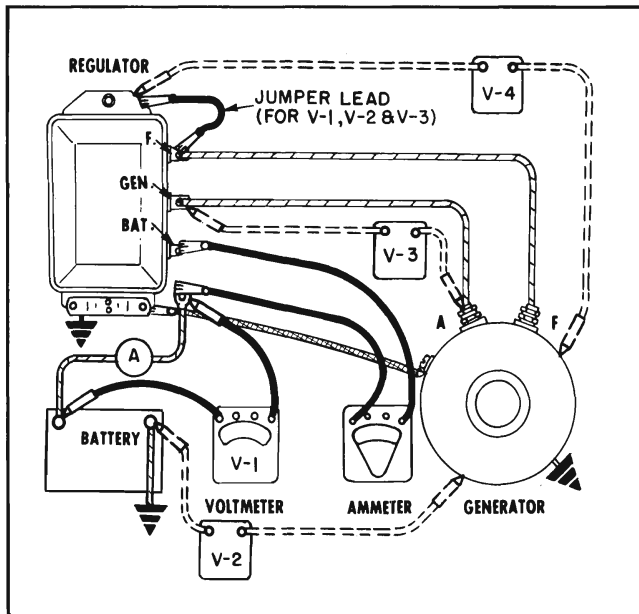


Fig. 11-34 Testing for Voltage Drops in Charging Circuit on Single Contact Voltage Regulator

Measure the voltage drop at V_4 (Fig. 11-34). If this voltage drop exceeds 0.1 volt, excessive resistance is indicated in this portion of the charging circuit.

If excessive resistance is found, check the wiring for defects, and replace if necessary. Clean and tighten all connections.

NOTE: Remove the ground jumper lead at the F terminal of the regulator after completion of these checks.

DOUBLE CONTACT VOLTAGE REGULATOR

Excessive voltage drop in the charging circuit (resulting from poor connections or other high resistance) tends to keep the battery in an undercharged condition. To check voltage drop, make connections as shown in Fig. 11-35 and proceed as follows:

NOTE: Check fuse on battery terminal before proceeding. Do not ground "F" terminal of regulator.

1. Make sure that all accessories are turned off and field rheostats are in place between the field lead to the regulator and ground.

2. Make sure that rheostat variable resistance is in the "Open" position. Set carburetor (except one barrel carburetor) on a step of fast idle cam to obtain approximately 1500 rpm. On the one barrel carburetor, set the throttle by pulling out the manual choke to give approximately 1500 rpm. Then slowly

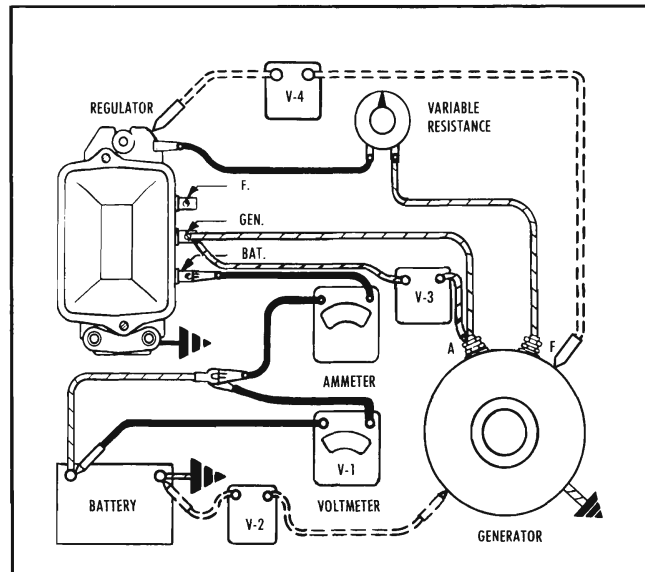


Fig. 11-35 Testing for Voltage Drops in Charging Circuit on Double Contact Voltage Regulator

turn variable resistance knob until ammeter reads 20 amperes.

3. Measure voltage drop at V_1 , V_2 , and V_3 . Return rheostat knob to "Open" position immediately after taking readings. Readings V_1 and V_3 should not exceed 0.3 volt each. Reading V_2 should not exceed 0.1 volt.

4. With the engine stopped, turn on the full lighting and accessory load (approximately 20 amperes). Measure the voltage drop at V_4 (Fig. 11-35). If this voltage drop exceeds 0.1 volt, excessive resistance is indicated in this portion of the charging circuit.

If any voltage reading exceeds these limits, excessive resistance is indicated in that part of the charging circuit. To correct, clean and tighten connections; if this fails to reduce voltage drop, replace faulty wire.

If generator regulator tests are to be made, leave ammeter and field rheostat in place making sure rheostat is turned to the "Open" position.

VOLTAGE REGULATOR SETTING

SINGLE CONTACT REGULATOR

It is seldom necessary to check and adjust the voltage regulator setting as long as (1) the battery remains satisfactorily charged without excessive use of water, (2) there is no evidence of damage to lights or other voltage sensitive equipment.

To check the voltage settings:

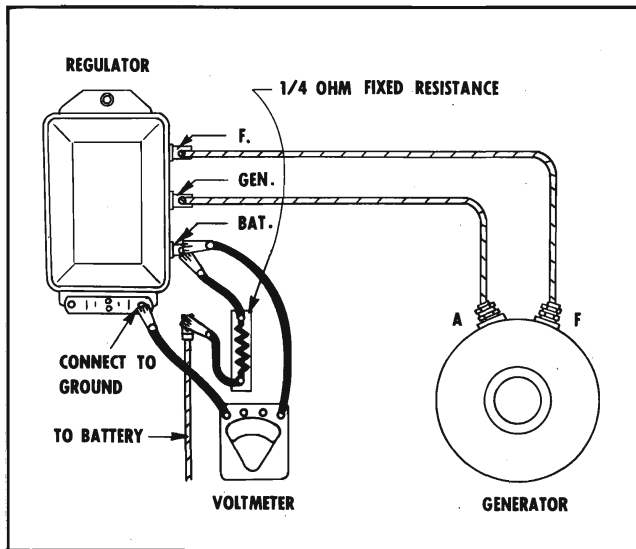


Fig. 11-36 Testing Single Contact Voltage Regulator

1. Connect a $\frac{1}{4}$ ohm fixed resistor (approximately 25 watts capacity) into the charging circuit at the "BAT" terminal of the regulator and connect a voltmeter from the "BAT" terminal to ground (Fig. 11-36).

2. Operate the engine at 1600 rpm for at least 15 minutes, with $\frac{1}{4}$ ohm resistor in circuit and regulator cover in place, to bring the regulator to operating temperature.

3. Place a thermometer near the regulator so that the bulb of the thermometer will be about $\frac{1}{4}$ " from the cover.

4. Cycle the generator by stopping the engine, restarting and returning to 1600 engine rpm.

5. Note the voltmeter reading and regulator ambient temperature (temperature of air about $\frac{1}{4}$ " from regulator). The voltmeter reading found represents the voltage regulator setting at the ambient temperature noted. The setting will be different at other temperatures. Regulator specifications are based on checks made at an ambient temperature of 125°F. If the temperature is above 125°F, the regulator will limit voltage to a lower value or if below 125°F, the same regulator will limit voltage to a higher value. A voltage correction factor must, therefore, be applied to the voltage reading before it can be compared with specifications.

Figure 11-37 shows the voltage correction factor to be applied to the voltage setting at different ambient temperatures. To obtain the "corrected" voltage regulator setting, note the reading in Figure 11-37

REGULATOR AMBIENT TEMPERATURE	VOLTAGE	
	LOW	HIGH
165° F	13.1	13.9
145° F	13.5	14.3
125° F	13.8	14.7
105° F	14.0	14.9
85° F	14.2	15.2
65° F	14.4	15.4
45° F	14.5	15.6
NORMAL SPECIFICATION RANGE ■ INDICATES PUBLISHED SPECIFICATIONS		

Fig. 11-37 Single Contact Voltage Regulator Temperature Correction Chart

that corresponds most nearly with the regulator ambient temperature noted in Step 5, and apply it to the voltage reading observed in Step 5.

When the "corrected" voltage regulator setting falls within the normal range given in the specifications and the battery condition has been satisfactory, the voltage regulator setting should not be disturbed.

When the "corrected" voltage regulator setting falls inside or outside the normal range given in the specifications but battery condition has been unsatisfactory, tailor the voltage regulator setting as follows:

The desired voltage regulator setting is that which keeps the battery in a satisfactory state of charge without causing excessive water usage (as evidenced by water consumption exceeding one ounce per cell each 1000 miles). In order to obtain the desired setting, tailor the voltage regulator setting:

a. When the battery uses too much water and the "corrected" voltage setting is above the normal range, lower the "corrected" setting to 14.3 volts and check for an improved condition over a reasonable service period. When the battery uses too much water and the "corrected" voltage setting is within the normal range, lower the setting 0.2 to 0.4 volt and check for an improved condition over a reasonable service period. Repeat until the battery remains charged with a minimum use of water.

b. When the battery is consistently undercharged and the "corrected" voltage setting is below the

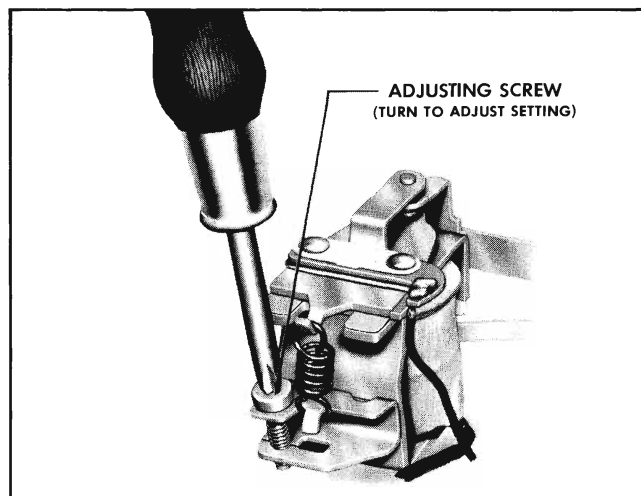


Fig. 11-38 Proper Relationship of Spring Support and Adjusting Screw

normal range, increase the "corrected" setting to 13.8-14.5 volts and check for an improved condition over a reasonable service period. When the battery is consistently undercharged and the "corrected" voltage setting is within the normal range, increase the setting 0.2 volt and check for an improved condition over a reasonable service period. Repeat until the battery remains charged with a minimum use of water.

NOTE: Avoid "corrected" settings above 14.8 volts as these may cause damage to lights and other voltage sensitive equipment.

It rarely will be found necessary to use a voltage regulator setting outside the normal range in order to correct battery conditions. Batteries which do not respond to voltage regulator settings within the normal range usually will be found to be (1) batteries used in cars that are operated consistently at low speeds or in heavy traffic, or (2) batteries that have abnormal charging characteristics.

(1) When a car is operated consistently at low speeds or in heavy traffic the battery may remain undercharged even at a voltage regulator setting of 14.8 volts. Under these operating conditions, generator output and charging time may be insufficient to offset electrical loads on the battery. Periodic recharging of the battery from an outside source or replacement of the original generator with a special generator will be required in these cases.

(2) Batteries suspected of having abnormal charging characteristics should be removed for a complete check. If the checks outlined under "Battery" indi-

REGULATOR AMBIENT TEMPERATURE	VOLTAGE		
	LOW		HIGH
205° F	13.3	—	14.1
185° F	13.4	—	14.2
165° F	13.5	—	14.4
145° F	13.7	—	14.5
125° F	13.8	—	14.6
105° F	14.0	—	14.8
85° F	14.1	—	14.9
NORMAL SPECIFICATION RANGE			

Fig. 11-39 Double Contact Voltage Regulator Temperature Correction Chart

cate that the battery is still serviceable, a voltage regulator setting outside the normal range may be adopted, provided it does not cause damage to lights or other voltage sensitive equipment or cause the battery to use water. **NOTE:** Bulb life will be shortened by setting the voltage regulator above the specified voltage.

On new cars or on other applications where no battery history is available, any "corrected" voltage regulator setting found within the normal range may be considered satisfactory unless local conditions or subsequent battery performance indicate the need for tailoring the voltage regulator setting.

When the need for changing the voltage regulator setting has been established, proceed as follows: Remove the regulator cover and turn adjusting screw clockwise to raise the setting, counterclockwise, to lower the setting. Before taking the new reading after each adjustment, replace the regulator cover as quickly as possible and cycle the generator.

CAUTION: Final adjustment should always be made by increasing spring tension to assure contact between the screw head and spring support (Fig. 11-38).

Sometimes the spring support does not follow the screw head as spring tension is decreased, and it will be necessary to bend the spring support up to insure contact between the screw head and spring support. Failure of the voltage regulator unit to "hold" its setting usually results from (1) setting or checking

the voltage regulator at other than operating temperature, and (2) the screw head not touching the spring support after final adjustment is completed.

DOUBLE CONTACT VOLTAGE REGULATOR

The regulator ambient temperature should be noted and set according to Chart (Fig. 11-39).

Check the double contact voltage regulator as follows:

1. To properly adjust voltage regulator, battery must be fully charged to limit the charge rate to 1 to 10 amperes. If above 10 amps. insert a $\frac{1}{4}$ ohm resistor in series with the battery.

2. Connect a voltmeter from regulator "BAT" terminal to ground (Fig. 11-40).

3. Connect a 25 ohm (25 watt) variable resistance (which has an "open" position) between the regulator "F" (field) terminal and the field lead from the generator. (Connections to the variable resistance should be made so that all the resistance can be inserted into the circuit before opening the circuit.)

4. With variable resistance turned out, operate generator at medium speed so that the voltage regulator is operating on the upper set of contacts. Continue to operate for 15 minutes to establish operating temperature of voltage regulator. Regulator cover must be in place.

5. Cycle the generator by turning the variable resistance to the "open" position momentarily, then slowly cut all the resistance out. Regulator should be operating on upper contacts between 14.0 and 14.6

volts. This is the voltage setting of the regulator and may be adjusted in the conventional manner by turning the Phillips screw to adjust spring tension (Fig. 11-38).

6. Increase resistance slowly until regulator begins to operate on the lower contacts. The voltmeter should indicate a slight drop in voltage of 0.3 to 0.5 volts. This differential voltage may be increased by increasing the air gap and decreased by decreasing the air gap. Air gap adjustment should seldom be necessary on this regulator. However, if the adjustment screw is turned, it will also affect the setting of the regulator, so that the voltage adjustment procedure must be repeated. The regulator must be cycled each time before taking voltmeter readings, as previously described.

CAUTION: Never ground the generator field with this regulator connected to the generator. This will burn up the upper set of contact points of the voltage regulator.

CUTOUT RELAY CLOSING VOLTAGE

The cutout relay is tested and adjusted on the single and double contact voltage regulators in the same manner.

NOTE: It is seldom necessary to check the closing voltage of the cutout relay as long as the relay functions to close and open the charging circuit. Any setting that falls within the specified range is satisfactory as long as the setting is at least 0.5 volt below the voltage regulator setting.

1. Connect a voltmeter between the regulator "Gen" terminal and ground (Fig. 11-41).

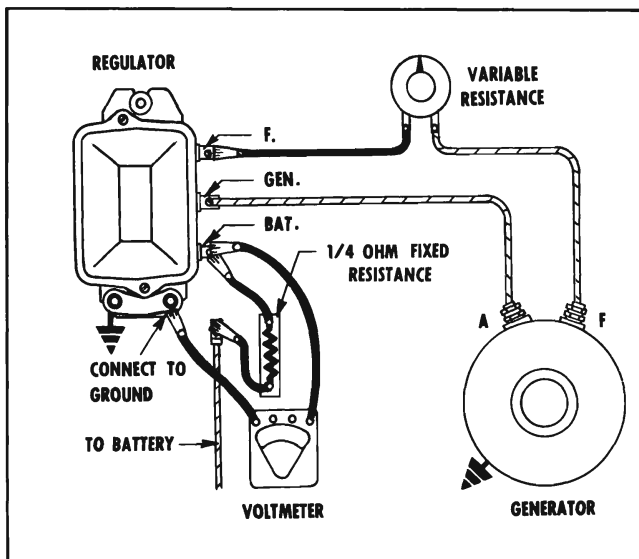


Fig. 11-40 Testing Double Contact Voltage Regulator

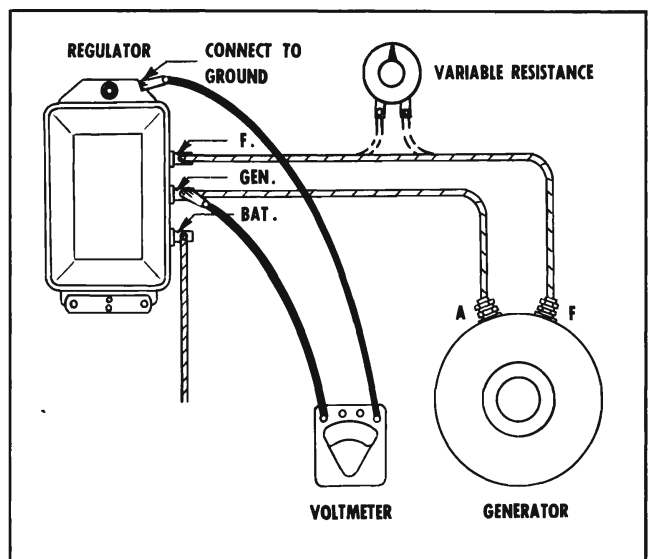


Fig. 11-41 Checking Closing Voltage

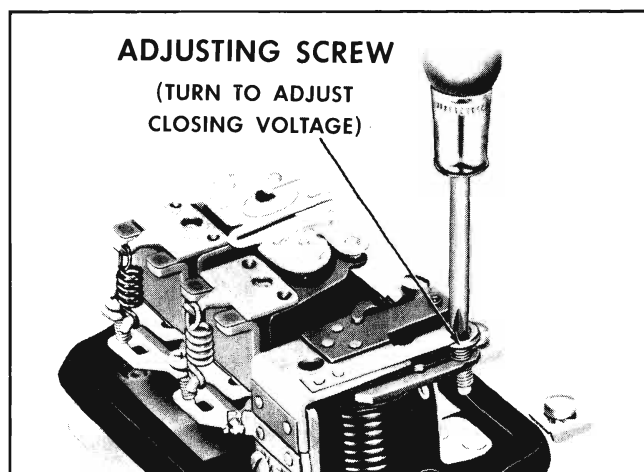


Fig. 11-42 Adjusting Closing Voltage

2. Check cutout relay closing voltage by the following method:

Connect a 25 ohm, 25 watt variable resistor in the field circuit. Operate the generator at medium speed at maximum resistance (with all the resistance of the variable resistor turned in the circuit). Slowly decrease (turn out) the resistance, and note the voltage at which the contact points close. Slowly increase the resistance and make sure that the contact points open.

Adjust the closing voltage by turning the adjusting screw (Fig. 11-42). Turn the screw clockwise to increase the setting and counterclockwise to decrease the setting.

CURRENT REGULATOR SETTING

The current regulator is tested and adjusted on the single and double contact regulators in the same manner.

It is seldom necessary to check the setting of the current regulator unless the generator armature shows signs of overheating. Any setting that falls within the specified range is satisfactory.

1. Connect an ammeter into the charging circuit and connect voltmeter from "Bat" to ground (Fig. 11-43).

2. Turn on all accessory load (lights, radio, etc.) and connect any additional load such as carbon pile or bank of lights across the battery to drop system voltage to 12.5-13 volts.

3. Operate the generator at 1600 engine rpm for

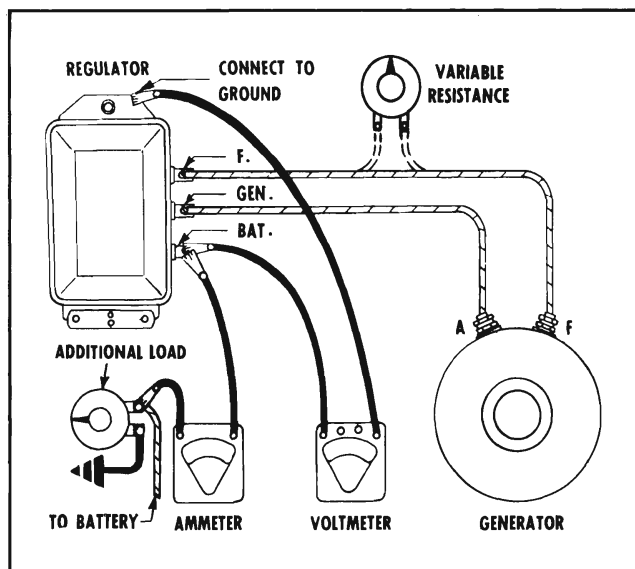


Fig. 11-43 Checking Current Regulator

at least 15 minutes to establish operating temperature. The regulator cover must be in place.

4. Cycle the generator by stopping engine, restarting and returning to 1000 engine rpm and note the current regulator setting.

5. Adjust the current setting to 31-35.5 amperes in the same manner as that used for adjusting the voltage regulator setting.

CHECK FOR OXIDIZED CONTACT POINTS

Abnormal flicker in the generator indicator light on the instrument panel, while testing the voltage or current regulator, indicates an oxidized condition of regulator contact points. This condition may cause a high resistance in the generator field circuit and reduced generator output. Test for oxidized contact points on the single and double contact regulators as follows:

1. With engine stopped, disconnect battery lead from regulator terminal marked "Bat". Connect ammeter red lead to "Bat" terminal and ammeter black lead to battery lead.

2. Turn on headlights. Start engine and adjust speed until test ammeter reads exactly 10 amperes.

3. On single contact voltage regulator, ground "F" terminal.

4. On double contact voltage regulator, disconnect field lead from regulator "F" terminal and ground it on regulator base (Fig. 11-44).

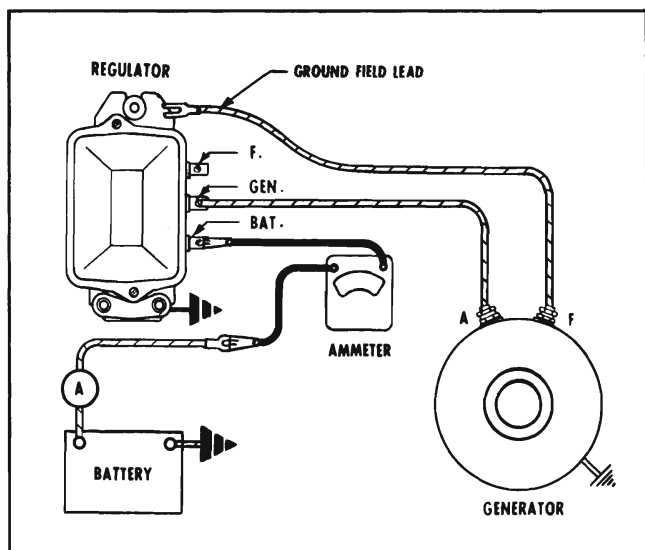


Fig. 11-44 Checking for Oxidized Contact Points on Double Contact Voltage Regulator

If ammeter reading increases more than 2 amperes, oxidized contact points are indicated. Regulator should be removed and contact points cleaned before proceeding to any other regulator tests.

CAUTION: (double contact regulator only): Never use a jumper to ground the generator to regulator field terminal when these units are connected and operating together, as this would burn the contacts of the voltage regulator.

REMOVE REGULATOR

To remove the regulator, disconnect battery ground cable and leads from the regulator and remove the regulator.

CHECK AND ADJUST OUT OF CAR

While electrical adjustments are made with the regulator on the car as outlined under "Check and Adjust on Car", it is necessary to remove the regulator for cleaning contact points and adjusting air gaps on the three regulator units.

CLEAN CONTACT POINTS

The regulator contact points will not operate indefinitely without some attention. Eventually they will oxidize and cause lower generator output which may contribute to a discharged battery. A large majority of replaced regulators can be returned to service by cleaning the contact points and adjusting the electrical settings.

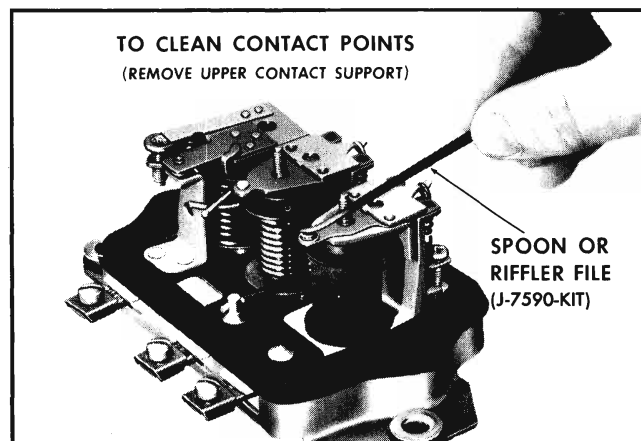


Fig. 11-45 Cleaning Regulator Contact Points

SINGLE CONTACT VOLTAGE REGULATOR

The large flat contact points located on the armature of the voltage regulator (Fig. 11-45), and on the upper contact support of the current regulator are hard and will usually require the most attention. Clean the contact points as follows:

1. Remove upper contact support.
2. Using spoon or riffler file (Fig. 11-45), remove all oxides from the flat contacts on the voltage regulator armature and current regulator upper contact support.

NOTE: It is not necessary to have a flat surface on these contacts, but all oxides should be removed so that pure metal is exposed.

3. The small soft alloy contact point, located on

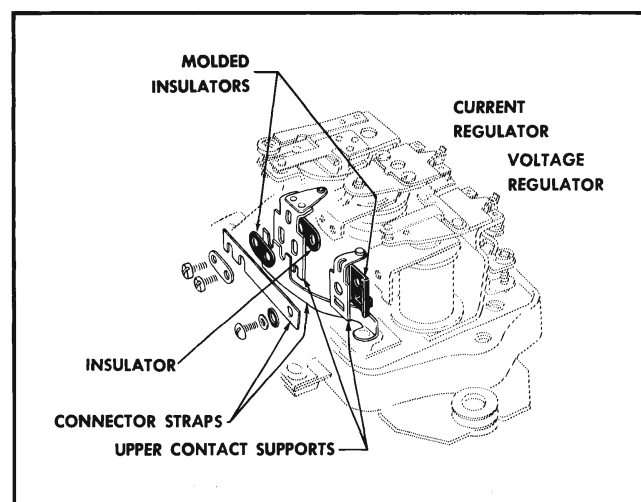


Fig. 11-46 Double Contact Voltage Regulator

the upper contact support of voltage regulator and on the armature of current regulator for negative grounded regulator units, does not oxidize. This contact point may be cleaned with crocus cloth or other fine abrasive material followed by a thorough washing with clear carbon tetrachloride to remove any foreign material remaining on the contact surface.

CAUTION: Do not file contact points excessively. Never use sandpaper or emery cloth.

4. Install upper contact support and adjust as outlined under "Adjust Air Gaps and Point Opening."

DOUBLE CONTACT VOLTAGE REGULATOR

The upper contact points of the double contact voltage regulator are of soft alloy material and should be cleaned as follows:

1. Remove voltage regulator upper contact support (Fig. 11-46).

2. Clean upper contact points in the same manner as the soft alloy contact points on the voltage and current regulators for the single contact voltage regulator. The lower contact points of the double contact voltage regulator should be cleaned in the same manner as the set of points on the single contact voltage regulator.

Install upper contact support (Fig. 11-46) and adjust as described under "Adjust Air Gaps and Point Opening". The upper contact point of the current regulator is of soft alloy and should be cleaned (after removing upper support) in the same manner as the soft alloy contact point on the voltage and current regulators for the single contact regulator.

The lower contact point of the current regulator is hard and should be cleaned in the same manner as the hard contact point on the voltage and current regulators for the single contact regulator.

If it is desirable to replace the contact points of the regulator, reassemble regulator as shown in Fig. 11-46.

