# BUICK SERVICE MANUAL

# 1965

BUICK
Authorized Service

## Skylark - Special

# 1965 BUICK SPECIAL CHASSIS SERVICE MANUAL

## For 43000 and 44000 Models

BUICK

Authorized Service

This service manual furnishes chassis service information for 1965 Buick Special, Special Deluxe, Skylark, and Sportwagon models. The information applies equally to all models unless otherwise specified.

Attention is directed to the Introduction—Group 0. This group describes the arrangement of the manual and will enable you to locate desired information easily.

SERVICE DEPARTMENT
BUICK MOTOR DIVISION
GENERAL MOTORS CORPORATION
FLINT, MICHIGAN 48550

GROUP INDEX



B.P.S. 1.66

LITHO IN U.S.A

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General Motors Corporation
Flint, Michigan

# GROUP 0
# INTRODUCTION—GENERAL INFORMATION

## CONTENTS OF GROUP 0



## INTRODUCTION

This manual is divided into major Groups, Sections, and Paragraphs as explained below. The purpose of this arrangement is to bring related subjects closely together in accordance with the usual methods of performing service operations, and consequently to present information in a logical and easily understood order.

Any desired subject in this manual may be located by reference to the alphabetical index at back of manual.

Any desired subject also may be located by turning to the first page of the appropriate Group where contents of the Group are listed. Where the Group is divided into Sections the first page of each Section lists the contents of the Section.

1. GROUPS. The manual is divided into the consecutively numbered major Groups shown on the preceding title page. To locate the first page of a Group, bend the manual until the black tab on first page of group can be seen in line with the Group title on title page.

The first page lists the contents of the Group.

2. SECTIONS. Large Groups are divided into appropriate Sections as shown on first page of the group. Sections bear the Group number and letters A, B, C, etc., in alphabetical order.

The first page of each Section lists the contents of section.

3. PARAGRAPHS. Each Group is divided into appropriate Paragraphs which are numbered consecutively within the Group, whether or not the group is divided into sections.

Paragraph titles and page numbers are listed on the first page of each Section if used, or on first page of the Group if sections are not used.

4. SUB-PARAGRAPHS. Where necessary for clarity, or distinction between models, Paragraphs are divided into appropriately titled Sub-paragraphs. These are usually lettered in alphabetical order within the paragraph.

5. PAGE AND ILLUSTRATION NUMBERS. Pages and illustrations are numbered consecutively within each Group. The number consists of the Group number followed by the Page or Figure number. Page numbers are printed in the upper outer corners of all pages.

6. CROSS REFERENCES. All references to information in other parts of manual are made by Paragraph Number, to avoid the necessity of first referring to the alphabetical index for location. Paragraph references are usually given in parentheses, for example: (par. 7-15) refers to the 15th paragraph in Group 7, "Chassis Suspension".

7. SPECIAL TOOLS. In locations where special tools are not locally available, they may be obtained through Kent-Moore Organization, Inc., 28635 Mound Road, Warren, Michigan.

## 1965 BUICK SPECIAL AND SKYLARK MODELS

| Series | Body Style | Designation V-6 | Designation V-8 |
|---|---|---|---|
| Special | 2-Door Thin Pillar Coupe | 43327 | 43427 |
| | 4-Door 2-Seat Station Wagon | 43335 | 43435 |
| | 2-Door Convertible | 43367 | 43467 |
| | 4-Door Thin Pillar Sedan | 43369 | 43469 |
| Special Deluxe | 4-Door 2-Seat Station Wagon | 43535 | 43635 |
| | 4-Door Thin Pillar Sedan | 43569 | 43669 |
| Sportwagon | 4-Door 2-Seat | | 44255 |
| | 4-Door 3-Seat | | 44265 |
| Skylark | 2-Door Thin Pillar Coupe | 44327 | 44427 |
| | 2-Door Hardtop Coupe | 44337 | 44437 |
| | 2-Door Convertible | 44367 | 44467 |
| | 4-Door Thin Pillar Sedan | 44369 | 44469 |
| Sportwagon Custom | 4-Door 2-Seat | | 44455 |
| | 4-Door 3-Seat | | 44465 |

## VEHICLE AND MAJOR COMPONENT IDENTIFICATION NUMBERS

**Vehicle Identification Numbers** - All 1965 models have a serial number identification plate attached to the left front body hinge pillar. An example of this plate is shown in Figure 0-1.

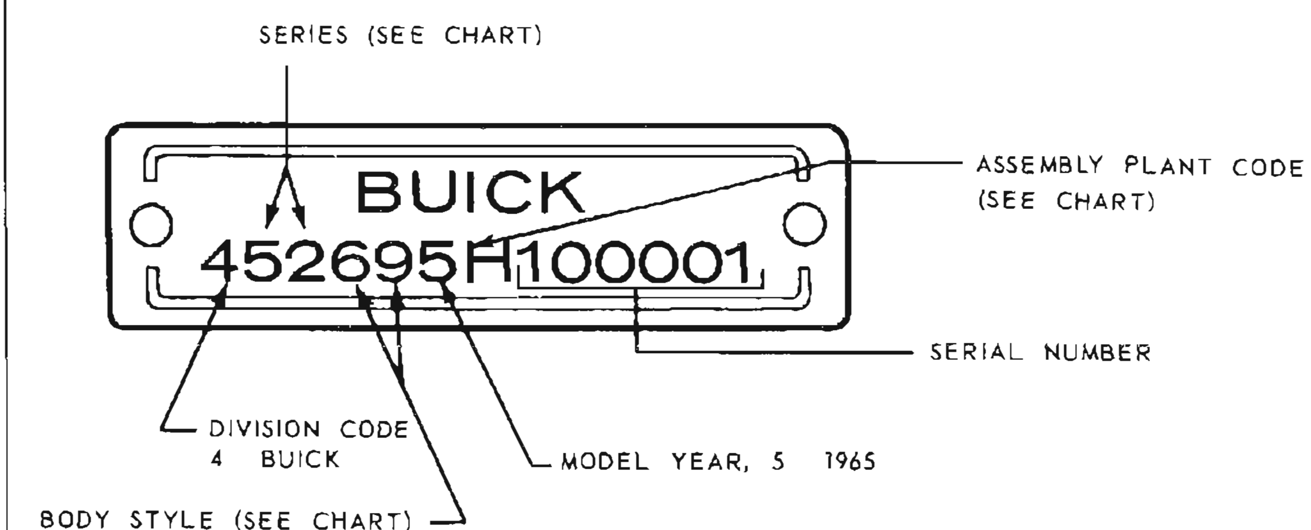



Figure 0-1—Vehicle Identification Plate

| Assembly Plant Codes | |
|---|---|
| Flint | H |
| South Gate | C |
| Fremont | Z |
| Kansas City, Kansas | X |
| Wilmington | Y |
| Atlanta | D |
| Baltimore | B |
| Kansas City, Mo. | K |
| Bloomfield | V |

| Body Style Code No. | |
|---|---|
| 2-Door Coupe | 27 |
| 4-Door 2-Seat Station Wagon | 35 |
| 2-Door Hardtop Coupe | 37 |
| 4-Door Hardtop | 39 |
| 2-Door Hardtop Coupe | 47 |
| 4-Door 2-Seat Sportwagon | 55 |
| 4-Door 3-Seat Sportwagon | 65 |
| 2-Door Convertible | 67 |
| 4-Door Sedan | 69 |

| Series Identification | V-6 | V-8 |
|---|---|---|
| Special | 33 | 34 |
| Special Deluxe | 35 | 36 |
| Sportwagon | | 42 |
| Skylark | 43 | 44 |

**Fisher Body Number Plate—** Body identification is provided by the Fisher Body Number Plate. Information such as style and body numbers, trim numbers, and paint color code is found on this plate. Refer to the 1965 Body Service Manual for detailed information regarding this plate.

**Engine Numbers—**All 1965 engines are stamped with two different identification codes. One is the production code number. See Figure 0-2. This identifies the type of engine and its production date. The other is the engine serial number. This is the legal engine number and is the same number found on the vehicle identification plate. This number is used on registrations, titles, and other legal documents while the production code number is used to identify the engine on product reports, and similar correspondence.

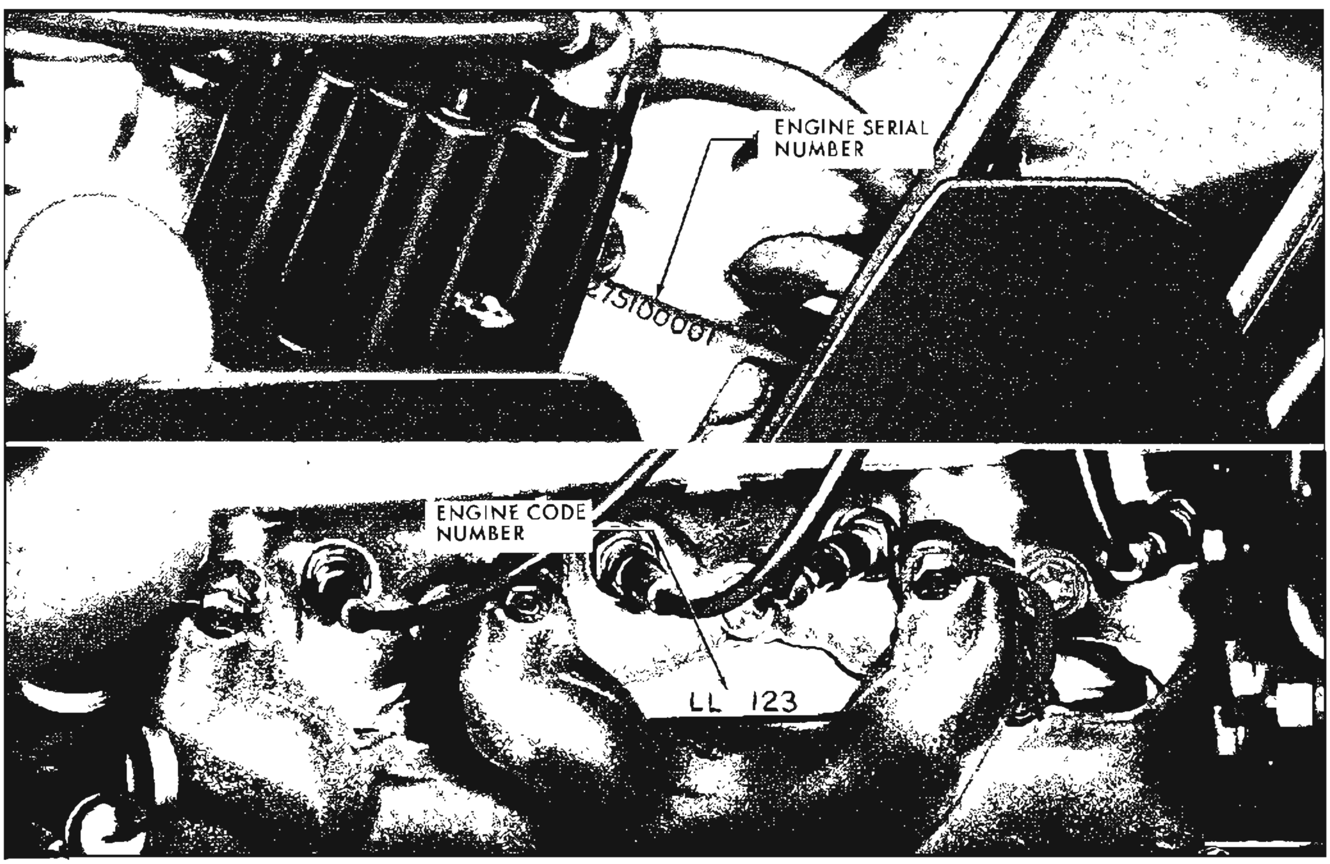



Figure 0-2—Engine Serial Number and Production Code Location

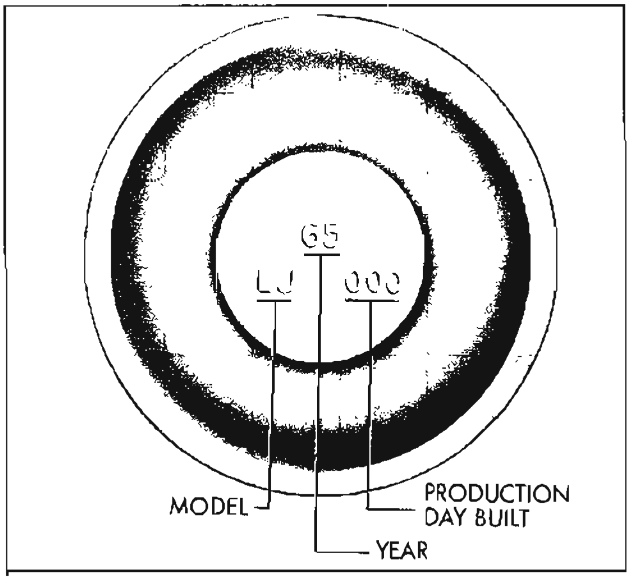



Figure 0-3—Transmission Identification - Super Turbine "300"

**225 cu. in. V-6**

**Production Code Number** This number can be found on the crankcase between the front and middle branches of the right exhaust manifold.

**Serial Number** This number is stamped on the left front face of the crankcase, just below the rocker arm cover. On power steering equipped cars it will be necessary to remove the power steering pump bracket to view the entire number.

**300 cu. in. V-8**

**Production Code Number** Stamped on the right side of the crankcase and can be viewed between the middle branches of the right exhaust manifold.

**Serial Number** Stamped on the left front face of the crankcase, just below the rocker arm cover. On cars equipped with power steering it will be necessary to remove the power steering pump bracket to view the complete number.

**Transmission Identification—** Automatic transmissions have the following information stamped on the low servo cover:

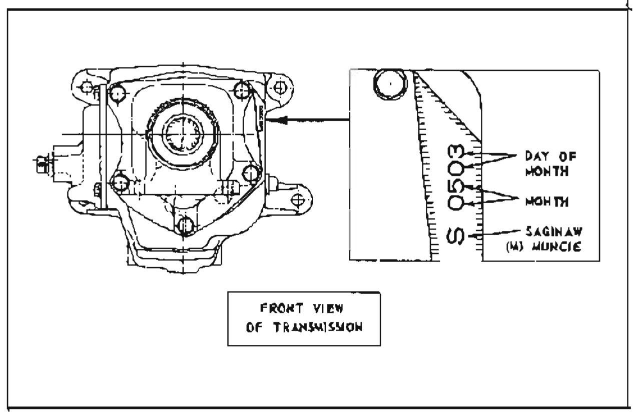



Figure 0-4—3-Speed Synchromesh Identification

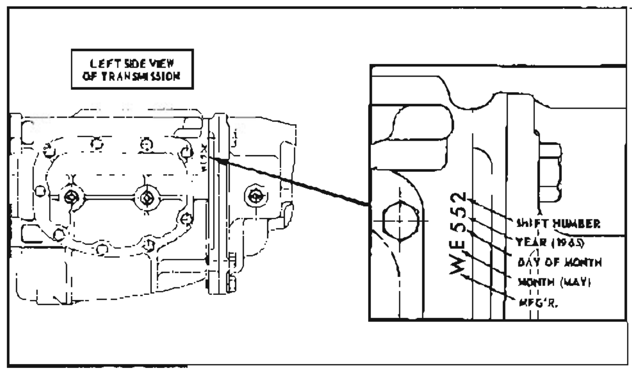



Figure 0-5—4-Speed Synchromesh Identification

1. Model Year
2. Transmission Model No.
3. Day of Transmission Production

**Synchromesh Transmission Serial Numbers—** 3 and 4-speed synchromesh transmissions have a series of numbers stamped on the case. This number should be used when identifying transmission on product reports. See Figure 0-4 and 0-5.

**Rear Axle Marking** Figure 0-6 shows the identification marking found on the rear axle. This information should also be included on product reports involving this area.

## STANDARD REAR AXLE RATIOS*

**V-6 Special and Skylark Sedans, Coupes, and Convertibles**

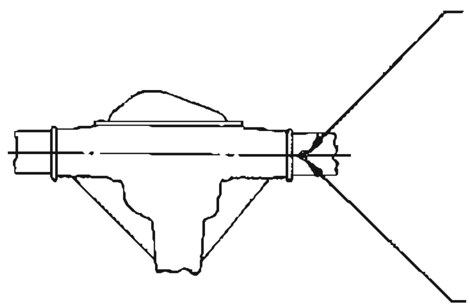
| Transmission | Ratio |
|---|---|
| Automatic | 3.08 |
| All Synchromesh | 3.23 |

**V-8 Special and Skylark Sedans, Coupes, and Convertibles**

| Transmission | Ratio |
|---|---|
| Automatic | 2.78 |
| 3-Sp. Synchromesh | 3.08 |
| 4-Sp. Synchromesh | 3.23 |

| AXLE TYPE | MFG. AXLE CODE | RATIO | SERIES |
|---|---|---|---|
| STANDARD DIFFERENTIAL | LA | 2.78 | 43427-67-69, 43627-69, 44437-67-69 AUTO. |
| | LB | 3.08 | 43435, 43635 AUTO. & 3-SP. SYNC.<br>43427-67-69, 43627-69, 44437-67-69 3-SP. SYNC.<br>43327-67-69, 43527-69, 44337-67-69 AUTO. |
| | MB | 3.08 | 44255-65, 44455-65 AUTO. |
| | LC | 3.23 | 43327-67-69, 43527-69, 44337-67-69 3 & 4-SP. SYNC.<br>434, 436, 44437-67-69 4-SP. SYNC.<br>43335, 43535 AUTO. |
| | MC | 3.23 | 44255-65, 44455-65 3 & 4-SP. SYNC. |
| | LD | 3.36 | 43335, 43535 3 & 4-SP. SYNC. |
| POSITIVE TRACTION DIFFERENTIAL | LN | 2.78 | 43427-67-69, 43627-69, 44437-67-69 AUTO. |
| | LO | 3.08 | 43327-67-69, 43527-69, 44337-67-69 AUTO.<br>43435, 43635 AUTO. & 3-SP. SYNC.<br>43427-67-69, 43627-69, 44437-67-69 3-SP. SYNC. |
| | MO | 3.08 | 442, 44455-65 AUTO. |
| | LP | 3.23 | 43335, 43535 AUTO.<br>43327-67-69, 43527-69, 44337-67-69 3 & 4 SP. SYNC.<br>434, 436, 44437-67-69 4-SP. SYNC. |
| | MP | 3.23 | 442, 44455-65 3 & 4 SP. SYNC. |
| | LR | 3.36 | 43335, 43535 3 & 4-SP. SYNC. |

(FIELD IDENTIFICATION)




NOTE: "S.C.O." INDICATES SPECIAL ORDER AXLE

Figure 0-6—Rear Axle Identification

**V-6 Special and Special Deluxe Station Wagons**

| Transmission | Ratio |
|---|---|
| Automatic | 3.23 |
| All Synchromesh | 3.36 |

**V-8 Special and Special Deluxe Station Wagons**

| Transmission | Ratio |
|---|---|
| Automatic | 3.08 |
| 3-Sp. Synchromesh | 3.08 |
| 4-Sp. Synchromesh | 3.23 |

**Sportwagons**

| Transmission | Ratio |
|---|---|
| Automatic | 3.08 |
| All Synchromesh | 3.23 |

*The same ratios are used for either Positive Traction or standard.

## PAINT COLOR CODES

1965 BUICK EXTERIOR COLORS

| CODE* | COLOR NAME & DESCRIPTION |
|---|---|
| A | REGAL BLACK |
| C | ARCTIC WHITE |
| D | ASTRO BLUE |
| E | MIDNIGHT BLUE |
| H | SEA FOAM GREEN |
| J | VERDE GREEN |
| K | TURQUOISE MIST |
| L | MIDNIGHT AQUA |
| N | BURGUNDY MIST |
| Y | BAMBOO CREAM |
| R | FLAME RED |
| S | SAHARA MIST |
| T | CHAMPAGNE MIST |
| V | SHELL BEIGE |
| Z | SILVER CLOUD |

* NOTE: CODE LETTER CAN BE FOUND ON THE FISHER BODY NUMBER PLATE.

Figure 0-7—Paint Color Codes

## GENERAL SPECIFICATIONS

### Special, Special Deluxe, and Skylark Coupes, Sedans and Convertibles

| Wheelbase | Front Tread | Rear Tread | Length | Width | Height |
|---|---|---|---|---|---|
| 115" | 58.0" | 58.0" | 203.4" | 73.6" | 54.4" |

### Sportwagons

| Wheelbase | Front Tread | Rear Tread | Length | Width | Height |
|---|---|---|---|---|---|
| 120.0" | 58.0" | 58.0" | 208.2" | 73.6" | 58.3" |

### TIRE SIZES

| Series | Models | Standard Tire | Optional Tire |
|---|---|---|---|
| Special V-6<br>Special Deluxe V-6<br>Skylark V-6 | Sedans, Coupes, & Convertibles Less A.C. | 6.95 x 14 | 7.35 x 14 |
| Special V-6<br>Special Deluxe V-6<br>Skylark V-6 | Sedans, Coupes, & Convertibles With A.C. | 7.35 x 14 | 7.75 x 14 |

## TIRE SIZES

| Series | Models | Standard Tire | Optional Tire |
|---|---|---|---|
| Special V-6<br>Special Deluxe V-6 | Station Wagons | 7.35 x 14 | 7.75 x 14 |
| Special V-8<br>Special Deluxe V-8<br>Skylark V-8 | Sedans, Coupes, &<br>Convertibles | 7.35 x 14 | 7.75 x 14 |
| Special V-8<br>Special Deluxe V-8 | Station Wagons | 7.35 x 14 | 7.75 x 14 |
| Sportwagon | All | 7.75 x 14 | 7.75 x 14<br>(4-ply, 8-ply rating) |

# GROUP 1

# MAINTENANCE

## CONTENTS OF GROUP 1



## 1-1 ENGINE OIL RECOMMENDATIONS

### a. Engine Oil

Engine crankcase oils have a definite effect on ease of starting, oil economy, combustion chamber deposits and engine wear. It is recommended that you use an oil which, according to the label on the can, is: (1) intended for service MS and (2) passes car makers' tests or meets General Motors Standard GM 4745-M. Oils conforming to these types contain detergent additives.

### b. Grade or Viscosity

The grade or viscosity (SAE number) of engine oil should be selected for the lowest anticipated temperature at which cold engine starting will be required as recommended in the temperature-viscosity chart below.

### c. Engine Oil Change and Viscosity Recommendations

Oil level should be checked more frequently during the break-in period since somewhat higher oil consumption is normal until piston rings become seated.

The oil level should be maintained between the "Operating Range" marks on the gauge rod; each space between marks represents one quart. Do not fill above upper mark.

### d. Oil Color

The color of "Service MS"-type oil does not indicate its condition since it normally becomes dark (black or gray) after only a few hundred miles of driving. This is because the detergent content envelopes and holds in suspension extremely fine but harmless soot (soft carbon) and lead particles. The oil filter element does not remove this harmless material but it does remove harmful particles such as road dust, metal chips and hard carbon.

### e. Crankcase Flushing

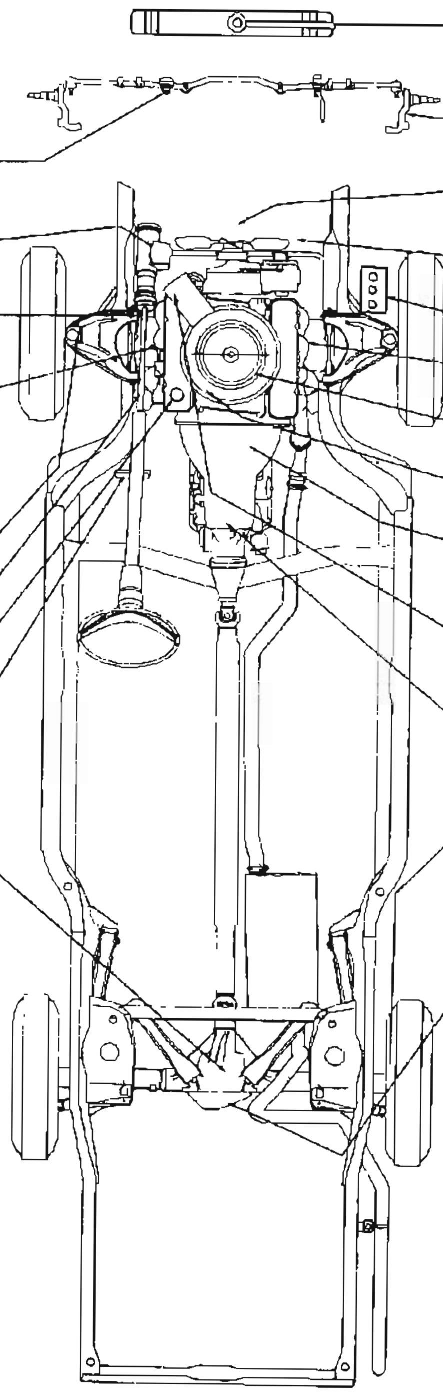
Flushing the crankcase with oils or solutions other than a good grade of 10W engine oil is not recommended. When flushing to remove contamination appears advisable, use 3 quarts 10W oil (4 quarts if filter is drained) and idle the engine at 1000 RPM (equivalent to 20 MPH) until the oil is hot, then drain crankcase

| Anticipated Lowest Temperatures | Use S.A.E. Viscosity Number | Change Your Oil At Least |
|---|---|---|
| Above Freezing (+32°F.) | S.A.E. 20W<br>S.A.E. 10W-30 | Every 60 days* |
| Below Freezing (+32°F. to 0°F.) | SS.A.E. 10W<br>S.A.E. 10W-30 | Every 60 days* |
| Below 0°F. | S.A.E. 5W<br>S.A.E. 5W-20 | Every 60 days* |

*Never exceed 6000 miles between oil changes. During extreme driving conditions which produce oil contamination by dust, water, or other foreign material, the oil should be changed more frequently than every 60 days. Your authorized Buick dealer is well qualified to advise you.

# 1965 BUICK LUBRICATION CHART

## 43000 - 44000 SERIES



RADIATOR—Maintain Coolant 1" below cap PERIODICALLY

LOWER STEERING KNUCKLE BALL JOINTS (2) —CL— 6,000 or 6 mos.

STEERING LINKAGE (4) -CL- 6,000 or 6 mos.

AIR CONDITIONER—Check Operation ONCE A YEAR

POWER STEER RESERVOIR Check Oil Level Hot -PSF- 6,000

OIL FILTER RECOMMENDATION Replace at Oil Change Nearest to 6,000 Miles or 6 Mos Whichever Occurs First

LOWER CONTROL ARM SHAFTS (4) 6,000 —CL— or 6 mos.

BATTERY - Add Colorless, Oderless, Drinking Water as Required. Do not Over-fill PERIODICALLY

UPPER CONTROL ARM SHAFTS (4) 6,000 —CL— or 6 mos.

Manifold Valve Shaft - Free Up -HTL- 6,000

ENGINE—CHECK OIL LEVEL—EO— PERIODICALLY

AIR CLEANER—Wash element in Kerosene—Re-oil. Squeeze out excess—EO— 12,000

POSITIVE CRANKCASE VENTILATOR- Replace with Correctly Calibrated Valve 12,000

AUTOMATIC TRANSMISSION—Check & Maintain Level-Hot—AT— 6,000 Clean Pan, Refill, and Adjust Low Band 24,000

UPPER STEERING KNUCKLE BALL JOINTS (2) —CL— 6,000 or 6 mos.

STD. STEERING GEAR—MPG— Check Level 24,000

FUEL FILTER (V-6) Remove From Carburetor and Clean 12,000
FUEL FILTER (V-8) Replacement of Element Recommended 24,000

FILLER CAP—Wash and Re-oil Elements —EO— 6,000

BRAKE MASTER CYLINDER—Maintain Level 1 8" Below Top of Reservoir Check Level —HBF— 6,000

SYNCHROMESH TRANSMISSION—Maintain at Filler Opening—Flushing & Seasonal Changes Not Recommended— MO — 6,000

POSITIVE TRACTION DIFFERENTIAL Maintain at Filler Opening to ¼" Below Flushing & Seasonal Changes Not Recommended
Special Lube - Buick Spec. No. 723 * Other Lubes May Cause Damage -TL- 6,000

BRAKE MECHANISM - Apply at Star Wheel Point of Contact and Lightly to 6 Surfaces on Which Shoe Rim Rests -BL- 18,000

STANDARD DIFFERENTIAL
REAR AXLE—Maintain at Filler Opening to ¼" below—Flushing & Seasonal Changes Not Recommended—MPG— 6,000
For Complete Refill Use Only Factory Hypoid Gear Lubricant—Unless Axle in Service 1000 Miles or More, Then Use -MPG-

**LUBRICANTS**

| | |
|---|---|
| BL | = Brake Lubricant, Self-adjusting Per Spec. MP 6805 |
| CL | = Chassis Lubricant (Long Effectiveness - Buick Spec. 742*) |
| AT | = Automatic Transmission Fluid, Type A (AQ-ATF)-Suffix A |
| EO | = Engine Oil (Current Viscosity) -GM - 4745-M * |
| HBF | = Hydraulic Brake Fluid-Delco Super No. 11 * |
| LUB | Lubriplate * |
| MPG | = Multi-Purpose Gear Lubricant (MIL-L-2105-B) |
| EP | = Multi-Purpose Grease EP No. 1 Grade |
| MO | = SAE 90 Multi Purpose Gear Lube or SAE 40 or 50 Engine Oil |
| TL | = Lube Performing To Buick Specifications No 723 * |
| HTL | = Buick Heat Trap Lube * |
| PSF | = Power Steering Fluid Per GM Spec 9985010 * |

* EQUIVALENT ACCEPTABLE IF MEETING SPECIFICATIONS

**CAPACITIES**

| | V-6 | V-8 |
|---|---|---|
| Cooling System | | |
| With Heater—Qts. | 10.7 | 13 7 |
| Without Heater—Qts. | 10.0 | 12 7 |
| With A/C - Qts. | 11 2 | 15 0 |
| Crankcase | | |
| Refill—Qts. | | 4 - (5*) |
| Dry Engine—Qts. | | 5 - (6*) |
| *With Dry Oil Filter | | |
| Gas Tank—Gal. | | 20 |
| Rear Axle—Pts. | | 2 5 |
| Transmission | | |
| Automatic— Pts. | | 21 |
| Std. Synchromesh—Pts | | 2 |
| 4 Speed Synchromesh - Pts | | 2 1/3 |
| Manual Steering Gear—Oz. | | 11 |
| Power Steering | | |
| Hydraulic System—Pts. | | 2 |

Figure 1-1—Lubrication Chart

and oil filter immediately after stopping engine. Fill crankcase with correct quantity and seasonal grade of oil. Install new oil filter element.

**f. Use of Buick HD Concentrate**

Buick HD Concentrate, available through Buick Parts Department under Group 1.850, is a compound of the materials used by oil refiners to manufacture high detergency motor oils. It is intended for use in engines operating under aggravated conditions where engine deposits, rust and corrosion cannot be adequately retarded by motor oils readily available to the average motorist. It is especially recommended for engines operated under restricted conditions, such as frequent stops, short trips and slow speeds where such symptoms as sticking valves, valve lifters and rings are noticed.

Although HD Concentrate may be used continually, it is normally unnecessary to use it with every crankcase refill. When used, the instructions on the container should be carefully observed.

Adverse driving conditions require more frequent draining and refilling. Adverse driving conditions are those which may cause early contamination of engine oil, such as operation under severe dust conditions or short runs with a cold engine.

## 1-2 MAINTENANCE—PERIODICALLY WHILE VEHICLE IS BEING REFUELED

**a. Battery**- Check Level.

If necessary add colorless, odorless drinking water to bring level to split ring at bottom of filler wells.

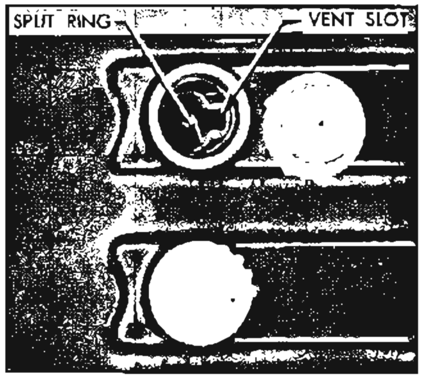



Figure 1-2—Battery Filler Well

NOTE: Do not overfill. Clean top of battery; if wet with acid, neutralize with soda and wash clean. See Figure 1-2.

**b. Tires**

For maximum tire life with corresponding good ride characteristics, maintain the tire pressure recommended in Group 7, Paragraph 7-1.

**c. Oil Filler Cap**

Check periodically for signs of dirt and other accumulations in filter portion of cap. Clean as often as necessary. This can be done by quickly washing in a suitable solvent and dipping in engine oil.

**d. Radiator Coolant**

Radiator coolant level should be checked when the engine is cold if at all possible. If the radiator cap is removed when the system is at normal operating temperature the coolant will boil and spurt out due to the release of pressure. Coolant lost in this manner must of course be replaced. If coolant should be needed, fill radiator to approximately 1" below filler neck when cold. Do not overfill as loss of coolant due to expansion will result.

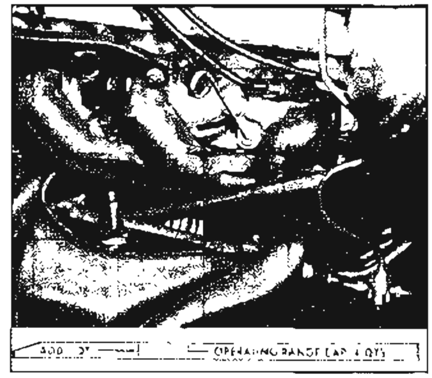


Figure 1-3—Engine Oil Gauge Rod

**e. Engine Oil**

This check should be performed last to allow the oil to drain back into the pan. Adding oil between changes may be necessary but only if the level is below the lower mark on the dip stick. See Figure 1-3.

NOTE: Oil level should only be checked when the engine is warm, as cold oil drains back to the oil pan very slowly.

## 1-3 MAINTENANCE—EVERY 6,000 MILES

**a. Engine Oil Change Recommendations**

Drain and refill engine crankcase every 60 days. However, never exceed 6,000 miles between changes. See Page 1-1 for oil recommendations.

**b. Engine Oil Filter Change Recommendations**

Replace engine oil filter with the engine oil change which comes nearest 6,000 miles or 6 months-whichever occurs first.

To change, screw filter off the filter base and discard. Wipe the gasket area of the base clean and install a new gasket in the groove


Figure 1-4—Oil Filter Installation

of a new AC Type PF-10 filter or equivalent. Lubricate the gasket and screw the filter on the nipple until the gasket just touches the base; tighten filter 2/3 turn more. Start engine. Do not accelerate engine beyond the normal idle until oil pressure is indicated. Check the filter area for leaks after the engine has run for five (5) minutes. See Figure 1-4.

### c. Oil Filler Cap

Wash cap thoroughly in a suitable solvent and dry. Dip in engine oil and allow to drain while performing other services. Just prior to installation re-oil and install on cover.

### d. Front Suspension and Steering Linkage

The Buick front suspension and steering linkage has been lubricated with a long-effectiveness lubricant at the factory and should be re-lubricated with a long-effectiveness lubricant equivalent to Buick Spec. #742 every 6,000 miles or six months whichever occurs first

NOTE: If lubricants not intended for long-effectiveness application are used, the lubrication interval should be shortened and should not exceed 2,000 miles.

Wipe dirt from the lubrication fittings and apply the lubricant under pressure at the following points (Figure 1-1):

Upper Ball Joints (2 fittings)
Lower Ball Joints (2 fittings)
Steering Linkage (4 fittings)

### e. Manifold Heat Valve

Place a few drops of "Buick Heat Trap Lube" or equivalent on shaft at each end, and free up if necessary. This can be found in the Buick Parts Book under Gr. 8.800, Part 980108. See Figure 1-5.

### f. Check Fluid Level

1. Master Brake Cylinder - Maintain fluid level 1/8" below top of filler opening. When adding brake fluid, use only Delco Supreme #11 hydraulic brake fluid or equivalent. Never use reclaimed fluid, mineral oil or fluid inferior to SAE Standard 70-R-1.

2. Synchromesh Transmission. Check oil level, after allowing time for oil to settle. Clean the surrounding area before removing filler plug. Level should be maintained at filler plug opening by adding SAE 90 multi-purpose gear lubricant.

NOTE: Draining and flushing transmission are not necessary unless the lubricant has become contaminated.

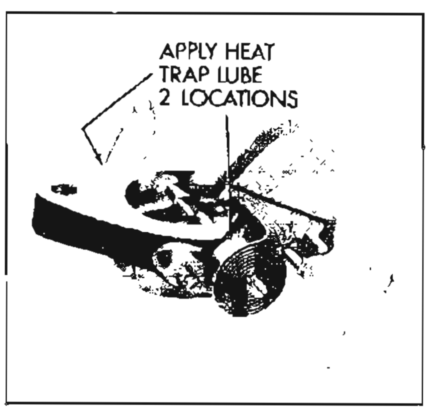



Figure 1-5—Exhaust Manifold Valve

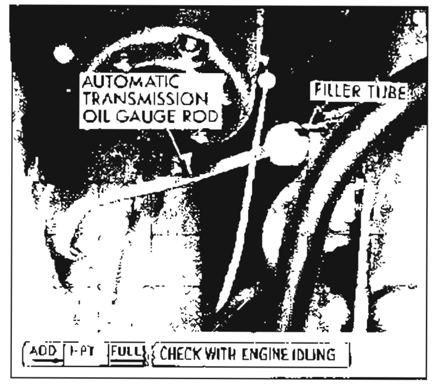



Figure 1-6—Automatic Transmission Oil Gauge Rod

3. Automatic Transmission. Check transmission oil level, with transmission oil at operating temperature (180° approximate), transmission in park and engine idling.

Remove gauge rod located under right side of hood, see Figure 1-6, wipe dry with clean cloth, then reinstall to full depth. Remove rod and note oil level.

If oil level is below the "ADD" mark on gauge rod, add oil specified under "every 24,000 miles" but do not fill above the "FULL" mark. Distance between the "FULL" and "ADD" marks represents approximately one pint.

4. Manual Steering Gear. Clean adjacent area, then remove gear housing filler plug. Add lubricant only as required to bring level to bottom of filler opening, using Chassis Lube. Seasonal or periodic change of lubricant is unnecessary.

5. Power Steering Gear. Thoroughly clean dirt from reservoir cap on top of oil pump, then remove cap. Fill within 1" of top of neck. Use only Buick Power Steering Fluid or equivalent meeting GM specification 9985010.

6. Rear Axle. Check lubricant level after allowing time for lube to settle. Clean the surrounding area before removing filler plug. Level should be maintained at

filler plug opening to 1/4" below by adding SAE 90 Multi-Purpose Gear Lubricant (MIL-1L-2105-B). See Figure 1-7. When car is operated in temperatures continuously below -10°F., use SAE 80 Multi-Purpose Gear Lubricant.

NOTE: Draining and flushing are not recommended, unless the lubricant has become contaminated. When complete refilling is necessary, SAE 80 or 90 Multi-Purpose Gear Lubricant may be used, provided the axle has been in service for 1000 miles or more. Axles with less than 1000 miles must not be completely refilled with any lubricant other than Factory Hypoid Lubricant. See paragraph 1-9.

7. Positive Traction Differential Rear Axle. Identified by embossed tag attached to the axle cover lower bolt stating "Use limited slip differential lube only." Check lubrication level after allowing time for lubricant to settle. Clean the surrounding area before removing filler plug. Level should be maintained at filler plug opening to 1/4" below by adding lubricant conforming to Buick Specification #723 only, as specified in paragraph 1-9. See Figure 1-7.

NOTE: If Positive Traction Differential lube becomes contaminated, the axle assembly may be flushed with light engine oil and then refilled with Positive Traction Lube.

### g. Minor Lubrication

Occasionally lubricate the pivot points of moving parts such as door and hood hinges and latches, door hold open, clutch, transmission, parking brake and folding top linkages with Lubriplate, or equivalent, or engine oil where applicable. A small quantity of lock lubricant occasionally applied to lock cylinders will prevent sticking. See details under "Maintenance - As Required".

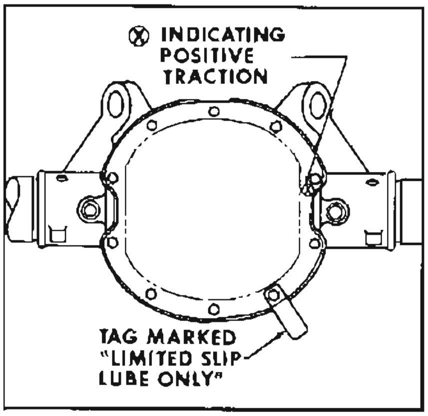



Figure 1-7—Differential Filler Plug (Positive Traction Shown)

NOTE: Do not lubricate carburetor or throttle linkage.

### h. Body Rubber Parts

Door, hood, and rear compartment rubber weatherstrips and bumpers may be kept pliable and quiet by the application of a light coat of Buick 4-X Compound or suitable silicone lubricant equivalent.

### i. Tires

For best tire mileage switch tires as recommended in Group 7.

## 1-4 MAINTENANCE—EVERY 12,000 MILES OR ONCE A YEAR

(Suggested in addition to the 6,000 mile recommendation)

### a. Tune-Care

Tune-Care includes: Clean and/or replace spark plugs and ignition points, check compression, battery, cranking system, charging system, fuel pump, choke, hose connection, belts, carburetor, set engine timing and adjust idle speed.

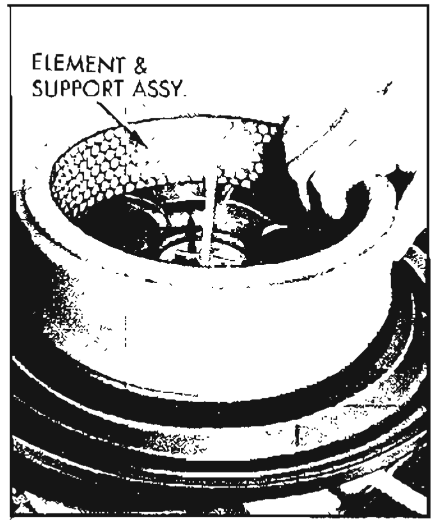



Figure 1-8—Air Cleaner Element and Support

### b. Air Cleaner

Recommendation is to normally service every 12,000 miles. If car is operated in dusty territory, check condition of air cleaner element more frequently and clean if dirty. See paragraph 1-10.

To clean the element, carefully remove from the mesh support, wash in kerosene and squeeze out. CAUTION: Take precautions against the possibility of fire. Do not wring the element or it may be torn. Wrap the element in a dry cloth and squeeze to remove all possible solvent.

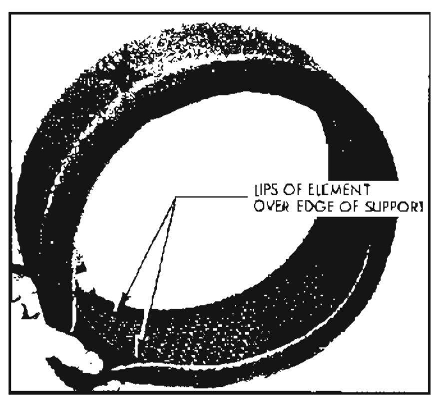



Figure 1-9—Installing Element on Support

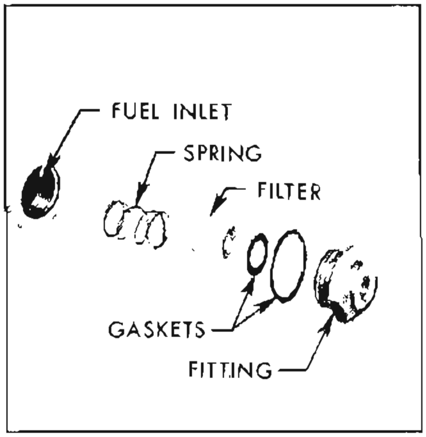



Figure 1-10—V-6 Engine Carburetor Fuel Filter

Oil the element liberally with engine oil and squeeze to evenly distribute the oil through the element and remove excess.

NOTE: The element should be only damp with oil not dripping.

Reinstall the element on mesh support, taking care to have edges of the element over the support to effect a good seal. See Figure 1-9. Clean any oil or accumulated dirt out of air cleaner housing before installing element. If the element becomes damaged, replace with AC-type A 96C or equivalent on V-8 engines and AC-type A 132C or equivalent on V-6 engines.

### c. Fuel Filter (V-6 Engine)

Remove from carburetor fuel inlet, inspect, clean, or replace, if necessary. More frequent servicing may be necessary if contaminants have entered the fuel system.

### d. Belts

Inspect engine driven belts for cracks and proper tension.

## 1-5 MAINTENANCE— EVERY 18,000 MILES

### a. Brakes

Examine brake linings for wear and the self-adjusting mechanism for proper functioning. Although linings may not be excessively worn, this check will indicate when another inspection should be made. If required, use Buick Factory Engineered replacement linings or equivalent. Lubricate the self-adjusting mechanism adjusting screw with Delco Moraine Special Brake Lubricant or equivalent.

### b. Front Wheel Bearings

There is no periodic lubrication schedule for front wheel bearings. They may be relubricated whenever brake drums are removed. Always follow with the correct bearing adjustment as outlined in paragraph 7-11.

## 1-6 MAINTENANCE— EVERY 24,000 MILES

(Suggested in addition to the 6,000 & 12,000 mile Recommendations)

### a. Fuel Filter (Exc. V-6's)

Replacement of the disposable filter is recommended. More frequent replacement may be necessary if contaminants have entered the fuel system. Replace with filter type GF-94 or equivalent on non-air conditioned cars and type GF-96 or equivalent for air conditioned cars.

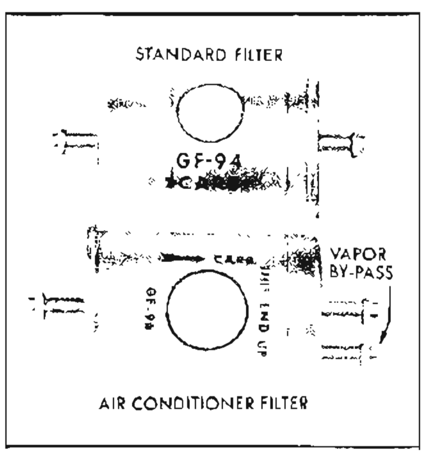



Figure 1-11—Fuel Filters (V-8 Engines)

### b. Automatic Transmission

At this interval the automatic transmission should be drained, the oil pan cleaned, the oil filter changed, new oil added, and the low band adjusted.

1. Approved Oil For Buick Automatic Transmissions - The following oils are approved for Buick Automatic Transmissions and no other fluid should be used:

Special Buick Oil - available through Buick Warehouses under Group 4.101.

Automatic Transmission Fluid Type A - available through petroleum suppliers. This fluid must have AQ-ATF and an identification number, suffix A, embossed on the lid of the can.

2. Installing New Oil Filter (Transmissions used with V-8 engines only)

a. Remove bolts from transmission oil pan, remove pan, and allow transmission to drain.

b. Carefully remove filter and pipe assembly from transmission.

c. Inspect seal near end of pipe. If it is damaged in any way, discard it along with the filter. If no damage is obvious, save seal for installation on new filter.

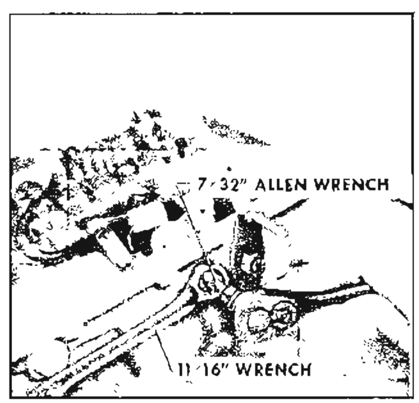



Figure 1-12—Torquing Low Band Screw

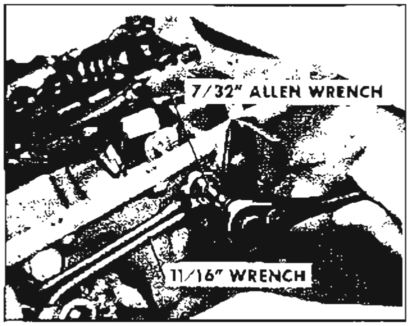



Figure 1-13—Backing Off Low Band Screw

d. Place seal on new filter. Use an AC Type PF-162 or equivalent for replacement purposes.

e. Carefully install new filter on transmission taking care not to cut or tear the "O" ring seal.

f. Clean oil pan and install on transmission. Torque pan bolts to 8-12 ft. lbs.

3. Draining Oil Pan (Transmissions used with V-6 engines only)

Follow the procedure outlined above with the exception of those references to an oil filter. Transmissions used with V-6 engines do not use an oil filter. Instead an oil screen is attached to the oil pipe. This screen and pipe assembly can be removed and cleaned in a suitable solvent. Upon reassembling, take care not to cut or tear the "O" ring located near the end of the pipe. If it is damaged in any way it must be replaced with a new one.

4. Low Band Adjustment

1. Adjust low band adjusting screw to 40 in. lbs. See Figure 1-12.

2. Back off adjusting screw four (4) turns and lock nut. See Figure 1-13.

3. Replace adjusting screw cap. Refer to Figure 1-14.

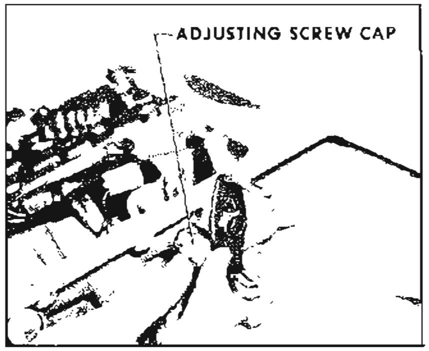



Figure 1-14—Installing Adjuster Screw Cap

### c. Manual Steering Gear

At this interval the manual steering gear lubricant level should be checked. Remove the lower bolt on gear cover marked "Lube". Add chassis lubricant conforming to Buick Specification #742 as necessary.

## 1-7 MAINTENANCE—SEASONAL (COOLING SYSTEM AND AIR CONDITIONER SERVICES)

### a. Anti-Freeze

A permanent glycol type corrosion and anti-freeze cooling system protection solution developed for year around use (General Motors Specification, GM 1899-M) has been installed in the cooling system of the Buick Special or Skylark at the factory.

Although this type coolant should be used continuously throughout the year, once a year the cooling system should be drained, flushed and permanent type anti-freeze also conforming to General Motors Specification GM 1899-M installed. Water alone, Methanol, or alcohol type anti-freeze is definitely not recommended.

If water alone must be used as coolant in an emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant be added to the cooling system as soon as possible. This material is supplied under Buick Part #980504. If any other cooling system protector is used, be sure it is labeled to indicate that it meets General Motors Specification GM 1894-M.

### b. Air Conditioner-Equipped Models

It is recommended that the air conditioner be checked each Spring in preparation for Summer operation.

It is good practice to occasionally remove insects and dirt from the air conditioner condenser.

## 1-8 MAINTENANCE—AS REQUIRED

### a. Body Lubrication

The movable mechanical parts of the body are lubricated at the factory to insure proper and quiet operation. If additional lubrication is required, the following specified materials should be used at the locations listed.

1. Front and Rear Door Hinge Hold Open - Wipe off dirt and apply a thin coat of Lubriplate or equivalent at points indicated in Figure 1-15.

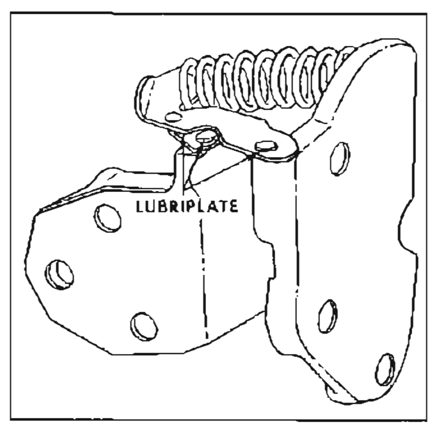



Figure 1-15—Door Hold Open Lubrication

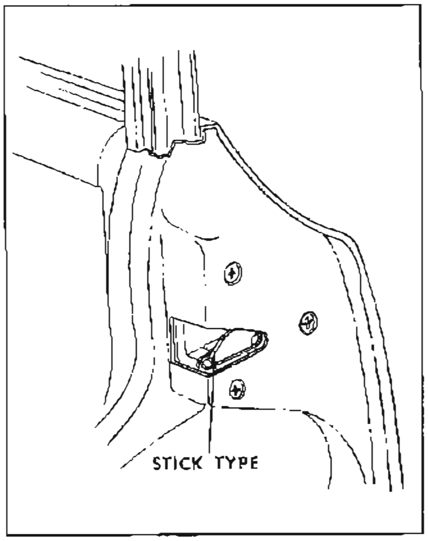



Figure 1-16—Door Lock Fork Bolt Lubrication

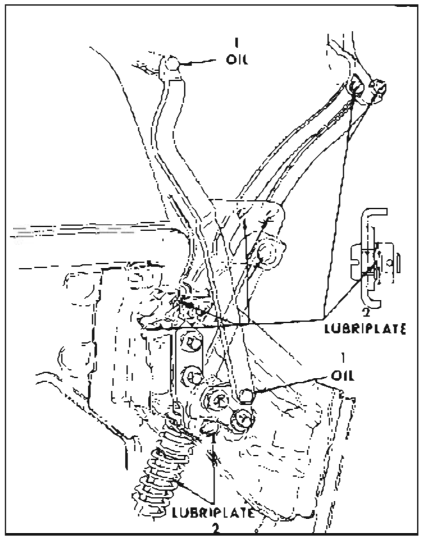



Figure 1-18—Convertible Top Linkage Lubrication

2. Instrument Panel Compartment Door Hinge - Wipe off dirt and apply a sparing amount of dripless oil to the hinge frictional points. Operate door and wipe off excess lubricant.

3. Lock Cylinders - If key operates roughly in any lock cylinder, blow powdered graphite into key slot. DO NOT USE OIL.

4. Gas Tank Filler Door - Apply a few drops of light engine oil to hinge. Wipe off excess oil to prevent accumulation of dirt.

5. Door Lock Fork Bolt - Wipe off dirt and apply a thin coat of stick type lubricant to contact point as shown in Figure 1-16.

6. Rear Compartment Lid Lock - Apply a thin coat of Lubriplate or equivalent to striker bolt as shown in Figure 1-17.

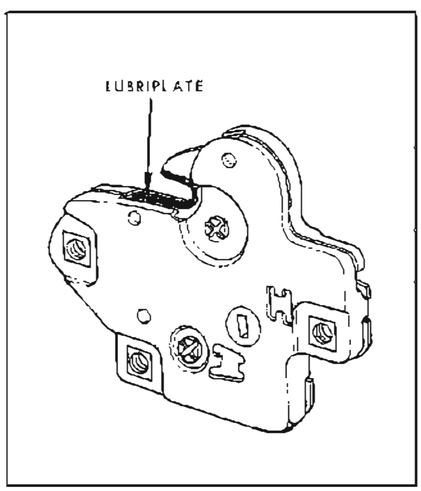



Figure 1-17—Rear Compartment Lid Lock Bolt Lubrication

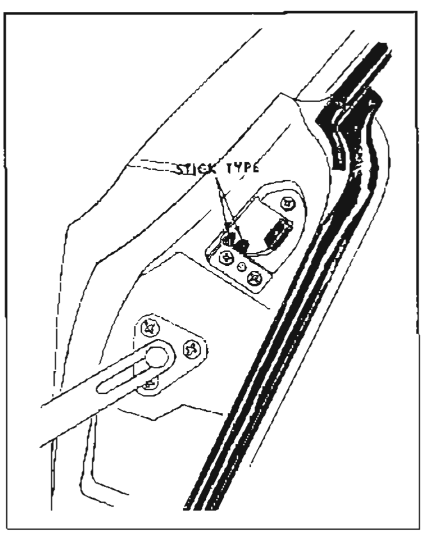



Figure 1-19—Tail Gate Lock Striker Lubrication

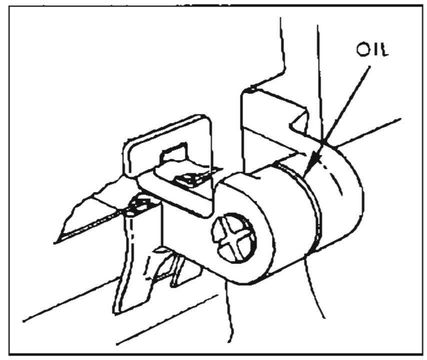



Figure 1-20—Tail Gate Hinge Lubrication

7. Door Jam Switch - Wipe off dirt and apply a thin coat of Lubriplate or equivalent to end surface of switch plunger and remove excess lubricant.

8. Front Seat Adjuster Tracks - A thin coat of Lubriplate or equivalent should be applied to seat tracks.

9. Convertible Top Mechanism - Apply a sparing amount of dripless oil to points indicated by "1" and Lubriplate or equivalent to those points indicated by "2" in Figure 1-18.

10. Station Wagon Folding Seat Linkage - Apply a sparing amount of dripless oil to all frictional points. Work seat as required and wipe off excess lubricant.

11. Tail Gate Lock Striker - Apply a thin coat of stick type lubricant to surface of lock bolt striker teeth. After lubrication, close door several times and remove excess lubricant. See Figure 1-19.

12. Tail Gate Hinges - Apply a sparing amount of dripless oil to frictional points of hinge. Work tail gate several times and remove excess lubricant. See Figure 1-20.

13. Folding Top Lift Cylinder Piston Rods - With folding top in raised position, wipe exposed portion of each top lift cylinder piston rod with a cloth dampened with brake fluid to remove any oxidation or accumulated grime.

With another clean cloth, apply a light film of brake film to act as a lubricant.

NOTE: DO NOT ALLOW BRAKE FLUID TO COME IN CONTACT WITH ANY PAINTED OR TRIMMED PARTS OF THE BODY.

#### b. Chassis Lubrication

1. Hood Latch and Hinges. Apply Lubriplate to hood latch as shown in Figure 1-21. Apply engine oil to hood hinge pins.

2. Hood Lacing and Hood Bumpers. Lightly coat hood lacing and bumpers with silicone lube. Wipe off excess.

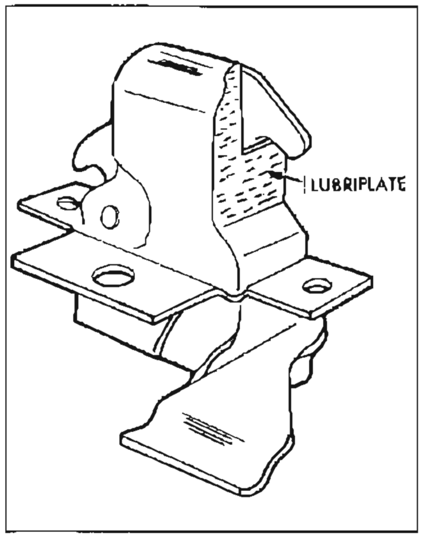



Figure 1-21—Hood Latch Lubrication

### 1-9 REAR AXLE LUBRICANT RECOMMENDATIONS

#### a. Standard Differential Axle

Buick Special and Skylark rear axles are filled at the factory with a special hypoid gear lubricant. It is not necessary to remove the original lubricant at any time except when it has become contaminated, or when it is required for inspection of parts or for repairs. Therefore there is no drain hole in the rear axle housing.

Draining and flushing are not recommended unless the lubricant has become contaminated. When complete refilling is necessary, Multi-Purpose Gear Lubricant (conforming to specification MIL-L-2105B) may be used, provided the axle has been in service for 1000 miles or more. Axles with less than 1000 miles service must not be completely refilled with any lubricant other than Factory Hypoid Lubricant.

The lube is packaged with replacement ring and pinion gear sets and is also available through the Buick Parts Department under Group 5.535.

#### b. Positive Traction Differential Axle

Buick Positive Traction Differential Axles are filled at the Factory with a special lubricant conforming to Buick Specification No. 723. It is not necessary to remove the lubricant at any time except when it has become contaminated or when it is required for inspection of parts or for repairs. There is no drain hole in the rear axle housing.

In all cases of adding lubricant to bring to proper level or complete refilling of Positive Traction Rear Axle, only lubricant conforming to Buick Specification No. 723 may be used. Lubricant conforming to this specification may be obtained from any Buick Parts Warehouse under Group 5.535.

Positive Traction Differential Rear Axles can be identified by an embossed tag which reads, "Use Limited Slip Differential Lube Only." It is secured to the differential rear cover by one of the attaching bolts. See Figure 1-7.

### 1-10 VEHICLE OPERATION UNDER DUSTY CONDITIONS

When cars are operated in dusty climates or under adverse conditions, the following precautions should be taken to prevent dirt and other foreign materials from entering the engine.

a. Change Engine Oil - Change more often than is recommended in paragraph 1-1. The severity of the conditions should determine the frequency of oil changes.

b. Oil Filter - Change each time that the oil is changed.

c. Oil Filler Cap - When dirt is found in cap, clean as directed in paragraph 1-3.

d. Air Cleaner Element - If dirt and foreign materials found on element are excessive, clean as directed in paragraph 1-4. Check periodically.

# GROUP 2

# ENGINE

## SECTIONS IN GROUP 2



## SECTION 2-A
## 225 CUBIC INCH V-6 ENGINE

### CONTENTS OF SECTION 2-A



(Refer to Para. 2-18 in V-8 section for engine mounting and flywheel balance information.)

## 2-1 GENERAL SPECIFICATIONS

| | |
|---|---|
| Engine Type | 90° V-6 |
| Valve Arrangement | In Head |
| Bore and Stroke | 3.750 x 3.400 |
| Piston Displacement | 225 Cu. In. |
| Compression Ratio | 9.0 to 1 |
| Brake Horsepower @ RPM | 155 BHP @ 4400 |
| Torque @ RPM | 225 lb. ft. @ 2400 |
| Octane Requirement | 84 Motor Method<br>93 Research Method |
| Taxable Horsepower | 33.748 |
| Cylinder Numbers Front to Rear | |
| Right Bank | 2-4-6 |
| Left Bank | 1-3-5 |
| Firing Order | 1-6-5-4-3-2 |
| Cylinder Block Material | Cast Iron |
| Cylinder Head Material | Cast Iron |
| Engine Idle Speed | |
| Synchromesh | 550 |
| Automatic | 550 Drive |
| A/C Auto | 600 Drive |

### Piston and Piston Pin Specifications

| | |
|---|---|
| Piston Material | Cast Aluminum Alloy |
| Piston Treatment | Tin Plated |
| Piston Pin Material | SAE 1018 or 1118 Steel |
| Piston Pin Type | Pressed In Rod |

### Connecting Rod Specifications

| | |
|---|---|
| Material - Rod | Pearlitic Malleable Iron |
| Bearing Type | Removable Steel Backed |
| Bearing Material | M/400 Aluminum |

## Ring Specifications

Compression Ring Material & Surface Treatment
#1 . . . . . . . . . . Iron - Chrome Plated
#2 . . . . . . . . . . Iron - Lubrited
Oil Ring Type . . . . . . . . . . Dual Steel Rail with Spacer
Oil Ring Expander . . . . . . . . . . Steel Humped Ring
Location of Rings . . . . . . . . . . Above Piston Pin

## Crankshaft Specifications

Material . . . . . . . . . . Pearlitic Malleable Iron
Bearings . . . . . . . . . . 4 Replaceable Liner
Bearing Material . . . . . . . . . . Durex 100A (#4) M-400 Alum. (#1, #2, and #3)
Bearing Taking End Thrust . . . . . . . . . . #2

## Camshaft Specifications

Material . . . . . . . . . . Cast Alloy Iron
Bearings . . . . . . . . . . Steel Backed Babbitt
Number of Bearings . . . . . . . . . . 4
Camshaft Location . . . . . . . . . . Above Crankshaft at Center of "V"
Type of Drive . . . . . . . . . . Chain
No. of Links . . . . . . . . . . 54
Crankshaft Sprocket . . . . . . . . . . Sintered Iron
Camshaft Sprocket . . . . . . . . . . Nylon Coated Aluminum

## Valve Specifications

Intake Valve Material . . . . . . . . . . SAE 1041 Steel
Exhaust Valve Material . . . . . . . . . . GM-N82152 (21-4N)
Valve Lifter Type . . . . . . . . . . Hydraulic
Valve Spring . . . . . . . . . . Single Helical

## Lubrication System Specifications

Type of Lubrication
Main Bearings . . . . . . . . . . Pressure
Connecting Rods . . . . . . . . . . Pressure
Piston Pins . . . . . . . . . . Splash
Camshaft Bearings . . . . . . . . . . Pressure
Timing Chain . . . . . . . . . . Splash & Nozzle
Cylinder Walls . . . . . . . . . . Splash & Nozzle
Oil Pump Type . . . . . . . . . . Gear Driven
Normal Oil Pressure . . . . . . . . . . 33 lbs. @ 2400 RPM
Oil Pressure Sending Unit . . . . . . . . . . Electrical
Oil Intake . . . . . . . . . . Screened Tube
Oil Filter System . . . . . . . . . . Full Flow
Filter Type . . . . . . . . . . Throw-Away Element & Can
Crankcase Capacity
Less Filter . . . . . . . . . . 4 qts.
With Filter . . . . . . . . . . 5 qts.

## Cooling System Specifications

System Type . . . . . . . . . . Pressure
Radiator Cap Relief Pressure . . . . . . . . . . 15 PSI
Thermostat . . . . . . . . . . Choke Type Opening at 180°
Water Pump
Type . . . . . . . . . . Centrifugal
GPM @ RPM . . . . . . . . . . 14 @ 1000
Drive . . . . . . . . . . V-Belt
Bearings . . . . . . . . . . Double Row
By-Pass Recirculation Type . . . . . . . . . . External
Cooling System Capacity
With Heater . . . . . . . . . . 10.7 Qts.
W/O Heater . . . . . . . . . . 10.0 Qts.
W.A.C. . . . . . . . . . . 11.2 Qts.

### Fan Diameter and Number of Blades

| | |
|---|---|
| Less AC | 17.12" - 4 |
| With AC | 17.00" - 7 |
| Fan Drive | |
| Less AC | Water Pump Shaft |
| With AC | Torque and Temperature Sensitive Clutch |

## 2-2 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. Overtightening to any extent may damage threads, thus preventing proper torque from being attained, requiring replacement or repair of the damaged part.

| | Torque Ft. Lbs. |
|---|---|
| Crankshaft Bearing Caps to Cylinder Block | 95-120 |
| Connecting Rods | 30-40 |
| Cylinder Head to Cylinder Block | 65-80 |
| Harmonic Balancer to Crankshaft | 140 Minimum |
| Fan Driving Pulley to Harmonic Balancer | 18-25 |
| Flywheel to Crankshaft (Auto. & Synchro.) | 50-65 |
| Oil Pan to Cylinder Block | 9-13 |
| Oil Pan Drain Plug | 25-35 |
| Oil Pump Cover to Timing Chain Cover | 8-12 |
| Oil Pump Pressure Regulator Retainer | 25-30 |
| Oil Screen Housing to Cylinder Block | 6-9 |
| Oil Pan Baffle to Cylinder Block | 9-13 |
| Oil Gallery Plugs | 20-30 |
| Filter Assembly to Pump Cover | 10-15 |
| Timing Chain Cover to Block | 17-23 |
| Water Pump Cover to Timing Chain Cover | 6-8 |
| Fan Driven Pulley | 17-23 |
| Thermostat Housing to Intake Manifold | 17-23 |
| Intake Manifold to Cylinder Head | 25-35 |
| Exhaust Manifold to Cylinder Head | 10-15 |
| Carburetor to Intake Manifold | 10-15 |
| Air Cleaner Stud | 17-23 Lb. In. |
| Air Cleaner Wing Nut | 17-23 Lb. In. |
| Fuel Pump to Cylinder Block | 17-23 |
| Motor Mount to Cylinder Block | 50-75 |
| Fuel Pump Eccentric and Timing Chain Sprocket to Camshaft | 40-55 |
| Rocker Arm Cover to Cylinder Head | 3 to 5 |
| Rocker Arm Shaft Bracket to Cylinder Head | 25-35 |
| Delcotron Bracket to Cylinder Head | 30 to 40 |
| Delcotron Bracket to Water Pump Timing Chain Cover | 18-25 |
| Delcotron Mounting Bracket thru Delcotron to Cylinder Head at Pivot Location | 30-40 |
| Starting Motor to Block | 30-40 |
| Starting Motor Brace to Block | 9-13 |
| Starting Motor Brace to Starting Motor | 9-13 |
| Distributor Holddown Clamp | 10-15 |
| Spark Plugs | 25-35 |
| Synchromesh Lower Flywheel Housing | 9-13 |
| Flywheel Housing to Cylinder Block | 30-40 |
| Timing Chain Damper to Cylinder Block Bolt | 6-9 |
| Bolt - Special Moveable Timing Chain Damper | 10-15 |

## 2-3 DIMENSIONS, ADJUSTMENTS, AND TOLERANCES

### Rings, Piston, and Piston Pin Specifications

| | |
|---|---|
| Piston Clearance Limits | |
| Top Land | .0215"-.0295" |
| Skirt - Top | .0005"-.0011" |
| Skirt - Bottom | .0005"-.0021" |

| | |
|---|---|
| Ring Groove Depth | |
| #1 - Compression Ring | .1880"-.1955" |
| #2 - Compression Ring | .1905"-.1980" |
| #3 - Oil Ring | .1905"-.1980" |
| Ring Width | |
| #1 - Compression Ring | .0785"-.0790" |
| #2 - Compression Ring | .0770"-.0780" |
| #3 - Oil Ring | .181"-.187" |
| Ring Gap | |
| #1 - Compression Ring | .010"-.020" |
| #2 - Compression Ring | .010"-.020" |
| #3 - Oil Ring | .015"-.035" |
| Piston Pin Length | 3.060" |
| Diameter of Pin | .9394"-.9397" |
| Clearance | |
| In Piston | .00005"-.0001" |
| In Rod | .0007"-.0015" Press |
| Direction & Amount Offset In Piston | .040" Toward High Thrust Side |

*All Measurements In Inches Unless Otherwise Specified.

## Connecting Rod Specifications

| | |
|---|---|
| Bearing Length | .737" |
| Bearing Clearance (Limits) | .0020"-.0023" |
| End Play - Total for both Rods | .006"-.014" |

## Crankshaft Specifications

| | |
|---|---|
| End Play at Thrust Bearing | .004"-.008" |
| Main Bearing Journal Diameter | 2.4995" |
| Crankpin Journal Diameter | 2.0000" |
| Main Bearing Overall Length | |
| #1 | .864" |
| #2 | .1057" |
| #3 | .864" |
| #4 | .864" |
| Main Bearing to Journal Clearance | .0005"-.0021" |

## Camshaft Specifications

| | |
|---|---|
| Bearing Journal Diameter | |
| #1 | 1.755"-1.756" |
| #2 | 1.725"-1.726" |
| #3 | 1.695"-1.696" |
| #4 | 1.665"-1.666" |
| Journal Clearance In Bearings | |

## Valve System Specifications

| | |
|---|---|
| Rocker Arm Ratio | 1.6 to 1 |
| Rocker Arm Clearance On Shaft | .0017"-.0032" |
| Valve Lifter Diameter | .8422"-.8427" |
| Valve Lifter Clearance In Crankcase | .0015"-.003" |
| Valve Lifter Leakdown Rate | 12 to 60 Sec. in Test Fixture |
| Intake Valve | |
| Head Diameter | 1.625" |
| Seat Angle | 45° |
| Stem Diameter | .3412" Top - .3407" Bottom |
| Clearance In Guide | Top .001"-.003" - Bottom .0015"-.0035" |
| Exhaust Valve | |
| Head Diameter | 1.3750" |
| Seat Angle | 45° |
| Stem Diameter | .3407" Top - .3402" Bottom |
| Clearance In Guide | Top .0015"-.0035" - Bottom .002"-.004" |
| Valve Spring | |
| Valve Closed - Pounds @ Length | 64 @ 1.640 |
| Valve Open - Pounds @ Length | 168 @ 1.260 |

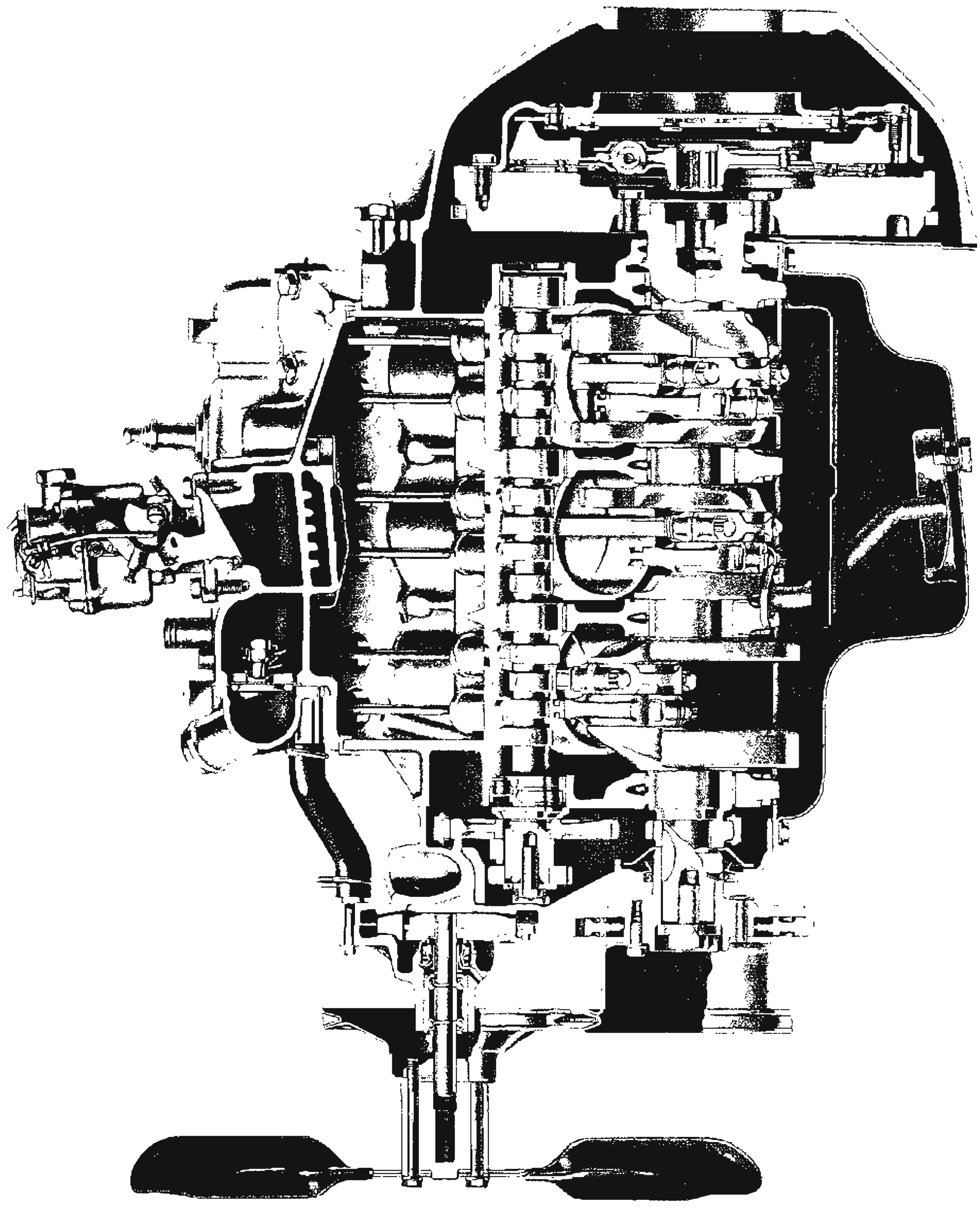


Figure 2-1—V-6 Engine Cross Section (Side View)

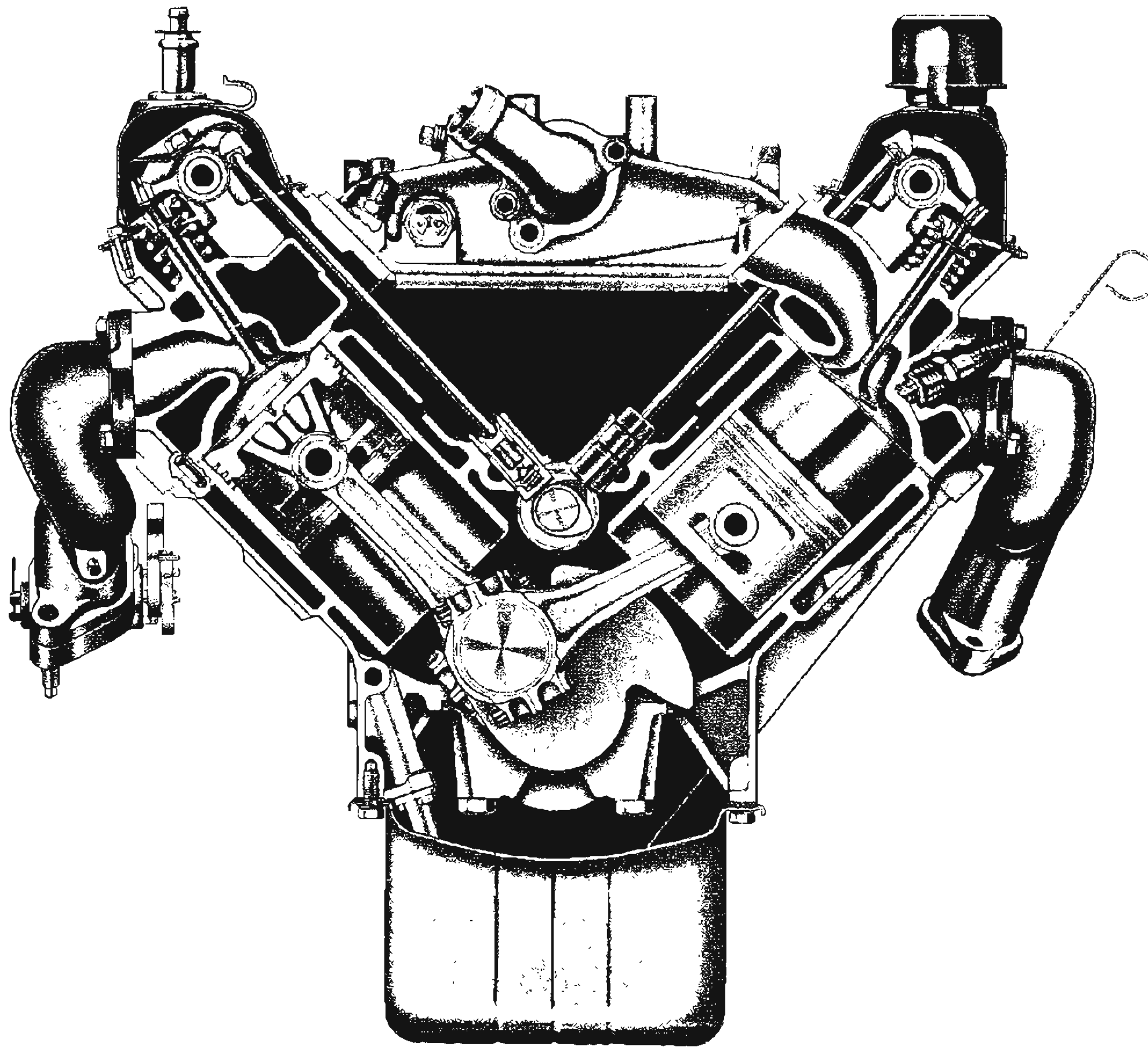


Figure 2-2—V-6 Engine Cross Section (Front View)

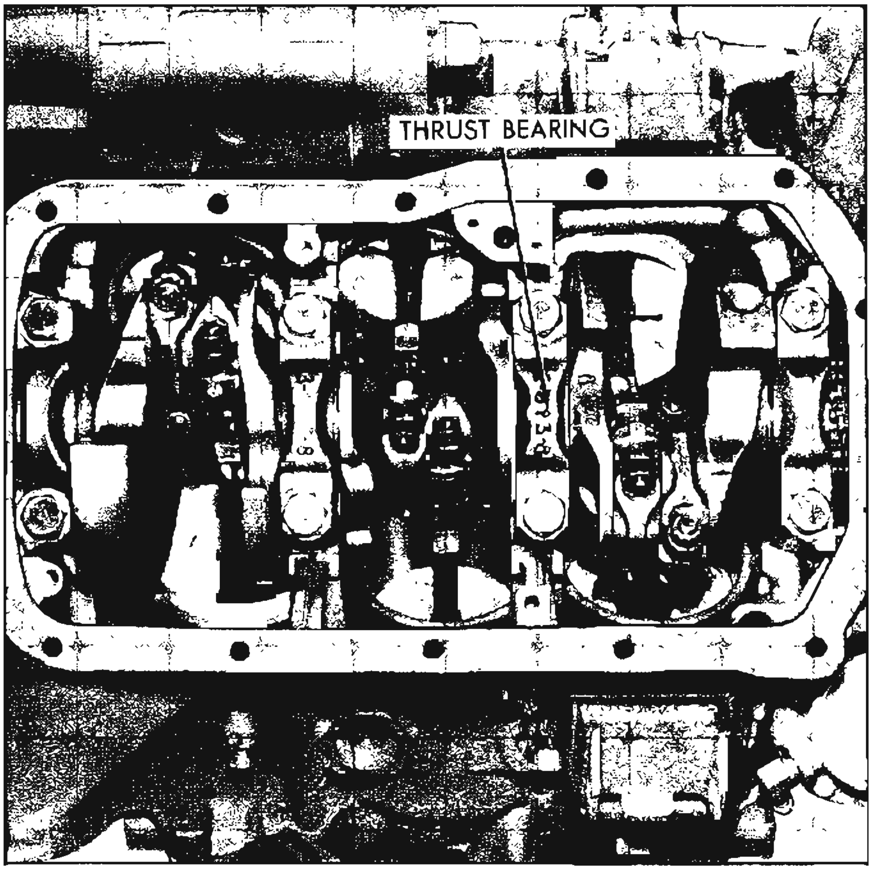



Figure 2-3—Lower Engine with Pan Removed

## 2-4 ENGINE DESCRIPTION

### a. Engine Usage

A V-6 engine with a displacement of 225 cubic inches is supplied as standard equipment on all 433-435-441-44300 models. The same basic engine is used with either synchromesh or automatic transmissions. The synchromesh model is equipped with a cast iron flywheel and flywheel housing. Automatic transmission engines are equipped with a stamped steel flywheel that bolts to the transmission converter pump. All V-6 engines have a compression ratio of 9.0 to 1 which permits the use of "regular" grade gasoline.

### b. Engine Mounting

The engine-transmission unit is mounted to the chassis at three points by synthetic rubber pads. The two front mounts are bolted to the engine crankcase and the frame cross member. These mounts support most of the engine weight and control its torsional characteristics. The single rear mount is placed between the transmission and the transmission support and is secured by two bolts. It supports part of the engine and transmission weight and locates the rear of the engine with respect to the centerline of the car.

### c. Engine Construction

The engine crankcase is made from cast iron. Two banks of cylinders - three cylinders per bank - are cast at a 90° angle. The lower part of the crankcase extends below the centerline of the crankshaft, forming a continuous flat surface with the rear bearing cap and the timing chain cover. This design allows installation of an oil sump pan with a one-piece gasket. The cylinders in the left bank (as viewed from the drivers seat) are numbered 1 - 3 - 5, counting from front to rear. The cylinders in the right bank are numbered 2 - 4 - 6, counting from front to rear.

The crankshaft is supported in the crankcase by steel-backed full precision bearings, all having the same nominal diameter. Except for the thrust bearing, all bearings are identical. The thrust bearing takes end thrust and has flanges for that purpose. The number 2 bearing is designated as the thrust bearing.

The crankshaft is counterbalanced by weights cast integral with the crank cheeks. Maximum counterweighting in the space available is accomplished by precision casting the counterweights to a contour which allows a minimum uniform clearance with cylinder barrels and piston skirts.

Connecting rods are 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. The piston pin is a press fit into the upper end. The outer ends of the piston pin are a slide fit in the piston bosses.

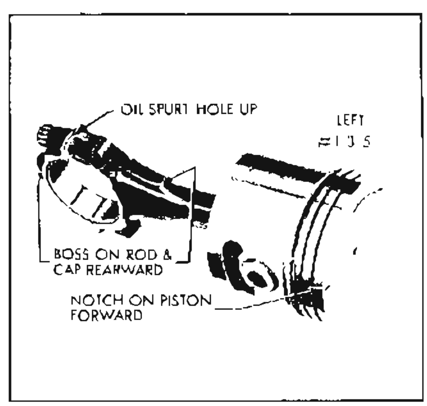



Figure 2-4—Piston and Connecting Rod

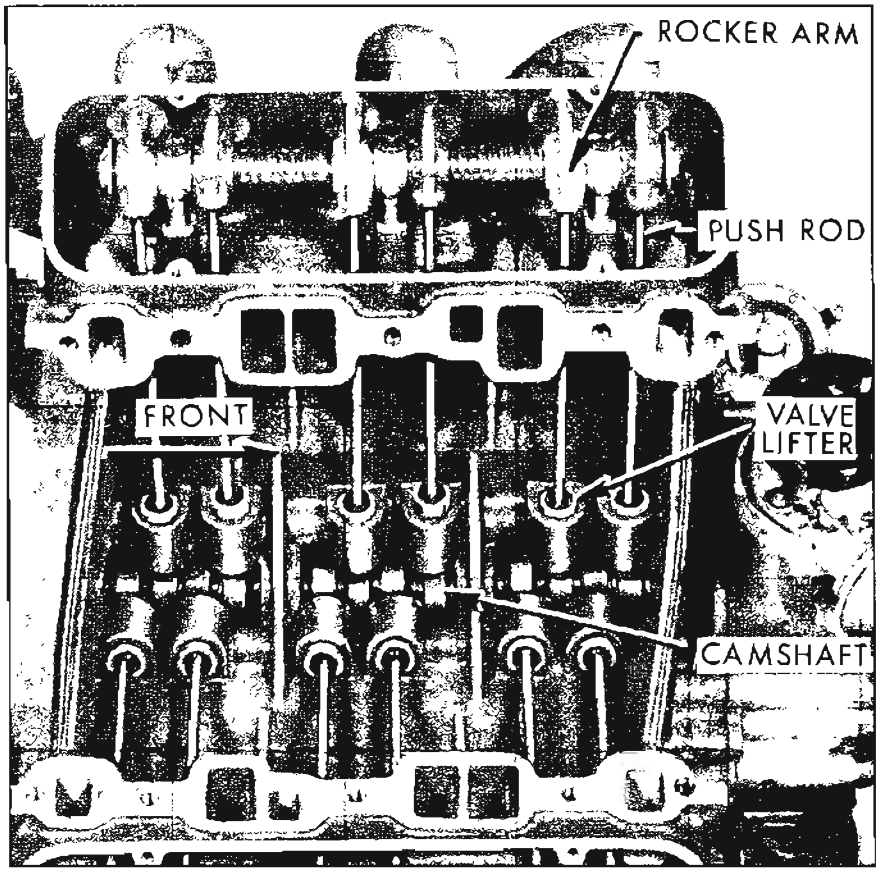



Figure 2-5—Engine Valve Mechanism

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 top compression rings are installed with this groove or bevel down. The lower compression ring is installed bevel up. The oil ring in the lower groove consists of two thin steel rails separated by a spacer. V-6 engine oil rings are backed by a hump-type spring steel expander.

V-6 cylinder heads are cast iron with valve stem guides cast in place. 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.

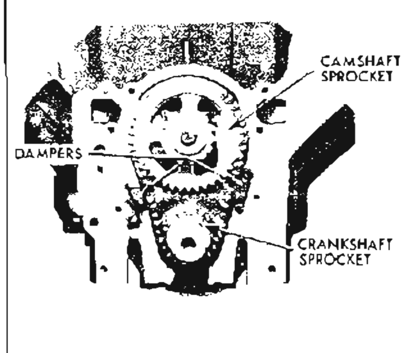



Figure 2-6—Timing Chain and Damper Installation

The valves are in line in each head and operate at an angle 10° above the centerline of the cylinder bores. The spark plug in each cylinder is located so the point gap is ideally located with respect to the sweep of the incoming charge. 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 1.625" in diameter and exhaust valve heads are 1.375" 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.

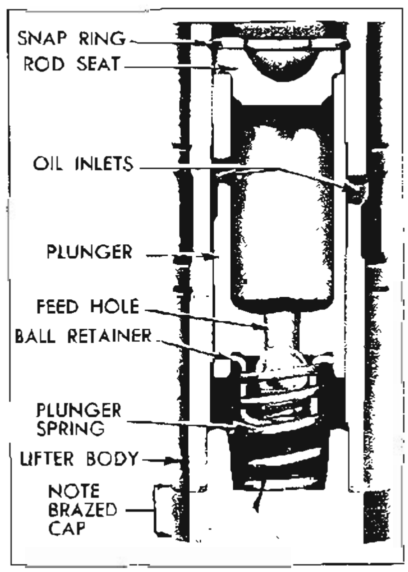



Figure 2-7—Hydraulic Lifter Cross Section

The rocker arms for each bank of cylinders are mounted on a tubular steel shaft supported on the cylinder head by die cast brackets. The rocker arms are die cast aluminum with inserts at the push rod socket and the valve stem contact face.

The camshaft is located above the crankshaft between the two banks of cylinders, where it is supported in five steel backed babbit bearings. It is driven at 1/2 crankshaft speed by sprockets and a single outside guide type chain.

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 assembly or in service. Construction and operation of hydraulic valve lifters are described below.

In addition to its normal function of a cam follower, each hydraulic valve lifter also serves as an automatic adjuster which maintains zero lash in the valve operating linkage under all operating conditions. By eliminating all lash in the operating linkage and also providing a cushion of oil to absorb operating shocks, the hydraulic valve lifter promotes quiet valve operation. It also eliminates the need for periodic valve adjustment to compensate for wear of parts.

As shown in Figure 2-7, all parts of a hydraulic lifter are housed in the body, which is the cam follower. The body and the plunger are ground to very close limits, then a plunger is selectively fitted to each body to assure free movement with very little clearance. The push rod seat is free to move with the plunger in the body and, as its name implies, it provides a spherical seat to support the lower end of the push rod.

The plunger and seat are pressed toward the upper end of the lifter body by a coil spring which also holds a check ball retainer against the lower end of the plunger. When lifter is out of engine, a spring wire retainer holds all parts in the body. The ball retainer holds a spring loaded check ball in position over the lower end of a feed hole in the plunger.

When the valve lifter is installed in the engine, the push rod holds the seat and plunger downward and clear of the plunger retainer at all times. The plunger spring then presses the lifter body down against the camshaft and presses the plunger and seat up against the push rod with an eight pound load; this is enough to take up all lash clearances between parts in the valve linkage without affecting positive seating of the valve.

Oil is fed to all lifters through galleries in the crankcase. Oil enters each lifter through grooves and oil holes in the lifter body and plunger, flows down into the chamber below the plunger through the feed hole and around the check ball. The first few cycles of operation after the engine is started forces out all air and completely fills the plunger and lower chamber of each lifter with oil.

At the start of a cycle of valve operation, the lifter body rests on the camshaft base circle. The plunger spring holds all lash clearances out of the valve linkage

As the rotating camshaft starts raising valve lifter body, oil in the lower chamber and the check ball spring firmly seat the check ball against the plunger to prevent appreciable loss of oil from the lower chamber. The lifting force against the body is then transmitted through the entrapped oil to the check ball and plunger so that the plunger and push rod seat move upward with the body to operate the linkage which opens the engine valve.

As the camshaft rotates further to close the engine valve, the valve spring forces the linkage and lifter to follow the cam down. When the engine valve seats, the linkage parts and lifter plunger stop but the plunger spring forces the body to follow the cam downward .002" to .003" until it again rests on the camshaft base circle. Oil pressure against the check ball from the lower chamber ceases when the plunger stops and allows passage of oil past the check ball into the lower chamber to replace the slight amount of oil lost by "leak-down".

During the valve opening and closing operation a very slight amount of oil escapes through the clearance between plunger and body and returns to the crankcase. This slight loss of oil (called "leak-down") is beneficial in providing a gradual change of oil in the lifter, since fresh oil enters the lower chamber when pressure is relieved on the check ball at the end of each cycle of operation.

When engine temperature increases and the valve linkage parts expand, the plunger must move to a slightly lower position in the lifter body to assure full closing of the engine valve. When engine temperature decreases and the linkage parts contract, the plunger must move to a slightly higher position in body to prevent lash clearances in the valve linkage. In either case, the capacity of the lower chamber changes and the volume of oil present is automatically controlled by passage of oil through the plunger feed hole.

**d. Engine Lubrication**

The engine lubrication system is the force feed type in which oil is supplied under pressure to the crankshaft, connecting rods, camshaft bearings and valve lifters. Oil is supplied under controlled volume to the 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. A removable oil gauge rod on the left side of the crankcase is provided to check oil level.

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.

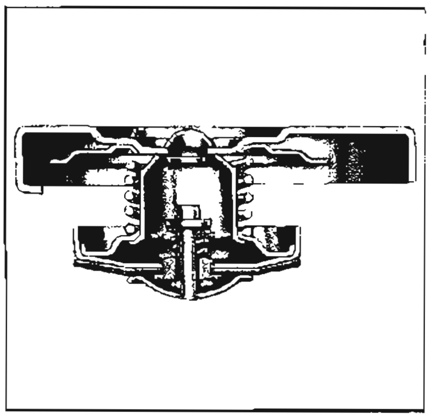


Figure 2-8—Engine Radiator Cap Cross Section

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 pressure to a maximum of 30 pounds per square inch. The oil filter by-pass valve opens when the filter has become clogged to the extent that 4-1/2 to 5 pounds pressure difference exists between the filter inlet and exhaust to by-pass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine.

An AC full flow oil filter 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, a spring loaded by-pass valve opens as mentioned above.

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. 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.

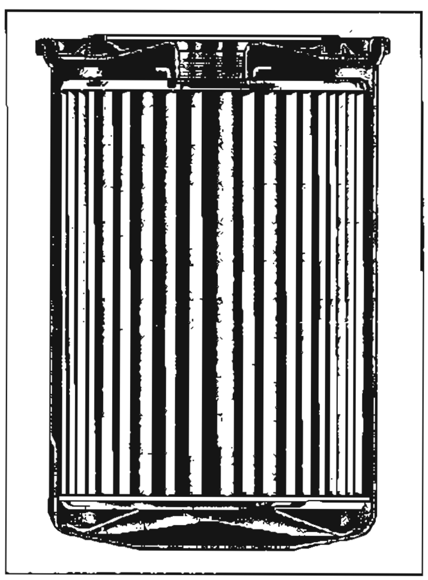


Figure 2-9—Oil Filter Cross Section

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 under side 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.

## e. Engine Cooling

The engine cooling system is the pressure type with thermostatic control of coolant circulation. The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. The higher pressure

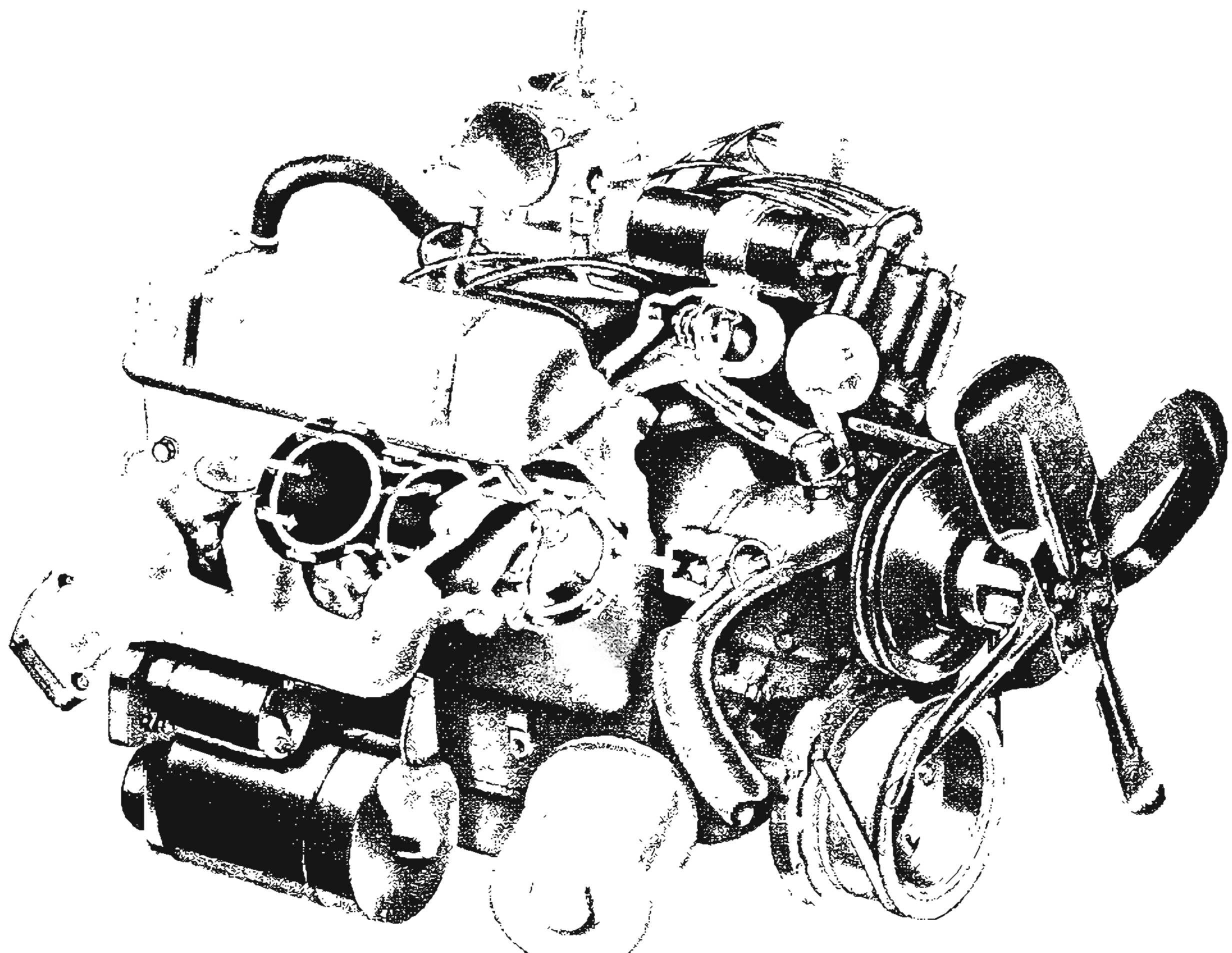


Figure 2-10—Engine Coolant Flow

raises the boiling point of the coolant and increases the cooling efficiency of the radiator. The 15 pound pressure cap used raises the coolant boiling approximately 38°F. at sea level.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. See Figure 2-8. The pressure valve is held against its seat by a spring of predetermined strength which protects the radiator by relieving the pressure if the pressure should exceed that for which the radiator is designed. The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created when the system cools off.

The coolant is circulated by a centrifugal pump mounted on the timing chain cover which forms the outlet side of the pump. The engine fan and pulley(s) are bolted to the pump shaft hub at its forward end. Thus both the fan and pump are belt driven by a crankshaft pulley bolted to the harmonic balancer. The pump shaft and bearing assembly is pressed in the 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 a ceramic insert in 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

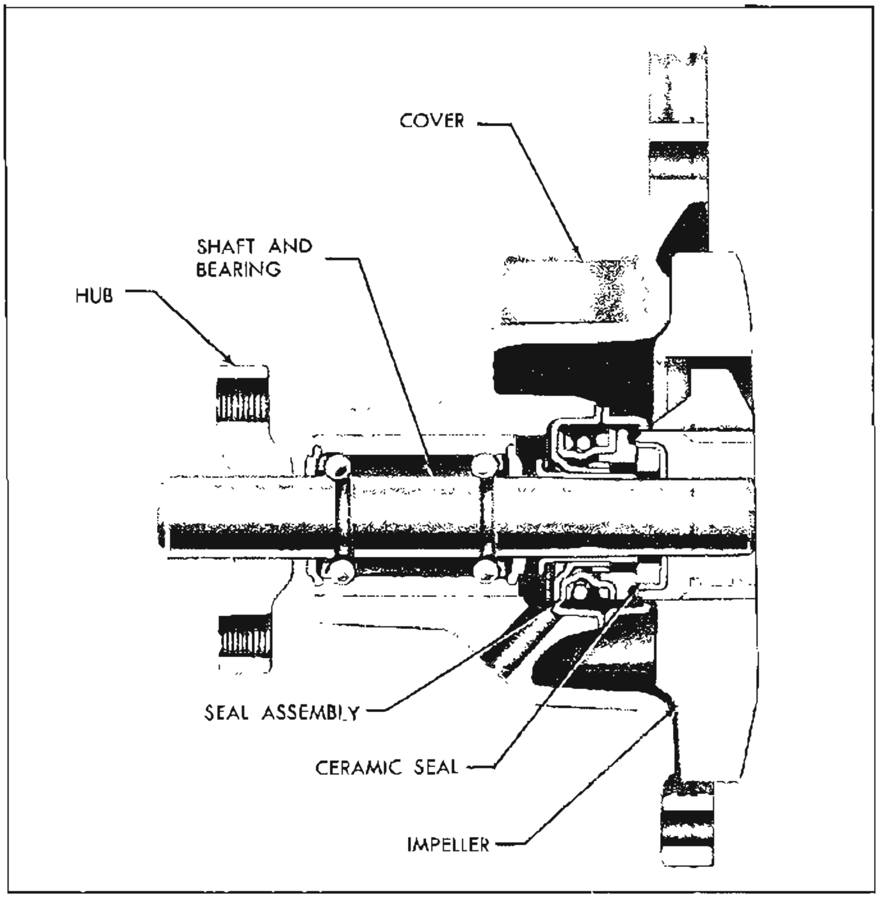



Figure 2-11—Water Pump Cross Section

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.

The coolant then flows rearward through the water jacket which surrounds each cylinder barrel and extends below the lower limit of piston ring travel. After flowing the full length of the cylinder banks, the coolant flows up through openings to the rear of the cylinder bank into the cylinder heads. The coolant flows forward in the cylinder heads to cool the combustion chamber areas. At the forward end of the cylinder heads the coolant flows into the intake manifold.

The coolant flows into the intake manifold water passage from the forward port of the cylinder heads to the thermostat housing and thermostat by-pass. A nipple in the manifold allows connection of the heater hose in heater equipped jobs. See Figure 2-10.

A pellet type thermostat housed in the forward (outlet) end of the intake manifold controls the circulation of water through the engine radiator. During cold engine operation when the thermostat is closed, a thermostat 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.

## 2-5 ENGINE TUNE-UP PROCEDURES

### a. Purpose of Tune-Up

The purpose of an engine tune-up is to restore power and performance that has been lost through wear, corrosion or deterioration of one or more parts or units. In the normal operation of an engine, these changes take place gradually at a number of points so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be obtained by following a definite and thorough procedure of analysis and correction of all items affecting power and performance.

Economical, trouble-free operation can better be assured if a complete tune-up is performed each 12,000 miles.

The parts or units which affect power and performance may be divided into three groups:

(1) Units affecting compression
(2) Units affecting ignition, and
(3) Units affecting carburetion.

The tune-up procedure should cover these groups in the order given. While the items affecting compression and ignition may be handled according to personal preference, correction of items in the carburetion group should not be attempted until all items affecting compression and ignition have been satisfactorily corrected.

Most of the procedures for performing a complete engine tune-up are covered separately in other sections of this manual;

therefore, this paragraph provides an outline only, with references to other sections where detailed information is given.

The suggested procedure for engine tune-up is as follows:

1. Remove all spark plugs.

2. Position throttle and choke valve in full open position.

3. Connect jumper wire between distributor terminal of coil and ground on engine to avoid high tension sparking while cranking engine.

4. Hook up starter remote control cable and turn ignition switch to "on" position.

CAUTION: The starter must not be energized when the ignition switch is in the LOCK position as the ground contact will be damaged in the ignition switch.

5. Firmly insert compression gauge in spark plug port. Crank engine through at least four compression strokes to obtain highest possible reading.

6. Check compression of each cylinder. Repeat compression check and record highest reading obtained on each cylinder during the two pressure checks. The recorded compression pressures are to be considered normal if the lowest reading cylinder is more than 75% of the highest reading cylinder. See the following example and the "Compression Pressure Limit Chart".

Example:

| Cylinder # | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Pressure (PSI) | 129 | 135 | 140 | 121 | 120 | 100 |

75% of 140 (highest) is 105. Thus, cylinder number 6 is less than 75% of number 3. This condition, accompanied by low speed missing, indicates an improperly seated valve or worn or broken piston ring.

7. If one or more cylinders read low, inject about a tablespoon of engine oil on top of pistons in low reading cylinders through spark plug port. Repeat compression check on these cylinders.

a. If compression improves considerably, rings are worn.

b. If compression does not improve, valves are sticking or seating poorly.

c. If two adjacent cylinders indicate low compression and injecting oil does not increase compression, the cause may be a head gasket leak between the cylinders. Engine coolant and/or oil in cylinders could result from this defect.

NOTE: Low compression pressure in two adjacent cylinders indicates a possible head gasket leak between the two cylinders.

8. Clean, inspect, gap to .035", and install spark plugs.

9. Inspect battery and cables.

10. If battery is in good condition but cranking speed is low, test cranking motor circuit. (See Group 10).

11. Adjust fan belt (and power steering belt if so equipped). If difficulty is experienced in keeping battery charged, check generator regulator. (See par. 10-21).

12. Inspect entire ignition system and make indicated corrections.

13. Inspect and test fuel pump. (See par. 3-12).

14. Clean gasoline filter. (See par. 1-4).

15. Check operation of choke valve and check setting of choke thermostat. (See par. 3-17).

**b. Tune-Up Specifications**

| Checks | Allen Uni-Tuner | Sun Tune-Up Tester |
|---|---|---|
| 1. Secondary Resistance | 27 Min. @ 1500 RPM | 3 + .5 Volts @ 1500 RPM |
| 2. Ignition Output | 26 Min. @ 1500 RPM | Blue Band @ 1500 RPM |
| 3. Cranking Voltage | 9 Volts Min. | |
| 4. Charging Voltage * (Quick Check) | 14-15 Volts @ 1500 RPM | |
| 5. Spark Plug Gap | .035 Inches | |
| 6. Dwell Angle | 30 Degrees | |
| 7. Engine Vacuum | 14 Inches Min. @ Idle | |
| 8. Engine Idle Speed (Synchromesh in Neutral or Automatic in Drive-Air Conditioner Off) | 550 RPM (Add 50 RPM for Air Conditioner) | |
| 9. Initial Timing (At Engine Idle, Vacuum Hose Disconnected) | 5° BTC | |
| 10. Total Distributor Advance ** (@ 2500 Engine RPM) | 30° - 39° | |
| 11. Centrifugal Advance Only ** (@ 2500 Engine RPM) | 17° - 21° | |

*Regular at Room Temperature (Below 85° F.)
**This Advance In Addition to Initial Timing Advance.

16. Check adjustment of fast idle cam and choke unloader. (See par. 3-17).

17. Check throttle linkage and dash pot adjustment. (See par. 3-9).

18. Adjust carburetor idle speed and mixture. (See par. 3-8).

19. Inspect all water hose connections and tighten clamps if necessary.

20. Road test car for power and overall performance.

**Compression Pressure Limit Chart**

This chart may be used when checking cylinder compression pressures. It has been calculated so that lowest reading number is 75% of the highest reading number.

Example: After checking the compression pressures in all cylinders, it was found that the highest pressure obtained was 182 psi. The lowest pressure reading was 145 psi. By locating 182 in the maximum column, it is seen that the minimum allowable pressure is 136 psi. Since the lowest reading obtained was 145 psi, the car is within limits and the compression is considered satisfactory.

| Maximum Pressure pounds/sq. inch | Minimum Pressure pounds/sq. inch |
|---|---|
| 134 | 101 |
| 136 | 102 |
| 138 | 104 |
| 140 | 105 |
| 142 | 107 |
| 144 | 108 |
| 146 | 110 |
| 148 | 111 |
| 150 | 113 |
| 152 | 114 |
| 154 | 115 |
| 156 | 117 |

| Maximum Pressure pounds/sq. inch | Minimum Pressure pounds/sq. inch |
|---|---|
| 158 | 118 |
| 160 | 120 |
| 162 | 121 |
| 164 | 123 |
| 166 | 124 |
| 168 | 126 |
| 170 | 127 |
| 172 | 129 |
| 174 | 131 |
| 176 | 132 |
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| 218 | 163 |
| 220 | 165 |
| 222 | 166 |
| 224 | 168 |
| 226 | 169 |
| 228 | 171 |
| 230 | 172 |
| 232 | 174 |
| 234 | 175 |
| 236 | 177 |
| 238 | 178 |

## 2-6 SERVICE PROCEDURES: CYLINDER HEAD AND VALVE TRAIN

### a. Cylinder Head Removal

1. Drain radiator and cylinder block.

2. Remove air cleaner. Disconnect all pipes and hoses from carburetor.

3. Remove coil. Disconnect water temperature indicator wire from switch.

4. Disconnect throttle linkage at carburetor.

5. Disconnect positive crankcase ventilator hose at valve.

6. Slide front thermostat by-pass hose clamp back on hose. Disconnect by-pass hose at timing chain cover to allow coolant to drain from manifold. Disconnect upper radiator hose at outlet.

7. Disconnect heater hose at intake manifold.

8. Remove bolts attaching manifold to cylinder heads.

9. Remove intake manifold and carburetor as an assembly.

10. Remove intake manifold gasket and seals.

11. Pull spark plug wire retainers from brackets on rocker arm cover. Disconnect spark plug wires at plugs and swing wires and retainer out of way.

12. Remove four screws attaching rocker arm cover to cylinder head. (On right side remove positive crankcase ventilator valve.) Remove rocker arm cover and gasket.

13. Remove rocker arm shaft bracket to cylinder head attaching bolts.

14. Remove rocker arm and shaft.

15. Remove push rods.

NOTE: If lifters are to be serviced, remove them at this point. Otherwise, protect lifters and camshaft from dirt by covering area with a clean cloth.

16. Disconnect battery cable and remove Delcotron generator mounting bracket and brace attaching bolts.

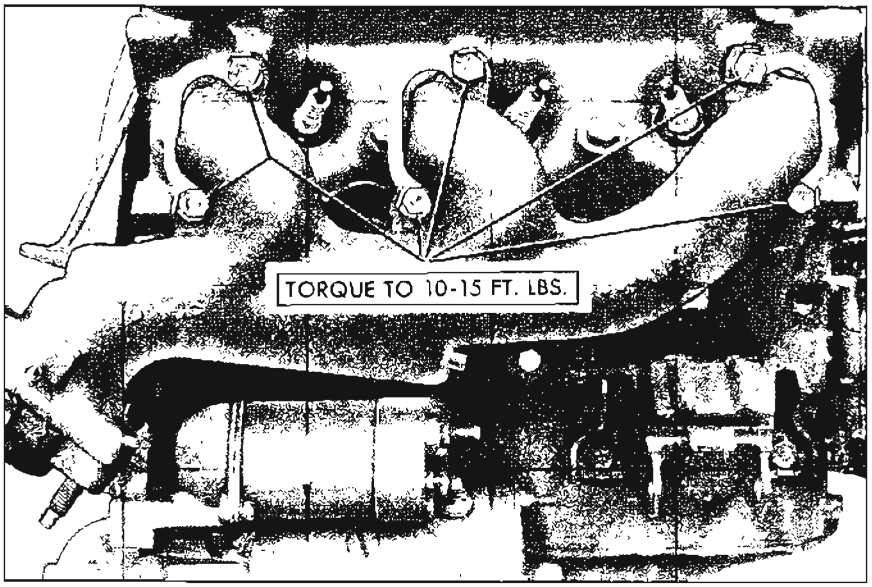


Figure 2-12—Exhaust Manifold Installation

17. Remove power steering pump rear bracket to cylinder head attaching bolts. Loosen bracket at pump.

18. Remove exhaust manifold to exhaust pipe bolts.

19. Remove cylinder head bolts.

20. Remove cylinder head with exhaust manifold attached. If work is to be performed on head, remove manifold on bench.

### b. Cylinder Head Installation

1. Wipe off engine block gasket surface and be certain no foreign material has fallen in the cylinder bores, bolt holes, or in the valve lifter area. It is good practice to clean out bolt holes with an air hose.

2. Install new head gasket on cylinder block. Dowels in the block will hold the gasket in position. Always handle gaskets carefully to avoid kinking or damage to the surface treatment of the gasket. Do not use any type of sealing material on head gaskets. The gaskets are coated with a special lacquer to provide a good seal, once the parts have warmed up.

3. Assemble exhaust manifold to cylinder head with bolts and locking plates as shown in Figure 2-12. Torque bolts to 10-15 ft. lbs.

4. Clean gasket surface of cylinder head and carefully set in place on the engine block dowel pins.

5. Clean and lubricate the head bolts with "Perfect Seal" sealing compound. Install bolts as shown in Figure 2-13.

6. Tighten the head bolts a little at a time about three times around in the sequence shown in Figure 2-14. Give bolts final torque in same sequence. Torque to 70-75 ft. lbs.

NOTE: Damage to the cylinder block threads can result if bolts are not lubricated with "Perfect Seal" prior to installation, or if the bolts are tightened excessively. Use an accurate torque wrench when installing head bolts and do not overtighten. Uneven tightening of the cylinder head bolts can distort the cylinder bores, causing compression loss and excessive oil consumption.

7. Install push rods through cylinder head openings so rods are correctly positioned on lifter plungers.

8. Wipe bases of rocker arm shaft brackets and bracket bosses on cylinder head clean.

9. Check notch on one end of rocker arm shaft. Be sure it is positioned as shown in Figure 2-15.

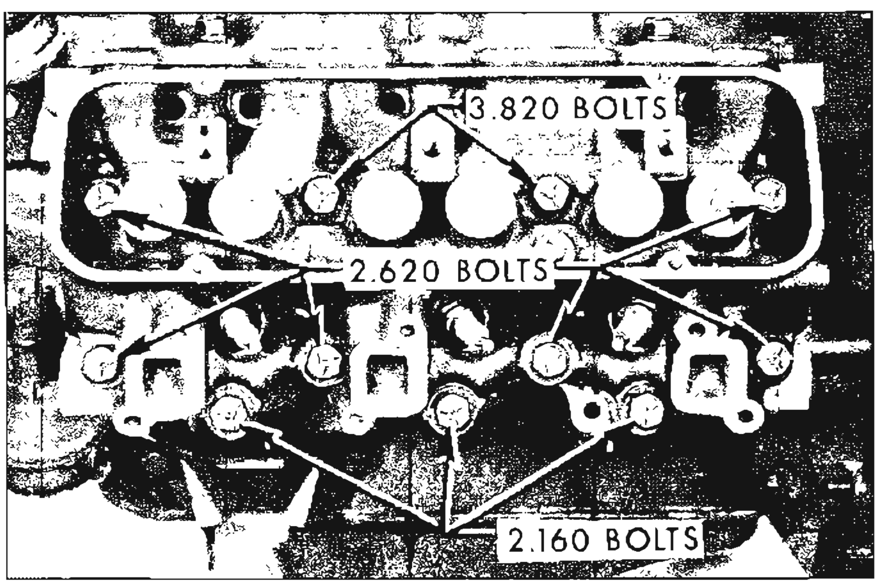


Figure 2-13—Cylinder Head Bolt Installation

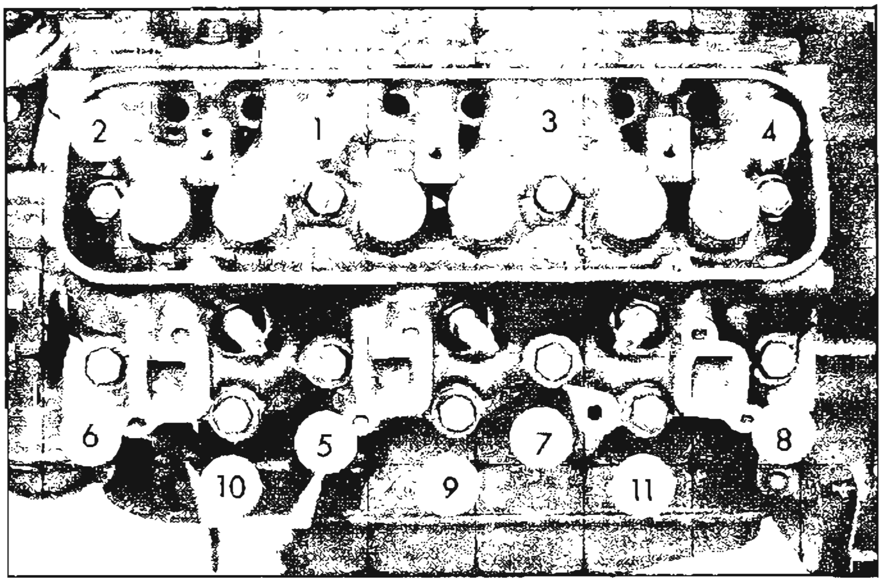



Figure 2-14—Cylinder Head Bolt Tightening Sequence

10. Tilt the rocker arms toward the push rods and locate the top of each push rod in its rocker arm seat.

11. Draw down the rocker arm and shaft assembly by tightening the bracket bolts a little at a time. Use a reliable torque wrench to torque the bracket bolts to 30 ft. lbs. Do not overtighten.

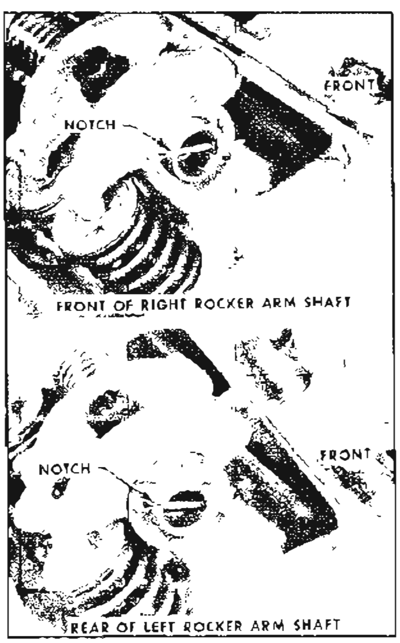



Figure 2-15—Rocker Arm Shaft Alignment

12. Install rocker arm cover and gasket.

13. Connect spark plug wires and set retainers in position on brackets.

14. Place new rubber manifold seal in position at front and rear rails of cylinder block. Be sure pointed ends of seal fit snugly against block and head. See Figure 2-16.

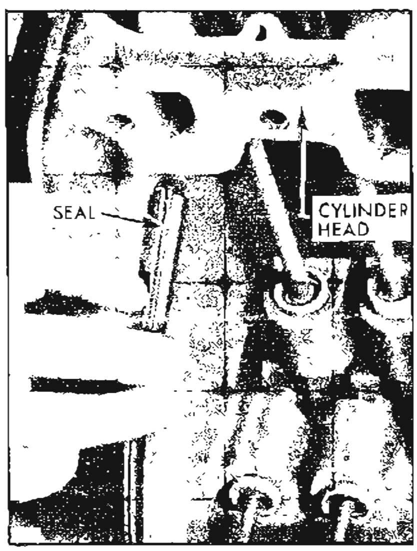



Figure 2-16—Installation of Intake Manifold Gasket Seal

15. Set intake manifold in place carefully and start two guide bolts on each side.

16. Lift the manifold slightly and slip the gaskets into position as shown in Figure 2-17. Take care to see that the gasket is installed with the three intake manifold ports aligned with the head and manifold. The gasket should be installed as shown in Figure 2-17 on the left side and reversed for right side installation.

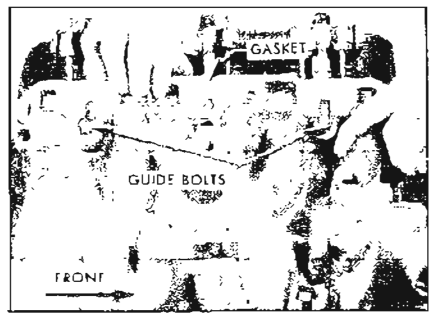



Figure 2-17—Installing Intake Manifold Gasket

17. Install manifold attaching bolt in open bolt hole as shown in Figure 2-18. Open bolt hole is held to close tolerances and the bolt in this location serves to locate the manifold fore and aft.

18. Install remaining manifold to cylinder head bolts. Longer bolts at forward location. Torque bolts alternately and evenly to 25-30 ft. lbs. See Figure 2-18.

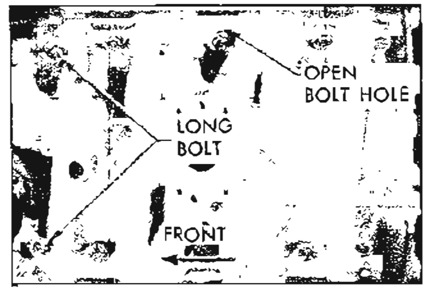



Figure 2-18—V-6 Intake Manifold

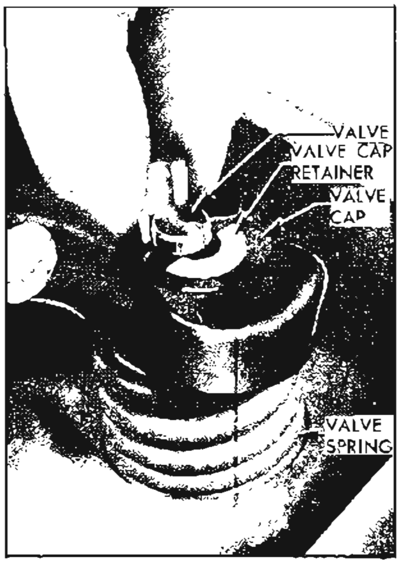



Figure 2-19—Removing Valve Cap Retainers

19. Reconnect remaining components (power steering pump brackets, Delcotron brackets, carburetor linkage, and etc.) Torque all bolts per Paragraph 2-2.

**c. Reconditioning Valves and Guides**

1. Place cylinder head on clean smooth surface.

2. Using suitable spring compressor, such as J-8062, compress valve spring and remove cap retainers. Release tool and remove spring and cap. See Figure 2-19.

NOTE: Cap retainers are copper colored for identification purposes only.

3. Remove valve. Valves should be set aside so they may be reinstalled in original location. A small board with numbered holes is handy for this purpose.

4. Remove carbon from combustion chamber of heads, using care to avoid scratching the head or the valve seats. A soft wire brush (such as J-8358) is suitable for this purpose.

5. Clean carbon and gum deposits from valve guide bores. Use Reamer J-5830-1.

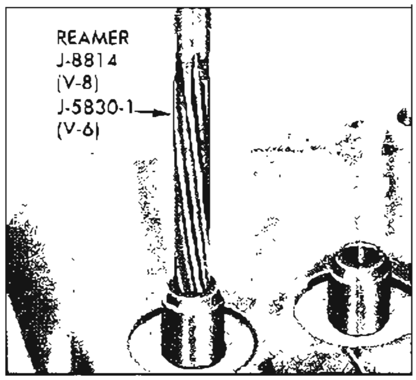



Figure 2-20—Reaming Valve Guide

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. If a V-6 valve stem has excessive clearance in its guide, the guide must be reamed .004" oversize, using Reamer J-5830-1. See Figure 2-20. .004 oversize valves are available through the Parts Department.

9. True up valve seats to 45°. Cutting a valve seat results in lowering the valve spring pressure and increases the width of the seat. The nominal width of the valve seat is 1/16". If a valve seat is over 5/64" wide after truing up it should be 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 1.925".

10. Lightly lap the valves into seats with fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that a minimum of lapping is required. Excessive lapping will groove the valve face preventing a good seat when hot.

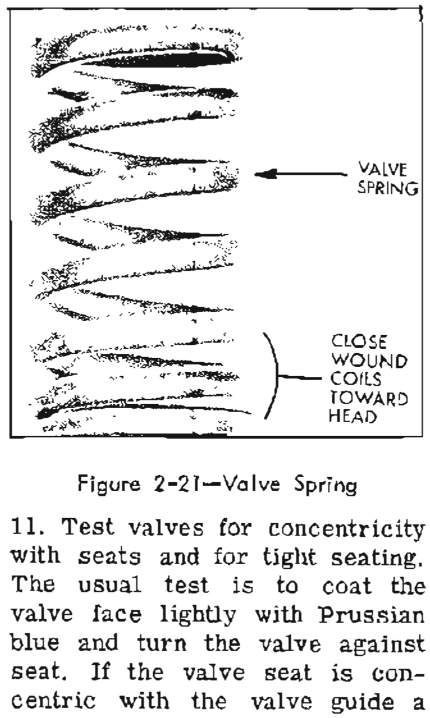



Figure 2-21—Valve Spring

11. 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.

12. Lube with "Service MS" engine oil and reinstall valves, valve springs, caps and cap retainers, using same equipment used for

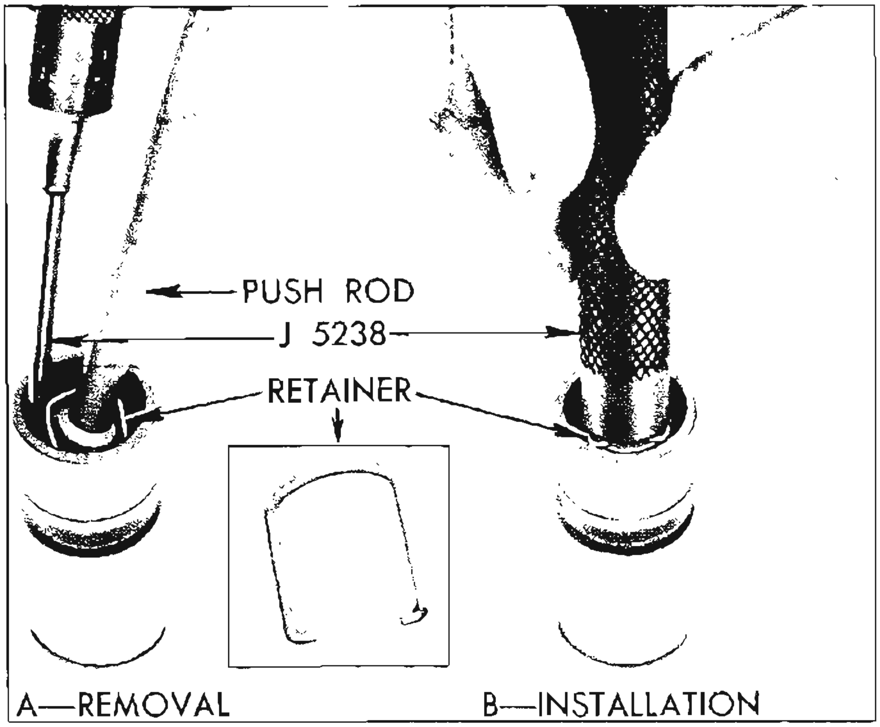



Figure 2-22—Removing and Installing Plunger Retainer

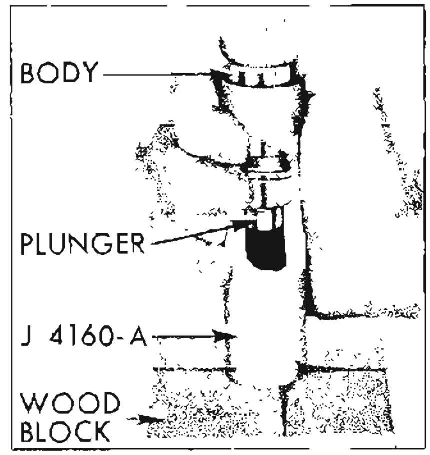



Figure 2-23—Removing Stuck Plunger With J-4160-A

removal. Install valve spring with closely wound coils toward the cylinder head. See Figure 2-21.

**d. Valve Lifter Service**

1. Refer to procedure outlined under "Cylinder Head Removal" (paragraph 2-6, subparagraph a., Steps 1-15) for lifter removal.

2. Place lifters in a wooden block with numbered holes or similar devise to keep them identified as to position in engine.

3. If less than a complete set of lifters is being removed, disassemble one or two and check for dirt or varnish. If this condition exists, it is advisable to remove all lifters for cleaning and inspection. Otherwise, service only those lifters that are not operating properly.

4. Examine the cam contact surface at lower end of lifter body. If this surface is excessively worn, galled, or otherwise damaged, discard the lifter assembly. In this case also examine the mating camshaft lobe for excessive wear or damage.

5. Disassemble each valve lifter by using a push rod to hold down the push rod seat while removing the plunger retainer from the lifter body, using Retainer Remover J-5238. See Figure 2-22, View A. Remove push rod seat and plunger from lifter body.

6. If a plunger sticks in lifter body place lifter in large end of Plunger Remover J-4160-A, with plunger inward. While holding lifter with thumb, rap the open end of remover against a block of wood with just enough force to jar the plunger from body. See Figure 2-23.

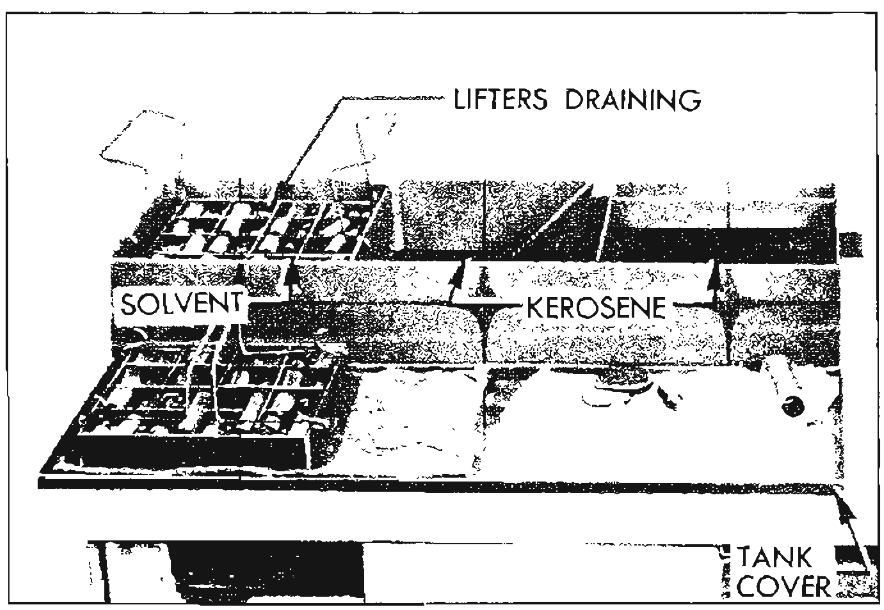



Figure 2-24—Tank J-5821 Set Up For Cleaning Lifter Parts

7. Drain oil out of body into waste can and remove the ball retainer, ball, ball spring, and plunger spring. A strainer placed over waste can will prevent dropping these parts into can.

8. Place all parts of each lifter in a separate compartment of a tray from Cleaning Tank J-5821. The body and plunger are selectively fitted to each other and must not be interchanged with parts of other lifters. Keeping all parts of the lifter together until cleaned and inspected will aid in diagnosing cause of improper operation.

9. Rinse the tray full of lifter parts in a pan of kerosene to remove as much oil as possible. This will reduce contamination of the cleaning solvent and extend its effective life.

10. Submerge the tray and parts in the cleaning solvent in left hand compartment of Cleaning Tank J-5821 and leave to soak for approximately one hour. The time required will depend on the varnish on lifter parts and the effectiveness of the solvent.

11. After the varnish has dissolved or has softened sufficiently to permit removal by wiping, raise the tray and suspend it above the solvent by means of the hooks on tray handles. Allow tray and parts to drain so that solvent will be saved.

12. Rinse the tray of parts in the pan of kerosene to cut the solvent and avoid injury to hands, then place tray on the tank cover located on bench in front of cleaning tank.

13. Working on one lifter at a time and using CLEAN lint-free cloths, thoroughly wipe off all parts. Clean the plunger and the external and internal sufaces of the body with a hard wiping action to remove any varnish deposits. Rinse the parts in the kerosene contained in the middle compartment of cleaning tank, using Cleaning Brush J-5099 in the bore of lifter body.

NOTE: To insure absolute cleanliness of a reconditioned lifter assembly, it is advisable to inspect and assemble each lifter before cleaning the next lifter.

14. The following list outlines the inspection of lifter parts. An inspection should be made at this point to determine whether or not a lifter is in need of replacement.

a. Lifter Body. Inspect inner and outer surfaces of body for blow holes and scoring. Replace lifter assembly if body is roughly scored or grooved, or has a blow hole extending through the wall in position to permit oil leakage from lower chamber. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored; it is caused by side thrust of cam against body while the lifter is moving vertically in its guide.

Inspect the cam contact surface on lower end of lifter body. Replace the lifter assembly if this surface is excessively worn, galled, or otherwise damaged. A lifter body that has been rotating will have a round wear pattern and a non-rotating lifter body will have a square wear pattern with a very slight depression near the center.

b. 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

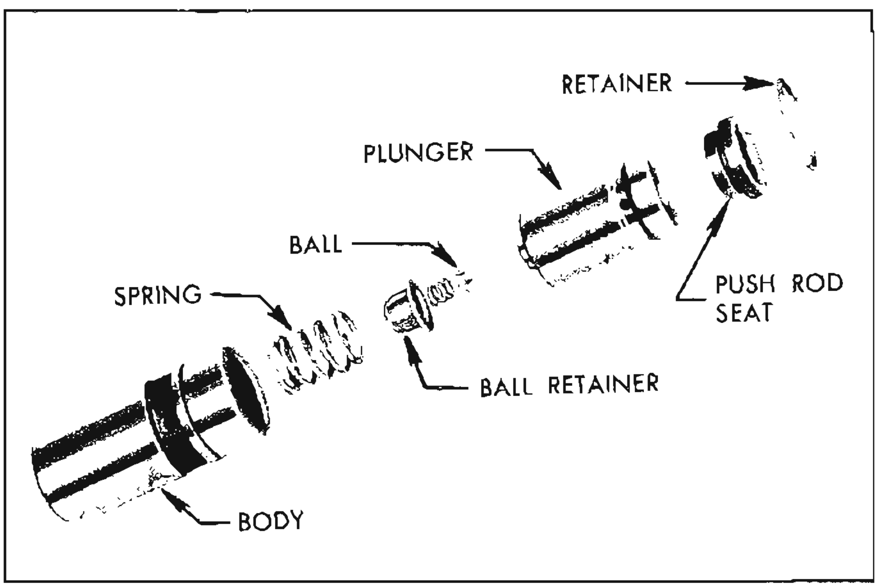



Figure 2-25—Hydraulic Valve Lifter Parts

cause improper operation, therefore it may be disregarded.

c. Push Rod and Seat. Replace the push rod seat if the area where the push rod contacts is rough or otherwise damaged. Replace any push rod having a rough or damaged ball end.

d. Check ball. Using a magnifying glass, carefully examine the check ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects would indicate the cause of intermittently noisy lifter operation. Even though no defects are found it is always advisable to discard the old ball and use a new one when reassembling the lifter.

e. Check Ball Spring. Examine check ball spring for wear or damage. Replace any spring that is distorted or shows evidence of wear.

f. Ball Retainer. Replace a retainer which is cracked or which has a heavily pounded area between the two holes. A small bright spot where the ball contacts the retainer is the normal condition.

g. Plunger Spring. Replace the plunger spring only if it is distorted or damaged. Exhaustive tests have shown that plunger springs seldom break down in service.

15. Rinse lifter plunger in the kerosene in middle compartment of cleaning tank and then give it a thorough final rinsing in the kerosene in right compartment.

16. Hold plunger in vertical position with feed hole up, then rinse and install the check ball, check ball spring, ball retainer, spring, and body over the plunger. See parts in Figure 2-25.

17. Rinse push rod seat and plunger retainer, place these parts in end of body and depress with handle of Remover J-5238 until retainer engages groove in body. See Figure 2-22, View B.

18. Wrap the lifter in clean paper or otherwise protect it from dirt while reconditioning the other valve lifters, preparatory to testing all lifters for leakdown rate.

19. Check lifter breakdown rate according to subparagraph e in this paragraph.

20. Make certain that valve lifter guide holes and adjacent area of cylinder block are clean. Liberally lubricate the camshaft and lifter bores with "Service MS" oil and install lifters. Each lifter must slide freely in its guide hole. If a lifter is tight in one guide hole, fit it another hole with a free fit.

21. Following the procedure outlined in paragraph 2-6, subparagraph b., Steps 7-19, reassemble engine.

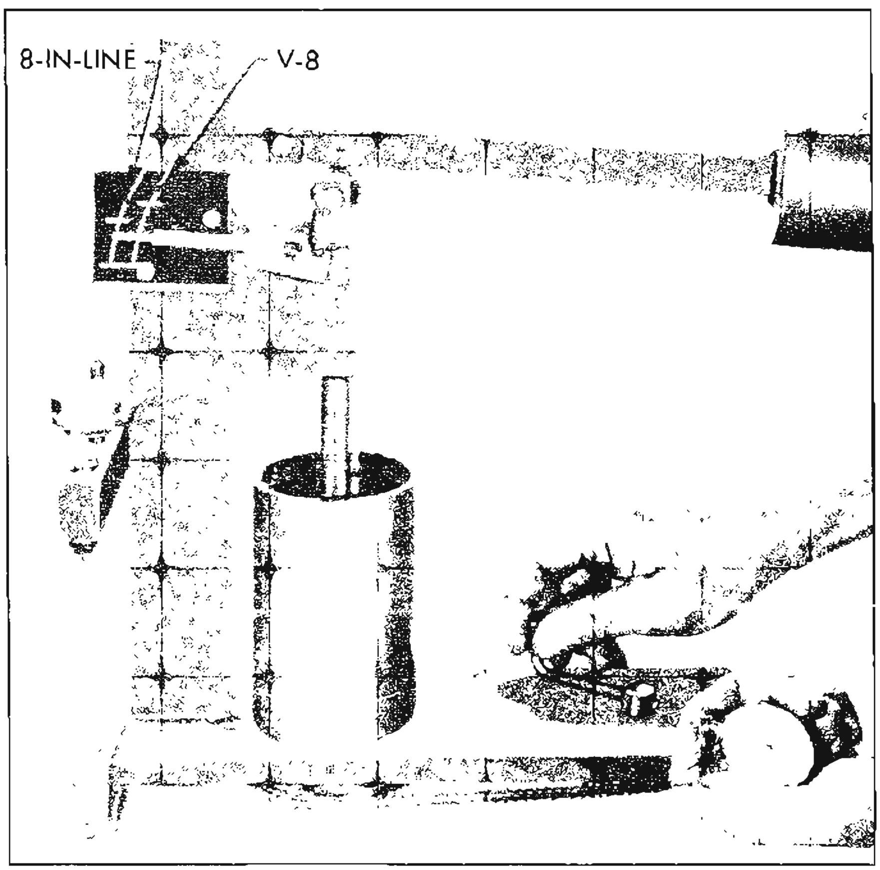


Figure 2-26—Checking Lifter Leakdown Rate

### e. Checking Valve Lifter Leakdown Rate

After a hydraulic lifter has been cleaned, inspected, and assembled it must be tested before it is installed in an engine. Lifter Test Fixture J-5790 has been designed to test the leakdown rate of a lifter to determine whether it is within limits which assure satisfactory lifter operation.

The following procedure must be carefully followed to obtain an accurate test.

1. Thoroughly clean the cup of test fixture, install cup on fixture, and fill it to within 1/2" of the top with "Hydraulic Lifter Test Fluid," which is available through Kent-Moore Organization, Inc., under K-M number J-5268.

2. Remove rubber washer (used for larger lifters) and install Gauge Sleeve J-5180-5 in the cup; also install Buick V-8 Gauge Rod Nose J-5180-15 in the ram.

3. Swing the weight arm up out of the way, raise the ram and place the valve lifter (top side up) in Sleeve J-5180-5. The lifter must be completely covered by the fluid during test.

4. Lower the ram to rest in the lifter push rod seat, then lower the weight arm to rest on the roller of ram.

5. Operate the lifter plunger through its full travel to force all air out of the lifter by using a vigorous pumping action on the weight arm. Continue the pumping action until considerable resistance is built up in the lifter and a definite grab point is felt at the top of the stroke, when the indicator pointer is at the bottom of the scale.

Finally, pump vigorously for approximately 10 additional strokes to make sure all air is removed from the lifter. NOTE: <u>If one stroke offers noticeable weak resistance during the last 10 pumping strokes replace the check ball in lifter and repeat the leakdown test to this point.</u>

6. Raise weight arm to allow the lifter plunger to come up to its retainer, then lower the arm to rest on the ram roller. As the pointer starts moving upward start rotating the fluid cup by turning the handle one revolution every two seconds. See Figure 2-26.

7. Use a stop watch to check the time required for pointer to move from the lower to the upper mark on scale where marked "BUICK V-8." The cup must be rotated during this test. See Figure 2-26.

8. The leakdown rate (time between marks) must be between 12 and 60 seconds to assure satisfactory lifter performance. A doubtful lifter should be tested three or four times. Replace any lifter which does not test within the specified limits.

9. After all lifters have been tested, place the cover over the test fixture to keep dirt out of the cup and fluid. The fluid should be discarded and the cup should be thoroughly cleaned after a few sets of lifters have been tested.

## f. Timing Chain Cover Removal

1. Drain radiator and block.

2. Disconnect upper radiator hose and heater return hose at water pump, disconnect lower radiator hose. Remove attaching bolts and brackets and remove radiator core.

3. Remove fan, fan pulleys and belt(s).

4. Remove fan driving pulley (crankshaft) and pulley reinforcement.

5. Remove harmonic balancer to crankshaft bolt and washer 15/16" socket. Remove harmonic balancer. It may be necessary to tap the 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 the brackets and pump to be moved out of the way.

7. Disconnect fuel lines and remove fuel pump.

8. Remove Delcotron generator and brackets.

9. Remove distributor cap and pull spark plug wire retainers off brackets on rocker arm cover. Swing distributor cap with wires attached out of the way. Disconnect distributor primary lead.

10. 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 by-pass hose rearward.

12. Remove bolts attaching timing chain cover to cylinder block. Remove two oil pan to timing chain cover bolts. Remove timing chain cover assembly and gasket. Thoroughly clean the cover, taking care to avoid damage to the gasket surfaces.

## g. Timing Chain Cover Replacement

Reinstall timing chain cover by reversing removal procedure, paying particular attention to the following points.

1. Remove oil pump cover and pack the space around the oil pump gears completely full of petroleum jelly. There must be no air space left inside the pump. Reinstall cover using new gasket. This step is very important as the oil pump may "lose its prime" whenever the pump, pump cover or timing chain cover is disturbed. If the pump is not packed, it may not begin to pump oil as soon as the engine is started.

2. The gasket surface of the block and timing chain cover must be smooth and clean. Use a new gasket and be certain it is positioned correctly.

3. Position timing chain cover against block and be certain dowel pins engage dowel pin holes before starting bolts.

4. Lube the bolt threads before installation and install them as shown in Figure 2-27.

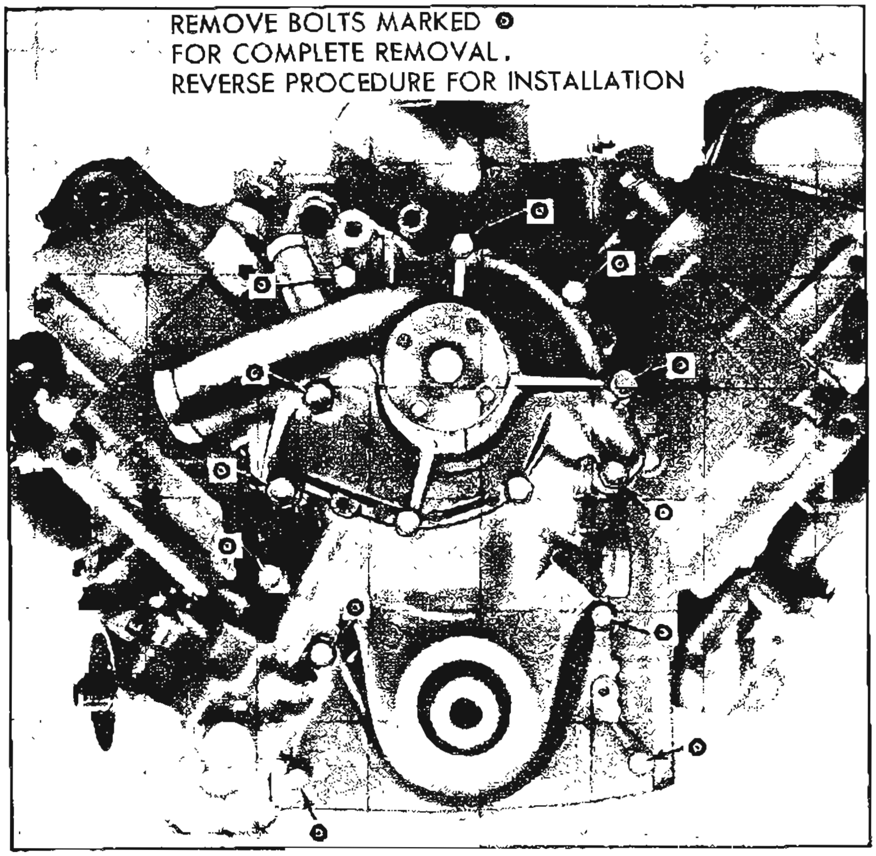



Figure 2-27—Timing Chain Cover Installation

NOTE: If the car is equipped with power steering the front steering pump bracket should be installed at this time.

5. Lube the O.D. of the harmonic balancer before installation to prevent damage to the seal during installation and when the engine is first started.

## h. Crankshaft Oil Seal Replacement

1. Use a punch to drive out old seal and shedder. Drive from the front toward the rear of the timing chain cover.

2. Coil new packing around opening so ends of packing are at top. Drive in new shedder using suitable punch. Stake the shedder in place in at least three places.

3. Size the packing by rotating a hammer handle or similar smooth tool around the packing till the balancer hub can be inserted through the opening.

## i. Timing Chain and Sprocket Removal

1. With timing chain cover removed (subpar. f above) temporarily install harmonic balancer bolt and washer in end of crankshaft. Turn crankshaft so sprockets are positioned as shown in Figure 2-28. Doing so will make it easier to reinstall parts. Remove harmonic balancer bolt and washer using a sharp rap on the wrench handle to start the bolt out without changing position of sprockets.

NOTE: It is not necessary to remove timing chain dampers on V-6 engines unless they are worn or damaged and require replacement.

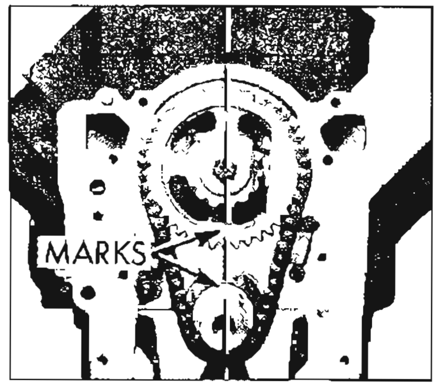



Figure 2-28—Proper Installation of V-6 Timing Chain and Sprocket

2. Remove front crankshaft oil slinger.

3. Remove bolt and special washer retaining camshaft distributor drive gear and fuel pump eccentric to camshaft forward end. Slide gear and eccentric off camshaft.

4. Use two large screwdrivers to alternately pry the camshaft sprocket then the crankshaft sprocket forward until the camshaft sprocket is free, then remove the camshaft sprocket and chain and finish working crankshaft sprocket off crankshaft.

5. Thoroughly clean the timing chain, sprockets, distributor drive gear, fuel pump eccentric and crankshaft oil slinger.

## j. Timing Chain and Sprocket Installation

1. Turn crankshaft so number one piston is at top dead center.

2. Turn camshaft so with sprocket temporarily installed, timing mark is straight down. See Figure 2-28. Remove sprocket.

3. Assemble timing chain on sprockets and slide the sprocket

and chain assembly on the shafts with the timing marks in their closest together position and in line with the sprocket hubs. See Figure 2-28.

NOTE: It will be necessary to hold spring loaded timing chain damper out of the way while sliding chain and sprockets into position.


Figure 2-29—Fuel Pump and Distributor Drive Gear Installation

4. Assemble 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 grove forward. See Figure 2-29.

6. Install distributor drive gear. See Figure 2-29.

7. Install drive gear and eccentric bolt and retaining washer. Torque to 40-55 ft. lbs.

8. Reinstall timing chain cover (subpar. g above).

**k. Camshaft Service**

1. Remove rocker arm and shaft assemblies, push rods and valve lifters.

2. Remove timing chain cover, timing chain and sprocket subparagraphs f and i above.

3. Slide camshaft forward out of bearing bores carefully to avoid marring the bearing surfaces.

4. Replace camshaft by reversing removal procedure, taking particular care to avoid damage to the camshaft bearings.

NOTE: The steel-backed babbitt-lined camshaft bearings are pressed into the crankcase. Going from front to rear, each bearing is bored .030" smaller than the preceding bearing and each camshaft journal is correspondingly reduced in diameter.

The camshaft bearings must be line reamed to size after being pressed into the crankcase. Since this operation requires special reaming equipment the original bearings should be retained unless severely damaged. Slightly scored camshaft bearings will be satisfactory if the surfaces of camshaft journals are polished and bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within the clearance limits of .0015" to .004".

## 2-7 SERVICE PROCEDURES:

Crankshaft And Connecting Rod Bearings, Pistons And Rings

A connecting rod bearing consists of two halves or shells which are alike and interchangeable in rod and cap. When the shells are placed in rod and cap the ends extend slightly beyond the parting surfaces so that when rod bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. The ends of shells must never be filed flush with parting surface of rod or cap.

If a precision type connecting rod bearing becomes noisy or is worn so that clearance on crankpin is excessive, a new bearing of proper size must be selected and installed since no provision is made for adjustment. Under no circumstances should the connecting rod or cap be filed to adjust the bearing clearance.

**a. Inspection of Connecting Rod Bearings and Crankpin Journals**

After removal of engine oil pan disconnect two connecting rods at a time from crankshaft and inspect the bearings and crankpin journals. While turning crankshaft it is necessary to temporarily reconnect the rods to crankshaft to avoid possibility of damaging the journals through contact with loose rods.

If connecting rod bearings are chipped or scored they should be replaced. If bearings are in good physical condition check for proper clearance on crankpin as described in subparagraph b, below.

If crankpin journals are scored or ridged the crankshaft must be replaced, or reground for undersize bearings, to insure satisfactory life of connecting rod bearings. 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.

Use an outside micrometer to check crankpins for out-of-round. If crankpins are more than .0015" out-of-round, satisfactory life of new bearings cannot be expected.

**b. Checking Clearance and Selecting Replacement Bearings**

Service bearings are furnished in standard size and several undersizes (including undersizes for reground crankpins.

The clearance of connecting rod (and crankshaft) bearings may be checked by use of Plastigage, Type PG-1 (green), which has a range of .001" to .003". Plastigage is manufactured by Perfect

Circle Corporation and is available through General Motors parts warehouses.

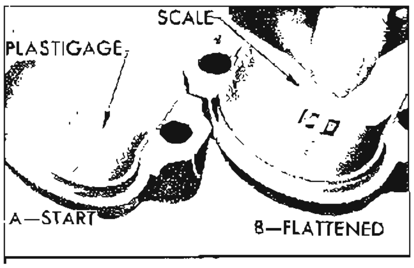



Figure 2-30—Checking Bearing Clearance with Plastigage

1. Remove connecting rod cap with bearing shell. Wipe oil from bearing and crankpin journal, also blow oil out of hole in crankshaft.

NOTE: Plastigage is soluble in oil.

2. Place a piece of Plastigage lengthwise along the bottom center of the lower bearing shell (Figure 2-30, View A), then install cap with shell and tighten bolt nuts to 30-35 ft. lbs. torque.

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 and toward front of engine in right bank.

3. DO NOT TURN CRANKSHAFT with Plastigage in bearing.

4. Remove bearing cap with bearing shell, the flattened Plastigage will be found adhering to either the bearing shell or the crankpin. Do not remove it.

5. Using the scale printed on the Plastigage envelope, measure the flattened Plastigage at its widest point. The number within the graduation which most closely corresponds to the width of Plastigage indicates the bearing clearance in thousandths of an inch. See Figure 2-30, View B.

6. The desired clearance with a new bearing is .0002" to .0023". If bearing has been in service it is advisable to install a new bearing if the clearance exceeds .003"; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

7. If a new bearing is being selected try a standard size, then each undersize bearing in turn until one is found that is within the specified limits when checked for clearance with Plastigage.

NOTE: Each undersize bearing shell has a number stamped on outer surface on or near the tang to indicate amount of undersize.

8. After the proper size bearing has been selected, clean off the Plastigage, oil the bearing thoroughly, reinstall cap with bearing shell and tighten bolt nuts. See NOTE in Step 2. Torque to 30-40 ft. lbs.

9. With selected bearing installed and bolts tightened, it should be possible to move connecting rod freely back and forth on crankpin as allowed by end clearance. If rod cannot be moved, either the bearing is too much undersize or a misaligned rod is indicated.

## c. Replacement of Crankshaft Bearings

A crankshaft bearing consists of two halves or shells which are not alike and not interchangeable in cap and crankcase. The upper (crankcase) half of the bearing is grooved to supply oil to the connecting rod bearings while the lower (bearing cap) half of the shell is not grooved, The two bearing halves must not be interchanged. All crankshaft bearings except the thrust bearing and the rear main bearing are identical. The thrust bearing (#2) is longer and flanged to take end thrust. When the shells are placed in crankcase and bearing cap, the ends extend slightly beyond the parting surfaces so that when cap bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. The ends of shells must never be filed flush with parting surface of crankcase or bearing cap.

If the thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times with the bearing cap bolts finger tight.

Crankshaft bearings are the precision type which do not require reaming to size or other fitting. Shims are not provided for adjustment since worn bearings are readily replaced with new bearings of proper size. Bearings for service replacement are furnished in standard size and undersizes. Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.

After removal of lower crankcase, oil pump pipe and screen and flywheel lower housing (synchromesh) or bell housing cover (automatic transmission) perform the following removal, inspection and installation operations on each crankshaft bearing in turn so that the crankshaft will be well supported by the other bearings.

NOTE: If crankshaft has been removed to check straightness the following procedure is suggested.

Rest crankshaft on "veeblocks" at number one and number five main bearing journals. Check indicator runout at No. 2, 3 and 4 main bearing journals. Total indicator readings at each journal should not exceed .003".

While checking runout at each journal note relation of "high" spot (or maximum eccentricity) on each journal to the others.

"High" spot on all journals should come at the same angular location. If "high" spots do not come at nearly the same angular location, crankshaft has a "crook" or "dogleg" in it and is unsatisfactory for service.

1. Since any service condition which affects the crankshaft bearings may also affect the connecting rod bearings, it is advisable to inspect connecting rod bearings first. If crankpins are worn to the extent that crankshaft should be replaced or reground, replacement of crankshaft bearings only will not be satisfactory.

2. Remove one bearing cap, then clean and inspect lower bearing shell and the crankshaft journal. If journal surface is scored or ridged, the crankshaft must be replaced or reground to insure satisfactory operation with new bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil, and burrs may be honed off with a fine stone.

3. If condition of lower bearing shell and crankshaft journal is satisfactory, check the bearing clearance with Plastigage as described for connecting rod bearings in subparagraph b.

4. When checking a crankshaft bearing with Plastigage, turn crankshaft so that oil hole is up to avoid dripping oil on Plastigage. Place paper shims in lower halves of adjacent bearings and tighten cap bolts to take the weight of crankshaft off the lower shell of bearing being checked.

5. If bearing clearance exceeds .003", it is advisable to install a new bearing; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

6. Loosen all crankshaft bearing cap bolts 1/2 turn, and remove cap of bearing to be replaced.

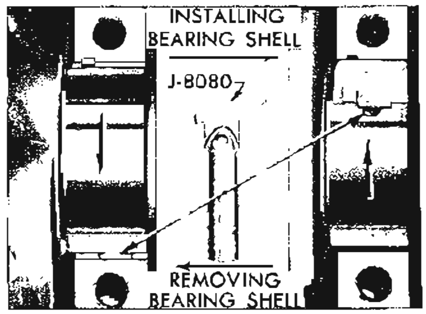



Figure 2-31—Removing and Installing Crankshaft Bearing Upper Shell

7. Remove upper bearing shell by inserting Bearing Shell Remover and Installer J-8080 in oil hole in crankshaft, then slowly turning crankshaft so that the tool rotates the shell out of place by pushing against the end without the tang. See Figure 2-31. CAUTION: When turning crankshaft with rear bearing cap removed hold oil seal to prevent it from rotating out of position in crankcase.

8. The crankshaft journal cannot be measured with an outside micrometer when shaft is in place; however, when upper bearing shell is removed the journal may be checked for out-of-round by using a special crankshaft caliper and inside micrometer. The caliper should not be applied to journal in line with oil hole.

If crankshaft journal is more than .0015" out-of-round, the crankshaft should be replaced since the full mileage cannot be expected from bearings used with an excessively out-of-round crankshaft.

9. Before installation of bearing shells make sure that crankshaft journal and the bearing seats in crankcase and cap are thoroughly cleaned.

10. Coat inside surface of upper bearing shell with engine oil and place shell against crankshaft journal so that tang on shell will engage notch in crankcase when shell is rotated into place. IMPORTANT: Upper bearing shells have an oil groove in their center, while lower shells are plain. They must not be interchanged.

11. Rotate bearing shell into place as far as possible by hand, then insert Installer J-8080 in crankshaft oil hole and rotate crankshaft to push shell into place. See Figure 2-31. CAUTION: Bearing shell should move into place with very little pressure. If heavy pressure is required, shell was not started squarely and will be distorted if forced into place.

12. Place lower bearing shell in bearing cap, then check clearance with Plastigage as previously described.

13. The desired clearance with a new bearing is .0004" to .0018". If this clearance cannot be obtained with a standard size bearing, insert an undersize bearing and check again with Plastigage. NOTE: Each undersize shell has a number stamped on outer surface on or near the tang to indicate amount of undersize.

14. When the proper size bearing has been selected, clean out all Plastigage, oil the lower shell and reinstall bearing cap. Clean the bolt holes and lube bolts, then torque cap bolts to specification given in paragraph 2-2. The crankshaft should turn freely at flywheel rim; however, a very slight drag is permissible if an undersize bearing is used.

10. If the thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap

bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times with the thrust bearing cap bolts finger tight.

11. After bearing is installed and tested, loosen all bearing cap bolts 1/2 turn and continue with other bearings. When bearings have been installed and tested, tighten all bearing cap bolts to specification given in paragraph 2-2.

12. Refer to subparagraph d for replacement of rear bearing oil seals.

13. Install oil pump, pipe and screen assembly following procedure given in paragraph 2-8.

14. Thoroughly clean lower crankcase and flywheel lower housing and bell housing cover before installation. Use new gaskets when installing lower crankcase and flywheel lower housing.

15. Reinstall steering idler arm to front cross member bolts, nuts and washers.

**d. Installation of Rear Bearing Oil Seals**

Braided fabric seals are pressed into grooves formed in crankcase and rear bearing cap to rear of the oil collecting groove, to seal against leakage of oil around the crankshaft.

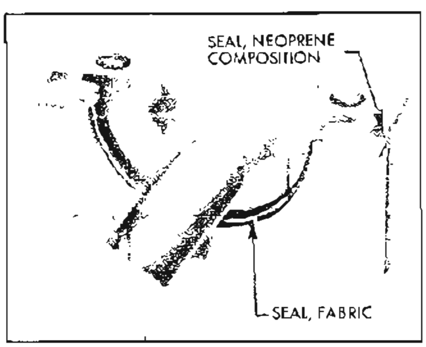



Figure 2-32—Installing Rear Bearing Oil Seals

Neoprene composition seals are placed in grooves in the sides of bearing cap to seal against leakage in the joints between cap and crankcase. The neoprene composition swells in the presence of oil and heat. The seals are undersize when newly installed and may even leak for a short time until the seals have had time to swell and seal the opening. See Figure 2-32.

The braided fabric seal can be installed in crankcase only when crankshaft is removed; however, the seal can be replaced in cap whenever cap is removed. Remove old seal and place new seal in groove with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth stick until seal projects above the groove not more than 1/16". Cut ends off flush with surface of cap, using sharp knife or razor blade. Lube the seal with heavy engine oil just before installation. See Figure 2-32.

CAUTION: The engine must be operated at slow speed when first started after new braided seal is installed.

The neoprene composition seals are slightly longer than the grooves in the bearing cap. The seals must not be cut to length. Just before installation of bearing cap in crankcase, lightly lubricate the seals and install in bearing cap with upper end protruding approximately 1/16".

After cap is installed, force seals up into the cap with a blunt instrument to be sure of a seal at the upper parting line between the cap and case.

**e. Replacement, Disassembly, and Inspection of Piston and Rod Assemblies**

1. Remove cylinder heads (par. 2-6, subpar. A).

2. Examine the cylinder bores above the ring travel. If bores are worn so a shoulder or ridge exists at this point, remove the ridges with a ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal.

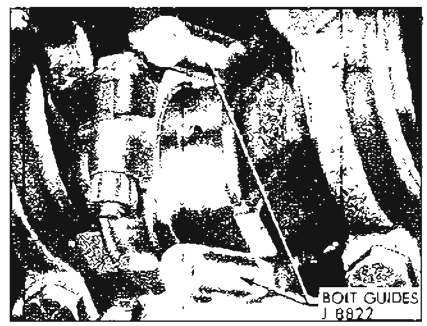



Figure 2-33—Connecting Rod Bolt Guides Installed

3. Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting rods and caps. Starting at the front end of the crankcase the cylinders in the right bank are numbered 2-4-6 and in the left bank are numbered 1-3-5.

4. Remove cap and bearing shell from number 1 connecting rod. Install connecting rod bolt guides on the bolts to hold the upper half of the bearing shell in place. See Figure 2-33.

5. Push the piston and rod assembly up out of the cylinder. Then remove guides and reinstall cap and bearing shell on rod.

6. Remove other rod and piston assemblies in same manner.

7. Remove compression rings with expander and remove oil ring by removing the two rails, and spacer-expander which are separate pieces in each piston third groove. See Figures 2-38 and 2-39.

8. To remove piston pin:

(a) Assemble press as shown in

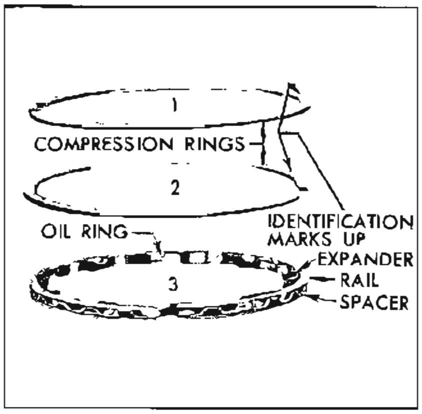



Figure 2-34—Piston Rings

Figure 2-53. Install Piston Pin pilot J-6047-20 in base. Install support with full radial face up. Set spring in support.

(b) Set piston, pin and rod in press with J-8355 inserted in piston pin.

(c) Press out piston pin.

9. (a) 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 centerline of the engine. The diameter of the cylinder bores at any point may be measured with an inside micrometer or by setting the cylinder gauge dial at "O" and measuring across the gauge contact points with outside micrometer while the gauge is at same "O" setting.

(b) 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 rebore the cylinder to fit an oversize piston in order to insure satisfactory results.

(c) If cylinder bore is tapered .005" or more or is out-of-round .003" or more, it is advisable to rebore for the smallest possible oversize piston and rings.

10. Clean carbon from piston surfaces and under side of piston heads. Clean carbon from ring grooves with suitable tool and remove any gum or varnish from piston skirts with suitable solvent.

11. 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.

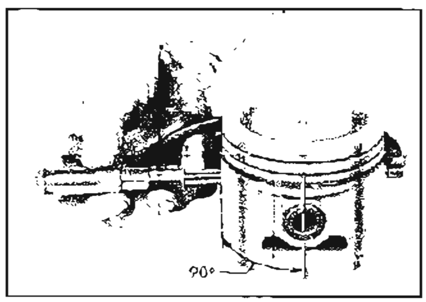



Figure 2-35—Measuring Piston

The pistons are cam ground, which means that the diameter at a right angle to the piston pin is greater than the diameter parallel to the piston pin. When a piston is checked for size, it must be measured with micrometers applied to the skirt at points 90° to the piston pin. See Figure 2-35. The piston should be measured (for fitting purposes) 1/4 below the bottom of the oil ring groove.

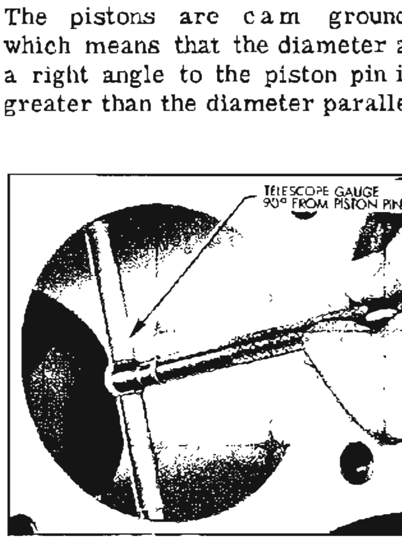



Figure 2-36—Checking Cylinder Bore

12. 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. Oversize pins are not practical due to the pin being a press fit in the connecting rod. Piston pins must fit the piston with an easy finger push at 70°F. (.0003" to .0005" clearance).

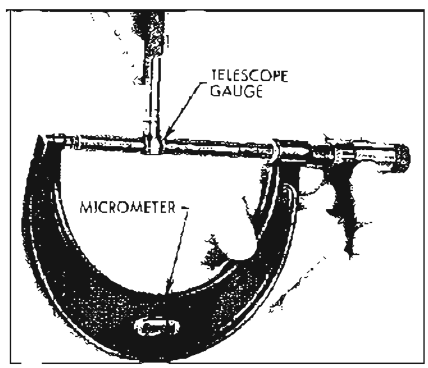



Figure 2-37—Measuring Telescope Gauge

13. Examine all piston rings for scores, chips or cracks. Check compression rings for tension by comparing with new rings. Check gap of compression rings by placing rings in bore at bottom of ring travel. Measure gap with feeler gauge. Gap should be between .010" and .020". If gaps are excessive (over .020") it indicates the rings have worn considerably and should be replaced.

**f. Reboring Cylinders and Fitting New Pistons**

If one or more cylinder bores are rough, scored, or worn beyond limits prescribed under subparagraph b, it will be necessary to smooth or true up such bores to fit new pistons.

If relatively few bores require correction it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance, since all oversize service pistons are held to the same weights as standard size pistons. If conditions justify replacement of all pistons, however, all new pistons should be the same nominal size.

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 .010" oversize. 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 the cylinder bores should be honed to size for proper clearance.

Before the honing or reboring operation is started, measure all new pistons with micrometer contacting at points exactly 90 degrees to piston pin (Figure 2-35) then select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston is fitted too free.

If wear at top of cylinder does not exceed .005" on the diameter or exceed .003" out-of-round, honing is recommended for truing the bore. If wear or out-of-round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

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.

When honing cylinders use clean sharp stones of proper grade for the amount of metal to be removed, in accordance with instructions of the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.

When finish honing, pass the hone through the entire length of cylinder at the rate of approximately 60 cycles per minute. This should produce the desired 45 degree cross hatch pattern on cylinder walls which will insure maximum ring life and minimum oil consumption.

It is of the greatest importance that refinished cylinder bores are trued up to have not over .0005" out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface. During final honing, each piston must be fitted individually to the bore in which it will be installed and should be marked to insure correct installation.

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. The dry bore should then be brushed clean with a power-driven fibre brush. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result. 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 1-1/2" and 2" from the top. See Figure 2-36.

3. Measure the piston to be installed. See Figure 2-35. The piston must be measured at right angles to the piston pin 1/4" below the oil ring groove. The piston must be between .001" and .0015" smaller than the cylinder bore.

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".

**g. Fitting New Piston Rings**

When new piston rings are installed without reboring cylinders, the glazed cylinder walls should be slightly dulled, but without increasing the bore diameter, by means of the finest grade of stones in a cylinder hone.

New piston rings must be checked for clearance in piston grooves and for gap in cylinder bores; however, the flexible oil rings are not checked for gap. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

With rings installed, check clearance in grooves by inserting feeler gauges between each ring and its lower land because any wear that occurs forms a step at inner portion of the lower land. If the piston grooves have worn to the extent that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with the operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

When fitting new rings to new pistons the side clearance of the compression rings should be .003" to .005" and side clearance of the oil ring should be .0035" to .0095".

To check the end gap of compression rings, place the ring in the cylinder in which it will be used, square it in the bore by tapping with the lower end of a piston, then measure the gap with feeler gauges. Piston rings should not have less than .015" gap when placed in cylinder bores. If gap is less than .015", file the ends of rings carefully with a smooth file to obtain proper gap.

### h. Assembly and Installation of Piston and Connecting Rod Assemblies

NOTE: Connecting rods may be sprung out of alignment in shipping or handling. Always check a new rod before installing piston and pin.

Check bend and twist on an accurate rod aligning fixture using Guide Pin J-6047-16 (from wrist pin press set) in place of wrist pin. Press Vee block firmly and evenly against guide pin to prevent cocking pin in eye of rod which may be up to .002" loose on pin.

1. To assemble piston and pin to connecting rod, assemble press with full radial face of support J-8754-1 "up".

2. If the piston and rod assembly is to be installed in the left bank the assembly must be made as shown in Figure 2-38.

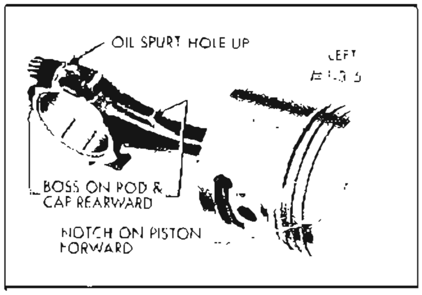



Figure 2-38—Left Bank Piston and Rod Assembly

3. If the piston and rod is to be installed in the right bank, the assembly must be made as shown in Figure 2-39.

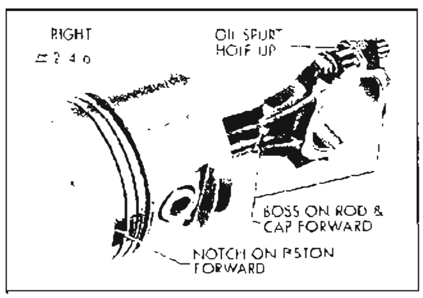



Figure 2-39—Right Bank Piston and Rod Assembly

4. Assemble piston and rod on spring loaded guide pin.

5. Lubricate piston pin to avoid damage when pressing through the connecting rod.

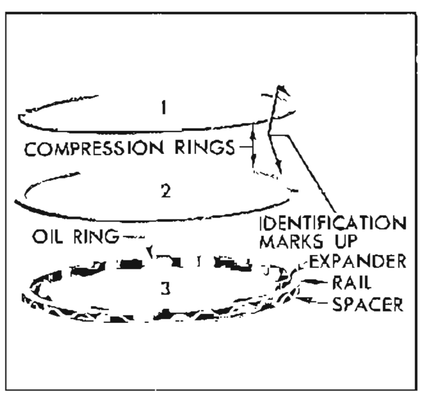



Figure 2-40—Piston Rings

6. Install drive pin in upper end of piston pin. Press on drive pin till piston pin bottoms.

7. Remove piston and rod assembly from press. Rotate piston on pin to be sure pin was not damaged during the pressing operation.

8. Install piston rings as shown in Figure 2-40. Position expander ends over piston pin. Install oil ring rail spacer, and oil ring rails. Position gaps in rails "up" on same side of piston as oil spurt hole in connecting rod. Install compression rings in upper two grooves. If a single chrome plated compression ring is used, the chrome ring must be installed in the top groove.

9. All compression rings are marked with a dimple, a letter "T", a letter "O" or word "TOP" to identify the side of the ring which must be assembled toward the top of the piston. If a single chrome plated compression ring is used, the chrome ring must be installed in the top groove.

10. Make sure cylinder bores, pistons, connecting rod bearings and crankshaft journals are absolutely clean, then coat all bearing surfaces with engine oil.

11. Before installation of a piston and rod assembly in its bore, position the crankpin straight down.


Figure 2-41—Installing Piston With Compressor Installed

12. Remove connecting rod cap, and with bearing upper shell seated in rod; install connecting rod guides. These guides hold the upper bearing shell in place and prevent damage to the crankpin during installation of the connecting rod and piston assembly.

13. Make sure the gap in the oil ring rails is "up" toward center of engine and the gaps of the compression rings are not in line with each other or the oil ring rails.

14. Lubricate the piston and rings and install in bore by compressing the rings either with a "wrap around" compressor or a split ring type such as shown in Figure 2-41.

15. Select new connecting rod bearing, if necessary, as described in paragraph 2-7. Otherwise install cap with bearing lower shell on rod and tighten bolt nuts to 30-40 ft. lbs. torque.

16. Install all other piston and rod assemblies in same manner. When piston and rod assemblies are properly installed, the oil spurt holes in the connecting rods will be "up" toward the camshaft, the rib on the edge of the rod cap will be on the same side as the conical boss on the connecting rod web, and these marks, (rib and boss) will be toward the other connecting rod on the same crankpin. See Figures 2-38 and 2-39.

17. Check end clearance between connecting rods on each crankpin using feeler gauges. Clearance should be between .005" and .012".

18. Install cylinder heads (par. 2-14). Install oil screen and oil pan.

IMPORTANT: After installation of new pistons and rings, care should be used in starting the engine and running it for the first hour. Avoid high speeds until the parts have had a reasonable amount of break in to avoid scuffing.

## 2-8 SERVICE PROCEDURES:

Cooling And Oiling Systems

### a. Checking and Filling Cooling System

The coolant level should be checked only when the engine is cold and only enough coolant added to bring the level approximately halfway between the top of the core and the top of the upper tank.

It is unnecessary and unadvisable to check the coolant level each time the car is stopped for fuel or oil, as the engine is usually hot at such times.

CAUTION: Never remove the radiator cap quickly when the radiator is hot. Sudden release of cooling system pressure may cause the coolant to boil and escape with some force.

If it becomes necessary to remove the radiator cap when the radiator is hot, rotate the cap slowly counterclockwise till a stop is reached. Leave cap in this position until all system pressure is released, then remove cap.

### b. Draining and Flushing the Cooling System

When the cooling system has been drained, reinstall a permanent glycol type corrosion and antifreeze cooling system protection solution developed for year around use (General Motors Specification GM 1899-M). Water alone, methanol, or alcohol type anti-freeze is definitely not recommended.

To drain the cooling system, remove radiator cap, open the drain cock in the lower radiator tank and remove the drain plugs on both sides of cylinder block. If car is heater equipped, set heater temperature control valve at full heat position.

After the cooling system is drained, plugs reinstalled and cock closed, fill the system with clean water. Run the engine long enough to open the thermostat for complete circulation through the system then completely drain the cooling system before sediment has a chance to settle.

### c. Conditioning the Cooling System

It is very important to make certain that the cooling system is properly prepared before an antifreeze solution is installed; otherwise, loss of solution through leakage may occur or seepage may result in damage to the engine. The cooling system should be drained and flushed as described above (subpar. b.), all joints should be checked for leakage and corrected.

Inspect the water pump, radiator core, heater core, drain cocks, water jacket plugs, and edge of cylinder head gaskets for evidence of leaks. Tighten all hose clamps in the cooling and heating systems and replace any deteriorated hoses.

### d. Using and Testing Anti-Freeze Solutions

Inhibited year around (permanent type) engine coolant solution which is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors should be used at all times (not less than 0° F. to freeze protection should be provided to protect against corrosion). When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20° F. may be encountered, a sufficient amount of any of the several brands of year around coolant (Ethylene Glycol base) compatible to GM Specification 1899-M available on the market should be used.

NOTE: Alcohol base coolants are not recommended for this vehicle at any time.

If for any reason water only is used as a coolant in an emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant be added to the cooling system as soon as possible. This material is available at your Buick dealer under Part #980504. If any other cooling system protector is used, be certain it is labeled to indicate that it meets General Motors Specification GM 1894-M. It should be recognized that this is only a temporary measure. The manufacturer intends that permanent type coolant solution be used year around in the cooling system of your Buick.

The cooling system should be completely drained and the recommended coolant installed every two (2) years.

It is advisable to test the anti-freeze solution at intervals during the winter to make certain that the solution has not been weakened by evaporation or leakage. Use only hydrometers which are calibrated to read both the specific gravity and the temperature, and have a table or other means of converting the freezing point at various temperatures of the solution. Disregarding the temperature of the solution when making the test may cause an error as large as 30°F. Care must be exercised to use the correct float or table for the particular type of anti-freeze being tested.

### e. Fan Belt Adjustment and Replacement

A tight fan belt will cause rapid wear of the Delcotron generator and water pump bearings. A loose belt will slip and wear excessively and will cause noise, engine overheating, and unsteady generator output. A fan belt which is cracked or frayed, or which is worn so that it bottoms in the pulleys should be replaced.

The fan belt may be replaced by loosening the generator brace at both ends slightly loosening the generator mounting bolts and moving generator inward to provide maximum slack in the belt.

The Delcotron generator must be moved sideways to adjust the fan belt.

After the Delcotron generator brace and mounting bolts are securely tightened, the fan belt tension should be checked as shown in Figure 2-42.

If the power steering oil pump belt is removed it should be adjusted to tension specified, in Figure 2-43.

If the Air Conditioner compressor belt is disturbed it should be adjusted as specified, in Figure 2-43.

### f. Radiator Thermostat Inspection and Test

A sticking radiator thermostat will prevent the cooling system from functioning properly. If the thermostat sticks in the open position, the engine will warm up very slowly. If the thermostat sticks in the closed position, overheating will result.

The thermostat may be removed for inspection and test partially draining the cooling system and disconnecting the water outlet and hose from the intake manifold in which the thermostat is located.

If the thermostat valve does not fully close when cold, check for the presence of foreign material that could hold it open. If no foreign material is present and valve still does not close, replace the thermostat.

Test the thermostat for correct opening temperature by immersing 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. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

The standard thermostat (170°) valve should start to open at a temperature of 167°F to 172°F, and should be fully open at a temperature not in excess of 192°F. The high temperature 180°) thermostat 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 temperatures it should be replaced as it cannot be adjusted.

### g. Water Pump Repairs

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.

### h. Removal of Water Pump

1. Drain cooling system being sure to drain into a clean container if anti-freeze solution is to be saved.

2. Loosen belt or belts, then remove fan blade, and pulley or pulleys from hub on water pump shaft. Remove belt or belts.

3. Disconnect hose from water pump inlet and heater hose from

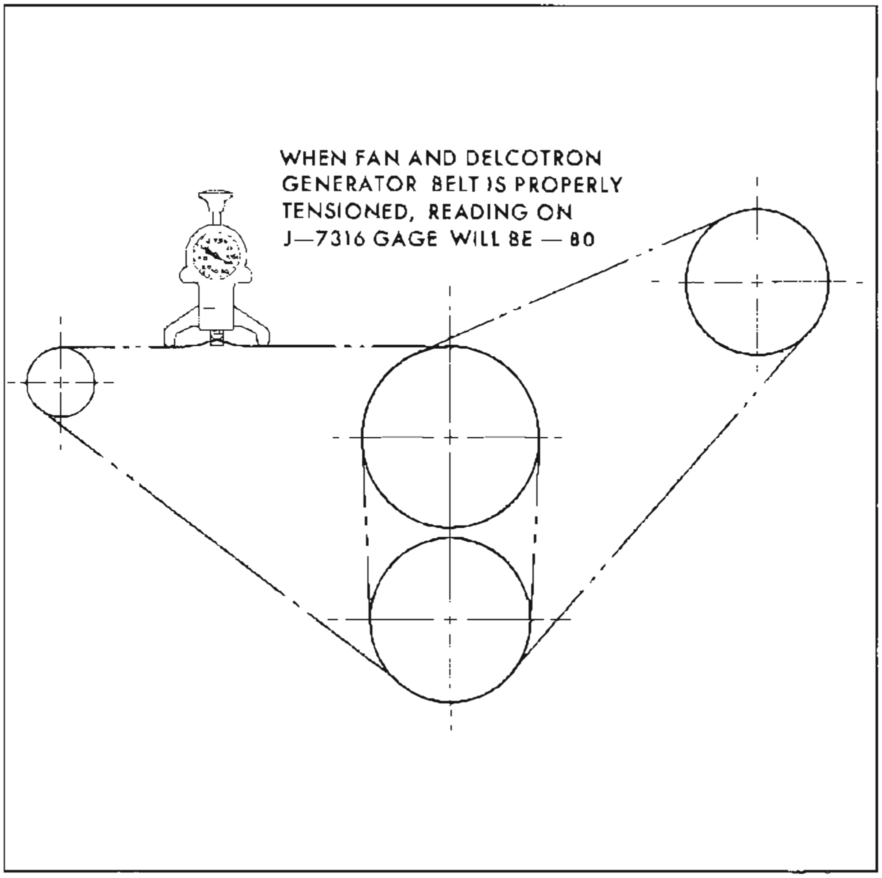



Figure 2-42—Belt Tension Chart - Delcotron Generator

nipple. Remove bolts then 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.

### i. Installation of Water Pump

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. Install belt or belts and adjust for proper tension.

### j. Removal and Inspection of Oil Pump Cover and Gears

1. Remove oil filter.

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.

4. Wash off gears and inspect for wear, scoring, etc. Replace any gears not found serviceable.

5. Remove the oil pressure relief valve cap, spring and valve. See Figure 2-46. Oil filter by-pass valve and spring are staked in place and should not be removed.

6. 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 it side or collapsed. Replace any relief valve spring that is questionable. Thoroughly clean the screen staked in the cover.

7. Check the relief 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.

8. Check filter by-pass valve for cracks, nicks, or warping. The valve should be flat and free of nicks or scratches.

### k. Oil Pump Assembly and Installation

1. Lubricate and install pressure relief valve and spring in bore of oil pump cover. See Figure 2-46. Install cap and gasket. Torque cap to 30-35 pounds with a reliable torque wrench. Do not over-tighten.

NOTE: Pressure relief valve cap has no hole tapped for installation of oil pressure switch.

2. Install oil pump gears and shaft in oil pump body section of timing chain cover to check gear end clearance.

3. Place a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. Clearance should be between .0023" and .0058". If clearance is less than .0018" check timing chain cover gear pocket for evidence of wear.

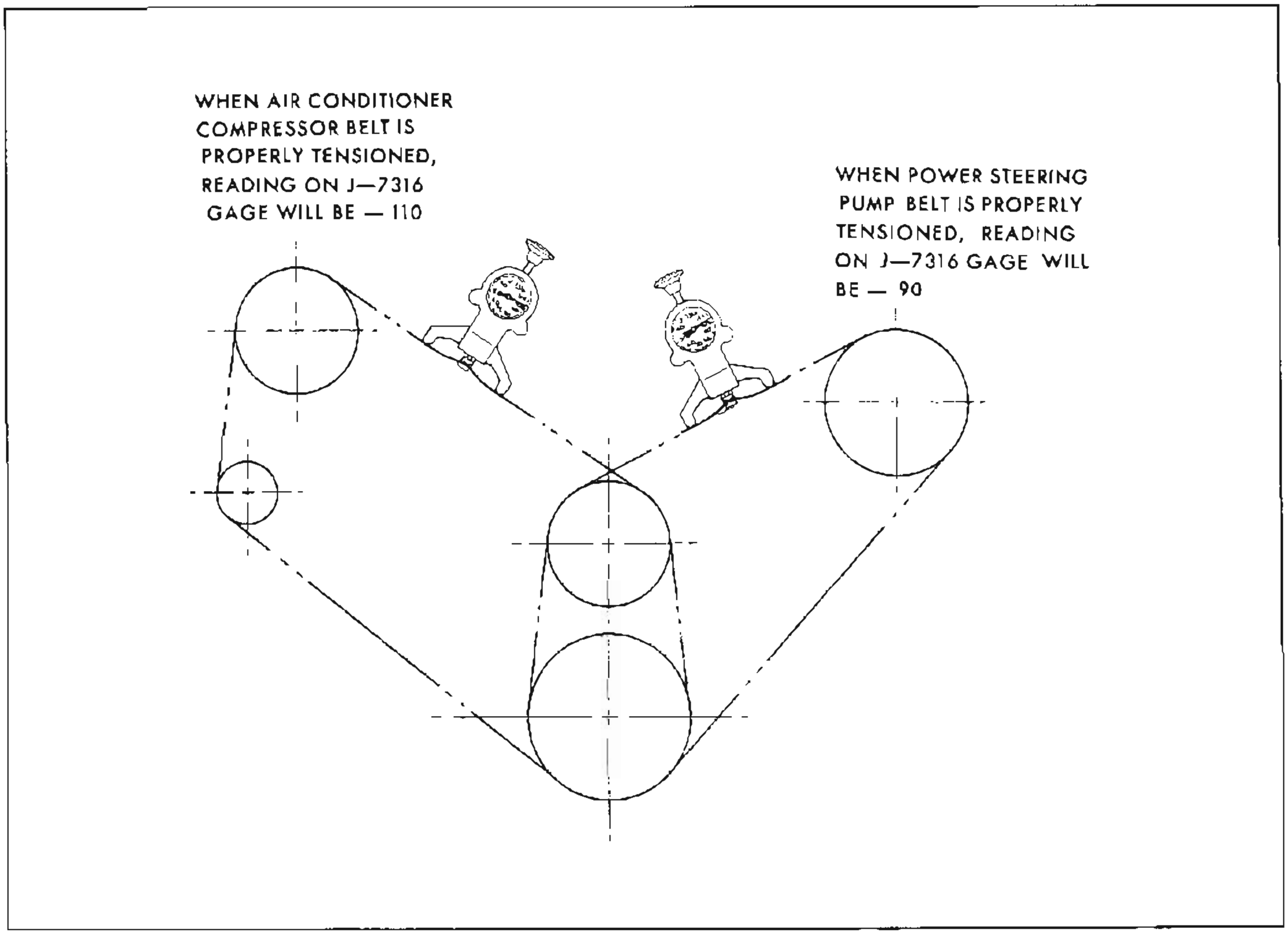



Figure 2-43—Belt Tension Chart - Power Steering and Air Conditioning

4. If gear end clearance is satisfactory, remove gears and pack gear pocket full of petroleum jelly. Do not use chassis lube!!!

5. Reinstall gears so petroleum jelly is forced into every cavity

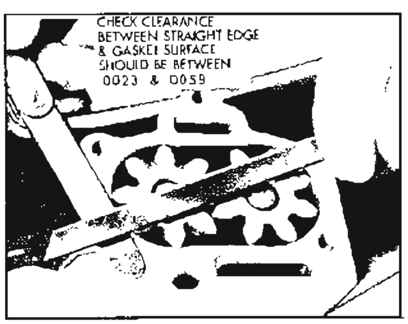



Figure 2-44—Checking Pump End Clearance

of the gear pocket and between the teeth of the gears. Place new gasket in position.

NOTE: This step is very important. Unless the pump is packed with petroleum jelly, it may not prime itself when the engine is started.

6. Install cover assembly screws. Tighten alternately and evenly. The torque specification is 10-15 ft. lbs.

7. Install filter on nipple.

### l. Removal and Inspection of Oil Pump Pipe and Screen Assembly

1. Raise car and support on stands.

2. Drain oil.

3. Remove oil pan attaching bolts. Remove pan.

4. Clean oil pan. Pry screen out of housing and examine for evidence of clogging due to deposit of sludge or other foreign material.

5. Clean the screen and housing thoroughly in solvent and blow dry with air stream.

6. Snap screen into housing.

### m. Installation of Oil Pump and Screen Assembly

Install by reversing removal procedure, paying particular attention to the following points.

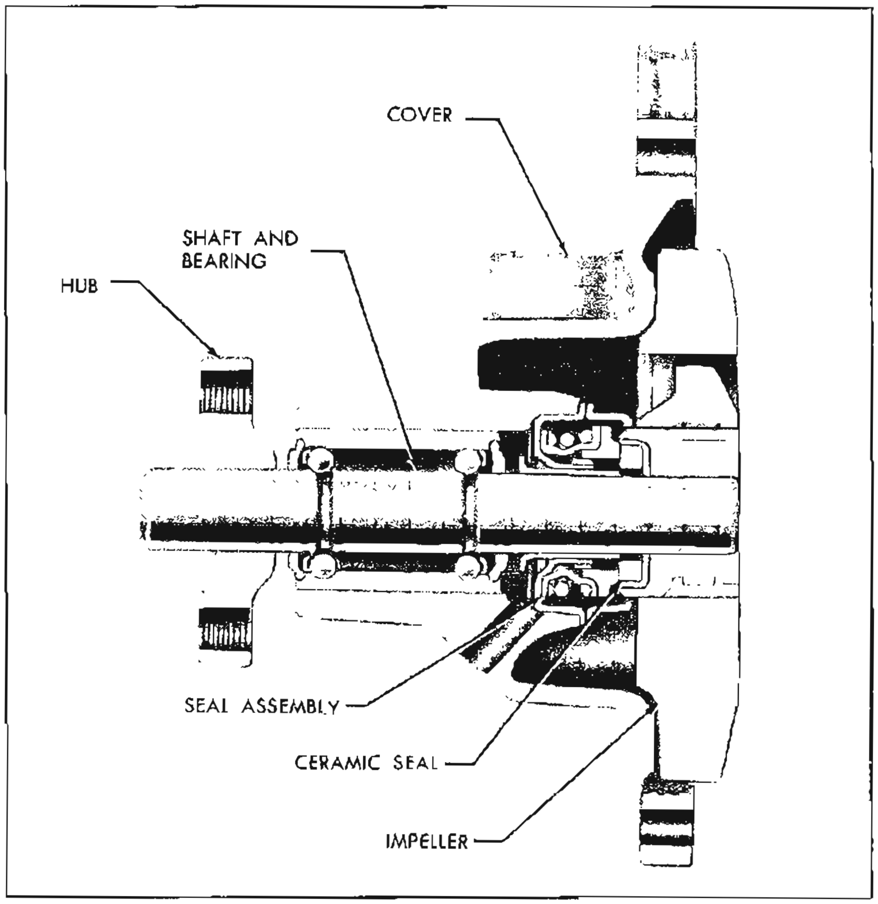



Figure 2-45—Water Pump - Cross Section

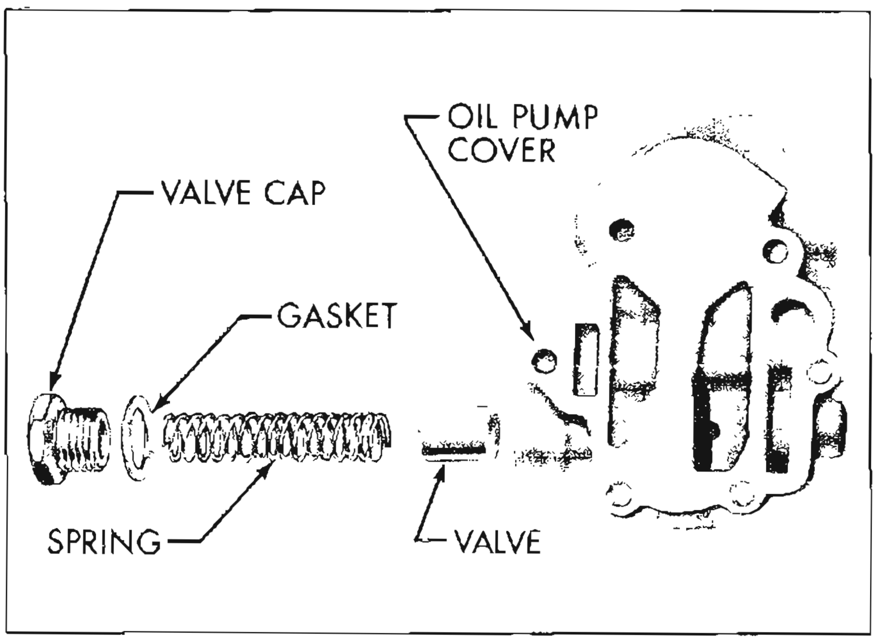



Figure 2-46—Oil Pump Cover and By-Pass Valve

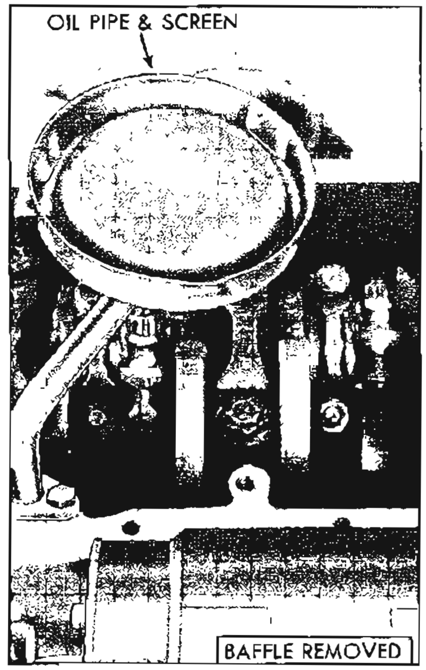



Figure 2-47—Installation of Pipe and Screen Assembly

1. Make sure oil pump pipe flange gasket surface of block is smooth and free of dirt.

2. Use a new gasket and tighten bolts to 6-9 ft. lbs. torque.

3. Tighten pan bolts evenly. Do not over tighten.

## 2-9 TROUBLE DIAGNOSIS

### a. Hard Starting, Improper Performance, Excessive Fuel Consumption

These subjects are covered in Group 3, Section 3-B.

### b. Excessive Oil Consumption

When investigating engines reported to be using large amounts of oil, a thorough inspection should be made for external leaks. Consideration should also be given to the operating conditions and the condition of other areas of the vehicle such as PCV valve and the associated hoses and connectors. If all of these possibilities have been checked and found to be satisfactory, then the chance that consumption is caused by internal leaks should be investigated.

To check for external oil leaks, place a clean piece of paper on floor beneath engine. Start car and run engine until oil is thoroughly warm. Stop engine and check for dripping or leaks. Inspect both sides and ends of engine for wet spots. Check the following areas for any sign of seepage or leakage:

1. Rocker Arm Cover
2. Timing Chain Cover
3. Oil Pan Gaskets
4. Around Starter Bolts and Bracket Attaching Points
5. Area Between Oil Pan and Flywheel Housing

The conditions of operation have an important bearing on oil consumption. The following areas should be checked:

(1) Improper reading of oil gauge rod. An erroneous reading will be obtained if car is not level, gauge rod is not pushed down against stop, or insufficient drain-back time (1 minute) is not allowed after stopping engine. An oversupply of oil may be added if gauge rod markings are not understood. The space between the "OPERATING RANGE" marks represent 1 quart.

(2) Oil too light. The use of oil of lower viscosity than specified for prevailing temperatures will contribute to excessive oil consumption.

(3) Continuous high speed driving. In any automobile engine, increased oil consumption per mile may be expected at speeds above 60 MPH.

(4) High speed driving following slow speed town driving. When a car is used principally for slow speed town driving under conditions where considerable crankcase dilution occurs, a rapid lowering of oil level may occur when the car is driven for some distance at high speed. This is because the dilution from town driving is removed by the heat of the high speed driving. This condition is normal and should not be mistaken for excessive consumption.

(5) Valve guides worn. Excessive clearance between the valve stem and valve guide can result in high oil consumption.

(6) Piston rings not worn in. A new engine, or an engine in which new rings have been installed, will require sufficient running time to wear in the rings against the cylinder walls. During the wear-in period a higher than average oil consumption rate is to be expected, and no attempt should be made to improve oil economy by replacing rings before the engine has been in service for at least 3000 miles.

### c. Excessive Valve Noise

The noise level of the valve mechanism cannot be properly judged where the engine is below operating temperature when the hood is raised, or when the valve rocker arm covers are removed.

Before attempting to judge valve noise level, the engine must be thoroughly warmed up (at least 20 minutes of operation at 1200 to 1500 RPM) to stabilize oil and coolant temperatures and bring all engine parts to a normal state of expansion. When the engine is warmed up, listen for engine noise while sitting in the drivers seat with the hood closed. Run the engine at idle and at various higher speeds. It is advisable to observe the noise level in several engines that have been properly broken in, in order to develop good judgment for checking the noise level in any given engine.

If the preceding check indicates the valve mechanism is abnormally noisy, remove the rocker arm covers so that the various conditions that cause noise may be checked. A piece of heater hose of convenient length may be used to pick out the particular valves or valve linkages that are causing abnormal noise. With the engine running at a speed where the noise is pronounced, hold one end of hose to an ear and hold other end about 1/2" from point of contact between rocker arm and valve stem. Mark or record the noisy valves for investigation of following causes.

(1) Excessive Oil In Crankcase. Crankcase oil level high enough to allow the crankshaft to churn the oil will cause air bubbles in the lubricating system. Air bubbles entering the hydraulic lifters will cause erratic operation resulting in excessive lash in the valve linkage. Locate and correct cause of high oil level, then run engine long enough to expel air from system.

(2) Sticking, Warped or Eccentric Valves, Worn Guides. Sticking valves will cause irregular engine operation or missing on a low speed pull and will usually cause intermittent noise.

Pour penetrating oil over the valve spring cap and allow it to drain down the valve stem. Apply pressure to the one side of the valve spring and then the other, and then rotate the valve spring about 1/2 turn. If these operations affect the valve noise, it may be assumed that valves should be reconditioned. (Par. 2-6, subpar. c.)

(3) Worn or scored parts in the valve train. Inspect rocker arms, push rod ends for scoring. Check push rods for bends, valve lifters and camshaft surfaces for scoring. Replace faulty parts.

(4) Valves and seats cut down excessively. Noisy and improper

valve action will result if a valve and its seat have been refinished enough to raise the end of the valve stem approximately .050" above normal position. 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 is 1.925 inches.

(5) Faulty Hydraulic Valve Lifters. If the preceding suggestions do not reveal the cause of noisy valve action, check operation of valve lifters as described in subparagraph C.

**d. Checking Hydraulic Valve Lifters**

When checking hydraulic valve lifters, remember that grit, sludge, varnish or other foreign matter will seriously affect operation of these lifters. If any foreign substance is found in the lifters or engine where it may be circulated by the lubrication system, a thorough cleaning job must be done to avoid a repetition of lifter trouble.

To help prevent lifter trouble, the engine oil and oil filter must be changed as recommended in Group 1. The engine oil must be heavyduty type (MS marked on container) and must also conform to General Motors Specification 4745-M to avoid detrimental formation of sludge and varnish. A car owner should be specifically advised of these requirements when the car is delivered. Faulty valve lifter operation usually appears under one of the following conditions:

(1) Rapping noise only when engine is started. When engine is stopped, any lifter on a camshaft lobe is under pressure of the valve spring; therefore, leak down or escape of oil from the lower chamber can occur. When the engine is started a few seconds may be required to fill the lifter, particularly in cold weather. If noise occurs only occasionally, it may be considered normal requiring no correction. If noise occurs daily, however, check for (a) oil too heavy for prevailing temperatures (b) excessive varnish in lifter.

(2) Intermittent Rapping Noise. An intermittent rapping noise that appears and disappears every few seconds indicates leakage at check ball seat due to foreign particles, varnish, or defective surface of check ball or seat. Recondition, clean, and/or replace lifters as necessary.

(3) Noise on idle and low speed. If one or more valve lifters are noisy on idle and up to approximately 25 MPH but quiet at higher speeds, it indicates excessive leakdown rate or faulty check ball seat on plunger. With engine idling, lifters with excessive leakdown rate may be spotted by pressing down on each rocker arm above the push rod with equal pressure. Recondition or replace noisy lifters.

(4) Generally noisy at all speeds. Check for high oil level in crankcase. See subparagraph b (1) above. With engine idling, strike each rocker arm above push rod several sharp blows with a mallet; if noise disappears, it indicates that foreign material was keeping check ball from seating. Stop engine and place lifters on camshaft base circle. If there is lash clearance in any valve linkage, it indicates a stuck lifter plunger, worn lifter body lower end, or worn camshaft lobe.

(5) Loud noise at normal operating temperature only. If a lifter develops a loud noise when engine is at normal operating temperature, but is quiet when engine is below normal temperature, it indicates an excessively fast leakdown rate or scored lifter plunger. Recondition or replace lifter.

**e. Engine Noise and Vibration**

If unusual vibration or noise develops in the car, test first to determine whether the condition originates in the engine or in other operating units. Time will often be saved by checking the recent history of the car to determine whether the vibration became noticeable gradually or followed an accident or installation of repair parts.

Vibration or noise is usually more pronounced at a certain car speed. If the engine is run at the equivalent speed with car standing and transmission in neutral, the condition will still exist if the engine or clutch is at fault. If the trouble does not exist with engine running and car standing still, refer to Rear Axle Section and/or Propeller Shaft Section.

An engine which is not properly tuned will run rough and vibrate, particularly at idling and low speeds. A thorough engine tune-care operation is the proper correction.

Bent fan blades will cause vibration and noise. Remove fan belt and run engine. If vibration or noise is eliminated or reduced it indicates that the condition is caused by the fan, Delcotron generator, belt, or possibly the water pump. Check water pump for rough or noisy bearings and replace parts as necessary.

Inspect fan belt, all pulleys, balancer, fan blades and generator for undercoating or other material that would cause an unbalanced condition.

Check fan blades for excessive run-out and correct if necessary. Check all pulleys for abnormal run-out or wobble and replace if necessary. Reinstall fan belt and adjust to proper tension.

With engine running, place one hand on generator and slowly open throttle from idle to approximately 60 MPH. If generator vibrates to create a noise in the car, it will vibrate enough to be felt by the hand. As the engine is slowly speeded up the generator may be felt to go into periods of vibration at different engine speeds. Noise caused by the generator should occur at the same time that generator vibration occurs. Repair or replace a noisy generator.

Vibration may be caused by loose, broken, or deteriorated engine mountings. Tighten loose mountings or replace faulty mountings.

Loose or broken rivets in the crankshaft balancer may cause vibration in the engine. If the balancer is damaged in such a manner that the parts cannot function freely, extreme roughness will result which may eventually break the crankshaft. A balancer which shows evidence of damage or which is suspected of being inoperative should be replaced and the result noted, since it is not possible to test the balancer any other way.

Vibration will result if connecting rods or pistons are installed which are not of equal weight with all other rods or pistons in engine. If new parts have recently been installed, these should be checked to determine whether they are standard Buick parts or if they have been altered in weight by filing, machining or other repairs.

Vibration existing with automatic transmission may be due to unbalanced flywheel or converter pump.

Engine roughness may be caused by an unbalanced combination of clutch, flywheel and crankshaft even though these units are balanced individually during manufacture. Unbalance may occur if clutch or flywheel is removed without marking to allow reinstallation in original position.

### f. Cooling System Trouble Diagnosis

If the radiator is filled too full when cold, expansion when hot will overfill the radiator and coolant will be lost through the overflow pipe. Adding unnecessary water will weaken the anti-freeze solution and raise the temperature at which freezing may occur.

The use of alcohol anti-freeze with a high temperature radiator thermostat will cause boiling and loss of coolant through the overflow pipe.

If the cooling system requires frequent addition of water in order to maintain the proper level in the radiator, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks which may show dampness or dripping can easily escape detection when the engine is hot, due to the rapid evaporation of coolant. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no dampness.

Air or gas entrained in the cooling system may raise the level in radiator and cause loss of coolant through the overflow pipe. Air may be drawn into the cooling system through leakage at the water pump seal. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber. The following quick check for air leaks on suction side of pump or gas leakage from engine may be made with a piece of rubber tubing and a glass bottle containing water.

1. With cooling system cold, add water to bring coolant to proper level.

2. Block open the radiator cap pressure valve, or use a plain cap, and be sure radiator cap is on tight. Attach a suitable length of rubber hose to overflow pipe.

3. Run engine in neutral at a safe high speed until the engine reaches a constant operating temperature.

4. Without changing engine speed, put the free end of rubber hose into a bottle of water, avoiding kinks or low bends that might block the flow of air.

5. Watch for air bubbles in water bottle. A continuous flow of bubbles indicates that air is being sucked into the cooling system, or exhaust gas is leaking into the cooling system past the cylinder head gasket.

### g. Cooling System Overheating

It must be remembered that the Buick pressure system operates at higher temperatures than systems operating at atmospheric pressure. Depending on the pressure in cooling system, the temperature of water or permanent type anti-freeze may go considerably above 212°F without danger of boiling.

In cases of actual overheating the following conditions should be checked:

1. Excessive water loss.

2. Slipping or broken fan belt.

3. Radiator thermostat stuck, radiator air passages clogged, restriction in radiator core, hoses, or water jacket passages.

4. Improper ignition timing.

5. Shortage of engine oil or improper lubrication due to internal conditions.

6. Dragging brakes.

# SECTION 2-B

# 300 CUBIC INCH V-8 ENGINE

## CONTENTS OF SECTION 2-B



## 2-10 GENERAL DESCRIPTION

| | |
|---|---|
| Engine Type | 90° V-8 |
| Valve Arrangement | In Head |
| Bore and Stroke | 3.750 x 3.400 |
| Piston Displacement | 300 Cu. In. |
| Compression Ratio | |
| 2-Barrel Carburetor | 9.0 to 1 |
| 4-Barrel Carburetor | 10.25 to 1 |
| Brake Horsepower at RPM | |
| Standard Compression | 210 @ 4600 |
| High Compression | 250 @ 4600 |
| Torque at RPM | |
| Standard Compression | 310 @ 2400 |
| High Compression | 335 @ 3000 |
| Octane Requirements | |
| Standard Compression | 84 Motor Method, 93 Research Method |
| High Compression | 90 Motor Method, 99 Research Method |
| Taxable Horsepower | 45.0 |
| Cylinder Numbers - Front to Rear | |
| Left Bank | 1-3-5-7 |
| Right Bank | 2-4-6-8 |
| Firing Order | 1-8-4-3-6-5-7-2 |
| Cylinder Block Material | Cast Iron |
| Cylinder Head Material | Cast Iron |
| Engine Idle Speed | |
| Synchromesh | 550 RPM |
| Automatic | 550 RPM (In Drive) |
| AC Cars | 600 RPM (Automatic In Drive) |

#### Piston and Piston Pin Specifications

| | |
|---|---|
| Piston Material | Cast Aluminum Alloy |
| Piston Treatment | Tin Plated |
| Piston Pin Material | SAE 1018 or 1118 Steel |
| Piston Pin Type | Pressed In Rod |

#### Connecting Rod Specifications

| | |
|---|---|
| Material - Rod | Pearlitic Malleable Iron |
| Bearing Type | Removable Steel Backed |
| Bearing Material | M/400 Aluminum |

#### Ring Specifications

Compression Ring Material & Surface Treatment

| | |
|---|---|
| #1 | Cast Iron - Chrome Plated |
| #2 | Cast Iron - Lubrited |
| Oil Ring Type | Dual Steel Rail With Spacer |
| Oil Ring Expander | Steel Humped Ring |
| Location of Rings | Above Piston Pin |

### Crankshaft Specifications

| | |
|---|---|
| Material | Pearlitic Malleable Iron |
| Bearings | 5-All Replaceable |
| Bearing Material | M-400 Aluminum (#1, #2, #3, and #4)<br>M-100 Durex (#5) |
| Bearing Taking End Thrust | #3 |

### Camshaft Specifications

| | |
|---|---|
| Material | Cast Iron Alloy |
| Bearings | Steel Backed Babbit |
| Number of Bearings | 5 |
| Camshaft Location | Above Crankshaft At Center of "V" |
| Type of Drive | Chain |
| No. of Links | 54 |
| Crankshaft Sprocket | Sintered Iron |
| Camshaft Sprocket | Nylon Coated Aluminum |

### Valve Specifications

| | |
|---|---|
| Intake Valve Material | SAE 1041 Steel |
| Exhaust Valve Material | GM-N82152 (21-4N) |
| Valve Lifter Mechanism | Hydraulic |
| Valve Spring | Single Helical |

### Lubrication System Specifications

| | |
|---|---|
| Type of Lubrication | |
| Main Bearings | Pressure |
| Connecting Rods | Pressure |
| Piston Pins | Splash |
| Camshaft Bearings | Pressure |
| Timing Chain | Splash & Nozzle |
| Cylinder Walls | Splash & Nozzle |
| Oil Pump Type | Gear Driven |
| Normal Oil Pressure | 30 lbs. @ 2400 RPM |
| Oil Pressure Sending Unit | Electrical |
| Oil Intake | Screened Tube |
| Oil Filter System | Full Flow |
| Filter Type | Throw-Away Element & Can |
| Crankcase Capacity | |
| Less Filter | 4 qts. |
| With Filter | 5 qts. |

### Cooling System Specifications

| | |
|---|---|
| System Type | Pressure |
| Radiator Cap Relief Pressure | 15 PSI |
| Thermostat | Choke Type Opening at 180° |
| Water Pump | |
| Type | Centrifugal |
| GPM @ RPM | 14 @ 1000 |
| Drive | V-Belt |
| Bearings | Double Row |
| By-Pass Recirculation Type | External |
| Cooling System Capacities | |
| With Heater | 13.7 qts. |
| W/O Heater | 12.7 qts. |
| With Air Conditioning | 15.0 qts. |
| Fan Diameter And Number Of Blades | |
| Less AC | 18" x 4 |
| With AC | 18" x 7 |
| Fan Drive | |
| Less AC | Water Pump Shaft |
| With AC | Torque and Temperature Sensitive Clutch |

## 2-11 TORQUE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed below. This will prevent straining or distorting the parts as well as preventing thread damage. These specifications are for clean and lubricated threads only. Dry or dirty threads produce friction which prevents accurate measurement of the actual torque. It is important that these specifications be strictly observed. Over-tightening can damage threads. This will prevent attainment of the proper torque and will require replacement of the damaged part.

| Area | Torque - Ft. Lbs. |
|---|---|
| Crankshaft Bearing Caps to Cylinder Block | 95-120 |
| Connecting Rods | 30-40 |
| Cylinder Head to Cylinder Block | 65-80 |
| Harmonic Balancer to Crankshaft | 140 Minimum |
| Fan Driving Pulley to Harmonic Balancer | 18-25 |
| Flywheel to Crankshaft (Auto. & Synchro.) | 50-65 |
| Oil Pan to Cylinder Block | 9-13 |
| Oil Pan Drain Plug | 25-35 |
| Oil Pump Cover to Timing Chain Cover | 8-12 |
| Oil Pump Pressure Regulator Retainer | 25-30 |
| Oil Screen Housing to Cylinder Block | 6-9 |
| Oil Pan Baffle to Cylinder Block | 9-13 |
| Oil Gallery Plugs | 20-30 |
| Filter Assembly to Pump Cover | 10-15 |
| Timing Chain Cover to Block | 17-23 |
| Water Pump Cover to Timing Chain Cover | 6-8 |
| Fan Driven Pulley | 17-23 |
| Thermostat Housing to Intake Manifold | 17-23 |
| Intake Manifold to Cylinder Head | 25-35 |
| Exhaust Manifold to Cylinder Head | 10-15 |
| Carburetor to Intake Manifold | 10-15 |
| Fuel Pump to Cylinder Block | 17-23 |
| Motor Mount to Cylinder Block | 50-75 |
| Fuel Pump Eccentric and Timing Chain Sprocket to Camshaft | 40-55 |
| Rocker Arm Cover to Cylinder Head | 3 to 5 |
| Rocker Arm Shaft Bracket to Cylinder Head | 25-35 |
| Delcotron Bracket to Cylinder Head | 30 to 40 |
| Delcotron Bracket to Water Pump Timing Chain Cover | 18-25 |
| Delcotron Mounting Bracket Thru Delcotron to Cylinder Head at Pivot Location | 30-40 |
| Starting Motor to Block | 30-40 |
| Starting Motor Brace to Block | 9-13 |
| Starting Motor Brace to Starting Motor | 9-13 |
| Distributor Holddown Clamp | 10-15 |
| Spark Plugs | 25-35 |
| Synchromesh Lower Flywheel Housing Plate | 9-13 |
| Flywheel Housing to Cylinder Block | 30-40 |
| Fuel Filter to Cylinder Head | 10-15 |

## 2-12 DIMENSIONS, ADJUSTMENTS, AND TOLERANCES

| | |
|---|---|
| Piston Clearance Limits* | |
| Top Land | .0215 - .0295 |
| Skirt - Top | .0015 - .0011 |
| Skirt - Bottom | .0005 - .0021 |
| Ring Groove Depth | |
| #1 - Compression Ring | .1880 - .1955 |
| #2 - Compression Ring | .1905 - .1980 |
| #3 - Oil Ring | .1905 - .1980 |
| Ring Width | |
| #1 - Compression Ring | .0785 - .0790 |
| #2 - Compression Ring | .0770 - .0780 |
| #3 - Oil Ring | .181 - .187 |
| Ring Gap | |
| #1 - Compression Ring | .010 - .020 |
| #2 - Compression Ring | .010 - .020 |
| #3 - Oil Ring | .015 - .035 |
| Piston Pin Length | 3.060 |
| Diameter of Pin | .9394 - .9397 |
| Clearance | |
| In Piston | .00005 - .0001 |
| In Rod | .0007 - .0015 Press |
| Direction & Amount Offset In Piston | .040 Toward High Thrust Side |

*All Measurements In Inches Unless Otherwise Specified.

#### Connecting Rod Specifications

| | |
|---|---|
| Bearing Length | .737 |
| Bearing Clearance (Limits) | .0020 - .0023 |
| End Play - Total for both Rods | .006 - .014 |

#### Crankshaft Specifications

| | |
|---|---|
| End Play at Thrust Bearing | .004 - .008 |
| Main Bearing Journal Diameter | 2.4995 |
| Crankpin Journal Diameter | 2.0000 |
| Main Bearing Overall Length | |
| #1 | .864 |
| #2 | .864 |
| #3 | 1.057 |
| #4 | .864 |
| #5 | .864 |
| Main Bearing to Journal Clearance | .0004 - .0018 |

#### Camshaft Specifications

| | |
|---|---|
| Bearing Journal Diameter | |
| #1 | 1.785 - 1.786 |
| #2 | 1.755 - 1.756 |
| #3 | 1.725 - 1.726 |
| #4 | 1.695 - 1.696 |
| #5 | 1.665 - 1.666 |
| Journal Clearance in Bearings | .0005 - .0025 (#1)<br>.0005 - .0035 (#2, #3, #4, & #5) |

#### Valve System Specifications

| | |
|---|---|
| Rocker Arm Ratio | 1.6 to 1 |
| Rocker Arm Clearance On Shaft | .0017 - .0032 |
| Valve Lifter Diameter | .8422 - .8427 |
| Valve Lifter Clearance In Crankcase | .0015 - .003 |
| Valve Lifter Leakdown Rate | 12 to 60 Sec. in Test [illegible]ture |
| Intake Valve | |
| Head Diameter | 1.625 |
| Seat Angle | 45° |
| Stem Diameter | .3412 Top - .3407 Bottom |
| Clearance In Guide | Top .0015 - .0035 — Bottom .002 - .004 |
| Valve Spring | |
| Valve Closed - Pounds @ Length | 64 @ 1.640 |
| Valve Open - Pounds @ Length | 168 @ 1.260 |

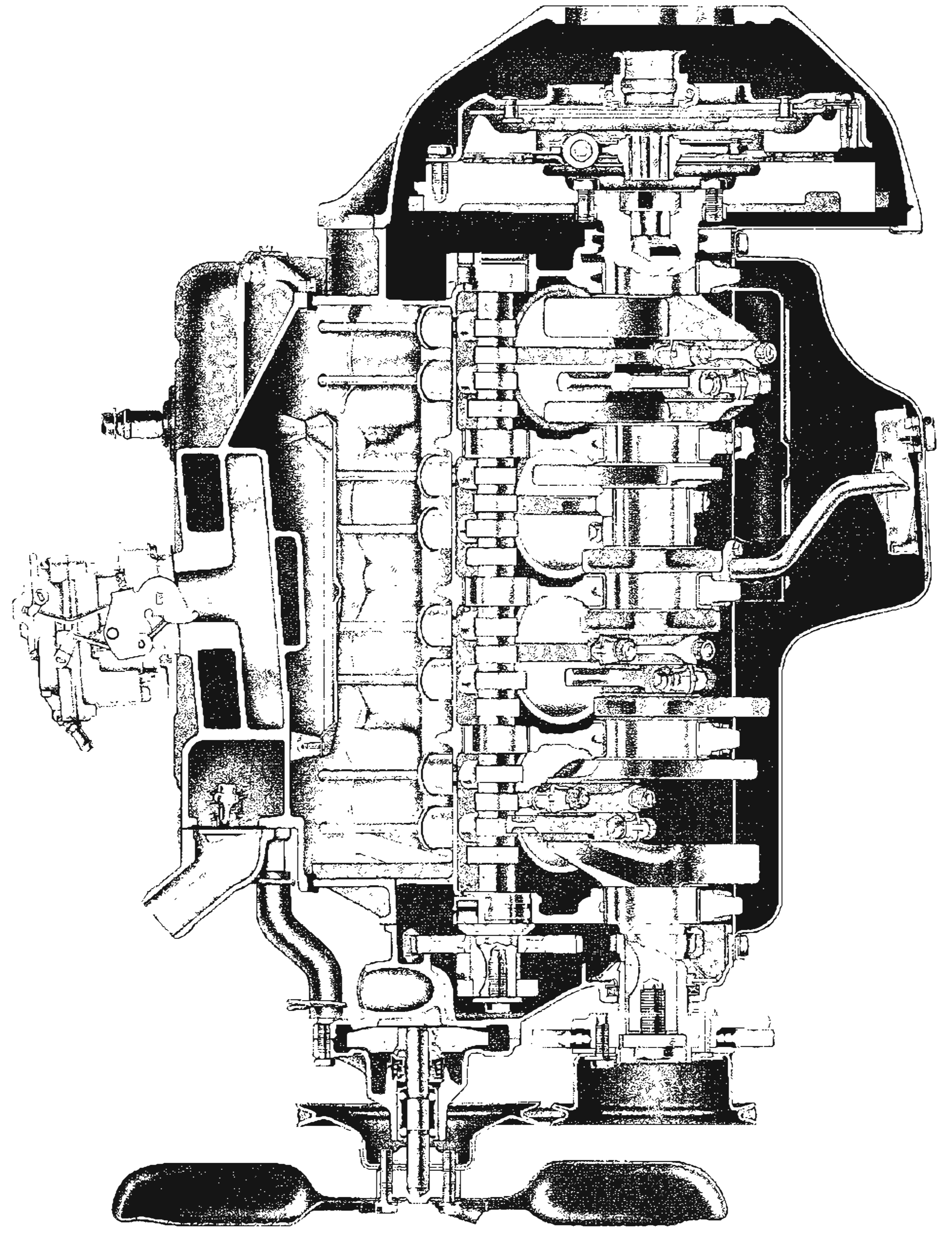


Fig. 2-48 V-8 Engine Cross Section

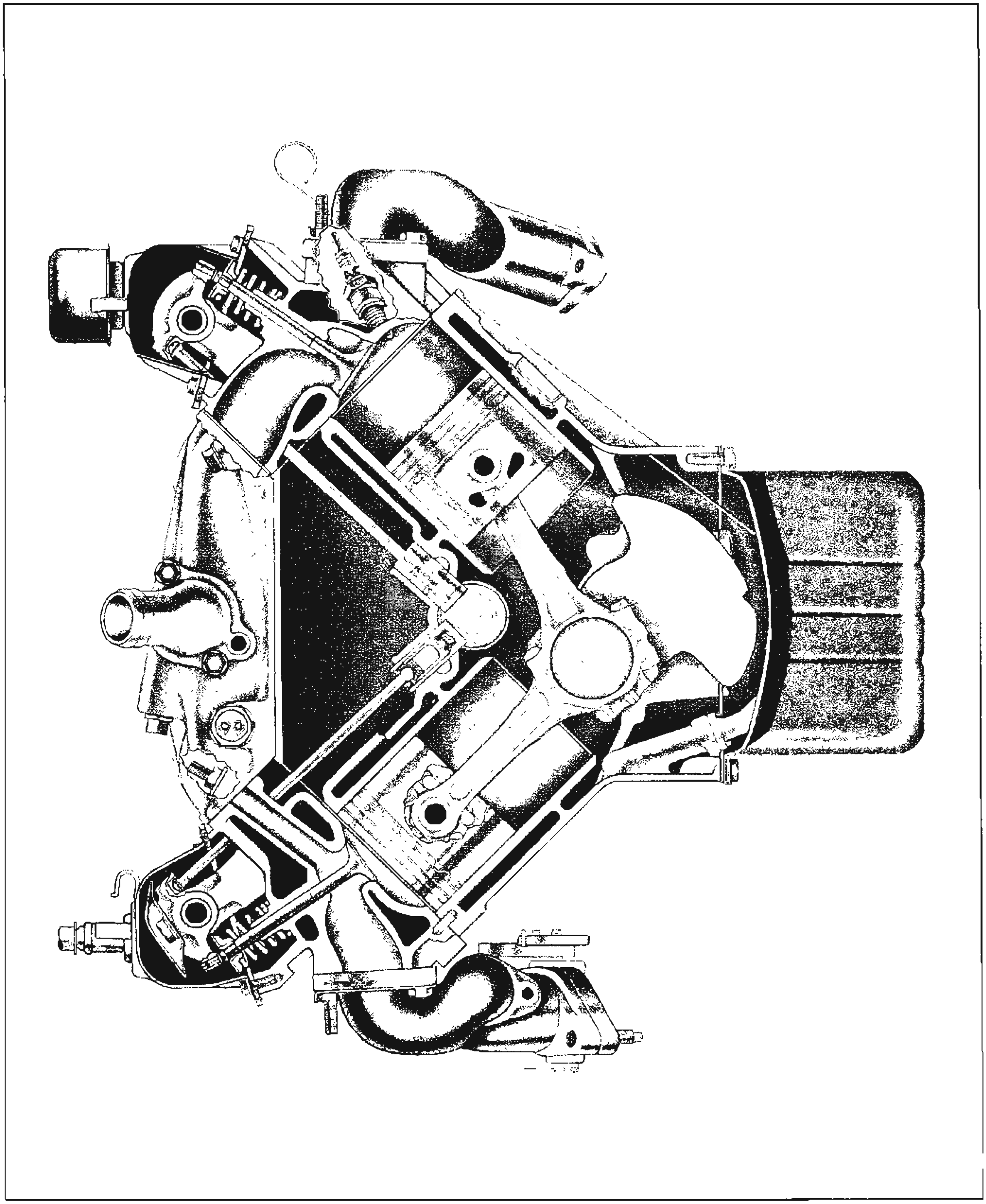


Figure 2-49—V-8 Engine Cross Section (Front View)

## 2-13 ENGINE DESCRIPTION

### a. Engine Usage

A V-8 engine with a displacement of 300 cubic inches is supplied as standard equipment on all 434-436-442-44400 models. The same basic engine is used with either synchromesh or automatic transmissions. The synchromesh model is equipped with a cast iron flywheel and flywheel housing. Automatic transmission engines are equipped with a stamped steel flywheel that bolts to the transmission converter pump. V-8 engines equipped with two barrel carburetors have a compression ratio of 9.0 to 1 which permits the use of "regular grade" gasoline. Engines equipped with 4 barrel carburetors have a compression ratio of 10.25 to 1 which requires the use of "premium" or "high test" gasoline.

### b. Engine Mounting

The engine-transmission unit is mounted to the chassis at three points by synthetic rubber pads.

The two front mounts are bolted to the engine crankcase and the frame cross member. These mounts support most of the engine weight and control its torsional characteristics. The single rear mount is placed between the transmission and the transmission support and is secured by two bolts. It supports part of the engine and transmission weight and locates the rear of the engine with respect to the centerline of the car.

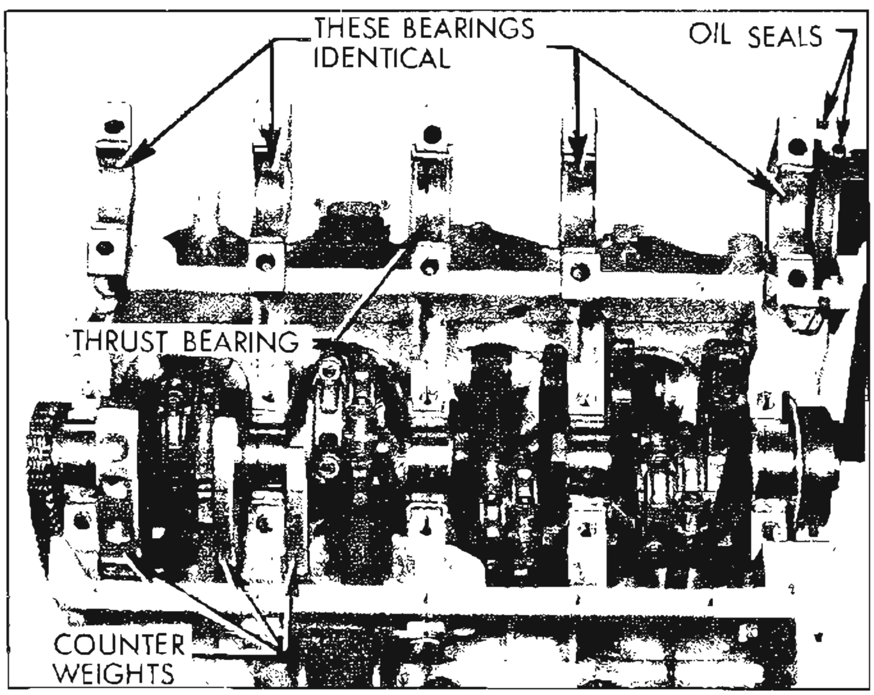



Figure 2-50—Lower Engine With Oil Pan Removed

### c. Engine Construction

The engine crankcase is made of cast iron. Two banks of cylinders - four cylinders per bank - are cast at a 90° angle. The lower part of the crankcase extends below the centerline of the crankshaft, forming a continuous flat surface with the rear bearing cap and the timing chain cover. This design allows installation of an oil sump pan with a one-piece gasket. The cylinders in the left bank (as viewed from the drivers seat) are numbered 1-3-5-7, counting from front to rear. The cylinders in the right bank are numbered 2-4-6-8, counting from front to rear.

The crankshaft is supported in the crankcase by steel-backed full precision bearings, all having the same nominal diameter. Except for the thrust bearing and the rear main bearing, all bearings are identical. The thrust bearing (#3) takes end thrust and has flanges for that purpose.

The crankshaft is counterbalanced by weights cast integral with the crank cheeks. Maximum counterweighting in the space available is accomplished by precision casting the counterweights to a contour which allows a minimum uniform clearance with cylinder barrels and piston skirts.

Connecting rods are of I-beam section with bosses on each side so metal can be removed as required to obtain correct weight and balance. The lower end of each rod is fitted with a steel-backed full precision bearing. The piston pin is a press fit into the upper end. The outer ends of the piston pin are a slide fit in the piston bosses.

The full skirt 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 upper grooves of the piston

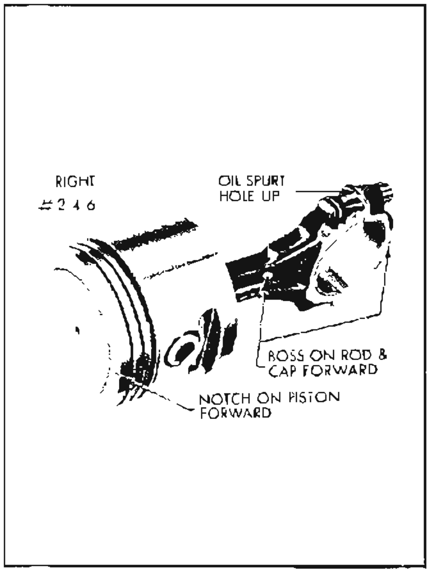



Figure 2-51—Piston and Connecting Rod

have a groove or bevel cut around the inner edge on one side. The top compression ring is installed with this groove or bevel down. The lower compression ring is installed bevel up. The oil ring in the lower groove consists of two thin steel rails separated by a spacer expander.

The cylinder heads are cast iron and incorporate cast in valve stem guides. 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.

The valves are in line in each head and operate at an angle 10° above the centerline of the cylinder bores. The spark plug in each cylinder is located so that the point gap is ideally located with respect to the sweep of the incoming charge. Each valve has

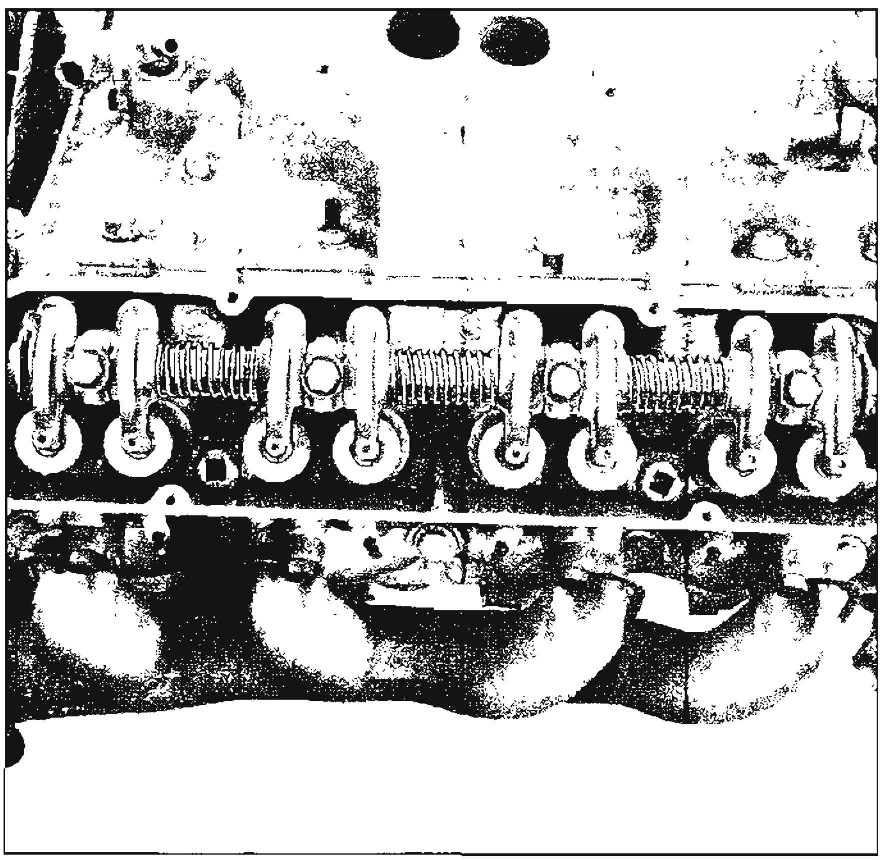


Figure 2-52—Engine Valve Mechanism

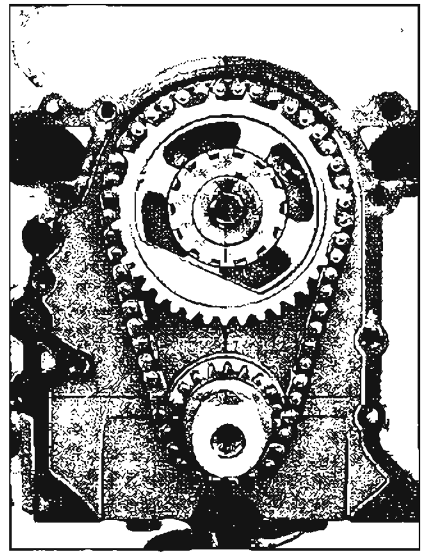


Figure 2-53—Timing Chain Installation

a spring of ample capacity to insure positive valve seating throughout the operating speed range of the engine. The intake valve heads are 1.625" in diameter while the exhaust valve heads are 1.375" in diameter.

The valve rocker arm mechanism is covered by a sheet metal cover which seats against a raised surface of the cylinder head and is gasketed to prevent oil leaks. The rocker arms for each bank of cylinders are mounted on a tubular steel shaft supported on the cylinder head by die cast brackets. Rocker arms are die cast aluminum with inserts at the push rod socket and the valve stem contact face.

The camshaft is located above the crankshaft between the two banks of cylinders. It is supported in five steel-backed babbit bearings and driven at half crankshaft speed by sprockets and a single outside guide type chain.

Hydraulic valve lifters and one piece push rods are used to operate the overhead rocker arms and valves on both banks of cylinders using a single camshaft. This system requires no lash adjustment at time of assembly

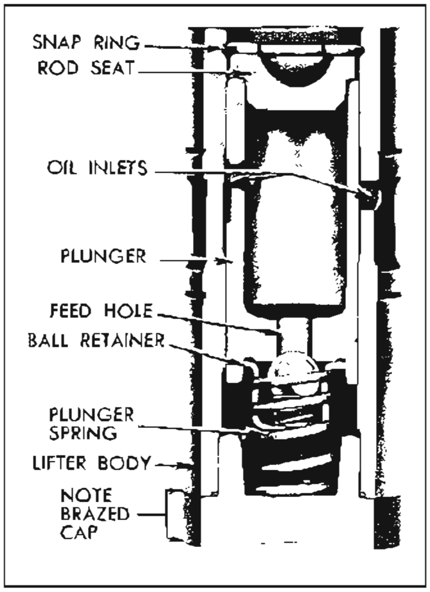



Figure 2-54—Hydraulic Lifter Cross Section

or in service. Construction of the hydraulic valve lifter can be seen in Figure 2-54. Refer to paragraph 2-4 in the V-6 engine section of the 1965 Special Chassis Service Manual for a detailed description of the operation of a hydraulic valve lifter.

### d. Engine Lubrication

The engine lubrication system is the force feed type in which oil is supplied under pressure to the crankshaft, connecting rods, camshaft bearings, and valve lifters. Oil is supplied under controlled volume to the rocker arm bearings and push rods. All other moving parts are lubricated by gravity flow or splash.

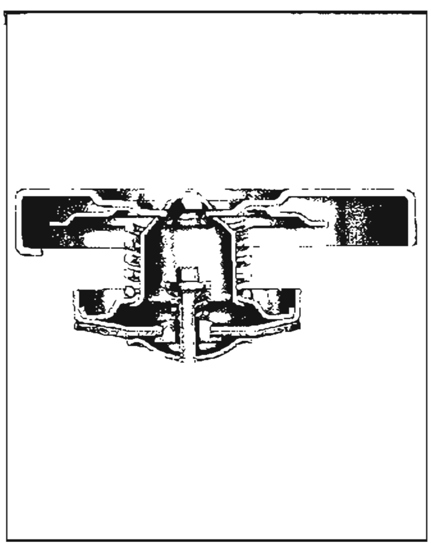


Figure 2-55—Engine Radiator Cap Cross Section

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. A removable oil gauge rod on the left side of the crankcase is provided to check oil level.

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 pressure to a maximum of 30 pounds per square inch. The oil filter by-pass valve opens when the filter has become clogged to the extent that 4-1/2 to 5 pounds pressure difference exists between the filter inlet and exhaust to by-pass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine.

An AC full flow oil filter 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, a spring loaded by-pass valve opens as mentioned above.

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. 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

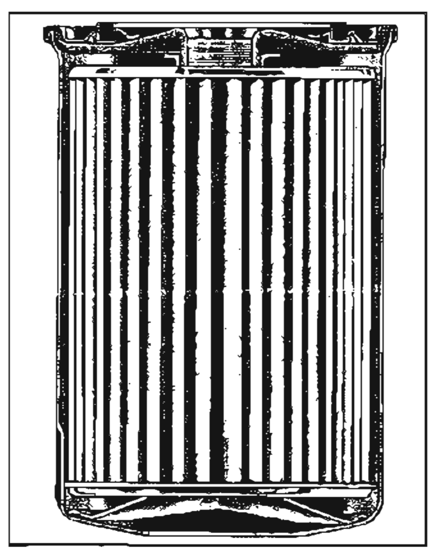


Figure 2-56—Oil Filter Cross Section

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 under side 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.

### e. Engine Cooling System

The engine cooling system is the pressure type with thermostatic control of coolant circulation.

The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric

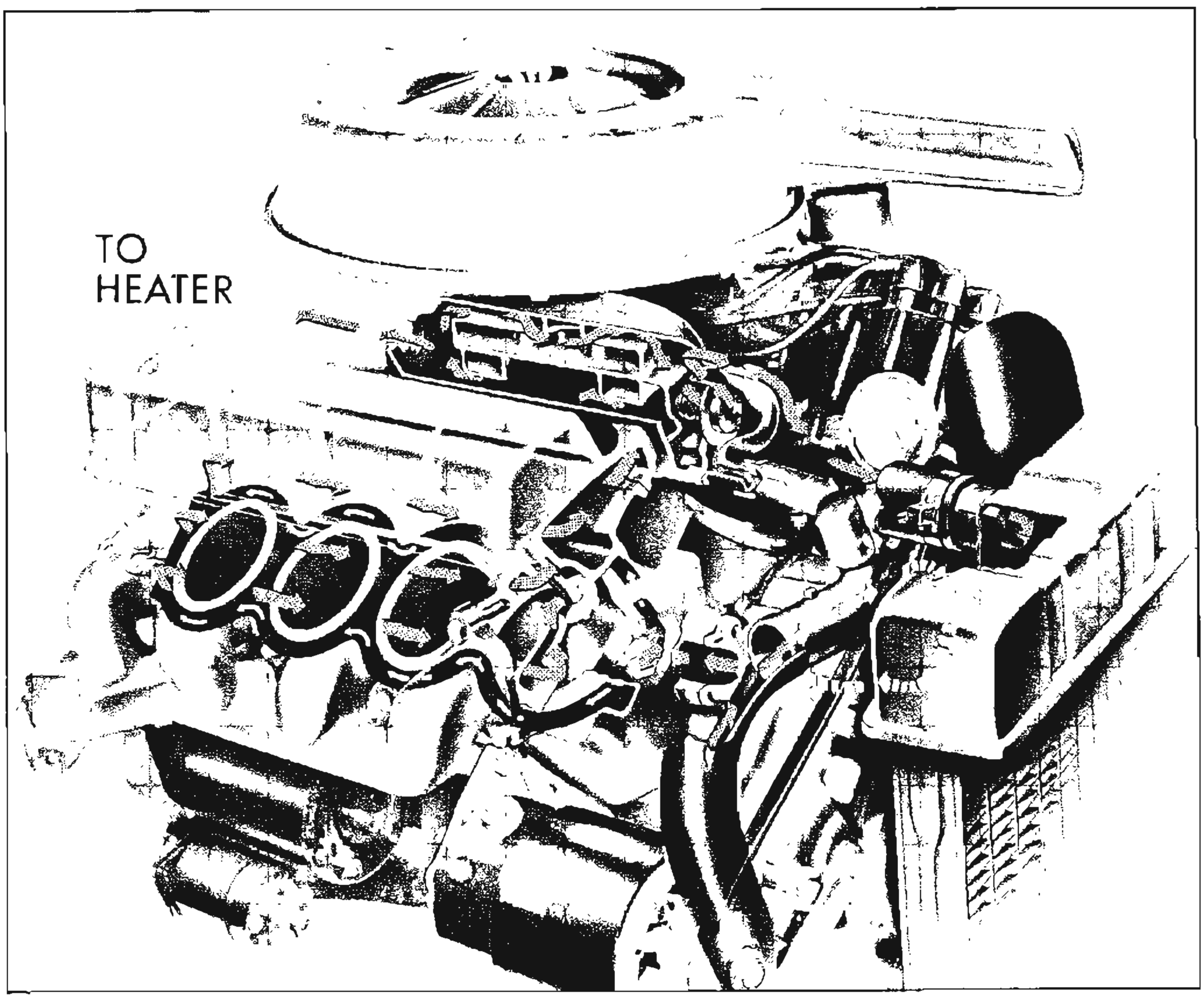



Figure 2-57—V-8 Engine Coolant Flow

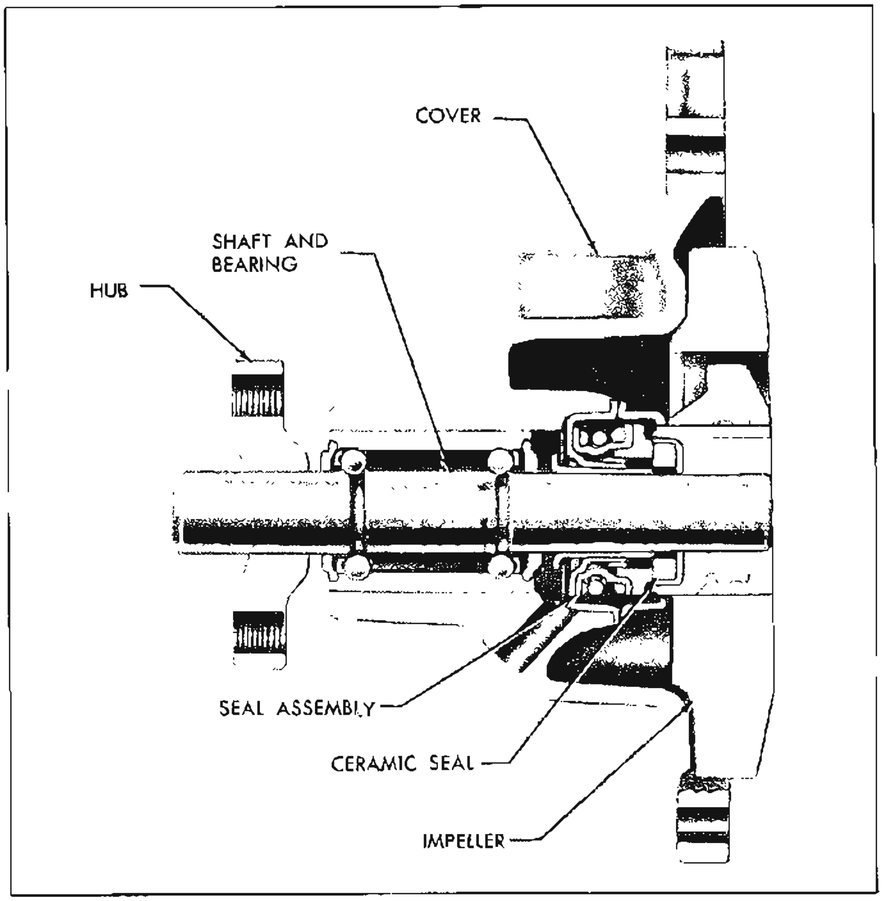



Figure 2-58—Water Pump Cross Section

pressure. The higher pressure raises the boiling point of the coolant and increases the cooling efficiency of the radiator. The 15 pound pressure cap used raises the coolant boiling point approximately 38°F.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring of predetermined strength which protects the radiator by relieving the pressure if the pressure should exceed that for which the radiator is designed.

The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created when the system cools off.

The coolant is circulated by a centrifugal pump mounted on the timing chain cover which forms the outlet side of the pump. The engine fan and pulley(s) are bolted to the pump shaft hub at its forward end. Thus both the fan and pump are belt driven by a crankshaft pulley bolted to the harmonic balancer. The pump shaft and bearing assembly is pressed in the 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.

The coolant then flows rearward through the water jacket which surrounds each cylinder barrel and extends below the lower limit of piston ring travel. After flowing the full length of the cylinder banks, the coolant flows up through openings to the rear of the cylinder bank into the cylinder heads. The coolant flows forward in the cylinder heads to cool the combustion chamber areas. At the forward end of the cylinder heads the coolant flows into the intake manifold.

In the V-8 engine the coolant flows into the intake manifold water jacket from the forward port in the cylinder heads. 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 vaporization of the incoming fuel charge. A port in the rear of the manifold allows connection to the heater hose in heater equipped jobs.

A pellet type thermostat housed in the forward (outlet) end of the intake manifold controls the circulation of water through the engine radiator. During cold engine operation when the thermostat is closed, a thermostat bypass, open at all times, allows recirculation of coolant through the engine to provide rapid warm-up. When the thermostat opens, 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.

## 2-14 ENGINE TUNE-UP

### a. Purpose of Tune-Up

The purpose of an engine tune-up is to restore power and performance that has been lost through wear, corrosion or deterioration of one or more parts or units. In the normal operation of an engine, these changes take place gradually at a number of points so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be obtained by following a definite and thorough procedure of analysis and correction of all items affecting power and performance.

Economical, trouble-free operation can better be assured if a complete tune-up is performed each 12,000 miles.

The parts or units which affect power and performance may be divided into three groups.

(1) Units affecting compression

(2) Units affecting ignition, and

(3) Units affecting carburetion.

The tune-up procedure should cover these groups in the order given. While the items affecting compression and ignition may be handled according to personal preference, correction of items in the carburetion group should not be attempted until all items affecting compression and ignition have been satisfactorily corrected.

Most of the procedures for performing a complete engine tune-up are covered separately in other sections of this manual; therefore, this paragraph provided an outline only with references to other sections where detailed information is given.

The suggested procedure for engine tune-up is as follows:

1. Remove all spark plugs.

2. Position throttle and choke valve in full open position.

3. Connect jumper wire between distributor terminal of coil and ground on engine to avoid high tension sparking while cranking engine.

4. Hook up starter remote control cable and turn ignition switch to "on" position. CAUTION: The starter must not be energized when the ignition switch is in the LOCK position as the ground contact will be damaged in the ignition switch.

5. Firmly insert compression gauge in spark plug port. Crank engine through at least four compression strokes to obtain highest possible reading.

6. Check compression of each cylinder. Repeat compression check and record highest reading obtained on each cylinder during the two pressure checks.

The recorded compression pressures are to be considered normal if the lowest reading cylinder is more than 75% of the highest reading cylinder. See the following example and the "Compression Pressure Limit Chart".

Example:

| Cylinder # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Pressure (psi) | 129 | 135 | 140 | 121 | 120 | 100 | 125 | 132 |

75% of 140 (highest) is 105. Thus, cylinder number 6 is less than 75% of number 3. This condition, accompanied by low speed missing, indicates an improperly seated valve or worn or broken piston ring.

7. If one or more cylinders read low, inject about a tablespoon of engine oil on top of pistons in low reading cylinders through spark plug port. Repeat compression check on these cylinders.

a. If compression improves considerably, rings are worn.

b. If compression does not improve, valves are sticking or seating poorly.

c. If two adjacent cylinders indicate low compression and injecting oil does not increase compression, the cause may be a head gasket leak between the cylinders. Engine coolant and/or oil in cylinders could result from this defect.

NOTE: Low compression pressure in two adjacent cylinders indicates a possible head gasket leak between the two cylinders.

8. Clean, inspect, gap to .035", and install spark plugs.

9. Inspect battery and cables.

10. If battery is in good condition but cranking speed is low, test cranking motor circuit. (See Group 10).

11. Adjust fan belt (and power steering belt if so equipped). If difficulty is experienced in keeping battery charged, check generator regulator. (See par. 10-21).

12. Inspect entire ignition system and make indicated corrections.

13. Inspect and test fuel pump. (See par. 3-12).

### b. Tune-Up Specifications

| Checks | Allen Uni-Tuner | Sun Tune-Up Tester |
|---|---|---|
| 1. Secondary Resistance | 27 Min. @ 1500 RPM | 3 + .5 volts @ 1500 RPM |
| 2. Ignition Output | 26 Min. @ 1500 RPM | Blue Band @ 1500 RPM |
| 3. Cranking Voltage | 9 volts min. | |
| 4. Charging Voltage* (Quick Check) | 14-15 volts @ 1500 RPM | |
| 5. Spark Plug Gap | .035 inches | |
| 6. Dwell Angle | 30 degrees | |
| 7. Engine Vacuum | 14 inches min. @ idle | |
| 8. Engine Idle Speed (Synchromesh in Neutral or Automatic in Drive-Air Conditioner OFF). | 550 RPM (add 50 RPM for air conditioner) | |
| 9. Initial Timing (At engine idle, Vacuum Hose Disconnected) | 5° BTC | |
| 10. Total Distributor Advance** (@ 2500 Engine RPM) | 30° - 39° | |
| 11. Centrifugal Advance Only** (@ 2500 Engine RPM) | 17° - 21° | |

*Regulator at room temperature (below 85° F.)
**This advance in addition to initial timing advance.

## COMPRESSION PRESSURE LIMIT CHART

This chart may be used when checking cylinder compression pressures. It has been calculated so that lowest reading number is 75% of the highest reading number.

Example: After checking the compression pressures in all cylinders, it was found that the highest pressure obtained was 182 psi. The lowest pressure reading was 145 psi. By locating 182 in the maximum column, it is seen that the minimum allowable pressure is 136 psi. Since the lowest reading obtained was 145 psi, the car is within limits and the compression is considered satisfactory.

| Maximum Pressure pounds/ sq. inch | Minimum Pressure pounds/ sq. inch | Maximum Pressure pounds/ sq. inch | Minimum Pressure pounds/ sq. inch |
|---|---|---|---|
| 134 | 101 | 136 | 140 |
| 136 | 102 | 188 | 141 |
| 138 | 104 | 190 | 142 |
| 140 | 105 | 192 | 144 |
| 142 | 107 | 194 | 145 |
| 144 | 108 | 196 | 147 |
| 146 | 110 | 198 | 148 |
| 148 | 111 | 200 | 150 |
| 150 | 113 | 202 | 151 |
| 152 | 114 | 204 | 153 |
| 154 | 115 | 206 | 154 |
| 156 | 117 | 208 | 156 |
| 158 | 118 | 210 | 157 |
| 160 | 120 | 212 | 158 |
| 162 | 121 | 214 | 160 |
| 164 | 123 | 216 | 162 |
| 166 | 124 | 218 | 163 |
| 168 | 126 | 220 | 165 |
| 170 | 127 | 222 | 166 |
| 172 | 129 | 224 | 168 |
| 174 | 131 | 226 | 169 |
| 176 | 132 | 228 | 171 |
| 178 | 133 | 230 | 172 |
| 180 | 135 | 232 | 174 |
| 182 | 136 | 234 | 175 |
| 184 | 138 | 236 | 177 |
| | | 238 | 178 |

14. Clean gasoline filter. (See par. 1-4).

15. Check operation of choke valve and check setting of choke thermostat. (See par. 3-17).

16. Check adjustment of fast idle cam and choke unloader. (See par. 3-17).

17. Check throttle linkage and dash pot adjustment. (See par. 3-9).

18. Adjust carburetor idle speed and mixture. (See par. 3-8).

19. Inspect all water hose connections and tighten clamps, if necessary.

20. Road test car for power and overall performance.

## 2-15 SERVICE PROCEDURES: CYLINDER HEAD AND VALVE TRAIN

### a. Cylinder Head Removal

1. Drain radiator and cylinder block.

2. Remove air cleaner. Disconnect all pipes and hoses from carburetor.

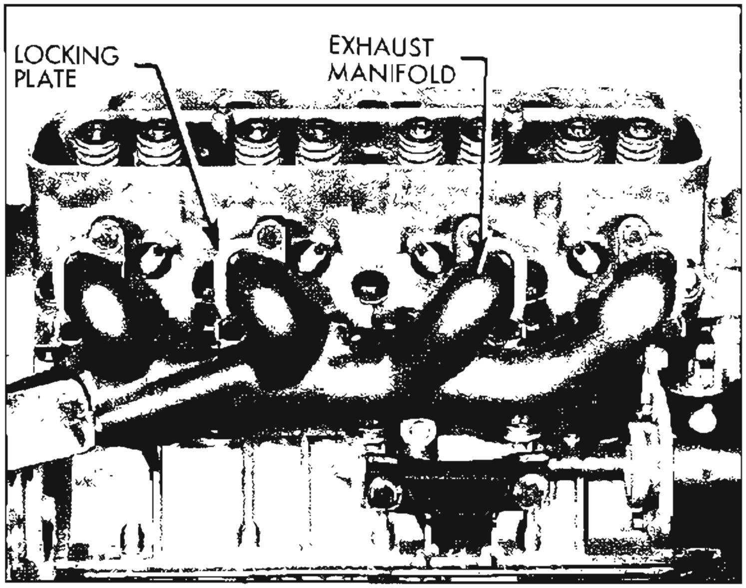



Figure 2-59—Exhaust Manifold Installation

3. Remove coil. Disconnect water temperature indicator wire from switch.

4. Disconnect throttle linkage at carburetor.

5. Disconnect positive crankcase ventilator hose at valve.

6. Slide front thermostat by-pass hose clamp back on hose. Disconnect by-pass hose at timing chain cover to allow coolant to drain from manifold. Disconnect upper radiator hose at outlet.

7. Disconnect heater hose at intake manifold.

8. Remove bolts attaching manifold to cylinder heads.

9. Remove intake manifold and carburetor as an assembly. Remove gasket and seals.

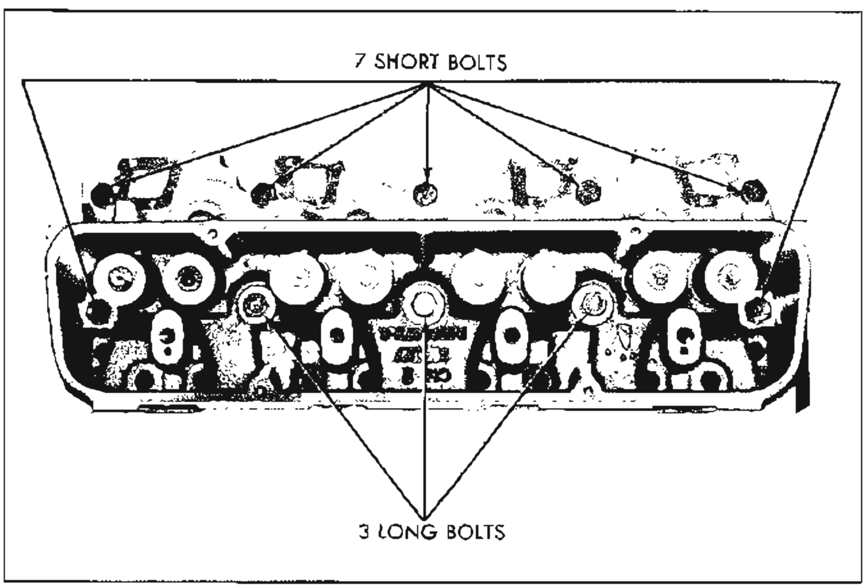



Figure 2-60—Cylinder Head Bolt Installation

10. Remove spark plug wires from retainer brackets on rocker arm covers. Disconnect spark plug wires at plugs and swing them out of way.

11. Remove four screws attaching rocker arm cover to cylinder head.

12. Remove rocker arm shaft bracket to cylinder head attaching bolts. Remove rocker arm and shaft.

13. Remove push rods.

NOTE: If lifters are to be serviced, remove them at this point. Otherwise, protect lifters and camshaft from dirt by covering area with a clean cloth.

14. Disconnect battery cable and remove Delcotron generator mounting bracket and brace attaching bolts.

15. Remove power steering pump rear bracket to cylinder head attaching bolts. Loosen bracket at pump.

16. Remove exhaust manifold to exhaust pipe bolts.

17. Remove cylinder head bolts.

18. Remove cylinder head with exhaust manifold attached. If work is to be performed on head, remove manifold on bench.

### b. Cylinder Head Installation

1. Wipe off engine block gasket surface and be certain no foreign material has fallen in the cylinder bores, bolt holes, or in the valve lifter area. It is good practice to clean out bolt holes with an air hose.

2. Install new head gasket on cylinder block. Dowels in the block will hold the gasket in position. Always handle gaskets carefully to avoid kinking or damage to the surface treatment of the gasket. Do not use any type of sealing material on head gaskets. The gaskets are coated with a special

lacquer to provide a good seal, once the parts have warmed up.

3. Assemble exhaust manifold to cylinder head with bolts and locking plates as shown in Figure 2-59. Torque bolts to 10-15 ft. lbs.

NOTE: Automatic transmission filler tube bracket fastens to rear bolt, right side.

4. Clean gasket surface of cylinder head and carefully set in place on the engine block dowel pins.

5. Clean and lubricate the head bolts with "Perfect Seal" sealing compound. Install bolts as shown in Figure 2-60.

6. Tighten the head bolts a little at a time about three times around in the sequence shown in Figure 2-61. Give bolts a final torque in the same sequence. Torque to 70-75 lb. ft.

NOTE: Damage to the cylinder block threads can result if bolts are not lubricated with "Perfect Seal" prior to installation or if bolts are tightened excessively. Use an accurate torque wrench when installing head bolts. Uneven tightening of the cylinder head bolts can distort the cylinder bores, causing compression loss and excessive oil consumption.

7. Install push rods through cylinder head openings so rods are correctly positioned on lifter plungers.

8. Wipe bases of rocker arm shaft brackets and bosses on cylinder head with a clean cloth.

9. Check notch on one end of rocker arm shaft. Be sure it is positioned as shown in Figure 2-62.

10. Tilt the rocker arm toward the push rods and locate the top of each push rod in its rocker arm seat.

11. Draw down the rocker arm and shaft assembly by tightening the bracket bolts a little at a time. Use a reliable torque wrench to torque the bracket bolts to 30 lb. ft. Do not overtighten.

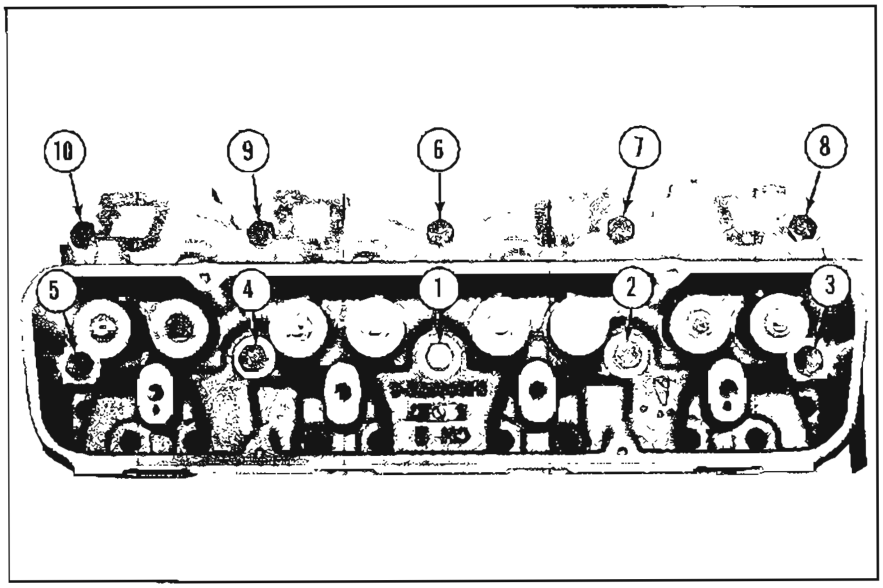



Figure 2-61—Cylinder Head Bolt Tightening Sequence

12. Install rocker arm cover and gasket.

13. Connect spark plug wires and place in position on brackets on rocker arm cover.

14. Place new rubber manifold seal in position at front and rear rails of cylinder block. Be sure pointed ends of seal fit snugly against block and head. See Figure 2-63.

15. Set intake manifold in place and start two guide bolts on each side.

16. Lift the manifold slightly and slip the gaskets into position as shown in Figure 2-64. Take care to see that the gasket is installed with the intake ports aligned with the head and manifold. The gasket should be installed as shown in Figure 2-64 on the left side and reversed for the right side installation.

17. Install manifold attaching bolt in open bolt hole as shown in Figure 2-65. Open bolt hole is held to close tolerances and the bolt in this location serves to locate the manifold fore and aft.

18. Install remaining manifold to cylinder head bolts. Longer bolts belong at forward location. Torque bolts alternately and evenly to 25-30 lb. ft. See Figure 2-65.

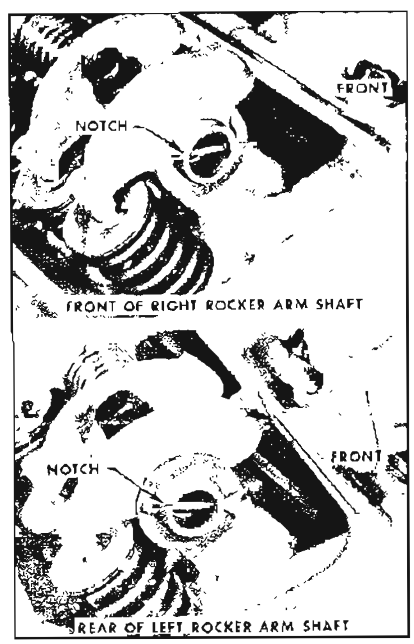



Figure 2-62—Rocker Arm Shaft Alignment

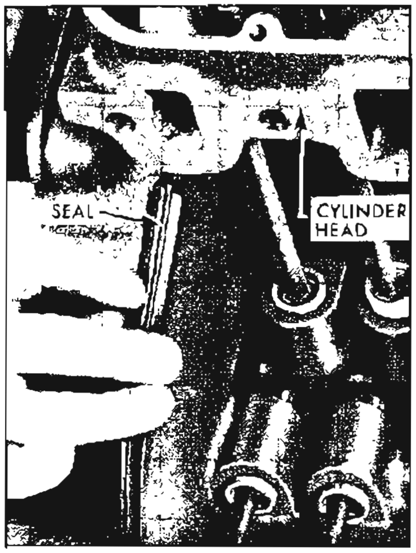


Figure 2-63—Installation of Intake Manifold Gasket Seal

19. Reconnect remaining components. See paragraph 2-11 for torque specifications.

**c. Reconditioning Valves and Guides**

1. Remove cylinder head per subparagraph a above. Place on clean smooth surface.

2. Using suitable spring compressor, such as J-8062, compress valve spring and remove cap retainers. Release tool and remove spring and cap. See Figure 2-66.

NOTE: Cap retainers are copper colored for identification purposes only.

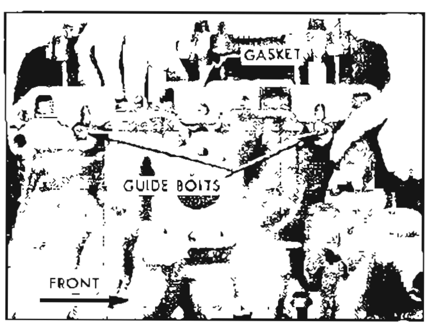


Figure 2-64—Installing Intake Manifold Gasket

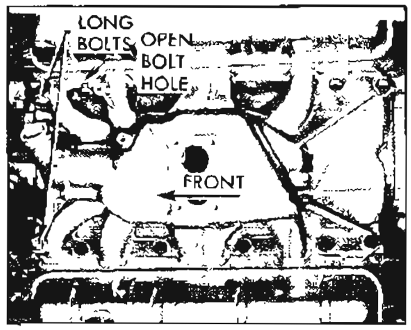


Figure 2-65—Installation of Intake Manifold

3. Remove valve. Valves should be set aside so they may be reinstalled in original location. A small board with numbered holes can be used for this purpose.

4. Remove carbon from combustion chamber of heads, using care to avoid scratching the head or the valve seats. A soft wire brush (such as J-8358) is suitable for this purpose.

5. Clean carbon and gum deposits from valve guide bores. Use 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.

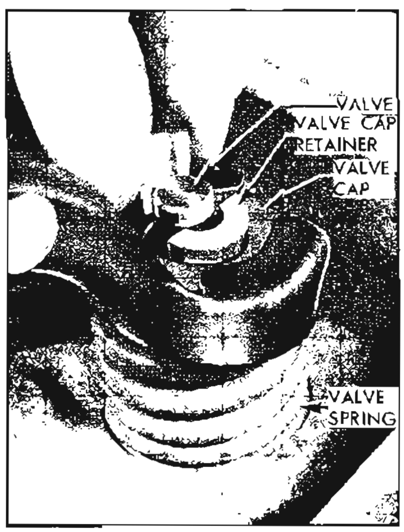


Figure 2-66—Removing Valve Cap Retainers

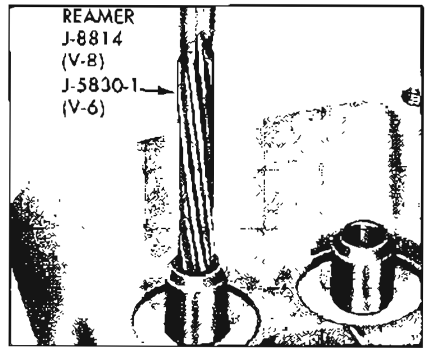


Figure 2-67—Reaming Valve Guide

8. If valve stem has too much clearance in its guide, the guide should be reamed to .004" oversize using J-5830-1. The Parts Department stocks .004" oversize valves for replacement purposes. See Figure 2-67.

9. True up valve seats to 45°. Cutting a valve seat results in lowering the valve spring pressure and increases the width of the seat. The nominal width of the valve seat is 1/16". If a valve seat is over 5/64" wide after truing up it should be narrowed to specified width by the use of 20° and 70° stones.

Improper hydraulic valve lifter

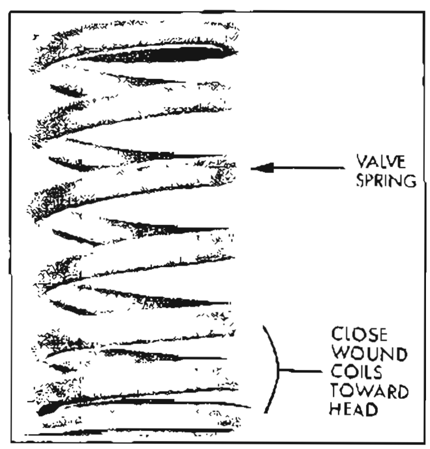


Figure 2-68—Valve Spring

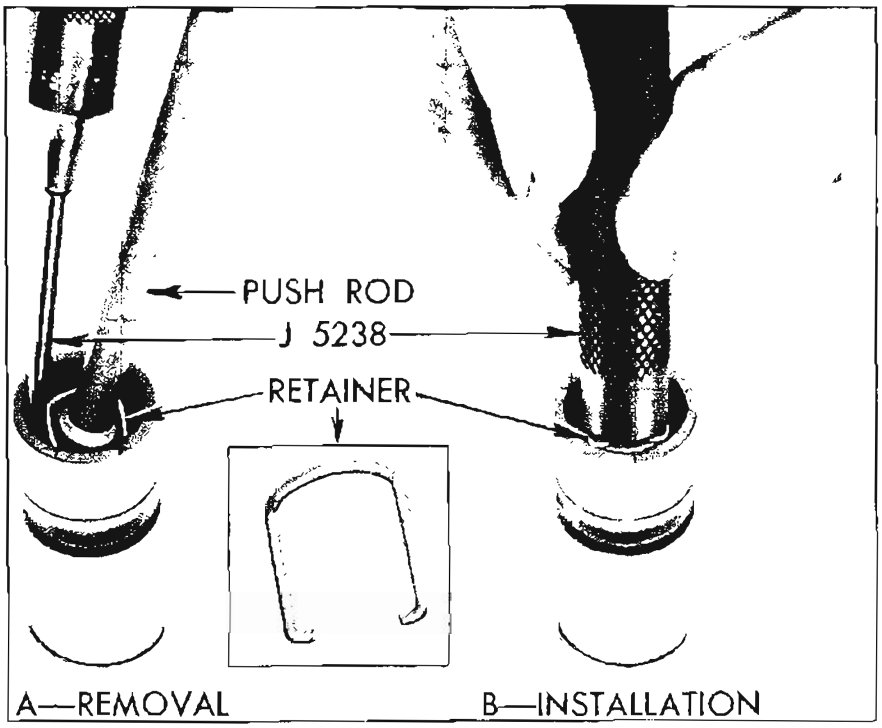


Figure 2-69—Removing and Installing Plunger Retainer

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 1.925".

10. Lightly lap the valves into seats with fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that a minimum of lapping is required. Excessive lapping will groove the valve face preventing a good seat when hot.

11. 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.

12. Lube with "Service MS" engine oil and 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.

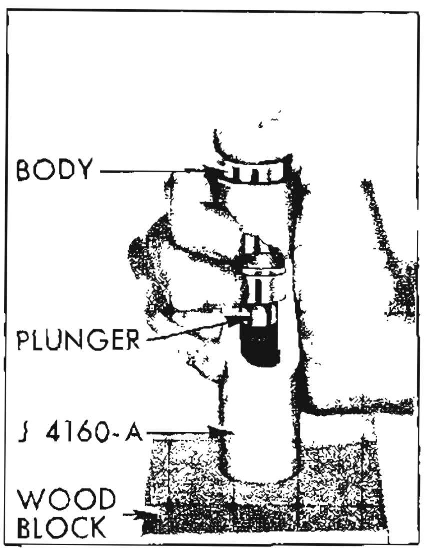


Figure 2-70—Removing Stuck Plunger With J-4160-A

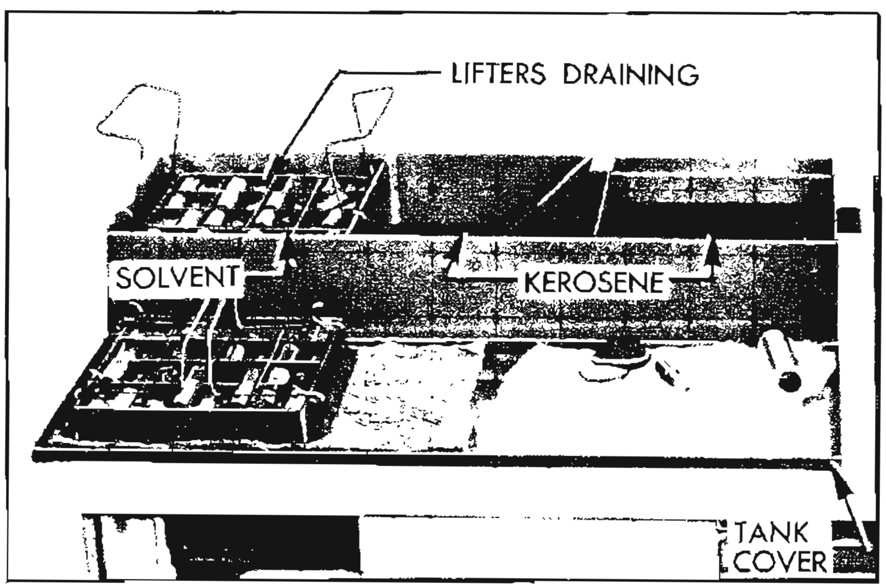


Figure 2-71—Tank J-5821 Set Up For Cleaning Lifter Parts

**d. Valve Lifter Service**

1. Refer to procedure outlined under "Cylinder Head Removal" (par. 2-6, subpar. a, Steps 1-15) for lifter removal.

2. Place lifter in a wooden block with numbered holes or similar device to keep them identified as to position in engine.

3. If less than a complete set of lifters is being removed, disassemble one or two and check for dirt or varnish. If this condition exists, it is advisable to remove all lifters for cleaning and inspection. Otherwise, service only those lifters that are not operating properly.

4. Examine the cam contact surface at lower end of lifter body. If this surface is excessively worn, galled, or otherwise damaged, discard the lifter assembly. In this case, examine the mating camshaft lobe for excessive wear or damage.

5. Disassemble each valve lifter by using a push rod to hold down the push rod seat while removing the plunger retainer from the lifter body using Retainer Remover J-5238. See Figure 2-69. Remove push rod seat and plunger from lifter body.

6. If a plunger sticks in lifter body, place lifter in large end of Plunger Remover J-4160-A with plunger inward. While holding lifter with thumb, rap the open end of remover against a block of wood with just enough force to jar the plunger from body. See Figure 2-70.

7. Drain oil out of body into waste can and remove the ball retainer, ball, ball spring, and plunger spring. A strainer placed over waste can will prevent dropping these parts into can.

8. Place all parts of each lifter in a separate compartment of a tray from Cleaning Tank J-5821. The body and plunger are selectively fitted to each other and must not be interchanged with parts of other lifters. Keeping all parts of the lifter together until cleaned and inspected will aid in diagnosing cause of improper operation.

9. Rinse the tray full of lifter parts in a pan of kerosene to remove as much oil as possible. This will reduce contamination of the cleaning solvent and extend its effective life.

10. Submerge the tray and parts in the cleaning solvent in left hand compartment of Cleaning Tank J-5821 and leave to soak for approximately one hour. The time required will depend on the varnish on lifter parts and the effectiveness of the solvent.

11. After the varnish has dissolved or has softened sufficiently to permit removal by wiping, raise the tray and suspend it above the solvent by means of the hooks on tray handles. Allow tray and parts to drain so that solvent will be saved.

12. Rinse the tray of parts in the pan of kerosene to cut the solvent and avoid injury to hands, then place tray on the tank cover located on bench in front of cleaning tank.

13. Working on one lifter at a time and using CLEAN lint-free cloths, thoroughly wipe off all parts. Clean the plunger and the external and internal surfaces of the body with a hard wiping action to remove any varnish deposits. Rinse the parts in the kerosene contained in the middle compartment of cleaning tank, using Cleaning Brush J-5099 in the bore of lifter body.

NOTE: To insure absolute cleanliness of a reconditioned lifter assembly, it is advisable to inspect and assemble each lifter (subpar. d, e, f) before cleaning the next lifter.

14. The following list outlines the inspection of lifter parts. An inspection should be made at this point to determine whether or not a lifter is in need of replacement.

(a) Lifter Body. Inspect inner and outer surfaces of body for blow holes and scoring. Replace lifter assembly if body is roughly scored or grooved, or has a blow hole extending through the wall in position to permit oil leakage from lower chamber. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored; it is caused by side thrust of cam against body while the lifter is moving vertically in its guide.

Inspect the cam contact surface on lower end of lifter body. Replace the lifter assembly if this surface is excessively worn, galled, or otherwise damaged. A lifter body that has been rotating will have a round wear pattern and a non-rotating lifter body will have a square wear pattern with a very slight depression near the center.

(b) 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.

(c) Push Rod and Seat. Replace the push rod seat if the area where the push rod contacts is rough or otherwise damaged. Replace any push rod having a rough or damaged ball end.

(d) Check ball. Using a magnifying glass, carefully examine the check ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects would indicate the cause of intermittently noisy lifter operation. Even though no defects are found it is always advisable to discard the old ball and use a new one when reassembling the lifter.

(e) Check Ball Spring. Examine check ball spring for wear or damage. Replace any spring that is distorted or shows evidence of wear.

(f) Ball Retainer. Replace a retainer which is cracked or which has a heavily pounded area between the two holes. A small bright spot where the ball contacts the retainer is the normal condition.

(g) Plunger Spring. Replace the plunger spring only if it is distorted or damaged. Exhaustive tests have shown that plunger springs seldom break down in service.

15. Rinse lifter plunger in the kerosene in middle compartment of cleaning tank and then give it a thorough final rinsing in the kerosene in right compartment.

16. Hold plunger in vertical position with feed hole up, then rinse and install the check ball, check ball spring, ball retainer, spring, and body over the plunger. See parts in Figure 2-72.

17. Rinse push rod seat and plunger retainer, place these parts in end of body and depress with handle of Remover J-5238 until retainer engages groove in body. See Figure 2-69, View B.

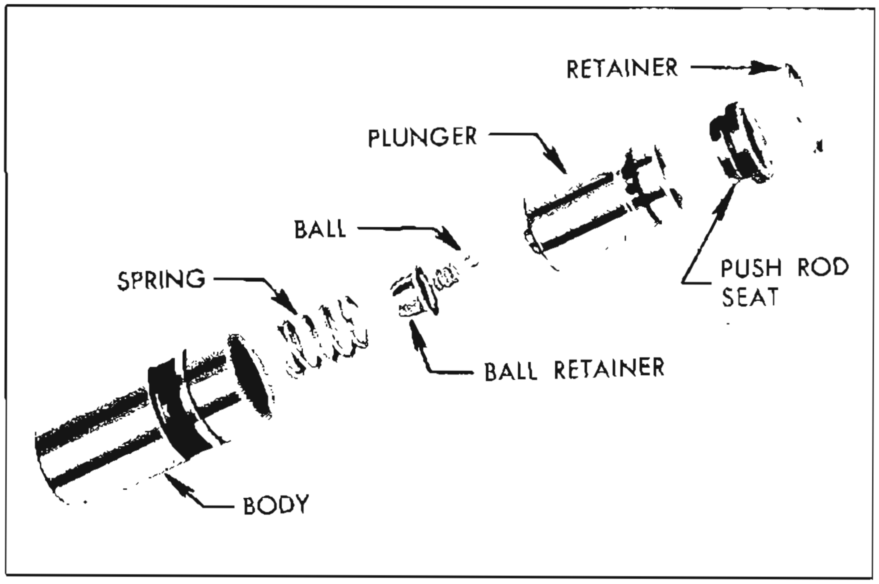



Figure 2-72—Hydraulic Valve Lifter Parts

18. Wrap the lifter in clean paper or otherwise protect it from dirt while reconditioning the other valve lifters, preparatory to testing all lifters for leakdown rate.

19. Check lifter leakdown rate according to subparagraph e below.

20. Make certain that valve lifter guide holes and adjacent area of cylinder block are clean. Liberally lubricate the camshaft and lifter bores with "Service MS" oil and install lifters. Each lifter must slide freely in its guide hole. If a lifter is tight in one guide hole, fit it into another hole where a free fit can be obtained.

21. Following the procedure outlined in paragraph 2-15, subparagraph b, Steps 7-19, reassemble engine.

**e. Checking Valve Lifter Leakdown Rate**

After a hydraulic lifter has been cleaned, inspected, and assembled it must be tested before it is installed in an engine. Lifter Test Fixture J-5790 has been designed to test the leakdown rate of a lifter to determine whether it is within limits which assure satisfactory lifter operation.

The following procedure must be carefully followed to obtain an accurate test.

1. Thoroughly clean the cup of test fixture, install cup on fixture, and fill it to within 1/2" of the top with "Hydraulic Lifter Test Fluid," which is available through Kent-Moore Organization, Inc., under K-M number J-5268.

2. Remove rubber washer (used for larger lifters) and install Gauge Sleeve J-5180-5 in the cup; also install Buick V-8 Gauge Rod Nose J-5180-15 in the ram.

3. Swing the weight arm up out of the way, raise the ram and place the valve lifter (top side up) in Sleeve J-5180-5. The lifter must be completely covered by the fluid during test.

4. Lower the ram to rest in the lifter push rod seat, then lower the weight arm to rest on the roller of ram as shown in Figure 2-73.

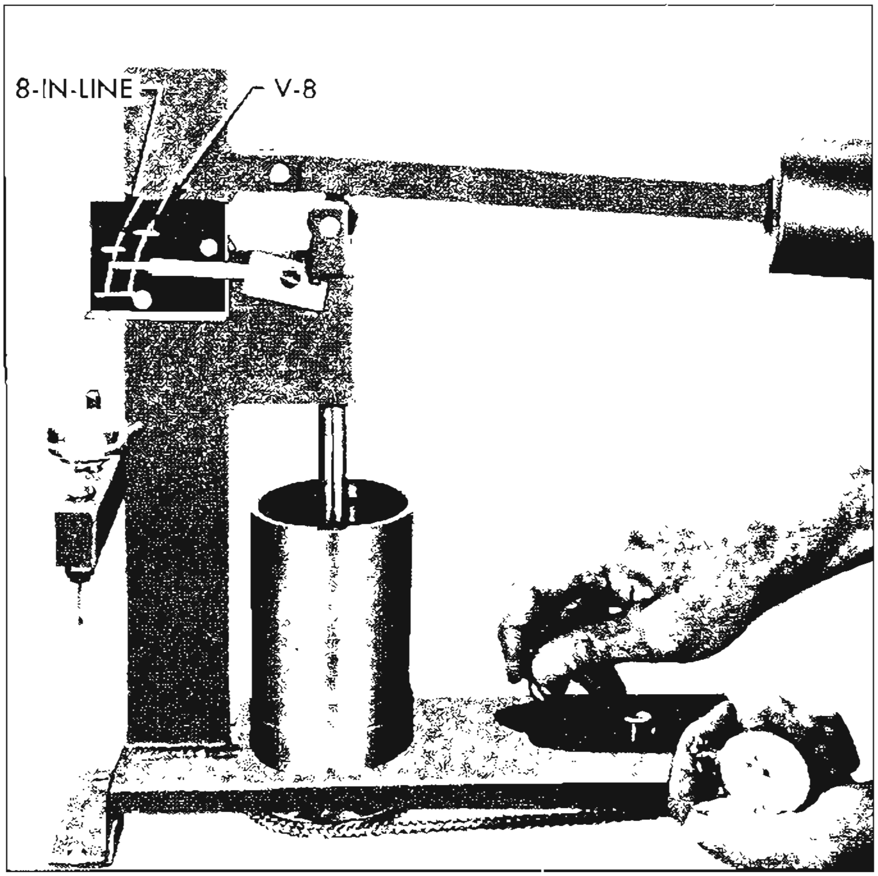



Figure 2-73—Checking Lifter Leakdown Rate

5. Operate the lifter plunger through its full travel to force all air out of the lifter by using a vigorous pumping action on the weight arm. Continue the pumping action until considerable resistance is built up in the lifter and a definite grab point is felt at the top of the stroke, when the indicator pointer is at the bottom of the scale.

Finally, pump vigorously for approximately 10 additional strokes to make sure all air is removed from the lifter. NOTE: If one stroke offers noticeable weak resistance during the last 10 pumping strokes replace the check ball in lifter and repeat the leakdown test to this point.

6. Raise weight arm to allow the lifter plunger to come up to its retainer, then lower the arm to rest on the ram roller. As the pointer starts moving upward start rotating the fluid cup by turning the handle one revolution every two seconds.

7. Use a stop watch to check the time required for pointer to move from the lower to the upper mark on scale where marked "BUICK V-8." The cup must be rotated during this test.

8. The leakdown rate (time between marks) must be between 12 and 60 seconds to assure satisfactory lifter performance. A doubtful lifter should be tested three or four times. Replace any lifter which does not test within the specified limits.

9. After all lifters have been tested, place the cover over the test fixture to keep dirt out of the cup and fluid. The fluid should be discarded and the cup should be thoroughly cleaned after a few sets of lifters have been tested.

### f. Timing Chain Cover Removal

1. Drain radiator and block.

2. Disconnect upper radiator hose and heater return hose at water pump, disconnect lower radiator hose. Remove attaching bolts and brackets and remove radiator core.

3. Remove fan, fan pulleys and belt(s).

4. Remove fan driving pulley (crankshaft) and pulley reinforcement.

5. Remove harmonic balancer to crankshaft bolt and washer 15/16" socket. Remove harmonic balancer. It may be necessary to tap the 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 the brackets and pump to be moved out of the way.

7. Disconnect fuel lines and remove fuel pump.

8. Remove Delcotron generator and brackets.

9. Remove distributor cap and pull spark plug wire retainers off brackets on rocker arm cover. Swing distributor cap with wires attached out of the way. Disconnect distributor primary lead.

10. 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 by-pass hose rearward.

12. Remove bolts attaching timing chain cover to cylinder block.

Remove two oil pan to timing chain cover bolts. Remove timing chain cover assembly and gasket. Thoroughly clean the cover, taking care to avoid damage to the gasket surfaces.

**g. Timing Chain Cover Replacement**

Reinstall timing chain cover by reversing removal procedure, paying particular attention to the following points.

1. Remove oil pump cover and pack the space around the oil pump gears completely full of petroleum jelly. There must be no air space left inside the pump. Reinstall cover using new gasket. This step is very important as the oil pump may "lose its prime" whenever the pump, pump cover or timing chain cover is disturbed. If the pump is not packed, it may not begin to pump oil as soon as the engine is started.

2. The gasket surface of the block and timing chain cover must be smooth and clean. Use a new gasket and be certain it is positioned correctly.

3. Position timing chain cover against block and be certain dowel pins engage dowel pin holes before starting bolts.

4. Lubricate the bolt threads before installation and install as shown in Figure 2-74.

NOTE: If the car is equipped with power steering, the front steering pump should be installed at this time.

5. Lubricate the O.D. of the harmonic balancer before installation to prevent damage to the seal during installation and when the engine is first started.

**h. Crankshaft Oil Seal Replacement**

1. Use a punch to drive out old seal and shedder. Drive from the front toward the rear of the timing chain cover.

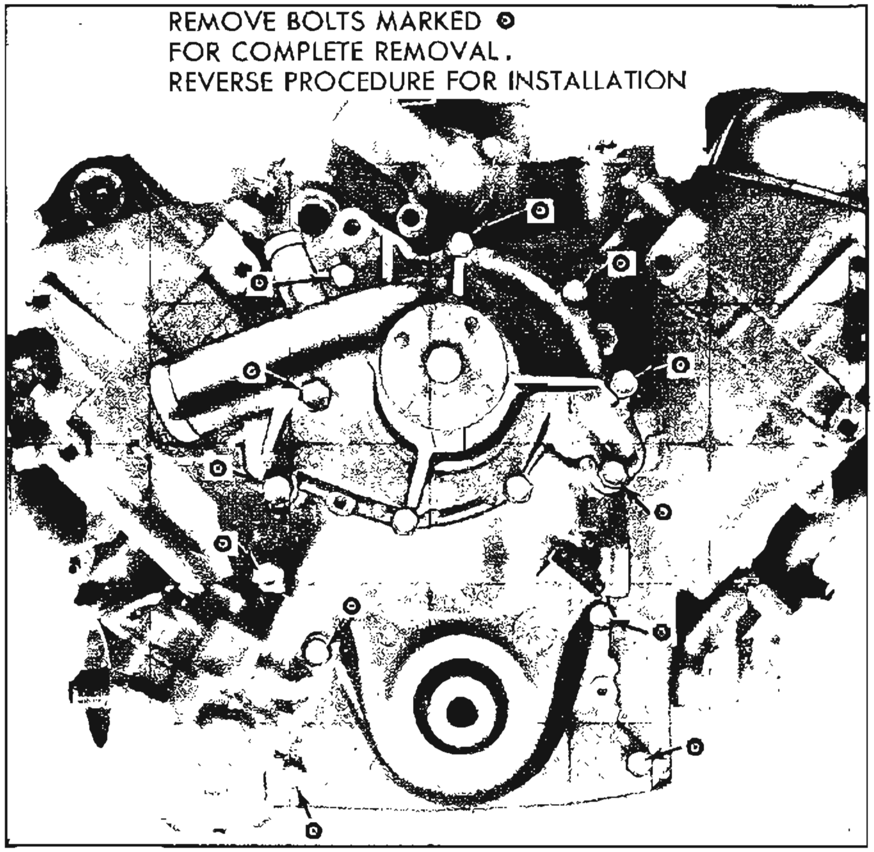



Figure 2-74—Timing Chain Cover Installation

2. Coil new packing around opening so ends of packing are at top. Drive in shedder using suitable punch. Stake the shedder in place in at least three places.

3. Size the packing by rotating a hammer handle or similar tool around the packing until the balancer hub can be inserted through the opening.

**i. Timing Chain and Sprocket Removal**

1. With timing chain cover removed (subpar. f above) temporarily install harmonic balancer bolt and washer in end of crankshaft. Turn crankshaft so sprockets are positioned as shown in Figure 2-75. Remove harmonic balancer bolt and washer using a sharp blow on the wrench handle, so that the bolt can be started out without changing position of sprockets.

2. Remove front crankshaft oil slinger.

3. Remove bolt and special washer retaining camshaft distributor

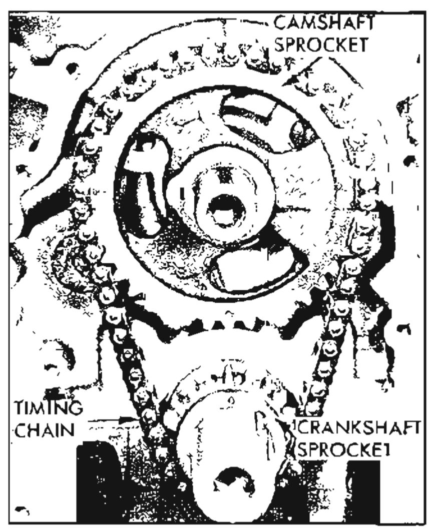



Figure 2-75—Installation Of Timing Chain and Sprocket

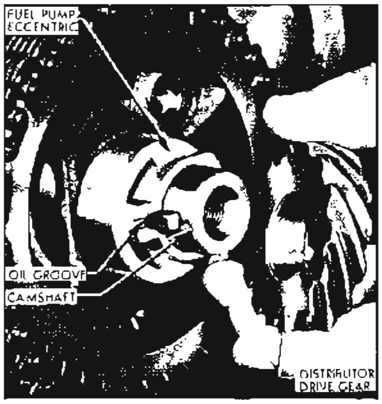



Figure 2-76—Fuel Pump and Distributor Drive Gear Installation

drive gear and fuel pump eccentric to camshaft forward end. Slide gear and eccentric off camshaft.

4. Use two large screwdrivers to alternately pry the camshaft sprocket then the crankshaft sprocket forward until the camshaft sprocket is free, then remove the camshaft sprocket and chain and finish working crankshaft sprocket off crankshaft.

5. Thoroughly clean the timing chain, sprockets, distributor drive gear, fuel pump eccentric and crankshaft oil slinger.

### j. Timing Chain and Sprocket Installation

1. Turn crankshaft so that #1 piston is at top dead center.

2. Turn camshaft so with sprocket temporarily installed, timing mark is straight down. See Figure 2-73. Remove sprocket.

3. Assemble timing chain on sprockets and slide the sprocket and chain assembly on the shafts with the timing marks in their closest together position and in line with the sprocket hubs.

4. Assemble 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. See Figure 2-75.

6. Install distributor drive gear. See Figure 2-75.

7. Install drive gear and eccentric bolt and retaining washer. Torque to 40-55 ft. lbs.

8. Reinstall timing chain cover (subpar. g above).

### k. Camshaft Service

1. Remove rocker arm and shaft assemblies, push rods and valve lifters.

2. Remove timing chain cover, timing chain and sprocket subparagraph i above.

3. Slide camshaft forward out of bearing bores carefully to avoid marring the bearing surfaces.

4. Replace camshaft by reversing removal procedure, taking particular care to avoid damage to the camshaft bearings.

NOTE: The steel-backed babbitt-lined camshaft bearings are pressed into the crankcase. Going from front to rear, each bearing is bored .030" smaller than the preceding bearing, and each camshaft journal is correspondingly reduced in diameter.

The camshaft bearings must be line reamed to size after being pressed into the crankcase. Since this operation requires special reaming equipment the original bearings should be retained unless severely damaged. Slightly scored camshaft bearings will be satisfactory if the surfaces of camshaft journals are polished and bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within the clearance limits of .0015" to .004".

## 2-16 SERVICE PROCEDURES: CRANKSHAFT AND CONNECTING ROD BEARINGS PISTONS AND RINGS

A connecting rod bearing consists of two halves or shells which are interchangeable in rod and cap. When the shells are placed in position, the ends extend slightly beyond the parting surfaces so that when the rod bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. The ends of the bearing shells must never be filed flush with parting surface of rod or cap.

If a rod bearing becomes noisy or is worn so that clearance on the crankpin is excessive, a new bearing of proper size must be selected and installed since no provision is made for adjustment. Under no circumstances should the connecting rod or cap be filed to adjust the bearing clearance.

### a. Inspection of Connecting Rod Bearings and Crankpin Journals

After removal of engine oil disconnect two connecting rods at a time from crankshaft and inspect the bearings and crankpin journals. While turning crankpin it is necessary to temporarily reconnect the rods to crankshaft to avoid possibility of damaging the journals through contact with loose rods.

If connecting rod bearings are chipped or scored they should be replaced. If bearings are in good physical condition check for proper clearance on crankpin as described in subparagraph b, below.

If crankpin journals are scored or ridged the crankshaft must be replaced, or reground for undersize bearings, to insure satisfactory life of connecting rod

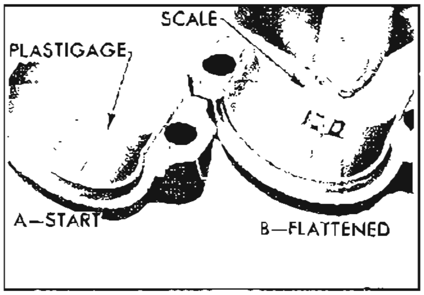



Figure 2-77—Checking Bearing Clearance With Plastigage

bearings. 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.

Use an outside micrometer to check crankpins for out-of-round. If crankpins are more than .0015" out-of-round, satisfactory life of new bearings cannot be expected.

### b. Checking Clearance and Selecting Replacement Bearings

Service bearings are furnished in standard size and several undersizes (including undersizes for reground crankpins).

The clearance of connecting rod (and crankshaft) bearings may be checked by use of Plastigage, Type PG-1 (green), which has a range of .001" to .003". Plastigage is manufactured by Perfect Circle Corporation, and is available through General Motors parts warehouses.

1. Remove connecting rod cap with bearing shell. Wipe oil from bearing and crankpin journal, also blow oil out of hole in crankshaft. NOTE: Plastigage is soluble in oil.

2. Place a piece of Plastigage lengthwise along the bottom center of the lower bearing shell (Figure 2-77, View A), then install cap with shell and tighten bolt nuts to 30-35 ft. lbs. torque. 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 and toward front of engine in right bank.

3. DO NOT TURN CRANKSHAFT with Plastigage in bearing.

4. Remove bearing cap with bearing shell, the flattened Plastigage will be found adhering to either the bearing shell or the crankpin. Do not remove it.

5. Using the scale printed on the Plastigage envelope, measure the flattened Plastigage at its widest point. The number within the graduation which most closely corresponds to the width of Plastigage indicates the bearing clearance in thousandths of an inch. See Figure 2-77, View B.

6. The desired clearance with a new bearing is .0002" to .0023". If bearing has been in service it is advisable to install a new bearing if the clearance exceeds .003"; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

7. If a new bearing is being selected, try a standard size, then each undersize bearing in turn until one is found that is within the specified limits when checked for clearance with Plastigage. NOTE: Each undersize bearing shell has a number stamped on outer surface on or near the tang to indicate amount of undersize.

8. After the proper size bearing has been selected, clean off the Plastigage, oil the bearing thoroughly, reinstall cap with bearing shell and tighten bolt nuts to 40-45 ft. lbs. torque. See NOTE in Step 2.

9. With selected bearing installed and bolts tightened, it should be possible to move connecting rod freely back and forth on crankpin as allowed by end clearance. If rod cannot be moved, either the bearing is too much undersize or a misaligned rod is indicated.

### c. Replacement of Crankshaft Bearings

A crankshaft bearing consists of two halves or shells which are not alike and not interchangeable in cap and crankcase. The upper (crankcase) half of the bearing is grooved to supply oil to the connecting rod bearings while the lower (bearing cap) half of the shell is not grooved. The two bearing halves must not be interchanged. All crankshaft bearings except the thrust bearing are identical. The thrust bearing (Center) and the rear main bearing is longer and flanged to take end thrust. When the shells are placed in crankcase and bearing cap, the ends extend slightly beyond the parting surfaces so that when cap bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. The ends of shells must never be filed flush with parting surface of crankcase or bearing cap.

If the thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times (the last movement fore) with the bearing cap bolts finger tight.

Crankshaft bearings are the precision type which do not require reaming to size or other fitting. Shims are not provided for adjustment since worn bearings are readily replaced with new bearings of proper size. Bearings for service replacement are furnished in standard size and undersizes. Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.

After removal of lower crankcase, oil pump pipe and screen and flywheel lower housing (synchromesh) or bell housing cover (automatic transmission)

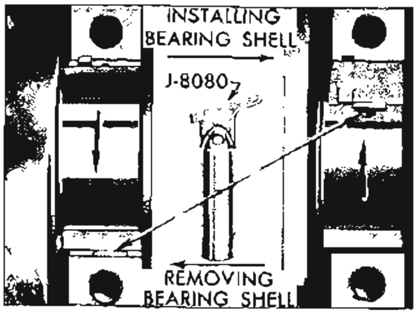



Figure 2-78—Removal and Installation of Crankshaft Bearing Upper Shell

perform the following removal, inspection and installation operations on each crankshaft bearing in turn so that the crankshaft will be well supported by the other bearings.

NOTE: If crankshaft has been removed to check straightness the following procedure is suggested.

Rest crankshaft on "veeblocks" at number one and number five main bearing journals. Check indicator runout at No. 2, 3 and 4 main bearing journals. Total indicator readings at each journal should not exceed .003".

While checking runout at each journal note relation of "high" spot (or maximum eccentricity) on each journal to the others. "High" spot on all journals should come at the same angular location. If "high" spots do not come at nearly the same angular location, crankshaft has a "crook" or "dogleg" in it and is unsatisfactory for service.

1. Since any service condition which affects the crankshaft bearings may also affect the connecting rod bearings, it is advisable to inspect connecting rod bearings first. If crankpins are worn to the extent that crankshaft should be replaced or reground, replacement of crankshaft bearings only will not be satisfactory.

2. Remove one bearing cap, then clean and inspect lower bearing shell and the crankshaft journal. If journal surface is scored or ridged, the crankshaft must be replaced or reground to insure satisfactory operation with new bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil, and burrs may be honed off with a fine stone.

3. If condition of lower bearing shell and crankshaft journal is satisfactory, check the bearing clearance with Plastigage as described for connecting rod bearings in subparagraph b.

4. When checking a crankshaft bearing with Plastigage, turn crankshaft so that oil hole is up to avoid dripping of oil on Plastigage. Place paper shims in lower halves of adjacent bearings and tighten cap bolts to take the weight of crankshaft off the lower shell of bearing being checked.

5. If bearing clearance exceeds .003", it is advisable to install a new bearing; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

6. Loosen all crankshaft bearing cap bolts 1/2 turn, and remove cap of bearing to be replaced.

7. Remove upper bearing shell by inserting Bearing Shell Remover and Installer J-8080 in oil hole in crankshaft, then slowly turning crankshaft so that the tool rotates the shell out of place by pushing against the end without the tang. See Figure 2-78. CAUTION: When turning crankshaft with rear bearing cap removed hold oil seal to prevent it from rotating out of position in crankcase.

8. The crankshaft journal cannot be measured with an outside micrometer when shaft is in place; however, when upper bearing shell is removed the journal may be checked for out-of-round by using a special crankshaft caliper and inside micrometer. The caliper should not be applied to journal in line with oil hole.

If crankshaft journal is more than .0015" out-of-round, the crankshaft should be replaced since the full mileage cannot be expected from bearings used with an excessively out-of-round crankshaft.

9. Before installation of bearing shells make sure that crankshaft journal and the bearing seats in crankcase and cap are thoroughly cleaned.

10. Coat inside surface of upper bearing shell with engine oil and place shell against crankshaft journal so that tang on shell will engage notch in crankcase when shell is rotated into place. IMPORTANT: Upper bearing shells have an oil groove in their center, while lower shells are plain. They must not be interchanged.

11. Rotate bearing shell into place as far as possible by hand, then insert Installer J-8080 in crankshaft oil hole and rotate crankshaft to push shell into place. CAUTION: Bearing shell should move into place with very little pressure. If heavy pressure is required, shell was not started squarely and will be distorted if forced into place.

12. Place lower bearing shell in bearing cap, then check clearance with Plastigage as previously described.

13. The desired clearance with a new bearing is .0004" to .0025". If this clearance cannot be obtained with a standard size bearing, insert an undersize bearing and check again with Plastigage. NOTE: Each undersize shell has a number stamped on outer surface on or near the tang to indicate amount of undersize.

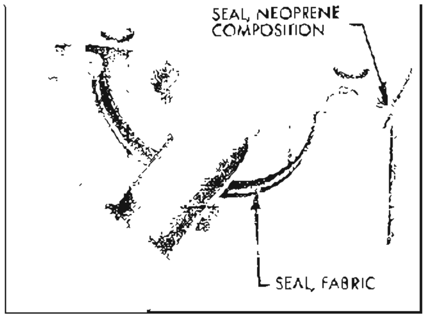



Figure 2-79—Installing Rear Bearing Oil Seals

14. When the proper size bearing has been selected, clean out all Plastigage, oil the lower shell and reinstall bearing cap. Clean the bolt holes and lube bolts, then torque cap bolts to specification given in paragraph 2-11. The crankshaft should turn freely at flywheel rim; however, a very slight drag is permissible if an undersize bearing is used.

15. If the thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times (last movement fore) with the thrust bearing cap bolts finger tight.

16. After bearing is installed and tested, loosen all bearing cap bolts tested, loosen all bearing cap bolts 1/2 turn and continue with other bearings. When bearings have been installed and tested, tighten all bearing cap bolts to specification given in paragraph 2-11.

17. Refer to subparagraph d for replacement of rear bearing oil seals.

18. Install oil pump, pipe and screen assembly following procedure outlined in paragraph 2-17.

19. Thoroughly clean engine oil pan prior to installation. Use new gaskets when installing, and torque pan bolts to 9-13 lb. ft.

20. Reinstall steering idler arm to front frame horn.

**d. Installation of Rear Bearing Oil Seals**

Braided fabric seals are pressed into grooves formed in crankcase and rear bearing cap to rear of the oil collecting groove, to seal against leakage of oil around the crankshaft.

Neoprene composition seals are placed in grooves in the sides of bearing cap to seal against leakage in the joints between cap and crankcase. The neoprene composition swells in the presence of oil and heat. The seals are undersize when newly installed and may even leak for a short time until the seals have had time to swell and seal the opening. See Figure 2-79.

The braided fabric seal can be installed in crankcase only when crankshaft is removed; however, the seal can be replaced in cap whenever cap is removed. Remove old seal and place new seal in groove with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth stick until seal projects above the groove not more than 1/16". Cut ends off flush with surface of cap, using sharp knife or razor blade. Lube the seal with heavy engine oil just before installation. See Figure 2-79. CAUTION: The engine must be operated at slow speed when first started after new braided seal is installed.

The neoprene composition seals are slightly longer than the grooves in the bearing cap. The seals must not be cut to length. Just before installation of bearing cap in crankcase, lightly lubricate the seals and install in bearing cap with upper end protruding approximately 1/16".

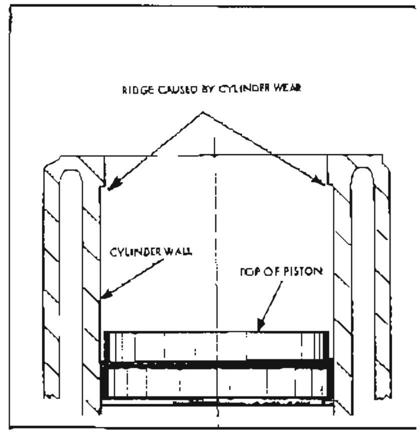



Figure 2-80—Ridge Formed By Rings A Top Of Travel

After cap is installed, force seal up into the cap with a blunt instrument to be sure of a seal a the upper parting line between th cap and case.

**e. Replacement, Disassembly, and Inspection of Piston and Rod Assemblies**

1. Remove cylinder heads. (par 2-15, subpar. a)

2. Examine the cylinder bores above the ring travel. If bores are worn so that a shoulder or ridge exists at the top of the cylinder, remove the ridges with a ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal. See Figure 2-80.

3. Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting


Figure 2-81—Connecting Rod Bolt Guides Installed

rods and caps. Starting at the front end of the crankcase the cylinders in the right bank are numbered 2-4-6-8. Those in the left bank are numbered 1-3-5-7.

4. Remove cap and bearing shell from #1 connecting rod. Install connecting rod bolt guides on the bolts to hold the upper half of the bearing shell in place. See Figure 2-81.

5. Push the piston and rod assembly up and out of the cylinder. Then remove guides and reinstall cap and bearing shell on rod.

6. Remove other rod and piston assemblies in the same manner.

7. Remove compression rings with expander and remove oil ring by removing the two rails, and spacer-expander which are separate pieces in each piston third groove.

8. To remove piston pin:

(a) Assemble press as shown in Figure 2-53. Install Piston Pin Pilot J-6047-20 in base. Install support with full radial face up. Set spring in support.

(b) Set piston, pin and rod in press with J-8355 inserted in piston pin.

(c) Press out piston pin.

9(a) Inspect cylinder walls for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper

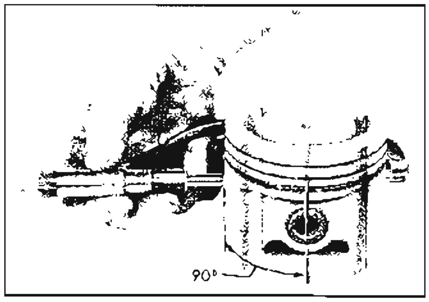



Figure 2-83—Measuring Piston

and out-of-round with an accurate cylinder gauge at top, middle and bottom of bore, both parallel and at right angles to the centerline of the engine. The diameter of the cylinder bores at any point may be measured with an inside micrometer or by setting the cylinder gauge dial at "O" and measuring across the gauge contact points with outside micrometer while the gauge is at same "O" setting.

(b) 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 rebore the cylinder to fit an oversize piston in order to insure satisfactory results.

(c) If cylinder bore is tapered .005" or more or is out-of-round .003" or more, it is advisable to rebore for the smallest possible oversize piston and rings.

10. Clean carbon from piston surfaces and under side of piston heads. Clean carbon from ring grooves with suitable tool and remove any gum or varnish from piston skirts with suitable solvent.

11. 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.

The pistons are cam ground, which means that the diameter at a right angle to the piston pin is greater than the diameter parallel to the piston pin. When a piston is checked for size, it must be measured with micrometers applied to the skirt at points 90° to the piston pin. See Figure 2-83. The piston should be measured (for fitting purposes) 1/4 below the bottom of the oil ring groove.

12. Inspect bearing surfaces of piston pins and check for wear by

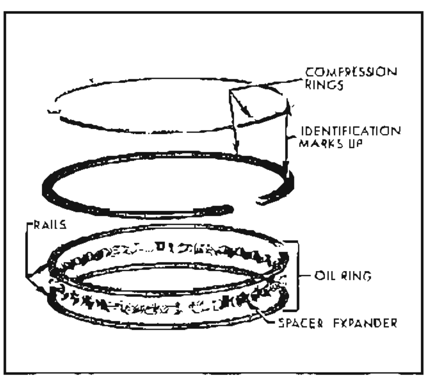



Figure 2-82—Piston Rings

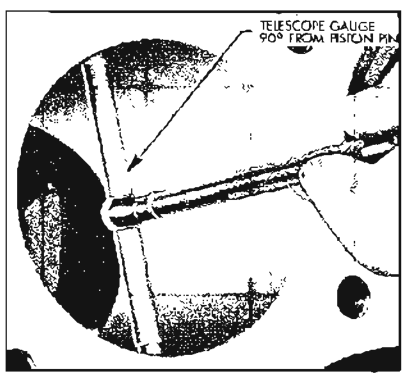



Figure 2-84—Checking Cylinder Bore

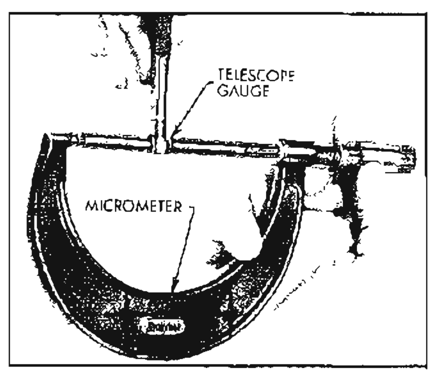



Figure 2-85—Measuring Telescope Gauge

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. Oversize pins are not practical due to the pin being a press fit in the connecting rod. Piston pins must fit the piston with an easy finger push at 70°F (.0003" to .005" clearance).

13. Examine all piston rings for scores, chips or cracks. Check compression rings for tension by comparing with new rings. Check gap of compression rings by placing rings in bore at bottom of ring travel. Measure gap with feeler gauge. Gap should be between .010" and .020". If gaps are excessive (over .020") it indicates the rings have worn considerably and should be replaced.

#### f. Reboring Cylinders and Fitting New Pistons

If one or more cylinder bores are rough, scored, or worn beyond limits prescribed under subparagraph b, it will be necessary to smooth or true up such bores to fit new pistons.

If relatively few bores require correction it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance, since all oversize service pistons are held to the same weights as standard size pistons. If conditions justify replacement of all pistons, however, all new pistons should be the same nominal size.

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 .010" oversize. 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 the cylinder bores should be honed to size for proper clearances.

Before the honing or reboring operation is started, measure all new pistons with micrometer contacting at points exactly 90 degrees to piston pin (Figure 2-83) then select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston is fitted too free.

If wear at top of cylinder does not exceed .005" on the diameter or exceed .003" out-of-round, honing is recommended for truing the bore. If wear or out-of-round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

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.

When honing cylinders use clean sharp stones of proper grade for the amount of metal to be removed, in accordance with instructions of the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.

When finish honing, pass the hone through the entire length of cylinder at the rate of approximately 60 cycles per minute. This should produce the desired 45 degree cross hatch pattern on cylinder walls which will insure maximum ring life and minimum oil consumption.

It is of the greatest importance that refinished cylinder bores are trued up to have not over .0005" out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface. During final honing, each piston must be fitted individually to the bore in which it will be installed and should be marked to insure correct installation.

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. The dry bore should then be brushed clean with a power-driven fibre brush. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result. 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 1-1/2" and 2" from the top. See Figure 2-84.

2. Measure the telescope gauge. See Figure 2-85.

3. Measure the piston to be installed. See Figure 2-83. The piston must be measured at right angles to the piston pin 1/4" below the oil ring groove. The piston must be between .001" and .0015" smaller than the cylinder bore.

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".

## g. Fitting New Piston Rings

When new piston rings are installed without reboring cylinders, the glazed cylinder walls should be slightly dulled, but without increasing the bore diameter, by means of the finest grade of stones in a cylinder hone.

New piston rings must be checked for clearance in piston grooves and for gap in cylinder bores; however, the flexible oil rings are not checked for gap. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

With rings installed, check clearance in grooves by inserting feeler gauges between each ring and its lower land because any wear that occurs forms a step at inner portion of the lower land. If the piston grooves have worn to the extent that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with the operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

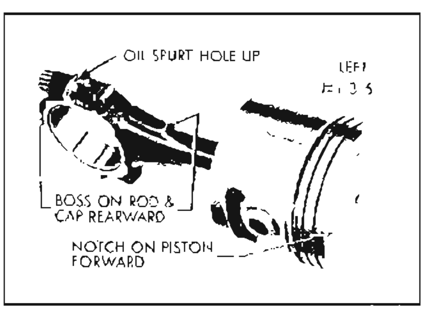



Figure 2-86—Left Bank Piston And Rod Assembly

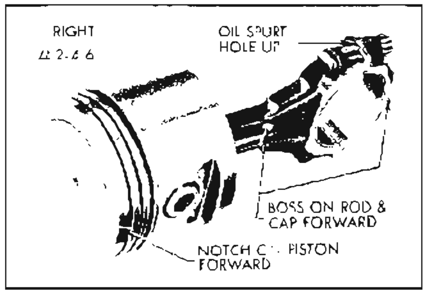



Figure 2-87—Right Bank Piston And Rod Assembly

When fitting new rings to new pistons the side clearance of the compression rings should be .003" to .005" and side clearance of the oil ring should be .0035" to .0095".

To check the end gap of compression rings, place the ring in the cylinder in which it will be used, square it in the bore by tapping with the lower end of a piston, then measure the tap with feeler gauges. Piston rings should not have less than .015" gap when placed in cylinder bores. If gap is less than .015", file the ends of rings carefully with a smooth file to obtain proper gap.

## h. Assembly and Installation of Piston and Connecting Rod Assemblies

NOTE: Connecting rods may be sprung out of alignment in shipping or handling. Always check a new rod before installing piston and pin.

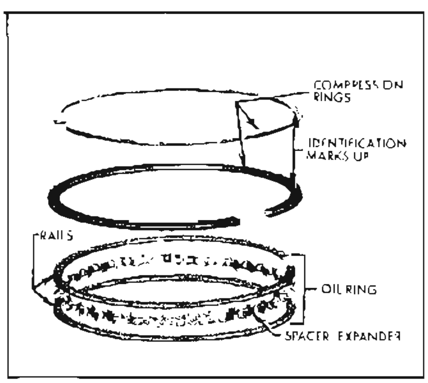



Figure 2-88—Piston Rings

Check bend and twist on an accurate rod aligning fixture using Guide Pin J-6047-16 (from wrist pin press set) in place of wrist pin. Press Vee block firmly and evenly against guide pin to prevent cocking pin in eye of rod which may be up to .002" loose on pin.

1. To assemble piston and pin to connecting rod, assemble press with radial face of Support J-8754-1 in the "up" position.

2. If the piston and rod assembly is to be installed in the left bank, the assembly must be made as shown in Figure 2-86.

3. If the piston and rod assembly is to be installed in the right bank, the assembly must be made as shown in Figure 2-87.

4. Assemble piston and rod on spring loaded guide pin.

5. Lubricate piston pin to avoid damage when pressing through the connecting rod.

6. Install drive pin in upper end of piston pin. Press on drive pin till piston pin bottoms.

7. Remove piston and rod assembly from press. Rotate piston on pin to be sure pin was not damaged during the pressing operation.

8. Install piston rings as shown in Figure 2-88. Position expander ends over piston pin where groove is not slotted, and be absolutely certain that the ends do not overlap. Install oil ring rails with gaps "up" on same side of piston as oil spurt hole in connecting rod. Install compression rings in upper two grooves. If a single chrome plated compression ring is used, the chrome ring must be installed in the top groove.

NOTE: All compression rings are marked with a dimple, a letter "T", a letter "O" or word "TOP" to identify the side of the ring which must be assembled toward the top of the piston. If a single chrome plated compression ring is used, the chrome ring must be installed in the top groove.

9. Make sure cylinder bores, pistons, connecting rod bearings and crankshaft journals are absolutely clean, then coat all bearing surfaces with engine oil.

10. Before installation of a piston and rod assembly in its bore, position the crankpin straight down.

11. Remove connecting rod cap. Retain bearing upper shell in rod and install rod guides. These guides hold the upper bearing shell in place and prevent damage to the crankpin during installation of the connecting rod and piston assembly.

12. Make sure the gap in the oil ring rails is "up" toward center of engine and the gaps of the compression rings are not in line with each other or the oil ring rails.

13. Lubricate the piston and rings and install in bore by compressing the rings either with a "wrap around" compressor or a split ring type such as shown in Figure 2-89.

14. Select new connecting rod bearing, if necessary, as described in paragraph 2-16. Otherwise install cap with bearing lower shell on rod and tighten bolt nuts to 30-40 ft. lbs. torque.

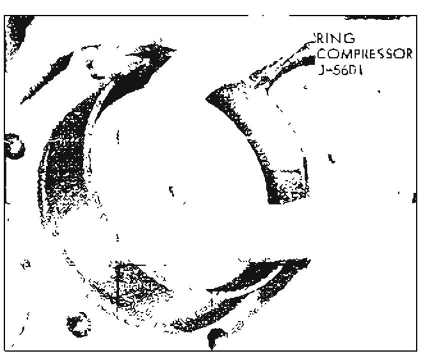



Figure 2-89—Installing Piston With Compressor Installed

15. Install all other piston and rod assemblies in same manner. When piston and rod assemblies are properly installed, the oil spurt holes in the connecting rods will be "up" toward the camshaft, the rib on the edge of the rod cap will be on the same side as the conical boss on the connecting rod web, and these marks, (rib and boss) will be toward the other connecting rod on the same crankpin.

16. Check end clearance between connecting rods on each crankpin using feeler gauges. Clearance should be between .005" and .012".

