# 1963

# TEMPEST

CHASSIS

**SHOP MANUAL**

# 1963 PONTIAC TEMPEST

# CHASSIS SHOP MANUAL

## GENERAL

This shop manual applies to 1963 Pontiac Tempest models. It contains information on all components of the car with the exception of the air conditioning, system and body information which will be covered in separate manuals. All pertinent information available at time of preparation is included.

## CONTENTS

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

## *AIR CONDITIONING CAUTION*

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


**PONTIAC MOTOR DIVISION**

**GENERAL MOTORS CORPORATION**

**PONTIAC 11, MICHIGAN**

S 6304 T August 1962 Litho in U.S.A.




*Table of Contents*

# GENERAL INFORMATION

## CONTENTS OF THIS SECTION



## GENERAL INFORMATION

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

### VEHICLE IDENTIFICATION PLATE

Serial, assembly plant and model year identification can be made from the Manufacturer's Motor Vehicle Identification Number Plate. This plate is a metal strip which is fastened to the left front hinge pillar post, visible when the left front door is open. The plate has embossed numerals as shown in Fig. 1-1.

### BODY IDENTIFICATION PLATE

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

### CAR MODEL IDENTIFICATION

Certain publications carry "series" numbers to identify models and others carry sales department names. Figure 1-3 below shows both methods of identification.

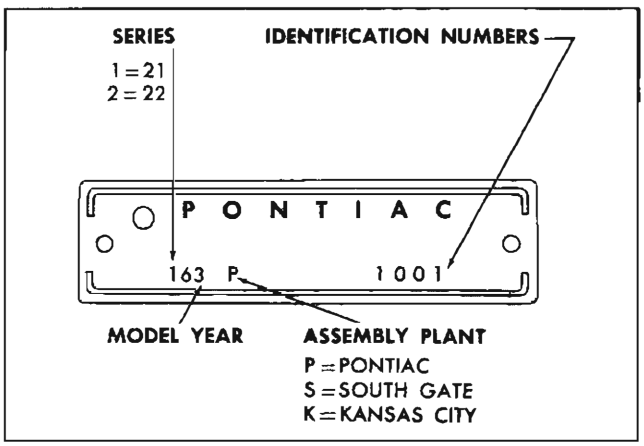



Fig. 1-1 Vehicle Identification Plate

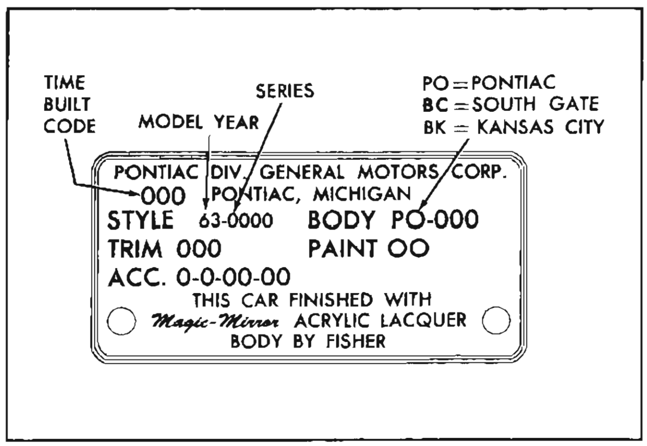



Fig. 1-2 Body Identification Plate

| Model | Style Number |
|---|---|
| 2 Door Sports Coupe | 2117 |
| 2 Door Coupe | 2127 |
| 4 Door Sedan | 2119 |
| 4 Door Station Wagon | 2135 |
| Convertible Coupe | 2167 |
| Le Mans 2 Door Coupe | 2217 |
| Le Mans Convertible Coupe | 2267 |

Fig. 1-3 Car Model Identification

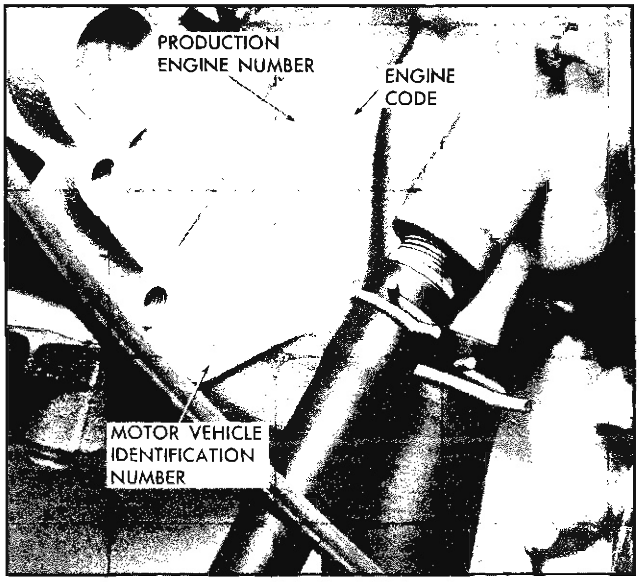



Fig. 1-4 Engine Serial Number Location

## ENGINE SERIAL NUMBERS

The manufacturer's motor vehicle identification number is located on a machined pad on the front of the right-hand bank of the block (Fig. 1-4).

The production engine number will also be found in the same area. This number is used for production control purposes during manufacture.

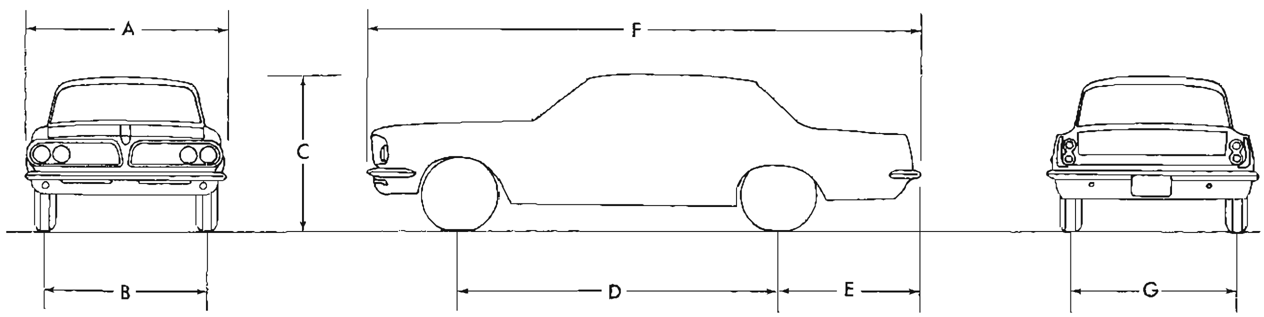
## RELATION OF CAR SPEED TO ENGINE RPM

| CAR SPEED M.P.H. | REAR WHEEL R.P.M. | | ENGINE R.P.M. FOR GIVEN AXLE RATIOS AND TIRES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2.69 | | 2.91 | | 3.09 | | 3.30 | | 3.56 | | 3.78 | |
| | 6.00 | 6.50 | 6.00 | 6.50 | 6.00 | 6.50 | 6.00 | 6.50 | 6.00 | 6.50 | 6.00 | 6.50 | 6.00 | 6.50 |
| 10 | 132 | 130 | 355 | 350 | 384 | 378 | 408 | 402 | 436 | 429 | 470 | 463 | 499 | 491 |
| 20 | 265 | 259 | 713 | 697 | 771 | 754 | 819 | 800 | 875 | 855 | 943 | 922 | 1002 | 979 |
| 30 | 398 | 388 | 1071 | 1044 | 1158 | 1129 | 1230 | 1199 | 1313 | 1280 | 1417 | 1381 | 1504 | 1467 |
| 40 | 530 | 518 | 1426 | 1393 | 1542 | 1507 | 1638 | 1601 | 1749 | 1709 | 1887 | 1844 | 2003 | 1958 |
| 50 | 662 | 648 | 1781 | 1743 | 1926 | 1886 | 2046 | 2002 | 2185 | 2138 | 2357 | 2307 | 2502 | 2449 |
| 60 | 795 | 777 | 2139 | 2090 | 2313 | 2261 | 2457 | 2401 | 2624 | 2564 | 2830 | 2766 | 3005 | 2937 |
| 70 | 928 | 906 | 2496 | 2437 | 2700 | 2636 | 2868 | 2800 | 3062 | 2990 | 3304 | 3225 | 3508 | 3425 |
| 80 | 1060 | 1036 | 2851 | 2787 | 3085 | 3015 | 3275 | 3201 | 3498 | 3419 | 3774 | 3688 | 4007 | 3916 |
| 90 | 1192 | 1166 | 3206 | 3137 | 3469 | 3393 | 3683 | 3603 | 3934 | 3848 | 4244 | 4151 | 4506 | 4407 |
| 100 | 1325 | 1295 | 3564 | 3484 | 3856 | 3768 | 4094 | 4002 | 4373 | 4274 | 4717 | 4610 | 5009 | 4895 |

| AXLE RATIO | N/V RATIO* TIRE SIZE | |
|---|---|---|
| | 6.00 x 15 | 6.50 x 15 |
| 2.53 | 33.4 | 32.9 |
| 2.69 | 35.5 | 35.0 |
| 2.91 | 38.4 | 37.8 |
| 3.09 | 40.8 | 40.2 |
| 3.30 | 43.6 | 42.9 |
| 3.56 | 47.0 | 46.3 |
| 3.78 | 49.9 | 49.1 |
| 3.90 | 51.7 | 50.5 |

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

## GENERAL SPECIFICATIONS




| DIMENSION | KEY | 2119—Sedan | 2117 & 2217 2Dr. Cpe. | 2127—2 Dr. Cpe. | 2167 & 2267 Conv. | 2135—Safari |
|---|---|---|---|---|---|---|
| Over-all length | F | 194.3 | 194.3 | 194.3 | 194.3 | 194.3 |
| Width | A | 74.2 | 74.2 | 74.2 | 74.2 | 74.2 |
| Height (with Passengers) | C | 54.0 | 53.6 | 53.6 | 54.2 | 55.3 |
| Wheelbase | D | 112 | 112 | 112 | 112 | 112 |
| Tread Front | B | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 |
| Rear | G | 58.0 | 58.0 | 58.0 | 58.0 | 58.0 |
| Turning Circle Curb to Curb | — | 37.7 | 37.7 | 37.7 | 37.7 | 37.7 |
| Road Clearance | — | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Overhang (rear) | E | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 |
| Tire Size (4 cyl. w/o A.C.) | — | 6.00 x 15 | 6.00 x 15 | 6.00 x 15 | 6.00 x 15 | 6.50 x 15 |
| Ramp Angle (4 cyl. w/o A.C.) | — | 15.0° | 15.0° | 15.0° | 15.0° | 16.0° |
| Tire Size (8 cyl. and A.C.) | — | 6.50 x 15 | 6.50 x 15 | 6.50 x 15 | 6.50 x 15 | 6.50 x 15 |
| Ramp Angle (8 cyl. and A.C.) | — | 16.0° | 16.0° | 16.0° | 16.0° | 16.0° |

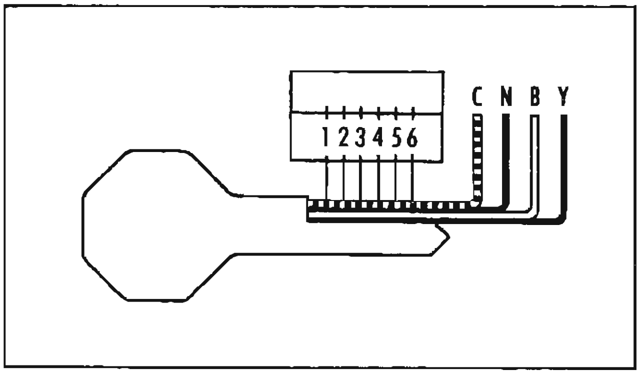



Fig. 1-5 Key Coding Diagram

### *CODING SIDE BAR LOCK*

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

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

1. Place key on diagram (Fig. 1-5) with bottom, head and point aligned.

2. Starting at the head of the key, code each of six cuts either C-N-B or Y by recording which area the bottom of the cut leaves exposed. Example: If the first line from the top is the only line exposed the cut would be coded C.

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

1. The letters determined from coding the key indicate different colored tumblers to be installed in slots of the lock (Fig. 1-6).

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

Fig. 1-6 Tumbler Color Chart

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

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

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

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

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

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

### *LIFTING AND TOWING*

#### LIFTING

Fig. 1-7 shows the Tempest may be lifted at any accessible point on the body-frame rail. It can also be lifted at the front crossmember or at either the front or rear lower control arms. When lifting on the lower control arms, use care to avoid the lower shock absorber brackets.

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

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

#### TOWING

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

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

Following are general towing instructions:

1. Place transmission in neutral.

2. If transmission or differential malfunction is suspected, tow from rear with rear wheels approximately six inches off ground.

3. Never tow over 30 mph. Do not raise car to height that would cause opposite end to be damaged by dragging.

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

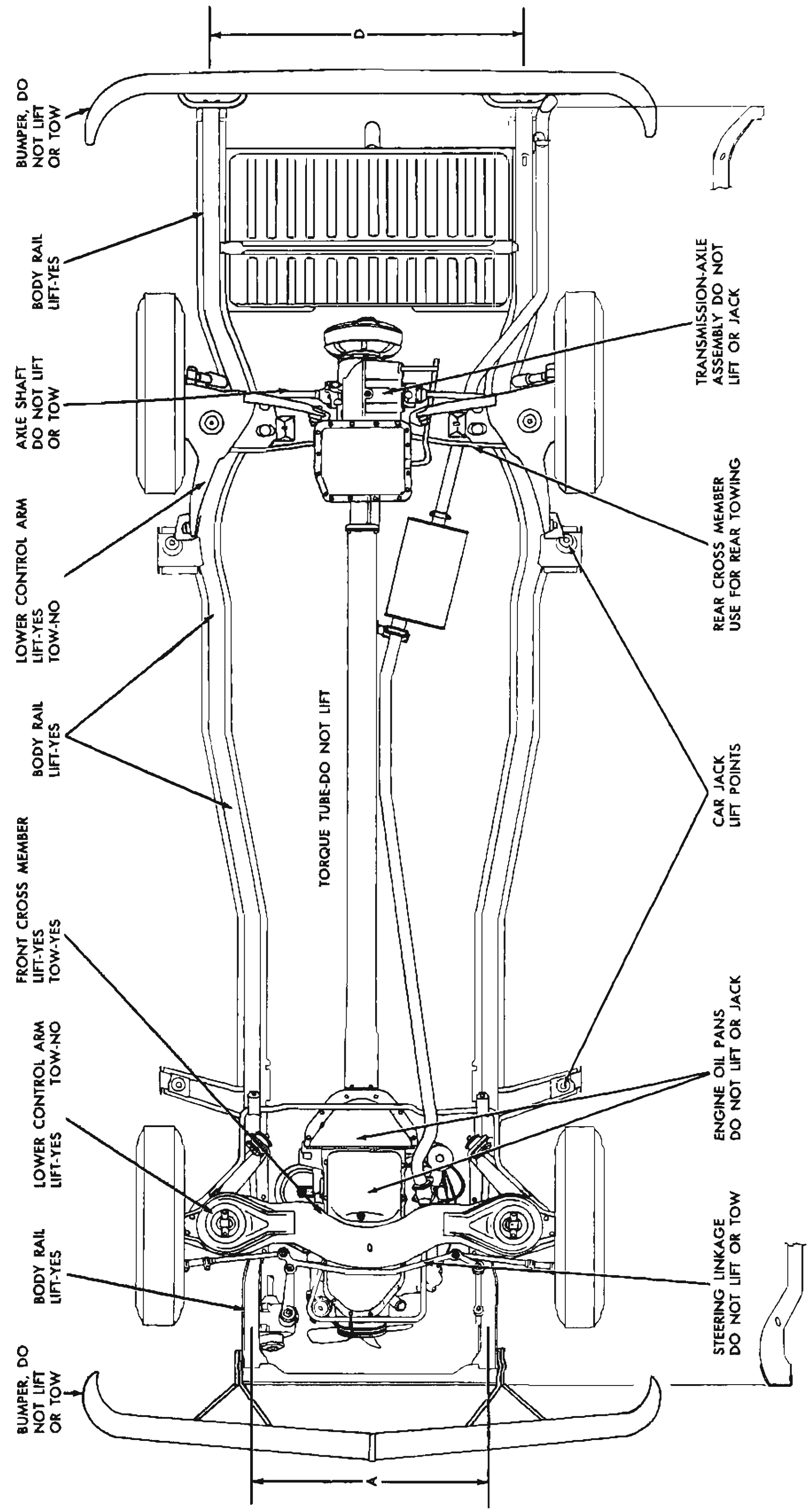



Fig. 1-7 Tempest Lift Points

# MISCELLANEOUS INFORMATION

## DECIMAL EQUIVALENTS

| | | | |
|---|---|---|---|
| 1/64 .015625 | 17/64 .265625 | 33/64 .515625 | 49/64 .765625 |
| 1/32 .03125 | 9/32 .28125 | 17/32 .53125 | 25/32 .78125 |
| 3/64 .046875 | 19/64 .296875 | 35/64 .546875 | 51/64 .796875 |
| 1/16 .0625 | 5/16 .3125 | 9/16 .5625 | 13/16 .8125 |
| 5/64 .078125 | 21/64 .328125 | 37/64 .578125 | 53/64 .828125 |
| 3/32 .09375 | 11/32 .34375 | 19/32 .59375 | 27/32 .84375 |
| 7/64 .109375 | 23/64 .359375 | 39/64 .609375 | 55/64 .859375 |
| 1/8 .125 | 3/8 .375 | 5/8 .625 | 7/8 .875 |
| 9/64 .140625 | 25/64 .390625 | 41/64 .640625 | 57/64 .890625 |
| 5/32 .15625 | 23/32 .40625 | 21/32 .65625 | 29/32 .90625 |
| 11/64 .171875 | 27/64 .421875 | 43/64 .671875 | 59/64 .921875 |
| 3/16 .1875 | 7/16 .4375 | 11/16 .6875 | 15/16 .9375 |
| 13/64 .203125 | 29/64 .453125 | 45/64 .703125 | 61/64 .953125 |
| 7/32 .21875 | 15/32 .46875 | 23/32 .71875 | 31/32 .96875 |
| 15/64 .234375 | 31/64 .484375 | 47/64 .734375 | 63/64 .984375 |
| 1/4 .25 | 1/2 .5 | 3/4 .75 | 1 1. |

## WEIGHTS AND MEASURES

### LINEAR MEASURE

1/12 foot (ft.) = 1 inch (in.)
12 inches = 1 foot
3 feet = 1 yard (1 yd.)

### AREA MEASURE

1/144 square foot (sq. ft.) = 1 square inch (sq. in.)
144 square inches = 1 square foot
9 square feet = 1 square yard (sq. yd.)

### LIQUID MEASURE

1/16 pint (pt.) = 1 ounce (oz.)
1 pint = 16 ounces
2 pints = 1 quart (qt.) = 32 ounces
4 quarts = 1 gallon (gal.)
31½ gallons = 1 barrel (bbl.)

### DRY MEASURE

½ quart (qt.) = 1 pint (pt.)
2 pints = 1 quart (qt.)
8 quarts = 1 peck (pk).
4 pecks = 1 bushel (bu.)
105 quarts = 1 barrel

### CUBIC MEASURE

1,728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard

### COMMON WEIGHT

16 ounces = 1 pound
100 pounds = 1 hundred weight (cwt.)
2000 pounds = 1 ton

### COMMON U.S.A. EQUIVALENTS

#### LENGTH

1 inch = 25.4001 millimeters
1 millimeter = 0.03937 inches
1 foot = 0.304801 meters
1 meter = 3.28083 feet
1 yard = 9.914402 meters
1 meter = 1.093611 yards
1 mile = 1.609347 kilometers
1 kilometer = 0.621370 miles

### LIQUID CAPACITY

1 quart = 0.94633 liters
1 liter = 1.05671 quarts
1 gallon = 3.78533 liters
1 liter = 0.26418 gallons

### DRY CAPACITY

1 quart = 1.1012 liters
1 liter = 0.9081 quarts
1 peck = 3.310 liters
1 liter = 0.11351 pecks

## DRILL SIZES

| Letter Sizes | Drill Diam. Inches | Wire Gage Sizes | Drill Diam. Inches | Wire Gage Sizes | Drill Diam. Inches | Wire Gage Sizes | Drill Diam. Inches |
|---|---|---|---|---|---|---|---|
| Z | 0.413 | 1 | 0.2280 | 28 | 0.1405 | 55 | 0.0520 |
| Y | 0.404 | 2 | 0.2210 | 29 | 0.1360 | 56 | 0.0465 |
| X | 0.397 | 3 | 0.2130 | 30 | 0.1285 | 57 | 0.0430 |
| W | 0.386 | 4 | 0.2090 | 31 | 0.1200 | 58 | 0.0420 |
| V | 0.377 | 5 | 0.2055 | 32 | 0.1160 | 59 | 0.0410 |
| U | 0.368 | 6 | 0.2040 | 33 | 0.1130 | 60 | 0.0400 |
| T | 0.358 | 7 | 0.2010 | 34 | 0.1110 | 61 | 0.0390 |
| S | 0.348 | 8 | 0.1990 | 35 | 0.1100 | 62 | 0.0380 |
| R | 0.339 | 9 | 0.1960 | 36 | 0.1065 | 63 | 0.0370 |
| Q | 0.332 | 10 | 0.1935 | 37 | 0.1040 | 64 | 0.0360 |
| P | 0.323 | 11 | 0.1910 | 38 | 0.1015 | 65 | 0.0350 |
| O | 0.316 | 12 | 0.1890 | 39 | 0.0995 | 66 | 0.0330 |
| N | 0.302 | 13 | 0.1850 | 40 | 0.0980 | 67 | 0.0320 |
| M | 0.295 | 14 | 0.1820 | 41 | 0.0960 | 68 | 0.0310 |
| L | 0.290 | 15 | 0.1800 | 42 | 0.0935 | 69 | 0.0292 |
| K | 0.281 | 16 | 0.1770 | 43 | 0.0890 | 70 | 0.0280 |
| J | 0.277 | 17 | 0.1730 | 44 | 0.0860 | 71 | 0.0260 |
| I | 0.272 | 18 | 0.1695 | 45 | 0.0820 | 72 | 0.0250 |
| H | 0.266 | 19 | 0.1660 | 46 | 0.0810 | 73 | 0.0240 |
| G | 0.261 | 20 | 0.1610 | 47 | 0.0785 | 74 | 0.0225 |
| F | 0.257 | 21 | 0.1590 | 48 | 0.0760 | 75 | 0.0210 |
| E | 0.250 | 22 | 0.1570 | 49 | 0.0730 | 76 | 0.0200 |
| D | 0.246 | 23 | 0.1540 | 50 | 0.0700 | 77 | 0.0180 |
| C | 0.242 | 24 | 0.1520 | 51 | 0.0670 | 78 | 0.0160 |
| B | 0.238 | 25 | 0.1495 | 52 | 0.0635 | 79 | 0.0145 |
| A | 0.234 | 26 | 0.1470 | 53 | 0.0595 | 80 | 0.0135 |
| | | 27 | 0.1440 | 54 | 0.0550 | | |

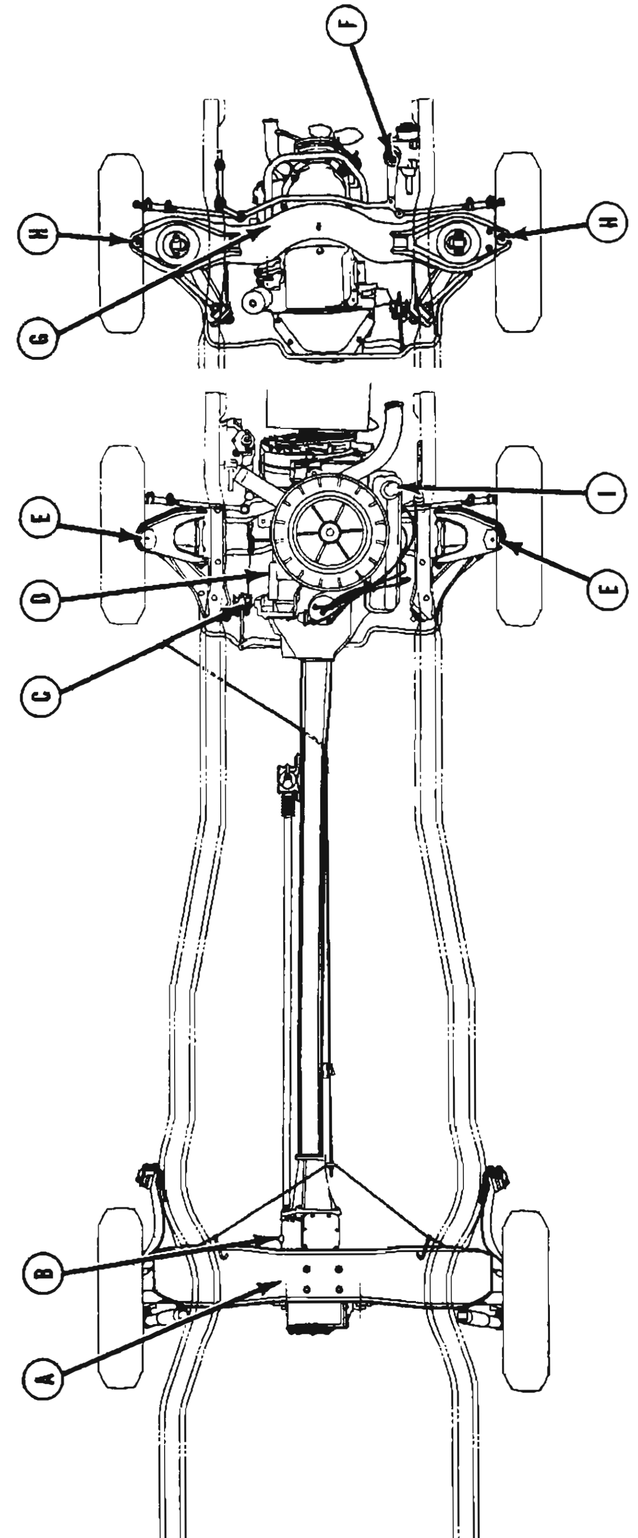



Fig. 2-0 Chassis Lubrication Chart

# GENERAL LUBRICATION

## CONTENTS OF THIS SECTION



## WHEN TO LUBRICATE

All Pontiac Tempests are completely lubricated at the factory with a special long-lasting chassis grease and under normal conditions, chassis lubrication will not be required for 12,000 miles or six months, whichever occurs first.

For additional chassis lubrication periods special Pontiac Tempest chassis grease is recommended (see Figure 2-1).

NOTE: If conventional chassis lubrication is used relubrication at 6,000 mile intervals is recommended.

## ENGINE OIL CHANGE

The crankcase of the Pontiac Tempest engine was filled at the factory with a high quality MS oil, especially compounded to ensure proper lubrication of all engine parts during the break-in period. This oil should be changed after 60 days or at 6,000 miles, whichever occurs first. Succeeding oil changes should also be made at 60 day or 6,000 mile intervals, whichever occurs first. NOTE: The 1963 Tempest engine has been equipped with specially engineered chromium plated piston rings. These rings allow oil to flow freely on the cylinder walls during the break-in period. Therefore, oil consumption may be higher during the break-in period than it will be afterward.

Oil which according to the label on the can, is intended for service MS and passes car maker's test or meets General Motors standard GM 4745-M should be used.

| Atmospheric Temperatures Expected | Recommended S.A.E. Single Viscosity Number | Acceptable Alternate |
|---|---|---|
| Above Freezing (+32°F. and above) | 20W | 10W-30 |
| Below Freezing (0° to +32°F.) | 10W | 5W-20 |
| Below Zero | 5W | 5W-20 |

## ENGINE OIL FILTER

The oil filter should be replaced at the first oil change. Thereafter replace the oil filter approximately every 6,000 miles or six months, whichever occurs first. For convenience the oil filter should be replaced at the time of an oil change.

The crankcase level capacity is four quarts (five quarts when the oil cartridge is replaced).

## SERVICE EVERY 6,000 MILES

### SYNCHRO-MESH TRANSMISSION

Add fluid as necessary. Change lubricant when necessary to disassemble.

Use SAE 80 "Multi-purpose gear lubricant." No special additive to this lubricant is required or recommended.

NOTE: Straight mineral oil gear lubricants or any "active sulphur soap" lubricants must not be used.

The capacity of the three-speed transmission is 3 pints; differential and transmission, 6.3 pints. The four-speed transmission capacity is 3.85 pints; differential and transmission, 7.15 pints.

### CLUTCH LINKAGE

Check lash and adjust as required at pre-delivery inspection and every 6,000 miles. Lubricate with engine oil at pivot points and light grease at push rod to clutch fork ball joint.

### TEMPESTORQUE TRANSMISSION

Check fluid level as necessary. Use automatic transmission fluid AQ-ATF Type "A". Refill capacity is 4 pints.

### DIFFERENTIAL

Check for leaks. Use any SAE 80 or 90 Multi-Purpose gear lubricant in the differential assembly. The lubricant should be changed only when necessary to disassemble.

Capacity is as follows: with synchro-mesh transmission see above; differential used with automatic transmission, 3.3 pints.

### MANUAL STEERING GEAR

Add fluid as necessary. Change lubricant only when necessary to disassemble. Use all-season steering gear lubricant.

Adjust worm shaft bearing and high-point loads at the end of the first 6,000 miles. Readjust as lash develops.

### POWER STEERING GEAR

### POWER STEERING SYSTEM

### PUMP RESERVOIR

Add fluid as necessary. Fill reservoir only to mark. Use Hydra-Matic fluid AQ-ATF Type "A". Replace fluid as necessary to disassemble.

Adjust worm shaft bearing and high point load at the end of the first 6,000 miles. Readjust as lash develops.

### BRAKE SYSTEM AND MASTER CYLINDER RESERVOIR

Check system for adequate brake pedal reserve and for evidence of leaks. Use GM or Delco Super 11 or any SEA 70R1 brake fluid. Fill reservior to ½" below top.

### STANDARD CARBURETOR AIR CLEANER ELEMENT

Clean and re-oil using engine oil. Clean and re-oil after each occasion of driving under severe dust conditions. NOTE: The heavy duty type air cleaner is recommended for continuous operation under severe dust conditions.

### MANIFOLD HEAT CONTROL VALVE

Observe for freedom of movement. Lubricate with graphite in alcohol if sticky.

### TIRES

Check wheel and tire balance and rotate tires.

## SERVICE EVERY 12,000 MILES OR SIX MONTHS, WHICHEVER OCCURS FIRST

### CHASSIS LUBRICATION

See Page 2-1.

### ACCELERATOR LINKAGE

Lubricate with engine oil at chassis lubrication. Do not lubricate the linkage which is a part of the carburetor assembly.

### FUEL FILTER (INTEGRAL TYPE)

### TEMPEST 195 ENGINES WITH ONE-BARREL CARBURETOR AND V-326 ENGINES WITH TWO-BARREL CARBURETOR

Clean twice yearly. Replace every 12,000 miles.

## SERVICE EVERY 12,000 MILES OR YEARLY, WHICHEVER OCCURS FIRST

### CRANKCASE INLET VENT

Clean and re-oil with engine oil. Clean and re-oil after each occasion of driving under severe dust conditions.

### POSITIVE CRANKCASE VENT

Replace valve assembly every 12,000 miles or yearly whichever occurs first. The valves should also be replaced if pinching off the hose from the valve causes engine idle speed reduction of less than 35 rpm on four-cylinder engines or less than 15 rpm on eight-cylinder engines.

### FUEL FILTER (CARTRIDGE TYPE) TEMPEST 195 ENGINES WITH FOUR-BARREL CARBURETOR AND V-326 ENGINES WITH A/C

Replace filter yearly or every 12,000 miles, whichever occurs first. If premature plugging is experienced, change brand of fuel.

### HEAVY DUTY AIR CLEANER ELEMENT (FOAM TYPE)

Wash element in solvent and re-oil using 10W-30 engine oil. Clean and re-oil after each occasion of driving under severe dust conditions.

## SERVICE AT SPECIAL INTERVALS

### ENGINE OIL CHANGE

See Page 2-1.

### PARKING BRAKE CABLE

Clean and relubricate at time rear brake drums are removed for major brake service. Use light grease.

### BRAKE PEDAL PIVOTS

Lubricate with engine oil at pivot points as required.

### SPEEDOMETER CABLE

If noise or needle flicker occurs, lubricate. Use speedometer cable grease.

### FRONT WHEEL BEARINGS

Only when wheels are off for other service, use special high temperature wheel bearing grease. Use only enough lubricant to thoroughly coat rollers. Do not fill the wheel hub cavity.

### DOOR LOCKS AND STRIKERS

Use a stick-type lubricant as required.

### DOOR HINGE HOLD OPENS

Use light grease on friction surfaces as required.

### DOOR HINGE PINS

Lubricate with engine oil as required.

### STATION WAGON TAIL GATE HINGE AND LINKAGE

Lubricate with engine oil as required.

### STATION WAGON FOLDING SEAT

Lubricate sparingly with engine oil on pivots as required.

### FUEL FILLER DOOR HINGE

Lubricate with engine oil on the hinge pin and spring anchor points as required.

### HOOD LATCH ASSEMBLY

Lubricate with engine oil on pivots and spring anchor points as required.

### HOOD HINGE

Use engine oil on hinge pins and spring anchor points as required.

### BATTERY

Add distilled water every 30 days. During high temperatures and/or extended trip operation check water level more often. Fill to bottom of vent well.

**CAUTION: *Battery fumes are highly flamable.***

### AIR CONDITIONING CONDENSER CORE

Clean off leaves, bugs, etc., and flush outside of condenser and radiator core yearly each spring .

### AIR CONDITIONING

Operate air conditioning system for a minimum of five minutes every month even in winter. This will supply oil to the compressor shaft seal.

### FAN AND ACCESSORY DRIVE BELTS

Adjust at pre-delivery inspection and at the end of the first 6,000 miles. Thereafter, adjust as required to prevent belt slippage.

## ITEMS NOT NORMALLY REQUIRING SERVICE

### *STARTING MOTOR*

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

### *ALTERNATOR*

The alternator is designed and constructed to give long periods of trouble-free service with a limited amount of maintenance. The rotor is mounted on a ball bearing and a roller bearing. Both bearings have a grease supply which eliminates the need for periodic lubrication. The alternator brushes are extra long and under normal operating conditions will provide extended service.

### *CLUTCH RELEASE BEARING*

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

### *SHOCK ABSORBERS*

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

### *REAR WHEEL BEARINGS*

The rear wheel bearings require no periodic lubrication.

# COIL SPRING SUSPENSION

## CONTENTS OF THIS SECTION



## DESCRIPTION

### *FRONT SUSPENSION (Fig. 3-1)*

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

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

### *REAR SUSPENSION. (FIG. 3-2 AND 3-3)*

The swing axle independent rear suspension provides independent action of each rear wheel and reduced unsprung weight as well as positive control of suspension geometry.

In this system the rear cross member is attached to the integral body with four bolts. Attached to the rear cross member is the trans-axle support cross member mounted in rubber at the ends for noise and vibration isolation (Fig. 3-3). The differential is in turn mounted to this cross member. The differential and final drive gear case is, therefore, mounted to the sprung mass of the car, the axle shafts being driven through a universal joint on either side of the differential.

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

The lower control arms form the lower seat for

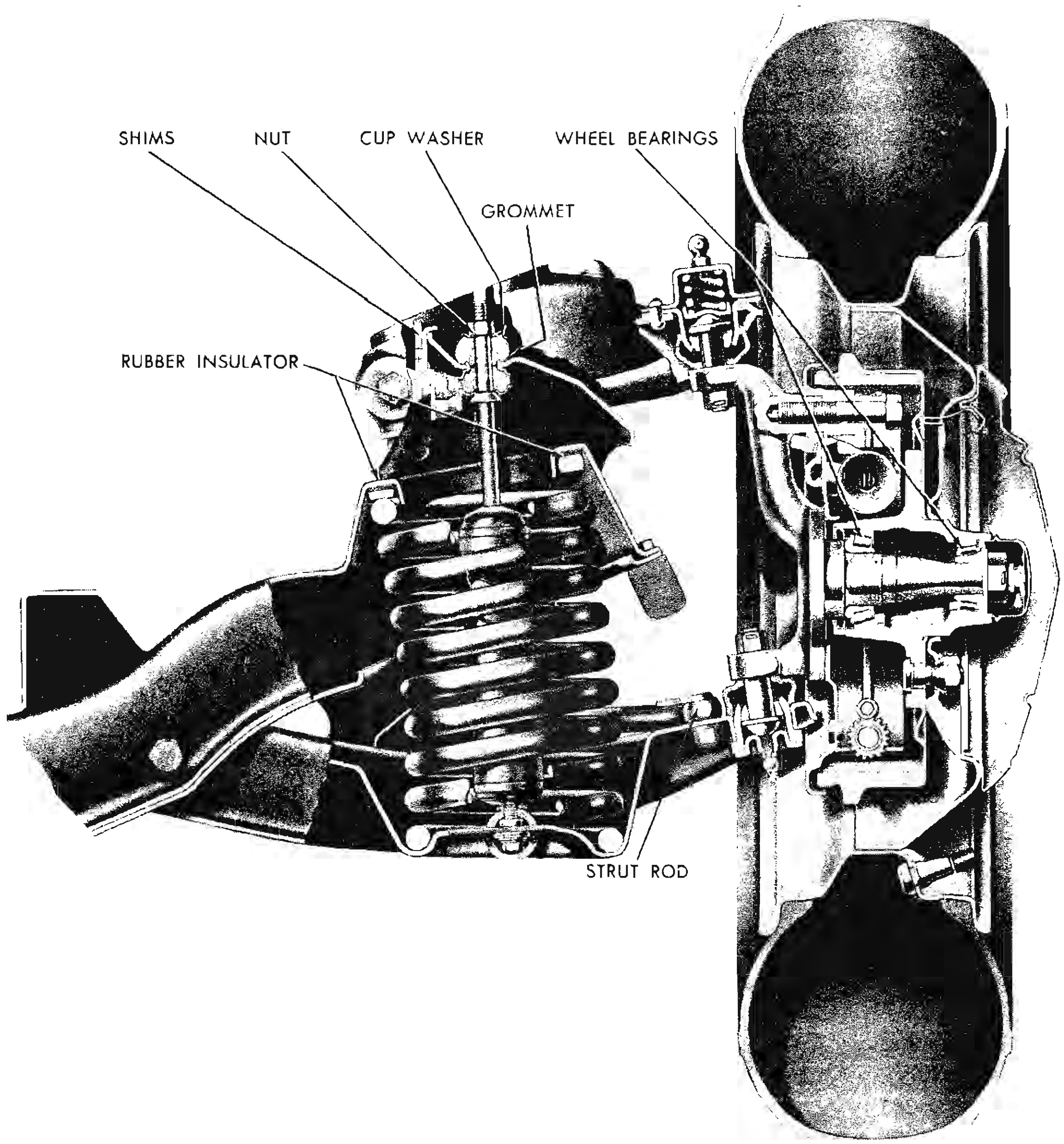



Fig. 3-1 Front Coil Spring Suspension

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

## PERIODIC SERVICE

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

## ADJUSTMENTS AND CHECKS ON CAR

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

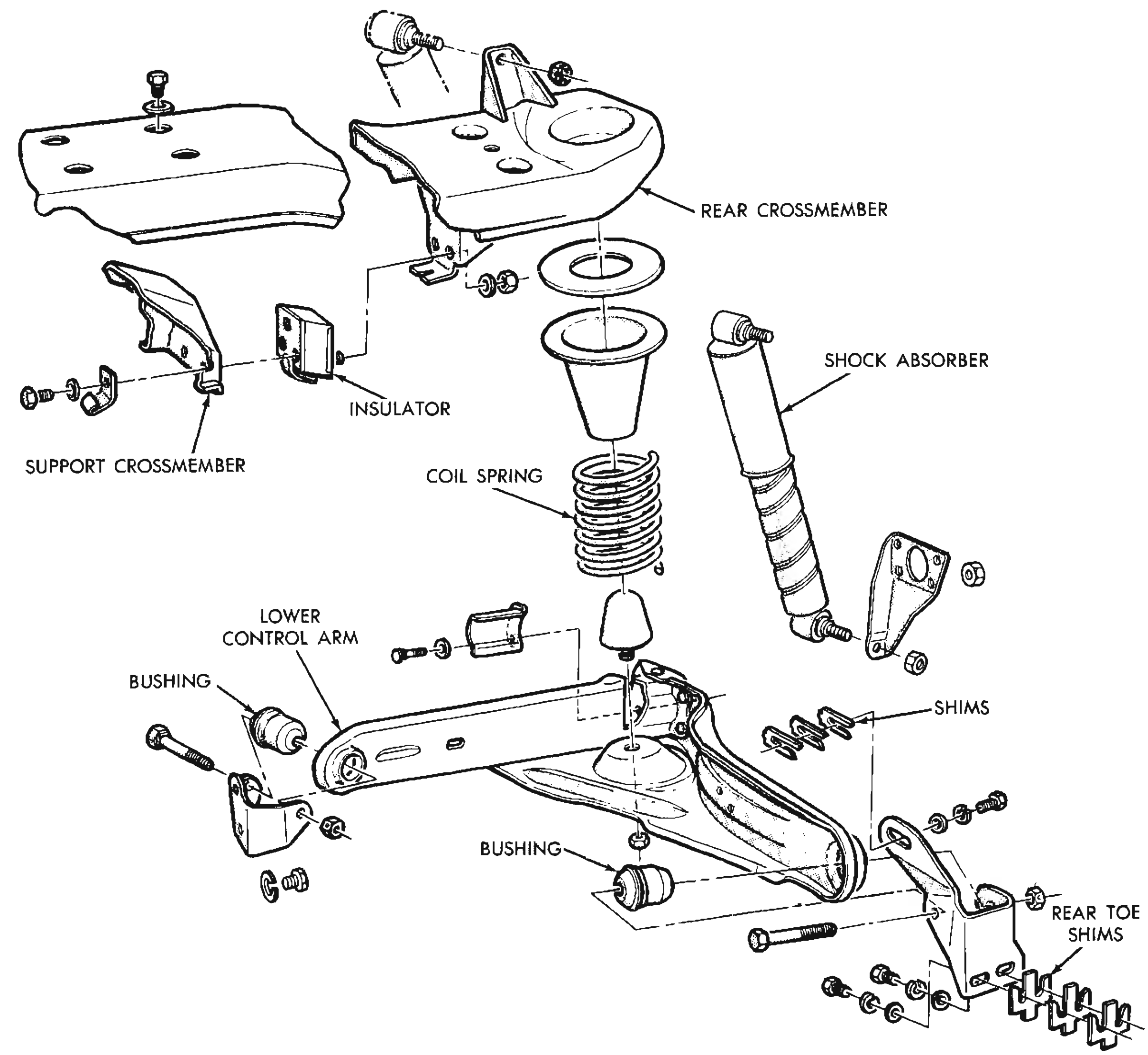



Fig. 3-2 Rear Coil Spring Suspension
(Exploded)

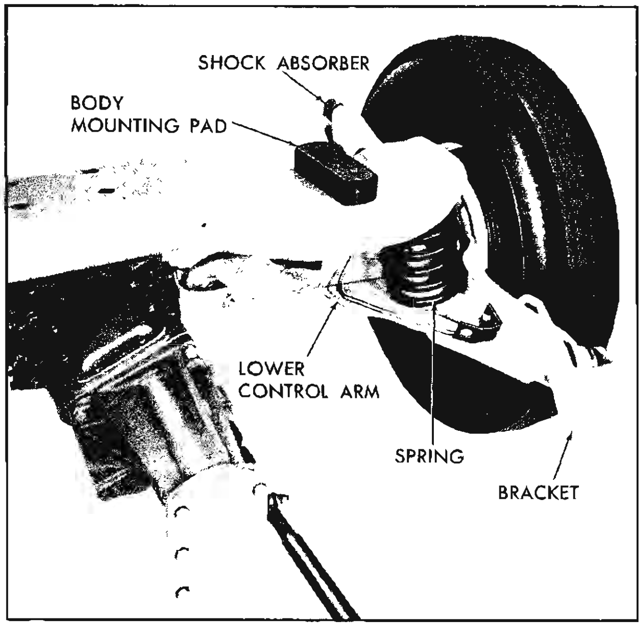



Fig. 3-3 Rear Suspension Assembly

### CHECK AND ADJUST FRONT WHEEL BEARINGS

NOTE: Tapered roller bearings have a slightly loose feel when properly adjusted. This differs from ball bearings which may be pre-loaded without adverse effect. Tapered roller bearings can be damaged by the steady thrust on roller ends which comes from pre-loading.

To Check:

1. Place lift or car jack under lower frame front cross-member and raise wheel off floor. This will maintain load on the ball joints.

2. Spin wheel to check for unusual noise.

3. Grip tire at top and bottom and rock. If movement of tire at outer edge exceeds 1/4", the wheel bearing may be excessively loose. If bearings are noisy or looseness is excessive, they should be cleaned and inspected prior to adjustment.

### TORQUE WRENCH METHOD (PREFERRED)

1. Remove dust cap.

2. Check for slip fit of bearing cones on spindles. Bores of bearing cones should have a light coat of wheel bearing lubricant to allow cones to creep on spindle.

3. If nut turns hard on spindle, check for and remove any burrs from spindle threads and cotter pin holes or slots in nut.

4. With tire off ground, adjust bearing as follows:

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

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

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

5. Install dust cap and lower tire to ground.

### HAND FEEL METHOD (OPTIONAL)

1. Remove dust cap.

2. Check for slip fit of bearing cones on spindles. Bores of bearing cones should have a light coat of wheel bearing lubricant to allow cones to creep.

3. If nut turns hard on spindle, check for and remove any burrs from spindle threads and cotter pin holes or slots in nut.

4. With tire off ground, adjust as follows:

a. Tighten nut with an 8" or 10" wrench using enough arm length leverage to ensure parts are properly seated while spinning wheel.

b. Back off nut finger loose then tighten finger tight.

c. If hole in spindle lines up with slot in nut, install cotter pin. If not, *back off* to next slot and install cotter pin.

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

5. Install dust cap and lower tire to ground.

### *CHECK BALL JOINTS*

If wheel bearing adjustment does not remove excessive movement (exceeds 1/4") at lower outer periphery of tire, check ball joints as follows:

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

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

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

3. Check movement of each front wheel by gripping top and bottom of tire and moving in and out. An excess of 1/4" travel (measured at the lower periphery of the tire) indicates worn ball joints. When moving tire, as mentioned above, observe each ball joint for looseness.

4. If ball joint is loose or worn use J-6627 ball stud remover to remove the upper ball stud from steering knuckle.

5. Install a nut (snug against the upper ball joint) and rotate the ball stud in its socket with a torque wrench. If the torque required is less than 1/2 lb ft. or more than 6 lb. ft., the ball joint should be replaced (page 3-15).

6. Install upper ball stud in knuckle and tighten stud nut to 70-85 lb. ft. torque. NOTE: Do not back off nut when aligning holes to install cotter pin.

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

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

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

a. When the ball joint is new, it is permissible to have a maximum of .020" end play.

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

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

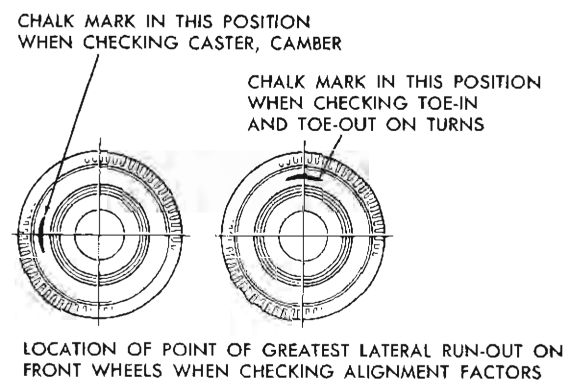



Fig. 3-4 Wheel Position for Checking Alignment

10. Install lower ball stud in steering knuckle and tighten stud nut to 70-85 lb. ft. torque. NOTE: Do not back off nut when aligning holes to install cotter pin.

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

12. Nuts on end of upper control arm shaft must be loosened and then torqued to 40-60 lb. ft after vehicle is lowered to floor and jounced.

### *CHECK LATERAL WHEEL AND TIRE RUN-OUT*

Lateral run-out of each front wheel and tire may be checked by placing a dial indicator against either of the tire buff ribs. Make the check on the inside buff rib if the outside is worn or distorted due to hard curbing.

The maximum allowable lateral run-out of each front wheel and tire is 1/8". The following corrective steps are taken if this is not obtainable.

1. Rotate tire on wheel.

2. Make wheel and tire run-out check.

3. Make wheel run-out check if lateral wheel and tire run-out exceeds 1/8" after tire rotation.

4. Excessive run-out is in wheel if run-out obtained in step 3 is greater than 1/8", and in tire if run-out obtained in step 3 is less than 1/8".

Certain types of front end alignment equipment require that the point of greatest lateral wheel and tire run-out be located on the tire for checking front end alignment factors. Tires can be marked in the

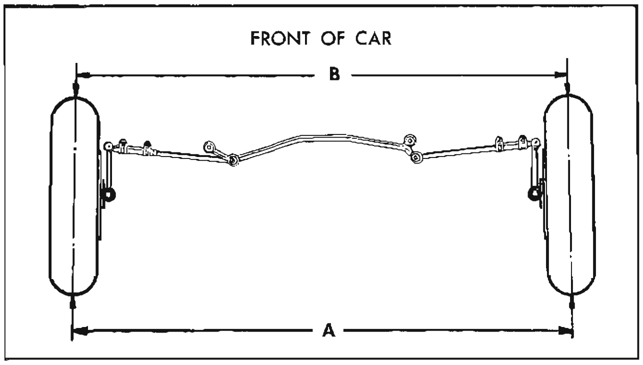



Fig. 3-5 Toe-in

manner shown in Fig. 3-4 when minimum wheel and tire run-out has been obtained. Hold a piece of chalk near wheel rim or tire sidewall while spinning wheel. Chalk can be moved inward to mark rim or tire at point of greatest run-out.

### *CHECK WHEEL AND TIRE BALANCE*

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

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

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

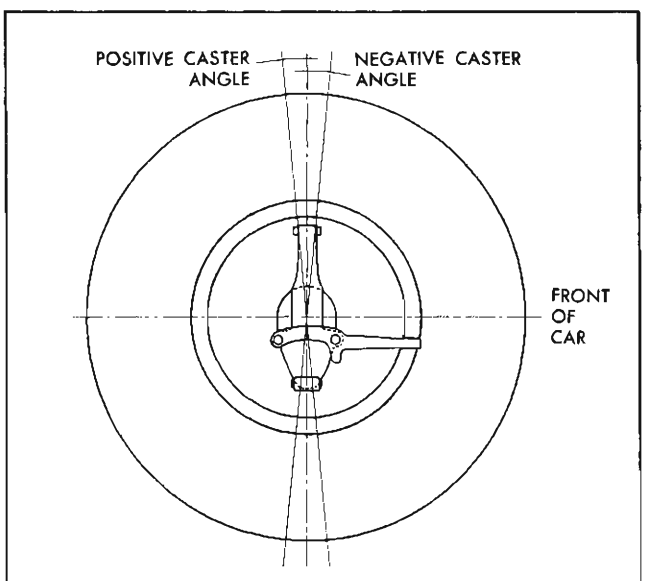



Fig. 3-6 Caster Angle

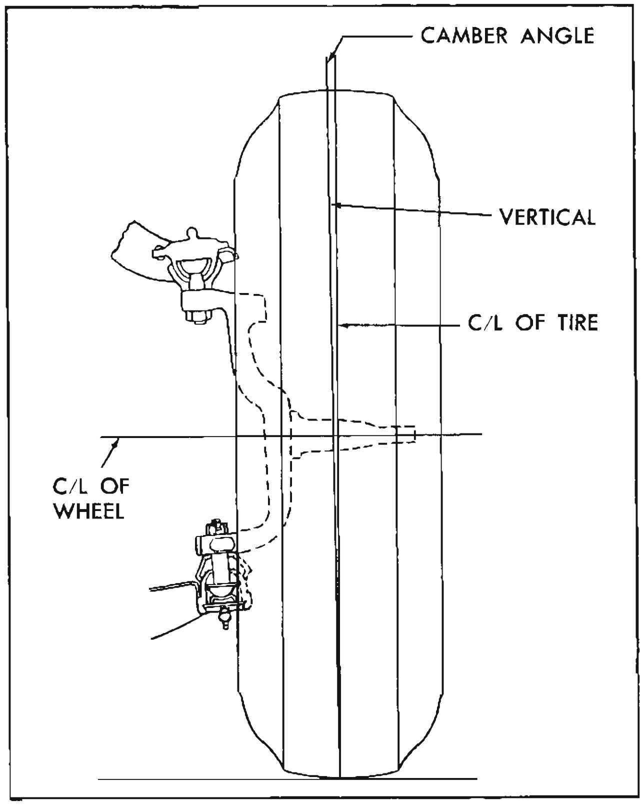



Fig. 3-7 Camber Angle

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

## WHEEL ALIGNMENT—DEFINITIONS

### *TOE-IN*

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

### *CASTER AND CAMBER*

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

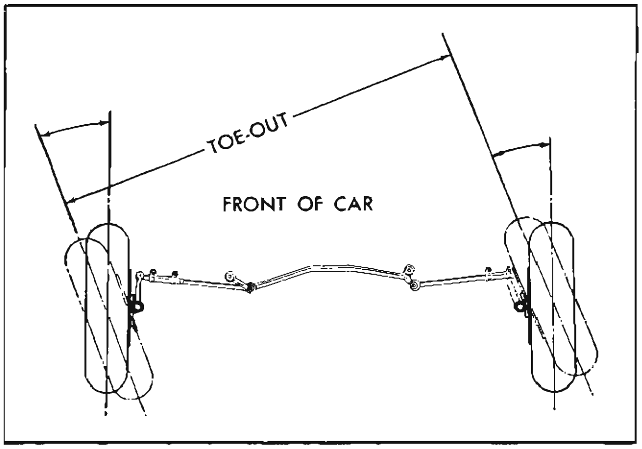



Fig. 3-8 Toe-out on Turns

### TOE-OUT ON TURNS

Toe-out on turns is the relationship between front wheels on turns (Fig. 3-8). Since the front wheels must turn on different radius circles, the steering linkage is designed to provide a greater turn angle of the inside wheel with respect to the outer wheel in a turn.

## INSPECTION BEFORE CHECKING FRONT WHEEL ALIGNMENT

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

1. Check tire inflation and bring to recommended pressure (see specifications in Section 3A).

2. Check front wheel bearing adjustment and correct if necessary (page 3-3).

3. Check wheel and tire run-out (page 3-5).

4. Check wheel and tire for excessive unbalance which would affect steering (page 3-6).

5. Check ball joints (page 3-5).

6. Check steering linkage for looseness. Replace or tighten parts.

7. Check shock absorbers for leaks or lack of control.

8. Check for extraordinary load in car. Remove load or compensate by setting height. (Samples, tools, etc., carried regularly should not be considered extraordinary load).

9. Check steering gear adjustment (see Section 9).

## FRONT SUSPENSION ALIGNMENT

It is necessary that the front end be properly lubricated and that there is no excessive play in wheel bearings and ball joints before performing wheel alignment or inspection.

### NEW CAR CURB HEIGHT

The tendency to remain upward and downward will be more noticeable on new cars because the suspension parts have not yet become burnished and completely free. For this reason, alignment on new cars should not be done unless the curb height is set to correspond with heights as shown in Fig. 3-10, Front Suspension, and Fig. 3-9, Rear Suspension. Blocks, or spacers made of rod or tubing, will be useful in positioning parts.

Measure height in front of spring for front suspension, and behind spring for rear suspension as shown in Fig. 3-9 and 3-10.

### SUBSEQUENT SERVICE SETTINGS

The suspension parts must be at normal curb load position before alignment. Curb load is defined as car with full tank of gasoline and unoccupied.

To determine whether car is at normal curb load, compare height measurement on the car in question with others of the same body style and having comparable equipment. Measure heights as described

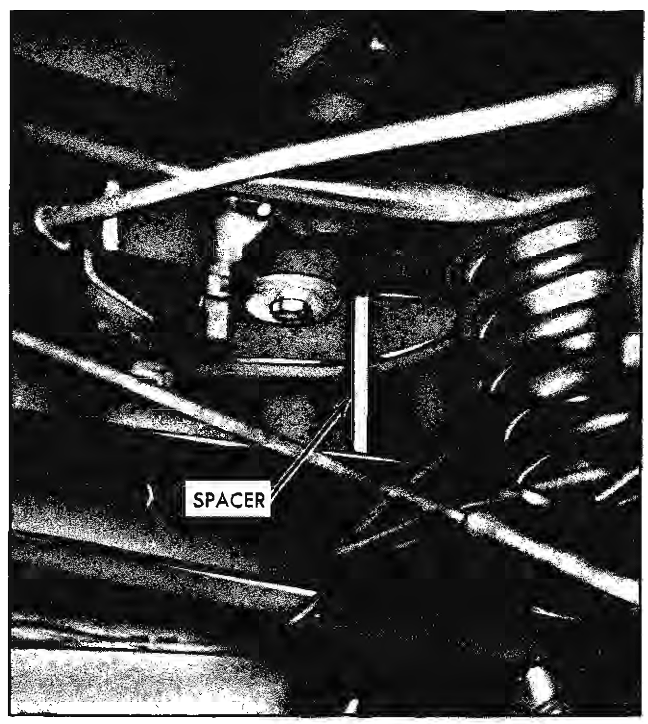



Fig. 3-9 Measuring Rear Suspension Curb Height

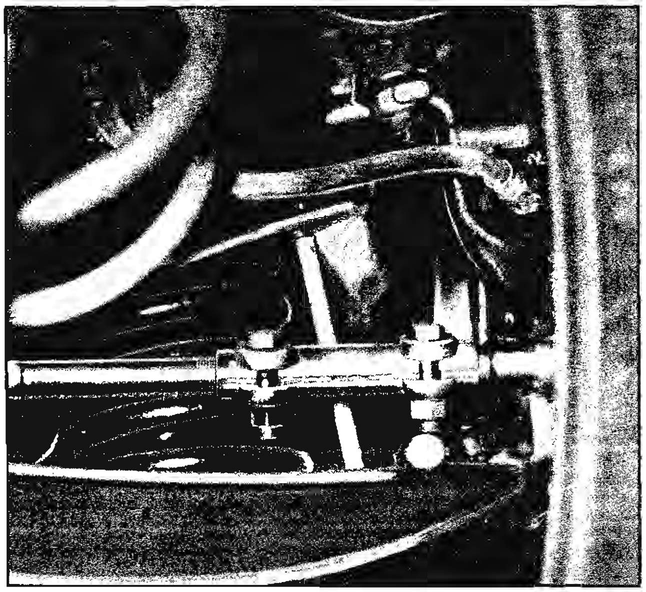


Fig. 3-10 Measuring Front Suspension Curb Height

under new car alignment above. The front and rear of car should be jounced up and down, decreasing the amount of movement until the suspension parts are equalized, before any measurements are made.

### ADJUST CAMBER

The camber adjustment is made before caster by means of shims between the upper control arm inner shaft and the front crossmember (Fig. 3-1). Although shims can be changed at either the front or rear attachment, it is important that the shimming be done equally so as to have no effect on caster. Adding shims at both front and rear of support shaft will decrease positive camber. The procedure for adjustment is to loosen the upper support shaft to crossmember bolts, add or remove shims (equally) as required and retighten the bolts. It may be necessary to remove the wheel to secure these bolts. Camber should be positive 0°8′ plus or minus 30′. After adjustment tighten nuts and bolts securing cross shaft to crossmember to 55-70 lb. ft. torque.

NOTE: To compensate for drift to the right, induced by road surface camber, it is desirable that the left camber be set 0°15′ greater (more positive) than the right camber.

### ADJUST CASTER

Caster adjustment is made by adjusting the length of the strut rod (Fig. 3-11) to give negative 1°40′ ±30′. Lengthening this rod by turning the nut increases caster. Shortening this rod by turning the nut decreases caster.

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

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

### TOE-IN

Front suspension toe-in should be checked at predelivery and 60-day inspection and set, if required.

Set toe-in to 0 to 1/8″ with a trammel or with other reputable front end alignment equipment, measuring from sidewall of tire or wheel felloes using methods given below.

### MEASURING BY TRAMMEL

1. After moving car forward on level floor, chalk tread on both front tires at a point 9″ above floor.

2. With trammel set at center to center distance of front tires, make mark in chalk on each front tire exactly trammel width apart.

3. Push car forward (never backward) until chalk with trammel marks is 9″ above floor at rear of wheels.

4. Measure difference from trammel marks made when chalk was in front of wheel; if trammel marks

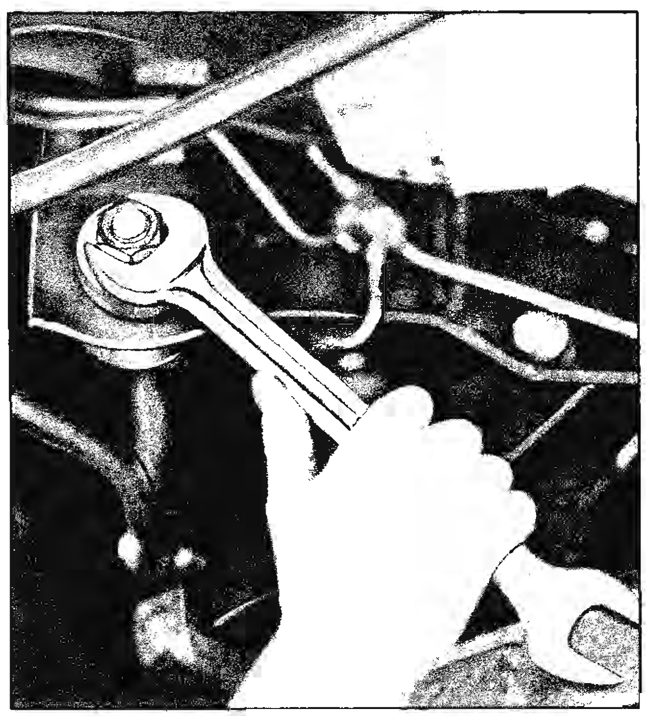


Fig. 3-11 Strut Rod Rear Adjusting Nut

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

EQUIPMENT MEASURING FROM SIDEWALL OR WHEEL FELLOES

When using this type of equipment, wheel run-out will have a very direct bearing on the readings. Since the allowable run-out is ⅛" the readings could possibly be off as far as ⅛" on each wheel if the effect of run-out is not cancelled. By taking the average of three readings with the wheel rotated 120° for each reading, the error due to wheel run-out can be cancelled. This should be done as follows:

1. After moving the car forward on level floor, take first reading.

2. Mark sidewall of both tires with the number "1" at rear of tire where instrument bears.

3. At 120° intervals (i.e. 1/3 and 2/3 distance around the tire) mark the numbers "2" and "3" on both tires.

4. Jack up and turn wheels until the number "2" is in the position which number "1" occupied when the first reading was taken.

5. Push car back one foot and bring forward to position and take second reading. This reading will then be taken with the instrument bearing 120° around the wheel from where the first reading was taken.

6. Use the same procedure for taking the third reading.

7. Average the three readings to find the actual toe-in.

***SET TOE-IN***

1. Remove horn button and set gear on high point of worm by turning steering wheel until mark on shaft is exactly at top. This mark locates the high point, or middle of gear travel.

2. Loosen tie rod end clamp bolts and turn tie rod tubes an equal amount until toe-in is 0-⅛". Turn right tie rod in direction of rotation of wheels, when car moves forward, to increase toe-in; turn left tie rod in opposite direction to increase toe-in.

3. Make sure front wheels are straight ahead by measuring from a reference point at same place on each side of frame center to front of wheel rims. If measurements are not equal, turn both tie rod tubes in same direction (so as not to change toe-in) until measurements become equal. Re-check toe-in since toe-in measurement is accurate only with wheels in straight ahead position.

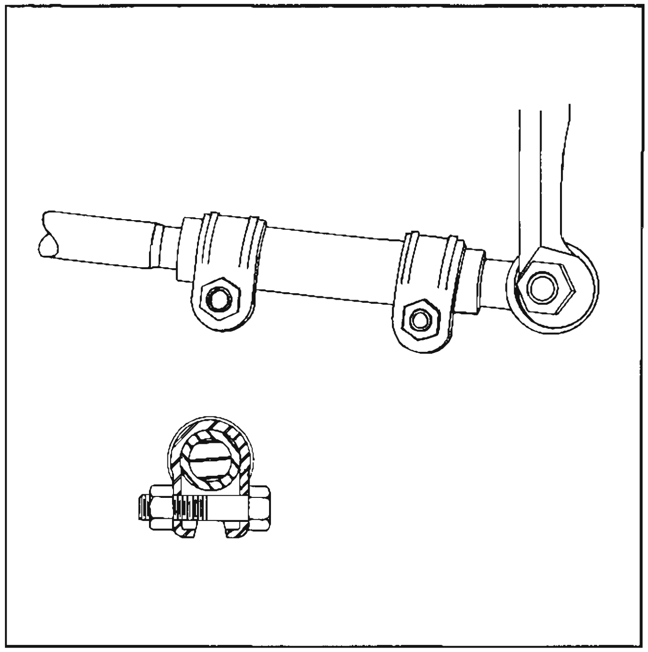


Fig. 3-12 Position for Tie-rod Adjuster Sleeve Bolts (Viewed from Top)

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

***CHECK TOE-OUT ON TURNS***

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

1. Check with any reputable front end aligning equipment using full floating turntables. With front wheels resting on turntables turn wheels to left until left wheel has been turned 20° from straight ahead. The right wheel should then be turned 18° to 19°.

2. Turn wheels to right until right wheel has been turned 20° from straight ahead. Left wheel should now be turned 18° to 19°.

3. Incorrect toe-out on turns may be caused by other incorrect front end adjustments but generally indicates bent steering arms which must be replaced.

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

## REAR SUSPENSION ALIGNMENT

***TOE-IN***

Rear suspension toe-in should be checked at pre-delivery and set, if required.

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

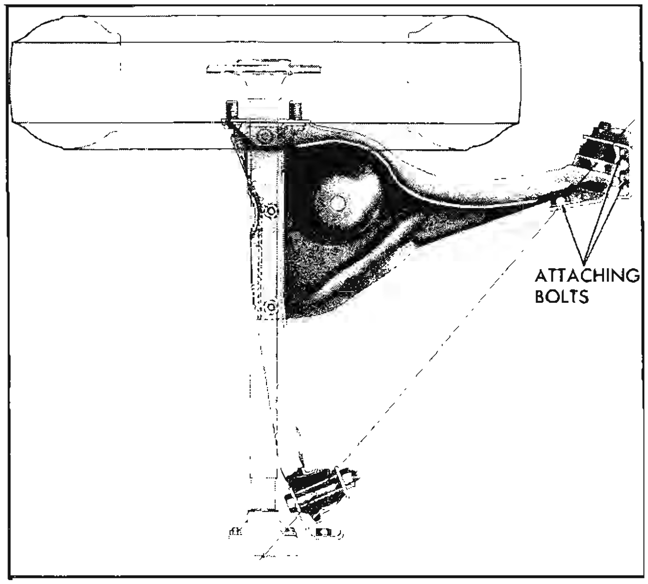



Fig. 3-13 Bracket Attaching Bolt Location

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

If drive-on type of equipment is used, reverse the vehicle and back it into position. Toe-in (overall) will be read as toe-out when the vehicle is backwards, because readings will be taken from the rear of the tire rather than the front. A trammel or side wall of tire (page 3-8) may also be used in a procedure similar to that used on the front wheels. Rear wheel toe is adjusted by adding or removing shims at the control arm to body side rail front attachment point Fig. 3-13).

#### SET REAR TOE

1. Loosen engine mount bolts before setting toe in order to ensure that mounts remain in a free position.

2. Loosen three control arm bracket to body attachment bolts (Fig. 3-13).

3. Adjust toe to 1/16" out to 3/16" in by adding or removing shims at control arm bracket to body bolts, at front attachment points (Fig. 3-13).

***CAUTION: Do not add or remove shims at control arm bracket upper bolt (Fig. 3-13). Shims are sometimes located here for manufacturing purposes only and should not be changed.***

4. Tighten two control arm bracket to body bolts at front attachment points to 40-55 lb. ft. torque.

NOTE: Make sure that bracket is in towards center of car as far as it will go before tightening. Bolt holes in bracket are elongated for this reason.

5. Tighten upper bracket bolt to 40-55 lb. ft. torque.

6. Tighten engine mount bolts to 40-55 lb. ft. torque.

## SERVICE OPERATIONS

### FRONT SUSPENSION

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

#### FRONT HUB AND DRUM ASSEMBLY

REMOVE

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

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

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

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

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

INSPECT

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

2. Check bearing outer races for cracks or pitting.

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

4. Check bearing outer race for looseness in hub.

REPAIRS

Replacement of Bearing Races:

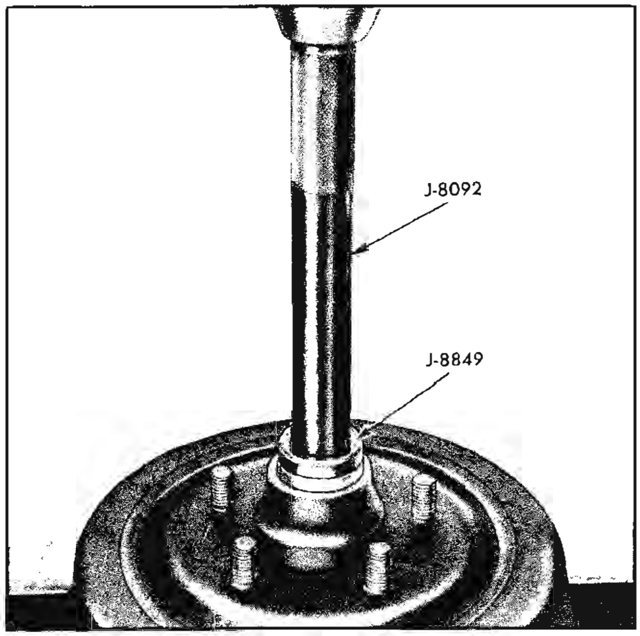



Fig. 3-14 Installing Outer Race in Hub

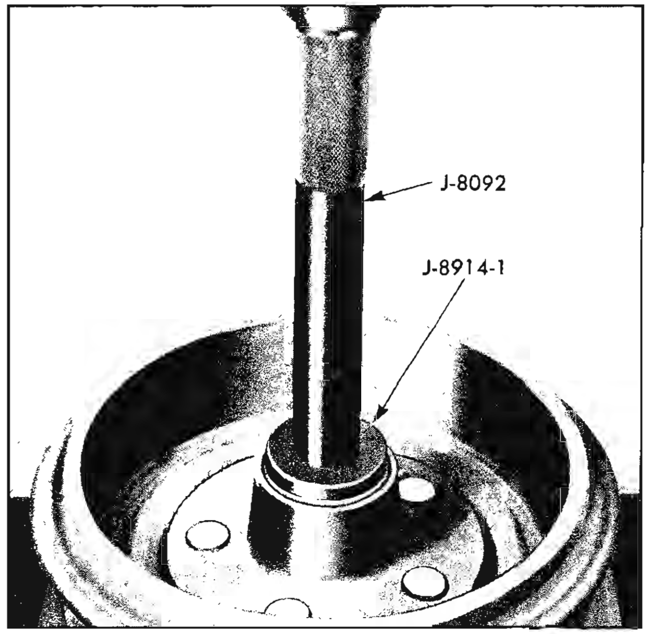



Fig. 3-15 Installing Inner Race in Hub

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

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

3. Install new bearing cup in hub using Tool J-8849 (Fig. 3-14) on the outer race and Tool J-8914 (Fig. 3-15) on the inner race. Tool J-8092 Driver Handle must be used with the above installers.

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

## INSTALL

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

2. Place inner bearing in hub, and install a new inner bearing seal assembly with Tool J-5154-A (Fig. 3-16). Side of seal with ridge should be down as installed, or away from center of the vehicle. Apply light coat of wheel bearing grease to inner diameter of seal which contacts spindle.