CUTOUT RELAY

The cutout relay contact points are both soft alloy and should be cleaned in the same manner as the small soft alloy contact points on the voltage and current regulators. This applies to both single and double contact regulators.

ADJUST AIR GAPS AND POINT OPENING

SINGLE CONTACT VOLTAGE REGULATOR GAP ADJUSTMENT

Push armature down to core and release it until contact points just touch and then measure air gap between armature and core. Air gap should be .075".

NOTE: Do not push against bi-metal strip to which contact points are attached when making this check. This would affect the tension of the bi-metal strip resulting in improper air gap.

To adjust air gap:

1. Set .075" gauge (Fig. 11-47) between armature and core and push down on armature.

2. Tighten contact support nut until contact points just touch.

DOUBLE CONTACT VOLTAGE REGULATOR GAP ADJUSTMENT

1. With lower contacts touching, measure air gap between armature and winding core as shown in Fig. 11-48. Air gap should be .067".

2. Adjust by loosening contact support bracket screw approximately $\frac{1}{8}$ to $\frac{1}{4}$ turn. Place a screwdriver in slot in contact support bracket and into the molded insulator as shown in Fig. 11-48. Raise on the handle of the screwdriver to increase air gap and lower the handle of the screwdriver to decrease air gap.

3. Retighten contact support bracket screw securely

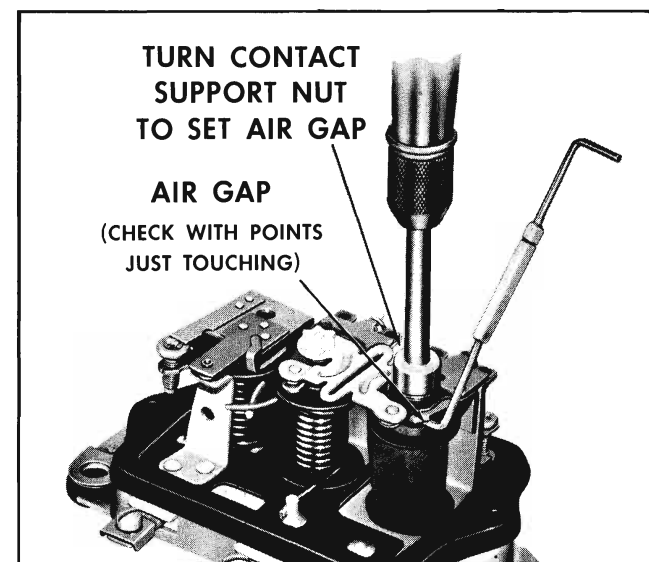


Fig. 11-47 Adjusting Voltage Regulator Air Gap on Single Contact Voltage Regulator

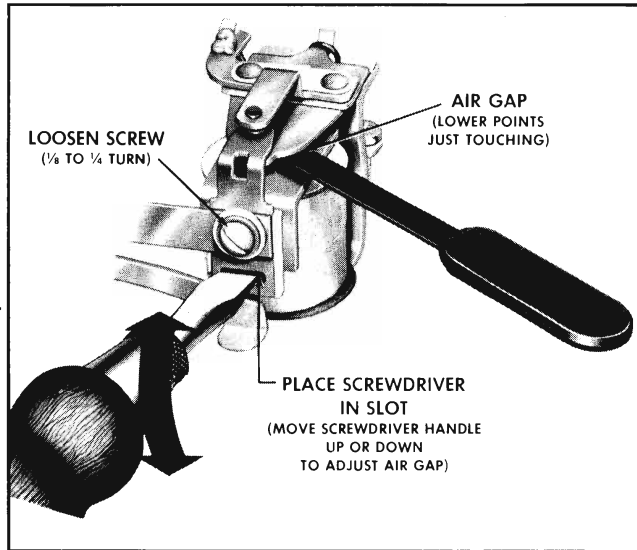


Fig. 11-48 Adjusting Voltage Regulator Air Gap on Double Contact Voltage Regulator

after adjustment. To measure voltage regulator point opening:

- a. Push armature down until the lower set of contacts are just touching. Measure point opening between upper set of contacts (Fig. 11-49). Point opening should be .016".
- b. Adjust by bending the upper contact arm on the armature assembly.

CUTOUT RELAY GAP ADJUSTMENT

The cutout relay gap and point opening adjustments are the same for the single and double contact voltage regulators.

1. Place fingers on armature directly above core and move armature directly down until points just close and then measure air gap between armature and center of core. Air gap should be .020". To adjust air gap, loosen two screws at back of relay and raise or lower armature as required. Tighten screws securely after adjustment (Fig. 11-50).

2. Check point opening and adjust to .020" by bending upper armature stop (Fig. 11-51).

CURRENT REGULATOR GAP ADJUSTMENT

Single Contact Voltage Regulator

Check and adjust current regulator air gap in exactly the same manner as the voltage regulator is adjusted (Fig. 11-47). Air gap should be .075". Be sure

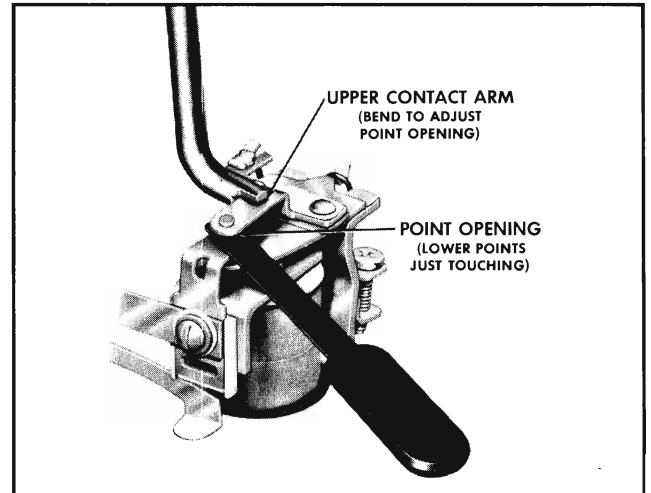


Fig. 11-49 Point Opening Adjustment on Double Contact Voltage Regulator

rubber gasket is in place on regulator base before installing regulator cover.

Double Contact Voltage Regulator

1. With contact points just touching, measure air gap between armature and winding core as shown in Fig. 11-52. Air gap should be .075".
2. Adjust by loosening contact mounting screws and raising or lowering contact mounting bracket as required.

CAUTION: Be sure the contact points are aligned and screws securely tightened after adjustment.

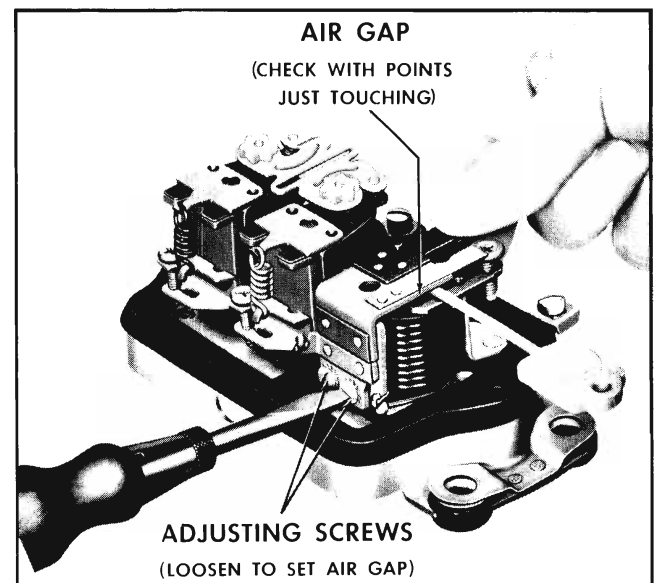


Fig. 11-50 Adjusting Cut-out Relay

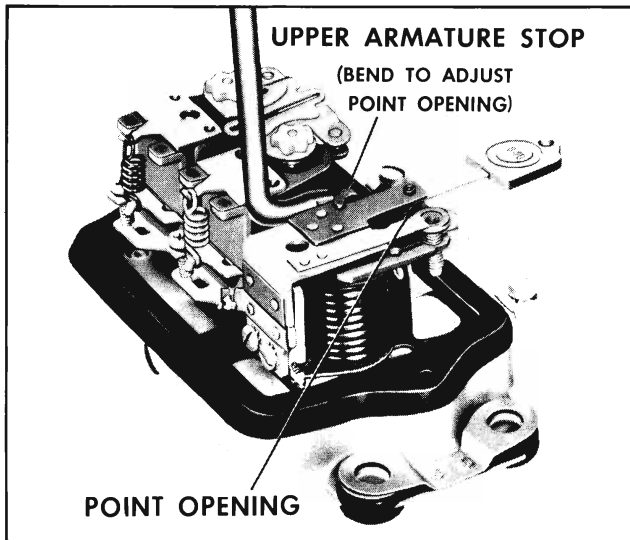


Fig. 11-51 Adjusting Cut-out Relay Point Opening

INSTALL REGULATOR

1. Install regulator and tighten mounting screws.

CAUTION: Do no tighten the mounting screws excessively as this will destroy the cushioning effect of rubber grommets in the mounting.

2. Attach regulator "Bat", "Gen", "Field" and ground leads and battery ground strap. Polarize generator by momentarily touching a jumper wire to the battery lead connection at the "Bat" terminal and to the "Gen" terminal on the regulator, before starting the engine.

3. Check and adjust the electrical settings of the

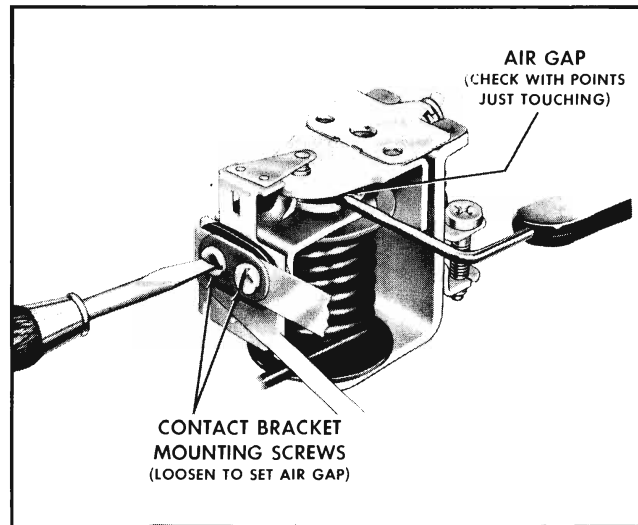


Fig. 11-52 Current Regulator Air Gap Adjustment on Double Contact Voltage Regulator

regulator on the car as outlined under "Check and Adjust on Car."

TROUBLE DIAGNOSIS

Measure the voltage between the "Bat" terminal of the regulator and ground at (1) idle speed, and (2) medium engine speed. The voltage should be higher at a medium engine speed than it is at idle speed. If it is not and the generator passes its tests above, make a complete check of the regulator. If it is the voltage regulator, setting still may require adjustments if the battery remains undercharged or uses too much water.

NOTE: If zero voltage—check for blown fuse.

IGNITION CIRCUIT

The ignition circuit (Fig. 11-53) includes the distributor, ignition coil, ignition resistance wire, ignition switch, spark plugs, battery, and the resistance type secondary cables.

For battery, see "Charging Circuit."

PERIODIC SERVICE

The distributor and spark plugs are the only components of the ignition circuit that require periodic service. The remainder of the ignition circuit requires only periodic inspection to check the operation of the units, tightness of the electrical connections, and the condition of the wiring.

All leads located in either the coil tower or distributor cap should be checked to make sure they are pressed all the way down in their inserts. If rubber boots are used at these connections, they, too, should be tightly in place over the connection.

CAUTION: Lead from distributor should be connected to coil negative terminal and lead from ignition switch to coil positive terminal.

DISTRIBUTOR

The procedures that follow in this section apply to both the four cylinder and eight cylinder engines. Although different model distributors are used for

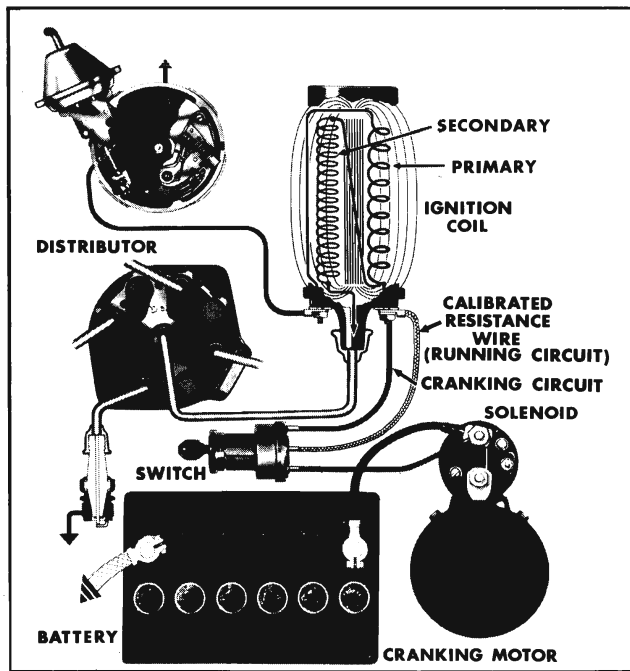


Fig. 11-53 Ignition Circuit—Schematic

each engine, they are similar enough that the write-up may apply to both models.

DESCRIPTION

The distributors are 12 volt, external adjustment type units (Figures 11-54 and 11-55). A window in the cap provides easy access for adjusting the dwell angle while the cap is mounted and the engine is running. The circuit breaker plate located below the centrifugal advance mechanism uses the outer diameter of the main shaft bushing for its bearing surface. A retainer clip in the upper shaft bushing holds the movable plate in position. The contact set is attached to the movable breaker plate and is serviced as a complete assembly.

A vacuum control unit, attached to the distributor housing, is mounted under the movable breaker plate, and contains an enclosed spring-loaded diaphragm linked mechanically to the movable breaker plate inside the distributor. The enclosed air tight side of the diaphragm is connected to the intake manifold side of the carburetor. Under part throttle operation, the intake manifold vacuum actuates the diaphragm and the movable plate moves, thus advancing the spark and increasing fuel economy. During acceleration or when the engine is pulling heavy, the vacuum is not sufficient to actuate the diaphragm and the movable breaker plate is held in the retarded position

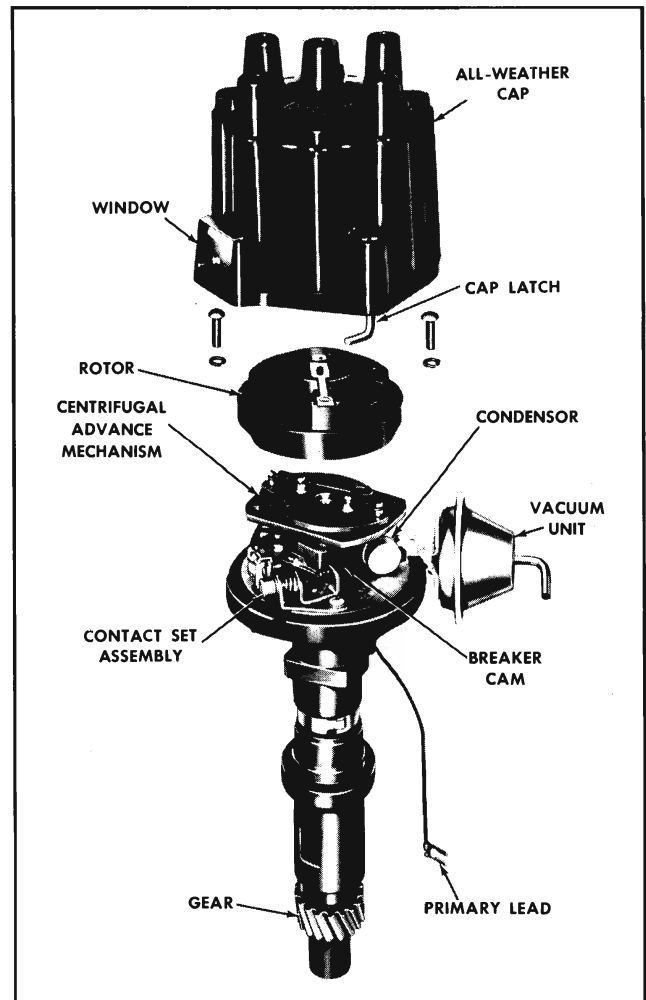


Fig. 11-54 4 Cylinder Engine Distributor

by a calibrated return spring which bears against the vacuum diaphragm.

The rotor, assembled in the distributor serves as a cover for the centrifugal advance mechanism which consists of an automatic cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, the weights are thrown outward against the pull of the springs. This movement advances the cam, causing the contact points to open earlier, thereby advancing the spark.

When replacing the contact set assembly, add a trace of Delco-Remy Cam and Ball Bearing Lubricant to the breaker cam. No other lubrication is required. The movable breaker plate is lubricated by oil from the upper shaft bushing. In addition to lubrication, there should be periodic inspection of the distributor cap, rotor, and breaker points and of the wiring and timing.

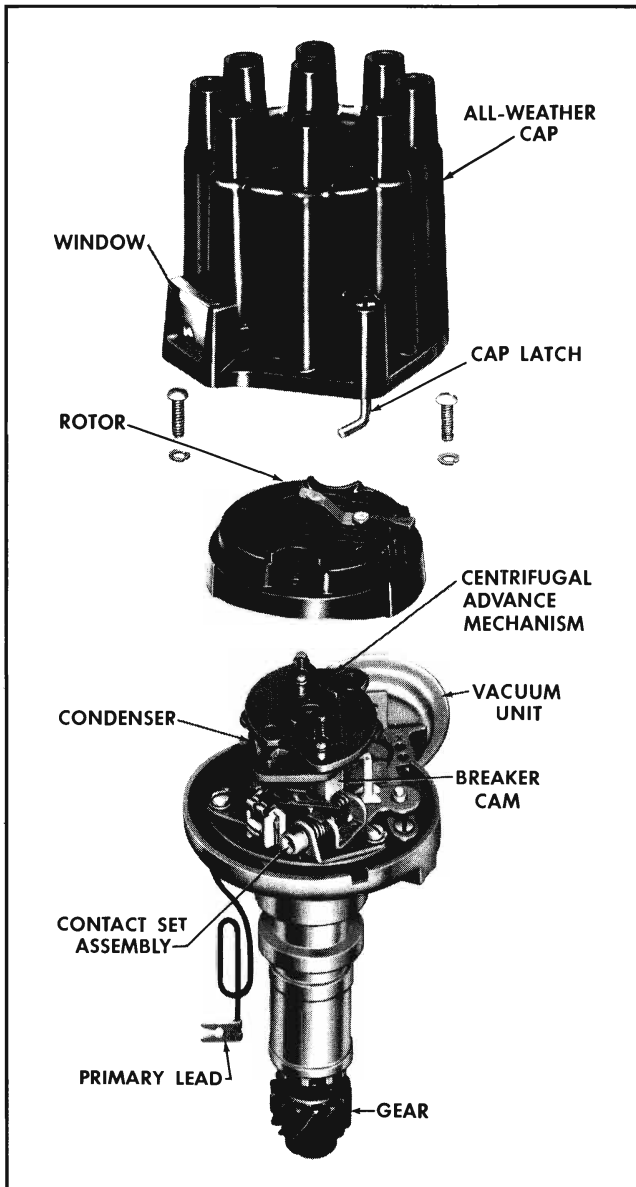


Fig. 11-55 V-8 Engine Distributor

ADJUSTMENT

With the engine running at idle, the dwell is adjusted by first raising the window provided in the distributor cap and inserting a "Hex" wrench into the head of the adjusting screw as shown in Figure 11-56.

PREFERRED METHOD

Turn the adjusting screw until the specified dwell angle is obtained as measured by a dwell meter.

ALTERNATE METHOD

Turn the adjusting screw in (clockwise) until the

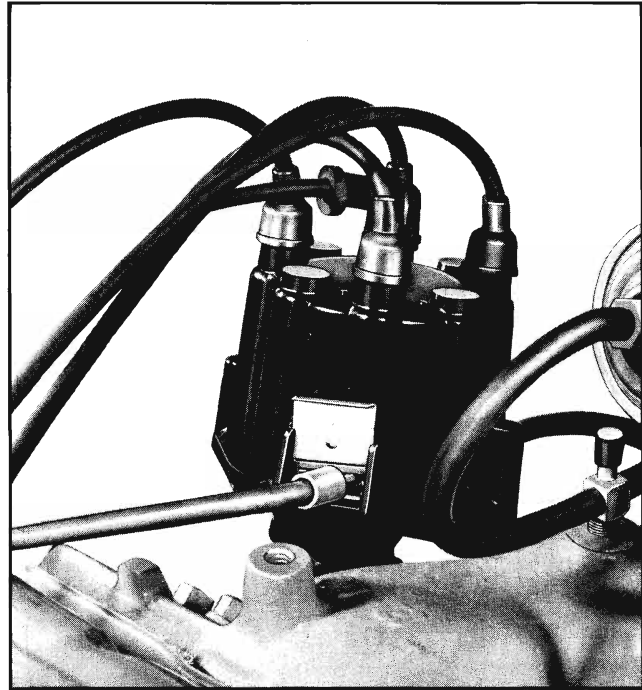


Fig. 11-56 Adjusting Dwell Angle

engine begins to misfire, then give the wrench one-half turn in the opposite direction (counterclockwise), thus giving the approximate dwell angle required.

REMOVE

1. Disconnect distributor-to-coil primary wire.
2. Remove distributor cap.
3. Crank engine so rotor is in position to fire No. 1 cylinder (Figures 11-60 and 11-61) and timing mark on harmonic balancer is indexed with pointer.
4. Remove vacuum line from distributor.
5. Remove distributor clamping screw and hold-down clamp.
6. Remove distributor. It will be noted that the rotor will rotate as the distributor is pulled out of the block. Note the relationship of the rotor and the distributor housing after removal so that the rotor can be set in the same position when the distributor is being installed. **NOTE:** Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.

INSPECT

With the distributor removed from the vehicle it is advisable to place the distributor in a distributor testing machine or synchroscope. 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, and condition of contacts. This test will give valuable information on the distributor condition and indicate parts replacement which may be necessary.

When checking the distributor condenser it should be checked with a reliable make of condenser tester. The condenser should be checked for the following properties: (1) Insulation Resistance (or Leakage), (2) Series Resistance, (3) Breakdown Test, (4) Capacity (mfd.).

REPLACE CONTACT SET

The contact point set is replaced as one complete assembly. The breaker lever spring tension and point alignment of the service contact set have been pre-adjusted at the factory. Only the point opening requires adjusting after replacement.

Replace contact set as follows:

1. Remove two attaching screws (Fig. 11-57) which hold base of contact set assembly in place.
2. Remove condenser lead and primary lead from nylon insulated connection by turning screw (Fig. 11-57) in contact set.

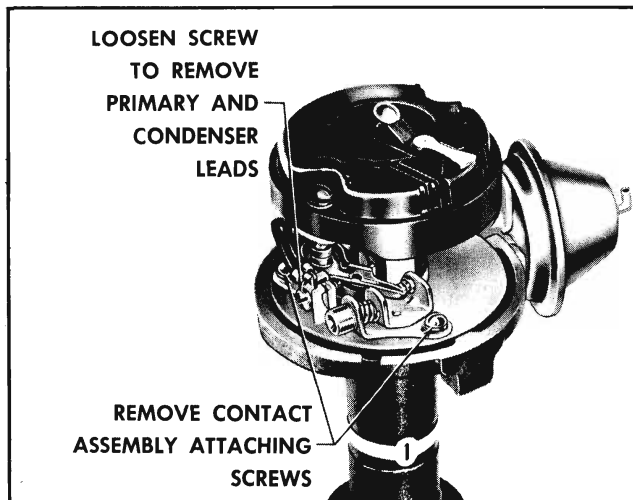


Fig. 11-57 Distributor Contact Details

3. Replacement is the reverse of removal.

CAUTION: Make sure the condenser lead and primary lead are located as in Fig. 11-58. Leads must be properly located to eliminate interference between leads and cap, weight base, or breaker plate.

4. Apply a trace of cam and ball bearing lubricant to the breaker cam.

ADJUST DISTRIBUTOR DWELL ANGLE

The following method can be used to adjust the dwell angle to the proper setting with the distributor removed from the car. **NOTE:** Dwell should always be rechecked after the distributor is installed in the car.

1. With distributor mounted in distributor testing machine, connect the dwell meter to the distributor primary lead.
2. With the distributor operating turn the adjusting screw (Fig. 11-56) until the proper dwell angle is obtained.

DISASSEMBLE

1. Remove the rotor by removing the two attaching screws and lock washers (Fig. 11-59).

NOTE: It will be observed that the rotor is doweled to the weight base so that it can be installed in only one position.

2. Remove both the weight springs and both the advance weights.
3. Drive out roll pin retaining gear.

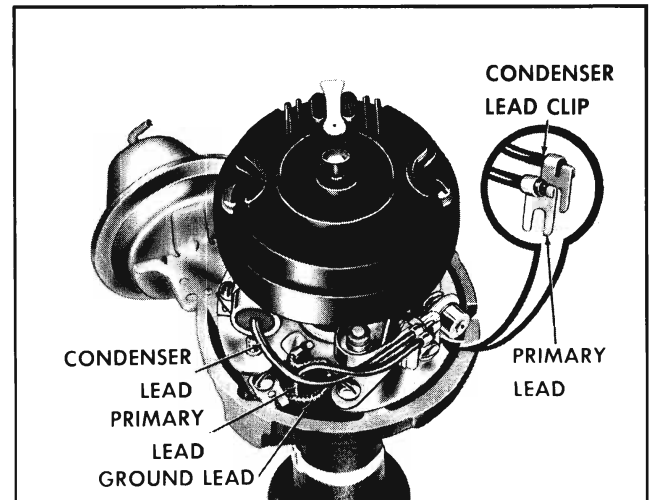


Fig. 11-58 Condenser and Primary Leads

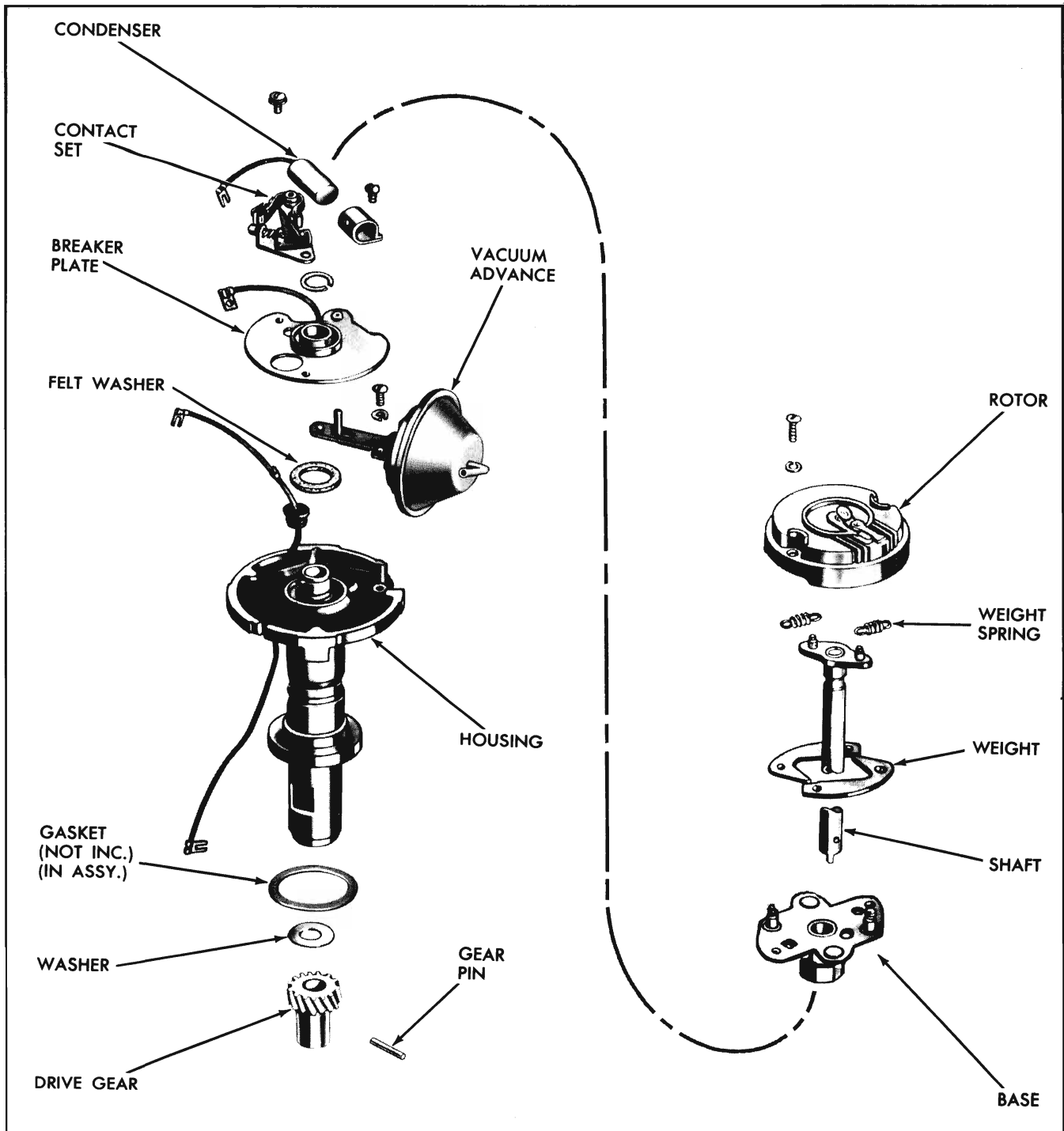


Fig. 11-59 Exploded View of Distributor (4 Cylinder Engine Distributor Shown)

CAUTION: Distributor should be supported in such a way that the distributor shaft will not be damaged when driving the pin out.