17. Install cylinder heads (par. 2-15). Install oil screen and engine oil pan.

IMPORTANT: After installation of new pistons and rings, care should be used in starting the engine and running it for the first hour. Avoid high speeds until the parts have had a reasonable amount of break in to avoid scuffing.

## 2-17 SERVICE PROCEDURES: COOLING AND OILING SYSTEMS

### a. Checking and Filling Cooling System

The coolant level should be checked only when the engine is cold and only enough coolant added to bring the level approximately halfway between the top of the core and the top of the upper tank.

It is unnecessary and unadvisable to check the coolant level each time the car is stopped for fuel or oil, as the engine is usually hot at such times.

CAUTION: Never remove the radiator cap quickly when the radiator is hot. Sudden release of cooling system pressure may cause the coolant to boil and escape with some force.

If it becomes necessary to remove the radiator cap when the radiator is hot, rotate the cap slowly counterclockwise till a stop is reached. Leave cap in this position until all system pressure is released, then remove cap.

### b. Draining and Flushing the Cooling System

When the cooling system has been drained, reinstall a permanent glycol type corrosion and anti-freeze cooling system protection solution developed for year around use (General Motors Specification GM 1899-M). Water alone, methanol, or alcohol type anti-freeze is definitely not recommended.

To drain the cooling system, remove radiator cap, open the drain cock in the lower radiator tank and remove the drain plugs on both sides of cylinder block. If car is heater equipped, set heater temperature control valve at full heat position.

After the cooling system is drained, plugs reinstalled and cock closed, fill the system with clean water. Run the engine long enough to open the thermostat for complete circulation through the system, then completely drain the cooling system before sediment has a chance to settle.

### c. Conditioning the Cooling System

It is very important to make certain that the cooling system is properly prepared before an anti-freeze solution is installed; otherwise, loss of solution through leakage may occur or seepage may result in damage to the engine. The cooling system should be drained and flushed as described above (subpar. b.), all joints should be checked for leakage and corrected.

Inspect the water pump, radiator core, heater core, drain cocks, water jacket plugs, and edge of cylinder head gaskets for evidence of leaks. Tighten all hose clamps in the cooling and heating systems and replace any deteriorated hoses.

**d. Using and Testing Anti-Freeze Solutions**

Inhibited year around (permanent type) engine coolant solution which is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors should be used at all times (not less than 0°F. to freeze protection should be provided to protect against corrosion). When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20°F. may be encountered, a sufficient amount of any of the several brands of year around coolant (Ethylene Glycol base) compatible to GM Specification 1899-M available on the market should be used.

NOTE: Alcohol base coolants are not recommended for this vehicle at any time.

If for any reason water only is used as a coolant in an emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant be added to the cooling system as soon as possible. This material is available at your Buick dealer under Part #980504. If any other cooling system protector is used, be certain it is labeled to indicate that it meets General Motors Specification GM 1894-M. It should be recognized that this is only a temporary measure. The manufacturer intends that permanent type coolant solution be used year around in the cooling system of your Buick.

The cooling system should be completely drained and the recommended coolant installed every two (2) years.

It is advisable to test the anti-freeze solution at intervals during the winter to make certain that the solution has not been weakened by evaporation or leakage. Use only hydrometers which are calibrated to read both the specific gravity and the temperature, and have a table or other means of converting the freezing point at various temperatures of the solution. Disregarding the temperature of the solution when making the test may cause an error as large as 30°F. Care must be exercised to use the correct float or table for the particular type of anti-freeze being tested.

**e. Fan Belt Adjustment or Replacement**

A tight fan belt will cause rapid wear of the delcotron generator and water pump bearings. A loose belt will slip and wear excessively and will cause noise, engine overheating, and unsteady generator output. A fan belt which is cracked or frayed, or which is worn so that it bottoms in the pulleys should be replaced.

The fan belt may be replaced by loosening the generator brace at both ends, slightly loosening the generator mounting bolts and moving generator inward to provide maximum slack in the belt.

The delcotron generator must be moved sideways to adjust the fan belt.

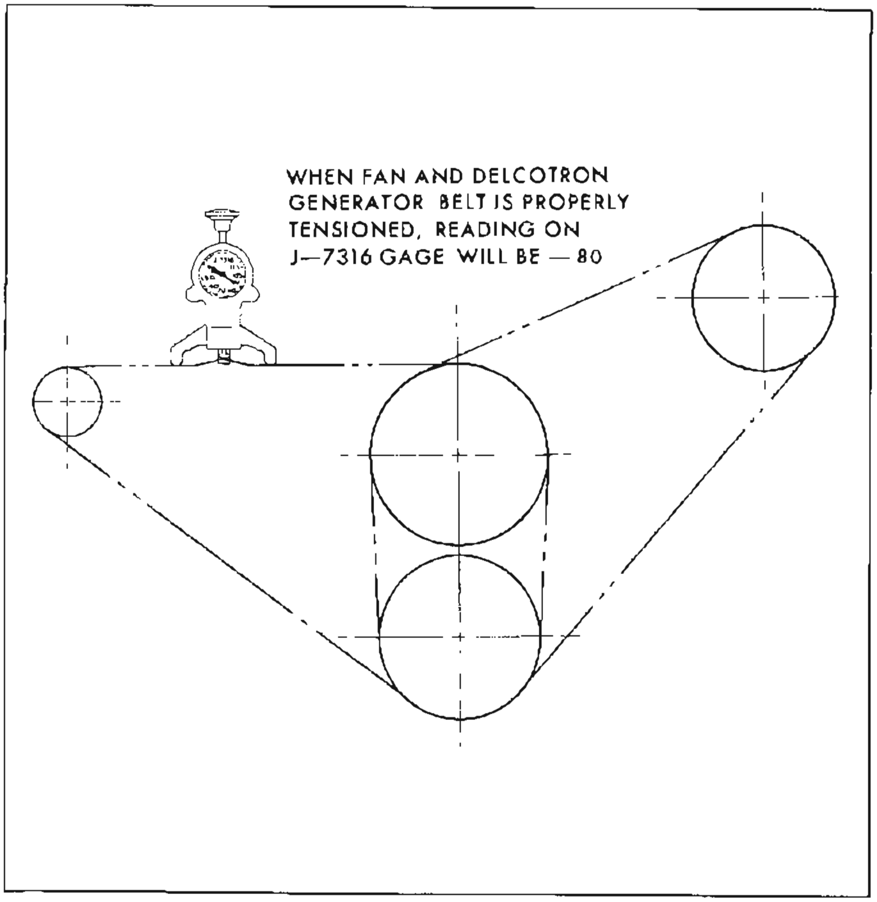



Figure 2-90—Belt Tension Chart - Delcotron Generator

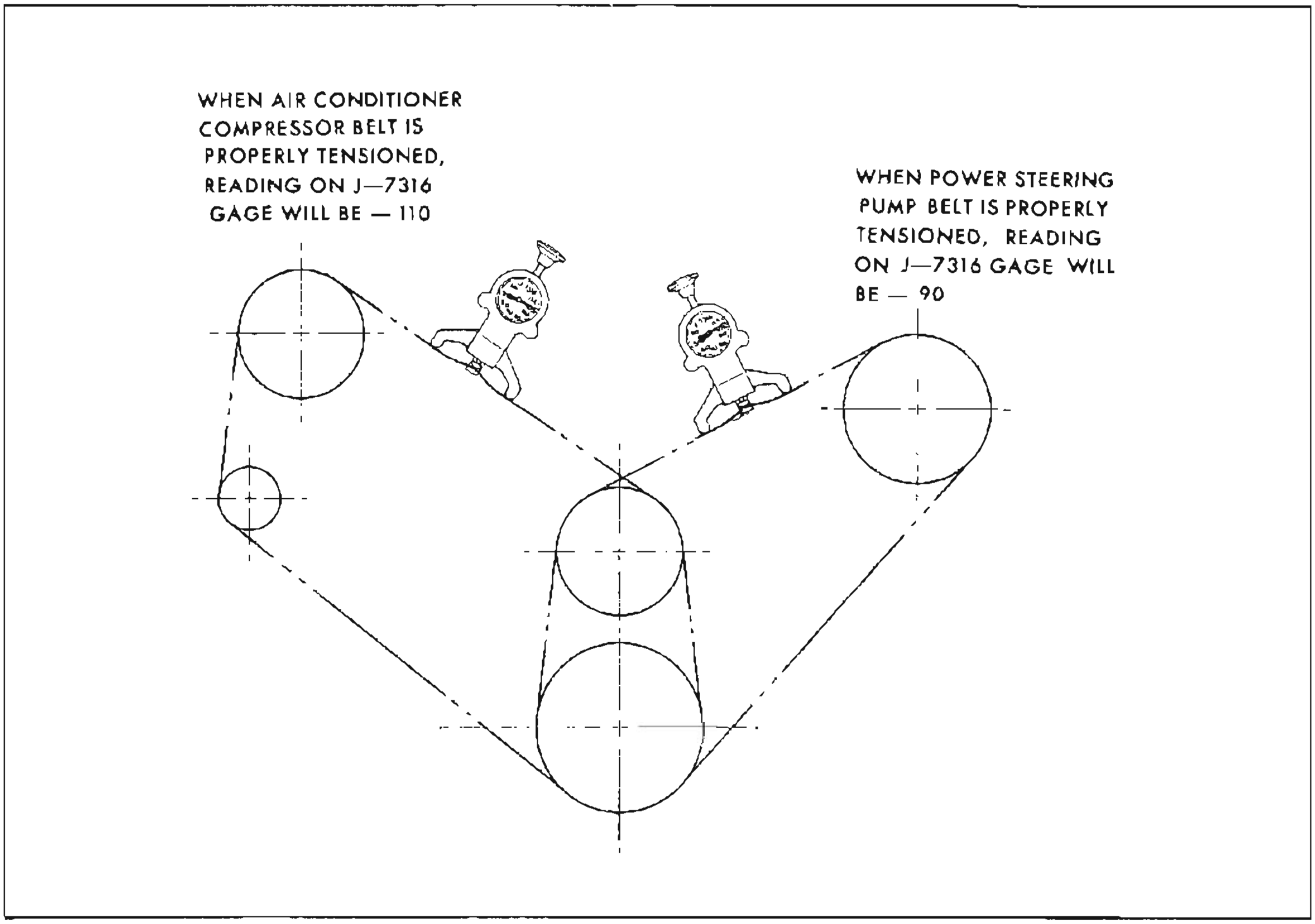



Figure 2-91—Belt Tension Chart - Power Steering & Air Conditioning

After the delcotron generator brace and mounting bolts are securely tightened, the fan belt tension should be checked as shown in Figure 2-90.

If the power steering oil pump belt is removed it should be adjusted to tension specified, in Figure 2-91.

If the Air Conditioner compressor belt is disturbed it should be adjusted as specified, in Figure 2-91.

### f. Radiator Thermostat Inspection and Test

A sticking radiator thermostat will prevent the cooling system from functioning properly. If the thermostat sticks in the open position, the engine will warm up very slowly. If the thermostat sticks in the closed position, overheating will result.

The thermostat may be removed for inspection and test partially draining the cooling system and disconnecting the water outlet and hose from the intake manifold in which the thermostat is located.

If the thermostat valve does not fully close when cold, check for the presence of foreign material that could hold it open. If no foreign material is present and valve still does not close, replace the thermostat.

Test the thermostat for correct opening temperature by immersing 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. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

The standard thermostat (170°) valve should start to open at a temperature of 167°F to 172°F., and should be fully open at a temperature not in excess of 192°F. The high temperature (180°) thermostat 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 temperatures it should be replaced as it cannot be adjusted.

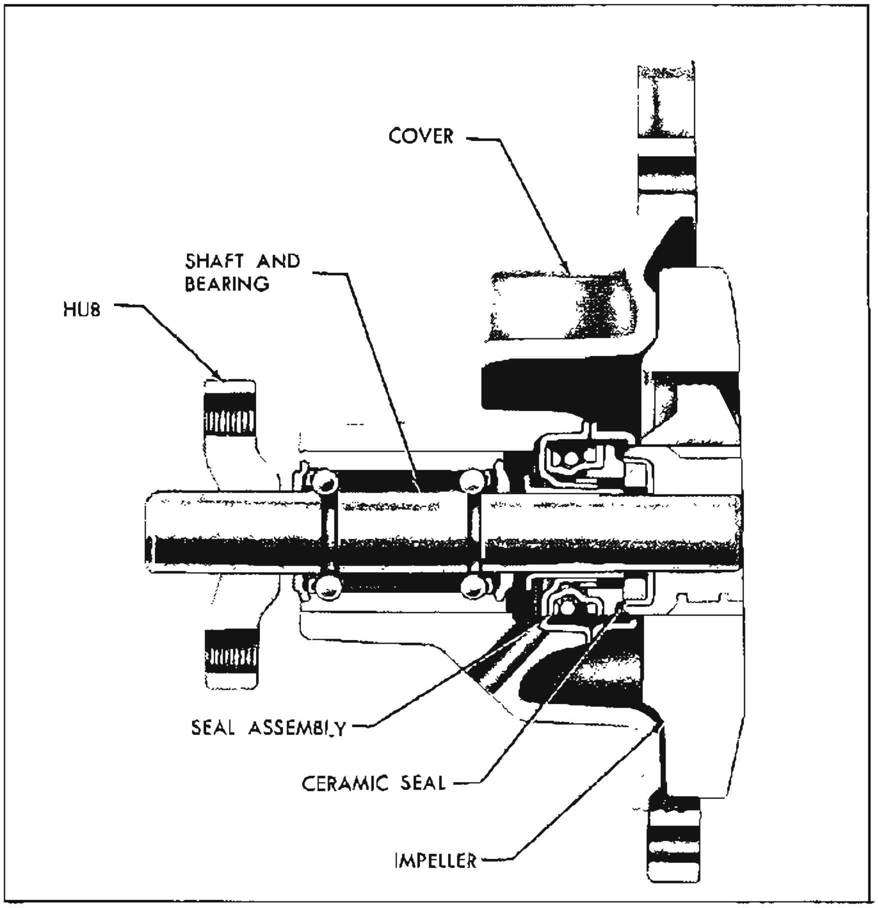



Figure 2-92—Water Pump Cross Section

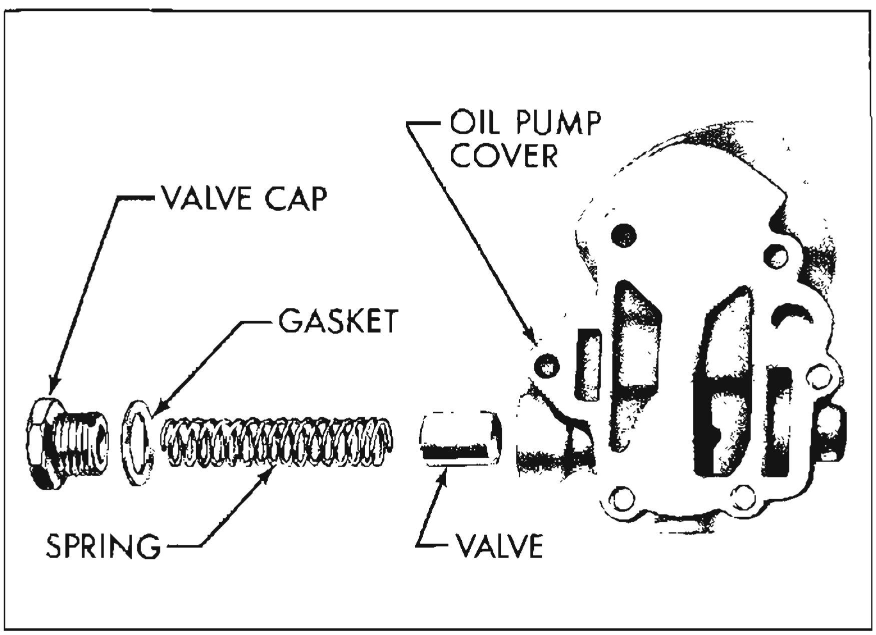



Figure 2-93—Oil Pump Cover & By-Pass Valve

## g. Water Pump Repairs

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.

## h. Removal of Water Pump

1. Drain cooling system being sure to drain into a clean container if anti-freeze solution is to be saved.

2. Loosen belt or belts, then remove fan blade, and pulley or pulleys from hub on water pump shaft. Remove belt or belts.

3. Disconnect hose from water pump inlet and heater hose from nipple. Remove bolts then 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.

## i. Installation of Water Pump

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. Install belt or belts and adjust for proper tension.

### j. Removal and Inspection of Oil Pump Cover and Gears

1. Remove oil filter.

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.

4. Wash off gears and inspect for wear, scoring, etc. Replace any gears not found serviceable.

5. Remove the oil pressure relief valve cap, spring and valve. See Figure 2-58. Oil filter by-pass valve and spring are staked in place and should not be removed.

6. 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. Thoroughly clean the screen staked in the cover.

7. Check the relief 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.

8. Check filter by-pass valve for cracks, nicks, or warping. The valve should be flat and free of nicks or scratches.

### k. Oil Pump Assembly and Installation

1. Lubricate and install pressure relief valve and spring in bore of oil pump cover. Install cap and gasket. Torque cap to 25-30 lb. ft. with a reliable torque wrench. Do not over-tighten.

2. Install oil pump gears and shaft in oil pump body section of timing chain cover to check gear end clearance.

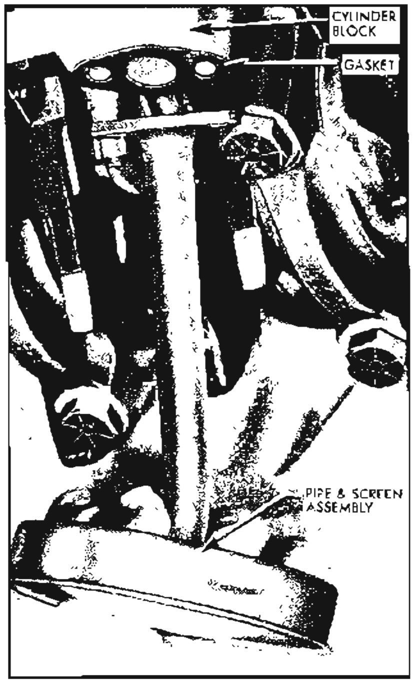



Figure 2-94—Installation Of Pipe And Screen Assembly

3. Place a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. Clearance should be between .0023" and .0058". If clearance is less than .0018" check timing chain cover gear pocket for evidence of wear.

4. If gear end clearance is satisfactory, remove gears and pack gear pocket full of petroleum jelly. Do not use chassis lube!!!

5. 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.

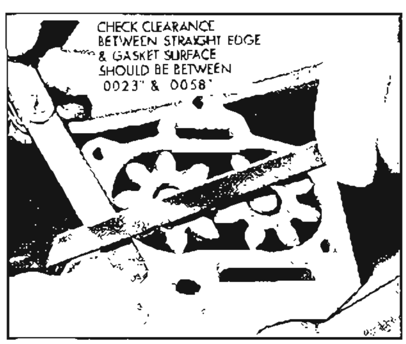



Figure 2-95—Checking Oil Pump End Clearance

NOTE: This step is very important. Unless the pump is packed with petroleum jelly, it may not prime itself when the engine is started.

6. Install cover assembly screws. Tighten alternately and evenly. The torque specification is 8-12 ft. lbs.

7. Install filter on nipple.

### l. Removal and Inspection of Oil Pump Pipe and Screen Assembly

1. Raise car and support on stands.

2. Remove air cleaner.

3. Drain oil.

4. If Synchromesh equipped, loosen clutch equalizer bracket to frame attaching bolts.

5. Loosen shift linkage attaching bolts.

6. Remove steering idler arm bracket to right front frame horn attaching bolts.

7. Support engine either with a jack under the oil pan, or with chains around the exhaust manifold.

8. Remove bolts and nuts attaching engine mounts to mount brackets.

9. Raise engine and insert bolts through bracket bolt holes, then lower engine so mounts rest on bolts.

10. Remove lower flywheel housing bolts. Remove housing.

11. Remove oil pan bolts and lower oil pan enough to remove oil pump pipe and screen to cylinder block bolts.

12. Rotate crankshaft to provide maximum clearance at forward end of oil pan. Move front of pan to the right and lower pan through opening between cross member

and steering linkage intermediate shaft.

13. Clean oil pan. Pry screen out of housing and examine for evidence of clogging due to deposit of sludge or other foreign material.

14. Clean the screen and housing thoroughly in solvent and blow dry with air stream.

15. Snap screen into housing.

### m. Installation of Oil Pump and Screen Assembly

Install by reversing removal procedure, paying particular attention to the following points.

1. Make sure oil pump pipe flange gasket surface of block is smooth and free of dirt.

2. Use a new gasket and tighten bolts to 6-9 ft. lbs. torque.

3. Tighten pan bolts evenly. Do not over tighten.

## 2-18 ENGINE MOUNTING AND FLYWHEEL BALANCING

### a. Removal of Front Mounts

1. Raise car and provide frame support at front of car.

2. Support weight of engine at forward end.

3. Remove mount to engine block bolts. Raise engine slightly and remove mount to mount bracket bolt and nut. Remove mount.

### b. Installation of Front Mount

1. Install mount to engine block bolts and torque to 50-75 ft. lbs.

2. Lower engine so mounts rest on frame cross member in normal manner. Install mount to bracket bolt and torque to 45-60 ft. lbs.

3. Remove frame support and lower car.

### c. Removal of Rear (Transmission) Mount

For details of engine and transmission mounts and transmission support installation refer to Figure 2-96.

### d. Removal and Replacement of Automatic Transmission Flywheel

1. Remove Transmission. (par. 5-7)

2. Remove six bolts attaching flywheel to crankshaft flange.

3. Inspect flywheel. If cracked at flywheel bolt holes, replace flywheel.

4. Inspect crankshaft flange and flywheel to be installed for burrs. Remove any burrs with a mill file.

5. Install flywheel. Bolt holes are unevenly spaced so all flywheel bolts may be installed with flywheel in only one position. Install bolts and torque evenly to 50-65 ft. lbs.

6. Mount dial indicator to engine block and check flywheel run-out at three flywheel attaching bosses. Run-out should not exceed .015".

NOTE: The crankshaft end play must be held in one direction during this check.

7. If run-out exceeds .015" attempt to correct by tapping high side with mallet. If this does not correct, remove flywheel and check for burrs between flywheel and crankshaft mounting flange.

### e. Replacement of Flywheel or Ring Gear on Synchromesh Engine

1. Remove transmission and clutch assembly, being sure to mark clutch cover and flywheel so clutch may be reinstalled in original position.

2. Remove flywheel. Flywheel is located in a definite position on crankshaft by the attaching bolts, which are unevenly spaced.

3. If the ring gear is to be replaced, drill a hole between two teeth and split the gear with a cold chisel.

4. Heat and shrink a new gear in place as follows:

(a) Polish several spots on the ring with emery cloth.

(b) Use a hot plate or slowly moving torch to heat the ring till the polished spots turn blue (approximately 600°F.)

CAUTION: Heating the ring in excess of 800°F. will destroy the heat treatment given during manufacture.

(c) Quickly place ring in position against shoulder of flywheel with chamfered inner edge of ring gear toward flywheel shoulder. Allow ring to cool slowly until it is held tightly in place.

5. Make certain the flywheel and crankshaft flange are free from burrs that would cause run-out. Then install flywheel.

### f. Flywheel Balance

All flywheels are balanced at the factory by drilling holes at various points on the flywheel surface. No attempt should be made to balance a flywheel after the initial factory balance.

### g. Harmonic Balancer

If a harmonic balancer is suspected of being a cause of vibration, it can be checked and/or balanced by following the outline below:

1. Using a tachometer, determine the engine speed at which the greatest amount of vibration occurs.

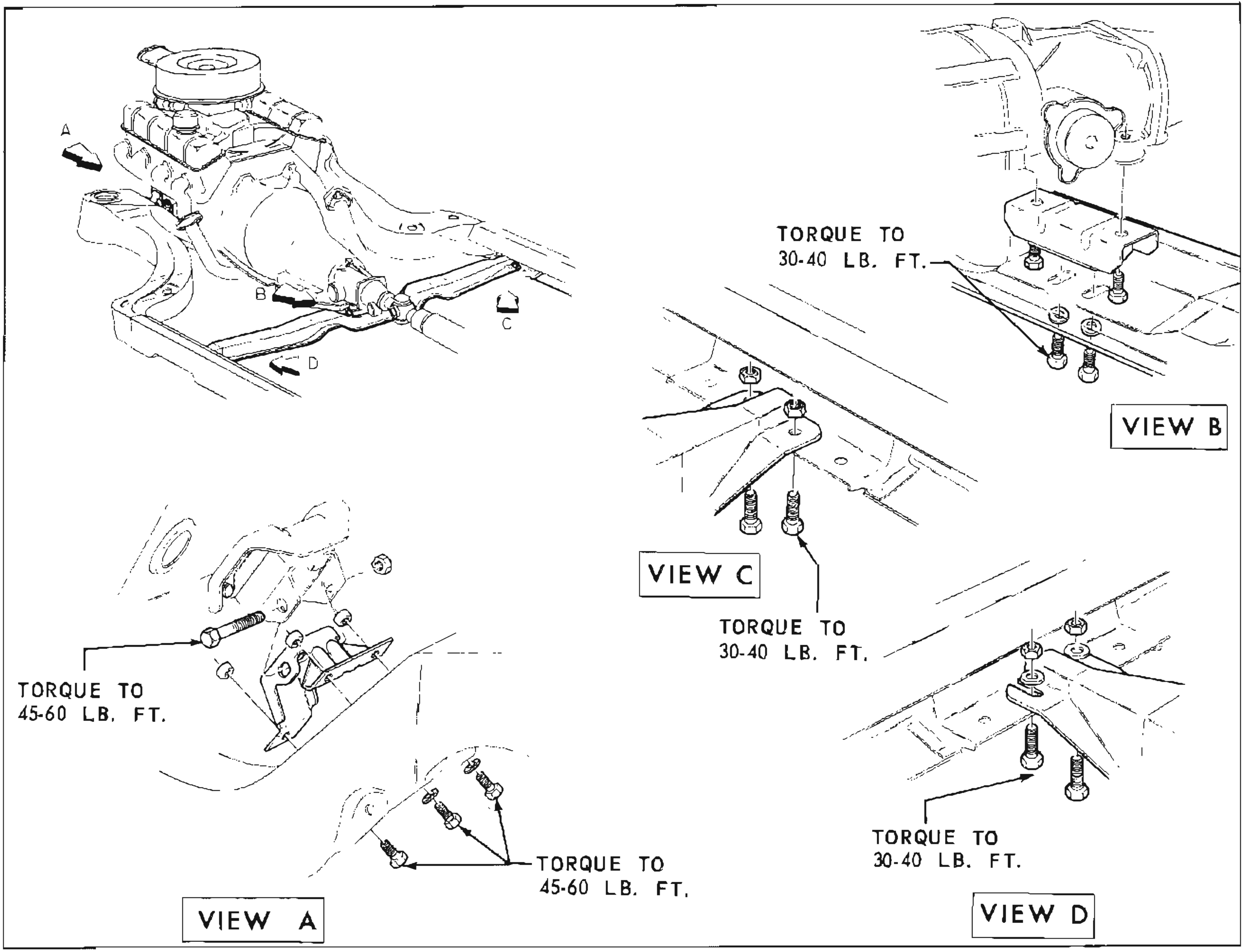



Figure 2-96—Engine And Transmission Mounting Details

2. Place an amount of body putty or similar material on the inside surface of the fan driving pulley. Run engine at critical speed and note vibration.

3. Repeat Step 2 above using varying amounts of putty at different locations until the vibration is diminished to a minimum.

4. When point of minimum vibration is found, mark the nearest hole drilled in the balancer at that point.

5. Cut a piece of 1/4" drill rod approximately 1/2" long. Using a chisel, upset a small amount of material on the side of the piece of drill rod as shown in Figure 2-97.

6. Install drill rod into hole marked in Step 4.

7. Additional weights should be added (if necessary) in adjoining holes.

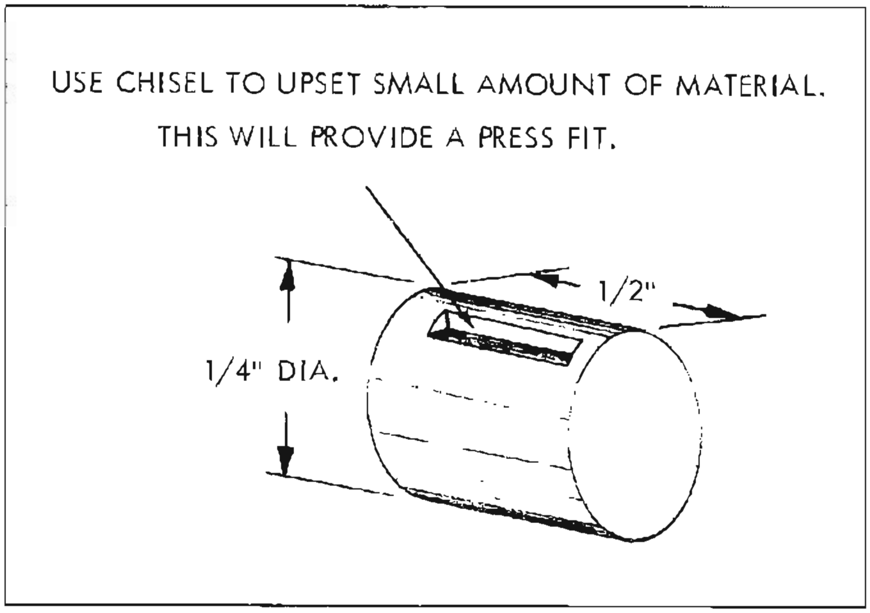



Figure 2-97—Harmonic Balancer Balance Weight Details

## 2-19 TROUBLE DIAGNOSIS

### a. Hard Starting, Improper Performance, and Excessive Fuel Consumption

These subjects are covered in Group 3, Section 3-B.

### b. Excessive Oil Consumption

When investigating engines reported to be using large amounts of oil, a thorough inspection should be made for external leaks. Consideration should be also given to the operating conditions and the condition of other areas of the vehicle such as PCU valves and the associated hoses and connectors. If all of these possibilities have been checked and found to be satisfactory, then the chance that consumption is caused by internal leaks should be investigated.

To check for external oil leaks, place a clean piece of paper on floor beneath engine. Start car and run engine until oil is completely warm. Stop engine and check for dripping or leaks. Inspect both sides and ends of engine for worn spots. Check the following areas for any sign of seepage or leakage:

(1) Rocker Arm Covers.

(2) Timing Chain Cover.

(3) Oil Pan Gaskets.

(4) Around Starter Bolts and Brackets.

(5) Between Oil Pan and Flywheel Housing.

The conditions of operation have an important bearing on oil consumption. The following areas should be checked:

(1) Improper reading of oil gauge rod. An erroneous reading will be obtained if car is not level, gauge rod is not pushed down against stop, or insufficient drain-back time (1 minute) is not allowed after stopping engine. An oversupply of oil may be added if gauge rod markings are not understood. The space between the "FULL" and "ADD" marks represent 1 quart.

(2) Oil too light. The use of oil of lower viscosity than specified for prevailing temperatures will contribute to excessive oil consumption.

(3) Continuous high speed driving. In any automobile engine, increased oil consumption per mile may be expected at speeds above 60 MPH.

(4) High speed driving following slow speed town driving. When a car is used principally for slow speed town driving under conditions where considerable crankcase dilution occurs, a rapid lowering of oil level may occur when the car is driven for some distance at high speed. This is because the dilution from town driving is removed by the heat of the high speed driving. This condition is normal and should not be mistaken for excessive consumption.

(5) Valve guides worn. Excessive clearance between the valve stem and valve guide can result in high oil consumption.

(6) Piston rings not worn in. A new engine, or an engine in which new rings have been installed, will require sufficient running time to wear in the rings against the cylinder walls. During the wear-in period a higher than average oil consumption rate is to be expected, and no attempt should be made to improve oil economy by replacing rings before the engine has been in service for at least 3000 miles.

**c. Excessive Valve Noise**

The noise level of the valve mechanism cannot be properly judged where the engine is below operating temperature when the hood is raised, or when the valve rocker arm covers are removed.

Before attempting to judge valve noise level, the engine must be thoroughly warmed up (at least 20 minutes of operation at 1200 to 1500 RPM) to stabilize oil and coolant temperatures and bring all engine parts to a normal state of expansion. When the engine is warmed up, listen for engine noise while sitting in the drivers seat with the hood closed. Run the engine at idle and at various higher speeds. It is advisable to observe the noise level in several engines that have been properly broken in, in order to develop good judgment for checking the noise level in any given engine.

If the preceding check indicates the valve mechanism is abnormally noisy, remove the rocker arm covers so that the various conditions that cause noise may be checked. A piece of heater hose of convenient length may be used to pick out the particular valves or valve linkages that are causing abnormal noise. With the engine running at a speed where the noise is pronounced, hold one end of hose to an ear and hold other end about 1/2" from point of contact between rocker arm and valve stem. Mark or record the noisy valves for investigation of following causes.

(1) Excessive Oil In Crankcase. Crankcase oil level high enough to allow the crankcase to churn the oil will cause air bubbles in the lubricating system. Air bubbles entering the hydraulic lifters will cause erratic operation resulting in excessive lash in the valve linkage. Locate and correct cause of high oil level, then run engine long enough to expel air from system.

(2) Sticking, Warped or Eccentric Valves, Worn Guides. Sticking valves will cause irregular engine operation or missing on a low speed pull and will usually cause intermittent noise.

Pour penetrating oil over the valve spring cap and allow it to drain down the valve stem. Apply pressure to the one side of the valve spring and then the other, and then rotate the valve spring about 1/2 turn. If these operations affect the valve noise, it may be assumed that valves should be reconditioned. (par. 2-15)

(3) Worn or scored parts in the valve train. Inspect rocker arms, push rod ends for scoring. Check push rods for bends, valve lifters and camshaft surfaces for scoring. Replace faulty parts.

(4) Valves and seats cut down excessively. Noisy and improper valve action will result if a valve and its seat have been refinished enough to raise the end of the valve stem approximately .050" above normal position. 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 is 1.925 inches.

(5) Faulty Hydraulic Valve Lifters. If the preceding suggestions do not reveal the cause of noisy valve action, check operation of valve lifters as described in paragraph 2-15, subparagraph d.

**d. Checking Hydraulic Valve Lifters**

When checking hydraulic valve lifters, remember that grit, sludge, varnish or other foreing matter will seriously affect operation of these lifters. If any foreign substance is found in the lifters or engine where it may be circulated by the lubrication system, a thorough cleaning job must be done to avoid a repetition of lifter trouble.

To help prevent lifter trouble, the engine oil and oil filter must be changed as recommended in Group 1. The engine oil must be heavy-duty type (MS marked on container) and must also conform to General Motors Specification 4745-M to avoid detrimental formation of sludge and varnish. A car owner should be specifically advised of these requirements when the car is delivered. Faulty valve lifter operation usually appears under one of the following conditions:

(1) Rapping noise only when engine is started. When engine is stopped, any lifter on a camshaft lobe is under pressure of the valve spring; therefore, leak down or escape of oil from the lower chamber can occur. When the engine is started a few seconds may be required to fill the lifter, particularly in cold weather. If noise occurs only occasionally, it may be considered normal requiring no correction. If noise occurs daily, however, check for (a) oil too heavy for prevailing temperatures (b) excessive varnish in lifter.

(2) Intermittent Rapping Noise. An intermittent rapping noise that appears and disappears every few seconds indicates leakage at check ball seat due to foreign particles, varnish, or defective surface of check ball or seat. Recondition, clean, and/or replace lifters as necessary.

(3) Noise on idle and low speed. If one or more valve lifters are noisy on idle and up to approximately 25 MPH but quiet at higher speeds, it indicates excessive leakdown rate or faulty check ball seat on plunger. With engine idling, lifters with excessive leakdown rate may be spotted by pressing down on each rocker arm above the push rod with equal pressure. Recondition or replace noisy lifters.

(4) Generally noisy at all speeds. Check for high oil level in crankcase. See subparagraph b (1) above. With engine idling, strike each rocker arm above push rod several sharp blows with a mallet; if noise disappears, it indicates that foreign material was keeping check ball from seating. Stop engine and place lifters on camshaft base circle. If there is lash clearance in any valve linkage, it indicates a stuck lifter plunger, worn lifter body lower end, or worn camshaft lobe.

(5) Loud noise at normal operating temperature only. If a lifter develops a loud noise when engine is at normal operating temperature, but is quiet when engine is below normal temperature, it indicates an excessively fast leakdown rate or scored lifter plunger. Recondition or replace lifter.

### e. Engine Vibration or Noise

If unusual vibration or noise develops in the car, test first to determine whether the condition originates in the engine or in other operating units. Time will often be saved by checking the recent history of the car to determine whether the vibration became noticeable gradually or followed an accident or installation or repair parts.

Vibration or noise is usually more pronounced at a certain car speed. If the engine is run at the equivalent speed with car standing and transmission in neutral, the condition will still exist if the engine or clutch is at fault. If the trouble does not exist with engine running and car standing still, refer to Rear Axle Section and/or Propeller Shaft section.

An engine which is not properly tuned will run rough and vibrate, particularly at idling and low speeds. A thorough engine tune-care operation is the proper correction.

Bent fan blades will cause vibration and noise. Remove fan belt and run engine. If vibration or noise is eliminated or reduced it indicates that the condition is caused by the fan, delcotron generator, belt, or possibly the water pump. Check water pump for rough or noisy bearings and replace parts as necessary.

Inspect fan belt, all pulleys, balancer, fan blades and generator for undercoating or other material that would cause an unbalanced condition.

Check fan blades for excessive run-out and correct if necessary. Check all pulleys for abnormal run-out or wobble and replace if necessary. Reinstall fan belt and adjust to proper tension.

With engine running, place one hand on generator and slowly open throttle from idle to approximately 60 MPH. If generator vibrates to create a noise in the car, it will vibrate enough to be felt by the hand. As the engine is slowly speeded up the generator may be felt to go into periods of vibration at different engine speeds. Noise caused by the generator should occur at the same time that generator vibration occurs. Repair or replace a noisy generator.

Vibration may be caused by loose, broken, or deteriorated engine mountings. Tighten loose mountings or replace faulty mountings.

Loose or broken rivets in the crankshaft balancer may cause vibration in the engine. If the balancer is damaged in such a manner that the parts cannot function freely, extreme roughness will result which may eventually break the crankshaft. A balancer which shows evidence of damage or which is suspected of being inoperative should be replaced and the result noted, since it is not possible to test the balancer any other way.

Vibration will result if connecting rods or pistons are installed which are not of equal weight with all other rods or pistons in engine. If new parts have recently been installed, these should be checked to determine whether they are standard Buick parts or if they have been altered in weight by filing, machining or other repairs.

Engine roughness may be caused by an unbalanced combination of clutch, flywheel and crankshaft even though these units are balanced individually during manufacture. Unbalance may occur if clutch or flywheel is removed without marking to allow reinstallation in original position.

Vibration existing with automatic transmission may be due to unbalanced flywheel or converter pump.

### f. Cooling System Trouble Diagnosis

If the radiator is filled too full when cold, expansion when hot will overfill the radiator and coolant will be lost through the overflow pipe. Adding unnecessary water will weaken the anti-freeze solution and raise the temperature at which freezing may occur.

The use of alcohol anti-freeze with a high temperature radiator thermostat will cause boiling and loss of coolant through the overflow pipe.

If the cooling system requires frequent addition of water in order to maintain the proper level in the radiator, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks which may show dampness or dripping can easily escape detection when the engine is hot, due to the rapid evaporation of coolant. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no dampness.

Air or gas entrained in the cooling system may raise the level in radiator and cause loss of coolant through the overflow pipe. Air may be drawn into the cooling system through leakage at the water pump seal. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber. The following quick check for air leaks on suction side of pump or gas leakage from engine may be made with a piece of rubber tubing and a glass bottle containing water.

1. With cooling system cold, add water to bring coolant to proper level.

2. Block open the radiator cap pressure valve, or use a plain cap, and be sure radiator cap is on tight. Attach a suitable length of rubber hose to overflow pipe.

3. Run engine in neutral at a safe high speed until the engine reaches a constant operating temperature.

4. Without changing engine speed, put the free end of rubber hose into a bottle of water, avoiding kinks or low bends that might block the flow of air.

5. Watch for air bubbles in water bottle. A continuous flow of bubbles indicates that air is being sucked into the cooling system, or exhaust gas is leaking into the cooling system past the cylinder head gasket.

It must be remembered that the Buick pressure system operates at higher temperatures than systems operating at atmospheric pressure. Depending on the pressure in cooling system, the temperature of water or permanent type anti-freeze may go considerably above 212°F without danger of boiling.

### g. Engine Overheating

In cases of actual overheating the following conditions should be checked:

1. Excessive water loss.

2. Slipping or broken fan belt.

3. Radiator thermostat stuck, radiator air passages clogged, restriction in radiator core, hoses, or water jacket passages.

4. Improper ignition timing.

5. Shortage of engine oil or improper lubrication due to internal conditions.

6. Dragging brakes.

# GROUP 3

# ENGINE FUEL AND EXHAUST SYSTEMS

## SECTIONS IN GROUP 3



## SECTION 3-A

## SPECIFICATIONS AND GENERAL DESCRIPTION

### CONTENTS OF SECTION 3-A



## 3-1 SPECIFICATIONS, FUEL AND EXHAUST SYSTEMS

### a. General Specifications

| | |
|---|---|
| Gasoline, Grade Required (with 1 and 2-Bbl. Carburetors) | Regular |
| Gasoline, Grade Required (with 4-Bbl. Carburetor) | Premium |
| Gasoline Tank Capacity (gal.) | 20 |
| Gasoline Gauge, Make and Type | A.C., Electric |
| Fuel Pump - Make and Type | A.C., Mechanical |
| Drive | Eccentric at Camshaft Sprocket |
| Fuel Pump Pressure | |
| At Pump Outlet, pounds | 4 1/2 to 5 3/4 |
| At Carburetor Inlet, pounds | 4 to 5 1/4 |
| Fuel Filter, Near Carb. Inlet (V-8 Engine) | A.C., Can-Type Throw-Away |
| Fuel Filter, In Carb. Inlet (V-6 Engine) | Rochester, Sintered Bronze |
| Fuel Filter, In Gas Tank (All) | Woven Plastic |
| Carburetor, Make and Type | Carter and Rochester, Downdraft |
| Carburetor, Barrels and Compression Ratio | |
| 1-Barrel (V-6 Engine) | 9 to 1 Comp. Ratio |
| 2-Barrel (V-8 Engine) | 9 to 1 Comp. Ratio |
| 4-Barrel (V-8 Engine) | 10.25 to 1 Comp. Ratio |
| Air Cleaner, Make and Type | A.C., Plastic Foam Element |
| Intake Manifold Heat, Type | Hot Exhaust Passage in Manifold |
| Thermostat Wind-up @ 70 Deg., Valve Closed | 1/2 Turn |
| Idle Speed, Automatic Trans. in Drive or Manual Trans. in Neutral | 550 RPM |
| With Air Conditioner - Off Position | Add 50 RPM |

**b. Carburetor Calibrations**

IMPORTANT: Calibrations are governed by the CODE number on the attached code tag.

## ROCHESTER 2-BARREL (V-8) AND 1-BARREL (V-6)

| | Syn. Trans. | | Auto. Trans. | |
|---|---|---|---|---|
| | V-8 | V-6 | V-8 | V-6 |
| Model Designation | 2GC | 1BC | 2GC | 1BC |
| Number of Barrels | 2 | 1 | 2 | 1 |
| Code Number, for Following Calibrations | 7025047 | 7025149 | 7025046 | 7025148 |
| Throttle Bore | 1 7/16" | 1 9/16" | 1 7/16" | 1 9/16" |
| Small Venturi | 1/8" | 19/32" | 1/8" | 19/32" |
| Large Venturi | 1 1/8" | 1 11/32" | 1 1/8" | 1 11/32" |
| Main Metering Jet | | | | |
| Production | .055"-60° | .061-Sq. | .052"-60° | .061-Sq. |
| High Altitude | .053"-60° | .060-Sq. | .049"-60° | .060-Sq. |

NOTE: Use high Altitude Jets Above 3500 Feet

| | Syn. Trans. V-8 | Syn. Trans. V-6 | Auto. Trans. V-8 | Auto. Trans. V-6 |
|---|---|---|---|---|
| Idle Tube Restriction | #69 | #52 | #70 | #54 |
| Idle Needle Hole | #56 | #44 | #56 | #44 |
| Spark Holes | 2-#55 | .030" x .200" | 1 1/8" | .030" x .200" |
| Pump Discharge Holes | 2-#68 | 2-#70 | 2-#71 | 2-#72 |
| Choke Restriction | | | | |
| Inlet | #42 | 3/16" | #42 | 3/16" |
| Outlet | 1/8" | #37 | 1/8" | #44 |
| Choke Setting | Index | Index | Index | Index |
| Choke Coil Number | 27 | 28 | 12 | 28 |
| Fast Idle Cam Number | 7029501 | 7029502 | 7028970 | 7029554 |
| Dome Vent | #70 | | #67 | |
| Cluster Top Bleed | #67 | | #68 | |
| Cluster Side Bleed | #69 | | #68 | |
| Float Level Adjustment | .594" | 1 9/32" | .594" | 1 9/32" |
| Float Drop Adjustment | 1 29/32" | 1 3/4" | 1 29/32" | 1 3/4" |
| Pump Rod Adjustment (Outer Hole) | 1 11/32" | | 1 11/32" | |
| Choke Rod Adjustment | .055" | .050" | .055" | .050" |
| Choke Unloader Adjustment | .136" | .230" | .136" | .230" |
| Initial Idle Speed | 3 Turns In | 2 Turns In | 3 Turns In | 2 Turns In |
| Initial Idle Mixture | 1 Turn Out | 1 3/4 Turns Out | 1 Turn Out | 1 3/4 Turns Out |

## CARTER 4-BARREL

IMPORTANT: Calibrations are governed by the CODE number.

| | 300 Eng. Auto. Trans. | 300 Eng. Syn. Trans. |
|---|---|---|
| Model Designation | AFB | AFB |
| Number of Barrels | 4 | 4 |
| Code Number, for Following Calibrations | 3826S | 3827S |
| Bore Diameter, Primary | 1 7/16 | 1 7/16 |
| Large Venturi Diameter, Primary | 1 1/8 | 1 1/8 |
| Bore Diameter, Secondary | 1 7/16 | 1 7/16 |
| Large Venturi Diameter, Secondary | 1 1/4 | 1 1/4 |
| Float Level Adjustment | 3/16 | 3/16 |
| Float Drop Adjustment | 3/4 | 3/4 |
| Float Needle Seat | #42 | #42 |
| Low Speed Jet | #68 | #66 |
| Idle Discharge Port | .180" x .030" | .180" x .030" |

**CARTER 4-BARREL Con't.**

| | 300 Eng. Auto. Trans. | 300 Eng. Syn. Trans. |
|---|---|---|
| Lower Idle Port | #52 | #52 |
| Metering Jet, Primary | 120-256 | 120-256 |
| Metering Jet, Secondary | | |
| Production | 120-222 | 120-222 |
| High Altitude | | |
| Metering Rod | | |
| Production | 16-341 | 16-341 |
| High Altitude | | |
| NOTE: Use High Altitude Kit Above 3500 Feet | | |
| Use Kit Consisting of Secondary Jets, Primary Rods and Springs. | | |
| Throttle Bore Vents | #42 | #42 |
| Anti-Percolator or Main Bleed Hole | #64 | #64 |
| Pump Setting at Closed Throttle | 7/16" Center Hole | 7/16" Center Hole |
| Pump Discharge Jet | #72 | #72 |
| Vacuum Spark Control Hole | 3/32" | .130" x .040" |
| Choke Coil Housing Number | 170AZ478S | 170AZ478S |
| Choke Thermostat Setting | One Notch Rich | Index |
| Choke Suction Hole | #40 | #40 |
| Choke Piston Setting (With .026" Wire) | .081" | .081" |
| Closing Shoe Clearance | .020" | .020" |
| F. I. Cam Setting, Choke Closed | Index | Index |
| F. I. Cam Number | 181-354 | 181-356 |
| Unloader Opening at Choke Valve Edge | 1/8" | 1/8" |
| Initial Idle Speed | 1/2 Turn In | 1/2 Turn In |
| Initial Idle Mixture | 1 Turn Out | 1 Turn Out |
| Fast Idle Speed in Drive (Hot, on Low Step) | 600 RPM | 600 RPM |

## 3-2 DESCRIPTION OF FUEL SYSTEM

### a. Gasoline Tank, Feed Pipe and Filter

The gasoline tank is attached by two strap type supports to the body under the trunk compartment, where it is seated in saddles. Two internal baffles spot-welded to the upper half at centerline of tank support seats act as struts to maintain the shape of tank and prevent flexing due to weight of gasoline and pull of the supporting straps.

In all models except station wagons, the gas tank filler is soldered into an opening at the rear center of the tank. The tank is vented at the front right corner. A special U-shaped vent pipe extends from the top of the tank to allow free movement of air without loss of fuel. This vent is designed to allow rapid filling of the tank. See Figure 3-2.

In station wagon models, the gas tank filler extends from the left side of the tank and is accessible through a door in the left rear quarter. The tank is vented at the filler cap. A special vent pipe extends from the top of the tank to a point in the filler neck just under the cap. See Figure 3-3.

The tank outlet is located in the forward top center of the tank. It consists of a combination fuel pickup, filter, and gas gauge tank unit. See Figure 3-2.

The fuel line is partly internal corrosion resistant metal line and partly synthetic rubber hose attached with clamps.

With all V-8 engines, a can-type throw-away filter is located just forward of the left cylinder bank in the line between the fuel pump and the carburetor. See Figure 3-5. On V-6 engines, a sintered bronze filter, located in the carburetor inlet, takes the place of the can-type filter. See Figure 3-16.

On all air conditioner equipped cars, a vapor by-pass system is installed. These cars have either a special tee or a special fuel filter which has a metering outlet. See Figure 3-5. All vapor which forms is bled off and returned to the gas tank through a separate line. This system greatly reduces any possibility of vapor lock.

**b. Fuel Pump, Carburetor, and Automatic Choke**

The fuel pump is mounted on the lower left side of the timing chain cover. It is actuated by a hardened, chrome-plated, stamped steel eccentric mounted on the front side of the camshaft sprocket. The pump is inverted, thereby placing it in a lower, cooler location. It has a built-in air dome with a diaphragm to dampen out pulsations in fuel pressure. The construction and operation of the pump are described in Section 3-D.

The Rochester 2-barrel carburetor is described in Section 3-E. The Carter 4-barrel carburetor is described in Section 3-F. The Rochester 1-barrel carburetor is described in Section 3-G. Idle and automatic choke adjustments are covered in paragraph 3-8.

**c. Air Cleaner and Intake Silencer**

All series engines are equipped with oil wetted polyurethane foam element air cleaners combined with intake silencers. The air cleaner removes abrasive dust and dirt from the air before it enters the engine through the carburetor. The intake silencer reduces to a very low level the roaring noise made by the air as it is drawn through the intake system. The cleaner and silencer also functions as a flame arrester in event of "backfire" through the intake system. See Figure 3-1.

It is important to securely tighten the air cleaner wing nut by hand after locating the air cleaner on the carburetor. Proper location of both 2-barrel and 4-barrel V-8 air cleaners is with the word "FRONT" located on the forward centerline of the engine; this locates the intake 30° left of center. The V-6 air cleaner is positively located 45° right of center by locating notches.

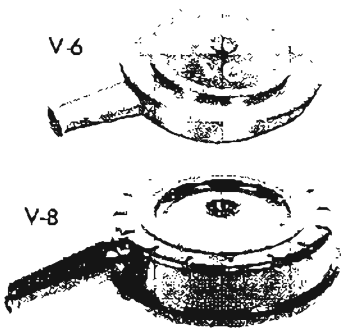



Figure 3-1—Air Cleaner and Silencer Assemblies

The air cleaner element is of the washable plastic foam type. It consists of a cylinder of polyurethane foam over a perforated sheet metal supporting screen. This screen also acts as a flame arrester in case of a backfire.

For normal operating conditions, the element should be cleaned every 12,000 miles (more often under dusty operating conditions). See paragraph 1-1, Step 3 for the cleaning procedure.

**d. Carburetor Throttle Control Linkage**

The carburetor throttle control linkage is designed to provide positive control of the throttle valves through their entire range without being affected by movement of the engine on its rubber mountings. See Figure 3-20.

The accelerator pedal is mounted on two ball studs which are screwed into weld nuts in the floor pan. Depressing the accelerator pedal causes the pedal to make a rolling contact with 3 rollers on the throttle operating lever, forcing the lower part of the lever to pivot forward and down. The lever pivots in a bearing mounted on the body cowl. See Figure 3-20.

As the lower part of the throttle operating lever is pushed forward by the accelerator pedal, the upper part of the lever is pulled rearward. This pulls the throttle rod rearward, causing the carburetor throttle lever to open the throttle valves.

The return spring returns the throttle linkage to idle position whenever pressure is released from the accelerator pedal. See Figure 3-20.

On all automatic transmission cars, a dash pot is mounted in position to be contacted by an arm of the carburetor throttle lever as the throttle is closed. The dash pot cushions the closing of the throttle to prevent engine stalling when the accelerator pedal is suddenly released.

On all automatic transmission cars, a transmission detent switch is mounted at the full throttle position of the carburetor throttle lever. When the throttle linkage is moved to wide open throttle position, the switch contacts are closed to cause the transmission to "down shift". This switch also has a second set of contacts which close slightly before wide open throttle position to cause the stator blades in the transmission to "switch-the-pitch" to high performance angle. See Figure 3-20.

On all automatic transmission cars, an idle stator switch is installed in a joint of the throttle linkage between the throttle lever and the throttle rod. Whenever the throttle linkage returns to curb idle position, the switch contacts are closed to cause the stator blades to "switch-the-pitch" to high angle. This reduces the transmission load on the engine at idle, thereby reducing the tendency of the car to creep. See Figure 3-20.

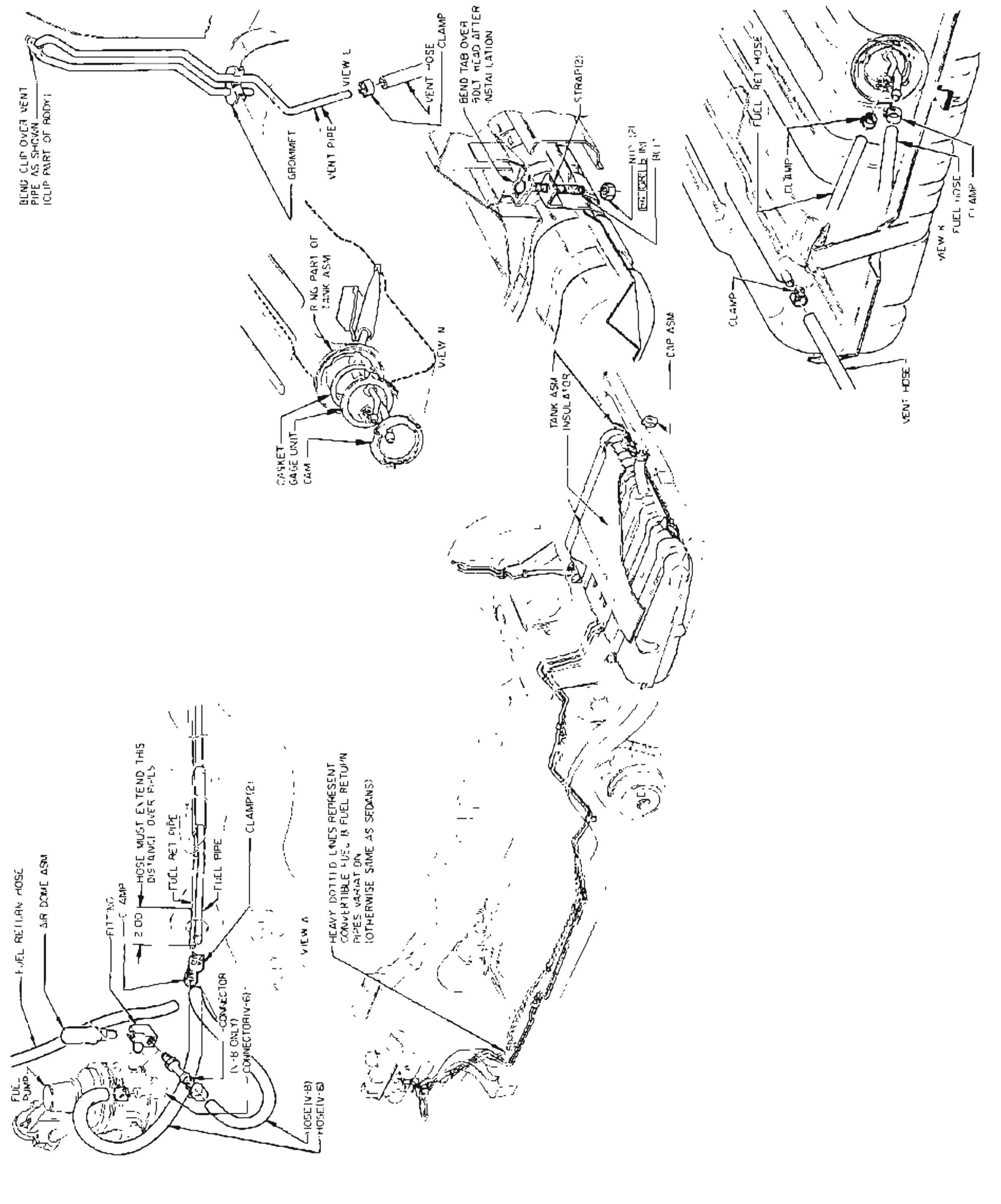



Figure 3-2—Fuel System - Air Cond. Except Wagons

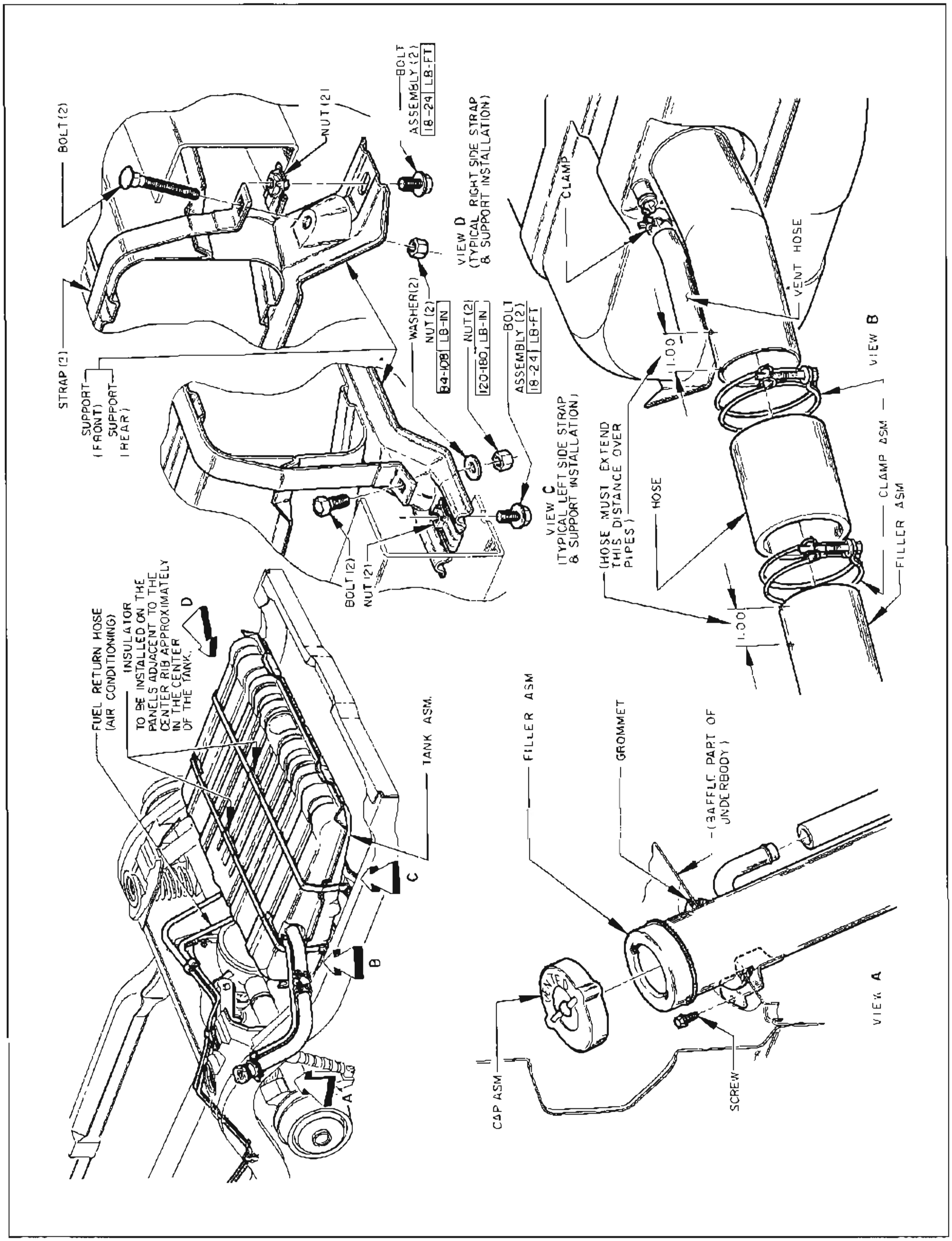



Figure 3-3—Fuel System - Air Cond. Special Wagons

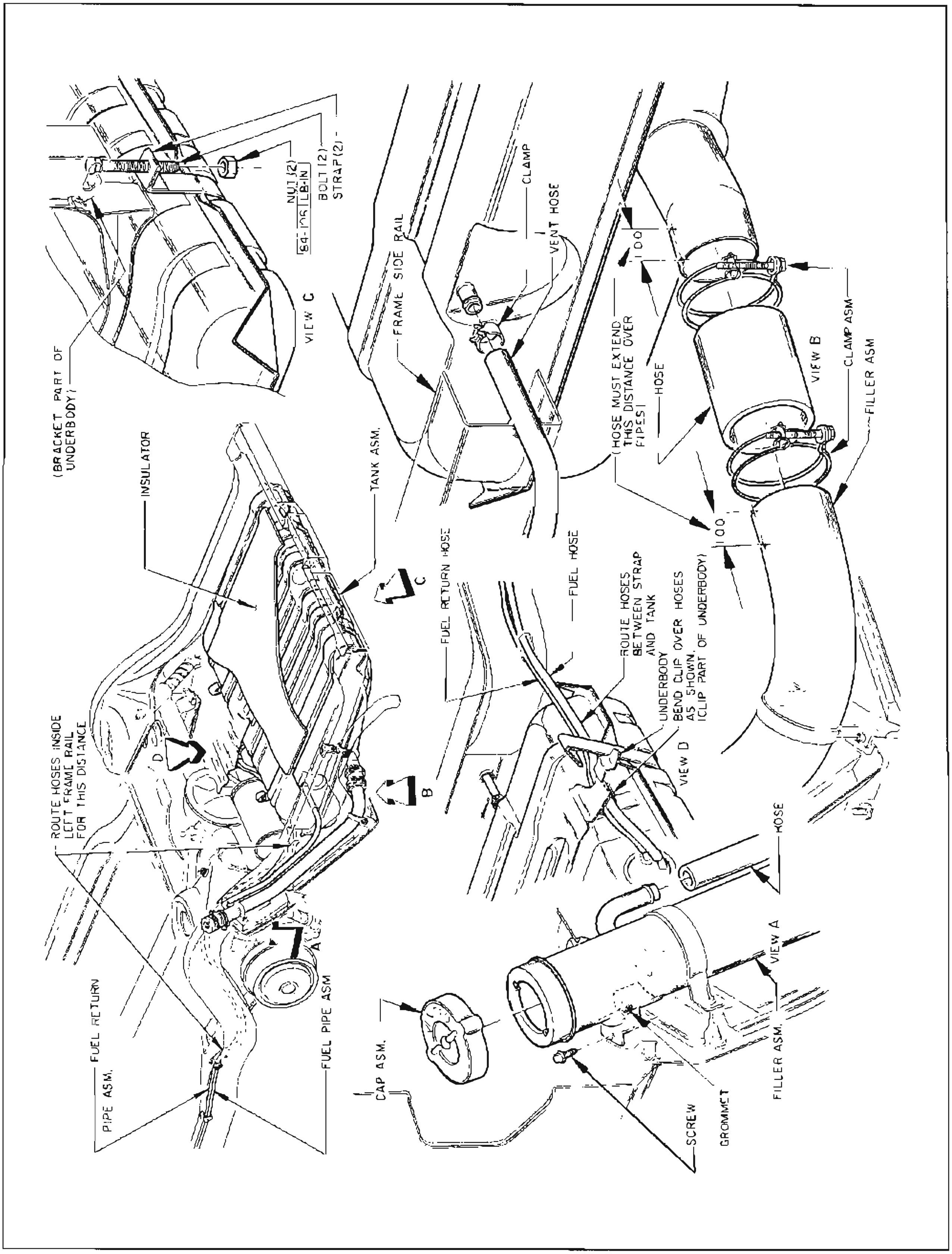



Figure 3-4—Fuel System - Air Conditioned Sportwagons

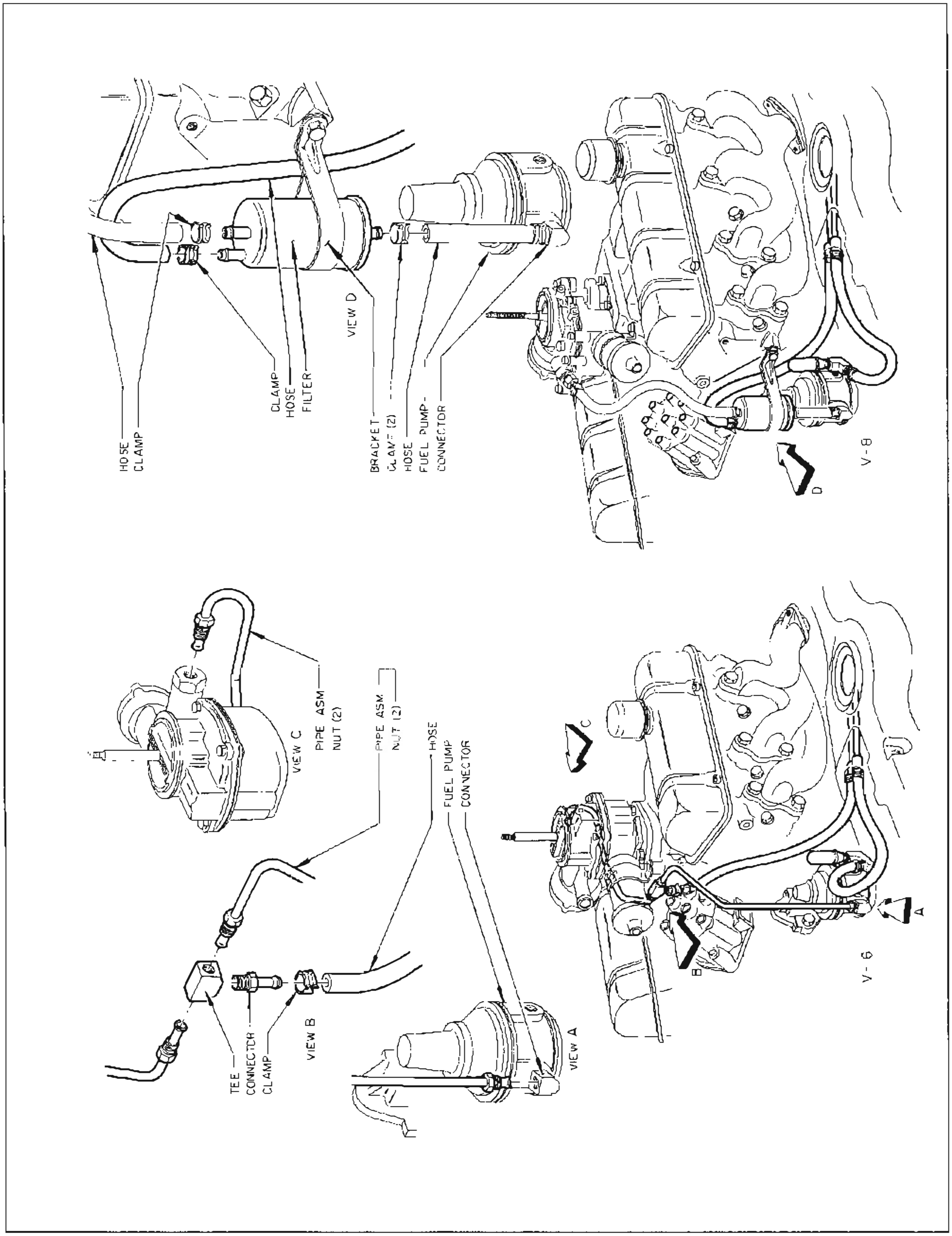



Figure 3-5—Fuel Pump to Carburetor Lines - Air Cond. Cars

## 3-3 DESCRIPTION OF INTAKE AND EXHAUST SYSTEMS

### a. Intake Manifold and Manifold Heat

The V-8 engine has a low-restriction, dual intake manifold which is bolted to the inner edges of both cylinder heads, where it connects with all inlet ports. The end branches of each section run at 90 degrees to the connecting middle branch, thereby forming a T-junction at the dividing point which assures a uniform division and distribution of fuel to all cylinder inlets. Each manifold section feeds four cylinders -- two in each bank. See Figure 3-6.

Both V-6 and V-8 engines have a cast iron intake manifold and a cast iron throttle body on the carburetor. The intake manifold has a special exhaust passage to provide heat when needed.

The controlling source of the exhaust heat is a heat control valve located below the right exhaust manifold. This offset valve has a bi-metal thermostat spring which tends to hold the valve closed under cold operating conditions. See Figure 3-7.

This causes a pressure build-up in the right exhaust manifold

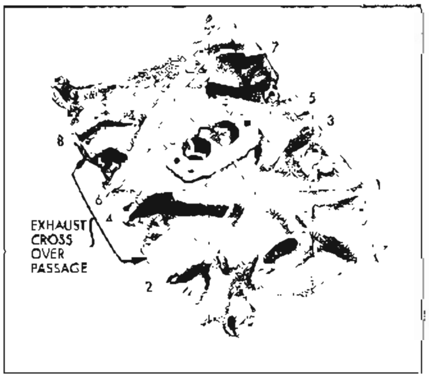



Figure 3-6—Intake Manifold Distribution - V-8 Engine

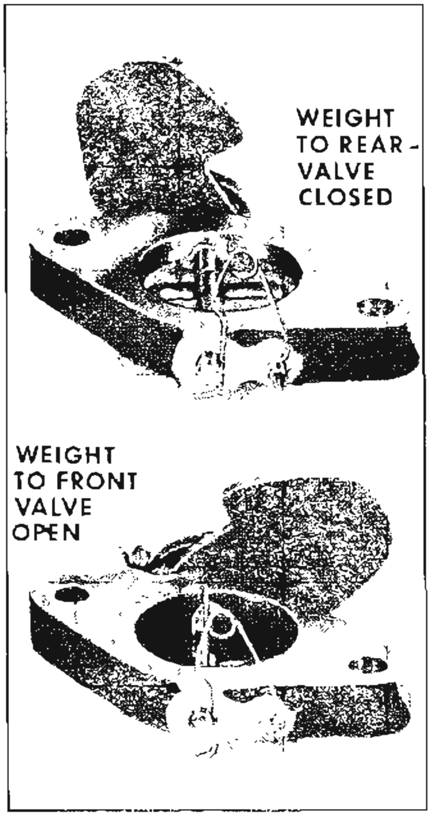



Figure 3-7—Exhaust Manifold Valve

which forces exhaust through the crossover passage under the carburetor to the left exhaust manifold and on out the exhaust system. See Figure 3-6.

As the exhaust manifold warms-up, the thermostat spring gradually releases the offset valve and the flow of hot exhaust through the crossover passage is gradually reduced. When the exhaust manifold gets hot, the valve opens wide and exhaust flow through the crossover passage is at a minimum. When operating at cold temperatures, the thermostat spring will never release the valve completely, thereby causing some exhaust to continue to cross over.

When the engine is cold and the heat control valve is closed, restricted openings in the metal intake manifold gaskets meter the

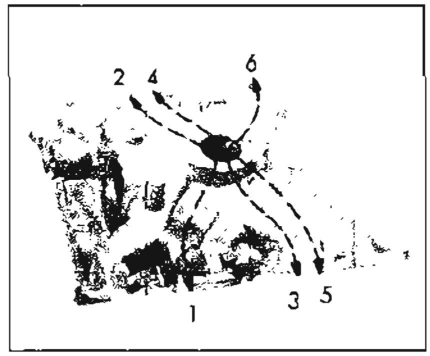



Figure 3-8—Intake Manifold Distribution - V-6 Engine

flow of exhaust through the crossover passage. At higher engine speeds and loads, the offset valve will be forced partially open to relieve the excess pressure built up in the right manifold.

Intake manifold heat is necessary for cold operating conditions to provide better fuel mixture vaporization and therefore more complete combustion. Carburetor heat is especially important during warm-up on cool, humid days; without heat in the throttle body, ice would form at the throttle valve edges and idle ports (called "carburetor icing") and would cause engine stalling.

### b. Exhaust Manifolds, Pipes, and Mufflers

Each cylinder exhausts through an individual port into a separate branch of the exhaust manifold. These separate branches empty immediately into a main branch for each bank of cylinders. See Figure 3-9.

The right manifold contains the carburetor choke heat stove which consists of an alloy steel heating tube mounted in a drilled hole in the manifold and a heating chamber located on the outside of the manifold. Heated air is drawn from the heat stove through an insulated pipe into the automatic choke housing.

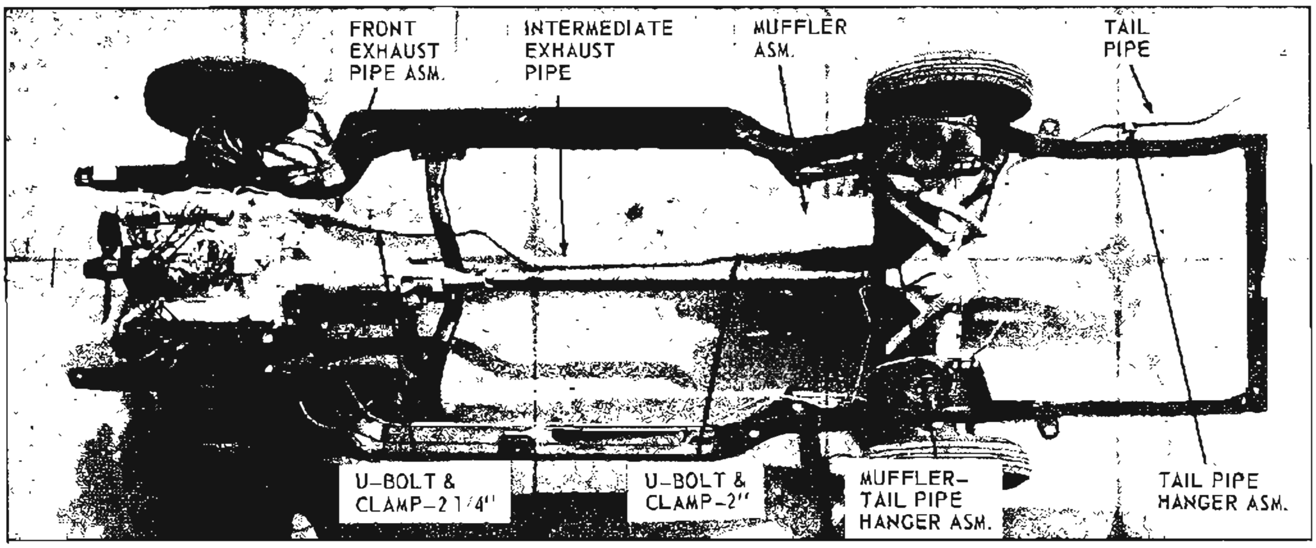



Figure 3-9—Exhaust System

All connections except at the exhaust manifold are of the slip joint type. Connections are made with U-bolts and clamps. See Figures 3-9 through 14.

The muffler is a round dynamic flow type having very low back pressure. It is double wrapped of heavy gauge galvanized steel with a layer of asbestos placed between wrappings to aid in reduction of noise transfer and to prevent any "oil-canning" effect. The muffler is supported by free hanging, rubber-fabric mountings which permit free movement but eliminate transfer of noise and vibration into the passenger compartment.

### c. Dual Exhaust System

The dual exhaust system is optional on all V-8 engine equipped cars. The right side of the dual exhaust system is similar in appearance to the V-8 single exhaust system, but the parts are not interchangeable.

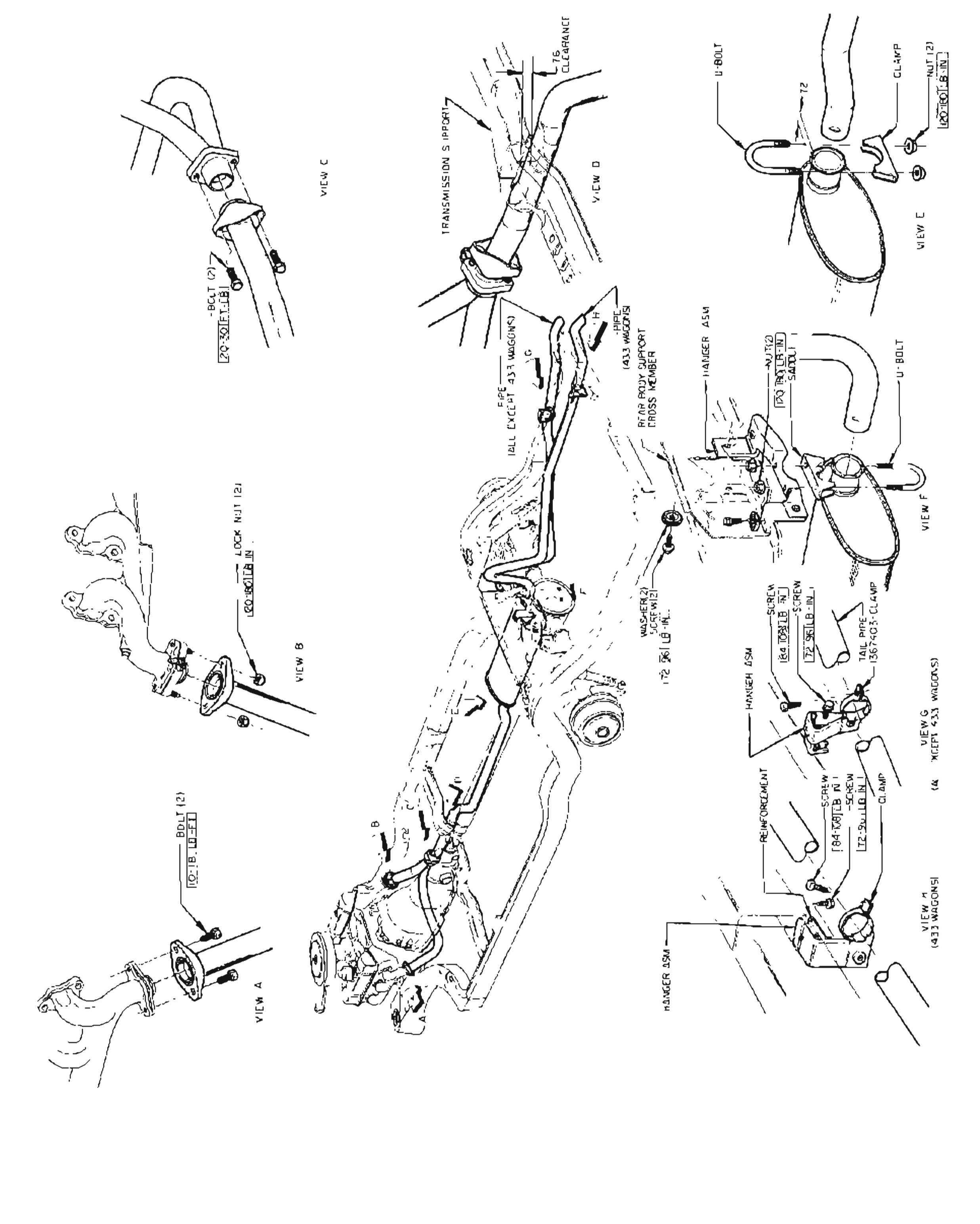



Figure 3-10—Single Exhaust System - V-6

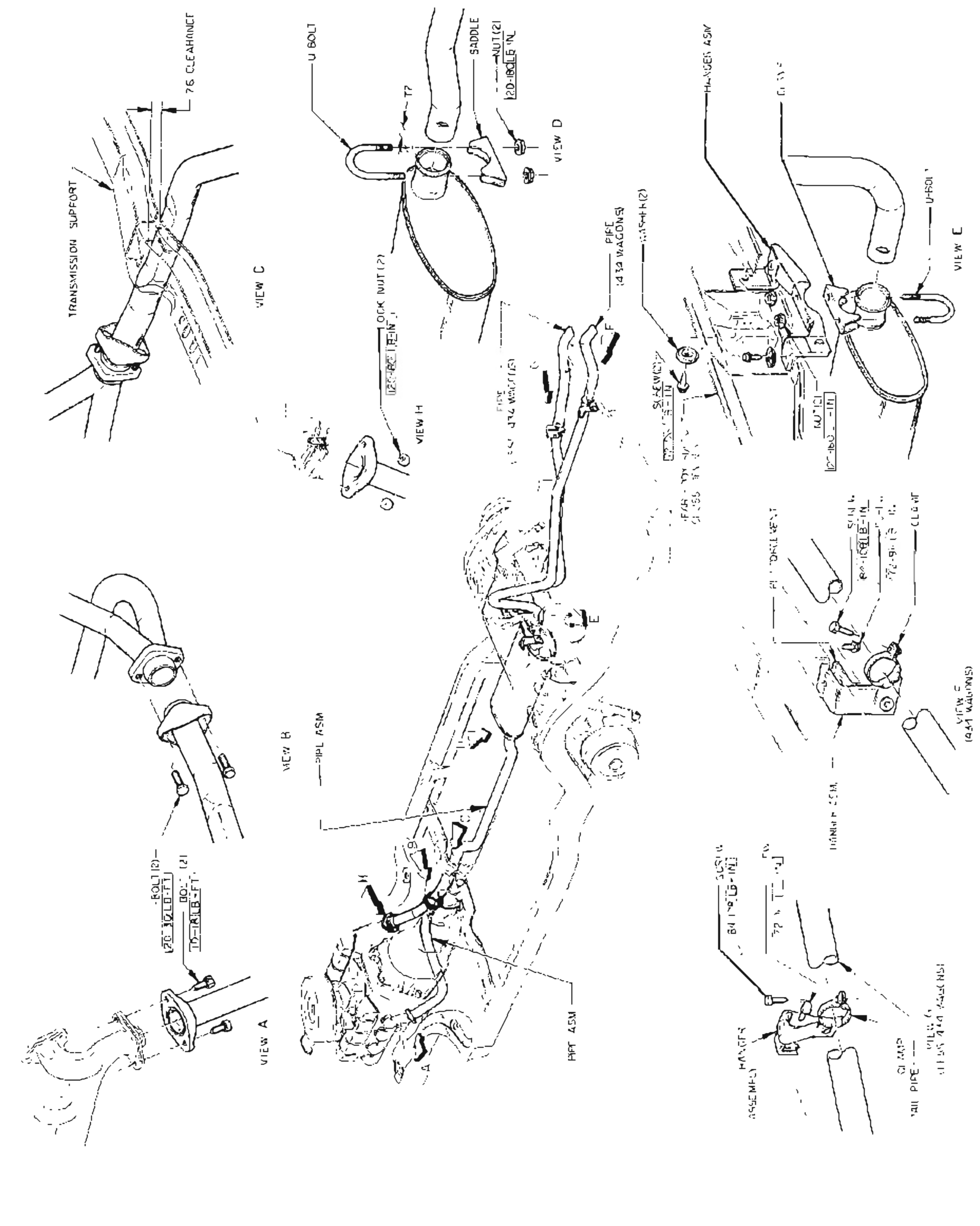



Figure 3-11—Single Exhaust System - V-8 (Except Sportwagons)

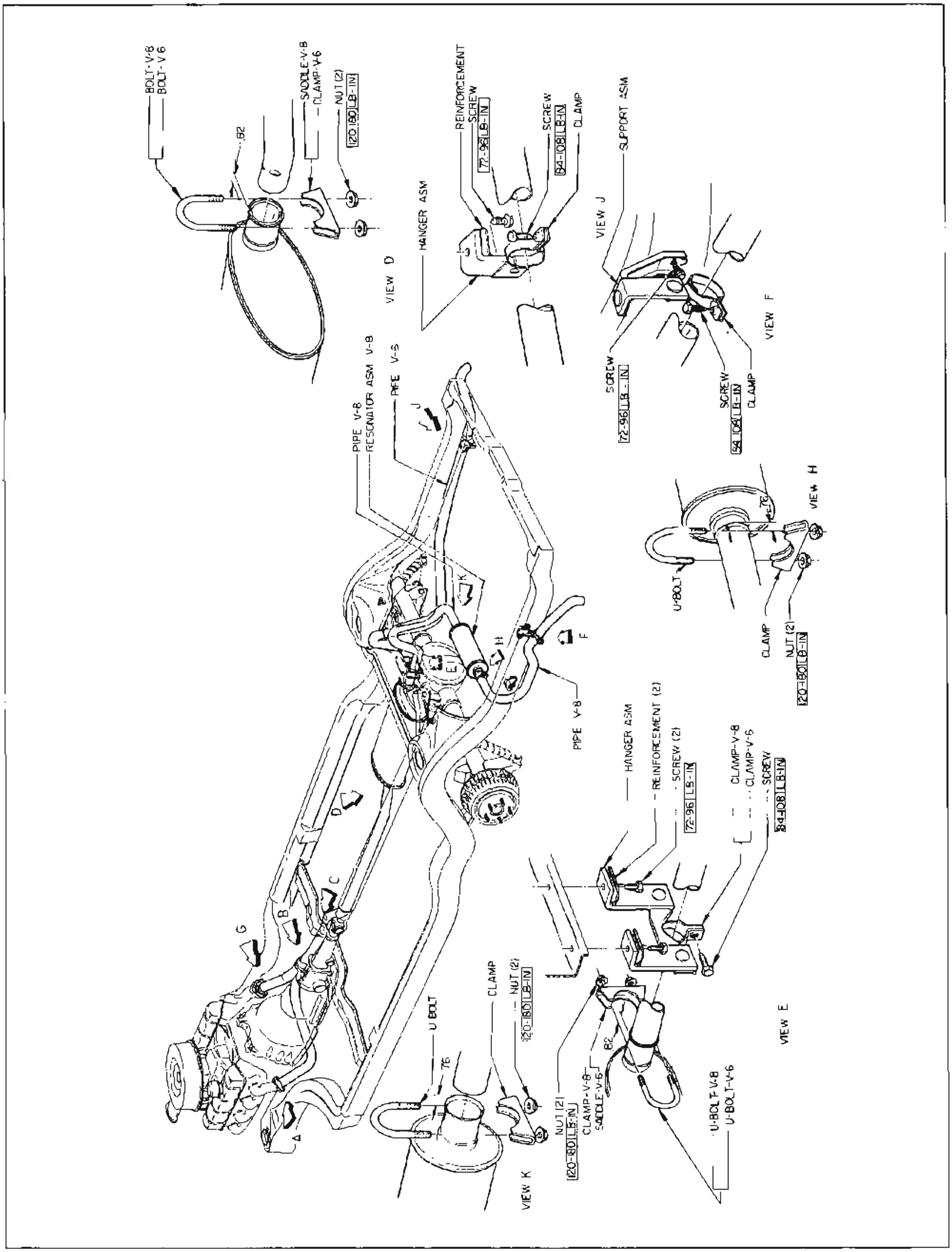



Figure 3-12—Single Exhaust System - Sportwagons

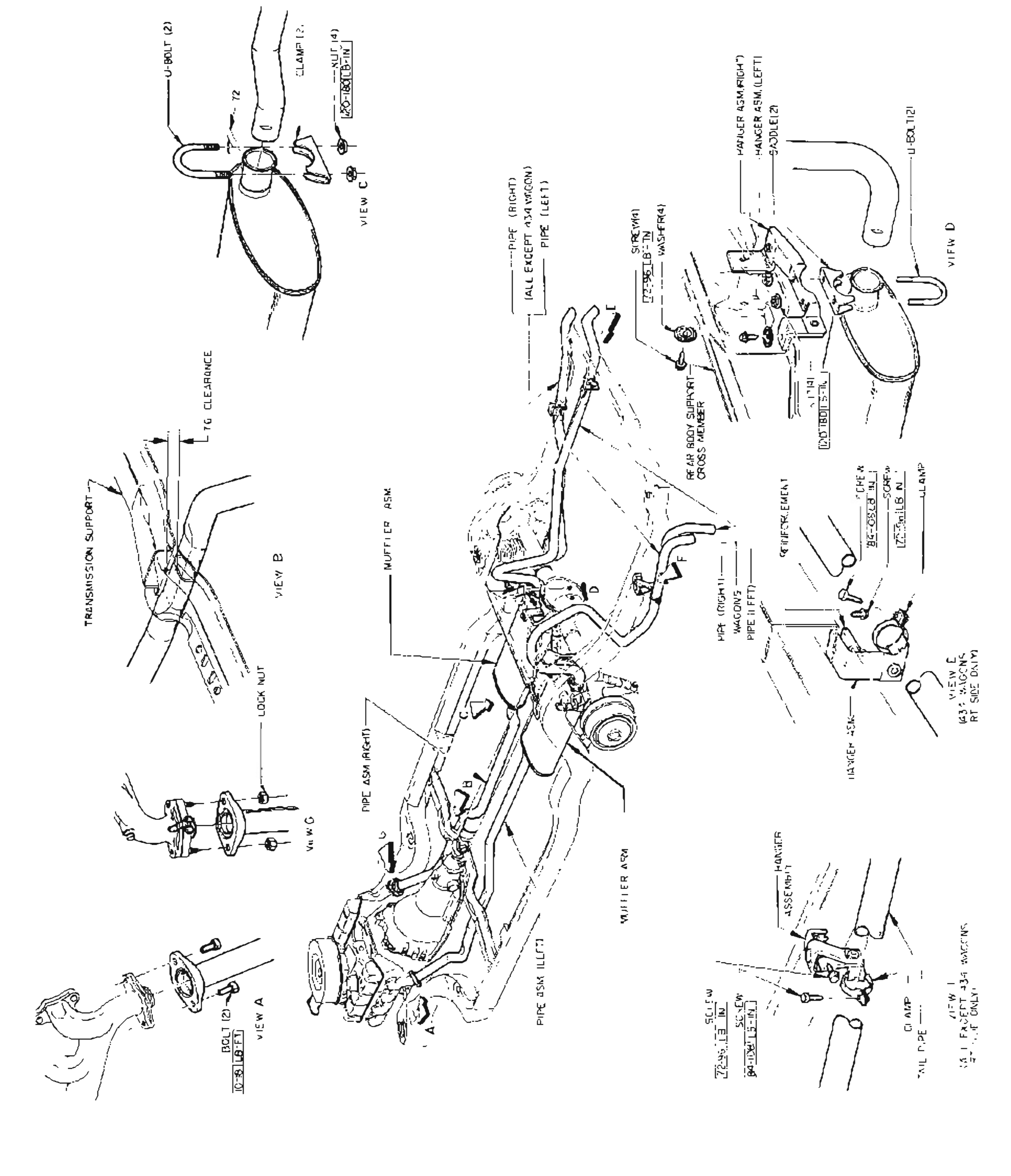



Figure 3-13—Dual Exhaust System - V-8 (Except Sportwagons)

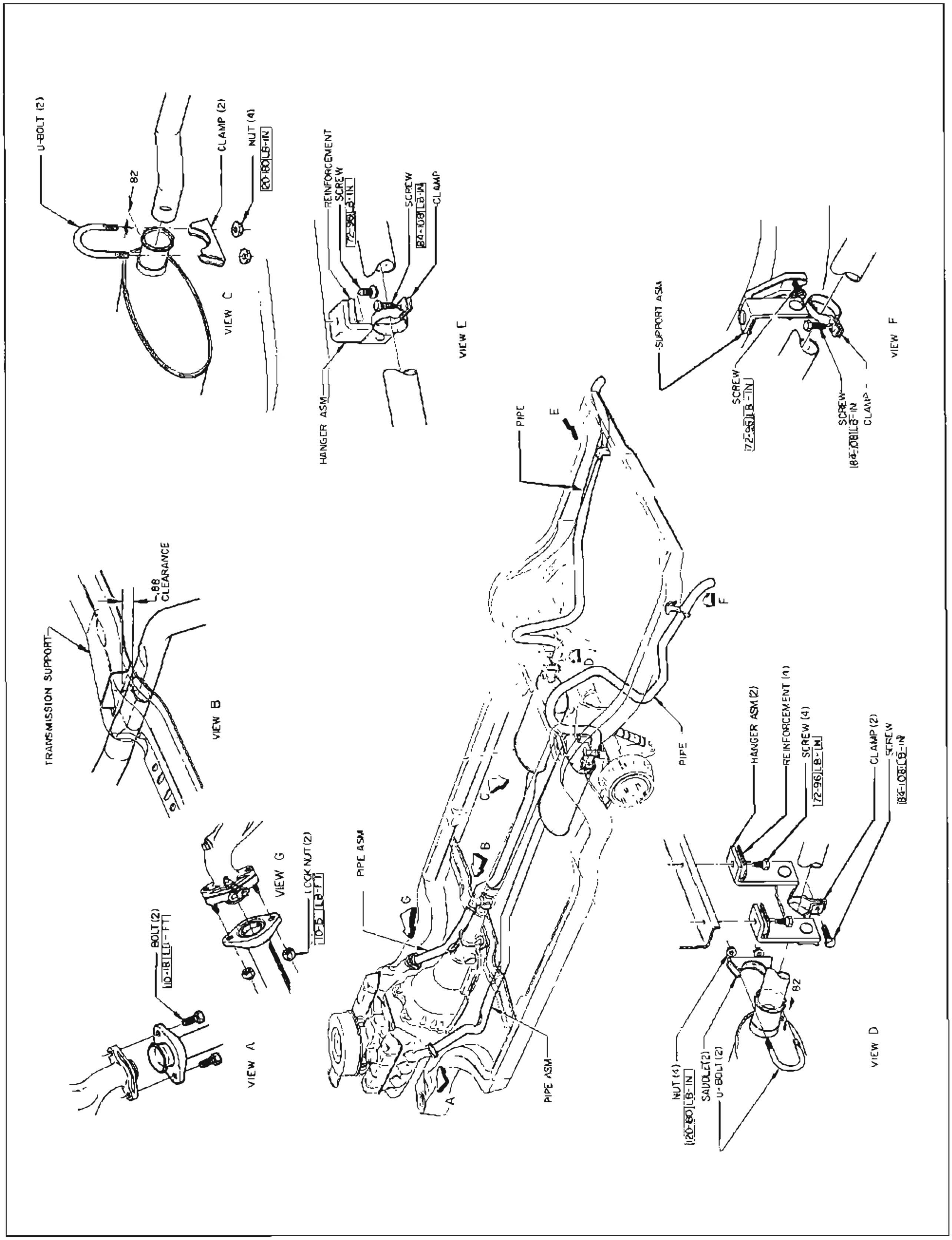



Figure 3-14—Dual Exhaust System - Sportwagons

# SECTION 3-B
# FUEL SYSTEM TROUBLE DIAGNOSIS

## CONTENTS OF SECTION 3-B



## 3-4 HARD STARTING

### a. Improper Starting Technique

Hard starting may be due to improper starting technique. If possible, observe the owner's method of starting; if not correct, suggest that he use the following procedure.

1. Automatic Transmission. Place control lever in "P" or "N" position. Starter cannot be operated in any other position.

Synchromesh Transmission. Place control lever in neutral and depress clutch pedal to floor.

2. Engine Cold. Depress accelerator pedal to floor once and release. This presets the automatic choke and throttle.

Engine Warm. Hold accelerator pedal about 1/3 down.

3. Turn ignition switch to "START" and release when engine starts. As soon as the engine is running smoothly, "jab" the accelerator pedal to slow the engine down to warm-up speed.

If the engine is warm, but fails to restart promptly, there may be an excess of fuel or "flooding". (This is more likely to occur at low temperatures.)

Flooding. Hold the accelerator pedal to the floor (fully depressed) while cranking the engine; this opens the choke to "unload" any excess fuel. When the engine fires, do not immediately release the accelerator pedal, but hold it down until the engine races a little.

If the engine has not been started for several days, most of the fuel will have evaporated from the carburetor. Pumping the accelerator pedal, while cranking, will pump fuel directly into the engine which will hasten the start.

### b. Improper Ignition

Before attempting any correction in fuel system make certain that the battery and ignition system are in proper condition. See paragraph 10-13 and 10-33.

### c. Improper Adjustment of Fast Idle Cam or Choke Unloader

An incorrectly adjusted fast idle cam may not provide sufficient throttle opening and stalling will result.

If the choke unloader goes into action too soon it may cause hard starting when engine is cold. If choke unloader goes into action too late or not at all, it may cause hard starting when engine is flooded. See paragraph 3-18.

### d. No Fuel at Carburetor

No fuel may be delivered to carburetor due to empty gasoline tank or stoppages in filters, strainers or feed hoses, or inoperative fuel pump. Test fuel supply as described in paragraph 3-12.

### e. Improper Carburetor Adjustment

Improper setting of carburetor idle needle valves may cause stalling after starting. A high fuel level in float bowl will cause flooding and consequent hard starting. Adjust carburetor (par. 3-8).

### f. Low Grade Gasoline

Low grade gasoline is usually insufficiently volatile to provide easy starting in cold weather even though it may perform reasonably well after the engine is started and warmed up. A change to higher grade gasoline is the only remedy.

### g. Volatile Gasoline

In some parts of the country, gasolines are marketed which are very volatile and generally advertised as "easy starting gasolines." Some of these fuels are so volatile they boil (commonly referred to as "percolation") in a carburetor bowl which is only normally warm, especially when the engine is shut off following a run. This overloads the manifold, resulting in an over rich mixture which may cause "delayed" starting.

Such gasolines are not necessary in a Buick since the automatic choke has been designed and calibrated to provide easy and positive starting with fuels of ordinary volatility, but if the owner wishes to use volatile gasolines the automatic choke thermostat should be adjusted for a "lean" setting (par. 3-8).

## 3-5 IMPROPER ENGINE PERFORMANCE

### a. Engine Idles Too Fast

A cold engine should operate on fast idle for two to five minutes depending on air temperature. At 32°F. the fast idle cam should move to slow idle position in approximately 1/2 to 3/4 mile of driving. At higher temperatures it should move to slow idle position in a correspondingly shorter distance.

If the engine operates too long on the fast idle cam, check the choke thermostat setting (par. 3-8) and the fast idle cam adjustment. See paragraphs 3-17 and 3-21.

If the engine idles faster than the specified idle speed when off the fast idle cam, check throttle linkage for binding or weak return spring and adjust throttle stop screw (par. 3-8). This trouble can also be caused by a sticking choke.

### b. Improper Idle and Low Speed Performance

Rough idling and tendency to stall may be caused by idling speed set below the specified idle speed. Idle mixture may be wrong due to improper needle valve adjustment (par 3-8).

Rough idling, poor performance, and back firing at low speeds frequently originates in improper ignition. Check ignition system (par. 10-33).

High fuel pump pressure will cause rough idling and poor low speed performance (par. 3-12).

An intake manifold air leak will cause rough idling and poor low speed performance. A manifold air leak produces a low, erratic reading on a vacuum gauge connected to the intake manifold.

Check for leaks at all pipe connections and check manifold joints with gasoline.

When rough idling and poor low speed performance cannot be corrected by checks of carburetion and ignition mentioned above, check cylinder compression.

Improper performance which is most noticeable at low speeds may be caused by sticking valves. Sticking valves may be caused by the use of low grade fuel or fuel that has been in storage too long. When a car is stored for any length of time, fuel should be drained from the tank, feed hoses, fuel pump, and carburetor in order to avoid gum formation.

### c. Improper High Speed Operation

Roughness or poor performance above 22 MPH indicates faulty ignition (par. 10-33) or improper settings in the high speed circuit of carburetor. Surging at high speed may be caused by low fuel pump pressure (par. 3-12).

Surging at 75 to 80 MPH constant speed indicates that the power jet is stopped up or the vacuum piston is sticking.

If there is lack of power at top speed, check throttle linkage to insure full throttle valve opening (par. 3-9).

### d. Excessive Detonation or Spark Knock

Light detonation may occur when operating a synchromesh car in high gear with full throttle between 14 and 22 MPH, or when operating an automatic transmission car in Drive with full throttle at low speed even when ignition timing is correct and proper fuel is used. This light detonation is normal and no attempt should be made to eliminate it by retarding the ignition timing, which would reduce economy and over-all performance.

Heavy detonation may be caused by improper ignition timing (par. 10-35), improper grade of fuel, or by an accumulation of carbon in combustion chambers.

Heavy detonation is injurious to any automotive engine. A car driven continuously under conditions and fuels which produce heavy detonation will overheat and lose power, with the possibility of damage to pistons and bearings.

## 3-6 EXCESSIVE FUEL CONSUMPTION

Complaints of excessive fuel consumption require a careful investigation of owner driving habits and operating conditions as well as the mechanical condtions of the engine and fuel system; otherwise, much useless work may be done in an attempt to increase fuel economy.

Driving habits which seriously affect fuel economy are: high speed driving, frequent and rapid acceleration, driving too long in a low speed range when getting under way, excessive idling while standing.

Operating conditions which adversely affect fuel economy are: excessive acceleration, frequent starts and stops, congested traffic, poor roads, hills and mountains, high winds, low tire pressures.

High speed is the greatest contributor to low gas mileage. Air resistance increases as the square of the speed. For instance, a car going sixty miles an hour must overcome air resistance four times as great as when going thirty miles an hour. At eighty miles an hour the resistance is over seven times as great as when going thirty miles an hour.

Over seventy-five per cent of the power required to drive a car eighty miles an hour is used in overcoming air resistance, while at thirty miles an hour only thirty per cent of the power required is used to overcome air resistance.

Gas mileage records made by car owners never give a true picture of the efficiency of the engine fuel system since they include the effects of driving habits and operating conditions. Because of the wide variation in these conditions, it is impossible to give average mileage figures for cars in general use; therefore, any investigation of a mileage complaint must be based on an accurate measurement of gasoline consumption per mile under proper test conditions.

**a. Gasoline Mileage Test**

A gas mileage test should be made with a 1/10th gallon gauge on a reasonably level road, at fixed speeds, without acceleration or deceleration. Test runs should be made in both directions over the same stretch of road to average the effect of grades and wind resistance. Test runs made at 20, 40 and 60 MPH will indicate the approximate efficiency of the low speed, high speed, and power systems of the carburetor and show whether fuel consumption is actually abnormal. If a mileage test indicates that the fuel consumption is above normal, check the following items:

1. Fuel Leaks. Check all gasoline hose connections, fuel pump, gasoline filter, and carburetor bowl gasket.

2. Tires. Check for low tire pressures (par. 1-1).

3. Brakes. Check for dragging brakes.

4. Ignition Timing--Spark Plugs. Late ignition timing causes loss of power and increases fuel consumption (par. 10-35). Dirty or worn out spark plugs are wasteful of fuel (par. 10-36).

5. Low Grade Gasoline. Use of gasoline of such low grade that ignition timing must be retarded to avoid excessive detonation will give very poor fuel economy.

6. Air Cleaner. Check for dirty or clogged cleaner element (par. 3-7).

7. Automatic Choke. Check for sticking choke valve and improper setting of thermostat (par. 3-8).

8. Valves. Check for sticking valves (par. 2-11).

9. Fuel Pump. Check for excessive fuel pump pressure (par. 3-12).

10. Carburetor Adjustment. Check idle adjustment (par. 3-8). For all other adjustments to high speed and power systems, the carburetors must be removed and disassembled.

**b. Changing Carburetor Calibrations**

Under no circumstances should the jet sizes, metering rods and other calibrations of a carburetor be changed from factory specifications. The calibrations given in paragraph 3-1 must be adhered to unless these are later changed by a bulletin issued from the Buick Factory Service Department.

# SECTION 3-C

# ADJUSTMENTS AND REPLACEMENTS—EXCEPT IN PUMP AND CARBURETOR ASSEMBLIES

## CONTENTS OF SECTION 3-C



## 3-7 AIR CLEANER, FUEL FILTER, MANIFOLD VALVE AND VENTILATOR VALVE SERVICE

### a. Air Cleaner Service

An air cleaner with a dirty element will restrict the air flow to the carburetor and cause a rich mixture at all speeds. The device will not properly remove dirt from the air and the dirt entering the engine will cause abnormal formation of carbon, sticking valves, and wear of piston rings and cylinder bores.

Regular cleaning and inspection of the element at 12,000 mile intervals (or more frequently in dusty territory) is necessary to prevent excessive engine wear and abnormal fuel consumption. The procedure for cleaning the air cleaner is given in paragraph 1-1.

### b. Fuel Filter— V-8 Engines

The fuel filter is a can-type throw-away filter and is located in the line between the fuel pump and the carburetor. See cutaway view in Figure 3-15.

The filter element has a large filtering area. It is of fine enough material to assure that any particles which pass through it are too small to interfere with the operation of the float needle and seat, and also too small to cause clogging of the smallest passages in the carburetor. This element prevents the passage of water under ordinary conditions. The filter should be replaced every 12,000 miles. See paragraph 1-1.

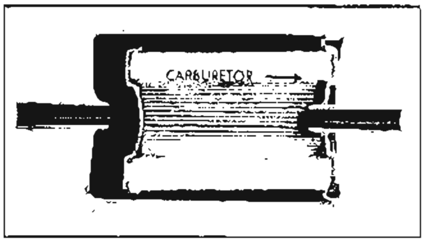



Figure 3-15—Can-Type Throw-Away Fuel Filter

After assembling the fuel filter, always start the engine and observe the filter carefully to make sure that the clamps are not leaking.

### c. Cleaning Fuel Filter— V-6 Engines

In the V-6 engine, the fuel filter is located in the carburetor fuel inlet. See Figure 3-16. When this filter is used, the can-type throw-away filter is omitted.

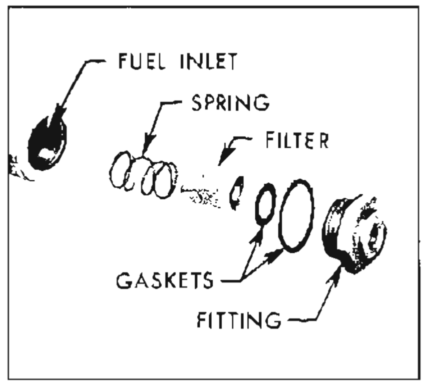



Figure 3-16—Fuel Filter Parts - V-6

The filter element is of sintered bronze, shaped to give the maximum filtering surface. The element is placed in the inlet hole with the cupped end with the center cone outward. The spring holds the element outward, sealing it against the small gasket in the inlet fitting. If the element should ever become plugged, pump pressure is sufficient to depress the spring so that the fuel by-passes the element. Thus, a plugged element, instead of causing the engine to stop running, allows the engine to continue running on unfiltered fuel. When carburetor flooding is encountered, this is an indication that the fuel is by-passing the element; the element should therefore be removed and cleaned.

Every 12,000 miles the filter element should be removed and washed thoroughly in a good cleaning solvent, then blown dry in a reverse direction. If the element does not clean up completely, a new element should be installed.

After assembling the filter element in the carburetor, always start the engine and check for leaks in the fuel line and fittings before installing the air cleaner.

**d. Other Filters of Strainers**

A woven plastic filter is located on the lower end of the fuel pickup pipe in the gas tank. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the gas tank contains an abnormal amount of sediment or water, the tank should therefore be removed and thoroughly cleaned.

Fine mesh strainers are located in the 4-barrel carburetor above each needle and seat. These strainers should seldom require cleaning because of the fuel filter which precedes them in the gasoline supply line. They should be inspected, however, if fuel supply at the carburetor inlet is adequate but carburetor operation indicates lack of fuel.

**e. Freeing Up Sticking Exhaust Manifold Valve**

Lubricate the exhaust manifold flange shaft every 6,000 miles (par. 1-1).

Carbon or lead salt deposits around the valve shaft may cause the valve to stick or become sluggish in operation. A valve sticking in the open position will cause slow engine warm up, excessive spitting and sluggish engine operation when cold. A valve sticking in the closed position will cause overheating, loss of power, and hard starting when the engine is hot, and may also cause warped or cracked manifolds. Sticking in either position will adversely affect fuel economy.

If the manifold heat control valve is sticking or seized in the flange assembly, free it up by applying a good solvent such as "Buick Heat Trap Lubricant" to the valve shaft and bushings at both sides of the flange. Allow the solvent to soak for a few minutes, then work the valve by rotating the counterweight. Severe cases may be freed by tapping endwise on the shaft with a light hammer. After the shaft is free, another application of lubricant will assure complete penetration of the shaft bushings.

**f. Checking Manifold Valve Thermostat Setting**

The setting of the exhaust manifold valve thermostat may be checked when the engine is at room temperature of approximately 70°F. Unhook the outer end of thermostat from anchor stud on the manifold and hold the valve in the closed position. To bring the end of thermostat to the anchor stud will then require approximately 1/2 turn wind-up of the thermostat as shown in Figure 3-17.

The thermostat is not adjustable and should never be distorted or altered in any way as this will affect its calibration. If the thermostat does not have the proper setting, or is damaged, it should be replaced.

**g. Positive Crankcase Ventilator System Service**

All cars have a positive crankcase ventilating system to help reduce air pollution and to provide more complete scavenging of crankcase impurities. Ventilation air is drawn in through the

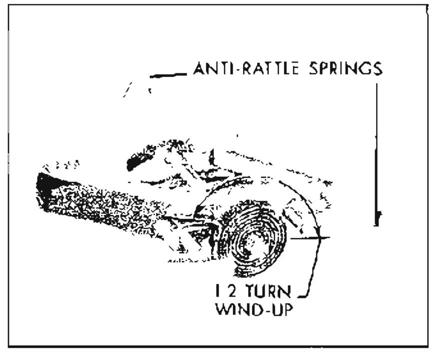



Figure 3-17—Manifold Valve Thermostat Wind-Up

filter in the filler cap on the left rocker arm cover, down into the crankcase, across and up into the right rocker arm cover, up through the ventilator valve, through a hose, into the carburetor throttle body and into the intake manifold. Intake manifold vacuum draws any fumes from the crankcase to be burned in the engine. See Figure 3-18.

When air flow through the carburetor is high, added air from the positive crankcase ventilating system has no noticeable effect on engine operation; however, at idle speed, air flow through the carburetor is so low that any large amount added by the ventilating system would upset the air-fuel mixture, causing rough idle. For this reason, a flow control valve is used which restricts the ventilating system flow whenever intake manifold vacuum is high.

After a period of operation, the ventilator valve tends to become clogged, which reduces and finally stops all crankcase ventilation. An engine which is operated without any crankcase ventilation can be damaged seriously. Therefore, it is important to replace the ventilator valve periodically (each 12,000 miles).

CAUTION: If an engine is idling too slow or rough, this may be caused by a clogged ventilator valve; therefore, never adjust the carburetor idle without first checking the crankcase ventilator check valve.

With the crankcase ventilator system operating normally, about 1/4 of the air used in the idle mixture is supplied through the ventilator valve. Therefore, if the ventilator air is shut off, the idle speed will be noticeably slower. Check operation of the ventilator system as follows:

1. Connect a reliable tachometer and adjust idle as specified.

2. Squeeze-off crankcase ventilator hose to stop all air flow.

3. If idle speed drops 60 RPM or more, crankcase ventilator system is okay.

4. If idle speed drops less than 60 RPM, ventilator system is probably partially clogged; install a new ventilator valve and re-check operation of system as described above.

5. After installing a new ventilator valve, always readjust engine idle.

### h. Closed Positive Crankcase Ventilator System

All cars manufactured for registration in California are required to have a closed positive crankcase ventilating system. The closed PCV system consists of the standard PCV system plus additional features as shown in Figure 3-18.

To review briefly, the standard PCV system draws air in through the mesh of the oil filler cap, down across the crankcase, up through the PCV valve and through a hose into the intake manifold.

The closed PCV system operates in the same manner except that the ventilating air is drawn in from the air cleaner, down through a rubber tube, through a mesh filled breather assembly and into the left rocker arm cover. The oil filler cap is sealed air tight in the closed PCV system. See Figure 3-19.

With the standard PCV system any blow-by in excess of the system capacity (from a badly worn engine, sustained heavy load, etc.) is exhausted to the atmosphere through the oil filler cap. In the closed PCV system any such blow-by is exhausted into the air cleaner and is drawn into the engine.

Maintenance of the closed PCV system is essentially the same as the standard PCV system with one exception, instead of cleaning the oil filler cap at 12,000 mile intervals (more often under dusty operating conditions), it is the breather assembly that will be cleaned.

## 3-8 CARBURETOR IDLE AND AUTOMATIC CHOKE ADJUSTMENTS

Carburetor adjustment should not be attempted until it is known that ignition and compression are in good order. Any attempt to adjust or alter the carburetor to compensate for faulty conditions elsewhere will result in reduced fuel economy and overall performance.

### a. Idle Speed and Mixture Adjustments

The positive crankcase ventilator valve should be checked as described in paragraph 3-7 before making carburetor adjustments, as this valve noticeably affects the air-fuel ratio at idle.

1. Remove air cleaner with V-8 engine. With V-6 engine, a much better idle adjustment can be obtained with air cleaner in place. Connect a tachometer from distributor terminal of coil to ground.

2. Start engine and run it at fast idle until upper radiator tank is hot and choke valve is wide open.

CAUTION: Idle speed and mixture adjustments cannot be made satisfactorily with an abnormally hot engine. On any carburetor with a hot idle compensating valve, it is particularly important that idle adjustments be made at normal temperature so that this valve will be closed.

3. On automatic transmission cars, place a block in front of a front wheel and apply parking brake firmly, then shift transmission into drive.

4. Adjust throttle stop screw to set idle speed at 550 RPM (add 50 RPM for an air conditioner).

5. Adjust idle mixture needles alternately to obtain highest tachometer reading. Readjust idle speed as necessary, always adjusting idle mixture last.

6. Make sure idle stator switch is closed by disconnecting switch connector. If idle speed does not decrease, switch was not closed; adjust idle stator switch (see par. 5-8), then readjust idle speed to specifications.

7. If carburetor is equipped with a hot idle compensating valve, press a finger on valve to make sure it was closed. If idle speed drops, valve was open, readjust idle speed and mixture, making sure valve remains closed.

### b. Automatic Choke Adjustments

The choke thermostat is calibrated to give satisfactory performance with regular blends of

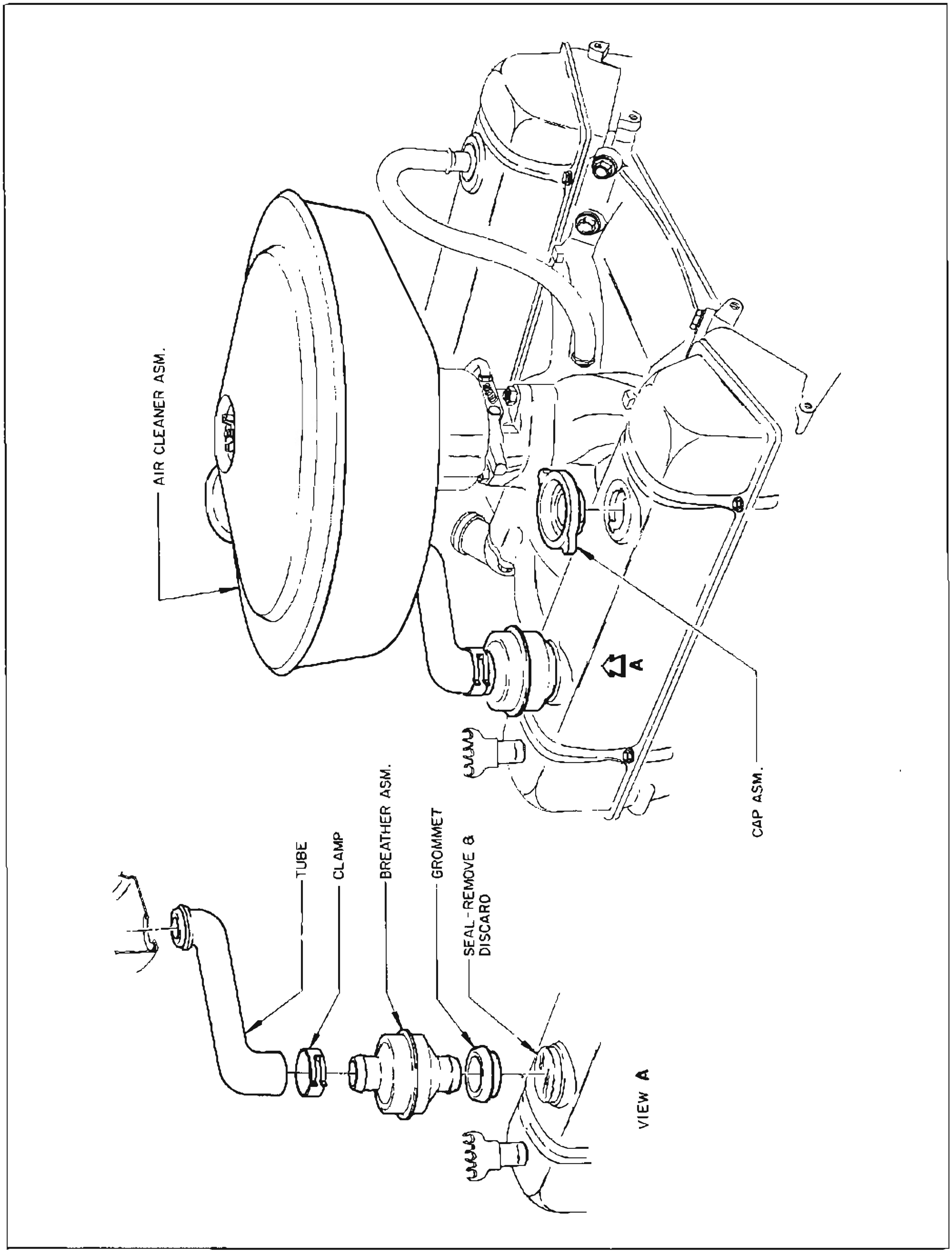



Figure 3-18—Closed Positive Crankcase Ventilation System - V-6

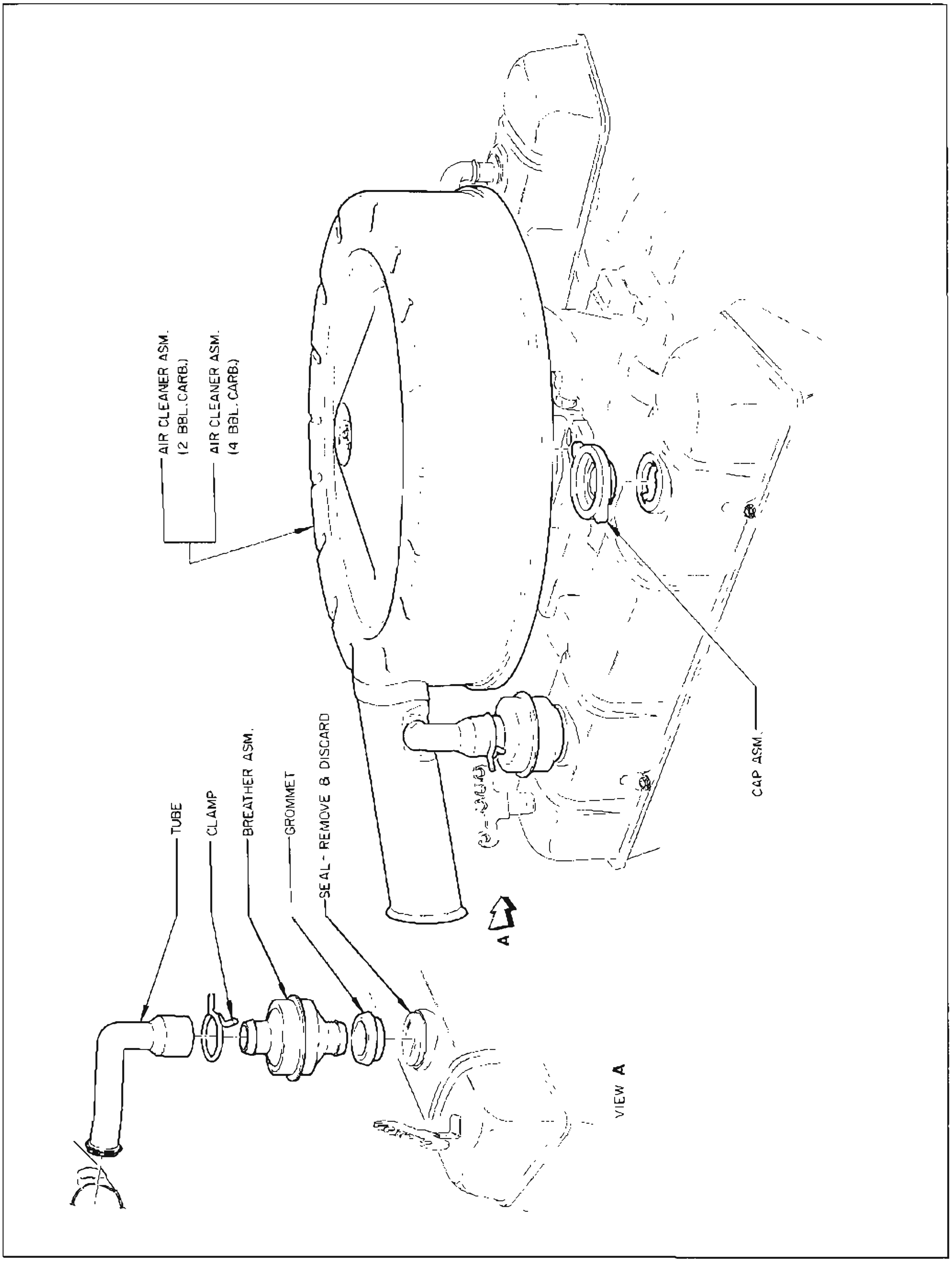



Figure 3-19—Closed Positive Crankcase Ventilation System - V-8

fuel when it is placed at the standard factory setting, which is listed in the specifications for each carburetor.

When it is necessary to adjust the thermostat loosen the housing or cover attaching screws, and turn as required.

Thermostat settings other than standard should be used only when the car is habitually operated on special blends of fuel which do not give satisfactory warm-up performance with the standard setting. A "Lean" setting may be required with highly volatile fuel which produces excessive loading or rolling of engine on warm-up with the standard thermostat setting. A "Rich" setting should be used only when excessive spitting occurs on engine warm-up with the standard thermostat setting. When making either a "Lean" or "Rich" setting, change one point at a time and test results with engine cold, until the desired performance is obtained.

If the engine operates on fast idle too long after starting or else moves to slow idle too soon, or the choke unloader does not operate properly, check the fast idle and choke unloader adjustments.

## 3-9 THROTTLE LINKAGE AND DASHPOT ADJUSTMENTS

The procedure for adjusting throttle linkage is identical on synchromesh and automatic transmission cars. Automatic transmission cars, however, have a dash pot which delays the closing action of the throttle to reduce any possibility of the engine stalling.

### a. Throttle Linkage Adjustments

1. Remove air cleaner. Check throttle linkage for proper lubrication. Make sure that linkage is free in all positions and that nothing touches or interferes with the linkage. Hold choke open and make sure that return spring fully closes throttle, even though throttle is released very slowly.

2. Adjust engine idle speed and mixture. See paragraph 3-8. With throttle linkage in hot curb idle position, measurement from throttle rod clevis pin horizontally to dash must be 4-1/2 inches ± 1/4 inch. If measurement is off, shorten or lengthen throttle operating rod as required to correct. See Figure 3-20.

3. Operate linkage to open carburetor and make sure carburetor wide open stop is contacting. If carburetor does not reach wide open position and nothing is interfering with throttle linkage, transmission stator and detent switch

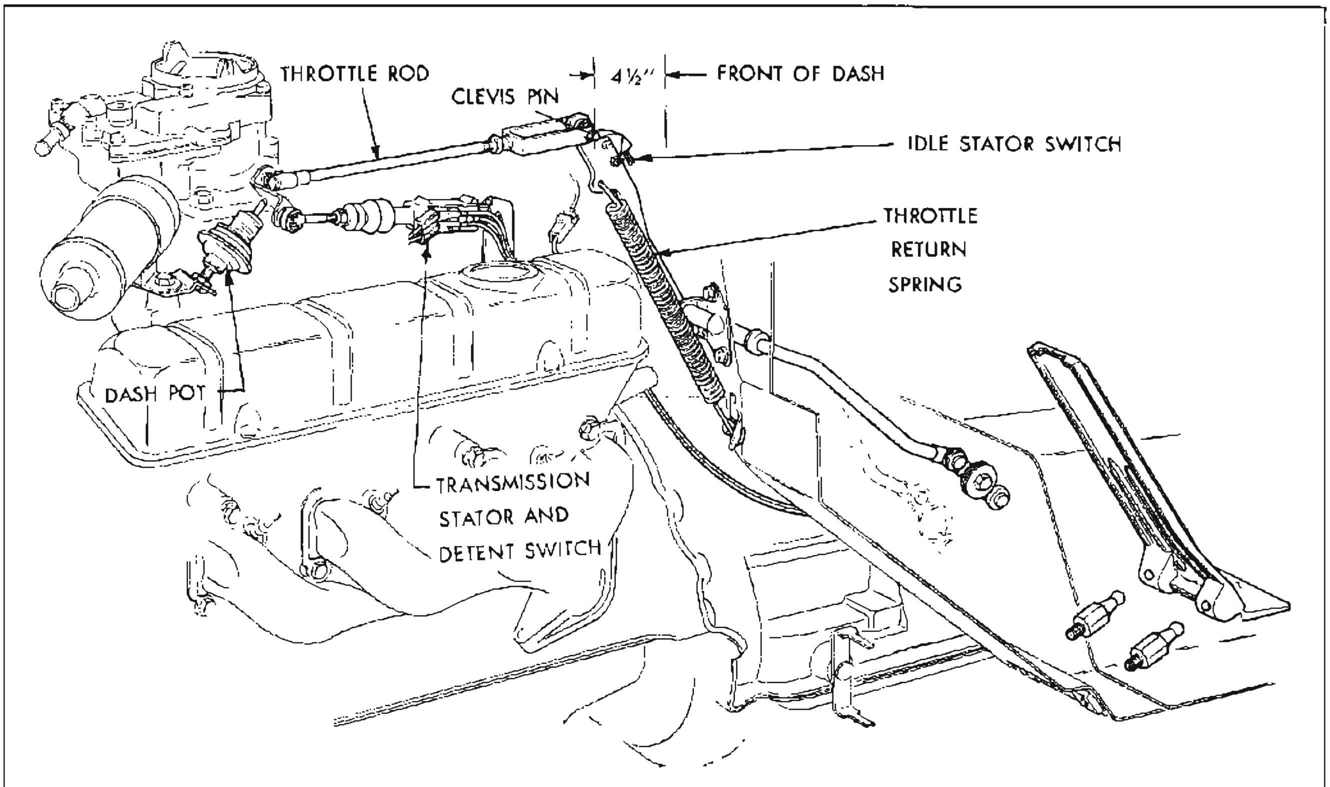



Figure 3-20—Throttle Linkage Adjustment

must be adjusted as described in paragraph 5-8.

4. As a final check, have a helper depress accelerator pedal and check to make sure wide open stop contacts at carburetor.

### b. Dash Pot Adjustment

Adjust the dash pot with the engine at normal operating temperature and with idle speed and mixture correctly adjusted.

1. While observing dash pot, open carburetor and allow throttle to snap closed. If dash pot does not delay closing action just before throttle is closed, adjust dash pot for more interference. If return to idle drags out excessively (more than 2 seconds), adjust dash pot for less interference.

2. As a final check, hold car with brakes and put transmission in drive, then jab accelerator pedal. If car stalls, adjust dash pot for slightly more interference and recheck as necessary.

3. Tighten lock nut securely.

## 3-10 REPLACEMENT OF GASOLINE TANK OR FILLER

The gas gauge tank unit is combined with the feed pipe. It is not necessary to lower the gas tank to replace this unit. See Figures 3-1 and 3-2. On air conditioner equipped cars, a vapor return pipe is also part of this assembly.

Before condemning a gas gauge tank unit, make sure that all dirt is cleaned from around the terminal; also make sure that the wire is securely fastened to the terminal and that the insulating cover is in place. An accumulation of road dirt around the gauge terminal may permit an electrical leak that will affect the accuracy of the gauge.

To remove a gasoline tank, first syphon the gas into a clean container. Remove the vent pipe, hoses and clips. Disconnect the vent hose from the breather pipe. Pull the wire to the gas gauge tank unit apart at the connector. Disconnect the support straps at their rear ends and remove the tank.

To install a gasoline tank, reverse the above procedure used for removal. Make sure that the wire to the gas gauge tank unit is clipped to the top of the tank.

# SECTION 3-D
# FUEL PUMP

### CONTENTS OF SECTION 3-D



## 3-11 DESCRIPTION AND OPERATION OF TYPE JU FUEL PUMP

### a. Description of Pump

An AC Type JU fuel pump is used on all engines. The pump assembly is mounted on the right side of the timing chain cover in an inverted position, and the pump rocker arm is actuated by an eccentric mounted on front side of the camshaft sprocket.

The fuel pump has a built-in air dome with a diaphragm to dampen out pulsations in the fuel stream on the pressure side. It is a diaphragm type pump and is actuated by the rocker arm through a pull rod. See Figure 3-21.

### b. Operation of Fuel Pump

The fuel pump draws gasoline from the tank and supplies it to

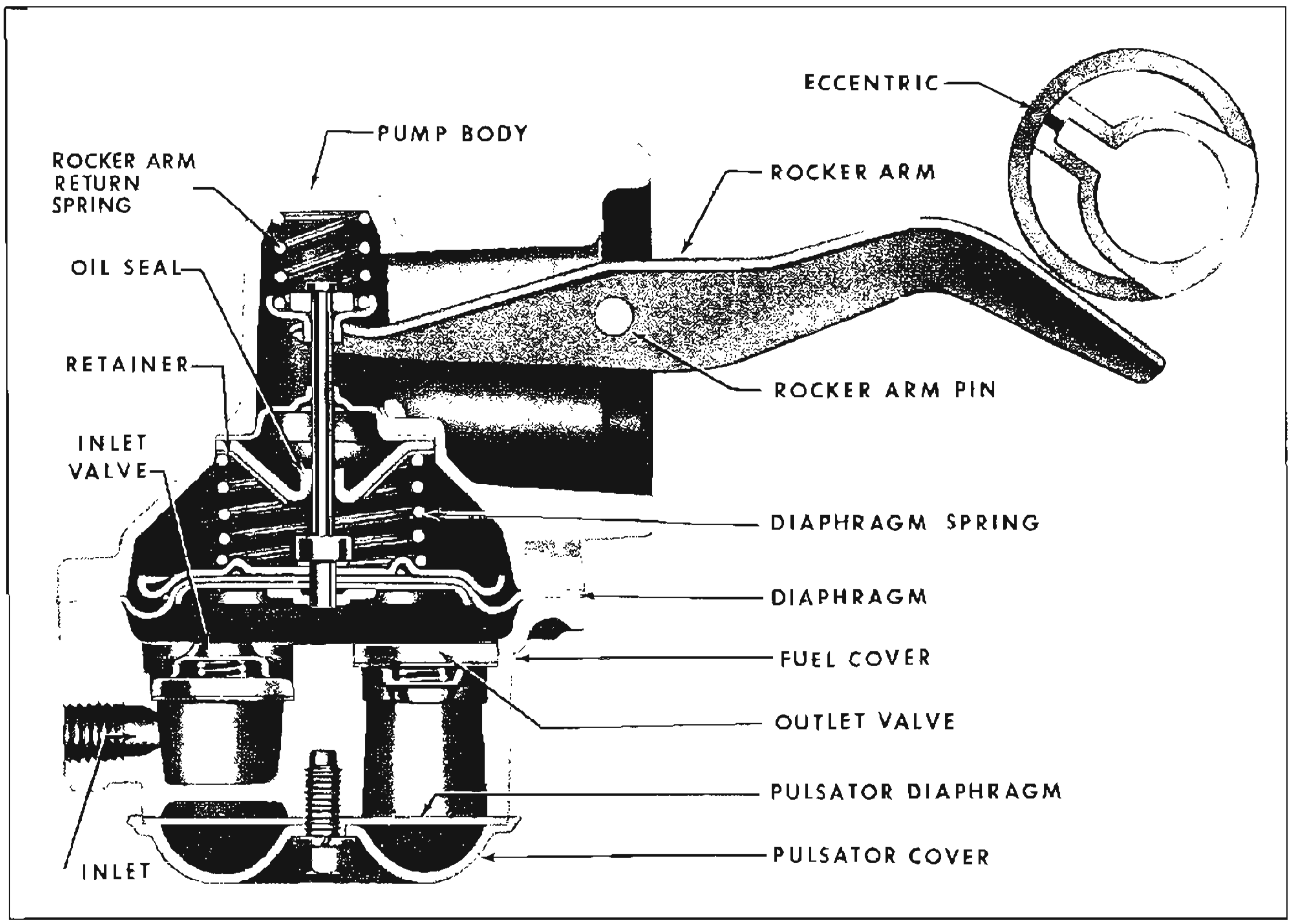



Figure 3-21—Type JU Fuel Pump

the carburetor in sufficient quantity to meet engine requirements under all operating conditions.

The principle parts of the fuel pump are shown in Figure 3-21.

The rocker arm return spring holds the rocker arm in constant contact with the eccentric on the engine camshaft sprocket so that the rocker arm swings up and down as the camshaft rotates. As the outer part of the arm swings downward, the inner part swings upward, thereby pulling the fuel diaphragm upward by means of the connecting pull rod.

Upward movement of the fuel diaphragm compresses the diaphragm spring and also creates a vacuum in the fuel chamber under the diaphragm. The vacuum causes the outlet valve to close and causes fuel from the gasoline tank to enter the fuel chamber through the inlet valve.

As the rotating eccentric permits the outer part of the rocker arm to swing upward, the inner part of the arm releases the diaphragm pull rod. The compressed diaphragm spring then exerts pressure on the diaphragm and the fuel in the chamber below diaphragm. This pressure closes the inlet valve and forces fuel out through the outlet valve to the carburetor.

Since the fuel 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. This condition arises when the carburetor float needle valve is not seated and the fuel passage from the pump into the carburetor float chamber is open. When the needle valve is closed and held in place by the pressure of the fuel on the float, the pump builds up pressure in fuel chamber until it overcomes the pressure of the diaphragm spring. This pressure results in almost complete stoppage of diaphragm movement until more fuel is needed.

The air dome with diaphragm in the bottom of fuel pump provides a pocket in which fuel under pressure can compress a certain volume of air. When the pressure is relieved (pump on suction stroke) the pocket of compressed air pushes the fuel on to its destination. The air dome minimizes flow variations experienced with two-cycle pump stroke and increases the pump output.

## 3-12 FUEL PUMP INSPECTION AND TEST

If the fuel pump is suspected of delivering an improper amount of fuel to the carburetor, it should be inspected and tested on the engine, as follows:

1. Make certain that there is gasoline in the tank.

2. Clean the gasoline filter (par. 3-7).

3. With engine running, inspect for leaks at all gasoline feed hose connections. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. Air leaks or restrictions on suction side of fuel pump will seriously affect pump output.

4. Inspect for leaks at fuel pump diaphragm flange. Tighten the cover screws alternately and securely. Do not use shellac or any other adhesive on diaphragm.

5. Disconnect feed hose at carburetor. Ground distributor terminal of coil with jumper wire so that engine can be cranked without firing. Place suitable container at end of hose and crank engine a few revolutions. If no gasoline, or only a little, flows from hose, the feed hoses are clogged or fuel pump is inoperative. Before condemning the fuel pump, disconnect feed hoses at pump and blow through them with air hose to make sure that they are clear.

6. If gasoline flows in good volume from hose at carburetor it may be assumed that the fuel pump and feed hoses are okay; however, it is advisable to make the following "static pressure" test to make certain that fuel pump is operating within specified pressure limits.

7. Attach a suitable pressure gauge to the disconnected end of gasoline hose at carburetor height. Run engine at idle on gasoline in carburetor bowl and note reading on pressure gauge.

8. If fuel pump is operating properly the pressure will be 4 to 5-1/4 pounds. If pressure is too low or too high, the pump should be removed for repairs (par. 3-13).

NOTE: If pressure gauge is at pump height instead of at carburetor height, the pressure should be 1/2 pound higher.

## 3-13 FUEL PUMP REPAIRS

There is a repair kit available consisting of all moving and wearing parts except the rocker arm. However, if a casting is damaged or the rocker arm is badly worn, it is advisable to replace the pump rather than attempt repairing it.

After removal of pump from engine and before disassembly is started, plug all openings and thoroughly wash exterior of pump with cleaning solvent to remove all dirt and grease.

### a. Removal of Valves

1. Mark edges of fuel cover and pump body with file so that cover may be reinstalled in its original position on body.

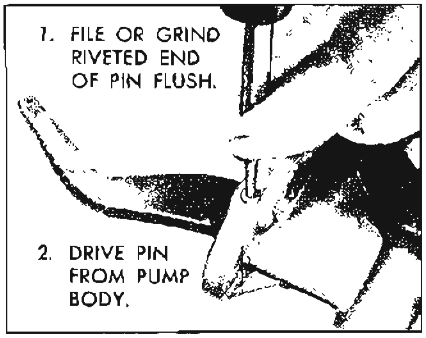



Figure 3-22—Removing Rocker Arm Pin

2. Remove all fuel cover screws and separate cover from pump body. If cover sticks to body, rap with soft mallet--do not pry between parts with a screwdriver.

3. Remove pulsator cover and diaphragm from fuel cover. Scrape out burrs produced by staking valves and drive both valves and gaskets from cover.

**b. Removal of Rocker Arm and Diaphragm Assembly**

1. File or grind riveted end of rocker arm pin flush with steel washer, or cut off end with a 3/8" drill. Then drive pin out with a drift punch and hammer. See Figure 3-22.

2. Remove rocker arm, diaphragm assembly, and rocker arm return spring from pump body.

**c. Inspection of Pump Parts**

1. Clean and rinse all parts to be reused in solvent. Blow out all passages with air hose.

2. Inspect pump body and fuel cover for cracks, breakage, or distorted flanges. Examine screw holes for stripped or crossed threads.

3. Inspect rocker arm for wear at pad. Check for excessive rocker arm side-play due to wear on rocker arm pin.

4. If a damaged casting or a badly worn rocker arm is found, it is advisable to discard old parts and install a new fuel pump.

**d. Assembly of Fuel Pump**

When overhauling pump, always use all new parts in kit as amount of wear of these parts cannot be determined visually.

1. Install rocker arm return spring and diaphragm assembly in pump body.

2. Align rocker arm hole with pump body hole. Drive new rocker arm pin through body and rocker arm. Install new steel washer over small end of rocker arm pin, support head of pin on a suitable steel block, and peen small end of pin to retain washer and pin in place.

3. Place a new gasket in each valve seat in fuel cover. Place valve in seat nearest "IN" connector with spring cage facing up. Place other valve in outlet valve seat with spring cage down. See Figure 3-23.

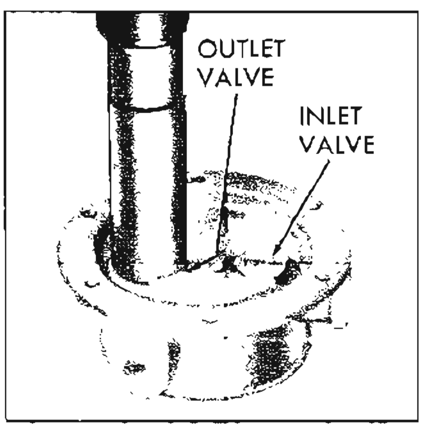



Figure 3-23—Installing Valves in Fuel Cover

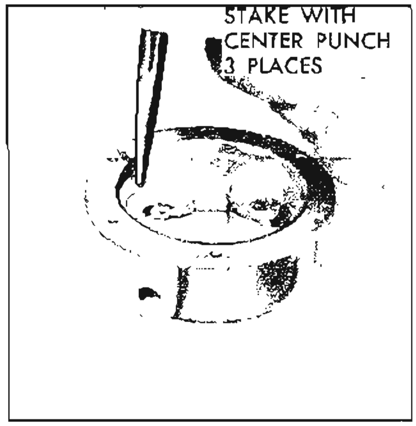



Figure 3-24—Staking Valves in Fuel Cover

4. Seat valves firmly against gaskets and stake cover in three places around edge of each valve. See Figure 3-24.

5. Install new pulsator diaphragm and cover on fuel cover and tighten screws securely.

6. Place fuel cover in position so that file marks on cover and pump body are in line and install all cover screws and lock washers until screws just engage lock washers. Be sure that screws pass through holes in diaphragm without chewing fabric.

7. Tighten screws alternately and evenly until all screws are tight.

**e. Testing Repaired Fuel Pump**

Bench tests of the fuel pump require equipment which is not available in most service organizations; therefore, tests must be made after installation of the pump on an engine. Test the fuel pump as described in paragraph 3-12.

# SECTION 3-E
# ROCHESTER 2-BARREL CARBURETOR

## CONTENTS OF SECTION 3-E



## 3-14 DESCRIPTION AND OPERATION OF ROCHESTER 2-BARREL CARBURETOR

### a. General Description

The Rochester Model 2GC carburetor is of the side bowl design. While not interchangeable, the carburetors used on automatic and standard transmission cars are basically the same, and the description and service operations are identical. The only difference is in some of the internal calibrations. The carburetor float bowl is located forward of the main bores of the carburetor. The carburetor is compact in design in that all of the fuel metering is centrally located. See Figure 3-25.

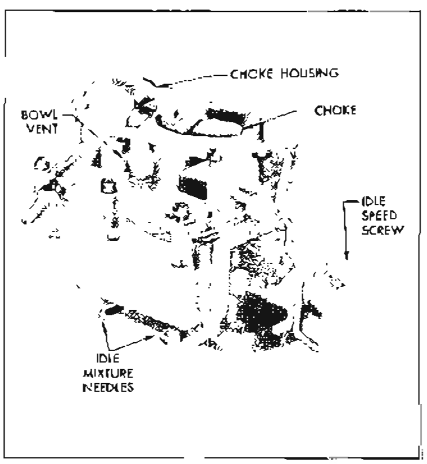



Figure 3-25—Rochester 2GC Carburetor Assembly-300 Engine

This carburetor uses a calibrated cluster design, which places in a removable assembly, the main well tubes, idle tubes, mixture passages, air bleeds and pump jets. This cluster can easily be removed for cleaning and inspection purposes. The cluster fits on a flat portion of the carburetor bowl in front of the main venturi with a gasket underneath. See Figure 3-26. The idle and main well tubes are permanently installed in the cluster body by means of a precision pressed fit and, therefore, cannot be serviced separately. The main nozzles and idle tubes are suspended in the float in the main wells of the float bowl.

The main metering jets are of the fixed type. Metering calibration is accomplished through a system of calibrated air bleeds which give the correct air/fuel mixtures throughout all operational ranges.

The Rochester Model 2GC carburetor employs the use of a vacuum operated power system for extra power when needed. Power mixtures are regulated by drop in engine manifold vacuum regardless of the degree of throttle opening. Thereby, additional fuel can be supplied for power mixtures according to the engine demands.

The pump system has a vented type pump plunger. This is accomplished by means of a vapor vent ball in the pump plunger

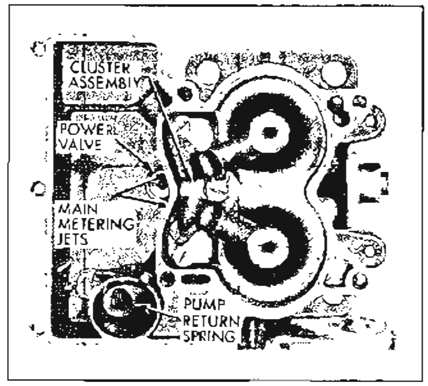



Figure 3-26—Main Body Parts

head. By venting the pump plunger, any fuel vapors which form in the pump well are vented to the fuel bowl during "hot" engine operation. This insures that the pump well and passages will be primed with solid fuel at all times, thereby improving accelerator pump action.

The carburetor is internally vented through a hole in the air horn and is externally vented through a capped vent hole located in the center of the carburetor air horn just above the float bowl.

Adjustments have been made as simple as possible. They consist of idle, float level, float drop, pump, fast idle, choke, choke rod and choke unloader adjustments only.

Incorporated in the Rochester Model 2GC carburetor are six basic systems. They are Float,

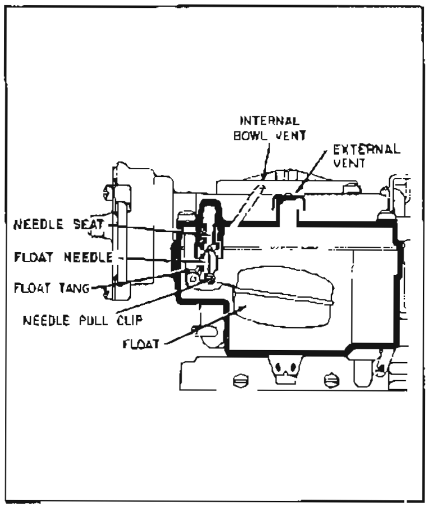



Figure 3-27—Float System

Low Speed, Main Metering, Power, Accelerating and Choke systems. The following explanation and illustrations show that each system operates to provide efficient carburetion through all operating conditions.

**b. Operation of Float System**

The float system controls the level of the fuel in the carburetor fuel bowl. Fuel level is very important because it must be maintained to give proper metering through all operating ranges.

Fuel entering the carburetor must first pass through the inlet screen, by the inlet needle seat, then past the float needle, into the float bowl; flow continues until the fuel level raises the float to a position where it closes the float valve. As fuel is used from the carburetor bowl the float drops, moving the float needle off its seat and replenishing the fuel in the bowl, thereby keeping the fuel level constant. See Figure 3-27.

A float tang located at the rear of the float arm between the float hangers prevents the float assembly from moving too far downward, but allows the float assembly to move down far enough for maximum fuel flow into the carburetor bowl. A float needle pull clip connecting the float arm to the needle valve keeps the needle from sticking closed in the seat, which may be caused by dirt or gum formation.

An external vent located on the top of the carburetor air horn vents any fuel vapors which may form in the float bowl to the outside atmosphere during periods of hot engine operation. This helps prevent poor hot engine idling and hard hot engine starting.

**c. Operation of Idle (Low Speed) System**

During engine idle operation, air flow through the carburetor venturi is very low and is not great enough to cause fuel to flow from the main discharge nozzles. Therefore, the idle system is used to provide the proper mixture ratios required during idle

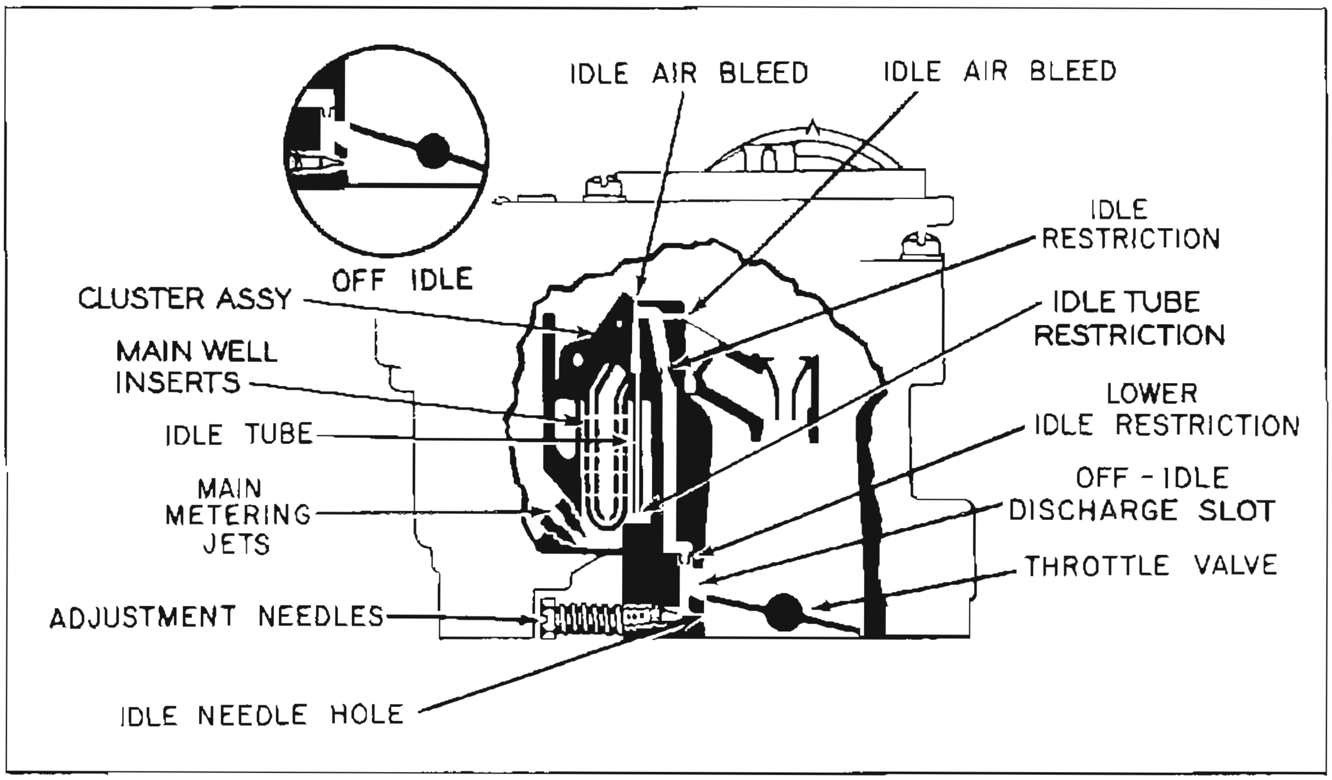



Figure 3-28—Low Speed System

and low speed operation of the engine.

The idle system consists of the idle tubes, idle passages, idle air bleeds, idle adjustment needles, off-idle discharge slots and the idle adjusting needle holes.

In idle speed position, each throttle valve is slightly open, allowing a small amount of air to pass between the wall of the carburetor bore and the edge of the throttle valve. Since there is not enough air flow for venturi action, the fuel is made to flow by the application of vacuum (low pressure) directly through the idle system to the fuel in the carburetor bowl. See Figure 3-28.

Fuel from the float bowl passes through each main metering jet into the main well where it is metered by the orifice at the lower end of the idle tube. It then passes up the idle tube and is mixed with air at the top of the idle tube by two calibrated idle air bleeds. The air/fuel mixture then passes down through a calibrated restriction into a vertical passage past a third idle bleed to the idle port located just above each closed throttle valve. Here the mixture is again bled with air and then moves down to the idle needle hole where it combines with air by-passing the slightly open throttle valve. The idle mixture needle controls the amount of fuel mixture which enters the carburetor bore at curb idle position of the throttle valve.

As the throttle valve is opened further, more and more of the idle port is exposed to manifold vacuum. This port supplies additional fuel mixture for off-idle engine requirements.

On all air conditioner equipped cars, a special thermostatic air valve is added in the hole in the rear side of the throttle body. This valve is designed to compensate for loss of engine RPM while idling under very hot operating conditions. When the underhood temperature rises beyond a certain point, the calibrated thermostatic spring opens the valve. This allows additional air to flow in below the throttle valves. At normal operating temperatures, the valve should be closed. The valve cannot be adjusted or repaired; therefore, a faulty valve must be replaced.

### d. Operation of Main Metering (High Speed) System

As the throttle valve continues to open, the edge of the throttle valve is gradually moved away from the wall of the carburetor bore, reducing the vacuum so that the discharge of fuel mixture at the idle needle hole and off-idle port gradually diminishes.

With the increased throttle opening, there is increased velocity in the venturi system. This causes a drop in pressure in the large venturi which is increased many times in the small venturi. Since the low pressure (high vacuum) is now in the small venturi, fuel will flow in the following manner:

Fuel from the float bowl passes through the main metering jets into the main well and rises in the main well tubes. Air entering the main well through the main well bleeds is mixed with fuel through calibrated holes in the main well tube. The mixture then moves up and out of the discharge nozzle into a channel where more air is added. The mixture travels down through the channel to the small venturi where it is delivered to the air stream and then to the intake manifold. See Figure 3-29.

### e. Operation of Power System

To achieve the proper mixtures required when more power is desired or for extreme high speed driving, a vacuum operated power piston in the air horn and a power valve located in the bottom of the float bowl are used. Through a connecting vacuum passage from the base of the carburetor to the power piston cylinder in the air horn, the power piston is exposed to manifold vacuum at all times. See Figure 3-30.

During idle and part throttle operation, the relatively high vacuum holds the power piston up against spring tension and the power valve remains closed.

Increase in engine load lowers the manifold vacuum. When it has dropped sufficiently the power piston spring overcomes the upward vacuum pull and the power piston moves downward, opening the power valve to allow additional fuel to flow through calibrated restrictions into the main well.

As the engine load decreases, the resulting higher vacuum overcomes the spring tension on the power piston and raises the power piston closing the power valve.

A 2-stage power valve is used. In the first stage, fuel is metered by the valve itself. This stage is used for light power loads. On heavy power loads the valve is fully opened to the second stage, and in this location the power valve allows the fuel to be metered by the power restrictions in the fuel channel located in the bottom of the fuel bowl.

It will be noted that the power piston cavity in the carburetor air horn is connected to the main air flow passage by a vacuum relief passage. It is the purpose of this passage to prevent the transfer of vacuum acting on the piston from acting also on the top of the fuel in the float bowl. Any leakage of air past the upper grooves of the piston will be compensated for by this relief passage and will not affect carburetor metering.

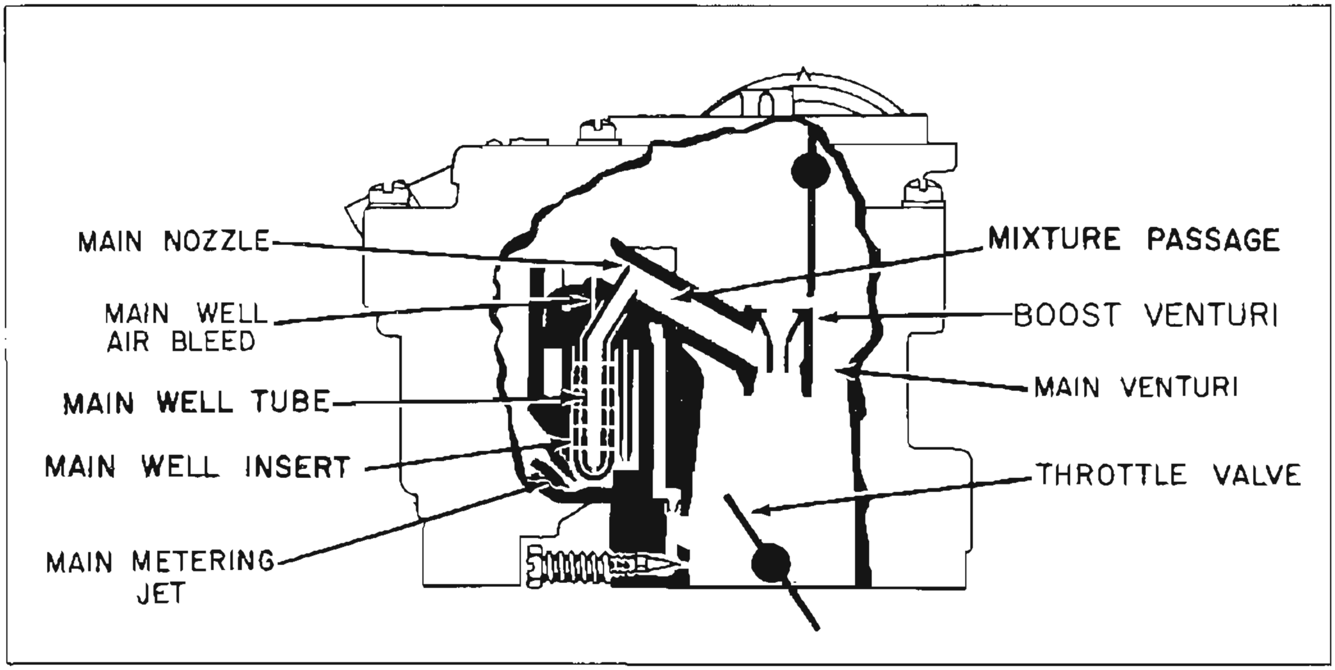



Figure 3-29—High Speed System

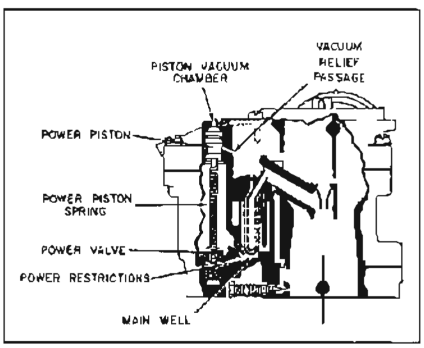



Figure 3-30—Power System

### f. Operation of Accelerating System

When the throttle valve is opened rapidly, the air flow and manifold vacuum change almost instantaneously, while the heavier fuel tends to lag behind causing a momentary leanness. The accelerator pump provides the fuel necessary for smooth operation on rapid acceleration.

Fuel for acceleration is supplied by a double-spring loaded pump plunger. The top and bottom springs combine to move the plunger so that a smooth, sustained charge of fuel is delivered for acceleration.

Fuel is drawn into the pump well through the inlet ball check on the intake stroke of the pump plunger (upward stroke). See Figure 3-31.

Downward motion of the pump plunger seats the inlet ball check and forces the fuel through the discharge passage where it unseats the pump discharge ball and then passes on through to the pump jets where it sprays into the venturi.

The ball check located in the pump plunger head serves as a vapor vent for the pump well. Without this vent, vapor pressure in the pump well might force fuel from the pump system into the engine manifold causing hard starting when the engine is hot.

There is an inner hole in the pump lever to provide a richer pump adjustment for extreme cold temperature conditions. This inner hole should be used only when low temperature hesitation indicates a too lean pump setting.

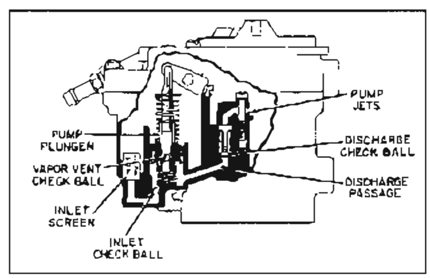



Figure 3-31—Accelerating Pump System

The pump discharge ball check in the accelerator pump passage prevents any pullover or discharge of fuel from the pump nozzles when the accelerator pump is inoperative.

### g. Operation of Choke System

The choke system is composed of a thermostatic coil, vacuum choke piston, offset choke valve, fast idle cam and choke linkage. Its operation is controlled by a combination of intake manifold vacuum, the offset choke valve, atmospheric temperature and exhaust manifold heat. See Figure 3-32.

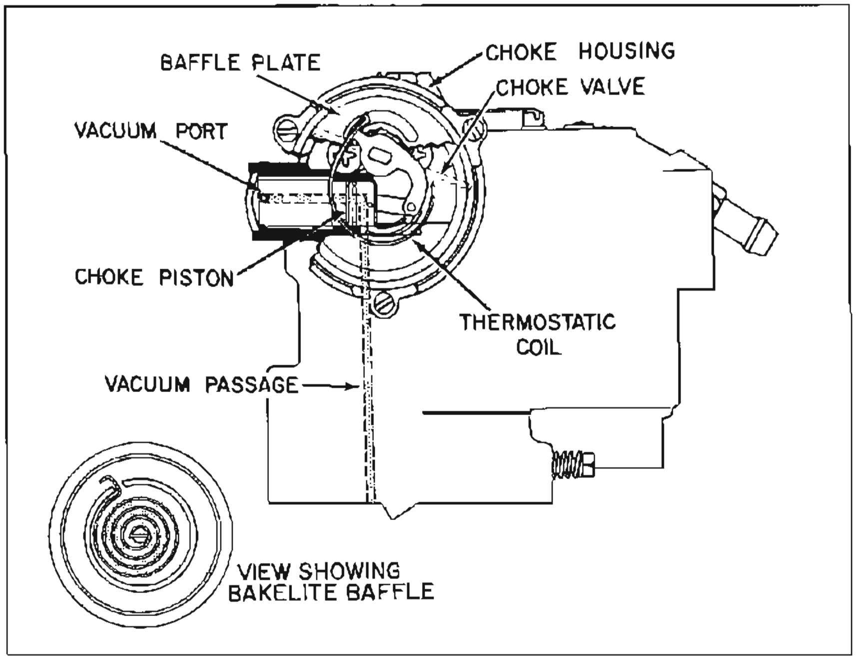



Figure 3-32—Choke System

The choke thermostatic coil is calibrated to hold the choke valve closed when the engine is cold. When the engine is started, air velocity against the offset choke valve causes the valve to open slightly against the torque of the thermostatic coil. In addition, intake manifold vacuum applied to the choke piston through the vacuum passage tends to open the choke valve. Vacuum pull on the choke piston is offset by the tension of the thermostatic coil. As the engine warms up, heated air is drawn into the choke housing through the choke heat tube through a passage in the choke housing. As the engine temperature increases, it causes the thermostatic coil to relax its tension, which together with vacuum pull on the choke piston and air flow against the offset choke valve causes the choke valve to open gradually until the engine is thoroughly warmed up, at which point the choke valve is fully opened.

Automatic choke failure due to build-up of dust or other foreign material in the choke housing is a common service item. This dirt is trapped from the air which is continually passing through the choke whenever the engine is running.

In past models, air for the choke was taken in at the rear end of a pipe passing through the exhaust manifold passage, then up to the choke housing through an insulated pipe. This part of the choke heat system remains the same; however, all Buicks now have a clean air pipe which conducts filtered air from the carburetor air horn to the intake end of the exhaust manifold pipe. Since nothing but filtered air passes through the choke housing with this new system, the action of the automatic choke remains trouble-free for a much longer period of use.

A mechanical choke unloader is incorporated to open the choke valve slightly when the engine is cold. The choke unloader provides a means for opening the choke valve to correct any loading condition encountered during cold starting.

To prevent stalling during the warm-up period, it is necessary to run the engine at a slightly higher idle speed than for a warm engine. This is accomplished by steps on the fast idle cam. The fast idle cam is in turn linked to the choke valve shaft by the choke rod, choke trip lever and choke lever and collar assembly. This holds the throttle valves open sufficiently during the warm-up period to give increased idle RPM until the choke valve moves to the fully open position and the engine is thoroughly warmed up.

## 3-15 DISASSEMBLY, CLEANING AND INSPECTION OF THE ROCHESTER 2-BARREL CARBURETOR

### a. Choke Disassembly and Removal of Air Horn

1. Mount carburetor on a proper mounting fixture such as J-5923.

2. Remove three choke cover attaching screws and retainers. Remove choke cover assembly, gasket and insulator baffle inside the choke housing.

3. Remove choke piston and lever assembly from the end of the choke shaft in the choke housing by removing retaining screw in the end of the choke shaft. Rotate choke piston lever to remove choke piston from bore in choke housing. Choke piston can now be removed from the lever by shaking piston pin into palm of hand.

4. Remove two Phillips choke housing attaching screws, then remove the choke housing and gasket from the air horn.

5. Remove pump rod by removing upper retaining clip.

6. Remove fast idle cam attaching screw. Then remove fast idle cam and rod assembly by rotating until lug on upper end of choke rod passes through slot in the upper choke lever and collar assembly. The lower end of choke rod can be removed from fast idle cam in the same manner.

7. Remove air horn attaching screws and carefully remove air horn assembly from float bowl by lifting gently upward.

**b. Disassembly of Air Horn**

1. Place air horn assembly inverted on bench. Remove float hinge pin and lift float assembly from cover. Remove float needle from the float arm. Remove float needle seat, fibre gasket and needle seat screen. See Figure 3-33.

2. Remove power piston by depressing shaft and allowing spring to snap repeatedly, thus forcing the power piston retaining washer from casting.

NOTE: If heavy staking is encountered, remove staking from around power piston retaining washer.

3. Remove retainer on the end of pump plunger shaft, then remove pump assembly from pump inner arm. Remove pump lever and shaft assembly by loosening set screw on inner arm and removing outer lever and shaft.

4. Remove air horn gasket.

5. Remove two choke valve retaining screws, then remove choke valve from choke shaft. Remove choke shaft from air horn, then choke lever and collar assembly can be removed from choke shaft.

Note position of the choke lever in relation to the choke trip lever on the end of the choke shaft for ease in reassembly.

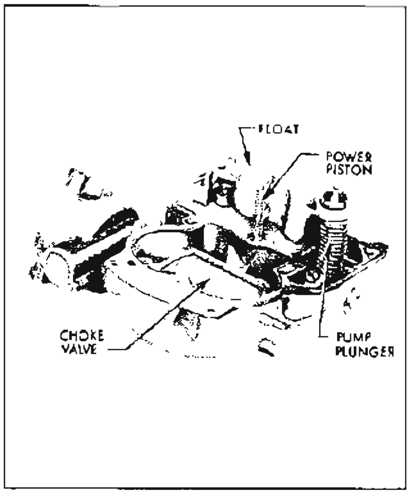



Figure 3-33—Air Horn Parts

**c. Disassembly of Float Bowl**

1. Remove pump plunger return spring and pump well. Remove small aluminum check ball from the bottom of pump well by inverting bowl and shaking into hand. Remove pump inlet screen from bottom of fuel bowl.

2. Remove main metering jets.

3. Remove power valve and fibre gasket.

4. Remove three venturi cluster attaching screws and remove cluster and gasket. Center cluster screw has smooth shank and fibre gasket for the accelerator pump fuel by-pass and sealing.

5. Using a pair of long nosed pliers, remove pump discharge ball spring "T" shaped retainer. Then remove pump discharge spring and steel discharge ball.

6. Remove two main well inserts in the main well.

7. Invert carburetor and remove three throttle body to bowl attaching screws. Remove throttle body and throttle body to bowl gasket.

**d. Disassembly of Throttle Body**

1. Remove idle mixture adjusting needles and springs.

No further disassembly of the throttle body is needed. The throttle valves should never be removed as the idle and spark holes are drilled in direct relation to the location of the throttle valves and shaft. Removal of the throttle valves will upset this location. The throttle body assembly is only serviced as a complete unit with throttle valves intact.

**e. Cleaning and Inspection**

Dirt, gum, water or carbon contamination in or on the exterior moving parts of a carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection while servicing.

1. Thoroughly clean carburetor castings and metal parts in carburetor cleaning solvent.

CAUTION: Pump plunger or any fiber or rubber parts should never be immersed in carburetor cleaner. Wash pump plunger in clean solvent.

2. Blow out all passages in the castings with compressed air and blow off all parts until they are dry. Make sure all jets and passages are clean. Do not use wires for cleaning fuel passages or air bleeds.

3. Check all parts for wear. If wear is noted, defective parts must be replaced. Note especially the following:

(a) Check float needle and seat

for wear. If wear is noted, the assembly must be replaced.

(b) Check float hinge pin for wear and float for dents or distortion. Check float for fuel leaks by shaking.

(c) Check throttle and choke shaft bores for wear and out of round.

(d) Inspect idle mixture adjusting needles for burrs or grooves. Such a condition requires replacement.

(e) Inspect pump plunger cup; replace if damaged, worn, or hard.

(f) Inspect pump well in bowl for wear or scoring.

4. Check filter screens for dirt or lint. Clean, and if they remain plugged, replace.

5. If for any reason, parts have become loose or damaged in the cluster casting, the cluster assembly must be replaced.

6. It is recommended that new gaskets be used whenever the carburetor is disassembled or overhauled.

## 3-16 ASSEMBLY OF ROCHESTER 2-BARREL CARBURETOR

### a. Assembly of Throttle Body

1. Screw idle mixture adjusting needles and springs into the throttle body until finger tight. Back out screw one turn as a preliminary idle adjustment.

CAUTION: Do not force idle needle against its seat or damage may result.

2. Invert float bowl assembly and place the new throttle body gasket on bowl. Install throttle body on bowl using three screws and lock washers. Tighten securely.

### b. Assembly of Float Bowl

1. Drop steel pump discharge check ball into discharge hole. Install pump discharge spring and "T" shaped retainer, staking retainer in place.

NOTE: Top of retainer must be flush with flat of bowl casting.

2. Install two main well inserts. Align flat on lip of insert with flat in recess on top of main well. Install venturi cluster with gasket. Install venturi cluster screws and tighten evenly and securely. Make sure center screw is fitted with fibre gasket and special smooth shank screw is used.

3. Install two main metering jets, power valve gasket and power valve.

4. Install small aluminum inlet check ball in pump inlet in the bottom of pump well; insert pump return spring and center in well by pressing downward with finger.

5. Install pump inlet screen in the bottom of float bowl.

### c. Assembly of Air Horn

1. Place new choke housing gasket in position on choke housing and install choke housing using two Phillips head attaching screws.

2. Install choke lever and collar onto choke shaft. Tang on choke lever faces away from air horn and is on top of choke trip lever.

3. Install choke shaft and lever assembly into the air horn. Choke rod hole in the choke lever faces fuel inlet side of carburetor.

4. Install choke valve in choke shaft so that letters "RP" will face upward in finished carburetor. Install two new choke valve attaching screws but do not tighten securely until choke valve is centered. Center choke valve on choke shaft by holding choke valve tightly closed; then slide choke shaft in to obtain approximately .020 clearance between choke trip lever and choke lever and collar assembly. Tighten choke valve screws securely and stake lightly in place. Choke valve will be perfectly free in all positions when installed correctly.

5. Install outer pump lever and shaft assembly into air horn with lever pointing toward choke shaft. Install inner pump arm with plunger hole inward and tighten set screw securely.

6. Attach pump plunger assembly to the inner pump arm with pump shaft off set pointing inward and install retainer.

7. Install needle seat screen on the needle seat and assemble float needle seat and gasket in air horn. Tighten needle seat securely, using a wide bladed screwdriver.

8. Install power piston into vacuum cavity. Lightly stake piston retainer washer in place. Piston should travel freely in cavity.

9. Install air horn gasket on air horn, fitting gasket over guide pin.

10. Attach float needle to float. Carefully position float and insert float hinge pin. Drop tang on rear of float arm should point downward toward air horn.

11. Fuel inlet fitting should be installed if removed.

12. Float level adjustment. (Use 1965 Gauge Set J-21946.) With air horn assembly inverted, measure the distance from the air horn gasket to lower edge (sharp edge) of float seam at end of float, using the .594 inch float

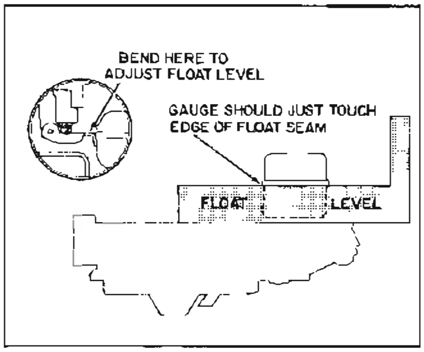



Figure 3-34—Float Level Adjustment

level gauge, as shown. Bend float arm as required to adjust float level. See Figure 3-34.

13. Float drop adjustment.

With air horn assembly held upright, measure distance from gasket to bottom of float pontoon at outer end, using 1-29/32 inch float drop gauge for scale, as shown. Bend float tang as required to adjust float drop, as shown in Figure 3-35.

14. Carefully place air horn assembly on float bowl, making certain that the pump plunger is properly positioned in the pump well. Lower the cover gently, straight down, then install air horn to float bowl attaching screws. Tighten evenly and securely.

NOTE: Longer air horn screw goes in top of pump housing.

15. Install choke rod into choke lever and fast idle cam. Install fast idle cam screw and tighten securely. See Figure 3-36 for proper installation.

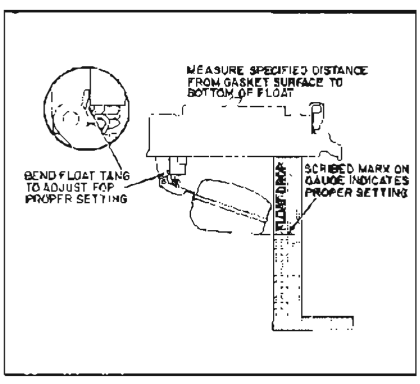



Figure 3-35—Float Drop Adjustment

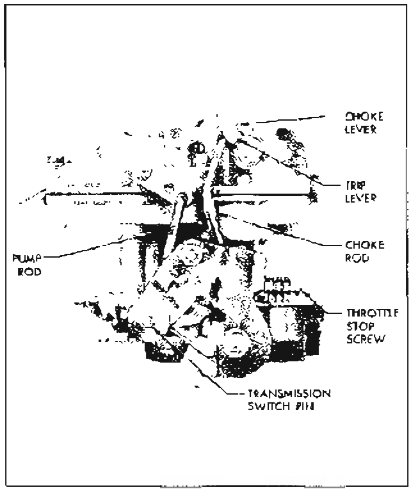



Figure 3-36—Choke Linkage

16. Install accelerator pump rod in outer hole and into throttle lever and install retainer.

17. Assemble choke piston to the choke lever and link assembly, retaining with piston pin. Piston pin hole in side of choke piston faces toward air horn. Install choke piston into the choke housing bore and attach choke piston lever to the end of the choke shaft, making sure flats on lever line up with flats on choke shaft. Install retaining screw and tighten securely.

18. Install insulator baffle into choke housing.

## 3-17 EXTERNAL ADJUSTMENT OF ROCHESTER 2-BARREL CARBURETOR

All adjustments on the carburetor, except for float adjustments, are made externally. For float level and drop adjustments, see Steps 12 and 13. (Use 1965 Carburetor Gauge Set J-21946.)

### a. Pump Rod Adjustment

Back out idle stop screw and completely close throttle valves in bore. Place pump gauge across top of carburetor air horn ring, as shown, with 1-11/32 inch leg of gauge pointing downwards towards top of pump rod. Lower edge of gauge leg should just touch the top of the pump rod. Bend the pump rod as required to obtain the proper setting using Tool J-4552. See Figure 3-37.

### b. Choke Rod Adjustment

Turn idle stop screw into the normal idle position (normal idle position would be with the idle stop screw turned in approximately one turn against the fast idle cam, with the choke valve held wide open). Place idle stop screw on the second step of the fast idle cam against shoulder of the high step. Wire gauge marked .055 should just go between the upper edge of choke valve and wall of air horn. Bend tang on choke lever to obtain correct choke rod setting. See Figure 3-38.

### c. Choke Unloader Adjustment

With throttle valves held wide open, choke valve should be opened enough to admit end of gauge marked .136 between upper

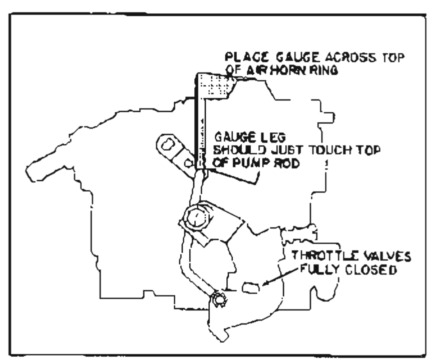



Figure 3-37—Pump Rod Adjustment

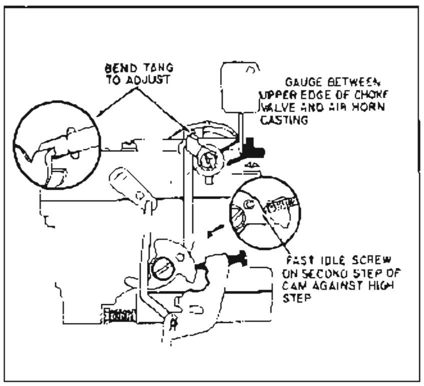



Figure 3-38—Choke Rod Adjustment

edge of choke valve and inner air horn wall. Bend unloader tang on throttle lever to obtain proper clearance. See Figure 3-39.

**d. Slow Idle Adjustment**

Adjust slow idle in drive to 550 RPM (add 50 RPM for air conditioner). When engine is at normal operating temperature, adjust idle mixture needle screws; readjust idle speed if necessary. See paragraph 3-8.

**e. Fast Idle Adjustment**

A fast idle speed adjustment is not required because fast idle is controlled by the throttle stop screw. If the idle speed is correctly set and the choke rod properly adjusted, the fast idle will be maintained.

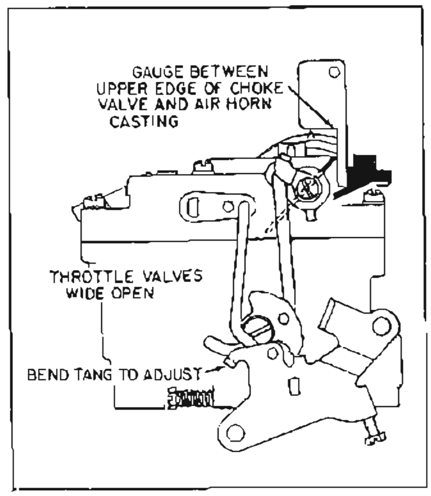



Figure 3-39—Choke Unloader Adjustment

# SECTION 3-F
# CARTER 4-BARREL CARBURETOR

## CONTENTS OF SECTION 3-F



## 3-18 DESCRIPTION AND OPERATION OF CARTER 4-BARREL CARBURETOR

### a. General Description

The Carter Model AFB carburetor is a 4-barrel downdraft type which provides the advantages of a compound installation of two 2-barrel carburetors in one compact unit. See Figure 3-40. See paragraph 3-1 (c) for the specifications of this carburetor.

The primary section covers the 2-barrelled forward half of the carburetor assembly. This section is essentially a complete 2-barrel carburetor containing a low speed system, high speed system, power system and accelerating system. This section also includes the automatic choke mechanism.

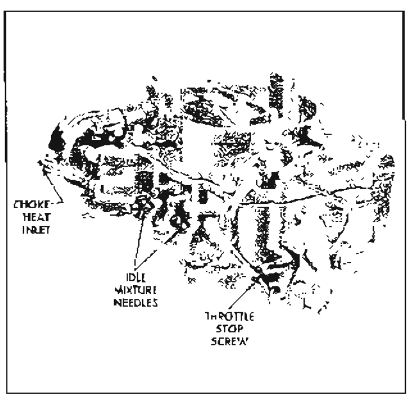



Figure 3-40—Carter AFB Carburetor Assembly

The secondary section covers the 2-barrelled rearward half of the carburetor assembly. This section is essentially a supplementary 2-barrel carburetor which cuts in to assist the primary section when a predetermined car speed or engine load is reached. This section contains its own high speed system. It has a separate set of throttle valves and a set of auxiliary valves which are located in the barrels above the throttle valves.

The primary throttle valves are operated by the accelerator pedal and the connecting throttle linkage. The secondary throttle valves are operated by the primary throttle valve shaft through delayed action linkage which permits a predetermined opening of the primary valves before the secondary valves start to open. Action of the linkage then causes both sets of throttle valves to reach the wide open position at the same time.

### b. Operation of Float Systems

The purpose of the float system is to maintain an adequate supply of fuel at the proper level in the bowl for use by the low-speed, high-speed, pump and choke circuits.

There are two separate float circuits. Each float circuit supplies fuel to a primary low-speed circuit and a primary and secondary high-speed circuit. See Figure 3-41.

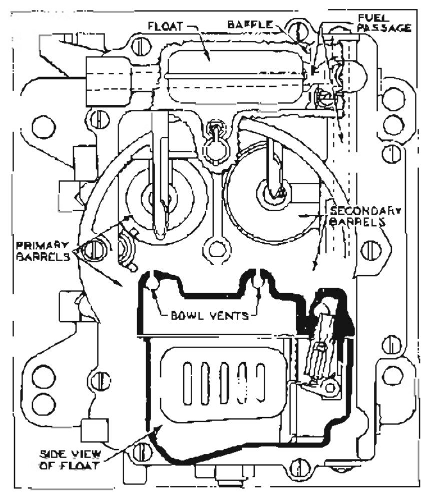



Figure 3-41—Float Circuits

Setting the floats to specifications assures an adequate supply of fuel in the bowls for all operating conditions. Special consideration should be given to be sure the floats do not bind in their hinge pin brackets or drag against inner walls of bowl.

The intake needle seats are installed at an angle to provide the best possible seating action of the intake needles.

Intake needles and seats are carefully matched during manufacture. Do not use the left needle in the right seat or vice versa. To avoid unnecessary bending, both floats should be reinstalled in their original positions and then adjusted.

The bowls are vented to the inside of the air horn and also to atmosphere. A connecting vent passage in the air horn effects a balance of the air pressure between the two bowls. Bowl vents are calibrated to provide proper air pressure above the fuel at all times.

### c. Operation of Low Speed Systems

Fuel for idle and early part throttle operation is metered through the low speed system. The low speed system is located on the primary side only. See Figure 3-42.

Gasoline enters the idle wells through the main metering jets. The low speed jets measure the amount of fuel for idle and early part throttle operation. The air by-pass passage economizers and idle air bleeds are carefully calibrated and serve to break up the liquid fuel and mix it with air as it moves through the passages to the idle ports and idle adjustment screw ports. Turning the idle adjustment screws toward their seats reduces the quantity of fuel mixture supplied by the idle circuit.

The idle ports are slot shaped. As the throttle valves are opened, more of the idle ports are uncovered allowing a greater quantity of the gasoline and air mixture to enter the carburetor bores. The secondary throttle valves remain seated at idle.

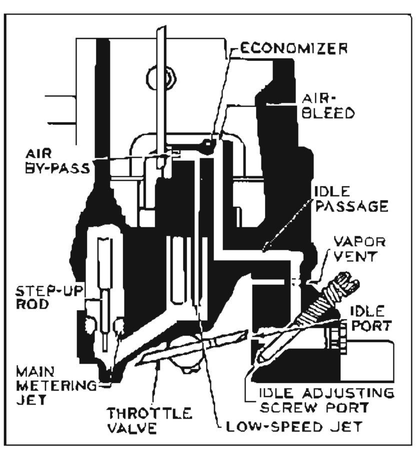



Figure 3-42—Low Speed Circuit

The low speed jets, air bleed, economizer and by-pass bushings are pressed in place in the venturi assemblies. Do not remove in servicing. If replacement is necessary, use a new venturi assembly. To insure proper alignment of the low speed mixture passage, each primary venturi assembly is designed so it can be installed on one side only.

To assist in quick hot engine starting, fuel vapor accumulated in the primary and secondary bores is vented to atmosphere through vent passages above throttle valves.

To combat engine stalling during warm-up on cool humid days, caused by "carburetor icing", exhaust gases are directed against a steel baffle plate that contacts the carburetor mounting flange. The heat transferred helps eliminate ice formation at the throttle valve edges and idle ports.

To compensate for loss of engine RPM while idling under very hot operating conditions, a thermostatic valve assembly is installed in the web between the right and left secondary venturi. When the temperature rises beyond a certain point, the calibrated thermostatic spring opens the valve. This allows additional air to flow through a special passage to an outlet below the secondary throttle valves. At normal operating temperatures, the valve should be closed. The thermostatic valve cannot be adjusted or repaired; therefore, a faulty valve must be replaced. See Figure 3-43.

### d. Operation of High Speed Systems

Fuel for all except early part throttle and for all full throttle operation is supplied through the high speed system. See Figure 3-44.

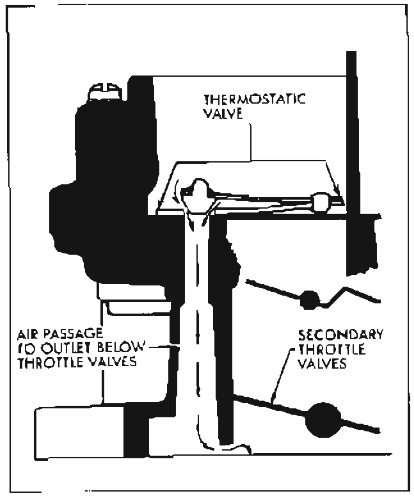



Figure 3-43—Thermostatic Valve Assembly

The position of the step-up rod in the primary main metering jet controls the amount of fuel admitted to the nozzles. The position of the step-up rod is controlled by a manifold vacuum piston.

During normal part throttle operation, manifold vacuum pulls the step-up piston and rod assembly down, holding the larger diameter of the step-up rod in the primary main metering jet. This is true when the vacuum

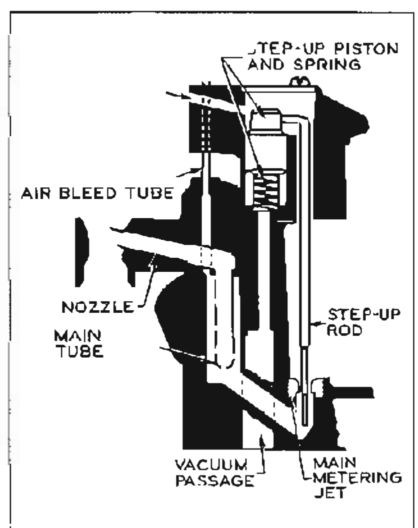



Figure 3-44—Primary High Speed Circuit

under the piston is strong enough to overcome the tension of the step-up piston spring. Fuel is then metered around the larger diameter of the step-up rod in the jet.

Under any operating condition, when the tension of the spring overcomes the pull of vacuum under the piston, the step-up rod will move up so its smaller diameter or power step is in the jet. This allows additional fuel to be metered through the jet. The step-up rod does not require adjustment.

Fuel for the high-speed circuit of the secondary is metered at the main metering jets (no step-up rods used). See Figure 3-45.

Initial discharge ports are incorporated to supplement starting of the fuel flow in the secondary high-speed circuit. These ports are located next to the venturi struts. When the auxiliary valves start to open, the vacuum on the initial discharge ports pulls fuel from the main vent tube well through passages that rise above the fuel level in the bowl. Air bleeds serve to break-up the liquid fuel and mix it with air as it moves through the passages to the initial discharge ports where it is discharged into the air stream. As the auxiliary valves continue to open, and the secondary nozzles start delivering fuel, less

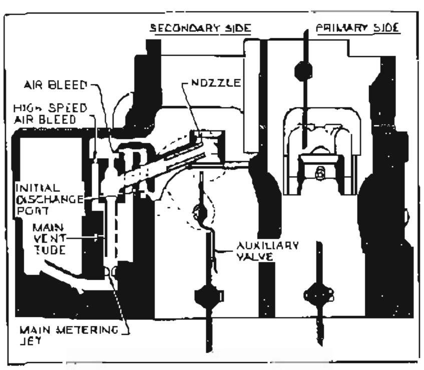



Figure 3-45—Secondary High Speed Circuit

fuel flows from the initial discharge ports.

The main vent tubes on primary and secondary sides mix air drawn through the high speed air bleed with the fuel before it passes out of the nozzles.

Air bleeds in the primary nozzle passage plugs cause the air fuel mixture to closely follow the requirements of the engine. Also, their position at the junction of the nozzle passage and the main vent tube serves to break the flow of fuel from the high speed circuit quickly as the throttle is closed upon deceleration.

A clogged air bleed or main vent tube may cause excessively rich mixtures. The high speed bleed and main vent tubes are permanently installed. If replacement is necessary, use a new venturi assembly.

The high speed bleeds also act as anti-percolator vents when a hot engine is stopped or at idling speed. This will help vent fuel vapor pressure in the high speed and idle well before it is sufficient to push fuel out of the nozzles and into the intake manifold.

Engines operated at part throttle on level road use a mixture of maximum leanness. The mixture for greatest power and acceleration is somewhat richer, and is furnished by the power and accelerating systems described later.

The high speed systems in the primary section control the flow of fuel during the intermediate or part throttle range of operation and up to approximately 85 MPH. The secondary throttle valves remain closed until the primary valves have opened approximately 50-55 degrees, after which they are opened proportionately so that all valves reach the wide open position at the same time. While the secondary valves are closed, the auxiliary valves located above them are held closed by the weights on the auxiliary valve shaft lever (Figure 3-45); therefore there is not sufficient air flow through the barrels to operate the high speed systems in the secondary section.

When the secondary throttle valves are open and the engine speed is at least 1400-1600 RPM, the resulting air flow through the secondary barrels starts to open the auxiliary valves because their supporting shaft is located off-center in the barrels. When the auxiliary valves are open the high speed systems in the secondary section also supply fuel to the engine.

### e. Operation of the Power System.

For maximum power or high speed operation above approximately 85 MPH, a richer mixture is required than that necessary for normal throttle opening. The richer mixture is supplied through the high speed systems in the primary section through vacuum control of the step-up rods.

Each power circuit consists of a vacuum piston located in a cylinder connected to manifold vacuum and a spring which tends to push the piston upward against manifold vacuum. See Figure 3-46.

Under part throttle operation, manifold vacuum is sufficient to hold the piston and rod down against the tension of the spring, so that the large diameter of the rod is in the metering jet for economy. When the throttle valve is opened to a point where additional fuel is required for satisfactory operation, manifold vacuum decreases sufficiently so that the piston spring moves the piston and rod upward to the small rod diameter to give the required richer mixture for power. As soon as the demand is passed

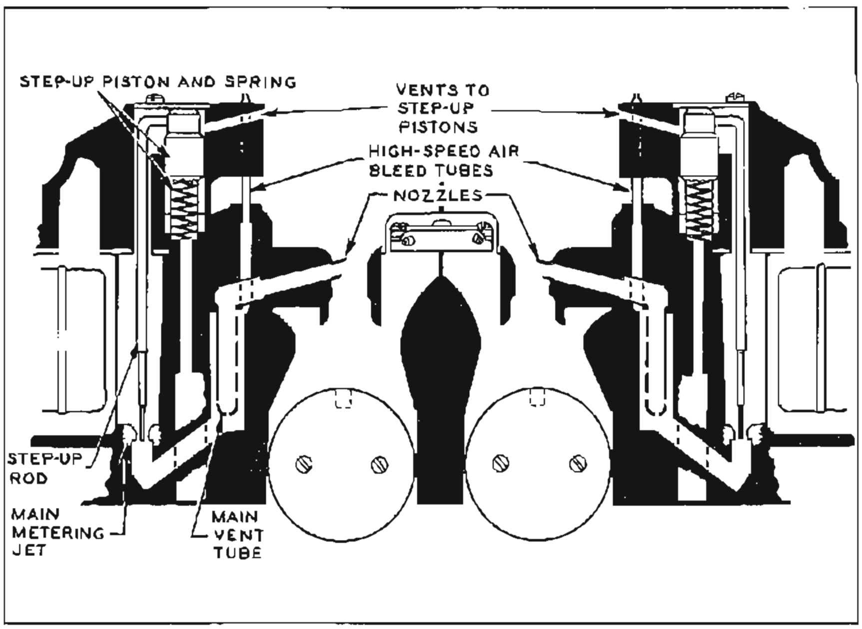



Figure 3-46—Power Circuit

manifold vacuum again moves the piston and rod down.

### f. Operation of Accelerating System

The accelerating pump circuit, located in the primary side, provides a measured amount of fuel necessary to insure smooth engine operation on acceleration at lower car speeds.

When the throttle is closed, the pump plunger moves upward in its cylinder and fuel is drawn into the pump cylinder through the intake check. The discharge check is seated at this time to prevent air from being drawn into the cylinder. When the throttle is opened, the pump plunger moves downward forcing fuel out through the discharge passage, past the discharge check, and out of the pump jets. When the plunger moves downward, the intake check is closed, preventing fuel from being forced back into the bowl. See Figure 3-47.

At higher car 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 further pump discharge.

Be sure the pump plunger cup is in good condition and the intake and discharge checks and pump jet are free of lint, gum or other foreign matter. The pump intake check is a one piece assembly

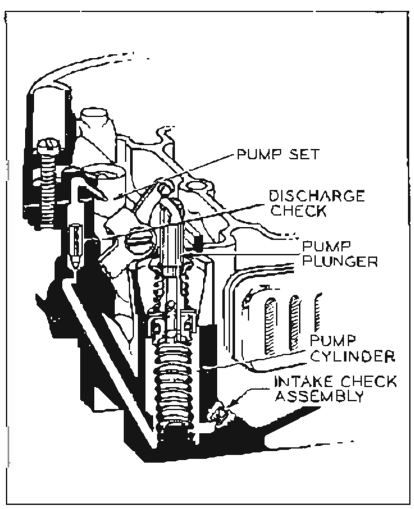



Figure 3-47—Pump Circuit

located in an angular passage at the base of the pump assembly. The intake check is serviced only as a complete assembly.

### g. Operation of Choke System

The choke circuit, located in the primary side, provides the correct mixture necessary for quick cold engine starting and during engine warm-up.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. When the engine is started, air velocity against the offset choke valve causes the valve to open slightly against the thermostatic coil tension. Intake manifold vacuum applied to the choke piston also tends to pull the choke valve open. The choke valve assumes a position, where tension of the thermostatic coil is balanced, by the pull of vacuum on the piston, and force of air velocity on the offset valve.

When the engine starts, slots located in the sides of the choke piston cylinder are uncovered, allowing intake manifold vacuum to draw warm air through the climatic control housing. This air is heated in a tube running through the exhaust manifold. Clean, filtered air is used to operate the choke thermostatic coil. Air is taken from the air horn of the carburetor, down a pipe to the right exhaust manifold. The flow of warm air heats the thermostatic coil and causes it to lose some of its tension. The thermostatic coil loses its tension gradually, until the choke valve reaches the full-open position.

If the engine is accelerated during the warm-up period, the corresponding drop in manifold vacuum allows the thermostatic coil to momentarily partially close the choke, providing a richer mixture.

During the warm-up period, it is necessary to provide a fast idle speed to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke linkage. The fast idle adjusting screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to a normal warm engine idle position, while the choke is in operation. See Figure 3-48.

If during the starting period the engine becomes flooded, the choke valve may be opened manually to clean out excessive fuel in the intake manifold. This is accomplished by depressing the accelerator pedal to the floor mat. The unloader projection on the throttle lever contacts the fast idle cam which rotates and partially opens the choke valve.

The secondary section does not have a choke valve. In order to prevent air entering the carburetor through the secondary side during the engine warm-up period, it is necessary to lock the secondary throttle valves in the closed position. This is accomplished by engagement of a lock-out arm with a locking tang on the secondary valve shaft lever. See Figure 3-48.

With the choke valve in wide open position the lock-out arm rests in a lowered position, clear of the secondary valve shaft lever. As the choke valve closes it rotates the fast idle cam trip lever, allowing the lock-out arm to rise. As soon as the choke valve is closed a few degrees from wide open position, the notch in the lock-out arm lies in the line of travel of the locking tang on the secondary valve shaft lever, thereby preventing the shaft and valves from turning.

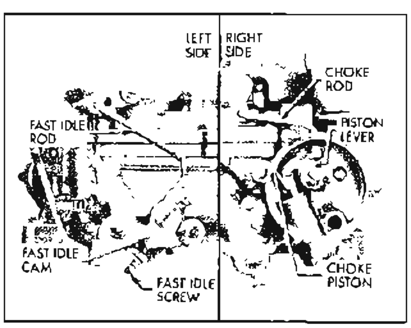



Figure 3-48—Choke Linkage

The choke fast idle linkage permits the choke valve to float in that it can close a few degrees, if necessary, should the engine falter while running on fast idle during the warm-up period. When the engine starts, manifold vacuum applied to the choke piston pulls the choke valve partially open. Should the engine falter, the choke piston will sense the condition because of the reduction in vacuum and allow the tension of the thermostatic coil to partially close the choke, providing a slightly richer mixture to smooth out the engine's performance. This feature of allowing the choke valve to close partially while the fast idle screw is in contact with the cam helps prevent stalling during the warm-up period. The choke valve is allowed to come open during the warm-up period if the car is left running on fast idle while warming up.

## 3-19 DISASSEMBLY, CLEANING, INSPECTION OF CARTER 4-BARREL CARBURETOR

1. Remove pin spring from upper end of choke rod and disconnect rod from choke shaft lever. Reinstall pin spring on choke rod for safe keeping.

2. Remove retainer and spring from upper end of pump rod and disconnect rod from pump arm. Reinstall spring and retainer on pump rod.

3. Remove screws holding two step-up piston cover plates to air horn. Remove cover plates and remove each step-up piston, rod, and rod retainer spring as an assembly. Then remove two step-up piston springs. See Figure 3-49.

4. Remove screw from end of choke shaft and remove outer lever and washer. Then remove inner lever and fast idle rod from carburetor as an assembly. Remove choke valve attaching screws. Remove choke valve and shaft.

5. Remove fuel inlet fitting and gasket. Remove all air horn screws and lock washers, noting location of attached cable clip. Remove air horn and gasket from main body, lifting straight up to avoid damaging floats or pump plunger.

6. Remove float lever pins and floats. Remove float needles, needle seats, and gaskets. Keep float system parts separated so that they may be reinstalled in original location with a minimum amount of adjusting.

7. Remove pin spring from pump link. Remove link and reinstall pin spring. Remove pump plunger assembly from air horn. Remove air horn gasket.

8. Remove lower pump spring from main body. Remove thermostatic coil and housing assembly, gasket, and baffle plate from

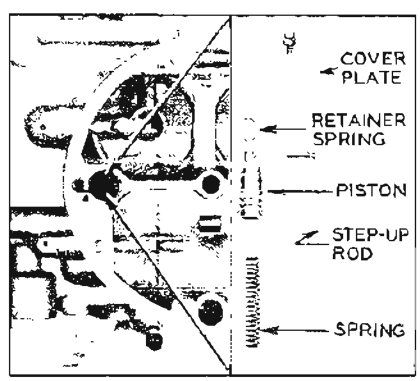



Figure 3-49—Step-Up Rod and Related Parts

choke piston housing. Remove screw from end of choke piston housing shaft and remove washer. Then remove choke piston, lever, link and pin assembly.

9. Remove piston housing from main body. Remove small round gasket from piston housing. Remove choke shaft, lever, and rod assembly from piston housing.

10. Remove idle mixture adjustment screws and springs.

11. Remove thermostatic valve and gasket. See Figure 3-43.

12. Remove both secondary venturi assemblies and gaskets. Remove auxiliary valve assembly. Remove both primary venturi assemblies and gaskets. Notice that each venturi assembly is different and can be assembled in only one location. Notice also that primary venturi assembly gaskets are different from secondary gaskets.

13. Remove pump jet housing and gasket. Remove pump discharge check needle.

14. Remove all four metering jets. Notice that the primary jets have larger orifices than the secondary jets. This is because step-up rods are used only in the primary jets.

15. Remove pump intake ball check assembly.

Unless passages in main body appear to be clogged with carbon or gum to such an extent that penetration of cleaning solution is doubtful, it is seldom necessary to remove passage plugs.

For normal cleaning and inspection, it is not necessary to remove primary or secondary throttle valves and their connecting linkage. However, if throttle linkage is worn or damaged, service replacement parts are available.

## 3-20 ASSEMBLY AND INTERNAL ADJUSTMENT OF CARTER 4-BARREL CARBURETOR

During assembly of carburetor use all new gaskets and any additional new parts found to be necessary during inspection. Calibrated parts must be as specified for carburetor CODE number which is stamped in edge of mounting flange at rear center.

1. Place main body in upright position on bench or mounting fixture. Install primary and secondary metering jets and tighten securely. NOTE: The primary jets are the two having the larger orifices and are installed in the holes nearest the center of the main body below step-up rod holes in air horn.

2. Install pump discharge check needle point down. Install pump jet housing and gasket. Install pump intake ball check assembly.

3. Install thermostatic valve using new gasket. See Figure 3-43.

4. Install auxiliary valve assembly with screw heads down. Then install secondary and primary venturi assemblies, using new gaskets. NOTE: If a primary venturi assembly does not fit in place flush with top of main body, it belongs on other side.

5. Install idle mixture adjustment screws. Seat lightly and back out 1 turn, which will provide an average initial adjustment.

6. Install choke piston housing shaft, lever and rod assembly in piston housing with lever and rod pointing away from heat pipe connector. Install small round rubber gasket in housing recess, then install piston housing on main body using three self tapping screws. Install choke piston, pin, link and lever assembly in piston housing. Install piston lever on flats of shaft in such a way that inner and outer levers are pointing in same general direction. Then install screw.

7. Place pump plunger assembly in position in air horn and install pump link. Install pin spring in upper end of link. Invert air horn and install new air horn gasket.

8. Install float needle seats and gaskets. Install float needles, floats, and lever pins, making sure they are installed in original locations.

9. Align Float - Sight down side of float to determine if side is parallel with outer edge of air horn. If adjustment is necessary, bend float lever by applying pressure to end of float with fingers while supporting float lever with thumb. See Figure 3-50.

Remove any excess clearance between arms of float lever and lugs on air horn by bending float lever arms. Arms should also be parallel to inner surfaces of lugs. After aligning, each float must operate freely.

10. Adjust Float Level. (Use 1964-5 Carburetor Gauge Set J-21944.) With air horn inverted and air horn gasket in place, check clearance between each float (at outer end) and air horn gasket using 3/16" gauge or a 3/16" drill. See Figure 3-51. To

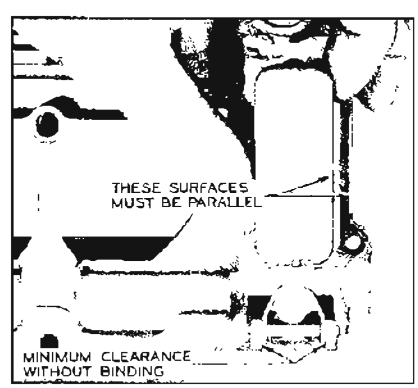



Figure 3-50—Float Alignment

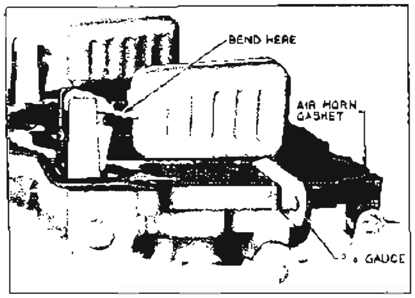



Figure 3-51—Checking Float Level

adjust, bend float lever. After any adjustment, recheck float alignment.

11. Adjust Float Drop. With air horn held in upright position, measure vertical distance from air horn gasket to outer end of each float using a scale. Bend float arm tang as required to obtain 3/4" measurement. See Figure 3-52.

12. Place lower pump spring in pump well (opposite choke piston housing). Install air horn assembly on main body, using care to avoid distortion of floats. Install air horn screws and tighten evenly. (Two longer screws go in middle holes.) Check auxiliary valve assembly by opening from above. Auxiliary valves must be perfectly free in any position.

13. Install choke shaft in air horn with attached lever toward choke piston housing. Install choke valve with markings up and install screws loosely. Align choke

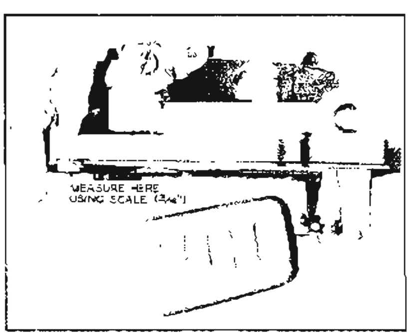



Figure 3-52—Checking Float Drop

valve by working choke shaft endwise while maintaining an upward pressure on choke shaft lever. Tighten and stake choke valve screws. Check for uniform clearance and freedom from sticking, as improper fit or binding may cause hard starting. Mechanism is free if choke valve will fall open from its own weight.

14. Install assembled fast idle rod and choke lever by first engaging fast idle rod in fast idle cam. Then place lever over end of choke shaft so that it points toward accelerator pump with choke closed.

15. Install two step-up piston springs. Install each assembled retainer spring. Carefully push down on each step-up piston and rod until rod enters metering jet. Use care to avoid bending step-up rods. Then install cover plates, holding plates down while tightening screws.

16. Install upper end of pump rod in pump arm. Install spring and retainer on rod, making sure that bronze washer is on opposite side of pump arm from spring.

17. Install upper end of choke rod in choke shaft lever, using pin spring on rod.

## 3-21 EXTERNAL ADJUSTMENT OF CARTER 4-BARREL CARBURETOR

(Use 1964-5 Carburetor Gauge Set J-21944.)

1. Adjust Choke Piston Linkage. Inside choke piston bore on left side, about 1/2 inch down, is a small slot. Insert 1/8 inch bent end of .026" wire gauge into upper end of slot; then close choke valve by pressing on piston lever in choke housing until piston stops against gauge. Check opening between upper edge of choke valve and inner wall of air horn using .081" Wire Gauge. See Figure 3-53. If adjustment is required,

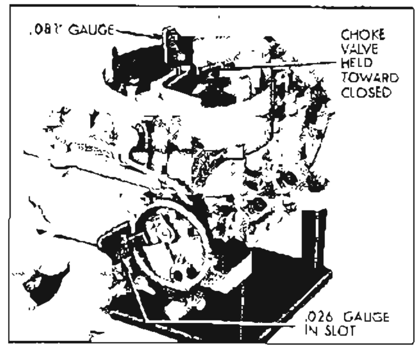



Figure 3-53—Choke Piston Adjustment

place Tool J-5197 on lower section of choke rod and bend as necessary.

2. Install baffle plate in choke piston housing. Install thermostatic coil and housing assembly with gasket. Rotate clockwise until index marks align and choke valve is just closed, then tighten screws and retainers.

3. Adjust Pump. Push fast idle cam aside and back out throttle stop screw until throttle valves seat in throttle bores. With pump rod in center hole, measure from air horn to top of plunger shaft with scale. Bend pump rod at lower angle as required to obtain 7/16" measurement using Tool J-4552. See Figure 3-54. Turn throttle stop screw in (from fully closed throttle position) 1/2 turn which should provide an initial idle adjustment.

4. Adjust Fast Idle Cam Position. With choke valve held fully closed, open throttle slightly to allow fast idle cam to spring to

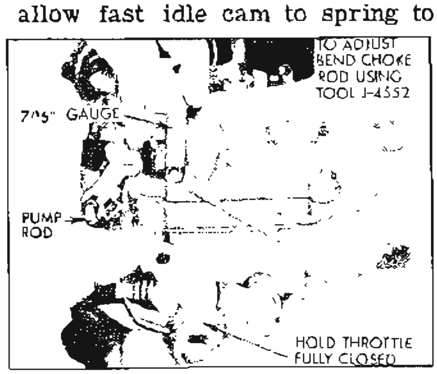



Figure 3-54—Pump Adjustment

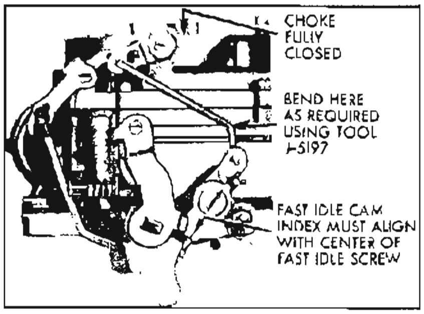



Figure 3-55—Fast Idle Cam Adjustment

a neutral position. Now index mark on fast idle cam must align with center of fast idle screw. If mark does not align, bend fast idle rod using Tool J-5197 as required to make mark align. See Figure 3-55.

NOTE: With choke fully closed and index mark aligned, lug on fast idle cam must clear stop on throttle body.

5. Adjust Unloader. Hold throttle wide open and check clearance between upper edge of choke valve and inner wall of air horn using the 1/8" gauge or a 1/8" drill. Bend unloader tang on throttle shaft lever as required to obtain this clearance using pliers. See Figure 3-56.

6. Adjust Closing Shoe. Hold choke open and rotate primary throttle lever through full range. Check clearance between positive closing shoes on primary and

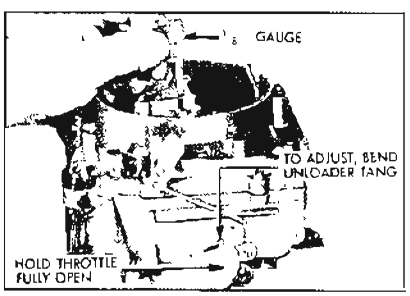



Figure 3-56—Unloader Adjustment

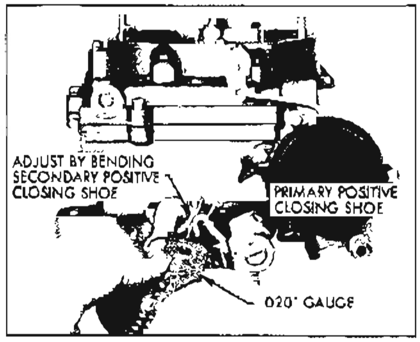



Figure 3-57—Closing Shoe Adjustment

secondary throttle levers at closest position using .020" gauge. Bend secondary closing shoe as required to obtain this clearance using pliers. See Figure 3-57.

7. Adjust Throttle Opening. At wide open throttle, primary throttle valves should be vertical. Secondary throttle valves should be a few degrees from vertical. Upper edge of secondary valves should just contact auxiliary valves when both are wide open. If necessary, bend wide open stop lug.

Primary and secondary throttle valves should reach wide open throttle at the same time. To synchronize, bend secondary operating rod. See Figure 3-58.

The pick-up lever located on the primary throttle shaft has two points of contact with the loose lever on the primary shaft. Caution should be taken that the pick-up lever contacts the loose lever

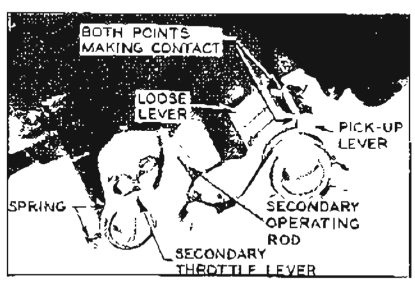



Figure 3-58—Secondary Throttle Opening Adjustment

at both points at the same time. See Figure 3-58. If they do not make this contact, bend pick-up lever to obtain proper engagement.

8. Adjust Secondary Throttle Lock-Out. Open primary throttle valves slightly to clear fast idle cam and manually open and close choke valve. Lock-out tang on secondary throttle should freely engage in notch of lock-out dog while barely missing edge of notch. If necessary to adjust, bend tang on secondary throttle lever using Tool J-6058-A. See Figure 3-59.

Install carburetor on car. Make final idle speed and mixture adjustments on car in normal manner. See Paragraph 3-8.

9. Adjust Fast Idle. Make adjustment on car with engine operating at normal temperature and transmission in drive as follows:

(a) Position fast idle cam so that fast idle screw is resting on low step of fast idle cam with edge of screw aligned with starting edge of cam.

(b) Adjust fast idle screw so that engine runs 600 RPM.

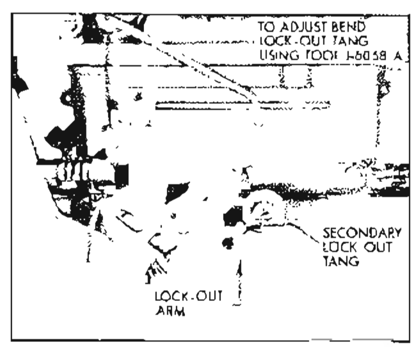



Figure 3-59—Secondary Throttle Lock-Out Adjustment

# SECTION 3-G

# ROCHESTER 1-BARREL CARBURETOR

## CONTENTS OF SECTION 3-G



## 3-22 DESCRIPTION AND OPERATION OF ROCHESTER 1-BARREL CARBURETOR

### a. General Description

The Rochester Model BC carburetor is a single barrel, downdraft, automatic choke model, used on the V-6, 225 cu. in. engine, for both automatic transmission and synchromesh transmission.

The Model BC carburetor has 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 spill-over regardless of the angle of the car. See Figure 3-60.

The main well assembly contains the main metering jet and power valve. It is attached to the carburetor air horn and is suspended in the float bowl. Engine heat cannot be directly transmitted from the float bowl into the main well area.

Clean, filtered air is supplied to the choke heat stove from a pipe in the air horn located just below the air cleaner. The heated air from the choke heat stove is drawn through an insulated tube into the choke housing. An external tube conducts the hot air from the choke housing to the intake manifold.

### b. Operation of Float System

Dual floats are used to maintain a constant fuel level at all times. The float bowl is designed so that the fuel is centrally located around the main well, so that efficient carburetor metering can be maintained under all engine operating conditions. See Figure 3-61.

As shown, components of the float system are the inlet fitting and gasket, fuel filter and gasket, pressure relief spring, needle valve and seat, and the float. It

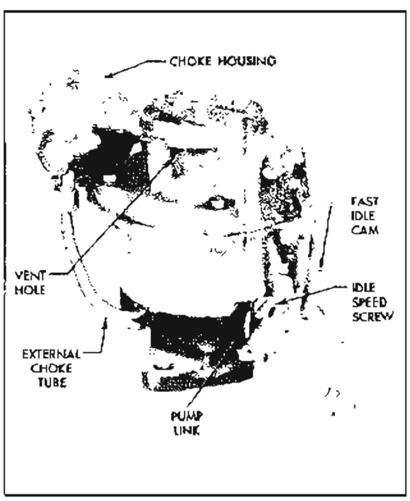



Figure 3-60—Rochester 1BC Carburetor Assembly - V-6 Engine

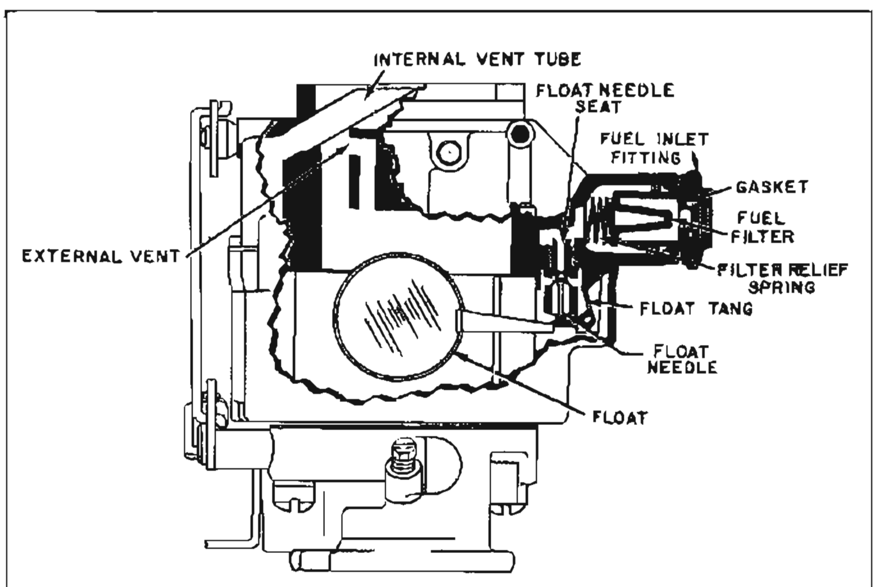



Figure 3-61—Float System

should be noted that the fuel filter is spring loaded. This provides a pressure relief feature so that in the event the filter should plug, fuel pump pressure would overcome the spring allowing fuel to by-pass the filter.

Three air vents are used for transmitting air pressure to the fuel in the float bowl. Two external vents, located in the air horn just beneath the air cleaner, supply atmospheric pressure to the fuel in the float bowl and are used to remove fuel vapors which might disrupt engine operation during prolonged, hot engine idling.

An internal vent tube, located inside the air horn bore, extends upward from the float bowl to the base of the air cleaner to provide a balance between external and internal air pressures acting upon the fuel in the float bowl.

**c. Operation of Idle (Low Speed) System**

At idle speeds, the throttle valve is nearly closed so there is not enough air flow through the venturi to lift fuel from the float bowl. Therefore, to supply enough fuel for idle and low speed requirements, a separate system is used. To make fuel flow, manifold vacuum from the idle needle hole is applied directly to the fuel in the bowl. The idle system consists of the idle pick up tube, idle tube, idle passages, idle air bleed, idle mixture adjustment needle, idle discharge holes, and an idle speed adjustment screw. See Figure 3-62.

Atmospheric pressure acting on the fuel in the float bowl, forces fuel through the main metering jet into the main well. It then travels through an anti-bubble screen located inside the main well to break up any vapor bubbles which might form during hot engine idle. The fuel then travels up through the idle pick up tube and through the cross bar channel in the air horn. Air is then bled into the idle fuel at the center of the cross bar through the two top bleeds and nozzle hole. The air/fuel mixture is picked up by the horizontal idle tube in the cross bar and metered through a calibrated restriction, then passes on into the vertical down channel where it is further bled with air by an internal idle air bleed in the vertical channel in the top of the float chamber. The fuel travels downward, past the off idle discharge port where more air is picked up to mix with the fuel mixture and it then passes out the idle needle port below the throttle valve. Here the fuel mixture mixes with air coming past the slightly open throttle valves and passes on into the engine as a combustible idle mixture.

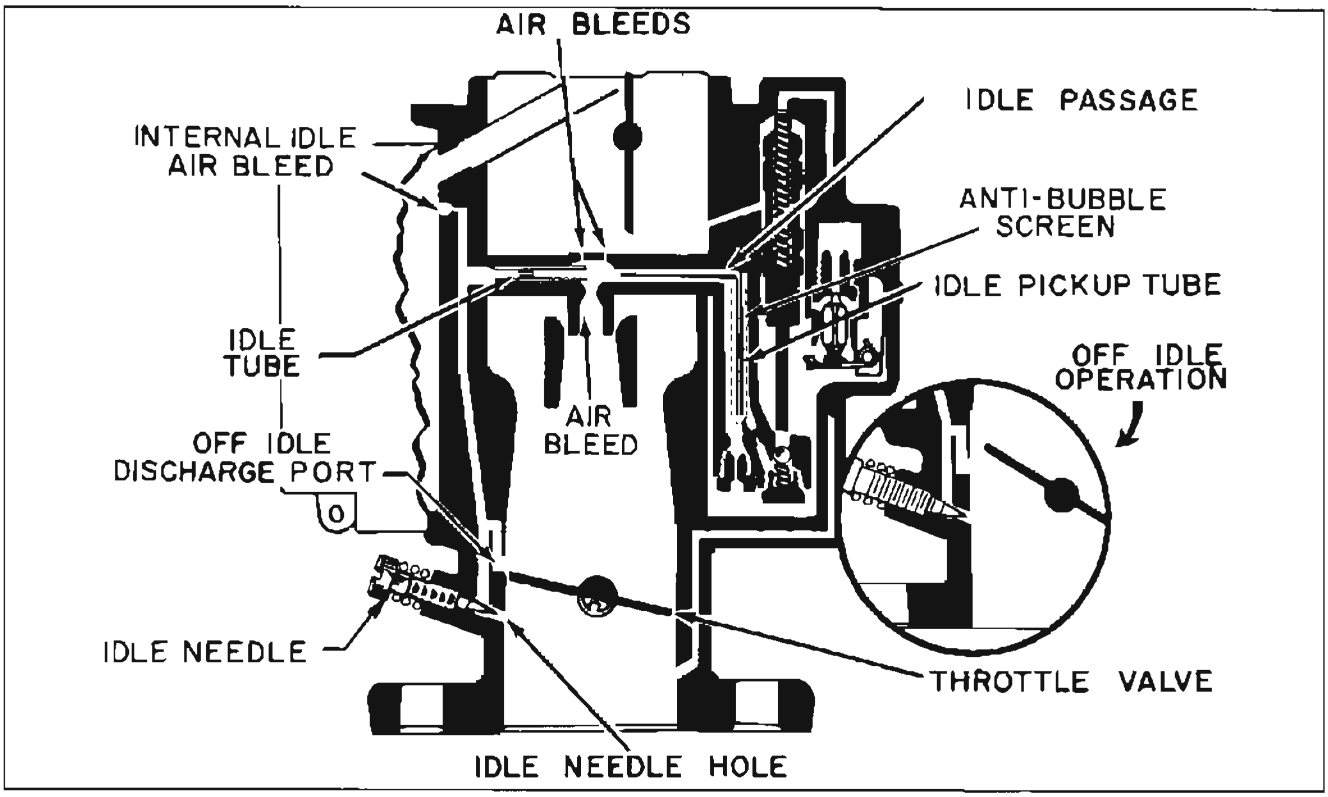



Figure 3-62—Low Speed System

As the throttle valve is opened slightly and engine speed increases, extra fuel is needed to combine with the additional air going by the throttle valve. This fuel is supplied by the off-idle discharge port.

Still further opening of the throttle valve causes increased air flow through the carburetor bore which causes a pressure drop in the small venturi sufficient to cause fuel delivery from the main nozzle. It should be remembered, however, that off-idle port discharge does not cease at this point, but rather diminishes as main nozzle discharge increases. Thus, the two systems combine to produce the correct air/fuel flow at intermediate engine speeds.

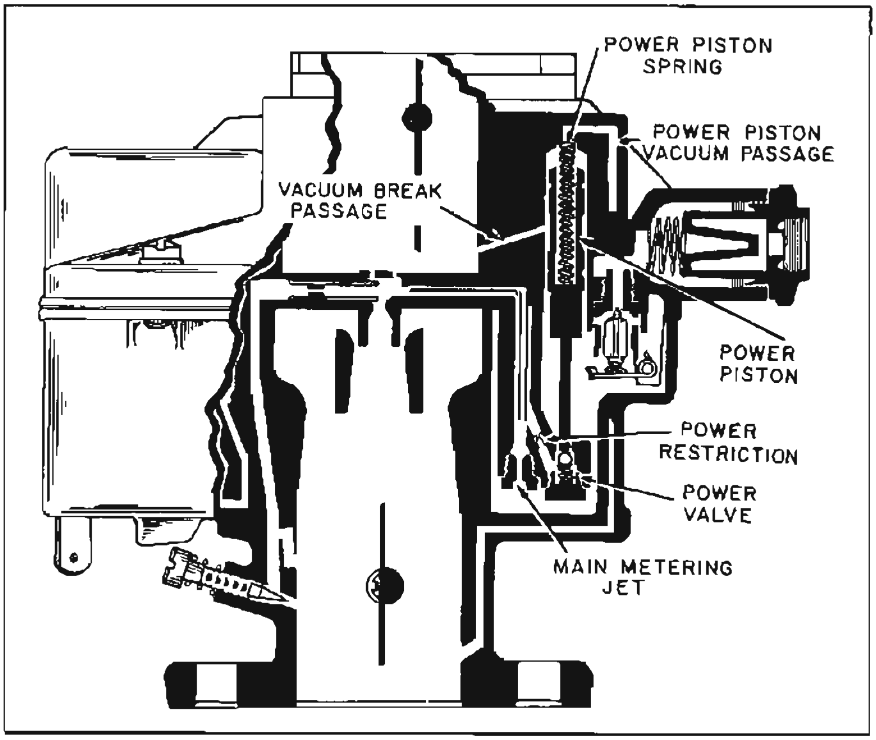



Figure 3-64—Power System

#### d. Operation of Main Metering (High Speed)

Once air flow is sufficient for fuel flow to start from the main nozzle, fuel will flow from the fuel bowl through the main metering system into the venturi, as follows:

Fuel passes through the main metering jet into the main well where it rises in the main well passage and idle pickup tube. It continues up the main well tube to the horizontal cross bar in the air horn and through the cross bar to the main discharge nozzle. At this point, air is bled into the fuel by the two air bleeds in the top of the cross bar channel. The mixture is then discharged through the main discharge nozzle into the small venturi; here, it mixes with additional air and moves on through the bore of the carburetor and into the intake manifold. See Figure 3-63.

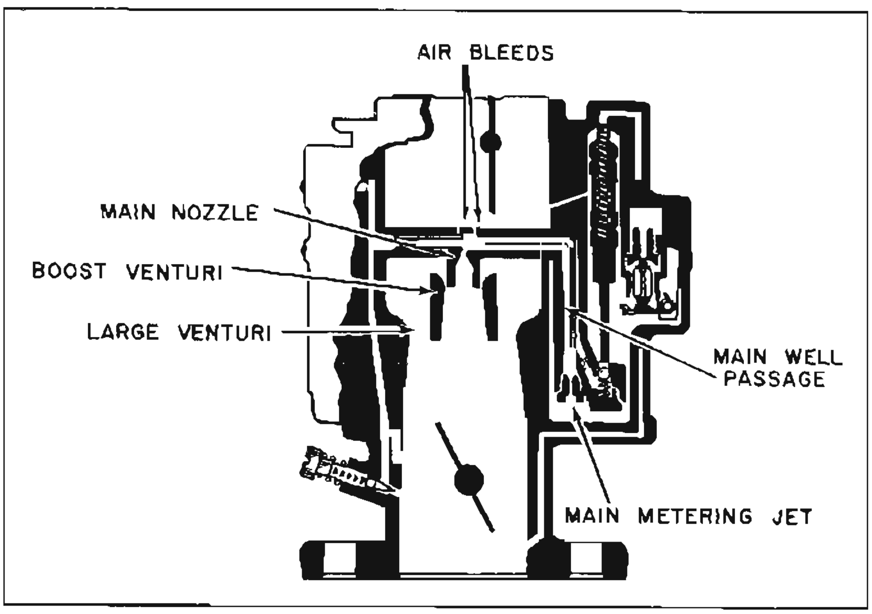



Figure 3-63—High Speed System

The calibration of the main metering jet and air bleeds in the cross bar maintain economical air/fuel ratios throughout the main metering or cruising range. Therefore, no adjustments are necessary in the main metering system.

#### e. Operation of Power System

A vacuum operated power system is used in the carburetor to provide additional fuel for extreme high speed operation or for heavy engine load. A direct manifold vacuum passage connects to the

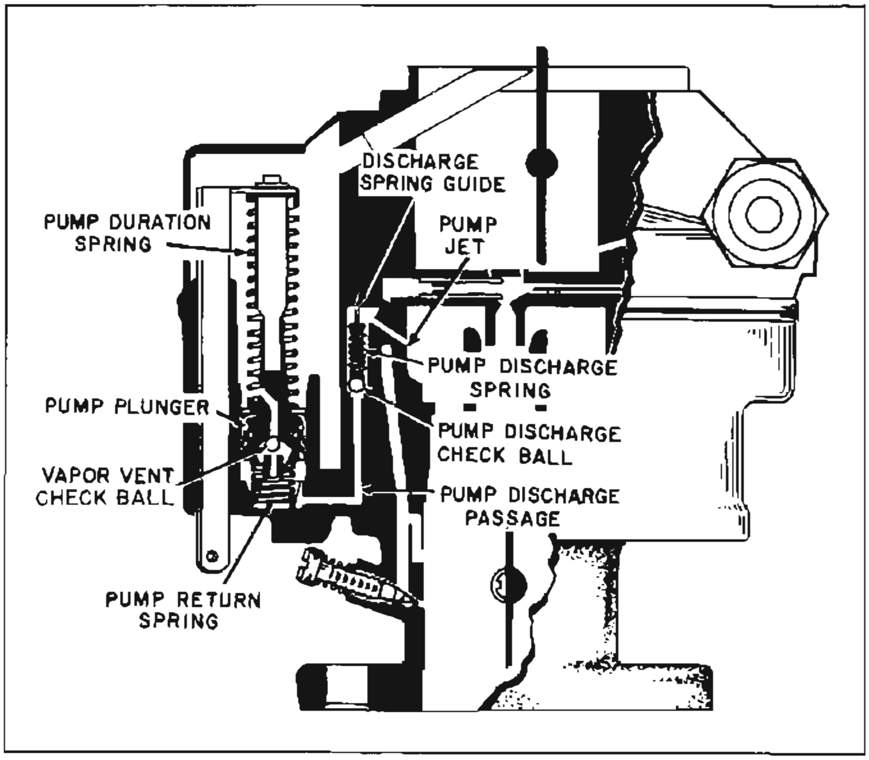



Figure 3-65—Accelerating Pump System

power piston. Under heavy engine load the manifold vacuum drops, thereby allowing a spring to force the power piston downward. The power piston spring is calibrated to force the power piston downward at a specified vacuum. See Figure 3-64.

The downward motion of the power piston unseats the spring loaded ball in the power valve assembly. Fuel passes around the ball in 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 a specific point, the power piston is drawn up and the spring loaded ball of the power valve closes, returning the carburetor to the economical part throttle mixture. There is no power system adjustment.

The relief passage which is drilled from the bore of the air horn to the power piston chamber serves to relieve any vacuum build-up around the piston diameter. This vacuum, if unrelieved, would draw fuel vapors from the float bowl past the piston and down the vacuum passage into the manifold, resulting in an overly rich mixture.

### f. Operation Accelerating (Pump) System

Rapid opening of the throttle valve causes an immediate increase in air velocity in the carburetor venturi and bore area. 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 squirts a quantity of liquid fuel into the air stream to mix with the incoming air and maintain the proper air/fuel mixture.

When the throttle valve is closed, the pump plunger moves upward in its cylinder allowing fuel to flow from the float bowl through a slot in the side of the pump well, into the pump well, past the plunger head, through the vapor check ball and on into the bottom of the pump well. The pump discharge ball is seated at this time to prevent fuel from draining from the pump discharge passage. See Figure 3-65.

When the pump plunger is moved downward for acceleration, the force of the stroke first seats the vapor check ball in the pump plunger head to prevent fuel flow back into the float bowl. Continued downward motion of the pump plunger forces fuel up through the discharge passage (lifting the pump discharge ball from its seat) and then passes on through the pump jets into the venturi.

### g. Operation of Choke System

The choke system includes a thermostatic coil, choke housing, choke piston, choke valve, fast idle cam and linkage. It is controlled by a combination of manifold vacuum, air velocity against the off-set choke valve, and tension of the thermostatic coil. See Figure 3-66.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. Starting the engine causes air velocity to strike the off-set choke valve which tends to open it along with the action of intake manifold vacuum connected by a passage directly to the choke piston bore. After a slight opening of the choke valve, the tension of the thermostatic coil balances the force of air on the valve and the pull of vacuum at the choke piston.

As the engine warms up, the manifold vacuum which exists in the choke housing pulls hot air from the choke stove through an air passage to heat the thermostatic coil.

A baffle plate inside the choke housing serves to distribute heat from its entry point at the side of the coil evenly throughout the choke housing. This prevents hot spots which would cause uneven opening of the choke valve. The thermostatic coil relaxes gradually until the choke valve is fully opened.

During warm-up it is necessary to provide a faster idle to prevent engine stalling. This is accomplished by a fast idle cam which is connected by a link to the upper choke lever on the choke shaft. The idle screw on the throttle lever contacts graduated steps on the fast idle cam to provide a faster idle than normal. When the engine is fully warm and the choke valve is wide open, the fast idle cam rotates so the idle screw rests on the low step on the fast idle cam where normal curb idle is obtained.

If the engine becomes flooded during the starting period, the choke valve can be partially opened manually to allow increased air flow to the carburetor. This is accomplished by depressing the accelerator pedal to the floor. The unloader projection on the throttle lever contacts the edge of the fast idle cam and, in turn, partially opens the choke valve.

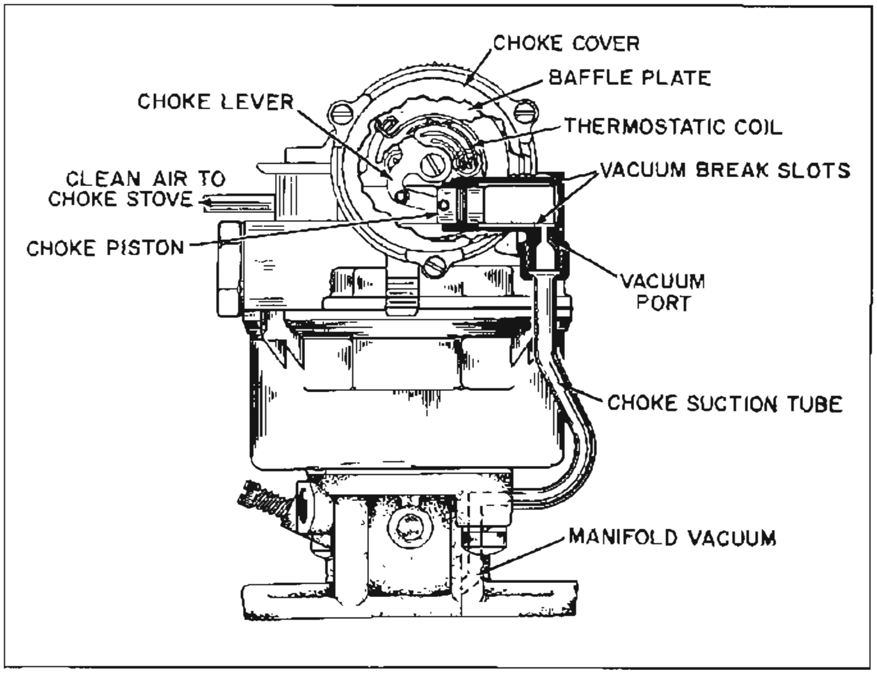



Figure 3-66—Choke System

## 3-23 DISASSEMBLY, CLEANING AND INSPECTION OF ROCHESTER 1-BARREL CARBURETOR

### a. Disassembly of Choke

1. Loosen 1/2" fitting on choke suction tube. Push fitting and gasket seal downward on the tube.

2. Remove three choke cover attaching screws and retainers. Remove choke cover, cover gasket, and thermostatic coil assembly from carburetor.

3. Remove baffle plate inside choke housing.

4. Remove choke piston and lever assembly from inside choke housing by removing lever attaching screw from center of choke shaft.

5. The choke piston may be removed from the choke piston lever by shaking out the choke piston pin.

6. Remove two choke housing attaching screws inside choke housing, then remove choke housing from the air horn.

7. Remove fast idle cam attaching screw. Then the fast idle cam and choke rod can be removed from upper choke lever by carefully rotating assembly upward and sliding end of rod out of upper choke lever.

8. To remove choke valve, remove air cleaner hold-downs. Then remove the two choke valve attaching screws from the choke shaft and pull upward on choke valve to remove from shaft. Choke shaft and lever assembly can now be removed from air horn.

Note position of choke trip lever in relation to upper choke lever tang for ease in reassembly.

### b. Air Horn Disassembly

1. Remove fuel filter inlet nut and gasket with 1" wrench. Then remove filter, filter spring and gasket between filter element and back side of inlet nut.

2. Remove four air horn attaching screws. Lift air horn straight up from bowl so as not to damage float. Place air horn, float side up, on a flat surface.

3. Remove float hinge pin and lift float assembly from air horn. Remove float needle.

4. Remove float needle seat and gasket with 1/2" bit screwdriver or wide blade screwdriver.

5. Remove main metering jet from bottom of main well support.

6. Remove hex head power valve check ball retainer from bottom of support, then remove power valve spring and ball.

7. Remove screw at base of main well support, then remove the main well support from air horn.

8. Remove power piston and power piston spring from air horn.

NOTE: Do not remove idle pick up tube from air horn as it is pressed in place.

9. Remove air horn gasket.

**c. Float Bowl Disassembly**

1. Remove small "O" ring seal around power piston vacuum tube on top of inner bowl parting surface.

2. Using a pair of long nosed pliers, remove pump discharge guide. Pump discharge spring and ball may now be removed by inverting bowl and shaking into palm of hand.

3. Remove two hair pin clips from pump link and then remove pump link from throttle lever and pump plunger rod.

4. Remove the pump plunger from the float bowl by pulling straight upward.

5. Remove pump return spring from bottom of pump well.

NOTE: Do not remove choke suction tube from throttle body.

6. 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.

**d. Throttle Body Disassembly**

1. Remove idle mixture adjusting needle and spring.

2. Remove throttle stop screw from throttle lever if necessary to replace.

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.

**e. Cleaning and Inspection**

1. Thoroughly clean carburetor castings and metal parts in carburetor cleaning solvent.

CAUTION: Pump plunger and any synthetic or plastic parts should not be immersed in commercial carburetor cleaner.

2. After cleaning, blow out all passages and castings with compressed air until dry.

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 area on float arm above float needle for wear and floats 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) Check idle mixture needles for burrs or ridges.

(e) If wear is noted on the steps of the fast idle cam, it should be replaced as it may upset engine idle during the engine warm-up period.

(f) Inspect pump plunger leather. Replace plunger if leather is scored, hardened or damaged.

(g) Check pump plunger vent ball to make sure that it is free inside pump plunger head. This may be done by shaking, ball should rattle freely.

(h) Inspect for burrs on the power piston or a distorted power piston stem or spring.

4. Always use new gaskets in reassembly.

5. Check to make sure that the lower end of the choke suction tube is tight in the throttle body.

6. Inspect choke suction tube hex nut packing. If packing is unduly compressed, out of round, or torn, it should be replaced.

7. Clean all dirt or lint out of the fuel inlet filter. If filter remains plugged, replace it. Check relief spring for distortion, replace it if necessary.

## 3-24 ASSEMBLY OF ROCHESTER 1-BARREL CARBURETOR

**a. Throttle Body Assembly**

1. Install throttle stop screw in throttle lever, if removed.

2. Screw idle mixture adjusting needle and spring into throttle body until it is finger tight. Back needle out 1-3/4 turns as a temporary idle mixture adjustment.

3. Using a new gasket, attach throttle body to bowl using two screws and lock washers. Tighten screws evenly and securely.

**b. Float Bowl Assembly**

1. Install 3/16" steel ball into pump discharge cavity. Carefully insert pump discharge spring and guide on top of ball. Tap the discharge guide lightly to seat flush with the float bowl casting.

NOTE: The pump discharge guide is installed correctly when it is at right angles with the pump discharge jet.

2. Place pump return spring in pump well and bottom spring in well by forcing downward with index finger.

3. Install pump plunger assembly in bowl, making sure not to curl plunger cup during installation.

4. Install small "O" ring seal around power piston vacuum tube

on top of inner bowl parting surface.

5. Attach pump link to pump plunger rod and throttle lever using two hair pin clips.

NOTE: Dog leg in pump link will face away from throttle shaft when installed correctly.

### c. Air Horn Assembly

1. Install float needle seat and gasket using a screwdriver with 1/2" bit or a wide blade screwdriver.

2. Place new air horn gasket on top air horn, check to be sure that all air horn and gasket holes are in line.

3. Install power piston spring and power piston in vacuum cavity.

NOTE: Piston should ride free in cavity.

4. Install power valve ball (small steel ball), power valve spring, and retainer in main well support.

5. Attach main well support to air horn assembly and tighten attaching screw securely. Tighten power valve retainer 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.

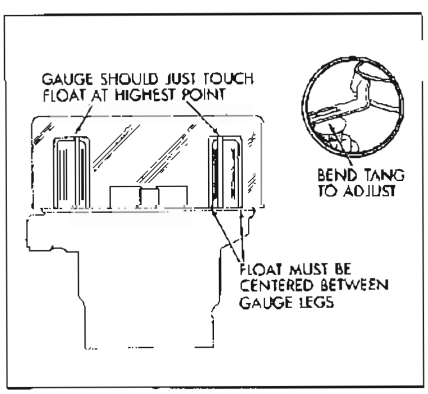



Figure 3-67—Float Level Adjustment

8. Place float carefully in position with drop tang pointing downward towards air horn and install float hinge pin.

### d. Float Level Adjustment

(Use 1964-5 Carburetor Gauge Set J-21615.)

With air horn inverted and gasket in place, position Gauge J-5127-2 over the float with the gauge tang inserted in the discharge nozzle. Bend the small tang over the float needle up or down until the top of each float just touches the gauge and the float is centered between the 1-9/32" gauge legs. See Figure 3-67.

### e. Float Drop Adjustment

Bend the float tang at the rear of the float arm, next to the needle seat, as necessary to obtain a distance of 1-3/4" from the gasket surface to the bottom of the float with the air horn held in the upright position and the float hanging free. Measure with Gauge J-5127-2. See Figure 3-68.

9. Install air horn to bowl assembly being careful to lower the air horn straight down so that the floats will not be bent during installation.

10. Install four air horn to float bowl attaching screws and tighten evenly and securely.

11. Install 2 gaskets and filter element in fuel inlet nut. Install filter relief spring in air horn. Install nut and assembled parts into air horn. See Figure 3-69.

### f. Choke Assembly

1. Install choke housing to air horn with two Phillips screws. Tighten screws evenly and securely.

NOTE: Install choke suction tube fitting and packing over choke suction tube. Engage tube in choke housing before assembling housing to air horn.

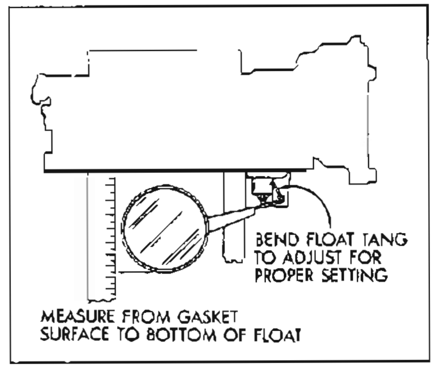



Figure 3-68—Float Drop Adjustment

2. Tighten choke housing suction tube fitting.

3. Install plastic upper choke rod lever on choke shaft. Tang on lever should point towards air horn casting.

4. Assemble choke shaft into air horn from the throttle lever side. Tang on the trip lever should be above the tang on the upper choke lever. See Figure 3-60.

5. Install choke valve into the slot in the choke shaft. RP trade mark should face upward. Install two choke valve attaching screws.

6. To insure proper end clearance between the choke trip lever and choke rod lever, move the choke shaft horizontally to obtain .020 clearance between the two levers. Then tighten the two choke valve attaching screws securely and stake in place.

7. Assemble choke piston to the

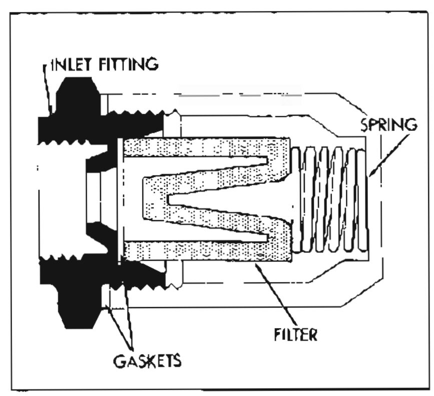



Figure 3-69—Fuel Inlet Filter

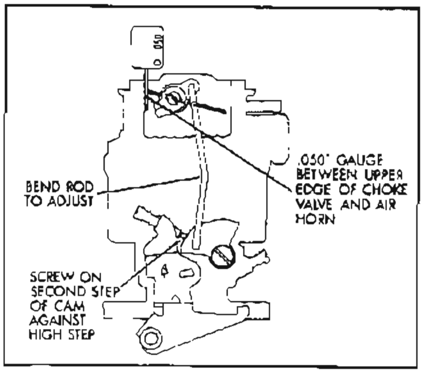



Figure 3-70—Choke Rod Adjustment

choke piston lever with small piston pin. Install choke piston and lever assembly into choke housing by placing choke piston into the choke piston bore.

8. Align flats on the choke shaft with the flats in the choke piston lever. Install attaching screw into the end of the choke shaft and tighten securely to retain choke piston lever to the choke shaft.

9. Install baffle plate into the choke housing. Place new choke cover gasket onto the thermostatic coil and cover assembly and then install the thermostatic coil to the choke housing.

10. Rotate the thermostatic cover and coil assembly clockwise until the tang on the thermostatic coil picks up the tang on the choke piston lever and begins to close the choke valve. Keep rotating in a clockwise direction until the marks are indexed.

11. Install three retainers and attaching screws to the choke cover and housing. Tighten securely. Install air cleaner hold-down.

12. Install the choke rod to the fast idle cam, then carefully insert the upper end of the choke rod into the upper choke lever. See Figure 3-60. The dog leg of rod must face towards the idle mixture adjusting needle.

14. Attach the fast idle cam to the throttle body assembly with the fast idle cam screw and tighten securely. The steps on the fast idle cam should face towards the idle speed screw.

## 3-25 EXTERNAL ADJUSTMENT OF ROCHESTER 1-BARREL CARBURETOR

(Use 1964-5 Carburetor Gauge Set J-21615.)

### a. Choke Rod Adjustment

With the idle screw resting on the second step of the fast idle cam and against the shoulder of the high step, bend the choke rod as shown to obtain sufficient clearance to allow the insertion of the .050" gauge between the upper edge of the choke valve and the air horn. See Figure 3-70.

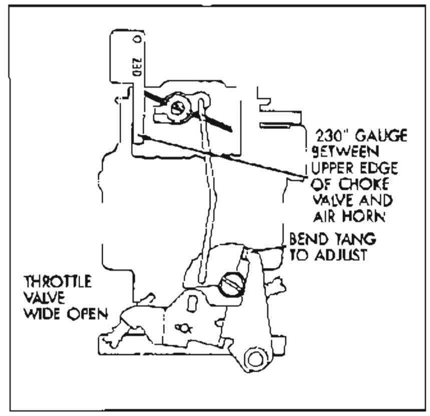



Figure 3-71—Choke Unloader Adjustment

### b. Choke Unloader Adjustment

Bend the unloader tang on the throttle lever as necessary to allow the insertion of the .230" gauge between the upper edge of the choke valve and the air horn, with the throttle valve held wide open. See Figure 3-71.

# GROUP 4

# CLUTCH, S-M TRANSMISSION

## SECTIONS IN GROUP 4



# SECTION 4-A

# CLUTCH

## CONTENTS OF SECTION 4-A



## 4-1 CLUTCH SPECIFICATIONS

### a. Tightening Specifications

| Part | Location | Thread Size | Torque Ft.-Lbs. |
|---|---|---|---|
| Bolt | Clutch Cover to Flywheel | 3/8 -16 x 1 | 30-40 |
| Stud | Clutch Release Fork Ball | 13/16-16 | 35-45 |
| Bolt | Transmission to Flywheel Housing | 1/2 -13 x 1 1/2 | 45-60 |
| Bolt | Flywheel Housing to Cylinder Block | 3/8 -16 x 1 1/4 | 30-40 |

### b. Clutch Specifications

| | V-6 | V-8 |
|---|---|---|
| Type | Single Plate Dry Disc | |
| Pedal Pressure | 28 to 33 lbs. | |
| Pedal Lash | See Par. 4-3 | |
| Driven Plate Diameter | 9 1/8" | 10 13/32" |
| Driven Plate Facings | Woven Asbestos | |
| Number of Facings | 2 | |
| Facing Attachment | Riveted | |
| Facing Area | 71.88 | 103.5 |
| Vibration Damping | 6 Torsional Springs | |

## 4-2 CLUTCH DESCRIPTION

All synchromesh cars are equipped with a single plate dry disc clutch, and incorporates a diaphragm type spring assembly. See Figure 4-1.

### a. Releasing Action

Depressing the clutch pedal causes movement of the clutch fork in the direction shown in Figure 4-2. Actual operation of the clutch linkage in this operation is explained in Paragraph C below. The clutch fork, pivoting on a ball stud, acts upon the throw out bearing. The bearing in turn, forces the tangs of the diaphragm spring in the direction shown in Figure 4-2. The diaphragm spring, being retained in the clutch cover by 9 rivets and 2 wire rings, is mounted in such a way that the spring can pivot or dish on these rings. This again reverses the direction of force. This force is applied directly to the 3 retracting springs which, in turn, pull the pressure plate rearward and out of contact with the driven plate.

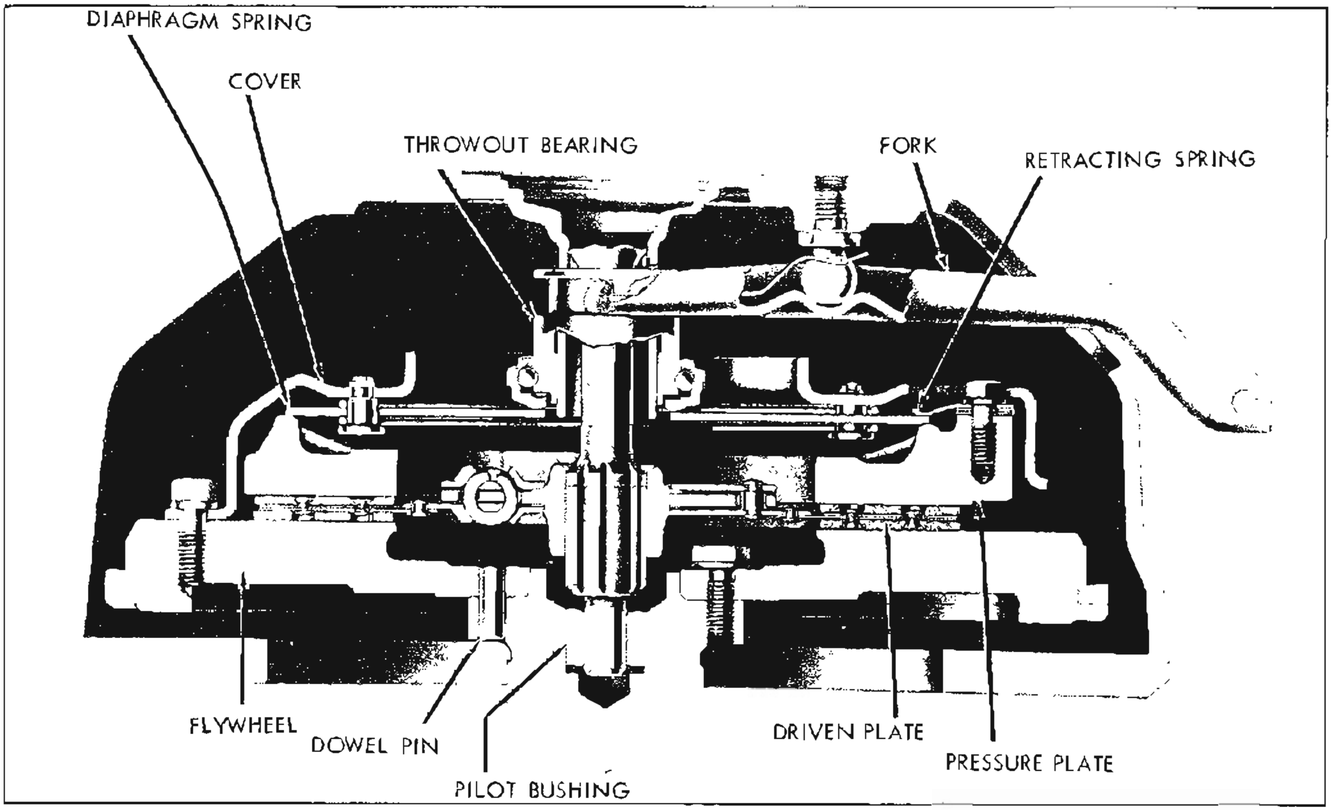



Figure 4-1—Standard Clutch

**b. Clutch Driven Plate**

The clutch driven plate assembly is mounted with a free sliding fit on the transmission main drive gear and is keyed to the gear by ten splines. The front end of the main drive gear is piloted by a bushing pressed into a recess in the rear end of the engine crankshaft. See Figure 4-1.

The outer area of the driven plate is divided into segments which are formed in low waves to provide springs between the plate facings and thereby cushion engagement of the clutch. A molded facing, grooved to give release, is riveted to each side of every segment of the plate. When the clutch is fully released, the waved segments cause the facings to spread approximately .045". The movement of pressure plate provides an additional clearance of approximately .030" to assure full release of the driven plate. See Figure 4-2.

The driven plate assembly is designed to prevent torsional periods of the engine from being transmitted to the transmission gears and causing rattle. This is accomplished by driving the plate hub through torsional coil springs and providing frictional dampening by means of molded frictional washers.

**c. Clutch Linkage**

The clutch pedal is the suspended

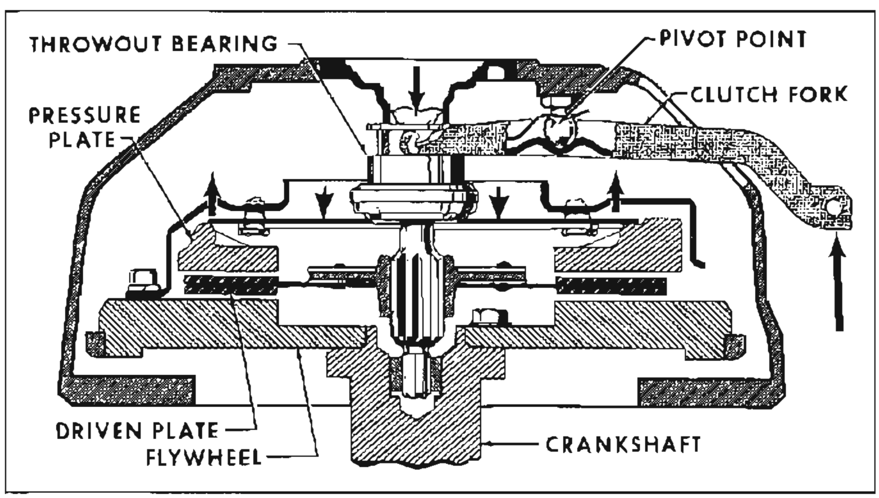



Figure 4-2—Clutch Releasing Action

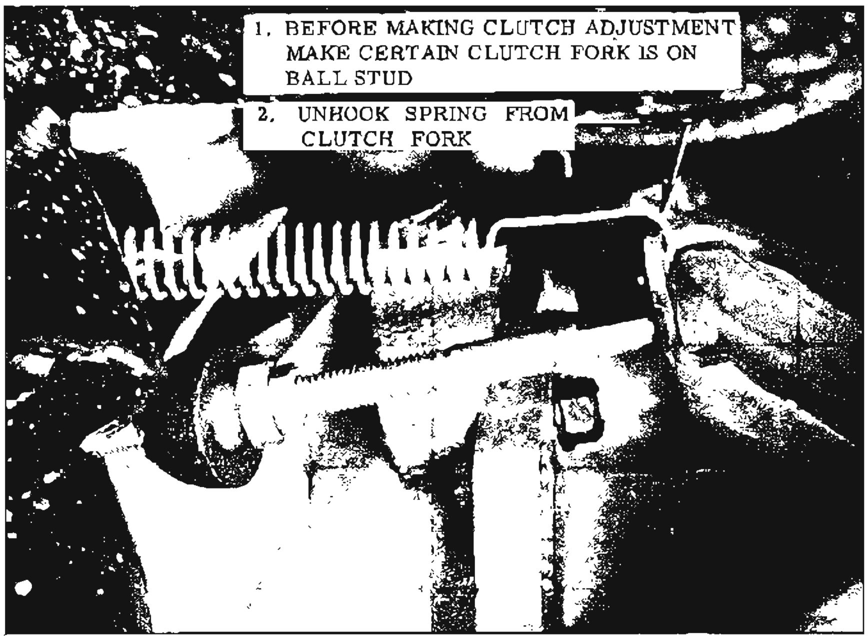



Figure 4-3—Removing Clutch Fork Spring

type and pivots on a shaft which extends thru a bracket bolted to the cowl. The pedal arm returns against a rubber bumper. See Figure 4-6.

The clutch operating rod extends from the clutch pedal thru the cowl, where it is retained to the outer equalizer operating lever by a washer and clip. The clutch outer equalizer lever is joined with the inner equalizer lever by the equalizer shaft assembly. Projections extending from the spherical ends of the equalizer shaft interlock with the equalizer levers at each end. The entire equalizer unit is supported by a pivot stud attached to the crankcase, and a bracket attached to the frame. See Figure 4-6.

A rod, threaded at one end, is attached to the equalizer lever and is provided with a locking nut for adjustment purposes. The other end is spherical and pivots in an indentation in the clutch fork. Movement of the equalizer assembly is thus transmitted to the clutch fork and the frame.

## 4-3 CLUTCH ADJUSTMENT

Pedal lash (free pedal) must be adjusted occasionally to compensate for normal wear of clutch facings. As the driven plate wears thinner, pedal lash decreases.

It is very important to maintain pedal lash at all times. Insufficient pedal lash will cause the throw out bearing to ride against the diaphragm spring tangs constantly, resulting in abnormal wear of these parts. It may also cause clutch slippage and abnormal wear of the driven plate, flywheel, and pressure plate if pressure on the spring tangs is enough to prevent positive engagement of the clutch.

Check pedal lash (free pedal) by pushing on the pedal pad with the hand. Pedal lash should be 5/8" to 7/8" measured at the pedal pad. (See Figure 4-6).

a. Adjust pedal lash as follows:

1. Check pedal at full release position, making sure it contacts rubber stop.

2. Adjust clutch release rod to give zero lash at pedal.

3. Back off release rod 3 full turns.

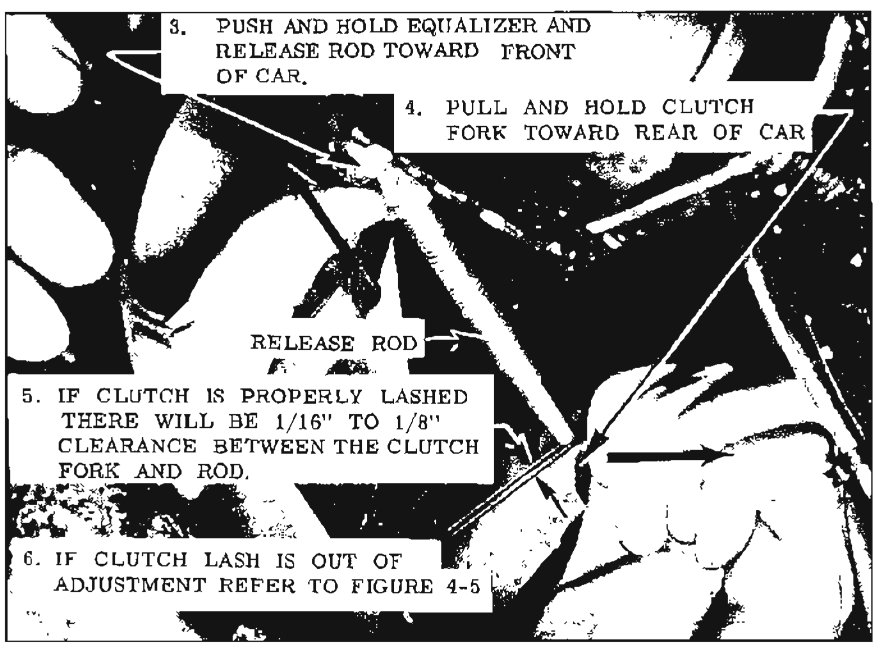



Figure 4-4—Checking Clutch Adjustment

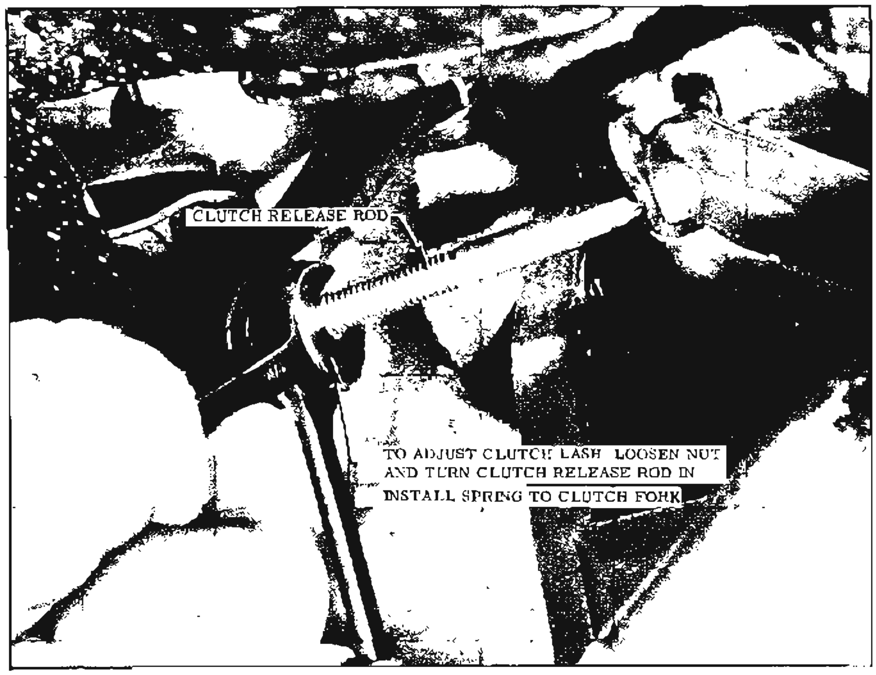



Figure 4-5—Adjusting Clutch

4. Check pedal lash. If not between 5/8" to 7/8", adjust release rod further.

b. Proceed as shown in Figures 4-3, 4-4 and 4-5 for an alternate method of adjusting clutch lash:

## 4-4 REMOVAL LUBRICATION AND INSTALLATION OF CLUTCH

### a. Removal from Vehicle

1. Remove transmission as outlined in Paragraph 4-9.

2. Remove clutch throw-out bearing from the clutch fork.

3. Remove pedal return spring from clutch fork.

4. Remove flywheel housing.

5. Disconnect clutch fork from ball stud by forcing it toward the center of the vehicle.

6. Mark clutch cover and flywheel with a center punch so that cover can be reinstalled in the same position of the flywheel in order to preserve engine balance.

7. Loosen the clutch attaching bolts one turn at a time to avoid bending of clutch cover flange until diaphragm spring is released.

8. Support the pressure plate and cover assembly while removing last bolts, then remove pressure plate, and driven plate.

NOTE: Use extreme care to keep clutch driven plate CLEAN.

9. If it becomes necessary to disassemble pressure plate, proceed as follows:

a. Remove three drive-strap to pressure plate bolts and retracting springs and remove pressure plate from clutch cover.

NOTE: When disassembling, note position of grooves on edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

b. The clutch diaphragm spring and two pivet rings are riveted to the clutch cover. Spring, rings and cover should be inspected for excessive wear or damage, and if there is a defect, it is necessary to replace the complete cover assembly.

### b. Lubrication of Clutch

1. Very sparingly apply wheel bearing lubricant in pilot bushing in crankshaft.

NOTE: If too much lubricant is used, it will run out on face of flywheel when hot and ruin the driven plate facings.

2. Make sure that splines in the driven plate hub are clean and apply a light coat of wheel bearing lubricant. Apply a light coat of wheel bearing lubricant on transmission drive gear splines. Slide driven plate over transmission drive gear several times. Remove driven plate and wipe off all excess lubricant pushed-up by hub of plate.

NOTE: Driven plate facings must be kept clean and dry.

3. Fill groove in throw-out bearing with wheel bearing lubricant. See Figure 4-8. Make sure transmission front bearing retainer is clean and apply a light coat of wheel bearing lubricant. Slide throw-out bearing over transmission retainer several times. Remove throw-out bearing and wipe off all excess lubricant pushed up by hub of bearing.

4. Clean and apply wheel bearing lubricant to ball stud in flywheel housing and to the seat in clutch fork.

5. Check clutch pilot bearing for excessive wear or damage. If replacement is necessary, remove bearing with J-1448. For installation use Driver J-1522.

NOTE: Very sparingly apply wheel bearing lubricant in pilot bushing. If too much lubricant is used, it will run out on face of flywheel when hot and ruin the driven plate facings.

### c. Inspection of Clutch

Wash all metal parts of clutch, except release bearing and driven

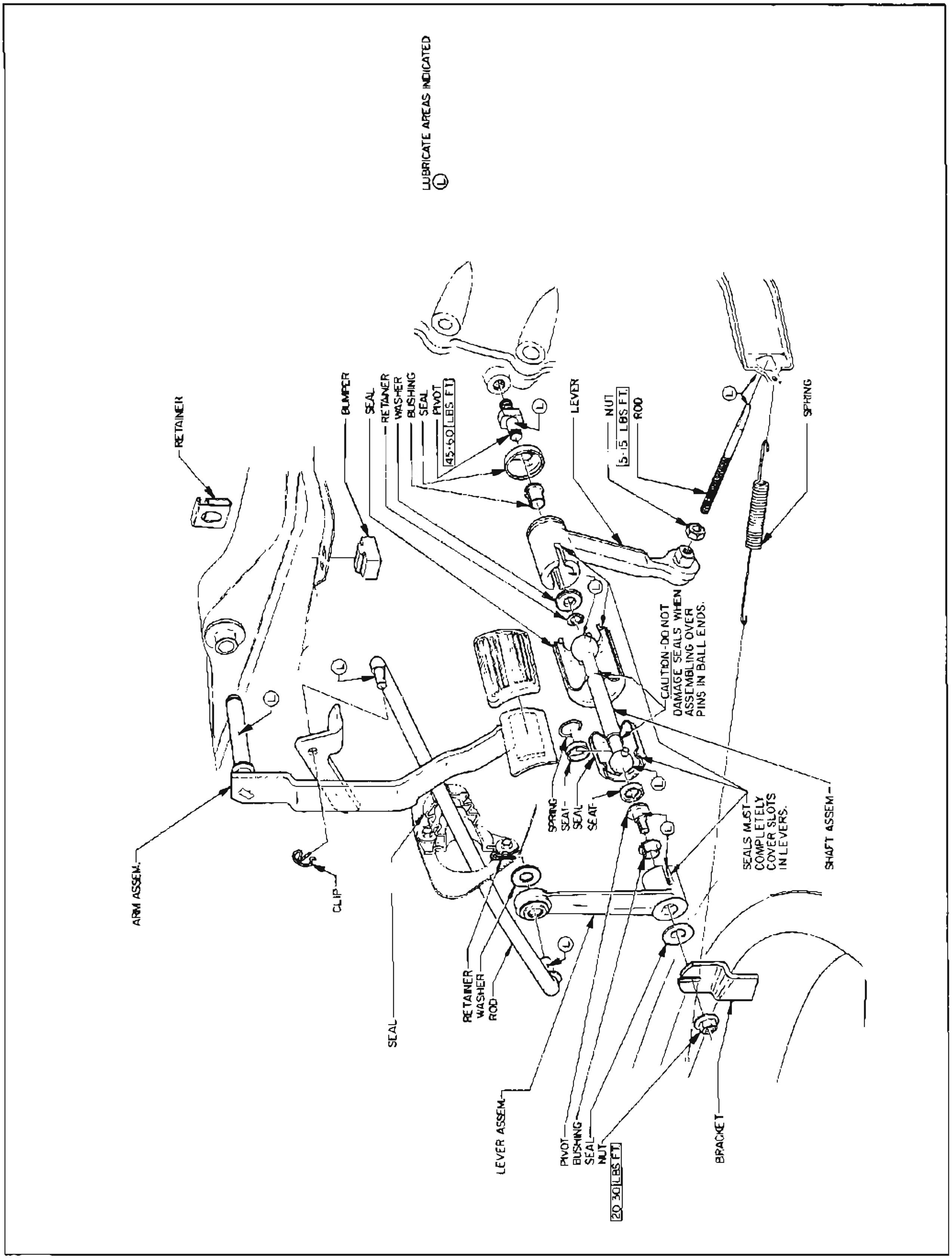



Figure 4-6—Clutch Linkage

plate, in suitable cleaning solution to remove dirt and grease. Soaking release bearing in cleaning solution would permit solution to seep into bearing and destroy the lubricant. Soaking driven plate in cleaning solution would damage the facings.

1. Flywheel and Pressure Plate. Examine friction surfaces of flywheel and pressure plate for scoring or roughness. Slight roughness may be smoothed with fine emery cloth, but if surface is deeply scored or grooved the part should be replaced.

2. Clutch Driven Plate. Inspect driven plate for condition of facings, loose rivets, broken or very loose torsional springs, and flattened cushion springs.

If facings are worn down near rivets or are oily, the plate assembly should be replaced. A very slight amount of oil on clutch facings will cause clutch grab and chatter. A large amount of oil on facings will cause slippage. Removal of oil by solvents or by buffing is not practical since oil will continue to bleed from facing material when hot.

When oil is found on driven plate facings, examine transmission drainback hole, pilot bushing, engine rear main bearing and other points of oil leakage.

Test the fit of driven plate hub on transmission main drive gear for an easy sliding fit.

3. Bearings. Inspect clutch release bearing for scoring or excessive wear on front contact face. Test for roughness of balls and races by pressing and turning front race slowly. Inspect main drive gear pilot bushing in crankshaft. If bushing is rough or worn it should be replaced.

Regardless of whether the old plate or a new one is to be installed, the plate should be checked for run-out. This check can be made by sliding the driven plate, front side first, over the transmission main drive gear until it is tight on the spline, then setting up a dial indicator to bear against the plate facing as shown in Figure 4-7. While holding firmly against front end of main drive gear to take up play in main drive gear bearing, slowly rotate driven plate and observe the amount of run-out shown by indicator. If run-out of front facing exceeds .025", the plate should not be used since it is not practical to correct excessive run-out by bending.

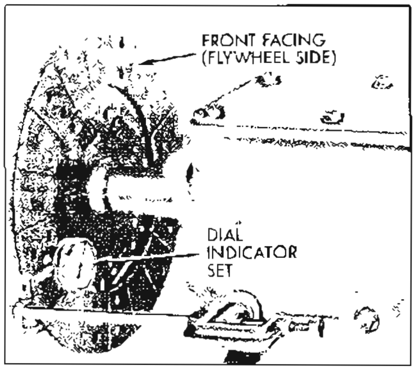



Figure 4-7—Checking Driven Plate For Run-Out

## d. Installation of Clutch

1. If the pressure plate was disassembled, follow steps a and b.

a. Install the pressure plate in the cover assembly, lining up the groove on the edge of the pressure plate with the groove on the edge of the cover.

b. Install pressure plate retracting springs and drive-strap to pressure plate bolts and lock washers and tighten to 11 ft. lbs. torque. The clutch is now ready to be installed.

2. Install the pressure plate and driven plate. Support both assemblies with a spare main drive gear.

NOTE: Be sure to align marks on clutch cover with the mark made of the flywheel on disassembly.

3. Install all bolts so that clutch is drawn in place square with flywheel. Each bolt must be drawn one turn at a time to avoid bending the clutch cover flange. Torque bolts to 30-40 ft. lbs.

4. Lubricate the ball stud and clutch fork with wheel bearing lubricant and install clutch fork.

NOTE: Check and insure that fork retaining spring is tight on pivot ball stud.

5. Install flywheel housing.

CAUTION: Insure that dowel pins are in place in crankcase.

6. Lubricate the recess on the inside of the throw-out bearing collar. See Figure 4-7.

CAUTION: Be careful not to use too much lubricant.

7. Install throw-out bearing assembly and hook up all clutch linkage.

NOTE: Make certain clutch fork is seated in throw-out bearing. (See Figures 4-1 and 4-2)

8. Install transmission as outlined in Paragraph 4-9.

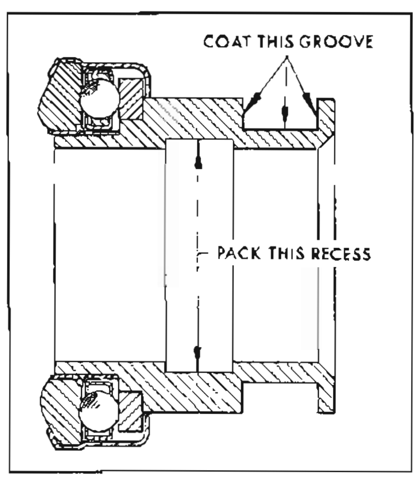



Figure 4-8—Throw-Out Bearing Lubrication

## 4-5 CLUTCH TROUBLE DIAGNOSIS

| SYMPTOM AND PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| FAILS TO RELEASE (PEDAL PRESSED TO FLOOR—SHIFT LEVER DOES NOT MOVE FREELY IN AND OUT OF REVERSE GEAR) | |
| a. Improper linkage adjustment | a. Adjust linkage |
| b. Improper pedal travel | b. Trim bumper stop and adjust linkage |
| c. Loose linkage | c. Replace bushings |
| d. Faulty pilot bearing | d. Replace bearing |
| e. Faulty driven disc | e. Replace disc |
| f. Fork off ball stud | f. Install properly and lubricate fingers at throw-out bearing |
| g. Clutch disc hub binding on clutch gear spline | g. Repair or replace clutch gear |
| SLIPPING | |
| a. Improper adjustment (no lash) | a. Adjust linkage (See Par. 4-3) |
| b. Oil soaked driven disc | b. Install new disc and correct oil leak at its source |
| c. Worn facing or facing torn from disc | c. Replace disc |
| d. Warped pressure plate or flywheel | d. Replace same |
| e. Weak diaphragm spring | e. Replace cover assembly |
| f. Driven plate not seated in | f. Make 20-50 normal starts |
| g. Driven plate overheated | g. Allow to cool—Check lash |
| GRABBING | |
| a. Oil on facing or burned or glazed facings | a. Install new disc |
| b. Worn splines on clutch gear | b. Replace transmission clutch gear |
| c. Loose engine mountings | c. Tighten or replace mountings |
| d. Warped pressure plate or flywheel | d. Replace pressure plate or flywheel |
| e. Burned or smeared resin on flywheel or pressure plate | e. Sand off if superficial, replace burned or heat checked parts |
| RATTLING—TRANSMISSION CLICK | |
| a. Weak retracting springs | a. Replace springs |
| b. Throw-out fork loose on ball stud or in bearing groove | b. Check ball stud and retaining spring and replace if necessary |
| c. Oil in driven plate damper | c. Replace driven disc |
| d. Driven plate damper spring failure | d. Replace driven disc |

## 4-5 CLUTCH TROUBLE DIAGNOSIS (Cont'd)

| SYMPTOM AND PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| THROW-OUT BEARING NOISE WITH CLUTCH FULLY ENGAGED | |
| a. Improper adjustment | a. Adjust linkage |
| b. Throw-out bearing binding on transmission bearing retainer | b. Clean, relubricate, check for burrs, nicks, etc. |
| c. Insufficient tension between clutch fork spring and ball stud | c. Replace fork |
| d. Fork improperly installed | d. Install properly |
| e. Weak linkage return spring | e. Replace spring |
| NOISY | |
| a. Worn throw-out bearing | a. Replace bearing |
| b. Fork off ball stud (Heavy clicking) | b. Install properly and lubricate fork fingers at bearing |
| PEDAL STAYS ON FLOOR WHEN DISENGAGED | |
| a. Bind in linkage | a. Lubricate and free up linkage |
| b. Springs weak in pressure plate | b. Replace |
| HIGH PEDAL EFFORT | |
| a. Bind in linkage | a. Lubricate and free up linkage |
| b. Driven plate worn | b. Replace driven plate |

# SECTION 4-B

# 3-SPEED SYNCHROMESH TRANSMISSION

## CONTENTS OF SECTION 4-B



NOTE: 3-Speed synchromesh transmission is standard equipment on Series 43-44000.

## 4-7 S-M TRANSMISSION SPECIFICATIONS

### a. Bolt Tightening Specifications

| Location | Size | Torque Ft. Lbs. |
|---|---|---|
| Side Cover Retaining Bolt (Use with 5/16 heavy lock washer) | 5/16-18 x 7/8 | 15-18 |
| Clutch Gear Bearing Retainer Bolt (Use with 5/16 internal tooth lock washer) | 5/16-18 x 3/4 | 10-12 |
| Transmission Rear Extension Retaining Bolt (Use with 7/16 external tooth lock washer) | 7/16-14 x 1 1/8 | 40-45 |

### b. Transmission Specifications

| | |
|---|---|
| Type | 3-Speed Manual Shift Synchromesh |
| Mounting | Unit with Engine |
| Lubricant | |
| Type | SAE 90 Transmission Multi-Purpose |
| Capacity | 2 Pints |
| Type of Gearing | All Helical |
| Synchronization | 2nd and 3rd Gears |
| Sliding Gears | 1st Reverse Gear |
| Gear Ratios | |
| 1st | 2.58 : 1 |
| 2nd | 1.48 : 1 |
| 3rd | 1.00 : 1 |
| Reverse | 2.58 : 1 |
| Gear Shifting | Remote, on Steering Column |

### c. Speedometer Gears

| | |
|---|---|
| Speedometer Driving Gear (on Mainshaft) | Press Fit |
| Driving Gear Teeth | |
| 3.08 Ratio Rear Axle | 8 |
| 3.23 Ratio Rear Axle | 8 |
| 3.55 Ratio Rear Axle | 8 |

| | Tire Size 6.95 x 14 | 7.35 x 14 | 7.75 x 14 |
|---|---|---|---|
| Driven Gear Teeth | | | |
| 3.08 Ratio Rear Axle | 20 | 19 | 19 |
| 3.23 Ratio Rear Axle | 21 | 20 | 20 |
| 3.55 Ratio Rear Axle | 23 | 22 | 21 |

## 4-8 S-M TRANSMISSION DESCRIPTION

The synchromesh transmission is solidly bolted to the rear face of the upper flywheel housing, forming a unit assembly with the engine. The clutch gear bearing retainer projects into a bore in the flywheel housing, serving as a pilot to center the transmission with the engine crankshaft.

### a. Transmission Gears and Shafts

The clutch gear extends thru the clutch driven plate into an oil impregnated bronze bushing in the rear of the engine crankshaft. The rear of the clutch gear is supported by a ball bearing in the front of the transmission case. The inner race of the bearing is a press fit on the clutch gear shaft. The outer race is grooved for a snap ring that fits between the transmission case and the front bearing retainer to hold the bearing and clutch gear in place.

The front end of the mainshaft is piloted in a double set of roller bearings set into the hollow end of the clutch gear, while the rear end is supported by the transmission rear bearing and is a slip fit in the front end of the transmission rear extension. The outer race is grooved for a snap ring which retains the race in the rear extension. The inner race is a press fit on the mainshaft. The bearing is prevented from moving forward by the second speed gear thrust washer, and retained at the rear by a snap ring fitted into a groove on the mainshaft.

The countergear is carried on roller bearings at both ends, while thrust is taken on washers located between each end of the gear and the case.

A hole in the hub of the countergear permits lubricant to reach the bearings and thrust washers.

The reverse idler gear is carried on ball indented bronze bushings. Forward thrust of the gear is taken on a washer located between the front of the gear and the case, while rearward thrust is taken on a radial needle bearing and a washer located between the rear of the gear and the case. The reverse idler gear shaft is held in position by a pin passing thru the case into the rear end of the shaft.

The second gear is mounted on the main shaft in such a position that it is constantly in mesh with the countergear. The gear is free to rotate on the main shaft except when engaged by the synchronizing assembly during second speed operation.

The first-reverse sliding gear is splined to the second-third speed clutch so that it can be moved forward to engage the countergear for first speed or rearward to engage the reverse idler for reverse.

### b. Gear Shifting and Synchronization

1. Gear Shifting - Shifter forks extending thru the transmission side cover constitute the gear change mechanism. The forward lever moves the clutch sleeve forward or rearward to provide synchronized 2nd and 3rd speeds. The rear lever moves the sliding ring gear forward or rearward to engage the countergear for 1st and Reverse speeds. A shift interlock prevents both levers from moving at the same time. One lever must be in neutral position before the other will function.

2. Synchronization

Gear shift synchronization is provided in 2nd and 3rd speeds by a clutch sleeve with one synchronizing ring at each end. The front ring is positioned over the drive splines of the main drive gear. The rear ring is positioned over the splines of the second speed gear. 4 lugs on the rings fit into slots in their respective gears, causing the rings to rotate when the gear rotates. This arrangement allows the ring to slide on the gear. An energizing spring, positioned in a groove on the gear, provides resistance to this movement. As the clutch sleeve is slid forward or rearward, the beveled outer diameter of the ring contacts the beveled inner diameter of the clutch sleeve. The ring, which is rotating at the same speed as the gear, causes the sleeve to rotate at the same speed the gear is rotating. Further movement of the sleeve forces the lugs of the synchronizing ring over the energizing spring on the gear. This resistance to movement of the ring, causes a more positive contact between the sleeve and the ring. Thus, the sleeve and ring rotate at the same speed. Still further movement of the sleeve allows the internal drive splines of the sleeve to mesh with the external drive splines of the gear. This provides a positive engagement of the sleeve with the gear. Since the clutch sleeve is splined to the mainshaft, the gear is "locked" to the mainshaft.

### c. Speedometer Gears

The speedometer driving gear is a press fit on the mainshaft. Normally, when changing rear axle ratios it is unnecessary to change the driving gear. However, with certain ratios, changing the driving gear becomes necessary. See Figure 4-20.

The driven gear and shaft is held in the rear extension by a fitting, lockplate, lock washer, and bolt. An "O" ring provides a seal between the driven gear assembly and the rear extension.

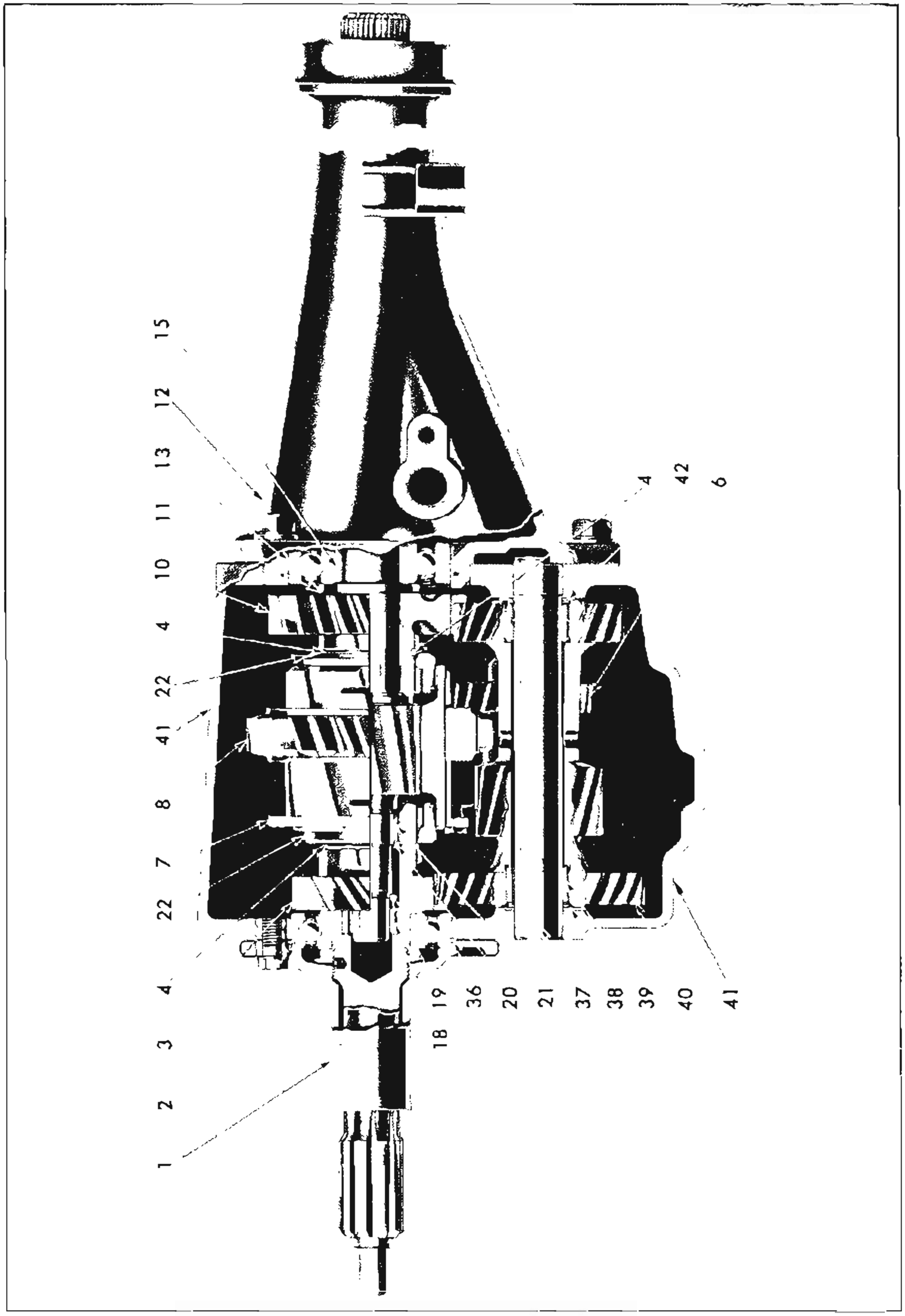



Figure 4-9—Transmission Cross-Section (Side View)

1. Clutch Gear Bearing Retainer
2. Clutch Gear Bearing
3. Clutch Gear
4. Energizing Spring
6. Reverse Idler Gear
7. Second and Third Speed Clutch
8. First and Reverse Sliding Gear
10. Second Speed Gear
11. Thrust Washer
12. Case Extension
13. Mainshaft Rear Bearing
15. Mainshaft
18. Front Pilot Bearing Rollers
19. Thrust Washer
20. Thrust Washer
21. Rear Pilot Bearing Rollers
22. Synchronizer Ring
36. Snap Ring
37. Countershaft
38. Thrust Washer
39. Roller Bearing
40. Countergear
41. Transmission Case
42. Roller Thrust Washer

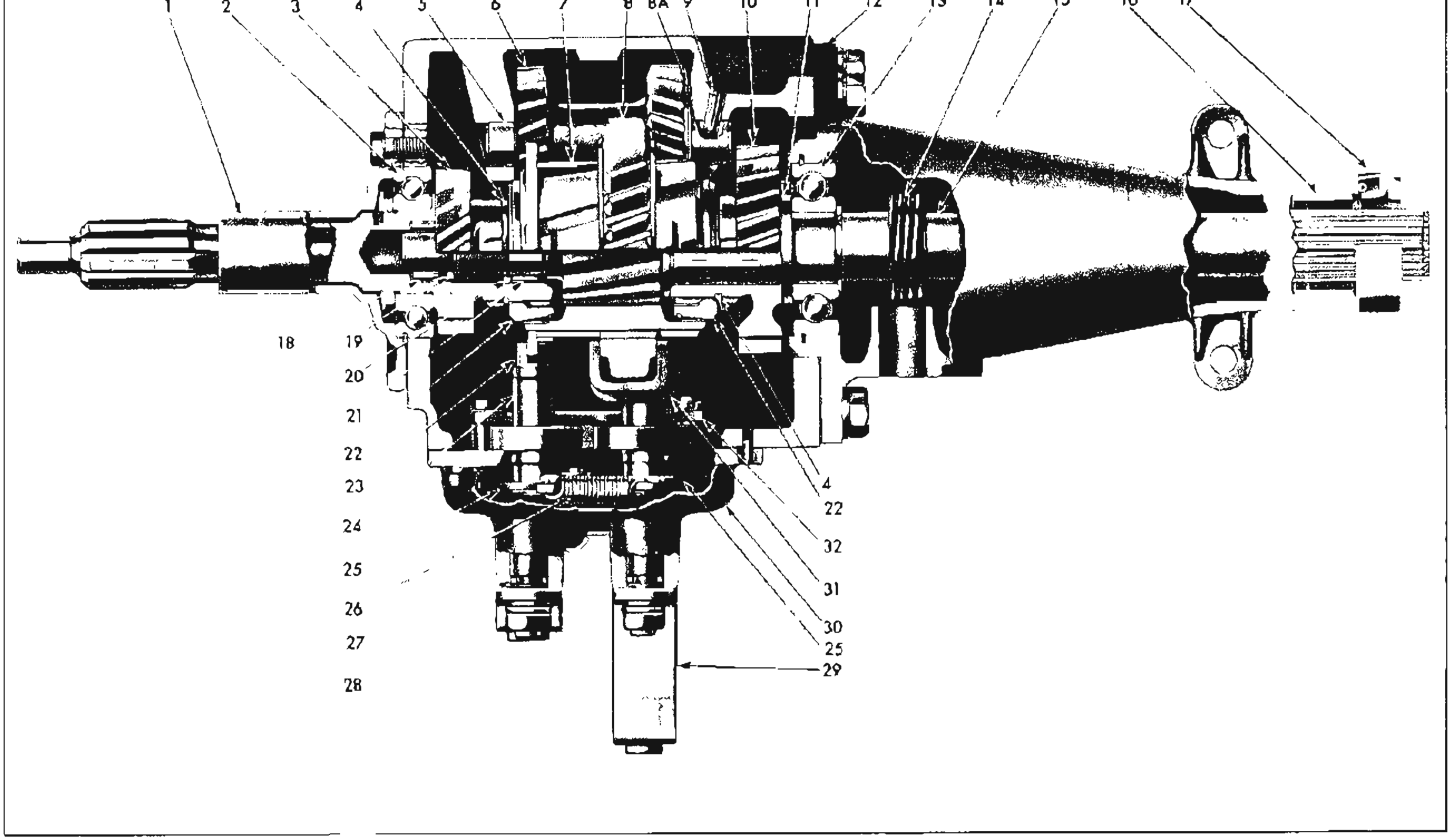



Figure 4-10—Transmission Cross Section (Top View)

1. Clutch Gear Bearing Retainer
2. Clutch Gear Bearing
3. Clutch Gear
4. Energizing Spring
5. Reverse Idler Shaft
6. Reverse Idler Gear
7. Second and Third Speed Clutch
8. First and Reverse Sliding Gear
8a. Thrust Bearing and Washer
9. Reverse Idler Shaft Pin
10. Second Speed Gear
11. Thrust Washer
12. Case Extension
13. Mainshaft Rear Bearing
14. Speedometer Drive Gear
15. Mainshaft
16. Bushing
17. Oil Seal
18. Front Pilot Bearing Rollers
19. Thrust Washer
20. Thrust Washer
21. Rear Pilot Bearing Rollers
22. Synchronizer Ring
23. Second and Third Shitter Fork
24. Second and Third Shitter Shaft
25. Detent Cam
26. Detent Cam Spring
27. "O" Ring Oil Seal
28. Second and Third Shifter Lever
29. First and Reverse Shifter Lever
30. Side Cover
31. First and Reverse Shifter Fork
32. Interlock Retainer

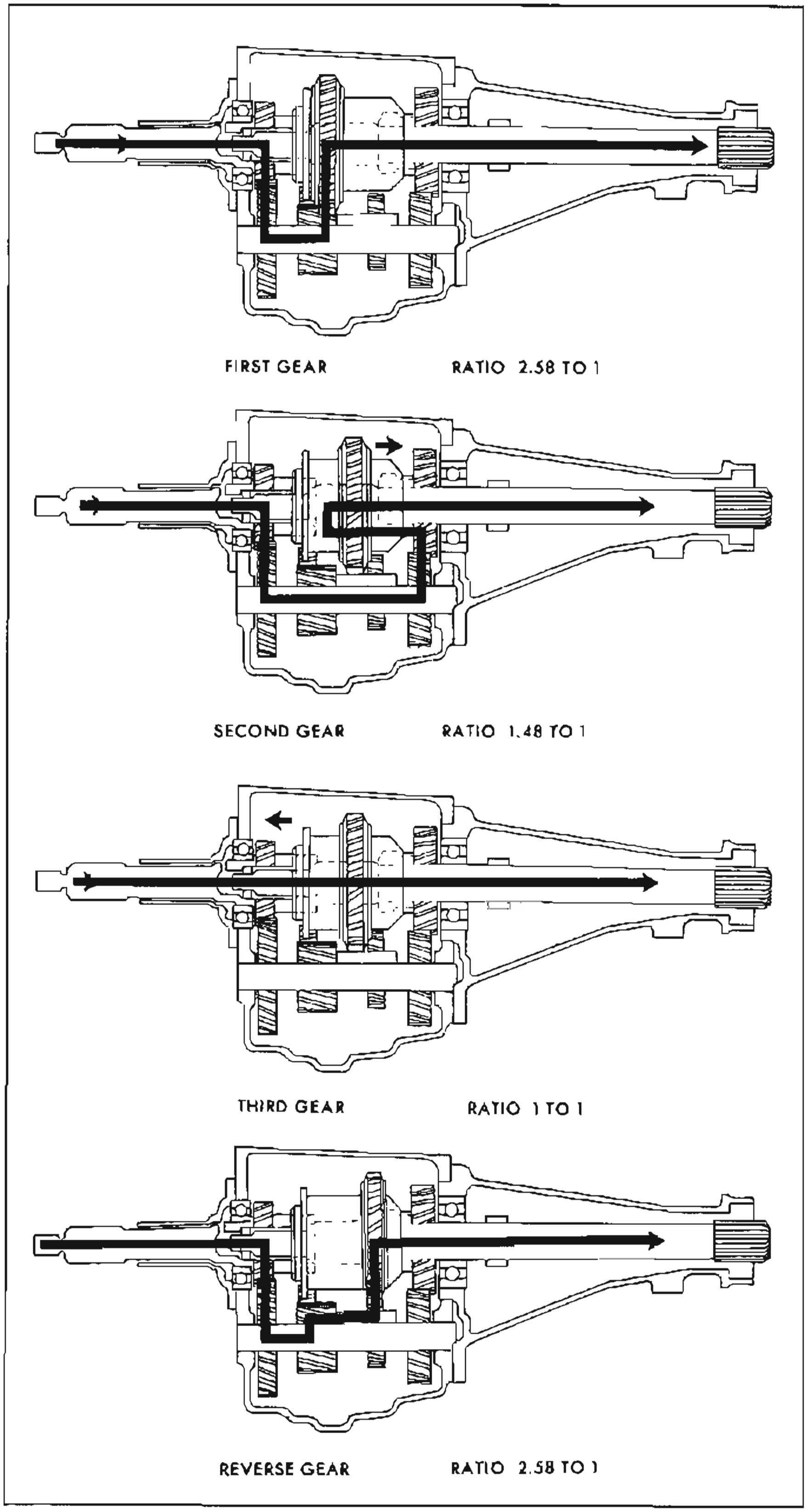



Figure 4-11—Transmission Power Flow

**d. Power Flow Thru Transmission**

1. First Gear - Mechanical Action - The shifter fork slides the ring gear into contact with the middle gear on the countergear. The countergear is in constant mesh with the main drive gear.

First Gear - Power Flow - Torque is imparted to the countergear by the main drive gear. It is then transferred to the ring gear on the clutch sleeve by the middle gear on the countergear. The ring gear is splined to the clutch sleeve which, in turn, is splined to the mainshaft.

2. Second Gear - Mechanical Action - The ring gear is moved back to the neutral position and the clutch sleeve is moved rearward to engage the front part of the second speed gear. The second speed gear is in constant mesh with the rear of the countergear.

Second Gear - Power Flow - Torque imparted to the countershaft by the main drive gear is transmitted to the second speed gear. The second speed gear, now splined to the clutch sleeve, transmits torque to the mainshaft thru the clutch sleeve.

3. 3rd or Direct Gear - Mechanical Action - The clutch sleeve is moved forward to engage the rear of the main drive gear. The ring gear remains in the neutral position. Thus the main drive gear is in contact with the mainshaft thru the clutch sleeve.

3rd or Direct Gear - Power Flow - Torque imparted to the main drive gear is applied directly to the mainshaft thru the clutch sleeve.

4. Reverse Gear - Mechanical Action - The shifter fork slides the ring gear rearward to engage the rear gear on the reverse idler

gear. The forward gear of the idler gear is always in constant mesh with the middle gear on the countergear. The clutch sleeve is in the neutral position.

Reverse Gear - Power Flow - Torque imparted to the main drive gear is applied to the countergear. The middle gear on the counter, being in mesh with the idler gear, transmits the torque to the idler gear. The idler gear, in turn, is in mesh with the ring gear and transmits torque to it and the clutch sleeve to which the ring gear is splined. The clutch sleeve then turns the mainshaft.

## 4-9 REMOVAL AND INSTALLATION OF TRANSMISSION

### a. Removal From Vehicle

1. Drain lubricant from transmission.

2. Disconnect the speedometer cable from speedometer driven gear fitting and disconnect shift control rods and equalizer from the shifter levers at the transmission.

3. Remove propeller shaft as outlined in Group 6. Support rear of engine and remove transmission mounting block-to-support (cross member) bolts and washers. Remove support-to-frame bolts and washers and remove support.

4. Remove the 2 top transmission to clutch housing cap screws and insert 2 transmission guide pins, a 1/2"-13 x 4-1/2" bolt with head removed, in these holes.

5. Remove the 2 lower transmission to clutch housing cap screws.

6. Slide the transmission straight back on guide pins until the clutch gear is free of splines in the clutch disc.

7. Remove transmission from under the body.

### b. Installation in Vehicle

1. Install guide pin, 1/2"-13 x 4-1/2" bolt with head removed, in upper right transmission to clutch housing bolt hole for alignment and place transmission on guide pin. Rotate transmission as necessary and start clutch gear shaft into clutch disc and slide transmission forward.

2. Install the two lower transmission mounting bolts and lock washers and tighten securely. Remove guide pin and install upper mounting bolts and lock washers. Torque to 45-60 ft. lbs.

3. Position the transmission support under transmission mounting bracket. Install transmission support and support-to-mounting block bolts and washers.

4. Install propeller shaft as outlined in Group 6.

5. Install and adjust linkage as outlined in Group 4A.

6. Remove speedometer driven gear and add 1/2 pint of transmission lubricant to housing. Install speedometer driven gear.

7. Connect speedometer cable to driven gear and tighten securely.

8. Fill transmission with lubricant.

### c. Transmission Alignment

If transmission slips out of high gear, particularly at 50 MPH and above, and all other probable causes outlined in paragraph 4-12 have been eliminated, the alignment of the engine crankshaft pilot, clutch housing bore, and the transmission should be checked.

A special tool, on which is mounted a dial indicator, is necessary to check the transmission rear bearing bore alignment. This tool may be made from a new or good used clutch gear which has a good bearing surface on the crankshaft pilot and front main bearing. The splines on the clutch gear shaft should be ground in so the shaft may be rotated in the clutch disc hub without interference when assembled in the car. Weld a piece of 1/4" rod, 8" long, in the mainshaft pilot bore. Assemble a good bearing on the shaft and secure it with a clutch gear bearing nut.

1. Remove the transmission from the car and completely disassemble.

2. Install the case extension on the case and tighten the extension-to-case bolts securely.

3. Install the special tool with the dial indicator in the transmission case, with the face of the indicator and the tracing finger to the rear of the transmission. Secure in place with a clutch gear bearing retainer.

4. Rotate the gear and make final adjustment of the indicator with the tracing finger to the rear of the case and in the center of the rear bearing bore in the case extension.

5. Assemble the transmission case to the clutch housing and tighten the four transmission mounting bolts securely.

6. Install transmission support and support-to-transmission mounting block bolts.

7. Remove the jack or other support from under the engine and let the weight of the engine rest on the transmission mounting in the normal position.

8. With the dial indicator, check the readings of the rear bearing bore at the 12, 3, 6, and 9 o'clock positions.

9. Install temporary slotted shims between the transmission case and the clutch housing in the quantities and at the bolt locations as necessary to bring misalignment at the transmission rear bearing bore to a maximum

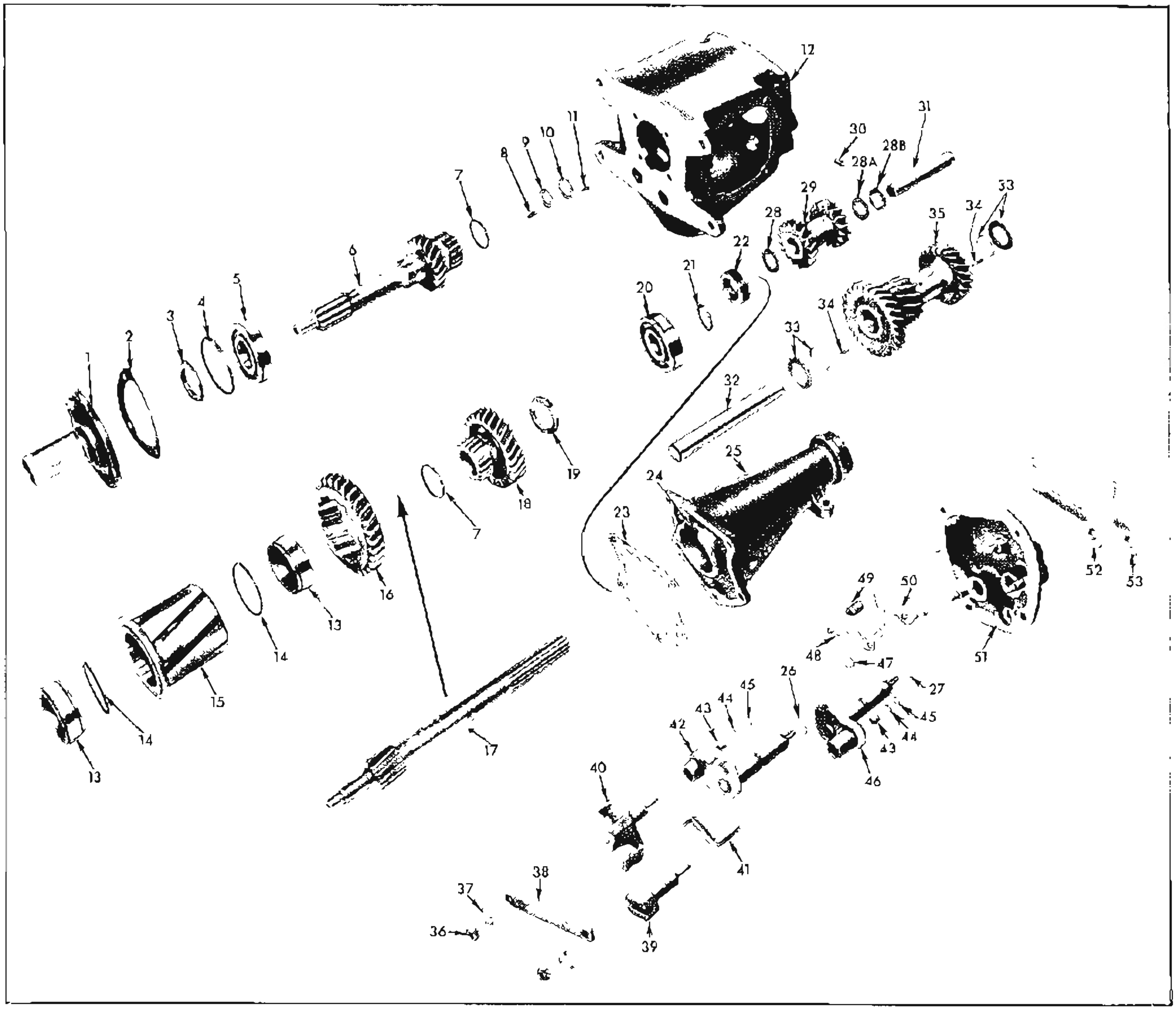


Figure 4-12—Exploded View of 3-Speed Synchromesh Transmission

1. Clutch Gear Bearing Retainer
2. Bearing Retainer Gasket
3. Bearing Nut and Oil Slinger
4. Bearing Snap Ring
5. Clutch Gear Bearing
6. Clutch Gear
7. Energizing Spring
8. Front Pilot Bearing Roller
9. Thrust Washer
10. Thrust Washer
11. Rear Pilot Bearing Rollers
12. Transmission Case
13. Synchronizer Ring
14. Snap Ring
15. Second and Third Speed Clutch
16. First and Reverse Sliding Gear
17. Mainshaft
18. Second Speed Gear
19. Thrust Washer
20. Mainshaft Rear Bearing
21. Snap Ring
22. Speedometer Drive Gear
23. Case Extension Gasket
24. Rear Bearing Snap Ring
25. Case Extension
26. First and Reverse Shifter Lever "O" Ring
27. Second and Third Shifter Lever "O" Ring
28. Thrust Washer
28a. Thrust Bearing
28b. Thrust Bearing Washer
29. Reverse Idler Gear
30. Reverse Idler Shaft Pin
31. Reverse Idler Shaft
32. Countershaft
33. Countergear and Roller Thrust Washers
34. Bearing Roller
35. Countergear
36. Shifter Interlock Retainer Stud Nut
37. Shifter Interlock Retainer Stud Nut Lock
38. Shifter Interlock Retainer
39. Second and Third Shifter Fork
40. First and Reverse Shifter Fork
41. Shifter Interlock Shaft
42. First and Reverse Shifter Lever (Inner)
43. Shifter Fork Spacer
44. Shifter Fork Washer
45. Shifter Fork Retainer
46. Second and Third Shifter Lever (Inner)
47. Detent Cam Retainer
48. First and Reverse Detent Cam
49. Detent Cam Spring
50. Second and Third Detent Cam
51. Side Cover
52. First and Reverse Shifter Lever (Outer)
53. Second and Third Shifter Lever (Outer)

of .010" indicator reading in either the horizontal or vertical plane.

10. After the position and quantity of shims has been determined and recorded, transmission case and extension may be removed.

NOTE: INSTALLATION OF A .002" SHIM BETWEEN THE TRANSMISSION CASE AND THE CLUTCH HOUSING AT TWO BOLT LOCATIONS OPPOSITE TO THE HIGH INDICATOR READING WILL CHANGE THE TRANSMISSION REAR BORE READING APPROXIMATELY .003" to .004".

## 4-10 DISASSEMBLY OF TRANSMISSION

### a. Major Disassembly

1. Remove the capscrews from the transmission side cover. Remove the side cover and gasket.

2. Remove extension-to-transmission case bolts and lock washers. Pull extension and mainshaft assembly from transmission case, leaving second and third speed clutch assembly and first-reverse ring gear in the case. Do not force the mainshaft. If necessary, rotate the second-third speed clutch slightly to aid removal. See Figure 4-14.

3. Slide the first-reverse ring gear off the clutch sleeve, and remove thru the side cover opening.

NOTE: Mark the 1st-reverse ring gear and the clutch sleeve so they can be reassembled in the same position.

4. Remove the clutch assembly from the clutch gear and then remove thru the side cover opening.

5. Remove the pilot bearing rollers from clutch gear.

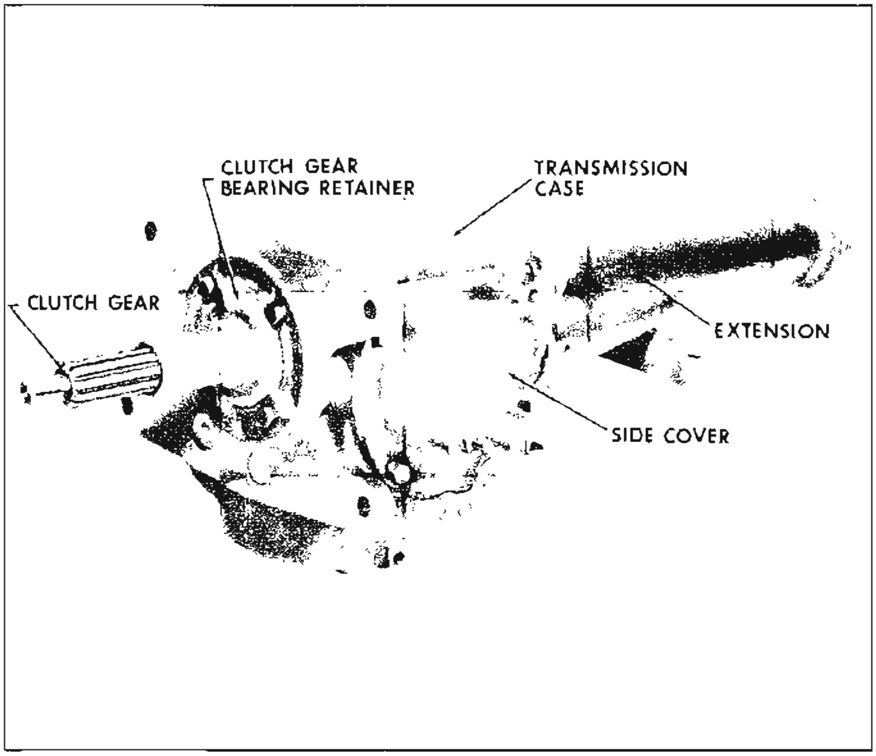



Figure 4-13—Transmission Identification

6. Remove the four clutch gear bearing retainer screws and washers. Remove retainer and gasket.

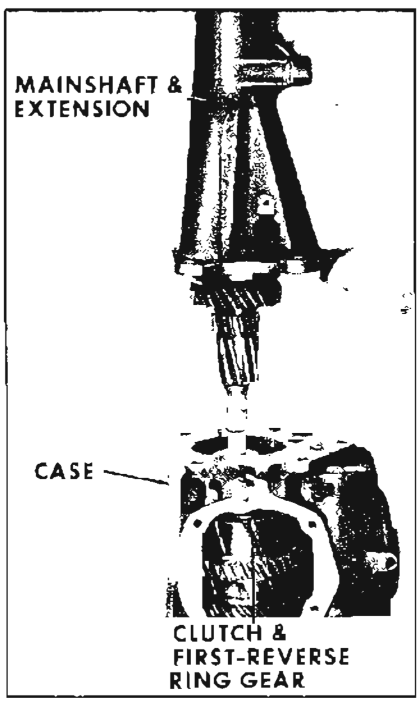



Figure 4-14—Mainshaft Removal

7. Using Tool J-5777, remove the countershaft. Leaving the tool in place, lower the countergear to the bottom of the case. See Figure 4-15.

NOTE: It is necessary to lower the countergear in order to provide clearance for clutch gear removal.

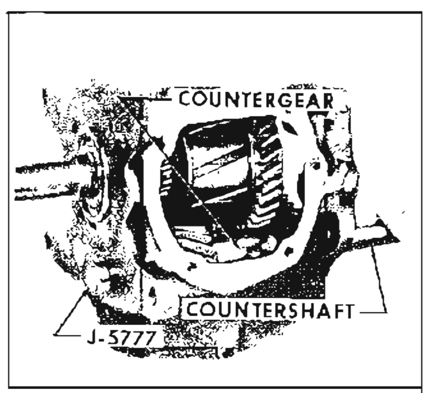



Figure 4-15—Removing Countershaft

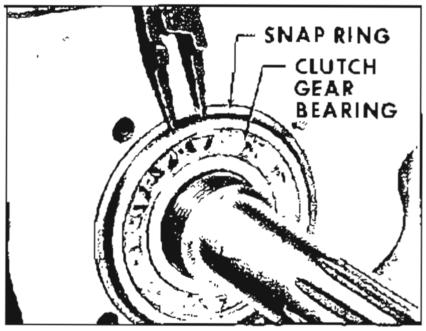



Figure 4-16—Clutch Gear Snap Ring Removal

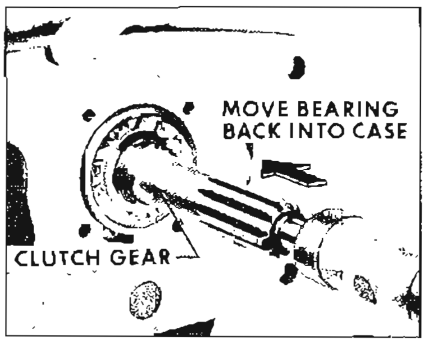



Figure 4-17—Clutch Gear Bearing Removal

8. Remove clutch gear bearing snap ring. See Figure 4-16.

9. Tap the end of the clutch gear with a soft hammer, moving the bearing and gear assembly back into the case. Remove the assembly thru the rear of the case. See Figure 4-17.

10. Remove the countergear assembly thru the rear of the case.

11. Using a drift pin, drive the idler shaft lock pin into the shaft.

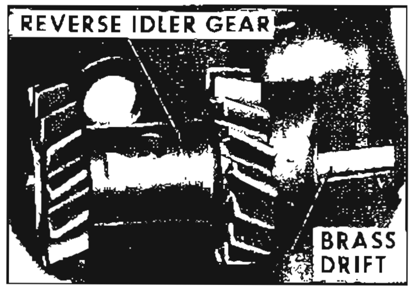



Figure 4-18—Idler Shaft Removal

12. Drive the idler gear shaft out of the case, being careful not to turn the shaft. See Figure 4-18.

CAUTION: Do not allow the idler shaft to rotate causing the lock pin to drop down. Damage to the washers could result.

13. Carefully remove the idler gear, thrust washer, thrust bearing, and bearing washer.

14. To remove mainshaft from extension, expand the bearing snap ring and tap the rear of the mainshaft with a soft hammer. Remove the complete mainshaft assembly from the extension. See Figure 4-19.

**b. Mainshaft Repair**

1. Remove speedometer drive gear using suitable plates in press. See Figure 4-20.

2. Remove bearing to mainshaft snap ring. Press bearing off shaft.

3. Remove second speed gear thrust and second speed gear.

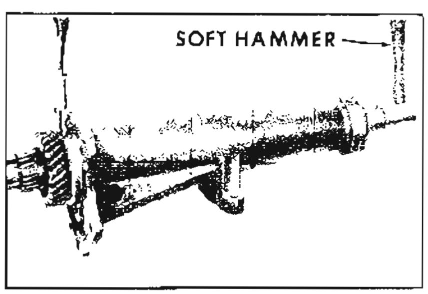



Figure 4-19—Mainshaft Removal

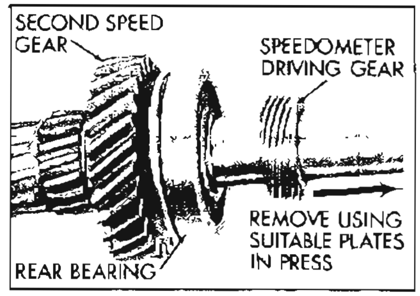



Figure 4-20—Removing Speedometer Driving Gear

4. Inspect and replace worn or damaged parts.

5. Lubricate bore of second speed gear, and install on mainshaft.

6. Install bearing. Make sure the groove in O.D. of bearing is toward second speed gear.

7. Install correct size snap ring. Determine size by using ring that gives no more than .004" of end play between bearing and shaft.

8. Start speedometer drive gear on shaft with chamfered I.D. of gear toward bearing. Press gear on shaft until forward face of gear is 7/8" from face of bearing. See Figure 4-21.

**c. Clutch Gear Bearing Repair**

1. Place the clutch gear in a vise with soft jaws, and remove the bearing retainer nut and oil slinger using Tool J-0933-01. See Figure 4-22.

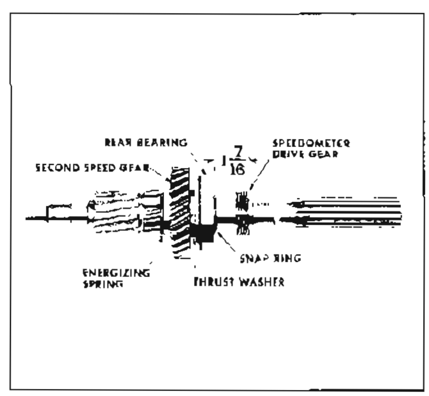



Figure 4-21—Mainshaft Identification

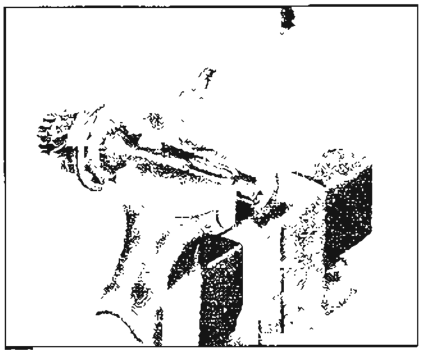


Figure 4-22—Removing Retainer Nut and Oil Slinger

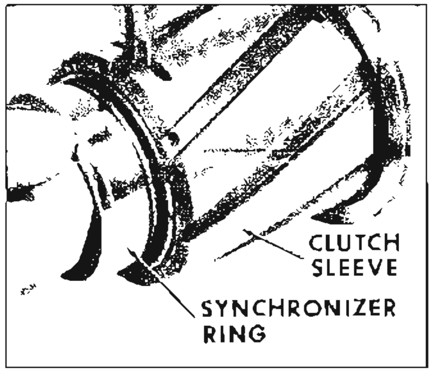



Figure 4-23—Removing Synchronizing Rings

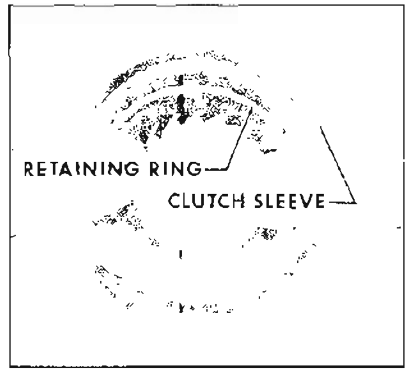



Figure 4-24—Installing Synchronizing Rings

2. Install gear and bearing in transmission case. Next, install snap ring on bearing.

3. Using a soft hammer, remove the bearing from the shaft by tapping the clutch gear shaft back into the case.

4. Remove the bearing from the case by tapping with a soft hammer.

5. After cleaning and inspecting all parts, replace any that are damaged or excessively worn.

6. Replace the bearing on the clutch gear shaft with the snap ring groove to the front.

7. Using Tool J-0933-01, install the bearing retaining nut and oil slinger. Tighten enough to permit free movement of the bearing. Lock in place by staking into hole with a center punch. Care must be taken not to damage the shaft threads.