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

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

4. Carefully position hub on spindle.

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

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

### *STEERING KNUCKLE*

## REMOVE

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

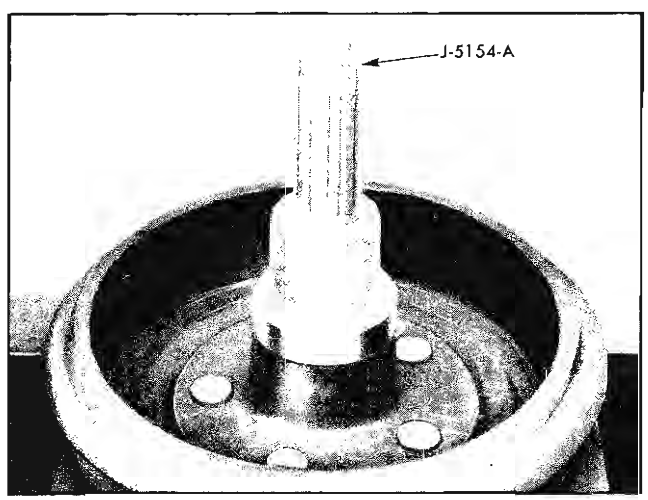



Fig. 3-16 Installing Inner Bearing Seal

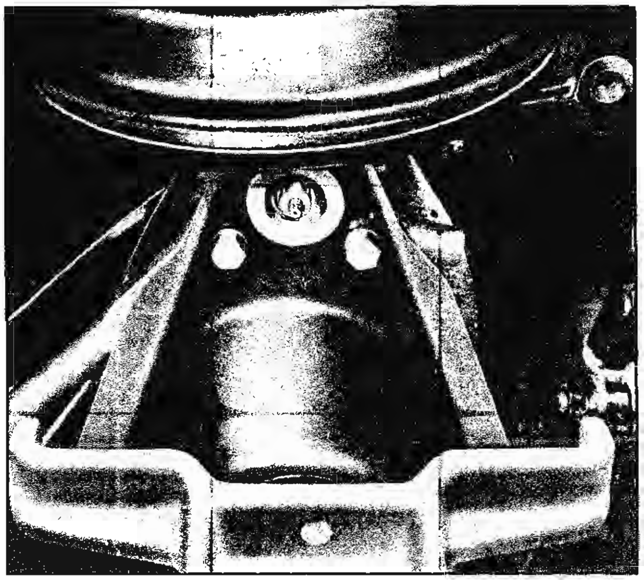


Fig. 3-17 Strut Rod Front Retaining Nuts

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

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

INSTALL

1. Install upper and lower ball studs through steering knuckle and tighten nuts to 70-85 lb. ft. torque.

NOTE: Do not back off nut when aligning holes to install cotter pins. Turn in a tightening direction only.

2. Secure backing plate to knuckle and steering arm with bolts, lockwashers and nuts. Tighten two lower bolts to 45-65 lb. ft. torque and upper bolt to 80-110 lb. ft torque.

3. Install hub and drum assembly as outlined above.

### *FRONT SHOCK ABSORBER*

REMOVE

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

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

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

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

INSTALL

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

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

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

4. Install upper grommet, cup washer, and retaining nut. Tighten to 60-120 lb. ft. torque.

NOTE: Nut must be bottomed at end of thread.

5. Lower vehicle to floor.

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

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

REMOVE COIL SPRING AND LOWER CONTROL ARM

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

2. Remove shock absorber.

3. Remove the two strut rod to control arm nuts and lockwashers (Fig. 3-17). The studs are pressed into the end of the strut rod.

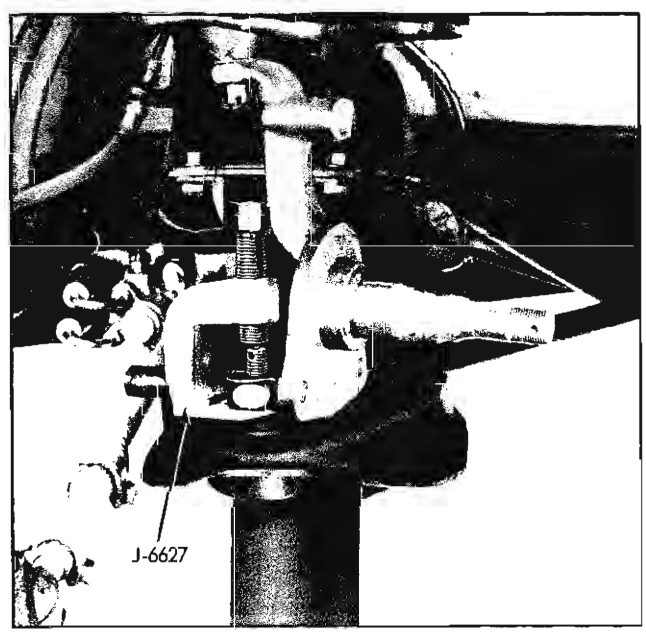



Fig. 3-18 Removing Lower Ball Stud

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

Place stand under control arm (Fig. 3-18). Take up slightly on spring compression.

5. Remove lower ball stud from steering knuckle with J-6627 (Fig. 3-18).

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

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

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

## REMOVE LOWER CONTROL ARM BALL JOINT

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

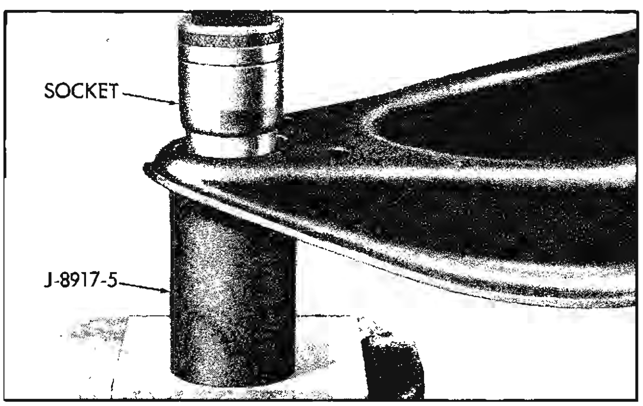



Fig. 3-19 Removing Lower Control Arm Ball Joint

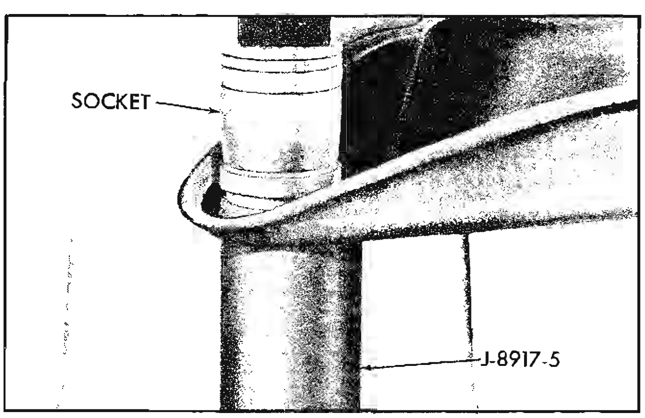



Fig. 3-20 Installing Lower Control Arm Ball Joint

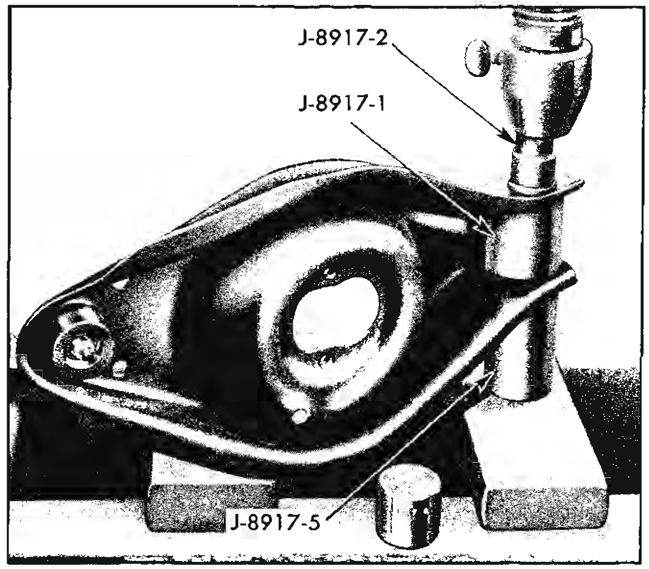



Fig. 3-21 Removing Control Arm Bushing

Using Tool J-8917-5 and suitable socket, press ball joint out of arm (Fig. 3-19).

## REMOVE LOWER CONTROL ARM BUSHINGS

To remove the bushing set up the tools as shown in Fig. 3-21. The bushing may be pressed out. Be certain to press on the end of the bushing that does not have the large collar on outer shell.

## INSTALL LOWER CONTROL ARM BUSHINGS

If lower arm bushing was removed, replace as shown in Fig. 3-22. The bushing must enter the control arm on the front side of arm.

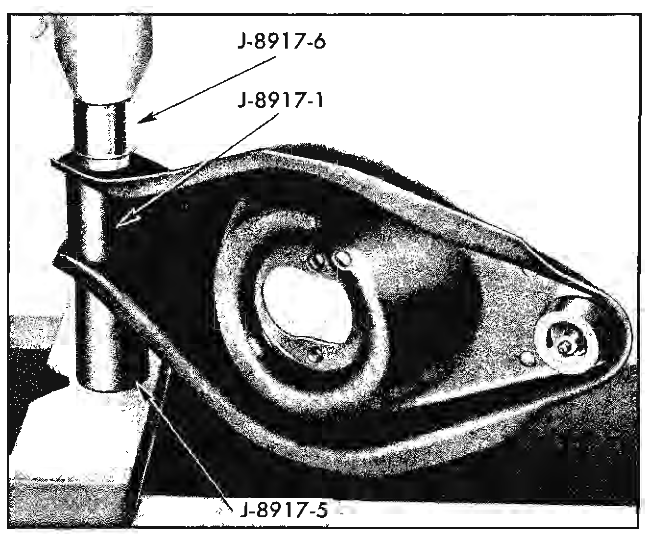



Fig. 3-22 Installing Control Arm Bushing

## INSTALL LOWER CONTROL ARM AND BALL JOINT

1. With Tool J-8917-5 and suitable socket, press ball joint into place (Fig. 3-20) and lubricate.

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

## INSTALL FRONT COIL SPRING

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

2. Place spring on control arm.

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

4. Install ball stud into steering knuckle. Tighten nut to 70-85 lb. ft torque.

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

5. Attach strut rod to control arm with two attaching nuts and lock washers. Tighten nuts to 60-75 lb. ft. torque. The studs are pressed into end of strut rod.

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

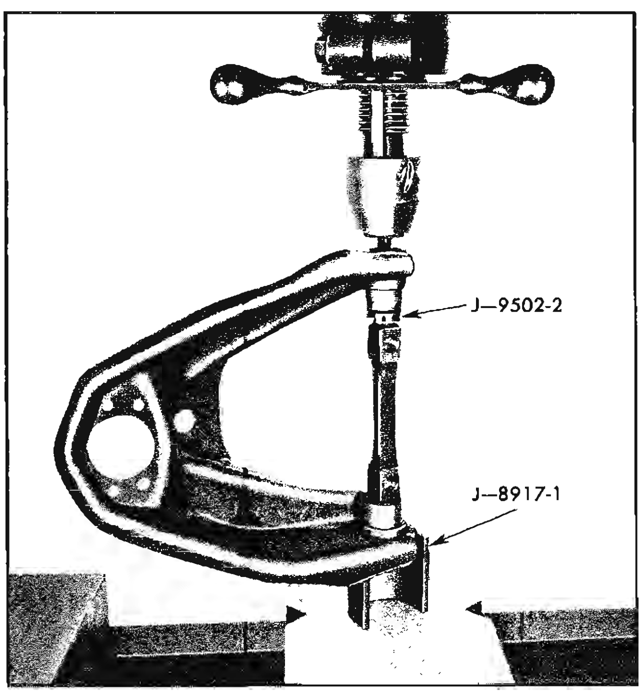



Fig. 3-23 Spacer J-9502-2 Installed

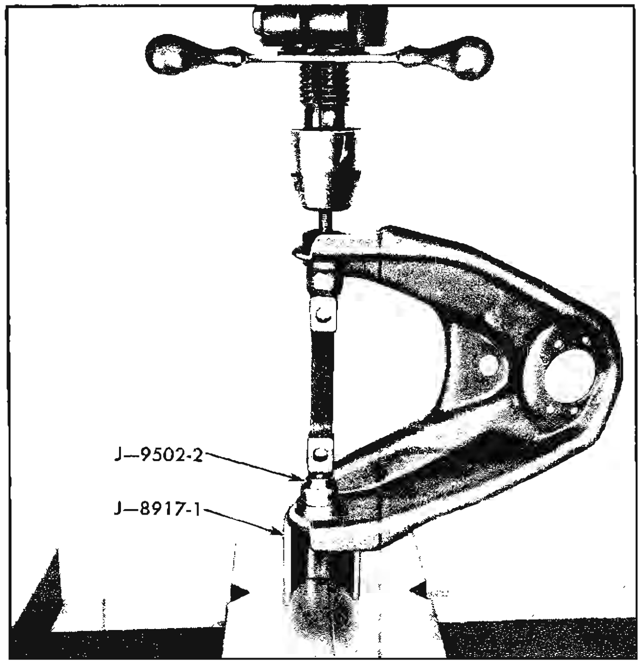



Fig. 3-24 Removing Bushing

6. Install shock absorber as outlined previously.

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

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

## REMOVE CONTROL ARM

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

2. Remove wheel and tire assembly.

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

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

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

6. Remove control arm retaining bolts.

7. Remove control arm.

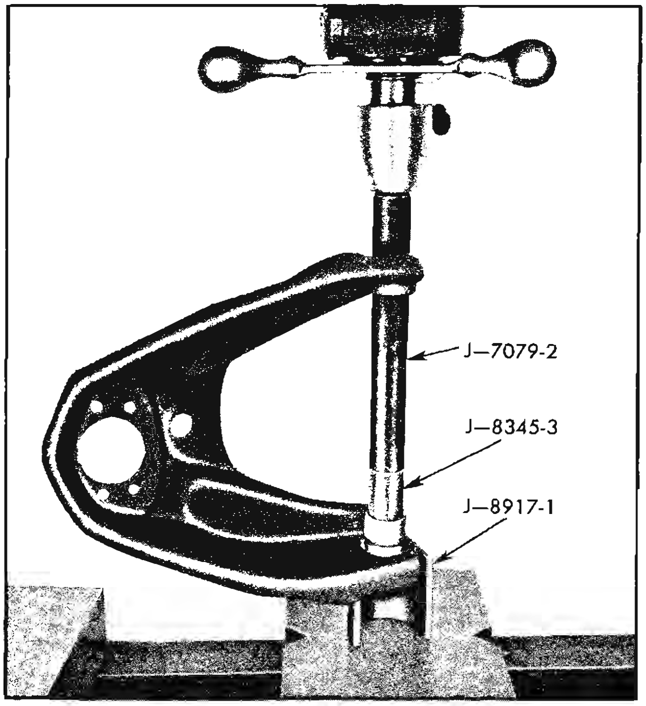



Fig. 3-25 Removing Control Arm Bushing

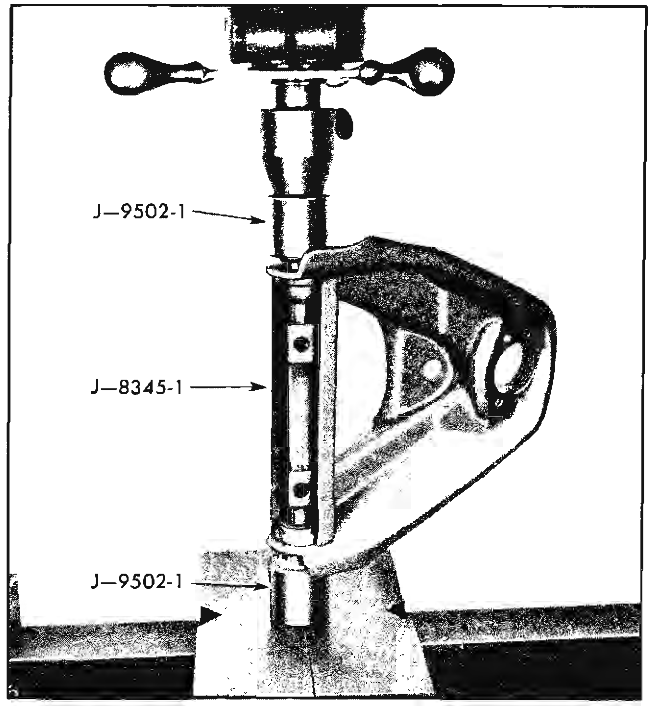



Fig. 3-26 Installing Cross Shaft and Bushing

## REMOVE BALL JOINT

1. Prick punch the center of the four rivets.

2. Drill through the heads of these rivets.

3. Using a sharp cold chisel cut off rivets, being careful not to enlarge holes in control arm.

4. Tap out rivets with a punch and remove joint from control arm.

## REMOVE CROSS SHAFT AND BUSHINGS

1. Remove nuts and collars from both ends of cross shaft.

2. Support control arm, press on cross shaft and install spacer J-9502-2 (Fig. 3-23).

3. Invert control arm and press out bushing (Fig. 3-24).

4. Remove cross shaft, support control arm, and press out remaining bushing (Fig. 3-25).

## INSTALL CROSS SHAFT AND BUSHINGS

1. Install cross shaft and bushings and press bushing into arm using J-8345-1 to prevent collapse of control arm (Fig. 3-26).

2. Install collars and nuts on both ends of cross shaft. Do not tighten nuts at this time.

## INSTALL BALL JOINT

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

***CAUTION: Use only alloy bolts supplied for this operation.***

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

INSTALL CONTROL ARM ASSEMBLY

1. Install bolts and upper control arm to crossmember.

2. Install two nuts and washers to the bolts retaining upper control arm shaft to front crossmember. Install same number of shims as removed at each bolt. Tighten nuts and bolts to 55-70 lb. ft. torque.

3. Install new rubber seal on ball joint stud and lubricate ball with chassis lubricant.

4. Install ball joint stud into knuckle, install nut and tighten to 70-85 lb. ft. torque.

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

5. Install wheel and tire assembly.

6. Lower vehicle to floor.

7. Jounce front end of vehicle to centralize bushings and tighten cross shaft nuts to 40-60 lb. ft.

8. If ball joint was replaced or if proper number of shims were not reinstalled, recheck caster and camber.

### STABILIZER BAR

REMOVE

1. Remove two body rail to stabilizer bar supports.

2. Remove bolts at each bar to strut rod clamp.

3. Remove bar.

INSTALL

1. Install bar.

2. Install bar into each strut rod clamp and install bolt and nut.

NOTE: Bolt must have head facing outside of car.

3. Install two body rail to stabilizer bar supports and bolts. Torque bolts to 20-35 lb. ft.

4. Torque bar to strut rod clamp nuts to 20-30 lb. ft.

### STRUT ROD

REMOVE

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

1. Remove the two nuts and lockwashers that secure the front end of strut rod to lower control arm. (Fig. 3-17).

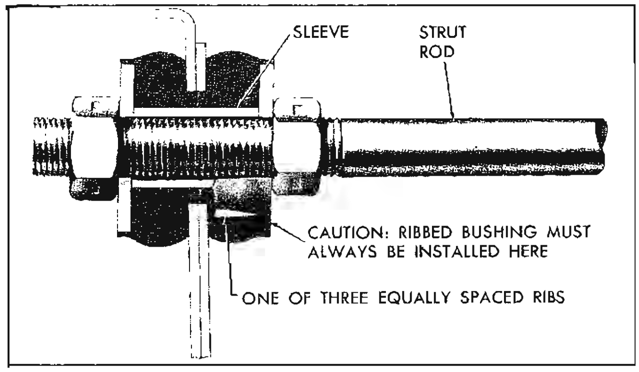



Fig. 3-27 Strut Rod Bushing Stack-up

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

2. Remove the nut and rubber bushing from rear end of strut rod.

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

INSTALL

1. Install the forward nut onto the rod. Position it about 1" from front end of threads. Install the spacer and rubber bushing with three equally spaced ribs. (Fig. 3-27).

2. Set strut rod in place in crossmember bracket. Install the remaining rubber bushing and nut. Snug up the rear nut.

***CAUTION: Do not interchange ribbed and smooth surfaced bushings.***

3. Install the rod to the lower control arm with the two attaching lockwashers and nuts. Tighten nuts to 60-75 lb. ft. torque.

4. Lower vehicle to floor (if raised) and reset caster as outlined earlier in this section. Tighten nut at rear of strut to 70-85 lb. ft. torque (Fig. 3-11).

## FRONT SUSPENSION CROSSMEMBER

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

***REMOVE***

1. Raise front end of car and install blocks or jack stands under front crossmember assembly in such a manner that crossmember will be supported when free of car.

2. Install suitable engine support.

3. Remove wheels.

4. Disconnect steering linkage at tie rod ends with J-6627.

5. Disconnect engine mounts at crossmember.

6. Remove ground straps from crossmember on both sides (Fig. 3-28).

7. Disconnect brake lines at junction block on crossmember (Fig. 3-28).

8. Disconnect fuel line from crossmember clip.

9. Remove three crossmember retaining bolts, washers, and nuts on each side of crossmember (Fig. 3-29).

10. Raise car to allow removal of crossmember assembly.

11. To reinstall, reverse above procedure plus bleeding brakes upon completion of installation. Tighten the three crossmember retaining bolts to 70-85 lb. ft. torque, the engine mount bolts to 30-45 lb. ft. torque, and the tie rod end nuts to 55-70 lb. ft. torque.

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

## REAR SUSPENSION

***REAR SHOCK ABSORBER***

REMOVE

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

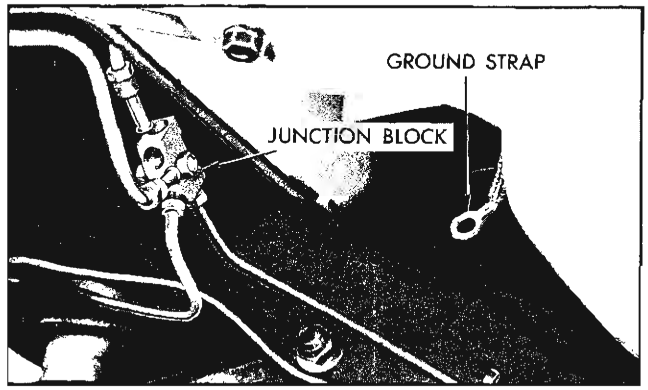



Fig. 3-28 Components to Disconnect From Crossmember

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

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

2. Remove upper and lower attaching nuts.

3. Withdraw shock absorber.

INSTALL

1. Replace by reversing procedure torquing nuts to 70-85 lb. ft. torque.

Fig. 3-29 Crossmember to Body Retaining Bolts

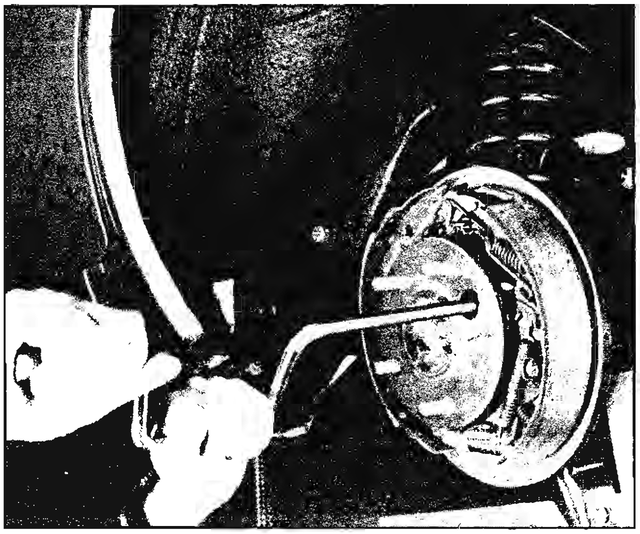


Fig. 3-30 Axle Shaft Flange Holes

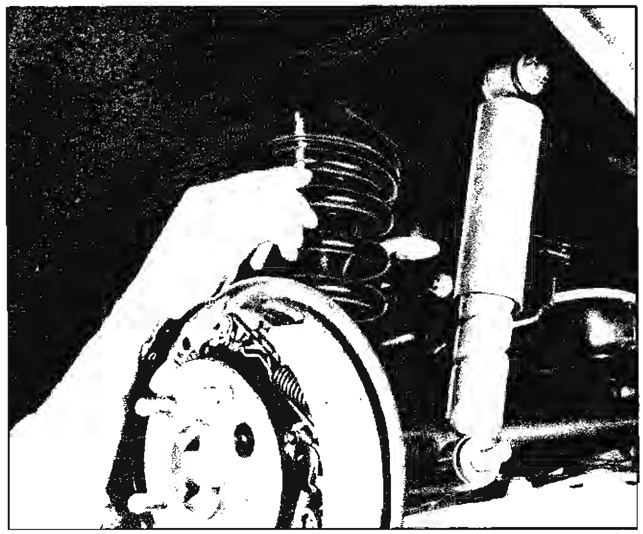


Fig. 3-31 Indexing Coil Spring

### COIL SPRING

REMOVE

1. Raise car supporting at body side rails.

2. Support at control arms raising slightly, placing slight load on coil springs.

3. Disconnect shock absorber at lower support.

4. Disconnect exhaust system (right spring removal only).

5. Remove wheel, tire and brake drum

6. Line up hole in axle shaft flange with four nuts retaining backing plate to lower control arm and remove nuts (Fig. 3-30).

7. Remove support from control arms.

8. Remove the four nuts and lock tabs that secure the universal joint U-bolts.

9. Remove parking brake strut.

10. Pull axle shaft outward sufficiently to separate yoke from U-bolts.

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

12. Remove coil spring by lowering control arm as shown in Fig. 3-32.

INSTALL

1. Set spring into crossmember spring tower and pry into place in lower control arm. If same spring is used, be sure that index marks line up (Fig. 3-31).

2. Install axle shaft through backing plate and install U-bolts (Fig. 3-33).

3. Lie up holes in axle bearing flange plate with studs on end of control arm and push axle shaft inward until yoke is fully attached to U-bolts. Install U-bolt, nuts and lock tabs. Torque nuts to 14-20 lb. ft. Install nuts through hole in axle shaft flange (Fig. 3-30). Torque nuts to 30-45 lb. ft.

4. Install parking brake strut.

5. Support under control arms and connect shock absorber, torque nuts to 70 to 85 lb. ft.

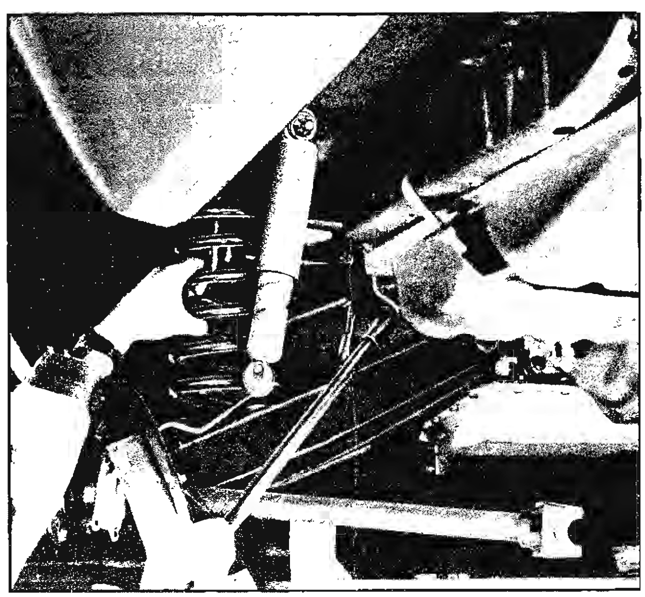


Fig. 3-32 Lowering Control Arm for Spring Removal

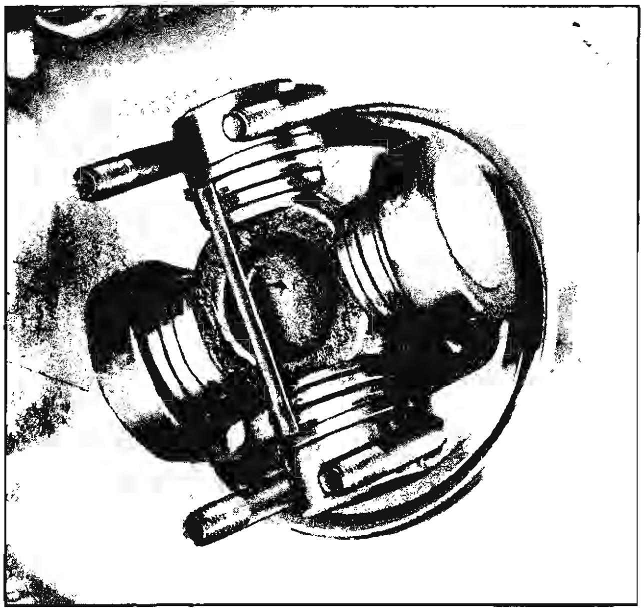


Fig. 3-33 U-Bolts Installed

6. Connect exhaust system (right spring removal only).

7. Install tire, wheel, brake drum and lower car.

### *REAR SUSPENSION LOWER CONTROL ARM*

#### REMOVE

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

2. Remove bolt, lockwasher and flat spacer securing yoke to axle shaft.

3. Remove universal joint yoke by using tool J-8614 (Fig. 3-34).

4. Withdraw axle shaft.

5. Disconnect brake line at backing plate and remove plate and shock absorber support from lower control arm studs.

6. Disconnect brake line support bracket from control arm.

7. Disconnect three bolts, lockwashers and flat washers securing control arm support bracket to body side rail. Remove shims.

8. Disconnect control arm at support bracket on differential and remove control arm.

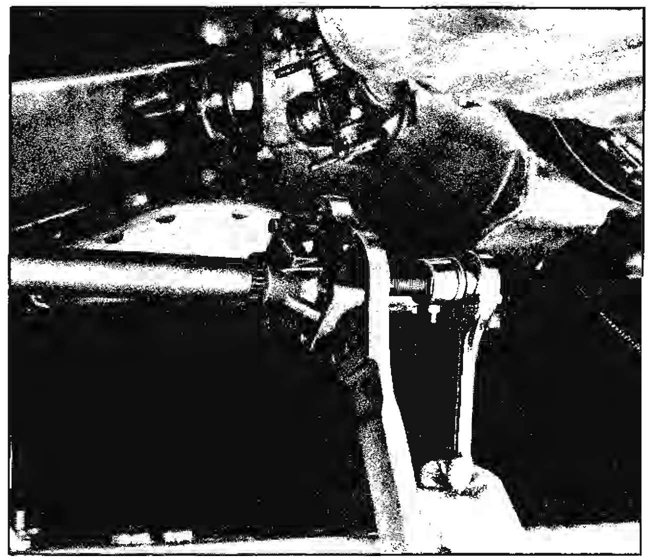


Fig. 3-34 Removing Yoke from Shaft

#### REPLACE

1. Replace by reversing procedure.

2. Bleed brakes upon completion. Torques are given in specifications section.

### *CONTROL ARM BUSHING REMOVE AND REPLACE*

1. Rest arm on support J-21027-2. Place remover J-21027-3 between control arm and arbor and press out bushing (Fig. 3-35). Remove other bushing from arm in same manner.

2. Install new bushing in control arm using J-21027-2 support and J-21027-1 installer (Fig. 3-36).

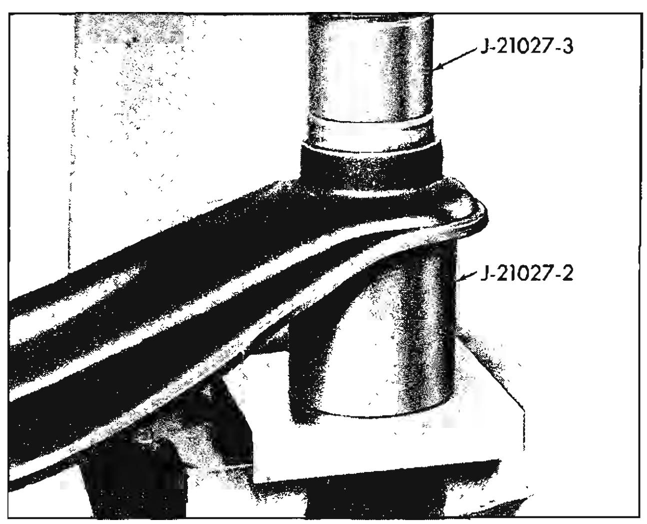



Fig. 3-35 Removing Bushing

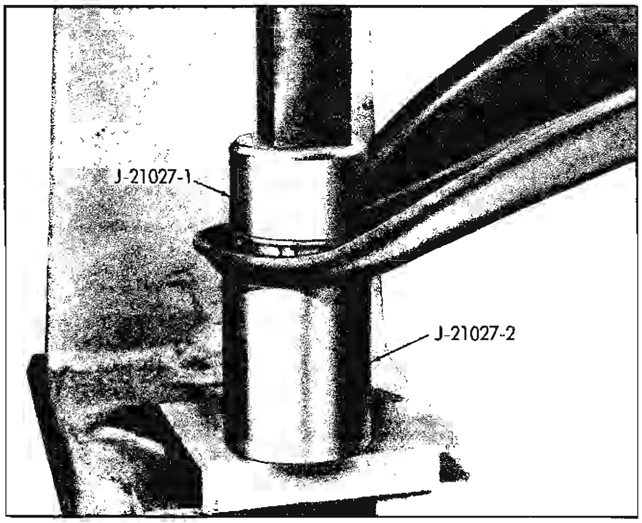



Fig. 36 Installing Bushing

3. Install control arm on car.

## REAR SUSPENSION CROSSMEMBER

### *REMOVE*

1. Remove shock absorbers, coil springs and control arms as outlined previously. Support body and trans-axle with separate jack stand.

2. Disconnect parking brake cable at rear equalizer and speedometer cable at trans-axle.

3. Disconnect downshift electrical connector, parking lock control cable, shift control cable and modulator vacuum line—automatic transmission only. On synchro-mesh disconnect shift control tube.

4. Remove two bolts on each side, connecting crossmember to body (Fig. 3-37).

5. Lower crossmember and trans-axle away from car.

***CAUTION: Be sure that the trans-axle and crossmember are properly supported prior to lowering. This will prevent it from losing balancing and falling.***

6. Remove crossmember by removing six trans-axle support crossmember to insulator bolts (Fig. 3-38).

### *INSTALL*

1. Connect rear crossmember to axle support crossmember with six support crossmember to insulator attaching bolts. Torque to 40-55 lb. ft.

2. Raise trans-axle and crossmember.

3. Install four bolts connecting crossmember to body. Torque bolts to 60-80 lb. ft.

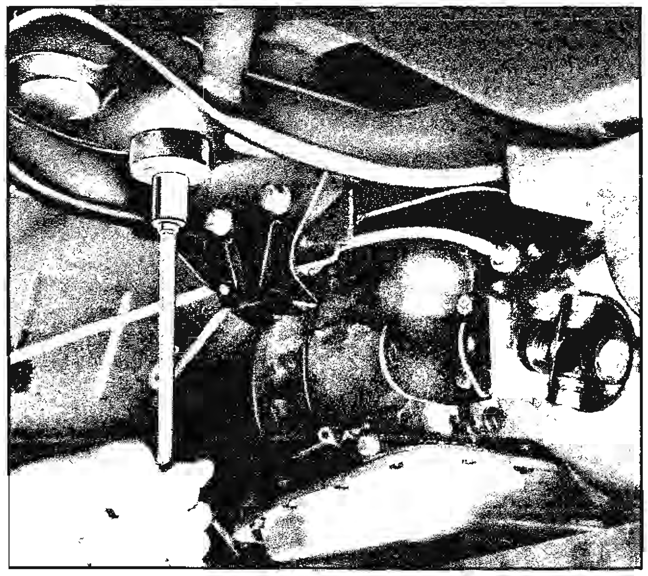


Fig. 3-37 Removing Rear Crossmember Mounting Bolts

4. Connect parking brake cable at rear equalizer and speedometer cable at trans-axle.

5. Install coil springs, shock absorbers and control arms as outlined previously.

6. Connect downshift electrical connector, parking lock control cable, shift control cable and vacuum modulator line on automatic transmission only. On synchro-mesh connect shift control tube.

7. Lower vehicle.

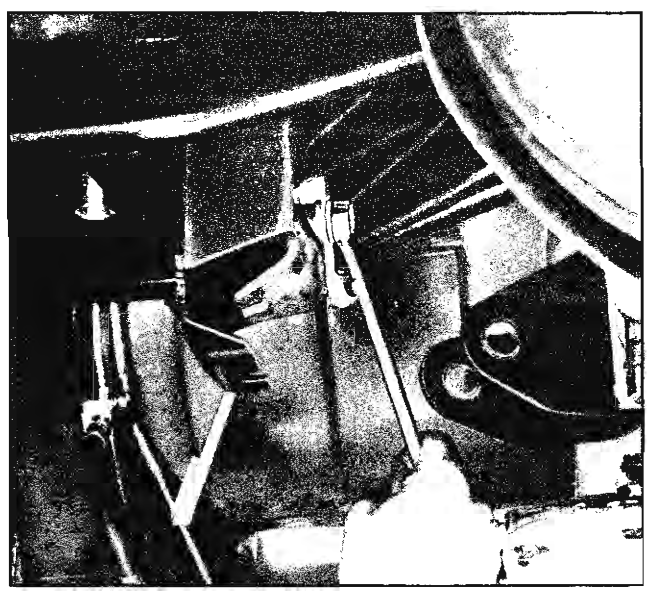


Fig 3-38 Removing Support Crossmember to Rear Crossmember Bolts

# TORQUE SPECIFICATIONS

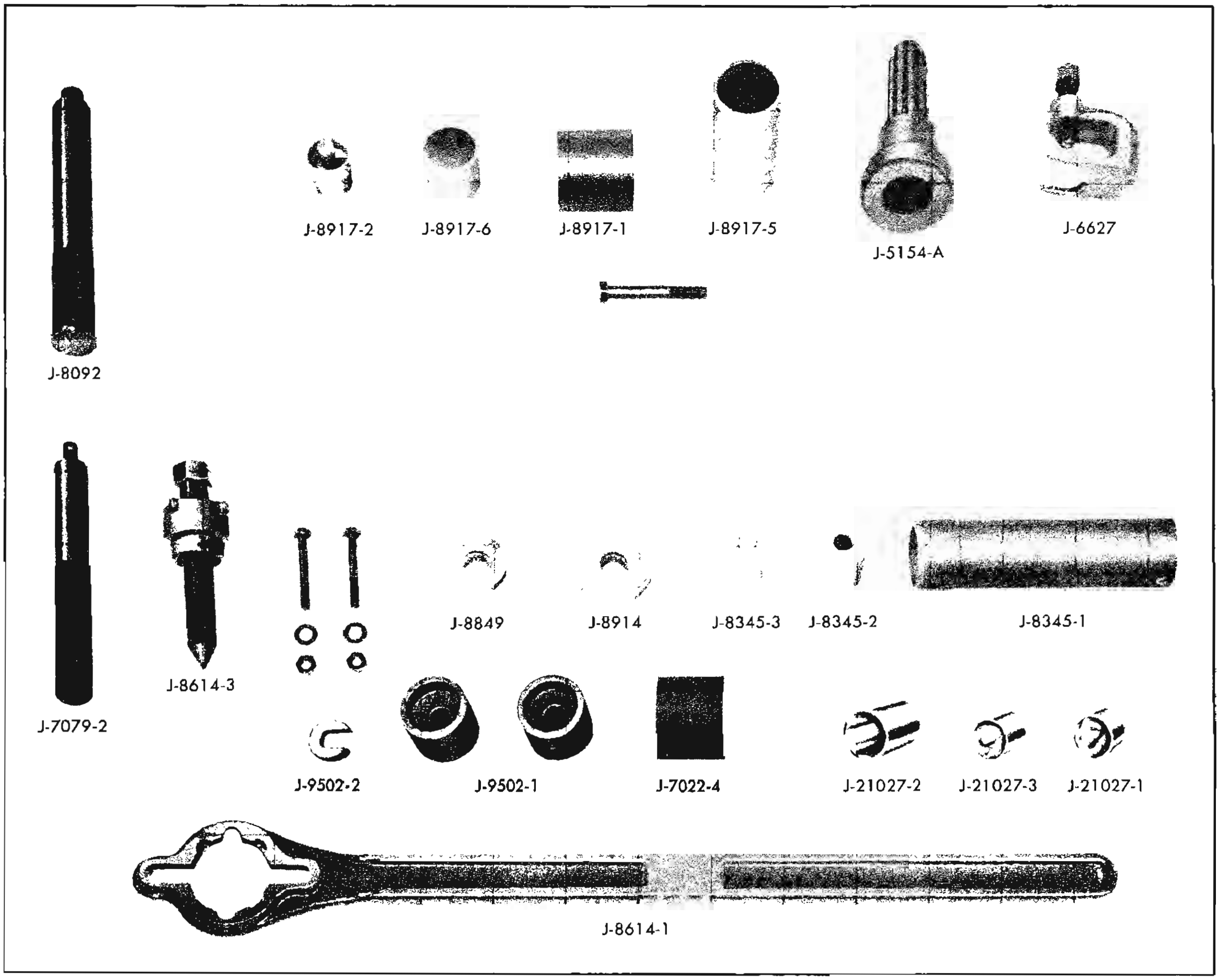
## FRONT SUSPENSION

| | LB. FT. |
|---|---|
| Front crossmember to body mounting bolt and nut | 70-85 |
| Front upper control arm pivot shaft nut | 40-60 |
| Steering knuckle to ball stud assembly (upper and lower) | 70-85 |
| Front lower control arm pivot bolt and nut | 75-90 |
| Front upper control arm to front crossmember bolt and nut | 55-70 |
| Stabilizer bar to body rail support bolt | 20-35 |
| Stabilizer bar to strut rod clamp nut | 20-30 |
| Strut rod to lower control arm nut | 60-75 |
| Front brake backing plate to steering knuckle lower nut and bolt | 45-65 |
| Front brake backing plate to steering knuckle upper bolt | 80-110 |
| Tie-rod adjuster sleeve nut and bolt | 14-20 |
| Strut rod adjusting nut | 70-85 |
| Front shock absorber to mounting bracket nut | 60-120 |
| Front shock absorber to lower control arm bolt | 15-25 |

## REAR SUSPENSION

| | LB. FT. |
|---|---|
| Rear shock absorber upper mounting bolt and nut | 70-85 |
| Rear shock absorber lower mounting bolt and nut | 70-85 |
| Rear control arm trans-axle bracket bolt and nut | 100-125 |
| Yoke to axle shaft bolt | 20-35 |
| U-joint yoke clamp nut | 14-20 |
| Rear brake backing plate to control arm nut | 30-45 |
| Rear crossmember to body bolts | 60-80 |
| Control arm support bracket to body side rail bolt and nut | 40-55 |

# SPECIAL TOOLS




| | |
|---|---|
| J-8092 | Driver Handle |
| J-8917 | Front Suspension Lower Control Arm Remover and Replacer Set |
| J-5154-A | Front Wheel Inner Bearing Seal Installer |
| J-6627 | Ball Stud Remover |
| J-7079-2 | Handle |
| J-8614-3 | Companion Flange Puller |
| J-8849 | Front Wheel Outer Bearing Outer Race Installer |
| J-8914 | Front Wheel Inner Bearing Inner Race Installer |
| J-8345 | Front Upper Control Arm Bushing Set |
| J-9502-2 | Spacer |
| J-9502-1 | Bushing Installer |
| J-7022-4 | Ball Joint Remover Support |
| J-8614-1 | Companion Flange Puller Holder |
| J-21027-1 | Bushing Installer |
| J-21027-2 | Bushing Support |
| J-21027-3 | Bushing Remover |

Fig. 3-39 Suspension Spacing Tools

# WHEELS AND TIRES

## CONTENTS OF THIS SECTION



## GENERAL DESCRIPTION

Drop center rim steel wheels secured by left hand thread nuts on left side of car and right hand thread nuts on right side of car are used on all models. The rim width is 5.0" and wheel diameter 15". Low pressure 6.00 x 15 4 ply rating tires are standard equipment on all models except station wagons, V-8 engine option and air conditioned cars. Station wagons, cars having V-8 engine option and air conditioned cars are equipped with 6.50 x 15 4 ply rating tires. All tires are of tubeless construction.

| TIRE SIZE | Starting Pressure (After Car Has Been Standing For Three Hours) | City Pressure (After Driving Car Three Miles or More Below 40 mph) | Highway Pressure (After driving Car Three Miles or More Above 40 mph) |
|---|---|---|---|
| 6.50 x 15–4 Ply Rating<br>4 Cyl. Engine<br>Front and Rear | 22 | 24 | 26 |
| 6.50 x 15–4 Ply Rating<br>4 Cyl. Engine<br>Except Sta. Wag. and Air Cond.<br>Front and Rear | 20 | 22 | 24 |
| 6.50 x 15–4 Ply Rating<br>4 Cyl. Engine<br>Sta. Wag.<br>Front<br>Rear | 22<br>26 | 24<br>28 | 26<br>30 |
| 6.50 x 15–4 Ply Rating<br>8 Cyl. Engine<br>With Air Cond., Except Sta. Wag.<br>Front<br>Rear | 24<br>22 | 26<br>24 | 28<br>26 |
| 6.00 x 15–4 Ply Rating<br>All Sta. Wag.<br>Front<br>Rear | 24<br>26 | 26<br>28 | 28<br>30 |

NOTE: It is normal for air pressure to build up in a tire due to driving conditions; therefore, do not let air out of tires to reduce this increase in pressure.

Fig. 3A-1 Tire Pressure Chart

## PERIODIC SERVICE

### *INFLATION OF TIRES:*

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

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

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

NOTE: Always check tires with accurate gauge.

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

Higher than recommended inflation pressure will give:

1. A harder riding car.

2. A tire carcass more susceptible to bruising or carcass damage directly under the tread.

3. Poorer traction at rear wheels resulting in uneven wear.

4. Fast tread wear at center of tire.

Lower inflation pressures than recommended will give:

1. Increased tire squeal on turns.

2. Harder steering.

3. Rapid and uneven wear on the edges of tire tread.

4. A tire more susceptible to rim bruises and various types of rupture.

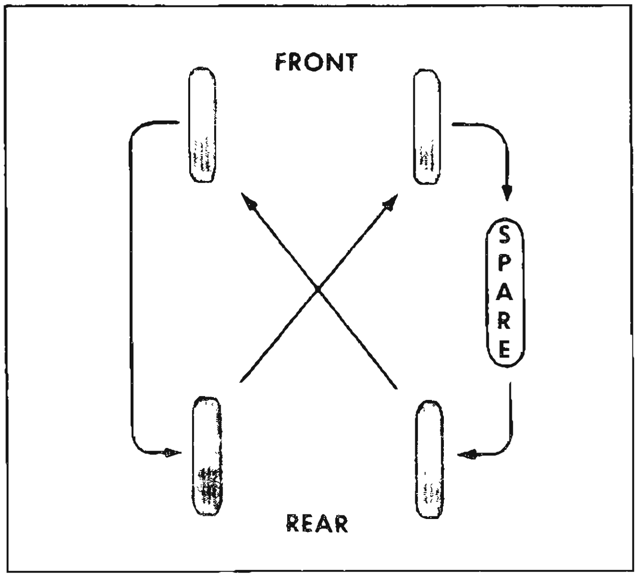



Fig. 3A-2 Diagram for Switching Tires

5. Increased cord fatigue or broken tire cords.

6. Increased tramp and shimmy troubles.

7. Higher tire temperatures.

8. Increased car roll when turning a corner or making a sharp swerve in traffic.

### *TIRE ROTATION:*

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

To minimize the possibility of tire noise and equalize wear, it is recommended that tires be rotated as shown in Fig. 3A-2, approximately each 6,000 miles. They should be rotated more frequently when tires are subjected to extremely hard use. This will prevent undue wear on any particular tire which might cause excessive noise. More important from the owner's viewpoint, will be equalization of wear on all tires and the saving made through getting some use from the spare tire which all too often is allowed to remain as a spare until the other tires are worn out. When this occurs, the spare tire, while appearing to be new will actually have deteriorated through disuse. If the rotating of tires is followed each 6,000 miles in accordance with Fig. 3A-2, all tires will have had the same number of miles in each wheel position at the end of the fourth change or when ready to interchange tires for the fifth time. The car will have been driven

30,000 miles, but each tire will have only 24,000 miles of use.

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

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

## MINOR REPAIRS

### *TEST FOR LEAKS:*

1. Use soapy water to check valve for leaks. In many cases air loss can be corrected by simply tightening the valve core.

2. If the reason for air loss is not immediately discernible, submerge the complete wheel assembly in a tank of water.

3. Mark the tire and rim at the point where air is escaping.

Tire Mounting and Dismounting Instructions:

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

### *REMOVE TIRE FROM WHEEL:*

1. Remove valve cap and valve core. Let out all the air.

2. With valve hole side of tire down, break beads away from rim. Use only conventional bead-breaker type machine.

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

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

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

### *PUNCTURE REPAIRS:*

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

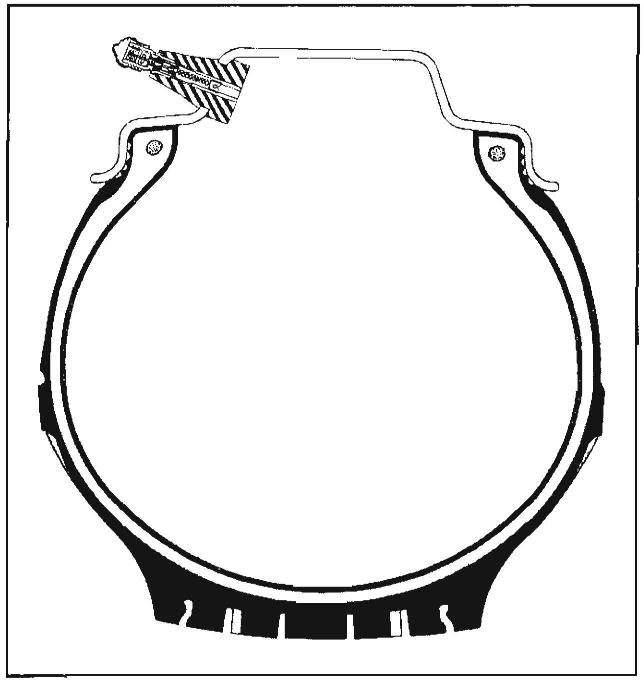


Fig. 3A-3 Cross Section of Typical Tubeless Tire

### *WHEEL LEAKS:*

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

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

### *PREPARATION OF TIRE:*

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

### *PREPARATION OF RIM:*

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

2. Straighten or replace rim if it is bent or damaged.

### *MOUNTING TIRE ON WHEEL:*

1. Install valve if valve was removed. Always install valve recommended by car manufacturer.

2. Apply liberal amounts of vegetable oil soap solution or approved rubber lubricant to rim edges and tire beads.

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

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

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

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

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

7. Install valve core and inflate to proper specifications.

8. General precautions in mounting tires:

A. Use tire mounting and dismounting machine.

B. Do not use hammer or tire irons.

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

### *TIRE BALANCING*

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

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

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

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

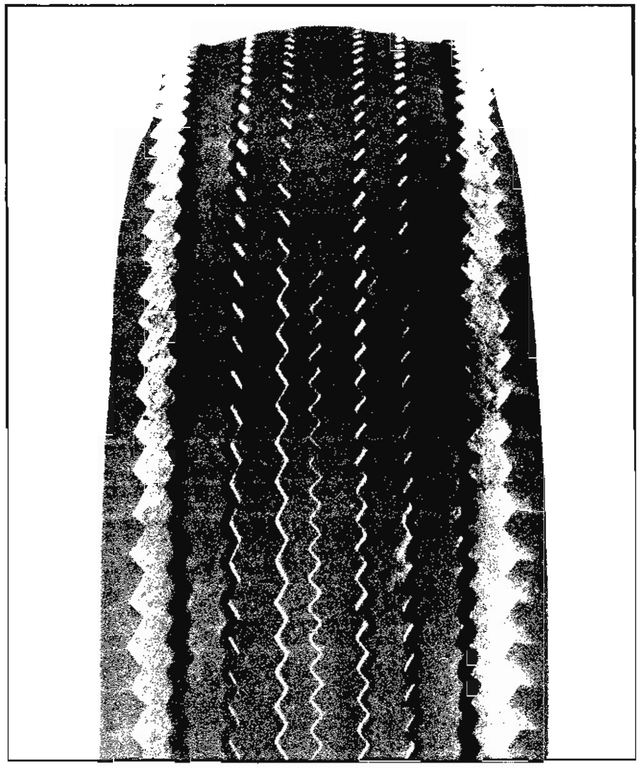


Fig. 3A-4 Wear from Underinflation

## TROUBLE DIAGNOSIS AND TESTING

### *TIRE INSPECTION*

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

### *UNDERINFLATION*

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

### *OVERINFLATION*

The result of overinflation is shown in Fig. 3A-5. When a tire is overinflated, increased tension caused

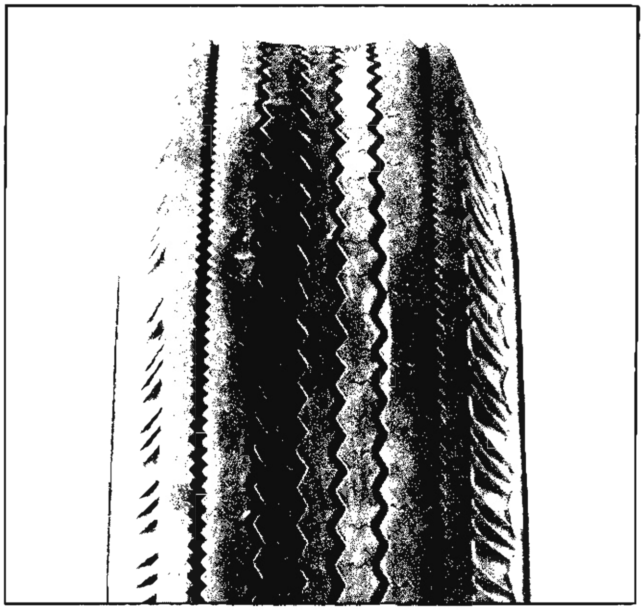


Fig. 3A-5 Wear from Overinflation

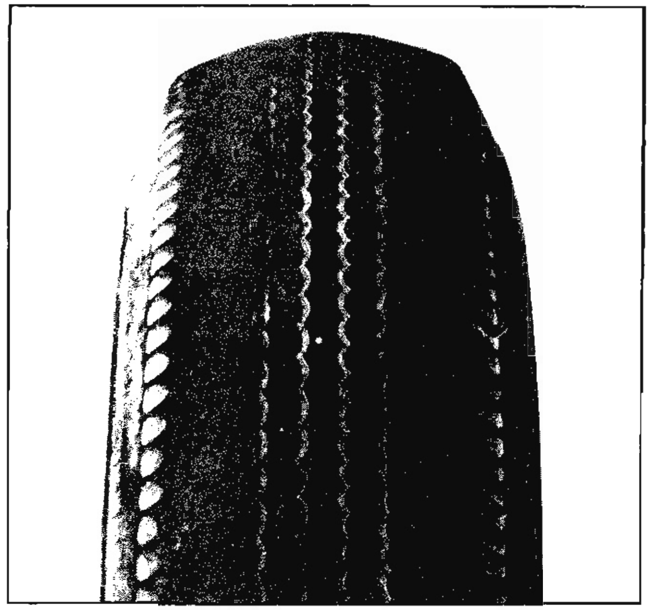


Fig. 3A-6 Cornering Wear

by excessive pressure prevents proper deflection of the sidewalls. This results in wear in the center of the tread and the tire also loses its ability to absorb road shocks. Under this increased strain, cords in the tread area eventually snap under impact, causing either a characteristic X-break or diagonal break.

#### SIDE WEAR (CAMBERING OR CORNERING WEAR):

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

1. Wheel camber causes the tires to run at a certain angle from the perpendicular, resulting in side wear.

2. Side thrust when rounding turns causes wear on the sides of front tire treads. In making a turn to the left, especially at high speeds, the outside shoulder of the right tire and the inside shoulder of the left tire take most of the wear. When making a right-hand turn, the opposite shoulders of the tires are worn.

3. High crowned roads cause increased wear on the side of the right front tire. This is particularly true when there is too much toe-in on front wheels or when positive camber of right front wheel is greater than the left.

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

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

#### TOE-IN OR TOE-OUT MISALIGNMENT WEAR

Front wheels should be straight ahead or toe-in slightly. When there is excessive toe-in or toe-out, tires will revolve with a side motion and scrape the tread rubber off. Front tires will show wear on the outside with a toe-in condition and on the inside with a toe-out condition The above wear pattern is reversed when considering toe relative to rear tires. Fig. 3A-7 illustrates the wear pattern due to improper toe.

#### UNEVEN TIRE WEAR

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

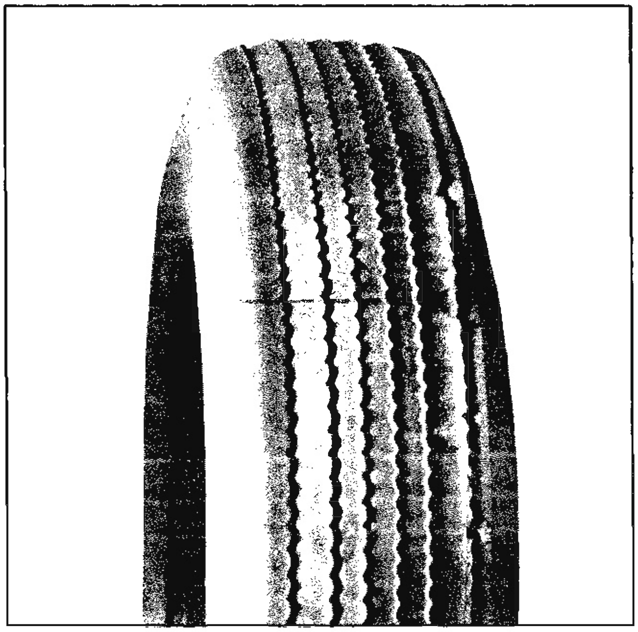


Fig. 3A-7 Toe-in or Toe-out Misalignment Wear

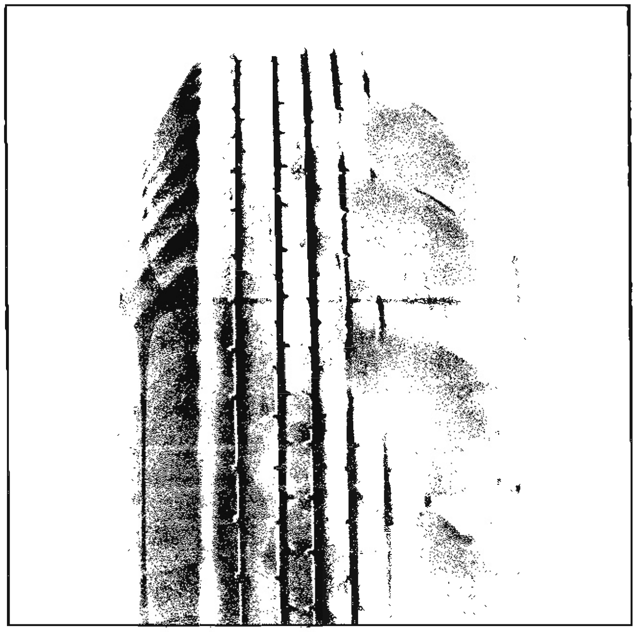


Fig. 3A-8 Spot Wear

### *TREAD WEAR*

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

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

### *TESTING FOR TIRE NOISES*

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

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

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

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

Carefully inspect the tire making the noise for bulges, irregular wear, low air pressure, toe and heel (saw tooth) wear, and unusual tread design (ribbed tread gives less noise than some all weather treads; mud and snow treads are very noisy). Checking wheel alignment and rotating tires will usually cure tire noises unless caused by tire tread design, heavy irregular tread wear, or tire bulges.

## SPECIFICATIONS

### *WHEELS*

Material ........................................ Steel

Type ...... Drop Center—with long flat safety ledge.

Diameter ........................................ 15″

Width ........................................ 5.0″

### *TIRES*

Size (Standard) ........................................ 6.00 x 15

Size (Station Wagons and
Air Conditioned Cars— 8 cyl. Eng.) ...... 6.50 x 15

Type ........................................ Tubeless

Ply Rating ........................................ 4

## TORQUE SPECIFICATIONS

| | LB. FT. |
|---|---|
| Wheel to Drum Nut—Front and Rear ........ | 70-85 |

# REAR AXLE AND PROPELLER SHAFT

## CONTENTS OF THIS SECTION



## GENERAL DESCRIPTION

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

Each axle shaft is independently suspended and is free to move in a vertical plane in an arc. The axle shaft is attached to universal joints, which in turn are splined into the differential side gears. Details on rear suspension are given in Section 3.

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

### *DIFFERENTIAL AND CARRIER ASSEMBLY*

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

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

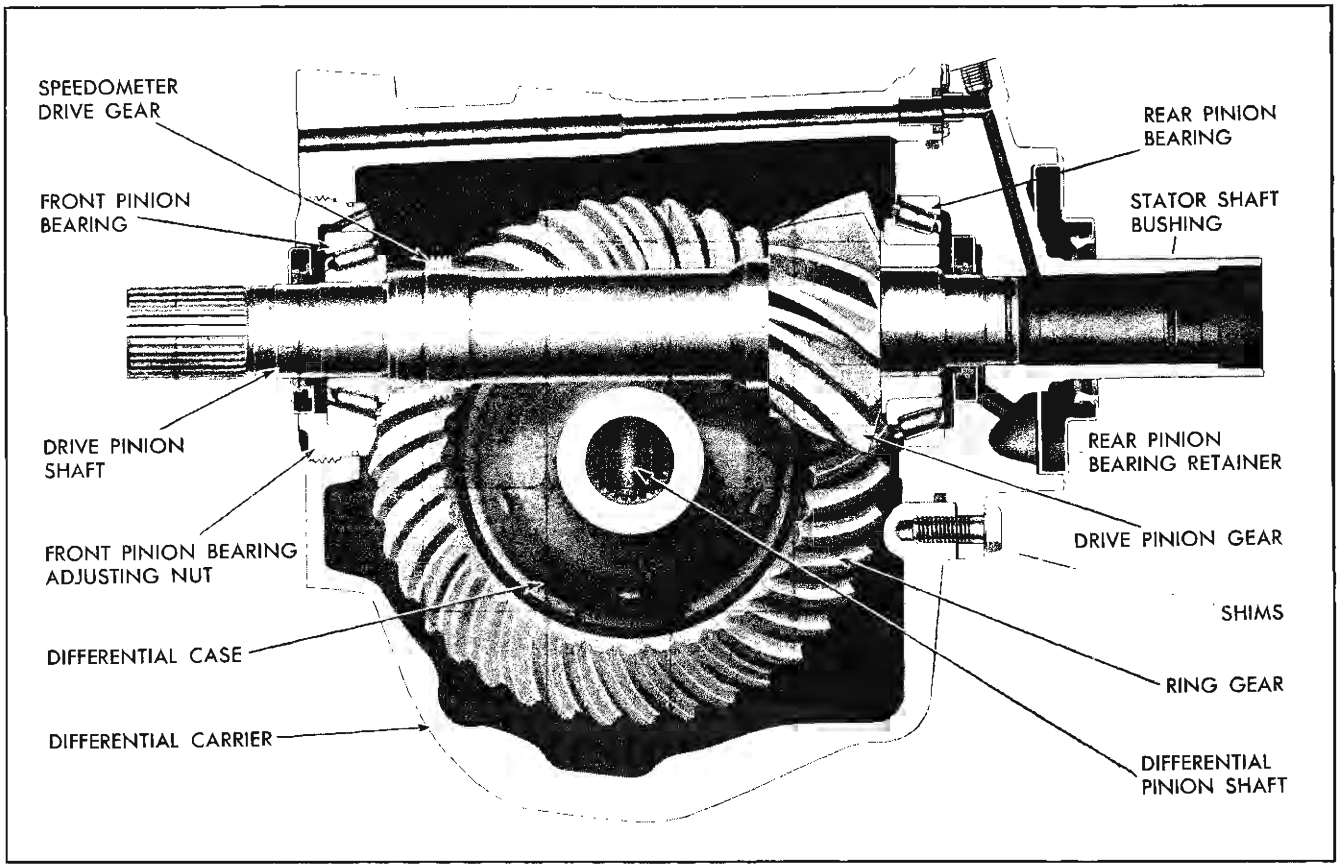



Fig. 4-1 Cross Section of Differential and Carrier

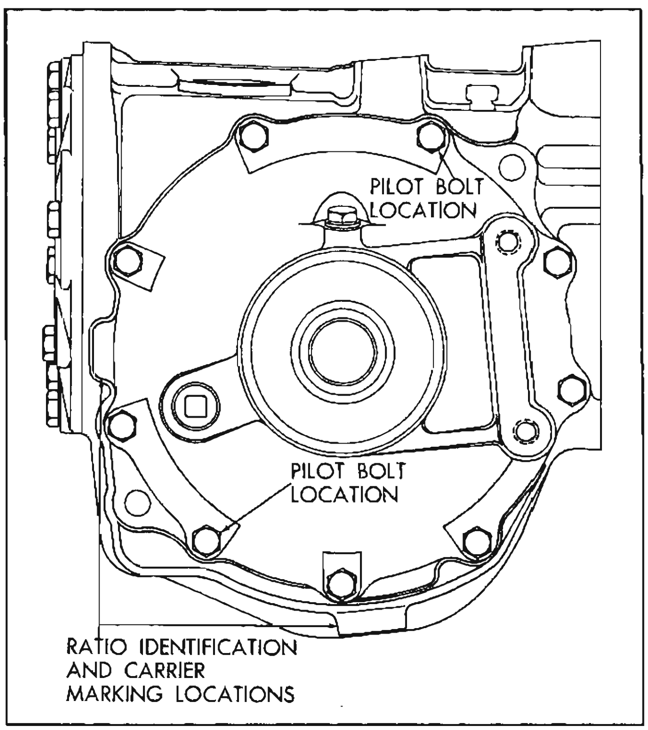



Fig. 4-2 Ratio Identification Locations

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

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

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

| Rear Axle Gear Comb | Rear Axle Gear Ratio | Transmission 3-Speed SM | Transmission 4-Speed SM | Transmission Auto. | Ratio Release Econ. | Ratio Release Std. | Ratio Release Perf. | Code Color | Code Letter | Model 2117 2119 2127 2217 | Model 2135 | Model 2167 2267 | Air Conditioning Without | Air Conditioning With | Trailer Provisions Without | Trailer Provisions With | Engine 195 1-Bbl. Reg. Fuel | Engine 195 1-Bbl. Pre. Fuel | Engine 195 4-Bbl. | Engine 326 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38:15 | 2.53 | | | X | X | SPECIAL ORDER | | GRAY | J | X | X | X | X | X | X | | | | | X |
| 35:13 | 2.69 | | | X | X | SPECIAL ORDER | | PINK | L | X | X | X | X | X | X | | | | | X |
| 32:11 | 2.91 | | | X | | X | | ORANGE | M | X | X | X | X | X | X | | | | | X |
| | | | | X | X | | | | C | X | | | X | | X | | X | | | |
| | | | | X | | X | | | C | X | | | X | | X | | | X | | |
| 34:11 | 3.09 | X | | | X | SPECIAL ORDER | | BLUE | N | X | X | X | X | X | X | | X | X | X | |
| | | X | | | | X | | | N | X | X | X | X | X | X | | | | | X |
| | | | | X | | X | | | N | X | X | X | X | X | | X | | | | X |
| | | | X | | X | | | | X | X | X | X | X | | X | | X | X | X | |
| | | | | X | X | | | | D | X | | | X | | X | | | | X | |
| | | | | X | X | | | | D | | X | X | X | | X | | X | X | X | |
| | | | | X | SPECIAL ORDER | | X | | N | X | X | X | X | | X | | | | | X |
| | | | | X | | X | | | D | X | | | X | | X | | X | | | |
| 33:10 | 3.30 | X | | | | X | | GREEN | P | X | X | X | X | | X | | X | X | X | |
| | | X | | | SPECIAL ORDER | | X | | P | X | X | X | X | | X | | | | | X |
| | | | X | | | X | | | Y | X | X | X | X | | X | | X | X | X | |
| | | | | X | | X | | | E | X | | | X | | X | | | | X | |
| | | | | X | | X | | | E | | X | X | X | | X | | X | X | X | |
| | | | | X | SPECIAL ORDER | | X | | P | X | X | X | X | | X | X | | | | X |
| | | | | X | SPECIAL ORDER | | X | | E | X | | | X | | X | | X | X | X | |
| 32:9 | 3.56 | X | | | | | X | YELLOW | S | X | X | X | X | | X | | X | X | X | |
| | | X | | | | X | | | S | X | X | X | | X | X | | X | X | X | |
| | | X | | | SPECIAL ORDER | | X | | S | X | X | X | X | X | X | X | | | | X |
| | | | X | | | | X | | Z | X | X | X | X | | X | | X | X | X | |
| | | | X | | | X | | | Z | X | X | X | | X | X | | X | X | X | |
| | | | | X | | | X | | F | X | X | X | X | | X | | X | X | X | |
| | | | | X | | X | | | F | X | X | X | | X | X | | X | X | X | |
| | | | | X | | X | | | F | X | X | X | X | X | | X | X | X | X | |
| | | | | X | SPECIAL ORDER | | X | | S | X | X | X | X | X | X | X | | | | X |
| | | X | | | | X | | | S | X | X | X | X | X | | X | | | | X |
| 34:9 | 3.78 | X | | | | X | | RED | T | X | X | X | X | | | X | X | X | X | |
| | | X | | | SPECIAL ORDER | | X | | T | X | X | X | X | | X | X | X | X | X | |
| | | X | | | SPECIAL ORDER | | X | | T | X | X | X | X | | X | X | | | | X |
| | | | X | | | X | | | A | X | X | X | X | | | X | X | X | X | |
| | | | X | | SPECIAL ORDER | | X | | A | X | X | X | X | | X | | X | X | X | |
| | | | | X | SPECIAL ORDER | | X | | G | X | X | X | X | | X | X | X | X | X | |
| | | | | X | SPECIAL ORDER | | X | | T | X | X | X | X | | X | X | | | | X |
| 39:10 | 3.90 | X | | | SPECIAL ORDER | | X | BLACK | U | X | X | X | X | | X | X | X | X | X | |
| | | X | | | SPECIAL ORDER | | X | | U | X | X | X | X | | X | X | | | | X |
| | | | X | | SPECIAL ORDER | | X | | B | X | X | X | X | | X | X | X | X | X | |
| | | | | X | SPECIAL ORDER | | X | | H | X | X | X | X | | X | X | X | X | X | |
| | | | | X | SPECIAL ORDER | | X | | U | X | X | X | X | | X | X | | | | X |

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

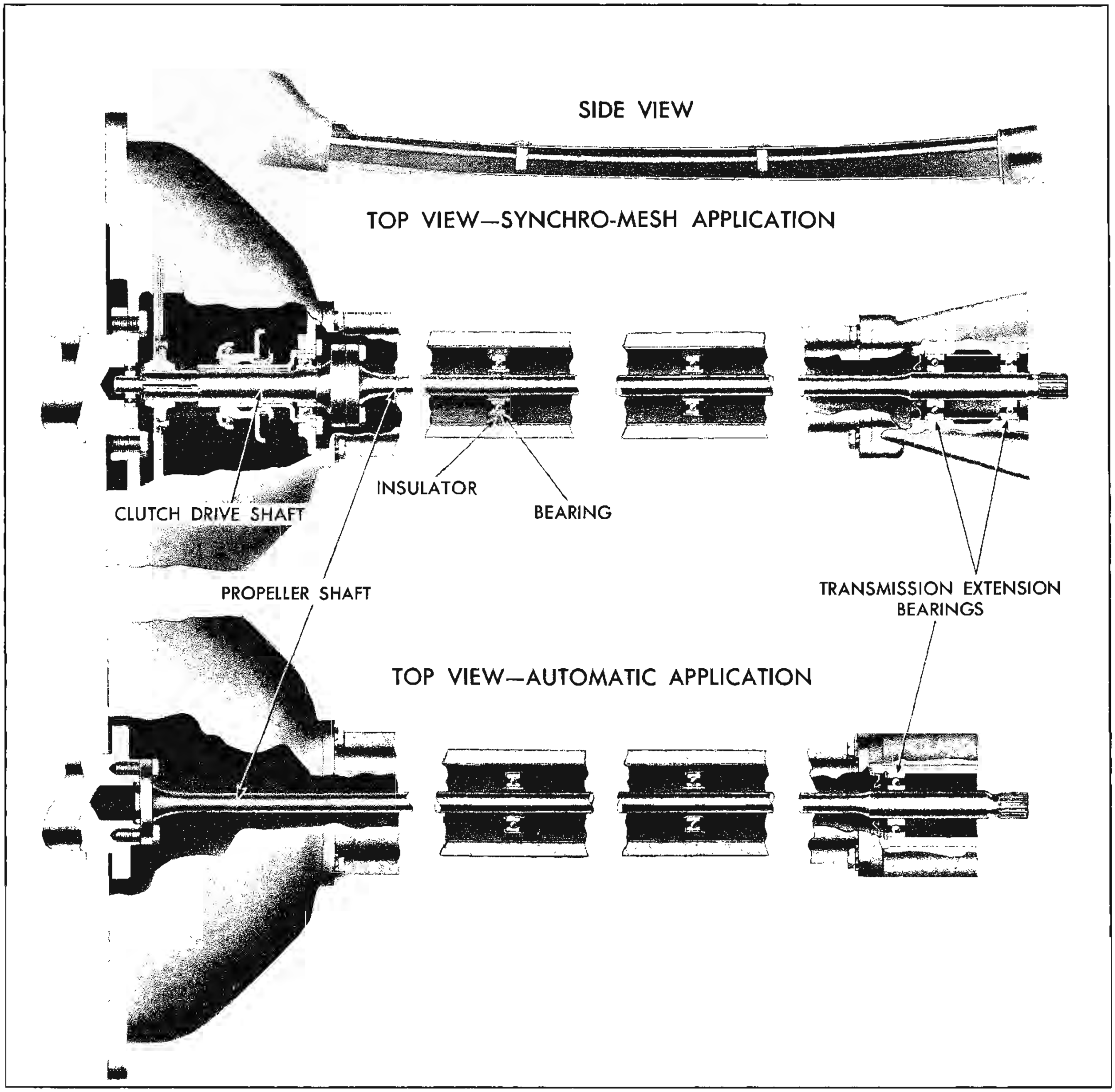



Fig. 4-4 Cross Section of Propeller Shaft and Torque Tube

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

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

The differential and carrier assembly used with the four speed synchro-mesh transmission and cars equipped with V-8 engine has four pinion gears in the differential case. The carrier is modified in design to accept the four speed transmission. All other components of the differential and carrier assembly are the same as the three speed synchro-mesh, differential and carrier assembly.