4. Slide gear and washer off the shaft.
5. Pull shaft and cam-weight base assembly from the housing.

6. Remove contact set assembly.
7. Remove condenser hold-down screw, condenser and bracket from the breaker plate.
8. Remove spring retainer and raise plate from the housing.

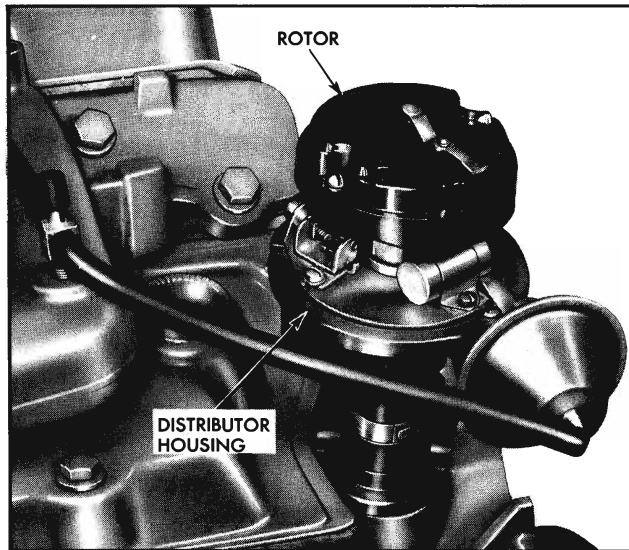


Fig. 11-60 Relationship of Distributor Housing and Rotor in Firing Position for No. 1 Cylinder—4 Cylinder Engine

9. Remove two attaching screws and lock washers and plate ground lead, and remove the vacuum advance unit.

10. Remove felt washer from around bushing in the housing.

NOTE: No attempt should be made to service the shaft bushings in the housing, as the housing and bushings are serviced as a complete assembly.

ASSEMBLE

Assembly of the distributor is the reverse of the disassembly procedure outlined above. When installing the gear on the shaft use a new roll pin. The pin must be tight in the hole to prevent any movement between the gear and the shaft.

Note that the rotor can be installed in only one position. It will be broken if an attempt is made to install it backwards.

INSTALL

1. Check to see that engine is at firing position for No. 1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with pointer.

2. On 4 cylinder engine, position new distributor to block gasket on block.

3. Before installing distributor, index rotor with

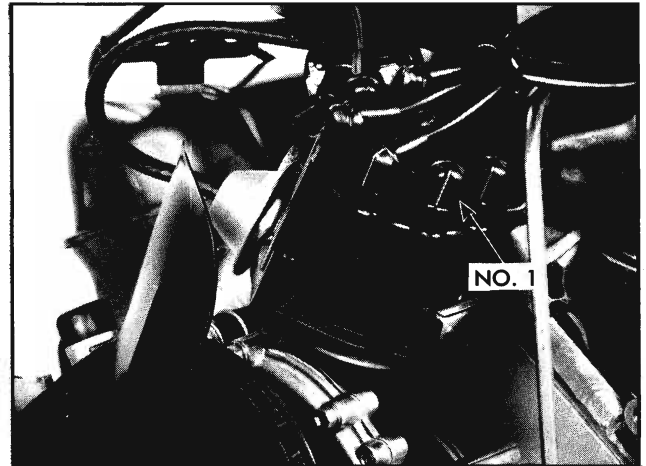


Fig. 11-61 Location for No. 1 Spark Plug Cable Terminal—V-8 Engine

housing as noted when distributor was removed. This will simplify indexing the distributor shaft and gear with the oil pump drive shaft and the drive gear on the camshaft. Distributor and rotor will be positioned as shown in Figures 11-60 and 11-61 when properly installed with No. 1 piston in firing position.

4. Replace distributor clamp leaving screw loose enough to allow distributor to be turned for adjustment.

5. Install spark plug wires in distributor cap. Place wire for No. 1 cylinder in tower (marked on old cap during disassembly) then install remaining wires around the cap according to the firing order (See Section 6).

6. Attach distributor to coil primary wire.

7. Replace distributor cap.

8. Adjust dwell and timing.

9. Attach vacuum line to distributor.

SPARK PLUGS

DESCRIPTION

AC type 45 spark plugs are used to provide optimum performance for all normal service.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that

may have accumulated from frequent idling or continual stop-and-go or slow-speed driving.

Spark plugs in Pontiac Tempest engines are protected by an insulating nipple made of special heat resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent "flash-over", with resulting missing of the engine, even though a film is allowed to accumulate on the exposed portion of the plug porcelains. **NOTE:** Do not mistake "Corona" discharge for "flash-over" or a shorted insulator. Corona is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

All AC Spark Plugs have a type number on the insulator which designates the thread size as well as relative position of the plug in the "Heat Range". Type numbers starting with "4" are 14 mm. thread size.

The last digit of the type number indicates the "Heat Range" position of the plug in the AC Heat Range System. Read these numbers as you would a thermometer—the higher the last digit, the "hotter" the plug will operate in the engine; the lower the last digit, the "cooler" the plug.

PERIODIC SERVICE

Periodically (the actual time depending on operating conditions) the plugs should be removed for cleaning, inspection and regapping.

REMOVE

1. Remove spark plug wires.
2. Remove any foreign matter from around spark plugs by blowing out with compressed air.
3. Using a $\frac{13}{16}$ " spark plug socket, remove the spark plugs.

INSPECT

Spark plug life is governed to a large extent by operating conditions and plug life varies accordingly. To insure peak performance, spark plugs should be checked, cleaned and regapped every 5000 miles.

Worn and dirty plugs may give satisfactory oper-

ation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear may be due to dirty or leaded plugs, excessive gap or broken insulator.

Dirty or leaded plugs may be evident by black carbon deposits, or red, brown, yellow or blistered oxide deposits on the plugs. The black deposits are usually the result of slow speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too "cold" will also result in carbon deposits. Red, brown, etc., oxide deposits, a consequence of the use of leaded fuel, usually result in spark plug failure under severe operating conditions. The oxides have no adverse effect on plug operation as long as they remain in a powdery state. But, under high speed or hard pull, the powder oxide deposits melt and form a heavy glaze coating on the insulating which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out the plug.

Excessive gap wear on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that are consistently greater than normal or that a plug which is too "hot" is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking past the threads and gasket, due to insufficient compression of the spark plug gasket, dirt under the gasket seat, or the use of old gaskets. Too "lean" carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or moisture penetrates the fracture. The fracture is usually just below the crimped part of the shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of a break may result from the plug operating too "hot" such as encountered in sustained periods of high speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the

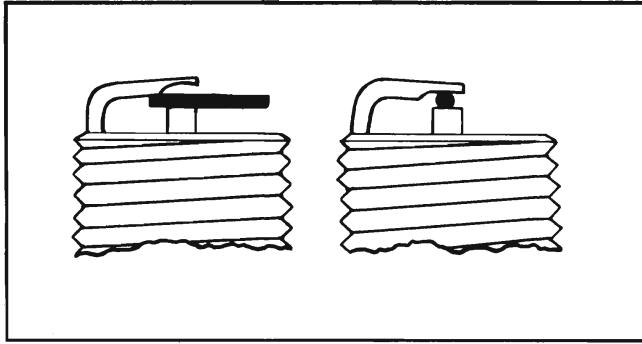


Fig. 11-62 Flat Feeler Versus Round Wire Gauge for Measuring Spark Plug Gap

ground (side) electrode. Never bend the center wire. Spark plugs with broken insulators should always be replaced.

CLEAN AND REGAP

Clean the spark plugs thoroughly using an abrasive type cleaner. All spark plugs must be of the same make and number or heat range (AC44FF is standard equipment). Use a round feeler gauge to adjust the spark plug gaps to .035" (Fig. 11-62). Test spark plugs following instructions furnished with Spark Plug Cleaner and Indicator (Fig. 11-63).

CAUTION: Before adjusting gap, file center electrode flat. In adjusting the spark plug gap, never bend the center electrode which extends through the porcelain center. Always make adjustments by bending the ground (side) electrode.

INSTALL

1. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. x 1.25 SAE spark plug tap (available through local jobbers) or by using a small, soft wire



Fig. 11-63 Spark Plug Cleaner and Indicator

brush in an electric drill. If a tap is used, coat it with plenty of grease to catch any chips.

CAUTION: Use extreme care when using tap to prevent cross threading. Also, crank engine several times to blow out any material dislodged during cleaning operation.

2. Install spark plugs in engine, using new gaskets, and tighten to 20-25 lb. ft. torque on the 4 cylinder engine and 15-20 lb. ft. on the V-8 engine.

CAUTION: Use thread lubricant on V-8 engine.

SPARK PLUG TROUBLE DIAGNOSIS

PLUG CONDITIONS	FACTORS CAUSING THIS CONDITION	CORRECTIVE ACTION
Plug "Flash Over" (Firing from upper terminal to base of plug).	Dirty insulator tops—oil, dirt and moisture on insulator will shunt current to base of plug. The above condition can be caused by failure of spark plug boot.	Keep plugs wiped clean with cloth moistened with cleaning solvent. Check spark plug boot and replace if necessary.
Oil or Carbon Fouling.	Wet, black deposits on firing end of plug indicate oil pumping condition. This is usually caused by worn piston rings, pistons, cylinders or sticky valves.	Correct engine condition. In most cases plugs in this condition will be serviceable after proper cleaning and regapping.

PLUG CONDITIONS	FACTORS CAUSING THIS CONDITION	CORRECTIVE ACTION
	Soft, fluffy, dry carbon deposits usually indicate a rich mixture operation, excessive idling, improper operation of automatic choke or faulty adjustment of carburetor.	If troubles are not eliminated, use "hotter" type plug.
	Hard baked-on, black carbon deposits result from use of too cold a plug.	Use "hotter" type plug.
Lead Fouling (Light and powdery or shiny glazed coating on firing end).	By-products of combustion and fuel additives, deposited as a powder which may later melt and glaze on insulator tip.	Remove deposits by blast cleaning. If this is not possible, plugs should be replaced.
Normal Electrode Wear.	Due to intense heat, pressure and corrosive gases together with spark discharge, the electrode wears and gap widens.	Plugs should be regapped every 5000 miles.
Rapid Electrode Wear.	Condition may be caused by (1) burned valves, (2) gas leakage past threads and seat gaskets, due to insufficient installation torque or damaged gasket (3) too lean a mixture or (4) plug too "hot" for operating speeds and loads.	Correct engine condition. Install plugs to specified torque. Use a new spark plug seat gasket each time a new or cleaned spark plug is installed. Use "colder" type plug if condition continues to exist.
Broken Upper Insulator (Firing around shell crimp under load conditions).	Careless removal or installation of spark plug.	Replace with a new spark plug.
Broken Upper Insulator (Firing Tip).	The cause is usually carelessness in regapping by either bending of center wire to adjust the gap or permitting the gapping tool to exert pressure against the tip of the center electrode or insulator when bending the side electrode to adjust the gap.	Replace with a new spark plug.
	Fracture or breakage of lower insulator may also occasionally occur if the engine has been operated under conditions causing severe and prolonged detonation or preignition.	Use "colder" type plug for the particular type of operation.
Damaged Shell.	Very seldom occurs but cause is almost always due to mishandling by applying excessive torque during installation. This failure is usually in the form of a crack in the Vee of the thread next to the seat gasket or at the groove below the hex.	Replace with a new spark plug.

IGNITION COIL AND RESISTOR

The 12 volt coil is an oil filled, hermetically sealed unit designed specifically for use with an external resistance. The number of turns in the primary winding results in a higher inductance in this winding, which makes it possible for this coil to provide a higher secondary voltage output throughout the speed range.

In order to improve ignition performance during cranking an external resistance is used. This resistor is an integral part of the wiring and is calibrated to the proper value.

For optimum starting performance at low temperatures, the resistance is by-passed during cranking, thereby connecting the ignition coil directly to the battery. This provides full battery voltage available at the coil and thus keeps ignition voltage as high as possible during cranking. The resistance is by-passed automatically through the ignition and starting switch when the switch is in the "start" position.

SECONDARY IGNITION CABLES

All ignition cables in the secondary or high tension system (coil to distributor and distributor to plugs) are neoprene jacketed. This cable is resistant to the action of oil, grease, battery acid and road salt, and offers resistance to corona breakdown. Ignition cables have a multiple, cloth thread core impregnated with a graphite solution to give the correct conductivity. These cables give proper resistance for suppression of radio and television interference.

No external suppressors should be used on the ignition system on car radio installation.

IGNITION TIMING

Correct timing of the spark, with relation to engine piston position, is made in the shop by use of a power timing light and timing marks on the harmonic balancer (Fig. 11-64).

NOTE: The V-8 engine specification is 5° BTDC. The mark on the harmonic balancer must line up with the 5° mark cast in the block.

It is imperative, due to vacuum advance at idle, to disconnect the distributor vacuum advance line before setting ignition timing.

At the time the spark is adjusted the general appearance of the breaker points should be observed.

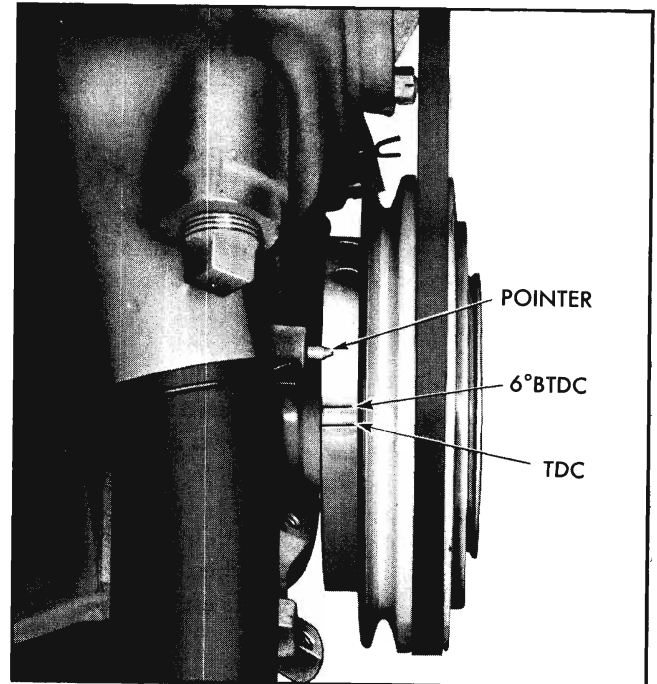


Fig. 11-64 Timing Marks and Pointer—
4 Cylinder Engine

If a smudge line appears on the point support and breaker plate just beneath the points, burned points (from oil or crankcase vapor between the points) are very probable. Points which have gone several thousand miles will have a rough surface, but this does not mean the points are worn out. The roughness between points matches so that a large contact area is maintained and the points will continue to provide satisfactory service. If dirt or scale are present the points should be cleaned with a few strokes of a clean, fine-cut, contact file. Do not attempt to remove all roughness or dress the point surfaces down smooth. Never use emery cloth or sandpaper to clean points. If points are burned or badly pitted they should be replaced and the cause of this condition found and corrected. If this is not done the new points will also burn and pit in a short time.

Adjust ignition timing as follows:

1. Adjust breaker point gap.
2. Connect power timing light.
3. Loosen distributor clamp screw and rotate distributor until power timing light shows that pointer is at 6° BTDC (4 cylinder engine) or 5° BTDC (V-8 engine) mark on harmonic balancer. Tighten distributor clamp screw to 15-20 lb. ft. torque.

IGNITION AND STARTING SWITCH

The ignition and starting switch is key-operated to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch has four positions, "Off" when the key is straight up and down, "Accessory" when turned to the left, "On" when turned to the right until spring pressure is felt, and "Start" when turned fully to the right against spring pressure.

With the switch in either the "Accessory" or "On" positions the following electrical circuits are activated: stop lights, air conditioning, directional signals, parking brake warning light, radio, back-up lights, heater and defroster and electric windshield wiper. In the "On" position the ignition primary circuit is activated through the resistance.

There are six terminals on the back of the switch. The terminal marked "Bat" is connected to the battery and supplies the power to the switch. The accessory terminal supplies power to the accessories when the switch is in the "Acc" or running positions. The "Sol" terminal supplies power to the solenoid to activate the starter in the start position. The terminal marked "Ground" completes the test circuit for the temperature "Hot" indicator bulb when the switch is turned to the start position.

These circuits are all cut off when the ignition switch is in the "Off" or "Start" positions.

When the ignition switch is turned to the start position, the ignition primary circuit is activated directly, by-passing the resistance, and the starting motor circuit is activated to crank the engine.

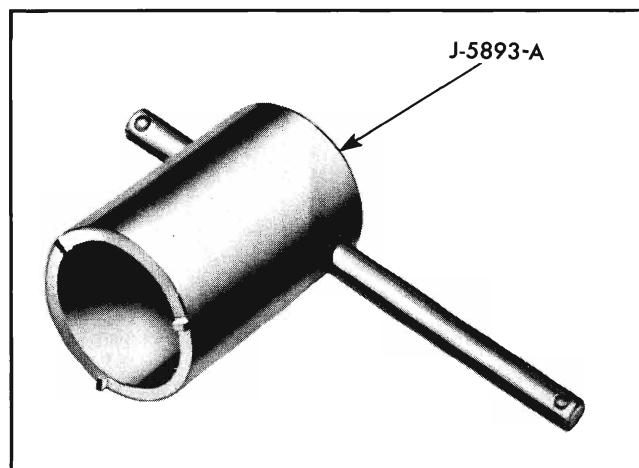


Fig. 11-65 Ignition Switch Ferrule Spanner

Two ignition terminals, marked "Ign-1" and "Ign-2", will be found on the back of the switch. The "Ign-1" terminal is energized when the ignition switch is in the normal operating position. It directs current to the ignition coil through the resistance. The "Ign-2" position is energized when the ignition switch is turned to the starting position. It directs current to the coil around the resistance to provide full battery voltage to the coil when starting.

REPLACE SWITCH

1. Remove positive cable from battery to protect against short circuit.
2. Remove ignition switch ferrule by unscrewing with special spanner J-5893-A (Fig. 11-65).
3. Remove switch from back of instrument panel and disconnect wires.
4. Replace switch by reversing above steps.

REPLACE SWITCH LOCK CYLINDER

1. Place ignition key in lock and depress lock plunger by inserting small pin through hole in lock cap.
2. While holding plunger in, turn key approximately 20° counterclockwise to release lock cylinder and remove cylinder from switch.
3. To install lock cylinder, insert key in cylinder. Then, with key and cylinder turned about 20° counterclockwise, insert cylinder in lock and rotate clockwise to lock in place.

FREE UP LOCK

Occasionally an ignition lock may stick, making it difficult to insert key and turn lock. In such case, blow a very small quantity of powdered graphite into the lock key hole and operate lock several times to free up.

IGNITION SYSTEM TROUBLE DIAGNOSIS

QUICK CHECKS

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 $\frac{1}{4}$ inch from the engine.

2. The engine starts but immediately stops when the ignition switch is released from the "Start" position.

If these checks indicate trouble in the ignition system, follow the procedure outlined below. This procedure may also be helpful in locating trouble in the ignition system if the car runs, but not satisfactorily.

DIAGNOSIS PROCEDURE

If the checks outlined above indicate that the ignition system is at fault, the following checks may be made to help locate the difficulty. All checks are to be made with the lights and accessories off and in the sequence shown. Voltage readings referred to are indicated in Fig. 11-66.

If these checks fail to find cause of trouble—remove distributor, coil, and resistance wire from engine and check to specifications. Also check wiring harness.

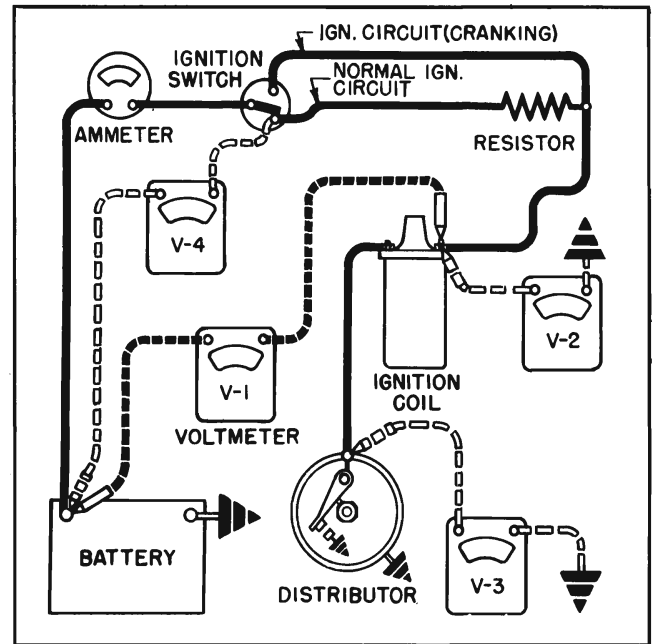


Fig. 11-66 Testing Diagram for Ignition Circuit

OPERATION	SPECIFICATION	POSSIBLE TROUBLE
Check all connections in primary and secondary circuit.		
Remove secondary coil lead from distributor cap. Hold $\frac{1}{4}$ inch from engine while cranking, and observe if spark occurs.		<p>If spark occurs:</p> <ul style="list-style-type: none"> Distributor cap. Rotor. Spark plug wiring.
Check Voltage V_1 while cranking.	1 Volt Max.	<ul style="list-style-type: none"> Open circuit from battery side of coil to solenoid switch. Solenoid switch not closing ignition circuit. Ground in circuit from coil terminal to solenoid switch. Ground in coil.
Check Voltage V_2 ignition switch "On", points open.	Normal Battery Voltage.	<ul style="list-style-type: none"> Low battery. Points not open. Ground in circuit from coil to distributor. Ground in distributor. Ground in coil. Ground in circuit from coil to solenoid switch or to resistor.

OPERATION	SPECIFICATION	POSSIBLE TROUBLE
Check Voltage V_2 ignition switch "On", points closed.	5 to 7 Volts.	<p>If over 7 volts check following:</p> <ul style="list-style-type: none"> Contacts not closed. Loose connection in distributor. Distributor not grounded to engine. Faulty contacts. Loose connection between coil and distributor. Resistance out of circuit due to shorted or incorrect wiring. Solenoid switch contacts stay closed. Wire resistor has too little resistance. Coil primary is open. <p>If under 5 volts, check following:</p> <ul style="list-style-type: none"> Loose connections between battery and resistor. Loose connections between resistor and coil. Resistor open or has excessive resistance.
Check Voltage V_3 ignition switch "On", points closed.	0.2 Volts Max.	<ul style="list-style-type: none"> Contacts not closed. Loose connection in distributor. Distributor not grounded to engine. Faulty contacts—if faulty, recheck voltage V_2, ignition switch on, points closed.
Check Voltage V_4 ignition switch "On", points closed.	0.7 Volts Max.	<ul style="list-style-type: none"> Loose connection from wire resistor through ignition switch circuit to battery.

LIGHTING, HORN, AND ACCESSORY POWER CIRCUITS

DESCRIPTION

FUSE BLOCK

The fuse block (Fig. 11-67) has replaceable fuse clips which are serviced separately. An efficient tool for fuse clip removal can be made from a cotter pin approximately $2\frac{1}{2}$ inches long. Cut off long leg even with short leg. File a bevel on the outside of both legs. Spread the pin wide enough to span the fuse clip.

To remove fuse clip, insert cotter pin over center of fuse clip (Fig. 11-68) and push in to disengage

locking ears on both sides of clip. Continue pushing after ears disengage and fuse clip will come out through fuse block.

NOTE: Fuse and light applications can be found in the specification tables at the end of this section.

WIRING HARNESS

The wiring harness routing has clip retainers to reduce the possibility of damage to the harness. Particular attention should be given toward making sure that the wiring is not pinched, stretched, or positioned

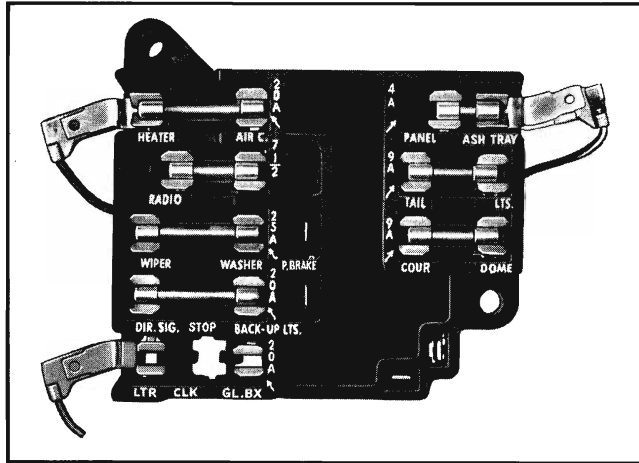


Fig. 11-67 Fuse Block

so as to contact any movable parts under the instrument panel. This includes the hand brake, foot brake, ash trays, accelerator linkage or the heater linkage. In the engine compartment the following routing should be checked: wires to generator, wires in clip retainer opposite carburetor choke heat tube, around regulator, horn relay, battery, starter solenoid, large dash clips, and the large dash grommet.

WIRING CONNECTORS

Wiring connectors have a locking design to insure a tight fit and to prevent them from separating.

NOTE: When servicing the connector, insert a thin bladed screwdriver between the male and female section to unlock the assembly before pulling it apart.

LIGHTING

The headlight system consists of two dual headlight units mounted in a horizontal arrangement on each side of the car. In this installation the outboard light is a dual filament seal beam unit. The inboard unit contains a single filament and is used as the primary source of light for the high beam.

When driving with low beam only the low beam filament of the outboard lights is used. On high beam all four lights are used.