### d. Clutch Sleeve and Synchronizer Rings

1. Remove the first-reverse sliding gear from the clutch assembly.

2. Turn the synchronizer ring in the clutch sleeve until the ends of the synchronizer ring retainer can be seen thru the slot in the clutch sleeve.

3. Using Tool J-0932, expand the retainer into the counterbore in the clutch sleeve. This raises the retainer from the groove in the ring so that the ring may be easily slipped out. See Figure 4-23.

4. Check the synchronizing rings for wear or looseness in the clutch sleeve. If rings are damaged in any way, it will be necessary to replace the clutch sleeve and both synchronizer rings.

5. Place each synchronizer retainer in its respective ring. Check for any rocking or excessive looseness. Excessive rocking will not permit proper synchronization. Replace any worn or damaged parts.

6. Install the ring retainers in the counterbores in the ends of the clutch sleeve.

7. Insert Tool J-0932 in the opening in the clutch sleeve. Expand the retainer with the fingers just enough to catch the tips of the tool jaws. Then open the jaws of the tool enough to expand the retainer back into the counterbore and allow the ring to slip in the sleeve. Install both rings in this manner.

CAUTION: Make sure the retainers are seated in the groove all the way around the ring, so that the ring can turn freely. See Figure 4-24.

8. Install the first-reverse sliding gear on the clutch sleeve.

### e. Synchronizer Engergizing 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 second speed gear. The offset or locking end must be between the third and fourth teeth in either bank of teeth. See Figure 4-25.

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 used for replacement.

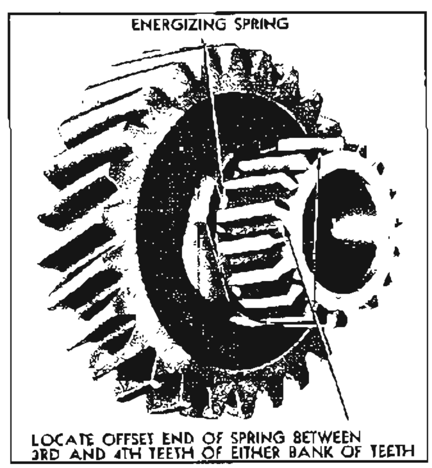



Figure 4-25—Energizing Ring Location

**f. Side Cover Repair**

1. Bend tabs on the shifter shaft nut retainers downward and remove nuts, nut retainers, and shifter shaft retainer.

2. Remove detent cam spring.

3. Remove cam retaining ring and cams.

4. Using a soft hammer, remove the shifter shaft and fork assemblies.

5. Remove interlock shaft.

6. Clean all parts and inspect for damage or excessive wear. Check the "O" rings at the ends of the shifter shafts for wear. Replace any parts required.

7. Install interlock shaft.

8. Lubricate the shifter shafts with transmission oil. Align the shaft of the 1st-Reverse shaft in the hole and tap in place with a soft hammer. Position interlock so as to clear shaft.

9. Repeat above procedure with the 2nd-3rd shifter shaft and fork assembly.

10. Install the detent cams with the 1st-Reverse cam on top of the 2nd-3rd detent cam. Retain with the special retaining ring.

11. Install detent cam spring.

12. Install shifter shaft retainer, nut retainers and nuts. Torque to 3-5 ft. lbs.

**g. Extension Bushing and Oil Seal**

If bushing in rear of extension requires replacement, remove oil seal with the aid of a screwdriver. Using Remover J-21424-9 and Drive Handle J-8092, drive bushing back into the extension. Using the same tools, install a new bushing in the extension from the rear. Drive it in until the end of the bushing is slightly below counterbore for oil seal. Coat I.D. of bushing with transmission lubricant and install new oil seal using Tool J-8613.

## 4-11 TRANSMISSION ASSEMBLY

1. Coat reverse idler thrustwashers and the thrust bearing with grease and install as shown in Figure 4-27. Coat bushings with transmission lubricant.

2. Place gear assembly in position in case with thrust bearing toward rear.

3. Install the idler shaft, making sure the lock pin hole in the shaft lines up with the hole in the case at the same angle. See Figure 4-27.

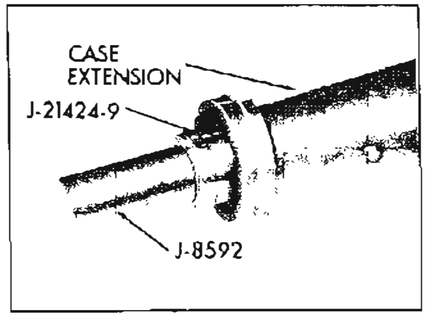



Figure 4-26—Installing Extension Bushing

4. Coat a new idler shaft lock pin with Permatex No. 2 or its equivalent. Drive it in approximately 1/16" beyond flush with the case. Peen the hole slightly.

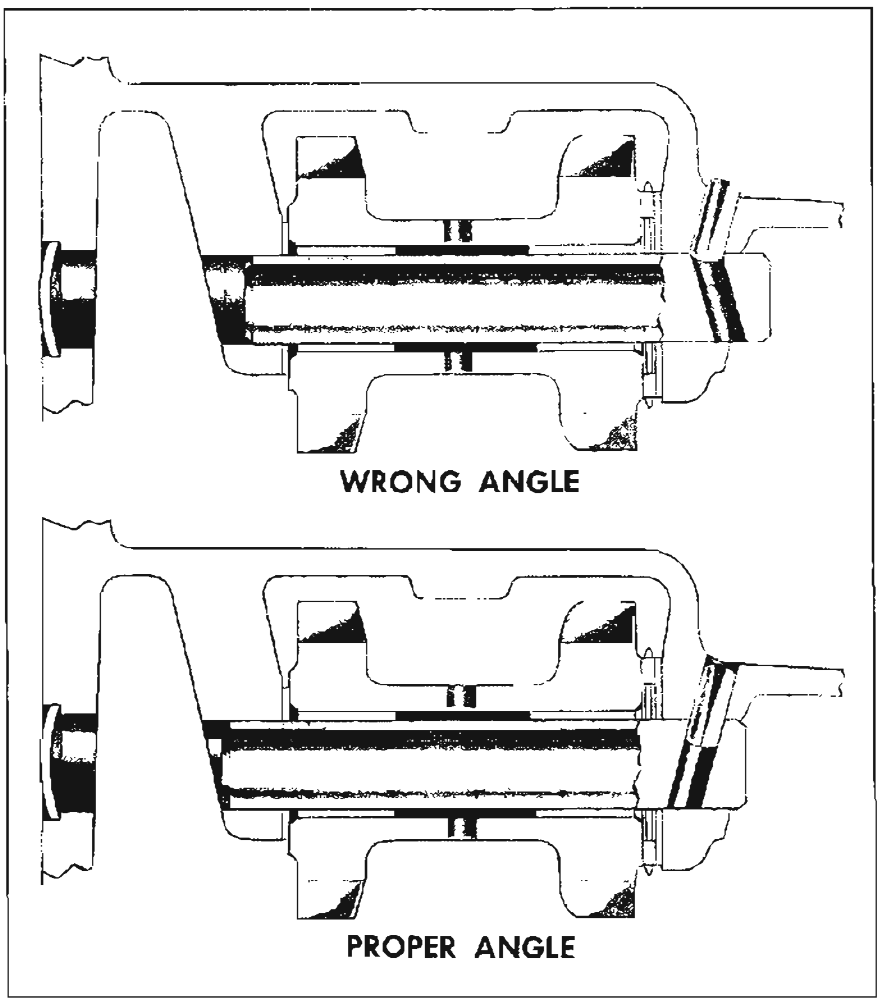



Figure 4-27—Reverse Idler Gear

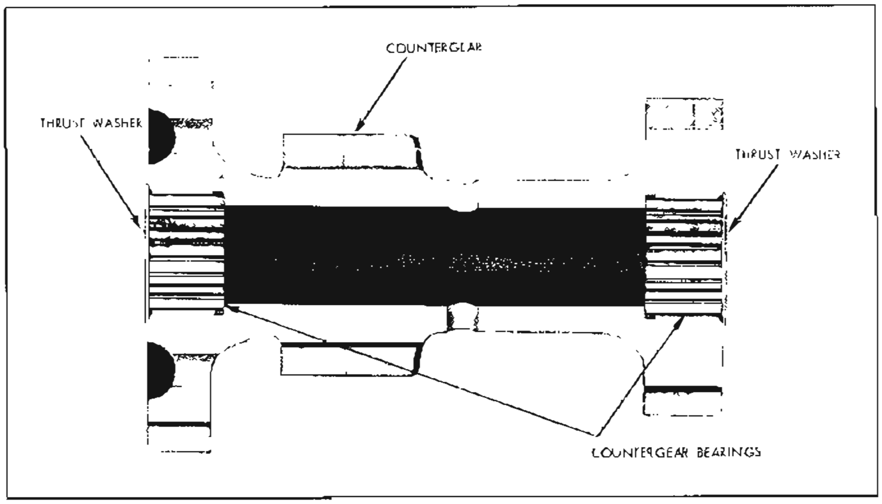



Figure 4-28—Countergear and Bearings

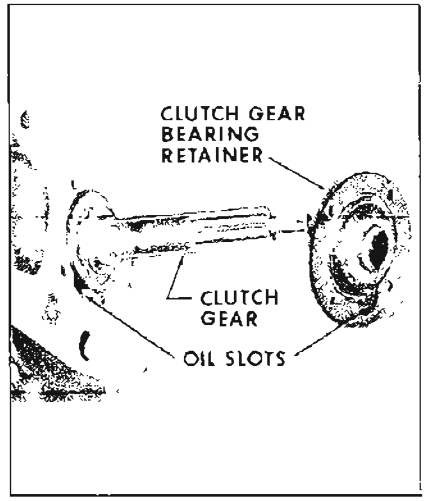



Figure 4-30—Clutch Gear Bearing Retainer Oil Slot

5. Install idler shaft expansion plug in case.

6. Place some cup grease in the roller bearing area on each end of countergear. Insert Tool J-5777 in countergear. Install 25 roller bearings in each end. Apply grease to bearing thrust washers; place one of each at each end of countergear. See Figure 4-28.

7. Insert countergear (with Tool J-5777) in transmission case and rest it on bottom of case.

8. Place some cup grease in the mainshaft pilot hole in the clutch gear and install the roller bearings. Install the larger group of 14 bearings and then the washer with the small I.D. Next install the washer with the large I.D. and then the group of 24 smaller roller bearings.

9. Insert clutch gear from inside case and using a soft drift, tap the outer race of the clutch gear bearing (back of gear) until the bearing locating ring groove is outside the front of the case. Drive the assembly straight to prevent damage. See Figure 4-29.

10. Install snap ring on bearing and tap clutch gear rearward until snap ring is firmly against case.

11. Install the clutch gear bearing retainer and gasket. Make sure the oil slot in the retainer lines up with the oil slot in the front face of the case. Do not allow the gasket to protrude beyond the edge of the retainer. See Figure 4-30.

12. Coat the retainer screws with Permatex No. 2 or equivalent and install in retainer, using the special shakeproof washers. Tighten to 12-15 ft. lbs. torque.

13. Lubricate and insert countershaft in rear of case. Align countergear with shaft and tap shaft thru, pushing Tool J-5777 out front of case. Be sure the flat on the end of countershaft is horizontal and to the bottom of the case. See Figure 4-31.

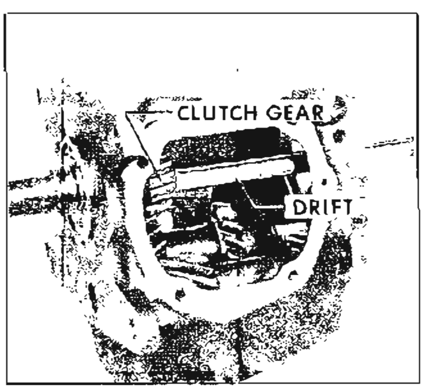



Figure 4-29—Clutch Gear Installation

14. After shaft is aligned as described above and as shown in Figure 4-31, drive shaft into case until the flat on shaft is flush with case.

CAUTION: Flat on shaft must be horizontal and at bottom of case in order to allow the rear extension to fit properly.

15. Assemble the first - reverse ring gear on the clutch sleeve noting marks made at disassembly. Insert this assembly into the side cover opening by tipping the front end of the unit into the opening first. Align the lug of the synchronizing ring with the slot

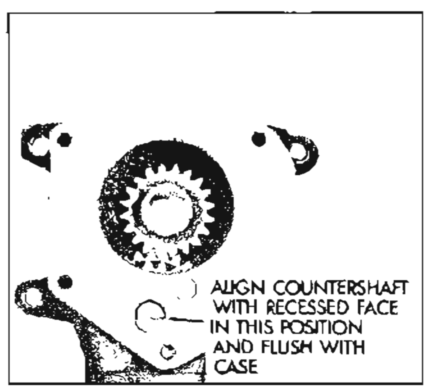



Figure 4-31—Countershaft Alignment

in the clutch sleeve when positioning the assembly on the clutch gear. See Figure 4-32.

16. Install mainshaft in extension and secure with snap ring.

17. Install gasket on transmission case rear face.

18. Align lugs on synchronizer rings with slot in mainshaft so that the lugs slide in slots on gear. Be sure that the clutch gear roller bearings are still in position. Push the shaft into the clutch sleeve until the extension is tight against the case. See Figure 4-33. Install bolts and lock washers. Torque to

NOTE: Coat the lower extension bolt with Permatex No. 2 or equivalent before installation. Torque to 40-45 ft. lbs.

19. Place transmission gears in neutral and shift forks on side cover in neutral. Install cover to transmission using a new gasket. Coat screws with Permatex No. 2 or equivalent. Torque to 15-18 ft. lbs.

20. Attach control levers to studs on shifter forks. Torque to 18-23 ft. lbs.

21. Fill transmission with 2 pints of SAE 90 multi-purpose gear lubricant.

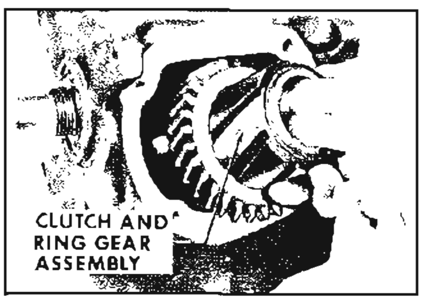



Figure 4-32—Installing Clutch and Ring Gear

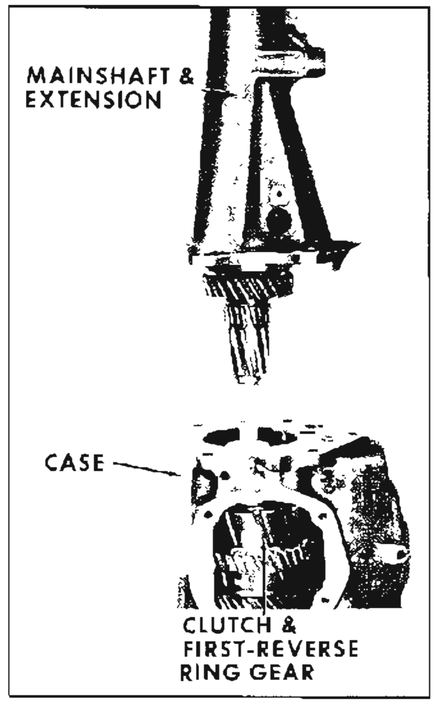



Figure 4-33—Mainshaft and Extension Installation

## 4-12 3-SPEED SYNCHROMESH TRANSMISSION TROUBLE DIAGNOSIS

| SYMPTOM AND PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| **SLIPS OUT OF HIGH GEAR** | |
| a. Transmission loose in clutch housing. | a. Tighten mounting bolts. |
| b. Control rods interfere with clutch throw-out lever. | b. Check for bent levers and rods. If bent replace. |
| c. Control linkage does not work freely, binds. | c. Adjust and free up shift linkage. Torque reactions of engine should not cause the lever on transmission to move. The movement of transmission with respect to body and frame should be transferred to the control linkage. |
| d. Does not fully engage. | d. Measure length of engagement pattern on clutching teeth. If less than 7/64", check for bent levers, shifter shafts, detent cam plates, control rods and other shift linkage. Replace or straighten defective parts. |
| e. Damaged mainshaft pilot bearing. | e. Replace pilot bearing. |
| f. Clutch gear bearing retainer broken or loose. | f. Tighten or replace clutch gear bearing retainer. |
| g. Dirt between transmission case and clutch housing causing misalignment. | g. Clean mating surface. (Remove burrs etc.) |
| h. Damaged or worn crankshaft pilot bushing. | h. Replace crankshaft pilot bushing. |
| **SLIPS OUT OF LOW AND/OR REVERSE** | |
| a. First and/or Reverse gears damaged from operating during partial engagement. | a. Determine cause, for example, worn shift fork and control lever or rod interference. Replace worn or bent parts. |
| b. Improper mated splines on inside of first and reverse gear and/or external spline on 2nd and 3rd clutch sleeve. | b. Replace 2nd or 3rd speed clutch sleeve and/or first, and reverse sliding gear. Possible correction is to change index of gear on clutch sleeve approximately 180° and/or turning the rear side of first and reverse gear to the front of the transmission. |
| c. Improperly adjusted linkage. | c. Adjust linkage. |
| **NOISY IN ALL GEARS** | |
| a. Insufficient lubricant. | a. Fill to correct level. |
| b. Worn countergear bearings. | b. Replace countergear bearings and shaft. |
| c. Worn or damaged clutch gear and countershaft drive gear. | c. Replace worn or damaged gears. |

| SYMPTOM AND PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| NOISY IN ALL GEARS (Cont'd.) | |
| d. Damaged clutch gear or mainshaft ball bearings. | d. Replace damaged bearings. |
| e. Damaged speedometer gears. | e. Replace damaged gears. |
| NOISY IN HIGH GEAR | |
| a. Damaged clutch gear bearing. | a. Replace damaged bearing. |
| b. Damaged mainshaft bearing. | b. Replace damaged bearing. |
| c. Damaged speedometer gears. | c. Replace speedometer gears. |
| NOISY IN NEUTRAL WITH ENGINE RUNNING | |
| a. Damaged clutch gear bearing. | a. Replace damaged bearing. |
| b. Damaged mainshaft pilot bearing roller. | b. Replace damaged bearing roller. |
| NOISY IN ALL REDUCTION GEARS | |
| a. Insufficient lubricant. | a. Fill to correct level. |
| b. Worn or damaged clutch gear or countergear. | b. Replace faulty or damaged gears. |
| NOISY IN SECOND ONLY | |
| a. Damaged or worn second speed constant mesh gears. | a. Replace damaged gears. |
| b. Worn or damaged countergear rear bearings. | b. Replace countergear bearings and shaft. |
| NOISY IN LOW AND REVERSE ONLY | |
| a. Worn or damaged first and reverse sliding gear. | a. Replace worn gear. |
| b. Damaged or worn countergear. | b. Replace countergear assembly. |
| NOISY IN REVERSE ONLY | |
| a. Worn or damaged reverse idler gear. | a. Replace reverse idler gear. |
| b. Worn reverse idler gear bushings. | b. Replace reverse idler gear. |
| c. Damaged or worn reverse countergear. | c. Replace countergear assembly. |

| SYMPTOM AND PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| EXCESSIVE BACKLASH IN SECOND ONLY | |
| a. Second speed gear thrust washer worn. | a. Replace thrust washer. |
| b. Mainshaft rear bearing not properly installed in case. | b. Replace bearing, lock or case as necessary. |
| c. Worn countergear rear bearing. | c. Replace countergear bearings and shaft. |
| EXCESSIVE BACKLASH IN ALL REDUCTION GEARS | |
| a. Worn countergear bearings. | a. Replace countergear bearings and shaft. |
| b. Excessive end play in countergear. | b. Replace countergear thrust washers. |
| LEAKS LUBRICANT | |
| a. Excessive amount of lubricant in transmission. | a. Drain to correct level. |
| b. Loose or broken clutch gear bearing retainer. | b. Tighten or replace retainer. |
| c. Clutch gear bearing retainer gasket damaged. | c. Replace gasket. |
| d. Cover loose or gasket damaged. | d. Tighten cover or replace gasket. |
| e. Operating shaft seal leaks. | e. Replace operating shaft seal. |
| f. Idler shaft expansion plugs loose. | f. Replace expansion plugs. |
| g. Countershaft loose in case. | g. Replace case. |
| h. Lack of sealant on bolts. | h. Coat bolts with sealant. |
| i. Worn extension oil seal. | i. Replace seal. |

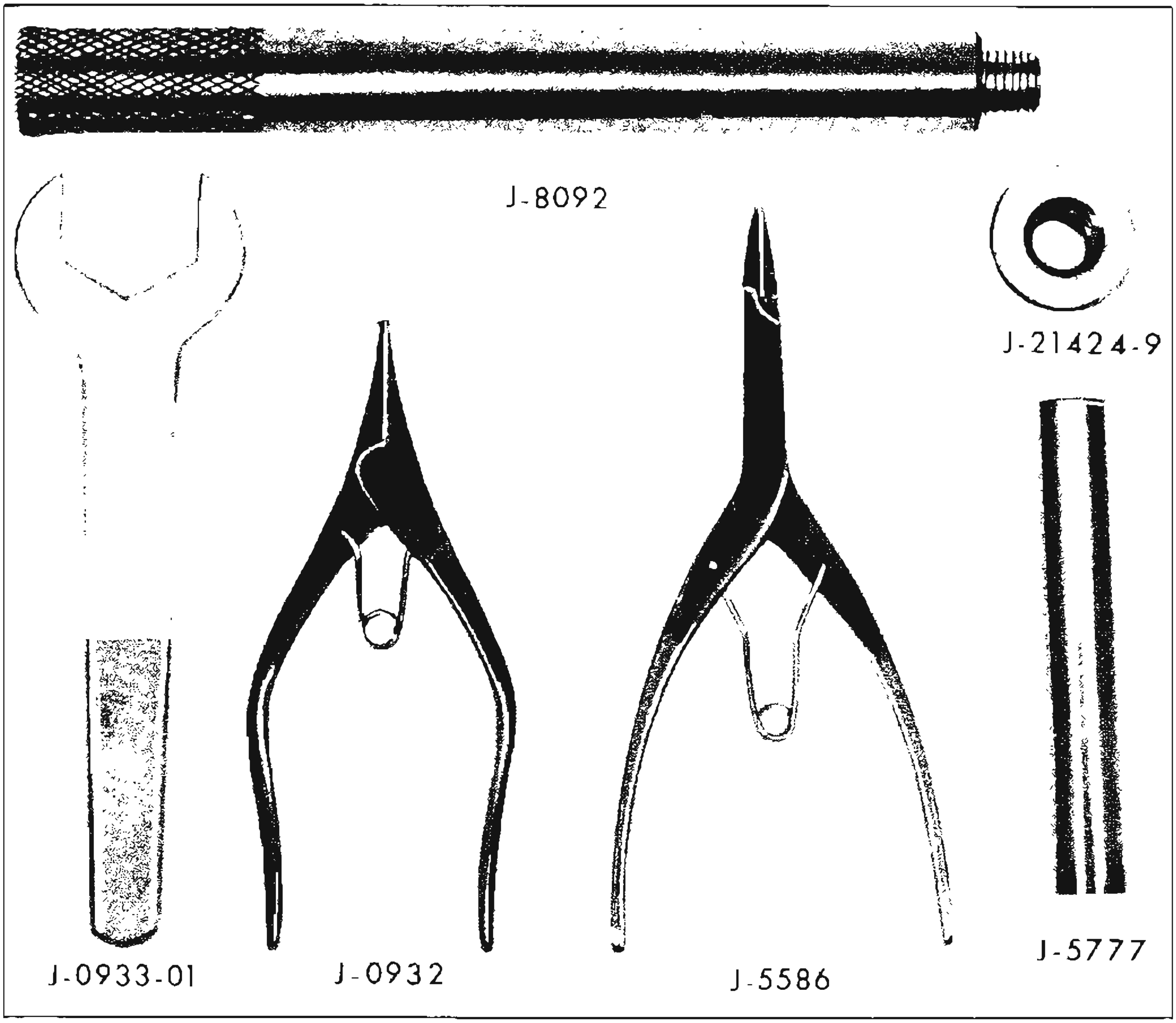



Figure 4-33A—3-Speed - Synchromesh Tools

# SECTION 4-C

# 4-SPEED SYNCHROMESH TRANSMISSION

## CONTENTS OF SECTION 4-C



## 4-13 4-SPEED TRANSMISSION SPECIFICATIONS

### a. Tightening Specifications

| Part | Location | Thread Size | Torque Ft. Lbs. |
|---|---|---|---|
| Bolt | Front bearing retainer to transmission case | 5/16-18 | 15-20 |
| Bolt | Side Cover Bolts | 5/16-18 | 15-20 |
| Nut | Shift lever to shaft | 5/16-18 | 12-18 |
| Bolt | Transmission to flywheel housing | 1/2-13 | 45-60 |
| Bolt | Flywheel Housing to engine | 3/8-16 | 30-35 |

### b. 4-Speed Transmission Specifications

| | |
|---|---|
| Mounting | Unit with Engine |
| Oil Capacity, Pints | 2 1/2 |
| Type of Gearing | All Helical |
| Transmission Ratio | |
| Fourth | 1.00:1 |
| Third | 1.51:1 |
| Second | 1.89:1 |
| First | 2.54:1 |
| Reverse | 2.61:1 |

### c. Speedometer Gear

| | |
|---|---|
| Speedometer Worm on Main Shaft | Press Fit |
| Teeth on Worm for Axle Ratios 3.08 and 3.36 | 8 |
| Teeth on Worm for Axle Ratios 2.78 | 9 |
| Teeth on Worm for Axle Ratios 3.90 and 4.3 | 6 |

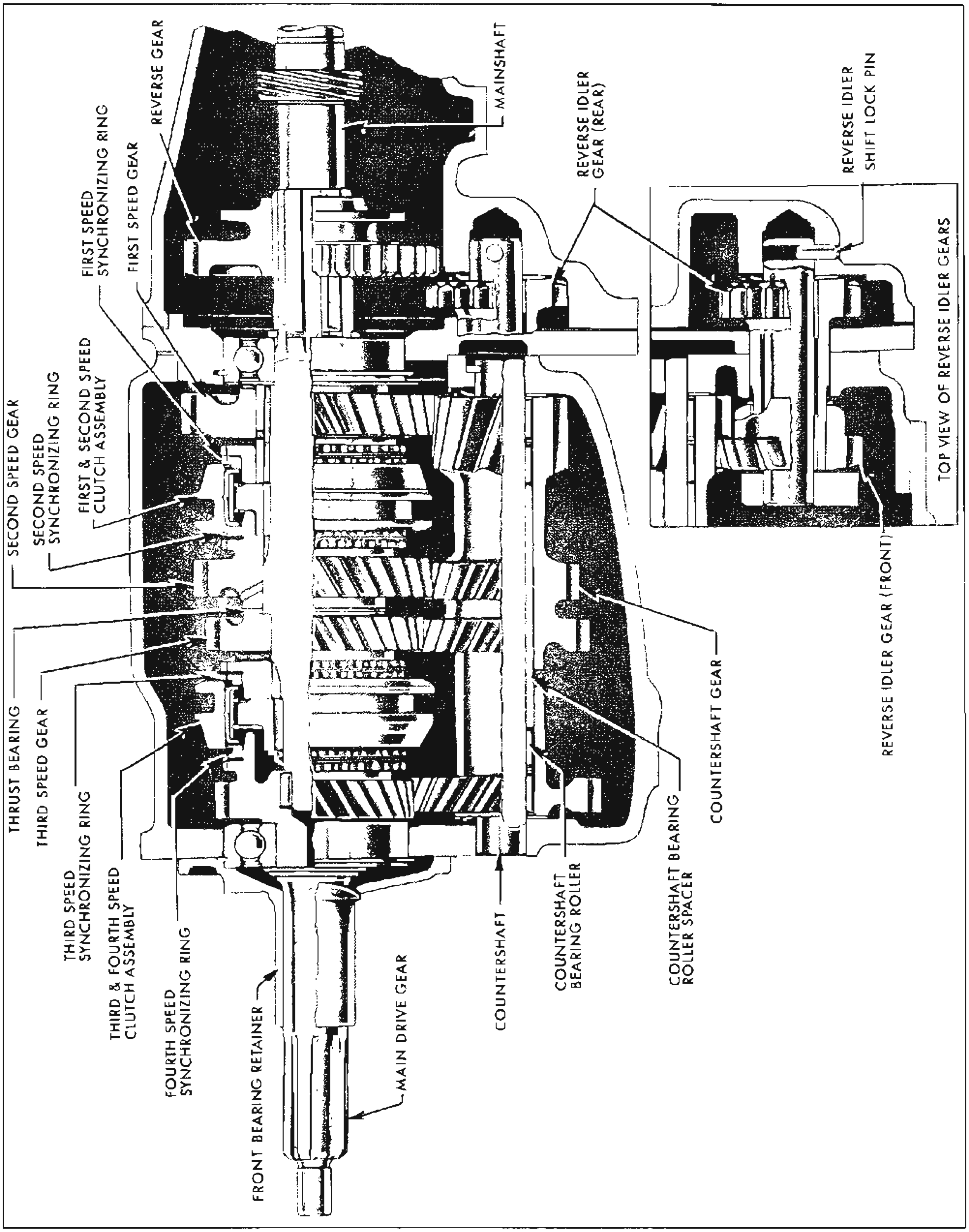



Figure 4-34—Four Speed Synchromesh Transmission

## 4-14 4-SPEED TRANSMISSION DESCRIPTION

The 4-speed synchromesh transmission is solidly bolted to the rear face of the flywheel upper housing to form a unit assembly with the engine. The transmission main drive gear shaft extends through the clutch driven plate into a bronze bushing seated in the rear end of the engine crankshaft. The front bearing retainer projects into a bore in the flywheel housing, serving as a pilot to center the transmission with the engine crankshaft.

### a. Transmission Gears and Shafts

The transmission main drive gear is supported by a ball bearing which is a slip fit in the front wall of the transmission case. The inner race of the bearing is held tight against a shoulder on the drive gear. The outer race of the bearing is grooved for a snap ring which fits between the transmission case and the front bearing retainer to hold the bearing and main drive gear in place. See Figure 4-34.

The front end of the transmission main shaft is piloted in the bored rear end of the main drive gear by 14 needle rollers. The rear end of the main shaft is supported by a heavy-duty bearing identical to the one which supports the main drive gear. The inner race of the rear bearing is grooved for a snap ring which fits in the rear bearing retainer. The outer race of the bearing is retained by a snap ring in a groove in the shaft.

The transmission counter gear is carried on a double row of needle rollers on each end of the counter shaft. A tubular spacer separates the four sets of needle rollers and two washer-type spacers separates each set of needle rollers. See Figure 4-61. Two spacers are located at the outer ends of each set to hold the rollers in position. End thrust is taken on thrust washers located between the ends of the gear and the front and rear of the case.

The two-piece reverse idler gear is carried on bronze bushings while thrust is taken on thrust washers located between the front of the gear and the back of the reverse idler thrust boss and between the rear of the gear and the reverse idler shaft boss in the case extension.

### b. Gear Ratios

All four forward gears are provided with synchronizing clutches which can be engaged while the car is in motion. Closely spaced gear ratios of 2.54 (first), 1.89 (second), 1.51 (third) and 1.00 (fourth) provide excellent ratio matching with minimum loss of engine speed at the shift points. Reverse gear (2.61 ratio) is not synchronized; therefore, vehicle must be brought to a complete stop before engaging reverse gear.

The transmission may be used as an aid in deceleration by downshifting in sequence without double clutching or gear clashing, due to all forward speeds being synchronized.

### c. Speedometer Gears

The speedometer driving worm gear is pressed on the transmission main shaft. When changing rear axle ratios it is necessary to change the driven gear, and on some axle ratios it is necessary to change the driving worm gear. The speedometer driven gear assembly consists of a sleeve, a gear and shaft, an O-ring sleeve seal, a sleeve retainer and bolt. The driven gear sleeve is a slip fit in the rear extension. The sleeve is held in place by a retainer which fits into a slot in the sleeve and is bolted to the rear bearing retainer. The gears are lubricated by splash from the transmission. The speedometer cable is attached to the sleeve by a threaded sleeve on the cable casing.

### d. Front Companion Flange

The front companion flange is splined to the rear end of the transmission main shaft and is retained by a heavy steel washer and bolt. An oil seal is located in the rear end of the case extension.

### e. Shift Linkage

Gearshifting is manual through a floor-type gear shift lever which activates shift control rods connected to the transmission cover shifter levers for first through fourth gears, and to the reverse lever located in the case extension. The shifter lever to the rear of the transmission cover controls the first and second speed gears, while the lever to the front controls the third and fourth speed gears.

### f. Power Flow Through Transmission

#### 1. Operation in Neutral

In neutral, with engine clutch engaged, the drive gear turns the countergear. The countergear then turns the third, second, first, and reverse idler gears. But, because the third and fourth and first and second speed clutch

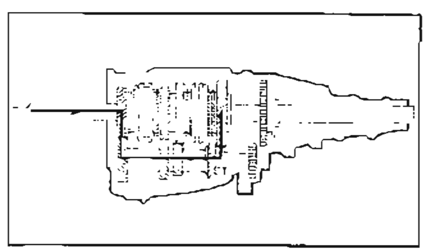


Figure 4-35—Neutral

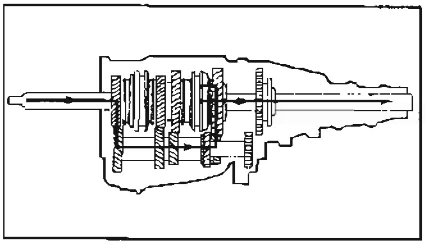


Figure 4-36—1st Gear

(sleeves) are neutrally positioned, and the reverse speed gear is positioned at the rear, away from the reverse idler gear, power will not flow through the mainshaft. See Figure 4-35.

### 2. Operation in First

In first speed, the first and second speed clutch (sleeve) is moved rearwards to engage the first speed gear, which is being turned by the countergear. Because the first and second speed clutch (hub) is splined to the mainshaft, torque is imparted to the mainshaft from the first speed gear through the clutch assembly. See Figure 4-36.

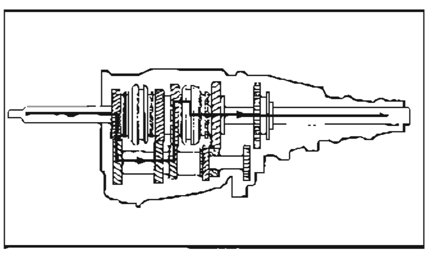


Figure 4-37—2nd Gear

### 3. Operation In Second

In second speed, the first and second speed clutch (sleeve) is moved forward to engage the second speed gear, which is being turned by the countergear. This engagement of the clutch (sleeve) with the second speed gear imparts torque to the mainshaft because the first and second speed clutch (hub) is splined to the mainshaft. See Figure 4-37.

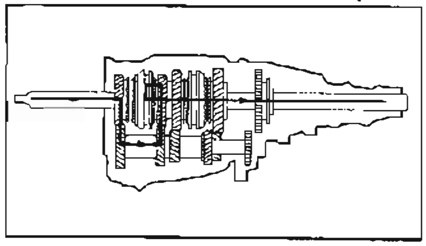


Figure 4-38—3rd Gear

### 4. Operation in Third

In third speed, the first and second speed clutch assumes a neutral position. The third and fourth speed clutch (sleeve) moves rearward to engage the third speed gear, which is being turned by the countergear. Because the third and fourth speed clutch (hub) is splined to the mainshaft, torque is imparted to the mainshaft from the third speed gear through the clutch assembly. See Figure 4-38.

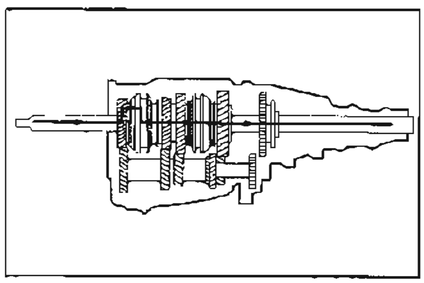


Figure 4-39—4th Gear

### 5. Operation in Fourth

In fourth speed, or direct drive, the third and fourth speed clutch (sleeve) is moved forward to engage the main drive gear and the first and second speed clutch remains in a neutral position. This engagement of the main drive gear with the third and fourth speed clutch assembly imparts torque directly to the mainshaft. See Figure 4-39.

### 6. Operation In Reverse

In reverse speed both clutch assemblies assume a neutral position. The reverse speed gear is

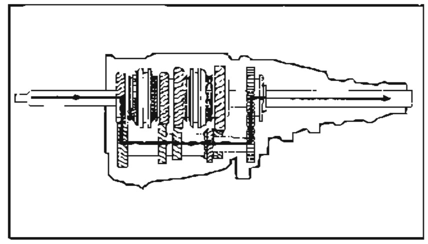


Figure 4-40—Reverse

moved forward to engage the rear reverse idler gear, which is being turned by the countergear. Because the reverse speed gear is splined to the mainshaft, this engagement causes the mainshaft to turn; however, because power flows from main drive gear to countergear and through reverse idler gear to reverse speed gear, the direction of rotation will be opposite that of the engine. See Figure 4-40

## 4-15 TRANSMISSION SIDE COVER REMOVAL AND INSTALLATION

NOTE: It is not necessary to remove transmission from vehicle for inspection or replacement of parts in transmission side cover assembly, but the side cover assembly itself must be removed from the transmission case.

### a. Removal

1. Remove drain plug at the bottom of transmission and drain lubricant.

2. Disconnect first, second, third and fourth shift rods from levers. See Group 4A.

3. Remove transmission side cover assembly from transmission case.

4. Remove the outer shifter lever nuts and lockwashers and pull levers from shafts.

5. Carefully push the shifter shafts into cover, allowing the

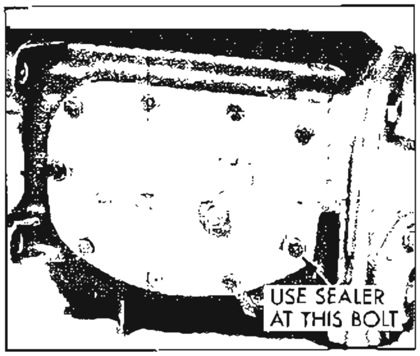



Figure 4-41—Side Cover

detent balls to fall free, then remove both shifter shafts.

6. Remove interlock sleeve, interlock pin and poppet spring.

7. Replace necessary parts.

**b. Installation**

1. Install interlock sleeve and one shifter shaft. Place steel detent into sleeve followed by poppet spring and interlock pin.

2. Start second shifter shaft into position and place second detent ball on poppet spring. Compress ball and spring with screwdriver and push the shifter shaft fully in.

3. With transmission in neutral and shifter forks and levers in place, lower side cover into place. Install attaching bolts, using sealer on lower right bolt (see Figure 4-41), and tighten evenly.

## 4-16 REMOVAL AND INSTALLATION OF 4-SPEED TRANSMISSION

**a. Removal of Transmission**

1. If transmission is to be disassembled, drain transmission lubricant.

2. Mark propeller shaft and front companion flange so that these parts can be reassembled in same relative position.

3. Remove the U-bolts attaching the propeller shaft to front companion flange. Slide propeller shaft rearward as far as possible for working clearance.

4. Remove trim bezel.

5. Remove rubber boot.

6. Disconnect speedometer cable from transmission.

7. Loosen all three exhaust pipe ball joints so that transmission and rear end of engine can be lowered.

8. Remove two bolts attaching transmission mounting pad to transmission support. Leave mounting pad bolted to transmission. See Figure 4-42.

9. Place a flat wood block on jack. Jack under engine pan until transmission mounting pad just clears transmission support.

10. Remove four bolts attaching transmission support to body members. Remove support, then lower jack so that transmission will clear underbody during removal.

11. Remove upper left transmission to flywheel housing bolt and install a 1/2"-13 x 4-1/2" bolt with the head removed; remove lower right bolt and install a guide pin.

12. Remove other two transmission to flywheel housing bolts. Slide transmission straight back until drive gear shaft is clear of flywheel housing, then lower transmission.

CAUTION: If weight of transmission is allowed to rest on main drive gear while drive gear splines are in clutch driven plate, driven plate may be damaged.

**b. Installation of Transmission**

1. Lightly coat splines on end of main drive gear with Lubriplate for a distance of approximately 1 inch. Fill groove in inner surface of throw-out bearing with wheel bearing grease.

2. Make certain that front face of transmission case and rear face of flywheel housing are absolutely clean. Install 1/2"-13 x 4-1/2" bolt with the head removed guide pin in lower right hole of flywheel housing.

3. Lift transmission into place on guide pins and slide straight forward, meanwhile fully supporting transmission. Rotate companion flange as required to engage drive gear with driven plate splines. Caution: If weight of transmission is allowed to rest on main drive gear shaft before

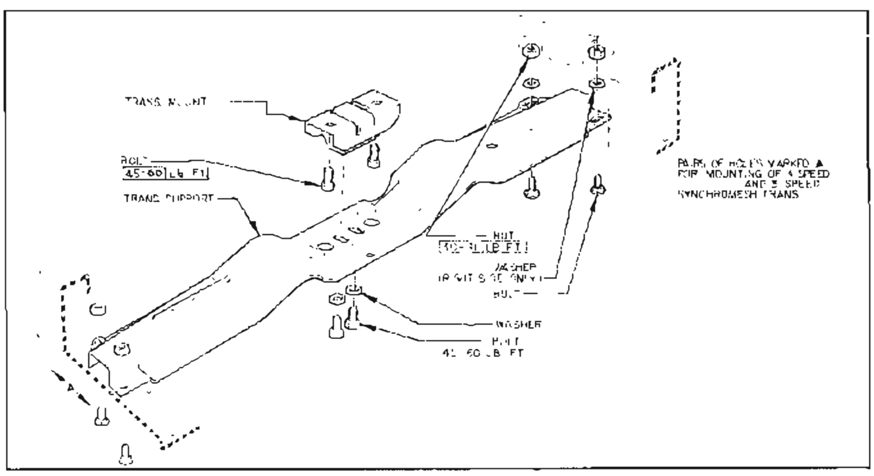


Figure 4-42—Transmission Mounting

shaft engages pilot bushing in flywheel, driven plate may be damaged.

4. Install two transmission to flywheel housing bolts; remove guide pins and install other two bolts. Tighten all four bolts securely.

5. Raise jack under engine pan so that transmission mounting pad will clear transmission support.

6. Install transmission support, leaving four nuts loose. Lower jack so that transmission rests on support.

7. Install two bolts attaching mounting pad to support, then tighten all six bolts securely.

8. Align exhaust system, if necessary, and tighten all bolts.

9. Connect speedometer cable to transmission.

10. Adjust shift linkage as described in Group 4A.

11. Reinstall rubber boot and bezel to floor pan.

## 4-17 DISASSEMBLY OF 4-SPEED TRANSMISSION

### a. Disassembly

1. Remove transmission side cover assembly from transmission case. NOTE: If cover assembly is to be disassembled for inspection or replacement of worn parts, follow procedures 2 through 6, Section 4-16.

2. Remove four bolts from front bearing retainer and remove retainer and gasket.

3. Drive lock pin up from reverse shifter lever boss, as shown in Figure 4-43, and pull shifter shaft out about 1/8". This disengages the reverse shift fork from reverse gear.

4. Remove five bolts attaching the case extension to the rear bearing retainer. Tap extension with soft hammer in a rearward direction to start. When the reverse idler shaft is out as far as it will go, move extension to left so reverse fork clears reverse gear and remove extension and gasket.

Figure 4-43—Removing Reverse Shifter Shaft Lock Pin

5. Remove rear bearing snap ring on mainshaft.

6. Remove case extension oil seal. See (Figure 4-44).

7. Remove the speedometer gear with J-8760 as shown in Figure 4-45.

8. Remove the reverse gear, reverse idler gear and tanged thrust washer.

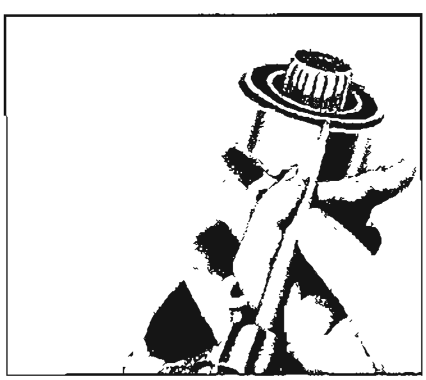


Figure 4-44—Removing Extension Oil Seal

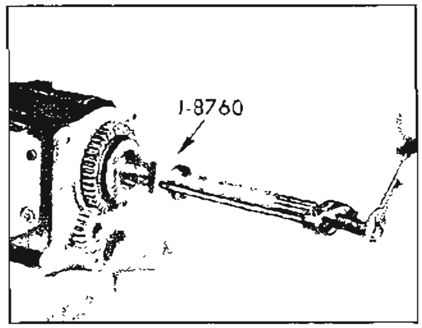



Figure 4-45—Removing Speedometer Gear

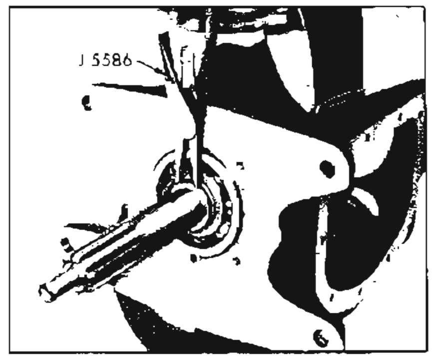



Figure 4-46—Removing Main Drive Gear Snap Ring

9. Remove the self-locking bolt attaching the rear bearing retainer to transmission case. Carefully remove the entire mainshaft assembly.

10. Unload bearing rollers from main drive gear and remove fourth speed synchronizer blocking ring.

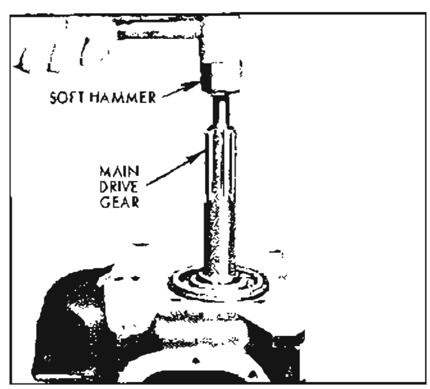



Figure 4-47—Removing Main Drive Gear

11. Lift the front half of reverse idler gear and its thrust washer from case.

12. Remove the main drive gear snap ring (see Figure 4-46), and remove spacer washer.

13. With soft hammer, tap main drive gear down from front bearing as shown in Figure 4-47.

14. From inside case, tap out front bearing and snap ring.

15. From the front of the case, remove countershaft with J-9573; then remove the countergear and both tanged washers.

16. Remove the 80 rollers, six .050" spacers and roller spacer from countergear.

17. Remove mainshaft front snap ring (see Figure 4-49), and slide third and fourth speed clutch assembly, third speed gear and synchronizing ring, second and third speed gear thrust washer (needle roller bearing), second speed gear and second speed synchronizing ring from front of mainshaft.

18. Spread rear bearing retainer snap ring and press mainshaft out of retainer. See Figure 4-50.

19. Remove the mainshaft rear

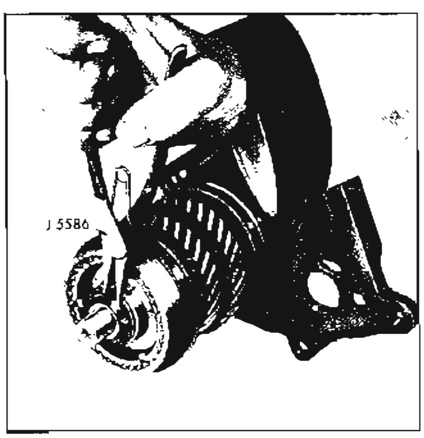



Figure 4-49—Removing Mainshaft Front Snap Ring

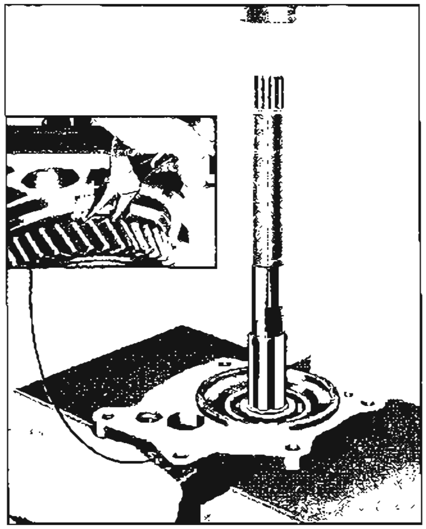


Figure 4-50—Removing Rear Bearing Retainer

snap ring. Support first and second speed clutch assembly as shown in Figure 4-50, and press on rear of mainshaft to remove shaft from rear bearing, first speed gear, and synchronizing ring first and second speed clutch sliding sleeve and first speed gear bushing.

**b. Reverse Idler Shaft Replacement**

1. With case extension removed from the transmission, drive the reverse idler shaft lock pin into the boss until it falls into the clearance hole in the shaft. See Figure 4-53.

2. Pry out the welch plug at the end of the shaft and press the shaft from the extension.

3. Line up the lock pin hole in the shaft with the hole in the boss. Install idler shaft and taper pin in place to lock.

**c. Reverse Shift and Seal Replacement**

1. With case extension removed from transmission, the reverse shifter shaft lock pin will already be removed.

2. Remove shift fork.

3. Carefully drive shifter shaft into case extension, allowing ball detent to drop into case. Remove shaft and ball detent spring.

4. Place ball detent spring into detent spring hole and start reverse shifter shaft into hole in boss.

5. Place detent ball on spring and, holding ball down with a suitable tool (see Figure 4-54), push the shifter shaft into place and turn; the ball drops into place in detent on shaft detent plate.

6. Install shift fork.

NOTE: Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission.

**d. Clutch Keys and Springs Replacement**

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the three keys and two springs may be replaced if worn or broken.

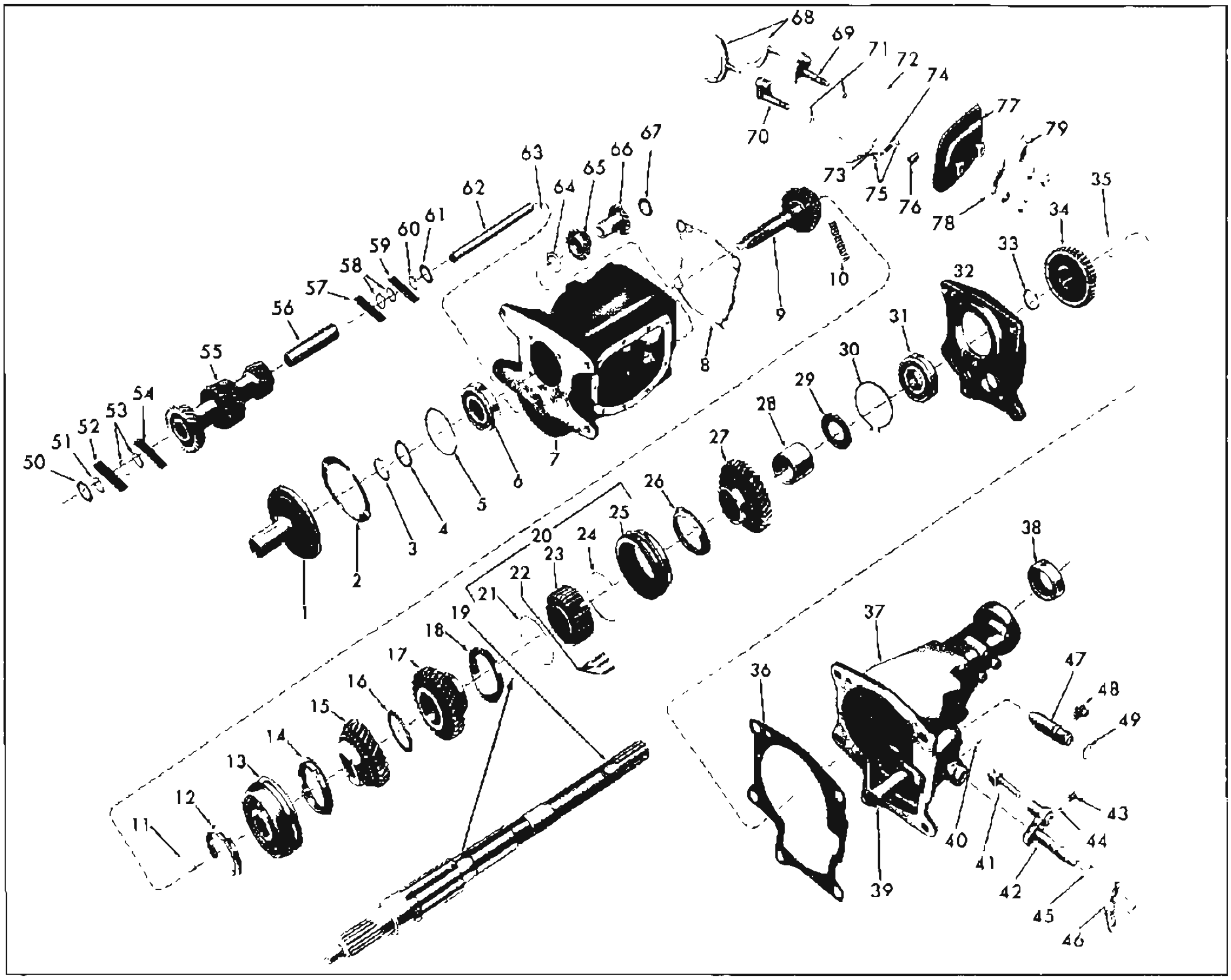
1. Push the hub from the sliding sleeve. The keys will fall free and the springs may be easily removed.

2. Place the two springs in position (one on each side of hub), so a tanged end of each spring falls into the same keyway in the hub. Place the keys in position and, holding them in place, slide the hub into the sleeve.

## 4-18 CLEANING AND INSPECTION

**a. Transmission Case**

Wash the transmission case inside and out with a cleaning solvent and inspect for cracks.



1. Bearing Retainer
2. Gasket
3. Selective Fit Snap Ring
4. Spacer Washer
5. Bearing Snap Ring
6. Main Drive Gear Bearing
7. Transmission Case
8. Rear Bearing Retainer Gasket
9. Main Drive Gear
10. Bearing Rollers (14)
11. Snap Ring (.086" to .088")
12. Fourth Speed Gear Synchronizing Ring
13. Third and Fourth Speed Clutch Sliding Sleeve
14. Third Speed Synchronizing Ring
15. Third Speed Gear
16. Second and Third Speed Gear Thrust Washer (Needle Roller Bearing)
17. Second Speed Gear
18. Second Speed Gear Synchronizing Ring
19. Mainshaft
20. First and Second Speed Clutch Assembly
21. Clutch Key Spring
22. Clutch Keys
23. Clutch Hub
24. Clutch Key Spring
25. First and Second Speed Clutch Sliding Sleeve
26. First Speed Gear Synchronizing Ring
27. First Speed Gear
28. First Speed Gear Bushing
29. First Speed Gear Thrust Washer
30. Rear Bearing Snap Ring
31. Rear Bearing
32. Rear Bearing Retainer
33. Selective Fit Snap Ring
34. Reverse Gear
35. Speedometer Drive Gear
35A. Special Snap Ring
36. Rear Bearing Retainer to Case Extension Gasket
37. Case Extension
38. Rear Oil Seal
39. Reverse Idler Shaft
40. Reverse Shifter Shaft Lock Pin
41. Reverse Shift Fork
42. Reverse Shifter Shaft and Detent Plate
43. Reverse Shifter Shaft Ball Detent Spring
44. Reverse Shifter Shaft Detent Ball
45. Reverse Shifter Shaft "O" Ring Seal
46. Reverse Shifter Lever
47. Speedometer Driven Gear and Fitting
48. Retainer and Bolt
49. "O" Ring Seal
50. Tanged Washer
51. Spacer (.050")
52. Bearing Rollers (20)
53. Spacer (2—.050")
54. Bearing Rollers (20)
55. Countergear
56. Countergear Roller Spacer
57. Bearing Rollers (20)
58. Spacers (2—.050")
59. Bearing Rollers (20)
60. Spacer (.050")
61. Tanged Washer
62. Countershaft
63. Countershaft Woodruff Key
64. Reverse Idler Front Thrust Washer (Flat)
65. Reverse Idler Gear (Front)
66. Reverse Idler Gear (Rear)
67. Tanged Thrust Washer
68. Forward Speed Shift Forks
69. First and Second Speed Gear Shifter Shaft and Detent Plate
70. Third and Fourth Speed Gear Shifter Shaft and Detent Plate
71. "O" Ring Seals
72. Gasket
73. Interlock Pin
74. Poppet Spring
75. Detent Balls
76. Interlock Sleeve
77. Transmission Side Cover
78. Third and Fourth Speed Shifter Lever
79. First and Second Speed Shifter Lever

Figure 4-51

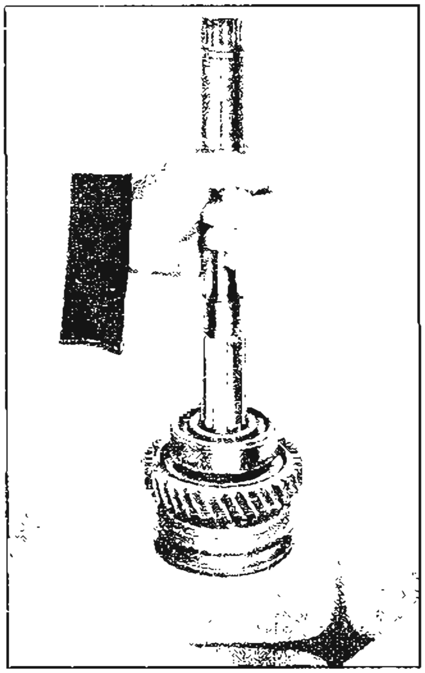


Figure 4-52—Removing Mainshaft From Clutch Assembly

Inspect the front face which fits against the clutch housing for burrs and if any are present, dress them off with a fine cut mill file.

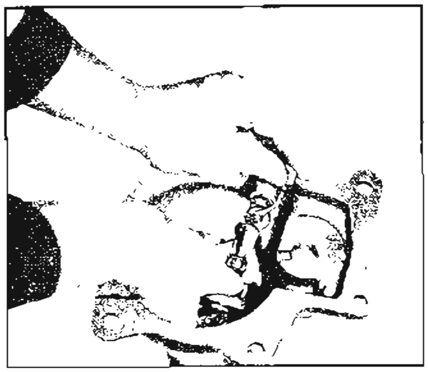


Figure 4-54—Installing Reverse Shifter Shaft

**b. Front and Rear Bearings**

1. Wash the front and rear thoroughly in a cleaning solvent.

2. Blow out bearing with compressed air.

NOTE: 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.

**c. Bearing Rollers and Spacers**

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft at the same time and replace if necessary. Replace all worn parts.

**d. Gears**

Inspect all gears and replace all that are worn or damaged.

## 4-19 TRANSMISSION ASSEMBLY

**a. Mainshaft Assembly**

1. From rear of mainshaft, assemble first and second speed clutch assembly to mainshaft (sliding clutch sleeve taper toward the rear, hub to the front) and, using J-8853, press the first gear bushing on shaft. See Figure 4-55.

2. Install the first speed gear synchronizing ring so the notches in the ring correspond to the keys in the hub. See Figure 4-56.

3. Install first speed gear (with hub toward the front) and the first speed gear thrust washer. Make certain that the grooves in the washer are facing the first speed gear.

4. Using J-8853, press on the rear bearing with the snap ring groove toward the front of the transmission (see Figure 4-57).

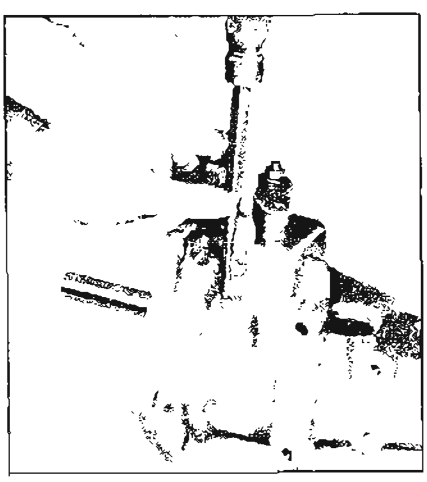


Figure 4-53—Removing Reverse Idler Shaft Lock Pin

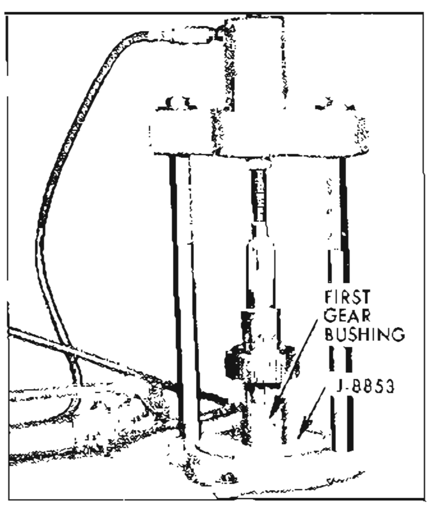



Figure 4-55—Installing First Speed Gear

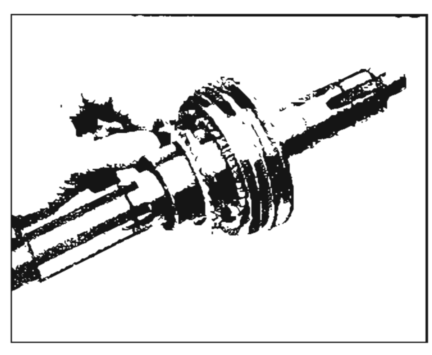


Figure 4-56—Installing Synchronizing Ring

Firmly seat bearing against the shoulder on the mainshaft.

5. Install snap ring in the groove in the mainshaft behind the rear bearing.

NOTE: Always use new snap ring when reassembling transmission and do not expand the snap ring further than is necessary for assembly.

6. From the front of the mainshaft, install the second speed gear synchronizing ring so notches in the ring correspond to the keys in the hub.

7. Install the second speed gear (with the hub of the gear toward the back of the transmission) and install the second and third speed gear thrust washer (needle roller bearing).

8. Install the third speed gear (hub to front of transmission) and the third speed gear synchronizing ring (notches to front of transmission).

9. Install the third speed and fourth speed gear clutch assembly (hub and sliding sleeve) with taper toward the front, making sure that the keys in the hub correspond to the notches in the third speed gear synchronizing ring.

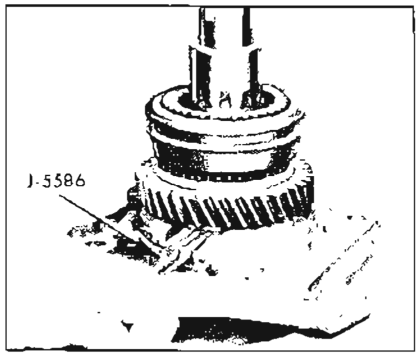



Figure 4-58—Installing Rear Bearing Retainer

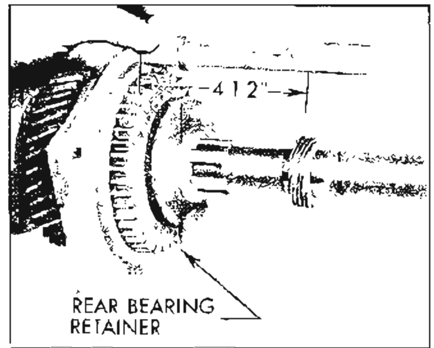



Figure 4-60—Speedometer Gear Location

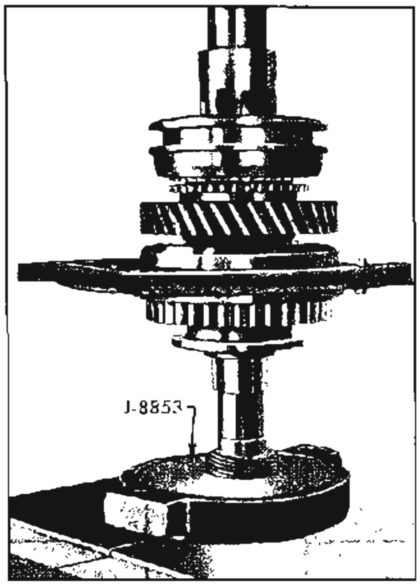



Figure 4-59—Installing Speedometer Drive Gear

10. Install snap ring in the groove in mainshaft in front of the third and fourth speed clutch assembly.

NOTE: If there is no end play, check the thickness of the snap ring just installed; it should be .087" thick. While the snap ring used at this location is NOT selective, it is identical to the selective washers used at the clutch gear and rear bearing locations.

11. Install the rear bearing retainer (see Figure 4-58). Spread the snap ring in the plate to allow the snap ring to drop around the rear bearing and press on the end of the mainshaft until the snap ring engages the groove in the rear bearing.

12. Install the reverse gear (shift collar to rear).

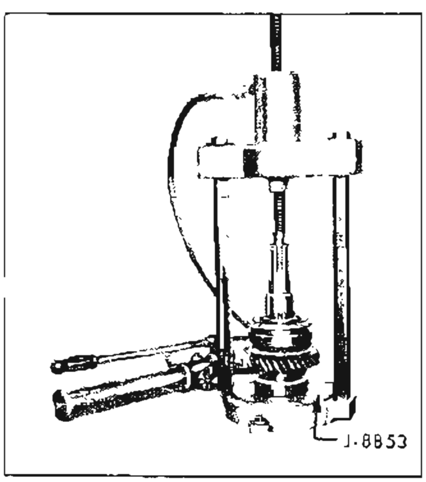



Figure 4-57—Installing Rear Bearing

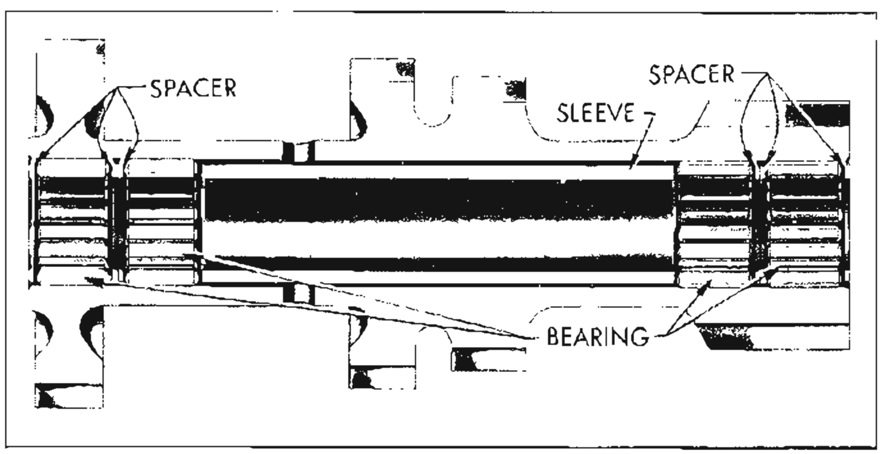



Figure 4-61—Counter Gear Assembly

13. Press speedometer drive gear onto the mainshaft, using a J-8853, press plate. (See Figure 4-59). Position the speedometer gear to get a measurement of 4-1/2" from the center of the gear to the flat surface of the rear bearing retainer. (See Figure 4-60).

14. Replace rear bearing snap ring on mainshaft.

### b. Counter Gear Assembly

1. Install roller spacer in countergear.

2. Using heavy grease to retain the rollers, install 20 rollers in either end of the countergear, two .050" spacers, 20 more rollers, then one .050" spacer. Install in the other end of the countergear, 20 rollers, two .050" spacers, 20 more rollers, and another .050" spacer. (See Figure 4-62).

### c. Transmission Assembly

1. Rest the transmission case on its side with the side cover opening toward the assembler. Reinstall retainer thrust washers on end of countergear with grease.

2. Set countergear in place in bottom of transmission case, making sure that tanged thrust washers are correctly positioned.

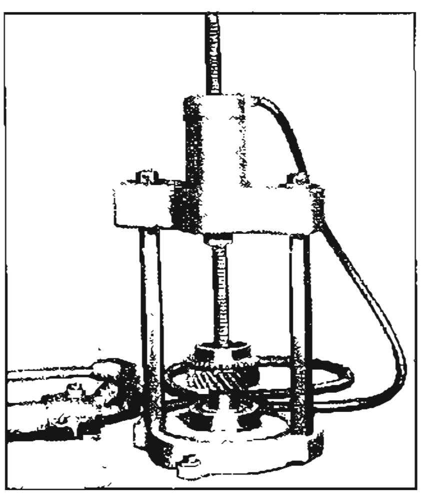


Figure 4-62—Installing Main Drive Gear Bearing

3. Press bearing onto main drive gear (snap ring groove to front), using J-5746 (Figure 4-62). Be sure bearing fully seats against shoulder on gear.

4. Install spacer washer and selective fit snap ring in groove on gear stem.

NOTE: <u>The snap ring is available in three thicknesses: .087", .093", and .099". Use the ring that will produce from zero to .005" clearance between the rear face of the snap ring and the front face of the spacer washer.</u>

5. Install the main drive gear and bearing assembly through the side cover opening and into position in transmission front bore. Tap lightly into place, if necessary, with a plastic hammer. Place snap ring and spacer in groove in front bearing.

6. With the transmission case resting on its front face, move countergear into mesh with main drive gear. Be sure thrust washers remain in place. Install woodruff key into end of countershaft and press shaft (Figure 4-63) until end of shaft is flush with rear face of transmission case.

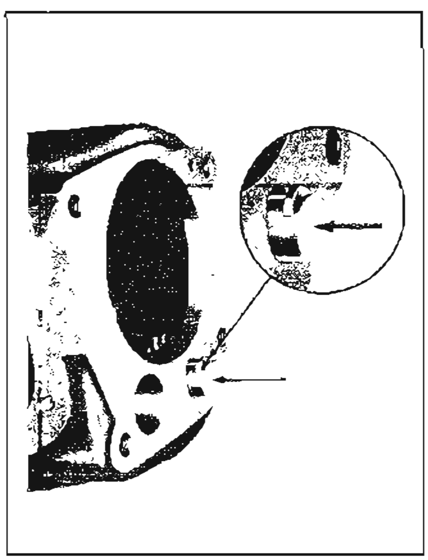


Figure 4-63—Installing Countershaft

7. Attach a dial indicator as shown in Figure 4-64, and check the end play of the countergear. End play must not be more than .025".

8. Install the fourteen roller bearings into the main drive gear, using heavy grease to hold the bearing in place.

9. Using heavy grease, place gasket in position on front face of rear bearing retainer.

10. Install fourth speed synchronizing ring on main drive gear with the notches toward the rear of the transmission.

11. Position the reverse idler gear thrust washer (untanged) on the machined face of the ear cast for the reverse idler shaft. Position the front reverse idler gear on top of the thrust washer, with the hub facing forward rear of the case.

12. Lower the mainshaft assembly into the case, making certain that the notches on the fourth speed synchronizing ring correspond to the keys in the clutch assembly. See Figure 4-65.

13. Install the self-locking bolt attaching rear bearing retainer

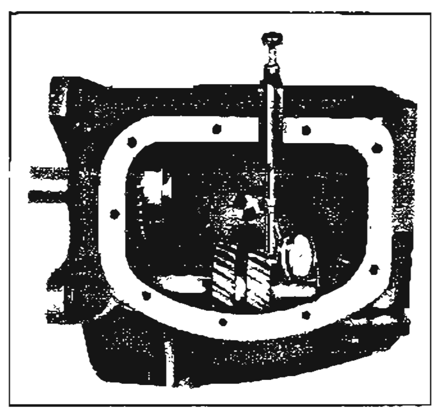


Figure 4-64—Checking Countergear End Play

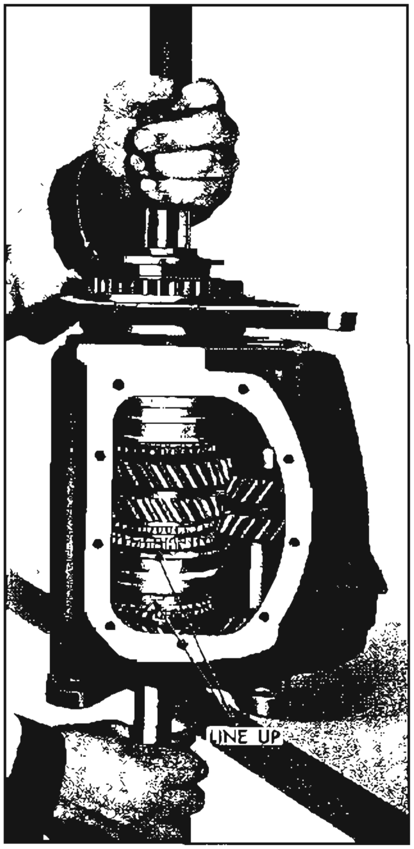



Figure 4-65—Installing Mainshaft

to transmission case. Torque to 20 to 30 ft. lbs.

14. From the rear of the case, insert the rear reverse idler gear, engaging the splines with the portion of the gear, within the case.

15. Using heavy grease, place gasket into position on rear face of rear bearing retainer.

16. Using heavy grease, install the remaining thrust washer into place on the reverse idler shaft, making sure tang on the thrust washer is in the notch in the idler thrust face of the extension.

17. Place the two clutches in neutral position. Pull reverse shifter shaft to left side of extension and rotate shaft to bring reverse shift fork as far forward in extension as possible. Start the extension

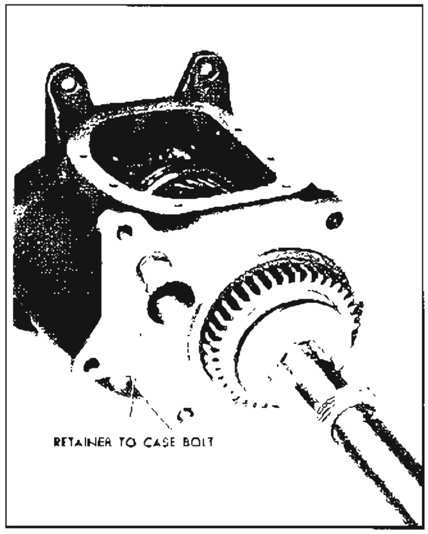



Figure 4-66—Bearing Retainer To Transmission Bolt

onto the transmission case (Figure 4-68) while slowly pushing in on the shifter shaft to engage the shift fork with the reverse gear shift collar. When the fork engages, rotate the shifter shaft to move the reverse gear rearward, permitting the extension to slide onto the transmission case.

18. Install new oil seal in rear bearing retainer, using Seal Installer J-8864. See Figure 4-67 Lightly coat seal with gear lubricant.

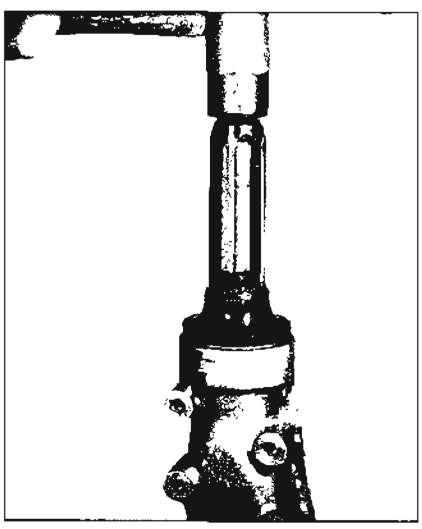


Figure 4-67—Installing Extension Oil Seal

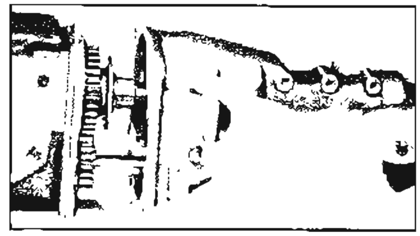


Figure 4-68—Installing Extension To Case

19. Install three extension and retainer to case attaching bolts (torque to 35 to 45 ft. lbs.) and two extension to retainer attaching bolts (torque to 20 to 30 ft.

20. Push or pull reverse shifter shaft to line up groove in the shaft with the holes in the boss and drive in the lock pin. Install shifter lever.

21. Install the main drive gear bearing retainer, gasket and four attaching bolts, using a suitable sealer on bolts. Torque to 15 to 20 ft. lbs.

22. Install a shift fork in each clutch sleeve.

23. Place both clutches in neutral, install side cover gasket and carefully lower side cover into place. Install attaching bolts and tighten evenly to avoid side cover distortion. Use suitable sealer when installing the lower right bolt.

NOTE: The transmission should "overshift" slightly in all ranges.

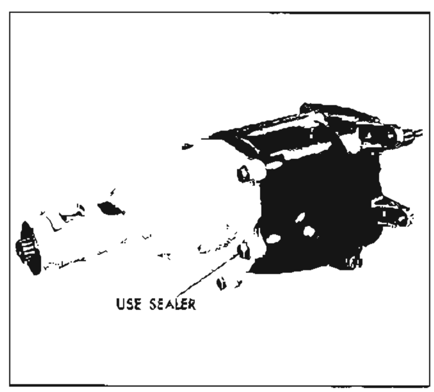



Figure 4-69—Sealing Case Extension Attaching Bolt

## 4-20 4-SPEED SYNCHROMESH TRANSMISSION TROUBLE DIAGNOSIS

| SYMPTOM AND PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| **SHIFTS HARD** | |
| a. Clutch not releasing engine or slow to release. | a. Adjust or repair clutch. |
| b. Shift linkage binding or selector not properly adjusted. | b. Free up and adjust as required. |
| **SHIFTS HARD ON DOWNSHIFT** | |
| a. Downshifting at too high an engine speed. | a. Shifting into low gear above 45 MPH and second above 65 MPH causes extra work for synchronizers and will require extra time or more force on lever to complete. There is also danger of over-speeding the engine if low or second is used at high car speeds. |
| **DISENGAGES FROM GEAR** | |
| a. Dirt between transmission case and clutch housing. | a. Clean mating surfaces. |
| b. Does not fully engage. | b. Check linkage for interference. Adjust or replace damaged shift linkage. |
| c. Clutching teeth worn or defective and/or clutch hub spline worn. | c. Replace gear, clutch sleeve and clutch hub. |
| **NOISY** | |
| a. Gears worn, scored or broken. | a. Replace gears. |
| b. Bearing dirty, worn. | b. Flush transmission with kerosene. If noise is still present, replace bearings and examine gears as above. |
| c. Interference of clutch sleeve with countergear of idler gear. | c. Replace worn shift forks, countergear, and idler gear thrust washers to restore gears and clutch sleeve to proper location. Examine thrust faces on these gears for wear. Replace if worn excessively. |
| **LEAKS LUBRICANT** | |
| a. Excessive amount of lubricant in transmission. | a. Drain to correct level. |
| b. Loose or broken clutch gear bearing retainer. | b. Tighten or replace retainer. |

## 4-20 4-SPEED SYNCHROMESH TRANSMISSION TROUBLE DIAGNOSIS (Cont'd)

| SYMPTOM AND PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| LEAKS LUBRICANT (Cont'd) | |
| c. Clutch gear bearing retainer gasket damaged. | c. Replace gasket. |
| d. Cover loose or gasket damaged. | d. Tighten cover or replace gasket. |
| e. Operating shaft seal leaks. | e. Replace operating shaft seal. |
| f. Idler shaft expansion plugs loose. | f. Replace expansion plugs. |
| g. Countershaft loose in case. | g. Replace case |
| h. Lack of sealant on bolts. | h. Coat bolts with sealant. |
| i. Worn extension oil seal. | i. Replace seal. |
| EXCESSIVE BACKLASH IN ALL REDUCTION GEARS | |
| a. Worn countergear bearings. | a. Replace countergear bearings and shaft. |
| b. Excessive end play in countergear. | b. Replace countergear thrust washers. |
| NOISY IN ALL REDUCTION GEARS | |
| a. Insufficient lubricant. | a. Fill to correct level. |
| b. Worn or damaged clutch gear.or countergear. | b. Replace faulty or damaged gears. |
| NOISY IN ALL GEARS | |
| a. Insufficient lubricant. | a. Fill to correct level. |
| b. Worn countergear bearings. | b. Replace countergear bearings and shaft. |
| c. Worn or damaged clutch gear and countershaft drive gear. | c. Replace worn or damaged gears. |
| d. Damaged clutch gear or mainshaft ball bearings. | d. Replace damaged bearings. |
| e. Damaged speedometer gears. | e. Replace damaged gears. |
| NOISY IN HIGH GEAR | |
| a. Damaged clutch gear bearing. | a. Replace damaged bearing. |
| b. Damaged mainshaft bearing. | b. Replace damaged bearing. |
| c. Damaged speedometer gears. | c. Replace speedometer gears. |
| NOISY IN NEUTRAL WITH ENGINE RUNNING | |
| a. Damaged clutch gear bearing. | a. Replace damaged bearing. |
| b. Damaged mainshaft pilot bearing roller. | b. Replace damaged bearing roller. |

# GROUP 4A
# TRANSMISSION SHIFT LINKAGE ADJUSTMENTS

SECTIONS IN GROUP 4A



## 4A-A SUPER TURBINE 300 TRANSMISSION SHIFT LINKAGE ADJUSTMENT

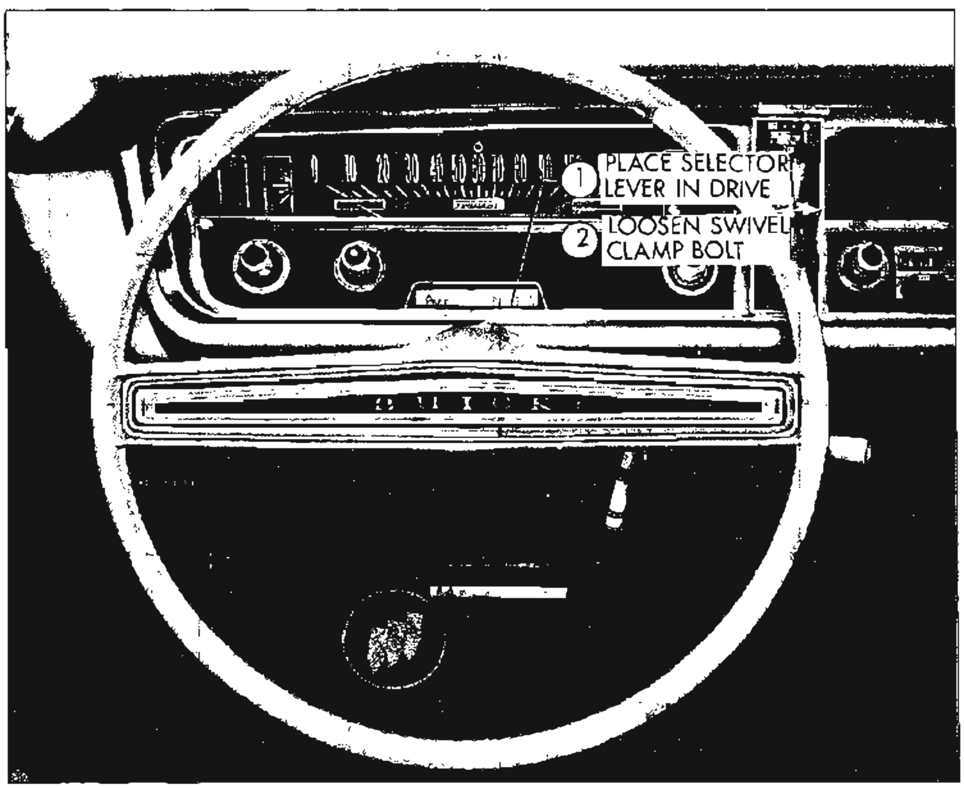



Fig. 4A-1

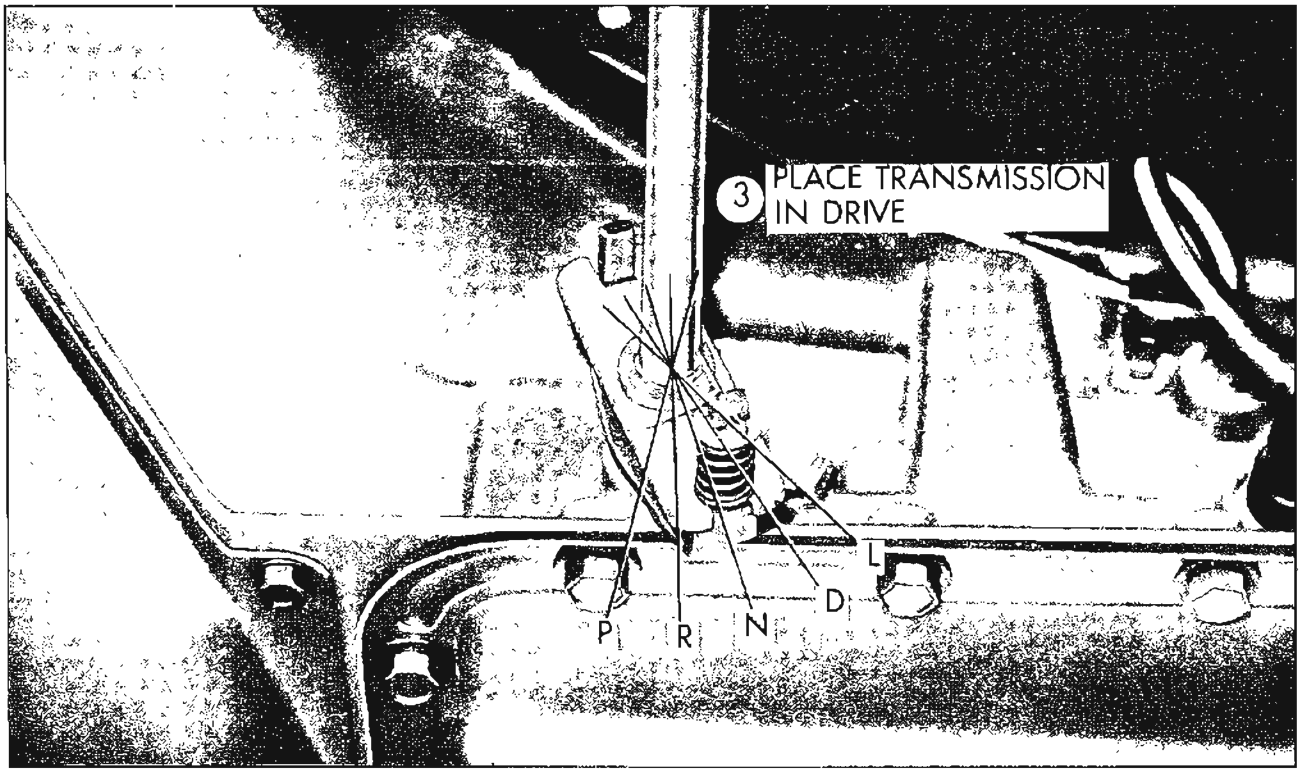



Fig. 4A-2

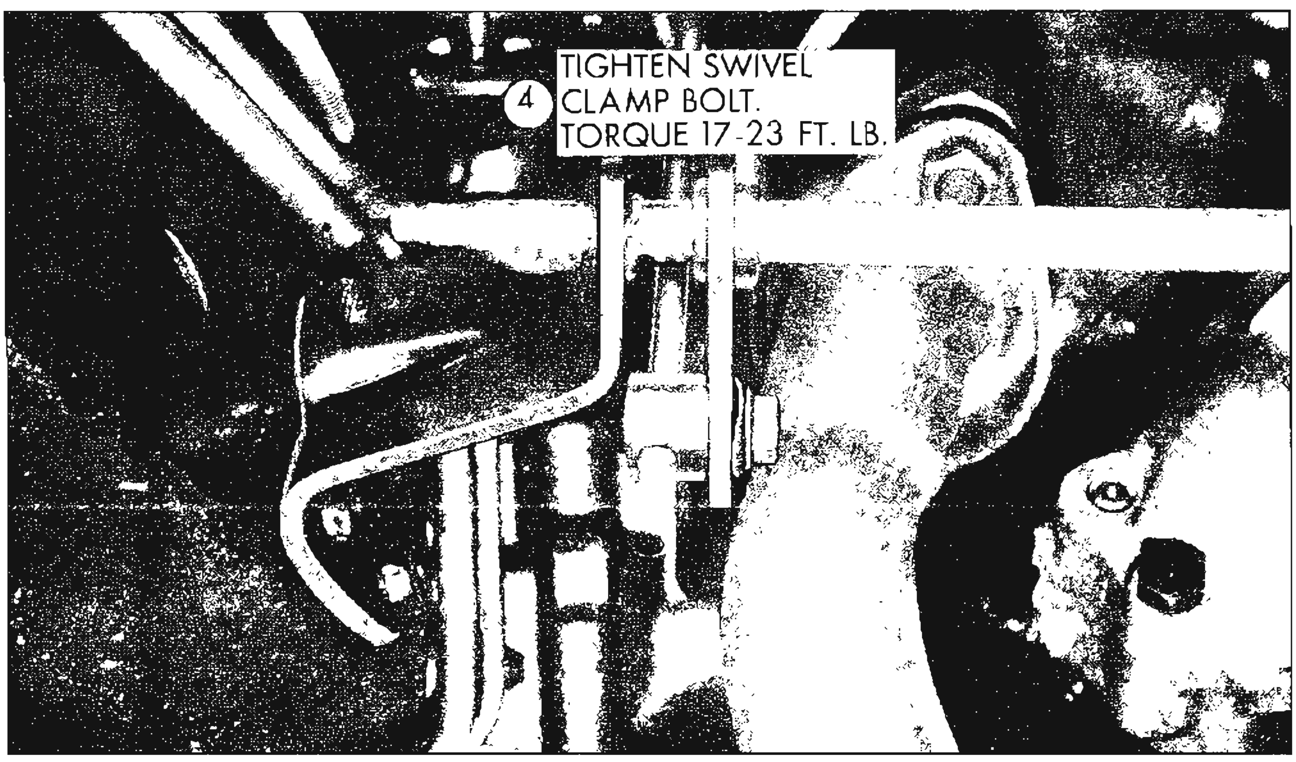



Fig. 4A-3

## 4A-B 3-SPEED SYNCHROMESH TRANSMISSION LINKAGE ADJUSTMENT

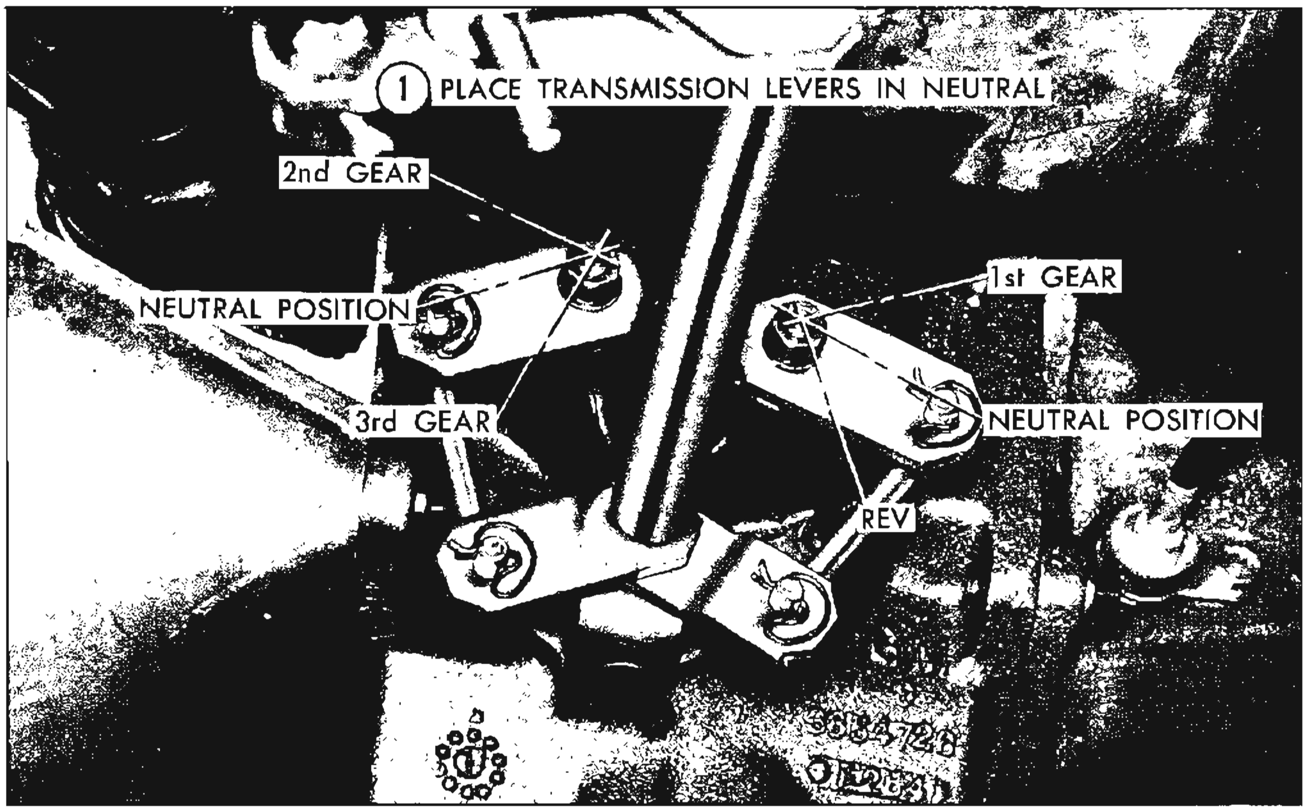



Fig. 4A-4

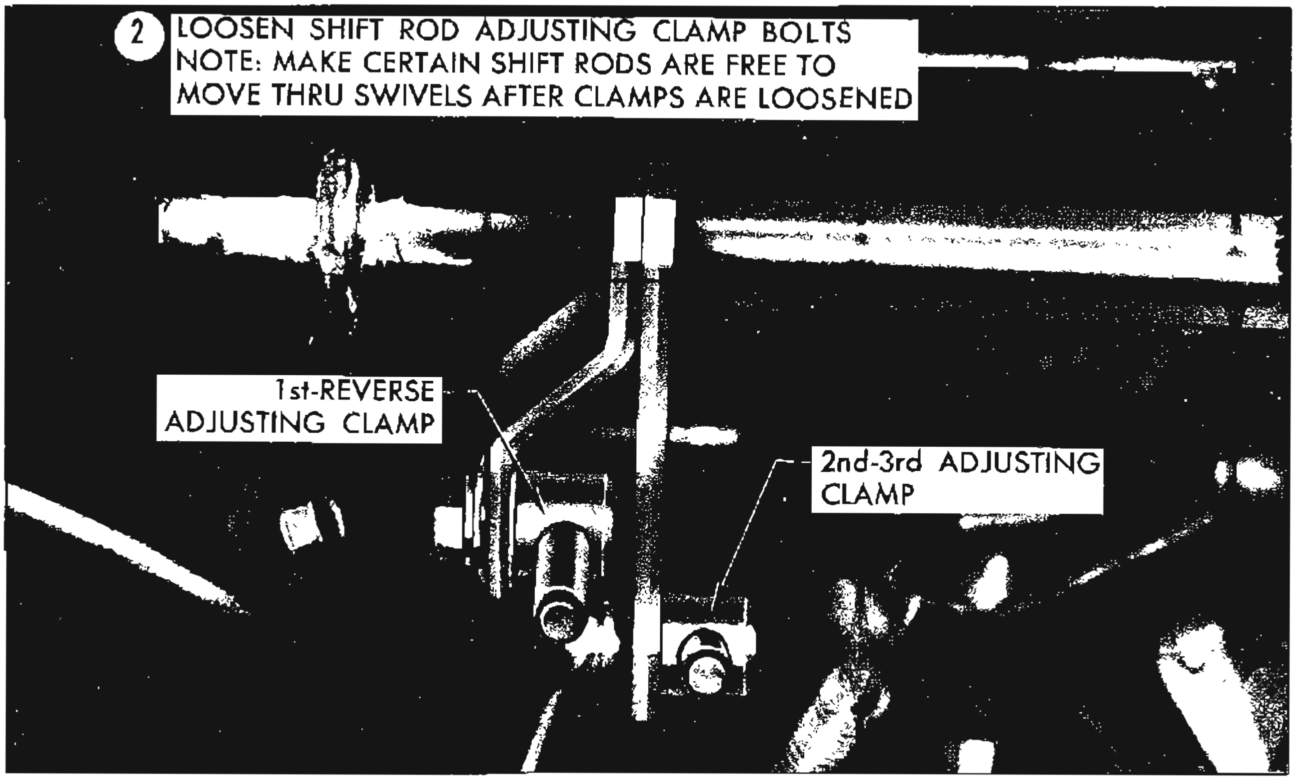



Fig. 4A-5


Fig. 4A-6

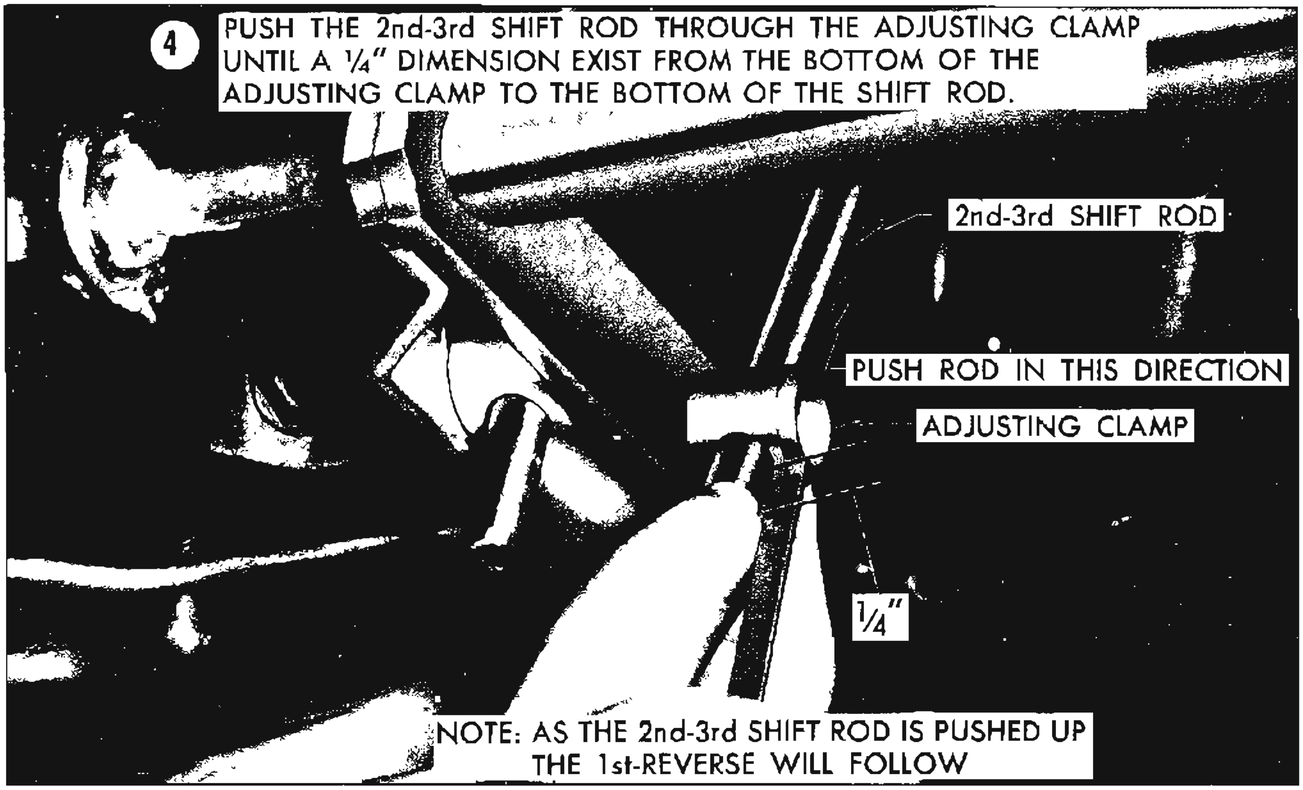



Fig. 4A-7

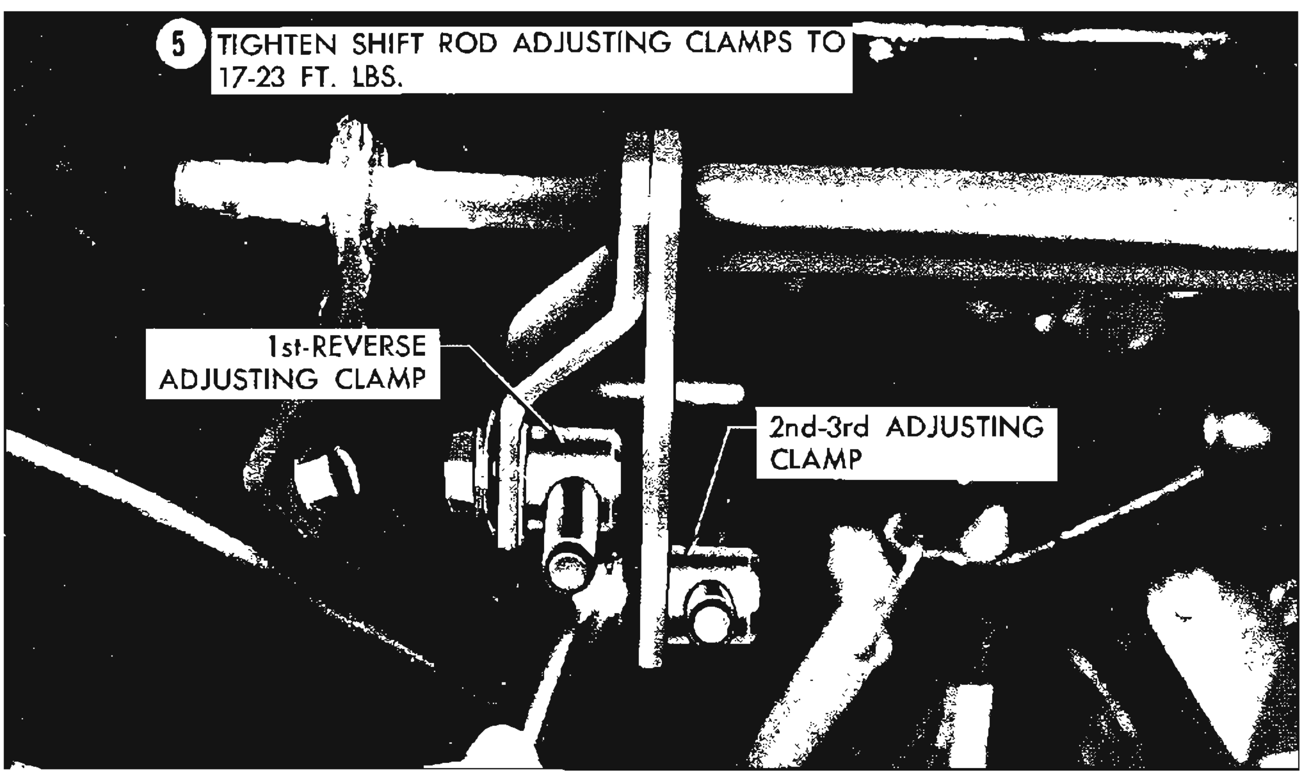



Fig. 4A-8

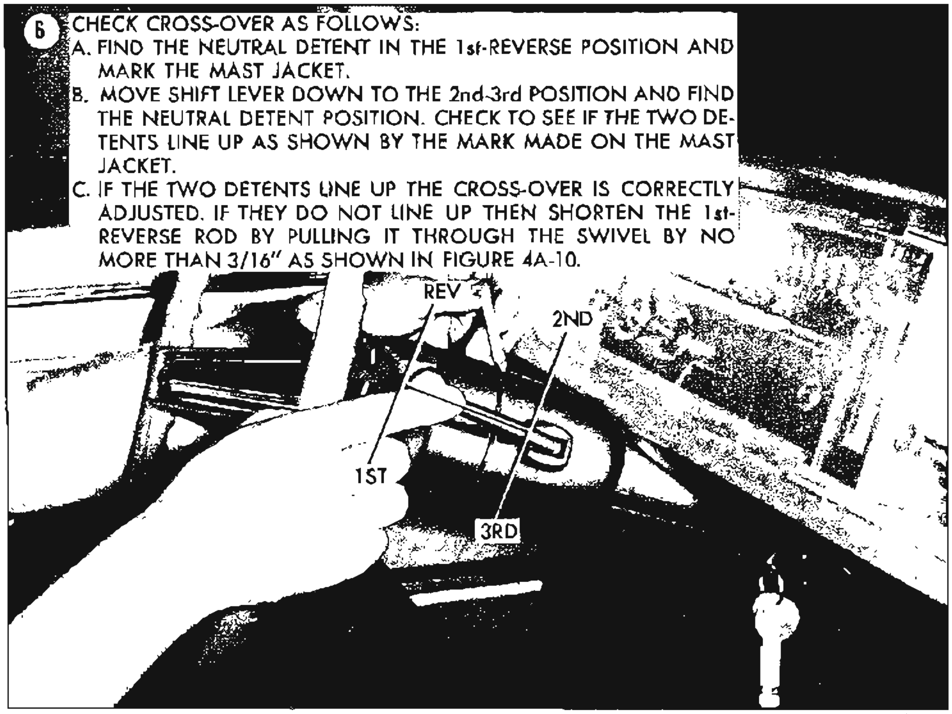



Fig. 4A-9

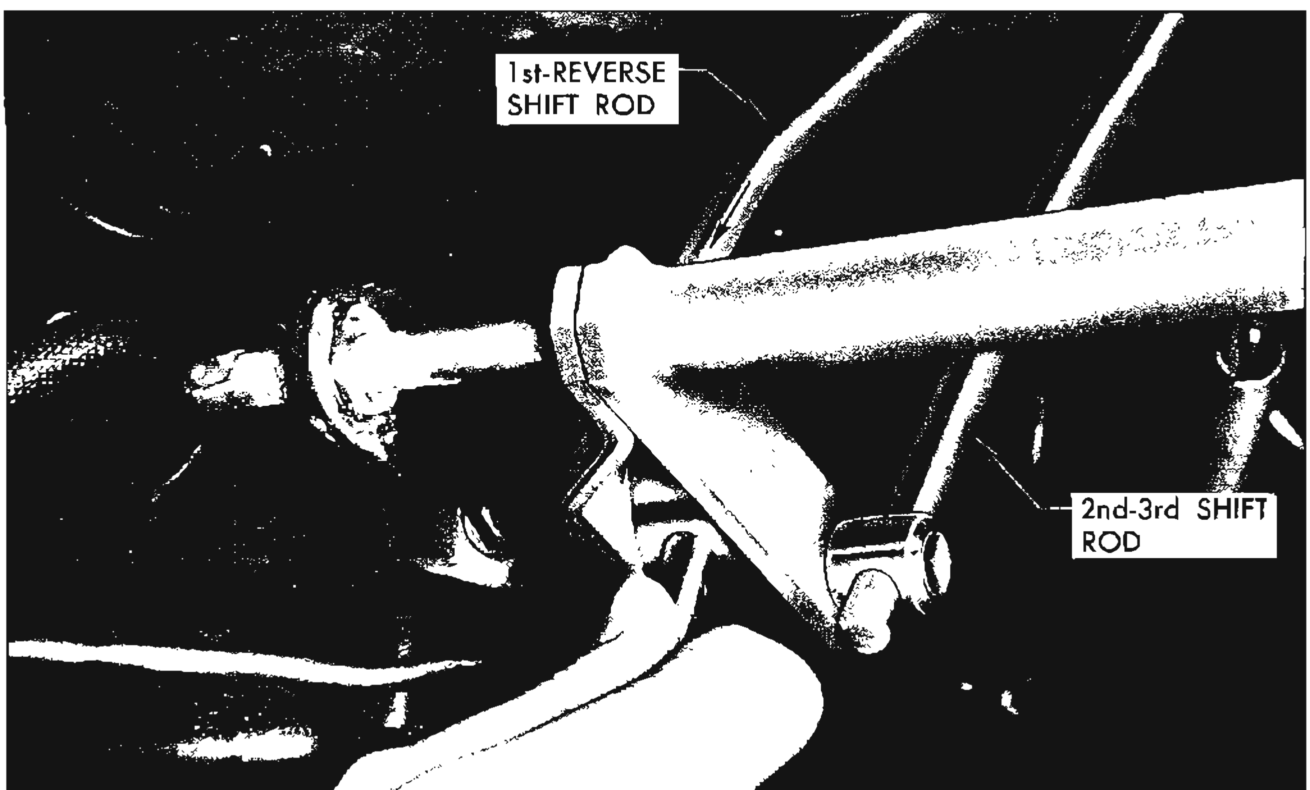



Fig. 4A-10

## 4A-C 4-SPEED SYNCHROMESH LINKAGE ADJUSTMENT

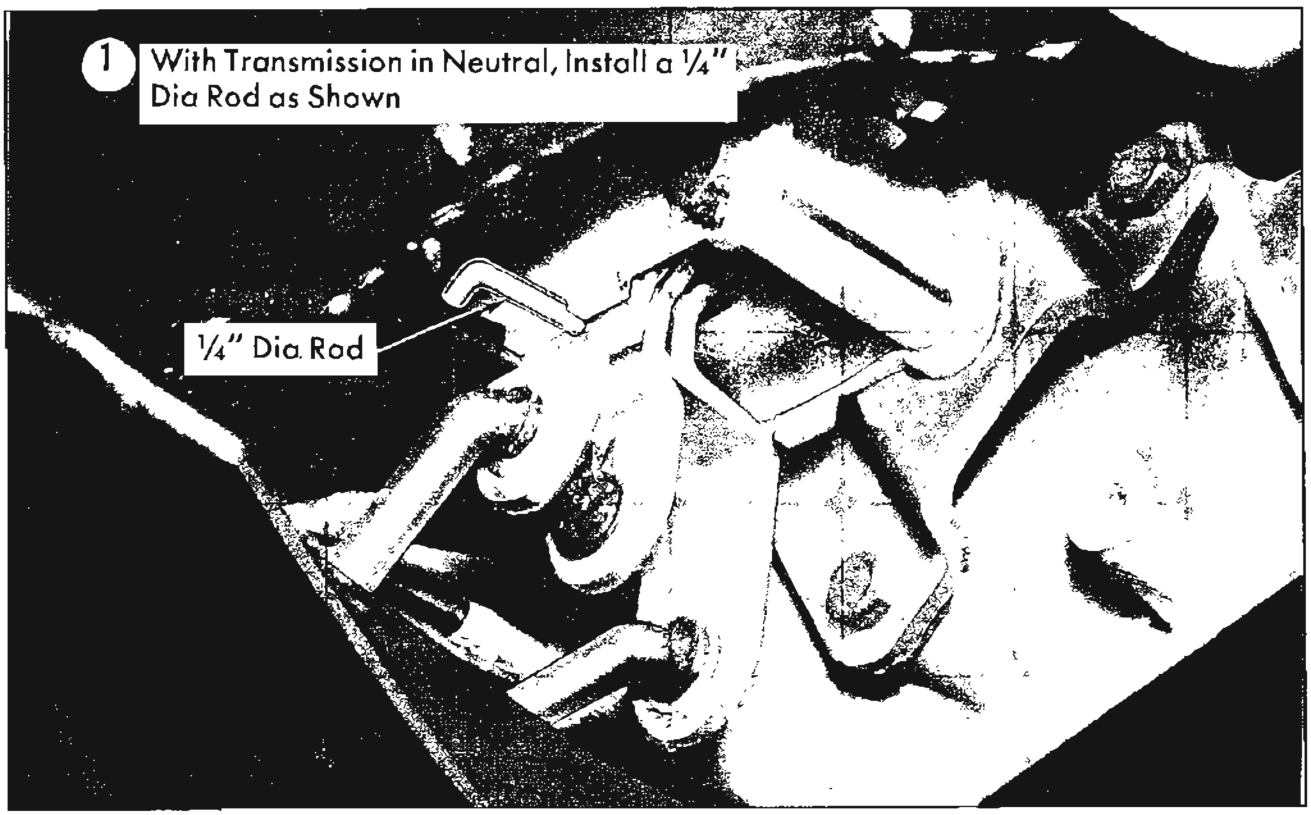



Fig. 4A-11

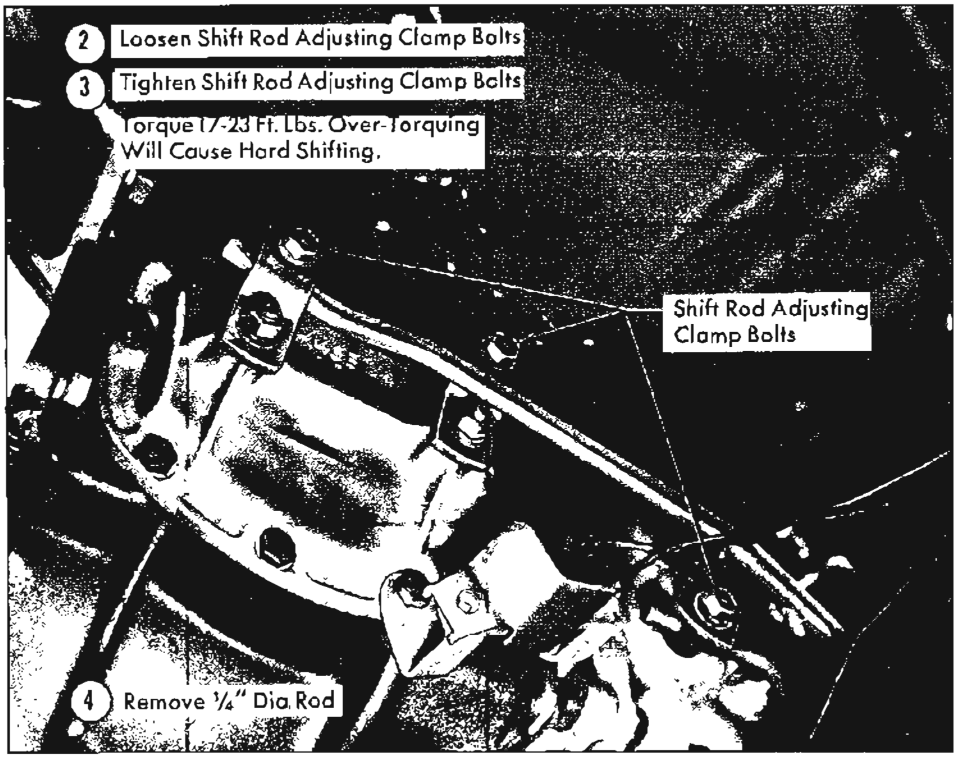



Fig. 4A-12

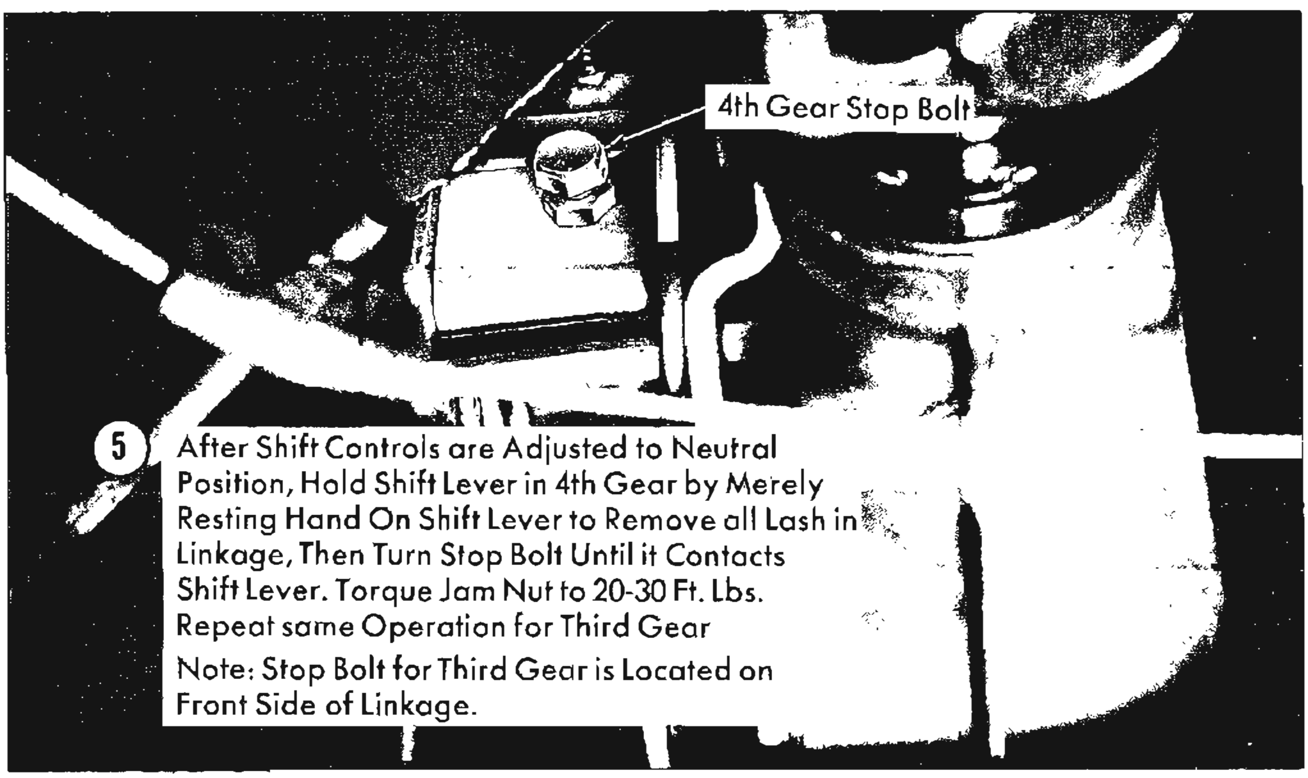



Fig. 4A-13

# GROUP 5
# SUPER TURBINE "300"
# AUTOMATIC TRANSMISSION

SECTIONS IN GROUP 5



## SECTION 5-A

## 43000-44000-45000 SUPER TURBINE "300" AUTOMATIC TRANSMISSION SPECIFICATIONS DESCRIPTION AND OPERATION

NOTE: All references to V-6 transmission does not apply to 45000 Series cars.

CONTENTS OF SECTION 5-A



## 5-1 AUTOMATIC TRANSMISSION GENERAL SPECIFICATIONS

### a. Model Designation

| Trans. Model | Converter Assembly Information | Valve Body Plate | Reverse Clutch Pressure Plate | Reverse Clutch Piston | Reverse Clutch Driven Plate Reqd. | Reverse Clutch Drive Plate Reqd. | Forward Clutch Driven Plate Reqd. | Forward Clutch Drive Plate Reqd. | Forward Clutch Piston | Modulator Can Assembly | Model Usage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MJ | Blue Dot of Paint | No Notch | See Figure 5-295 | 1366133 | 5 | 5 | 6 | 5 | 1357081 | 8623364 8623365 8623947 | All 300 Cu. In. V-8 Models except Sportwagons |
| MR | Blue Dot of Paint | No Notch | | 1366133 | 5 | 5 | 6 | 5 | 1357081 | 8623364 8623365 8623947 | All 300 Cu. In. V-8 Model Sportwagons |
| LS | Orange Dot of Paint | Notch in Valve Body Plate | 5-295 | 1366132 | 4 | 4 | 5 | 4 | 1357082 | 1367031 1367032 | All 225 Cu. In. V-6 Model Cars |

### b. Transmission Identification Number

A production model number, trans model and model year is stamped on a metal tag, (see Figure 5-1B) or on the low servo cover located on the middle right side of the transmission case. (See Figure 5-1A)

The production code number is located in a circle on the low servo cover see Figure 5-1A. Since the production identification number furnishes the key to construction and interchangeability of parts in each transmission, the number should be used when selecting replacement parts as listed in the master parts list. The number should always be furnished on product reports, AFA forms, and all correspondence with the factory concerning a particular transmission.

### c. General Specifications

Oil Capacity . . . . . . . . . . 19 Pints
Oil Capacity indicated between Marks on Gauge Rod . . . . . . . . . . 1 Pint
Oil Specification . . . . . . . . . . Automatic Transmission Fluid Type A, Suffix A
Planetary Gearing Type . . . . . . . . . . Compound
Number of Pinions . . . . . . . . . . 3 Short 3 Long
Drain and Refill Mileage Recommendations. Drain pan replace the Filter on MJ and MR Models and Clean Screen on LJ Models . . . . . . . . . . 24,000 Mi.
NOTE: Under extreme heavy operation the above should be performed at . . . . . . . . . . 12,000 Mi.
If a major overhaul is necessary the strainer or the filter must be replaced.
Adjust Low Band . . . . . . . . . . 24,000 Mi.
Under Heavy Operation . . . . . . . . . . 12,000 Mi.

## 5-2 AUTOMATIC TRANSMISSION TIGHTENING SPECIFICATIONS

Use a reliable torque wrench to tighten the attaching bolts or nuts of the parts listed below.

NOTE: These specifications are for clean and lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

| Part | Location | Thread Size | Torque Ft.-Lbs. |
|---|---|---|---|
| Bolt | Case to Cylinder Block | 3/8 -16 | 30-40 |
| Screw-Tapping | Converter Cover Pan to Transmission Case | 1/4 -20 | 8-12 |
| Pipe Fitting | Water Cooler Pipes to Transmission Case | 1/4 -18 | 25-35 |
| Nut | Nut for Low Band Adjusting Screw | 7/16-20 | 20-30 |
| Bolt | Pump Body to Pump Cover | 5/16-18 | 16-24 |
| Bolt | Stator Control Valve Body to Transmission Case | 5/16-18 | 8-12 |
| Bolt | Valve Body Assembly to Transmission Case | 5/16-18 | 8-12 |
| Bolt | Solenoid Valve to Valve Body | 1/4 -20 | 8-12 |
| Bolt | Vacuum Modulator to Transmission Case | 5/16-18 | 8-12 |
| Bolt | Pump Assembly to Transmission Case | 5/16-18 | 16-24 |
| Bolt | Rear Bearing Retainer to Transmission Case | 3/8 -16 | 25-35 |
| Bolt-Special | Oil Pan to Transmission Case | 5/16-18 | 8-12 |
| Bolt | Speedo Sleeve Retainer to Bearing Retainer | 5/16-18 | 5-10 |
| Bolt | Governor Cover to Transmission Case | 5/16-18 | 8-12 |

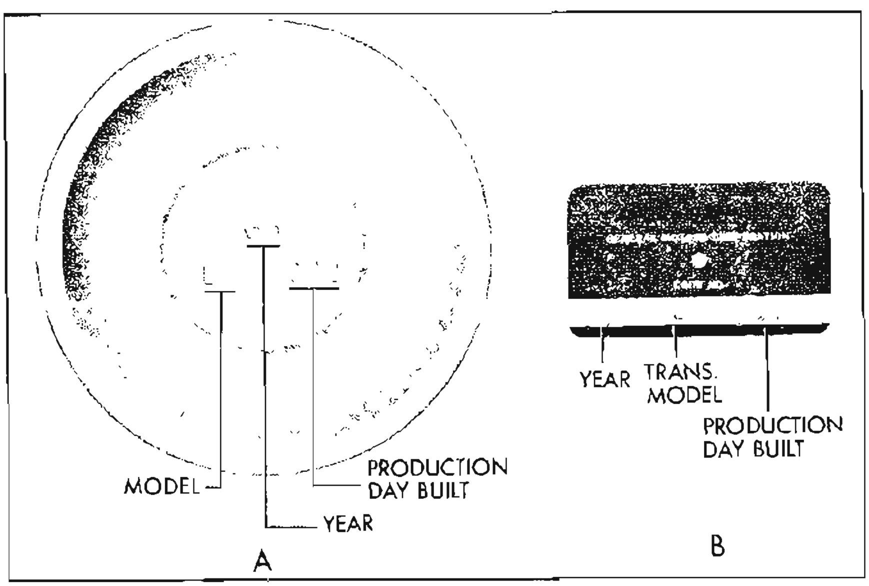



Figure 5-1—Transmission Model Identification

## 5-3 DESCRIPTION OF SUPER TURBINE "300" AUTOMATIC TRANSMISSION

The Super Turbine "300" automatic transmission is a combination torque converter, two speed planetary geared transmission. Torque multiplication is obtained hydraulically through the converter, and mechanically through a compound planetary gear set. The gear set, in combination with the torque converter, provides a high starting ratio for acceleration from a stop, up steep grades, etc. The torque converter provides torque multiplication for performance and exceptionally

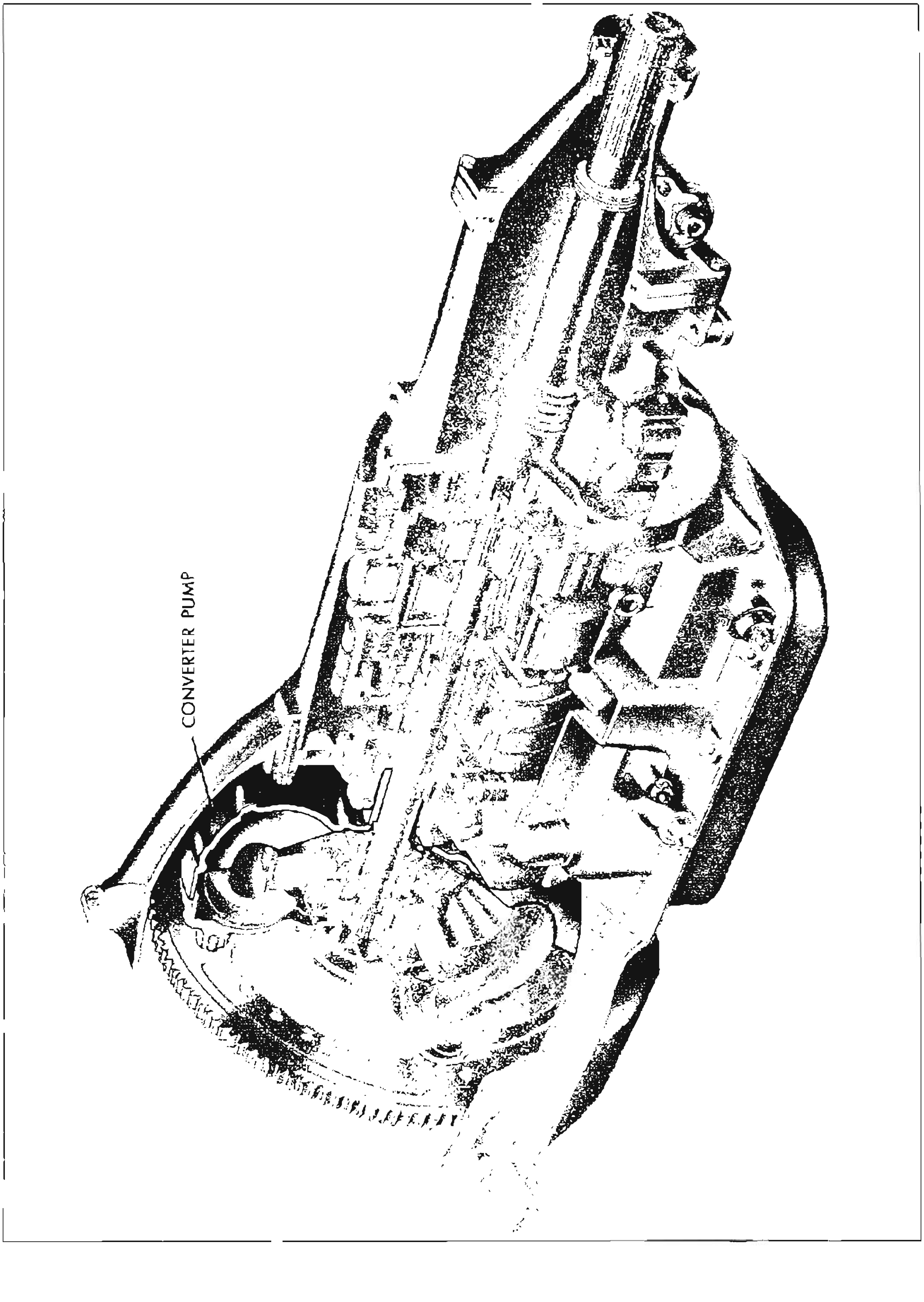



Figure 5-2—Converter Pump

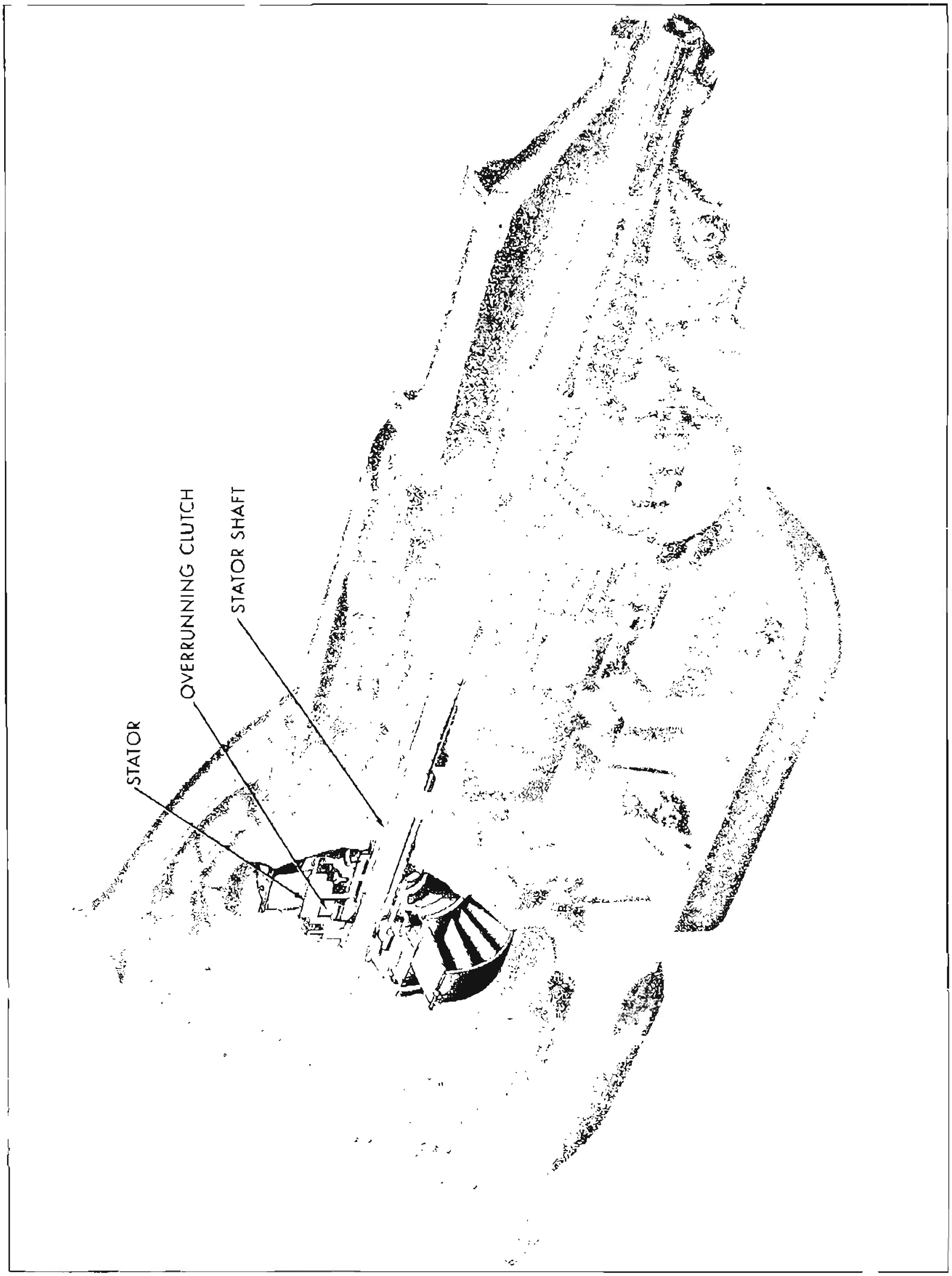



Figure 5-3—Stator and Stator Shaft

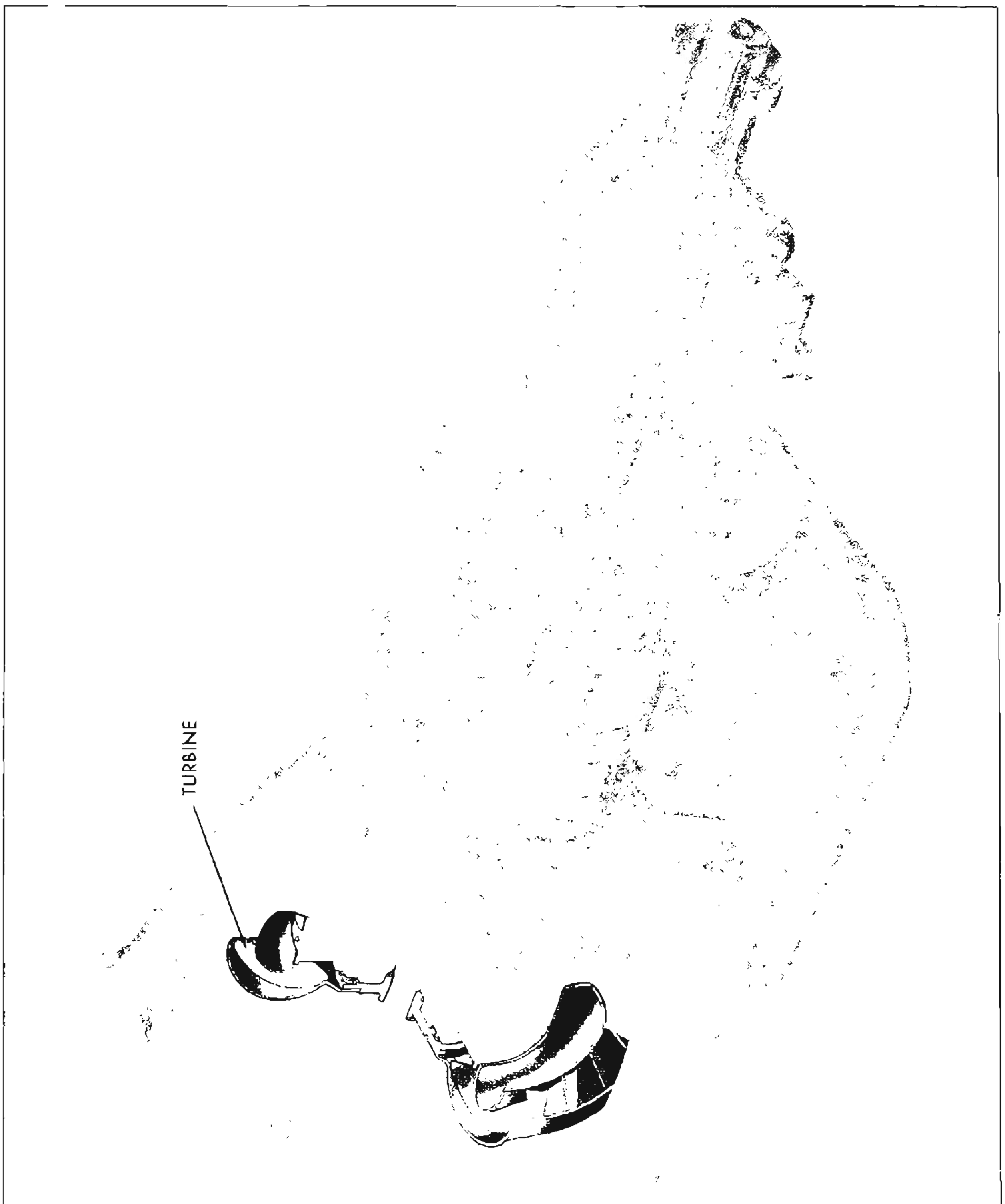



Figure 5-4—Converter Turbine

smooth operation. It functions as a fluid coupling at normal road load conditions and at higher speeds. Description of transmission is divided into six (6) basic sections: (1) Torque Converter, (2) Oil Pump, (3) Planetary Gear Set and Controls, (4) Reverse Clutch, (5) Governor, (6) Valve Body.

### 1. Torque Converter

The torque converter is connected to the engine flywheel and serves as a hydraulic coupling through which engine torque is transmitted to the input shaft. The torque converter steps up or multiplies engine torque whenever operating conditions demand greater torque than the engine alone can supply. The torque converter consists of three (3) basic sections: (a) Converter Pump, (b) Variable Pitch Stator, (c) Converter Turbine.

a. Converter Pump

The function of the converter pump is to convert engine torque into an energy transmitting flow of oil to drive the converter turbine into which the oil is projected. The converter pump operates as a centrifugal pump, picking up oil as its center and discharging the oil at its rim. However, the converter is shaped to discharge the oil parallel to its axis in the form of a spinning hollow cylinder. See Figure 5-2.

b. Variable Pitch Stator

The variable pitch stator is located between the converter turbine and the converter pump, and is supported by the stator shaft. The stator is equipped with a free wheel clutch assembly. When the clutch assembly is held stationary, it changes the direction of oil flow from the turbine to the proper angle for smooth entrance into the converter pump. As the turbine approaches pump speed the direction of oil flow changes until it no longer opposes pump rotation. The stator then free wheels so that it will not interfere with the flow of oil between the turbine and converter pump. For normal operation in Drive range the stator blades are set at low angle. For increased acceleration and performance, torque may be obtained by setting the stator blades at high angle. See Figure 5-3.

c. Converter Turbine

The function of the converter turbine is to absorb energy from the oil projected into it by the pump and convert the energy into torque and transmit that torque to the input shaft. See Figure 5-4.

### 2. Oil Pump

A positive displacement internal-external gear type oil pump is used to supply oil to fill the converter, for engagement of forward and reverse clutches for application and release of the low band and to circulate oil for lubrication and heat transfer. See Figure 5-5.

### 3. Planetry Gear Set and Controls

The planetary gear set consists of an input sun gear, low sun gear, short and long pinions, a reverse ring gear and a planet carrier. The input sun gear is splined to the input shaft. The low sun gear, which is part of the forward clutch assembly, may revolve freely until the low band is applied. The input sun gear is in mesh with three (3) long pinions and the long pinions are in mesh with three (3) short pinions. The short pinions are in mesh with the low sun gear and reverse ring gear. The input sun gear and short pinions always rotate in the same direction. Application of either the low band or the reverse clutch determines whether the output shaft rotates forward or backward. See Figure 5-6.

a. Forward Clutch

The forward clutch assembly consists of a drum, piston, springs, piston seals, and a clutch pack. These parts are retained inside the drum by the low sun gear and flange assembly and retainer ring. When oil pressure is applied to the piston, the clutch plates are pressed together connecting the clutch drum to the input shaft through the clutch hub. This engagement of the clutch causes the low sun gear to rotate with the input shaft. See Figure 5-7.

b. Low Band

The low band is a double-wrap steel band faced with a bonded lining which surrounds the forward clutch drum. The band is hydraulically applied by the low servo piston, and released by spring pressure. See Figure 5-7.

### 4. Reverse Clutch

The reverse clutch assembly consists of a piston, inner and outer seal, cushion spring, coil springs, clutch pack, and pressure plate. These parts are retained inside the case by a retaining snap ring. When oil pressure is applied to the piston, the clutch plates are pressed together holding the reverse ring gear stationary. This engagement of the clutch causes reverse rotation of the output shaft. See Figure 5-8.

### 5. Governor

The governor is located to the rear of the transmission case on the left side and is driven off the output shaft. The purpose of the governor is to generate a speed

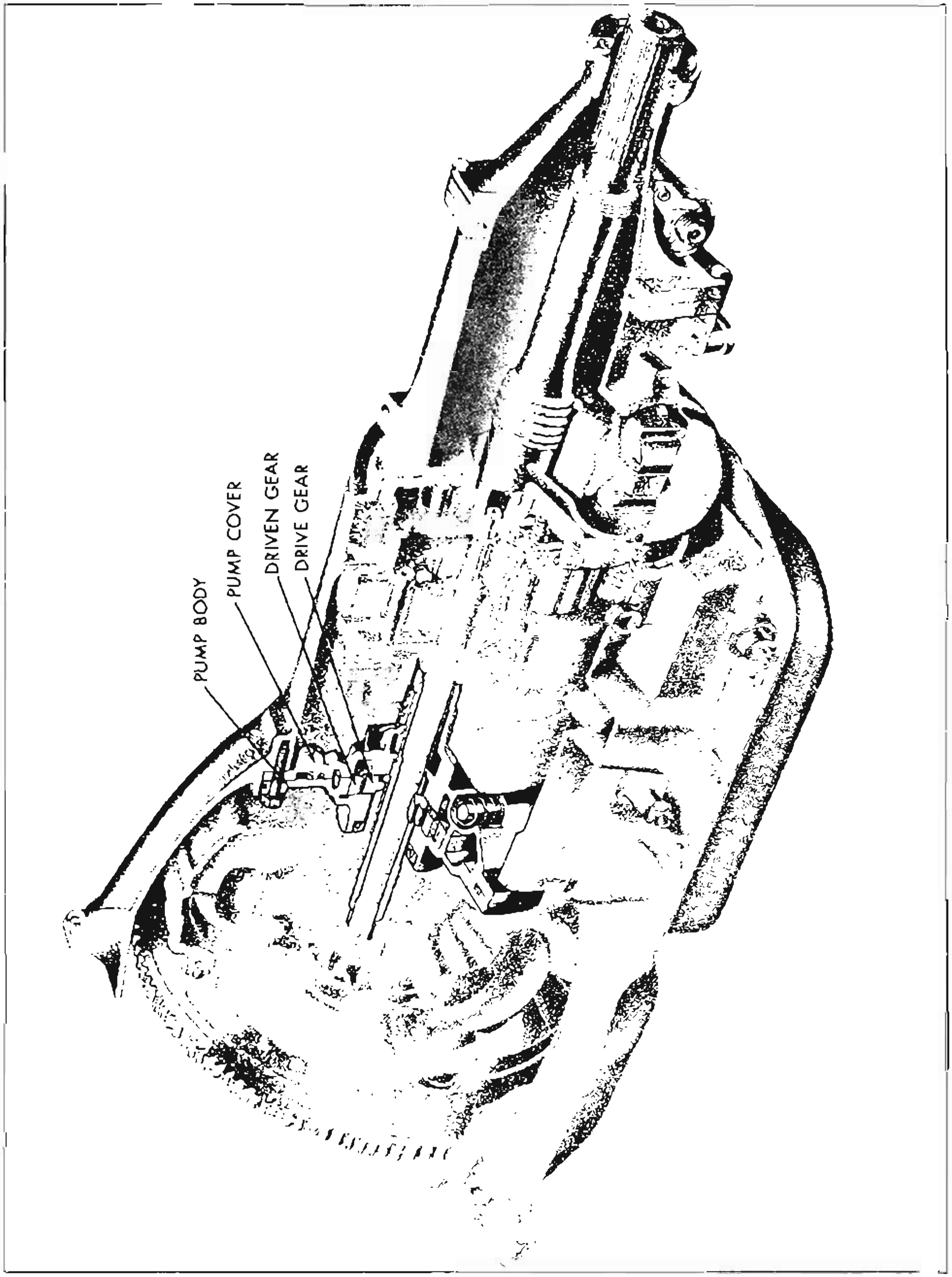



Figure 5-5—Oil Pump and Stator Shaft

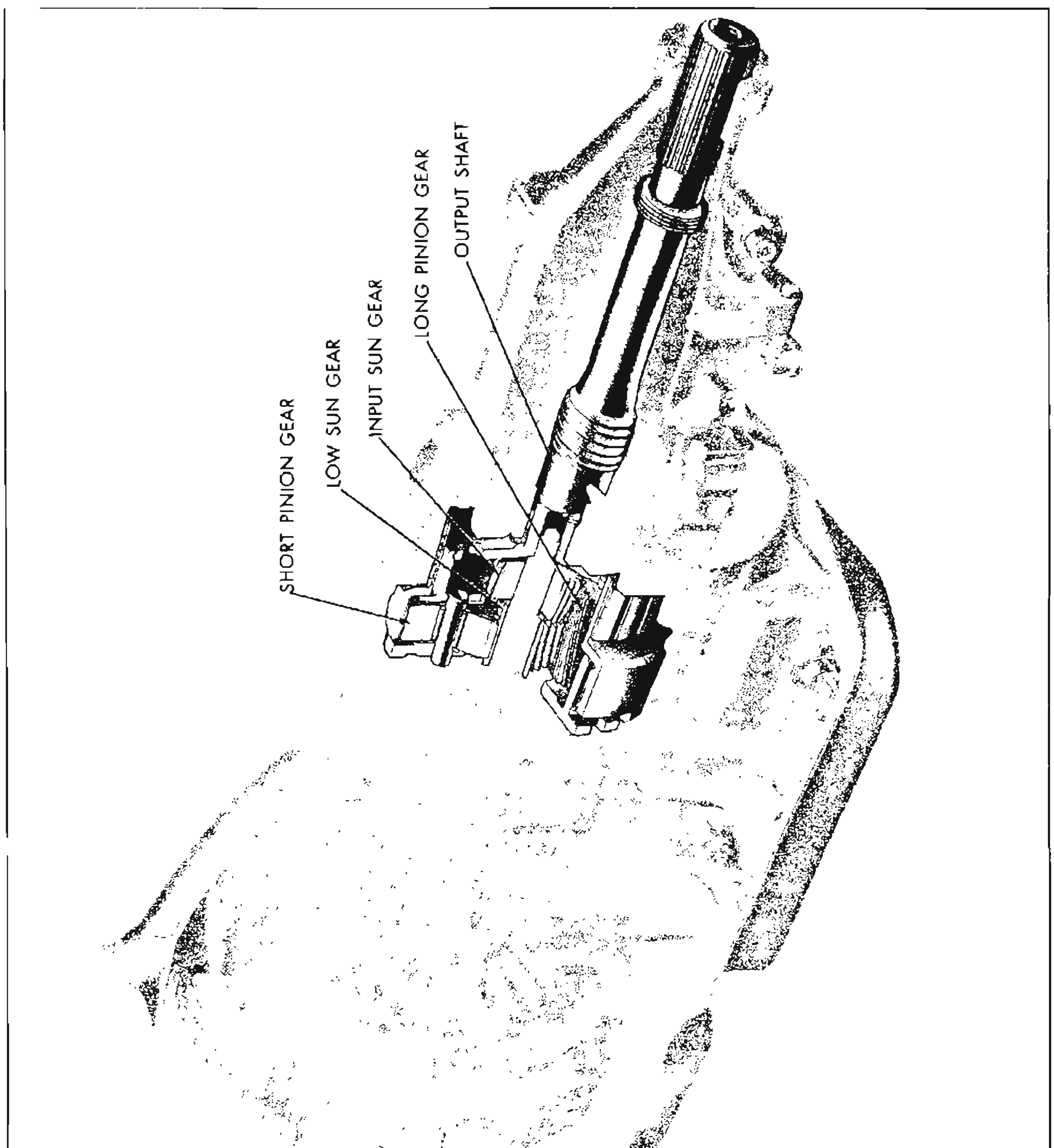



Figure 5-6—Planetary Gear Set

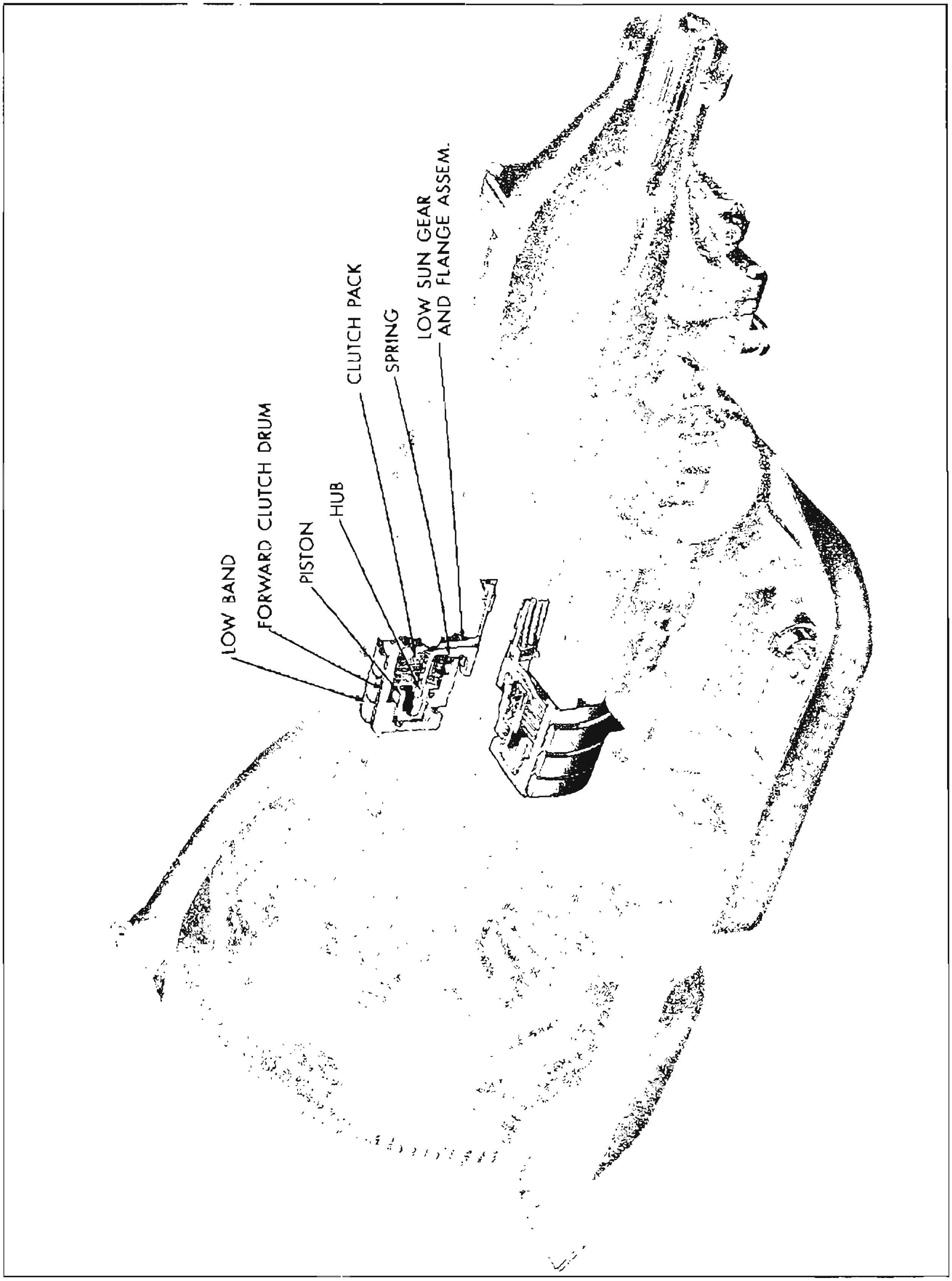



Figure 5-7—Forward Clutch and Low Band

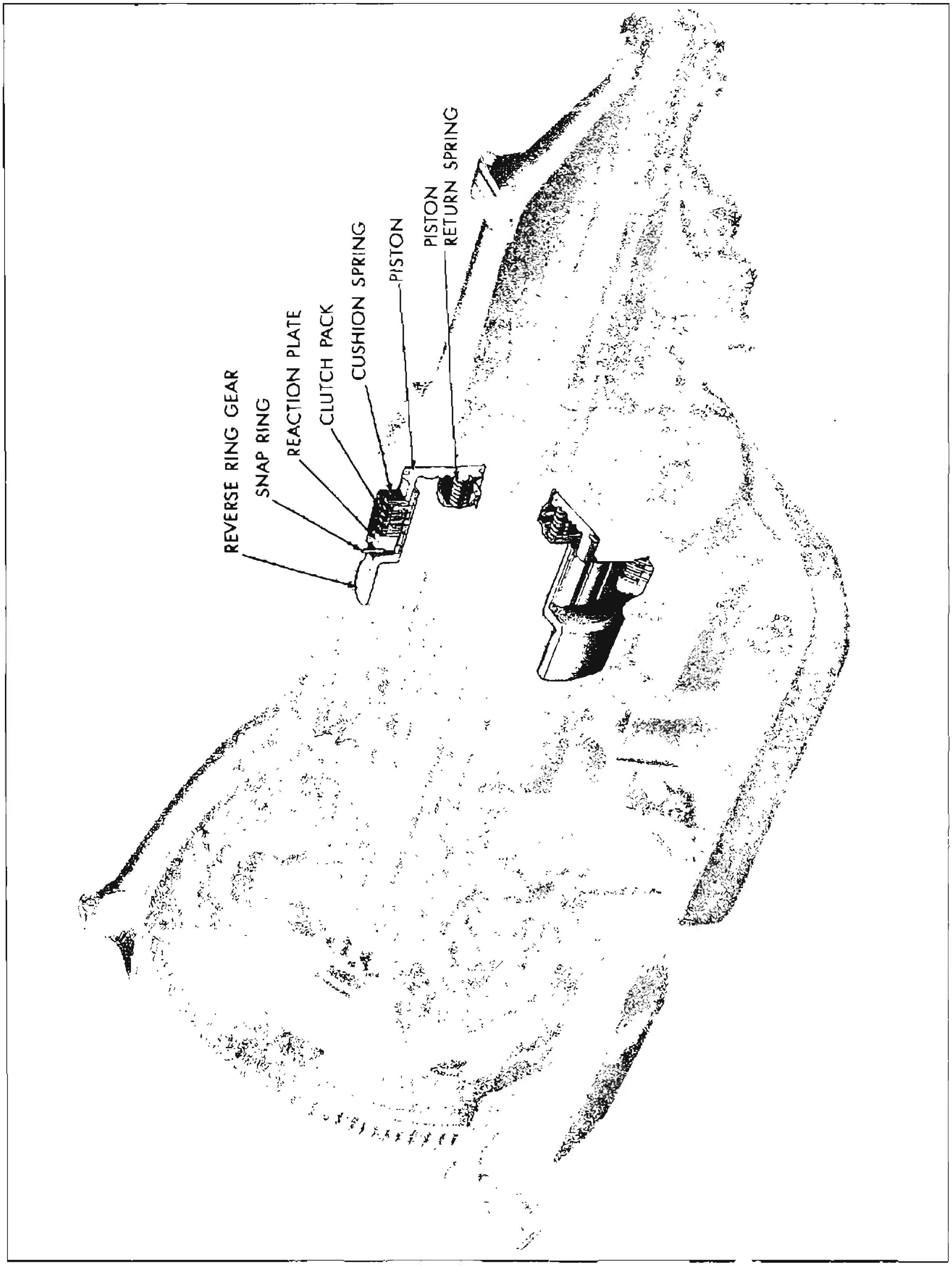



Figure 5-8—Reverse Clutch

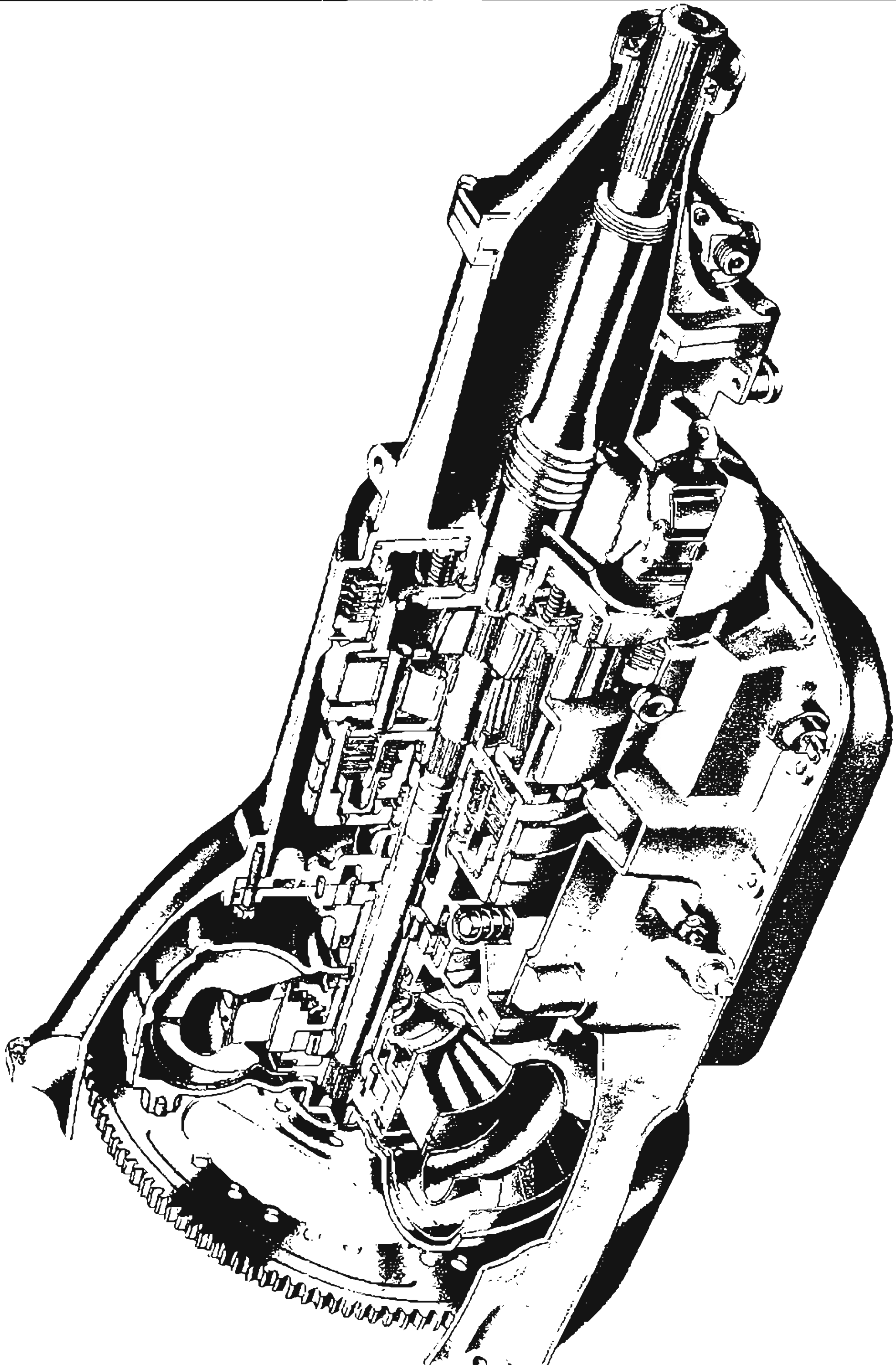


Figure 5-9—Cross Section of Transmission

sensitive modulating oil pressure that increases up to a point with output shaft or car speed.

### 6. Valve Body

The valve body assemblies are bolted to the bottom of the transmission case and are accessible for service by removing the oil pan. The main valve body assembly consists of manual control valve, stator and detent valve, shift valve, modulator limit valve, and high speed downshift timing valve. The stator valve body consists of a stator control valve.

## 5-4 MECHANICAL OPERATION OF SUPER TURBINE "300" AUTOMATIC TRANSMISSION

### 1. Operation of Components in Drive Range

With the manual control lever in Drive range, the transmission is started automatically in Low range. The forward clutch is released and the low band is applied to the outside diameter of the forward clutch drum. With the low band applied, the low sun gear and flange assembly are held stationary. Drive then is from the converter through the input shaft to the input sun gear in the planetary gear set. The input sun gear drives the long planet pinions which in turn drive the short planet pinions. The short pinions are in mesh with the low sun gear. With the low sun gear held stationary by the low band application, the short pinions will walk around the low sun gear. As they walk around the sun gear, they carry with them the planet carrier and the output shaft to which they are attached, at a reduction of 1.76 to 1.

The upshift into Drive range is dependent upon car speed and throttle opening. When the shift occurs, the low band is released and the forward clutch is applied. Application of the forward clutch locks the planetary system causing it to rotate as a unit. With the clutch applied, the clutch hub which is splined to the input shaft is locked to the low sun gear and flange assembly through the clutch plates. The low sun gear is meshed to the short pinions, the short pinions are meshed with the long pinions, and the long pinions are meshed with the input sun gear; the sun gear is also splined to the input shaft. Since both the low sun gear and input sun gear are now locked to the input shaft, the entire planetary unit will revolve at input shaft speed. See Figure 5-10.

### 2. Operation of Components in Manual or Automatic Low Range

In Low range, the forward clutch is released and the low band is applied to the outside diameter of the forward clutch drum. With the low band applied, the low sun gear and flange assembly is held stationary. Drive then is from the converter through the input shaft to the input sun gear in the planetary gear set. The input sun gear drives the long planet pinions which are in mesh with the low sun gear. Since the low sun gear is held stationary with the low band applied, the short pinions walk around the low sun gear, and as they walk around the sun gear, they carry with them the planet carrier and the output shaft to which they are attached at a reduction of 1.76 to 1. See Figure 5-11.

### 3. Operation of Components in Reverse Range

When the manual control lever is in Reverse position, the forward clutch and low band are released, and the reverse clutch is applied, holding the ring gear stationary. Drive is through the input shaft and input sun gear to the long pinions and then to the short pinions. The short pinions mesh with the reverse ring gear which is held stationary by the reverse clutch. The short pinions walk around the inside of the ring gear in a reverse direction, turning the output shaft to which they are attached at a reduction of 1.76 to 1. See Figure 5-12.

### 4. Operation of Components in Neutral

With the shift control lever in Neutral position, the output shaft remains stationary. The clutches and low band are released; therefore, there is no reaction member to provide positive drive. All gears are free to spin around their own axis, and no motion is imparted to the planet carrier. See Figure 5-13.

### 5. Operation of Components in Park

In Park, all reaction members are released as in Neutral. A positive gear train lock is provided when the parking pawl is engaged with the heavy teeth spaced around the front face of the planetary carrier. The linkage is actuated by direct manual action, but the parking pawl is activated by spring action. If the pawl is in line with a tooth of the planet carrier, rather than a space between teeth, the linkage remains in the park position with the spring holding pressure against the pawl. Slight rotation of the planet carrier will immediately seat the pawl and lock the output shaft to the case. See Figure 5-13.

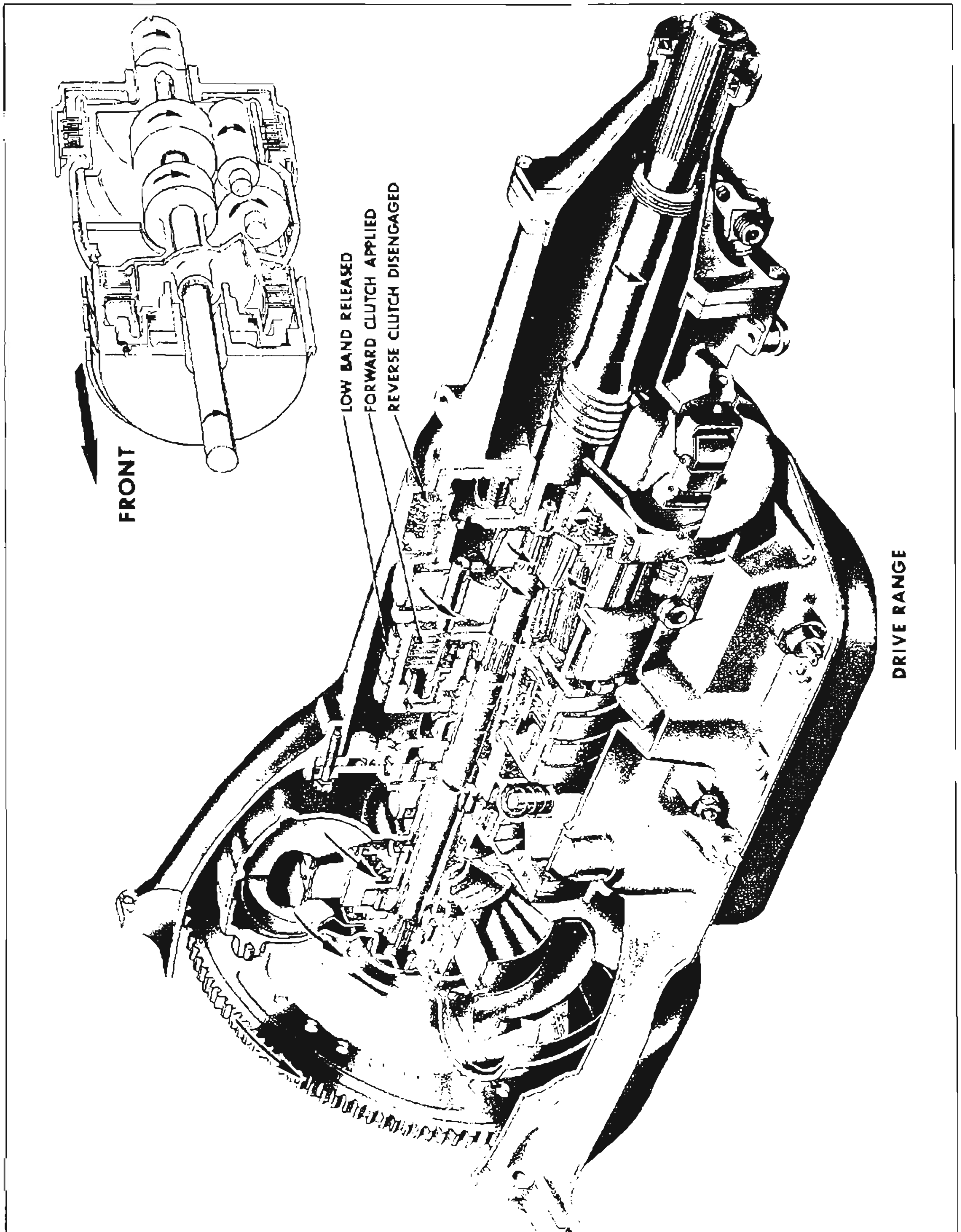



Figure 5-10—Operation of Components in Drive Range

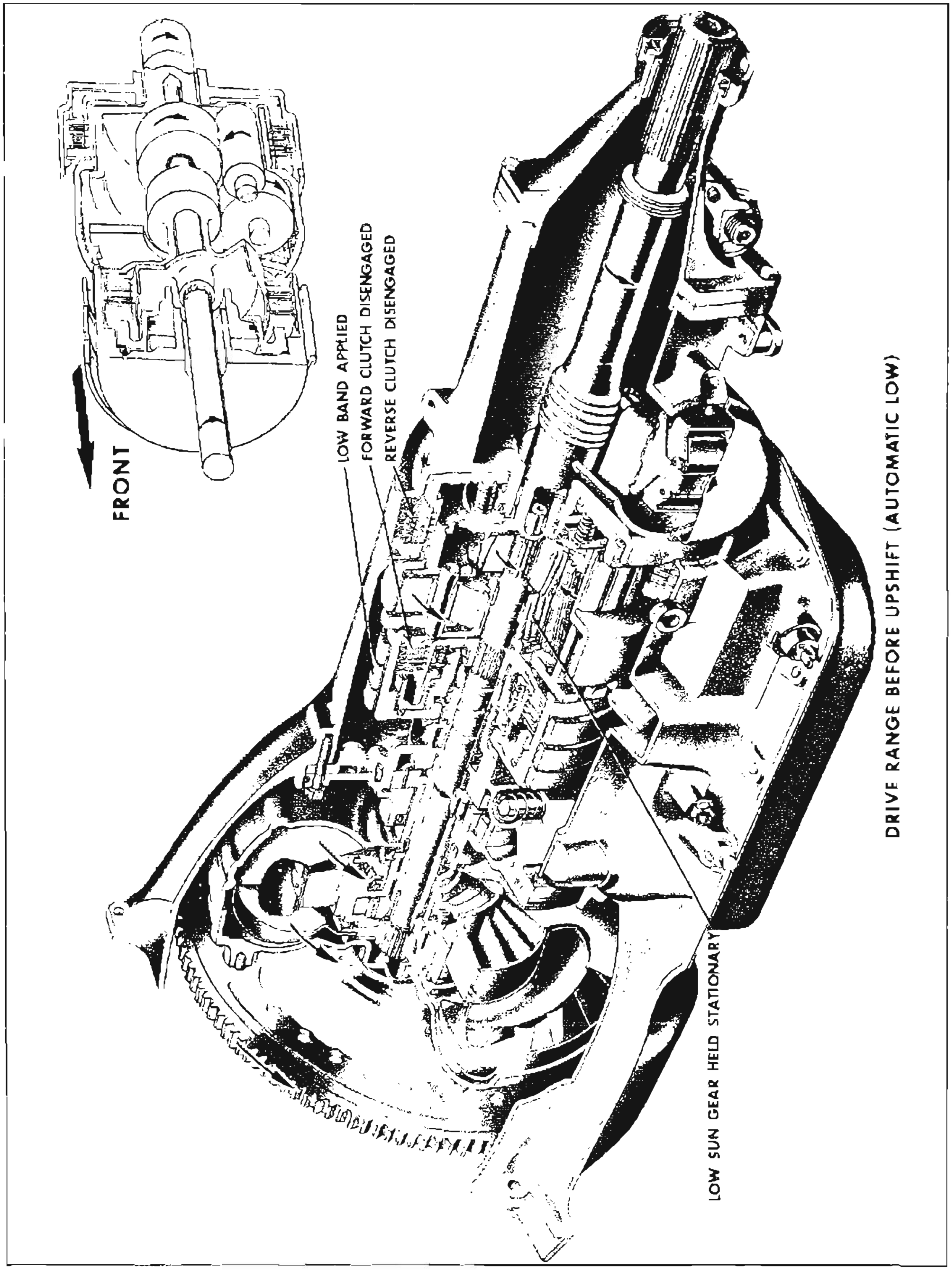



Figure 5-11—Operation of Components in Manual Low or Automatic Low

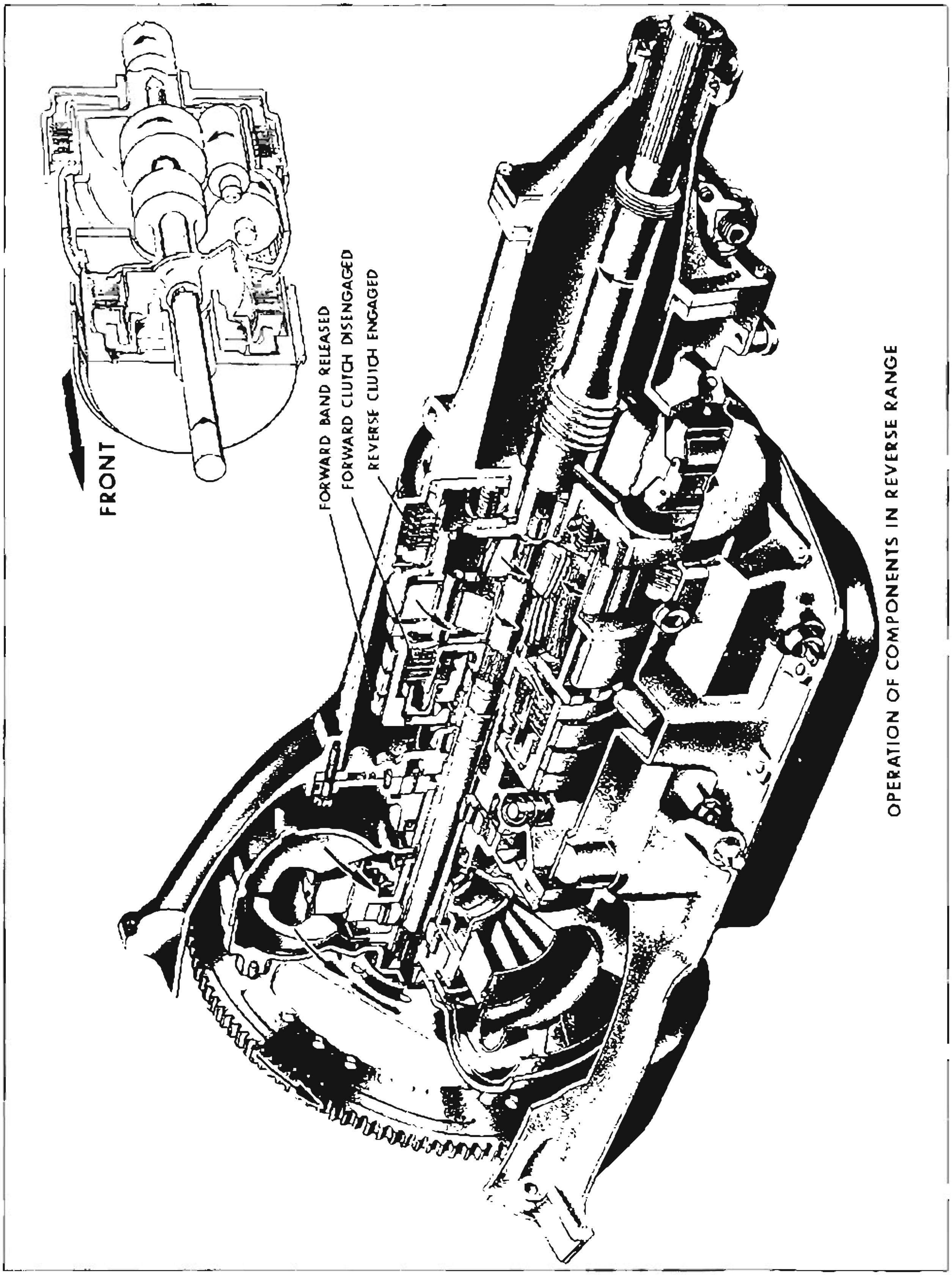



Figure 5-12—Operation of Components in Reverse Range

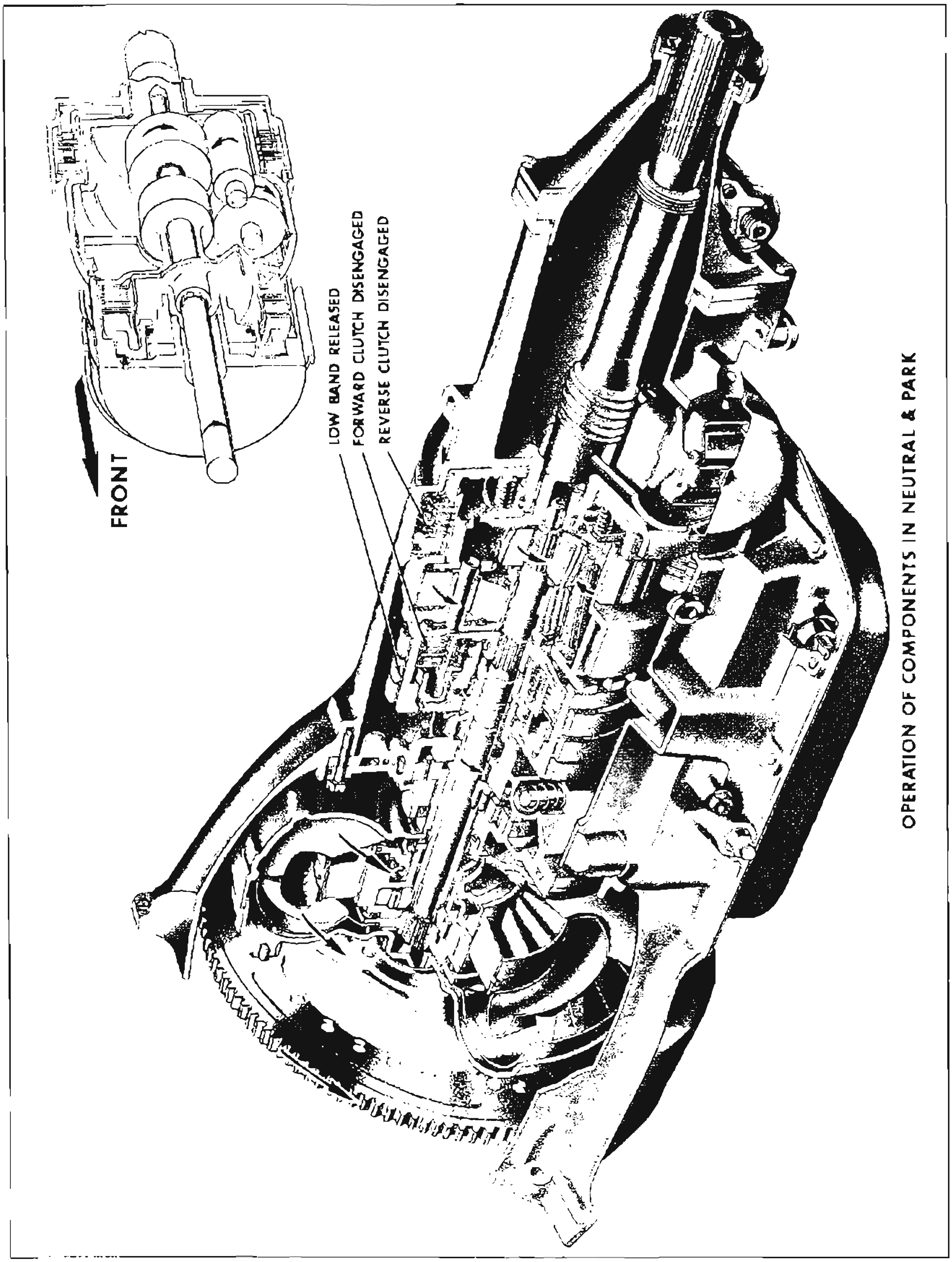



Figure 5-13—Operation of Components in Neutral and Park Range

# SECTION 5-B
# HYDRAULIC CONTROLS

## CONTENTS OF SECTION 5-B



## 5-5 OIL PUMP AND PRESSURE REGULATOR

### a. Oil Pumps

A positive displacement internal-external gear type oil pump is used to supply oil to fill the converter, for engagement of the forward and reverse clutches for application and release of the low band and to accumulate oil for lubrication and heat transfer.

### b. Main Pressure Regulator Valve

The pressure regulator valve located in the pump cover is used as the basic control of hydraulic pressure within the transmission.

1. First Stage Regulation

When the engine is idling or has just been started, oil enters the main pressure regulator valve assembly between the first and second lands and flows through interconnecting drilled holes in the valve to occupy the space between the third land and the oil pump cover. Oil under pressure between the third land and the pump cover moves the valve against its spring to uncover the port which directs oil to the converter and thence to the oil cooler and lubrication systems of the transmission. Figure 5-14 shows the pressure regulator valve in first stage regulator position.

2. Second Stage Regulation

As higher engine speeds are attained, the volume of oil leaving the pump increases until the valve moves to the position shown in Figure 5-15 which opens a port to allow main line oil to escape to suction to regulate pressure. Second state regulation is only necessary during operation at high speeds or operations with cold oil.

3. Boost Valve

A boost valve at the spring end of the pressure regulator valve functions to raise line pressure when necessary by adding hydraulic pressure to the spring pressure on the main pressure regulator valve.

4. Modulator Boost

With the manual shift control valve positioned in drive range, oil under pressure varied by operating conditions (load, car speed, grade, etc.) is directed to the space between the first land of the boost valve and the valve body. Oil under pressure in this space has the same effect as increasing the spring pressure against the pressure regulator valve, that is, it increases main line oil pressure.

5. Reverse Boost

With the manual shift control valve positioned in reverse range, oil under pressure is directed to the space between the first and second lands of the boost valve. Since the second land is larger than the first, the boost valve bears on the spring end of the pressure regulator valve adding

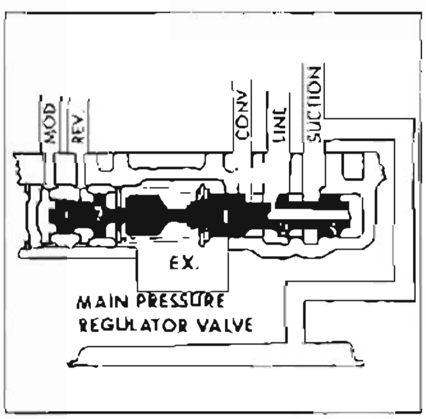



Figure 5-14—Pressure Regulator Valve (First Stage Regulation)

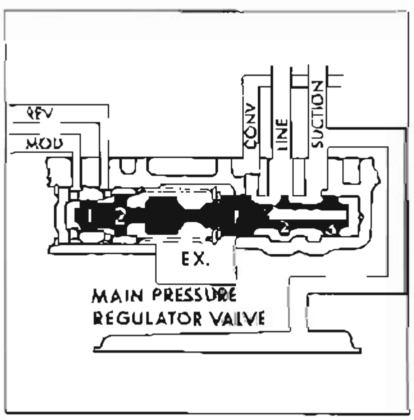



Figure 5-15—Pressure Regulator Valve (Second Stage Regulation)

to the spring pressure of the valve, thus increasing mainline oil pressure for operation in reverse range.

## 5-6 HYDRAULIC CONTROLS

The hydraulic control system consists of the following main components:

- Manual Shift Control Valve
- Stator Control Valve
- Shift Valve and Shift Control Valve
- Vacuum Modulator Valve
- Governor Valve
- Modulator Limit Valve
- Detent Valve
- High Speed Downshift Timing Valve
- Coast Downshift Timing Valve

### a. Manual Shift Control Valve

The manual shift control valve in the valve body routes oil to the controlling devices that govern operation in Drive, Low and Reverse. In Neutral and Park ranges, the manual control valve cuts off oil pressure to the low servo and forward clutch. See Figure 5-16. The manual shift control valve is connected by mechanical linkage to the manual control lever on the steering column.

### b. Stator Control Valve

The stator control valve is a spring load valve located in the stator control valve body. The function of this valve is to control high or low angle of the stator blades. See Figures 5-17-5-18. The action of the valve is affected by spring pressure and a solenoid valve. When the stator control valve solenoid is energized the valve plunger is retracted, uncovering an exhaust port through which oil may excape from the spring side of the stator control valve. Oil thus escaping allows oil at converter charging pressure to move the valve aginst its spring. With the stator valve positioned against the valve plug no oil is directed to the front of the stator blade piston and converter charging pressure then moves the piston (connected to the stator blade cranks) to shift the blades to high angle. See Figure 5-17.

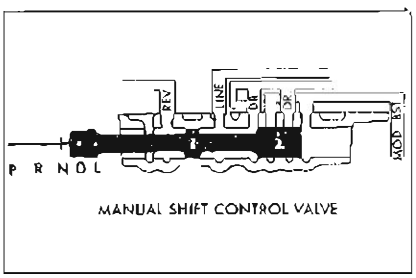



Figure 5-16—Manual Shift Control Valve

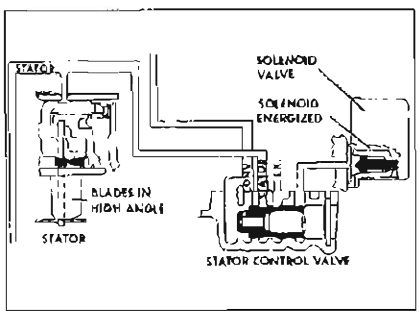



Figure 5-17—Stator Blades in High Angle

### c. Shift Valve and Shift Control Valve

The shift valve and shift control valve are housed together in the main valve body. They interpret oil pressure from the governor and vacuum modulator valve to the shift from automatic low (manual shift control valve in drive range) to drive range or from drive to automatic low range.

1. Upshift from automatic low range to drive range

As the car is accelerated from a stop the shift valve and shift regulator valve are positioned as shown in Figure 5-20. The shift valve is held against the end of its bore by the force of a spring and the pressure exerted on the end of the shift regulator valve. With the shift valve thus positioned no oil under pressure is directed to the high clutch piston or spring side of the low servo piston, thus the low band is applied and the transmission is in low range.

When the proper relationship between car speed and throttle opening exists, governor oil pressure against the first land of the shift valve will overcome spring pressure and the force of limited modulator oil pressure against the shift regulator valve and move both valves to the right as shown in Figure 5-21.

With the valves thus positioned, oil under pressure is directed to the forward clutch piston and the spring side of the low servo piston.

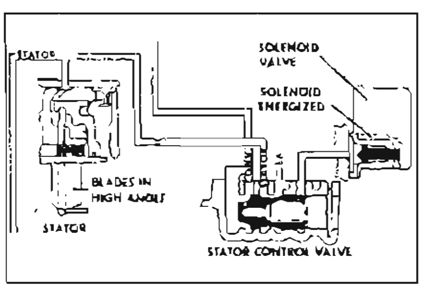



Figure 5-18—Low Angle

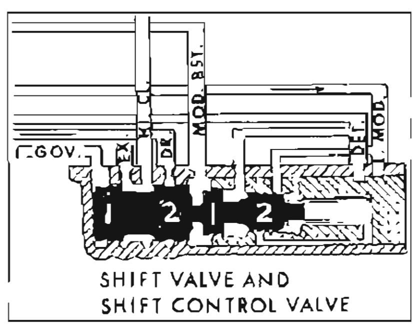



Figure 5-20—Automatic Low

2. Downshift from drive to low

When detent pressure against the shift regulator valve in combination with the spring reaches a value sufficient to overcome governor valve pressure against the first land of the shift valve, both valves move to the shift valve end of the bore and the transmission is downshifted by exhausting oil under pressure to the high clutch and spring side of the low servo piston. See Figure 5-20.

3. Manual Low

With the manual shift control valve positioned in low (L) range oil under pressure is directed to the space between the shift valve and the shift regulator valve. Oil under pressure in this space moves the shift valve to the end of its bore. With the shift valve thus positioned no oil under pressure is directed to the high clutch piston or spring side of the low servo piston, thus the low band is applied and the transmission is in low range. See Figure 5-22.

### d. Vacuum Modulator and Valve

The vacuum modulator and valve assembly is a device to translate load (engine manifold vacuum), barometric pressure (altitude) and speed (governor valve oil pres-

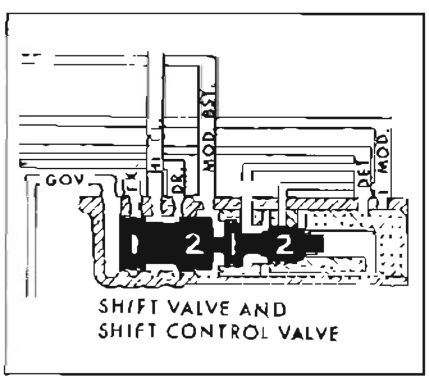



Figure 5-21—Up-Shifted

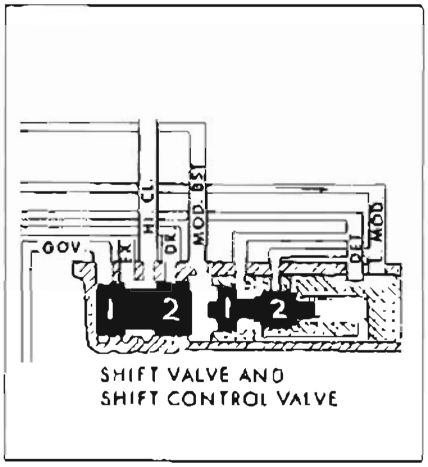



Figure 5-22—Manual Low

sure) into modulated oil pressures to regulate main line oil pressure at an efficient value.

Main line oil enters the valve between the first and second lands of the valve, flows through the drilled ports to the space between the first land and the valve body. Here, the oil when it reaches sufficient pressure moves the valve against its spring to regulate the exit oil (called modulator oil).

1. Manifold vacuum effect

The modulator valve spring is housed in a sealed container in such a way that engine manifold vacuum may act upon it to reduce the force of the spring against the valve and thus affect modulator oil pressure. Conditions of load or grade that lower manifold vacuum increase modulator oil pressure, while high manifold vacuum decreases modulator pressure. See Figure 5-23.

2. Altitude or barometric pressure effect

If the car is operated at high altitudes where barometric pressure is reduced the aneroid device in the vacuum modulator housing expands and acts against the valve spring to reduce modu-

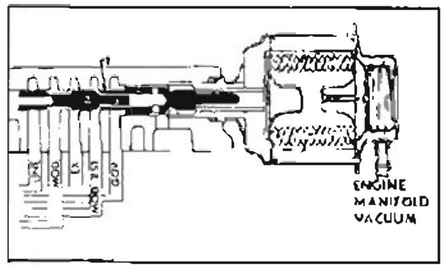



Figure 5-23—Vacuum Modulator and Valve

lator oil pressure in proportion to the barometric pressure.

At high altitudes engine output is reduced. Comparable reduction in transmission main line oil pressure is necessary to accomplish smooth shifts under these conditions.

3. Governor effect

As car speed increases governor valve oil pressure increases (up to the limit of the valve as described in subpar. e below).

Oil at governor valve pressure bearing on the fourth land of the vacuum modulator valve has the effect of reducing the spring pressure against the valve, thereby reducing modulator oil pressure as governor pressure (car speed) increases.

4. Modulator boost effect

With the manual shift control valve positioned in Low (L) range, oil at main line pressure bears against the second land of the modulator valve which separates the two pieces of the valve and tends to move the valve to the bottom of its bore independent of the valve spring. Thus, modulator oil under pressure is directed to the main line pressure regulator valve to provide an increase in main line oil pressure in low range, regardless of engine vacuum. If driving conditions result in low engine vacuum however, the valve spring will move the two sections of the valve back together. Then both the valve spring and the pressure of main line oil against the second land of the valve will regulate modulator oil pressure.

### e. Governor Valve

The governor valve is a pressure regulator valve the output of which is determined by car speed acting through the centrifugal force of a pair of dual weights; the inner pair of which is spring loaded. See Figure 5-24.

As the car begins to move the weight assemblies move outward to provide a regulating force against the valve through the springs between the primary and secondary weights. As car speed is further increased, regulating force against the valve is provided by the secondary weights moving outward. At approximately 35 MPH the primary weights have reached the limit of their travel and the force against the valve is then entirely through the secondary weights.

Thus governor valve pressure is determined at very low speeds by the primary weights at intermediate speeds by the springs between the weights and at higher speeds by the secondary weights. In this manner governor pressure is increased rapidly but smoothly from very low speeds

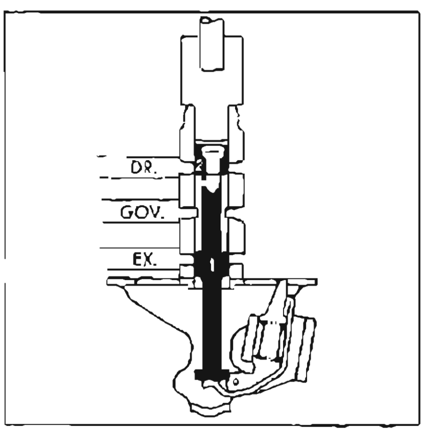



Figure 5-24—Governor Valve

to approximately 40 MPH, where it increases at a slower rate.

Regulated oil from the governor valve is channeled to the shift valve, vacuum modulator valve, modulator limit valve, and high speed down shift timing valve.

Governor pressure thus determines or affects shift points, main line oil pressure, and down shift timing.

### f. Modulator Limit Valve

The modulator limit valve is a pressure regulator valve that regulates the point at which a wide open throttle up shift will occur.

The valve regulates limited feed oil (main line pressure) to provide diminishing oil pressure bearing against the shift control valve as car speed is increased. This decrease in oil pressure is accomplished by governor valve pressure bearing on the third land of the valve and acting to diminish spring pressure as car speed (governor valve pressure) increases. See Figures 5-25 and 5-26.

The modulator limit valve is in operation only before the upshift during wide open throttle operation with the manual shift control valve in Drive position.

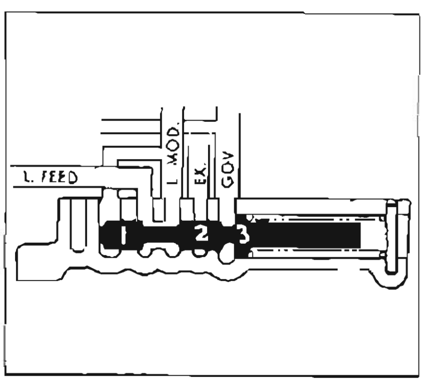



Figure 5-25—Modulator Limit Valve (First Stage)

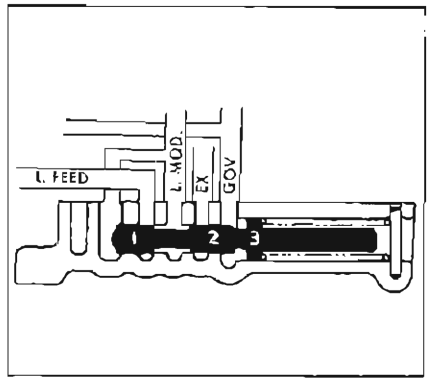



Figure 5-26—Modulator Limit Valve (Second Stage)

### g. Detent Valve

The detent valve is a solenoid operated two position valve that provides a downshift at wide open throttle if car speed is low enough.

Electrical contacts on the carburetor linkage energize the detent solenoid as wide open throttle is reached. Energization of the solenoid retracts its plunger and allows oil from the center of the valve to flow to exhaust. Main line oil pressure against the first land and end of the valve moves the valve against its spring as shown in Figure 5-27.

With the valve in this position, ports are opened to allow oil at main line pressure flow to the modulator limit valve and limited modulator oil to flow to the detent port of the shift control valve. When the solenoid is de-energized the spring loaded plunger seals the port in the valve center. Oil

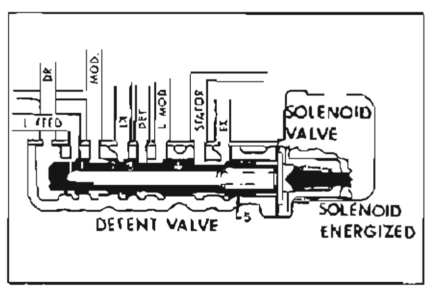



Figure 5-27—Solenoid Valve Energized

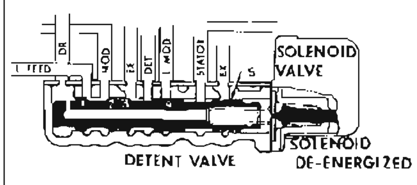



Figure 5-28—Solenoid Valve De-Energized

at main line pressure then occupies the center of the valve and bears against the fifth land of the valve as well as the first land. The detent valve spring then moves the valve to the position shown in Figure 5-28, shutting off the modulator, detent and limited modulator ports.

### h. High Speed Down Shift Timing Valve

The high speed downshift timing valve is a spring loaded valve located in the main valve body. Its function is to control the rate of low servo application at high road speeds.

At sufficiently high road speeds governor pressure against the first land of the valve overcomes spring pressure to move the valve to the position shown in Figure 5-29. With the valve in this position oil for low servo application must pass two orifices as shown. At lower car speeds, governor valve pressure is not sufficient to overcome the spring pressure and low servo application is made through passages containing one orifice as shown in Figure 5-30.

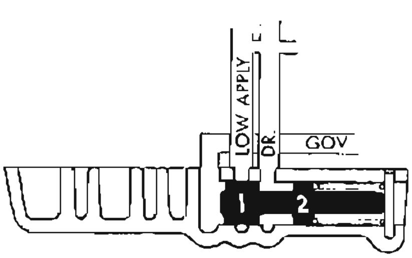



Figure 5-29—High Speed Downshift Timing Valve

### i. Coast Down Shift Timing Valve

As the car is decelerating with closed throttle or very light throttle (such as when approaching a stop) governor valve pressure diminishes to a point where spring pressure moves the shift valve to the down shift position. When this occurs, oil is exhausted from the band release chamber of the low servo through the coast down shift timing valve

A rush of oil through the valve moves the ball retainer and ball against light spring pressure off its seat, oil may then escape around the ball retainer and spring. This action cushions the initial engagement of the low band. See Figure 5-31.

### j. Operation of Hydraulic Controls in Drive Range (Part Throttle Upshifted)

During operation in Drive range the manual shift control valve is positioned as shown in Figure 5-32. During part throttle acceleration main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is routed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed down shift timing valve and low servo.

Main line oil being directed to the modulator valve enters between the first and second lands. At low

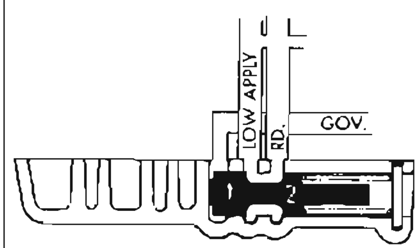



Figure 5-30—High Speed Downshift Timing Valve Regulated

engine vacuum the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position oil is delivered through a drilled passage in the valve to the space between the first land of the valve and the valve body. Oil under pressure in this area plus governor pressure on the second land of the second modulator valve tends to move the valve against the force of its spring to regulator modulator oil pressure leaving the valve. Modulator oil leaves the modulator valve and is routed to the boost valve, detent valve, modulator limit valve, and to the second land of the shift control

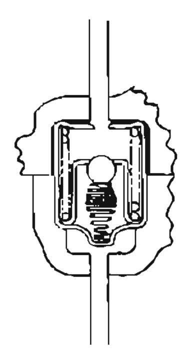


Figure 5-31—Coast Downshift Timing Valve

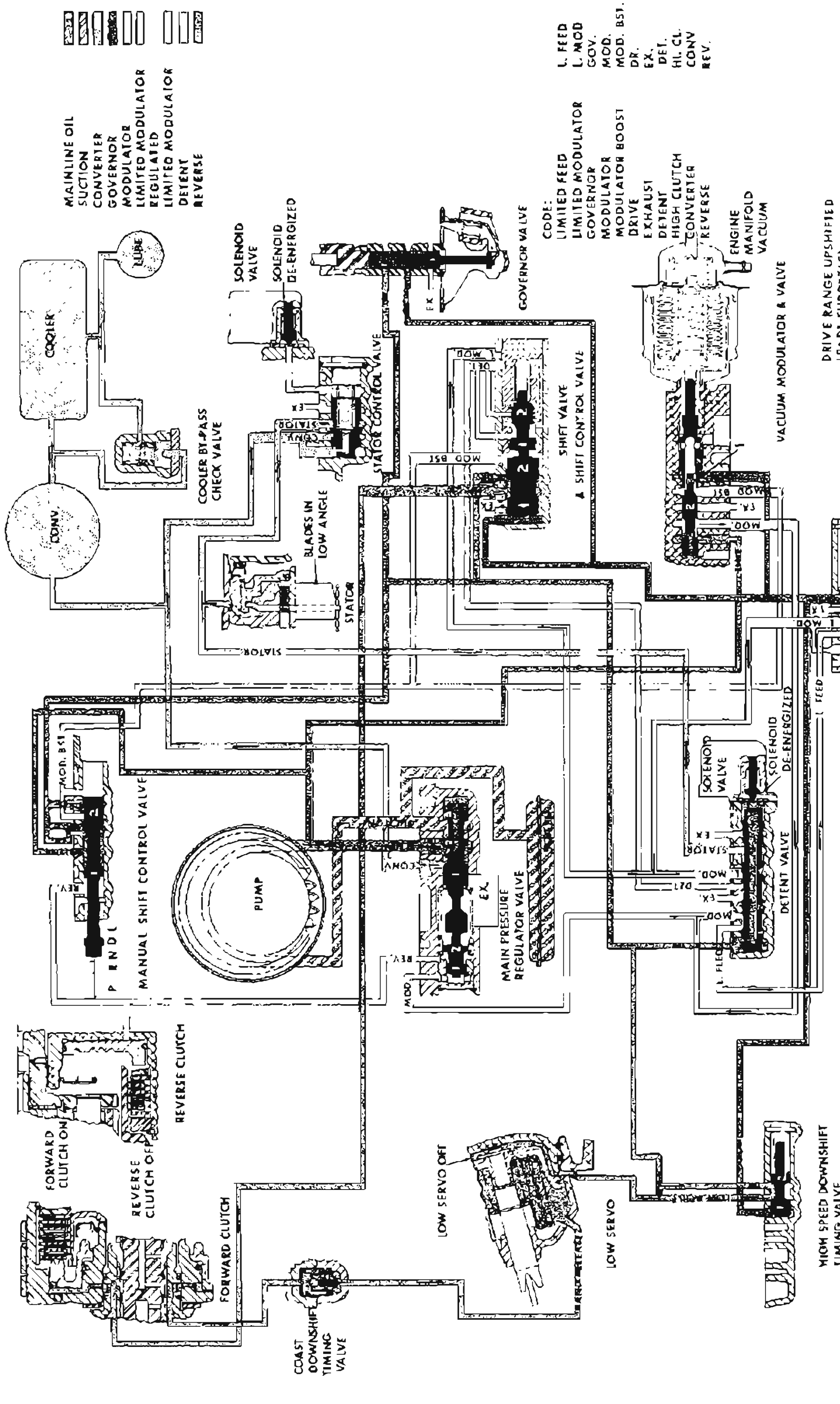



Figure 5-32—Drive Range Upshifted (Part Throttle)

valve. Modulator pressure applies a force to the space between the first land of the boost valve and the oil pump body causing it to move to the right in Figure 5-32. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in higher main line pressure. Also modulator pressure is routed through the detent valve and modulator limit valve to the shift control valve.

When sufficient car speed has been obtained, the governor valve will move allowing drive oil to be directed at regulated pressure to the space between the first land of the shift valve and the valve body and between second and third lands of the modulator valve, between the second and third lands of the modulator limit valve and in the space between the first land of the high speed down shift timing valve and the valve body. As governor pressure is received between the second and third lands of the modulator valve it will tend to move the valve against its spring, reducing modulator pressure.

When governor pressure reaches a high enough value the shift valve will move to the right allowing drive oil to apply the forward clutch and release the low band.

**k. Operation of Hydraulic Controls in Drive Range (Full Throttle to Detent Switch Pitch Only)**

During operation in Drive range at full throttle to detent switch pitch only, the stator control solenoid is energized. See Figure 5-33.

Main line oil passes through the pressure regulator valve to the converter and stator control valve. Energization of the stator control solenoid allows oil from the center of the valve to flow to exhaust. Converter oil pressure against the valve body and the first land of the valve moves the valve against its spring until it bottoms in its bore. When the valve reaches the bottom of its bore it will exhaust the stator, switching the blades to high angle.

Main line oil entering the manual shift control valve is routed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed down shift timing valve and low servo. Main line oil directed to the modulator valve enters between the first and second lands. At low engine vacuum, the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position, oil is delivered through a drilled passage in the valve to the space between the first land of the valve and the valve body. Oil pressure in this area plus governor pressure on the second land of the second modulator valve will tend to move the valve against the force of its spring to regulate modulator oil pressure leaving the valve. At the same time, line oil pressure enters the area between the first and second lands of the modulator valve and into the modulator pressure line. Modulator oil leaves the modulator valve and is routed to the boost valve, detent valve, modulator limit valve, and to the shift control valve. Modulator pressure applies a force to the space between the first land of the boost valve and the oil pump body causing it to move to the right in Figure 5-33. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in a higher main line pressure. Also limited modulator pressure is routed through the detent valve and to the modulator limit valve. Limited modulator from the modulator limit valve is routed to the shift control valve.

When sufficient speed is obtained, the governor valve will move, allowing drive oil to be directed at reduced pressure to left end of the shift valve and between the second and third lands of the modulator valve, between the second and third lands of the modulator limit valve and at the left end of the high speed down shift timing valve. As governor pressure is received between the second and third lands of the modulator valve it will tend to move the valve to the right, reducing modulator pressure. When governor pressure reaches a high enough value, the shift valve will move to the right allowing drive oil to apply the forward clutch.

**l. Operation of Hydraulic Controls in Drive Range (Full Throttle Detent and Switch Pitch)**

During operation in Drive range at full throttle detent and switch pitch, both the stator control valve and detent valve solenoids are energized. The manual shift control valve is positioned as shown in Figure 5-34.

Main line oil passes through the pressure regulator valve to the converter and detent valve. When the stator control valve solenoid is energized it allows oil from the center of the valve to flow to exhaust. Converter oil applying force to the area between the valve body and the first land of the valve moves the valve against its spring pressure to the bottom of its bore.

When the valve reaches the bottom of its bore it will exhaust the stator, switching the pitch to high angle. Converter pressure oil applies force to the area between the valve body and the first land

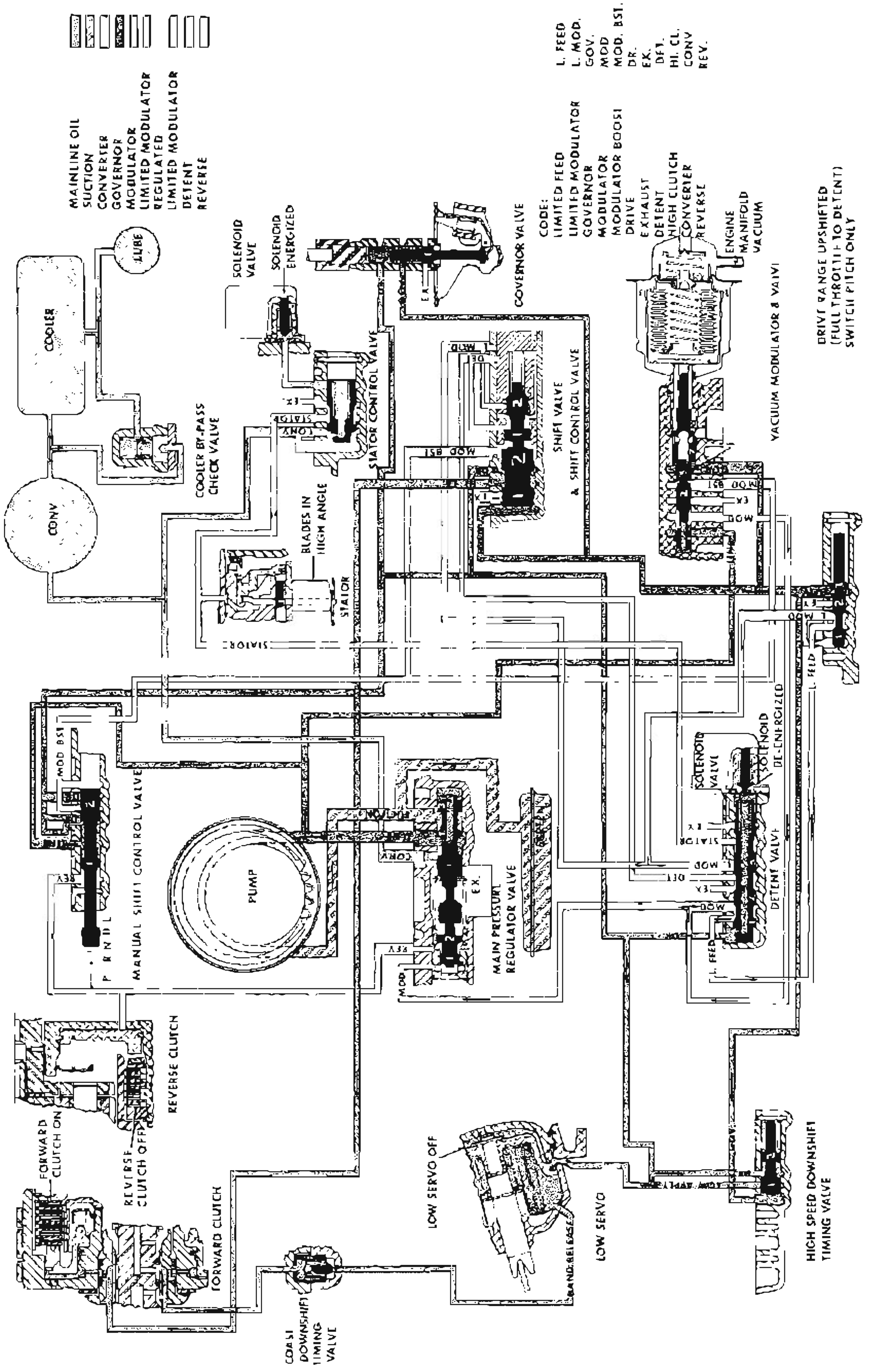



Figure 5-33—Drive Range (Full Throttle to Detent Switch Pitch Only)

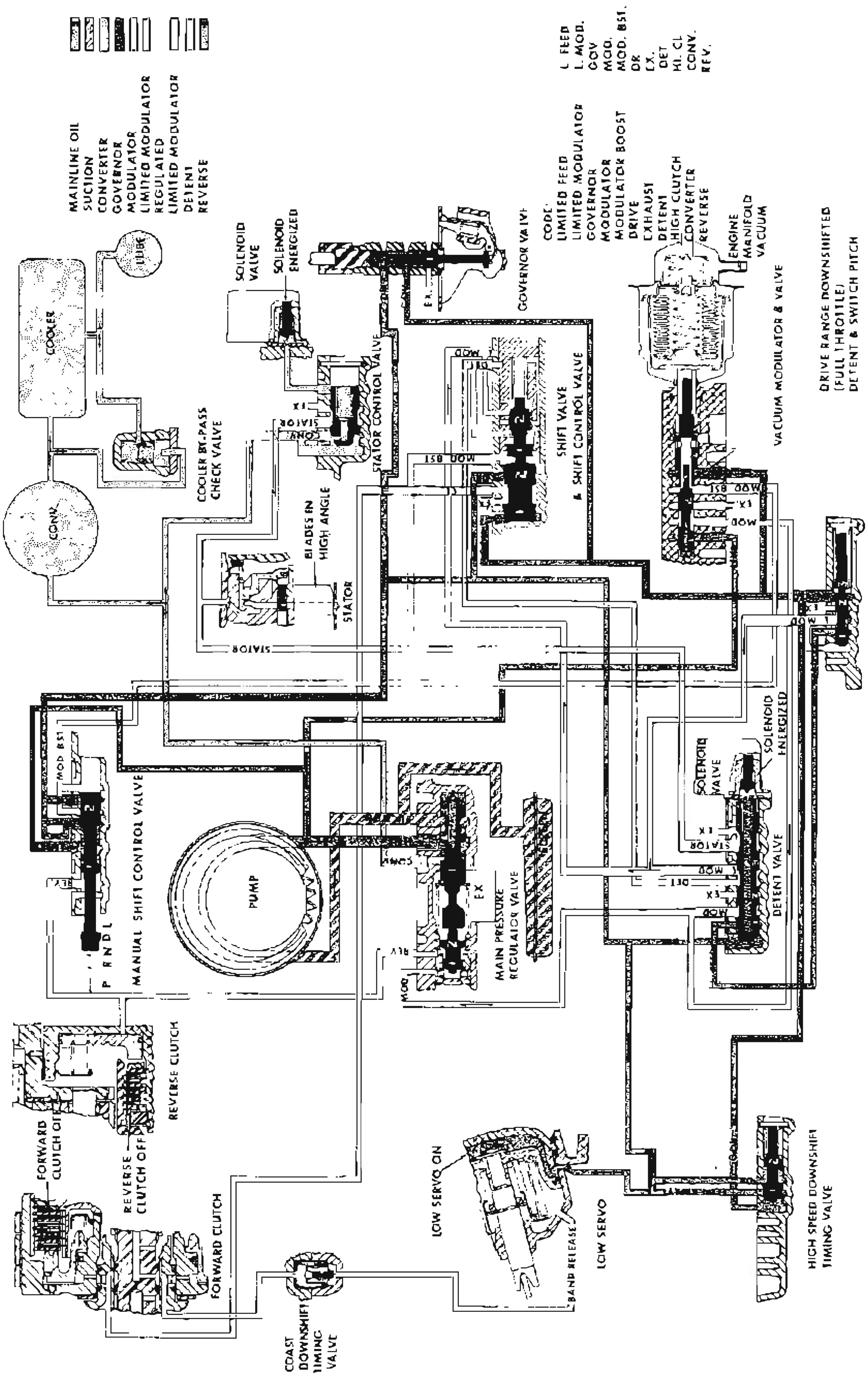



Figure 5-34—Drive Range (Full Throttle to Detent and Switch Pitch)

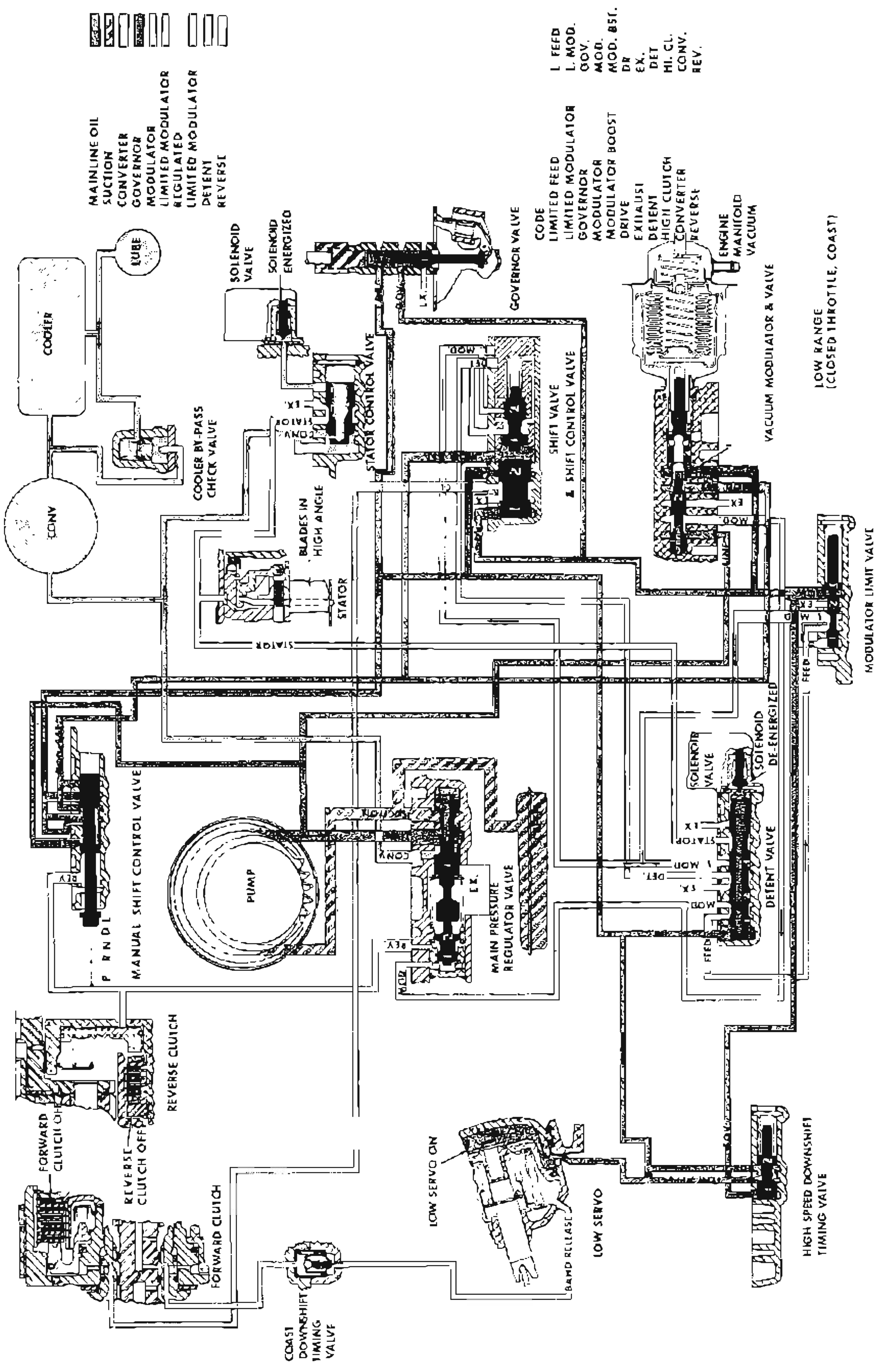



Figure 5-35—Low Range (Closed Throttle Coast)

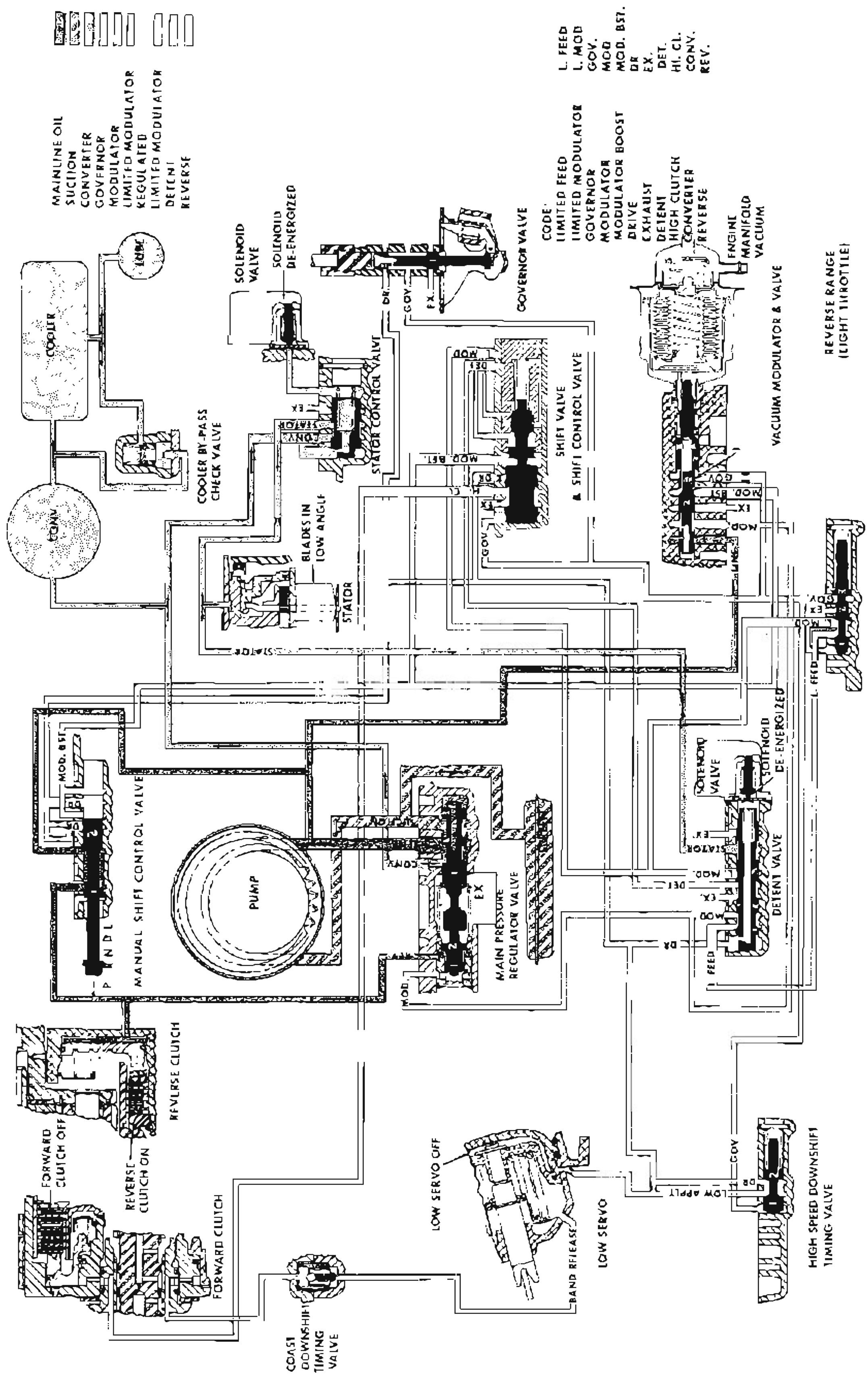



Figure 5-36—Reverse Range (Light Throttle)

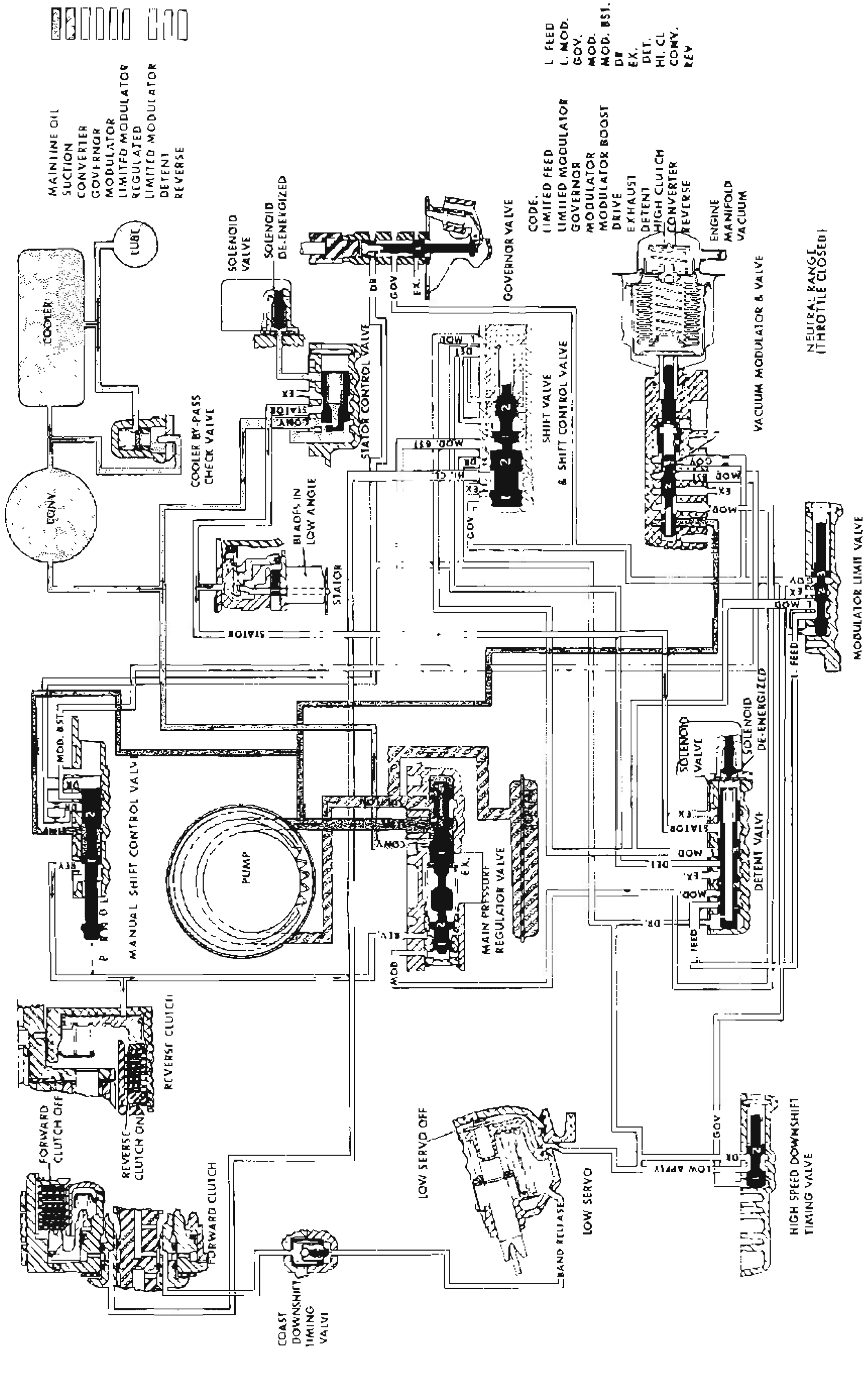



Figure 5-37—Neutral Range (Throttle Closed)

of the valve keeping it at the bottom of its bore as long as the solenoid is energized.

Energization of the detent solenoid allows oil from the center of the valve to flow to exhaust. Drive oil applying force to the area between the valve body and the first land of the valve moves the valve against its spring pressure to the bottom of its bore.

During a full-throttle acceleration main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is routed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed down shift timing valve, and modulator limit valve, and low servo.

Main line oil directed to the modulator valve enters between the first and second lands. At low engine vacuum the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position oil is delivered through a drilled passage in the valve to the space between the first land of the valve and the valve body. Oil pressure in this area plus governor pressure on the second land of the second modulator valve tend to move the valve against the force of its spring to regulate oil pressure leaving the valve.

Modulator pressure applies force to the left end of the boost valve causing it to move to the right. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in a higher main line pressure. With the detent valve solenoid energized, drive oil pressure will enter into the limited feed line. When limited feed pressure reaches a high enough value and exerts enough force to overcome spring pressure on the modulator limit valve, the valve will regulate governing the limited modulator and detent pressure behind the shift regulator valve.

As higher governor pressure is reached it acts on in the area between the valve body and the first land of the high speed down shift timing valve until governor pressure overcomes spring pressure and moves the valve to the right. This movement blocks the nonrestricted line, routing the servo apply oil through the restricted orifice. On a down shift this restriction of flow causes the band apply to be delayed slightly and is thus timed to the forward clutch release for a smooth down shift.

### m. Operation of Hydraulic Controls in Low Range (Closed Throttle Coast)

During operation in Low range, the manual shift control valve is positioned as shown in Figure 5-35. During a closed throttle coast in low range, main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is routed into drive oil passage and modulator boost passage. Oil routed in the drive oil passage is directed to the governor valve, shift valve, and detent valve, high speed down shift timing valve and low servo. Oil routed in the modulator boost passage is directed to the shift valve and vacuum modulator valve.

Modulator boost oil enters the shift valve between the shift valve and the shift control valve, moving the shift valve to the left and holding it in the bottom of its bore thus exhausting the forward clutch. Drive oil directed from the manual shift control valve will apply the low servo.

### n. Operation of Hydraulic Controls in Reverse Range (Light Throttle)

During operation in Reverse range the manual shift control valve is positioned as shown in Figure 5-36. During light throttle in reverse, main line oil is directed to the manual shift control valve. Main line oil entering the manual shift control valve is directed to the reverse clutch and between the 1st and 2nd land of the boost valve. Main line pressure applies a force to the 2nd land of the boost valve causing it to move to the right. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in a higher main line pressure needed for reverse operation. When the manual shift control valve is in reverse the forward clutch and low servo are exhausted.

### o. Operation of Hydraulic Controls in Neutral Range(Closed Throttle)

During operation in Neutral range, the manual shift control valve is positioned as shown in Figure 5-37. In neutral operation main line oil entering the manual shift control valve is routed to the vacuum modulator only. In neutral operation the stator control solenoid is energized switching the pitch to high angle.

NOTE: <u>At any closed throttle condition a switch on the carburetor will energize the stator control solenoid switching the pitch to high angle. By switching the pitch to high angle it will allow higher engine RPM in relation to turbine speed. With the solenoid energized the valve will bottom in its bore allowing the stator to exhaust switching the pitch to high angle.</u>

## 5-7 TRANSMISSION ASSEMBLY—REMOVAL AND INSTALLATION

### a. Removal

1. Raise car and provide support for front and rear of car.

2. Disconnect front exhaust pipe bolts at the exhaust manifold and at the connection of the intermediate exhaust pipe location (single exhaust only). On dual exhaust the exhaust pipes need not be removed.

3. Remove pinion flange "U" bolts and slide propeller shaft toward transmission as far as possible to separate universal joint from pinion flange. Remove propeller shaft from car.

4. Place suitable jack under transmission and fasten transmission securely to jack.

5. Remove vacuum line to vacuum modulator hose from vacuum modulator.

6. Loosen cooler line nuts and separate cooler lines from transmission.

7. Remove transmission mounting pad to cross member bolts.

8. Remove transmission cross member support to frame rail bolts. Remove cross member.

9. Disconnect speedometer cable.

10. Loosen shift linkage adjusting swivel clamp nut. Remove cotter key, spring, and washer attaching equalizer to outer range selector lever. Remove equalizer.

11. Disconnect transmission filler pipe at engine. Remove filler pipe from transmission.

12. Support engine at oil pan.

13. Remove transmission flywheel cover pan to case tapping screws. Remove flywheel cover pan.

14. Mark flywheel and converter pump for reassembly in same position, and remove three converter pump to flywheel bolts.

15. Remove transmission case to engine block bolts.

CAUTION: Install Tool J-21366 to retain converter.

16. Move transmission rearward to provide clearance between converter pump and crankshaft. Lower transmission and move to bench.

### b. Installation

1. Assemble transmission to suitable transmission jack and raise transmission into position. Rotate converter to permit coupling of flywheel and converter with original relationship.

2. Install transmission case to engine block bolts. Torque to 30-40 ft. lbs. Do not overtighten.

3. Install flywheel to converter pump bolts. Torque to 30-40 ft. lbs.

4. Install transmission cross member support. Install mounting pad to cross member.

5. Remove transmission jack and engine support.

6. Install transmission flywheel cover pan with tapping screws.

7. Install transmission filler pipe using a new "O" ring.

8. Reconnect speedometer cable.

9. Install propeller shaft. Connect propeller shaft to pinion flange.

10. Reinstall front exhaust crossover pipe.

11. Install oil cooler lines to transmission.

12. Install vacuum line to vacuum modulator.

13. Fill transmission with oil as follows:

a. Add 4 pints of oil.

b. Start engine in neutral. DO NOT RACE ENGINE. Move manual control lever through each range.

c. Check oil level, adjust oil level to full mark on dipstick, only when oil is hot.

## 5-8 ADJUSTMENT ON CAR

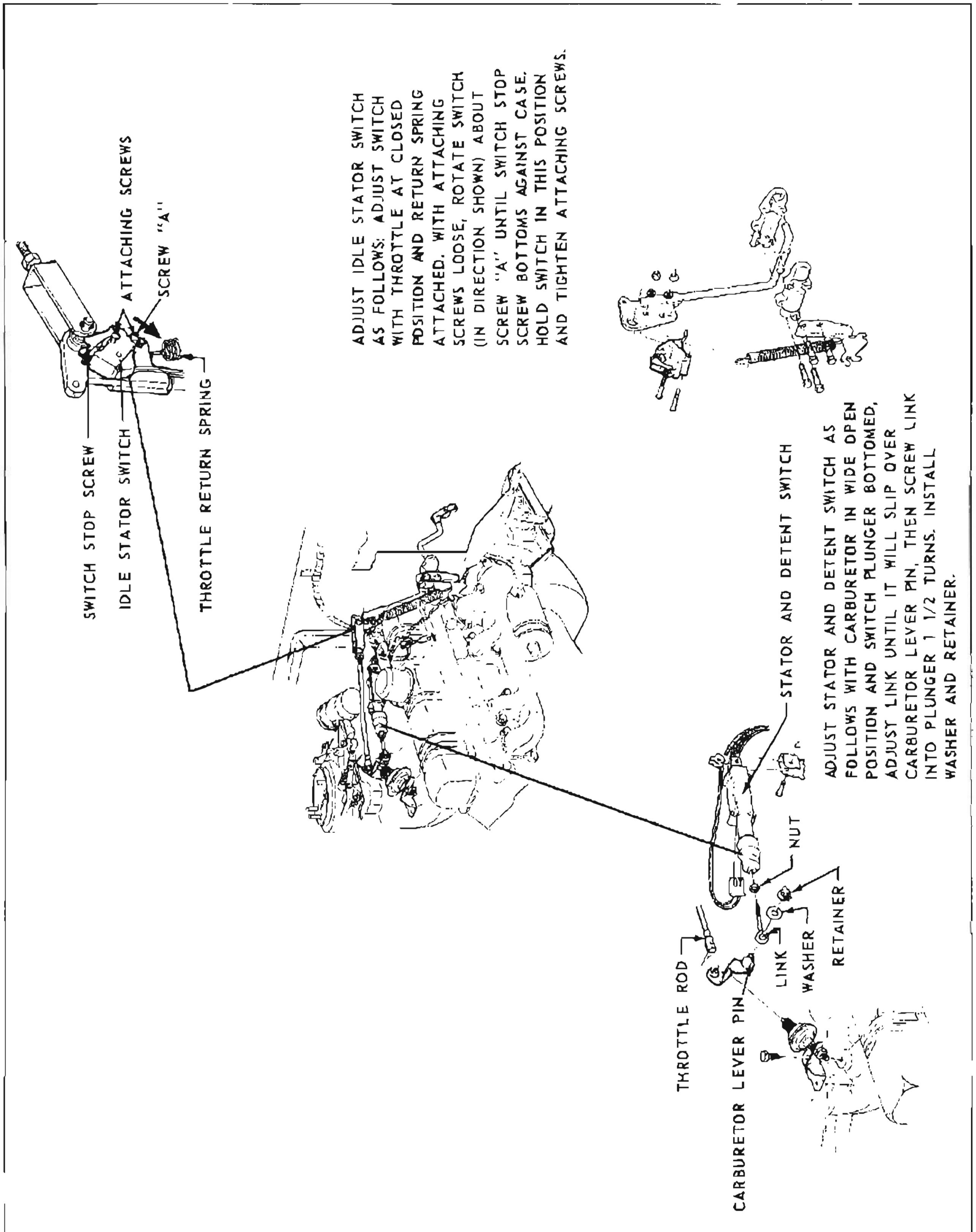



Figure 5-38—Transmission Control Switch Adjustments

# SECTION 5-C

# TRANSMISSION REMOVAL AND INSTALLATION DISASSEMBLY AND ASSEMBLY

## CONTENTS OF SECTION 5-C



## 5-9 DISASSEMBLY OF TRANSMISSION TO REMOVE MAJOR PARTS AND UNITS

1. Preliminary Instructions

a. Before starting disassembly of the transmission it should be thoroughly cleaned externally to avoid getting dirt inside.

b. Place transmission on a CLEAN work bench and use CLEAN tools during disassembly. Provide CLEAN storage space for parts and units removed from transmission. An excellent working arrangement is provided by assembling the transmission to Holding Fixture J-8763. See Figure 5-100.

c. The transmission contains parts which are ground and highly polished, therefore, parts should be kept separated to avoid nicking and burring surfaces.

d. When disassembling transmission carefully inspect all gaskets at times of removal. The imprint of parts on both sides of an old gasket will show whether a good seal was obtained. A poor imprint indicates a possible source of oil leakage due to gasket condition, looseness of bolts, or uneven surfaces of parts.

e. None of the parts require forcing when disassembling or assembling transmission. Use a rawhide or plastic mallet to separate tight fitting cases - do not use a hard hammer.

## 5-10 REMOVAL OF OIL PAN, OIL STRAINER AND PIPE, VALVE BODY, LOW SERVO COVER AND PISTON ASSEMBLY

### a. Removal of Oil Pan

NOTE: Transmission need not be removed from car to perform the following operations Paragraph 5-0. Subparagraph a, b, c and d.

1. If transmission has been removed from car, assemble transmission in Fixture J-8763. See Figure 5-100.

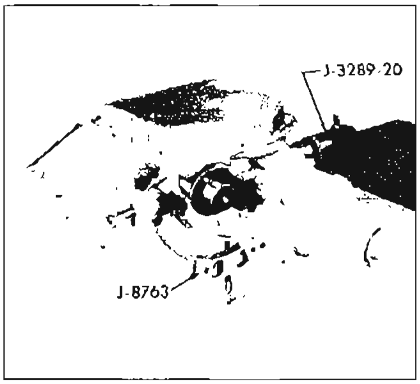



Figure 5-100

2. With transmission in horizontal position pull converter from case. See Figure 5-101.

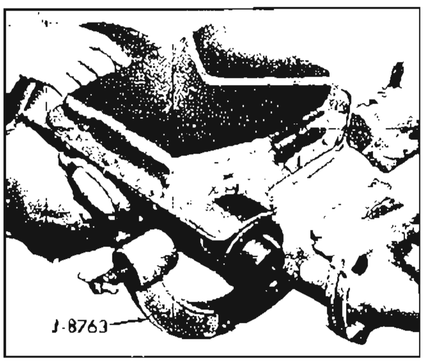



Figure 5-101

3. Remove fourteen (14) oil pan attaching bolts using a 1/2" socket. See Figure 5-102.

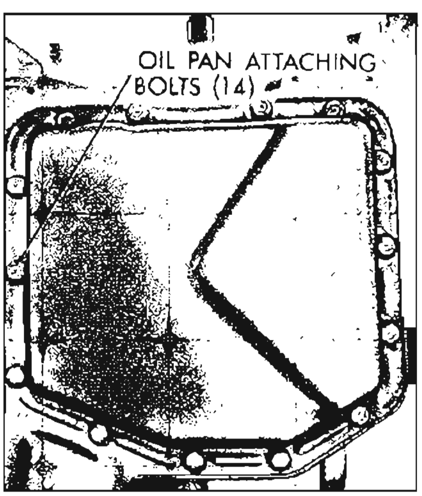



Figure 5-102

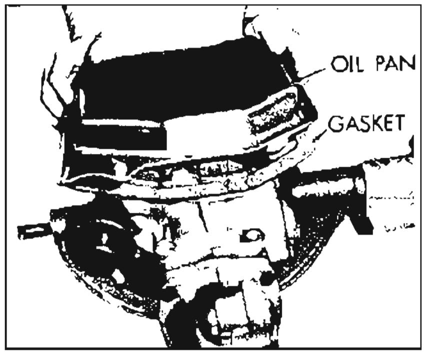



Figure 5-103

4. Remove oil pan and gasket from transmission. See Figure 5-103.

**b. Removal of Oil Strainer and Pipe**

1. Remove the PF-162 filter on V-8 models. See Figure 5-104.

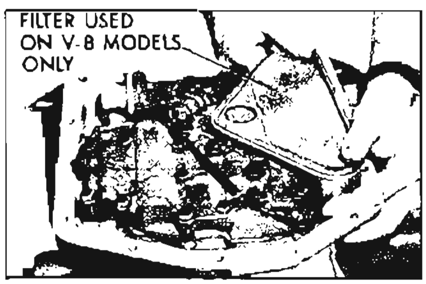



Figure 5-104

2. Remove the oil strainer from model V-6 transmissions. See Figure 5-105.

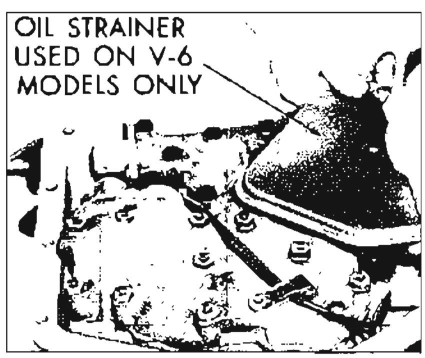



Figure 5-105

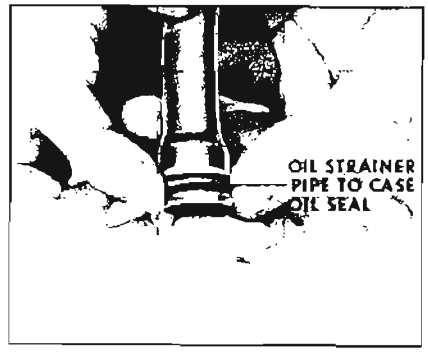



Figure 5-106

3. Examine oil strainer or filter to case oil seal. If nicked, torn or worn, remove seal. See Figure 5-106.

**c. Removal of Valve Body**

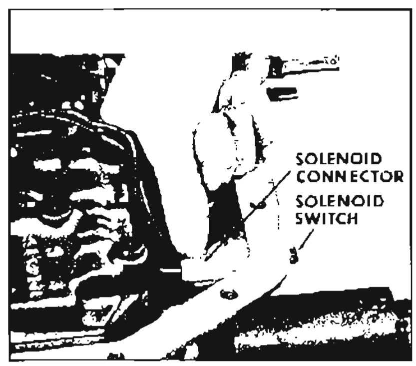
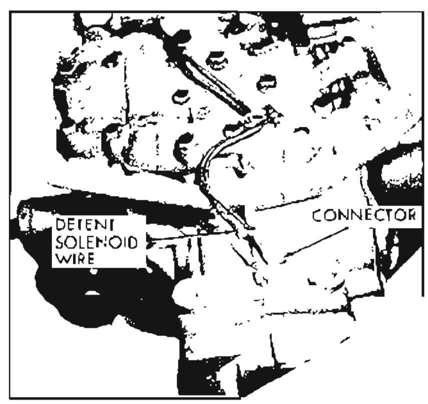



Figure 5-107

1. Disconnect solenoid connector from solenoid switch. See Figure 5-107.




Figu


Figure 5-110

2. Remove detent solenoid wire from connector. See Figure 5-108.

3. Remove solenoid switch from case. Inspect switch "O" ring. If nicked, torn or worn replace. See Figure 5-110.

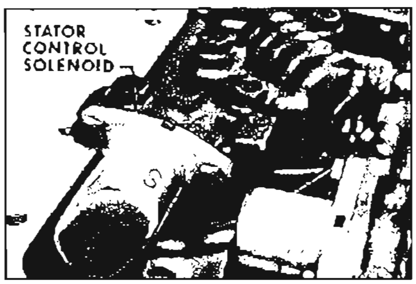



Figure 5-111

4. With a grease pencil mark stator control solenoid with an "S". This "S" will identify stator control solenoid for reassembly. See Figure 5-111.

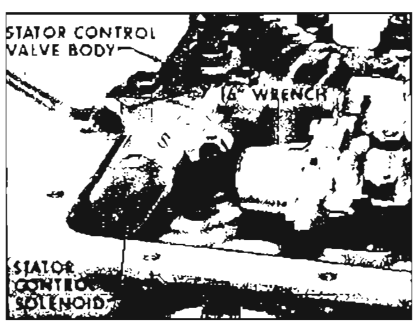



Figure 5-112

5. Remove two (2) solenoid to stator control valve body retaining bolts with 7/16" wrench. Remove stator control solenoid gasket. See Figure 5-112.

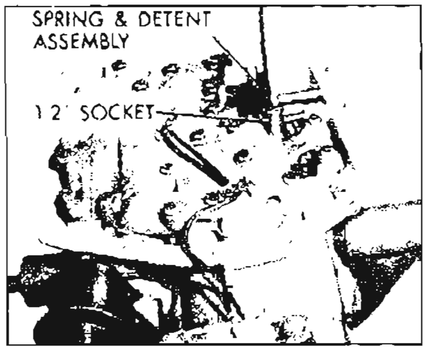



Figure 5-113

6. Remove spring detent assembly bolt with a 1/2" socket. Remove spring detent assembly from valve body. See Figure 5-113.

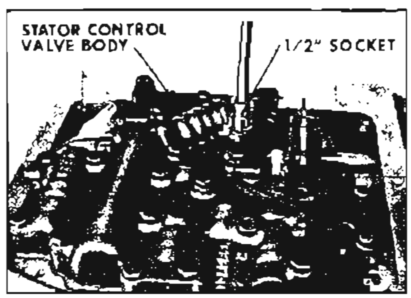



Figure 5-114

7. Remove seven (7) bolts retaining stator control valve body to transmission case using a 1/2" socket. Remove stator control valve body. See Figure 5-114.

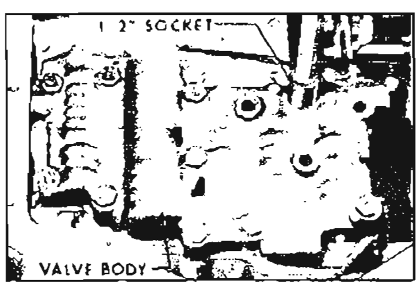



Figure 5-115

8. Remove eleven (11) valve body to case bolts only using a 1/2" socket. Do not remove valve body. See Figure 5-115.

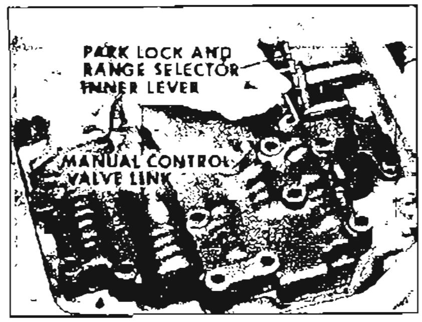



Figure 5-116

9. Remove manual control valve link by rotating valve body in a counterclockwise direction to remove link from Park lock and range selector inner valve. See Figure 5-116.

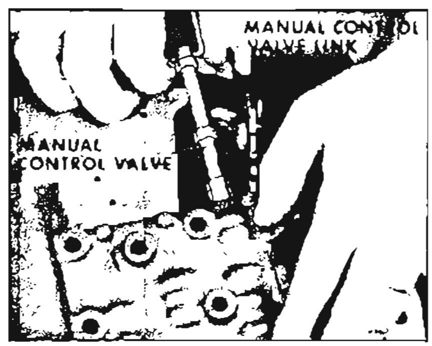



Figure 5-117

10. Remove manual control valve and link from valve body assembly. Remove valve body. See Figure 5-117.

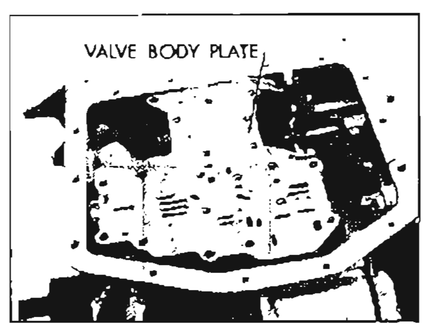



Figure 5-118

11. Remove valve body plate. See Figure 5-118.

12. On V-6 models note the identification notch. See Figure 5-120.

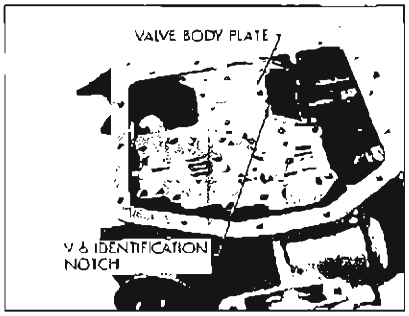



Figure 5-120

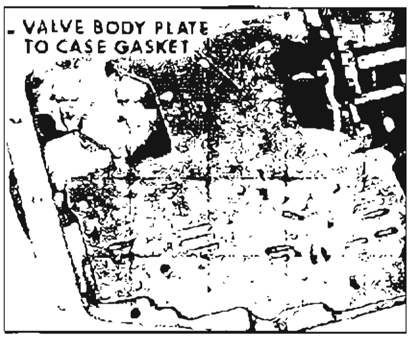



Figure 5-121

13. Remove valve body plate to case gasket. See Figure 5-121.

**d. Removal of Low Servo Cover and Piston Assembly**

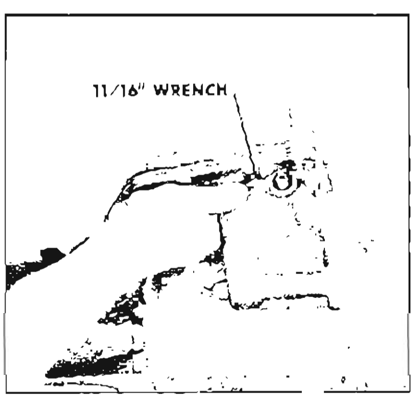



Figure 5-122

1. Release tension on low band adjusting screw retaining nut. Release tension on low band by turning adjusting screw in a counterclockwise direction. Use a 7/32" Allen Wrench. See Figure 5-122.

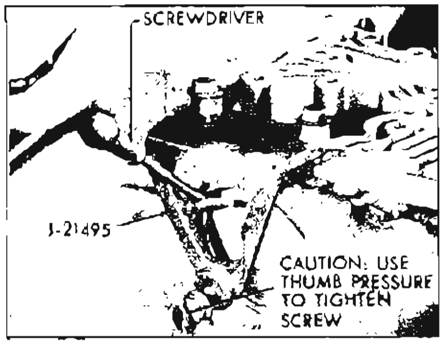



Figure 5-123

2. Remove low servo cover snap ring. Use Tool J-21495 to compress servo cover so snap ring can be removed. See Fig- 5-123.

NOTE: Use thumb pressure only to tighten screw on Tool J-21495.


Figure 5-124

3. Remove tool J-21495-1 from case. Remove low servo cover.

NOTE: If necessary aid removal with screwdriver. See Figure 5-124.

NOTE: If low servo cover has to be replaced make certain all model information is stamped on new cover.

4. Inspect low servo cover seal.

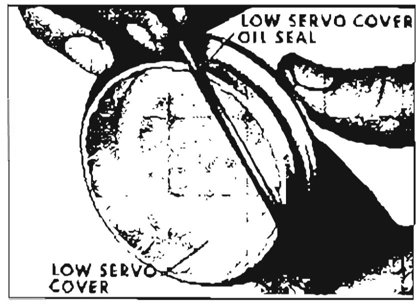



Figure 5-125

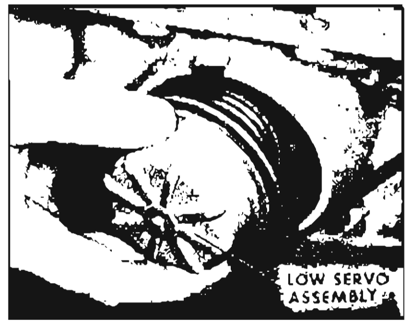



Figure 5-126

If nicked, torn or worn discard. See Figure 5-125.

5. Remove low servo piston assembly from case. See Figure 5-126.

NOTE: When removing low servo cover take extreme care not to disturb low band apply strut.

## 5-11 REMOVAL OF OIL PUMP, FORWARD CLUTCH, AND LOW BAND

**a. Removal of Oil Pump**

1. With transmission in vertical position, remove eight (8) pump attaching bolts with "O" ring seals, then install Slide Hammers J-7004 into threaded holes in pump. Using slide hammers, loosen pump from case. Remove pump and gasket from case. See Figure 5-127.

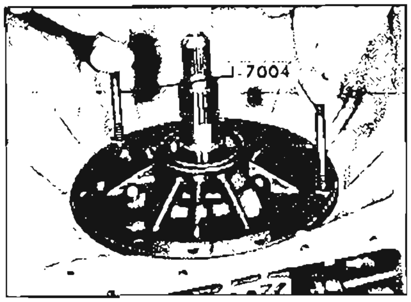



Figure 5-127

**b. Removal of Forward Clutch**

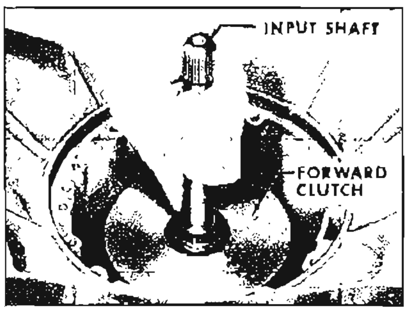



Figure 5-128

1. Remove input shaft from forward clutch drum. See Figure 5-128.

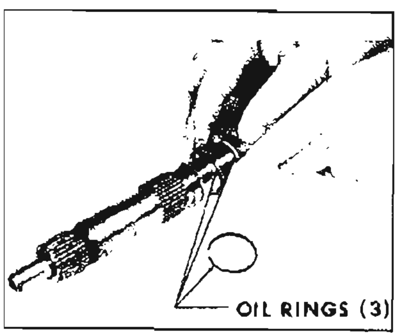



Figure 5-129

2. Examine input shaft oil rings. If nicked or worn, remove rings. See Figure 5-129.

3. Remove forward clutch assembly by pulling straight out of case. Make certain low band has been released before attempting to remove forward clutch. See Figure 5-130.

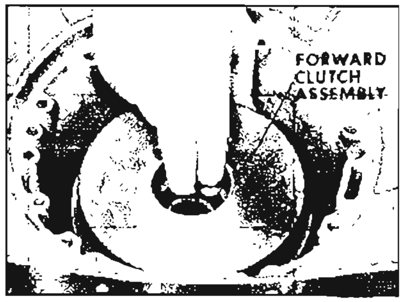



Figure 5-130

**c. Removal of Low Band**

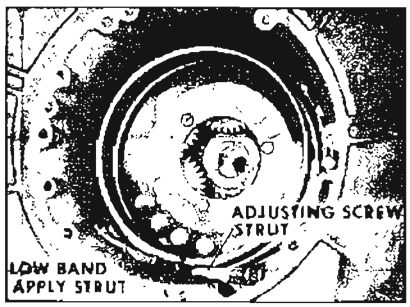



Figure 5-131

1. Remove low band and struts from inside the case. See Figure 5-131.

2. Remove low band adjusting screw. See Figure 5-132.

## 5-12 REMOVE SPEEDOMETER DRIVEN GEAR, REAR BEARING RETAINER, RETAINER OIL SEAL RETAINER BUSHING, AND GOVERNOR

**a. Removal of Speedometer Driven Gear**

NOTE: Transmission need not be removed from the car to perform the following operations, paragraphs 5-12 and 5-13.

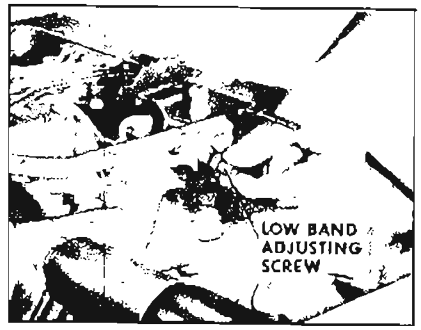



Figure 5-132

1. With transmission in horizontal position, remove speedometer driven gear sleeve retainer with a 1/2" wrench. See Figure 5-133.

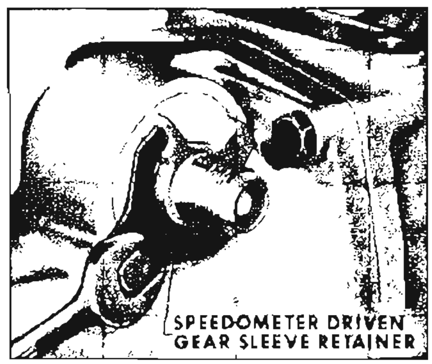



Figure 5-133

2. Remove speedometer driven gear sleeve. See Figure 5-134.

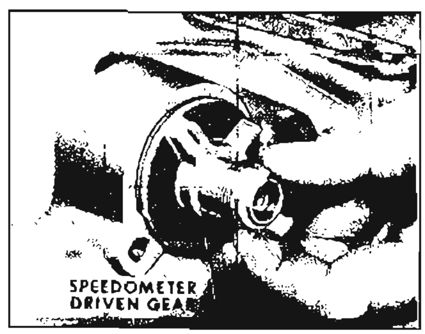



Figure 5-134

**b. Removal of Rear Bearing Retainer**

1. Remove four (4) rear bearing retaining bolts with a 9/16"

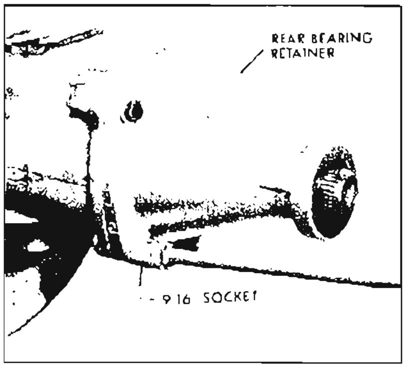



Figure 5-135

socket. Remove rear bearing retainer from case. See Figure 5-135.

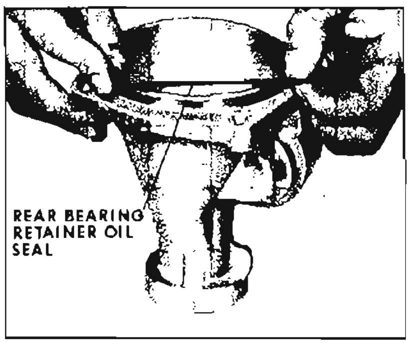



Figure 5-136

2. Remove rear bearing retainer oil seal. See Figure 5-136.

**c. Removal of Rear Bearing Retainer Oil Seal**

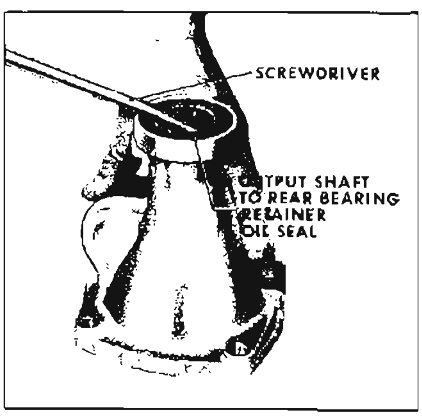



Figure 5-137

1. Inspect and if necessary remove output shaft to rear bearing retainer oil seal. See Figure 5-137.

**d. Removal of Rear Bearing Retainer Bushing**

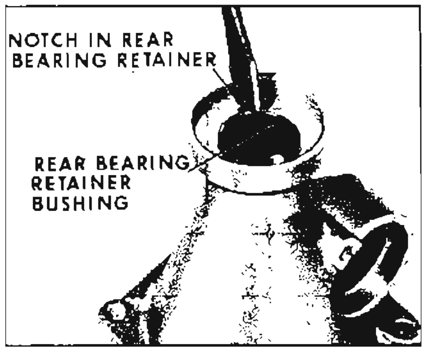



Figure 5-138

1. Inspect and if necessary replace rear bearing retainer bushing. Place screwdriver in notch in rear bearing retainer, then tap screwdriver with hammer to collapse bushing. See Figure 5-138.

**e. Removal of Governor**

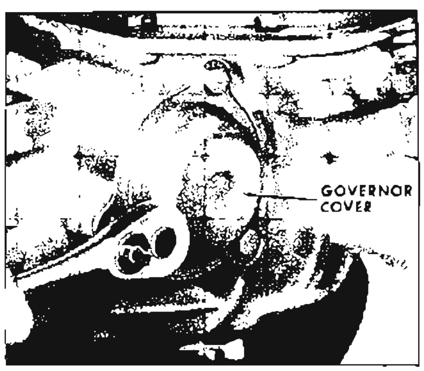



Figure 5-140

1. Remove three (3) attaching bolts retaining governor cover to case using a 1/2" socket. Remove cover and gasket. See Figure 5-140.

2. With a twisting motion slide governor assembly out of its bore in case. See Figure 5-141.

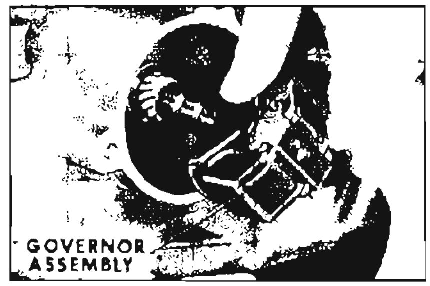



Figure 5-141

## 5-13 SPEEDOMETER DRIVE GEAR AND VACUUM MODULATOR

**a. Removal of Speedometer Driving Gear**

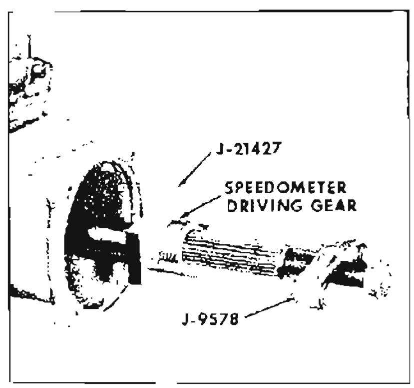



Figure 5-142

1. Place transmission in Park range, then remove speedometer driving gear with J-9578. See Figure 5-142.

2. When removing speedometer driving gear on extended wagons use slide hammer bolts in conjunction with detail J-9578.

**b. Removal of the Vacuum Modulator Assembly**

1. Remove vacuum modulator retainer bolt and retainer using a 1/2" socket. Remove vacuum modulator and valve assembly. See Figure 5-143.

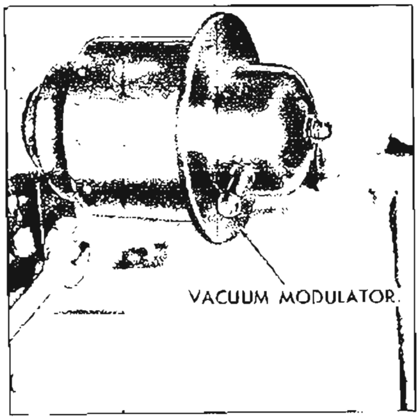



Figure 5-143

2. Inspect and if necessary remove vacuum modulator to case oil seal. See Figure 5-144.

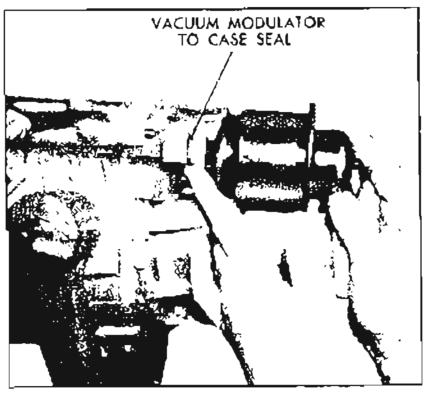



Figure 5-144

## 5-14 REMOVAL OF PLANETARY GEAR SET, REVERSE CLUTCH AND PARKING LOCK MECHANISM

### a. Removal of Planetary Gear Set

1. Remove planet carrier assembly from case, using care not to damage case bushing. See Figure 5-145.

2. Remove reverse ring gear from case. See Figure 5-146.

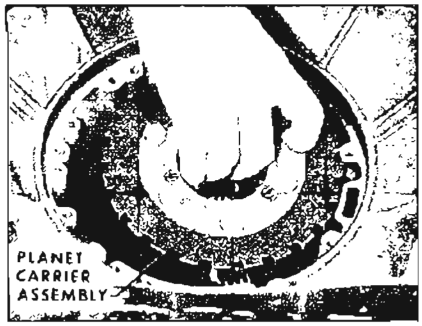



Figure 5-145

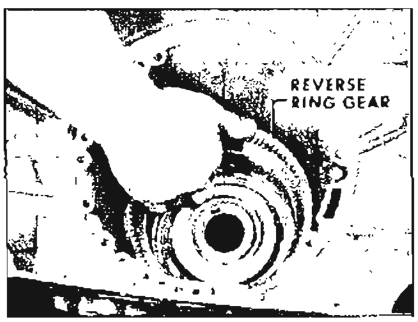



Figure 5-146

3. Remove needle bearing and two (2) bearing races from rear of planet carrier. See Figure 5-147.

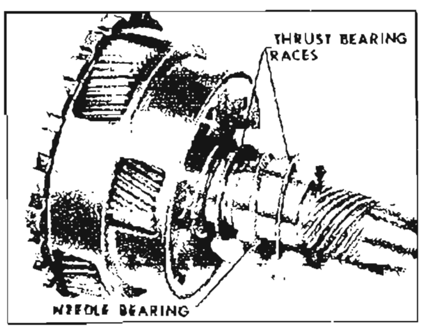



Figure 5-147

### b. Removal of Reverse Clutch

1. Place transmission in vertical position and remove reverse clutch pack snap ring with screwdriver. See Figure 5-148.

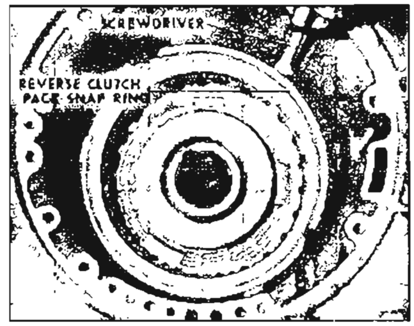



Figure 5-148

2. Lift reverse clutch pressure plate from transmission case. See Figure 5-150.

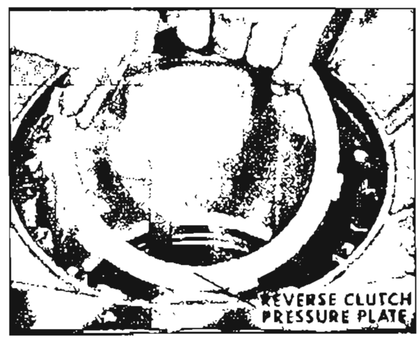



Figure 5-150

3. Remove reverse clutch pack from transmission case. See Figure 5-151.

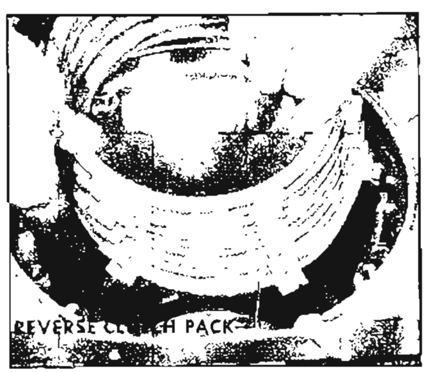


Figure 5-151

4. Remove reverse clutch cushion spring. See Figure 5-152.

5. To remove reverse piston, center Tool J-21420-1 on reverse

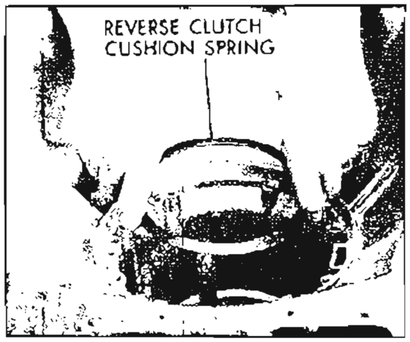



Figure 5-152

piston return seat. Install Flat Plate J-21420-2 over threaded shaft at rear of case. Tighten wing nut to compress piston return seat; then remove snap ring with Pliers J-5586. See Figure 5-153.

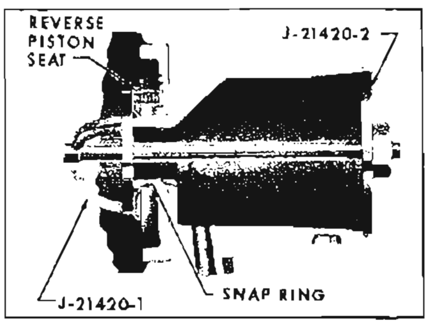



Figure 5-153

6. Remove Tool J-21420-2 being careful that piston return seat does not catch in snap ring groove. Lift off piston return seat and remove seventeen (17) piston return springs. See Figure 5-154.

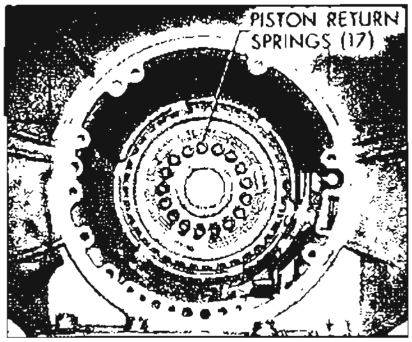



Figure 5-154

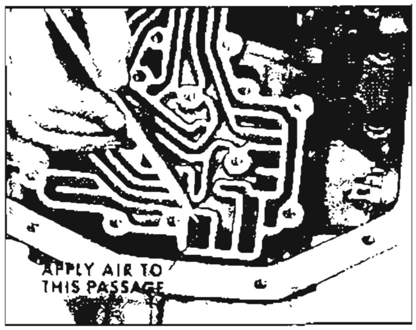



Figure 5-155

7. Place transmission in a horizontal position and remove reverse clutch piston with compressed air. As air is applied to the rear surface of the piston, it will pop out far enough so it can be removed. Insert air nozzle to rear of case as shown in figure. See Figure 5-155.

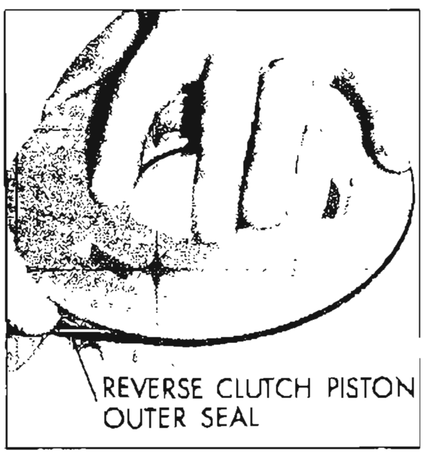



Figure 5-156

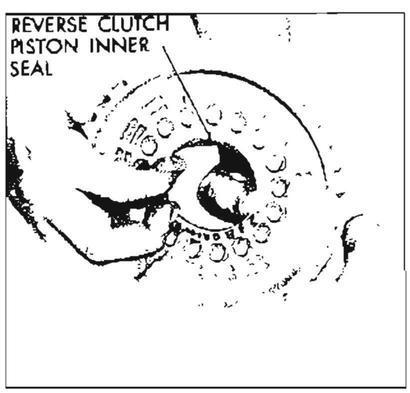



Figure 5-157

8. Examine reverse clutch piston outer seal. If nicked, torn or worn, remove seal. See Figure 5-156.

9. Examine reverse clutch piston inner seal. If nicked, torn or worn, remove seal. See Figure 5-157.

### c. Removal of Range Selector Lever and Shaft, and Parking Lock Actuator

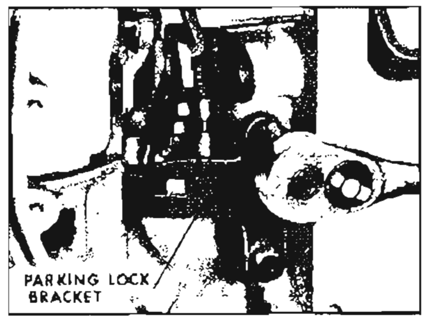



Figure 5-158

1. Remove two (2) parking lock bracket bolts with 1/2" socket. Remove parking lock bracket. See Figure 5-158.

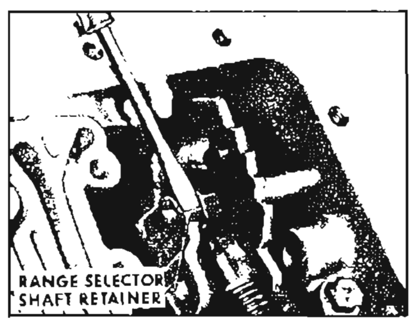



Figure 5-160

2. Remove range selector shaft retainer. See Figure 5-160.

3. With a 9/16" wrench fully loosen nut that retains outer range selector lever to inner park lock and range selector lever. See Figure 5-161.

4. Slide outer range selector lever out of case. Remove nut,

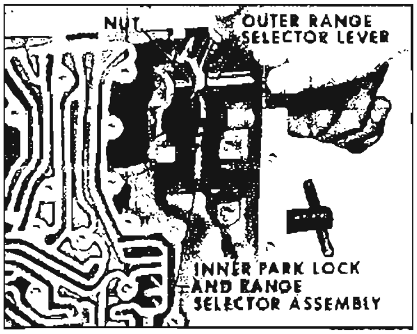



Figure 5-161

inner park lock and range selector lever. See Figure 5-162.

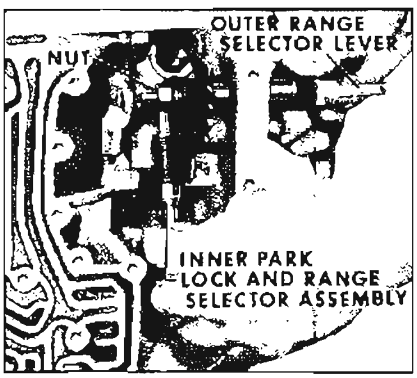



Figure 5-162

5. Remove retaining ring which holds inner park lock and range selector to park lock assembly. See Figure 5-163.

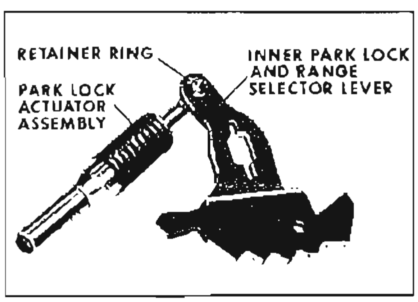



Figure 5-163

6. Slide parking lock pawl shaft out of parking lock pawl. Remove parking lock pawl and spring. See Figure 5-164.

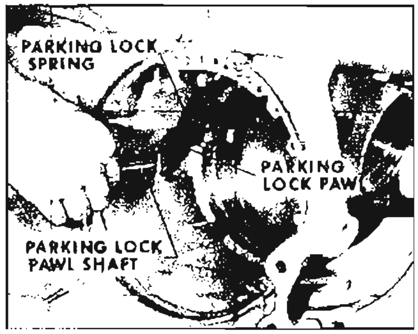



Figure 5-164

7. Examine outer shift lever oil seal. If nicked, torn or worn, replace seal. See Figure 5-165.

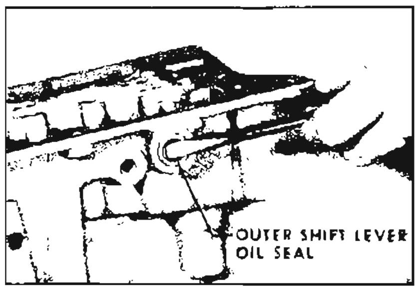



Figure 5-165

**d. Removal of Case Bushing**

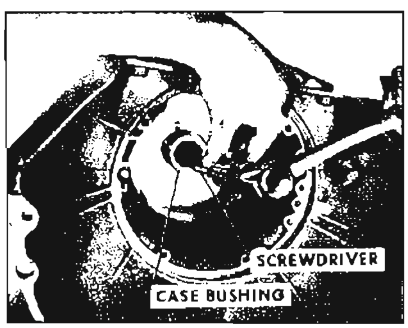



Figure 5-166

1. Inspect case bushing for nicks, scoring or excessive wear. If damaged, replace as follows: Place screwdriver in notch in case, then tap screwdriver with hammer to collapse bushing. See Figure 5-166.

## 5-15 VALVE BODY DISASSEMBLY INSPECTION AND REASSEMBLY

**a. Disassembly**

NOTE: Transmission need not be removed from the car to perform the following operations. Paragraphs 5-15, 5-16 and 5-17.

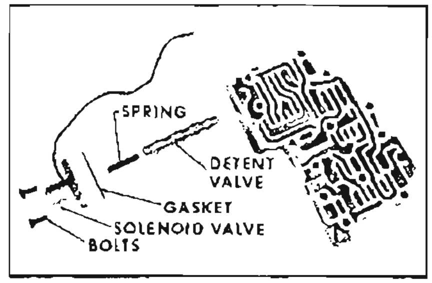



Figure 5-167

1. Remove two (2) bolts attaching stator and detent solenoid valve. Remove the solenoid valve, gasket, spring and stator and detent valve. See Figure 5-167.

NOTE: Notice cutout notch on solenoid valve gasket.

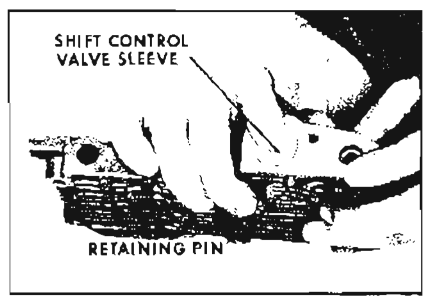



Figure 5-168

2. Depress shift control valve sleeve and remove retaining pin by turning valve body over so pin will fall free. Remove shift control valve sleeve, shift control valve, spring, washer, and shift valve. See Figure 5-168.

3. Depress modulator limit spring with Tool J-21547-1. Turn

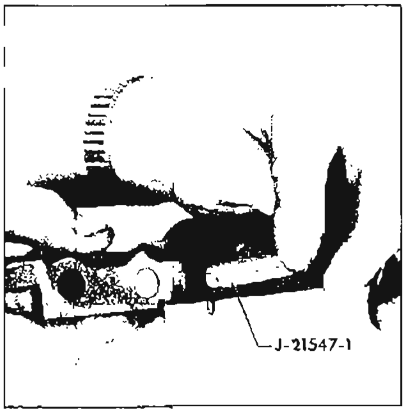



Figure 5-170

valve body over and retaining pin will fall free. Remove spring and valve from body. See Figure 5-170.

NOTE: Modulator limit spring is under moderate pressure. Care should be exercised in removal.

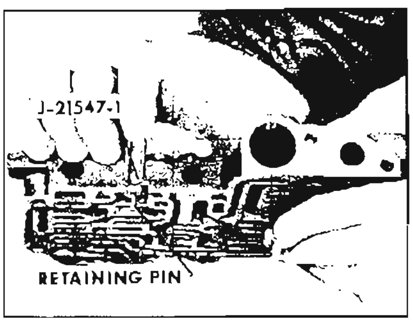



Figure 5-171

4. Depress high speed down shift timing valve plug and remove pin by turning valve body over so pin will fall free. See Figure 5-171.

**b. Inspection**

1. Thoroughly clean all valves and valve body in solvent. Inspect valves and valve body for evidence of wear or damage due to foreign material. Dry valve body and valves with clean air blast.

2. Test each valve in its bore. All valves must move freely of their own weight.

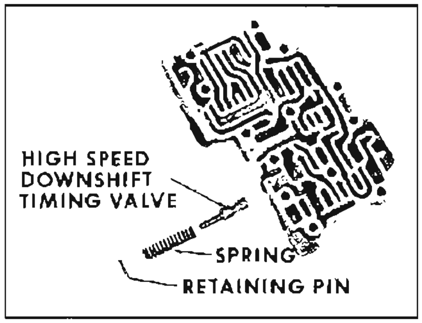



Figure 5-172

**c. Reassembly of Valve Body**

1. Install high speed down shift timing valve and spring. Depress spring with J-21547 and install retaining pin. See Figure 5-172.

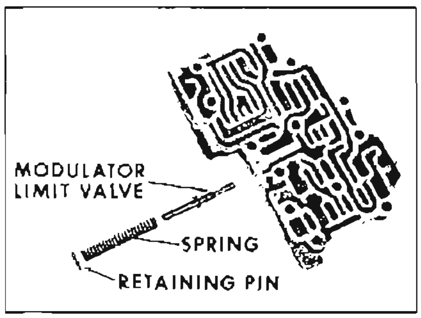



Figure 5-173

2. Install modulator limit valve, and spring into bore of valve body. With aid of Tool J-21547 compress spring and install retaining pin. See Figure 5-173.

3. Install shift valve, washer, spring, shift control valve and shift control valve sleeve. Depress shift control valve sleeve

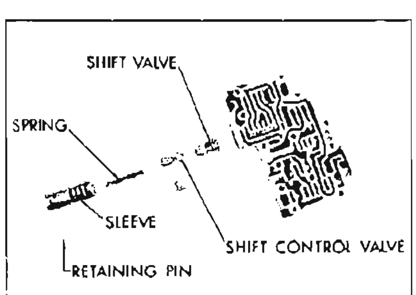



Figure 5-174

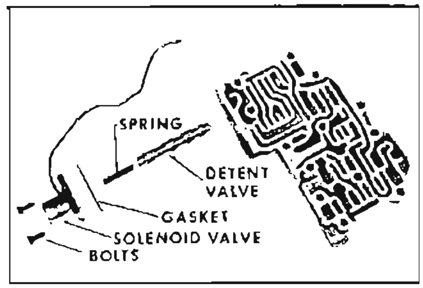



Figure 5-175

with thumb and install retaining pin. See Figure 5-174.

4. Install detent valve and spring. Install gasket to solenoid with notch facing bottom of valve body. Install solenoid to valve body using two 7/16" bolts. See Figure 5-175.

## 5-16 STATOR CONTROL VALVE BODY DISASSEMBLY AND REASSEMBLY

**a. Disassembly**

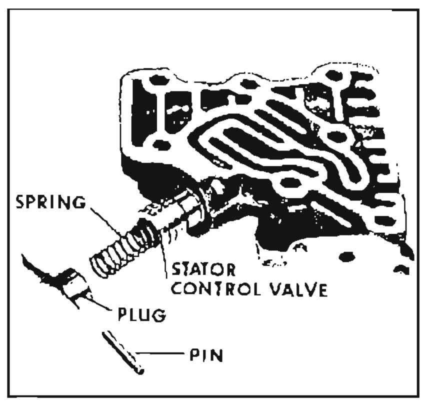



Figure 5-176

1. Compress stator control valve plug. Turn valve body over and retaining pin will fall free. Remove plug, spring and valve from body. See Figure 5-176.

**b. Reassembly**

2. Install stator control valve, spring and plug into bore of valve

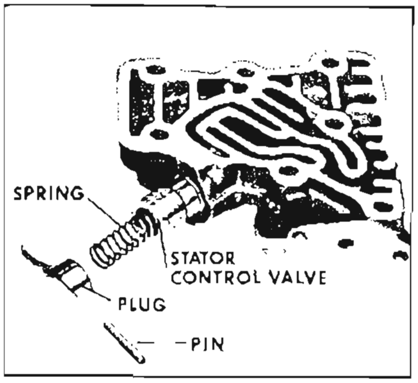



Figure 5-177

body. Compress plug and install retaining pin. See Figure 5-177.

## 5-17 LOW SERVO DISASSEMBLY AND REASSEMBLY

### a. Disassembly

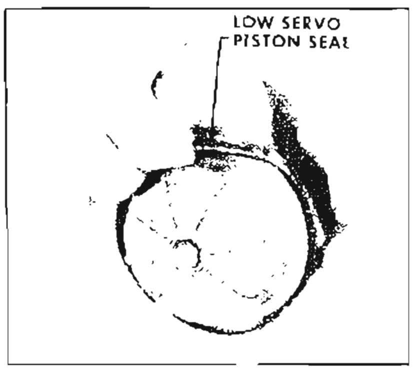



Figure 5-177A

1. Remove low servo piston seal. See Figure 5-177-A.

2. Compress low servo piston. EXTREME CAUTION MUST BE TAKEN WHEN THE LOW SERVO IS BEING COMPRESSED. Install J-9522-2 to hydraulic ram. Install J-21421-1 on top of servo piston. Install a piece of metal 6" x 1-1/2" x 1/2 between J-9522-2 and J-21421-1. Using hydraulic press compress piston and remove retaining pin.

NOTE: After retaining pin has been removed released hydraulic

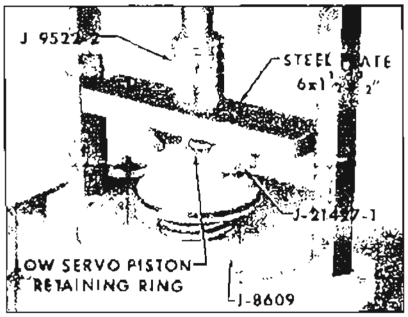



Figure 5-178

ram very slowly. See Figure 5-178.

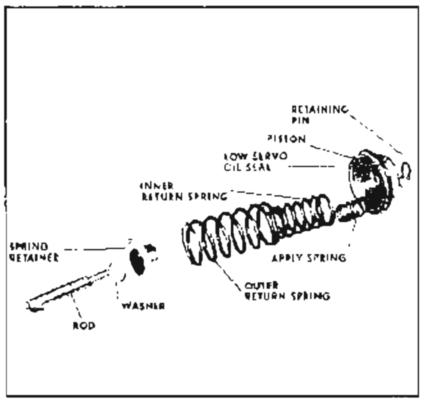



Figure 5-179

3. After hydraulic ram has been released remove piston low servo apply piston spring inner, outer return springs, spring retainer, washer and piston apply rod. See Figure 5-179.

### b. Reassembly

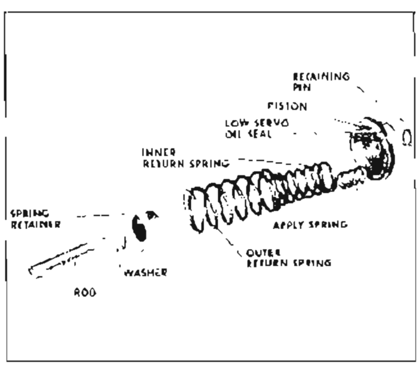



Figure 5-180

1. Assemble the inner and outer return springs into the piston. Install spring retainer. See Figure 5-180. Install this assembly into the ram press as shown in Figure 5-180.

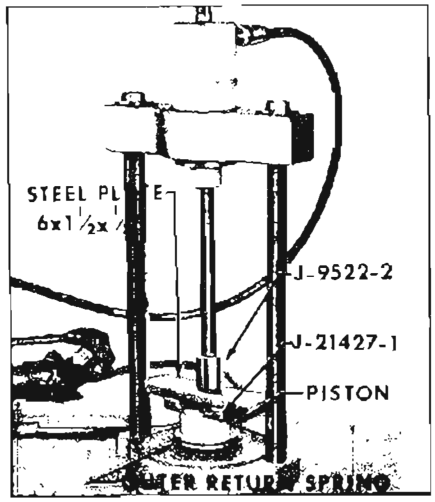



Figure 5-181

2. Assemble tools on top of piston in same manner as removing. Center spring retainer over hole in press Plate J-8690. Compress springs. Install piston apply rod and washer through hole in press plate and install retainer pin.

CAUTION: BEFORE RELEASING RAM MAKE CERTAIN RETAINER RING IS PROPERLY INSTALLED.

Install low servo piston seal. See Figure 5-181.

## 5-18 DISASSEMBLY, INSPECTION, AND THE REASSEMBLY OF THE OIL PUMP

### a. Disassembly

1. Remove the two (2) hook type oil sealing rings from pump hub. See Figure 5-182.

2. Remove pump cover to forward clutch drum thrust washer. See Figure 5-183.

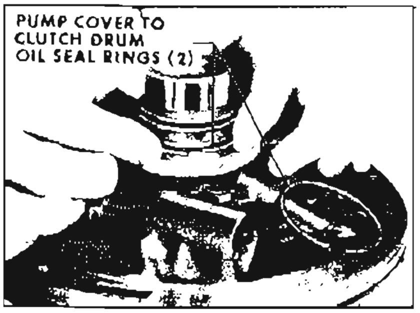



Figure 5-182

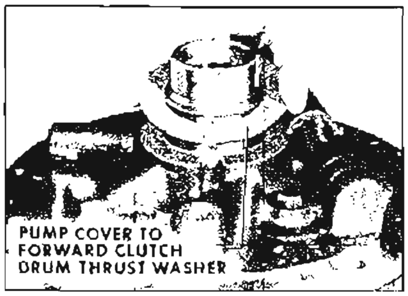



Figure 5-183

3. Remove oil pump to case seal and discard. See Figure 5-184.

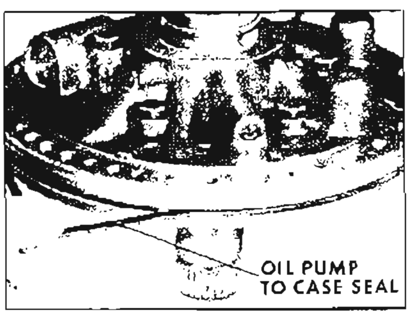



Figure 5-184

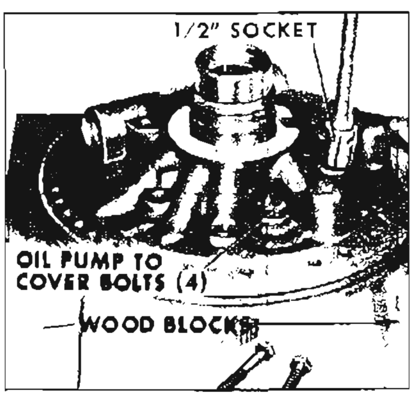



Figure 5-185

4. Support oil pump on wood blocks. Remove five (5) pump cover bolts with a 1/2" socket. Remove pump cover. See Figure 5-185.

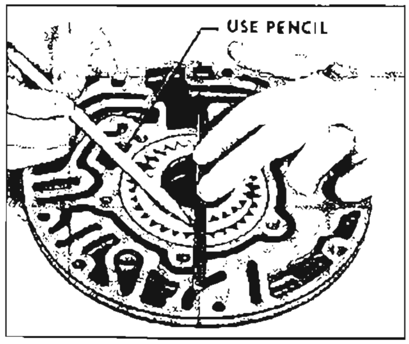



Figure 5-186

5. Mark, but do not scar, gear faces so gears can be reassembled in same manner. See Figure 5-186.

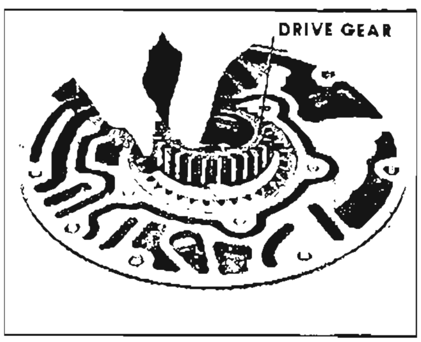



Figure 5-187

6. Remove oil pump drive gear. See Figure 5-187.

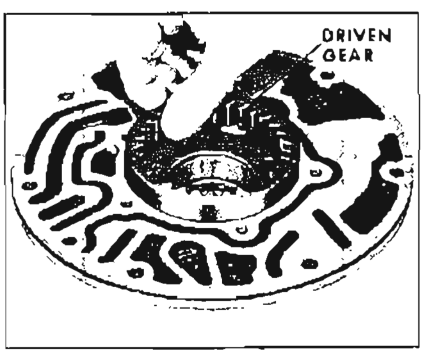



Figure 5-188

7. Remove oil pump driven gear. See Figure 5-188.

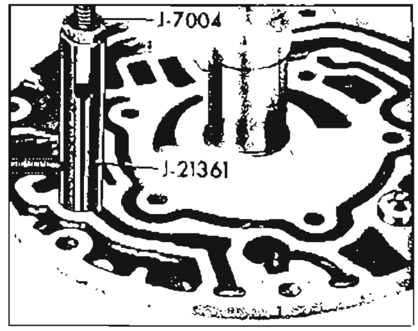



Figure 5-190

8. Remove seat, valve and spring from cooler by-pass valve. Use Tool J-21361 to remove seat from bore in pump cover. See Figure 5-190.

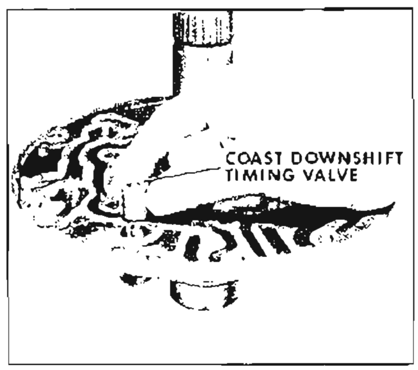



Figure 5-191

9. Remove coast down shift timing valve from the pump cover and inspect for damage. Carefully check to be sure the spring returns the ball to its seat. See Figure 5-191.

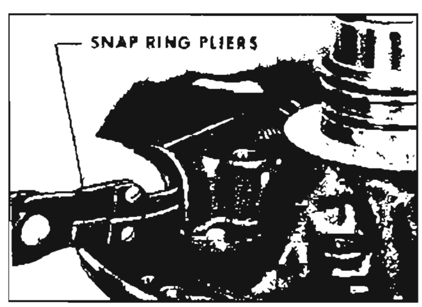



Figure 5-192

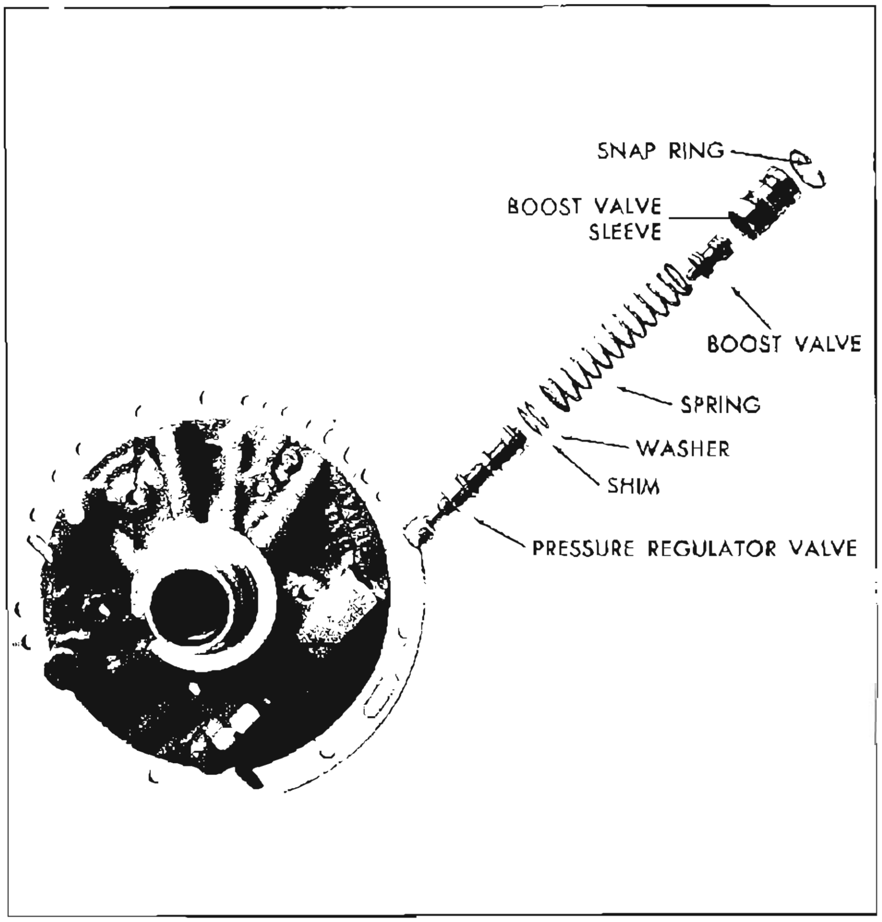



Figure 5-193

10. Compress reverse and modulator boost valve with thumb and remove retaining snap ring. See Figure 5-192.

CAUTION: Reverse and modulator boost valve sleeve is under extreme spring pressure. Extreme care should be taken after retaining snap ring has been removed.

11. After retaining snap ring has been removed, remove reverse and modulator boost valve sleeve and valve, spring, washer, and pressure regulator valve. See Figure 5-193.

12. Examine oil pump seal. If nicked, torn or worn remove seal as follows: Support oil pump body on wood blocks. Remove oil seal

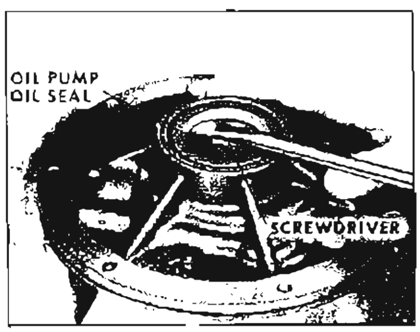



Figure 5-194

with a screwdriver and discard. See Figure 5-194.

13. Check oil pump bushing for nicks, severe scoring or wear. If bushing replacement is necessary proceed as follows: Support pump on wood blocks using Tool J-21465-17 and Drive Handle

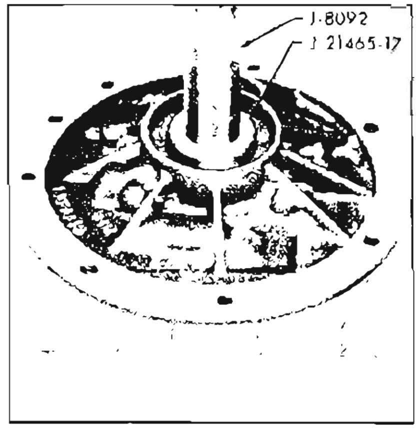



Figure 5-195

J-8092. Press bushing out of pump body. See Figure 5-195.

14. Check stator shaft bushing for

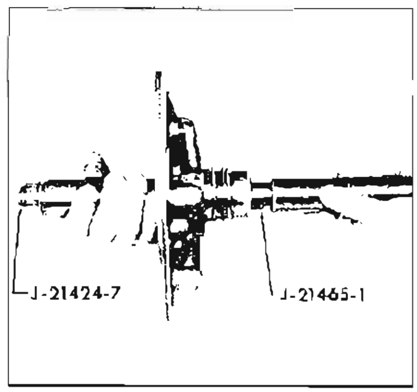



Figure 5-196

nicks, severe scoring or wear. If bushing replacement is necessary proceed as follows: Assemble Bushing Remover J-21424-7 to Extension J-21465-13. Assemble this assembly to Drive Handle J-8092. Grasp stator shaft with hand using other hand and assembled tool drive out bushing. See Figure 5-196.

**b. Inspection**

1. Wash all parts in a cleaning solvent and blow out oil passages with compressed air.

2. Inspect pump gears for nicks or damage.

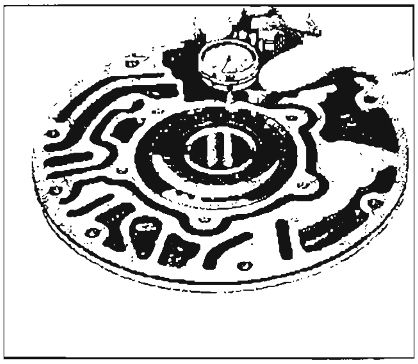


Figure 5-197

3. Inspect pump body for nicks or scoring.

4. Check condition of bushing in oil pump body.

5. With parts clean and dry, install pump gears, noting mark on gears for identification of the side that faces the pump cover. After gears have been installed, proceed as follows:

a. Install pump on converter hub. With dial indicator set check end clearance. The clearance allowed is .0005/.0035. See Figure 5-197.

### c. Reassembly

1. Using Tool J-21465-17 press new bushing into pump body until it is flush with top of pump hub. See Figure 5-198.

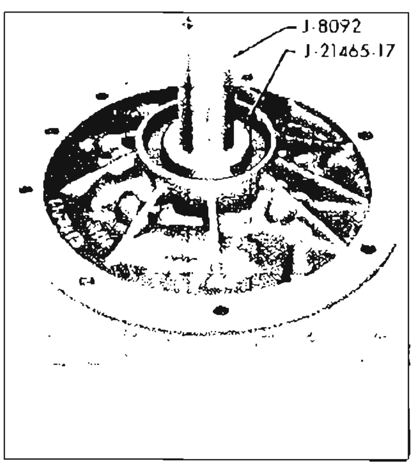



Figure 5-198

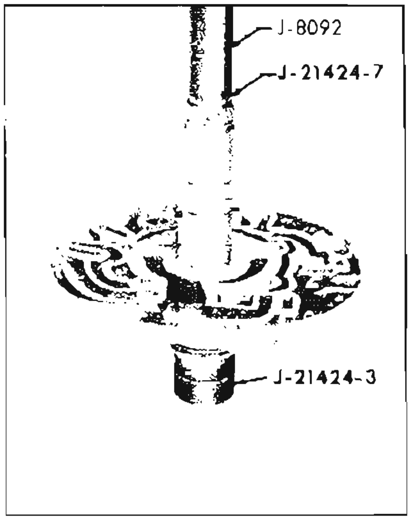



Figure 5-200

2. Install stator shaft bushing as follows: Support pump assembly on J-21424-3 before installing bushing. Install bushing into the front end of stator shaft. Using Installer J-2142-7 and Drive Handle J-8092 tap bushing into shaft until it bottoms in counterbore.

NOTE: Extreme care must be taken so bushing is not driven past counterbore.

3. Using Installer J-21359 tap in new oil seal. See Figure 5-201.

4. Install new oil pump to case seal. See Figure 5-202.

5. Assemble pressure regulator valve, washer, spring, reverse

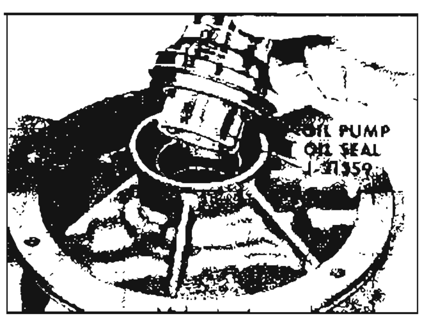



Figure 5-201

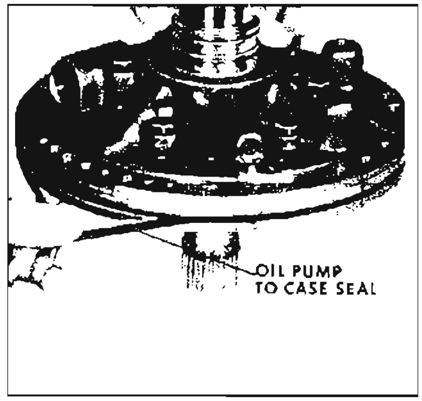



Figure 5-202

and modulator boost valve and sleeve. See Figure 5-203.

When installing spring and shim make certain the same springs and the proper number of shims are installed.

| Color of Spring | Number of Shims |
|---|---|
| Yellow | None |
| Blue | One |
| Green | Two |
| Actual number of shims may vary to meet production standards. | |

6. Compress reverse and modulator boost valve with thumb, then install retaining snap ring. See Figure 5-204.

7. Install coast down shift timing valve "button end" up in cover. See Figure 5-205.

8. Install spring, valve, and seat into cooler by-pass valve. Using Tool J-21558 press seat into bore of pump body until tool bottoms on face of pump. See Figure 5-206.

NOTE: Thrust washer and oil pump sealing ring will be installed during later operation.

9. Install pump cover to pump body. Install five (5) retaining

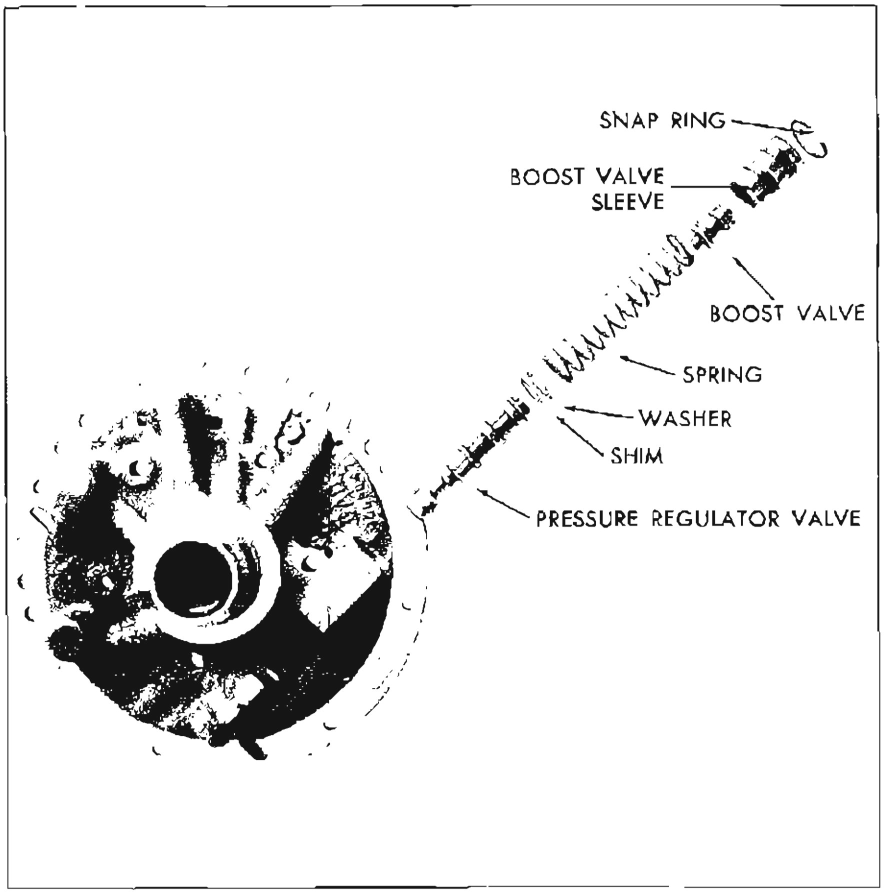



Figure 5-203

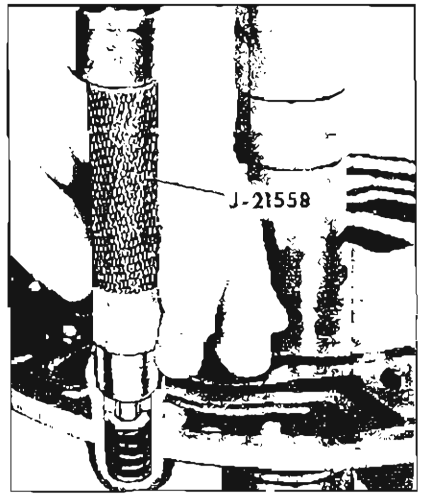



Figure 5-206

bolts but do not tighten. Place Tool J-21368 around pump to obtain proper alignment. Tighten bolts to 16-24 ft. lbs. torque. See Figure 5-207.

NOTE: The bolt location at the pressure regulator takes a longer bolt.

## 5-19 DISASSEMBLY, INSPECTION, AND REASSEMBLY OF FORWARD CLUTCH

### a. Disassembly

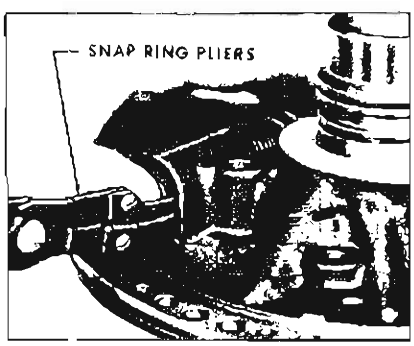



Figure 5-204


Figure 5-205

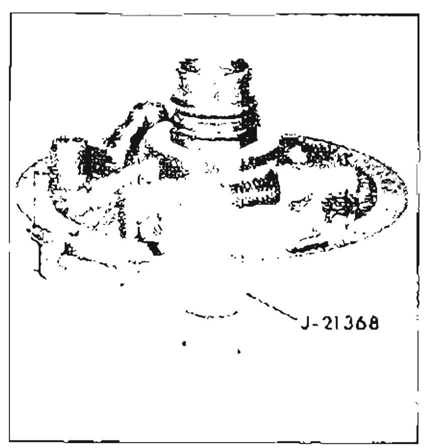



Figure 5-207

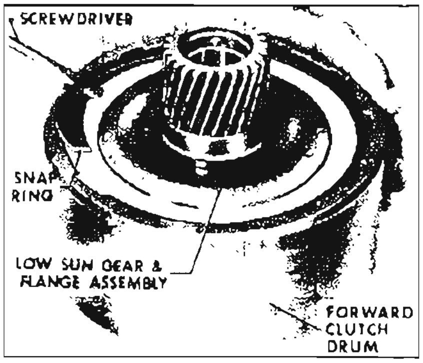



Figure 5-208

1. Remove low sun gear and flange assembly retaining snap ring. See Figure 5-208.

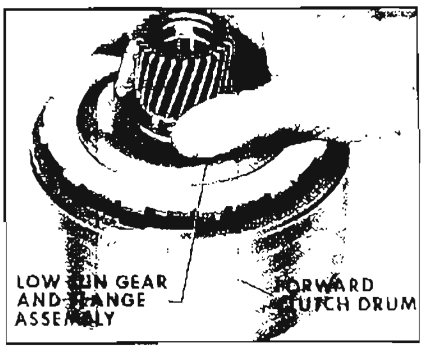


Figure 5-210

2. Remove low sun gear and flange assembly. See Figure 5-210.

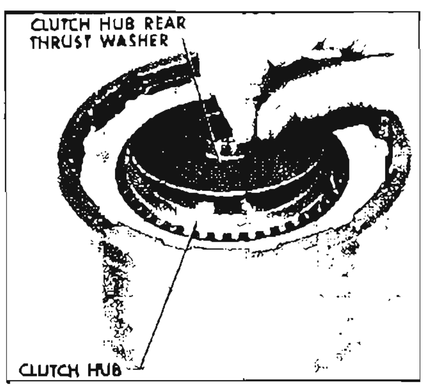



Figure 5-211

3. Remove clutch hub rear thrust washer. See Figure 5-211.

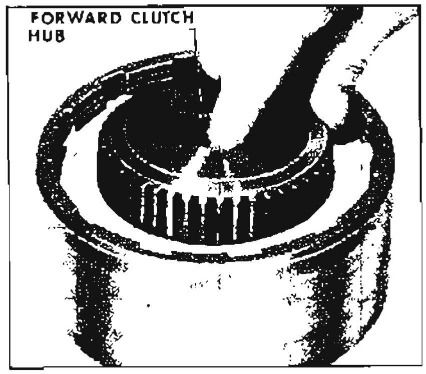



Figure 5-212

4. Lift forward clutch hub from clutch pack. See Figure 5-212.

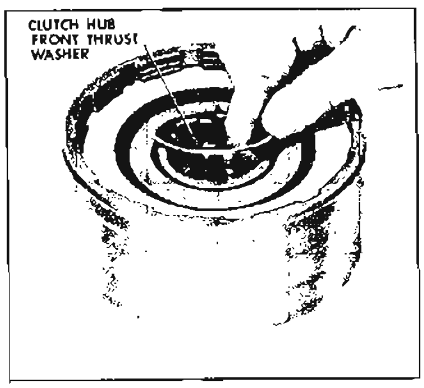



Figure 5-213

5. Remove clutch hub front thrust washer. See Figure 5-213.

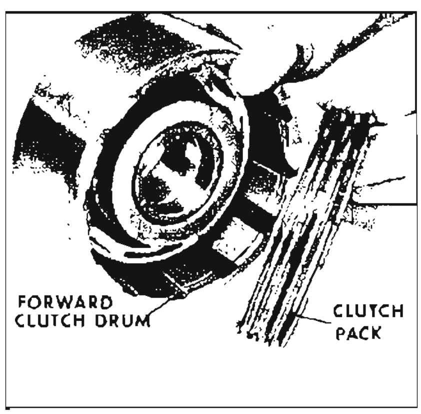



Figure 5-214

6. Remove clutch pack from forward clutch drum. See Figure 5-214.

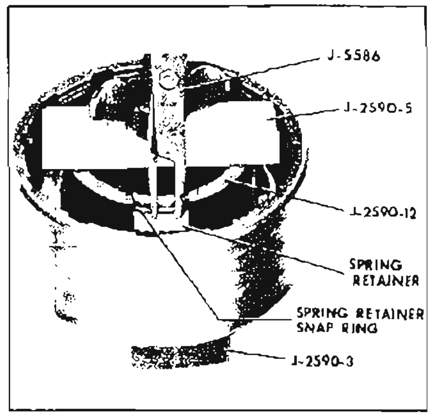



Figure 5-215

7. Using Tools J-2590-3, J-2590-5 and J-2590-12 compress spring retainer. Remove snap ring. Then remove Tool J-2590 and component parts, being careful that spring retainer does not catch in snap ring groove. See Figure 5-215.

NOTE: Place a piece of hard board between Tool J-2590-3 and surface of forward clutch hub.

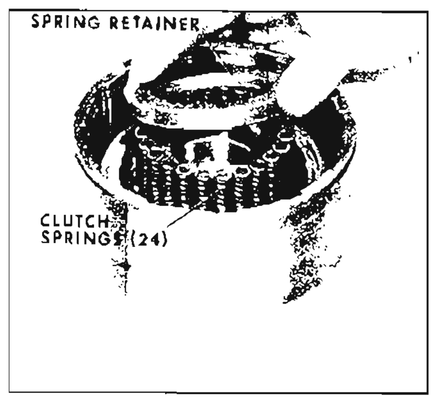



Figure 5-216

8. Lift off spring retainer and twenty-four (24) clutch springs. See Figure 5-216.

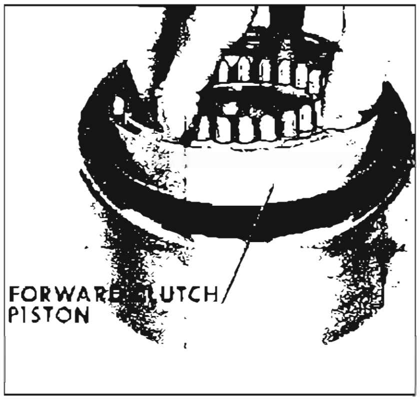



Figure 5-217

9. Lift up on forward clutch piston with a twisting motion and remove. See Figure 5-217.

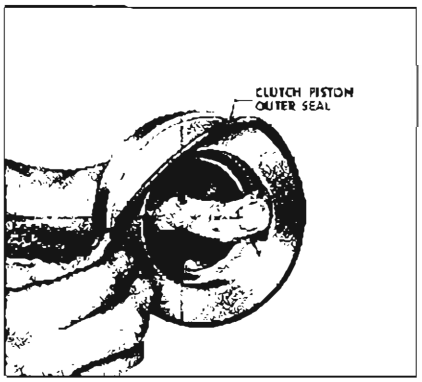



Figure 5-218

10. Examine forward clutch piston outer seal. If nicked, torn or worn, remove seal. See Figure 5-218.

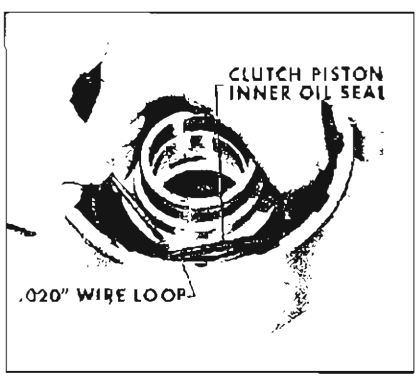



Figure 5-220

11. Examine forward clutch piston inner seal. If nicked, torn or worn, remove seal. See Figure 5-220.

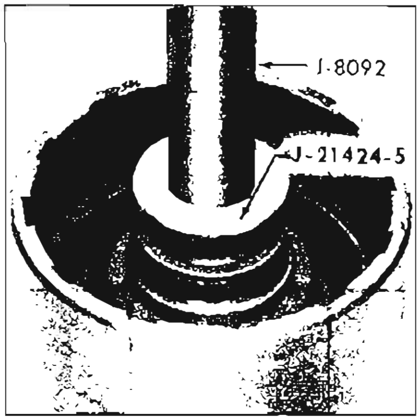



Figure 5-221

12. Check forward clutch drum bushing for nicks, severe scoring or wear. If bushing replacement is necessary proceed as follows: Using Tool J-21424-5, press damaged bushing from forward clutch drum. See Figure 5-221.

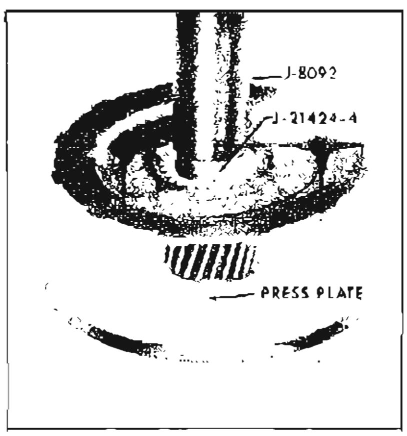



Figure 5-222

13. Check low sun gear and flange assembly bushing for nicks, severe scoring, or wear. If bushing replacement is necessary proceed as follows: Support low sun gear assembly on press plate using Tool J-21424-4 and Drive Handle J-8092 press out bushing. See Fig. 5-222.

**b. Inspection**

1. Wash all parts in a suitable cleaning solvent. Use compressed air to dry.

2. Check steel ball in the forward clutch drum. Be sure it is free to move in hole and that orifice leading to front of clutch drum is open.

3. Check clutch plates for wear or scoring.

**c. Reassembly**

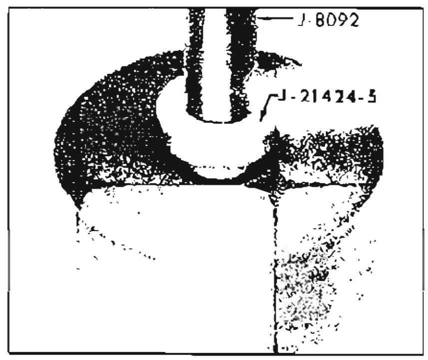



Figure 5-223

1. Install J-21424-5 in front of forward clutch drum. Using Drive Handle J-8092 press bushing into bore until Tool J-21424-5 bottoms on hub. See Figure 5-223.