#### *AXLE SHAFT*

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

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

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

The torque tube rigidly joins the engine and transmission and forms a housing for the propeller shaft. The flexible propeller shaft permits a curved torque tube so that the center tunnel in the body floor is virtually eliminated. Hat sectioned steel is used in the construction of the torque tube.

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

## PERIODIC SERVICE

See Lubrication Section.

## MINOR REPAIRS

#### *REPLACE DIFFERENTIAL SIDE BEARING OIL SEALS*

1. Drain lubricant from differential and carrier assembly.

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

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

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

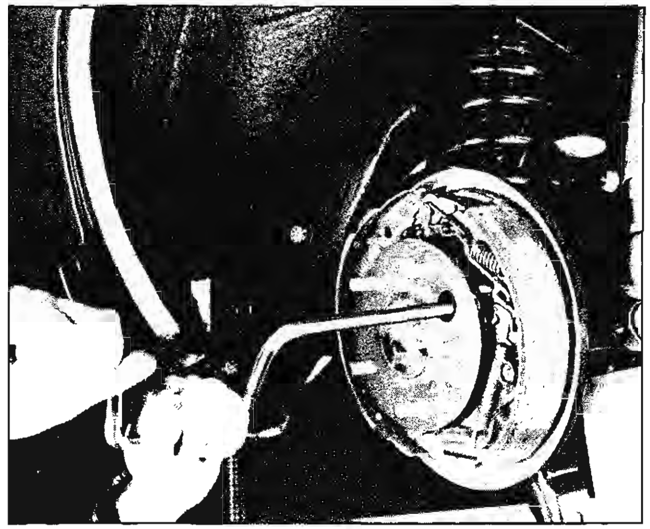


Fig. 4-5 Removing Nuts from Axle Shaft Bearing Retainer

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

6. Clean seal seat area to remove old sealer.

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

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

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

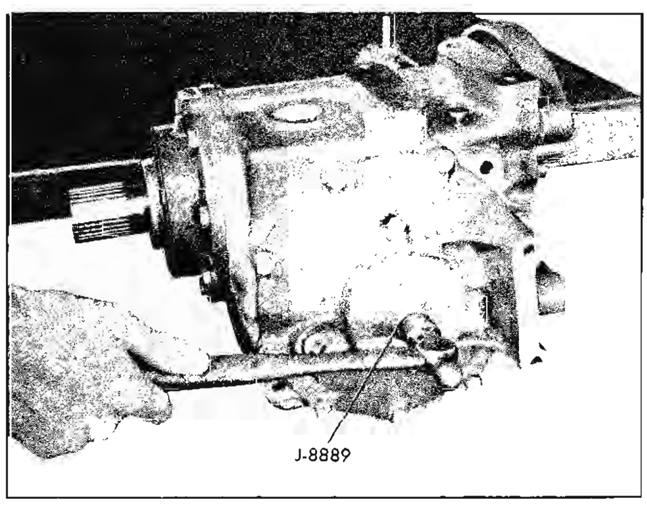



Fig. 4-6 Installing Side Bearing Oil Seal

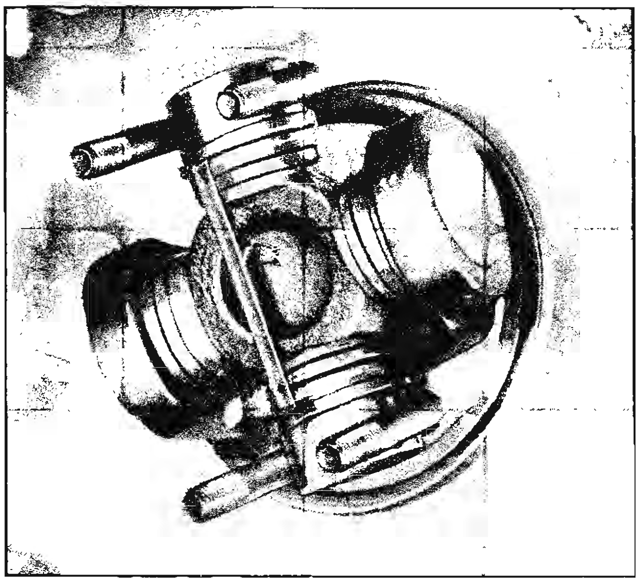


Fig. 4-7 Flange Separated from U-Bolts

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

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

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

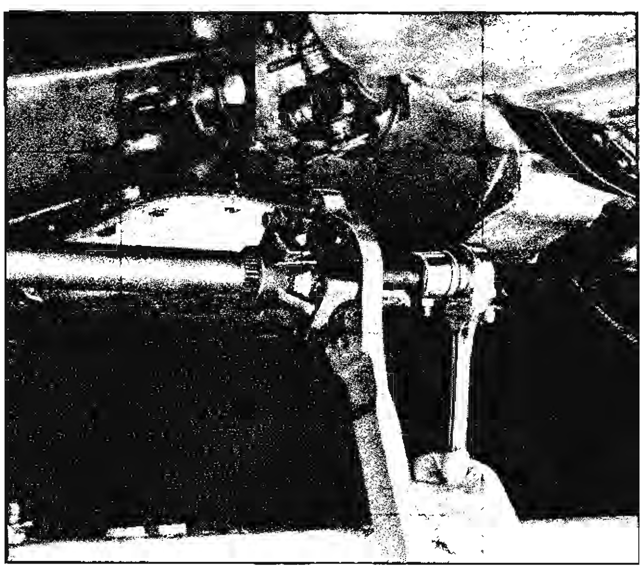


Fig. 4-8 Removing Flange from Axle Shaft

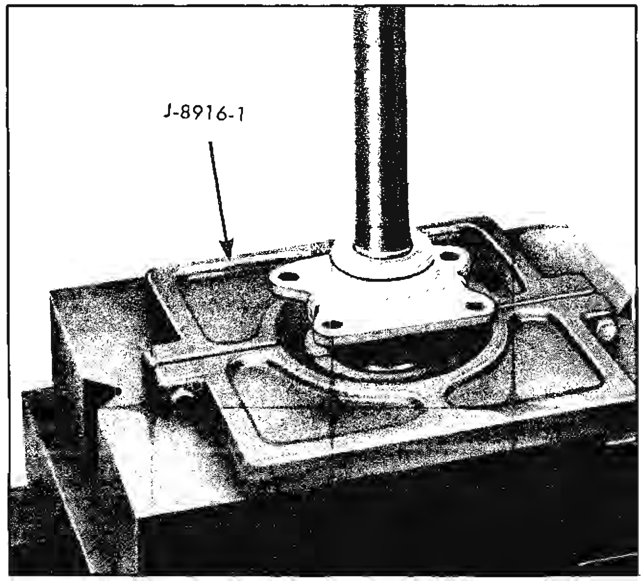



Fig. 4-9 Removing Axle Shaft Bearing

***REMOVE AND REPLACE AXLE SHAFT OR BEARING***

## REMOVE AXLE SHAFT

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

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

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

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

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

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

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

8. Remove axle shaft from lower control arm.

## AXLE BEARING REPLACEMENT

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

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

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

4. Pack shield with approximately ½ oz. wheel bearing grease. Install shield over bearing assembly tapping carefully on flange of shield.

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

## REPLACE AXLE SHAFT

1. Insert axle shaft through the lower control arm. Install flange on splines of axle shaft. It may be necessary to lightly tap flange to start splines if original pieces are being installed.

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

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

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

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

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

## *REMOVE, REPACK AND REPLACE UNIVERSAL JOINT*

### REMOVE UNIVERSAL JOINT

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

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

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

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

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

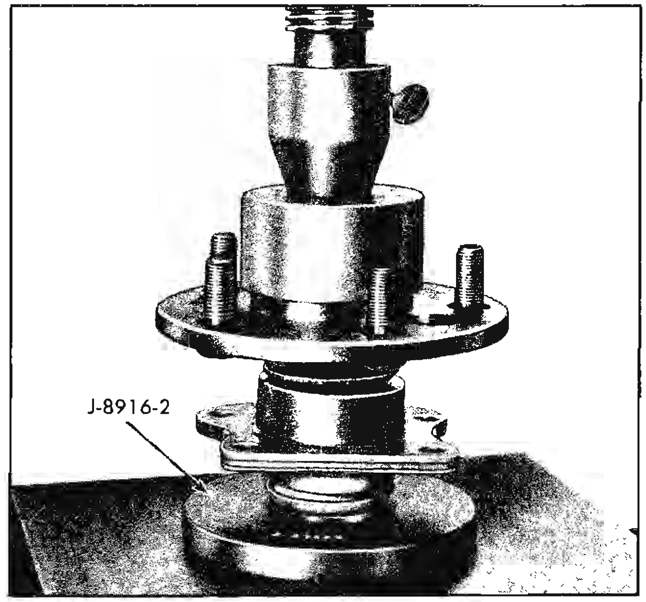



Fig. 4-10 Replace Axle Shaft Bearing

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

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

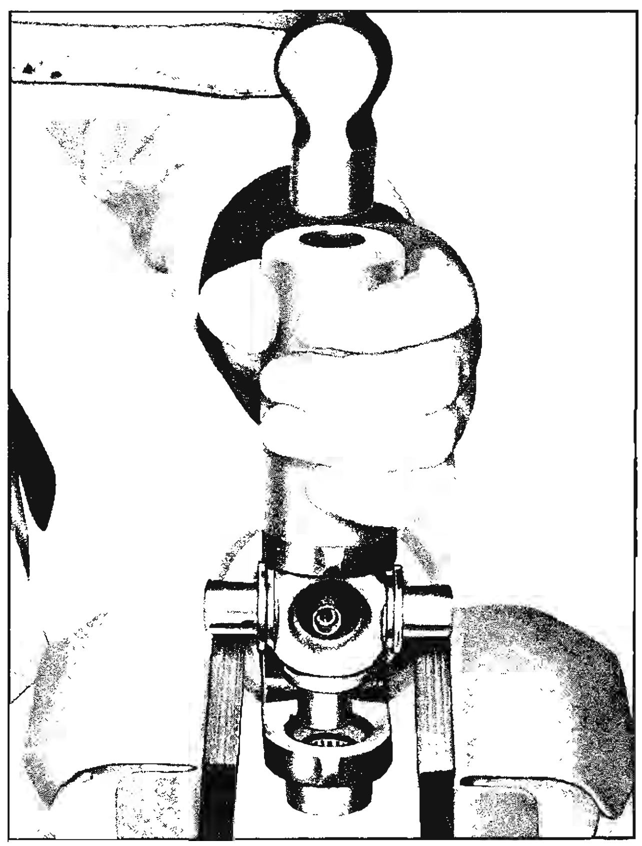


Fig. 4-11 Removing Bearing from Yoke

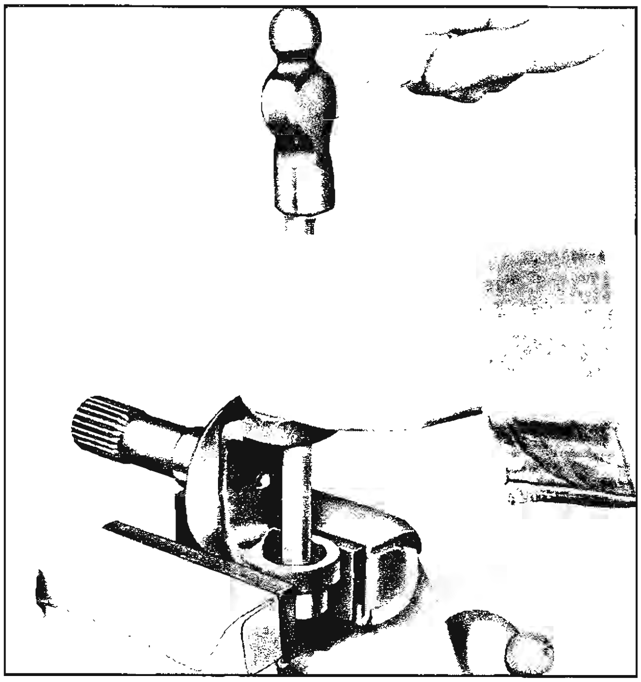


Fig. 4-12 Removing Bearing

8. Remove universal joint from differential and carrier.

## DISASSEMBLE UNIVERSAL JOINT

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

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

2. Remove snap rings from yoke assembly.

3. Place ends of journal (spider) on vise jaws so that splined yoke shaft is horizontal. Yoke member must be free to move vertically between jaws of vise.

4. Using a piece of pipe 1⅛" I.D. or tool J-4774, drive yoke down causing journal (spider) to force bearing partially out of yoke (Fig. 4-11).

5. Rotate yoke 180° and repeat above operations.

6. When using pipe, drive yoke down as far as possible. Place one or more flat washers 9/16" O.D. inside of lower bearing.

NOTE: Total thickness of washer should be ⅛"-3/16".

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

8. Remove journal (spider) from yoke.

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

10. Remove washers.

## CLEANING AND INSPECTION

1. Wash all parts thoroughly in cleaning fluid.

2. Inspect roller bearing surfaces of journal (spider), inner bearing surfaces of outer races, and rollers for wear, scores, flat spots, or other damage. Replace damaged or worn parts.

3. Inspect packings (cork washers) and journal dust shields for wear or injury. Replace if necessary. Packing should be flexible; if brittle or hard, replace with new packing.

## REASSEMBLE UNIVERSAL JOINT

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

NOTE: 25 rollers are used in each bearing.

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

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

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

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

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

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

## REPLACE UNIVERSAL JOINT

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

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

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

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

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

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

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

REMOVE

1. Remove parking brake cable from torque tube.

2. Disconnect exhaust system from torque tube.

3. Remove three bolts from gearshift lever housing and remove gearshift housing.

4. Remove flywheel housing bottom cover.

5. Remove six screws from torque tube access hole cover and remove cover.

6. Remove six bolts from propeller shaft flange (Fig. 4-13).

7. Place a short piece of rubber hose or rag between propeller shaft and torque tube.

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

9. Support torque tube so it will not fall down.

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

11. Pry torque tube and propeller shaft away and down from flywheel housing (Fig. 4-14).

12. Place block of wood approximately 2″ square between transmission extension and floor of car to position transmission for reassembly. Support torque tube with stand.

13. Remove six bolts connecting torque tube to transmission (Fig. 4-15).

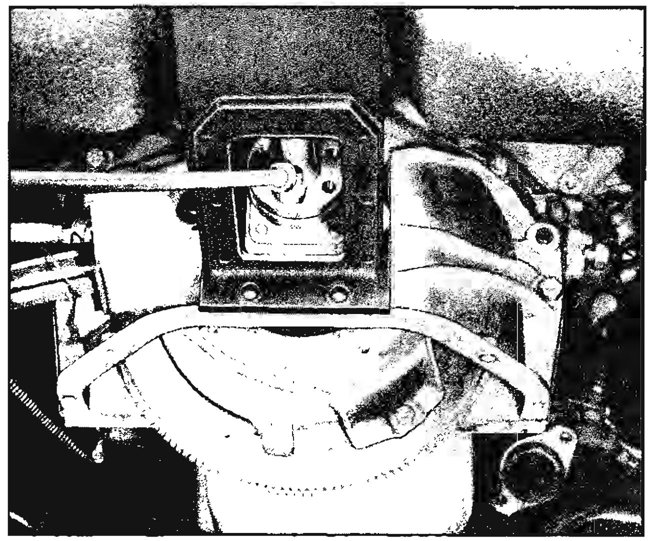


Fig. 4-13 Removing Bolts from Propeller Shaft Flange

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

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

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

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

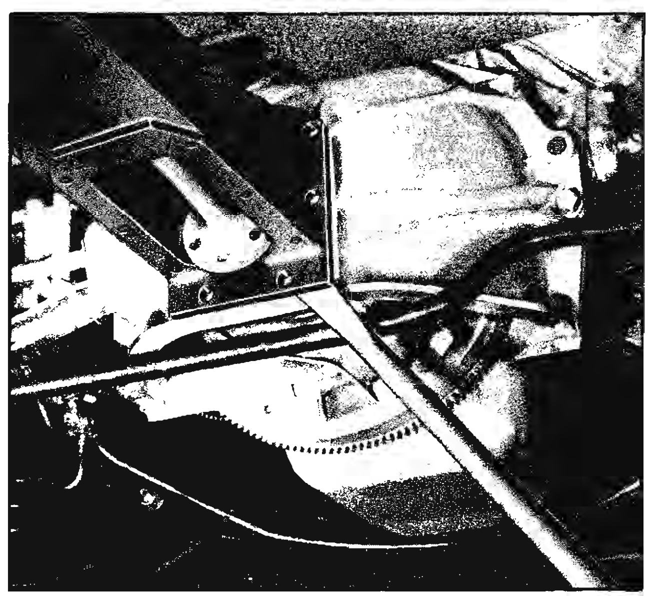


Fig. 4-14 Removing Torque Tube and Propeller Shaft from Flywheel Housing

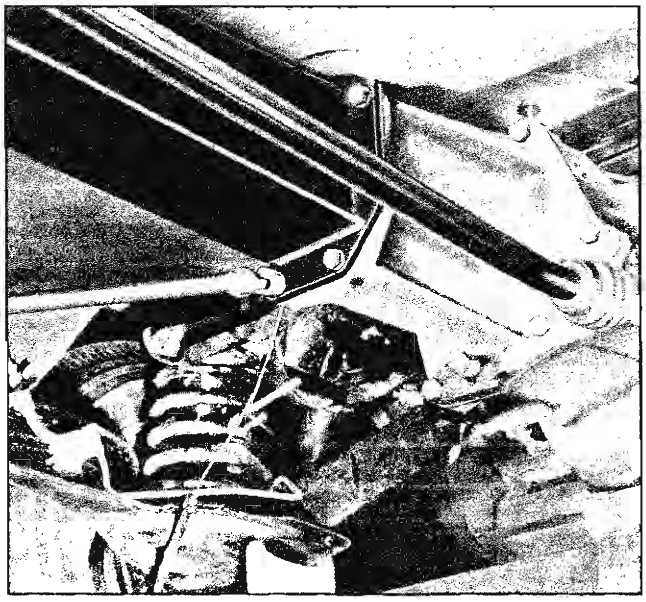


Fig. 4-15 Removing Bolts Connecting Torque Tube to Transmission

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

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

REPLACE

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

2. Coat spline generously with transmission fluid and take care introducing shaft into extension seal. Never allow weight of shaft to rest on seal. Install propeller shaft into transmission. Care must be used to engage spline of propeller shaft into transmission and journal diameter into transmission extension bearings so as not to damage journal surface. Visual check of propeller shaft alignment into transmission extension is required and if absolutely necessary, tap front flange lightly with a soft rubber hammer. BE SURE SPLINES ARE COMPLETELY ENGAGED IN TRANSMISSION.

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

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

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

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

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

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

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

10. Install gearshift housing.

11. Connect exhaust system.

***REMOVE AND REPLACE PROPELLER SHAFT AND TORQUE TUBE (AUTOMATIC TRANSMISSION— 4 CYL. ENGINE)***

REMOVE

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

2. Break exhaust system from torque tube.

3. Remove flywheel bottom cover from engine.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

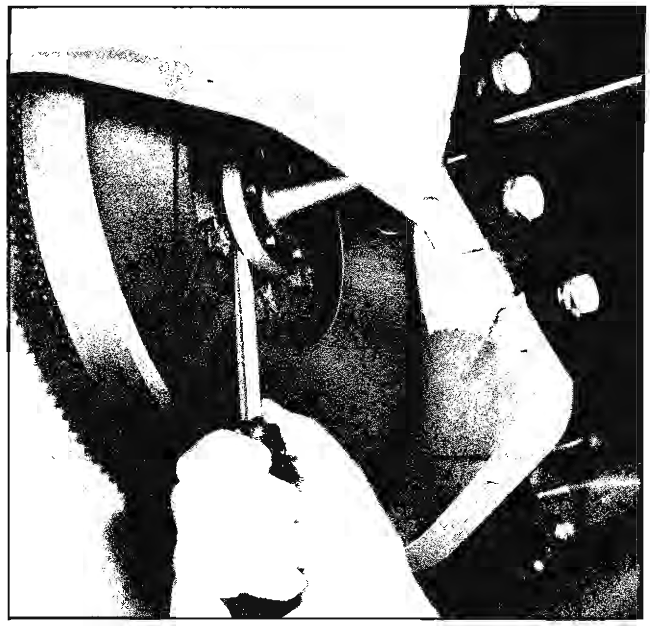


Fig. 4-16 Removing Propeller Shaft from Flywheel

## REPLACE

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

2. Coat spline generously with transmission fluid and take care introducing shaft into extension seal. Never allow weight of shaft to rest on seal. Install propeller shaft into transmission. Care must be used to engage spline of propeller shaft into transmission and journal diameter into transmission extension bearings so as not to damage journal surface. Visual check of propeller shaft alignment into transmission extension is required and if absolutely necessary, tap front flange lightly with a soft rubber hammer. BE SURE SPLINES ARE COMPLETELY ENGAGED IN TRANSMISSION.

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

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

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

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

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

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

9. Install flywheel cover.

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

11. Connect exhaust system at torque tube.

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

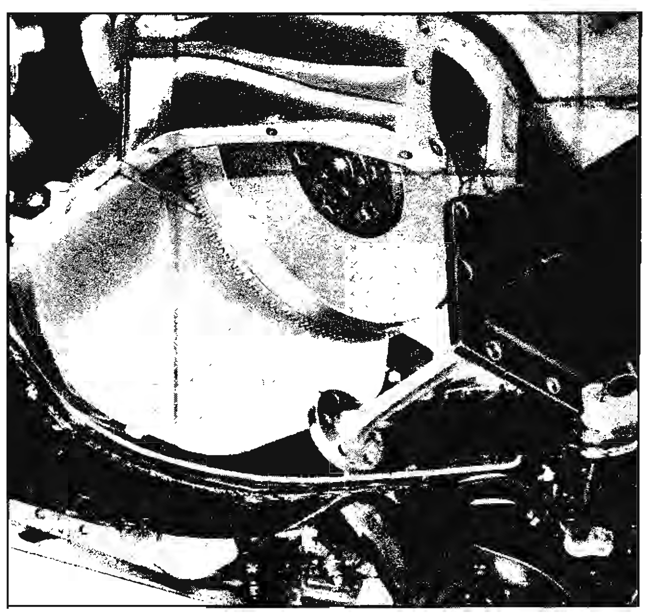


Fig. 4-17 Lowering Torque Tube and Propeller Shaft from Flywheel Housing

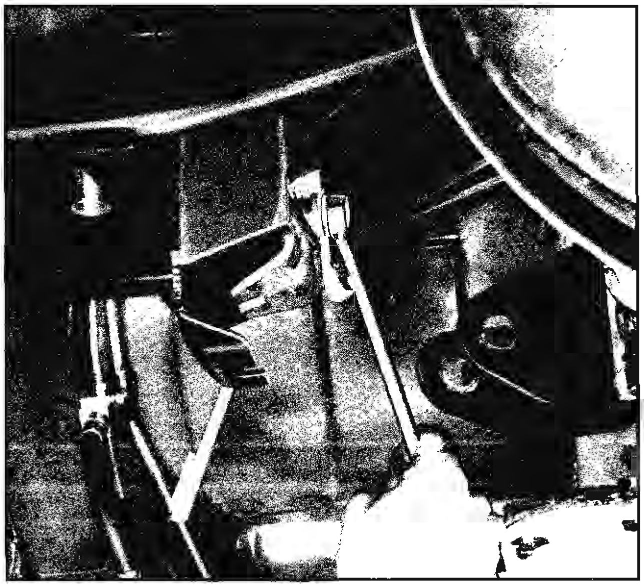


Fig. 4-18 Removing Six Axle Support Crossmember to Insulator Bolts

### *REMOVE AND REPLACE PROPELLER SHAFT AND TORQUE TUBE (AUTOMATIC TRANSMISSION V-8 ENGINE)*

1. Raise car so that rear wheels hang free supporting under body side rails.

2. Drain transmission and remove filler tube.

3. Remove rear wheels and brake drums.

4. Remove four nuts securing axle shaft bearing retainer to brake backing plate. Nuts are accessible through hole in axle shaft flange.

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

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

6. Disconnect speedometer cable, transmission control cable, downshift electrical connector, retaining clip, vacuum modulator line and parking lock control cable.

7. Remove parking brake cable from torque tube and disconnect exhaust system from rear tail pipe hanger.

8. Remove flywheel bottom cover.

9. Remove six bolts securing propeller shaft flange to flywheel.

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

11. Support torque tube and trans-axle separately.

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

13. Remove six axle support crossmember to insulator bolts (Fig. 4-18).

14. Disconnect rear lower control arms from differential housing by removing control arm to attachment bracket bolts.

15. Remove axle support crossmember from trans-axle assembly by lowering trans-axle slightly, permitting access to four attachment bolts.

16. Lower trans-axle until top of torque converter clears gasoline tank and pull rearward until propeller shaft emerges from flywheel housing.

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

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

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

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

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

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

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

#### REPLACE

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

2. Support torque tube separately and secure torque tube to flywheel housing with six attachment bolts. Tighten bolts to 30-45 lb. ft. torque.

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

4. Install propeller shaft in place on flywheel and secure front flange of propeller shaft to flywheel with six attachment bolts. Tighten bolts to 30-45 lb. ft. torque.

5. Replace trans-axle support crossmember on trans-axle assembly. Tighten four attaching bolts to 40-55 lb. ft. torque.

6. Coat spline generously with transmission fluid and take care introducing shaft into extension seal. Never allow weight of shaft to rest on seal. Install propeller shaft into transmission. Care must be used to engage spline of propeller shaft into transmission and journal diameter into transmission extension bearings so as not to damage journal surface. Visual check of propeller shaft alignment into transmission extension is required and if absolutely necessary tap front flange lightly with soft rubber hammer. Be sure splines are completely engaged in transmission.

7. Replace six bolts connecting torque tube to transmission extension and tighten to 30-45 lb. ft. torque.

8. Replace four bolts attaching trans-axle support crossmember to rear crossmember by raising trans-axle until mounting holes in ends of trans-axle support line up with insulator bolt holes. Tighten bolts to 40-55 lb. ft. torque.

9. Connect control arms to differential housing. Tighten pivot bolts to 100-125 lb. ft. torque.

10. Replace transmission control cable, downshift electrical connector, retaining clip, speedometer cable, vacuum modulator line and parking lock control cable.

11. Install axle shaft universal joint splines in differential and carrier assembly using extreme care so as not to damage side cover oil seals.

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

12. Connect parking brake cable to torque tube and exhaust system at rear tail pipe hanger.

13. Replace transmission lubricant filler tube.

14. Install four nuts securing axle bearing retainer to brake backing plate via access hole in axle shaft flange. Tighten nuts to 30-45 lb. ft. torque.

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

16. Replace flywheel housing access plate.

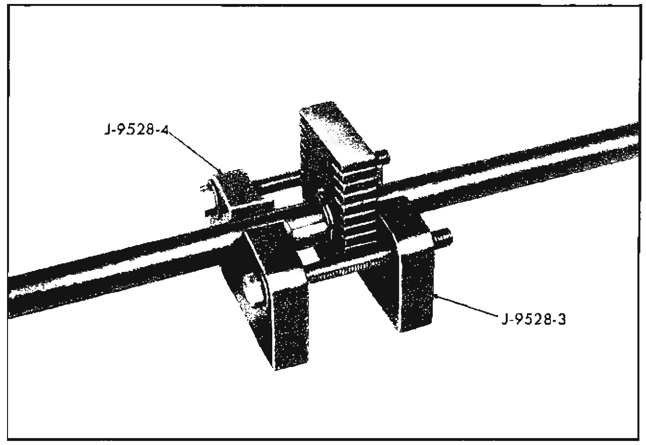



Fig. 4-19 Tools J-9528-3 and J-9528-4 Installed

17. Refill transmission with proper amount of recommended lubricant (see General Lubrication Section).

18. Remove all stands and supports and lower car.

### REMOVE AND REPLACE PROPELLER SHAFT BEARINGS

#### REMOVE

1. Position tools J-9528-3 and J-9528-4 on propeller shaft (Fig. 4-19).

2. Tighten bolts evenly until bearing is pulled off half-shell.

3. Carefully remove half-shells from propeller shaft.

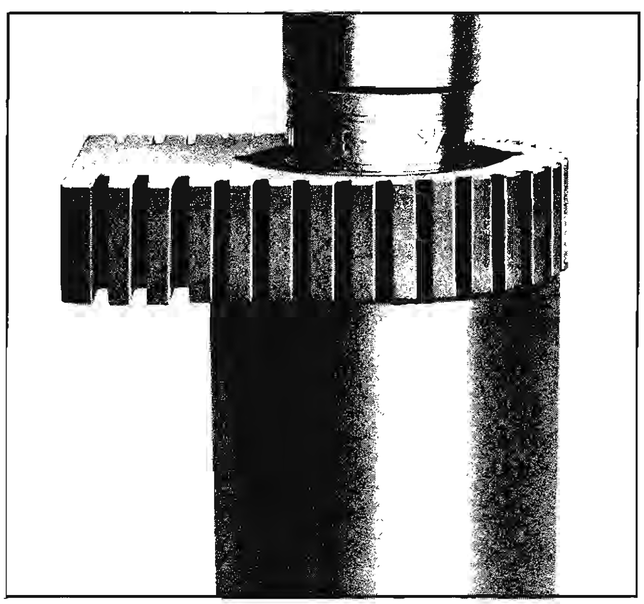


Fig. 4-20 Removing Bearing from Insulator

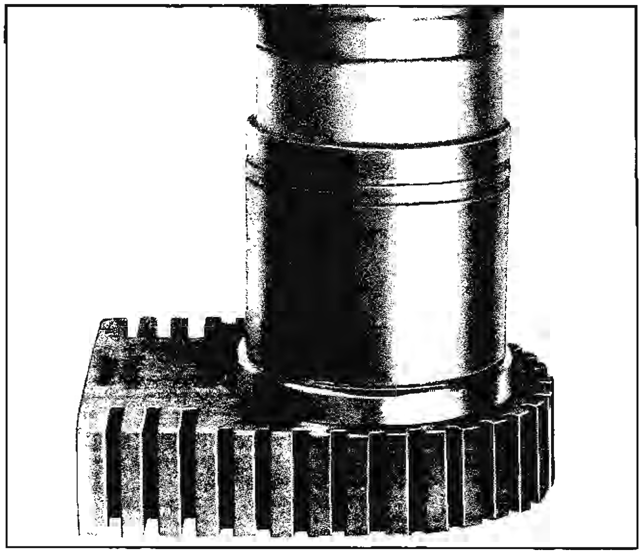


Fig. 4-21 Installing Bearing in Insulator

## REMOVE BEARING FROM INSULATOR

While supporting insulator with J-7022-3 or other suitable tool (Fig. 4-20 press bearing from insulator using socket. Use inner race to press out bearing.

## INSTALL BEARING IN INSULATOR

Using socket (Fig. 4-21), press bearing into insulator. Press on outside diameter only.

## REPLACE BEARING AND INSULATOR

1. Position bearings and insulators on shaft, as shown (Fig. 4-22).

2. Position half-shells on shaft and secure with J-9528-1 & 2 (Fig. 4-23). Tighten bolts securely.

3. Locate bearing between arrows on J-9528-1 & 2 and J-9528-3.

4. Position J-9528-4 in place and install bolts through J-9528-1 & 2 and into J-9528-3 (Fig. 4-24).

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

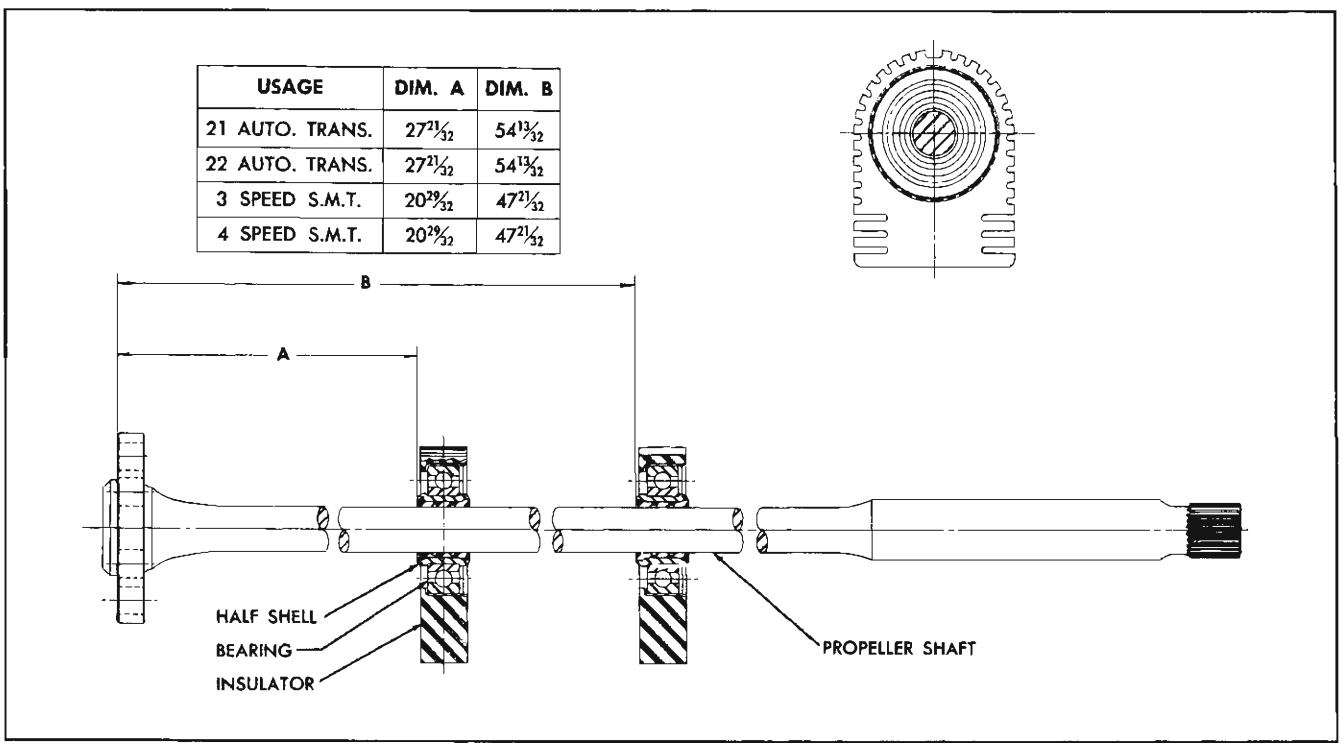
6. Carefully remove tool from propeller shaft. Inspect for centering (nibs on each side of I.D.). Make certain shells are not cocked or edge damaged (failing rubber bond to metal).

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

## REMOVE

1. Raise car supporting underbody side rails.

2. Drain both differential and carrier assembly and transmission.



| USAGE | DIM. A | DIM. B |
|---|---|---|
| 21 AUTO. TRANS. | 27 21/32 | 54 13/32 |
| 22 AUTO. TRANS. | 27 21/32 | 54 13/32 |
| 3 SPEED S.M.T. | 20 29/32 | 47 21/32 |
| 4 SPEED S.M.T. | 20 29/32 | 47 21/32 |



Fig. 4-22 Location of Bearings on Shaft

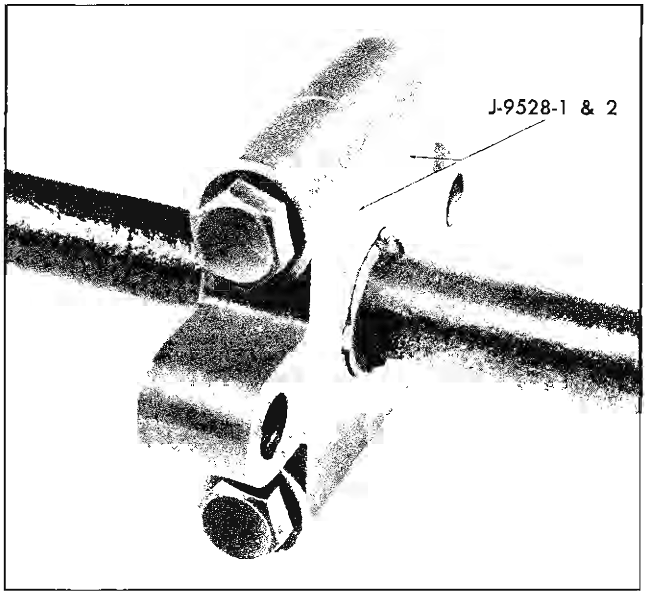



Fig. 4-23 J-9528-1 & 2 Installed on Shaft

3. Remove rear wheels and brake drums.

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

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

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

6. Disconnect speedometer cable.

7. Support transmission separately.

8. Remove six axle support crossmember to insulator bolts (Fig. 4-18).

9. Disconnect rear lower control arms from attachment bracket on differential housing by removing control arm pivot bolts.

10. Remove axle support crossmember from trans-axle assembly by lowering trans-axle slightly, permitting access to four attachment bolts (Fig. 4-25).

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

12. Separate transmission from differential and carrier assembly.

13. Carefully lower differential and carrier assembly from car.

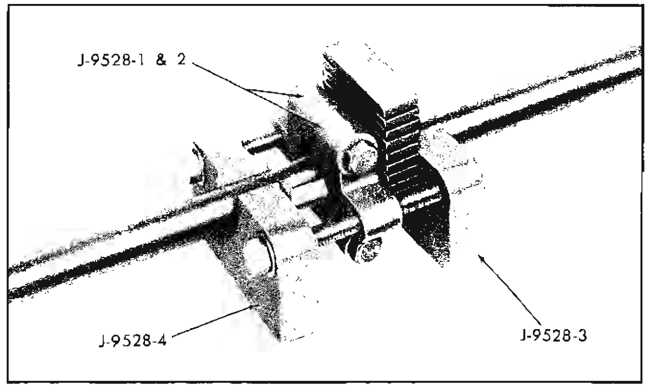



Fig. 4-24 Tool Positioned to Install Bearing

## REPLACE

1. With new gasket in place, install differential and carrier on transmission with four attachment bolts tightening to 30-35 lb. ft. torque.

2. Replace trans-axle support crossmember on trans-axle assembly. Tighten four attachment bolts to 40-45 lb. ft. torque.

3. Connect control arms to differential housing. Tighten pivot bolts to 100-125 lb. ft. torque.

4. Replace six bolts attaching trans-axle support crossmember to rear crossmember by raising trans-axle until mounting holes in ends of trans-axle support line up with insulator bolt holes. Tighten bolts to 40-45 lb. ft. torque.

5. Connect speedometer cable.

6. Install axle shaft universal joint splines in differential and carrier assembly using extreme care so

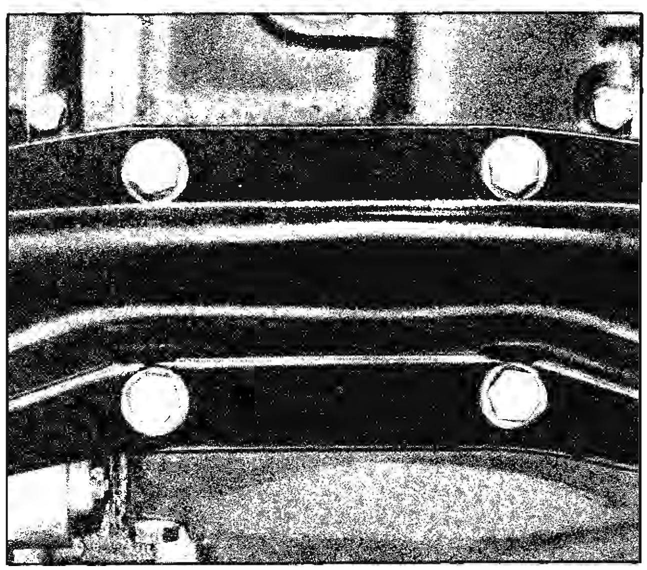


Fig. 4-25 Location of Mounting Bolts

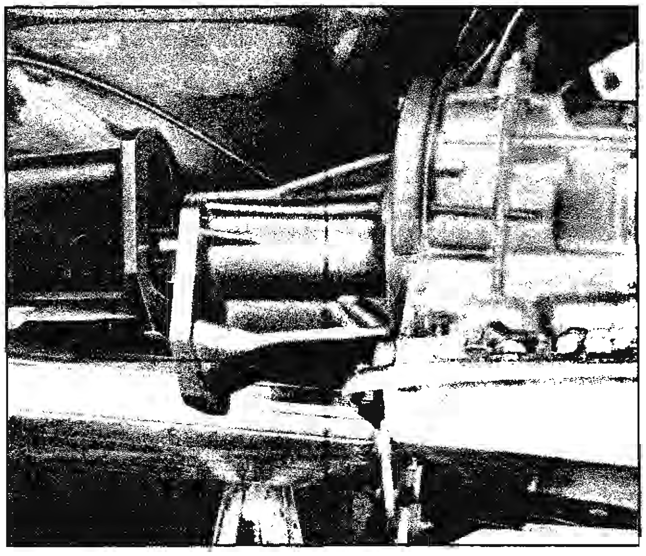


Fig. 4-26 Separating Trans-Axle from Torque Tube

as not to damage side cover oil seal.

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

7. Install four nuts securing axle bearing retainer to brake backing plate via access hole in axle shaft flange. Tighten nuts to 30-45 lb. ft. torque.

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

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

10. Remove all stands and supports and lower car.

## MAJOR REPAIRS

### *REMOVE AND REPLACE TRANS-AXLE ASSEMBLY*

#### REMOVE

1. Raise car supporting underbody side rails.

2. Drain both differential and carrier assembly and transmission.

3. Remove transmission filler tube (Automatic Transmission).

4. Remove rear wheels and brake drums.

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

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

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

7. Disconnect speedometer cable.

8. Disconnect transmission control cable, downshift electrical connector, retaining clip, vacuum modulator line and parking lock control cable, (Automatic Transmission).

9. Support torque tube and trans-axle separately.

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

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

11. Remove six axle support crossmember to insulator bolts (Fig. 4-18).

12. Disconnect rear lower control arms from attachment bracket on differential housing by removing control arm pivot bolts.

13. Disconnect shift tube from transmission (Synchro-Mesh Transmission).

14. Disconnect exhaust system from rear tail pipe hanger.

15. Remove axle support crossmember from trans-axle assembly by lowering trans-axle slightly, permitting access to four attachment bolts (Fig. 4-25).

16. Separate trans-axle assembly from torque tube and propeller shaft (Fig. 4-26).

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

17. Carefully lower trans-axle assembly from car.

#### REPLACE

1. Coat spline generously with transmission oil and take care introducing shaft into extension seal. Never allow weight of shaft to rest on seal. Install propeller shaft into transmission. Care must be used to engage spline of propeller shaft into transmission and journal diameter into transmission extension bearings so as not to damage journal surface. Visual check of propeller shaft alignment into transmission extension is required and if absolutely necessary, tap front flange lightly with a soft rubber hammer. Be sure splines are completely engaged in transmission.

2. Replace six bolts connecting torque tube to transmission extension and tighten to 30-45 lb. ft. torque.

3. Replace trans-axle support crossmember on trans-axle assembly. Tighten four attaching bolts to to 40-55 lb. ft. torque.

4. Replace six bolts attaching trans-axle support crossmember to rear crossmember by raising trans-axle until mounting holes in ends of trans-axle support line up with insulator bolt holes. Tighten bolts to 40-45 lb. ft. torque.

5. Connect control arms to differential housing. Tighten pivot bolts to 100-125 lb. ft. torque.

6. Connect exhaust system at rear tailpipe hanger.

7. Connect shift tube to transmission (Synchro-Mesh Transmission).

8. Connect speedometer cable.

9. Replace transmission control cable, downshift electrical connector, retaining clip, vacuum modulator line and parking lock control cable (Automatic Transmission).

10. Install axle shaft universal joint splines in differential and carrier assembly using extreme care so as not to damage side cover oil seal.

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

11. Install four nuts securing axle bearing retainer to brake backing plate via access hole in axle shaft flange. Tighten nuts to 30-45 lb. ft. torque.

12. Replace transmission lubricant filler tube (Automatic Transmission).

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

14. Fill transmission and differential with proper amount of recommended lubricant.

15. Remove all stands and supports and lower car.

### DISASSEMBLY OF DIFFERENTIAL AND CARRIER ASSEMBLY

1. Separate differential and transmission, Section 7A.

2. Mount differential on holding fixture J-7896-01 (Fig. 4-27).

3. Remove differential side bearing oil seals (Fig. 4-28).

4. Remove differential carrier side cover from carrier.

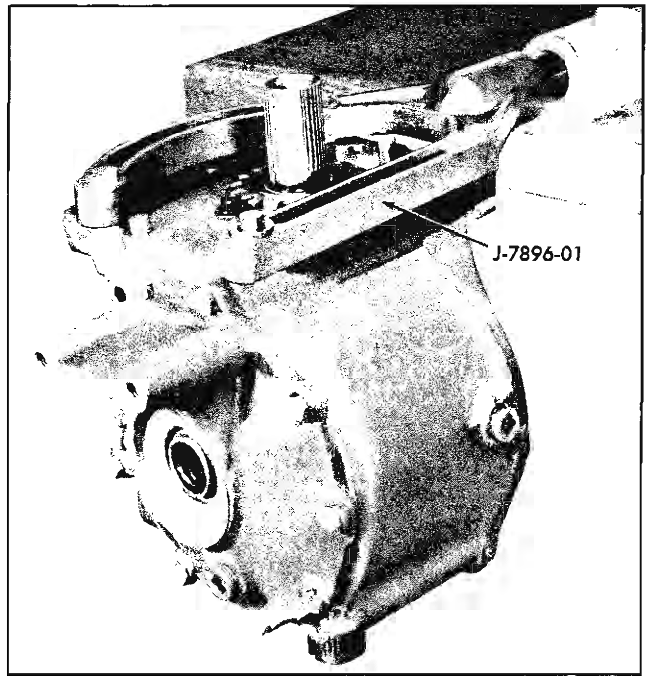



Fig. 4-27 Carrier Assembly Mounted on Fixture

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

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

6. In order to provide complete diagnosis, a red lead test should be made as described on page 4-23.

7. Remove front pinion bearing adjusting nut lock.

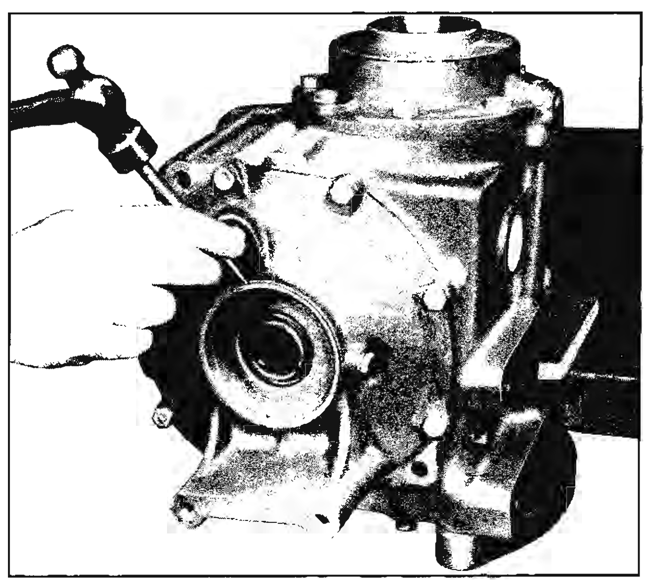


Fig. 4-28 Removing Side Bearing Oil Seal

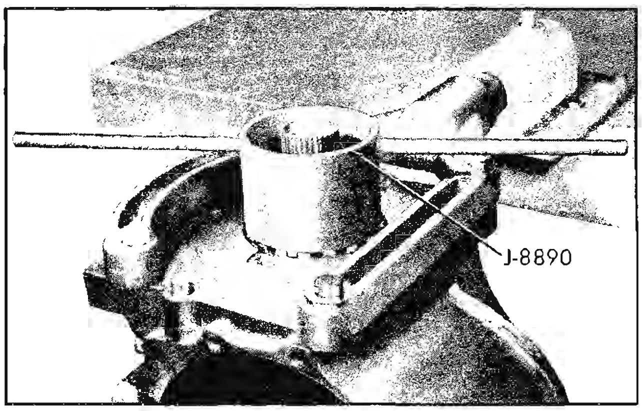



Fig: 4-29 Tool Positioned to Remove Front Pinion Bearing Adjusting Nut

8. Remove front pinion bearing adjusting nut using J-8890 (Fig. 4-29).

9. Remove pinion rear bearing retainer and shim pack. Remove rubber oil passage seal (automatic only). (If difficulty should arise tap retainer out from inside carrier.)

10. Remove pinion and shaft assembly from carrier.

11. Remove side bearing adjusting nut lock screw.

12. Remove side bearing adjusting nut from carrier.

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

14. Remove drain and filler plugs from carrier housing.

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

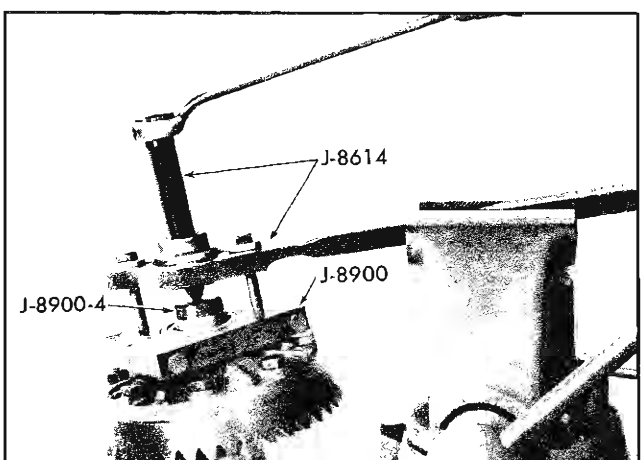



Fig. 4-30 Removing Side Bearing

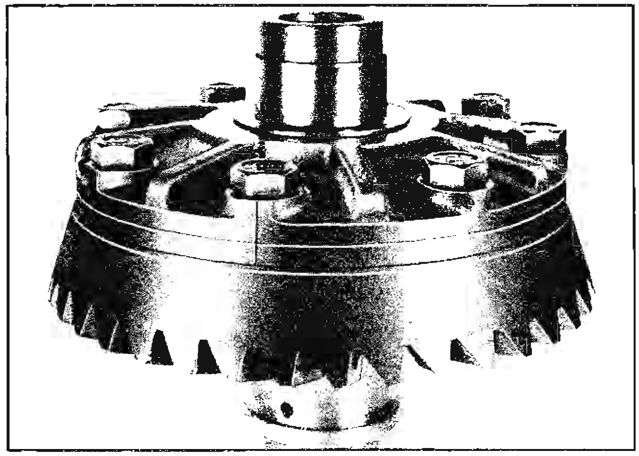


Fig. 4-31 Scribe Mark on Differential

***OVERHAUL: TWO PINION DIFFERENTIAL CASE AND RING GEAR ASSEMBLY (AUTOMATIC TRANSMISSION, 4 CYL. ENGINE)***

## DISASSEMBLE

1. If side bearing or case is to be replaced, remove bearings using J-8900 and J-8614 (Fig. 4-30).

2. A mark is scribed across parting line of differential case and cover to aid in alignment on reassembly (Fig. 4-31).

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

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

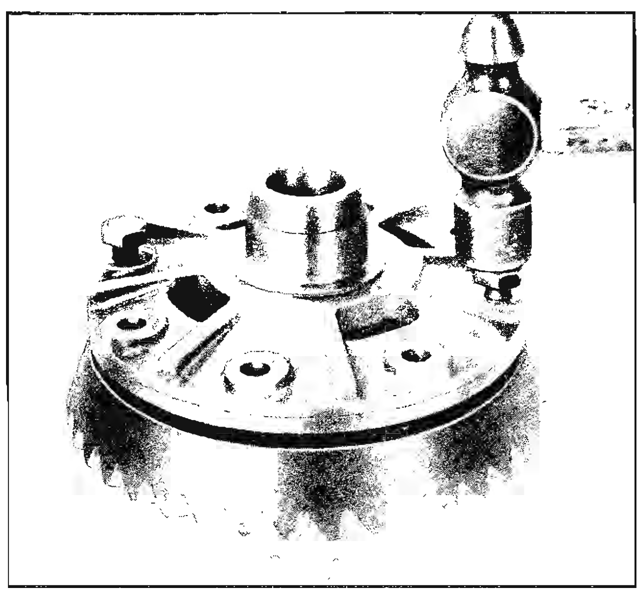


Fig. 4-32 Removing Ring Gear from Case

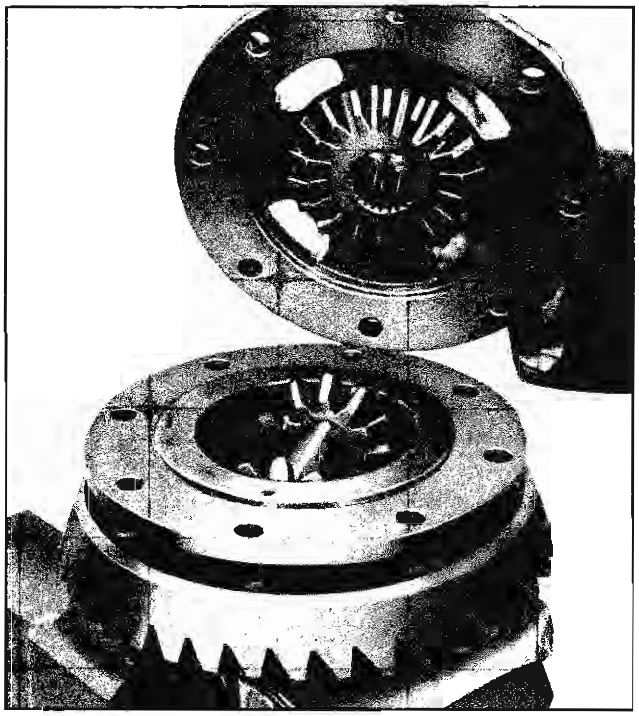


Fig. 4-33 Separating Cover and Case

5. Using ball peen hammer, tap ring gear off of case (Fig. 4-32).

6. Separate cover and case (Fig. 4-33).

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

8. Drive out roll pin which retains cross shaft (Fig. 4-34).

9. Drive out cross shaft.

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

## INSPECT

1. Clean all parts of assembly with cleaning fluid.

2. Inspect all castings for cracks or other damage.

3. Inspect all bearings for loose rollers, flaked or pitted rollers, and locking of bearings.

4. Inspect gears for nicks and scoring.

5. Replace all excessively worn or damaged parts.

## ASSEMBLE

1. Install side gear and thrust washer in case.

2. Install two pinion gears and thrust washers in case.

3. Drive cross shaft into case being sure to align holes for pin.

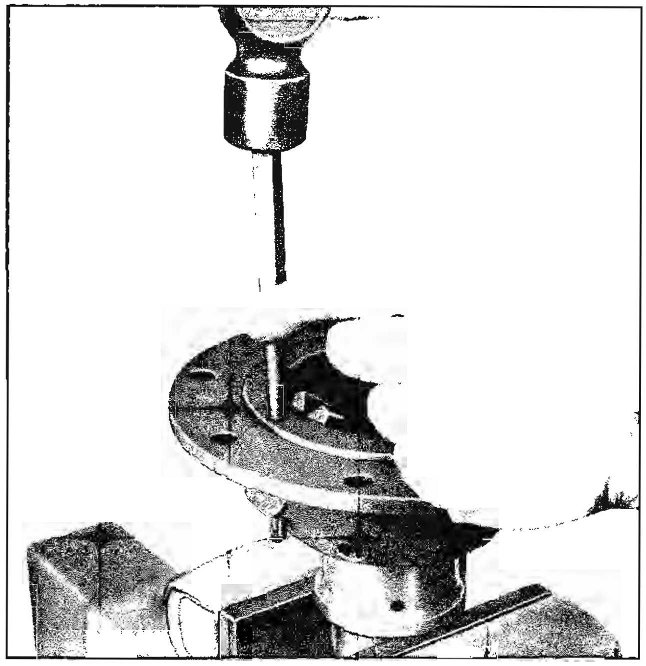


Fig. 4-34 Removing Roll Pin

4. Install pin through cross shaft.

5. Install side gear and thrust washer in cover.

6. Install cover on case being sure to align scribe marks.

7. Install bolts through case into ring gear. Tighten to 60-70 lb. ft. torque.

8. Press on side bearings using J-8901 and J-8092 handle (Fig. 4-35).

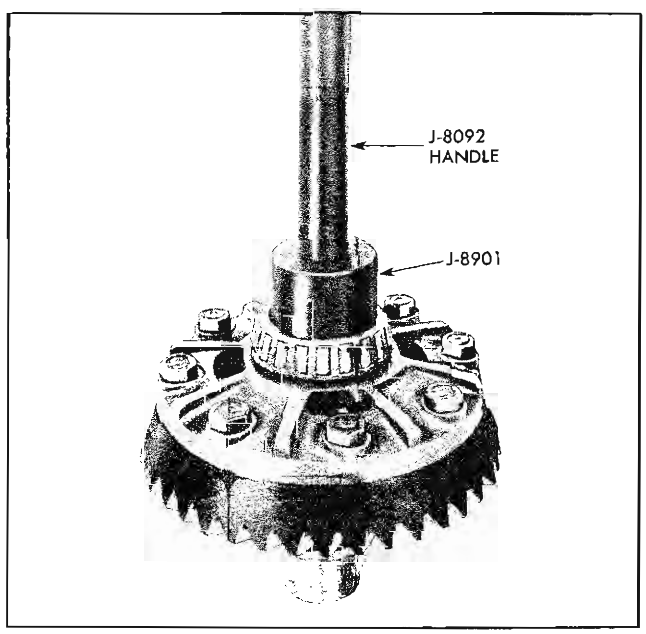



Fig. 4-35 Installing Differential Side Bearing

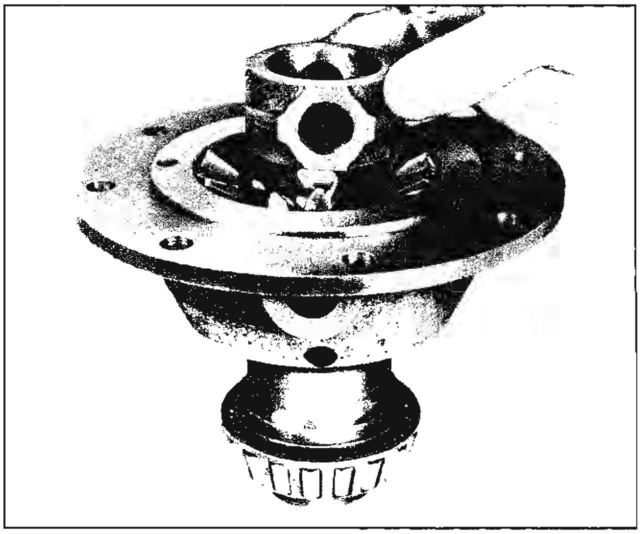


Fig. 4-36 Removing Differential Ring from Case

***OVERHAUL: FOUR PINION DIFFERENTIAL CASE AND RING GEAR (ALL EXCEPT 4 CYL. ENGINE WITH AUTOMATIC TRANSMISSION)***

DISASSEMBLE

1. If side bearing or case is to be replaced, remove bearings using J-8900 and J-8614 (Fig. 4-30).

2. A mark is scribed across parting line of differential case and cover to aid in alignment on reassembly (Fig. 4-31).

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

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

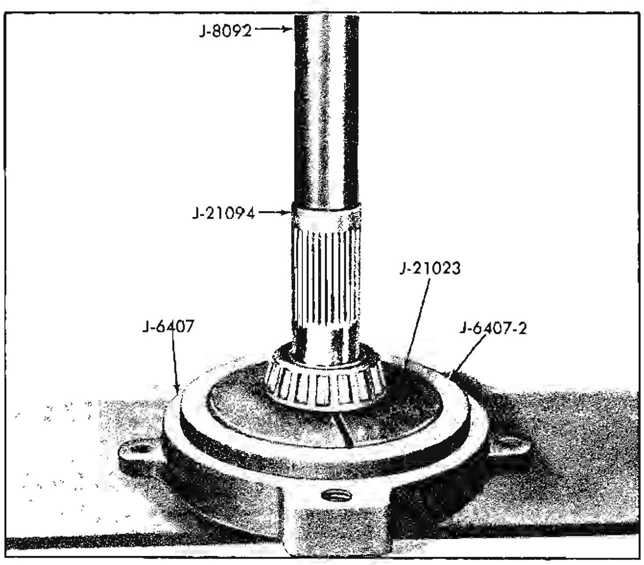



Fig. 4-37 Removing Front Pinion Bearing

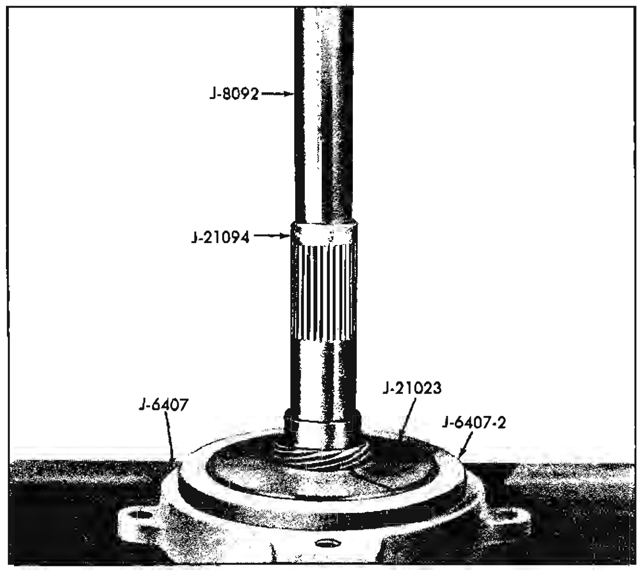



Fig. 4-38 Removing Speedometer Drive Gear

5. Using ball peen hammer, tap ring gear off of case (Fig. 4-32).

6. Separate cover and case.

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

8. Drive out roll pins which retain cross shafts.

9. Drive out cross shafts.

10. Remove differential pinion shaft ring from case (Fig. 4-36).

11. Remove four pinions and thrust washers from case.

12. Remove side gear from case.

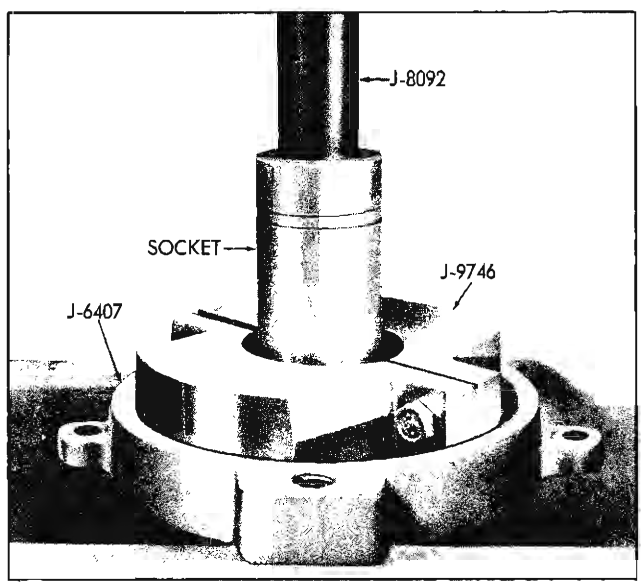



Fig. 4-39 Removing Rear Pinion Bearing

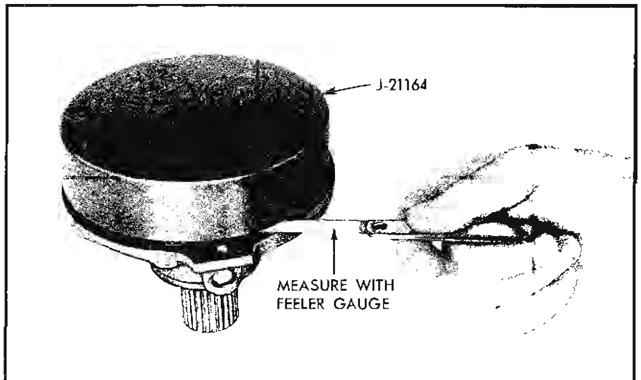



Fig. 4-40 Determining Shim Thickness Required

## INSPECT

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

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

Fig. 4-41 Shim Chart

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

Fig. 4-42 Pinion Correction Chart

## ASSEMBLE

1. Install side gear and thrust washer in case.
2. Install four pinion gears and thrust washers in case.
3. Install differential shaft ring in case.
4. Drive cross shafts into case being sure to align hole for pin.
5. Install pins through cross shafts.
6. Install side gear and thrust washer in cover.
7. Install cover on case being sure to align scribe marks.
8. Install bolts through case into ring gear. Tighten to 60-70 lb. ft. torque.
9. Press on side bearings, if removed, using J-8901 and J-8092 handle (Fig. 4-35).

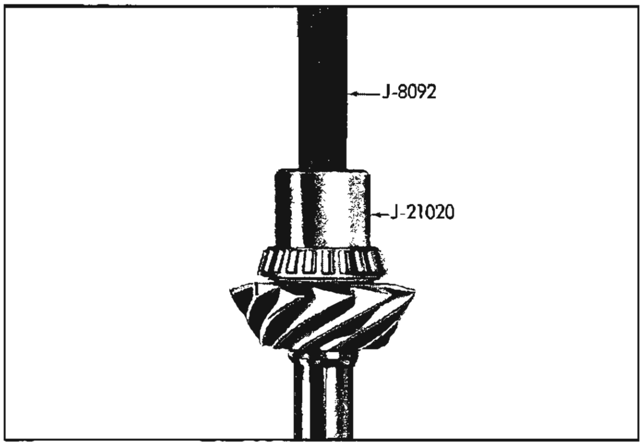



Fig. 4-43 Tool Positioned to Install Rear Pinion Bearing

***OVERHAUL: PINION AND SHAFT ASSEMBLY***

DISASSEMBLE

1. Remove front pinion bearing–press off using J-21023 in J-6407 holder and J-8092 handle with adapter J-21094 (Fig. 4-37).

2. Press off speedometer gear using J-21023 held in J-6407 holder, and J-8092 handle with adapter J-21094 (Fig. 4-38).

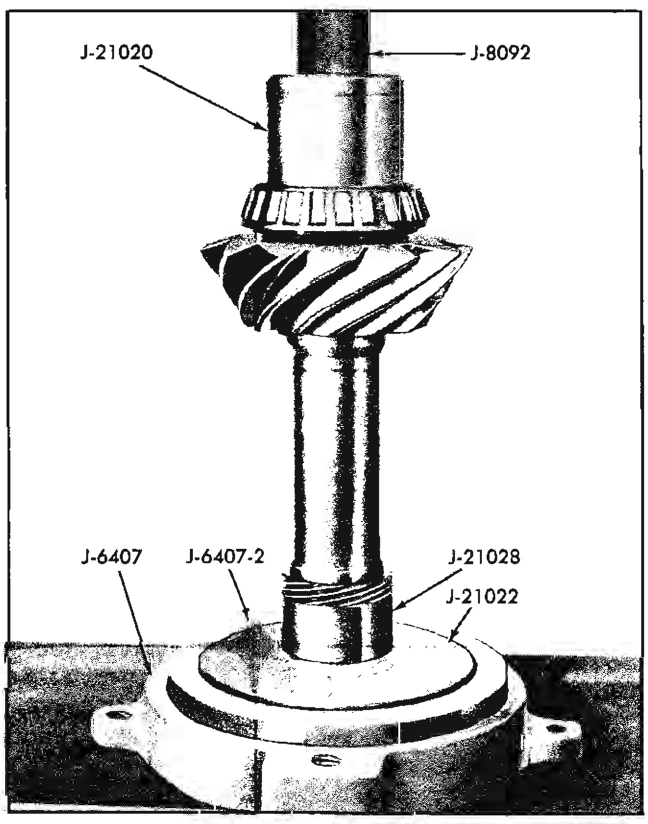



Fig. 4-44 Installing Speedometer Drive Gear

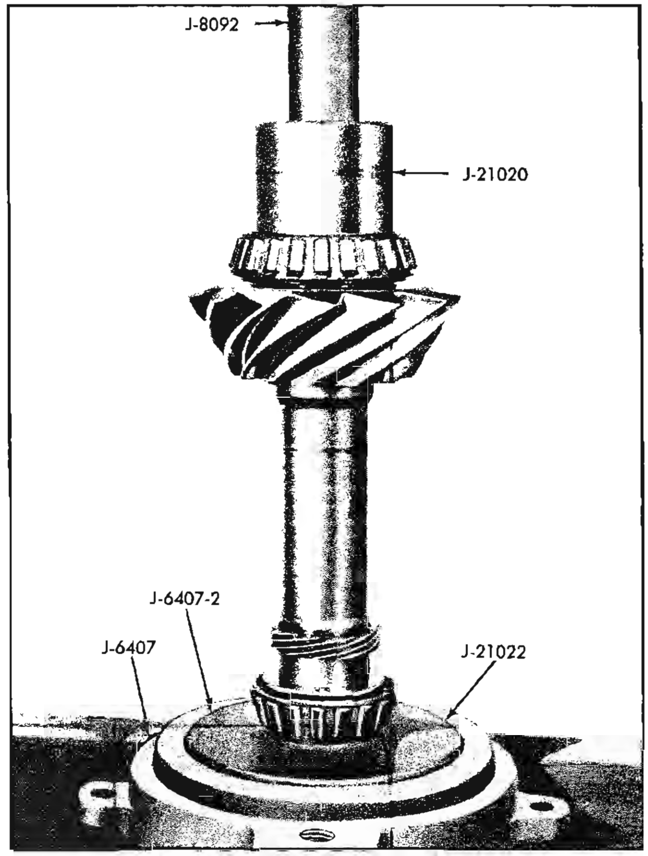



Fig. 4-45 Installing Front Pinion Bearing

3. Clamp rear pinion bearing in tool J-9746 and support in press with J-6407 holder. Press off rear pinion bearing using J-8092 handle and large socket as adapter to bear against pinion (Fig. 4-39).

4. Place rear pinion bearing in rear pinion bearing retainer. Place tool J-21164 on retainer as shown

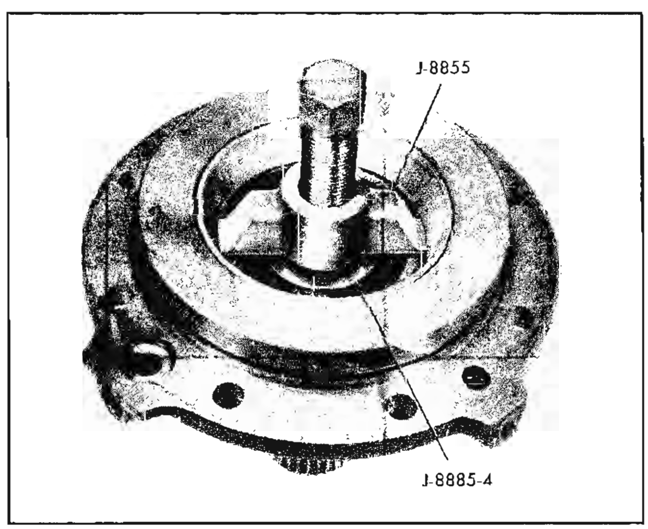



Fig. 4-46 Removing Rear Pinion Bearing Outer Race

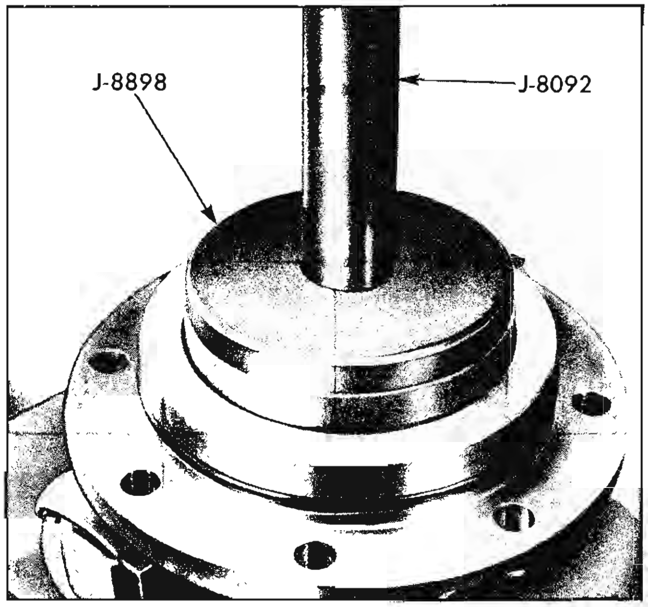



Fig. 4-47 Installing Rear Pinion Bearing Outer Race

(Fig. 4-40). Use feeler gauge as shown to determine correct shim thickness required for reassembly. Use chart (Fig. 4-41) to convert feeler gauge readings to shim specifications. If pinion shaft is marked on end of shaft use chart (Fig. 4-42) for correction.