Lighting is controlled by two switches. First, the instrument panel main lighting switch which has two "on" positions or notches, the first for parking, tail and license lights, and the extreme out position for the headlights, tail and license lights. Rotating the lighting switch knob operates a rheostat for dimming the instrument panel lights; with the rheostat in the extreme counterclockwise position the instrument

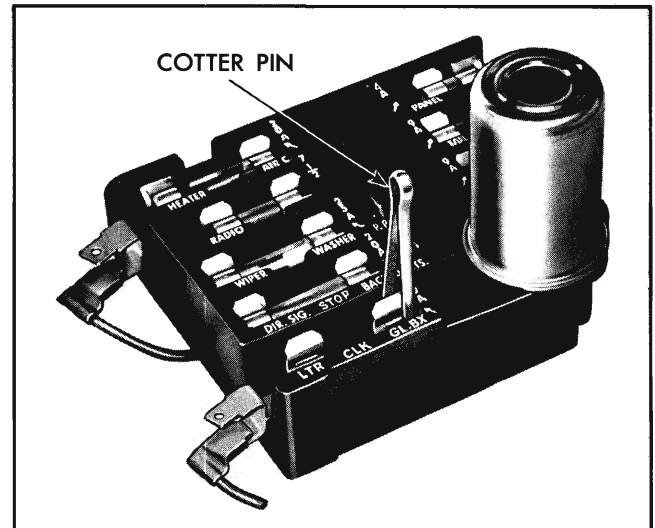


Fig. 11-68 Removing Fuse Clip

panel lights are completely off and the dome light is turned on. Second, the headlight beam switch (foot operated) determines if the headlight country (bright) beam or traffic (dim) beam is on when the main lighting switch is pulled out. A red indicator lamp on the speedometer shows when the headlight country beam is on.

Parking lights use a two filament bulb. One filament is for the directional signal and the other is for the parking light.

Headlights are of sealed beam construction so that the light source, reflector, lens, and lens gasket are all assembled in one sealed unit. When the filament burns out or the lens is cracked or broken, the entire unit is readily replaceable with a new unit.

The filaments used in the twelve volt headlights are very fragile. Therefore, these headlight units must be handled carefully.

HEADLIGHT AIMING

Preparation of car for aiming operation includes:

1. Make sure car is in good horizontal and vertical alignment with aiming test equipment.
2. Jounce car to equalize suspension.
3. Make sure the aiming is performed with car at curb height (see Section 3).
4. Tires should be inflated uniformly to recommended pressure (see Section 3A).

Aiming screen data is contained in Fig. 11-69. When aiming upper beam the pattern of only the inboard upper beam units is to be used.

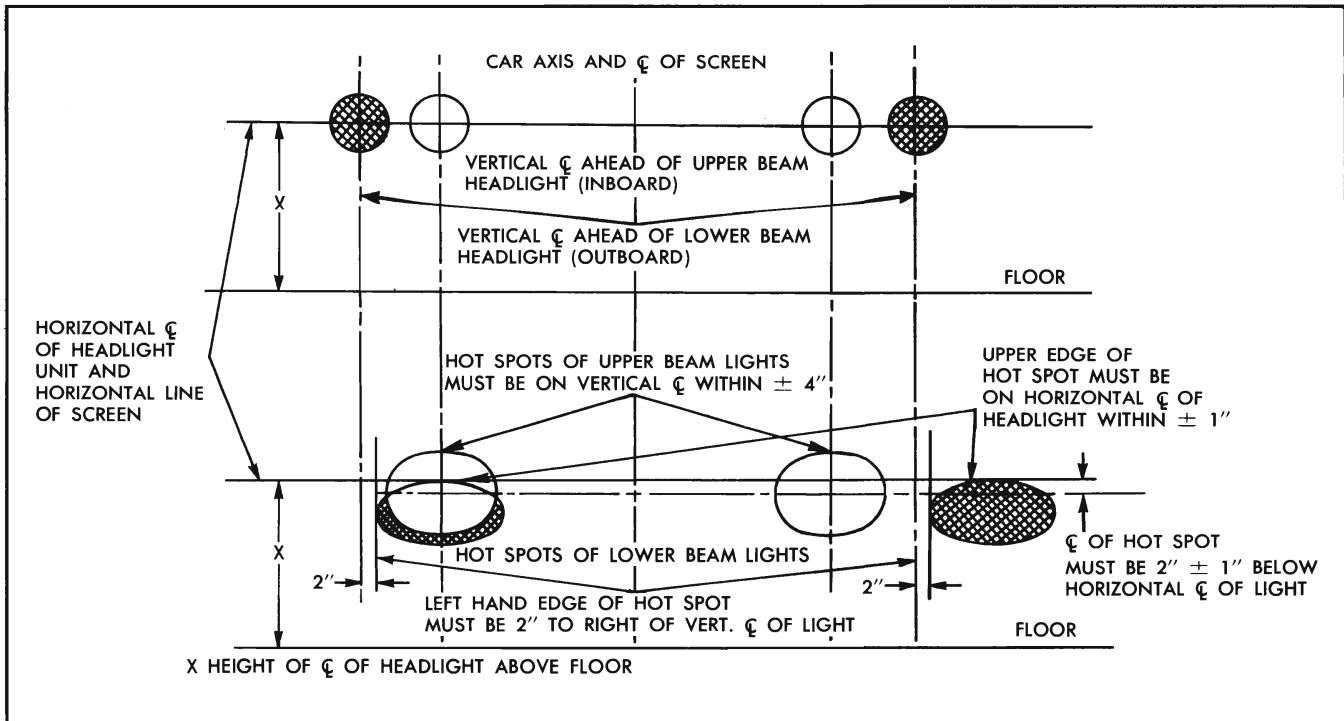


Fig. 11-69 Headlight Aiming Screen Chart

The hot spot of each light shall have relationship to the vertical and horizontal center line of the individual light unit within the limits and conditions shown in Fig. 11-69 at a distance of 25 feet.

TAIL LIGHT

The tail light bulb is a double filament bulb which acts as a stop light, tail light and turn signal light. The bulb can be removed from the inside of the trunk.

STOP LIGHT SWITCH

The stop light switch must be checked whenever the brake pedal height has been changed. Adjustment is made by positioning the switch and bracket in relation to the pedal arm.

NOTE: Make sure that the switch does not restrict pedal action.

HORNS

The two horns used on the car are designed to give a blended tone when operated together. Each of these horns uses a solenoid actuated diaphragm to develop a resonating air column in the horn projector.

A relay is used in the horn circuit because of the

high current required to operate horns. The relay reduces the length of heavy gauge wire required and makes a more direct connection between the horns and the battery. Consequently, higher voltage is available at the horns and better performance is obtained by eliminating the voltage drop which otherwise would be in the horn button wiring circuit.

CIGAR LIGHTER

The cigar lighter releases automatically (usual time for release is 10 to 14 seconds) which means that if the plug assembly for some reason is held in by the operator's hand a sufficient length of time (60 to 90 seconds), the fuse will blow or circuit breaker contact button will release. This may in some cases account for a blown fuse or released circuit breaker contact button where none of the other parts of the lighters are defective.

If temperature of the element shows indications of incorrect timing (too hot or too cold), the socket assembly containing the bi-metal hold-in fingers must be replaced.

The lighters have a safety feature in the form of two retaining fingers, which prevent the knob and element assembly from falling out or popping out of the socket onto the floor. If these fingers do not keep

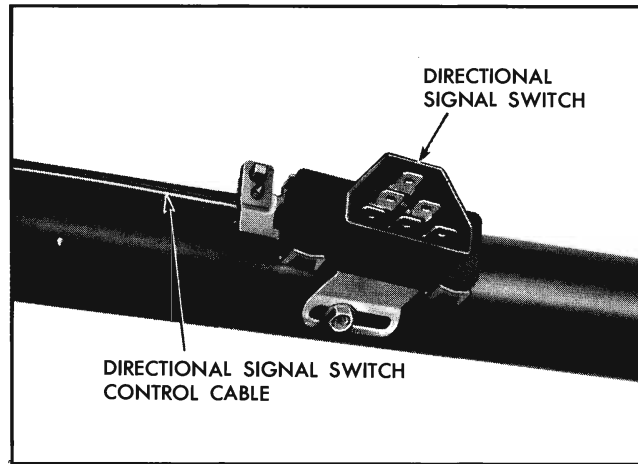


Fig. 11-70 Directional Signal Switch

the knob and element assembly from falling out onto floor, the socket assembly should be replaced.

DIRECTIONAL SIGNAL

The directional signal circuit consists of the switch, flasher, one light in the instrument cluster, the stop light filaments in the rear lights, and the turn signal filaments in the parking lights.

The electrical switch is mounted on the steering column jacket just below the steering column to instrument panel bracket (Fig. 11-70). It is actuated by a rod running to the inside of the directional signal housing.

The flasher, which is mounted on the fuse block, consists of two sets of points, a coil, and resistor. One

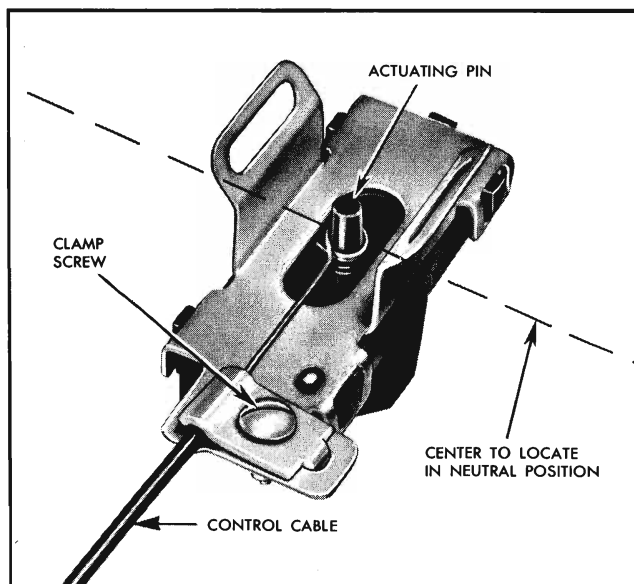


Fig. 11-71 Control Cable Wire

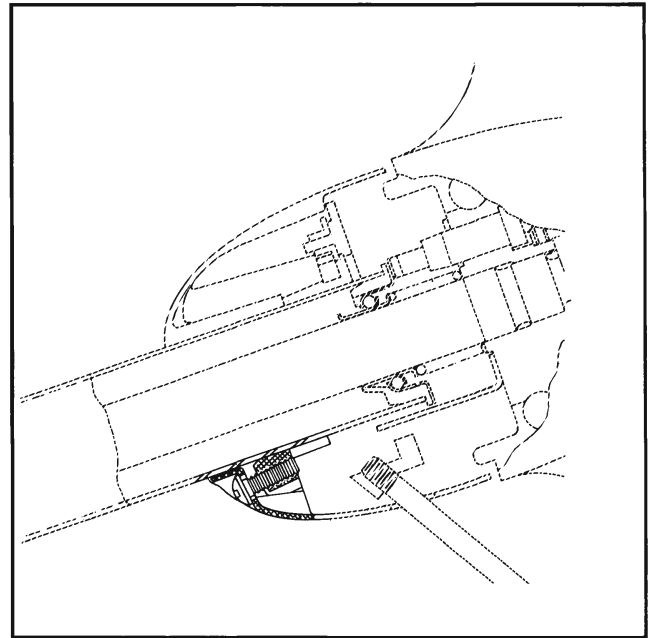


Fig. 11-72 Directional Signal Housing to Steering Column Securing Screw

set of points controls the flashing of the instrument panel light and the other set controls the flashing of the front and rear lights. The frequency of the turn signal is 80 to 100 flashes per minute.

SERVICE OPERATIONS

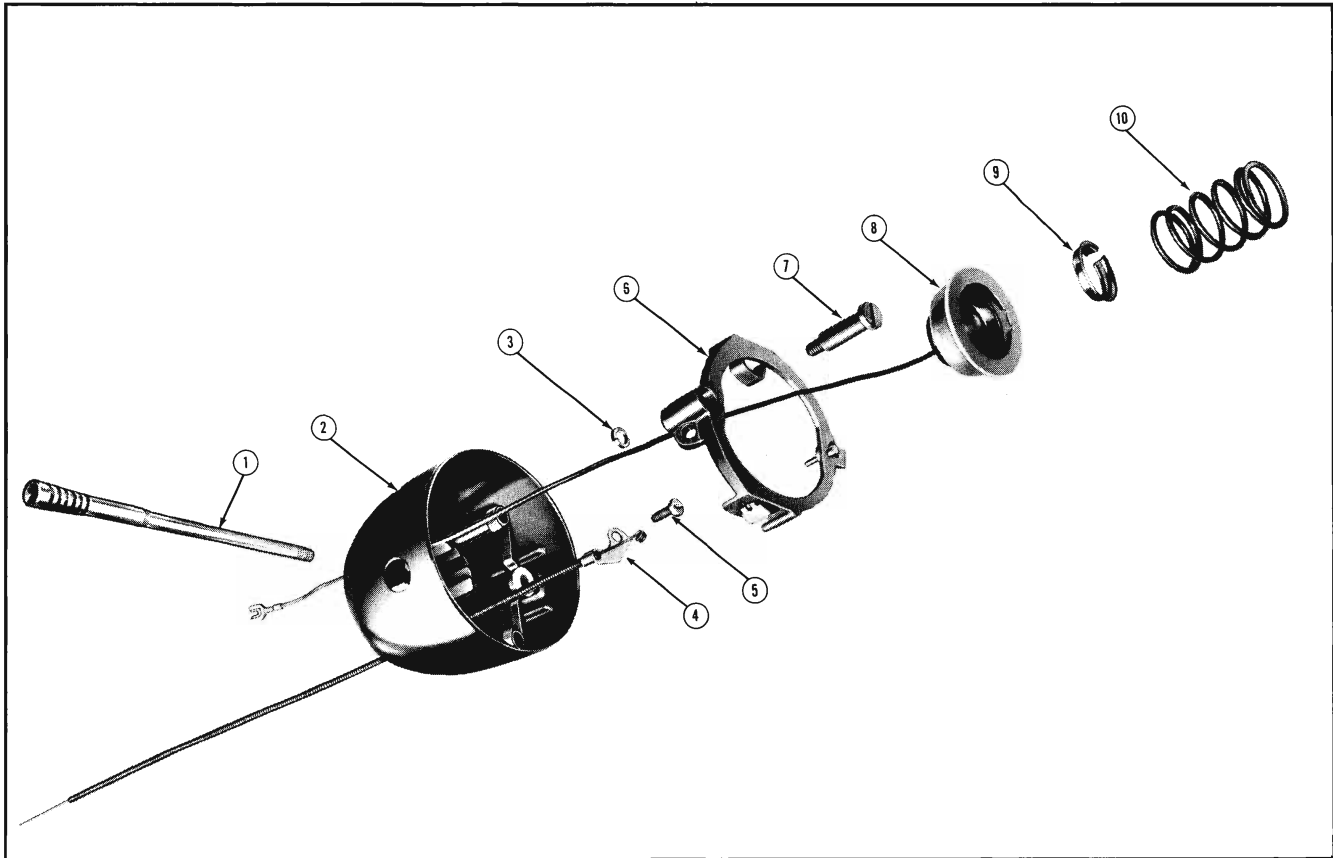
DIRECTIONAL SIGNAL

REMOVE

1. Remove steering wheel as outlined in Section 9.
2. Disconnect horn wire at connector.
3. Remove directional signal switch from steering column jacket.
4. Loosen screw and remove control cable assembly from switch (Fig. 11-71).
5. Loosen screw securing directional signal housing to steering column jacket and remove housing from steering jacket (Fig. 11-72).
6. To remove control cable from housing, remove screw as shown in Fig. 11-73.

INSTALL

1. Install directional signal housing on steering column.
2. Install steering wheel as outlined in Section 9.
3. Position directional signal housing as shown in



1. Control Lever
2. Housing

3. Lock Washer
4. Control Cable

5. Screw
6. Yoke

7. Bolt
8. Upper Bearing and Horn Contact

9. Spring Seat
10. Spring

Fig. 11-73 Directional Signal Control—Exploded View

Fig. 11-74 and tighten screw which secures housing to steering column jacket (Fig. 11-72).

4. Hook control cable wire over actuating pin on switch.

5. Place control lever in neutral position.

6. Move carrier in switch to neutral position (Fig. 11-71).

7. Lock cable by tightening conduit clamp screw.

NOTE: The ability of this screw to tighten the clamp depends on the angular direction the screw takes when initially driven. If the screw head bearing is toward the clamp hinge, it will probably not hold the control cable housing. This definitely affects switch adjustment.

When the clamp does not hold the cable, with the screw properly tightened, the clamp should be bent to close the normal gap.

8. Holding switch in normal location on steering column jacket, start the two switch mounting screws.

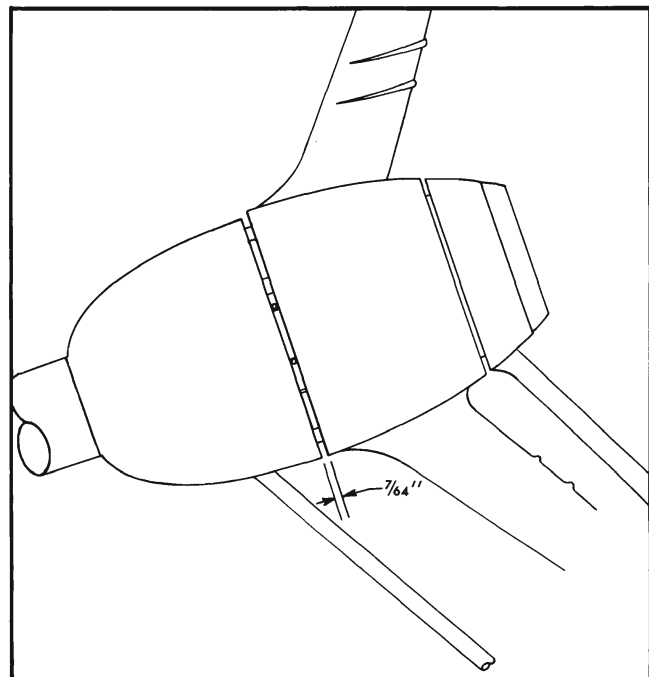


Fig. 11-74 Position for Directional Signal Housing

9. Recheck to make certain that lever and switch are still in neutral, and tighten the two switch mounting screws.

NOTE: Switch base has slotted holes.

10. Connect horn wire at connector.

DIRECTIONAL SIGNAL WIRING

Direction signal schematic wiring diagram is shown in Fig. 11-1.

REPLACE SEALED BEAM UNIT

1. Remove headlight door.
2. Remove retaining ring and sealed beam unit from mounting.
3. Pull connector from rear of beam unit and separate sealed beam unit from retaining ring and mounting ring.
4. Assemble new sealed beam unit into mounting ring and retaining ring and plug sealed beam unit into connector.
5. Install beam unit and retaining ring.
6. Check headlight aiming and readjust if necessary.
7. If headlight door rubber seal is defective, remove seal and cement new seal securely to door.
8. Replace headlight door.

REPLACE LIGHT SWITCH

1. Remove one battery cable from battery post.
2. Pull switch knob to headlight "On" position,

push latch button on bottom of switch assembly and pull out switch knob assembly.

3. Unscrew ferrule and remove switch assembly.
4. Remove "push-on" connectors from light switch and connect to new switch.
5. Position new switch in instrument panel, and start ferrule into switch assembly. Tighten securely.
6. Insert knob assembly into switch assembly until end of rod engages catch.
7. Install cable on battery post.

CIGAR LIGHTER

REPLACE ELEMENT

Unscrew element and shield assembly from knob and install new element.

REPLACE LIGHTER SOCKET

1. Remove wire connector from rear of lighter socket.
2. Use 1" deep socket to loosen clamping shell. Unscrew lighter socket and remove socket from instrument panel.
3. To install, reverse above procedure, seeing that clamping shell is turned up *finger tight only* on lighter socket.

TROUBLE DIAGNOSIS

Troubles in the lighting and accessory power circuits are caused by loose connections, open or shorted wiring, or blown fuses. In each case trouble diagnosis requires following through the circuit until the source of difficulty is found. To aid in making an orderly point-to-point check, refer to the schematic wiring diagram (Fig. 11-1 and 11-2).

CAUSE	REMEDY
STOP LIGHT INOPERATIVE	
Improperly centered directional signal switch.	Center directional signal switch.
DIRECTIONAL SIGNAL FAILS TO OPERATE	
Blown Fuse.	Replace Fuse.
Defective flasher unit.	Replace flasher unit.
Loose connection circuit.	Check and tighten connections.
Failure of directional signal in left or right parking light or stop light.	Replace light.

CAUSE	REMEDY
INDICATOR LIGHT FLASHES EXTREMELY FAST	
Loose connections in circuit.	Check and tighten connections.
Failure of parking light.	Replace parking light.
Failure of stop light.	Replace stop light.
HORNS WILL NOT OPERATE	
<p>NOTE: To locate the trouble, connect a jumper lead to the first and last terminals of the relay (terminal numbers are stamped on the relay base). If the horn blows, the trouble is in the relay, horn button, or wiring. To determine whether the relay, horn button, or wiring is at fault, ground the No. 2 terminal of the relay. If the horn blows, the horn button or wiring is at fault. If the horn does not blow and the wiring between the battery and relay is not defective, connect a voltmeter between the horn terminal and the horn mounting nut. Again connect the jumper lead to the first and last terminals of the relay and note the voltmeter reading.</p>	
<p>If no voltmeter reading is obtained, the wiring between the relay and horn is open or the horn is not grounded. If the voltmeter reading is less than 7.0 volts, the trouble is due to high resistance connections in the wiring or a faulty horn. If the voltmeter reading is above 7.0 volts, the trouble is due to faulty horn.</p>	
Loose connections in circuit.	Check and tighten connections.
Defective horn switch.	Replace defective parts.
Defective horn relay.	Replace relay.
Defects within horn.	Replace horn.
HORNS HAVE POOR TONE	
Low available voltage at horn.	Check battery and charging circuit.
Defects within horn.	<p>Although the horn should blow at any voltage above 7.0 volts, a weak or poor tone may occur at operating voltages below 11.00 volts. If the horn has a weak or poor tone at an operating voltage of 11.00 volts or higher, remove the horn and replace.</p>
HORNS OPERATE INTERMITTENTLY	
Loose or intermittent connections in horn relay or horn circuit.	Check and tighten connections.
Defective horn switch.	Remove button or ring and replace defective parts.
Defective relay.	Replace relay.
Defects within horn.	Replace horn.

INSTRUMENTS

DESCRIPTION

Instruments consist of a fuel gauge, temperature indicator light (thermo-gauge), charge indicator light, oil pressure indicator light, and speedometer. Authorized service on the instruments can be obtained through branches of United Motors Service Division and AC Service Stations. However, knowledge of instrument circuit checks helps to determine if operating difficulties lie in the instrument itself or in its allied circuit.

FUEL GAUGE

An electric fuel gauge is used on all models. The fuel gauge indicates the quantity of gasoline in the tank only when the ignition switch is turned on or to the accessory position. When the ignition is turned off or to start the pointer may come to rest at any position. The letters "E" and "F" on the fuel gauge are used to point our direction of indicator travel only. Gauge readings are made from five markings on the gauge face. The left hand line indicates empty, the center line half-full and the right hand line full. The dash unit of this instrument consists principally of two coils spaced 90° apart, with an armature and pointer assembly mounted at the intersection of the center lines of the two coil end pieces (Fig. 11-75). Silicone liquid in the armature bearing prevents vibration of the pointer on rough roads. One end of the left coil is connected to the left gauge terminal which is connected directly to the battery (through the ignition switch). The other end of the left coil and one end of the right coil are connected to the right gauge terminal which is connected directly to a rheostat which is the fuel gauge tank unit. The other end of the right coil and the tank unit are grounded. The resistance allows more current to flow through the right hand coil as the tank fills up, causing the right hand coil to balance the constant magnetism of the left hand coil, bringing the pointer and armature assembly to rest somewhere between the two coils, the exact position depending on the relative magnetic strength between the two coils. The fuel gauge tank unit consists of a float, with linkage connecting to a movable contact arm and a rheostat. As the float rises, due to filling the tank, the contact arm moves over the rheostat cutting in resistance and allowing more current to flow through the right-hand "full" coil of the panel unit.

TEMPERATURE INDICATOR LIGHT

The engine temperature indicator light is con-

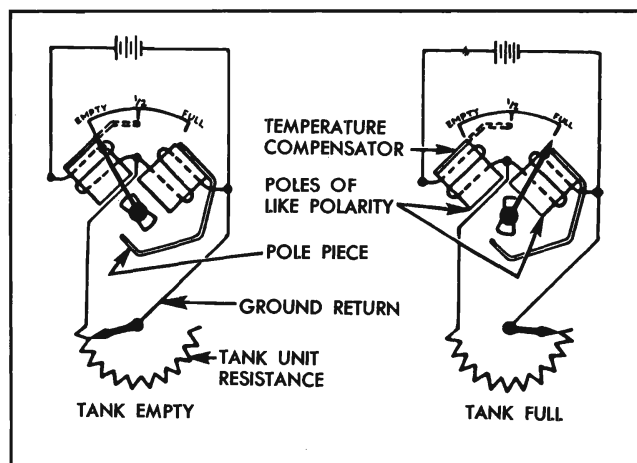


Fig. 11-75 Fuel Gauge Diagram

trolled by a thermal switch which senses coolant temperatures.

When the ignition switch is turned to the "Start" position a test circuit is closed to indicate whether the red light is functioning properly.

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 248°F. The thermal switch does not require servicing. If it's defective, it should be replaced.

CAUTION: Low boiling coolants will not operate light.

GENERATOR WARNING LIGHT

The red generator warning light, located in the instrument panel, should light when the ignition switch is turned on and the engine is not running. If not, either the bulb is burned out, the generator has an open circuit, or the instrument lamp fuse is blown.

When the generator voltage output becomes greater than the battery voltage, the red light should go out. This does not, however, indicate whether the battery is being charged or the regulator is functioning properly. The charging system should be checked if trouble is experienced.

ENGINE OIL PRESSURE LIGHT

The engine oil pressure indicator light is controlled by a pressure operated switch located in the oil filter pad (4 cylinder engine) or oil pump (V-8 engine).

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.

The oil pressure switch breaks contact at 5 ± 1.5 psi on increasing pressure and makes contact at 5 ± 1.5 psi on decreasing pressure.

SPEEDOMETER

The speedometer incorporates a speed indicating mechanism and an odometer to record total mileage. A flexible cable, which enters the speedometer driven gear in the transmission on one end and the speedometer head at the other, rotates both mechanisms whenever the transmission main shaft, propeller shaft and wheels rotate. The speed indicating portion of the speedometer operates on the magnetic principle. In the speedometer head is a permanent magnet which rotates at the same speed as the cable. This magnet exerts a pull on a speed cup causing it to move in direct ratio to the revolving magnet speed. A pointer is attached to the speed cup spindle to indicate speed on the speedometer dial. A finely calibrated hair spring (also part of the speed cup assembly) opposes the magnetic pull on the speed cup so the pointer indicates true speed; it also pulls the cup and pointer to zero when the car stops.

The odometer is driven by a series of gears from a worm gear cut on the magnet shaft. The odometer discs are so geared that as any one disc finishes a complete revolution, the next disc to the left is turned one-tenth of a revolution.

PERIODIC SERVICE

No periodic service or lubrication of instruments (except for the speedometer cable) is required. In fact lubrication of instruments must never be attempted since it will interfere with their satisfactory operation. Never attempt to lubricate the fuel gauge tank unit; adequate lubrication of this unit is provided by splash of the gasoline.

In some cases the speedometer cable becomes noisy or the speed indicator wavers or jerks. This may be due to a dry cable which should be lubricated as outlined in the General Lubrication Section.