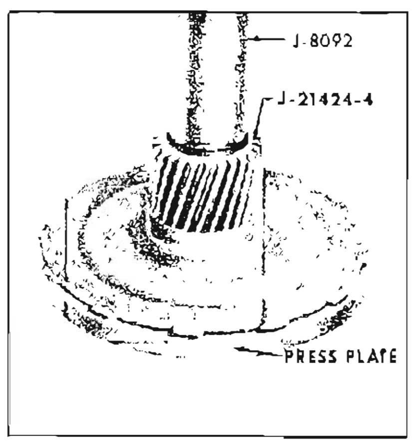



Figure 5-224

2. Install Tool J-21424-4 into low sun gear. Using Drive Handle

J-8092 press bushing into low sun gear until bushing installer is flush with top of low sun gear. See Figure 5-224.

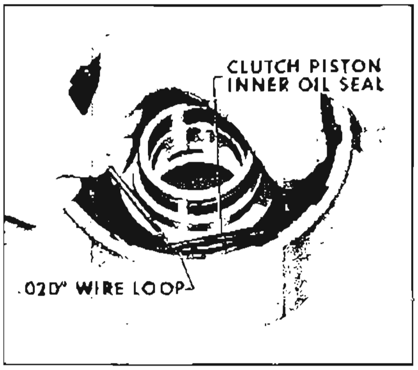



Figure 5-225

3. Lubricate with transmission oil and install new forward clutch piston inner seal with seal lip pointing downward. See Figure 5-225.

NOTE: Run hand around seal after it is installed to see if seal is fully in groove.

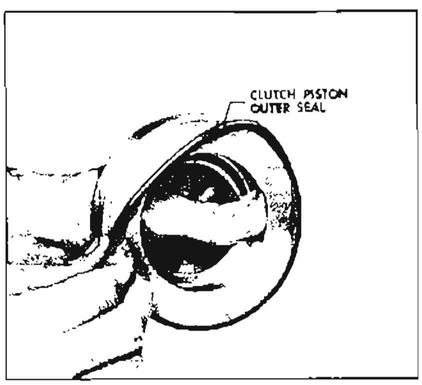



Figure 5-226

4. Lubricate with transmission oil and install new forward clutch piston outer seal in clutch piston. Seal lip must point down. See Figure 5-226.

5. Install forward clutch piston into clutch drum using a loop of smooth wire to start lip of seal into bore. Piston should turn freely. See Figure 5-227.

NOTE: A satisfactory tool can be made by crimping a loop of .020" music wire in a short length of copper tubing.

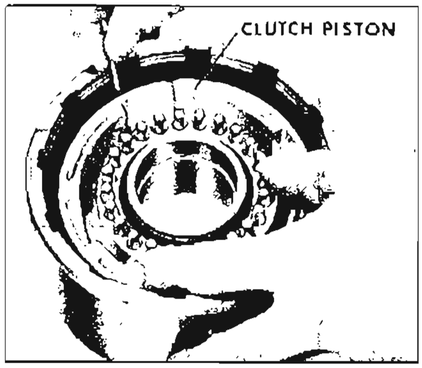



Figure 5-227

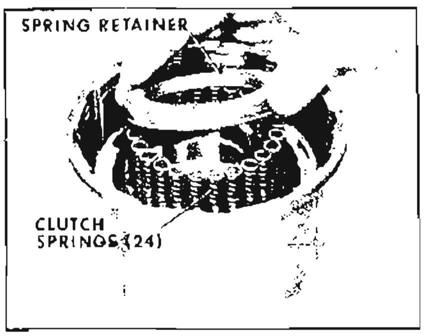



Figure 5-228

6. Carefully reassemble return springs, retainer and snap ring. See Figure 5-228.

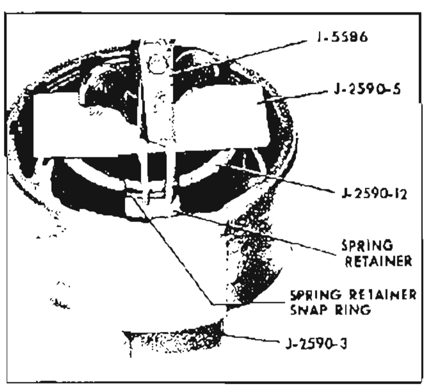



Figure 5-230

7. With spring retainer in place compress spring retainer with Tools J-2590-3, J-2590-4 and J-2590-5 far enough so the spring retainer snap ring can be installed. Make sure retainer doesn't catch in snap ring groove when compressing springs. See Figure 5-230.

NOTE: Place a piece of hard board between Tool J-2590-3 and forward clutch drum.


Figure 5-231

8. Install clutch hub front thrust washer to clutch hub (retain with grease) aligning tangs in clutch hub with grooves in thrust washer. Install clutch hub. See Figure 5-231.

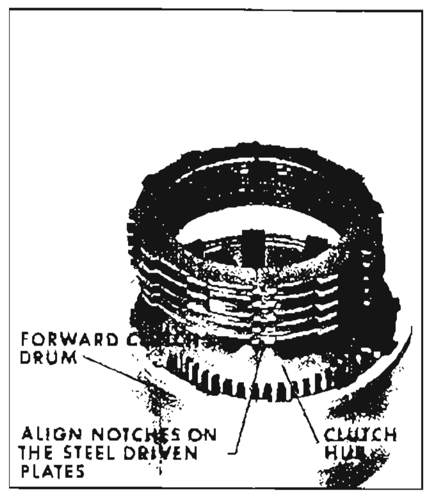



Figure 5-232

9. Align notches on steel driven plates. Install steel driven plates and lined drive plates alternately, beginning with a steel driven plate. See Figure 5-232.

NOTE: Cars equipped with V-6 engines have 4 drive plates and 5 driven plates. Cars equipped with V-8 engines have 5 drive plates and 6 driven plates.

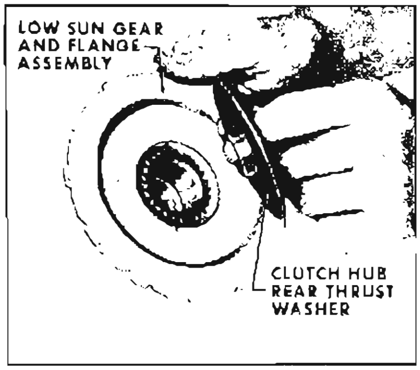



Figure 5-233

10. Install clutch hub rear thrust washer with its flange toward low sun gear and flange assembly. See Figure 5-233.

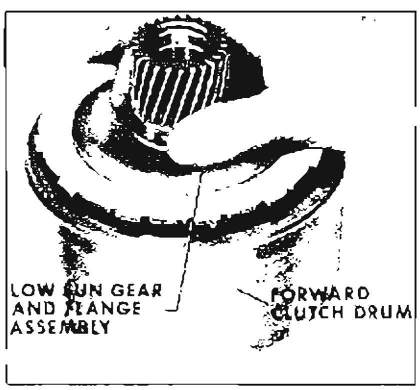



Figure 5-234

11. Install low sun gear and flange assembly. See Fig-5-234.

12. Install low sun gear and flange assembly retaining ring. Position snap ring so gap is centered between slots in drum. See Figure 5-235.

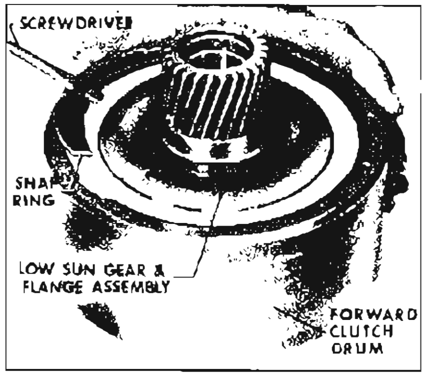



Figure 5-235

## 5-20 SPEEDO DRIVEN GEAR DISASSEMBLY, AND REASSEMBLY

NOTE: Transmission need not be removed from the car to perform the following operations. Paragraphs 5-20 and 5-21.

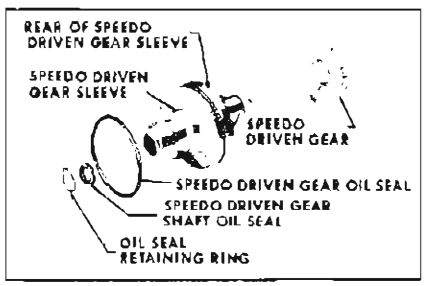



Figure 5-236

### a. Disassembly

1. Remove speedo driven gear. See Figure 5-236.

2. Examine speedo driven gear oil seal. If nicked, torn or worn remove seal.

3. Examine speedo driven gear shaft oil seal. If nicked, torn or worn remove seal.

### b. Reassembly

1. Install speedo driven gear shaft oil seal with lip of seal pointing toward rear of speedo gear sleeve. Install oil seal retaining ring.

2. Install speedo driven gear oil seal. See Figure 5-236.

3. Install speedo driven gear.

## 5-21 REMOVAL AND INSTALLATION OF GOVERNOR DRIVEN GEAR

Before any attempt is made to service the governor gear, the following checks must be made.

1. Check secondary governor weight tab wear. See Figure 5-237.

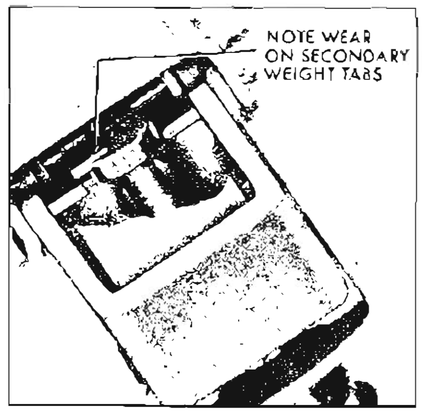



Figure 5-237

2. Check governor feed port opening. See Figure 5-238.

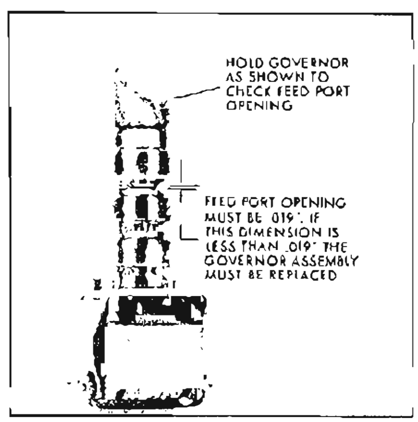



Figure 5-238

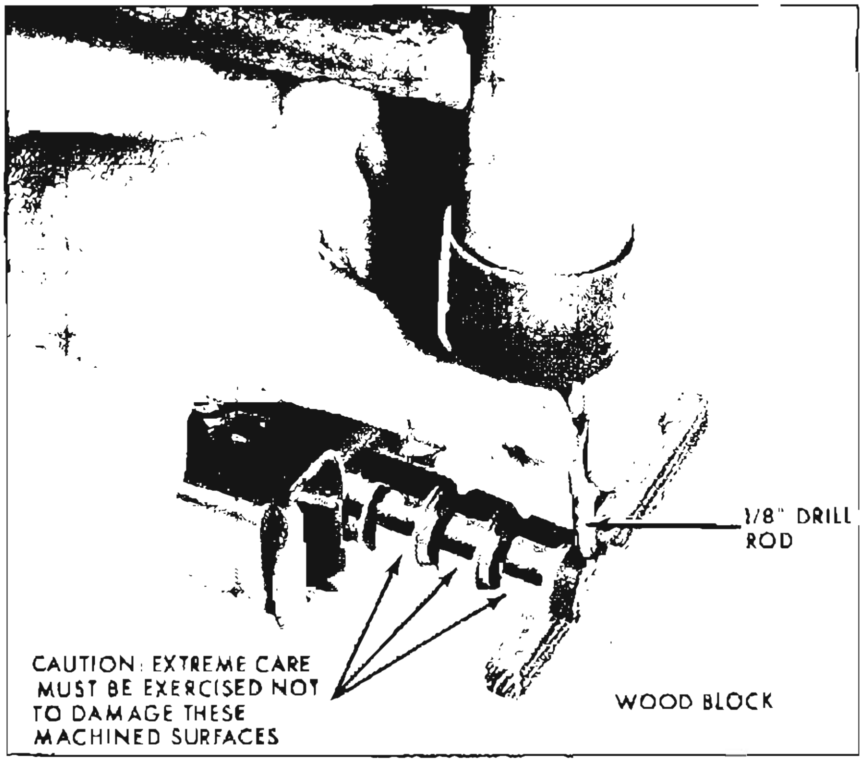



Figure 5-240

If either secondary tab wear or less than .019 feed port opening is found, the complete governor assembly must be replaced.

**a. Removal**

1. Support governor sleeve on wood block as shown in Figure 5-240, remove roll pin with a 1/8" drill rod.

CAUTION: If wood block is placed under nylon gear, breakage of gear inside governor sleeve will result. Exercise extreme care not to damage machine surfaces of governor sleeve.

2. Remove driven gear. Remove any chips or burrs from inside governor sleeve.

**b. Installation**

1. Install replacement gear by carefully pressing new gear into sleeve as follows:

a. Use press plate J-8853.

b. Place shim supplied in replacement gear kit between the second and third lands of governor sleeve. See Figure 5-241.

c. Make certain new gear is positioned squarely on sleeve and press gear onto sleeve. Gear must be seated against sleeve. See Figure 5-241.

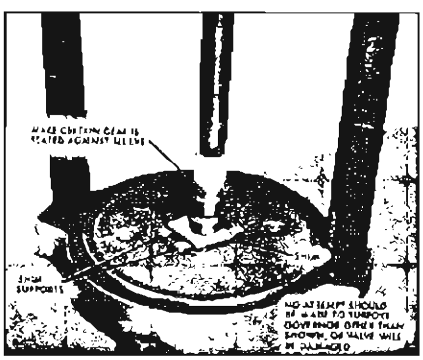


Figure 5-241

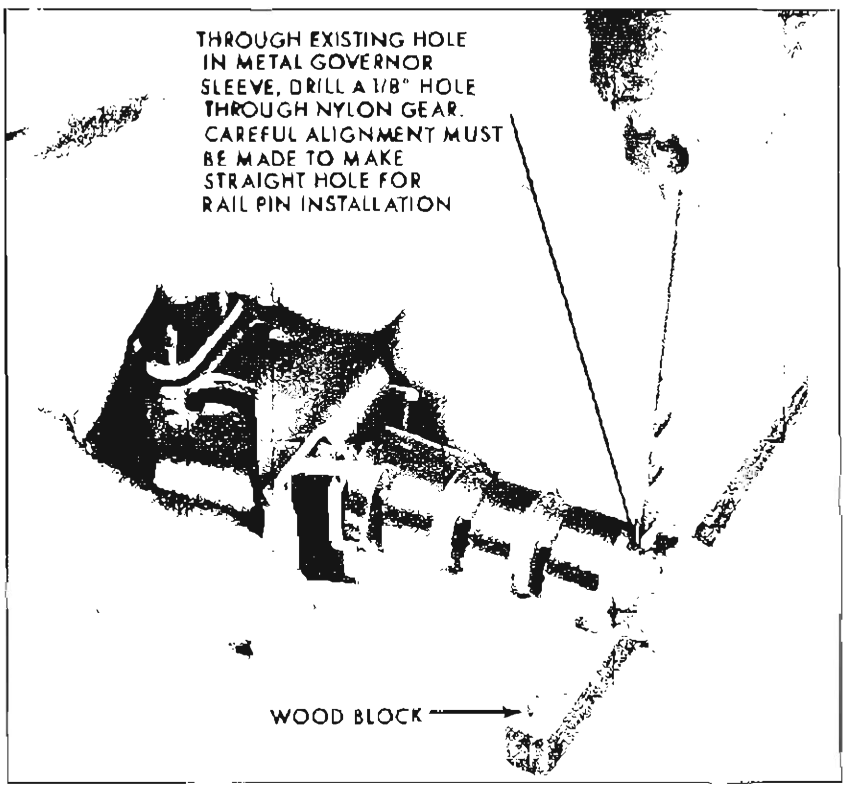



Figure 5-242

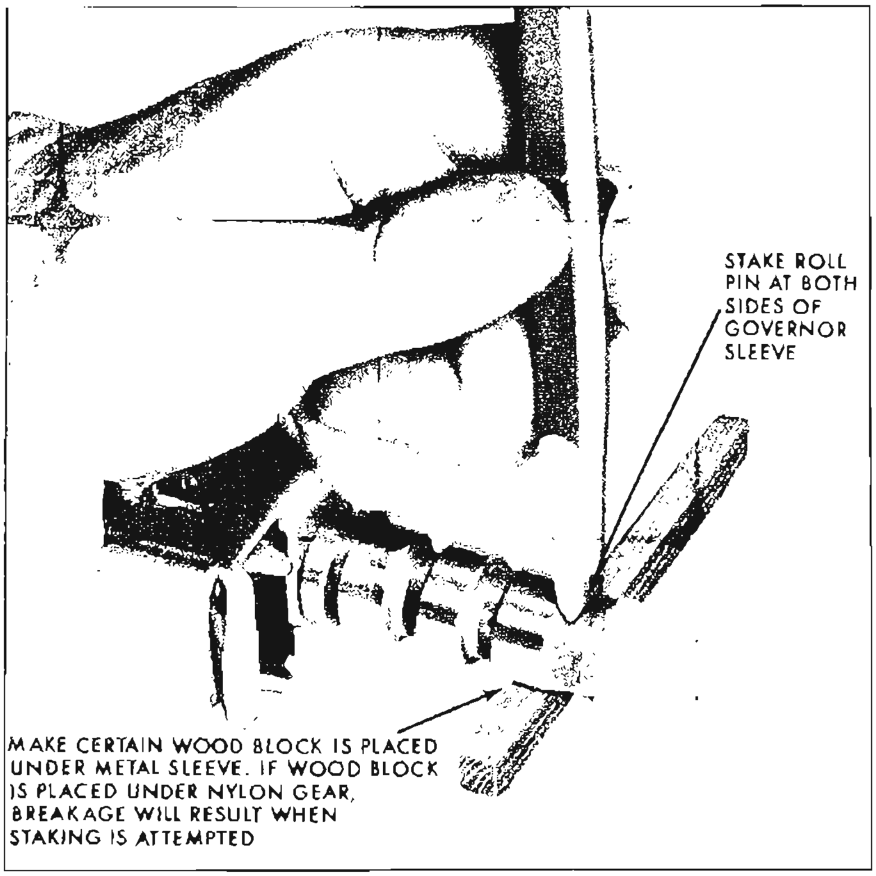



Figure 5-243

CAUTION: DO NOT SUPPORT OR HAMMER ON REAR OF GOVERNOR.

2. Through existing hole in governor sleeve, drill a 1/8" hole half-way through from each end. See Figure 5-242.

NOTE: It is important that the hole for roll pin be drilled straight as possible to insure proper retention and installation of roll pin and gear. This can be best accomplished by above method.

3. Support end of governor sleeve (not gear) on a wooden block. Install new roll pin; then using a small chisel, stake pin in place at both ends of pin to prevent pin from becoming loose. See Figure 5-243.

4. Check for burrs on sleeve and if valve is free in its bore. Any burrs that are left on governor sleeve will damage the case.

## 5-22 PLANET CARRIER DISASSEMBLY INSPECTION, AND ASSEMBLY

### a. Disassembly

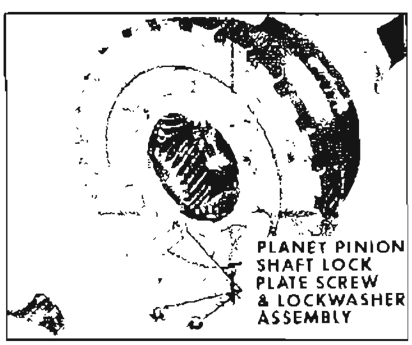



Figure 5-244

1. Remove three (3) planet pinion shaft lock plate screw and lock washers. See Figure 5-244.

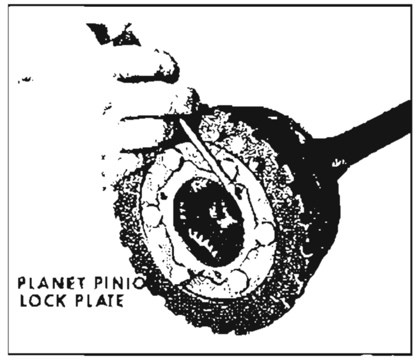



Figure 5-245

2. Rotate planet pinion lock plate and remove. See Figure 5-245.

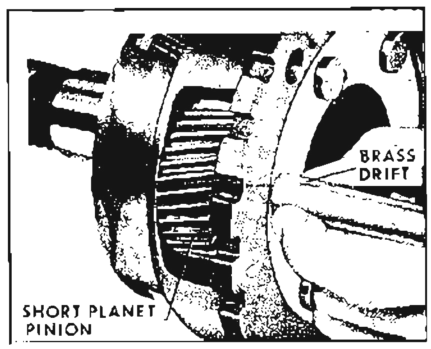



Figure 5-246

3. Start with the short planet pinion first. Insert Brass Drift into front of carrier. See Figure 5-246.

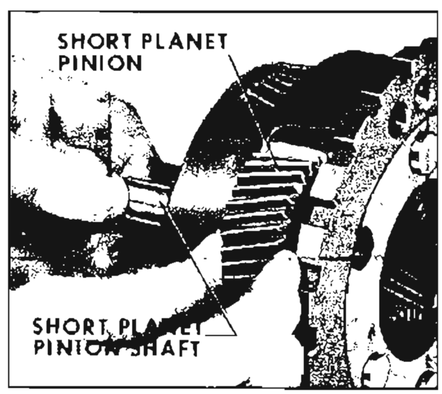



Figure 5-247

4. Remove pinion shaft and pinion gear from planet carrier. See Figure 5-247.

NOTE: Remove the other two (2) short planet pinion gears in same manner as described in Steps 4 and 5.

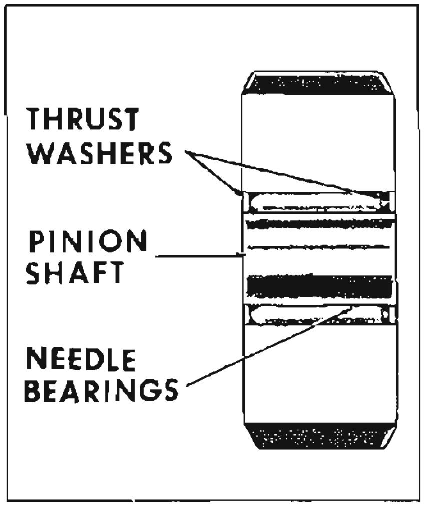



Figure 5-248

5. Remove needle bearings, and thrust washers (2) from the short planet pinion gear. See Figure 5-248.

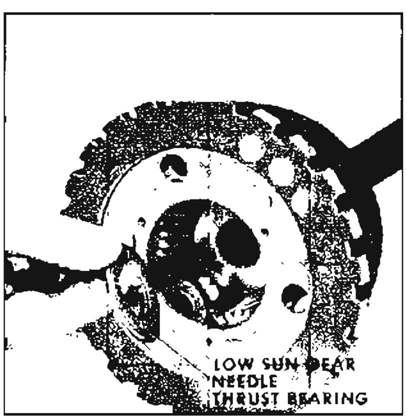



Figure 5-250

6. Remove low sun gear needle thrust bearing. See Figure 5-250.

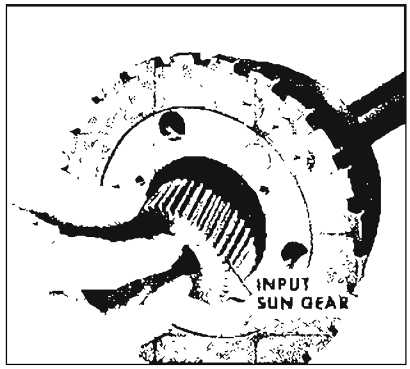



Figure 5-251

7. Remove input sun gear. See Figure 5-251.

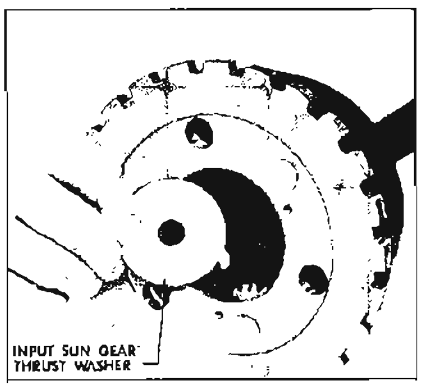



Figure 5-252

8. Remove input sun gear thrust washer. See Figure 5-252.

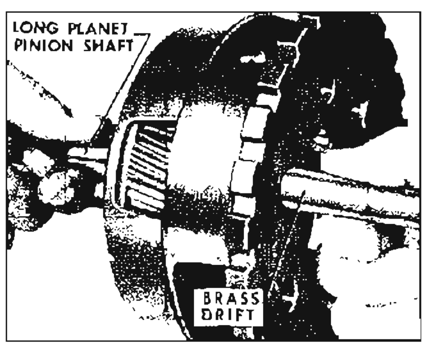



Figure 5-253

9. Insert Brass Drift through long planet pinion. Remove the long planet pinion shaft. See Figure 5-253.

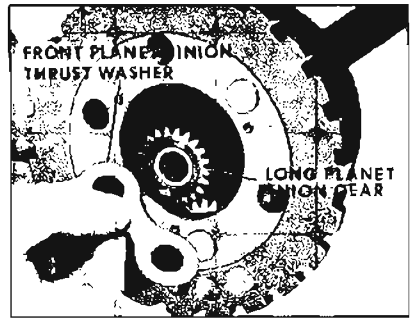



Figure 5-254

10. Remove front planet pinion thrust washer and long planet pinion gear. See Figure 5-254.

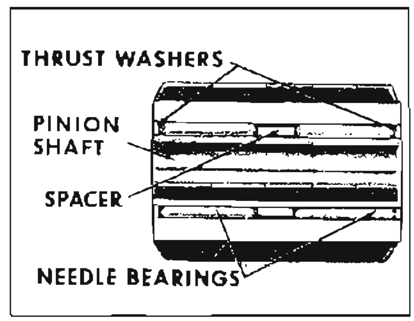



Figure 5-255

11. Remove needle bearings, spacer and two (2) thrust washers from the long planet pinion gear. See Figure 5-255.

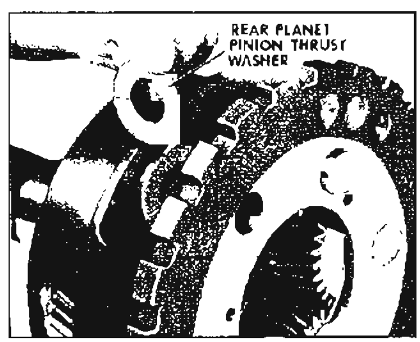



Figure 5-256

12. Remove rear planet pinion thrust washer. See Figure 5-256.

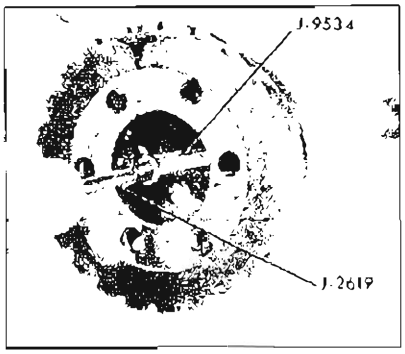



Figure 5-257

13. Check output shaft bushing for nicks, severe scoring or wear. If bushing replacement is necessary continue as follows: Install Bushing Remover J-9534 into bushing. Install Slide Hammer J-2619 into J-9534, using slide hammer remove bushing from planet carrier. See Figure 5-257.

## b. Inspection of Planet Carrier Parts

1. Wash all parts in a cleaning solvent. Air dry all parts.

2. Check the planet pinion gears and input sun gear tooth damage.

3. Check the planet pinion thrust washers and input sun gear thrust washer.

4. Check planet pinion needle bearings. If bearings show excessive wear, all the needle bearings must be replaced.

5. Check the planet pinion shafts closely, if worn replace the worn shafts.

6. Check the output shaft bushing, if worn replace.

## c. Reassembly

1. Using tool J-21424-3 and J-8092 press the new bushing in until J-21424-3 touches the machined surface of the planet carrier assembly. See Figure 5-258.

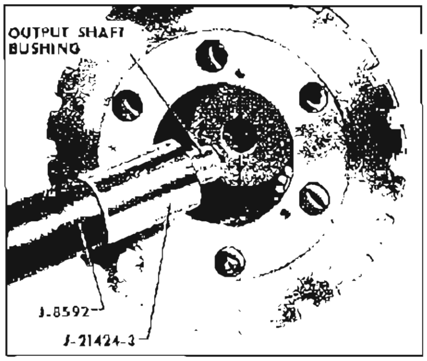



Figure 5-258

2. Install the long planet pinion gears first. Install the rear planet pinion thrust washer. Oil groove must be toward pinion gear. See Figure 5-260.

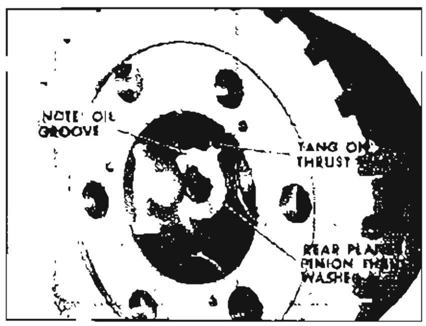



Figure 5-260

3. Install front planet pinion thrust washer. Retain thrust washer to case with grease. Oil grooves on the thrust washer must be toward the pinion gears. See Figure 5-261.

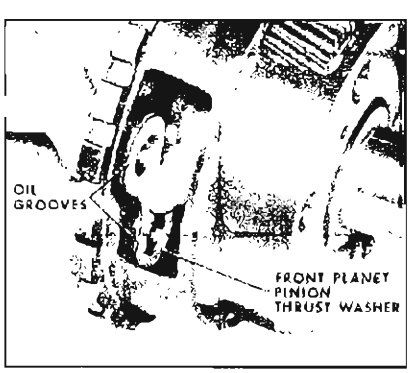



Figure 5-261

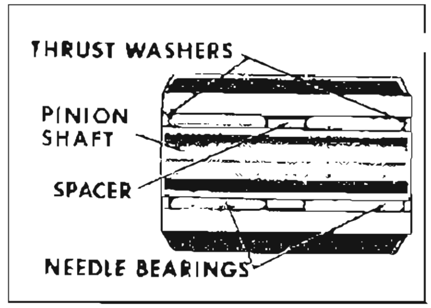



Figure 5-262

4. Coat inside pinion gear with petrolatum. Install Pinion Shaft into long planet pinion gear. Install twenty (20) needle bearings, spacer, twenty more needle rollers, and two (2) thrust washers. See Figure 5-273. Carefully remove pinion shaft. With a twisting motion lock both sets of needle rollers in place. See Figure 5-263.

Figure 5-263

5. Position the long planet pinion assembly with the thrust washers at each end, in the planet carrier. Install the pinion shaft from the front of the carrier. As the shaft is being pushed in, make certain that it picks up the thrust washer. Turn the pinion shaft so the groove faces the center of the planet carrier. See Figure 5-264.

NOTE: Install the other two (2) long planet pinion gears as described in Steps 2-3-4-5.

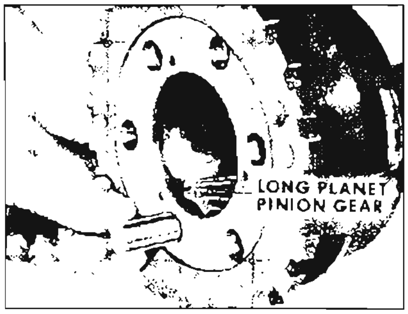



Figure 5-264

6. Install the input sun gear thrust washer with the oil groove facing input sun gear. See Figure 5-265.

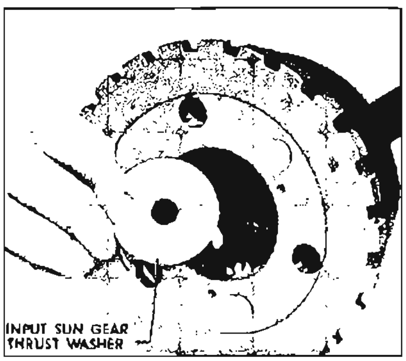



Figure 5-265

7. Install input sun gear into planet carrier. See Figure 5-266.

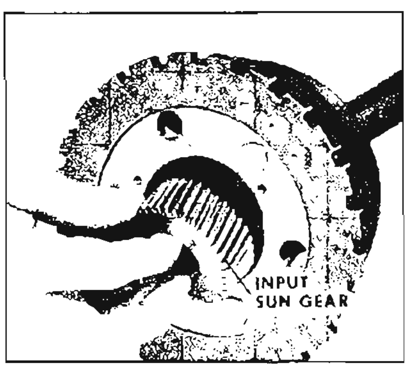



Figure 5-266

8. Install low sun gear needle thrust bearing. See Figure 5-267.

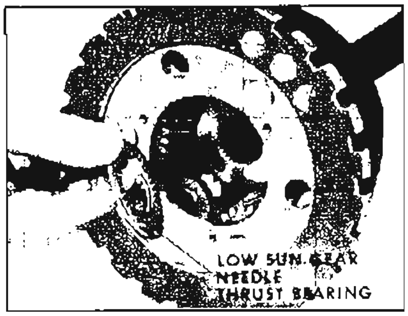



Figure 5-267

9. Install the rear planet pinion thrust washer. Oil groove must be toward pinion gear. See Figure 5-268.

NOTE: The front thrust washer already installed with the long planet pinions also is used for the short planet pinions as the two (2) pinions are paired together on one set of thrust washers.

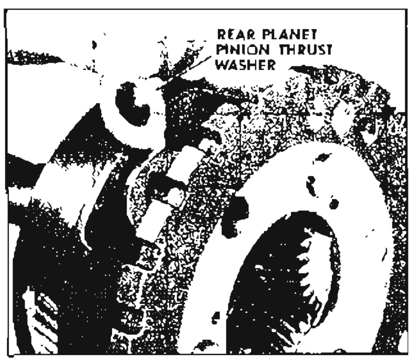



Figure 5-268

10. Install twenty (20) needle bearings, and one thrust washer in the pinion gear. See Figure 5-270. With a twisting motion, lock the needle rollers in place. See Figure 5-271.

11. Position short planet pinion assembly and thrust washers at each end of the planet carrier. Install pinion shaft from the front of planet carrier. As the pinion shaft is being pushed in, make certain that it picks up the thrust washers. Turn the pinion shaft so the groove faces center of planet carrier. See Figure 5-272.

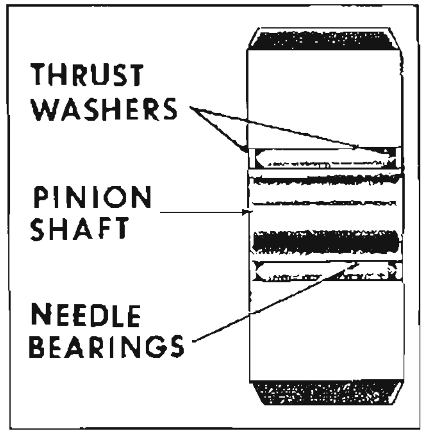



Figure 5-270

Figure 5-271

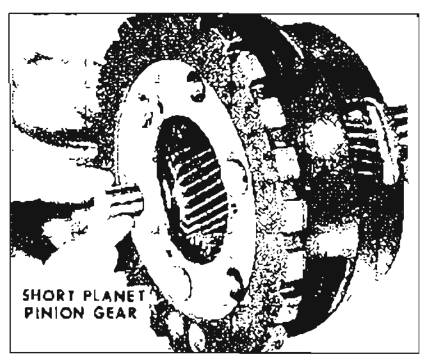



Figure 5-272

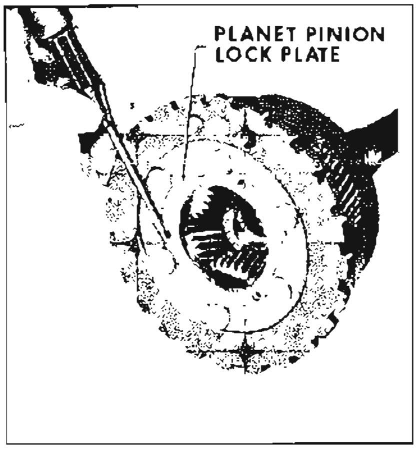



Figure 5-273

12. Install planet pinion lock plate. Rotate plate so extended portions align with slots in planet pinion shafts, and three (3) attaching screw holes. See Figure 5-273.

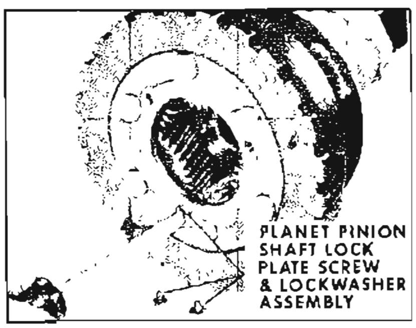



Figure 5-274

13. Install three (3) planet pinion shaft lock plate screw and lock washers. See Figure 5-274.

## 5-23 ASSEMBLY OF TRANSMISSION FROM MAJOR PARTS AND UNITS

### a. General Instructions

1. Before starting to assemble the transmission make certain that all parts are absolutely clean. Keep hands and tools clean to avoid getting dirt into assembly. If work is stopped before assembly is completed cover all openings with clean cloths.

2. All moving parts should be given a light coating of transmission oil before installation. Thrust washers may be held in place with petroleum jelly, sparingly applied.

3. Do not take a chance on used gaskets and seals - use new ones to avoid oil leaks.

4. Use care to avoid making nicks or burrs on parts, particularly at bearing surfaces and surfaces where gaskets are used.

5. It is extremely important to tighten all parts evenly and in proper sequence, to avoid distortion of parts and leakage at gaskets and other joints. Use a reliable torque wrench to tighten all bolts and nuts to specified torque and in the specified sequence.

### b. Installation of Range Selector Lever, Shaft and Parking Lock Actuator

1. Install case bushing, make certain split on bushing is opposite notch in case. See Figure 5-275.

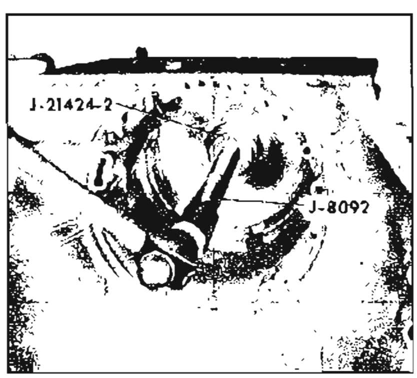



Figure 5-275

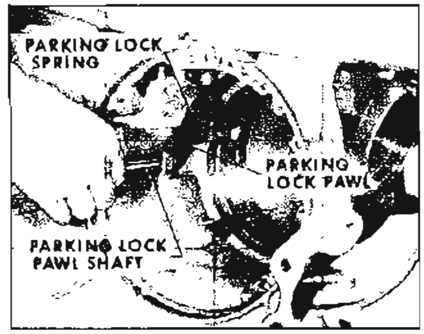



Figure 5-276

2. Retain parking lock pawl and spring in case with parking lock pawl shaft. See Figure 5-276.

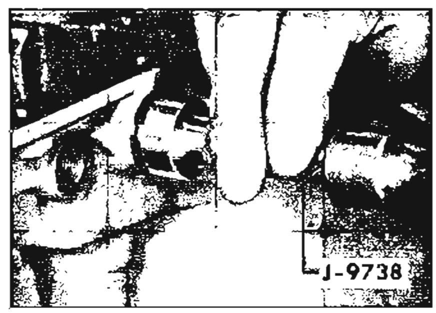



Figure 5-277

NOTE: Make certain parking pawl shaft is bottomed in its bore in case.

3. Install outer shift lever seal using J-9738. Make certain lip of

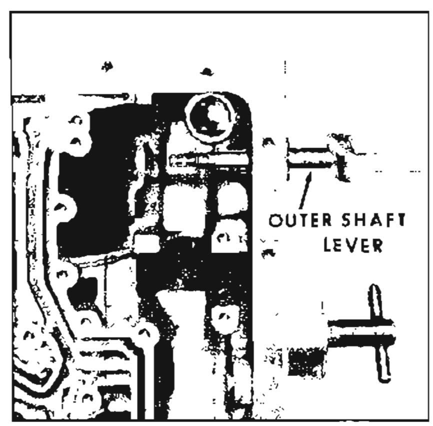



Figure 5-278

seal points toward center of case. See Figure 5-277.

4. With a twisting motion insert outer range selector lever into case. See Figure 5-278.

5. Assemble park lock actuator assembly to inner park lock and range selector. See Figure 5-280.

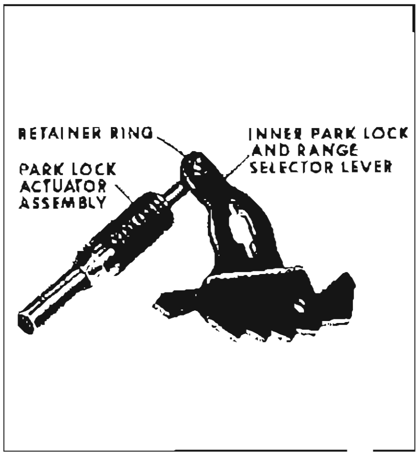



Figure 5-280

6. Install outer range selector lever to selector lever shaft.

7. Install inner park lock and range selector assembly to outer range selector lever. Install nut on range selector lever. See Figure 5-281.

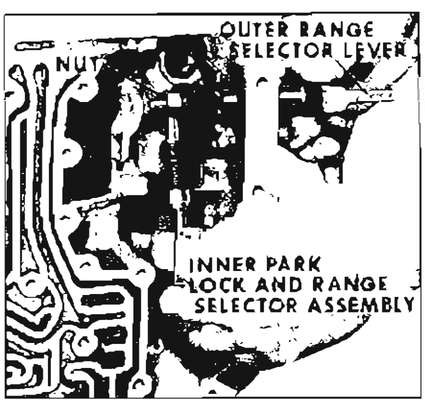



Figure 5-281

NOTE: Make certain longest end on range selector lever is to the bottom of transmission.

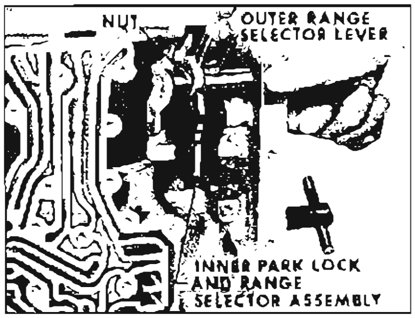



Figure 5-282

8. Slide outer range selector lever into case and tighten nut using a 9/16" wrench. See Figure 5-282.

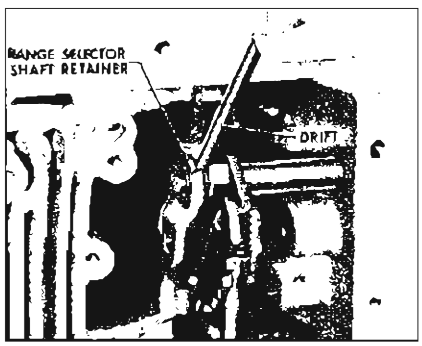



Figure 5-283

9. Install range selector shaft retainer. See Figure 5-283.

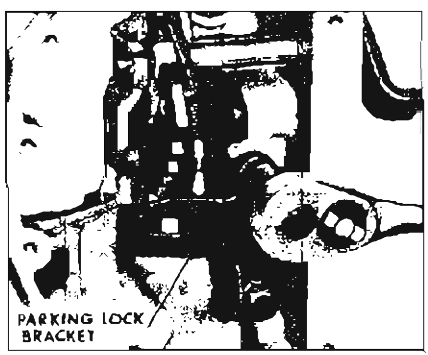



Figure 5-284

10. Install parking bracket to transmission case. Torque bolts to 8-12 ft. lbs. torque. See Figure 5-284.

11. If outer range selector lever was removed install nut torque to 20-30 ft. lbs.

**c. Installing Reverse Clutch**

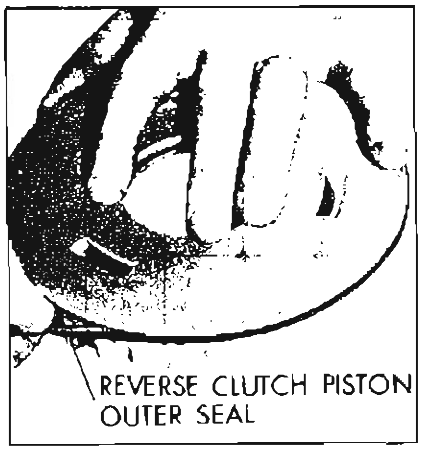



Figure 5-285

1. Lubricate with transmission oil and install reverse clutch piston outer seal. See Figure 5-285.

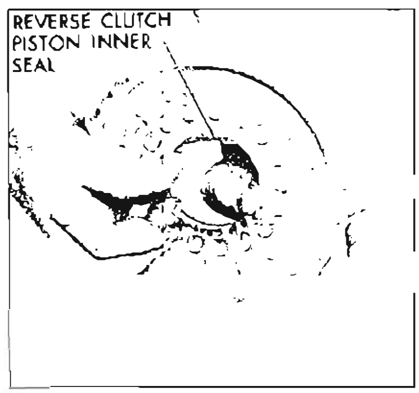



Figure 5-286

2. Lubricate with transmission oil and install reverse clutch piston inner seal. See Figure 5-286.

3. With transmission in vertical position install the reverse clutch piston into case. Tap piston with hammer handle to make certain piston is seated in case. See Figure 5-287.

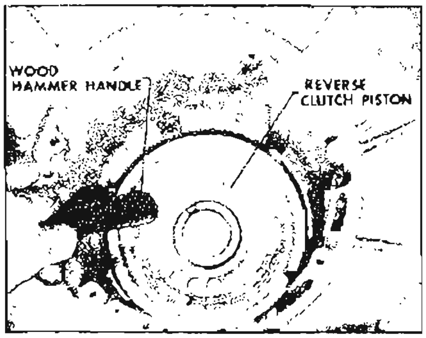



Figure 5-287

4. Install seventeen (17) clutch piston return springs. See Figure 5-290.

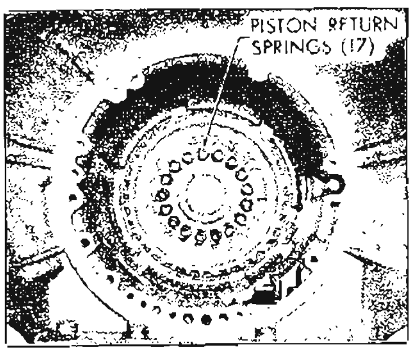



Figure 5-290

5. Position piston return seat on piston return springs. Place snap ring on return seat so that ring may be easily installed when seat is compressed with tool. See Figure 5-291.

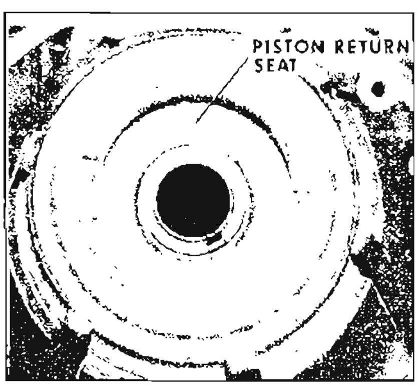



Figure 5-291

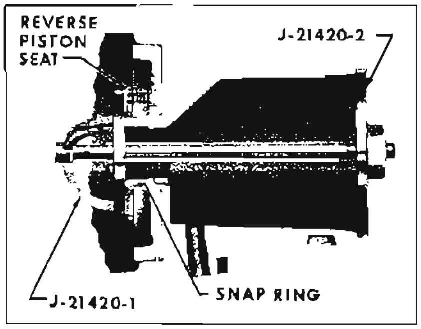



Figure 5-292

6. Using J-21420-1 and J-21420-2 compress piston return seat so snap ring may be installed with J-5586 Pliers. See Figure 5-292.

CAUTION: Make certain inner edge of seat does not hang up on snap ring groove while being compressed.

7. Install reverse clutch cushion spring. See Figure 5-293.

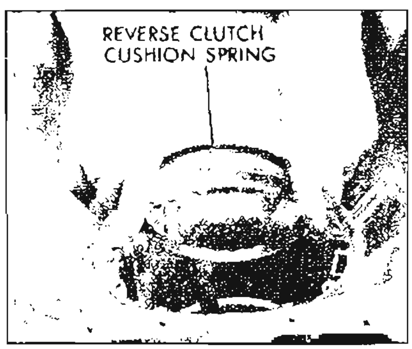



Figure 5-293

8. Align notches on the steel driven plates. Install the steel driven plates and lined drive plates alternately, beginning with a steel driven plate. The notched lug on each driven plate goes in the 5 o'clock groove in case. See Figure 5-294.

CAUTION: Steel plates are waved and should all face same direction. For this reason notches are provided to indicate correct installation.

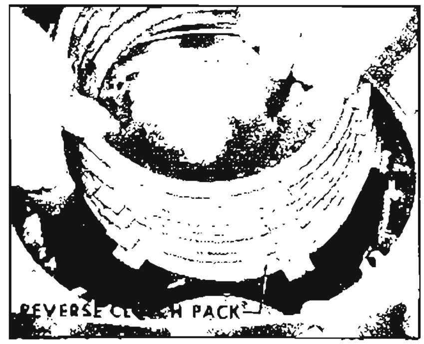


Figure 5-294

NOTE: Cars equipped with V-6 engines have 4 driven and 4 drive clutch plates. Cars equipped with V-8 engine have 5 driven and 5 drive clutch plates.

9. Install reverse clutch pressure plate with the identification mark being installed in the 5 o'clock groove in case. See Figure 5-295.

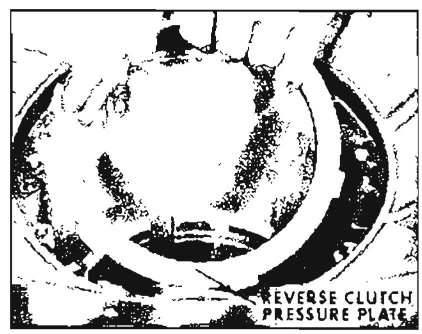



Figure 5-295

10. Install reverse clutch pack snap ring. See Figure 5-296.

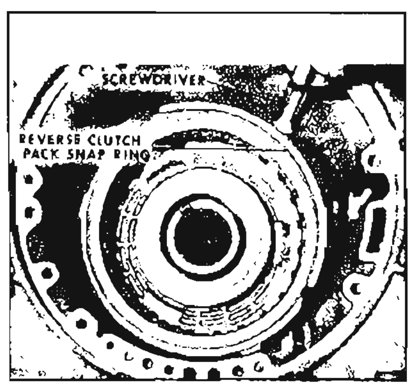



Figure 5-296

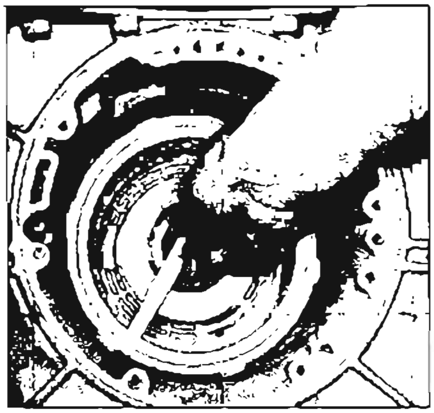


Figure 5-297

11. Insert feeler gauge between reaction plate and adjacent faced plate. See Figure 5-297. Clearance for the reaction plates are shown below:

Three selective plates are released for service. These plates are identified with one, two or three identification marks. Plates are graduated in size with one identification mark being the smallest. The clearance should be .020" - .058".

**d. Installing Planetary Gear Set**

1. Install thrust bearing race with a lip, needle bearing, and a second plain thrust bearing race to the rear face of the planetary gear set. Retain with grease. See Figure 5-298.

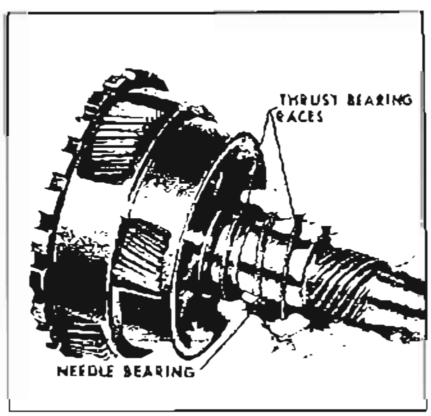



Figure 5-298

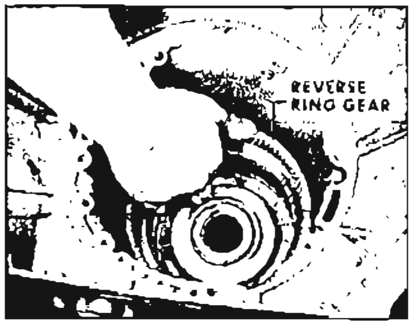



Figure 5-300

2. Install reverse ring gear into case. Rock and turn ring gear to pick up clutch plate splines. See Figure 5-300.

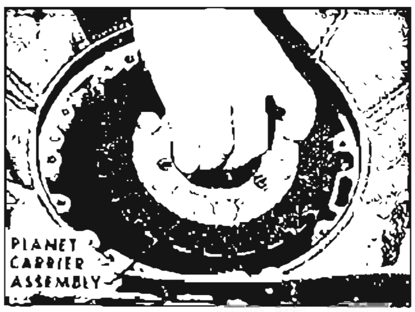



Figure 5-301

3. Install planetary gear set into case. See Figure 5-301.

## 5-24 INSTALLATION OF LOW SERVO ASSEMBLY, LOW BAND, AND FORWARD CLUTCH

**a. Installation of Low Servo**

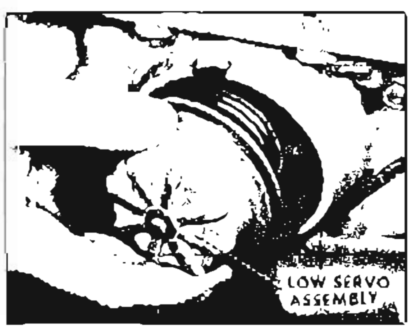



Figure 5-302

1. Install low servo piston assembly into case. See Figure 5-302.

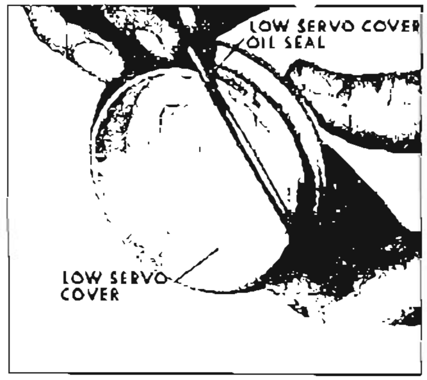



Figure 5-303

2. Install low servo cover oil seal. See Figure 5-303.


Figure 5-304

3. Install low servo cover to case. See Figure 5-304.

4. Compress low servo cover with J-21495 and install retaining snap ring. See Figure 5-305.

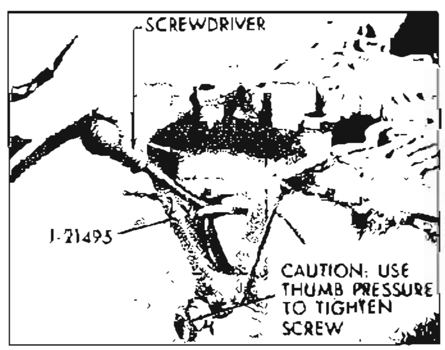



Figure 5-305

### b. Installation of Low Band

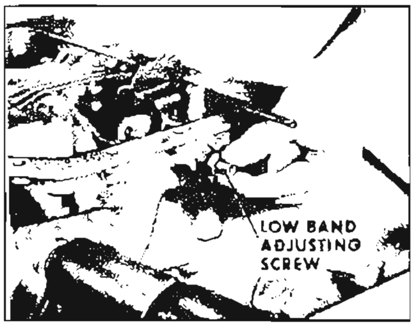



Figure 5-306

1. With transmission in vertical position install band adjusting screw into case. See Figure 5-306.

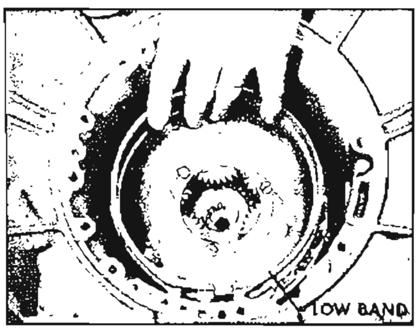



Figure 5-307

2. Install low band into case. See Figure 5-307,

3. This picture is for illustration purposes only. It shows the proper positioning of the low band apply strut and band adjusting screw anchor strut. See Figure 5-310.

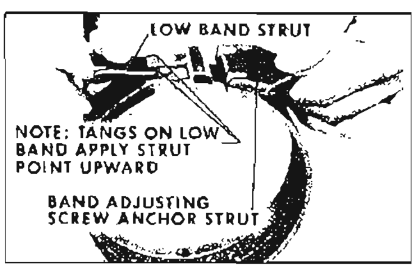



Figure 5-310

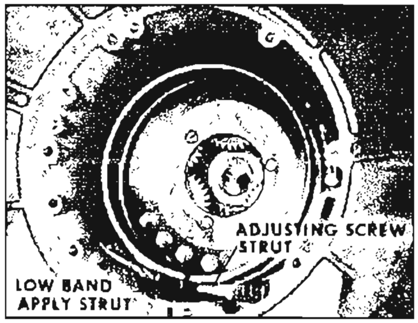



Figure 5-311

4. Install low band apply strut and band adjusting screw strut. After both struts have been installed, tighten low band adjusting screw enough to prevent struts from falling out. See Figure 5-311.

### c. Installing the Forward Clutch Assembly

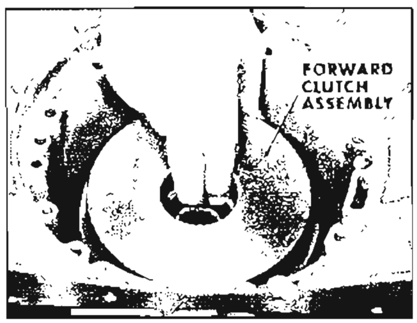



Figure 5-312

1. Install forward clutch assembly turning slightly to engage low sun gear with planet pinions. See Figure 5-312.

### d. Check Forward Clutch to Oil Pump Clearance

1. Attach slide hammer bolt to threaded hole in oil pump. With flat of hand on end of input shaft move so parts are clear back. Install dial indicator set on rod and "O" dial indicator on end of input shaft. Push on end of output shaft to move everything forward, the reading obtained will be the

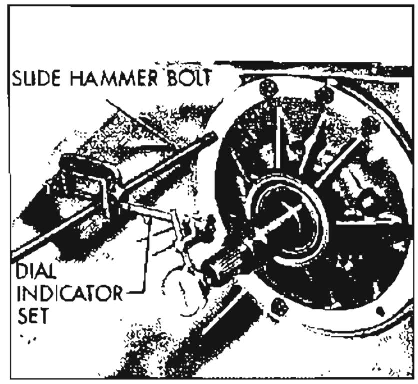



Figure 5-313

clearance. There are three selective thrust washers available, .099/.095, .081/.077 and .063/.059. Select end washer so the clearance will be between .022" and .054". See Figure 5-313.

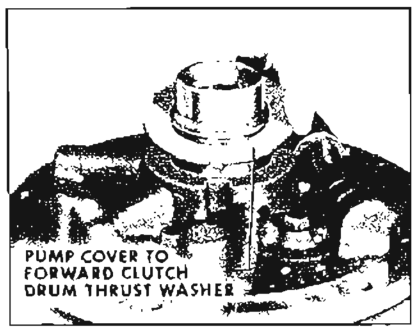



Figure 5-314

2. Grease and install selective fit washer to pump cover hub. See Figure 5-314.

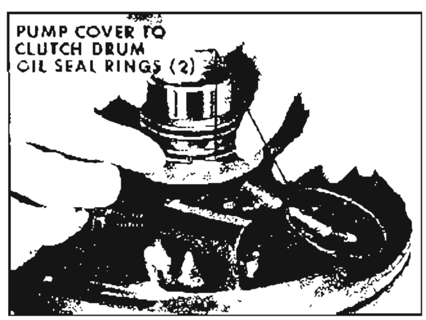



Figure 5-315

3. Install two (2) pump cover to clutch drum oil sealing rings. See Figure 5-315.

## 5-25 INSTALLATION OF OIL PUMP GUIDE PIN, GASKET AND OIL PUMP ASSEMBLY

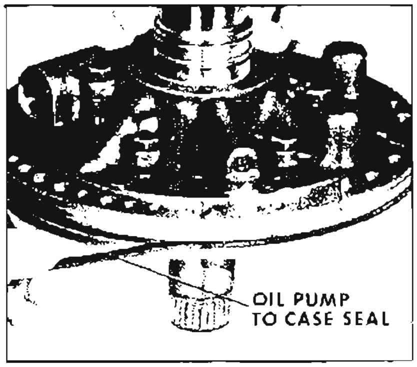



Figure 5-316

1. Install oil pump to case seal. See Figure 5-316.

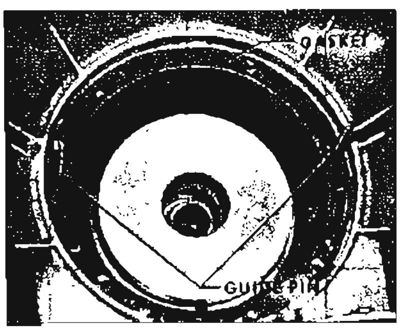


Figure 5-317

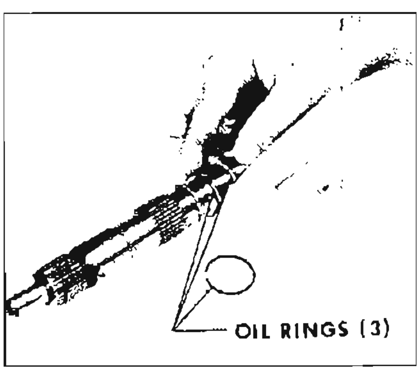



Figure 5-318

2. Install new pump gasket and guide pins. See Figure 5-317.

3. Install input shaft oil rings. See Figure 5-318.

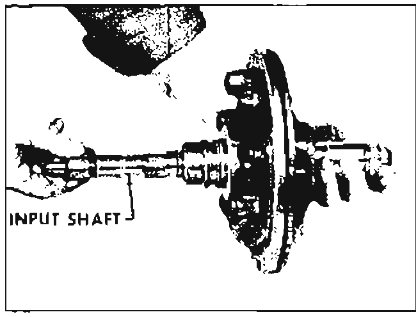



Figure 5-320

4. Coat input shaft oil rings with oil and install into oil pump. Then install pump into case. Apply a thin coat of oil around edge of pump. See Figure 5-320.

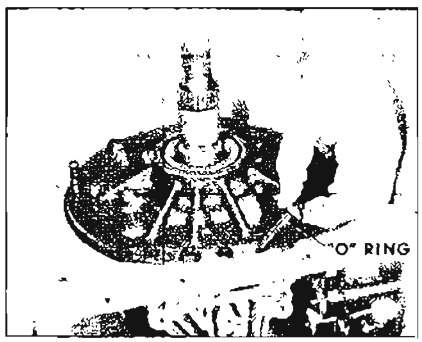



Figure 5-321

5. Remove guide pins and install eight (8) retaining bolts (with new "O" rings under head). See Figure 5-321.

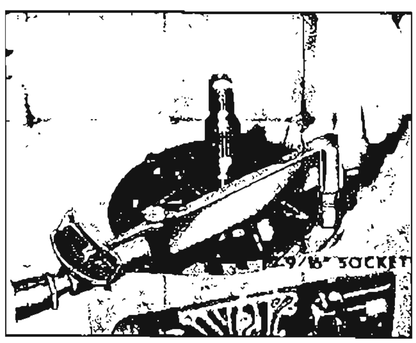



Figure 5-322

6. Torque the eight (8) pump retaining bolts to 16-24 ft. lbs. See Figure 5-322.

## 5-26 LOW BAND ADJUSTMENT

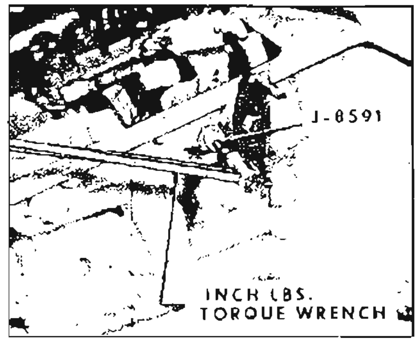



Figure 5-323

1. Adjust low band by first tightening adjusting screw to 40 in. lbs. torque. See Figure 5-323.

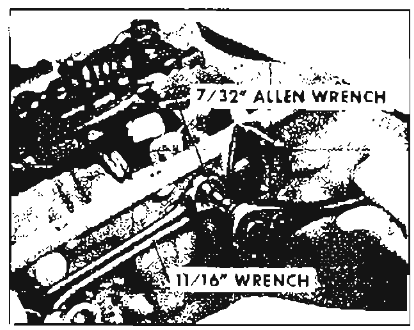



Figure 5-324

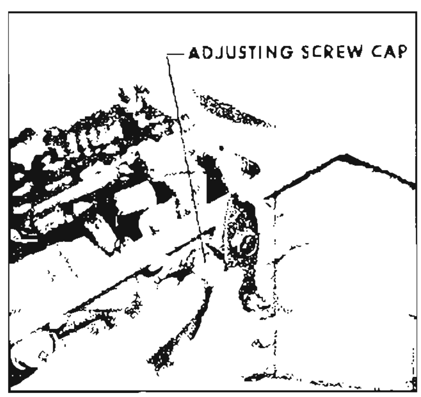



Figure 5-325

2. Back off band adjusting screw four (4) turns and lock nut. See Figure 5-324.

3. Install adjusting screw, cap. See Figure 5-325.

## 5-27 INSTALLATION OF SPEEDOMETER DRIVING GEAR

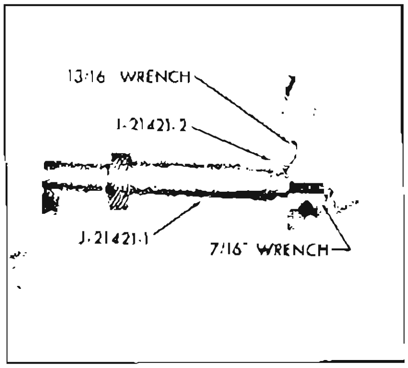



Figure 5-326

1. With transmission in a horizontal position install speedometer driving gear. Place transmission in Park range. Using Tools J-21421-1 and J-21421-2 drive speedometer driving worm gear onto output shaft. Drive gear on until J-21421-2 bottoms on end of output shaft. When tool bottoms speedometer driving gear is in proper location. See Figure 5-326. When installing speedometer driven gear on "55" and "65" Style wagons use Detail J-21421-3 instead of J-21421-1.

## 5-28 INSTALLATION OF REAR BEARING RETAINER BUSHING, OIL SEAL, BEARING RETAINER AND SPEEDO DRIVEN GEAR

### a. Installation of Rear Bearing Retainer Bushing

1. Using Drive Handle J-8092 and Installer J-21424-1 install rear

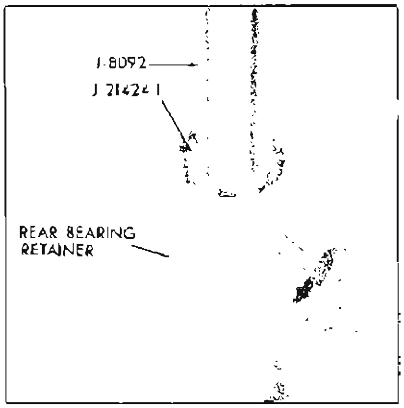



Figure 5-327

bearing retainer bushing. See Figure 5-327.

### b. Installation of Output Shaft to Rear Bearing Retainer Oil Seal

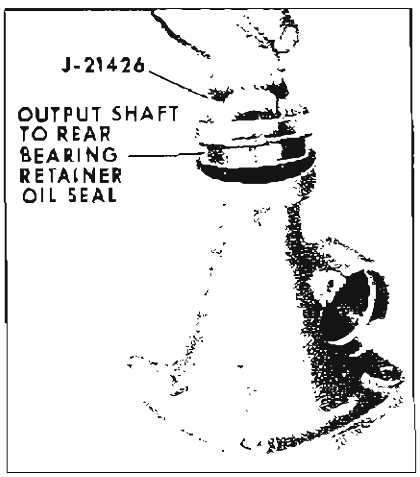



Figure 5-328

1. Install output shaft to rear bearing retainer oil seal using Installer J-21426. See Figure 5-328.

### c. Installation of Rear Bearing Retainer

1. Install rear bearing retainer oil seal. See Figure 5-330.

2. Install rear bearing retainer to case and install four (4) retaining bolts, using a 9/16" socket.

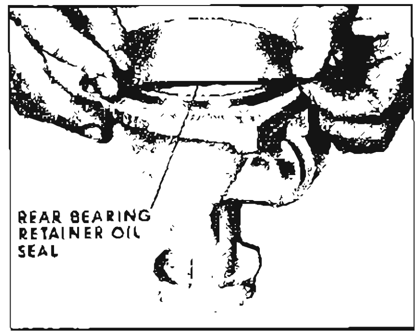



Figure 5-330

Torque bolts to 25-35 ft. lbs. torque. See Figure 5-331.

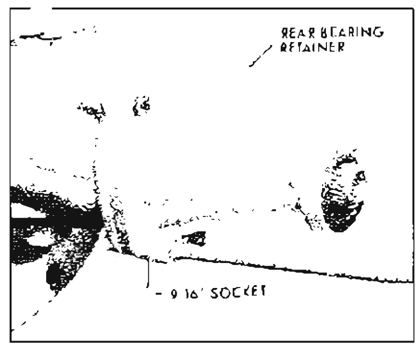



Figure 5-331

### d. Installing Speedometer Driven Gear Assembly

1. Install speedo driven gear assembly into rear bearing retainer. See Figure 5-332.


Figure 5-332

2. Install speedometer driven gear sleeve retainer. Torque bolt

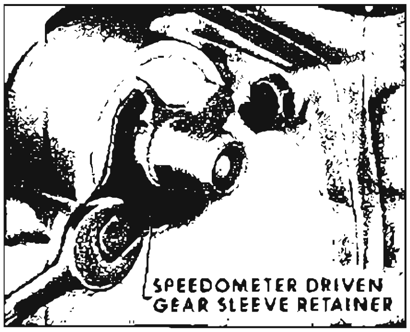



Figure 5-333

to 5-10 ft. lb. torque. See Figure 5-333.

## 5-29 INSTALLATION OF VALVE BODY

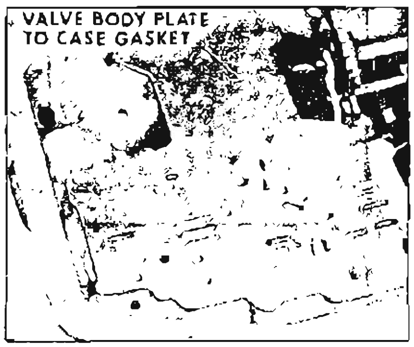



Figure 5-334

1. With transmission in horizontal position, install valve body to plate gasket. See Figure 5-334.

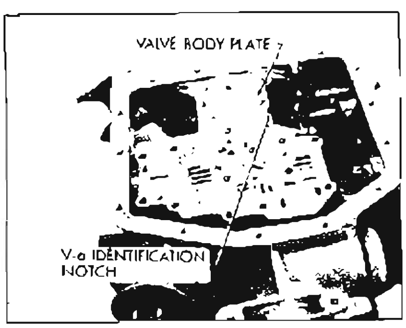



Figure 5-335

2. Install valve body plate.

NOTE: V-6 valve body plate have identification notch. See Figure 5-120.

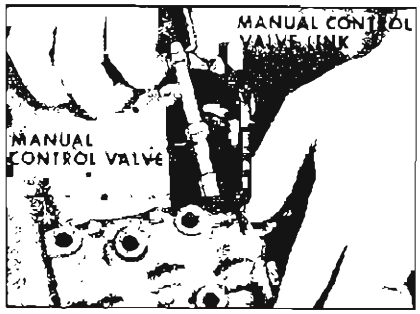



Figure 5-336

3. Install manual control valve and link into valve body assembly. See Figure 5-336.

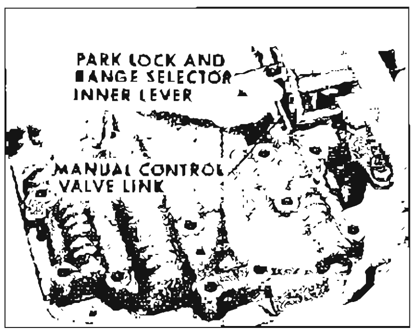



Figure 5-337

4. Install manual control valve link into park, lock and range selector inner lever. See Figure 5-337.

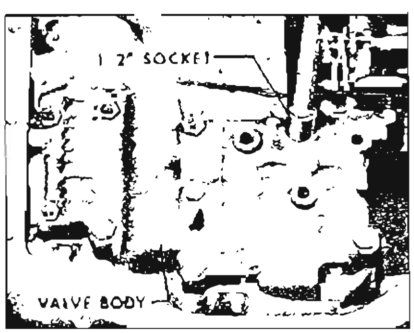



Figure 5-338

5. Install eleven (11) valve body to case retaining bolts. Torque bolts to 8-11 ft. lbs. See Figure 5-338.

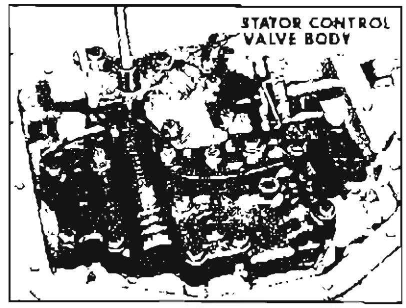



Figure 5-340

6. Install stator control valve body and seven (7) bolts retaining the stator control valve body. Torque bolts to 8-12 ft. lbs. See Figure 5-340.

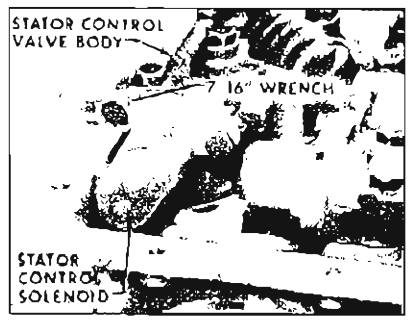



Figure 5-341

7. Install stator control solenoid and gasket to stator control valve body. Torque bolts to 8-12 ft. lbs. See Figure 5-341.

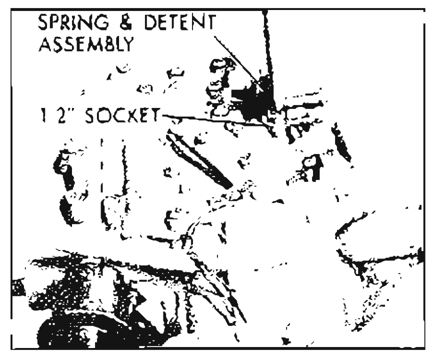



Figure 5-342

8. Before installing spring detent assembly note routing of solenoid wires. Install spring detent assembly. Torque bolt to 8-12

ft. lbs. Center spring over detent plate. See Figure 5-342.


Figure 5-343

9. Install solenoid switch into case. See Figure 5-343.

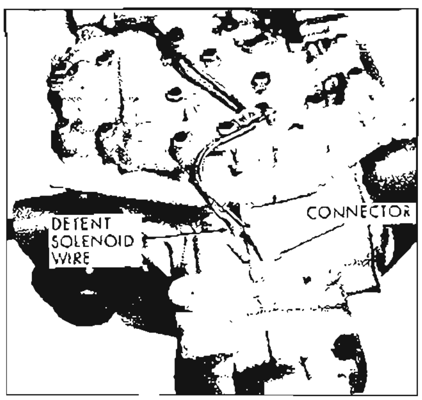



Figure 5-344

10. Install detent solenoid wire to connector. See Figure 5-344.

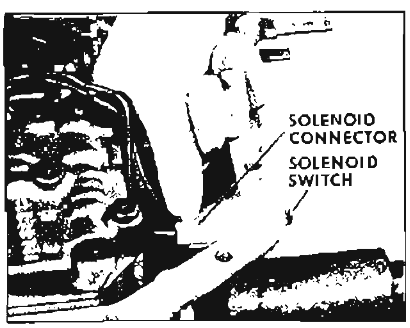



Figure 5-345

11. Install solenoid connector to solenoid switch. See Figure 5-345.

12. Install oil strainer pipe to case seal.

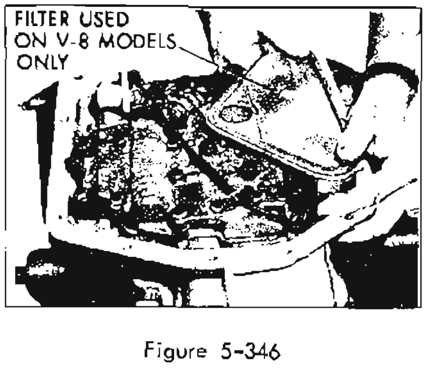



Figure 5-346

13. Install oil filter on V-8 models. See Figure 5-346.

14. Install oil strainer on V-6 models. See Figure 5-347.

15. Install oil pan gasket and pan. See Figure 5-348.

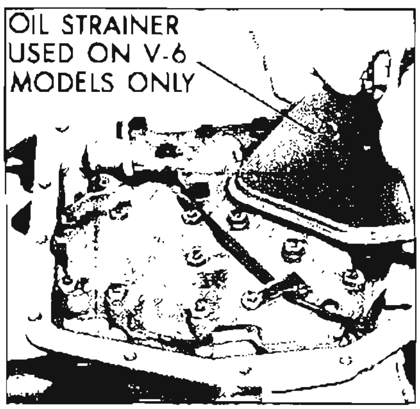



Figure 5-347

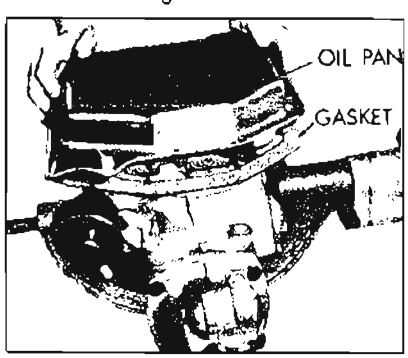



Figure 5-348

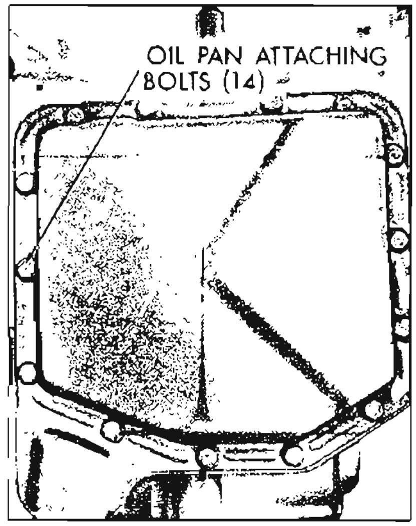



Figure 5-350

16. Install fourteen (14) oil pan attaching bolts. Torque bolts to 10-12 ft. lbs. See Figure 5-350.

## 5-30 INSTALLATION OF GOVERNOR AND VACUUM MODULATOR

### a. Installation of Governor

1. Slide governor into its bore in case. Turn governor assembly so teeth on governor gear engage teeth on output shaft. See Figure 5-351.


Figure 5-351

2. Install governor gasket and cover to case. Torque bolts to 8-12 ft. lbs. See Figure 5-352.

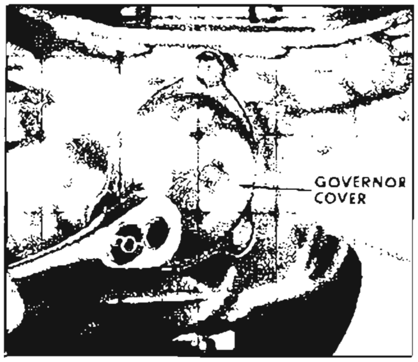



Figure 5-352

## b. Installation of Vacuum Modulator

1. Slide rear modulator valve into front modulator valve then install into bore in case. See Figure 5-353.

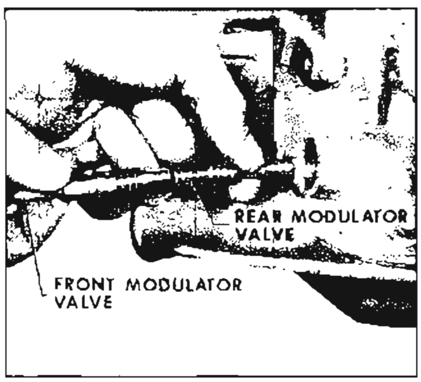



Figure 5-353

2. Install case to vacuum modulator oil seal. Install modulator into case. See Figure 5-354.

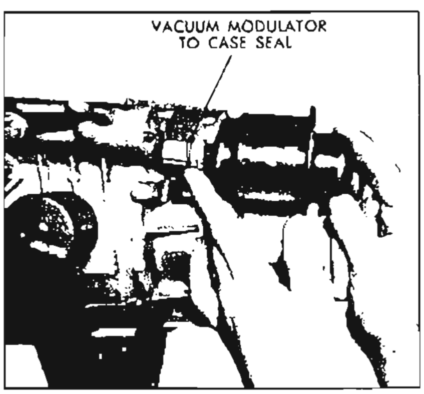



Figure 5-354

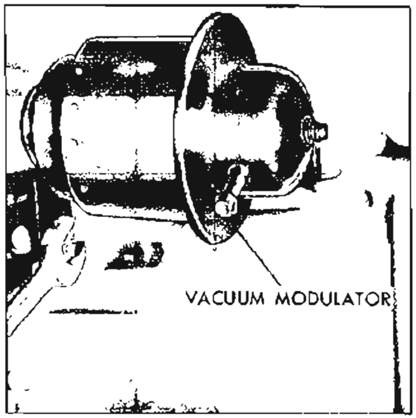



Figure 5-355

NOTE: V-6 vacuum modulators have a brown daub of paint for identification. V-8 has no paint identification.

3. Install vacuum modulator retainer. Install retainer so tang points toward vacuum modulator. Torque bolt to 8-12 ft. lbs. See Figure 5-355.

## 5-31 CHECKING CONVERTER

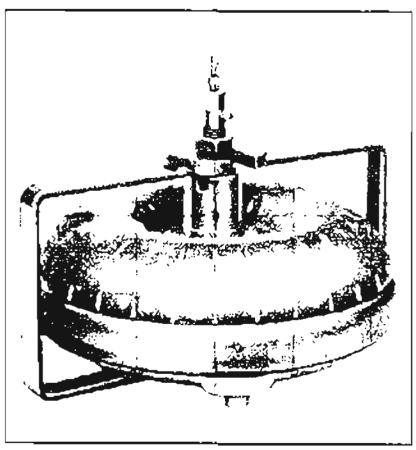


Figure 5-356

1. Check converter for leaks as follows:

a. Install Tool J-21369 and tighten. See Figure 5-356.

b. Fill converter with air; 80 psi.

c. Submerge in water and check for leaks.

2. Check converter end clearance as follows:

a. Install Tool J-21371-2 and tighten brass nut. See Figure 5-357.

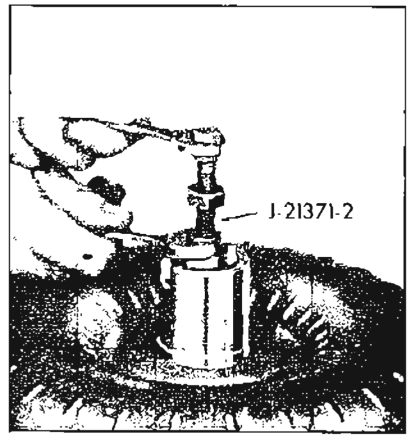



Figure 5-357

b. Install Tool J-21371-3 and tighten hex nut. See Figure 5-358.

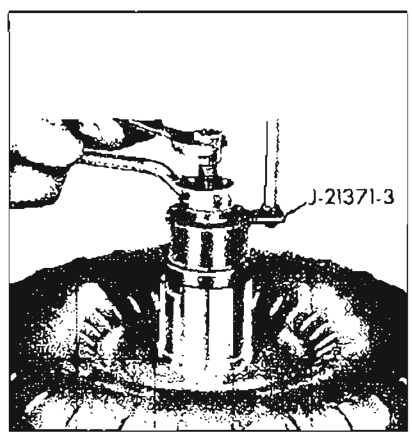



Figure 5-358

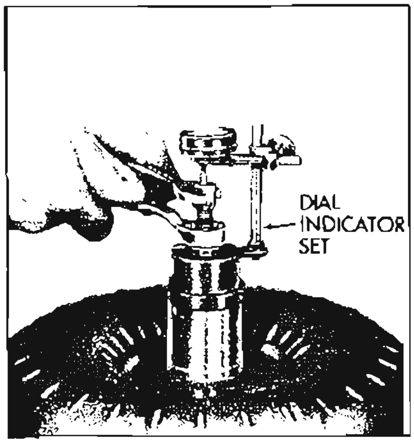



Figure 5-360

c. Install dial indicator set at 0 as shown in Figure 5-365.

d. Loosen hex nut. When nut is fully loosened the reading obtained on the dial indicator will be converter end clearance. If clearance is .050" or over and the oil has the appearance of having been mixed with aluminum paint, replace the converter. See Figure 5-360.

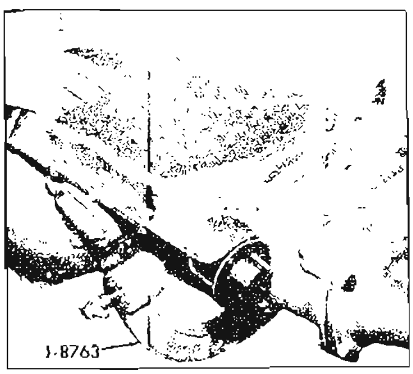



Figure 5-361

3. Install converter. See Figure 5-361.

## 5-32 TROUBLE DIAGNOSIS GUIDE

### a. Oil Check

Before diagnosis of any transmission complaint is attempted, the oil level should be checked. At the same time, it should be observed on the dipstick whether the oil is solid in texture or aerated. Aerated oil gives an indication of an oil leak in the suction line, which can cause erratic operation and slippage. Water in the oil imparts a milky, pink cast to the oil and can cause spewing.

### b. No Drive In Any Selector Position

1. Check oil level.

2. Check oil pressure as described in paragraph 5-33.

3. Check manual shift linkage adjustment. See Section 4A.

4. Check internal linkage. See Figure 5-282.

5. Check for defective pressure regulator valve.

6. Check for pressure regulator valve retaining ring out of groove.

7. Check for defective front pump.

### c. Erratic Operation and Slippage (Light to Medium Acceleration)

1. Check filter or screen and suction pipe assembly for leaks.

2. Check suction pipe "O" ring.

3. Low oil level.

4. Check for defective modulator. See Figure 5-362.

### d. Excessive Slip or Engine Flare on Coasting to A Stop or When Cornering

1. Check engine idle. See paragraph 3-8.

2. Check for suction leak as described in items 1 and 3.

3. Check low band adjustment. See paragraph 5-26.

4. Check for proper modulator can assembly. See chart on page 5-1.

5. In severe customer complaints, proceed as follows:

a. Remove transmission from car.

b. Check pump cover and stator shaft for cross leakage. See Figure 5-363.

c. Remove coast downshift timing valve. See Figure 5-205.

### e. Transmission Sluggish From A Standing Start

1. Check idle stator switch. See Figure 5-38.

2. Check stator valve body including valve and solenoid. See Figure 5-371.

### f. No Reverse

1. Check reverse clutch piston seals.

2. Check freedom of reverse clutch piston.

3. Check for open feed lines to reverse clutch. See Figures 5-364 thru 5-372.

4. Loose stator valve body attaching bolts. Specification is 8-12 ft. lbs.

### g. Slips (In Any Range)

1. Refer to items 3 and 20.

### h. Harsh Neutral To Drive Shift At Idle

1. Check vacuum line connections.

2. Check engine idle speed. See paragraph 3-8.

3. Check for three (3) springs in the low servo assembly or improper assembly of washers. See Figure 5-179.

4. Check to see if center spring of low servo assembly has end coils ground.

5. Check for broken engine mounts.

**i. No Upshift**

1. Check vacuum line connections.

2. Check governor for failed pinion or stuck valve.

3. Check freedom of shift valve and detent valve.

4. Check for plugged orfice in detent valve.

5. Check for open detent solenoid and loose attaching bolts.

6. Check for plug in front pump cover assembly. See Figure 5-373.

7. Check clutch piston seals.

8. Check for broken clutch piston oil seal rings.

9. Check clutch lines in front pump cover and stator shaft assembly. See Figure 5-366.

**j. Long Shift Time—Shift Does Not Have Positive Engagement**

1. Check for proper modulator can assembly. See chart on page 5-1.

2. Check for leak in clutch circuit. See Figures 5-364 thru 5-372.

3. Check valve body port between modulator boost and clutch feed in shift valve bore. See Figure 5-372.

4. If foreign material in oil pan indicates a clutch failure, replace clutch plates and necessary parts.

**k. Engine Flares On Upshift**

1. Refer to item 19.

**l. Late Upshift**

1. Check vacuum line connections.

2. Stuck detent valve.*

3. Open detent solenoid or loose solenoid attaching bolts.*

4. Sticky shift valve.

5. Check governor assembly. See paragraph 5-21.

*Transmission will upshift only at wide-open throttle.

**m. Upshifts-Downshifts Erratic**

1. Refer to paragraph 5-21.

2. Refer to item (3).

3. Check for crossed solenoid wires. See Figure 5-374.

**n. No Wide Open Throttle Downshift**

1. Check detent control switch adjustment and continuity in wiring. (Wiring fused with windshield wiper.)

2. Check for stuck detent valve and shift valves. See Figure 5-32.

3. Check orfice hole in detent valve.

4. Check solenoid on valve body.

**o. Engine Flares On Wide Open Throttle Downshift**

1. Check low band adjustment. See paragraph 5-26.

2. Check item 20.

3. Check for restriction in vacuum line or fitting to transmission.

4. Check for correct valve body plate. See Figures 5-118 and 5-120.

**p. Delayed Engagement Of Manual Low**

1. Check freedom of 2-piece modulator valve.

**q. No Stator Action**

1. Check stator idle and detent control switch adjustments and wiring.

2. Check stator solenoid and stator valve body.

3. Check stator bushings for excessive wear and scoring.

4. Check reaction shaft bushing for extreme wear and scoring.

5. Check front oil seal ring on input shaft. See Figure 5-129.

**r. Oil Spews Out Breather**

1. High oil level.

2. Water in oil.

3. Chip or burr between pump cover and housing or between complete pump assembly and case.

4. Direct leak from front pump pressure line into vent chamber. See Figure 5-

**s. Drive Clutch Plates Burned (Usually Low Band and Reverse Clutch Good)**

1. Check for leakage in clutch circuit. See Figures 5-364 thru 5-372.

a. Check ball in forward clutch drum.

b. Clutch lines in front pump cover and stator shaft assembly. See Figure 5-366.

c. Plug in pump cover assembly missing. See Figure 5-373.

d. Clutch piston seals.

e. Clutch feed oil rings.

f. Check for proper number of clutch plates and correct piston. See chart on page 5-1.

**t. Drive Clutch Plates, Low Band and Reverse Clutch Plates—All Burned**

1. Check for following causes of

low maximum line pressue.

a. Modulator can load check. See Figure 5-362.

b. Check for proper modulator can. See chart on page 5-1.

c. Check modulator valve and bore in case for freedom of movement.

d. Check freedom of boost valve in front pump regulator.

2. Valve body bolts loose. Torque specification is 8-12 ft. lbs.

3. Low oil level.

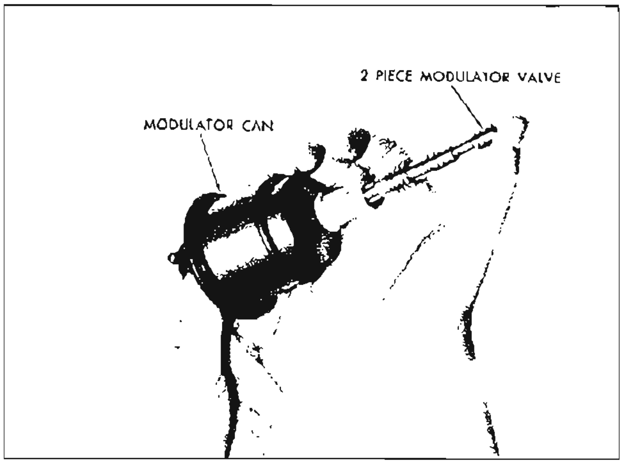



Figure 5-362—Checking Modulator Can Assembly

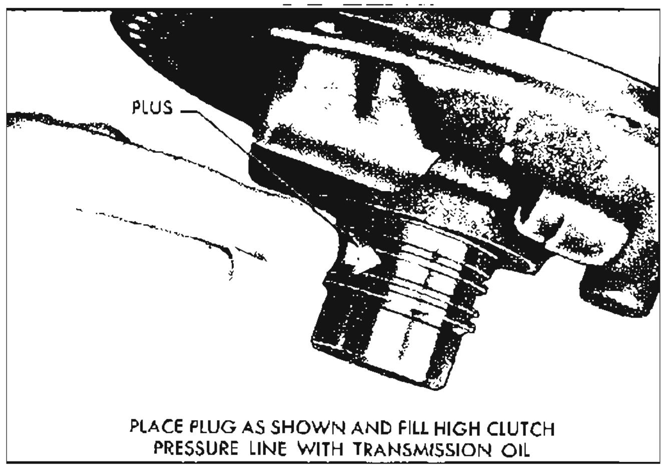



Figure 5-363—Checking Cross Leakage Between Pump Cover and stator shaft

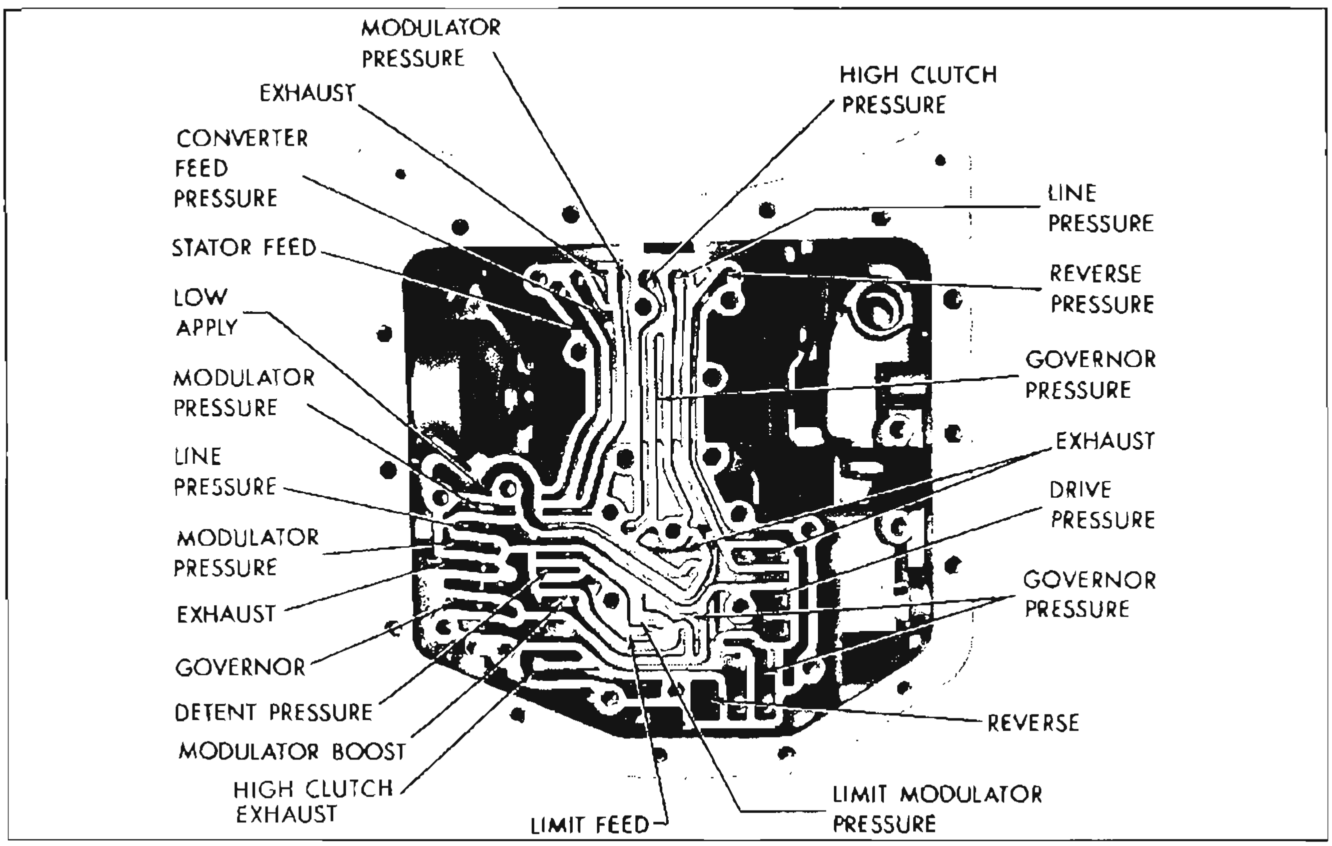
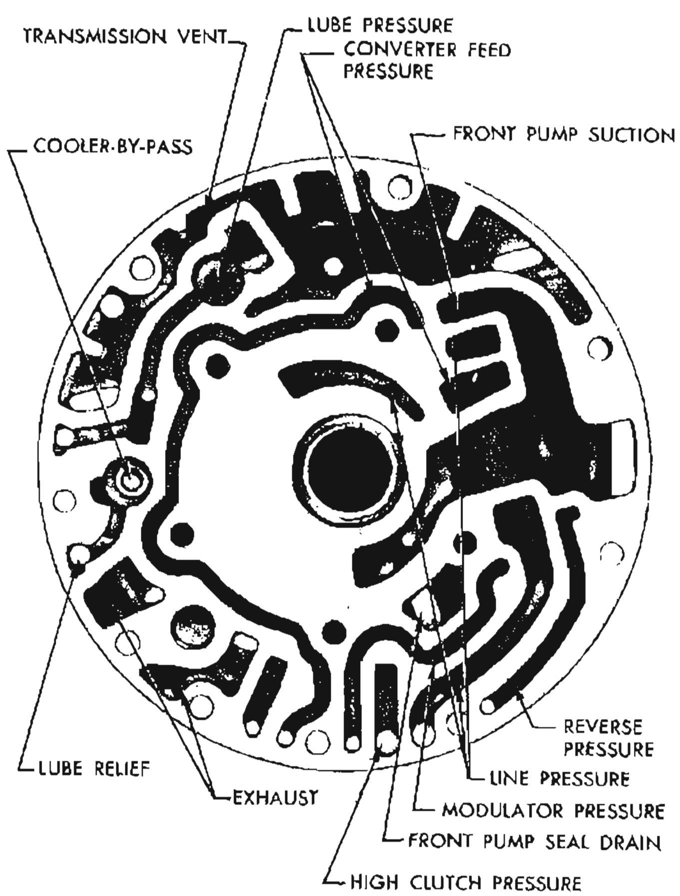



Figure 5-364—Oil, Passages in Bottom of Transmission Case




Figures 5-366—Oil Passages in Pump Cover

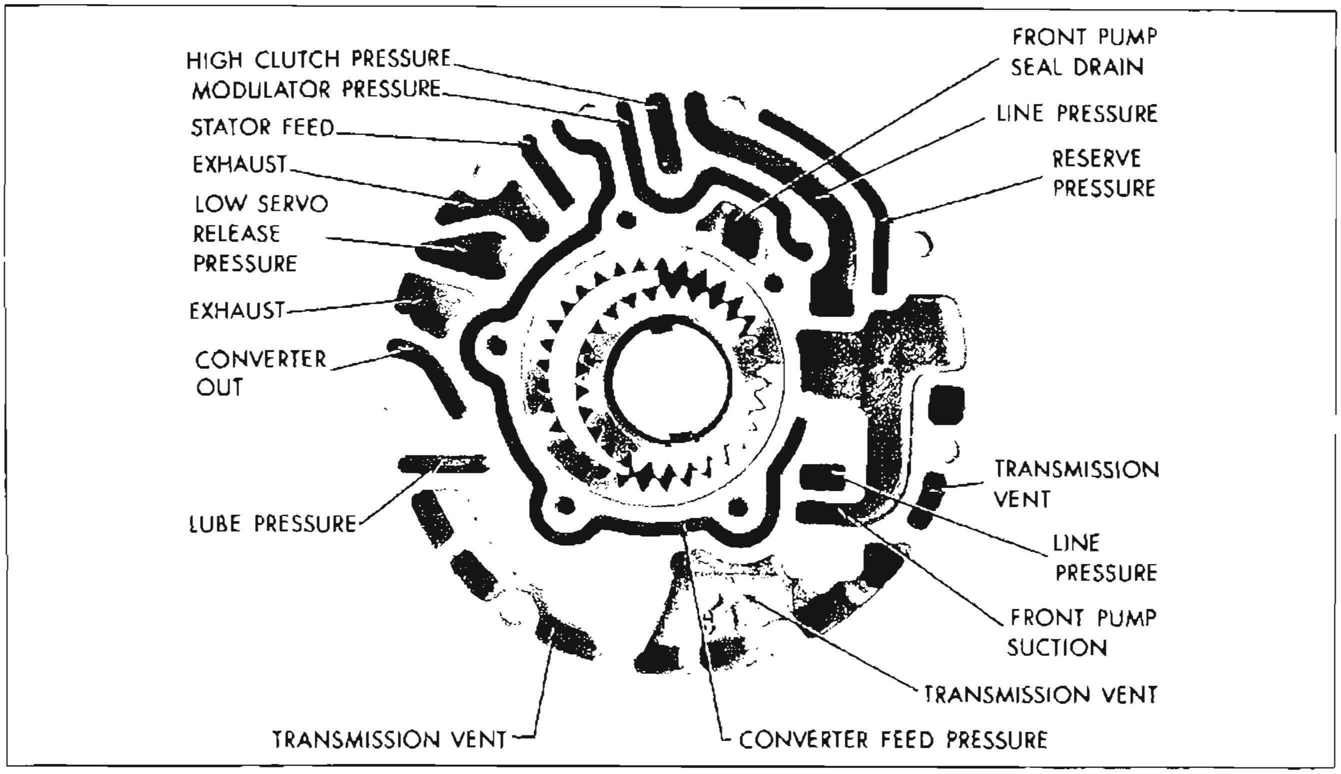



Figure 5-367—Oil Passages in Pump Body

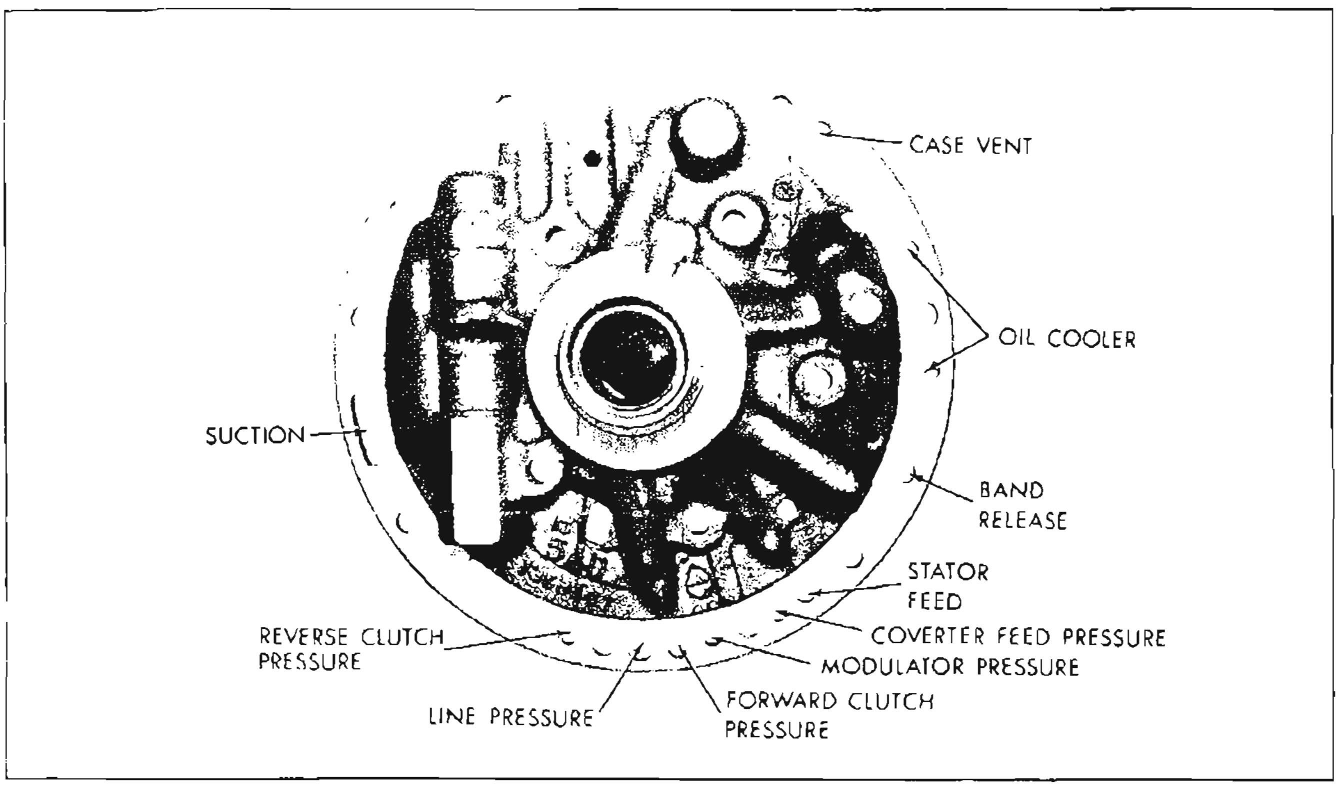



Figure 5-368—Oil Passages in Rear Face of Pump Cover

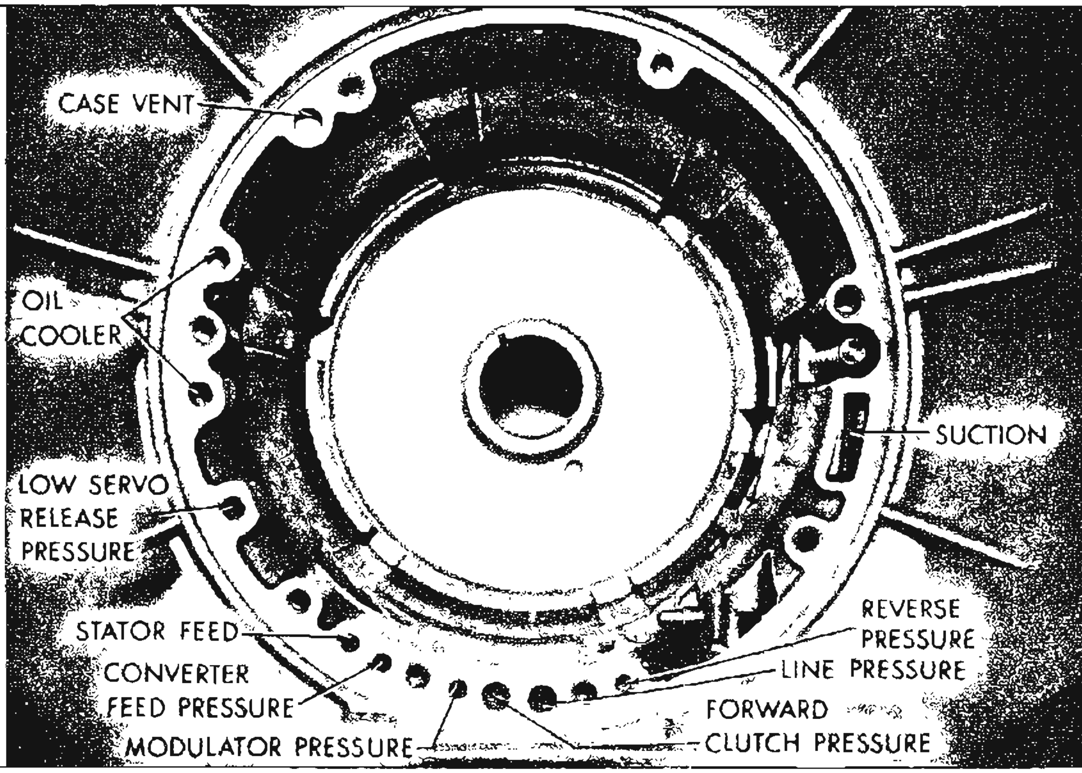



Figure 5-370—Oil Passages in Front Transmission Case

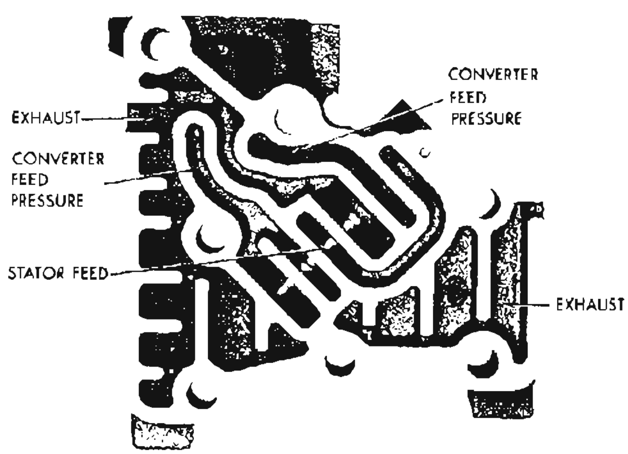



Figure 5-371—Oil Passages in Stator Valve Body

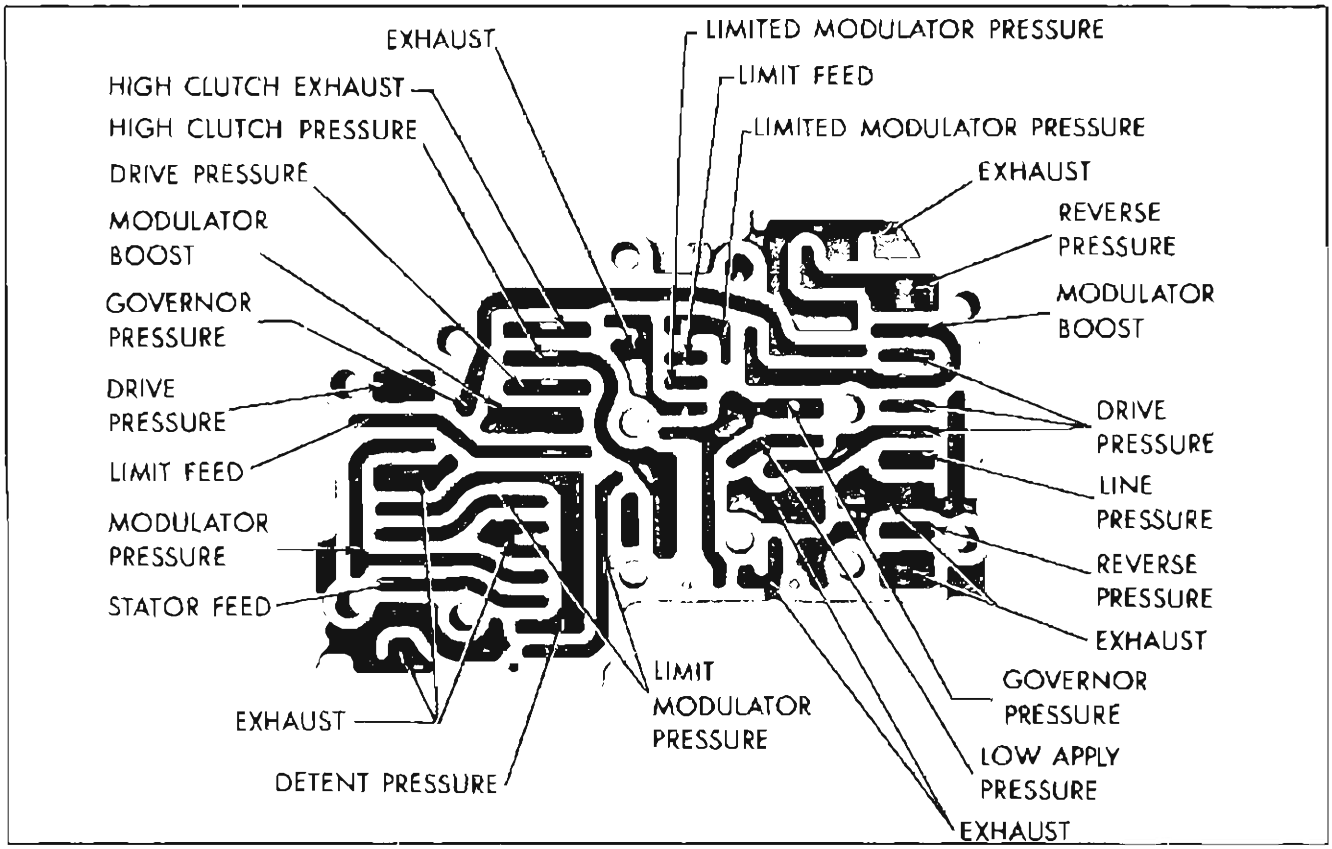



Figure 5-372—Oil Passages in Main Valve Body

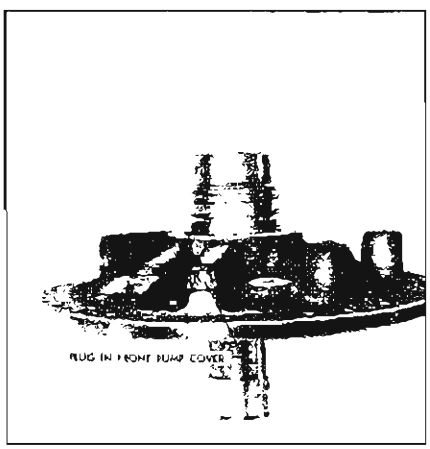



Figure 5-373—Checking for Plug in Front Pump Cover

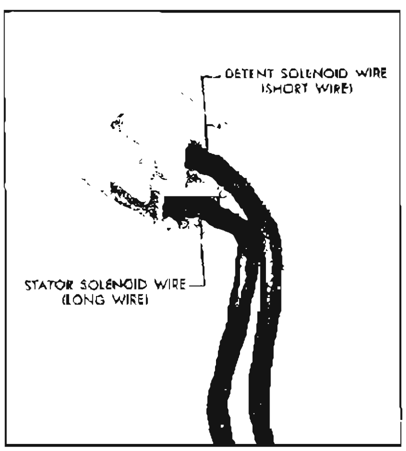



Figure 5-374—Location of Solenoid Wires

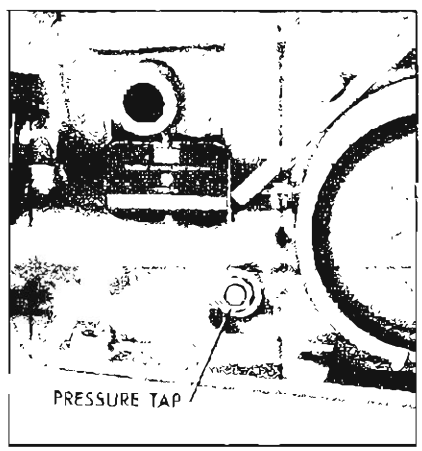



Figure 5-375—Super Turbine "300" Transmission Pressure Checks

## 5-33 OIL PRESSURE CHECKS

SUPER TURBINE "300"
TRANSMISSION PRESSURE CHECKS

MAXIMUM MAIN LINE PRESSURE CHECKS are to be made in the garage bay with the vacuum modulator line disconnected and plugged. The engine speed set at 1000 RPM.

| ALTITUDE | Barometric Pressure (in Hg.) at Standard Conditions* | 25 V-6 Vacuum Modulator Part No. 1365186 or 1365187 | | 25 V-6 Vacuum Modulator Part No. 1367031 or 1367032 | | 35 V-8 Vacuum Modulator Part No. 8623364 or 8623365 | |
|---|---|---|---|---|---|---|---|
| | | D and L ±4 PSI | R ±6 PSI | D and L ±4 PSI | R ±6 PSI | D and L ±4 PSI | R ±6 PSI |
| Sea Level | 29.92 | 137 | 213 | 141 | 219 | 149 | 230 |
| 2,000 Ft. | 27.82 | 130 | 202 | 134 | 207 | 142 | 219 |
| 5,000 Ft. | 24.89 | 120 | 186 | 124 | 192 | 131 | 203 |
| 10,000 Ft. | 20.58 | 105 | 163 | 109 | 168 | 117 | 183 |

MINIMUM LINE PRESSURE CHECKS are to be made while road testing car. The vacuum modulator line connected. Engine and/or car speed as shown in note below.**

MINIMUM LINE PRESSURE CHECKS FOR ALL MODELS REGARDLESS OF VACUUM MODULATOR USED. (Pressures not affected by Altitude or Barometric Pressure)

| | |
|---|---|
| Park, Neutral, and Drive | 60 ± 2 PSI |
| Low | 90 ± 4 PSI |
| Reverse | 93 ± 4 PSI |

*Line pressures vary 3.5 PSI for each 1 in. hg. change in Barometric Pressure.
**Minimum line pressure checks to be made as follows:
1. Drive 20-40 mph coast with foot off throttle. Park and Neutral can be checked at 1000 RPM.
2. Low 20-40 mph coast with foot off throttle.
3. Reverse-coast with foot off throttle.

NOTE: PRESSURE TAP IS LOCATED BESIDE THE LOW SERVO COVER. See Figure 5-375.

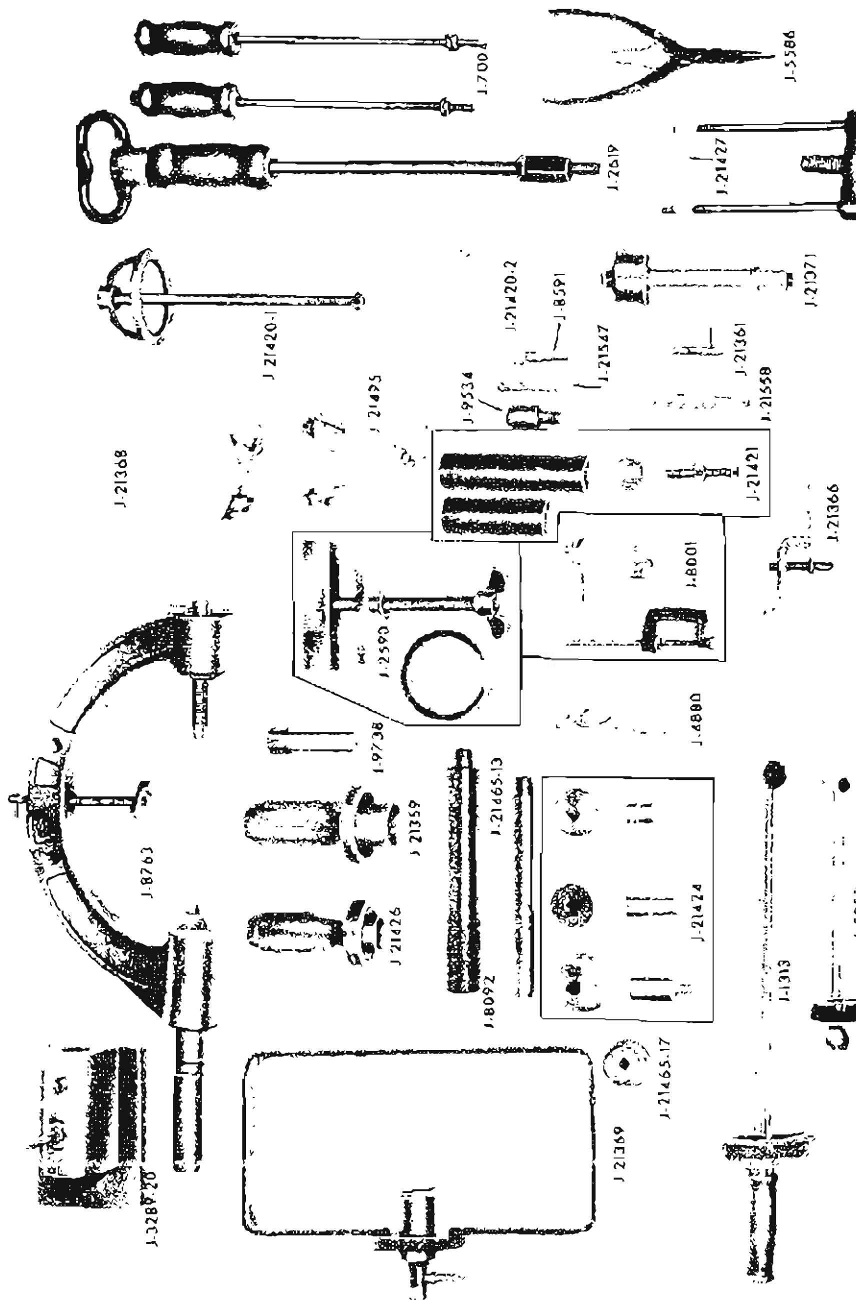



Figure 5-376—Special Tools

| | | |
|---|---|---|
| J-3289-20 | - | HOLDING FIXTURE BASE |
| J-8763 | - | HOLDING FIXTURE |
| J-21368 | - | PUMP BODY TO COVER ALIGNMENT BAND |
| J-21420-1<br>J-21420-2 | - | REVERSE CLUTCH SPRING COMPRESSOR |
| J-21495 | - | LOW SERVO COVER REMOVER AND INSTALLER |
| J-7004 | - | SLIDE HAMMER |
| J-2619 | - | SLIDE HAMMER |
| J-5586 | - | SNAP RING PLIERS |
| J-9578 | - | SPEEDO GEAR REMOVER |
| J-21371 | - | CONVERTER END PLAY CHECKING FIXTURE |
| J-21361 | - | CHECK VALVE SEAT REMOVER |
| J-21558 | - | CHECK VALVE SEAT INSTALLER |
| J-21547 | - | MODULATOR LIMIT VALVE SPRING COMPRESSOR |
| J-9534 | - | PLANET CARRIER BUSHING REMOVER |
| J-21421 | - | SPEEDO GEAR INSTALLER |
| J-8001 | - | DIAL INDICATOR SET |
| J-21366 | - | CONVERTER HOLDING STRAP |
| J-4880 | - | SNAP RING PLIERS |
| J-2590 | - | FORWARD CLUTCH SPRING COMPRESSOR |
| J-9738 | - | OUTER SHIFT LEVER SEAL INSTALLER |
| J-21359 | - | OIL PUMP SEAL INSTALLER |
| J-21426 | - | CASE EXTENSION OIL SEAL INSTALLER |
| J-8093 | - | DRIVE HANDLE |
| J-21424 | - | BUSHING SET |
| J-1313 | - | FT. LB. TORQUE WRENCH |
| J-5853 | - | IN. LB. TORQUE WRENCH |
| J-21369 | - | CONVERTER PRESSURE CHECK FIXTURE |
| J-21465-17 | - | PUMP BODY BUSHING REMOVER AND INSTALLER |

Figure 5-377—Special Tool Identification

# GROUP 6

# REAR AXLE AND PROPELLER SHAFT

## SECTIONS IN GROUP 6



# SECTION 6-A

# REAR AXLE SPECIFICATIONS, DESCRIPTION, TROUBLE DIAGNOSIS

## CONTENTS OF SECTION 6-A



## 6-1 REAR AXLE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed, to insure proper tightening without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

| Part | Location | Thread Size | Torque Ft. Lbs. |
|---|---|---|---|
| Nut | Rear Universal Joint to Pinion Flange | 5/16-18 | 15-18 |
| Bolt | Differential Pinion Shaft Locking Bolt | 5/16 | 20-28 |
| Bolt | Rear Axle Housing Cover to Carrier | 5/16-18 | 25-35 |
| Bolt & Nut | Upper End of Shock Absorber to Rear Suspension Crossmember | 5/16-18 | 12-24 |
| Nut | Brake Assembly to Rear Axle Housing | 3/8 -16 | 45-60 |
| Bolt | Ring Gear to Differential Case | 3/8 -24 | 50-60 |
| Bolt | Bearing Cap to Carrier | 7/16-14 | 40-60 |
| Nut | Rear Wheel to Axle Shaft | 7/16-14 | 55-75 |
| Bolt & Nut | Lower Control Arm to Axle Bracket | 1/2 -13 | 20-30 |
| Bolt & Nut | Upper Control Arm to Frame & Rear Axle Housing | 1/2 -13 | 65-90 |
| Bolt & Nut | Lower Control Arm to Frame Bracket | 1/2 -13 | 65-90 |
| Nut | Lower End of Shock Absorber to Lower Control Arm Axle Bracket | 1/2 -20 | 30-60 |

## b. General Specifications

| Items | All Series |
|---|---|
| Rear Axle Type | Semi-Floating Hypoid |
| Drive and Torque | Through 4 Arms |
| Rear Axle Oil Capacity | 2 pints |
| Ring and Pinion Gear Set Type | Hypoid |
| Pinion Depth Setting | + .0015 from marking on pinion |

## c. Limits for Fitting and Adjusting

| | |
|---|---|
| Pinion Bearing Preload | |
| New Bearings | 20-30 inch lbs. torque with new seal |
| Reused Bearings | 12-20 inch lbs. torque with new seal |
| Ring Gear Position | .007-.009 Backlash |
| Ring Gear Preload | |
| New Bearings | 30-40 inch lbs. torque at ring gear with pinion |
| Reused Bearings | 20-30 inch lbs. torque at ring gear with pinion |

## d. Rear Axle Gear Ratios

Gear ratios are indicated by numbers stamped on the bottom of the right axle tube. See Figure 6-1. The letter designates the axle ratio while the number designates the day of the year that the axle was assembled.

## e. Speedometer Gears

Speedometer gears must correspond with axle ratios and tire sizes in order to have correct speedometer and odometer readings.

# 6-2 DESCRIPTION OF REAR AXLE

The rear axle assembly is of the semi-floating type in which the car weight is carried on the axle shafts through ball bearings enclosed in the outer axle housing tubes. The rear axle is designed for use with an open drive line and coil springs. Drive from the axle housing is transmitted to body members through two lower and two upper control arms. Large rubber bushings at either end of these control arms are designed to absorb vibration and noise. The upper control arms are angle mounted to also hold the body in sidewise alignment with the rear axle assembly. The final drive has a hypoid type ring gear and pinion with the centerline of the pinion below the centerline of the ring gear. See Figure 6-2.

The drive pinion is mounted in two tapered roller bearings which are preloaded by a collapsible spacer during assembly. The pinion is positioned by shims located between a shoulder on the drive pinion and the rear bearing. The front bearing is held in place by a large nut.

The differential is supported in the carrier by two tapered roller side bearings. These are preloaded by inserting shims between the bearings and the pedestals. The differential assembly is positioned for proper gear and pinion back-lash by varying these shims. The ring gear is bolted to the case. The case houses two side gears in mesh with two pinions mounted on a pinion axle which is anchored in the case by a bolt. The pinions and side gears are backed by thrust washers.

The axle shaft inner splines engage the differential side gears with a floating fit. The outer ends are supported in the axle housing by thrust type ball bearings which are factory packed for the life of the bearing and sealed on both sides. The axle shaft oil seals are located inboard of the bearings. The bearings are secured against shoulders on the shafts by press fit retainer rings. Retainer plates hold the bearings against shoulders in the housing. Wheel side thrust is taken at the wheel bearings, so an axle shaft may be removed simply by removing the bolts holding the retainer to the brake backing plate and axle housing flange. See Figure 6-3.

The differential carrier is a malleable iron casting with tubular axle housings pressed into the sides to form a complete assembly. A removable, heavy steel cover is bolted on the rear of the carrier to permit service of the differential without removing the rear axle from the car. A seal in the front of the carrier bears against the pinion flange. See Figure 6-2.

Brackets welded to the tubular axle housings and upper brackets integral with main carrier casting, form means of attaching the rear axle to the body. An oil feed

| AXLE TYPE | MFG AXLE CODE | RATIO | SERIES |
|---|---|---|---|
| STANDARD DIFFERENTIAL | LA | 2.78 | 43427-67-69, 43627-69, 44437-67-69 AUTO. |
| | LB | 3.08 | 43435, 43635 AUTO. & 3-SP SYNC.<br>43427-67-69, 43627-69, 44437-67-69 3-SP. SYNC.<br>43327-67-69, 43527-69, 44337-67-69 AUTO. |
| | MB | 3.08 | 44255-65, 44456-65 AUTO. |
| | LC | 3.23 | 43327-67-69, 43527-69, 44337-67-69 3 & 4-SP SYNC.<br>434, 436, 44437-67-69 4-SP. SYNC.<br>43335, 43535 AUTO. |
| | MC | 3.23 | 44255-65, 44455-65 3 & 4-SP SYNC. |
| | LD | 3.36 | 43335, 43535 3 & 4-SP SYNC. |
| | MD | 3.36 | 44355-65 AUTO. |
| | ME | 3.55 | 44355-65 3 & 4-SP SYNC. |
| | NA | 3.55 | 45 SYNC. |
| | NB | 3.08 | 45 2 & 3-SP AUTO. |
| | NC | (S.C.O.) | ALL |
| | | | |
| | | | |
| POSITIVE TRACTION DIFFERENTIAL | LN | 2.78 | 43427-67-69, 43627-69, 44437-67-69 AUTO. |
| | LO | 3.08 | 43327-67-69, 43527-69, 44337-67-69 AUTO.<br>43435, 43635 AUTO. & 3-SP. SYNC.<br>43427-67-69, 43627-69, 44437-67-69 3-SP. SYNC. |
| | MO | 3.08 | 442, 44455-65 AUTO. |
| | LP | 3.23 | 43335, 43535 AUTO.<br>43327-67-69, 43527-69, 44337-67-69 3 & 4-SP. SYNC.<br>434, 436, 44437-67-69 4-SP. SYNC. |
| | MP | 3.23 | 442, 44455-65 3 & 4 SP. SYNC. |
| | LR | 3.36 | 43335, 43535 3 & 4-SP. SYNC |
| | MR | 3.36 | 44355-65 AUTO. |
| | MS | 3.55 | 44355-65 3 & 4-SP. SYNC. |
| | NN | 3.55 | 45 SYNC. |
| | NO | 3.08 | 45 2 & 3-SP. AUTO. |
| | NP | (S.C.O.) | ALL |
| | | | |
| | | | |

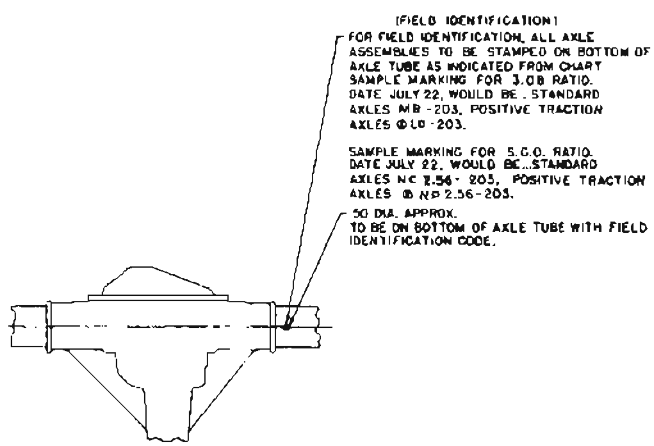



Figure 6-1—Rear Axle Markings

passage to the pinion bearings and an oil return hole are provided in the carrier casting to allow lubricant to circulate.

The rear axle filler plug is located on the right side of the carrier casting just ahead of and below the axle housing.

The rear brake drum is mounted directly against the axle flange on hub bolts pressed through the back of the axle flange.

## 6-3 REAR AXLE TROUBLE DIAGNOSIS

### a. Elimination of External Noises

When a rear axle is suspected of being noisy it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front wheel bearings, engine, transmission, or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

(1) Road Noise. Some road surfaces, such as brick or rough surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.

(2) Tire Noise. Tire noise may easily be mistaken for rear axle noise even though the noisy tires may be located on the front wheels. Tires worn unevenly or having surfaces of non-skid divisions worn in saw-tooth fashion are usually noisy, and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure. Some designs of non-skid treads may be more noisy than others, even when tires are new.

(3) Test for Tire Noise. Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure, for test purposes only, will materially alter noise caused by tires, but will not affect noise caused by rear axle. Rear axle noise usually ceases when coasting at speeds under 30 miles per hour; however, tire noise continues but with lower tone as car speed is reduced. Rear axle noise usually changes when comparing "pull" and "coast," but tire noise remains about the same.

(4) Front Wheel Bearing Noise. Loose or rough front wheel

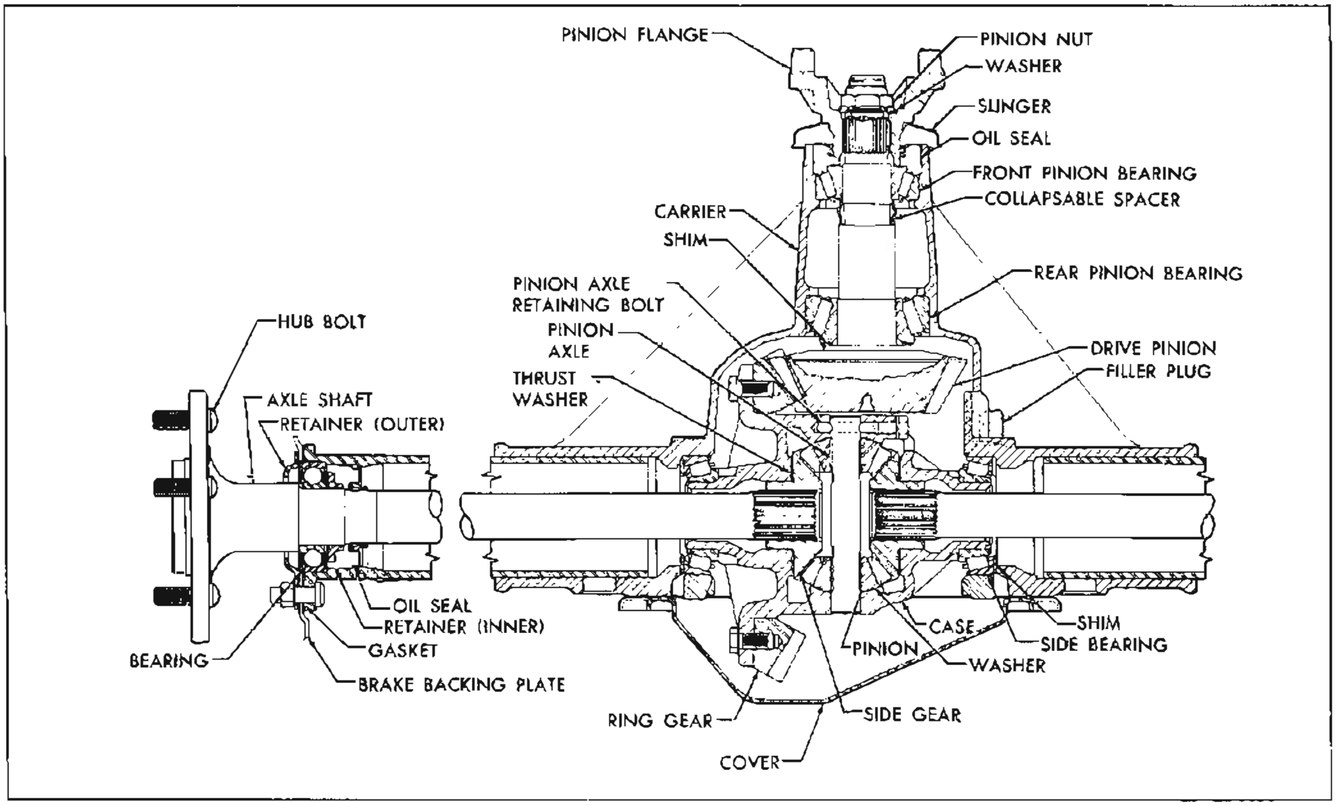



Figure 6-2—Rear Axle Assembly

bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing "pull and "coast". Light application of brake while holding car speed steady will often cause wheel bearing noise to diminish as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, also by shaking wheels to determine if bearings are loose.

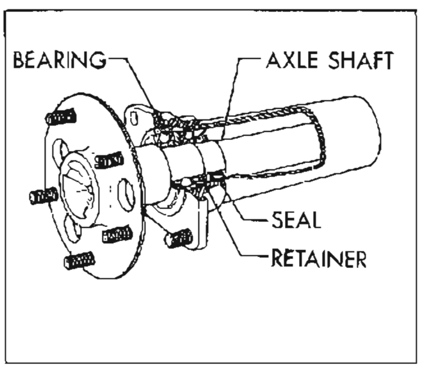



Figure 6-3—Rear Axle Shaft Bearing and Seal

(5) Engine and Transmission Noises. Sometimes a noise which seems to originate in the rear axle is actually caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate car speeds and conditions under which the noise is most pronounced; then stop car in a quiet place to avoid interfering noises. With transmission in neutral, run engine slowly up and down through engine speeds corresponding to car speed at which the noise was most pronounced. If a similar noise is produced with car standing, it is caused by the engine or transmission, and not the rear axle.

**b. Rear Axle Noises**

If a careful test of car shows that noise is not caused by external items as described in subparagraph a, it is then reasonable to assume that noise is caused by rear axle assembly. The rear axle should be tested on a smooth level road to avoid road noise. It is not advisable to test rear axle for noise by running with rear wheels jacked up.

Noises in rear axle assembly may be caused by a faulty propeller shaft, faulty rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, or worn differential side gears and pinions; noises may also be caused by mismatched, improperly adjusted, or scored ring and pinion gear set.

(1) Rear Wheel Bearing Noise. A rough rear wheel bearing produces a vibration or growl which continues with car coasting and transmission in neutral. A brinelled rear wheel bearing causes

a knock or click approximately every two revolutions of rear wheel, since the bearing rollers do not travel at the same speed as the rear axle and wheel. With rear wheels jacked up, spin rear wheels by hand while listening at hubs for evidence of rough or brinelled wheel bearing.

(2) Differential Side Gear and Pinion Noise. Differential side gears and pinions seldom cause noise since their movement is relatively slight on straight ahead driving. Noise produced by these gears will be most pronounced on turns.

(3) Pinion Bearing Noise. Rough or brinelled pinion bearings produce a continuous low pitch whirring or scraping noise starting at relatively low speed.

(4) Ring and Pinion Gear Noise. Noise produced by the ring and pinion gear set generally shows up as drive noise, coast noise, or float noise.

(a) Drive noise is noise produced during vehicle acceleration.

(b) Coast noise is noise produced while allowing car to coast with throttle closed.

(c) Float noise is noise occurring while just maintaining constant car speed at light throttle on a level road.

(d) Drive, coast, and float noises will vary in tone with speed, and will be very rough and irregular if the differential or pinion shaft bearings are rough, worn, or loose.

### c. Body Boom Noise or Vibration

Objectional "body boom" noise or vibration at 55-65 MPH can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft causing unbalance.

2. Shaft balance weights missing.

3. Shaft damage such as bending, dents or nicks.

4. Tire-type roughness. Switch tires from a known good car to determine tire fault.

### d. Check for Propeller Shaft Vibration

Objectionable vibrations at high speed (65 MPH or higher) may be caused by a propeller shaft that is out of balance. Out of balance may be due to a bent shaft.

To determine whether propeller shaft is causing vibration, drive car through speed range and note speed at which vibration is most pronounced. Shift transmission into lower gear range, and drive car at same engine speed as when vibration was most pronounced in direct drive. Note effect on vibration.

To determine engine speed, divide vehicle speed by the following transmission gear ratios as listed below:

1.55 (three speed synchromesh in second gear)

1.51 (four speed synchromesh in third gear)

1.76 (automatic transmission in low range).

EXAMPLE: If vibration is most pronounced in direct drive at 65 MPH, the same engine speed would be produced in second gear (three speed synchromesh) at 65/1.55 = 42 MPH; in third gear (four speed synchromesh) at 65/1.51 = 43 MPH; in low range (automatic) at 65/1.76 = 37 MPH.

If the vibration is still present at the same engine speed whether in direct drive or in the lower gear, since the propeller shaft speed varies, this cannot be the fault. If the vibration decreases or is eliminated in the lower gear, then the propeller shaft is out of balance and should be rebalanced. See paragraph 6-17. See paragraph 6-11 for a more complete trouble diagnosis.

### e. Oil Leaks

It is difficult to determine the source of some oil leaks. When there is evidence of an oil leak, determine source as follows:

(1) Oil coming from the drain hole under the axle housing at the brake backing plate is caused by a leaking axle shaft seal or a leaking wheel bearing inner gasket.

(2) Oil coming from between the rear pinion flange slinger and the carrier is caused by a leaking pinion seal.

Even after the point of leakage has been determined, it is hard to tell whether the oil is leaking past the lip of the seal or past the O.D. of the seal. Therefore it is a good idea to make sure the leak is stopped by using a nonhardening sealing compound around the O.D. of the new seal.

# SECTION 6-B
# REAR AXLE SERVICE PROCEDURES

## CONTENTS OF SECTION 6-B



## 6-4 REMOVAL AND INSTALLATION OF REAR AXLE ASSEMBLY

It is not necessary to remove the rear axle assembly for any normal repairs. However, if the housing is damaged, the rear axle assembly may be removed and installed using the following procedure:

### a. Removal of Rear Axle Assembly

1. Raise rear of car high enough to permit working underneath. Place a floor jack under center of axle housing so it just starts to raise rear axle assembly. Place car stands solidly under body members on both sides.

2. Disconnect rear universal joint from pinion flange by removing two U-bolts. Wire propeller shaft to exhaust pipe to support it out of the way.

3. Disconnect parking brake cables by removing adjusting nut at sheave. Remove cable connector and two clips and slide cables back until free of body.

4. Disconnect rear brake hose at floor pan. Cover brake hose and pipe openings to prevent entrance of dirt.

5. Disconnect shock absorbers at axle housing. Lower jack under axle housing until rear springs can be removed.

6. Disconnect upper control arms at frame brackets.

7. Disconnect lower control arms at axle housing and roll rear axle assembly out from under car.

### b. Installation of Rear Axle Assembly

1. Rest car solidly on stands placed under body side members, with rear end of car high enough to permit working underneath. Roll rear axle assembly under car.

2. Connect lower control arms to axle housing.

3. Connect upper control arms at frame brackets.

4. Place rear springs in position and jack axle housing upward until shock absorbers will reach.

5. Connect shock absorbers and tighten nuts to 30-60 ft. lbs. Connect lower control arms and tighten pivot bolts to 20-30 ft. lbs. Connect upper control arm bolts and tighten to 65-90 ft. lbs.

6. Connect parking brake cables. Adjust parking brake according to procedure in paragraph 9-9.

7. Connect rear universal joint to pinion flange. Tighten nuts evenly to 15-18 ft. lbs.

CAUTION: U-bolt nuts must be torqued as specified, as over-tightening will distort bearings and cause early failure.

8. Connect rear brake hose at floor pan. Bleed both rear brakes and refill master cylinder. See paragraph 9-7.

9. Fill rear axle with specified gear lubricant (See par. 1-9). If axle housing or any rear suspension parts were replaced due to damage, rear universal joint angle must be checked and adjusted if necessary. See paragraph 6-16.

## 6-5 DISASSEMBLY OF REAR AXLE ASSEMBLY

Most rear axle service repairs can be made with the rear axle assembly in the car by raising the rear end of the car with the rear axle hanging on the shock absorbers. See Figure 6-4. Rear axle lubricant may be drained by backing-out all cover bolts and breaking cover loose at the bottom.

### a. Remove Axle Shaft Assemblies

Design allows for axle shaft end play up to .042" loose. This end play can be checked with the wheel and brake drum removed by measuring the difference between the end of the housing and the axle shaft flange while moving the axle shaft in and out by hand.


Figure 6-4—Rear Axle Assembly in Position for Repair

End play over .042" is excessive. Compensating for all of the end play by inserting a shim inboard of the bearing in the housing is not recommended since it ignores the the end play of the bearing itself, and may result in improper seating of the gasket or backing plate against the housing. If the end play is excessive, the axle shaft and bearing assembly should be removed and the cause of the excessive end play determined and corrected.

1. Remove wheels. Both right and left wheels have right hand threads.

2. Remove brake drums.

3. Remove nuts holding retainer plates to brake backing plates. Pull retainers clear of bolts, and reinstall two lower nuts finger tight to hold brake backing plate in position.

4. Pull out axle shaft assemblies using Puller J-5748 and Adapter J-2619-4 with a slide hammer. See Figure 6-5.

CAUTION: While pulling axle shaft out through oil seal, support shaft carefully in center of seal to avoid cutting seal lip.

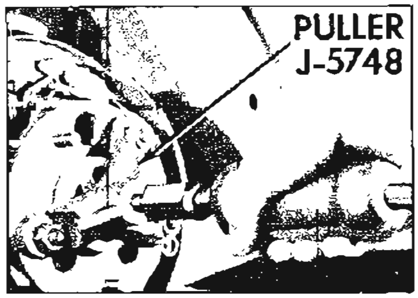



Figure 6-5—Removing Rear Axle Shaft

**b. Remove and Install Axle Shaft Bearing**

1. Nick bearing retainer in 3 or 4 places with a chisel deep enough to spread ring. Retainer will then slip off. See Figure 6-6.

2. Press axle shaft bearing off using Puller Plate J-8621 with Remover J-6525. An arbor press may be used or a set-up may be made using Ram and Yoke Assembly J-6180 with Adapter J-6258 and Puller J-5748. See Figure 6-7.

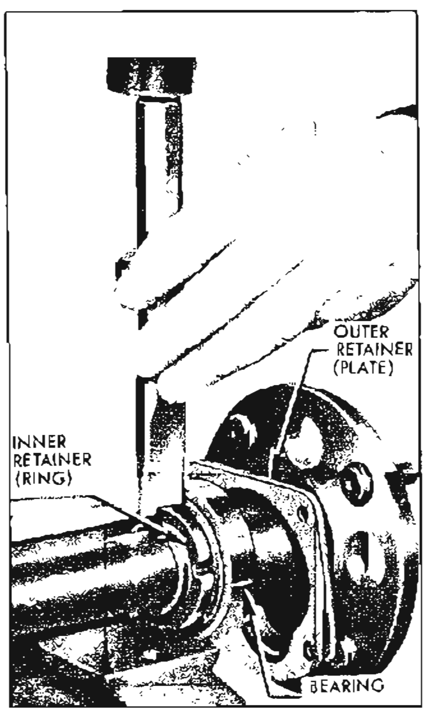



Figure 6-6—Removing Axle Shaft Bearing Retainer

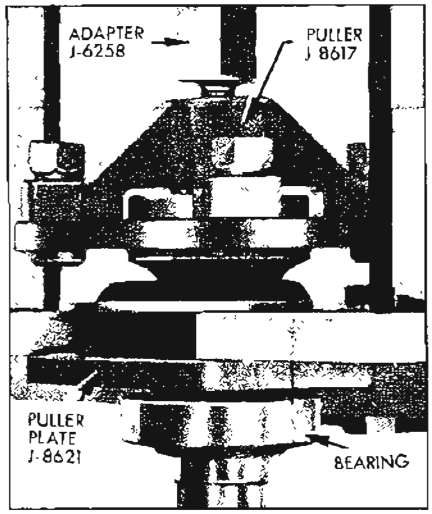



Figure 6-7—Removing Axle Shaft Bearing

3. Press new axle shaft bearing against shoulder on axle shaft using Installer J-8853 with Holder J-6407. See Figure 6-8. CAUTION: Retainer plate which retains bearing in housing must be on axle shaft before bearing

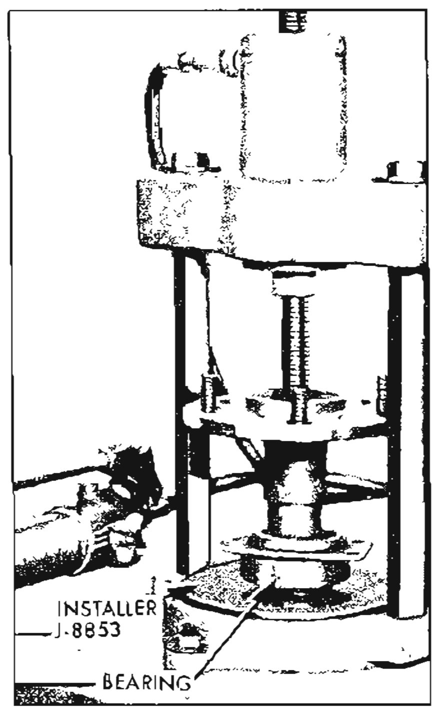



Figure 6-8—Installing Axle Shaft Bearing

is installed; retainer gasket can be installed after bearing.

4. Press new retainer ring against bearing using Installer J-8853.

**c. Remove and Install Rear Wheel Bolt**

1. To remove and install a rear wheel bolt, axle shaft assembly must be out of car. Remove rear wheel bolt by pressing from axle flange.

2. Install new rear wheel bolt by pressing through axle flange. Check new bolt for looseness; if bolt is loose, axle shaft must be replaced.

**d. Remove and Install Axle Shaft Seal**

1. Insert axle shaft so that splined end is just through seal.

2. Using axle shaft as a lever, push down on shaft until seal is pried from housing. See Figure 6-9.

3. Apply sealer to O.D. of new seal.

4. Position seal over Installer J-21129 and drive seal straight into axle housing until fully seated. See Figure 6-10.

**e. Remove Differential Case Assembly**

1. Before removing differential from housing, it is advisable to check the existing ring gear to pinion backlash as described in paragraph 6-6(f). This will indicate gear or bearing wear or an error in backlash or preload setting which will help in determining cause of axle noise. Backlash should be recorded so that if same gears are reused, they may be reinstalled at original lash to avoid changing gear tooth contact.

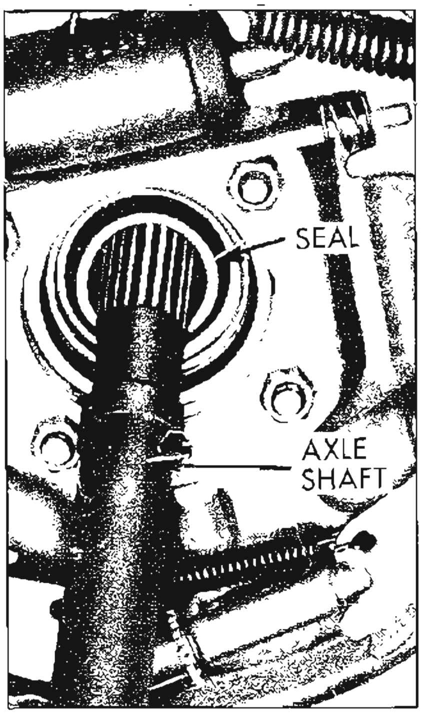



Figure 6-9—Removing Axle Shaft Seal

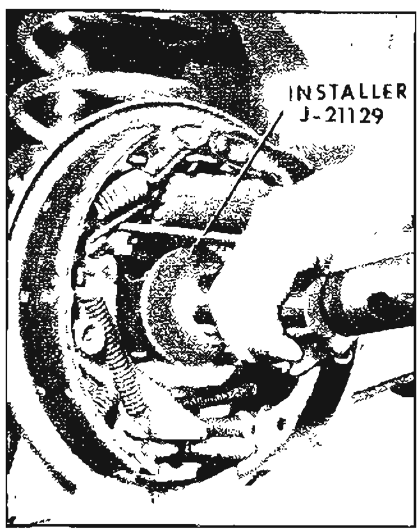



Figure 6-10—Installing Axle Shaft Seal

2. Remove differential bearing cap bolts. Bearing caps are marked "R TOP" and "L TOP" in production to make sure they will be reassembled correctly.

3. Remove two ring gear retaining bolts from differential case and install Ring Gear & Case Remover J-21322 with slide hammer as shown in Figure 6-11. Remove case assembly and place right and left bearing outer races and shims in sets with marked bearing caps so that they can be reinstalled in their original positions.

**f. Disassemble Differential Case Assembly**

1. If differential side bearings are to be replaced, insert Remover Adapter J-2241-8 in center hole and pull bearing using Puller J-2241 or Hydraulic Puller J-9005. See Figure 6-12.

2. Remove bolt that retains differential pinion axle. See Figure 6-13. Remove differential pinions, side gears and thrust washers from case.

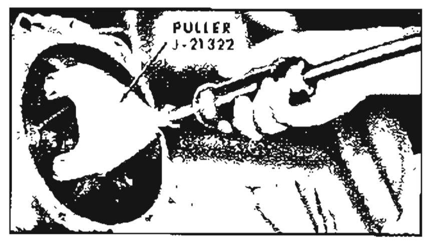



Figure 6-11—Removing Differential Assembly

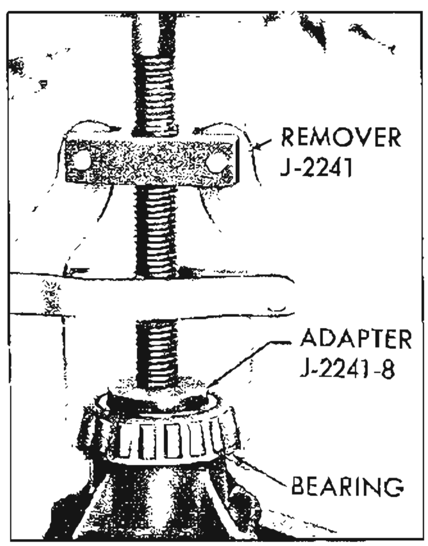



Figure 6-12—Removing Differential Side Bearing

3. If ring gear is to be replaced and it is tight on case after removing bolts, tap it off using a soft hammer; do not pry between ring gear and case.

## g. Remove Pinion Assembly

1. Check pinion bearing preload as described in paragraph 6-6(c). If there is no preload reading, check for looseness of pinion assembly by shaking. Looseness indicates need for bearing replacement. If assembly is run long with very loose bearings, ring and pinion will also require replacement.

2. Install holder J-8614-01 on pinion flange by using two 5/16-18 x 2 bolts with flat washers. Remove pinion nut and washer. See Figure 6-14.

3. Pull pinion flange from pinion using Puller J-8614-02 in Holder J-8614-01. To install puller, back out puller screw, insert puller through holder, and rotate 1/8 turn. See Figure 6-15.

4. Remove pinion assembly. If necessary, tap pinion out with soft hammer, while being careful to guide pinion with hand to avoid damage to bearing outer races.


Figure 6-13—Removing Pinion Axle Retaining Bolt

## h. Disassemble Pinion Assembly

1. If rear pinion bearing is to be replaced, remove rear pinion bearing from pinion shaft using Remover J-21493 with Holder J-6407. See Figure 6-16.

2. Pry pinion oil seal from carrier and remove front pinion bearing. If this bearing is to be replaced, drive outer race from carrier using a drift.

3. If rear pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose.

# 6-6 ASSEMBLY OF REAR AXLE ASSEMBLY

## a. Install Pinion Bearing Outer Races in Carrier

1. If rear pinion bearing is to be replaced, install new outer race using Installer J-6197 with Driver Handle J-8092. See Figure 6-17.

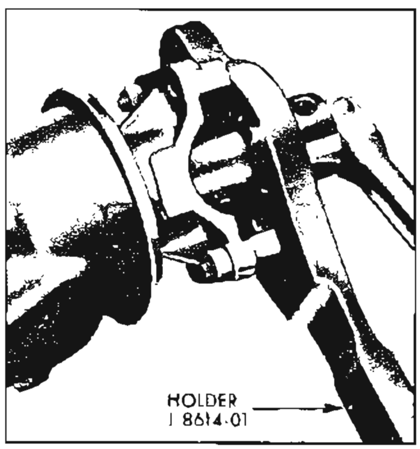



Figure 6-14—Removing Pinion Nut

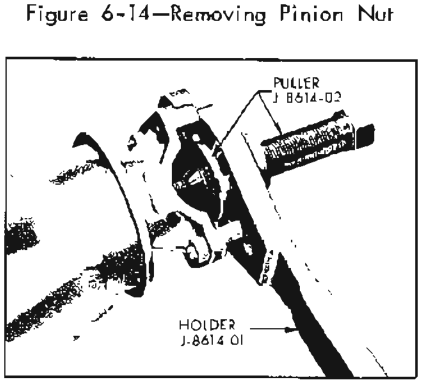



Figure 6-15—Removing Pinion Flange

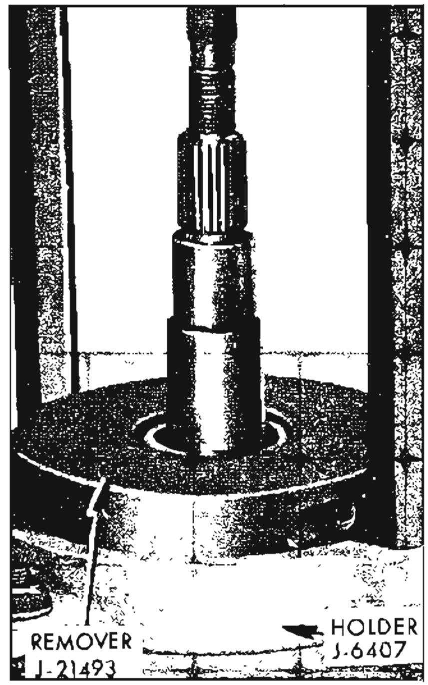



Figure 6-16—Removing Rear Pinion Bearing

2. If front pinion bearing is to be replaced, install new outer race using Installer J-7817 with Driver Handle J-8092. See Figure 6-18.

## b. Set Pinion Depth

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts. However, most production pinions and all pinions used for service replacement are zero or nominal pinions.

If during repair, a pinion is found having a plus or minus reading recorded in thousandths on the rear face of the pinion, this indicates that the pinion during testing was found to have best

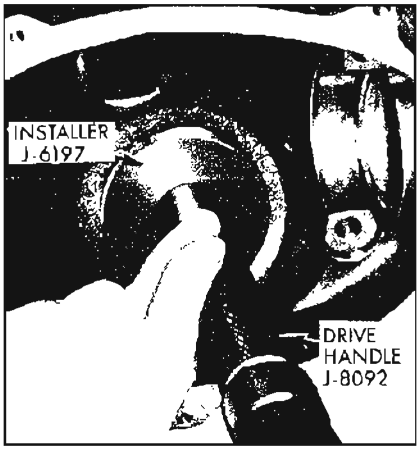



Figure 6-17—Installing Rear Pinion Bearing Outer Race

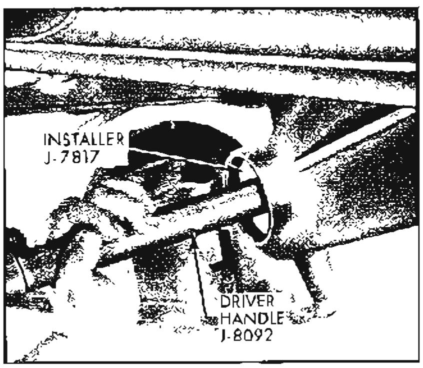



Figure 6-18—Installing Front Pinion Bearing Outer Race

tooth contact at a position varying from design or nominal depth.

In order to compensate for all of the allowable machining variables, a procedure of gauging the carrier and shimming the pinion has been developed. After gauging a carrier, the assembler is able to install a shim between the front face of the pinion and its bearing so that pinion depth can be adjusted to an exact required specification for best tooth contact in each axle assembly.

Pinion depth is set with Pinion Setting Gauge J-8619 which consists of the following: (1) master gauge, (1) indicator gauge with dial indicator, (2) J-8619-10 Disks, (1) J-8619-11 Gauge Plate, J-8619-12 Pilot and Nut with J-8619-13 Stud. See Figure 6-19. Although production pinions are marked, neither production nor service pinions have a gauging tooth. The pinion setting gauge provides in affect a nominal or zero pinion as a gauging reference.

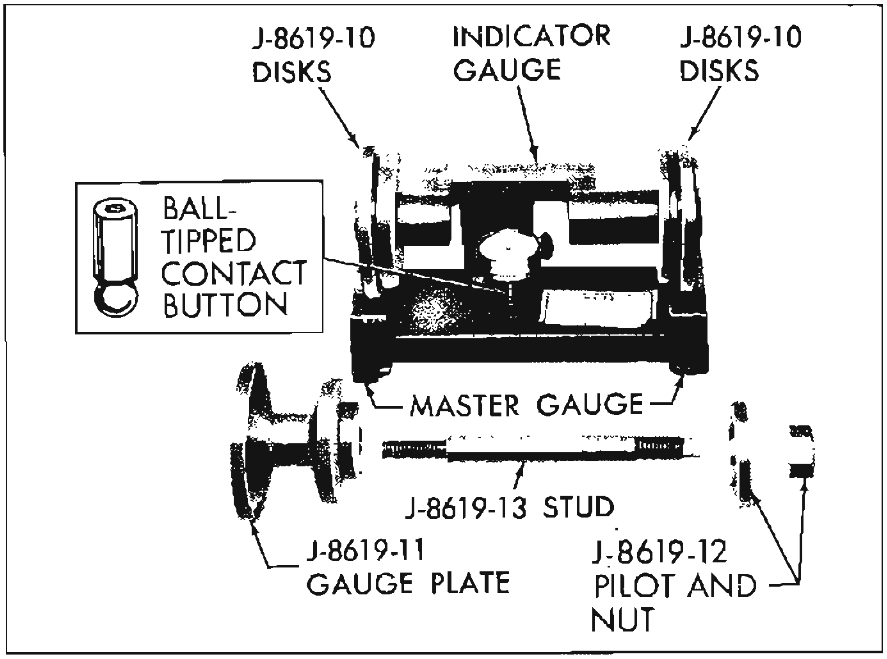



Figure 6-19—Pinion Setting Gauge

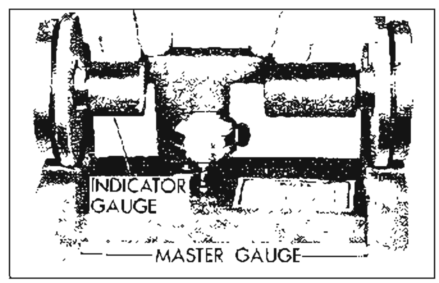



Figure 6-20—Zeroing Pinion Setting Gauge

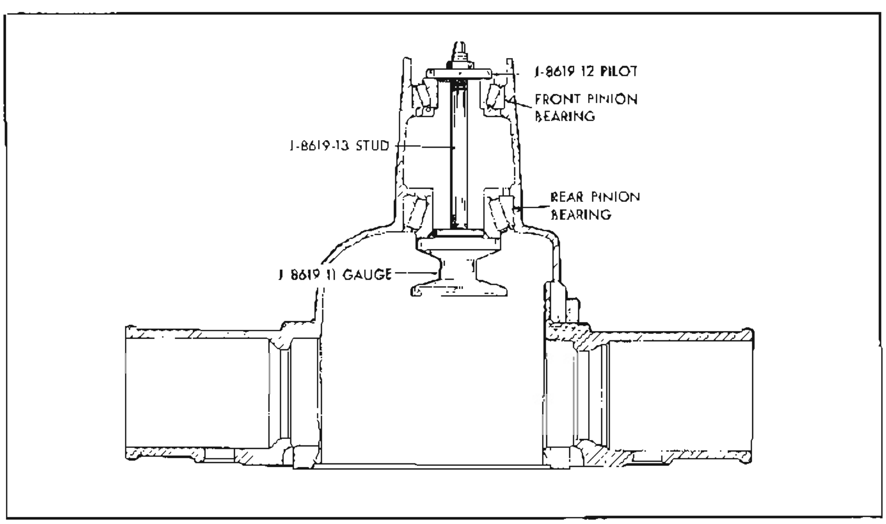



Figure 6-21—Securing Gauge Plate In Carrier

Set up pinion setting gauge as follows:

1. Make certain all of the gauge parts are clean, particularly the disks and center of the indicator gauge; also check the centering hole and disk pads on the master gauge.

2. Install the J-8619-10 Disks on the indicator gauge. Install the small ball-tipped contact button on the stem of the dial indicator and mount the dial indicator on the indicator gauge. See Figure 6-19.

NOTE: When gauging for pinion depth, the ball-tipped contact button must be used on dial indicator in order to reach Gauge Plate J-8619-11 in carrier.

3. Place the indicator gauge on the master gauge, as shown in Figure 6-20 so that the spring loaded center is engaged in the centering hole, and the inner, large diameter portion of each disk contacts the master gauge pads.

4. Center the indicator contact button on the indicator pad and lock the indicator by tightening the thumb screw.

5. Hold yoke down firmly, with both disks contacting the horizontal and vertical pads on master gauge, and set master gauge at zero.

6. Lubricate front and rear pinion bearings; then position them in their respective races in the carrier. While holding bearings in place, install Gauge Plate J-8619-11 in carrier on rear pinion bearing inner race as shown in Figure 6-21 and place Pilot J-8619-12 on surface of front pinion bearing. Insert Stud J-8619-13 through pilot, front and rear bearings, and thread it into gauge plate. See Figure 6-21.

7. Install nut on Stud J-8619-13. Hold stud stationary with wrench positioned over flats on ends of stud and tighten nut until a reading of 15-20 inch pounds is obtained when rotating gauge plate assembly with an inch pound torque wrench.

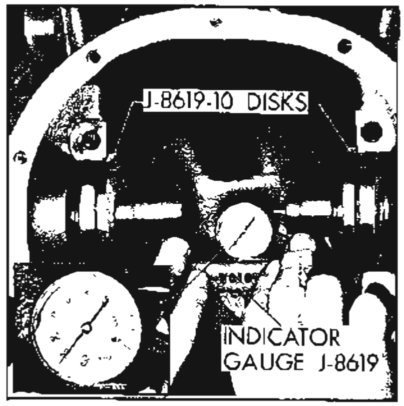


Figure 6-22—Checking Pinion Depth

8. Make certain differential bearing support bores are free of burrs. Install indicator gauge in carrier so that small diameter outer portion of disks rest in differential bearing pedestal support bores. Spring-loaded center of gauge must be located in centering hole of gauge plate, and ball-tipped contact button of dial indicator must be positioned to bear against outer edge of gauge plate top surface. See Figure 6-22.

9. Press gauge yoke down firmly toward gauging plate; record the number of thousandths the dial moves from zero. Remove indicator gauge and recheck "zero setting" on master gauge to make sure this setting was not disturbed by handling.

10. If zero setting is still correct, remove gauging set up and both bearings from the carrier. Then subtract reading recorded in previous step from 100. For example, a typical reading of 70 should be subtracted from 100; this answer (30) indicates the thickness of the shims to be selected as further qualified in Step 12 following.

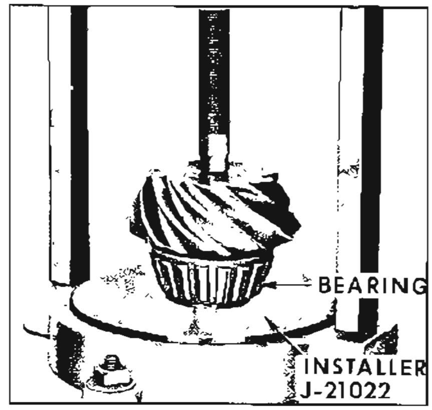


Figure 6-23—Installing Rear Pinion Bearing

NOTE: An average dial indicator reading will range from 65 to 75 thousandths with a corresponding shim thickness range of 35-25 thousandths.

11. Examine the ring gear for nicks, burrs, or scoring. Any of these conditions will require replacement of the gear set.

12. Select the correct pinion shim to be used during pinion reassembly on the following basis:

(a) If the production (marked) pinion is being reused and the pinion is marked "+" (plus), subtract the amount specified on the pinion from the shim thickness as determined in Step 9.

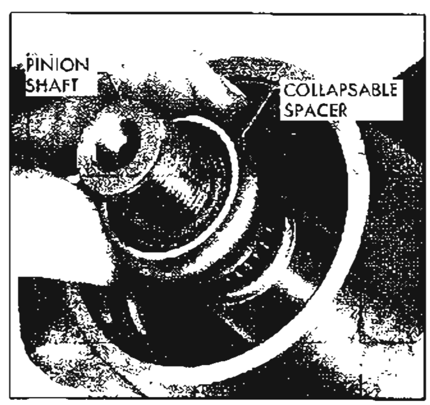


Figure 6-24—Installing Collapsible Spacer

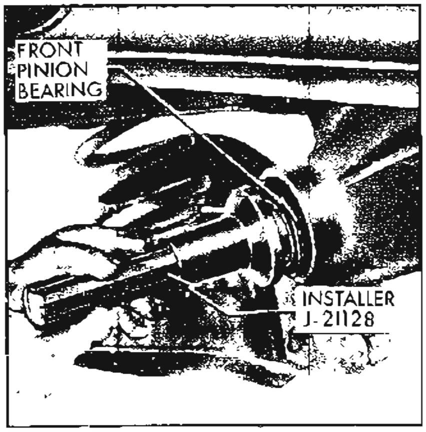



Figure 6-25—Installing Front Pinion Bearing

(b) If the production (marked) pinion is being reused and the pinion is marked "-" (minus), add the amount specified on the pinion to the shim thickness as determined in Step 9.

(c) If a service pinion is being used (no marking), shim pinion using shim thickness directly as determined in Step 9.

NOTE: Frequently production pinions are nominal or zero pinions (no marking). When reusing a nominal production pinion, shim as with service pinion using shim thickness directly as determined in Step 9.

13. Position correct shim on pinion shaft and install rear pinion bearing. Use Installer J-21022 as shown in Figure 6-23.

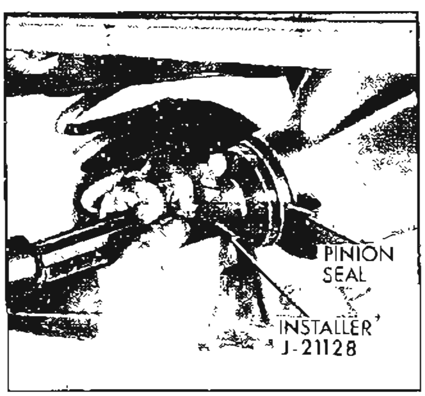



Figure 6-26—Installing Pinion Oil Seal

### c. Install Pinion Assembly and Adjust Pinion Preload

1. Position pinion assembly in carrier and install collapsible spacer as shown in Figure 6-24.

2. Place front pinion bearing in position on pinion. Hold pinion fully forward and drive bearing over pinion until seated. Use Installer J-21128. See Figure 6-25.

3. Install pinion oil seal in carrier. Coat O.D. of seal with sealing compound. Install seal by using Installer J-21128. See Figure 6-26.

4. Coat lips of pinion oil seal; seal surface of pinion flange with gear lube. Install pinion flange on pinion by tapping with a soft hammer until a few pinion threads project through flange.

5. Install pinion washer and nut. Hold companion flange with Holder J-8614-01. While intermittently rotating pinion to seat bearings, tighten pinion nut until end play begins to be taken up. See Figure 6-27.

CAUTION: When no further end play is detectable, and when Holder J-8614 will no longer pivot freely as pinion is rotated, preload specifications are being neared. Further tightening should be done only after preload has been checked.

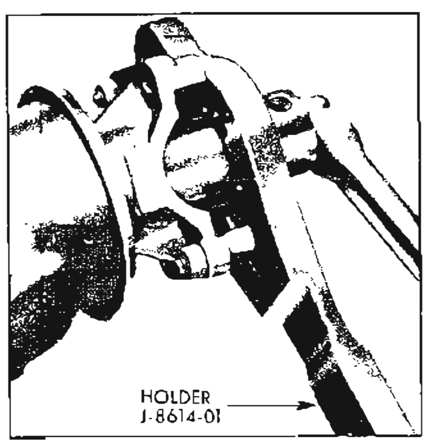



Figure 6-27—Installing Pinion Nut

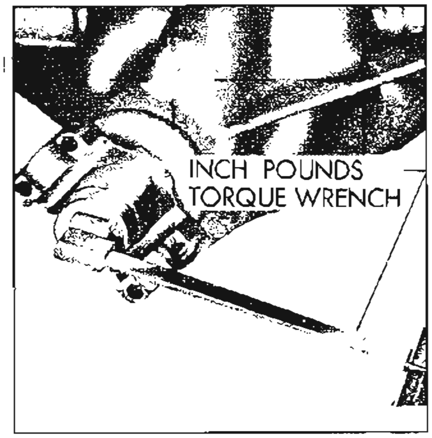



Figure 6-28—Checking Pinion Bearing Preload

6. Check preload by using an inch pound torque wrench as shown in Figure 6-28.

CAUTION: After preload has been checked, final tightening should be done very cautiously. For example, if when checking, preload was found to be 5 inch pounds, additional tightening of the pinion nut as little as 1/8 turn can add 5 additional inch pounds drag. Therefore, the pinion nut should be further tightened only a little at a time and preload should be checked after each slight amount of tightening. Exceeding preload specifications will compress the collapsible spacer too far and require its replacement.

7. While observing the preceeding caution, carefully set preload drag at 20 to 30 inch pounds on

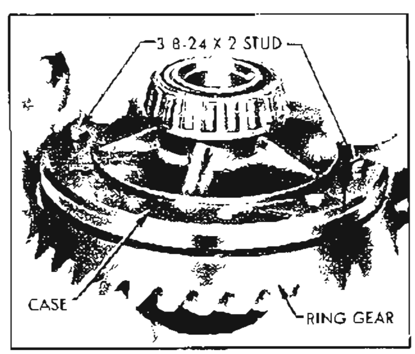



Figure 6-29—Installing Ring Gear On Differential Case

new bearings or 15 to 20 inch pounds on used bearings.

8. Rotate pinion several times to assure that bearings have been seated. Check preload again. If drag has been reduced by rotating pinion, re-set preload to specification.

### d. Assemble Differential Case Assembly

Before assembling the differential, examine the wearing surfaces of all parts for scoring or unusual wear. Also make certain that all parts are absolutely clean. Lubricate parts with rear axle lubricant just before assembly.

1. Place side gear thrust washers over side gear hubs and install side gears in case. If same parts are reused, replace in original sides.

2. Position one pinion (without washer) between side gears and rotate gears until pinion is directly opposite from loading opening in case. Place other pinion between side gears so that pinion axle holes are in line, then rotate gears to make sure holes in pinions will line up with holes in case.

3. If holes line up, rotate pinions back toward loading opening just enough to permit sliding in pinion thrust washers.

4. Install pinion axle. Install pinion axle retaining bolt. Torque to 20-28 ft. lbs.

5. After making certain that mating surfaces of case and ring gear are clean and free of burrs, thread two 3/8-24 x 2 studs into opposite sides of ring gear, then install ring gear on case. See Figure 6-29. Install ring gear attaching bolts just snug. Torque bolts alternately in progressive stages to 50-60 ft. lbs.

6. If differential side bearings were removed, install new bearings using Installer J-21132 with Driver Handle J-8092. See Figure 6-30.

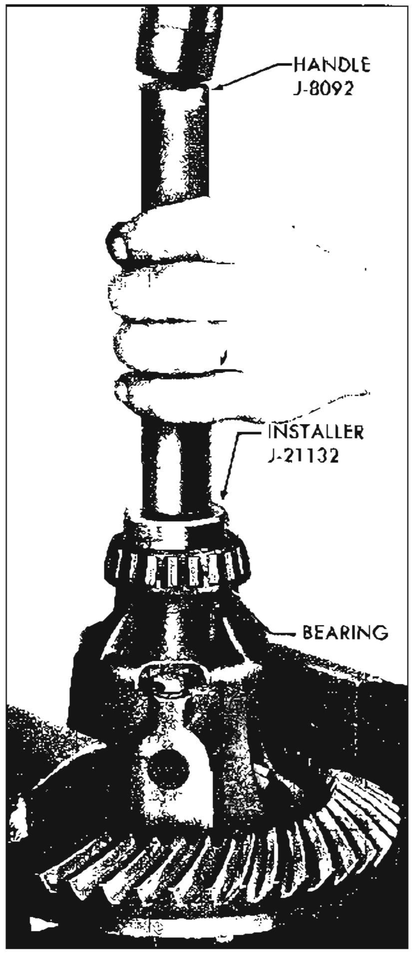



Figure 6-30—Installing Differential Side Bearings

### e. Install Differential Case and Adjust Side Bearing Preload

Differential side bearing preload is adjusted by changing the thickness of both the right and left shims by an equal amount. By changing the thickness of both shims equally, the original backlash will be maintained. Differential adjusting shims are available in thicknesses ranging from .040" to .082" by two thousandths.

1. Before installation of case assembly, make sure that side bearing surfaces in carrier are clean and free of burrs. Side bearings must be oiled with gear lube, and if same bearings are being reused, they must have original outer races in place.

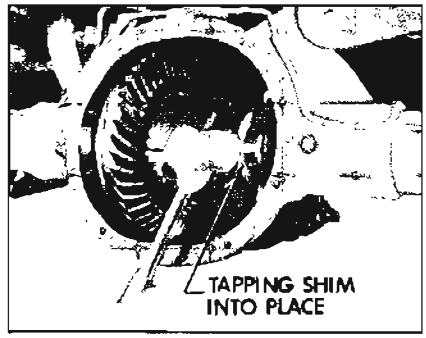



Figure 6-31—Installing Differential Adjusting Shim

2. Place differential case and bearing assembly in position in carrier. If new side bearings were installed, use original adjusting shims; if same bearings are to be reused, select new right and left adjusting shims each .002" thicker than original shim. Slip left shim in position at left bearing, then drive right shim carefully into position using a soft hammer. See Figure 6-31.

3. As a safety precaution, install bearing caps using four 7/16-14 x 4-1/4 cylinder head bolts.

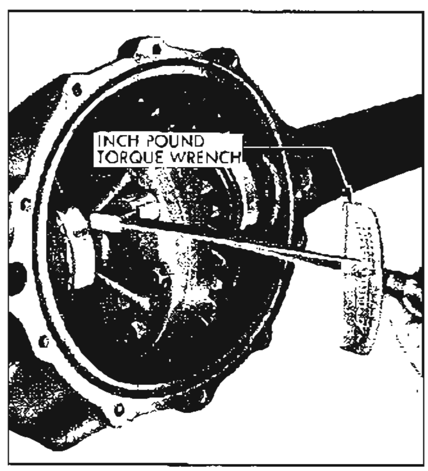



Figure 6-32—Checking Differential Case Preload

4. Rotate differential case several complete turns to seat bearings. Check bearing preload using an inch pound torque wrench connected at ring gear attaching bolt. With wrench projecting approximately straight out, bearing preload should read 30 to 40 in. lbs. with new bearings, or 15 to 25 in. lbs. with reused bearings. See Figure 6-32. If preload is not according to these specifications, increase shim thickness on each side .002" for each additional 10 in. lbs. preload desired, or decrease shim thickness .002" on each side for each 10 in. lbs. preload to be subtracted.

5. When preload is correctly adjusted, leave four safety head bolts and caps in position as a safety precaution while performing following backlash checking operation.

#### f. Adjust Differential Backlash

1. Rotate differential case several times to seat bearings, then mount dial indicator as shown in Figure 6-33. Use a small button on indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is as nearly as possible in line with gear rotation and perpendicular to tooth angle for accurate backlash reading.

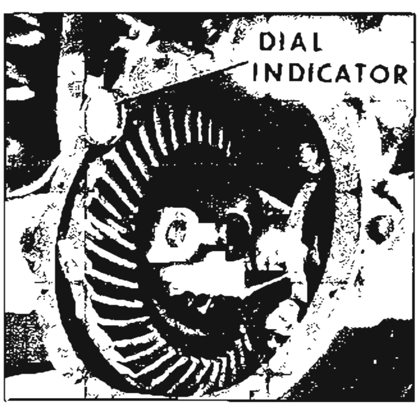



Figure 6-33—Checking Ring Gear To Pinion Backlash

2. With pinion locked to carrier, check gear lash at 3 or 4 points around ring gear. Lash must not vary over .001" around ring gear.

If variation is over .001" check for burrs, uneven bolting conditions or distorted case flange, and make corrections as necessary.

3. Gear lash at the point of minimum lash should be .007" to .009" for all new gears. If adjustment is necessary, adjust to .008".

If original gear set having a wear pattern is being reinstalled, original gear lash should be maintained within ± .001".

4. If gear backlash is not within specifications, correct by increasing thickness of one differential shim and decreasing thickness of other shim the same amount. In this way, correct differential bearing preload will be maintained.

Shift .002" in shim thickness for each .001" change in backlash desired. If backlash is .001" too much, decrease thickness of right shim .002" and increase thickness of left shim .002". If backlash is .002" too little, increase thickness of right shim .004" and decrease thickness of left shim .004".

5. When gear backlash is correctly adjusted, remove 4 safety head bolts and install bearing caps according to markings. Torque bearing cap bolts to 40-60 ft. lbs.

6. Install new gasket in housing using heavy grease to retain it in place. Install cover. Torque cover bolts to 25-35 ft. lbs. Wait 20 minutes and retorque cover bolts to specification.

#### g. Install Axle Shaft Assemblies

1. Apply a coat of wheel bearing grease in bearing recesses of housing. Install new outer retainer gaskets. Apply a thin coating of Permatex #2 or equivalent to outer diameter of seal if replaced. To help prevent damage to the lip of the wheel seal when installing axle shaft and to ensure lubricant on the seal lip during the first few miles of operation, the axle shaft should be lightly lubricated with axle lubricant from the sealing surface to approximately 6 inches inboard of the shaft. Insert axle shaft assemblies carefully until shaft splines engage in differential to avoid damage to seals.

2. Drive axle shaft assemblies into position.

3. Place gasket and retainer over studs and install nuts. Torque nuts to 60 ft. lbs.

4. Install brake drums over wheel bolts.

5. Install wheels and tighten wheel nuts.

#### h. Install Pinion Oil Seal with Differential Installed in Car

In case of pinion oil seal failure, remove old oil seal and install new one (with differential remaining in car) as follows:

1. Mark Propeller shaft and companion flange to permit proper alignment at reinstallation. Disconnect propeller shaft from companion flange and support shaft out of way. If U-joint bearings are not held by a retainer strap, use a piece of wire or tape to retain bearings in their journals.

2. Raise car and remove wheels and brake drums. Install inch pound torque wrench on pinion nut, and record torque required to rotate pinion freely.

3. Mark position of companion flange, pinion shaft threads, and pinion nut so that they can be reinstalled in the same position.

4. Remove companion flange nut and washer using Holder J-8614-01 to hold flange.

5. Pry oil seal out of carrier.

6. Examine surface of companion flange for nicks or damaged surface. If damaged, replace flange.

7. Examine carrier bore and remove any burrs that might cause leaks around O.D. of seal.

8. Install oil seal using Pinion Oil Seal Installer J-21128.

9. Apply seal lubricant to O.D. of companion flange.

10. While holding companion flange with Holder J-8614-01, install companion flange nut and tighten to same position as marked in Step 3 preceding. Tighten nut 1/8 turn beyond alignment marks on pinion shaft threads in order to preload collapsible spacer. Check preload using an inch pound torque wrench; torque reading should be equal to or five inch pounds above that recorded in Step 2.

11. Connect propeller shaft to companion flange using alignment marks. Torque the four (4) bolts to 12-15 ft. lbs.

# SECTION 6-C
# POSITIVE TRACTION DIFFERENTIAL



## 6-8 DESCRIPTION OF POSITIVE TRACTION DIFFERENTIAL

### a. General Description

Buick Positive Traction Differential is optional equipment on all Buicks. It is designed to perform all the desirable functions of a conventional differential and at the same time overcome its limitations. With a conventional differential, when one wheel is on a slippery surface, its pulling power is limited by the wheel with the lowest traction. Unlike the conventional differential, with the Positive Traction device, the anti-spinning action is limited by the wheel having the best traction, thus limiting the possibility of becoming stuck.

Buick Positive Traction Differential is not a fully locking type and will release before excessive driving force can be directed to one rear wheel. The safety value of this feature eliminates the possibility of dangerous steering reaction. When the rear wheels are under extremely unbalanced tractive conditions, such as having one wheel on ice and the other on dry pavement, wheel spin can occur, if over-acceleration is attempted. However, even when wheel spin does occur, the major driving force is directed to the non-spinning wheel.

Another advantage of the Positive Traction Differential is that on uneven surfaces such as railroad tracks, chuck holes, etc., wheel action is not adversely affected. During power application on a conventional differential, when one wheel hits a bump and bounces clear of the road, it spins momentarily. When this rapidly spinning wheel again contacts the road, the sudden shock may cause the car to swerve. This action is also hard on tires and the entire drive train. With a Positive Traction Differential the free wheel rotates at the same speed as the wheel on the road, thereby minimizing adverse effects.

### b. Operation

The design of the Positive Traction Differential is basic and simple. The unit is completely interchangeable with a conventional differential. However, this unit has in addition coarse, spiral-threaded cone brakes installed behind the side gears. These brakes are statically spring pre-loaded to provide an internal resistance to the differential action within the case itself. This preload assures an adequate amount of pull when extremely low tractive conditions such as wet ice, mud, or snow are encountered at one rear wheel. It also provides smooth transfer of torque when traveling over alternating to tractive conditions at both rear wheels.

During application of torque to the axle, the initial spring loading of the cone brakes is supplemented by the inherent gear separating forces between the side and spider gears which progressively increases the resistance in the differential. This unit is therefore an automatic throttle-sensitive device that provides greater resistance under greater torque loads. It should be remembered however, that this is not a positive lock differential, and it will release before excessive driving force can be applied to one wheel.

CAUTION: When working on a car with Positive Traction Differential, never raise one rear wheel and run the engine with the transmission in gear. The driving force to the wheel on the floor could cause the car to move.

## 6-9 LUBRICATION OF POSITIVE TRACTION DIFFERENTIAL

The lubricant level should be checked every 6000 miles. Maintain level between the bottom of the filler plug opening and 1/4 inch below the opening by adding Special Positive Traction Lubricant or equivalent available through the Buick Parts Department under part No. 531536. Never use any lubricant other than this special lubricant, even for adding.

Positive Traction Differentials can be easily identified either by a stainless steel plate attached by a rear cover bolt or by an X in a circle stamped on the bottom edge of the right rear axle tube. See Figures 6-1 & 6-37. However, if

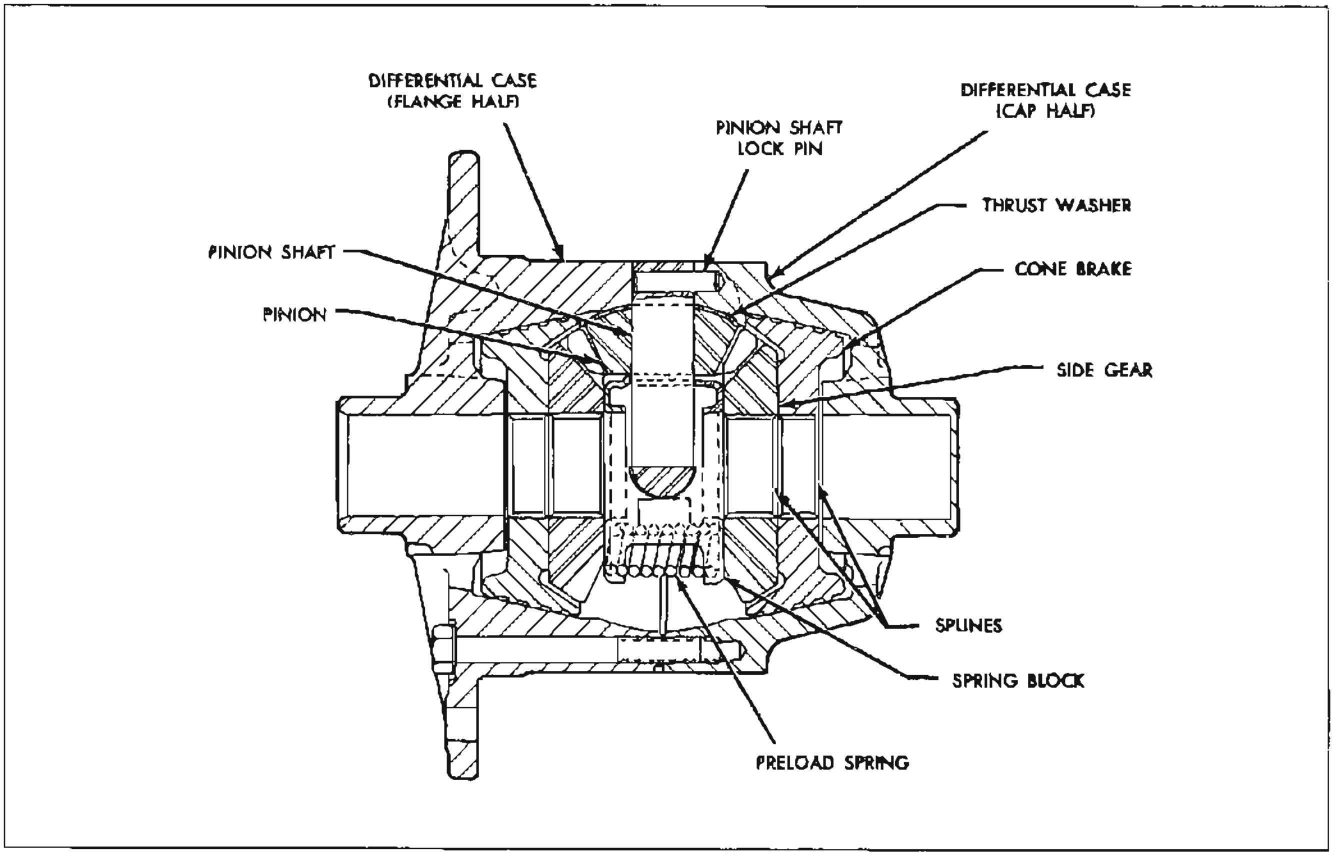



Figure 6-35—Positive Traction Differential

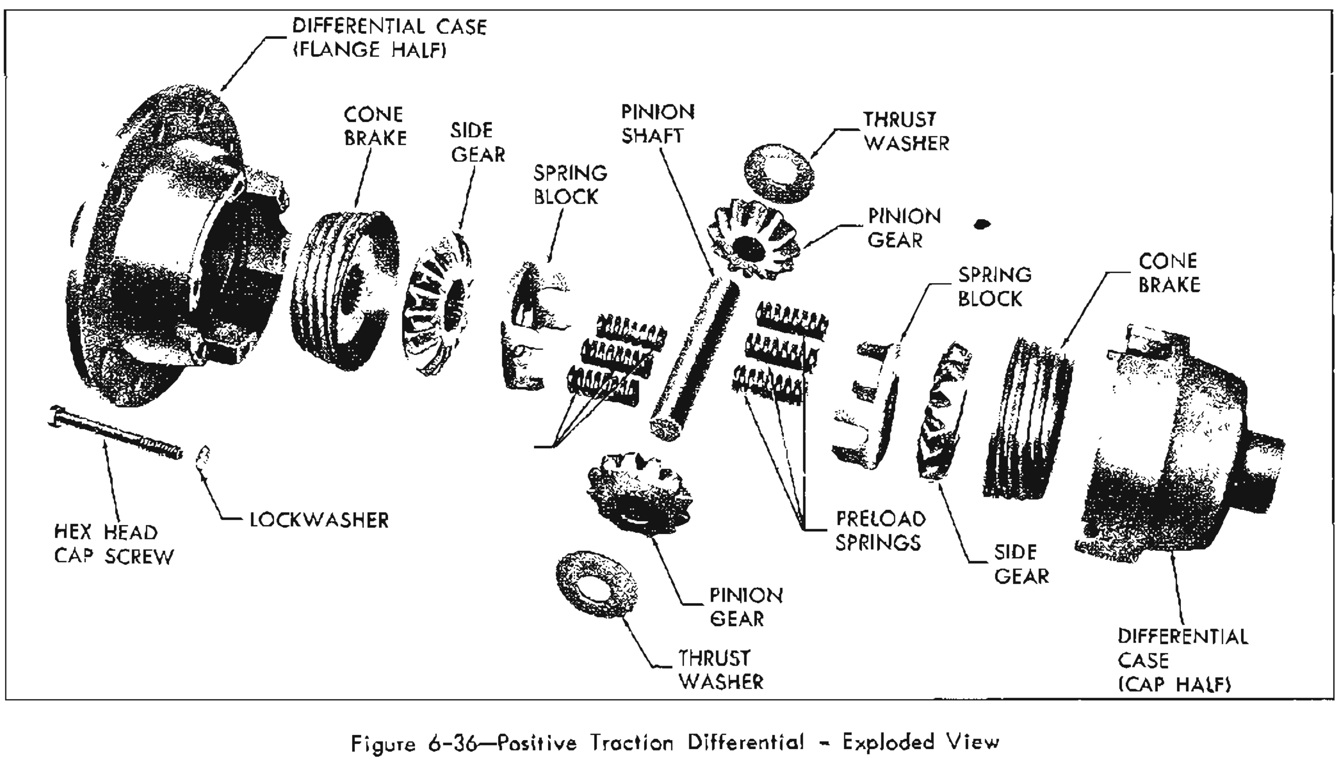



Figure 6-36—Positive Traction Differential - Exploded View

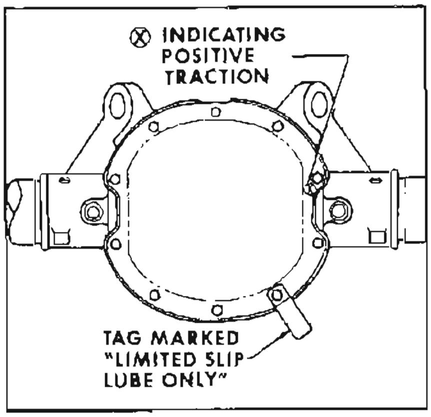



Figure 6-37—Identification of Positive Traction Differential

the wrong lubricant is accidentally added, it will be necessary to completely remove all lubricant, flush with light engine oil, and then fill with the special lubricant. Capacity of the rear axle housing is 2 pints.

## 6-10 POSITIVE TRACTION DIFFERENTIAL SERVICE PROCEDURES

All rear axle service procedures are the same in the Positive Traction rear axle as in a conventional rear axle, except for servicing the internal parts of the differential assembly. All rear axle parts outside of the differential, such as the ring gear, differential side bearings, and axle shafts, are the same in either rear axle assembly.

### a. Disassembly of Differential

1. If ring gear or differential case is to be replaced, remove ring gear from case. Otherwise ring gear need not be removed.

2. If a differential bearing is to be replaced, pull bearing outer race from case, using Remover J-2241-A as described in paragraph 6-5 (f).

3. Clamp case assembly in a brass jawed vise by ring gear or by case flange.

4. Mark flange half of case and cover half with a center punch or paint to provide alignment for reassembly. See Figure 6-38.

5. Loosen six bolts holding cover half of case to cap half. Remove assembly from vise, place on bench with bolt heads up, and remove bolts.

6. Lift cap half of case from flange half. Remove cap half, cone brake, preload springs, spring block, and side gear shims if provided, from assembly so that they can be reinstalled in their original positions.

7. Remove corresponding parts from flange half of case and keep with flange half.

### b. Cleaning and Inspection of Parts

1. Make certain all parts are absolutely clean and dry.

2. Inspect pinion shaft, pinion and side gears, brake cone surfaces and corresponding cone seats in the case. The cone seats in the case should be smooth and free of any excessive scoring. Slight grooves or scratches indicating passage of foreign material are permissible and normal. The land surface on the heavy spirals of the male cones will duplicate the case surface condition. Replace any parts which are excessively scored, pitted or worn. Both

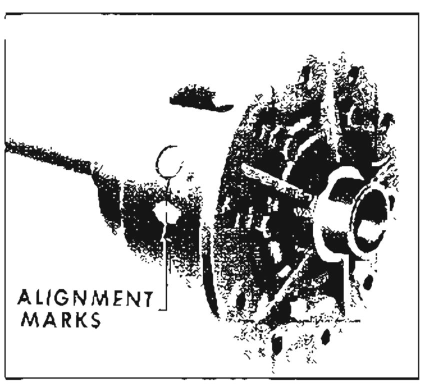



Figure 6-38—Alignment Marks

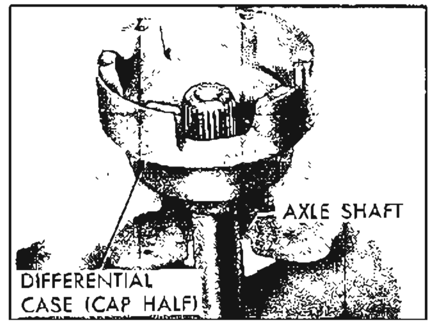



Figure 6-39—Axle Shaft & Cap Half of Differential Positioned in a Vise

halves of case must be replaced if one half is damaged or worn.

### c. Assembly of Differential

CAUTION: When assembling the unit, use axle shafts as mounting tools to assure proper gear and cone spline alignment. Do not ignore this procedure as it will be impossible to install shafts at final assembly and attempting to force the shafts into position may result in damage to the spring thrust blocks.

1. Clamp one axle shaft in a vise allowing three inches to extend above vise jaws. Then place the cap side of differential case over extended axle shaft with interior of case facing up. See Figure 6-39.

2. Install proper cone over axle shaft splines, seating it into position in cap half of case. NOTE: Be certain that each cone is installed in proper case half since tapers and surfaces become matched and their positions should not be changed.

3. If unit was orignally assembled with shims located between side gears and cones for backlash adjustment, reinstall side gear with shim so that gear may seat on shim. If unit was originally assembled without shims, reassemble the same way.

4. Place one spring block in position over gear face in alignment with pinion gear shaft

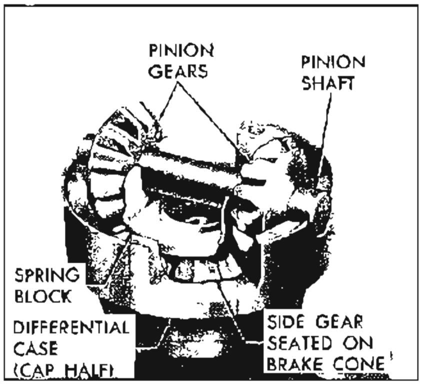



Figure 6-40—Installing Parts Into Cap Half of Differential Case

grooves. Install thrust block, pinion shaft, pinion gears and thrust washers into cap half of differential case in such a manner that pinion shaft retaining dowel can be inserted through pinion gear shaft into differential case. This prevents the pinion shaft from sliding out and causing damage to the carrier assembly. See Figure 6-40.

5. Insert springs into spring thrust block that is already installed into case, and then place second thrust block over springs. See Figure 6-41.

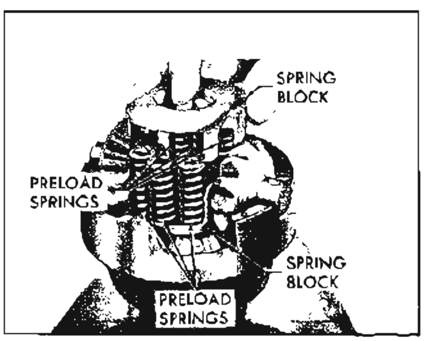



Figure 6-41—Installing Preload Springs & Second Thrust Block Into Differential Case

6. Install second side gear face down on spring thrust block so that side gear will mesh with pinion gears.

7. Place shim, if provided, and remaining cone over side gear.

8. Install flange side of differential assembly over cone in proper position to match alignment marks; insert two bolts finger tight 180° apart. See Figure 6-42.

9. Install other axle shaft through flange half of differential case rotating axle to enter cone splines and then side gear splines. Leaving the axle shaft in this position, insert remaining bolts and tighten to 15-18 ft. lb. See Figure 6-43.

10. Remove axle shafts. A slight tapping on the shafts with a soft hammer may be necessary to align the splines during assembly. The shafts can then be readily reinstalled without spline interference during final assembly.

11. Install unit into axle carrier following instructions given in paragraph 6-6 (f). CAUTION: After unit is installed in carrier, do not attempt to rotate one axle shaft until both are in position. Rotation of one shaft without the other installed will result in misalignment of cone and side gear splines and may prevent entry of second shaft.

### d. Simple Procedure for Testing a Positive Traction Differential

If there is a doubt that a Buick is equipped with a Positive Traction Differential, or to determine if

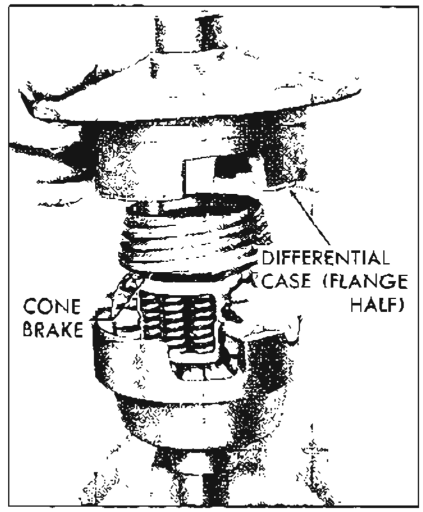



Figure 6-42—Installing Flange Half of Differential Case

this option is performing satisfactorily, a simple test can be performed. Place a roller-mounted floor jack far outboard under the rear axle housing and slightly raise one wheel off floor. With one person guiding the jack, another can attempt to slowly drive the car forward. If the car is equipped with a properly-functioning Positive Traction Differential, the car will move forward since the spring-loaded brake cones partially lock the rear axle to point that the car will move.

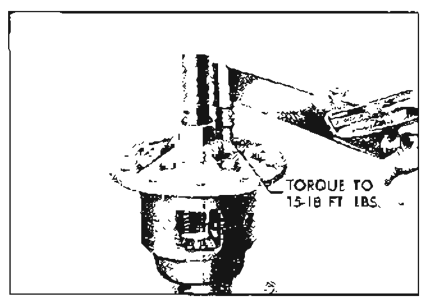



Figure 6-43—Torquing Differential Bolts

# SECTION 6-D
# PROPELLER SHAFT

## CONTENTS OF SECTION 6-D



## 6-10 DESCRIPTION OF PROPELLER SHAFT

Power is transmitted from the transmission output shaft to the differential by either one of two type propeller shaft assemblies: One type, used on synchromesh cars, consists of a solid piece of tubular steel; the second type incorporates torsional rubber dampers and is used with automatic transmission cars. On either type a universal joint and splined yoke is located at the transmission end, and a second universal joint is used at the differential end. See Figure 6-44.

Two U-bolt type clamps are used to attach the rear universal joint to the pinion flange at the differential. The front universal joint attaches to the output shaft of the transmission by means of a splined yoke which permits fore and aft movement of the propeller shaft as the rear axle assembly moves up and down. This splined yoke connection is lubricated internally with transmission lubricant. An oil seal at the transmission prevents loss of lubricant and protects the splined yoke from harmful foreign material.

The propeller shaft assembly requires very little periodic service. The universal joints are lubricated for life and cannot be lubricated while on the car. A

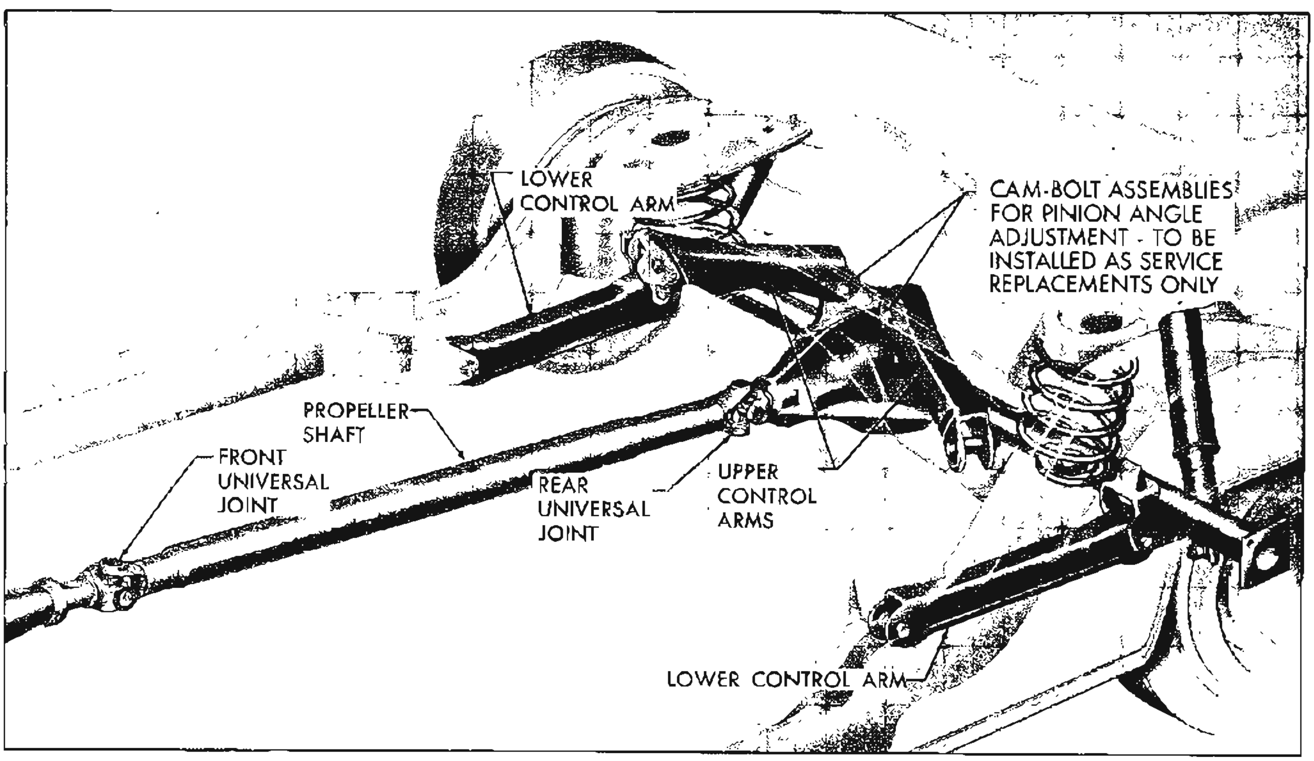



Figure 6-44—Propeller Shaft Assembly

service kit which consists of a spider with bearing assemblies and snap rings must be installed on the car if a universal joint becomes worn or noisy. If it becomes necessary to repair a universal joint, the entire propeller shaft must be removed from the car. Care should be taken to avoid jamming or bending of any parts of the assembly.

If a car is to be undercoated, the propeller shaft must be kept completely free of undercoating material. Undercoating material or any other foreign material could upset the propeller shaft balance and produce serious vibration.

## 6-11 PROPELLER SHAFT TROUBLE DIAGNOSIS

| COMPLAINT | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| Shudder on acceleration low speed | Improperly adjusted rear joint angle | Check and adjust using Kent-Moore alignment gauge. |
| Roughness or vibration any speed | Bent or dented shaft | Replace |
| | Tight universal joints | Impact yokes with hammer to free up. Replace joint if unable to free up or if joint feels rough when rotated by hand. See Figure 6-51. |
| | Worn universal joints | Replace |
| | U-Joint retainer bent against bearing cup | Replace |
| | Undercoating on shaft | Clean up shaft |
| | Incorrect U-bolt torque | Check and correct - 15-18 ft. lbs.) |
| | Burrs or gouges on companion flange snap ring location surfaces | Replace companion flange if it can't be reworked |
| | Incorrect rear joint angle (usually too large an angle) | Check and adjust using Kent-Moore alignment gauge. |
| | Tire unbalance | Balance wheel and tire assembly or replace from known good car. |
| | Shaft or companion flange unbalance combination | 1. Check for missing balance weights.<br>2. Remove and reassemble shaft to companion flange 180° from initial location.<br>3. Rebalance in car using (2) hose clamp method. See paragraph 6-18. |
| Roughness usually at low speeds, light load, 15-35 MPH | Improperly adjusted joint angles usually rear joint angle is too large. | Check and adjust rear joint angle using Kent-Moore alignment gauge. |

## 6-11 PROPELLER SHAFT TROUBLE DIAGNOSIS (Cont'd.)

| COMPLAINT | POSSIBLE CAUSE | CORRECTION |
|---|---|---|
| Roughness usually at low speeds, light load, 15-35 MPH (Cont'd) | U-bolt clamp nuts excessively tight. | Check and correct torque (15-18 lb. ft.) |
| Knock or click | Loose upper or lower control arm bushing bolts | Tighten bolts |
| Scraping noise | Slinger on companion flange rubbing on rear axle carrier | Straighten out slinger to remove interference. |

## 6-12 REMOVAL OF PROPELLER SHAFT

1. Remove U-bolt nuts and U-bolts from rear pinion flange. NOTE: If universal spider bearings are not retained on spider with connecting strap, use tape or wire to retain bearings. Mark propeller shaft and companion flange so that shaft can be reinstalled in same position.

2. Remove entire propeller shaft assembly by sliding rearward to disengage splines on transmission main shaft.

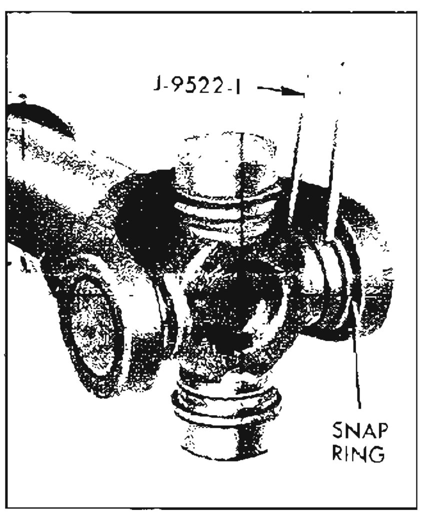



Figure 6-45—Removing Snap Rings From Propeller Shaft

## 6-13 DISASSEMBLY OF PROPELLER SHAFT

1. Remove snap rings from the bearings. The snap rings are on the inside of the yoke and can be removed with the aid of Tool J-9522-1. See Figure 6-45.

2. Set up J-6180-01 Power Ram and J-6207 Hydraulic Pump in preparation for removing the propeller shaft bearings. With this use Axle Bearing and Retainer Replacer J-8853 as a base plate. Attach Adapter J-9522-2 onto the ram screw. See Figure 6-46.

3. Position the propeller shaft universal joint into the fixture as set up in Step 2 with a bearing over the hole in Replacer J-8853. Install Spider Press J-9522-4 on spider. See Figure 6-46.

With tools in position actuate the pump and force the spider against the lower bearing, pushing the bearing as far out of the universal joint and through the hole in Tool J-8853 as possible.

4. Release the pump and remove the propeller shaft. Install Spacer J-9522-6 over the spider journal at the space provided with bearing forced partially through the yoke. See Figure 6-47. Reposition the propeller shaft in the fixture as before and force the bearing completely out of the yoke with the added assistance of the spacer.

5. Release pump and propeller

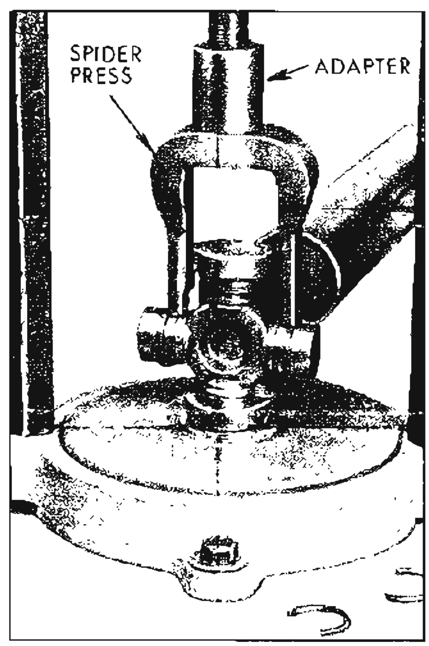



Figure 6-46—Pressing Out U-Joint Bearing

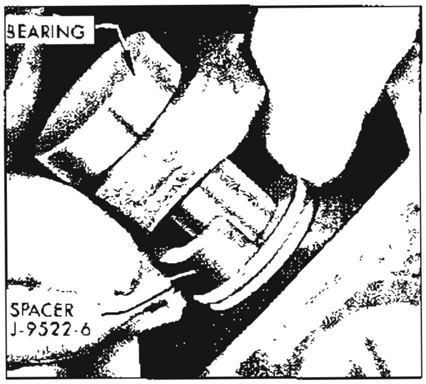



Figure 6-47—Installing Spacer

shaft. Install Guide J-9522-9 through the bearing hole in the yoke and over the journal end of the spider. See Figure 6-48. This guide assures alignment of the spider while removing the opposite bearing.

6. Install Spacer J-9522-6 adjacent to the bearing as in Step 4 and remove the bearing. See Figure 6-49.

7. Repeat Steps 3, 4, 5 and 6 to remove other bearings until the propeller shaft is disassembled to a point desired.

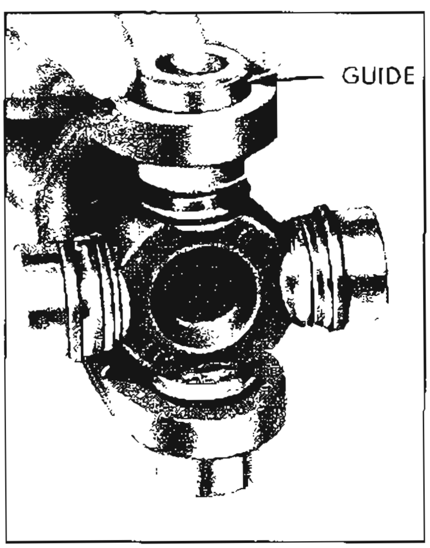



Figure 6-48—Installing Guide on U-Joint

8. Wash all parts in cleaning fluid. Inspect all bearings and races for wear; inspect splined yoke for wear and freedom from dirt. Replace any damaged parts.

## 6-14 ASSEMBLY OF PROPELLER SHAFT

When inspection indicates any worn or damaged universal joint parts, always install a complete universal joint repair kit. Repair kits are listed in the Buick Parts Book under Gr. 5.442 and include a spider, four bearings, and four snap rings.

1. Position the new spider inside the yoke; it may face either direction. Make certain that the spider dust shields are not damaged upon installation.

2. Make certain that the bearings have a full set of rollers, are packed with lubricant, and that the seals are in position. Multi-purpose Universal Joint bearing grease #2 grade should be added to bearings if they are dry, although new bearings are normally pre-lubricated as received from the source.

Place the assembly in position with Power Ram J-6180 and Pump J-6207 as shown in Figure 6-50. Position the bearing straight over the hole in the yoke. Carefully pull up the spider so that the spider journal enters the loose bearing. With the pump, force the bearing into the yoke continuing to hold the spider up in this bearing. Failure to do this could cause the bearing needles to become dislodged if the journal is engaged incorrectly.

When the bearing is correctly positioned in the yoke turn the assembly over. Again place the bearing over the hole in the yoke. Carefully slide the spider partially out of the previously seated bearing and start it carefully into

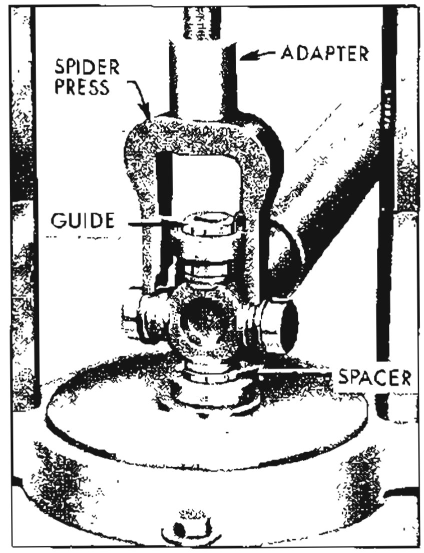



Figure 6-49—Removing Bearing With Guide and Spacer in Place

the bearing being installed. This prevents the bearing needles from burring the edge of the spider journal if forced over journal other than straight. Even slight burring of the journal can cause premature failure.

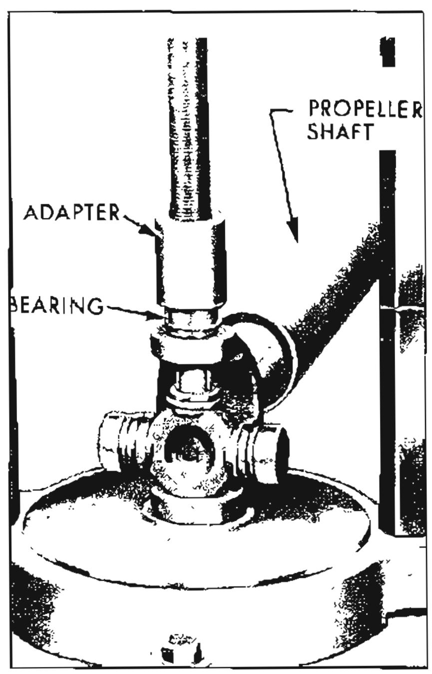



Figure 6-50—Pressing Bearing Into Place

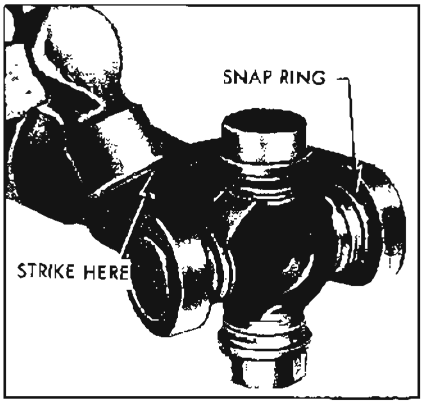



Figure 6-51—Seating U-Joint Snap Rings

While pressing bearings into position, move the spider back and forth to make certain that the spider journals engage the bearings squarely to avoid damage and binding. If binding exists, remove the bearings and spider and examine for dislodged rollers or damaged journals.

3. While observing the previous precautions, install the balance of the bearings necessary to complete the assembly, and install snap rings.

4. Strike the yoke with a hammer to fully seat the snap rings against the yoke. Turn the spider to make certain that it is free. See Figure 6-51.

## 6-15 INSTALLATION OF PROPELLER SHAFT ASSEMBLY

1. Apply engine oil to splined propeller shaft yoke, and then slide yoke and propeller shaft assembly onto transmission output shaft.

2. Position rear universal joint to rear axle pinion flange. Make certain spider bearings are properly aligned in pinion flange yoke. Use marks made prior to shaft removal to align shaft with companion flange.

3. Install U-bolts, lock washers, and nuts; torque nuts evenly to 15-18 ft. lbs. See Figure 6-52.

## 6-16 ADJUSTMENT OF REAR UNIVERSAL JOINT ANGLE

When torque is transmitted through any ordinary universal joint, the driven yoke fluctuates slightly in speed. In other words, although the driving yoke rotates at a constant speed, the driven yoke speeds-up and slows-down twice per revolution. This fluctuation of the driven yoke is in direct proportion to the angle through which the universal joint is operating; the greater the angle, the greater the fluctuation.

Whenever two universal joints are used, this fluctuation effect can be eliminated by staggering the joints so that the two driving yokes are 90° apart provided the two joints are transmitting torque through the same angle.

Therefore, when two universal joints are used, the angles through which they operate must be very nearly the same. This allows the alternate acceleration and deceleration of one joint to be offset by the alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation is rough and an objectionable vibration is produced.

In addition, universal joints are designed to operate safely and efficiently within certain angles. If the designed angle is exceeded, the joint may be broken or otherwise damaged.

The front universal joint angle is actually the angle between the engine - transmission centerline and the propeller shaft. This angle is determined by the design of the body assembly. Since this angle is not liable to change with use, no method has been established for adjusting this front joint angle.

Because sensitivity to pinion angle adjustment has been reduced, non-adjustable rear upper control arms are installed at the best pinion angle during factory installation. If pinion angle adjustment should become necessary during service, adjustable cam-bolt type rear upper control arms may be ordered in pairs from the Parts Department. These arms make adjustment possible by utilizing cam bolts which are located in slotted holes at the rearward ends of each upper control arm. See Figure 6-53. Rotating the cam bolts causes the upper axle brackets to move forward or backward in the slotted upper control arm holes. This forward or backward movement rotates the entire axle assembly which in turn causes the pinion flange and universal joint to move up or down. This vertical movement allows the pinion angle to be adjusted as required. See Section 7 for control arm removal and installation.

If any irregular roughness or vibration is detectable in the drive line, the rear universal joint angle should be checked. Also, if a car is involved in a severe rear end collision, or if the rear axle housing or upper control arms

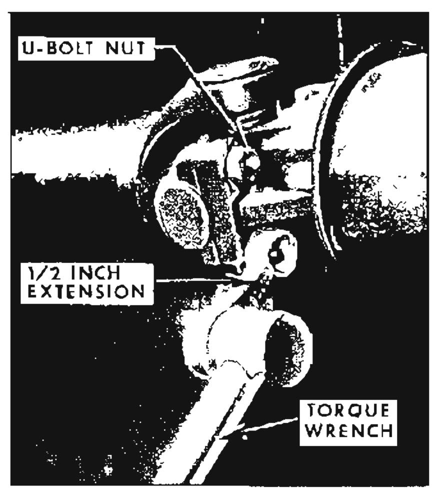



Figure 6-52—Using Extension to Torque U-Bolt Clamps

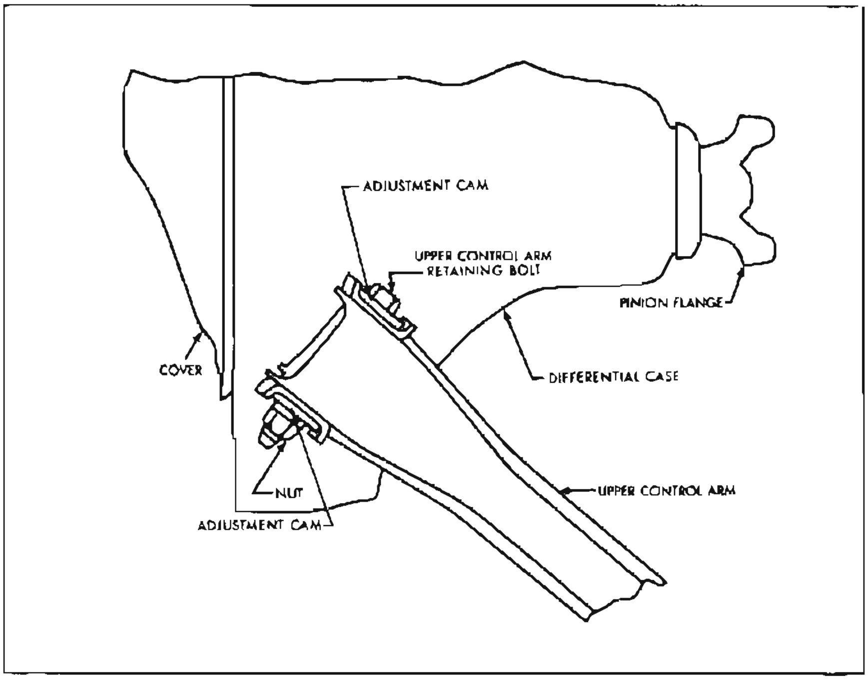



Figure 6-53—Upper Control Arm Cam Bolt Adjustment Assembly For Service Replacement

are replaced, the rear universal joint angle should be checked and corrected if necessary.

Since it is very difficult to measure rear universal joint angle using a bubble protractor, a simple method has been developed using a spring-loaded steel cable stretched between the front of the chassis and the rear axle carrier. When the rear universal joint angle is adjusted correctly, this steel cable will clear the underside of the pinion flange by a definite amount. Therefore, if this single direct measurement is within specified limits, the rear universal joint angle is correct; if this measurement is out of limits, the joint angle is not correct.

Rear universal joint angle is checked using Alignment Set J-8973. This set also contains two pieces, J-8973-22 and J-8973-23 which are used for front end alignment only.

The spacer blocks in the set are designed to raise the rear of the car above normal trim height. Use of these blocks makes certain that the rear universal joint angle will be checked at a predetermined trim height. These blocks must be used since rear universal joint reading varies at different trim heights and the only reference dimension given is for the particular height block supplied.

The front end of the cable is equipped with two attaching brackets so that the cable may be used on all series 1965 Buicks. The rear end of the cable has stops attached at various points to allow the cable to be placed in tension on all wheelbase Buicks.

Check and adjust rear universal joint angle using the following procedure:

If the work is to be done with the aid of a hoist, a drive-on hoist is preferable. A frame contact lift hoist cannot be used because alignment spacers must be inserted between the axle tubes and the frame.

1. With car on hoist, raise rear of car and position spacer blocks with tips up so that they contact frame just ahead of rubber bumper; bottom of block should be parallel to axle. Hold blocks up against frame and allow car to settle until axle housing contacts block. NOTE: Use same blocks for Station Wagons and Sedans. See Figure 6-54.

2. Remove differential cover bolt on either side of lowest cover bolt. Using two 5/16-18 x 1-1/8 bolts with 3/8" spacers, attach rear Bracket J-8973-16 so that slotted lower portion extends rearward at about a 45° angle.

3. Engage front attaching Bracket J-8973-15 in lower opening of vertical center support assembly located at front of radiator. Hook bracket into bottom of opening. See Figure 6-54.

4. Place Engine Height Plate J-8973-14 so that the upper end bears against the engine oil pan between the two rear oil pan bolts. See Figure 6-54. Place the cable in notch of height plate, pull cable tight and hook into rear bracket so one of the stops on the cable is to the rear of the bracket slot. It is important that the cable is fully in the slot and is taut and free of kinks.

5. Measure perpendicular distance from cable to surface immediately in front of slinger on rear pinion flange. The correct dimension is given in Figure 6-54.

6. If the distance measured in the preceding step is not within tolerances, adjustable control arms may be ordered and installed as described above, and then adjusted as follows: Loosen nuts retaining cam bolts which are located at rearward ends of each upper control arm. Turn both loosened cam bolts an equal amount (same relative position left and right) to move rear universal joint up or down. When

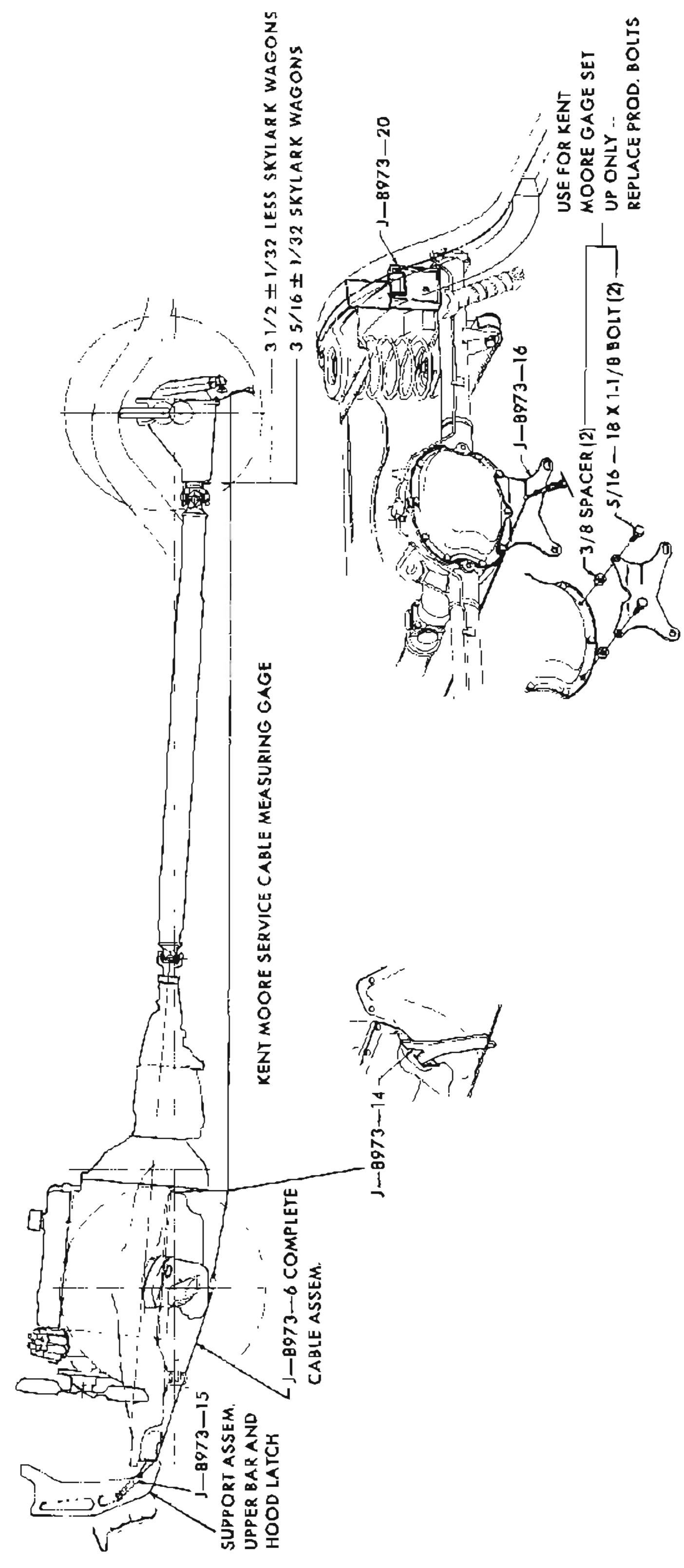



Figure 6-54—Checking Rear Universal Joint Angle

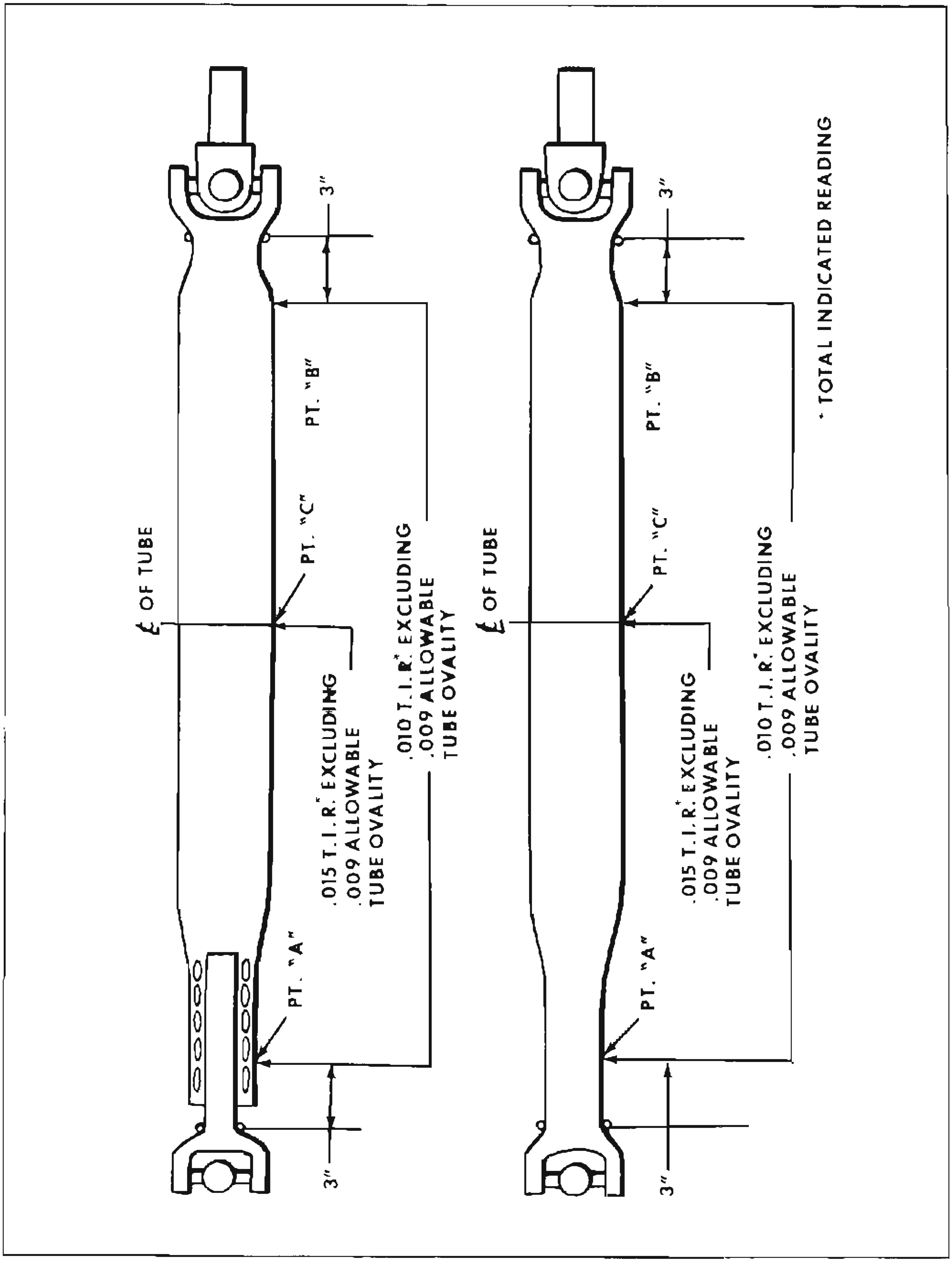



Figure 6-55—Propeller Shaft Run Out

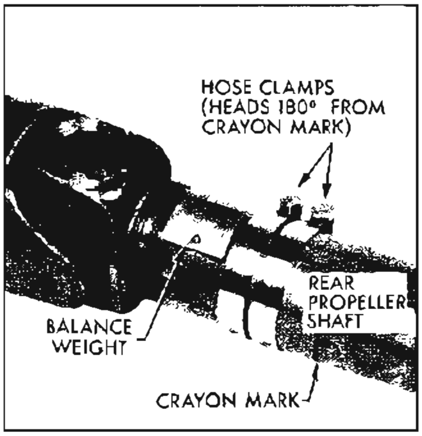



Figure 6-56—Balance Hose Clamps in Place

universal joint is positioned to give the proper vertical dimension on Alignment Set J-8973, tighten nuts and torque to 60-85 ft. lbs. See Figures 6-53 and 54.

7. Remove height rod, cable, bracket and spacer blocks. Reinstall differential cover bolts. Torque to 25-35 ft. lbs.

## 6-17 CHECKING PROPELLER SHAFT RUN-OUT

If there is noise or vibration at high speed which might be caused by a bent shaft (par. 6-11), or if shaft has been damaged through rough handling or a collision, it may be checked for straightness as follows:

1. Raise car on a twin post hoist so that rear of car is supported on rear axle housing with wheels free to rotate.

2. Mount a dial indicator on a movable support that is high enough to permit contact of indicator contact button with propeller shaft. Readings are to be taken at points indicated in Figure 6-55.

3. With transmission in neutral, check for run-out by having a second person turn rear wheel so that propeller shaft will rotate. At points "A" and "B" run-out should not exceed .010. At point "C" run-out should not exceed .015". Care must be taken not to include indicator variation caused by ridges, flat spots, or other variations of the tube.

4. If run-out exceeds specifications because the propeller shaft is bent, it is probably more economical to replace propeller shaft than to attempt straightening it. However, if run-out is within specifications and noise or vibration problem exists, see paragraph 6-18 for propeller shaft corrective balancing procedure.

## 6-18 PROPELLER SHAFT BALANCING PROCEDURE

1. Place car on a twin post hoist so that rear of car is supported on rear axle housing with wheels free to rotate.

2. A car is normally more sensitive to excessive unbalance at the rear so that checking should begin at the rearward end of propeller shaft. Therefore, locate the heavy side of propeller shaft by holding crayon or colored pencil close to rearward end of shaft while shaft is rotating (speedometer indicating 40-50 MPH). Carefully bring crayon up until it just contacts rotating shaft. If carefully done, only the heavy side (point of maximum run-out) will be marked by crayon. This normally gives a good indication of which side of shaft is heavy for unbalance and indicates a starting point for initial location of clamps.

3. Install two Whittek #28 hose clamps (Gr. 1.166, Part #1351813) on propeller shaft as shown in Figure 6-56. Position each clamp with heads 180° from crayon marking. Tighten clamps.

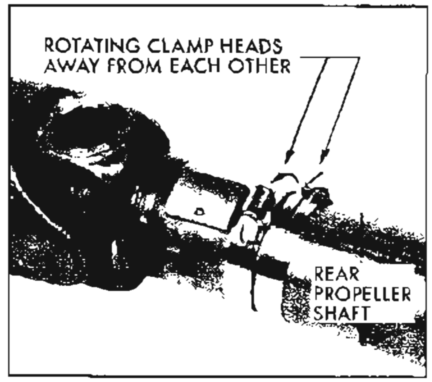



Figure 6-57—Rotating Balance Hose Clamps

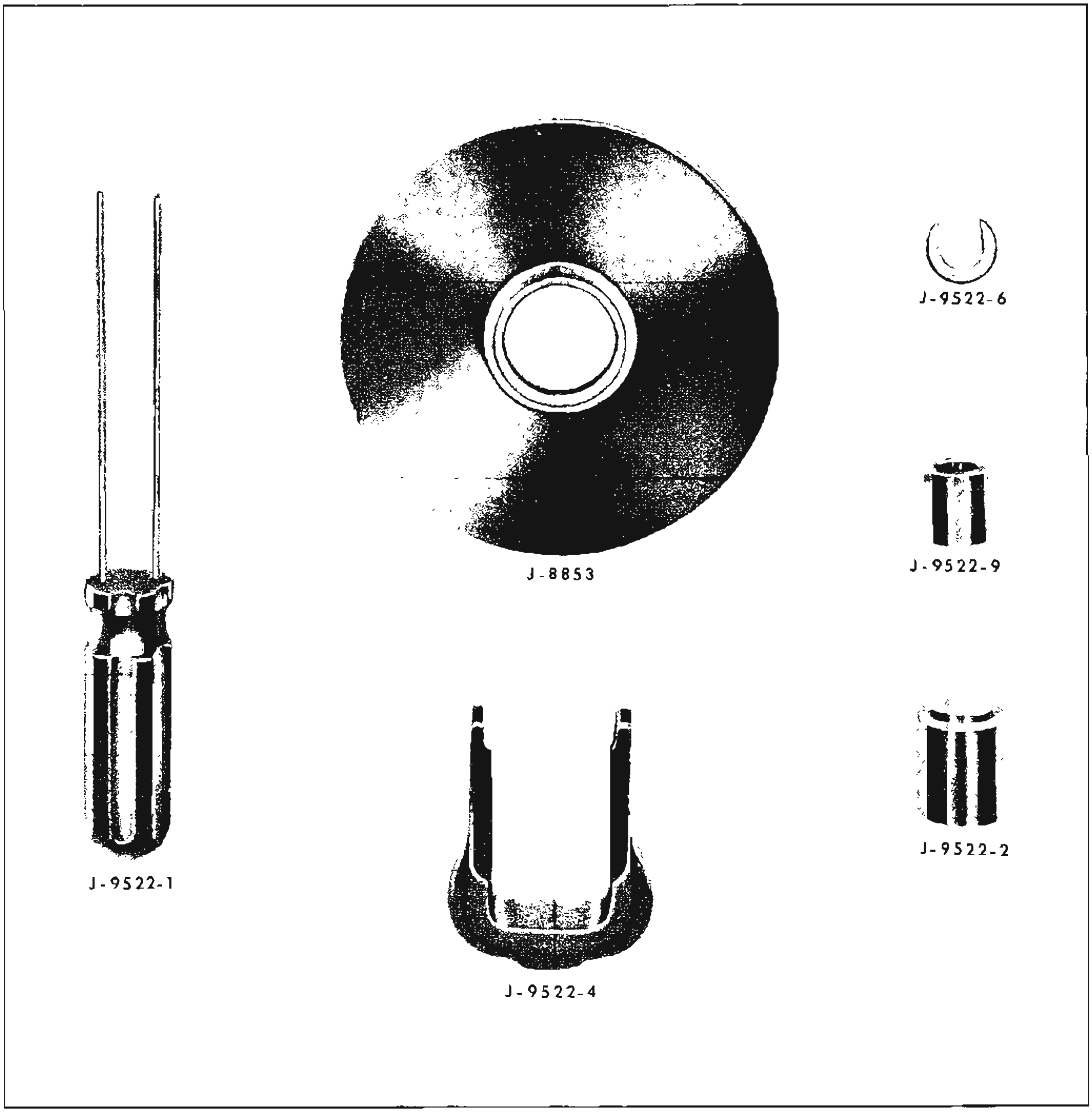
4. Run the car through the speed range to 65 - 70 MPH. If no unbalance is felt, nothing further need be done on the hoist. However, if unbalance still exists, rotate both clamps to the opposite side of the shaft and retighten. Run car again and notice if the unbalance feel is better or worse; if worse, return the clamps to the original position. Apparently the combined weight of the two hose clamp heads was excessive, so to reduce this excess, rotate the clamp heads away from each other 45° (one each way from the original position). See Figure 6-57. Run car and note if unbalance has improved.

5. Continue to rotate the clamps apart in smaller angular increments until the car feel for unbalance is best.

CAUTION: Do not run car on hoist for extended periods due to danger of overheating the transmission or engine.

6. Roadtest the car again for final check of balance.

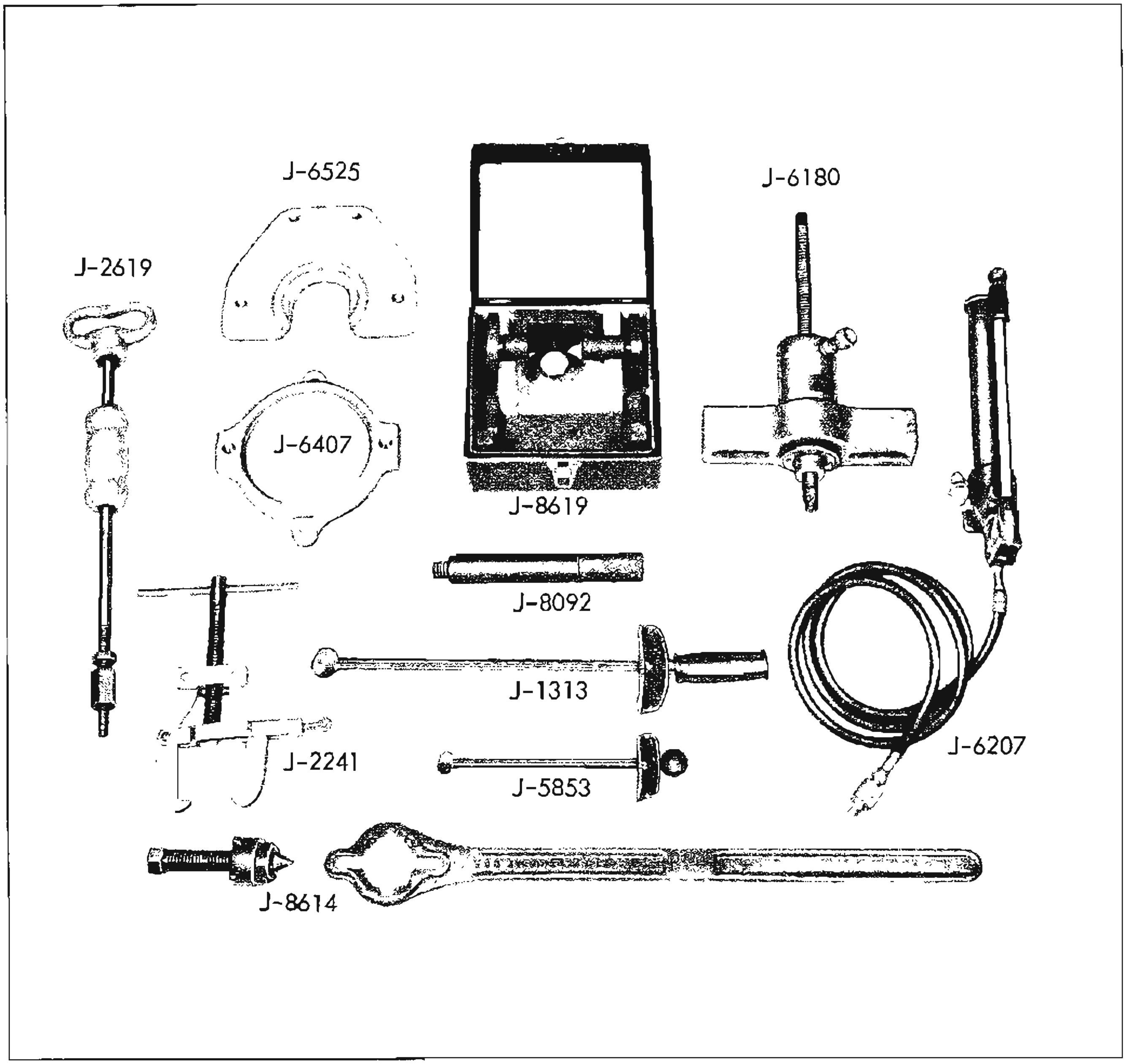
NOTE: Slight vibration felt in the car on the hoist may not show up in a roadtest which is after all the final determining factor.




Propeller Shaft Tools

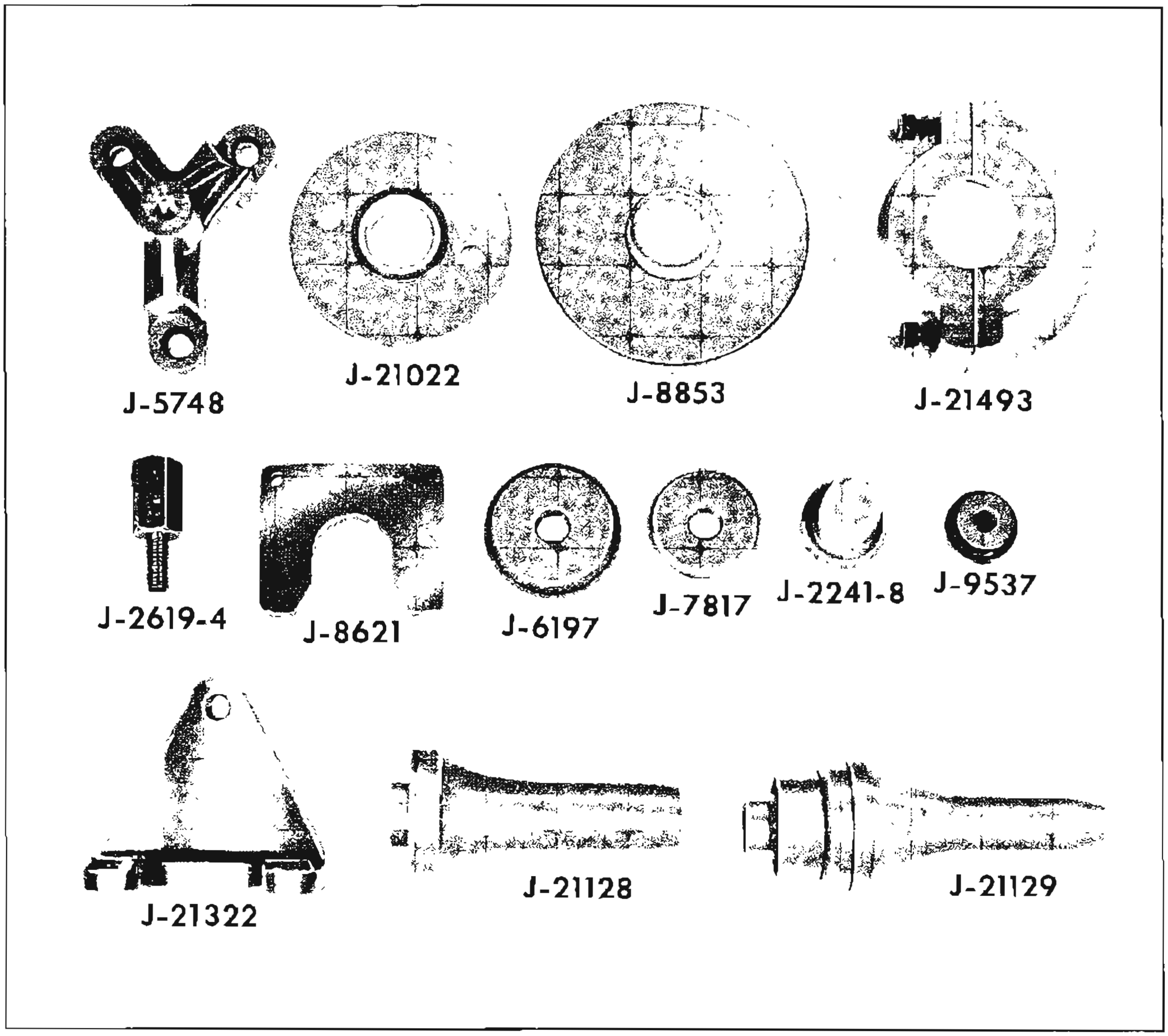
J-8853 Axle Bearing & Bearing Retainer Replacer
J-9522-1 Snap Ring Remover
J-9522-2 Power Ram Adapter
J-9522-4 Spider Press
J-9522-6 Bearing Spacer
J-9522-9 Bearing Guide

Figure 6-58—Propeller Shaft Tools




J-1313 Torque Wrench (0 - 150 ft. lb.)
J-2241 Side Carrier Bearing Puller
J-2619 Slide Hammer
J-5853 Torque Wrench (0 100 in. lb.)
J-6180 12 Ton Power Ram
J-6207 Hydraulic Pump
J-6407 Press Plate Holder
J-6525 Axle Shaft Bearing Remover
J-8092 Driver Handle
J-8614 Companion Flange Holder and Puller
J-8619 Pinion Setting Gauge

Figure 6-59—Rear Axle Tools




Rear Axle Tools (Group 2)

| | |
|---|---|
| J-5748 | Axle Shaft Remover |
| J-6197 | Rear Pinion Bearing & Race Installer |
| J-7817 | Front Pinion Bearing & Outer Race Installer |
| J-8621 | Axle Shaft Bearing Puller Plate |
| J-8853 | Axle Shaft Retainer & Ring Installer |
| J-9537 | Side Bearing Puller Support |
| J-21022 | Rear Pinion Bearing Installer |
| J-21128 | Pinion Oil Seal Installer |
| J-21129 | Axle Shaft Oil Seal Installer |
| J-21322 | Differential Case Remover |
| J-21493 | Rear Pinion Bearing Remover |
| J-2241-8 | Differential Side Bearing Installer |
| J-2619-4 | Ram Screw Adapter |

Figure 6-60—Rear Axle Tools (Group 2)

# GROUP 7

# CHASSIS SUSPENSION

## SECTIONS IN GROUP 7



# SECTION 7-A

# SPECIFICATIONS AND DESCRIPTION OF CHASSIS SUSPENSION

## CONTENTS OF SECTION 7-A



## 7-1 CHASSIS SUSPENSION SPECIFICATIONS

### a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only, dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

#### FRONT SUSPENSION

| Part | Location | Thread Size | Torque Ft. Lbs. |
|---|---|---|---|
| Link & Nut | Stabilizer Link and Nut | Special | 5-10 |
| Bolt | Front Shock Absorber to Upper Control Arm | Special | 5-10 |
| Screw | Front Shock Absorber to Lower Control Arm | 5/16-18 x 7/8" | 12-24 |
| Screw | Stabilizer Shaft Bracket to Frame | 5/16-18 x 1 1/8" | 10-15 |
| Nut | Upper Ball Joint to Knuckle | 1/2-20 | 40-60 |
| Nut | Lower Ball Joint to Knuckle | 9/16-18 | 60-95 |
| Bolt & Nut | Upper Control Arm Shaft to Frame | 7/16-14 x 2 1/4" | 45-60 |
| Bolt & Nut | Lower Control Arm to Frame | 1/2-13 x 3 3/4" | 65-90 |
| Nut | Robber Bumper to Lower Control Arm | 3/8-16 | 15-25 |

#### REAR SUSPENSION

| Part | Location | Thread Size | Torque Ft. Lbs. |
|---|---|---|---|
| Bolt & Nut | Coil Spring to Axle | 1/2-13 x 1 3/4" | 20-30 |
| Nut | Rear Shock Absorber Mounting (Sportwagon only) | 3/8 x 24 | 5-10 |
| Bolt & Nut | Rear Shock Absorber Upper Mounting | 5/16-18 x 7/8" | 12-24 |
| Nut | Rear Shock Absorber Lower Mounting | 1/2-20 | 30-60 |
| Bolt & Nut | Upper Control Arm (Either End) | 1/2-13 x 3 3/4" | 65-90 |
| Bolt & Nut | Lower Control Arm (Either End) | 1/2-13 x 3 3/4" | 65-90 |
| Bolt & Nut | Rubber Bumper Spacer Attaching | 7/16-14 x 1" | 35-60 |

### b. Wheels

| | |
|---|---|
| Type | Demountable Steel Disc With Drop Center Rim |
| Size | 14 x 5.00 All Models 14 x 6.00 - Standard on Sportwagon and Option Other Models Where 7.77 x 15 Tires Are Used |
| Attachment | 5 Studs |

### c. Tires

Size

| Series | Models | Standard Tire | Optional Tire |
|---|---|---|---|
| Special V-6<br>Special DeLuxe V-6<br>Skylark V-6 | Sedans, Coupes, & Convertibles Less A.C. | 6.95 x 14 | 7.35 x 14 |
| Special V-6<br>Special DeLuxe V-6<br>Skylark V-6 | Sedans, Coupes, & Convertibles With A.C. | 7.35 x 14 | 7.75 x 14 |
| Special V-6<br>Special DeLuxe V-6 | Station Wagons | 7.35 x 14 | 7.75 x 14 |
| Special V-8<br>Special DeLuxe V-8<br>Skylark V-8 | Sedans, Coupes, & Convertibles | 7.35 x 14 | 7.75 x 14 |
| Special V-8<br>Special DeLuxe V-8 | Station Wagons | 7.35 x 14 | 7.75 x 14 |
| Skylark V-8 | Sportwagons | 7.75 x 14 | 7.75 x 14 (4-ply, 8-ply, rating) |

Inflation Pressures

| Type of Car | Average Load Front - Rear | Full Rated Load Front - Rear |
|---|---|---|
| All Models (Except Station Wagons) | 24 Cold<br>30 Hot | 28 - 30 Cold<br>34 - 36 Hot |
| Station Wagons | 22 - 28 Cold<br>28 - 34 Hot | 24 - 30 Cold<br>30 - 36 Hot |

### d. Shock Absorbers, Springs, and Stabilizers

Shock Absorbers . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Delco Double Direct-Acting - Front and Rear
Springs . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Coil - Front and Rear
Stabilizer Bar Diameter . . . . . . . . . . . 3/4" - Std. on All Coupes and Convertibles (Less Heavy Duty)
13/16" - Std. on All Special Wagons, Sedans, Coupes and Convertibles With Heavy Duty Suspension
7/8" - Std. on All Skylark Wagons
15/16" - Std. on All Special Wagons With Heavy Duty Suspension

## 7-2 DESCRIPTION OF SUSPENSION

### a. Front Suspension

The front wheel suspension is designed to allow each front wheel to rise and fall, due to change in road surface level, without appreciably affecting the opposite wheel.

Each wheel is independently connected to the frame front cross member by a steering knuckle, ball and socket assemblies, and upper and lower control arm assemblies. See Figure 7-1. The upper and lower arms are so placed and proportioned in length that they allow each knuckle, and wheel to move through a vertical arc only. The front wheels are held in proper relation to each other for steering by means of two tie rods which connect to steering arms on the steering knuckles and to an intermediate rod.

Coil chassis springs are mounted between the spring housings on the frame and the lower control arms. Ride control is provided by double direct acting shock absorbers mounted inside the coil springs and attached to the lower control arms by bolts. The upper portion of each shock absorber extends through the spring housing and is secured with two grommets, two grommet retainers, and a nut.

Side roll of the front suspension is controlled by a spring steel stabilizer shaft. It is mounted in rubber bushings which are held to

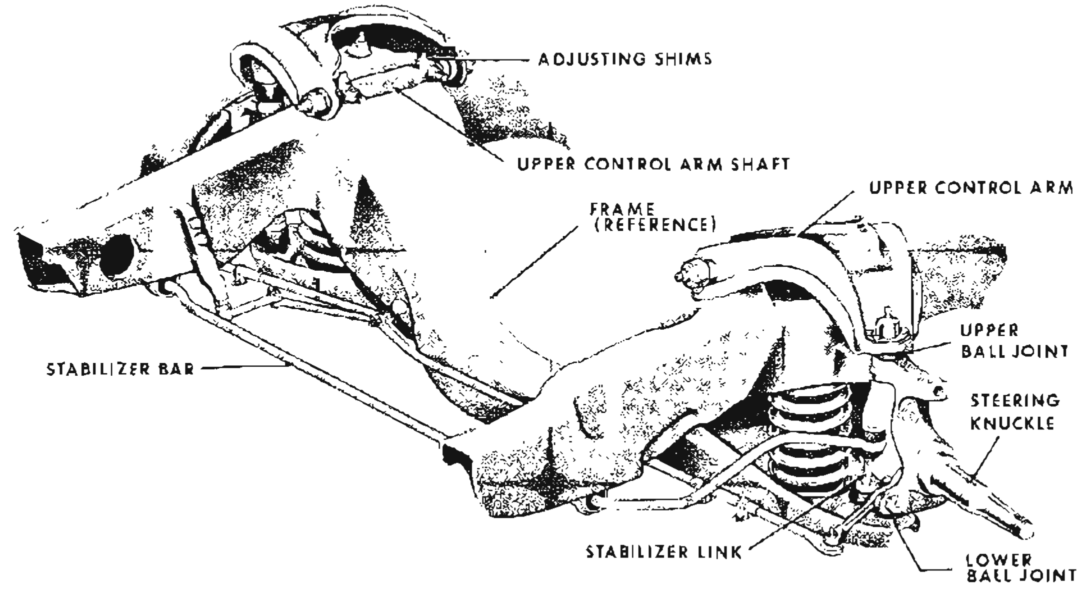



Figure 7-1—Front Suspension

the frame side rails by brackets. The ends of the stabilizer are connected to the front side of the lower control arms. Rubber grommets at these connections provide flexibility and prevent rattles.

The upper control arms are provided with hardened, replaceable, threaded steel bushings that are screwed securely into the inner ends of the arms. The upper control arm shaft is screwed into the inner portion of the bushing, thus providing a thread type bearing. A ball joint is riveted to the outer end of the upper arm. It is spring loaded to insure proper alignment of the ball in the socket. See Figure 7-3.

The inner end of the lower control arm has pressed-in bushings. Two bolts, passing through the bushings, attach the arm to the frame. See Figure 7-3. The lower ball joint is a press fit in the arm and attaches to the steering knuckle with a castellated nut that is retained with a cotter pin.

Rubber seals are provided on upper and lower arm shafts and at ball socket assemblies to exclude dirt and moisture from bearing surfaces. Lubrication fittings are provided at all bearing locations.

### b. Rear Suspension

The rear wheels are not independently sprung, being incorporated into the rear axle assembly. Alignment is maintained by the rigid rear axle housing. See Figure 7-4.

The rear axle is attached to the frame through a link type suspension system. Two rubber bushed lower control arms mounted between the axle housing and the frame maintain fore and aft relationship of the axle housing to the chassis. Two rubber bushed upper control arms, angularly mounted with respect to the center line of the car, control sideways movement of the axle assembly.

The upper control arms are shorter than the lower arms, causing the axle housing to "rock" or tilt forward on compression. This rocking or tilting lowers the rear propeller shaft to make possible the use of a much lower tunnel through the rear floor pan than would be possible with a conventional rear suspension. See Figure 7-5.

Coil chassis springs are located between the spring housings on the frame and brackets on the rear axle housing. A clamp secures the spring to the axle bracket and is attached with a bolt. A rubber bumper attached to the rear axle housing just outboard of the coil spring, limits axle travel during spring compression.

Ride control is provided by two double direct acting shock absorbers angularly mounted between axle housing brackets and the frame. Rubber bushings at both ends of the shock absorbers prevent vibration and aid in reducing noise transference to the frame.

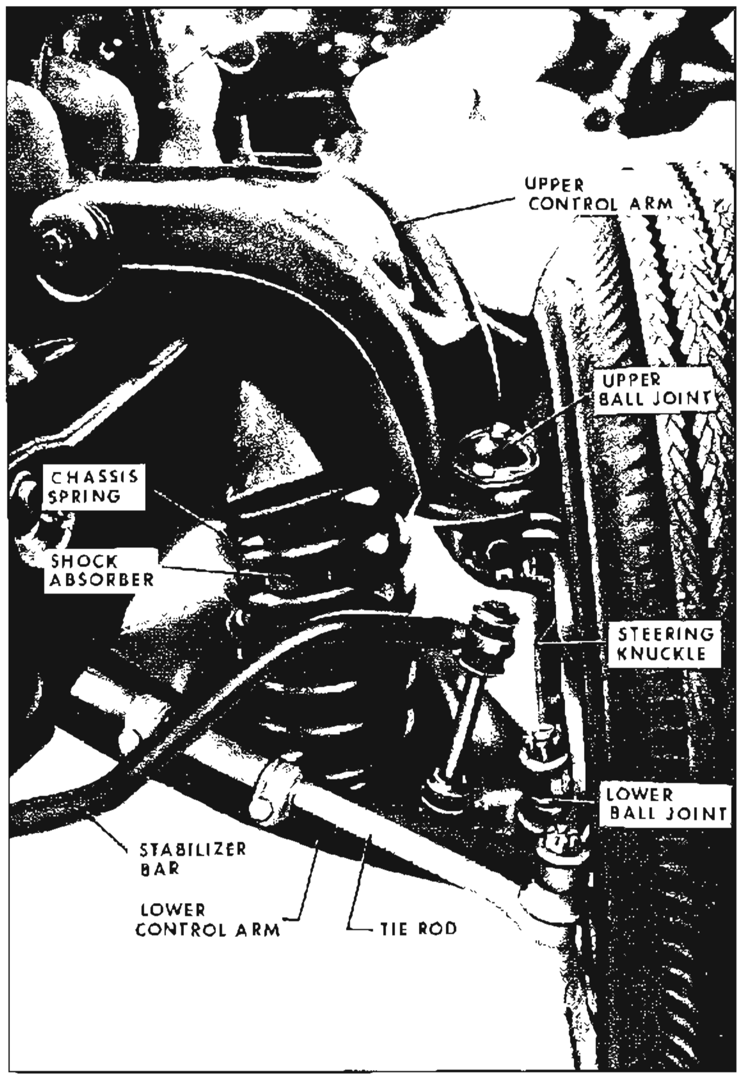



Figure 7-2—Steering Knuckle and Ball Joints

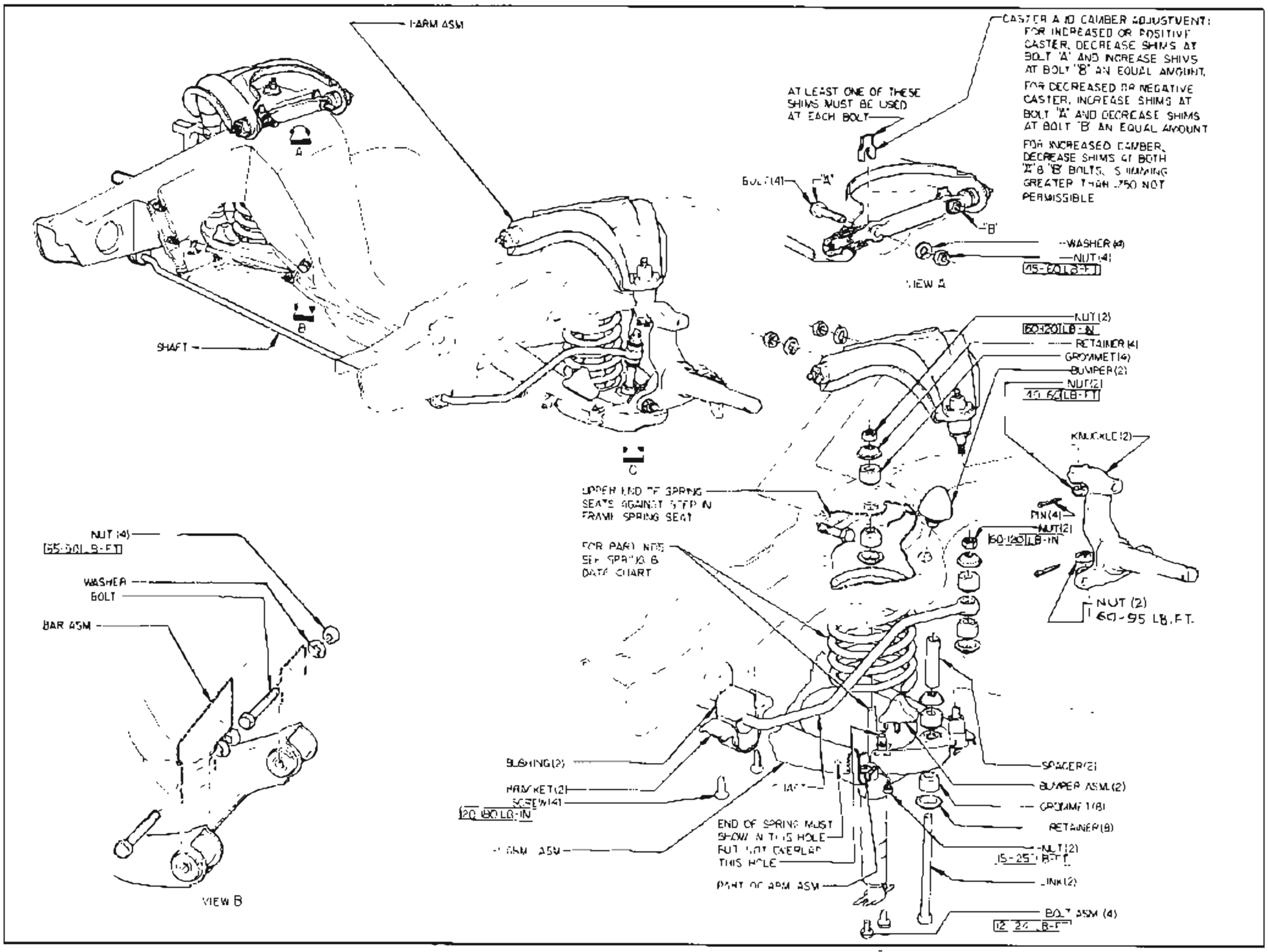



Figure 7-3—Front Suspension Details

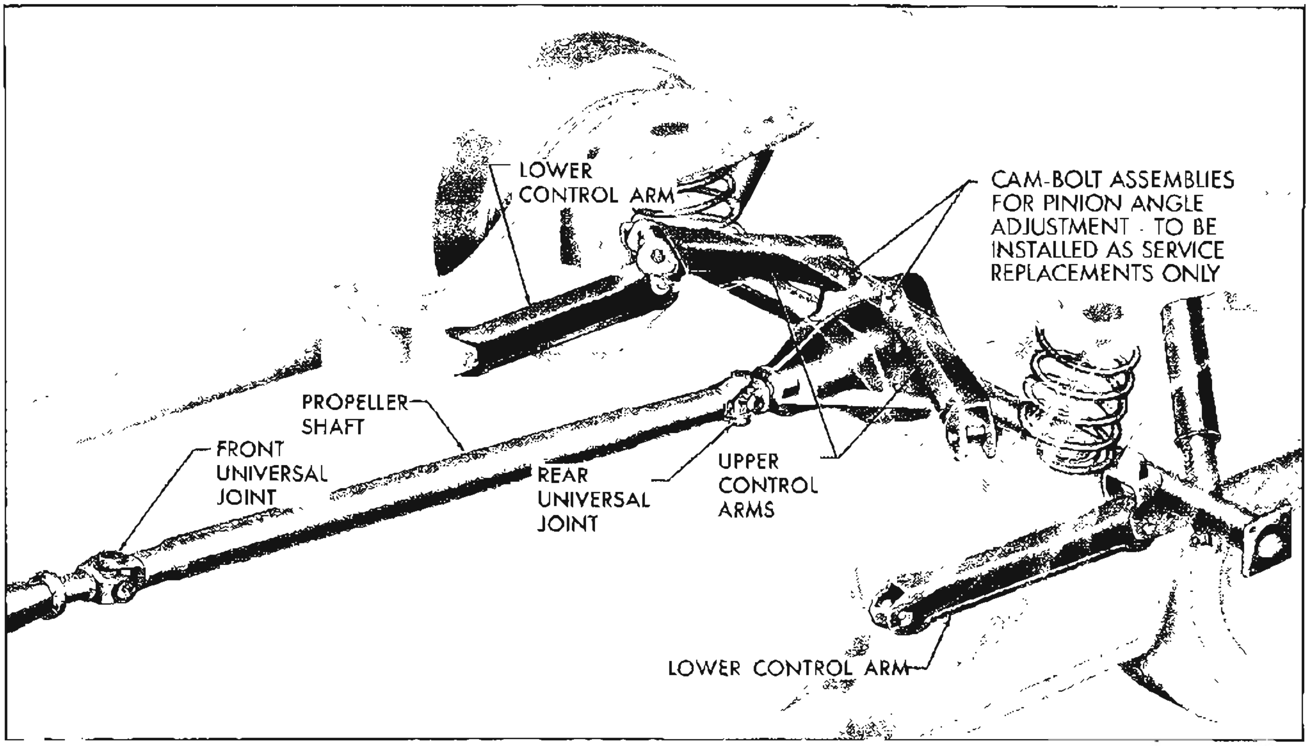



Figure 7-4—Rear Suspension

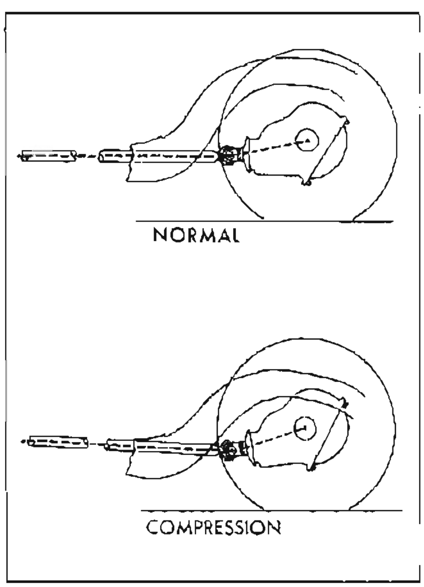



Figure 7-5—Rear Axle Tilting Action

# SECTION 7-B

# TROUBLE DIAGNOSIS—CHASSIS SUSPENSION

## CONTENTS OF SECTION 7-B



## 7-3 CAR ROUGHNESS OR VIBRATION

Car roughness or vibration may be caused by road surface conditions as some types of road set up unusual vibrations in cars at various speeds. Testing the car on a different type of road will show whether the road is causing the vibration.

Some types of tire treads, and tire construction other than those chosen for production may cause abnormal vibration or roughness. If car is equipped with tires other than those which have been selected for production equipment, it is advisable to test the car with standard tire equipment before deciding that a mechanical condition is the cause of roughness.

The following procedure should be used to determine cause of roughness or vibration in car operation at various speeds, which may be due to an unbalanced condition of wheels, tires, brake drums, propeller shaft, or engine.

1. Jack up all wheels, having jack support rear end of car at center of rear axle housing.

2. Check runout of front and rear wheels and tires. Runout should not exceed specifications shown in Figure 7-7.

3. With transmission in third speed or Drive run engine at various car speeds to note speeds at which vibration or roughness occurs.

4. Remove rear wheels and run engine again at the critical speeds noted in Step 3. If roughness is gone the condition is caused by unbalanced rear wheel and tire assemblies (par. 7-9).

5. If roughness still exists with rear wheels removed, remove rear brake drums and repeat the running test. Elimination of the roughness indicates out of balance brake drums (par. 9-12).

6. If roughness still exists with brake drums removed, run engine with transmission in Neutral. Elimination of the roughness indicates that propeller shaft is out of balance or not running true (par. 6-18). Continued roughness with engine running along indicates an out of balance condition of engine.

## 7-4 IMPROPER STEERING ACTION

Steering action is dependent upon the chassis suspension members as well as the steering gear assembly and tie rods. Improper steering actions which are most likely to be caused by chassis suspension are covered in this paragraph, while conditions most likely to be caused by the steering gear assembly or tie rods are covered in paragraph 8-3.

### a. Car Pulls or Leads to One Side

1. High crowned roads.

2. Low or uneven tire pressure (par. 1-2).

3. Front tires of unequal diameter due to wear.

4. Brakes dragging on one side (par. 9-8).

5. Incorrect caster, camber, or toe of front wheels (par. 7-18).

6. Suspension components bent or broken.

### b. Steering Affected by Application of Brakes

1. Oil or other foreign matter on brake lining. See paragraph 9-6.

2. Low or uneven tire pressure (par. 1-2).

3. Type of road surface.

4. Wheels toe out in straight ahead position (par. 7-18).

5. Incorrect or uneven caster or camber (par. 7-18).

6. Steering gear adjusted too loose or too tight (par. 8-4).

7. No lubrication in ball joints or upper ball joint worn (par. 7-12).

8. Loose suspension components.

### c. Road Shocks Transmitted to Steering Wheel

1. High tire pressure (par. 1-2).

2. Wrong type of tires used (par. 7-6).

3. Worn tires (especially

shoulder or cornering wear) (par. 7-6).

4. Steering gear loosely adjusted (par. 8-4).

5. Shock absorbers inoperative (worn or leaking) (par. 7-8).

6. Steering knuckle upper ball joint worn (par. 7-12).

### d. Front Wheel Shimmy (Low Speed)

Low speed shimmy is a rapid series of oscillations of the front wheel and tire assembly as the wheels attempt to point alternately to the right and left. This movement is often transmitted through the steering linkage to the steering gear. Low speed shimmy usually occurs below 30 MPH.

1. Uneven or low tire pressure or highly worn tires (par. 1-2).

2. One or both wheel and tire assemblies out of balance (par. 7-9).

3. Front wheel bearings loose or worn (par. 7-11).

4. Incorrect alignment of front wheels (par 7-18).

5. Steering knuckle upper ball joint worn (par. 7-12).

6. Steering gear incorrectly adjusted or worn (par. 8-4).

## 7-5 WHEEL TRAMP

Wheel tramp, sometimes called high speed shimmy, is a rapid up and down movement of a wheel and tire assembly, as though the tire were decidedly eccentric. In severe cases the tire actually hops clear of the road surface. Wheel tramp may develop in either front or rear wheels, and occur at speeds above 35 MPH.

1. Wheel tire or brake drum out of balance (par. 7-9).

2. Excessive tire and wheel runout (par. 7-7).

3. Shock absorber inoperative (pars. 7-14, 7-21).

4. Item 1 or 2 in combination with one or more items listed under Front Wheel Shimmy (subpar. d, preceding).

## 7-6 ABNORMAL TIRE WEAR

### a. General Operating Conditions

Assuming that there is no misalignment condition to cause unnatural wear, the life of tires depend largely upon car operating conditions and driving habits.

Tires wear at a much faster rate in some localities than in others because of road and operating conditions. Some types of roads are much more abrasive than others. Tire wear is also dependent upon the number of hills and mountains which the car must go up and down, the severity of grades, the number of starts and stops, driving speeds, the amount of rain and snow, and prevailing temperatures. Tire wear increases rapidly with speed, temperature and load on the tire. Tires used at low speeds, in cool climates, or with light loads will have longer life than tires used for high speed driving in hot climates with heavy loads.

Driving habits have a very important bearing on tire life. A careful driver may obtain much greater mileage from a set of tires than would be obtained by a severe or careless driver. Rapid acceleration and deceleration, severe application of brakes, taking turns at excessive speed, high speed driving, and striking curbs or other obstructions which lead to misalignment are driving habits which will shorten the life of any tire.

Maintenance of proper inflation pressure and periodic interchanging of tires to equalize wear are within the control of the driver. Underinflation raises the internal temperature of a tire greatly, due to the continual friction caused by the flexing of the side walls. Tire squealing on turns is an indication of underinflation or excessive speed on the turns. A combination of underinflation, high road temperatures, and high speed driving will quickly ruin the best tire made.

High speed on straight highways causes more rapid wear on the rear than on the front tires, and driving turns and curves at too high a rate of speed causes the front tires to wear much faster than the rear tires.

An inspection of the tires, together with information as to locality in which the car has been operated will usually indicate whether abnormal wear is due to the operating conditions described above, or to mechanical faults which should be corrected.

The various types of abnormal tire wear and their causes are described in the following subparagraphs.

### b. Shoulder or Underinflation Tread Wear

When a tire is underinflated, the side walls and shoulders of the tread carry the load while the center of tread folds in or compresses due to the low internal air pressure. This action causes the shoulders to take all of the driving and braking load, resulting in much faster wear of shoulders than of the center of tread. See Figure 7-6, view A. For maximum results in handling, riding and tire life, tire inflation pressures should never be allowed to go below the specified minimum pressure (par. 1-2).

Continuous high speed driving on curves, right and left, may produce tread wear very similar to underinflation wear and might very easily be mistaken for such.

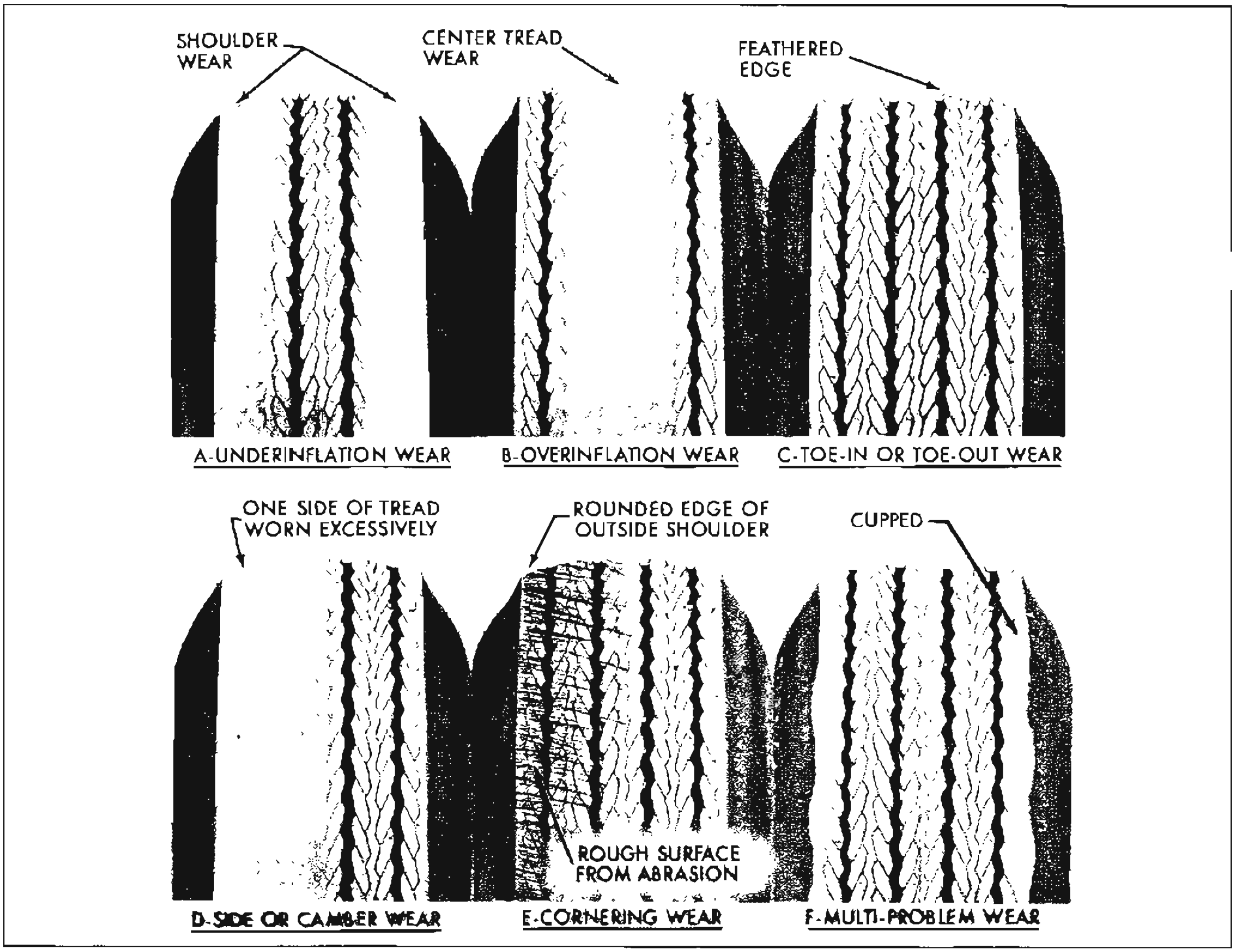



Figure 7-6—Abnormal Tire Tread Wear Patterns

Side thrust when rounding turns causes wear on the sides of tire tread. 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 the side thrust and naturally receive the most wear. The only possible correction is to advise slower speeds on curves. Do not increase tire inflation pressures beyond specified limits as this will cause center or overinflation wear (subpar. c, below).

**c. Center or Overinflation Tread Wear**

On a tire that is overinflated, the center of the tread receives much more driving and braking strain than the sides or shoulders. The center of the tread therefore wears away much faster than the shoulders and, if tire is continuously overinflated, may be worn thin while the shoulders have plenty of tread material left. See Figure 7-6, view B.

When tire inflation pressures are maintained within the specified limits (par. 1-2) the tire will make a full contact across the entire width of tread, thereby distributing the wear evenly over the total surface of the entire tread area.

**d. Cross or Toe Tread Wear**

When the front wheels have an excessive amount of either toe-in or toe-out, the tires are actually dragged sideways when they travel straight down the road, and cross wear or scraping action takes place, rapidly wearing away the tread of tires. This cross wear condition will usually produce a tapered or feathered edge on the ribs of the tire tread. See Figure 7-6, view C. In most cases this can be detected by rubbing the hand across the tire tread.

If the tapered or feathered edges are on the inner sides of the ribs on one or both sides, it indicates that one or both tires have excessive toe-in, while the same condition in the outer sides of ribs indicate excessive toe-out. Usually, excessive toe-in causes excessive tire wear on the outer edge of the right front tire and toe-out causes tire wear on the inner edge of the left front tire. See paragraph 7-18 for toe-in correction.

Cornering wear caused by high speed driving on curves (subpar. f, following) sometimes has the appearance of toe wear. Care must be used to distinguish between these two types of wear so that the proper corrective measures will be used.

#### e. Side or Camber Wear

Excessive wheel camber, either positive or negative, causes the tire to run at such an angle to the road surface that one side of the tread wears much more than the other. See Figure 7-6, view D.

The amount or angle of the camber wear will be governed by the amount of positive or negative camber.

Tire tread wear very similar in appearance to camber wear may be caused by driving on turns at excessive speeds. This "cornering" tread wear (subpar. f, following) cannot be corrected by change of camber angle.
Adjustments for specified camber is covered in paragraph 7-18.

#### f. Cornering Tread Wear

The modern independently sprung automobile allows the driver to negotiate turns at a high rate of speed with a greater feeling of safety. This fact is responsible for a comparatively new type of tread wear that can easily be mistaken for toe or camber wear.

When a car is making a turn, the tires are supposed to be rolling in a circle. When the turn is made at high speed, however, centrifugal force acting on the car causes the tires to be distorted sideways and to slip or skid on the road surface. This produces a diagonal cross type of wear, which in severe cases will result in a fin or sharp edge on each rib of the tire treads.

Cornering wear can be distinguished from toe or camber wear by the rounding of the outside shoulder of the tire, and by the roughening of tread surface in this section denoting severe abrasion. See Figure 7-6, view E.

No alignment or tire pressure change can be made that will relieve cornering wear. Only the driver can effect a cure, and that is by slowing down on curves.

#### g. Heel and Toe Tread Wear

Heel and toe wear is a saw-tooth effect with one end of each tread block worn more than the other. The end which wears is that which first grips the road when the brakes are applied. High speed driving and excessive use of the brakes will cause this type of irregular tire wear. This type of wear will occur on any type of block tread design. See Figure 7-6, view F.

Heel and toe wear is not so prevalent on the rear tires because of the propelling action which creates a counteracting force which wears the opposite end of the tread block. These two stresses on the rear tires wear the tread blocks in opposite directions and result in more even wear, while on the front tires the braking stress is the only one which is effective. This may be counteracted by interchanging tires (par. 7-9).

A small amount of irregular wear, slightly saw-toothed in appearance, at the outer segments of tires is a normal condition and is due to the difference in circumference between the center and the outer edges of the tire tread. This saw-toothed appearance, however, will be exaggerated by underinflation, improper toe-in, or both.

#### h. Cupped or Scalloped Type Tire Wear

Cupping or scalloping is associated with wear on a car driven mostly at highway speeds without recommended tire rotation. Factors which promote cupping include underinflation, incorrect toe-in setting or camber setting, and steady highway speeds on smooth, paved surfaces as opposed to gravel or rough asphalt. See Figure 7-6.

The following recommendations suggest action that may be taken to help prevent cupping:

1. Rotate tires as recommended in paragraph 7-9, subparagraph e.

2. Frequently inspect front tires for irregular wear due to underinflation, improper toe-in setting, or camber setting.

Regardless of the original cause of cupped tread wear on either front tire, no alignment or balance job, however perfect, can prevent future excessive wear of the spots. Once a front tire acquires flat or cupped spots additional wear will continue at a rapid rate. At the time of correction, however, the cupped tire should be interchanged with a rear tire on which the tread runs true. The cupped tire will, to a certain degree, true itself up on a rear wheel.

Although not normally the cause of cupping, the following factors can contribute to the problem: Looseness of parts in the suspension system such as worn steering knuckle ball joints, loose wheel bearings, inoperative shock absorbers, and any excessive looseness throughout the steering system all tend to allow the front wheels to kick around, and if any of the wheel alignment factors are incorrect, irregular spotty tire tread wear of one type or another may result.

Wobble or runout of a tire, either front or rear, due to bent wheel or to tire being improperly mounted will cause uneven wear. The runout of wheel and tire when rotated should not exceed specification shown in Figure 7-7.

## 7-7 TIRE AND WHEEL RUNOUT

Excessive vibration or shake similar to out-of-balance tires can be caused by excessive tire or wheel runout. This runout may be both radial and lateral. Radial runout usually has greater affect on vibration or shake than lateral runout.

A dial indicator may be used to check runout on wheel and tire assemblies at points shown on Figure 7-7. Tire runout should be checked immediately after the car has been driven, as tires take a "set" after standing for a short period. NOTE: It should be stressed that the runout found is a mere indication and not proof of the source of trouble.

Procedure:

1. Make certain that the wheel lug nuts are tightened adequately and evenly.

2. If checking front wheels and tires make certain that wheel bearings are correctly adjusted.

3. Mount the dial indicator on a firm base and check total indicator runout at the points indicated in Figure 7-7.

4. If runout exceeds specifications check for the source of the trouble and correct as necessary.

## 7-8 FAULTY SPRINGS, SCHOCK ABSORBERS OR BALL JOINTS

### a. Springs

Measurement of the trim dimension with springs installed is the only practical method of checking chassis springs that are reported to be weak. See paragraph 7-15 for checking trim dimension. The strength of chassis springs cannot be determined by measurement of the free length when removed from car, because springs of equal strength under rated load may vary considerably in length when not loaded.

### b. Weak or Inoperative Shock Absorbers

Many shock absorbers have been replaced and returned to the factory with the report that they were weak. When tested with special factory equipment very few of these replaced units have been found weak or otherwise below standard in operation. This indicates that these shock absorbers were needlessly replaced in an attempt to improve riding conditions that were actually standard, or that erroneous methods were used in judging the operating condition of the units.

Before attempting to test shock absorbers make sure that all attaching bolts and nuts are tight. Tires should be uniformly inflated to specified pressure (par. 1-2). The chassis should be well lubricated to make sure that suspension parts are free moving.

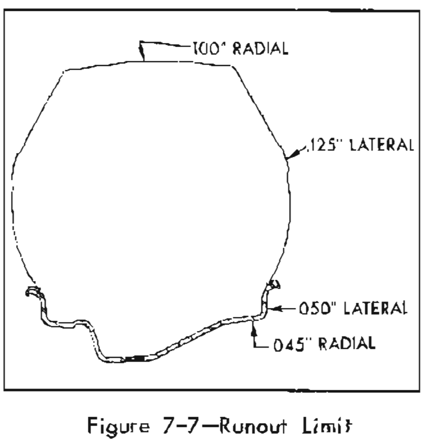



Figure 7-7—Runout Limit Specifications

Test each front and rear shock absorber in turn by quickly pushing down and then lifting up on the end of the car bumper adjacent to the unit being checked. Use the same force as near as possible on each test, and note the amount of resistance provided by the shock absorber on compression and rebound. A little practice on another car of the same model which has satisfactory ride control will aid in judging the amount of resistance that should exist.

Both front shock absorbers should provide the same feeling of resistance and both rear shock absorbers should do likewise. Any noticeable variation between right and left shock absorbers indicates that one unit is not operating normally. Little or no resistance on compression or rebound indicates air in shock absorbers, internal leakage due to wear, or that the valve is held open by dirt. Excessive resistance indicates that bleeder hole in valve is plugged with dirt.

If there is any doubt about the action of a shock absorber after testing as described above, remove the unit from car. Mount it vertically in vise with safe jaws gripping the mounting eye firmly, then move the piston rod up and down by hand. There should be no free movement in this test. Lack of resistance to movement indicates air in the shock absorber, internal leakage due to wear, or that the valve is held open by dirt. A faulty shock absorber must be replaced as it cannot be disassembled for repairs.

In the test given above, the amount of force that can be applied is not sufficient to open a valve against its spring pressure; therefore, this test only checks the flow of fluid through the valve bleeder hole as well as any leakage due to a valve being held open, or due to internal wear of piston and cylinder. Since it is unlikely that the valve springs will weaken in service, it may be assumed that the shock absorber action is normal if it operates satisfactorily in the test given above.

**c. Loose Ball Joints**

The upper ball stud is spring-equipped and thus preloaded in its socket at all times. This minimizes looseness at this point and compensates for normal wear. If the upper stud has any perceptible lateral shake, or if it can be twisted in its socket with the fingers, the upper ball joint should be replaced.

The lower ball joint is not spring loaded but firmly seated by the weight of the car. With the chassis spring load removed from the ball joint, this ball joint may show looseness. Such looseness is probably due to normal operating clearance.

1. Place jack under lower control arm as far outboard as possible and still have access to the lower ball joint grease fitting. Be sure the upper control arm does not contact the rebound bumper when the car is raised. Raise car until front wheel clears the floor.

2. Remove lower ball joint grease fitting and install Gauge J-21240.

3. Place a pry bar between floor and tire and raise tire. This puts a load on the ball joint.

4. Repeat procedure several times and take maximum and minimum gauge readings under load and no load conditions.

5. Subtract minimum reading from maximum reading. If difference is more than .070", replace ball joint.

# SECTION 7-C
# SERVICE, ADJUSTMENT, INSTALLATION PROCEDURES— CHASSIS SUSPENSION

## CONTENTS OF SECTION 7-C



## 7-9 TIRE SERVICE AND INSPECTION

### a. Tire Inflation and Inspection

Maintenance of correct inflation pressure in all tires is one of the most important elements of tire care. Correct tire pressure is also of great importance to ease of handling and riding comfort. Overinflation is detrimental to tire life but not so much as underinflation. Inflate all tires as specified in paragraph 7-1 or 1-2.

All tires should be inspected regularly to avoid abnormal deterioration from preventable causes. If tires show abnormal or uneven wear the cause should be determined and correction should be made.

### b. Tubeless Tire Repairs

After removal of puncturing object a small puncture may be sealed without removal of tire from wheel by injecting sealing dough with a gun. Larger punctures may be sealed by installation of a rubber plug with cement, after tire has been removed from wheel. Sealing dough with gun, and rubber plugs with cement are contained in tire repair kits available through tire dealers. These materials should be used as directed in the instructions supplied with the kits. If a puncture is unrepairable or there is other damage to the tire carcass, repairs should be made by authorized tire dealers in accordance with instructions of the tire manufacturer.

### c. Wheel Leaks

Examine rim flanges for sharp dents and straighten, if necessary. The rim flanges should be thoroughly cleaned with No. 3 coarse steel wool, thereby removing all oxidized rubber, soap solution, etc.

In isolated cases loss of air may result from loose rivets or porous welds. If the leak is minute and the rivet is not perceptibly loose, the leak can be sealed with a cement available from tire manufacturers for this purpose. If the rivet is noticeably loose or the air leak is large, replace the wheel.

CAUTION: Under no condition should loose rivets or porous welds be brazed, welded or peened.

### d. Demounting and Mounting of Tubeless Tire

When demounting a tubeless tire use care to avoid damaging the rim-seal ridges on tire beads. DO NOT USE TIRE IRONS TO FORCE BEADS AWAY FROM WHEEL RIM FLANGES.

When tire is removed, inspect it carefully to determine whether loss of air was caused by puncture or by improper fit of beads against rim flanges. If improper fit is indicated, check wheel as follows:

1. Straighten wheel rim flanges if bent or dented.

2. Clean rims thoroughly, using No. 3 course steel wool, to remove all oxidized rubber, soap solution, etc. Remove rust with wire brush.

3. Inspect butt weld and other areas of rim contacted by tire beads, to make certain there is

no groove or high spot. Remove any groove or high spot by filing smooth.

4. Inspect valve stem and replace it if damaged. Make certain that valve stem is properly installed to provide an air tight joint.

Before mounting a tubeless tire on a wheel, moisten a cloth with mounting compound or soap solution and wipe rim-seal ridges of both beads to remove all foreign substances.

Moisten base of both beads with mounting compound or soap solution to help beads snap into place when tire is inflated. Start tire over rim flange at point opposite valve stem. Align balance mark on tire with valve stem.

Inflate tire until both beads are firmly seated against rim flanges and temporarily inflate to 50 pounds pressure. Leak test wheel and tire assembly and if satisfactory, reduce to recommended pressure.

### e. Interchanging Tires

Tires tend to wear unevenly and become unbalanced as mileage accumulates. Uneven tire wear is frequently the cause of tire noises which are attributed to rear axle gears, bearing, etc., and work is sometimes needlessly done on rear axles in an endeavor to correct the noise.

Tire life will be increased and uneven wear and noise will be less likely to occur if the tires, including the spare are balanced and interchanged at regular intervals of approximately 6000 miles. The recommended method of interchanging tires is shown in Figure 7-8.

### f. Use of Tire Chains

Do not use tire chains on the front wheels under any circumstances because they will interfere with the steering mechanism. Any of the conventional full-type non-skid tire chains can be used on the rear wheels.

Tire chains should be loose enough to "creep" but tight enough to avoid striking fenders or other parts. If chains remain in one position, the tire side wall will be damaged. Tension springs (either metal coil springs or the rubber band type) must also be used in order to prevent chains contacting frame, etc. The use of tension springs will also reduce ordinary chain noise caused by loose cross links contacting pavement.

### g. Wheel and Tire Balance

Wheel and tire balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. Wheel unbalance is the principal cause of tramp and general car shake and roughness, and contributes somewhat to steering troubles.

The original balance of the tire and wheel assembly may change as the tire wears. Severe acceleration, severe brake applications, fast cornering and side slip wear the tires out in spots and often upset the original balance condition and make it desirable to rebalance the tire and wheel as an assembly. Tire and wheel assemblies should be rebalanced after punctures are repaired.

Because of the speed at which cars are driven, it is occasionally necessary in a severe case to test the wheel and tire assembly for dynamic balance. Dynamic balancing of a wheel and tire assembly must be done on a machine designed to indicate out-of-balance conditions while the wheel is rotating. Since procedures differ with different machines, the instructions of the equipment manufacturer must be carefully followed.

In some cases off the car wheel and tire balance does not overcome wheel balance complaints because the brake drums themselves are out-of-balance. In this case, either balance the tire and wheel with an on-the-car spin balance, or correct the brake drum balance as described in paragraph 9-12.

## 7-10 STABILIZER SHAFT, LINK AND GROMMETS

### a. Stabilizer Shaft, Removal and Replacement

Disconnect stabilizer links (subpar. c following) and disconnect

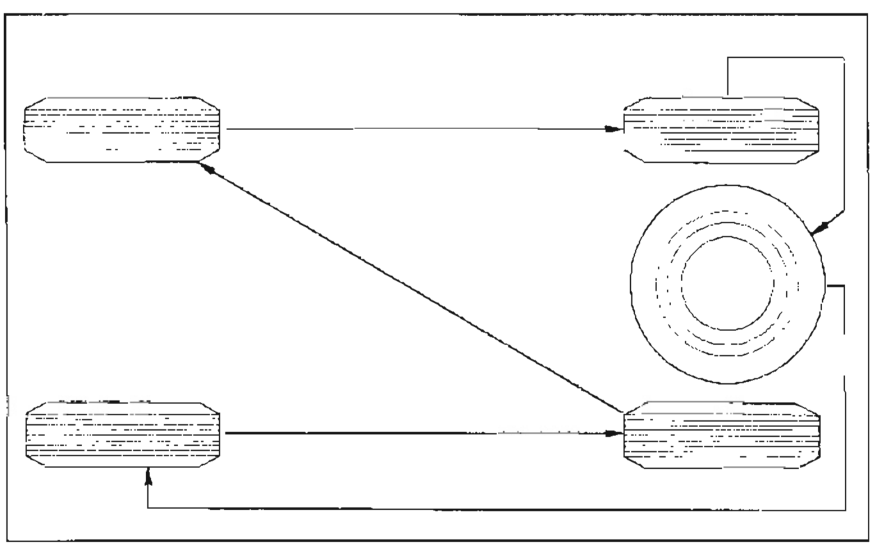


Figure 7-8—Method of Interchanging Tires

the two underbody-to-shaft insulator mounts and brackets.

To install, position insulator mounts and brackets over shaft and connect bracket to underbody. Torque bracket bolts to 13 ft. lbs. Connect stabilizer links, subparagraph c below. Do not lubricate insulator mounts.

**b. Stabilizer Bracket and Insulator, Removal and Replacement**

Stabilizer brackets should be replaced if damaged, and rubber insulator mounts replaced if deteriorated.

Replace by supporting stabilizer shaft in position and replacing brackets and mounts one at a time. Torque bracket bolts 35 ft. lbs.

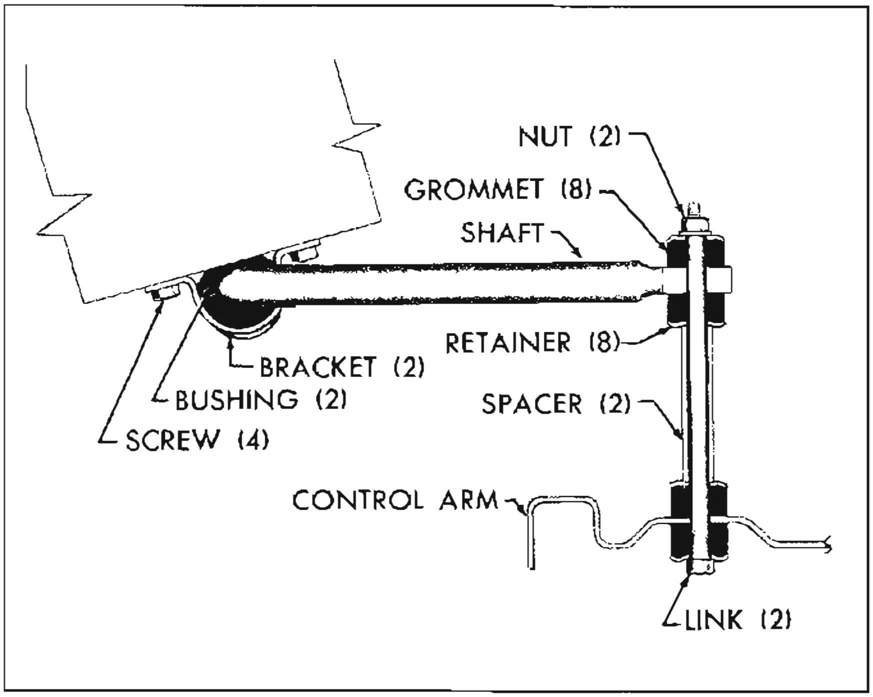



Figure 7-9—Stabilizer and Link

**c. Stabilizer Link Removal and Replacement**

1. Remove nut from upper end of link. Remove link, spacer, retainers and grommets. See Figure 7-9.

2. Inspect link and grommets.

3. Install grommets dry and use care to center the grommets in the seats on stabilizer shaft and bracket on lower control arm. Also, center the retainers on grommets before tightening rod nut.

4. Tighten rod nut to 7 ft. lbs.

NOTE: The measured distance from stabilizer shaft to bracket on lower control arm should be equal at both links. If dimensions are not equal, adjust nut, or replace grommets.

## 7-11 REPLACEMENT AND ADJUSTMENT OF FRONT WHEEL BEARINGS

**a. Replacement of Bearings**

1. Raise front of car and remove wheel with hub and drum assembly.

2. Remove outer race and outer bearing assembly from hub. Remove oil seal from hub so that inner race and bearing assembly can be removed from hub. See Figure 7-10.

3. Clean and inspect all bearing parts. When inspecting or replacing race and bearing assemblies, make certain the assemblies are free to creep on spindle of steering knuckle. Wiping the spindle clean and applying bearing lubricant will permit creeping and prevent rust forming between races and spindle.

4. If bearings require replacement, drive the old outer races from the hub. Install new outer races with a soft (brass) drift being certain to start each squarely into hub to avoid distortion and possible cracking.

5. Thoroughly pack both roller bearing assemblies with new wheel bearing lubricant. Remove surplus lubricant. Apply light coating of lubricant to spindle and inside surface of wheel hub.

6. Place inner race and bearing assembly in cup and install new oil seal.

7. Install wheel on spindle; then install outer race and bearing assembly, washer and spindle nut.

8. Adjust bearings as described in subparagraph b following.

**b. Adjustment of Front Wheel Roller Bearings**

1. Torque spindle nut to 19 ft. lbs. while rotating wheel.

2. Back off nut and re-torque to 11 ft. lbs.

3. If a spindle hole lines up with one of the six nut slots, back off nut 1/6 turn and insert cotter key.

4. If neither spindle hole lines up with nut slot, back off nut a maximum of 3/12 turn and install cotter key.

5. Before installation of grease

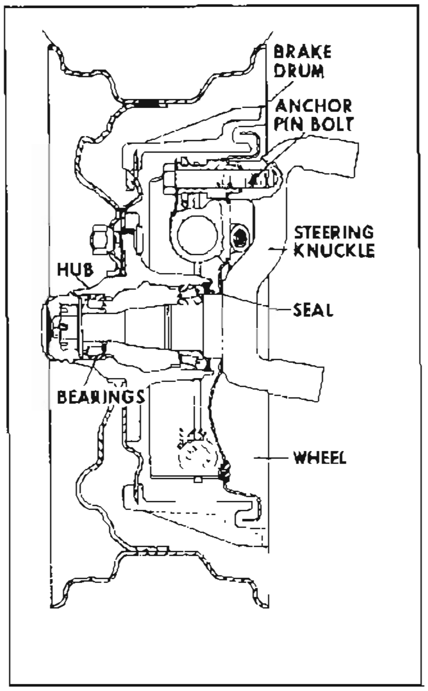



Figure 7-10—Front Wheel Hub and Bearings

cap in hub, make sure that end of spindle and inside of cap are free of grease so the radio static collector makes good contact. Make sure that static collector is properly shaped to provide good contact between end of spindle and the grease cap.

## 7-12 BALL JOINTS

### a. Upper Ball Joint Removal and Installation

The upper ball joint is riveted to the upper control arm. All service ball joints, however, will be provided with nut and bolt assemblies for replacement purposes.

The upper ball joint stud is spring loaded in its socket. If the upper stud has any perceptible shake, or can be twisted with the fingers, the upper ball joint should be replaced. See Figure 7-11.

### b. Removal

1. Support car on car stand at the frame so front suspension is in full rebound position.

2. Remove front wheel.

3. Remove upper ball stud cotter key.

4. Loosen, but do not remove ball stud nut. Warning: If ball stud nut is removed, injury could result since heavily compressed chassis spring will be completely released.

5. Rap steering knuckle sharply in area of ball stud to allow force of chassis spring to disengage tapered stud from knuckle. See Figure 7-12.

6. Place jack under lower control arm at spring seat. Raise jack until compression is relieved on upper control arm rubber rebound bumper.

7. Remove the stud nut and lift upper control arm from knuckle.

8. Support the brake drum assembly by wiring it to the frame or sheet metal out of way of work area. See Figure 7-13.

9. Place a wood block between the upper control arm and the frame to act as a support during the following operations.

10. Center punch the four rivets as close to the center as possible.

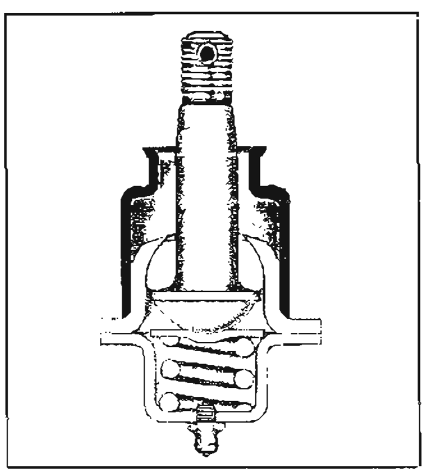


Figure 7-11—Upper Ball Joint

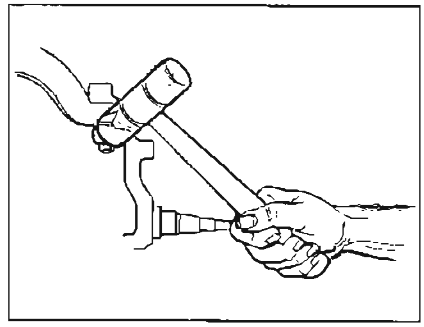


Figure 7-12—Separating Steering Knuckle from Ball Joint

11. Drill a 1/8" hole through the center of the rivets about 1/2 to 3/4 the length of the rivet.

12. Using a 7/32" drill, enlarge the hole, drilling again about 1/2 the length of the rivet.

13. With a chisel, remove the rivet heads.

14. Using a 1/4" punch and hammer, remove the rivets. Remove ball joint.

### c. Installation

1. Install the new ball joint in the upper control arm, and attach with the bolt and nut assemblies provided. Insert the bolts from the bottom with the nut and lock washers on top. Torque to 15-20 ft. lbs.

2. Turn tapered stud so cotter pin hole is fore and aft and assemble

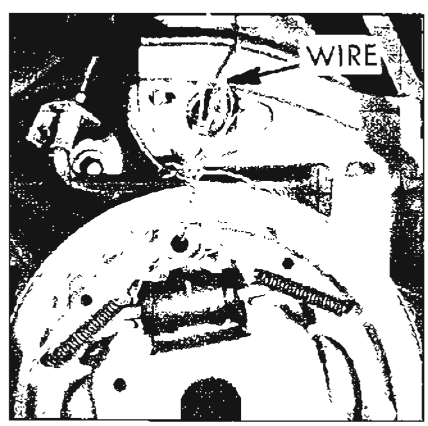



Figure 7-13—Wiring Brake Drum to Frame Flange

the dust shields over the stud. After unwiring the brake drum assembly and removing the wood block from between the arm and the frame, move the knuckle up by jacking under outer edge of spring seat.

3. Wipe tapered hole in knuckle and tapered stud clean and assemble stud to knuckle with castellated nut. Torque to 40-60 ft. lbs. Install the cotter pin.

4. Install wheel and tire.

### d. Lower Ball Joint Removal and Installation

The lower ball joint assembly is pressed into the lower control arm and is serviced separately. The lower ball joint is not spring equipped and depends upon car weight to load the ball. Refer to paragraph 7-8, subparagraph c for method of checking. See Figure 7-14.

The lower ball joint should never be replaced merely because it "feels" loose when in an unloaded position.

### e. Removal

1. Raise front of car and place jack stands under frame side

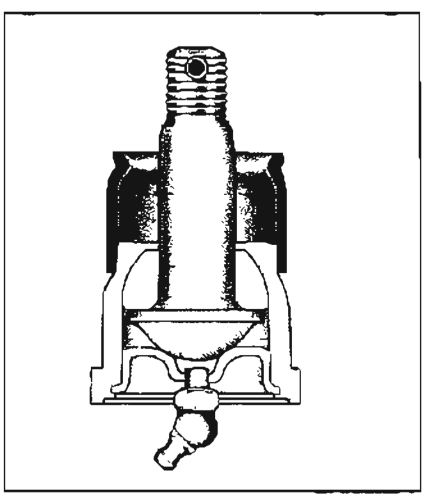


Figure 7-14—Lower Ball Joint

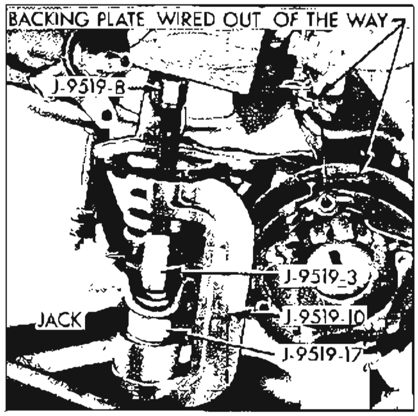



Figure 7-15—Lower Ball Joint Remover Tool in Place

rails. Remove wheel with hub and drum assembly.

2. Remove the brake backing plate. If the backing plate is wired carefully out of the way as shown in Figure 7-15, there will be no need to disconnect the brake hose.

3. Remove the ball stud cotter key. Loosen, but do not remove, the ball stud nut. Warning: If ball stud nut is removed, injury could result since heavily compressed chassis spring will be completely released.

4. Rap lower control arm sharply in the area of the ball stud to allow the force of the chassis spring to disengage the tapered ball stud from the knuckle. NOTE: It is sometimes helpful to wedge

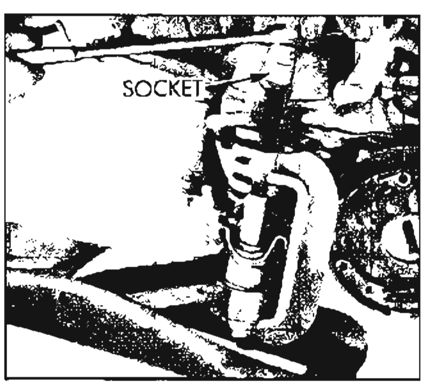



Figure 7-16—Removing Lower Ball Joint

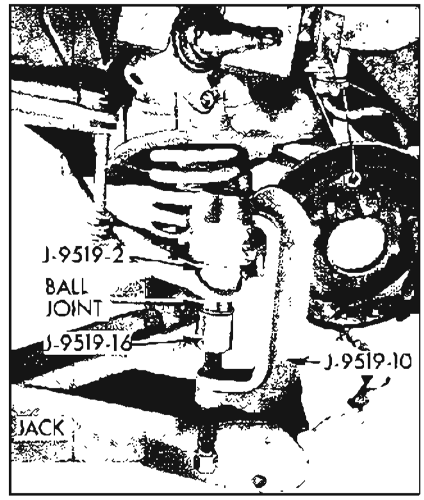



Figure 7-17—Lower Ball Joint Installer in Place

a block of wood under the upper control arm to provide a solid stop so the lower ball stud can be loosened with a more solid hammer rap.

5. Place a jack under the lower control arm at the spring seat. Raise the jack until compression is relieved on the upper control arm rubber rebound bumper. Remove the stud nut. Move the steering knuckle out of the way.

6. Install Lower Ball Joint Remover and Installer J-9519 as shown in Figure 7-15. Note that the larger O.D. portion of Detail J-9519-17 is positioned in J-9519-10.

7. Tighten Detail J-9519-8 with a socket and handle as shown in Figure 7-16 until ball joint is forced out of the lower control arm. Warning: Ball joint may pop out suddenly!

### f. Installation

1. Position ball joint minus shipping protector in lower control arm and install Tool J-9519 as shown in Figure 7-17. Note that the larger O.D. portion of Tool Detail J-9519-17 is positioned in Detail J-9519-10.

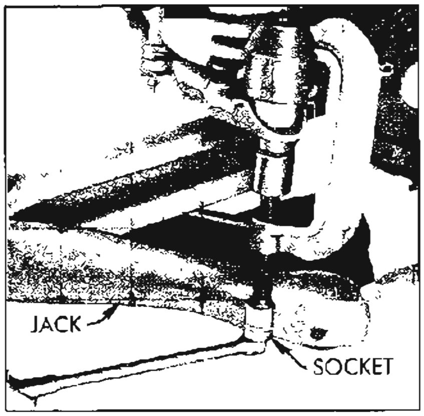



Figure 7-18—Lower Ball Joint Installation

2. With a suitable socket and handle force the ball joint into the lower control arm until is is fully seated. Turn the stud so the cotter key hole is fore and aft.

3. Position the tapered stud in the knuckle and install nut. Tighten the nut to 80 ft. lbs. and install cotter key.

4. Install wheel with hub and drum assembly. Adjust wheel bearing (par. 7-11). Remove car stand and lower car.

## 7-13 FRONT UPPER CONTROL ARM AND SHAFT—REMOVAL AND INSTALLATION

### a. Removal

1. Support car on car stand by frame, allowing front suspension to be in the full rebound position.

2. Remove front wheel.

3. Remove upper ball joint stud cotter key.

4. Loosen, but do not remove ball stud nut. Warning: If ball stud nut is removed, injury could result since heavily compressed chassis spring will be completely released.

5. Rap steering knuckle sharply in area of ball stud to allow force of chassis spring to disengage tapered stud from knuckle.

6. Place jack under lower control arm at spring seat. Raise jack until compression on upper rebound bumper is relieved.

7. Remove ball stud nut and lift upper control arm from knuckle.

8. Remove upper control arm shaft to frame nuts and lock washers, noting the number, thickness and location of the adjusting shims.

9. Clamp the arm in a vise and remove the bushings, seals and shaft. Clean away old grease and inspect parts for damage or wear. Replace all excessively worn parts.

### b. Installation

1. Assemble new grease seals on the shaft. Apply a coating of good quality chassis lubricant to the shaft threads and position the shaft in the new control arm-ball joint assembly.

2. Start second bushing into the upper control arm with shaft threaded into the opposite bushing. See Figure 7-19.

3. After bushing has been threaded part way into arm, rotate shaft to engage threads of second bushing as an aid in piloting the bushing squarely into position.

4. Tighten bushing into arm until hex section of bushing seats firmly into arm. Shaft should be free enough to turn by hand. Install grease fittings and lubricate bushings.

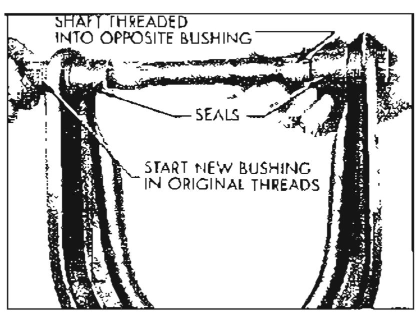



Figure 7-19—Upper Control Arm Bushing Replacement

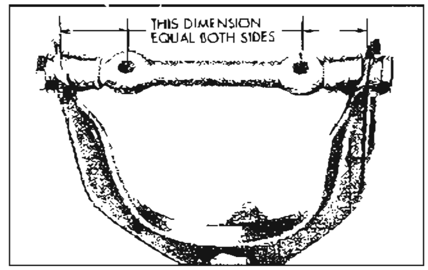



Figure 7-20—Upper Control Arm Shaft Position

5. Rotate shaft to make distance between shaft bolt holes and arm equal both sides as nearly as possible. See Figure 7-20.

6. Assemble upper control arm and shaft assembly to frame, making certain the number, thickness, and location of adjusting shims between shaft and bracket are correct. Torque shaft to frame nuts to 45-60 ft. lbs. with a standard drive socket and J-1313 Torque Wrench or its equivalent.