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

ASSEMBLE

1. Press on rear pinion bearing using adapter J-21020 and J-8092 handle (Fig. 4-43).

2. Press on speedometer drive gear using adapter J-21020 installed in end of pinion shaft, and spacer

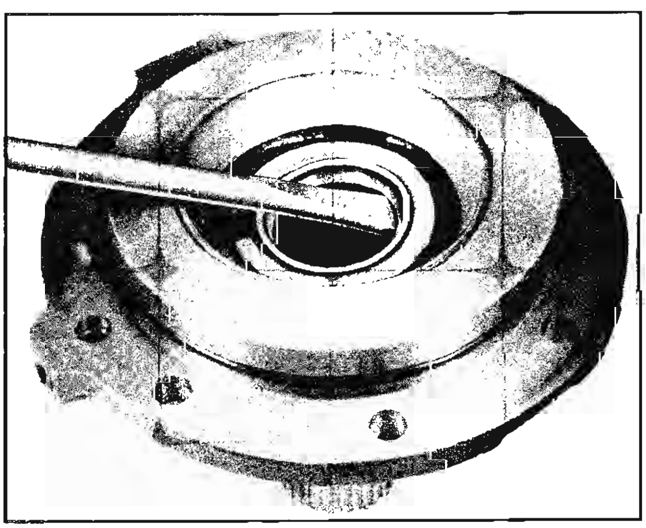


Fig. 4-48 Removing Rear Pinion Oil Seal

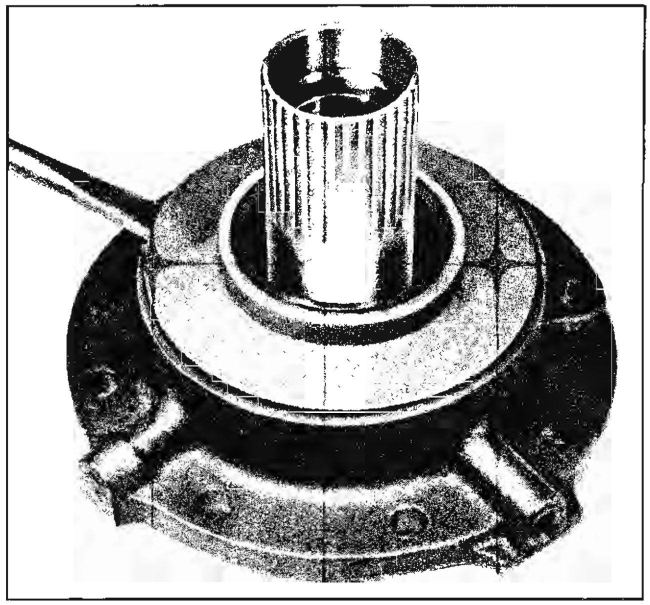


Fig. 4-49 Removing Rear Flange and Stator Seal

J-21028 with J-21022 in J-6407 holder (Fig. 4-44).

3. Press on front pinion bearing using J-21022 in J-6407 holder and J-8092 handle with J-21020 adapter (Fig. 4-45).

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

DISASSEMBLE

1. Remove "O" ring seal from retainer.

2. Remove rear pinion bearing outer race using J-8855 and button J-8855 (Fig. 4-46).

ASSEMBLE

1. Install rear pinion bearing outer race using J-8898 with J-8092 handle (Fig. 4-47).

2. Install new "O" ring seal.

***OVERHAUL: REAR PINION BEARING RETAINER (AUTOMATIC TRANSMISSION)***

DISASSEMBLE

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

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

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

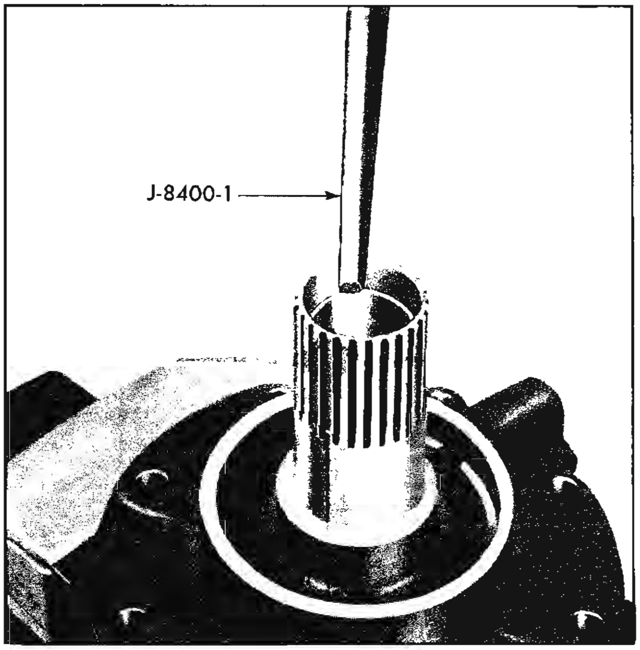



Fig. 4-50 Removing Stator Shaft Bushing

3. Remove rear oil seal from retainer using small chisel or other suitable tool (Fig. 4-48).

4. Remove rear pinion bearing outer race from retainer using tool J-8855 with J-8855-4 adapter (Fig. 4-46).

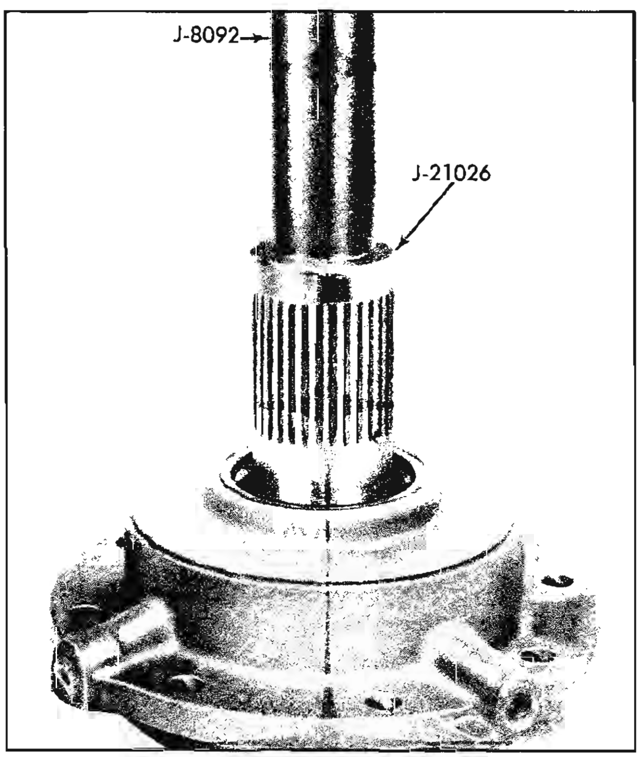



Fig. 4-51 Installing New Bushing

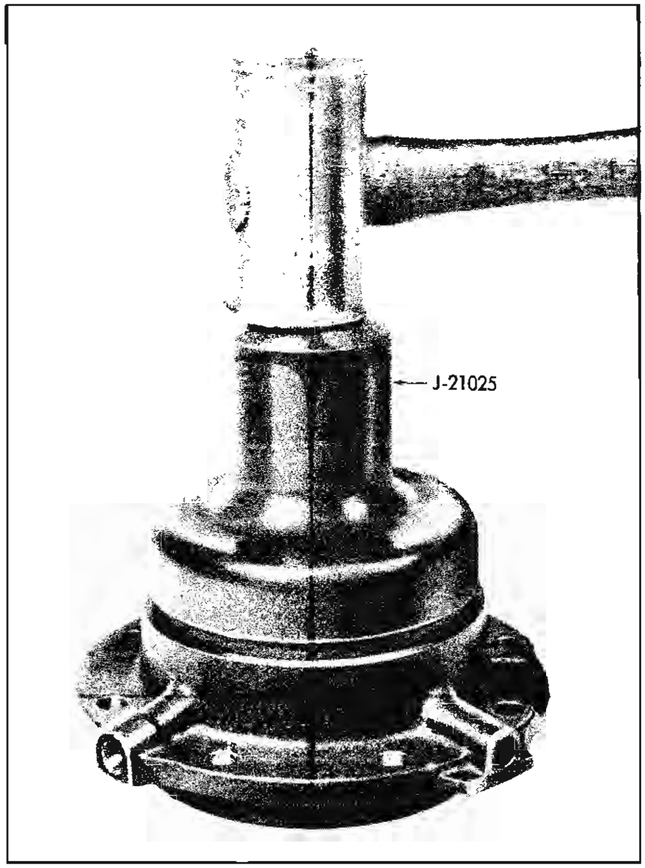



Fig. 4-52 Installing Rear Flange and Oil Seal

5. Pry off rear flange and stator seal as shown (Fig. 4-49).

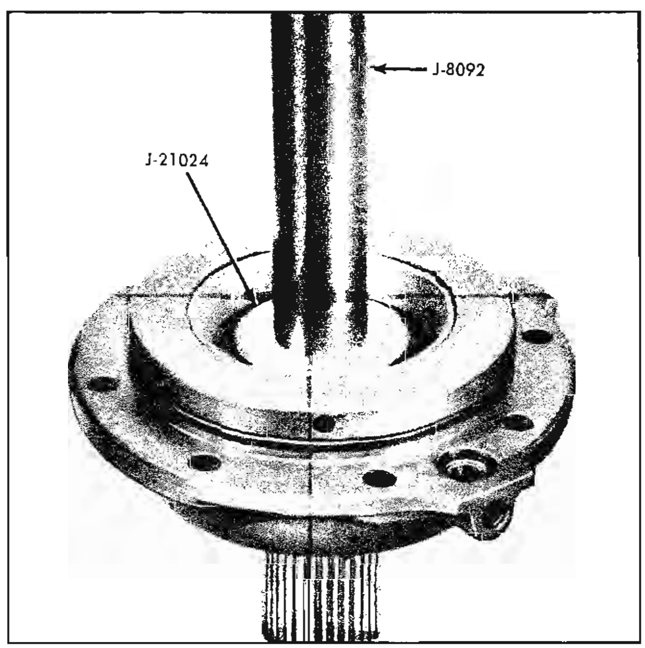



Fig. 4-53 Installing Rear Pinion Oil Seal

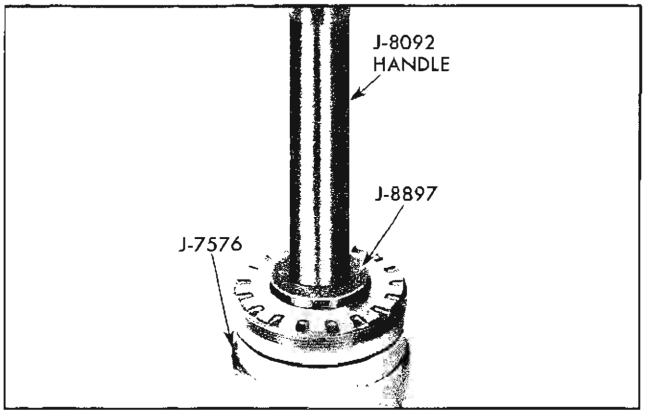



Fig. 4-54 Tool Positioned to Remove Front Pinion Bearing Outer Race (Synchro-mesh)

6. Remove stator shaft bushing using tool J-8400-1 (Fig. 4-50).

ASSEMBLE

1. Apply uniform bead of sealer and install new rear flange and stator seal using J-21025 (Fig. 4-52).

2. Install new bushing using tool J-21026 with J-8092 handle (Fig. 4-51).

3. Install new rear pinion oil seal using tool J-21024 with J-8092 handle (Fig. 4-53).

4. Install rear pinion bearing outer race using tool J-8898 with J-8092 handle (Fig. 4-47).

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

### *OVERHAUL: FRONT PINION BEARING ADJUSTING NUT*

DISASSEMBLE

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

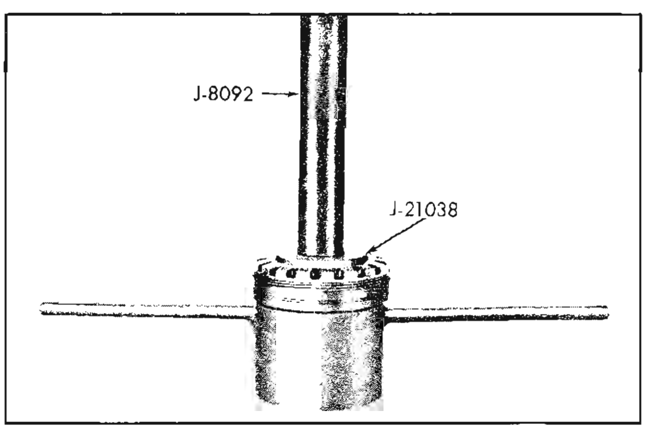



Fig. 4-55 Removing Front Pinion Bearing Outer Race (Automatic)

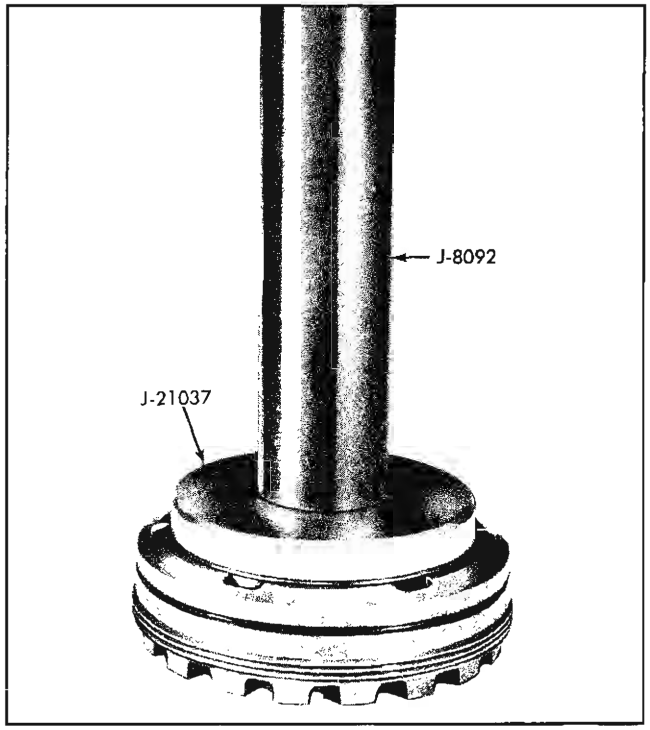



Fig. 4-56 Tool Positioned to Install Front Pinion Bearing Outer Race

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

3. Remove front pinion bearing race:

STANDARD TRANSMISSION: Supporting nut on tool J-7576 using J-8897 with J-8092 handle, press out race on arbor press (Fig. 4-54).

AUTOMATIC TRANSMISSION: Holding nut in soft jawed vise or Tool J-8890, drive race out of nut using Tool J-21038 with J-8092 handle.

REASSEMBLE

1. Install front bearing race in nut using tool J-21037 with J-8092 handle (Fig. 4-56).

2. Apply uniform bead of sealer and replace front oil seal (automatic transmission only) using tool J-21197 (Fig. 4-57).

3. Install new "O" ring seal (automatic transmission only).

### *ASSEMBLE AND ADJUST DIFFERENTIAL AND CARRIER*

1. Install side bearing race in carrier casting.

2. Start side bearing adjusting nut in carrier casting. Five turns in at this time.

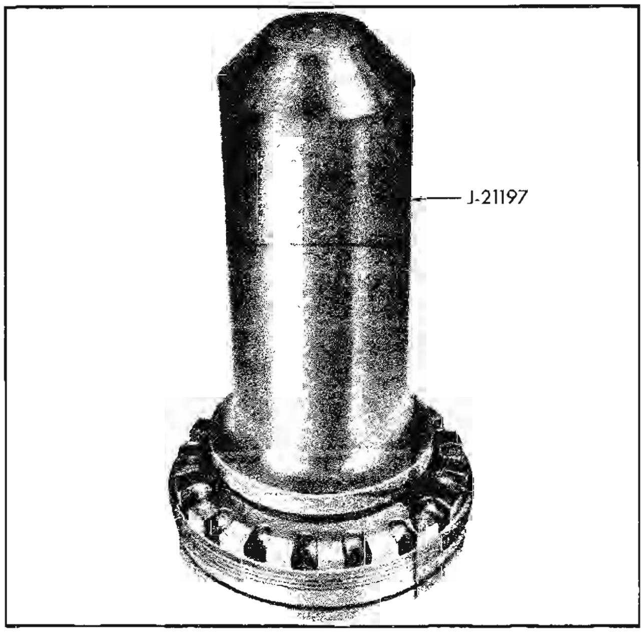



Fig. 4-57 Tool Positioned to Install Front Oil Seal (Automatic only)

3. Position side bearing race in side cover and start side bearing adjusting nut.

4. Position ring gear and differential case in carrier casting.

5. With oil seal and "O" ring removed, place side cover on case and retain with four bolts. Be sure the two aligning bolts are installed in the correct holes.

6. Turn side bearing adjusting nut in cover casting finger tight.

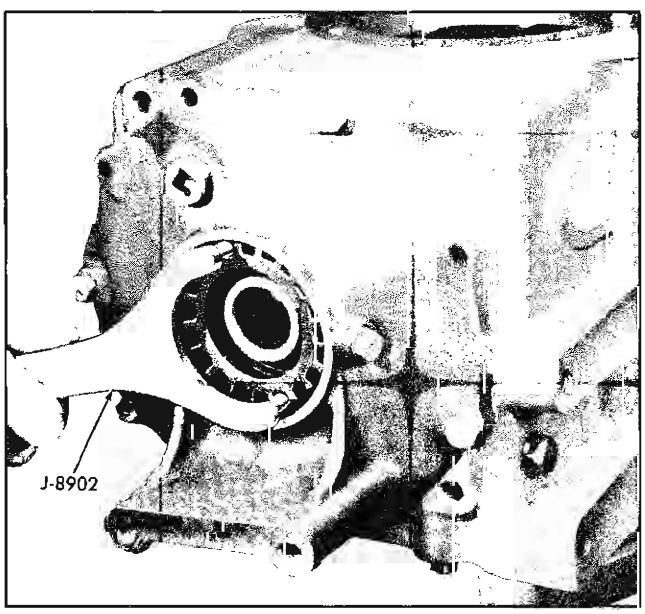



Fig. 4-58 Adjusting Side Bearing Preload

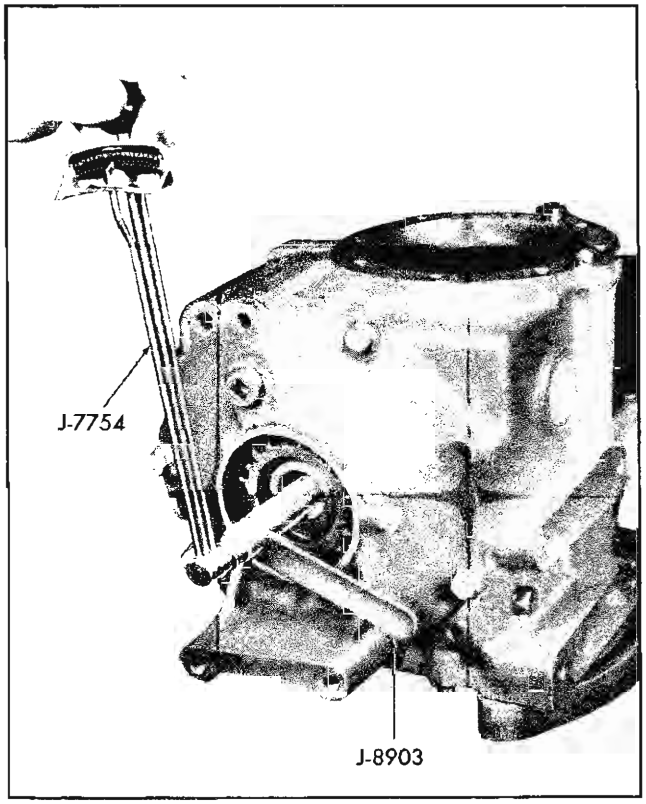



Fig. 4-59 Checking Side Bearing Preload

7. Install J-8903 in end of differential cross shaft through side cover.

8. Adjust side bearing preload to 10-20 lb. in. torque by turning side bearing adjusting nut in carrier using tool J-8902 (Fig. 4-58). Check side bearing preload using J-8903 in shaft and J-7754 torque wrench (Fig. 4-59).

9. Install adjusting nut lock screws and washers in carrier and cover.

10. Remove tool J-8903 from shaft.

11. Remove side cover from carrier.

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

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

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

14. Position pinion shaft assembly in carrier. Use seal protector J-21072 so as not to damage seal.

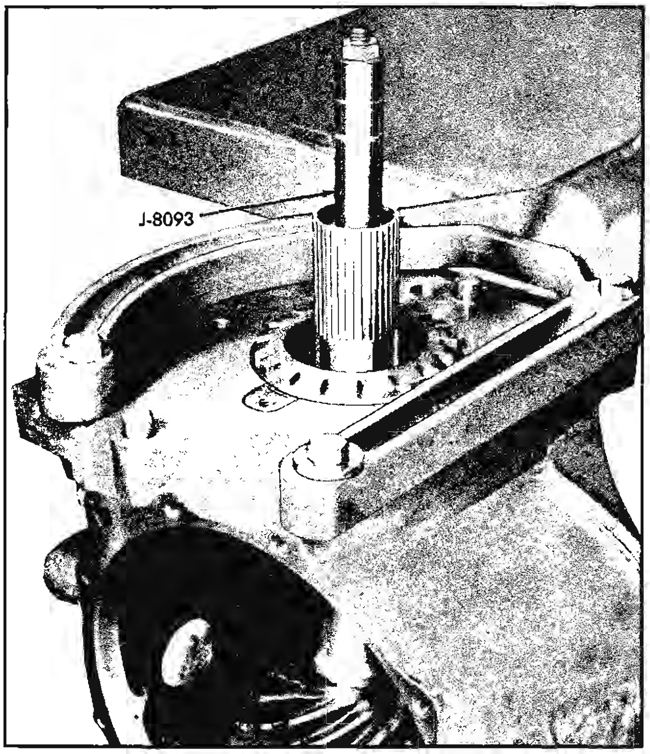



Fig. 4-60 J-8362 Installed in Pinion Shaft

15. Install shim pack thickness as determined. Install new rubber oil passage seal (automatic transmission only). Install new "O" ring on rear pinion bearing retainer. Install retainer on housing using 8 bolts. Tighten bolts to 25-40 lb. ft. torque.

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

17. Install J-8903 inside pinion shaft and tighten nut (Fig. 4-60). Adjust pinion bearing preload to

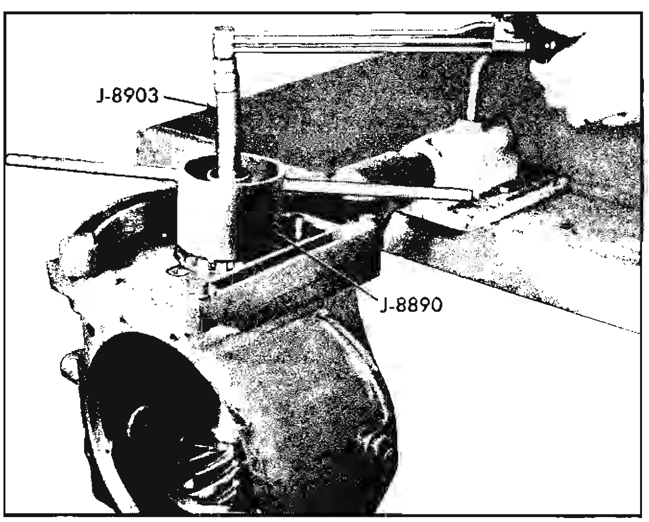



Fig. 4-61 Adjusting Pinion Bearing Preload

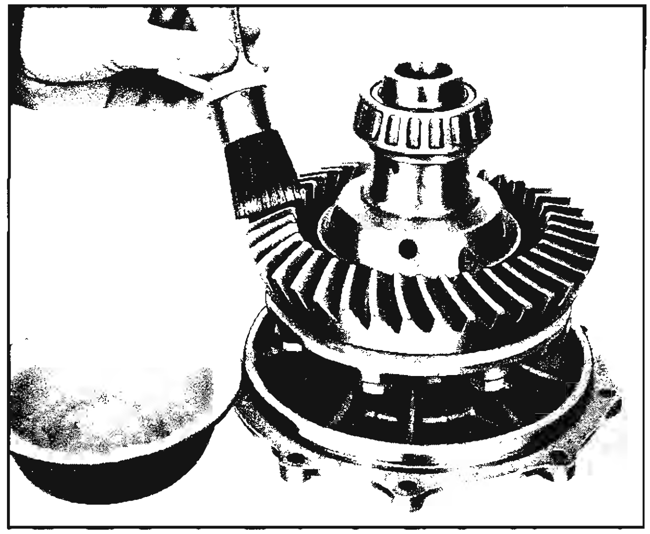


Fig. 4-62 Painting Ring Gear

10-16 lb. in. of torque (Fig. 4-61) and install adjusting nut lock.

18. Paint ring gear with red lead as described on page 4-28 (Fig. 4-62).

19. Position ring gear and differential assembly in carrier.

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

21. Remove side bearing adjusting nut lock screws.

22. Install tool J-8903 inside of differential case and set up dial indicator as illustrated (Fig. 4-63). Dial indicator should rest squarely on line scribed on handle of J-8903.

23. Insert large screwdriver in other end of differential case so that assembly can be rotated for backlash measurement.

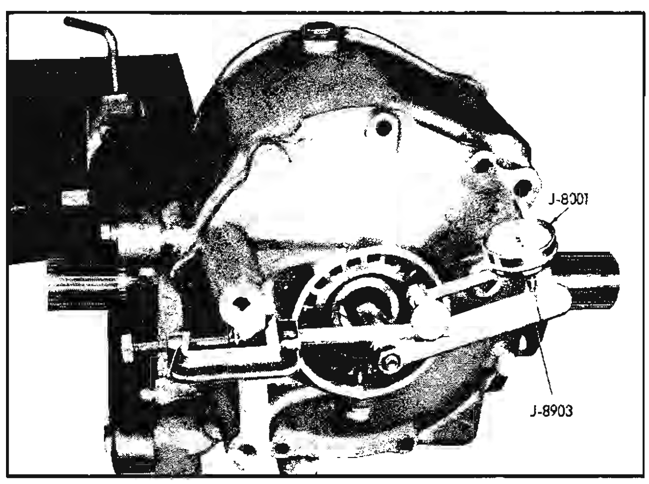



Fig. 4-63 Tools in Position for Adjusting Backlash

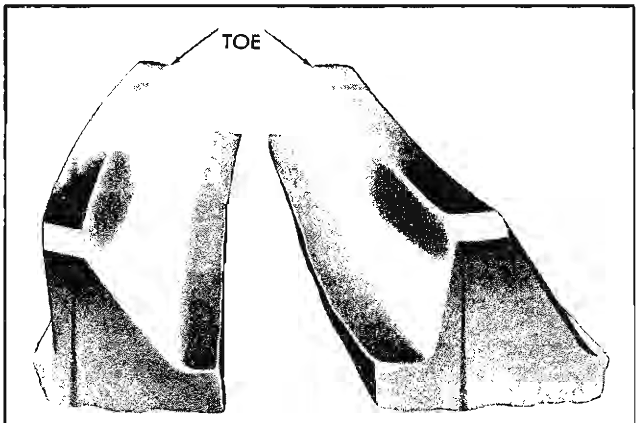



Fig. 4-64 Tooth Pattern—Excess Backlash

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

***CAUTION: Do not rotate pinion.***

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

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

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

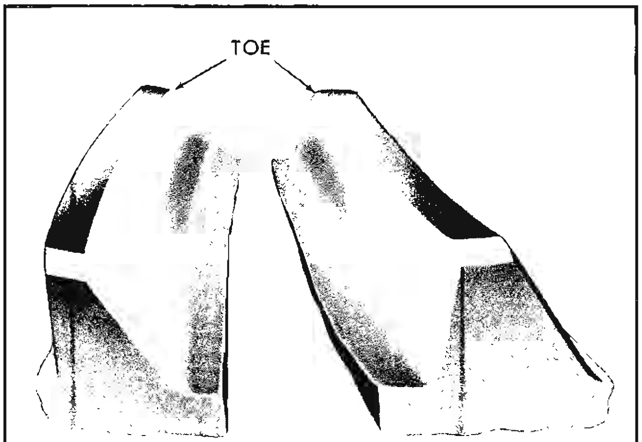



Fig. 4-65 Tooth Pattern—Insufficient Backlash

28. Remove side cover and ring gear assembly.

29. Analyze tooth patterns and make corrections as described in section on red lead test.

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

30. Reinstall ring gear and differential assembly.

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

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

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

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

### *ANALYSIS OF RED LEAD TEST*

NOTE: The red lead test should be performed as described in steps 18-29 above.

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

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

## ADJUSTMENTS AFFECTING TOOTH CONTACT

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

BACKLASH is adjusted by means of the side bearing adjusting nuts which move the ring gear assembly closer to or farther from the drive pinion (the adjust-

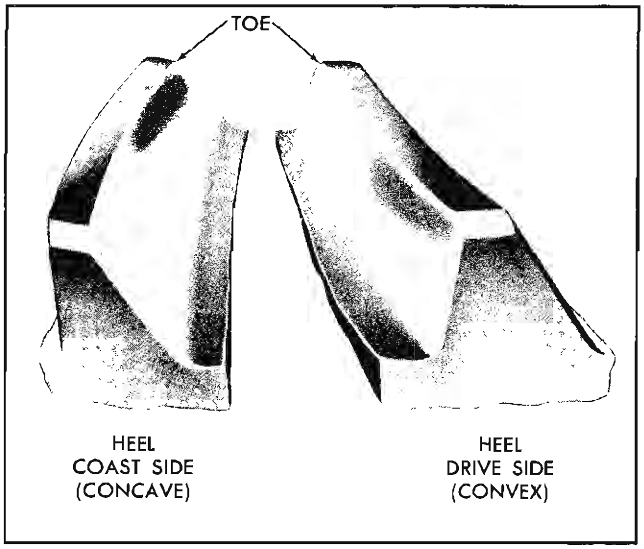



Fig. 4-66 Tooth Pattern—Pinion Too Far Away from Ring Gear

ing nuts are also used to set side bearing preload).

The POSITION OF THE DRIVE PINION is adjusted by increasing or decreasing the shim pack between the rear pinion bearing retainer and the carrier housing. Increasing shim pack thickness will move the pinion farther away from the center line of the ring gear, decreasing shim pack thickness will move pinion closer to the center line of ring gear.

## ANALYSIS OF TOOTH CONTACT PATTERNS

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

## EFFECTS OF BACKLASH ON TOOTH PATTERN

Excess backlash, provided pinion is properly positioned, will give a heel pattern on both drive and coast sides (Fig. 4-64). Decreasing backlash by moving ring gear assembly closer to pinion will cause pattern to move toward the toe and toward the top of teeth on both drive and coast sides.

Insufficient backlash, provided pinion is properly positioned, will give a low toe pattern on both drive and coast sides (Fig. 4-65). Increasing backlash will cause pattern to move toward heel end and up toward top of teeth on both drive and coast sides.

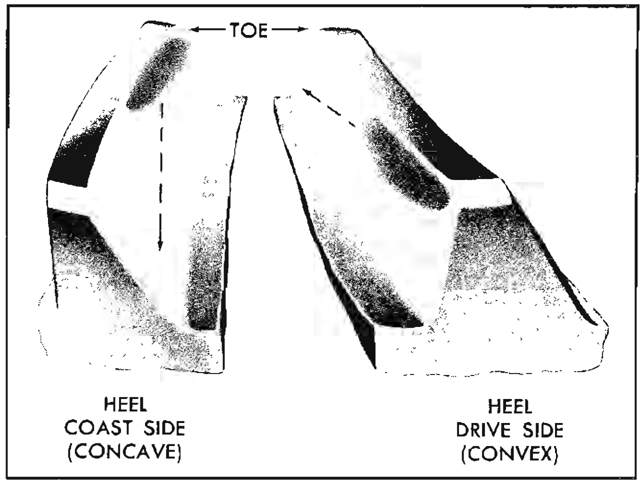



Fig. 4-67 Direction of Tooth Contact Movement—Increasing Shim Pack

## EFFECTS OF PINION POSITION ON TOOTH PATTERN

When drive pinion is too far away from center line of ring gear, the pattern will be a high heel contact on drive side and a high toe contact on coast side (Fig. 4-66) provided backlash is within specifications of .004"-.009". Moving pinion closer to center line of the ring gear by decreasing shim pack thickness will cause the high heel contact on drive side to lower and move toward toe; the high toe contact on coast side will lower and move toward the heel (Fig. 4-67).

When pinion is too close to ring gear the pattern will be a low toe contact on drive side, and a low heel contact on coast (Fig. 4-68), provided backlash is within specifications of .004"-.009". Moving pinion

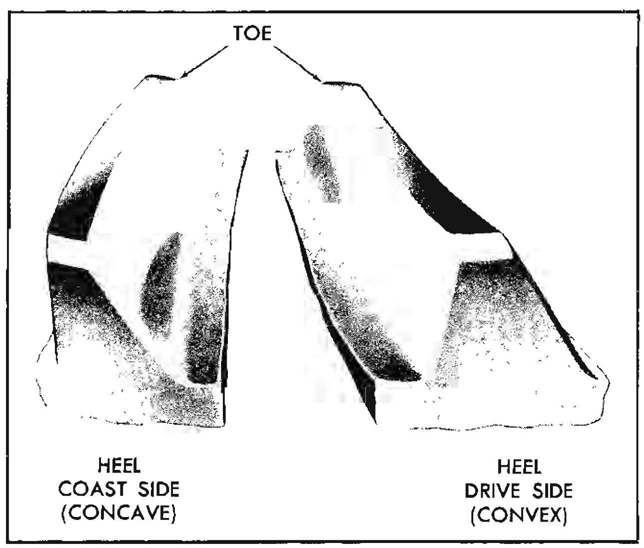



Fig. 4-68 Tooth Pattern—Pinion Too Close to Ring Gear

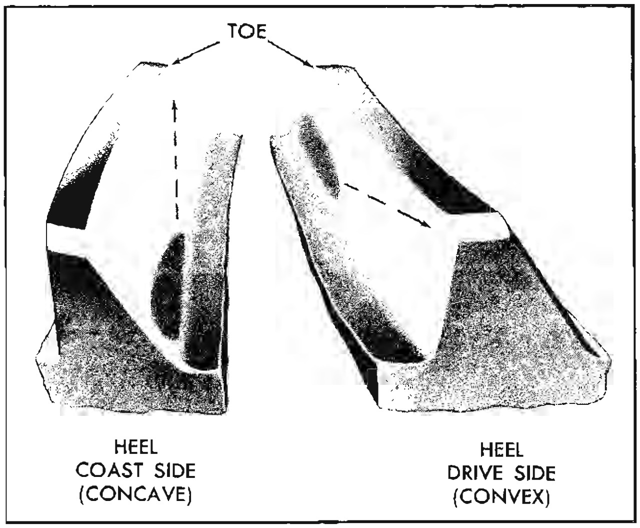



Fig. 4-69 Direction of Tooth Contact Movement—Decreasing Shim Pack

farther away from the ring gear by increasing shim pack thickness will cause the low toe contact on drive side to raise and move toward heel; the low heel contact on coast will raise and move toward toe (Fig. 4-69).

## TROUBLE DIAGNOSIS

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

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

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

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

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

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

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

### *AXLE NOISE*

### GEAR NOISE

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

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

1. Drive—acceleration or heavy pull.

2. Road load—car driving load or constant speed.

3. Float—using enough throttle to keep the car from driving the engine—car slows down gradually but engine still pulls slightly.

4. Coast—throttle closed and car in gear.

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

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

### BEARING NOISE

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

## SPECIFICATIONS

### REAR AXLE

| | |
|---|---|
| Type of Suspension | Swing Axle Independent Rear Suspension |
| Drive Final | Hypoid Gear |
| Lubricant Capacity | 3.3 Pints |
| Lubricant Level | Bottom of Filler Plug |
| Lubricant | SAE 90 Multi-Purpose Lubricant |

### RING AND PINION GEAR

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

### PROPELLER SHAFT AND TORQUE TUBE

| | |
|---|---|
| Type of Drive | Torsion Bar |
| Length of Propeller Shaft | |
| Automatic | 85.368" |
| 3 Speed S/M | 81.945" |
| 4 Speed S/M | 80.325" |
| Outside Diameter of Shaft | |
| Automatic 4 cyl. | .650" |
| 8 cyl. | .750" |
| Synchro-Mesh | .750" |
| Length of Torque Tube | |
| Automatic | 73.54" |
| 3 Speed S/M | 73.54" |
| 4 Speed S/M | 73.54" |
| Tube Wall Thickness 4 Cyl. | .054" |
| 8 Cyl. | .090" |

## TORQUE SPECIFICATIONS

| | Lb. Ft. |
|---|---|
| Differential carrier side cover to carrier bolt | 15-25 |
| Differential bearing adjusting nut lock screw | 10-20 |
| Differential rear pinion bearing retainer to differential bolt | 25-40 |
| Rear axle universal joint yoke clamp nut | 14-20 |
| Rear axle to universal joint yoke bolt | 20-35 |
| Rear brake assembly to lower control arm nut | 30-45 |
| Torque tube to transmission extension bolt | 30-45 |
| Torque tube to flywheel housing bolt | 30-45 |

| | Lb. Ft. |
|---|---|
| Ring gear retaining bolt | 60-70 |
| Propeller shaft and bearing assembly to drive shaft bolt | 20-35 |
| Differential assembly to bracket bolt | 65-85 |
| Differential support assembly to differential carrier bolt | 40-55 |
| Transmission control lever housing to torque tube bolt | 5-10 |
| Stabilizer bar to body side rail bolt | 20-35 |
| Stabilizer bar to strut rod bolt and nut | 20-30 |

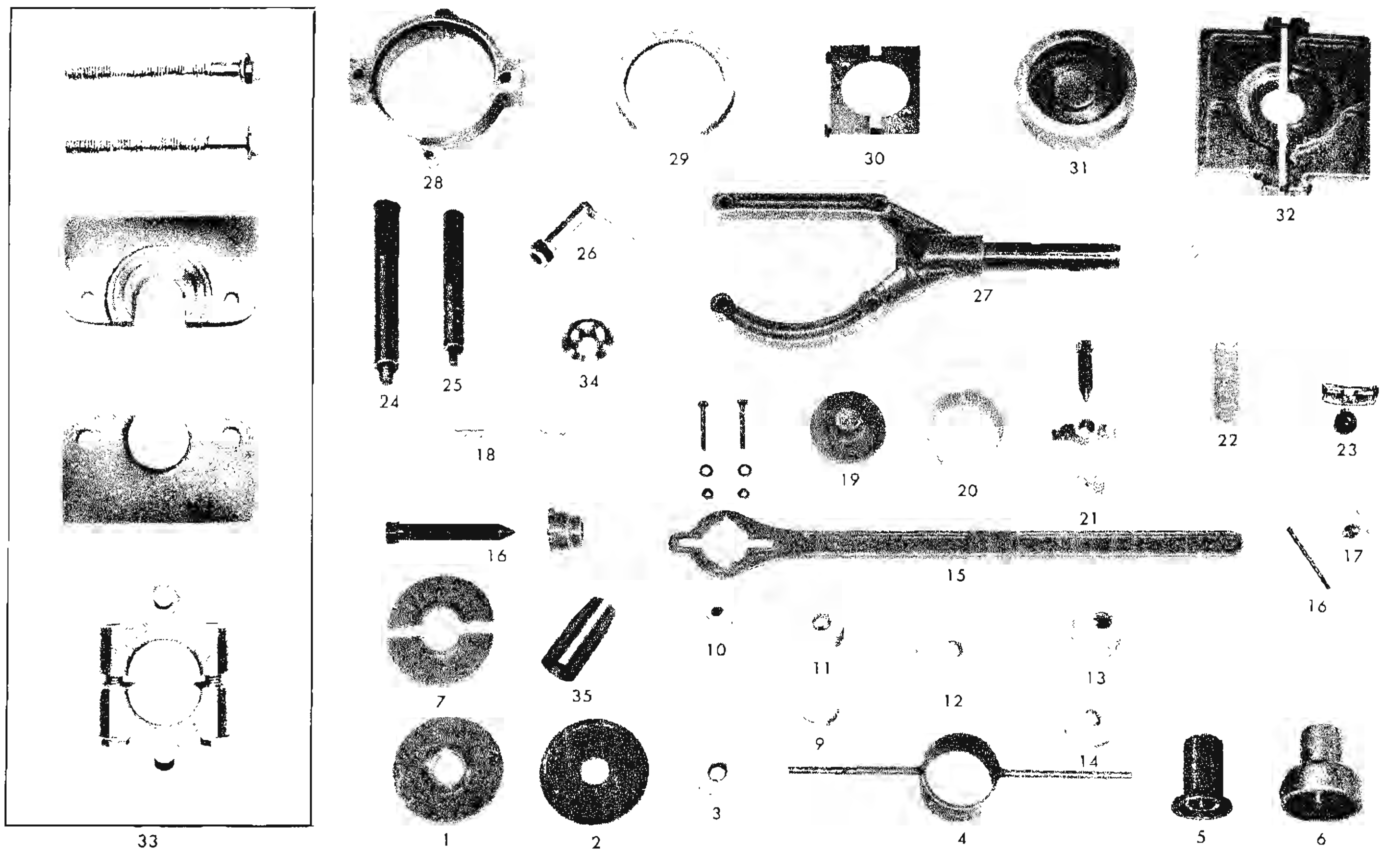



Fig. 4-70 Special Tools

## SPECIAL TOOLS

| | | |
|---|---|---|
| 1. | J-21022 | Front Pinion Bearing Installer |
| 2. | J-8916 | Rear Axle Shaft Bearing Installer |
| 3. | J-8897 | Pinion Bearing Adjusting Nut Outer Race Remover |
| 4. | J-8890 | Pinion Bearing Adjusting Nut Wrench |
| 5. | J-21197 | Pinion Bearing Adjusting Nut Wrench |
| 6. | J-21025 | Torus Hub Oil Seal Installer |
| 7. | J-8891 | Front Pinion Bearing and Speedo Gear Remover |
| 8. | J-9746 | Rear Pinion Bearing Remover |
| 9. | J-8980 | Speedometer Gear Installer |
| 10. | J-21026 | Rear Bearing Retainer Bushing Installer |
| 11. | J-8901 | Differential Side Bearing Installer |
| 12. | J-8898 | Rear Pinion Bearing Race Installer |
| 13. | J-21020 | Rear Pinion Bearing Installer |
| 14. | J-21037 | Front Pinion Bearing Race Installer |
| 15. | J-8614 | Companion Flange Holder and Puller |
| 16. | J-3387-3 | Stud |
| 17. | J-8801 | Dial Indicator |
| 18. | J-8400-1 | Bushing Chisel |
| 19. | J-8889 | Companion Flange Oil Seal Installer |
| 20. | J-7576 | Piston Installer |
| 21. | J-8855 | Pinion Bearing Race Remover |
| 22. | J-8902 | Side Bearing Adjusting Nut Wrench |
| 23. | J-7754 | Inch Pound Torque Wrench |
| 24. | J-8092 | Handle |
| 25. | J-7079-2 | Handle |
| 26. | J-8903 | Side Bearing Preload and Backlash Checking Fixture |
| 27. | J-7896-01 | Holding Fixture |
| 28. | J-6407 | Press Plate Holder |
| 29. | J-6407-2 | Press Plate Holder Adapter |
| 30. | J-8900 | Differential Side Bearing Remover |
| 31. | J-21164-2 | Pinion Shim Gauge |
| 32. | J-8916 | Rear Axle Bearing Remover |
| 33. | J-9528 | Propeller Shaft Bearing Remover and Installer |
| 34. | J-21024 | Rear Pinion Bearing Oil Seal Installer |
| 35. | J-21072 | Pinion Shaft Oil Seal Protector |

# BRAKES

## CONTENTS OF THIS SECTION



## GENERAL DESCRIPTION (Fig. 5-1)

All Tempest models are equipped with duo-servo self-adjusting hydraulic brakes. The brake mechanism consists of an adjuster lever, actuating link, actuating lever, actuating lever return spring, override spring and override pivot.

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

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

### *DRUM DESIGN*

Effective brake cooling and water sealing have been achieved with the backing plate. It combines one piece construction with the multi-seal design. Braking surface of the brake drums is cast iron in a steel shell.

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

### *SHOES—LINING*

Brake shoe web contour provides precise conformity of brake linings to drums for true contour effect. In cases of severe brake usage it is possible for shoes to take the shape of worn linings permanently and lining wear is more uniform.

### *PARKING BRAKE*

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

## OPERATION

### *BRAKE MECHANISM*

The self-adjusting brake mechanism operates only when brakes are applied while car is moving rearward. This action causes the secondary shoe to move a pre-determined distance toward the brake drum providing the brake linings are worn enough to allow this movement.

As a car moves in reverse and brakes are applied, friction develops between the primary shoe and the drum. This friction forces the primary shoe against the anchor pin. At the same time, induced hydraulic

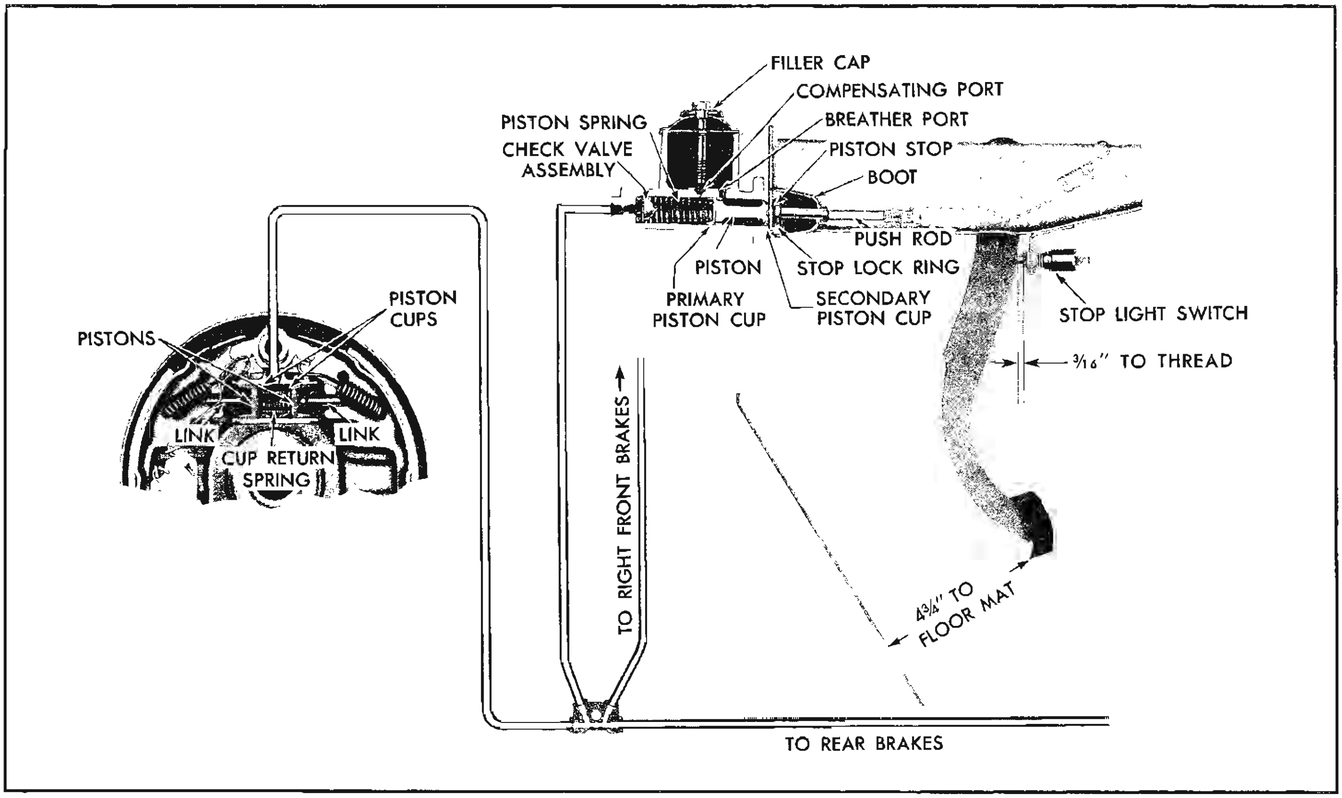



Fig. 5-1 Schematic Diagram of Hydraulic System

pressure in the wheel cylinder forces the upper end of the secondary shoe away from the anchor pin. As the secondary shoe moves away from the anchor pin, the upper end of the adjuster lever is prevented from moving by the actuating link which is attached to the anchor pin. This causes the adjuster lever to pivot on the secondary shoe forcing the lower end of the adjuster lever against the adjusting screw star wheel.

If the brake linings are worn enough to allow the secondary shoe to move the pre-determined distance, the adjuster lever will turn the adjusting screw star wheel one or two teeth, depending on amount of lining wear. If the secondary shoe does not move the pre-determined distance, adjuster lever movement will not be enough to rotate the adjusting screw star wheel.

When brakes are released, the actuating lever return spring will reposition the actuating lever into the adjusting position on the adjusing screw star wheel.

An override feature is incorporated into the self-adjusting brake which allows the secondary shoe to be applied in reverse in the event the adjusting screw is "frozen" preventing the self-adjuster from operating.

When car is moving forward and brakes are applied, the upper end of the secondary shoe is forced against the anchor pin because of the self-energizing action of the brakes, and the self-adjuster does not operate.

## HYDRAULIC SYSTEM

Depressing the brake pedal moves the master cylinder push rod and piston, forcing hydraulic fluid out through a check valve (Fig. 5-1). This fluid flows through the hydraulic lines into the wheel cylinders, forcing the wheel cylinder pistons outward from the center of the cylinder and expanding the brake shoes and linings against the brake drums.

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

At the same time (when the pedal is released) the brake shoe return springs force the wheel cylinder pistons to return toward the center of the wheel cylinder (released position). Fluid forced out of the wheel cylinders by this action returns to the master cylinder by overcoming the pressure of the master cylinder piston spring which holds the check valve closed. As this fluid returns, the execss portion will return to the reservoir through the compensating port which

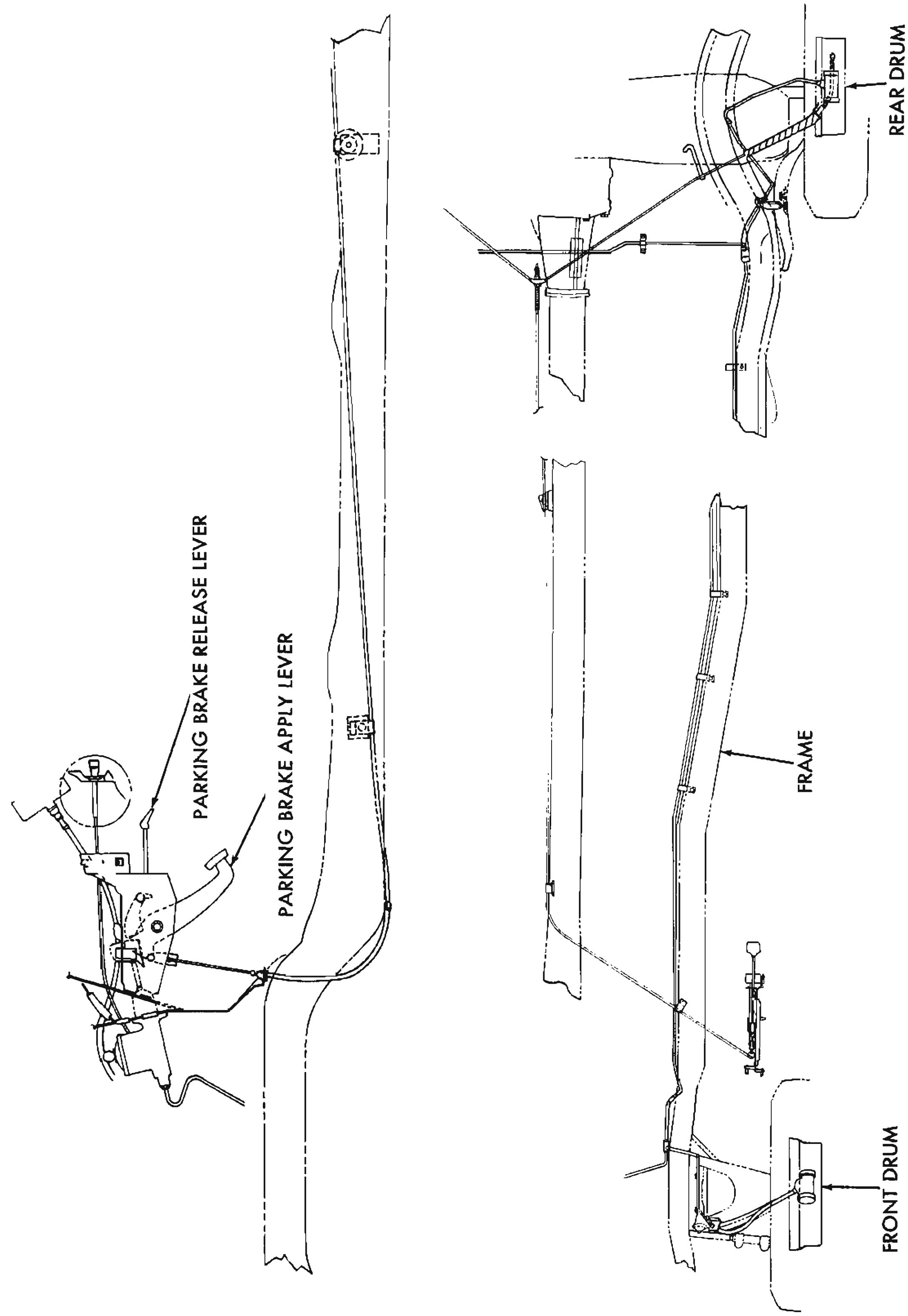



Fig. 5-2 Schematic Diagram of Parking Brake System

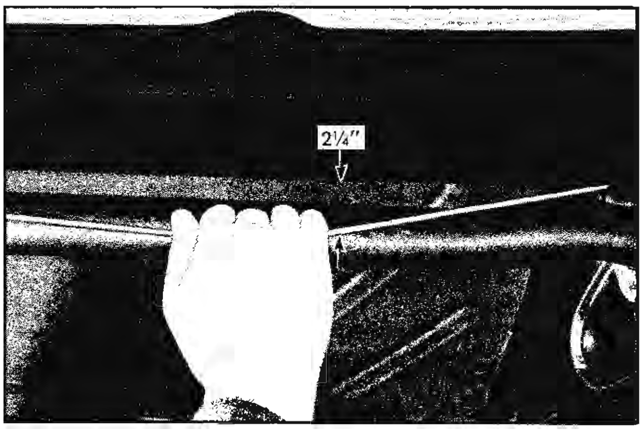



Fig. 5-3 Correct Cable Tension

must be uncovered when the master cylinder piston is in the released position. The piston spring will close the check valve when the pressure in the lines is reduced to 8-12 pounds per square inch, maintaining a slight pressure in the lines at all times. The purpose of this pressure is to keep wheel cylinder cups from leaking fluid and to reduce the possibility of air entering the system.

### *PARKING BRAKES*

When the parking brake lever is depressed with foot pressure, the action of the parking brake lever pulls cables to the rear brakes tight to actuate the rear brakes.

Each cable attaches to a rear brake actuating lever which pivots about a lever pin. When the bottom of the lever is moved forward (when pulled by the brake cable) the top of the lever engages the secondary shoe (rear) and forces the secondary shoe against the brake drum. At the same time the actuating lever forces the primary (front) to contact the brake drum by means of a strut between the actuating lever and the primary shoe.

To release the parking brake, apply a slight downward pressure to the release lever handle (just below the lower left side of the instrument panel).

## PERIODIC SERVICE

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

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

The parking brake cables must be lubricated yearly or when brakes are relined. The procedure for lubricating cables is outlined on page 5-7.

## MINOR BRAKE ADJUSTMENT

### *PEDAL AND STOP LIGHT SWITCH—ADJUST*

Specified pedal height for normal usage may be changed to accommodate special owner requirements. The pedal may be raised or lowered by moving clevis toward or away from the master cylinder. If pedal is moved it is essential to reset stop light switch. Do not lower pedal to less than 3½" as insufficient brake pedal travel may result when used at high speed with worn linings.

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

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

### *PARKING BRAKE—ADJUST*

Parking brake cable is properly adjusted when a 30 lb. pull downward (Fig. 5-3) on the cable 49" from front of torque tube places cable 2¼" below bottom of torque tube (parking brake lever should be fully released).

1. Adjust parking brake cable at equalizer as required to obtain proper tension.

2. Tighten lock nut to 5-10 lb. ft. torque.

3. Be sure cable slides freely in equalizer.

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

***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.***

### *BLEEDING BRAKES*

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

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

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

When bleeding by operating pedal proceed as outlined below:

1. Fill master cylinder reservoir with recommended brake fluid.

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

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

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

3. Close bleeder valve securely and remove bleeder tube; proceed bleeding one brake at a time as described above, right front, left rear and right rear.

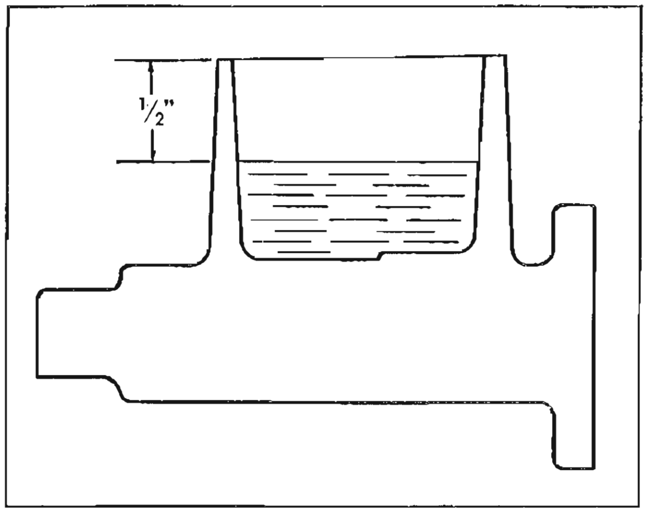



Fig. 5-4 Correct Fluid Level in Master Cylinder

4. When bleeding operation is completed, refill reservoir to within ½" of top of master cylinder filler neck gasket surface and then replace filler cap (Fig. 5-4).

## MAJOR BRAKE ADJUSTMENT

A manual brake shoe adjustment is required only when new linings are installed or whenever the length of the brake shoe adjusting screw has been changed.

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

### *INSPECTION*

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

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

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

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

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

4. If an excessive amount of fluid is present, overhaul wheel cylinder as outlined on page 5-10.

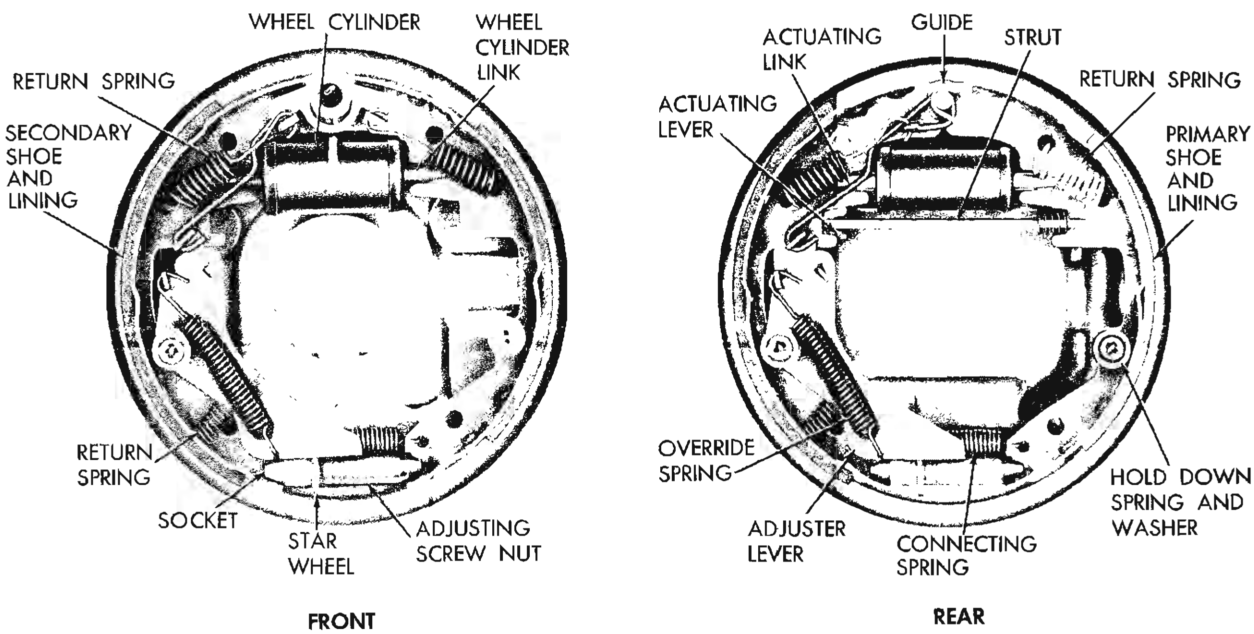



Fig. 5-5 Front and Rear Self-Adjusting Brake Assemblies

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

Pull all shoe assemblies away from backing plate and apply a small amount of petroleum base lubricant to pads where brake shoes contact backing plates. Remove adjusting hole covers from backing plates.

6. Reinstall brake drums and wheels (see page 3-3 of this manual for front wheel bearing adjustment).

### FRONT BRAKES—ADJUST

1. Using tool J-8915, expand adjusting screw to produce 5-8 lb. drag on outside of tire.

2. Insert a small rod or screwdriver through the adjusting screw slot in the backing plate and hold automatic adjuster lever away from the adjusting screw star wheel (Figs. 5-6 and 5-7).

3. Back off 22 notches.

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

5. Install adjusting hole covers.

### REAR BRAKES—ADJUST

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

1. Raise car so rear wheels hang down.

2. Loosen parking brake cable or disconnect anchor from side of torque tube.

3. Expand adjusting screw to produce 5-8 lb. drag on outside of tire.

4. Insert a small rod or screwdriver through the adjusting screw slot in the backing plate and hold automatic adjusting lever away from the adjusting screw star wheel (Figs. 5-6 and 5-7).

5. Back off 26 notches with shock absorbers fully extended. (Back off 30 notches if hoist supports rear suspension near ends of control arms and prevents rear wheels from hanging down.)

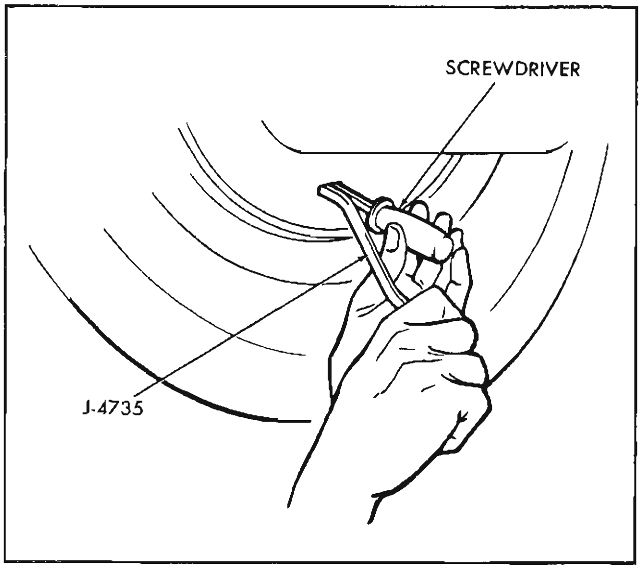



Fig. 5-6 Preparing to Back Off Adjusting Screw

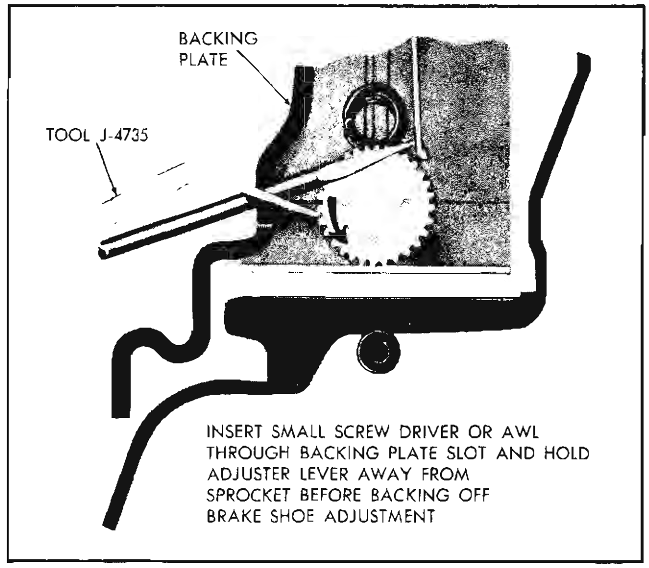



Fig. 5-7 Backing Off Adjusting Screw

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

7. Install adjusting hole covers.

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

8. Reconnect and adjust parking brake cable.

Parking brake cable is properly adjusted when a 30 lb. pull downward on the cable 49" from front of torque tube places cable 2¼" below bottom of torque tube (Fig. 5-3). Parking brake lever should be fully released.

9. Adjust parking brake cable at equalizer as required to obtain proper tension.

10. Tighten lock nut 5-10 lb. ft. torque.

11. Be sure cable slides freely in equalizer.

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

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

Fluid level in master cylinder should be ½" below cap sealing surface (Fig. 5-4).

Road test car to check brake operation.

### FLUSHING HYDRAULIC SYSTEM

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

To flush the hydraulic system, proceed as follows:

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

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

3. Repeat steps 1 and 2 at remaining wheel cylinders. To ensure thorough flushing approximately ½ pint of alcohol should be bled through each wheel cylinder.

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

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

### PARKING BRAKE—LUBRICATE

1. Thoroughly clean cable, from conduit to cable equalizer.

2. Remove retainer at forward end of conduits.

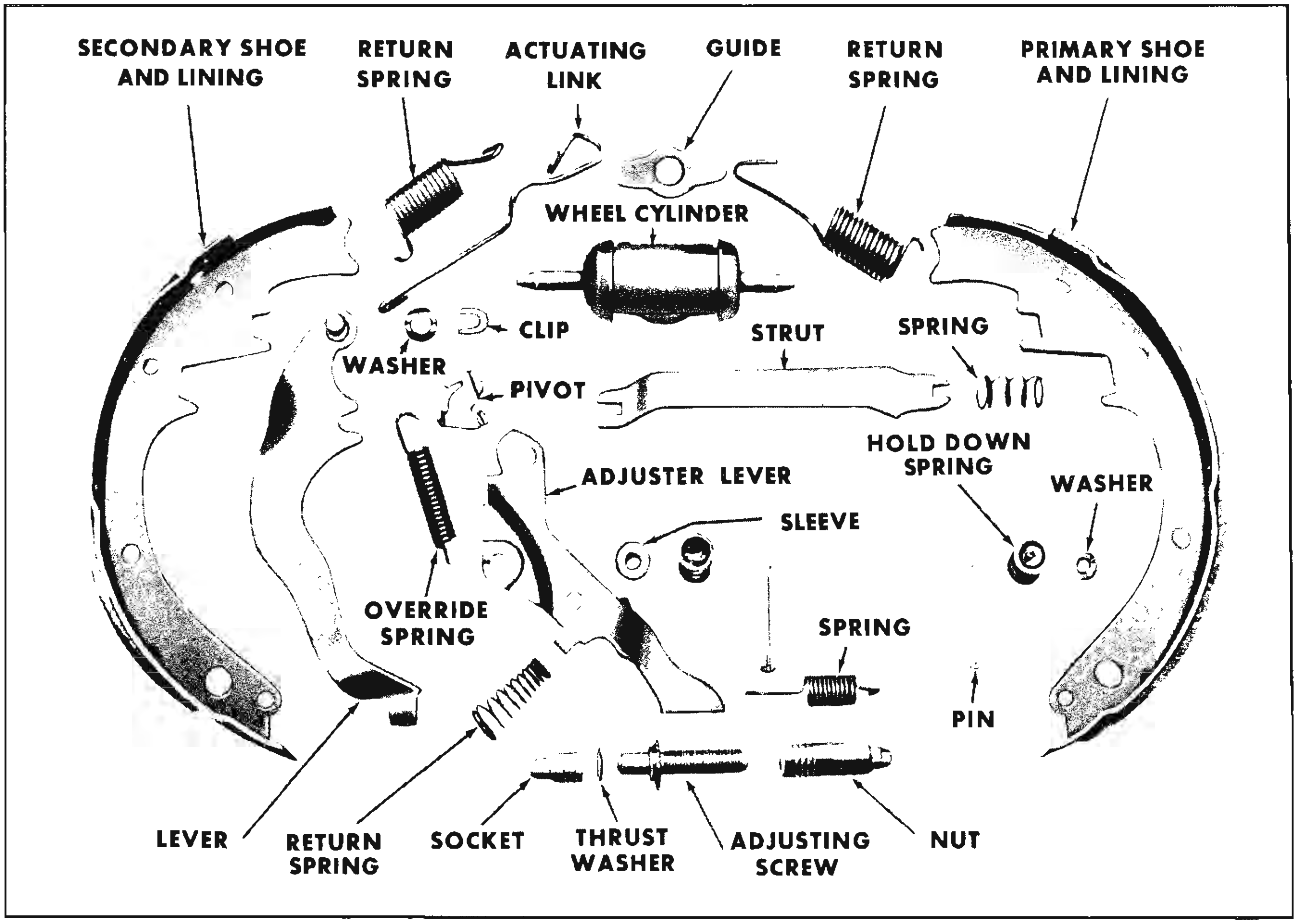



Fig. 5-8 Self-Adjusting Brake Assembly—Exploded View

3. Unhook parking brake cable at equalizer.

4. Unhook cable from parking brake lever assembly in drum and remove cable from backing plate.

5. Slide the conduit forward on the brake cable.

6. Clean the cable, examine for broken strands, especially where cable passes over transmission extension, and apply light grease, chassis lubricant, or equivalent.

7. Inspect cable connections to hand brake actuating lever to be certain cable is seated in lever hook.

8. Slide brake cable conduit back in position and secure at forward end with retainer.

9. Install brake cable in backing plate and secure to lever assembly.

10. Connect parking brake at equalizer and adjust as described under PARKING BRAKE—ADJUST.

## BRAKES—OVERHAUL (Fig. 5-8)

### *BRAKE SHOES—REMOVE*

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

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 adjusting screw upward (Fig. 5-7).

2. Remove the primary and secondary shoe return springs.

3. Remove the actuating lever.

4. On rear brakes, spread shoes slightly and remove the parking brake lever strut and spring, then disconnect the parking brake cable from the operating lever.

5. Remove the brake shoe hold down springs, pins and washers, and the adjuster lever and return spring.

6. Spread shoes to clear wheel cylinder links, then remove the primary and secondary shoes as an assembly.

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

7. Remove the primary to secondary shoe spring and the adjusting screw.

8. On rear brakes, remove the parking brake lever from the secondary shoe.

### BRAKE SHOES—INSPECT

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

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

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

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

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

4. If an excessive amount of fluid is present, overhaul wheel cylinder as outlined on page 5-10.

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

6. Clean inner surfaces of brake backing plates and all shoe contacting points.

7. Clean exposed portions of parking brake cables.

8. Disassemble the adjusting screw assembly and inspect as follows:

a. Check thrust washer and mating surfaces for burrs or excessive wear.

b. Inspect teeth on star wheel for wear.

c. Remove all foreign material from adjusting screw and nut. Nut must rotate freely on threads.

9. Check adjuster lever to be certain it is not bent or distorted and that lock is not worn excessively.

10. Check the override pivot for wear or deformed parts.

11. Check brake drum for build-up of rust and dirt at outer circumference. Remove build-up so that drums can be installed over pre-adjusted linings.

12. Check and make sure all bolts and nuts securing backing plate to suspension are tightened to 80-110 lb. ft. torque at upper plate to knuckle bolt, 45-65 lb. ft. torque at lower bolt and 30-45 lb. ft. torque on all plate to control arm bolts.

### BRAKE SHOES—INSTALL

1. Lubricate the adjusting screw threads, thrust washer mating surfaces, backing plate ledges and all other contacting surfaces with a small amount of brake lubricant or wheel bearing lubricant. Do not lubricate teeth of star wheel of adjusting screw.

2. Pull parking brake cable forward and rearward through conduit and examine for broken strands. Lubricate freely with light grease or chassis lubricant and return cable to normal position. Remove any excess lubricant.

3. On rear brake assemblies, install the parking brake lever to the secondary shoe.

4. Assemble the adjusting screw.

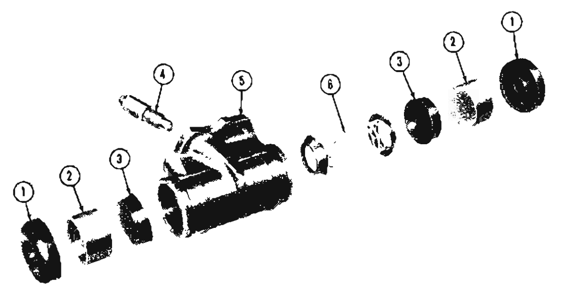
5. Attach the primary to secondary shoe spring to the shoes, and install the adjusting screw. The primary to secondary shoe spring must not contact the adjusting screw star wheel.

NOTE: The right front and right rear adjusting screws have left hand threads and can be identified by 4 grooves. All adjusting screws must be installed with the starwheel end of the screw toward the rear of the car.

6. Position shoe assembly on the backing plate. Be sure wheel cylinder links are properly positioned in the shoe notches.

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

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




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

Fig.5-9 Wheel Cylinder—Exploded View

8. Position the upper end of actuating link over the anchor pin on rear brakes or onto the brake shoe guide on front brakes.