REPAIRS

REMOVE INSTRUMENT CLUSTER

1. Disconnect battery.
2. Remove upper two $\frac{1}{4}$ " nuts (Fig. 11-76).

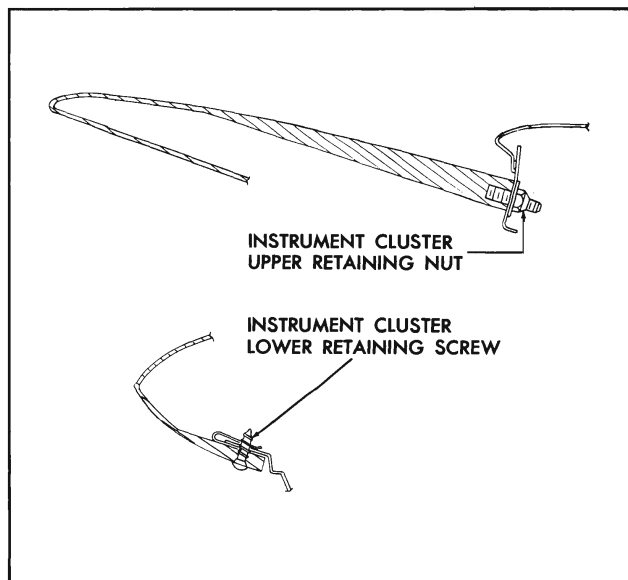


Fig. 11-76 Instrument Panel Cluster Retained

3. Remove four screws at lower edge of instrument cluster housing.
 4. Remove two screws from lower steering column bezel.
 5. Remove speedometer cable.
 6. Pull cluster and housing out from instrument panel opening to gain access to wiring.
- NOTE:** Protect the panel and steering column with a rag or other means to prevent scratching.
7. Starting at the top, remove bulbs and wiring.
 8. Remove four screws retaining cluster to housing.
 9. Remove cluster.
 10. To replace, reverse above procedure.

REMOVE AND REPLACE INDIVIDUAL INSTRUMENT

(Cluster removed from car)

SPEEDOMETER

1. Remove eight screws.
2. Remove screws retaining speedometer head.
3. Replace—reverse steps.

FUEL GAUGE

1. Remove wire connector and bulb (in car operation).

2. Remove two screws.
3. Remove gauge.
4. Replace—reverse steps 1-3.

IGNITION SWITCH

See Page 11-41.

HEATER CONTROL

1. Remove three nuts at rear of panel.
2. Remove Packard connector.
3. Remove light bulb.
4. Remove control cable.
5. Remove heater control assembly.
6. Reverse above procedure to install.

FUEL GAUGE TANK UNIT

See Section 8.

SPEEDOMETER CABLE

1. Disconnect speedometer cable casing from speedometer head.

2. Slide old cable from upper end of casing, or if broken, from both ends of casing.

3. Take a short piece of speedometer cable with a tip to fit the speedometer and insert it in the speedometer socket. Spin the short cable between the fingers in the direction that higher speed is indicated on the speedometer dial and note if there is any tendency to bind. If binding is noted, there is trouble inside the head and the speedometer should be repaired.

4. Inspect cable casing, especially at transmission end, for sharp bends and breaks. If breaks are noted, replace casing.

5. Lubricate cable as outlined in General Lubrication Section.

6. Insert cable into upper end of casing, lower end first.

7. Seat upper cable tip in speedometer and tighten casing connector to speedometer case as tightly as possible with fingers.

NOTE: Insufficient tightening of connector will result in connector loosening, causing speedometer indicator to waver.

8. See that there are no sharp bends in casing.

INSTRUMENT TROUBLE DIAGNOSIS

CAUSE

REMEDY

GASOLINE GAUGE DOES NOT REGISTER WITH IGNITION ON

Break in line between instrument panel unit and ignition switch.

Check line and connections to switch and panel unit.

Defective panel unit.

Check and replace.

GASOLINE GAUGE SHOWS FULL UNDER ALL CONDITIONS

Break in line between tank and instrument panel unit.

Check and repair.

Defective tank unit.

Check and replace.

Tank unit improperly grounded.

Ground tank to chassis and check gauge operation.

GASOLINE GAUGE SHOWS EMPTY UNDER ALL CONDITIONS

Lead to tank unit grounded.

Make necessary repair.

Defective tank unit.

Check and replace.

Defective panel unit.

Check and replace.

CAUSE	REMEDY
SPEEDOMETER	
Noisy Speedometer Cable.	Loosen over-tightened casing nuts and retighten finger tight at both ends.
Pointer and Odometer Inoperative.	Remove kinks from cable. Remove kinks from cable.
Inaccurate Reading.	Replace broken cable. Check for lubricant in speedometer head.
Cable dry.	Check tire size.
Kinked cable.	Check for correct speedometer driven gear.
Defective speedometer head.	Lubricate.
Casing connector loose on speedometer case.	Replace cable. Reroute casing so that bends have no less than 6" radius.
	Replace or have repaired at authorized service station.
	Tighten connector.

INSTRUMENT TESTING

FUEL GAUGE TANK AND INSTRUMENT PANEL UNITS

In order to isolate trouble in the fuel tank or instrument panel unit, use either an extra tank unit, which is known to be good, or commercial gas gauge tester.

CAUTION: *In process of testing fuel gauge panel unit never place full battery current on terminal to which wire to tank is normally attached. To do so will burn out resistance coil in tank unit even though the terminal is touched only momentarily.*

To test, remove lead to tank unit from instrument panel unit and then use one of the following methods:

TESTING WITH EXTRA TANK UNIT

1. Attach a wire lead from the terminal on the extra tank unit to the tank unit terminal on the panel unit and connect a second wire from body of extra tank unit to car chassis.

2. Turn on ignition and move float on extra tank unit to full and empty positions. If panel unit indicates corresponding reading, it is satisfactory and trouble is in tank unit or wire lead from panel unit to tank unit.

3. Check wiring to tank unit by disconnecting

lead from tank unit in car and connecting to test unit. With test unit grounded to chassis, move float to full and empty positions and see that instrument panel unit reads correctly. Incorrect reading indicates defect in wiring.

4. Check tank unit by removing from tank, reconnecting the lead and operating unit in same manner as the test unit (tank unit must be grounded while testing). If instrument panel shows correct reading, trouble was caused by poor connection of lead to tank unit or poor ground. If instrument panel does not give correct reading, install a new tank unit.

TESTING WITH TESTER

The calibration limits of the fuel gauge dash unit are 30 ohms-full, 15 ohms- $\frac{1}{2}$ full and 1 ohm-empty.

1. Remove lead to tank unit from instrument panel unit. Attach wire of tester to the tank unit terminal on panel unit and ground the tester by connecting the black wire to a good ground.

2. Turn on ignition switch and move lever on tester through its full travel. If panel unit reads "empty" and "full", it is satisfactory and trouble is in tank unit or possibly wire lead from instrument panel unit to tank unit.

3. Check wiring to tank by disconnecting lead from tank unit in car and connecting to tester. Ground

tester and move lever on tester through its full travel. If instrument panel unit shows "empty" and "full",

tank unit is probably defective and should be checked as in step 4 above.

ONE SPEED WIPER

DESCRIPTION

The 1962 Model single speed wiper consists of a shunt wound motor, similar to the 1960-61 model, but adapted to a new type gear train. (See Fig. 11-77 for new type gear train.)

The new type gear train consists of helical gear at the end of the armature shaft. The helical gear drives an intermediate gear and pinion assembly, the pinion of which drives an output gear and shaft assembly. The crank arm is attached to the shaft of the output gear. (Fig. 11-77).

An impulse type washer pump, similar in operation to that used on 1961 model, has been adapted to the new type single speed wiper. See washer pump section for detailed explanation.

The circuit breaker previously mounted on the motor brush plate on 1961 model, is eliminated on the 1962 model.

OPERATION

The principle of operation of the 1962 model single speed wiper is the same as the 1961 model. Two

switches, dash and parking are connected in parallel and control the starting and stopping of the wiper. The park switch contacts, which are located in the wiper gear box (Fig. 11-77), are normally closed. The purpose of the parking switch is explained in the following paragraph. (Refer to wiring diagram in Fig. 11-79.)

When the car owner shuts the wiper "off" at the dash switch, the motor circuit to ground is opened at the dash. However, the parking switch contacts, which are normally closed, maintain the motor circuit to ground at the wiper. This allows the wiper to keep operating until the blades or wiper crank arm can reach the park position (Blades approx. 2" above windshield molding). At the same time the blades reach the park position, a cam on the output gear opens the park switch contacts. This opens the motor circuit to ground, stopping the motor. Thus, the parking switch actually controls wiper operation only during that short period of time, between the owner turning the wiper "off" at the dash switch and when the wiper has completely stopped.

Turning the wiper "on" at the dash switch overrides the open park switch contacts and closes the wiper motor circuit to ground starting the wiper. NOTE: Although the park switch contacts are opened once during each revolution of the output gear, the park switch

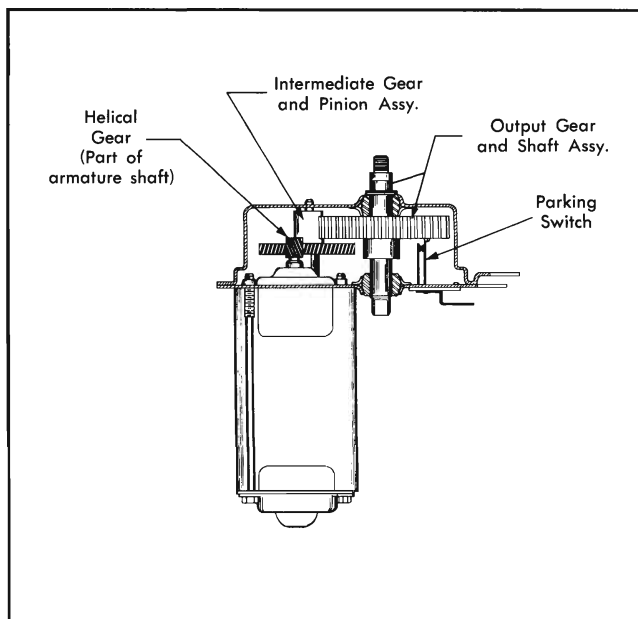


Fig. 11-77 Wiper Gear Train

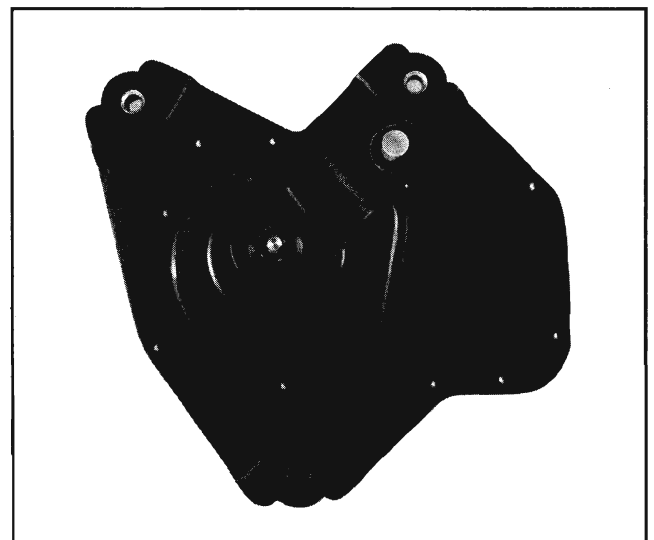


Fig. 11-78 Mounting for Wiper

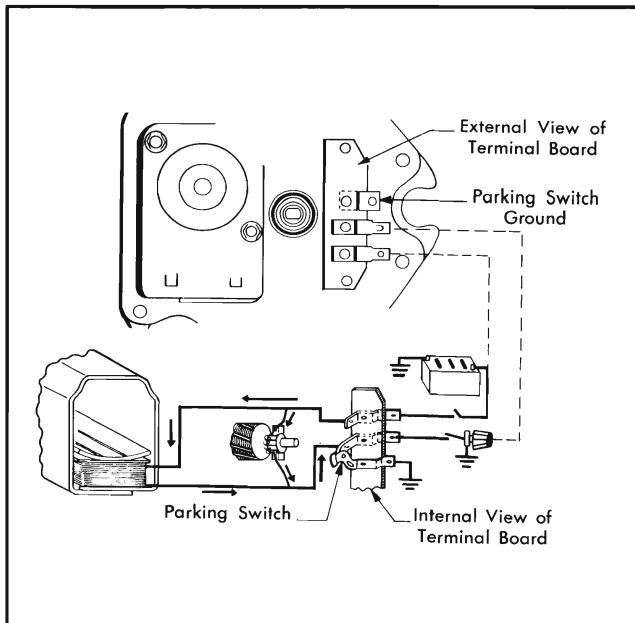


Fig. 11-79 Wiper Wiring Diagram

has no control over the wiper until the dash switch is turned "off."

CONNECTIONS TO OPERATE WIPER

Fig. 11-80 shows the proper method of connecting jumper leads to the wiper so that it can be operated independently of the dash switch or car wiring for test purposes. NOTE: Specification table at end of this section lists current draw data.

WIPER SWITCH—REPLACE (FIG. 11-81)

1. Loosen Allen screw and remove knob.
2. Remove retaining nut securing shaft and escutcheon.
3. Remove switch and disconnect terminals.
4. To install, reverse above procedure.

WIPER TRANSMISSION—REPLACE (FIG. 11-82)

1. Remove arm and blade assemblies.
2. Remove fresh air intake grille.
3. Remove wiper transmission retaining screws.
4. Remove clip securing left wiper transmission crank to linkage which attaches to wiper motor crank.
5. Remove small snap ring securing wiper transmission connecting linkage to right hand transmission crank and remove transmission.

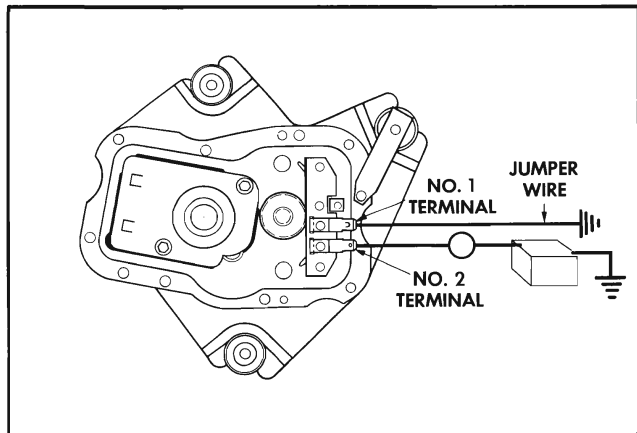


Fig. 11-80 Connections for Test Purposes

6. Drop left hand wiper transmission and invert.
7. Remove snap ring securing wiper transmission connecting linkage to left hand transmission crank.
8. Remove wiper transmission and linkage.
9. To install, reverse above procedure. Make sure wiper blades are in park position after they are installed.

REMOVE WIPER

1. Remove hoses and wire terminals connected to wiper unit.
2. Remove clip securing wiper crank to wiper transmission arm. This connects inside the car at fire wall, under instrument panel.
3. Remove screws securing wiper assembly to fire wall.

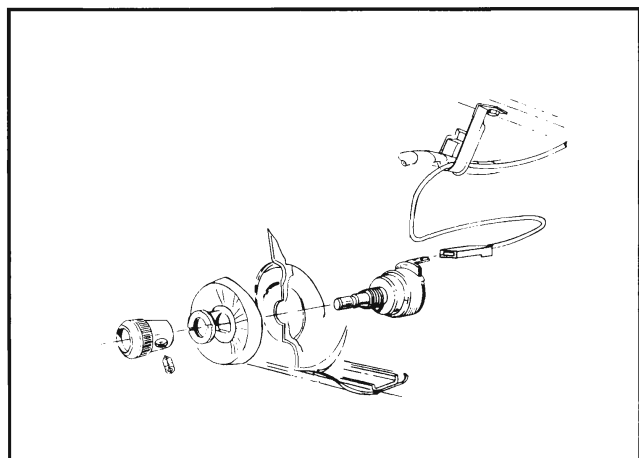


Fig. 11-81 Windshield Wiper Switch

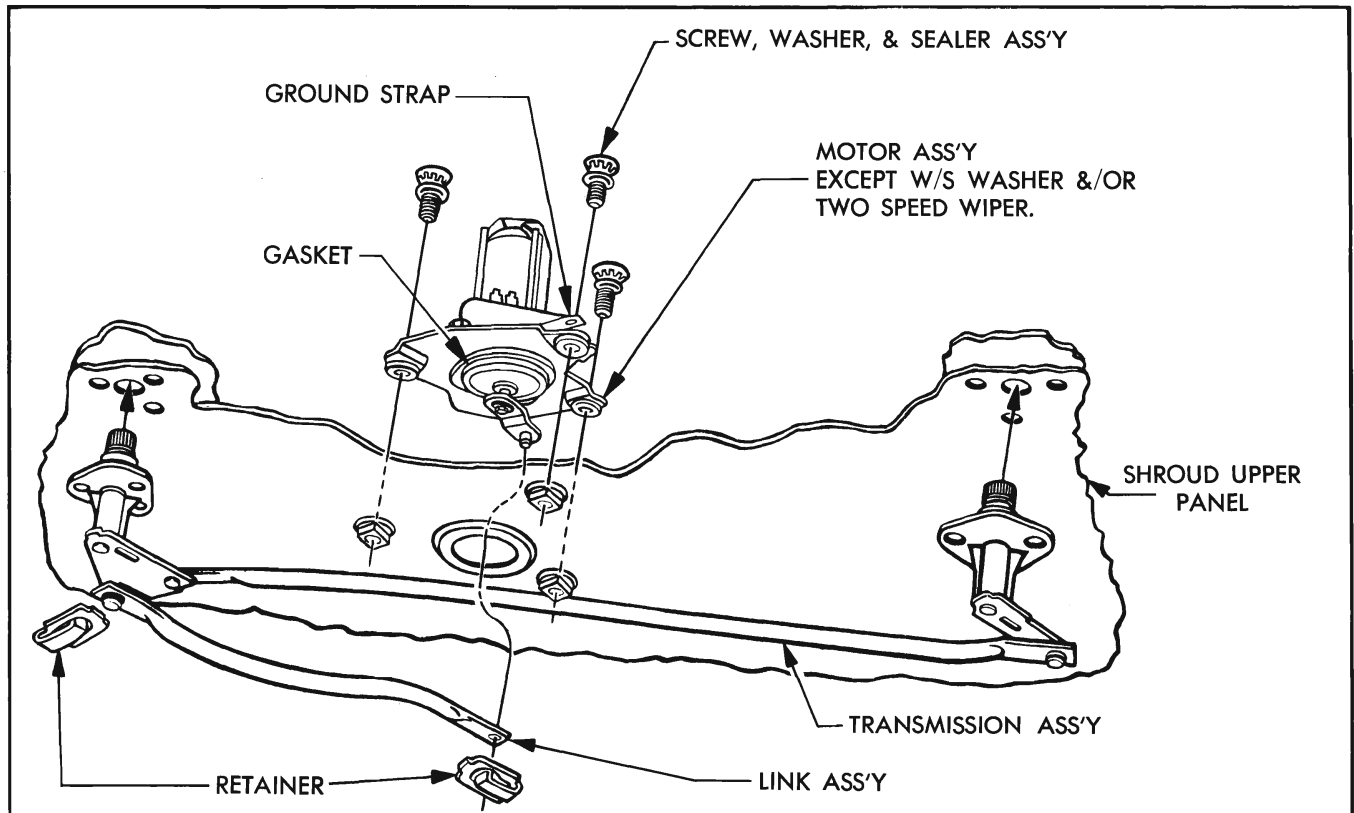


Fig. 11-82 Windshield Wiper Transmission

INSTALL WIPER

1. Make sure gasket is on motor (Fig. 11-82).
2. Install wiper assembly on fire wall and secure.
3. Connect wire terminals and hoses.
4. Connect wiper crank to wiper transmission arm.

TROUBLE DIAGNOSIS

Trouble diagnosis procedures are divided into two categories: (1) Wiper installed in car; (2) Wiper detached from car.

TYPICAL TROUBLE CONDITIONS:

- A. Inoperative
- B. Will not shut off
- C. Intermittent operation
- D. Blades do not return to park position when wiper is turned off.

WIPER INSTALLED IN CAR

WIPER INOPERATIVE – Important: Ignition switch must be on to make electrical tests.

1. Check the following:

- (1) Car wiring harness is properly attached to wiper terminals and dash switch.
- (2) Wiper ground strap properly connected to wiper and car body.
- (3) Dash switch is mounted securely in dash.
- (4) Check fuse.

2. If everything checks out in Step 1 and wiper fails to operate, disconnect wiring harness from wiper and check for 12 volts at harness terminal that connects to wiper terminal No. 2, Fig. 11-80.

No voltage indicates defective car wiring.

CAUTION: Do not connect hot line to No. 1 Terminal.

3. Connect 12 volt supply to No. 2 wiper terminal and connect a jumper wire from terminal No. 1 to ground (Fig. 11-80). If wiper operates, the dash switch or wiring between dash switch and wiper is defective.

4. If wiper fails to operate in Step 3 remove body parts as required to disconnect wiper transmission

from wiper crank arm. Recheck wiper operation as explained in Step 3. If wiper operates correctly, a defective transmission or binding condition exists. If wiper still fails to operate, remove wiper from car and follow instructions under "Wiper Detached From Car."

WIPER WILL NOT SHUT OFF

1. Disconnect wiring from dash switch. If wiper shuts off, a defective dash switch is indicated.

2. If wiper still operates in Step 1, disconnect wiring from wiper and connect 12 volt supply direct to wiper terminal No. 2 (Fig. 11-80). Do Not connect any jumper wire to terminal No. 1.

—Wiper shuts off correctly—check for grounded lead that extends between wiper terminal No. 1 and dash switch.

—Wiper fails to shut off—remove wiper from car and follow instructions under "Wiper Detached From Car."

INTERMITTENT OPERATION

1. Check the following: Loose ground strap, loose dash switch mounting, loose connection.

DO NOT RETURN TO PARK POSITION WHEN WIPER IS TURNED OFF

Remove wiper from car and check for a dirty or broken park switch. (See Fig. 11-77 for park switch location).

WIPER DETACHED FROM CAR

Connect 12 VDC Power source and ammeter to wiper as shown in Fig. 11-80 and observe current draw and wiper operation. NOTE: Identify wiper part number from wiper motor end cap and select proper current draw from specification table.

WIPER INOPERATIVE

—Current Draw—0

1. Check solder connection at terminal board.
2. Disassemble motor section and check all splice connections (Fig. 11-83).

—Current Draw—2-3 amps

Disassemble motor and check for the following items:

- a. Open armature.
- b. Brushes sticking.
- c. Brush springs improperly positioned (See Fig. 11-84).

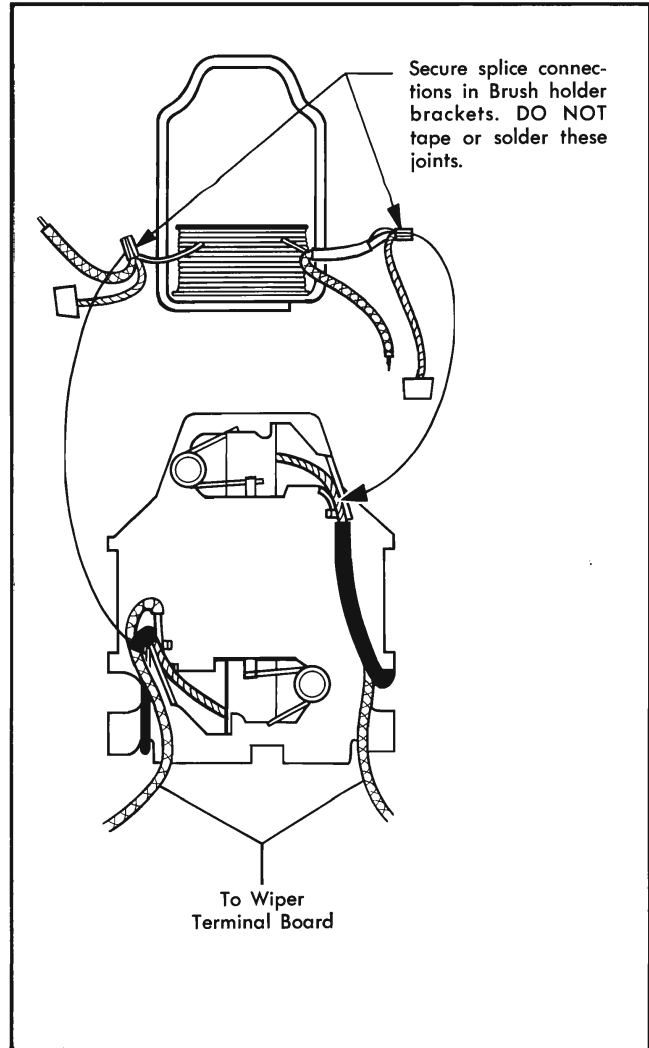


Fig. 11-83 Motor Splice Connections

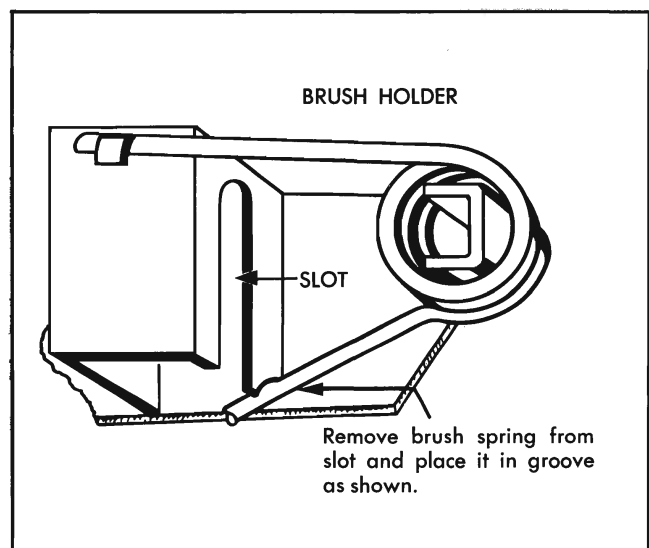


Fig. 11-84 Brush Spring

d. Brush pigtail connections at splice joints (Fig. 11-83).

—Current Draw—10-12 Amps.

1. Check for open shunt field circuit.
2. Check for broken gear.

WIPER RUNS SLOW, VIBRATES AND CURRENT DRAW APPROX. 7-9 AMPS.

1. Check for binds in gear train.
2. Check for shorted armature (armature may be checked on a growler).

WIPER SHUTS OFF BEFORE CRANK ARM REACHES PARK POSITION

Wiper crank arm stops rotating immediately when jumper wire is disconnected from wiper terminal No. 1 (Fig. 11-80). **NOTE:** When crank arm has reached park position the crank arm index grooves will line up approx. with the ridges on the gear box cover.

Check for dirty, broken or bent park switch contacts.

WIPER WILL NOT SHUT OFF

Wiper crank arm fails to stop in park position when jumper wire is removed from wiper Terminal No. 1, Fig. 11-80.

1. Check that park switch contacts are opening.
2. Check for grounded condition in the internal motor lead that connects to terminal No. 1, Fig. 11-80.

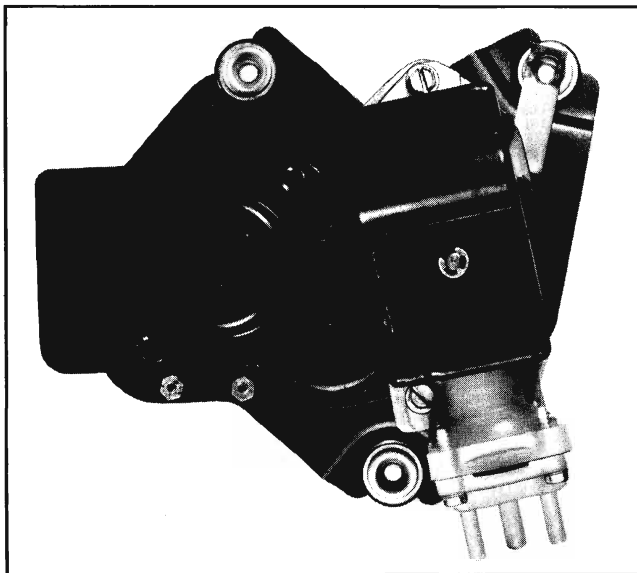


Fig. 11-85 Washer Pump Mounting Screws

ADJUSTMENTS

Armature end play is automatically adjusted by the proper assembly of end play washers. See Fig. 11-88 for proper assembly of end play washers.