7. Assemble tapered stud to knuckle with cotter pin holes fore and aft. Install castellated nut. Torque to 40-60 ft. lbs. and install cotter pin.

8. Install wheel.

9. Check and adjust front end alignment if necessary.

10. Lubricate with a long effectiveness grease equivalent to Buick Specification #742.

## 7-14 FRONT SHOCK ABSOBER—REMOVAL AND INSTALLATION

### a. Removal

1. Remove upper shock absorber attaching nut, grommet retainer, and grommet. See Figure 7-21.

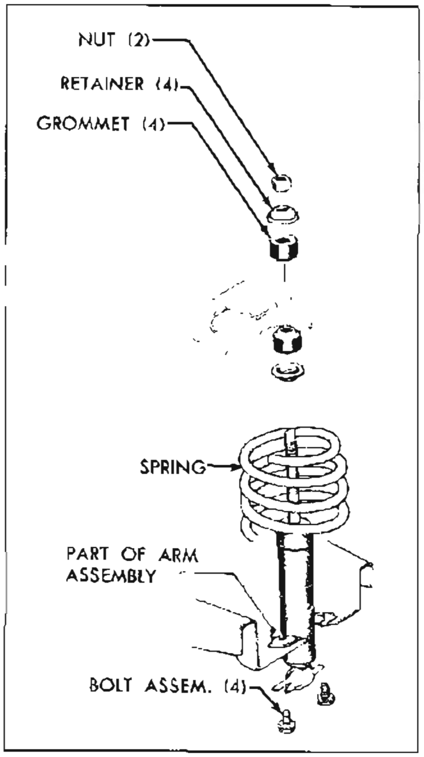



Figure 7-21—Shock Absorber Mounting

2. Raise front of car.

3. Remove the two lower attaching screws and remove shock absorber, lower grommet retainer, and grommet through the spring seat.

4. Check shock absorber for damage or oil leakage. Push and pull shock absorber in an upright position. If smooth hydraulic resistance is not present in both directions, replace shock.

### b. Installation

1. Make certain that new shock absorber is correct for car model. Check part number stamped on out-tube against number in the Master Chassis Parts Catalog in Group 7.345. Substitution of other than the correctly calibrated shock absorber may adversely affect car performance, and is not recommended by Buick Motor Division.

2. Extend shock and install one grommet retainer and one grommet on shock absorber and slide through hole in lower spring seat. Attach with two screws. Torque to 12-24 ft. lbs. See Figure 7-21.

3. Install one grommet and one grommet retainer on shaft extending through frame. Attach one nut and torque to 5-10 ft. lbs. Lower car and remove jack.

## 7-15 CHECKING AND INSTALLATION OF CHASSIS SPRINGS OR SPRING SHIMS

Optional equipment, undercoating, accumulated dirt, etc., change the car weight and must be considered when checking spring trim dimensions. Because of the many possible variations in loading due to optional equipment, it is not possible to give dimensions for all; therefore, the spring trim dimensions following are for the standard car only, without optional equipment or undercoating and with car at curb weight. Curb weight includes gas, oil, water, and spare tire but no passengers.

Before measuring spring trim dimensions, bounce both ends of car up and down several times to make sure there is no bind in suspension members, and to let springs take a natural position.

### a. Measuring Trim Height

1. On a car having service miles, the front spring trim dimension "Y" should be as shown in Figure 7-22 chart.

NOTE: When checking NEW springs, add 1/4".

2. On a car having service miles, the rear spring trim dimensions should be as shown in Figure 7-22 chart.

NOTE: When checking NEW springs, add 3/8".

3. When checking side to side differences in trim height at the front, take measurements at the front wheel house openings as shown in Figure 7-23.

NOTE: If a variation exists in trim height from side to side at front, installation of one shim will increase height of low side by approximately 3/4". Only one shim can be installed at each front location. If side to side variation is in excess of one inch, check suspension components for damage, excessive wear, or incorrect spring installation. See subparagraph c following for front shim installation.

4. When checking side to side differences in trim height at rear, take measurements at rear wheel house openings as shown in Figure 7-23. If shimming is required, see paragraph 7-23.

### b. Removal and Installation of Chassis Springs

#### Front Springs

1. Raise front of car. Remove wheel with hub and drum assembly.

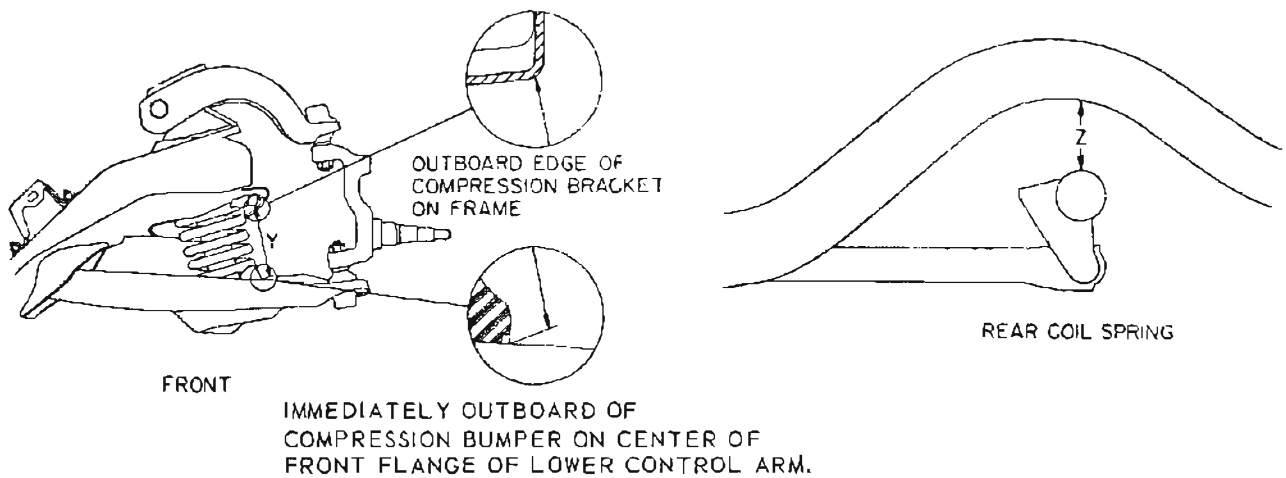
2. Disconnect stabilizer link from lower control arm and remove shock absorber according to instructions in paragraph 7-14.

3. Disconnect lower control arm ball joint from steering knuckle according to instructions in paragraph 7-12.

4. Lower floor jack until spring is fully extended and remove coil spring.

5. Position spring with top of spring seated in spring tower of frame cross member. Rotate spring so the end of the bottom coil will index with edge of hole in lower control arm spring seat.

6. Raise lower control arm to compress spring and allow assembly of ball joint to steering knuckle. Connect ball joint to




| CHASSIS TRIM DIMENSION | | |
|---|---|---|
| MODEL | FRONT COIL Y ± 1/4 CURB WEIGHT | REAR COIL Z ± 1/4 CURB WEIGHT |
| 43327 | 3.88 | 5.14 |
| 43335 | 4.05 | 6.34 |
| | | |
| | | |
| 43367 | 3.88 | 5.14 |
| 43369 | 3.88 | 5.64 |
| 43527 | 3.88 | 5.14 |
| 43535 | 4.05 | 6.34 |
| 43569 | 3.88 | 5.64 |
| 44337 | 3.88 | 5.14 |
| 44355 | 4.39 | 6.92 |
| 44365 | 4.39 | 6.92 |
| 44367 | 3.98 | 5.14 |
| 44369 | 3.98 | 5.64 |

THESE DIMENSIONS DO NOT APPLY TO OPTIONAL SPRINGS.

ALL DIMENSIONS SHOWN ARE FOR V-6 BASE CAR.

SUBTRACT .05 FROM FRONT CURB WEIGHT TRIM DIMENSIONS FOR ALL V-8 CARS.

Figure 7-22—Trim Height Chart

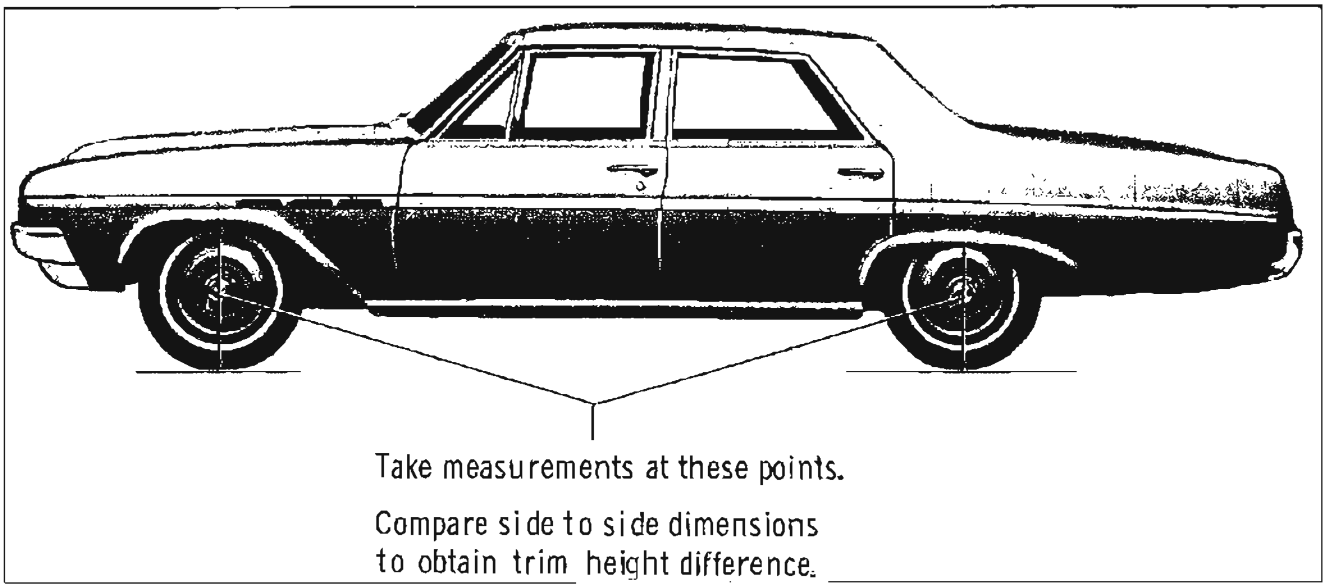



Fig. 7-23—Locations for Checking Side to Side Trim Height Dimensions

knuckle according to instructions in paragraph 7-12.

7. Install shock absorber according to instructions in paragraph 7-14. Connect stabilizer link to lower control arm according to instructions in paragraph 7-10.

8. Reinstall wheel with hub and drum assembly. Adjust wheel bearings (par. 7-11).

**c. Installation of Front Spring Shim**

To correct variations in trim height, front spring shims may be ordered from the Parts Department under group 7.425.

1. Remove front spring from car. Refer to preceding subparagraph b.

2. Remove 1" of stock from end of shim as shown in Figure 7-24.

3. Place shim at top of spring as shown in Figure 7-25.

4. Install spring in car. CAUTION: Be certain that end of shim is seated in groove as shown in Figure 7-26.

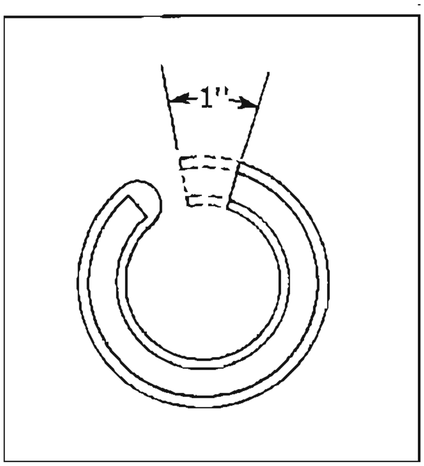



Figure 7-24—Removal of Stock from Shim

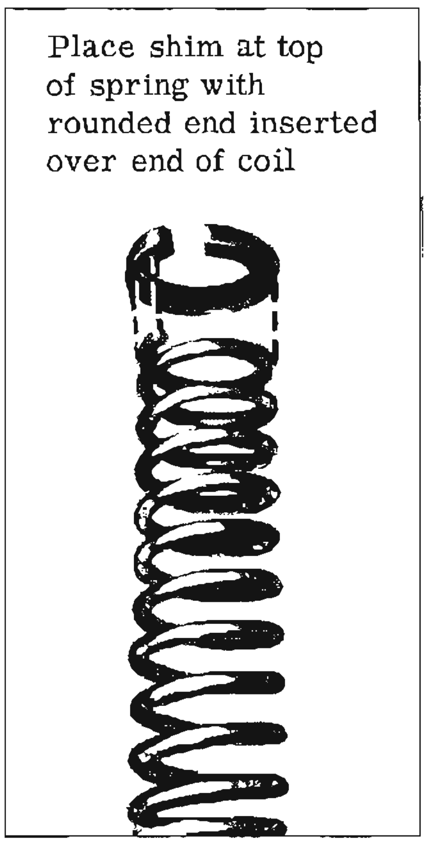



Figure 7-25—Installing Shim

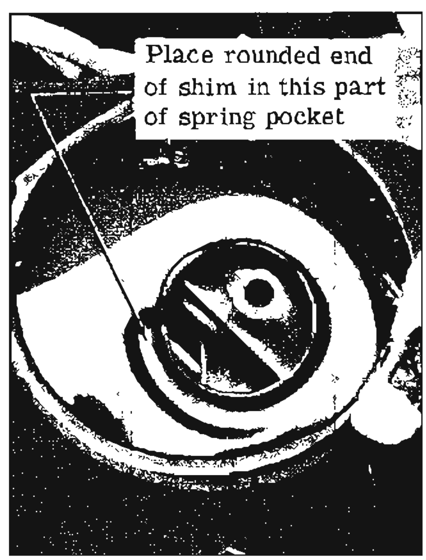



Figure 7-26—Spring Seat Location

## 7-16 FRONT LOWER CONTROL ARM—REMOVAL AND INSTALLATION

### a. Removal

1. Remove coil spring according to outline in paragraph 7-15.

2. Remove the two nuts and lock washers attaching the control arm to the frame. See Figure 7-27.

3. If lower control arm is to be replaced, remove the rubber bumper and attaching nut.

### b. Installation

1. Install rubber bumper and attaching nut. Torque to 15-25 ft. lbs.

2. Install arm with the bolt heads to the front of the car. See Figure 7-27.

3. Reinstall coil spring according to instructions in paragraph 7-15.

## 7-17 STEERING KNUCKLE REMOVAL

### a. Removal

1. Raise front of car. Remove wheel with hub and drum assembly.

2. Disengage lock plate from brake anchor bolt and remove bolt. Remove two bolts holding brake backing plate and steering arm to steering knuckle. Support brake backing plate out of the way to avoid damage to brake hose and linings.

3. Remove cotter pins from nuts on both ball joint tapered studs. Loosen, but do not remove nuts.

Warning: If ball stud nut is removed, injury could result since heavily compressed chassis spring will be completely released.

4. Force of chassis spring will tend to disengage ball joint tapered stud from steering knuckle. Rap knuckle sharply in area of ball stud to loosen stud from knuckle.

5. Support lower control arm and remove nuts from ball joint tapered studs. Raise upper control arm and remove tapered studs from knuckle. Remove steering knuckle. See Figure 7-28.

### b. Installation

1. Clean the tapered studs of the ball joints and insert them into steering knuckle.

2. Align the cotter pin holes fore and aft and install the castellated nuts. Torque to 50 ft. lbs. on the upper nut and 78 ft. lbs. on the lower nut. See Figure 7-28.

3. Position steering arm and brake backing plate to steering knuckle, being certain that the brake anchor pin engages properly in steering knuckle. Install backing plate retaining bolts and nuts. Torque to 60-82 ft. lbs. Install anchor pin bolt and torque to 92 ft. lbs. Bend lock plate to engage flats on brake anchor bolt head.

4. Install wheels, lubricate and adjust bearings (par. 7-11).

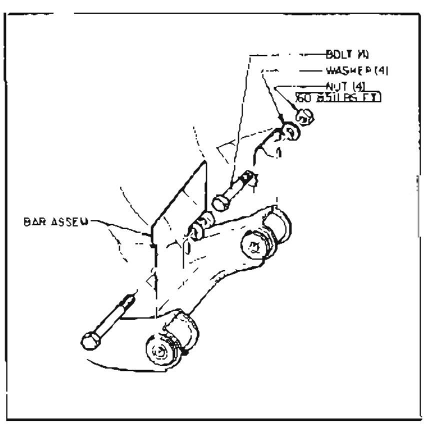



Figure 7-27—Lower Control Arm Detail

## 7-18 FRONT WHEEL ALIGNMENT

Wheel alignment is the mechanics of adjusting the position of the front wheels in order to attain the least steering effort with a minimal amount of tire wear.

Correct alignment of the underbody is essential to proper alignment of front and rear wheels. Briefly, the essentials are that the underbody must be square in plan view within specified limits, that the top and bottom surfaces of the front cross member must be parallel fore and aft, and that the upper and lower control arms must be at correct location in respect to shafts and the front cross member. All bushings, ball joints and bolts must be of proper torque and in usable condition.

Wheel and tire balance has an important effect on steering and tire wear. If wheels and tires are out of balance, "shimmy" or "tramp" may develop or tires may wear unevenly and give the erroneous impression that the wheels are not in proper alignment. For this reason, the wheel and tire assemblies should be known to be in proper balance before assuming that wheels are out of alignment.

Close limits on caster, front wheel camber, and theoretical king pin inclination are beneficial to car handling, but require only reasonable accuracy to provide normal tire life. With the type of front suspension used, the toe-in adjustment is much more important than caster and camber are as far as tire wear is concerned.

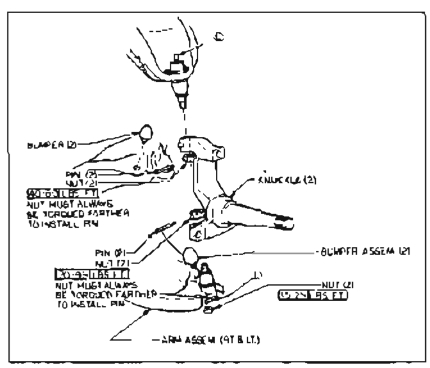


Figure 7-28—Steering Knuckle Detail

Caster and camber adjustments need not be considered unless visual inspection shows these settings to be out, or unless the car gives poor handling on the road. In the majority of cases, services consisting of inflating tires to specified pressure and interchanging tires at recommended intervals (par. 7-9), balancing all wheels and tires (par. 7-9), adjusting steering gear (par. 8-4), and setting toe-in correctly (subpar. e, following) will provide more improvement in car handling and tire wear than will front end alignment adjustments.

The correct use of accurate front end alignment equipment is essential to determine whether front suspension parts have been damaged by shock or accident, and to obtain correct alignment settings after new parts have been installed.

### a. Inspection Before Checking Front Wheel Alignment

Before making any adjustment affecting caster, camber, toe-in, theoretical king pin inclination, or steering geometry, the following checks and inspections must be made to insure correctness of alignment equipment readings and alignment adjustments.

1. The front tires should have approximately the same wear and all tires must be inflated to specified pressures (par. 1-2).

2. Check front wheel bearings for looseness and adjust, if necessary

3. Check for run-out of wheels and tires and correct to within limit of .107" run-out at sides of tires, if necessary.

4. Check wheels and tires for balance and correct if out of balance (par. 7-9).

5. Check for looseness at ball joints and tie rod ends; if found excessive it must be corrected before alignment readings will have any value (par. 8-4).

6. Check shock absorber action and correct, if necessary (par. 7-14, 7-21).

7. Check trim height; if out of limits, correct with shims or replace spring.

NOTE: There are no alignment height tools available for the Special and Skylark Series. If desired, trim height gauging pins may be constructed from 1/2" pipe or cold rolled steel cut to the correct trim height. Refer to Figure 7-22 for correct trim heights.

CAUTION: Consideration must be given the optional equipment on the car, undercoating, dirt, etc.

Good judgment should be exercised before replacing a spring when car trim height is only slightly out of limits. Spring replacement under conditions of excessive weight as mentioned above will accomplish little and must be accompanied by shimming to obtain satisfactory results. Front shims are available through Buick Parts Warehouses under Group 7.425. Rear shims are available under Group 7.545. Refer to paragraphs 7-15 for front springs and 7-22 for rear springs.

8. It is advisable to check the condition and accuracy of any equipment being used to check front end alignment, and to make certain that instructions of the manufacturer are thoroughly understood.

### b. Checking Caster and Camber Settings

Since caster and camber are both adjusted by shimming in the same locations, both of these settings must be checked before changing either setting.

CAUTION: Regardless of equipment used to check caster and camber, car must be on level surface both transversely and fore and aft. Since camber and

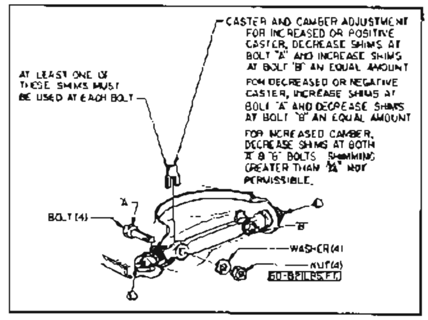



Figure 7-29—Adjusting Shims

caster vary in proportion to the height of the front springs, it is very important that the correct alignment height is maintained while checking (subpar. a, preceding).

Alignment height is used only when checking and adjusting caster and camber and should not be confused with trim height which is used to establish proper spring dimensions.

When equipment is used which bears against the tire or wheel rim to obtain readings, it is very essential that the tires or wheels be checked for run-out.

Readings must be taken at points which have no run-out or which lie in the same plane. Caster and camber should be within limits shown in Figure 7-30. Note that the caster angles at both front wheels need not be exactly the same but must be within 1/2 degrees of each other. Likewise, the camber angles on both sides must be within 1/2 degrees of each other. If caster and camber are not within the specified limits, adjust as described below.

### c. Adjustment of Caster and Camber

Caster and camber are adjusted by shimming at the upper control arm shaft attaching points. These shims are available in thicknesses of .030", .060" and .120", and are listed under Group 6.178 of the Master Parts list.

Adding shims at the front locations will change caster and camber toward negative. Adding shims at the rear locations will change caster toward positive and camber toward negative. Adding equal shims at both front and rear locations will not change caster but will change camber toward negative. See Figure 7-29.

To adjust, loosen both front and rear bolts to free the shims for removal or addition. After installing or removing shims (limit to .380" in any one stack), tighten and torque shaft nuts to 53 ft. lbs. Recheck alignment and correct toe-in, if necessary. It is imperative to adhere strictly to the torque range specification given in paragraph 7-1.

**d. Checking Theoretical King Pin Inclination**

CAUTION: When checking theoretical king pin inclination, car must be on a level surface, both transversely and fore and aft. It must be maintained at specified alignment height while checking (subpar. a, preceding).

With camber known to be within specified limits, theoretical king pin inclination should check within specified limits given in Figure 7-30

If camber is incorrect beyond limits of adjustment and theoretical king pin inclination is correct, or nearly so, a bent steering knuckle is indicated.

There is no adjustment for theoretical king pin inclination as this factor depends on the accuracy of the front suspension parts. Distorted parts should be replaced with new parts. CAUTION: The practice of heating and bending front suspension parts to correct errors must be avoided as this may produce soft spots in the metal in which fatigue and breakage may develop in service.

**e. Checking and Adjusting Toe-In**

CAUTION: Car must be at curb weight and running height (DO NOT USE ALIGNMENT SET J-8973 - bounce front end and allow it to settle to running height). Steering gear and front wheel bearings must be properly adjusted with no looseness at tie rod ends. The car should be moved forward one complete revolution of the wheels before the toe-in check and adjustment are started and the car should never be moved backward while making the check and adjustment.

1. Turn steering wheel to straight ahead position, with front wheels in straight ahead position.

2. Measure the horizontal distance from the near edge of front boss of lower control arm shaft to the front edge of brake backing plate, on each side. Adjust tie rods, if necessary, to make measurements equal on both sides.

3. Using a suitable toe-in gauge, measure the distance between outside walls of tires at the front at a height approximately horizontal to floor and through the centerline of the wheel assembly. See Figure 7-30.

NOTE: An accurate check also can be made by raising and rotating front wheels to scribe a fine line near the center of each tire, then, with tires on the floor and front end at running height, measure between scribed lines with a suitable trammel.

4. Roll the car forward until measuring points on tires are approximately 180° from point used in Step 3 above.

The measurement at the front (dimension "A") should be 7/32" to 5/16" less than the measurement at the rear (dimension "B"). See Figure 7-30.

5. If toe-in is not within specified limits, loosen clamp bolts and turn adjusting sleeves at tie rod ends as required. Decrease toe-in by turning left sleeve in same direction as wheel rotates moving forward and turn right sleeve in opposite direction. Increase toe-in by turning both sleeves in opposite direction.

CAUTION: Left and right adjusting sleeves must be turned exactly the same amount but in opposite directions when changing toe-in, in order to maintain front wheels in straight ahead position when steering wheel is in straight ahead position.

6. After correct toe-in is secured, tighten clamp bolts securely.

CAUTION: The steering knuckle and steering arm "rock" or tilt as front wheel rises and falls. Therefore, it is of vital importance to position the bottom face of tie rod end parallel with machined surface at outer end of steering arm when tie rod length is adjusted. Severe damage and possible failure can result unless this precaution is observed. Tie rod sleeve clamps must be positioned straight down to 45° forward to provide clearance.

**f. Checking Steering Geometry (Turning Angles)**

CAUTION: Be sure that caster, camber, and toe-in have all been properly corrected before checking steering geometry. Steering geometry must be checked with the weight of the car on the wheels.

1. With the front wheels resting on full floating turntables, turn wheels to the right until the outside (left) wheel is set at 20 degrees. The inside (right) wheel should then set at 21-1/4°. See Figure 7-30.

2. Repeat this test by turning front wheels to the left until the

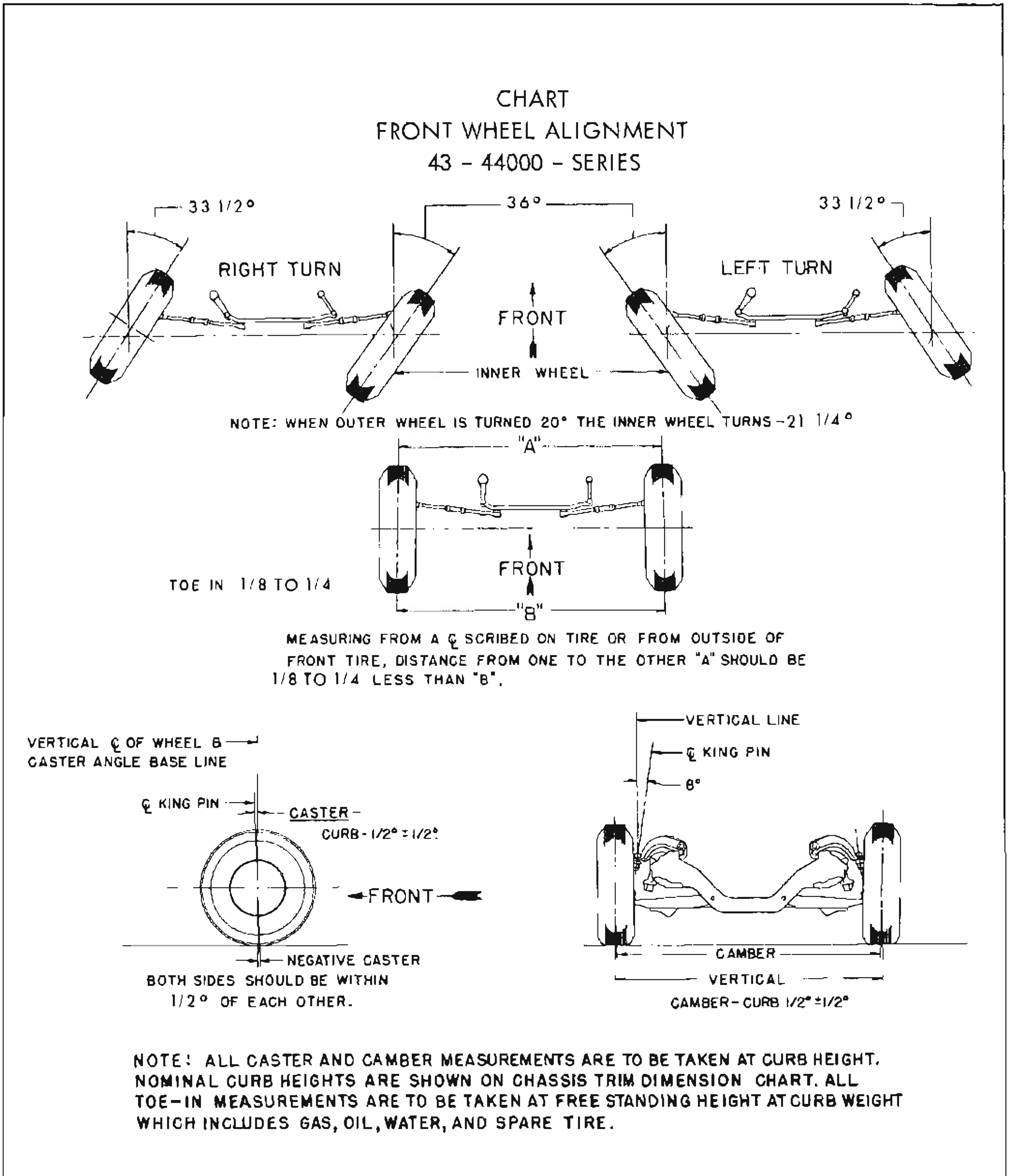



Figure 7-30—Front Wheel Alignment

outside (right) wheel sets at 20 degrees; the inside (left) wheel should then set at 21-1/4°.

3. Errors in steering geometry generally indicate bent steering arms, but may also be caused by other incorrect front end factors. If the error is caused by a bent steering arm, it must be replaced. Replacement of such parts must be followed by a complete front end check as described above.

## 7-19 REAR LOWER CONTROL ARM—REMOVAL AND INSTALLATION

### a. Removal

1. Remove rear coil spring (par. 7-22).

2. Remove rear attaching nuts, lock washers, and bolts.

3. Remove front attaching parts and remove arm.

4. Check arm and bushings for obvious damage. Replace if necessary. See Figure 7-31.

### b. Installation

1. Position arm in place and attach as shown in Figure 7-31. Torque front and rear attaching nuts and bolts to 78 ft. lbs.

2. Check for correct pinion angle and adjust if necessary (par. 6-16).

## 7-20 REAR UPPER CONTROL ARM—REMOVAL AND INSTALLATION

### a. Removal

1. Raise rear of car and support rear axle assembly.

2. Disconnect control arm at carrier housing by removing attaching nut, lock washer, and bolt. See Figure 7-31.

3. Disconnect arm at frame by removing nut, lock washer, and bolt. Remove arm.

4. Check control arm and bushing at carrier housing for damage or

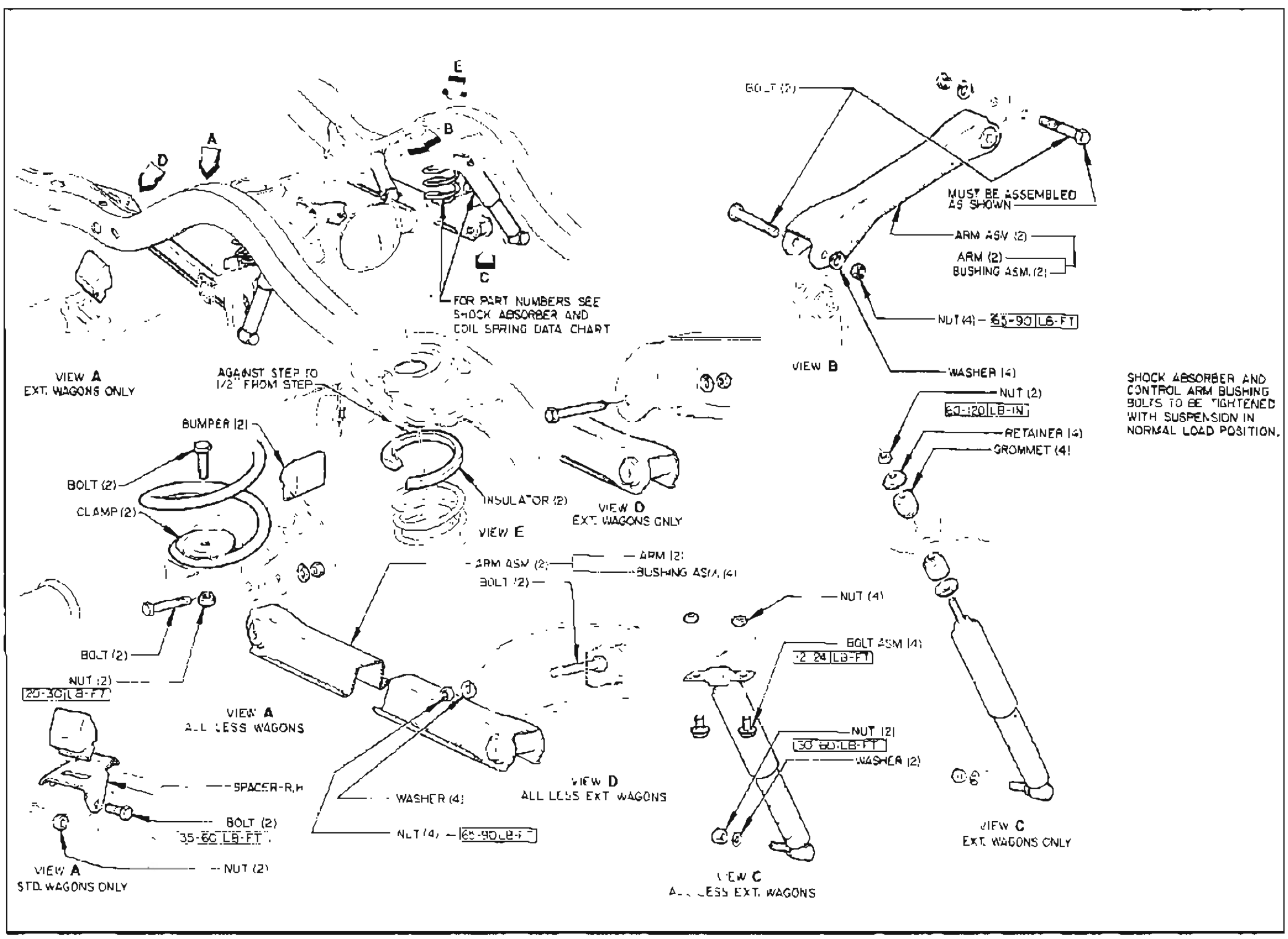



Figure 7-31—Rear Suspension Details

wear. Replace bushing if necessary. Replace arm if bent or damaged.

**b. Installation**

1. Attach arm at the frame with nut, lock washer, and bolt. Torque to 78 ft. lbs. See Figure 7-31.

2. Attach arm at bracket on carrier with nut, lock washer, and bolt. Torque to 78 ft. lbs. See Figure 7-31.

NOTE: If adjustable cam bolt arms are being installed to make pinion angle adjustment (refer par. 6-16), install cam bolt, cam, and nut. Torque to 78 ft. lbs.

## 7-21 REAR SHOCK ABSORBER—REMOVAL AND INSTALLATION

**a. Removal**

1. Raise rear of car and support rear axle assembly.

2. Disconnect shock at upper end. Disconnect shock at lower end and remove shock. See Figure 7-32.

CAUTION: A hex is located on the stud between the axle bracket and shock absorber lower bushing in order that a wrench may be used to remove the lower attaching nut without turning the stud. Failure to hold the stud in this manner will result in damage to the mechanical bond between the shock absorber bushing and the lower mounting stud.

3. Check shock absorber for obvious physical damage and oil leakage. Push and pull shock absorber in an upright position. If smooth hydraulic resistance is not present in both directions, replace shock.

**b. Installation**

1. Make certain that new shock absorber is correct for car model as indicated by part number stamped on the outer tube. See Master Chassis Parts Catalog Group 7.345 for standard and optional parts.

2. Loosely attach shock to both mounting points. Torque upper bolts to 12-24 ft. lbs. (5-10 ft. lbs. Sportwagons) and the lower hex nut to 30-60 ft. lbs. See Figure 7-32.

CAUTION: Shock absorber calibrations as furnished in production have been carefully engineered to provide the best ride control over a wide range of driving conditions. Substitution of other calibrations can alter handling and ride characteristics and are not recommended by Buick Motor Division.

## 7-22 REAR CHASSIS SPRINGS REMOVAL AND INSTALLATION

**a. Removal**

1. Raise car and support rear axle assembly.

2. Provide slack in parking brake cable to allow rear axle to be lowered without damaging cable. Disconnect shock absorber at lower end on same side that spring is being removed. See Figure 7-27.

3. Remove bolt and nut that hold spring clamp to lower end of spring.

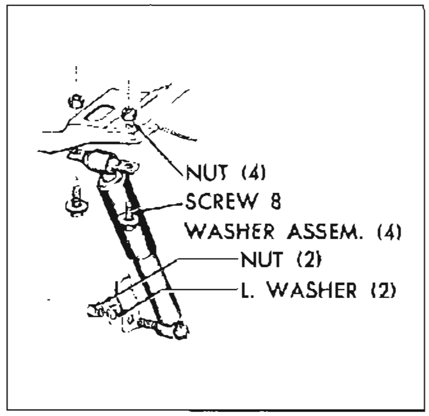



Figure 7-32—Rear Shock Absorber Installation

4. Lower rear axle and remove spring.

**b. Installation**

1. Position spring so that the flat or ground end is at the top of the spring seat.

2. Raise rear axle and connect shock absorber to rear axle. Torque nut to 45 ft. lbs.

3. Tighten parking brake cable, remove rear axle support and lower car. See paragraph 7-15 for checking procedure.

## 7-23 INSTALLATION OF REAR SPRING SHIMS

The Upper Series spring seat (Group 7.545) is used as a shim on the rear springs for the Special and Skylark. When using this rear spring seat as a shim, the number of shims at any one location should be limited to three. Place shims between the bottom of the rear spring and the bracket on the axle housing. Secure with the attaching bolt at this location. Trim height at the wheel opening will increase approximately the same distance as the thickness of the shims installed.

# GROUP 8

# STEERING GEARS, MAST JACKETS AND STEERING LINKAGE

## SECTIONS IN GROUP 8



# SECTION 8-A

# MANUAL STEERING GEAR

## CONTENTS OF SECTION 8-A



## 8-1 MANUAL STEERING GEAR SPECIFICATIONS

### a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

| Part | Location | Thread Size | Torque |
|---|---|---|---|
| Bolt | Lower Coupling Flange Pinch | 3/8-24 | 20-35 |
| Bolt | Gear Side Cover to Housing | 3/8-16 | 25-40 |
| Bolt & Nut | Idler Arm Support to Front Suspension Cross Member | 3/8-24 | 25-45 |
| Bolt & Nut | Gear Housing to Front Suspension Cross Member | 7/16-20 | 60-70 |
| Nut | Steering Wheel to Steering Shaft | 1/2-20 | 25-40 |
| Nut | Pitman Arm to Pitman Shaft | 7/8-14 | 120-150 |
| Nut | Lash Adjuster Lock | 7/16-20 | 18-27 |
| Nuts | Lower Coupling Flange to Steering Shaft Flange | 5/16-18 | 15-20 |

### b. Steering Gear Specifications

| Items | Specification |
|---|---|
| Gear Type | Recirculating Ball Worm and Nut |
| Make | Saginaw |
| Housing Material | Cast Aluminum |
| Ratio, Gear Only | 24 to 1 |
| Ratio, Overall (Including Linkage) | 28 to 1 |
| Turns of Wheel, Lt. to Rt. (Gear connected) | 5 |
| Oil Capacity | 11 oz. |
| Steering Wheel Diameter | 16" |

| Items | Specification |
|---|---|
| Number and Type of Pitman Shaft Bearings | 2 Bushings |
| Number and Type of Worm Shaft Bearings | 2 Ball Bearings |
| Worm and Nut Balls - No. and Diameter | 50, 9/32" |
| Adjusting Screw and Shim Clearance in Pitman Shaft | 0 to .002" |
| Worm Bearing Preload - Lbs. Pull at Wheel Rim | 1/4 to 3/4 lbs. |
| Pitman Shaft Overcenter - Lbs. Pull at Wheel Rim | 1/2 to 1 lb. Higher than worm Bearing Preload |
| Worm Bearing Preload - Torque at Spline | 2 to 7 in. lbs. |
| Pitman Shaft Overcenter - Torque at Spline | 4 to 8 in. lbs. Higher than worm Bearing Preload |

## 8-2 DESCRIPTION OF MANUAL STEERING GEAR

The steering gear is the recirculating ball worm and nut type. The worm on lower end of the steering shaft and the ball nut which is mounted on the worm have mating spiral grooves in which steel balls circulate to provide a low-friction drive between worm and nut. See Figure 8-1.

Two sets of 25 balls are used, with each set operating independently of the other. The circuit through which each set of balls circulates includes the grooves in worm and ball nut and a ball return guide attached to outer surface of nut.

When the wheel and steering shaft turn to the left the ball nut is moved downward by the balls which roll between the worm and nut. As the balls reach the outer surface of nut they enter the return guides which direct them across and down into the ball nut, where they enter the circuit again. When a right turn is made, the ball nut moves upward and the balls circulate in the reverse direction. See Figure 8-1.

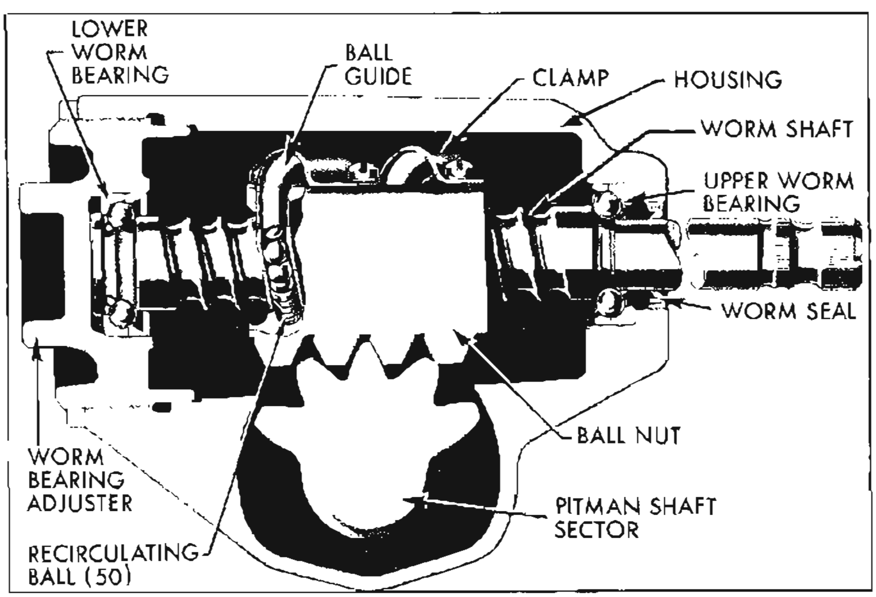



Figure 8-1—Steering Gear Worm and Ball Nut

Teeth on the ball nut engage teeth on a sector forged integral with the pitman shaft. The teeth on the ball nut are made so that a "high point" or tighter fit exists between the ball nut and pitman shaft sector teeth when front wheels are in the straight-ahead position. The teeth of sector are slightly tapered so that a proper lash may be obtained by moving the pitman shaft endways by means of a lash adjuster screw which extends through the gear housing side cover. The head of lash adjuster and a selectively fitted shim fit snugly into a T-slot in the end of the pitman shaft, so that the screw also controls end play of shaft. The screw is locked by an external lock nut. See Figure 8-2.

The pitman shaft is carried by a bushing in the steering gear housing and a bushing in the housing side cover. A seal in the housing prevents leakage of lubricant at the lower end of the shaft. See Figure 8-2.

The steering worm shaft is carried by two ball thrust bearings which bear against seats on the ends of the worm. The outer race or cup of the upper worm bearing is pressed into the gear housing.

The outer race or cup of the lower worm bearing is pressed into the worm bearing adjuster

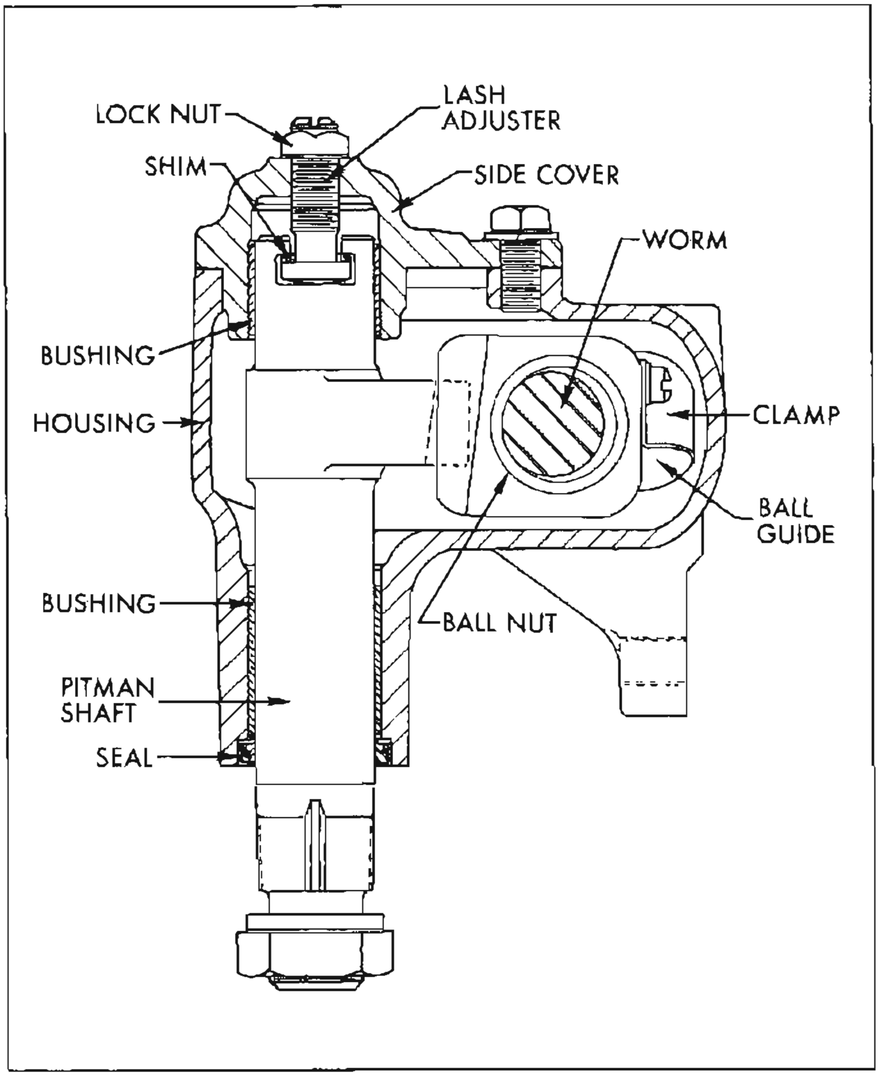



Figure 8-2—Steering Gear Pitman Shaft and Ball Nut

which screws into the housing and is locked by a nut.

This adjuster is turned to provide proper preloading of the upper and lower worm bearings. The steering gear housing is attached to the frame by three bolts.

The upper steering shaft is a separate shaft supported in the steering column jacket. Its upper and lower ends are supported by ball bearings.

The upper steering shaft is connected to the steering worm shaft through a rag-joint type coupling. This coupling allows slight variations in alignment between the steering gear worm shaft and the steering shaft.

## 8-3 TROUBLE DIAGNOSIS - MANUAL STEERING GEAR

This paragraph covers steering malfunctions which are most likely to be caused by the steering gear assembly or tie rods. Steering malfunctions which are most likely to be caused by chassis suspension members are covered in paragraph 7-4.

### a. Excessive Play or Looseness in Steering System

1. Front wheel bearings loosely adjusted (par. 7-8).

2. Worn upper ball joints (par. 7-9).

3. Steering wheel loose on shaft, loose pitman arm, tie rods, steering arms or steering linkage ball studs.

4. Excessive pitman shaft sector to ball nut lash (par. 8-4).

5. Worm bearings loosely adjusted (par. 8-4).

### b. Hard Steering—Excessive Effort Required at Steering Wheel

1. Low or uneven tire pressure (par. 1-2).

2. Insufficient or improper lubricant in steering gear or front suspension (par. 1-3 and 1-6).

3. Excessive steering shaft coupling misalignment.

4. Steering gear adjusted too tight (par. 8-4).

5. Front wheel alignment incorrect (par. 7-15).

### c. Rattle or Chuckle in Steering Gear

1. Insufficient or improper lubricant in steering gear (par. 1-6).

2. Excessive back lash between ball nut and pitman shaft sector in straight ahead position or worm thrust bearings adjusted too loose (par. 8-4). NOTE: On turns a slight rattle may occur, due to the increased lash between ball nut and sector as gear moves off the center or "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.

3. Pitman arm loose on shaft or steering gear loose at mounting bolts.

4. Loose or worn steering shaft bearing.

**d. Poor Returnability**

1. Steering gear adjusted too tight (par. 8-4).

2. Front wheel alignment incorrect (par. 7-15).

3. Insufficient or improper lubricant in steering gear or front suspension (par. 1-3 and 1-6).

## 8-4 ADJUSTMENT OF MANUAL STEERING GEAR

IMPORTANT: Never attempt to adjust the steering gear while it is connected to the intermediate rod. The steering gear must be free of all outside load in order to properly make any steering gear adjustment.

**a. Adjustment of Steering Gear in Car**

NOTE: If an inch pound torque wrench is not available, a spring scale may be used to check adjustment following specifications in paragraph 8-1, b.

There are two adjustments on the steering gear: worm bearing preload, and pitman shaft overcenter preload. See Figure 8-3.

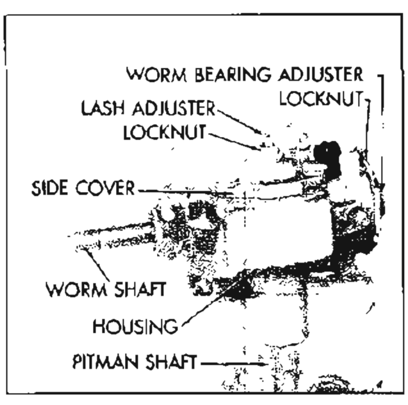



Figure 8-3—Manual Steering Gear Adjusters

1. Torque steering gear to cross member bolts to 60-70 lb. ft.

2. Disconnect intermediate rod from pitman arm by removing ball stud cotter pin, nut. Then using Remover J-3295, screw remover onto intermediate rod stud and tap on end of remover to separate parts. Support pitman arm to avoid undue pitman arm strain.

3. Turn steering wheel slowly from one extreme to the other. CAUTION: Never turn the wheel hard against the stopping point in the gear, as damage to the ball nut assembly may result.

Steering wheel should turn freely and smoothly through entire range. Roughness indicates faulty internal parts, requiring disassembly of the steering gear. Hard pull or binding indicates an excessively tight adjustment of worm bearings, or excessive misalignment of steering shaft. Any excessive misalignment must be corrected before steering gear can be properly adjusted.

4. Remove cap from steering wheel hub.

5. Check Worm Bearing Preload. Turn steering wheel gently in one direction until it stops. This positions gear away from "high point" load.

6. Attach Torque Wrench J-5853 to steering wheel retaining nut and check the torque required to turn the wheel steadily in the range where lash exists between ball nut and pitman shaft sector. See Figure 8-4. The torque required to keep wheel turning should be between 2 and 7 inch pounds. Adjust worm bearing preload if necessary.

7. Adjust Worm Bearing Preload. Loosen worm bearing adjuster lock nut using a drift. See Figure 8-3. Turn bearing adjuster as required to bring pull between 2 and 7 inch pounds. Tighten lock nut, then recheck preload.

8. Torque side cover bolts to 25-40 lb. ft.

9. Check Pitman Shaft Overcenter Preload. Turn steering wheel from one extreme to the other while counting the total turns, then turn wheel back 1/2 the number of turns. This positions steering gear on "high point" where a preload should exist between ball nut and pitman shaft teeth.

10. Check the torque required to turn wheel through the "high point" range. Torque should be between 4 and 8 inch pounds higher than worm bearing preload. Adjust pitman shaft lash adjuster if necessary. Total "overcenter" pull should not exceed 13 inch pounds.

11. Adjust Pitman Shaft Overcenter Preload. Loosen lock nut and turn pitman shaft lash adjuster screw as required to bring torque between 4 and 8 inch pounds higher than worm bearing preload. After tightening lock nut, rotate steering wheel back and forth through the "high point" and through the entire range to check for tight spots.

NOTE: If lash cannot be removed at "high point", or if gear load varies greatly and feels rough, gear assembly should be removed for inspection of internal parts.

12. Attach pitman arm to intermediate rod. Torque ball stud

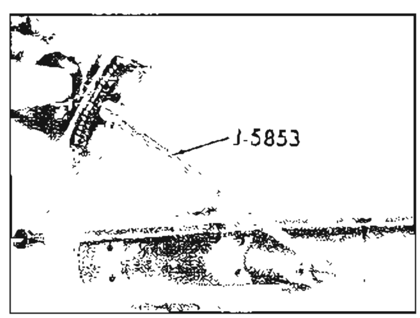



Figure 8-4—Checking Adjustments in Car

attaching nut to 30-50 lb. ft., then tighten to nearest slot and insert new cotter pin. Do not back off nut to install cotter pin.

**b. Adjustment of Steering Gear on Bench**

1. Attach Torque Wrench J-5853 to worm shaft and turn shaft to extreme right or left position. See Figure 8-5.

2. Turn worm bearing adjuster to obtain a reading of 2 to 7 inch pounds with worm shaft turning slowly. Worm bearing preload adjustment must be made within 1/2 turn of worm shaft from extreme position.

3. Tighten worm bearing adjuster lock nut and recheck reading.

4. Turn worm shaft from one extreme to the other while counting turns, then turn back 1/2 the total number of turns. This places the steering gear on the "high point".

5. Turn pitman shaft lash adjuster clockwise until a reading of 4 to 8 inch pounds higher than worm bearing preload is obtained while rotating worm shaft through the "overcenter" range. Tighten lock nut and recheck reading. Total "overcenter" pull should not exceed 13 inch pounds.

**c. Road Test after Adjustment**

Road test car for ease of steering. If steering gear was adjusted to specified load limits and hard steering exists, the front suspension members should be checked for lubrication and alignment and tire inflation pressures should be checked. When the car is moving straight ahead, the steering wheel should be in the straight-ahead position, or not over 5/8" to either side of the straight-ahead position. If steering wheel is too far to either side, check wheel for proper position on steering shaft (Figure 8-9) and check tie rods for equal adjustment and toe-in (Group 7). It is important to have the steering gear in the no-lash range when car is moving straight forward.

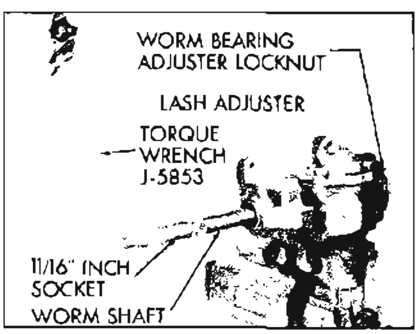



Figure 8-5—Checking Adjustments on Bench

## 8-5 STEERING WHEEL REMOVAL AND INSTALLATION

**a. Removal of Steering Wheel**

1. Unplug large curved connector on mast jacket to prevent horn from blowing.

NOTE: Connector has locking tabs on outside edges. Lift tabs to release.

2. On deluxe steering wheels, remove the actuator cap and pull out lead plug in steering wheel. See Figure 8-6.

On standard steering wheels, pry off cap, remove three Phillips head screws and take off spacer bushing, receiver cup and Belleville spring. See Figure 8-7.

3. Loosen steering wheel retaining nut several turns. Do not remove nut.

4. Attach Puller J-3274 to wheel hub and pull wheel up to nut. See Figure 8-8. If wheel hub is very tight on shaft, apply a moderate strain with puller then rap on end of puller screw to break hub loose from shaft. Remove puller, nut, and steering wheel.

**b. Installation of Steering Wheel**

1. Install steering wheel and align location marks on shaft and hub of wheel. See Figure 8-9.

NOTE: Location marks for proper installation of steering wheel on steering shaft are provided to insure a straight-ahead position of the steering wheel when front wheels are in straight-ahead position.

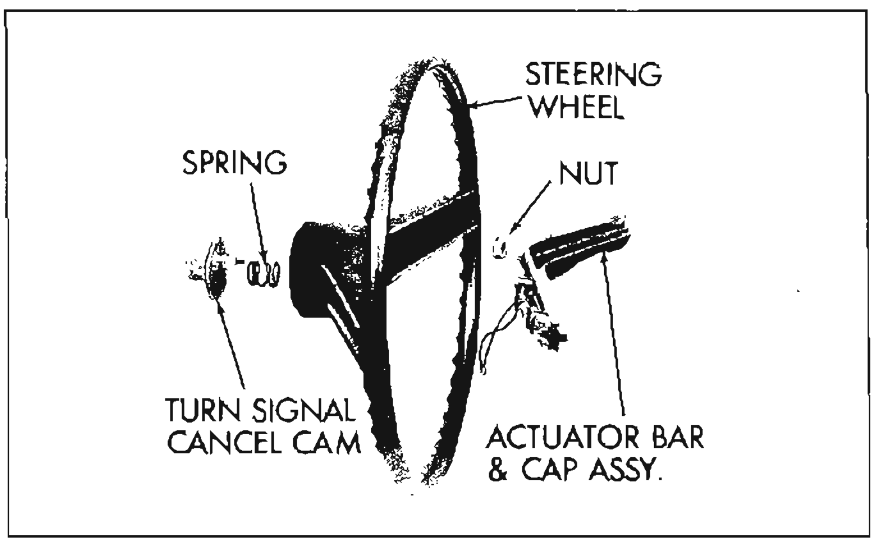



Figure 8-6—Deluxe Steering Wheel Installation (Non-Tilt Column)

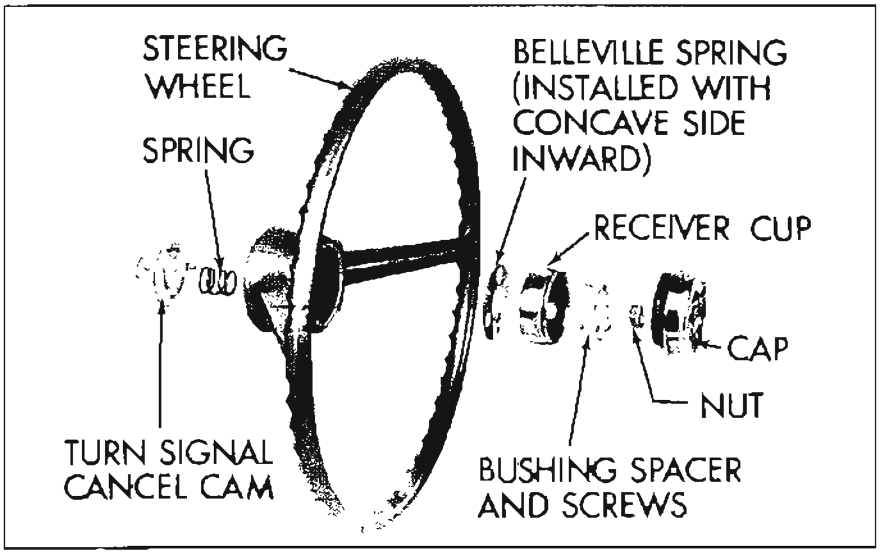



Figure 8-7—Standard Steering Wheel Installation (Non-Tilt Column)

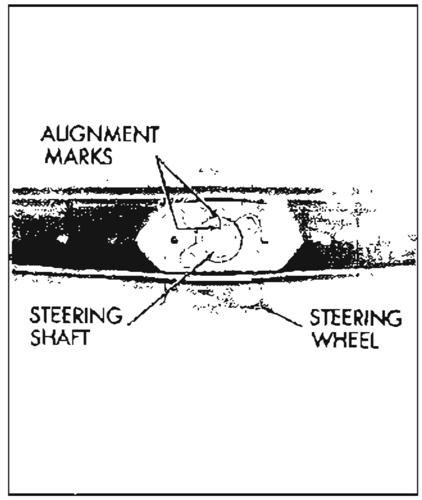



Figure 8-9—Steering Wheel and Shaft Alignment Marks

2. With wheel properly located on shaft, install nut and tighten to 30 lb. ft.

3. On deluxe steering wheels install lead plug into steering wheel and reassemble actuator cap onto steering wheel.

4. On standard steering wheels reassemble the Belleville spring, receiver cup, and spacer bushing into steering wheel hub and secure in place with screws. Install cap.

NOTE: When installing Belleville spring be sure concave side of spring faces inward. Also locate receiver cup so that slot in cup is uppermost.

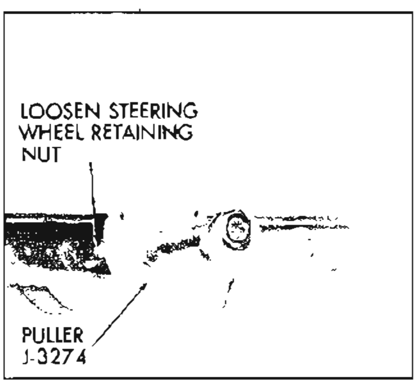



Figure 8-8—Removing Steering Wheel

## 8-6 REMOVAL AND INSTALLATION OF MANUAL GEAR ASSEMBLY

### a. Removal of Steering Gear

1. Remove two nuts securing lower coupling flange to steering shaft flange.

2. Jack up car. Remove pitman nut and disconnect pitman shaft from gear by use of Puller J-5504.

CAUTION: When pulling pitman arm from pitman shaft, do not hammer on end of puller as damage will result to gear. If necessary, tapping on side of pitman arm may help in removing arm.

3. Remove three steering gear to frame bolts and remove gear assembly. See Figure 8-10.

### b. Installation of Steering Gear

NOTE: If gear coupling was removed be sure to reinstall coupling so that tab on coupling is aligned with mark on gear worm shaft. See Figure 8-11.

1. Align studs on gear coupling with holes in steering shaft coupling, and install gear onto frame. Secure in position on frame side member with three bolts. Torque bolts 60-70 lb. ft.

2. Install two nuts on studs of gear coupling and tighten to 15-20 lb. ft.

3. Reconnect pitman arm to gear pitman shaft and torque pitman nut 100-140 lb. ft.

## 8-7 DISASSEMBLY, INSPECTION, AND ASSEMBLY OF MANUAL STEERING GEAR

### a. Disassembly of Steering Gear

NOTE: It is not necessary to disassemble gear to replace worm seal. Remove worm seal with awl being careful not to damage housing or shaft and install a new seal with Installer J-8564. See Figure 8-16.

1. Thoroughly clean exterior of gear assembly with a suitable solvent.

2. Place steering gear in a soft jaw vise. See Figure 8-3. Do not

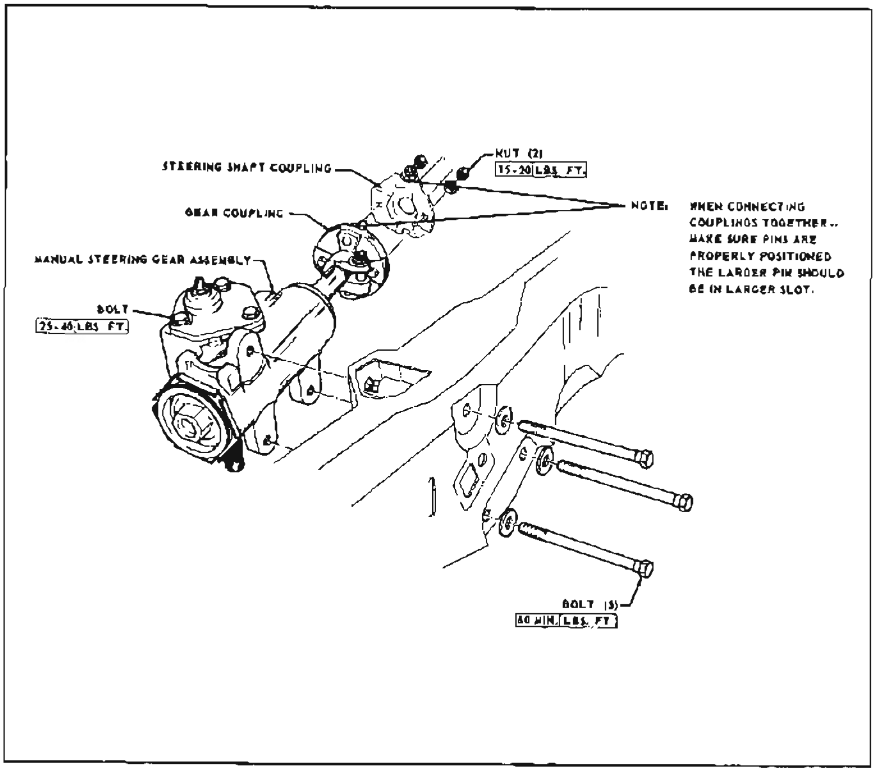



Figure 8-10—Manual Steering Gear Installation

clamp too tightly in vise as aluminum housing may be damaged.

NOTE: If only pitman shaft seal is going to be replaced do not disassemble pitman shaft and side cover, but remove seal with an awl and install seal using Installer J-8569.

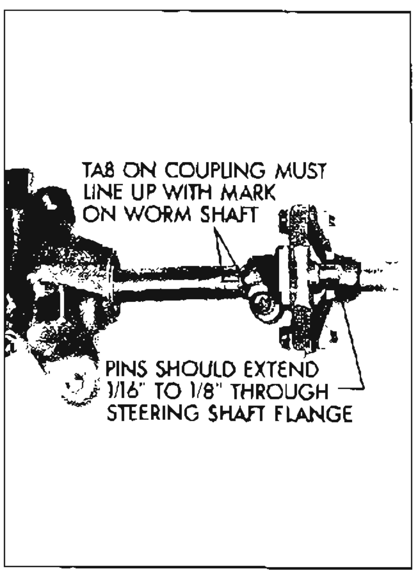



Figure 8-11—Gear Lower Coupling Installation

3. Rotate worm shaft to center of travel, approximately 3-1/2 turns from either extreme.

4. Remove pitman shaft lash adjuster lock nut. Remove three side cover bolts and lock washers.

5. Remove side cover by turning lash adjuster clockwise through cover. Slip lash adjuster with shim from slot end of pitman shaft. Remove and discard side cover gasket.

6. Remove pitman shaft from housing by lightly tapping on spline end with a soft mallet. Pry pitman shaft seal out of housing with a screwdriver. Discard seal.

7. Loosen worm bearing adjuster lock nut with a punch and remove

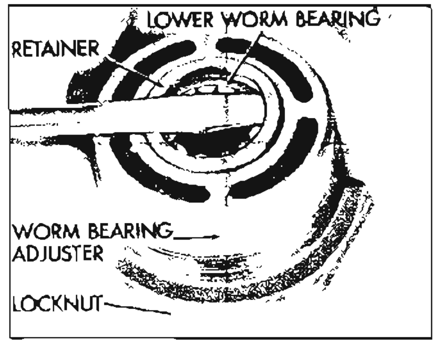



Figure 8-12—Removing Lower Worm Bearing Retainer

worm bearing adjuster and lock nut.

8. Remove worm shaft and ball nut assembly, and also upper worm bearing from housing.

9. Remove lower worm bearing from adjuster by prying retainer out with a screwdriver. See Figure 8-12.

10. Remove ball return guide clamp and guides from ball nut. Turn ball nut over and rotate worm shaft back and forth until all balls (50) drop out into a clean cloth. Remove ball nut from worm shaft.

11. Pry worm shaft seal from housing with screwdriver. Discard seal.

**b. Inspection of Steering Gear**

1. Wash all parts in clean solvent and wipe dry with a clean cloth.

2. Inspect worm bearings and cups for damage or excessive wear. Replace bearings if necessary. The lower worm bearing cup is not replaced separately, but is serviced with the worm bearing adjuster. If upper worm bearing cup is defective, drive cup out of housing with a punch and install new cup using Installer J-8811 with Driver Handle J-8092. See Figure 8-13.

NOTE: J-8811 may be used for installing pitman shaft seal in housing when pitman shaft is removed.

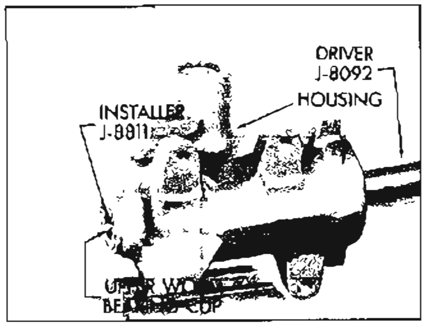



Figure 8-13—Installing Upper Worm Bearing Cup

3. Check fit of the pitman shaft in the bushing of side cover. If bushing is worn, side cover must be replaced as bushing is not serviced separately.

4. Inspect the worm and nut balls and the grooves of worm and nut for damage or excessive wear. Replace parts as necessary.

5. Inspect teeth of ball nut and pitman shaft for pitting or scoring which would require replacement of ball nut or pitman shaft. Inspect pitman shaft bushing in housing for excessive wear or scoring. If necessary, remove pitman shaft bushing and install a new bushing with Remover and Replacer J-8810 and Drive Handle J-8092. See Figure 8-14.

6. Check pitman shaft surface for wear or scoring, then check fit of pitman shaft lash adjuster and shim in the slot in end of pitman shaft by inserting feeler gauge between the head of screw and bottom of slot. Adjuster must be free to turn and end play should not exceed .002". If end play exceeds .002" install proper shim. The shims are available in four different thicknesses - .063", .065", .067", and .069".

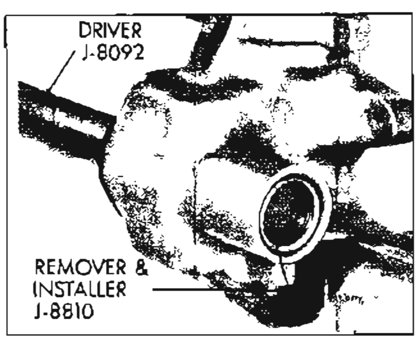



Figure 8-14—Installing Pitman Shaft Bushing

7. Check ball guides for damage and replace if necessary.

### c. Assembly of Steering Gear

NOTE: Lubricate all seals, bushings, bearings and gears with multi-purpose gear lubricant just before assembling.

1. Position ball nut over worm shaft so that deep side of teeth will be toward side cover when installed in gear housing. Install 19 balls in each circuit (rock worm shaft slightly to aid in installing balls). Place 6 balls in each return guide, using grease to hold balls in place. Install return guides, clamp and screws. Rotate worm through its complete travel several times to insure balls are installed correctly and rotate freely.

2. Place upper bearing on worm shaft and slide worm shaft assembly into housing.

3. Place lower bearing in worm bearing adjuster and install bearing retainer with Installer J-8564. Install adjuster assembly and lock nut on housing. Tighten adjuster only enough to hold worm bearings in place. Final adjustment will be made later.

4. Turn worm shaft until second and third teeth of ball nut line up with center tooth of pitman shaft. Assemble pitman shaft and lash adjuster with shim and install pitman shaft so that center tooth meshes with center groove in ball nut.

5. Place new gasket on side cover. Install side cover with gasket on lash adjuster by turning adjuster counterclockwise.

6. Install three side cover bolts and lock washers. Torque bolts 25-40 lb. ft.

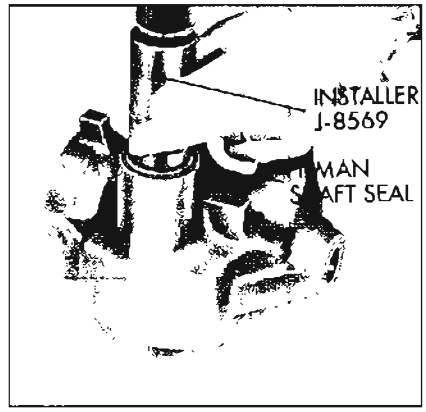



Figure 8-15—Installing Pitman Shaft Seal

7. Turn lash adjuster so that teeth on shaft and ball nut engage smoothly but do not bind. Install lash adjuster lock nut loosely. Final adjustment will be made later.

8. To protect pitman shaft seal from damage, cover shaft splines with masking tape. Slide new seal into place and seat against shoulder in housing using Installer J-8569. See Figure 8-15.

9. Install new worm shaft seal using Installer J-8564. See Figure 8-16. Drive seal flush with surface of housing.

10. Fill steering gear with multi-purpose gear lubricant. Gear is now ready for final adjustment as described in Paragraph 8-4.

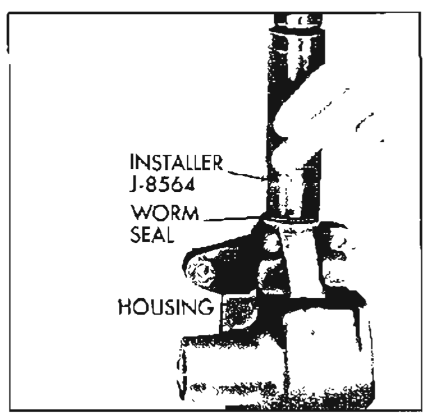



Figure 8-16—Installing Worm Shaft Seal

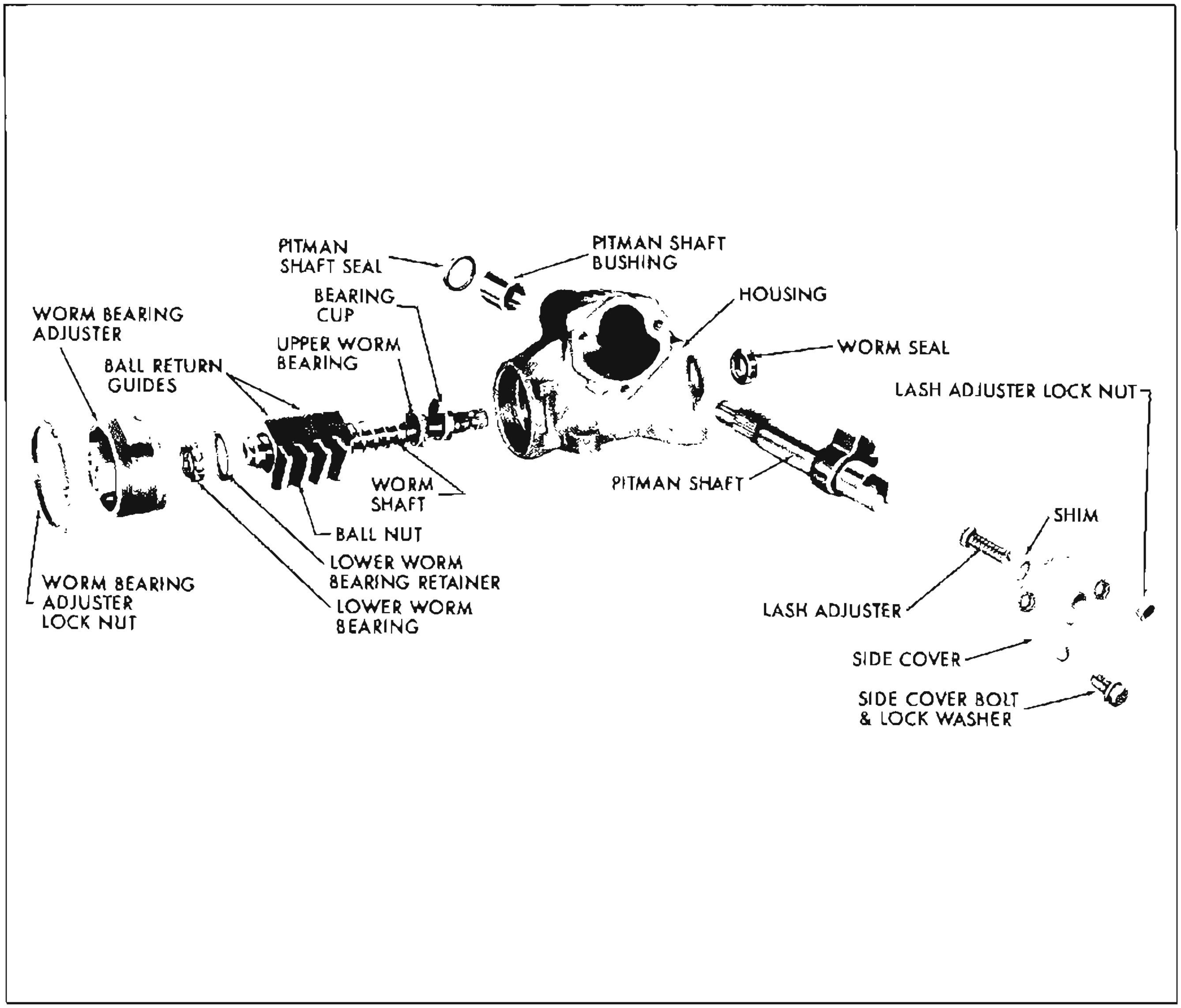



Figure 8-17—Manual Steering Gear (Exploded View)

# SECTION 8-B

# POWER STEERING GEAR AND PUMP

### CONTENTS OF SECTION 8-B



## 8-8 POWER STEERING GEAR AND PUMP SPECIFICATIONS

### a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

NOTE: See Figures 8-31 and 8-32 for location of mounting bolts and nuts.

| Part | Location | Thread Size | Torque Lb. Ft. |
|---|---|---|---|
| Bolt | Lower Coupling Flange Pinch | 3/8-24 | 25-35 |
| Bolt | Gear Side Cover to Housing | 3/8-16 | 25-35 |
| Stud | Pump Reservoir to Housing | 3/8-16 | 25-35 |
| Bolt | Gear Housing to Frame | 7/16-14 | 60-70 |
| Union | Pump Pressure Outlet | 5/8-18 | 25-35 |
| Nut | Pitman Arm to Pitman Shaft | 7/8-14 | 120-150 |
| Nut | Pulley to Pump Shaft | 1/2-20 | 40-50 |
| Nut | Rear Mounting Bracket to Pump | 3/8-16 | 25-35 |
| Nut | Lash Adjuster Lock | 7/16-20 | 20-30 |
| Plug | Rack Piston Nut End | 1 5/16-16 | 50-110 |

### b. Steering Gear Specifications

| Items | Specification |
|---|---|
| Gear Type | Recirculating Ball Nut and Worm |
| Make | Saginaw |
| Ratio, Gear Only | 17.5 to 1 |
| Ratio, Overall (Including Linkage) | 20.5 to 1 |
| Steering Wheel Diameter | 16" |
| Effort Necessary at Wheel Rim for Initial Hydraulic Assist | Approx. 1 lb. |
| Effort Necessary at Wheel Rim for Full Hydraulic Assist | Approx. 3 1/4 lbs. |
| Turns of Steering Wheel, Left to Right (Gear Connected) | 3 1/2 |
| Steering System Oil | Buick Power Steering Oil |
| Steering System Oil Capacity (Dry) | 1 1/4 qts. |

**b. Steering Gear Specifications (Cont'd.)**

| Items | Specifications |
|---|---|
| Worm and Rack—Piston Nut Balls—No. and Diameter | 11 Black, 11 Plain, 6 Sizes Plain From .28117 (Code 6) to .28157 (Code 11) by .00008th |
| Adjustments | |
| Thrust Bearing Preload (Including Valve Assembly Drag) | |
| Torque at Stub or Steering Shaft | 1 to 11 in. lbs. |
| Lbs. Pull at Steering Wheel Rim | 1/4 to 1 1/2 lb. |
| Worm and Rack Ball Preload | |
| Torque at Stub or Steering Shaft | 1 to 5 in. lbs. Higher than Thrust Bearing Preload |
| Lbs. Pull at Steering Wheel Rim | 1/8 to 5/8 lb. Higher than Thrust Bearing Preload |
| Pitman Shaft "Over Center" | |
| Torque at stub or Steering Shaft | 4 to 8 in. lbs. Higher than Worm and Rack Ball Preload |
| Lbs. Pull at Steering Wheel Rim | 1/2 to 1 lb. Higher than Worm and Rack Ball Preload |

**c. Pump Specifications**

| | |
|---|---|
| Pump Capacity. Gal./Min. @ 465 RPM (Engine) x 665/735 psi | 1.25 Minimum |
| Relief Valve Opening Pressure, psi | 1100 to 1200 |
| Pump Test Pressure, Min. psi. @ 485 RPM (Engine) and 170° F. Oil Temperature | 1000 Minimum |
| Drive Belt Adjustment | 90 Pounds |

## 8-9 DESCRIPTION OF POWER STEERING GEAR AND PUMP

The rotary valve power steering gear gives precise, positive steering with very little driver effort. Initial hydraulic assist is obtained with approximately .3 degrees of steering wheel rotation and one pound of effort at the steering wheel rim. Full hydraulic assist is obtained with approximately 4 degrees of wheel rotation and 3-1/4 pounds of effort at the wheel rim.

The hydraulic pump is used to supply oil under pressure to operate the steering gear. The housing of the pump is enclosed in a reservoir which minimizes the possibilities of external leakage. A twist-off cap is used on the reservoir to simplify checking the oil level.

With the engine running, steering is manual under conditions which require an effort of less than one pound at the steering wheel rim. When a greater effort is required, the power mechanism operates to assist in turning the front wheels. The effort then required of the steering wheel rim is limited to a maximum of approximately 3-1/4 pounds for normal steering and parking conditions.

When the engine is not running or if any part of the power mechanism is inoperative the steering gear will operate manually giving the driver full control of the car.

The driver's effort on the steering wheel is always proportioned to the force necessary to turn the front wheels. When the effort on the wheel drops to less than one pound, power assistance ceases. When the steering wheel is released to recover from a turn, the front wheels return to the straight-ahead position in the normal manner without assistance or interference from the power mechanism. Through this conventional steering action the driver always has the "feel" of steering.

### a. Power Steering Gear Assembly

The power steering gear assembly is the recirculating ball type, having a ratio of 17.5 to 1.

The upper end of the pitman shaft has a gear sector meshing with a rack-piston nut. The one-piece rack-piston nut serves as a nut for the recirculating balls and as a power piston to which the oil under pressure is applied. The rack-piston nut has a Teflon piston ring with a back-up "O" ring under it located on its lower outside diameter which serves as a seal between the rack-piston nut and its cylinder gear housing. A snap ring serves as a stop for the piston at the upper end and the housing end plug serves as a stop at the lower end. See Figure 8-18.

A worm shaft turns in the rack-piston nut using the selectively fitted steel balls as a rolling thread. The ball groove is more shallow in the center of the worm so that when the proper size balls are used, there is a slight worm to rack-piston nut preload in the straight-ahead position.

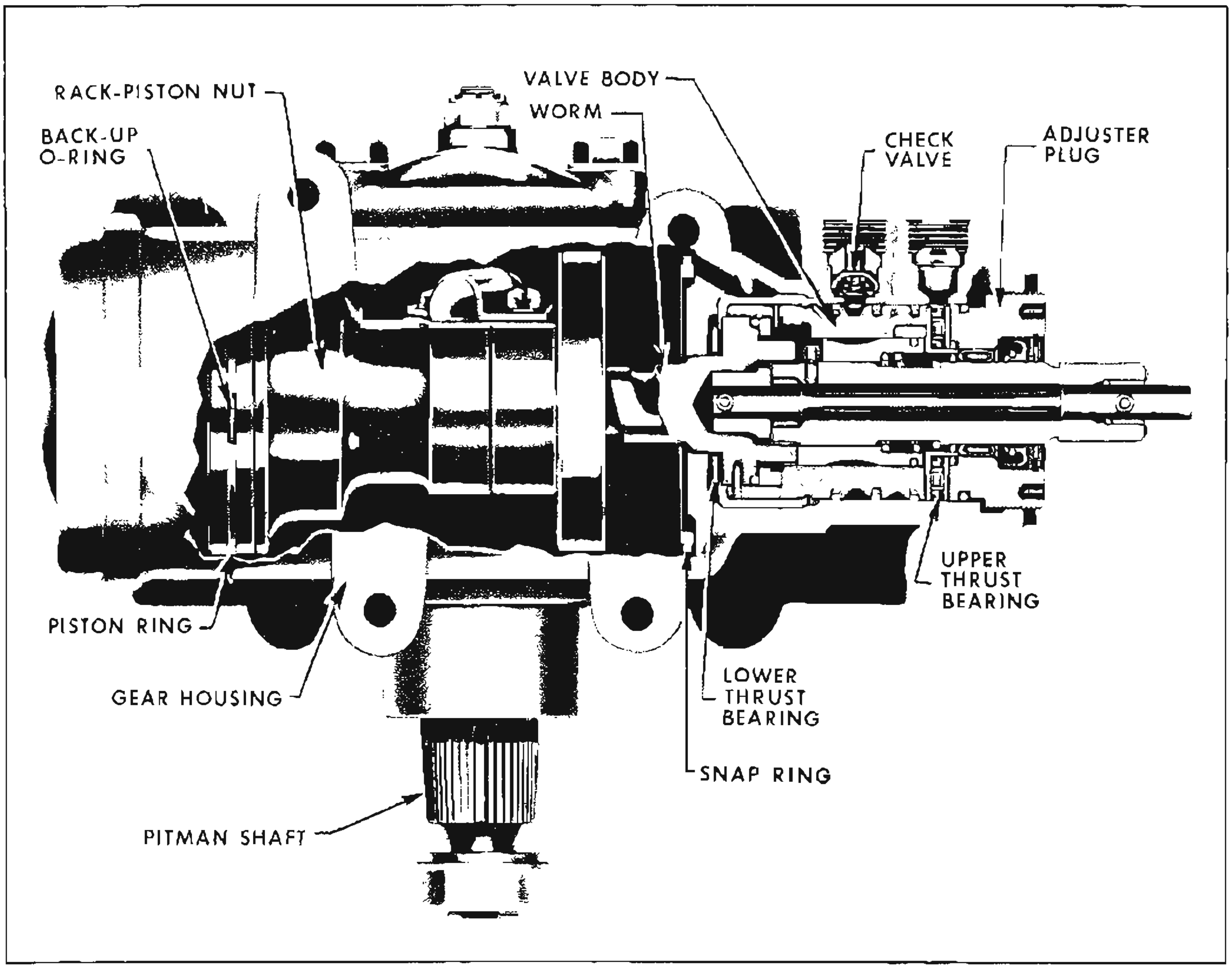



Figure 8-18—Power Steering Gear

Worm shaft radial loads are transmitted to the gear housing through the rack-piston nut. Worm end thrust is caused by the tendency of the worm to thread itself into or out of the rack-piston nut as the steering wheel is turned right or left. This end thrust is absorbed entirely by the upper and lower thrust bearings. The upper thrust bearing is located between the valve body and adjuster plug and the lower thrust bearing is located between the housing and upper end of worm.

The upper steering shaft is a separate shaft supported in the steering column jacket. Its upper and lower ends are supported by a bearing.

The steering shaft is connected to the power steering gear through a flexible coupling which is bolted to the steering shaft flange. This flexible coupling helps absorb minor shocks and vibrations, dampens out hydraulic noises and gear assembly and the steering column jacket assembly vibrations.

The power steering gear identification number is stamped on the gear housing side cover. The first 3 digits show the day of the year (1 through 365) the gear was tested. The last digit shows the year (3 for 1963, etc.)

### b. Rotary Valve Assembly

The rotary valve assembly controls the flow of oil from the pump to the proper side of the rack-piston nut when power assistance is required and cuts off this flow when power assistance is not required.

The rotary valve assembly is located in the upper section of the gear housing and consists of a stub shaft, a torsion bar, a valve body, a valve spool and a valve body cap. See Figure 8-19. The

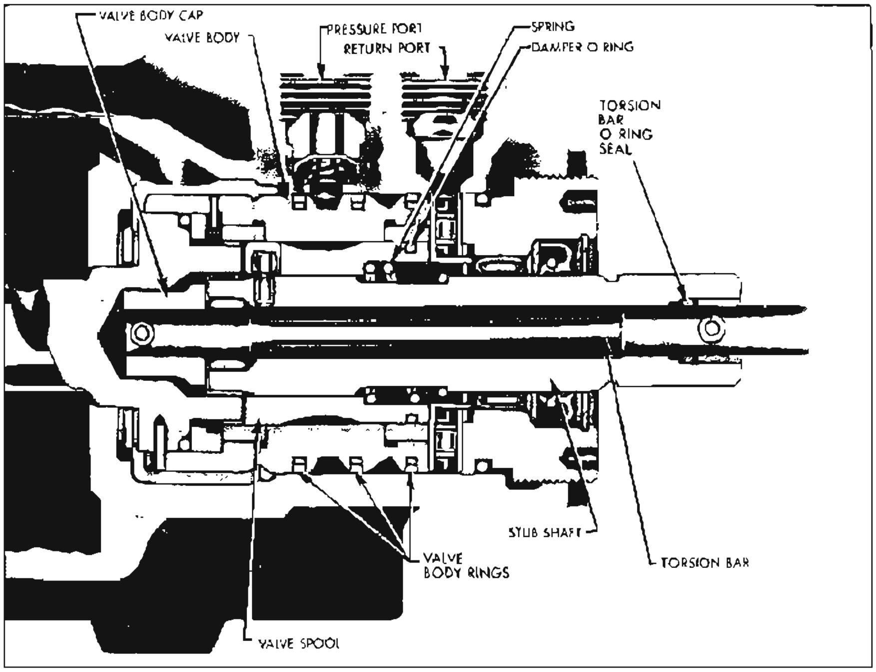



Figure 8-19—Rotary Valve Assembly

stub shaft is attached to the upper steering shaft through the flange assembly. The lower flange is splined to a stub shaft and is retained by a pinch bolt. The torsion bar is located in the center of the stub shaft. The valve spool is an open center valve and is positioned on the lower end of the stub shaft. The valve body encloses the valve spool. The valve body cap is located at the lower end of the valve body.

The valve body has two large oil grooves around its outside diameter. Each groove has four holes drilled into the inside diameter of the valve body. The lower groove is lined up with the pressure port in the gear housing. The upper groove is lined up with a drilled passage in the housing which directs oil to the right turn chamber in the housing, located at the lower end of the rack-piston nut. Three valve body Teflon rings provide leakproof seals for the oil grooves on the valve body. The inside diameter of the valve body has eight slots machined in it, four are connected to the pressure groove by the four drilled holes. See Figure 8-20. The other four slots, which are wider, are connected to the return port in the housing through the valve spool. Near the center of the valve body are four other drilled holes which are used to direct oil to a passage in the housing that opens to the left turn chamber. This chamber is located at the upper end of the rack-piston nut.

The valve spool which fits inside the valve body may have an outside diameter as close as only

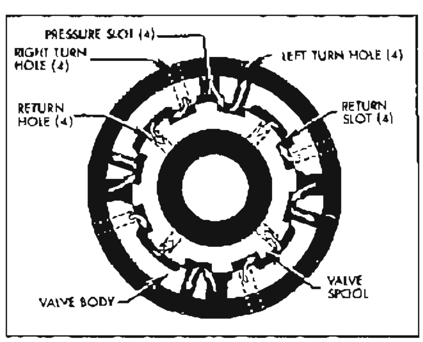



Figure 8-20—Rotary Valve-Left Turn (Upper End View)

.0004 in. smaller than the inside diameter of the valve body. This close fit allows very little, if any, oil flow between the two surfaces. The valve spool has four holes drilled near the upper end of it which are in line with the four return slots in the valve body. These holes allow oil to flow from the return slots in the valve body to the center of the spool and on to return port in the housing. The outside diameter of the spool has eight slots machined on it, four are for opening the right turn holes in the valve body to the pressure slots or to the return slots in the valve body. The other four slots on the spool serve the same function for the left turn holes in the valve body.

Basically the rotary valve assembly is divided into two separate assemblies which are fastened together by the torsion bar. To completely understand how the rotary valve functions, it must be known what parts are firmly attached together. Starting with the stub shaft which is fastened to the steering wheel through the upper steering shaft, the first assembly consists of the stub shaft, valve spool and upper end of the torsion bar. A pin on the outside diameter of the stub shaft retains the valve spool to it and a pin at the upper end of the stub shaft attached the upper end of the torsion bar and shaft together. See Figure 8-21.

The balance of the assembly which is connected to the front wheels of the car through linkage, pitman shaft and rack-piston nut, consists of the worm, valve body, valve body cap and lower end of the torsion bar.

The worm is attached to the valve body by a pin located at the upper end of the worm. A pin on the inside diameter of the valve body fastens the valve body cap to the valve body. To complete this assembly, a pin attaches the valve body cap to the lower end of the torsion bar.

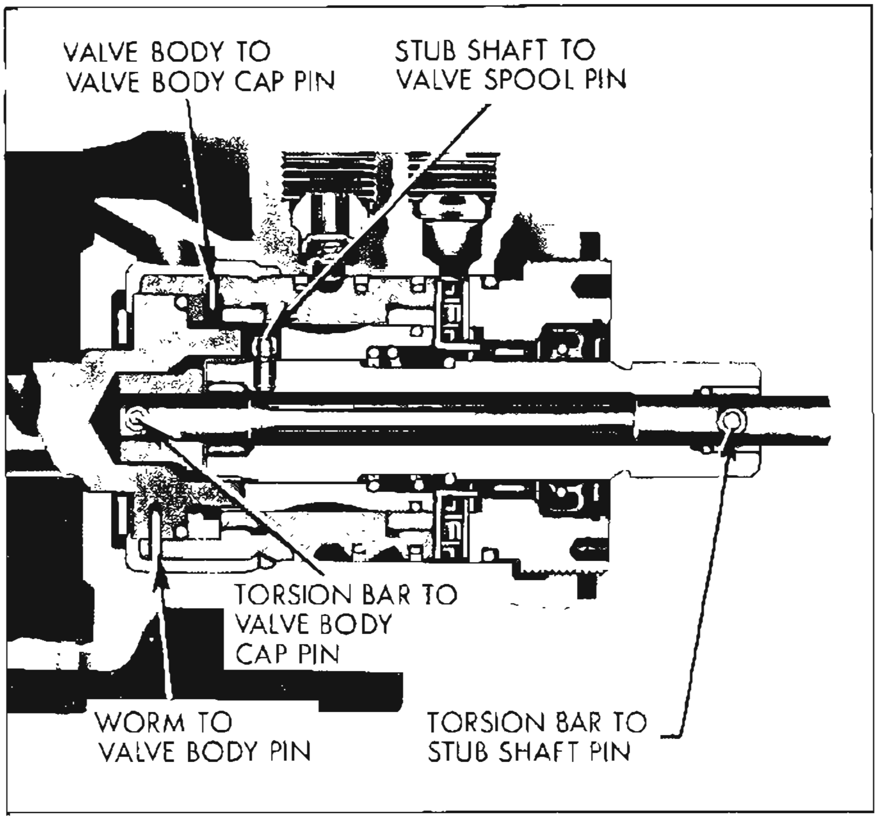



Figure 8-21—Attaching Pins for Valve Parts

When there is resistance to turning between the roadbed and the wheels of the car, the parts attached to the worm will also resist turning. Thus when the steering wheel is turned by the driver, the torsion bar will deflect and allow the stub shaft and valve spool to rotate with the steering wheel. When this occurs, the relationship between the valve spool and valve body is changed and oil flow is directed by the slots on the valve spool through the holes in the valve body to the proper side of the rack-piston nut to assist the driver. The torsion bar deflection is limited to a predetermined amount. The upper end of the worm has two tangs which fit through slots in the valve body cap and into two slots in the end of the stub shaft. In case of a power mechanism failure, the stub shaft will contact the tangs of the worm and steering will be manual.

**c. Oil Pump and Hoses**

The oil pump, which is mounted on the engine in position to be driven by a belt from the crankshaft balancer, converts some engine power into oil pressure which is used against the rack-piston nut to rotate the pitman shaft.

The pump reservoir encloses the pump housing and provides a reserve supply of oil to assure complete filling of the hydraulic system. See Figure 8-22. The reservoir cap is vented which permits escape of any air that may be introduced into the system during assembly of the various units and maintains atmospheric pressure in the reservoir.

The pump housing encloses the flow control valve and the rotor assembly. The flow control valve and spring are retained in pump housing by the pressure union. See Figure 8-23. This allows servicing the flow control valve without removing pump from the engine. Inside the flow control valve is the pressure relief valve. Also in the end of the flow control valve is a filter screen which filters the oil that enters this valve. The pressure union which is the pump outlet, contains the pump exit hole and an orifice.

The rotor assembly consists of a drive shaft, a thrust plate, a rotor with ten vanes, a pump ring and a pressure plate. Oil enters the rotor section of the housing through a reservoir hole in housing which is open to the surrounding reservoir.

The rotor is loosely splined to the end of the drive shaft, is located adjacent to the face of the thrust plate and is enclosed by the pump ring. The rotor has a pressed-in sleeve which fits through the thrust plate and keeps the rotor in alignment. The rotor vanes slide radially outward to contact the hardened and ground inside cam surface of the ring. See Figure 8-24.

As the shaft and rotor rotate, centrifugal force and fluid pressure against the inner ends cause the vanes to follow the cam contour of the ring. The cam surface is so shaped that two opposite pumping chambers are formed which cause a complete pumping cycle to occur every 180 degrees of rotation of the rotor. The pump ring has two crossover passages drilled in it which transfer oil from the thrust plate into a discharge cavity located at the rear of the pressure plate.

When the engine is started, each pumping chamber picks up oil from two openings, one between the pressure plate and ring and the other between the thrust plate and ring. See Figure 8-22. The oil is then propelled by the decreasing pockets in each pumping chamber into the discharge cavity

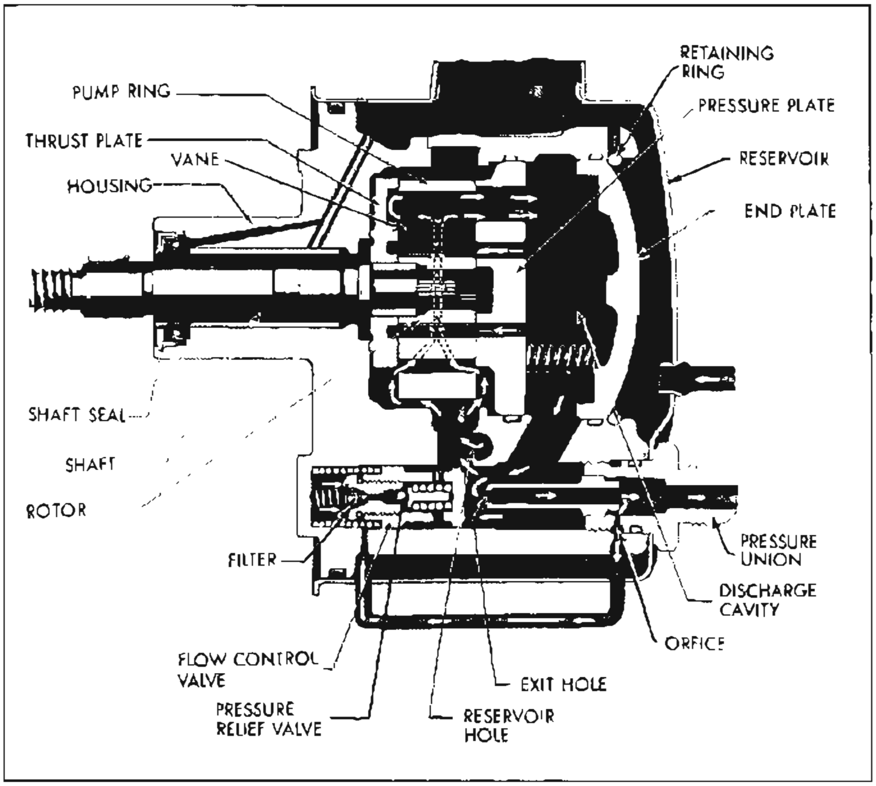



Figure 8-22—Oil Flow in Pump

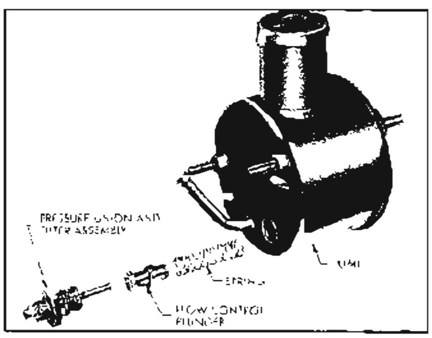


Figure 8-23—Flow Control Valve Installation

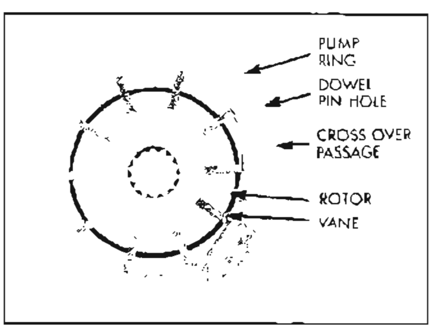



Figure 8-24—Pump Ring and Rotor

through an opening in the pressure plate and an opening in the thrust plate which is connected to the crossover passage in the ring. The oil flows from the discharge cavity into a passage which is open to the rear of the flow control valve and to the exit hole in one end of the pressure union. A certain quantity of oil flows through the outlet end of pressure union and on to the steering gear rotary valve assembly. Some oil flows through the orifice in the pressure union and into a passage in pump housing which directs oil into the spring chamber located in front of the flow control valve. Pressure in the discharge cavity is always greater than the pressure of the oil that has passed through the exit hole in the pressure union.

The flow control valve regulates the opening of a by-pass passage through which oil may be returned back to the suction and reservoir section of the pump.

When the pump is running without demand for steering pressure, pressure in the discharge cavity is great enough to push the flow control valve open against a spring load of approximately ten pounds. See Figure 8-25. The pressure in the spring chamber tends to close the valve but, since pressure in the discharge cavity is always greater than in the spring chamber, the valve is not closed. The movement of the valve is controlled by the spring tension and the difference in pressure on the front and rear side of the valve.

When power steering is demanded and the steering gear rotary valve restricts free circulation of oil as described later (par. 8-10), the pump pressure builds up rapidly. As the pressure increases in the discharge cavity it also increases in the spring chamber and in turn additional pressure is required to move the flow control valve to open the by-pass passage. The maximum amount of build-up of pressure by the pump depends on the amount of restriction through the gear which is controlled by the rotary valve. When power assistance is no longer required, the restriction through the gear is reduced to a predetermined minimum. With a small amount of restriction through the gear, the

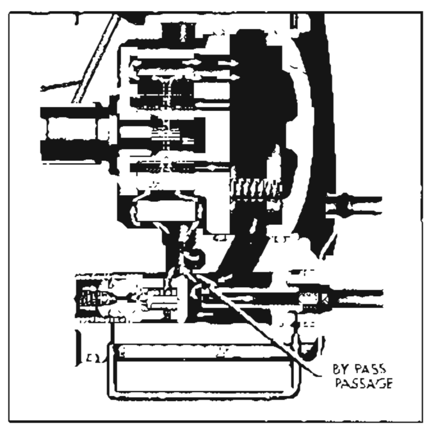



Figure 8-25—Flow Control Valve Operation

pressure in the spring chamber drops to a minimum value. Thus, the pressure in the discharge cavity also is reduced as this pressure is governed by the spring tension and the oil pressure present in the spring chamber of the pump.

If pump output pressure reaches 1100 to 1200 psi, the increased pressure in the spring chamber forces a pressure relief valve open and oil escapes from the spring chamber into the by-pass hole around the pressure relief valve ball. See Figure 8-25.

As oil pressure is relieved in the spring chamber, the high pressure in the pump discharge cavity overcomes the spring load to open the flow control valve. Because outlet pressure has to pass through an orifice to get into the spring chamber, the pressure in the spring chamber drops below outlet pressure for a fraction of a second. This allows the flow control valve to be open enough to lower line pressure to a safe level immediately. Oil is then pumped into the by-pass passage until the line pressure opposing the pump drops below the relief valve setting, permitting this valve to close. The flow control valve then resumes normal operation.

The flow control valve starts to open at 300-400 RPM of pump and is functioning when the pump is running 465 RPM (400 RPM of engine). The minimum flow a new pump must produce is 1.75 gal. per minute at 465 pump RPM against a pressure of 700 psi. The flow plunger permits a maximum flow of 2.3 gal. per minute at 1500 RPM against a pressure of 50 psi. The pressure relief valve is set for 1100 to 1200 psi.

The power steering pump identification number is stamped on the left side of the reservoir below filler neck. The first 3 digits show the day of the year (1 through 365) the pump was tested. Next is a letter for manufacturer identification (S for Saginaw). The last digit shows the year (3 for 1963, etc.).

A pressure hose connects the pressure union in the pump to the rotary valve in the steering gear housing and a return hose connects the rotary valve to the pump reservoir.

## 8-10 OPERATION OF POWER STEERING GEAR

### a. Neutral or Straight-Ahead

Figure 8-26 shows the rotary valve in the neutral or straight-ahead position. Oil flows from

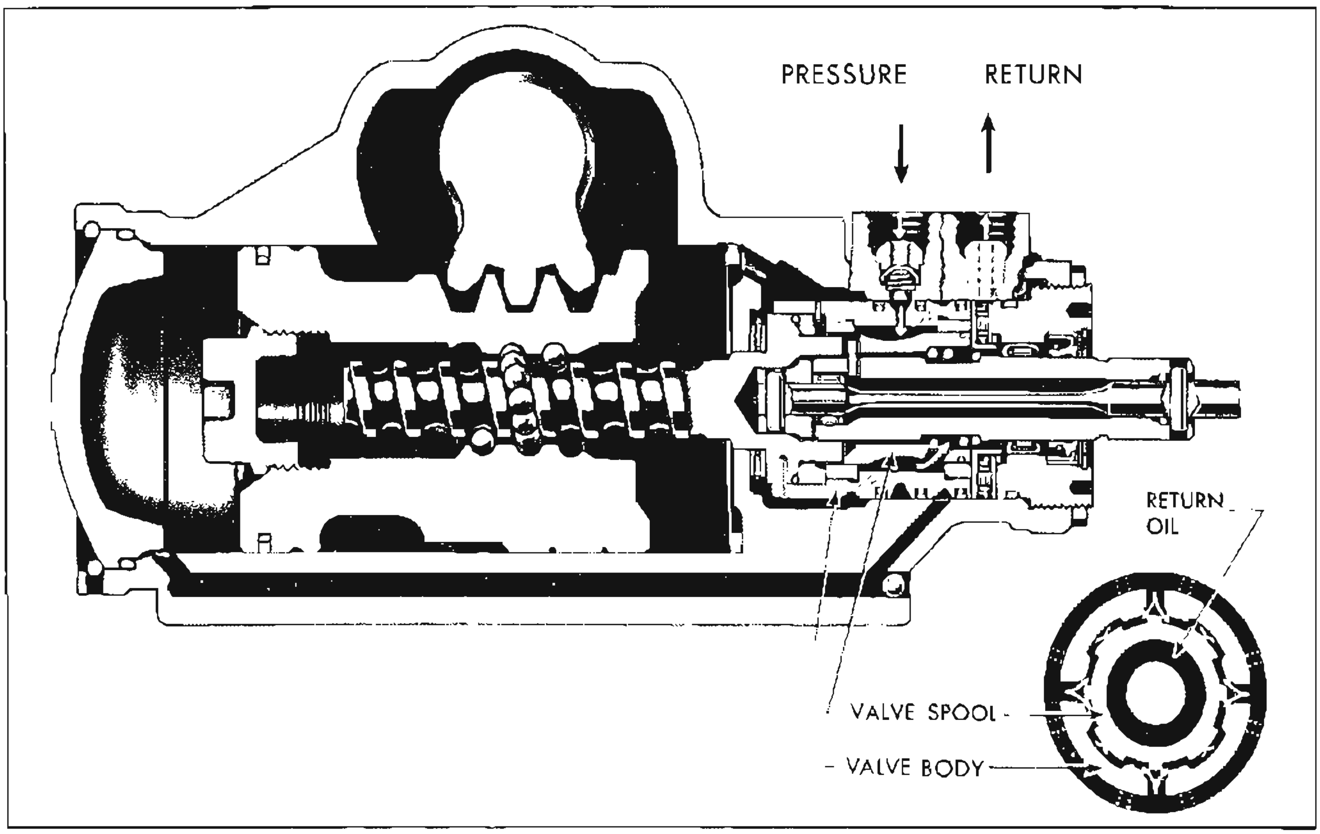



Figure 8-26—Oil Flow in Power Steering Gear - Straight Ahead Position

the pump into the pressure port of the gear, through the open center valve spool and back to the pump reservoir through the return port. The slots on the valve spool are so positioned in the valve body that the oil entering through the pressure port is directed to the return slots in the valve body, then through the center of the spool which is open to the return port. There is no flow to either side of the rack-piston nut, but each side is full of oil at all times. In the straight-ahead position the pressure on both sides is equal. The oil acts as a cushion that absorbs road shocks so they are not transferred to the steering wheel, thus giving safer and more effortless driving. In addition, this oil lubricates all the internal components of the gear.

All passages in the gear are open in the straight-ahead position and the valve remains in this position at all times except when effort applied to the steering wheel is more than one pound. The rotary valve's open center position design reduces pump losses to a minimum by allowing a minimum of restriction to oil flow in the straight-ahead position.

**b. Right Turn**

Figure 8-27 illustrates the operation of the gear when the steering wheel is turned to the right. Due to the resistance of turning between the front wheels and the roadbed, the torsion bar is deflected, changing the relationship between the slots in the valve spool and the slots in the valve body. The right turn slots on the valve spool are closed off from the return slots in the valve body and are opened more to the pressure slots. The left turn slots of the spool are closed off from the pressure slots and opened more to the return slots. This causes oil to flow into the right turn chamber of the housing and force the rack-piston nut upward. As the rack-piston nut moves upward, it applies turning effort to the pitman shaft.

The oil in the left turn chamber in the housing is simultaneously forced out through the valve and back to the pump reservoir. The higher the resistance to turning between the roadbed and the car wheels, the more the position of the valve spool is changed in relationship to the valve body and the higher the oil pressure on the lower end of the rack-piston nut. Since the amount of hydraulic pressure directed to the right turn chamber is dependent upon

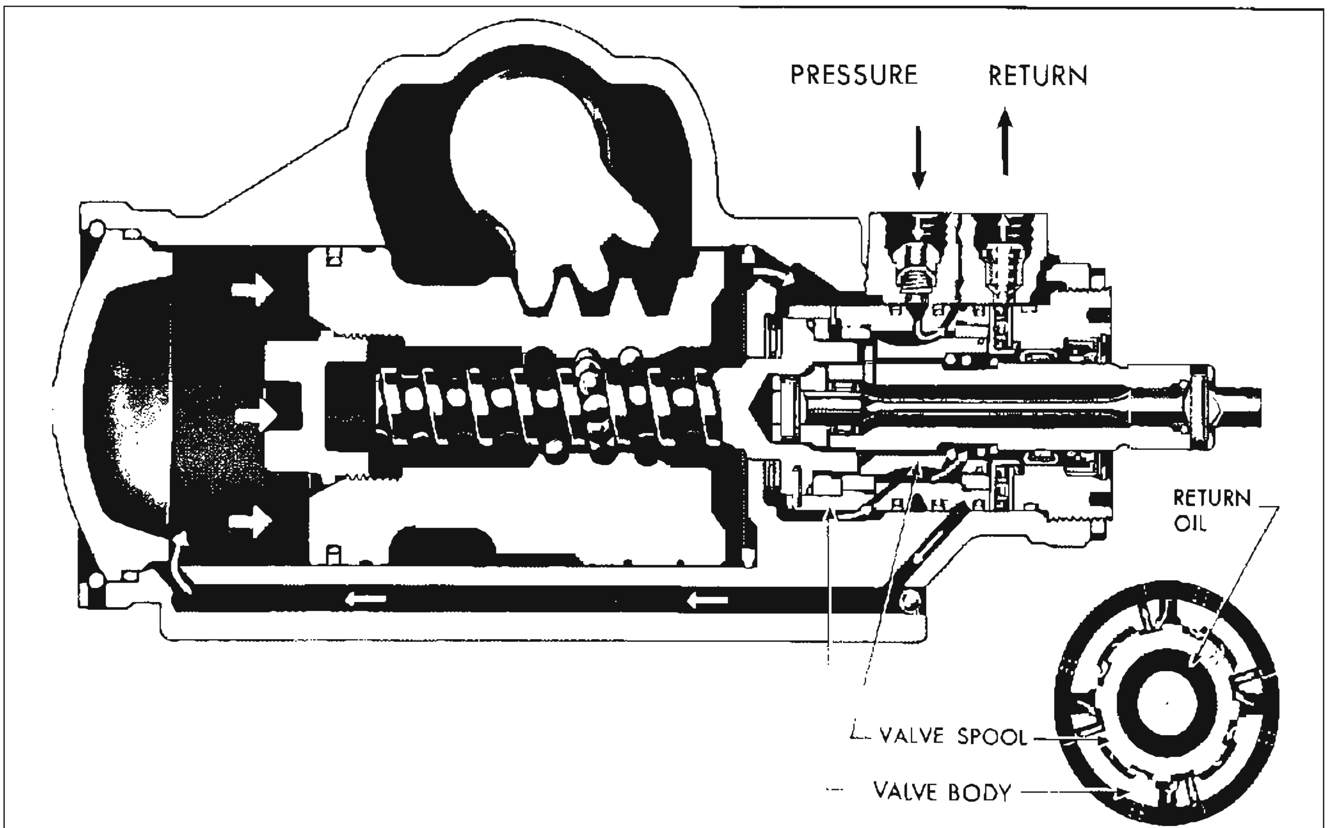



Figure 8-27—Oil Flow in Power Steering Gear - Right Turn

the resistance to turning, the driver is assured of the proper amount of smooth hydraulic assistance at all times.

The instant the driver stops applying steering effort to the steering wheel, the valve spool is moved back into its straight-ahead position in the valve body by the torsion bar.

When this happens, the oil pressure is again equal on both sides of the rack-piston nut, and the steering geometry of the car causes the wheels to return to the straight-ahead position.

### c. Left Turn

Figure 8-28 illustrates the operation of the gear when the steering wheel is turned to the left. The resistance to turning of the front wheels causes the torsion bar to deflect, changing the relationship between the valve spool slots and the valve body slots. The slots are reversed from the right turn position and change the flow of oil into the left turn chamber in the housing, moving the rack-piston nut downward. Thus, turning effort is applied to the pitman shaft. The oil in the right turn chamber is forced through the valve and back to the reservoir. When the driver stops applying steering effort, the valve spool returns to straight-ahead position.

### d. Check Valve Poppet

The check valve is located in the pressure port of the housing under the connector. The valve consists of a poppet and a spring and its purpose is to reduce the possibility of steering wheel "kick-back". If when making a turn, the front tire hits a bump which forces it in a direction opposite the turn, the impact will be carried up to the rack-piston nut by the pitman shaft. If the force is great enough, the rack-piston nut will tend to move against the applied oil pressure and force oil back through the valve assembly and out through the pressure port where the poppet valve is now located. If the rack-piston moved in the opposite direction, the steering wheel would resist momentarily or would "kick-back". The poppet valve is designed to prevent the above action from occurring by trapping the oil inside the gear.

### e. Steering Effort

During normal driving, the steering wheel effort will range from 1 to 2-1/4 pounds. The parking effort ranges from 2 to 3-1/4 pounds, depending upon the road

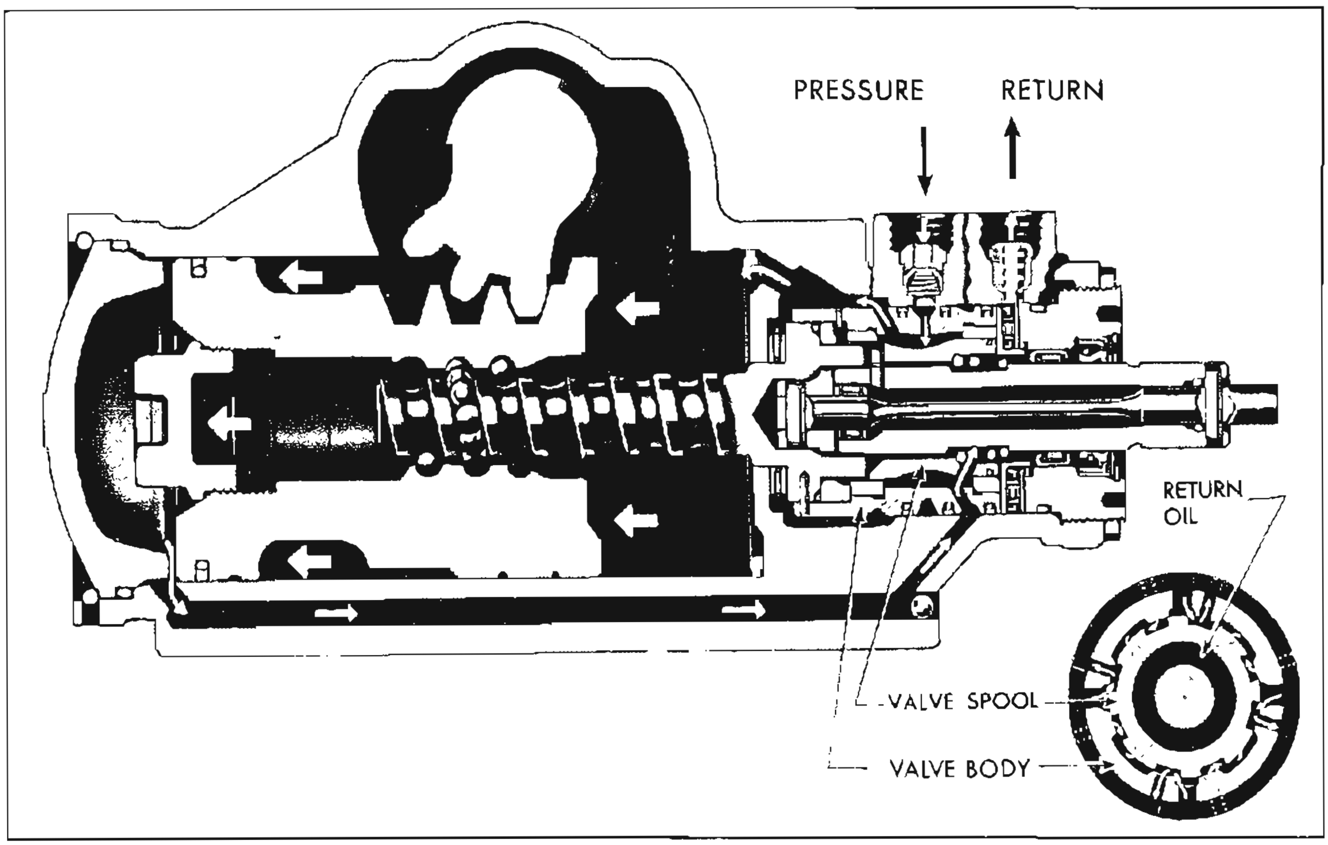



Figure 8-28—Oil Flow in Power Steering Gear - Left Turn

conditions. Full hydraulic assist is obtained with approximately 3-1/4 pounds of effort at steering wheel rim. The more the turning resistance, the greater the pressure in the right or left turn chamber and the more effort the driver must apply to the steering wheel to turn the car. This proportional effort gives the driver the "feel of the road" at all times.

During normal driving conditions, the hydraulic oil pressure in the turn chambers should not exceed 125 psi. Pressure for cornering should not exceed 400 psi and parking pressure may range up to 1100-1200 psi depending upon the road surface.

## 8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP

NOTE: This paragraph covers only those causes of trouble which may be due to the hydraulic power mechanism. Causes which are due to the steering linkage and front suspension are the same as described for standard steering gear in paragraph 8-3.

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| a. HARD STEERING WHILE DRIVING | |
| 1. Lower coupling flange rubbing against adjuster plug. | 1. Loosen pinch bolt and assemble properly. There should be 1/16" clearance between plug and flange. |
| 2. Steering adjustment tight. | 2. Check adjustment by disconnecting pitman arm from gear. |
| 3. Insufficient pressure build-up in gear power cylinder due to leak or faulty valve. | 3. Replace defective parts. |
| 4. Incorrect installation or operation of the gear check valve poppet. | 4. Check operation of valve, paragraph 8-16, subparagraph c, Step 6. |
| b. POOR RETURN OF STEERING GEAR TO CENTER | |
| 1. Lower coupling flange rubbing against adjuster plug. | 1. Loosen pinch bolt and assemble properly. |
| 2. Tighten pitman sector to rack-piston nut adjustment. | 2. Adjust in car to specification. |
| 3. Rack-piston nut to worm preload too tight. | 3. Remove gear and replace balls as required. |
| 4. Thrust bearing adjustment incorrect. | 4. Adjust to specification. |
| 5. Sticky valve spool. | 5. Remove and clean valve. Replace rotary valve assembly if necessary. |
| c. PUMP INOPERATIVE OR POOR OR NO ASSIST | |
| NOTE: Refer to subparagraph i, Step 4, to determine if pump is at fault. | |
| 1. Loose drive belt. | 1. Tighten belt. |
| 2. Low oil level. | 2. Fill reservoir. |
| 3. Air in the oil. | 3. Locate source of air leak and correct. |
| 4. Defective hoses. | 4. Replace hose. |
| 5. Flow control valve stuck open. | 5. Remove burrs or dirt. |
| 6. Loose screw in end of flow control valve. | 6. Tighten. |
| 7. Pressure plate not flat against ring. | 7. Properly seat pressure plate against ring. |

## 8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| c. PUMP INOPERATIVE OR POOR OR NO ASSIST (Cont'd) | |
| 8. Extreme wear of pump ring. | 8. Replace part. |
| 9. Scored pressure plate, thrust and/or rotor. | 9. Lap off light scoring. Replace heavily scored parts. |
| 10. Vanes not installed properly. | 10. Install properly. |
| 11. Vanes sticking in rotor slots. | 11. Free up by removing burrs or dirt. |
| 12. Faulty flow control valve assembly. | 12. Replace assembly. |
| 13. "O" ring improperly installed on presure union. | 13. "O" ring must be in groove nearest outlet of union. |
| 14. End plate improperly installed or seal damaged. | 14. Install properly. Replace seal. |
| d. MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO THE RIGHT OR TO THE LEFT. | |
| 1. Air in system. | 1. Bleed gear. |
| 2. Low oil level in pump. | 2. Check oil level in pump reservoir. |
| 3. High internal leakage. | 3. Replace rack-piston ring and back-up "O" ring, rack-piston nut end plug seal, and/or replace valve. |
| e. EXTERNAL OIL LEAKS | |
| NOTE: Wipe gear and pump thoroughly and make sure source of leakage is determined. | |
| 1. Gear leaks. | |
| (a) Loose hose connections. | (a) Tighten. |
| (b) Damaged hose. | (b) Replace. |
| (c) Side cover "O" ring seal. | (c) Replace seal. |
| (d) Pitman shaft seal. | (d) Replace seals. |
| (e) Housing end plug "O" ring seal. | (e) Replace seal. |
| (f) Adjuster plug "O" ring seal. | (f) Replace seal. |
| (g) Torsion bar "O" ring seal (See Figure 8-19). | (g) Replace valve. |
| (h) Pitman shaft lash adjuster nut. | (h) Replace nut. |
| (i) Stub shaft seal. | (i) Replace seal. |
| 2. Pump leaks. | |
| (a) Oil leaking at top of reservoir as it is too full. | (a) Remove oil to proper level. |
| (b) Oil leaking at top of reservoir caused by air bubbles in oil. | (b) Locate source of air leak and correct. |
| (c) Reservoir "O" ring seal damaged or improperly installed. | (c) Replace "O" ring. |

## 8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| e. EXTERNAL OIL LEAKS (Cont'd) | |
| (d) Pressure union or reservoir to housing bolt and stud not tightened sufficiently. | (d) Torque union and stud and bolt to 30 lb. ft. |
| (e) Pressure union or reservoir to housing bolt and stud cross threaded or damaged. | (e) Replace damaged parts. |
| (f) Defective pressure fitting seat on hose end. | (f) Replace hose. |
| (g) Damaged reservoir to housing or pressure union "O" ring seals. | (g) Replace seals. |
| (h) Defective shaft seal. | (h) Replace seal. |
| (i) Damaged shaft at seal area. | (i) Replace shaft. |
| (j) Leaks in metal parts. (Example: Drawing crack in reservoir.) | (j) Replace defective part. |
| f. NOISE | |
| 1. Gear Noise (rattle or chuckle) | |
| (a) Loose "overcenter" adjustment. | (a) Adjust to specification. |
| NOTE: A slight rattle may occur on turns because of the increased lash when off the "high point". This is normal and the lash must not be reduced below the specified limits to eliminate this slight rattle. | |
| (b) Gear loose on frame. | (b) Tighten mounting bolts to 65 lb. ft. |
| 2. Gear Noise ("hissing" sound). | |
| (a) A hissing noise is natural when steering wheel is at end of travel or when slowly turning at stand still. | (a) Do not replace valve unless "hiss" is extremely objectionable. Investigate clearance around safety drive rivet pins. Be sure there is no metal-to-metal contact around flexible coupling as this will transmit valve hiss to car. |
| 3. Gear Noise (squawk when turning or when recovering from a turn). | |
| (a) Cut or worn dampener "O" ring on valve spool. | (a) Replace dampener "O" ring. |

## 8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| f. NOISE (Cont'd) | |
| 4. Pump Noise. | |
| (a) Loose belt. | (a) Tighten belt. |
| (b) Hoses touching other parts of car. | (b) Adjust hose positions. |
| (c) Low oil level. | (c) Fill reservoir. |
| (d) Air in the oil. | (d) Locate source of air leak and correct. |
| (e) Excessive back pressure caused by hoses or steering gear. | (e) Locate restriction and correct. With pressure gauge installed in pressure hose between pump and gear and engine running at 1500 RPM, oil warm, and no effort on the steering wheel. See Figure 8-29. Pressure should not exceed 125 psi. Check operation of check valve poppet, paragraph 8-16, subparagraph c, Step 6. |
| (f) Scored pressure plate. | (f) Lap out light scoring. Replace heavily scored part. |
| (g) Vanes not installed properly. | (g) Install properly. |
| (h) Vanes sticking in rotor slots. | (h) Free up by removing burrs or dirt. |
| (i) Extreme wear of pump ring. | (i) Replace part. |
| (j) Face of thrust plate scored. | (j) Lap out light scoring. Replace heavily scored part. |
| (k) Scored rotor. | (k) Lap out light scoring. Replace heavily scored part. |
| (l) Defective flow control valve. | (l) Replace. |
| g. EXCESSIVE WHEEL KICKBACK OR LOOSE STEERING | |
| 1. Air in system. | 1. Add oil to pump reservoir and bleed. |
| 2. Excessive lash between pitman shaft sector and rack-piston. | 2. Adjust to specification. |
| 3. Loose thrust bearing adjustment. | 3. Remove gear and adjust to specification. |
| 4. Rack-piston nut to worm preload too low. | 4. Remove rack-piston nut and worm, and change balls to obtain specified preload. |
| 5. Incorrect installation or operation of the gear check valve poppet. | 5. Check operation of valve, paragraph 8-16, subparagraph c, Step 6. |
| h. STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING | |
| Loose pump belt. | Adjust to specification. |

## 8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| i. HARD STEERING WHEN PARKING | |
| 1. Loose pump belt. | 1. Adjust to specification. |
| 2. Low oil level in reservoir. | 2. Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage. |
| 3. Steering gear adjustments tight. | 3. Adjust to specification. |
| 4. Insufficient oil pressure. | 4. If all of the above checks do not reveal the cause of hard steering, make the following tests of oil pressure:<br>(a) Disconnect the pressure line at oil pump. Attach pressure gauge to pump. Connect the hose to end of gauge where the valve is located. See Figure 8-29.<br>(b) With engine at warm idle (525 RPM) and gauge valve open, note the oil pressure on the gauge while turning steering wheel from one extreme position to the other. Especially note the maximum pressure which can be built up with the wheel held in either right or left extreme position.<br>CAUTION: Do not hold wheel in extreme position for an extended period of time because it will drastically increase the oil temperature and will cause undue wear on the oil pump.<br>(c) With oil temperature between 150°F and 170°F, as measured with a thermometer in the reservoir, the maximum oil pressure should not be less than 1000 psi for satisfactory power steering operation.<br>(d) If the maximum oil pressure is less than 1000 psi, it indicates trouble in the pump, oil hoses, steering gear, or a combination of these parts. To eliminate the hoses and gear, close the gauge valve and quickly test pressure of the pump only with the engine at warm idle, then open the valve to avoid increasing oil temperature. A minimum pressure of 1000 psi should be present with valve closed. |

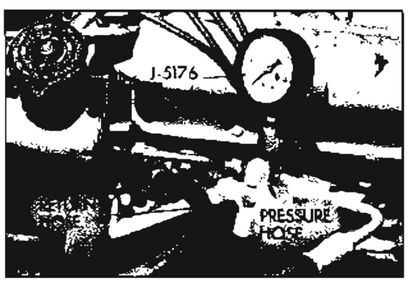


Figure 8-29—Pressure Gauge Installed

## 8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

| COMPLAINT AND CAUSE | CORRECTION |
|---|---|
| i. HARD STEERING WHEN PARKING (Cont'd) | |
| | (e) Comparing the maximum pressure obtained in these two tests will indicate source of trouble as follows: Step (b) pressure low and Step (d) pressure normal indicates faulty external oil lines or steering gear. Step (b) and Step (d) pressures equally low indicates faulty oil pump. |
| 5. Low oil pressure in gear caused by restriction in hoses. | |
| (a) Check for kinks in hoses. | (a) Remove kink. |
| (b) Foreign object in hose. | (b) Remove hoses and remove restricting object or replace hose. |
| 6. Low oil pressure due to steering gear: | |
| (a) Leakage at side cover "O" ring, housing end plug "O" ring, pitman shaft seals. | (a) Replace defective seals. |
| (b) Pressure loss in cylinder due to worn piston ring, damaged back-up "O" ring or scored housing bore. | (b) Remove gear from car for disassembly and inspection of rings and housing bore. |
| (c) Leakage at valve rings, valve body to worm seal, rack-piston end plug seal. | (c) Remove gear from car for disassembly and replace seals. |
| (d) Loose fit of spool in valve body or leaky valve body. | (d) Replace rotary valve assembly. |
| 7. Incorrect installation or operation of the gear check poppet valve. | 7. To determine if the poppet valve is installed and operating correctly, disconnect the pressure hose and install a pressure gauge between the hose and the pump. With the engine at warm idle (525 RPM) and no effort on the steering wheel, oil pressure should not exceed 60 psi with warm oil. If gauge indicates more than 60 psi the poppet valve should be checked for correct installation. Paragraph 8-16, subparagraph c., Step 6. |
| j. NO EFFORT REQUIRED TO TURN | |
| Broken torsion bar. | Replace rotary valve assembly. |

## 8-12 REMOVAL AND INSTALLATION OF PITMAN SHAFT SEALS, STEERING GEAR AND OIL PUMP

### a. Removal and Installation of Pitman Shaft Seals with Steering Gear in Car

If, upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may often be replaced without removing gear assembly from car as follows:

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller J-5504. See Figure 8-30.

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during assembly.

NOTE: Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due to the close tolerance between the seals and the pitman shaft.

3. Remove pitman shaft seal retaining ring with No. 3 Truarc Pliers J-4245.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

NOTE: Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out.

5. Inspect seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation.

6. Clean the end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.

7. Lubricate the seals thoroughly with petroleum jelly and install seals with Installer J-6219. Install the inner single lip seal first, then a back-up washer. Drive seal in far enough to provide clearance for the other seal, back-up washer and retaining ring. Make sure that the inner seal does not bottom on the counterbore. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.

8. Fill pump reservoir to proper level. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.

9. Remove tape and reconnect pitman arm.

### b. Removal of Power Steering Gear

1. Place fender cover over left front fender.

2. Disconnect the pressure and return line hoses at the steering gear and elevate ends of hoses higher than pump to prevent oil from draining out of pump.

3. Remove two nuts securing gear coupling to steering shaft lower flange. See Figure 8-31.

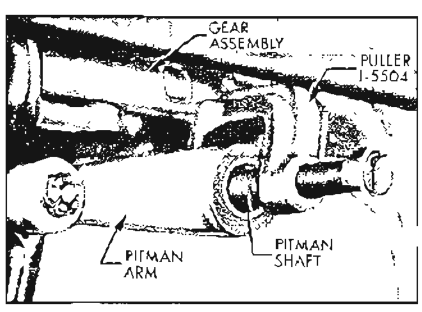



Figure 8-30—Removing Pitman Arm from Pitman Shaft

4. Jack up car and remove the pitman shaft nut, then remove the pitman arm using Puller J-5504. See Figure 8-30.

5. Loosen the three-frame-to-steering gear bolts at outside of frame and remove steering gear.

### c. Installation of Steering Gear Assembly

1. Install the gear assembly by reversing the procedure for removal. See Figure 8-31 for tightening specifications. Torque pitman nut 100-140 lb. ft. Torque lower coupling pinch bolt 20-35 lb. ft. Be sure there is 1/16" clearance between adjuster plug and gear coupling (see Figure 8-31).

2. Fill pump reservoir to correct level with Buick Power Steering oil.

3. Start engine and maintain oil level in reservoir while allowing engine to idle for at least three minutes before turning steering wheel. Then rotate steering wheel through its entire range slowly a few times with engine running. Recheck oil level and inspect for possible leaks.

NOTE: If air becomes trapped in the oil, the oil pump may be noisy until all air is out of oil. This may take some time since air trapped in oil does not bleed out rapidly.

### d. Removal of Oil Pump

NOTE: It is not necessary to remove oil pump to service the flow control valve or to replace the shaft seal. The flow control valve is retained in pump housing by a pressure union and filter assembly. See Figure 8-23. Refer to paragraph 8-18 for replacing shaft seal without removing pump.

1. Remove pump pulley nut. See Figure 8-32. Disconnect belt from pulley and remove pulley

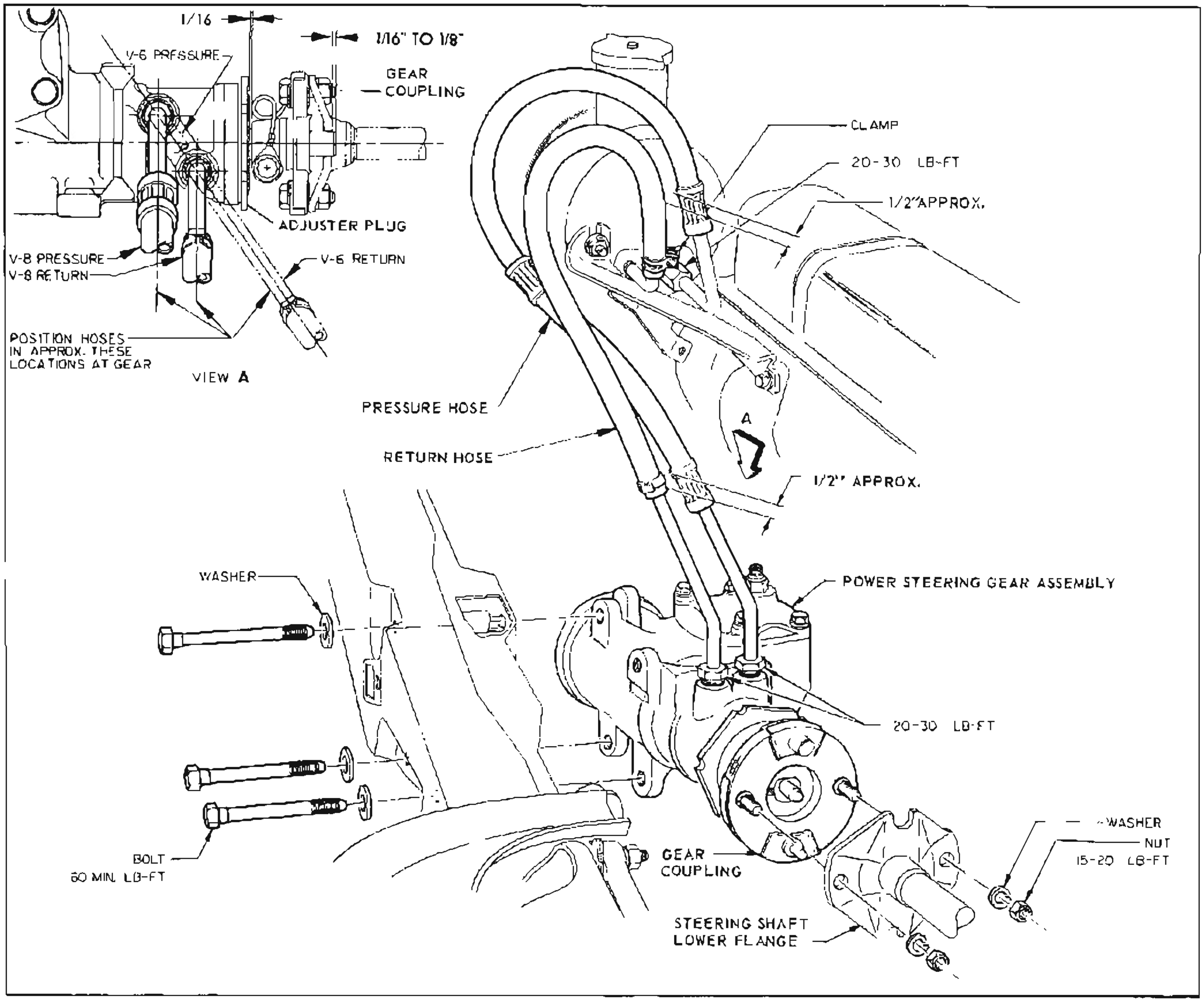



Figure 8-31—Power Steering Gear Installation

using a suitable puller. Do not hammer pulley off.

2. Disconnect return and pressure hoses from pump. Cover the hose connector and union on pump and open ends of the hoses to avoid entrance of dirt.

3. Loosen nut that attach pump to rear mounting bracket.

4. Remove the two bolts that attach pump to the front mounting bracket and lift out pump.

**e. Installation and Bleeding of Oil Pump**

1. Install the oil pump by reversing the procedure for removal.

2. When pump is reinstalled on engine, adjust drive belt tension to 90 pounds.

3. Fill pump reservoir to correct level with Buick Power Steering oil.

4. Start engine and maintain oil level in reservoir while allowing engine to idle for at least three minutes before turning steering wheel. Then rotate steering wheel through its entire range slowly a few times with engine running. Recheck oil level and inspect for possible leaks.

NOTE: If air becomes trapped in the oil, the oil pump may be noisy until all air is out of oil. This may take some time since air trapped in oil does not bleed out rapidly.

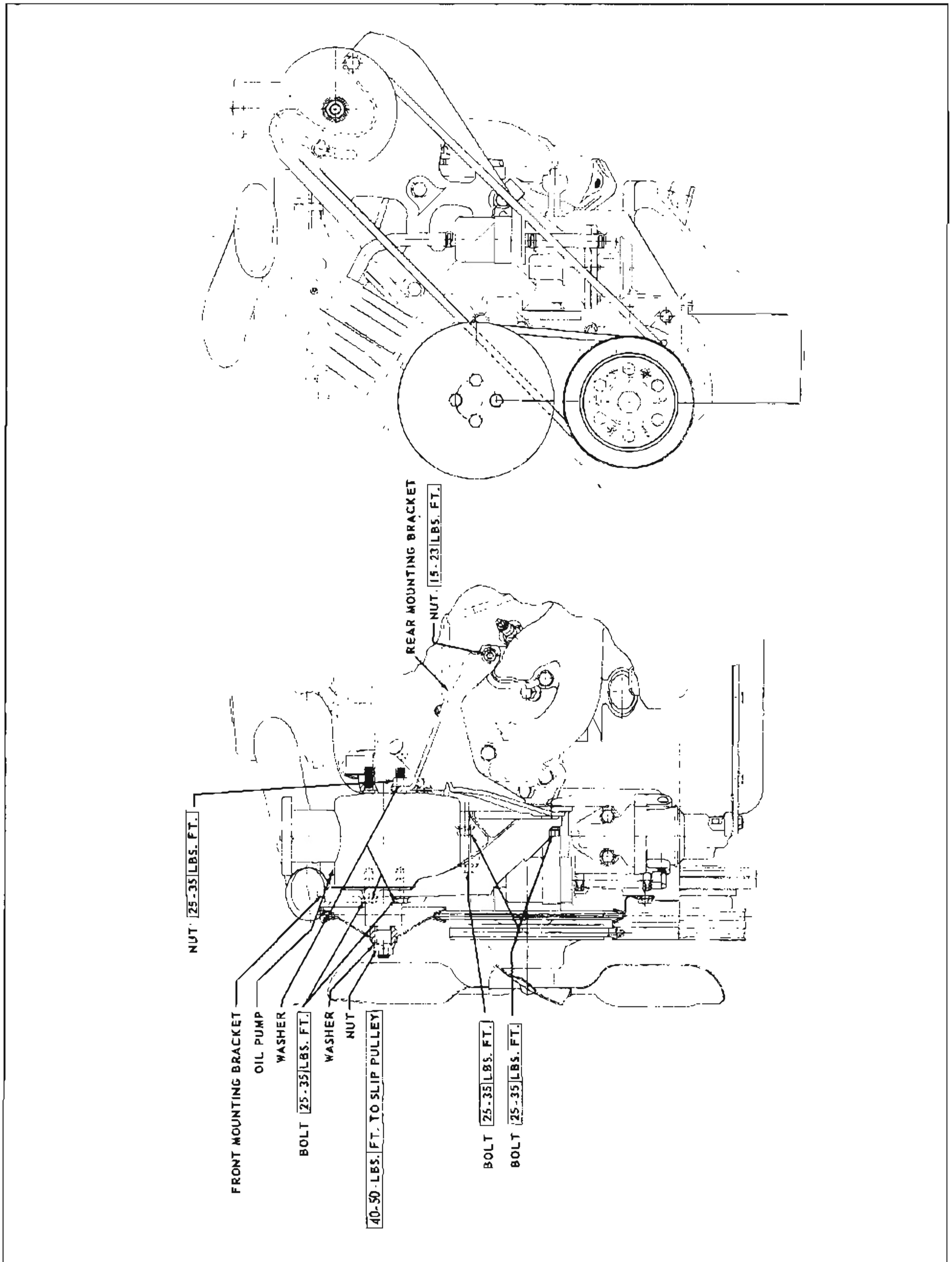



Figure 8-32—Power Steering Oil Pump Installation

## 8-13 ADJUSTMENT OF POWER STEERING GEAR

### a. Adjustment of Power Steering Gear in Car

IMPORTANT: Thrust bearing preload and worm to rack piston nut ball preload have little effect on handling. The most important gear adjustment affecting handling is the pitman shaft "overcenter" preload. The "overcenter" adjustment is made without removing gear from car, thus on handling complaints this adjustment should be checked and corrected and car road tested before removing gear to change thrust bearing preload or ball preload.

1. Remove pitman arm from pitman shaft. See Figure 8-30.

NOTE: Never attempt to adjust steering gear with pitman arm connected to pitman shaft.

2. Remove cap from steering wheel. See Figures 8-6 or 8-7.

3. Turn steering wheel slowly through its full travel to check for binding, tight spots or uneven action.

NOTE: If a spring scale is used to check adjustments, follow specifications listed in paragraph 8-8 (b).

4. Turn steering wheel to extreme right or left position. Attach Torque Wrench J-5853 to steering wheel retaining nut and check the torque required to turn the wheel steadily in the range where lash normally exists between rack-piston nut and pitman shaft sector. See Figure 8-4. The lash range exists for one-eighth turn of steering wheel from either extreme position.

5. The reading on the torque wrench should be between 1 and 11 inch pounds, which would indicate normal preload at the thrust bearing and drag at the valve assembly.

6. Turn steering wheel 1/2 to 3/4 of a turn off "high-point" (center position) of gear. Worm to rack ball preload is checked with gear in this position.

NOTE: It is not necessary to back off pitman shaft lash adjuster to check ball preload when gear is positioned as instructed in Step 6.

7. Check the torque required to turn the wheel. The reading should be 1 to 5 inch pounds higher than reading recorded in Step 5 which would indicate normal ball preload between worm and rack-piston nut.

NOTE: The thrust bearing preload and ball preload readings should be close to the minimum specification on a gear that has been in use. On a new gear, these readings will be greater.

8. Check torque required to turn wheel through the gear "high-point" (center position). The reading should be 4 to 8 inch pounds higher than was obtained in Step 7. Adjust pitman shaft lash adjuster if necessary.

### b. Adjustment of Power Steering Gear Out of Car

1. This adjustment is made when the gear is completely assembled and with gear on bench.

2. Loosen adjuster plug lock nut and back off adjuster plug approximately 1/8 turn with adjustable Spanner Wrench J-7624. Attach Torque Wrench J-5853 with 3/4 inch 12 point socket to stub shaft and turn shaft to approximately 1/2 turn from either extreme. Slowly rotate wrench in an arc approximately 60° (1/6 turn) in both directions several

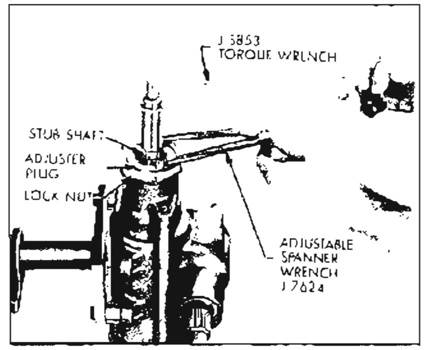



Figure 8-33—Adjusting Thrust Bearing Preload

times to measure valve drag and record highest reading. See Figure 8-33. Then tighten adjuster plug until thrust bearing preload is 1 to 3 inch pounds in excess of drag measured with adjuster plug backed out. Total of thrust bearing preload and valve drag should not exceed 11 inch pounds.

3. Turn stub shaft 1/2 to 3/4 of a turn off "high-point" (center position) of gear. Worm to rack ball preload is checked with gear in this position.

NOTE: It is not necessary to back off pitman shaft lash adjuster to check ball preload when gear is positioned as instructed in Step 4.

4. Check the pull required to turn stub shaft. The reading should be 1 to 5 inch pounds higher than total reading obtained in Step 3. If reading is not within specification it will be necessary to readjust ball preload between worm and rack-piston nut.

5. If readings are within specifications, check and adjust if necessary, pitman shaft "overcenter" adjustment. Reading on torque wrench should be 4 to 8 inch pounds higher than was obtained in Step 5. See Figure 8-34. This reading is taken when rotating stub shaft through "high-point" range with lash adjuster nut tight.

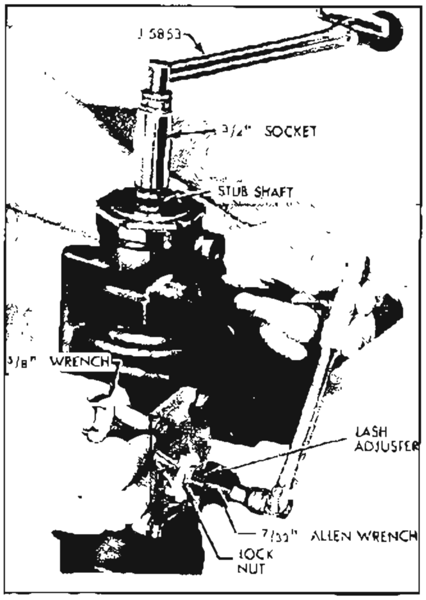



Figure 8-34—Pitman Shaft Over-Center Adjustment

## 8-14 DISASSEMBLY, INSPECTION AND ASSEMBLY OF ADJUSTER PLUG ASSEMBLY AND ROTARY VALVE ASSEMBLY

### a. Removal of Adjuster Plug Assembly and Rotary Valve Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Place gear assembly in vise.

3. Loosen adjuster plug lock nut with punch and remove adjuster plug using adjustable Spanner Wrench, J-7624.

4. Remove rotary valve assembly from gear by grasping stub shaft and pulling out.

NOTE: If it is only necessary to service the rotary valve assembly, proceed with subparagraph "d" below.

### b. Disassembly of Adjuster Plug Assembly

1. Remove the upper thrust bearing retainer with a screwdriver, being careful not to damage the needle bearing bore. See Figure 8-35. Discard retainer. Remove thrust bearing spacer, upper thrust bearing and thrust bearing races.

2. Remove adjuster plug "O" ring and discard.

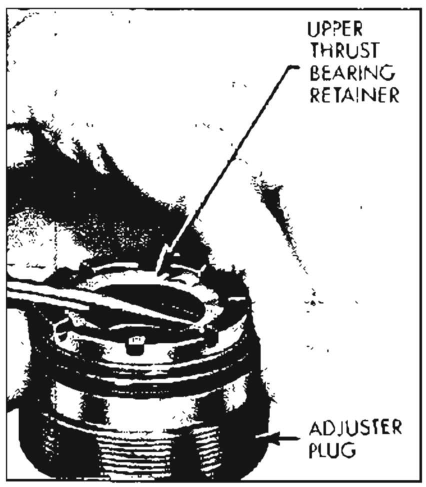



Figure 8-35—Removing Upper Thrust Bearing Retainer

3. Remove stub shaft seal retaining ring using No. 3 Truarc Pliers J-4245 and remove and discard dust seal. See Figure 8-36.

4. Remove stub shaft seal by prying out with screwdriver and discard.

5. Inspect needle bearing in adjuster plug and if rollers are broken or pitted, remove needle bearing by pressing from thrust bearing end using Tool J-6221 and discard bearing. See Figure 8-37.

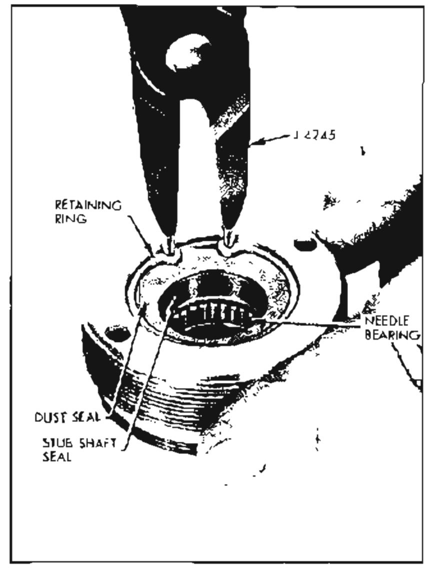



Figure 8-36—Removing Stub Shaft Seal Retaining Ring

6. Inspect thrust bearing spacer for cracks.

7. Inspect thrust bearing rollers and thrust bearing races for wear, pitting, scoring, cracking or brinelling. Replace any damaged parts.

### c. Reassembly of Adjuster Plug Assembly

1. If needle bearing was removed because of damage, install new

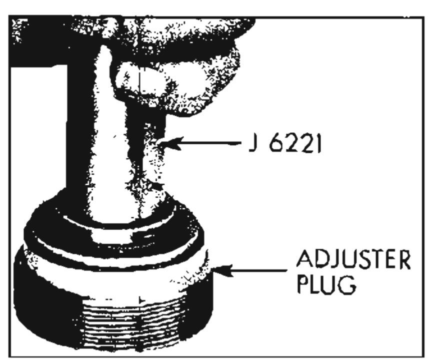



Figure 8-37—Removing Needle Bearing

needle bearing from thrust bearing end of adjuster plug, by pressing against identification end of bearing using Tool J-6221. End of bearing must be flush with bottom surface of stub shaft seal bore.

2. Lubricate new stub shaft seal with automatic transmission oil and install seal with spring in seal toward adjuster plug using Tool J-5188. See Figure 8-38. Install seal only far enough in plug to provide clearance for dust seal and retaining ring. Place new dust seal with lip up in plug, then install retaining ring with No. 3 Truarc Pliers, J-4245.

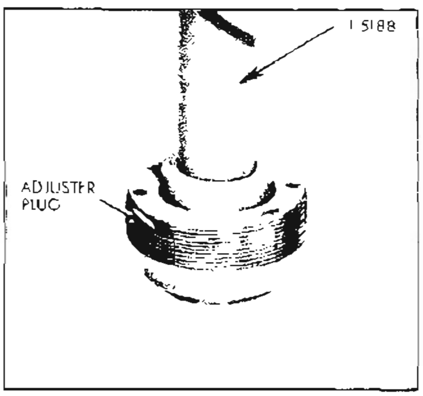



Figure 8-38—Installing Stub Shaft Seal

3. Lubricate new adjuster plug "O" ring seal with petroleum jelly and install on adjuster plug. Assemble large O.D. thrust bearing race with internal flange up on adjuster plug, then thrust bearing, smaller thrust bearing race and thrust bearing spacer on adjuster plug. Install new thrust bearing retainer into needle bearing bore using punch, being careful not to damage spacer. See Figure 8-39. Radial location of dimples on retainer is not important. Thrust bearing assembly and spacer must be free to rotate and retainer must be completely below surface of spacer.

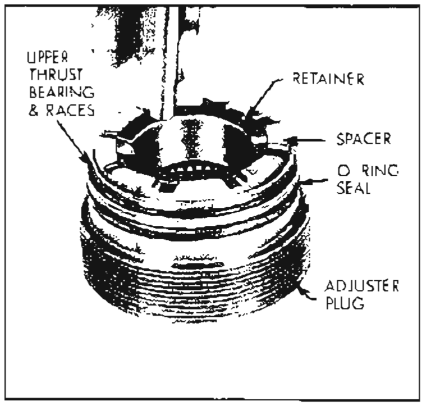



Figure 8-39—Installing Upper Thrust Bearing Retainer

### d. Disassembly of Rotary Valve Assembly

It is very uncommon to have to make any service repairs to the valve assembly with the possible exception of the valve spool dampener "O" ring seal. DO NOT disassemble the valve unless absolutely necessary since this may result in damaging the assembly. If the valve spool dampener "O" ring seal requires replacement, remove the valve spool only, replace the "O" ring and reinstall the spool immediately. DO NOT disassemble further.

CAUTION: Cleanliness of parts, tools and work area is of the utmost importance during servicing of the valve assembly.

1. Remove cap to worm "O" ring seal and discard.

2. Remove valve spool spring by prying on small coil with a small screwdriver to work spring onto bearing surface of stub shaft. Slide spring off shaft. Be very careful not to damage stub shaft surface.

3. Remove the valve spool by holding the valve assembly in one hand with the stub shaft pointing downward. Insert the end of a pencil or wood rod through the opening in the valve body cap and lightly push on the valve spool until it is far enough out of the valve body to be withdrawn. See Figure 8-40. Withdraw the spool with a steady rotating pull to prevent jamming. See Figure 8-41. If slight sticking occurs, make a gentle attempt to reverse the withdrawal procedure. If this does not free spool, it has become cocked in the valve body bore. Do not attempt to force the spool in or out if it becomes cocked, but continue with the following step.

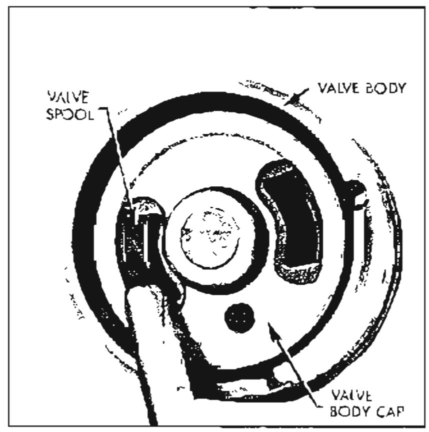



Figure 8-40—Separating Valve Spool From Valve Body

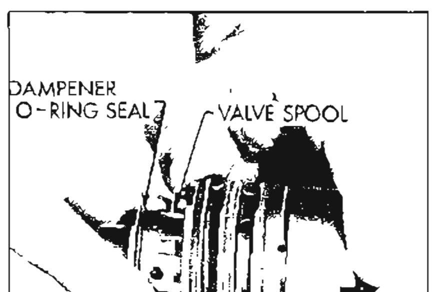



Figure 8-41—Withdrawing Valve From Valve Body

CAUTION: The valve spool must be removed with extreme care. The clearance between the valve body and the spool may be as low as .0004 inch. The slightest cocking of the spool may jam it in the valve body.

4. Remove the stub shaft, torsion bar and cap assembly by holding the valve assembly with stub shaft downward as shown and rapping torsion bar lightly against workbench to dislodge the cap from the valve body to cap pin. See Figure 8-42. Complete the removal of the stub shaft torsion bar and cap assembly.

5. If the valve spool became cocked as described in Step 3 above, it can now be freed by visually determining in which direction it is cocked. Tap the spool lightly with a plastic or wood rod to align it and free it in the valve body bore. Do not tap spool with anything metallic.

6. Remove valve spool dampener "O" ring seal and discard.

7. If there is evidence of wear or leakage carefully cut and remove three valve body rings and three ring back-up "O" ring seals. Discard rings and seals.

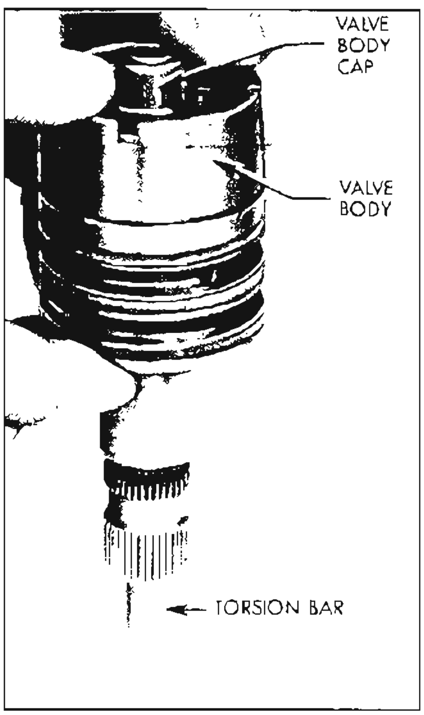



Figure 8-42—Removing Stub Shaft, Torsion Bar and Cap Assembly From Valve Body

**e. Inspection of Rotary Valve Assembly**

NOTE: The rotary valve assembly is a precision unit with selectively fitted parts and is hydraulically balanced when assembled at the factory. Only those parts which are listed in parts book are replaceable and interchangeable. No other valve parts are individually interchangeable. If replacement of any non-serviceable valve part is necessary, the rotary valve assembly should be replaced.

1. If the valve assembly leaks externally between the torsion bar and stub shaft, the valve assembly should be replaced. The torsion bar "O" ring seal in the stub shaft is not serviced.

2. Inspect the pin in the valve body that engages the valve cap for being badly worn, cracked, or broken. If the pin is damaged the valve assembly should be replaced..

3. Inspect the smaller of the two grooves in the end of valve body. If it is worn badly the valve assembly should be replaced.

4. Inspect the valve spool drive pin in the stub shaft. If it is worn badly, cracked or broken the valve assembly should be replaced.

5. Examine the valve spool O.D. and the valve body I.D. for nicks, burrs or bad wear spots. If any are found, the valve assembly should be replaced. A slight polishing is normal on the valve surfaces.

6. Check the fit of the spool in the valve body. Lubricate the spool with automatic transmission oil and install it in the valve body without the dampener "O" ring seal on it. The spool should rotate smoothly without binding or catching. If spool does not rotate smoothly, the valve assembly should be replaced.

7. Measure the length of the valve spool spring. The free length should be approximately 3/4 to 7/8 inch. If it measures 11/16 inch or less, the spring should be replaced because this indicates that the spring has set.

8. Examine the needle bearing surface on the stub shaft for being badly worn, brinelled or scored. If damaged, the valve assembly should be replaced.

**f. Reassembly of Rotary Valve Assembly**

CAUTION: All parts must be free and clear of dirt, chips, etc., before assembly and must be protected after assembly.

1. If removed from valve body, lubricate three new ring back-up "O" ring seals in automatic transmission oil and assemble in the three ring grooves on the valve body. Assemble three new valve body rings in the ring grooves over the "O" ring seals by carefully slipping over the valve body. See Figure 8-43.

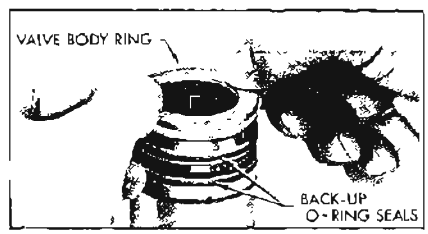



Figure 8-43—Installing Valve Body Rings

NOTE: The valve body rings may appear loose or twisted in the grooves, but the heat of the oil during operation after assembly will cause them to straighten.

2. Lubricate a new valve dampener "O" ring seal in automatic transmission oil and install in valve spool groove.

3. Assemble the stub shaft torsion bar and cap assembly in the valve body, aligning the groove in

the valve cap with the pin in the valve body. See Figure 8-44. Tap lightly on the cap with a soft mallet until cap is against the shoulder in the valve body. Valve body pin must be in the cap groove. Hold these parts together during the rest of valve assembly.

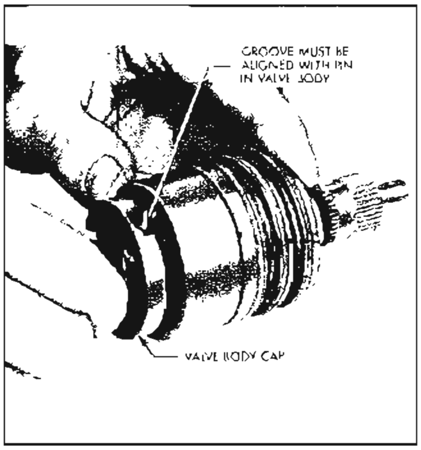



Figure 8-44—Assembling Stub Shaft, Torsion Bar and Cap Assembly in Valve Body

4. Lubricate valve spool with automatic transmission oil. With notch in spool toward valve body, slide the spool over the stub shaft. Align the notch on the valve spool with the spool drive pin on the stub shaft and carefully engage the spool in the valve body bore. Push the spool evenly and slowly with a slight rotating motion until spool reaches drive pin. Rotate spool slowly with pressure until the notch engages the pin. Before pushing the spool completely in, make sure dampener "O" ring seal is evenly distributed in the spool groove.

Complete the spool assembly slowly with care so the "O" ring seal is not damaged.

CAUTION: Because the clearance between the spool and valve body is very small, extreme care must be taken when assembling these parts.

5. Place Seal Protector J-6222 over stub shaft and slide valve spool spring over stub shaft with smaller diameter coil going over end of shaft last. See Figure 8-45. Work spring on shaft with a small screwdriver until small coil of spring is seated in the stub shaft groove. Be careful not to damage surface of shaft.

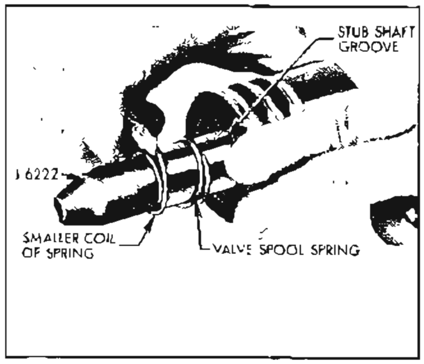



Figure 8-45—Installing Valve Spool Ring

NOTE: Spring must be seated properly in groove in stub shaft.

6. Lubricate a new cap to worm "O" ring seal in automatic transmission oil and install in valve body.

NOTE: If during the assembly of the valve, the stub shaft and valve cap were allowed to slip out of engagement with the valve body pin, the spool will be permitted to enter the valve body too far. The spool dampener "O" ring seal will expand into the valve body oil slots and will prevent withdrawal of the spool. If this has occurred, attempt to withdraw spool with a slight pull and much rotary motion. If this does not free the spool make sure spool is free to rotate and place valve body on a flat surface with notched end up. Tap spool with wooden or plastic rod until "O" ring seal is cut and spool can be removed. Install new dampener "O" ring seal and proceed with assembly as before starting with Step 2 above.

**g. Installation of Rotary Valve Assembly and Adjuster Plug Assembly**

1. Align the narrow pin slot on the valve body with the valve body drive pin on the worm. Insert the valve assembly into the gear housing by pressing against the valve body with the finger tips. Do not press on stub shaft or torsion bar. See Figure 8-46. The return hole in the gear housing should be fully visible when valve is assembled properly. See Figure 8-47.

CAUTION: Do not push against the stub shaft during assembly as this may cause the stub shaft and cap to pull out of the valve body, allowing the spool dampener "O" ring seal to slip into valve

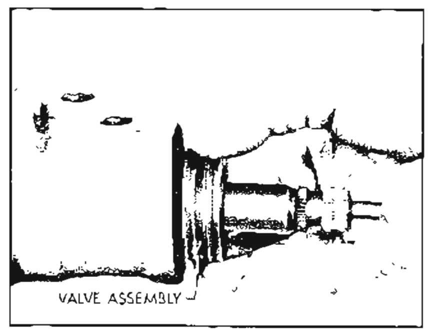



Figure 8-46—Inserting Valve Assembly in Housing

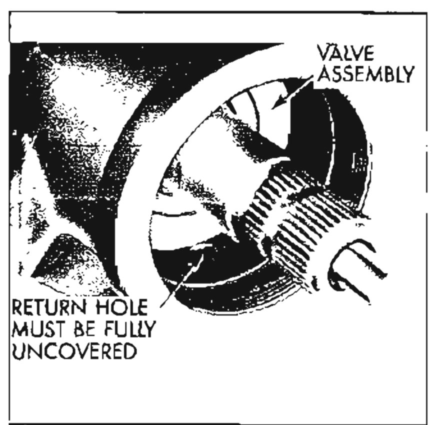



Figure 8-47—Valve Assembly Installed in Housing

body oil grooves. Be sure valve is properly seated before installing adjuster plug assembly.

2. Place Seal Protector J-6222 over end of stub shaft. Install adjuster plug assembly in gear housing snugly with adjustable Spanner Wrench J-7624 then back plug off approximately 1/8 turn. Install adjuster plug lock nut if removed, but do not tighten.

3. Adjust the thrust bearing preload. Attach Torque Wrench J-5853 with a 3/4 inch socket to the stub shaft. Turn stub shaft to approximately 1/2 turn from either extreme. Slowly rotate wrench in an arc approximately 60° (1/6 turn) in both directions several times to measure valve drag. See Figure 8-33. Then tighten adjuster plug until thrust bearing preload is 1 to 3 inch pounds in excess of valve drag measured with adjuster plug backed out. Total of thrust bearing preload and drag should not exceed 11 inch pounds.

4. Tighten adjuster plug lock nut with adjustable Spanner Wrench J-7624. Recheck thrust bearing preload to be sure that tightening lock nut did not change adjustment.

## 8-15 DISASSEMBLY, INSPECTION AND ASSEMBLY OF PITMAN SHAFT ASSEMBLY

### a. Removal of Pitman Shaft Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Place gear assembly in vise.

3. Rotate the stub shaft until pitman shaft gear is in center position. Remove the housing side cover retaining bolts.

4. Tap the end of the pitman shaft with a soft mallet and slide shaft out of housing.

5. Remove the side cover "O" ring seal and discard.

### b. Disassembly of Pitman Shaft Assembly

1. Remove the pitman shaft seal retaining ring from end of housing using No. 3 Truarc Pliers J-4245 and remove outer seal back-up washer. Tap a screwdriver between the outer seal and the inner back-up washer and pry out seal. Tap the screwdriver between the inner seal and the shoulder in the gear housing and pry out inner seal. Be careful not to damage the seal bore in housing. Discard seals.

2. Check the pitman shaft needle bearing for wear, pitting, or scoring. If damaged, remove needle bearing from gear housing bore by driving from the seal bore side of housing using Tool J-6657. See Figure 8-48. Discard bearing.

3. Hold the lash adjuster with an Allen Wrench and remove the lash adjuster nut. Discard nut. Remove side cover from lash adjuster.

### c. Inspection of Pitman Shaft Assembly

1. Inspect pitman shaft bushing surface in side cover for excessive wear or scoring. If worn or scored, replace side cover.

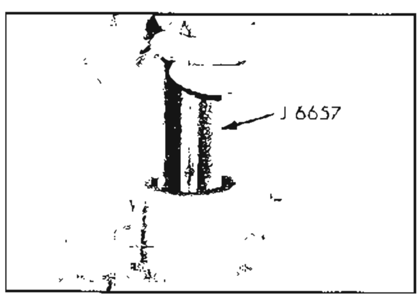



Figure 8-48—Removing Pitman Shaft Needle Bearing

2. Check the pitman shaft sector teeth and the bearing and seal surfaces. If worn, pitted or scored replace pitman shaft.

3. Check the torque on the lash adjuster. See Figure 8-49. If torque exceeds 15 inch pounds, pitman shaft assembly should be replaced.

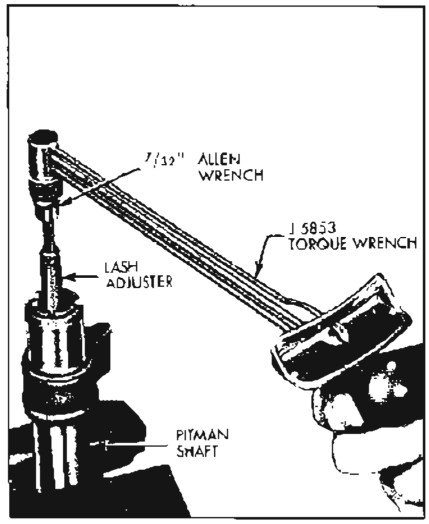



Figure 8-49—Checking Torque on Lash Adjuster

### d. Reassembly of Pitman Shaft Assembly

1. If pitman shaft needle bearing was removed because of damage, install new needle bearing into gear housing bore from seal bore end, pressing against stamped identification on bearing with Tool J-6657. Press in until bearing clears shoulder in gear housing, 1/32" maximum. Rollers in bearing must be free to rotate.

2. Lubricate new pitman shaft seals in automatic transmission oil. Install the inner, single lip seal in bore first, then a back-up washer. See Figure 8-50. Using Tool J-6219, drive the seal and washer in far enough to provide clearance for the outer seal, back-up washer and retaining ring. See Figure 8-51. The inner seal must not bottom on the

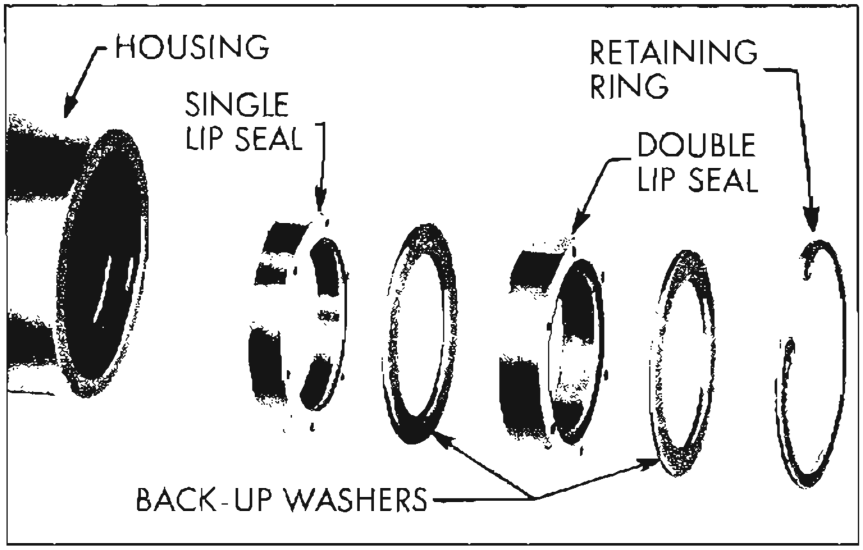



Figure 8-50—Pitman Shaft Seals

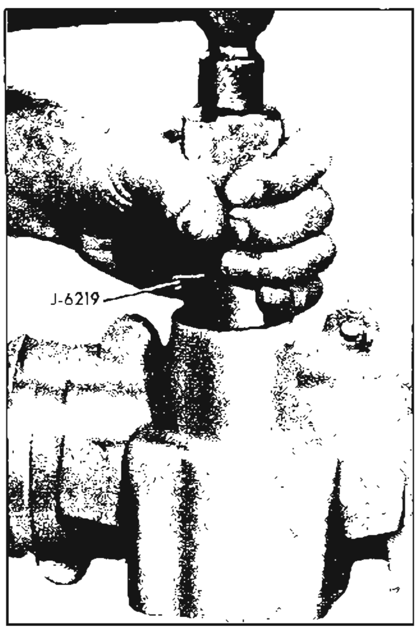



Figure 8-51—Installing Pitman Shaft Seals

counterbore. Install the outer double lip seal and the second back-up washer in bore only far enough to provide clearance for the retaining ring with Tool J-6219. Install retaining ring with No. 3 Truarc Pliers Tool J-4245, making certain that ring is seated properly.

3. Assemble the side cover on the pitman shaft. Screw the lash adjuster through the side cover until the side cover bottoms on the shaft and then back off 1/2 turn.

**e. Installation of Pitman Shaft Assembly**

1. Lubricate a new side cover "O" ring seal in automatic transmission oil and install in groove in the face of side cover.

2. Turn the stub shaft until the center groove of the rack-piston is aligned with the center of the pitman shaft hole.

3. Wrap masking tape over the end of pitman shaft. Install the pitman shaft so that the center tooth in the sector meshes with the center groove of the rack-piston nut. Make sure the side cover "O" ring seal is in place before pushing the side cover down on gear housing. Remove masking tape from end of shaft.

4. Install the four side cover bolts with lock washers and tighten to 30 ft. lbs.

5. Install new lash adjuster nut on lash adjuster, but do not tighten.

6. Adjust pitman shaft as outlined in paragraph 8-13 (b).

## 8-16 DISASSEMBLY, INSPECTION AND ASSEMBLY OF RACK-PISTON NUT AND WORM ASSEMBLY

**a. Removal of Rack-Piston Nut and Worm Assembly**

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Remove pitman shaft assembly as outlined in paragraph 8-15 (a).

3. Rotate housing end plug retainer ring so that one end of ring is over hole in gear housing. Spring one end of ring with punch to allow screwdriver to be inserted to lift ring out. See Figure 8-52.

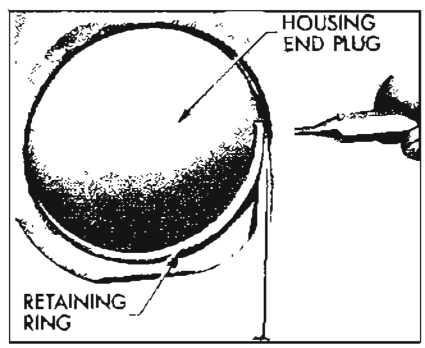



Figure 8-52—Removing Housing End Plug Retaining Ring

4. Rotate stub shaft to full left turn position to force end plug out of housing.

CAUTION: Do not rotate farther than necessary or the balls from the rack-piston and worm assembly will fall out.

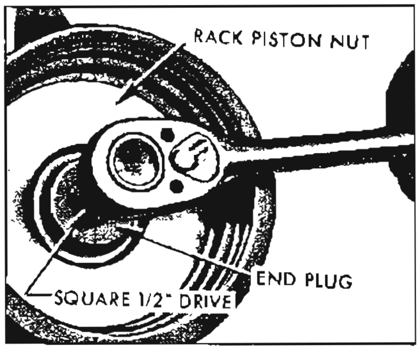



Figure 8-53—Removing Rack-Piston Nut End Plug

5. Remove and discard housing end plug "O" ring seal.

6. Remove rack-piston nut end plug with a 1/2 square drive. See Figure 8-53.

7. Insert Ball Retaining Tool J-7539 in end of worm. See Figure 8-54. Turn stub shaft so that rack-piston nut will go onto the tool and remove rack-piston nut from gear housing. Keep ball retaining tool completely through rack-piston nut to prevent balls from falling out.

NOTE: Do not remove snap ring in upper end of piston bore in housing.

8. Remove adjuster plug assembly and rotary valve assembly as outlined in paragraph 8-14 (a).

9. Remove worm and lower thrust bearing and races.

10. Remove cap to worm "O" ring seal and discard.

**b. Disassembly of Rack-Piston Nut and Worm Assembly**

1. Remove and discard piston ring and back-up "O" ring on rack-piston nut.

2. Remove ball return guide clamp to rackpiston nut screws and lock washers and remove clamp.

3. Place the rack-piston nut on a clean cloth and remove ball return guide and ball retaining tool. Make sure all 22 balls are caught on the cloth.

**c. Inspection of Rack-Piston Nut and Worm Assembly**

1. Inspect gear housing bore. If badly scored or worn, replace housing.

2. Inspect the worm and rack-piston nut grooves and all the balls for excessive wear or scoring. Inspect rack-piston nut teeth for pitting, wear or scoring. Inspect O.D. of rack-piston nut for wear, scoring or burrs. If either the worm or rack-piston nut need replacing, both must be replaced as a matched assembly.

3. Inspect ball return guides, making sure that the ends where the balls enter and leave the guides are not damaged. Replace if necessary.

4. Inspect lower thrust bearing and races for wear, pitting, scoring or cracking. Replace any damaged parts.

5. Inspect the hose connectors on gear housing. If badly brinelled or scored, replacement will be necessary. To remove the connectors, tap threads using 5/16-18 tap. Thread a bolt with a nut and flat washer into the tapped hole. Pull the connector by holding the bolt and turning the nut off the bolt. Wash and blow the housing out thoroughly to remove any tapping chips. To install new connector, use Replacer J-6217 to drive connector in place.

6. Check the operation of check valve poppet located under connector in pressure port of housing. Poppet should reseat itself against connector after being lightly pushed down. If poppet is not operating properly, remove connector, poppet and spring from pressure port. Then install a new spring with large end down, a new poppet with tangs pointed down. Install a new connector using Installer J-6217. Be sure new poppet operates properly.

7. Inspect the ball plug in gear housing. If it is leaking or raised above the housing surface, it may be driven in flush to 1/16 inch below surface. The ball can be tightened by staking the housing. If the leakage cannot be stopped, the housing should be replaced.

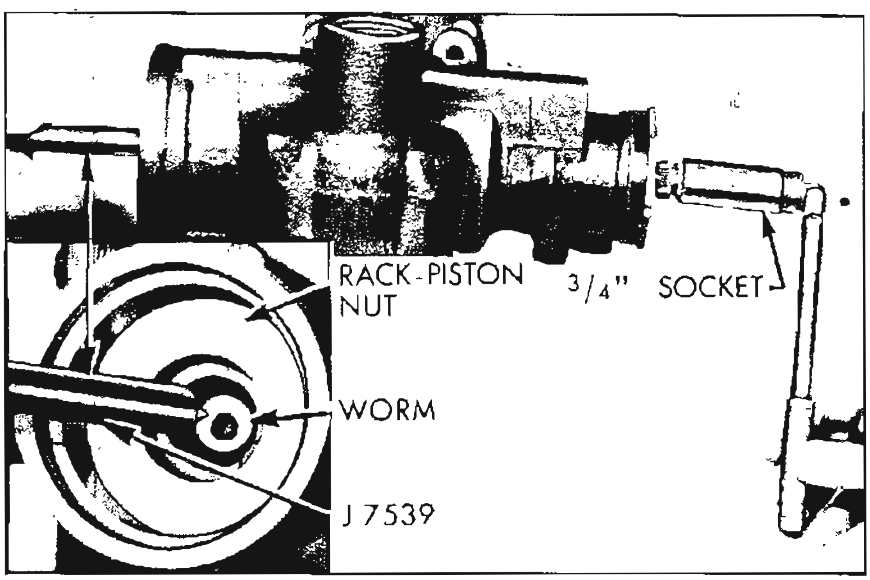



Figure 8-54—Removing Rack-Piston Nut

### d. Reassembly of Rack-Piston Nut and Worm Assembly

1. Thoroughly clean and lubricate the internal parts with automatic transmission oil.

2. Install new piston ring back-up "O" ring in groove on rack-piston nut. Place a new piston ring over the back-up "O" ring. See Figure 8-55.

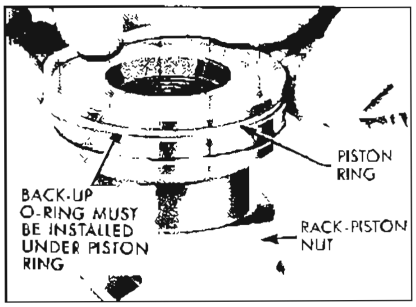



Figure 8-55—Installing Rack-Piston Ring on Rack-Piston Nut

3. Install worm into rack-piston nut to bearing shoulder.

4. Align the ball return guide holes in the rack-piston nut with the worm groove. Load 16 balls, 8 plain and 8 black in alternate sequence into the guide hole nearest the piston ring while slowly rotating worm counterclockwise. See Figure 8-56.

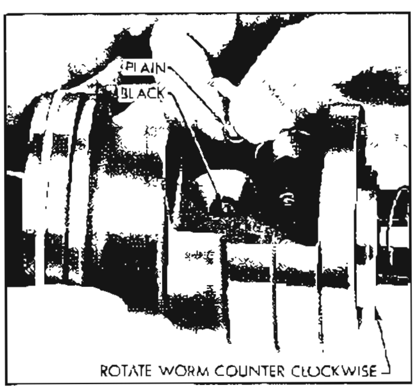



Figure 8-56—Loading Balls in Rack-Piston Nut

5. Fill one-half the ball return guide with the remaining 6 balls, 3 plain and 3 black balls in alternate sequence. Place the other half of guide over the balls and plug each end with heavy grease to prevent the balls from falling out when installing the guide to the rack-piston nut.

6. Insert ball return guide into guide holes of the rack-piston nut so that balls in the guide alternate with the balls in the rack-piston nut. Guide should fit loosely.

7. Place clamp over guide and install 2 screws with special lock washers and tighten.

8. The worm groove is ground with a high point in the center. When the rack-piston nut passes over this high point, a preload of 1 to 5 inch pounds should be obtained. To measure the preload of the assembly, lightly clamp rack-piston nut in a soft jaw vise with worm pointing up. Do not distort rack-piston nut by tightening too heavily. Place valve assembly on worm, engaging worm drive pin. Rotate the worm until it extends 1-1/4 inches from the edge of rack-piston nut to the thrust bearing face of worm; this is the center position. Attach Torque Wrench J-5853 with 3/4 inch, 12 point socket to the stub shaft. See Figure 8-57. Rotate the wrench through a total arc of approximately 60 degrees (1/6 turn) in both directions several times and take a reading. The highest reading obtained with the worm rotating should be from 1 to 5 inch pounds. If the reading is too high, disassemble and reassemble, using the next size smaller plain balls and recheck. (A rack-piston nut with a ball size of 7 does not have a number stamped on the flat surface. For ball sizes other than 7, the ball size is stamped on the flat surface of the rack-piston nut.) If the reading is too small, use the next size larger plain balls and recheck. See paragraph 8-8, subparagraph b for ball size. Remove valve assembly from worm.

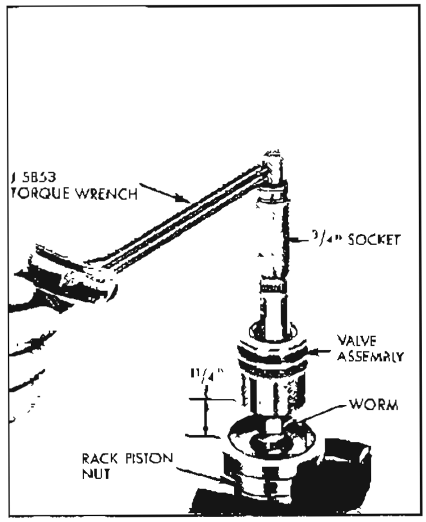



Figure 8-57—Checking Rack-Piston Nut Ball Preload

9. Turn the rack-piston nut and worm assembly to a horizontal position in the vise and insert ball retaining Tool J-7539 in end of worm and turn worm out of the rack-piston nut. Do not allow the tool to separate from the worm until worm is fully removed from rack-piston nut.

### e. Installation of Rack-Piston Nut and Worm Assembly

1. Assemble lower thrust bearing and races on worm. Install new cap to worm "O" ring seal. Assemble rotary valve assembly to worm by aligning narrow pin slot in valve body with pin on worm.

2. Insert the valve assembly and worm in gear housing as an integral unit. Do not press on stub shaft or torsion bar. See Figure 8-46. Return hole in housing should be fully visible when valve and worm are properly installed. See Figure 8-47.

3. Place Seal Protector J-6222 over end of stub shaft. Install adjuster plug assembly in gear housing snugly with adjustable Spanner Wrench J-7624 then back

plug off approximately 1/8 turn. Install adjuster plug lock nut if removed, but do not tighten.

4. Adjust the thrust bearing preload. Using Torque Wrench J-5853, rotate stub shaft to measure valve assembly drag. See Figure 8-33. Then tighten adjuster plug to obtain a reading 1 to 3 inch lbs. in excess of valve drag.

NOTE: Total of thrust bearing preload and valve drag should not exceed 11 inch lbs.

5. Tighten adjuster plug lock nut. Recheck thrust bearing preload to be sure that tightening lock nut did not change adjustment.

6. Install ring compressor sleeve Tool J-8947 in gear housing and hold it tightly against shoulder in the housing. See Figure 8-58. Insert the rack-piston nut into the housing until the ball retaining Tool J-7539 engages the worm. Turn the stub shaft drawing the rack-piston nut into the housing. When the piston ring is into the housing bore, the ball retaining tool and ring compressor may be removed.

7. Install rack-piston end plug using 1/2 square drive. Torque plug to 50 ft. lbs. See Figure 8-59.

8. Lubricate housing end plug "O" ring seal with automatic transmission oil and install in gear housing.

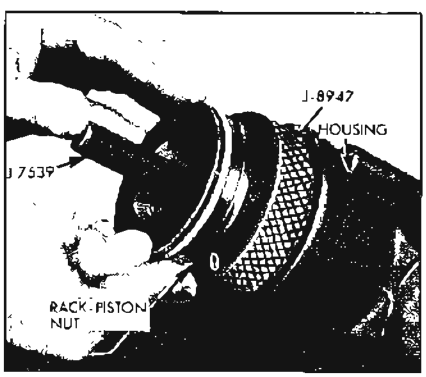



Figure 8-58—Installing Rack-Piston Nut

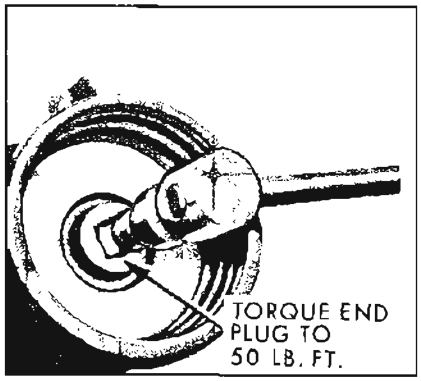



Figure 8-59—Torquing Rack-Piston Nut End Plug

9. Insert end plug into gear housing and seat against "O" ring seal. Slight tapping with a soft mallet may be necessary to seat plug properly. Install end plug retainer ring.

10. Install pitman shaft assembly as outlined in paragraph 8-15, subparagraph e, Steps 1 through 5.

11. Turn lash adjuster counterclockwise a few turns and obtain a reading with Torque Wrench J-5853 while rotating stub shaft through "high point" range. Adjust lash adjuster to obtain a reading 4 to 8 in. lbs. higher than first reading.

## 8-17 DISASSEMBLY, INSPECTION AND ASSEMBLY OF OIL PUMP

NOTE: Refer to paragraph 8-12 for removal and installation of oil pump.

### a. Disassembly of Oil Pump

1. Using masking tape, cover the hose union and pipe on pump and then thoroughly clean exterior of pump.

2. Remove pump pulley key from pump shaft.

3. Remove reservoir cap and drain out oil in pump reservoir.

4. Install pump in a soft jaw vise with pump shaft pointing down. Do not clamp pump too tightly in vise as this may distort bushing.

5. Remove two reservoir to pump housing studs and "O" rings. Discard the "O" rings.

6. Remove pressure union. Remove "O" ring from union and discard "O" ring.

7. Remove reservoir from housing by rocking housing back and forth while pulling upward. Remove reservoir "O" ring seal on housing and discard. Remove small reservoir to housing "O" ring seal from counterbore in housing and discard.

8. Rotate end plate retaining ring until one end of ring is over hole in housing. Spring one end of ring with 1/8" punch to allow screwdriver to be inserted and lift ring out. See Figure 8-61.

9. Remove pump from vise and remove end plate, two pressure plate springs, flow control valve and spring by turning pump over. If end plate should stick in housing, lightly tap it to align and free it.

NOTE: Do not disassemble flow control valve.

10. Remove and discard end plate "O" ring seal.

11. Place shaft end on bench and press down on housing until shaft is free. Turn housing over and remove shaft and rotor assembly, being careful not to drop parts. If the two dowel pins did not come out with assembly, remove dowel pins from housing.

12. Remove and discard pressure plate "O" ring seal.

13. Remove shaft seal, if defective, by prying out with small screwdriver.

### b. Inspection of Oil Pump Parts

Clean all parts thoroughly with solvent and wipe dry with clean, lint-free cloth before inspecting.

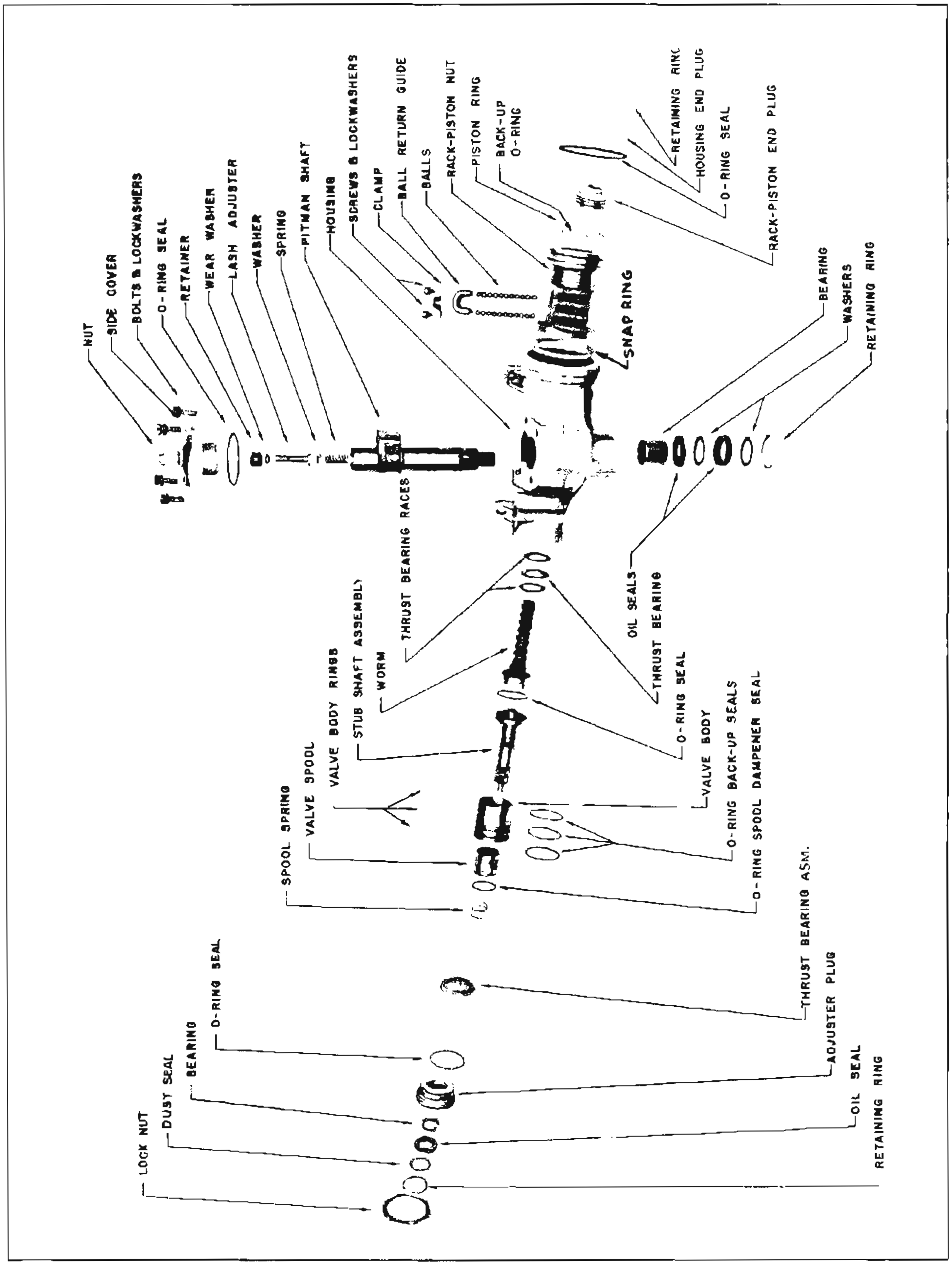



Figure 8-60—Power Steering Gear (Exploded View)

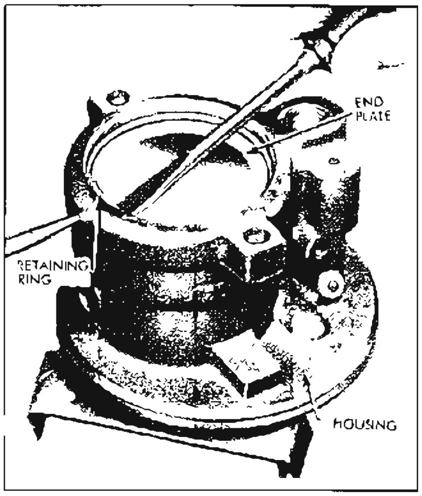



Figure 8-61—Removing End Plate Retaining Ring

1. Inspect shaft for wear.

2. Check fit of the ten vanes in slots of rotor; vanes must slide freely but fit snugly in slots. Tightness may be removed by thorough cleaning or removal of irregularities using a hard Arkansas stone. Replace rotor if excessive looseness exists between rotor and vanes and replace vanes if they are irregularly worn or scored. Light scoring on the rotor can be repaired by carefully lapping surface of rotor.

3. Inspect all ground surfaces of the rotor ring for roughness or irregular wear. Slight irregularities may be removed with a hard Arkansas stone. Replace ring if inside cam surface is badly scored or worn and inspect outside radius of vanes very closely for damage.

4. Inspect the surfaces of the pressure plate and thrust plate for wear or scoring. Light scoring can be repaired by carefully lapping until surface is smooth and flat, after which all lapping compound must be thoroughly washed away.

5. Inspect the flow control valve bore in the housing for scoring, burrs or other damage. Hair line scratches are normal. Inspect bushing in housing, if worn or scored, replace housing.

6. Inspect the surfaces of the flow control valve for scores and burrs. Hair line scratches are normal. Replace valve if badly scored or if it is the cause of low pump pressure. Check the screw in the end of the valve, if loose, tighten being careful not to damage machined surfaces. Filter in end of screw must be clean.

7. Check orifice in pressure union to be sure it is not plugged.

#### c. Assembly of Oil Pump

1. Make sure all parts are absolutely clean. Lubricate seals and moving parts with automatic transmission oil during assembly.

2. If shaft seal was removed, use Installer J-7017 to drive new seal into housing with spring side of seal toward housing. See Figure 8-62. Just bottom seal in housing.

3. Mount housing in vise with shaft end down. Install new pressure plate "O" ring seal in groove in housing bore. This seal is smaller than the end plate "O" ring seal and it has a daub of paint on it for identification.

4. Insert shaft into housing and press down with thumb on splined end to properly seat shaft. Be careful not to damage shaft seal in housing.

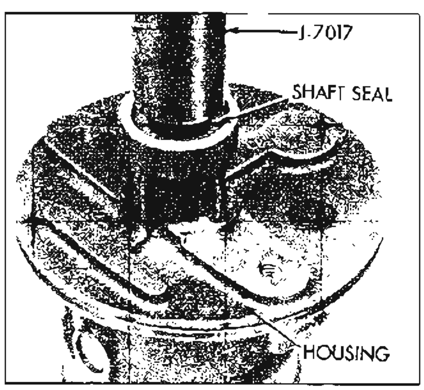



Figure 8-62—Installing Shaft Seal

5. Install the two dowel pins in housing and install thrust plate on the pins with ported face of plate to rear of housing.

6. Install pump ring with small holes in ring on dowel pins and with arrow on outer edge to rear of housing.

7. Install rotor on pump shaft with alignment sleeve toward front of housing. Rotor must be free on shaft splines.

8. Install ten vanes in rotor slots with radius edge toward outside and flat edge toward center of rotor.

9. Lubricate the outside diameter and chamfer of pressure plate with petroleum jelly and install on dowel pins with ported face toward pump ring. Dowel pins fit into slots in plate that are nearest outside diameter of plate. Use a soft plastic or wood rod and lightly tap around outside diameter of pressure plate to seat it. See Figure 8-63. Pressure plate will travel about 1/16" to seat. Never press or hammer on the center of pressure plate as this will cause permanent distortion and result in pump failure.

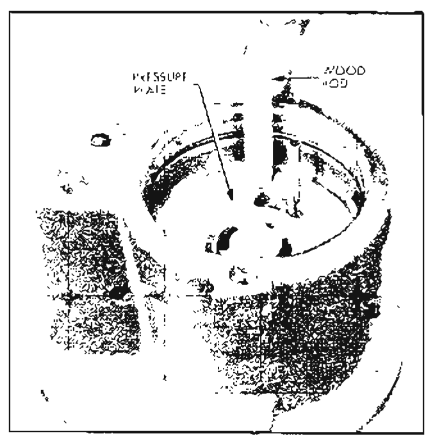


Figure 8-63—Seating Pressure Plate in Housing

10. Install new end plate "O" ring seal in groove in bore of housing. Be sure not to install it in end plate retaining ring groove which is first groove from rear of housing.

11. Install the two pressure plate springs on the dowel pins.

12. Lubricate outside diameter and chamfer of end plate with petroleum jelly and insert in housing.

13. Place end plate retaining ring on top of end plate. Lay a 1/4" spacer on center of end plate, then position Installer J-7663 on end plate so that the depression on it is against the spacer. See Figure 8-64. Attach installer to housing studs with long end of studs threading in housing. Press end plate down by tightening studs until ring groove in housing is evenly exposed. Install retaining ring. Be sure ring is completely seated in housing groove and end plate is aligned properly. Remove studs.

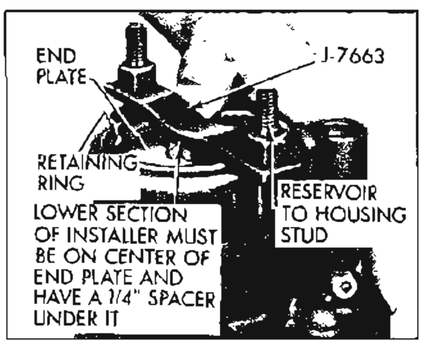



Figure 8-64—Installing Housing End Plate

CAUTION: Press end plate into housing only far enough to install retaining ring in groove.

14. Install new reservoir "O" ring seal on housing. Place a new small reservoir in housing "O" ring seal in counterbore in housing.

15. Install reservoir on housing and line up holes for studs. Tap reservoir with a soft mallet to seat it on housing and install reservoir to housing studs with new "O" ring seals. Torque studs 25-35 lb. ft.

16. Install flow control spring in housing. Then install flow control valve with screw head of valve going in housing first.

17. Assemble new "O" ring in groove nearest outlet end of pressure union. Install union in pump and torque 25-35 lb. ft.

CAUTION: If "O" ring is installed in groove on pressure union that contains the flow orifice, pump will not build-up pressure.

18. Remove pump from vise and install shaft key on shaft. Support shaft on opposite side while installing key.

19. Check for bind in pump by rotating drive shaft. Shaft must rotate freely by hand.

## 8-18 REMOVAL AND INSTALLATION OF OIL PUMP SHAFT SEAL WITH PUMP NOT REMOVED

### a. Removal

1. Remove pump pulley nut.

2. Remove pump drive belt from pulley.

3. Remove pulley from pump using a suitable puller. Do not hammer pulley off shaft.

4. Remove pulley drive key from shaft.

5. Insert a piece of .005" shim stock (approximately 2-1/2" long) around shaft and push it past seal until it bottoms in pump housing. See Figure 8-65.


Figure 8-65—Removing Oil Pump Shaft Seal

6. Remove seal by cutting metal body of seal with a sharp tool and prying out. See Figure 8-65. Extreme care must be used to prevent damage to shaft and pump housing.

### b. Installation

1. Place Seal Protector J-7586 over shaft. Lubricate new seal with Buick Power Steering oil and drive in pump housing spring side first with Installer J-7728. See Figure 8-66. Just bottom seal in housing. Excessive force must not be used when driving seal in place.

2. Install pulley drive key in shaft.

3. Install pulley and drive belt. Adjust belt tension to 90 pounds.

4. Fill pump reservoir to proper level with Buick Power Steering oil and bleed pump as instructed in paragraph 8-12, subparagraph e.

5. Install fan guard.

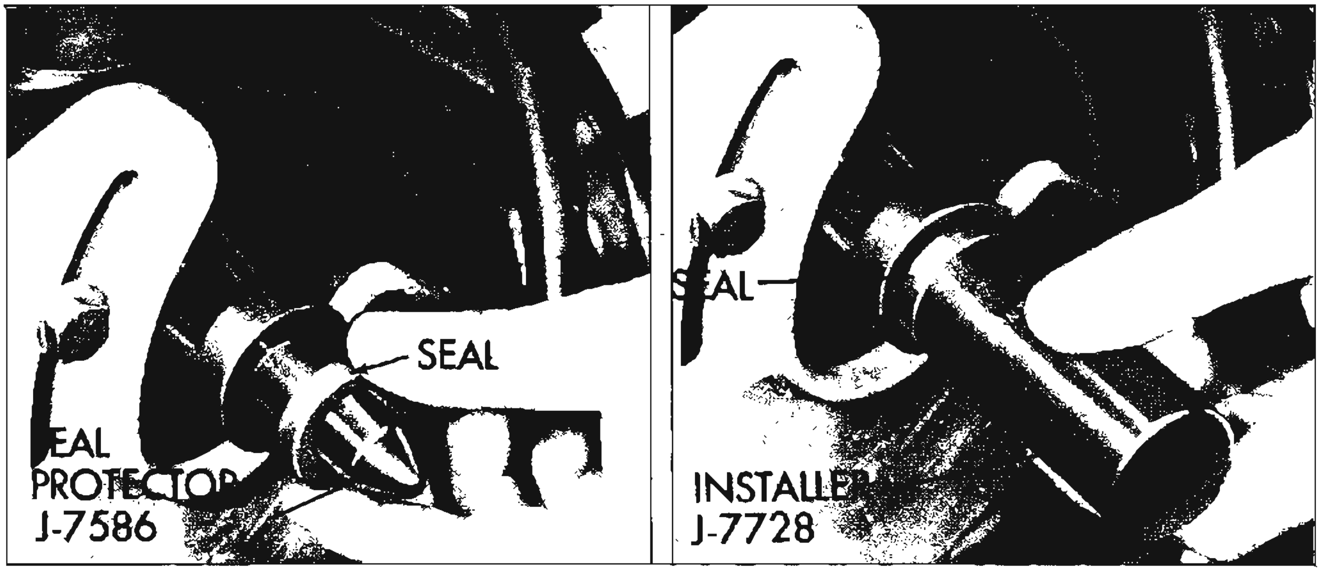



Figure 8-66—Installing Oil Pump Shaft Seal

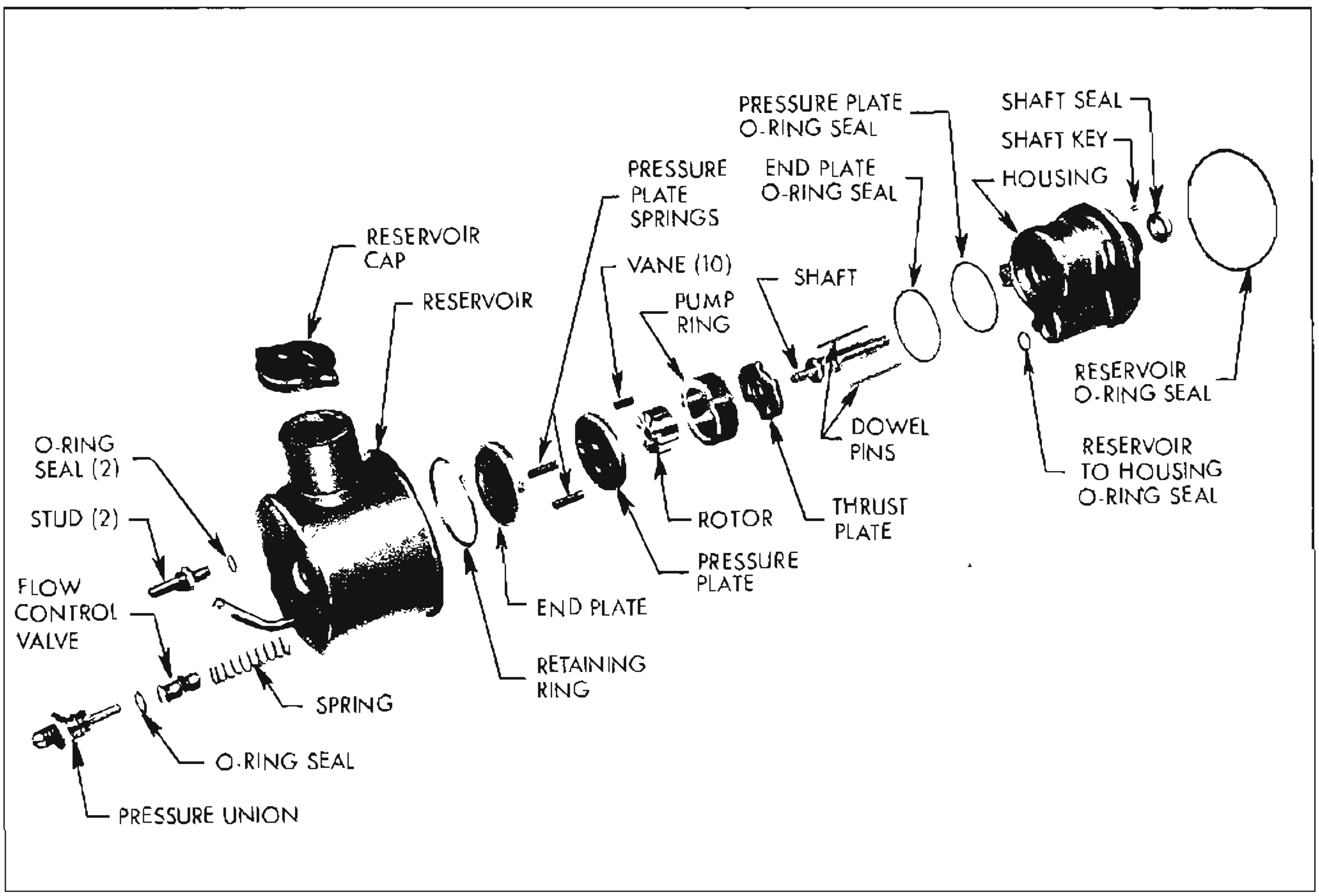



Figure 8-67—Oil Pump (Exploded View)

# SECTION 8-C
# MAST JACKET ASSEMBLY

## CONTENTS OF SECTION 8-C



## 8-19 REMOVAL AND INSTALLATION OF STEERING MAST JACKET ASSEMBLY

### a. Removal

1. Remove two nuts securing shaft lower coupling to lower steering shaft flange. See Figures 8-10 and 8-31.

2. On automatic or three speed synchromission transmission equipped cars remove clip from shift rod(s) and pull rod(s) out of mast jacket shift lever (s).

3. On three speed synchromesh transmission equipped cars remove clip securing clutch rod to clutch pedal, and disengage rod.

4. Remove screws that retain toe pan cover to toe pan. See Figure 8-68.

5. Disconnect wiring harness from mast jacket.

6. Remove nut that retains mast jacket clamp to instrument panel.

7. Align shift lever(s) with hole in toe pan (automatic and three speed synchromesh transmissions only) and remove jacket assembly.

### b. Installation

1. Align shift lever(s) with hole in toe pan (automatic and three speed synchromesh transmissions only) and install end of mast jacket through hole. Position lower steering shaft flange onto gear coupling flange and loosely attach jacket to instrument panel.

NOTE: When installing mast jacket be sure to align tab on bracket with slot in mast jacket (see Figure 8-68).

NOTE: When connecting steering shaft coupling to gear coupling, be sure that pin of larger diameter fits into slot of larger diameter.

2. Install bolt to mast jacket clamp and torque 12 to 20 lb. ft.

3. Tighten two nuts securing steering shaft coupling to gear coupling and torque nuts 15 to 20 lb. ft.

4. Place a bead of body sealer between mating surfaces of toe pan and mast jacket lower cover. Secure cover to toe pan with four screws and washers.

5. Plug wiring harness connectors into switches.

6. On three speed synchromesh transmission cars connect clutch rod to clutch pedal and secure in position with clip.

7. Attach and secure shift rod(s) to shift lever(s) on three speed transmission and automatic transmission equipped cars.

8. On automatic transmission cars check and adjust neutral safety switch.

9. Install plastic trim cover and secure in position with two fastener pins. Drive pins in place with suitable dowel.

## 8-20 DISASSEMBLY AND REASSEMBLY OF AUTOMATIC TRANSMISSION MAST JACKET AND TRANSMISSION CONTROL SHAFT ASSEMBLY

### a. Disassembly

1. Take off steering wheel (refer to subpar. 8-5), spring, and turn signal cancelling cam. See Figure 8-69.

2. Remove mast jacket assembly from car (refer to par. 8-19).

3. Remove neutral safety and back-up lights switch from mast jacket.

4. Remove clip holding mast jacket wiring cover to mast jacket and pull out cover.

5. Remove screw from directional signal lever and take out lever.

6. Loosen set screw holding shift pointer to shift tube and slide out pointer. See Figure 8-70.

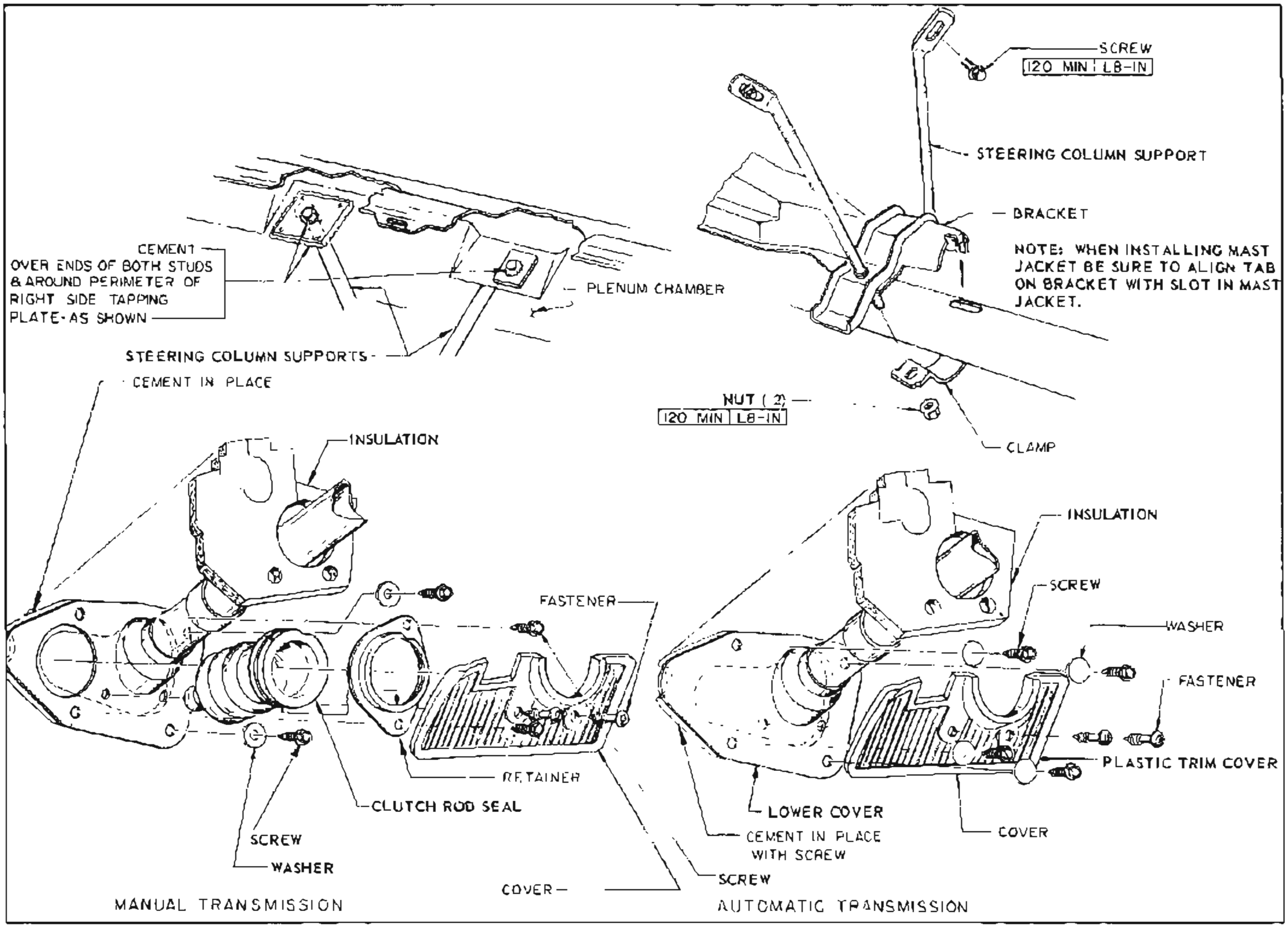



Figure 8-68—Mast Jacket Installation

7. Drive out pin holding shift lever to shift bowl and take off lever and spring.

8. Remove three screws on steering shaft upper bearing adapter. See Figure 8-71.

9. Twist steering column cover in a counterclockwise direction and lift out turn signal control with upper bearing adapter and bearing assemblies, cover, shift stop plate, washer, and shift bowl (see Figure 8-72).

10. Take out steering tube centering wave washer and plain washer.

11. Remove two screws securing bearing adapter assembly to mast jacket and withdraw steering shaft, washer, bearing, bearing adapter, shift tube and felt seal from mast jacket (see Figure 8-73).

**b. Reassembly**

Reassembly reverse of disassembly procedures.

NOTE: To facilitate reassembly of upper portion of mast jacket, align screw holes (3) of bearing adapter, cover and shift stop plate prior to reassembly. It will be necessary to hold the shift stop plate in position by inserting a thin bladed tool behind the shift stop plate. Insert the tool in the opening at the bottom of the shift bowl.

NOTE: If the clamp on the steering shaft was loosened or removed, readjust dimension of upper end of shaft to cover as shown in Figure 8-76.

## 8-21 DISASSEMBLY AND REASSEMBLY OF THREE SPEED SYNCHROMESH TRANSMISSION MAST JACKET AND TRANSMISSION CONTROL SHAFT ASSEMBLY

**a. Disassembly**

NOTE: The disassembly of the three speed synchromesh transmission mast jacket is similar to

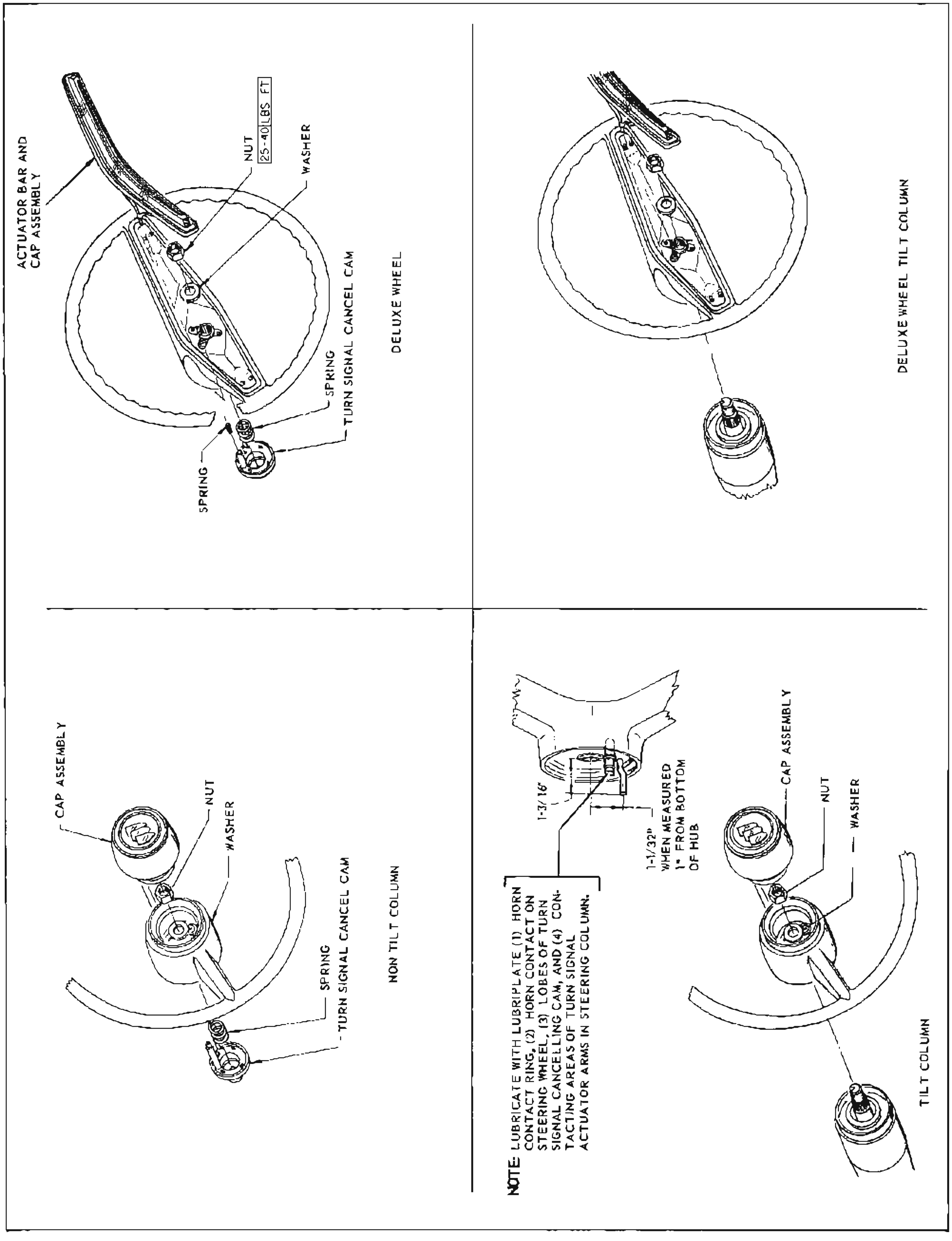



*Figure 8-69—Deluxe and Standard Steering Wheel Installation*

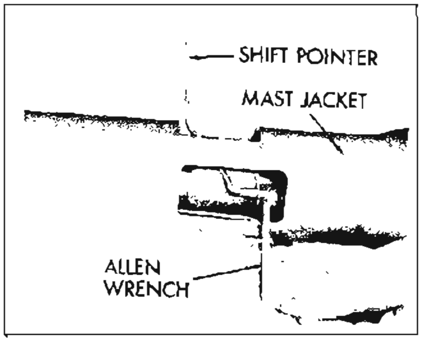



Figure 8-70—Removing Shift Pointer

the disassembly procedures for automatic transmission mast jacket. To disassemble perform Steps 1 through 5, and 7 and 8 of paragraph 8-20, subparagraph "a", and proceed as follows:

1. Twist steering column cover in a counterclockwise direction, and lift out turn signal control with upper bearing adapter and

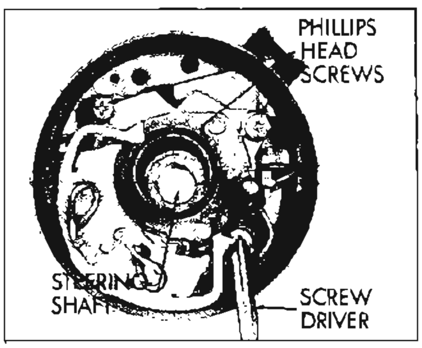



Figure 8-71—Removing Steering Shaft Upper Bearing Adapter Screws

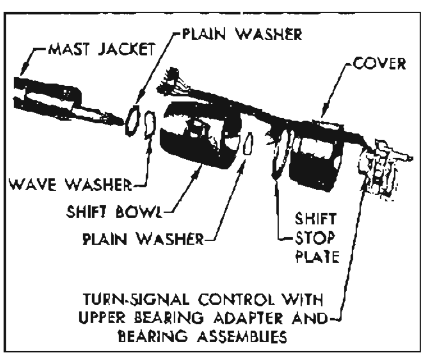



Figure 8-72—Disassembly of Upper Portion of Automatic Transmission Mast Jacket

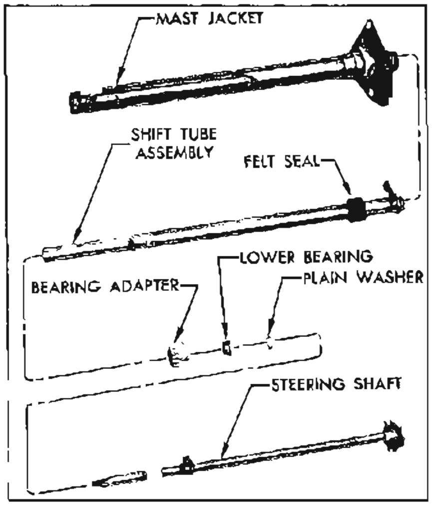



Figure 8-73—Disassembly of Lower Portion of Automatic Transmission Mast Jacket

bearing assembly, cover, washer, and shift bowl (see Figure 8-74).

2. Take out steering tube centering wave washer and plain washer.

3. From lower end of mast jacket assembly pull out steering shaft and plain washer.

4. Remove two screws securing ring assembly to mast jacket and pull out lower bearing, ring, lever, spacer, shift tube assembly with felt seal, and mast jacket (see Figure 8-75).

### b. Reassembly

1. Reassemble reverse of disassembly procedures.

NOTE: When reassembling steering column cover be sure the cover is rotated to its full extent in a clockwise direction or the three phillips screws will not lock the cover to the mast jacket.

NOTE: If the clamp on the steering shaft was loosened, readjust dimension of upper end of shaft to cover as shown in Figure 8-77.

2. Adjust ring at lower portion of mast jacket for maximum gap of .005 inch. Lower lever must move freely. See Figure 8-77.

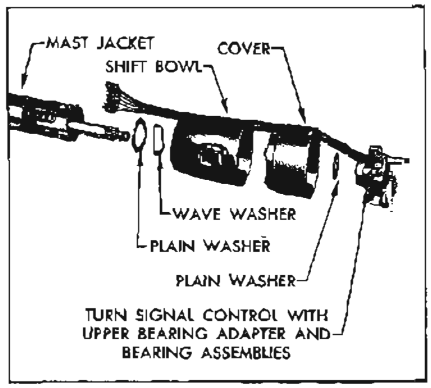



Figure 8-74—Disassembly of Upper Portion of 3 Speed Transmission Mast Jacket

## 8-22 DISASSEMBLY AND REASSEMBLY OF FOUR SPEED SYNCHROMESH TRANSMISSION MAST JACKET

### a. Disassembly

1. Take out steering wheel (refer to par. 8-5), spring and turn signal cancelling cam. See Figure 8-69.

2. Remove mast jacket assembly from car (refer to par. 8-19).

3. Remove clip holding mast jacket wiring cover to jacket and pull off cover.

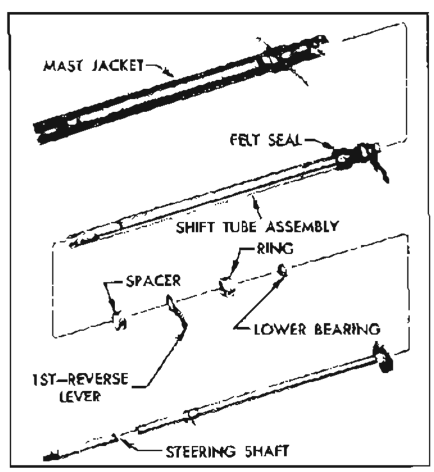



Figure 8-75—Disassembly of Lower Portion of 3 Speed Transmission Mast Jacket

4. Remove screw from directional signal lever and take out lever.

5. Remove three phillips screws on steering shaft upper bearing adapter.

6. Twist steering column cover in a counterclockwise direction and lift out steering column cover with shift bowl, and also turn signal control with upper bearing adapter and bearing assembly.

7. Remove two screws securing lower bearing adapter to mast jacket and slide out steering shaft, plain washer, steering shaft lower bearing adapter and bearing, and seal.

**b. Reassembly**

Reassemble reverse of disassembly procedure.

NOTE: When reassembling steering column cover be sure the cover is rotated to its full extent in a clockwise direction or the three phillips screws will not lock the cover to the mast jacket.

If the clamp on the steering shaft was loosened, readjust dimension of upper end of shaft to cover as shown in Figure 8-78.

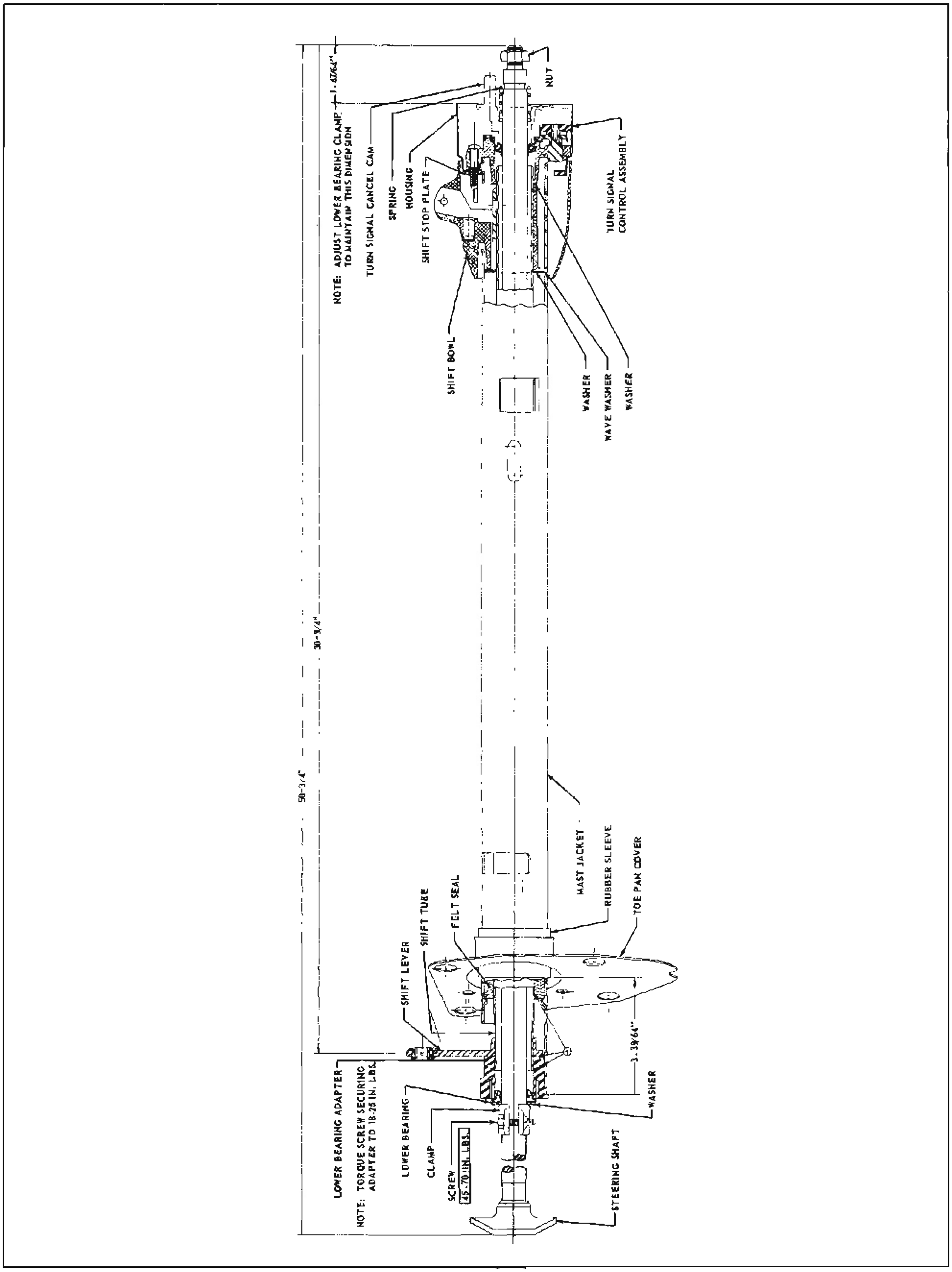



Figure 8-76—Mast Jacket and Transmission Control Shaft Assembly - Automatic Transmission

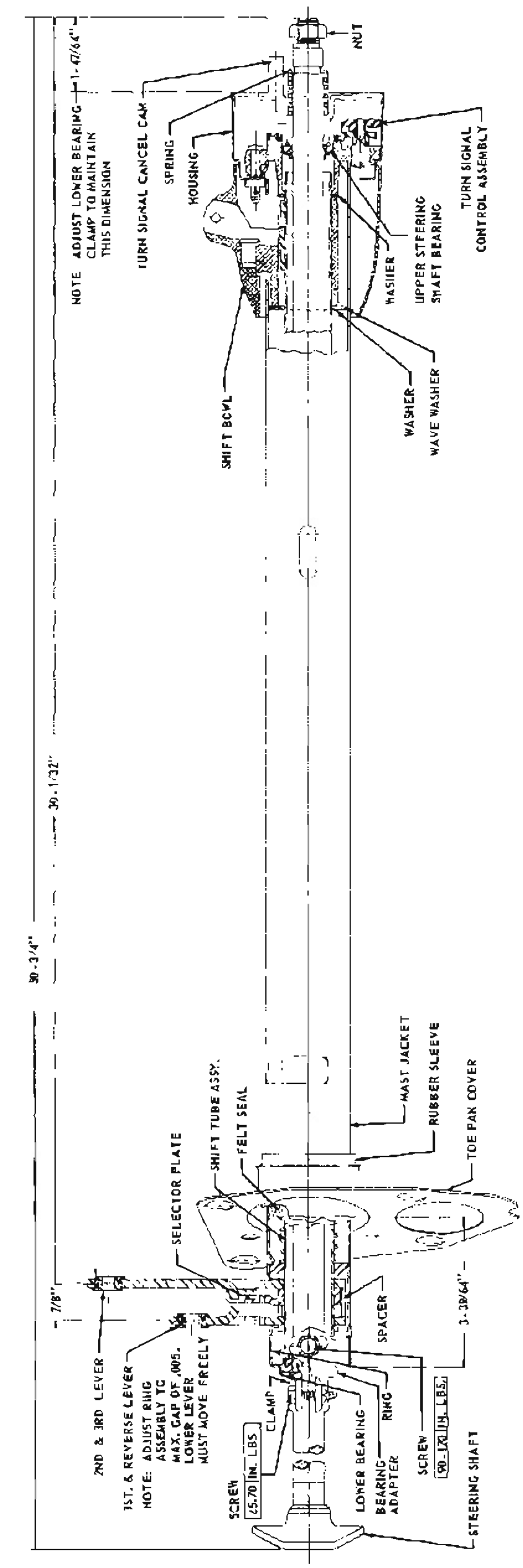



Figure 8-77—Mast Jacket and Transmission Control Shaft Assembly - Three Speed Synchromesh Transmission

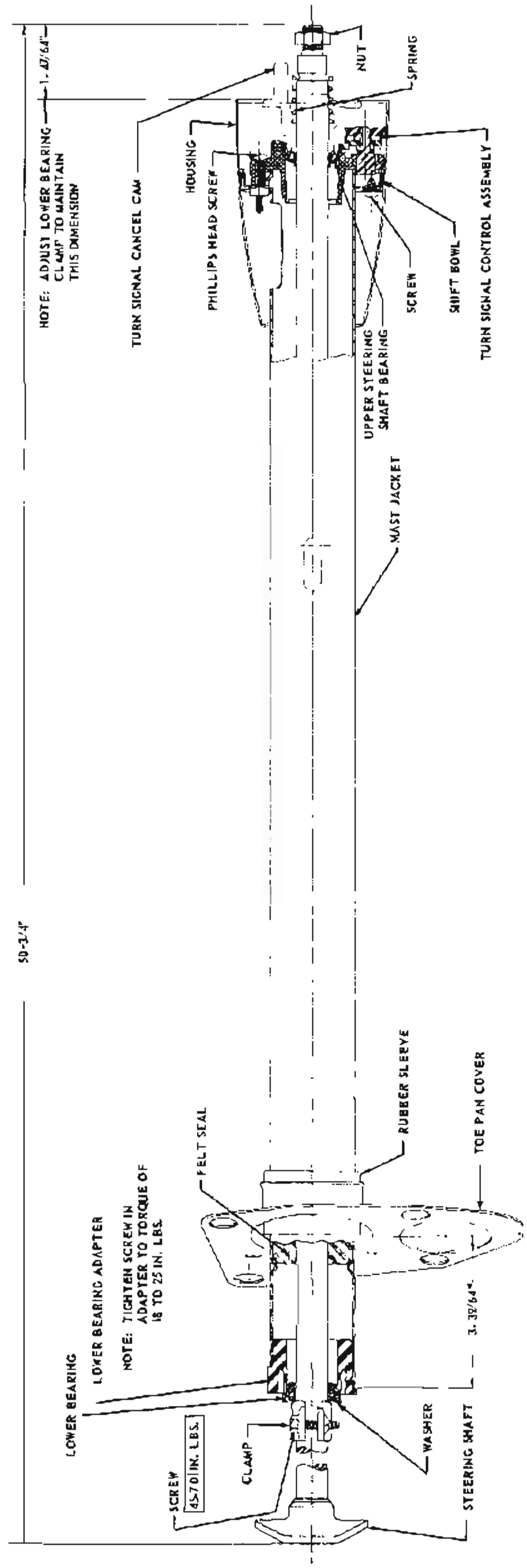



Figure 8-78—Mast Jacket Assembly - Four Speed Synchromesh Transmission

# SECTION 8-D
# TILT WHEEL MAST JACKET ASSEMBLY

## CONTENTS OF SECTION 8-D



## 8-23 DESCRIPTION OF THE TILT STEERING WHEEL

The optional tilt steering wheel is designed to give ease of entry and driver comfort through seven different steering wheel angle positions. The steering wheel is locked in the selected position by a lever located to the left of the steering column. See Figure 8-79. This lever is pulled toward the steering wheel to disengage the lock and allow positioning the wheel at the desired angle.

The tilt steering assembly basically consists of an upper and lower steering shaft assembly with a universal type joint between them. The joint has two nylon spheres with a spring installed inside them to prevent any looseness in the joint. A support assembly is held to the mast jacket by a lock plate. An actuator is positioned over the upper steering shaft and is attached to the support by two pivot pins. The upper and lower lock shoes, which are retained to the actuator assembly, engage pins in the support. Two springs are attached between the upper edge of the support and actuator and provide for the spring return of the steering wheel to the upward position.

The upper shaft is secured in the actuator assembly by an upper and lower bearing. The bearings are preloaded by means of a 12-sided nut on the steering shaft. When the lever is released, the lock shoes will engage the pins in the support and hold assembly at angle desired.

When the tilt wheel release lever is moved upward the shoe release actuator causes the lock shoes to move inward and disengage the support. This allows the upper shaft which steering wheel is attached to and the actuator assembly to be set at a different position.

If no pressure is applied to the steering wheel when lever releases lock shoes, the tilt springs will position the steering wheel in its upper most position. Each position moves the steering wheel five degrees.

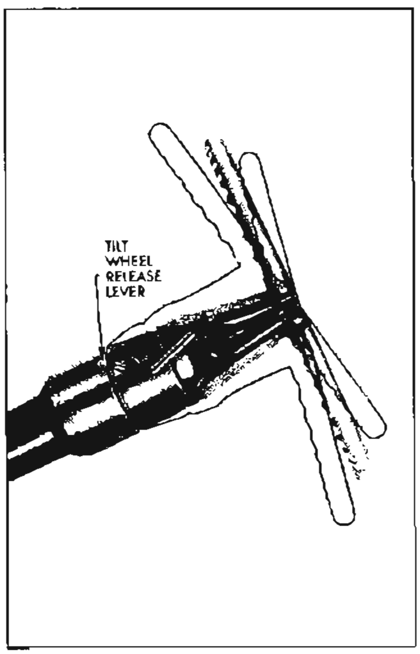



Figure 8-79—Tilt Steering Wheel Release Lever

## 8-24 REMOVAL AND INSTALLATION OF MAST JACKET ASSEMBLY

### a. Removal

1. Disconnect ground strap from battery.
2. Disconnect shift rod from lower shift lever (automatic transmission only).
3. Remove steering shaft lower coupling pinch bolt.
4. Remove all connectors from mast jacket switches.
5. Remove nut from clamp that retains jacket to lower edge of instrument panel.
6. Pry off plastic trim cover and remove screws and washers that retain toe pan lower cover in position.
7. Carefully pull mast jacket assembly up and out of opening in toe pan.

CAUTION: Use care not to damage shift indicator pointer.

### b. Installation

1. Position mast jacket assembly through opening in toe pan.
2. Install steering shaft into lower coupling on steering gear shaft so that the flat on the shaft is parallel with pinch bolt.
3. Attach jacket to instrument panel and to toe pan. Install plastic trim cover onto toe pan and

secure in position with plastic fastener pins. Drive pins in position with suitable dowel.

4. Install wiring connectors on switches on jacket.

5. Connect battery ground cable.

6. Check neutral safety switch adjustment and adjust if necessary.

## 8-25 TILT STEERING WHEEL SERVICE PROCEDURES

### a. Disassembly of Actuator, Steering Shaft, and Support

NOTE: The parts of the tilt wheel mechanism may be removed while the mast jacket assembly is installed in the car. If it is necessary to remove shift tube, the jacket assembly must be removed from car.

Reassembly will be facilitated if during disassembly the parts are laid out in the sequence that they are removed.

1. Remove steering wheel (ref. par. 8-5).

2. Remove direction signal switch from mast jacket. Disconnect control cable from switch.

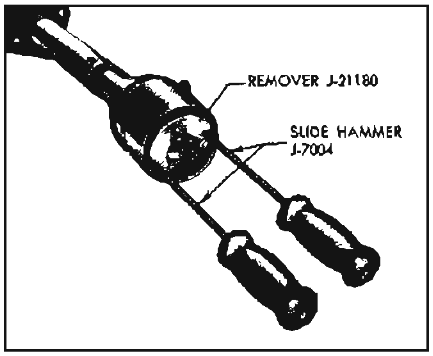



Figure 8-81—Removing Cover from Mast Jacket

3. Remove direction signal lever and tilt wheel release lever.

4. Straighten locking tabs of lock plate (see Figure 8-80) and remove 12-sided nut, lock plate, and inner race seat from upper portion of mast jacket.

5. Assemble two Slide Hammers J-7004 to Remover J-21180 and install inside cover as shown in Figure 8-81. Hold edges of Remover J-21180 against rim of cover and evenly work cover off of mast jacket.

6. Remove turn signal detent spring and carefully pry out actuator yoke.

7. Pry up horn contact ring and plastic bearing cap, and withdraw horn contact ring wire as far as

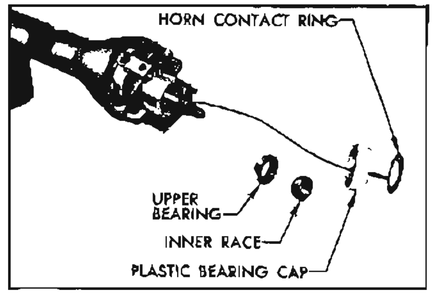



Figure 8-82—Removing Inner Race and Upper Bearing from Upper Portion of Mast Jacket

necessary. Lift off inner race and upper bearing (see Figure 8-82).

8. Reinstall tilt release lever and position actuator assembly at the extreme up position.

9. Unhook upper ends of tilt springs by inserting a screwdriver (or Installer J-21181) in top coil of spring and prying upward, then disengage top loop of spring with another screwdriver. See Figure 8-83. View A shows removing spring on left side and View B shows removing spring on right side.

10. Remove the two pivot pins with Remover J-21179. See Figure 8-84. Thread stud of J-21179 into pin. Hold stud and turn nut to remove pin.

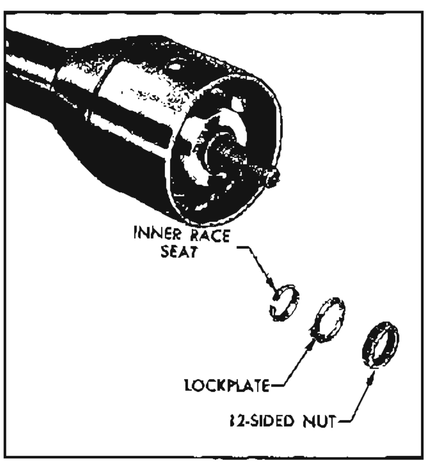



Figure 8-80—Removing - 12-Sided Nut, Inner Race and Lockplate

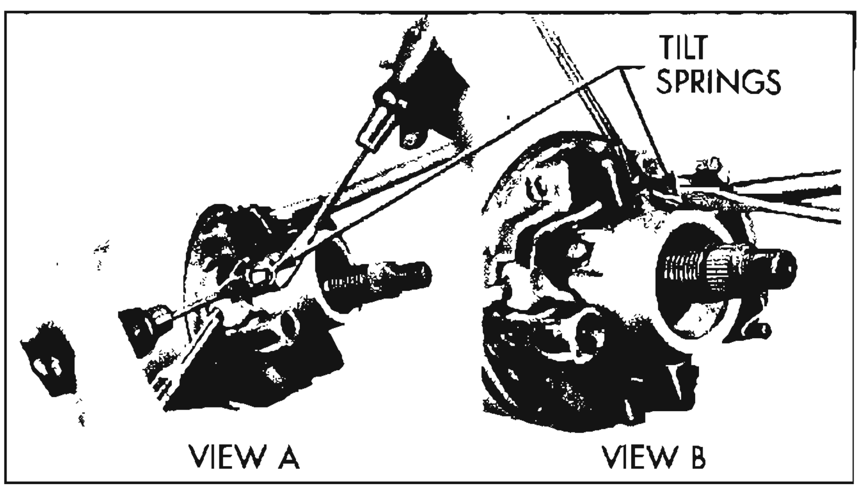



Figure 8-83—Removing Tilt Springs

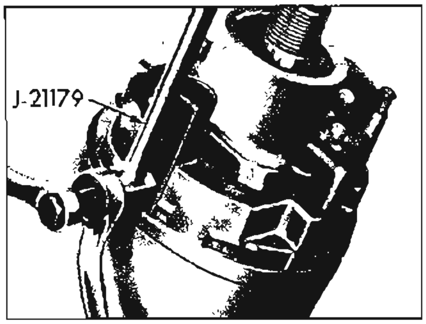



Figure 8-84—Removing Pivot Pin

11. Lift tilt wheel release lever to disengage lock shoes from the support and remove actuator assembly. See Figure 8-85. Remove tilt springs.

12. Remove lower bearing from steering shaft.

13. From the engine compartment remove the pinch bolt from the lower steering shaft coupling.

14. Mark location of clamp on lower portion of steering shaft and remove clamp and spring.

15. Remove steering shaft assembly by pulling it up and out of mast jacket.

16. Remove the four Phillips head support screws and then lift support off jacket.

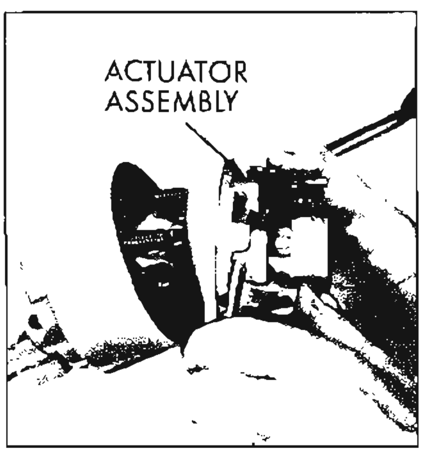



Figure 8-85—Removing Actuator Assembly

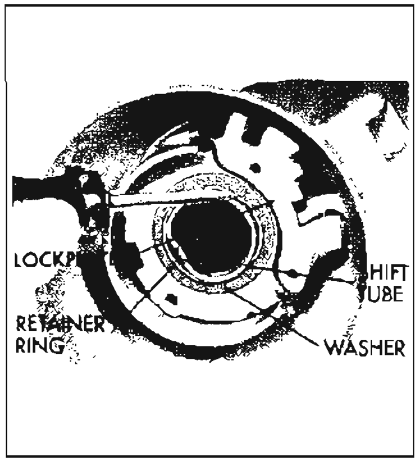



Figure 8-86—Removing Shift Tube Retainer Ring

**b. Disassembly of Shift Bowl and Shift Tube**

1. Remove mast jacket assembly from car. Paragraph 8-24.

2. Remove actuator, steering shaft and support from mast jacket. Refer to subparagraph "a".

3. Remove the shift tube retainer ring and washer from the top of shift tube. See Figure 8-86.

4. Remove steering shaft bearing and adapter from the lower end of the mast jacket.

5. Remove the shift tube and felt seal downward through column by tapping lightly with a mallet on shift lever. See Figure 8-87.

6. Remove lock plate, wave washer and shift bowl from upper end of the mast jacket.

**c. Reassembly of Shift Bowl and Shift Tube**

1. Install shift bowl on the mast jacket, the wave washer lubricated with front wheel bearing lube over the mast jacket, and then slide the lock plate into position through the opening in the mast jacket.

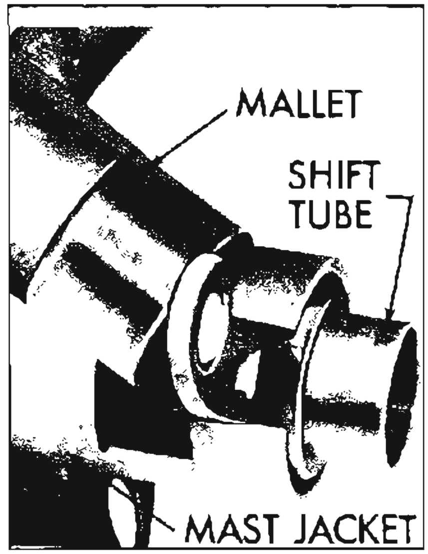



Figure 8-87—Removing Shift Tube

2. Install the shift tube assembly with felt seal into the mast jacket from the lower end of the jacket.

3. Apply lube to thrust washer and install the washer and retaining ring on the upper end of the shift tube.

4. Install lower steering shaft bearing and adapter into lower end of mast jacket.

5. Install support, steering shaft, and actuator assemblies in mast jacket. Refer to subparagraph "f".

6. Install mast jacket in car. Paragraph 8-24, subparagraph "b".

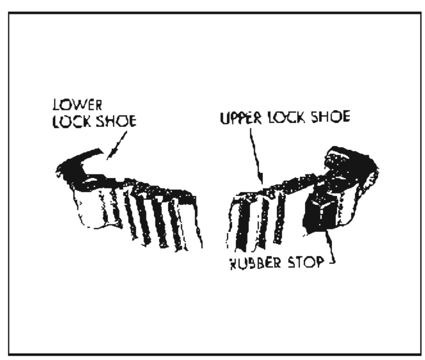



Figure 8-88—Lock Shoes

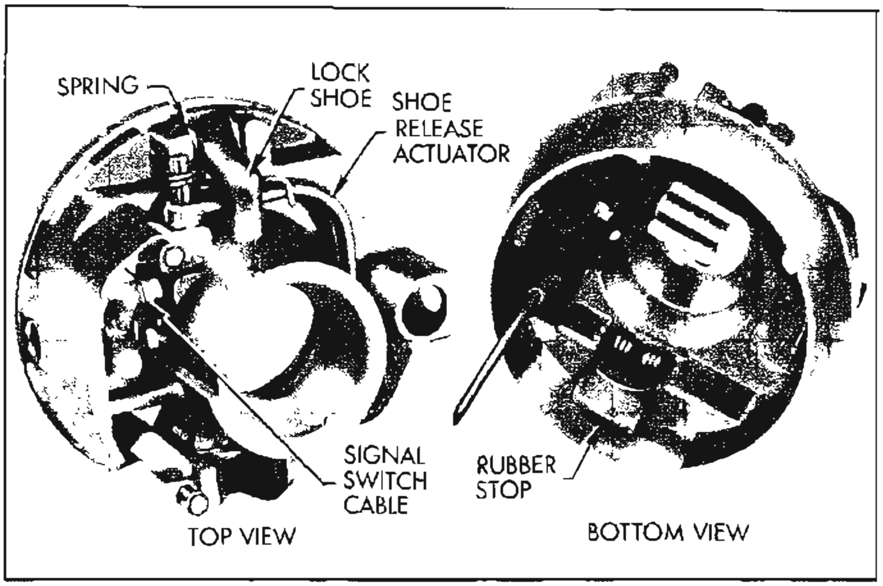



Figure 8-89—Actuator Assembly

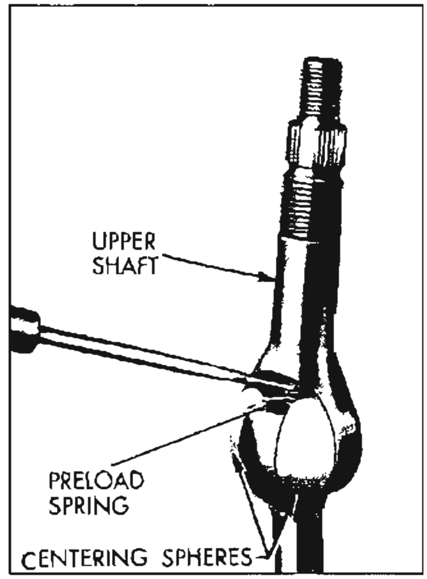



Figure 8-90—Removing Joint Preload Spring

### d. Disassembly and Reassembly of Actuator

DISASSEMBLY

NOTE: The actuator, lock shoes and springs may be replaced separately. The shoe release actuator is serviced only with the actuator. See subparagraph "a" for removal of actuator.

1. Drive lock shoe pins out of actuator and remove shoes and springs. The upper shoe has a rubber stop on it. See Figure 8-88.

2. If necessary remove control cable from actuator.

REASSEMBLY

3. If control cable was removed, install the control cable on the bell crank in actuator and mount cable loop inboard. Install cable bracket screw.

4. If lock shoes were removed from actuator, install the springs on the upper end over lock shoes, then install the shoes in the actuator and retain with the pins. See Figure 8-89.

NOTE: The upper lock shoe must have the rubber stop installed.

### e. Disassembly and Reassembly of Steering Shaft Assembly

DISASSEMBLY

NOTE: See subparagraph "a" for removal of shaft assembly.

1. Turn upper shaft slightly from centerline of lower shaft.

2. Using a narrow bladed screwdriver, compress joint preload spring enough to remove from upper shaft, then remove spring from centering spheres. See Figure 8-90.

3. Turn upper shaft 90° from centerline of lower shaft and remove shaft over flats of centering sphere.

4. Remove the sphere from the upper shaft by rotating so sphere flats align with shaft socket.

REASSEMBLY

5. Apply front wheel bearing lube to the centering spheres and the steering shaft sockets.

6. Place the centering spheres in the upper shaft socket.

7. Turn the spheres so the lower shaft can be installed over the flat area of the spheres. (Approximately 90° from centerline of lower shaft.) Then install lower shaft socket over the sphere so that locating mark on end of upper shaft is on same side as flat on lower shaft.

8. Insert the joint preload spring through centering spheres into lower shaft. Using the upper shaft to hold the spring in place and a screwdriver in the other hand, carefully feed spring into shaft joint. See Figure 8-91.

### f. Reassembly of Support, Steering Shaft, and Actuator

When assembling parts, apply a thin coat of front wheel bearing lube to all friction parts.

1. Install the support on the upper end of the mast jacket and install the four attaching support screws. Torque screws to 25 in. lb. Torque larger screws first.

2. Install the steering shaft into the mast jacket.

3. Place the lower bearing on upper portion of steering shaft.

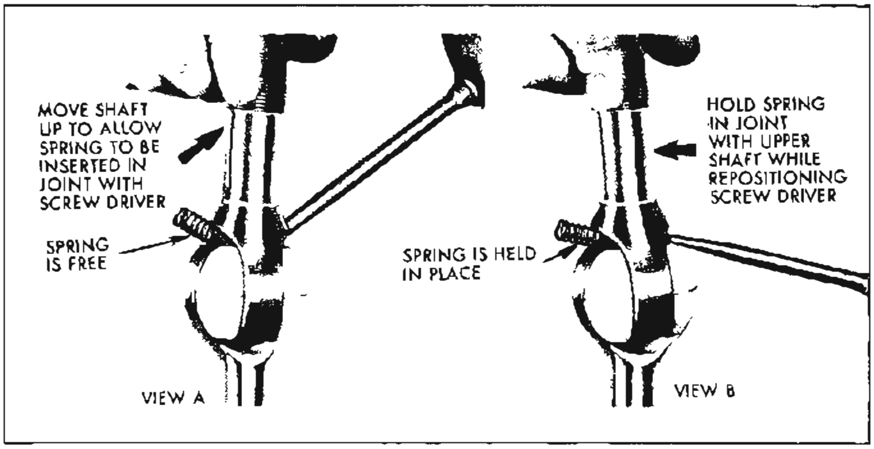



Figure 8-91—Installing Preload Spring

4. Snap the lower ends of the two tilt springs on the support spring anchor.

5. Install the tilt lever into the lock shoe release actuator.

6. Apply front wheel bearing lube on lock shoes and on frictional surfaces at actuator assembly including surfaces where actuate contacts support. Move the tilt lever up slightly to prevent the lock shoes from engaging the support pins, then install the actuator assembly over the steering shaft and feed horn contact ring wire and direction signal switch control cable thru shift bowl. Position actuator assembly on support.

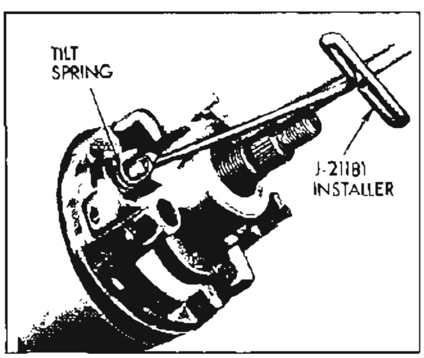



Figure 8-92—Installing Tilt Springs

NOTE: Reassembly will be facilitated during seating of actuator in support if the mast jacket is supported in a vise and the steering shaft is slightly moved up.

7. Apply lube to pivot pins. Align the actuator assembly pivot pin holes with the holes in the support assembly and install pivot pins. Pins should be flush with edge of actuator.

8. Raise tilt release lever and position actuator at extreme up position.

9. Connect the upper ends of the tube tilt springs using Installer J-21181 (see Figure 8-92) to lobes on actuator.

10. Install the turn signal actuator yoke and detent spring. Be sure yoke engages turn signal cable operating lever in actuator.

11. Install upper bearing, inner race, plastic bearing cap and horn contact ring in original positions. Replace cover by driving into position using a rubber mallet.

12. Install inner race seat, lock plate and 12-sided nut.

13. Tighten 12-sided nut moderately tight. Place steering wheel on steering shaft and use Steering Gear Tension Scale J-544 on outer edge of steering wheel to measure pull required to turn steering shaft. Pull required should not exceed 35-40 inch ounces. Retighten 12-sided nut as necessary.

14. Coat horn contact ring with lubriplate.

15. Install the tilt release and direction signal turn levers in actuator.

16. Install steering wheel. Paragraph 8-5.

17. Install direction signal switch as follows:

a. Position tilt wheel in full down position. Locate switch pin in center position.

b. Place direction signal lever in off position, then install control wire loop over switch operating pin.

c. Attach cable wire clamp to switch.

d. Assemble switch to mast jacket and position switch bracket as far forward (spring extended) as possible and secure to mast jacket.

18. Install spring and clamp onto lower end of steering shaft and compress spring to approximately 1/2 inch dimension.

19. Install lower coupling pinch bolt and tighten to 25 ft. lbs.

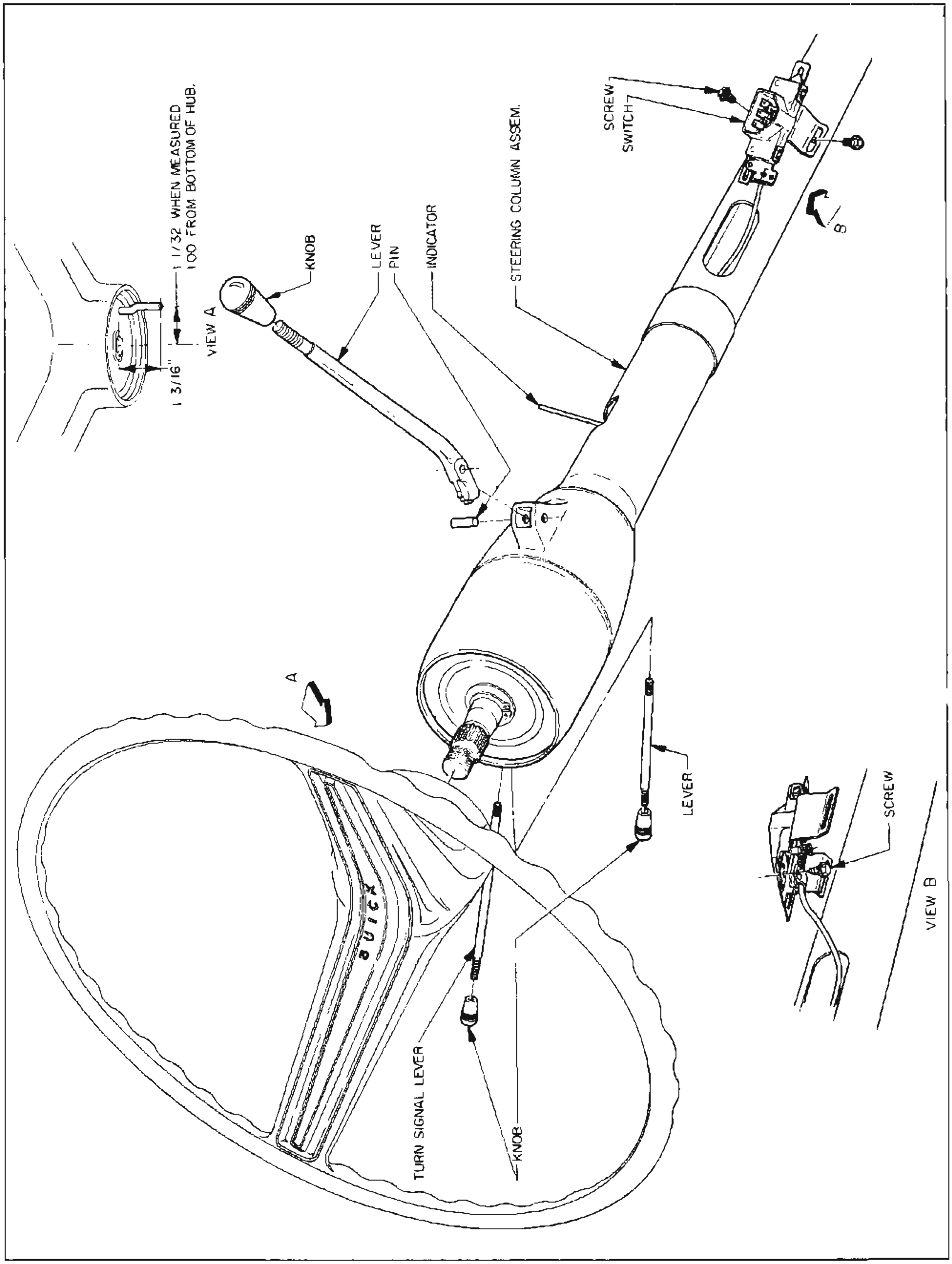



Figure 8-93—Tilt Steering Wheel Installation

# SECTION 8-E
# MANUAL AND POWER STEERING LINKAGE

## CONTENTS OF SECTION 8-E



## 8-26 STEERING LINKAGE SPECIFICATIONS

### a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

| Part | Location | Thread Size | Torque Lb. Ft. |
|---|---|---|---|
| Bolt & Nut | Tie Rod Clamp | 3/8-24 | 15-25 |
| Bolt & Nut | Idler Arm Support to Front Suspension Cross Member | 3/8-24 | 30-40 |
| Nut | Tie Rod Ball Stud to Steering Arm and Intermediate Rod | 1/2-20 | 30-50 |
| Nut | Pitman and Idler Arm to Intermediate Rod | 1/2-20 | 30-50 |
| Nut | Pitman Arm to Pitman Shaft | 7/8-14 | 100-140 |

### b. Steering Linkage Specifications

| | |
|---|---|
| Type | Forged-Parallelogram |
| Make | Saginaw |
| Toe-in, Caster, Camber, etc. | See Group 7 |
| Turning Circle Diameter (Curb to Curb) | 38.1 feet |

## 8-27 DESCRIPTION OF STEERING LINKAGE

The parallelogram type steering linkage is used to connect both front wheels to the steering gear pitman arm. The right and left tie rods are attached to a forged intermediate rod by ball studs. See Figure 8-95. The left end of the intermediate rod is supported by the pitman arm and the right end by an idler arm which pivots on a support attached to the frame. The pitman and idler arms are always paralleled with each other and move through symmetrical arcs.

The steering linkage ball studs are of the permanent lubricated design and do not require periodic lubrication. However, the inner and outer tie rod ends have removable plugs. If a squeak develops in one of these studs, the plug may be removed and a grease fitting (1/4-28) installed and stud lubricated.

The linkages used for manual steering and power steering are the same.

## 8-28 STEERING LINKAGE SERVICE PROCEDURES

When disconnecting the pitman arm or the idler arm from the intermediate rod, Remover J-3295 may be used to drive stud portion of ball joint out of arms. Other portions of the linkage may be separated by use of a suitable commercial type puller.

IMPORTANT: When installing a ball stud nut, torque nut to 45 lb. ft., then tighten to nearest slot for insertion of the cotter pin. Do not back nut off to insert cotter pin.

The linkage idler arm does not require any adjustment.

See Group 7 for adjustment of tie rods to obtain proper toe-in of front wheels.

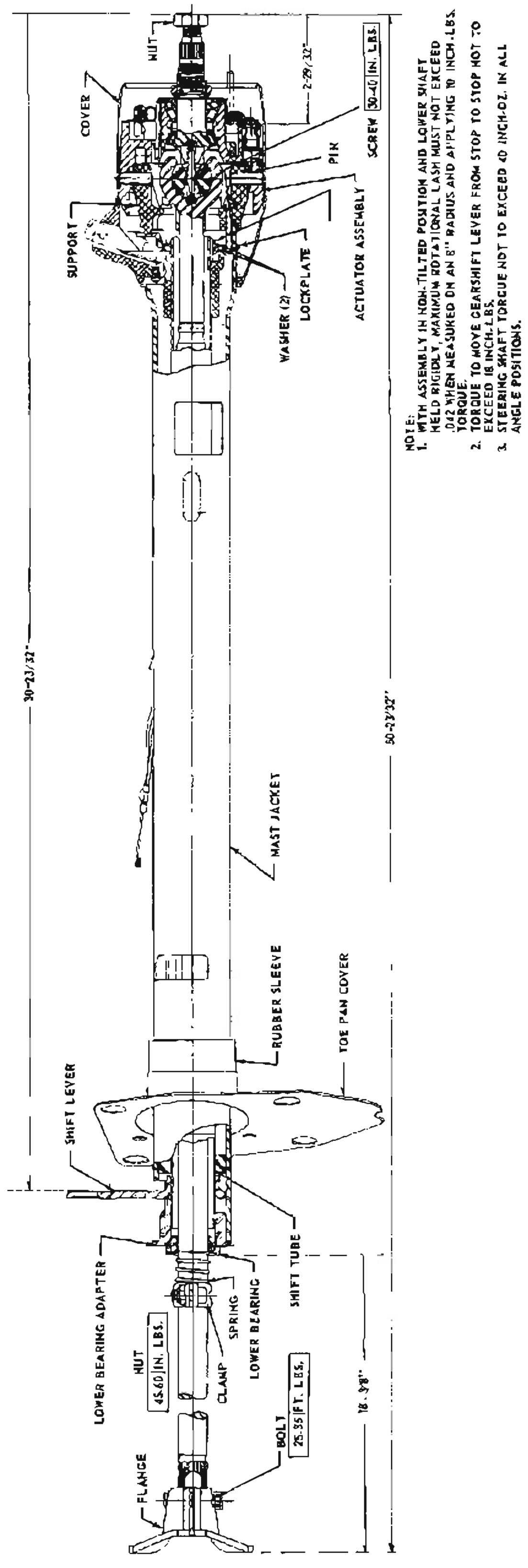



Figure 8-94—Tilt Wheel Mast Jacket and Transmission Control Shaft - Automatic Transmission

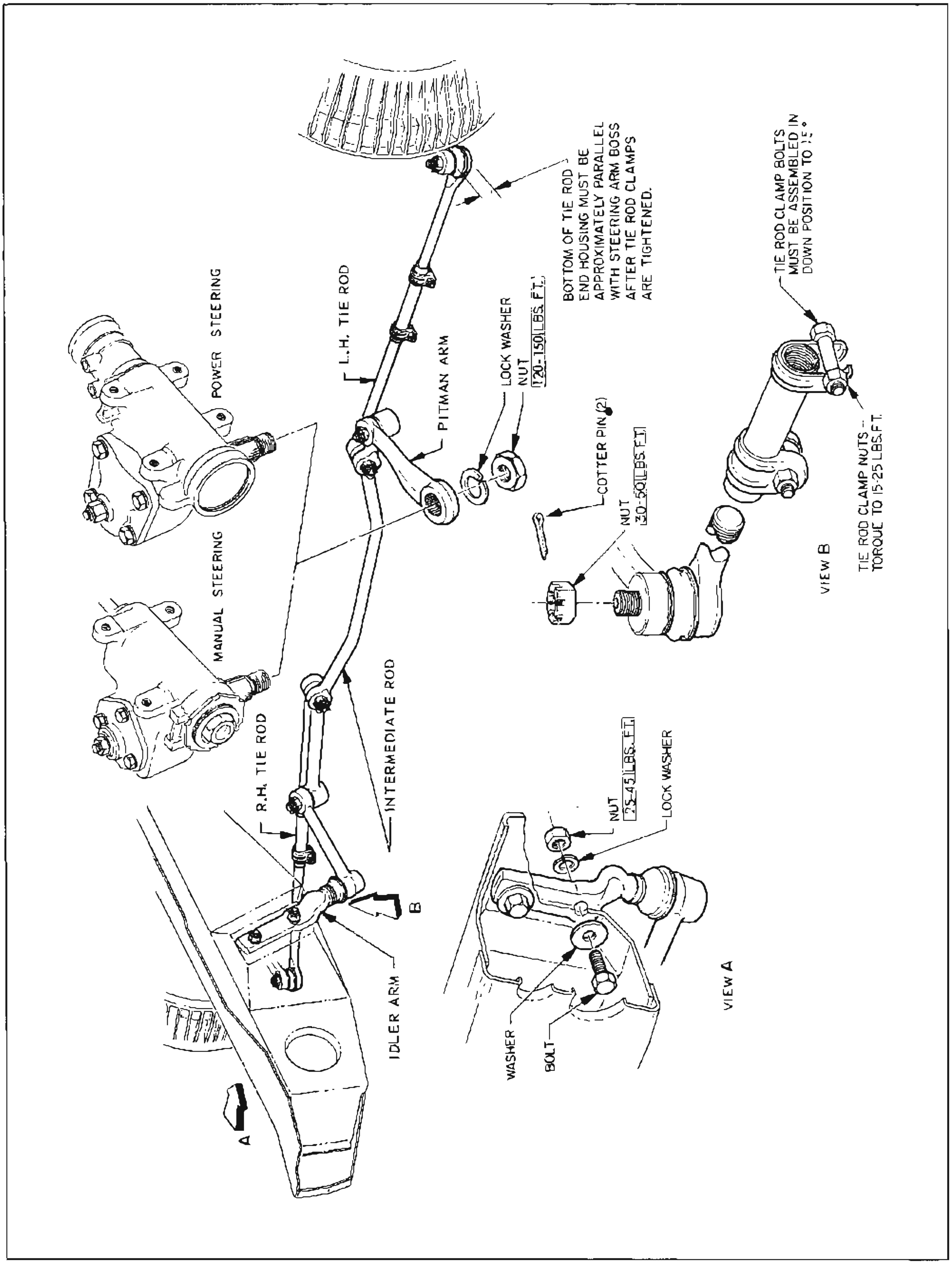
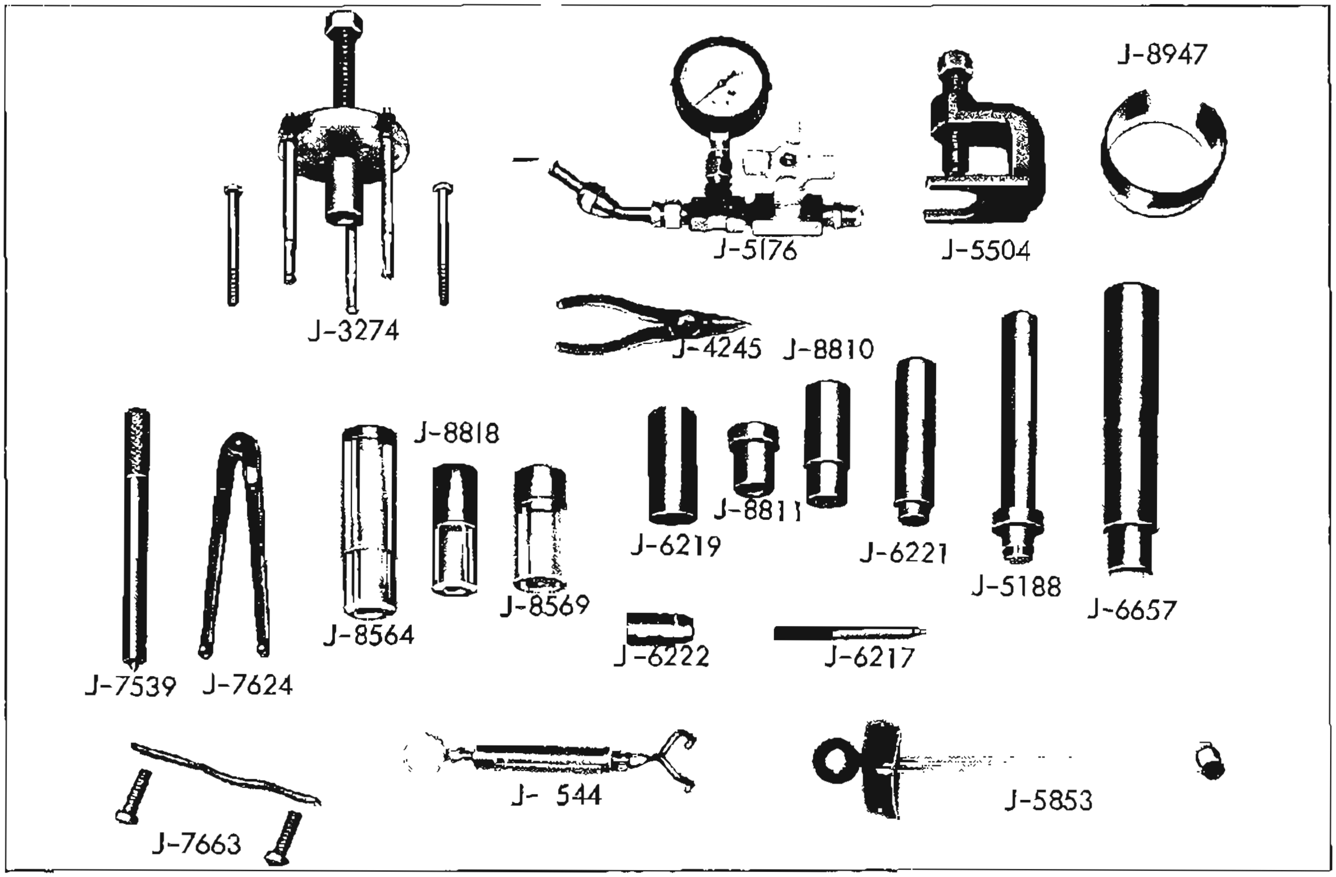



Figure 8-95—Steering Linkage Installation




STEERING TOOLS

| | |
|---|---|
| J- 544 | Steering Gear Tension Scale 0-4 lbs. |
| J-3274 | Steering Wheel Puller |
| J-4245 | Truarc Pliers |
| J-5176 | Testing Gauge |
| J-5188 | Valve Cover Seal Installer |
| J-5504 | Pitman Arm Puller |
| J-5854 | 0-100 in. lb. Torque Wrench |
| J-6217 | Valve Connector Seal Installer |
| J-6219 | Steering Gear Pitman Shaft Oil Seal Installer |
| J-6221 | End Cover Bearing Remover and Installer (Adjuster Plug Needle Bearing) |
| J-6222 | End Cover Seal Protector (Stub Shaft Protector) |
| J 6657 | Pitman Shaft Needle Bearing Remover and Installer |
| J-7539 | Power Steering Gear Ball Retaining Tool |
| J-7624 | Power Steering Gear Adjustable Spanner Wrench |
| J-7663 | Power Steering Pump End Plate Installer |
| J-8564 | Worm Shaft Oil Seal Installer |
| J-8569 | Pitman Shaft Oil Seal Installer |
| J-8810 | Pitman Shaft Bushing Remover and Replacer |
| J-8811 | Pitman Shaft Seal and Upper Bearing Cup Installer |
| J-8818 | Power Steering Pump Seal Installer |
| J-8947 | Teflon Ring Compressor |

Figure 8-96—Manual and Power Steering Special Tools

# GROUP 9
# BRAKES

## SECTIONS IN GROUP 9



# SECTION 9-A
# BRAKE SPECIFICATIONS, DESCRIPTION, OPERATION

## CONTENTS OF SECTION 9-A



## 9-1 BRAKE SPECIFICATIONS

### a. Tightening Specification

Use a reliable torque wrench to tighten the parts listed, to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

| Part | Name | Thread Size | Torque Ft. Lbs. |
|---|---|---|---|
| Nut | Brake Cylinder and Pedal Mounting Bracket to Dash | 3/8 -16 | 20-28 |
| Nut | Rear Brake Assembly to Axle Housing | 3/8 -24 | 45-60 |
| Bolt & Nut | Front Brake Assembly and Steering Arm to Knuckle | 7/16-20 | 60-82 |
| Bolt | Front Brake Anchor Pin | 1/2 -20 | 80-105 |
| Screw | Attaching Wheel Cylinder to Backing Plate | | 10-12 |

### b. General Specifications

| Items | |
|---|---|
| Operating Mechanism, Service Brakes | Hydraulic |
| Parking Brakes | Lever and Cables |
| Operation of Service Brakes Independent of Parking Brakes | Yes |
| Wheels Braked, Service | Front and Rear |
| Parking | Rear Only |
| Approx. % of Total Braking Power on - Front Wheel Brakes (All Series except Sportwagon) | 56 |
| Rear Wheel Brakes (All Series except Sportwagon) | 44 |
| Front Wheel Brakes (Sportwagon) | 53 |
| Rear Wheel Brakes (Sportwagon) | 47 |
| Brake Pedal Height Adjustment | Yes |
| Static Pressure in Hydraulic System when Brakes are Released | 8 to 16 lbs. |
| Number of Brake Shoes at Each Wheel | 2 |
| Brake Type | Self Energizing-Servo |
| Brake Shoe Lining Type | 1 pc., Molded-Riveted |
| Front Shoe Lining Width x Minimum Thickness (All Series) | Primary 2.50" x .196"<br>Secondary 2.50" x .260" |
| Rear Shoe Lining Width x Minimum Thickness (All Series Except Sportwagon) | Primary 2.00" x .196"<br>Secondary 2.00" x .260" |
| Rear Shoe Lining Width x Minimum Thickness (Sportwagon) | Primary 2.50" x .196"<br>Secondary 2.50" x .260" |

### b. General Specifications (Cont'd)

| Items | |
|---|---|
| Master Cylinder Piston Diameter | 1" |
| Wheel Cylinder Size Front (All Series Except Sportwagon) | 1 1/16" |
| Rear (All Series Except Sportwagon) | 15/16" |
| Front (Sportwagon) | 1 1/16" |
| Rear (Sportwagon) | 1" |
| Approved Hydraulic Brake Fluid | GM or Delco Supreme No. 11 or Equivalent |
| Fluid Level, Below Lip of Filler Opening | 1/8" |
| Shoe Adjusting Screw Setting, from Point where Wheels can just be turned by hand | Back Off 30 Notches |
| Brake Drum Inside Diameter, New | 9.495" to 9.505" |
| Brake Drum Rebore, Max. Allowable Inside Diameter | 9.565" |
| Max. Allowable Taper, Before Rebore | .003" |
| Max. Allowable Out-of-Round, Before Rebore | .006" |
| Max. Allowable Out-of-Balance of Drum | 2 in. oz. |
| Max. Allowable Space Between Lining and Shoe Rim after Riveting | .005" |

## 9-2 DESCRIPTION OF BRAKE MECHANISM

The vehicle brake mechanism includes four brake drums, four wheel brake assemblies (each assemble with its own self-adjuster), and two separate and independent control systems including the service brake system and the parking brake system.

### a. Wheel Brake Assemblies

Enclosing each wheel brake assembly is a brake drum which consists of a cast iron rim fused to a pressed steel disk. At all four wheels the rims are finned for external heat dissipation. The cast iron rim provides an ideal braking surface which increases brake lining life. See Figure 9-1.

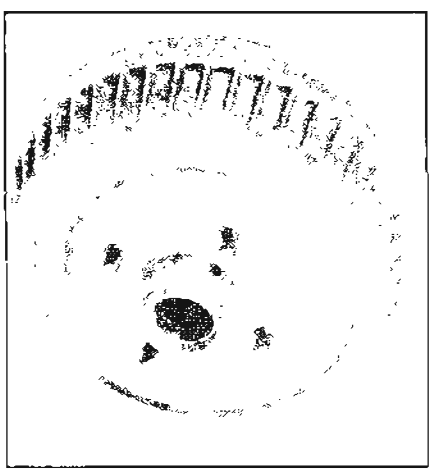


Figure 9-1—Brake Drum

The brake assembly at each wheel uses a primary (front) and secondary (rear) brake shoe of welded steel construction. One-piece molded linings are attached to the brake shoes by rivets. The primary shoe lining is shorter than the secondary shoe lining and is of different composition; therefore the two shoes are not interchangeable. See Figure 9-2.

Each brake shoe is held against the backing plate by a hold-down spring, pin, and cup which allows free movement of the shoe. The notched upper end of each shoe is held against the single anchor pin by a heavy coil spring. An adjusting screw and spring connects the lower ends of both shoes together and provides adjustment for clearance with the brake drum. There is no anchor pin adjustment as the pins are fixed in the backing plates.

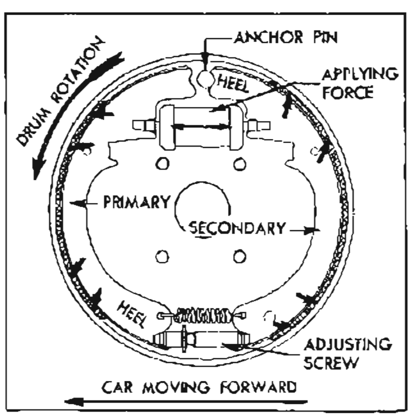



Figure 9-2—Brake Shoe Action

A hydraulic wheel cylinder mounted on the backing plate between the upper ends of the brake shoes forces the shoes against the brake drum when the service brakes are applied. On rear wheels only, a lever mounted on each secondary shoe and connected to the primary shoe by a strut is used for applying the shoes when used as parking brakes. See Figure 9-11.

During service brake application, in either direction of car travel, the brake shoes contact the rotating drum at each wheel and move with the drum until one shoe is stopped by the anchor pin and the other shoe is stopped through the connecting adjusting screw. Frictional force betweem drum and shoe lining tries to rotate each shoe outward around its anchor point but the drum itself prevents this rotation; consequently the shoes are forced more strongly against the drum than the applying force is pushing them. See Figure 9-2. It is also evident that the force applied by the drum to one shoe is imparted to the other shoe through the connecting adjusting screw.

Utilization of the frictional force to increase the pressure of shoes against the drum is called self-energizing action. Utilization of force in one shoe to apply the opposite shoe is called servo action. The self-energizing servo action of Buick brakes provides powerful braking action with relatively light pedal pressure.

**b. Parking Brake Control System**

The parking brake control system, which applies only the rear wheel brakes, uses a foot-operated lever, conduit enclosed cables, and brake shoe levers and struts. By means of an equalizer, the front parking brake cable is connected to the forward portion of a center cable. See Figure 9-3. This center cable is routed rearward from the equalizer through retaining guides which attach to right and left side frame rails. The center cable attaches at either end to a rear cable assembly. Each rear cable connects to the free lower end of a brake shoe lever. These levers (one in each brake shoe assembly) pivot on the secondary shoes. Struts are mounted between the brake shoe levers and the primary shoes. See Figure 9-12.

When the foot-operated lever is depressed, the cables apply an equal pull to each brake shoe lever. The levers and struts force all rear brake shoes into firm contact with brake drums. A rachet mechanism on the pedal-lever assembly automatically locks the control system in applied position. The brakes are released by pulling on the release knob.

**c. Service Brake Control System**

The regular foot-powered service brake control system is a pedal-operated hydraulic system which applies the brakes at all four wheels with equalized pressure. The hydraulic system consists of one master cylinder connected by pipes and flexible hoses to a wheel cylinder mounted between the brake shoes at each wheel. The master cylinder, pipes, hoses, and four wheel cylinders are filled with a special fluid. A 1/4" O.D. brake pipe connects the master cylinder assembly to a distributor located on the left frame rail. From the distributor, (all brake lines 3/16" O.D. from distributor outward), the right front brake pipe is routed forward a short distance to the front frame cross member and along the cross member to the right front hose bracket. The left front brake pipe extends across the top of the frame rail to the left front hose bracket. The center pipe extends rearward from the distributor, and follows the left frame rail to the rear frame cross member where it extends inboard and connects at the front of the cross member to the rear brake hose bracket. A flexible hose connects the center brake pipe to a rear tee block located at the center of the axle assembly. Two pipes lead from the tee block, one to the rear left wheel cylinder, and the other to the rear right wheel cylinder. See Figure 9-4.

The brake pedal is suspended from a pivot shaft on the pedal support. The master cylinder push rod clevis attaches directly to the shank of the pedal. The overall mechanical advantage in the brake linkage is approximately 6 to 1. See Figure 9-5.

The pivot shaft in the brake pedal has nylon bearings which are lubricated during installation, but do not require periodic lubrication. Whenever the linkage is disassembled, however, all friction surfaces should be lightly coated with Lubriplate. Because there is no pedal stop, the pedal is stopped in the "off" position by contact of the push rod with the stop plate in the master cylinder. A clevis threaded onto the end of the push rod makes it possible to adjust brake pedal height.

A plunger type stop light switch, which operates mechanically, is mounted on a bracket just rearward of the brake pedal. When the brakes are fully released, the brake pedal bears against the plunger and depresses it in "off" position. As the pedal arm moves forward during brake application, the spring-loaded plunger moves to the "on" position. See Figure 9-5.

The master cylinder contains a integrally cast fluid reservoir and a cylinderical pressure chamber in which force applied to the brake pedal is transmitted to the fluid that actuates the brake shoes. A breather port and a compensating port permit passage of fluid between the reservoir and the pressure chamber during certain operating conditions. The reservoir itself is sealed against entrance of outside atmosphere and possible contamination by a diaphragm located under the vented reservoir cover. During brake application and release, the fluid level within the reservoir changes; the diaphragm permits increase and decrease of fluid volume without the necessity of venting.

A coil spring holds a check valve against the seat and also holds a rubber primary cup against the forward end of the piston. This cup and a rubber secondary cup on the rearward end of the piston prevent escape of fluid past the piston. The piston is retained in the cylinder by a stop plate and lock ring. The push rod which actuates the piston extends through the stop plate, and a rubber boot is installed over this end of the cylinder to exclude foreign matter.

Each wheel cylinder contains two pistons and two rubber cups which

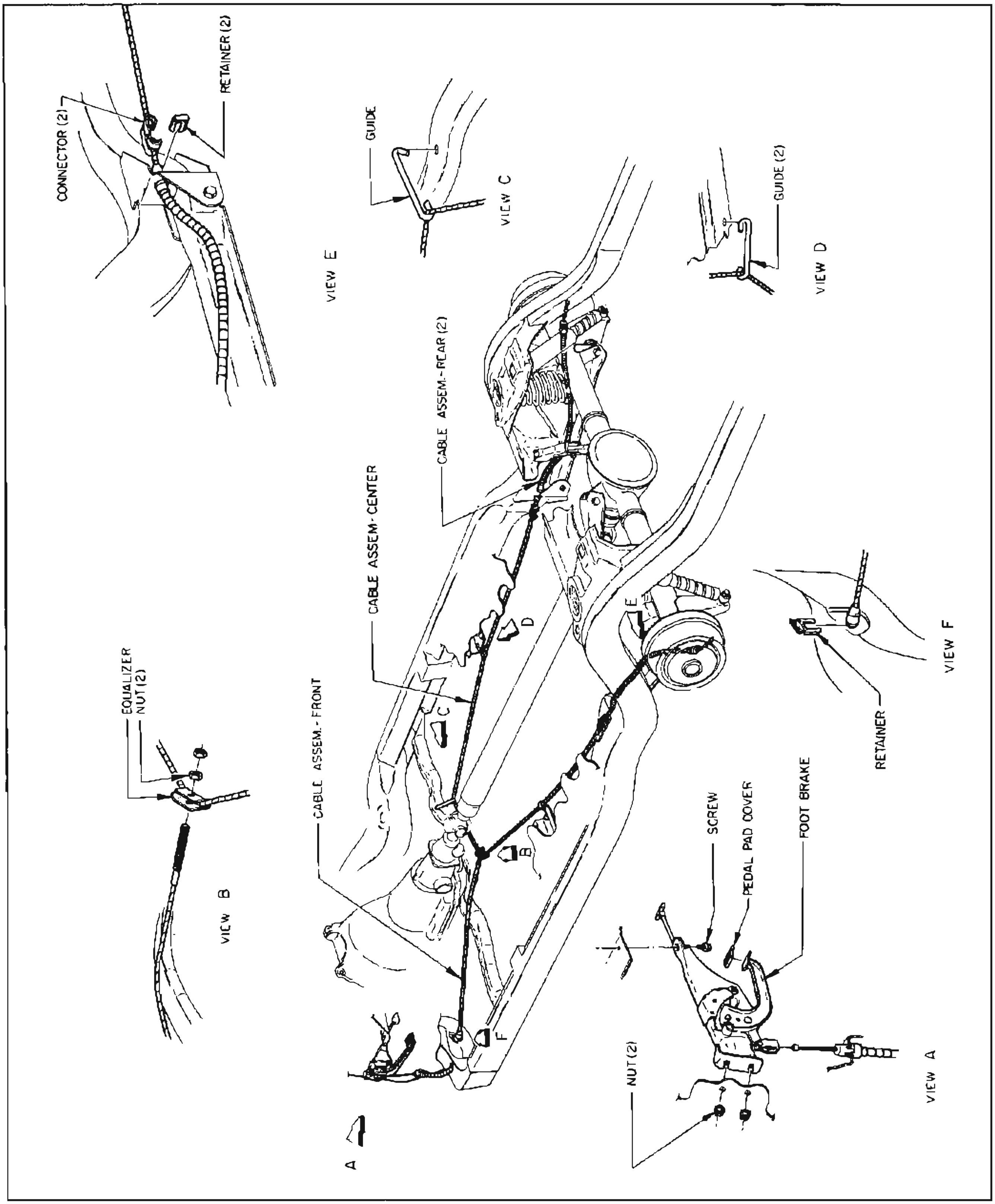



Figure 9-3—Parking Brake Control System

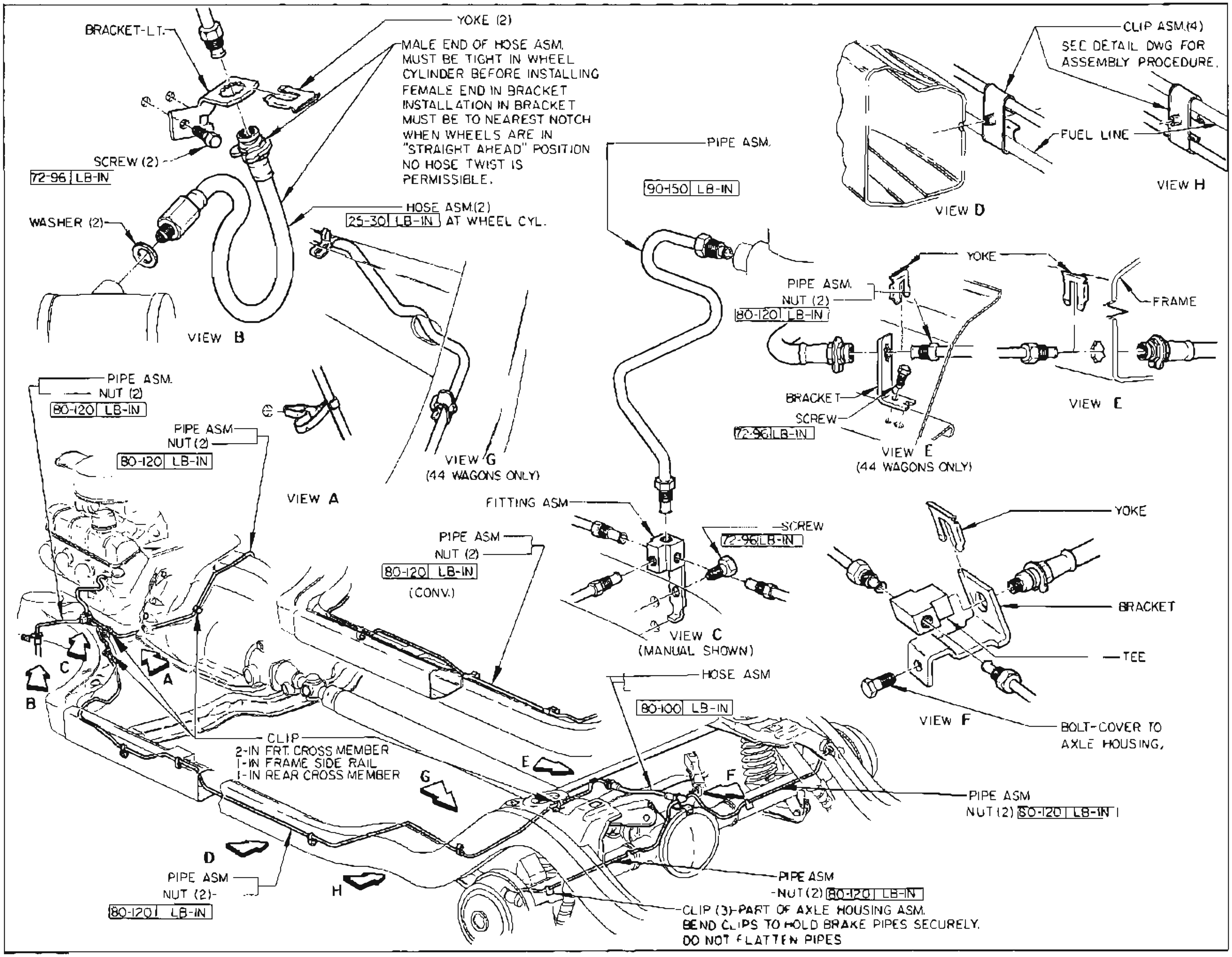



Figure 9-4—Service Brake Control System

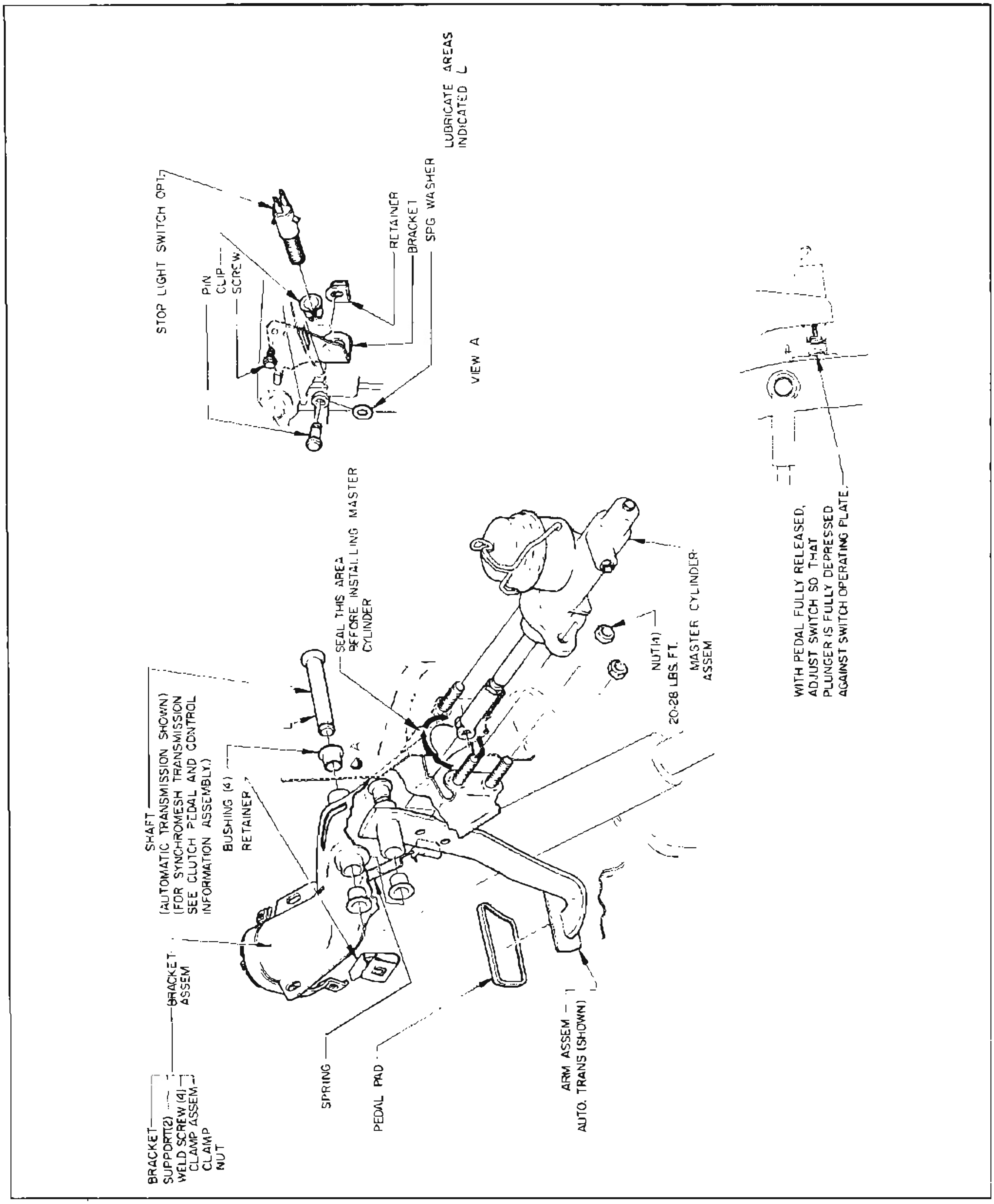



Figure 9-5—Mounting of Brake Pedal and Master Cylinder

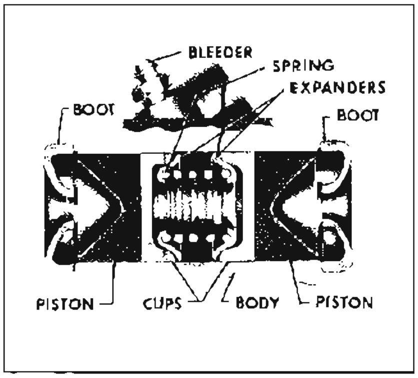



Figure 9-6—Wheel Cylinder Assembly

are held in contact with the pistons by a central coil spring with cup expanders to provide a fluid-tight seal. The wheel cylinder cups are of a special heat resisting rubber. Cups of this material must have an expander to hold the lips of the cup out against the wheel cylinder bore. These cup expanders are crimped on each end of the wheel cylinder spring. The inlet port for brake fluid is located between the pistons so that when fluid pressure is applied both pistons move outward toward the ends of wheel cylinders. The pistons impart movement to the brake shoes by means of connecting links which seat in pistons and bear against webs of the shoes. Rubber boots enclose both ends of the cylinder to exclude foreign matter. A valve for bleeding the brake pipes and wheel cylinder is located above the inlet port. See Figure 9-6.

### d. Self-Adjusting Brake

The self-adjusting brake mechanism consists of an actuator, actuator pivot, actuator return spring, override spring, and an actuating link. The self-adjusting brake mechanism is mounted on the secondary shoe and operates only when the brakes are applied while the car is moving in a rearward direction and only when the secondary shoe moves a predetermined distance toward the brake drum. See Figure 9-7.

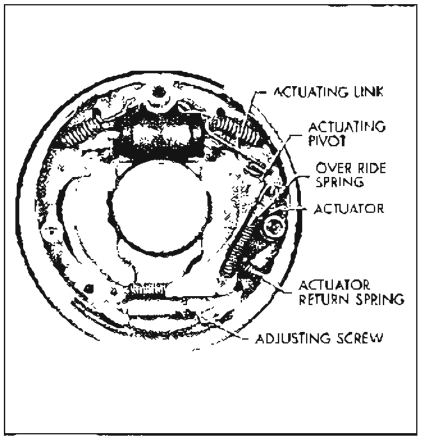



Figure 9-7—Front Left Brake Self-Adjuster Assembly

When the car is moved in a rearward direction and the brakes are applied, friction between the primary shoe and the drum forces the primary shoe against the anchor pin. Hydraulic pressure in the wheel cylinder forces the upper end of the secondary shoe away from the anchor pin, and the upper end of the actuator is prevented from moving by the actuating link. This causes the actuator to pivot on the secondary shoe, forcing the actuator lever against the adjusting screw star wheel. If the brake linings are worn enough to allow the secondary shoe to move the predetermined distance, the actuator will turn the adjusting screw one tooth. If the secondary shoe does not move the predetermined distance, movement of the actuator will not be great enough to rotate the adjusting screw.

When the brakes are released, the actuator return spring returns the actuator to adjusting position on the adjusting screw.

## 9-3 OPERATION OF HYDRAULIC SERVICE BRAKES

When the brakes are fully released, the master cylinder piston is held against the stop plate and the primary cup is held just clear of the compensating port by the master cylinder spring, which also holds the check valve against its seat on the valve seat washer. The pressure chamber is filled with fluid at atmospheric pressure due to the open compensating port and the flexible reservoir diaphragm. All pipes and wheel cylinders are filled with fluid under a "static" pressure of 8-16 pounds, which helps to hold the lips of the wheel cylinder cups in firm contact with cylinder walls to prevent loss of fluid or entrance of air. See Figure 9-8, view A.

When the brake pedal is depressed to apply the brakes, the push rod forces the master cylinder piston and primary cup forward. As this movement starts, the lip of the primary cup covers the compensating port to prevent escape of fluid into the reservoir. Continued movement of the piston builds pressure in the pressure chamber and fluid is then forced through holes in the check valve and out into the pipes leading to all wheel cylinders. Fluid forced into the wheel cylinders between the pistons and cups causes the pistons and connecting links to move outward and force the brake shoes into contact with the drums. See Figure 9-8, view B.

Movement of all brake shoes into contact with drums is accomplished with very light pedal pressure. Since pressure is equal in all parts of the hydraulic system, effective braking pressure cannot be applied to any one drum until all of the shoes are in contact with their respective drums; therefore the system is self-equalizing. After all shoes are contacting the drums, further force on brake pedal builds up additional pressure in the hydraulic system, thereby increasing the pressure of shoes against drums.

On rapid stops some car weight is transferred from the rear to the

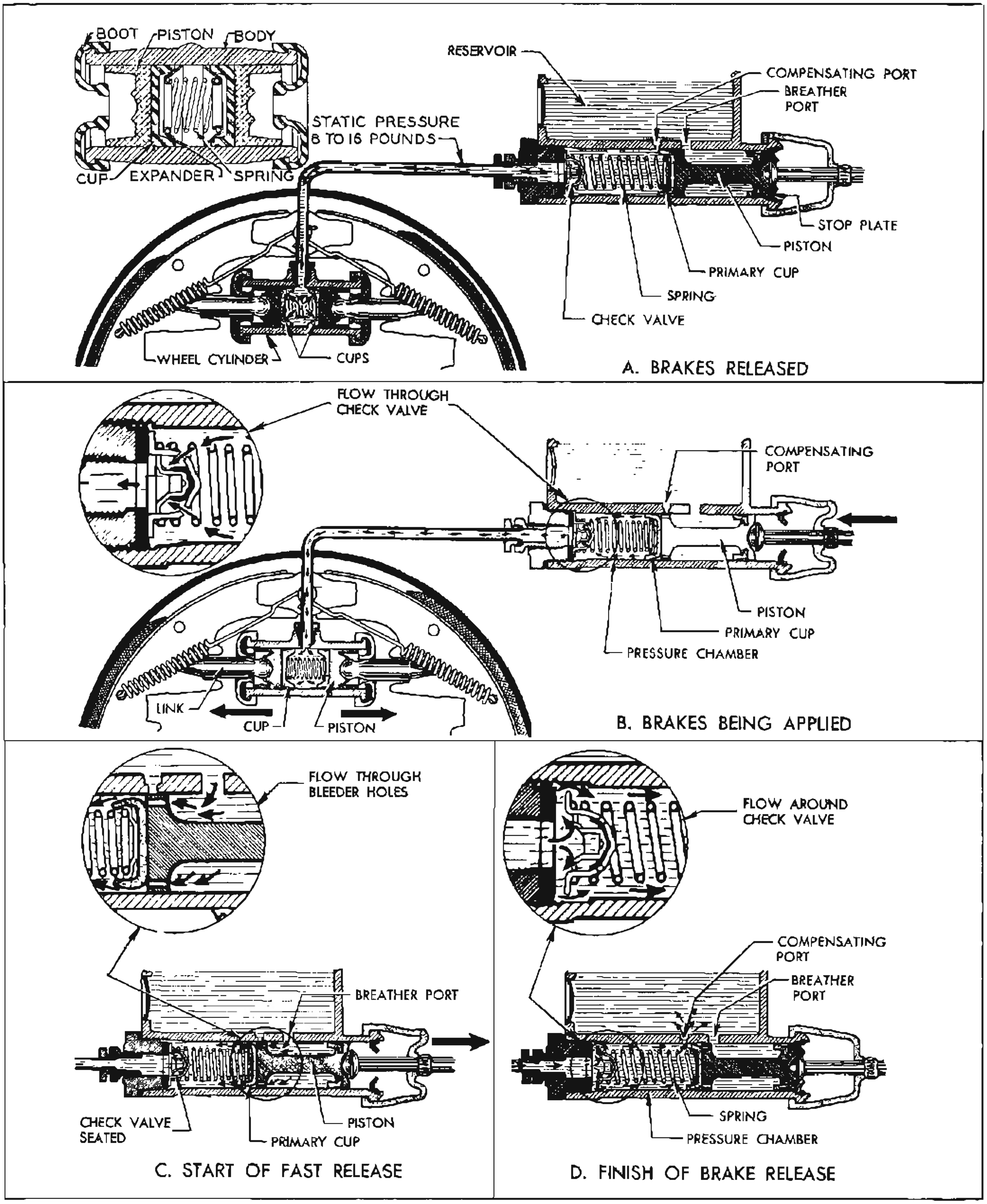



Figure 9-8—Operation of Brake Hydraulic System

front wheels, consequently greater braking power is required at front wheels in order to equalize the braking effect at front and rear wheels. Greater pressure is applied to front brake shoes by using larger wheel cylinders, so that distribution of braking power is approximately 56% at front wheels and 44% at rear wheels on all series except the sport-wagon which has an approximate distribution of 53% at the front wheels and 47% at the rear wheels.

When the brake pedal is released, the master cylinder spring forces the pedal back until the push rod contacts the stop plate in the master cylinder. This spring also forces the piston and primary cup to follow the push rod and presses the check valve firmly against its seat.

At start of a fast release the piston moves faster than fluid can follow it in returning from the pipes and wheel cylinders, therefore, a partial vacuum is momentarily created in the pressure chamber. Fluid supplied through the breather port is then drawn through the bleeder holes in piston head and past the primary cup to keep the pressure chamber filled. See Figure 9-8, View C.

As pressure drops in the master cylinder, the shoe springs retract all brake shoes, and the connecting links push the wheel cylinder pistons inward, forcing fluid back to master cylinder. Pressure of returning fluid causes a rubber disc to close all holes in the check valve and forces the check valve off its seat against the tension of the master cylinder spring; fluid then flows around the check valve into the pressure chamber. With the piston bearing against the stop plate and the lip of the primary cup just clear of the compensating port, excess fluid which entered through the bleeder holes, or was created by expansion due to increased temperature, now returns to reservoir through the uncovered compensating port. See Figure 9-8, view D.

When pressure in wheel cylinders and pipes becomes slightly less than the tension of master cylinder spring, the check valve returns to its seat on the head nut to hold 8 to 16 pounds of "static" pressure in the pipes and cylinders.

# SECTION 9-B
# BRAKE TROUBLE DIAGNOSIS

## CONTENTS OF SECTION 9-B



## 9-5 INSPECTING AND TESTING BRAKES

### a. Inspecting Brakes

At reasonably frequent intervals the brakes should be inspected for pedal reserve, which is the clearance between the pedal pad and the toeboard. Inspection should be made with brake pedal firmly depressed while brakes are cold.

Pedal reserve, on manual brake-equipped car should be not less than 2-1/4". On power brake-equipped car, pedal reserve should be not less than 1-1/2".

Heat generated by high speed stops will expand brake drums and increase shoe clearance, thereby permitting pedal pad to go closer to toeboard when brakes are hot.

Brake shoe linings should not be permitted to wear down until rivets contact drums because drums will be scored. As car mileage approaches the point where relining may be required it is advisable to remove one or more drums for inspection of lining in order to avoid the possibility of damaging brake drums.

### b. Testing Brakes

Overall brake performance cannot be properly tested with the wheels jacked up because this procedure does not test the self-energizing servo action of the brake shoes and the effect of car weight distribution on deceleration.

Brakes should be tested on dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if roadway is wet or greasy, or covered with loose dirt so that all tires do not grip the road equally. Testing will also be adversely affected if roadway is crowned so as to throw weight of car toward wheels on one side, or if roadway is so rough that wheels tend to bounce.

Test brakes at different car speeds with both light and heavy pedal pressure; however, avoid locking the wheels and sliding the tires on roadway. Locked wheels and sliding tires do not indicate brake efficiency since heavily braked, but turning wheels will stop the car in less distance than locked wheels. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

### c. External Conditions That Affect Brake Performance

In addition to roadway conditions mentioned above (subpar. b) the following external conditions may affect brake performance and should be corrected before work is done on the brake mechanism.

a. Tires. Tires having unequal contact and grip on road will cause unequal braking. Tires must be equally inflated and non-skid tread pattern of right and left tires must be approximately equal.

b. Car Loading. When car has abnormally unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded car requires more braking effort.

c. Front Wheel Bearings. A loose front wheel bearing permits the drum to tilt and have spotty contact with brake shoe linings, causing erratic brake action. See paragraph 7-8.

d. Front End Alignment. Misalignment of the front end particularly in regard to limits on camber and theoretical king pin inclination, will cause brake action to appear unequal between sides.

e. Shock Absorbers. Faulty shock absorbers that permit bouncing of car on quick stops may give the erroneous impression that brakes are too severe.

## 9-6 BRAKE TROUBLE INDICATIONS AND CORRECTIONS

### a. Brake Pedal Travel Excessive, or Pedal Goes to Toeboard

(1) Excessive Brake Shoe Clearance. Excessive clearance is indicated if a good brake is obtained after pumping brake pedal several times. Condition may be caused

by wear of brake linings or by improperly functioning self-adjusting mechanism.

(2) Fluid Reservoir Empty. If fluid reservoir is empty, a good brake cannot be obtained by pumping brake pedal. Fill reservoir (par. 9-7) and check for springy pedal action (subpar. b, below).

(3) Air in Hydraulic System. Air in hydraulic system will cause a springy action of brake pedal. If volume of air is large, the pedal will go to toeboard under normal pressure. See subparagraph (b) below for causes of air in hydraulic system. Bleed hydraulic system (par. 9-7).

(4) Fluid Leak in Hydraulic System. A leak in the hydraulic system will allow the pedal to go to the toeboard gradually under continued pressure. An external leak is indicated by loss of fluid in fluid reservoir. Check all brake pipe connections and all cylinders for evidence of fluid loss. If no leaks are found, remove master cylinder, disassemble and check for internal leak. Check for scores or other damage to cylinder bore, piston, or primary cup (par. 9-14).

(5) Improper Brake Fluid. Improper brake fluid may boil due to high temperature. Flush system and refill with specified brake fluid (par. 9-7).

**b. Springy, Spongy Action of Brake Pedal**

(1) Air in Hydraulic System. Air will enter the hydraulic system if there is not sufficient reserve fluid in the master cylinder reservoir. A disconnected pipe permits air to enter the system. A clogged filler cap vent will permit air to be drawn in past the piston secondary cup on the return stroke. A leaking check valve causes loss of static pressure in the system, thus permitting air to be drawn in past wheel cylinder cups.

Clean out clogged vent or replace leaking check valve as required. Fill reservoir and bleed hydraulic system (par. 9-7).

(2) Brake Drum Out of Round. This condition is usually indicated by an unstable action of brake pedal. Check brake drums and true up if necessary (par. 9-12).

**c. Brakes Severe on Light Pedal Pressure**

(1) Loose Front Wheel Bearings. Check for play in bearings with wheels jacked up and adjust if necessary (group 7).

(2) Loose Brake Backing Plate. Tighten all backing plate bolts.

(3) Brake Shoes Not Properly Adjusted. Inspect self-adjuster mechanisms.

(4) Excessive Dust in Brake Assemblies. When excessive dust is present, brakes are usually more severe. Thoroughly clean brake shoe linings to remove embedded dirt (par. 9-11).

(5) Faulty Brake Shoe Linings or Drums. Charred linings or scored drums cause grabbing action. A small amount of grease or brake fluid on linings may cause grabbing action. Replace linings and true up or replace scored drums (par. 9-12).

(6) Brake Shoe Linings Reversed. The primary lining is shorter than secondary lining and of different composition. Install brake shoes in proper positions (par. 9-11).

**d. Excessive Pedal Pressure Required**

(1) If brake shoes do not have full contact with drums, excessive pedal pressure is required to obtain effective braking. Repair brake linings (par. 9-11, subpar. d).

(2) Foreign Substances on Brake Linings. Check for grease, brake fluid, or other foreign substances on linings. Replace grease or fluid soaked linings (par. 9-11). Sand off other foreign substances.

(3) Improper Brake Lining. Very hard brake lining may have poor braking effect. Install standard Buick lining or equivalent (par. 9-11).

(4) Improper Brake Fluid. Fluid containing substances injurious to rubber will cause swelling of rubber cups in master and wheel cylinders. Replace rubber cups, flush system and refill with specified brake fluid (par. 9-7, 9-13, 9-14).

**e. Brakes Drag at One Wheel**

(1) Loose Front Wheel Bearings. Check for play in bearings with wheel jacked up and adjust if necessary (group 7).

(2) Insufficient Clearance at Brake Shoes. Check self-adjuster mechanism.

(3) Weak or Broken Brake Shoe Spring. Replace spring and check brake shoe adjustment (par. 9-11).

(4) Wheel Cylinder Piston Stuck or Cups Distorted. These conditions may be caused by dirt in hydraulic fluid, improper fluid, or previous use of a cleaning fluid which is detrimental to rubber parts. Overhaul wheel cylinder and replace any defective parts (par. 9-13). It is also advisable to flush hydraulic system to prevent repetition of trouble (par. 9-7).

(5) Obstruction in Brake Pipes or Hoses. Obstruction may be caused by foreign material, damaged pipe, kinked or deteriorated brake hose. Flush hydraulic system (par. 9-7) or replace damaged or defective parts as required.

**f. Brakes Drag at All Wheels**

(1) Insufficient Clearance at Brake Shoes. Check self-adjuster mechanism.

(2) Master Cylinder Piston Compensating Holes Closed. If the compensating holes are plugged by foreign material, or are covered by the piston primary cup when brake pedal is in released position, high pressure will be maintained in hydraulic system and brake shoes will be held in contact with drums. This condition is indicated by lack of normal pedal travel and a very solid feel when pedal is depressed.

Make certain that pedal is free on pivot and at push rod connection.

If freeing up brake pedal does not correct the trouble, remove master cylinder for disassembly and thorough cleaning (par. 9-14).

CAUTION: Never insert a test wire through compensating holes as this may leave a burr, which will cut a groove in primary cup.

(3) Wheel Cylinder Piston Cups Distorted. If the rubber parts in master cylinder are found to be swollen and distorted (step 2, above), it indicates the presence in hydraulic system of a mineral base oil such as kerosene, gasoline, or engine oil. Such substances will cause all rubber parts to swell and distort, therefore it is necessary to thoroughly flush the hydraulic system (par. 9-7) and replace all rubber parts.

**g. Car Pull to One Side**

(1) Tires Unequal. Tires Unequally inflated, or having unequal wear of treads, or tires of different non-skid tread designs may cause car to pull to one side when brakes are applied. Inflate all tires to specified pressure (par. 1-1). Rearrange tires if necessary so that tread non-skid characteristics are more nearly equal on both sides of car.

(2) Loose Front Wheel Bearings. With wheels jacked up check for play in bearings and adjust if necessary. See Group 7.

(3) Out-of-Round or Scored Brake Drums. True up or replace as required (par. 9-12).

(4) Brake Linings Not Matched, or Improperly Placed. Brake linings must be of same composition on left and right sides of car, otherwise unequal braking action will result. If primary and secondary linings are interchanged at any wheel, unequal braking will be obtained. Replace or change linings as required (par. 9-11).

(5) Foreign Substances on Some Brake Linings. Any foreign substance on linings will affect braking action. Thoroughly clean any linings having water, sand, paint, imbedded particles of metal, etc., on surface. Sand or brush the affected surface--do not use any liquid cleaning agent. Linings having oil, grease, or hydraulic fluid on surface cannot be cleaned satisfactorily and must be replaced (par. 9-11).

(6) Loose Brake Backing Plate. Tighten all backing plates.

(7) Unequal Camber. If car has a tendency to lead to one side when driven on a level road it will also pull to one side when brakes are applied. Adjust camber to specified limits (group 7).

**h. Brakes Noisey**

(1) Brake Drum Condition. Carefully inspect brake drums for out-of-round, scoring, or cracks. Rebore any drum if out-of-round or scored (par. 9-12). Replace any drum which is cracked or has hard spots in braking surface.

(2) Foreign Material Imbedded in Lining. Metallic particles or grit imbedded in brake lining will cause squeaking. Sand the surfaces of linings and remove all particles of metal. In some cases it may be necessary to dress the lining surfaces with a portable resurfacing machine in order to properly clean the surfaces and insure good contact with brake drums.