9. Engage the actuating lever with the override pivot then position the adjuster lever and return spring on the secondary shoe. Fasten with the red hold down spring assembly.

NOTE: The front brake uses 4 hold down springs. The spring retaining pins are identified with the numeral 1 stamped on the outer face. The rear brake uses 2 hold down springs, with the retaining pins being identified with the numeral 8 stamped on the outer face.

10. Install the remaining hold down springs.

11. On rear brakes, install the parking brake cable on the parking brake lever.

12. Install the primary and secondary brake shoe return springs.

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

13. Sand linings lightly to remove any trace of dirt.

14. When new shoes or linings have been installed, shorten adjusting screw until drum will slide freely over shoes and check to see that adjusting actuator lever can turn adjusting screw star wheel with minimum effort.

15. Install drums, observing instructions for front wheel bearing adjustment as outlined on page 3-3 of this manual.

16. Adjust brake shoes as described in this section under MAJOR BRAKE ADJUSTMENT.

17. If wheel cylinder has been replaced or repaired or hydraulic line has been replaced, bleed brakes as described in this section on BLEEDING BRAKES.

18. Install wheels.

19. Adjust parking brake as outlined under PARKING BRAKE–ADJUST.

20. Check fluid level in master cylinder. Fluid level should be ½" below the reservoir opening.

21. Check brake pedal travel to be sure it is within specifications, then road test car for proper operation of the brake system.

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

### *WHEEL CYLINDER—REMOVE AND REPLACE*

#### REMOVE

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

#### DISASSEMBLE (Fig. 5-9)

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

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

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

#### INSPECT

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

rubber parts in wheel cylinders as well as in master cylinder.

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

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

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

## ASSEMBLE

1. Apply clean brake fluid to cylinder bore, pistons, and rubber cups before assembly.

2. Place a boot over one end of cylinder.

3. Place a piston in cylinder so that flat side will be toward center of completed assembly.

4. Insert a rubber cup with flat side against piston.

5. Insert spring and expander assembly.

6. Insert a rubber cup with flat side toward opening.

7. Install piston with flat side against cup.

8. Place rubber boot over end of cylinder.

## REPLACE

1. Install wheel cylinder on backing plate with screws and lock washers. Tighten to 60-90 pound inches of torque.

2. Replace wheel cylinder connecting links.

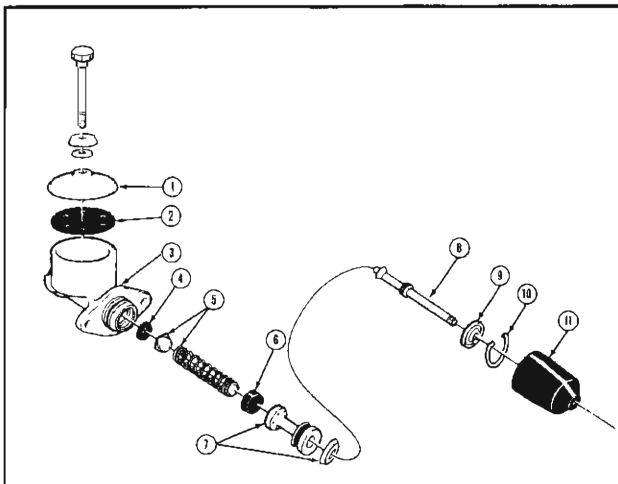
3. Install brake shoe return springs.

4. Connect hose to wheel cylinder using new gasket.

5. Install brake drums and adjust wheel bearings, if front drum was removed, as described on page 3-3 of this manual.

6. Bleed all brake lines as described under BLEEDING BRAKES in this section.

7. Adjust and test brakes as previously described on page 5-6 of this section.



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

Fig. 5-10 Master Cylinder—Exploded View

### *MASTER CYLINDER—REMOVE AND REPLACE*

## REMOVE

1. Disconnect brake pedal return spring.

2. Disconnect stop light switch.

3. Remove cotter pin and clevis pin from clevis.

4. Remove hydraulic brake line from end of master cylinder.

5. Remove four nuts, holding master cylinder to cowl.

6. Remove master cylinder from automobile.

## DISASSEMBLE (Fig. 5-10)

1. Remove reservoir cover from top of master cylinder and dump fluid.

2. Remove boot from master cylinder.

3. Carefully remove push rod stop plate lock ring from end of cylinder.

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

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

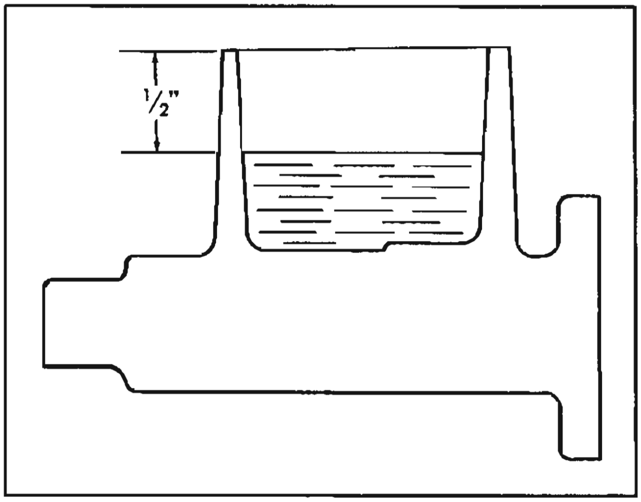



Fig. 5-11 Correct Fluid Level in Master Cylinder

4. Remove piston, piston cups, piston spring, and check valve assembly from cylinder.

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

5. Wash all parts in clean alcohol.

6. Place clean parts on clean paper.

7. Prevent parts from becoming dirty.

INSPECT

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

2. Inspect master cylinder bore for signs of scoring, rust, pitting, or etching. Any of these will require replacement of master cylinder. Presence of pitting, rust, or deep etching in master cylinder calls for replacement and careful inspection for similar condition in all wheel cylinders. Stains may be removed with crocus cloth.

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

ASSEMBLE

1. Install check valve and spring in cylinder.

2. Coat primary cup with clean brake fluid and install in cylinder with flat side toward opening, make certain cup seats over end of spring.

3. Coat secondary cup with clean brake fluid and install on piston.

4. Install secondary cup and piston in cylinder so that flat end of piston is toward front of cylinder.

5. Install push rod and stop plate in cylinder.

6. Install push rod stop plate lock ring in cylinder.

***CAUTION: Use eye protection.***

NOTE: Inspect piston stop washer in end of master cylinder to see that it is held firmly in place by lock ring bottoming fully in groove seat in master cylinder.

7. Place rubber boot on end of cylinder.

8. Fill and bleed reservoir.

9. Install reservoir cover.

REPLACE

1. Install master cylinder on dash and secure with two nuts. Tighten to 15-25 lb. ft. torque.

2. Connect master cylinder push rod and clevis to brake pedal with clevis pin and secure with cotter pin.

3. Connect brake pedal return spring.

4. Connect stop light switch wires.

5. Check stop light switch adjustment.

6. Connect hydraulic line to master cylinder.

7. Check level after working pedal several times. Fill master cylinder with recommended fluid to within ½" of top of cylinder and replace filler cap.

8. Brake system may be bled as described in this section on BLEEDING BRAKES if necessary.

9. Test operation of stop light switch.

10. Adjust and test brakes as outlined previously in this section.

## TROUBLE DIAGNOSIS AND TESTING

### *TESTING FOR LEAK IN HYDRAULIC SYSTEM*

NOTE: If there is any evidence of air in system, brakes must be bled before making this test.

1. Apply brakes manually, holding as steady a force as possible.

2. If pedal sinks slowly toward floor, a leak is indicated. Check for location of the leak by examining all lines, connections, wheel cylinders and inside of master cylinder boot. If external leak is not found, remove master cylinder, disassemble and inspect parts. Leak will usually be past primary piston cup due to defective cup or cylinder bore.

NOTE: If leak at wheel cylinder has allowed fluid to reach linings, they must be replaced.

The following is a list of common troubles occurring in the brake system with possible causes and remedies:

### *PEDAL GOES TO TOE BOARD*

| CAUSE | REMEDY |
|---|---|
| Automatic adjusters not working. | Inspect for inoperative condition and correct as necessary. |
| Normal wear of lining. | Readjust or replace lining. |
| Low fluid level in master cylinder reservoir. | Low fluid level in reservoir will permit air to be pumped into hydraulic lines. This necessitates refilling reservoir and bleeding lines. Find cause of low fluid and correct. |
| External leak in hydraulic system, or leak past master cylinder primary piston cup. | Check for leak in system as outlined above. |
| Air trapped in hydraulic system. | Air trapped in hydraulic system gives pedal a spongy feeling when depressed. Bleed lines. |

### *ALL BRAKES DRAG AFTER BRAKE ADJUSTMENT IS CHECKED AND FOUND TO BE CORRECT OR PEDAL BUILDS UP WITH USE*

| CAUSE | REMEDY |
|---|---|
| Mineral oil, etc., in system. | The presence in the hydraulic system of any mineral oil, kerosene, gasoline, shock absorber or transmission fluid or carbon tetrachloride will cause swelling of rubber piston cups and valves, so they become inoperative. This is first noticed in the master cylinder. Brakes will not release freely if master cylinder primary piston cup has swollen sufficiently to obstruct the compensating port. Flush system thoroughly with a good grade of clean denatured alcohol and replace all internal rubber parts in brake system. |
| Master cylinder piston does not return to stop or push rod is adjusted too long. | See that pedal return spring has not lost its tension and promptly returns pedal. |

***ALL BRAKES DRAG AFTER BRAKE ADJUSTMENT IS CHECKED AND FOUND TO BE CORRECT OR PEDAL BUILDS UP WITH USE (Continued)***

| CAUSE | REMEDY |
|---|---|
| Compensating port of master cylinder closed. | The compensating port in master cylinder must be completely clear when pedal is in released position.<br>1. See that pedal returns freely.<br>2. See that push rod is not adjusted too long.<br>3. See that compensating port is not plugged by dirt. To check compensator port, remove master cylinder reservoir cover and watch the fluid in the cylinder as the brake pedal is moved. A "geyser" should be seen as the pedal is first depressed. If no geyser is seen, the compensating port is blocked.<br>4. Inspect master cylinder piston cup and if found to be swollen or elongated, flush system and replace damaged parts. |

***ONE WHEEL DRAGS***

| CAUSE | REMEDY |
|---|---|
| Improperly adjusted parking brake cables (rear wheels only) or stuck cable. | Adjust parking brake cables and lubricate. |
| Weak or broken brake shoe return springs. | Replace defective brake shoe springs and lubricate brake shoe ledges and shoe contact at anchor pin with grease. |
| Brake shoe or drum clearance too small. | Readjust brakes to secure complete freedom from drag. |
| Loose or incorrect front wheel bearings. | Adjust front wheel bearings or replace as described in section 3. |
| Wheel cylinder piston cups swollen or distorted or piston stuck. | Replace defective or damaged parts. Look for evidence of dirt in hydraulic system which could cause damage to the cylinders or cups. See first item under ALL BRAKES DRAG . . . |
| Obstruction in line. | Obstruction in line may be caused by foreign material in line or flattened or kinked tube. If dirt is found in line, remove obstruction and flush hydraulic system with fresh brake fluid. If tube is flattened or kinked, replace damaged parts. |
| Support assembly shoe ledges grooved. | Grind or file ledges on backing plate smooth and lubricate. |
| Incorrect brake shoe radius. | Replace defective brake shoe. |

### BRAKES DO NOT AUTOMATICALLY ADJUST

| CAUSE | REMEDY |
|---|---|
| Worn, bent or distorted adjuster lever. | Replace adjuster lever. |
| Improper secondary lining to drum clearance. | Adjust clearance. |
| Brake linings excessively worn. | Install new linings. |

### CAR PULLS TO ONE SIDE

| CAUSE | REMEDY |
|---|---|
| Grease or fluid on lining. | Replace with new linings. See BRAKE CAUTIONS on page 5-18. Linings with even a slight trace of grease or fluid will cause trouble, and can seldom be salvaged by cleaning. Correct cause of grease or fluid reaching linings. |
| Loose wheel bearings. | Adjust wheel bearings. |
| Loose backing plate at rear axle or front axle. | Tighten backing plate on rear or front axle. |
| Linings not to specifications, or primary and secondary shoes reversed. New and used linings mixed on one end of car. | Various kinds of linings have different friction effect on the drums. Each wheel must have similar linings. The primary and secondary linings must not be interchanged. Use only factory specified linings. |
| Tires not properly inflated or unequal wear of tread. Different tread non-skid design. | Inflate tires to specified pressures. Rearrange tires so that a pair with non-skid tread surfaces of similar design and equal wear will be installed on front wheels and another pair with like tread will be installed on rear wheels. |
| Linings charred or drums scored. | Sand surfaces of linings and drums. Remove particles of metal that have become embedded in surfaces of linings. See COMPLETE BRAKE RECONDITIONING, regarding road dirt grooving brake drums. Seriously charred linings should be replaced. |
| Wheel cylinder link off shoe. | Check boot for holes. Check for burrs on wheel cylinder piston. |
| Water, mud, etc., in brakes. | Remove any foreign material from all brake parts and the inside of drums. Lubricate shoe ledges and rear brake cable ramps with grease. Examine support assembly for damage. |
| Weak chassis springs, loose steering gear, etc. | Replace springs, adjust steering gear, etc. |
| Incorrect geometry setting of suspension. | Adjust geometry so that car does not have a tendency to "lead" when driven on a level road. |
| Rigid and flexible shoes intermixed. | Use only approved type parts. |

### SPONGY PEDAL

| CAUSE | REMEDY |
|---|---|
| Air trapped in hydraulic system. | Remove air by bleeding (if bleeding is not effective check for closed compensating port). |

### SPONGY PEDAL (Continued)

| CAUSE | REMEDY |
|---|---|
| Brake adjustment not correct. | Adjust brakes. |
| Bent shoes. | Replace. |
| Compensating port closed. | See ALL BRAKES DRAG. |

### EXCESSIVE PEDAL PRESSURE REQUIRED TO STOP CAR

| CAUSE | REMEDY |
|---|---|
| Brake adjustment not correct. | Adjust brakes. |
| Improper lining. | Install factory specified lining. |
| Improper shoes. | Install factory specified shoes. |
| Grease or fluid soaked linings. | Correct cause and replace linings. See BRAKE CAUTIONS page 5-18. |
| Rusted wheel cylinder. | Replace necessary parts. |
| Wheel cylinder link incorrectly aligned. | Check wheel cylinder piston and boot for damage. Install link. |
| Brake pedal set too high. | Set to specified height. |
| Compensating port not cleared. | Check pedal linkage, stop lite switch adjustment, etc. See also "Compensating Port" under "All Brakes Drag . . .". |

### LIGHT PEDAL PRESSURE—BRAKES TOO SEVERE

| CAUSE | REMEDY |
|---|---|
| Brake adjustment not correct. | Adjust brakes. |
| Loose support assembly on rear axle or front spindle. | Adjust front wheel bearings and tighten front backing plates. Tighten rear backing plates. Adjust brakes. |
| Small amount of grease or fluid on linings. | Correct cause and replace linings. |
| Charred linings or scored drums. | Sand surfaces of linings and drums. Clean loose dust from brakes and drums. In severe cases replace shoes. Warn owner regarding abuse of brakes. |
| | Remove all particles of metal that have become embedded in surfaces of linings. Slightly scored drums do not require replacing. |
| Improper linings. | Install factory specified linings. |

### BRAKE NOISES

| NOISE | CAUSE | REMEDY |
|---|---|---|
| 1. *Squeak in brake with car stationary (sometimes mistaken for pedal squeak). | Shoe pads on backing plates dry and rusty. | Pry shoes out with screwdriver—apply grease sparingly to shoe pads with feeler stock. |
| 2. *Snaps in brakes as pedal is applied, car stationary. | Hold down nail heads dry. | Lubricate. |

***BRAKE NOISES (Continued)***

| NOISE | CAUSE | REMEDY |
|---|---|---|
| 3. Pedal squeak. | Return spring or stoplight switch rubbing pedal nylon bushing. | Lubricate. |
| 4. Crunch or groan, holding car on hill. | Brake dust and possibly linings which have been overheated. | Sand and de-dust linings. |
| 5. High pitch squeak while brakes operate. | A. New linings not yet fully burnished. | Let run or sand off high spots of linings. |
| | B. Persistent squeak—no apparent cause. | Sand linings for temporary cure of mild cases. Install drum springs for stubborn cases of high pitch squeak. |
| | C. Rigid brake shoes. | Install factory specified shoes. |
| 6. Low pitch squeal at end of high rate stop. | A. New linings not fully burnished. | Check adjustment. Sand lining high spots. |
| | B. Incorrect adjustment. | Adjust. |
| | C. Bent backing plate (top of shoe webs should be in line with each other looking down on them. Check after pushing shoes toward backing plate at top). | Straighten or replace. NOTE: Drum springs not effective against low pitch squeal or howl. |
| 7. Clicks during high rate stops, usually once per wheel revolution in one wheel only. | Threaded drum. | Disappears with usage as drum surface is conditioned by lining wear. |
| 8. Chatter at high speed. | Drum out of round with 2 or more distinct high spots in circumference. | Sometimes corrects with usage. Turn drum. |
| 9. Pedal throb at light applications at low speed. | Drum out of round simply off center, remove. | Turn drum. |
| 10. "Rough feel" during high rate stops from moderate speed. | Tool chatter. Look for faint light and darker stripes running across the braking surface. | Usually corrects with usage. |
| 11. Loud clank as foot is slipped off depressed manual brake. | Normal for design. | For special complaints stretch pedal return spring (make sure pedal returns fully even when pedal is eased back slowly). |
| 12. *Click, first application after reversing | Shoes holding out from anchor pins. | File shoe pads on backing plates; lubricate. |
| | Incorrect parking brake adjustment. | Check parking brake adjustment. |

*Although adjusting brakes temporarily changes these noises, lubrication is the only long term fix.

## BRAKE CAUTIONS

1. Do not use a substitute for recommended brake fluid (see below) or reclaimed brake fluid.

2. Do not allow grease, paint, oil or brake fluid to come in contact with brake lining.

3. Do not handle brake shoes or drums with greasy hands.

4. Do not clean rubber parts or inside of cylinders with anything but clean alcohol, or clean brake fluid.

5. Do not use any linings other than those specified by the factory.

6. Do not allow master cylinder reservoir to become less than half full of brake fluid.

7. Under no circumstances should brakes be severely used after new shoes are installed. They should be given moderate use for several hundred miles until linings become well burnished. Repeated severe applications will cause erratic brake action and may permanently injure brake linings. Under no circumstances should severe testing be done that will burn the linings.

8. When linings of one brake require replacement, the linings should also be replaced on the other brake at the same end of the car (except on very low mileage new cars on which the brakes have not been abused).

## SPECIFICATIONS

### *NEW DRUMS*

Inside diameter—Front .......... 9″
—Rear .......... 9″

Out of Round including taper for full width (max.)
—Front .......... .005″
—Rear .......... .006″

Indicator shall not change more than .0005″ in any inch of circumference.

### *FLUID*

Fluid that complies with heavy duty standards of S.A.E. 70R3 Specifications.

### *LINING*

Width—Primary .......... 1¾″
—Secondary .......... 1¾″

Thickness (Front and Rear) .......... .222″

### *MASTER CYLINDER BORE*

.......... 1″

### *PEDAL HEIGHT*

Underside of Pedal Pad
to floor mat .......... 4½″ +¼″ −0″

### *WHEEL CYLINDER BORE*

—Front .......... 1 1/16″
—Rear .......... 15/16″

## TORQUE SPECIFICATIONS

| | LB. FT. |
|---|---|
| Front brake assembly to steering knuckle—lower Bolt and Nut | 45-65 |
| Front brake assembly to steering knuckle—upper Bolt (Bolt Lubricated) | 80-110 |
| Rear brake assembly to control arm Bolt and Nut | 30-45 |
| Brake master cylinder assembly to dash Nut | 20-35 |
| Brake and clutch pedal pivot Bolt and Nut | 20-35 |
| Wheel cylinder to backing plate Screw | 5-7 |
| Wheel brake cylinder bleeder Screw | 5-10 |
| Parking brake lever assembly to dash Nut | 10-20 |
| Parking brake lever assembly to reinforcement Bolt | 10-25 |
| Parking brake front cable to equalizer Nut | 5-10 |

## SPECIAL TOOLS

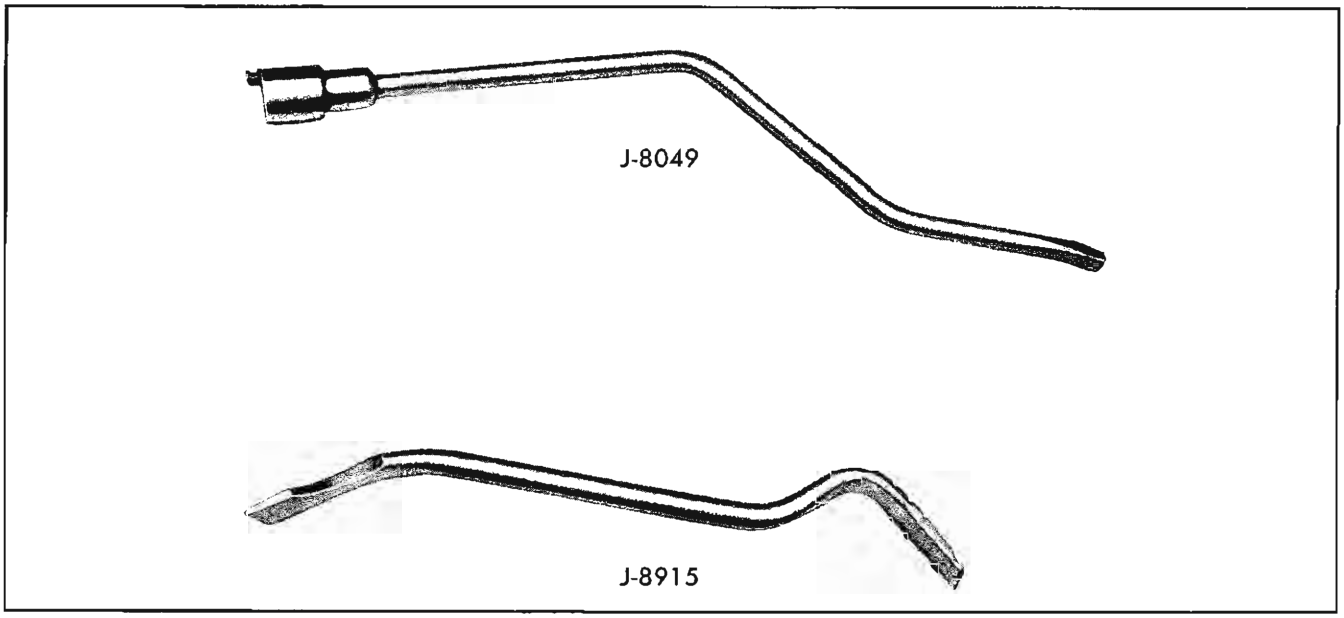



Fig. 5-12 Tempest Brake Tools

# ENGINE MECHANICAL

## CONTENTS OF THIS SECTION



# TEMPEST ENGINE

## GENERAL DESCRIPTION

Throughout this Tempest engine section parts description and service procedures will be identical for Four cylinder and V-8 engine unless otherwise indicated.

The Pontiac Tempest uses a 195 cubic inch 45° inclined, four cylinder engine as standard equipment. This engine has a $4\frac{1}{16}''$ bore and $3\frac{3}{4}''$ stroke. Two compression ratios are available, an 8.6:1 ratio as standard equipment and a 10.25:1 ratio available on special order. In addition a 7.6:1 compression ratio is used for export.

An optional V-8 engine with 326 cubic inches displacement and a 10.25:1 compression ratio is also available on special order.

Fourteen different engine combinations are available; these combinations and their usage are shown in the engine chart Fig. 6-1.

Engine identification is facilitated by a number-

| Engine Code | Horse-Power* | Trans. Type | Model | Application | Comp. Ratio 7.6:1 | 8.6:1 | 10.25:1 | 10.00:1 | Carb. 1 bbl. | 2 bbl. | 4 bbl. | Valve Spring Sgl. | Dbl. | Spec. Lifter | Camshaft Ident. No. 537995 | 539099 | 537441 | Distributor 1110301 | 1110300 | 1111020 | H.D. Clutch |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 89Z | 115 | SM | 195 | Standard | | X | | | X | | | X | | | X | | | X | | | |
| 88Z | 115 | SM | 195 | Export | X | | | | X | | | X | | | X | | | X | | | |
| 87Z | 166 | SM | 195 | Spec. Eqpt. | | | X | | | | X | | X | X | | X | | | X | | |
| 86Z | 120 | SM | 195 | Spec. Eqpt. | | | X | | X | | | X | | | X | | | | X | | |
| 85Z | 115 | SM | 195 | Std. Taxi—Spec. Eqpt. | | X | | | X | | | X | | | X | | | X | | | X |
| 84Z | 166 | SM | 195 | Spec. Eqpt. | | | X | | | | X | | X | X | | X | | | X | | X |
| 83Z | 120 | SM | 195 | Spec. Eqpt. | | | X | | X | | | X | | | X | | | | X | | X |
| 82Z | 115 | SM | 195 | Spec. Eqpt. | X | | | | X | | | X | | | X | | | X | | | X |
| 79Y | 115 | Auto. | 195 | Standard | | X | | | X | | | X | | | X | | | X | | | |
| 78Y | 115 | Auto. | 195 | Export | X | | | | X | | | X | | | X | | | X | | | |
| 77Y | 166 | Auto. | 195 | Spec. Eqpt. | | | X | | | | X | | X | X | | X | | | X | | |
| 76Y | 140 | Auto. | 195 | Spec. Eqpt. | | | X | | X | | | | X | X | | X | | | X | | |
| 68X | 250 | SM | 326 | Spec. Eqpt. | | X | | | | X | | | X | | | | X | | | X | |
| 71X | 260 | SM | 326 | Spec. Eqpt. | | | | X | | X | | | X | | | | X | | | X | |
| 600 | 260 | Auto. | 326 | Spec. Eqpt. | | | | X | | X | | | X | | | | X | | | X | |
| 690 | 250 | Auto. | 326 | Spec. Eqpt. | | X | | | | X | | | X | | | | X | | | X | |

Last Letter of Engine Code Designates Type Transmission.

*Note: For engine horsepower qualifications see page 6-47

Transmission Code
Z—Synchromesh 3-Speed (4 cyl.) O—Automatic (V-8)
X—Synchromesh 3-Speed (V-8) W—Synchromesh 4-Speed
Y—Automatic (4-cyl.)

**Fig. 6-1 Engine Identification Chart**

letter code stamped below the production engine number. By referring to the identification code and Fig. 6-1 each engine may be readily identified.

Both engines (Fig 6-2 and 6-3) feature completely machined combustion chambers, overhead valves, ball pivot rocker arm construction, harmonic balancer, hydraulic lifters, aluminum pistons, straight valve guides, superior crankcase ventilation and lubrication systems, and large displacement combined with high compression ratio for utmost performance and economy.

Detailed descriptions of cooling, crankcase ventilation, and the lubrication system are given in ENGINE COOLING AND LUBRICATION, page 6A-1.

### CYLINDER BLOCK (4-CYL.)

The cylinder block has one bank of four cylinders inclined at 45° to the right. Cylinders are numbered from the front 1-2-3-4.

The 45° inclination of the engine permits installation of the intake manifold, carburetor, fuel pump, starter and generator on the left side of the engine. This provides the best possible use of the engine compartment space and maximum serviceability.

Engine rigidity is maintained by the cast iron block which has three main bearing bulkheads and five main bearings for the crankshaft. All main bearing caps are doweled to the cylinder block to insure accurate alignment and facilitate assembly.

### CYLINDER BLOCK (V-8-CYL.)

The cylinder block has two banks of four cylinders each, cast 90° to each other. Left bank cylinders are numbered 1-3-5-7 and right bank cylinders are numbered 2-4-6-8.

The left bank is set slightly behind the right bank. This provides room for mounting the fuel pump in front of the engine on the left side where it receives direct cooling from the fan (Fig. 6-3). Also, it permits a shorter fuel line. Both these factors minimize the possibility of vapor lock. This arrangement of cylinders also provides for mounting the generator on the right side. This location is advantageous since it places the most severe turn in the belt on the slack, or lowest tension side, of the belt.

All main bearing caps are doweled to the cylinder block to insure accurate alignment and facilitate assembly.

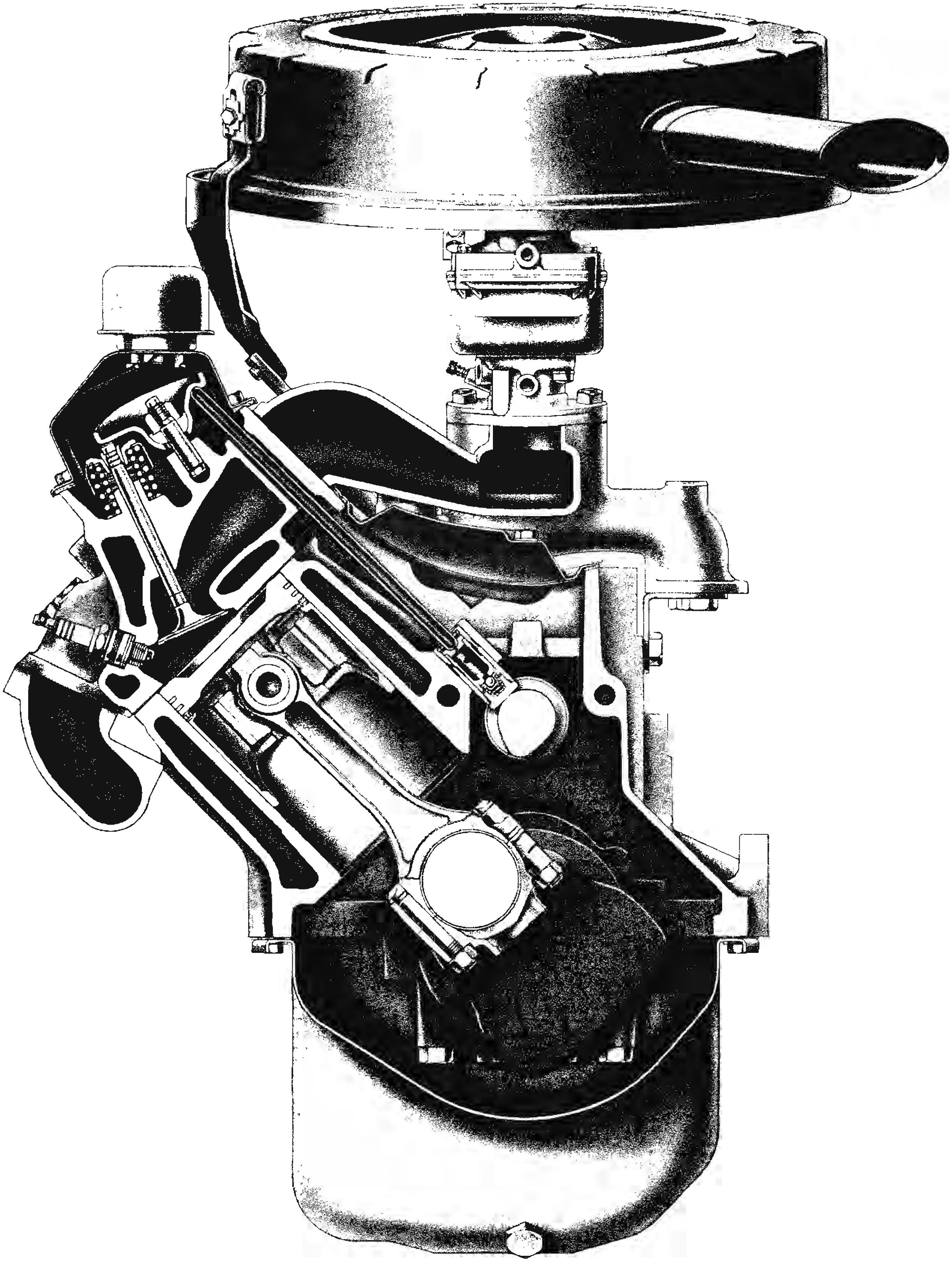


Fig. 6-2 Transverse Cross Section of Tempest 4 Engine

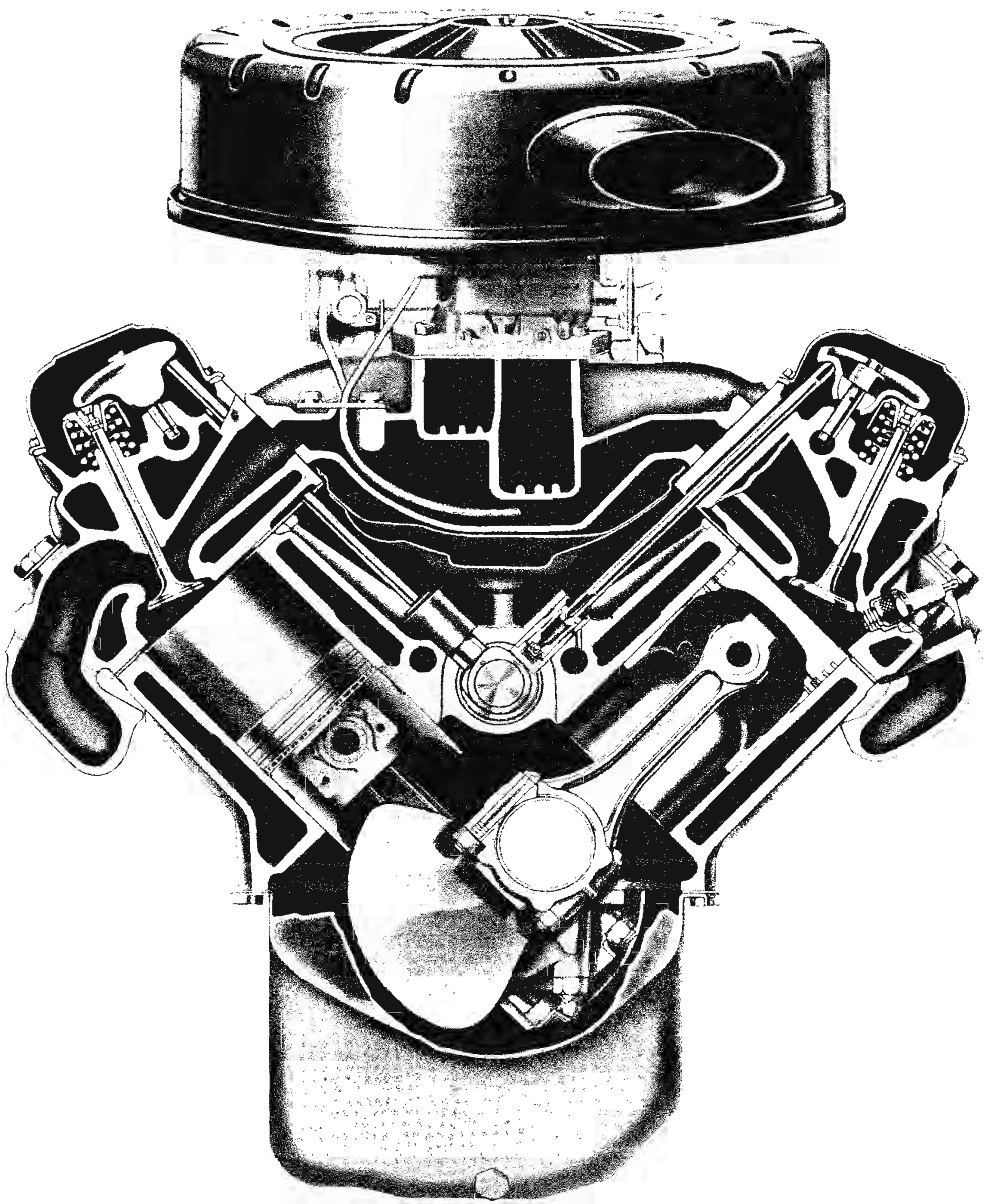


Fig. 6-3 Transverse Cross Section of Tempest V-8 Engine

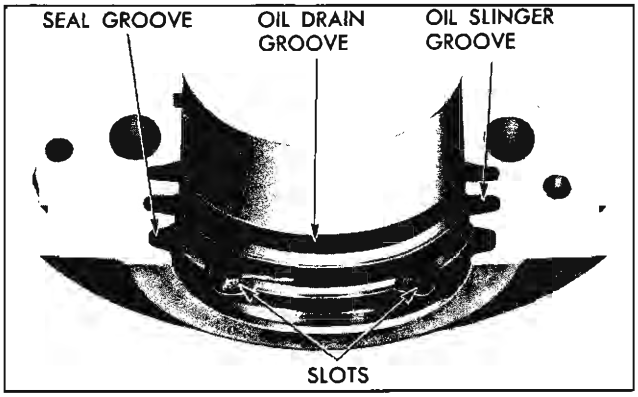



Fig. 6-4 Rear Main Bearing Cap

### CYLINDER HEAD

Different heads are used on 8.6:1 and 10.25:1 compression ratio engines in the 4 cylinder engine.

On the Tempest V-8 optional engine the left and right cylinder heads are identical. The same casting is used for both heads, and affords a 10.25 to 1 compression ratio.

Valve seats are completely surrounded by water and the head has an oil gallery which feeds oil to the rocker arm studs to provide lubrication of the upper valve train parts.

Cylinder head casting date is located at the right front corner of the head.

### CRANKSHAFT AND BEARINGS

The crankshaft is cast pearlitic malleable iron and is supported by five main bearings. The rear main bearing shells have two oil grooves (Fig. 6-4). The rear oil groove has three oil drain holes evenly spaced. The first four upper and lower shells are interchangeable. The rear is not. Torsional vibration is dampened by the harmonic balancer mounted on the front end of the crankshaft.

The rear main bearing is sealed by a packing seated in a chamfered groove in the block and bearing cap. A slinger on the crankshaft in front of the seal and the drain groove in the rear main bearing prevent an excess of oil from getting to the seal.

Slots are cast in the cylinder block and cap seal groove to prevent seal rotation.

### CONNECTING RODS

I beam cast pearlitic malleable iron connecting rods are used. In the Tempest V-8 engine a lubrication groove between the connecting rod and cap, directs a jet of oil to the opposite cylinder wall to lubricate the piston and rings and to provide splash for lubricating the piston pins.

### CAMSHAFT AND DRIVE

Four different camshafts are used as shown in engine identification chart.

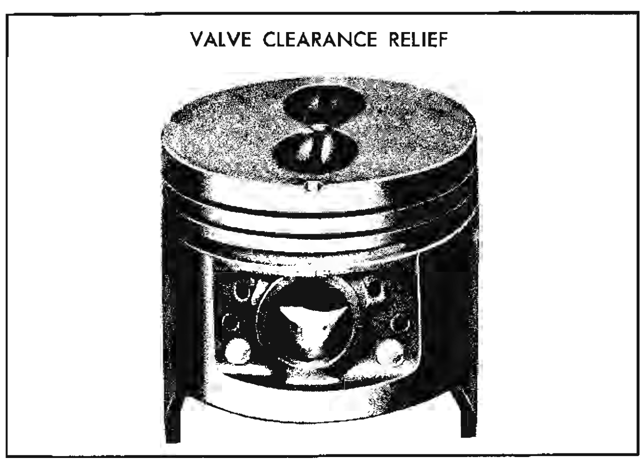
The camshafts are cast from alloy iron. Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes valve lifters to rotate. The camshaft is supported by five bearings.

A 7/8" wide, 60 link timing chain is used to drive the camshaft. In the four cylinder engine, the timing chain, by means of cambered double bushing construction at each link, has built-in friction to provide quite operation. To further assure quiet operation the timing chain is contained by two rubber bumpers. The pivotal bumper on the right hand side (slack side) is connected by a spring to the fixed position bumper on the left hand side (tension side) to absorb slack which develops in the chain. A spring damper is mounted from the left side to eliminate surge of spring coils. The 42 tooth camshaft drive sprocket is made from cyanide hardened, cast alloy iron, while the 21 tooth crankshaft sprocket is made from case hardened steel.

### PISTONS

The pistons are aluminum alloy, tin plated, with steel struts to control expansion and give added strength. Pistons are cam ground so that the diameter across the thrust faces is larger than the diameter fore and aft of the engine. The steel struts force expansion and contraction to occur to the front and rear and thus provides a constant diameter across the thrust faces. Two compression rings and one oil control ring are used, all of which are located above the piston pin.

All pistons are flat on top as shown in Fig 6-5, except export engines which use a recessed piston.




STANDARD PISTON
Fig. 6-5 Standard Pistons

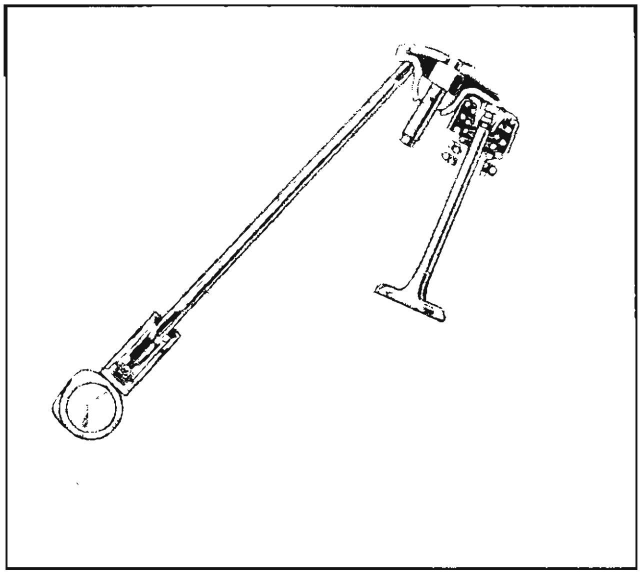


Fig. 6-6 Fixed Setting Rocker Arm Valve Train

The piston has a relief machined into the head of the piston for valve clearance.

Piston pins are offset $\frac{1}{16}$" toward thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. This feature provides quieter engine operation. Pins are hardened steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

## VALVE TRAIN

A very simple ball pivot type valve train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball is retained by a nut which locks against a chamfer on the stud (Fig. 6-6).

The maximum in durability is assured by the use of cyanide hardened stamped steel rocker arms. In addition all friction points to the valve train are positively lubricated.

The cylinder head has straight valve guides cast integrally (Fig. 6-7). External shields are used on both intake and exhaust valves to reduce the amount of oil splashed against stems. Valve stem seals are used on exhaust as well as intake valves to prevent oil from entering the valve guides.

In the 4 cyl. engine inner and outer valve springs are used on all four barrel engines and the 10.25:1 ratio automatic transmission equipped one barrel. The

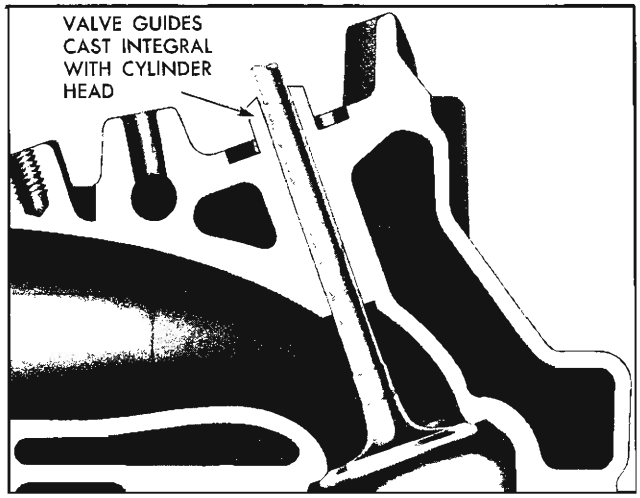



Fig. 6-7 Cross Section at Intake Valve

balance use single valve springs. The V-8 engine has inner and outer valve springs.

## HYDRAULIC VALVE LIFTERS

Hydraulic lifters are used to keep all parts of the valve train in constant contact. In other words each lifter is an automatic adjuster maintaining zero lash under all conditions. This insures precision valve timing and silent operation, increases valve life, and eliminates the need for tappet adjustment.

The hydraulic lifter assembly (Fig. 6-8) includes: the cast iron body which rides in the cylinder block boss, the plunger, push rod seat, plunger spring, ball

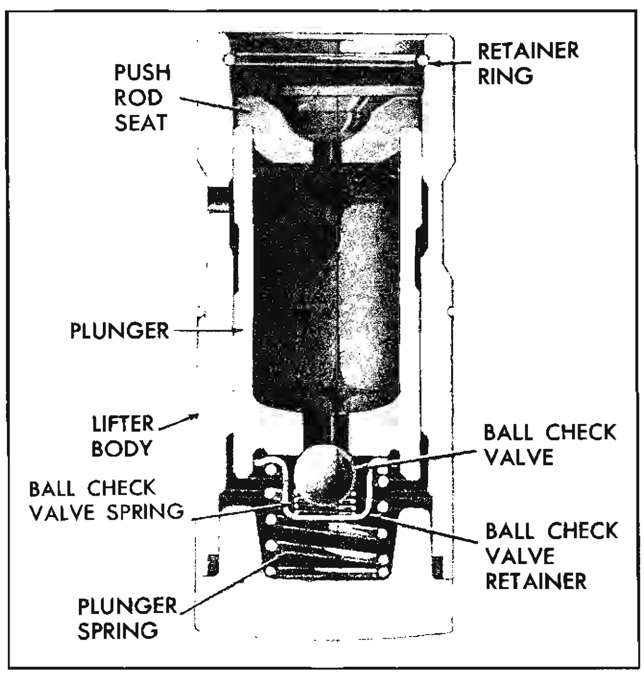



Fig. 6-8 Hydraulic Valve Lifter Assembly

check valve, ball check valve retainer, and retainer ring.

The hydraulic valve lifter functions as follows: when the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the ball check valve cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

During operation a small amount of oil leaks out of the lifter between the plunger and body. A controlled amount of leakage is important to provide continuous adjustment of the plunger position within the lifter. This leakage is called "leak down" and must be within certain limits to provide correct operation (see page 6-16).

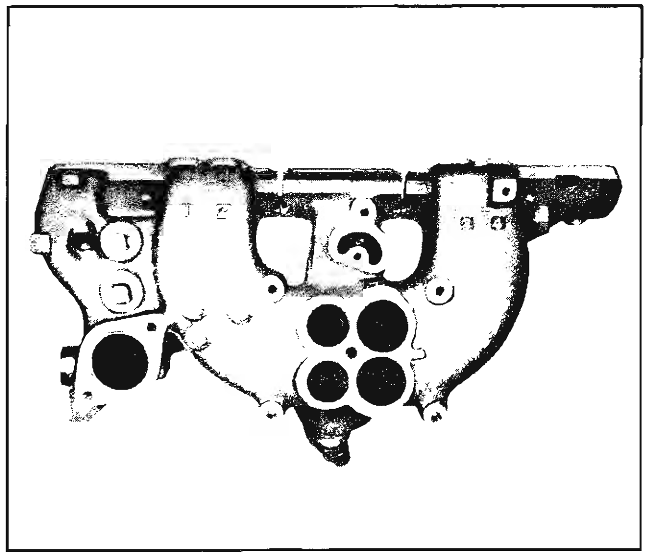
Oil is supplied to the lifter by the cylinder block oil gallery to replace that lost through leak down. The annular groove around the outside of the lifter body indexes with the passage drilled from the gallery to the lifter boss. Oil then enters the lifter from this groove and passes into the plunger cavity. From the plunger cavity, oil under pressure is also fed up the push rod to lubricate the friction area between the upper end of the push rod and the rocker arm.

### FUEL DISTRIBUTION SYSTEM

The intake manifold is designed to provide fuel passages which are short and practically equal in length. On the single barrel carburetor all cylinders feed off a single carburetor throat. On the four barrel manifold (Fig. 6-8) the front two openings feed the number 2 and 3 cylinders and the rear openings feed number 1 and 4 cylinders.

On the optional V-8 engine with the two barrel carburetor each throat of the carburetor feeds four cylinders as shown in Fig 6-10.

A stove is included in the intake manifold surrounding the heat risers which lead to the carburetor.



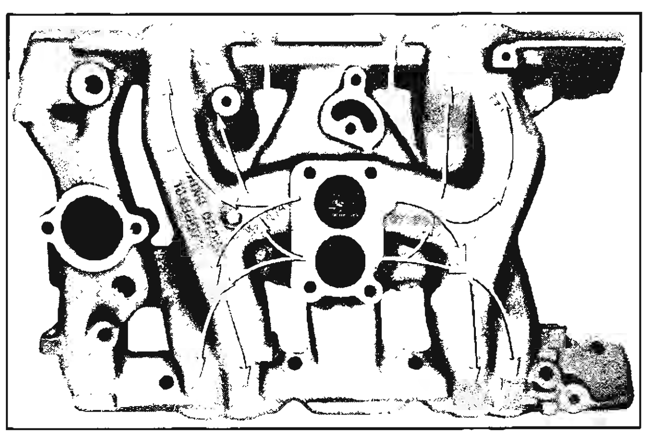
Tempest 4
Fig. 6-9 Intake Manifold—4 Barrel Carburetor

When the engine is cold exhaust gases are diverted through a passage in the intake manifold to circulate around and heat the risers. The fuel-air mixture is thereby pre-heated to the desired temperature for proper combustion.

### EXHAUST MANIFOLD (4 CYL.)

A cast iron manifold is used. A thermostatically controlled valve in the outlet of the manifold blocks the passage of exhaust out of the manifold when the engine is cold. Exhaust gases will then pass through the intake manifold exhaust crossover passage and into the exhaust system through the crossover pipe.

In passing through the crossover passage, the hot gases serve to heat the intake manifold stove and the choke heat tube.



Tempest V-8
Fig. 6-10 Intake Manifold—Two Barrel Carburetor

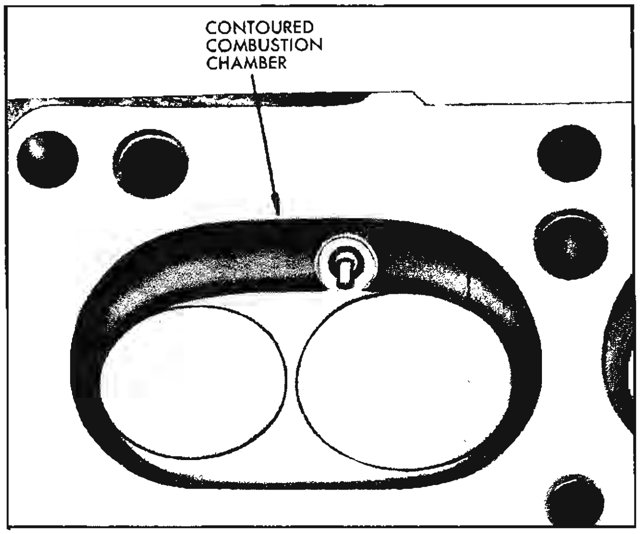



Fig. 6-11 Cylinder Head Combustion Chamber

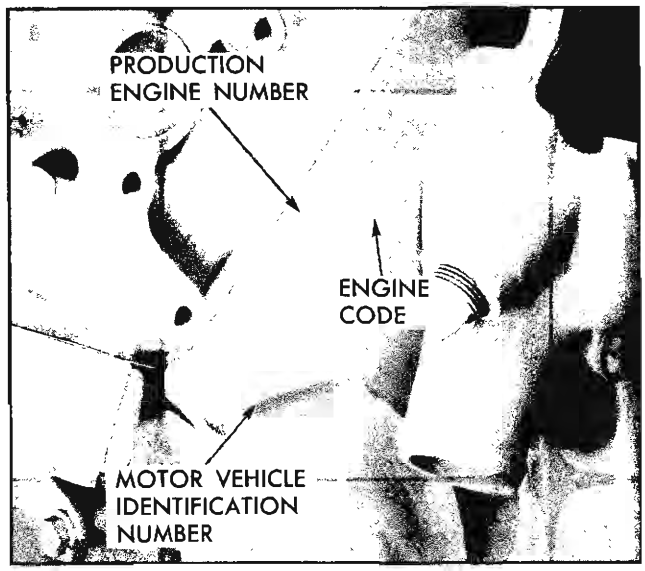



Fig. 6-12 Serial Number Location

### EXHAUST MANIFOLD (V-8)

Two cast iron exhaust manifolds are used, one for each bank of cylinders. Exhaust gases from the left manifold pass through a crossover pipe which passes beneath the engine to the right side. At this point the exhaust pipe from the right manifold joins the crossover pipe and gases are carried rearward to the muffler and tailpipe. A thermostatically controlled valve in the outlet of the right manifold blocks the passage of exhaust out of this manifold when the engine is cold. Exhaust from the cylinders on the right bank will then pass through the intake manifold exhaust crossover passage and out the left cylinder head and exhaust manifold.

In passing through the crossover passage, the hot gases serve to heat the intake manifold stove.

### COMBUSTION CHAMBERS

Combustion chambers are completely machined to insure accurate volume control and uniform shape for all cylinders. Spark plugs are located near intake valves for maximum power and to properly fire economically lean mixtures.

The contoured wedge shape of the combustion chamber (Fig. 6-11) minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

Intake valves are large and have 30° seat angles to further provide easy breathing for high combustion efficiency. Exhaust valve seat angle is 45°.

### SERIAL NUMBERS

The manufacturer's motor vehicle identification number is located on a machined pad on the front, right-hand side of the block.

The production engine number will also be found in the same area (Fig. 6-12). This number is used for production control purposes during manufacture. The production engine number should be included on AFA's or P.I. Reports concerning the engine.

## GENERAL INFORMATION ON ENGINE SERVICE

Cleanliness is a primary factor when servicing the engine. The slightest particle of dirt that finds its way into a hydraulic lifter may cause a malfunction.

Since any dirt which may enter the oil galleries or passages in the engine could eventually get to a lifter, cleanliness should be exercised when any part of the engine is removed or disassembled. When a cylinder head is removed for any purpose, it is necessary to remove the push rod cover. This exposes the lifters to any dirt which may fall from the upper portion of the block or which may be carried in the air. Thus, it is wise to cover the lifter galleries until ready to reassemble the engine.

When lifters are removed for any reason, they should immediately be placed in order in Valve Lifter Storage Box J-5763 (Fig. 6-13). This is important for

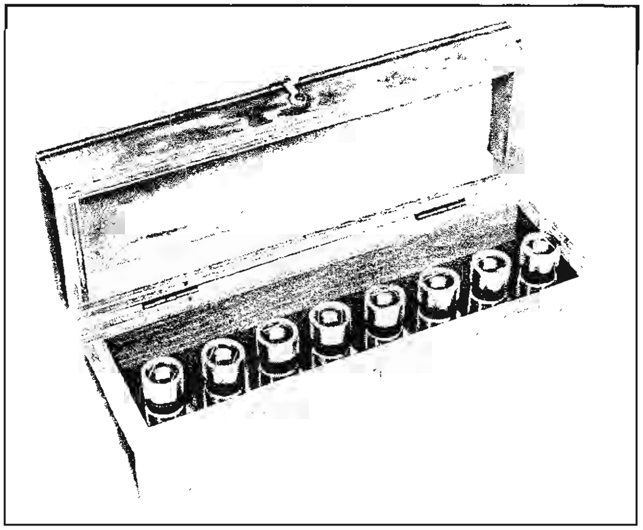


Fig. 6-13 Valve Lifter Storage Box

two reasons. First, it is the easiest way to keep lifters clean. Second, lifters should always be replaced in the same bosses from which they were removed.

Valves, valve lifters, push rods, rocker arms, rocker arm balls, and rocker arm ball nuts should always be kept in sets and returned to their original positions. These parts will tend to mate as the engine operates and will provide more satisfactory operation when kept together. By storing lifters in Storage Box J-5763 and valves, push rods, rocker arms, balls and nuts in Holding Stand J-5709 (Fig. 6-14), whenever they are removed, they can easily be kept in sets for identification during assembly. In addition to keeping the parts in sets, the push rods should be replaced with the same end up. In other words, the same end will contact the rocker arm as before the engine was disassembled. The upper end can usually be identified by the polished surface which contacts the rocker arm. Push rods will also be polished somewhat in the area where the rod passes through the head.

When hydraulic valve lifters are disassembled, the various parts of each lifter must be kept together. This is especially important since the lifter body and plunger are selectively fitted. The use of the special tray included with Cleaning Tank J-5821 will aid in keeping the parts of each lifter together when lifters are being serviced.

Cylinder head screws should be installed without thread sealer of any kind.

When raising or supporting the engine for any reason, do not use a jack under the oil pan or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump, jacking against the oil pan

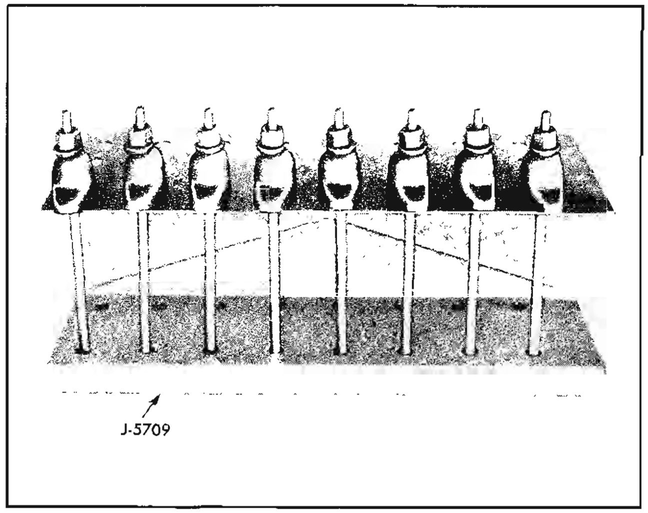



Fig. 6-14 Valve and Valve Train Holding Stand

may cause it to be bent against the pump. The result would be a telegraphed noise which would be difficult to trace. The crankshaft pulley is sheet steel and will not support engine weight.

It should be kept in mind, while working on the engine, that the twelve volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

In the mechanical procedures described in this section generally no references will be made to the removal of optional equipment such as power steering pump, air conditioning compressor, etc.

Should it become necessary to remove any such item to perform other service refer to the appropriate section of the manual for specific information.

## PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, fuel filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this book.

## SERVICE OPERATIONS ON CAR

### *ENGINE INSULATORS—REMOVE AND REPLACE*

INSULATORS

1. Raise hood and, using suitable engine lifting equipment, take weight of engine off insulators.

***CAUTION: Disconnect battery ground strap before raising engine. When the engine is raised, the starting motor solenoid terminals may contact the steering gear which could energize the starting motor if the ground cable is not dsconnected.***

2. Remove bolts fastening engine insulators to engine.

3. Remove bolts which fasten insulators to frame.

4. Raise engine just clear of insulator.

5. Remove insulator.

6. Position new insulator against engine and install attaching screws and washers. Tighten to 40-55 lb. ft. torque.

7. Lower engine.

8. Install frame to insulator bolts with lockwashers and plain washers and tighten securely.

### *ADJUST DRIVE BELTS*

Engine fan and accessory drive belts may be adjusted either by the deflection method or by use of the Borroughs Belt Tension gauge. Section 6-A gives the correct specifications for both methods.

## ENGINE ASSEMBLY REMOVE AND REPLACE

### *REMOVE*

1. Remove hood.

2. Drain and remove radiator.

3. Disconnect heater hoses at engine.

4. Disconnect wiring harness at generator, ignition coil, starter solenoid, heater blower, thermogauge and oil pressure switch.

5. Disconnect engine ground strap at both sides of engine.

6. Disconnect fuel line at fuel pump.

7. Disconnect vacuum modulator line on automatic transmission equipped unit.

8. Remove front fender cross brace.

9. Remove fan and fan pulley.

10. Disconnect accelerator rod at engine lever.

11. Raise front of car.

12. Disconnect exhaust pipe at manifold.

13. Disconnect clutch linkage on Synchro-Mesh.

14. Position wooden block at rear of engine to prevent damage to distributor if engine rocks to the rear. Disconnect propeller shaft and torque tube from rear of engine by following first 11 steps of removal procedure given in Section 4.

15. Disconnect engine support at crossmember.

16. Carefully raise engine with chainfall or overhead hoist. Move forward to clear firewall and heater.

### *REPLACE*

The replacement procedure is essentially a reversal of removal. Follow instructions given in Section 4 for the installation of propeller shaft and torque tube. Failure to follow procedure may result in drive-line damage.

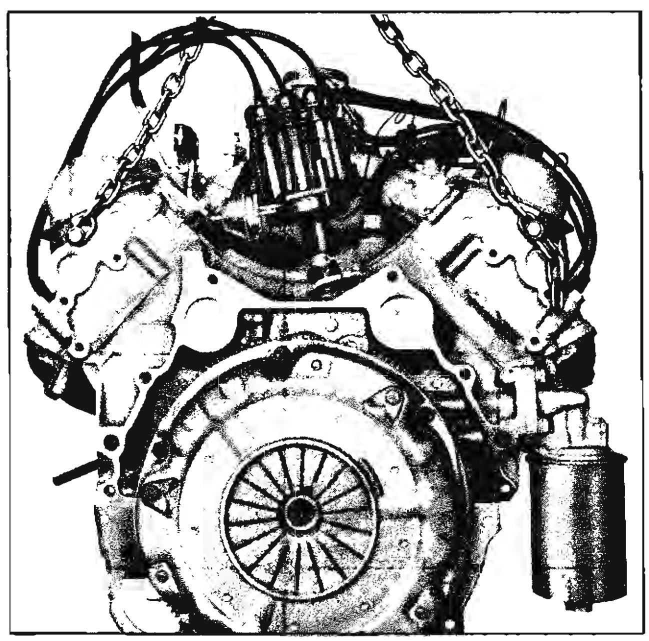


Fig. 6-15 Engine Removal—Rear Attaching Points

## MANIFOLDS—VALVE TRAIN—CYLINDER HEAD

### *EXHAUST MANIFOLD OR GASKET REPLACE*

REMOVE

1. Remove bolts from exhaust crossover pipe at exhaust manifold.

2. Straighten tabs on manifold front and rear screw locks and remove manifold attaching bolts, manifold and gasket.

3. Remove old gasket from exhaust crossover pipe connector.

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold. Check condition of heat control valve and related parts.

2. Place new gasket on exhaust crossover pipe connector.

3. Replace exhaust manifold and new gasket. Use new individual manifold bolt locks on front and rear pairs of bolts. NOTE: Place manifold outlet in position over end of crossover pipe, but do not permit weight of manifold to rest on crossover pipe. Since the end holes of the gasket are slotted, installation of gasket may be simplified by first installing the manifold using only the front and rear bolts to retain manifold. Allow clearance of about 3/16" between cylinder head and exhaust manifold. After inserting the gasket between head and manifold the remaining bolts may be installed.

4. Tighten all bolts evenly and securely (30 lb. ft. torque). Bend tabs of bolt locks against bolt heads. NOTE: Be sure tabs are bent against sides of bolt heads, not on top of bolt heads.

### *INTAKE MANIFOLD ASSEMBLY AND/OR GASKET REPLACE*

REMOVE

1. Drain radiator.

2. Remove air cleaner assembly.

3. Disconnect exhaust crossover pipe at manifold.

4. Disconnect carburetor linkage at carburetor.

5. Disconnect fuel line at carburetor.

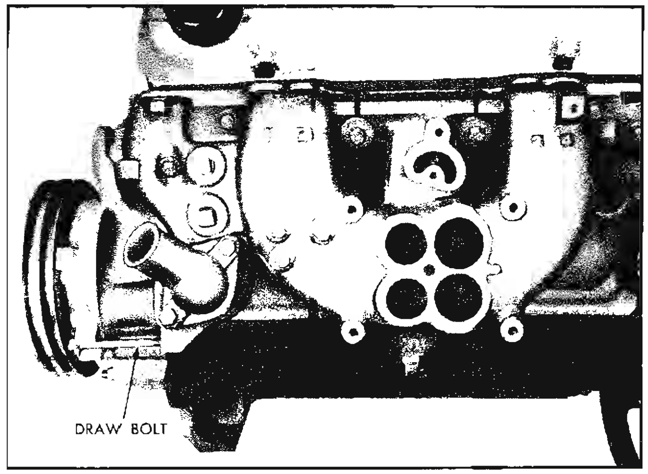



Fig. 6-16 Location of Manifold Attaching Screws

6. Disconnect temperature gauge wire at thermo-gauge.

7. Disconnect upper radiator hose at thermostat housing.

8. Disconnect vacuum advance hose at manifold.

9. Disconnect heater hose at manifold.

10. Disconnect crankcase vent hose to push rod cover.

11. Remove high tension wires from bracket on coil.

12. Disconnect coil high tension wire at coil.

13. Loosen manifold to timing cover draw bolt.

14. Remove manifold attaching screws (Fig. 6-16).

15. Remove manifold using care not to lose locating retainers in head.

16. Remove manifold gasket and retainers.

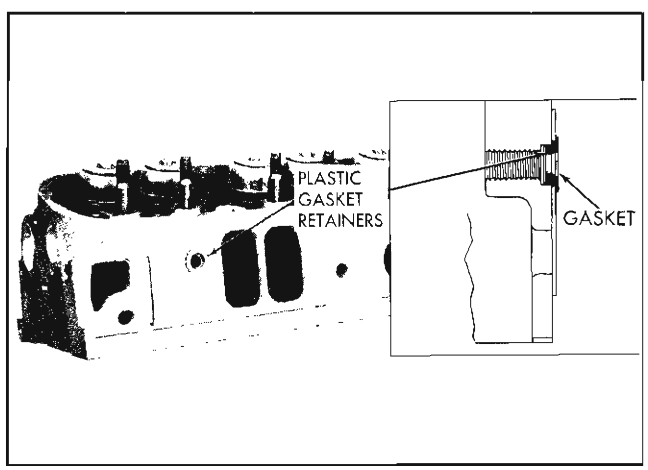



Fig. 6-17 Intake Manifold Gasket Retainers

REPLACE

NOTE: If new manifold is to be installed all parts and assemblies from old manifold must be transferred. Use new gaskets on those units requiring gaskets.

1. Position gasket using retainers in cylinder head (Fig. 6-17). Replace "O" ring seal in recess at front of manifold.

2. Position intake manifold assembly on cylinder head. Install screws finger tight.

3. Tighten manifold to timing cover draw bolt to obtain metal to metal contact between parts (10-20 lb. ft. torque). Be sure "O" ring is in place.

4. Tighten manifold attaching screws to 40 lb. ft. torque.

5. Connect coil high tension wire at coil.

6. Position high tension wires in coil bracket.

7. Connect heater hose.

8. Connect vacuum advance hose.

9. Connect upper radiator hose.

10. Connect wires to thermogauge.

11. Connect carburetor linkage.

12. Connect fuel line at carburetor.

13. Connect positive crankcase vent hose.

14. Connect exhaust crossover pipe.

15. Install air cleaner assembly.

16. Fill radiator.

### PUSH ROD COVER OR GASKET— REMOVE AND REPLACE

REMOVE

1. Remove intake manifold, retaining O-ring seal.

2. Remove positive crankcase ventilation hose.

3. Remove screws from push rod cover and remove cover.

REPLACE

1. Cement new gasket on push rod cover.

2. Replace push rod cover and tighten screws to 5 lb. ft. torque.

3. Replace positive crankcase ventilation valve, hose.

4. Install intake manifold and O-ring seal.

### VALVE SPRINGS, SHIELDS OR SEALS REPLACE

1. Remove rocker arm cover.

2. Remove rocker arm.

3. After removing rocker arm, thread valve spring compressor stud J-8929-1 on rocker arm stud and compress valve spring using compressor J-6384-1 and nut J-8929-2 while holding valve up with Valve Holder J-5961-2 (Fig. 6-18). Remove valve spring retainer cup locks and then remove valve spring compressor, valve spring retainer cup shield and valve stem seal.

4. Remove valve springs.

5. Install new part or parts, compress springs with Valve Spring Compressor J-6384-1 and Nut J-8929-2 (while holding valve up with Holder J-5961-2), install valve stem seal, and install retainer cup locks. Remove spring compressor and valve holder, then test valve stem seal using suction cup end of tool J-5751.

6. Install rocker arm. Tighten rocker arm ball retaining nut to 15-25 lb. ft. torque.

7. Replace rocker arm cover.

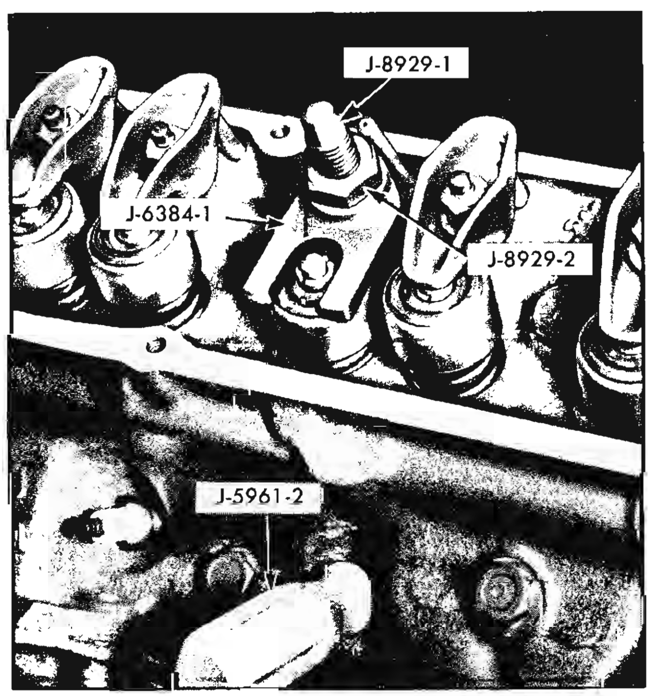



Fig. 6-18 Valve Spring Compressed

### *PUSH ROD REPLACE*

REMOVE

1. Remove rocker arm cover.

2. Loosen rocker arm nuts and rotate rocker arms to allow removal of push rods (Fig. 6-19).

3. Remove push rods and store in such a manner as to allow installation in original position.

REPLACE

1. Install push rod in original location with same end toward valve lifter.

2. Position rocker arms and tighten rocker arm nuts to 15-25 lb. ft. torque.

3. Install rocker arm cover.

### *VALVE LIFTER REPLACE*

REMOVE

1. Remove intake manifold (Page 6-11).

2. Disconnect crankcase ventilator outlet hose and remove push rod cover.

3. Remove rocker arm cover.

4. Loosen rocker arm nuts and rotate rocker arms to allow removal of push rods.

5. Remove push rods and store in such a manner as to allow installation in original position.

6. Before removing lifter that is suspected of having a stuck plunger, it can be tested using unloader J-5097. To check lifter insert pin of unloader tool through hole in push rod seat and push down on tool. Pin will unseat ball and tool will move push rod seat and plunger down. If lifter plunger is stuck, it will be impossible to move push rod seat down.

7. Remove lifter. Hydraulic Valve Lifter Remover J-3049 may facilitate removal of lifter. Store lifters so that they can be installed in exactly the same location.

REPLACE

NOTE: If new lifter is to be installed be sure to remove all sealer coating from inside of new lifter and check leak down rate, page 6-16.

1. Place lifter in original lifter boss.

2. Replace push rod exactly as removed.

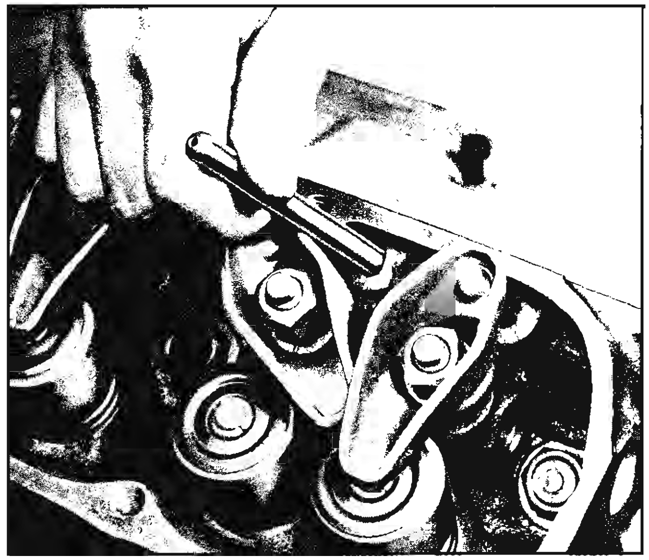


Fig. 6-19 Removing Push Rod

3. Position rocker arm on push rod and tighten rocker arm ball retaining nut to 15-25 lb. ft. torque.

4. Install rocker arm cover.

5. Install push rod cover and connect crankcase ventilator outlet hose.

6. Install intake manifold.

### *RECONDITION HYDRAULIC VALVE LIFTERS*

NOTE: Because of the important part hydraulic valve lifters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, cleanliness, cannot be overstressed when servicing these parts.