GEAR BOX

DISASSEMBLE

(Gear Box disassembly is the same regardless of mounting type).

1. For wipers equipped with a washer pump remove the two washer pump mounting screws (Fig. 11-85) and lift washer pump off wiper.

2. Remove sintered iron washer pump drive gear as required (Fig. 11-86). The gear is pressed on the shaft but can be wedged off by using two screwdrivers between gear and plate.

3. Clamp crank arm in a vise and remove crank arm retaining nut and arm.

4. Drill out the gear box cover retaining rivets and remove cover from gear train.

CAUTION: Mark ground strap location for re-assembly purposes.

NOTE: Screws, nuts and lockwashers for reassembling cover to wiper are contained in a service repair pkg., Part No. 4910591.

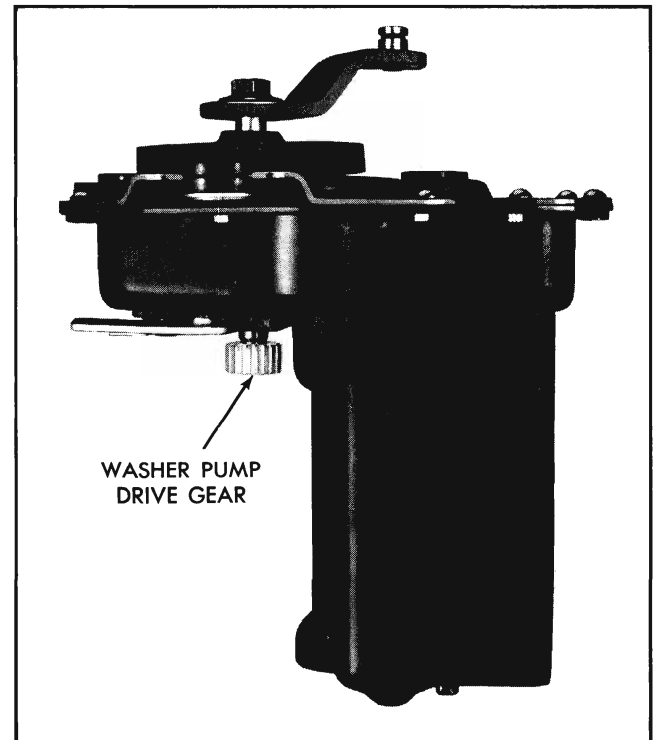


Fig. 11-86 Washer Pump Drive Gear

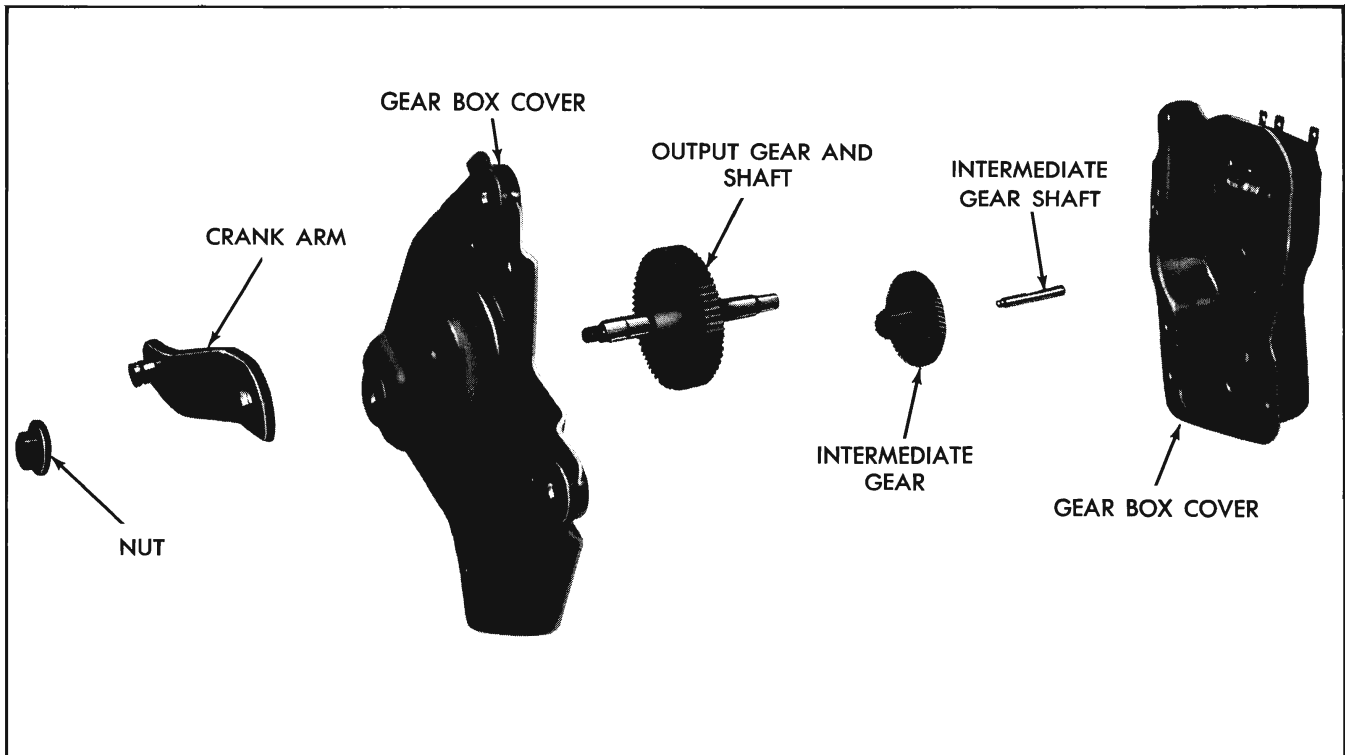


Fig. 11-87 Gear Box Exploded View

5. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft. (Fig. 11-87).

6. Remove terminal board and park switch assembly as follows:

a. Unsolder motor leads from terminals, coding of these leads on 1962 model single speed wipers is not necessary.

b. Drill out rivets that secure terminal board and park switch ground strap to plate.

NOTE: Screws, nuts and washers for attaching a replacement terminal board-park switch assembly are included with the replacement assembly.

ASSEMBLY

Reverse steps 1 thru 7 except as noted:

1. Reassembly of Gear Cover—Be sure cover is located properly over locating dowel pins and be sure to re-install ground strap and gasket.

2. Reassembly of Crank Arm—Operate wiper to park position (Fig. 11-80) and install crank arm on output shaft so that identification marks line up with those in the cover. Clamp crank in vise before securing the retaining nut.

MOTOR SECTION

DISASSEMBLE AND ASSEMBLE

Refer to Fig. 11-89.

1. Follow steps 1 thru 7(a) under gear box disassembly.

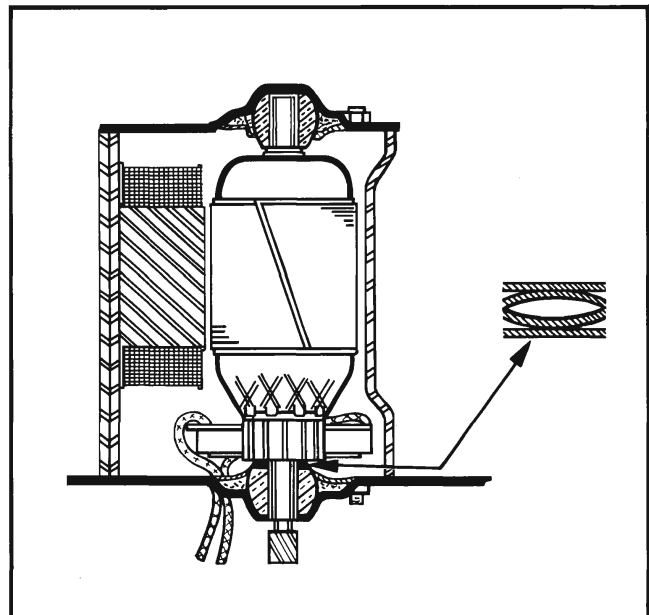


Fig. 11-88 End Play Washers

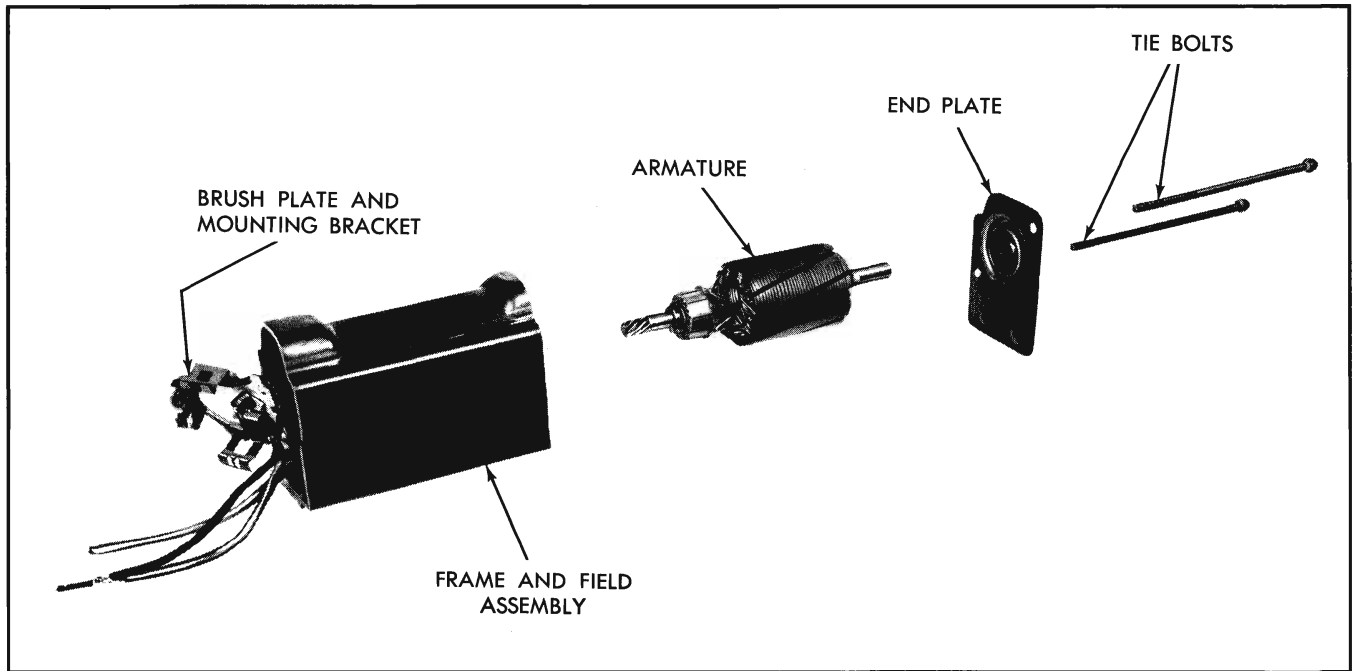


Fig. 11-89 Motor Exploded View

2. Remove tie bolts.
3. Release brush spring pressure against brushes as shown in Fig. 11-84.
4. Move brushes away from armature and slide armature out of frame and field assembly. Pull end cap assembly off armature.
5. Remove end play adjusting washers.

To reassemble motor, reverse steps 1 thru 4 as required.

LUBRICATION

Armature shafts and Bearings:

Light Grade Machine Oil.

Gear Teeth (All):

Delco Cam and Ball Bearing Lubricant.

WIPER SPECIFICATIONS

-Operating Test Voltage	12 VDC
-Crank Arm Rotation (looking at arm)	CCW
-Crank Arm Speed	43RPM
-Current Draw (Amps.)	
No load	3 Max.
Dry windshield	3.5 Max.
Stall	11.0 Max.

TWO SPEED WIPER

GENERAL DESCRIPTION

The 1962 two-speed non depressed park wiper, has been re-designed. The new design consists of a rectangular shaped compound wound motor (series and shunt field) adapted to the same type gear train as that used with the new single speed wiper.

The mounting used for the single speed wiper is used for the 2 speed wiper.

The washer pump used on the new type two-speed

wiper is the same as that used on the new type single speed wiper.

The circuit breaker previously mounted on the brush plate of the past model wipers, has been eliminated.

PRINCIPLE OF OPERATION

The principle of operation is very similar to that of the single speed wiper. A combination pictorial and schematic circuit is shown in Fig. 11-90. An explanation of "LO," "HI" and parking circuits follows:

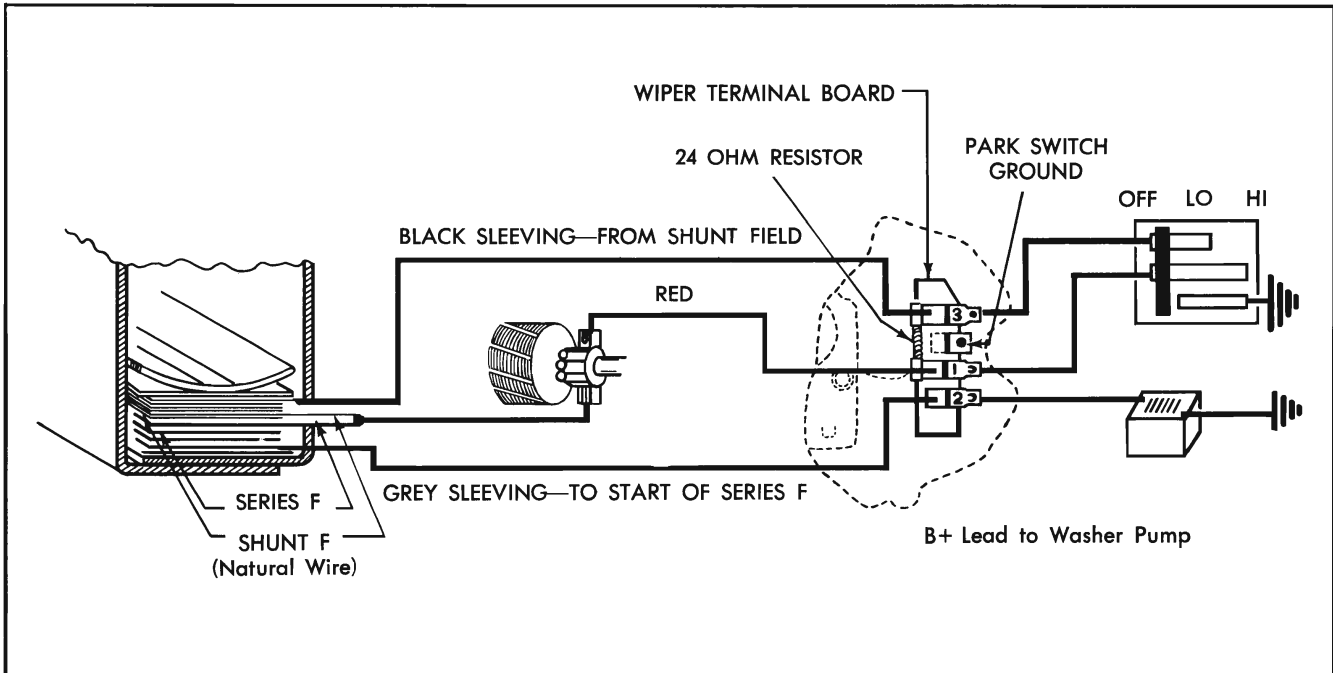


Fig. 11-90 Wiper Wire Schematic

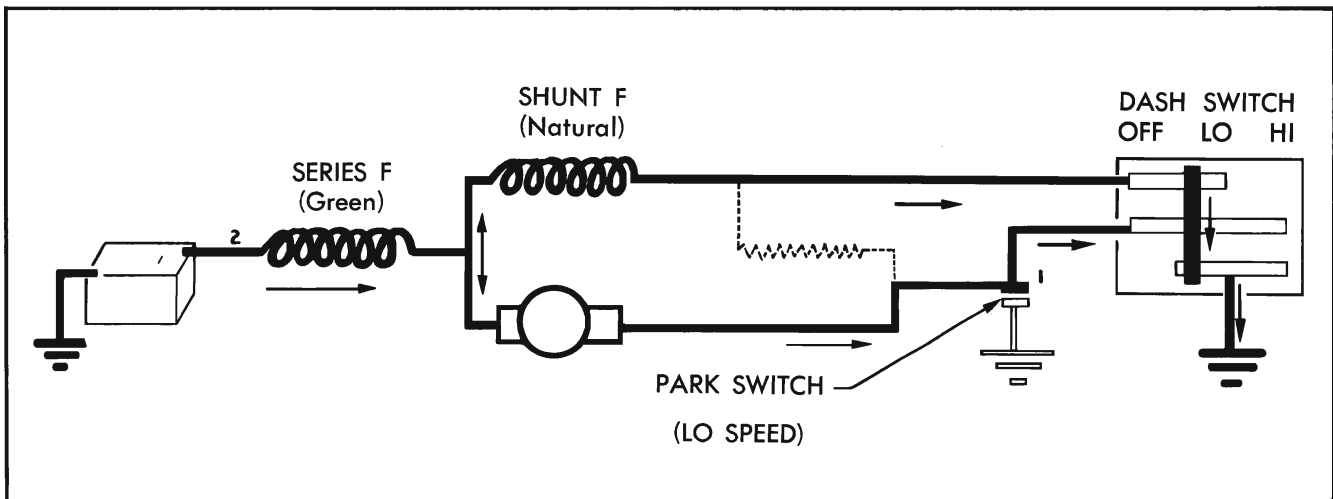


Fig. 11-91 Low Speed Circuit

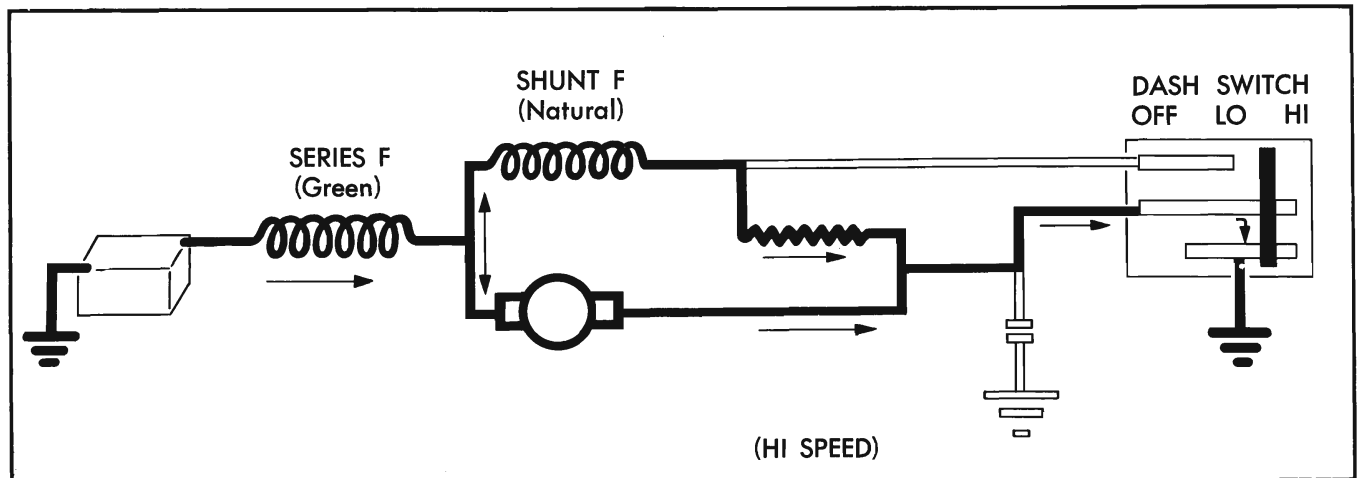


Fig. 11-92 Hi Speed Circuit

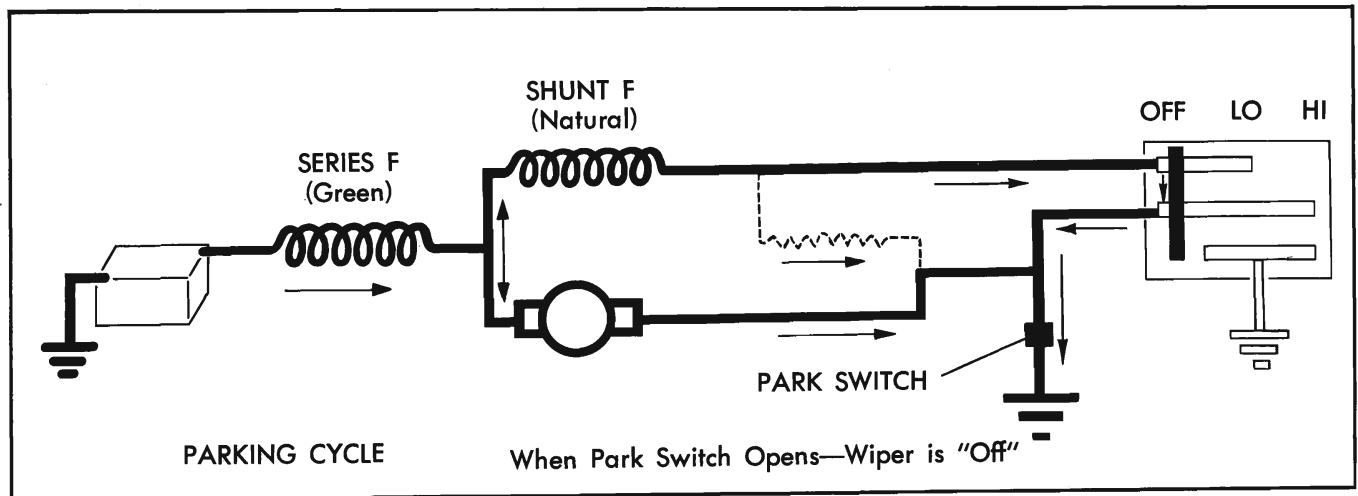


Fig. 11-93 Parking Cycle

LO SPEED—Figure 11-91

When the dash switch is moved to the "LO" speed position (Ign. Sw. On) current from the battery flows through the series field coil and divides; part passing through the shunt field coil to ground at the dash switch, the other part passing through the armature to ground at the dash switch.

HI SPEED—Figure 11-92

Moving the "Dash" switch to the "HI" speed position opens the shunt field circuit to ground at the dash switch and keeps the armature circuit closed to ground. The shunt field current must then pass through a 24 ohm resistor located on the back of the wiper terminal board, and then through the same lead

that connects the armature circuit to ground through the dash switch.

PARKING CIRCUIT—Figure 11-93

Moving the dash switch to the "off" position opens both the armature and shunt field circuits to ground at the dash switch. However, both of these circuits are still closed to ground through the parking switch. (NOTE: The shunt field circuit actually flows via the dash switch back to the wiper parking switch direct to ground which means that wiper is *actually operating in "LO" speed during the parking cycle.*)

When the cam on the wiper output gear opens the park switch contacts, the wiper is "off" and the blades and/or wiper crank arm should be in the park position.

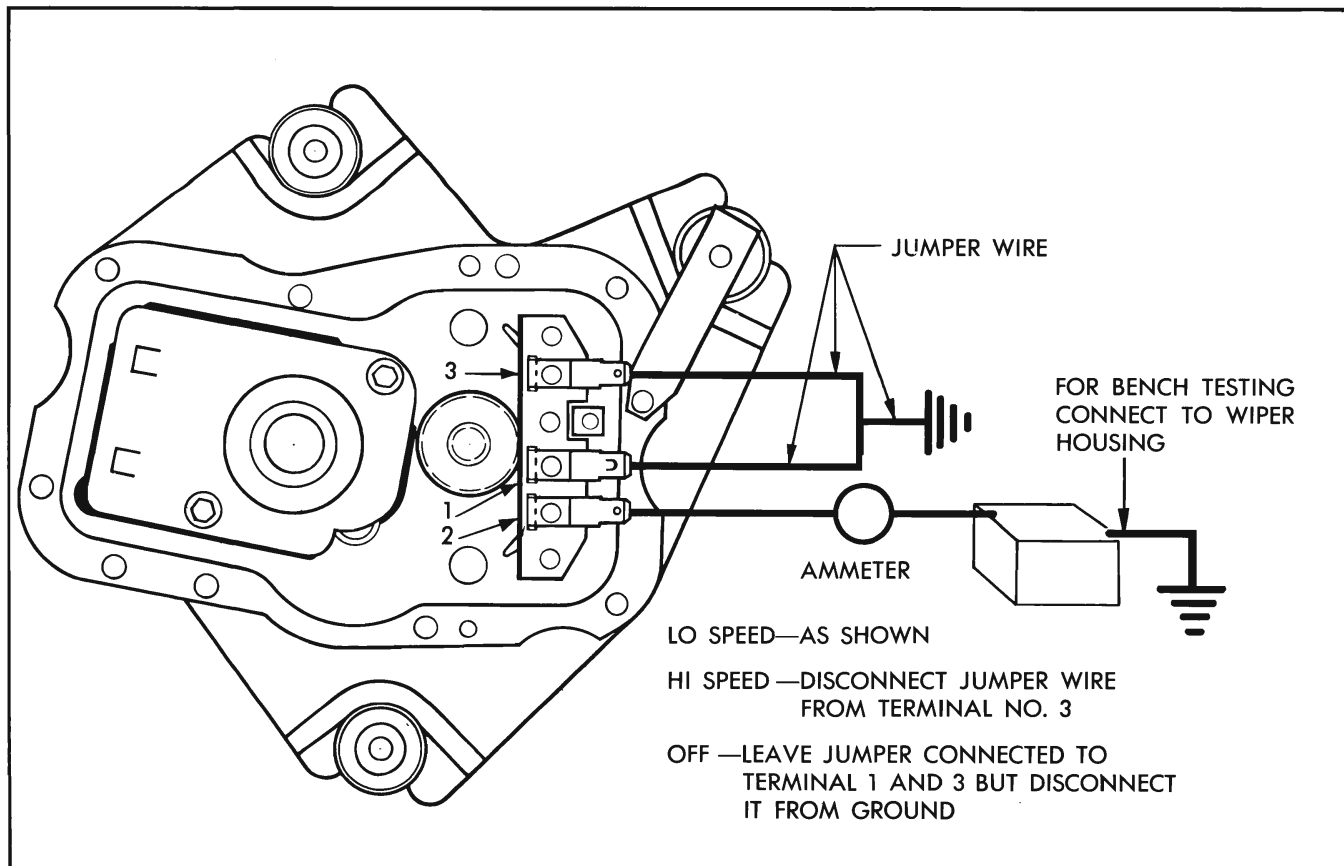


Fig. 11-94 Connections for Testing

CONNECTIONS TO OPERATE WIPER

Fig. 11-94 illustrates the method of connecting leads to the wiper for either bench operation or to run wiper independently of dash switch and car wiring when installed in car.

TROUBLE DIAGNOSIS

Typical Wiper Troubles:

- A. Wiper inoperative.
- B. Wiper will not shut off.
- C. Wiper has one speed *fast*.
- D. Wiper has one speed *slow* and shuts off with Dash Switch in "Hi" speed position.
- E. Blades do not return to park position when wiper is turned "off."
- F. Wiper speed normal in "Lo" but too fast in "Hi."
- G. Intermittent operation.

Trouble diagnosis procedures are divided into two (2) main categories:

- (1) Wiper Installed In Car.
- (2) Wiper Detached From Car.