(3) Linings Loose on Brake Shoes. Replace any rivets that are loose. Lining must be tightly held against brake shoe flange, particularly at the ends (par. 9-11).

(4) Bent Brake Backing Plate. True up or replace backing plate.

(5) Improper Brake Shoe Lining. Install standard Buick Lining or equivalent.

(6) Shoes Scraping on Backing Plate. Squeaking or "crunch" will be produced if contact surfaces are dry, rusty, or rough. The noise is more pronounced if brake shoes have considerable movement due to large clearance between shoes and drums. Clean, smooth up, and lubricate contact surfaces and reduce shoe movement by adjusting to safe minimum clearance (par. 9-8).

(7) Shoes Slapping Against Backing Plate. If drums have been turned with noticeable lead, shoes tend to follow lead and produce a regular slapping noise against backing plate during brake application. Polishing drums with light emery cloth will reduce noise.

**i. Brakes Fade (Fail to Hold)**

The condition known as "fade" is caused by loss of friction between brake lining and drums as a result of abnormally high lining temperatures. Excessive heat cooks out the most volatile ingredients of the bonding material in lining and this acts as a lubricant.

Excessive lining temperatures will be produced by partial or spotty contact of linings with brake drums, due to improper adjustment. Excessive lining temperature also can be caused by frequent and heavy braking at high speed, driving with parking brakes partially applied, "riding" the brake pedal, or prolonged use of brakes on steep grades without using second gear (synchromesh) or low range (automatic transmission) to obtain adequate engine braking.

After a set of brakes have faded a few times, it is probable that they will continue to fade even though the shoes have been adjusted to establish full contact of linings with drums. This is because the cooking out of bonding ingredients has destroyed the frictional properties of the lining surfaces. If the lining thickness is ample and the cooking process has not been prolonged, it may be possible to obtain a correction and some useful life by grinding off about .020" from the lining. Merely sanding off the lining surface will not remove destroyed lining material. If this cannot be done, replacement of lining is the only remedy.

The use of improperly compounded linings will also produce fade. Some replacement linings lose their frictional properties at lower temperatures than the linings selected for Buick brakes. Such linings must be replaced.

When brake drums are rebored too thinly they will have excessive expansion due to heat. The result is loss of pedal reserve and braking when drums are hot, and good brakes when drums are cold. This may be erroneously diagnosed as fade, but fade occurs with ample pedal reserve.

# SECTION 9-C
# BRAKE SERVICE, ADJUSTMENT, REPAIR PROCEDURES

## CONTENTS OF SECTION 9-C



## 9-7 FILLING, BLEEDING FLUSHING BRAKE HYDRAULIC SYSTEM

### a. Filling Brake Master Cylinder

The master cylinder must be kept properly filled to insure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, master cylinder must not be overfilled.

The brake fluid reservoir is on the master cylinder which is located under the hood on the left side of the cowl.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and diaphragm. Add fluid as required to bring level 1/8" below lip of reservoir opening. Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent.

CAUTION: Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil. Even a trace of mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system.

### b. Bleeding Brake Hydraulic System

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system. Since air is compressible and hydraulic fluid is not, the presence of air in the system is indicated by a springy, spongy feeling of the brake pedal accompanied by poor braking action.

Air will be introduced into the hydraulic system if the brake pedal is operated when the fluid is too low in master cylinder reservoir. Air will also enter the system whenever any part of hydraulic system is disconnected.

It will be necessary to bleed the hydraulic system at all four wheel cylinders if air has been introduced through low fluid level or by disconnecting brake pipe at master cylinder. If brake pipe is disconnected at any wheel cylinder, then that wheel cylinder only need be bled. If pipes are disconnected at any fitting located between master cylinder and wheel cylinders, then all wheel cylinders served by the disconnected pipe must be bled. See Figure 9-4.

NOTE: On power-brake equipped models, the master cylinder and power brake unit is mounted at an angle on the cowl. A bleeder valve is located at the upper end of the master cylinder. Because of the mounting angle, it will be necessary to bleed the master cylinder first and then the wheel cylinders whenever the master cylinder reservoir has become empty, or whenever the master cylinder is removed from car.

### c. Sequence for Bleeding Wheel Cylinders

It is advisable to bleed one wheel cylinder at a time to avoid getting fluid level in reservoir dangerously low. The correct sequence of bleeding is left front, right front, and then rear wheels, either first. This sequence expels air from the lines and wheel cylinders nearest to the master cylinder first, and eliminates the possibility that air in a line close to the master cylinder may enter a line farther away after it has been bled.

CAUTION: Do not perform bleeding operation while any brake drum is removed.

### d. Bleeding Wheel Cylinder without Pressure Tank

1. Fill master cylinder (subpar. a, above).

2. Install bleeder Wrench J-21472 on bleeder valve. Slip a brake bleeder tube over ball of wheel cylinder bleeder valve. Place lower end of bleeder tube in a glass jar that is partially filled with clean brake fluid. Position end of tube so that it will remain submerged under fluid during bleeding operation. Unscrew bleeder valve 3/4 of a turn. See Figure 9-9.

3. Depress brake pedal a full stroke, then allow pedal to return slowly to released position. Allowing pedal to return quickly

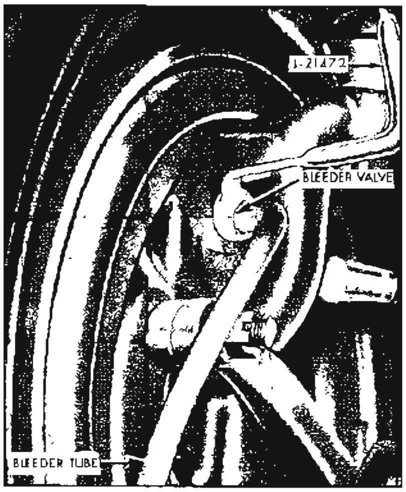



Figure 9-9—Bleeding Front Wheel Cylinder

may draw air into system. Continue operating pedal in this manner until fluid flows from bleeder tube into glass jar in a solid stream that is free of air bubbles, then close the bleeder valve securely and remove bleeder tube and wrench.

4. Frequently check master cylinder to make sure that it contains fluid. Allowing reservoir to be emptied will cause air to be drawn into hydraulic system.

5. When bleeding operation is completed at all wheel cylinders where needed, make sure that fluid level is within 1/8" of top of reservoir, then install rubber diaphragm and cover.

6. Discard the brake fluid deposited in glass jar during bleeding operation. It is poor economy to attempt to clean fluid that has once been used.

**e. Bleeding Wheel Cylinder with Pressure Tank**

IMPORTANT: When using a pressure tank with Adapter J-21479, air bubbles may form in the tank and enter the brake hydraulic system. To avoid this, observe the following points when handling a pressure tank: (1) Do not shake or agitate the pressure tank after air pressure has been added or is being added. (2) Allow pressure tank to stand in one position as much as possible, and bring air hose over to tank when adding head of air. (3) Make certain the valves on the pressure tank lines are not defective allowing air to be sucked in when fluid passes through the lines. (4) Pressure tank should be kept at least 1/3 full of fluid to avoid air bubbles forming. (5) If pressure tank is full of air bubbles, release air pressure and those bubbles will increase in size, be forced to top of fluid, and escape.

1. Thoroughly clean master cylinder reservoir cover and surrounding area.

2. Make sure that pressure tank is at least 1/3 full of specified brake fluid, that hose and master cylinder reservoir are filled with fluid, then attach hose to master cylinder reservoir adapter cover.

3. Install bleeder Wrench J-21472 on bleeder valve. Slip a brake bleeder tube over ball of wheel cylinder bleeder valve. Place lower end of bleeder tube in a clean glass jar. Unscrew bleeder valve 3/4 of a turn. See Figure 9-9.

4. Open pressure tank hose valve to apply fluid to master cylinder under pressure that does not exceed 35 pounds. It is not necessary to pump the brake pedal when using pressure tank.

5. When fluid flows from bleeder tube into glass jar in a solid stream that is free of air bubbles, that particular cylinder and line are bled; tighten bleeder valve securely and remove bleeder tube.

6. When bleeding operation is completed at all wheel cylinders, make sure that fluid level is 1/8" below top of master cylinder opening, then install rubber diaphragm and cover.

**f. Flushing Brake Hydraulic System**

It is recommended that the entire hydraulic system be thoroughly flushed whenever new parts are installed in the hydraulic system.

Flushing is also recommended if there is any doubt as to the grade of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil.

Flushing is performed at each wheel cylinder in turn, and in the same manner as the bleeding operation except that bleeder valve is opened 1-1/2 turns and the fluid is forced through the pipes and wheel cylinder until it emerges clear in color. Approximately one pint of fluid is required to flush the hydraulic system thoroughly.

When flushing is completed at all wheel cylinders, make certain that master cylinder reservoir is filled to proper level.

## 9-8 BRAKE ADJUSTMENT

**a. Preliminary Checks**

1. Depress brake pedal firmly. If pedal travels to within 2-1/4 inches of toeboard on manual brake-equipped car or 1-1/2 inches of toeboard on power brake-equipped car, and pedal has hard feel, brake shoes require adjustment or relining. However, if pedal has a spongy feel, brake system needs bleeding.

2. Remove one front wheel with hub and drum assembly. Inspect brake lining. If lining is worn nearly to rivets, reline brakes (par. 9-11).

3. Check fluid level in master cylinder reservoir and add fluid if necessary (par. 9-7).

4. Fully release parking brake lever and place transmission in neutral.

5. Pull on both ends of rear brake cable a number of times to make sure that cables operate rear brake shoes freely and do not bind in conduits. Check for free movement of cable in brake cable sheathing and check brake cable spring for tension. Replace cable assembly if spring is weak or broken.

**b. Pedal Height Adjustment**

Brake pedal height adjustment is made possible on both manual and power brakes by a clevis which is threaded on the pedal push rod. Before making a pedal height adjustment, check all pivot points for binding or lack of lubrication. If pedal pivots freely but height is incorrectly set, adjust as follows:

1. Loosen jam nut which is tightened against master cylinder push rod clevis.

2. Clamp vise-grips on push rod. Rotate push rod clockwise in order to adjust push rod out or counterclockwise to adjust push-rod in.

3. When specified pedal height is attained as shown in Figure 9-10, tighten jam nut.

4. Disconnect wires and adjust stop light switch by turning in or out as necessary so that plunger is fully depressed against switch operating plate when pedal is in released position.

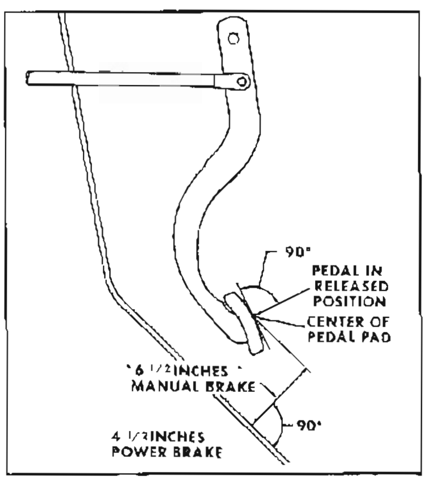



Figure 9-10—Brake Pedal Height

**c. Adjustment at Wheels**

1. Remove adjusting hole cover from brake backing plate. Install J-21231 through adjusting hole to move actuator off adjusting screw. Use J-6166 to turn brake adjusting screw; expand brake shoes at each wheel until the wheel can just be turned by hand. See Figure 9-11. The drag should be equal at all wheels.

2. Back off brake adjusting screw at each wheel 30 notches. If shoes still drag lightly on drum, back off adjusting screw one or two additional notches. NOTE: Brakes should be free of drag when screw has been backed off approximately 12 notches. Heavy drag at this point indicates tight parking brake cables.

3. Install adjusting hole cover in brake backing plate when adjustment is completed.

4. Check parking brake adjustment as described in paragraph 9-9.

5. Road test car for service and parking brake performance (par. 9-5).

## 9-9 PARKING BRAKE ADJUSTMENT

Adjustment of parking brake cable is necessary whenever the rear brake cables have been disconnected, or when cables have been stretched through extended use. Need for parking brake adjustment is indicated if the service brake operates with good reserve, but the parking brake pedal can be depressed more than eight ratchet clicks under heavy foot pressure.

After making certain that service brakes are in good adjustment, adjust parking brake mechanism as follows:

1. Depress parking brake pedal exactly three ratchet clicks.

2. Loosen jam nut located at rear of equalizer adjusting nut. See Figure 9-5. Then tighten adjusting nut until rear wheels can just be turned rearward using two hands, but are locked when forward rotation is attempted.

3. Release parking brake ratchet one click; at this two-click engagement, the rear wheels should rotate forward with a light drag and rearward freely.

4. Release mechanism one more ratchet click. At a one-click engagement, as well as with mechanism totally disengaged, rear wheels should turn freely in either direction.

CAUTION: It is very important that parking brake cables are not adjusted too tightly to cause brake drag. With automatic brake adjusters, a tight cable causes brake drag and also positions the secondary brake shoe, hence the adjuster lever, so that it continues to adjust to compensate for wear caused by the drag. The result is a cycle of wear and adjustment that can wear out linings very rapidly.

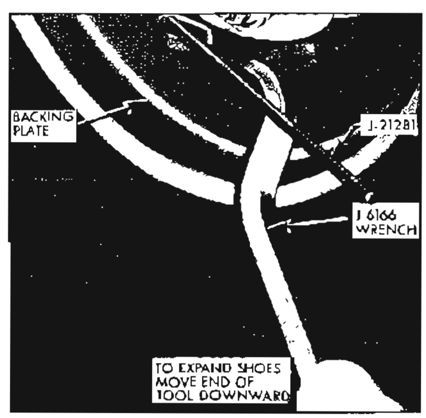



Figure 9-11—Adjusting Right Front Brake Shoes

## 9-10 REPLACING BRAKE PIPES

Since brake pipe assemblies (except master cylinder to distributor pipe) are not available from Buick Parts Warehouses, it is therefore necessary to order service bulk tubing and fittings to make-up any pipe assembly which is needed. All brake pipes must be made of tin plated or copper coated wrapped steel tubing with the ends double lap flared. CAUTION: Never use copper tubing because copper is subject to fatigue cracking which would result in brake failure.

To make-up a brake pipe assembly, proceed as follows:

a. Procure the recommended tubing and fittings of the correct size. (Outside diameter of tubing is used to specify size.)

b. Cut tubing to length. The correct length may be determined either by measuring the old pipe using a cord, or the length may be found in Group 4.685 of the Buick Chassis Parts Book.

c. Double lap flare tubing ends using a suitable flaring tool such as J-8051. Follow the instructions included in the tool set. CAUTION: Make sure fittings are installed before starting second flare.

d. Bend pipe assembly to match old pipe.

## 9-11 REPLACE OR RELINE BRAKE SHOES—REPAIR BRAKE LININGS

The most satisfactory method of replacing brake lining is to install new shoe and lining assemblies. This insures brake shoes that are not distorted through use, and linings are properly riveted to shoes and ground to correct radius by accurate factory machinery.

Each brake shoe and lining set listed under Group 5.017 is packed in a carton containing two primary and two secondary shoe and lining assemblies, enough for two wheels. Sets are available in standard size and also in .030" oversize for use where brake drums have been rebored.

Use brake shoe lining sets listed under Group 5.018 if the old shoes are to be relined. Each lining set is packed in a carton containing two primary and two secondary linings, enough for two wheels. Linings are shaped, drilled, and ground to correct thickness and radius, and are packaged with enough rivets for installation on shoes. Lining sets are available in standard and .030" oversizes.

Brake linings are made of asbestos for its heat resisting qualities and compounds of bonding material for strength. Some bonding materials are used for their lubricating qualities to guard against drum scoring while others are used to control the friction producing property of the lining, called "coefficient of friction". Good molded linings also have imbedded particles of material used to control friction and wear. When linings are ground, some of the surface particles may be pulled out, giving a pitted appearance. These pits do not affect lining efficiency.

The heat generated by friction will produce different effects in different compounds of bonding material. Some compounds increase friction with increased temperature, which might cause grabbing or locking. Other compounds lose friction with increased temperature, which might cause materially lowered braking power.

Brake lining compounds must be carefully selected to produce the braking friction required at the temperatures normally attained in each vehicle application.

### a. Removal and Inspection

NOTE: When paragraph references in parentheses () have an asterisk (*) the operation referred to is additional work not covered by the standard replacement operation.

1. Jack up car in a safe manner, remove wheel and brake drum (rear), or drum and hub assembly (front). NOTE: Safety stops located on the backing plates will prevent pistons from leaving the wheel cylinders; however, brake pedal must not be operated while a brake drum is removed since damage to wheel cylinder rubber boots will result.

NOTE: It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. To back off shoe adjustment, rotate shoe adjusting screw upward. See Figure 9-12.

2. Unhook the primary and secondary shoe return springs using large pliers.

3. Remove shoe hold down springs.

4. Lift up on actuator, unhook actuating link from anchor pin, then remove.

5. Spread shoes to clear wheel cylinder connecting links, remove

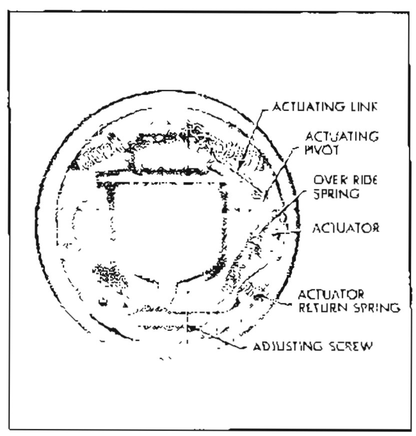



Figure 9-12—Rear Wheel Brake Assembly Left

parking brake strut and spring (rear only), disconnect cable from parking brake lever, remove shoes from the backing plate.

6. Separate the brake shoes by removing adjusting screw and lock spring. Remove parking brake lever from secondary brake shoe (rear only). See Figure 9-12.

7. Clean all dirt out of brake drum, using care to avoid getting dirt into front wheel bearings. Inspect drums and replace or recondition if required (*par. 9-12). If front drum and hub is removed, inspect wheel bearings and oil seal and replace faulty parts (*Group 7).

8. Blow all dirt from brake assemblies and inspect for any unusual condition.

9. Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Fluid at this point indicates leakage past piston cup, requiring overhaul of wheel cylinder (*par. 9-13).

10. If working at rear wheels, inspect backing plate for oil leak past wheel bearing oil seals. Correct any leak by installation of new seals (*par. 6-6).

11. Check all backing plate attaching bolts to make sure they are tight. Using fine emery cloth, clean all rust and dirt from shoe contact surfaces on plate.

### b. Relining Brake Shoes

If old brake shoes are to be relined, inspect shoes for distortion and for looseness between the rim and web; these are causes for discarding any shoe. If shoes are serviceable, be governed by the following points in installing new linings:

1. Remove old linings by drilling out rivets. Punching rivets out will distort shoe rim. Thoroughly clean surface of shoe rim and file off any burrs or high spots.

2. Use Delco Brake lining or equivalent and the rivets included in lining package which are of correct size. The rivets must fit the holes and the solid body of rivet should extend through the shoe rim, but no farther.

3. Keep hands clean while handling brake lining. Do not permit oil or grease to come in contact with lining.

4. Start the riveting at center of shoe and lining and work toward the ends. Use a roll set for riveting; a star set might split the tabular end and then the rivet would not fill the hole. The primary lining is shorter than secondary lining, therefore the rivet holes at each end of shoe rim are not used.

5. After riveting is completed, lining must seat snugly against shoe with no more than .005" separation midway between rivets. Check with a .004" (permissible) and a .006" (no go) feeler gauge.

### c. Installation and Adjustment

1. On rear brakes only, lubricate fulcrum end of parking brake lever with Delco Brake Lubricant, or equivalent, then attach lever to secondary shoe. Make sure that lever is free moving.

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

CAUTION: WHEN INSTALLING ADJUSTING SCREW MAKE SURE RIGHT HAND THREAD ADJUSTING SCREW IS ON LEFT SIDE OF CAR AND LEFT HAND THREAD ADJUSTING SCREW ON RIGHT SIDE OF CAR. MAKE CERTAIN STAR WHEEL LINES UP WITH ADJUSTING HOLE IN BACKING PLATE.

3. Lubricate shoe contact surfaces on backing plate with a thin coating of Delco Brake Lubricant or equivalent. On rear brakes, sparingly apply same lubricant where brake cable contacts backing plate.

4. Place brake shoes on backing plate, at the same time engaging shoes with wheel cylinder links. The primary shoe (short lining) goes forward. On rear brakes, connect cable to parking brake lever and install strut and spring between lever and primary shoe as shown in Figure 9-12.

5. Install actuator, actuator return spring and actuating link as shown in Figure 9-12.

NOTE: If old brake shoe return springs are nicked, distorted, or of doubtful strength (discolored from heat), it is advisable to install new ones.

6. Install shoe hold down springs.

7. Install the primary and secondary shoe return springs using large pliers. Be careful not to distort springs.

8. Install brake drums and wheels. Lubricate and adjust front wheel bearings. Remove all adjusting hole covers from backing plates.

9. Install J-21231 through adjusting hole to move actuator off adjusting screw. See Figure 9-10.

10. Turn adjusting screws to provide an equal two-hand drag and back-off 30 notches for proper shoe clearance (par. 9-8).

11. If any hydraulic connections were disturbed, bleed hydraulic system (par. 9-7). If new parts were installed in brake system, flushing of hydraulic system is recommended (par. 9-7).

12. Adjust parking brake as described in paragraph 9-9.

13. Inspect all brake pipe hose and connections for evidence of fluid leakage. Tighten any leaking connection. Then apply heavy pedal pressure to brake pedal and recheck connections.

14. Check fluid level in master cylinder and add fluid if necessary.

15. Check brake pedal for proper feel and for proper return.

16. Remove jacks and road test car for proper brake action (par. 9-5).

CAUTION: Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently injure new linings and may score brake drums. When linings are new they must be given moderate use for several days until burnished.

**d. Repairing Brake Linings**

This procedure is to be used when brake action is unequal, severe, hard, noisy or otherwise unsatisfactory, but brake linings have had very little wear.

1. Check fluid in master cylinder and add fluid if necessary.

2. Check brake pedal for proper feel and for proper return.

3. Jack up car in a safe manner and remove all wheels.

4. Remove all brake drums. CAUTION: Brake pedal must not be operated while drums are removed.

5. Clean all dirt out of brake drums, using care to avoid getting dirt into front wheel bearings. Inspect drums and replace or recondition if required (par. 9-12).

6. Blow all dirt from brake assemblies, then inspect brake linings for uneven wear, oil soaking, loose rivets, or imbedded foreign particles. If linings are oil soaked, they must be replaced.

7. If linings are otherwise serviceable, tighten or replace loose rivets and thoroughly clean all steel or other imbedded particles from surfaces and rivet counterbores of linings.

8. If brake linings at any wheel show a spotty wear pattern indicating uneven contact with brake drum it is advisable to true up the linings with a light grinding cut, if suitable grinding equipment is available. If brake action is unequal, severe or hard, indicating that brake shoes are not centralized in drums, the grinder may also be used to correct this condition.

Grinding equipment which locates and swings off the wheel spindle or axle shaft may be used to grind shoes concentric with drums, or a bench mounted grinder may be used to grind shoes to the proper radius (.010" less than drum radius). The instructions of equipment manufacturer must be carefully followed.

9. Check all backing plate bolts to make sure they are tight.

10. Lubricate front wheel bearings, if necessary. Install front hub and drum assemblies and adjust wheel bearings.

11. Install brake drums. Remove all adjusting hole covers.

12. Install all wheels, turn adjusting screws to provide an equal two-hand drag and back-off 30 notches (par. 9-8).

13. Install adjusting hole cover in backing plate when adjustment is complete.

14. Remove jacks and road test car for proper brake action.

CAUTION: Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently injure new linings and may score brake drums. When linings are new they must be given moderate use for several days until nicely burnished.

## 9-12 INSPECTING AND RECONDITIONING BRAKE DRUMS

Whenever brake drums are removed they should be thoroughly cleaned and inspected for cracks, scores, deep grooves, and out-of-round. Any of these conditions must be corrected since they can impair the efficiency of brake operation and also can cause premature failure of other parts.

**a. Cracked, Scored, or Grooved Drum**

WARNING: A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores by polishing with fine emery cloth. Heavy or extensive scoring will cause excessive brake lining wear and it will probably be necessary to rebore in order to true up the braking surface.

If the brake linings are little worn and drum is grooved, the drum should be rebored just enough to remove grooves, and the ridges in the lining should be lightly removed with a lining grinder.

If brake linings are more than half worn, but do not need replacement, the drum should be polished with fine emery cloth but should not be rebored. At this stage, eliminating the grooves in drum and smoothing the ridges on lining would necessitate removal of too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be rebored for use with oversize linings (subpar. c, following). A grooved drum, if used with new lining, will not only wear the lining but will make it difficult, if not impossible, to obtain efficient brake performance.

### b. Out-of-round or Tapered Drum

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and very irregular tire tread wear.

A drum that is more than .006" out-of-round on the diameter is unfit for service and should be rebored (subpar. c, below). A drum that has more than .003" taper should be rebored. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round taper, and wear, take measurements at the open and closed edges of machined surface and at right angles to each other. Standard drums are machined to an inside diameter of 9.495" to 9.505", with runout of braking surface held within .003" front and .004" rear total indicator reading.

### c. Reboring Brake Drum

If a drum is to be rebored, enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when rebored to a diameter of 9.565", it must be replaced. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

A newly bored drum should always have center contact with the shoes on initial break-in, thus ensuring greater uniformity in brake performance with less danger of brake pulling. To get this desired position, the shoe radius should always be .010" less than the drum radius (or .020" less on the diameter). This fit may be accomplished by either grinding the shoes or boring the drums, whichever is the more practical.

If cleaning up a drum requires boring to a size larger than 9.550", then .030" oversize lining must be used.

Fit between the brake shoes and the drum must always be the same on both sides of the car to get equal braking action.

Brake drums may be refinished either by turning or grinding. Best brake performance is obtained by turning drums with a very fine feed. Too coarse a feed will cause a condition on the car called "shoe slap" in which the shoes attempt to follow the spiral of cut, then snap back against the backing plate. Ground and polished drums do not wear in as readily as turned drums and are more likely to cause unequal braking when new. To insure maximum lining life, the refinished braking surface must be smooth and free from chatter or tool marks.

Run-out of the refinished surface of brake drum must not exceed .003" front and .004" rear total indicator reading. Run-out (sideways wobble) of the open edge of drum must not exceed .030".

### d. Brake Drum Balance

During manufacture, brake drums are balanced within 2 inch ounces by fastening weights, as required, near the rim. These weights must not be removed.

After drums are rebored, or if difficulty is experienced in maintaining proper wheel balance, it is recommended that brake drums be checked for balance. Drums out of balance more than 2 inch ounces may be corrected by installation of service balance weights. Brake drums may be checked for balance on most off-the-car wheel balancers.

## 9-13 BRAKE WHEEL CYLINDER OVERHAUL

1. Remove wheel, drum, and brake shoes. Be careful not to get grease or dirt on brake lining.

2. Disconnect brake pipe or hose from wheel cylinder and cover opening with tape to prevent entrance of dirt. Remove wheel cylinder from backing plate.

3. Remove links, boots, pistons, cups, cup expanders and spring from cylinder. Remove bleeder valve.

4. Discard rubber boots, expander assembly, and piston cups. Thoroughly clean all other parts with hydraulic brake fluid or a good grade of alcohol. CAUTION: Do not use anti-freeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

5. Inspect pistons and cylinder bore for scores, scratches, or corrosion. Light scratches may be polished with crocus cloth. Do not use emery cloth or sandpaper. Slight corrosion may be cleaned with fine steel wool and alcohol. If scratches or corroded spots are too deep to be polished satisfactorily the cylinder should be replaced since honing is not recommended.

6. Dip internal parts in brake fluid and reassemble wheel cylinder. When installing piston cups use care to avoid damaging the edges.

NOTE: Front wheel cylinder pistons and cups are 1-1/16" diameter and rear wheel cylinder parts are 15/16" diameter on all series except Sportwagons. Sportwagons use 1-1/16" diameter cylinder front and 1" rear.

7. Install wheel cylinder on brake backing plate and connect brake pipe or hose.

8. Install brake shoes, drum, and wheel, then flush and bleed hydraulic system (par. 9-7).

9. Adjust brakes (par. 9-8) then road test car for brake performance (par. 9-5 and 9-6).

## 9-14 BRAKE MASTER CYLINDER OVERHAUL

### a. Removal of Brake Master Cylinder

1. Disconnect brake pipe from master cylinder and tape end of pipe to prevent entrance of dirt.

2. Disconnect brake pedal from master cylinder push rod by removing retainer clip, washer and clevis pin. See Figure 9-5.

3. Remove two nuts holding master cylinder to dash panel and remove cylinder from car. Be careful not to drip brake fluid on exterior paint.

### b. Disassembly of Brake Master Cylinder

1. Clean outside of master cylinder thoroughly. Remove reservoir cover and diaphragm. Turn cylinder over and pump push rod by hand to drain all brake fluid. Always discard used fluid. See Figure 9-13.

2. Remove clevis, jam nut, and rubber boot from push rod.

3. Place master cylinder in a vise so that the lock ring may be removed from the I.D. of the bore. Remove lock ring, master cylinder piston assembly, primary cup, spring and retainer, check valve and check valve washer.

4. From the master cylinder piston, remove the secondary seal. Check small by-pass holes in the end of the piston to make sure they are open.

5. Remove casting from vise and inspect bore for corrosion, pits and foreign matter. Check by-pass and compensating ports to master cylinder bore to determine if they are unrestricted.

CAUTION: Make certain that compensating port in cylinder is clear; however, do not run a wire through the port as this may leave a burr which will cut a groove in primary cup.

6. Discard boot, lock ring, piston and rubber cups, spring, check valve, and valve seat washer. These parts are furnished in master cylinder repair kit (group 4.649).

7. Thoroughly clean master cylinder with brake fluid or alcohol. CAUTION: Do not use anti-freeze alcohol gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

### c. Inspection of Brake Master Cylinder

Inspect cylinder bore for scores, scratches, or corrosion. Light scratches in cylinder bore may be polished with crocus cloth.

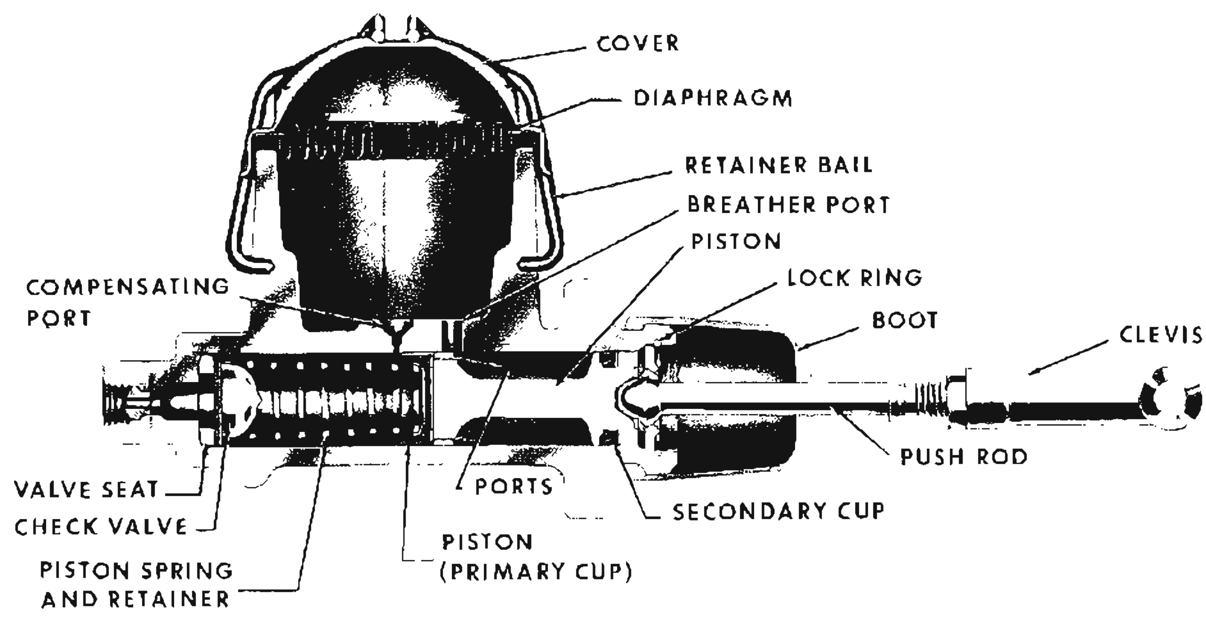



Figure 9-13—Brake Master Cylinder

Do not use emery cloth or sandpaper. Slight corrosion may be cleaned with fine steel wool and alcohol.

If scratches or corroded spots are too deep to be polished satisfactorily, the cylinder should be replaced since honing is not recommended and oversize pistons and cups are not furnished for service.

Wheel and master cylinder bores have a hard, highly polished "bearingized" surface produced by diamond boring followed by rolling under very heavy pressure. Honing destroys the bearingized surface, leaving a softer and rougher surface which will cause more rapid wear of pistons and rubber cups. Higher friction produced by the rougher surface will also reduce braking power for a given pressure on brake pedal.

The maximum allowable clearance between piston and cylinder bore is .0055". If this clearance is increased by honing, the heavy pressure of brake fluid may force rubber of the cup into the clearance and cause sticking or early failure of the cup. If a choice must be made between honing or replacement of the cylinder, it must be remembered that while a new cylinder may be more expensive a honed cylinder may not give satisfactory length of service.

### d. Assembly of Brake Master Cylinder

1. Dip all internal parts in clean brake fluid just before installation. Also wet master cylinder bore with brake fluid.

2. Install valve seat washer, check valve, spring, primary cup, and piston with secondary cup. Then install push rod and stop plate assembly. Hold push rod in and install lock ring. See Figure 9-13.

Check for proper seating of lock ring with a hard pull on push rod.

3. Install rubber boot, jam nut, and clevis. Then install rubber diaphragm and reservoir cover.

### e. Installation of Brake Master Cylinder

1. Install master cylinder on dash panel. Torque nuts to 26-28 foot pounds.

2. Connect push rod to brake pedal by installing clevis pin, special washer and retainer pin.

3. Connect brake pipe to master cylinder. For pedal height adjustment, see paragraph 9-8, subparagraph b.

4. Bleed hydraulic system as described in paragraph 9-7. Bleed left front wheel cylinder first and check for proper pedal feel. If system still has air in it, bleed other three wheel cylinders. After bleeding, bring fluid to 1/8" below lip of reservoir opening.

5. Road test car for proper brake performance (par. 9-5).

# GROUP 9-D

# DELCO MORAINE POWER BRAKES

## CONTENTS IN SECTION 9-D



## 9-25 DESCRIPTION OF POWER BRAKE MECHANISM

### a. General Description of Power Brake Unit

The Delco Moraine Power Brake Unit is a combined vacuum and hydraulic unit which utilizes engine intake-manifold vacuum and atmospheric pressure to provide power-assisted application of vehicle brakes. The Unit takes the place of the master cylinder in a conventional brake system. From the master cylinder connection outward to the wheel units, there is no other change in the brake system. In addition to the master cylinder connections, the unit requires a vacuum connection to the engine intake-manifold (through a vacuum check valve) and a mechanical connection to the brake pedal. As shown in Figure 9-14, the unit is self-contained with no external rods or levers exposed to dirt or moisture.

The Power Brake Unit provides lighter pedal pressures. These lighter pedal pressures are obtained in combination with reduced pedal travel, making it possible to bring the brake pedal down to the approximate height of the accelerator pedal when at closed throttle position. Thus, the driver, after closing the throttle, can shift his toe from one pedal to the other without lifting his heel from the floor.

The vacuum check valve mounted on the power brake front housing permits several applications of the Power Brake Unit with vacuum-assist after the engine has stopped or after any other loss of vacuum. When the vacuum stored in the unit has been lost, or in case of vacuum failure at the unit or its vacuum connections, the brakes can be applied in the conventional manner. Since the vacuum assist is not available, the pedal pressure will be greater.

### b. Construction of Power Brake Unit

The Unit is composed of two main sections: The vacuum power cylinder and the hydraulic master cylinder.

The vacuum power cylinder contains the power piston assembly which houses the control valve and reaction mechanism, and the power piston return spring. The control valve is composed of the air valve and the floating control valve assembly. The reaction mechanism consists of a hydraulic piston reaction plate and a series of levers. An air filter element is assembled around the push rod and fills the cavity inside the hub of the power piston. The push rod, which operates the air valve, projects out of the end of the power cylinder housing through a boot. A vacuum check valve assembly is mounted in the front housing assembly for connection to the vacuum source.

A fluid reservoir is integrally cast with the master cylinder and supplies fluid to the space between the primary and secondary seals through a hole in the casting.

Connection is made to the wheel cylinder through the hydraulic outlet and a conventional check valve.

### c. Operation of Power Brake Unit

(1) Released Position

A line from the engine intake-manifold is connected to the vacuum check valve in the front housing of the power brake. This check valve prevents loss of vacuum when manifold vacuum falls below that in the power brake system.

At the released position the air valve is seated on the floating control valve. See Figure 9-15. The air under atmospheric pressure, which enters through the filter element in the tube extension of the power piston, is shut off at the air valve. The floating control valve is held away from the valve seat in the power piston. Vacuum, which is present at all times in the space to the left of the power piston, is free to evacuate any existing air on the right side of the power piston.

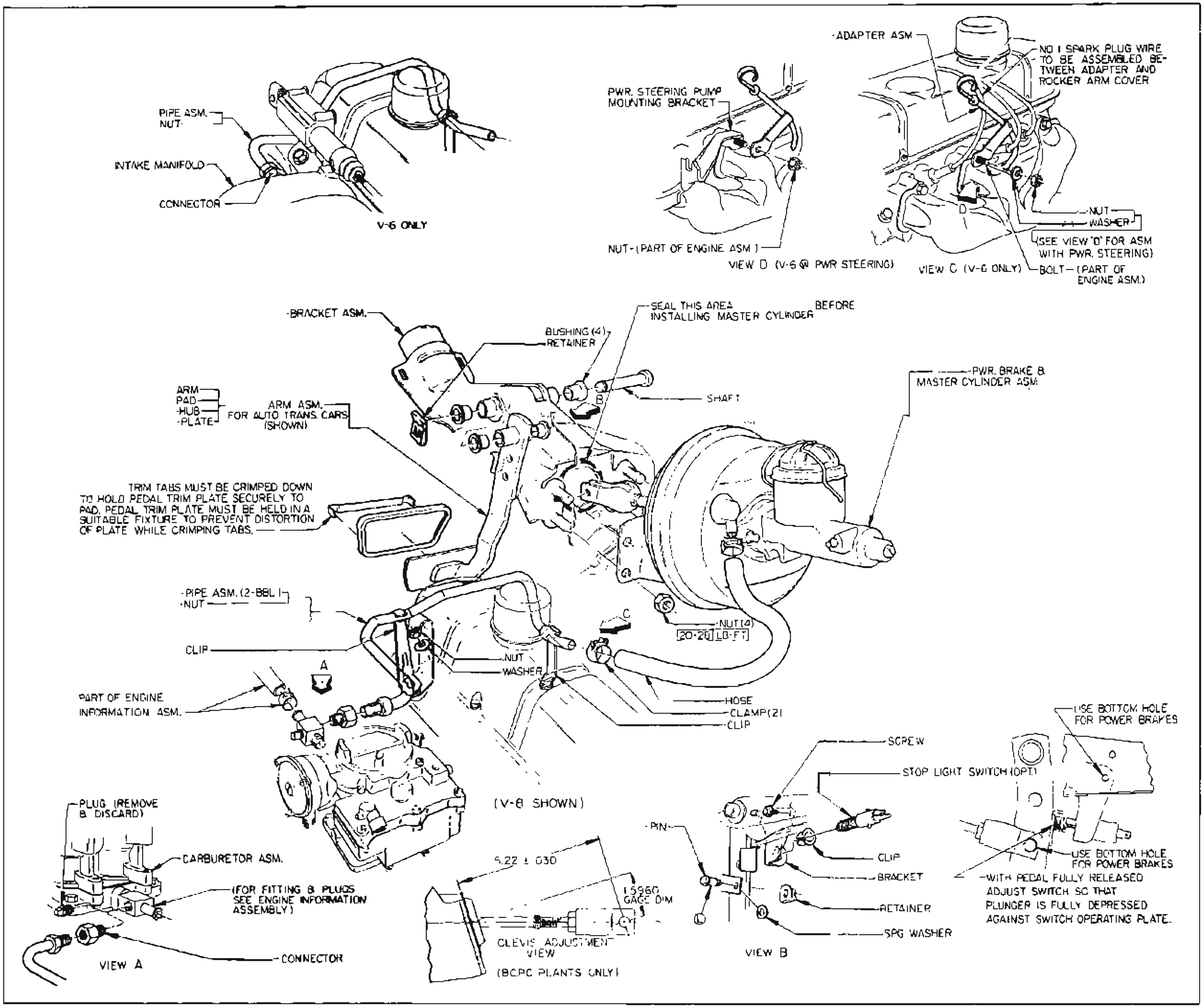



Figure 9-14—Power Brake Installation

This air is drawn through two small passages in the power piston, over the valve seat in the power piston and then through the power piston into the space at the left of the power piston. It is then drawn through the check valve and thence to the vacuum source.

In this position there is vacuum on both sides of the power piston, and the power piston is held against the rear housing by the power piston return spring. At rest, the hydraulic reaction plate is held against the reaction retainer. The reaction levers are held back against the hydraulic reaction plate by the air valve spring. The air valve spring holds the air valve back so that its retaining ring rests against the power piston.

The floating control valve assembly is held against the air valve seat by the floating control valve spring. In this position, the by-pass hole in the hydraulic master cylinder is open to the reservoir and fluid can flow freely in either direction between the hydraulic cylinder and the fluid reservoir.

A residual pressure is maintained in the brake lines by the check valve and its spring.

(2) Applying Position

As the pedal is depressed, the push rod carries the air valve away from the floating control valve. See Figure 9-16. The floating control valve will follow until it is in contact with the raised seat in the power piston. When this occurs, the vacuum is shut off to the right hand side of the power piston, and air under atmospheric pressure rushes through the air filter and travels past the seat of the air valve and through two passageways into the housing on the right of the power piston.

Since there is still vacuum on the left side of the power piston, the force of the air at atmospheric pressure on the right of the piston will force the power piston to travel to the left.

As the power piston travels to the left, the piston rod carries the master cylinder piston into the bore of the master cylinder. After the master cylinder piston cup passes the by-pass hole, hydraulic pressure starts to build up in the hydraulic system. As the pressure builds up on the end of the master cylinder piston, the hydraulic reaction plate is moved off its seat on the reaction retainer and presses against the reaction levers. The levers, in turn, swing about their pivots and bear against the end of the air valve-push rod assembly.

In this manner, approximately 30% of the load on the piston is transferred back through the reaction system to the brake pedal. This gives the operator a feel, which is proportional to the degree of brake application.

In case of vacuum source interruption, as the pedal is pushed down, the end of the air valve contacts the reaction levers and forces them, in turn, against the

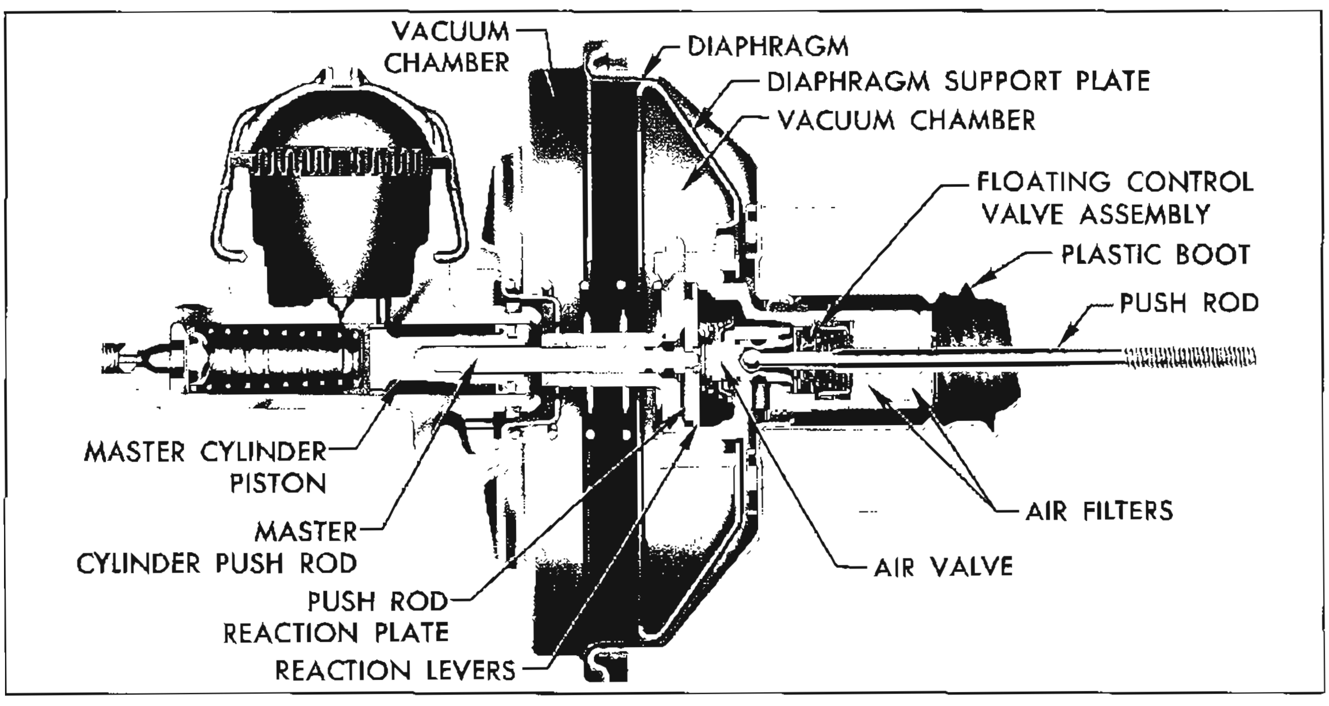



Figure 9-15—Power Brake Unit - Released Position

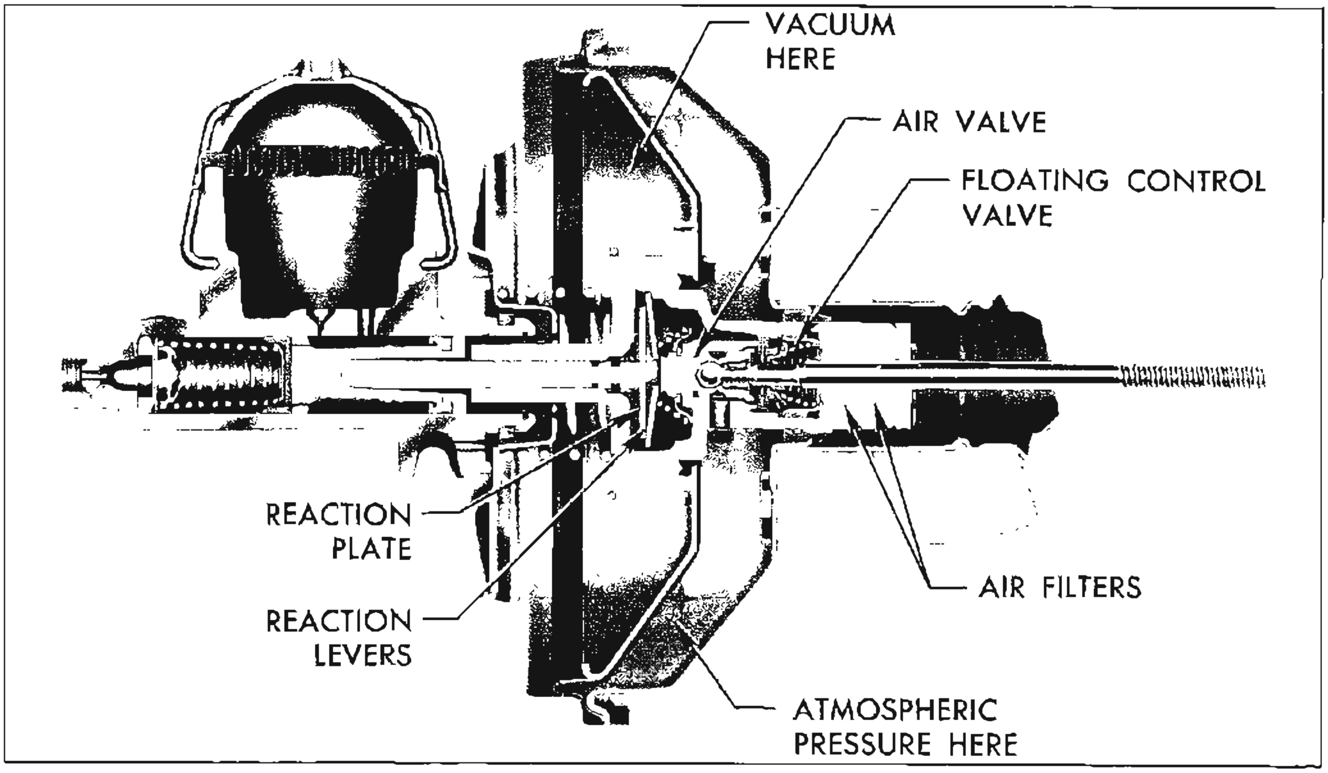



Figure 9-16—Power Brake Unit - Applying

hydraulic reaction plate. Since the hydraulic reaction plate is fastened to the piston rod, it forces the piston rod against the master cylinder piston, which builds up the hydraulic line pressure.

The pedal pressure required for a manual application, such as described, is considerably greater than with vacuum assist.

(3) Holding Position

When the desired pedal pressure is reached, the power piston moves to the left until the floating control valve, which is still seated on the power piston, again seats on the air valve. The power brake will now remain stationary, until either pressure is applied or released at the brake pedal. See Figure 9-17.

(4) Releasing Position

As the pressure at the pedal is released, the air valve spring forces the air valve back until its snap ring rests against the power piston. As it returns, the air valve pushes the floating control valve off its seat on the power piston.

The air valve seating on the floating control valve has shut off the outside air source. When it lifts the floating control valve from its seat on the power piston, it opens the space to the right of the power piston to the vacuum source.

Since both sides of the power piston are now under vacuum, the power piston return spring will return the piston to its released position against the rear housing. As the power piston is returned, the hydraulic master cylinder piston moves back, and the fluid from the wheel cylinders flows back into the master cylinder through the check valve.

If the brake pedal is released quickly, the master cylinder piston immediately returns to the released position. If the fluid in the lines cannot return as quickly as the piston, compensation is provided for by the flow of fluid from the space between the primary cup and the secondary seal through the holes in the piston. The excess fluid in the system can flow back to the fluid reservoir through the small by-pass hole in the master cylinder bore after the brake is released.

## 9-26 POWER BRAKE UNIT TROUBLE DIAGNOSIS

The same types of brake trouble are encountered with power brakes as with standard brakes. Before checking the power brake system for the source of trouble, refer to the trouble diagnosis of standard brakes in Section 9-B. After these possible causes have been eliminated, check for the cause as outlined below:

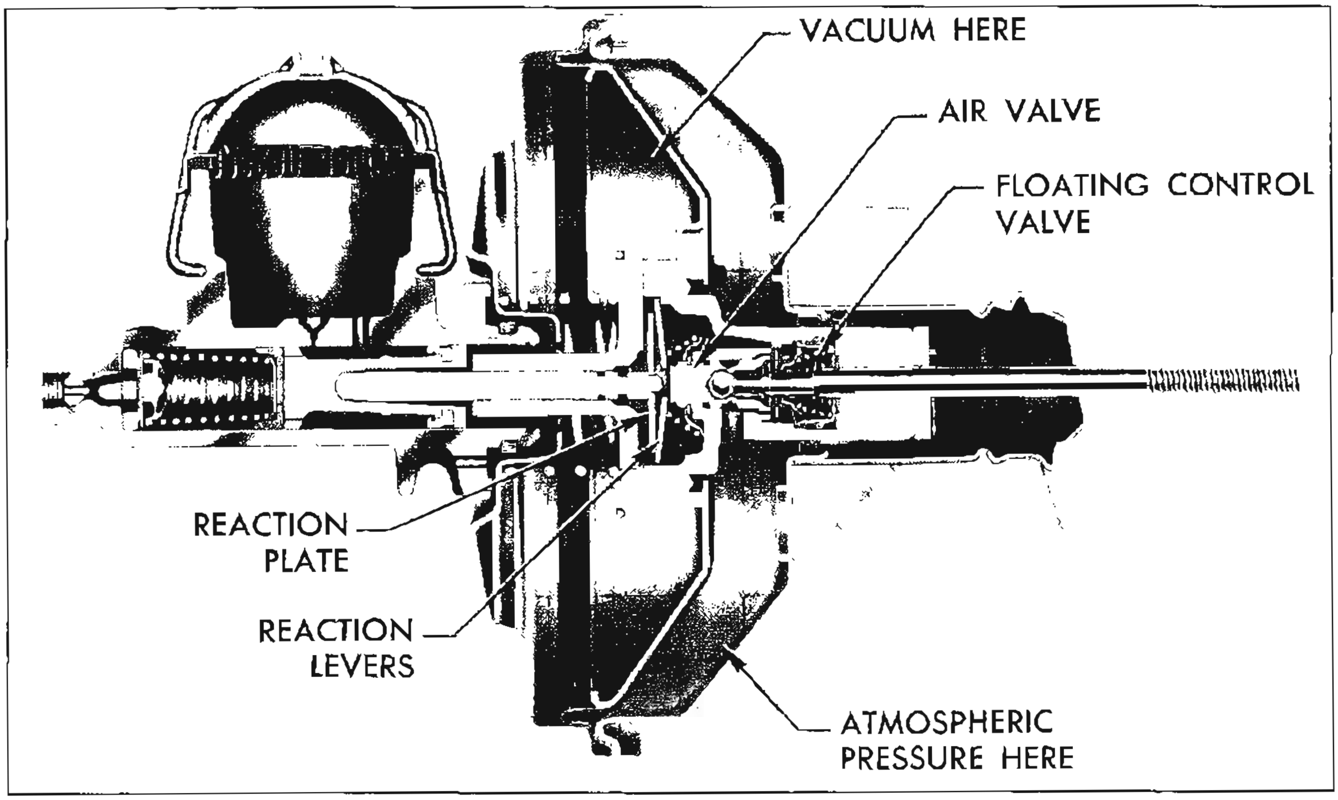



Figure 9-17—Power Brake Unit - Holding

a. Hard Pedal

(1) Vacuum failure due to:

(a) Faulty vacuum check valve
(b) Collapsed vacuum hose to manifold
(c) Plugged or loose vacuum fittings

(2) Boundup pedal mechanism

(3) Power brake unit trouble

(a) Jammed air valve
(b) Vacuum leaks in unit caused by faulty air valve seal or support plate seal. Also, a damaged, floating control valve, bad seal of master cylinder, or power cylinder mounting studs in housings, bad seal on master cylinder push rod or a bad seal of the diaphragm bead between the housings, or at power piston. It is possible to have faulty vacuum check valve grommet.
(c) Defective rolling diaphragm
(d) Restricted air filter elements
(e) Worn or badly-distorted reaction plate or levers
(f) Cracked or broken power piston or reaction retainer.

b. Grabby Brakes (Apparent Off-and-On Condition)

(1) Power brake unit valve trouble

(a) Sticking air valve
(b) Restricted diaphragm passage

(2) Reaction system

(a) Dislodged reaction levers
(b) Broken air valve spring
(c) Worn or distorted levers or plates

c. Pedal goes either to the Floor (or almost to Floor)

(1) Fluid reservoir needs replenishing

(2) Power brake hydraulic leakage

(a) Defective primary or secondary cups
(b) Cracked master cylinder casting
(c) Leaks at wheel cylinder in pipes or connections

(3) Faulty master cylinder check valve has permitted air to enter system, causing spongy pedal.

d. Brakes Fail to Release

(1) Faulty hydraulic check valve

(2) Blocked passage in power piston

(3) Air valve sticking shut

(4) Broken piston return spring

(5) Broken air valve spring

(6) Tight pedal linkage

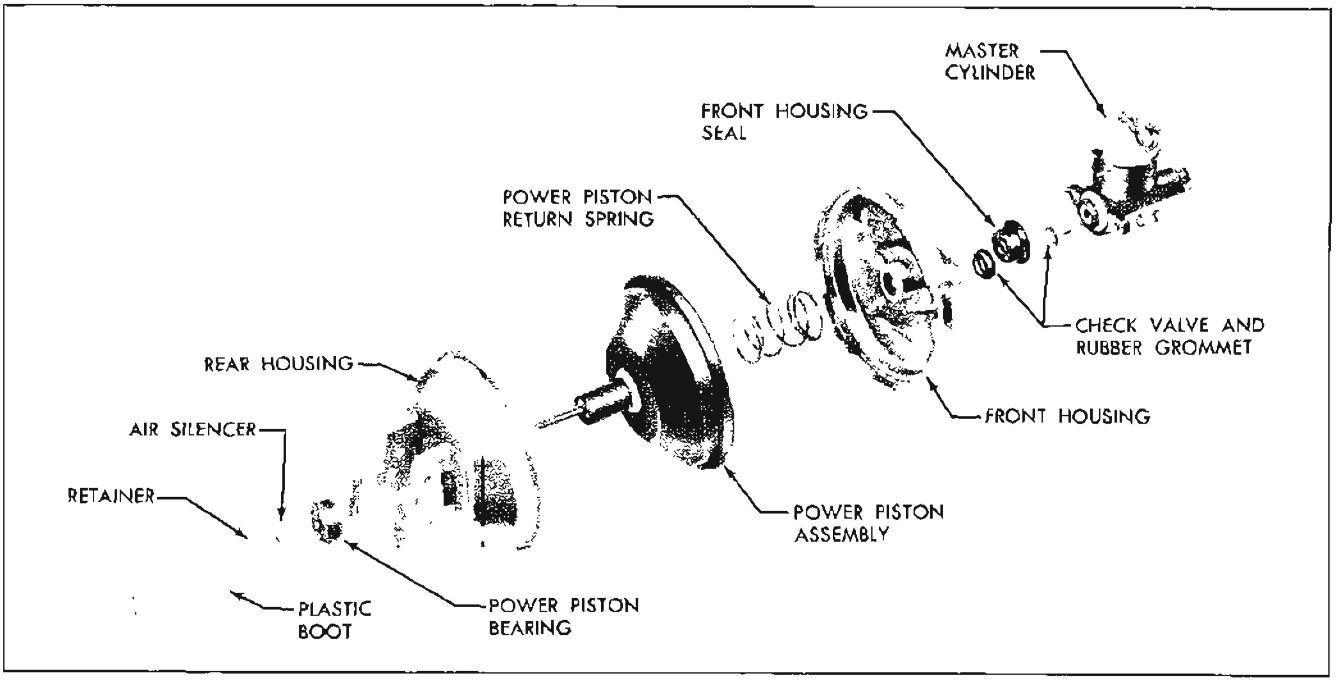



Figure 9-18—Power Brake Unit - Exploded View

## 9-27 REMOVAL OF POWER BRAKE UNIT

1. Disconnect brake pipe from hydraulic master cylinder and tape end of pipe to prevent entrance of dirt.

2. Remove retainer and special washer from brake pedal pin and disengage push rod clevis.

3. Remove four nuts holding power brake unit to dash.

4. Disconnect vacuum hose from power brake unit.

5. Remove power brake unit from car, while being careful not to drip brake fluid on exterior paint.

6. Remove filler cap and position unit so that brake fluid will drain out. Pump push rod by hand for full interior drainage. Discard old fluid. Install filler cap and cover master cylinder outlet with tape to exclude dirt. Clean all loose dirt from outside of unit before disassembling.

## 9-28 DISASSEMBLY OF POWER BRAKE UNIT

### a. Disassembly of Overall Unit & Front Housing Group

1. Place the power brake assembly in a vise or fixture with the push rod up. Pump the push rod three or four times to empty the master cylinder of fluid.

NOTE: Scribe a mark on the top center of the front and rear housings in line with master cylinder reservoir cover to facilitate reassembly.

2. With the master cylinder reservoir unit firmly clasped in a vise, place two adjustable wrenches of at least 10" in length, so that each wrench will grip on a bracket. Rotate the housings counterclockwise into the unlocked position. See Figure 9-19.

3. Lift the power piston assembly and rear housing from the unit.

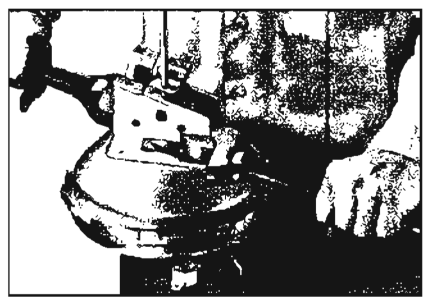


Figure 9-19—Power Brake Unit Positioned in a Vise

4. Remove the clevis from the push rod. Remove the jam nut. Remove the boot from the rear housing. (The plastic boot must be pulled from between the brackets to release it from the housing.) Remove retaining ring on the push rod that holds the silencer in place on the push rod. Remove silencer.

5. Remove the power piston return spring from the front housing.

6. Reposition the master cylinder assembly in the vise to facilitate

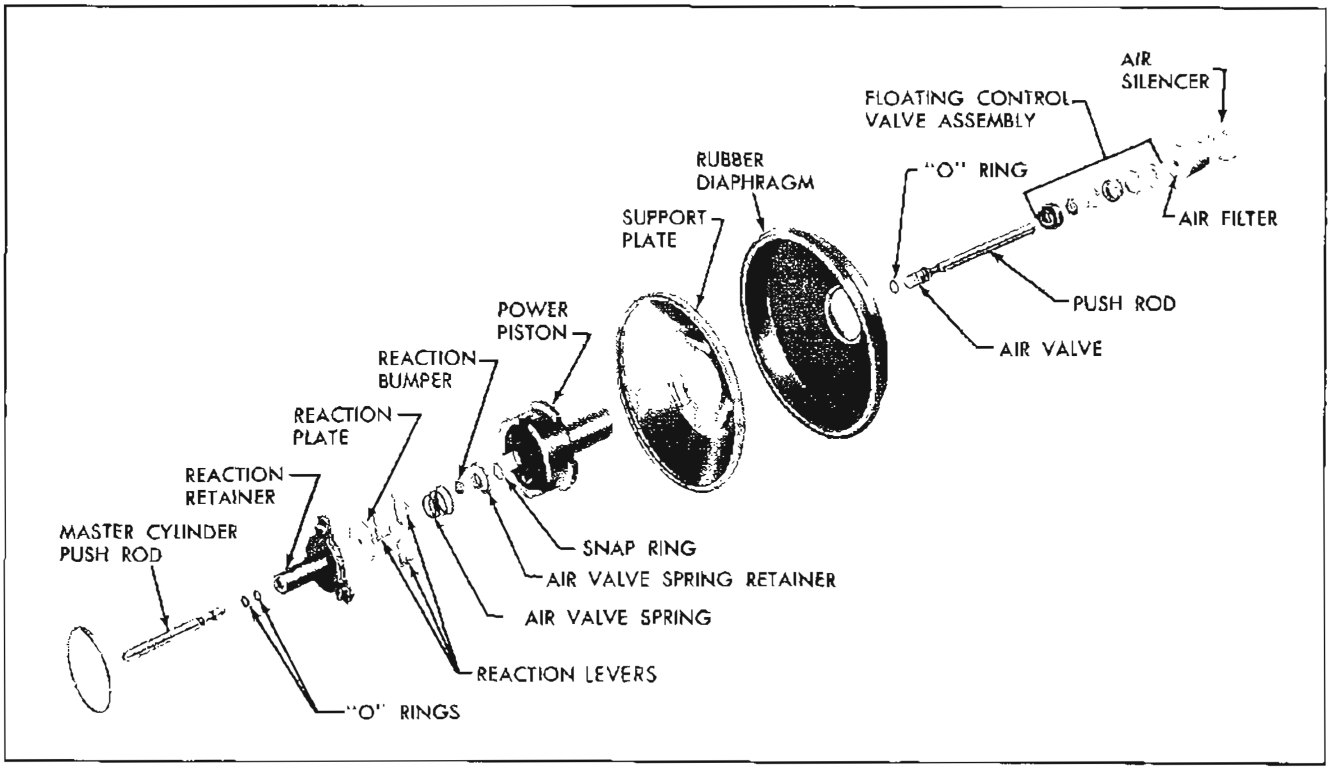



Figure 9-20—Power Piston Assembly - Exploded View

removal of the front housing from the master cylinder. Remove the two nuts and lock washers from the studs. Remove the master cylinder from the studs and lay aside.

NOTE: For master cylinder disassembly and reassembly, see Section 9-C.

7. Remove the front housing seal from the center of the front housing. From the front housing, remove the vacuum check valve and grommet.

**b. Disassembly of Power Piston Group**

Caution must be taken in handling the diaphragm of the power piston group. Guard the diaphragm against grease, oil, foreign matter and nicks or cuts.

1. Remove the lock ring from the power piston by prying one of the ends out from under the large divided locking lug, and then proceed to pull it from under the other two small locking lugs on the power piston. See Figure 9-21.

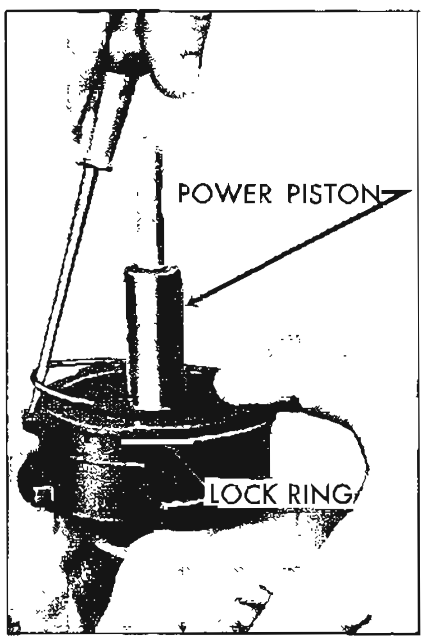



Figure 9-21—Removing Locking Ring from Power Piston

2. Remove the reaction retainer, piston rod, reaction plate, three

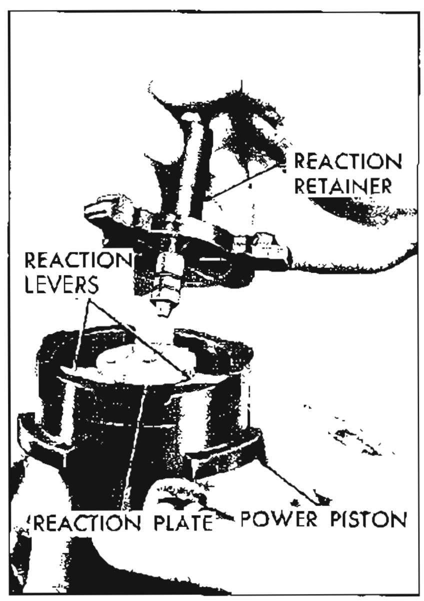



Figure 9-22—Removing Reaction Retainer

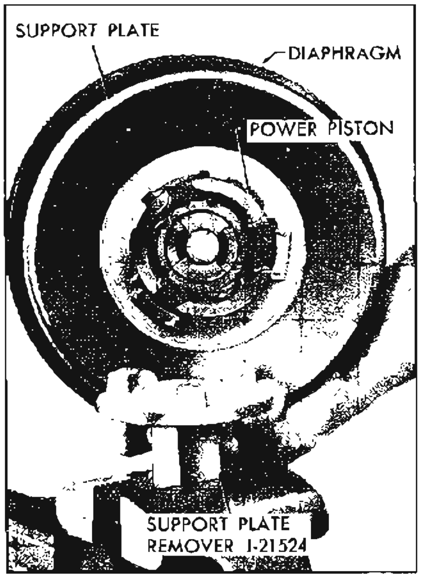



Figure 9-23—Positioning Support Plate Remover in a Vise

(3) reaction levers and air valve spring. Also remove the small reaction bumper and the air valve spring retainer from the air valve. See Figure 9-22.

3. Place Power Piston Wrench J-21524 in vise with square shank in vise. Hold support plate and power piston with the tube of the power piston up. See Figure 9-23.

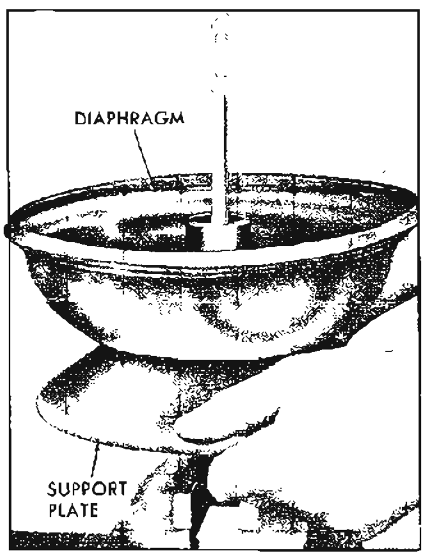



Figure 9-24—Positioning Power Piston on Support Plate Remover

4. Pull the diaphragm edges away from the support plate, so that the hands can grip on the steel support plate. Position the assembly down on the Power Piston Wrench J-21524 so that the three lugs on the tool fit into the three notches in the power piston. See Figure 9-24.

5. Press down on the support plate and rotate counterclockwise until the support plate separates from the power piston. See Figure 9-25.

6. Remove the rolling diaphragm from the support plate and lay both parts aside.

7. Remove the silencer from the neck of the power piston tube.

8. Position the power piston in a vise padded with shop towels, with the tube down (Do Not Clamp on Tube). The outside surface of the tube acts as a bearing surface.)

9. Use Truarc Pliers #2, or KM J-4880, to remove the snap ring on the air valve. See Figure 9-26.

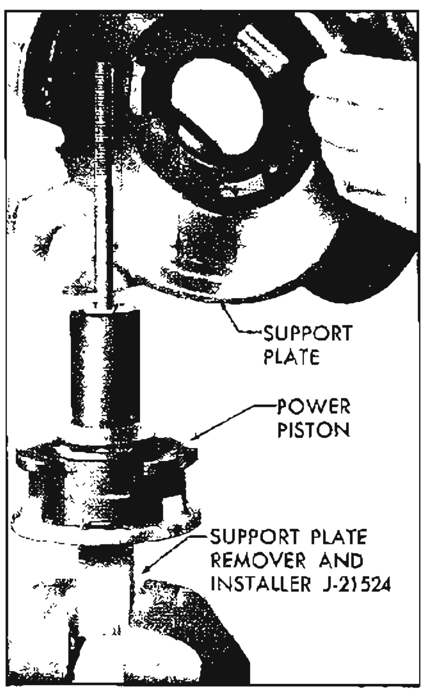



Figure 9-25—Removing Support Plate

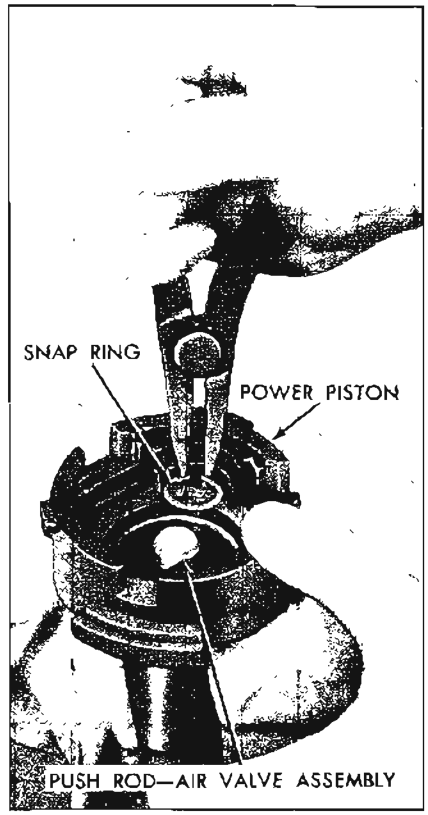



Figure 9-26—Removing Power Piston Snap Ring

10. Set up J-6180-01 Power Ram and J-6207 Hydraulic Pump with J-8609 Press Plate. Insert power piston, tube down, in press plate,

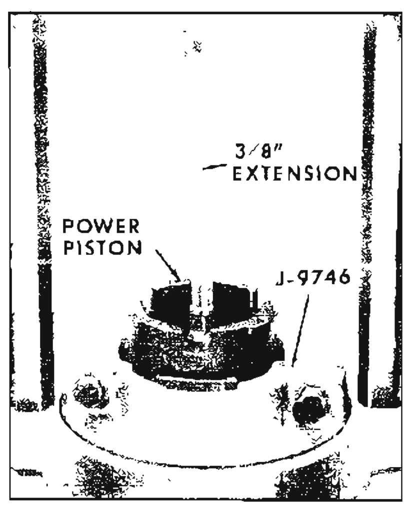



Figure 9-27—Removing Air Valve Assembly

and remove air valve assembly using a 3/8" drive extension as a remover. See Figure 9-27.

11. The removal of the air valve push rod assembly disassembles the following parts from the power piston: the floating control valve assembly, floating valve retainer, push rod limiter washer and air filters.

12. Remove the floating control assembly from the push rod as it must be replaced by a new floating control valve assembly at rebuild.

13. The master cylinder push rod can now be pushed from the center of the reaction retainer. Remove the two "O" rings from the grooves in the master cylinder piston rod.

## 9-29 CLEANING, INSPECTION AND REPLACEMENT OF PARTS

### a. Cleaning of Parts

1. Use Declene or clean brake fluid to clean all metal brake parts thoroughly. Immerse in the cleaning fluid and brush with hair brush to remove foreign matter. Blow out all passages, orifices, and valve holes. Air dry and place cleaned parts on clean paper or lintfree clean cloth.

2. If slight rust is found inside either the front or rear half housing assemblies, polish clean with crocus cloth or fine emery paper, washing clean afterwards.

NOTICE: Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean until reassembly. Re-wash at reassembly, if there is any occasion to doubt cleanliness -- such as parts dropped or left exposed for eight hours or longer.

CAUTION: If there is any suspicion of contamination or any evidence of corrosion, completely flush the hydraulic brake system in accordance with paragraph 9-7. Failure to clean the hydraulic brake system can result in early repetition of trouble. Use of gasoline, kerosene, anti-freeze alcohol or any other cleaner, with even a trace of mineral oil, will damage rubber parts.

### b. Inspection & Replacement of Parts

1. Inspect all rubber parts. Wipe free of fluid and carefully inspect each rubber part for cuts, nicks, or other damage. These parts are the key to the control of fluid or air flow, and should account for the majority of troubles traceable to leakage. Re-use rubber parts only if a fairly new Unit is dismantled for some particular trouble, and only then if there is no doubt that the parts are in equal-to-new condition. Badly damaged items, or those which would take extensive work or time to repair, should be replaced. In case of doubt, install new parts for safety and for ultimate lower cost.

2. Inspect in accordance with the following table: (The table is organized by power brake unit groups.)

a. Master Cylinder Group - see Section 9-C

b. Power Piston Group

| PART | INSPECT FOR | CORRECTIVE ACTION |
|---|---|---|
| Power Piston & support plate & Reaction Retainer | Cracks, distortion, chipping, damaged lever seats, pitted or rough holes. Worn seal surfaces (tubes). | Cleanup or replace. |
| | Rough or uneven floating valve seat. | Replace. |
| | Open passages and flow holes. | Clean. |
| Reaction Levers or Plates | Cracks, deformation, tears, and heavy wear. | Replace. |
| Floating Control Valve. | Deterioration of rubber or warped valve face. | Replace. |

b. Power Piston Group (cont'd.)

| PART | INSPECT FOR | CORRECTIVE ACTION |
|---|---|---|
| Air Valve-Push Rod Assembly | Air valve: scratches, dents, distortion, or corrosion of ID or OD. All seats to be smooth and free of nicks and dents. | Do not repair; replace. |
| | Push rod must move freely in air valve, but must not pull out. | If worn, replace air valve-push rod assembly. |

c. Over-All Unit

| PART | INSPECT FOR | CORRECTIVE ACTION |
|---|---|---|
| Front & Rear Half Housing | Scratches, scores, pits, dents or other damage affecting rolling or sealing of diaphragm or other seals. | Replace unless easily repaired. |
| | Cracks, damage at ears, damaged threads on studs. | Replace unless easily repaired. |
| | Bent or nicked locking lugs. | Replace unless easily repaired. |
| | Loose studs. | Replace or repair. |
| Air Filters & Silencer | Dirty | Replace |

## 9-30 ASSEMBLY OF POWER BRAKE UNIT

Be certain that all rubber parts are clean at reassembly. Re-wash in Del-clean or clean brake fluid, if there is any doubt of cleanliness. Be careful during the rebuild process that no grease or mineral oil comes in contact with the rubber parts of the power brake unit. Lubricate rubber parts with Delco Moraine approved lubricant or equivalent.

### a. Assembly of Front Housing Group

1. Replace the vacuum check valve, using a new grommet, if old one is cracked or damaged.

2. Place new front housing seal in the center of the front housing so that the flat surface of the cup lies against the bottom of depression in the housing.

### b. Assembly of Power Piston Group

1. Place two new "O" rings in the grooves on the master cylinder piston rod. Wipe a thin film of #5459912 Power Brake Lube or equivalent on the "O" rings.

2. The master cylinder piston rod is now inserted through the reaction retainer so that the round end of the piston rod protrudes from the end of the tube on the reaction retainer.

3. Place the Power Piston Wrench, J-21542 in a vise. Position the power piston on the wrench with the three lugs fitting into the notches in the power piston. See Figure 9-28.

4. Position a new "O" ring on the air valve in the second groove from the push rod end.

5. On reassembly of the power piston, the floating control valve assembly must be replaced with a new one, since the force required to remove it distorts the component parts.

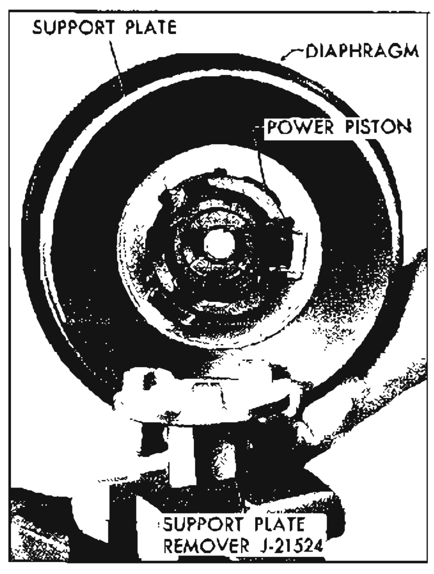



Figure 9-28—Positioning Power Piston in Wrench

6. Place the floating control valve on the push rod-air valve assembly, so that the flat face of the valve will seat against the valve seat on the air valve.

7. Wipe a thin film of Power Brake Lube on the large O.D. of the floating control valve and on the "O" ring on the air valve.

8. Press the air valve-push rod assembly, air valve first, to its seat in the tube of the power piston.

9. Place the floating valve retainer over the push rod, so that the flat side seats on the floating control valve.

10. Start the floating valve and its retainer into the power piston tube. Press the floating valve to seat in the tube, by placing the J-21601 Floating Control Valve Retainer Installer on top of the retainer and pushing down manually. See Figure 9-29.

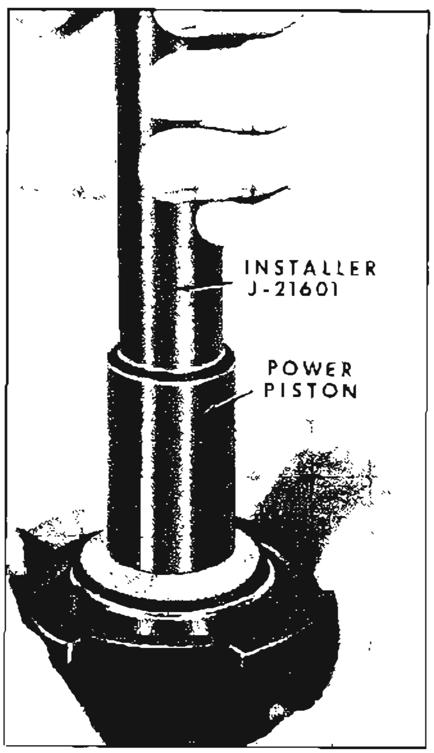



Figure 9-29—Installing Floating Control Valve Assembly

11. After floating valve is seated, position the push rod limiter washer over the push rod and down onto the floating valve. The two air filter elements can now be stretched over the end of the push rod and pressed into the power piston tube.

12. Assemble the power piston diaphragm to the diaphragm support plate from the side of the support plate opposite the locking tangs. The raised flange of the diaphragm is pressed through the hole in the center of the support plate. Be sure that the edge of the center hole fits into the groove in the flange of the diaphragm.

13. Pull the diaphragm away from the O.D. of the support plate so that the metal of the support plate can be gripped with the hands.

14. With power piston still positioned on the holding tool in vise, coat bead of diaphragm that contacts power piston with Power Brake Tube.

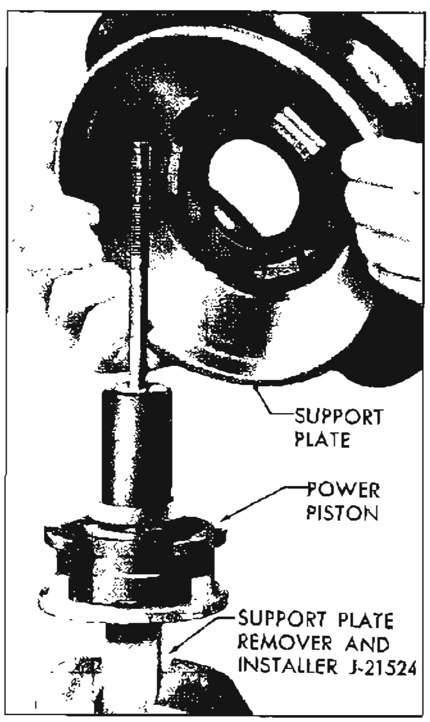



Figure 9-30—Installing Power Piston into Support Plate

15. Holding the support plate on the bare metal, with the locking tangs down, place the support plate and diaphragm assembly down over the tube of the power piston. The flange of the diaphragm will fit into the groove on the power piston. See Figure 9-30.

16. Press down and rotate the support plate counterclockwise, until the lugs on the power piston come against the stops on the support plate.

17. This assembly can now be turned over and placed, tube down, in a padded vise (Do Not Clamp).

18. With a pair of #2 Truarc or #J-4880 Pliers, assemble the snap ring into the groove in the air valve.

19. Place the air valve spring retainer to seat on the snap ring. Assemble the reaction bumper into the groove in the end of the air valve.

20. Position the air valve return spring, large end down, on the spring retainer.

21. The three reaction levers are now placed into position with the ears on the wide end, in the slots provided for them in the power piston. The narrow ends will rest on the top of the air valve return spring.

22. Position the reaction plate (with numbered side up) on top of the reaction levers. Press down on the plate until the large ends of the reaction levers pop up so that the plate rests flat on the levers. Be sure the reaction plate is centered.

23. The master cylinder piston rod and reaction retainer assembly is now assembled to the power piston.

24. With the round end of the piston rod up, and with the reaction retainer held toward the top of the piston rod, place the small end of the piston rod in the hole in the center of the reaction plate. Line up the ears on the reaction retainer with the notches in the power piston and push the reaction retainer down until the ears seat in these notches.

25. Maintain pressure on the reaction retainer and position the large lock ring down over the master cylinder push rod.

26. There is a lug on the power piston which has a raised divider in the center. One end of the lock ring goes under the lug and on one side of the divider. See Figure 9-31.

27. As you work your way around the power piston (either way) the lock ring goes over the ear of the reaction retainer, under a lug on the power piston, and so forth, until the other end of the lock ring is seated under the lug with the raised divider.

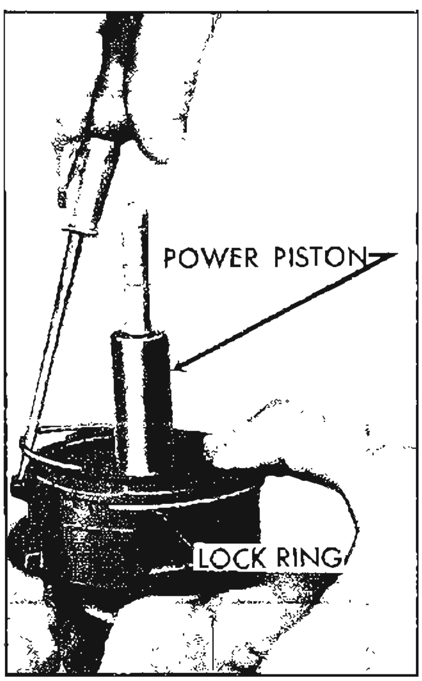



Figure 9-31—Installing Power Piston Lock Ring

Be sure both ends of the lock ring are securely under the large lug.

### c. Assembly of Rear Housing Group

1. Place a new power piston bearing in center of rear housing so that the flange on the center hole of housing fits into the groove of the power piston bearing. The large flange on the power piston bearing will be on the stud side of the housing.

2. Coat the inside of the power piston bearing with Power Brake Lube.

### d. Final Assembly of Power Brake Unit

1. Place the air silencer over the holes on the tube of the power piston. Wipe the tube of the power piston with Power Brake Lube.

2. Assemble the power piston to the rear housing by pushing the tube of the power piston through the rear housing from the side opposite the studs.

3. Wipe tube of the reaction retainer with Power Brake Lube and lay the assembly aside.

4. Place the front housing in a vise with the master cylinder down. Position power piston return spring over the inset in the front housing. Lubricate the I.D. of the support plate seal with Power Brake Lube.

5. Lubricate lightly with talcum powder the beaded edge of the diaphragm. Hold the rear housing and power piston assembly over the front housing with the master cylinder push rod down. Position the rear housing so that when it is rotated into the locked position, the scribe marks on the housings will be in line.

6. Place the two adjustable wrenches on opposite brackets and press down and rotate clockwise into the locked position.

CAUTION: Be extremely careful not to break the studs loose in the rear housing. Also, do not put pressure on the power piston tube when locking the housings.

7. Push the felt silencer over the push rod to seat against the end of the power piston tube. The snap ring retainer is now placed on the push rod so that it can hold the silencer against the power piston tube. The plastic boot is now pushed to seat against the rear housing. The raised tabs on the side of the boot will locate in the large holes in the center of the brackets. The jam nut and clevis can now be re-assembled to the push rod.

### e. Gauging Power Brake Piston

The following gauging operation is necessary only when a major structural part such as the front or rear housing, the power piston assembly, the master cylinder piston, or the master cylinder assembly is replaced with a new part. The gauge measures how far the master cylinder push rod projects from the front housing. This dimension must be correct to insure the proper clearance in the master cylinder between the primary cup and the compensating port.

Make check as follows:

1. Place the power brake assembly in a vise so that the master cylinder is up. Remove the master cylinder from the front housing. The master cylinder push rod is now exposed.

2. Place Gauge J-7723-01 over the piston rod so that it fits between the two studs on the front housing. It should be parallel to the studs and resting on the surface of the housing. The cutout portion of the gauge should never be lower than the end of the piston rod, and the gap between the cutout in the gauge and the end of the piston rod should never be more than .010 inch. See Figure 9-32.

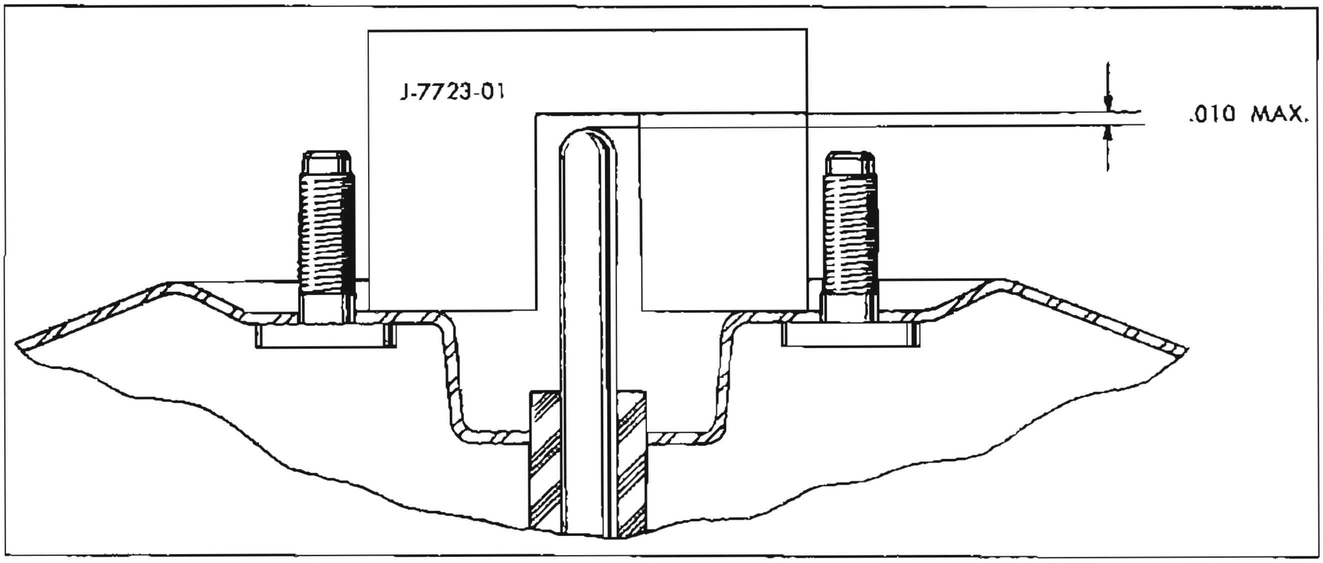



Figure 9-32—Gauging Master Cylinder Push Rod

3. Any variation beyond these two limits must be compensated for by obtaining the service adjustable piston rod, Part #5464521, and adjusting the screw in the end to match the height of the gage.

4. Replace the master cylinder on the studs on the front housing. Install nuts and lock washers on the studs and torque to 15-20 foot pounds.

CAUTION: When replacing the unit on the vehicle, start the engine and allow vacuum to build up before applying the brake.

## 9-31 INSTALLATION OF POWER BRAKE UNIT

1. Place power brake unit in position on cowl and install four nuts on studs. Torque nuts to 20-28 foot pounds.

2. Using retainer and special washer, connect push rod clevis to brake pedal pin. Adjust pedal height as indicated in paragraph 9-8.

3. Connect brake pipe to master cylinder.

4. Connect vacuum hose to check valve on power brake housing.

5. Bleed hydraulic system according to procedure in paragraph 9-7.

6. After bleeding, bring fluid level to 1/8" below reservoir lid. Install rubber diaphragm and master cylinder lid.

NOTE: When pressure bleeding equipment is not available, do not use any vacuum assist. The engine should not be running and the vacuum reserve should be used up by repeatedly applying the brake before starting the bleeding procedure.

## 9-32 TESTING OF POWER BRAKE UNIT

1. Road test the brakes by making a brake application at about 20 MPH to determine if the vehicle stops evenly and quickly. If the pedal has a spongy feel when applying the brakes, air may be present in the hydraulic system. Bleed system as described in paragraph 9-7.

2. When the engine is stopped and the transmission is in neutral, apply brakes several times to deplete all vacuum reserve in the system. Depress brake pedal, hold light-foot pressure on the pedal, and start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, the vacuum system is not functioning.

3. Stop engine. Again deplete all vacuum reserve in the system. Depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away under foot pressure, the hydraulic system is leaking.

4. If the brake pedal travels to within one inch of the toeboard, the brake shoes require adjustment or relining.

5. Start engine. With brakes off, run to medium speed and turn off the ignition. Immediately close the throttle. This builds up vacuum. Wait no less than 90 seconds, then try brake action. If not vacuum-assisted for two or more applications, vacuum check valve is faulty or there is a leak in the vacuum system.

# GROUP 10
# ELECTRICAL SYSTEMS

## SECTIONS IN GROUP 10



# SECTION 10-A
# ELECTRICAL SPECIFICATIONS

## CONTENTS OF SECTION 10-A



## 10-1 BATTERY SPECIFICATIONS

| | |
|---|---|
| Make | Delco-Remy |
| Model | 1980568 |
| Location Under Hood | R.F. Fender Skirt |
| Terminal Grounded | Negative |
| Voltage | 12 |
| Capacity - Wet (Amp. Hrs. @ 20 Hr. Rate) | 61 |
| Number of Cells & Plates/Cell | 6,11 |
| Specific Gravity, Full Charge @ 80° F | 1.260 to 1.280 |
| Bench Charging Rate, Start | 5 Amps. |
| Bench Charging Rate, Finish | 2 Amps. |
| Separators | Porous Rubber |
| Case | Hard Rubber |
| Dimensions | 10 1/4" x 6 13/16" x 8 27/32" High |

## 10-2 GENERATING SYSTEM SPECIFICATIONS

### a. Generator

| | |
|---|---|
| Make and Type | Delco Remy, Delcotron |
| Location, Side of Engine | Right |
| Drive and Rotation (Viewing Drive End) | Fan Belt, Clockwise |

| | V-6 Engine | V-8 Engine | All Air Condition |
|---|---|---|---|
| Number | 1100705 | 1100691 | 1100710 |
| Speed Ratio, Generator to Engine | 2.34 to 1 | 2.34 to 1 | 2.67 to 1 |
| Field Current Draw (Amps.) @ 80° F and 12 Volts | 2.2 to 2.6 | 2.2 to 2.6 | 2.2 to 2.6 |
| Bench Test at 14 Volts (Amps. Cold @ Generator RPM) | 37 @ 6500 | 42 @ 6500 | 55 @ 6500 |
| Current Output @ 500 Engine RPM | 10 Amps. Min. | 10 Amps. Min. | 10 Amps. Min. |
| Current Output @ 1500 Engine RPM | 30 Amps. Min. | 30 Amps. Min. | 40 Amps. Min. |
| Belt Tension | 80 Lbs. | 80 Lbs. | 80 Lbs. |

### b. Generator Regulator

| | |
|---|---|
| Make and Type | Delco-Remy, Double Contact |
| Number | 1119515 |
| Field Relay Air Gap | .015" |
| Field Relay Closing Voltage | 2.3 to 3.7 |
| Voltage Regulator Air Gap, Lower Points Just Touching | .060" |
| Voltage Regulator Upper Contact Point Opening | .014" |
| Voltage Regulator Upper Contact Setting @ 2000 Eng. RPM (After 15 Min. Warm-Up @ 1500 Eng. RPM) | See Figure 10-21 |
| Voltage Regulator Lower Contact Setting (Step Voltage) | .1 to .3 Below Upper Setting |

### c. Police Car Generator

| | |
|---|---|
| Make and Type | Delco-Remy, Delcotron |
| Number | 1117765 |
| Location, Side of Engine | Right |
| Drive and Rotation (Viewing Drive End) | Fan Belt, Clockwise |
| Speed Ratio, Generator to Engine | 2.46 to 1 |
| Field Current Draw (Amps) @ 80° F. and 12 Volts | 3.7 to 4.4 |
| Bench Test at 14 Volts (Amps. Cold @ Generator RPM) | 62 @ 6500 |
| Current Output @ 500 Engine RPM | 20 Amps. Min. |
| Current Output @ 1500 Engine RPM | 50 Amps. Min. |
| Belt Tension | 80 lbs. |

### d. Police Car Generator Regulator

| | |
|---|---|
| Make and Type | Delco-Remy, Transistor |
| Number | 1116368 |
| Point Gap and Air Gap | None, No Moving Parts |
| Voltage Setting @ 1500 Engine RPM | 14 ± .3 Volts |

## 10-3 CRANKING (STARTER) SYSTEM SPECIFICATIONS

### a. Cranking Motor

| | V-6 Engine | V-8 Engine |
|---|---|---|
| Make | Delco-Remy | Delco-Remy |
| Number | 1107260 | 1107306 |
| Location, Side of Engine | Right | Right |
| Type of Shift | Mechanical | Mechanical |
| Shift Actuation | Solenoid | Solenoid |
| Shift Operation | Ignition Switch | Ignition Switch |
| Type of Drive | Overrunning Clutch | Overrunning Clutch |
| Rotation, Viewing Drive End | Clockwise | Clockwise |
| Gear Ratio, Motor to Engine | 17.8 to 1 | 17.8 to 1 |
| No. Teeth on Ring Gear and Drive Pinion | 160, 9 | 160, 9 |
| Cranking Speed, Engine RPM (at Operating Temperature) | 160 Approx. | 160 Approx. |
| No Load Test | | |
| Amperes | 58 to 80 | 65 to 100 |
| Volts | 10.6 | 10.6 |
| RPM | 6750 to 10500 | 3600 to 5100 |
| Locked Armature Test | | |
| Amperes | 280 to 320 | 300 to 360 |
| Volt | 4.0 | 3.5 |
| Brush Spring Tension - Ounces | 35 min. | 35 min. |
| Armature End Play | .005" to .050" | .005" to .050" |
| Pinion Clearance in Cranking Position | .010" to .140" | .010" to .140" |

### b. Solenoid Switch

| | V-6 Engine | V-8 Engine |
|---|---|---|
| Make | Delco-Remy | Delco-Remy |
| Solenoid Switch Number | 1114304 | 1114341 |
| Current Draw of Solenoid Winding @ 80° F. | | |
| Hold-In Winding, Amps, @ 10 Volts | 10.5 - 12.5 | 10.5 - 12.5 |
| Both Windings in Parallel, Amps @ 10 Volts | 42 - 49 | 42 - 49 |

## 10-4 IGNITION SYSTEM SPECIFICATIONS

### a. Ignition Coil and Resistor

| | |
|---|---|
| Make | Delco-Remy |
| Coil Number (Less Bracket) | 1115087 |
| Current Draw, Amperes @ 12.6 Volts | |
| Engine Stopped | 3.8 |
| Engine Idling | 2.3 |
| Coil Resistance (Ohms) @ 80° F. | |
| Primary | 1.28 to 1.42 |
| Secondary | 7200 to 9500 |
| Resistance Wire | Part of Wiring Harness |
| Resistance, Ohms @ 80° F. | 1.80 ± .05 |

### b. Spark Plugs

| | |
|---|---|
| Make and Model for Normal Operation | AC 44S |
| Make and Model for High Speed Operation | AC 42COM |
| Thread and Shell Hex. Sizes | 14MM, 13/16" |
| Gap at Points | .035" |
| Terminal Nut Length | 3/8" |
| Tightening Torque in ft. lbs. | 30 |

### c. Distributor

| | |
|---|---|
| Make | Delco-Remy |
| Drive | From Camshaft |
| Rotation, Top View | Clockwise |
| Contact Point Opening | .016" |
| Contact Point Dwell Angle | 30° ± 1° |
| Dwell Variation | 3° Max. |
| Breaker Arm Spring Tension, at Side of Point, Ounces | 19 to 23 |
| Condenser Make and Capacity (Microfarads) | Delco-Remy, .18 to .23 |

| | V-6 | V-8 |
|---|---|---|
| Timing, Before U.D.C. (with Vacuum Hose Disconnected and Engine at Idle) | 5° | 2 1/2° |
| Firing Order | 1-6-5-4-3-2 | 1-8-4-3-6-5-7-2 |
| Number (Less Cap) | 1110322 | 1111083 |
| Vacuum Control Number | 1116210 | 1116210 |
| Vacuum Advance, Crankshaft Degrees and Inches of Vacuum | | |
| Start Advance, @ Inches of Vacuum | 6 to 8 | 6 to 8 |
| Maximum Advance, Degrees @ Inches of Vacuum | 14° @ 16 | 14° @ 16 |
| Centrifugal Advance, Crankshaft Degrees and RPM | | |
| Start Advance @ RPM | 700 to 950 | 550 to 750 |
| Medium Advance, Degrees @ RPM | 14° to 18° @ 1800 | 12° to 16° @ 1400 |
| Maximum Advance, Degrees @ RPM | 24° to 28° @ 4200 | 30° to 34° @ 4600 |

## 10-5 LIGHTING SYSTEM SPECIFICATIONS

### a. Lamps, Switches, Wiring

| | |
|---|---|
| Headlamp Make and Type | Guide, Dual T-3 Sealed Beam |
| Headlamp Lens Diameter | 5 3/4" |
| Tail, Stop, Parking, Signal Lamps, Make | Guide |
| Lighting Switch, Make | Delco-Remy |
| Wiring Circuit Type | Single Wire |
| Wiring Circuit Protection for Head and Front Parking Lights | Thermo Circuit Breaker |
| Thermo Circuit Breaker Location | In Lighting Switch |
| Thermo Circuit Breaker Calibration @ 75°F. | |
| Stay Closed Indefinitely @ Amps. | 15 |
| Open Within 60 Seconds @ Amps. | 26 |

### b. Fuses and Circuit Breakers

| Used For | Ampere Rating | Length |
|---|---|---|
| Back-Up, Stop, Turn Signal and Signal Indicator Lights | 15 | 1 1/4" |
| Blower for Heater - Air Conditioner, and Air Conditioner Compressor Clutch | 30 | 1 1/4" |
| Dome Light, Trunk Light and Cigar Lighter | 15 | 7/8" |
| Panel Lights and Rheostat | 3 | 1 1/4" |
| Radio and Dial Light | 7.5 | 1 1/4" |
| Tail, License and Glove Box Lights, Panel Light Fuse and Clock | 10 | 5/8" |
| Transmission Shift Solenoids, Wiper and Washer Motor | 25 | 1 1/4" |
| Rear Window Defroster | 5 | 1 1/4" |
| Location | In Line | |
| Headlights and Front Parking Lights | 15 Amp. Circuit Breaker | |
| Location | In Light Switch | |

Unless otherwise noted, all fuses are in a fuse block located above the driver's left toe.

### c. Light Bulbs

| Location | Bulb No. | Candlepower |
|---|---|---|
| Ash Tray | 1445 | .5 |
| Automatic Transmission Control Dial | 1893 | 2 |
| Back-Up | 1156 | 32 |
| Courtesy Light, Instrument Panel | 89 | 6 |
| Courtesy Light, Rear Seat Area | 90 | 6 |
| Dome, Center Roof | 211 | 15 |
| Glove Box | 1893 | 2 |
| Headlight High Beam Indicator | 194 | 2 |
| Headlight, 5 3/4" Dia. Type 1 (Inner) | 4001 | 37.5 watts |
| Headlight, 5 3/4" Dia. Type 2 (Outer) | 4002-L | 37.5-55 watts |
| Heater-Air Conditioner Control Dial | 1893 | 2 |
| Indicator Lights (Oil, Temp. and Gen.) | 194 | 2 |
| Instrument Cluster Dials | 194 | 2 |
| License | 97 | 4 |
| Parking Light Warning | 1816 | 3 |
| Radio Dial | 1881 | 2 |
| Trunk | 89 | 6 |
| Turn Signal and Parking, Front | 1157A | 32-4 |
| Turn Signal, Tail and Stop | 1157 | 32-4 |
| Turn Signal Indicator | 194 | 2 |

## 10-6 SIGNAL SYSTEMS SPECIFICATIONS

| | |
|---|---|
| Stop Light Switch, Type | Mechanical |
| Stop Light Switch, Location | Pedal Mounting Bracket |
| Turn Signal Switch, Make | Boyne or Delco-Remy |
| Turn Signal Flasher, Make | Tung-Sol |
| Location | Fuse Block |
| Type for 2-32 CP Lamp Load | 224 |
| Type for 3-32 CP Lamp Load | 323 |
| Flash Rate, Cycles per Minute | 60 to 120 |
| Lamp Bulbs - No. and Candle Power | See Par. 10-5, c |
| Direction Signal and Stop Light Fuse | See Par. 10-5, b |
| Horn - Make and Type | Delco-Remy, Solenoid |
| Horn Number, Low Note | 9000491 |
| High Note | 9000492 |
| Horn Amperage Draw at 12 volts (Either Horn) | 4.5 to 5.5 |
| Horn Relay and Junction Block Number | 9779867 |
| Horn Relay Closing Voltage | 3.0 to 9.0 |

# SECTION 10-B
# BATTERY AND CABLES

## CONTENTS OF SECTION 10-B



## 10-7 GENERAL BATTERY INFORMATION

Delco-Remy 12-volt storage battery Model 558 is used in all models. This battery has 6 cells with 11 plates per cell and a capacity of 61 ampere hours at a 20 hour rate.

### a. Registration of Battery

Delco-Remy Battery dealers and distributors are prepared to carry out terms of the manufacturer's warranty on Delco-Remy batteries. In order that Buick owners shall have the protection and benefit of this warranty, it is necessary for the dealer or car owner to register his battery with the local Delco-Remy Battery dealer or distributor on all new car deliveries, and on all deliveries of new replacement Delco-Remy batteries. The Battery Owner's Certificate is located in the Owner's Protection Plan Booklet.

### b. Care of Wet Batteries in Storage

Batteries in stored new cars, as well as batteries in stock, must be given regular attention to prevent sulphation of plates that may result from inactivity and self-discharge. All automotive wet batteries will slowly discharge on standing idle, whether in stored vehicles or in stock, and will self-discharge much faster when warm than when cold. Batteries in stock should be rotated and the older ones used first.

To minimize the extent of self-discharge always store batteries fully charged and in cool place where the temperature does not go below freezing. Every 30 days check the level of electrolyte, add water as required and charge the batteries at a 5 ampere rate until fully charged.

Batteries used for display purposes or standing in cars in storage must be treated in the same manner as batteries in stock.

When a new car, or a new replacement battery is delivered, make certain that it is fully charged and the electrolyte is at proper level. This is extremely important because the delivery of a partially discharged battery may not only lead to its return for charging but may also result in shortened life of battery.

### c. Importance of Maintaining Electrolyte at Proper Level

Water is the only component of the battery which is lost as the result of charging and discharging, and it must be replaced before the electrolyte level falls to the tops of the separators. If

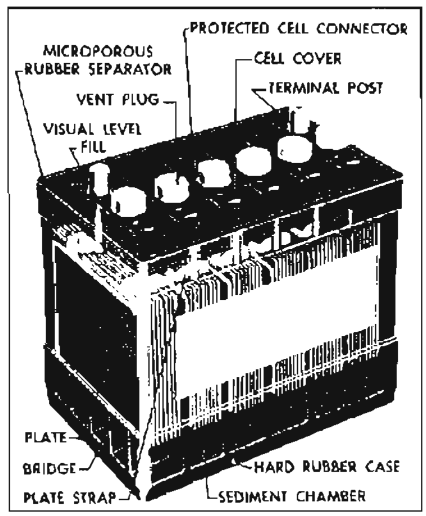



Figure 10-1—Battery

the water is not replaced and the plates become exposed, they may become permanently sulphated, which would impair the performance of the plates. Also, the plates cannot take full part in the battery action unless they are completely covered by the electrolyte.

### d. Importance of Keeping Battery Properly Charged

The battery has three major functions: (1) It provides a source of energy for cranking the engine. (2) It acts as a stabilizer to the voltage in the electrical system. (3) It can for a limited time furnish energy when the demands of the electrical units in operation exceed the output of the generator.

In order for the battery to continue to function, it is necessary that current withdrawal from the battery be balanced by current input from the generator so that the battery is maintained in a properly charged condition. If the outgo exceeds the input the battery will become discharged so that it cannot supply sufficient energy.

The state of charge of the battery as well as the temperature of the electrolyte has an important bearing on its capacity for supplying energy. Battery efficiency is greatly reduced by decreased electrolyte temperature as it has a decided numbing effect on its electrochemical action. Under high discharge such as cranking, battery voltage drops to lower values in cold temperatures than in warm temperatures.

In extremely cold climates it is important to keep batteries in a nearly full charged condition to avoid the possibility of freezing, which will damage any battery. The following table shows the temperatures at which freezing will occur in electrolytes of different densities, with specific gravity corrected to 80°F.

| Specific Gravity | Freezing Point |
|---|---|
| 1.220 | -35°F. |
| 1.200 | -20°F. |
| 1.160 | 0°F. |

**e. Care of Dry Batteries in Storage**

A "dry charge" battery contains fully charged positive and negative plates but no electrolyte.

Dry charged batteries should be stored in a dry place away from excessive heat. A dry charged battery should be kept in its original carton until ready to be put into service. This type of battery will retain its "charged" condition indefinitely if protected from moisture. Dry batteries may be stacked in vertical columns provided they are not stacked more than four high.

**f. Preparing Dry Charged Batteries for Service**

To prepare "dry charge" batteries for service use approved battery-grade acid electrolyte (1.265 sp. gr. at 80°F). Care should be exercised in its use to prevent bodily injury or damage to clothing or other material resulting from actual contact with the electrolyte.

Electrolyte should be added to dry charged batteries in an area where water is readily available for flushing in case the electrolyte comes into contact with the body. Refer to instructions on side of electrolyte container for antidotes to use if electrolyte comes into contact with the body.

It is strongly recommended that a person filling batteries with electrolyte wear glasses (preferably safety glasses) to prevent possible damage to the eyes should any spattering of the electrolyte occur.

1. Remove dry charged battery from its original carton.
2. Remove the vent plugs.
3. Using a glass or acid-proof plastic funnel, fill each battery cell with electrolyte. Do not use a metal funnel for filling the battery. The cell is properly filled when the electrolyte level rises to the split ring at the bottom of the vent well. Do not overfill or underfill. Overfilling will cause acid corrosion in the battery area; underfilling will cause early battery failure.
4. After filling cells, wait five to ten minutes and add additional electrolyte, if necessary, to bring the electrolyte to the proper level.
5. Never finish filling a dry charge battery with water. If electrolyte is spilled, more electrolyte must be obtained.

**g. Test After Batteries are Prepared for Service**

The Delco Dry Charge Battery may be put into service immediately after activation. However, to insure good battery performance, the following activation tests are recommended:

1. After adding electrolyte, check the open circuit voltage. Less than 10 volts indicates a reverse cell or an open circuit and the battery should be replaced.

2. Check the specific gravity of all cells. If the specific gravity corrected to 80°F. shows more than a thirty point (.030) drop from the initial filling with electrolyte, or if one or more cells gas violently after addition of electrolyte, the battery should be fully charged before use.

3. For best performance in cold weather (32°F. or less), or if the battery and the electrolyte are not at 60°F. or above at time of activation, warm the battery by boost charging.

## 10-8 PERIODIC BATTERY INSPECTION AND SERVICE

The battery requires very little attention, but periodic inspection is essential to secure the maximum efficiency and life. The following services are essential to maintain the battery at maximum efficiency:

CAUTION: The gas which is produced in the battery cells during charging is dangerously explosive. Extreme care must be taken to avoid bringing open flames, lighted matches, etc., near a battery which is or has been recently on charge, and which is or has been gassing. Likewise care must be taken to avoid causing any sparks near a battery with jumper cables or fast charger cables, since this can also set off an explosion of the gases.

### a. Maintain Electrolyte Level

Add distilled water as required to maintain the electrolyte level at the split ring at bottom of filler well. See Figure 10-2. CAUTION: Do not overfill, as electrolyte may be sprayed out by gassing or may overflow due to heat expansion during charging.

If distilled water is not available, it is better to add clean, mineral-free tap water than to allow the electrolyte level to remain below the top of the plates.

In freezing weather the water should be added just before using the car or otherwise charging the battery so that the water will be mixed with the acid before it is allowed to stand in freezing temperatures.

If it is found necessary to add water to the battery more frequently than about every 1,000 miles and the quantity of water added per cell is great, check setting of voltage regulator and adjust, if necessary (par. 10-21). Abnormal water loss is an indication that the battery is being overcharged.

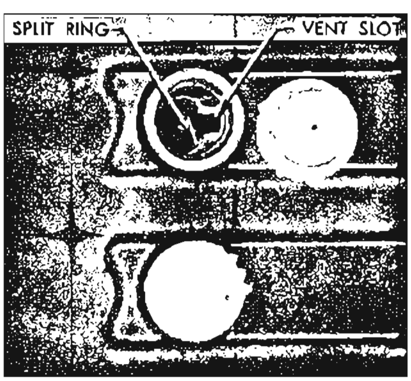



Figure 10-2—Battery Filler Well

### b. Inspect Battery, Mounting and Cables

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 to see, or bad or unusual odors. If battery shows signs of serious damage or abuse, it should be replaced.

Check the battery hold down bolts to make certain that battery is securely held in place. The nut should be drawn-up to 20 lbs. in.; excessive tightening may distort or crack the battery case.

If the top of battery is dirty or the hold down strap is corroded, clean thoroughly with a brush dipped in ammonia or soda solution. Care must be used to prevent any solution from getting into battery cells. After the foaming of solution stops, flush off with clean water and dry thoroughly. If hold down strap is corroded it should be painted with acid-resisting paint after cleaning.

Check battery cables to make certain they are tight at battery posts, engine mounting bracket and junction block. If a connection is found loose it should be cleaned before being tightened as arcing and corrosion may have taken place in the loose connection. Check condition of cables and replace if badly corroded or frayed. See paragraph 10-11 for instructions on cleaning terminals and for removing and replacement of cables.

## 10-9 LIGHT LOAD TEST OF BATTERY

The light load battery test is an in-the-car test designed to quickly determine the serviceability of any lead-acid battery. Nonuniform readings, as described in c below, are sufficient evidence for immediate replacement of the battery. This test is more simple and more conclusive than the hydrometer test; however, a cell voltage tester having .01 volt division is required. Before testing, visually inspect the battery as described in paragraph 10-8.

If battery passes visual inspection, check condition of battery cells as follows:

1. Add water to fill all cells to proper level.

2. Place load on battery by closing starter switch for 3 seconds. It makes no difference whether starter turns engine or not. However, if engine starts, turn off ignition immediately.

3. Turn headlights on low beam. After 1 minute, with lights still on, read individual cell voltages of battery with voltmeter having .01 volt divisions.

Compare readings with the following:

(a) Uniform Readings. If any cell reads 1.95 volts or more, and the difference between the highest and lowest cell is less than .05 volt (5 divisions), battery is good and sufficiently charged.

(b) Low Readings. If all cells read less than 1.95 volts, battery is too low to test properly. Failures of the meter to register on all cells does not indicate a defective battery. Quick-charge

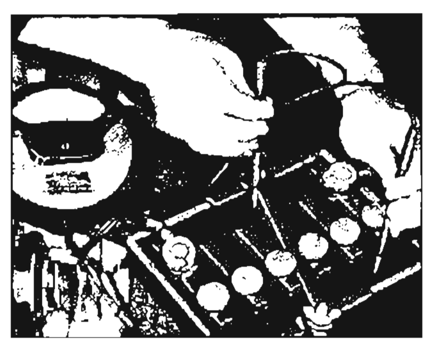


Figure 10-3—Light Load Test

battery and repeat light load test. See paragraph 10-12, subparagraph b. If none of the cells come up to 1.95 volts after the first quick-charge, the battery should be given a second charge. Batteries which do not come up after second quick-charge should be replaced.

(c) Nonuniform Readings. If any cell reads 1.95 volts or more and there is a difference of .05 volts (5 divisions) or more between the highest and lowest cell, battery should be replaced.

4. After test, close openings in sealing compound above cell connector straps.

NOTE: If any battery found to be "good" by Light Load Test does not perform satisfactorily in subsequent service, it should again be tested by the Light Load Test and if it still tests "good", it should be removed from car and tested as outlined under Full Charge Hydrometer Test. See paragraph 10-10.

## 10-10 FULL CHARGE HYDROMETER TEST OF BATTERY AND USE OF HYDROMETER

### a. Full Charge Hydrometer Test

The full charge hydrometer test should be used on any battery originally found to be "good" by the Light Load Test, but has since failed to perform satisfactorily in service and which still tests "good" by the Light Load Test.

IMPORTANT: The full charge hydrometer test is not valid unless battery has been tested and found to be "good" by the Light Load Test.

1. Fully charge battery as described under slow-charging (par. 10-12, subpar. a).

NOTE: Hydrometer reading taken on partially charged batteries are unreliable for this test.

2. Measure specific gravity of electrolyte in each cell and compare readings with the following:

(a) If cell readings range between 1.230 and 1.310, the battery is ready for use. All it needed was a full charge. Any variation in the specific gravity between cells within this range does not indicate a defective battery.

(b) If any cell reads less than 1.230 and:

(1) 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.

(2) Battery has been in service more than 3 months, it should be replaced.

(c) If any cell reads above 1.310 battery may be returned to service. However, specific gravities above 1.310 are harmful to battery and will cause early failure. Such high readings are caused by improper addition of electrolyte. Adjusting the specific gravity will not correct the damage that has been done by high gravity.

### b. Use of Hydrometer

The hydrometer measures the percentage of sulphuric acid in the battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, the acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. With a hydrometer, an indication of the concentration of the electrolyte is obtained.

The specific gravity of the electrolyte varies not only with the percentage of acid in the liquid, it also varies with temperature. As temperature increases, the electrolyte expands so that the specific gravity is reduced. As temperature drops, the electrolyte contracts so that the specific gravity increases. Unless these variations in specific gravity are taken into account, the specific gravity obtained by the hydrometer may not give a true indication of the concentration of acid in the electrolyte.

Correction can be made for temperature by adding .004, usually referred to as 4 "points of gravity", to the hydrometer reading for every 10°F. that the electrolyte is above 80°F. or subtracting .004 for every 10°F. that electrolyte is below 80°F. Figure 10-4 shows the exact correction figure to use for any temperature above or below 80°F., the three steps used in obtaining the corrected or true specific gravity, and two examples showing how it is figured.

When using a hydrometer, observe the following points:

1. Hydrometer must be clean, inside and out, to insure an accurate reading.

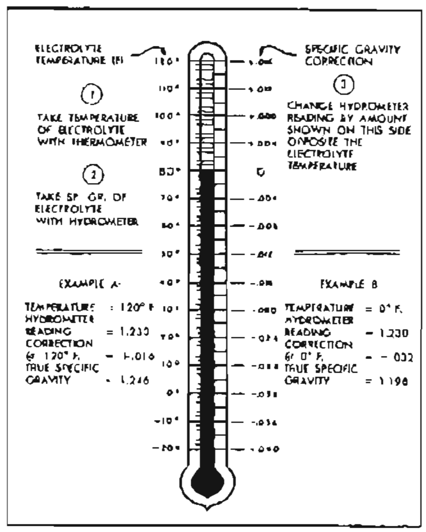



Figure 10-4—Specific Gravity Temperature Correction Scale

2. Hydrometer readings must never be taken immediately after water has been added. The water must be thoroughly mixed with the electrolyte by charging for at least 30 minutes before hydrometer values are reliable.

3. If hydrometer has built-in thermometer, draw liquid into it several times to insure correct temperature before taking a reading.

4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free floating, and with bulb fully released. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard the curvature where the liquid rises against float stem due to surface tension.

5. Avoid dropping liquid on car or clothing as it is extremely corrosive. Any liquid that drops should be washed off immediately with soda solution.

## 10-11 TESTING, REMOVING, INSTALLING AND CLEANING BATTERY AND CRANKING MOTOR CABLES

Whenever the battery is tested (par. 10-9) the battery and cranking motor cables should also be inspected for condition and tested for resistance. Resistance in the cables and connections causes voltage drop, and excessive voltage drop is liable to cause starting difficulties.

Carefully inspect the battery to junction block, battery to engine (ground) and cranking motor to junction block cables. If cable strands are broken, corroded, or loose in terminals the cable should be replaced with the correct cable to insure ample capacity.

Check terminals at both ends of each cable for tight connections. Since loose connections are usually dirty or corroded, any loose connections should be thoroughly cleaned before being tightened. If terminals are tight and cables are apparently in good condition, it is advisable to test them with a low-reading voltmeter to detect any abnormal internal resistance.

### a. Testing Resistance of Cables and Terminal Connections

Battery cables and terminal connections may be tested with equipment comprising a voltmeter (5 volts maximum), ammeter of 300 or more amperes capacity, and carbonpile rheostat having a minimum capacity of 300 amperes connected in series with the ammeter.

1. Adjust rheostat to provide maximum resistance ("OFF" position).

2. Connect ammeter positive (+) lead to battery terminal stud on junction block. Connect ammeter negative (-) lead to one side of rheostat and connect other side of rheostat to ground on engine, preferably at point where battery ground strap is attached. In the instrument shown in Figure 10-5 the ammeter and rheostat are connected in series inside the case.

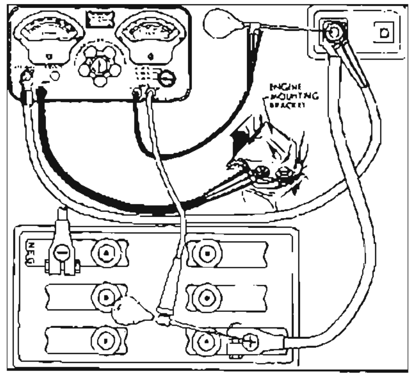


Figure 10-5—Battery Cable Test Connections

3. Connect voltmeter negative (-) lead to battery terminal stud on junction block. Use a prod with voltmeter lead, if necessary, to insure direct contact with the terminal stud. Do not connect to the ammeter lead clip. Attach a prod to voltmeter positive (+) lead and apply the prod to center of battery positive (+) post (Figure 10-5). Make sure that clips of voltmeter leads have clean metal contact with prods.

4. Adjust rheostat until ammeter reads 200 amperes, immediately read voltmeter, then turn rheostat to starting ("OFF") position to avoid excessive drain on battery. Voltage drop across battery positive cable and terminal connections should not exceed 2/10 volt.

5. Connect voltmeter positive (+) lead to ground on engine. Attach prod to voltmeter negative (-) lead and apply prod to center of battery negative (-) post. Voltage drop across the battery ground cable and terminal connections should not exceed 2/10 volt at 200 amps.

6. A reading in excess of 2/10 volt when testing either battery cable indicates excessive resistance in cable or connections. Clean and tighten cable or connections. Clean and tighten cable terminals (subpar. b, below) and recheck for voltage drop. If voltage drop still exceeds 2/10 volt replace cable with a Buick cable or equivalent to insure ample capacity.

7. If cranking is below normal speed, connect the ammeter positive (+) lead to the battery terminal stud on cranking motor solenoid switch, leaving the other lead attached to ground in engine.

8. Connect voltmeter negative (-) lead directly to battery terminal stud on solenoid switch. With prod of voltmeter positive (+) lead applied directly to battery terminal

stud on junction block, repeat Step 4 above. The voltage drop across cranking motor cable and terminal connections should not exceed 4/10 volt at 200 amperes.

### b. Removing, Installing and Cleaning of Battery Cable Terminals

If loose connections are found by inspection, or high resistance is found by voltage test, remove the cable for thorough cleaning of terminals. See Figure 10-6. The spring type battery cables clamps require that the ends of the clamp must be spread with suitable pliers to remove or install.

CAUTION: Do not spread cable clamp any more than is necessary or do not pry clamp off battery post.

Thoroughly clean all corrosion from disconnected battery cable terminals and terminal posts using suitable wire brushes. If wire brushes are not available, corroded terminals may be cleaned by brushing with a strong soda solution, using care not to get solution into battery cells.

IMPORTANT: Do not ream or cut ring inside battery cable terminal.

Do not grease post or terminal before installing terminal to post. After installing terminal, grease post and terminal to reduce possibility of corrosion.

CAUTION: Do not drive terminal onto battery post with hammer or other tool.

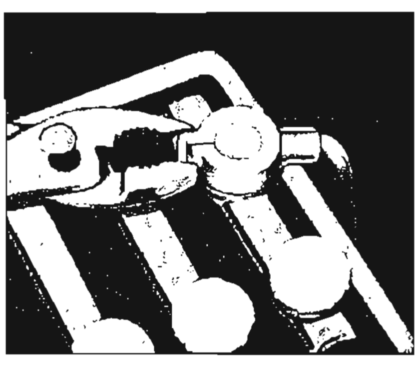


Figure 10-6—Removing Battery Cable

## 10-12 BATTERY RECHARGING

There are two separate methods of recharging batteries which differ basically in the rate of charge. In the slow-charge method, the battery is supplied a relatively small amount of current for an extended period of time. In the quick-charge method, the battery is supplied with a high current for a short period of time. CAUTION: To prevent damage to the charging system, connect + to + and - to - only.

### a. Slow-Charging

Slow-charging is the only method of completely charging a battery. The slow-charge method, properly applied, may be safely used under all possible conditions of the battery, provided electrolyte is at proper level in all cells. The battery may be fully charged by this method, unless the battery is not capable of taking a full charge. The normal slow charging rate for the 12-volt battery is 5 amperes.

Full charge of battery is indicated when all cell specific gravities do not increase when checked at three intervals of one hour 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.

### b. Quick-Charging

Since time is often of most importance to the battery owner, quick-charging must sometimes be used to partially charge the battery so that the engine will start and he can be on his way.

Charge at 40 amperes for 25 minutes (40 x 25 = 1000 ampere minutes). If charger will not give this rate, charge for an equal number of ampere minutes at the best rate available. For purposes of charging for the light load test, do not boost battery more than the amount indicated.

CAUTION: Too high a current during Quick-charging will damage battery plates.

A battery cannot be brought up to a fully charged condition by the quick-charge method. The battery can be substantially recharged or boosted, but in order to bring the battery to a fully charged condition, the charging cycle must be finished by charging at a low or normal rate. Some quick-chargers have a provision for finishing the charging cycle at a low rate so that the battery can be brought up to a fully charged condition.

Used with care, and employing all safeguards provided by the manufacturer, a quick-charger will not damage a battery which is in good condition.

## 10-13 BATTERY AND CABLES—TROUBLE DIAGNOSIS

### a. Quick Check of Battery and Cables

Whenever electrical trouble develops it is desirable to make a quick check of the battery and cables to make certain that this source of current is in good condition, securely connected, and is functioning properly. This check will also give a good check on the cranking system.

1. Turn on the lights. They should burn steadily and with normal brilliance.

2. With lights burning, operate the cranking motor. Either have the headlights shining on a wall so their brilliance can be noted, or have someone watching the headlights.

3. When cranking motor solenoid switch is closed, one of the following conditions will occur: (1) Lights will stay bright or will dim slightly if temperature is cold, and engine will be cranked at normal speed; (2) Lights will go out; (3) Lights will dim considerably; (4) Lights will stay bright but no cranking action will take place. The first named condition indicates that nothing is wrong with the battery, cables, and cranking system. The other conditions indicate troubles as follows:

4. If lights go out as cranking motor solenoid switch is closed, it indicates a poor connection in the circuit between battery and cranking motor. Check battery cables and clean and tighten loose or corroded terminals (par. 10-11).

5. If lights dim considerably as cranking motor solenoid switch is closed, it indicates that the battery is run down, or there is a condition in cranking motor or engine which causes an excessive current drain on the battery. A low battery will be indicated by a clattering noise in cranking motor solenoid because the battery cannot sustain the voltage required to hold solenoid plunger "in" after switch contacts close and the "pull in" winding is shorted out. Test battery with a light load test (par. 10-9). If battery is found to be in good condition check cranking motor (par. 10-28).

6. If lights stay bright but no cranking action occurs when cranking motor solenoid switch is closed, it indicates an open circuit in cranking motor, switch, or control circuit. See paragraph 10-28.

### b. Undercharge Failure of Battery

The most frequent trouble experienced with storage batteries is failure to maintain a state of charge sufficient to crank the engine and also furnish current to the ignition system, lights and accessories. Failure to maintain a proper state of charge may be due to one or more of the following conditions:

1. Operating Conditions. When determining cause of premature failure of a battery, consideration must be given to the conditions under which the car is operated.

In very low temperatures the capacity of a storage battery is considerably reduced and the energy required for cranking the engine is considerably increased.

Frequent starting, particularly in cold weather, accompanied by short runs may take more energy from the battery for cranking than the generator can replace in the limited running time. This condition is aggravated by night driving when lights are turned on, or by operation of an air conditioner in heavy traffic.

When the car is operated under these conditions, adjusting the voltage regulator to the high limit may allow enough increase to keep the battery at a safe state of charge. If the high limit setting does not maintain a safe state of charge an occasional booster charge should be given to the battery or an extra output generator obtained through dealer.

2. Low Charging Rate. In case of premature battery failure the charging rate of generator should always be checked and adjusted if below specifications. See paragraph 10-21.

3. Internal Condition. The internal condition of the battery may be such that it cannot hold a charge satisfactorily. Check electrolyte level and light load test the battery (par. 10-11).

### c. Overcharge Failure of Battery

A common cause of battery failure is overcharging, that is, continued input of excessive charging current after the battery has reached a fully charged condition.

One evidence that battery is being overcharged is the need for frequent addition of water to the battery in order to maintain the electrolyte level above the tops of the battery separators, since overcharging causes rapid water loss. When this becomes evident the charging rate of generator should be immediately checked and adjusted (par. 10-21) to avoid internal damage to battery.

# SECTION 10-C
# GENERATING SYSTEM

## CONTENTS OF SECTION 10-C



## 10-14 DESCRIPTION OF DELCOTRON GENERATOR

"Delcotron"* generators are continuous-output, diode-rectified alternating current generators. See Figure 10-7. The rotor is mounted on a ball bearing at the drive end, and a roller bearing at the slip ring end, and each bearing has a grease supply which eliminates the need for periodic lubrication. Two brushes are used to carry current through the two slip rings to the field coil which is mounted on the rotor. The brushes are extra long and under normal operating conditions will provide long periods of service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. See Figure 10-8. Six rectifier diodes are mounted in the slip ring end frame and are connected to the stator windings. The six diodes act to change the generator a.c. voltages to d.c. voltage which appears at the "BAT" terminal of the generator.

*General Motors Trademark

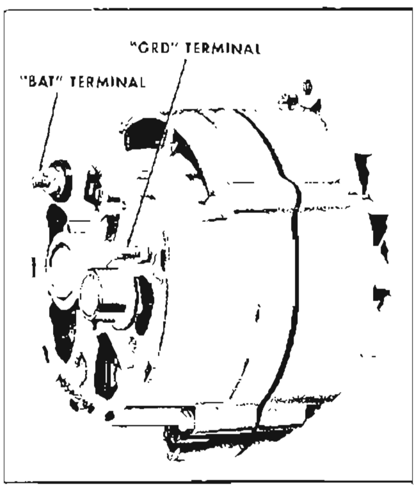



Figure 10-7—Delcotron Generator

IMPORTANT: Since the generator and regulator are designed for use on only one polarity system (negative ground), the following precautions must be observed when working on the charging circuit. Failure to observe these precautions will result in serious damage to the electrical equipment.

1. When installing a battery, always make absolutely sure the negative post is toward ground.

2. When connecting a booster battery make certain to connect the negative battery terminals together and the positive battery terminals together.

3. When connecting a charger to the battery, connect the charger positive lead to the battery positive terminal and the charger negative lead to the battery negative terminal.

4. Never operate the generator on open circuit. Make absolutely certain all connections in the circuit are secure.

5. Do not short across or ground any of the terminals on the generator or regulator.

6. Do not attempt to polarize the Delcotron generator.

## 10-15 GENERATOR REPAIR—ON BENCH

### a. Disassembly

To disassemble the generator, take out the four thru-bolts, and separate the drive end frame and rotor assembly from the stator assembly by prying apart with a screwdriver at the stator slot. See Figure 10-8. A scribe mark will help locate the parts in the same position during assembly. The fit between stator and frame is not tight, and the two can be separated easily. Note that the separation is to be made between the stator frame and drive end frame. After disassembly, place a piece of tape over the slip ring end frame bearing to prevent entry of dirt and other foreign material.

To remove the drive end frame from the rotor, place the rotor in a vise and tighten only enough to permit removal of the shaft nut. CAUTION: Avoid excessive tightening as this may cause distortion of the rotor. Remove the shaft nut, washer pulley, fan and the collar, and then separate the drive end frame from the rotor shaft.

If the rotor shaft has a hex socket in the drive end, use a 5/16" Allen wrench to hold the shaft during removal of the shaft nut.

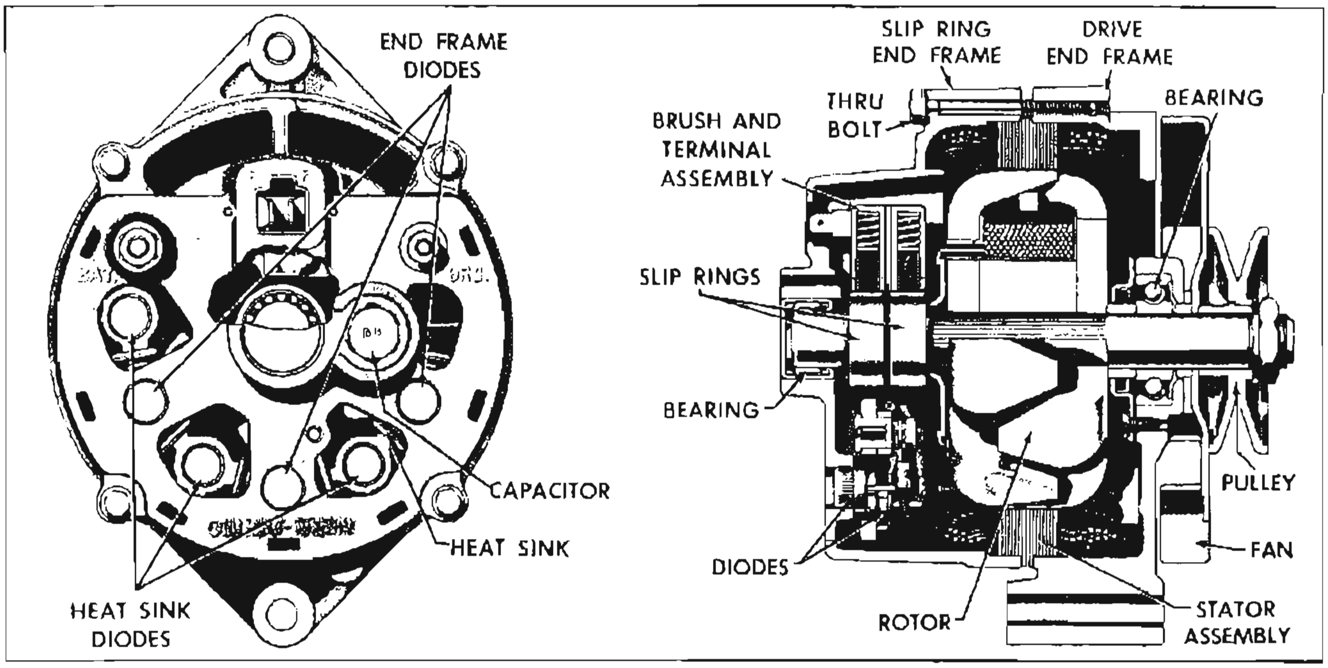



Figure 10-8—Sectional View

**b. Rotor Checks**

The rotor may be checked electrically for grounded, open or short circuited field coils. To check for grounds, connect a test lamp from either slip ring to the rotor shaft. See Figure 10-9. If the lamp lights, the field winding is grounded.

To check for opens, connect the test lamp to each slip ring. If the lamp fails to light, the winding is open.

The field winding is checked for short-circuits by connecting a battery and ammeter in series with the two slip rings. The field current at 12 volts and 80°F. should be between 2.2 and 2.6 amperes. An ammeter reading above the specified value indicates shorted windings.

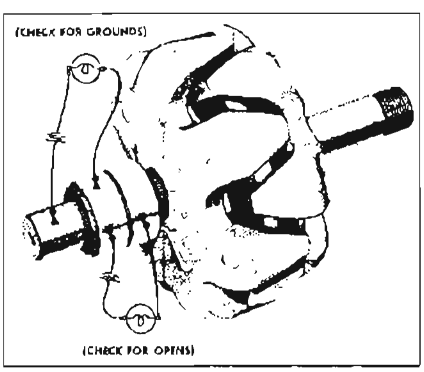



Figure 10-9—Checking Rotor for Opens or Grounds

If the rotor is not defective but the generator failed to supply rated output, the trouble is in the stator or rectifying diodes.

**c. Stator Checks**

To check the stator windings, remove all three stator lead attaching nuts, and then separate the stator assembly from the end frame. The fit between stator frame and end frame is not tight, and the two can be separated easily.

The stator winding may be checked with a test lamp. If the lamp lights when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light when successively connected between each pair of stator leads, the windings are open. See Figure 10-10.

A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated.

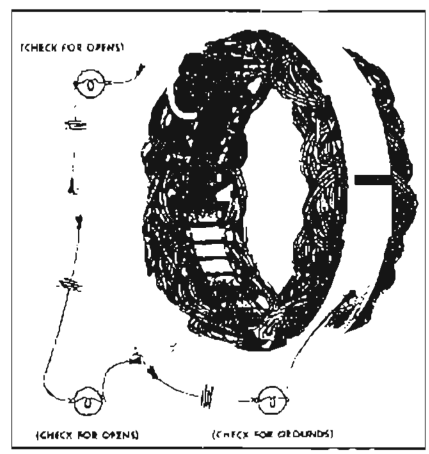



Figure 10-10—Checking Stator for Opens or Grounds

**d. Diode Checks**

Each diode should be checked electrically for a shorted or open condition using a test lamp of not more than 12 volts. CAUTION: Do not use a 110-volt test lamp to check diodes.

With the stator disconnected, connect the test lamp leads across each diode, first in one direction and then in the other. See Figure 10-11. If the lamp lights in both checks, or fails to light in both checks, the diode is defective. When checking a good diode, the lamp will light in only one of the two directions.

**e. Diode Replacement**

1. To remove a diode, place slip ring end frame in a vise so that Remover J-9717-1 bears against defective diode and Support J-9717-2 supports casting. Tighten vise to remove defective diode. See Figure 10-12.

2. To install a diode, place new diode in Installer J-9600-2. Place slip ring end frame in a vise so that new diode is in position and Remover J-9717-1 supports casting. See Figure 10-13. Tighten vise to install new diode. CAUTION: Never attempt to remove or install a diode by striking it, as the shock may damage the other diodes.

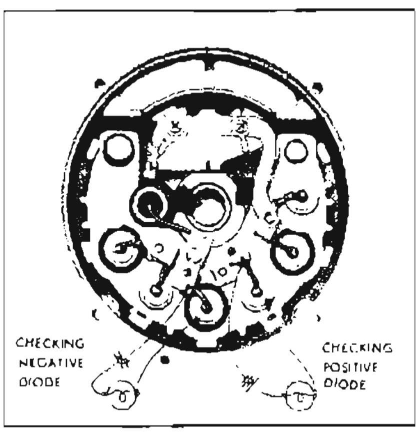



Figure 10-11—Checking Diodes for Opens or Shorts

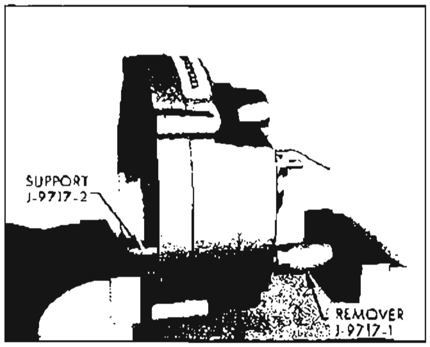



Figure 10-12—Removing a Diode

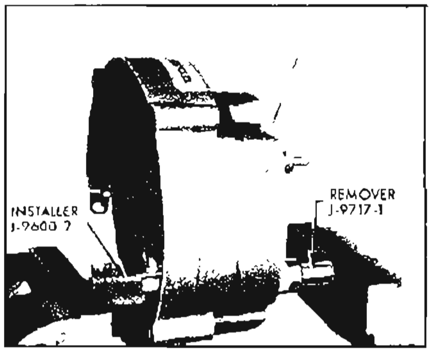



Figure 10-13—Installing a Diode

**f. Slip Ring Servicing**

If the slip rings are dirty, they may be cleaned with No. 400 silicon carbide paper and finish polished with crocus cloth. Spin the rotor in a lathe, or otherwise spin the rotor, and hold the polishing cloth against the slip rings until they are clean. CAUTION: The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out-of-round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish polish with crocus cloth and blow away all dust.

**g. Bearing Replacement**

The bearing in the drive end frame can be removed by detaching the retainer plate screws, and then pressing the bearing from the end frame with Support J-9717-2.

To install a new bearing, press in with a tube or collar that just fits over the outer race. It is recommended that a new retainer plate be installed if the felt seal in the retainer plate is hardened or excessively worn.

The bearing in the slip ring end frame can be removed by pressing with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside using Support J-9717-2.

To install a new bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

Saturate the felt seal with S.A.E. 20 oil, and then reassemble the felt seal and steel retainer.

The bearings in the generator are permanently lubricated and require no lubrication during the life of the bearings. If a dry bearing is encountered, do not attempt to lubricate the bearing as improper lubricant or an excessive amount of lubricant may be thrown off and contaminate the inside of the Delcotron. Replace a dry, worn, or rough bearing with a new bearing which will be prepacked with the proper kind and amount of lubricant.

### h. Brush Replacement

When the slip ring end frame assembly is separated from the rotor and drive end frame assembly, the brushes will fall down onto the shaft and come in contact with the lubricant. If the brushes are to be re-used, they must be thoroughly cleaned with a soft dry cloth. Also, the shaft must be thoroughly cleaned before reassembly.

The brush springs should be inspected for any evidence of damage or corrosion. If there is any doubt as to the condition of the brush springs, they should be replaced.

To install new brushes, remove the brush holder assembly from the end frame by detaching the two brush holder assembly screws. Install the springs and brushes into the brush holder, and insert a straight wire or pin into the holes at the bottom of the holder to retain the brushes. Then attach the brush holder assembly onto the end frame, noting carefully the proper stack-up of parts as shown in Figure 10-14. Allow the straight wire to protrude through the hole in the end frame.

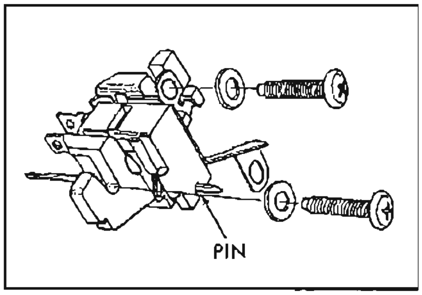



Figure 10-14—Assembling Brush Holder and Parts

### i. Heat Sink Replacement

The heat sink may be replaced by removing the "BAT" and "GRD" terminals from the end frame, and the screw attaching the condenser lead to the heat sink. During reassembly, note carefully the proper stack-up of parts as shown in Figure 10-15.

### j. Reassembly

Reassembly is the reverse of disassembly. See Figure 10-16 for connection of internal leads. Remember when assembling the pulley to secure the rotor in a vise only tight enough to permit tightening the shaft nut to 50-60 ft.lbs. If excessive pressure is applied against the rotor, the assembly may become distorted.

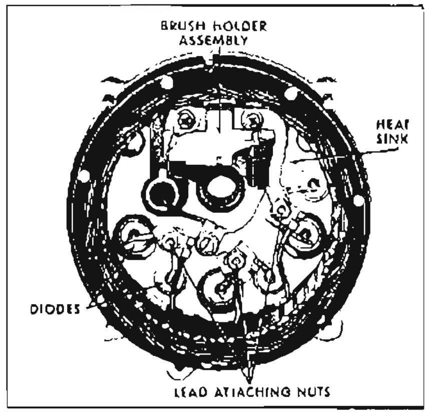



Figure 10-16—Internal Leads

To install the slip ring end frame assembly to the rotor and drive end frame assembly, remove the tape over the bearing and shaft, and make sure the shaft is perfectly clean.

Insert a straight wire as previously mentioned through the holes in the brush holder and end frame to retain the brushes in the holder. Then withdraw the wire after the generator has been completely assembled. The brushes will then drop onto the slip rings.

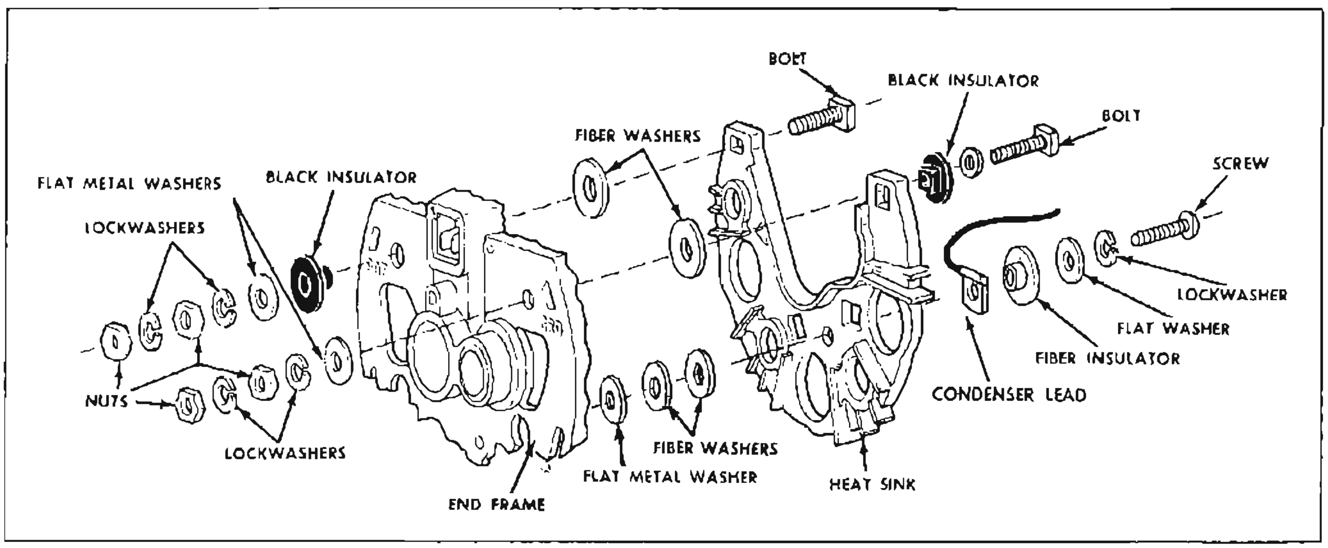



Figure 10-15—Assembling Heat Sink and Parts

## 10-16 DESCRIPTION OF REGULATOR

The regulator assembly is made up of a double contact voltage regulator unit and a field relay. See Figure 10-17. The voltage regulator unit operates to limit the generator voltage to a pre-set maximum. The field relay connects and disconnects the voltage regulator and generator field directly to the battery. The indicator lamp lights at about 1/2 brightness when the ignition switch is turned on; when the engine is started, the indicator light goes out. If the indicator light ever comes on with the engine running, trouble in the charging system is indicated.

## 10-17 OPERATION OF CHARGING SYSTEM

Before the generator will put out any current, the rotor field must be energized. The rotor poles have practically no residual magnetism, so unless current is supplied to the field from the battery, there can be no output from the generator.

When the ignition switch is turned on, current flows immediately through the field to ground inside the generator. Before the engine is started, the path of the field current is from the junction block, to the "BAT" terminal of the ignition switch, through the switch to both the "IGN" and the "ACC" terminal. From the "IGN" terminal, current flows through the generator indicator light in the instrument cluster (causing it to light), to the "4" terminal of the regulator. See Figure 10-18.

The indicator light circuit allows only about 1/4 ampere to flow, which is not sufficient to initially energize the field. Therefore a parallel circuit is necessary; this circuit allows about 3/4 ampere to flow from the "ACC" terminal, through the large cowl connector, through a 10 ohm resistance wire to the "4" terminal of the regulator. The combined current of about one ampere flows through the lower contacts of the voltage regulator (held closed by the spring), out the "F" terminal of the regulator, in the "F" terminal of the generator, through the brush and slip ring, through the field, through another brush and slip ring to ground. See Figure 10-19.

When the engine is started, the stator windings immediately put-out a voltage. This voltage is conducted from one phase of the stator, out the "R" terminal of the generator, in the "2" terminal of the regulator, through the field relay windings to ground. Even a low voltage at the field relay is sufficient to overcome the spring tension of the armature, thereby closing the field relay contacts.

The instant the field relay closes, the field current is supplied directly from the battery instead of through the ignition switch and resistance wire. The field current then comes from the battery, into the "3" terminal of the regulator, through the field relay, and on through the field as before. This allows the same voltage to be present at the "4" terminal as at the ignition switch, thereby causing current to stop flowing through either connecting wire and causing the generator indicator light to go out. The field relay, therefore, has a dual function; it not only completes the circuit between the battery and the field, but also acts as an indicator light relay.

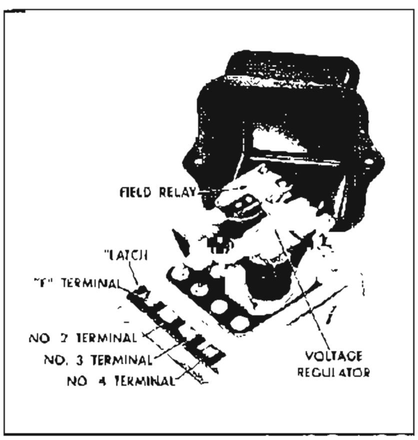



Figure 10-17—Regulator

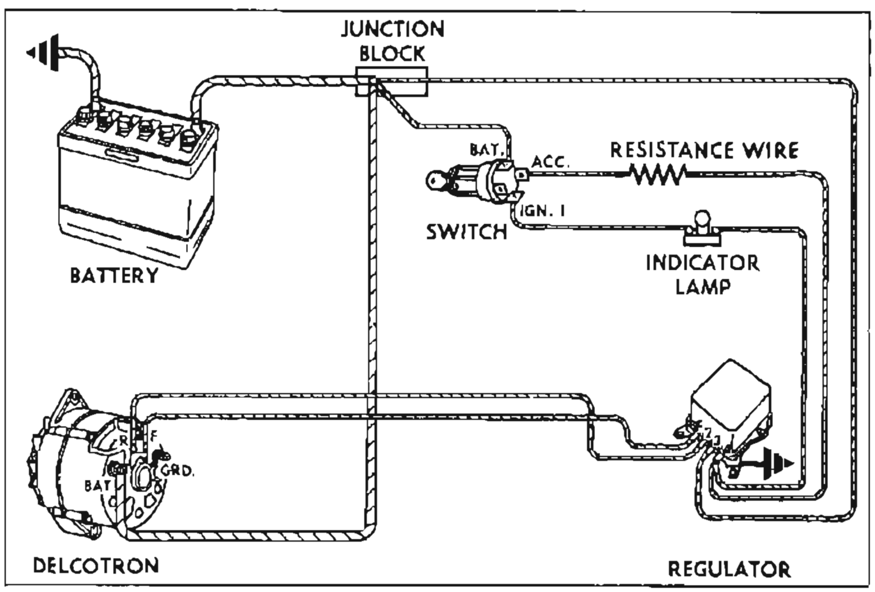



Figure 10-18—Delcotron Generator Wiring

The voltage regulator armature has two contact points which are over and under stationary contact points. When the voltage regulator unit is not operating, the tension of a spiral spring holds the armature away from the core so that the lower set of contacts is closed. See Figure 10-19.

Generator output depends on two variables: speed and field strength. Only the field strength can be controlled, however. Voltage regulator operation varies according to operating conditions of the car electrical system. There are several stages of voltage regulator operations as follows:

**a. Lower Contacts Closed**

When the accessories and/or battery need a great deal of current, but the engine speed is low, the lower contacts will remain tightly closed to allow full field current of approximately 2 amperes. The accessory load not supplied from the generator will be supplied from the battery.

**b. Lower Contacts Vibrating**

When the accessory load or battery needs are somewhat less, or the engine speed is a little higher, 2 amperes field current would cause too much generator output. Therefore, the lower voltage regulator contact will vibrate to reduce field current. When the contacts are open, the entire field current must flow through the resistor, which limits current to about 3/4 ampere. While the lower contacts are vibrating, then, field current will be somewhere between 2 amperes and 3/4 ampere, depending on the rate of vibration.

**c. Both Contacts Open**

When the balance of the accessory load and the engine speed is such that approximately 3/4 ampere field current will provide exactly the needed generator output, the voltage regulator armature will "float" with neither set of contacts touching. Any change in speed or load will upset the balance, however, causing the regulator contacts to again vibrate.

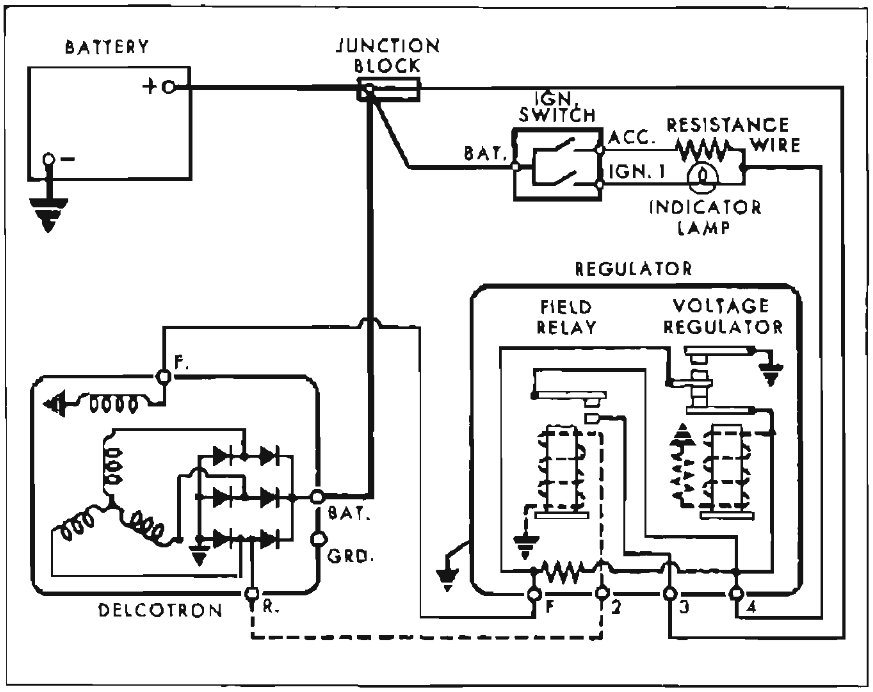



Figure 10-19—Delcotron Generator Wiring Circuit Diagram

**d. Upper Contacts Vibrating**

When the combined accessory and battery load is low and the engine speed is high, very little field current is required to provide the needed generator output. The voltage in the charging circuit will rise between .1 and .3 volt and the regulator armature will be drawn farther down to operate on the upper set of contacts. When the contacts are open, field current will be about 3/4 ampere; when the contacts are closed, the upper armature grounds the current from the resistor and field current is zero. See Figure 10-19. While the upper contacts are vibrating, then, field current will be somewhere between 3/4 ampere and zero, depending on the rate of vibration.

The regulator does not contain a cutout relay unit. The rectifier diodes act as one-way check valves to prevent the battery from discharging back through the generator, thereby making a cutout relay unnecessary.

The regulator does not contain a current limiting unit because an alternating current generator acts as its own current regulator.

## 10-18 TROUBLE-SHOOTING CHARGING SYSTEM

SPECIAL PRECAUTIONS: Alternating current charging system circuits are completely different from direct current charging system circuits. Therefore, none of the troubleshooting checks used for direct current systems can be used. The diodes may be burned out if you do not observe the following precautions:

1. Never arc terminals. Never short between terminals on the

generator or regulator; never arc any terminal to ground. The field has no residual magnetism and therefore cannot be polarized; any attempt to do so may cause damage.

2. Always observe polarity. Use extreme caution before installing a battery, connecting a fast charger or connecting a booster battery to insure that the ground polarity is matched to the ground polarity of the generator and regulator. For example, if a battery is accidentally installed in reverse, the diodes in the generator may be burned out and the wiring harness between the generator and battery will be burned. The generator charging system is a negative ground system, just as Buick's charging systems have always been.

3. Always disconnect battery before doing any work on the generator or regulator. Complaints on operation of the charging system generally fall into one of the following classifications. Go through steps listing possible troubles in order until the trouble is found.

#### a. Battery Runs Down

1. Check generator belt tension. Belt tension as measured with Gauge J-7316 should be 80 pounds.

2. Check battery condition. Light load test battery to see if battery is actually low (par. 10-9). If low, quick-charge battery and retest to see if battery is defective. A battery which is sulphated or one with an intermittent internal "open" will remain in an undercharged condition. Replace a defective battery.

3. Check for short or ground. To check complete car electrical system for a short or ground, disconnect ground cable from battery and connect a voltmeter between ground cable and battery post. Make sure all lights and accessories are off and that clock is wound. If voltmeter reads battery voltage, there is a short or ground which must be traced and eliminated; any reading less than battery voltage indicates current leakage so slight that nothing need be done about it.

4. Check generator output. Hookup test instruments and check current output of generator as described in Delcotron Generator Tests paragraph. If output is low, remove generator for disassembly, test and repair. If generator output tests okay, leave test instruments hooked up and proceed with Step 5.

5. Check voltage regulator setting, as described in Delcotron Generator Tests paragraph. If voltage fluctuates, look for loose or corroded connections in the charging system; if none, clean voltage contacts as described in paragraph on Cleaning Regulator Contacts. If voltage setting is low, adjust to specifications shown in Figure 10-21.

If voltage setting is within the specified limits, but battery checked low in Step 2, raise voltage setting slightly as described in paragraph on Tailoring The Voltage Setting.

#### b. Battery Uses Too Much Water

1. Check battery condition. Light load test battery to see if there is a shorted cell (par. 10-9). A battery having a shorted cell will use water excessively. Replace a defective battery.

2. Check voltage regulator setting, as described in Delcotron Tests paragraph. If voltage setting is high, adjust to specifications shown in Figure 10-21. If voltage setting is within limits, lower voltage setting slightly as described in paragraph on Tailoring Voltage Setting.

#### c. Faulty Indicator Light Operation

There are three conditions of indicator light operation which indicate trouble in the charging system.

1. Indicator light on-ignition off. This is caused by a shorted positive diode. There will be a continuous drain on the battery through the generator. Remove generator for disassembly, test and repair.

2. Indicator light off-ignition on. Before the engine is started, the indicator light should glow at about 1/2 the brightness of the oil pressure light. If the light does not come on, check for either a burned out bulb or an open in the indicator light circuit. A shorted diode as described in Step 1 will also cause the indicator light to go off when the ignition is switched on.

3. Indicator light on - engine running. This can be caused by a loose or missing belt, a defective field relay, or a defective generator. Determine source of trouble as follows:

a. Check generator belt tension.

b. Check voltage at field relay coil by connecting a voltmeter from regulator "2" terminal to ground. If voltmeter reading is above 5 volts and the indicator light fails to go out, field relay is defective. Check and replace, if necessary. If voltmeter reading is below 5 volts, field relay is probably okay so proceed with Step c.

c. Check voltage at generator field by connecting a voltmeter from generator "F" terminal to ground. If voltmeter reading is below 5 volts, check for a resistance or open in the circuit that should supply the initial field current. See Figure 10-23.

If voltmeter reading at "F" terminal is above 5 volts but voltage output from "R" terminal is low, trouble is in the generator. Hook-up test instruments and check current output of generator as described in Delcotron Generator Tests paragraph. If output is low, remove generator for disassembly, test and repair.

## 10-19 INSPECTING CHARGING SYSTEM

At regular intervals, inspect the terminals for corrosion and loose connections, and the wiring for frayed insulation. Check the mounting bolts for tightness and the belt for alignment, proper tension and wear. Belt tension should be adjusted to 80 lbs. as measured with Gauge J-7316. When tightening belt tension, apply pressure against the stator laminations between the end frames, and not against either end frame.

Noise from a Delcotron generator may be caused by worn or dirty bearings, loose mounting bolts, a loose drive pulley, a defective diode, or a defective stator.

## 10-20 CLEANING REGULATOR CONTACTS

The voltage regulator contacts should not be cleaned unless the electrical performance indicates it is necessary. A sooty or discolored condition of the contacts is normal after a relatively short period of operation and is not an indication that cleaning is necessary. However, if the voltage fluctuates as evidenced by an unsteady voltmeter reading when checking the voltage setting, the contacts may have excessive resistance or be sticking and they, therefore, should be cleaned. CAUTION: Before cleaning contacts, make sure the unsteady voltage is not being caused by loose connections or high resistance elsewhere in the system.

The contacts on the voltage regulator unit are of a soft material and must not be cleaned with a file. A strip of No. 400 silicon carbide paper or equivalent folded over and then pulled back and forth between the contacts is recommended as a satisfactory method of cleaning. After cleaning, the contacts should be washed with trichlorethylene or alcohol to remove any residue. If the voltage control has not improved, repeat the cleaning and washing process.

To clean the field relay contacts, use a thin fine-cut, flat file. Remove only enough material to clean the points. CAUTION: Never use emery cloth or sandpaper to clean contact points.

## 10-21 DELCOTRON GENERATOR TESTS

### a. Test Current Output

1. Check belt tension. Adjust to 80 lbs. as measured with Gauge J-7316.

2. Disconnect ground cable from battery.

3. Connect ammeter between generator "BAT" terminal and disconnected lead as shown in Figure 10-20.

4. Connect a tachometer from distributor terminal of coil to ground.

5. Reconnect battery ground cable. Connect a voltmeter across battery.

6. Turn on all possible accessory load. Apply parking brake firmly. Start engine. Adjust engine idle to exactly 500 RPM in Drive. At this engine speed, generator output should be 5 amperes or over. Shift transmission to Park.

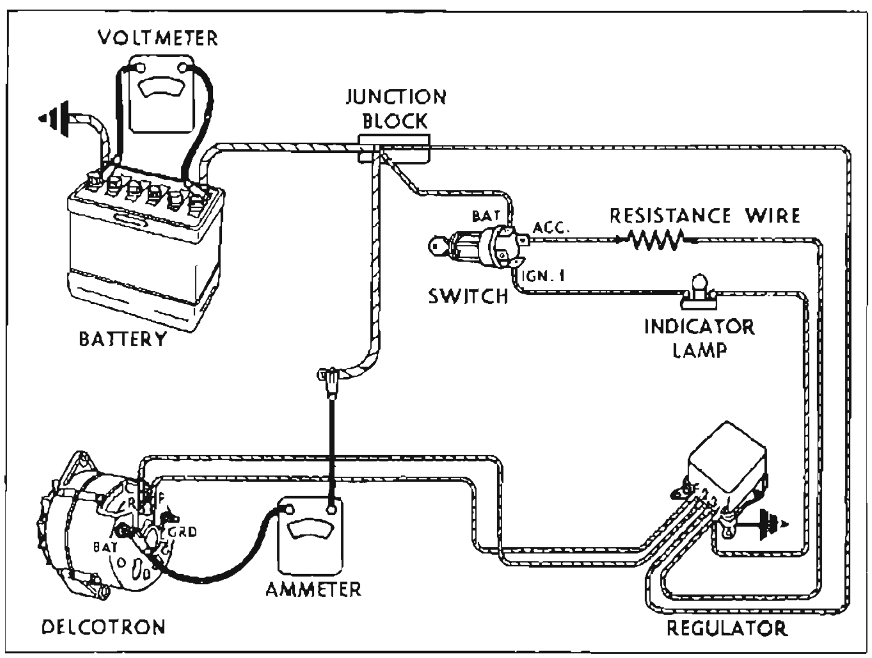



Figure 10-20—Delcotron Generator Tests

Increase engine speed to exactly 1500 RPM; output should be 25 amperes or over. Shut off engine. Turn off all accessories.

7. If output is low in either of the above tests, try supplying field directly to cause full generator output. Unplug connector from generator. Connect a jumper such as Adaptor J-21053 from generator "F" terminal to "BAT" terminal. Retest as described in Step 6. If output is still low, generator is faulty and must be removed for bench tests and repairs. To see if fault is in the diodes, test diodes as described in subparagraph b.

8. If output (using field jumper) is now okay, trouble is in the regulator or wiring harness. Clean and test regulator. Check all wiring connections.

9. Remove field jumper and reinstall vehicle field connector.

### b. Test Generator Diodes (On-The-Car)

1. Disconnect ground cable from battery.

2. Disconnect battery lead and relay - field connector from generator.

3. To test all three positive diodes, connect a test light such as J-21008 from the generator "R" terminal to the "BAT" terminal and observe test light; then reverse test light connections and again observe light. The test light should light in only one of the two directions.

4. To test all three negative diodes, connect the test light from the "R" terminal to the "GRD." terminal and observe test light; then reverse test light connections and again observe light. The test light should light in only one of the two directions.

5. If the test light lights in both directions in either Step 3 or Step 4, there is at least one defective diode. Remove generator and disassemble on bench. Test diodes individually and replace as necessary.

### c. Test and Adjust Voltage Regulator Setting

1. Test current output as described above. See Figure 10-20. Leave all test instruments in place, but make sure field jumper is removed, if used.

2. Install a thermometer such as Gauge J-8529 near regulator.

3. Run engine at approximately 1500 RPM for 15 minutes. Make sure all electrical load except ignition is turned off.

4. Check ammeter reading. For an accurate voltage setting check, ammeter must read between 3 and 10 amperes. (If ammeter reading is still high after 15 minutes, it may be necessary to substitute a fully charged battery.) Momentarily increase engine speed to approximately 2000 RPM and read voltmeter and thermometer. See Figure 10-21 to determine if upper voltage regulator setting is within limits for the existing temperature. If setting is within limits and battery condition has been satisfactory, voltage setting should not be disturbed.

5. If voltage regulator setting is out of limits, make a note of change required to put voltage in middle of specified range. Remove regulator cover, lifting cover carefully straight up. CAUTION: If the cover touches either regulator unit, the resulting arc may ruin the regulator assembly.

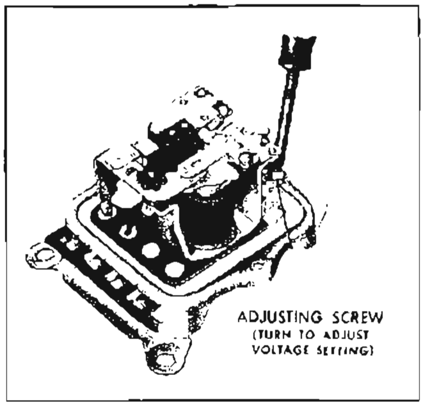



Figure 10-22—Adjusting Voltage Regulator Setting

6. With cover off, voltage reading will change considerably. Starting with the changed voltage reading, increase or decrease voltage (the amount determined in Step 5) as shown in Figure 10-22. CAUTION: Always make final adjustment by increasing spring tension to assure contact between screw head and spring support.

7. Replace cover carefully and recheck voltage setting of regulator.

## 10-22 TAILORING THE VOLTAGE SETTING

It is important to remember that the voltage setting for one type of operating condition may not be satisfacory for a different type of operating condition. Vehicle underhood temperatures, operating speeds, and nighttime service all are factors which help determine the proper voltage setting. The proper setting is

| Air Temperature at Regulator . . . . . . | 85° | 105° | 125° | 145° | 165° |
|---|---|---|---|---|---|
| Voltage Setting . . . . | 13.8-14.6 | 13.7-14.5 | 13.5-14.3 | 13.4-14.2 | 13.2-14.0 |

Figure 10-21—Voltage Regulator Settings

attained when the battery remains fully charged with a minimum use of water.

If no circuit defects are found, yet the battery is continually undercharged, raise the setting by .3 volt, and then check for an improved battery condition over a service period of reasonable length. If the battery is continually overcharged, lower the setting by .3 volt, and then check for an improved battery condition. However, never adjust the voltage setting out of the limits specified in Figure 10-21.

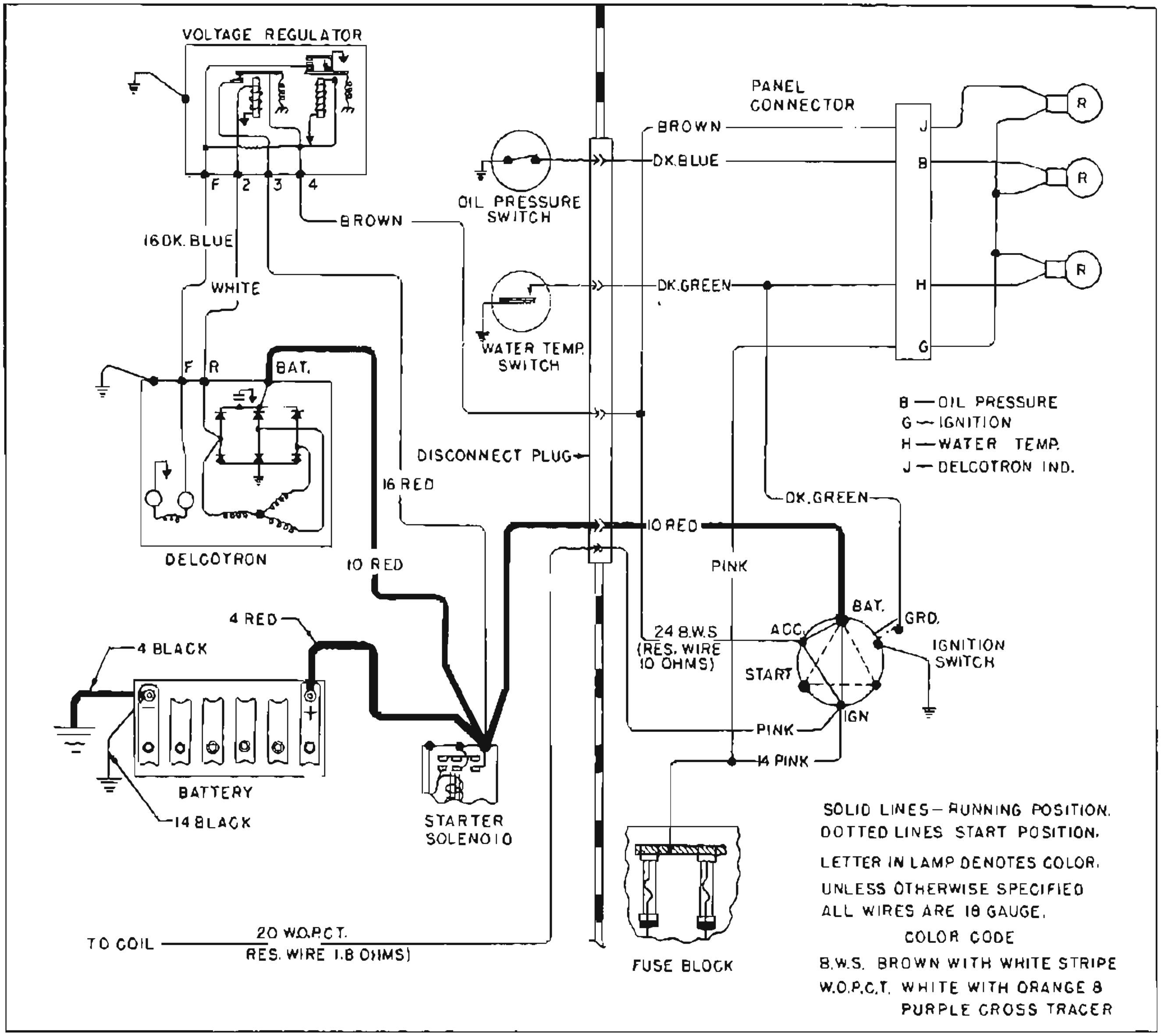



Figure 10-23—Delcotron Generator Wiring Diagram

# SECTION 10-D
# CRANKING (STARTER) SYSTEM

## CONTENTS OF SECTION 10-D



## 10-23 DESCRIPTION OF CRANKING SYSTEM

In the Buick cranking system, the engine is cranked by turning the ignition switch to the extreme clockwise position marked "START". The "START" position is spring loaded in such a way that the switch returns to the "ON" position when released.

The cranking system, shown schematically in Figure 10-24, is composed of the following units:

1. Battery and battery cables (par. 10-11).

2. Cranking motor, including the drive assembly which engages the flywheel ring gear during cranking operation (par. 10-25).

3. Cranking motor solenoid switch, mounted on the cranking motor, for shifting the drive assembly and closing the motor circuit (par. 10-25). During cranking the solenoid switch also connects the battery directly to the ignition coil, thereby bypassing the resistance wire which normally supplies the ignition coil at a lower voltage.

4. Ignition switch, which when in the "START" position connects a lead from the battery to the solenoid switch, passing through the neutral safety switch on the way.

5. Neutral safety switch, used only on cars equipped with automatic transmissions. This switch is connected between the ignition switch and the solenoid switch to prevent cranking of the engine except when the transmission control lever is in either neutral (N) or park (P) position.

## 10-24 OPERATION OF CRANKING SYSTEM

When the ignition switch is turned fully clockwise to the "START" position, a connection is made from the battery terminal of the ignition switch to the solenoid terminal of the switch. From here, a large wire carries the current to a terminal on the solenoid switch of the cranking motor. On automatic transmission cars, a neutral safety switch is located in series in this wire. On these cars, the transmission control lever must be in neutral (N) or (P) position so that the neutral safety switch is also closed.

Closing of the ignition "START" switch and the neutral safety switch permits battery current to flow through the "pull-in" and "hold-in" coils of the solenoid, magnetizing the solenoid. The plunger is pulled into the solenoid so that it operates the shift lever to move the drive pinion into engagement with the flywheel ring gear. The solenoid switch contacts then closes after the drive pinion is partially engaged with the ring gear; this prevents any possible gear clash. See Figure 10-24.

The closing of the solenoid switch contacts causes the motor to crank the engine and also cuts out the "pull-in" coil of the solenoid, the magnetic pull of the "hold-in" being sufficient to hold the pinion in mesh after the shifting has been performed. This reduces the current consumed by the solenoid while the cranking motor is operating. See Figure 10-24.

As soon as the engine starts running, the overrunning clutch starts free-wheeling. This allows the starter pinion to be driven by the flywheel ring gear without causing the armature speed to increase greatly. (Because of the large gear ratio between the pinion and the ring gear, a seized overrunning clutch will cause the armature to be driven at an excessive speed which may cause the armature windings to be thrown). As soon as the driver realizes that the engine has started, he releases the ignition key and a spring in the ignition switch returns it to the "ON" position. This breaks the solenoid circuit so that the solenoid is demagnetized. A return spring then actuates the shift lever to retract

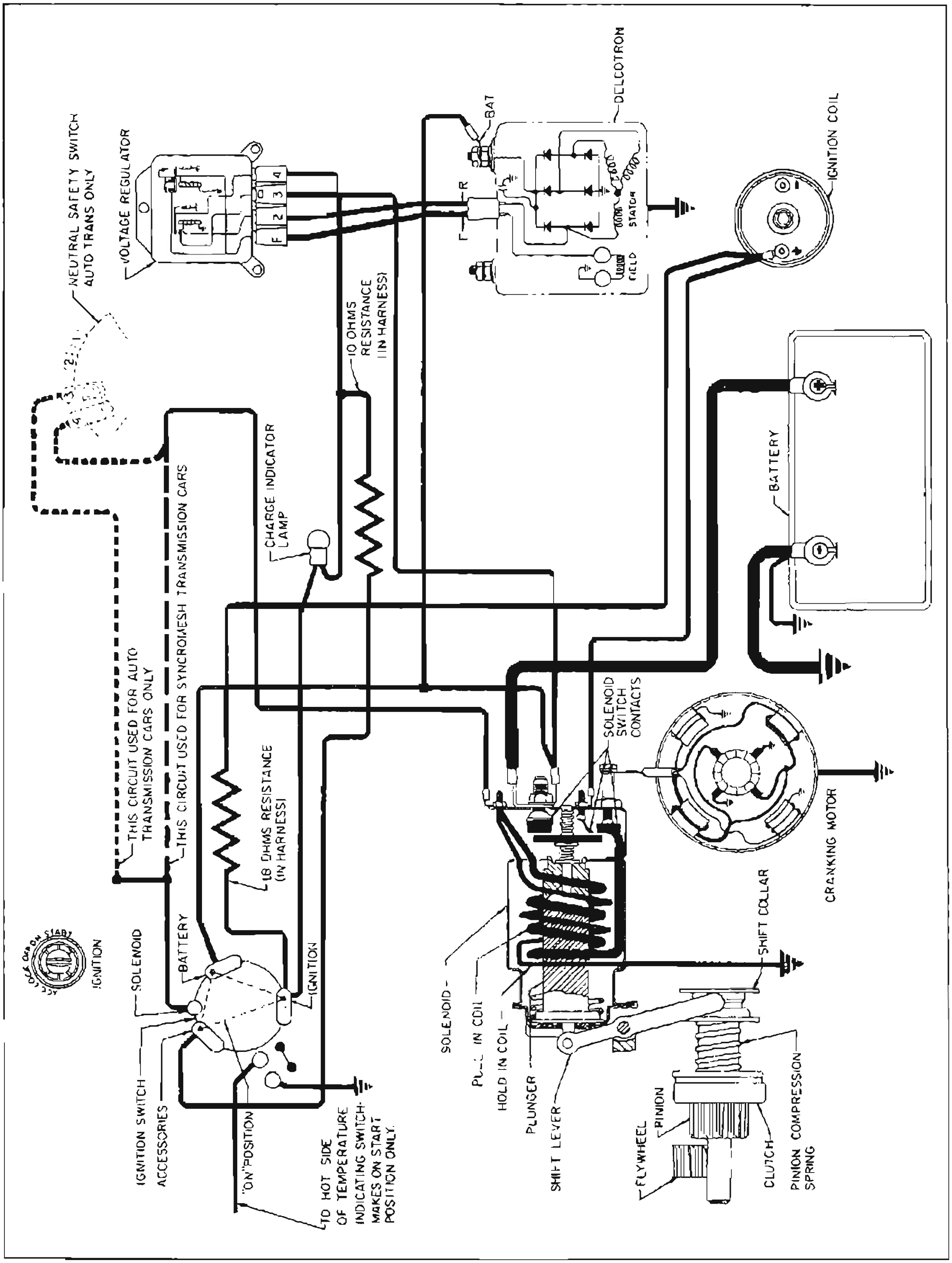



Figure 10-24—Starter and Generator Circuit Diagram

the solenoid plunger, which permits another spring to open the solenoid switch contacts. The shift lever then disengages the drive pinion from the flywheel ring gear. After the transmission is shifted out of park or neutral, the neutral safety switch will prevent accidental engagement of the drive pinion with the flywheel.

## 10-25 CRANKING MOTOR AND SOLENOID SWITCH

The cranking motor assembly consists of a motor, drive assembly, shift lever, and solenoid switch. See Figure 10-25. It is mounted on the flywheel upper housing on the right side of engine.

### a. Cranking Motor, Drive and Shift Lever

The cranking motor is an enclosed shift lever type, having an extruded frame, four poles and a series field. The drive end housing is extended to enclose the entire shift lever mechanism and plunger to protect them from road dirt, icing conditions, and splash. The solenoid is flange mounted onto the drive end housing and is sealed to the drive housing by a sealing compound. The shift lever return spring is a compression type and is located inside the solenoid case. All four field coils are connected in series from the solenoid motor terminal to the insulated brushes. A rubber grommet assembled in the frame around the field lead insulates it from grounding and also prevents dirt, water, and oil from entering the motor.

The armature shaft is supported at both ends in graphite bronze bushings pressed into the commutator end frame and the drive housing. Neither of these bearings require lubrication except during assembly.

The four brushes are supported by brush holders mounted on the field frame. Two opposing brushes are connected to the field coils. The field coils are held in place by the pole shoes which are attached to the field by large screws. The field coils are connected to an insulated connecting link in the field frame, through which current is supplied to the motor.

The drive assembly is mounted on the motor armature shaft and keyed to it by helical splines so that it can be moved endwise on the shaft by the solenoid operated shift lever. It transmits cranking torque to the flywheel ring gear, but its overrunning clutch allows the drive pinion to rotate freely with reference to the armature shaft when the engine begins to operate, thus preventing the armature from being driven at excessive speed by the engine.

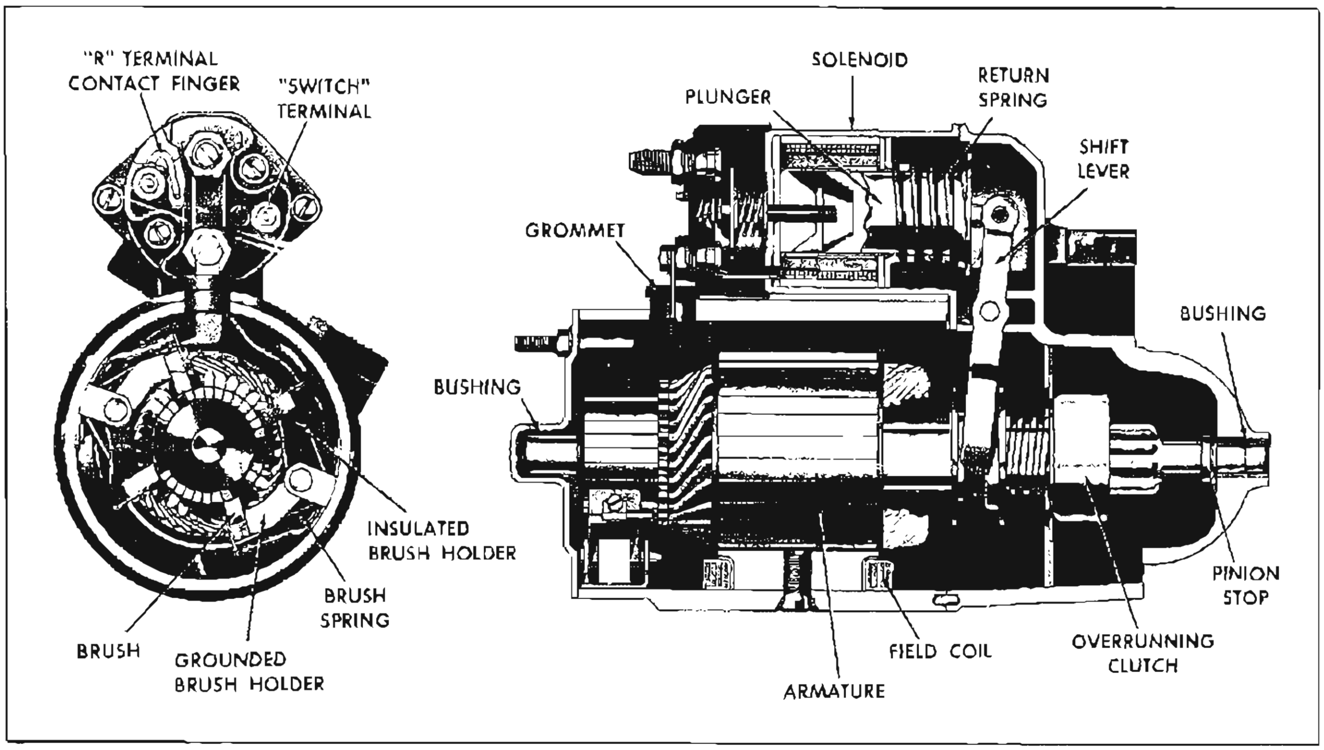



Figure 10-25—Cranking Motor-Sectional View

The drive assembly pinion is moved into engagement with flywheel ring gear by action of the solenoid upon the shift lever, which engages the shift collar of drive assembly. The shift collar moves the drive assembly by pushing on the clutch spring, which serves as a cushion in case the pinion and gear teeth butt instead of meshing. The helical splines assist in obtaining proper pinion engagement. The drive pinion is pulled out of engagement, after engine starts, by action of the shift lever return spring. The shift lever is connected to the solenoid switch plunger by a link and adjusting screw. See Figure 10-25.

The cranking motor in the V-6 engine has four field coils connected in series between the terminal and the insulated brushes. See Figure 10-26.

The cranking motor in the V-8 engine has three field coils connected in series between the terminal and the insulated brushes, and one shunt field coil connected to ground. See Figure 10-27.

**b. Solenoid Switch**

The solenoid switch not only closes the circuit between the battery and the cranking motor to produce cranking action, but it also operates the shift lever to move the drive pinion into engagement with the flywheel ring gear.

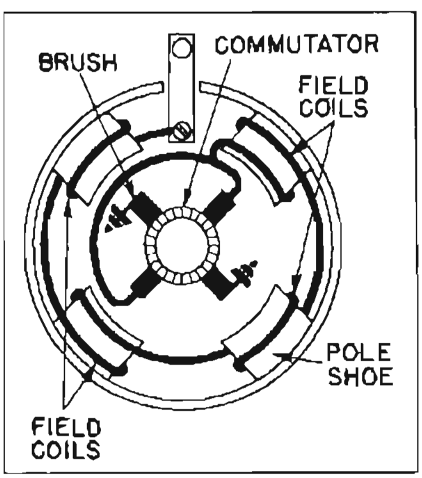



Figure 10-26—Cranking Motor Circuit - V-6

The solenoid section of the switch has a plunger and two windings, the "pull-in" winding and the "hold-in" winding. Together, they provide sufficient magnetic attraction to pull the solenoid plunger into the solenoid. The plunger actuates the shift lever and drive assembly and it also closes the solenoid switch contacts by pressing against a push rod upon which a contact disk is mounted between two coil springs. One spring serves as a cushion to insure firm contact of the disk with two stationary contacts. The other spring pushes the disk away from the stationary contacts to break the circuit when the solenoid is demagnetized after the engine starts. One stationary contact is connected to the battery positive cable and the other is connected to the motor windings through a connector or bus bar. See Figure 10-25.

Operation of the solenoid switch, as well as the entire cranking system, is described in paragraph 10-25.

## 10-26 TROUBLE-SHOOTING CRANKING SYSTEM

**a. No Cranking Action**

1. Make sure that on cars equipped with automatic transmission, control lever is in neutral (N) or park (P) position.

2. Make quick check of battery and cables (par. 10-11). If battery is low, the solenoid usually will produce a clattering noise, because a nearly discharged battery will not sustain the voltage required to hold solenoid plunger in after solenoid switch has been closed.

3. If drive pinion engages ring gear but does not drive it, overrunning clutch is slipping. Remove motor to replace drive assembly.

4. If cranking motor does not operate, note whether solenoid plunger is pulled into solenoid when solenoid circuit is closed. Ordinarily the plunger makes a loud click when it is pulled in. If plunger is pulled in, solenoid circuit is okay and trouble is in solenoid switch or cranking motor. The cranking motor must be removed for repairs to switch or motor (par. 10-31).

5. If plunger does not pull into solenoid when ignition switch is turned to "START", the solenoid circuit is open, or solenoid is at fault.

6. To find reason why plunger does not pull into solenoid, disconnect purple solenoid wire at connector near battery terminal block and press wire end against post of terminal block. If cranking motor operates, solenoid is okay; trouble is in ignition switch, neutral safety switch, or in wires and connections between these units.

7. As a final test, connect jumper between solenoid battery terminal and terminal on solenoid

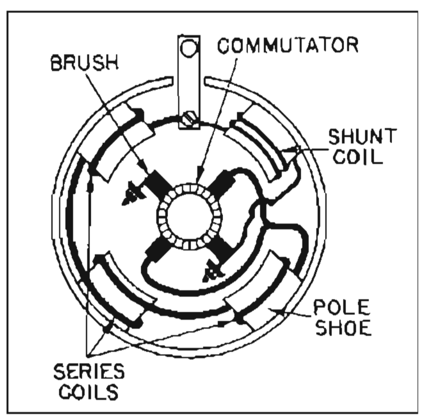



Figure 10-27—Cranking Motor Circuit - V-8

switch relay to which purple wire is connected. If cranking motor still does not operate, remove motor for inspection and test of solenoid switch (par. 10-29).

**b. Cranking Speed Abnormally Low**

Abnormally low cranking speed may be caused by low battery or defective cables, defective solenoid switch, defective cranking motor, or an internal condition of engine.

1. Make quick check of battery. If low battery is indicated, test battery (par. 10-9). If defective cables are indicated, test cables (par. 10-11).

2. If battery and cables are okay, test cranking motor and solenoid switch (par. 10-28).

3. If cranking motor and solenoid switch test okay, the trouble is due to an internal condition of engine. This may be due to use of engine oil which is too heavy for prevailing temperatures.

NOTE: In cold weather always depress clutch pedal when cranking engine to avoid the load caused by stiff lubricant in a synchromesh transmission. Car owners should be given this instruction. Tight pistons or bearings also impose a heavy load on the cranking motor.

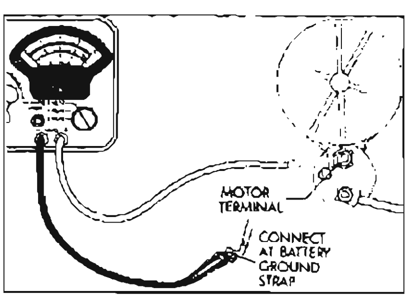



Figure 10-28—Cranking Voltage Test Connections

## 10-27 PERIODIC INSPECTION OF CRANKING MOTOR

No periodic lubrication of the cranking motor or solenoid is required. The cranking motor and brushes cannot be inspected without disassembling the unit so no service is required on the cranking motor and solenoid between inspection periods.

Cranking motor action is indicative, to some extent, of the cranking motor condition. A cranking motor that responds readily and cranks the engine at normal speed when the control circuit is closed is usually in good condition.

Check motor and solenoid switch attaching bolts to make sure these units are solidly mounted. Inspect and manually check all wiring connections at solenoid switch, generator regulator, generator, ignition switch, and neutral safety switch (automatic transmission cars only). Make sure that all these connections in the cranking motor and control circuits are clean and tight. It is advisable to test the cranking circuit to make certain that excessive resistance does not exist. See paragraph 10-28.

## 10-28 VOLTAGE TEST OF CRANKING SYSTEM AND SOLENOID SWITCH

The voltage across the cranking motor and switch while cranking the engine gives a good indication of any excessive resistance. NOTE: Engine must be at normal operating temperature when test is made.

1. Inspect battery and cables (par. 10-11) to make certain that battery has ample capacity for cranking and ignition.

2. Connect jumper wire to distributor terminal of coil and to ground on engine, so that engine can be cranked without firing.

3. Connect voltmeter positive (+) lead to the motor terminal on solenoid switch; connect voltmeter negative (-) lead to ground on starter. See Figure 10-28.

4. Turn ignition switch on, crank engine and take voltmeter reading as quickly as possible. If cranking motor turns engine at normal cranking speed with voltmeter reading 9 or more volts, the motor and switch are satisfactory.

If cranking speed is below normal and voltmeter reading is 9 or greater, the cranking motor is defective.

CAUTION: Do not operate cranking motor more than 30 seconds at a time without pausing to allow motor to cool for at least two minutes; otherwise, overheating and damage to motor may result.

5. If cranking motor turns engine at low rate of speed with voltmeter reading less than 9 volts, test solenoid switch contacts as follows.

6. With voltmeter switch turned to any scale above 12 volts, connect voltmeter negative (-) lead to the motor terminal of solenoid switch, and connect positive (+) lead to battery terminal of switch. See Figure 10-29.

7. Turn ignition switch on and crank engine. Immediately turn voltmeter switch to low scale and take reading as quickly as possible, then turn switch back to higher scale and stop engine.

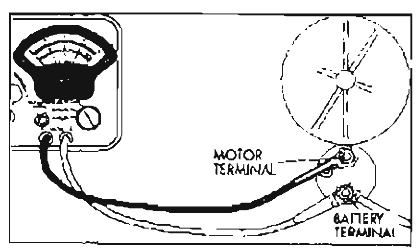



Figure 10-29—Solenoid Switch Contact Test Connections

The voltmeter will read not more than 1/10 volt if switch contacts are satisfactory. If voltmeter reads more than 1/10 volt, switch should be repaired or replaced.

## 10-29 AMPERAGE TEST OF SOLENOID AND PINION CLEARANCE CHECK

### a. Testing Solenoid Switch Windings

(1) Current draw of both windings in parallel.

(2) Current draw of hold-in winding alone.

1. Remove screw from solenoid motor terminal and bend field leads slightly until clear of terminal. Then ground solenoid motor terminal with a heavy jumper wire. See Figure 10-30.

2. Connect a 12-volt battery, a variable resistance, and an ammeter of 100 amperes capacity in series with solenoid "S" terminal. Connect a heavy jumper wire from solenoid base to ground post of battery.

3. Connect a voltmeter between base of solenoid and small solenoid "S" terminal.

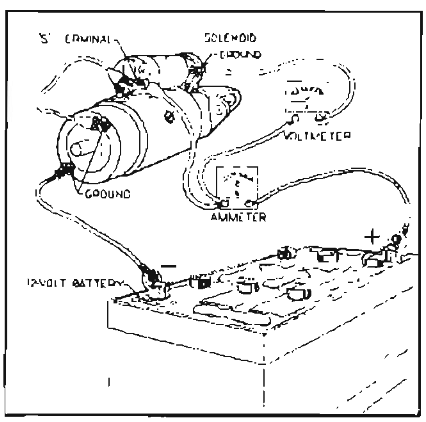



Figure 10-30—Amperage Test of Solenoid

4. Slowly adjust resistance until voltmeter reads 10 volts and note ammeter reading. This shows current draw of both windings in parallel, and should be 42 to 49 amperes at 10 volts, with solenoid at room temperature. See Figure 10-28 for a diagram of solenoid circuits.

5. Remove jumper wire from solenoid motor terminal and readjust resistance until voltmeter reads 10 volts, then note ammeter reading. This shows current draw of hold-in winding alone, and should be 10.5 to 12.5 amperes at 10 volts, with solenoid at room temperature.

6. If solenoid windings do not test within specifications given, solenoid switch assembly should be replaced.

### b. Checking Pinion Clearance

Whenever the cranking motor is disassembled and reassembled, the pinion clearance should be checked. This is to make sure that proper clearance exists between the pinion and the pinion stop retainer when pinion is in cranking position. Lack of clearance would prevent solenoid starter switch from closing properly; too much clearance would cause improper pinion engagement in ring gear.

1. Connect a source of approximately 6 volts (3 battery cells or a 6 volt battery) between the solenoid "S" terminal and ground. CAUTION: Do not use more than 6 volts or the motor will operate. As a further precaution to prevent motoring, connect a heavy jumper wire from the solenoid motor terminal to ground.

2. After energizing the solenoid, push the pinion away from the stop retainer as far as possible and use feeler gauge to check clearance between pinion and retainer. See Figure 10-31.

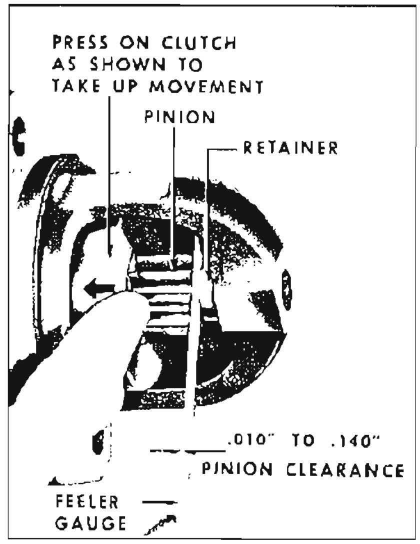



Figure 10-31—Checking Pinion Clearance

3. If clearance is not between .010" and .140", it indicates excessive wear of solenoid linkage, shift lever mechanism, or improper assembly of these parts. NOTE: Pinion clearance cannot be adjusted. If clearance is not correct, motor must be disassembled and checked for the above mentioned defects. Any defective parts must be replaced.

## 10-30 BENCH TEST OF CRANKING MOTOR

To obtain full performance data on a cranking motor, or to determine the cause of abnormal operation, the motor should be removed from the engine and be submitted to a no-load and a locked armature test with equipment designed for such tests. A high current carrying variable resistance should be connected into the circuit so that the specified voltage at the cranking motor may be obtained, since a small variation in the voltage will produce a marked difference in the current draw. Test specifications are given under Electrical Specifications in paragraph 10-3.

(a) No-Load Test. Connect the cranking motor in series with a 12-volt battery and an ammeter capable of indicating several hundred amperes. If an RPM indicator is available, set it up to read armature RPM. Check current draw and armature RPM at the specified voltage.

(b) Locked Armature Test. With the armature locked, check current draw at the specified voltage.

Rated current draw and no-load speed indicates normal condition of cranking motor. Abnormal conditions may be indicated by one of the following:

1. Low free speed and high current draw with low developed torque may result from:

(a) Tight, dirty, or worn bearings, bent armature shaft or loose field pole screws which would allow the armature to drag.

(b) Shorted armature. Check armature further on growler (par. 10-20).

(c) A grounded armature or field.

Check for grounds by raising the grounded brushes and insulating them from the commutator with cardboard, and then checking with a test lamp between the insulated terminal and the frame. If lamp lights, raise other brushes from commutator and check fields and commutator separately to determine whether it is the fields or armature that is grounded.

2. Failure to operate with high current draw may result from:

(a) A direct ground in the terminal or fields.

(b) Frozen shaft bearings which prevent the armature from turning.

3. Failure to operate with no current draw may result from.

(a) Open field circuit. Inspect internal connections and trace circuit with test lamp.

(b) Open armature coils. Inspect the commutator for badly burned bars.

(c) Broken or weakened brush springs, worn brushes, high mica on the commutator, or other causes which would prevent good contact between the brushes and commutator. Any of these conditions will cause burned commutator bars.

4. Low no-load speed with low torque and low current draw indicates.

(a) An open field winding. Raise and insulate ungrounded brushes from commutator and check field with test lamp.

(b) High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under item 3 (c).

5. High free speed with low developed torque and high current draw indicates shorted fields. There is no easy way to detect shorted fields, since the field resistance is already low. If shorted fields are suspected, replace the fields and check for improvement in performance.

## 10-31 CRANKING MOTOR REPAIRS—ON BENCH

### a. Disassembly, Cleaning and Inspection

When it is necessary to disassemble cranking motor for any reason, make a complete clean-up and inspection to make sure all parts are in satisfactory condition. See Figure 10-25 for identification of parts.

1. Remove field lead connecting nut from motor terminal or solenoid.

2. Remove two thru bolts and remove commutator end frame and field frame assembly.

3. Pull out brush holder pivot pin and remove the two brush holders and the spring as a group. Remove screws attaching brushes and leads to holders.

4. Remove armature and drive assembly from drive housing. Remove thrust collar from pinion end of armature shaft, and remove leather thrust washer from opposite end of shaft.

5. To remove drive assembly from armature, place a metal cylinder of proper size (1/2" pipe coupling will do) over end of shaft to bear against the pinion stop retainer. Tap retainer toward armature to uncover snap ring. See Figure 10-32. Remove snap ring from groove in shaft, then slide retainer and pinion drive assembly from shaft. Remove assist spring.

6. Remove two screws holding solenoid to drive housing and remove solenoid. Remove small nut and insulating washer from the solenoid "S" terminal. Remove

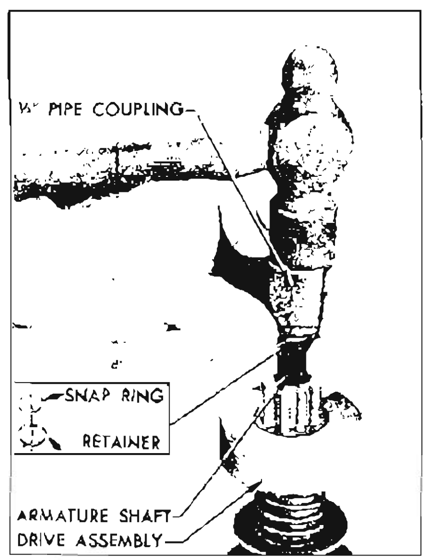



Figure 10-32—Removing Pinion Stop Retainer and Snap Ring

large nut and insulating washer from the solenoid battery terminal. See Figure 10-25. Then, remove two screws that attach switch cover to solenoid and remove cover for inspection of switch parts.

7. Remove shift lever fulcrum bolt and remove shift lever, plunger and return spring.

8. Clean all parts by wiping with clean cloths. The armature, field coils, and drive assembly must not be cleaned by any degreasing or high temperature method. This might damage insulation so that a short or ground would subsequently develop, and will remove lubricant originally packed in the overrunning clutch so that clutch would soon be ruined.

9. Carefully inspect all parts for wear or damage and make necessary repairs or replace unserviceable parts. Any soldering must be done with rosin flux; never use acid flux on electrical connections.

10. Test armature and make necessary repairs or turn commutator if required, following the same procedure as specified for generator in paragraph 10-20.

**b. Assembly of Cranking Motor**

1. Lubricate shift lever linkage and install in drive housing. CAUTION: Never lubricate solenoid plunger or plunger cylinder.

2. Assemble solenoid by reversing the disassembly procedure. Install return spring. Apply sealing compound on both sides of solenoid flange where it extends between drive housing and field frame. Then install solenoid.

3. Lubricate armature shaft with silicone grease. Install assist spring; then install drive assembly with pinion outward.

4. Slide pinion stop retainer down over shaft with recessed side outward.

5. Place a new snap ring on drive end of shaft and hold it in place with a hard wood block. Strike block with hammer to force snap ring over end of shaft, then slide the ring down into groove in shaft. See Figure 10-33, View A.

6. Place thrust collar on shaft with shoulder next to snap ring, and move the retainer into contact with ring. Using pliers on opposite sides of shaft squeeze retainer and thrust collar together until snap ring is forced into the retainer. See Figure 10-33, View B.

7. Lubricate drive housing bushing with silicone grease and install armature and drive assembly in housing.

8. Continue with assembly of cranking motor by reversing disassembly procedure. If field coils were removed from field frame, use care in tightening pole shoe screws to avoid distortion of

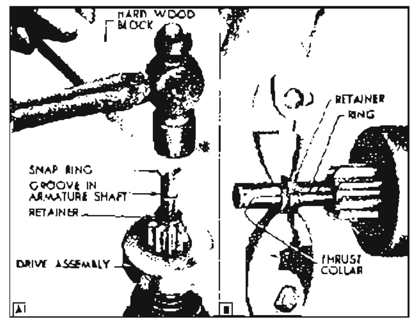



Figure 10-33—Pinion Stop Retainer and Snap Ring Installation

parts and make sure that screws are securely tightened.

9. Position field frame assembly over armature assembly so that dowel pin engages hole in drive housing. Use care to prevent damage to brushes and brush holders. Make sure that brushes are properly seated on commutator.

10. Install leather thrust washer on commutator end of armature assembly. Lubricate bushing in commutator end frame with silicone grease and install end frame.

11. Install thru bolts and tighten securely. Connect field leads to motor terminal of solenoid with connecting nut.

12. Test solenoid switch and check pinion clearance as described in paragraph 10-29. If a reliable starter tester is available, test motor as described in paragraph 10-30.

# SECTION 10-E
# IGNITION SYSTEM

## CONTENTS OF SECTION 10-E



## 10-32 IGNITION SYSTEM DESCRIPTION AND OPERATION

### a. Ignition System Components

The ignition system consists of the ignition switch, ignition coil resistance wire, ignition coil, ignition distributor, spark plugs, and the low and high tension wiring. Electrical energy is obtained from the battery while cranking and from the generator after the engine is running. These supply circuits must be considered part of the ignition system.

1. Ignition Switch. The ignition switch has four positions: (1) ACCESSORY, (2) LOCK, (3) ON, and (4) START. The key must be in the switch to turn it to any position other than LOCK, and the key can be removed only in the LOCK position.

(a) In "ACC.", a connection is made from the battery terminal to the accessory terminal of the switch to allow the radio and blower to be operated with the ignition, fuel gauge and indicator light circuits off.

(b) In "LOCK", no accessory supplied through the ignition switch can be operated. Also, the resistance wire circuit to the ignition coil is grounded; this is to prevent the engine from being run illegally using a jumper to the coil.

(c) In "ON", a connection is made from the battery terminal to the accessory terminal so that all ignition switch supplied accessories can be operated. Also the battery is connected to the resistance wire leading to the ignition coil. From this same terminal, a lead into the instrument cluster energizes the fuel gauge and indicator lights.

(d) In "START", all ignition switch supplied accessories are temporarily disconnected. A connection is made to the starter solenoid lead, also the water temperature light circuit is temporarily grounded to provide a means of checking the "TEMP." light bulb. When the ignition switch is released, a spring returns it to "ON".

2. Ignition Coil Resistance Wire. The ignition coil resistance wire is an integral part of the instrument panel wiring harness. This resistance wire is connected between the ignition switch and the positive (+) terminal of the coil. The resistance wire limits to a safe maximum the primary current flow through the coil and the distributor contact points, thereby protecting the contact points during slow speed operation when they are closed for longer-intervals. It also protects against excessive build up of primary current when the ignition switch is closed with engine stopped and contact points closed.

When the ignition switch is held in the "START" position and the starter is cranking, a connection is made from starter solenoid directly to the positive terminal of the ignition coil, bypassing the resistance. Elimination of the resistance overcomes the effects of reduced voltage due to cranking motor drain on the battery.

(3) Ignition Coil. The oil filled ignition coil is mounted on the front end of the intake manifold, adjacent to the ignition distributor. The positive (+) terminal is connected to the ignition switch through the resistance wire, and is also connected directly to the starter solenoid to bypass the resistance wire during cranking of engine. The negative (-) terminal is connected to the distributor. The secondary (high tension) terminal is connected by a short cable to the center terminal in the distributor cap.

(4) Ignition Distributor. The ignition distributor is of the external adjustment type. See Figure 10-37. It is driven clockwise directly from the camshaft

through cast iron gears which are automatically lubricated by the engine oiling system. Contact point opening is adjusted through a window in the distributor cap while the engine is idling. Any accurate dwell meter may be used. See paragraph 10-34 for adjustment procedure.

The distributor is of the single contact type with a 6 or 8-lobe cam. High speed operation is improved by an especially light contact breaker arm and a high speed cam. Maximum operating efficiency of the engine is obtained under all speed and load conditions by the centrifugal advance mechanism, which is located above the circuit breaker cam inside the rotor, and the vacuum advance mechanism built into the distributor. See Figures 10-35 and 10-36.

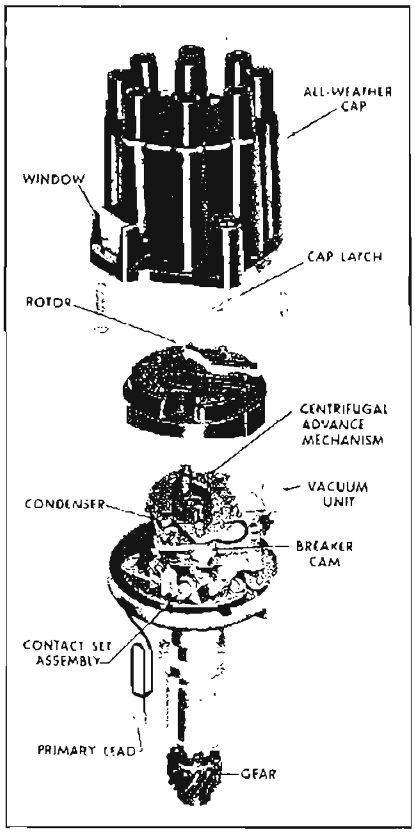



Figure 10-34—Distributor and Cap Assembly

The contact point set is replaced as one complete assembly. The service replacement contact set has the breaker lever spring tension and point alignment adjusted at the factory. Only the point opening requires adjusting after replacement.

(5) Spark Plugs. AC spark plugs having 14 MM threads, short (3/8") terminals, and .035" gaps are specified for normal operation. See paragraph 10-36, d for the type plug recommended.

(6) Radio Suppression. All secondary wiring has a resistance of 4000 ohms per foot so that it is unnecessary to install a suppressor on the high tension cable when a radio is installed. A capacitor is mounted on the side of ignition coil and connected to the positive (battery) terminal of coil when a radio is installed.

An additional capacitor must never be connected to the distributor terminal as this will cause excessive pitting of breaker points or engine missing.

**b. Ignition Operating Circuits**

To clarify operating principles as well as to simplify the process of tracing troubles, the parts of the ignition system should be understood to provide two separate and distinct circuits, as follows:

1. The Primary Circuit carries the low voltage current supplied by the battery or generator. In addition to these sources of electrical energy, the primary circuit contains the ignition switch, ignition coil resistance unit, primary winding of the ignition coil, distributor contact points, condenser, and all connecting low tension wiring.

2. The Secondary Circuit carries the high voltage surges produced by the ignition coil, which result in high voltage spark between the electrodes of the spark plugs in engine cylinders. This circuit contains the secondary winding of the ignition coil, coil to distributor high tension lead, distributor rotor and cap, ignition cables, and spark plugs.

**c. Cycle of Operation**

When the ignition switch is turned on and the distributor contact points are closed, battery or generator current flows through the primary winding of the coil and through the contact points to ground. This flow of current through the primary winding of the coil produces a magnetic field around the coil windings and thereby stores electrical energy in the coil.

When the contact points are separated by the revolving distributor cam, the primary circuit is broken. The condenser absorbs the current which tends to surge across the gap as the points separate, thereby producing a sharp break in the flow of current. If the flow of current were not sharply broken it would form an arc which would burn the points badly and would also drain away most of the energy stored in the coil. There would be insufficient energy left in the coil to produce the necessary high voltage surge in the secondary circuit.

The very rapid change in strength of the magnetic field when the primary circuit is sharply broken causes a high voltage to be induced in every turn of both the primary and secondary windings.

The high voltage surge produced in the secondary winding of the coil travels through the cable to the center of distributor cap, through the rotor to the adjacent distributor cap segment from which it is conducted to the proper spark plug by the ignition cable. The high voltage surge jumps the gap between the insulated center electrode and the grounded side electrode of the spark plug, thus producing the spark required to ignite the charge in the selected combustion chamber of the engine.

As the spark appears at the spark plug gap the energy in the coil begins to drain from the coil through the secondary circuit, thus sustaining the spark for a small fraction of a second. During this interval the condenser discharges back through the primary circuit, producing an oscillation of the current flow in the primary circuit during the brief instant that is required for the primary circuit to return to a state of equilibrium. Note particularly that the ignition condenser does not discharge until after the spark has occurred at the spark plug gap.

The sequence of action described above is repeated as each lobe of the distributor cam moves under and past the rubbing block on the contact breaker arm to cause the contact points to close and open.

**d. Control of Spark Timing**

The timing of the spark with respect to piston position in the cylinder must vary in accordance with operating conditions if best engine performance is obtained. The spark advance for obtaining satisfactory idling should be as low as possible. At high speed, the spark must occur earlier in the compression stroke in order to give the fuel-air mixture ample time to ignite, burn and deliver its power to the piston as it starts down on the power stroke.

Under part throttle light load operation, a smaller amount of fuel-air mixture (by weight) enters the cylinder so that the mixture is less highly compressed. Under this condition, advancing the spark permits fuller utilization of the fuel-air charge. During acceleration or on heavy loads (wide open throttle) the spark advance required to develop the maximum power of the engine is considerably less than that required for light loads.

Control of spark timing to satisfy these constantly changing operating requirements is obtained in three ways, as follows:

1. Initial, manual setting of distributor is made so that contact points open at a specified position of piston, as indicated by a timing mark on crankshaft balancer. See Ignition Timing (par. 10-35).

2. Centrifugal Advance is governed by engine speed. The centrifugal advance mechanism is located above the circuit breaker cam inside the rotor and consists of an advance cam which is integral with the distributor shaft, a pair of advance weights, two springs, and a weight base plate which is assembled to the distributor cam.

At idle speeds, the springs hold the advance weights as shown in Figure 10-35A, so that there is no spark advance and the spark occurs in accordance with the initial manual setting of distributor.

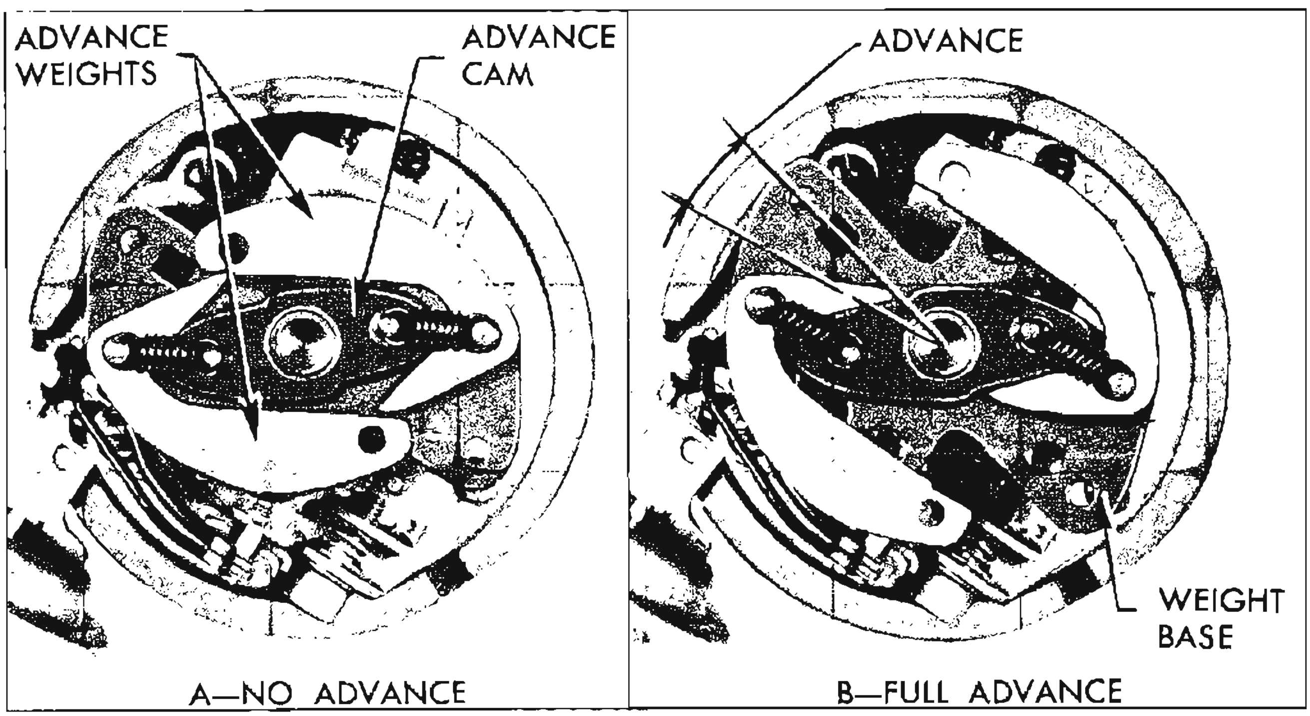



Figure 10-35—Centrifugal Advance Mechanism

As speed increases, centrifugal force causes the advance weights to throw outward and push against the advance cam, thus rotating the weight base plate and integral distributor cam ahead of the distributor shaft. This causes the distributor cam lobes to open and close the contact points earlier in the compression stroke so that the spark is advanced. See Figure 10-35B.

3. Vacuum Advance is governed by manifold vacuum. The contact point set is mounted on a breaker plate which is located below the centrifugal advance mechanism and uses the outer diameter of the upper shaft bushing for its bearing surface. The movable breaker plate is held in position on the upper shaft bushing by a retainer. The vacuum unit is mounted on the distributor base and under the movable breaker plate so that the breaker plate can be rotated around the distributor cam by a link from the vacuum unit. See Figure 10-36.

The vacuum unit contains a spring-loaded diaphragm. The spring-loaded side of the diaphragm is connected by a hose to an opening in the carburetor barrel. This opening may be above or below the edge of the throttle valve when the engine is idling, depending on carburetor design.

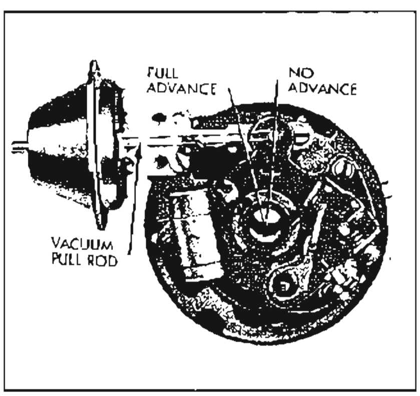



Figure 10-36—Vacuum Advance Mechanism

If the opening is below the throttle valve, the distributor will always have vacuum advance, even at idle; if the opening is above the throttle valve at idle, the vacuum advance unit will not begin to operate until the throttle is opened slightly, causing the edge of the throttle valve to move above the opening.

When the vacuum at the opening is sufficient to act on the control diaphragm, it compresses the spring and rotates the breaker plate in a counterclockwise direction. This moves the contact points so that the distributor cam lobes open the points earlier in the compression stroke. The amount of throttle opening and the engine load determine the amount of intake manifold vacuum and thus the amount of spark advance obtained. The advance obtained by the vacuum control is added to the advance obtained by the centrifugal advance mechanism as shown in Figures 10-37 and 38.

## 10-33 IGNITION SYSTEM—TROUBLE DIAGNOSIS

If engine trouble has arisen which seems to be due to improper operation of the ignition system, it may be desirable to make a quick preliminary check of the ignition system before making a complete analysis, in order to determine whether the ignition system is actually at fault. The quick checks described in this paragraph may be used but it must be understood that they are no substitute for the complete ignition system inspection. The checks to be made depend on whether the engine will or will not run.

### a. Engine Will Not Run

1. Make quick check of battery and cables (par. 10-11) if cranking motor does not turn engine at normal cranking speed.

2. Pull coil high tension cable from distributor cap and hold the lead terminal about 3/16" from a clean ground point on engine. If a good spark occurs while engine is being cranked, the primary circuit and the secondary circuit to this point may be considered to be okay. Proceed with Steps 3 through 6.

3. Remove distributor cap and check interior for moisture, corroded terminal segments, and check terminal sockets for corrosion. Check rotor for corrosion. Clean off corrosion and wipe distributor cap dry. Check for a crack or carbon path in cap or rotor.

4. Inspect ignition cables for possible short circuits and corroded terminals. Remove and inspect spark plugs (par. 10-36).

5. If cause of trouble has not been found, check approximate ignition timing (par. 10-35).

6. If engine still fails to run, the trouble is probably due to causes other than ignition, such as lack of fuel, carburetion, or compression loss.

7. If spark did not occur at coil high tension lead (Step 2 above) then connect 12-volt test lamp between distributor terminal of coil and ground and crank engine. If test light flickers on and off as engine is cranked the primary circuit is probably okay. Check ignition coil (par. 10-37) and condenser (par. 10-38).

8. If test light remains on as engine is cranked, contact points are not closing properly; check point opening and ground connection in distributor (par. 10-39).

9. If test light remains off as engine is cranked, the primary

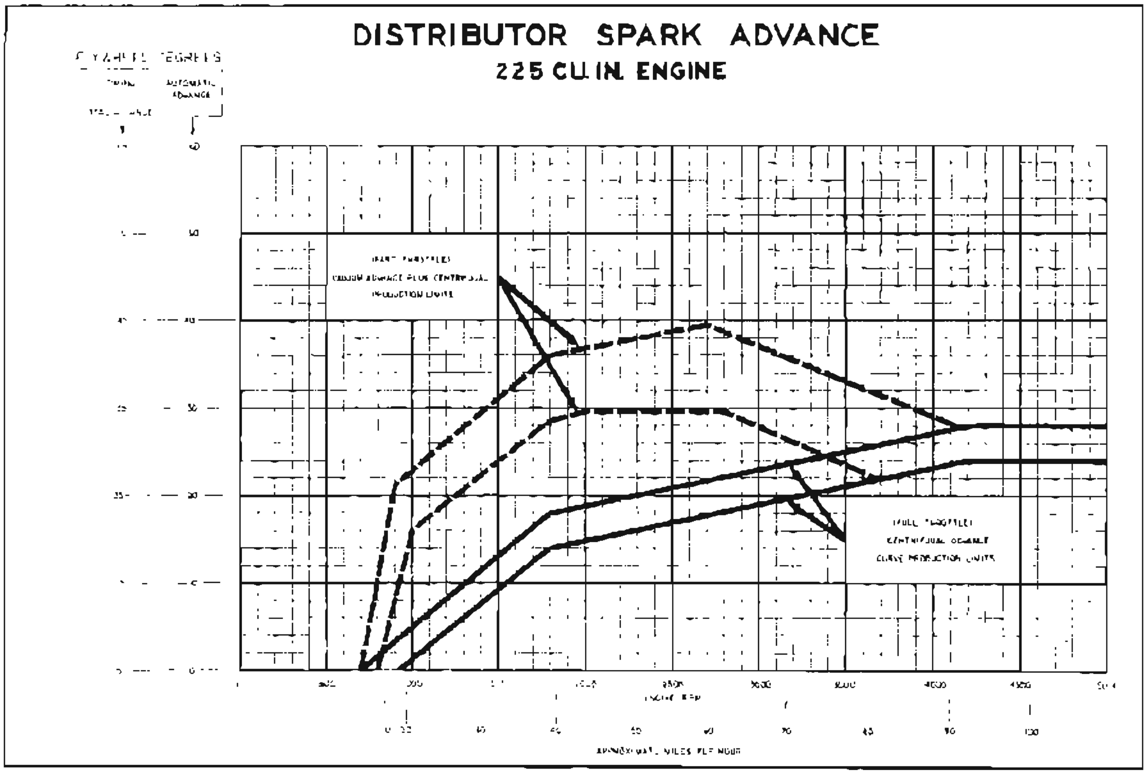



Figure 10-37—Distributor Spark Advance Chart—All V-6 Engines

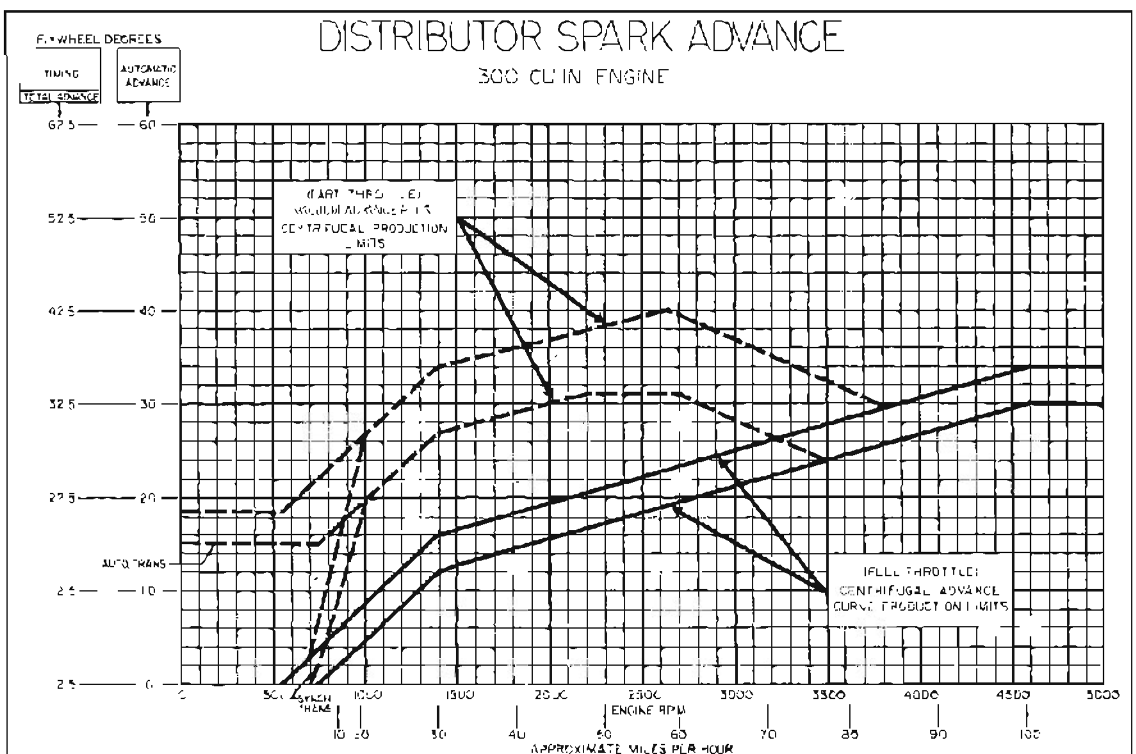



Figure 10-38—Distributor Spark Advance Chart—All V-8 Engines

circuit is open or the points are not opening properly. Check for loose connections, broken leads, defective switch, contact point opening, and primary circuit winding in coil. Visual inspection of points and the use of a test lamp or voltmeter will locate the source of this trouble.

**b. Engine Runs, But Not Satisfactorily**

1. When missing, loss of power, or hard starting is present a complete checkup of the ignition system is in order, since these conditions may result from anything from a low battery to defective spark plugs, or from other engine conditions not related to ignition. In this case, the complete inspection of ignition system should be used.

2. Detonation may be caused by improper timing (par. 10-35), improper operation of centrifugal or vacuum advance mechanism (par. 10-32, d), worn distributor bearings or a bent shaft, dirty or wrong heat range spark plugs (par. 10-36). It may also be caused by overheating, excessive carbon in cylinders, or by low octane fuel.

3. Overheating may be caused by one or more of the conditions which contribute to detonation, as well as by faults in engine cooling system.

## 10-34 REPLACEMENT AND ADJUSTMENT OF DISTRIBUTOR CONTACT POINT SET

When inspection of the contact points as described in paragraph 10-39 shows replacement to be advisable, the following procedure should be used.

NOTE: The service replacement contact point set has the breaker spring tension and point alignment adjusted at the factory.

**a. Removal of Contact Point Set**

1. Remove distributor cap by inserting a screwdriver in upper slotted end of cap retainers, press down and turn 90° counterclockwise. Push distributor cap aside and remove rotor. Disconnect the condenser and primary leads from their terminal by loosening the retaining screw.

2. Loosen two screws and lock washers which hold the contact point set in place. Then remove point set.

**b. Installation of Contact Point Set**

1. Apply a thin layer of high temperature cam and ball bearing lubricant to cam.

2. Slide contact point set over boss on breaker plate and under the two screw heads. Tighten two screws and lock washers.

3. Install condenser and primary leads.

NOTE: Leads must be properly positioned so they will not come in contact with bottom of weight base or rotor.

4. If engine does not start readily, position contact arm rubbing block on peak of cam lobe, insert a 1/8" Allen wrench in adjusting screw and turn screw in (clockwise) until contact points just close. Then back screw out (counterclockwise) 1/2 turn (180°) to obtain a point gap of approximately .016" for a preliminary setting.

**c. Adjustment of Contact Points—Engine Running**

NOTE: When adjusting contact point dwell angle, always follow the instructions which come with the dwell meter.

1. Connect dwell tester leads: red to distributor side of coil, black to ground.

2. Turn selector switch to position for 8-lobe cam for V-8 engines or to position for 6-lobe cam for V-6 engines. Turn ignition switch on.

3. Start engine. Lift adjustment window and insert 1/8" Allen wrench in adjusting screw. See Figure 10-39. Set dwell angle at 30 degrees.

4. After adjusting dwell angle, always check ignition timing.

## 10-35 IGNITION TIMING

The timing mark is a groove filled with yellow paint, which is on the rear edge of the harmonic balancer. The timing indicator, a part of the timing chain cover, has four ridges outlined with yellow paint. These ridges indicate U.D.C. (marked "0"), "5", "10" and "15" degrees before U.D.C. See Figure 10-40.

Correct timing of V-6 engines exist when the yellow timing mark on the harmonic balancer is


Figure 10-39—Adjusting Contact Point Dwell Angle

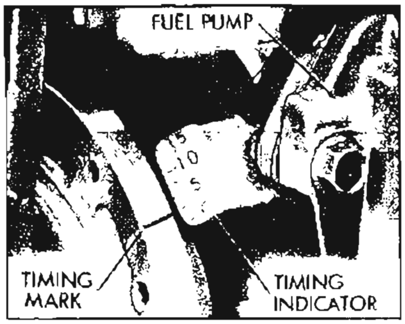



Figure 10-40—Ignition Timing Mark and Indicator—V-8 Setting

aligned with the "5" on the timing indicator with the engine running at correct idle. (Vacuum hose disconnected.) V-8 engines are timed at 2-1/2 degrees (halfway between the "0" and the "5").

**a. Preliminary Timing (Engine Won't Run)**

CAUTION: If the engine must be cranked from under the hood or under the car to change its rotational position for any assembly operation, this cranking can only be done in the "ACC." position. Since the ignition system primary is grounded inside the ignition switch in the "LOCK" position, energizing the starter in this position will cause damage to the ground contact in the ignition switch.

To time the ignition on any engine which will run, use subparagraph b only. However, if the timing of an engine is completely off, the following procedure must first be used to get the engine to run.

1. With left rocker arm cover removed, rotate crankshaft in a forward direction using a suitable wrench on the harmonic balancer to crankshaft bolt. Continue rotation until both valves for No. 1 cylinder are completely closed and the timing mark on balancer

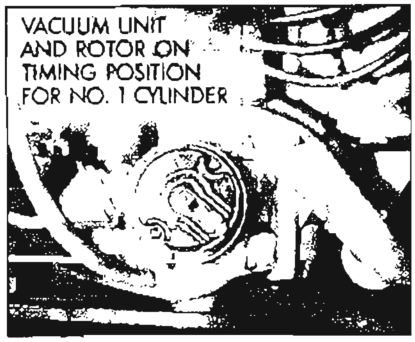



Figure 10-41—Installing Distributor in Engine (V-8)

is aligned with the proper mark on timing indicator. See Figure 10-40. No. 1 cylinder is now in position to fire.

2. Install distributor in engine with rotor in position to fire No. 1 cylinder and with vacuum control in position to connect vacuum pipe. See Figures 10-41 or 42. Install distributor clamp and bolt

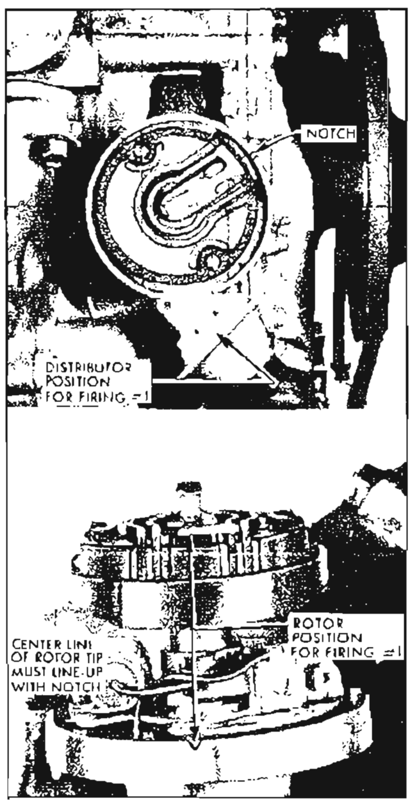



Figure 10-42—Installing Distributor in Engine (V-6)

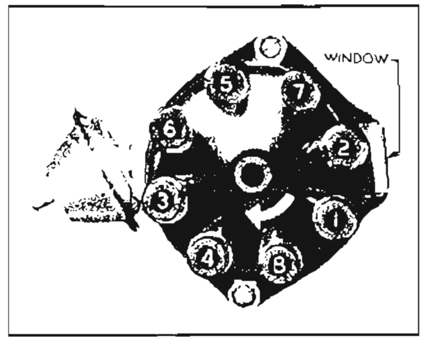



Figure 10-43—Installing Spark Plug Wires in Cap (V-8 Engine)

with lock washer, leaving bolt just loose enough to permit movement of distributor with heavy hand pressure. NOTE: If distributor does not seat in engine block, press down lightly on distributor housing while cranking engine with starter. After distributor tang snaps into slot in oil pump shaft, start timing again from Step 1, leaving distributor installed.

3. Connect primary wire to coil.

4. Rotate distributor counterclockwise slightly until contact points just start to open.

CAUTION: This must be done very carefully or engine will not start.

5. Install distributor cap. Make sure that spark plug wires are correctly installed in distributor cap, through clips on rocker arm covers, and on spark plugs. See Figures 10-43 or 44.

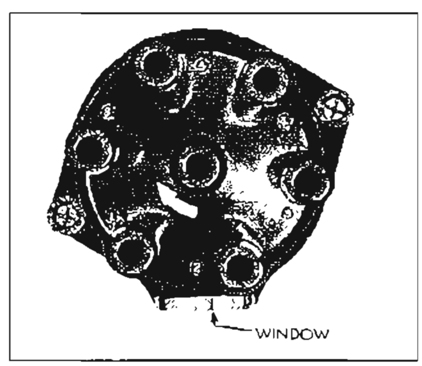



Figure 10-44—Installing Spark Plug Wires in Cap (V-6 Engine)

**b. Finish Timing (Engine Running)**

Contact point dwell angle should always be checked before adjusting ignition timing.

1. Connect a 12-volt power timing light to No. 1 spark plug, using a suitable adapter and following the instructions of the instrument manufacturer. CAUTION: Be careful not to puncture wire or boot as this would start a high voltage leak.

2. Connect a tachometer from distributor terminal of coil to ground.

3. Start engine and adjust contact point dwell angle to 30 degrees. While engine is warming up, make certain that spark plug wires are pushed all the way down into the distributor cap terminals and onto the spark plugs. Nipples must be pushed firmly over the terminals and boots over the spark plugs.

4. Leave engine running until upper radiator tank is hot and choke valve is wide open. On automatic transmission cars, place a block in front of a front wheel and apply parking brake firmly, then shift transmission into drive.

5. Adjust idle speed to 550 RPM. Add 50 RPM for air conditioner.

6. Check stator switch setting and adjust if necessary. See paragraph 3-9.

7. Disconnect vacuum hose.

8. Direct beam of timing light on the timing indicator and edge of harmonic balancer. Turn distributor slowly until yellow mark on balancer is halfway between the "0" and "5" degree marks on timing indicator with a V-8 engine. (V-6 engine cars are timed at 5 degrees.) Tighten clamp bolt securely.

9. Recheck timing mark. Reset if necessary. Reconnect vacuum hose.

10. Recheck idle speed and mixture adjustments.

## 10-36 SPARK PLUG AND WIRE SERVICE

**a. Remove and Inspect Spark Plugs and Wires**

1. To disconnect wires, pull only on boot because pulling on wire might cause separation of the core of the wire. Remove spark plugs and gaskets using a 13/16" deep socket wrench. Use care in this operation to avoid cracking spark plug insulators.

2. Carefully inspect the insulators and electrodes of all spark plugs. Replace any spark plug which has a cracked or broken insulator, or which has loose electrodes. If the insulator is worn away around the center electrode, or the electrodes are burned or worn, the spark plug is worn out and should be discarded. Spark plugs which are in good condition except for carbon or oxide deposits should be thoroughly cleaned and adjusted.

3. The spark plug wires are of a special resistance type. The core is carbon-impregnated linen. This wire is designed to eliminate radio and television interference radiation, but is also superior in resistance to cross-fire. The resistance type wire, however, is more easily damaged than copper core wire. For this reason care must be taken that the spark plug wires are removed by pulling on the spark plug boots rather than on the wire insulation. Also, when it is necessary to replace a spark plug boot, the old boot should be carefully cut from the wire and a small amount of silicone lubricant used to aid in installing the new boot. If the wire is stretched, the core may be broken with no evidence of damage on the outer insulation. The terminal may also pull off the wire. If the core is broken, it will cause missing. In the case of wire damage, it is necessary to replace the complete wire assembly as a satisfactory repair cannot be made.

4. Wipe ignition wires with cloth moistened with kerosene, and wipe dry. Bend wires to check for brittle, cracked, or loose insulation. Defective insulation will permit missing or cross-firing of engine, therefore defective wires should be replaced.

5. If the wires are in good condition, clean any terminals that are corroded and replace any terminals that are broken or distorted. Replace any broken or deteriorated cable nipples or spark plug boots.

Spark plug wires have a built-in resistance of approximately 4000 ohms per foot. However, even the longer wires should never have a total resistance over 20,000 ohms; a wire having more than 20,000 ohms resistance should be replaced.

**b. Spark Plug Cleaning**

Spark plugs which have carbon or oxide deposits should be cleaned in a blast type spark plug cleaner. Scraping with a pointed tool will not properly remove the deposits and may damage the insulator. If spark plugs have a wet or oily deposit dip them in a degreasing solvent and then dry thoroughly with dry compressed air. Oily plugs will cause the cleaning compound to pack in the shell.

Carefully follow the instructions of the manufacturer of the cleaner being used, cleaning each plug until the interior of shell and the entire insulator are clean; however, avoid excessive blasting.

Examine interior of plug in good light. Remove any cleaning compound with compressed air. If traces of carbon or oxide remain in plug, finish the cleaning with a light blasting operation. Clean firing surfaces of center and side electrodes with several strokes of a fine file.

When spark plugs have been thoroughly cleaned, carefully inspect for cracks or other defects which may not have been visible before cleaning.

#### c. Adjusting Spark Plug Gap

Use round wire feeler gauges to check the gap between spark plug electrodes. Flat feeler gauges will not give a correct measurement if the electrodes are worn. Adjust gap by bending the side electrodes only; bending the center electrode will crack the insulator. Adjust gaps to .035". Setting spark plug gap to any other specification to improve idle or effect other changes in engine performance is not recommended.

#### d. Installation of Spark Plugs

For proper engine operation, it is very important that the correct spark plugs are used. If the car is operated under average conditions, AC 44S spark plugs should be used.

For cars operated mainly at high speeds, however, AC 42COM spark plugs should be used.

When installing spark plugs, make sure that gaskets are in good condition to insure a tight seal and also make sure that all surfaces on plugs and in cylinder heads are clean. Install spark plugs by hand, and tighten to 30 ft. lbs. torque, using a 13/16" deep socket, an extension and a torque wrench.

#### e. Installation of Spark Plug Wires

Spark plug wires must be arranged to pass through the wire clips on the rocker arm covers in the same order as they are attached to the spark plugs. If spark plug wires are not correctly installed, missing or cross-firing may result. For instance, No. 5 and 7 cylinders may cross-fire (since they fire consecutively) unless the rubber grommet is inserted in the clip so that No. 5 and 7 wires are separated.

No. 1 spark plug wire is installed in the first distributor cap tower after the adjusting window, moving in the direction of rotation. The other wires are then installed in a clockwise direction according to the firing order. See Figure 10-43 for V-8 engines or Figure 10-44 for V-6 engines.

## 10-37 IGNITION COIL TESTS

#### a. Weak Coils

Most ignition coils that are replaced by service stations are classified by them as weak. Many coils rejected as weak actually test up to specifications and give normal performance.

A coil that actually is weak will first affect engine performance when the ignition reserve is at a minimum. This may be in starting, low speed acceleration or top speed. Eventually the engine will fail to start.

High resistance connections in either the primary or secondary circuit wiring will react the same as a weak coil. Wide spark plug gaps, which require higher voltage than the coil can produce, put the coil under suspicion. High compression and lean carburetors increase the voltage requirements and lead to many needless coil changes. Leakage of high tension current through moisture on an unprotected coil terminal may produce carbon tracks which weaken the coil output voltage. For this reason the nipple on coil high tension terminal must be properly installed and in good condition.

When an ignition coil is suspected of being defective it should be tested as described below before being replaced.

#### b. Testing Coil for Open and Grounded Circuits

Before using a coil test instrument, the coil should be tested for open and grounded circuits, using a 110-volt test lamp and test points.

1. Apply test points to both primary terminals of coil. If test lamp does not light, the primary circuit is open.

2. Apply one test point to the high tension terminal, and the other test point to one of the primary terminals. If secondary circuit is not open, the lamp will not light but tiny sparks will appear at test points when they are rubbed over terminals. If secondary circuit is open, no sparks will occur.

3. Apply one test point to a clean spot on the metal coil case and touch the other point to the primary and high tension terminals. If the lamp lights, or tiny sparks appear at the points of contact, the coil windings are grounded.

4. A coil with open or grounded windings must be replaced since internal repairs cannot be made. It is unnecessary to test such a

coil with instruments. If windings are not open or grounded, a test for short circuits and other internal defects should be made with a reliable coil test instrument.

#### c. Coil Test Instruments

Two general types of instruments are used in testing iginition coils. One type makes use of an open or protected spark gap, while the other reports the condition of the coil on a meter.

The spark gap type of tester should always be used comparatively, that is, the questionable coil should be compared with a coil of the same model that is known to be good. Both coils must be at the same temperature and identical test leads must be used. Certain variables caused by altitude, atmospheric or spark gap electrode conditions are usually present in the spark gap type of test.

The meter type testers are usually designed to permit testing the coil without making any connection to the secondary terminal. This eliminates the variables usually present in the spark type of test and avoids the necessity for comparison with a good coil.

Since different makes and models of coil testers differ in their methods of use, as well as in the markings on meters, the instructions of the manufacturer must be carefully followed when using any coil tester. The instrument must be frequently checked to make certain that it is accurately calibrated.

Regardless of instrument or method used, the coil must be tested at normal operating temperature because internal defects often fail to show up on a cold test.

## 10-38 DISTRIBUTOR CONDENSER TESTS

When a condenser is suspected of being faulty it should be tested with a reliable condenser tester to determine whether it is actually the cause of ignition trouble. The condenser should be tested for (a) high series resistance (b) insufficient or excessive capacity (c) low insulation resistance.

A special condenser tester is required to make these tests. When using a condenser tester the instructions of the manufacturer must be carefully followed: IMPORTANT: The condenser must be at normal operating temperature when it is being tested.

#### a. High Series Resistance

High series resistance in the condenser causes condenser to be slow in taking the charge and, consequently, a higher than normal voltage is developed across the contact points when they first start to open. This higher voltage causes more disturbance at the contact points, which in turn causes more rapid wear and more tendency toward oxidized surfaces. The condition can become severe enough to cause complete failure of the ignition system. It would first show up during starting and low speed operation.

High series resistance may be caused by internal resistance in condenser or by resistance in the connections. Any defect caused by internal resistance should show up at low mileage since this does not change very much with time or use. The damaging changes are in the connections, in which looseness, corrosion, or broken strands may develop.

New condensers may have a series resistance as low as .05 ohm. Some condenser testers are set to reject condensers which have a resistance of .3 ohm; however, tests show that the resistance can go to .5 ohm before ignition performance if affected.

#### b. Insufficient or Excessive Capacity

The condenser specified for use in the Buick ignition system has a capacity of .18 to .23 microfarads.

If a condenser is used which does not have the specified capacity of .18 to .23 microfarads, excessive pitting of one contact point and a corresponding build-up of metal on the other contact point will result. A condenser having insufficient capacity will cause build-up of metal on the breaker arm (positive) point. A condenser having excessive capacity will cause build-up of metal on the contact support (negative) point.

In exceptional cases, pitting and metal build-up on contact points may be experienced even when condenser capacity is within the specified limits. In such cases the life of contact points will be improved by installing a condenser of high-limit capacity if metal build-up is on breaker arm point, or a condenser of low-limit capacity if metal build-up is on contact support point. There is usually sufficient variation in the capacities of stock condensers to permit selection of a high or low limit condenser by testing the available stock.

#### c. Low Insulation Resistance

A weak or leaking condenser is usually one that has absorbed water so that the insulation resistance of the winding is lowered to the extent that the condenser will not hold a charge satisfactorily. A condenser with low insulation resistance will drain sufficient energy from the ignition system to lower the secondary voltage seriously. The condenser specified for use in the Buick ignition system is sealed to prevent absorption of water, and no other type should be used.

A leaky condenser usually does not affect engine performance except when hot. It is unlikely that a condenser with low insulation resistance would cause missing at low or medium speeds under conditions where the condenser does not get hot. A condenser that has low enough resistance to affect engine performance when cold would probably be indicated as broken down on most condenser testers.

Condenser testers equipped to check condensers for low insulation resistance usually give a reading in megohms, a megohm being one million ohms. The scale is marked to indicate whether the condenser is good or bad.

When testing a condenser for low insulation resistance the lead should always be disconnected from the distributor. Since the distributor terminals and the connected circuit have much lower insulation resistance than the condenser, failure to disconnect the condenser lead will give a reading much to low.

## 10-39 DISTRIBUTOR SERVICE OPERATIONS

### a. Removal and Disassembly of Distributor for Inspection

1. Disconnect the distributor primary wire from coil and disconnect hose from vacuum unit. Remove distributor cap by inserting a screwdriver in upper slotted end of cap latches; then press down and turn 90° counterclockwise.

2. Make a mark on distributor base in line with center of rotor. Then carefully note the direction the vacuum unit points in relation to engine so that the distributor can be replaced in the exact position after it is serviced. See Figure 10-41 or 42. CAUTION: If engine is turned over while distributor is out, complete ignition timing procedure must be followed (par. 10-35).

3. Remove distributor clamp and lift distributor out of timing chain cover.

4. Remove rotor from end of distributor shaft by removing two attaching screws and lock washers.

5. Remove contact point set and condenser as described in paragraph 10-40.

6. Remove two screws holding vacuum advance unit to housing. Remove advance unit.

7. Remove "O" ring seal from shaft housing.

### b. Inspection of Distributor Parts

1. Wash the distributor assembly in clean solvent, holding housing horizontal to avoid getting cleaning solvent into the lubricant reservoir. Dry parts thoroughly.

2. Cap. Wipe out distributor cap with a clean cloth and inspect it for chips, cracks, and carbonized paths which would allow high-tension leakage to ground. Such defects require replacement of cap. Clean loose corrosion from surfaces of terminal segments inside the cap. Do not use emery cloth or sandpaper. If segments are deeply grooved, the cap should be replaced. Pull cables from terminal sockets and inspect sockets for corrosion. Clean sockets, using a stiff wire brush to loosen corrosion.

3. Rotor. If rotor is cracked, spring contact is badly worn, or rotor tip is badly burned, rotor must be replaced.

4. Condenser. Inspect condenser and primary leads for loose or frayed terminal connections. Check condenser in a reliable condenser tester as described in paragraph 10-21.

5. Vacuum Advance Unit. Inspect rod end for excessive wear. Push rod into unit as far as possible, hold finger tightly over nipple, and then release rod. After about 15 seconds, release finger from hole and notice if air is drawn in. If not, diaphragm is leaking and unit must be replaced.

6. Contact Points. Carefully examine the mating surfaces of the contact points, noting whether they are flat and making good contact, or whether they are blackened, pitted, burned, or worn excessively. Contact points which have been in service for some time will appear dull and gray. This

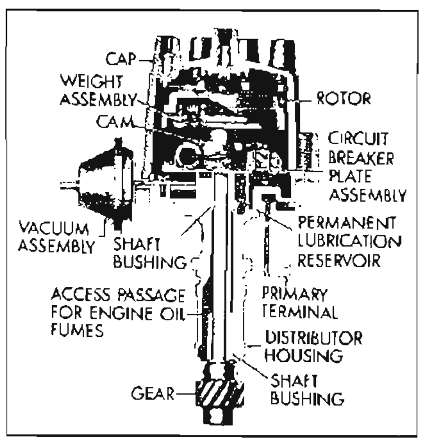



Figure 10-45—Distributor, Sectional View

condition is normal and such points should not be replaced.

Contact points which are blackened or only slightly burned or pitted may be cleaned with a thin contact stone or a clean fine-cut contact file. Remove high points only; it is not necessary to remove all build-up or pit. CAUTION: Do not use emery cloth or sandpaper to clean contact points because particles of these materials usually imbed in contact surfaces and cause points to burn.

Excessively burned, pitted or worn contact points cannot be cleaned up and aligned satisfactorily; therefore, they must be replaced to insure satisfactory ignition (par. 10-34).

If contact points are excessively burned, pitted, or blackened it is advisable to check for cause and make the necessary correction so that new points will give satisfactory service. Burned or pitted points may be caused by:

(a) Ignition coil resistance unit not properly connected into circuit. Connect between ignition switch and coil positive (+) terminal.

(b) Defective condenser. Test the condenser (par. 10-38).

(c) Insufficient contact point opening. Adjust contact point dwell as described in paragraph 10-34.

(d) Oil vapors getting into the distributor and depositing on contact surfaces of points. This causes arcing and rapid burning of contact points. Oil vapor entering distributor usually produces a smudgy line under the points.

(e) High voltage, or any other condition in electrical system causing excessive flow through contact points. This results in a blue scale forming on point surfaces. Check condenser for high series resistance (par. 10-38). Check voltage and current regulator (par. 10-21).

(f) Radio capacitor connected to distributor terminal. This will cause excessive pitting of contact point. Capacitor should be connected to the positive (battery) terminal of coil.

7. If any remaining parts are defective, the distributor must be completely disassembled to replace them. Before disassembling distributor further, inspect parts as follows:

(a) Centrifugal Advance. Inspect for excessive wear between centrifugal weights and advance cam, or pivot pins. Turn weight base plate in a clockwise direction until weights are fully extended, then release and allow springs to return weights to retard position. Repeat several times. Springs should return weights to stop without sticking and there should be no excess free movement in the retard position.

(b) Cam and Weight Base Plate. Inspect cam lobes for scoring or excessive wear. Check weight base plate for bind or excessive looseness on distributor shaft.

(c) Breaker Plate. Attempt to rotate plate to check for excess free motion between plate and vacuum advance unit linkage. Check plate for excessive looseness on O.D. of upper distributor shaft bushing. Check breaker plate ground lead for poor spotweld at plate end or for loose or frayed terminal connections.

(d) Distributor Shaft. Check for excessive wear between shaft and bushings in housing.

(e) Driven Gear. Inspect gear for scoring of teeth or excessive wear.

8. To replace any part found to be defective in Step 7, the distributor must be completely disassembled as follows:

(a) Drive spring pin through driven gear and shaft using a 1/8" straight punch. See Figure 10-46. CAUTION: Be careful not to bend distributor shaft or damage gear when driving pin out.

(b) Slide gear off shaft and then pull the shaft, breaker cam, and centrifugal advance mechanism from the housing.

(c) Remove two advance weight springs and weights. Slide the integral weight base plate and breaker cam off the lower end of shaft.

(d) Remove retainer from upper bushing and lift breaker plate and felt washer from upper bushing. NOTE: Lubricant reservoir contains sufficient lubrication for the life of the distributor. Never remove plastic reservoir cover or degrease bore of housing.

(e) Remove distributor primary lead and grommet from housing. NOTE: No attempt should be made to replace the shaft bushings in the housing as the housing and bushings are only serviced as an assembly.

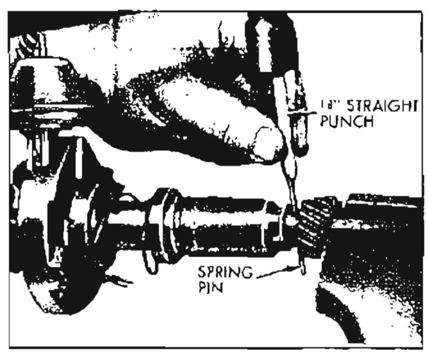



Figure 10-46—Removing Distributor Gear Pin

**c. Assembly and Installation of Distributor**

NOTE: The first five steps apply only if the distributor has been completely disassembled.

1. Install distributor primary lead and rubber grommet. Install vacuum advance unit with ground lead terminal from breaker plate under outer mounting screw.

2. Install felt washer over upper bushing and apply a few drops of light oil. Then place breaker plate over upper bushing and vacuum advance link. Install retainer on upper bushing. See Figure 10-47.

3. Slide distributor cam and weight base plate on distributor shaft.

4. Install distributor shaft and breaker cam assembly in housing. Install advance weights and springs.

5. Slide driven gear on shaft. Install spring pin. Be careful not to damage gear.

6. Place condenser and bracket over bosses on breaker plate and secure with screw.

7. Place contact point set over boss on breaker plate and secure with two screws and lock washers. Apply one drop of light oil to breaker arm pivot. Then install condenser and primary leads.

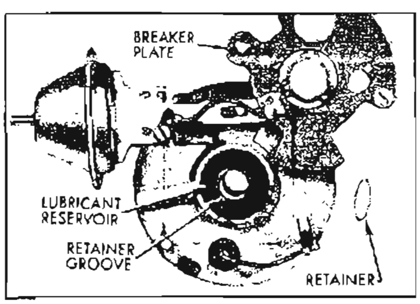



Figure 10-47—Installing Breaker Plate and Retainer

8. Work a small amount of high temperature cam and ball bearing lubricant (available through U.M.S.) into a clean cloth, then hold cloth against distributor cam while turning distributor shaft. CAUTION: Excessive grease may throw off into contact points when hot.

Petroleum jelly is not suitable for temperature reached by the cam.

9. Make the preliminary contact point adjustment (par. 10-34, b).

10. Install rotor and secure with two screws, lock washers, and plain washers.

NOTE: The square and round lugs on the bottom of the rotor must be positioned in the corresponding holes in the weight base plate.

11. If a reliable distributor tester is available, check the distributor to make certain that the centrifugal and vacuum advance mechanisms are operating according to the specifications given in paragraph 10-4 (c). NOTE: Mount distributor in tester with all end-play of the distributor shaft in the up position; this is to eliminate any possible drag between the centrifugal advance cam and weight base plate.

12. Install new "O" ring seal on distributor housing.

13. Insert distributor in engine block so that rotor is pointing to mark made on distributor base, with vacuum advance unit pointing in exact original direction.

14. Install distributor clamp and bolt with lock washer, leaving bolt just loose enough to permit movement of the distributor with heavy hand pressure.

15. Connect primary wire to distributor side of coil. Install distributor cap.

16. If spark wires were removed, make certain that they are arranged as shown in Figure 10-43 or 44. Wires must be pushed all the way down into the distributor cap terminals and onto the spark plugs. Nipples must be pushed firmly over the terminals and boots over the spark plugs.

17. Start engine and adjust contact point dwell angle (par. 10-34, c). Then adjust ignition timing (par. 10-35, b). NOTE: If engine was accidentally turned over while distributor was out, complete ignition timing procedure must be followed (par. 10-35, a and b).

## 10-40 IGNITION SWITCH AND LOCK REPAIRS

**a. Ignition Switch Key**

If ignition key sticks or feels rough as it is inserted into the lock, examine it for burrs and smooth up with a fine cut file. Blow finely powdered graphite into lock cylinder, then work key in and out of cylinder a number of times to work graphite into tumblers. Do not use oil in lock cylinder as this will cause tumblers to stick.

The ignition switch key has an octagonal shaped head and also operates the door locks. The round head key operates the glove box lock and the trunk lock. The key code number for each key is stamped in the small knock-out insert. See Figure 10-48.

**b. Lock Cylinder Replacement**

To remove lock cylinder, insert key and turn ignition switch to "ACC" position. Insert a stiff wire (paper clip) in small hole in face of cylinder to depress the pin which locks the cylinder, turn cylinder counterclockwise and pull out. To install lock cylinder insert key, place cylinder in switch

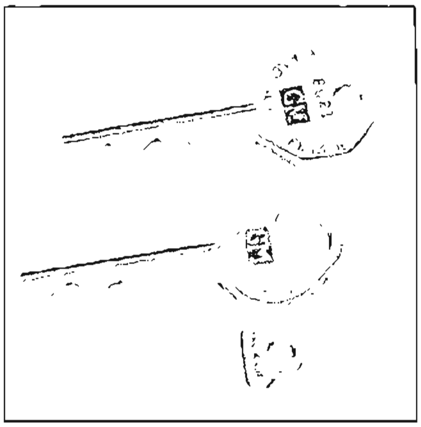


Figure 10-48—Keys

slightly counterclockwise from "ACC" position, press inward and turn cylinder clockwise.

**c. Ignition Switch Replacement**

1. Disconnect battery ground cable to avoid a possible short circuit.

2. Unplug connector from switch.

3. Remove lock cylinder (subpar. b).

4. Remove ignition switch escutcheon using Wrench J-8562. Remove ignition switch. See Figure 10-65.

5. Install new switch by reversing above procedure.

**d. Removal of Lock Cylinder Which Cannot be Unlocked With Key**

When ignition switch fails to unlock with the proper key, and lock has previously been operating satisfactorily, the lock cylinder can be removed as follows:

1. Draw a centerline on cylinder at 90° to left side of key slot, insert key, and make a prick punch mark on centerline 3/8" from side of key. Carefully drill a .0465 hole (No. 56 drill) through cylinder flange at this point.

2. File the end of a stiff wire (paper clip) to a taper. Insert this end of wire in drilled hole to pry the cage bar assembly down so that lock cylinder can be turned. After turning cylinder slightly, remove the wire to avoid wedging, then remove lock cylinder in the regular manner (subpar. b, above).

3. Stake cage bar in place at four points. Staking must not distort cage. Reinstall lock cylinder and check operation with key. If operation is satisfactory, plug the drilled hole with a small pin No. 00 x 1/8" (Parker Kalon type "U").

# SECTION 10-F

# LIGHTING SYSTEM

## CONTENTS OF SECTION 10-F



## 10-41 HEADLIGHTS AND CONTROLS

### a. Description of Lighting Switch

The switch uses a multiple push-on type connector. The switch is a "push-pull" type which also incorporates a manually operated rheostat for controlling the instrument panel lights, and a detent position which completes the dome light circuit. Three "push-pull" positions of the switch knob provide control of the exterior lights as follows:

1. Off position (knob all the way in) cuts off all lights controlled by the switch.

2. Parking position (knob pulled out to first notch) turns on the parking lights, tail lights, and license light. The instrument panel lights also will be turned on if the rheostat is set for these lights.

3. Driving position (knob pulled out to last notch) turns parking lights off and turns headlights on, while the other lights remain as in the parking position. The headlights will be on the upper or lower beams depending on the position of the separate dimmer switch.

In the parking and driving positions, the instrument panel lights are controlled by rotating the light switch knob. With the knob turned counterclockwise, these lights are on maximum brightness. As the knob is turned clockwise, they gradually dim until they are off at the full clockwise position of the knob.

4. Dome light position (knob turned fully counterclockwise) turns the dome light on. The dome light can be turned on regardless of the in-or-out position of the switch.

### b. Description of Thermo Circuit Breaker

A thermo circuit breaker is incorporated in the lighting switch assembly, to protect wiring from damage due to short circuits in the headlight and front parking light circuits only.

The thermo circuit breaker consists of a bi-metal blade and set of contact points connected in series with the lighting circuits. An abnormal flow of current throught the circuit breaker, such as would be caused by a short circuit in a lighting circuit, heats the bi-metal blade sufficiently to separate the points and cause them to vibrate. The vibrating blade alternately opens and closes the circuit thus reducing the flow of current and protecting the wiring against overheating and burning. The flickering light produced by the vibrating circuit breaker serves as a warning to the operator of vehicle that a short circuit exists.

### c. Test of Lighting Switch

If the lighting switch is suspected of being faulty, the contacts can be tested by connecting a low reading voltmeter between the wire supplying current to the contact and the wire conducting current away. This must be done with the switch in a position where the contact under test is closed. See Figure 10-49.

1. To check the switch contact for the headlights, pull switch knob out to last notch and also make sure dimmer switch is in upper beam position. Connect voltmeter prods between battery and headlight terminals of switch (between red and light blue wires). If voltage loss through switch contacts is over .2 volt, switch must be replaced.

2. To check the contact for the tail lights, connect voltmeter between tail lights and tail light fuse terminals (between two brown wires). If voltage loss is over .1 volt, switch must be replaced.

3. To check the contact for the parking lights, put switch knob in first notch position. Connect voltmeter between battery and parking light terminals (between red and purple wires). If voltage loss is over .1 volt, switch must be replaced.

### d. Replacement of Lighting Switch

1. Disconnect battery ground cable to avoid a possible short circuit.

2. Unplug multiple connector from lighting switch.

3. Pull switch knob out to last notch, then depress the spring loaded latch button on left side of switch, while pulling knob and rod assembly out of switch.

NOTE: If latch button is depressed before switch knob is pulled out, knob and rod assembly will not release.

4. Remove switch escutcheon using Wrench J-8563 and remove switch from instrument panel. See Figure 10-65.

5. Install switch in reverse order of above steps, making sure that switch alignment tang lines up with slot in instrument cluster before tightening mounting nut.

### e. Test of Thermo Circuit Breaker

To test the thermo circuit breaker, remove lighting switch from instrument cluster to avoid possible damage to adjacent instruments.

Since the current required to open the circuit breaker contacts depends somewhat on outside temperature, the circuit breaker should be tested at normal temperature (70° to 80°F.).

1. Connect an ammeter and a carbon-pile rheostat in series with the battery terminal of lighting switch and positive terminal of a 12-volt battery, and set rheostat to provide maximum resistance. Rheostat must have capacity for 50 amperes and be adjustable down to .3 ohms.

2. With switch on, connect the headlight terminal of lighting switch and the negative post of battery. See Figure 10-49.

3. Adjust rheostat to give 26 amperes. The circuit breaker should open within 60 seconds.

4. Adjust rheostat to give 15 amperes on ammeter. The circuit breaker should remain closed indefinitely at 15 amperes.

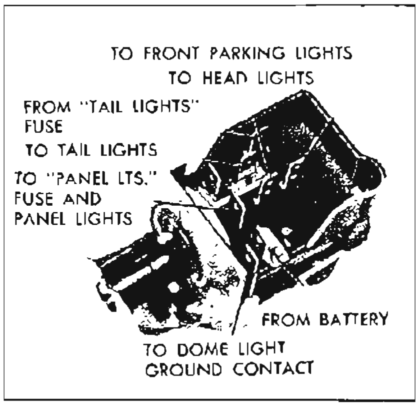



Figure 10-49—Light Switch

5. If circuit breaker does not operate as specified the lighting switch assembly must be replaced since internal repairs cannot be made.

### f. Dual Headlamp Assembly

A dual headlamp system is standard equipment on all series and consists of two dual headlamp assemblies, one mounted on each side of the car.

Each dual headlamp includes two 5 3/4" T-3 sealed beam units mounted in a single housing enclosed by one headlamp door. The inboard unit is used for bright lights only and has a single filament. The outboard unit is used for both bright and dim lights and has two filaments. For identification, the inboard unit is marked "1," the outboard unit is marked "2".

When the dimmer switch is in the dim or lower beam position only, the outboard unit of each dual headlamp is on. Both outboard and inboard units of each dual headlamp are on when the dimmer switch is in the bright or high beam position.

The T-3 sealed beam unit has three projections equally spaced around the perimeter of the lens. These projections are ground off at the factory to provide a mounting surface for aiming devices.

These aiming devices are used without having headlights on as described below.

### g. Dimmer Switch

The driver may select the upper or lower headlight beam as traffic and road conditions demand by operating the dimmer switch mounted on the toe panel in a convenient position for the left foot.

The dimmer switch opens and closes the circuits to the upper and lower lamp filaments in the sealed beam units, thereby alternately raising and lowering the headlight beams with each successive operation of the switch. Depression of switch button turns the rotary contacts one position within the switch. The spring-loaded button automatically returns to the reset position when released.

The wiring connection to the dimmer switch is made by a multiple connector. The dimmer switch is mounted on the inner side of the toe pan, so the switch, connector and wiring are all inside the car.

### h. Headlight Beam Indicator

Whenever the upper headlight beams are lighted, a beam indicator bulb in the instrument cluster also lights, producing a small spot of red light in front of the driver. See Figure 10-61. For safety reasons, never pass an approaching car with the beam indicator showing red.

## 10-42 HEADLAMP SEALED BEAM UNIT REPLACEMENT AND ADJUSTMENT

### a. Replacement of Sealed Beam Unit

1. Raise hood and pull the wiring connector from the sealed beam unit.

2. Remove headlamp door by removing retaining screws.

3. Unhook the spring from retaining ring, then remove sealed beam unit and retaining ring assembly, being careful not to disturb the two beam adjusting screws.

4. Remove two screws fastening retaining ring to mounting ring. Remove retaining ring and sealed beam unit.

5. Install new sealed beam unit by reversing removal procedure. Position lens with the "1" or "2" up. The reflector has three lugs which fit into notches in the headlamp mounting ring.

CAUTION: Make sure that sealed beam unit is marked "1" for an inboard unit or "2" for an outboard unit.

6. Before installation of headlamp door, adjust headlamp for proper aim as described below.

### b. Headlamp Aiming

The headlamps must be properly aimed in order to obtain the maximum road illumination and safety that has been built into the headlighting equipment. With the Guide T-3 type sealed beam units, proper aiming is even more important because the increased range and power of this lamp make even slight variations from recommended aiming hazardous to approaching motorists. The headlamps must be checked for proper aim whenever a sealed beam unit is replaced and after any adjustment or repairs of the front end sheet metal assembly.

Regardless of method used for hecking headlamp aim, car must be at normal weight. Tires must be uniformly inflated to specified pressure (par. 1-1). If car will regularly carry an unusual load in rear compartment, or a trailer, these loads should be on car when headlamps are checked. Some states have special requirements for headlamp aiming adjustment and these requirements should be known and observed.

Horizontal and vertical aiming of each sealed beam unit is provided by two adjusting screws which move the mounting ring in the body against the tension of the coil spring. There is no adjustment for focus since the sealed beam unit is set for proper focus during manufacturing assembly.

## 10-43 PARKING, TAIL, STOP, LICENSE AND BACK-UP LIGHTS

NOTE: See paragraph 10-5 for lamp bulb and fuse specifications.

### a. Front Parking and Signal Lights

Each front parking and signal lamp contains one 32-4 CP lamp bulb which provides a 4 CP parking light and a separate 32 CP direction signal light. The pins on lamp bulb and slots in socket are offset to prevent improper installation of bulb in socket. The parking light is controlled by the lighting switch and the circuit is protected by the switch thermo circuit breaker. The turn signal light is separately controlled by the signal switch and the circuit is protected by the 15 ampere "BACK-UP, STOP, TURN" fuse on the fuse block under the instrument panel. The lamp bulb is serviced by removing the lens from the lamp body. Front turn signal lens are amber in color.

### b. Tail, Stop, and Signal Lights

Each rear lamp assembly contains a 32-4 CP bulb which is used as a combination tail, stop, and turn signal light. The tail lights are controlled by the lighting switch and the circuit is protected by the 10 ampere "TAIL-CLOCK" fuse on the fuse block.

The combination tail, stop, and directional signal lamp bulb sockets can be snapped out from inside the trunk compartment on sedans. Since the position of the bulb filaments is important in the rear lamps, these sockets have been provided with a tongue and groove index to insure correct positioning. To change the bulb on the station wagon it is necessary to remove the lens.

The stop lights are controlled by a mechanical switch mounted on the brake pedal bracket. This spring-loaded switch makes contact whenever the brake pedal is applied. When the brake pedal is released, it depresses the switch plunger to open the contacts and turn the brake lights off. The turn signal switch is in the circuit, so the stop lights may be flashing or constant depending on the position of the turn signal switch. The turn signal, stop and back-up light circuits are all portected by the 15 ampere "BACK-UP, STOP, TURN" fuse mounted on the fuse block.

### c. Rear License Light

The rear license lamp is mounted above the license plate to provide adequate lighting of the plate. The lamp contains one 4 CP lamp bulb which operates in conjunction with the tail lights, and its circuit is also protected by the 10 ampere "TAIL-CLOCK" fuse on the fuse block.

### d. Back-up Lamps and Switch

Back-up lamps are optional on all series and are located in the rear bumper. Each lamp contains a 32 CP bulb behind clear plastic lens.

On 3-speed synchromesh transmission cars, the back-up light switch is mounted on the upper side of the steering column mast jacket in approximately the same location as the combined neutral safety back-up light switch on automatic transmission cars. See Figure 10-50. The synchromesh back-up light switch has a spring-loaded switch slide which is engaged by a tang turned up from the control shaft tube metal. When the transmission is shifted into reverse, this tang pushes the slide to the left, closing the back-up switch contacts; when shifted out of reverse, the spring-loaded switch slide returns to the off position. When the transmission is shifted into second gear, the control shaft tang rotates in a different location so that it misses the switch slide.

To check for proper operation of the back-up light switch, turn on the ignition switch, place the shift lever in reverse, and make sure the back-up lights are lit. Then place the shift lever in neutral and make sure the back-up lights are out. Next place the shift lever in second gear and make sure the lights are not lit. The switch mounting screw holes are slotted slightly, allowing some adjustment if necessary. See Figure 10-50.

On 4-speed synchromesh transmission cars, the back-up light switch is mounted on the side cover of the transmission. See Figure 10-51. The switch is actuated by a small diameter rod connected to the reverse shift lever. Switch timing can be changed, if necessary, by bending the rod.

On automatic transmission cars, the back-up light switch is combined with the neutral safety switch. It is mounted on the mast jacket under the instrument panel.

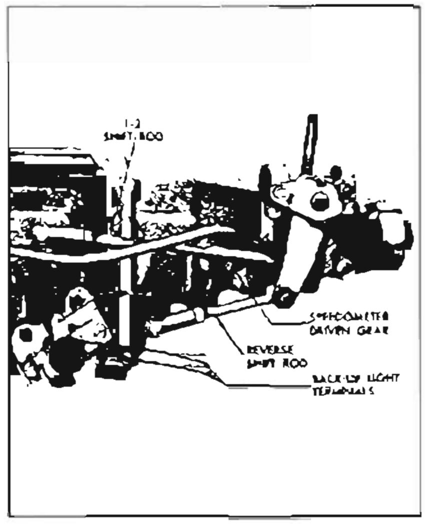


Figure 10-51—Back-Up Light Switch—4-Speed Transmission

The switch is actuated by a flange turned up from the transmission control shaft; a slotted portion of the plastic switch slide projects through the opening in the mast jacket to engage this metal flange.

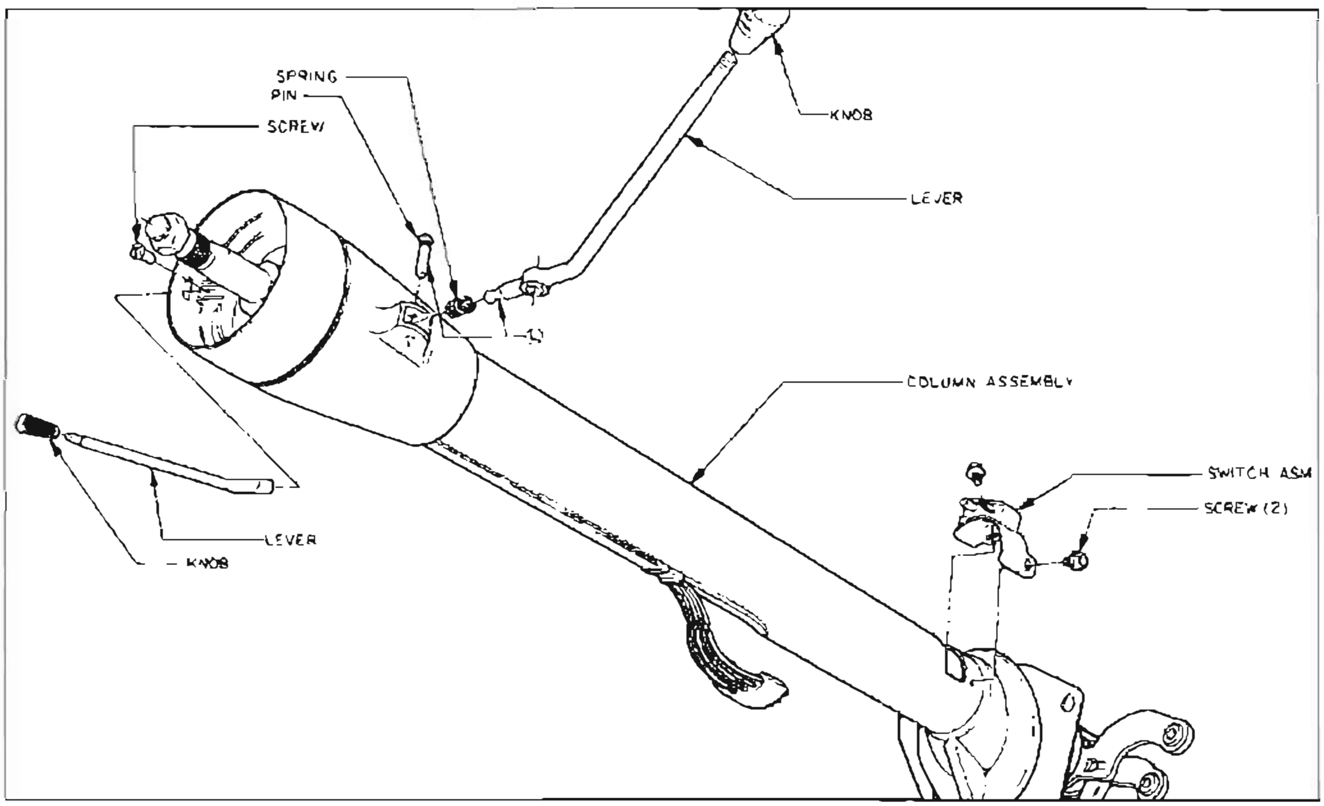



Figure 10-50—Back-Up Light Switch Installation - Synchromesh Transmission Cars

When the neutral safety portion of the switch is correctly timed, the back-up portion is properly timed automatically. Slotted mounting screw holes permit sidewise movement of the switch for proper timing. See Figure 10-52.

See subparagraph e for the adjusting procedure for the neutral safety and back-up light switch. The back-up light circuit is protected by the 15 ampere "BACK-UP, STOP, TURN" fuse on the fuse block.

### e. Neutral Safety Switch Adjustment (All Automatic Transmission Cars)

Adjust neutral safety switch as follows:

1. Check shift control linkage and adjust if necessary (par. 5-12).
2. Place shift control lever in Drive position.
3. Insert a 3/32" drill or a No. 42 drill through gauging hole in right forward face of switch and into gauging hole in center of switch slide.
4. If gauging drill enters hole in switch slide (approximately 1/4 inch), neutral safety switch adjustment is OK. If gauging drill will not enter hole in switch slide, loosen two switch mounting screws and move switch sidewise until gauge enters hole. Then retighten screws.
5. To recheck adjustment, turn on ignition switch, place shift control lever in reverse, and make sure back-up lights are lit. Set parking brake, place shift lever in Neutral and make sure engine will start. Then place shift lever in Park and try starting engine again. Engine must not start in Drive or Reverse.

## 10-44 INTERIOR LIGHTS AND CIGAR LIGHTER

NOTE: See paragraph 10-5 for lamp bulb and fuse specifications.

### a. Instrument Panel Lights

The speedometer, heater-defroster controls and clock are illuminated by lamp bulbs mounted to provide indirect lighting.

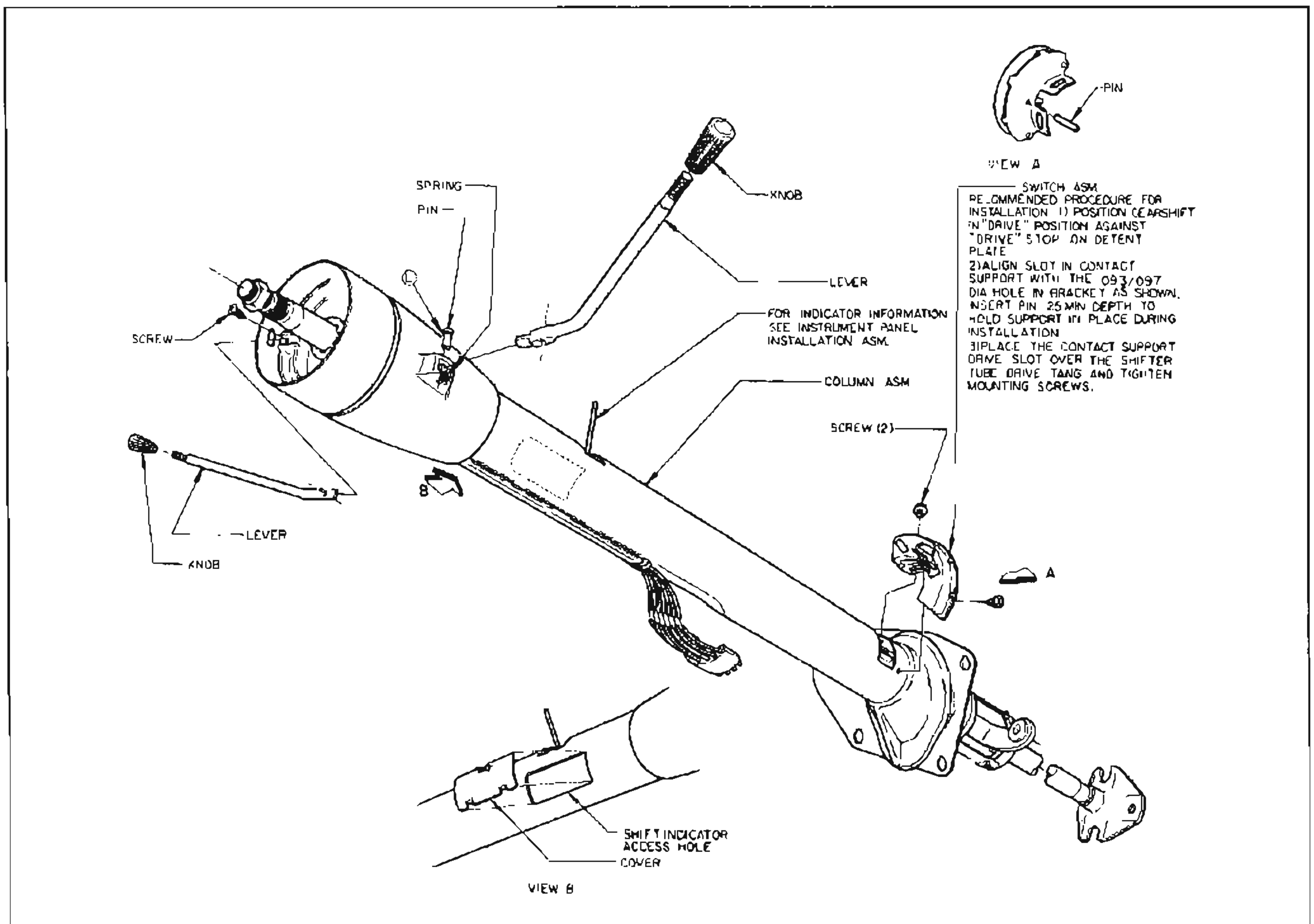



Figure 10-52—Neutral Safety and Back-Up Light Switch Installation - Automatic Transmission Cars

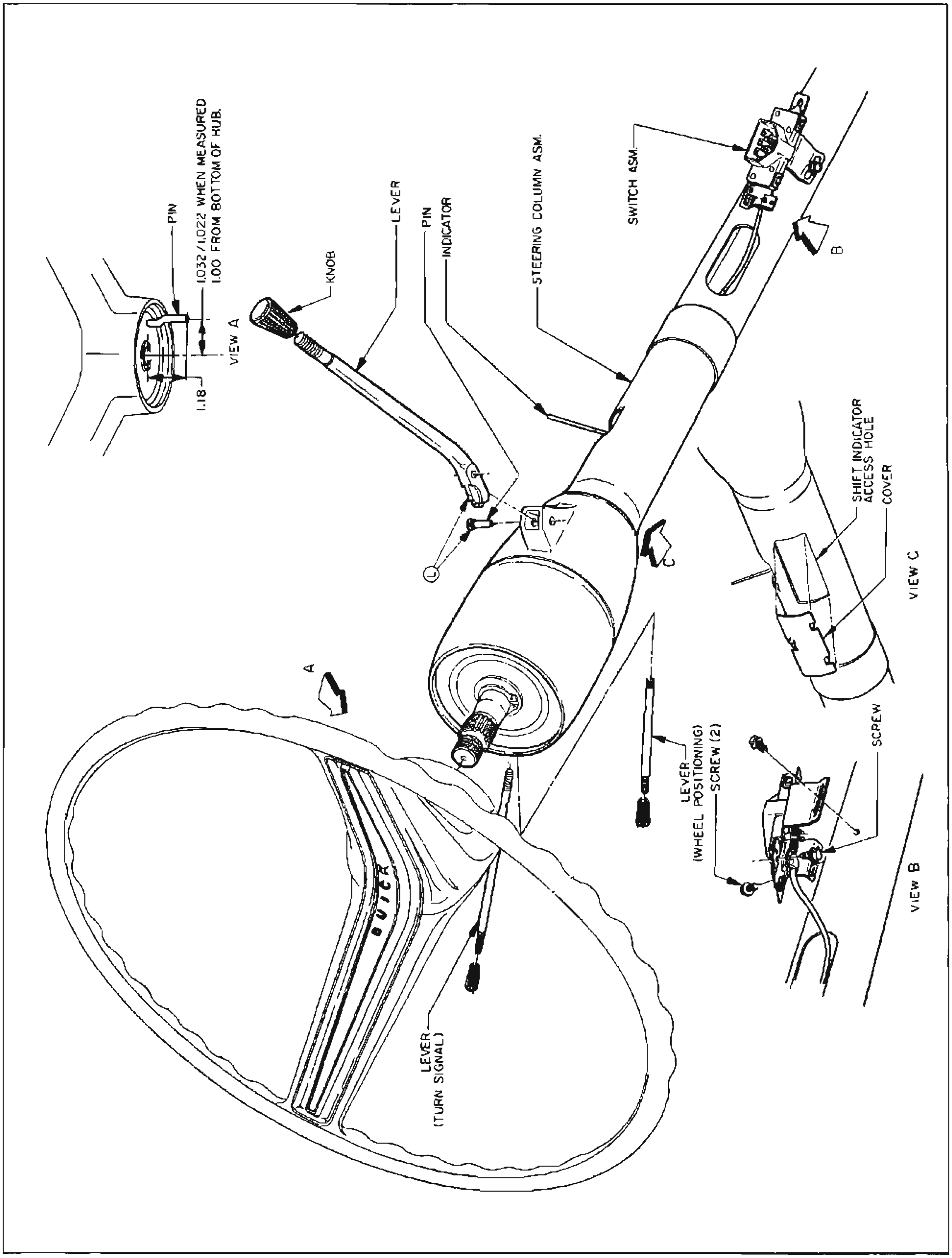



Figure 10-53—Turn Signal Switch Installation - Tilt Wheel Cars

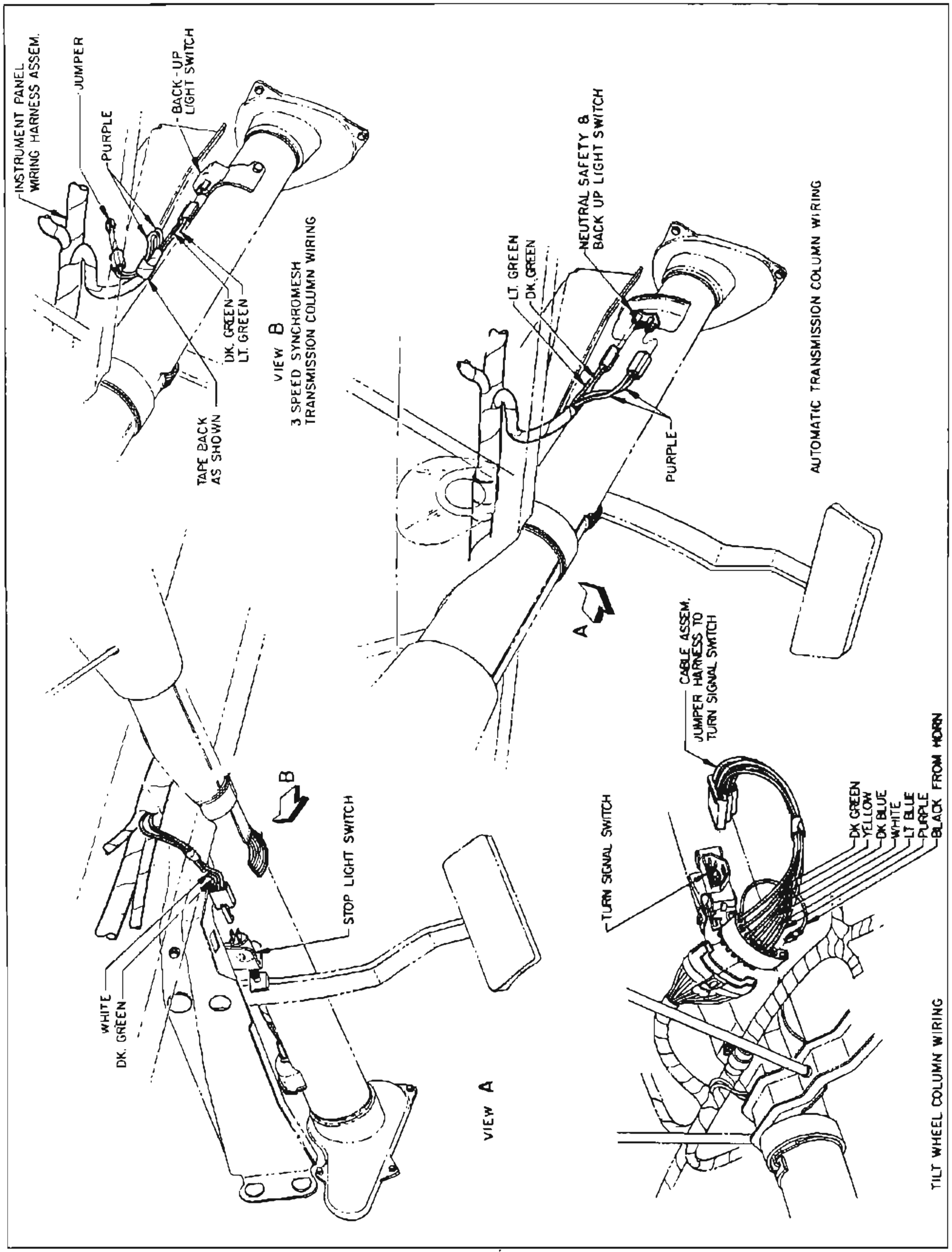



Figure 10-54—Neutral Safety, Back-Up and Stop Light Switches

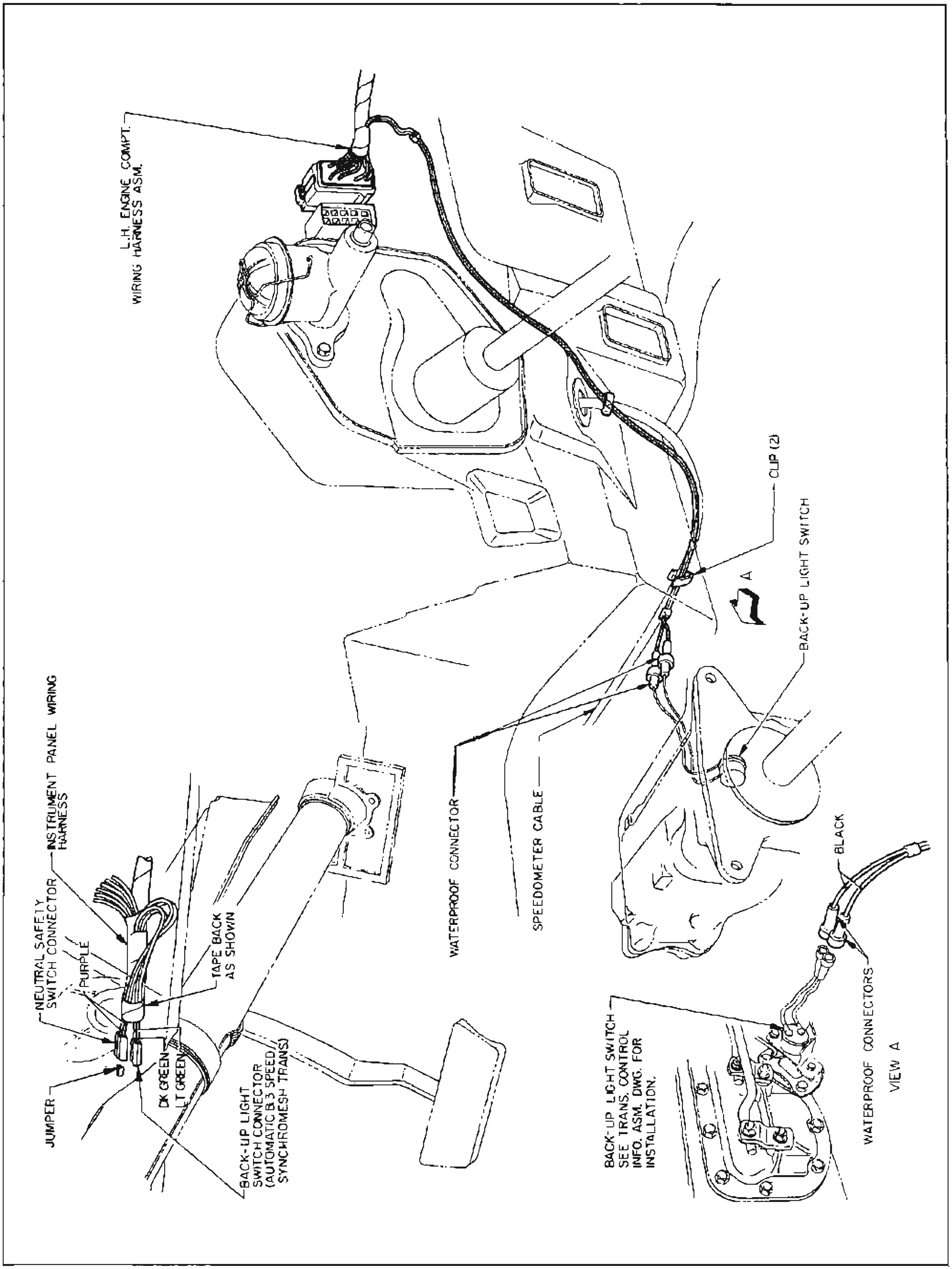



Figure 10-55—Back-Up Light Wiring - 4 Speed Transmission

The instrument panel lights are controlled by the lighting switch as described in paragraph 10-41 and the circuits are protected by the 3 ampere "PANEL" fuse on the fuse block.

To replace any of the instrument cluster light bulbs, remove the socket and bulb assembly from the instrument cluster by rotating counterclockwise. Replace the bulb and reinstall the assembly by rotating it clockwise.

**b. Direction Signal Indicator Lights**

The direction signal indicator consists of a 2 CP bulb mounted at each end of the instrument cluster.

**c. Cigar Lighter**

The cigar lighter is heated by pressing the knob in until it latches; the knob will automatically unlatch and return to "off" position when heated to proper temperature.

The lighter is equipped with an ash guard, to prevent ashes and loose tobacco from falling on the user's clothing and to permit the lighter to be passed around with less danger of burning the fingers.

A thermal operated circuit breaker is used to protect the element. The circuit breaker is reset manually simply by removing the plastic covered cup on the back of the lighter base and depressing the spring plunger until it indexes in position.

**d. Automatic Transmission Dial Light**

The transmission control dial is illuminated by a 2 CP bulb located just below the point where the speedo cable enters the speedometer.

The light intensity is controlled by the light switch in the same manner as the instrument panel lights.

# SECTION 10-G
# SIGNAL SYSTEMS

## CONTENTS OF SECTION 10-G



## 10-45 HORNS AND CONTROL CIRCUIT

### a. Horns and Relay

Two Delco-Remy electrically operated vibrator type horns are mounted in the engine compartment. Both horns are operated simultaneously by a horn relay which is controlled by the horn push button on steering wheel. One horn is high pitched and one horn is low pitched, so that together they produce a pleasant blended tone.

The horn relay is an electrical switch which closes the circuit between the battery and the horns when the push button is pressed and opens the circuit when the button is released. The relay permits control of the horns with a small amount of current passing through the horn button contacts. The high current required by the horns would cause arcing and burning of these contacts.

When the horn button contacts are closed, a small amount of current flows through the relay winding to ground at the horn push button contact. This magnetizes the relay core which attracts the flat steel relay armature. The armature has a contact point which makes contact with a stationary point to close the horn circuit. When horn push button is released, current stops flowing through relay winding so that the core loses its magnetism; the armature spring then causes contact points to be separated.

### b. Horn Relay Ground Circuit

The standard steering wheel has a cap at hub of wheel with a push button mounted in its center. See Figure 10-56. This push button operates the same as the two that are used with the deluxe steering wheel which is described below.

The deluxe steering wheel has an actuator bar mounted across the steering wheel. Fastened to the base of the actuator bar, but insulated from it, is a contact plate which is "hot" at all times. When the actuator bar is rocked, the contact plate contacts a ground plate on the steel hub of the steering wheel to ground the horn relay winding, close the relay contacts, and blow the horn. When the actuator bar is released, two springs move the actuator bar and contact plate assembly clear of the ground plate.

Current is supplied to the contact plate by a spring-loaded brush. See Figure 10-56. A wire attached to the contact ring runs down inside the steering column jacket and out under the instrument panel. The wire from the horn relay connects at this point.

## 10-46 TROUBLE DIAGNOSIS AND ADJUSTMENT OF HORNS

If a horn button contact is constantly grounded, the horn will not stop blowing or if a contact cannot be grounded, the horns will not blow.

There are two basic troubles which may be caused by a defective horn relay. If neither horn will blow at all, this trouble may be caused by the relay points not making contact. Or if horns will not stop blowing, this trouble may be caused by relay points sticking.

### a. Horns Will Not Blow

When horns fail to blow, first check wiring circuit and relay because even a faulty horn will generally make some sort of noise if current is getting to it. If horns are at fault, or tone is poor, adjust each horn for specified current draw as instructed in subparagraph e.

1. Break circuit at multiple connector on steering mast jacket and ground wire from horn relay. If horn now blows, horn relay ground circuit in mast jacket or steering wheel has an open. Reconnect wire on connector and check horn wire and horn contacts. Circuit from connector at mast jacket to contact on steering wheel must be complete.

2. If horns still do not blow when wire at mast jacket is grounded, unplug double connector from horn relay part of junction block assembly. See Figure 10-56. Then plug a known good relay and junction block assembly onto the connector and press battery terminal of new assembly against old junction block battery terminal stud for a source of current. Have helper try blowing horns. If horns blow, original

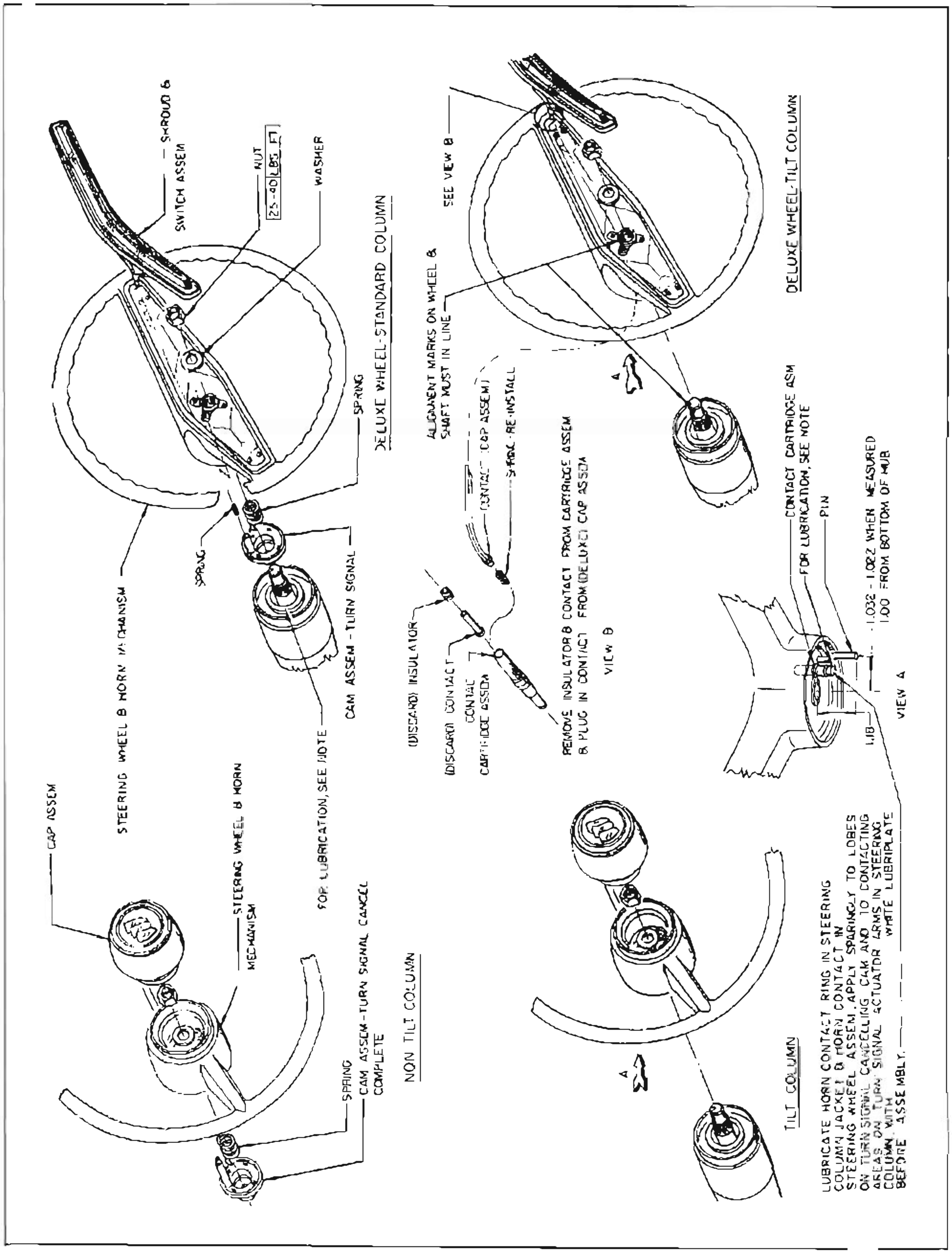



Figure 10-56—Steering Wheel Installation

relay is defective and must be replaced.

3. If horns still will not blow with substitute horn relay trouble is elsewhere. Check wiring connections and wiring throughout horn circuit. See Figures 10-119 and 120 for wiring diagram.

**b. Horns Will Not Stop Blowing**

1. Disconnect multiple connector on harness that enters mast jacket. If horns stop blowing, relay is OK, but horn control circuit in jacket is grounded. If horns do not stop blowing, horn relay control circuit is grounded. Check horn wire and contacts in mast jacket and steering wheel if horns stopped blowing. See Figure 10-56.

2. If horns still do not stop blowing, unplug double connector from horn relay. Then plug a known good relay onto the connector and make contact with junction block stud.

3. If horns now stop blowing, original relay contacts are sticking and relay and junction block assembly must be replaced. However, if horns still do not stop blowing, control circuit is grounded between relay and connector on harness that enters jacket.

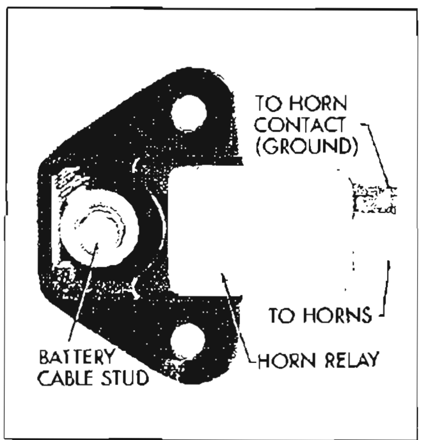



Figure 10-57—Horn Relay and Junction Block Assembly

**c. Horn Tone Is Poor**

If either norn blows only part of the time or tone is poor, adjust current draw at horn, subparagraph e.

**d. Voltage Test at Horn**

An improperly operating horn and its wiring circuit can be tested by connecting a voltmeter between the horn terminal and ground and noting the voltage while the horn button is pressed. The voltage at the horn gives an indication of the cause of trouble as follows:

1. No voltage indicates trouble in horn button, relay, wiring, or ground.

2. Less than 7 volts indicates trouble in wiring or excessive current draw due to short circuit in horn.

3. Voltage between 7 and 11 indicates that wiring is okay. Look for sticking or improper adjustment of horn.

4. Voltage above 11 indicates improper adjustment or open circuit in horn due to broken coil lead.

**e. Adjustment of Horns**

1. Remove horn from car.

2. Connect an ammeter in series with horn and a fully charged 12 volt battery to measure current draw while horn is blowing. Current draw for each horn (either high or low note) should be between 4.5 and 5.5 amperes at 12.0 volts.

3. Adjust to specified current draw if necessary, by turning adjusting screw clockwise to decrease or counterclockwise to increase current draw. Turn only 1/4 of a turn at a time. If adjustment loosens screw excessively, it may be staked with a prick punch. See Figure 10-58.

Increasing the current draw increases the horn volume. Too much current will cause a high

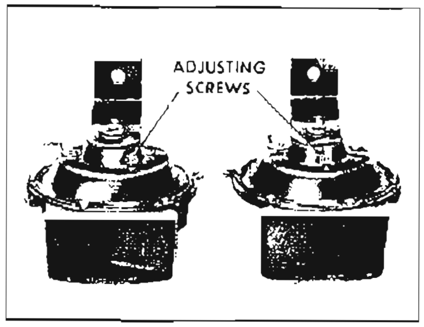



Figure 10-58—Matched Horn Set

cut-in voltage which will cause a sputtering sound and may cause horn to stick in cold weather.

4. After each horn has been adjusted individually, sound both horns together to check for proper blend of tone. If adjustment does not provide a satisfactory tone, horn contacts are pitted, making it necessary to replace horn.

5. With horns reinstalled on car, connect a voltmeter between each horn terminal and ground to check voltage while both horns are blowing. This should be between 7 and 11 volts.

## 10-47 DIRECTION SIGNAL LAMPS AND SWITCH

**a. Direction Signal Lamps and Indicators**

The front direction signal light is produced by the 32 CP filament in the bulb mounted in the front parking lamp. The rear direction signal light is produced by the 32 CP filament in the bulb of the rear lamp assembly. This filament also serves as a stoplight.

When the ignition switch is turned on and the direction signal switch is manually operated to indicate a turn, the front and rear signal lights flash on and off on the side of car for which a turn is indicated. The flashing of signal lights is caused by a flasher which is connected into the proper signal circuit by contacts made in

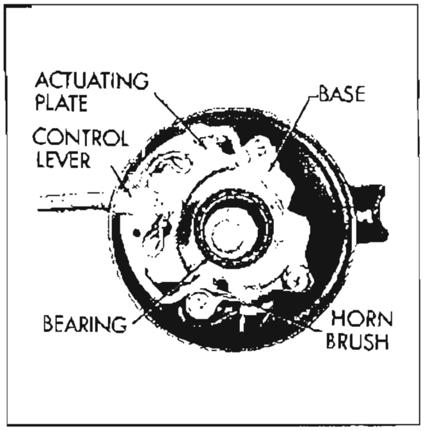



Figure 10-59—Top View of Turn Signal Switch Control

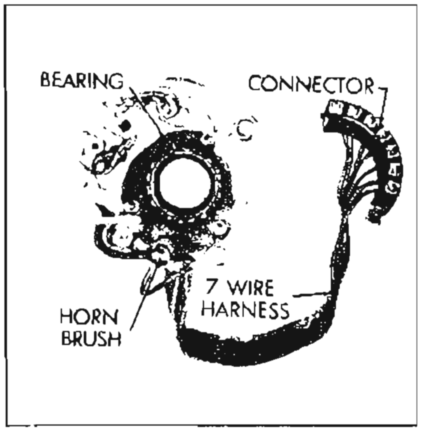



Figure 10-60—Turn Signal Switch Plate and Wiring Assembly

the direction switch when switch is set for a turn.

When the direction signal lights are flashing, a signal indicator bulb on instrument panel also flashes, producing a green light to indicate the direction for which the signal has been set.

**b. Direction Signal Switch Operation**

The direction or turn signal switch is mounted in a housing at the upper end of the steering column mast jacket, just below the steering wheel. See Figure 10-58. The turn signal actuating plate (on the inner end of the control lever) is mounted to a pivot just over and contacting the turn signal switch. This switch is integral with a seven wire harness (about 1-1/2 feet long) and a multiple connector. See Figure 10-60. The switch and a spring-loaded horn brush are both mounted in the switch plate base.

The turn signal actuating plate and base are both formed from plastic. Interference between these two plastic parts provides the detent feel for right, left and neutral positions of the control lever.

A plastic cancelling cam assembly fits over the steering shaft; the lower end of the cam contacts the steering shaft upper bearing and the upper face of the cam engages the steering wheel hub, causing the cam to turn with the wheel. At the outer edge of the cam there is a horn contact ring in a position to depress the horn brush.

Whenever the control lever is in either turn position, a projection on the cancelling cam contacts one arm of the actuating plate once per revolution of the steering wheel. Rotation of the cam in one direction simply snaps the flexible tip of the plastic actuating plate but does not move it; rotation in the other direction causes the actuating plate to be pushed back to neutral position.

**c. Trouble-Shooting Direction Signal System**

When a front or rear signal bulb is burned-out, the indicator light for that direction will stay on. This immediately notifies driver when any signal light quits operating.

1. No Signal Anywhere. If there is no signal at any front, rear, or indicator light, first check fuse on fuse block marked "BACK-UP, STOP TURN". Since this fuse also protects the stop light system, functioning stop lights indicate that fuse is OK.

If fuse checks OK, next eliminate flasher unit by substituting a known good flasher. If new flasher does not cure trouble, check signal system wiring connections at fuse block and at signal switch.

2. Signals One Direction Only. If signal works properly on one side, but there is no signal at front, rear, or indicator light on other side, trouble is in signal switch. If trouble cannot be easily corrected replace switch assembly.

3. Signal Stays On One Direction. If the indicator light stays on in one direction (does not flash), check for a burned-out light bulb or an open circuit in wire to bulb not lighting.

NOTE: If brake stop lights function properly, rear signal light bulbs are OK.

4. Fails to Cancel After Completion of Turn. If signal lights do not turn off after completion of turn, check for worn or broken switch actuator parts or for broken cancelling cam.

NOTE: It is necessary to remove steering wheel to service switch actuator parts.

**d. Direction Signal Lamp Circuits**

Since the direction signal lights are independent of the headlamp lighting switch and thermo circuit breaker, the wiring circuits are protected by a "DIR. SIG." fuse on the fuse block under the cowl. The flasher is also mounted on the fuse block, which serves as a terminal block between the signal switch and the chassis wiring.

Figure 10-61 shows the directional signal circuits when signal switch is set for No Turn, Right Turn, and Left Turn. Direction signal switch wiring is also shown in the wiring circuit diagram, Figures 10-119 and 120.

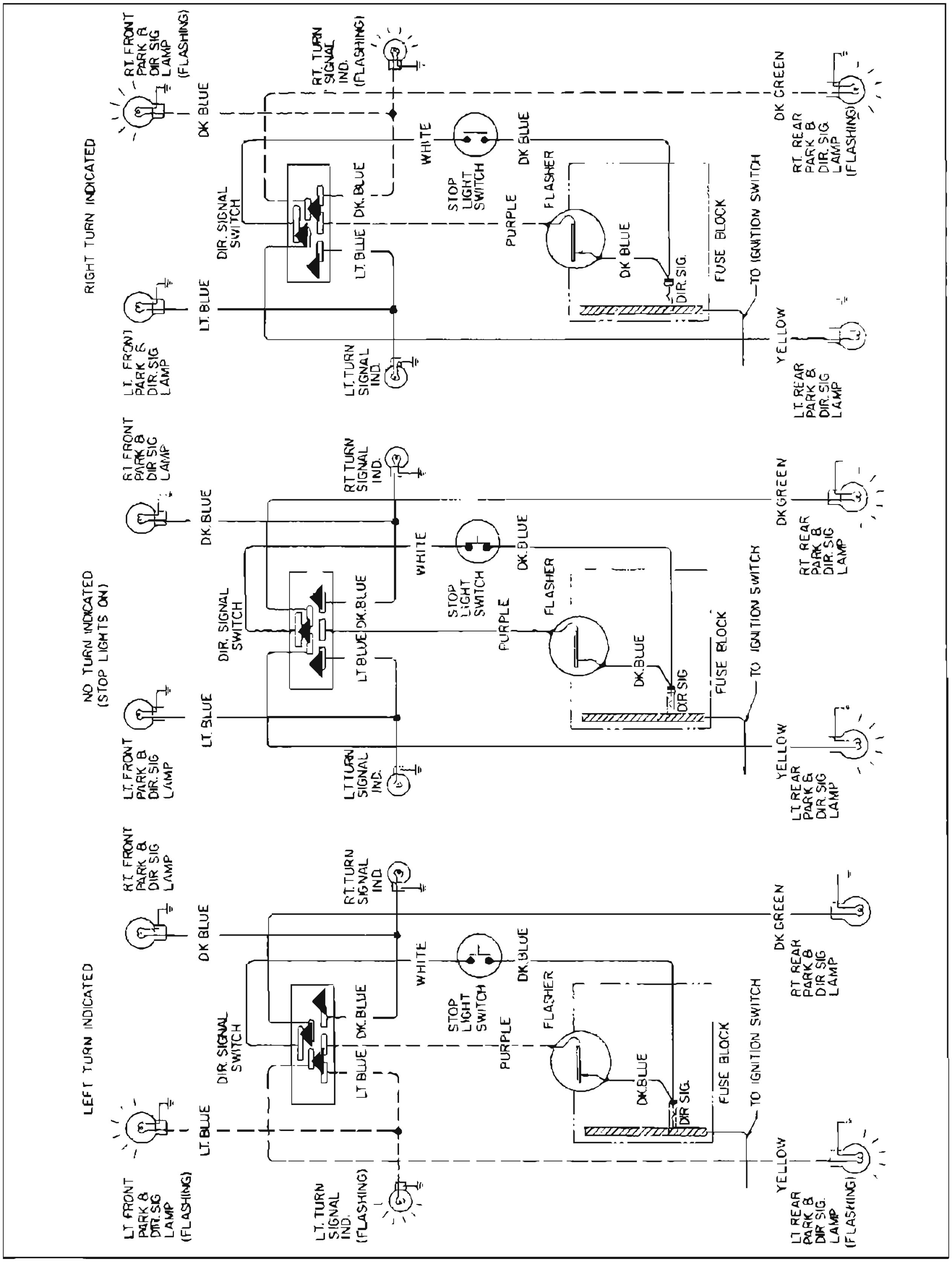



Figure 10-61—Turn Signal Wiring Diagram

# SECTION 10-H
# INSTRUMENTS AND CLOCK

## CONTENTS OF SECTION 10-H



## 10-48 INSTRUMENT CLUSTER ASSEMBLY, GENERATOR INDICATOR, OIL PRESSURE INDICATOR, TEMPERATURE INDICATOR

### a. Description of Instrument Cluster Assembly

The instrument cluster assembly contains the speedometer, fuel gauge, indicator lights and clock. For the instrument cluster location on the instrument panel, see Figure 10-62.

The generator, temperature and oil pressure indicators use red lights to warn the driver of conditions other than normal when the engine is running.

A printed circuit which is part of the speedometer housing is used to complete the circuit for the fuel gauge and the lights in the cluster assembly.

A rectangular disconnect plug, which is part of the instrument panel wiring harness, attaches to the printed circuit contacts. The two retaining fingers are of different widths to insure correct assembly of the disconnect plug in the printed circuit. If the printed circuit should become defective, it should be replaced as it is not practical to repair it.

To remove the printed circuit and housing assembly, it is necessary to remove the instrument cluster.

The light bulb sockets are accessible without removing the cluster and are removed from the printed circuit by turning the bulb sockets counterclockwise.

CAUTION: Disconnect battery ground cable from battery terminal before removing any instrument panel unit or wiring.

### b. Removal and Installation of Instrument Cluster Assembly

1. Remove cover extension assembly by removing four screws across the bottom, then raising the entire extension to disengage it from four clips across the top. See Figure 10-66.

2. Remove heater control trim bezel by removing four screws from corners. See Figure 10-65.

3. Remove four screws from instrument cluster and pull cluster out as far as connections allow.

4. Disconnect speedometer cable, printed circuit plug, shift indicator lamp, clock wire, light switch connector, wiper switch wires, lighter wire and accessory switch wires (if any).