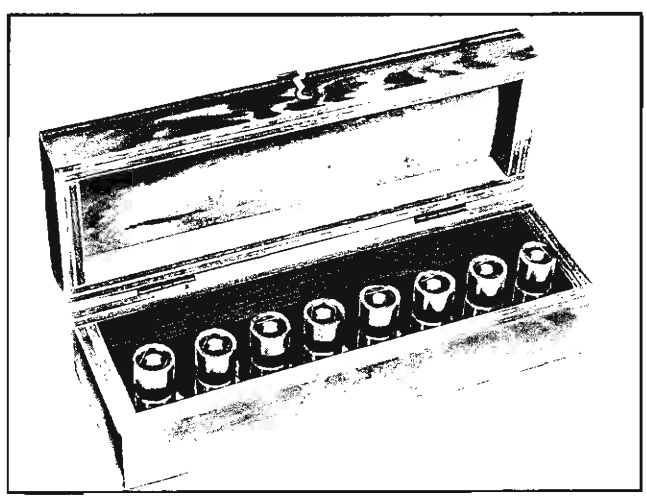


Fig. 6-20 Valve Lifter Storage Box

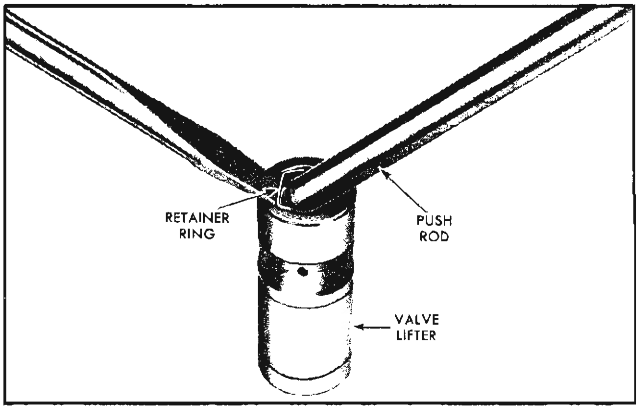



Fig. 6-21 Removing Push Rod Seat Retainer Ring

New lifters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leak down rate. It is not necessary to remove the oil from new lifters prior to checking leak down rate since special leak down oil is already in new lifters.

Wash Tank and Tray J-5821 is recommended for cleaning valve lifters. This tank should be used only for valve lifters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Lifters should at all times be stored in a covered box (Fig. 6-20) which will aid in keeping them clean. The lifter box should be kept dry and as free of oil as possible.

## DISASSEMBLE VALVE LIFTER

1. Remove push rod seat retainer ring by holding seat down with push rod while dislodging spring from lifter body with a pointed tool (Fig. 6-21). NOTE: It may be necessary to unseat lifter ball, using plunger unloader J-5097, before plunger can be pushed down.

2. Invert lifter and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place lifter in large end of Hydraulic Valve Lifter Plunger Remover, J-4160-A, with push rod end of lifter downward. Hold tool firmly in hand with thumb over lifter body and sharply strike tool against a block of wood (Fig. 6-22) until plunger falls out.

NOTE: It may be necessary to soak a lifter having a stuck plunger in cleaning solvent for several minutes in order to remove the plunger.

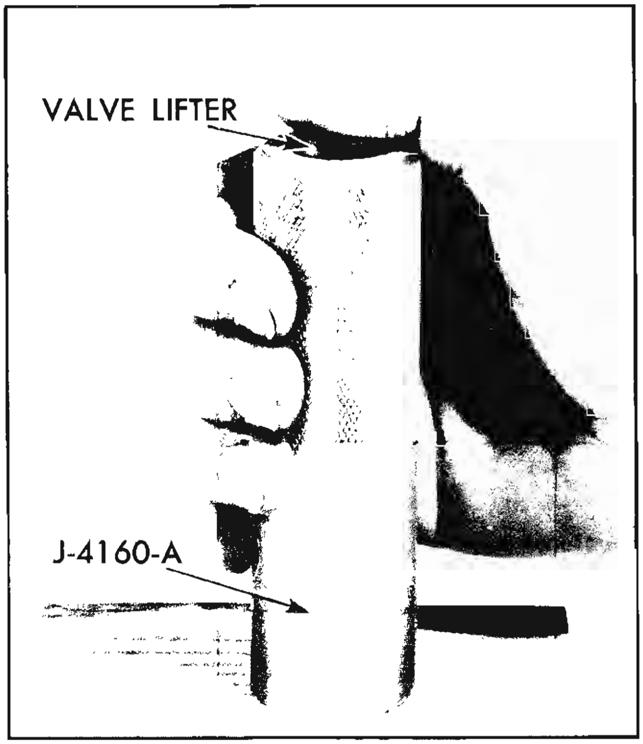



Fig. 6-22 Removing Stuck Plunger

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from wash tank J-5821 (Fig. 6-23).

***CAUTION: Valve lifter body and plunger are selectively fitted and must not be interchanged with parts of other lifters. (Keeping all parts of lifters together will also aid in trouble diagnosis.)***

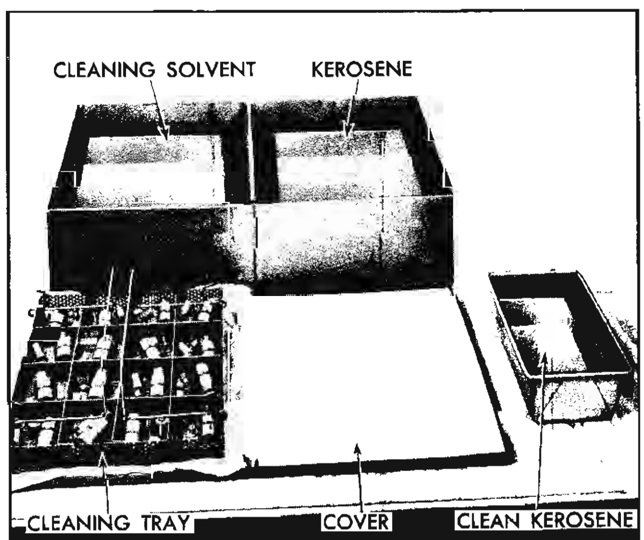



Fig. 6-23 Lifter Wash Tank and Tray

## CLEAN AND INSPECT VALVE LIFTER

Wash Tank J-5821 is recommended for cleaning valve lifter parts. This tank consists of two chambers, a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be closed.

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Wipe out tank cover and place tray of parts on cover in front of tank. A shop towel under tray and clean paper on remainder of cover will ensure cleanliness.

6. Working on one lifter at a time and using clean, lint-free cloths, thoroughly wipe off lifter parts. Clean plunger and external and internal surfaces of body with a hard wiping action. A bristle brush may be used to clean internal surface of lifter body.

***CAUTION: Do not use wire brush or sand paper, as these may damage machined surfaces.***

NOTE: Absolute cleanliness can be assured if each lifter is inspected and assembled after cleaning, but before proceeding to the next lifter.

7. Inspect lifter body. Both inner and outer surfaces of lifter body should be inspected for scoring. Lifter assembly should be replaced if body is roughly scored, grooved, or galled. Inspect cam contact surface on lower end of lifter body. Replace lifter assembly if this surface is excessively worn, galled or otherwise damaged.

8. Inspect lifter plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

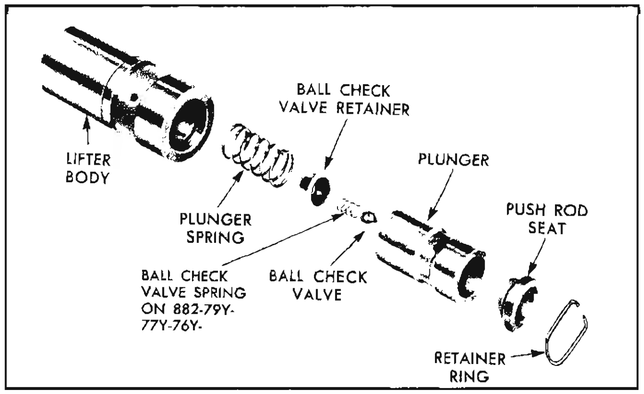



Fig. 6-24 Exploded View of Valve Lifter

A blackened appearance is not a defective condition. Sometimes the discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect push rod seat. Inspect push rod seat for roughness and to insure that hole in center is open.

10. Inspect valve lifter ball. Carefully examine ball for nicks, embedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy lifter operation. Also inspect plunger face of ball retainer for excessive wear.

## ASSEMBLE VALVE LIFTER

NOTE: All parts must be absolutely clean when assembling a hydraulic lifter. Since lint and dust may adhere to parts they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of lifters being overhauled.

Figure 6-24 shows the relative position of component parts of valve lifters. The recommended procedure for assembly is given in the following steps.

1. Rinse plunger spring and ball retainer and position retainer in spring.

2. Rinse lifter ball and place in retainer.

3. Rinse plunger and place on retainer so that seat on plunger mates with ball.

4. Invert plunger with parts assembled thus far and, after rinsing lifter body, install body over spring and plunger.

5. Place lifter body on clean paper, rinse and install push rod seat and retainer ring.

6. After lifter has been assembled, place in lifter box and close lid to preserve cleanliness.

## TEST VALVE LIFTER LEAK DOWN RATE

After all lifters have been assembled, the leak down rate must be checked before they are installed in the engine. Valve Lifter Leak Down Tester J-5790 (Fig. 6-25) is designed to test leak down rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is paramount. The tester cup, and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

1. Fill tester cup to approximately one inch from top with special fluid which is available from tester manufacturer.

2. Swing weight arm up out of the way, raise ram, and position lifter into boss in center of tester cup.

3. Adjust ram (with weight arm clear of ram) so that the pointer is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.

4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and force out air. (Lifter must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds).

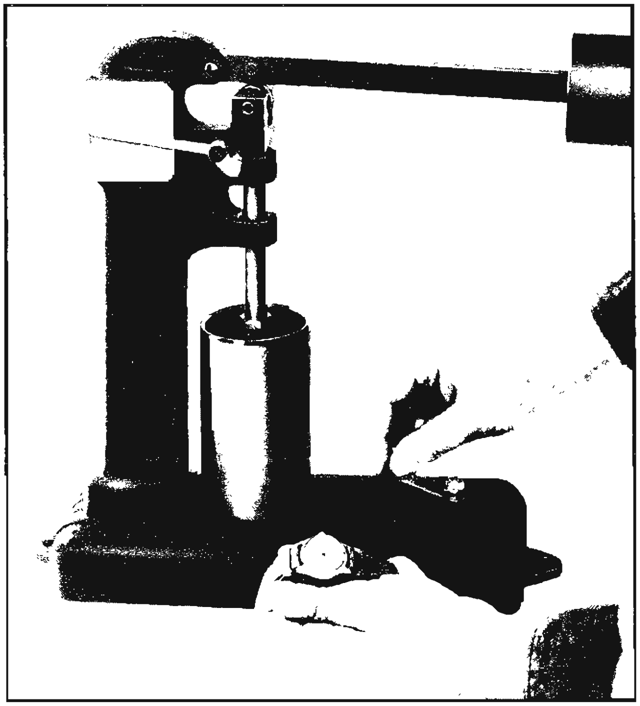


Fig. 6-25 Testing Leak Down Rate

Time indicator travel from lower line (first line above set line) to line marked .125" or 1/8", while still rotating cup with crank (Fig. 6-25). Lifter is satisfactory if rate is between 12 and 60 seconds.

A doubtful lifter should be tested three or four times. Disassemble, inspect, and re-test doubtful lifters. If leak down still is not within specifications, replace lifter.

6. After each lifter is tested, replace in lifter box to insure cleanliness. Leave lifters in box until ready for installation in cylinder block.

7. When all lifters have been tested, empty cup, clean, and place cover over tester to maintain its cleanliness.

## *REMOVE AND REPLACE CYLINDER HEAD AND/OR GASKET*

### REMOVE

1. Remove intake manifold assembly.

2. Disconnect hose from vent valve and remove push rod cover.

3. Remove bolts attaching exhaust manifold to cylinder head.

4. Remove rocker arm cover assembly.

5. Loosen rocker arm nuts and rotate rocker arms so push rods can be removed.

6. Remove push rods and store so that they can be installed in original position.

7. Disconnect spark plug wires.

8. Remove cylinder head attaching bolts.

9. Remove cylinder head using lifting hooks J-4266.

10. Remove cylinder head gasket.

REPLACE

1. Thoroughly clean gasket surfaces of block and head, position new cylinder head gasket over locating dowels.

2. Place cylinder head in position on locating dowels (Fig. 6-26).

NOTE: Three different length bolts are used. When installed in their proper position, they will project an equal amount from their bosses. Do not use sealer on threads.

3. Install cylinder head attaching bolts. Torque to 95 lb. ft.

4. Install push rods in original location and position.

5. Position rocker arms and tighten rocker arm nuts to 15-25 lb. ft. torque.

6. Install rocker arm cover.

7. Install bolts attaching exhaust manifold to cylinder head and lock in position. Torque bolts to 30 lb. ft.

8. Install push rod cover and reinstall vent valve hose.

9. Install intake manifold.

10. Connect spark plug wires.

### *ROCKER ARM STUD REPLACE*

Rocker arm studs are replaceable providing a press of two tons capacity or more is available.

NOTE: Both standard and .003" oversize studs are available. If replacing stud which has become loose, measure stud diameter with micrometer. Standard size stud should measure .4340"-.4345". If stud is loose because it is undersize, replace with standard stud. If loose because hole is oversize, replace with .003" oversize stud. No reaming operation is necessary.

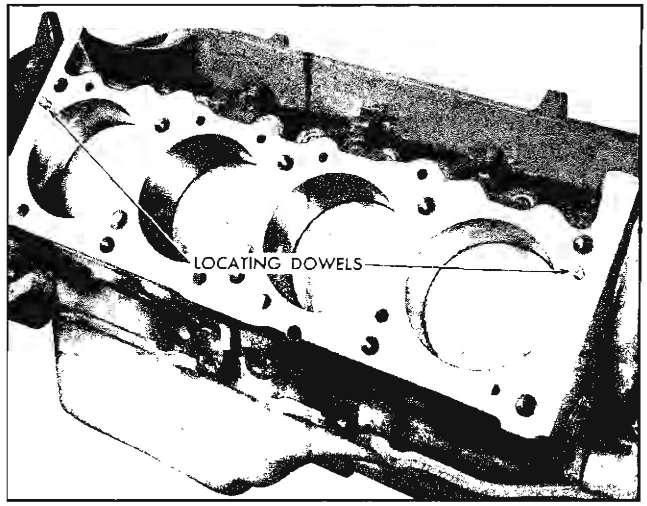



Fig. 6-26 Cylinder Head Locating Dowels

1. Remove cylinder head from engine (page 6-16).

2. With rocker arm removed, file two slots 3/32" to 1/8" deep on opposite sides of rocker arm stud (Fig. 6-27). Top of slots should be 1/4" to 3/8" below thread travel.

3. Place washer J-8934-3 at bottom of rocker arm stud.

4. Position Rocker Arm Stud Remover J-8934-1 on rocker arm stud and tighten screws securely with 5/32" allen wrench.

5. Place spacer J-8934-2 over Stud Remover J-8934-1.

6. Thread 7/8" standard nut on stud remover and turn nut until rocker arm stud is out of cylinder head (Fig. 6-28).

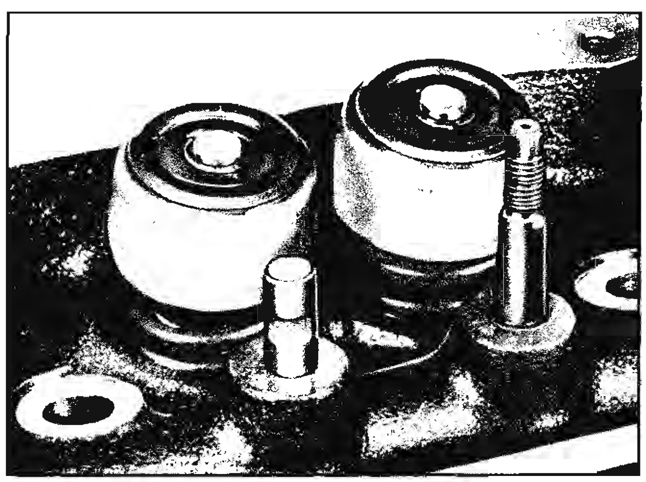


Fig. 6-27 Slots Filed in Rocker Arm Stud

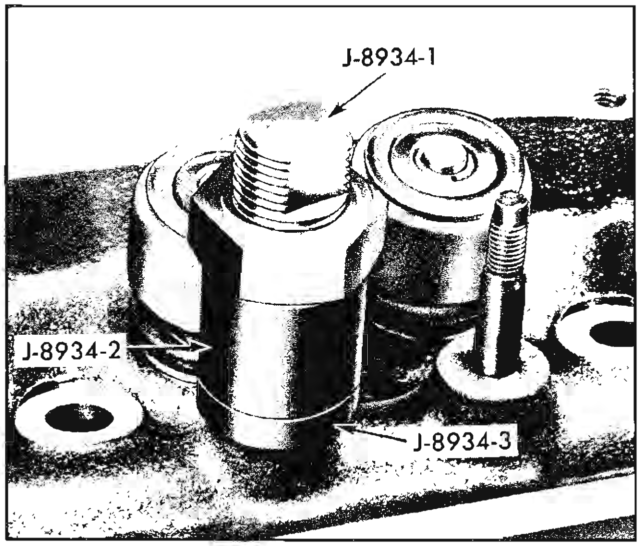



Fig. 6-28 Tools Positioned to Remove Rocker Arm Stud

7. Remove plugs (Fig. 6-29) from ends of cylinder head oil gallery and thoroughly clean out metal deposits and foreign matter from oil gallery (head must be right side up so foreign material will not lodge in or around studs).

8. Position rocker arm on new rocker arm stud and place Rocker Arm Stud Installer J-8927 on stud in place of rocker arm ball.

9. Coat rocker arm stud with white lead and oil and with cylinder head mounted in press so studs are vertical, position new stud with rocker arm and rocker arm stud installer over hole in head (Fig. 6-30).

10. Carefully press stud into head until it is in about half way ($7/16''$).

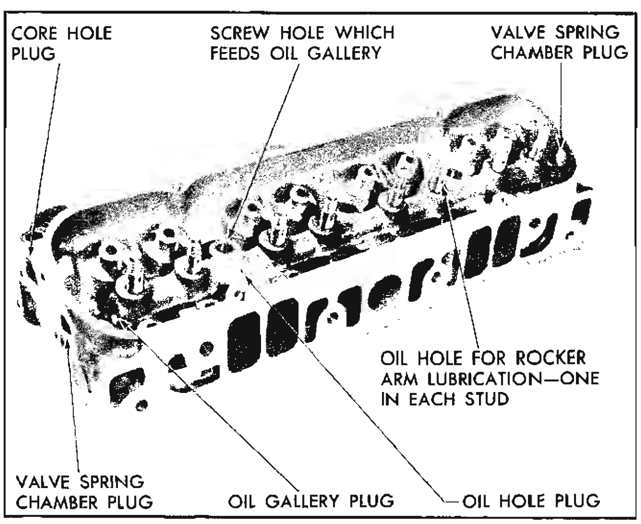



Fig. 6-29 Location of Oil Gallery Plugs

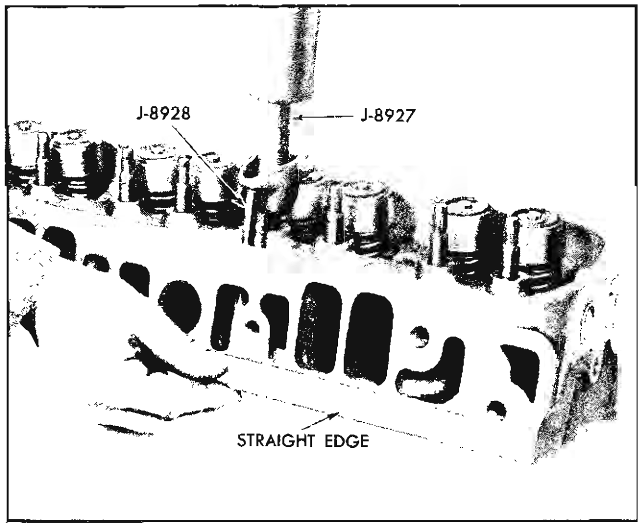



Fig. 6-30 Positioning Rocker Arm Stud

11. Position Valve Train Gauge J-8928 in push rod hole so that it seats properly in the rocker arm.

12. With valve seated, slowly press rocker arm stud into cylinder head until gauge projects about midway between the end of the gauge and the step with respect to the gasket surface of the cylinder head.

NOTE: It will be necessary to clamp a straight edge along the edge of the cylinder head as shown in Fig. 6-31 to simulate this gasket surface.

13. Remove Rocker Arm Stud Installer, rocker arm and ball.

14. Blow air through hole in new stud to insure that the passage is not restricted.

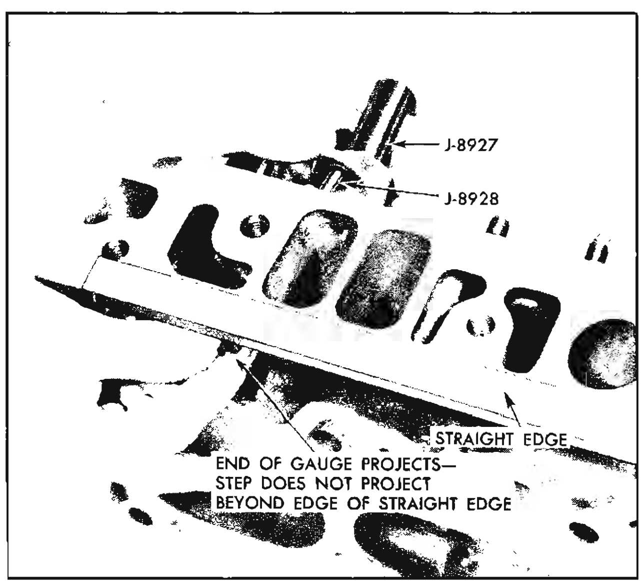



Fig. 6-31 Checking Stud Height

15. Blow air through oil gallery to remove any foreign matter.

16. Replace plugs in ends of oil gallery.

17. Check oil passages from oil gallery to all studs. (See step 3c, CLEAN AND INSPECT CYLINDER HEAD AND VALVES.

18. Install rocker arm and ball and install nut loosely.

19. Replace cylinder head (page 6-16).

### *RECONDITION CYLINDER HEAD AND VALVES*

## DISASSEMBLE CYLINDER HEAD AND VALVES

Remove valve spring retainer cup locks (keepers), valve stem oil seals, valve spring retainer cups, valve stem shields, valve springs, and valves, using valve spring compressor. Valve stem oil seals must be discarded and replaced with new seals any time they are removed. Place valves in Valve and Valve Train Holding Stand J-5709.

## CLEAN AND INSPECT CYLINDER HEAD AND VALVES

1. Inspect valves and seats to determine condition before cleaning. Also check oil and water passage plugs for evidence of leakage (Fig. 6-32).

2. Clean valves thoroughly to remove deposits from head and stem.

3. Clean and inspect cylinder head as follows:

a. Clean carbon deposits from combustion chambers and all sludge or foreign matter from other areas of cylinder head. If a scraper or wire brush is used for cleaning, use care to prevent damage to valve seats.

***CAUTION: To prevent damage to valve seat it is good practice to keep wire brush well away from seat.***

b. Clean cylinder head thoroughly using suitable cleaning equipment.

c. Check oil passages from oil gallery through rocker arm studs. A simple test can be made using a rubber hose and smoke. Block lower end of cylinder head screw hole which feeds oil gallery (Fig. 6-32) and blow smoke in top end of hole through rubber hose. Smoke should come out hole in each stud.

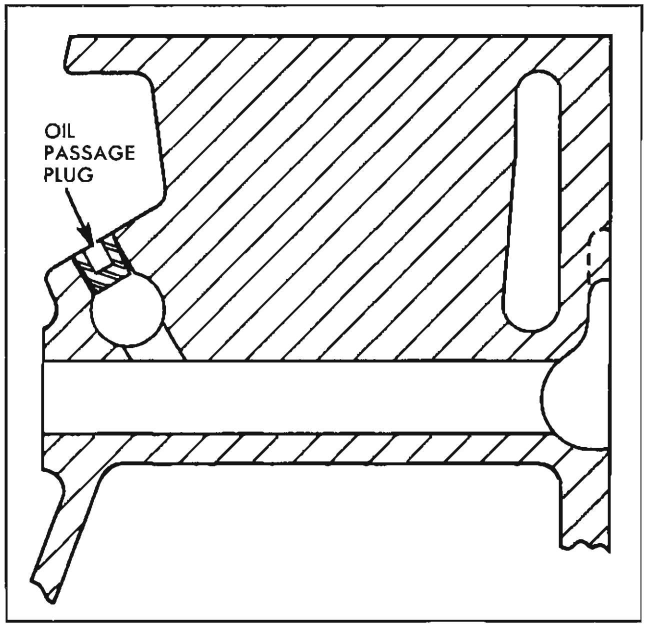



Fig. 6-32 Cylinder Head Oil Passage Plug

4. Clean valve guides thoroughly using Valve Guide Cleaner J-8101 (Fig. 6-33).

5. Visually inspect valve guides for evidence of wear, especially the end toward the spring seat. If a guide is scored or galled, install valve with proper oversize stem according to procedure on page 6-19.

6. Clean valve springs and inspect to see that they meet specifications.

7. Clean push rods and thoroughly clean out oil passage through center of rod. Inspect to see that the rod is straight.

8. Clean rocker arms and rocker arm balls, and visually inspect for evidence of wear.

9. Clean spark plugs as outlined in section 12.

10. Clean and inspect valve lifters.

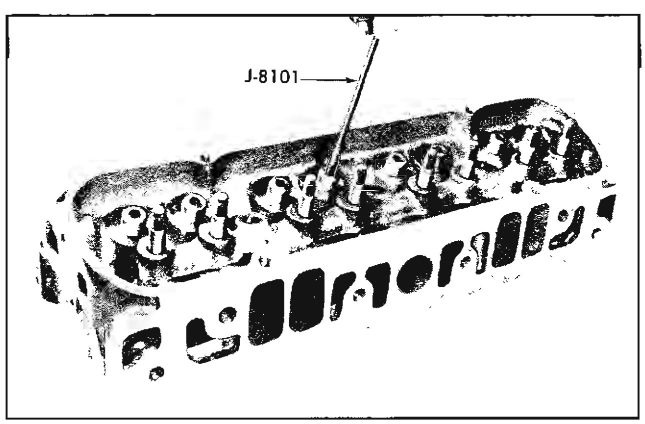



Fig. 6-33 Cleaning Valve Guide

RECONDITION VALVES AND SEATS

1. Reface valves and seats as follows:

Valves should be ground on a special bench grinder designed specifically for this purpose and built by a reputable manufacturer. Valve seats should be ground with reputable power grinding equipment having stones of the correct seat angle and a suitable pilot which pilots in the valve stem guide. To ensure positive sealing of the valve face to its seat, the grinding stones should be carefully refaced before any grinding is done. Intake valve seat angle is 30°, exhaust valve seat angle is 45°. Intake valve face angle is 29° and exhaust valve face angle is 44°. This will provide hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces (Fig. 6-34).

DO NOT USE REFACING EQUIPMENT EXCESSIVELY; only enough material should be removed to true up surfaces and remove pits. The valve head will run hotter as its thickness is diminished; therefore, if valve face cannot be cleaned up without grinding to point where outside diameter of valve has a sharp edge, the valve should be replaced. Whenever it is necessary to replace a valve, the new valve should be of the same stem diameter as the valve removed (unless the valve guide is reamed to provide proper fit).

Width of valve seats should be $\frac{1}{16}''$ (.048"–.070"). If seat width is excessive it should be narrowed by grinding with a flat stone (Fig. 6-35). This is the only method that should be used to narrow the seat.

NOTE: Lapping of valve seats is not required or recommended.

2. Check concentricity of valve seat and valve guide. Concentricity of valve seat and valve guide can be checked by using a suitable dial indicator or prussian blue. When using a dial indicator, total runout should not exceed .002".

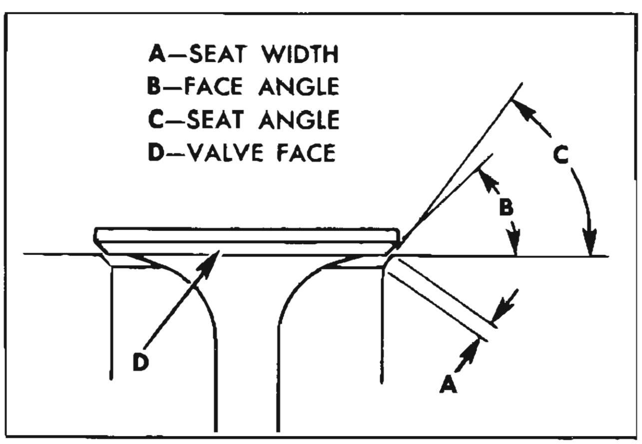



Fig. 6-34 Valve Seat and Face Angles

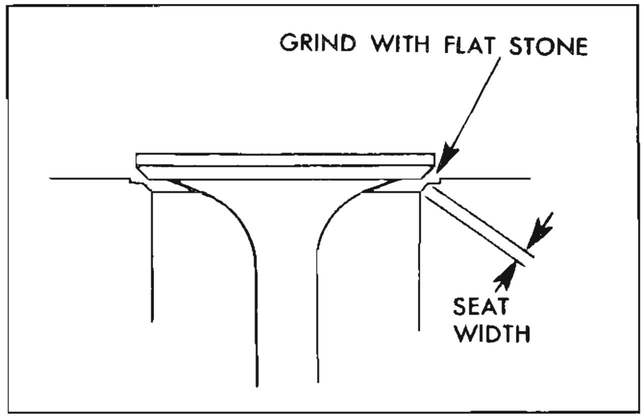



Fig. 6-35 Valve Seat after Grinding with Flat Stone

When prussian blue is used, a light coat should be applied to the face of the valve only and the valve rotated in its seat. If blue appears all the way around the valve seat, the valve seat and the valve guide are concentric with one another.

3. Check concentricity of valve stem and face of valve. After cleaning prussian blue from valve and seat from preceding check, lightly coat valve seat with prussian blue and rotate valve in guide. If blue appears all the way around the valve, the valve stem and valve face are concentric with one another.

NOTE: Both tests in steps 2 and 3 are necessary to insure proper valve seating.

4. Check and correct length of valve stem using Valve Train Gauge J-8928 as follows:

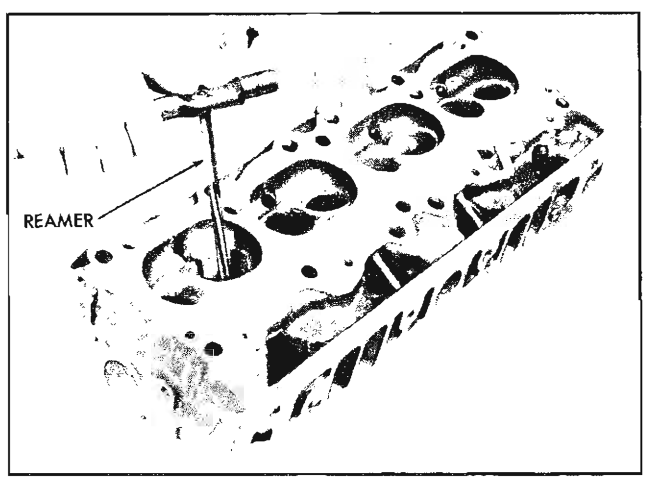



Fig. 6-36 Reaming Valve Guide

a. Position rocker arm on stud and hold in place using Rocker Arm Stud Installer J-8927. Slip valve into place and hold it against valve seat. While holding rocker arm and valve in position securely, insert Valve Train Gauge through push rod hole and seat snugly in push rod seat of rocker arm (Fig. 6-31). With all parts seated, step end of gauge should be at least flush with gasket face of head, but should not project past the step on the gauge.

b. If gauge projects too far, indicating that the valve stem is too long, grind the tip of the valve stem as necessary to make the gauge index properly.

***CAUTION: When grinding valve stem be very careful not to overheat it. Overheating will soften the hardened stem causing rapid wear.***

## FITTING VALVE STEMS TO GUIDES

Correct valve stem clearance for valve guides is .0021" to .0038" for the intake valve and .0026" to .0043" for the exhaust valve.

Valves with oversize stems are available in .001", .003" and .005" larger than standard. The same valve stem to guide clearance applies for oversize stems.

Oversize reamers are required to enlarge valve guide holes to fit the oversize stems. When the reamer is turned through the valve guide it will size the hole to fit the valve stem according to the above limits.

Carefully ream the valve guide using Valve Guide Reamer J-5830-1 for .003" oversize stems and Valve Guide Reamer J-6621 for .005" oversize stems (Fig. 6-36). For best results when installing .005" oversize valve stem use the .003" oversize reamer first and then ream to .005" oversize. Always reface the valve and valve seat after reaming valve guide. NOTE: Valves are marked .001, .003 or .005 with colored ink.

## ASSEMBLE CYLINDER HEAD AND VALVES

1. Install valves, valve springs, valve stem shields, valve spring retainer cups, valve stem seals and retainer cup locks using suitable spring compressor. The valve stem seals must be installed in the second groove (from end of stem). Valve Stem Seal Installer and Tester J-5751 can be used to install this seal (Fig. 6-37).

After the valves have been installed, the suction cup end of special tool J-5751 should be used to test for leaks between the valve spring retainer cup and valve stem seal (Fig. 6-38). The suction cup will tend to be held to the valve spring retainer cup by suction when the seal is satisfactory. If a leak is detected, replace seal or valve spring retainer cup as necessary. It is important to have a positive seal between the valve spring retainer cup and the valve stem seal to prevent excessive amounts of oil from being drawn down the valve stem which will cause exhaust smoke and oil consumption.

2. Install spark plugs.

## TIMING COVER—TIMING CHAIN—CAMSHAFT

### *HARMONIC BALANCER REPLACE*

1. Remove alternator and accessory drive belts.

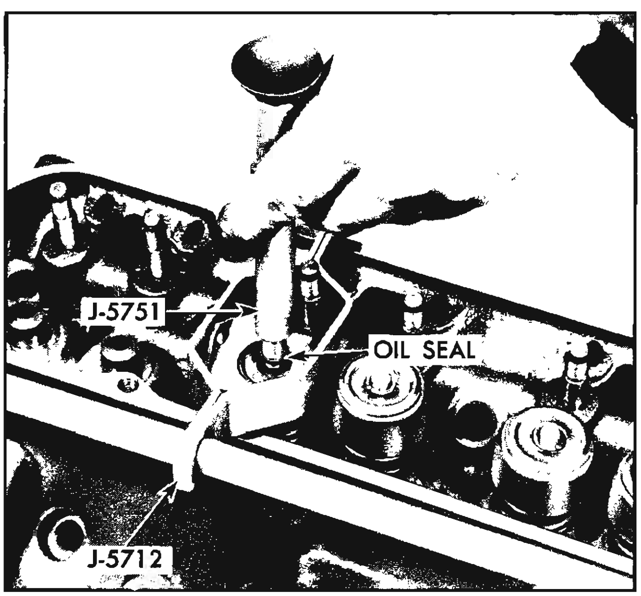



Fig. 6-37 Installing Valve Stem Seal

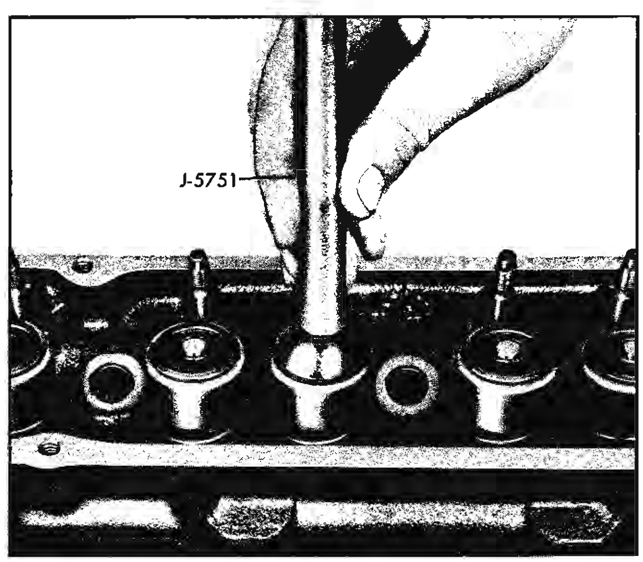



Fig. 6-38 Checking Value Stem Seal

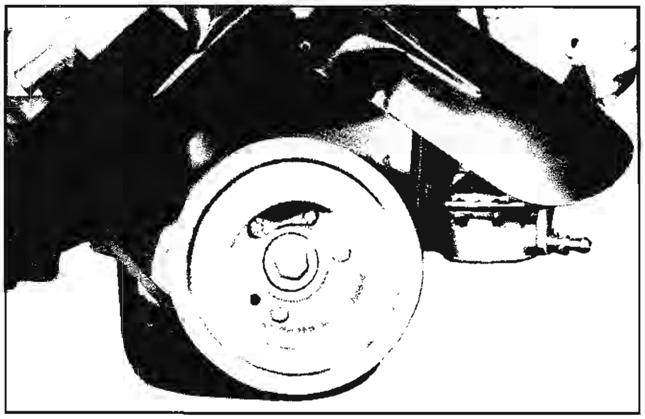


Fig. 6-39 Harmonic Balancer

2. Position fan so wide angles will be at bottom allowing access to balancer.

3. Remove harmonic balancer attaching bolt and retainer washer (Fig. 6-39).

4. Remove harmonic balancer by sliding it off end of crankshaft.

5. Install new harmonic balancer by reversing above steps. Tighten to 160 lb. ft. torque.

NOTE: Remove flywheel cover and lock flywheel before tightening balancer.

### TIMING CHAIN COVER SEAL REPLACE

1. Loosen alternator adjusting bolts.

2. Remove fan and accessory drive belts.

3. Remove harmonic balancer.

4. Remove timing chain cover seal by prying out of bore with pry bar (Fig. 6-40).

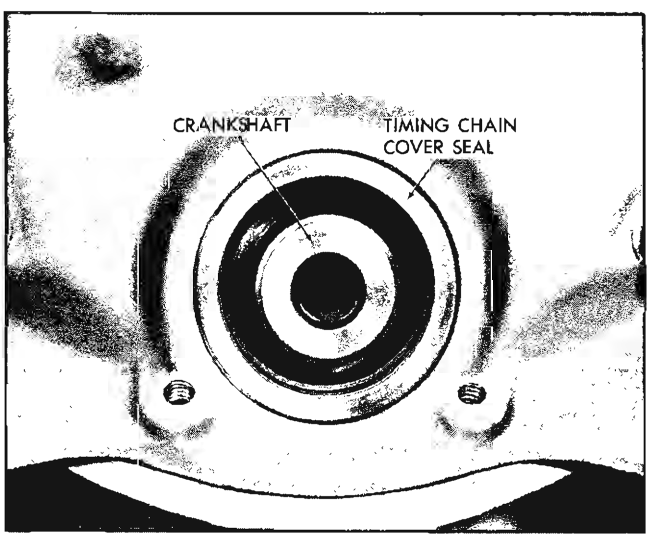



Fig. 6-40 Timing Chain Cover Seal

5. Install new seal with lip of seal facing rear of engine using seal installer J-21147.

6. Replace harmonic balancer. Tighten to 160 lb. ft. torque.

7. Install drive belts and adjust to proper tension.

### TIMING CHAIN COVER, GASKET, AND/OR FUEL PUMP ECCENTRIC

#### REMOVE

1. Drain radiator.

2. Loosen alternator fan drive belt and remove alternator mounting brackets.

3. Remove harmonic balancer.

4. Remove fuel pump.

5. Disconnect lower radiator hose and heater hose at cover.

6. Remove timing cover attaching bolts.

7. Loosen timing cover to intake manifold draw bolt and remove cover. Make certain hollow dowels are retained for installation.

8. Remove fuel pump eccentric and bushing (Fig. 6-41).

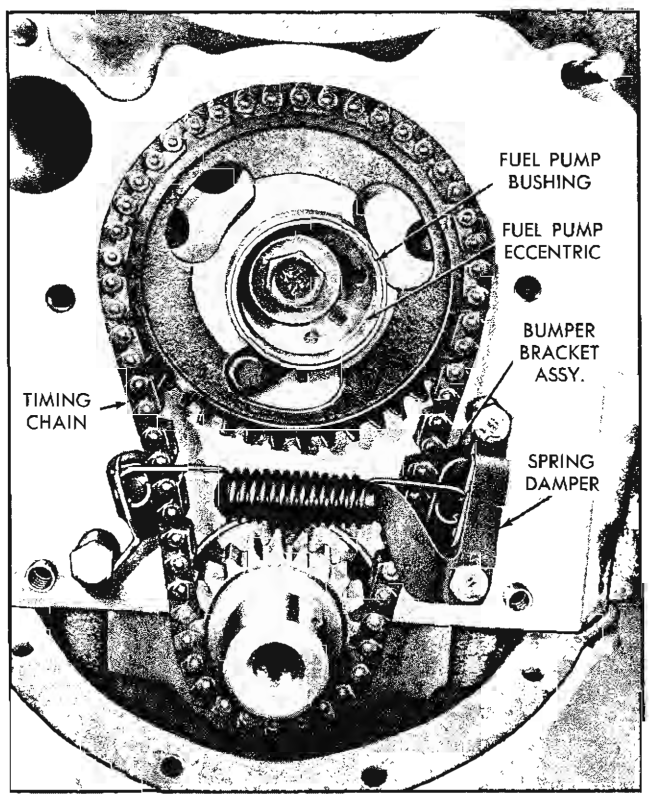



Fig. 6-41 Front of Engine with Timing Cover Removed (4 cyl.)

REPLACE

1. Inspect oil pan gasket at front of pan and replace gasket if necessary.

2. Install bushing over eccentric with flange against sprocket.

3. Install fuel pump eccentric, indexing tang on eccentric with keyway in camshaft sprocket.

4. Install dowels in lower cover attaching bolt holes.

5. Clean gasket surfaces of cover and block, and position new cover gasket on block over studs and dowels.

6. Position timing chain cover assembly over studs and locating dowels. Install attaching bolts and tighten bolts and manifold to cover draw bolt securely.

7. Install oil pan to timing cover screws and tighten to 15 lb. ft. torque.

8. Connect lower radiator hose and heater hose to timing cover.

9. Install harmonic balancer.

10. Install alternator and fan belt.

11. Fill radiator.

### *TIMING CHAIN AND SPROCKETS REPLACE*

1. Remove timing cover and fuel pump eccentric and bushing (Page 6-22).

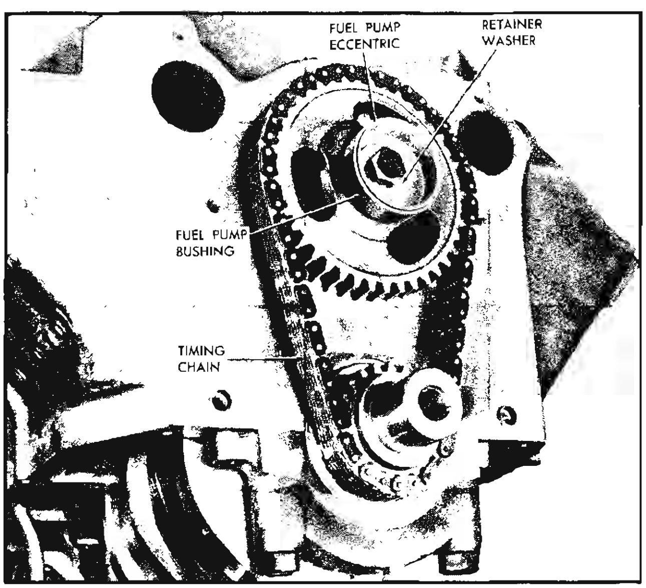



Fig. 6-42 Front of Engine with Timing Cover Removed (V-8)

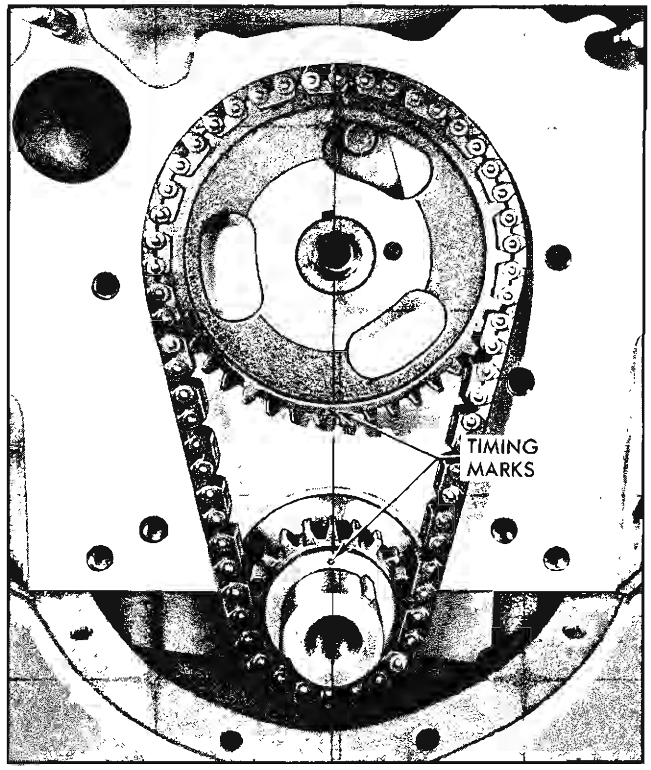



Fig. 6-43 Valve Timing Marks

2. Remove timing chain tensioner spring damper and bumper (Fig. 6-41) on 4 cylinder only.

NOTE: Right hand bumper must be removed before spring can be removed. This is because of hook in end of spring. Do not attempt to remove spring by stretching or twisting as this may damage spring.

3. Align timing marks on sprockets to simplify proper positioning on reassembly.

4. Slide timing chain and sprockets off ends of crankshaft and camshaft.

5. Install new timing chain and/or sprockets making sure marks on timing sprockets are aligned exactly on a straight line passing through the shaft centers (Fig. 6-43). Camshaft should extend through sprocket so that hole in fuel pump eccentric will locate on shaft.

6. On 4 cylinder engine inspect tensioner bumpers; if worn excessively replace. Install timing chain tensioner assembly.

7. Install fuel pump eccentric, eccentric bushing and timing cover assembly.

## CAMSHAFT REPLACE

### REMOVE

1. Remove radiator grille lower panel, grille and hood latch as an assembly.

2. Remove front bumper assembly.

3. Drain and remove radiator.

4. Remove intake manifold, page 6-11.

5. Remove timing cover, page 6-22.

6. Remove distributor assembly.

7. Remove damper and tensioner (4 cyl.).

8. Remove timing chain and sprockets.

9. Remove valve lifters.

10. Remove camshaft thrust plate.

11. Carefully pull out camshaft using care not to damage camshaft bearings.

### REPLACE

1. Install camshaft using care not to damage bearings.

2. Install camshaft thrust plate indexing slot in plate with slot in block.

3. Install timing chain and sprockets. Install tensioner assy. (4 cyl only).

4. Install distributor following procedure outlined in Section 11 to set ignition timing.

5. Install timing cover.

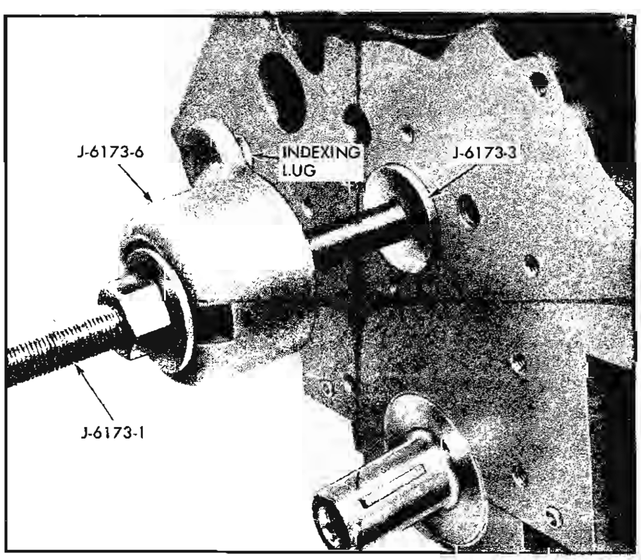



Fig. 6-44 Positioning Indexing Collar

6. Install intake manifold.

7. Install radiator.

8. Install radiator grille lower panel, grille and hood latch.

9. Install front bumper assembly.

10. Fill radiator.

## CAMSHAFT BEARING—REPLACE

Camshaft bearings can be replaced while the engine is disassembled for overhaul, or without completely disassembling the engine. To replace bearing without completely disassembling engine, remove the camshaft.

### REMOVE BEARING

1. Insert Replacer Adapter J-6173-3 into front bearing to act as a support for Shaft J-6173-1.

NOTE: If front bearing is to be replaced, insert Installer Adapter in center bearing to act as support for shaft.

2. Insert Remover Adapter J-6173-4 into rear of bearing to be removed so that shoulder on Remover bears against rear edge of bearing.

NOTE: If rear bearing is to be removed, it will be necessary to remove camshaft rear plug.

3. Place Indexing Collar J-6173-6 on threaded end of shaft with open side toward unthreaded end and and start thrust washer and nut on shaft.

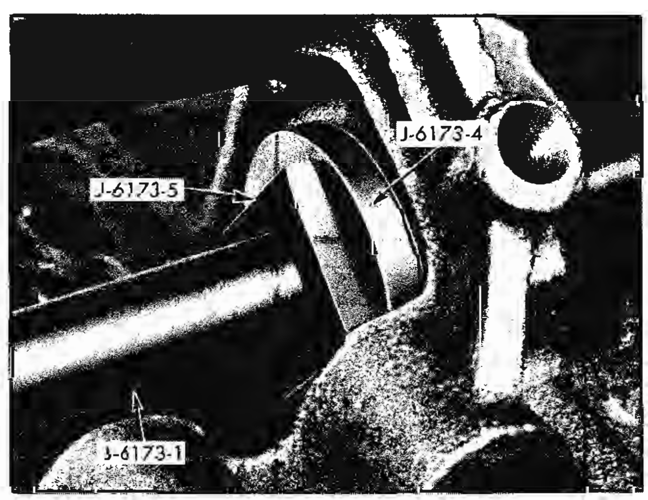



Fig. 6-45 Tools Positioned for Bearing Removal

4. Insert shaft and Indexing Collar through Remover and Replacer Adapters and position lug on Indexing Collar in ventilator hole in front of block (Fig. 6-44). This indexes the shaft so that it cannot rotate.

5. Slip Key J-6173-5 into notches in shaft behind bearing to be removed (Fig. 6-45).

6. Turn nut on front of shaft to pull key against Remover J-6173-4, then continue to turn nut until bearing is pulled out of its hole.

## INSTALL BEARING

1. Place a rag against each side of the transverse member just below the bearing hole to catch any shavings and carefully clean up the hole. All scratches or nicks in the cast iron should be smoothed with a scraper or file, being careful not to get any chips in cylinder head gallery feed hole. Chamfer the rear edge of the hole slightly to reduce the possibility of shavings down the outer diameter of the bearing when it is installed.

2. Insert Remover Adapter J-6173-4 into front bearing to act as a support for the shaft. NOTE: If front bearing is being replaced, insert Remover Adapter in center bearing to act as support for the shaft.

3. Insert pilot J-6173-7 into hole in which bushing is to be installed.

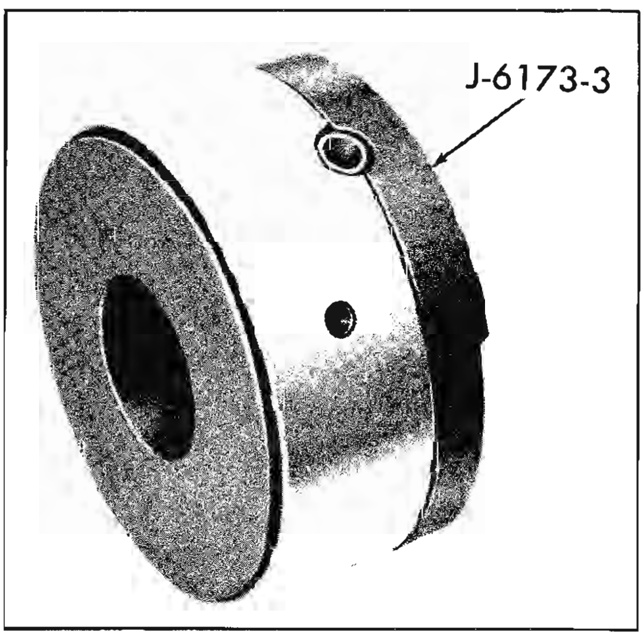



Fig. 6-46 Bearing Installed on Replacer Adapter

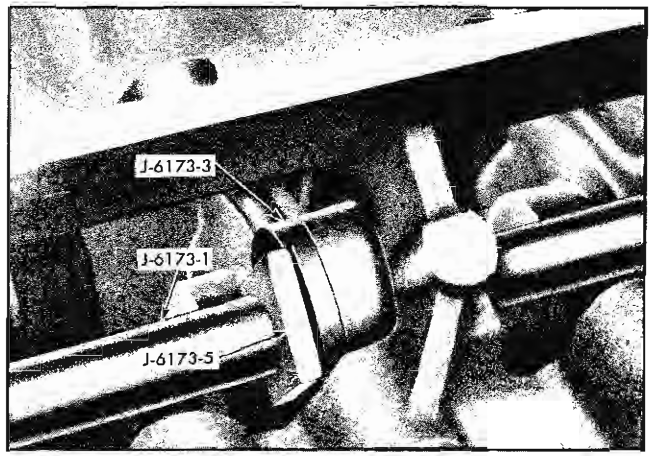



Fig. 6-47 Tools Positioned for Bearing Installation

4. Coat outside of new bearing with oil and place it over Replacer Adapter J-6173-3, indexing notch in edge of bearing with pin on Replacer Adapter (Fig. 6-46).

NOTE: The notch in the edge of the bearing is used to properly position the bearing, with respect to the oil holes, when it is installed. When bearings are installed in production, the notches all face the front except the one in the rear bearing. In the field it is necessary to install bearings with the notch facing the rear.

5. Position Replacer Adapter J-6173-3, with bearing in position against shoulder, against rear of hole in which bearing is to be installed (Fig. 6-47). Index mark on shoulder of Replacer must point toward crankshaft to properly position bearing.

6. Insert Shaft with Indexing Collar, thrust washer, and nut through Remover, pilot and Replacer Adapters and index lug on Collar with ventilation hole in front of block (Fig. 6-44).

7. Slip key J-6173-5 into notches in shaft behind Replacer Adapter J-6173-3 and tighten nut to start bearing into hole (Fig. 6-47). Continue to tighten nut until bearing has been pulled completely into its hole. When properly positioned, it will be approximately flush with both sides of the transverse member.

NOTE: Rear bearing should be pulled in until front edge is flush with block. This will leave shoulder at end of counterbore for camshaft rear plug visible behind bearing.

8. Remove Remover and Replacer J-6173.

9. Visually observe that holes in bearing line up with drillings in block.

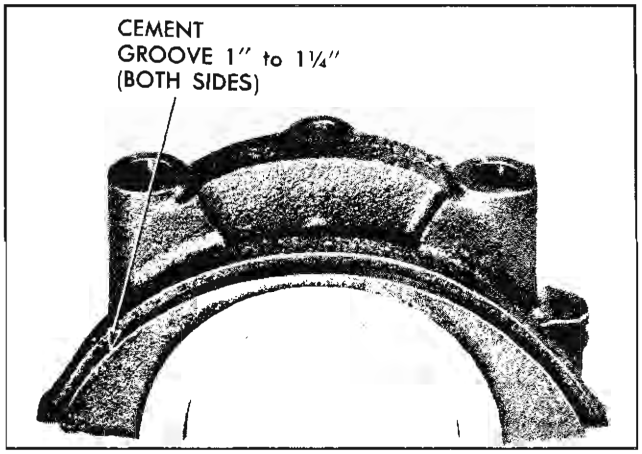



Fig. 6-48 Oil Pan Gasket Positioned in Bearing Cap

10. Carefully remove rags used to catch particles of metal and use magnet or vacuum cleaner to make sure that all metal particles are removed from block surfaces and oil drillings.

11. Coat inner diameters of all camshaft bearings with oil and install camshaft. Rotate camshaft through several revolutions to make sure it is completely free. If any tight spots are found, remove camshaft and very carefully polish down the center journal slightly. If still not free, polish the front and rear journals slightly. If any particular bearing causes binding of the camshaft, replace that bearing also.

NOTE: Front center and rear center journals should not be polished except to remove slight roughness or scratches. Slight warpage of the camshaft is not harmful providing the journals are polished down until the camshaft rotates freely in its bearings.

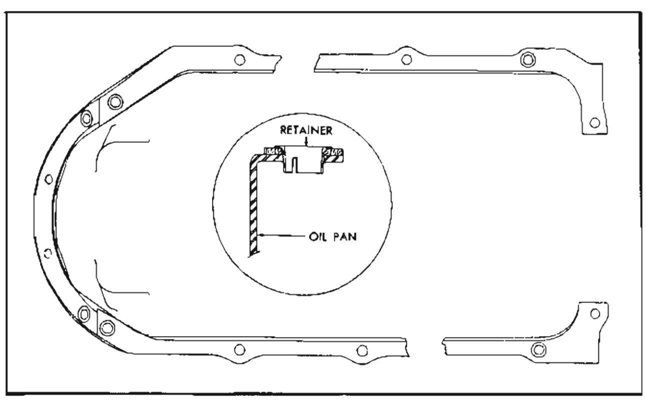



Fig. 6-49 Pan Gasket Retainer Location

## OIL PAN—BEARINGS CONNECTING ROD—PISTON—CRANKSHAFT

### ENGINE OIL PAN AND/OR GASKET REPLACE

1. Drain oil from crankcase.

2. Remove exhaust crossover pipe.

3. Support engine and remove front crossmember assembly as covered in Section 3.

4. Remove flywheel housing front shield and lower cover.

5. Remove oil pan bolts and remove oil pan.

6. Remove oil pan gaskets from oil pan. Thoroughly clean gasket surfaces of oil pan and block.

7. Remove rear bearing cap gasket from groove in cap and thoroughly clean groove.

8. Apply gasket cement to gasket groove from joint face down 1" to 1¼" (Fig. 6-48) and install new gasket.

9. Apply gasket cement to gasket surface of oil pan and position new gaskets on pan using gasket retainers where shown (Fig. 6-49). Make sure front gasket overlaps side gaskets (Fig. 6-50). Retainers should be used to hold gasket in position for installation.

10. Reverse procedure for installing oil pan. Use new oil pan gasket.

11. Refill crankcase.

### OIL PUMP—REMOVE AND REPLACE

1. Remove engine oil pan.

2. Remove oil pump attaching bolts while holding

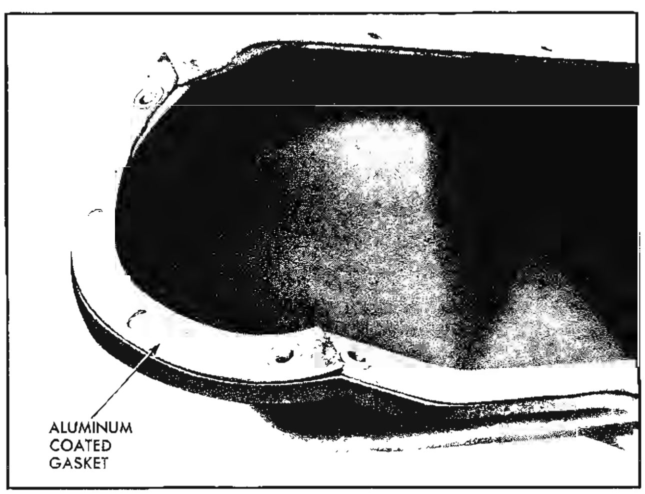



Fig. 6-50 Oil Pan Gaskets Positioned for Installation

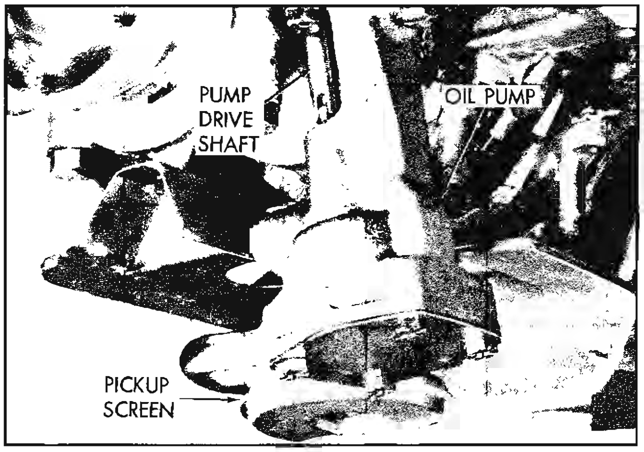



Fig. 6-51 Oil Pump and Oil Pump Drive Shaft

oil pump in place. Carefully lower oil pump away from block with one hand while removing oil pump drive shaft with other hand (Fig. 6-51).

3. Position drive shaft in distributor and oil pump drive gears. Place pump against block using new gasket between pump and block. Index drive shaft with pump drive gear shaft. Install two attaching screws with lock washers and tighten securely.

NOTE: Removal and installation of pump does not affect ignition timing, since the oil pump and distributor drive gear is mounted on the distributor shaft.

4. Install oil pan.

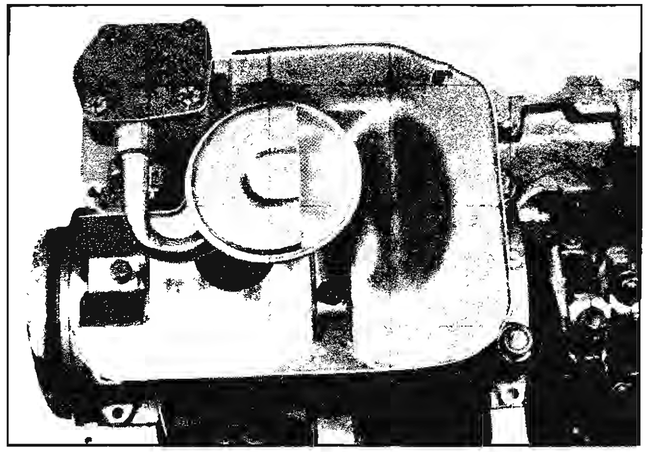


Fig. 6-52 Oil Pump Screen Assembly

***OIL PUMP—RECONDITION***

## DISASSEMBLE

1. Remove pressure regulator spring retainer, spring, and pressure regulator ball.

2. Remove screws retaining cover to oil pump body and remove cover.

3. Remove driven gear and drive gear with shaft.

***CAUTION: Do not remove or loosen oil pump screen.***

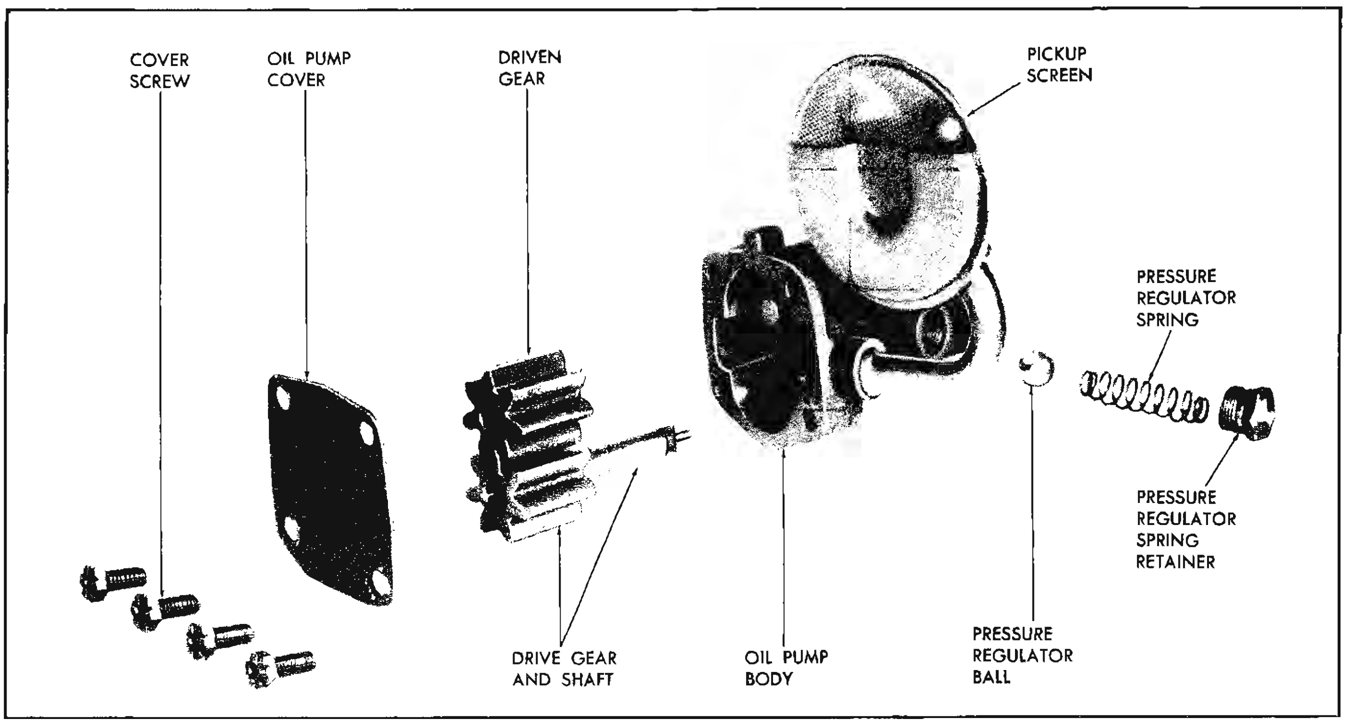



Fig. 6-53 Oil Pump Exploded View

## CLEAN AND INSPECT

1. Clean all parts thoroughly. Screen must be thoroughly cleaned by using a fluid such as used for carburetor cleaning (Fig. 6-52).

2. Inspect pressure regulator spring (Fig. 6-53) for distortion, cracks, and wear on sides.

3. Inspect pressure regulator ball to see that it is not nicked or otherwise damaged.

4. Inspect pump body, driven gear shaft and cover for evidence of wear.

5. Inspect pump gears and end of drive gear shaft for wear (Fig. 6-53).

6. Inspect oil pump drive shaft (distributor to pump shaft) for evidence of wear and cracks.

## ASSEMBLE

1. Install drive and driven gears.

2. Install cover and turn drive shaft by hand to ensure that it turns freely.

3. Install pressure regulator ball, spring and retainer.

***CAUTION: Do not attempt to change oil pressure by varying length of pressure regulator valve spring.***

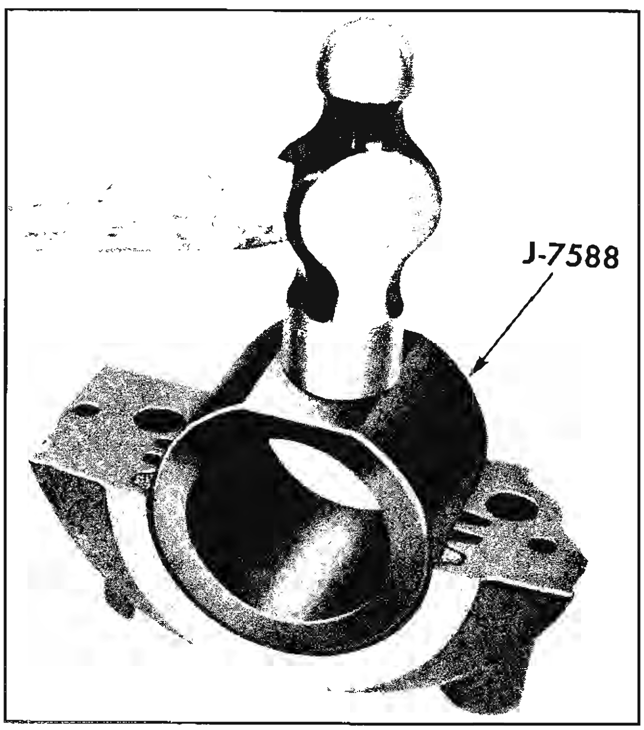



Fig. 6-54 Compressing Seal in Bearing Cap

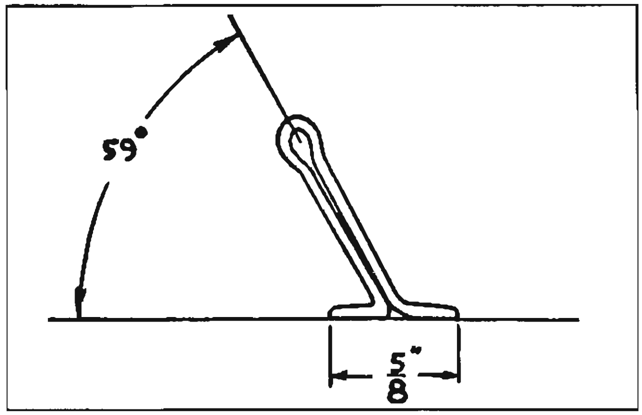



Fig. 6-55 Tool for Removing Upper Half of Main Bearing

### *REAR MAIN BEARING OIL SEAL REPLACE*

1. Drain oil from crankcase.

2. Disconnect propeller shaft and torque tube from rear of engine by following procedure given in Section 4.

3. Support engine and remove front crossmember assembly as covered in Section 3.

4. Remove oil pan.

5. Remove oil baffle and cylinder block to oil baffle tube.

6. Remove rear center main bearing cap and upper half of rear center main bearing shell. This will eliminate danger of damaging thrust surfaces of bearing and will also allow crankshaft to be lowered more easily.

NOTE: See steps 4 and 5 under "Main Bearings Replace" page 6-29 for method of removing upper half of bearing insert.

7. Remove rear main bearing cap and loosen remaining bearing caps sufficiently to allow crankshaft to be lowered approximately ½" at the rear.

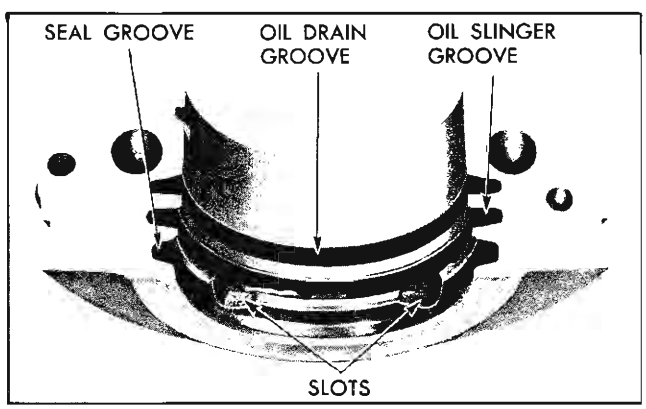



Fig. 6-56 Rear Main Bearing Cap

8. With crankshaft lowered to provide clearance, remove upper half of rear main bearing oil seal.

9. With rear main bearing cap on bench, remove oil seal and bearing shell (Fig. 6-56).

10. Install new seal in block as follows:

a. First install seal in cap and compress seal using hammer and Seal Compressor J-7588 (Fig. 6-54).

b. Trim one end of seal flush with cap.

c. Rotate seal slightly and recompress to eliminate "bumps" caused by seal retention slots.

d. Remove seal from cap, and install in block by slipping up over crankshaft into seal cavity of block. Insert end which was flush with cap first.

e. Install rear center main bearing cap with bearing shell and tighten to 95 lb. ft. torque to pull crankshaft up into place against seal.

f. Carefully trim both ends of seal flush with block.

11. Install a new seal in rear main bearing cap using tool J-7588 to pack seal tightly. Be sure to pack seal tightly into groove and trim flush with cap.

12. Install cap with shell and tighten to 120 lb. ft. torque.

13. Remove rear main bearing cap again and inspect split line between cap and block to be certain that none of the seal material has been compressed between the two. If inspection shows material between cap and block surface, scrape it off to insure proper seating of metal surfaces.

14. Clean face of rear main bearing cap with volatile type cleaner to remove all oiliness. Then apply a $\frac{1}{16}''$ diameter bead of sealer on face of the cap from packing groove to external cork groove on both sides. Reinstall cap and tighten to 120 lb. ft. torque.

15. Remove rear center main bearing cap and reinstall upper half of bearing shell. Reinstall rear center main bearing cap and tighten to 95 lb. ft. torque. Tighten remaining main bearing caps to 95 lb. ft. torque.

16. Replace transmission, oil pump, oil baffle, oil pan and flywheel housing lower cover and shield.

17. Reinstall crossmember assembly and refill crankcase.

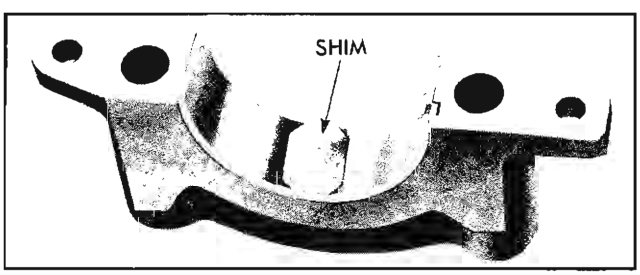


Fig. 6-57 Shim Positioned in Bearing Cap

### *MAIN BEARINGS REPLACE*

1. Drain oil and remove oil pan (page 6-26).

2. To gain access to rear center bearing cap, remove oil baffle. To gain access to rear main, remove oil pump in addition to oil baffle.

3. Remove bearing cap of main bearing to be replaced.

4. Make a tool for removing upper half of bearing shell as shown in Fig. 6-55; J-8080 can also be used.

NOTE: Rear main journal does not have oil hole. To remove upper bearing use screw driver or punch in oil groove to start bearing around to where it can be rotated free of block.

5. Insert tool in oil hole of crankshaft and rotate crankshaft in usual direction of rotation. This will cause bearing to be moved from between shaft and bearing seat.

6. Oil bearing surface of shell and stall by inserting plain end of bearing shell at indented side of bearing seat and gently rotating shell into place by turning shaft.