WIPER INSTALLED IN CAR

WIPER INOPERATIVE

1. Check that wiring harness is properly connected to wiper and dash switch; wiper ground strap is connected securely to car body; and dash switch is securely mounted.

2. With ignition switch on, check for 12 volts at harness terminal that connects to number (2) terminal (Figure 11-94).

3. To determine if dash switch or car wiring are at fault, disconnect harness from wiper motor and try operating wiper as shown in Fig. 11-94. If wiper fails to operate, remove body parts as required, disconnect transmissions from wiper crank arm and re-check wiper operation. If wiper still fails to perform correctly, remove wiper from car and check wiper ac-

cording to procedure under "Wiper Detached From Car."

WIPER WILL NOT SHUT OFF

1. Determine if wiper has both "Lo" and "Hi" speeds, "Lo" speed only, or "Hi" speed only. (IMPORTANT—wiper must operate in "Lo" speed during parking cycle)

2. Disconnect wiring harness from wiper motor and try operating wiper independently of dash switch as shown in Fig. 11-94.

—If wiper operates correctly independently of the dash switch, (i.e. shuts off correctly with crank arm in park position) refer to the table below for possible trouble location—

Step 1 Diagnosis	Possible Trouble
Wiper had both speeds	(1) Lead between wiper terminal No. 1 and dash switch grounded. (2) Defective dash switch.
Wiper had "Lo" speed only	(1) Lead between wiper terminal No. 3 and dash switch grounded. (2) Defective dash switch.
Wiper had "Hi" speed only	(1) Lead between wiper terminal and dash switch open. (2) Defective dash switch.

—If wiper still fails to operate correctly in Step 2, remove it from car and check it per instructions under "Wiper Detached From Car."

WIPER HAS ONE SPEED—FAST

Check for a defective dash switch or open lead between terminal Number 3 and dash switch.

WIPER HAS ONE SPEED SLOW AND SHUTS "OFF" WITH DASH SWITCH IN "HI" SPEED POSITION

Reverse harness leads that connect to wiper terminals 1 and 3.

BLADES DO NOT RETURN TO PARK POSITION WHEN WIPER IS TURNED "OFF"

1. Check wiper ground strap connection to car body.

2. Remove wiper from car and check for dirty, bent or broken park switch contacts.

WIPER SPEED NORMAL IN "LO" BUT TOO FAST IN "HI"

Remove wiper from car and check for an open terminal board resistor.

INTERMITTENT OPERATION

Check for loose wiper ground strap connections and/or loose dash switch mounting.

WIPER DETACHED FROM CAR

It is assumed that in many cases there is no information available to the repairman about the original wiper complaint. It is necessary, therefore, that wiper operation be checked according to the instructions shown in Fig. 11-94. IMPORTANT—Be sure and use an ammeter capable of reading at least 30 amperes in the feed wire circuit.

WIPER INOPERATIVE

Connect up wiper to operate in "Lo" speed and observe current draw. Current draw ratings shown below will provide a hint as to the possible source of trouble.

Ammeter Reading (Amps)	Possible Trouble
0	(1) Loose solder connection at wiper terminal No. 2. (2) Loose splice joints (Fig. 11-95).
1-1.5	(1) Open armature. (2) Brushes sticking. (3) Loose splice joint.
11.0	(1) Broken gear or some other condition that will stall the wiper.

WIPER WILL NOT SHUT OFF AND,

	Possible Trouble—Refer
Wiper has both speeds	(1) Park switch contacts not opening. (2) Internal wiper motor lead that connects to wiper terminal No. 1 grounded.
Wiper has "Lo" speed only	(1) Internal wiper motor lead that connects to wiper terminal No. 3 grounded. (2) Shunt field coil grounded.
Wiper has "Hi" speed only	(1) Internal wiper motor lead that connects to wiper terminal No. 3 open. (2) Shunt field open.

WIPER HAS "HI" SPEED ONLY—See Typical Trouble in table above.

WIPER HAS "LO" SPEED ONLY—See Typical Trouble in table above.

WIPER CRANK ARM DOES NOT RETURN TO PARK POSITION when wiper is turned off (i.e. crank arm stops rotating immediately).

Check for dirty, bent or broken park switch contacts.

WIPER SPEED NORMAL IN "LO" BUT TOO FAST IN "HI"

Check for open 24 ohm resistor on back of wiper terminal board.

INTERMITTENT OPERATION

Check for sticking brushes, loose splice joints, etc.

DISASSEMBLY-ASSEMBLY PROCEDURES

Except for the internal wiring to the wiper terminal board, the disassembly-assembly procedures for the two speed wiper covered in this section are the same as those outlined for the single speed wiper. See Fig. 11-95 for internal wiring.

WIPER SPECIFICATIONS

Operating Volts 12 VDC

Crank Arm Rotation (looking at Crank Arm)
Counterclockwise

Crank Arm Speed (RPM's) (No Load):

Lo 34 Min.

Hi 65 Min.

Current Draw—Amps.:

No Load (Lo Speed) 3.6 Max.

Installed in Car—(Dry Glass) 4.5 Max.

Stall 12 Max.

Shunt Field Resistance

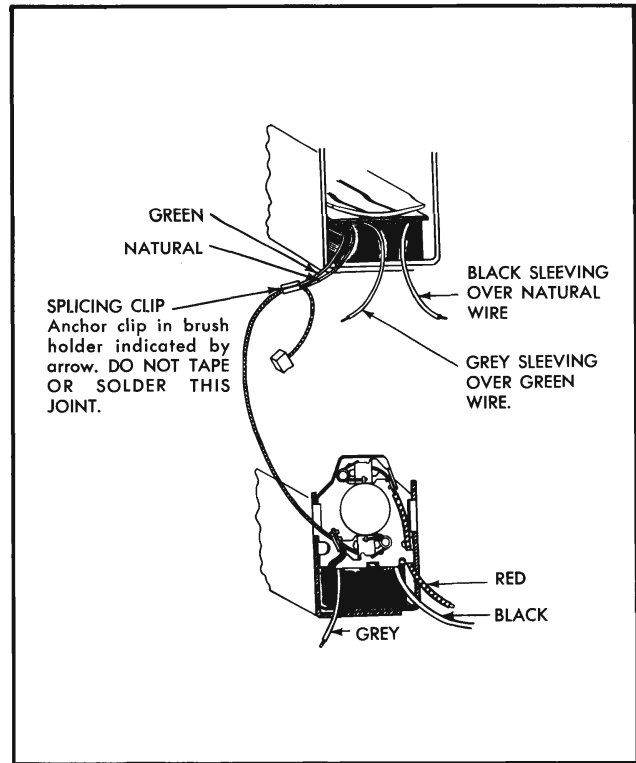


Fig. 11-95 Internal Wiring

WINDSHIELD WASHER PUMP

GENERAL DESCRIPTION

Washer pumps used on the 1962 one and two speed non-depressed park wipers differ considerably in appearance from the 1961 integral type pump but the basic pumping action and valve arrangement remain the same.

PRINCIPLE OF OPERATION

As with the 1961 integral type washer pump, the new model is a positive displacement type pump employing a small bellows, bellows spring and valve arrangement. The pumping mechanism is actuated by a 3 lobe nylon cam and gear assembly driven by the wiper. The programming (starting and completion of a wash cycle) is accomplished electrically and mechanically by a relay assembly and ratchet wheel arrangement. (See Fig. 11-96).

Explanation of pump operation follows:

WIPER ON—WASHER OFF

When the washer pump is mounted on the wiper correctly, a gear on the washer pump 3 lobe cam engages with a gear on the output shaft of the wiper output gear (Fig. 11-97). The 3 lobe cam, in turn, actuates a spring loaded plate and ratchet pawl assembly (Fig. 11-96). Thus, with the wiper running the 3 lobe cam rotates continuously and actuates 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 "lock-out" position and no pumping action occurs.

The pump is in the "lock-out" position when the relay holding contacts are open and a tang on the plunger arm rests against the widest part of an eccentric ramp located on the lower surface of the ratchet wheel (Fig. 11-98). The tang holds the bellows plunger arm in a retracted position (bellows spring compressed) allowing the plunger arm actuator pin on the plate and ratchet pawl assembly (Fig. 11-96) to move freely back and forth in the plunger arm slot and thus no pumping action occurs.

The ratchet pawl is spring loaded to hold it away from engaging the ratchet wheel teeth until such time as the washer pump relay is energized by the dash switch washer button.

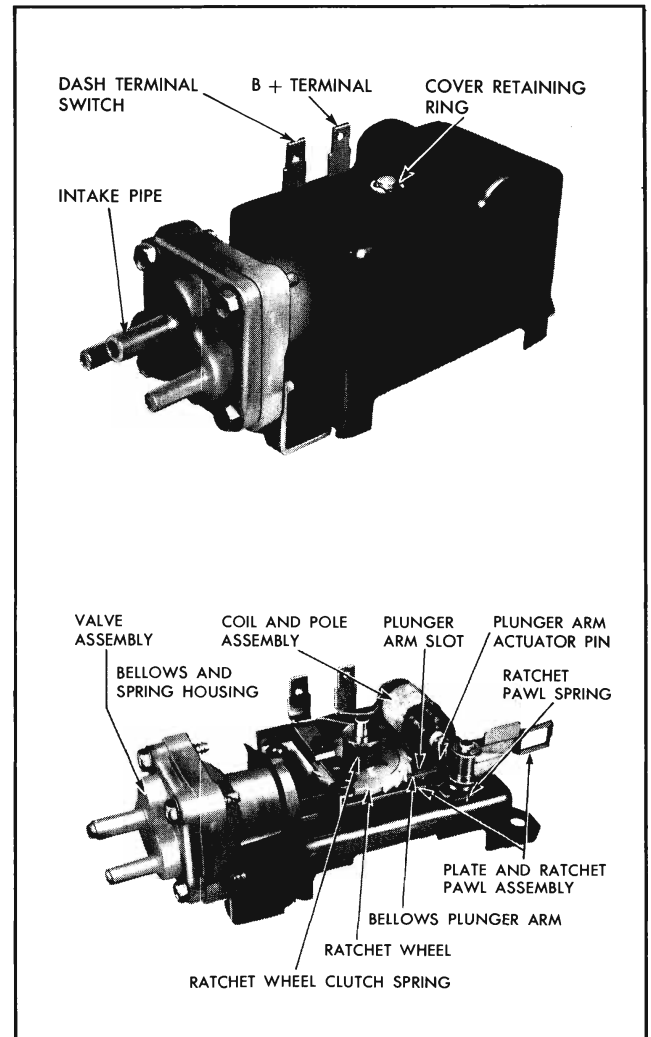


Fig. 11-96 Washer Pump Assembly

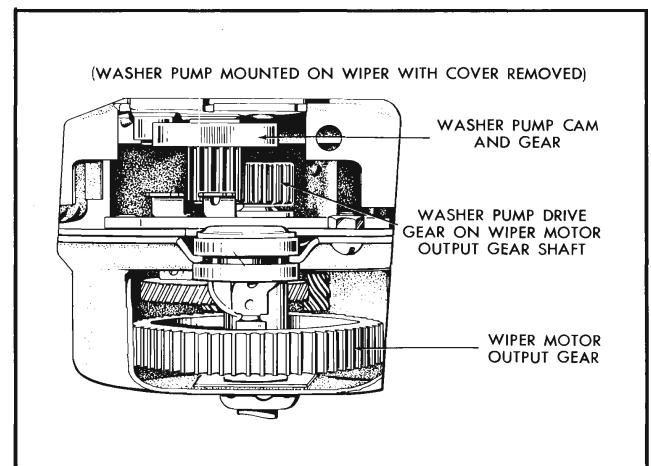


Fig. 11-97 Washer Pump Gears

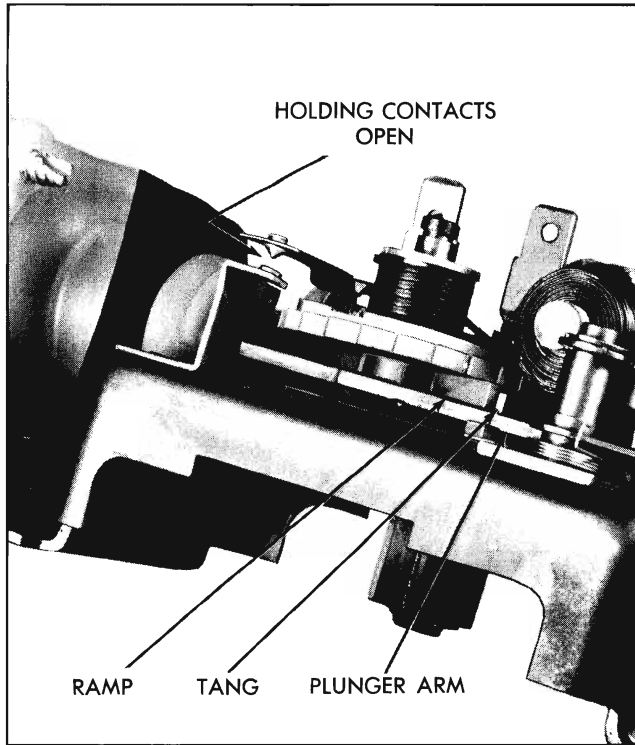


Fig. 11-98 Washer Pump Assembly

TURNING THE WASHER ON

Depressing the dash switch washer button closes the washer pump relay circuit to ground. (Refer to Fig. 11-99). (NOTE: If wiper was "off" the wiper switch is mechanically turned to the "On" position by the washer button.)

With the washer relay coil energized, the ratchet pawl, which is normally held away from the ratchet wheel by a spring, is pulled toward the coil pole and engages the ratchet wheel teeth. The ratchet pawl and plate assembly, which moves back and forth continuously when the wiper is on, now starts to rotate the ratchet wheel (Fig. 11-100).

When the ratchet wheel has been rotated one tooth, two simultaneous functions occur (1) the eccentric ramp on the ratchet wheel is moved away from the plunger arm tang, releasing the pumping mechanism from its "lock-out" position and (2) a set of holding contacts close, maintaining the coil circuit to ground. The contacts will stay closed until the ratchet wheel has been turned through 360° or 21 teeth, at which time the ratchet wheel will again open the contacts.

PUMPING CYCLE

(EXHAUST HALF OF PUMP STROKE):

With the pumping mechanism released from its

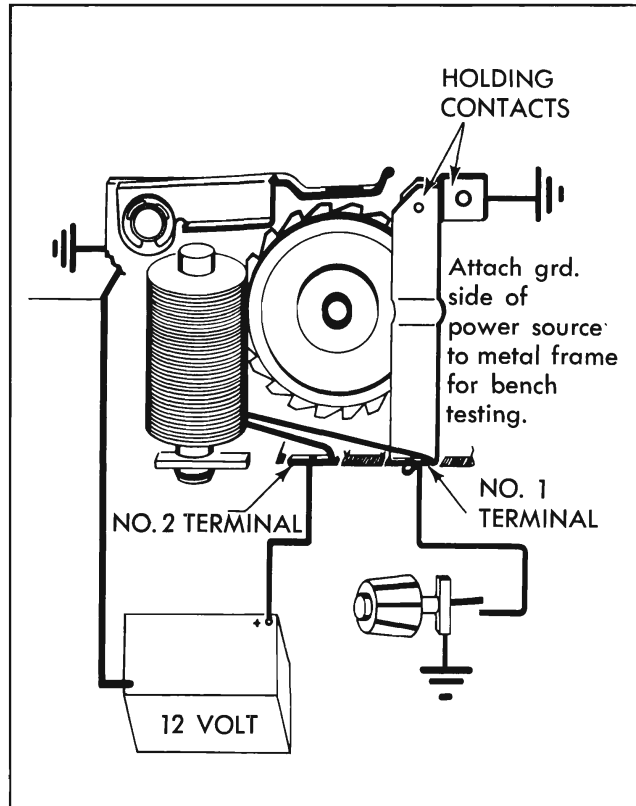


Fig. 11-99 Pump Wiring Circuit

"lock-out" position, the bellows spring expands and collapses the bellows forcing water out two outlet valves (Fig. 11-102). The plunger arm, which is 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. (Refer to Figure 11-96 to identify plunger arm slot and pin.) The actuator pin, which was previously moving back and forth freely in the plunger arm slot, will now pull the plunger arm back and compress the bellows spring each time a lobe of the 3 lobe cam actuates the plate and ratchet pawl assembly.

(INTAKE HALF OF PUMP STROKE):

Pulling the plunger arm back compresses the bellows spring (Fig. 11-103) and water is drawn into the bellows through the intake valve. During the intake of water, 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.

COMPLETION OF WASH CYCLE

The wash cycle is completed when the electrical circuit to the relay coil is opened and the pumping

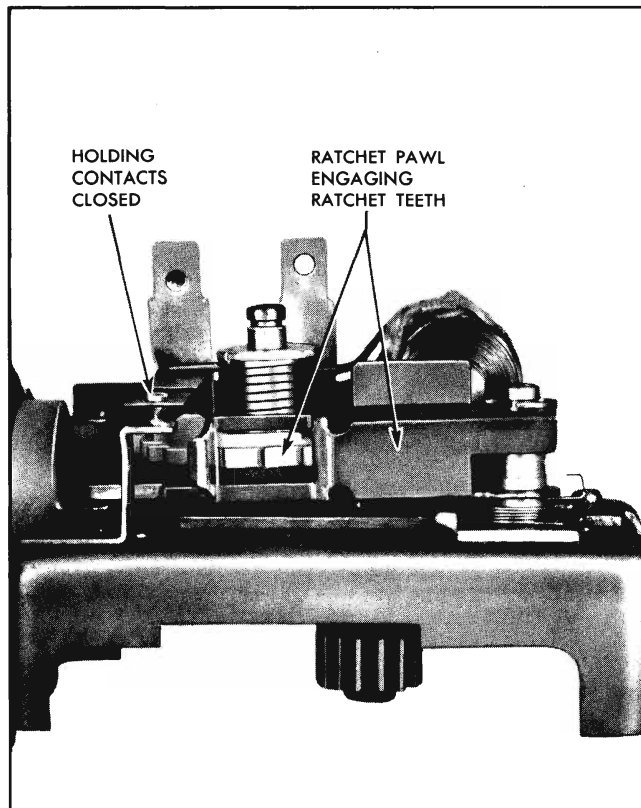


Fig. 11-100 Pump Contacts and Ratchet Pawl

mechanism reaches its "lock-out" position. This is accomplished as follows:

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 "lock-out" position of the pumping mechanism is reached when the tang is up on the widest part of the ramp (Fig. 11-98). The tang reaches the "lock-out" position at the same time the relay coil holding contacts open.

TROUBLE DIAGNOSIS

Trouble shooting procedures are divided into two categories (1) Washer installed in car and (2) Washer detached.

WASHER PUMP ON CAR

WASHER INOPERATIVE:

1. Check the following items:

- (1) Jar has adequate quantity of water solution.
- (2) Hoses are not damaged and hose connections are tight.
- (3) Screen at end of jar cover hose is not plugged.
- (4) Electrical connections to washer pump and dash switch.
- (5) 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. 11-104). 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. 11-104) and operate wiper. If washer relay "click" is heard and pump functions correctly, a defective dash switch or an open circuit between washer pump and dash 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 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 PUMP DETACHED

CHECK PUMP OPERATION AS FOLLOWS:

1. Remove washer pump cover and connect 12 volt power supply to washer pump as shown in Fig. 11-99. Connect jumper wire from terminal No. 1 to ground. Turn ratchet pawl to the position shown in Fig. 11-99. Ratchet pawl should be pulled toward relay pole and engage ratchet teeth. Failure to do as described above indicates an open relay coil.

2. If relay and ratchet pawl perform correctly in Step 1, manually rotate the 3 lobe cam one lobe in a clockwise direction (looking at the cam). Observe if relay holding contacts close (Fig. 11-100) and the pump plunger arm is released from its "lock-out" position. (Fig. 11-98 shows plunger arm in "lock-out" position.)

3. Disconnect jumper wire from terminal No. 1. Relay coil should remain energized and hold ratchet pawl against ratchet wheel. Failure to do so indicates open or dirty holding contacts.

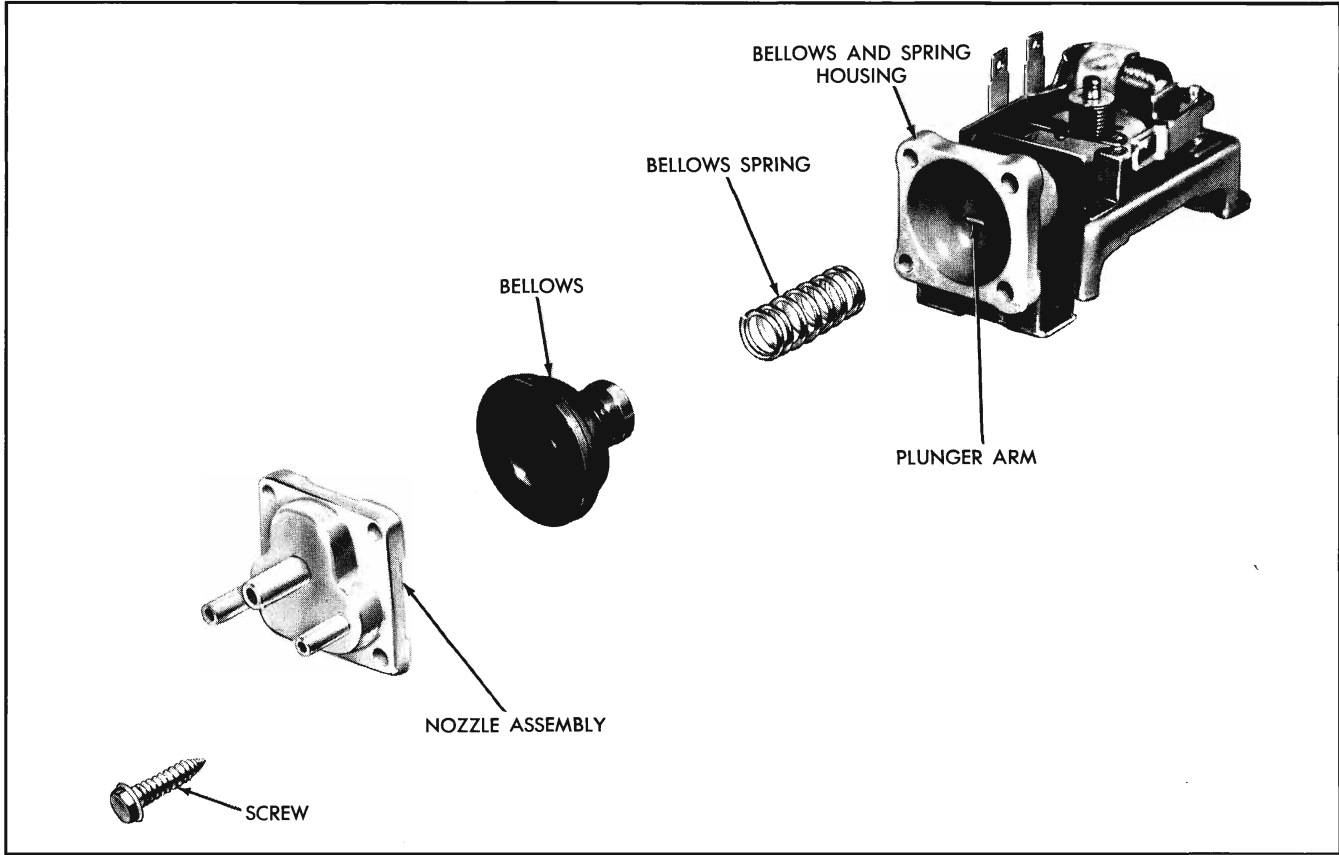


Fig. 11-101 Washer Pump Exploded View

4. If pump performs correctly in Step 3, continue to manually rotate the 3 lobe cam 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

“lock-out” position (Fig. 11-98).

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.

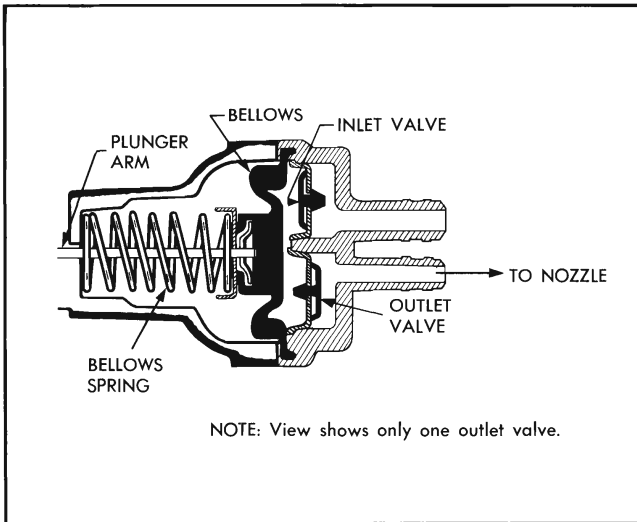


Fig. 11-102 Pumping Cycle (Exhaust)

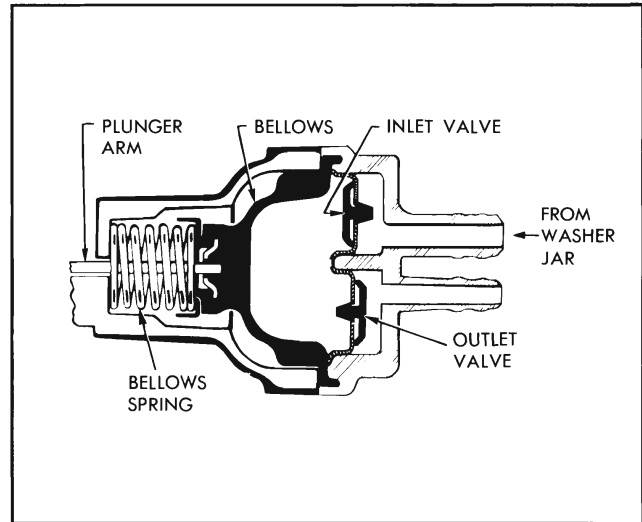


Fig. 11-103 Pumping Cycle (Intake)

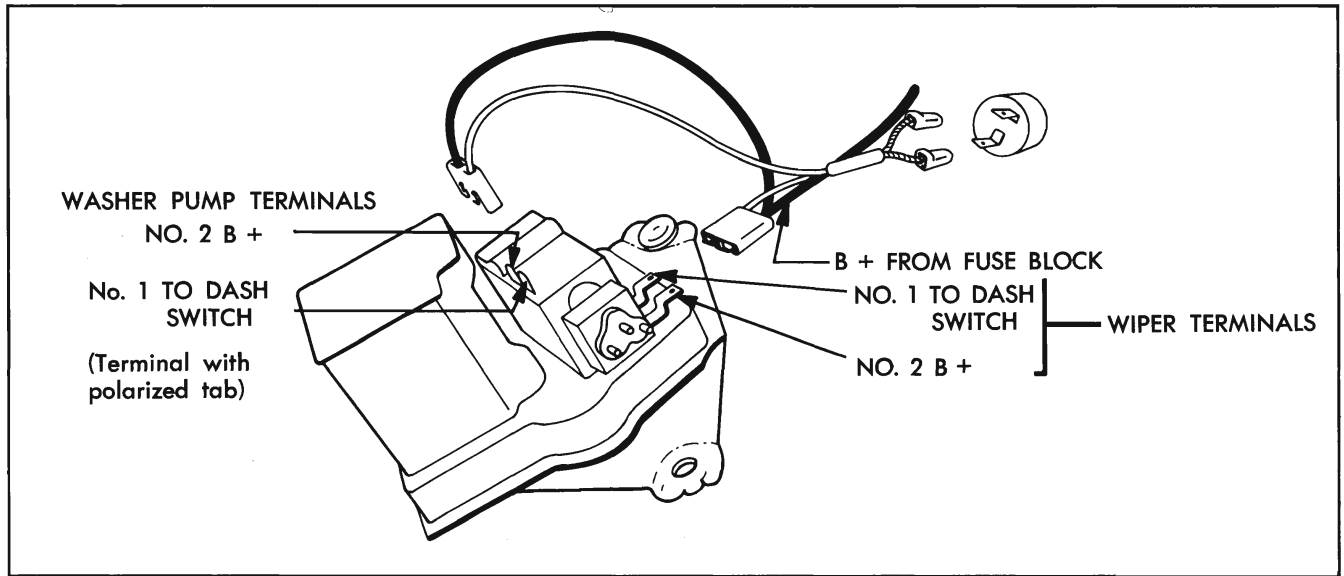


Fig. 11-104 Washer Pump Terminals

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 three valves allow air to pass in both directions, the valve assembly is defective.