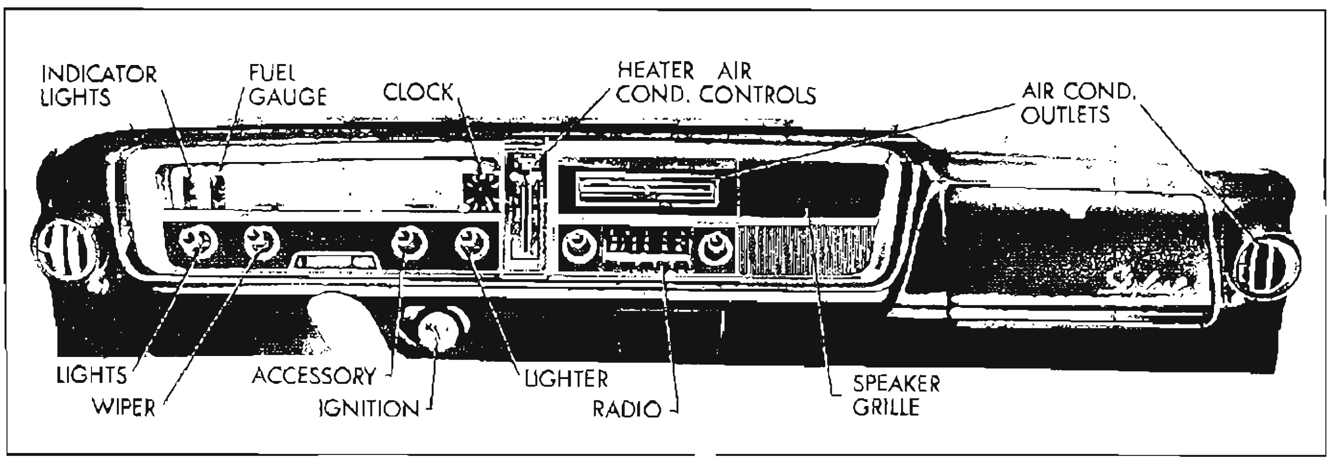



Figure 10-62—Instrument Panel

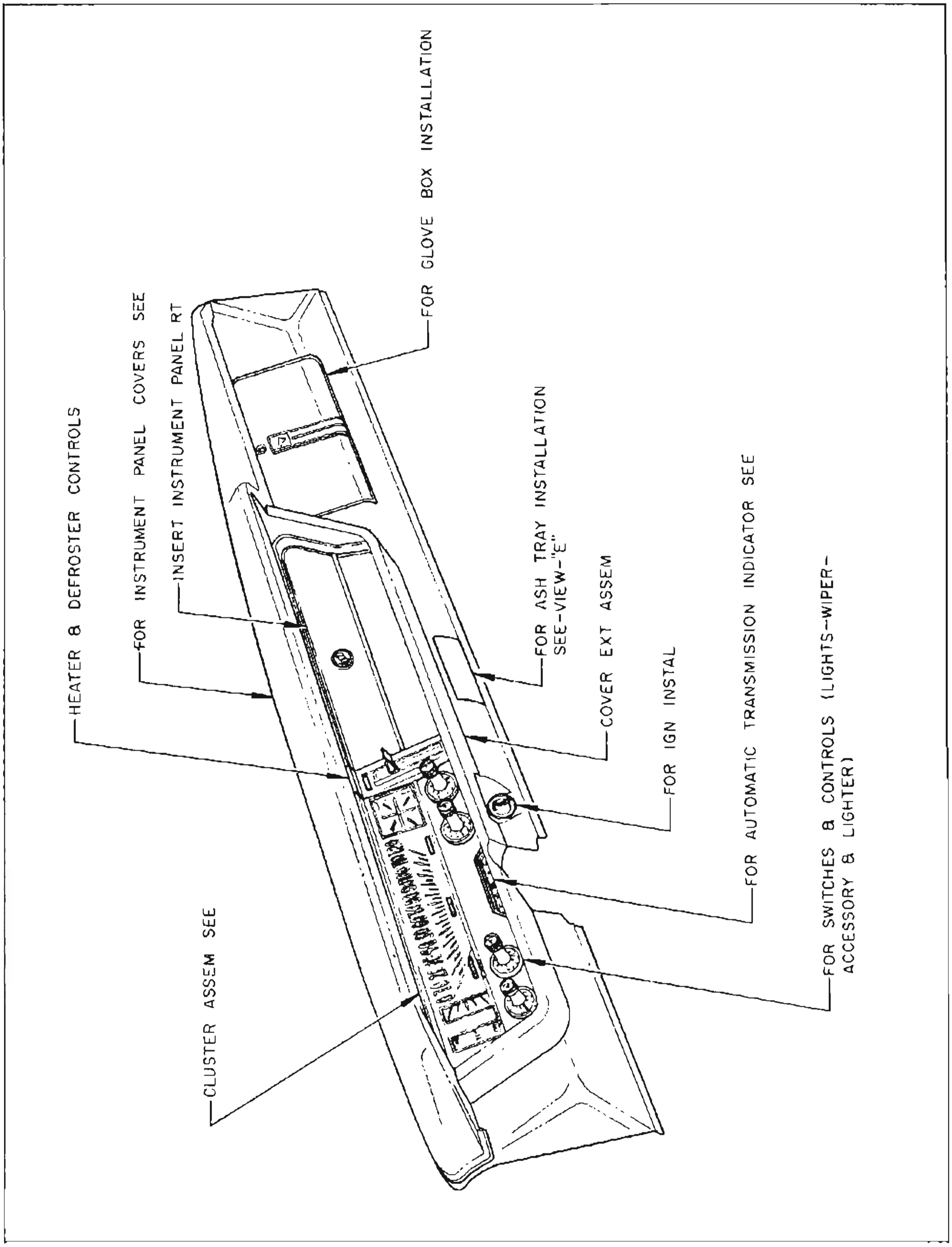



*Figure 10-63—Instrument Panel Installation - Index*

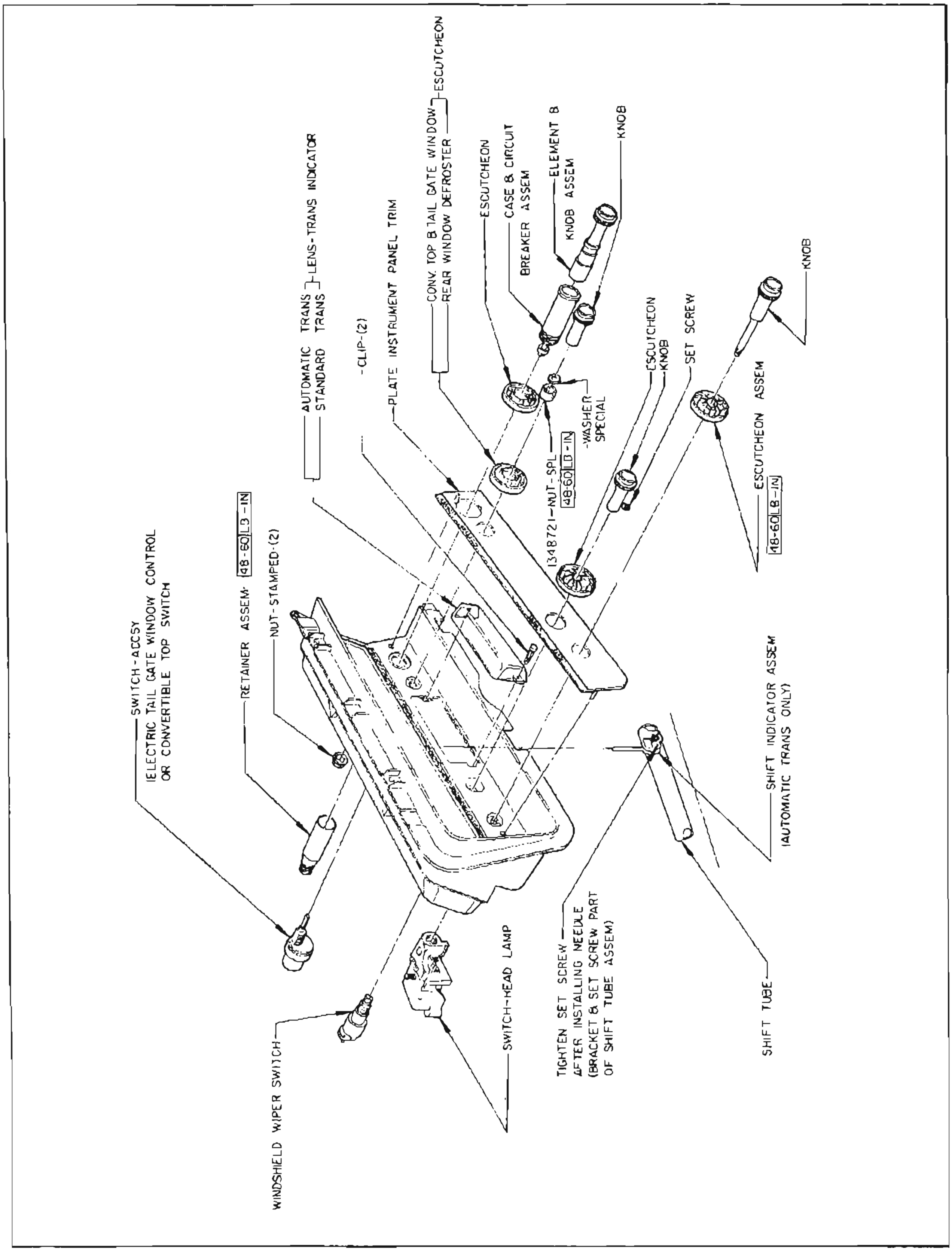



Figure 10-64—Instrument Panel Switch Installation

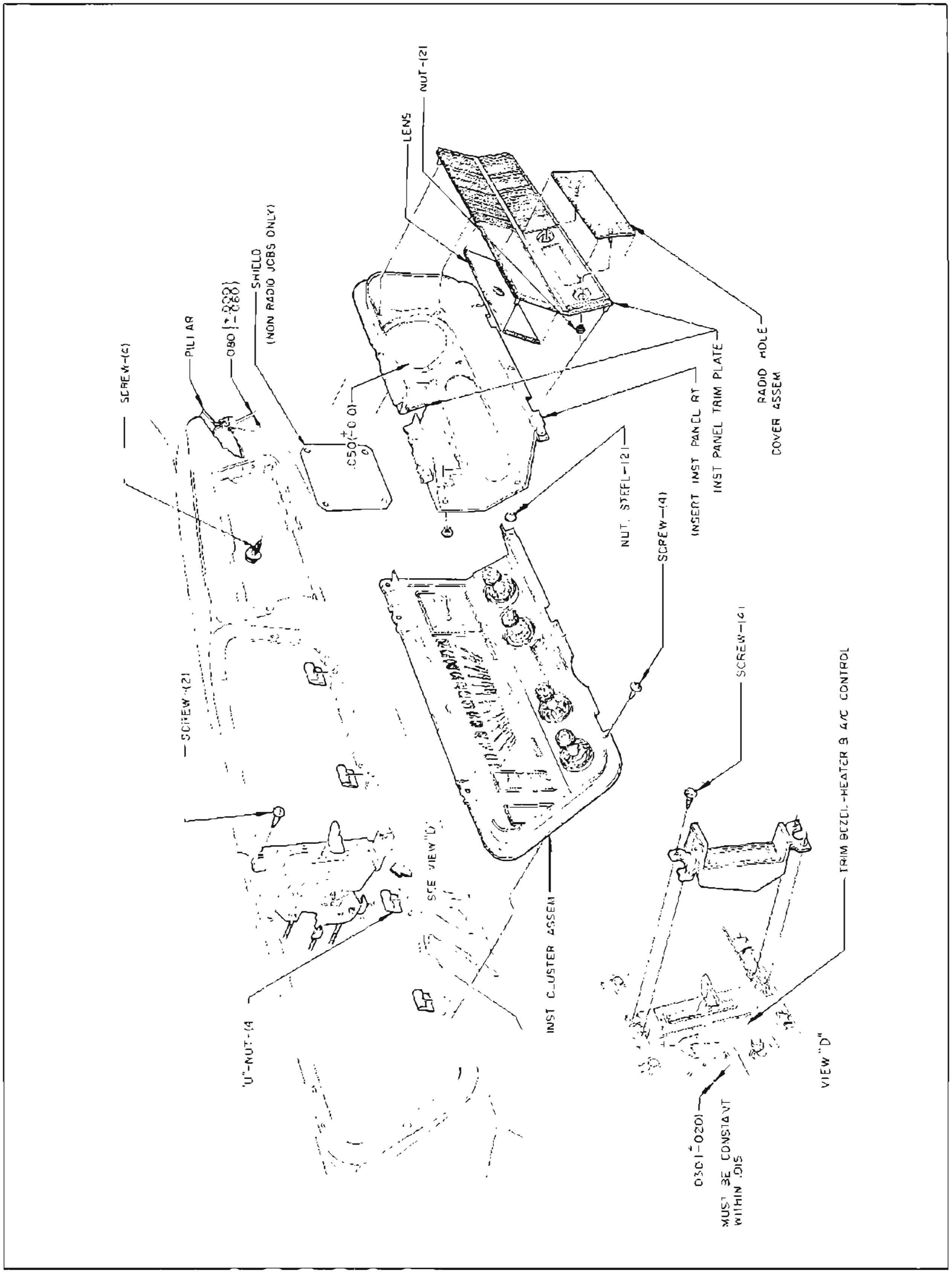



Figure 10-65—Instrument Cluster and Right Insert Installation

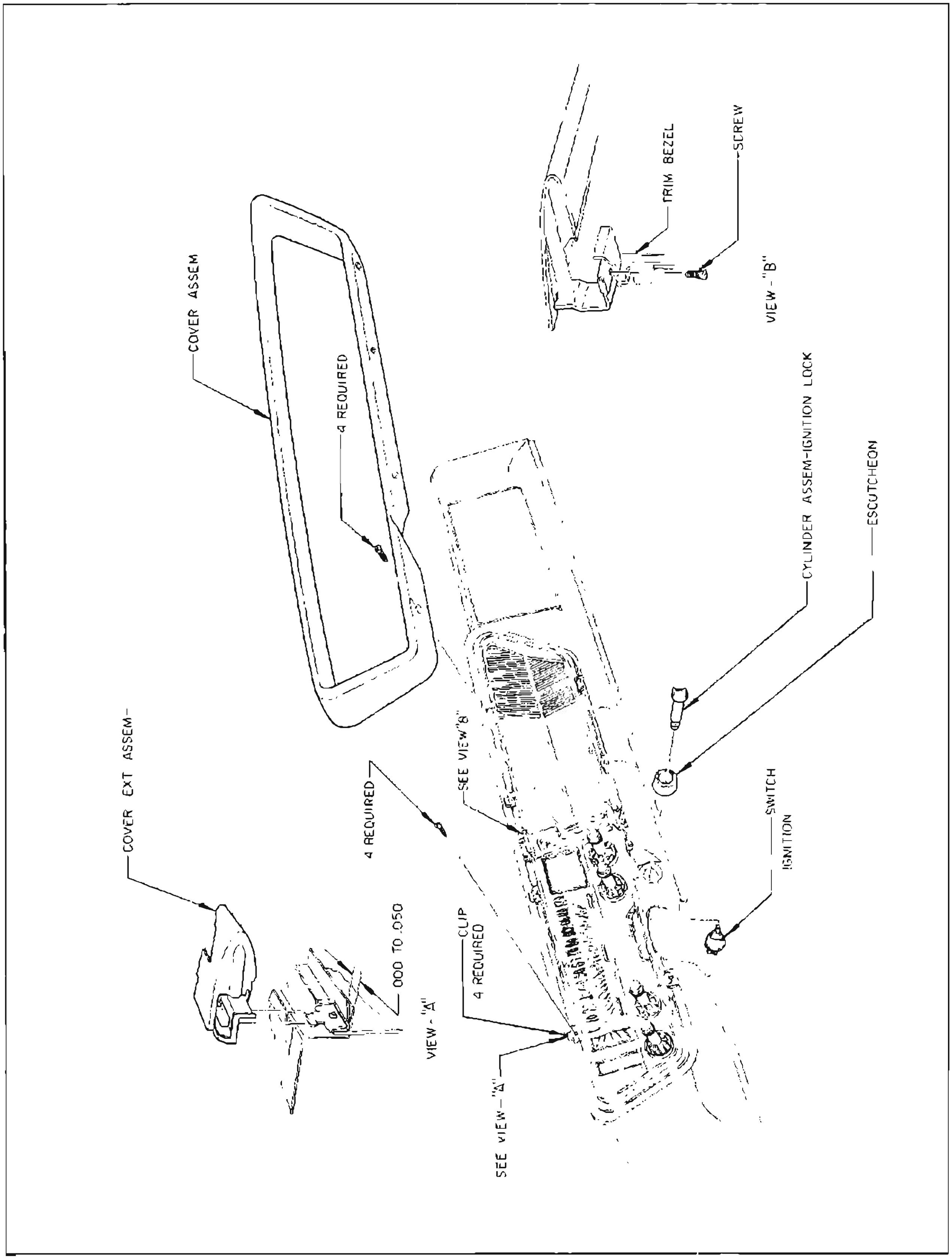



Figure 10-66—Instrument Panel Cover Extension and Ignition Switch Installation

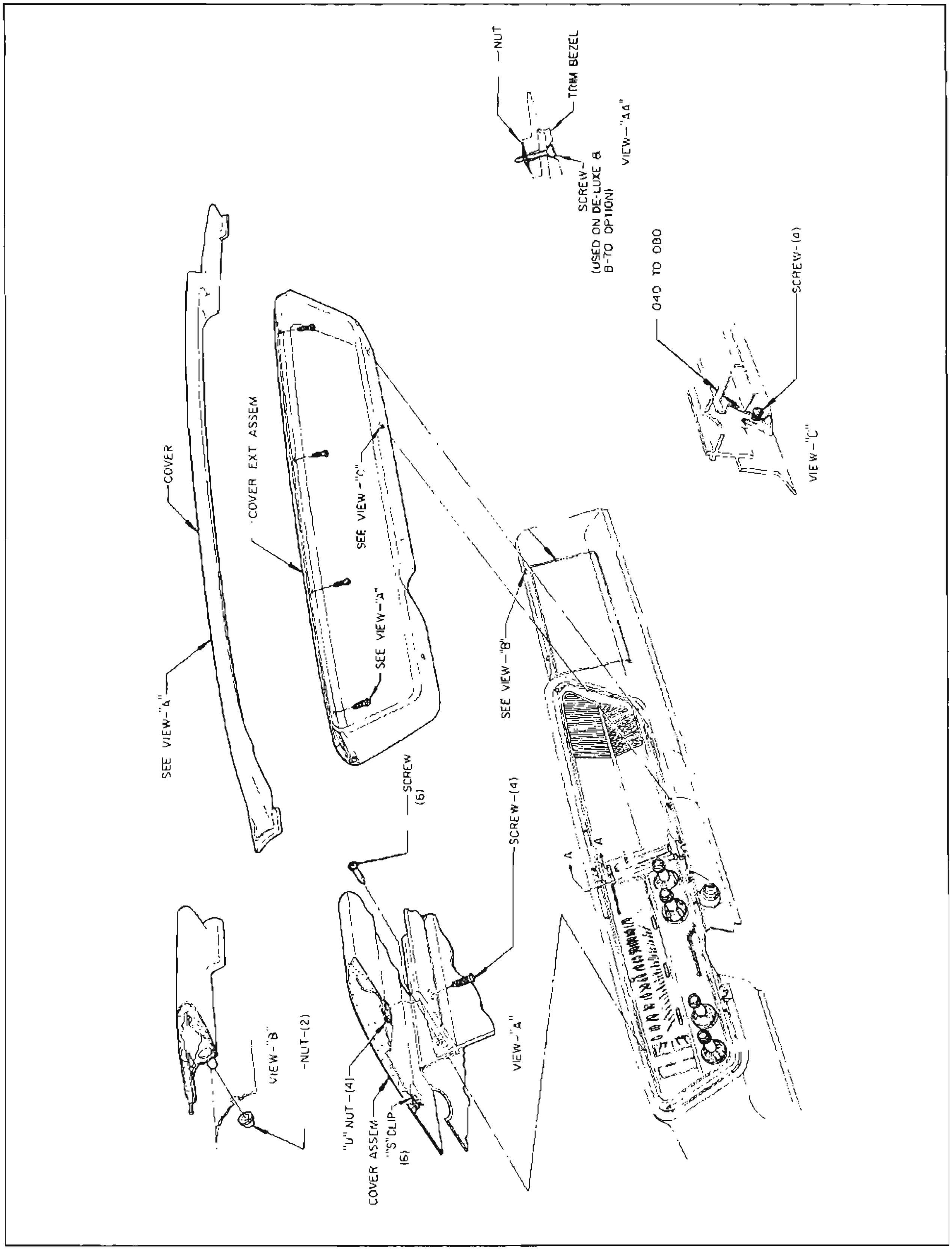



Figure 10-67—Instrument Panel Cover and Extension Installation

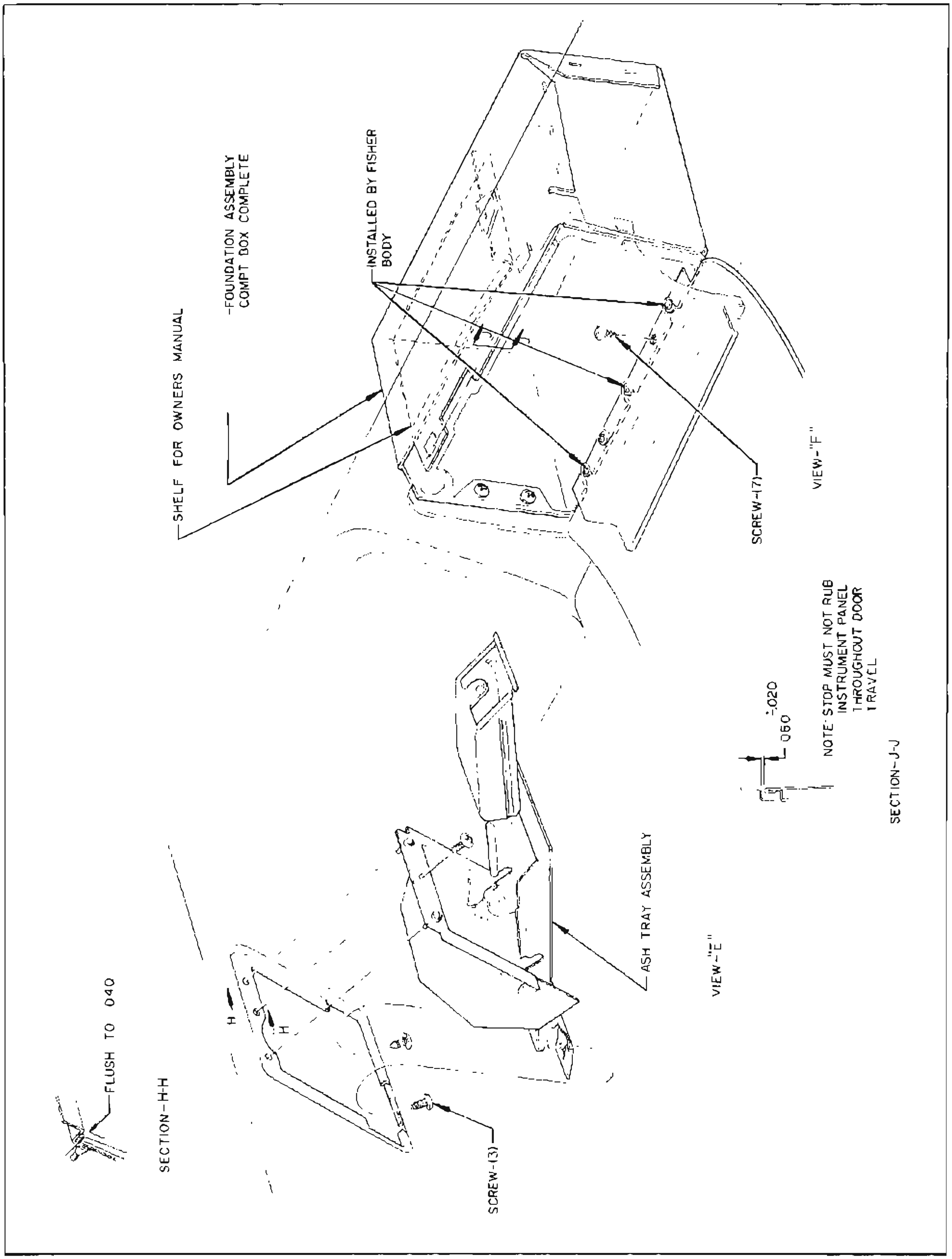



Figure 10-68—Ash Tray and Glove Box Installation

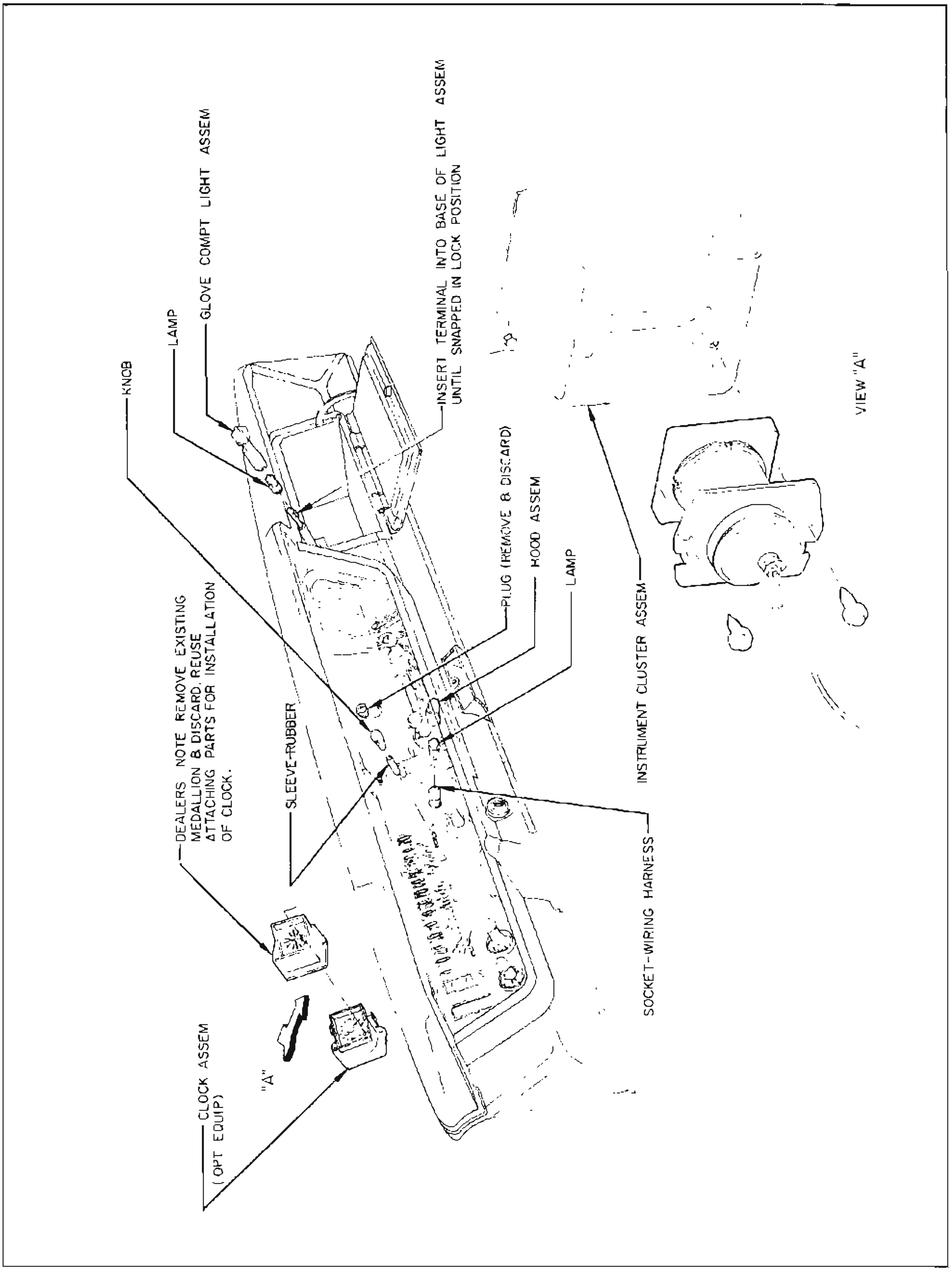



Figure 10-69—Clock, Ash Tray Light and Glove Box Light Installation

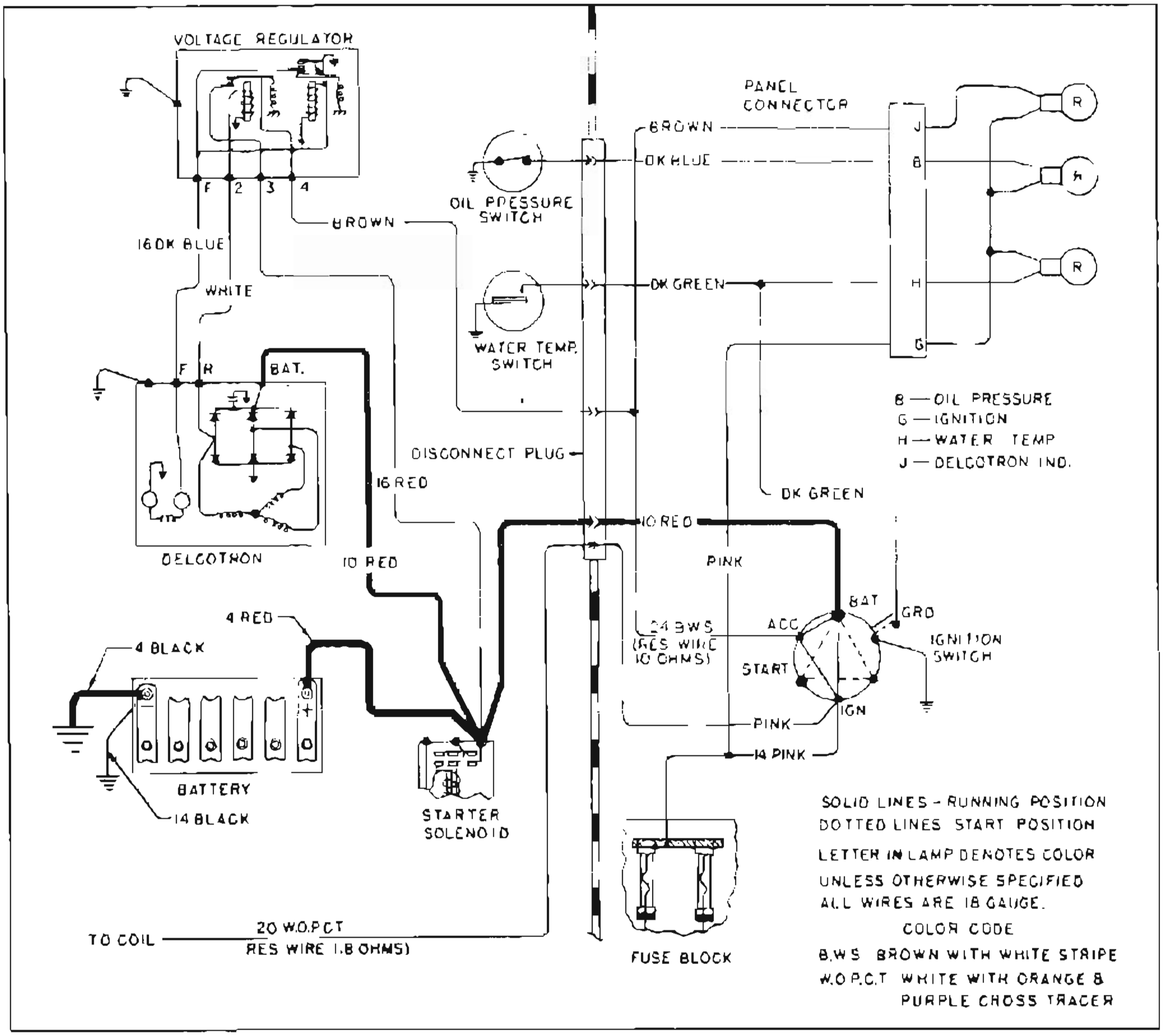



Figure 10-70—Indicator Light Circuits

5. Remove cluster.

6. Reinstall instrument cluster by reversing above steps.

NOTE: Connector plug can only be installed in one direction, because one retaining tang is wider than the other.

**c. Generator Charge Indicator**

The red "GEN" warning light should light when the ignition is turned "ON" and before the engine is started; if not lighted, either the bulb is burned out or the indicator light wiring has an open circuit. After the engine is started, the "GEN" light should be out at all times; if the light comes on, the generator belt may be loose or missing, the generator or regulator may be defective, or the charging circuit may be defective. See paragraph 10-18 for trouble shooting procedures.

To trace the generator indicator light circuit, see Figure 10-70. With the ignition switch turned on (engine not running), current flow is through the ignition switch, out the "IGN" terminal, through the generator light in the instrument cluster, to the "4" terminal of the regulator, through the lower contacts of the voltage regulator (held closed by the spring), out the "F" terminal, in the "F" terminal of the generator, through the brush and slip ring, through the field, through another brush and slip ring to ground.

Before the engine is started, the generator light should glow at about 1/2 brightness. This is because the voltage in the circuit before the light is about 12 volts, but the voltage at the "4" terminal after the light is about 5 volts. This makes the effective voltage across the generator light approximately 7 volts for about 1/2 brightness.

After the engine is started, the voltage put out by the generator immediately closes the field relay. This causes battery voltage from the "3" terminal to be present at the "4" terminal. See Figure 10-70. Since battery voltage is present on both sides of the generator light, the light goes out. If the generator light comes on with the engine running, the charging circuit should be tested at the first opportunity to determine the cause of the trouble. See paragraph 10-21.

### d. Oil Pressure Indicator

The engine oil pressure indicator light is controlled by a pressure operated switch located in the oil pump cover. This light should come on when the ignition is turned "on" and the engine is not running. If not lit, either the bulb is burned out, the wiring has an open circuit or the oil switch is defective.

If the engine oil pressure drops below a safe level during operation, the circuit is completed through the pressure switch to ground, and the "Oil" indicator light in the cluster will be turned on. See Figure 10-70.

If the "Oil" indicator stays on or comes on when the engine is running at speeds above idle, stop engine immediately and find out reason. The following may be

| COMPLAINT | POSSIBLE CAUSE |
|---|---|
| 1. GENERATOR INDICATOR | |
| Light not lit, ignition "On" and engine not running. | Bulb burned out. Replace. |
| | Open in light circuit. Locate and correct. |
| Light on, engine running. | No generator output. Check output, paragraph 10-21. |
| | Loose or broken generator belt. |
| 2. OIL PRESSURE INDICATOR | |
| Light not lit, ignition "On" and engine not running. | Bulb burned out. Replace. |
| | Open in light circuit. Locate and correct. |
| | Oil pressure switch defective. Replace. |
| Light on, engine running above idle speed. | Wiring between light and switch grounded. Locate and correct. |
| | Oil pressure switch defective. Replace. |
| | Low oil pressure. Locate cause and correct. |
| 3. TEMPERATURE INDICATOR | |
| Light not lit when cranking engine. | Bulb burned out. Replace. |
| | Open in light circuit. Locate and correct. |
| | Ignition switch defective. Replace. |
| Light on, engine running. | Wiring between light and switch grounded. Locate and correct. |
| | Temperature switch defective. Replace. |
| | Cooling system water temperature above 248°F. Find cause and correct. |
| | Ignition switch defective. Replace. |

the cause, rather than low oil pressure:

1. Wiring circuit between oil pressure switch and light grounded. Remove connector from pressure switch, if light stays on trouble is in wiring.

2. Switch defective. Replace switch.

**e. Temperature Indicator**

A temperature switch located in right front of the intake manifold controls the operation of the "Temp" indicator light located in instrument cluster.

If the engine cooling system is not functioning properly and the water temperature should reach 248°F., the "Temp" indicator will be turned on by the temperature switch. As a test circuit to check whether the "Temp" indicator bulb is functioning properly, a wire which is connected to the "GND" terminal of ignition switch is tapped into the temperature switch circuit. See Figure 10-70. When the ignition is in the "Start" position (engine cranking), the "GND" terminal is grounded inside switch and the "Temp" bulb will be lit. When the engine is started and the ignition switch is in the "On" position, the test circuit is opened and the bulb is then controlled by the temperature switch.

**f. Trouble Diagnosis—Generator Indicator, Oil Pressure Indicator, Temperature Indicator**

Use Figure 10-70 to trace wiring circuits for indicator lights. To determine if there is a ground in the indicator light circuit, remove connector from control switch. If light stays on, trouble is in circuit.

## 10-49 ELECTRIC CLOCK

The electric clock is mounted in the right end of the instrument cluster. The clock wiring circuit is protected by the 10 ampere "TAIL-CLOCK" fuse on the fuse block. Clock light brilliance is controlled by the rheostat in the lighting switch and is protected by the "PANEL" fuse on the fuse block.

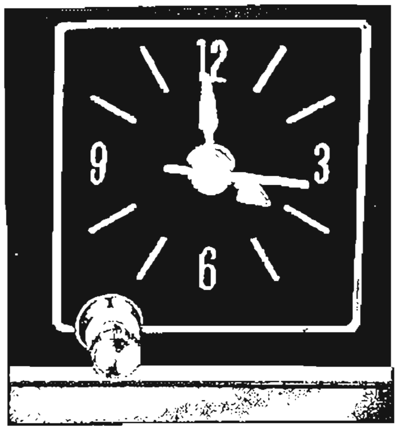


Figure 10-71—Electric Clock

**a. Clock Time Reset and Automatic Regulation**

The electric clock incorporates a sweep-second hand and an automatic regulator. A reset knob extends through the glass on bottom of the clock dial. To reset the time, pull the knob out and turn in either direction as required. See Figure 10-71.

There is no regulator knob because regulation is accomplished automatically by the action of resetting the time. If a clock is running fast, the action of turning the hands back to correct the time will automatically cause the clock to run slightly slower; if a clock is running slow, the action of turning the hands forward to correct the time will automatically cause the clock to run slightly faster (10 to 15 seconds per day).

A lockout feature prevents the regulator mechanism from being moved more than once during a rewind period (approximately 3 minutes), regardless of the number of times the clock reset is operated. After clock rewinds, if it is again reset, automatic regulation will take place.

**b. Clock Service**

The clock manufacturers have established Authorized Service Stations in many cities throughout the United States and Canada. These service stations are prepared to carry out terms of the manufacturer's warranty and also to perform any repairs made necessary through use of clock.

When a clock requires warranty service or repairs other than regulation, it should be removed by the Buick dealer and sent to the nearest authorized service station. The manufacturer's warranty is void if repairs have been attempted outside of an authorized service station.

## 10-50 GASOLINE GAUGE—DASH AND TANK UNITS

The gasoline gauge consists of two units; the dash unit located in the instrument cluster, and the tank unit located in the gasoline tank. One terminal of the dash unit is connected to the ignition switch so that the unit registers only when the ignition switch is turned on.

With the ignition turned off, the pointer may register any place on the dial of gauge. The other terminal of the dash unit is connected by a single wire to the tank unit, which is grounded on the tank to complete the circuit. See Figure 10-72.

The dash unit pointer is moved by changing the magnetic pull of two coils in the unit. The magnetic pull is controlled by action of the tank unit which contains a variable rheostat, the value of which varies with movement of a float and arm. The tank unit is mounted in the tank so that the

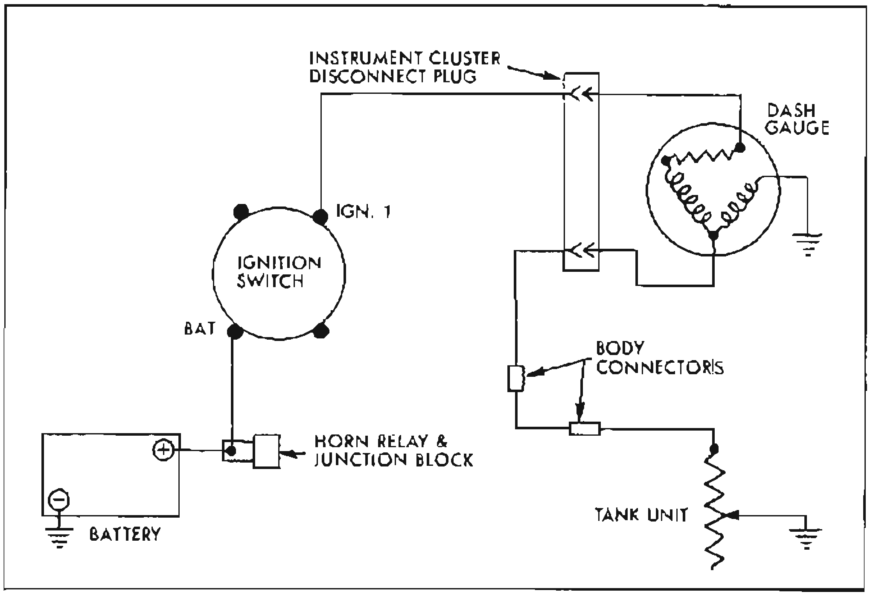



Figure 10-72—Fuel Gauge Circuit

float rises and falls on the surface of the gasoline near the middle of the tank. The float is adjusted to provide approximately 1 gallon reserve when the dash unit pointer is at the dot next to the "E" position.

If the gasoline gauge does not operate properly, the dash unit, wiring between dash unit and tank unit and tank unit should be separately tested to determine which is at fault. The units and wiring may be tested by using a known good tank unit with a 12 foot piece of red insulated (#16) wire attached to binding post of unit and a similar 5 foot piece of black wire attached to flange of unit. Attach a spring clip to end of black wire and a terminal to end of red wire.

**a. Test of Dash Unit and Tank Unit Wiring**

1. Disconnect the tank unit (tan) wire at connector under rear floor of luggage compartment. See Figure 10-108, 109 or 110. Plug the red test wire terminal into the connector and attach the black test wire to any convenient ground on the car.

2. Turn ignition switch on and move arm of test unit up and down against the stops while observing dash unit. If dash unit and wiring are okay, dash unit pointer will move freely from "Empty" to "Full" with movement of tester arm, indicating that trouble is in tank unit or the short wire leading to it.

**b. Test of Dash Unit**

1. Disconnect the tank unit at connector under rear floor of luggage compartment. See Figure 10-108, 109 or 110. Attach the test unit black wire to ground.

2. Turn ignition on. Then with terminal of red test wire contacting the dash unit to tank unit terminal on printed circuit, move arm of test unit up and down against the stops. If dash unit is okay, the pointer will move freely from "Empty" to "Full" with movement of tester arm, indicating that trouble is in wiring or printed circuit. If pointer does not move or only moves part way, remove tan wire from printed circuit disconnect plug and repeat test on dash unit. If dash unit still does not operate properly, the printed circuit may be defective or the dash unit is faulty and should be replaced.

CAUTION: If the wrong terminal is contacted on dash unit, the rheostat in test unit may be damaged.

3. If, on the test of dash unit and tank unit wiring, (subpar. a) dash unit reads "Empty" or noticeably low at all times, look for a ground in the wiring circuit between dash unit and tank unit connector. If dash unit reads above "Full" or noticeably high at all times during test, look for points of high resistance or open circuit in wiring.

**c. Test of Tank Unit**

1. If tests given above indicate that the trouble is in the tank unit, remove the gasoline tank so that the tank unit may be cleaned and tested.

2. Before removing unit from gasoline tank clean away all dirt that has collected around the terminal; also make sure that insulation was in proper position over the terminal and wire. Road dirt, particularly calcium chloride, may have caused an electrical leak that threw the tank unit out of calibration.

3. After thorough cleaning and removal of tank unit, connect it to ground and to wire leading to dash unit, and test in the same manner as when using tester. If tank unit tests okay it should be reinstalled in tank, otherwise it should be replaced with a new unit. When installing tank unit make certain that insulation is folded over the terminal and snapped over wire.

**d. Removal and Installation of Dash Unit**

1. Disconnect battery ground cable.

2. Remove the dash unit to instrument cluster printed circuit

retaining screws. See Figure 10-63.

3. Remove dash unit.

4. To install dash unit reverse procedure.

**e. Removal and Installation of Tank Unit**

To replace tank unit it is necessary to remove gas tank as instructed in paragraph 3-10.

## 10-51 SPEEDOMETER

**a. Speedometer Head**

The speedometer head has a magnetic speed indicator and a gear driven odometer. It is driven by a flexible cable connected to a worm gear in the transmission rear bearing retainer. See Group 4 for gear ratios.

The speed indicating portion of 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 spee' cup spindle to indicate speed on the speedometer dial. A calibrated hair spring (part of speed cup) opposes the magnetic pull on the speed cup so the pointer indicates and pulls the cup and pointer to zero when car stops.

**b. Checking Noisy Speedometer**

1. Jack up rear wheels in safe manner and close car windows to exclude outside noises.

2. With transmission in direct drive, run slowly from 0 to 50 MPH and back to 0, noting speed range where noise appears.

3. Apply brakes and shift transmission to neutral or parking position, then run engine through same speed range as before.

4. If noise continued with transmission parts stationary, something other than the speedometer installation is at fault.

5. If noise disappeared with transmission stationary, check further for cause of noise by checking routing of speedometer cable as shown in Figure 10-84.

6. If cable routing was okay, next remove inner cable from casing. Lay inner cable on clean paper to keep dirt from cable lubricant. Reconnect empty casing to speedometer and recheck for noise at various speeds.

7. If noise still continues, noise is coming from transmission rather than speedometer.

8. If noise stopped with inner cable removed, speedometer or cable is at fault. Inspect and lubricate cable as described in subparagraph c.

**c. Inspection and Lubrication of Speedometer Cable**

If the speedometer installation appears to be noisy or the speed indicator wavers, inspect the cable casing for damage, sharp bends, or for being out of the supporting clips. If casing is in good condition and properly installed, remove cable for inspection and lubrication.

1. Disconnect speedometer cable casing at the speedometer head, then pull cable out of upper end of casing.

2. Inspect cable for worn spots or breaks. Check cable for kinks by holding one end vertically in each hand and turning cable slowly; if cable is kinked, the loop will "flop." Replace a cable which has kinks or bent tips.

3. Coat the lower two thirds of the cable lightly with AC spec. 640 speedometer cable lubricant. If this is not available, #110 Lubriplate may be used. As cable is inserted into casing from upper end the lubricant will spread over its entire length.

4. When cable is connected to speedometer head make sure that the cable tip seats properly in the head socket.

5. If speedometer noise is still present, install a new service speedometer cable assembly.

6. If this does not correct noise, have speedometer head checked by a UMS Service Station.

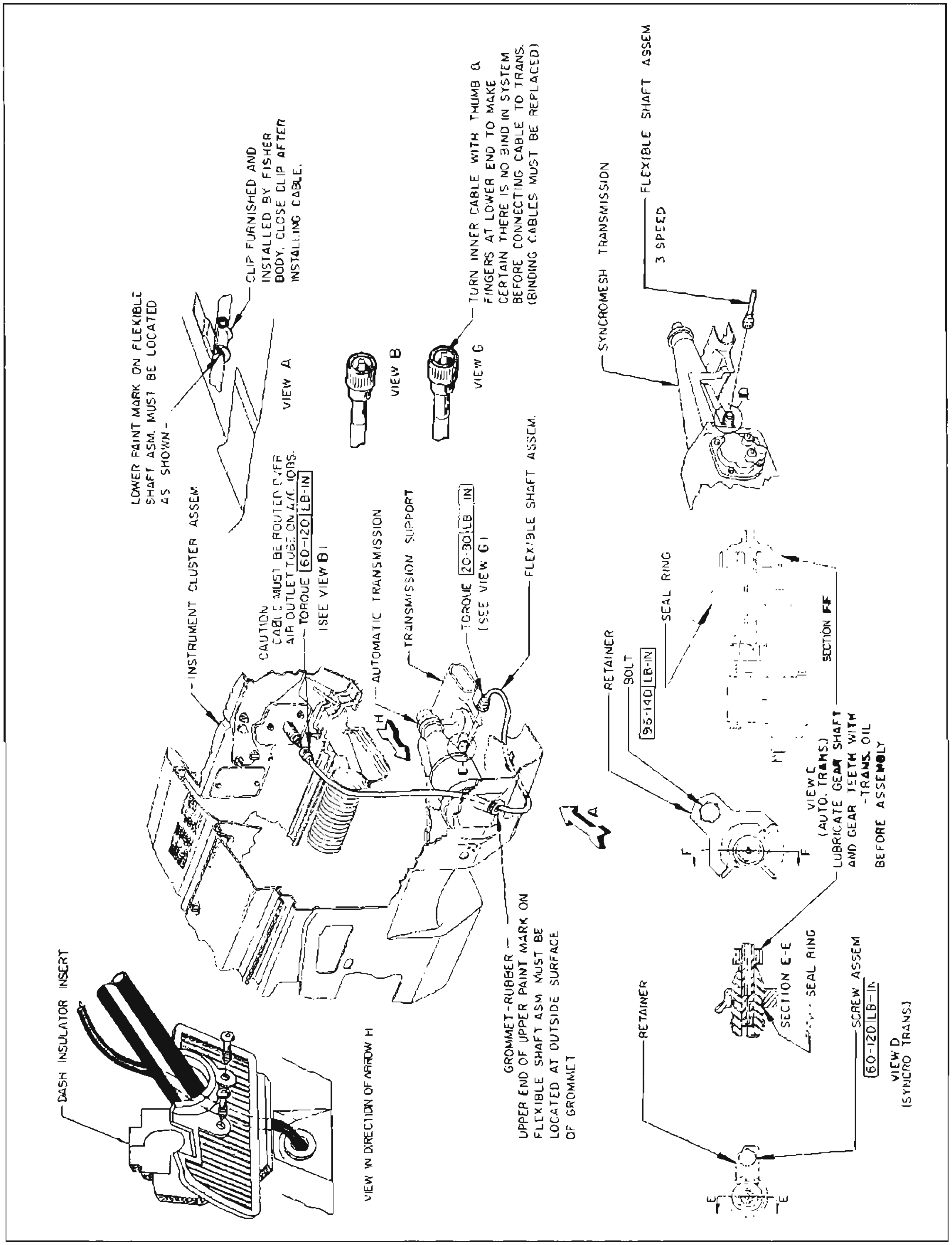



Figure 10-73—Speedometer Cable Installation

# SECTION 10-I
# WINDSHIELD WIPER AND WASHER ASSEMBLY

## CONTENTS OF SECTION 10-I



## 10-52 DESCRIPTION AND OPERATION—SINGLE SPEED

### a. General Description

The gear train consists of a helical gear at end of armature shaft. The helical gear drives an intermediate gear and pinion assembly, the pinion of which drives an output gear and shaft assembly. See Figure 10-74. The crank arm is attached to the shaft of the output gear and drives the two wiper transmissions through connecting link arms.

There is no circuit breaker in this model wiper motor.

### b. Principle of Operation

Two switches, a dash switch and a park switch control the starting and stopping of the wiper. The switch mounted on the dash controls starting the wiper. The park switch, which is located in the wiper gear box (Figure 10-74), controls stopping the wiper. The operation of the park switch is explained in the following paragraph. (Refer to the wiring diagram in Figure 10-76).

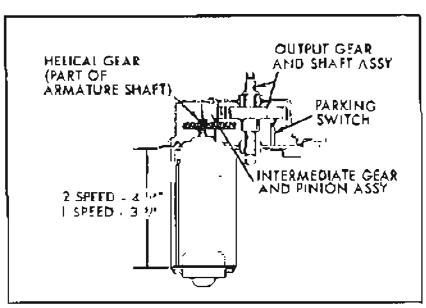



Figure 10-74—Typical View of Gear Train

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 reach the park position (Blades approx. 2" above windshield molding). (Figure 10-75 shows the crank arm in park position.) 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 park switch actually controls wiper operation only during that short period of time, after the owner turns the wiper "off" at the dash switch but before 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 has no control over the wiper until the dash switch is turned "off".)

### c. Connections to Operate Wiper

Figure 10-77 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.)

## 10-53 TROUBLE-SHOOTING—SINGLE SPEED

### a. Description

Trouble-shooting procedures are divided into two categories: Wiper in car; wiper out of car.

Typical Trouble Conditions:

1. Inoperative.
2. Will not shut off.
3. Intermittent or slow operation.
4. Wiper will not park.

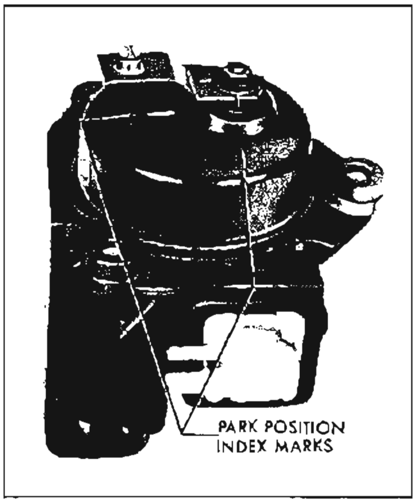



Figure 10-75—Park Position of Crank Arm

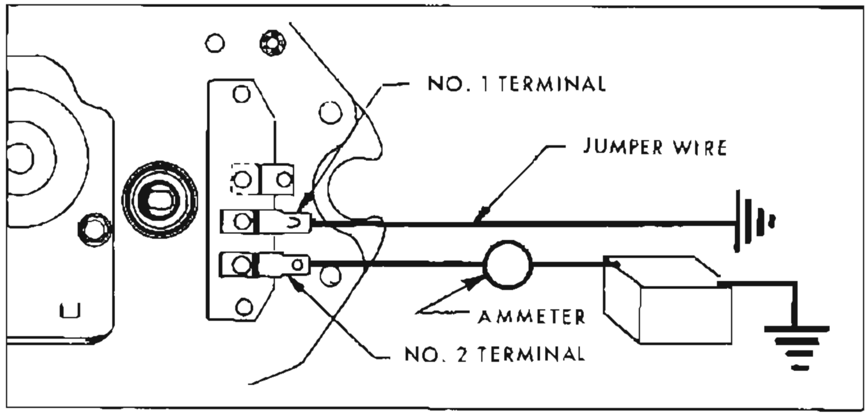



Figure 10-77—Connections to Operate Wiper out of Car

**b. Wiper in Car**

1. Wiper Inoperative - IMPORTANT: Ignition switch must be on to make electrical tests.

(a) Check the following:

(1) Make sure wiring harness is properly attached to wiper terminals and dash switch. See Figure 10-76.

(2) Make sure wiper ground strap is properly connected to wiper and car body.

(3) Make sure switch is mounted securely in dash.

(4) Check fuse.

(b) If everything checks out in Step (a) but wiper still fails to operate, disconnect wiring harness from wiper and check for 12 volts at harness terminal that connects to wiper terminal No. 2, Figure 10-77. No voltage indicates defective car wiring. CAUTION: DO NOT connect hot line to No. 1 terminal.

(c) Connect 12 volt supply to No. 2 wiper terminal and connect a jumper wire from terminal No. 1 to ground (Figure 10-77). If wiper operates, the dash switch or wiring between dash switch and wiper is defective.

(d) If wiper still fails to operate with jumper wires, remove body parts as required to disconnect wiper transmission from wiper crank arm. Recheck wiper operation with jumper wires. 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 "Trouble-Shooting Wiper Out-of-Car".

2. Wiper Will Not Shut Off

(a) Disconnect wiring from dash switch. If wiper shuts off, a defective dash switch is indicated.

(b) If wiper still operates, disconnect wiring from wiper and connect 12 volt supply direct to wiper terminal No. 2 (Figure 10-77). DO NOT connect any jumper wire to terminal No. 1.

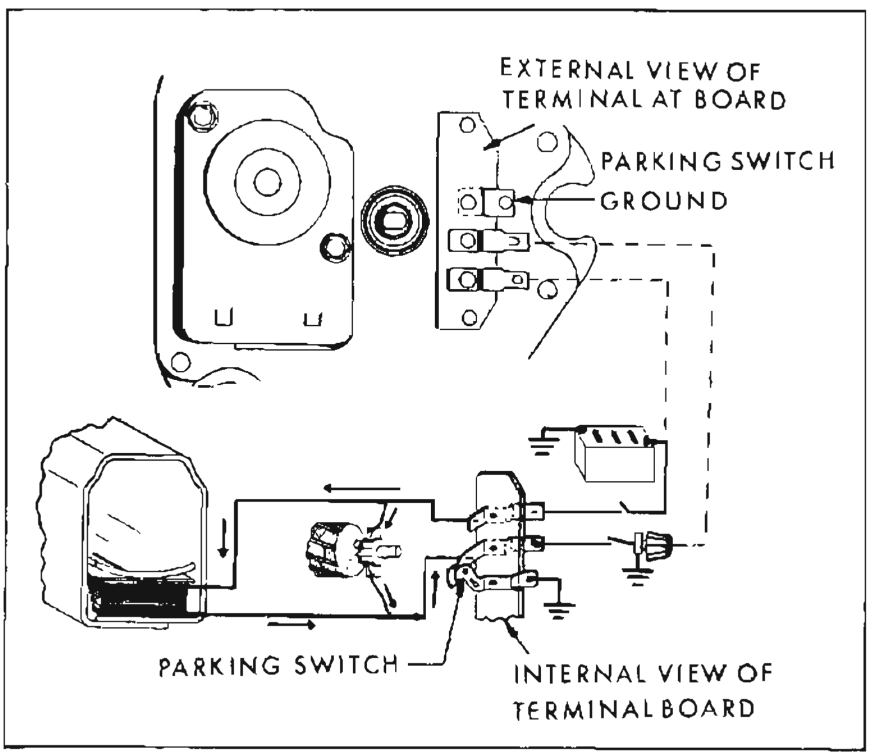



Figure 10-76—Single Speed Wiper Wiring Diagram

If wiper now shuts off correctly, check for a ground in lead that extends between wiper terminal No. 1 and dash switch.

If wiper still fails to shut off-remove wiper from car and follow instructions under "Trouble-Shooting Wiper Out-of-Car".

3. Intermittent or Slow Operation

(a) Check the following: Loose ground strap, loose dash switch mounting, loose connection.

4. Wiper Will Not Park

(a) Remove wiper from car and check for a dirty or broken park switch.

#### c. Wiper Out of Car

Connect a 12 volt supply and an ammeter to wiper as shown in Figure 10-77 and observe current draw and wiper operation.

1. Wiper Inoperative

(a) Current Draw - O.

(1) Check solder connection at terminal board.

(2) Disassemble motor section and check all splice connections (Figure 10-78).

(b) Current Draw-1-1.5 amps.— Disassemble motor and check for the following items:

(1) Open armature.

(2) Brushes sticking.

(3) Brush springs improperly positioned (see Figure 10-79).

(4) Brush pigtail connections at splice joints (Figure 10-78).

(c) Current Draw-10-12 amps.

(1) Check for open shunt field circuit.

(2) Check for broken gear.

2. Wiper Will Not Shut Off.

Wiper crank arm fails to stop in park position when jumper wire

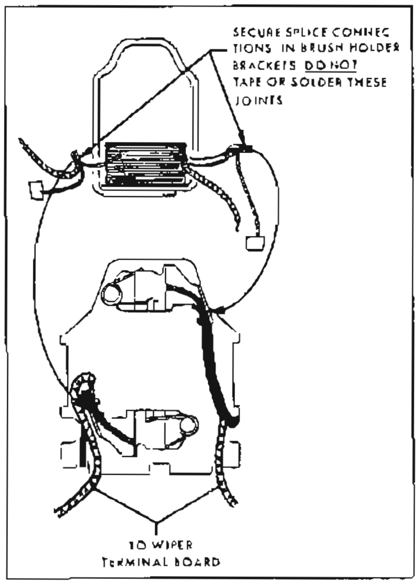



Figure 10-78—Motor Wiring

is removed from wiper terminal No. 1 (Figure 10-77).

(a) Check that park switch contacts are opening.

(b) Check for grounded condition in the internal motor lead that connects to terminal No. 1, Figure 10-77.

3. Intermittent or Slow Operation

(a) Current Draw-7-9 amps.

(1) Check for binds in gear train.

(2) Check for shorted armature. (Armature may be checked on a growler).

4. Wiper Will Not Park.

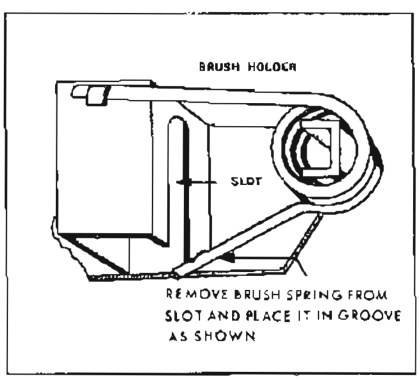



Figure 10-79—Releasing Brush Holder Spring Pressure

Wiper crank arm stops rotating immediately when jumper wire is disconnected from wiper terminal No. 1 (Figure 10-77). NOTE: Crank arm should continue to rotate until park position is reached (Figure 10-75).

## 10-54 DISASSEMBLY AND ASSEMBLY—SINGLE SPEED

#### a. Gear Box Disassembly

1. Remove washer pump drive cam as required. The cam is pressed on the shaft but can be wedged off by using two screwdrivers between cam and plate.

2. Clamp crank arm in a vise and loosen crank arm retaining nut.

3. Remove seal cap, retaining ring and end-play washers. NOTE: Seal cap should be cleaned and repacked with a water proof type grease before reassembly.

4. Drill out the gear box cover retaining rivets and remove cover from gear train. CAUTION: Mark ground strap location for reassembly purposes.

5. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft. (Figure 10-81).

6. Remove terminal board and park switch assembly as follows:

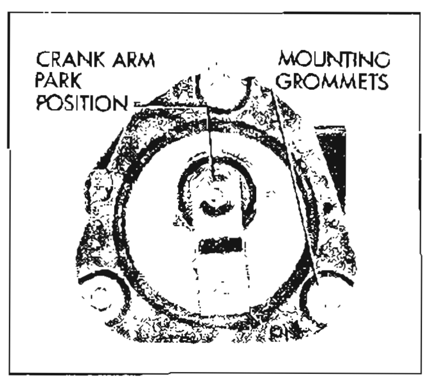



Figure 10-80—Single and Two Speed Wiper Mounting Grommets

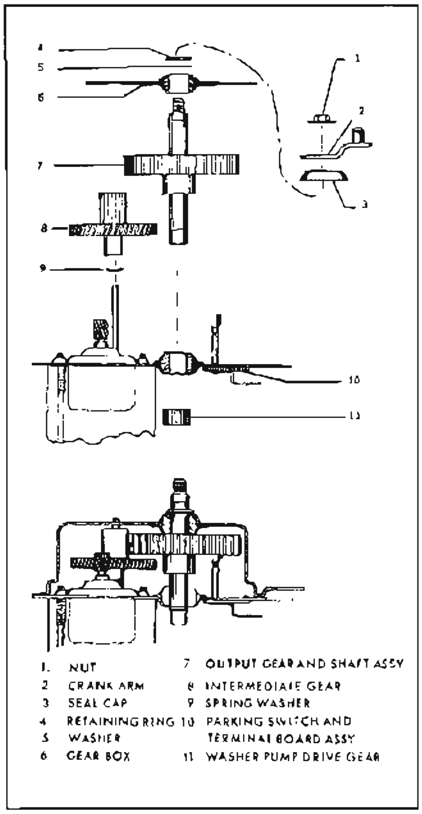



Figure 10-81—Gear Box Assembly

(a) Unsolder motor leads from terminals.

(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.

**b. Gear Box Assembly**

Reverse Steps 1 thu 7 except as noted:

1. Reassembly of Gear Box Cover - Be sure cover is located properly over locating dowel pins and be sure to reinstall ground strap.

2. Reassembly of Crank Arm - Operate wiper to park position (Figure 10-77) and install crank arm on output shaft in the position shown in Figure 10-75. Clamp crank in vise before securing the retaining nut.

**c. Motor Disassembly and Assembly**

1. Follow Steps 1 thru 7(a) under gear box disassembly.

2 Release brush spring pressure against brushes as shown in Figure 10-79.

3. Move brushes away from armature and slide armature out of frame and field assembly. Pull end cap assembly off armature. See Figure 10-83.

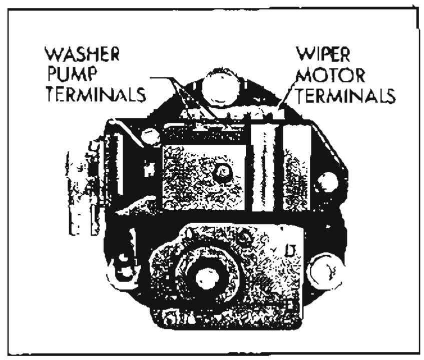



Figure 10-83—Windshield Wiper Motor-Two Speed

4. Remove end play adjusting washers.

To reassemble motor, reverse Steps 1 thru 4.

NOTE: Lubrication of armature shafts and bearings should be with light grade machine oil. Gear teeth and cam should be lubricated with Delco gear and cam lubricant.

**d. Wiper Specifications**

Operating Test Voltage . . . . 12

Crank Arm Rotation (looking at arm) . . . . . CCW

Current Draw (Amps.)

No load . . . . . . . . . . 3 Max.

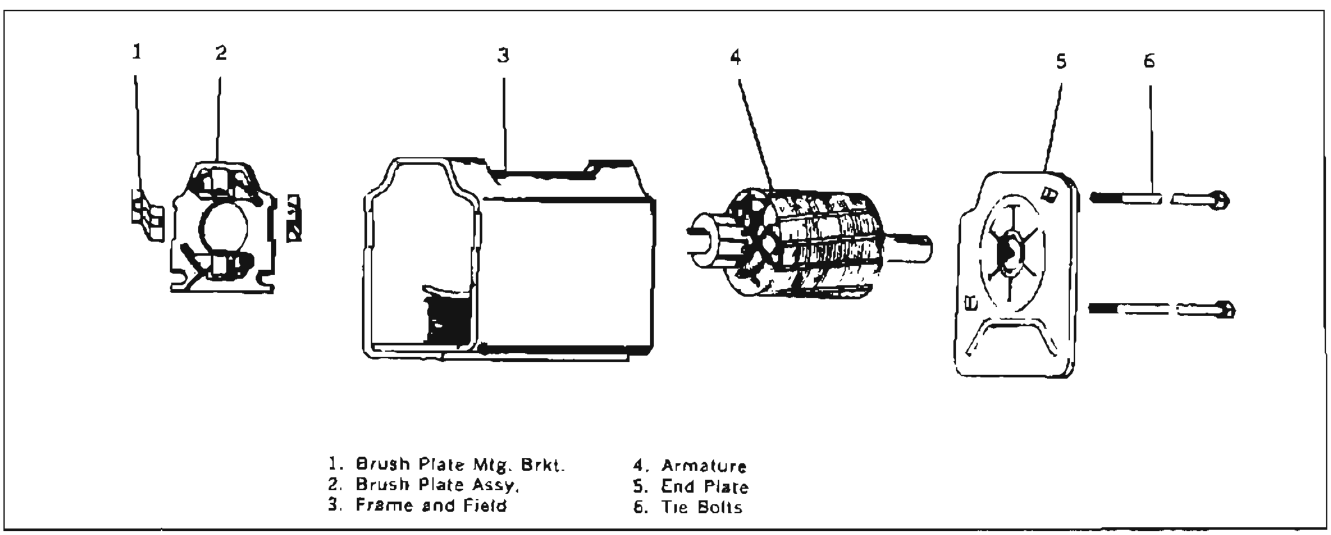



Figure 10-82—Motor Assembly

Dry windshield . . . . 3.5 Max.

Stall . . . . . . . . . 11.0 Max.

## 10-55 DESCRIPTION AND OPERATION— TWO SPEED

### a. General Description

The two-speed non-depressed park wiper consists of a rectangular shaped compound wound motor (series and shunt field) adapted to the same type gear train as that used with the single speed wiper (See Figure 10-74). The two-speed wipers have a 36:1 gear ratio.

### b. Operation

The principle of operation is very similar to that of the single speed wiper as explained under "Principal of Operation" in paragraph 10-52 A combination pictorial and schematic circuit is shown in Figure 10-84. An explanation of "LO", "HI" and parking circuits follows:

1. Lo Speed

When the wiper 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. See Figure 10-85.

2. Hi Speed

Moving the wiper 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 20 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. See Figure 10-86.

3. Parking Circuit

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. See Figure 10-75 which shows a typical crank arm in park position. See Figure 10-87.

4. Connections to Operate Wiper

Figure 10-88 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.

## 10-56 TROUBLE-SHOOTING AND TESTING

### a. Trouble-Shooting—Wiper in-Car

1. Wiper Inoperative

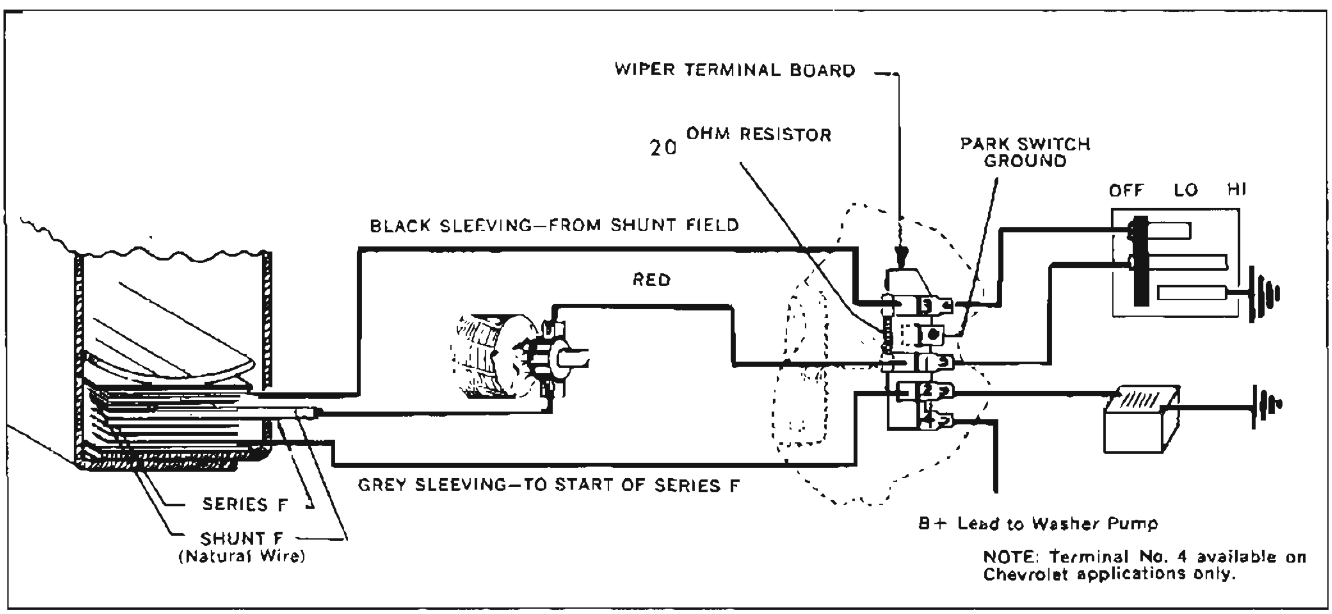



Figure 10-84—Two Speed Wiper Motor Wiring

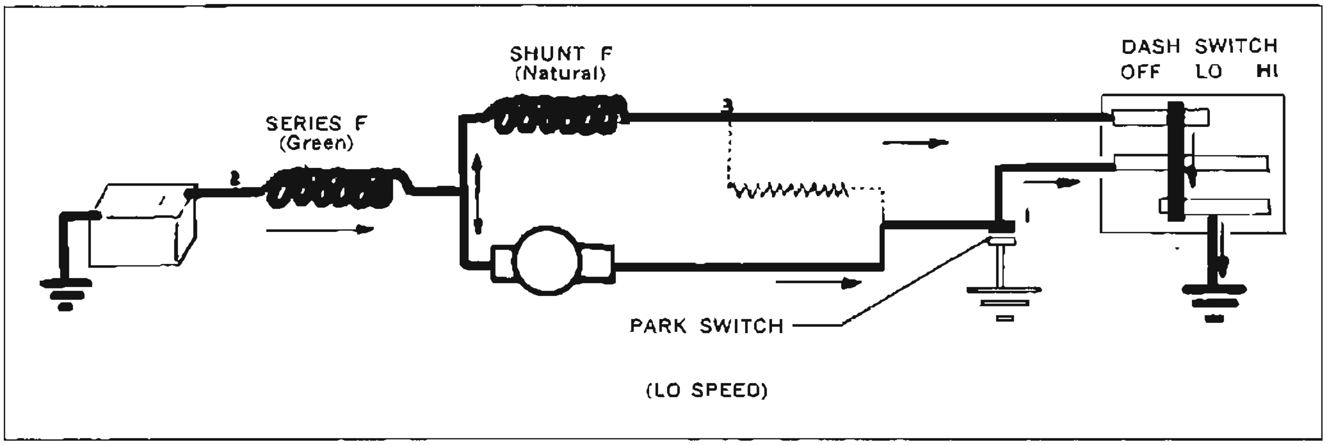



Figure 10-85—Lo Speed Circuit

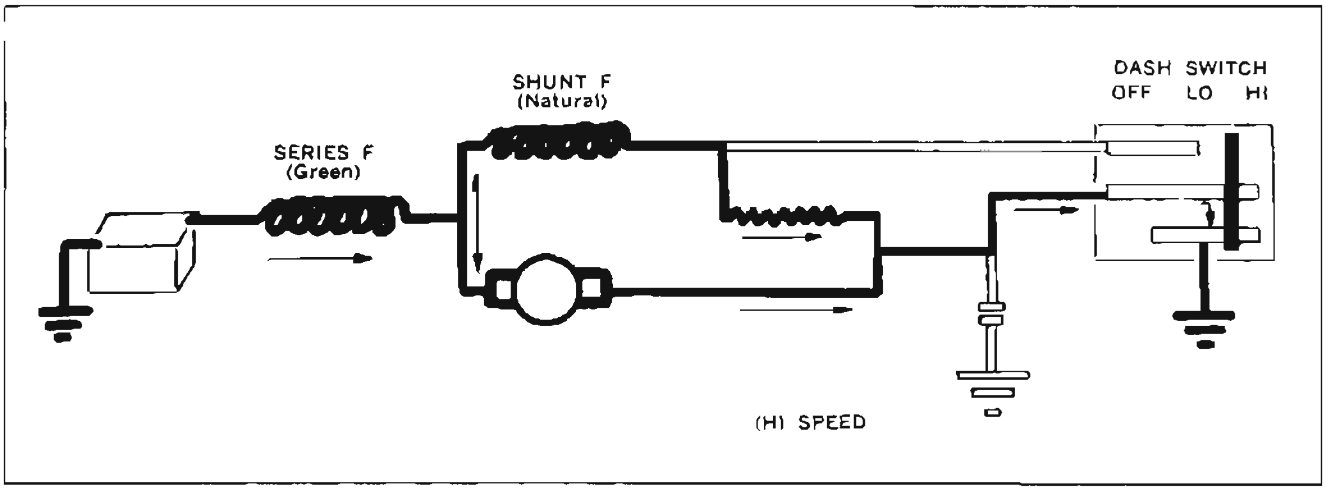



Figure 10-86—Hi Speed Circuit

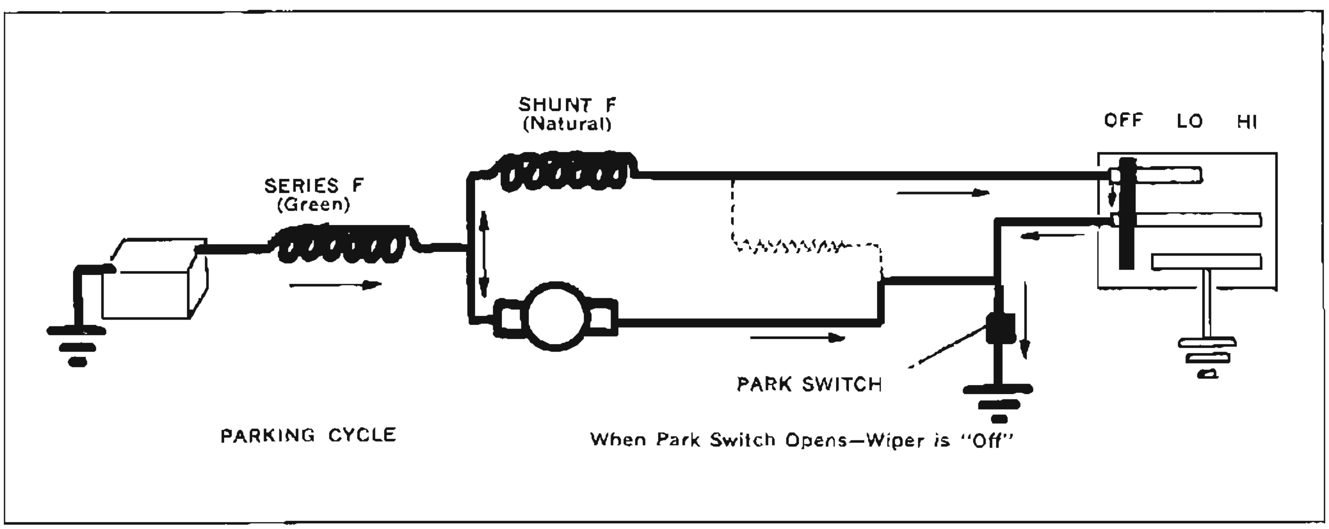



Figure 10-87—Parking Circuit

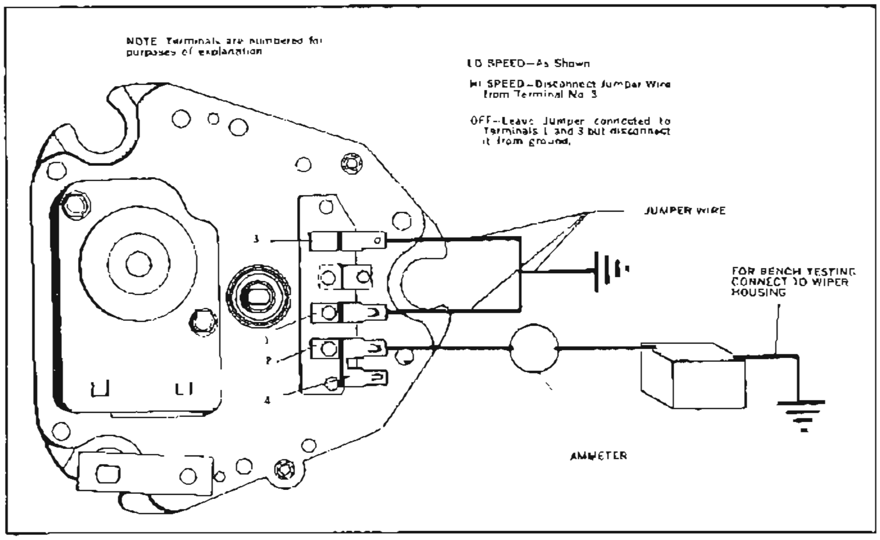



Figure 10-88—Connections to Operate Wipers

(a) 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.

(b) With ignition switch on, check for 12 volts at harness terminal that connects to number (2) terminal (Figure 10-88).

(c) To determine if dash switch or car wiring are at fault, disconnect harness from wiper motor and try operating wiper as shown in Figure 10-88. If wiper fails to operate, remove body parts as required, disconnect transmission from wiper crank arm and recheck wiper operation. If wiper still fails to perform correctly, remove wiper from car and check wiper according to procedure under Trouble-Shooting Wiper Out-of-Car.

2. Wiper Will Not Shut Off

(a) 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).

(b) Disconnect wiring harness from wiper motor and try operating wiper independently of dash switch as shown in Figure 10-88.

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 -

If wiper still fails to operate correctly in Step (b), remove it from car and check it per instructions under Trouble-Shooting Wiper Out-of-Car.

| Wiper Will Not Shut Off And: | Possible Trouble |
|---|---|
| Wiper has both speeds. | (1) Lead between wiper terminal No. 1 and dash switch grounded. |
| | (2) Defective dash switch. |
| Wiper has "Lo" speed only. | (1) Lead between wiper terminal No. 3 and dash switch grounded. |
| | (2) Defective dash switch. |
| Wiper has "Hi" speed only. | (1) Lead between wiper terminal and dash switch open. |
| | (2) Defective dash switch. |

3. Wiper Has One Speed - Fast

Check for a defective dash switch or open lead between terminal Number 3 and dash switch.

4. Wiper Has One Speed (Slow) and Shuts "Off" With Dash Switch In "Hi" Speed Position

Reverse harness leads that connect to wiper terminal 1 and 3.

5. Blades Do Not Return to Park Position When Wiper is Turned "Off"

(a) Check wiper ground strap connection to car body.

(b) Remove wiper from car and check for dirty, bent or broken park switch contacts.

6. Wiper Speed Normal In "Lo" But Too Fast In "Hi"

Remove wiper from car and check for an open terminal board resistor.

7. Intermittent Operation

Check for loose wiper ground connections and/or loose dash switch mounting.

**b. Trouble Diagnosis— Wiper Out-of-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 Figure 10-88. IMPORTANT - Be sure and use an ammeter capable of reading at least 30 amperes in the feed wire circuit.

1. Wiper Inoperative

Connect 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.

3. Wiper Has "Hi" Speed Only

See Possible Trouble under 2.

4. Wiper Has "Lo" Speed Only

See Possible Trouble under 2.

5. Wiper Crank Arm Does Not Return To Park Position When Wiper Is Turned Off. Park Position is shown in Figure 10-89. Check for dirty, bent or broken park switch contacts.

6. Wiper Speed Normal In "Lo" But Too Fast In "Hi"

Check for open 20 ohm resistor on back of wiper terminal board.

| Ammeter Reading (Amps) | Possible Trouble |
|---|---|
| 0 | (1) Loose solder connection at wiper terminal No. 2.<br>(2) Loose splice joints or brush lead connections. |
| 1-1.5 | (1) Open armature.<br>(2) Brushes sticking.<br>(3) Loose splice joint. |
| 11.0 | (1) Broken gear or some other condition that will stall the wiper. |
| **2. Wiper will not shut off and:** | **Possible Trouble** |
| Wiper has both speeds. | (1) Park switch contacts not opening.<br>(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.<br>(2) Shunt field coil grounded. |
| Wiper has "Hi" speed only. | (1) Internal wiper motor lead that connects to wiper terminal No. 3 open.<br>(2) Shunt field open. |

7. Intermittent Operation

Check for sticking brushes, loose splice joints, etc.

## 10-57 DISASSEMBLY AND ASSEMBLY

Except for the internal wiring to the wiper terminal board, the disassembly and assembly procedures for the two speed wipers covered in this section are the same as those outlined for the single speed wipers in paragraph 10-56 of this manual. See Figure 10-89 for internal wiring.

**a. Specifications**

Operating Volts . . . . . 12 VDC

Gear Ratio . . . . . . . . . . 36:1

Crank Arm Rotation
(looking at Crank Arm) . . CCW

Crank Arm Speed:
(RPMs) (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 Resistor. . 20 OHMS

## 10-58 WINDSHIELD WASHER DESCRIPTION AND OPERATION

**a. General Description**

The washer pump used on the two speed non-depressed park wiper is a positive displacement type pump employing a small bellows, bellows spring and valve arrangement. The pumping mechanism is actuated by a 4 lobe cam driven by the wiper. See Figure 10-91. The programming (starting and

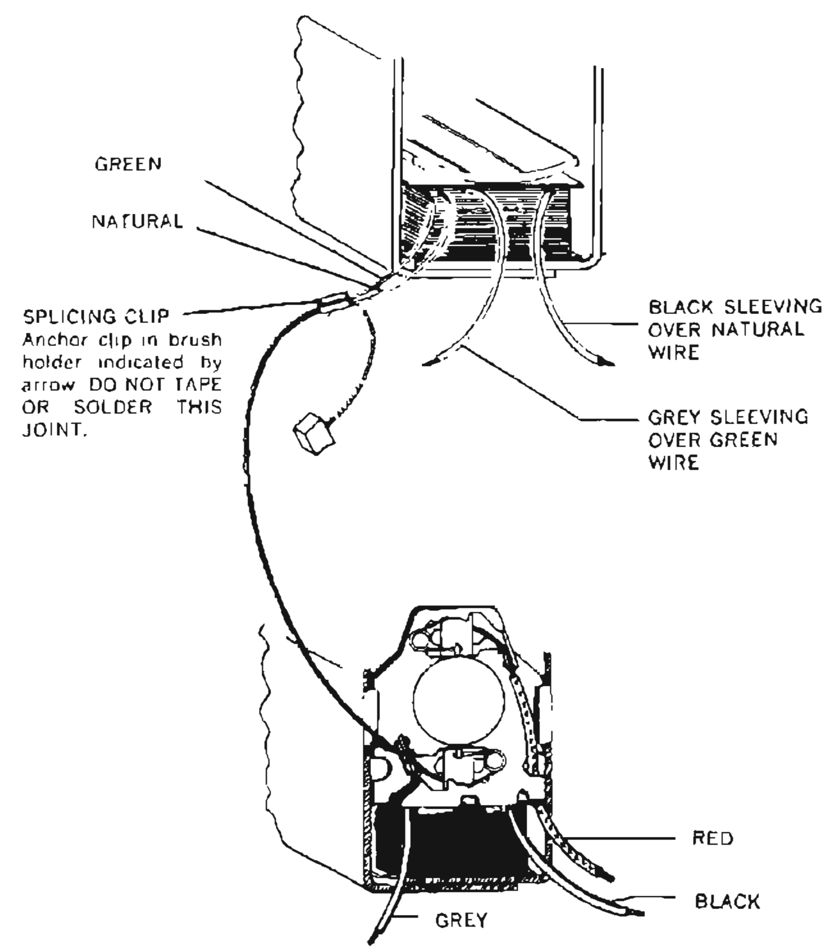



Figure 10-89—Two Speed Motor Wiring

completion of a wash cycle) is accomplished electrically and mechanically by a relay assembly and ratchet wheel arrangement. See Figure 10-90.

Explanation of pump operation follows:

**b. Washer Operation**

1. Wiper On - Washer Off

When the washer pump is mounted on the wiper correctly, a pin and roller assembly on the washer pump engages a 4 lobe cam on the output shaft of the wiper output gear. (Figure 10-91). The pin and roller assembly is attached to the spring loaded plate and ratchet pawl assembly. See Figure 10-90. Thus, with the wiper running, the 4 lobe cam rotates continuously and actuates the plate and ratchet pawl assembly back and forth in a horizontal plane. A second 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. 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 (Figure 10-90) 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.

2. Turning The Washer On

Depressing the dash switch washer button closes the washer pump relay circuit to ground. (Refer to Figure 10-92). 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 (Figure 10-93).

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

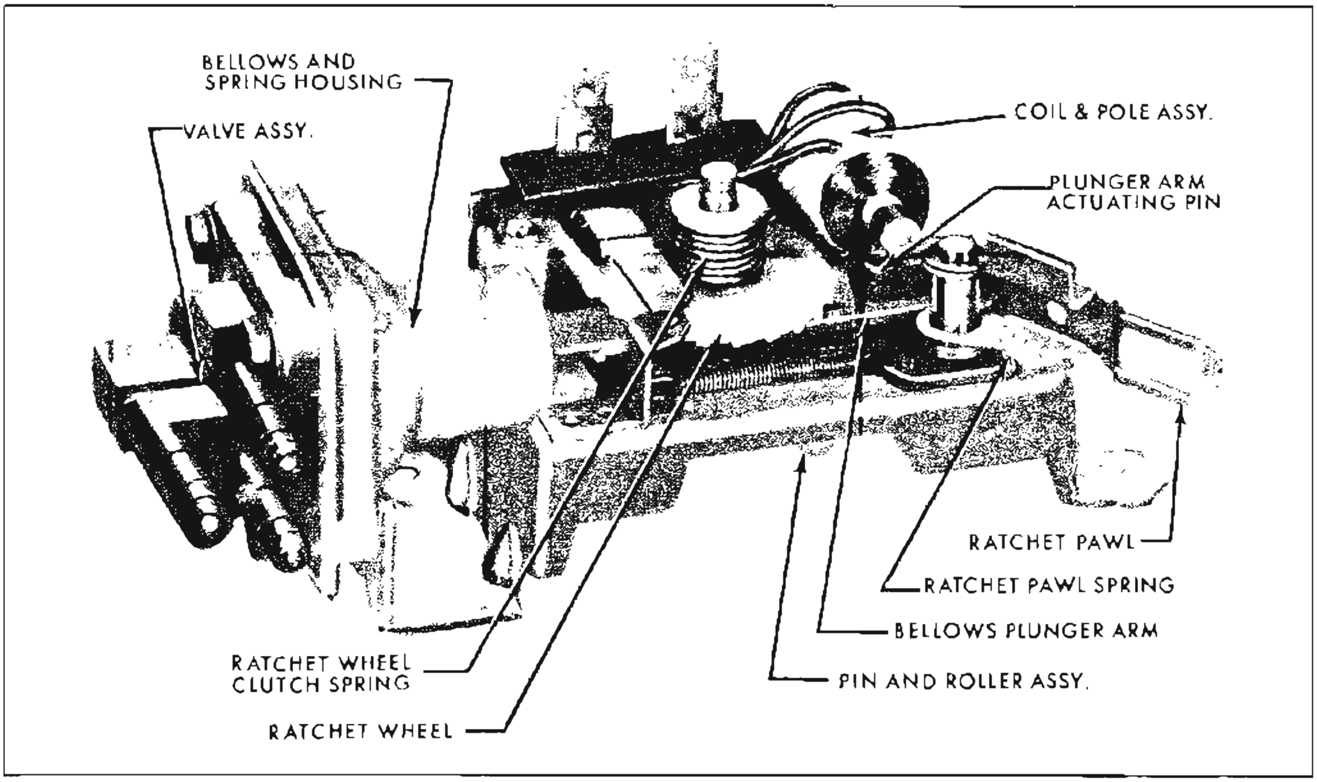



Figure 10-90—Washer Pump with Cover Removed

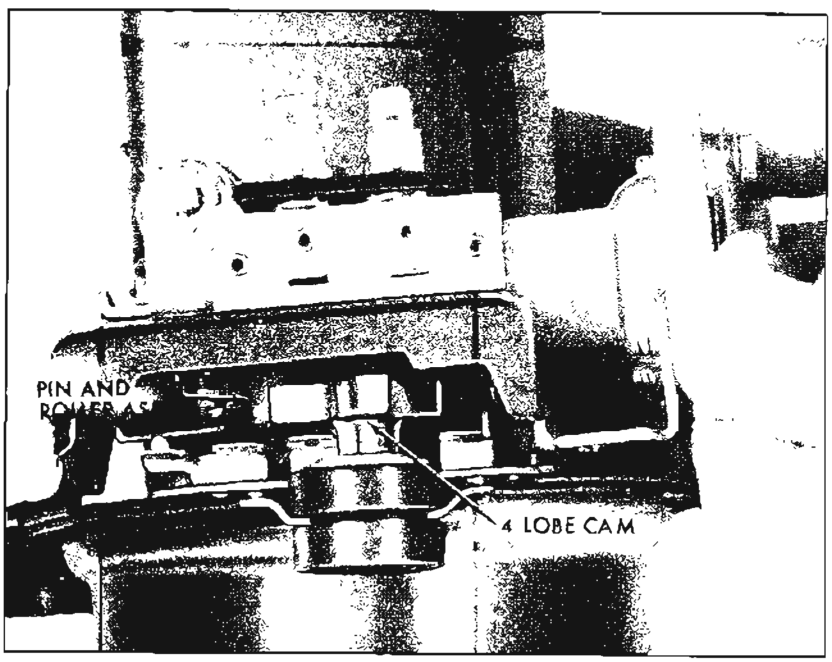



Figure 10-91—Washer Pump Drive

been turned through 360° or 21 teeth, at which time the ratchet wheel will again open the contacts.

3. Pumping Cycle

(a) (Exhaust half of pump stroke:)

With the pumping mechanism released from its "lock-out" position, the bellows spring expands and collapses the bellows forcing water out two outlet valves. (Figure 10-94). 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. 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 4 lobe cam actuates the plate and ratchet pawl assembly.

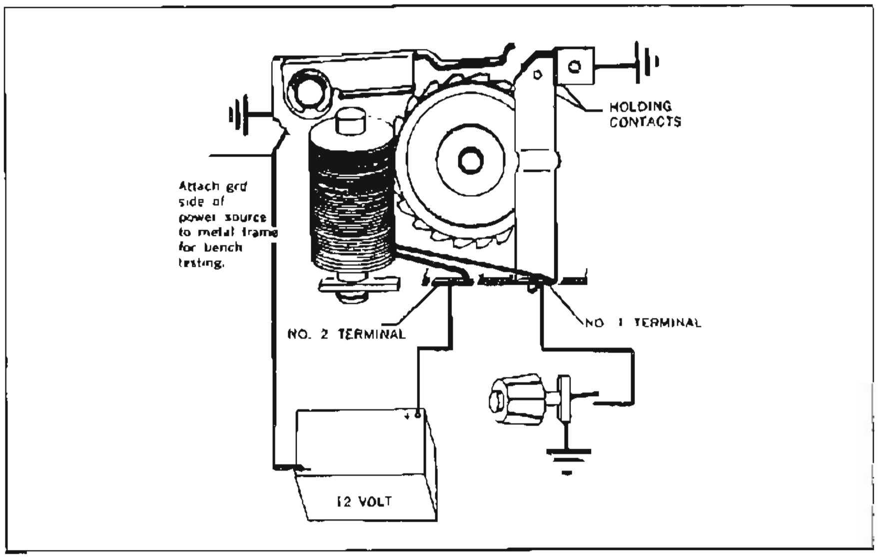



Figure 10-92—Washer Pump Wiring Diagram

(b) (Intake half of pump stroke:)

Pulling the plunger arm back compresses the bellows spring (Figure 10-95) 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.

4. Completion Of Wash Cycle

The wash cycle is completed when the electrical circuit to the relay coil is opened and the pumping 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. The tang reaches the "lock-out" position at the same time the relay coil holding contacts open.

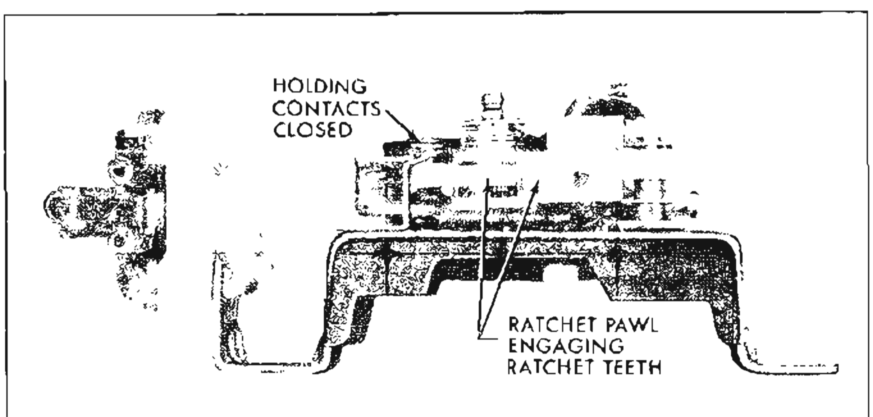



Figure 10-93—Ratchet Pawl Engaging Ratchet Wheel

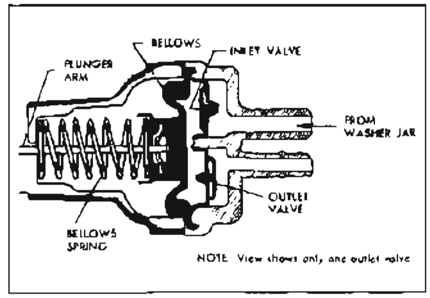



Figure 10-94—Pump Stroke (Exhaust)

## 10-59 WINDSHIELD WASHER TROUBLE SHOOTING

### a. Washer Inoperative

1. Check the following items:

(a) Jar has adequate quantity of water solution.

(b) Hoses are not damaged and hose connections are tight.

(c) Screen at end of jar cover hose is not plugged.

(d) Electrical connections to washer pump and dash switch.

(e) Nozzles are not plugged.

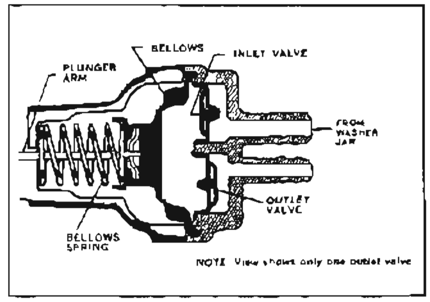



Figure 10-95—Pump Stroke (Intake)

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 without tab. 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 with tab to ground 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.

**b. Checking Pump Operation With Washer Pump Detached**

1. Remove washer pump cover and connect 12 volt power supply to washer pump as shown in Figure 10-92. Connect jumper wire from terminal No. 1 to ground. Turn ratchet pawl to the position shown in Figure 10-92. 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 1 lobe in a clockwise direction (looking at the cam). Observe if relay holding contacts close (Figure 10-93) and the pump plunger arm is released from its 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.

4. If pump performs correctly in Step 3, manually operate pin and roller assembly until the ratchet wheel has been turned through 360° or 21 teeth. After the ratchet wheel has been rotated 21 teeth, the holding contacts should be opened by a "hump" on the wheel and the pump plunger arm should be in the "lock-out" position.

**c. Checking Valve Assembly**

1. Attach a hose to the large or intake pipe. You should be able to blow through it but not draw through it.

2. Attach a hose individually to each of the small or exhaust pipes. You should be able to draw through them but not blow through them.

If any of three valves allow air to pass in both directions, the valve assembly is defective.

## 10-60 WINDSHIELD WASHER DISASSEMBLY AND ASSEMBLY

**a. Removal and Installation of 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.

4. To install reverse removal procedure.

**b. Removal and Installation of 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.

4. To install reverse removal procedure.

**c. Removal and Installation of 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.)

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.

4. To install reverse removal procedure.

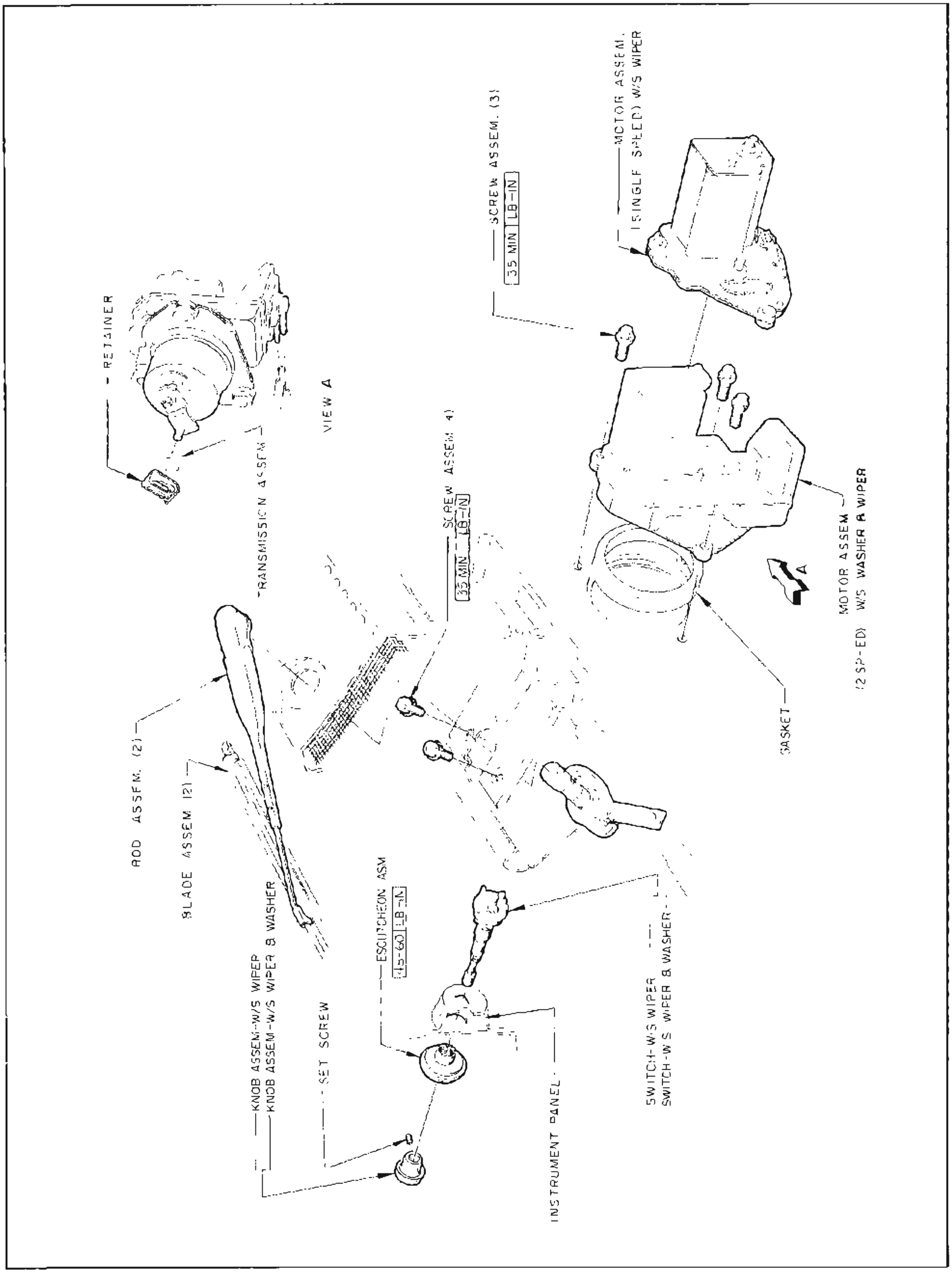



Figure 10-96—Windshield Wiper Installation

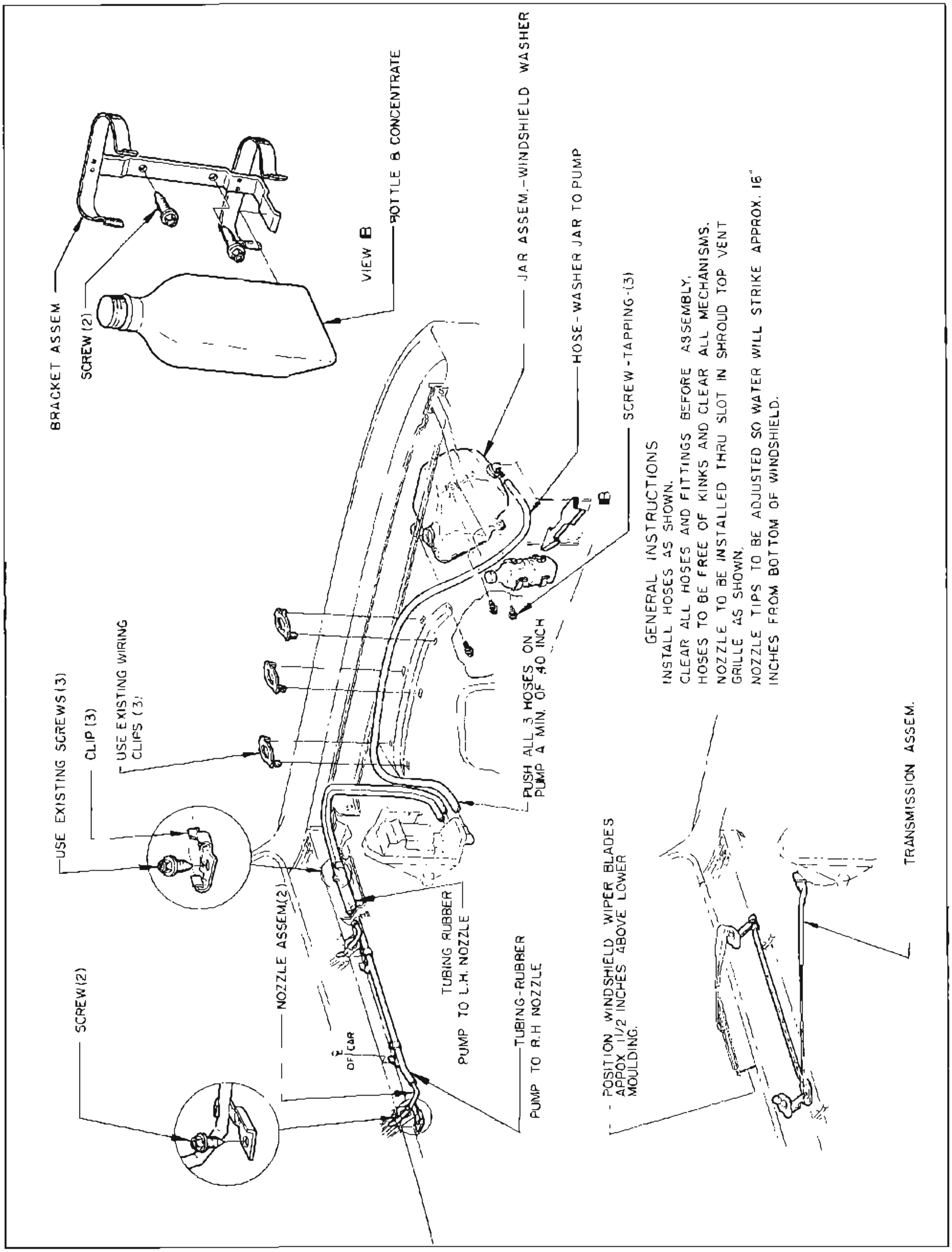



Figure 10-97—Windshield Washer Hose Installation

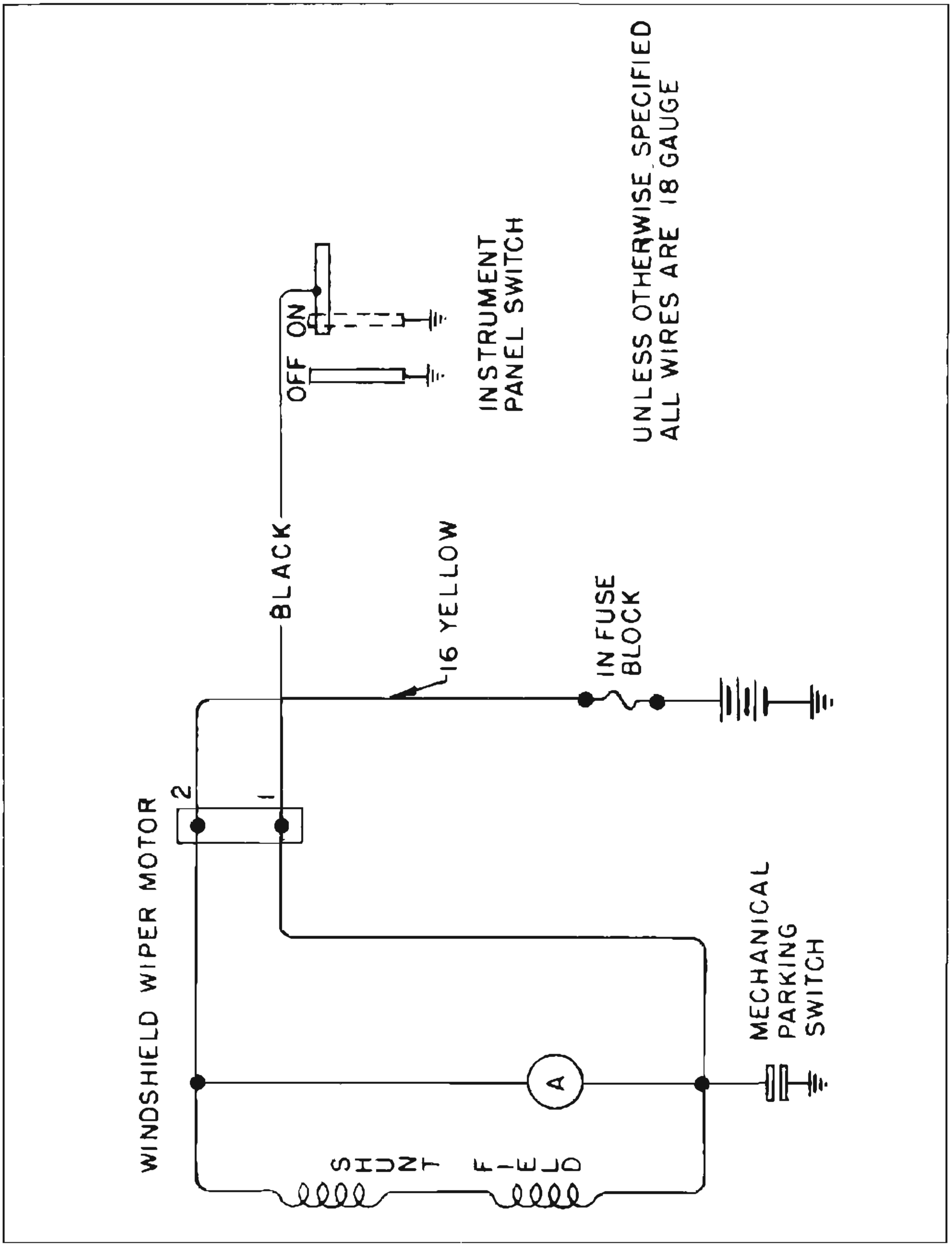



Figure 10-98—Windshield Wiper Circuit Diagram - Single Speed

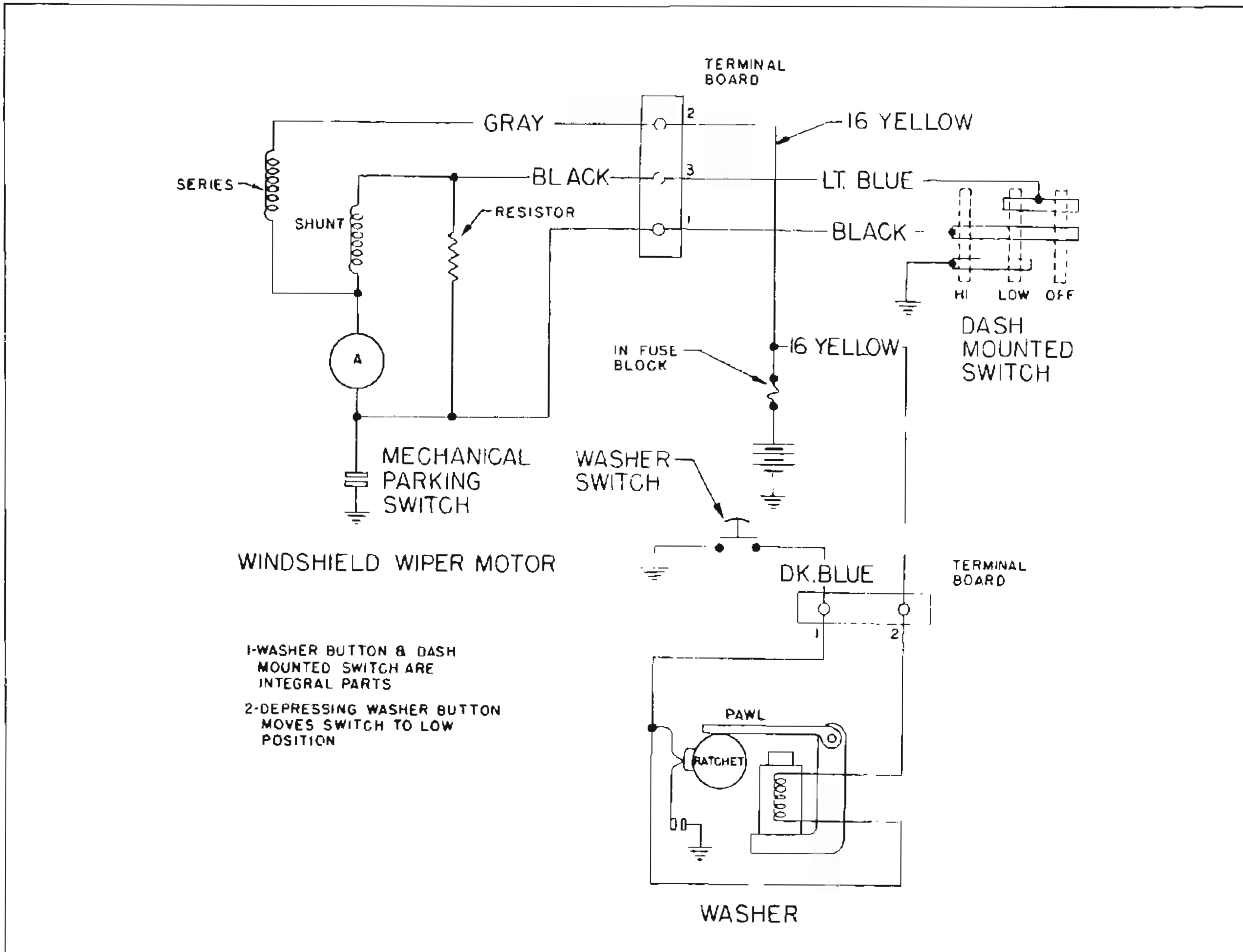



Figure 10-99—Windshield Wiper and Washer Wiring Circuit Diagram (Two Speed Wiper)

# SECTION 10-J

# WIRING CIRCUIT DIAGRAMS

## CONTENTS OF SECTION 10-J



## 10-61 CIRCUIT DIAGRAMS AND FUSE BLOCK

This section contains schematic wiring circuit diagrams for the complete car. For more detailed body wiring diagrams showing the routing of the wires and the location of the switches, connectors and retaining clips, see the Body Service Manual.

A few of the most important terminals are connected with screws. However, most of the terminals have a flat push-pull type connector. With this connector, the terminal on the wire requires a straight hard push to seat it in the socket. A hard steady pull on the terminal is required to detach it from the socket.

A central fuse block is mounted under the instrument panel on the left side. This fuse block serves as a convenient junction point for a number of circuits, provides a mounting for the direction signal flasher and contains most of the fuses.

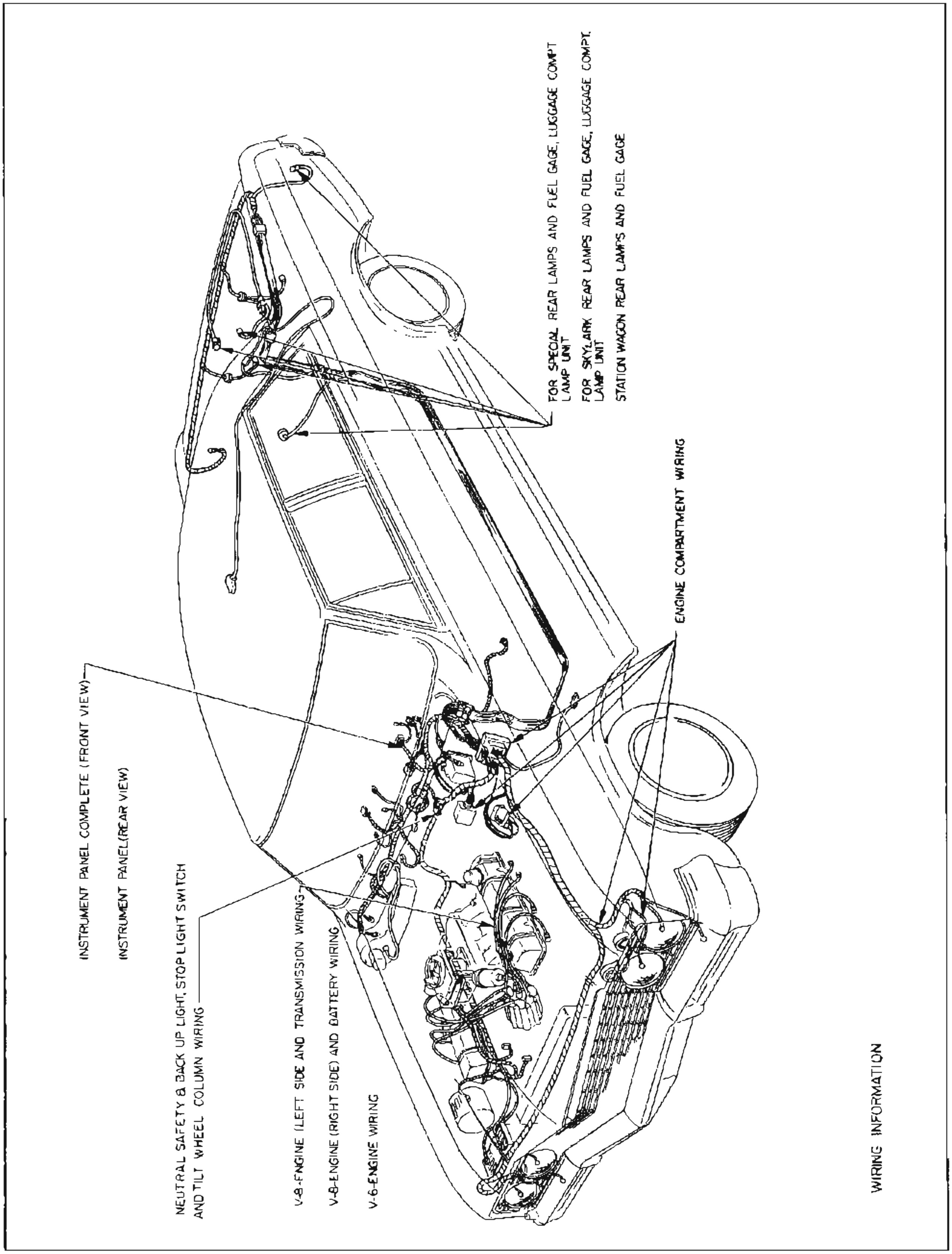



Figure 10-100—Electrical Information - Index

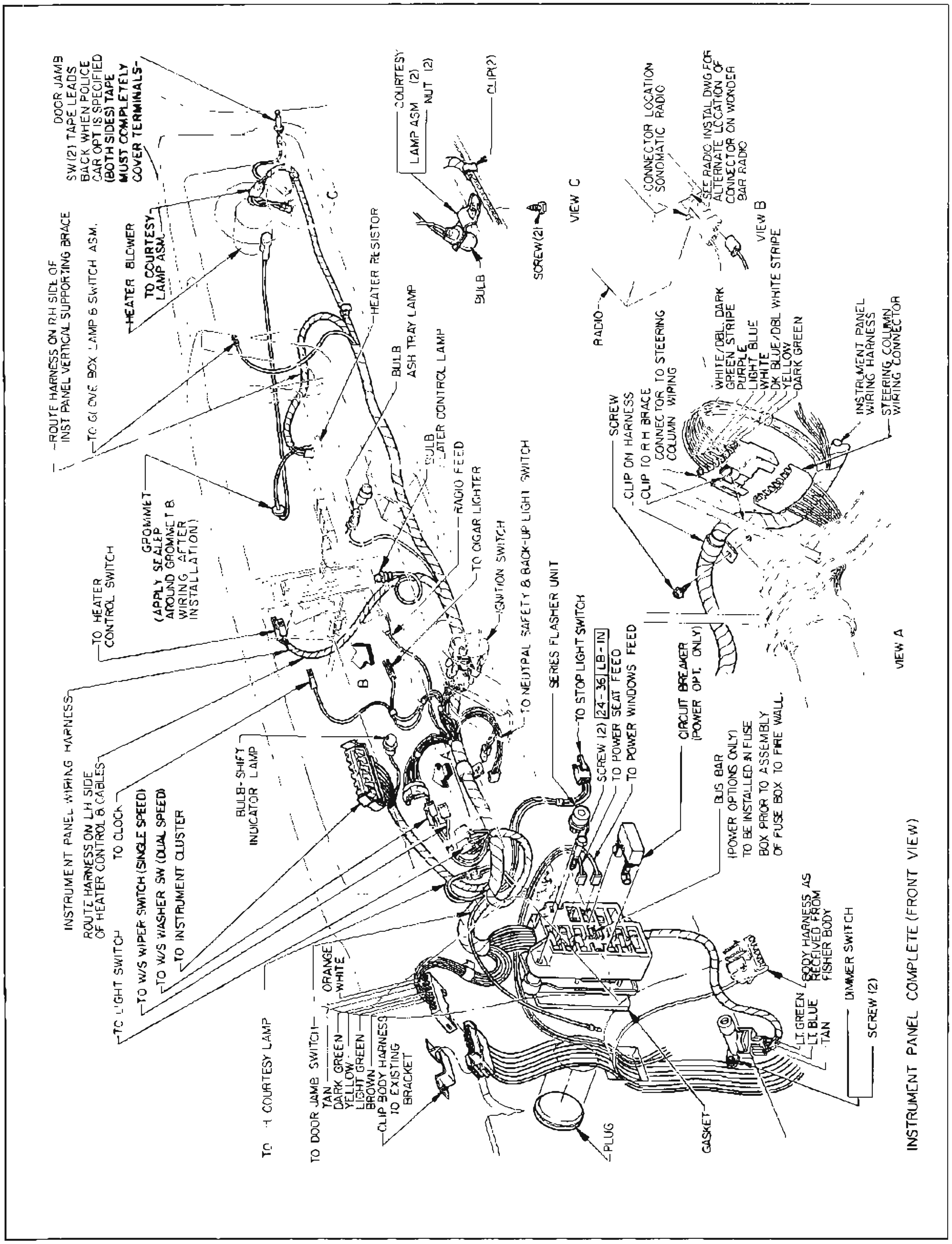



Figure 10-101—Instrument Panel Wiring Harness - View from Passengers' Side

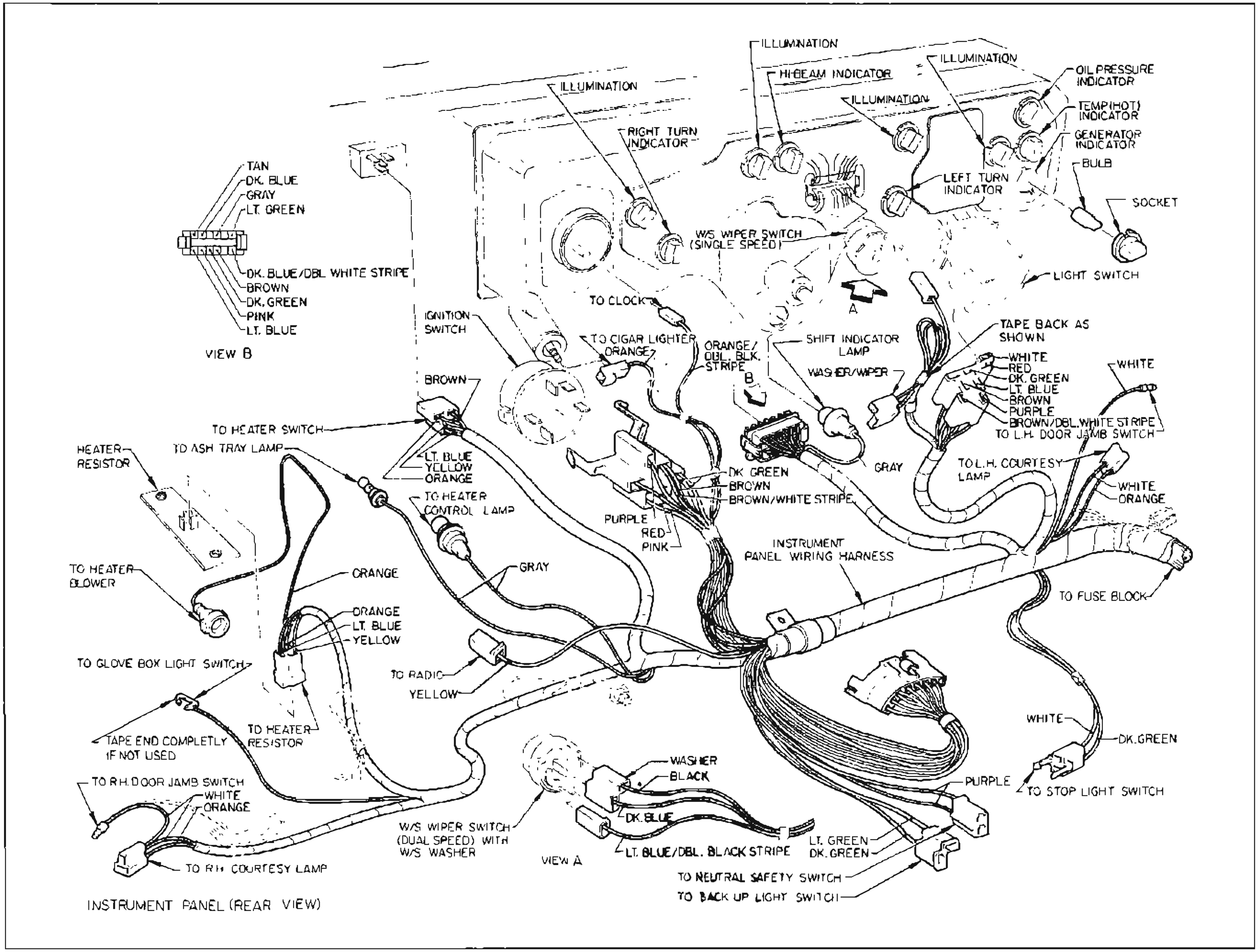



Figure 10-102—Instrument Panel Wiring Harness - View from Forward Side

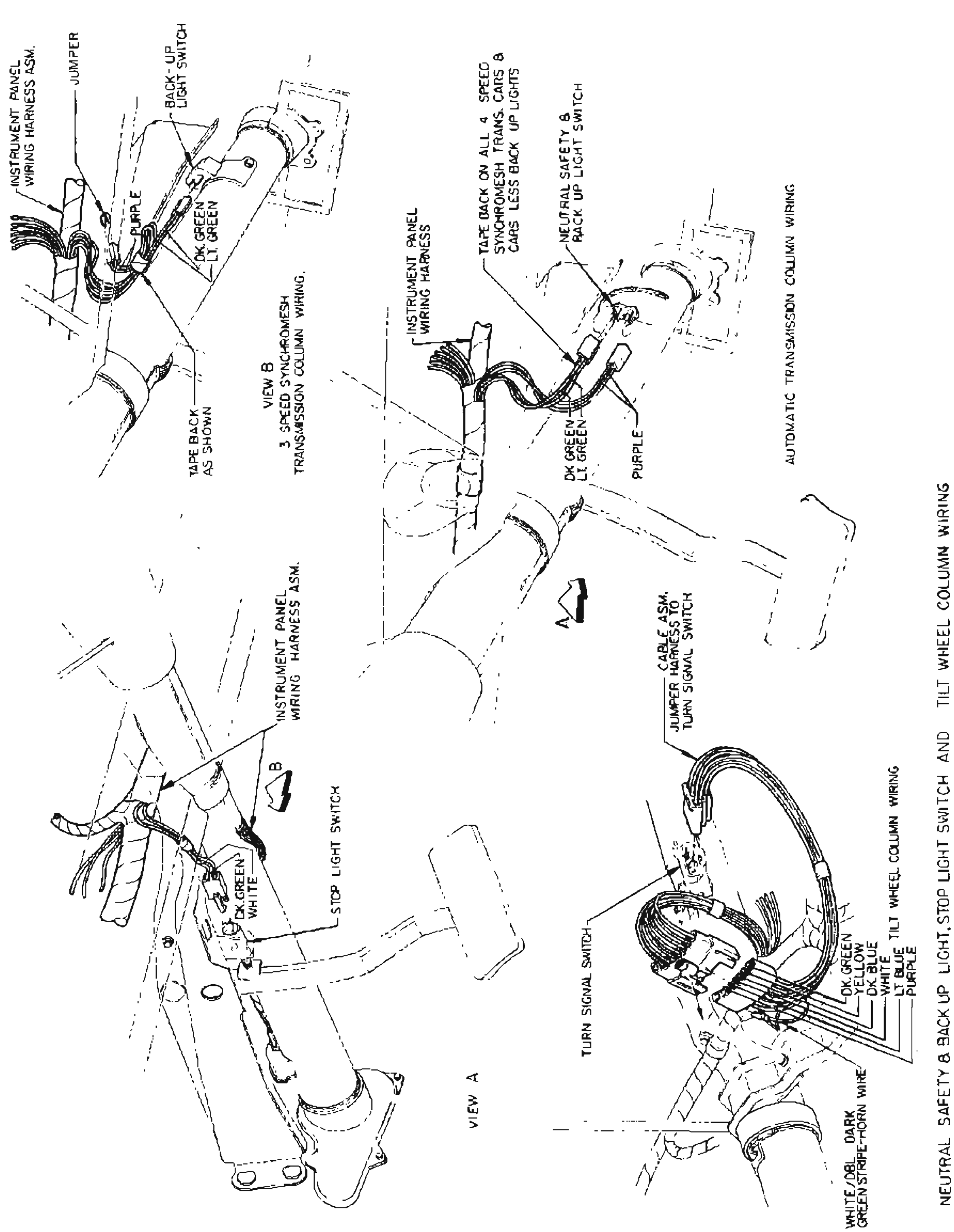



Figure 10-103—Neutral Safety, Back-Up and Stop Light Switches

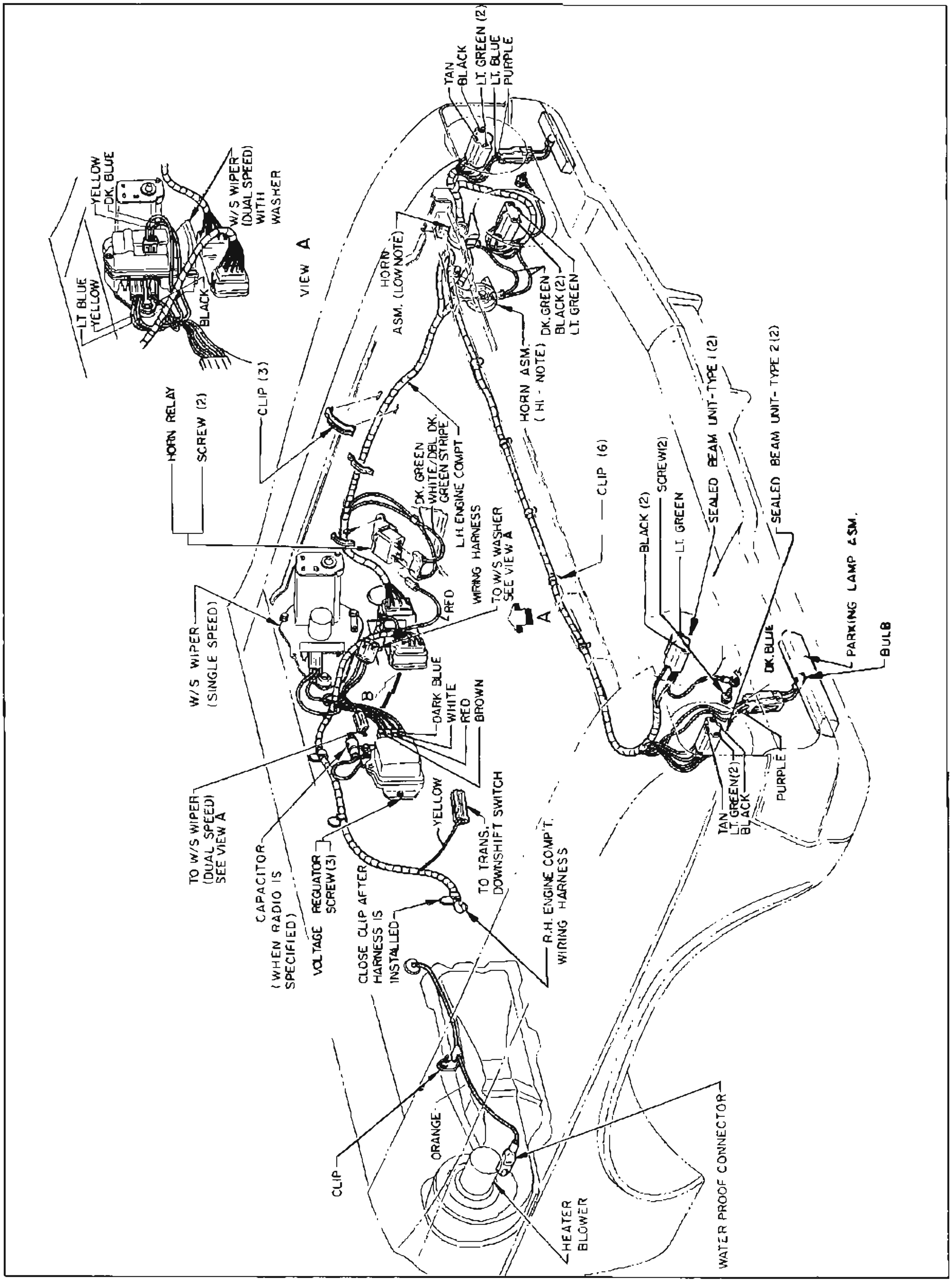



Figure 10-104—Engine Compartment Wiring

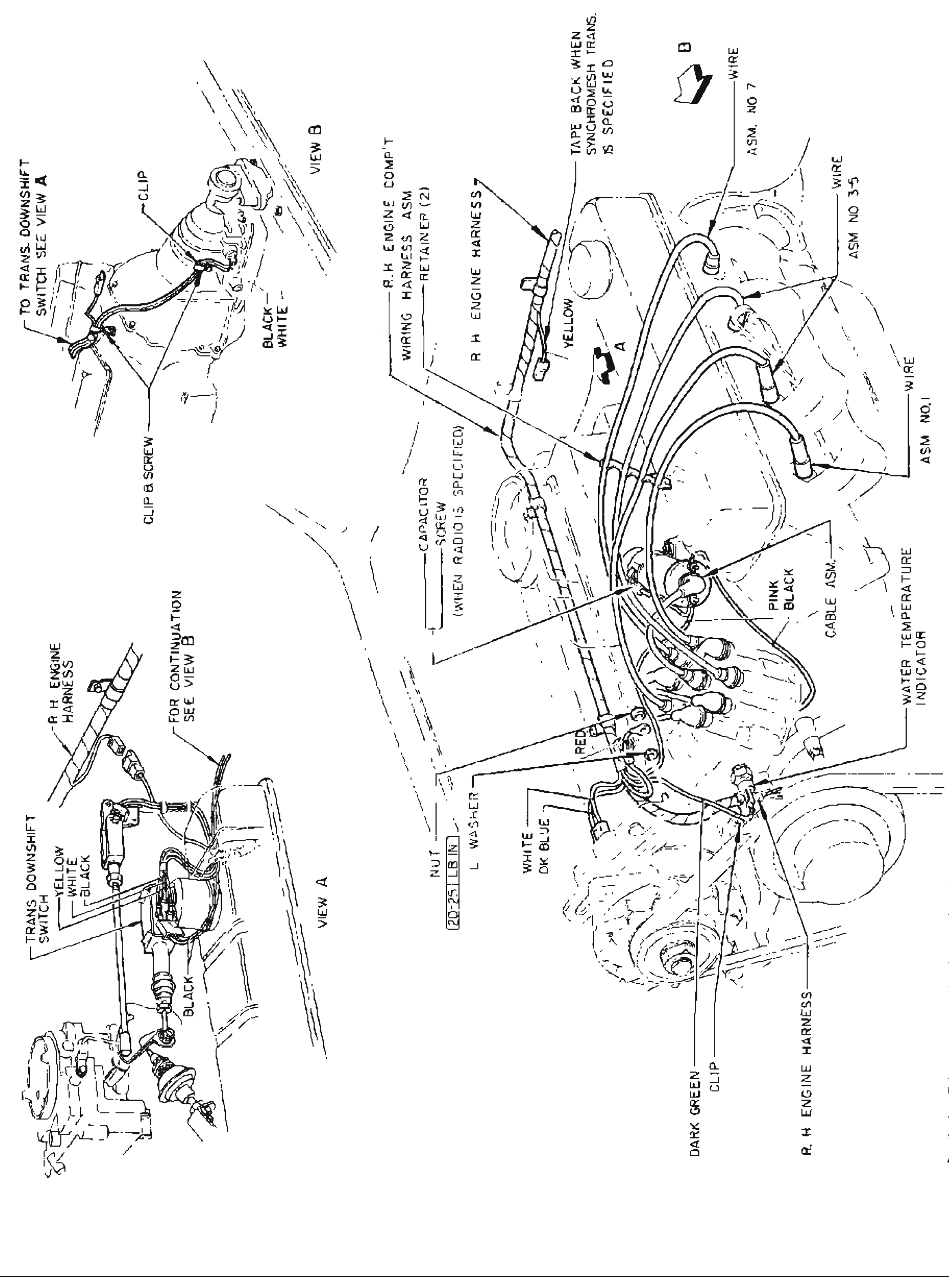



Figure 10-105—Left Side V-8 Engine and Transmission Wiring

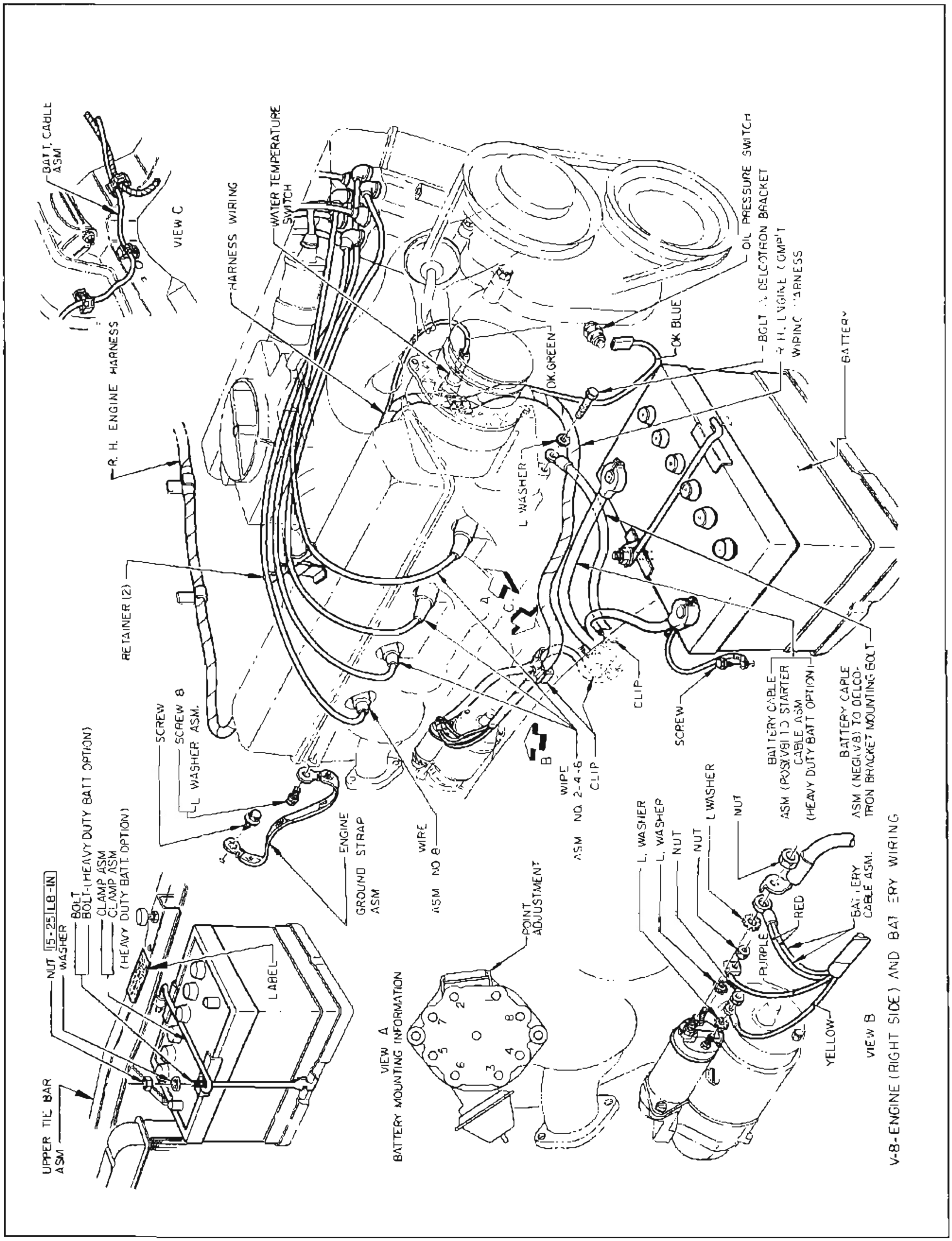



Figure 10-106—Right Side V-8 Engine Wiring and Battery Wiring

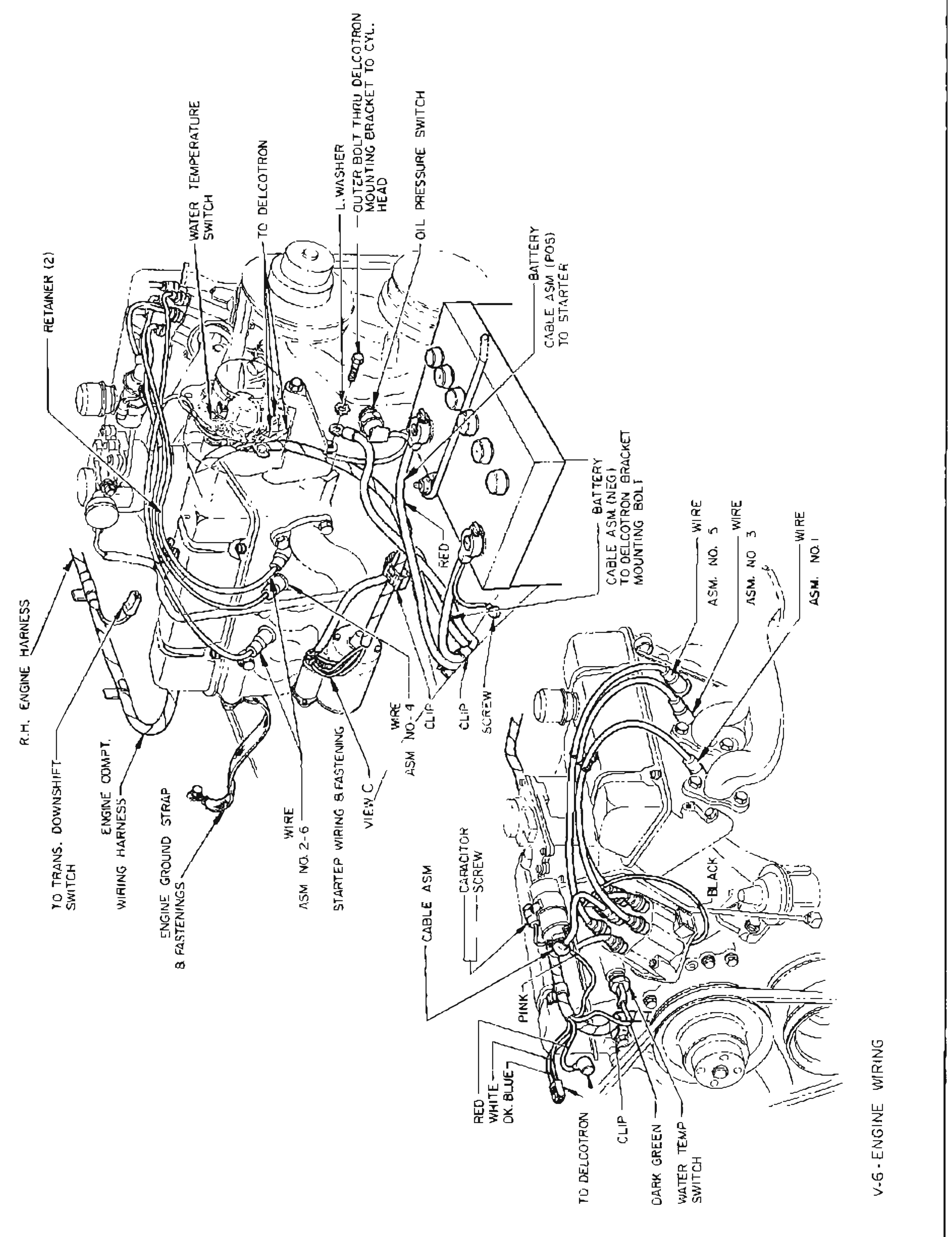



Figure 10-107—V-6 Engine Wiring

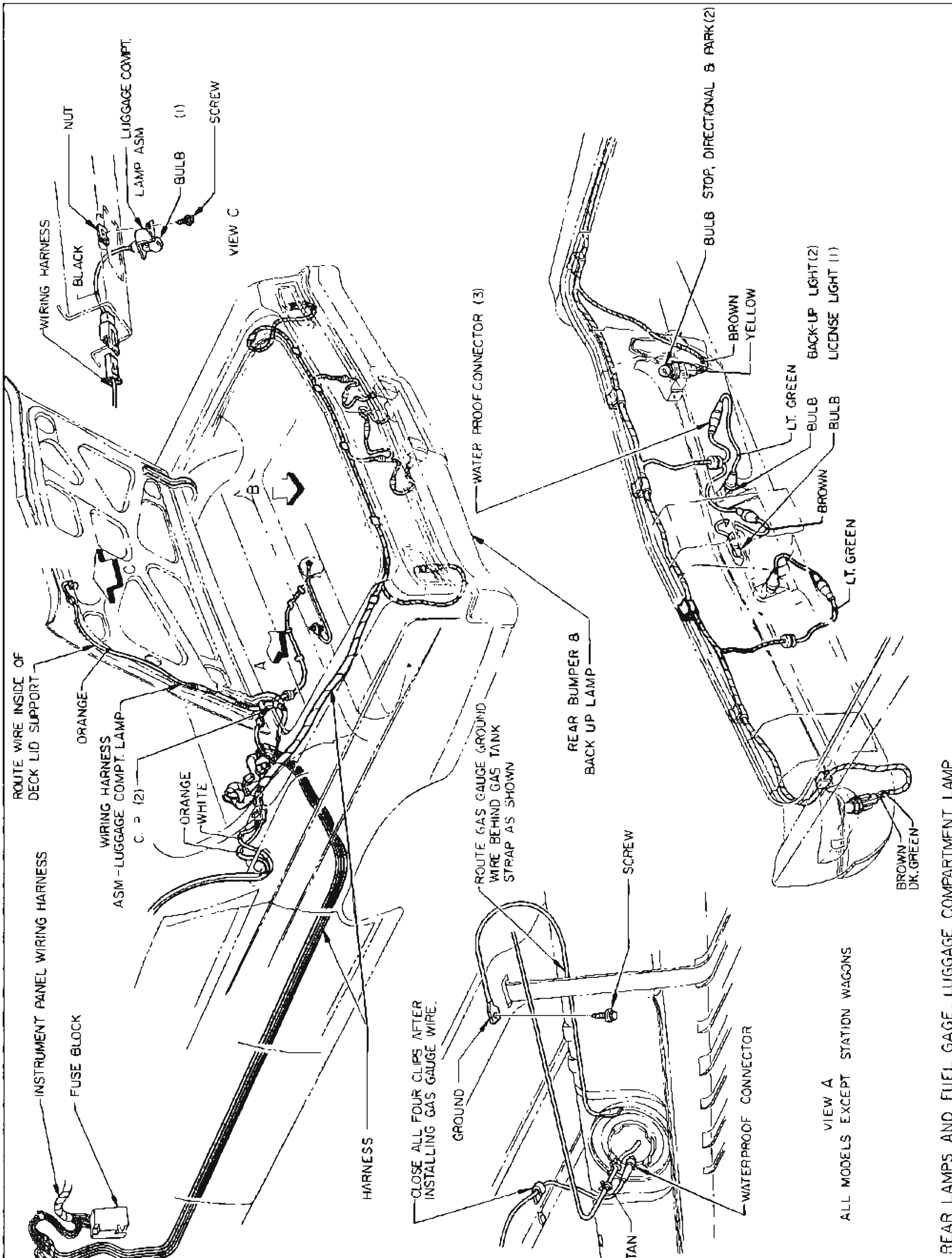



Figure 10-108—Rear Lamps and Fuel Gauge Tank Unit Wiring - Specials Except Wagons

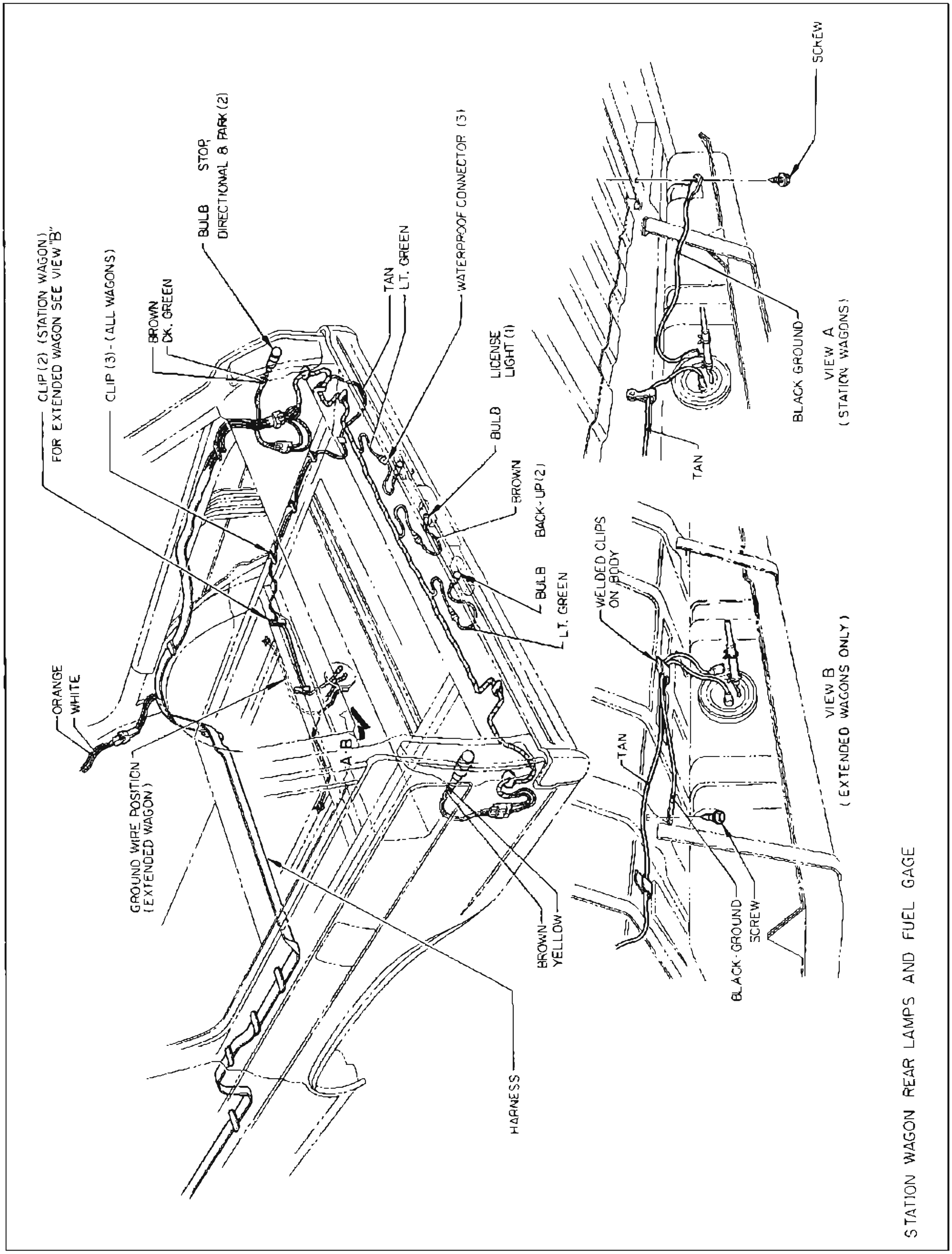



Figure 10-109—Rear Lamps and Fuel Gauge Tank Unit Wiring - Wagons

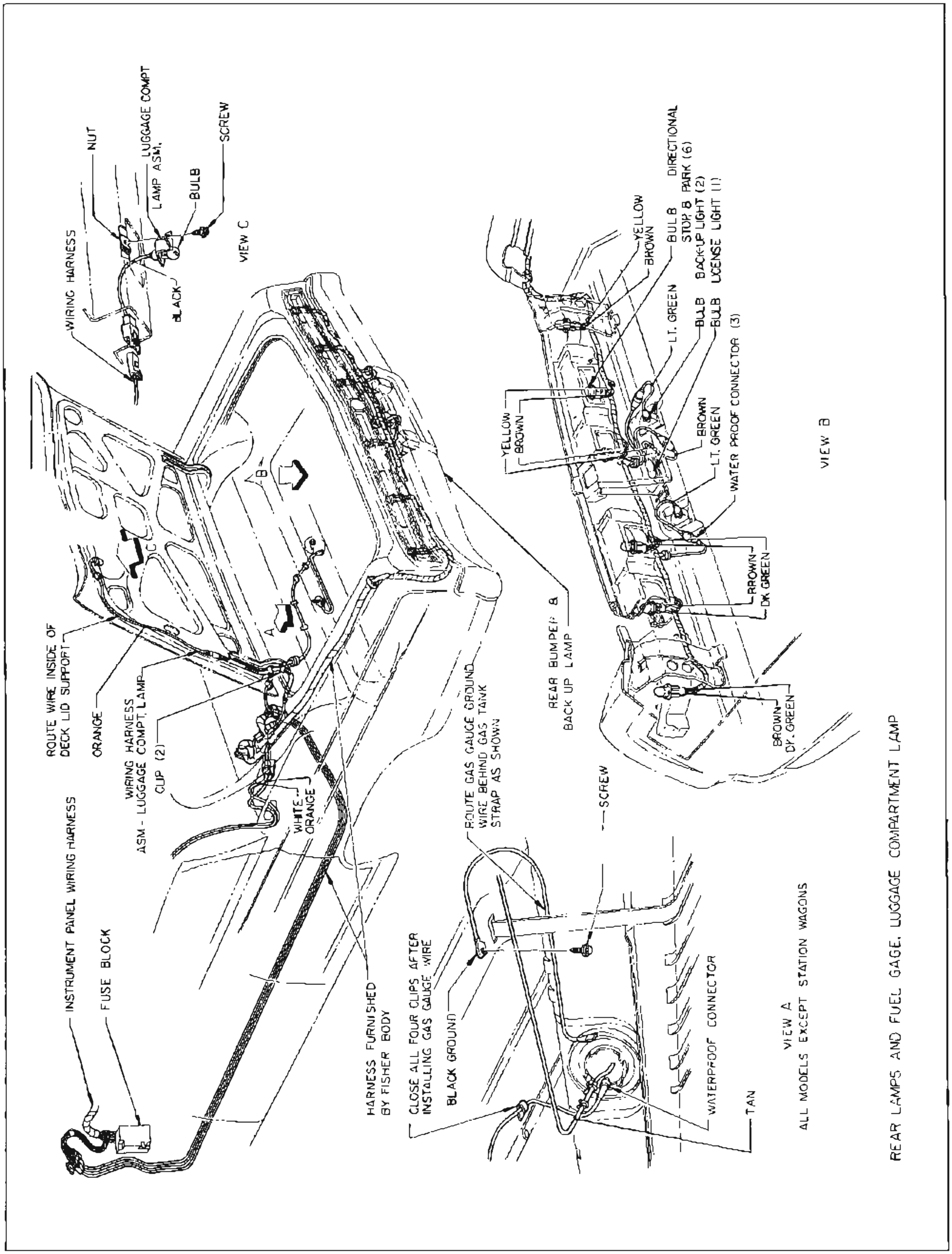



Figure 10-110—Rear Lamps and Fuel Gauge Tank Unit Wiring - Skylarks Except Wagons

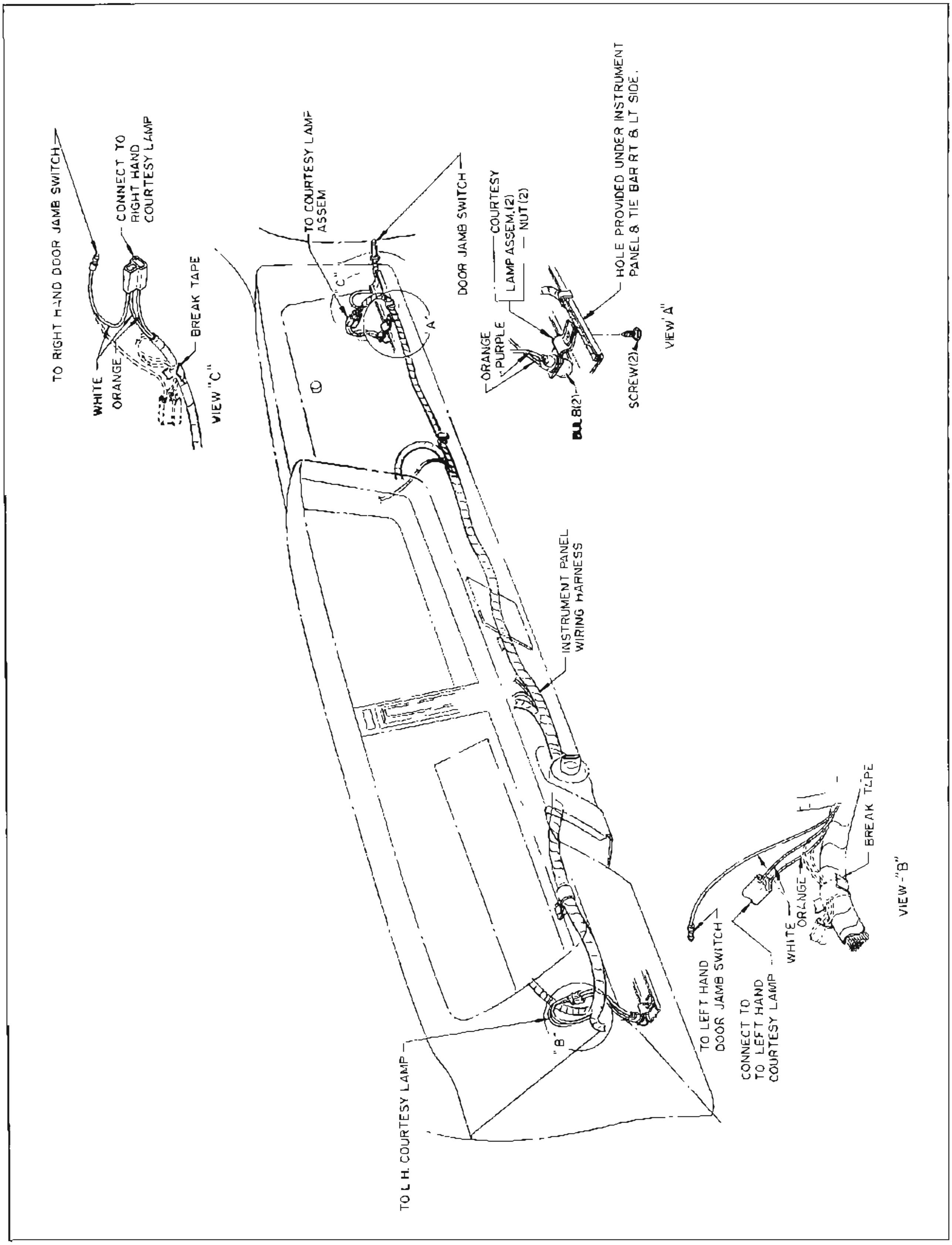



Figure 10-111—Courtesy Lamp Installation

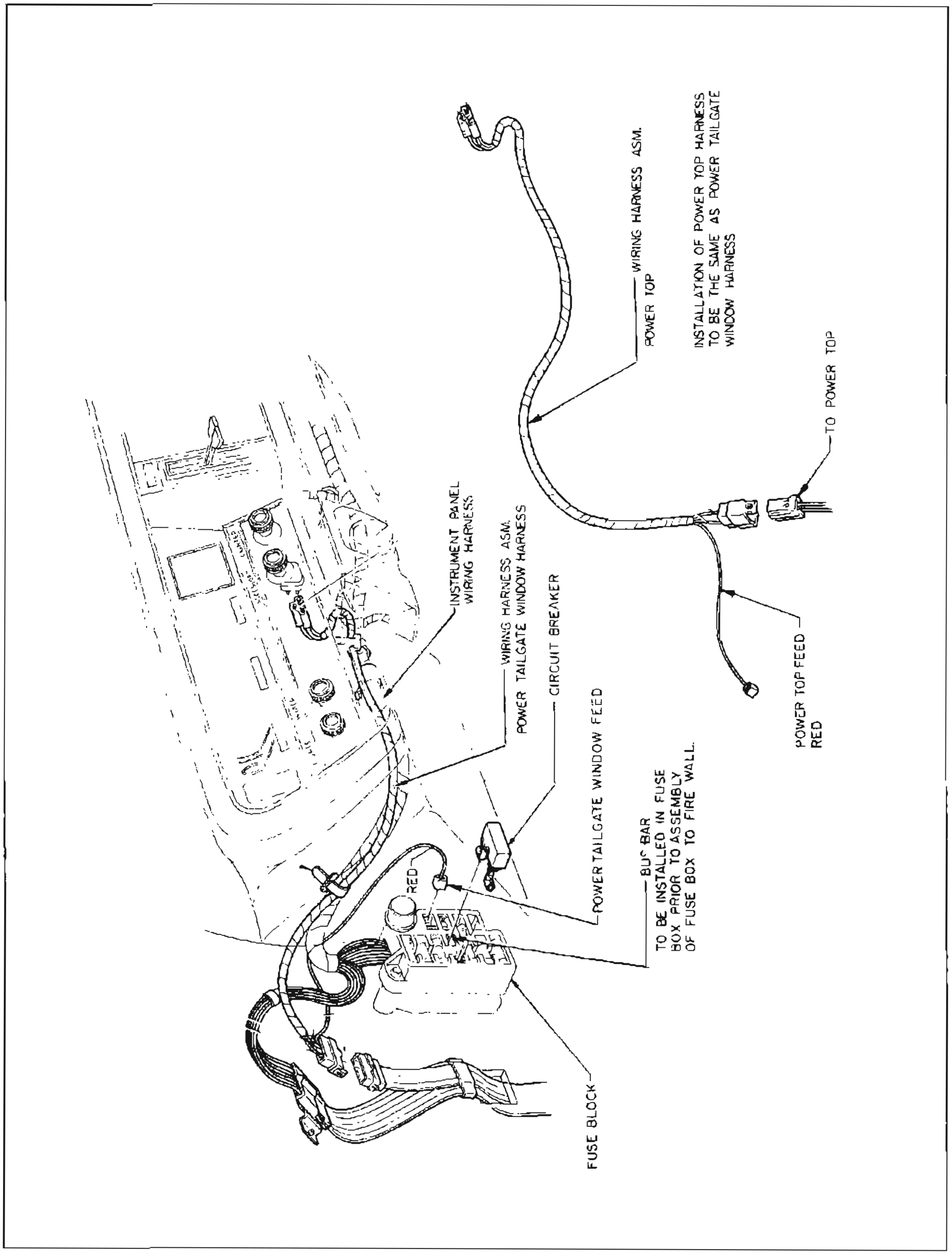



Figure 10-112—Power Top or Tail Gate Window Wiring

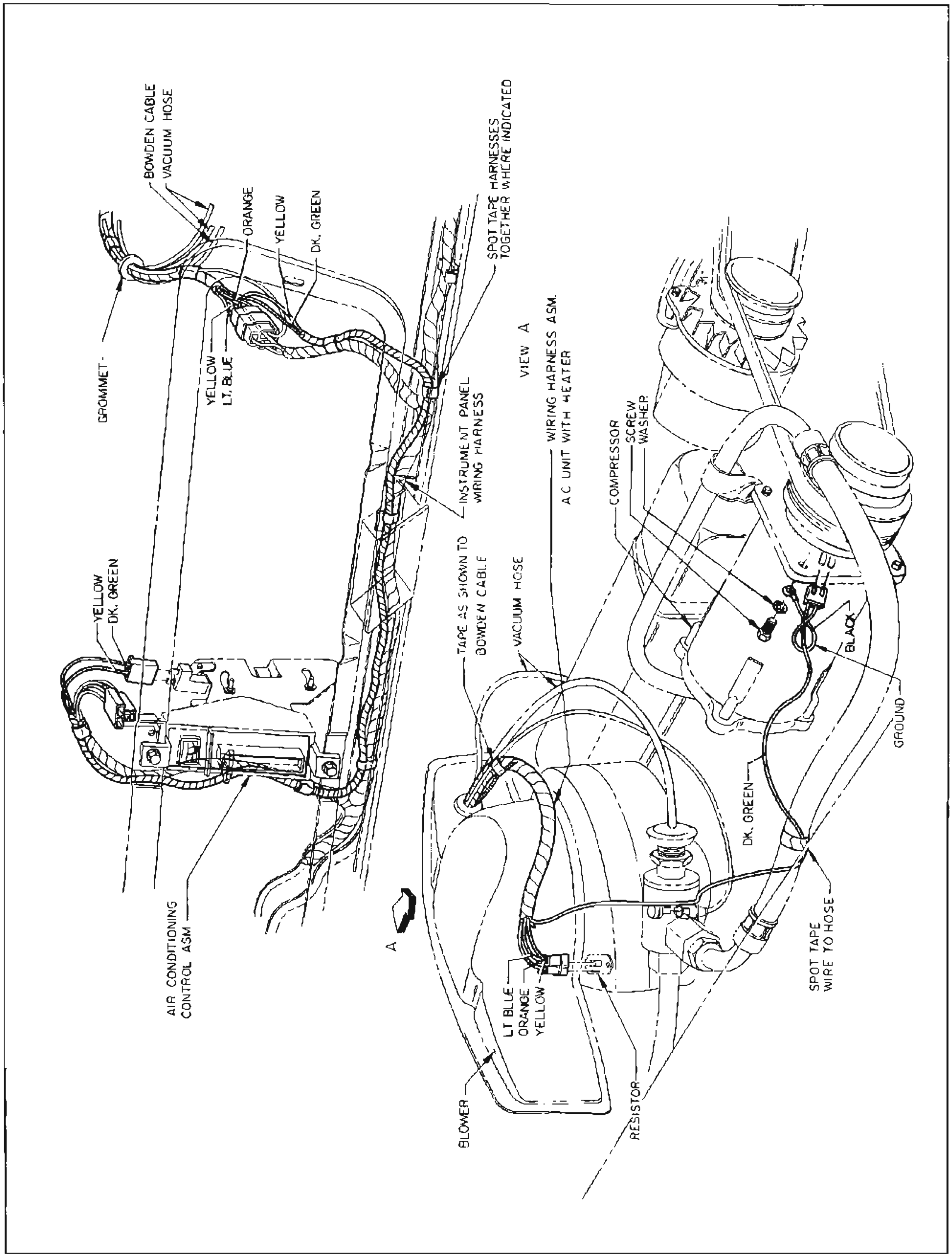



Figure 10-113—Air Conditioner Wiring

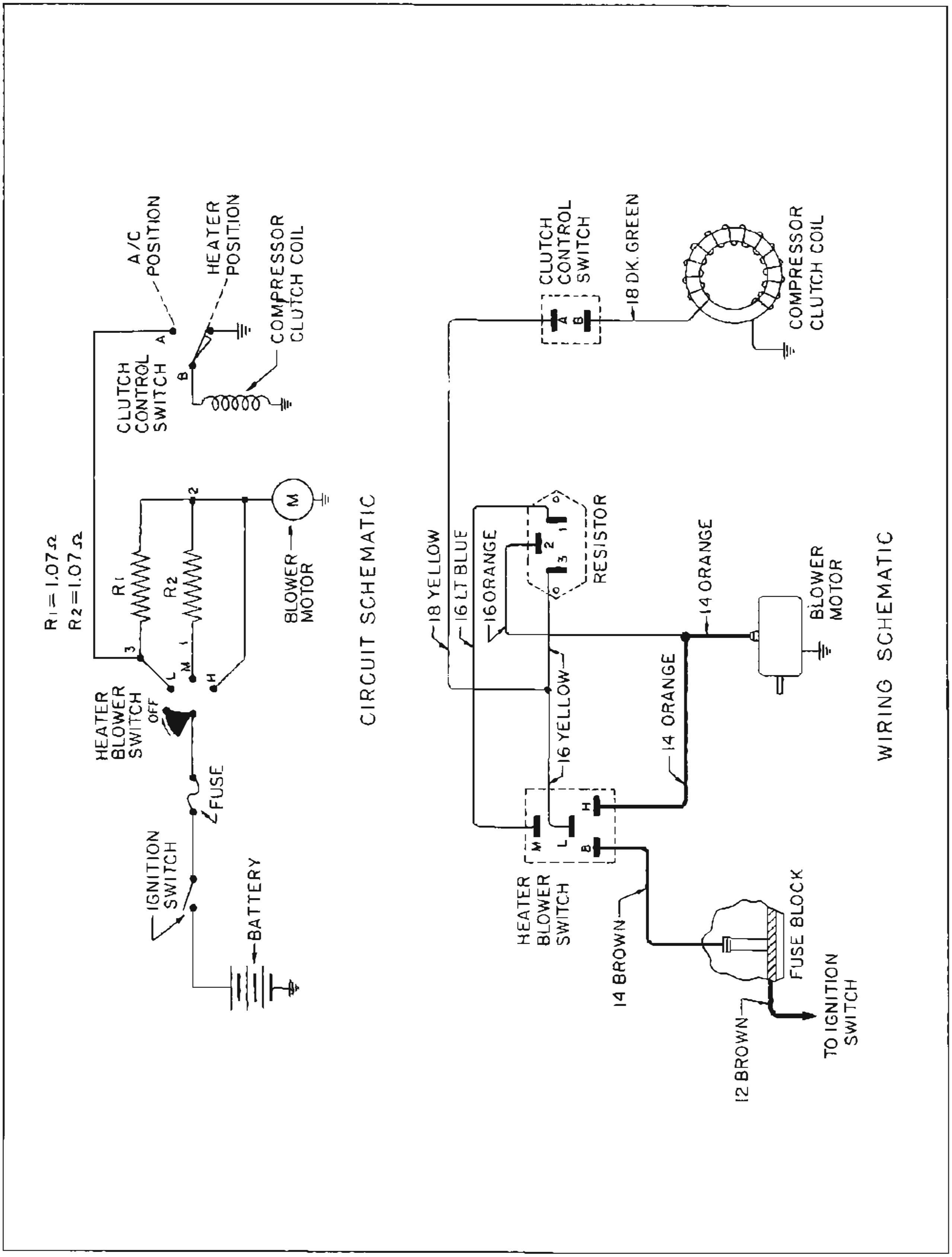



Figure 10-114—Air Conditioner Schematic Diagrams

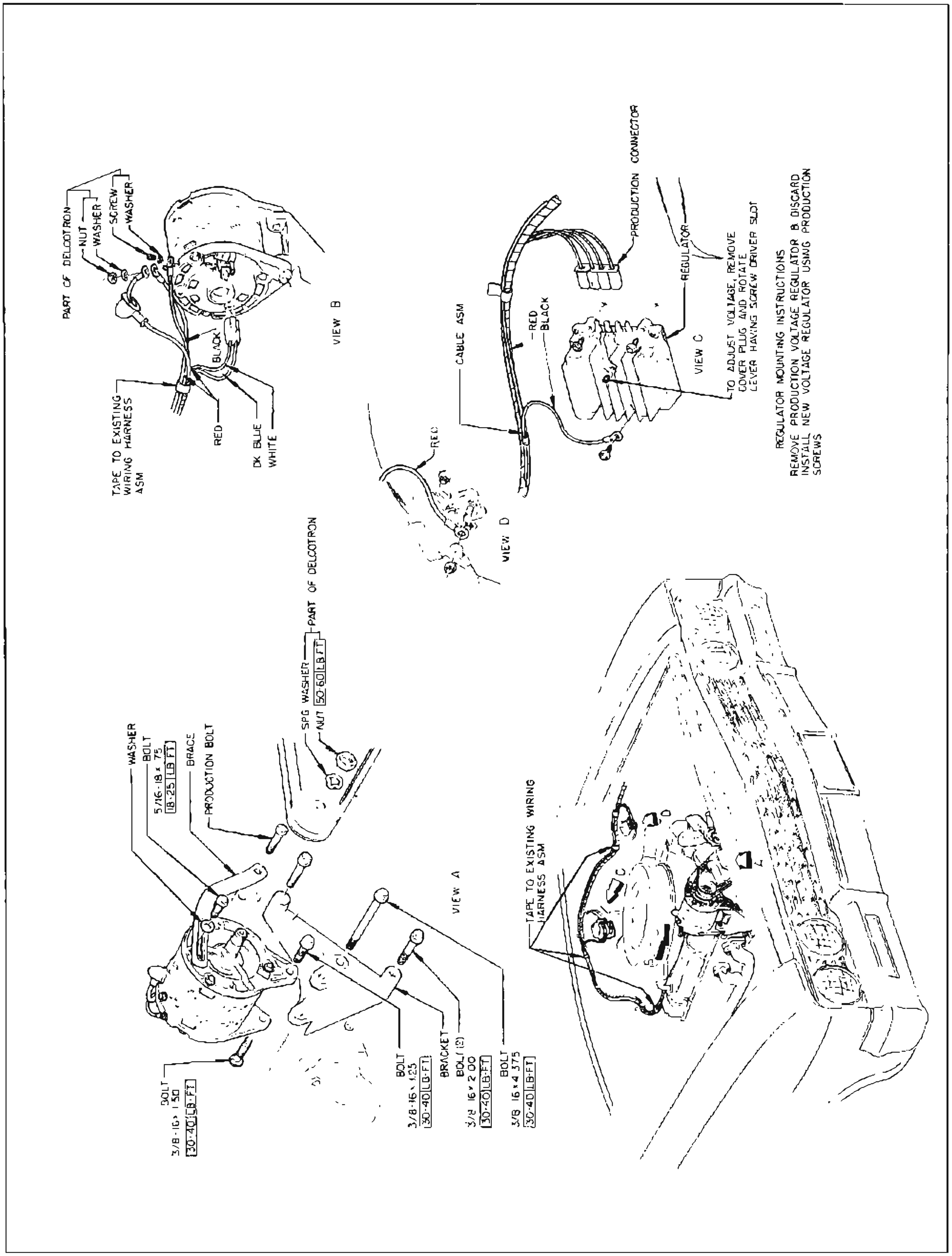



Figure 10-115—Police Generator Installation

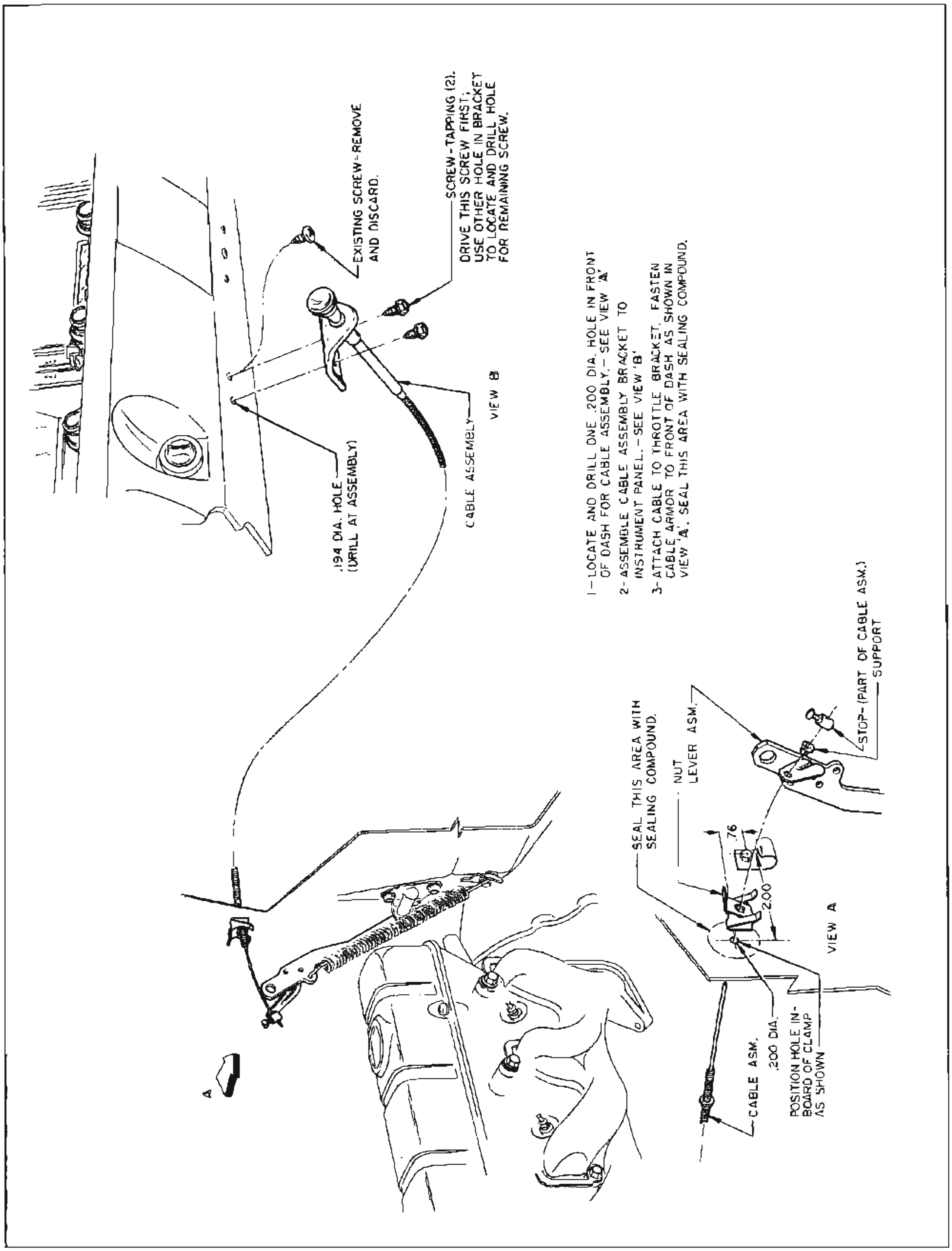



Figure 10-116—Hand Fast Idle Control Installation - Police Car

| WHERE USED | AMPERES | TYPE | LENGTH |
|---|---|---|---|
| RADIO | 7.5 | AGC | 1-1/4 |
| DIR. SIGNAL, STOP AND BACK-UP LAMPS | 15 | AGC | 1-1/4 |
| TAIL LAMPS, CLOCK AND GLOVE BOX LAMP (SPOT LAMP) | 10 | AGC | 5/8 |
| BLOWER MOTOR (HEATER AND/OR AIR CONDITIONING) | 30 | AGC | 1-1/4 |
| PANEL LIGHTS-SHIFT INDICATOR, CLOCK LAMP, HEATER LAMP, ASH TRAY LAMP | 3 | AGC | 1-1/4 |
| WIPER & TRANS. SHIFT SWITCH | 25 | AGC | 1-1/4 |
| LIGHTER & DOME LAMP | 15 | AGC | 7/8 |
| REAR WINDOW DEF. (IN LINE FUSE) | 5 | AGC | 1-1/4 |

Figure 10-117 - Fuse Chart

| WHERE USED | LAMP NO. | NO. USED | CANDLE POWER | MODEL |
|---|---|---|---|---|
| (FRONT) | | | | |
| HEADLAMP-5-3/4 DIA. TYPE-1 | 4001 | 2 | 37.5W | 43-44 |
| HEADLAMP-5-3/4 DIA. TYPE-2 | 4002-L | 2 | 37.5-55W | 43-44 |
| HEADLAMP-5-3/4 DIA. TYPE-2 (EXPORT) | 4002-L | 2 | 37.5-55W | 43-44 |
| PARK & DIR. SIGNAL LAMP | 1157A | 2 | 34/4 | 43-44 |
| SPOT LAMP | 4404 | 1 | 30 W | 43-44 |
| (REAR) | | | | |
| TAIL, STOP & DIR. SIGNAL LAMP | 1157 | 6 | 32/4 | 44 |
| TAIL, STOP & DIR. SIGNAL LAMP | 1157 | 2 | 32/4 | 43 |
| BACK UP LAMP | 1156 | 2 | 32 | 43-44 |
| LICENSE LAMP | 97 | 1 | 4 | 43-44 |
| LUGGAGE COMPARTMENT | 89 | 1 | 6 | 43-44 |
| (INSTRUMENT PANEL) | | | | |
| INDIRECT LAMP | 194 | 3 | 2 | 43-44 |
| (INDICATORS) | | | | |
| HEADLAMP HI BEAM | 194 | 1 | 2 | 43-44 |
| DIR. SIGNAL | 194 | 2 | 2 | 43-44 |
| OIL PRESSURE | 194 | 1 | 2 | 43-44 |
| WATER TEMP. | 194 | 1 | 2 | 43-44 |
| GEN. CHARGE | 194 | 1 | 2 | 43-44 |
| (SERVICE ILLUMINATION) | | | | |
| AUTO. TRANSMISSION DIAL | 1893 | 1 | 2 | 43-44 |
| RADIO DIAL | 1881 | 1 | 2 | 43-44 |
| HEATER-DEFROSTER CONTROL DIAL | 1893 | 1 | 2 | 43-44 |
| GLOVE COMPARTMENT LIGHT | 1893 | 1 | 2 | 43-44 |
| ASH RECEIVER | 1445 | 1 | .5 | 43-44 |
| PARKING BRAKE WARNING | 1816 | 1 | 3 | 43-44 |
| (INTERIOR ILLUMINATION) | | | | |
| DOME-ROOF CENTER | 211 | 1 | 15 | 43-44 |
| FLASHER DIR. SIGNAL } OPT. | | 1 | | 43 |
| FLASHER DIR. SIGNAL } OPT. | | 1 | | 43 |
| FLASHER DIR. SIGNAL } OPT. | | 1 | | 44 |
| FLASHER DIR. SIGNAL } OPT. | | 1 | | 44 |
| COURTESY-RT. & LT. SAIL PANELS (EXCEPT WAGONS) | 90 | 2 | 6 | 43-44 |
| COURTESY LIGHT INST. PANEL | 89 | 2 | 6 | 43-44 |
| COURTESY LIGHT INTERIOR (WAGONS ONLY) | 90 | 3 | 6 | 43-44 |

Figure 10-118 - Light Bulb Chart

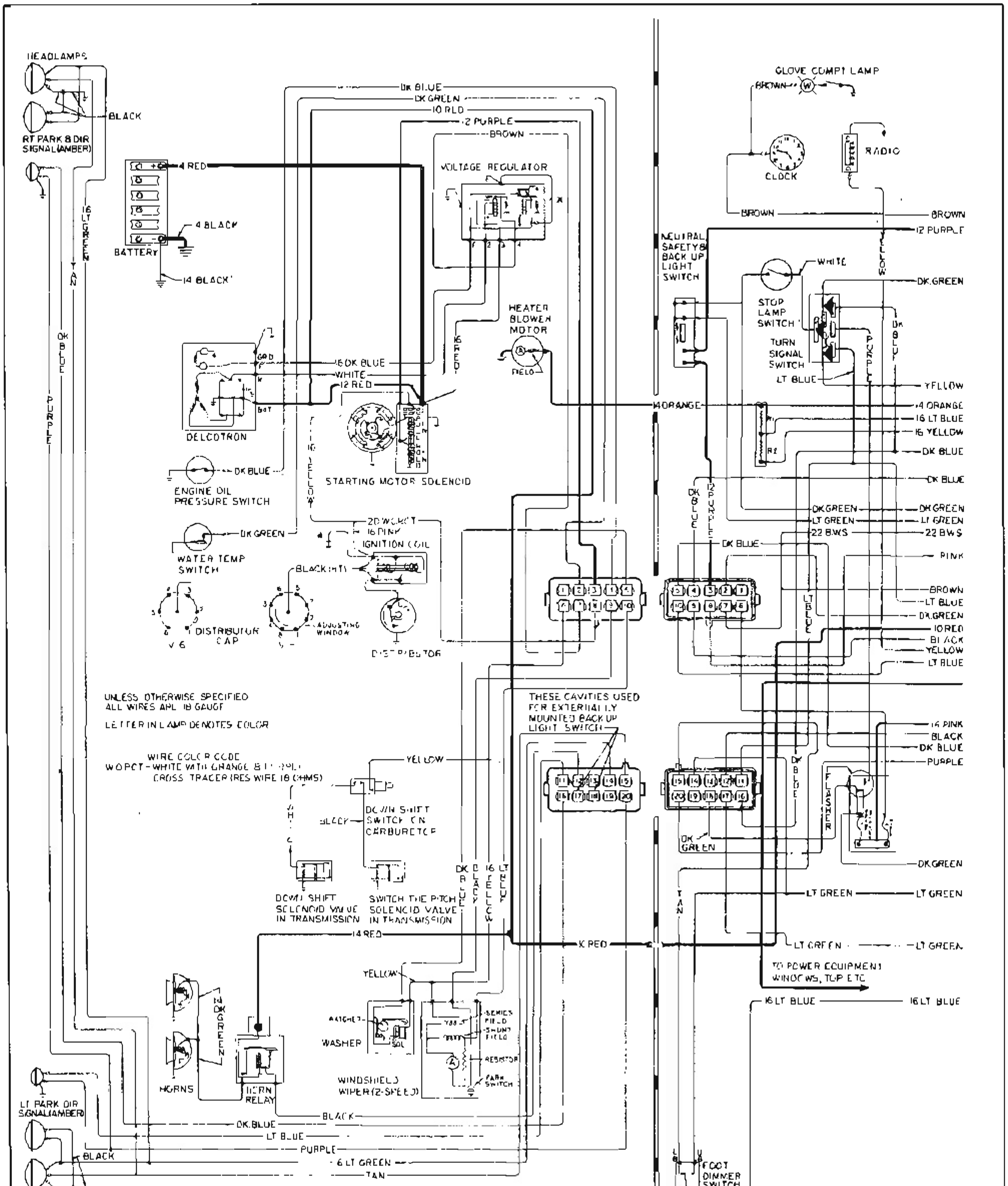



Figure 10-119—Wiring Diagram - Front Half

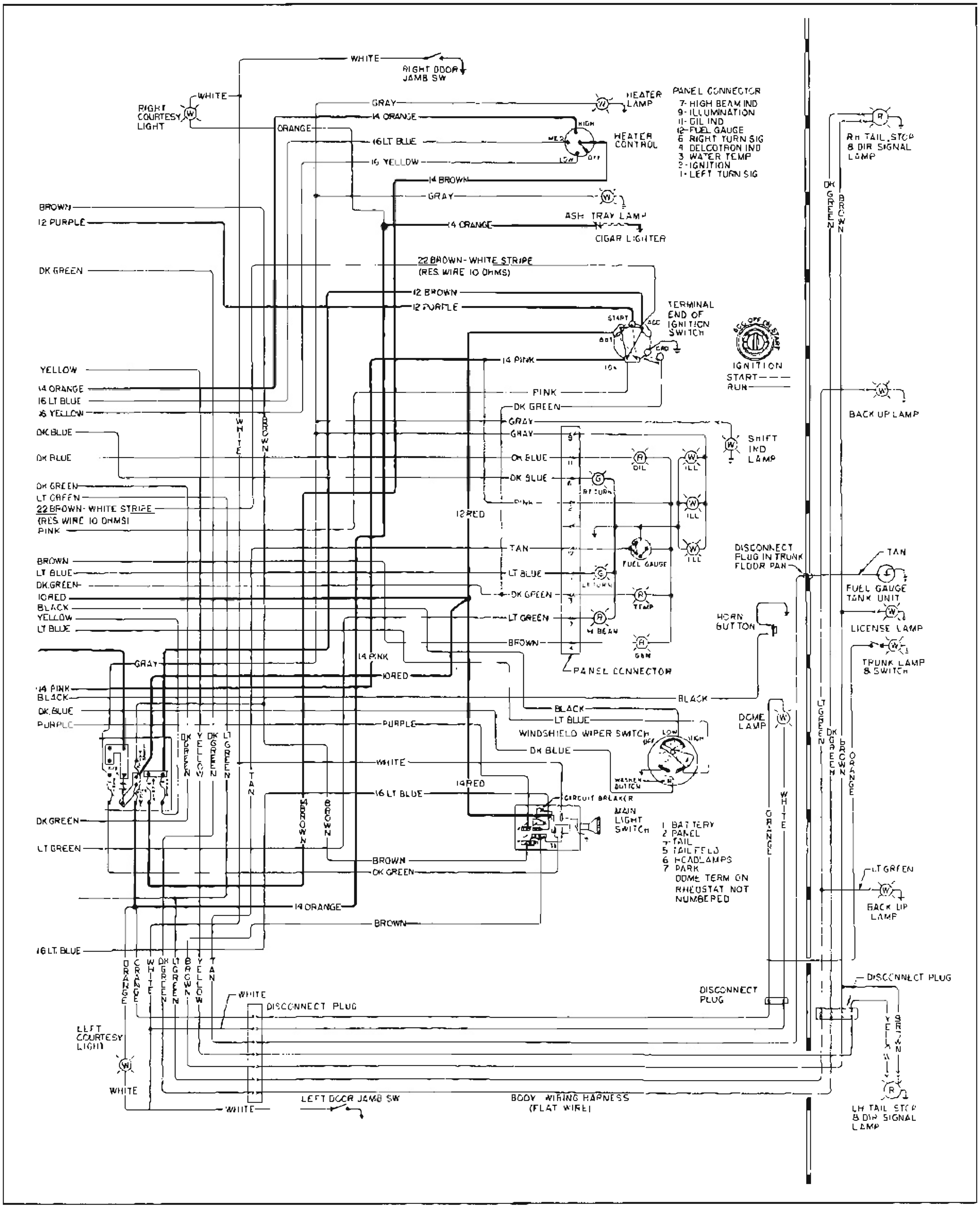



Figure 10-120—Wiring Diagram - Rear Half

# GROUP 11
# RADIO, HEATER, VENTILATION AND AIR CONDITIONER

## SECTIONS IN GROUP 11



## SECTION 11-A
## RADIO.

### CONTENTS OF SECTION 11-A



## 11-1 BUICK RADIO DESCRIPTION AND OPERATING INSTRUCTIONS

### a. Description

The Buick push button radio is available as optional equipment on the 43000 and 44000 Series.

This is an all transistor radio which plays immediately when turned on as there are no vacuum tubes to warm up. Even though this radio plays on less than half the current required for a tube-transistor radio, it has the same station pick-up ability and the same power output as a tube-transistor radio.

A manual antenna located on the right front fender and is extended and retracted by hand.

The Buick radio installation consists of a receiver with separate speaker mounted at the center of the instrument panel. Noise suppressors are installed at various locations to eliminate interference.

The receiver has five push buttons for push-tuning of five preselected stations. In addition to the push buttons, a control knob permits manual selection of stations.

The radio has a current draw of 1.3 amps at 12 VDC. This includes .3 amp for the light bulb.

All speakers have an impedance of 10 ohms. When replacing a speaker, the replacement speaker should have the same impedance for satisfactory results.

### b. Switch, Volume, and Tone Control Operation

Clockwise rotation of the switch knob, to left of dial, turns the radio on, and further rotation increases the volume.

Best fidelity (true tone) is provided when the tone control knob, behind the switch knob, is at the midposition of the tone control range. A detent in the control provides a method of quick location of this position. Rotation clockwise of the tone control knob will diminish bass response. Rotation counterclockwise will diminish treble response.

### c. Push Button Tuning Operation

To tune in the station for which the push button is set, simply push the button in as far as possible. The button will move easily at start, then a slightly harder push is required to complete the travel. At end of button travel the tuner will rest at the station for which the button has previously been set as described in paragraph 11-5.

### d. Manual Tuning Operation

The manual tuning knob is to right of the receiver dial. See Figure 11-1. This knob may be used to tune in stations other than those for which the push buttons are set; it is also used when tuning to set the push buttons for preselected stations.

When tuning manually, and particularly when setting up a station

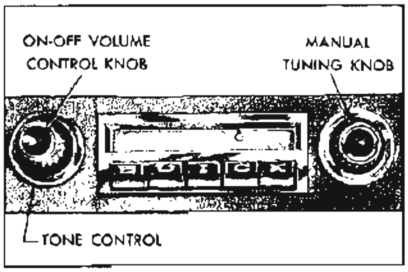



Figure 11-1—Radio Receiver Controls

on one of the push buttons, careful adjustment of the tuning knob is essential to good radio reception.

On push button selection, if the program sounds shrill or distorted, it is probably caused by improper tuning and can be corrected by adjusting the tuning knob slightly. Since the low notes are apparently more affected by tuning than the high ones, it is preferable to tune the set to a point where the low notes are heard best, and high notes are clear but not shrill. This point may be most readily found by listening to the background noise and tuning for the lowest volume and pitch of this noise. Turning the control knob back and forth until the station is almost lost on either side will enable the operator to hear the difference in reception and select the intermediate position giving best results.

## 11-2 RADIO NOISE INTERFERENCE SUPPRESSORS

Three noise suppressor capacitors are used to eliminate radio interference (see Figure 11-2). Two of the capacitors are exterior mounted, one on the voltage regulator and the other on the ignition coil. The third capacitor is pressed into the end bell of the delcotron. The ignition coil capacitor (0.3 MF) is connected to the positive terminal of the coil. Connection of the capacitor lead to the negative terminal will cause excessive pitting of the distributor points. The voltage regulator and delcotron capacitors are both rated at 0.5 MF. The built in resistance of each spark plug wire approximates 4000 ohms per foot.

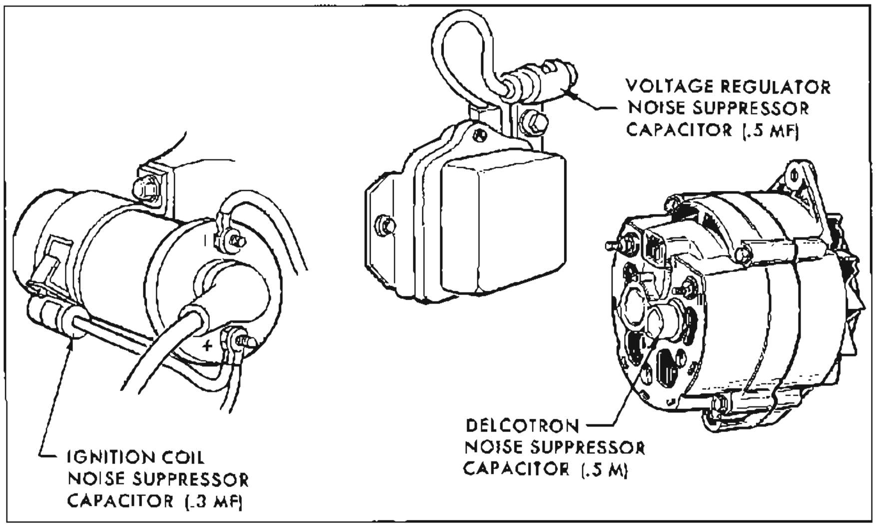



Figure 11-2—Noise Suppressors

A static collector is installed in each front wheel hub cup. For good results the cup and the center of steering knuckle spindle must be clean and free from grease. The contact button of the static collector is made of self-lubricating material.

## 11-3 RADIO TROUBLE DIAGNOSIS—ON CAR

The trouble diagnosis table is intended as an aid in locating minor faults which can be corrected without a specialized knowledge of radio and without special radio test equipment. If the suggestions given here do not effect a correction, further testing should be done only by a trained radio technician having proper test equipment.

CAUTION: Never turn radio on with speaker disconnected.

NOTE: Because radio service problems are generally corrected by United Motors Service repair shops, there is a tendency for many dealer servicemen to remove a set when a problem is reported. The irritation to an owner of having to drive with his radio missing can frequently be avoided if the following quick checks are used to eliminate problems which are external to the radio or involve adjustment of trimmer.

## RADIO TROUBLE DIAGNOSIS

| CONDITION | QUICK CHECK | POSSIBLE CAUSE AND CORRECTION |
|---|---|---|
| Radio Inoperative | Turn radio on and listen for thump in speaker | |
| | If no thump is heard see opposite causes | Defective Fuse-Replace with known good fuse |

## RADIO TROUBLE DIAGNOSIS (Cont'd.)

| CONDITION | QUICK CHECK | POSSIBLE CAUSE AND CORRECTION |
|---|---|---|
| Radio Inoperative (Cont'd) | | Defective Power, Receiver or Speaker Connectors–Repair or replace as necessary |
| | If no thump is heard substitute a known good speaker<br>NOTE: <u>If car is equipped with a rear speaker, rotate the rear speaker knob fully clockwise instead of substituting a test speaker.</u> | Defective Speaker-Replace speaker |
| | If a thump is heard plug in a known good antenna and hold antenna outside car | Defective Antenna-Repair or replace antenna |
| Radio Operation Intermittent | Attempt to reproduce failure by tapping antenna and speaker. Also move connectors | Loose Antenna Connections<br>Loose Speaker or Power Supply Connectors<br>Defective Speaker<br>Defective Antenna Lead |
| Weak Radio Signal | Check Antenna Height | Antenna Not Properly Extended - Extend antenna 31 inches |
| | Tune radio to weak station, adjust for maximum volume and remove inner and outer knobs. Rotate trimmer screw to check for maximum volume | Incorrect Radio Trim Adjustment - Trim radio (Refer to subparagraph 11-5, "a"). |
| | Substitute a known good antenna and hold antenna outside car | Corroded Antenna Connections or Defective Antenna - Repair or replace as required |
| Radio Noisy<br>Brake Light, Turn Signal or Window Lift Noise | Check that antenna connections are tight | Loose Antenna Connections and Mounting - Tighten<br>Defective Antenna Leak - Repair or replace as necessary |
| Static When Driving | Visually Inspect Static Collectors | Dirty or Defective Static Collectors - Clean or replace as required |
| Engine Ignition Noise | Substitute new noise suppressors | Ignition Coil, Regulator or Delcotron Noise Suppressors Loose or Defective - Replace |
| Poor Tone | Substitute speaker with known good speaker<br>NOTE: <u>If car is equipped with a rear speaker, rotate the rear speaker knob fully clockwise instead of substituting a test speaker</u> | Defective Speaker - Replace |

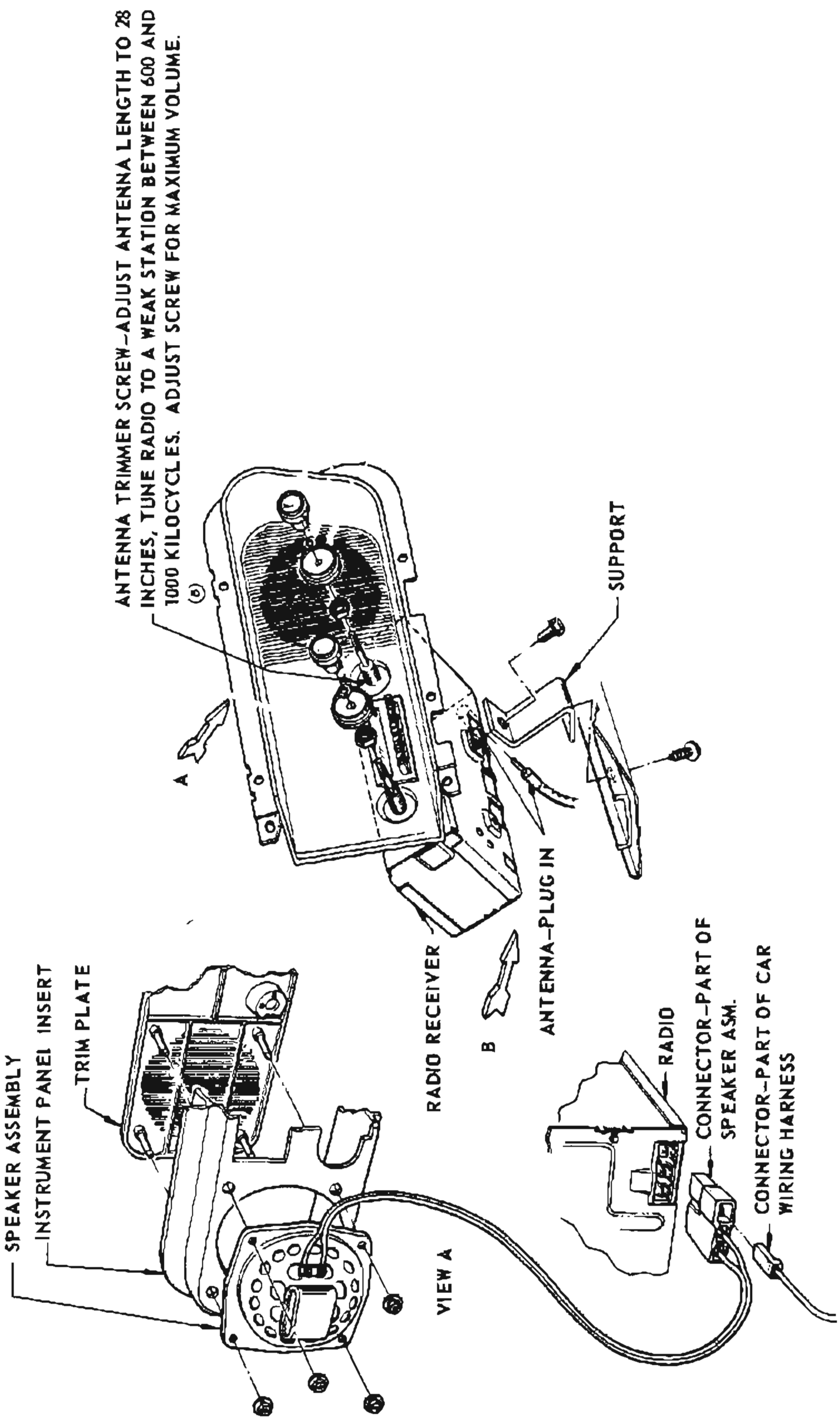



Figure 11-3—Radio Receiver and Speaker Installation

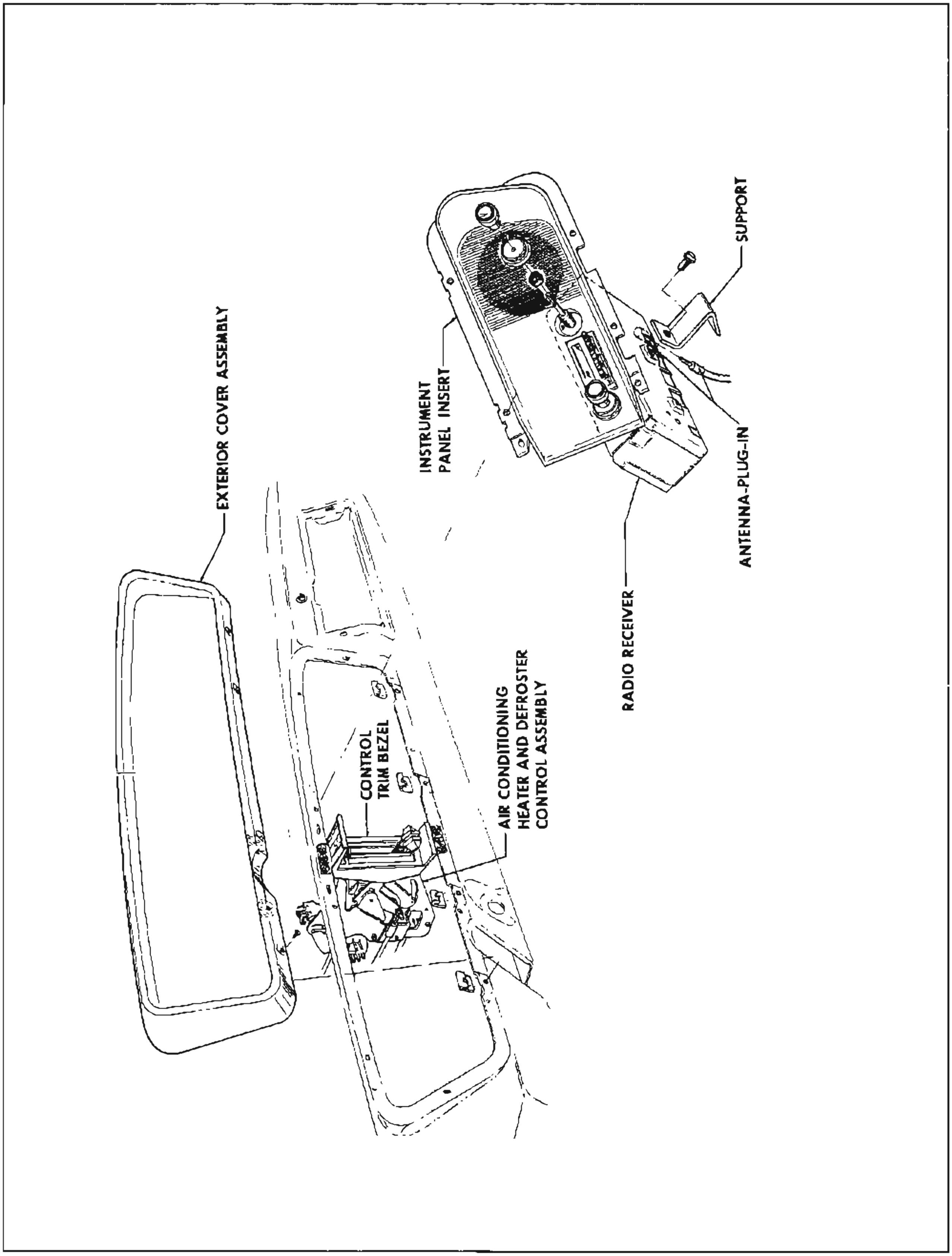



Figure 11-4—Radio Receiver Removal and Installation

## 11-4 SERVICING RADIO COMPONENTS

### a. Removal and Installation of Radio Receiver

REMOVAL (WITHOUT AIR CONDITIONING)

1. Disconnect battery negative lead.

2. Pull off receiver control knobs.

3. Disconnect radio lead, speaker lead, and antenna lead connectors.

4. Remove screw holding support to receiver and withdraw receiver from underside of dash.

REMOVAL (WITH AIR CONDITIONING)

1. Disconnect battery negative lead.

2. Remove five screws and take out exterior cover assembly (see Figure 11-4).

3. Remove four screws from control trim bezel and take out bezel.

4. Take out ash tray assembly and remove screw holding support to radio receiver.

5. Remove four screws securing instrument panel insert to instrument panel and partially withdraw insert. Disconnect radio lead and antenna lead connectors and complete removal of assembly.

6. Further disassembly and separation of receiver from instrument panel insert will be evident upon inspection.

INSTALLATION

7. Install radio receiver reverse of removal and trim antenna if receiver was repaired.

### b. Removal and Installation of Speaker

REMOVAL (WITHOUT AIR CONDITIONING)

1. Disconnect double series connected connectors from rear of receiver and separate connectors.

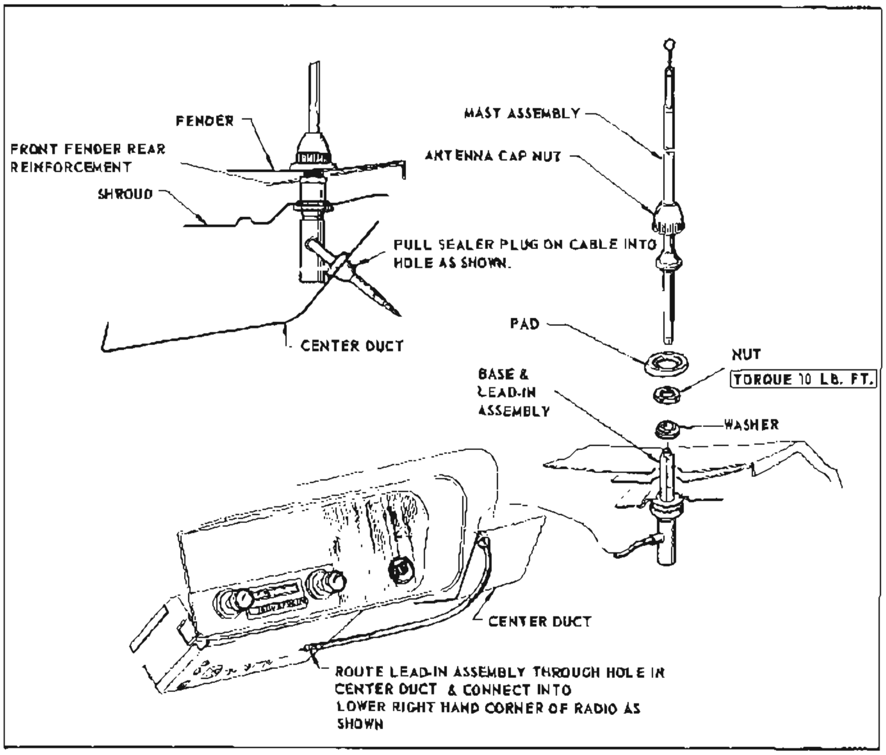



Figure 11-5—Antenna Installation

2. Remove four nuts securing speaker to trim plate and take out speaker.

REMOVAL (WITH AIR CONDITIONING)

1. Disconnect negative battery lead.

2. Remove five screws and take out exterior cover assembly (see Figure 11-3).

3. Remove four screws from control, trim bezel and take out bezel.

4. Take out ash tray assembly and remove screw holding support to radio receiver.

5. Remove four screws securing instrument panel insert to instrument panel and partially withdraw insert. Disconnect radio lead and antenna lead connectors and complete removal of assembly.

6. Further disassembly and separation of speaker from instrument panel insert will be evident upon inspection.

INSTALLATION

7. Install speaker reverse of removal.

### c. Removal and Installation of Antenna

REMOVAL

1. Unscrew antenna cap nut (see Figure 11-5) and lift mast assembly out of base and lead-in assembly. Remove pad.

2. Remove outside air inlet grille located forward of the windshield.

3. Unplug antenna wire from receiver, remove nut securing spacer, and also the base and lead-in assembly to shroud and withdraw base and lead-in assembly through opening in topside of cowl.

INSTALLATION

4. Install antenna reverse of removal procedures and trim antenna if antenna was repaired.

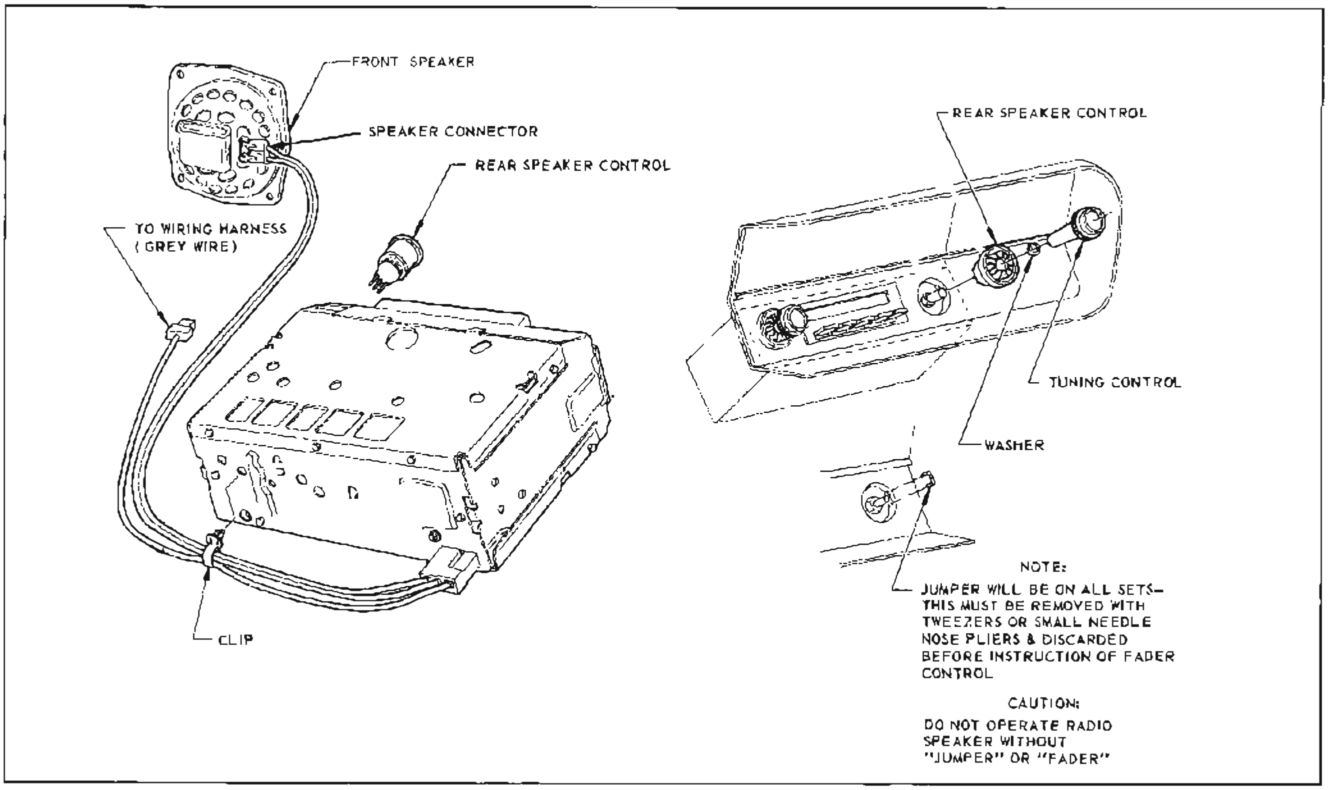



Figure 11-6—Rear Speaker Instrument Panel Connection

NOTE: The antenna is matched to the receiver within the range of the trimmer adjustment. Other antennas may not match the receiver within the range of the trimmer adjustment. Use of other than authorized replacement parts is not recommended.

## 11-5 RADIO ADJUSTMENTS—ON CAR

NOTE: When making the adjustments covered in this paragraph, it is essential to have the car in a location that is as free as possible from outside interference.

### a. Antenna Trimmer Adjustment

An antenna trimmer adjustment is provided for matching the antenna coil in the receiver to the car antenna. This adjustment must always be made after installation of receiver and antenna, or after any repairs to these units. This adjustment should also be performed whenever the radio reception is unsatisfactory.

1. Position antenna at a height of 31".

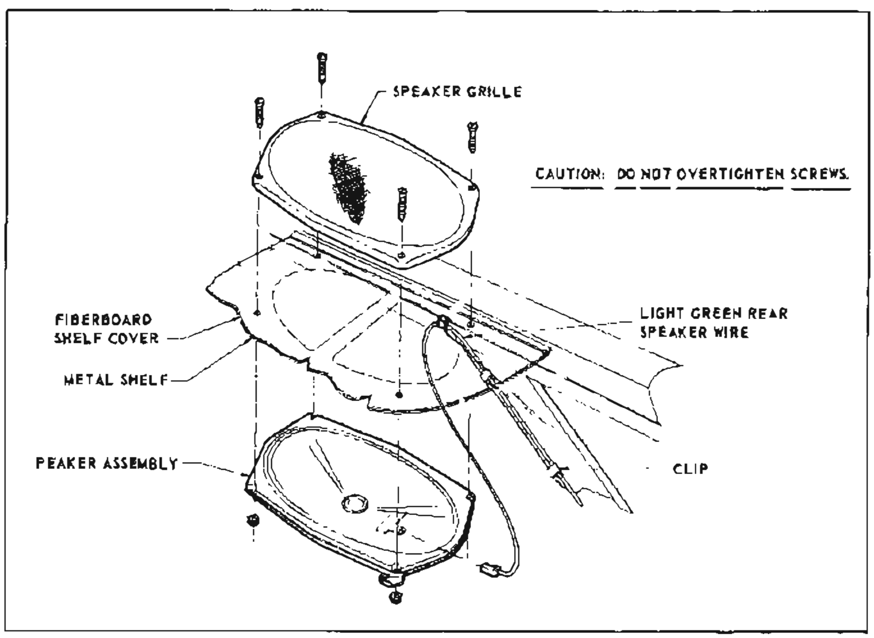



Figure 11-7—Rear Speaker Installation (Sedan)

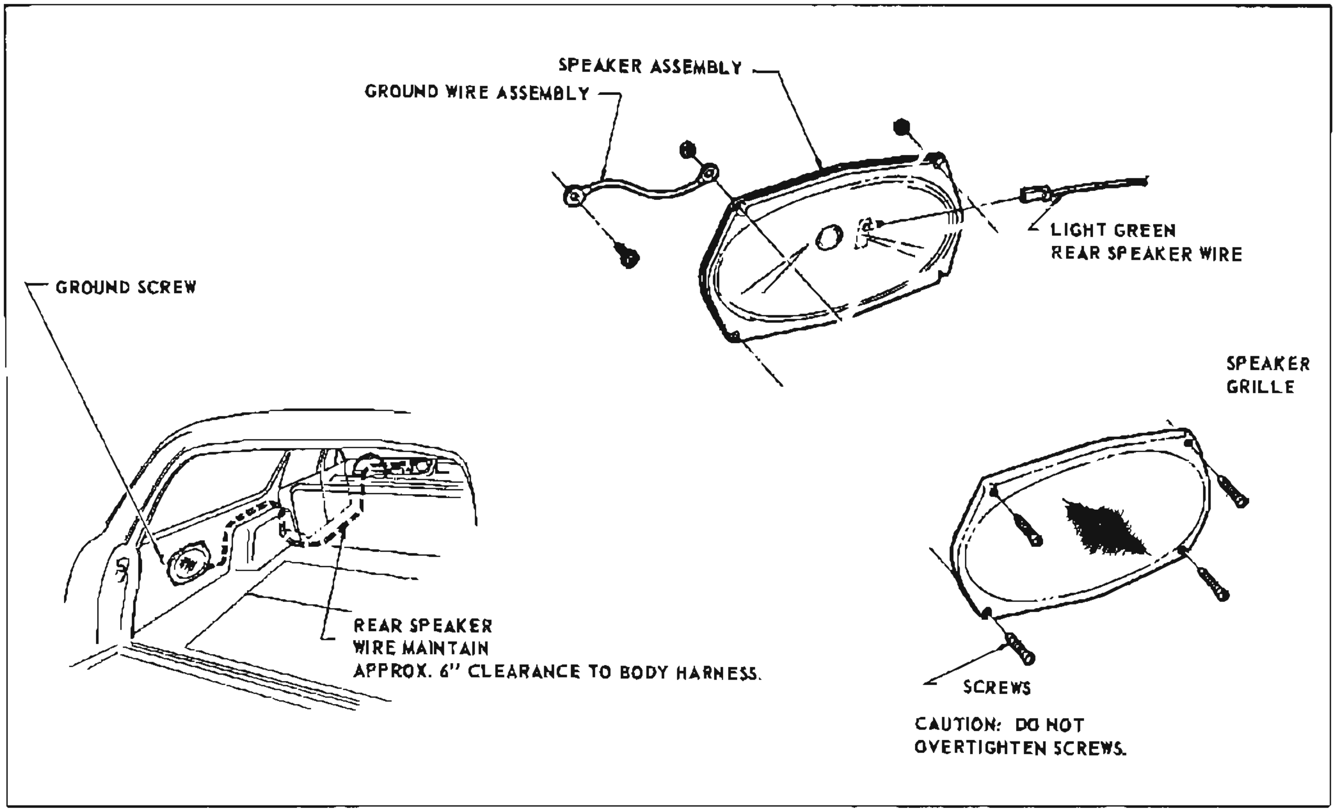



Figure 11-8—Rear Speaker Installation (Estate Wagon)

2. Tune radio to a weak station between 600 and 1000 KC that can barely be heard with volume turned full on.

3. Remove both right inner and outer knobs from radio tuning control shaft and turn antenna trimmer screw for maximum volume (see Figure 11-3).

### b. Setting Push Buttons to Desired Stations

1. Turn on the radio.

2. Pull push button all the way out as far as it will go. It is desirable to set-up the push buttons in logical sequence. For example, lowest frequency station on first button, next higher frequency station on second button, etc.

3. Carefully tune in the desired station manually, then push the button all the way in.

4. Move dial pointer away from the selected station and push the button to make certain that the station will be properly tuned in.

5. Turn tuning knob back and forth to make certain that best tuning is obtained with the push button. If best tuning is not obtained, repeat Steps 2, 3, and 4.

## 11-6 REAR SPEAKER REMOVAL AND INSTALLATION

Removal and installation of rear speaker will be obvious when viewing Figures 11-7 and 11-8.

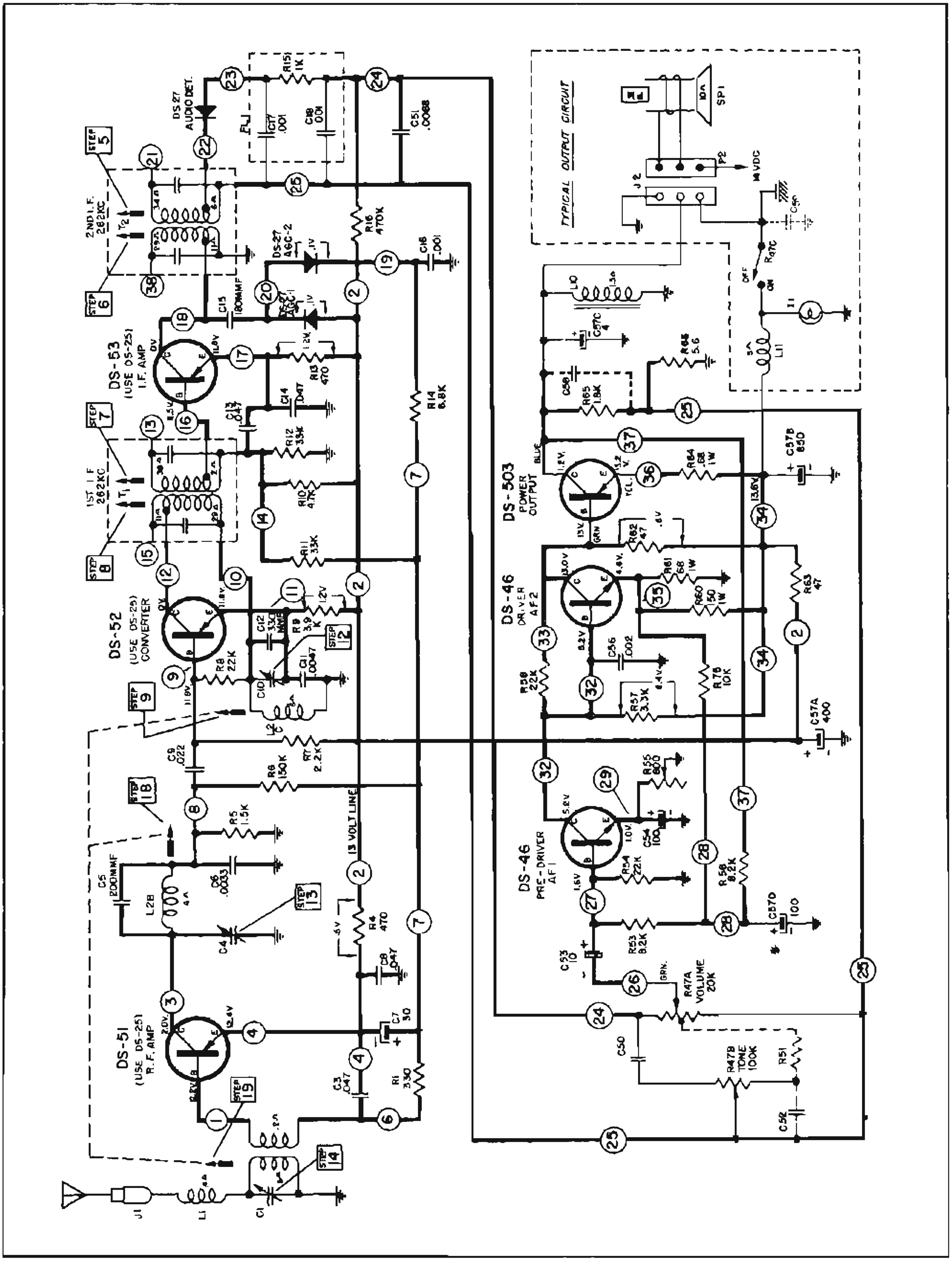



Figure 11-9—Radio Circuit Schematic

# SECTION 11-B
# HEATER SYSTEM

## CONTENTS OF SECTION 11-B



## 11-7 HEATER DEFROSTER DESCRIPTION AND OPERATION

### a. Description

The heater system is an air-mix type system in which outside air is heated and then mixed in varying amounts with cooler outside air to attain the desired air temperature. The system consists basically of three parts: (1) the blower and air inlet assembly, (2) the heater assembly, and (3) the heater control assembly (see Figure 11-10). The operation of the system is as follows:

1. Blower and Air Inlet Assembly—The blower and air inlet assembly draws outside air through the outside air inlet grille located forward of the windshield reveal molding and channels the air into the heater assembly. The operation of the blower motor is controlled by a FAN switch on the heater control. The motor is connected in series with the three position FAN switch and also the blower resistor assembly (see Figure 11-11). A 30 amp fuse, located in the fuse block, is in series between the blower motor and the battery.

2. Heater Assembly—The heater assembly (see Figure 11-12) houses the heater core and the doors necessary to control mixing and channeling of the air. Air entering the heater assembly divides into two channels: (1) through the heater core and (2) through a by-pass around the heater core. The ratio of the mixture of heated to unheated air is controlled by the temperature door. An outside air inlet door initiates the air flow through the heater assembly. A defroster door controls the amount of air deflected through the defroster outlets. The defroster door may be adjusted to deflect all air to the defroster outlet, all air to the floor outlet, or to both the defroster and floor outlets.

The heater core, located in the heater assembly, has water flowing through it at all times. The water flow begins at the right front portion of the intake manifold (see Figure 11-14) and flows to the lower inlet port of the heater core, thru the heater core, out the upper outlet port of the heater core and to the suction port of the water pump.

The heater assembly has fixed vane outlets to distribute air evenly throughout the passenger compartment.

3. Heater Control Assembly–The heater control assembly (see Figures 11-14 and 11-15) consists of three controls, namely the temperature control lever, air control lever, and FAN lever. The temperature control lever is connected by a control wire to the temperature door on the heater assembly, and regulates the ratio of mixture between heated and unheated air—hence the temperature of the air. The temperature control lever has three detents: OFF, MED, and HOT. When the temperature control is in the OFF position the temperature door is fully closed and prevents heated air from flowing through the heater core. When the temperature control is in MED position, the outside air flow is split and approximately one half of the outside air flows through the heater core and one half of the outside air flows around and by-passes the heater core. When the temperature control is in the HOT position the temperature door is fully open and prevents outside air from by-passing the heater core.

The air lever of the heater control assembly regulates the positioning of two doors the outside air door and the defroster door. The air lever has three positions: OFF, HTR and DEF. Positioning of the air control to the OFF position closes the outside air door and the defroster door. When the outside air door is closed, all air is blocked from passing through the heater assembly. When the air lever is moved to the HTR position, the outside air door is fully opened. Air is permitted to pass through the heater assembly and is directed to the floor of the car. Moving of the air lever to DEF position, opens the defroster door and channels the air to the defroster outlets. Locating of the air lever midway between HTR and DEF positions causes the air to be routed to both the defroster outlets and the floor outlets.

The FAN lever operates a four-position switch. A two resistor

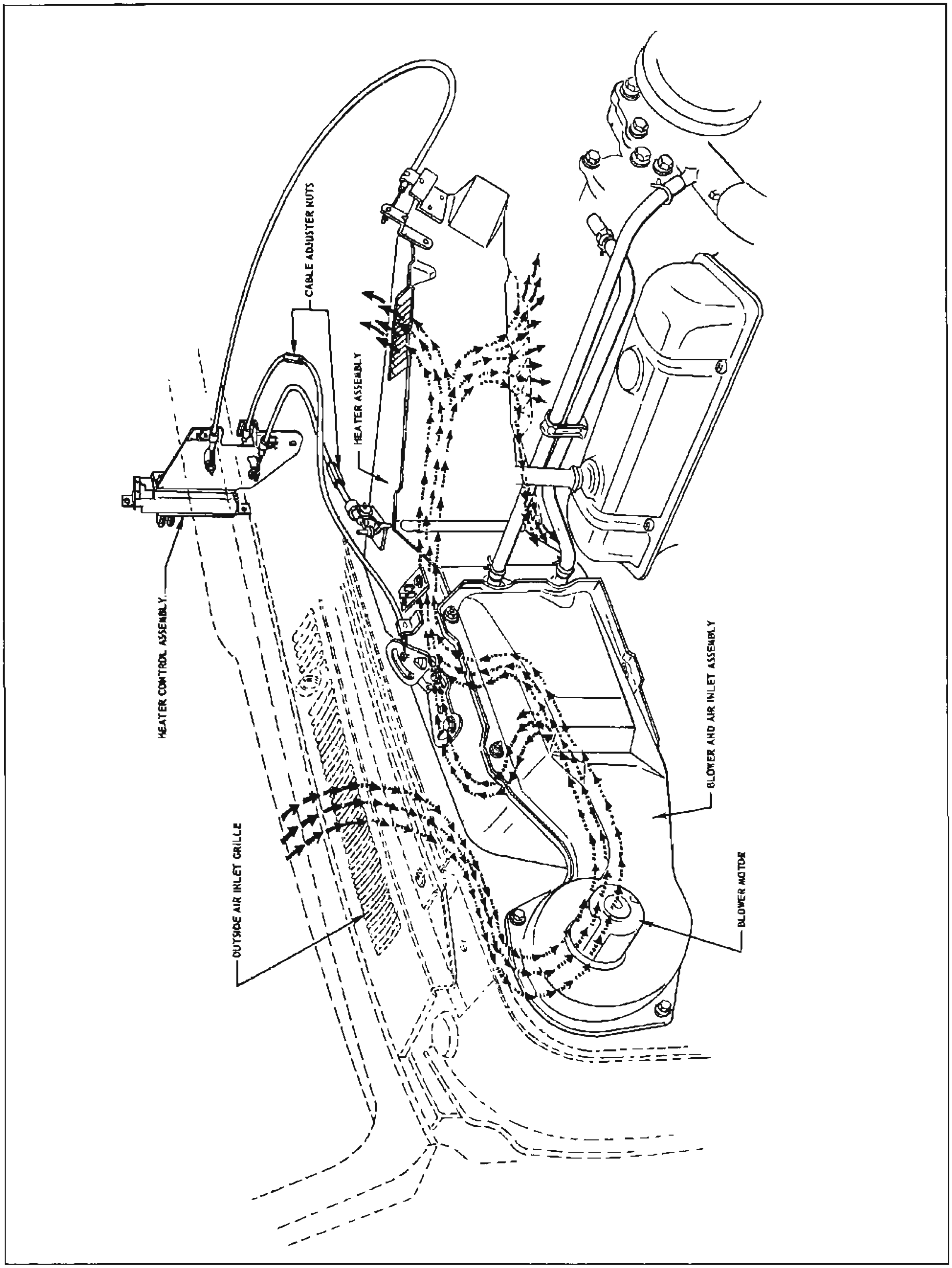



Figure 11-10—Heater System - 43000 and 44000 Series

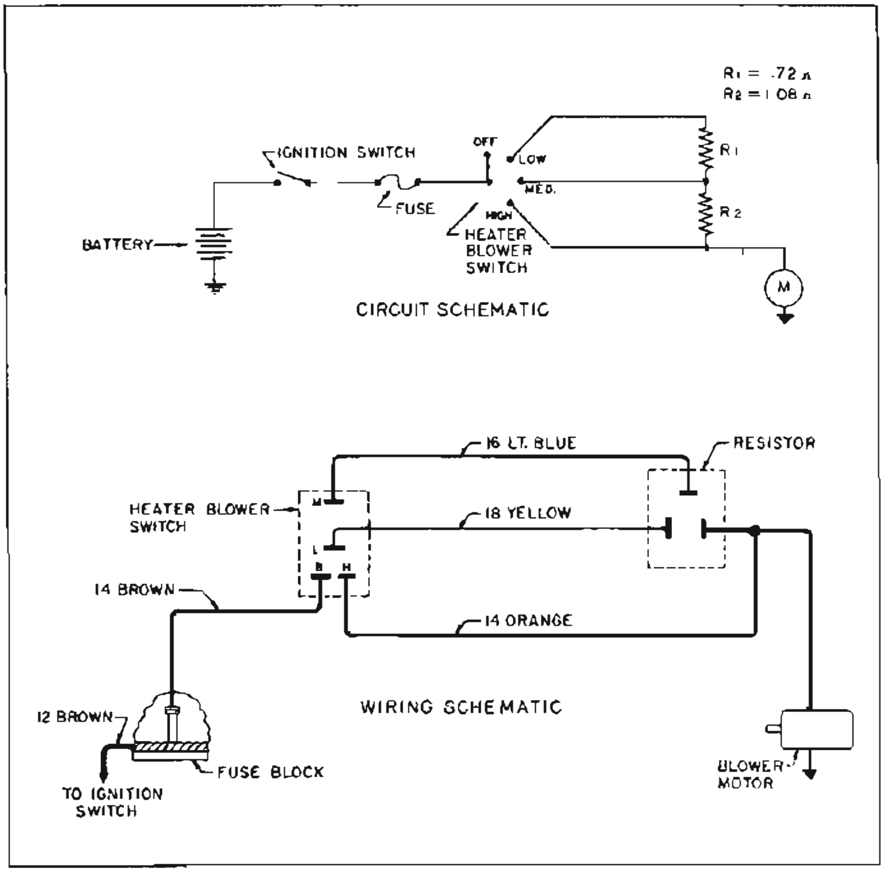



Figure 11-11—Heater System Wiring Diagram and Schematic

blower resistor assembly is connected in series between the blower motor and the switch, and serves to reduce the speed of the motor. When the FAN lever is positioned fully to the left, the blower motor is off. Movement of the lever to the right provides low, medium and high blower speeds. A 180°F. thermostat is provided as standard equipment on all series cars.

**b. Operation**

The heater system is completely controlled by the air, temperature and FAN levers located on the instrument panel. These levers should be operated as follows:

1. Air Lever—The air lever opens and closes heater system doors for channeling or routing of outside air through the system. If channeling of the air flow to the floor is desired, move air lever from OFF position to HTR position. Any downward movement beyond the HTR detent increases air flow to the defroster nozzles and decreases flow to floor. If maximum defrosting is desired, push air lever to full down (DEF) position.

2. Temperature Lever—If heating of the outside air flowing through the heater system is desired, the temperature lever is moved downward. Depending on the position of the temperature lever, mildly warmed to hot air can be obtained. As the lever is moved downward, heated air passing through the heater core is diluted in gradually decreasing amounts with unheated outside air. Full downward position ducts all outside air through heater core.

3. FAN Lever—To turn blower on move FAN lever to the right. There are three detents which provide low, medium and high blower speeds.

## 11-8 HEATER-DEFROSTER SERVICE PROCEDURES

### a. Adjustment of Air Control Lever, Outside Air Door, and Defroster Door

NOTE: It is suggested that the control wires regulating the air lever, outside air door and defroster door be adjusted when: recommended springback of 1/8 to 3/16 inch of air control lever in OFF position not present, heater assembly has been removed, or when outside air and/or defroster doors do not open sufficiently to permit maximum air flow.

The following adjustment procedure is based on the assumption that all control wires involved are completely disconnected. Minor after installation adjustments of the air lever may be accomplished by rotation of the control wire adjuster nut, without disconnecting the control wires. However, if satisfactory results are not obtained, the following complete adjustment procedure is recommended.

1. Attach outside air door and defroster door control wires to respective pins on heater control assembly.

2. Loose assemble defroster control cable to lever of defroster door.

3. Place air control lever (on instrument panel) in OFF position, hold defroster door closed (to the left), and tighten clamp securing defroster control cable to heater assembly.

4. Secure outside air control cable to lever of outside air door.

5. Insure that the air control lever is in the OFF position and rotate the control wire adjuster nut until: approximately 1/8

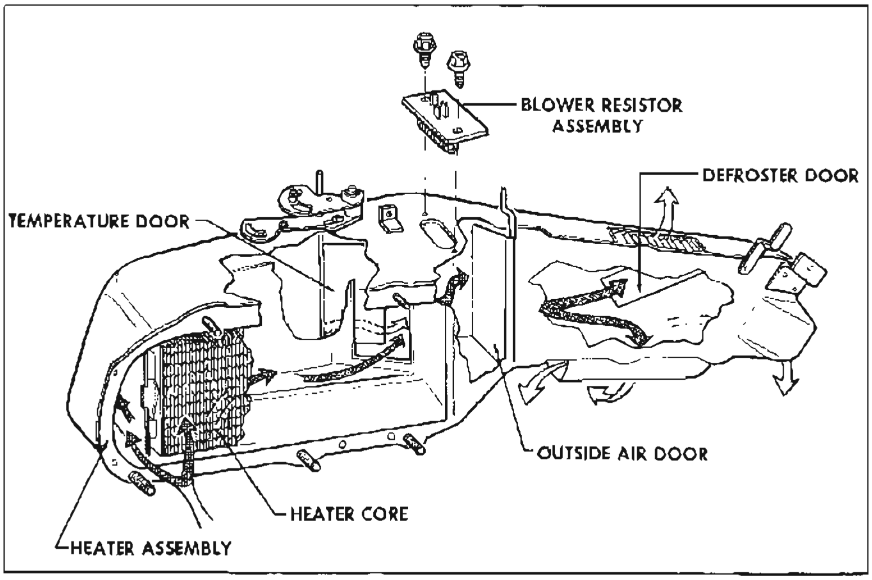



Figure 11-12—Heater Assembly

to 3/16 inch springback is obtained when air control lever is in OFF position.

NOTE: After adjustment is completed, check that 1/16 inch clearance exists between outside air inlet door control pin and end of slot (see Figure 11-16) when AIR control lever is in off position.

NOTE: The air control lever will lock in the mid (HTR) position if less than 1/8 inch springback occurs. The outside air door will not fully open if more than 3/16 inch springback exists.

**b. Adjustment of Temperature Control Lever and Temperature Valve**

NOTE: It is suggested that the control wire regulating the temperature lever and door be adjusted when recommended springback is not present, heater assembly has been removed, or when temperature door does not open sufficiently to permit maximum heating of air.

The following adjustment procedure is based on the assumption that temperature control wire is completely disconnected. After installation adjustment may be accomplished by rotation of the control wire adjuster nut, without disconnecting the control wire.

1. Attach temperature control wire to respective pin on heater control assembly and to lever of temperature door on heater assembly.

2. Position temperature lever to OFF and rotate control wire adjuster nut until a slight springback occurs.

3. Move temperature lever to HOT position and rotate (if necessary) adjuster nut to obtain 1/8 to 3/16 inch springback.

**c. Removal and Installation of Heater Control Assembly**

REMOVAL

1. Remove five screws from instrument panel nose trim pad and lift off nose trim pad (see Figure 11-15).

2. Remove four screws securing trim control bezel to instrument panel and take off bezel.

3. Disconnect three control cables from heater assembly.

4. Remove three screws holding heater control assembly to instrument panel and partially withdraw heater control assembly and attach control wires.

5. Remove connector from fan switch, and disconnect lamp socket from heater control assembly.

6. Complete removal of heater control assembly.

INSTALLATION

7. Install heater control assembly reverse of removal procedures.

8. Check and adjust air and temperature control levers as necessary (ref. subpar. "a" and "b").

**d. Removal and Installation of Blower and Air Inlet Assembly**

REMOVAL

1. Remove right front wheel.

Figure 11-13—Locating Dimple on Right Inner Fender Skirt

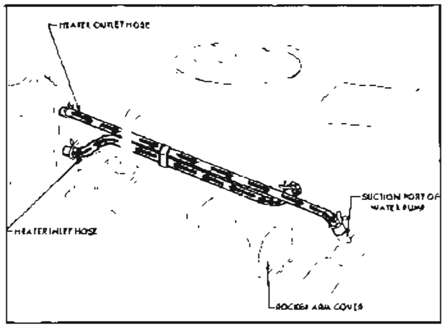



Figure 11-14—Heater Hose Routing V-6 and V-8 Engine

2. Draw an arc on inside of skirt 11 inches from upper bolt of wheel opening (see Figure 11-13). Draw another arc 16-3/4 inches from lower bolt of wheel opening. Punch a dimple at the intersection of the arcs.

3. Drill a 3/4 inch hole through the inner fender skirt at the dimple.

4. Remove lower right attaching nut from heater assembly stud thru hole in fender skirt.

5. Remove remaining four attaching nuts from heater assembly studs.

6. Remove two screws holding blower and air inlet assembly to cowl.

7. Disconnect blower motor wire and take off blower and air inlet assembly.

INSTALLATION

8. Install blower and air inlet assembly reverse of removal procedures and check for proper operation of blower.

9. Plug hole in inner fender skirt using a 3/4 inch body plug (Group No. 12.980, Part No. 4725594) and body sealer.

### e. Removal and Installation of Heater Assembly

REMOVAL

1. Drill a 3/4 inch hole in right fender skirt (refer to subparagraph "d", Steps 1 and 2).

2. Disconnect air control wires from levers of defroster door and outside air door on heater assembly.

3. Disconnect temperature control wire from lever of temperature door on heater assembly.

4. Drain radiator.

5. Disconnect heater inlet and outlet hoses from heater core inlet and outlet ports (see Figure 11-14).

6. Remove connector from blower resistor assembly (see Figure 11-12).

7. Remove five nuts and washers securing heater assembly to cowl. Pull heater assembly rearward until studs clear cowl, and lift out heater assembly.

INSTALLATION

8. Installation is reverse of removal procedures and plug hole in inner fender skirt using a 3/4 inch body plug (Group No. 12.980 Part No. 4725594) and body sealer.

9. Check and adjust control wires as necessary (ref. subpar. "a" and "b").

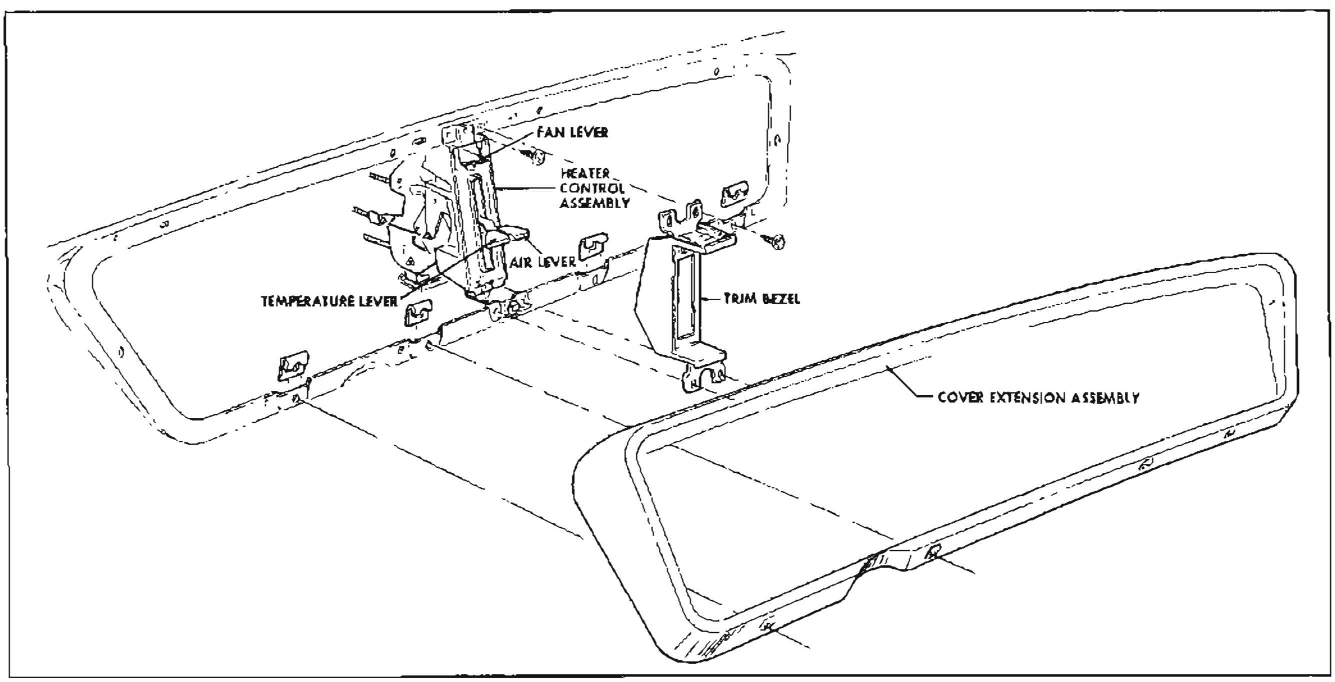



Figure 11-15—Heater Control Assembly Removal

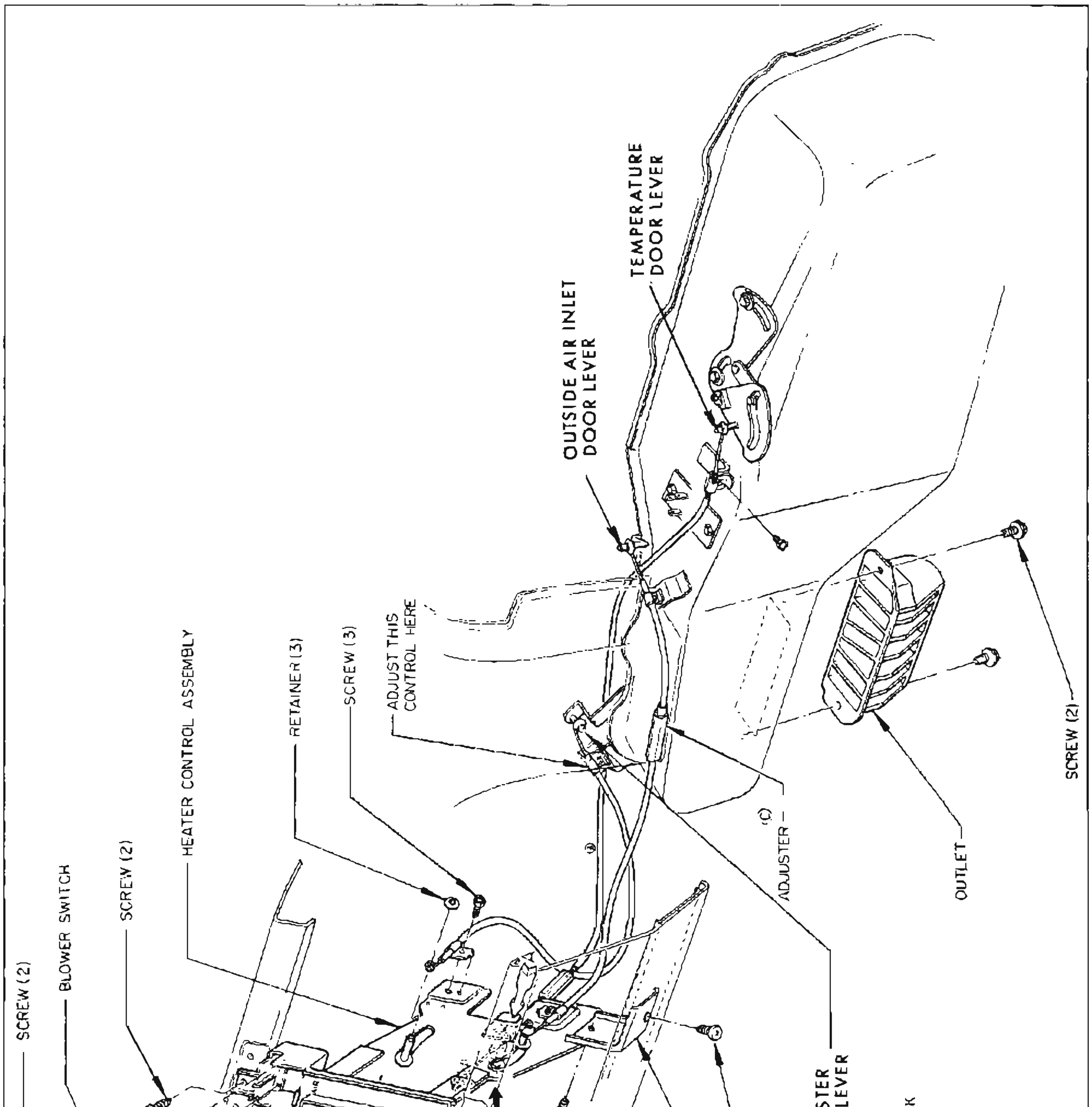



Figure 11-16—Heater Installation - 43000 and 44000 Series

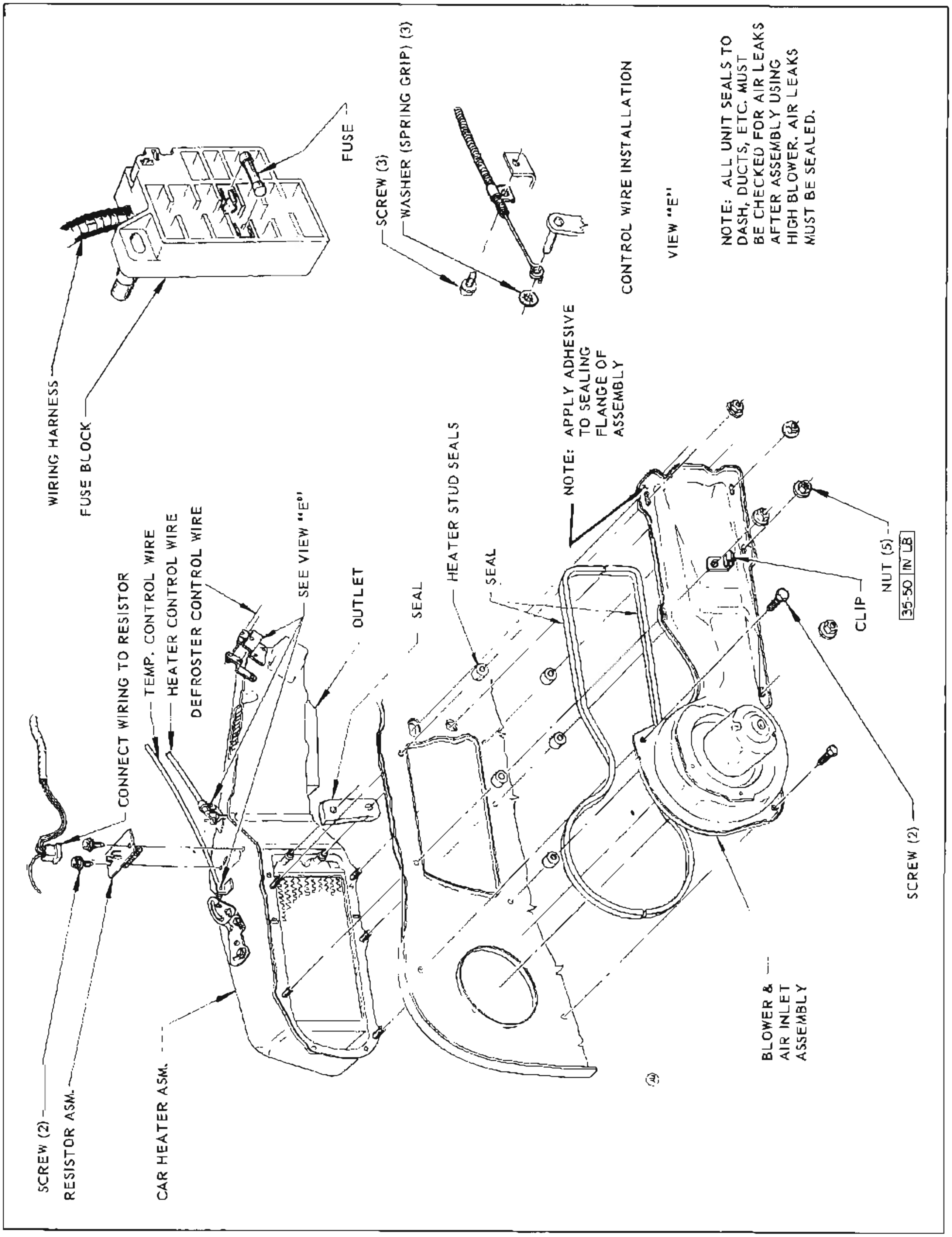



Figure 11-17—Heater Installation - 43000 and 44000 Series

## 11-9 HEATER-DEFROSTER TROUBLE DIAGNOSIS

NOTE: It is suggested that prior to inspecting a car for heater system malfunctions, the owner be checked to determine if system is being operated correctly. All windows and vents must be closed to effect maximum heat buildup.

<table>
<tr><th>TROUBLE</th><th>CAUSE AND CORRECTION</th></tr>
<tr><td>Temperature of heated air at outlets too low<br><table><tr><td>Outlet Air</td><td>145</td><td>150</td><td>155</td></tr><tr><td>Ambient Air</td><td>0</td><td>25</td><td>40</td></tr></table></td><td>Check radiator cap for proper sealing action—replace if necessary.<br>Check for proper engine coolant level. If level is down, correct cause of coolant loss and refill radiator.<br>Inspect for kinks in heater or radiator hoses—relieve kink or replace hose.<br>Check thermostat operation by measuring temperature of coolant at radiator filler neck cap. Temperature should be within ± 5°F. of rated thermostat value.<br>NOTE: This will be true when ambient temperature is below approximately 50°F.<br>Check that temperature lever operates temperature door full extent of travel—adjust as required (ref. subpar. 11-8, "b").<br>Heater core partially plugged due to sediment in cooling system—backflush heater core as necessary.</td></tr>
<tr><td>Temperature of heater air at outlets adequate—car will not build up sufficient heat</td><td>Check for body leaks such as: (1) floor side kick pad ventilators partially open, (2) leaking grommets in cowl, (3) leaking welded seams along rocker panel and windshield, (4) leaks through access holes and screw holes, (5) leaking rubber molding around door and windows, (6) leaks between sealing edge of blower and air inlet assembly and cowl, and between sealing edge of heater assembly and cowl.</td></tr>
<tr><td>Inadequate defrosting action</td><td>Check owner to determine if window side vents are kept closed to promote maximum defrosting.<br>Check that air lever completely opens defroster door in DEF position—adjust as required (ref. subpar. 11-8, "a").<br>Check for air leak in ducting between defroster outlet on heater assembly and defroster duct under instrument panel—seal area as necessary with body sealer.<br>Insure that temperature and outside air doors open to full limit of travel—adjust as necessary (ref. subpar. 11-8, "a" and "b").</td></tr>
</table>

## 11-9 HEATER-DEFROSTER TROUBLE DIAGNOSIS (Cont'd)

| TROUBLE | CAUSE AND CORRECTION |
|---|---|
| Inadequate heated air circulated through car | Inspect floor carpet to insure that carpet lies flat under front seat and does not obstruct air flow under seat, and also inspect around outlet ducts to insure that carpet is well fastened to floor to prevent cupping of air flow—correct as necessary. |
| Erratic heater operation | Partially plugged heated core—backflush heater core as necessary.<br>Sediment in heater lines and radiator causing engine thermostat to stick open—flush system and replace thermostat if necessary.<br>Check for kinked heater hoses—relieve kinks or replace hose as necessary. |
| Hard operating or broken control wires | Check for loose wire clamps or misadjusted wires—correct as required (ref. subpar. 11-8, "a" and "b").<br>Check for sticking heater system door(s) - lubricate as required using Buick Silicone Spray (Group No. 8.800, Part No. 980473). |
| Blower inoperative | Check fuse in fuse block and replace if necessary.<br>Check wiring for open circuit—correct as necessary.<br>Inspect for defective fan switch—replace as necessary.<br>Check for defective blower motor—replace as necessary.<br>Check blower resistor—replace if necessary. |

# SECTION 11-C

# OPTIONAL HEATER WITH AIR CONDITIONER

## CONTENTS OF SECTION 11-C



## 11-10 SPECIFICATIONS

### a. Tightening Specifications

| Part | Location | Torque Lb. Ft. |
|---|---|---|
| Nut | Hub of Clutch Drive Plate to Shaft and Swashplate Assembly | 14-16 |
| Nut | Rear Head to Shell | 19-23 |

(For compressor mounting bracket bolts and nuts see figure 11-49)

### b. Compressor Specifications

| | |
|---|---|
| Type | Six Cylinder Axial Opposed |
| Make | Frigidaire |
| Effective Displacement (cu. in.) | 12.6 |
| Oil | Frigidaire 525 Viscosity |
| Internal Clearances | See Figure 11-33 |
| Oil Content (New) | 10 1/2 fl. oz. |
| Air gap between Clutch Drive Plate and Pulley | 0.022 to 0.057 inch |
| Clutch Type | Magnetic |
| Belt Tension | See Figure 11-116 |
| Freon Charge | 3 3/4 lbs. |

## 11-11 GENERAL DESCRIPTION OF HEATER—AIR CONDITIONER SYSTEM

The heater—air conditioner is a series, custom type system in which the cooling unit and the heating unit are positioned in series with each other so that the air may be heated; dried and cooled; or dried, cooled and slightly reheated (muggy weather). The heating and air conditioning portions of the system are integral with each other. Doors are provided to afford custom regulation of temperature and humidity within the passenger compartment.

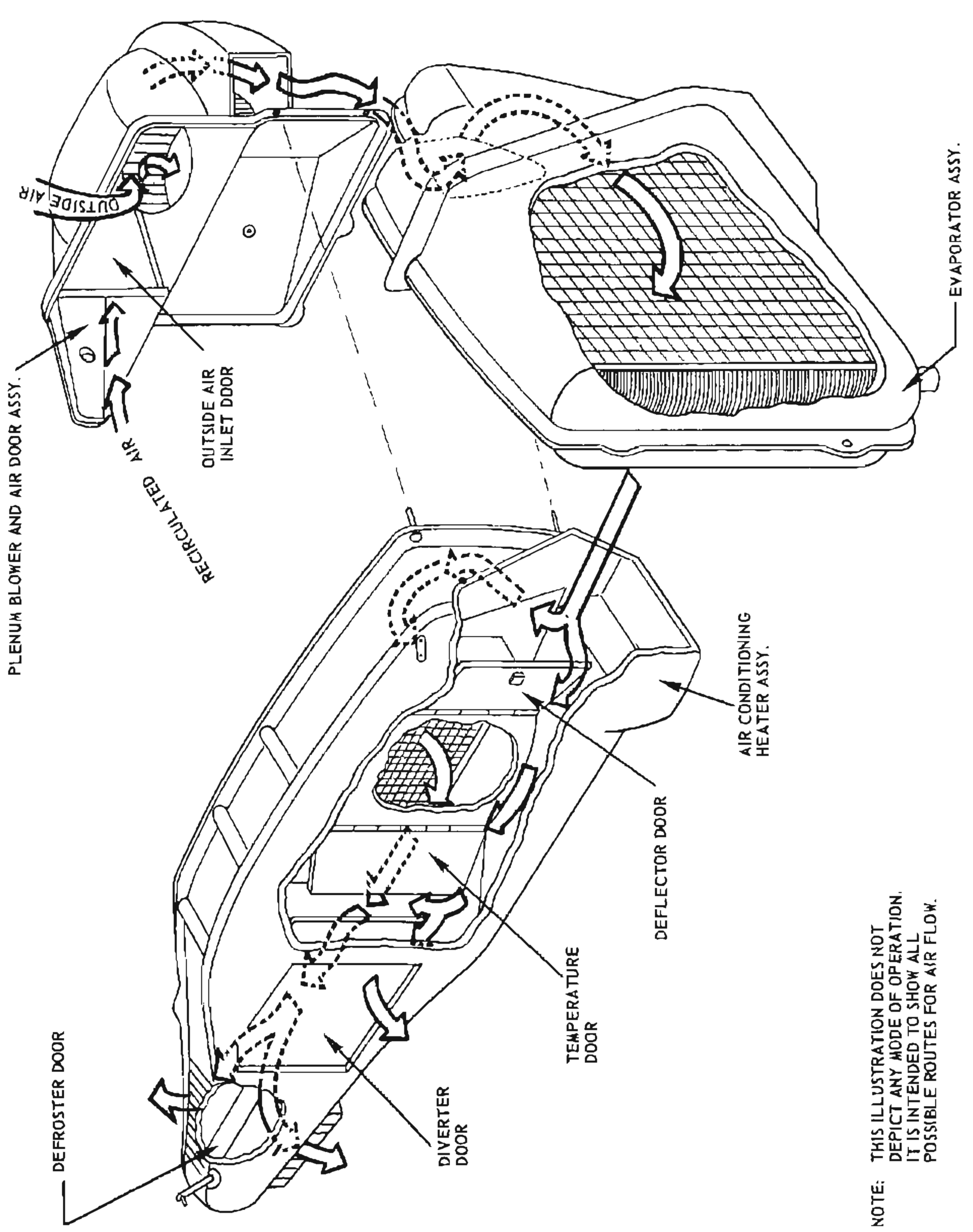
The following description of the heater—air conditioning system is divided into five areas: description of air flow through system, operation of door controls, theory of operation of heater portion of system, theory of operation of air conditioner portion of system, and description of air conditioning components.

## 11-12 DESCRIPTION OF AIR FLOW THRU SYSTEM

The following description for the flow of air in the heater—air conditioner system is divided into four groups: air flow for air conditioning, air flow for heating, air flow for defrosting, and air flow for both air conditioning and heating.

### a. Air Flow For Air Conditioning

During air conditioner operation the temperature control lever (see Figures 11-18 and 11-19) is set between COLD and halfway to MED positions. The air control lever is set at A/C position, and the FAN lever should be in low, medium or HI detents. Outside air enters the car through the air inlet grille and flows through the cowl air chamber and into the plenum blower and air door assembly. When the temperature




NOTE: THIS ILLUSTRATION DOES NOT DEPICT ANY MODE OF OPERATION. IT IS INTENDED TO SHOW ALL POSSIBLE ROUTES FOR AIR FLOW.

Figure 11-18—Air Flow Thru Heater - Air Conditioner System

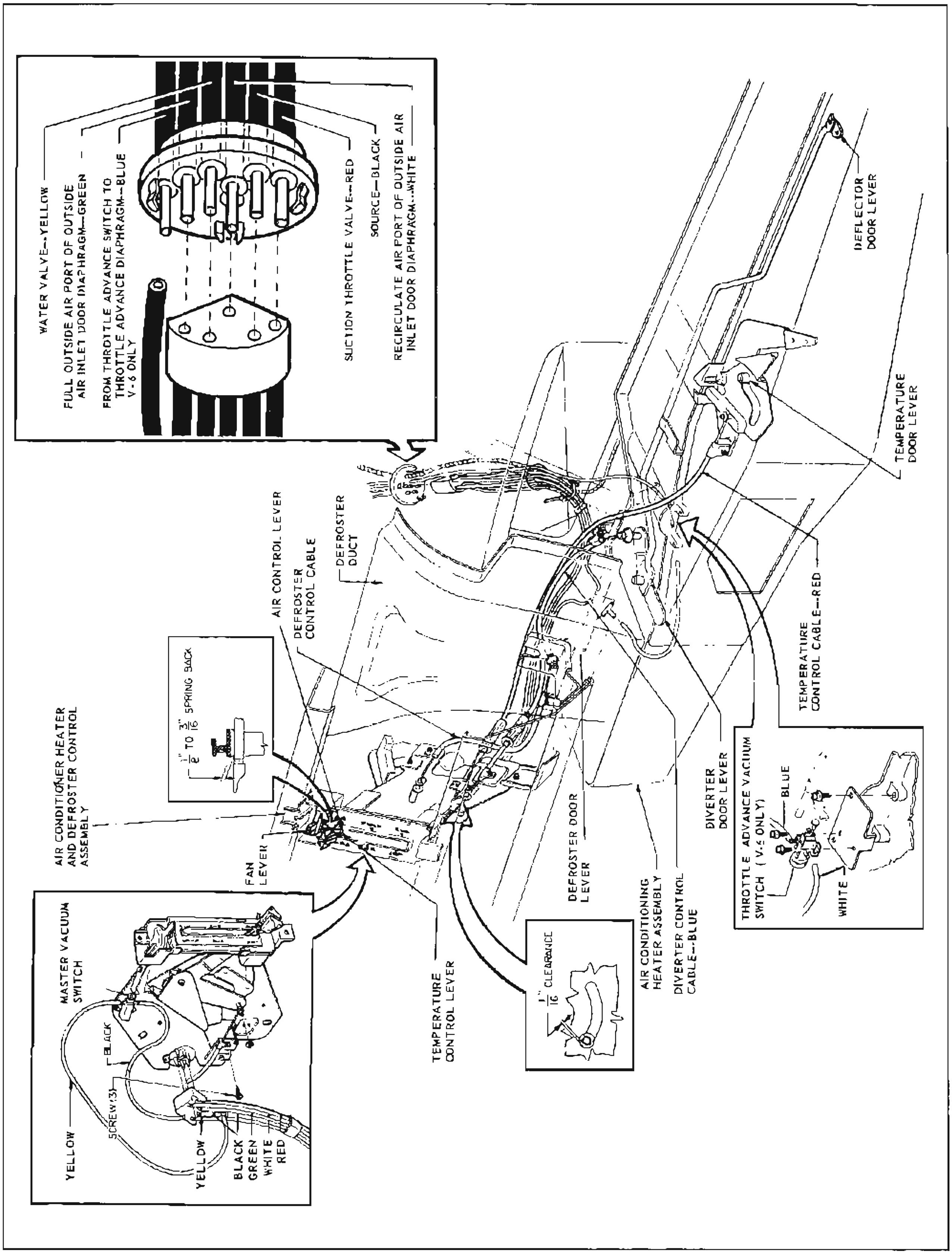



Figure 11-19—Air Conditioner Heater Assembly Control Wires and Controls

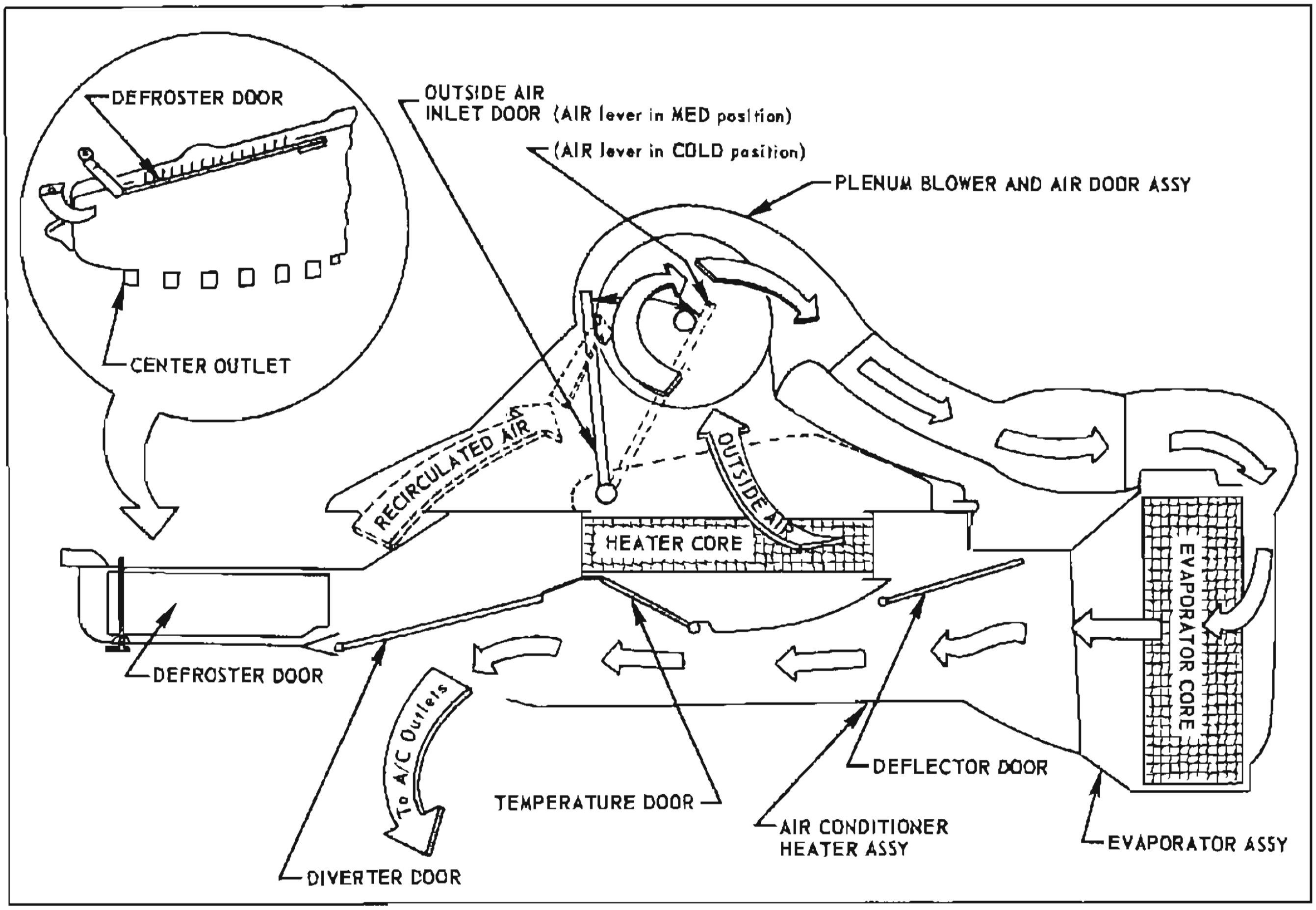



Figure 11-20—Air Flow for Air Conditioner Operation

lever is set at low, medium or HI detents the outside air inlet door partially opens (see Figure 11-20) and allows recirculated air from inside car to re-enter system and mix with outside air.

Positioning of the temperature lever to COLD provides maximum cooling of the passenger compartment. When the temperature lever is moved just past COLD position the outside air inlet door fully opens and blocks off all recirculated air flow. From the plenum blower and air door assembly the air is directed into the evaporator assembly. Movement of the air flow through the system is initiated by the blower motor switch. During air conditioner operation the air control lever is in A/C position and the deflector door and the diverter door are positioned so that they will divert the air flow after it leaves the evaporator assembly to the air conditioner outlets.

**b. Air Flow For Heating**

During heater operation (temperature lever between MED and HOT position) the outside air inlet door will be fully open (see Figure 11-21) and only outside air will pass through the plenum blower and air door assembly. From the plenum blower and air door assembly the air is channeled through the inactive evaporator core and is directed into the air conditioner heater assembly. The deflector and diverter doors will be positioned as shown in Figure 11-21 when the air lever is in HTR position. The air is diverted through the heater core as shown. The amount of air allowed to pass through the heater core is regulated by the temperature door. A small amount of unheated air is allowed to by-pass the deflector door. This unheated air will dilute the heated air depending on the opening of the temperature door. Maximum setting of the temperature lever to HOT position fully opens the temperature door and blocks off all unheated air by-passing the heater core. After the heated air leaves the heater core it passes thru the center outlet of the heater assembly and onto the front floor of the passenger compartment.

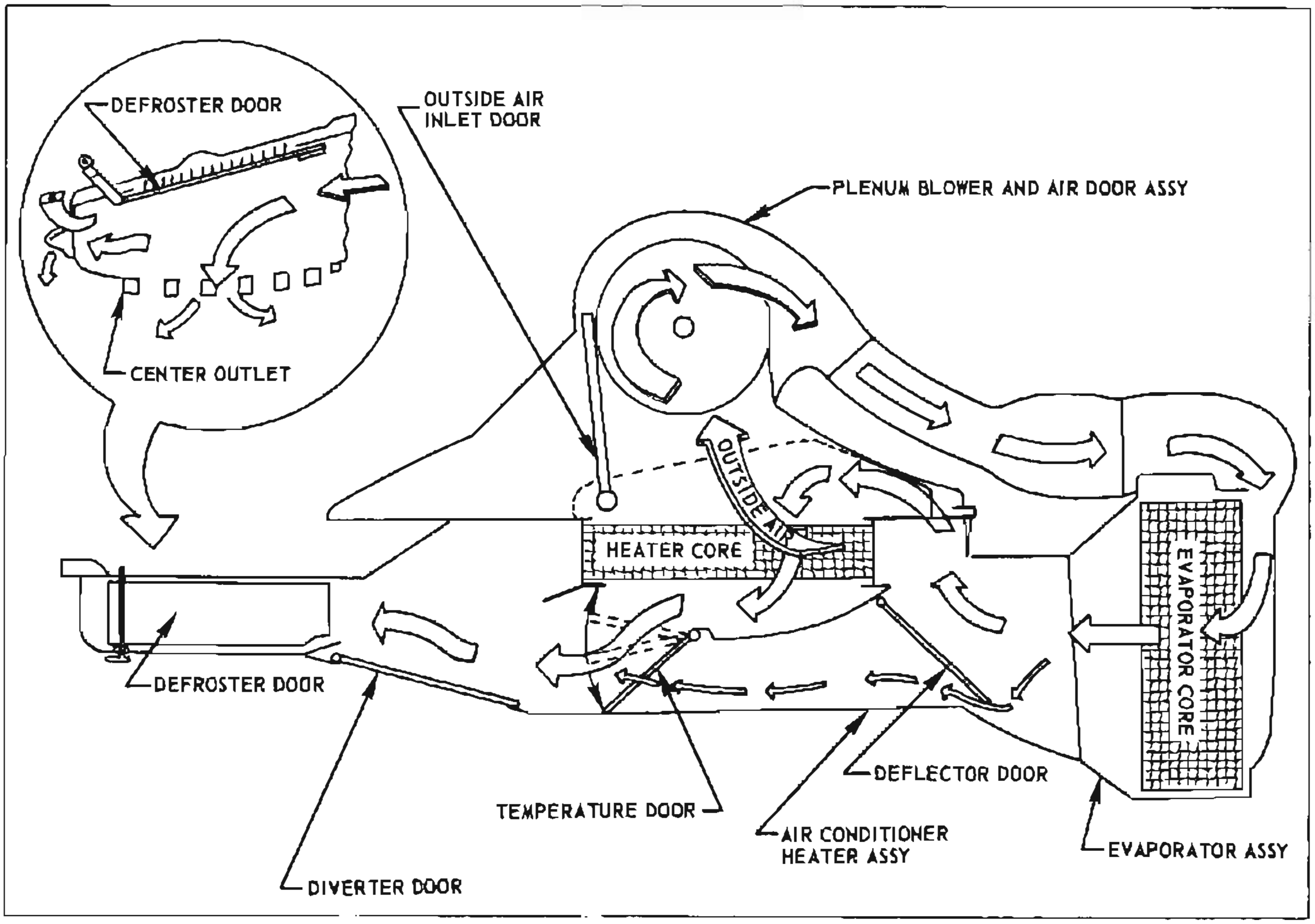



Figure 11-21—Air Flow for Heater Operation

**c. Air Flow For Defrosting**

The air flow for defrosting is similar to air flow for heating, except that the defroster door is opened and air is routed to the defroster outlets. When the system is adjusted for defrosting (air control lever set at DEF position and temperature control lever set between MED and HOT positions) the doors will be positioned as shown in Figure 11-22. The balance of the air flow not diverted to the defroster outlets is channeled to the floor outlet.

**d. Air Flow For Both Air Conditioning and Heating**

To set the air conditioner system for combined heating and air conditioning operation adjust the temperature control lever between MED and HOT, and the air control lever to A/C.

Positioning of temperature control lever between MED and HOT positions fully opens the outside air inlet door (blocking off recirculated air flow) and partially opens the temperature door. The air flows from the plenum blower and air door assembly to the evaporator assembly. The now cooled air flows from the evaporator assembly to the air conditioner heater assembly. Most of the air flow is diverted by the deflector and diverter doors to bypass the heater core. A small portion of the air flow is allowed to get past the deflector door and flow through the heater core. Both the heated and the air conditioned air mix together and are channeled to the air conditioner outlets. The air flow under these conditions is dehumidified and slightly warmed, and is particularly suited to provide comfortable driving conditions during muggy weather.

NOTE: When the air control lever is positioned just below the A/C detent (move lever downward until a click is heard) the air conditioner will be shut off and non-cooled air will flow from the air conditioner outlets. This air also may be subsequently heated by moving the temperature control lever downward.

## 11-13 OPERATION OF DOOR CONTROLS

All the controls for regulation of

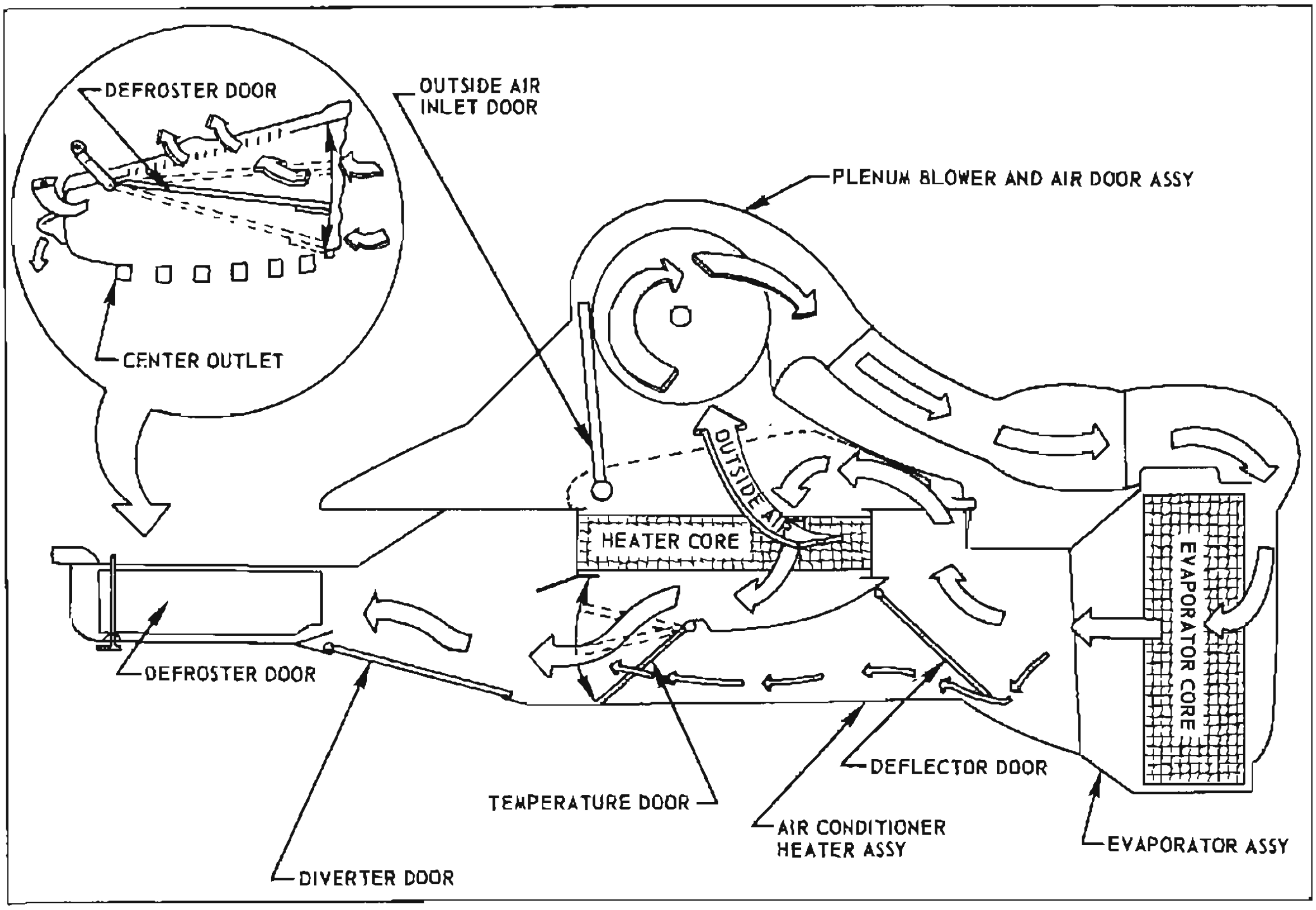



Figure 11-22—Air Flow for Defroster Operation

the heater—air conditioner system are located on the air conditioning heater and defroster control assembly. They operate as follows:

### a. Temperature Control Lever

The temperature control lever (see Figure 11-19) regulates the outside air inlet door, the temperature door, the vacuum operated water valve, and the vacuum diaphragm of the suction throttling valve. When the temperature control lever is in COLD position, the temperature door and the vacuum operated water valve are closed. Movement of the temperature control lever slightly past COLD position to MED position performs three successive system changes which have the effect of gradually increasing the temperature of the air conditioned air. As the lever is moved toward MED positions, first the outside air inlet door is fully opened cutting off recirculated air flow from inside car. Thus, only outside air is used, and the previously cooled recirculated air is cut-off. Next, vacuum is removed from the vacuum diaphragm of the suction throttling valve (provided FAN lever on), and the result is that the evaporator operates at a higher pressure—hence decreased cooling. Thirdly, vacuum is applied to the vacuum element of the water valve, thereby allowing circulation through the heater core. This results in a further increase of the temperature of the air conditioned air. As the temperature lever is moved from MED to HOT positions the temperature door is proportionately opened and more air is forced to circulate around the heater core.

### b. Air Control Lever

The air control lever (see Figure 11-19) regulates the position of the diverter door, deflector door, defroster door, and also operates one of the three electrical switches (air conditioner clutch compressor switch) in the air conditioner circuit. When the air control lever is in AC position the diverter and deflector doors divert most of the air flow and cause it to by-pass the heater core. In addition, when the air control lever is in AC position, a pin on the lever holds the air conditioner clutch compressor switch

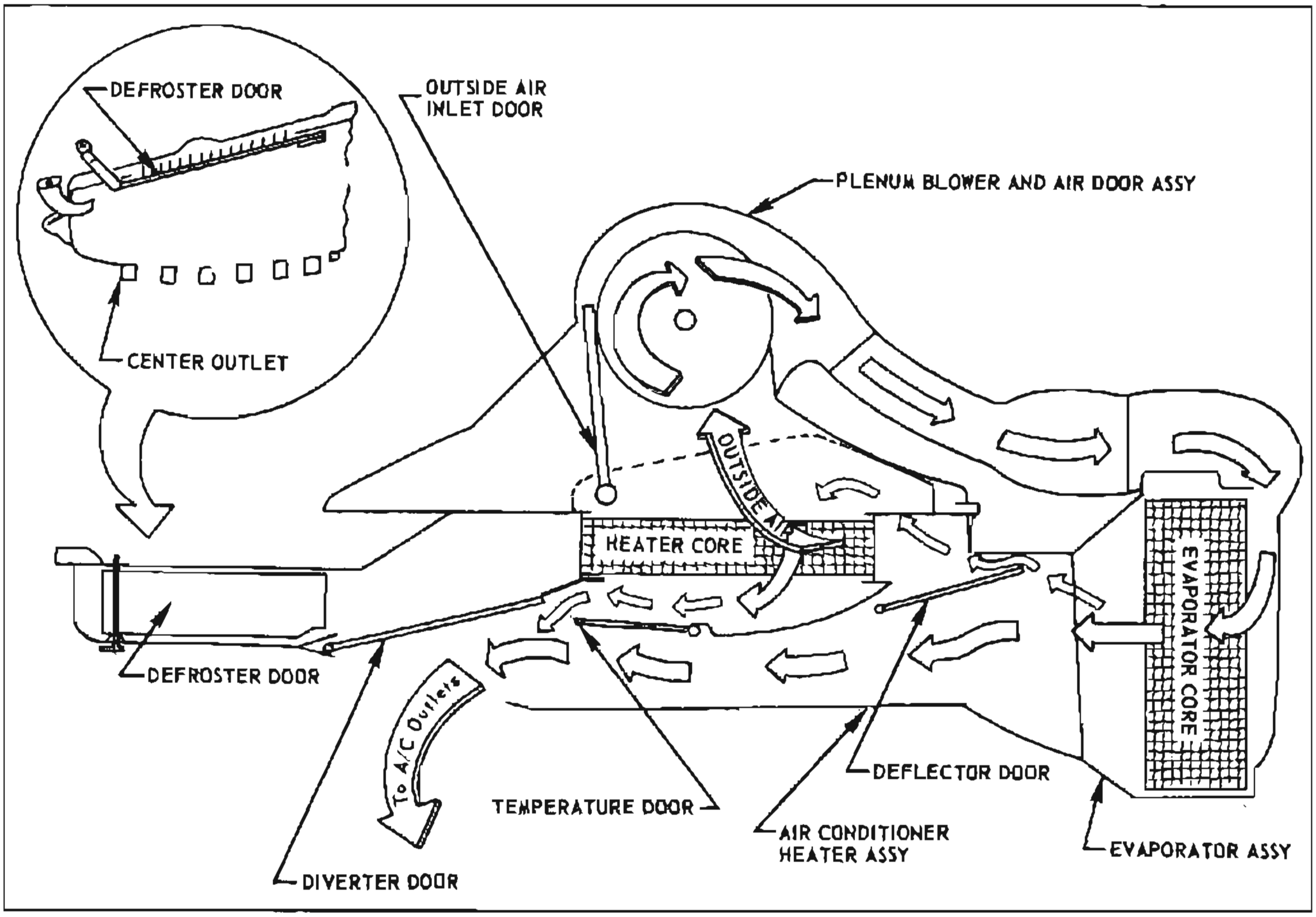



Figure 11-23—Air Flow for both Air Conditioner and Heater Operation

closed. This switch is one of three switches (see Figure 11-24) in the heater-air conditioner circuit which must be closed to operate the compressor. Movement of the air control lever to HTR position changes the angle of the diverter and deflector doors, and diverts most of the air flow through the heater core. Also, when the air control lever is in HTR position the air conditioner clutch compressor switch is allowed to open and break the circuit for air conditioner operation. Further movement of the air control lever to DEF position opens the defroster door and diverts air flow from floor outlet to defroster outlet. Midway location of air lever between HTR and DEF positions will apportion the air flow to both the defroster and floor outlets.

**c. Fan Control Lever**

The fan control lever (see Figure 11-19) operates the heater blower switch and applies vacuum to the vacuum diaphragms of the outside air inlet door and suction throttling valve. When the lever is moved to low position (1st detent) four changes take place in the system, provided the air control lever is in A/C position. First, the blower motor is actuated and air is force fed through the system. Secondly, the magnetic clutch of the compressor is actuated and air conditioning system is in turn actuated. Thirdly, the vacuum is applied to the vacuum diaphragm of the suction throttling valve (provided the temperature control lever is in COLD position) and the evaporator operates at maximum cooling. Fourthly, a vacuum is applied to the dual stage diaphragm of the outside air inlet door and the door partially opens permitting outside and recirculated air flow through system. Further movement of the FAN lever to medium or HI positions (2nd and 3rd detents) proportionately increases the blower speeds.

## 11-14 THEORY OF OPERATION OF HEATER PORTION OF SYSTEM

Engine heat is transmitted to the heater core by the flow of coolant through the core. The flow of coolant or water through the heater core of the heater--air conditioner system is as shown in Figure 11-26. Coolant or water enters the lower port of the

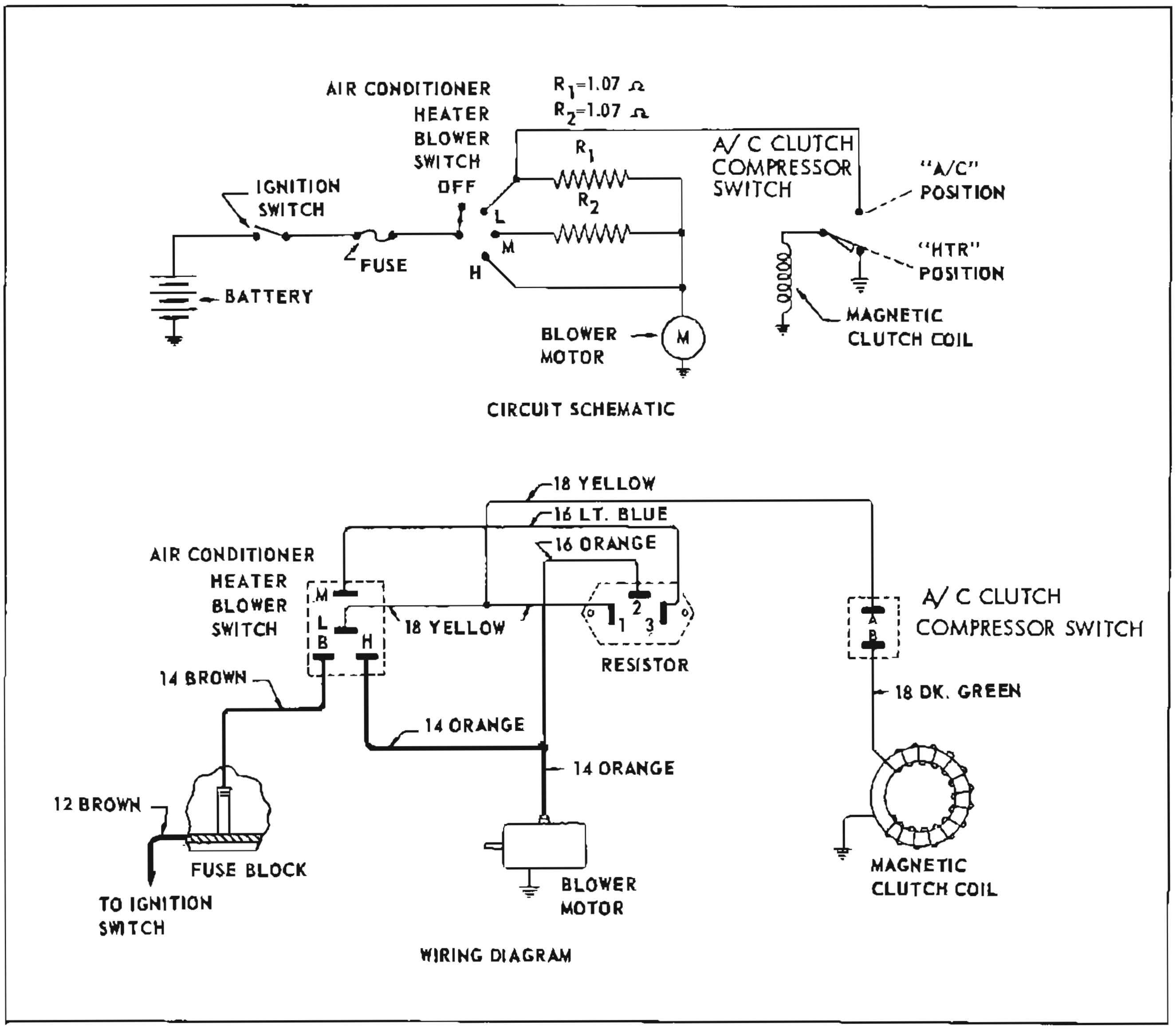



Figure 11-24—Circuit Schematic and Wiring Diagram of Heater Air Conditioner System

heater core and exits from the upper port. The flow of coolant (hence operation of the heater core) is turned on and off by means of the water valve. The valve is vacuum operated and is actuated by a vacuum disc switch located on the heater and defroster control assembly. The water valve is closed when the temperature control lever is between the COLD and MED positions. The valve is fully opened whenever the temperature control lever is moved slightly past the MED position, and will stay fully open for the remainder of the travel of the temperature control lever to HOT position. A 180° thermostat is provided as standard equipment on both V-6 and V-8 engines.

## 11-15 THEORY OF OPERATION OF AIR CONDITIONER PORTION OF SYSTEM

The state of the refrigerant at the inlet port of the compressor is a low pressure gas. The compressor compresses the gas into a high pressure high temperature gas (see Figure 11-27). Because of the increase in pressure, the heat in the gas has been concentrated and therefore is increased above the ambient (outside air) temperature. This heat in excess above the ambient temperature tends to dissipate itself. A condenser is utilized in the refrigeration circuit to provide a means whereby the heat of the refrigerant can be easily dissipated.

The high pressure, high temperature (hot) gas flows through the condenser and is cooled to a high pressure liquid as it gives up its heat. From the condenser the high pressure liquid flows to the receiver-dehydrator and then to the expansion valve where the pressure is reduced and the liquid is allowed to expand in the evaporator. When the pressure is reduced the refrigerant will successively transform itself from a high pressure liquid to a low pressure liquid, and then to a low pressure gas. As the low pressure liquid expands and becomes a low pressure gas it absorbs heat. To satisfy the refrigerant demand for heat, the air passing over the evaporator gives up heat to the evaporator and in doing so, it as a result is cooled.

The low pressure gas returns to the inlet port of the compressor (the original starting point) where the cycle just described repeats itself. Although the foregoing description holds true in actual system operation, it should be qualified insofar as whenever the compressor is running, a portion of the refrigerant remains in a liquid state and consequently there is a certain amount of continuous liquid flow of refrigerant and oil throughout the system at all times during the refrigerating cycle.

## 11-16 DESCRIPTION OF AIR CONDITIONING COMPONENTS

### a. Compressor

The compressor is located on right side of the engine compartment (see Figure 11-28). The purpose of the unit is to draw the low pressure vapor from the evaporator and compress this vapor into a high temperature and high pressure gas. This action will result in the refrigerant having a higher temperature than the surrounding air.

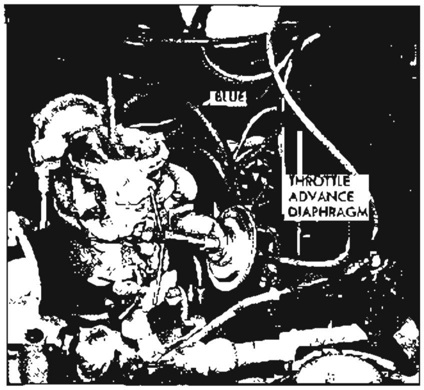



Figure 11-25—Idle Speed-Up Control

The compressor is of basic double action piston design. Three horizontal double acting pistons make up a six cylinder compressor (see Figure 11-29). The pistons operate in 1-1/2 inch bore and have a 1-1/8 inch stroke. A swash plate keyed to the shaft drives the pistons. The shaft is belt driven through a magnetic clutch and pulley arrangement. An oil pump mounted at the rear of the compressor picks up oil from the bottom of the compressor and lubricates the bearings and other internal parts of the compressor. Reed type valves at each end of the compressor open or close to control the flow of incoming and outgoing refrigerant. Two gas tight passages interconnect chambers of the front and rear heads so that there is one common suction port, and one common discharge port. The internal parts of the compressor function as follows:

1. Suction Valve Reed Discs and Discharge Valve Plates—The two suction valve reed discs and two discharge valve plates (see Figure 11-30) operate in a similar but opposite manner. The discs are composed of three reeds and function to open when the pistons are on the intake portion of their stroke (downstroke), and close on the compression stroke. The reeds allow low pressure gas to enter the cylinder heads. The discharge valve plates also have three reeds, however, they function to open when the pistons are on the compression portion of their stroke (upstroke), and close on the intake stroke. High pressure gas exits from the cylinder head discharge port. Three retainers riveted directly above the reeds on the valve plate serve to limit the opening of the reeds on the compression stroke.

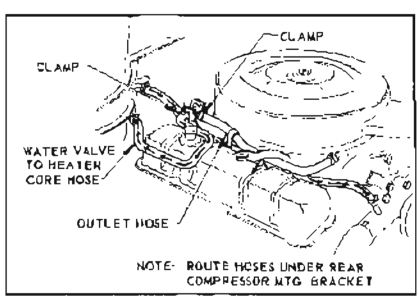



Figure 11-26—Heater Coolant Circulation - V-8 Engine

2. Front and Rear Heads—The front and rear heads (Figure 11-31) serve to channel the refrigerant into and out of the cylinder heads. The front head is divided into two separate passages and the rear head is divided into three separate passages. The outer passage on both the front and rear heads channels low pressure gas to the suction valve reeds. The middle passage on both front and rear heads channels high pressure gas to the discharge valve plate reeds. The inner passage on the rear head houses the oil pump inner and outer rotors. A teflon sealing material is bonded to the sealing edges separating the passages in the front and rear head. "O" rings are used to affect a seal between the mating edges of the heads and the shell. The front head suction and discharge passages are connected to the suction and discharge passages of the rear head by a discharge tube and suction passage in the body of the cylinder assembly. A screen located in the suction port of the rear head prevents foreign material from entering the circuit.

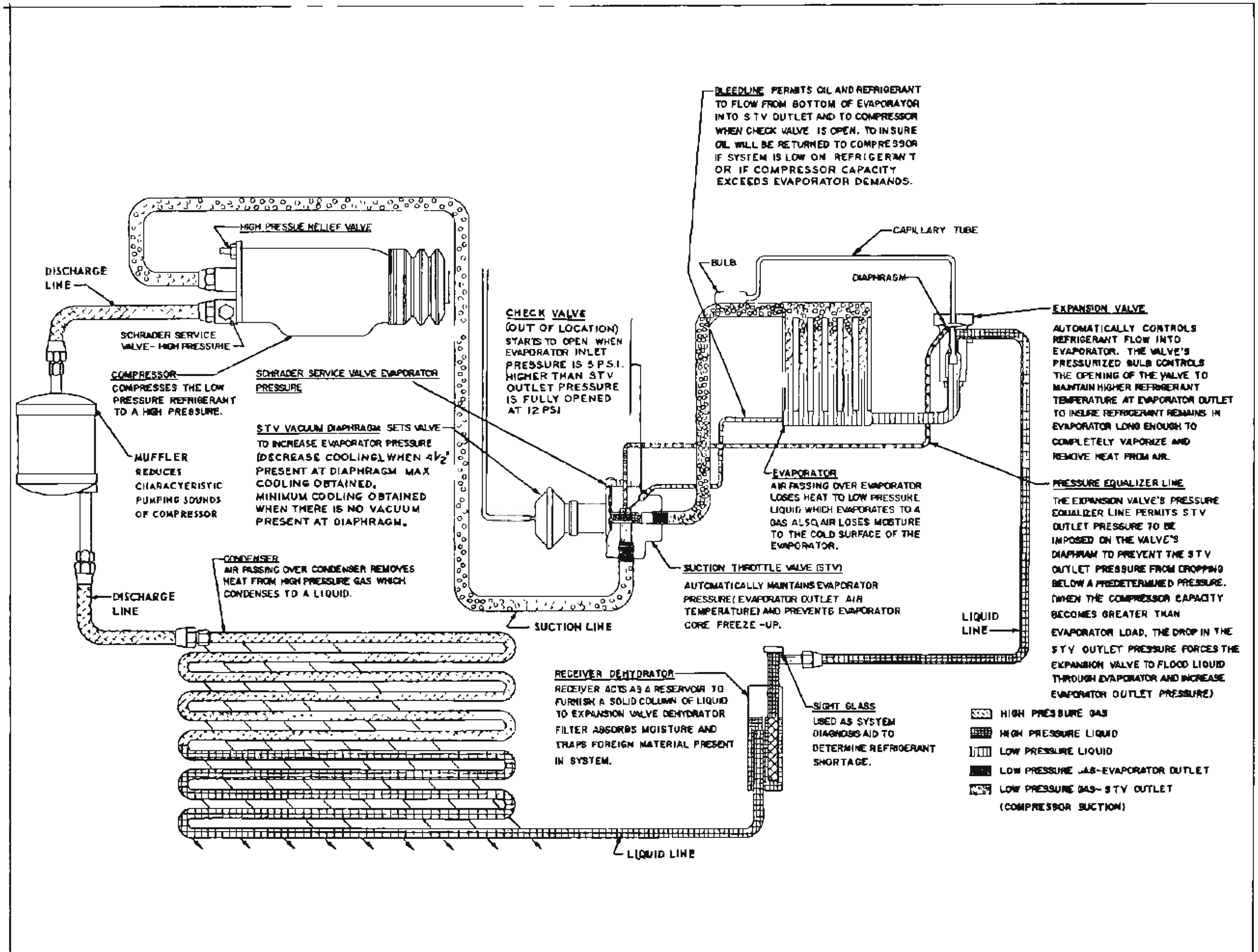



Figure 11-27—Air Conditioner Refrigeration Circuit

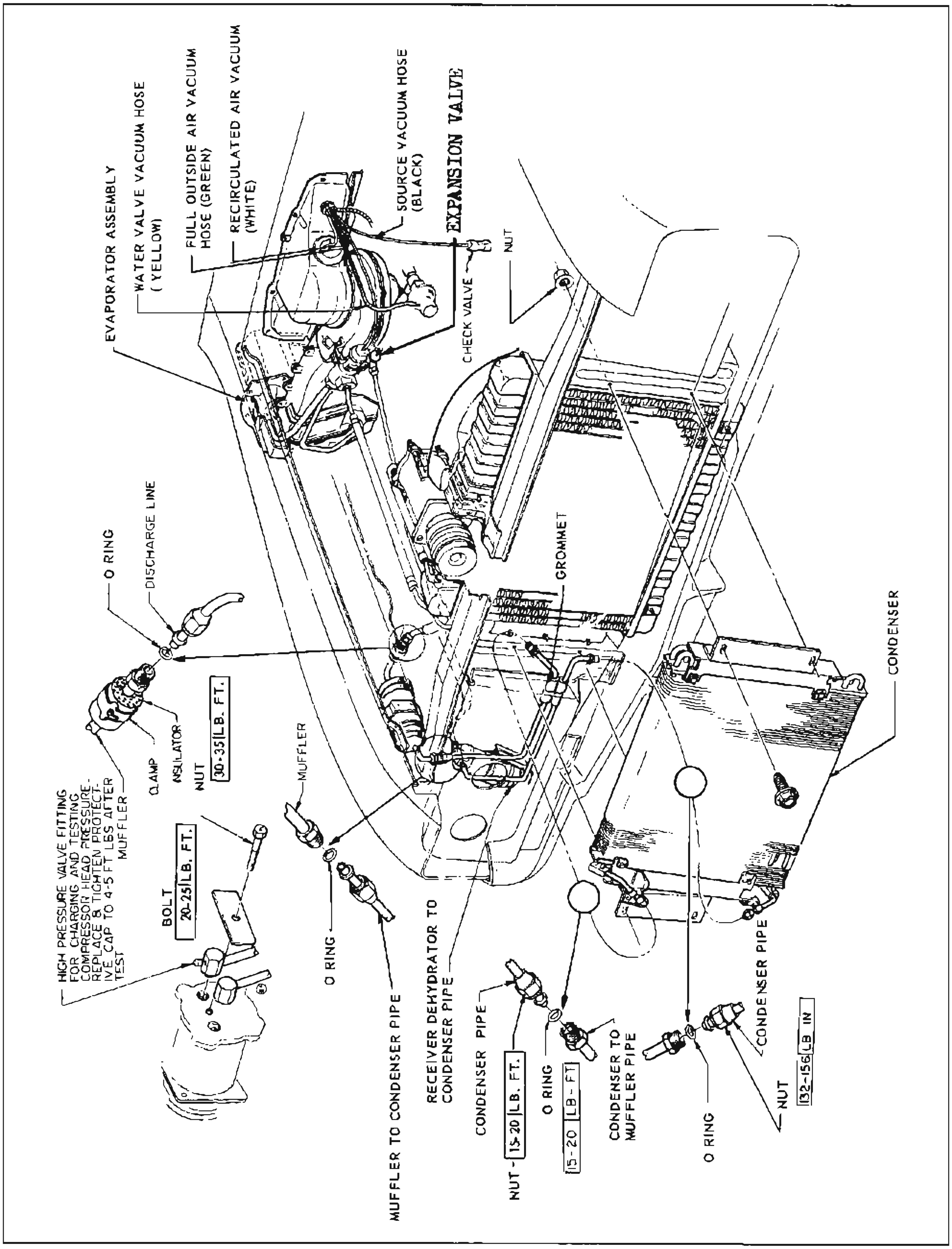



Figure 11-28—Air Conditioner Refrigeration Components Installation

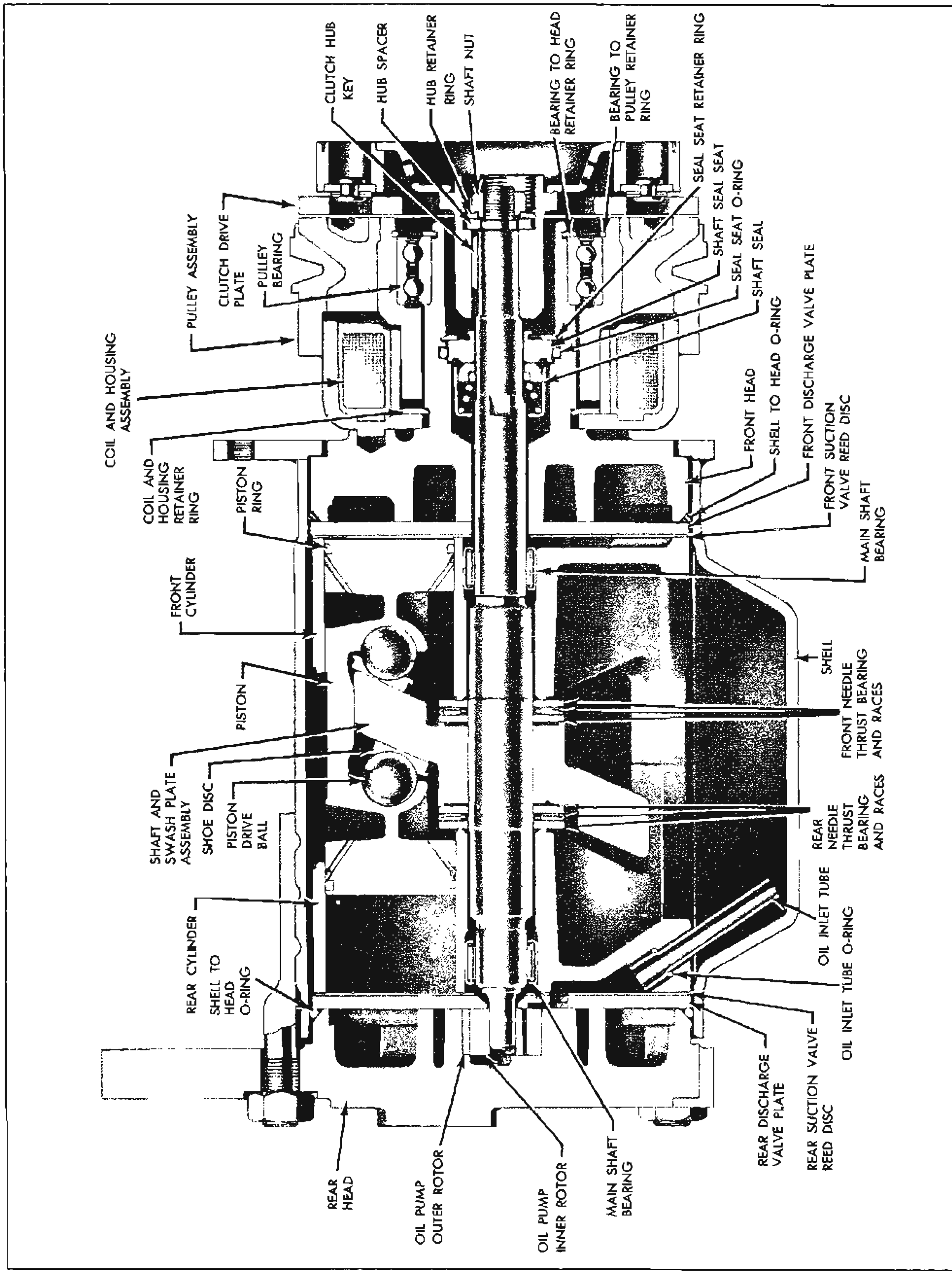



Figure 11-29—Compressor (Sectional View)

3. Oil Pump—An internal tooth outer rotor and external tooth inner rotor comprise the oil pump. The pump works on the principle of a rotary type pump. Oil is drawn up from oil reservoir in underside of shell through the oil inlet tube (see Figure 11-32) and circulated through the system via a 3/16 inch diameter oil passage through the shaft center and also four 5/64 inch diameter holes drilled perpendicular to the shaft. The inner rotor is driven by the shaft.

4. Shaft and Swash Plate Assembly—The shaft and swash plate assembly (see Figure 11-29) consists of an elliptical plate positioned obliquely to the shaft. As the plate rotates on the shaft, the surface of the plate moves to and fro lengthwise relative to the centerline of the shaft. This reciprocating motion is transmitted to the pistons which contact the surface of the swash plate. A woodruff key locks the swash plate onto the shaft. The swash plate and shaft are serviced as an assembly. The shaft is driven by a pulley when the magnetic clutch is energized. A needle thrust bearing and a mainshaft bearing support the shaft horizontally and vertically.

5. Needle Thrust Bearing and Races—Two needle thrust bearings, each "sandwiched" between two races are located on either side of the swash plate hub. The front needle thrust bearing and races provide 0.010" to 0.015" clearance between the top of the pistons and the rear side of the front suction valve reed disc (see Figure. 11-33). The rear needle thrust bearings and races provide 0.0005" to 0.0015" clearance between the hub of the swash plate and the rear hub of the rear cylinder. Races of various thicknesses are provided for service replacement to achieve required clearances when rebuilding units.

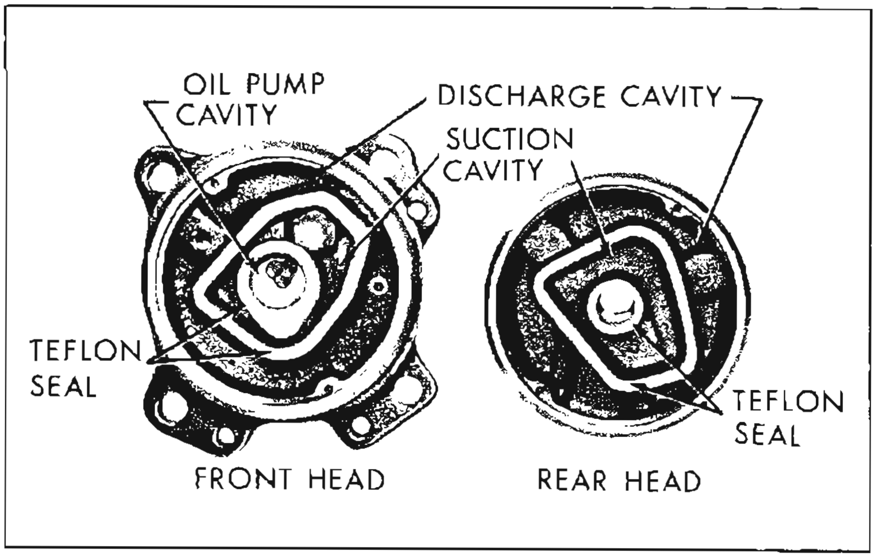



Figure 11-31—Compressor Front and Rear Heads

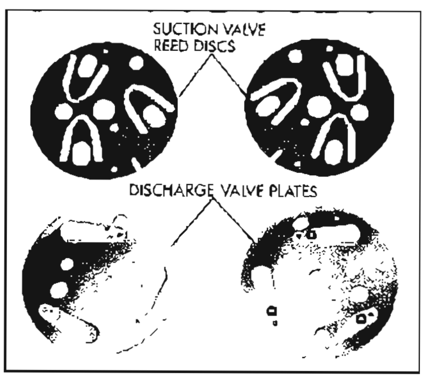



Figure 11-30—Compressor Suction Valve Reed Discs and Discharge Valve Plates

6. Cylinder Assembly and Pistons—The cylinder assembly (front cylinder and rear cylinder) is serviced only as a matched set. Alignment of the two halves is maintained by two dowel (locater) pins.

The double ended pistons are made of cast aluminum. There are two grooves on each end of the piston. The outer grooves will receive a piston ring. The inner grooves act as oil scraper grooves to collect any excess oil. Two oil return holes are drilled into the scraper grooves and allow oil to drain back into the reservoir.

7. Shoe Discs—The shoe discs are made of bronze and act as a bearing between the ball and the swash plate. An oil circulation hole is provided through the center of each shoe for lubrication purposes. These shoes are of various thicknesses and are provided in 0.0005 inch increments. Ten sizes are available for service replacement. A basic "zero" shoe size is available for preliminary gauging procedures when rebuilding a cylinder assembly.

8. Suction Pass Cover—The suction pass cover fits over a suction passage (see Figure 11-34) in the body at the cylinder assembly. A rectangular neoprene seal is used to insure proper sealing action along the edges of the cover. Low pressure vapor flows from the

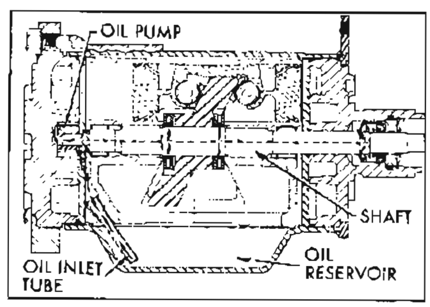



Figure 11-32—Compressor Oil Flow

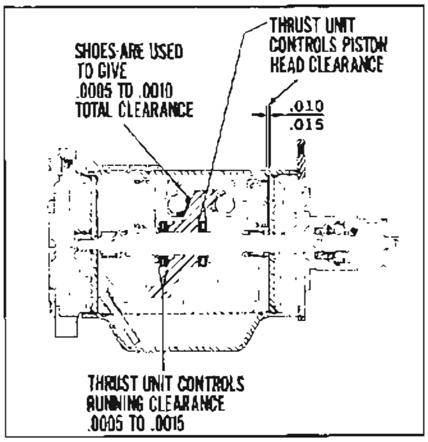



Figure 11-33—Compressor Needle Thrust Bearings and Races

suction port through the suction passage in the cylinder assembly, and into the suction cavity of the front head.

9. Discharge Tube—The discharge tube is used to connect the discharge cavity in the front head with the discharge port in the rear head. High pressure vapor discharge is channeled via the tube to discharge port. A slightly modified discharge tube is provided to be used as a service replacement tube (see Figure 11-35). The service replacement tube has a reduced end and a built up shoulder to accommodate an "O" ring and bushing. These added parts achieve the necessary sealing of the high pressure vapor within the compressor.

10. Pressure Relief Valve—The purpose of the pressure relief valve is to prevent the discharge pressure from exceeding 440 psi. Opening of the pressure relief valve will be accompanied by a loud popping noise and perhaps the ejection of some refrigerant from the valve. If the pressure relief valve is actuated due to excessive pressures in the compressor, the cause of the malfunction should be corrected immediately. The pressure relief valve is located on the rear head of the compressor.

11. Shell and Oil Drain Screw—The shell of the compressor contains a reservoir which furnishes a continuous supply of oil to the moving parts of the compressor. A baffle plate covers the reservoir and is tack-welded to the inside of the shell. In addition an oil drain screw and gasket are located on the side of the reservoir and are provided for draining or adding of oil to system. To add oil, compressor must be removed from system. The necessity to add oil should only be required when the system has ruptured violently and oil has been lost along with refrigerant. Under controlled conditions or slow leak conditions it is possible to loose only a small amount of oil with the refrigerant gas. The serial number, part or model number, and rating of the compressor is stamped on name plates located on top of shell. This information should be included on all reports, claims, and correspondence covering the unit.

12. Magnetic Clutch and Pulley Assembly—The magnetic clutch and pulley assembly (see Figure 11-36) together transmit power from the engine crankshaft to the compressor. The magnetic clutch is actuated when the air conditioning clutch compressor switch and the FAN switch located on the air conditioning control assembly


Figure 11-34—Suction Passage and Discharge Tube

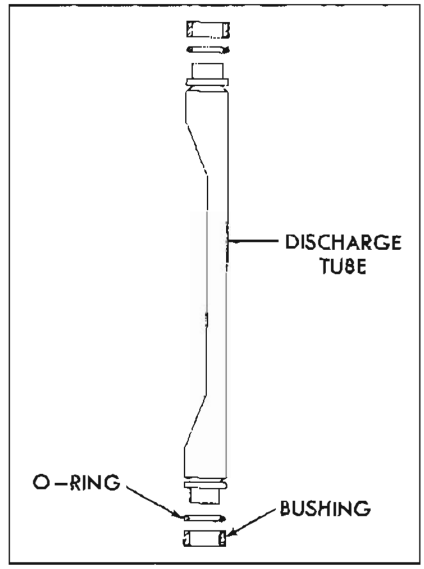



Figure 11-35—Service Replacement Discharge Tube

are closed. When the switches are closed (air lever in A/C position and fan lever in low-medium or HI positions) the coil sets up a magnetic flux and attracts the armature plate (movable element of the clutch drive plate). The armature plate portion of the clutch drive plate moves forward and contacts the friction surface of the pulley assembly, thereby mechanically linking the compressor to the motor. The compressor will operate continuously whenever the air conditioner clutch compressor switch and the FAN switch are closed. When one or both of the switches are open the armature plate will be released due to spring tension, and move away from the pulley assembly. This allows the pulley to rotate without driving the shaft. It should be noted that if the air conditioner system was in use when the engine was turned off, the armature plate may remain in contact with the pulley due to residual magnetism. When the engine is started the armature plate will separate from the pulley assembly. The coil is rated at 3.85 ohms (85°F.) and will draw 3.2 amperes at 12 volts d.c.

**b. Muffler**

A muffler is located on the discharge line side of the compressor. The muffler acts to reduce the characteristic pumping sound of the compressor. To further reduce compressor noise transfer through the body to the passenger compartment, a sheet of soft rubber insulation is wrapped around the outside of the muffler.

**c. Condenser**

The condenser which is made of aluminum is located in front of the radiator (see Figure 11-28) so that it receives a high volume of air flow. Air passing over the condenser absorbs the heat from the high pressure gas and causes the refrigerant to condense into a high pressure liquid.

**d. Receiver—Dehydrator**

The receiver-dehydrator is located on the right front side of the engine compartment (see Figure 11-28). The purpose of the receiver-dehydrator is twofold: the unit insures (provided the system is properly charged) a solid column of liquid refrigerant to the expansion valve at all times, and also absorbs any moisture in the system that might be present. A bag of desiccant (moisture absorbing material) is provided to absorb moisture. A sight glass (see Figure 11-37) permits visual checking of the refrigerant flow for bubbles or foam. The appearance of bubbles or foam above an ambient temperature of 70°F. indicates air in the line or an inadequate refrigerant charge. Bubbles or foam appearing at ambient temperatures below 70°F. do not necessarily indicate air or an inadequate charge and may appear even when the system is operating properly. A filter screein in the unit prevents foreign material from circulating through the system.