NOTE: The rear main bearing cap has three grooves, one for oil drain, one for the oil slinger and the other for the seal (Fig. 6-56). The bearing shells have two oil grooves. The front oil groove in the upper shell has an oil hole in the center while the rear oil groove has three oil drain holes evenly spaced. The upper and lower shells are not interchangeable due to location of tang slots in block and cap. For the front, front center, center, and rear center bearings install the shells with the oil grooves in the cylinder block (upper) position and install the shells without the oil grooves in the cap (lower) position. There will be no oil supply to the bearings if the shells are reversed.

7. Install new bearing lower half by inserting in bearing cap so indentation in shell and cap coincide.

8. Install bearing cap and check fit of bearing using plastigage or shim stock as outlined on page 6-30.

9. Replace oil pump, cylinder-block-to-oil-baffle tube, and oil baffle if they were previously removed.

10. Replace oil pan using new gaskets and fill crankcase with oil.

### MAIN BEARING CLEARANCE CHECK

#### PLASTIGAGE METHOD

1. Place a piece of Plastigage plastic for length of bearing in bearing (bearing must be free of oil); install main bearing and cap and tighten to 95 lb. ft. except rear main torque to 120 lb. ft. DO NOT TURN CRANKSHAFT WITH PLASTIGAGE IN PLACE.

When position of engine is such that weight of crankshaft is on bearing caps, all bearing caps must be in place and tightened so crankshaft weight will be properly supported and not give error in reading at bearing being checked. Shim caps on either side of bearing being checked to force crankshaft against upper half of bearing.

2. Remove bearing cap and using Plastigage scale measure width of flattened piece of plastic. If reading is not over 2, standard size main bearing should be used; if reading is over 2, use .001" undersize bearing and recheck. Main bearing inserts .002" undersize are available for cases where use of the .001" undersize bearing results in excessive clearance.

3 After determining that the correct bearing insert has been fitted, tighten bearing cap to final tightness of 95 lb. ft. torque except rear main bearing cap which should be tightened to 120 lb. ft. torque. NOTE: Before installing rear main bearing cap, apply a 1/16" wide bead of sealer on face of rear main bearing cap from packing groove to external cork groove on both sides. Reinstall cap and tighten to 120 lb. ft. torque. NOTE: Lock washers are not used on main bearing cap screws.

#### SHIM STOCK METHOD

1. Place .002" brass shim 1/2" wide by 1" long in main bearing cap with new standard bearing and install cap, pulling up bolts 95 lb. ft. except rear main torque to 120 lb. ft. in step 6. Refer to Fig. 6-57 for position of shim in cap.

2. Attempt to rock crankshaft by hand 1" in either direction.

***CAUTION: Do not attempt to move crankshaft more than 1" in either direction or shim may damage bearing.***

3. Repeat test in step 2 without shim. If crankshaft moves freely without shim in place and locks with .002" shim, the standard bearing is satisfactory. If it is possible to rock the crankshaft freely with the .002" shim, the .001" undersize bearing should be used and the fit rechecked. If necessary recheck with .002" undersize bearing.

4. After determining that the correct bearing insert has been fitted, tighten bearing cap to final tightness of 95 lb. ft. torque except rear main bearing cap which should be tightened to 120 lb. ft. torque.

NOTE: Before installing rear main bearing cap, apply a 1/16" wide bead of sealer on face of rear main bearing cap from packing groove to external cork groove on both sides. Reinstall cap and tighten to 120 lb. ft. torque. Note: Lock washers are not used on main bearing cap screws.

### CONNECTING ROD BEARINGS REPLACE

1. Drain oil and remove oil pan (page 6-26).

2. To gain access to numbers 3 or 4 connecting rod caps it will be necessary to remove oil pump screen and oil baffle.

3. Rotate crankshaft as necessary to bring crank pin carry bearing to be replaced straight down.

4. Remove bearing cap of bearing to be replaced.

5. Install Connecting Rod Bolt Guide Set J-5239 on connecting rod bolts (Fig. 6-58).

6. Push piston and rod assembly up far enough to allow removal of bearing shell. Remove bearing shells from rod and cap.

7. Inspect crank pin for damage, out-of-round, and taper.

8. Reassemble cap and rod with new bearing shells and check fit using plastigage or shim stock as outlined on page 6-31.

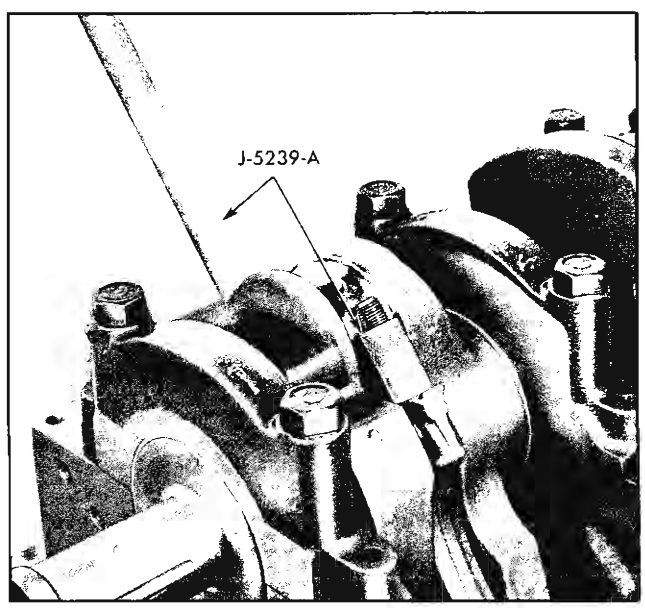



Fig. 6-58 Bolt Guide Set Installed

9. Replace oil baffle and oil pump screen if they were removed.

10. Replace oil pan (page 6-26) using new gaskets and fill with engine oil.

## *CONNECTING ROD BEARING CLEARANCE CHECK*

### PLASTIGAGE METHOD

1. Place a piece of Plastigage plastic the length of bearing in bearing (bearing must be free of oil); install bearing and cap and tighten nuts to 45 lb. ft. torque. DO NOT TURN CRANKSHAFT WITH PLASTIGAGE IN PLACE.

2. Remove bearing cap. Using Plastigage scale, measure width of flattened piece of plastic. If reading is not over 2¼, standard size connecting rod bearing should be used; if over 2¼, use .001″ undersize bearing and recheck. Connecting rod bearing inserts .002″ undersize are available for cases where use of the .001″ undersize bearing results in excessive clearance.

3. After determining that the correct bearing insert has been fitted, tighten connecting rod cap nuts to final tightness of 45 lb. ft. torque. Nuts are self-locking and require no lock washers or cotter pins.

### SHIM STOCK METHOD

1. Place .0015″ brass shim ½″ wide by ⅞″ long in bearing cap with new standard insert and install cap. Tighten nuts to 45 lb. ft. torque.

2. Attempt to move connecting rod endwise on crankpin by hand and then by a light tap of a hammer.

3. Repeat test to move rod endwise by hand with shim removed. If connecting rod did not move by hand, but moved by tap of hammer in Step 2 and moved freely in this step, the standard bearing should be used. If rod could be moved by hand in Step 2, install .001″ undersize bearing. If necessary, recheck with 002″ undersize bearing.

4. After determining that the correct bearing insert has been fitted, tighten connecting rod cap nuts to final tightness of 45 lb. ft. torque. Nuts are self-locking and require no lock washers or cotter pins.

### PISTON AND ROD ASSEMBLY—REMOVE

1. Remove engine and mount in holding fixture.

2. Remove intake manifold (Page 6-11).

3. Remove cylinder head (Page 6-16).

4. Drain oil, invert engine and remove oil pan. If number 3 or 4 rod and piston are to be removed, remove oil baffle and oil pump screen.

5. Rotate crankshaft so crank pin carrying assemblies to be replaced projects straight upward.

6. Remove bearing cap and install connecting Rod Bolt Guide Set J-5239 (Fig. 6-58).

7. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide (J-5239).

### PISTON AND ROD ASSEMBLY—INSTALL

1. Install connecting rod bolt guide set on connecting rod bolts with long handle guide on same side as oil groove in rod.

2. Using suitable ring compressor insert piston and connecting rod assembly into cylinder so that notch in top of piston is toward front of engine.

3. From beneath engine, pull connecting rod, with bearing shell in place, into position against crank pin.

4. Remove guide set J-5239. Install bearing cap and cap nuts and tighten to 45 lb. ft. torque.

5. Replace oil pump and baffle.

6. Replace oil pan using new gaskets. Tighten oil pan screws to 15 lb. ft. torque.

7. Install cylinder head and intake manifold.

8. Install engine.

9. Refill crankcase and cooling system, and check for leaks.

| PISTON | BASE SUPPORT | PILOT PLUNGER |
|---|---|---|
| 4 Cyl. | J-6901-1 | J-6901-2 |
| V-8 | J-6901-1 | J-6901-6 |

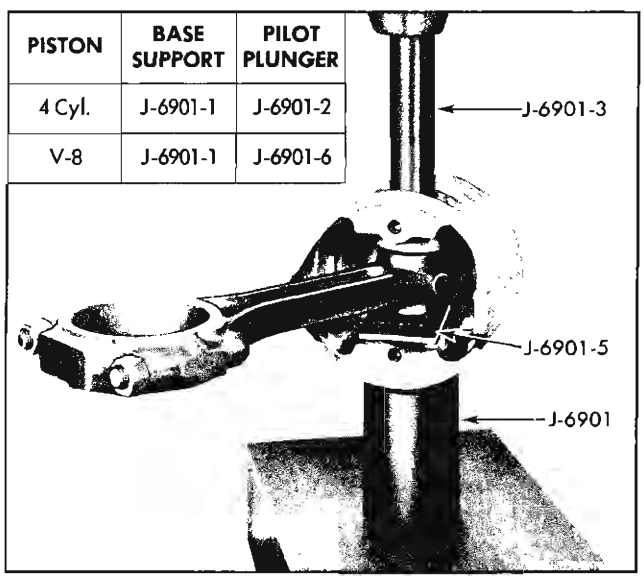



Fig. 6-59 Removal of Piston Pin

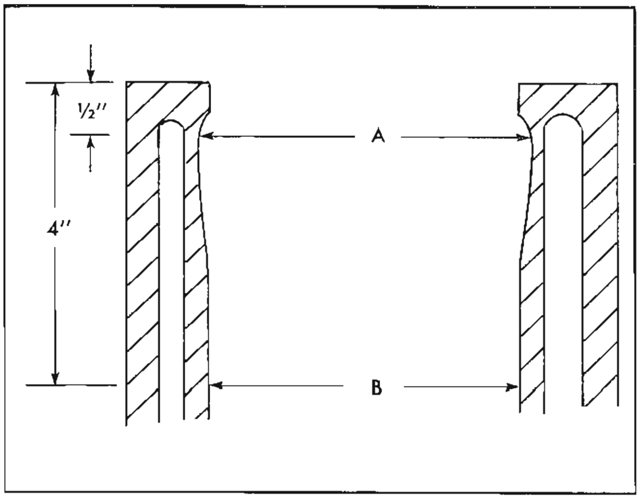



Fig. 6-60 Normal Cylinder Wear Pattern

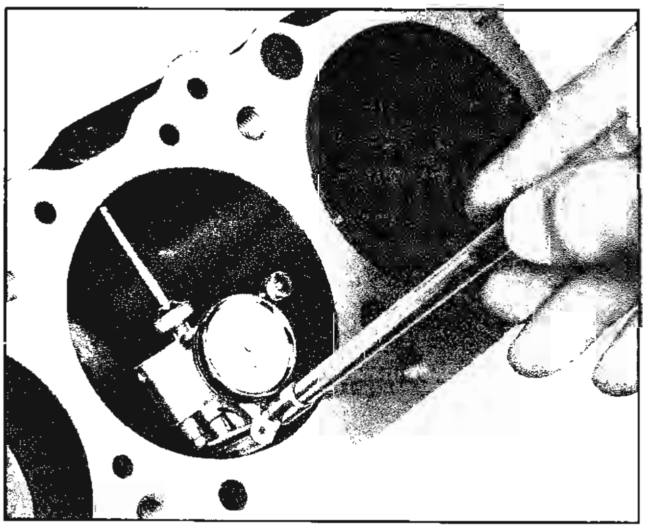


Fig. 6-61 Measuring Cylinder Bore

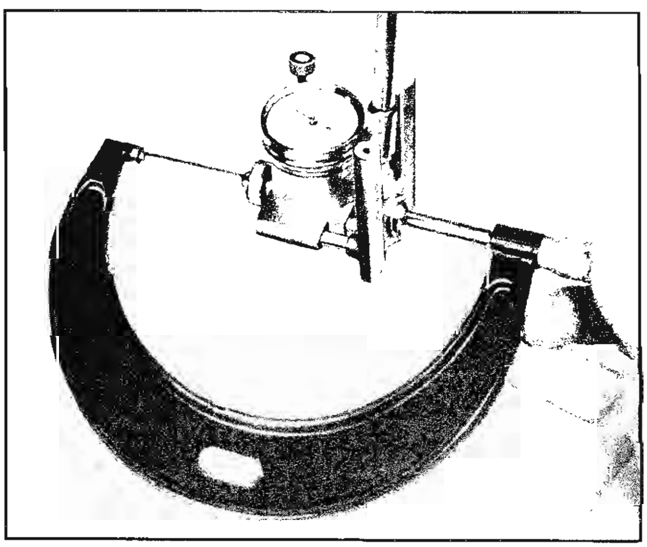


Fig. 6-62 Measuring Cylinder Gauge

***CONNECTING ROD AND PISTON ASSY. RECONDITION***

NOTE: Use care at all times when handling and servicing connecting rods and pistons. To prevent possible damage to these units, do not clamp rod or piston in vise since they may become distorted. Do not allow pistons to strike against one another, against hard objects or bench surfaces, since distortion of piston contour or nicks in the soft aluminum material may result.

## DISASSEMBLE ROD AND PISTON

1. Remove connecting rod and piston assembly as covered on page 6-31.

2. Remove piston rings using suitable piston ring remover.

NOTE: It is important that rings be removed carefully to prevent scratching or burring of ring grooves and lands.

3. Using a suitable arbor press place the spring and plunger into the bore of the base support and position on an arbor press with the pilot plunger indexed in the bottom of piston pin bore. See Fig. 6-59 insert for correct base support and pilot plunger for the type pistons being serviced.

4. Place tool J-6901-5 between connecting rod and piston boss (Fig. 6-59).

5. Place tool J-6901-3 (Fig. 6-59) in piston pin and press piston pin down until pin bottoms in tool J-6901.

6. Remove tool J-6901-5 from between connecting rod and piston boss.

7. Remove pilot plunger and spring from tool J-6901.

8. Place end of piston pin in tool J-6901 and place on arbor press.

9. Using tool J-6901-3 (Fig. 6-59) press pin out of piston and connecting rod.

10. Remove bearing cap and bearings.

## CLEAN AND INSPECT CONNECTING ROD AND PISTON

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to assure against subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

NOTE: If piston pin bosses are rough or worn out-of-round and the piston is otherwise serviceable, the pin bosses may be honed for oversize pins. Before fitting oversize pins, however, it is advisable to check fit of piston in bore.

4. Inspect piston pin for scoring, roughness, or uneven wear.

5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.

## CYLINDER BORES—INSPECT

Inspect cylinder bores for out-of-round or excessive taper, with an accurate cylinder gauge J-8087 or comparable, at top, middle and bottom of bore. (Fig. 6-61). Measure cylinder bore parallel and at right angles to the center line of the engine to determine out-of-round. Variation in measure from top to bottom of cylinder indicates the taper in the cylinder. Fig. 6-60 illustrates area in cylinder where normal wear occurs. If dimension "A" is larger than dimension "B" by .007", it indicates the necessity of cylinder boring and installing new rings and pistons. Cylinder bores can be measured by setting the cylinder gauge dial at zero in the cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across the gauge contact points with outside micrometer with the gauge at the same zero setting when removed from the cylinder (Fig. 6-62).

Fine vertical scratches made by ring ends will not cause excessive oil consumption, therefore, honing to remove is unnecessary.

## HONING OR BORING

If a piston in excess of .005" oversize is to be installed, the cylinder should be bored, rather than honed, to effect a true bore.

Full strokes of the hone in cylinder should be made, in addition to checking measurement at top, middle and bottom of bore repeatedly, to eliminate the possibility of honing taper into the cylinder.

When boring each cylinder always be sure the crankshaft is out of the way of boring cutter.

Crankshaft bearings and other internal parts must be covered or taped to protect them during boring or honing operation. When taking the final cut with a boring bar leave .001" on the diameter for finish honing to give the required piston to cylinder clearance specifications.

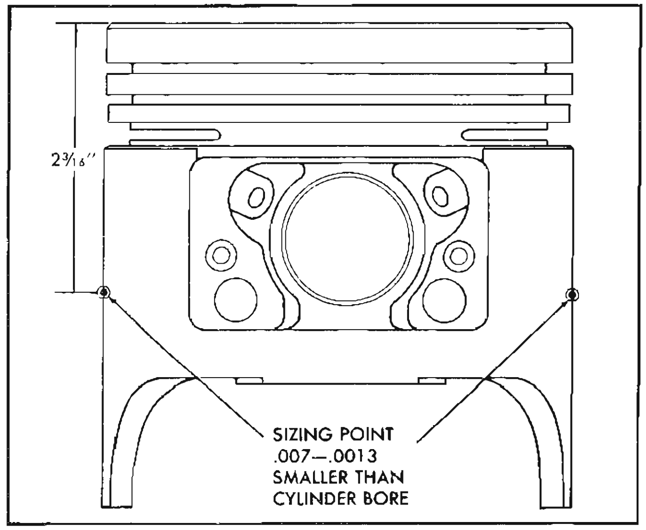



Fig. 6-63 Sizing Points of Piston

NOTE: Honing or boring operation must be done under close supervision so that specified clearance between pistons, rings, and cylinder bores is maintained.

By measuring the piston to be installed at the sizing points (Fig. 6-63) and adding the mean of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both the block and piston be measured at normal room temperature, 60°-90°F.

After final honing and before the piston is checked for fit, each cylinder bore must be thoroughly cleaned.

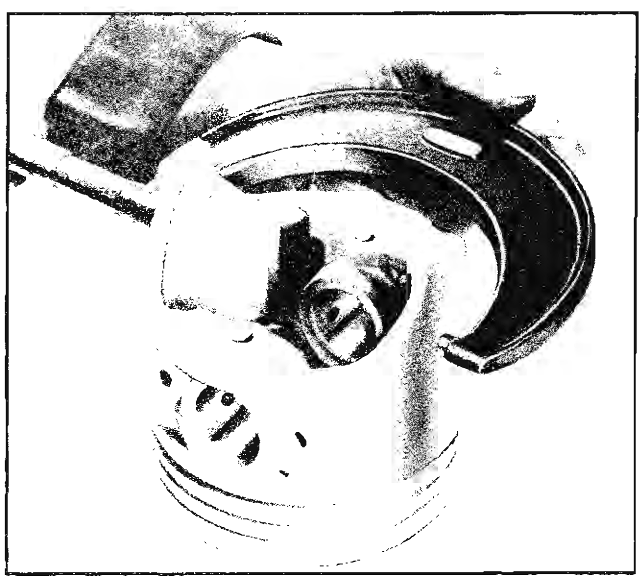


Fig. 6-64 Measuring Piston

| PISTON | BASE SUPPORT | PILOT PLUNGER |
|---|---|---|
| 4 Cyl. | J-6901-1 | J-6901-2 |
| V-8 | J-6901-8 | J-6901-6 |

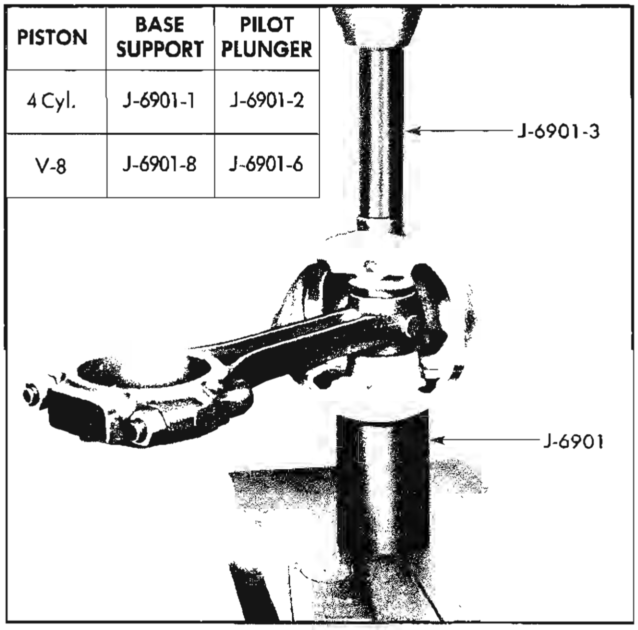



Fig. 6-65 Installation of Piston Pin

Use soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will result.

Intermixing different size pistons has no effect on engine balance as all Pontiac pistons from standard size up to .030" oversize weigh exactly the same.

## FIT AND REPLACE PISTON

Pistons should be fitted in the bores by actually measuring the fit. Clearance between the piston and the cylinder bore should be .0007" to .0013".

If cylinder bores have been reconditioned, or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated. If bore has been honed, it should be washed thoroughly with hot, soapy water and stiff bristle brush.

Using a cylinder checking gauge, measure the cylinder bore crosswise of the block to find the smallest diameter. Record the smallest diameter of each bore.

NOTE: When measuring cylinder bores and pistons it is very important that the block and pistons be at room temperature. If any or all of the parts are hotter or colder than normal room temperature, improper fitting will result.

Measure the piston skirt perpendicular to the piston pin boss (piston pin removed) at the sizing point (Fig. 6-63). Make sure the micrometer is in full contact (Fig. 6-64).

As pistons are measured they should be marked for size identification and the measurements recorded. If there is excessive clearance between a cylinder bore and the piston which was installed in that bore, a new piston should be used.

New pistons are serviced for both standard and premium fuel engines in standard size and .005", .010", .020" and .030" oversizes.

NOTE: Since these are nominal or basic sizes, it is important that new pistons be measured to ensure proper fit. All new pistons are serviced with selectively fitted piston pins.

After all measurements have been made, match the new pistons with the cylinders where they will fit with proper clearance. Honing of cylinder bore may be necessary to effect a proper fit. When properly mated, mark the pistons with the cylinder numbers they fit so they will not become mixed.

## FITTING PIN IN PISTON

The piston pin fit in piston is .0003" to .0005" loose with pin and bosses clean and dry.

NOTE: Piston and pin must be at room temperature when checking fit and pin must be able to fall from piston by its own weight.

## FITTING OVERSIZE PINS IN PISTONS AND CONNECTING ROD PIN BORES

In case the standard size piston pin does not fit properly in the piston, an oversize piston pin must be fitted. Piston pins are available in .001" and .003" oversize.

When oversize pins are used, the piston pin bosses must be honed to give the required fit. It will also be necessary to hone the connecting rod pin bore to fit the oversize pin using a Sunnen hone or similar accurate equipment.

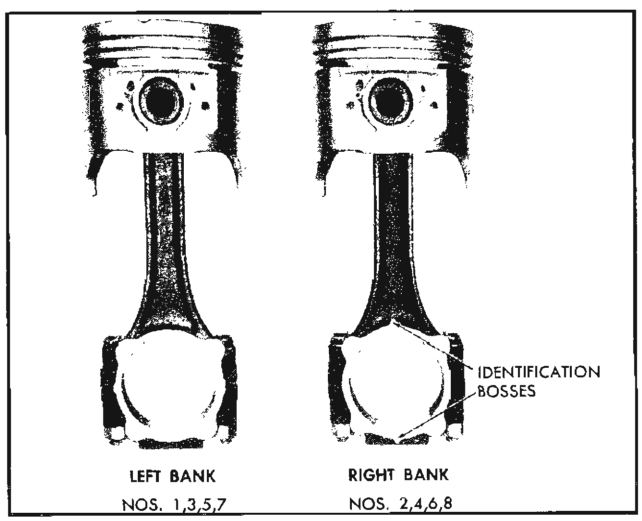



Fig. 6-66 Rod and Piston Assembly

NOTE: A special grit hone is used for honing the connecting rod pin bore. The piston pin size should be .0008" to .0016" larger than the connecting rod pin bore for the proper press fit. The piston pin should not show any movement under 1500 lb. minimum load after assembly in rod.

## ASSEMBLE CONNECTING ROD TO PISTON

All pistons have a notch cast in the top of the piston head at the front to facilitate proper installation. The piston assemblies should always be installed with the notch or notches toward the front of the engine.

One side of the connecting rod will have small identification bosses (Fig. 6-66). This side of the connecting rod should be installed toward the rear of the engine (four cylinder). In the V-8 engine the connecting rod small identification bosses on the odd number rods will always be facing the rear of the engine while the small identification bosses on even number rods will be facing the front of the engine.

## REPLACE PISTON PIN

1. Place plunger and spring in tool J-6901 (Fig. 6-65) to be used as a pilot and stop.

2. Place plunger of tool J-6901 in piston pin bore and place on arbor press.

3. Coat piston pin and rod lightly with graphite lubricant.

4. Place tool J-6901-3 in piston pin and press pin into piston and connecting rod (Fig. 6-65) until piston pin bottoms against plunger of tool J-6901. Piston must turn freely on pin. If piston binds on pin, disassemble, hone piston bosses slightly and reassemble.

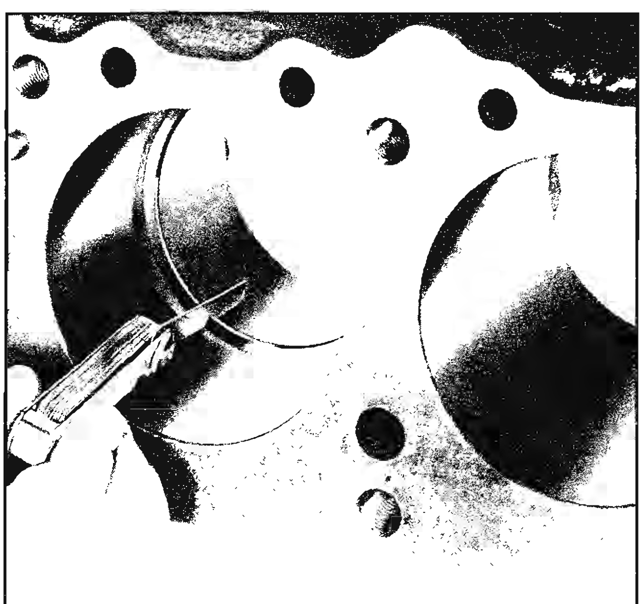


Fig. 6-67 Checking Ring Cap

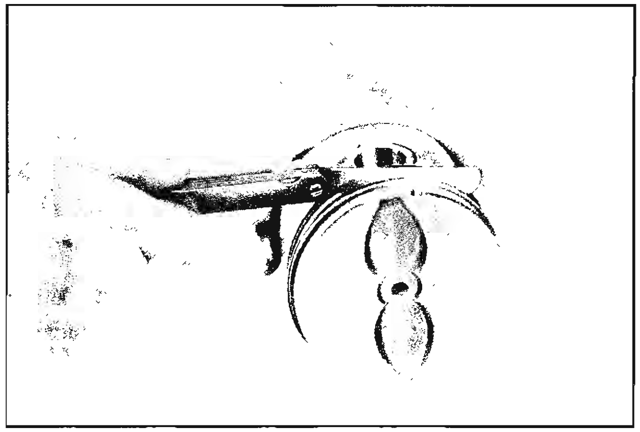


Fig. 6-68 Measuring Side Clearance of Ring in Groove

## *PISTON RINGS REPLACE*

1. Remove oil pan.

2. Remove oil pump and baffle.

3. Remove intake manifold.

4. Remove cylinder heads.

5. Rotate crankshaft so crank pin carrying assembly to be replaced projects straight upwards.

6. Remove bearing cap and install connecting rod bolt guide set J-5239. Reinstall cap on connecting rod to ensure against subsequent mix of caps and connecting rod.

7. Carefully remove connecting rod and piston assembly by pushing out with narrow handle of ring guide (J-5239).

8. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

9. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

10. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.

11. Inspect cylinder bores for out-of-round or excessive taper. If bores show excessive out-of-round or

taper, or if cylinder walls are badly scored, scratched or worn beyond specified limits, the cylinder block should be rebored and new pistons and rings installed.

## INSTALL PISTON RINGS

Two compression rings and one 4-piece oil control ring, all above the piston pin, are used on pistons for both standard and premium fuel engines. The top compression rings are taper faced and also have either a step or a chamfer on the inside diameter of the top side. The top compression ring is chrome plated. The lower compression ring may have a step or chamfer on the inside but **should always be installed with the mark (letter "T", dot or word "TOP") toward the top.**

New rings are serviced for the standard size pistons, and for .005", .010", .020" and .030" oversize pistons. When selecting rings be sure they match the size of the piston on which they are to be installed, i.e. standard rings for standard pistons, .010" oversize rings for .010" oversize pistons, etc. Ring gap and side clearance should be checked while installing rings as follows:

1. Check pistons to see that ring grooves and oil return holes have been properly cleaned.

2. Place ring down at the bottom of the ring traveled part of the cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.

3. Measure gap between ends of ring with feeler gauge (Fig. 6-67). Gaps should be as follows:

| | |
|---|---|
| Upper Compression Ring | .016"-.026" |
| Lower Compression Ring | .013"-.025" |
| Oil Ring | .015"-.035" |

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore (standard .005" oversize, etc.) they should have the proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston using good ring installing tool to prevent breakage, or fracture of rings, or damage to pistons.

5. Measure side clearance of rings in ring groove (Fig. 6-68) as each ring is installed. Clearance with new pistons and rings should be as follows:

| | |
|---|---|
| Upper Compression Ring | .0015"-.0030" |
| Lower Compression Ring | .0015"-.0035" |
| Oil Control Ring | .0015"-.0085" |

If side clearance is excessive, piston should be replaced.

## PISTON AND ROD ASSEMBLY—INSTALL

1. Install connecting rod bolt guide set on connecting rod bolts with long handle guide on same side as oil groove in rod.

2. Using suitable ring compressor insert piston and connecting rod assembly into cylinder so that notch in top of piston is toward front of engine.

3. From beneath engine, pull connecting rod, with bearing shell in place, into position against crank pin.

4. Remove guide set J-5239. Install bearing cap and cap nuts and tighten to 45 lb. ft. torque.

5. Replace oil pump screen and oil baffle, if they were removed.

6. Replace oil pan using new gaskets. Tighten oil pan screws to 15 lb. ft. torque.

7. Install cylinder head and intake manifold (page 6-16).

8. Install engine.

9. Refill crankcase and cooling system, and check for leaks.

## *CRANKSHAFT—REMOVE AND REPLACE*

The crankshaft can be removed and replaced with cylinder head, pistons, rods, manifolds and other upper engine components installed, but the flywheel, clutch and transmission assemblies must be removed.

### REMOVE

1. Remove spark plugs.

2. Remove engine oil pan.

3. Remove oil pump assembly and oil pump drive shaft (Fig. 6-51).

4. Remove oil baffle and oil baffle tube (Fig. 6-52).

5. Remove harmonic balancer.

6. Remove fuel pump.

7. Remove timing chain cover, gasket and O-ring seal.

8. Remove fuel pump eccentric and bushing (Fig. 6-41 and 6-42).

9. Remove sprockets and timing chain.

10. Remove connecting rod caps.

11. Remove main bearing caps from block.

NOTE: Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Depress pistons until connecting rods are free of crankshaft.

12. Lift crankshaft from block.

REPLACE

1. With upper bearings installed position crankshaft in block.

2. Install main bearing caps (with bearing shells in place) but do not tighten retaining bolts.

3. Pull connecting rods and piston assemblies into place, rotating crankshaft as necessary to properly seat rods.

NOTE: Make sure upper bearings remain in proper position.

4. Remove tape from connecting rod threads and install connecting rod caps (with bearings) and retaining nuts, but do not tighten.

5. Tighten rear main bearing cap to 110-130 lb. ft. torque and all remaining bearing caps 90-110 lb. ft. torque.

6. Tighten connecting rod bearing cap retaining nuts 40-46 lb. ft. torque.

7. Install sprockets and timing chain, making sure timing marks on sprockets are aligned properly (Fig. 6-44).

8. Install fuel pump eccentric and bushing and insert sprocket retaining bolt with washer. Tighten securely.

9. Install timing chain cover, new cover gasket and new O-ring seal.

10. Install fuel pump.

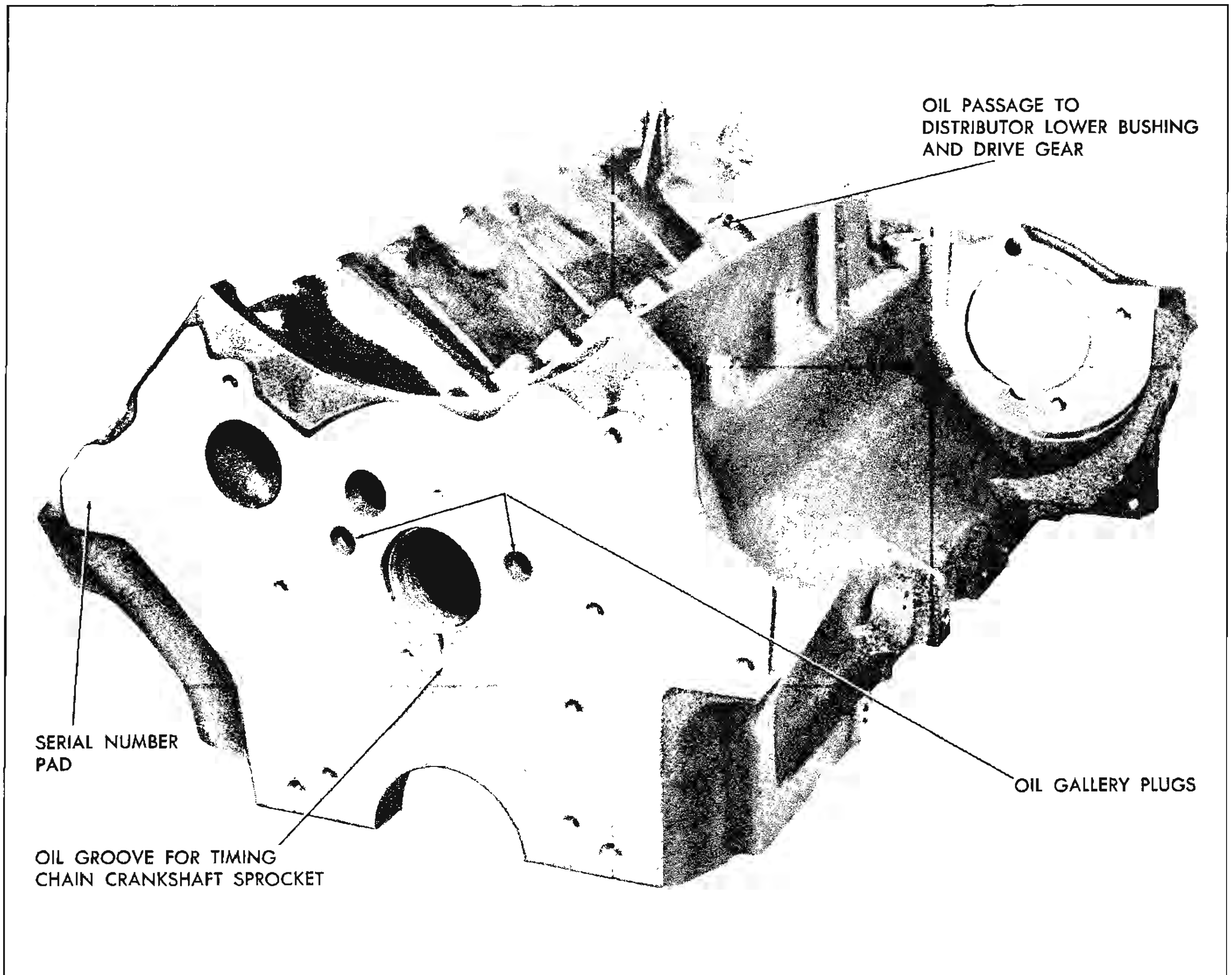



Fig. 6-69 Cylinder Block—View from Left Front—4 Cylinder Engine

11. Install harmonic balancer.

12. Install oil baffle and oil baffle tube.

13. Install oil pump drive shaft and oil pump assembly.

14. Install engine oil pan.

15. Install spark plugs.

## CYLINDER BLOCK CORE HOLE PLUGS AND OIL PASSAGE PLUGS, INSPECT AND REPLACE

Engine moving parts failure may be caused by lack of proper lubrication. Oil pressure drop may also be caused by leaking oil passage plugs. For these reasons it may be necessary to trace oil supply in block to determine area of obstructions or leaks.

NOTE: Oil circulation diagram is provided in Engine Lubrication section.

The following is a suggested procedure for tracing oil circuits.

1. Inspect all oil passages in block to see that they are not obstructed. The following is a suggested procedure.

a. With cylinder block inverted, use pen light to see that passage from oil pump to filter is open (Fig. 6-79).

b. Check passage from filter outlet to rear main bearing by inserting wire in oil filter outlet passage and using pen light to see that wire is visible in passage to rear main bearing (Fig. 6-73).

c. Visually check passage from each main bearing to corresponding camshaft bearing (Fig. 6-71 and 6-74).

d. Check passage from filter outlet (through left oil gallery) to main bearings. Use rubber hose to blow smoke in oil filter outlet while observing to

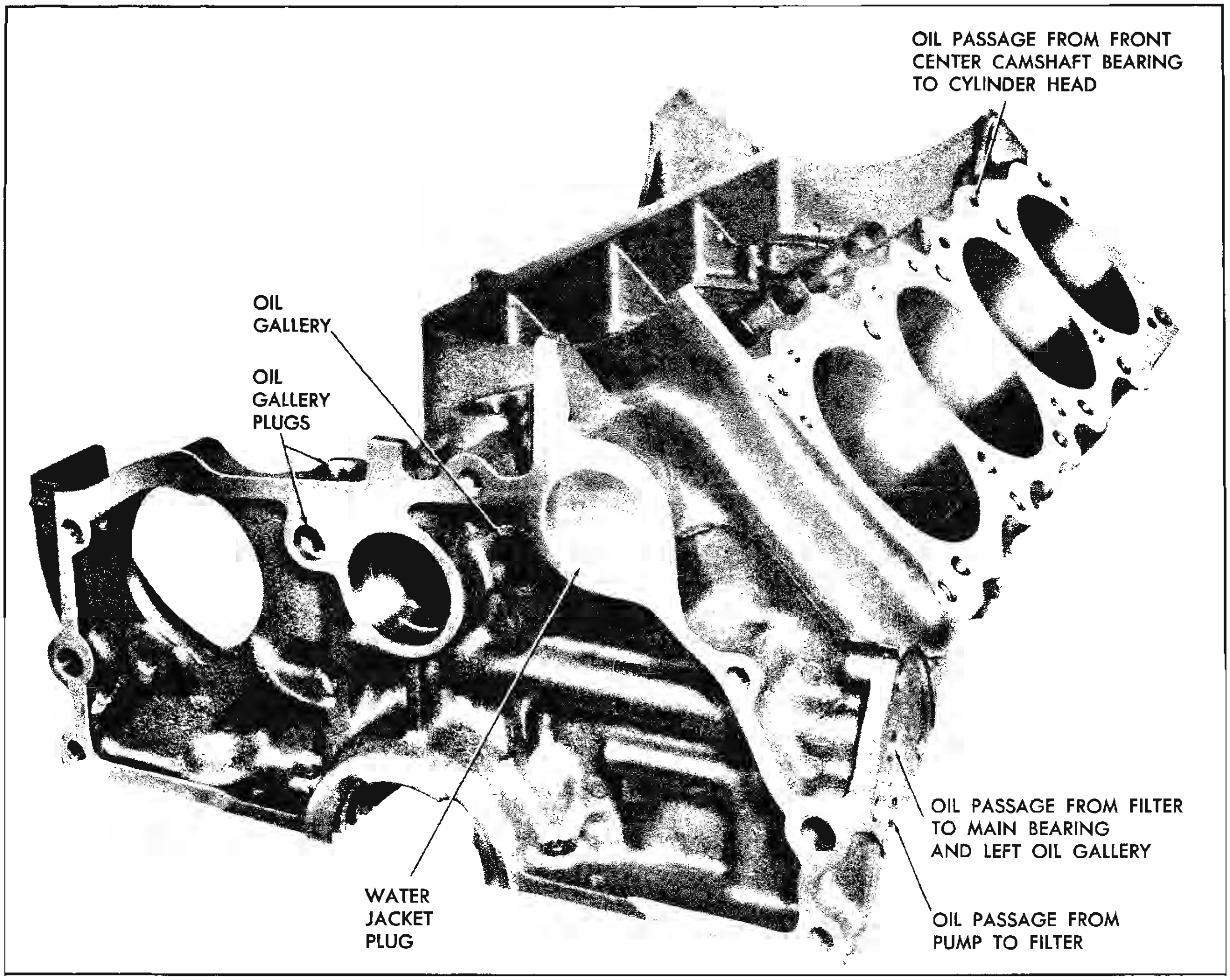



Fig. 6-70 Cylinder Block—View from Right Rear—4 Cylinder Engine

see that smoke passes out passages leading to all main bearings.

e. Check oil passages to right bank lifter bosses. Use rubber hose to blow smoke in passage from front main bearing to right main oil gallery while observing for smoke passing out passages from right gallery to lifter bosses.

f. Visually check passage from rear center camshaft bearing to left cylinder head (V-8 only) and passage from front center camshaft bearing to right cylinder head (Fig. 6-70 and 6-73).

g. Use wire to check two drain holes in lifter galley.

## REPLACE PARTIAL ENGINE ASSEMBLY

### *DISASSEMBLE*

1. Remove flywheel housing and clutch assembly.

2. Remove flywheel and mount engine in holding stand.

3. Remove motor mounts and linkage bracket.

4. Remove alternator and mounting brackets.

5. Remove fuel pump.

6. Remove harmonic balancer.

7. Remove timing chain cover, fan and pulley as

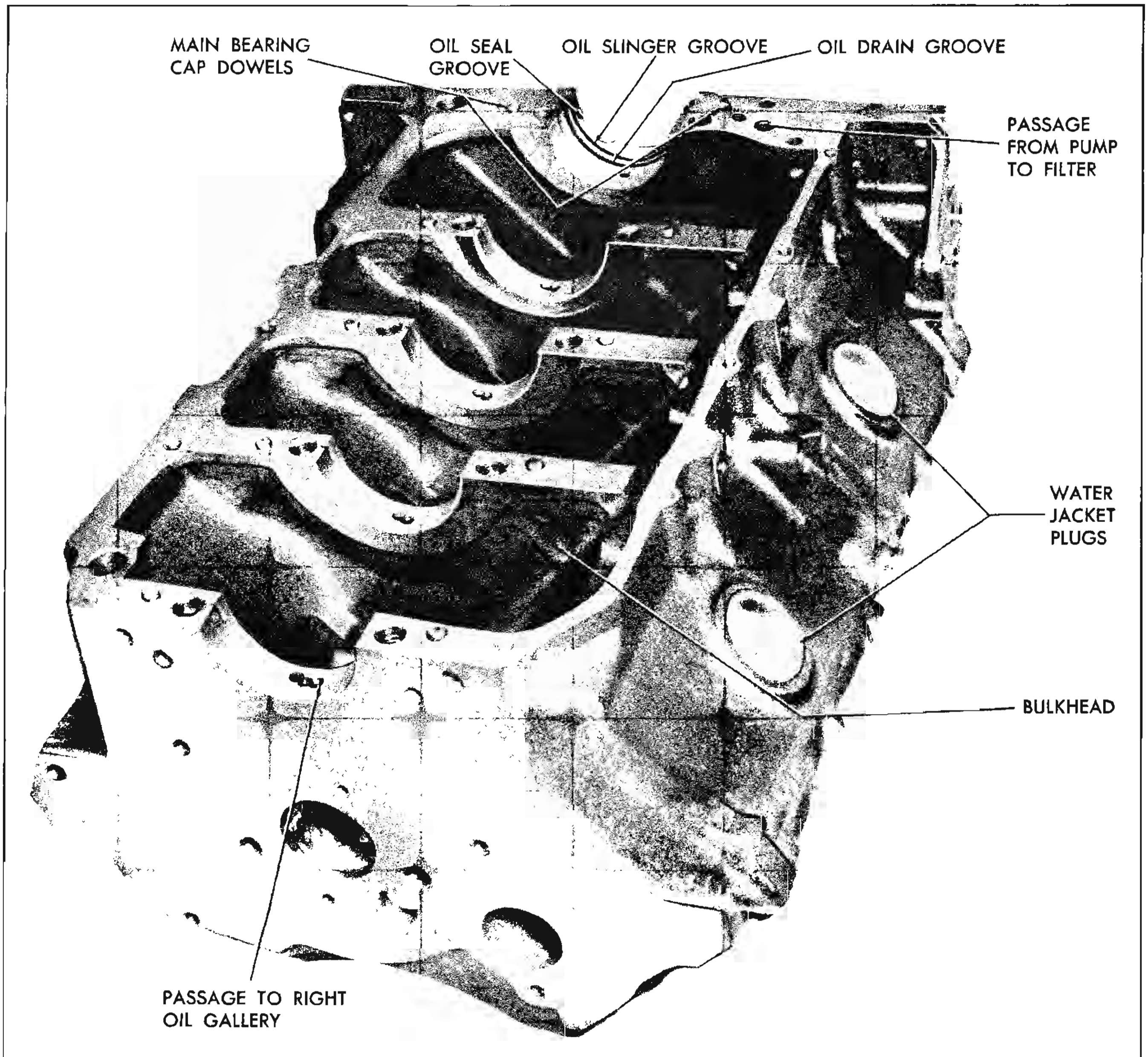



Fig. 6-71 Cylinder Block—View from Bottom—4 Cylinder Engine

an assembly. Remove timing cover mounting studs and dowels.

8. Remove timing chain tensioner bumpers, damper and spring (4 cyl. only).

9. Remove fuel pump eccentric and bushing.

10. Slide timing chain and sprockets off end of camshaft and crankshaft.

11. Remove camshaft thrust plate.

12. Remove exhaust crossover pipe.

13. Remove distributor and high tension wires.

14. Remove starter-assembly using straight box end wrench through slot in casting.

15. Remove crankcase ventilator hose.

16. Remove intake manifold.

17. Remove gasket and retainers.

18. Remove push rod cover.

19. Remove oil level indicator.

20. Remove rocker arm cover.

21. Loosen rocker arm nuts, rotate rocker arms and remove push rods. Store push rods so that they may be reinstalled in the same position as removed.

22. Remove cylinder head and exhaust manifold as an assembly.

23. Remove cylinder head gasket.

24. Remove oil filter assembly.

25. Remove valve lifters; use J-3049 if necessary. Place valve lifters in storage box J-5763 so lifters can be reinstalled in original location.

26. Remove camshaft.

27. Invert engine and remove oil pan and flywheel

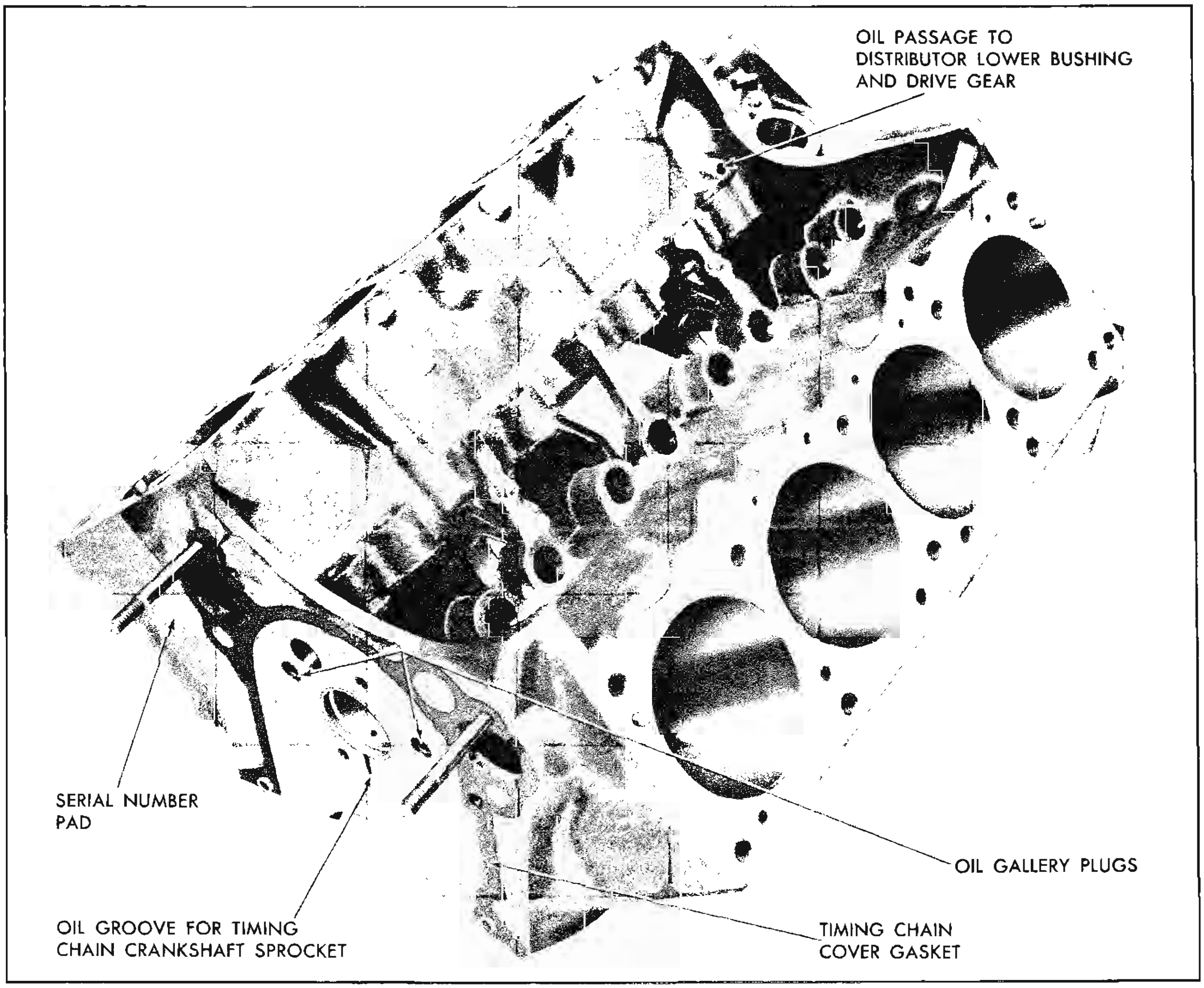



Fig. 6-72 Cylinder Block—View from Left Front—V-8 Engine

front cover.

28. Remove oil pump assembly and drive shaft.

29. Remove baffle and oil indicator tube extension.

This completes disassembly for partial engine replacement. Mount new partial engine assembly in holding fixture and proceed with assembly operations. Use new gaskets throughout and pay special attention to torque requirements.

**ASSEMBLE**

1. Install two timing cover mounting studs.

2. Install camshaft using care not to damage bearings.

3. Install camshaft thrust plate indexing oiling slot in plate with oil groove in block.

4. Make sure keys are in place in crankshaft and camshaft. Install timing chain and sprockets making sure marks in sprockets are aligned exactly on a straight line passing through the shaft centers. Alignment can be simplified by first installing sprockets without chain to align timing marks. If timing chain is excessively loose, new chain or new chain and sprockets should be used.

5. Position fuel pump eccentric bushing over eccentric with flange toward camshaft sprocket.

6. Install fuel pump eccentric on camshaft sprocket, indexing tang on eccentric with keyway cutout in camshaft sprocket.

7. Install timing chain tensioner bumpers (replace bumpers if worn), spring, and damper (4 cyl. only).

8. Install dowels in lower block holes. (Holes are counterbored to accommodate dowels).

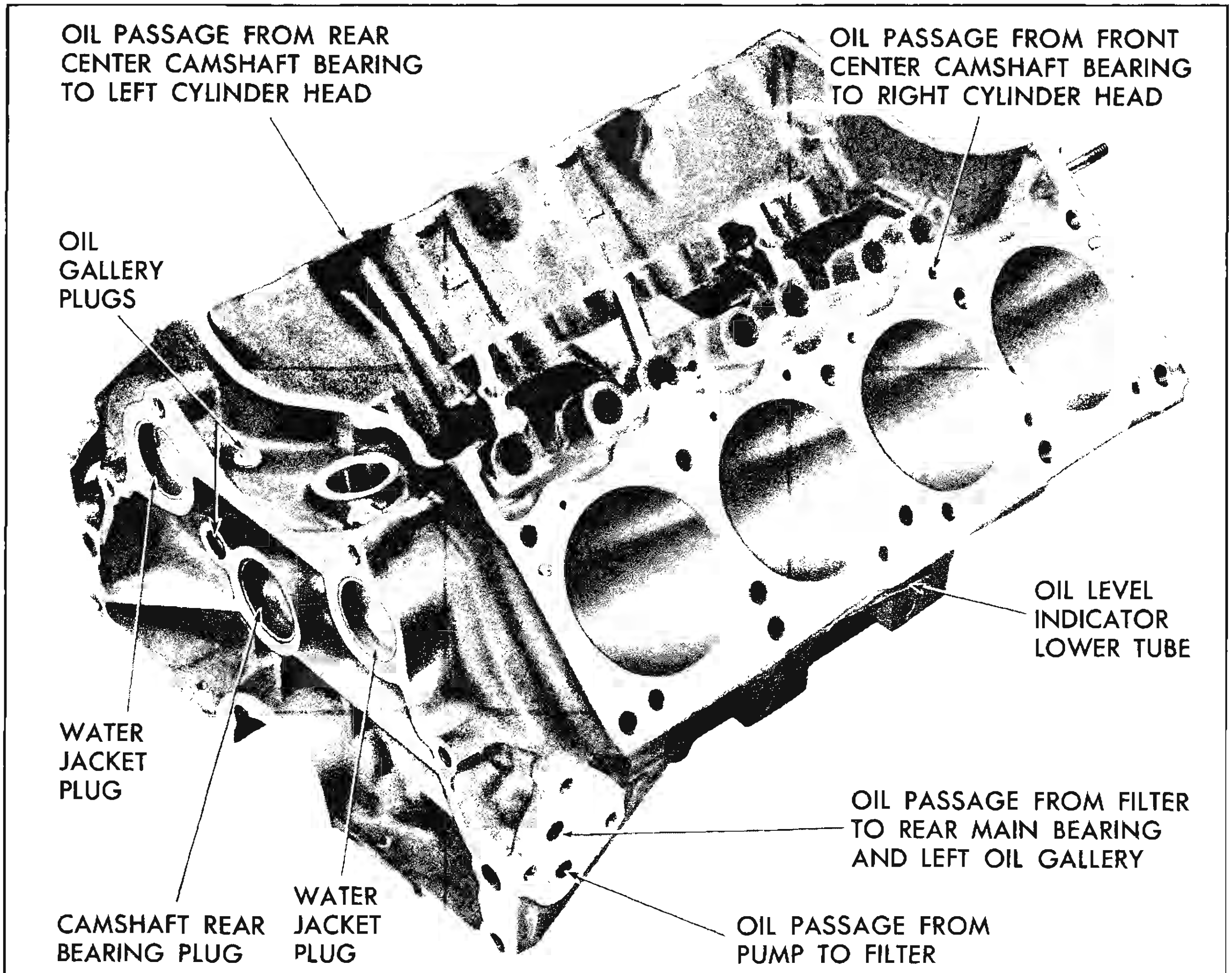



Fig. 6-73 Cylinder Block—View from Right Rear—V-8 Engine

9. Position timing cover gasket over mounting studs and dowels on block.

10. Install timing cover, water pump, fan and pulley as an assembly. Do not install stud nuts at this time.

11. Slide harmonic balancer onto crankshaft, and install harmonic balancer to crankshaft bolt and washer. Place hammer handle between block and crankshaft counterweight to keep crankshaft from turning and tighten harmonic balancer to crankshaft bolt 160 lb. ft. torque.

12. Install baffle and oil indicator tube extension (Fig. 6-59).

13. Insert oil pump drive shaft with dimpled end towards block.

14. Install oil pump and gasket.

15. Cement new gaskets to oil pan and rear main bearing cap; use retainers to hold gasket. Install oil pan except for two rear screws. Position flywheel housing front shield and gasket against oil pan and install two rear oil pan bolts.

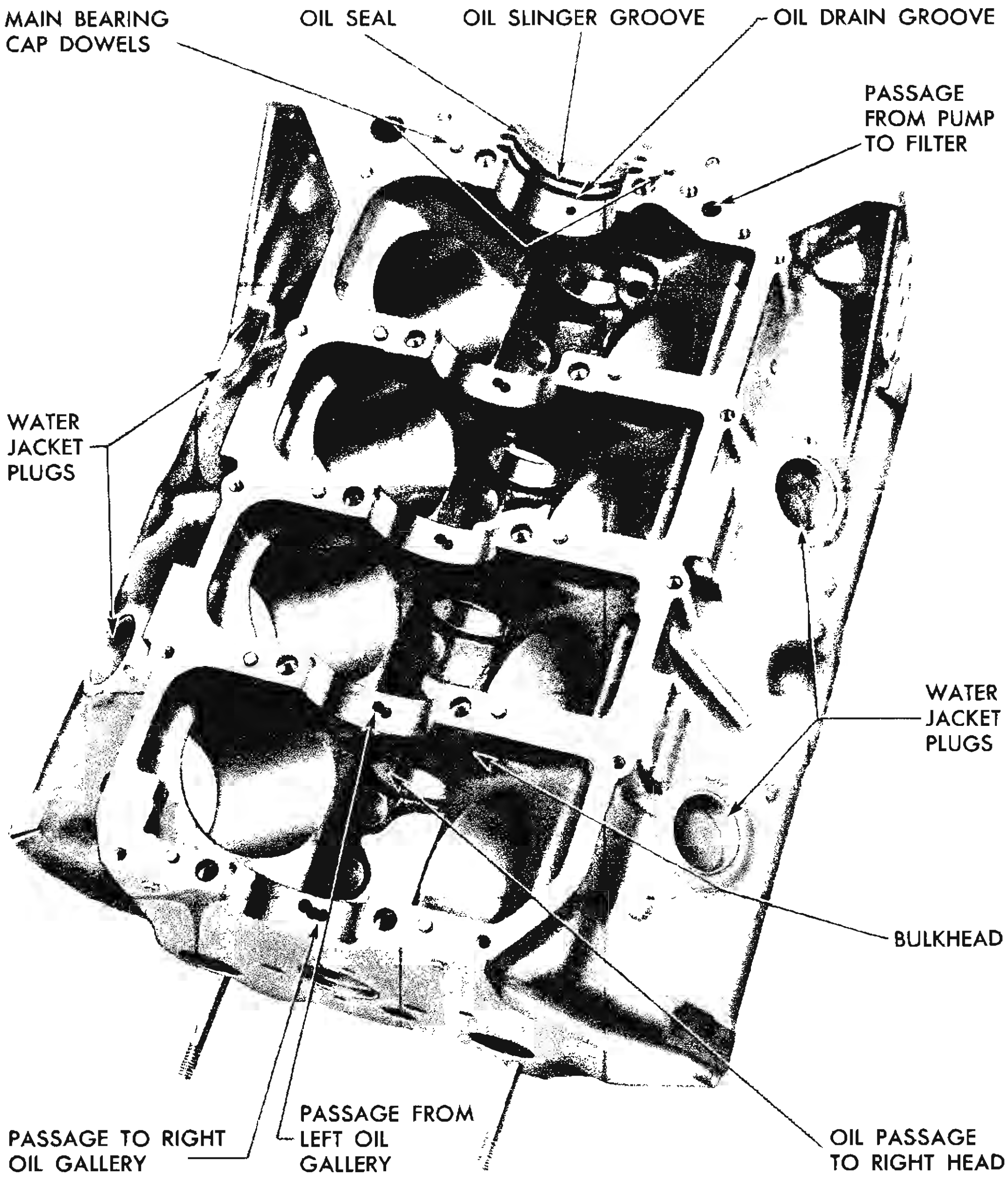



Fig. 6-74 Cylinder Block—View from Bottom—V-8 Engine

16. Position new cylinder head gasket on block.

17. Position cylinder head and exhaust manifold assembly on locating pins. Install head bolts and torque to 95 lb. ft.

NOTE: Three different length bolts are used. When inserted on proper holes, all will project an equal amount from their respective bosses.

18. Install lifters in bosses from which they were removed.

19. Install push rods in same location as originally removed and with same end facing valve lifter.

20. Tighten rocker arm ball retaining nuts to 15-25 lb. ft. torque.

21. Install distributor.

## TROUBLE DIAGNOSIS

### *ENGINE FAILS TO START*

CAUSE:

a. Corroded or loose battery terminal connections and/or weak battery.

b. Broken or loose ignition wires and/or faulty ignition switch.

c. Excessive moisture on plugs, caps or ignition system.

d. Damaged distributor rotor, cracked distributor cap and/or corroded distributor contact points.

e. Fouled spark plugs and/or improper spark plug gap.

f. Weak or faulty coil.

g. Carburetor flooded and/or fuel level in carburetor bowl not correct.

h. Dirt and water in gas line or carburetor.

i. Sticking choke.

j. Faulty fuel pump.

k. Faulty solenoid or starting motor.

l. Park or neutral switch inoperative.

### *ENGINE MISSES WHILE IDLING*

CAUSE:

a. Spark plugs damp or gap incorrectly set.

b. Excessive moisture on ignition wires and caps.

c. Leaks in ignition wiring.

d. Ignition wires making poor contact.

e. Uneven compression.

f. Burned, pitted or incorrectly set contact points.

g. Faulty coil or condenser.

h. Worn distributor cam or cracked distributor cap.

i. Incorrect carburetor idle adjustment and/or dirty jets or plugged passages in carburetor.

j. Foreign matter, such as dirt or water, in gas line or carburetor.

k. Air leak at carburetor mounting gasket.

l. Choke inoperative.

m. Faulty spark advance mechanism.

n. Burned, warped, pitted, or sticking valves.

o. Incorrect valve lifter clearance.

p. Low compression.

### *ENGINE STALLS*

CAUSE:

a. Carburetor idle speed set too low and/or idle mixture too rich or too lean.

b. Carburetor needle valve and seat inoperative.

c. Incorrect carburetor float level and/or carburetor flooding.

d. Dirt or water in gasoline or carburetor.

e. Choke improperly adjusted or sticking.

f. Faulty ignition system.

g. Spark plugs damp or dirty and/or gaps incorrectly set.

h. Faulty coil or condenser.

i. Distributor points burned, pitted, dirty, or incorrectly set.

j. Distributor advance inoperative.

k. Exhaust system restricted.

l. Leaks in carburetor mounting gasket or intake manifold.

m. Incorrect valve lifter clearance.

n. Burned, warped, or sticking valves.

o. Low compression.

p. Engine overheating.

### *ENGINE "LOPES" WHILE IDLING*

CAUSE:

a. Air leaks between intake manifold and heads.

b. Blown head gasket.

c. Worn timing chain or sprockets.

d. Worn camshaft lobes.

e. Overheated engine.

f. Plugged Crankcase Vent Valve.

### *ENGINE MISSES AT VARIOUS SPEEDS*

CAUSE:

a. Dirt and water in gas line or carburetor.

b. Fouled carburetor jets.

c. Incorrect ignition timing.

d. Points dirty, pitted or incorrectly spaced.

e. Excessive play in distributor shaft.

f. Insufficient spring tension on points.

g. Distributor cam lobe worn.

h. Weak coil or condenser.

i. Spark plugs dirty or damp and/or gaps set too wide.

j. Insufficient point dwell.

k. Detonation or pre-ignition.

l. Heat control valve not functioning properly.

m. Excessively worn fuel pump diaphragm.

n. Weak valve spring.

o. Worn camshaft lobes.

p. Engine overheating.

q. Sub-standard fuel.

### *ENGINE HAS NO POWER*

CAUSE:

a. Weak coil or condenser.

b. Incorrect ignition timing.

c. Excessive play in distributor shaft or distributor cam worn.

d. Insufficient point dwell.

e. Spark plugs dirty or gaps incorrectly set.

f. Carburetor not functioning properly.

g. Improper carburetor float level.

h. Carburetor fuel mixture too rich or too lean.

i. Foreign matter, such as dirt or water, in gas line or carburetor.

j. Faulty fuel pump.

k. Valve springs weak and/or valves sticking when hot.

l. Burned, warped, or pitted valves.

m. Valve timing incorrect.

n. Incorrect valve lifter clearance.

o. Worn camshaft lobes.

p. Pistons incorrectly fitted in block.

q. Blown cylinder head gasket.

r. Low compression.

s. Flow control valve inoperative (Power Steering).

t. Clutch slipping.

u. Brakes dragging.

v. Engine overheating.

w. Transmission regulator valve sticking (Hydra-Matic).

x. Faulty spark plug wires.

y. Sub-standard fuel.

z. Fuel filter plugged.

### *EXTERNAL ENGINE OIL LEAKAGE*

CAUSE:

a. Improperly seated or broken fuel pump gasket.

b. Improperly seated or broken push rod cover gasket.

c. Improperly seated or broken oil filter gasket.

d. Broken or improperly seated oil pan gasket.

e. Gasket surface of oil pan bent or distorted.

f. Improperly seated or broken timing chain cover gasket.

g. Worn timing chain cover oil seal.

### EXTERNAL ENGINE OIL LEAKAGE (cont'd)

h. Worn or improperly seated rear main bearing oil seal

i. Loose oil line plugs.

j. Engine oil pan drain plug improperly seated.

k. Rear camshaft bearing drain hole plugged.

l. Loose rocker arm covers, gasket broken, or cover distorted or bent.

### EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER THROUGH HEAD AREA

CAUSE:

a. Intake valve seals damaged or missing.

b. Worn valve stems or guides.

c. Cylinder head porous between oil gallery and intake ports.

d. Plugged drain back holes in head.

e. Intake manifold gasket leak in conjunction with rocker cover gasket leak.

f. Cylinder head gasket leak at head oil gallery feed passage.

### EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER BY PASSING PISTON RINGS

CAUSE:

a. Oil level too high.

b. Excessive main or connecting rod bearing clearance.

c. Piston ring gaps not staggered.

d. Incorrect size rings installed.

e. Piston rings out of round, broken or scored.

f. Insufficient piston ring tension due to engine overheating.

g. Ring grooves or oil return slots clogged.

h. Rings sticking in ring grooves of piston.

i. Ring grooves worn excessively in piston.

j. Compression rings installed upside down.

k. Excessively worn or scored cylinder walls.

l. Oil too thin.

### NO OIL PRESSURE WHILE IDLING

CAUSE:

a. Faulty oil gauge.

b. Oil pump not functioning properly. (Regulator ball stuck in position by foreign material).

c. Excessive clearance at main and connecting rod bearings.

d. Loose camshaft bearings.

e. Leakage at internal oil passages.

### NO OIL PRESSURE WHILE ACCELERATING

CAUSE:

a. Oil pump not functioning properly.

b. Low oil level in oil pan.

c. Leakage at internal oil passages.

### BURNED, STICKING OR BROKEN VALVES

CAUSE:

a. Weak valve springs.

b. Improper valve lifter clearance.

c. Improper valve guide clearance and/or worn valve guides.

d. Out-of-round valve seats or incorrect valve seat width.

e. Deposits on valve seats and/or gum formation on stems or guides.

f. Warped valve or faulty valve forgings.

g. Exhaust back pressure.

h. Improper spark timing.

### NOISY CONNECTING RODS

CAUSE:

a. Connecting rods improperly aligned.

b. Excessive bearing clearance.

c. Eccentric or out-of-round crankshaft journals.

d. Insufficient oil supply.

e. Low oil pressure.

f. Connectig rod bolts not tightened correctly.

### NOISY MAIN BEARINGS

CAUSE:

a. Low oil pressure and/or insufficient oil supply.

b. Excessive bearing clearance.

c. Excessive crankshaft end play.

d. Eccentric or out-of-round crankshaft journals.

e. Sprung crankshaft.

f. Excessive belt tension.

g. Loose harmonic balancer.

### NOISY PISTONS AND RINGS

CAUSE:

a. Excessive clearance between piston and bore.

b. Improper fit of piston pin.

c. Excessive accumulation of carbon in heads.

d. Connecting rods improperly aligned.

e. Excessive clearance between rings and grooves.

f. Rings broken.

### NOISY VALVES

CAUSE:

a. Incorrect valve lifter clearance.

b. Excessively worn or faulty valve lifters.

c. Worn valve guides.

d. Excessive run-out of valve seat or valve face.

e. Worn camshaft lobes.

f. Pulled or loose rocker arm studs.

g. Bent push rods.

### NOISY VALVE LIFTERS

CAUSE:

a. Broken valve springs.

b. Worn or sticking rocker arms.

c. Worn or bent push rods.

d. Valve lifters incorrectly fitted to bore size.

e. Faulty valve lifter plunger or push rod seat.

f. Plungers excessively worn causing fast leakdown under pressure.

g. Excessively worn camshaft lobes.

h. Valve lifter oil feed holes plugged causing internal breakdown.

i. Faulty valve lifter check ball. (Nicked, flat spot, or out of round.)

j. Rocker arm retaining nut installed upside down.

k. End of push rod excessively worn or flaked.

### BROKEN PISTONS AND/OR RINGS

CAUSE:

a. Undersize pistons installed.

b. Wrong type and/or size rings installed.

c. Cylinder bores tapered or eccentric.

d. Connecting rods improperly aligned.

e. Excessively worn ring grooves.

f. Rings improperly assembled.

g. Insufficient ring gap clearance.

h. Engine overheating.

i. Fuel of too low octane rating.

### NOISY PISTON PIN

Incorrect pin clearance and tight piston fit.

# SPECIFICATIONS

### *GENERAL*

Type ........ Line 4 & V-8

Bore and Stroke ........ 4 cylinder $4\frac{1}{16}''$ x $3\frac{3}{4}''$
V-cylinder $3\frac{25}{32}''$ x $3\frac{3}{4}''$

Piston Displacement ........ (4 cyl) 195 cu. in
(V-8) 326 cu. in.

Taxable Horsepower ........ 4 cyl. 26.4
V-8 44.3

Compression Ratio ........ 4 cyl. 8.6: or 10.25:1
V-8 10.25:1

HORSEPOWER AND TORQUE

| | 8.6:1 C.R. | | 10.25:1 C.R. | |
|---|---|---|---|---|
| | Synchromesh | Automatic | Synchromesh | Automatic |
| Brake Horsepower—4 cyl. 1 bbl. carburetor | 110 @ 3800 rpm | 115 @ 4000 rpm | 120 @ 3800 rpm | 140 @ 4400 rpm |
| Torque (lb. ft.)—4 cyl. 1 bbl. carburetor | 195 @ 2000 rpm | 195 @ 2300 rpm | 204 @ 2000 rpm | 209 @ 2200 rpm |
| Brake Horsepower—4 cyl. 4 bbl. Carburetor | — | — | 166 @ 4800 rpm | 166 @ 4800 rpm |
| Torque (lb. ft.)—4 cyl. 4 bbl. Carburetor | — | — | 217 @ 2800 rpm | 217 @ 2800 rpm |
| Brake Horsepower–8 cyl. 2 bbl. Carburetor | — | — | 260 @ 4800 rpm | 260 @ 4800 rpm |
| Torque (lb. ft.)–8 cyl. 2 bbl. Carburetor | — | — | 352 @ 2800 rpm | 352 @ 2800 rpm |

Compression Pressure at Cranking Speed ........ 140-150 psi @ 155-165 rpm
(8.6:1 Compression Ratio)

Compression Pressure at Cranking Speed ........ 155-165 psi @ 155-165 rpm
(10.25:1 Compression Ratio)

Firing Order 4 cyl. ........ 1-3-4-2
8 cyl. ........ 1-8-4-3-6-5-7-2

Car-Engine Serial No. Location ........ Front Face of Right Cylinder Bank

Production Engine No. Location ........ Front Face of Right Cylinder Bank

Cylinder Nos.–Front to Rear 4 cyl. ........ 1-2-3-4
8 cyl. ........ Left Bank 1-3-5-7
Right Bank 2-4-6-8

### *CAMSHAFTS*

Material ........ Alloy Cast Iron

Journal Diameter ........ 1.8987″-1.8997″

Bearing–Inside Dia. (after line reaming) ........ 1.9012″-1.9017″

### CAMSHAFTS (Continued)

| | |
|---|---|
| Bearing Length | |
| Front | 1.060″ |
| All Others | .680″ |
| Bearing Clearance | .0015″-.0030″ |
| End Play | .003″-.007″ |

### CONNECTING RODS

| | |
|---|---|
| Material | Cast Pearlitic Malleable Iron |
| Length, center to center | 6.625″ |
| Lower end bearing, inside diameter and length | 2.25″ x .82″ |
| Bearing clearance on crank pin—limits when new | .0005″-.0025″ |
| End Play of connecting rod on crank pin | .0045″-.0085″ |

### CRANKSHAFTS

| | |
|---|---|
| Material | Pearlitic Malleable Iron |
| Journal Diameter | 3.000″ |
| Bearing Length—bearing shell, including chamfer | |
| Front | 15/16″ |
| Front Center | 15/16″ |
| Center | 15/16″ |
| Rear Center Including Thrust Flanges | 1.133″-1.135″ |
| Rear | 1.590″ |
| Thrust Taken On | Rear Center |
| Crank Pin Diameter | 2.25″ |
| Journal and Pin Maximum Out of Round and Taper | .00025″ |
| Thrust Bearing End Play—Limits When New | .0035″-.0085″ |
| Main Bearing Clearance—Limits When New | Front .0005″-.002″<br>Front center, Center, Rear center and Rear .0005″-.002″ |

### FLYWHEEL

| | |
|---|---|
| Teeth on ring | 155 (8 cyl.)<br>150 (4 cyl.) |
| Teeth on starter pinion | 9 |

### PISTONS AND CYLINDERS

| | |
|---|---|
| Cylinder bore out-of-round and taper when new | .001″ |
| Piston material | Aluminum Alloy |

### PISTONS AND CYLINDERS (Continued)

Piston clearance in cylinder—STD .......... .0007" to .0013"

Piston ring gap

Compression rings

Upper .......... .016"-.026"

Lower .......... .013"-.025"

Oil Ring Segments .......... .015"-.055"

Piston ring to groove clearance

Compression rings

Upper .......... .0015"-.0030"

Lower .......... .0015"-.0035"

Oil Ring Assembly .......... .0005"-.0055"

### PISTON PINS

Fit in piston .......... .0003"-.0005" loose with piston and pin at 70°F.