DISASSEMBLY PROCEDURES

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.

CAUTION: Be sure spring is properly assembled before replacing washer pump cover.

3. Remove "E" ring and slide ratchet pawl off shaft.

VALVE ASSEMBLY

1. Remove the four screws that secure the valve assembly to the bellows housing.

CAUTION: 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 "lock-out" 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 PROCEDURES

In each of above cases, reverse procedure to assemble.

SPECIFICATIONS

Number of "squirts" at full pressure	12
Pressure (PSI)	11-15
Coil Resistance (ohms)	20

SPECIFICATIONS

	30 Amp Generator	35 Amp Generator	
Battery Model	455	459	
Capacity at 20 hr. rate, amp.-hr.	42	53	
	4 Cylinder Engine	V-8 Engine	
Generator Model	1102266	1105145	1102267
Brush Spring Tension, Oz.	28	28	28
Cold Output	30 amps., 14V, 2310 rpm.	35 amps., 14V, 1730 rpm.	30 amps., 14V, 2310 rpm.
Field Current Draw	1.48-1.62	2.73-3.0	1.48-1.62
Regulator Model	1119263	1119641	1119263
Cutout Relay:			
Air Gap, inches .....	.020	.020	.020
Point Openings, inches .....	.020	.020	.020
Closing Voltage, volts	11.8-13.5	11.8-13.0	11.8-13.5
Voltage Regulator			
Air Gap, inches .....	.075	.067	.075
Point Opening, in. ....		.016	
Normal Range (125°F.), volts	13.8-14.7	24	13.8-14.7
Current Regulator			
Air Gap, inches .....	.075	.075	.075
Allowable Limits (125°F.), amperes	31-35.5	31-35.5	31-35.5
	4-Cylinder Engine	V-8 Engine	
Starting Motor Model	1107796	1108303	
Brush Spring Tension, Oz.	35	35	
Resistance Test (Armature Locked)			
Volts	3.5	4.0	
Amperes	300-360	280-320	
Solenoid Switch Model	1114271	1114266	
Hold-in Winding	10.5-12.5 Amps., 10 Volts	10.5-12.5 Amps., 10 Volts	
Both Windings	42-49 Amps., 10 Volts	42-49 Amps., 10 Volts	

	4-Cylinder Engine		V-8 Engine
Distributor Model	1110282	1110283	1110983
Application	Lo-Comp.	Hi-Comp.	
Rotation Viewed From Cap End	CC	CC	C
Point Opening, inches .....	.016"	.016"	.016"
Breaker Lever Tension	19-23 oz.	19-23 oz.	19-23 oz.
Cam Angle (Set To Range)	74°-76°	74°-76°	28°-32°
Condenser Capacity Mfd. ....	.18-.23	.18-23	.18-23
Centrifugal Advance (Distributor)			
Start	0°-2°	0°-2°	0°-2°
	400 rpm	400 rpm	500 rpm
Intermediate	7.5°-9.5°	9°-11°	6.5°-8.5°
	1000 rpm	1875 rpm	1050 rpm
Maximum	12°-14°	9°-11°	12°-14°
	2125 rpm	2200 rpm	1850 rpm
Vacuum Control Model	1116203	1116203	1116190
Application	For Dist.	For Dist.	For Dist.
	1110282	1110283	1110983
Inches of Mercury to start advance	6-8	6-8	6-8
Inches of Mercury for full advance	13-15	13-15	14.5-15.75
Maximum Advance (mean)	10°±0.75°	10°±0.75°	8°±0.75°

	4 Cylinder Engine	V-8 Engine
Ignition Coil Model	1115169	1115136
Primary Resistance, Ohms (80°F.)	1.46-1.63	1.28-1.42
Secondary Resistance, Ohms (80°F.)	5600-6900	7200-9500
Spark Plugs	A.C.	A.C.
Size	14 MM	14 MM
Type	45S	45FFS
Gap .....	.035"	.035"
Torque	15-25 lb. ft.	15-20 lb. ft. (use thread lubricant)
Ignition Resistor Wire		
Resistance at 80°F. Ohms		1.80
Ignition timing (at hot idle speed with vacuum line disconnected and manifold opening covered)	6°BTDC	5°BTDC

Horns	Model	Type	Ampere Draw
	9000439	Standard	8-11 Amps. 12.5V
	9000440	Optional	8-11 Amps. 12.5V

Relays	Model	Application	Air Gap at Core —Points Closed (in.)	Point Opening (in.)	Closing Voltage (Range)
	1116980	Horn	.020	.018	1.5-9.5

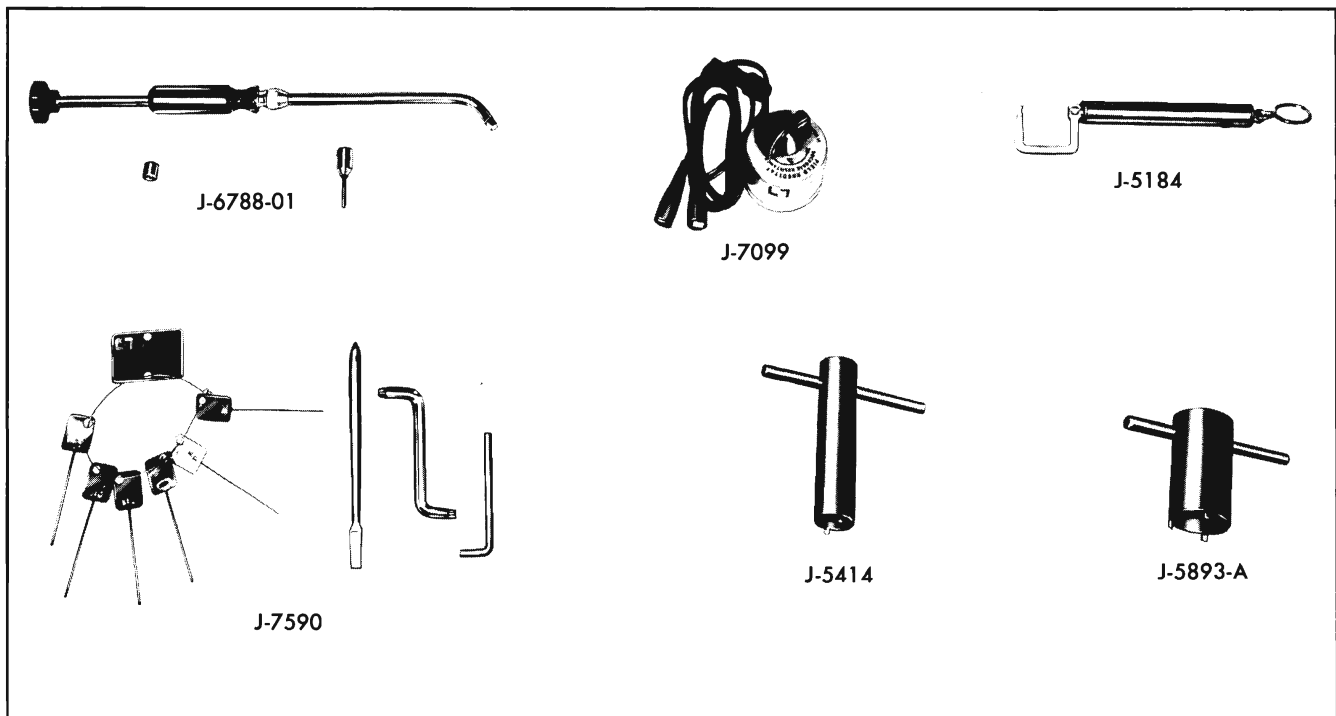
FUSES AND CIRCUIT PROTECTION		Fuse Capacity—Amps	Location on Fuse Block	"On" and "Off" with Lighting Switch	"On" and "Off" with Ignition Switch	Rheostat Control by Turning the Lighting Switch Knob	In Series with Circuit Breaker on Lighting Switch	Direct Connection to Battery
REGULAR EQUIPMENT								
Headlights				*			*	
Headlight Beam Indicator				*			*	
Parking Lights				*			*	
STANDARD EQUIPMENT	Tail Lights and Trunk Light	9	Tail Lts.	*			*	*
	License Light	9	Tail Lts.	*			*	
	Instrument, Clock and Ash Tray Lights	4	Panel Lights	*		*	*	
	Dome Light and Courtesy Lights	9	Covr-Dome	*				*
	Electric W/S Wiper Motor #	25	Wiper		*			
	Stoplights	9	Stop					*
	Direction Signals & Indicator	20	Dir. Sig.		*			
	Cigar Lighter, Clock and Glove Box Light	20	Ltr-Clk-Gl. Bx.					*
	Back-Up Lights	25	Back-up Lts.		*			
	Parking Brake "On" Warning Light	25	P. Brake		*			
SPECIAL EQUIPMENT	Heater Control Panel Light	4	Panel Lights	*		*	*	
	Heater Blower Motor and Air Conditioning Power	20	Heater, Air C.		*			
	Radio Dial Light	4	Panel Lights	*		*	*	
	Radio Power	7.5	Radio		*			
	Shift Lever Indicator Light Auto. Trans.	4	Panel Lights	*		*	*	
	Windshield Washer	25	Washer		*			

(#) Electric W/S Wiper Motor has an internal Circuit Breaker.

Lighting Switch Circuit Breaker will carry a 22 amp. load continuously. Will open with 35 amps. within 30 to 60 seconds.

Fuse Block is located on Passenger side of dash, left side of car.

LIGHT USAGE		TRADE NO.	2-Door Sedans	4-Door Sedans	Convert.	Station Wagon	LeMans
LIGHT							
STANDARD EQUIPMENT							
Head (37.5W)		4001	2	2	2	2	2
Head (37.5-50W)		4002	2	2	2	2	2
Parking & Directional Signal		1034	2	2	2	2	2
Tail, Stop & Directional Signal		1034	2	2	2	2	2
Tail		67				2	
Directional Signal Indicator		57	1	1	1	1	1
License		67	1	1	1	1	1
Instrument		57	6	6	6	6	6
Oil Pressure Indicator		57	1	1	1	1	1
Temperature Indicator		57	1	1	1	1	1
Beam Indicator, Head Light		57	1	1	1	1	1
Dome		211	1	1		1	
Ammeter Tell-tale		57		1		1	
SPECIAL ORDER EQUIPMENT							
Back-Up		1073	2	2	2	2	2
Heater Control		57	1	1	1	1	1
Auto. Trans. Indicator		53	1	1	1	1	1
Parking Brake, Warning		57	1	1	1	1	1
Radio Dial		1881	1	1	1	1	1
Clock		57	1	1	1	1	1
Courtesy		89	1	1	1	1	1
Glove Box		57	1	1	1	1	1
Ash Tray		53	1	1	1	1	1
Trunk		1003	1	1	1		1
Side Roof Rail		90					2



SPECIAL TOOLS

- J-6788-01 Distributor Adjusting Tool
- J-7099 25 Ohm Rheostat
- J-5184 Brush Tension Scale
- J-7590 Generator Regulator Service Set
- J-5414 Instrument Panel Nut Wrench
- J-5893-A Ignition Switch Ferrule Spanner

ACCESSORIES

CONTENTS OF THIS SECTION

SUBJECT	PAGE	SUBJECT	PAGE
Service			
Replace Radio	12-1	Set Radio Push Buttons	12-3
Replace Speaker	12-1	Radio Trouble Diagnosis	12-3
Replace Antenna	12-2	Back-Up Light Switch	12-4
Adjust Antenna Trimmer	12-2	Electric Clock	12-4

RADIO SERVICE

REMOVE RADIO

1. Disconnect antenna and power leads from radio (Figs. 12-3 and 12-4).
2. Loosen hex screws and remove radio knobs.
3. Remove retaining nuts and escutcheon (Fig. 12-1).
4. Remove screw securing radio receiver to instrument panel-to-radio bracket (Fig. 12-2).
5. Remove radio.

NOTE: On air conditioned cars the glove box and left hand evaporator support must be removed and the radio removed through this opening.

INSTALL RADIO

1. Install radio.
2. Connect leads to radio.
3. Install screw holding radio to bracket (Fig. 12-2).
4. Install left hand evaporator support and glove box on air conditioned cars.
5. Install escutcheon and retaining nuts (Fig. 12-1).
6. Install radio knobs.
7. Connect battery ground cable.

REMOVE AND REPLACE SPEAKER

1. Remove radio as outlined above.

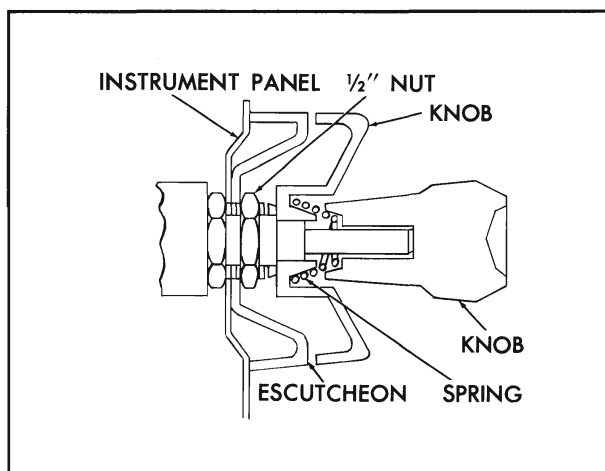


Fig. 12-1 Radio Knob Assembly

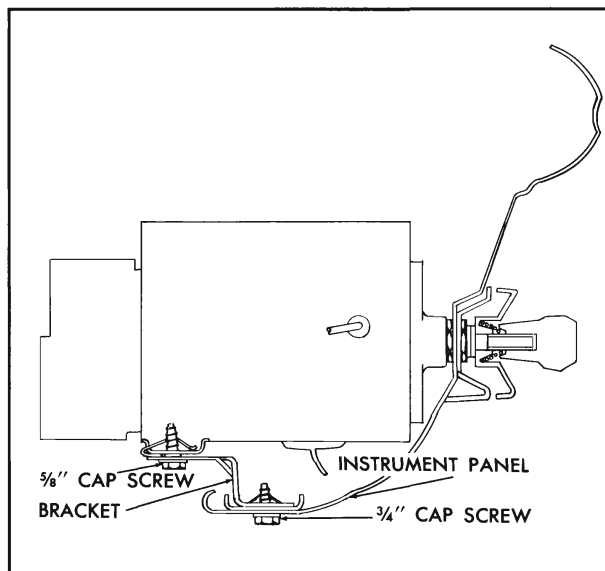


Fig. 12-2 Panel-to-Radio Bracket

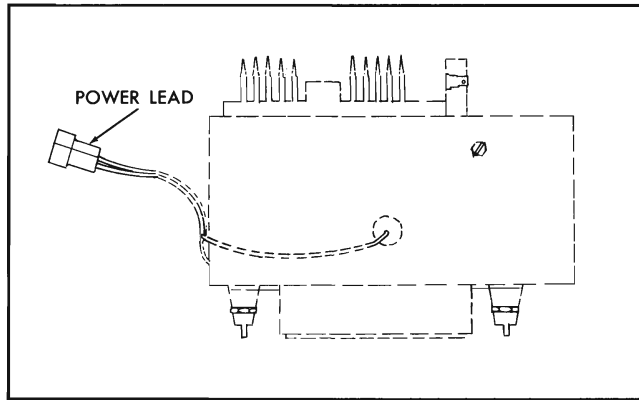


Fig. 12-3 Radio Power Lead

2. Remove nuts securing speaker to speaker support (Fig. 12-5).
3. Disconnect output connector and remove speaker.
4. Reverse above procedure to install.

REMOVE AND REPLACE ANTENNA

1. Remove glove box.
2. Disconnect lead-in plug from radio receiver (Fig. 12-4).
3. Disconnect lead-in from clip on defroster nozzle.
4. Remove right hand kick pad.
5. Remove antenna mast assembly.
6. Remove upper nut, adapter, and pad (Fig. 12-6).
7. Remove antenna body.
8. Reverse above procedure to install.

ADJUST ANTENNA TRIMMER

In order to make the antenna trimmer adjustment, the car should be outdoors and as far removed from electrical disturbances as possible. Extend the antenna to its full height. After radio has warmed up, tune in a weak station between 600 and 1000 kilocycles and turn the volume control on full. This is necessary in order to offset the action of the automatic volume control. Using a screwdriver, turn the trimmer adjusting screw on the bottom side of receiver. Turn the screw until the station peaks in volume.

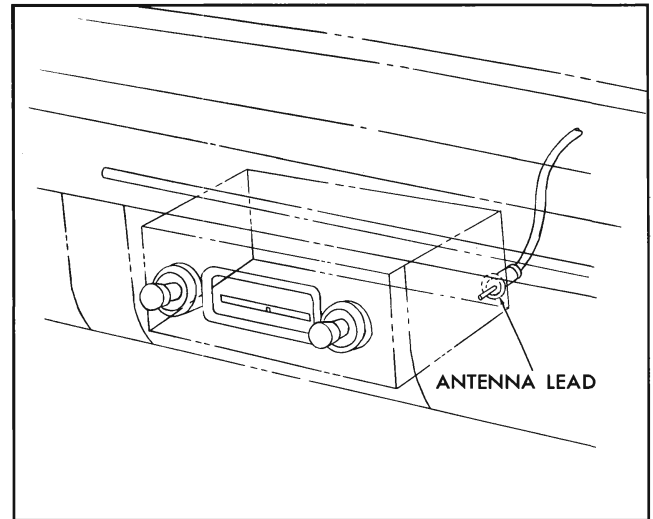


Fig. 12-4 Antenna Lead

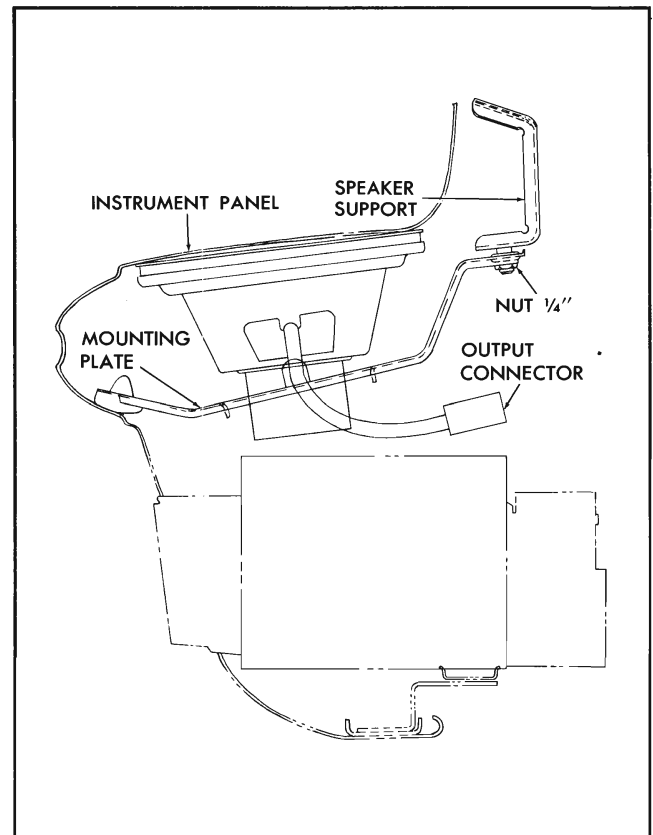


Fig. 12-5 Speaker Installation

The antenna trimmer adjustment should be made on new car pre-delivery inspection and also after a set has been removed from the car and worked on by a radio repair man. The reason for trimming the antenna after service work has been performed is that the radio repair man will undoubtedly have adjusted

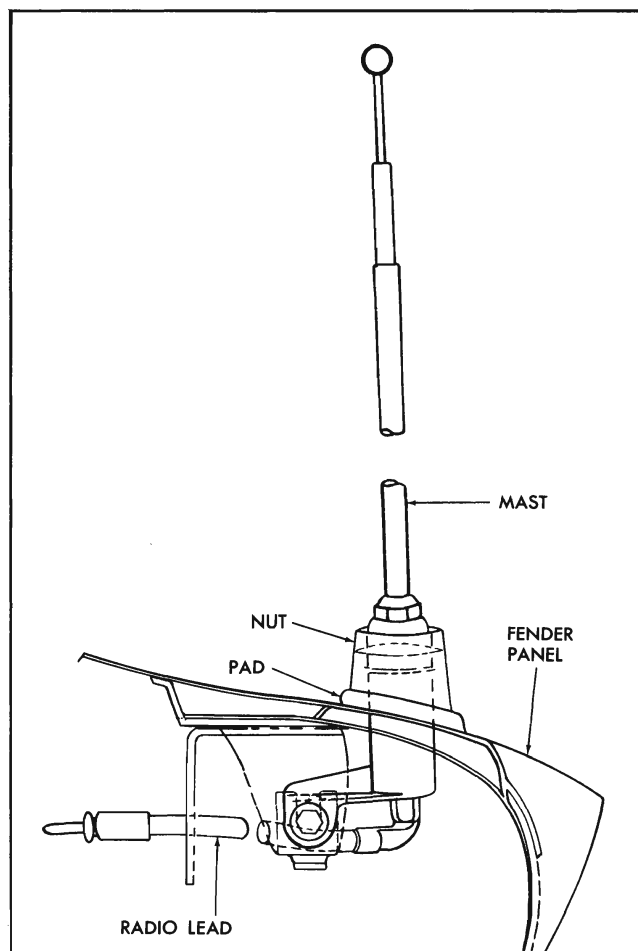


Fig. 12-6 Antenna Installation

the trimmer to match his antenna so that it no longer matches the antenna in the car from which it was removed.

SET RADIO PUSH BUTTONS

1. Turn on radio and allow it to warm up.
2. Select five desired stations (set buttons one at a time).
3. Pull selector button out as far as it will go.
4. Tune in the desired station, using the manual control knob.
5. Push the selector button in and release.

RADIO TROUBLE DIAGNOSIS

GENERATOR NOISE

Connect capacitor from the armature terminal on the generator to ground or the frame of the car.

VOLTAGE REGULATOR NOISE

Place capacitor between the battery terminal of the regulator and chassis.

IGNITION INTERFERENCE

Eliminate by inserting a resistance type rotor in the distributor cap, using resistance wiring harness and installing a capacitor from the "A" connection of the ignition coil to ground.

IGNITION INTERFERENCE THROUGH HOOD TO RADIO ANTENNA

Eliminate by installing a hood grounding clip.

BALL ON END OF ANTENNA ROD

Ball eliminates the sharp point and reduces the effect of corona discharge. Curb feelers bent too close to ground will cause noise in the auto radio.

NOISE FROM WHEELS AND TIRES OF CAR

Noise caused by friction both between the wheels and axles and between the tires and the road surfaces.

WHEEL STATIC

Caused by voltage being developed as the wheel rotates on the axle. Noise is eliminated by placing wheel static collectors in the two front wheels; button end of spiral spring must ride snugly in hole on end of axle.

TIRE STATIC

Caused by electrical charge being built up inside tire due to friction between tire and road. Noise is eliminated by inserting tire static powder into tires using a special injection gun.

CAUTION: Inject powder carefully or powder will backfire in face.

DEAD, WEAK OR NOISY

A. Dead.

Make necessary checks to determine if some part other than the radio is causing the complaint.

a. Thump check radio.

Simply turn on radio and listen intently to speaker. As power is applied to radio, current builds up through the transistor causing a distinct thump to be heard in the speaker. If the thump is not heard—

b. Check fuse.

If fuse is blown, replace with good one of correct value. If radio plays, let it play while racing engine; tap radio with rubber mallet or heel of hand. If radio blows another fuse, remove radio for repair or send car to authorized radio service shop.

c. Transistor cooling fin is grounded.

If cable or piece of metal touches transistor cooling fin it will cause radio to be dead. A short to ground at this point will not damage any of the components but just eliminates the sound.

d. Check antenna.

If a thump is heard as radio is turned on defect is either in radio or antenna. Check by substitution; simply unplug regular antenna and plug in spare.

B. Weak.

a. Trouble could be an inoperative antenna or mismatch between antenna and radio. To quick check to determine if radio and antenna are matched, tune radio to station (preferably not local) and grasp antenna rod with hand. If volume drops considerably, antenna trimmer is peaked properly; if the volume remains same or increases slightly, antenna trimmer needs adjusting. To peak antenna to radio, simply tune radio to a weak station and adjust antenna trimmer for maximum volume. Antenna can be checked by substituting with a known good one.

b. Plug speaker in securely.

Make sure speaker is plugged in securely at radio.

C. Noisy.

a. Noisy all the time complaint is almost always due to a defect inside the radio but could be caused by a bad antenna, so check with a substitute antenna.

b. Noisy when tapped or jarred: caused by loose antenna connection to the radio, a poor connection to car's power, poor speaker connection, or a loose part or connection inside the radio.

c. Noisy only when engine is running: due to faulty noise suppression equipment. Engine noise can also be caused by some leads or cables laying too close to transistor cooling fin on engine side of firewall. Antenna lead-in shielding must be grounded both at antenna base and at radio; poor connections at either of these points can result in engine noise getting into radio. If noise is present only while car is

moving, problem is either wheel or tire static. To check, drive car on a macadam road until noise is noticed, then apply brakes. If noise disappears, it's wheel static. If noise persists, it's tire static. Check for presence and correct installation of static collectors in front wheels or insert tire static powder in tires as required.

If all the above checks fail to turn up the problem, the condition is in the radio itself. The radio should be removed from the car and sent to an authorized service station.

BACK UP LIGHT SWITCH

SYNCHRO-MESH TRANSMISSION CARS

The back up light switch on synchro-mesh transmission equipped cars is located at the rear of the synchro-mesh transmission. **NOTE:** the switch is located below the lubricant level in the transmission, therefore, be careful when removing or replacing the switch to avoid loss of lubricant.

AUTOMATIC TRANSMISSION CARS

The location and adjustment of the back-up light and neutralizer switch on automatic transmission equipped cars is described in Section 7A.

ELECTRIC CLOCK

The electric clock is operated by current from the car battery so that hand winding is eliminated. Automobile clocks operating on direct current from the car battery must not be compared too closely for accuracy to the home electric clock operating on alternating current. The cycles per second of alternating current used in the home are controlled and periodically corrected at the power house, thereby eliminating accumulation of errors.

With the direct current system such as used in a car, no such control is possible; therefore, automobile electric clocks will accumulate errors day by day the same as hand wound, spring operated clocks.

The electric clock provides automatic regulation of the rate when the position of the hands is changed. Movement of the hands forward or backward automatically adjusts the length of the hair spring to make the clock run faster or slower. The amount of change in rate depends upon the amount the hands are changed. Maximum rate change is approximately 20 seconds per day and is obtained when the hands are moved five minutes. If the clock is reset less than five minutes the change in rate is proportionally less than 20 seconds.

SETTING CLOCK

When setting clock to correct for errors in time, pull reset stem out, move hands counterclockwise to correct time if clock is running fast, or move hands clockwise to correct time if clock is running slow, then allow reset stem to return to its normal position.

This will automatically adjust the rate of the clock to run slower if it is running fast, or faster if it is running slow.

Owners should be advised to set the clock to the correct time once a week at regular intervals to ensure maximum accuracy.

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