**e. Expansion Valve**

The expansion valve is located at the rear of the engine compartment on the passenger side of the car (see Figure 11-28). It is held secure by a bracket which is attached to the plenum blower and air door assembly (see Figure 11-38). The function of the expansion valve is to automatically regulate the flow of refrigerant in the evaporator. The expansion valve is the dividing point in the system between the high and low pressure liquid refrigerant. A temperature sensing bulb is connected by a capillary tube to the expansion valve (see Figure 11-39). The temperature sensing bulb (clamped to the outlet pipe on the evaporator) measures the temperature of the evaporator outlet pipe and transmits the temperature variations to the expansion valve (see Figure 11-40). The capillary tube and bulb are filled with carbon dioxide and sealed to one side of the expansion valve diaphragm. An increase in temperature will cause the carbon dioxide in the bulb and capillary tube to expand, overcoming the spring pressure and pushing the diaphragm against the operating pins (see Figure 11-39). This in turn will force the needle valve off its seat. When the refrigerant low pressure gas flowing through the outlet pipe of the evaporator becomes more than 6° higher or warmer than the temperature at which it originally began to vaporize or boil, then the expansion valve will automatically allow more refrigerant to enter

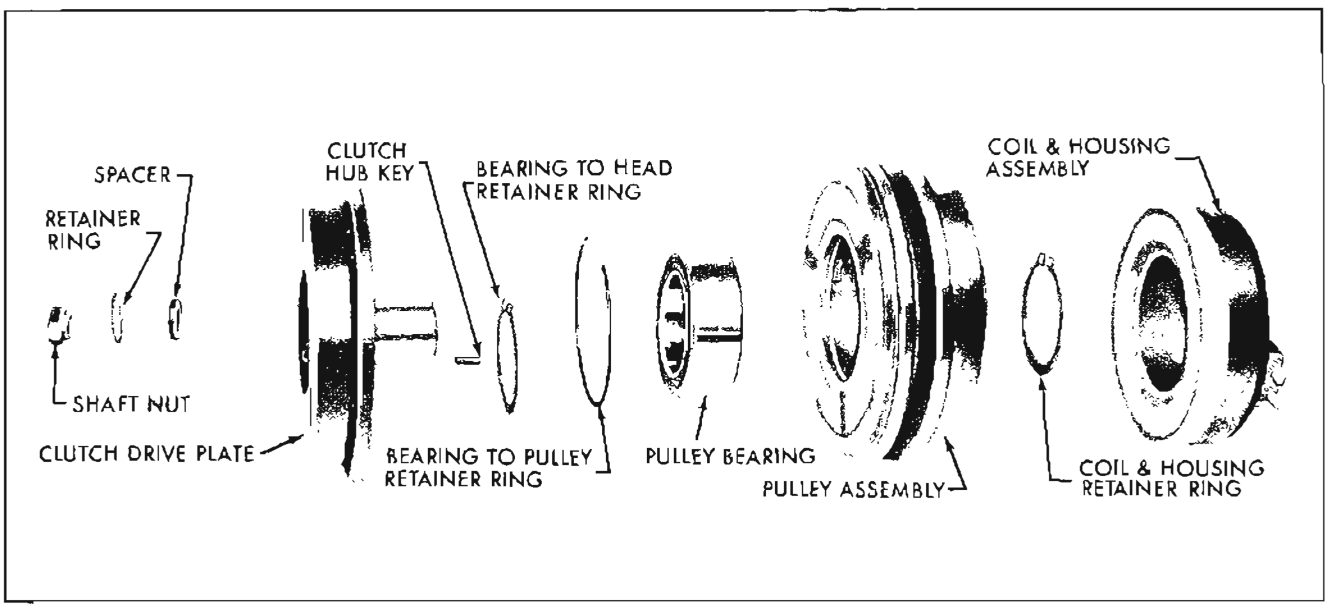



Figure 11-36—Magnetic Clutch Assembly

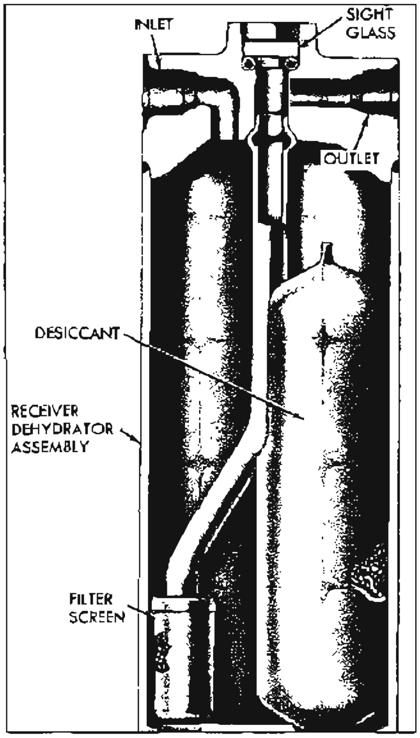



Figure 11-37—Receiver - Dehydrator Assembly

evaporator. If the temperature of the low pressure gas decreases more than 6° below the temperature at which it originally began to vaporize or boil, then the expansion valve will automatically reduce the flow of refrigerant. Thus, an increase or decrease in the flow of refrigerant through the evaporator will result in an increase or decrease in the cooling by the evaporator. The temperature and volume of the air passing over the evaporator affects to some degree the rate of absorption of heat by the evaporator. As the ambient temperature varies, the frequency which the temperature bulb calls for more or less refrigerant will increase or decrease. When the air is very warm, the heat transfer from the air to the refrigerant is great and a greater quantity of refrigerant is required to maintain the temperature at the evaporator pipe at the predetermined valve. Conversely, cool days will result in slower heat transfer and

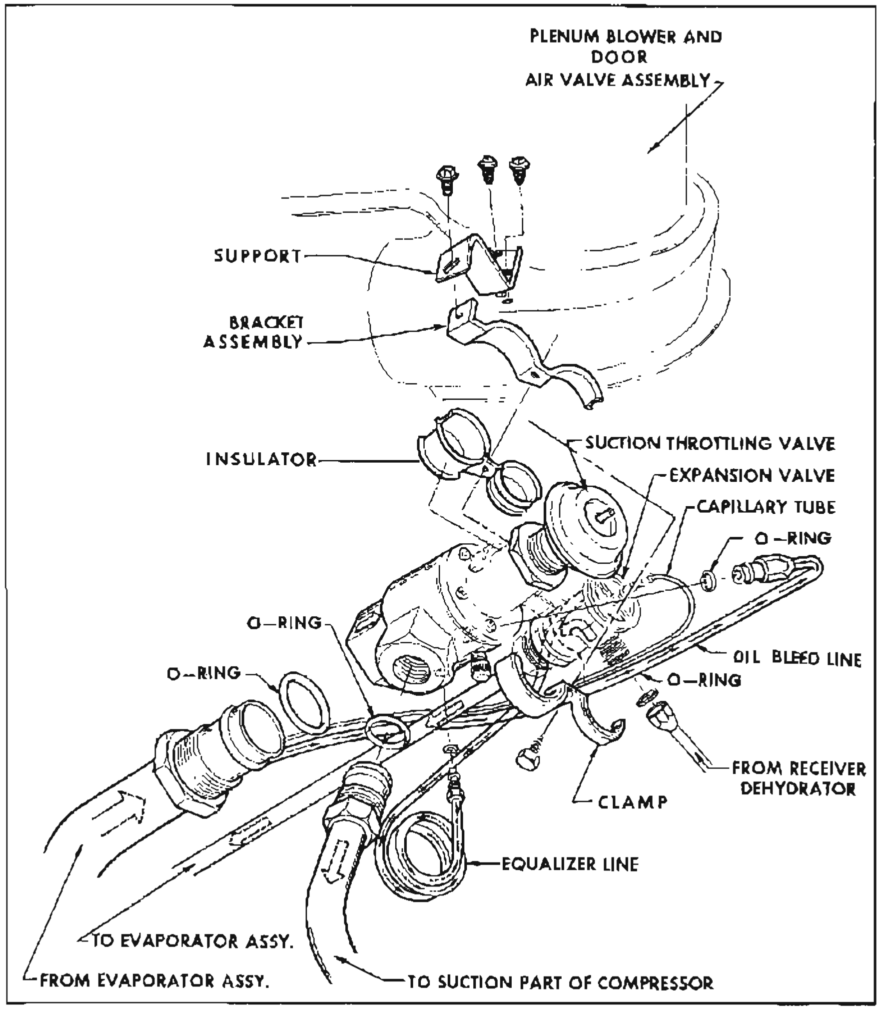



Figure 11-38—Suction Throttling Valve and Expansion Valve Installation

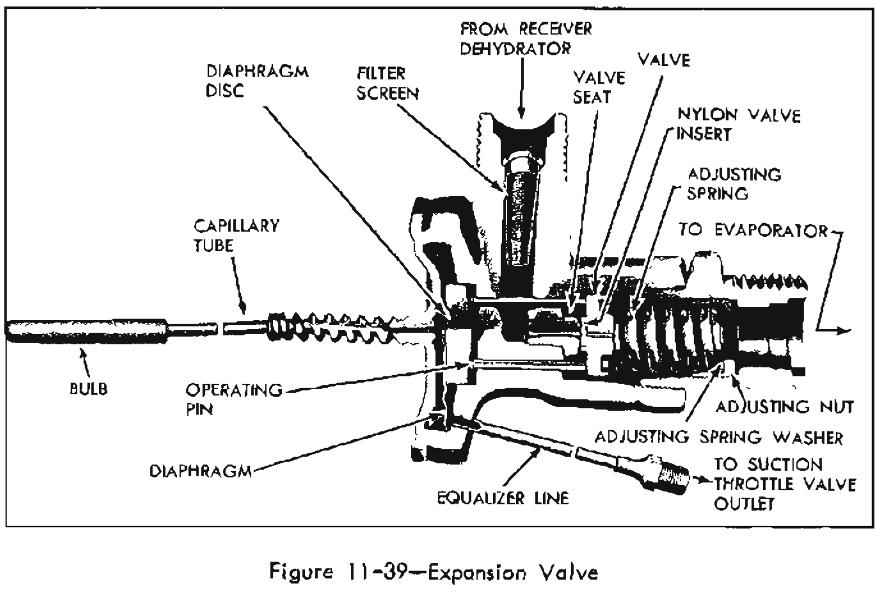



Figure 11-39—Expansion Valve

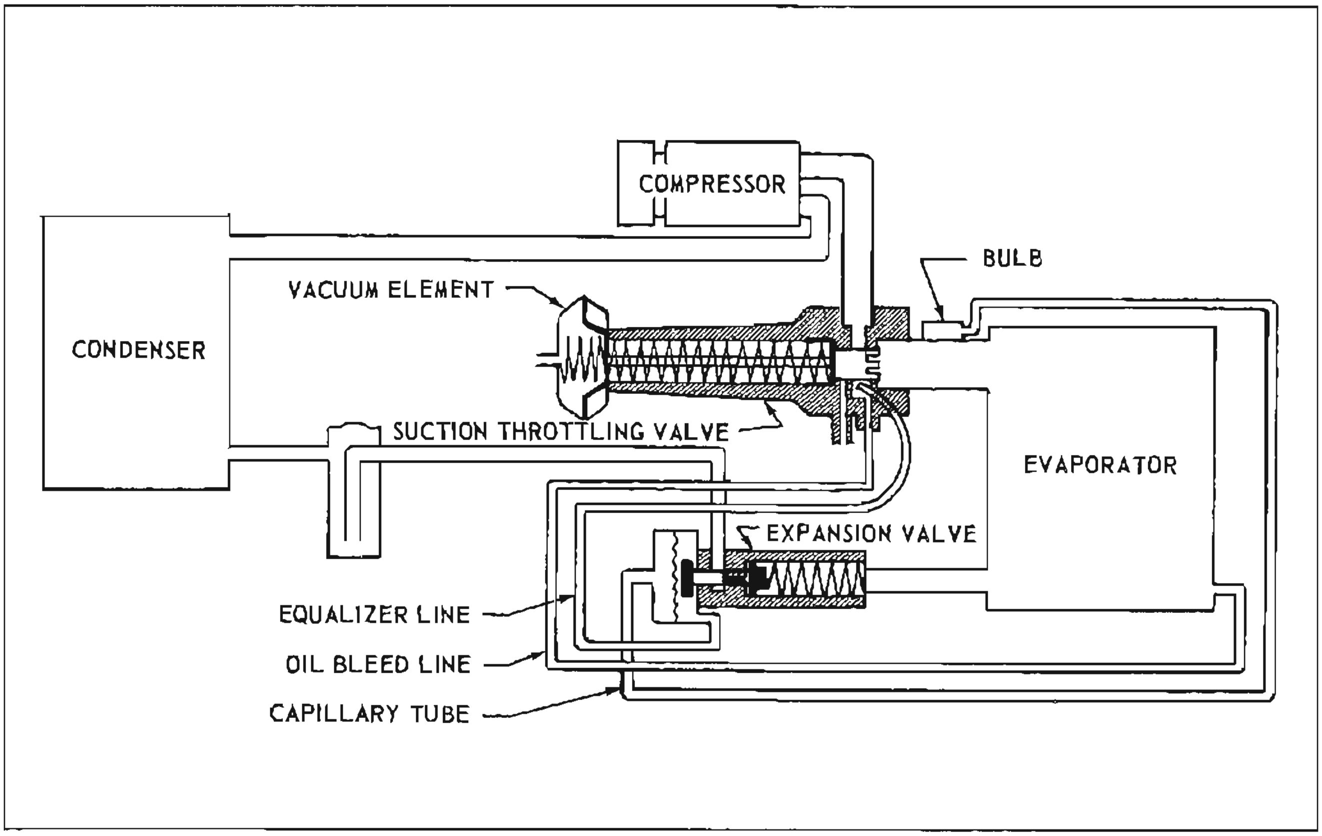



Figure 11-40—Suction Throttling Valve and Expansion Valve in Refrigeration Circuit

thereby require lesser quantities of refrigerant to maintain the predetermined temperature of the evaporator outlet pipe.

An equalizer line connects the expansion valve to the suction throttling valve. The equalizer line is used primarily to prevent prolonged and constant operation of the compressor under conditions where it is not receiving enough refrigerant. This operation is undesirable due to the resultant noise factor, and also due to the possibility of subjecting the compressor to reduced oil return. The equalizer line functions to permit the outlet pressure of the suction throttling valve to be imposed on the diaphragm of the expansion valve. When the outlet pressure of the suction throttling valve drops below a predetermined pressure, this decrease in pressure is also transmitted to the diaphragm of the expansion valve, via the equalizer line. The expansion valve is caused to open and flood refrigerant through the evaporator, thereby resulting in an increase in the evaporator pressure. This action only occurs during times when the compressor capacity becomes greater than the evaporator output with the resultant drop in suction throttling valve outlet pressure.

**f. Evaporator**

The function of the evaporator (see Figure 11-41) is to cool and dehumidify the air flow before it enters the passenger compartment. The evaporator assembly consists of an aluminum core enclosed in a reinforced plastic housing. A water drain port is located in the bottom of the housing. Two refrigerant pipe lines are connected to the side of the evaporator core; one at the bottom and one at the top. The expansion valve is attached to the lower inlet pipe, and the suction throttling valve is attached to the upper outlet pipe. The temperature sensing bulb of the expansion valve is clamped to the outlet pipe of the evaporator core. The high pressure liquid refrigerant, after it is metered through the expansion valve, passes into the evaporator core where it is allowed to expand under reduced pressure. As a result of the reduced pressure the refrigerant begins to expand and return to the original gaseous state. To accomplish this transformation it begins to boil.

The boiling action of the refrigerant demands heat. To satisfy the demand for heat, the air passing over the core gives up heat to the evaporator and is subsequently cooled.

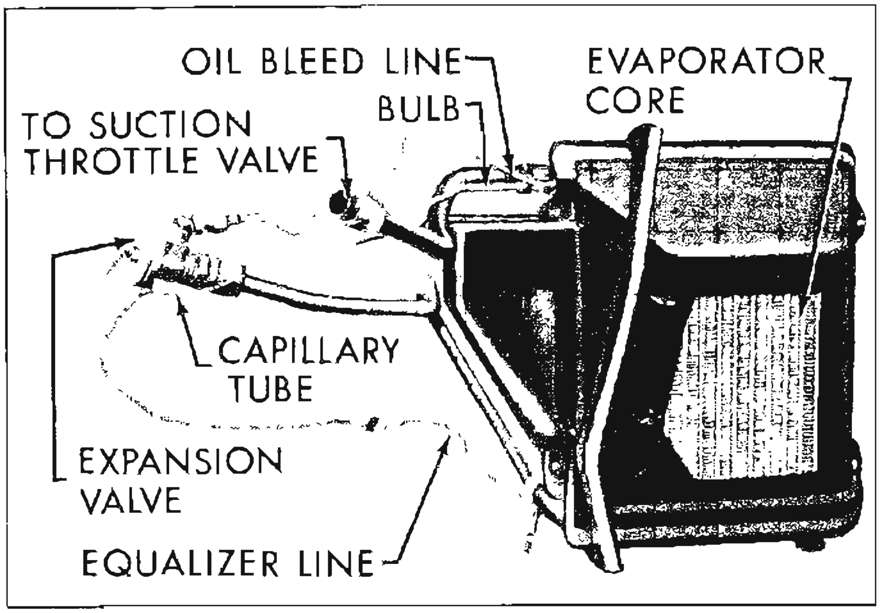



Figure 11-41—Evaporator Assembly

**g. Suction Throttling Valve**

The suction throttling valve is located on the discharge pipe of the evaporator core. The function of this valve (see Figure 11-42) is to maintain the evaporator at a predetermined pressure (approx. 28-30 psig) so that the temperature of the core remains relatively constant and the core does not freeze up. When the evaporator pressure rises above 29 psi, the suction throttling valve opens to permit the evaporator pressure (hence the evaporator temperature) to return to the predetermined level. Conversely, the suction throttling valve closes during periods when the evaporator pressure is low until sufficient pressure is built up. During times when the suction throttling valve is closed (light load operation), refrigerant is supplied to the compressor for lubrication purposes via the oil bleed line. The oil bleed line interconnects the bottom of the evaporator with the suction throttling valve at a point where it can bypass the valve piston when it is closed. A liquid bleed valve located in the suction throttling valve body, starts to open when there is a 5 psig pressure increase in the evaporator inlet pressure over the suction throttling valve outlet pressure. The bleed line valve will be fully open when there is greater than a 12 psig pressure differential between the STV and the evaporator. Refrigerant flows from the evaporator via the oil bleed line, around the closed piston of the suction throttling valve, and out the outlet of the suction throttling valve into the compressor.

A vacuum diaphragm unit is attached to the end of the valve and consists of a diaphragm element and a small spring. The function of the vacuum diaphragm is to permit a limited degree of regulation of the suction throttling valve. Essentially, the vacuum diaphragm unit adds an additional spring force to hold the piston closed. This additional pressure on the piston permits the evaporator to operate at higher pressures, hence higher temperatures (pressure and temperature increase or decrease linearly). When no vacuum is applied to the diaphragm, the diaphragm spring

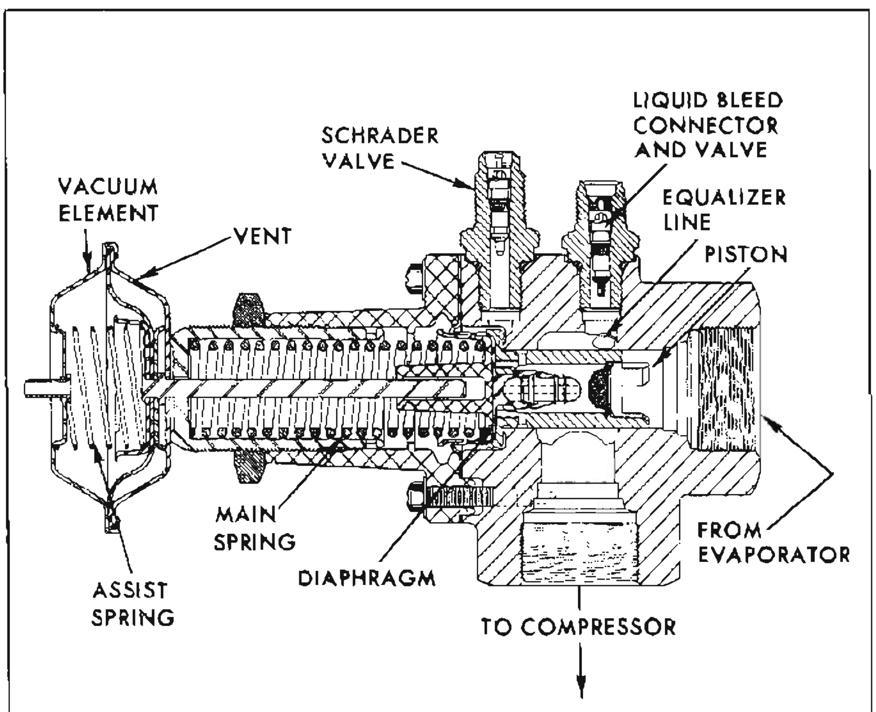



Figure 11-42—Suction Throttling Valve

is released and adds to the spring pressure (transmitted by the actuating pin) on the piston. This additional piston force causes the evaporator to operate at higher pressures—hence higher temperatures, or in other words, reduced cooling. When vacuum is applied to the diaphragm, the diaphragm spring is compressed, thereby reducing force to open piston. In this situation the suction throttling valve will open at lower pressures. The evaporator in turn will operate at lower pressures—hence colder temperatures (maximum cooling). Vacuum (maximum cooling) is applied whenever the temperature lever is in COLD position and FAN switch lever is on. No vacuum (reduced cooling) is applied when the temperature lever is moved just past COLD position. Application of vacuum is controlled by a vacuum disc switch located on the heater and defroster control assembly. The vacuum disc switch is actuated by a cam attached to the temperature control lever. The vacuum circuit is pictured in Figure 11-43.

### h. Fuel Filter Assembly

Air conditioning equipped cars have the fuel vapor by-pass system. This system consists of a special fuel filter and fuel return lines which allow a constant flow of fuel from gas tank to filter and back to tank (see Figure 11-44). The system reduces the possibility of vapor lock when operating in extreme hot weather.

### i. Fan Drive Clutch Assembly

During periods of operation when radiator discharge air temperature is low (below approximately 150° F), the fan clutch (see Figure 11-44) limits the fan speed to 800-1600 RPM. In this position, the clutch is disengaged since a small oil pump driven by the separator plate forces the silicone oil into the reservoir between the separator plate and the front cover assembly. In this position also, the passage from this cavity to the clutch area is closed by the coil spring leaf valve.

As operating conditions produce a high radiator discharge air temperature (above approximately 150° F.), the temperature sensitive bi-metal coil tightens to move the leaf valve (attached to the coil) which opens a port in the separator plate allowing flow of silicone oil into the clutch chamber to engage clutch providing a maximum fan speed of approximately 2350 RPM.

The clutch coil is calibrated so that at road load with an ambient temperature of approximately 90° F., the clutch is just at a point of shift between high and low fan speed.

No attempt should be made to disturb the calibration of the engine fan clutch assembly as each assembly is individually calibrated at the time of manufacture.

## 11-17 SERVICE PROCEDURES

Service procedures have been limited to removal of the unit, disassembly of unit (complicated disassembly procedures only), and reassembly and installation of units. It is presumed that all cleaning, inspection and checking of parts will be performed as required in accordance with good service procedures. Exceptions to the above mentioned standard practices will be noted at appropriate points within the disassembly procedures. The following service procedures are divided into three general areas: servicing refrigerant charged components, servicing air distribution components and trouble diagnosis.

## 11-18 SERVICING REFRIGERANT CHARGED COMPONENTS

### a. Safety Precautions

The following safety precautions should always be followed when servicing refrigerant charged components:

1. Do not leave refrigerant-12 cylinder uncapped.

2. Do not carry cylinder in passenger compartment of car.

3. Do not subject cylinder to high temperatures.

4. Do not weld or steam clean on or near cylinder.

5. Do not fill cylinder completely.

6. Do not discharge vapor into area where flame is exposed or directly into engine air intake.

7. Do not expose eyes to liquid - wear safety goggles whenever discharging, charging or leak testing system.

### b. General Service Precautions for Refrigerant Circuit Components

1. All subassemblies are shipped sealed and dehydrated. They are to remain sealed until just prior to making connections.

2. All subassemblies should be at room temperature before uncapping. This prevents condensation of moisture from air that enters the system.

3. All precautions should be taken to prevent damage to fittings or connections. Even minute damage to a connection could cause it to leak.

4. Any fittings with grease or dirt on them should be wiped clean with a cloth dipped in alcohol.

5. Do not clean fitting or hoses with chlorinated salts because they are contaminants. If dirt, grease or moisture gets inside

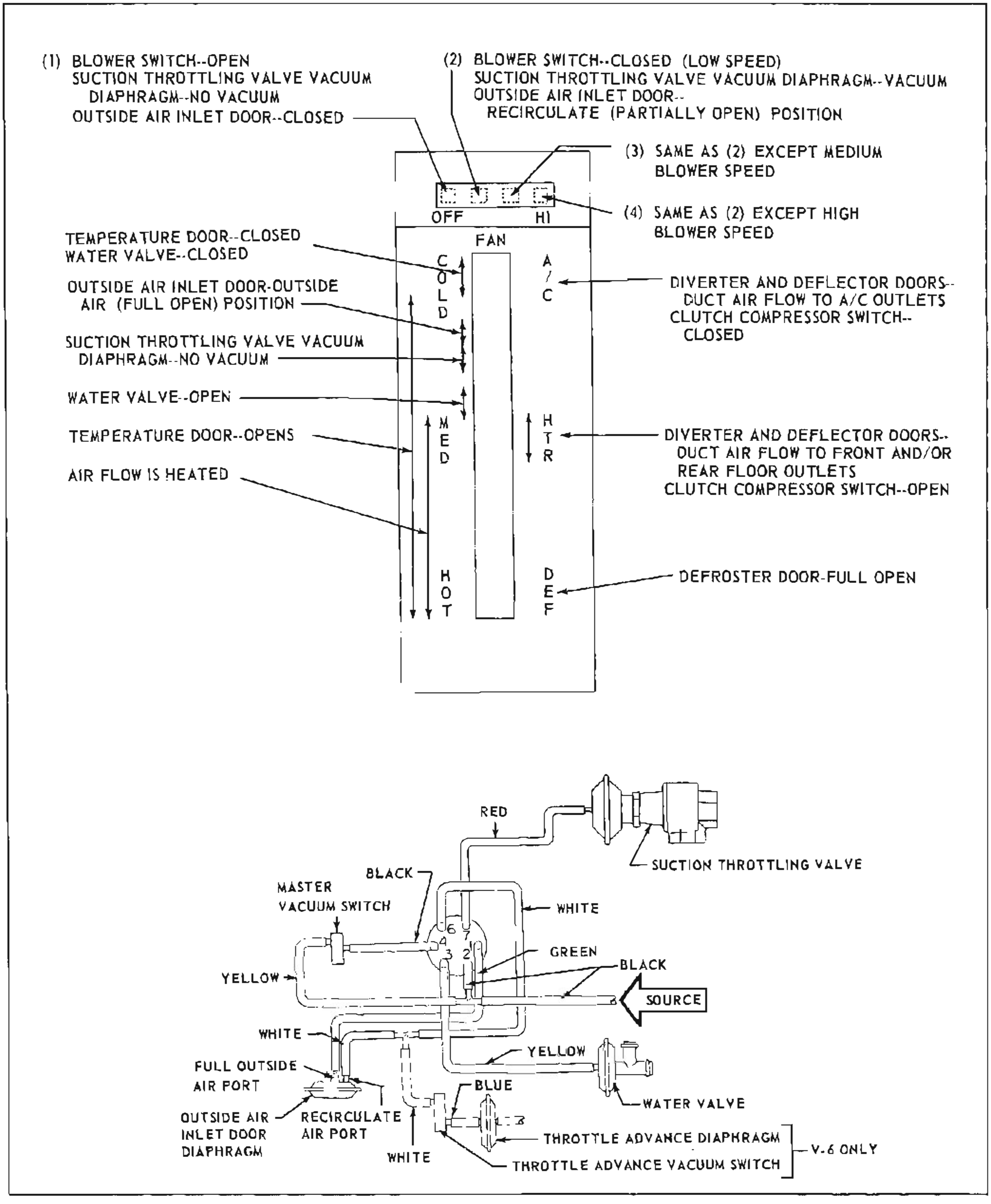



Figure 11-43—Heater System Vacuum Sequence

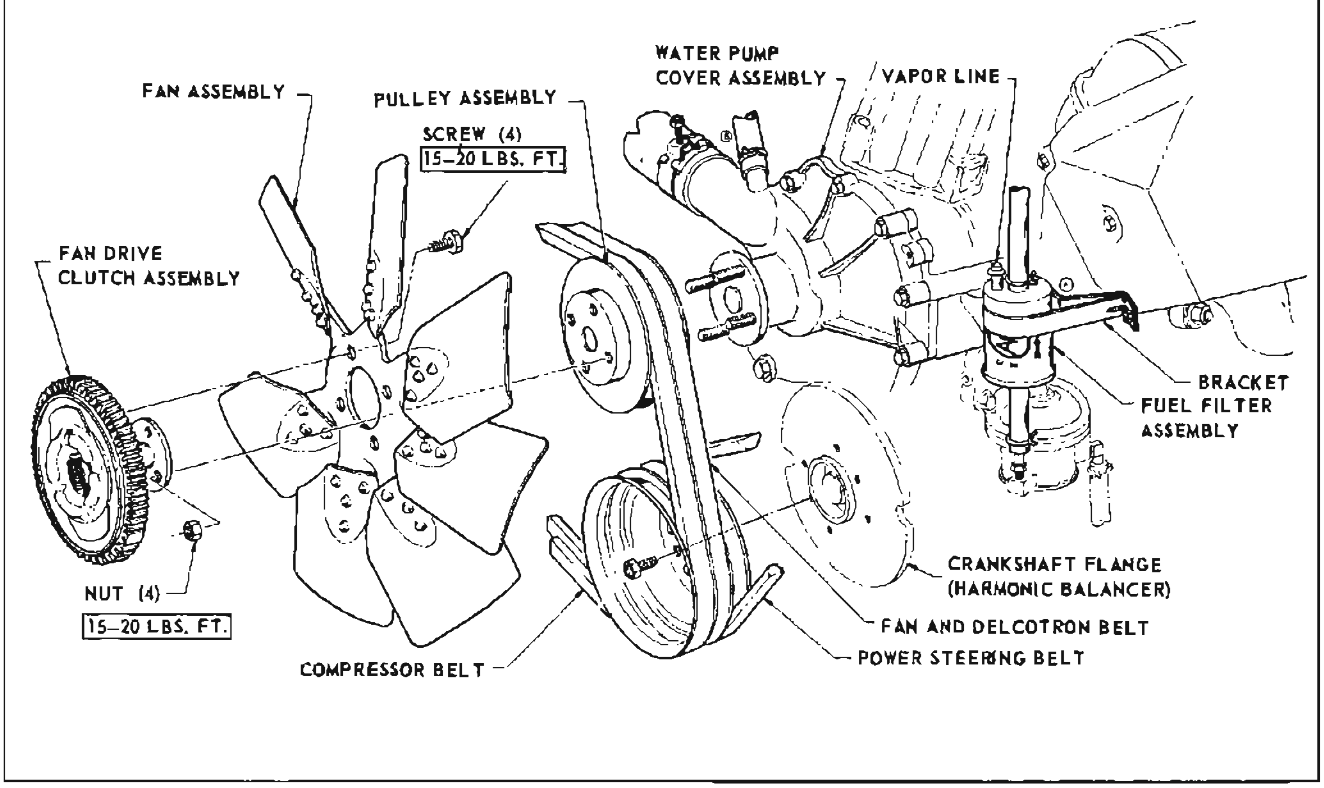



Figure 11-44—Fan Drive Clutch and Pulley Installation

the pipes and cannot be removed, the pipe is to be replaced.

6. Use a small amount of refrigeration oil on all tube and hose connecting joints, and lubricate the "O" ring gasket with this oil before assembling the joint. The oil will help in effecting a leak-proof joint and assist the "O" ring to slip into the proper location without being cut or damaged.

7. When tightening joints, use a second wrench to hold the stationary part of the connection to prevent twisting and to prevent hose kinking. Kinked hoses are apt to transmit noise and vibration.

8. Tighten all connections in accordance with recommended torques (ref. Figure 11-45).

9. Do not connect receiver-dehydrator assembly until all other connections have been made. This is necessary to insure maximum moisture removal from system.

| Metal Tube Outside Diameter | Thread and Fitting Size | Steel Tubing Torque Lb.-Ft. | Aluminum or Copper Tubing Torque Lb.-Ft. | Nominal Torque Wrench Span |
|---|---|---|---|---|
| 1/4 | 7/16 | 10-15 | 5-7 | 5/8 |
| 3/8 | 5/8 | 30-35 | 11-13 | 3/4 |
| 1/2 | 3/4 | 30-35 | 11-13 | 7/8 |
| 5/8 | 7/8 | 30-35 | 18-21 | 1 1/16 |
| 3/4 | 1 1/16 | 30-35 | 23-28 | 1 1/4 |

If a connection is made with steel to aluminum or copper, use torques for aluminum. In other words, use the lower torque specification.

Use steel torques only when both ends of connection are steel.

Figure 11-45—Pipe and Hose Connection Torque Chart

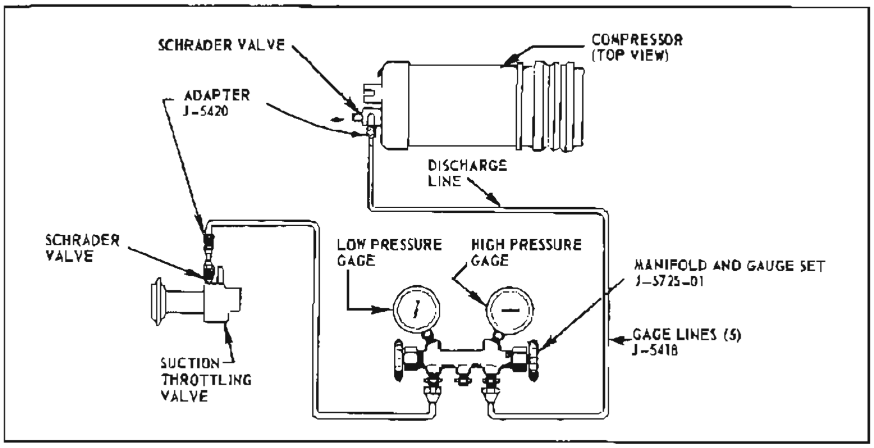



Figure 11-46—Functional Test Set-Up

10. It is important that air conditioning hoses do not rest on or contact body sheet metal except where necessary. Because of the high frequency at which the compressor operates, the passenger compartment is susceptible to transfer of noise.

**c. Functional Testing System**

Function testing is a measurement of the air conditioner system performance to determine if discharge air temperature, pressure in suction line, and pressure in discharge line are within specific limitations.

To perform functional test proceed as follows:

1. Remove protective caps from Schrader valve located on suction throttle valve and Schrader valve located on compressor discharge port.
2. Interconnect Manifold and Gauge Set (J-5725-01), Gauge Charging Lines (J-5418) and Gauge Adaptors (J-5420) to air conditioning system as shown in Figure 11-46.
3. Open doors and hood of car to be tested.
4. Set temperature lever to COLD position and FAN lever to HI. Air

4000, 4100 AND 4300 SERIES FUNCTIONAL TEST

TEST #1

| Ambient Temperature (°F) | Evaporator Pressure (PSIG) | Compressor Pressure (PSIG) | Right A/C Outlet (TEMP) | Left A/C Outlet (TEMP) |
|---|---|---|---|---|
| 70 | 28.5 - 30 | 150 - 225 | 39 - 42 | 39 - 42 |
| 80 | 28.5 - 30 | 200 - 245 | 40 - 43 | 40 - 43 |
| 90 | 28.5 - 30 | 240 - 290 | 42 - 45 | 43 - 45 |
| 100 | 28.5 - 30 | 270 - 330 | 44 - 47 | 45 - 48 |
| 110 | 28.5 - 30 | 310 - 345 | 47 - 52 | 47 - 52 |

TEST #2

| Ambient Temperature (°F) | Humidity | Engine RPM | Evaporator Pressure (PSIG) | Compressor Pressure (PSIG) | Right A/C Outlet (°F) | Left A/C Outlet (°F) |
|---|---|---|---|---|---|---|
| 90 | High | 480 | 35 | 210 | 59 | 57 |
| 90 | Low | 400 | 35 | 190 | 54 | 52 |
| 100 | High | 570 | 35 | 235 | 60 | 58 |
| 100 | Low | 550 | 35 | 230 | 55 | 54 |
| 110 | High | 940 | 35 | 320 | 59 | 59 |
| 110 | Low | 615 | 35 | 270 | 58 | 58 |

Figure 11-47—Air Conditioner Functional Test Table

control lever in A/C position.

5. Idle engine at 2000 RPM.

6. Place a fan in front of radiator grille to insure minimum differential between temperature of air passing through radiator grille and condenser, and temperature of air flow through cowl air inlet and past evaporator core.

7. Measure relative humidity and ambient temperature in immediate vicinity of car to be tested.

NOTE: The temperature obtained at the air outlets will be lower on dry days and higher on humid days.

8. Open all air conditioner outlets and measure temperature at right and left outlets.

9. Compare the actual pressures and temperatures with the pressures and temperatures indicated in Test #1 of Functional Test Table (see Figure 11-47). If the relationship, specified in Test #1 of Figure 11-47, between pressures and temperatures is not obtained, adjust the suction throttling valve as required (ref. subpar. r).

10. Road test the car and recheck outlet temperatures. If outlet temperatures are not satisfactory, readjust the suction throttling valve to achieve the pressures and temperatures specified in Test #2 of Functional Test Table. The engine speed should be adjusted to the ambient temperature and humidity.

### d. Leak Testing System

The following two methods are recommended when attempting to locate refrigerant leaks in the system. Loss of refrigerant is always indicative of a leak since refrigerant is not consumed and does not wear out.

1. Open Flame Method - This method utilizes a gas operated torch type Leak Detector (J-6084). Use of this method is recommended when checking for leaks in confined areas. To perform test, light torch and adjust to obtain a pale blue flame, approximately 3/8 inch in height, in burner.

Explore for leaks by moving end of search tube around suspected area. Check bottom of connections since refrigerant-12 is heavier than air and will be more apparent at underside of fittings. The flame color will turn yellow-green when a small leak is detected. Large leaks will turn the flame blue or purple.

CAUTION: Do not breath fumes resulting from burning of refrigerant gas. These fumes are extremely poisonous.

2. Liquid Leak Detectors - This method utilizes a solution which will bubble (soap solution) to signify a gas leak. Use of this method of checking is recommended for locating small leaks.

### e. Discharging System

Removal of any part in the refrigerant circuit will require discharging of the entire system.

1. Remove protective cap from the Schrader valve located on the suction throttling valve and Schrader valve located on discharge port of compressor.

2. Install Adapters (J-5420) onto each Schrader valve, and connect a Gauge Charging Line (J-5418) between each adapter and the outer connecting ports of the manifold and Gauge Set (J-5725-01. Both valves of manifold and gauge set must be closed.

3. Hold a large size rag over center port of manifold and gauge set and slowly open both valves on manifold and gauge set until refrigerant starts to flow without discharging refrigerant oil.

NOTE: Do not open valves too fast as oil will be blown out of system.

### f. Replacement of Oil Loss in System

The oil in the refrigerant circuit does not remain in the compressor during system operation, but circulates throughout the system. The compressor is initially charged with 10-1/2 oz. of 525 viscosity oil. After system has been in operation the oil content in the compressor will vary depending on the engine RPM and air conditioning load. At higher engine RPM's a lesser amount of oil will be retained in the compressor reservoir. It is important that the total system oil content does not vary from a total of 10-1/2 oz. Excessive oil content will reduce cooling capacity. Inadequate oil content may result in damage to compressor moving parts.

The refrigerant system will not require adding of oil unless there is an oil loss because of a ruptured line, badly leaking compressor seal, replacement of a component, or oil loss due to a collision. Oil is generally added to the system via the oil drain hole in the lower side of the compressor. To add oil to the system via the compressor, the compressor must be removed. If no major loss of oil has occurred and a component (condenser, receiver-dehydrator or evaporator) is removed for servicing, the oil may be added directly to the component. To add oil to a component removed for servicing and when no major loss has occurred, drain and measure oil in component, replace with a like amount. To add oil to the system when a major loss of oil is evidenced, or when compressor is being serviced, remove compressor, drain and measure oil, and replace oil amount specified in Figure 11-48. If foreign material or moisture is noted in oil drained from system, it is recommended that the entire system be flushed (ref. subpar. g) and the receiver-dehydrator be replaced. A full

| CONDITION | AMOUNT OF OIL DRAINED FROM COMPRESSOR | AMOUNT OF 525 OIL TO INSTALL IN COMPRESSOR |
|---|---|---|
| 1. Major loss of oil and a component (condenser, receiver-dehydrator, or evaporator) has to be replaced. | a. More than 4 oz. | a. Amount drained from compressor plus amount for component being replaced:<br><br>Evaporator — Add 2 oz.<br>Condenser — Add 1 oz.<br>Receiver Dehydrator - Add 1 oz. |
| | b. Less than 4 oz. | b. Install 6 oz. plus amount for component being replaced as shown above. |
| 2. Compressor being replaced with a service replacement compressor —no major oil loss. | a. More than 1-1/2 oz. | a. Same amount as drained from compressor being replaced. |
| | b. Less than 1-1/2 oz. | b. Install 6 oz. |
| 3. Compressor being replaced with a service replacement compressor —major oil loss evident. | a. More than 4 oz. | a. Same amount as drained from compressor being replaced. |
| | b. Less than 4 oz. | b. Install 6 oz. |
| 4. Compressor being rebuilt or repaired—no major oil loss evident. | a. More than 1-1/2 oz. | a. Same amount as drained from compressor plus 1 oz. additional. |
| | b. Less than 1-1/2 oz. | b. Install 7 oz. |
| 5. Compressor being rebuilt or repaired— major loss of oil evident. | a. More than 4 oz. | a. Same amount as drained from compressor plus 1 oz. additional. |
| | b. Less than 4 oz. | b. Install 7 oz. |

Figure 11-48—Oil Replacement Table

oil charge of 10-1/2 oz. of 525 viscosity refrigerant oil should be replaced in the system. It should be noted that all service replacement compressors will be supplied with 10-1/2 oz. of oil. In most cases it will be necessary to drain oil from service replacement compressor and refill it with amount as specified in table (ref. Figure 11-48).

**g. Flushing System**

Flushing of the system may involve all the components of the system or individual components in the system. The components may be flushed while mounted in the engine compartment or may be removed for flushing. When a component is not removed, disconnect all refrigerant lines attached to component. To perform flushing operation, connect a cylinder of refrigerant-12 to the component to be flushed, then invert the cylinder and open the cylinder valve so that the liquid refrigerant pours out and through the component.

CAUTION: When liquid refrigerant-12 reaches atmospheric pressure it immediately drops to -21.7°F. Insure that area immediately surrounding outlet of component is clear of anything that may be damaged by contact because of the sudden drop in temperature.

In all cases where a complete system flushing operation is performed, the receiver-dehydrator and the filter screen on the expansion valve should be replaced. If the evaporator assembly is flushed while installed in the car, the temperature bulb on the evaporator outlet pipe must be disconnected to keep the expansion valve from closing at the inlet source.

NOTE: It is recommended that dry nitrogen be used as a flushing agent due to the low cost involved. In addition, dry nitrogen will not cause a temperature drop, as in the case of refrigerant-12, which results in thickening of refrigerant oil. Dry nitrogen has the additional advantage of removing moisture from the system.

### h. Removal and Installation of Compressor

REMOVAL

1. Discharge refrigerant from system (ref. subpar. "e").

2. Disconnect leads from compressor magnetic clutch assembly.

3. Remove bolt and plate holding suction and discharge lines into rear head (see Figure 11-28). Disengage both lines from compressor and tape securely closed openings in both lines and ports in rear head. NOTE: It is important to seal compressor ports to avoid an undeterminable loss of refrigerant oil and also to prevent foreign material and moisture from entering compressor.

4. Remove bolt holding suction line clamp in position (see Figure 11-49).

5. Remove bolts in slots of front and rear compressor braces and tilt compressor inward. Move belt off compressor pulley.

6. Remove two bolts holding front and rear adapter plates to compressor mounting bracket and lift out compressor.

NOTE: During removal maintain the compressor positioned so that the sump is downward. Do not rotate compressor shaft.

INSTALLATION

7. Installation is reverse of removal. Torque bolts as specified in Figure 11-49.

NOTE: Insure that compressor has sufficient oil charge (ref. subpar. f).

8. Use new "O" rings when attaching suction and discharge lines.

9. Adjust compressor belt tension to 110 pounds using Belt Tension Gauge (J-7316).

10. Charge compressor (ref. subpar. "s").

### i. Disassembly and Reassembly of Clutch Drive Plate and Shaft Seal

NOTE: The following procedure can be performed with the compressor mounted in the engine compartment, or the compressor may be removed for greater accessibility. The following procedure is performed under the presumption that the compressor has been removed.

DISASSEMBLY

1. Firmly clamp Holding Fixture (J-9396) in a vise and attach compressor assembly to fixture (see Figure 11-50).

2. Hold hub of clutch drive plate with Wrench (J-9403). Using special thin wall 9/16 inch Socket (J-9399) and 3/8 inch drive, take off shaft nut (see Figure 11-36).

3. Install threaded Hub Puller (J-9401) onto hub of clutch drive plate (see Figure 11-51). Hold body of hub puller with wrench, tighten center screw of hub puller, and lift off clutch drive plate and woodruff key.

4. Using No. 21 Truarc Pliers (J-5403) take out retainer ring from hub of clutch drive plate (see Figure 11-52). Lift out spacer.

5. Using No. 21 Truarc Pliers (J-5403) take out seal seat retainer ring (see Figure 11-53) from inside front head.

6. Disassemble shaft seal seat (see Figure 11-54) by use of Seal Seat Remover and Installer (J-9393). Grasp flange of shaft seal seat with tool and pull straight out.

7. Using Seal Remover and Installer (J-9392) insert tool into hub of front head, press downward and twist clockwise to engage tabs of shaft seal, and gently but firmly, pull tool straight out (see Figure 11-55).

8. Take out seal seat "O" ring (see Figure 11-56) from inside hub of front head using "O" ring Remover (J-9553).

REASSEMBLY

9. Liberally coat seal seat "O" ring with 525 viscosity oil and insert "O" ring into hub of front head (see Figure 11-57) with seal seat "O" ring Installer (J-21508).

10. Generously coat shaft seal with 525 viscosity oil, mount shaft

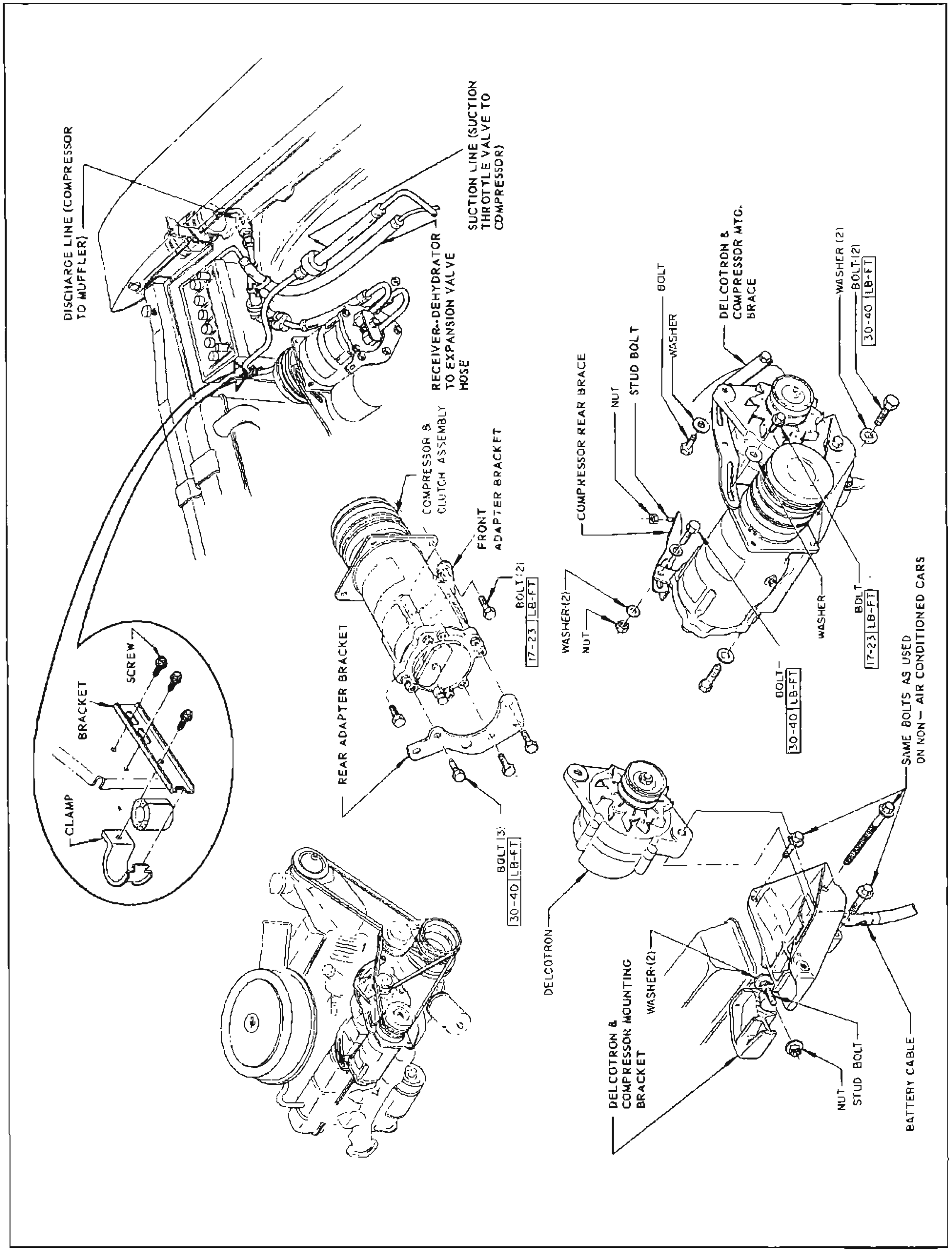



Figure 11-49—Compressor Removal and Installation

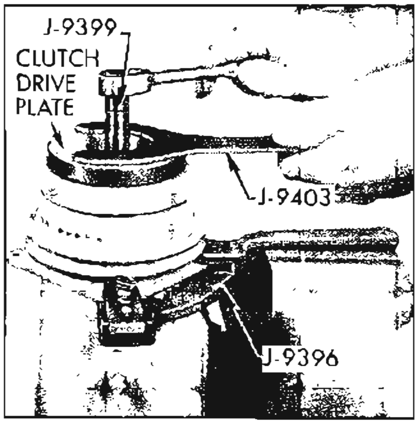



Figure 11-50—Removing or Installing Shaft Nut

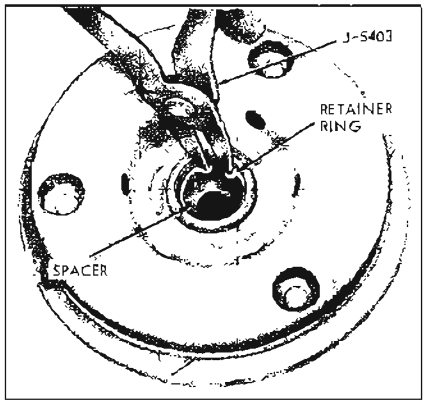



Figure 11-52—Removing or Installing Retainer Ring in Clutch Drive Plate

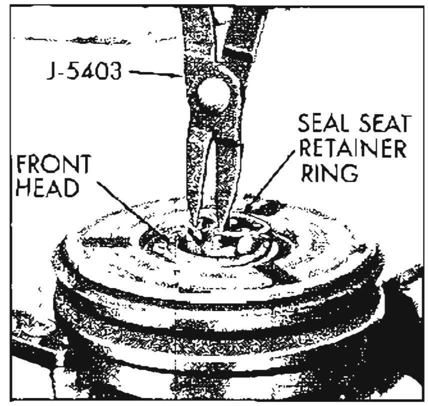



Figure 11-53—Removing or Installing Shaft Seal Seat Retaining Ring

seal on Seal Remover and Installer (J-9392) and insert in hub of front head (see Figure 11-55).

Press downward and turn counterclockwise on installer to release shaft seal.

11. Lubricate shaft seal seat with 525 viscosity oil, mount seat on Seal Seat Remover and Installer (J-9393) and reassemble into hub of front head (see Figure 11-54).

12. Using No. 21 Truarc Pliers (J-5403) reassemble seal seat retainer ring (flat side of retainer ring downward) into hub of front head and engage retainer ring in ring groove (see Figure 11-53). If necessary, retainer ring may be pushed into groove using sleeve portion of Seal Seat Remover and Installer (J-9393).

13. Attach Compressor Leak Test Fixture (J-9527) on rear head of compressor and connect gauge charging lines as shown in Figure 11-58. Pressurize suction side of compressor with refrigerant 12 (cylinder at room temperature). Temporarily install shaft nut and rotate compressor shaft several times. Leak test seal and correct any leaks as necessary. Remove and discard shaft nut.

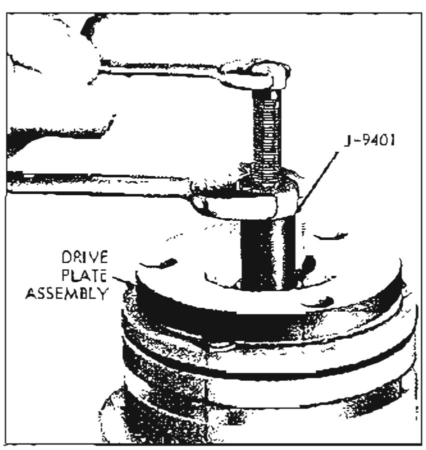



Figure 11-51—Removing Clutch Drive Plate

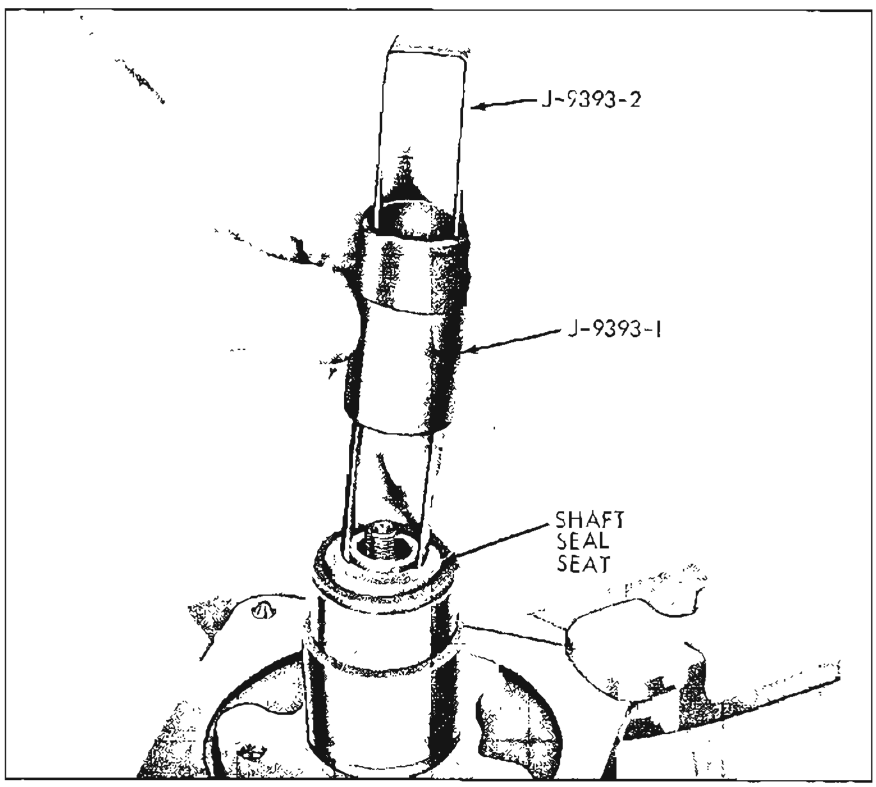



Figure 11-54—Removing or Installing Shaft Seal Seat

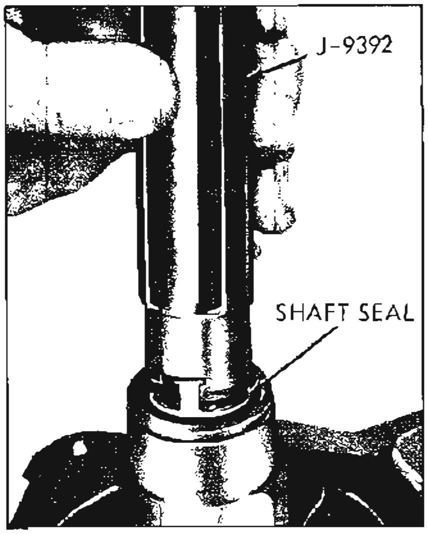



Figure 11-55—Removing or Installing Shaft Seal

14. Insert woodruff key into hub of clutch drive plate so that it projects out approximately 3/16 inch (see Figure 11-59) and position clutch drive plate onto shaft.

15. Using Drive Plate Installer (J-9480), screw installer on end of shaft as shown in Figure 11-60. Hold nut and turn bolt until clutch drive plate is pressed within 3/32 inch of the pulley assembly.

16. Reassemble spacer into hub of clutch drive plate (see Figure 11-52).

17. Reassemble retainer ring into hub of clutch drive plate (see Figure 11-52) using No. 21 Truarc Pliers (J-5403).

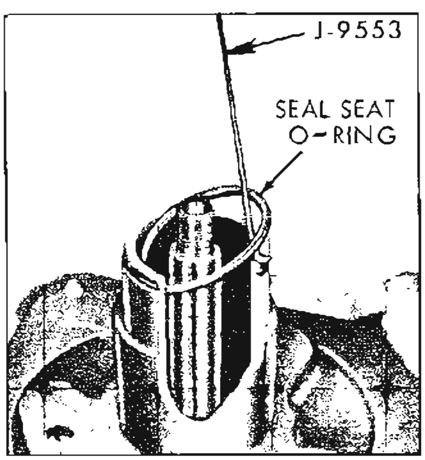



Figure 11-56—Removing Seal Seat O-Ring

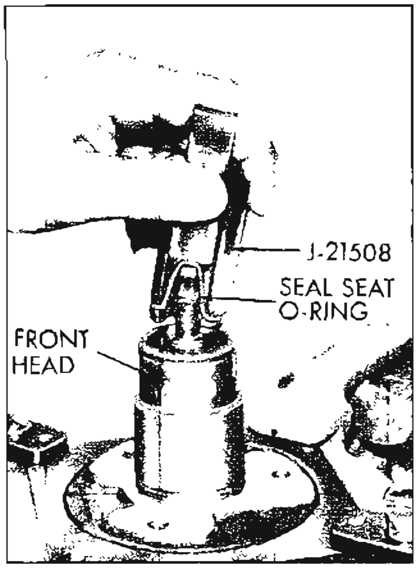



Figure 11-57—Installing Seal Seat O-Ring

18. Thread on new shaft nut using special thin wall 9/16 Socket (J-9399) and 3/8 inch drive. Hold clutch drive plate secure using Wrench (J-9403) and torque nut to 15 lb. ft. The air gap between the friction surfaces of the pulley assembly and clutch drive plate should be approximately 1/32 to 1/16 inch (see Figure 11-61).

### j. Disassembly and Reassembly of Pulley Assembly, and Coil and Housing Assembly

DISASSEMBLY

1. Disassemble clutch drive plate (ref. subpar. "i").

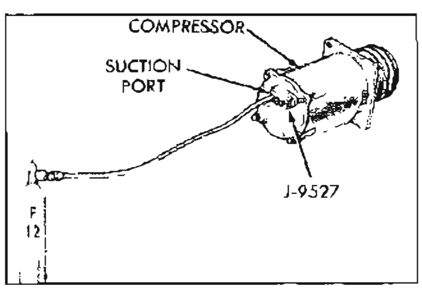



Figure 11-58—Leak Testing Shaft Seal and Seal Seat O-Ring

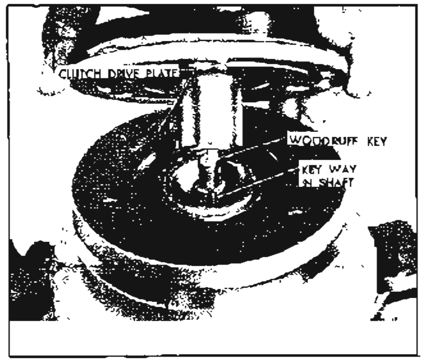



Figure 11-59—Positioning Clutch Drive Plate on Shaft

2. Using No. 26 Truarc Pliers (J-6435) take out bearing to head retainer ring (see Figure 11-62).

3. Place Puller Pilot (J-9395) on hub of front head and take off pulley assembly (see Figure 11-63) using Pulley Puller (J-8433).

CAUTION: Puller pilot must be used. If force is exerted on shaft, damage will result to the internal parts of the compressor.

4. Withdraw bearing to pulley retaining ring with a small screwdriver (see Figure 11-64).

5. Drive out bearing (see Figure 11-65) by use of Puller Pilot (J-9398) and Handle (J-8092).

NOTE: Do not take out pulley bearing unless it is going to be replaced as removal may damage bearing.

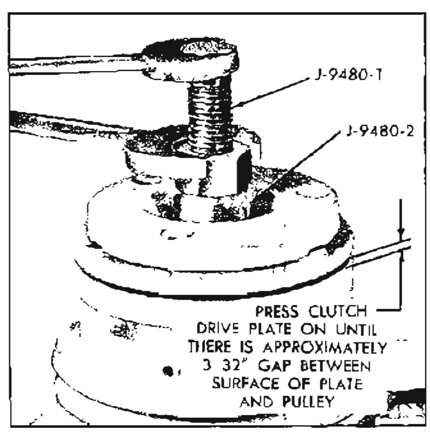



Figure 11-60—Installing Clutch Drive Plate

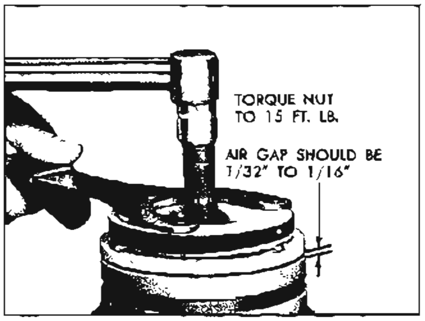



Figure 11-61—Torquing Shaft Nut

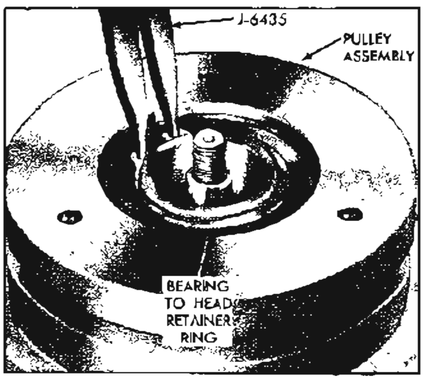



Figure 11-62—Removing or Installing Bearing to Head Retainer Ring

6. Mark position of coil and housing assembly in relationship to shell of compressor, withdraw coil and housing retainer ring (see Figure 11-66) using No. 26 Truarc Pliers (J-6435), and lift out coil and housing assembly.

REASSEMBLY

7. Reassemble coil and housing

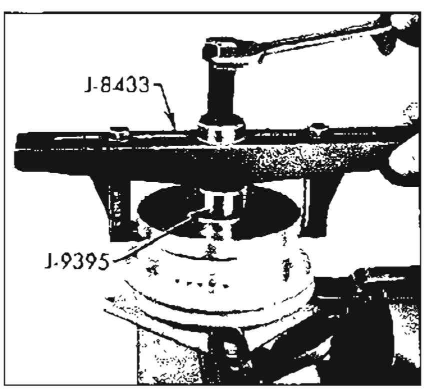



Figure 11-63—Removing Pulley Assembly

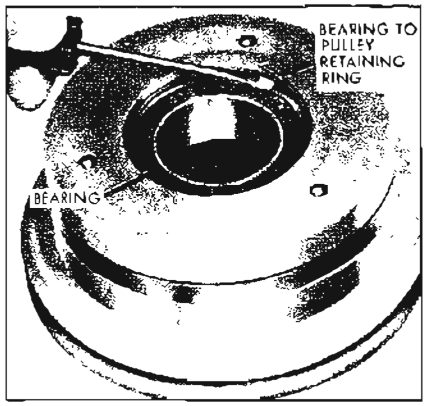



Figure 11-64—Removing Bearing Retainer Wire

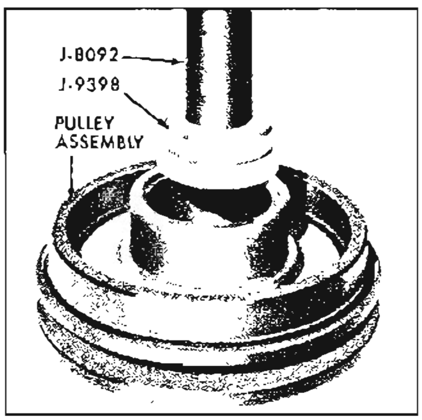



Figure 11-65—Removing Bearing from Pulley Assembly

assembly reverse of disassembly.

8. Drive new bearing into pulley assembly (see Figure 11-67) with

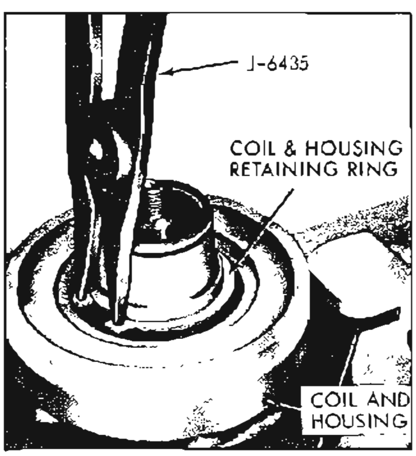



Figure 11-66—Removing and Installing Coil and Housing Retainer Ring

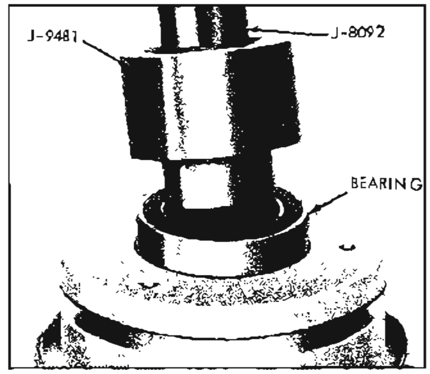



Figure 11-67—Installing Bearing into Pulley Assembly

Installer (J-9481) and Handle (J-8092).

9. Lock bearing in position with bearing to pulley retainer ring (see Figure 11-64) using No. 26 Truarc Pliers (J-6435).

10. Drive pulley assembly onto hub of front head (see Figure 11-68) using Installer (J-9481) and Handle (J-8092).

NOTE: If the pulley assembly is going to be reused, clean the friction surface with trichlorethylene, alcohol or a similar solvent.

11. Lock pulley assembly in position with bearing to head retainer ring (flat side of retainer ring downward) using No. 26 Truarc Pliers (J-6435). See Figure 11-62.

12. Reassemble clutch drive plate (ref. subpar. "i").

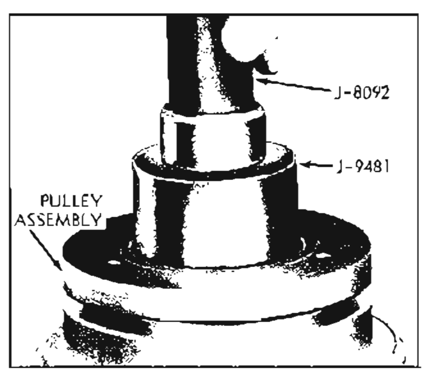



Figure 11-68—Installing Pulley Assembly

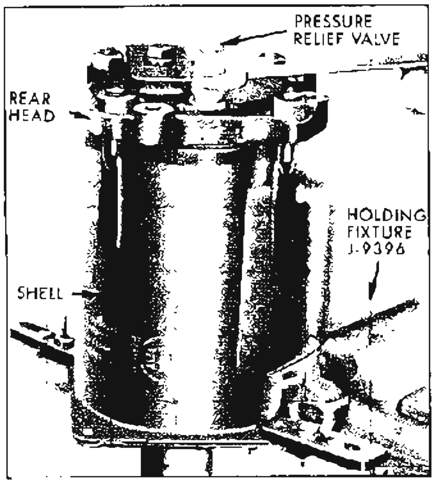



Figure 11-69—Compressor Installed in Holding Fixture

**k. Disassembly and Reassembly of Internal Parts of Compressor and Leak Testing Compressor**

CAUTION: A clean work area and a place for each part removed is required to properly disassemble and reassemble compressor. The internal ports of the compressor must be kept free of dirt or foreign material.

When working with compressor, under no circumstances should compressor be rested on pulley end.

DISASSEMBLY OF REAR HEAD, OIL PUMP, REAR DISCHARGE VALVE PLATE, AND REAR SUCTION VALVE REED DISC

NOTE: If compressor is not going to be disassembled any further than removal of rear head, oil pump, rear discharge valve plate, or rear suction valve reed disc, omit Steps "1, 2 and 4".

1. Disassemble clutch drive plate and shaft seal (ref. subpar. "i").

2. Disassemble pulley assembly, and coil and housing assembly (ref. subpar. "j").

3. Clean surface of compressor shell and dry with compressed air.

4. Remove compressor from Holding Fixture (J-9396), unscrew drain screw, and remove oil plugs in ports of rear head. Drain, measure and record amount of oil in compressor.

5. Reinstall compressor in Holding Fixture (J-9396) positioned as shown in Figure 11-69.

6. Unscrew and discard four lock nuts from rear of compressor, and lift off rear head by tapping head with a mallet.

NOTE: If teflon surfaces are damaged (see Figure 11-70), replace rear head. Clean or replace suction screen as necessary.

7. Pencil mark top side of both oil pump rotors and lift out rotors.

NOTE: Replace both oil pump inner and outer rotors if one or both are damaged or worn.

8. Take out and discard shell to head "O" ring.

9. Carefully pry out rear discharge valve plate and rear suction valve reed disc with screwdrivers (see Figures 11-71 and 11-72). Check both pieces and replace as necessary.

NOTE: During disassembly, the disc generally adheres to the plate and both pieces lift out together.

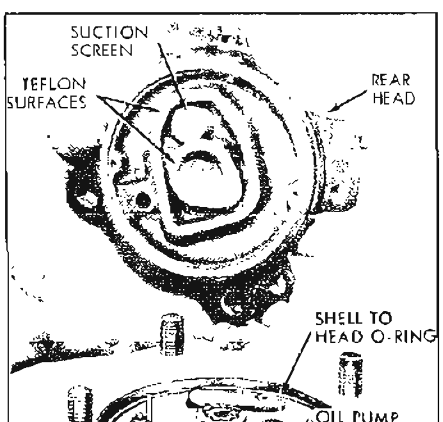



Figure 11-70—Rear Head Removal

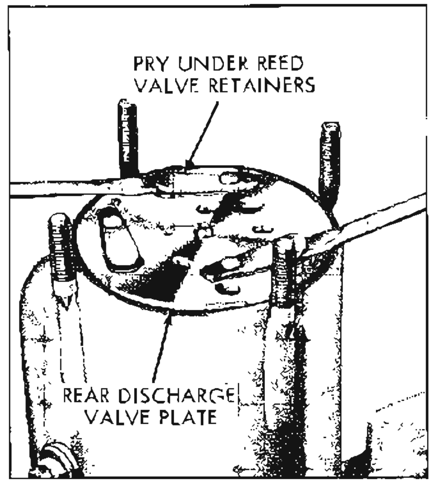



Figure 11-71—Removing Rear Discharge Valve Plate

REMOVING CYLINDER ASSEMBLY, AND DISASSEMBLY OF FRONT SUCTION VALVE REED DISC, FRONT DISCHARGE VALVE PLATE, AND FRONT HEAD

10. Pull out oil inlet tube (see Figure 11-73) and oil inlet tube "O" ring using Remover (J-6586).

11. Push shaft upward from front head and lift out cylinder assembly (see Figure 11-74), front suction valve reed disc, and front discharge valve plate.

NOTE: When lifting out the cylinder assembly, the front suction valve reed disc and the front discharge valve plate generally adhere to the cylinder assembly and lift out with it. Check and replace if necessary.

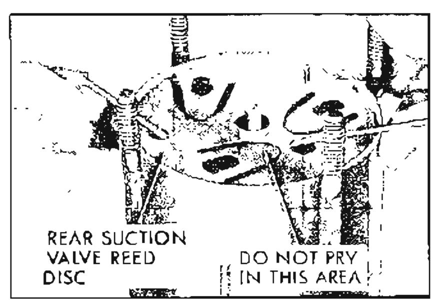



Figure 11-72—Removing Rear Suction Valve Reed Disc

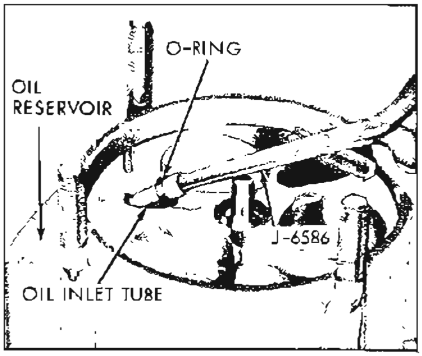



Figure 11-73—Removing Oil Inlet Tube

Depending on wear or damage to cylinder assembly, it may be advisable to replace complete cylinder assembly. If service replacement cylinder is used omit following steps and continue on with subparagraph entitled "FINAL REASSEMBLY OF CYLINDER ASSEMBLY".

12. Disassemble front head from shell by tapping front head with a mallet to unseat head, and lifting straight out through rear of shell the front head and shell to head "O" ring (see Figure 11-75). Discard "O" ring.

NOTE: If teflon surfaces of front head (see Figure 11-76) are damaged, replace front head.

DISASSEMBLY OF CYLINDER ASSEMBLY

13. Pry off suction pass cover and suction pass cover seal using

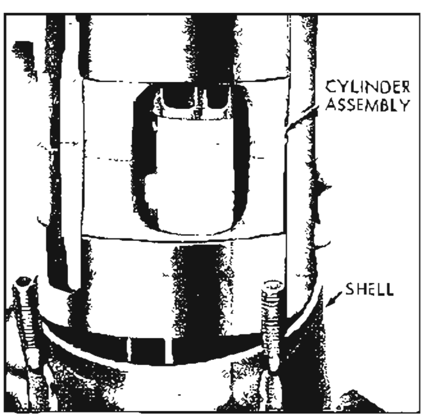



Figure 11-74—Removing Cylinder Assembly

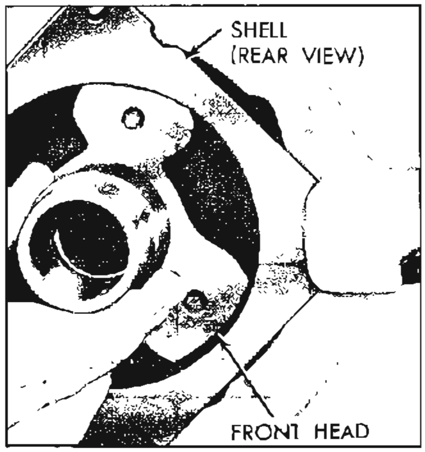



Figure 11-75—Removing Front Head

screwdriver (see Figure 11-77) and discard seal.

14. Place cylinder assembly (front end downward) on top of Compressing Fixture (J-9397), number pistons and cylinders "1, 2 and 3" to facilitate reassembly (see Figure 11-78), and separate cylinder halves using a rubber mallet and wood block.

15. Disassemble rear cylinder half and discharge tube from cylinder assembly and discard discharge tube.

NOTE: Depending on whether or not discharge tube comes out with rear cylinder half or remains in front cylinder half--it may be necessary to rotate shaft and

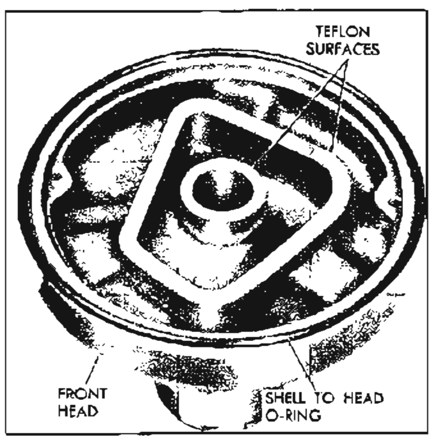



Figure 11-76—Front Head Teflon Sealing Surfaces

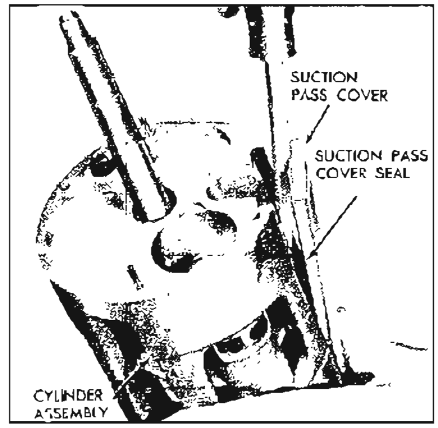



Figure 11-77—Removing Suction Pass Cover and Seal

swash plate assembly (using 9/16 inch open end wrench on shaft seal portion of shaft) to achieve necessary clearance.

16. Carefully disassemble from cylinder assembly (see Figure 11-79) and lay in respective place of Parts Tray (J-9402) the following: number "1, 2 and 3" pistons, piston drive balls, and piston rings. To disassemble, rotate swash plate until piston is at highest point, raise swash plate approximately 1/2 inch and lift out piston and related parts one at a time. Discard shoe discs and rear needle thrust bearings and races.

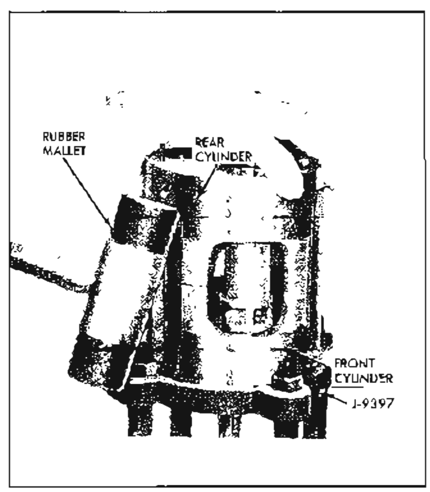



Figure 11-78—Separating Cylinder Halves

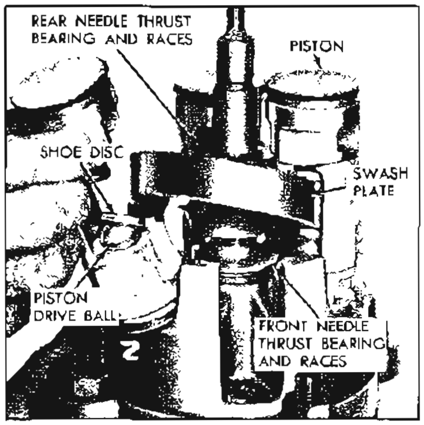



Figure 11-79—Disassembly of Cylinder Assembly

NOTE: Examine piston drive balls and replace if necessary. The front end of the piston may be identified by a recessed notch (see Figure 11-80).

17. Lift out shaft and swash plate assembly and front needle thrust bearing races. Discard front needle thrust bearing and races.

NOTE: Examine shaft and swash plate assembly and replace as necessary.

18. Wash all salvaged parts of cylinder assembly in bath of trichlorethylene, alcohol, or similar solvent and dry parts with filtered, dry compressed air.

NOTE: Examine front and rear cylinder halves, front and rear main shaft bearings, and replace as necessary. If bearings are to be replaced, drive out of cylinder halves with suitable socket or punch. Install new bearing (lettering on bearing edge facing outward) using Bearing Installer (J-9432). See Figure 11-81.

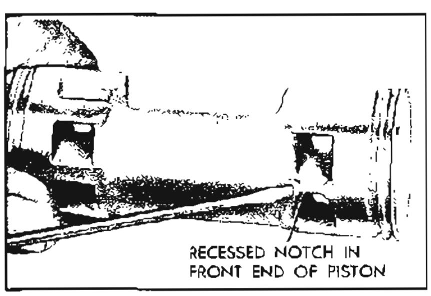



Figure 11-80—Piston Identification

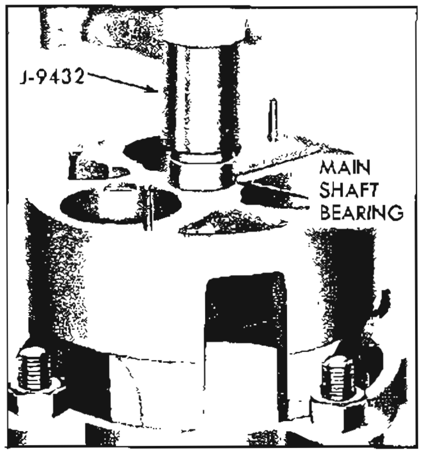



Figure 11-81—Installing Main Shaft Bearing

## PARTIAL REASSEMBLY OF CYLINDER ASSEMBLY, AND GAUGING OF PISTON PLAY AND SHAFT END PLAY

19. Procure from parts stock four "zero" thrust races, two needle thrust bearings, and three "zero" shoe discs.

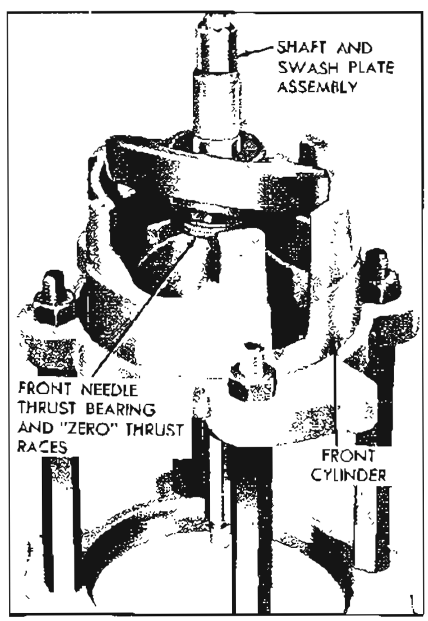



Figure 11-82—Shaft and Front Needle Thrust Bearing in Cylinder Half

20. Place front cylinder on top of Compressing Fixture (J-9397) as shown in Figure 11-82.

21. Generously coat with clean petroleum jelly two "zero" thrust races, and a new needle thrust bearing. Assemble races and bearing to front end of shaft and swash plate assembly and insert assembly into front cylinder (see Figure 11-82).

22. Assemble two additional "zero" thrust races and a new needle thrust bearing to rear end of shaft and swash plate assembly.

23. Lightly coat ball pockets of the three pistons and place a piston drive ball in each pocket.

24. Lightly coat the three "zero" shoe discs with clean petroleum jelly and place a disc on only the piston drive ball at the front of each piston.

NOTE: Do not place shoe discs on rear piston drive balls. Do not reassemble piston rings on pistons at this time. Use lubricant in sufficient quantity so that piston drive balls and shoe discs stick to piston.

25. Rotate shaft and swash plate assembly until high point of swash plate is over No. "1" cylinder bore. Position No. "1" piston onto swash plate (see Figure


Figure 11-83—Installing Piston into Cylinder Half

11-83) and lower the piston and swash plate so the front end (notched end—see Figure 11-80) of the piston enters the cylinder bore.

NOTE: In order to fit the piston onto the swash plate, the shaft and swash plate assembly must be raised approximately 1/2 inch, and also the front needle thrust bearing and races must be held up against the hub of the swash plate.

26. Repeat preceding step for reassembly of pistons No. "2" and No. "3".

27. Reassemble rear cylinder onto front cylinder using wood block and mallet (see Figure 11-84).

28. Remove cylinder assembly from on top of Compressing Fixture (J-9397), position assembly inside fixture so that discharge tube opening in cylinder halves is located between fixture legs, and front of cylinder assembly is downward. Install and torque fixture nuts to 15 lb. ft.

29. Gauge piston play as follows:

(a) Using a feeler gauge, select a leaf or combination of leaves which result in satisfactory "feel" when inserted between rear piston drive ball and swash plate (see Figures 11-85 and 11-86).

(b) Remove selected leaf or leaves from feeler gauge and attach end of spring scale that is calibrated in ounces. (A Generator Brush Spring Scale (J-5184) or the spring scale or checking distributor point setting may be used for this step.)

(c) Reinsert feeler gauge leaf or leaves between rear piston drive ball and swash plate and draw leaf or leaves out again, simultaneously measuring "drag" on leaf or leaves (see Figure 11-87). If correct leaf (leaves) has been selected, spring scale will read

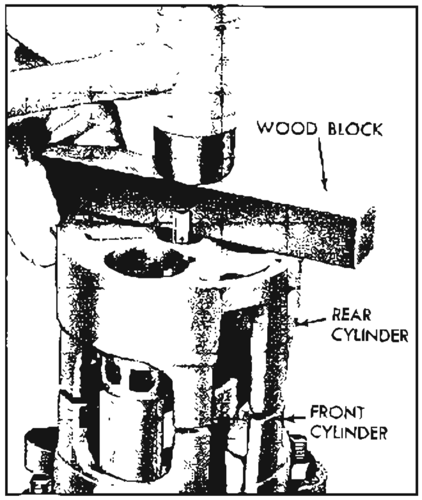



Figure 11-84—Assembling Rear Cylinder Half

between 4 to 8 ounces pull (the higher reading is desired). To perform this step correctly, feeler gauge leaf (leaves) must be withdrawn straight out with a steady even motion, and all surfaces involved must be coated with No. 525 viscosity oil. Record gauge dimension.

NOTE: Use of the spring scale establishes a standard of measurement of the amount of feeler gauge leaf "drag" required.

(d) Rotate the shaft and swash plate assembly 120 degrees and perform a second check (Steps "a, b and c") between same pis-

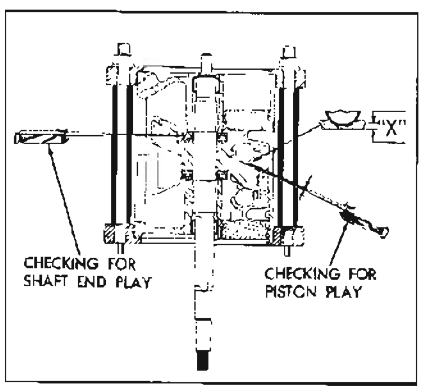



Figure 11-85—Checking Piston Play and Shaft End Play

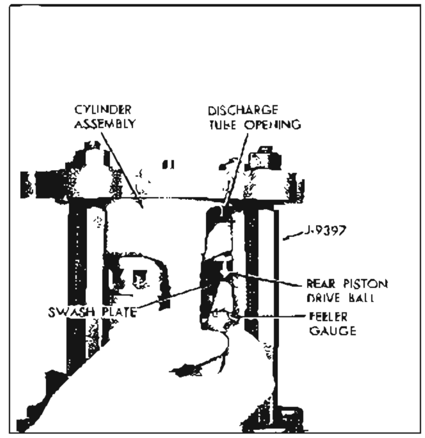



Figure 11-86—Checking Clearance Between Rear Piston Drive Ball and Swashplate

ton drive ball and swash plate. Record gauge dimension.

(e) Rotate shaft and swash plate again approximately 120 degrees and repeat third check (Steps "a, b and c") between same piston drive ball and swash plate. Record gauge dimension.

(f) From the three recorded checks (Steps "c, d and e") select minimum feeler gauge reading and procure from stock (ref. Figure 11-88 for part number of shoe disc) one shoe disc corresponding to the minimum gauge reading (ref. example below). Place shoe disc in respective position of Parts Tray (J-9402).

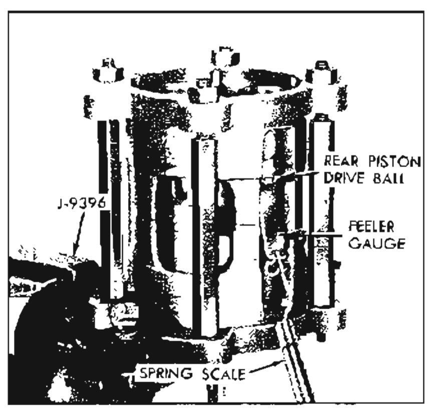



Figure 11-87—Checking "Drag" on Selected Feeler Gauge Leaf with Spring Scale

SHOE DISC CHART

| SERVICE PART NO. | IDENTIFICATION NO. STAMPED SHOE DISC |
|---|---|
| 6557000 | 0 ("ZERO" SHOE DISC) |
| 6556175 | 17½ |
| 6556180 | 18 |
| 6556185 | 18½ |
| 6556190 | 19 |
| 6556195 | 19½ |
| 6556200 | 20 |
| 6556205 | 20½ |
| 6556210 | 21 |
| 6556215 | 21½ |
| 6556220 | 22 |

Figure 11-88—Shoe Disc Table

EXAMPLE

| | 1st check | 2nd check | 3rd check |
|---|---|---|---|
| Piston #1 | .019 | .020 | .019 |

(Select No. 19 shoe disc)

| | | | |
|---|---|---|---|
| Piston #2 | .020 | .020 | .020 |

(Select No. 20 shoe disc)

| | | | |
|---|---|---|---|
| Piston #3 | .021 | .020 | .021 |

(Select No. 20 shoe disc)

(g) Repeat Steps "c, d, e and f" for other two pistons and procure two more selected shoe discs for other two pistons.

NOTE: In the rebuilt cylinder assembly, each piston will have one selected shoe disc and one "zero" shoe disc.

30. Gauge shaft end play as follows:

(a) Using a feeler gauge, select a leaf or combination of leaves which result in satisfactory "feel" when inserted between rear needle thrust bearing and outer rear thrust race (see Figure 11-89).

(b) Remove selected leaf or leaves from feeler gauge. Attach to end of spring scale calibrated in ounces. (A Generator Brush Spring Scale (J-5184) or the spring scale for checking distributor point setting may be used for this step.)

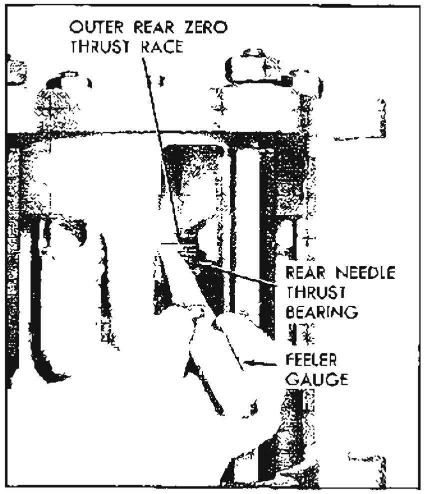



Figure 11-89—Gauging Clearance Between Rear Needle Thrust Bearing and Outer Rear Thrust Race

(c) Reinsert feeler gauge leaf (leaves) between rear needle thrust bearing and outer rear thrust race and draw leaf (leaves) out again, this time simultaneously noting the "drag" or pull on the leaf (leaves) as measured by the spring scale (see Figure 11-90). If correct leaf (leaves) have been selected, spring scale will read between 4 to 8 ounces pull (the higher reading is desired). To perform this step correctly, the feeler gauge leaf (leaves) must be withdrawn straight out with a steady, even motion. All contacting surfaces involved in gauging operation must be coated with No. 525 viscosity oil.

NOTE: The measurement for selection of the thrust race needs to be performed at only one place on the shaft and swash plate assembly.

(d) Select from stock one thrust race (ref. Figure 11-91 for part number of thrust race) corresponding to the feeler gauge reading determined in Step "c", and place the selected thrust race in the parts tray slot designated for the outer rear thrust race. If, for example, a feeler gauge reading of 0.009 inch results, a thrust race with a number "9" stamped on it should be selected.

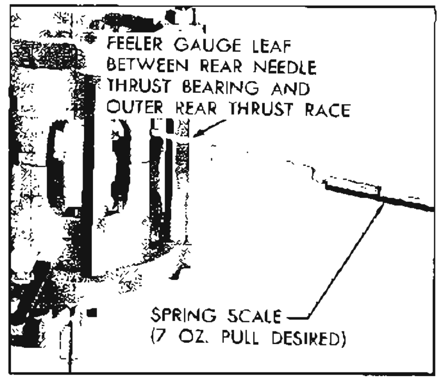



Figure 11-90—Checking "Drag" on Selected Feeler Gauge Leaf with Spring Scale

NOTE: The selected thrust race will replace only the "zero" outer rear thrust race. The remaining three "zero" thrust races will remain as part of the cylinder assembly.

31. Remove cylinder assembly from inside Compressing Fixture (J-9397), place on top of compressing fixture (see Figure 11-82) and disassemble rear cylinder from front cylinder using rubber mallet and wood block.

32. Carefully disassemble one piston at a time from front cylinder and lay piston, front and rear piston drive balls and front

| SERVICE PART NO. | IDENTIFICATION NO. STAMPED ON RACE |
|---|---|
| 6556000 | 0 |
| 6556055 | 5½ |
| 6556060 | 6 |
| 6556065 | 6½ |
| 6556070 | 7 |
| 6556075 | 7½ |
| 6556080 | 8 |
| 6556085 | 8½ |
| 6556090 | 9 |
| 6556095 | 9½ |
| 6556100 | 10 |
| 6556105 | 10½ |
| 6556110 | 11 |
| 6556115 | 11½ |
| 6556120 | 12 |

Figure 11-91—Thrust Race Table

"zero" shoe disc in respective slot of Parts Tray (J-9402). To disassemble, rotate swash plate until piston is at highest point, raise swash plate approximately 1/2 inch and lift out piston and related parts, one at a time.

33. Remove outer rear "zero" thrust race from shaft and set it aside for future gauging procedures.

34. Remove previously selected outer rear thrust race from parts tray, lightly coat with clear petroleum jelly and assemble onto shaft.

FINAL REASSEMBLY OF CYLINDER ASSEMBLY

35. Reassemble piston rings onto pistons (ring scraper groove toward center of piston) and rotate ring so that break or gap in ring can be squeezed together when piston is being inserted into cylinder bore.

36. Reassemble piston drive balls, "zero" and selected shoe discs onto No. "1" piston, and apply clear petroleum jelly to piston pockets and shoe discs so that balls and discs stick to piston.

NOTE: Be sure to reassemble balls and shoe discs into their specific positions on front and rear of piston.

37. Rotate shaft and swash plate assembly until high point of swash plate is over No. "1" cylinder bore. Position No. "1" piston onto swash plate (see Figure 11-92) and lower the piston and swash plate so that the front end (notched end) of the piston enters the cylinder bore.

NOTE: In order to fit the piston onto the swash plate and into the cylinder bore, the swash plate must be raised approximately 1/2 inch, the front needle thrust bearing and races must be held up against the hub of the swash plate, and the piston rings must be squeezed together (see Figure 11-93). Lubricate cylinder bore, piston assembly and swash plate with No. 525 viscosity oil to facilitate reassembly.

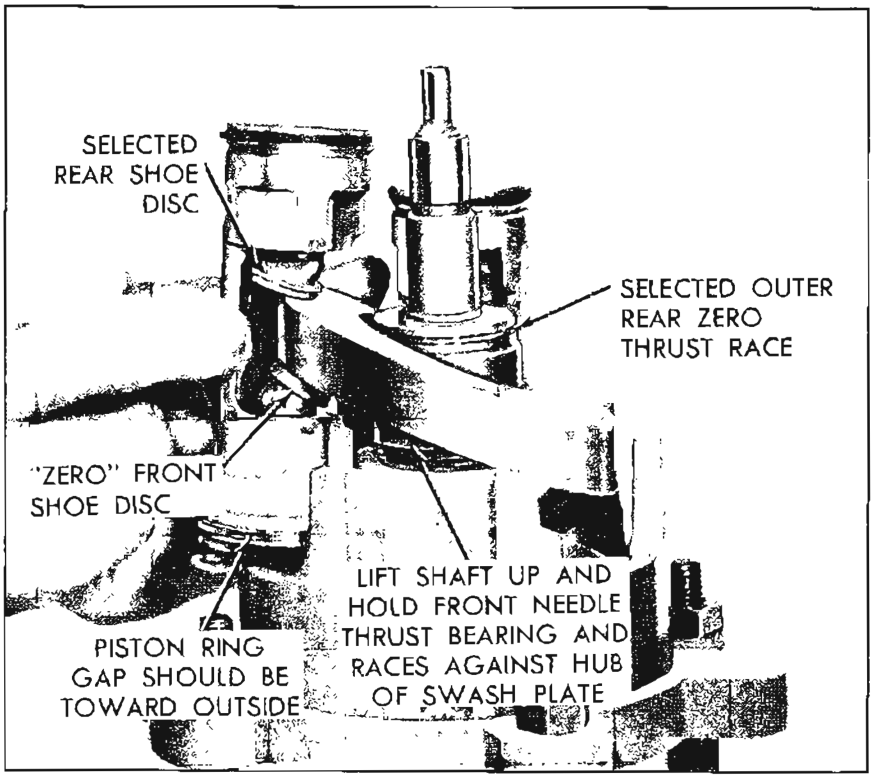



Figure 11-92—Installing Piston Assembly in Front Cylinder Half

38. Repeat procedure in Steps 36 and 37 for installation of No. 2 and No. 3 pistons.

39. Obtain new service replacement discharge tube and assemble into front cylinder (see Figure 11-94).

40. Liberally lubricate cylinder bores of rear cylinder and reassemble rear cylinder onto front cylinder being sure to compress piston rings. Align discharge tube and dowel pins, and tap cylinder halves together. Check for free rotation of shaft.

NOTE: If pistons are positioned in a "stair-step" arrangement (see Figure 11-95), installation of rear cylinder will be facilitated. In addition once the piston and ring are started into the cylinder, slight rotation of the shaft to and fro will work the ring into the bore.

41. Liberally lubricate with No. 525 viscosity oil, suction pass cover seal and lips of suction passage in body of cylinder assembly, and reassemble suction

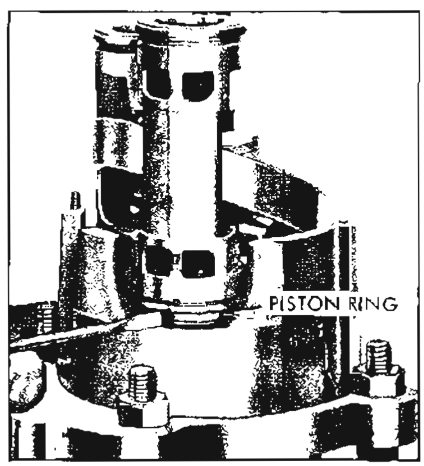



Figure 11-93—Compressing Front Piston Rings

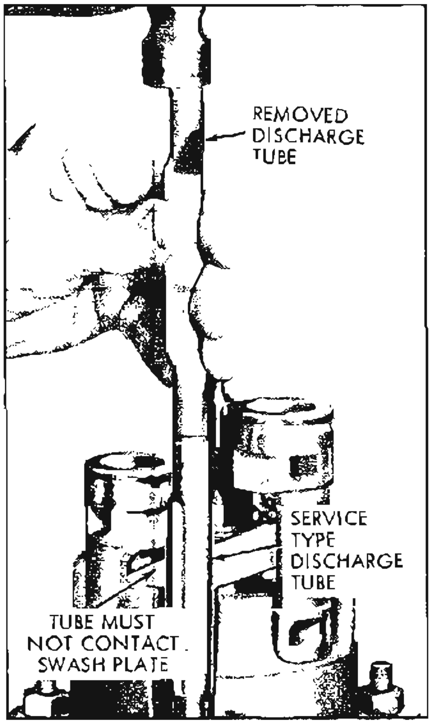



Figure 11-94—Installing Service Type Discharge Tube

pass cover and seal over suction passage (see Figures 11-96 and 11-97) using Seal Installer (J-9433).

NOTE: Use Seal Installer (J-9433) as a shoe horn and snap cover into place.

42. Assemble both service replacement discharge tube "O" rings and bushings (see Figure 11-98) onto cylinder assembly.

REASSEMBLY OF FRONT SUCTION VALVE REED DISC, FRONT DISCHARGE VALVE PLATE, FRONT HEAD, AND INSTALLING OF CYLINDER ASSEMBLY

43. Assemble suction reed valve disc to front of cylinder assembly and align with dowel pins, suction port and discharge port (see Figure 11-99).

44. Assemble front discharge valve plate to front of cylinder assembly and align with dowel pins.

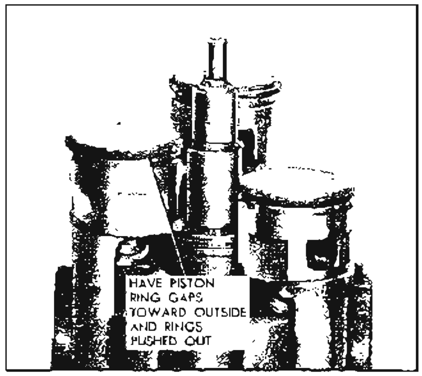



Figure 11-95—Pistons Position In "Stair-Step" Arrangement

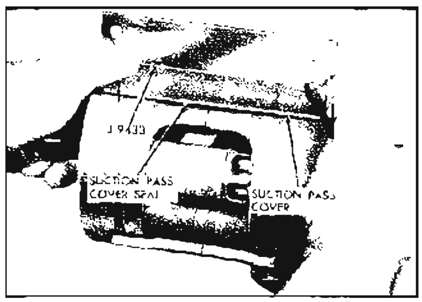



Figure 11-96—Installing Suction Pass Cover and Seal

45. Coat teflon surfaces on front head (see Figure 11-100) with No. 525 viscosity oil.

46. Mark with pencil on side of front head the location of dowel pin holes (see Figure 11-100), align front head with dowel pins, and tap head lightly with mallet to seat on cylinder assembly.

47. Place new shell to head "O" ring on shoulder of front head (see Figure 11-101) and liberally coat "O" ring and front head

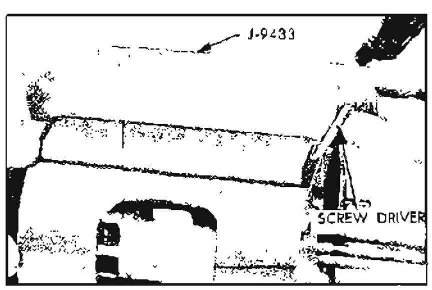



Figure 11-97—Removing Installer J-9433

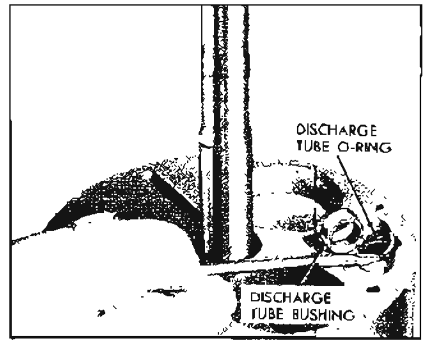



Figure 11-98—Installing Discharge Tube O-Ring and Bushing

surface with No. 525 viscosity oil.

48. Install shell in Holding Fixture (J-9396) and position so that rear studs of shell are up. Coat inside surface of shell with No. 525 viscosity oil.

49. Reassemble as a unit cylinder assembly and front head into the shell (see Figure 11-102).

NOTE: Extreme care must be used to prevent shell to head "O" ring seal from being damaged.

REASSEMBLY OF REAR SUCTION VALVE REED DISC, REAR DISCHARGE VALVE PLATE, OIL PUMP AND REAR HEAD

50. Rotate the cylinder assembly

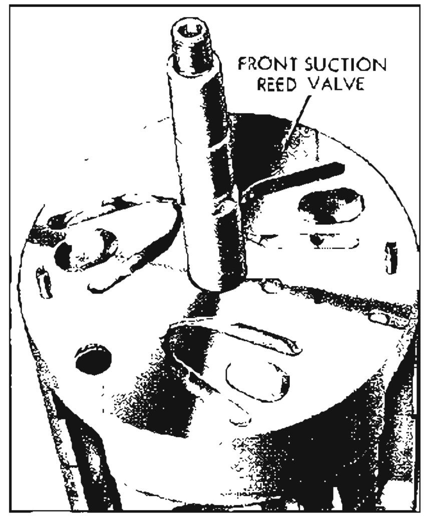



Figure 11-99—Front Suction Valve Reed Disc Installed

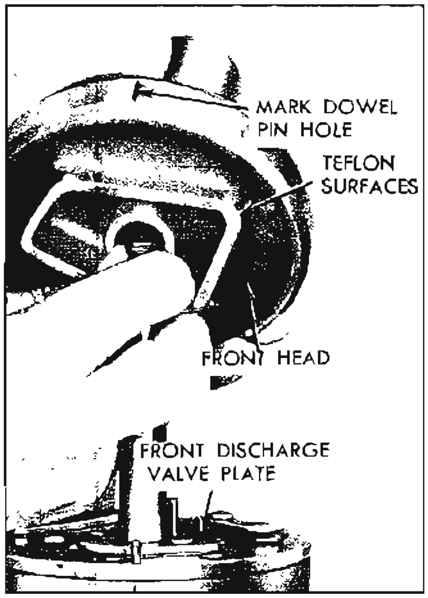



Figure 11-100—Placing Front Head on Cylinder Assembly

and front head until the hole for the oil inlet tube in the cylinder assembly is aligned with the reservoir hole in the shell, and reassemble the oil inlet tube and "O" ring.

51. Assemble suction reed valve disc to rear of cylinder assembly and align with dowel pins, suction port, and discharge port of cylinder assembly.

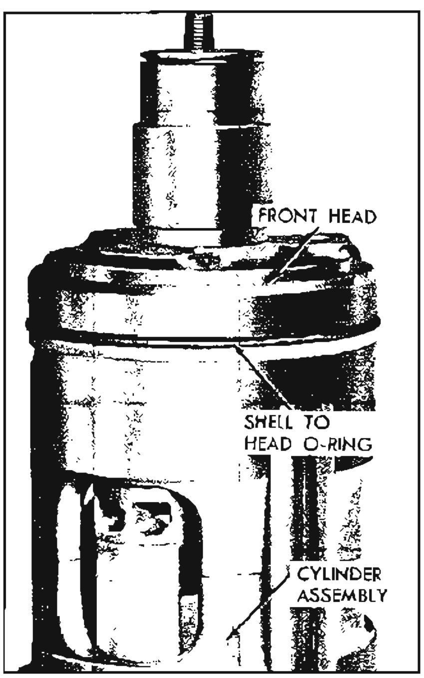



Figure 11-101—Shell to Head O-Ring Installation

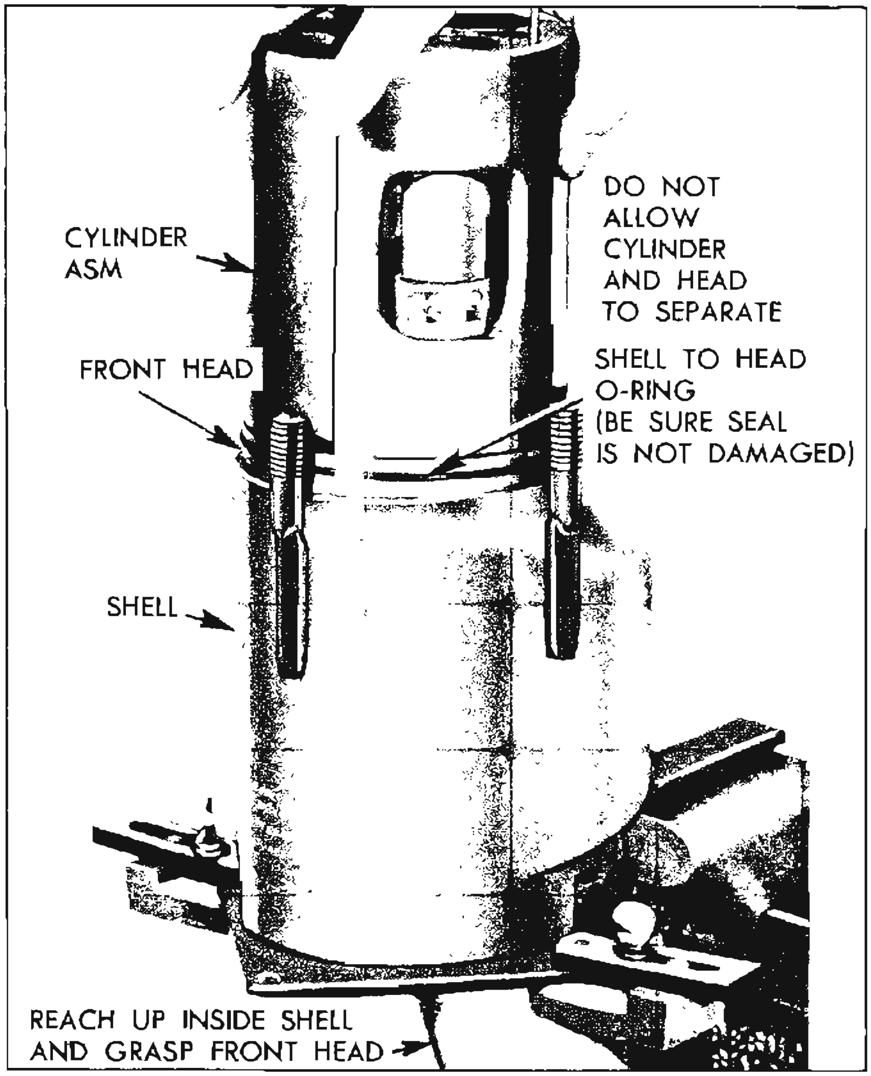



Figure 11-102—Installing Cylinder Assembly and Front Head in Shell

52. Assemble rear discharge valve plate to rear of cylinder assembly and align with dowel pins.

53. Reassemble inner and outer oil pump rotors so that the sides previously identified are in their original location, and then position oil pump outer rotor as shown in Figure 11-103.

54. Generously coat with No. 525 viscosity oil new shell to head "O" ring and install in shell (see Figure 11-103).

55. Coat teflon surfaces of rear head with No. 525 viscosity oil, mark with pencil on side of rear head the location of the dowel pin holes and reassemble onto compressor.

NOTE: It may be necessary to reposition oil pump outer rotor slightly in order to install rear head. In addition, if dowel pins do not engage holes in rear head, grasp front head and rotate cylinder assembly slightly (see Figure 11-104).

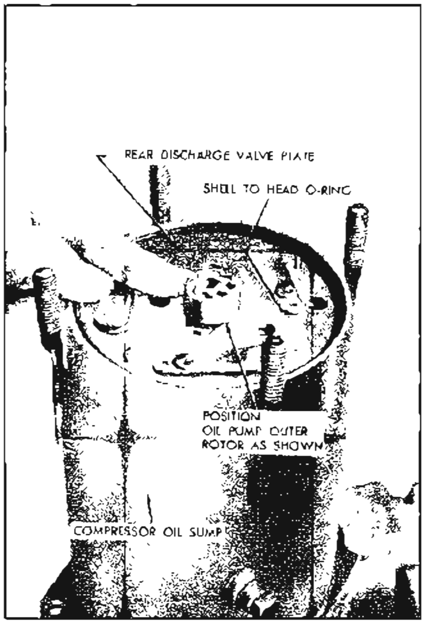



Figure 11-103—Positioning Oil Pump Outer Rotor

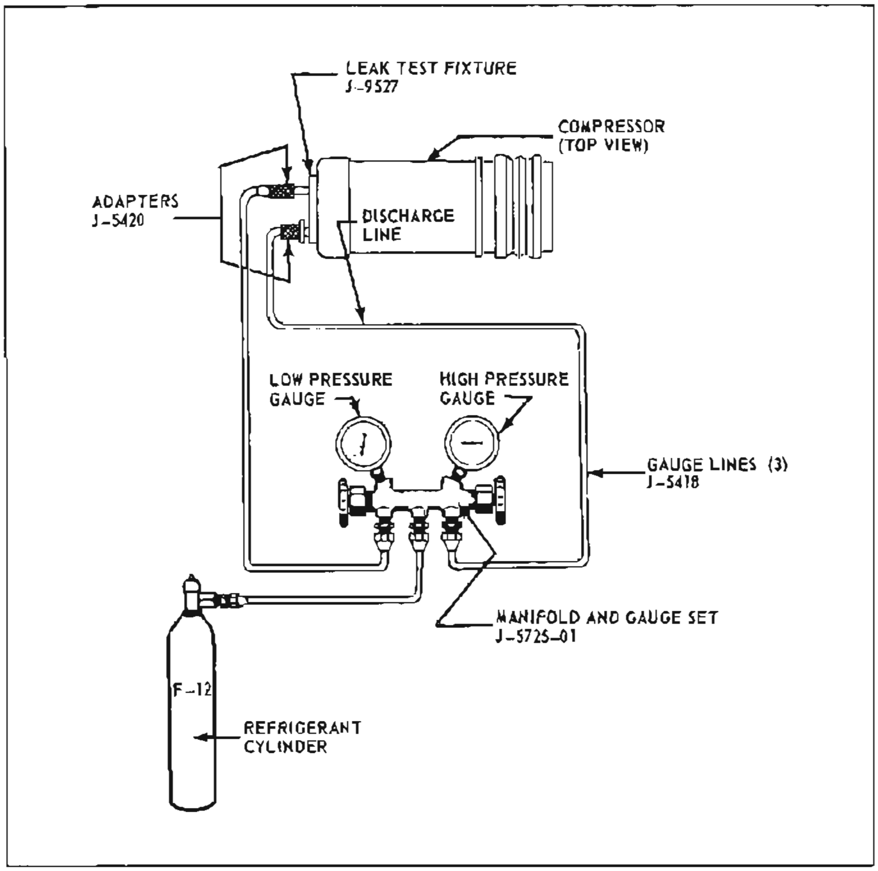



Figure 11-105—Compressor Internal Leak Test

56. Assemble new nuts to threaded shell studs and torque to 20 lb. ft.

NOTE: If pressure relief valve has been removed, reassemble using a new pressure relief valve gasket.

57. Reassemble new lubricated suction and discharge "O" rings into suction and discharge ports of rear head.

58. Reassemble shaft seal onto front of shaft and swash plate assembly (ref. subpar. "i").

NOTE: Do not reassemble clutch drive plate at this time.

## LEAK TESTING COMPRESSOR

59. After the shaft seal pressure test (ref. subpar. "i") has been performed, change the test circuit to the configuration shown in Figure 11-105.

60. Pressurize only discharge side (refrigerant cylinder at room temperature) of compressor by opening cylinder valve, lower pressure gauge valve and high pressure gauge valve. If the same pressure is noted on the discharge high pressure gauge as on the low pressure gauge--an internal leak exists. Correct leak as necessary.

NOTE: If internal leak exists, leak may exist in sealing surface of teflon seal, discharge tube, shell to head "O" rings, or suction valve reed discs.

61. Close high pressure gauge valve and observe if high pressure gauge drops more than 10 pounds in 30 seconds. Indication of this also evidences an internal leak. Correct leak as necessary.

62. Remove drain screw from shell and add No. 525 viscosity oil as specified in subparagraph "f".

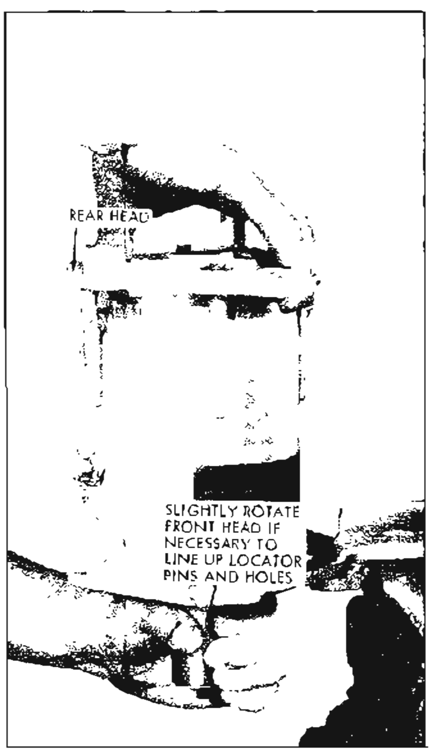



Figure 11-104—Installing Rear Head

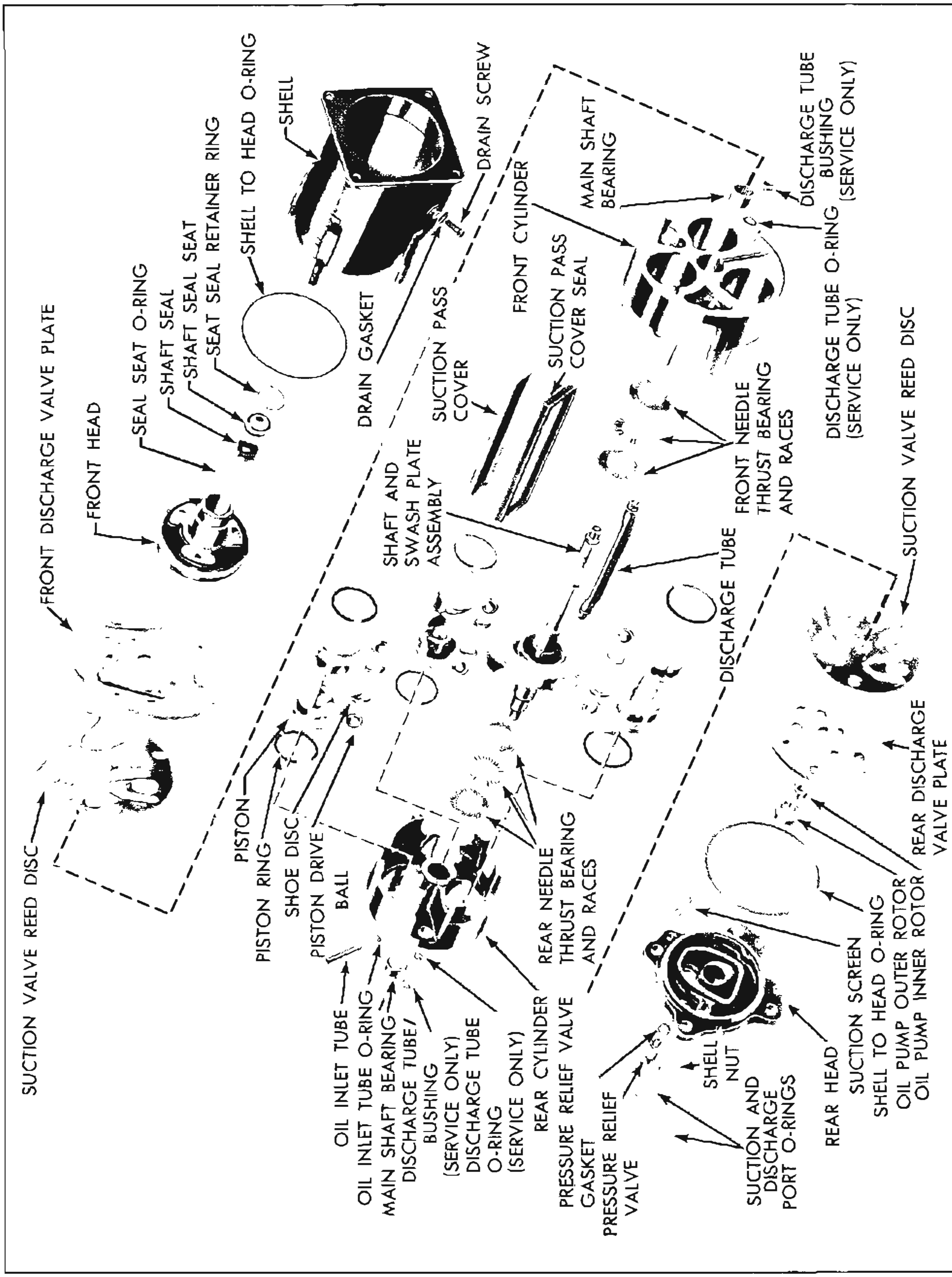



Figure 11-106—Compressor (Exploded View)

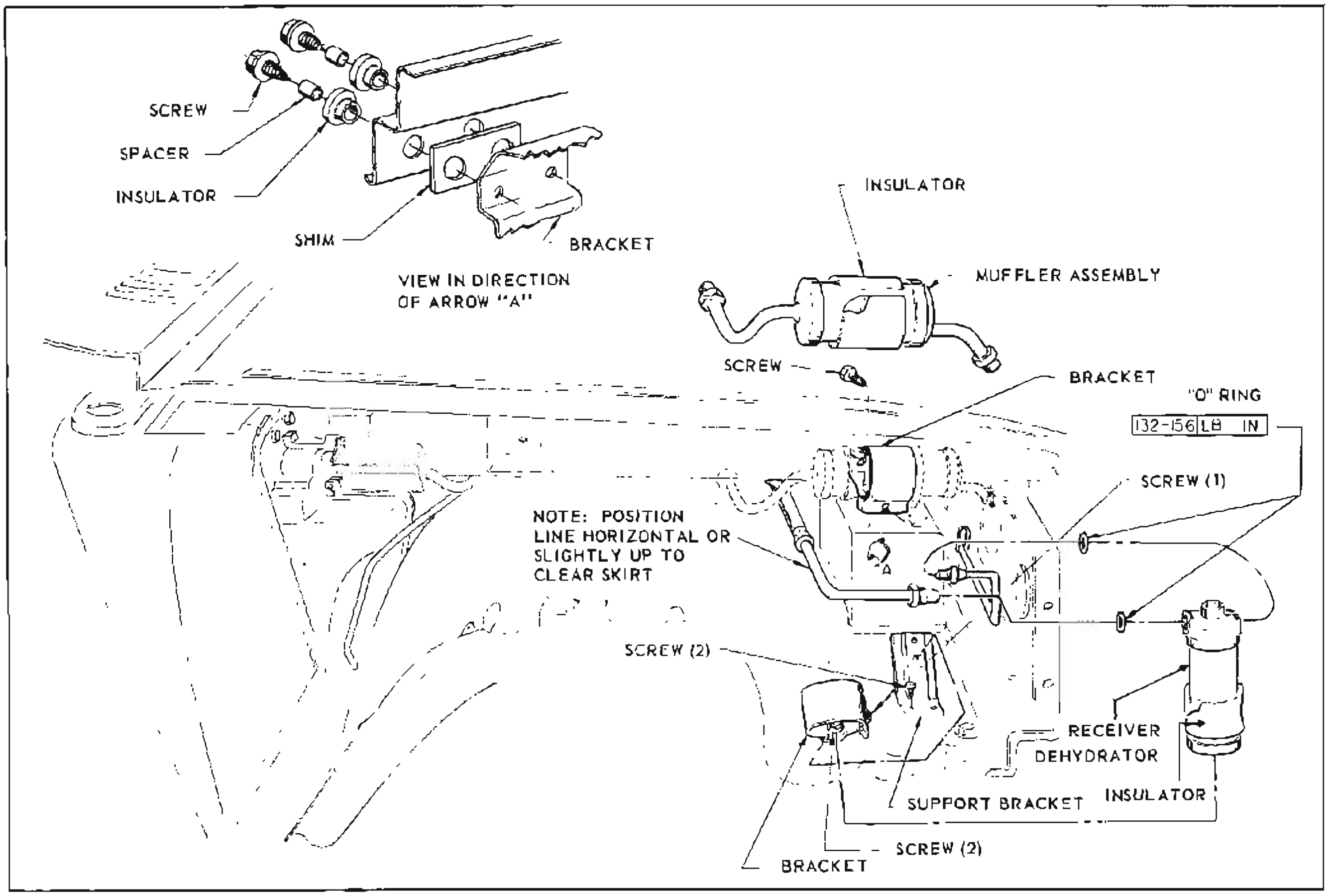



Figure 11-107—Muffler and Receiver - Dehydrator Installation

63. Reassemble pulley assembly, and coil and housing assembly onto hub of front head (ref. subpar. "j").

64. Complete reassembly by installing clutch drive plate onto hub of front head (ref. subpar. "i").

## l. Removal and Installation of Muffler

REMOVAL

1. Discharge system (ref. subpar. "e".)

2. Remove battery.

3. Disconnect refrigerant lines connected to muffler (see Figure 11-107) and tape closed both open ends of refrigerant lines and both ends of muffler.

4. Remove two screws holding muffler clamp to inner portion of fender and lift out muffler and clamp, and disassemble as required.

INSTALLATION

5. Install muffler reverse of removal, using new "O" rings during installation coated with No. 525 viscosity oil.

NOTE: If refrigerant circuit or muffler has been exposed to the atmosphere for any amount of time and moisture may be present in the circuit, flush the muffler or system as necessary (ref. subpar. g). Install a new receiver-dehydrator in system.

6. Charge the system (ref. subpar. s).

## m. Removal and Installation of Condenser

REMOVAL

1. Discharge system (ref. subpar. "e").

2. Disconnect inlet and outlet pipes of condenser (see Figure 11-28) and tape closed both open ends of refrigerant lines, and also the open ends of the inlet and outlet pipes of the condenser.

3. Remove screws and clamps holding condenser pipes to radiator baffle.

4. Remove one bolt securing each cross brace (see Figure 11-108) to the radiator baffle and position front and rear braces out of way.

5. Remove five screws and take out grille support.

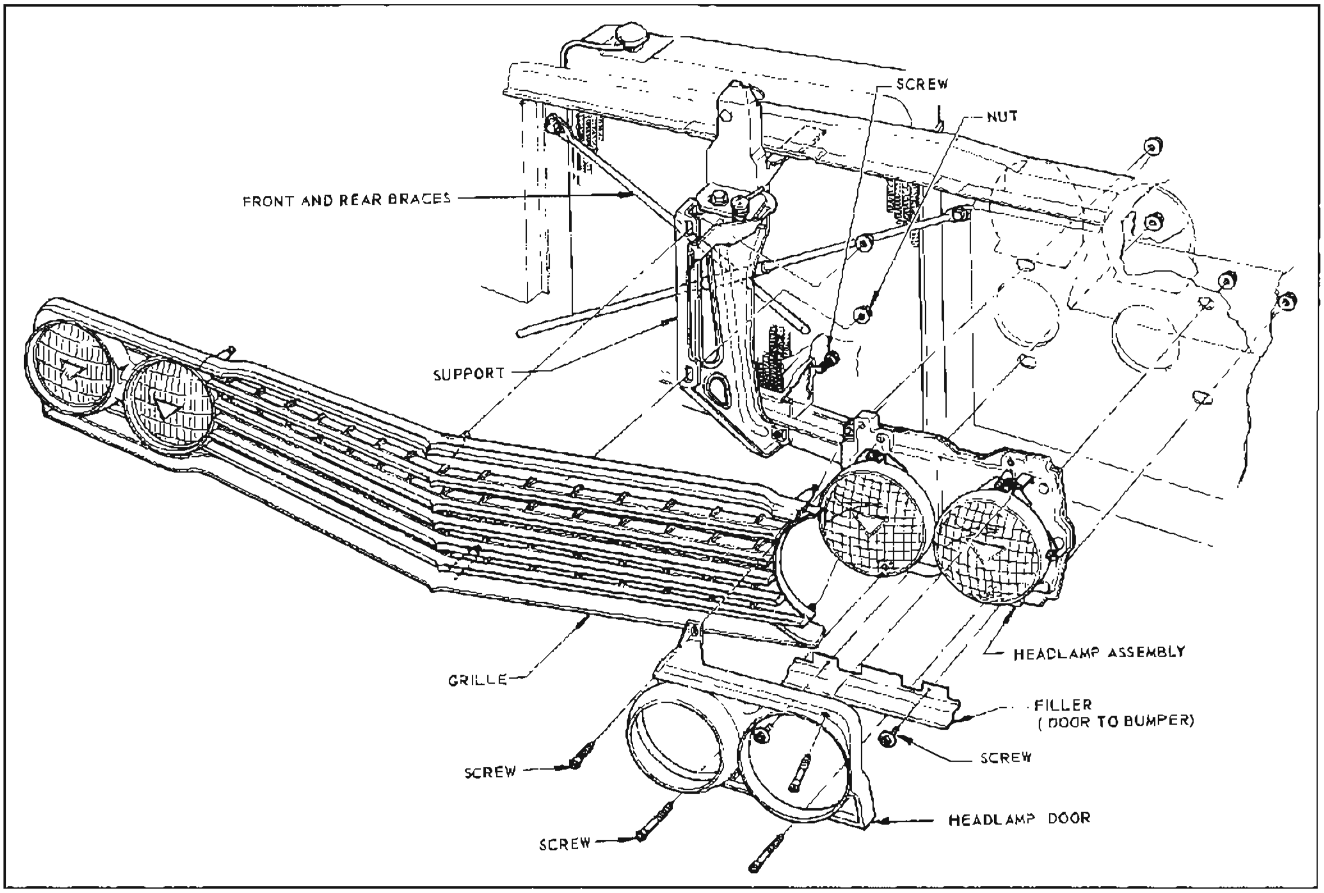



Figure 11-108—Front End and Headlamp Installation

6. Remove screws holding right and left flanges of condenser to radiator baffle and remove condenser.

INSTALLATION

7. Install condenser reverse of removel and use new "O" rings during installation. Lubricate "O" rings prior to installation using No. 525 viscosity oil.

NOTE: If refrigerant circuit or condenser has been exposed to the atmosphere and moisture may be present in circuit, the system and/or component must be flushed prior to installation (ref. subpar. "g").

8. Charge the refrigerant circuit (ref. subpar. "s").

### n. Removal and Installation of Receiver—Dehydrator

REMOVAL

1. Discharge system (ref. subpar. "e").

2. Remove battery.

3. Disconnect refrigerant lines to both ends of receiver-dehydrator (see Figure 11-107) and tape closed both open ends of refrigerant lines, and also the open ends of the inlet and outlet pipes of the receiver-dehydrator.

4. Remove two screws securing receiver-dehydrator and clamp to support bracket and lift out receiver-dehydrator.

INSTALLATION

5. Install receiver-dehydrator reverse of removal and use new "O" rings during installation. Lubricate "O" rings with No. 525 viscosity oil prior to installation.

NOTE: If the receiver-dehydrator has been exposed to the atmosphere for any amount of time, the receiver-dehydrator should be replaced, since the life of desiccant is probably expended.

6. Charge refrigerant circuit (ref. subpar. "s").

### o. Removal and Installation of Expansion Valve

REMOVAL

1. Remove right front fender and skirt as follows:

(a) Unscrew four screws securing right headlamp door (see Figure 11-108) to headlamp assembly.

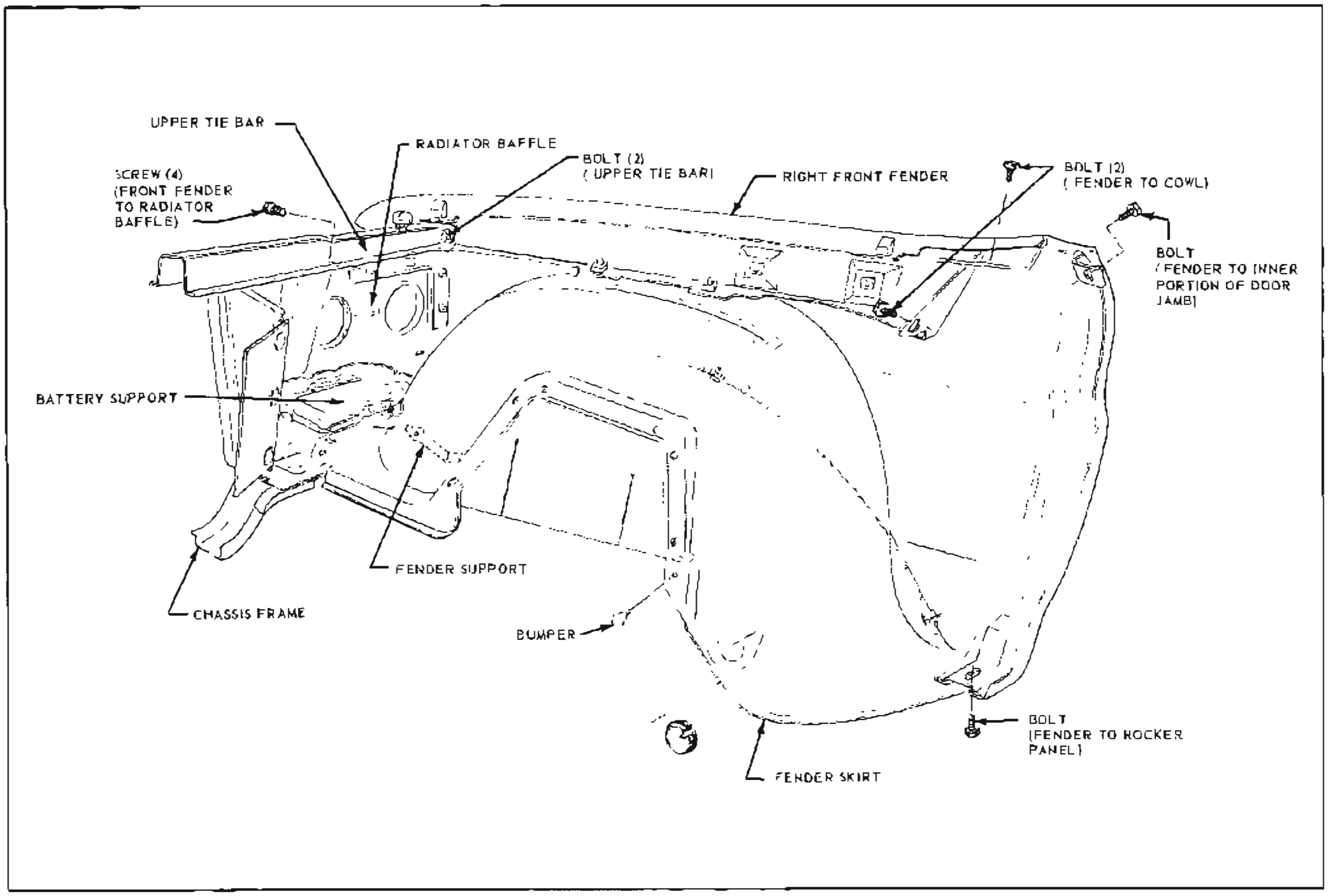



Figure 11-109—Right Front Fender Installation

(b) Remove four screws securing front fender to radiator baffle.

(c) Remove battery, unscrew six screws securing battery support to battery support brackets and lift out battery support.

(d) Discharge refrigerant circuit (ref. subpar. "e").

(e) Disconnect lines to muffler and receiver-dehydrator, tape closed open lines, and also both openings in muffler and receiver-dehydrator.

(f) Unfasten all electrical wires attached to fender skirt.

(g) Remove one bolt and five sheet metal screws securing front of fender skirt to radiator baffle.

(h) Remove two bolts securing front of fender to upper tie bar.

(i) Remove two bolts securing upper rear portion of fender to cowl.

(j) Remove one bolt securing rear edge of fender to inner portion of door jamb.

(k) Remove one bolt securing lower rear edge of fender to rocker panel.

(l) Rest a 2 x 4 inch board across cowl and radiator, and position another board vertically to support hood. Remove bolts holding hood hinge to fender.

(m) Disconnect antenna lead (if so equipped) from radio.

(n) Raise up and lift off fender and skirt, and withdraw antenna lead.

2. Disconnect expansion valve capillary tube bulb attached to the outlet pipe of the evaporator. (See Figure 11-41).

3. Disconnect the equalizer line from the body of suction throttling valve. (See Figure 11-38). Tape closed equalizer line port on suction throttling valve, and also open end of equalizer line.

4. Disconnect inlet and outlet ends of expansion valve from refrigerant circuit, and tape closed open ends of refrigerant lines and inlet and outlet ports of expansion valve.

5. Remove outer clamp of bracket securing expansion valve and suction throttling valve to plenum blower and air valve assembly and lift out expansion valve.

INSTALLATION

6. Install expansion valve reverse

of removal, and use new "O" rings during installation. Lubricate "O" rings prior to installation using No. 525 viscosity oil.

NOTE: If expansion valve or refrigerant lines have been exposed to the atmosphere for any amount of time and moisture may have entered the valve or the system, flush the system or valve as necessary (ref. subpar. "g").

7. Install new receiver-dehydrator.

8. Charge system (ref. subpar. "s").

NOTE: Due to the possible adjustment difficulties involved if the expansion valve is disassembled, disassembly of the valve is not recommended. The valve may be cleaned by submerging it in a bath of trichlorethylene, alcohol, or similar solvent. Dry by blowing filtered compressed air through the outlet port of the valve. The filter screen at the inlet port may be replaced. Remove screen by threading a 10-32 NF screw into old filter screen. With a washer and a nut on the screw arranged to work as a puller screw, hold the body of the screw and turn the nut. Insert the new filter screen into the inlet port and lightly tap screen only enough to seat.

## p. Removal and Installation of Evaporator

REMOVAL

1. Remove right front fender and skirt as follows:

(a) Unscrew four screws securing right headlamp door assembly (see Figure 11-108) to headlamp assembly.

(b) Remove four screws securing front fender to radiator baffle.

(c) Remove battery, unscrew six screws securing battery support to battery support brackets and lift out battery support.

(d) Discharge refrigerant circuit (ref. subpar. "e").

(e) Disconnect lines to muffler and receiver-dehydrator, tape closed open lines, and also both openings in muffler and receiver-dehydrator.

(f) Unfasten all electrical wires attached to fender skirt.

(g) Remove one bolt and five sheet metal screws securing front of fender skirt to radiator baffle.

(h) Remove two bolts securing front of fender to upper tie bar.

(i) Remove two bolts securing upper rear portion of fender to cowl.

(j) Remove one bolt securing rear edge of fender to inner portion of door jamb.

(k) Remove one bolt securing lower rear edge of fender to rocker panel.

(l) Rest a 2 x 4 inch board across cowl and radiator and position another board to vertically support hood. Remove bolts holding hood hinge to fender.

(m) Disconnect antenna lead (if so equipped) from radio.

(n) Raise up and lift off fender and skirt, and withdraw antenna lead.

2. Remove eight screws securing front and rear halves of duct between evaporator, and plenum blower and air door assemblies (see Figure 11-110). Remove front half of duct by pushing it down under the evaporator pipes. Remove rear half in a similar manner.

3. Disconnect oil bleed line from suction throttling valve (see Figure 11-38) and capillary tube bulb from outlet pipe of evaporator (see Figure 11-41). Tape closed openings in valve and line.

4. Disconnect suction throttling valve and expansion valve from evaporator outlet and inlet pipes. Tape closed all connection openings.

5. Remove five stamped nuts from studs of air conditioner heater assembly (see Figure 11-110).

6. Remove glove box, disconnect air conditioner outlet hoses from distributor duct (see Figure 11-111). Remove two screws securing duct to heater assembly and take out distributor duct.

7. Disconnect temperature, diverter, and defroster control wires (see Figure 11-19). Remove rear retainer and seal assembly (see Figure 11-111) and pull out air conditioner heater assembly.

8. Remove eight screws securing evaporator to front retainer and seal assembly and pull out evaporator.

INSTALLATION

9. Install evaporator reverse of removal and charge system (ref. subpar. "s").

NOTE: It is recommended that a rubber lubricant be used to assist in effecting a good seal between side of evaporator and front seal. After evaporator is reassembled to the cowl, reposition front edge of rubber seal on front retainer and seal assembly so that a proper seal is created. Poor sealing action may seriously affect system performance.

## q. Removal and Installation of Suction Throttling Valve

REMOVAL

1. Discharge system (ref. subpar. "e").

2. Disconnect evaporator oil bleed line from body of suction throttling valve (see Figure 11-38) and tape closed opening on suction throttling valve and evaporator oil bleed line.

3. Disconnect equalizer line from the body of the suction throttling

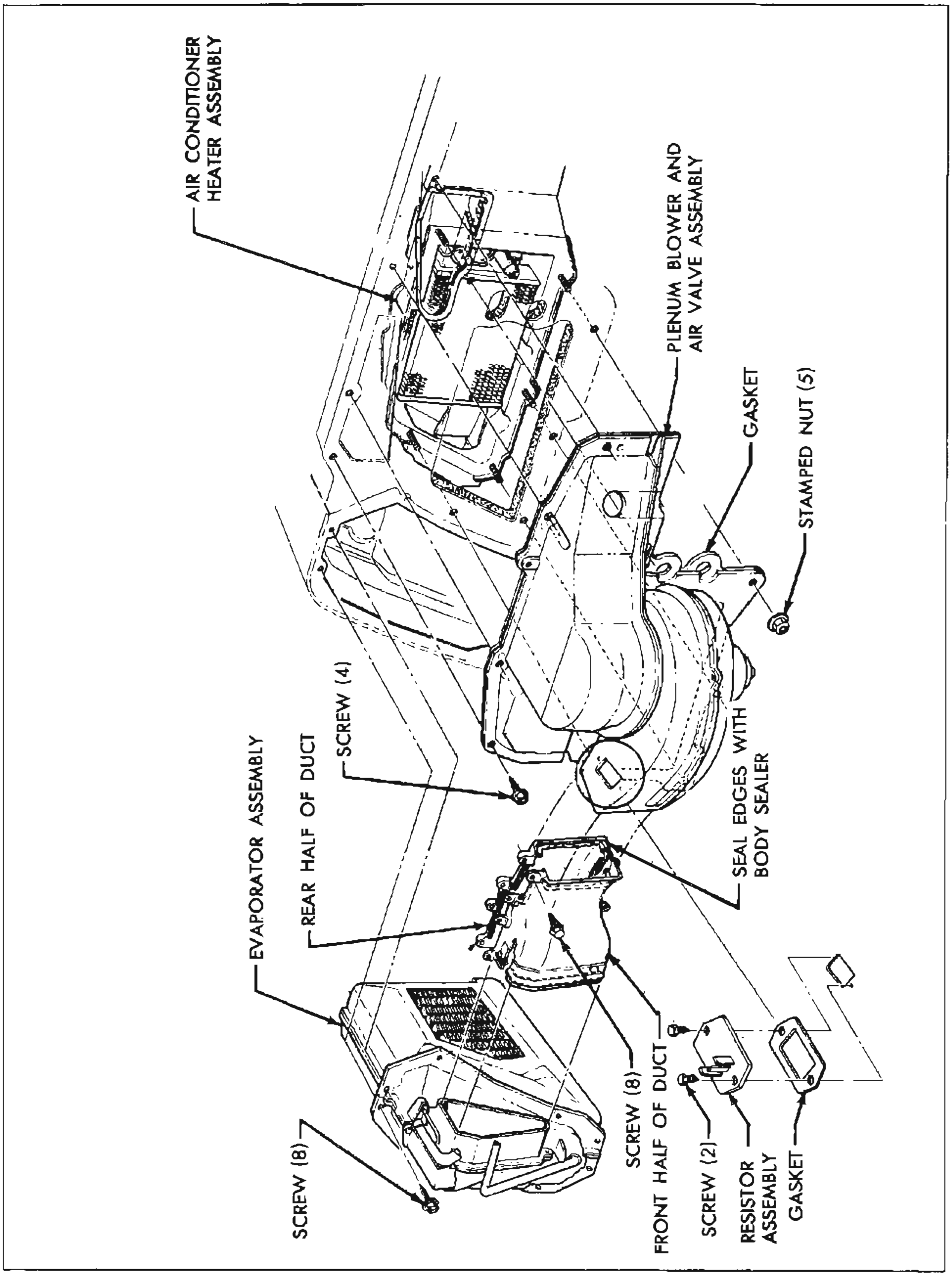



Figure 11-110—Evaporator Assembly, and Plenum Blower and Air Valve Assembly Installation

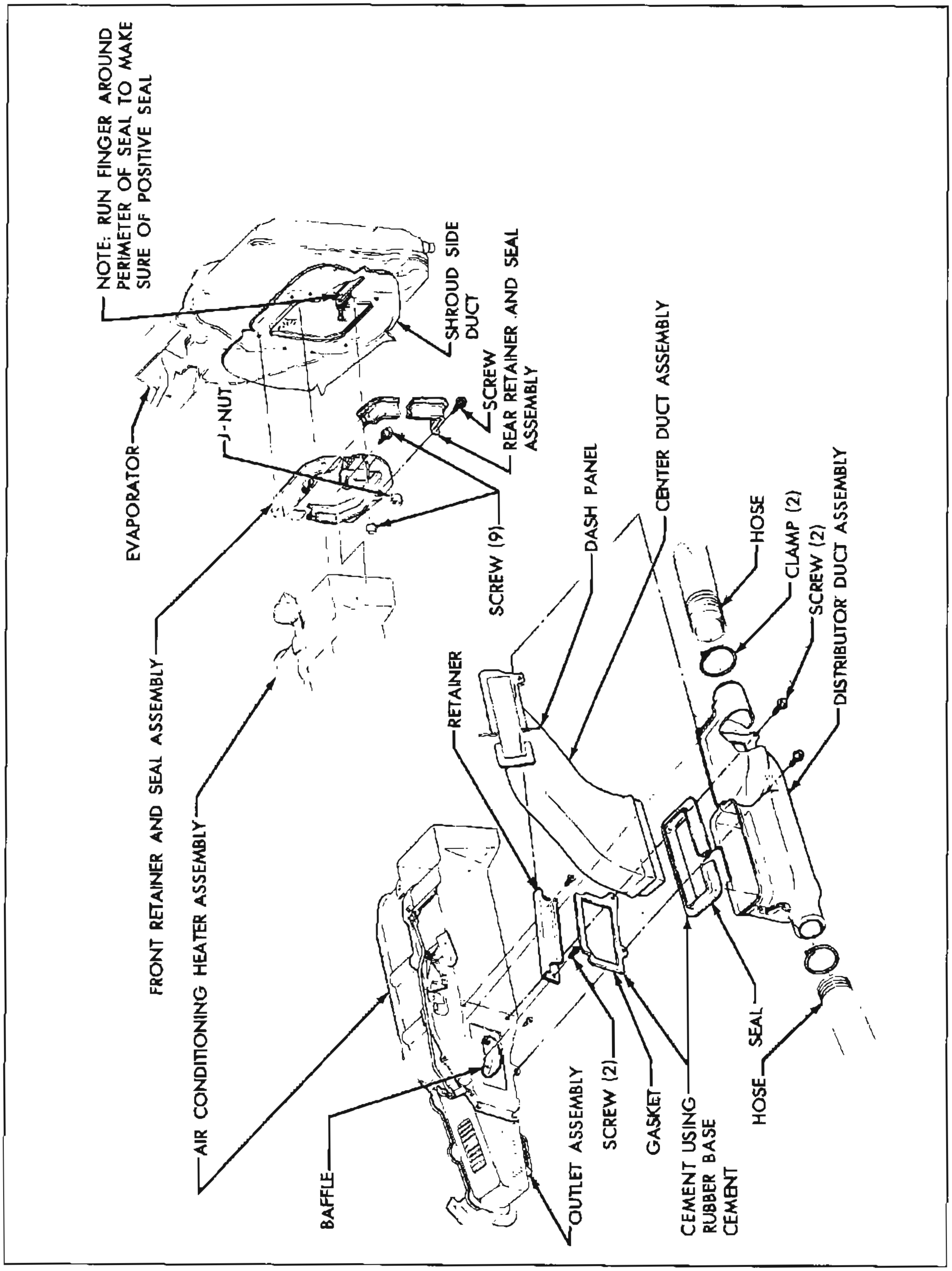



Figure 11-111—Distributor Duct Assembly, and Front Retainer and Seal Installation

valve. Tape closed the equalizer line port on suction throttling valve, and also open end of equalizer line.

4. Disconnect inlet and outlet ports of valve from refrigerant lines, and tape closed inlet and outlet ports. Also tape closed both refrigerant line openings.

5. Disconnect vacuum tube from vacuum diaphragm.

6. Remove lower clamp of bracket securing expansion valve and suction throttling valve to plenum blower and air door assembly, and lift out suction throttling valve.

INSTALLATION

7. Install suction throttling valve reverse of removal procedure using new "O" rings during installation. Lubricate "O" rings prior to installation with No. 525 viscosity oil.

NOTE: If suction throttling valve or refrigerant lines have been exposed to the atmosphere for any amount of time, and moisture may have entered the valve or system, flush system or valve as required (ref. subpar. "g").

8. Charge system (ref. subpar. "s").

### r. Disassembly, Reassembly and Adjustment of Suction Throttling Valve

DISASSEMBLY

1. Loosen lock nut and unscrew and separate vacuum diaphragm (see Figure 11-112) and outer spring from suction throttling valve.

NOTE: Due to spring tension of the outer spring, care should be exercised when separating vacuum diaphragm from valve body.

2. Remove five screws securing diaphragm cover to valve body and disassemble diaphragm cover, retainer cup and piston assembly from valve body.

NOTE: Do not disassemble screen diaphragm or piston from piston assembly. Exercise care not to pinch or otherwise damage rubber diaphragm portion of piston assembly. Clean assembly by submerging in solution of trichlorethylene, alcohol or similar solvent.

3. Unscrew evaporator gauge connector from valve body and disassemble cap, valve core and "O" ring from connector.

4. Unscrew bleed connector from valve body and separate cap, valve core and "O" ring from connector.

NOTE: Due to close tolerances involved, repair of damaged parts of suction throttling valve is not recommended. Replace all unserviceable parts.

REASSEMBLY

5. Reassemble reverse of disassembly procedure, the evaporator gauge connector and bleed connector onto valve body.

6. Lightly coat rubber diaphragm portion of piston assembly with Molykote Type Z powder. Coat only the outer side (side nearest vacuum diaphragm) of the rubber diaphragm using Molykote Type Z (Alpha-Molykote Corporation, Stamford, Connecticut). No other powder is recommended.

7. Lightly coat inside of valve body with No. 525 viscosity oil and reassemble and hold together piston assembly, retainer cup and diaphragm cover onto valve body.

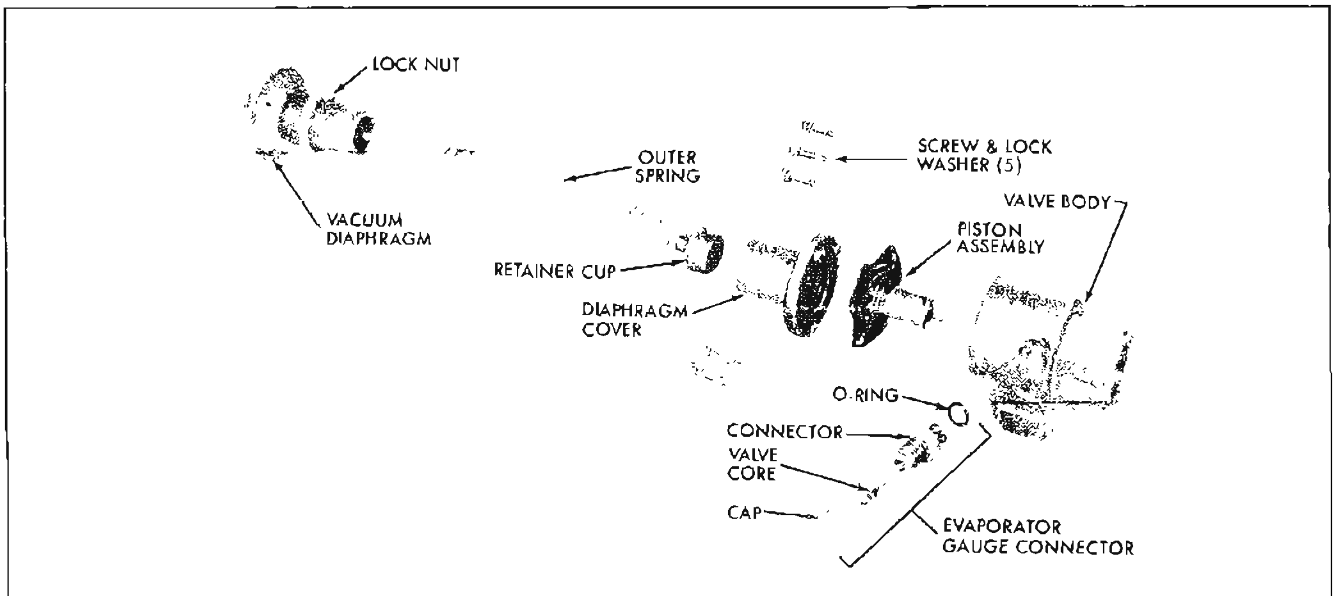



Figure 11-112—Suction Throttling Valve (Exploded View)

Do not install screws at this time.

8. Press a finger into the inlet port and push the piston upward into the valve body. This action will force the rubber diaphragm to form inside the diaphragm cover, and thereby take up the excess rubber allowing the diaphragm cover to be seated on the valve body.

9. Once the rubber diaphragm has formed inside the diaphragm cover, press the retainer cup down several times from the opposite end of the assembly. This action will insure that the piston will seat against the inner shoulder of the body.

10. Reassemble five screws and torque 45-50 lb. inches.

11. Reassemble outer spring, washer, lock nut and vacuum diaphragm onto assembly and turn vacuum diaphragm approximately ten turns into diaphragm cover.

ADJUSTMENT

12. Reinstall suction throttling valve in car and perform functional tests as described in subparagraph "c".

13. If adjustment of the suction throttling valve is required, rotate vacuum diaphragm clockwise to increase suction throttle valve (low pressure gauge) pressure, and counterclockwise to decrease suction throttle valve pressure.

14. Move temperature lever from COLD to MED position and note an increase in suction throttling valve pressure of approximately 3 psi.

NOTE: If a pressure increase is not noted, check for proper operation of the suction throttling valve vacuum disc switch located on the heater and defroster control assembly, loose vacuum hose connections or kinked vacuum hoses. If these checks do not correct the problem, the difficulty is in the suction throttling valve

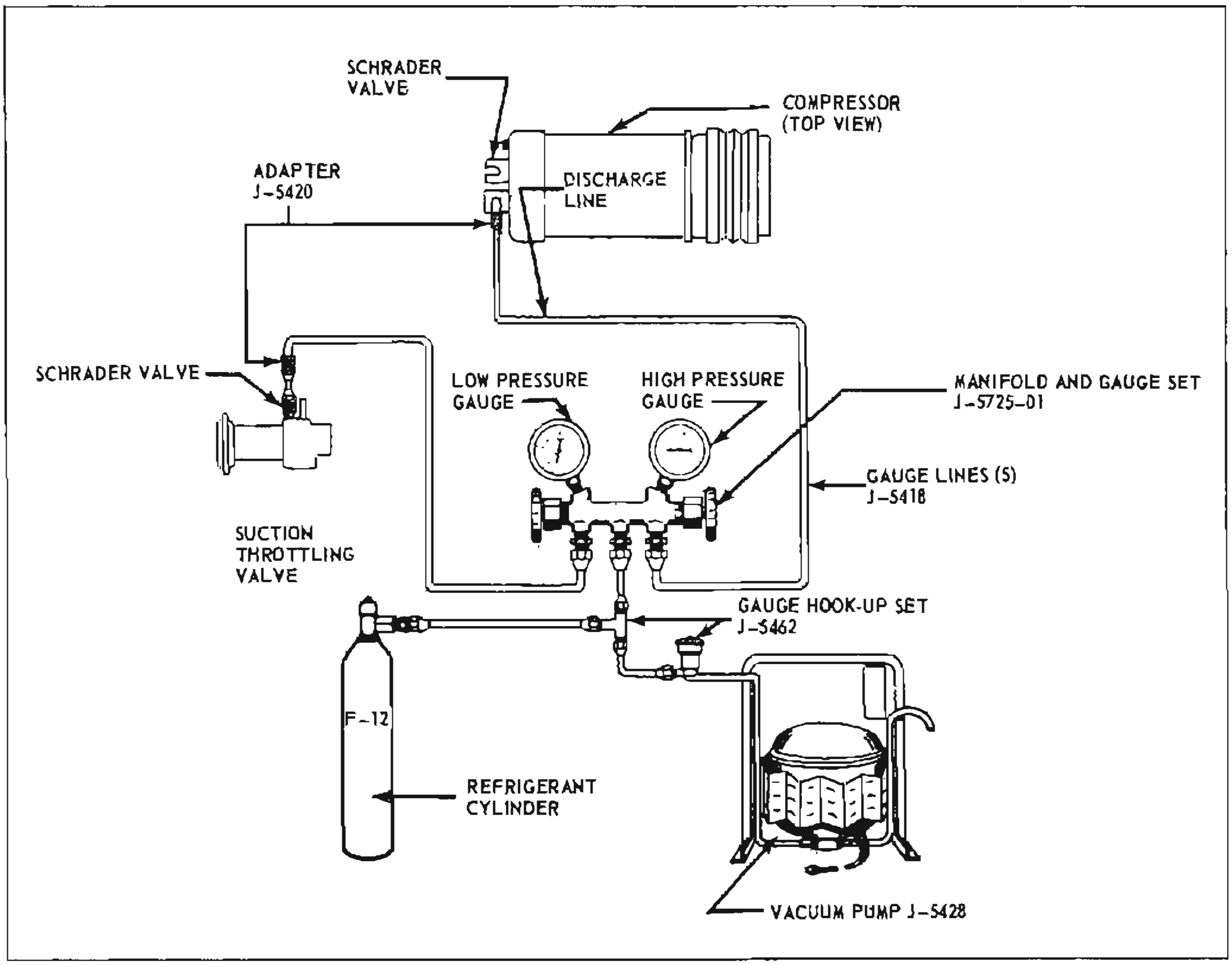



Figure 11-113—Charging Air Conditioner System

vacuum diaphragm. Repair valve as necessary.

15. Tighten lock nut on vacuum diaphragm.

### s. Charging System

Charging of air conditioner system consists essentially of evacuating the system, checking for leaks, primary charging, final evacuation and final charging of system. Proceed as follows:

NOTE: A portable air conditioner service station unit (J-8393) is available for air conditioner servicing. The unit provides a means of measuring refrigerants without the use of scales and heating of the refrigerant cylinder. Due to the fact that complete instruction on use of the service station are contained on the unit, the information will not be repeated here.

1. Remove protective cap from Schrader valve located on suction throttling valve, and Schrader valve located on discharge port of compressor.

2. Interconnect vacuum pump (J-5428), Manifold and Gauge Set (J-5225-01), Gauge Hook-Up Set (J-5462), Gauge Adapters (J-5420), five Gauge Charging Lines (J-5418) and refrigerant-12 cylinder with air conditioner system (see Figure 11-113). Be sure all valves are closed.

3. Start vacuum pump and open both high and low pressure valves on manifold and gauge set. Slowly open shut-off valve of gauge hook-up set.

NOTE: If shut off valve is opened too quickly, oil may be forced out of vacuum pump.

4. Operate pump until at least 28 inches of vacuum (at sea level) registers on the low pressure gauge of the manifold and gauge set and operate vacuum for 10 minutes at or below this vacuum level. Stop vacuum pump, close shut-off valve and observe that vacuum does not drop more than 2 inches in 5 minutes.

NOTE: Allowance should be made for elevation when obtaining a vacuum. Compute vacuum level to be obtained by subtracting 1 inch of vacuum for each 1000 feet of elevation above sea level.

If 28 inches of vacuum (sea level) cannot be obtained, or if vacuum drop with vacuum pump off is more than 2 inches in 5 minutes, then open cylinder valve to charge system at ambient cylinder pressure. Close cylinder valve, test the system for leaks using appropriate equipment (ref. subpar. "d"), and correct any leaks found. Repeat preceding step 4.

5. Primary charge system at ambient cylinder pressure by opening cylinder valve.

6. Final evacuate system by closing cylinder valve, starting vacuum pump, and slowly opening shut-off valve. Maintain 28 inches of vacuum for 10 minutes and then close shut-off valve and stop vacuum pump.

7. Close high pressure valve on manifold and gauge set.

8. Place cylinder in a bucket of water which does not exceed 125°F. Weigh cylinder and bucket of water, and record weight.

CAUTION: Never heat cylinder above 125°F. as dangerous hydrostatic pressures result in cylinder. When there is danger of cylinder overheating, a suitable pressure relief valve should be connected into the circuit. It may be necessary to reheat the water during charging operation to maintain proper temperature.

9. Open cylinder valve, idle engine and operate compressor until 3-3/4 lbs. of refrigerant-12 have been charged into the system.

NOTE: It may be necessary to move temperature lever on instrument panel from OFF to MED positions approximately 12 times to normalize the piston diaphragm in the suction throttling valve.

10. Close valve on refrigerant-12 cylinder, low pressure valve, and remove cylinder from bucket of water.

11. Perform functional test (ref. subpar. "c").

12. Remove gauge charging lines from system and replace protective caps over Schrader valve fittings and tighten securely.

## 11-19 SERVICING AIR DISTRIBUTION COMPONENTS

### a. Adjustment of Temperature Control Lever and Temperature Door

NOTE: It is suggested that control wires regulating the position of the temperature control lever and the temperature door be adjusted when: air conditioner heater control assembly has been removed, or when temperature door does not properly regulate the mixing of, or blocking off of heated air.

The following adjustment procedure is based on the assumption that the control wire involved is completely disconnected. Minor after installation adjustments of the temperature lever may be accomplished, without disconnecting the control wire, by rotation of the control wire adjuster nut.

Adjustment of the vacuum diaphragms of the suction throttling valve, and outside air inlet door, although actuated by the temperature lever, is not treated in the following adjustment procedure. Refer to subparagraph 11-18, "r" for adjustment of suction throttling valve vacuum diaphragm. No adjustment is possible for the vacuum diaphragm of the water valve. The linkage between the outside air inlet door and the vacuum diaphragm on the plenum blower and air door assembly may be adjusted. To adjust, the plenum blower and air door assembly must be removed (ref. subpar. 11-19 "c"). Method of adjustment will be obvious on inspection.

1. Connect temperature control wire to respective pin on heater and defroster control assembly (see Figure 11-19) and secure in position.

2. Loose assemble temperature control wire to pin located on cam of temperature door.

3. Place temperature control lever in OFF position, hold temperature door closed, and secure control wire in position at temperature cam.

4. Rotate adjuster nut until 1/8 to 3/16 inch springback exits when temperature control lever in OFF position.

### b. Adjustment of Air Control Lever, Defroster Door, Diverter and Deflector Doors

NOTE: It is suggested that the control wires regulating the action of the air control lever and the related doors be adjusted when: recommended springback of 1/8 to 3/16 inch not present, air conditioner heater control assembly has been removed, or when diverter, deflector, or defroster doors do not properly regulate flow of air.

The following adjustment procedure is based on the assumption that all control wires involved are completely disconnected. Minor after installation adjustment of the air lever, diverter and deflector doors may be accomplished, without disconnecting the control wires, by rotation of the control wire adjuster nut.

1. Connect defroster control wire to respective pin on heater and defroster control assembly (see Figure 11-19) and secure in position.

2. Loose assemble defroster control wire to pin located on lever of defroster valve.

3. Move air control lever to OFF position, hold defroster door closed and secure control wire in position at defroster lever.

4. Connect diverter control wire to respective pin on heater and defroster control assembly and secure in position.

5. Secure opposite end of control wire to diverter lever on heater assembly.

6. Insure that air control lever is in OFF position and rotate the control wire adjuster nut until: (1) approximately 1/8 to 3/16 inch springback is obtained when the air control lever is in OFF position, (2) approximately 1/16 inch clearance exists between surface of heater and defroster control assembly pin and edge of slot in control assembly (see Figure 11-19).

NOTE: The air control lever will lock in the mid (HTR) position if less than 1/8 inch springback occurs. The diverter door will not fully open if more than 3/16 inch springback exists.

### c. Adjustment of Master Vacuum Switch

To adjust vacuum switch on air conditioner heater and defroster control assembly proceed as follows:

1. Position the FAN switch lever to OFF.

2. Loosen the vacuum switch attaching screws and move the switch forward until the plunger is fully depressed.

3. Secure vacuum switch in position.

### d. Adjustment of Throttle Advance Vacuum Switch (V-6 Only)

To adjust vacuum switch on air-conditioner-heater assembly proceed as follows:

1. Position A/C control lever to A/C position.

2. Loosen vacuum switch attaching screws and move switch forward until the plunger is fully depressed.

3. Secure vacuum switch in position.

### e. Removal and Installation of Plenum Blower and Air Door Assembly

REMOVAL

1. Remove right front wheel.

2. Draw an arc on inside of fender skirt 11 inches from upper bolt on wheel opening (see Figure 11-13). Draw another arc 16-3/4 inches from lower bolt of wheel opening. Punch a dimple at the intersection of the arcs.

3. Drill a 3/4 inch hole through the inner fender skirt at the dimple.

4. Remove lower right attaching nut from heater assembly stud through hole in fender skirt.

5. Remove remaining four attaching nuts from heater assembly studs.

6. Remove four screws securing upper portion of plenum blower and air door assembly to cowl (see Figure 11-110).

7. Loosen screws on duct located between evaporator and plenum blower and air door assemblies.

8. Disconnect vacuum hose from vacuum diaphragm of outside air inlet door.

9. Disconnect blower motor wire, resistor assembly lead, and compressor lead. Pull vacuum hose grommet from plenum blower and

air door assembly and separate rubber plug from grommet.

10. Withdraw plenum blower and air door assembly from cowl and lift out.

INSTALLATION

11. Install assembly reverse of removal.

NOTE: During installation, mating edges between the assembly and cowl must effect a good seal. Use body sealer as required along edges of plenum chamber and also recirculate to outside air dividing rib of plenum chamber.

12. Plug hole in inner fender skirt using a 3/4 inch body plug (Group No. 12.980, Part No. 4725594) and body sealer.

### f. Removal and Installation of Air Conditioner Heater Assembly

REMOVAL

1. Remove right front wheel.

2. Draw an arc on inside of fender skirt 11 inches from upper bolt on wheel opening (see Figure 11-13). Draw another arc 16-3/4 inches from lower bolt of wheelhouse opening. Punch a dimple at the intersection of the two arcs.

3. Drill a 3/4 inch hole through the inner fender skirt at the dimple.

4. Remove nut from lower right hand stud of heater-air conditioning assembly.

5. Remove remaining four attaching nuts from heater-air conditioner assembly.

6. Remove glove box, disconnect air conditioner outlet hoses from distributor duct (see Figure 11-111). Remove two screws securing duct to heater assembly and take out duct.

7. Disconnect temperature, diverter, and defroster control wires (see Figure 11-19).

8. Remove rear retainer and seal assembly (see Figure 11-111) and pull out air conditioner heater assembly.

INSTALLATION

9. Install heater assembly reverse of removal and check for proper operation of control levers.

10. Plug hole in inner fender skirt using a 3/4 inch body plug (Group No. 12980, Part No. 4725594) and body sealer.

### g. Removal and Installation of Air Conditioner Control Assembly

REMOVAL

1. Remove five screws and take out exterior cover assembly (see Figure 11-114).

2. Remove four screws from control trim bezel and take out bezel.

3. Remove ash tray assembly and take out screw holding support to radio receiver.

4. Remove four screws securing instrument panel insert (see Figure 11-114) to instrument panel and partially withdraw insert. Disconnect radio lead and antenna lead connectors and complete removal of assembly.

5. Remove three screws securing control assembly to instrument panel and partially withdraw control assembly.

6. Disconnect all attached control wires, clutch compressor switch and heater blower switch connectors, vacuum hoses, and lamp holder from heater and defroster control assembly. Complete removal of assembly.

INSTALLATION

7. Install control assembly reverse of removal and check controls for proper operation.

## 11-20 TROUBLE DIAGNOSIS

The following is a brief description of the type of symptom each refrigerant component will evidence if a malfunction occurs:

### a. Compressor

Compressor malfunction will appear in one of four ways: noise, seizure, leakage, or low discharge pressure.

NOTE: Resonant compressor noises are not cause for alarm; however, irregular noise or rattles are likely to indicate broken parts. To check seizure, deenergize the magnetic clutch and check to see if drive plate can be rotated. If rotation is impossible, compressor is seized. To check for a leak, refer to subparagraph 11-18 "d". Low discharge pressure may be due to a faulty internal seal of the compressor, or a restriction in the compressor.

NOTE: Low discharge pressure may also be due to an insufficient refrigerant charge or a restriction elsewhere in the system These possibilities should be checked prior to servicing the compressor. If the compressor is inoperative; however, is not seized, check to see if current is being supplied to the magnetic clutch coil terminals.

### b. Condenser

A condenser may malfunction in two ways: it may leak, or it may be restricted. A condenser leak will be evidenced by low system pressure. A condenser restriction will result in excessive compressor discharge pressure. If a partial restriction is present, sometimes ice or frost will form immediately after the restriction as the refrigerant expands after passing through the restriction. If air flow through the condenser or radiator is blocked, high discharge pressures will result. During normal condenser operation, the outlet pipe will be colder than the inlet pipe.

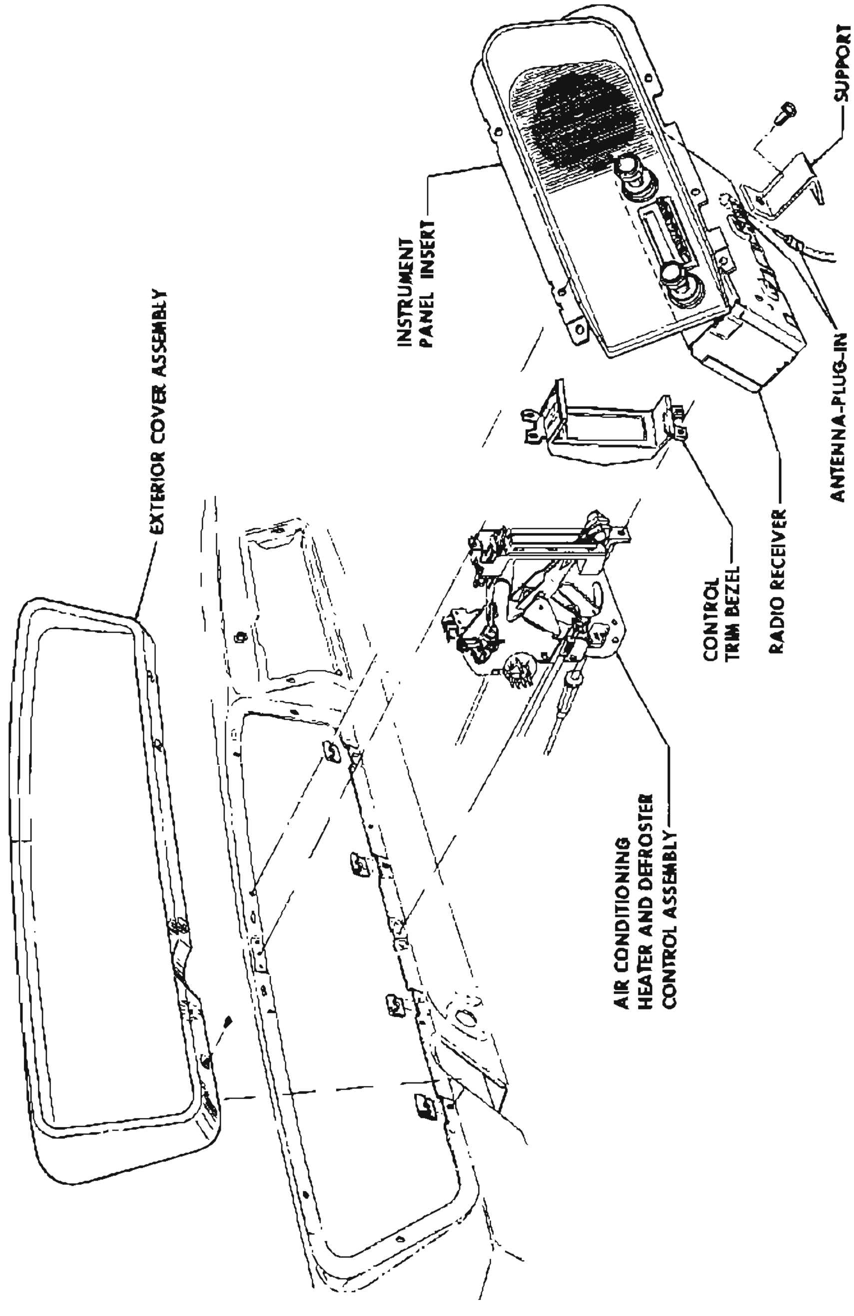



Figure 11-114—Air Conditioner Heater and Defroster Control Assembly Installation

### c. Receiver-Dehydrator

A receiver-dehydrator may fail due to a restriction inside of body of the unit. A restriction at the inlet to the receiver-dehydrator will cause high head pressures. Outlet tube restrictions will be indicated by low head pressures and little or no cooling. An excessively cold receiver-dehydrator outlet may be indicative of a restriction.

### d. Expansion Valve

Expansion valve failures usually will be indicated by low suction and discharge pressures, and insufficient evaporator cooling. The failure is generally due to malfunction of the power element and subsequent closing of the valve. A less common cause of the above symptom is a clogged inlet screen.

### e. Evaporator

When the evaporator malfunctions, the trouble will show up as inadequate supply of cool air. A partially plugged core due to dirt, a cracked case, or a leaking seal will generally be the cause.

### f. Suction Throttling Valve

If the suction throttling valve is defective, it may cause evaporator pressure (hence air temperature) to be either too high or too low depending on the type of failure. Prior to servicing valve, perform adjustment procedures (ref. subpar. 11-16 "r"). If vaporator pressure remains high after adjusting, the expansion valve may be malfunctioning.

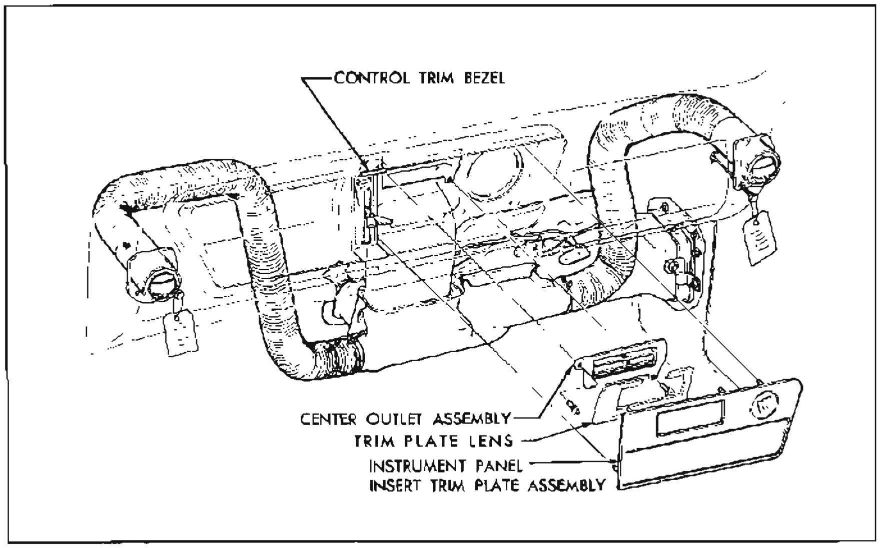



Figure 11-115—Dash Units Installation

### g. Refrigerant Line Restrictions

Restrictions in the refrigerant lines will be indicated as follows:

1. Suction - A restricted suction line (see Figure 11-27) will cause low suction pressure at the compressor, low discharge pressure and little or no cooling.

2. Discharge Line - A restriction in the discharge line generally will cause the pressure relief valve to open.

3. Liquid Line - A liquid line restriction will be evidenced by low discharge and suction pressure, and insufficient cooling.

### h. Use of Receiver Sight Glass for Diagnosis

At temperatures higher than 70°F., the sight glass may indicate whether the refrigerant charge is sufficient. A shortage of liquid refrigerant is indicated after about five minutes of compressor operation by the appearance of slow-moving bubbles (vapor) or a broken column of refrigerant under the glass. Continuous bubbles may appear in a properly charged system on a cool day. This is a normal situation. If the sight glass is generally clear and performance is satisfactory, occasional bubbles do not indicate refrigerant shortage.

If the sight glass consistently shows foaming or a broken liquid column, it should be observed after partially blocking the air to the condenser. If under this condition the sight glass clears and the performance is otherwise satisfactory, the charge shall be considered adequate.

In all instances where the indications of refrigerant shortage continues, additional refrigerant should be added in 1/4 lb. increments until the sight glass is clear. An additional charge of 1/2 lb. should be added as a reserve. In no case should the system be overcharged.

## TROUBLE-SHOOTING TABLE

| TROUBLE AND SYMPTOM | CAUSE AND CORRECTION |
|---|---|
| 1. Insufficient Cooling | |
| a. Low air flow | a. Check that blower is operative, proper door operation, obstructions, or iced evaporator core. Check adjustment of suction throttling valve (ref. subpar. 11-18 "r"). |
| b. Air temperature not cool | b. Check suction throttling valve and adjust if necessary (ref. subpar. 11-18 "r").<br>Check that water valve is closed. |
| c. Improper operation of system | c. Vents and windows open, and/or improper operation of controls. Correctly advise owner. |
| NOTE: If the above corrections do not remedy the complaint, perform the functional test (ref. subpar. 11-18 "c"). If complaint is not corrected, check items 2, 3, 4 and 5 of this table. | |
| 2. Compressor Discharge Pressure Too High | 2. Engine overheated (refer to Section 2 of this manual for correction).<br>Overcharge of refrigerant in system. Release pressure slowly.<br>NOTE: If pressure drops rapidly, air or moisture in the refrigerant is indicated. A slow decrease in pressure indicates only an excessive refrigerant charge. Release pressure until pressure gauges are within specifications (ref. Figure 11-47) or pressure drop levels. Release just enough additional refrigerant to cause bubbles or foam to appear in the receiver-dehydrator sight glass. Recharge to eliminate bubbles or foam, and then add additional 1/2 lb. of refrigerant. If system pressures remain high and are not corrected, there is possibility a restriction in the high pressure side of the system.<br>Restriction in condenser or receiver-dehydrator. Repair or replace as applicable. Condenser air flow blocked. Clean fins of condenser and radiator. Also refer to item 4 of this table. |
| 3. Compressor Discharge Pressure Too Low | |
| a. Bubbles or foam under indicator sight glass | a. Insufficient refrigerant charge (ref. subpar. 11-18, "c"). Charge system until sight glass clears and then add an additional 1/2 lb of refrigerant. |

## TROUBLE-SHOOTING TABLE (Cont.)

| TROUBLE | CAUSE & CORRECTION |
|---|---|
| 3. Compressor Discharge Pressure Too Low (Cont'd.) | |
| b. Inadequate cooling | b. Defective compressor such as broken reed valves, leaking internal seal. Repair compressor as required (ref. subpar. 11-18, "k"). |
| 4. Evaporator Pressure Too High | 4. Capillary bulb loose. Secure bulb to evaporator outlet pipe. Check expansion valve and/or suction throttling valve. Replace or adjust, whichever applicable. |
| 5. Evaporator Pressure Too Low and Core Freezing | 5. Check expansion valve and clean or replace as necessary. Check for restriction in liquid lines and correct as necessary. Check and adjust suction throttling valve if necessary (ref. subpar. 11-18, "r"). |

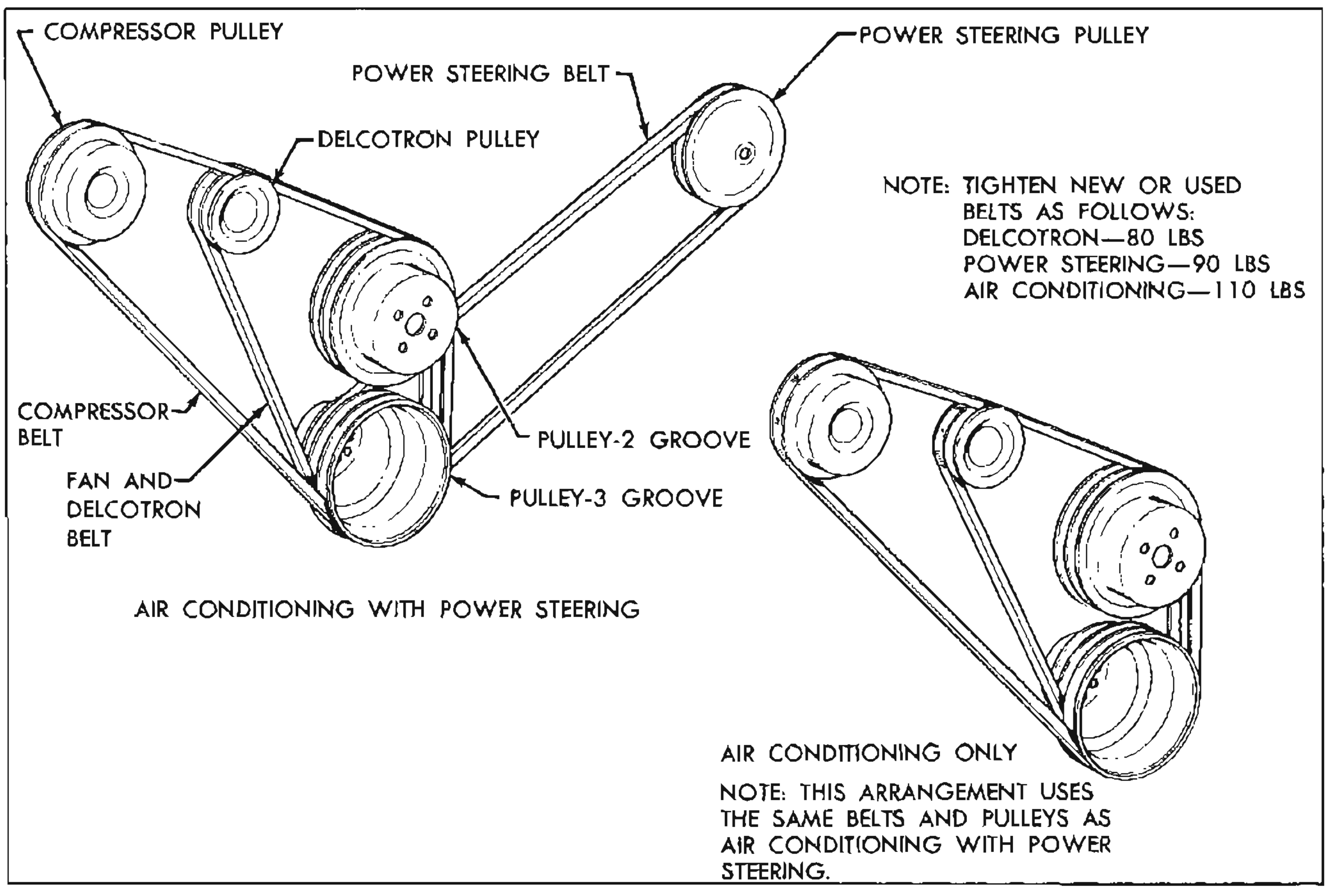



Figure 11-116—Belt and Pulley Installation

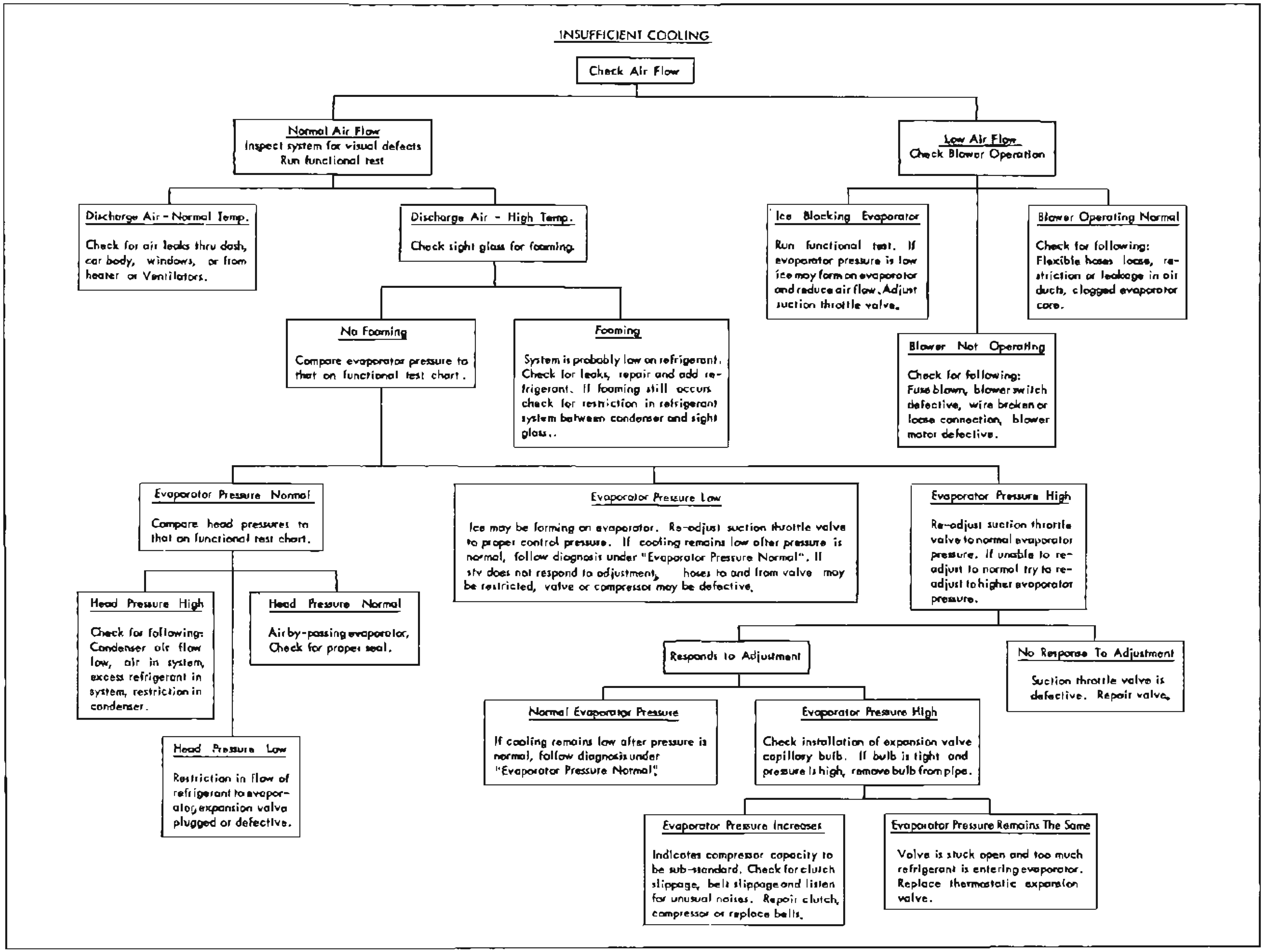



Figure 11-117—Air Conditioner Trouble Diagnosis Chart

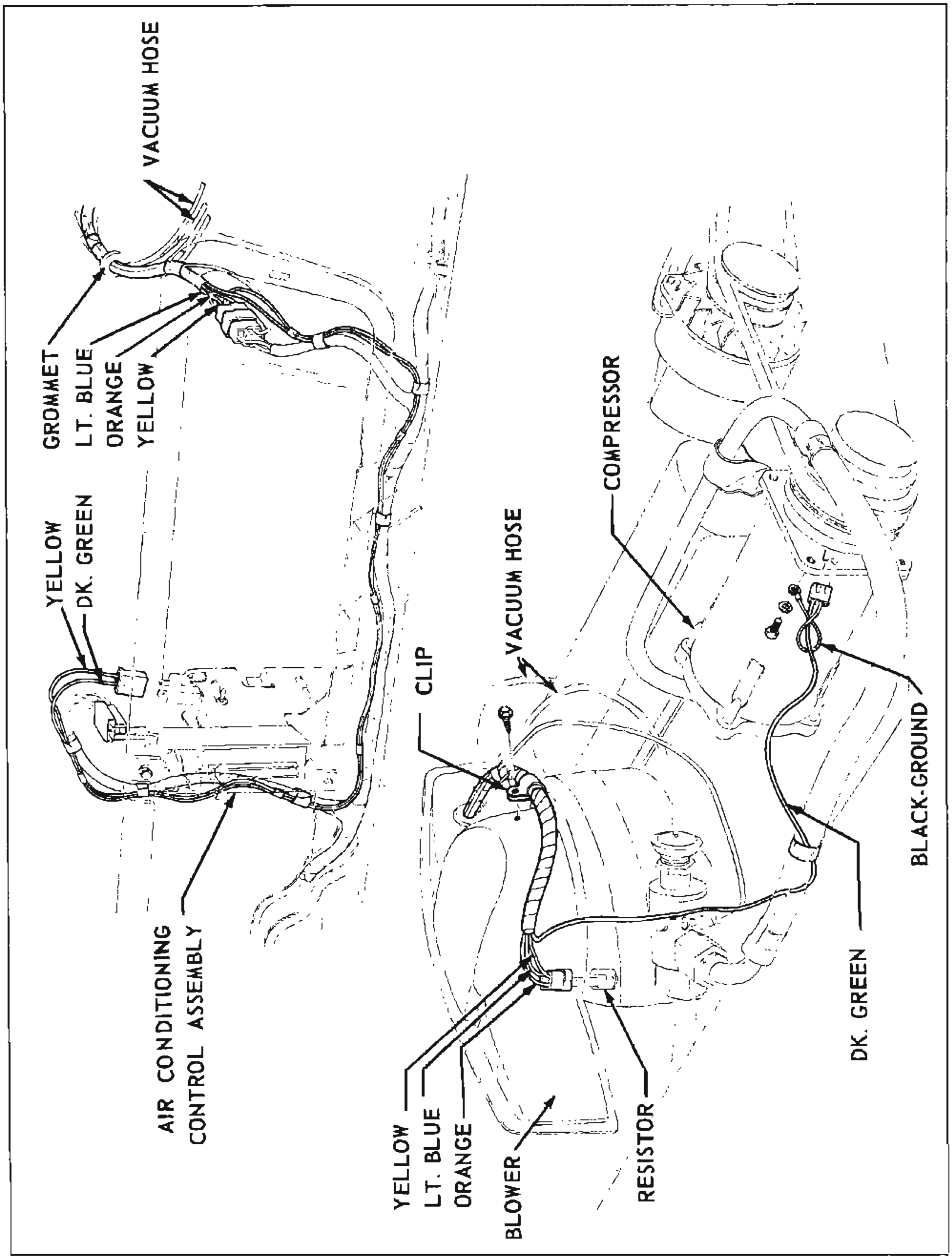



Figure 11-118—Air Conditioner Wiring Installation

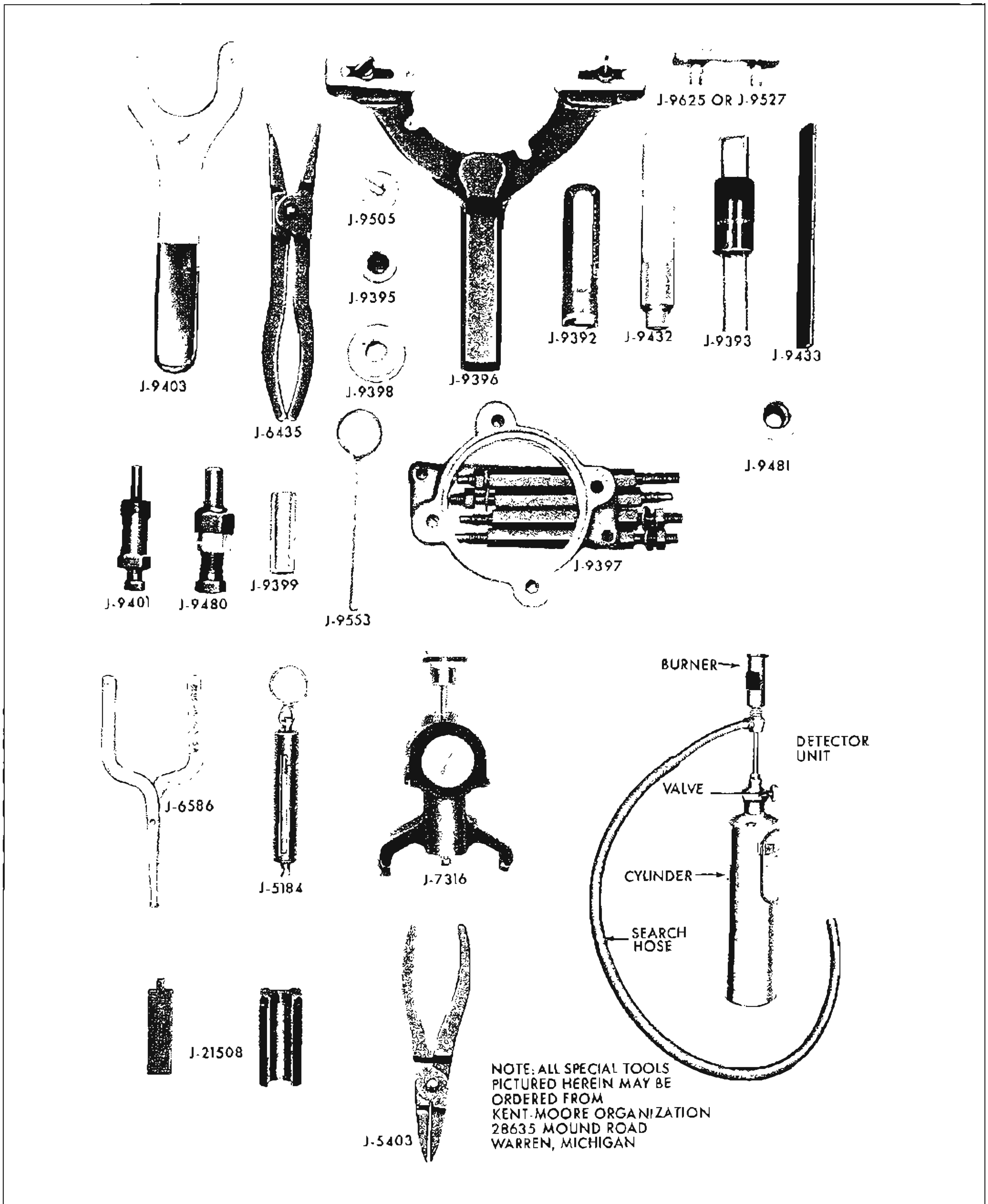



Figure 11-119—Special Tools (Page 1 of 2)

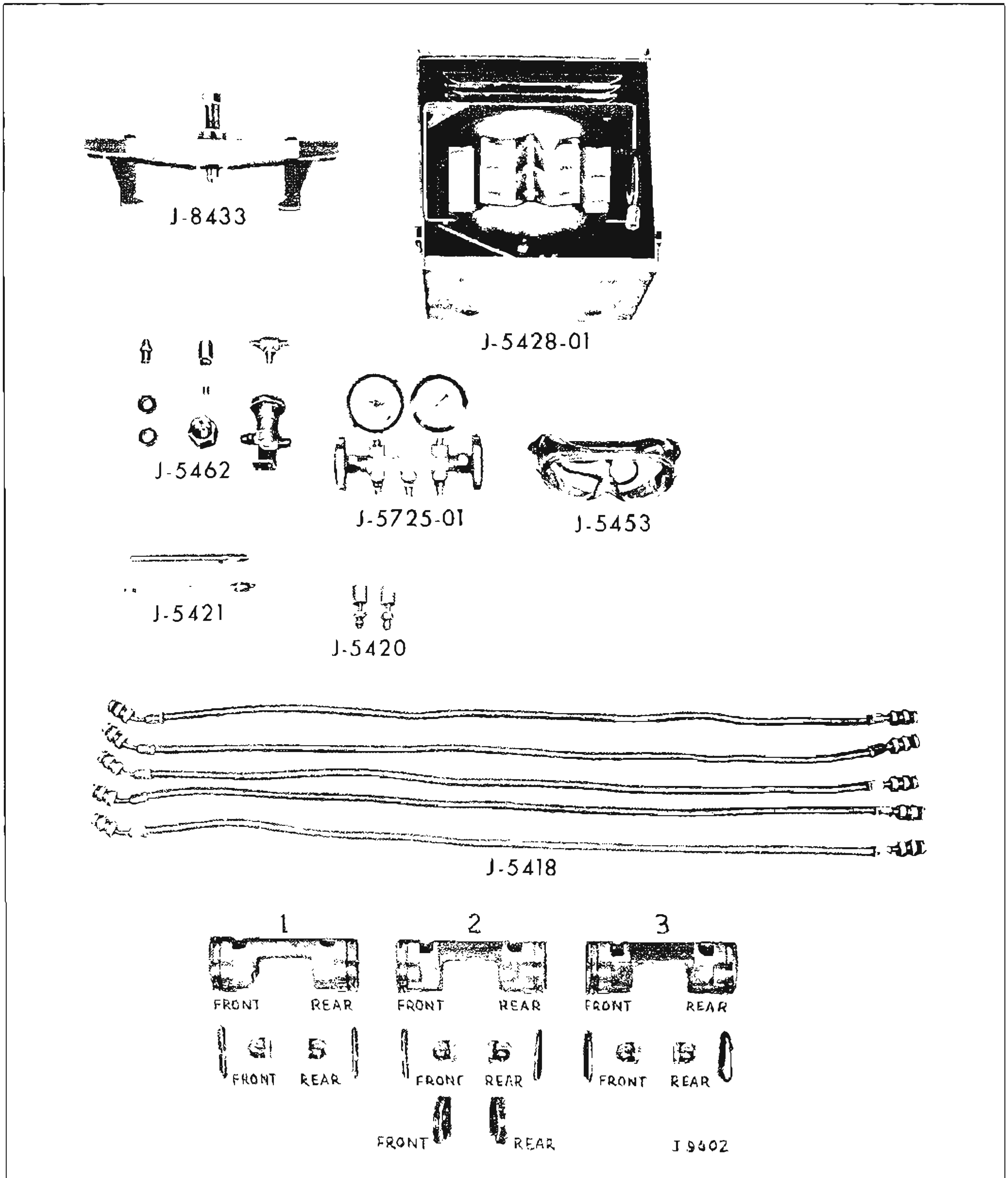



Figure 11-119—Special Tools (Page 2 of 2)

# SECTION 11-D

# REMOTE CONTROL OUTSIDE MIRROR, REAR WINDOW DEFROSTER, AND TACHOMETER INSTALLATIONS

CONTENTS OF SECTION 11-D



## 11-21 SERVICING ACCESSORIES

The following accessories pictured herein are provided as optional equipment on 1965 Buick 43000 and 44000 Series cars. The servicing, such as removal and installation, of the accessory components will be obvious when viewing the installation illustrations contained on the following pages.

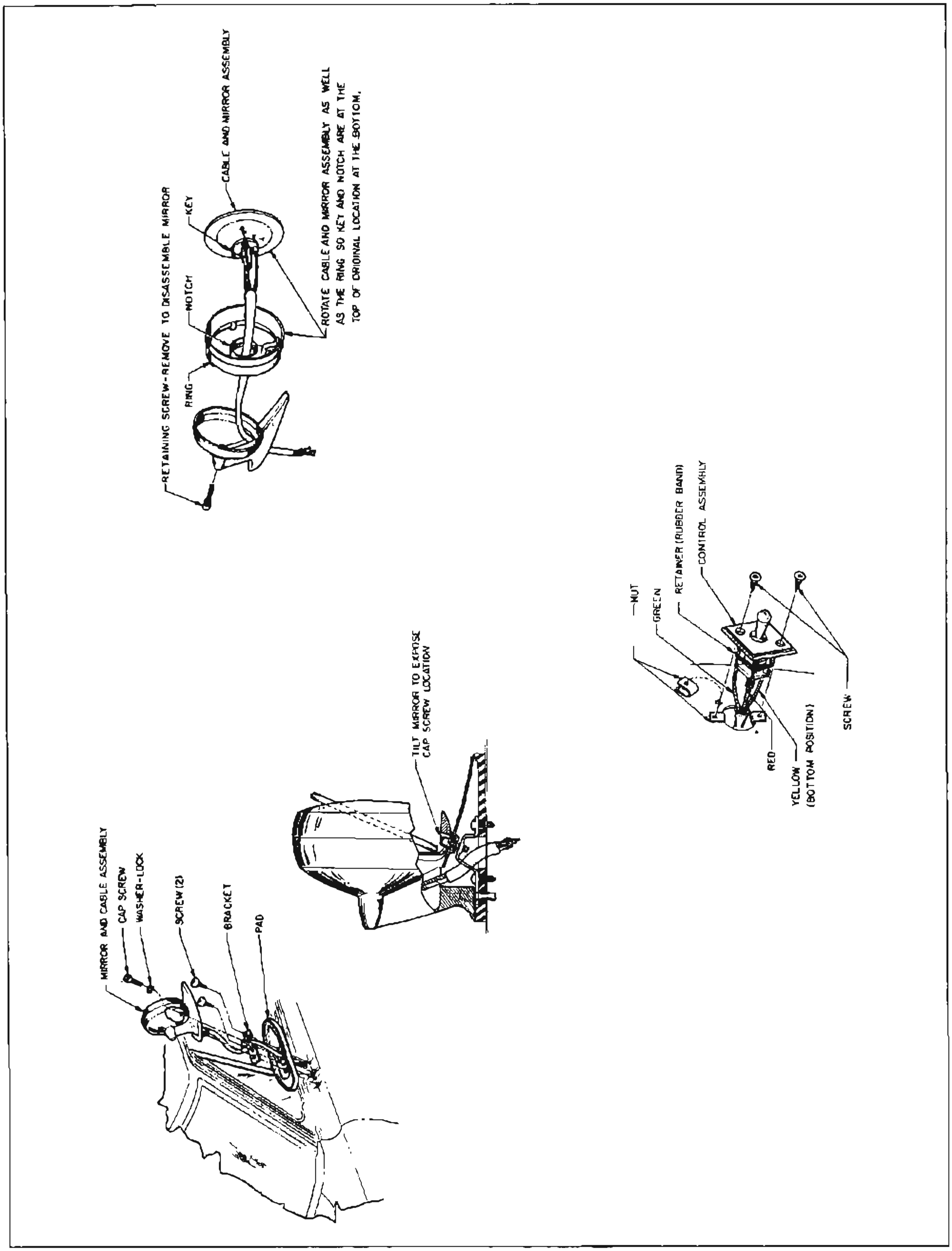



Figure 11-120—Remote Control Outside Mirror Installation

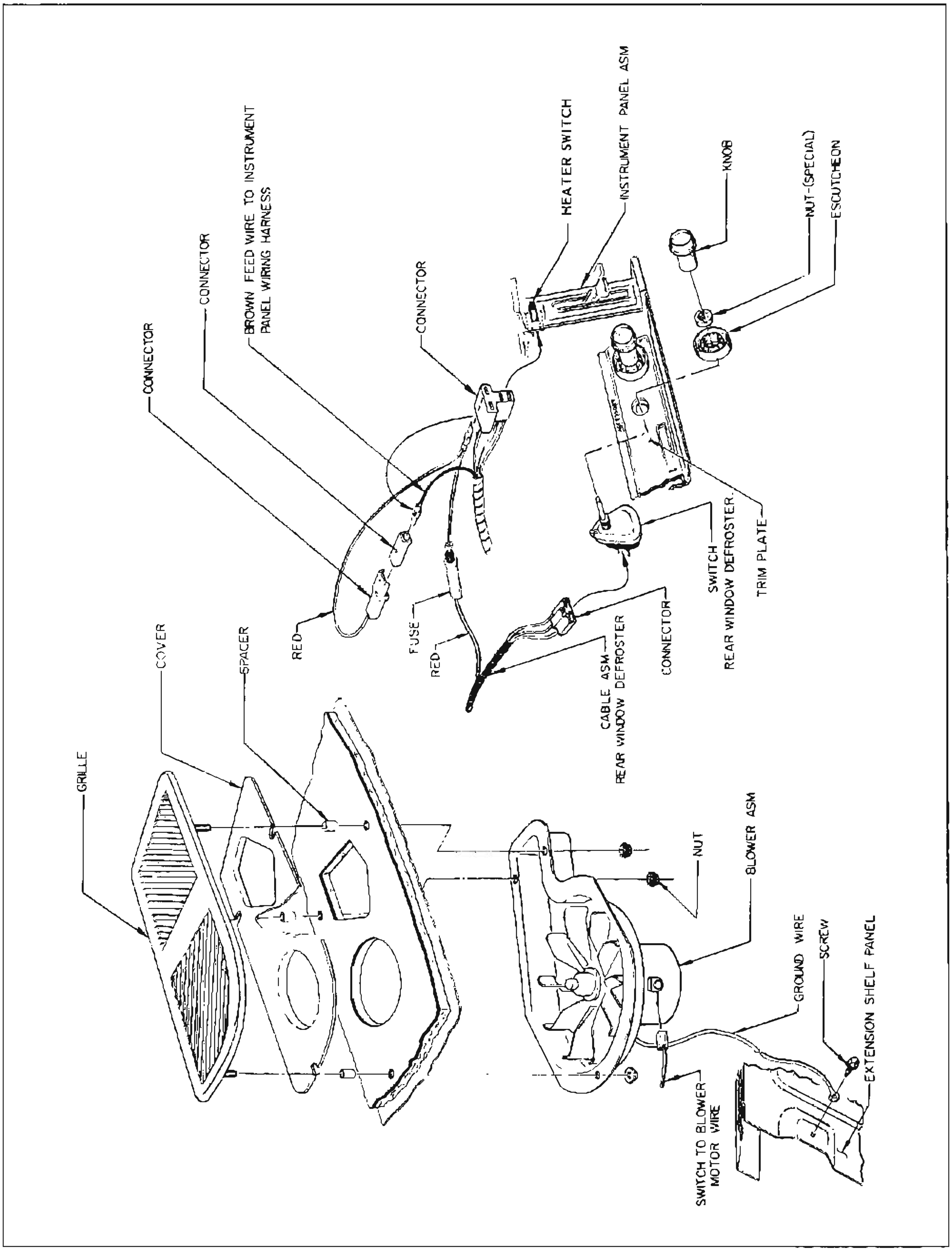



Figure 11-121—Rear Window Defroster Blower and Switch Installation

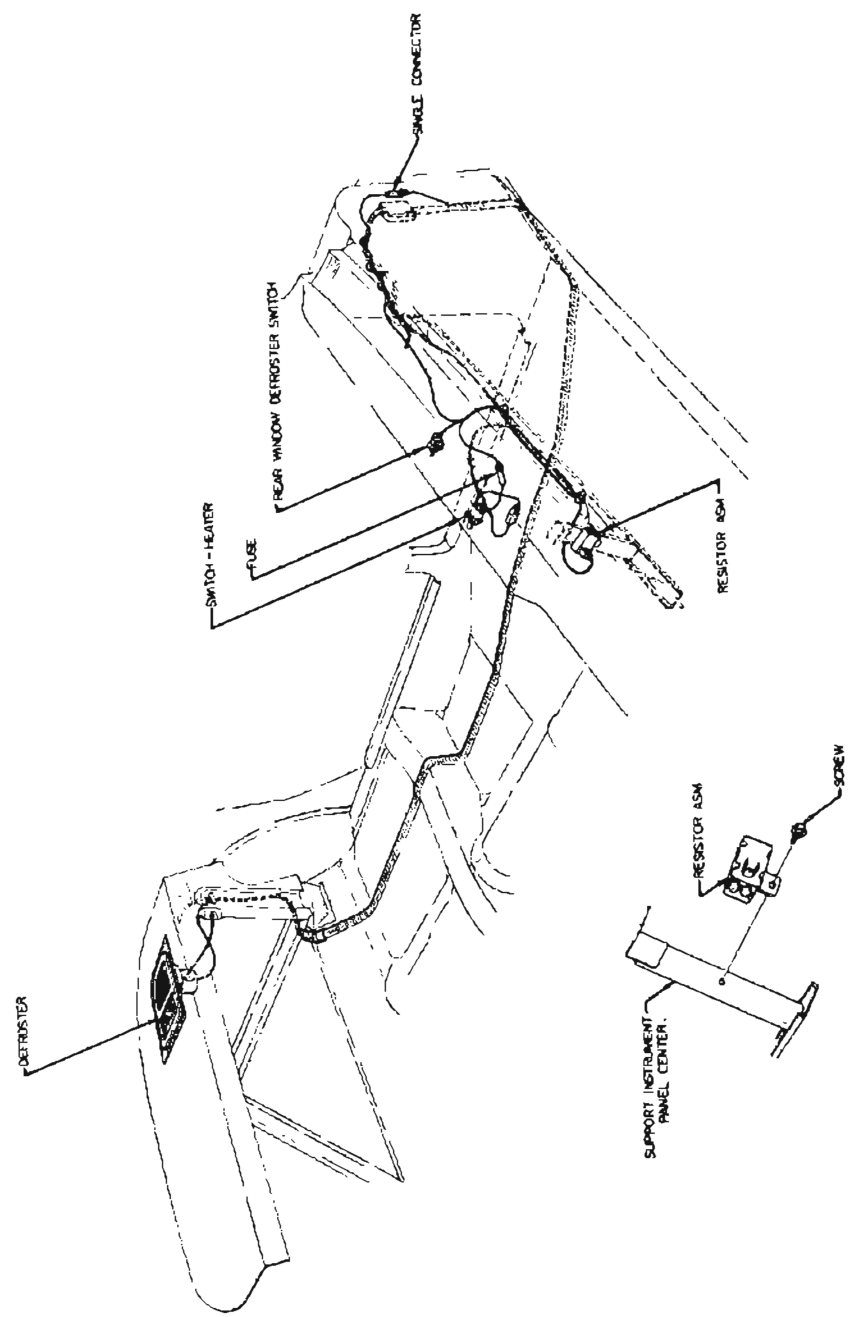



Figure 11-122—Rear Window Defroster Wiring Installation

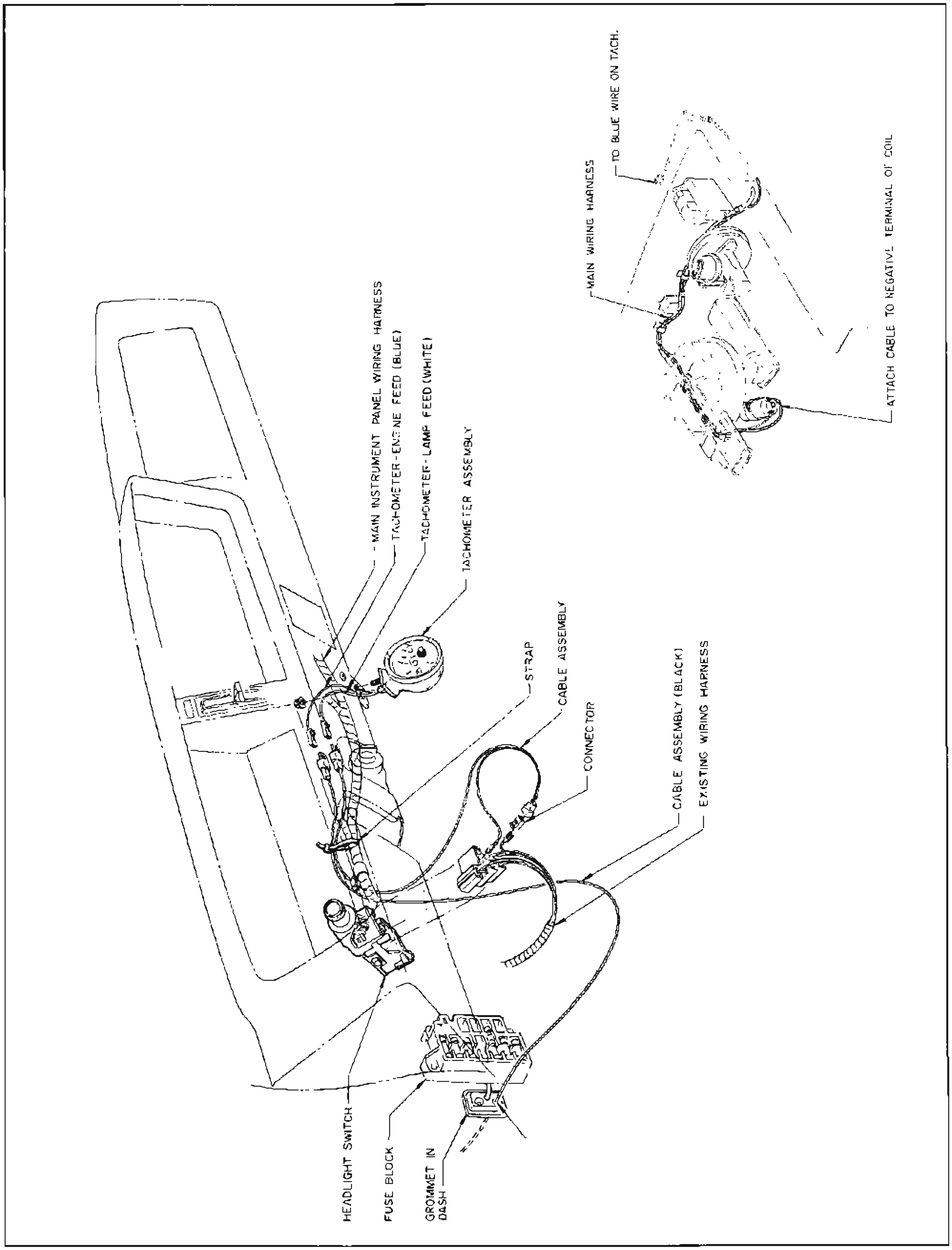



Figure 11-123—Tachometer Installation

# GROUP 12
# SHEET METAL AND BUMPERS

CONTENTS OF GROUP 12



## 12-1 DESCRIPTION OF FRONT END SHEET METAL

The front sheet metal parts are attached directly to the inner fender skirts and the frame to provide rigidity with a minimum of vibration. The radiator assembly is suspended by "U"-shaped, rubber-faced bracket assemblies. The lower brackets attach to the lower radiator cross support. On V-8 models, two upper radiator brackets attach to the radiator upper tie bar; on V-6 models, one bracket attaches to the upper tie bar. The fan shroud attaches to the upper bracket arrangement on both V-8 and V-6 models.

## 12-2 HOOD ASSEMBLY REMOVAL AND REPLACEMENT

### a. Removal

1. Prop the hood in the open position and place the protective covering at top of cowl and on fenders.

2. Scribe a reference line along edge of each hinge flange so hood can be replaced in same position.

3. Remove hinge to hood bolts shown in Figure 12-1. Then lift hood from car.

### b. Installation

1. Protect top of hood and fenders with a covering.

2. Place hood in position over hinges and loosely install attaching four bolts and washers.

3. Prop hood in open position, and place hinge to hood attaching plate within scribe marks and torque bolts to 15 ft. lbs.

4. Remove prop and protective covering. Adjust if necessary.

## 12-3 HOOD ADJUSTMENT

1. Rear Height. Rear hood height is determined by slots in the hood hinge.

2. Front Height. This is determined by two adjustable bumpers. (See Figure 12-1.) However, the front of the hood may not contact these bumpers unless the hood latch is correctly adjusted as described in Step 4.

3. Latch Tension.

a. Raise hood of car.

b. Loosen three bolts attaching latch to panel assembly. (See Figure 12-8).

c. Close hood; hood will align itself in hood lock catch.

d. Raise hood carefully and tighten all four bolts on the panel assembly to a torque of 10-15 ft. lbs. Close hood to check alignment.

## 12-4 REMOVAL AND INSTALLATION OF HOOD SPRINGS

1. Remove hood as described in paragraph 12-2, Steps 1-3.

2. To remove hood spring, insert Remover and Installer J-9214 through loop in forward end of spring with bend of tool approximately one inch from loop. Using inside corner formed by hinge as a pivot, unseat spring from notch.

3. Then push tool forward, causing hood spring to slide clear of hinge.

4. To replace hood spring, insert Remover and Installer J-9214 through loop in forward end of spring. Using hinge as a pivot, seat spring into notch.

## 12-5 REMOVAL & INSTALLATION OF HOOD HINGE

### a. Removal

1. Prop the hood in the extreme open position and place protective covering over the cowl panel and fenders.

2. Scribe position of the hood hinge on the hood and remove two bolts. Remove hood as described in paragraph 12-2, Steps 1-3.

3. Scribe position of the hinge attachment on wheelhouse. Remove the two bolts attaching the front of the hinge to the wheelhouse (Figure 12-12) and remove the hinge.

### b. Installation

1. Align hood hinge with scribe marks on wheelhouse and install

three bolts and washers attaching the hinge to the wheelhouse. Do not tighten.

2. Replace the hood as described in paragraph 12-2, Steps 1-3.

3. Close hood and align flush with cowl and fenders.

4. Raise hood and tighten all mounting bolts to 15 ft. lbs.

5. Remove all protective coverings.

## 12-6 HOOD, FENDER, AND BUMPER ALIGNMENT INSPECTION & ADJUSTMENT

The hood, front fenders and bumper must be aligned with each other on every car to take care of slight variations in form and dimensions of the individual parts. Sheet metal parts stamped in a given set of dies will vary somewhat in form and dimensions due to variations in the hardness of different batches of sheet metal, which cause the stampings to spring in varying amounts when released from the form dies.

The hood and front fenders are properly aligned during the installation at the factory; however, some readjustment may be required after a car has been shipped or has been in service for some time. In judging the need for readjustment it must be understood that exactly uniform fit and spacing cannot be obtained on all cars of a given model.

### a. Preliminary Tightening

Before deciding upon any adjustment to correct hood or fender misalignment, it is advisable to check tightness of all attaching screws and bolts, since a true picture of correction requirements cannot be obtained when the sheet metal is loose and free to shift.

After all parts are properly tightened, inspect fender and hood alignment (subpar. c) and hood alignment (subpar. d). Make all inspections before performing any adjustments because an adjustment at one point will usually alter alignment at other points. The preliminary inspection should determine the adjustments that will produce the best overall alignment of hood and fenders at all points.

### b. Hood Noises or Panel Flutter

Squeaks or grunting noises in the hood when driving over rough roads do not necessarily indicate misalignment of hood and fenders. These noises may be caused by metal contact at some point where clearance should exist or by worn or dry hood bumpers.

If the hood squeaks, check for uniform clearance all around the hood, fenders and cowl. If an edge of metal is making contact at any point where clearance should exist, a bright metal spot will usually be found. Such spots may be depressed by spring hammering to provide clearance.

A grunting noise in the hood is usually caused by dry rubber bumpers or cowl ledge lacing. Lubricate all rubber bumpers on fender rails and cowl with silicone rubber lubricant. To correct a persistent case of squeaking or grunting where hood top panel contacts ledge lacing, even when lubricated, cement a 1/16 inch thick strip of felt to panel where the lacing makes contact.

To prevent hood panel flutter, the rear end of the hood panel must have firm contact with the rubber bumpers and lacing attached to cowl ledge. The hood may be raised or lowered by adjustment at hinges. (See Figure 12-1).

### c. Fender and Hood Alignment at Front Doors

With front doors closed there should be no metal-to-metal contact between doors and rear ends of front fenders. Check for clearance at frequent points, using a strip of fibre or other soft material 1/32 inch thick. The spacing between rear end of front fenders and the shoulder on front edge of doors should be approximately 1/8 inch and fairly uniform from top to bottom.

Before making any adjustment of sheet metal to provide necessary clearance at points mentioned, first make sure that front doors are properly aligned in the body openings. If fender and door panel surfaces are not reasonably flush, correction may be made by adding or removing shims between the fender and the cowl.

See Figure 12-4. Where spacing between rear edge of front fender and door is objectionably uneven from top to bottom, it may be necessary to loosen fender attaching bolts and pry between fender and rocker panel to have fender into position; then retighten bolts.

Up and down adjustment of the lower rear edge of the front fender is accomplished by shimming at the fender to body attaching point shown in Figure 12-3. The fender line should be flush with the rocker panel.

### d. Hood Alignment Inspection

When closed and latched, the hood should bear firmly against the rubber bumpers on upper tie bar panel and on edge of fenders. Height of hood and width of space between hood and fenders should be reasonably even from front to rear. See paragraph 12-3 for adjustment.

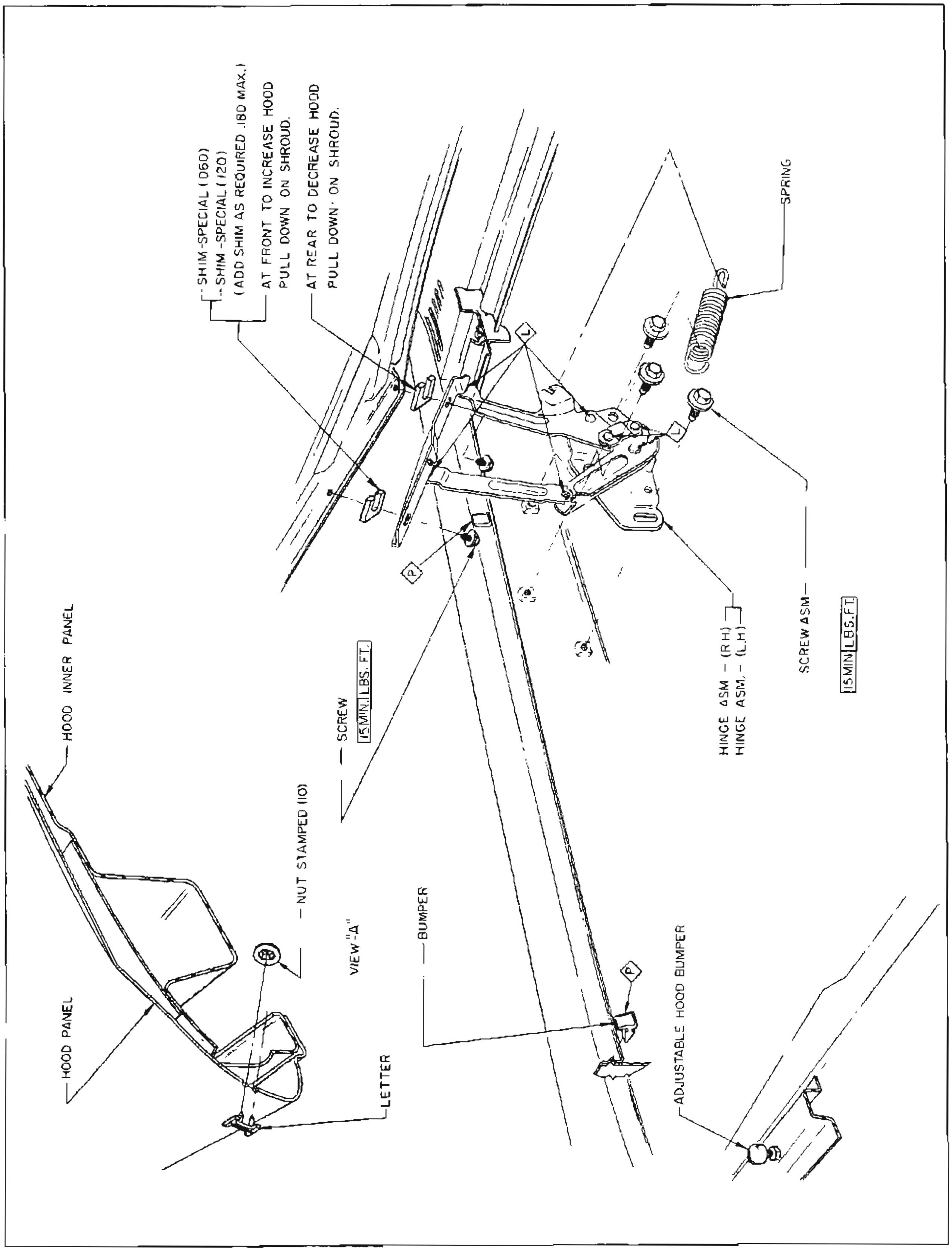



Figure 12-1—Hood Installation

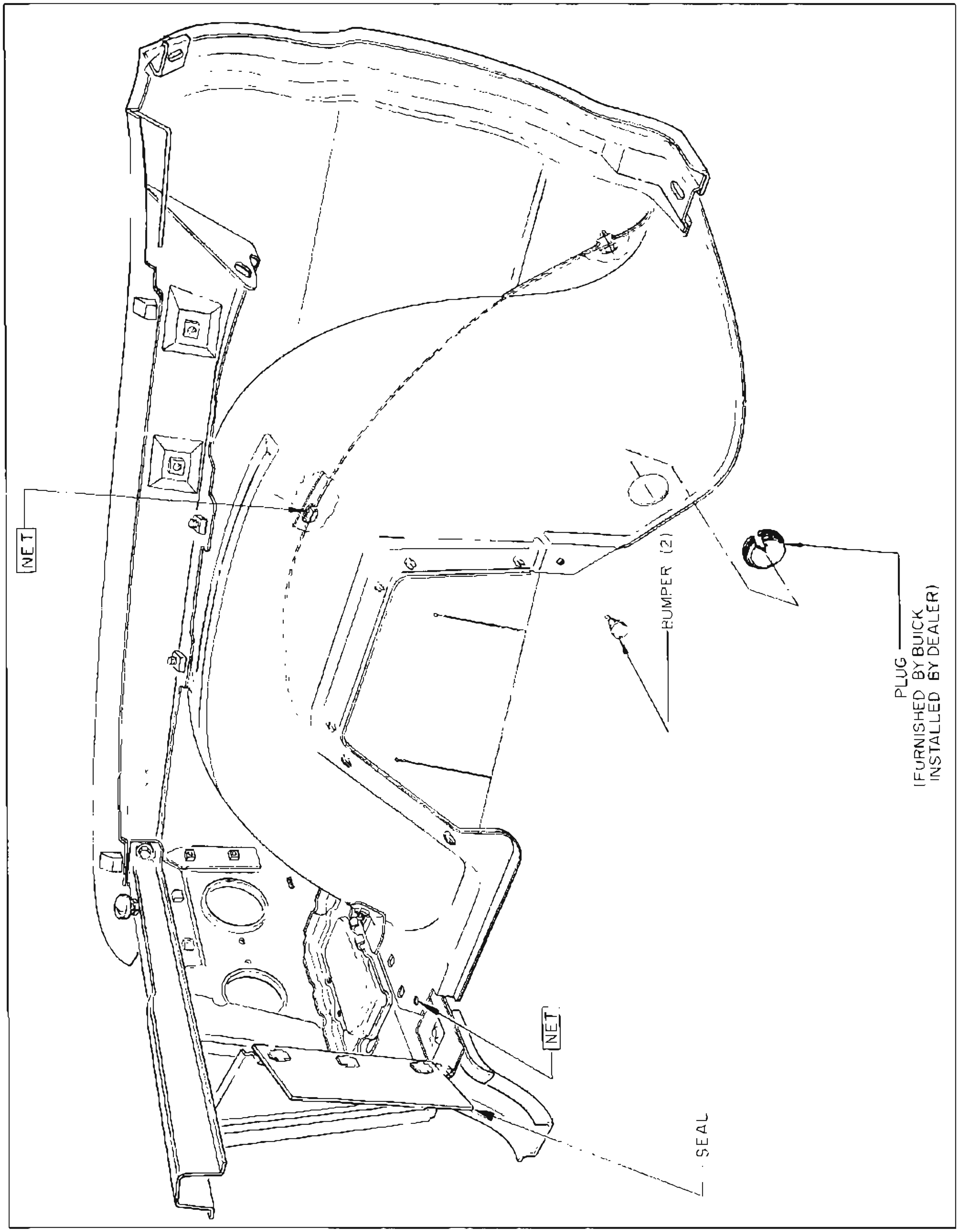



Figure 12-2—Front Fender and Skirt Installation

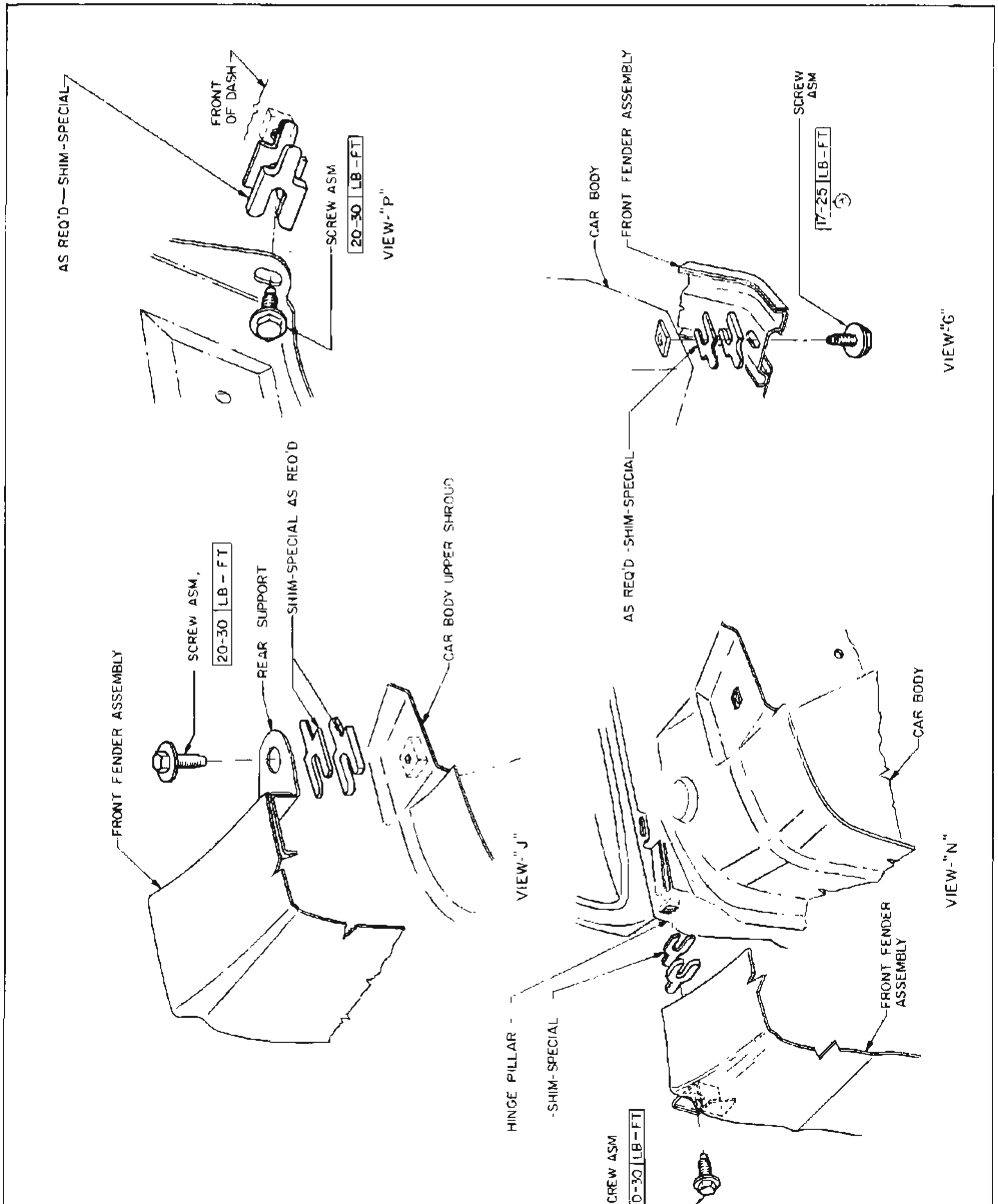



Figure 12-3—Front Fender and Skirt Installation

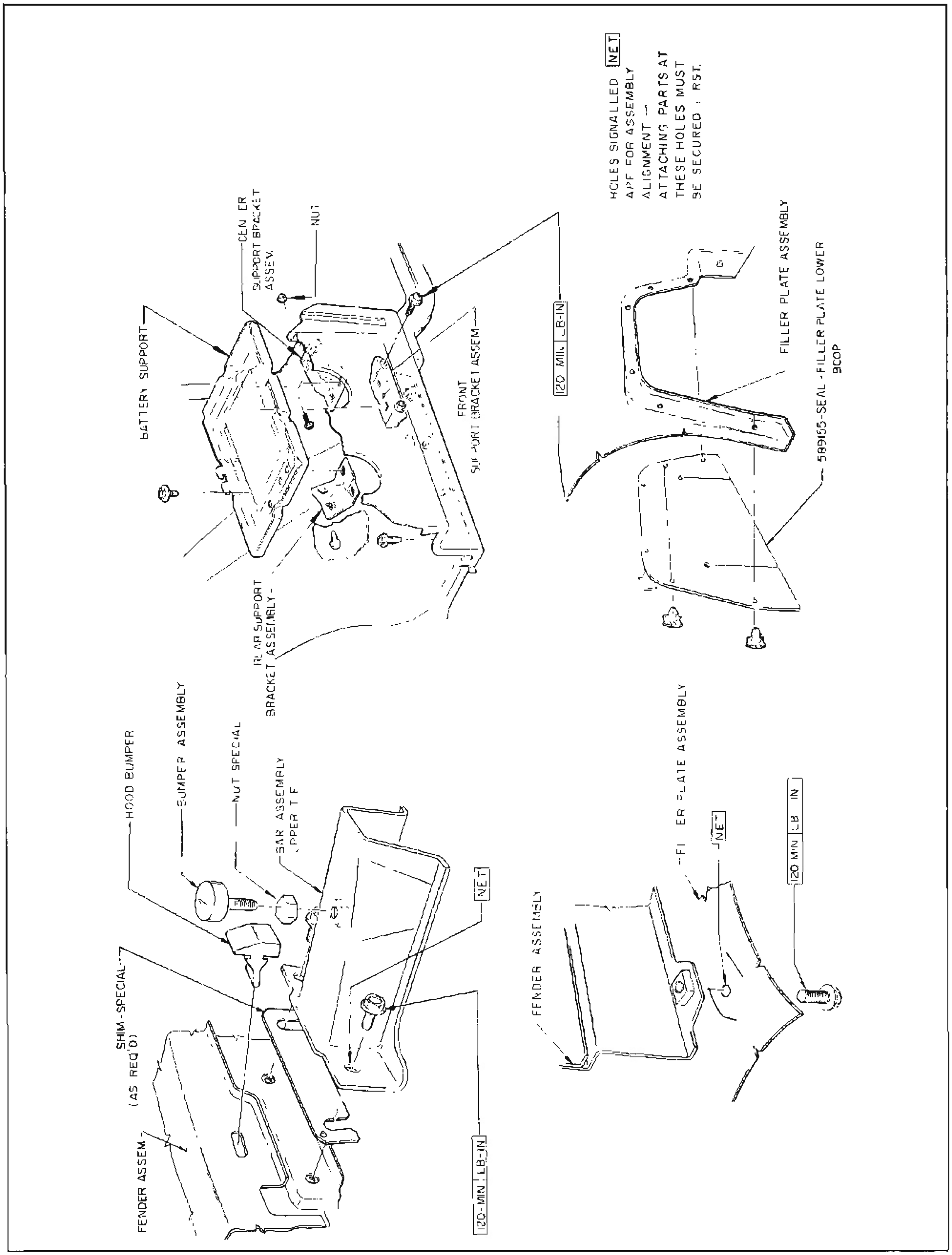



Figure 12-4—Front Fender and Skirt Installation

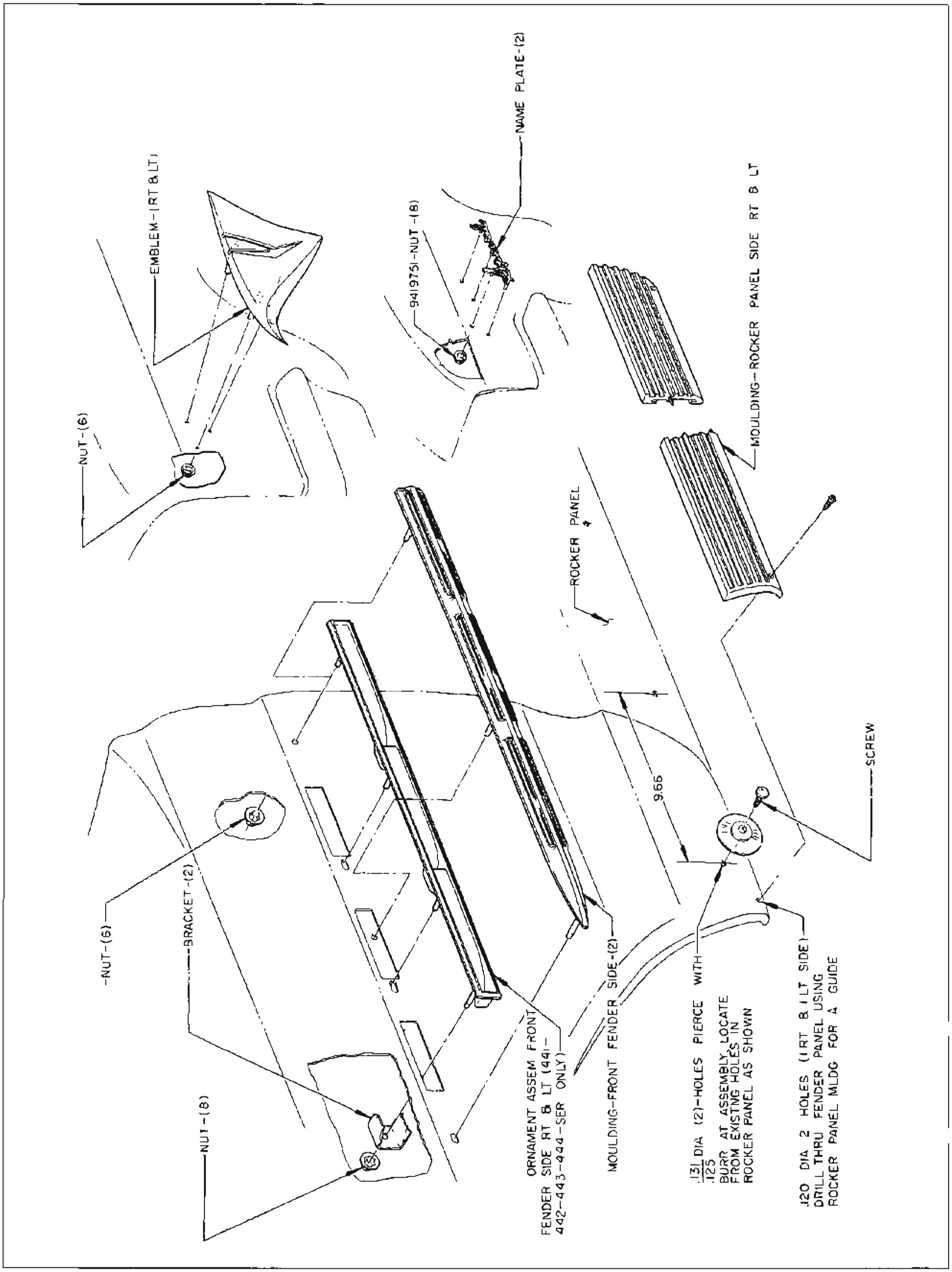



Figure 12-5—Front Fender and Skirt Installation

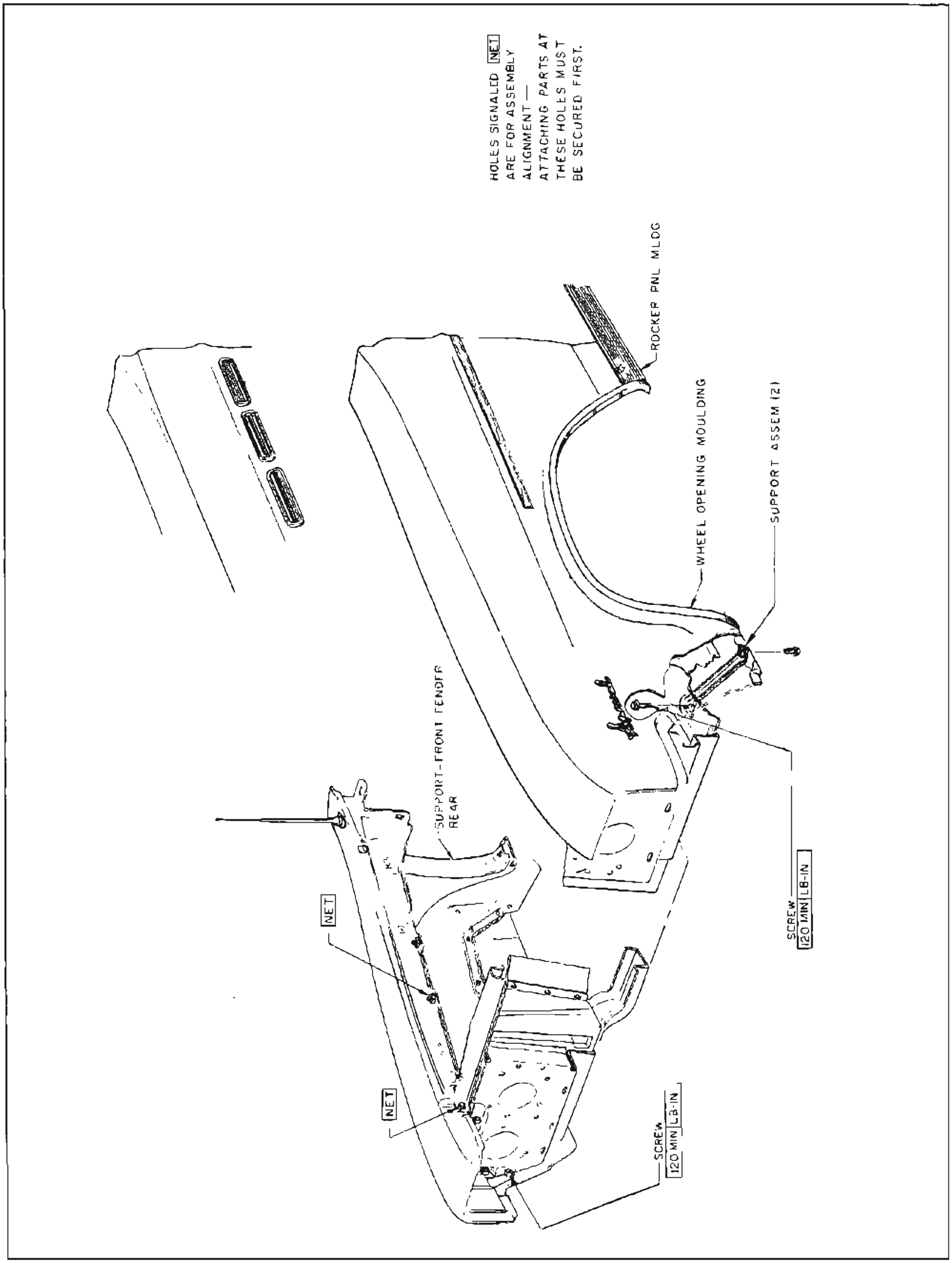



Figure 12-6—Front Fender and Skirt Installation

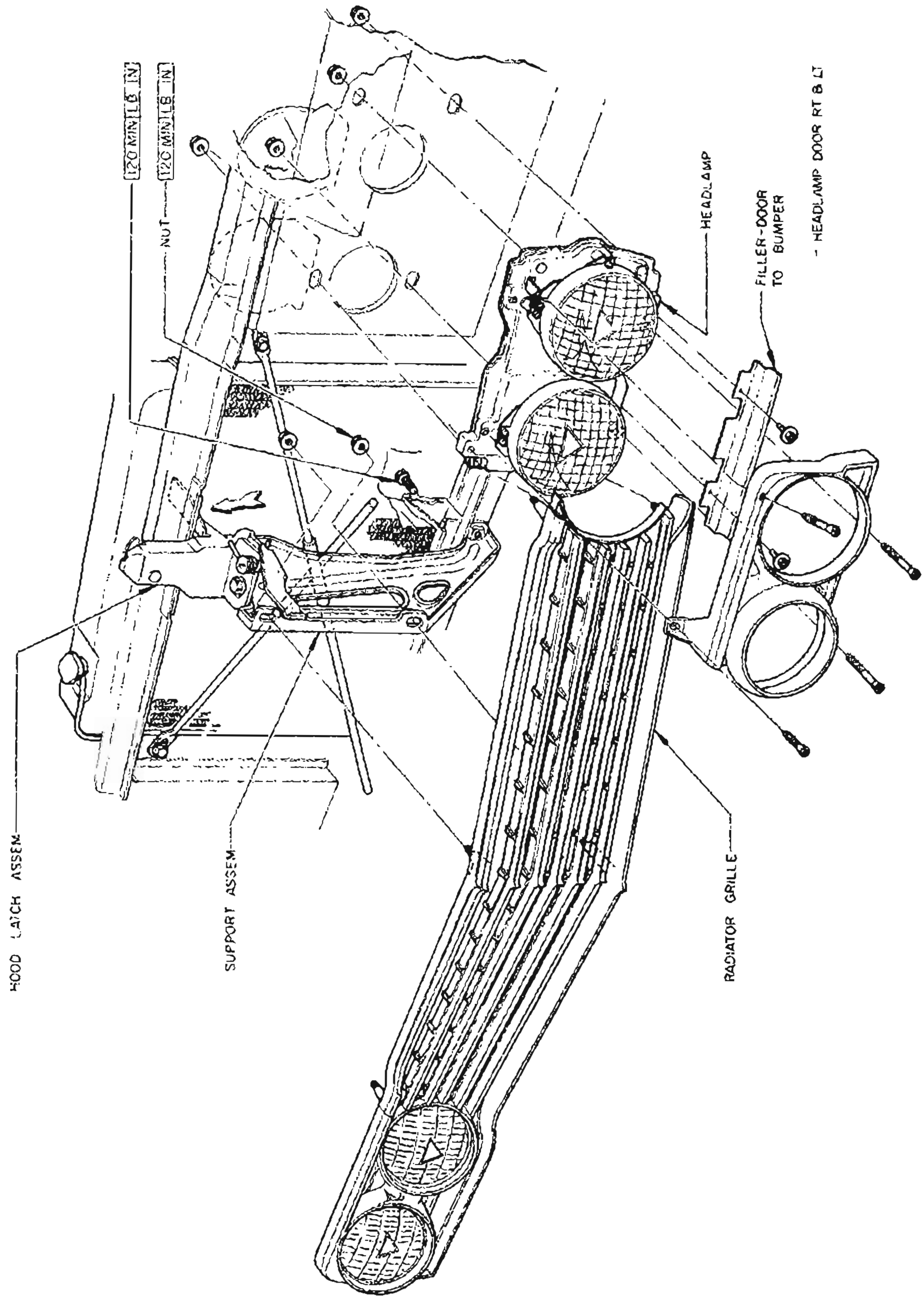



Figure 12-7—Grille and Headlamp

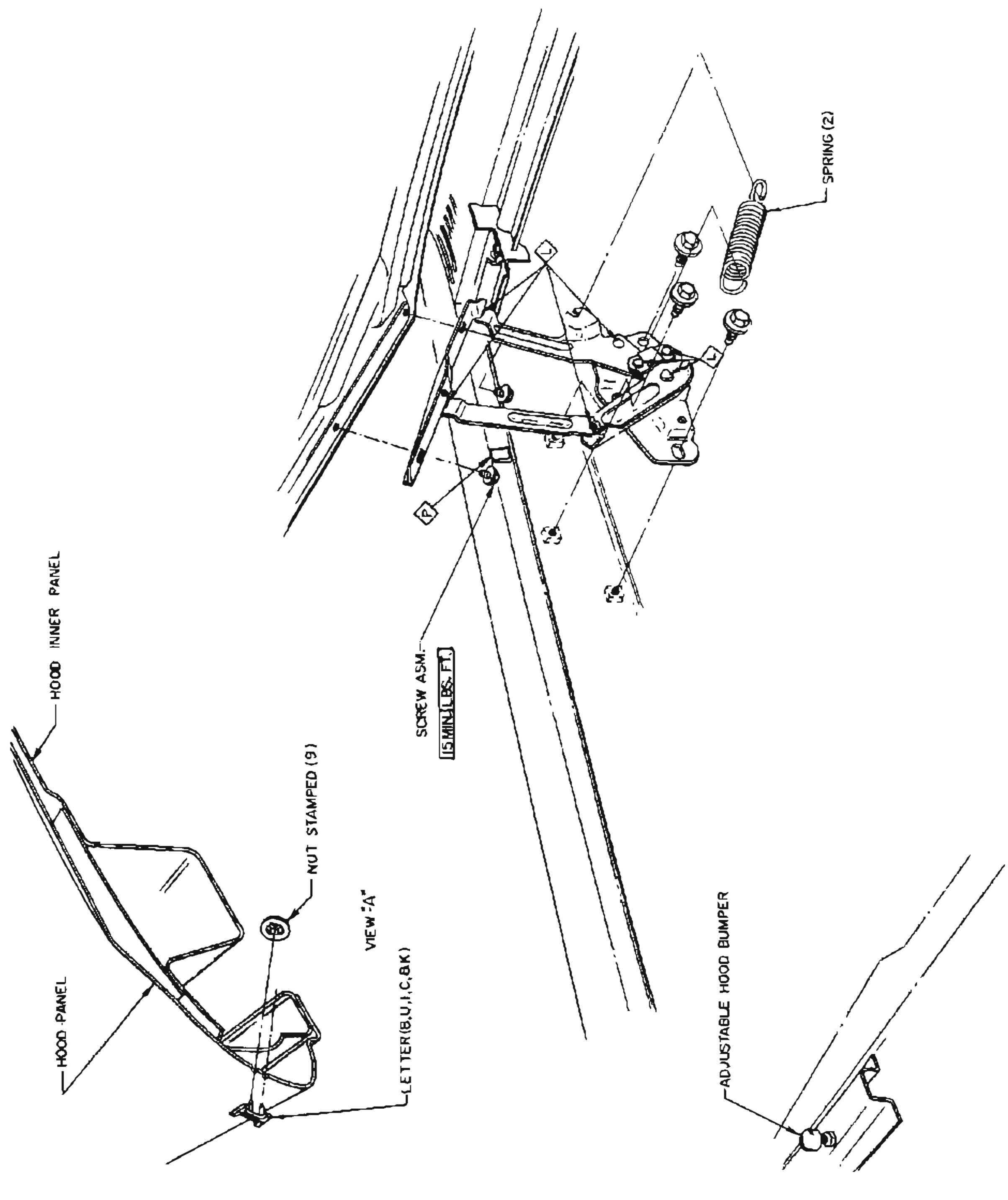



Figure 12-8—Hood Latch

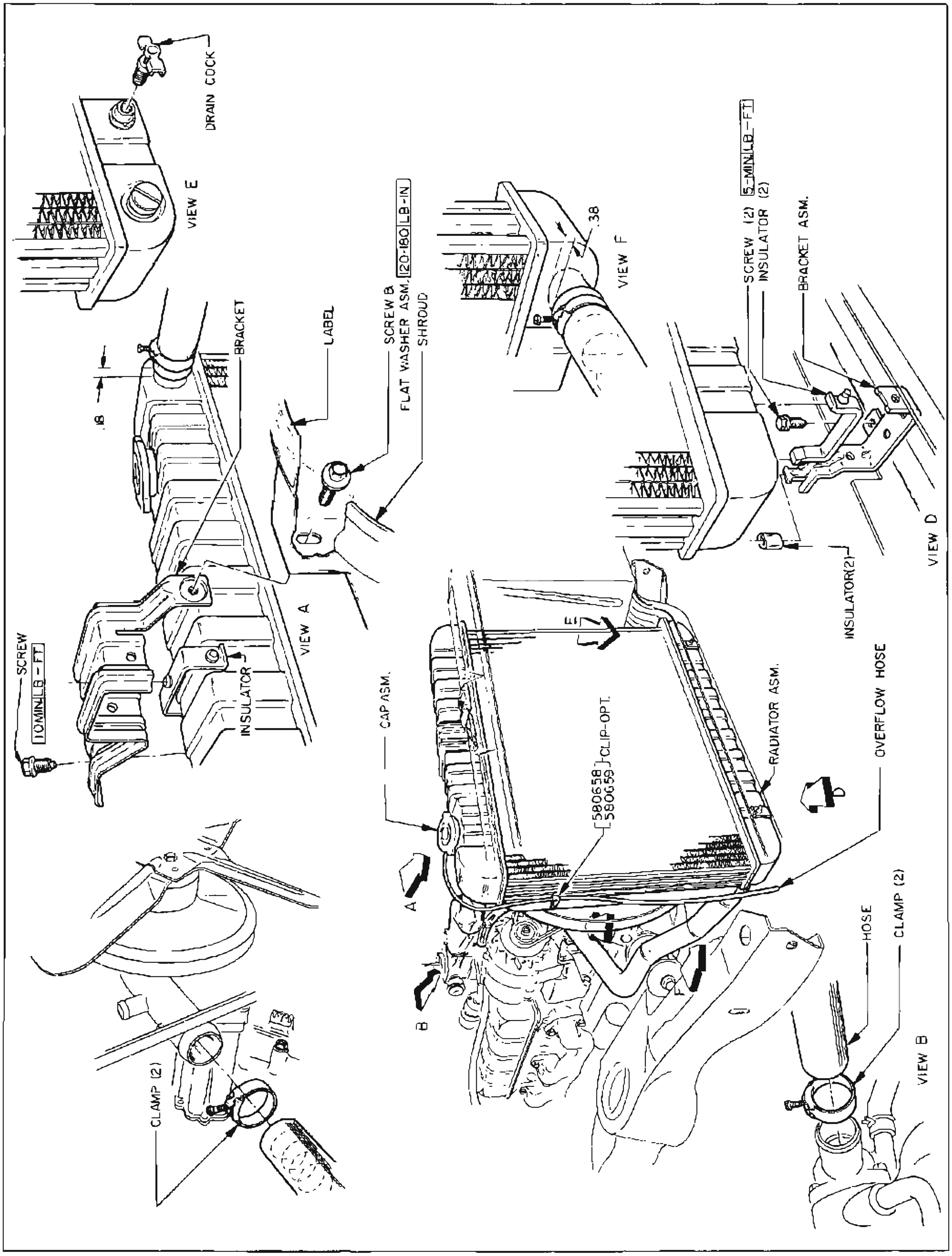



Figure 12-9—Radiator Installation V-6

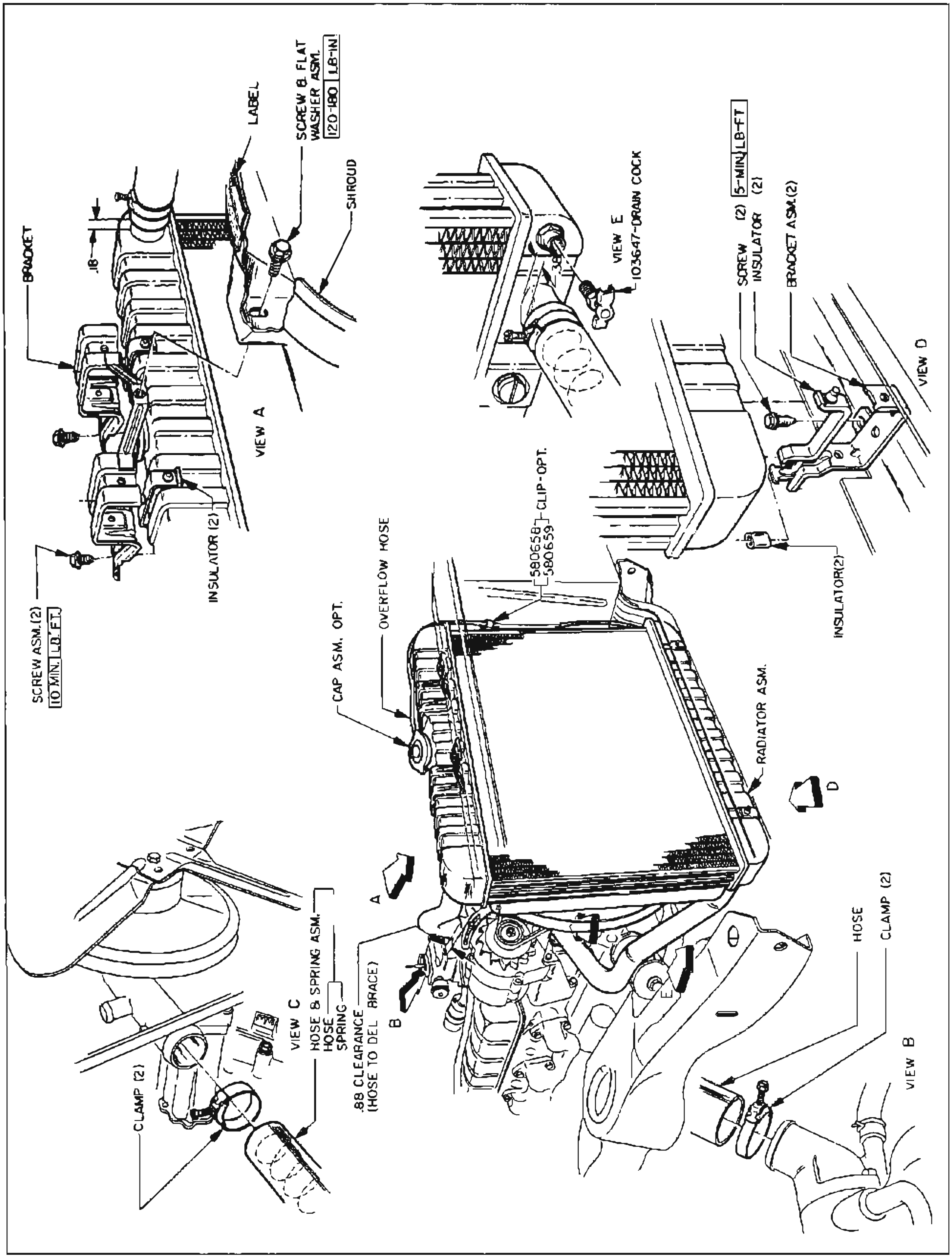



Figure 12-10—Radiator Installation

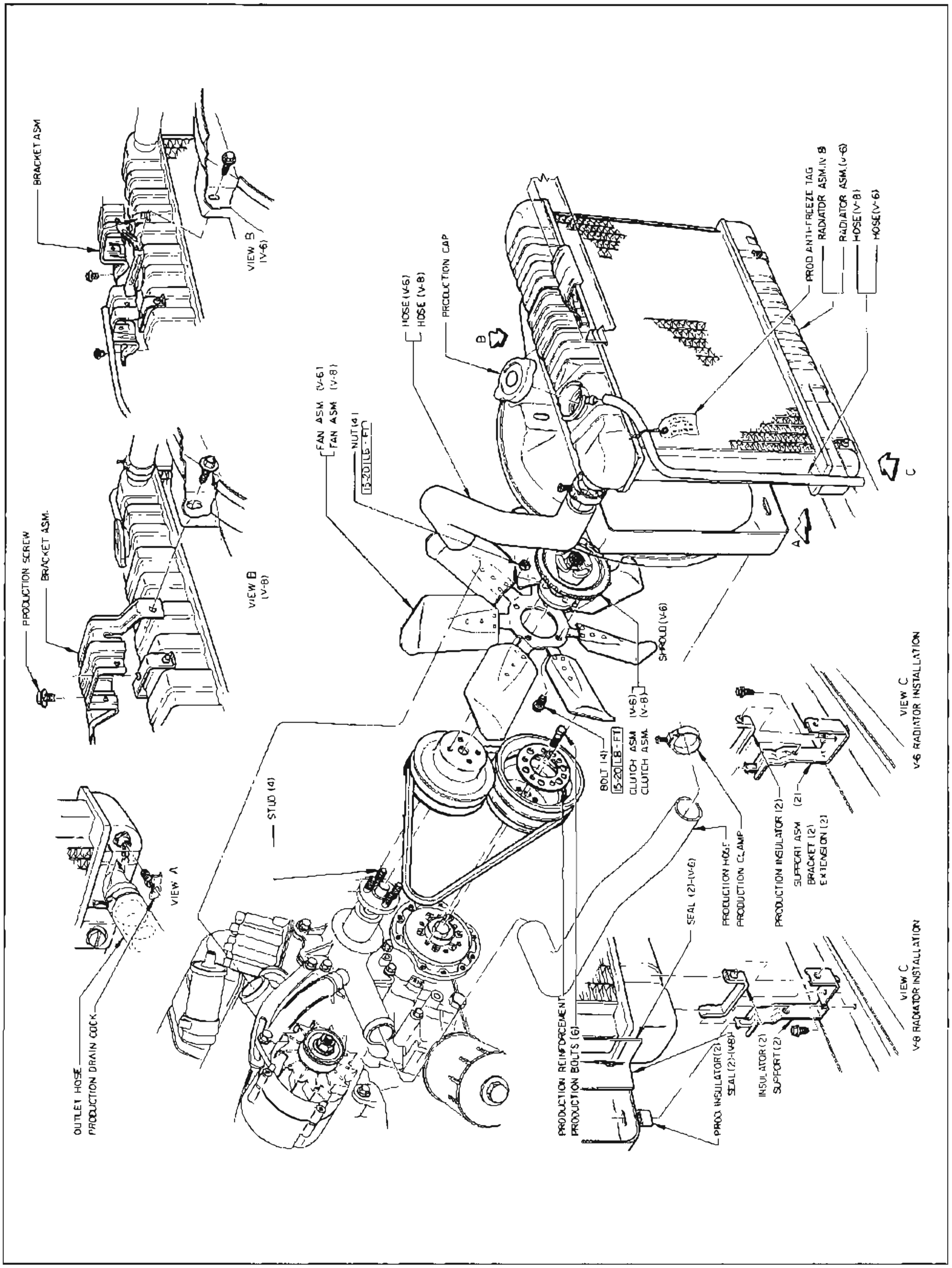



Figure 12-11—Radiator Installation - Heavy Duty

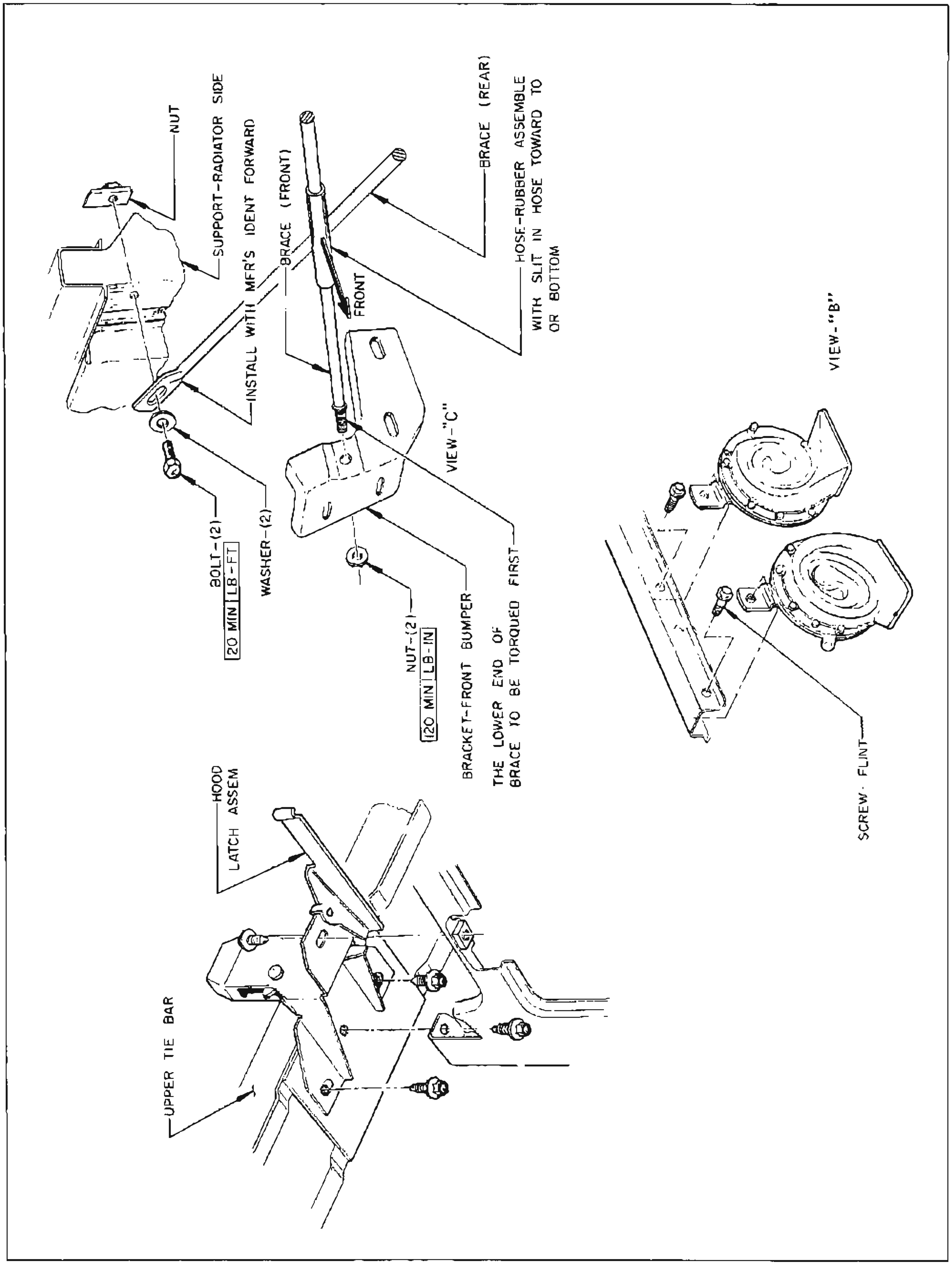



Figure 12-12—Hood Latch Installation

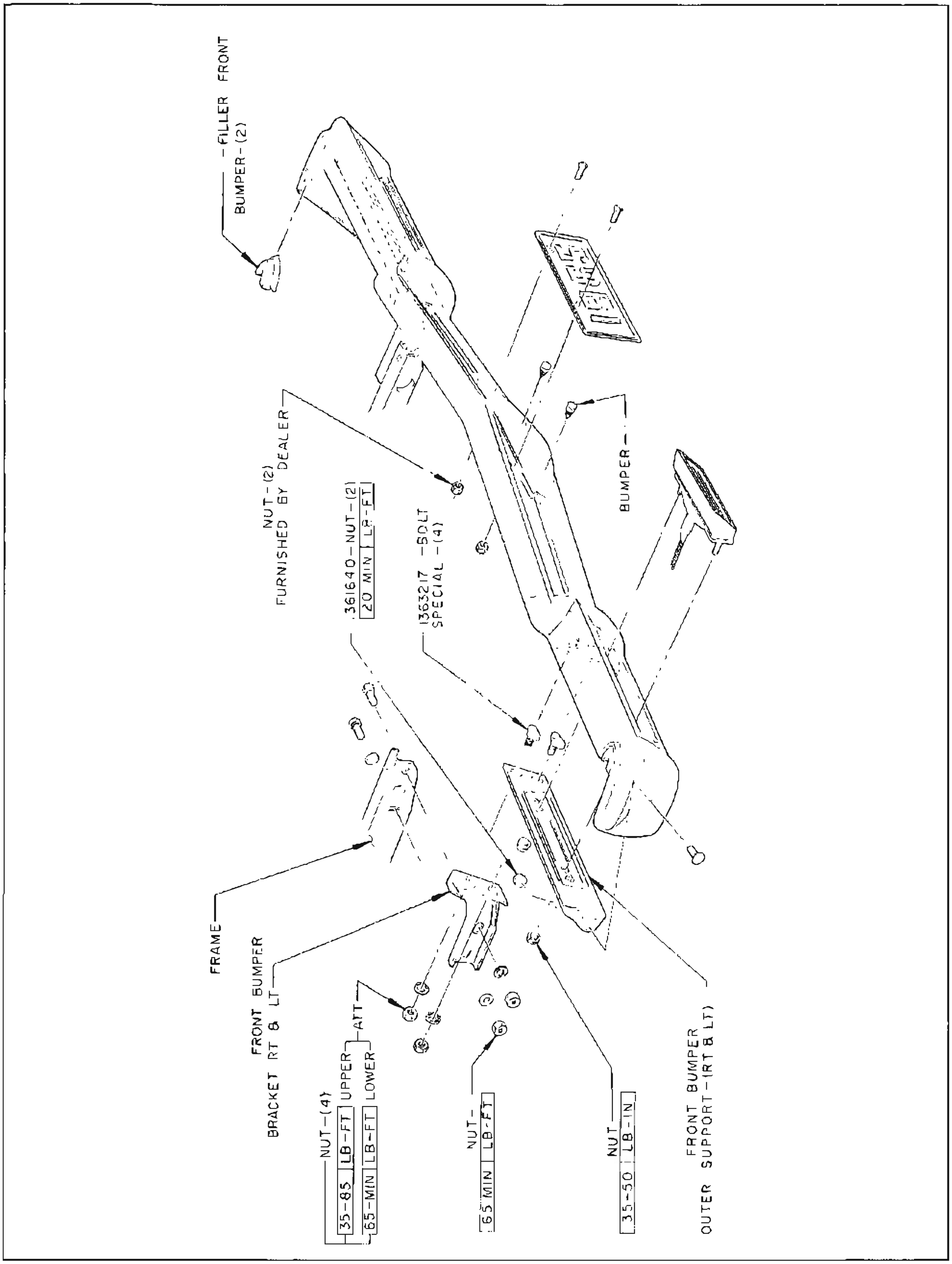



Figure 12-13—Front Bumper Installation

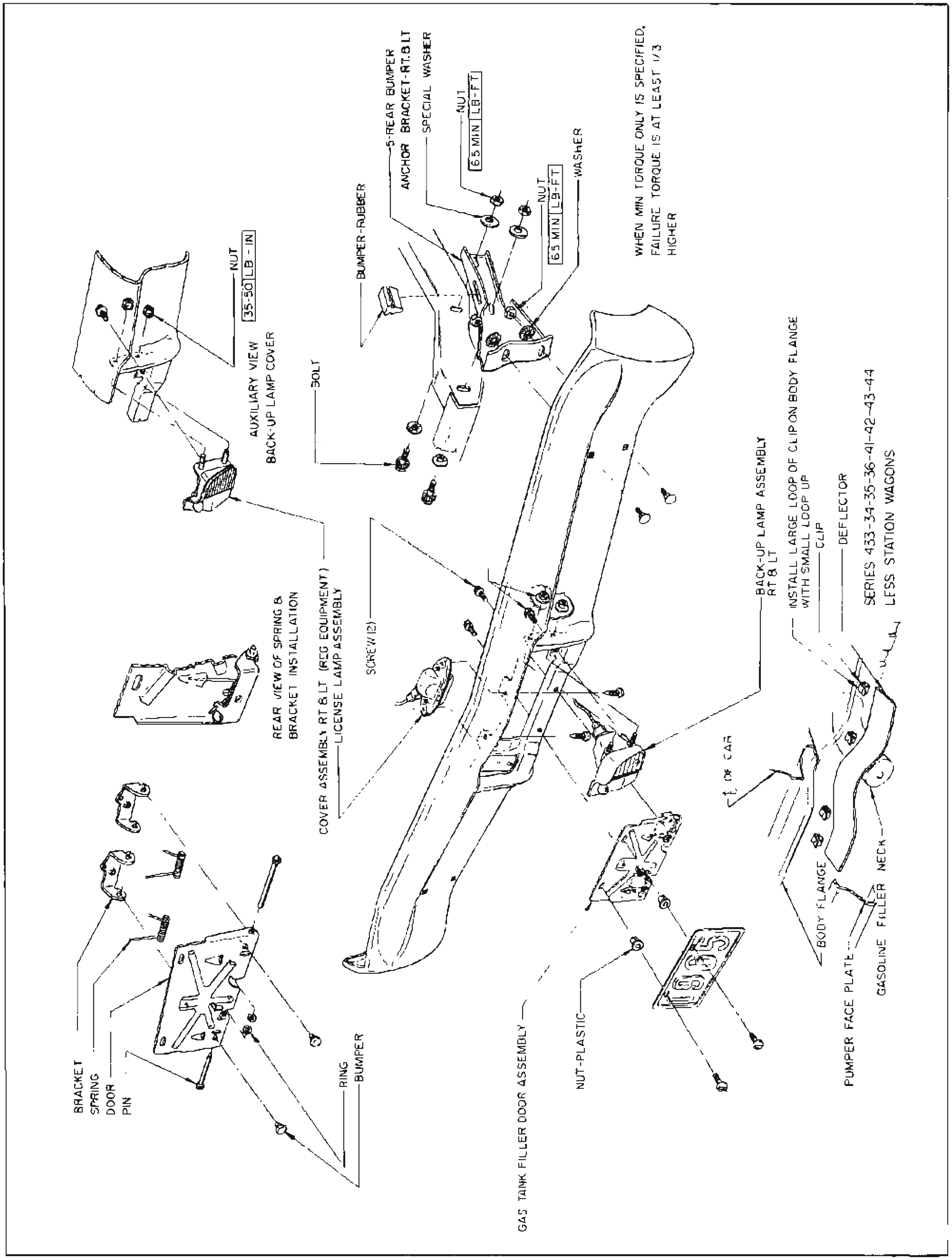



Figure 12-14—Rear Bumper Installation

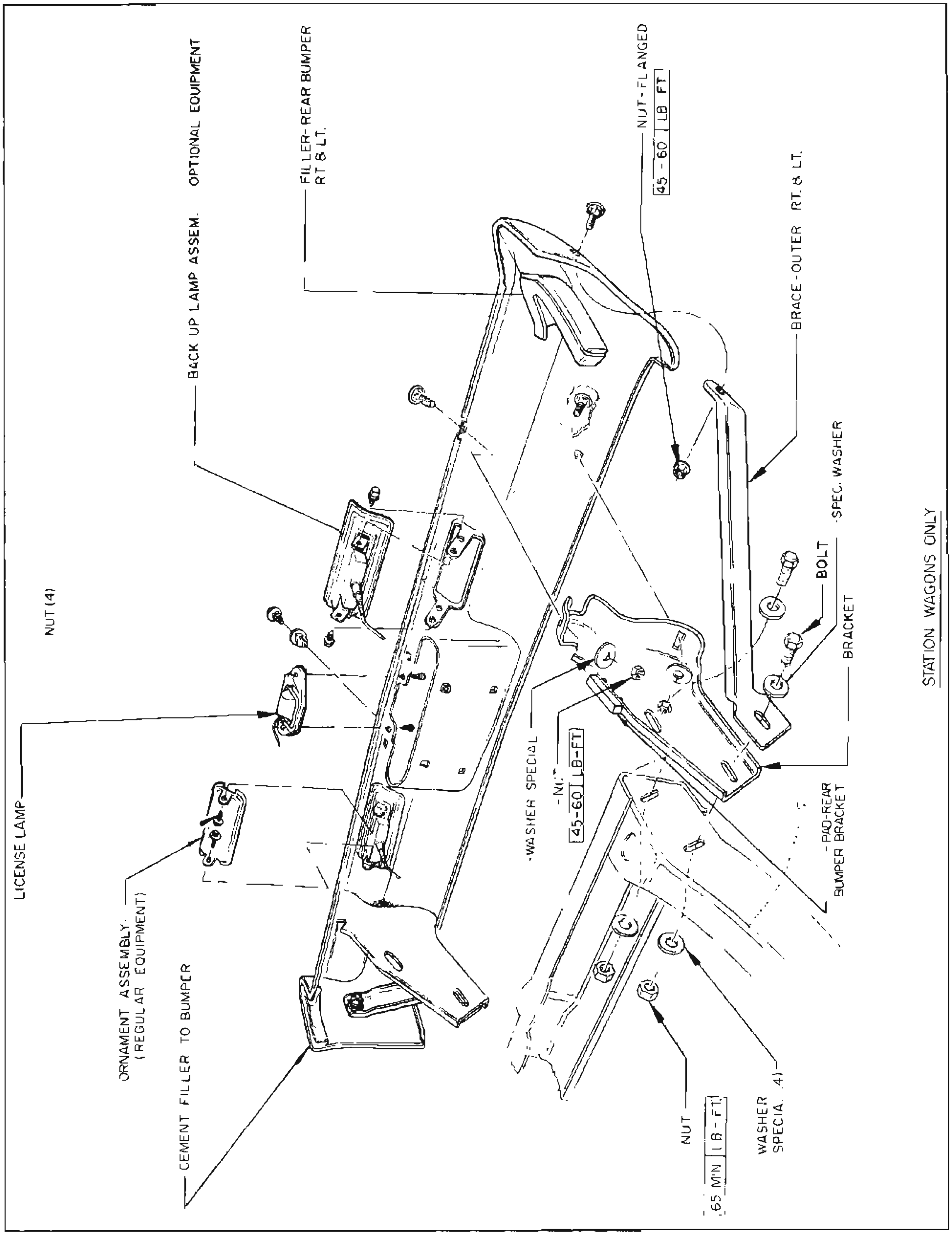



Figure 12-15—Rear Bumper Installation, Station Wagons

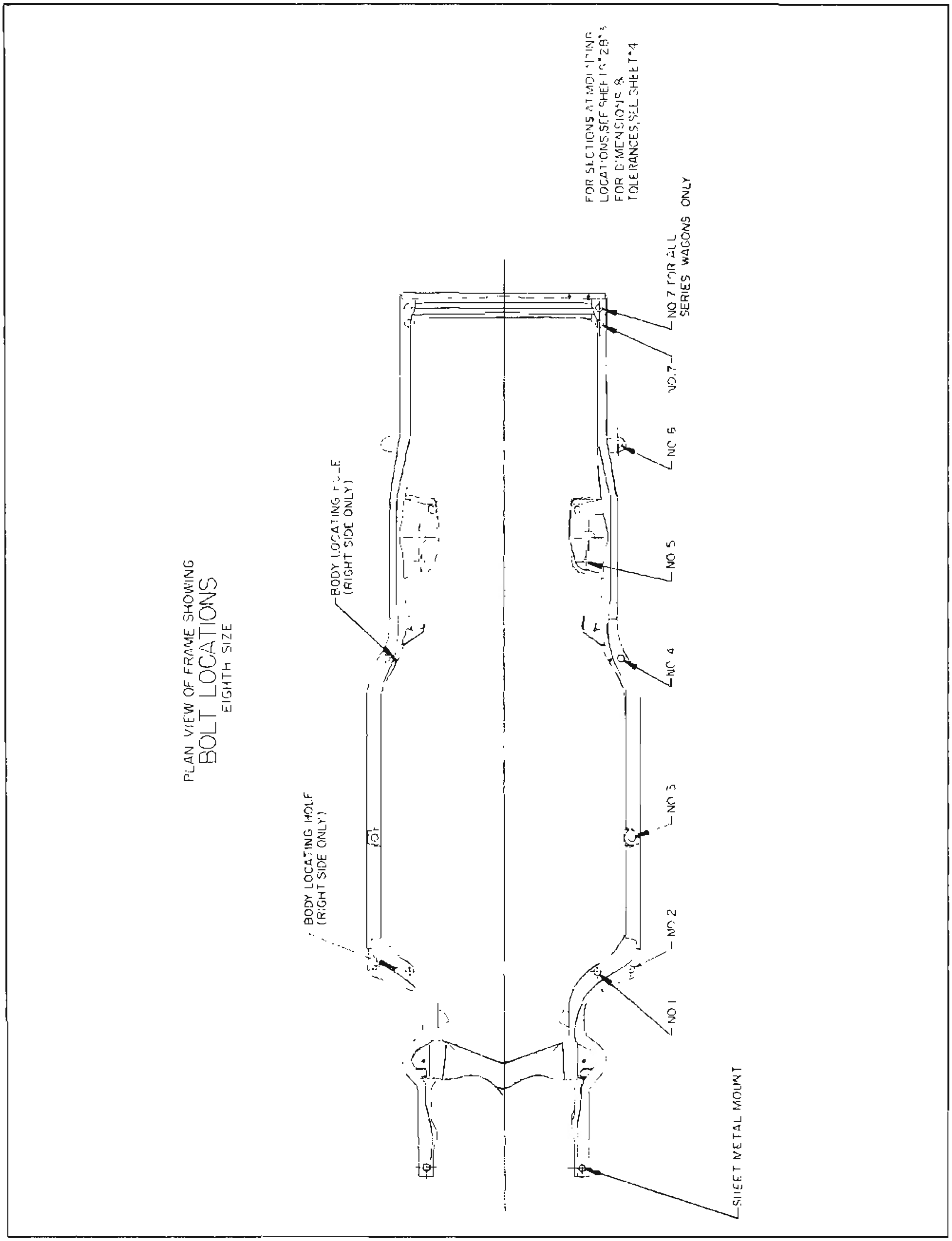



Figure 12-16—Frame Bolt Locations

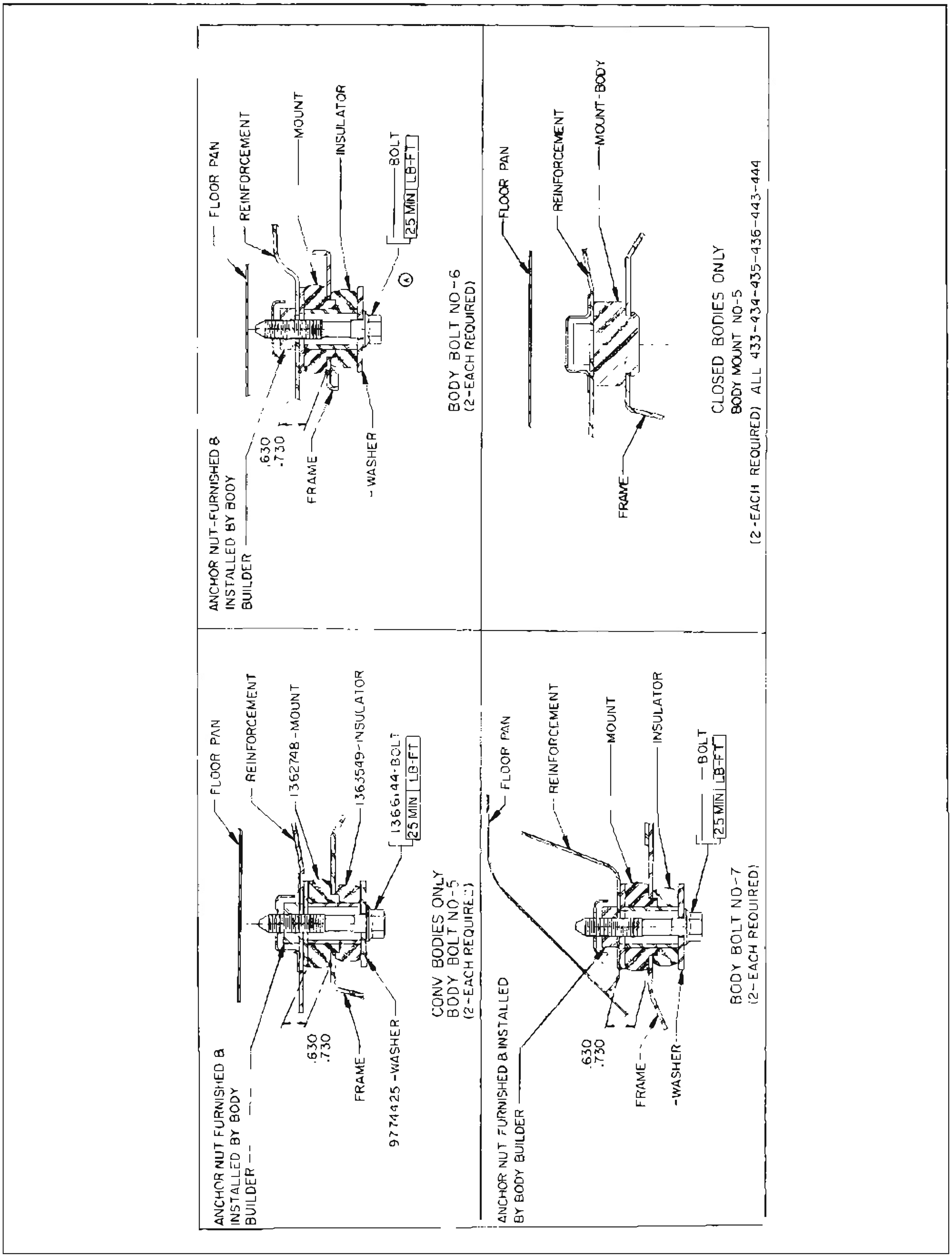



Figure 12-17—Body Mounts

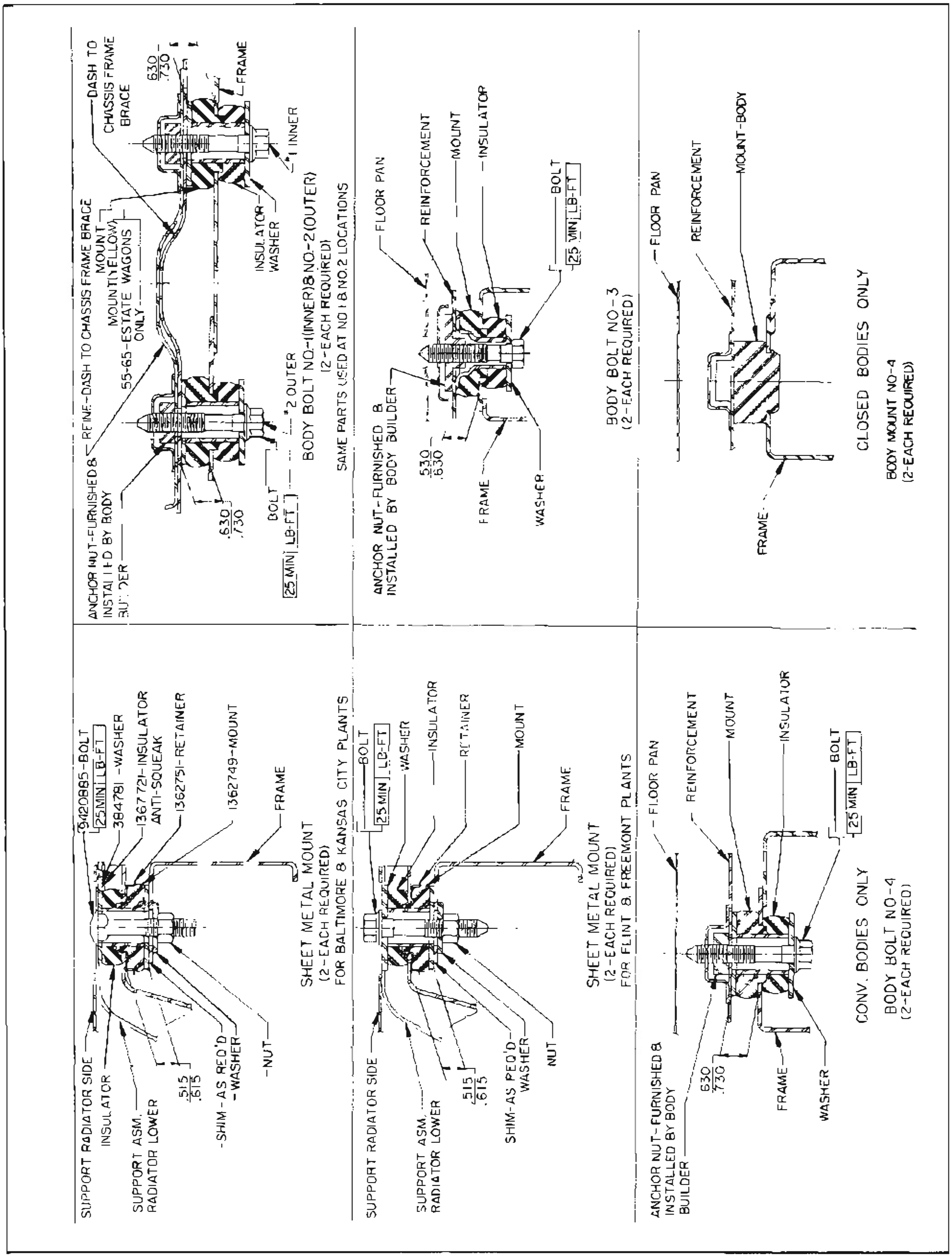



Figure 12-18—Body Mounts

## 12-7 BUMPER ADJUSTMENT AND REPLACEMENT

The front bumper inner and outer brackets are slotted which permits proper alignment of bumper with adjacent parts. (See Figure 12-13) The rear bumper brackets and outer braces are also both slotted to permit adjustment. (See Figures 12-14 and 12-15).

## 12-8 BODY MOUNT INSTALLATION

At each closed body mounting point, a rubber mount is placed between the body and the frame bracket and a rubber insulator washer is placed under the frame bracket. A plain steel washer and a tubular spacer limit compression of the rubber parts to a predetermined amount as the body bolt is tightened. This form of mounting eliminates metal-to-metal transmission of road and chassis noise into the body. For mounting information see Figures 12-16, 12-17 and 12-18.

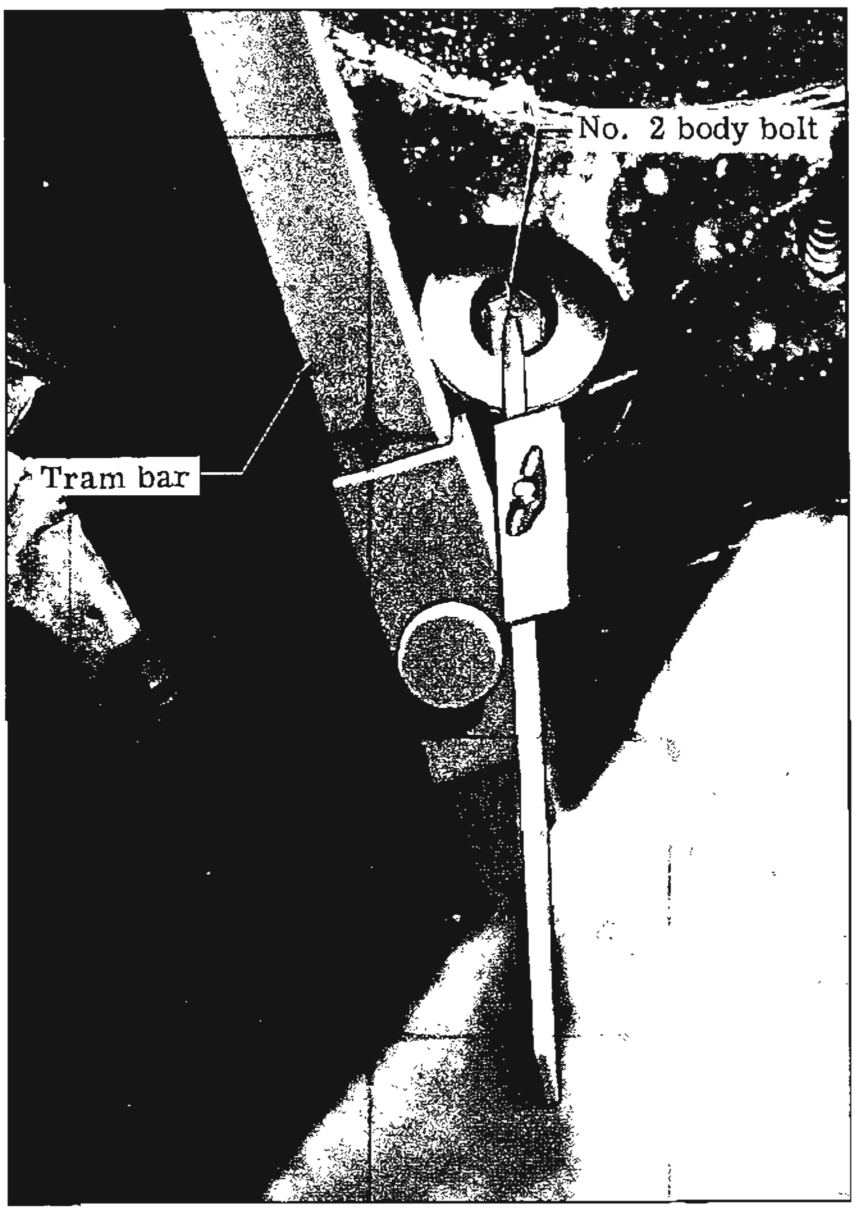



Figure 12-19—Measuring with Tram Bar to a Typical Body Reference Location

## 12-9 PROCEDURE FOR MEASURING DAMAGED FRAMES ON SPECIALS AND SKYLARKS

### a. Taking Horizontal Measurements (Tramming)

1. Jack up car and support securely on jack stands, or if available, use twin post hoist to raise car.

2. All body bolts are accessible through openings in the frame on the Special and Skylark Series. The center of these bolt heads serves as accurate reference points, and it is not necessary to establish reference points. Figure 12-19 and frame layouts 12-20 and 12-21 show location of these reference points.

3. Two men are required to measure using tram bar method. CAUTION: To get accurate measurements, it is important to hold tram bar the same way, both when setting pointers between frame reference points and when measuring between pointer tips after pointers are set and bar is removed. For example, slight flexing of the bar may change the distance between the pointer tips if the tram is held by the ends when taking measurements on the frame and by the middle when measuring between the tips.

4. To determine the extent of frame damage, measure car using frame layouts shown in Figures 12-26 and 12-27 which indicate reference points, dimensions, and tolerances. In addition to body bolt locations, frame layouts

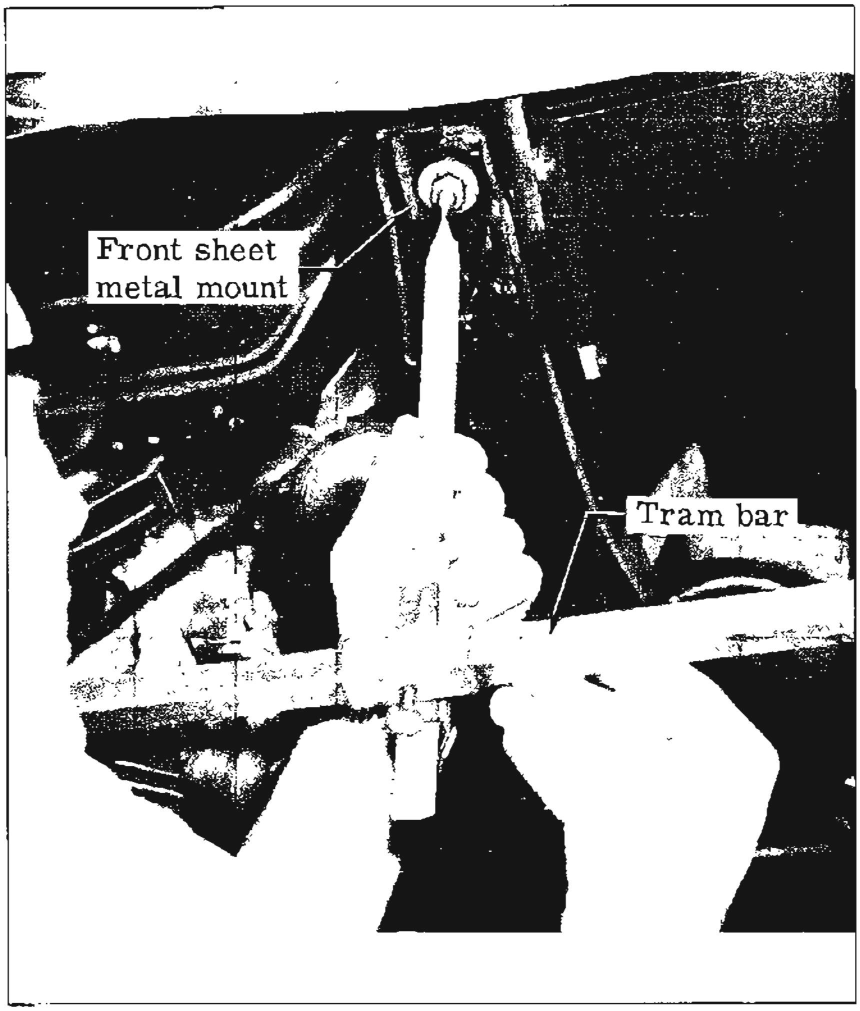



Figure 12-20—Measuring to Front Sheet Metal Mount

12-20 and 12-21 show front sheet metal mounts and lower control arm bolts which are also used as reference points.

**b. Taking Vertical (Datum) Measurements**

1. With car still on stands, suspend two centering gauges from frame mid-section. Hang forward gauge from inner holes in frame as shown in Figure 12-22. Hang rearward gauge on lower control arm bracket flanges as shown in Figure 12-23. The vertical supports of each gauge should then be adjusted so that both horizontal bars are suspended the same distance below the bottom surface of the frame rail mid-section. Thus, the horizontal cross bars on the two gauges will be aligned with each other and will establish a plane parallel to the bottom surface of the mid-section. (It is suggested that gauges be suspended 6-3/4" below the frame mid-section. This distance will drop the horizontal gauge bars lower than the rear axle and front suspension so that the front-to-rear line of sight is not obstructed.)

2. After the first two gauges are set, the third gauge may be suspended from either the front or rear frame horn areas, and adjusted vertically by sighting the alignment with the two center gauges. See Figures 12-24 and 12-25. The actual dimensions, front or rear, are found by measuring up from the top edge of the cross bar on the third gauge to the bottom surface of the frame rail above. After checking on one end is completed, the operation can be repeated in similar fashion on the opposite end.

3. To determine the extent of frame damage, compare actual measurements with dimensions and tolerances given in frame layouts 12-26 and 12-27.

**c. Frame Repair Suggestions**

When straightening sharply buckled areas, it is common practice to use heat while force is being applied by use of jacks or suitable frame machines. Heat can be applied without materially weakening a frame, provided heating temperatures are kept below 1200°F. A steel temperature of 1200°F. is seen as a deep cherry red when viewed in subdued daylight conditions which exist in an average repair shop. (Metal at the same temperature will appear slightly brighter under direct artificial light.) CAUTION: Heat in excess of 1200°F. will permanently weaken the metal structure and lead to eventual frame failure in service.

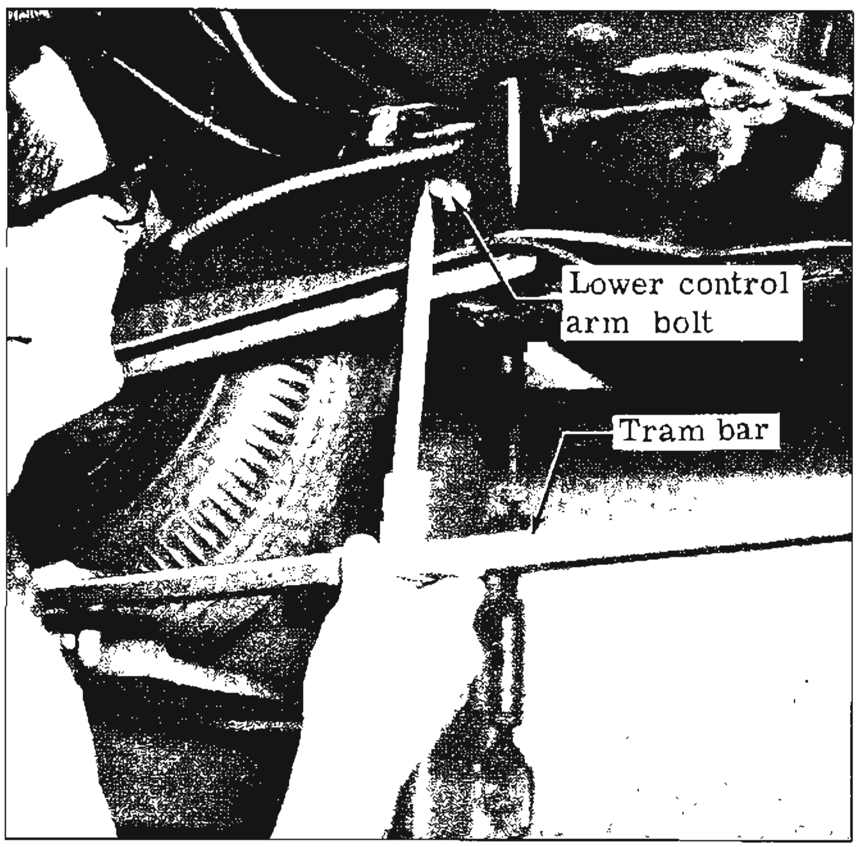



Figure 12-21—Measuring to Lower Control Arm Bolt

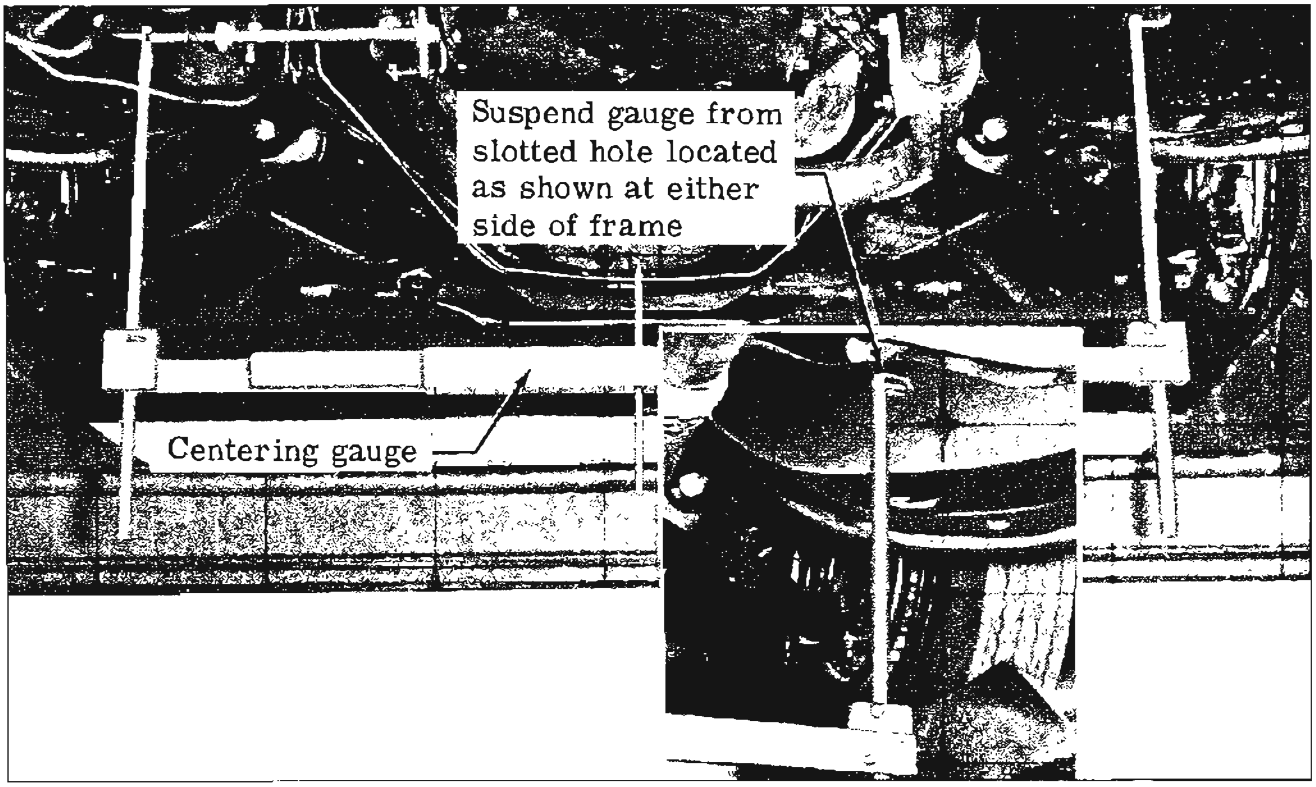



Figure 12-22—Centering Gauge Installed at Forward Portion of Frame Mid-Section

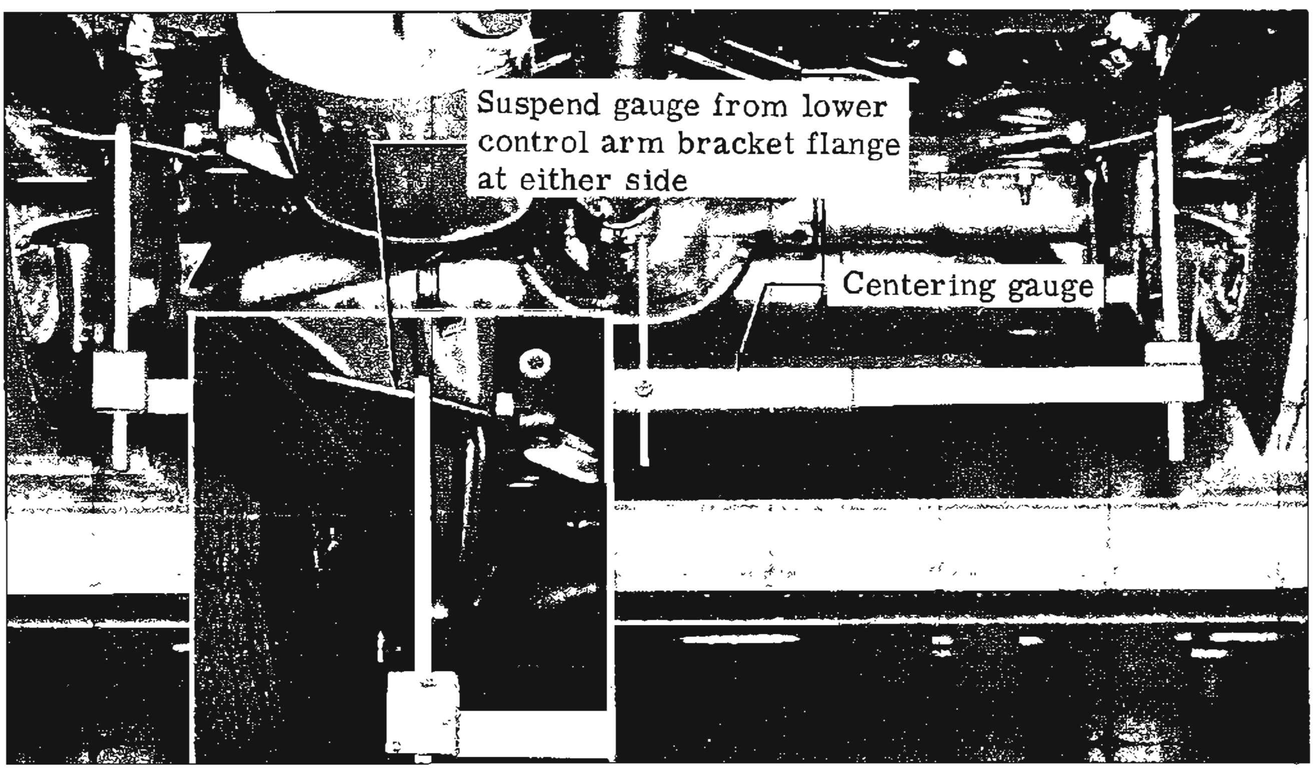



Figure 12-23—Centering Gauge Installed at Rearward Portion of Frame Mid-Section

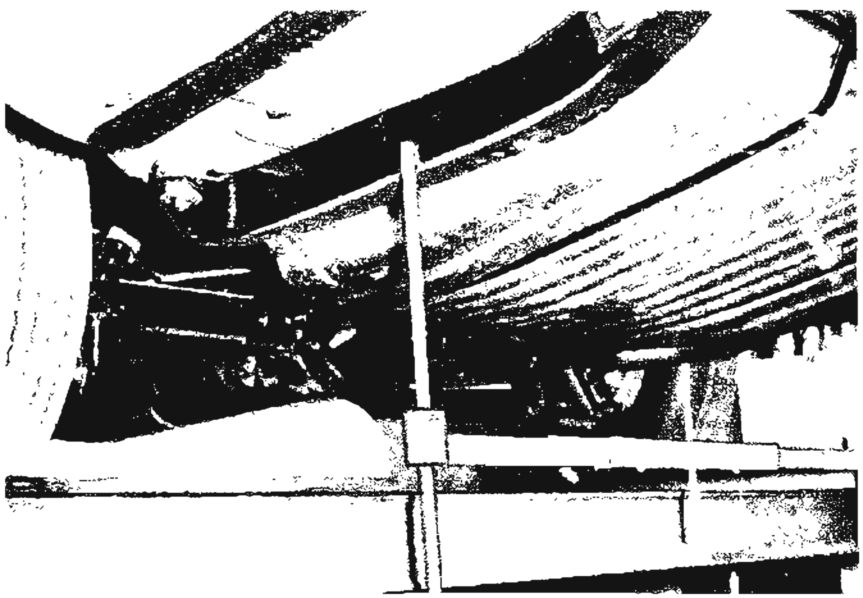


Figure 12-24—Centering Gauge Suspended from Holes in Frame Rear Horn Area

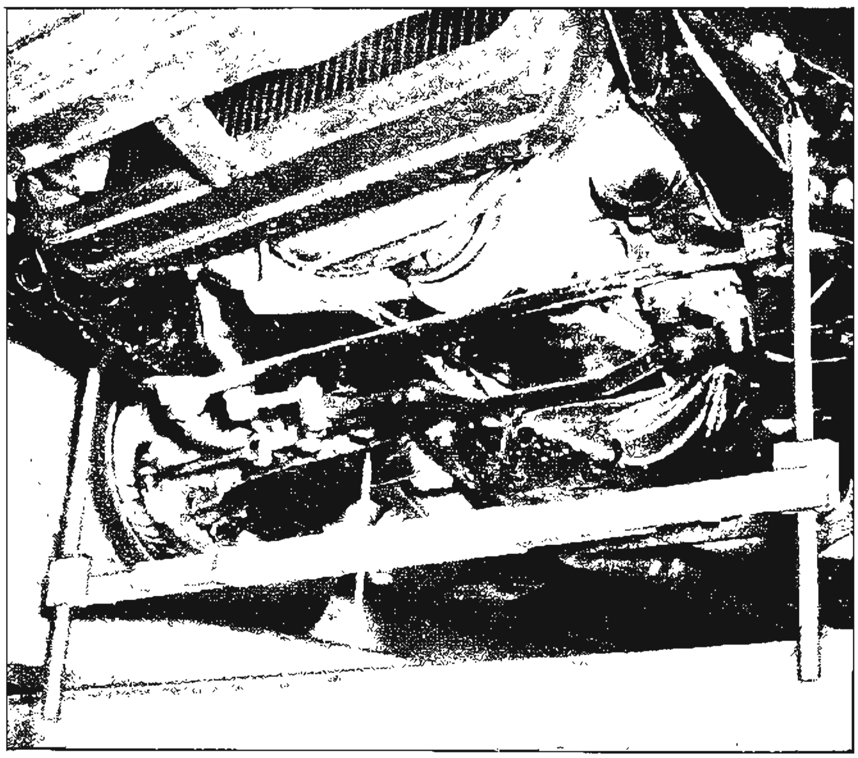


Figure 12-25—Centering Gauge Suspended from Square Cut Outs in Frame Front Horn Area

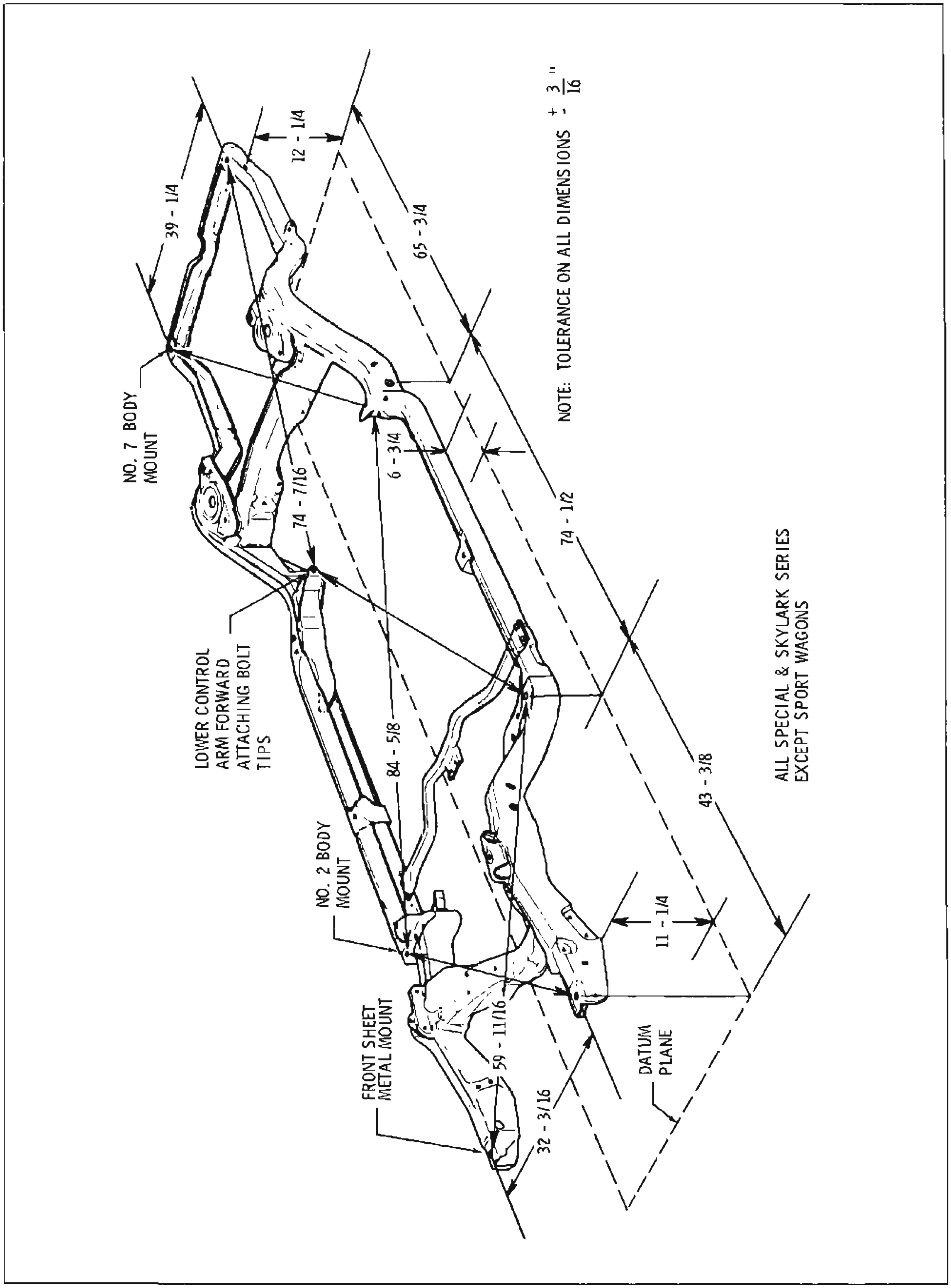



Figure 12-26—All Special and Skylark Series - Except Extended Wagons

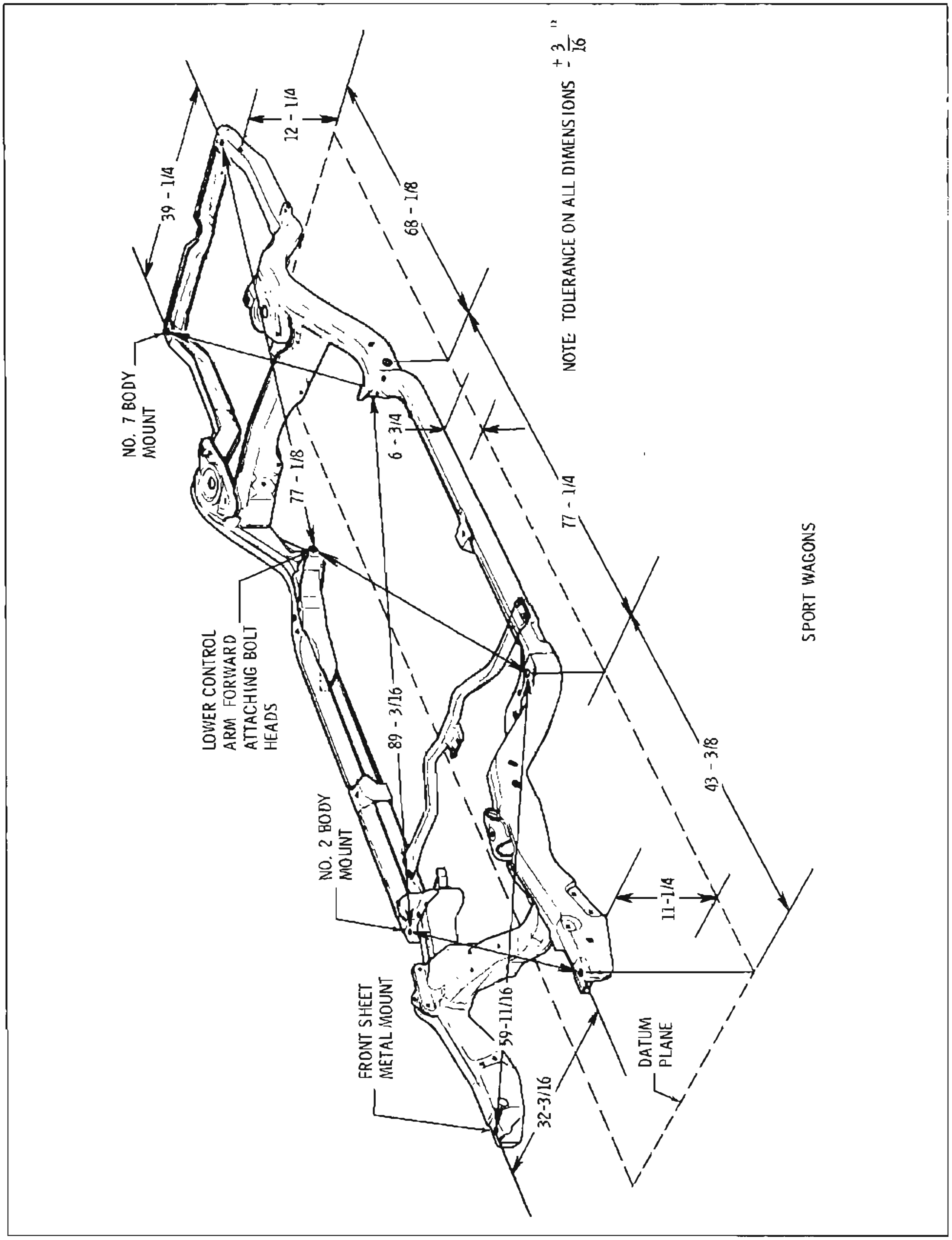



Figure 12-27—Skylark Extended Wagon

# GROUP 14
# ALPHABETICAL INDEX

## M



## N



## O



## P



## R



## S

## T



## U