Fit in rod .......... .0008"-.0016" press

Diameter (selective) .......... .9800"-.9804"

Length .......... 3.250"

### TIMING CHAIN

Camshaft sprocket material .......... Cyanide hardened alloy cast iron (cylinder iron)

Crankshaft sprocket material .......... Case hardened steel

Number of links in chain .......... 60

### VALVES

Material

Intake .......... G. M. Manganese Molybdenum Steel

Exhaust .......... G. M. T-XCR Steel

Head Diameter

Intake .......... 1.88"

Exhaust .......... 1.60"

Stem Diameter

Intake .......... .3407"-.3414"

Exhaust .......... .3402"-.3409"

Seat Angle

Intake .......... 30°

Exhaust .......... 45°

### VALVES (Continued)

Fit of stem in guide (new) ........ Intake .0021"-.0038"
Exhaust .0026"-.0043"

Valve Lift ........ Engines Coded 87Z, 77Y, 76Y .40"
Engines Coded 89Z, 88Z, 86Z, 85Z .33"
Engines Coded 79Y .34"

### VALVE LIFTER

Diameter ........ .8422"-.8427"

Clearance in boss ........ .0013"-.0028"

Length-overall ........ 2.000"

Leakdown rate ........ 12-60 seconds with 50 lbs. load

Plunger travel (for gauging purposes) ........ .125"

### VALVE SPRINGS

| | ENGINES CODED 87Z, 77Y, 76Y, 60Y, 84Z, 71Z | ENGINES CODED 89Z, 88Z, 86Z, 85Z, 83Z, 82Z, 78Y, 79Y |
|---|---|---|
| OUTER | | |
| Spring Pressure and Length | 60 @ 1.52"<br>114 @ 1.12" | 83 @ 1.52"<br>174 @ 1.19" |
| INNER | | |
| Spring Pressure and Length | 27 @ 1.47"<br>65 @ 1.07" | |

## ENGINE TORQUE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed to prevent straining or distorting the parts or possibly damaging the threads. These specifications are for clean and lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurement of tightness. It is important that these torque specifications be strictly observed. Over-tightening to any extent may damage threads, thus preventing proper torque from being attained, requiring replacement or repair of the damaged part.

| PART | APPLICATION | LB. FT. |
|---|---|---|
| Bolt | Main Bearing Cap to Block (Exc. Rear Main) | 90-110 |
| Bolt | Rear Main Bearing Cap to Block | 110-130 |
| Bolt | Cylinder Head | 85-100 |
| Bolt | Harmonic Weight to Pulley | 15-25 |
| Bolt | Harmonic Balancer to Crankshaft | 130-190 |
| Bolt | Flywheel to Crankshaft | 85-100 |
| Nut | Connecting Rod & Bushing Cap to Rod | 40-46 |
| Bolt | Engine Oil Baffle to Bearing Cap | 10-20 |
| Bolt | Oil Pan to Cylinder Block | 8-15 |
| Bolt | Engine Oil Pump Cover to Body | 10-20 |

| PART | APPLICATION | LB. FT. |
|---|---|---|
| Retainer | Oil Pump Pressure Regulator Spring | 8-18 |
| Bolt | Engine Oil Pump Assy. to Block | 20-35 |
| Bolt | Timing Chain Cover to Intake Manifold Seal Clamp | 10-20 |
| Bolt | Timing Chain Cover to Cyl. Block | 20-35 |
| Nut | Timing Chain Cover to Block (Stud) | 20-35 |
| Bolt | Fan & Pulley to Water Pump Shaft Flange | 15-25 |
| Bolt | Crankshaft Pulley & Hub Assy. to Crankshaft | 130-190 |
| Nut | Water Pump to Timing Chain Cover & Stud | 10-25 |
| Bolt | Intake Manifold Water Outlet Fitting to Manifold | 20-35 |
| Bolt | Intake Manifold to Cyl. Head | 30-45 |
| Bolt | Intake Manifold Supp. Brace to Cyl. Block & Manifold | 30-45 |
| Bolt | Exhaust Manifold to Cyl. Head | 20-35 |
| Bolt | Timing Chain Bumper to Cyl. Block | 20-35 |
| Bolt | Valve Push Rod Cover Assy. to Block | 25-70 (Lb. In.) |
| Bolt | Camshaft Thrust Plate to Block | 10-25 |
| Bolt | Camshaft Sprocket to Camshaft | 30-45 |
| Bolt | Valve Rocker Arm Cover to Head | 45-80 (Lb. In.) |
| Nut | Valve Rocker Arm Ball Retainer | 15-25 |
| Bolt | Starting Motor to Cylinder Block | 20-45 |
| Screw | Distributor Hold-Down Clamp to Cyl. Block | 15-25 |
| Bolt | Ignition Coil Brkt. to Intake Manifold | 10-20 |
| Plug. Assy. | Spark | 15-25 |

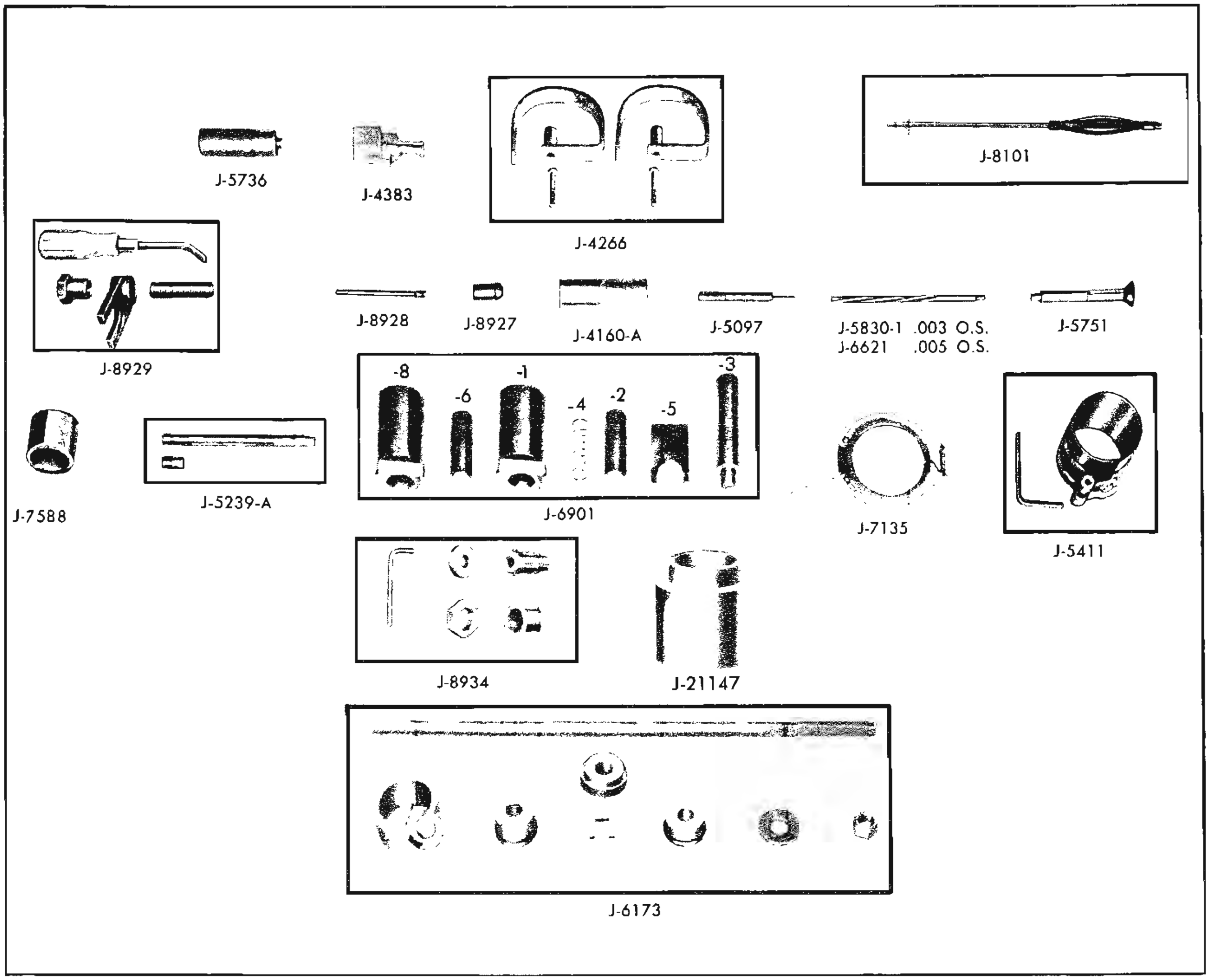



Fig. 6-75 Engine Special Tool

## SPECIAL TOOLS

| | |
|---|---|
| J-4160-A | Hydraulic Valve Lifter Plunger Remover |
| J-4266 | Cylinder Head Lifting Hooks |
| J-5097 | Hydraulic Valve Lifter Plunger Unloading Tool |
| J-5239-A | Connecting Rod Bolt Guide Set |
| J-5411 | Piston Ring Compressor |
| J-5751 | Intake and Exhaust Valve Stem Seal Installer and Tester |
| J-5830-1 | Valve Guide Reamer .003 oversize |
| J-6173 | Camshaft Bearing Remover and Replacer |
| J-8927 | Rocker Arm Stud Installer |
| J-8928 | Valve Train Gauge |
| J-8929 | Valve Spring Compressor Set |
| J-8934 | Rocker Arm Stud Remover |
| J-6621 | Valve Guide Reamer .005 oversize |
| J-6901 | Piston Pin Remover and Replacer Set |
| J-7135 | Piston Ring Remover and Replacer |
| J-7588 | Rear Main Bearing Oil Seal Installer |

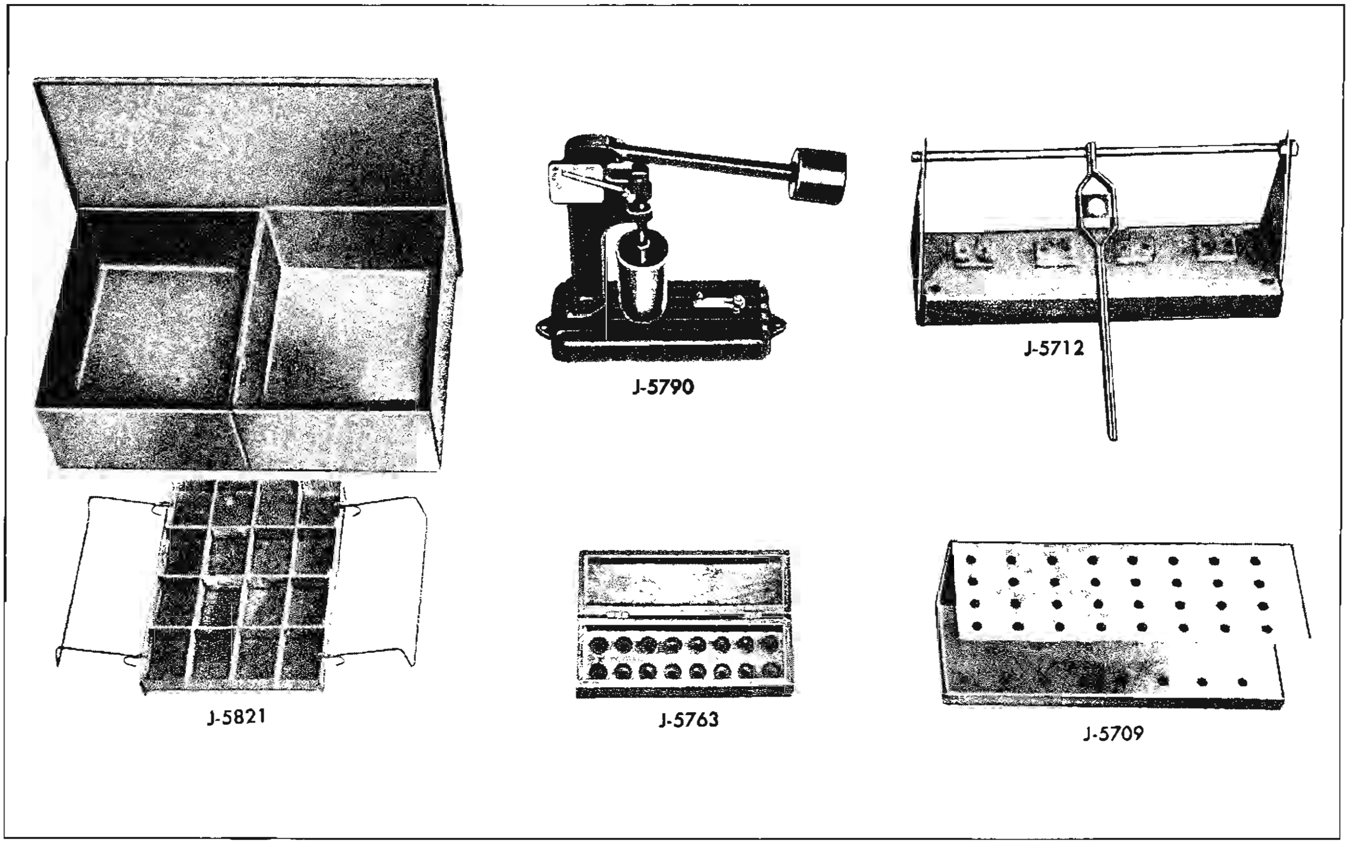



Fig. 6-76 Engine Special Tools

## SPECIAL TOOLS

| | |
|---|---|
| J-5709 | Valve and Valve Train Holding Stand |
| J-5712 | Cylinder Head Holder and Valve Spring Compressor |
| J-5763 | Hydraulic Valve Lifter Storage Box |
| J-5790 | Hydraulic Valve Lifter Tester |
| J-5821 | Hydraulic Valve Lifter Solvent Tank and Tray |
| J-21147 | Timing Chain Cover Seal Installer |

# ENGINE COOLING AND LUBRICATION

## CONTENTS OF THIS SECTION



## COOLING SYSTEM DESCRIPTION

The cooling system consists of the radiator core, cooling fan, pellet type thermostat, water pump and suitable passages for water circulation through the engine.

### RADIATOR

Four different radiators are used on Tempest cars. They may be identified by the radiator code stamped on upper inside right corner of top tank.

| CODE | USAGE |
|---|---|
| 151 | 195 L-4 Engine |
| 152 | 195 L-4 A/C |
| 154 | 326 V-8 Engine |
| 157 | 326 V-8 A/C |

The radiator is of the down-flow tube and center type and is constructed of copper. A drain cock is located at the inside lower left corner of the radiator.

A pressure-vent type cap is used on the radiator to allow a build-up of 15 psi of pressure in the cooling system. This pressure raises the boiling point of water 38°.

***CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the normal boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while the engine is hot and the pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over the engine, fenders, and the person removing the cap. If the solution contains inflammable anti-freeze (not recommended), such as alcohol, there is also the possibility of causing a serious fire. When removing filler cap, rotate cap toward left very slowly; if hissing of vapor is encountered, tighten cap immediately and wait for system to cool sufficiently to allow removal of cap. After pressure in the system has been relieved, turn cap more forcibly to left and remove. Turn cap all the way to the right when installing. It should not be necessary to check coolant level unless temperature gauge shows over-heating, and then not until engine is stopped and allowed to cool to normal.***

### FAN

The fan is used to increase the air flow through the radiator at low speeds.

The standard fan has four blades. A seven bladed fan is used on cars with air conditioners and has curled tips to provide minimum noise.

### THERMOSTAT

A pellet type thermostat is used in the water outlet passage in the intake manifold. The thermostat controls the flow of coolant to provide rapid engine warm up and regulate coolant temperature. A thermostat is installed as standard equipment.

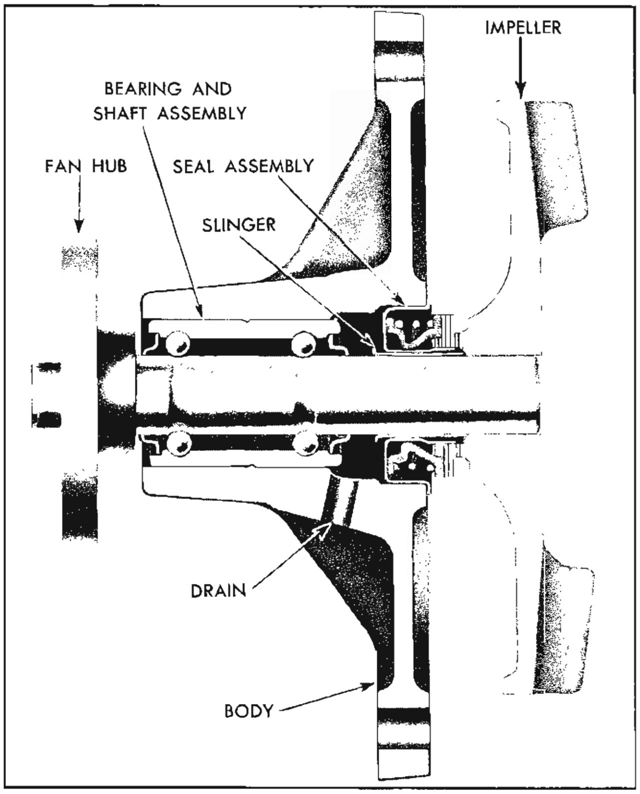



Fig. 6A-1 Water Pump for 4 Cylinder Engine

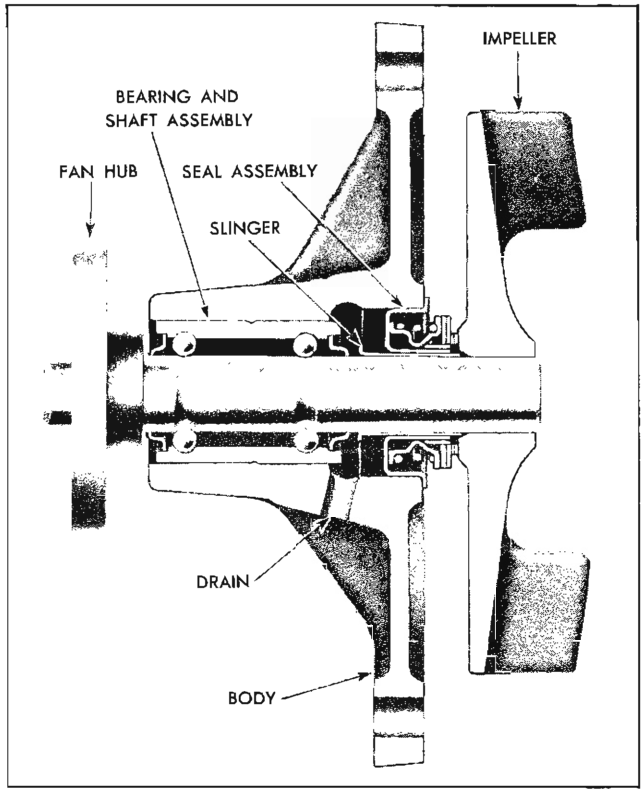



Fig. 6A-2—Water Pump for V-8 Engine

### *WATER PUMP—4 CYLINDER ENGINE—V-8 ENGINE*

A centrifugal type water pump is used to circulate the water through the system. The water pump impeller turns on a steel shaft mounted on a double-row permanently lubricated, sealed ball bearing (Fig. 6A-2). A bellows type seal is seated in the water pump body between the bearing and the impeller. The seal surface is a phenolic washer which is held by the spring loaded bellows against a machined surface on the impeller.

The inlet side of the pump is connected to the lower radiator tank by means of a hose. A water leg in the intake manifold connects to the timing chain cover (which acts as the pump body) to provide recirculation of water when the thermostat is closed. The timing chain cover also has a heater water return connection.

### *COOLING SYSTEM CIRCULATION— 4 CYLINDER ENGINE—V-8 ENGINE*

Water circulation (Fig. 6A-4) is provided by a single impeller, specially designed water pump which provides flow of water into the cylinder block.

Water circulation during warm-up (thermostat closed) is from the pump to the cylinder block, up into the cylinder head, into the front of the intake manifold, and back to the inlet of the pump, via the timing chain cover, which acts as a pump body. The inlet side of the pump has a heater water return connection.

After normal operating temperatures are reached (thermostat open), part of the water will recirculate as outlined above. A major portion of the water, however, will pass into the radiator via the outlet passage and hose above the thermostat. It will then circulate back to the pump inlet. The water pump and the water transfer holes between the block and cylinder head have been designed to provide the proper flow of coolant to provide temperature balance within the engine bank and its cylinder head.

## LUBRICATION SYSTEM DESCRIPTION

### *OIL FILTER—4 CYLINDER ENGINE*

A full flow oil filter is optional equipment on the engine. The filter is mounted on a machined boss on the right rear side of the engine block.

All oil from the pump passes through the filter

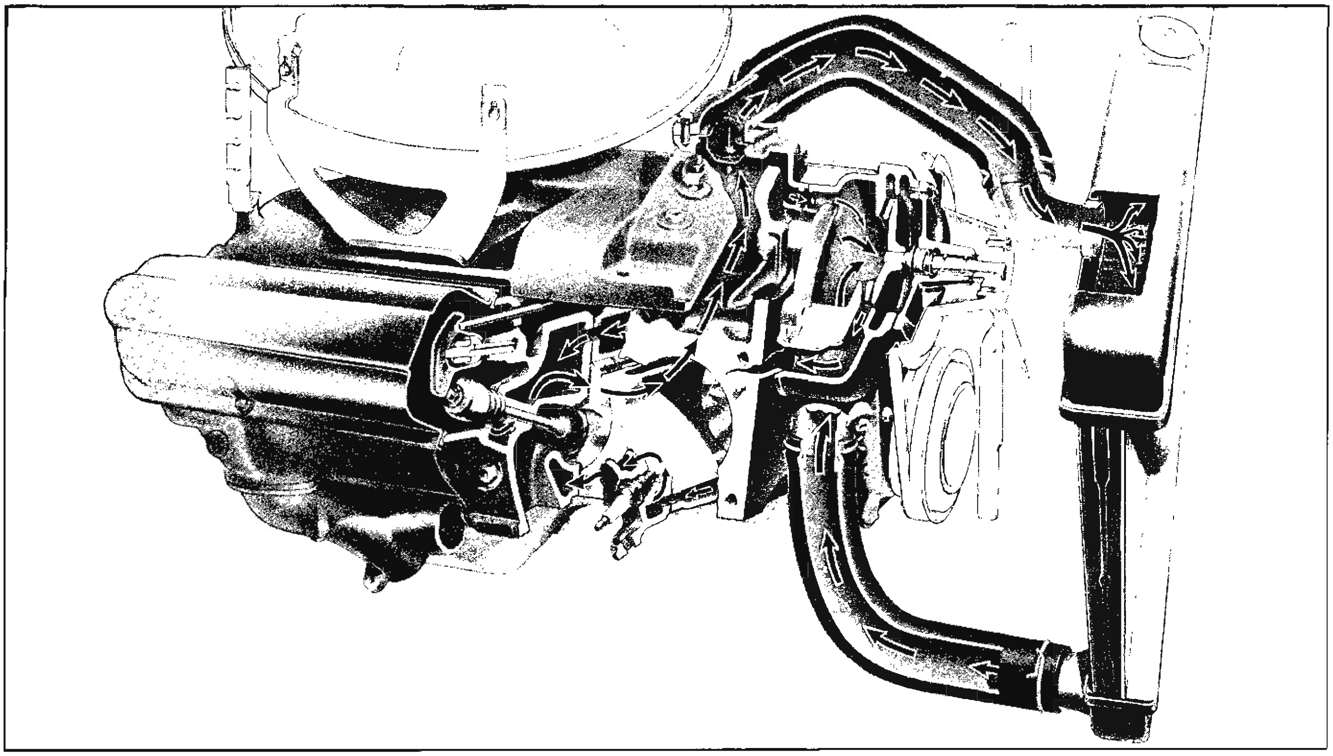


Fig. 6A-3 Cooling System Circulation—4 Cylinder Engine

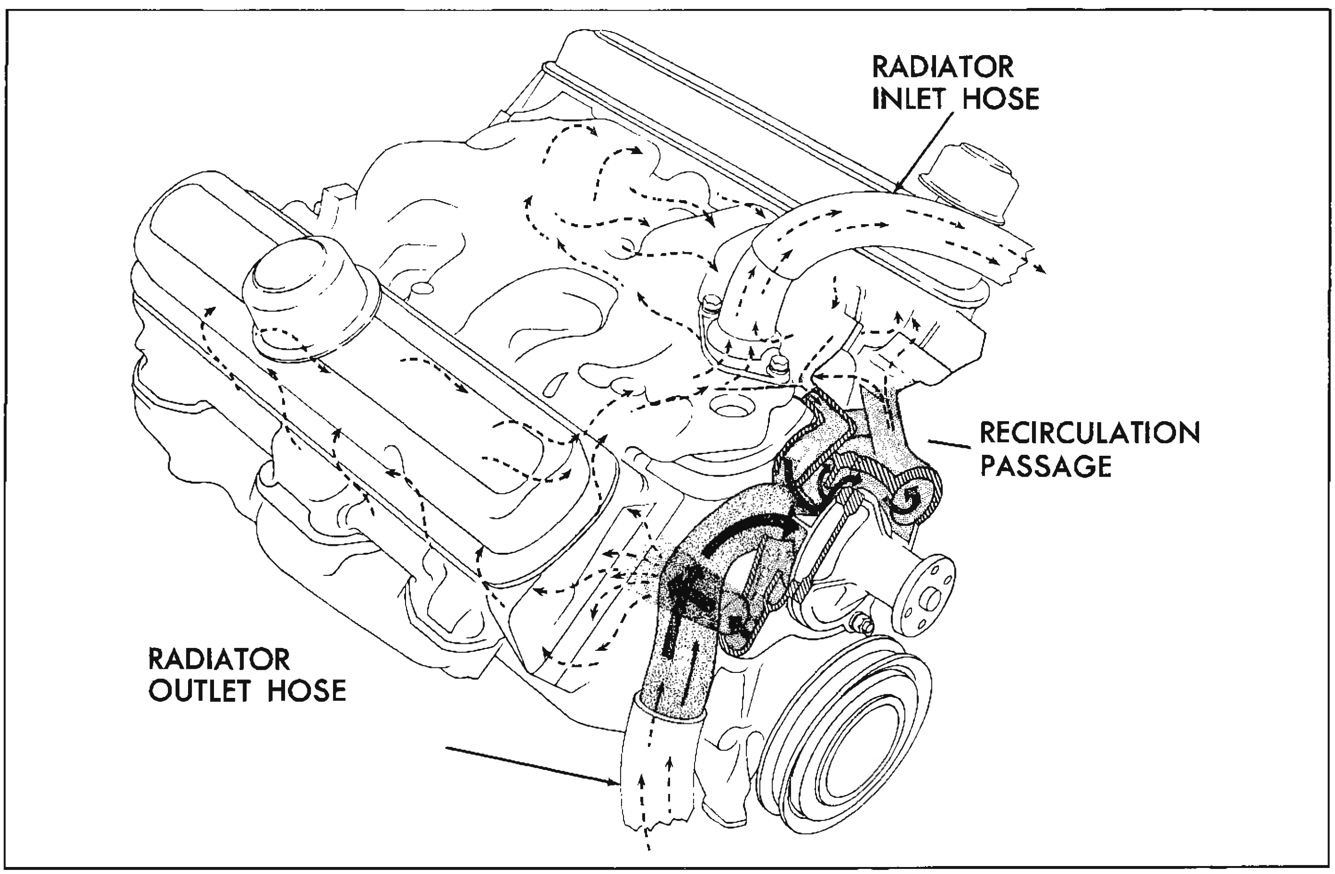



Fig. 6A-4 Engine Cooling System—V-8

before going to the engine oil galleries. In the filter, the oil passes through a filtering element where all dirt and foreign particles are removed.

A by-pass valve is located in the filter base casting to insure ample lubrication in case the filter element becomes restricted. Thus, if required, oil will flow directly from the inlet through the spring loaded by-pass valve to the outlet without any possibility of washing accumulated dirt off the filter element.

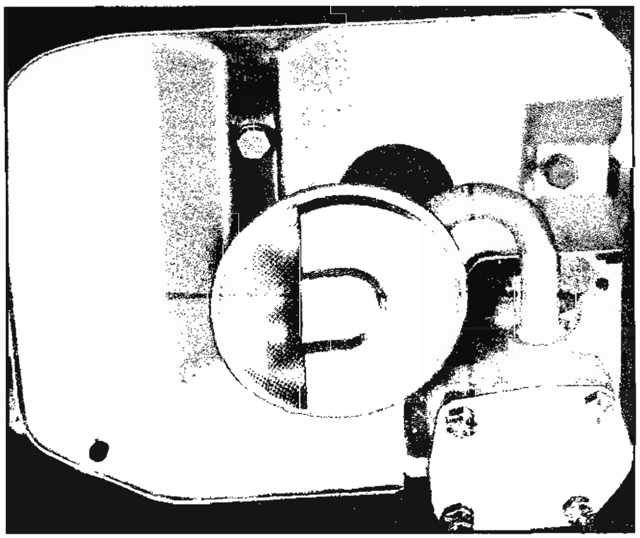


Fig. 6A-5 Oil Pump and Intake for 4 Cylinder Engine

### OIL PUMP—4 CYLINDER ENGINE—V-8 ENGINE

Oil is circulated under pressure by a spur gear type pump. The pump is mounted on the right rear lower face of the cylinder block (Fig. 6A-5) and is driven by the distributor drive gear. Maximum oil pressure is regulated by a spring loaded, ball type, pressure regulator valve. No adjustment of the pressure regulator valve is provided.

Oil is taken into the pump through a floating type oil intake. By allowing the intake to float, only the cleanest oil near the surface is pumped through the engine. All oil entering the floating intake passes through a screen. As a safety precaution a large hole is provided in the middle of the screen. During normal operation no oil can pass through this hole since the grommet around the hole is seated against the baffle. If the screen should become plugged, however, pump suction will cause the screen to move away from the baffle, and oil will flow through the large center hole.

### OIL CIRCULATION—4 CYLINDER ENGINE V-8 ENGINE (FIG. 6A-6) (FIG. 6A-7)

The positive pressure system delivers oil under pressure to the crankshaft, connecting rod, and camshaft bearings and to the valve train parts. Spray from main and connecting rod bearings lubricates the cylinder walls, piston pins and bushings. Timing chain and sprockets receive metered jet lubrication as do the fuel pump eccentric and rocker arm. A hole in the block from the push rod gallery through the distributor boss lubricates the distributor shaft and bushings.

Oil flow through the engine is as follows: Oil is first supplied by the pump and filter to two parallel oil galleries drilled in the block on each side of the camshaft. Oil travels from rear to front in the left gallery and from front to rear in the right gallery. The rear crankshaft and camshaft bearings receive oil from a hole drilled through the passage connecting the filter to the left gallery. All other crankshaft bearings receive oil from holes drilled to the left hand gallery. The remaining four camshaft bearings are supplied by a hole drilled vertically from each crankshaft bearing journal to camshaft bearing journal.

Hydraulic valve lifters are fed by holes drilled from each lifter boss to the oil gallery. Oil is fed under pressure from a hole in the push rod seat of the valve lifter up through the hollow push rod to provide pressure lubrication of both ends of the push rod.

Oil is also positively fed to the cylinder head to lubricate all valve train surfaces. An oil gallery in the head is fed from the front center camshaft journal. Oil from cylinder head gallery flows up holes in each rocker arm ball stud and out through a $\frac{1}{16}''$ hole drilled into the side of the stud to index with the ball. This oil lubricates the ball seat and also flows out through grooves in the top of the ball to fill the rocker arm with oil. Overflow from the rocker arm passes over the end onto the valve stem to lubricate the contact area between the rocker arm and the end of the valve stem.

Lubrication of the camshaft thrust plate, timing chain and sprockets, and fuel pump eccentric and rocker arm is provided for by a passage in the front of the camshaft. A lateral hole in the front bearing journal indexes with the camshaft bearing oil supply hole in the block once each revolution.

An oil jet then squirts out of the horizontal hole in the end of the camshaft toward the front of the engine. Part of this oil is projected straight forward, against the camshaft thrust plate. Another part of the oil is projected downward through the grooves in the block and thrust plate to the crankshaft timing chain sprocket (Fig. 6A-7). Oil passing down the groove also is forced out the hole in the thrust plate. The jet of oil from this hole is timed to pass through one of the openings in the camshaft sprocket and strike the fuel pump eccentric and rocker arm.

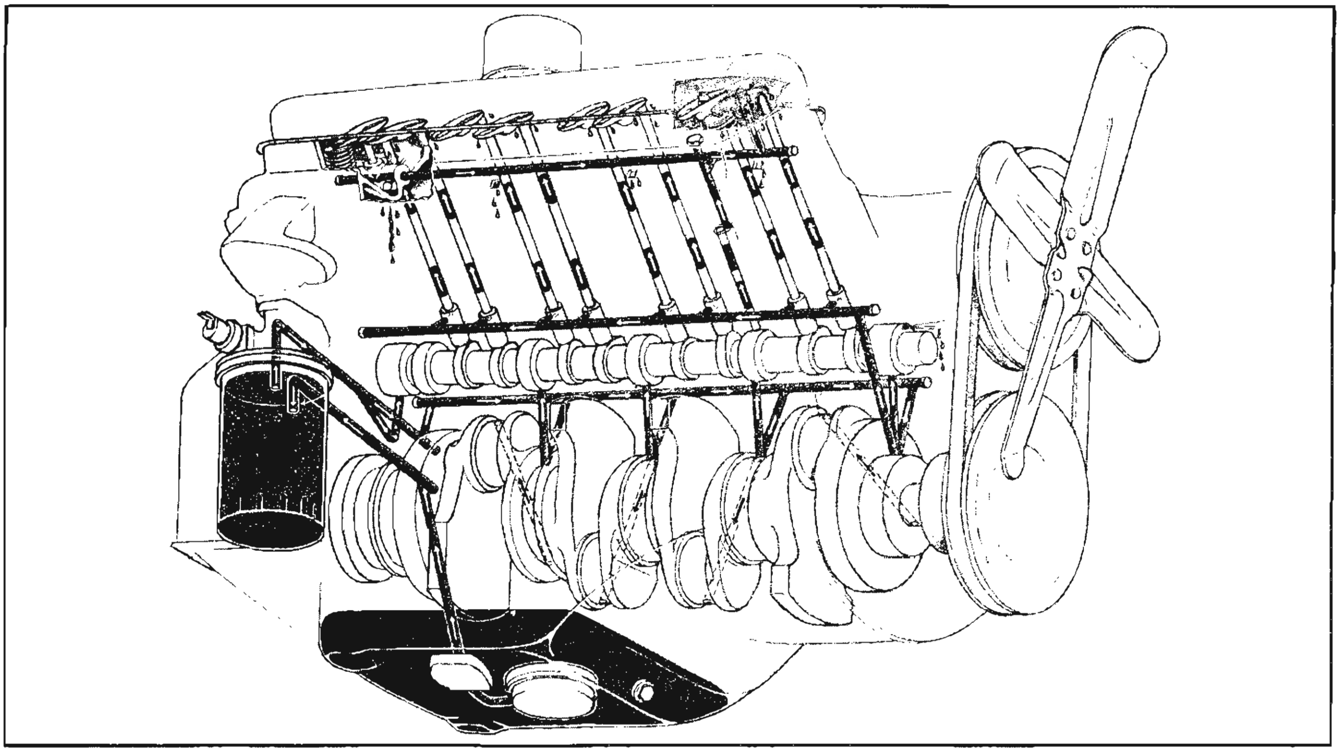


Fig. 6A-6 Oil Circulation for 4 Cylinder Engine

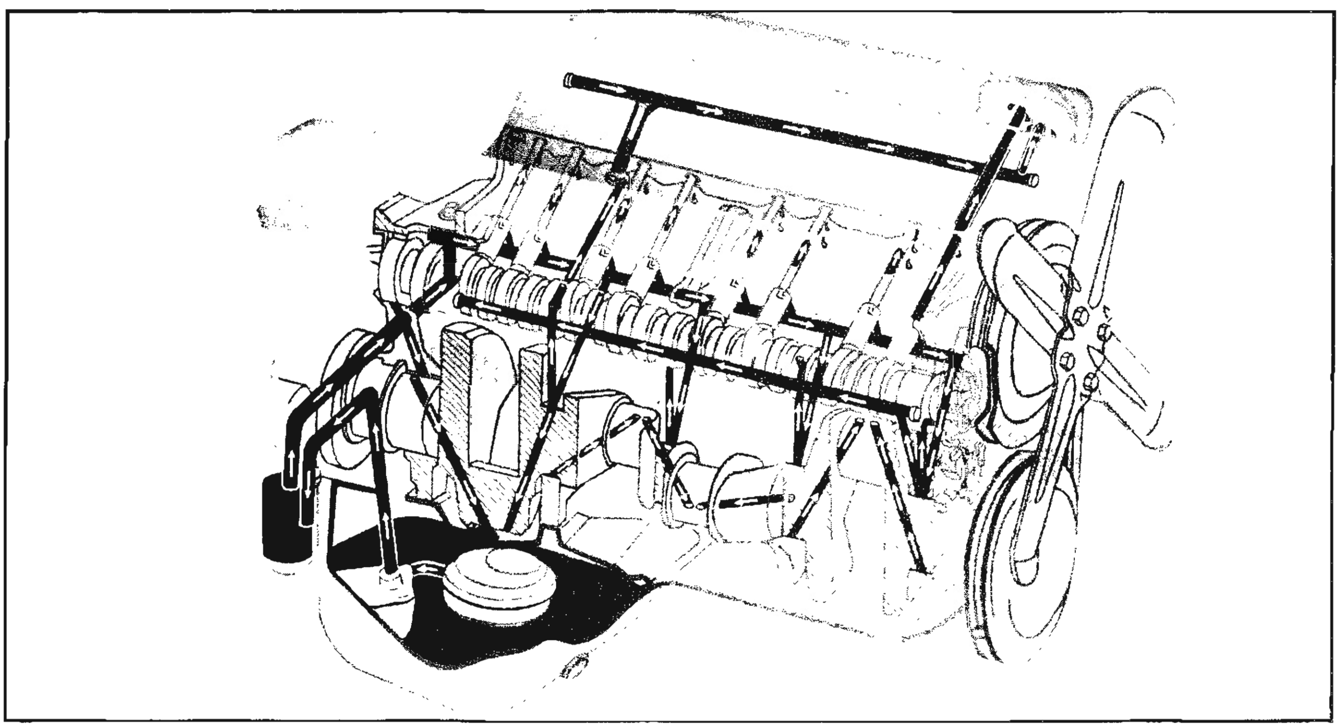


Fig. 6A-7 Engine Lubrication—V-8

The oil pan has been made as deep as possible to provide the maximum depth of oil. This minimizes splashing and foaming which would be detrimental to the operation of hydraulic lifters. It also insures a constant supply of oil during rapid acceleration and sharp turns. Additional protection against splashing and foaming is provided by the oil pan baffle. The baffle extends across the entire sump area of the oil pan preventing oil which is thrown off the crankshaft from churning that in the sump.

# POSITIVE CRANKCASE VENTILATION SYSTEM

## GENERAL DESCRIPTION

The function of the positive crankcase ventilation system is to reclaim unburned fuel, prevent dilution and contamination of lubricating oils, and reduce the amount of harmful and irritating gases discharged into the atmosphere. The positive crankcase ventilation system utilizes the vacuum in the intake manifold to remove blow by gases from the crankcase and return them to the combustion chambers to be burned. The crankcase vent pipe is replaced by a valve and rubber hose, which carry the gases from the crankcase to the intake manifold.

The valve automatically meters the flow of gases so that the normal operation of the engine is not disturbed. Valve is designed to maintain an almost constant rate of flow, regardless of manifold vacuum. Should the engine backfire, the valve is automatically held closed by the reverse air flow to prevent fuel vapor from entering crankcase.

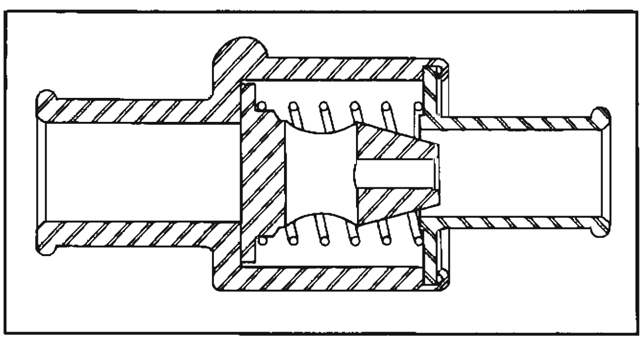


Fig. 6A-8 Crimped Type Valve

## PERIODIC SERVICE

Once a year or 12,000 miles the positive crankcase ventilation system should be serviced as follows:

1. Disconnect both ends of the hose and blow it out with compressed air. If the hose cannot be freed of obstructions, replace with new hose.

2. Remove crankcase ventilation valve assembly from rubber grommet.

3. The Tempest engine is equipped with a crimped type valve (Fig. 6A-8), no further disassembly is possible and a new valve should be installed.

4. Clean crankcase and intake manifold connectors using care not to allow dirt to enter openings.

5. Remove crankcase oil filler cap. Clean cap in solvent, blow dry, and re-oil.

6. Reinstall positive crankcase ventilation system.

7. Adjust carburetor idle to manufacturer's specifications.

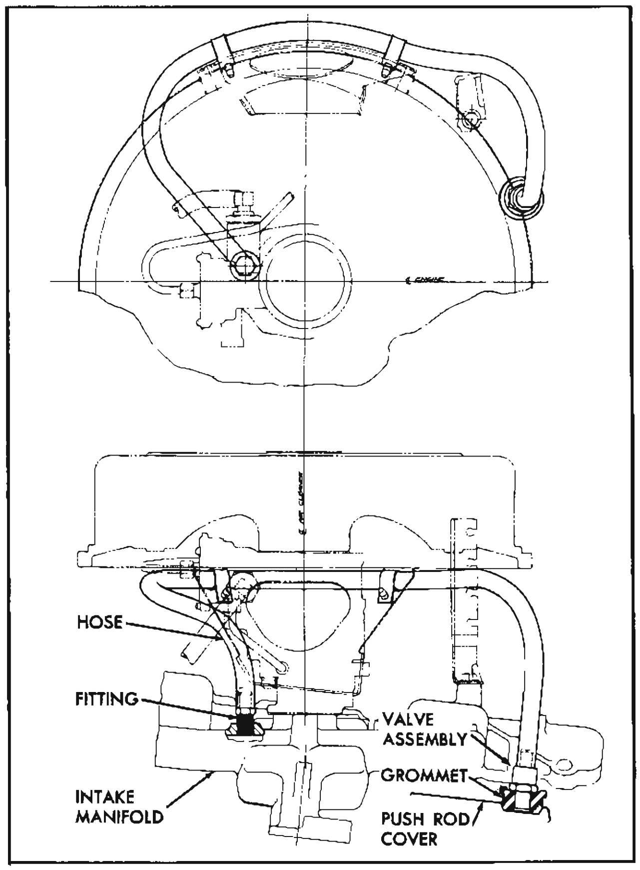



Fig. 6A-9 Positive Crankcase Ventilation 1 Bbl. Carb. 4 Cyl. Engine

### POSITIVE CRANKCASE VENTILATION VALVE CHECK

The following procedure should be followed for determining the condition of positive crankcase ventilation valves without removing them from the engine. On Tempest 4 cylinder engines the valve should be replaced if pinching off the hose from the valve causes an engine idle speed reduction of less than 35 rpm.

On Tempest V-8 engines the valve should be replaced if pinching off the hose from the valve causes an engine idle speed reduction of less than 15 rpm. The valve should be replaced every 12 months in any event.

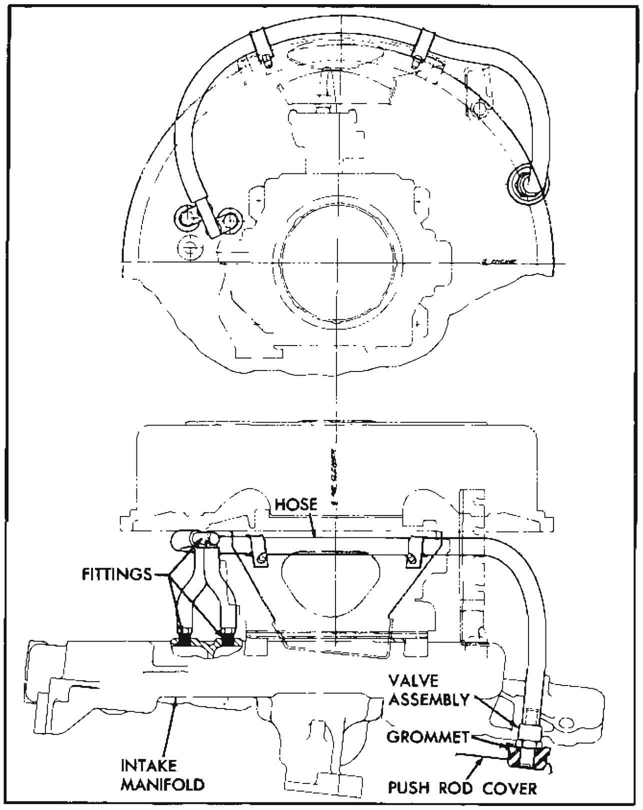



Fig. 6A-10 Positive Crankcase Ventilation
4 Bbl. Carb. 4 Cyl. Engine

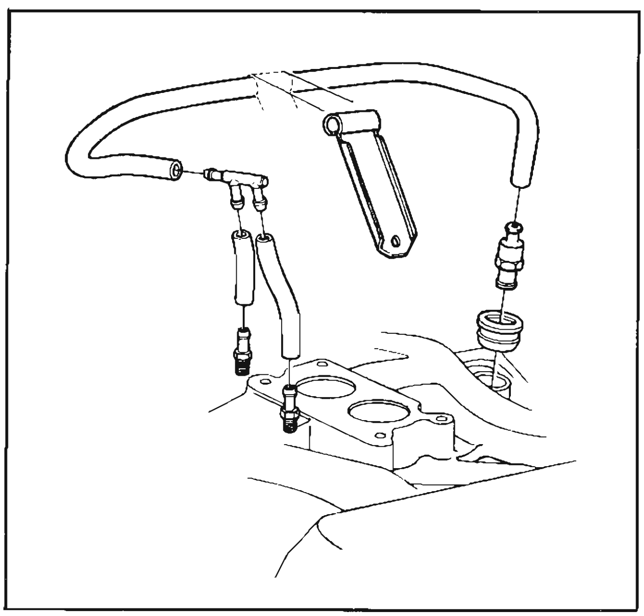


Fig. 6A-11 Positive Crankcase Ventilation
2 Bbl. Carb. V-8 Engine

## SERVICE OPERATIONS

### CHECKING AND FILLING COOLING SYSTEM

The Pontiac Tempest cooling system requires little care, except for maintaining an adequate coolant level, checking the coolant level whenever the car is serviced, and use of ethylene glycol type anti-freeze with soluble oil corrosion inhibitor for winter months.

If GM ethylene glycol type inhibitor engine coolant is used, it is not necessary to drain the coolant for summer driving because this coolant has been especially formulated to last 12 months in the engine. After service for 12 months, drain the system, flush it with water and refill with an inhibitor year round coolant. If a regular glycol type anti-freeze solution is used, the cooling system should be drained, flushed and refilled with water for the summer months. When water is used a good corrosion inhibitor should be added to the system.

### FLUSHING COOLING SYSTEM

It is especially important to flush and check the cooling system for leaks when anti-freeze is used, because of the possibility of damage to engine parts should it reach the interior of the engine.

1. Drain radiator and block by opening drain cock on radiator lower tank and removing plug on right side of 4 cylinder engine block and on both sides of V-8 engine block.

2. After system is empty, with drains open, run water into radiator. Engine should be running and occasionally accelerated to aid in circulating water and dislodge rust and scale.

***CAUTION: Do not introduce cold water into a hot engine or block may be cracked. Allow engine to cool, then add water with engine running.***

3. Where there is difficulty in getting water to run clear or there is an excessive amount of rust and scale, the cooling system should be cleaned with a cleanser (reputable source) supplied for that purpose. If force flushing equipment is used it should be used on the *radiator only* (engine to radiator inlet and outlet hoses removed) as any reverse flushing of the block with the water pump in place may cause the water pump seal to leak, if flushing pressure is excessive.

### PREPARING COOLING SYSTEM FOR COOLANT

The cooling system should be properly prepared for the addition of coolant each fall.

To properly prepare cooling system:

1. Bring engine up to operating temperature.

2. Flush out cooling system as instructed previously.

3. Tighten all hose connections on radiator, heater and defroster. Replace any deteriorated hose. Check to see that radiator hold down bolts are tightened properly.

4. Fill system with water and operate engine, checking for water leaks at radiator core, hose connections, water pump seal and gaskets, heater and defroster connections, and head to block joint.

5. Drain sufficient water to allow addition of proper quantity of anti-freeze.

***DO NOT OVER FILL. COOLANT SHOULD NOT BE OVER 1 INCH ABOVE THE RADIATOR CORE.***

***CAUTION: A pressure radiator cap is used to provide the best cooling. When removing, rotate the cap to the left very slowly. If a hissing noise is heard, stop and allow pressure to decrease before removing cap completely.***

To assure most effective heater performance, the Tempest has been equipped with a 180°F. thermostat. Therefore, the use of ethylene glycol type engine coolant gives best heater performance.

Alcohol base coolant is not recommended for use in Tempest automobiles. If for some reason alcohol type anti-freeze must be used, a 160°F. thermostat should be installed. This type anti-freeze should also contain soluble oil corrosion inhibitor.

### ANTI-FREEZES

Most well-known brand commercially available anti-freezes are acceptable. However, general rules for the selection of anti-freeze are: avoid the use of salt-base inhibited anti-freezes and use an anti-freeze with a soluble oil inhibitor where possible. No well-known brand of anti-freeze uses a salt base inhibitor and most use soluble oils. Occasionally, an off-brand anti-freeze will be found with a salt-base inhibitor.

### INHIBITORS

When no anti-freeze is in the system, a cooling system corrosion inhibitor is recommended to prevent corrosion of the cooling system. This is particularly recommended in areas in southwest United States where native water contains chemical salts which accelerate corrosion.

### TESTING COOLANT

In using a hydrometer to determine the freezing point of radiator solution, make sure the correct hydrometer markings are read. Unless hydrometer is provided with means for temperature correction, test should be made at the temperature at which hydrometer is calibrated, for if the solution is warmer or colder large errors may result (in some cases as much as 30° F.). Most good hydrometers are equipped with a thermometer and temperature correction scale which allows an accurate test of freezing point over a range of temperatures.

### ENGINE OIL

See General Lubrication Section.

### OIL FILTER CARTRIDGE

Install a new oil filter at 6,000 miles and then each six months or each 6,000 miles thereafter, whichever occurs first.

1. Turn hex nut on bottom of filter counterclockwise to unscrew filter from base.

2. Wipe filter base with clean cloth and make sure filter base attaching screws are tight.

3. Apply light grease or oil on new gasket furnished in filter package and place gasket firmly in groove at open end of filter.

4. *Hand-tighten* filter on hollow center stud until gasket contacts filter base, then complete tightening with additional 2/3 turn of filter but *do not over tighten*. Use care when tightening to prevent "bunching" of gasket. *Do not use wrench to tighten cartridge to base.*

5. Add oil to bring to "FULL" mark on dipstick.

6. Run engine and check for leaks at filter to base gasket. Recheck crankcase oil level. If necessary, add oil to bring level to"FULL " mark on dipstick.

### CRANKCASE VENTILATOR INLET AND OUTLET

See General Lubrication Section.

### THERMOSTAT

1. Drain radiator, disconnect upper hose and remove water outlet assembly from intake manifold.

2. Remove thermostat. Unless obviously defective, test the thermostat as follows, before replacing with new one:

a. Immerse the unit and a thermometer in a container of water over a heater. While heating the water do not rest either the thermometer or thermostat on bottom of container as this will cause them to be at higher temperature than the water.

b. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

A new thermostat (180°) valve should start to open (.002") at a temperature of 177°F. to 182°F., and should be fully (.380") or more at a temperature not in excess of 202°F. A used thermostat can be about 7°F. above or below this setting (170°-190°F.) without adverse effect and should not be replaced. If thermostat does not operate at specified temperatures, it should be replaced as it cannot be adjusted.

3. Install thermostat with pellet or cartridge projecting down into water passage in intake manifold.

4. Using new gasket, install water outlet fitting. Tighten bolts to 20-35 lb. ft. torque.

5. Connect upper radiator hose.

6. Refill radiator to approximately three inches from top and check for leaks.

### WATER PUMP—4 CYLINDER ENGINE AND V-8

NOTE: Water pump is serviced only as an assembly.

1. Drain radiator and engine block.

2. Loosen generator at adjusting strap and remove fan belt from fan pulley.

3. Remove fan and pulley.

4. Remove pump.

5. Install pump by reversing above steps. When pump is installed on engine, drain hole will be at bottom. Tighten water pump attaching nuts to 15 lb. ft. torque. Adjust belt for proper tension on chart, page 6A-10.

### RADIATOR—REMOVE AND REPLACE

1. Drain radiator.

2. Disconnect overflow, upper and lower radiator hoses.

3. Remove radiator fan shield (Fig. 6A-12).

4. Remove radiator.

5. To install radiator, reverse above procedure.

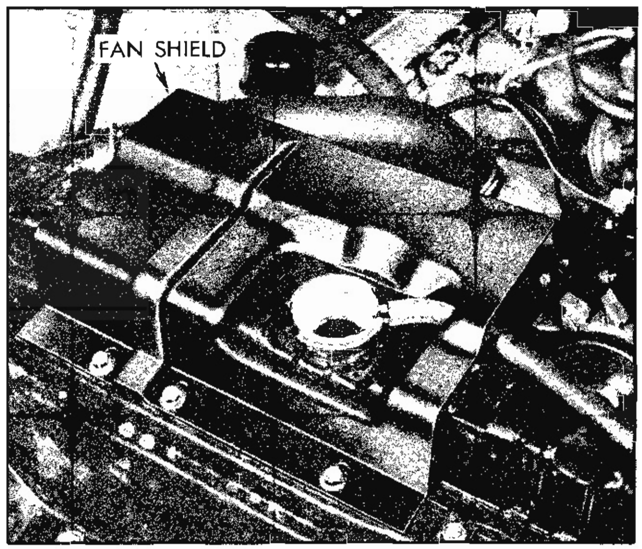



Fig. 6A-12 Radiator Fan Shield

## TROUBLE DIAGNOSIS

| SYMPTOM | CAUSE |
|---|---|
| Cooling system loses water. | 1. Make sure owner is not trying to keep radiator filled to top, and is not filling while cold. The expansion and contraction of water during operation will cause level to drop to several inches below the top of the filler neck. Once the level becomes stabilized it will not change appreciably during operation.<br>2. If cooling system has excess soluble oil, drain and refill.<br>3. Check for leaks from radiator or hose connections, including heater.<br>4. Check for crack in block. Pull engine oil dipstick to check for water in crankcase.<br>5. Remove rocker arm cover and check for cracked cylinder head.<br>6. Remove cylinder head and check gasket. While head is off, check for crack in head or block. |

| SYMPTOM | CAUSE |
|---|---|
| Buzzing noise from radiator cap. | This is caused by the relieving of excessive pressure when radiator boils. Check causes of overheating. |
| Overheating (coolant actually boils). | 1. Check engine thermostat.<br>2. Check for driving conditions which may cause overheating. Prolonged idling, start and stop driving in long lines of traffic on hot days, climbing steep grades on hot days, etc. will occasionally cause coolant to boil.<br>3. Check engine operation to make sure tune-up is not needed. Timing retarded past TDC may cause overheating. NOTE: Timing must be set with vacuum advance line disconnected.<br>4. Check fan belt for excessive looseness.<br>5. Clean debris from radiator.<br>6. Clean cooling system.<br>7. Remove cylinder head and check water passages in head and block for obstructions. |

## DRIVE BELTS FOR PONTIAC TEMPEST ENGINE AND ACCESSORY DRIVE COMBINATIONS

| Belt Width | Belt Name | Borroughs Gauge |
|---|---|---|
| 3/8" | Water Pump and Alternator Belt (4-Cylinder and V-8 Engine) | 70-75 lbs. |
| 3/8" | Power Steering Pump Belt (4 Cylinder and V-8 Engines) | 70-75 lbs. |
| 3/8" | Air Conditioning Comp. Drive Belt (4 Cylinder Engine) | 70-75 lbs. |
| 15/32" | Air Conditioning Comp. Drive Belt (V-8 Engine) | 100-105 lbs. |

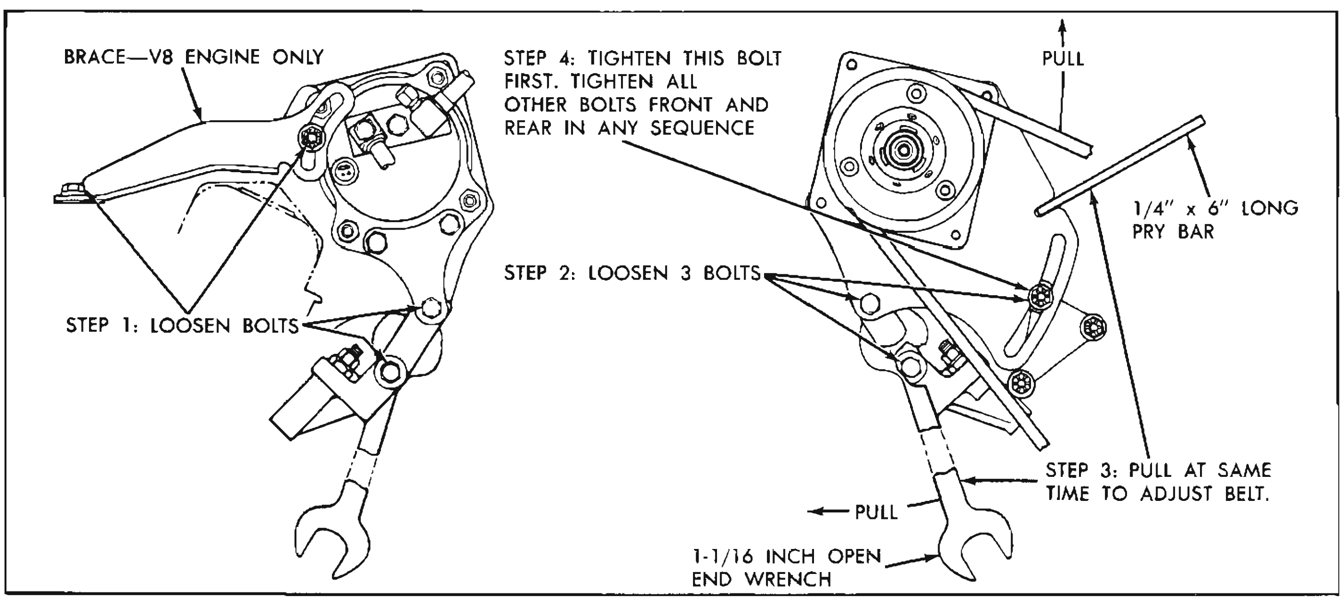



Fig. 6A-13 A. C. Compressor Belt Tensioning Procedure

## SPECIFICATIONS

### COOLING SYSTEM

| | |
|---|---|
| Type | Pressure with vent |
| Operating Pressure | 15 psi |
| Pump Type | Centrifugal |
| Pump and Fan Drive | V-Belt |
| Pump Bearings | Sealed Ball Bearings |
| Radiator | Tube and Center |
| Core Area | 360.1 sq. in. |
| Thermostat | 180° |
| Fan Diameter—Standard | 17″ |
| Fan Diameter—w/Air Conditioning | |
| 4 Cylinder Engine | 18″ |
| V-8 Engine (w/fan clutch) | 18″ |
| Number of Blades—Standard Fan—4-cyl. | 4 |
| V-8 | 5 |
| Number of Blades—Air Conditioning Fan | 7 |
| Cooling System Capacity 4-cyl. | |
| With Heater | 12.6 qts. |
| With Air Conditioning | 13.0 qts. |
| Cooling System Capacity 8-cyl. | 20.5 qts. |

### LUBRICATION

| | |
|---|---|
| Type | Pressure |
| Oil Pressure at 2600 r.p.m. | 30-40 psi |
| Lubricant Capacity When Refilling | 4 qts. (5 qts. if filter element is changed) |
| Oil Pump Type | Spur Gear |

### TEMPEST RADIATOR USAGE

| MODEL | CODE* | CORE THICKNESS |
|---|---|---|
| 195 L-4 Engine | 151 | 1.26″ |
| 195 L-4 Engine with A/C | 152 | 2.0″ |
| 326 V-8 Engine | 154 | 2.0″ |
| 326 V-8 Engine with A/C | 157 | 2.0″ |

*Code number is stamped on inside upper right corner of raditor assembly.

# ENGINE FUEL

## CONTENTS OF THIS SECTION



## CARBURETOR AIR CLEANER AND SILENCER

A combined air cleaner—silencer is used on all models. These units filter air entering the carburetor to keep abrasive dust from being carried into the engine, and reduce air induction noises.

Two types of air cleaners are available:

Standard and heavy duty. The heavy duty filter is intended for areas where the standard air cleaner is inadequate.

The standard air cleaner used on one barrel, four cylinder engine contains an oil moistened aluminum mesh filter element which catches dust particles as the air passes through.

The heavy duty type of filter is used on the remainder of the applications. This filter contains an oiled polyurethane filter element.

For service instruction see Lubrication, section 2.

## HEAT CONTROL VALVE (FIG. 6B-1)

A thermostatically controlled valve in the outlet of the exhaust manifold on the four cylinder engine blocks the passage of exhaust gases out of the manifold when the engine is cold (Fig. 6B-2). Exhaust gases will then pass through to crossover passage in the intake manifold heating the manifold stove. From the intake manifold the gases pass through the exhaust crossover pipe and into the exhaust system. As the engine warms up, the thermostatic valve opens allowing a greater amount of the exhaust gases to pass directly out the exhaust manifold and gas to pass through the crossover pipe.

## THROTTLE RETURN CHECK

The throttle return check is mounted on the carburetor and is designed to open the throttle valves to increase engine speed slightly and prevent stalling

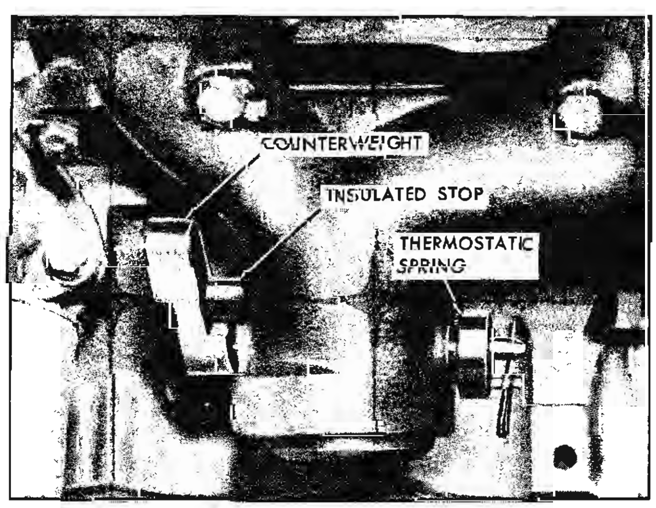



Fig. 6B-1 Thermostatic Heat Control Valve when engine vacuum drops. It also acts to retard throttle when the driver suddenly takes his foot off the accelerator pedal. The throttle return check is standard on the following engines:

All Tempest four barrel four cylinder engines, except air conditioning.

All Tempest V-8 engines with automatic transmissions.

## IDLE SPEED-UP DEVICE

The idle speed-up device (Figs. 6B-3 and 6B-4) is standard on 4 cyl. 1 Bbl. and 4 Bbl. engines with automatic transmission and air conditioning. It consists of a solenoid (connected by two wires to the air conditioning compressor) and a vacuum diaphragm similar to a throttle return check diaphragm. The mechanism increases idle speed when air conditioning is on and acts as a throttle return check when the air conditioning is off. When the air conditioning compressor is operating, the solenoid opens a release valve, decreasing diaphragm vacuum, thus causing the diaphragm plunger to partially open the carburetor throttle valve. The solenoid is inoperative when the air conditioning is off.

Idle speed-up device adjustments are:

1. One Bbl. carburetor
   A. Air cond. off, trans. in dr.—580-600 rpm
   B. Air cond. on, trans. in dr.—620-640 rpm
2. Four Bbl. carburetor
   A. Air cond. off, trans. in drive,
      hot idle compensator closed—620-640 rpm
      hot idle compensator open—580-600 rpm
   B. Air cond. on, trans. in drive,
      hot idle compensator closed—620-640 rpm
      hot idle compensator open—580-600 rpm

## ACCELERATOR LINKAGE ADJUSTMENT

1. Check accelerator pedal height. If necessary, adjust linkage (Fig. 6B-3-4-5) to obtain correct height.

2. Depress accelerator to floor and check to see that carburetor throttle valves are wide open.

NOTE: Disconnect automatic transmission T.V. cable from carburetor.

3. For adjustment of transmission T.V. cable see Section 7A.

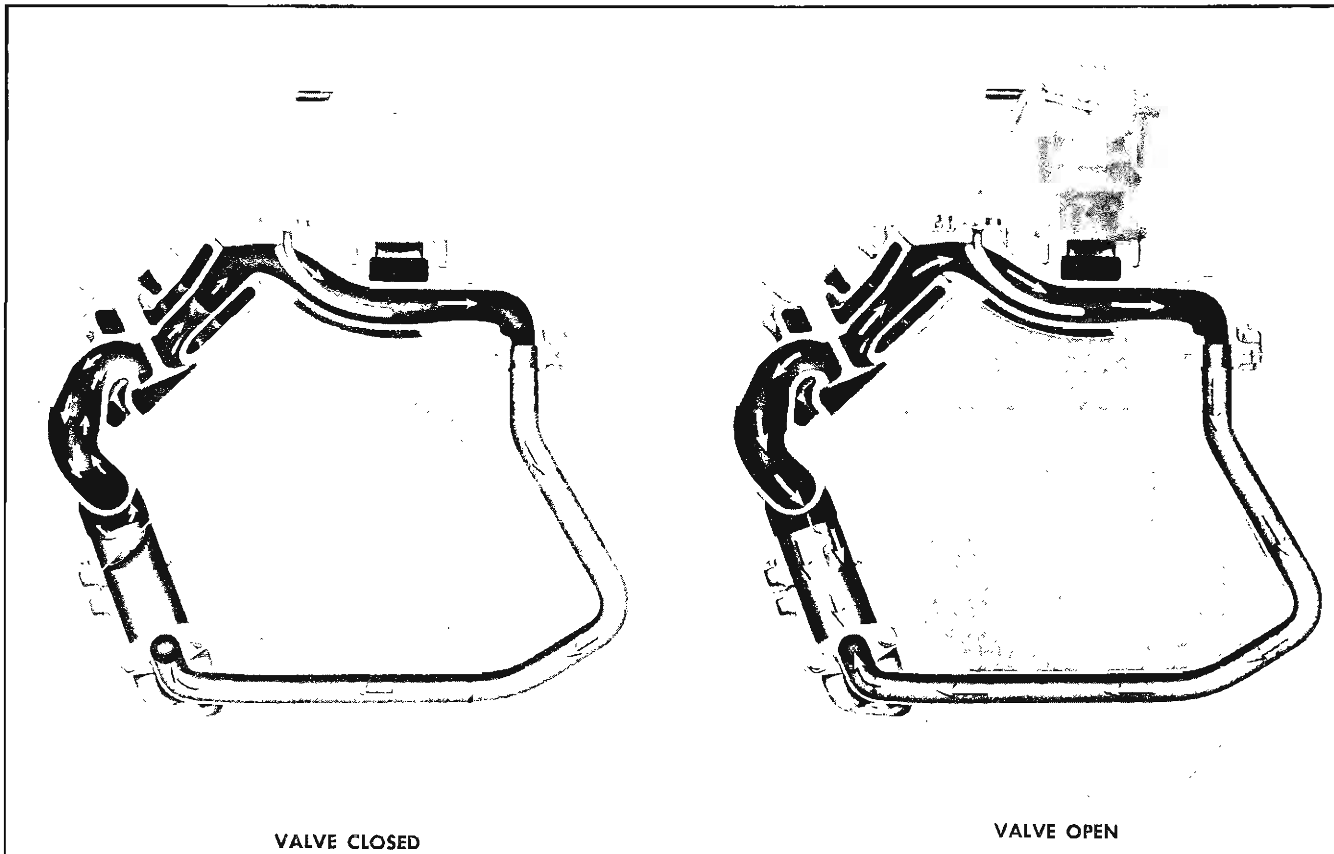



Fig. 6B-2 Operation Heat Control Valve

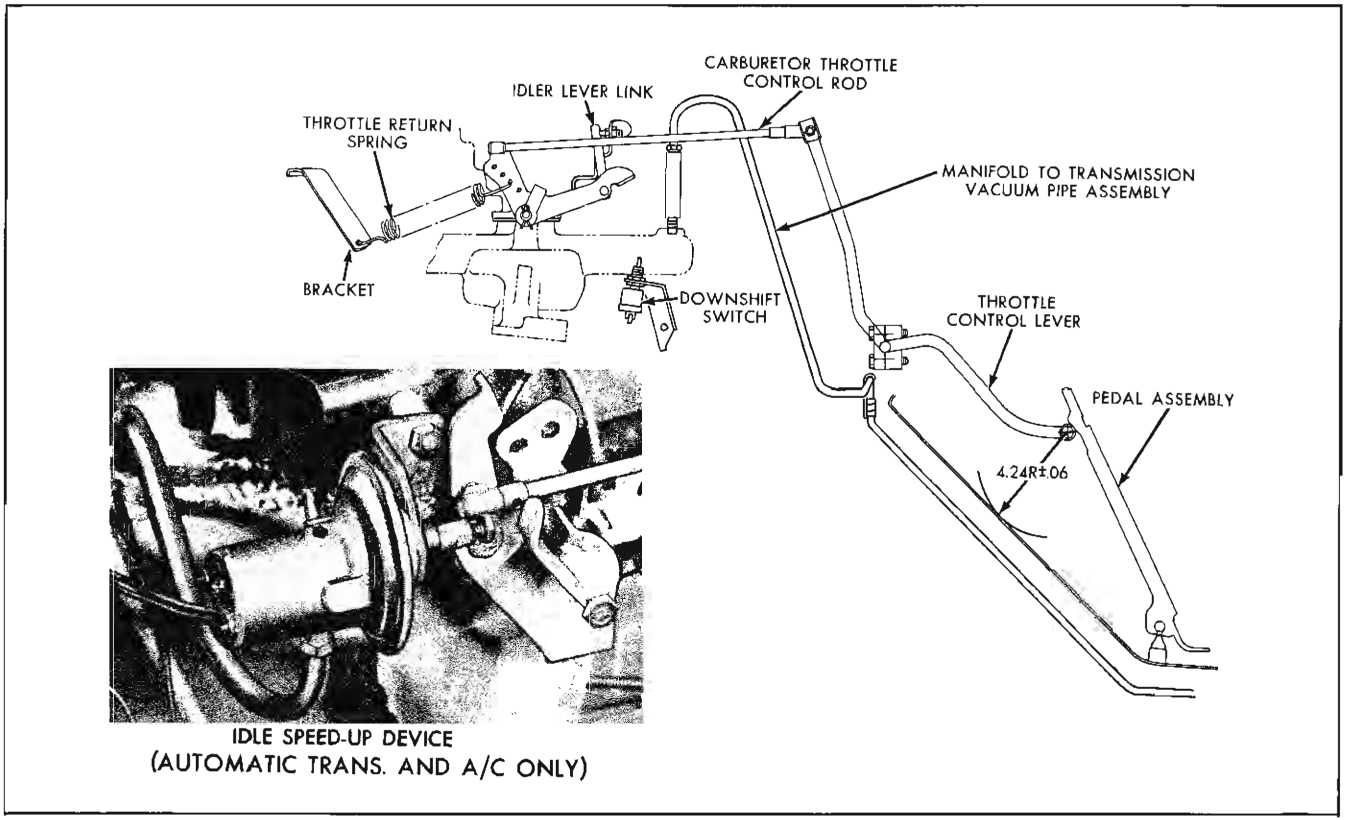



Fig. 6B-3 Four Cylinder—One Barrel—Accelerator Linkage

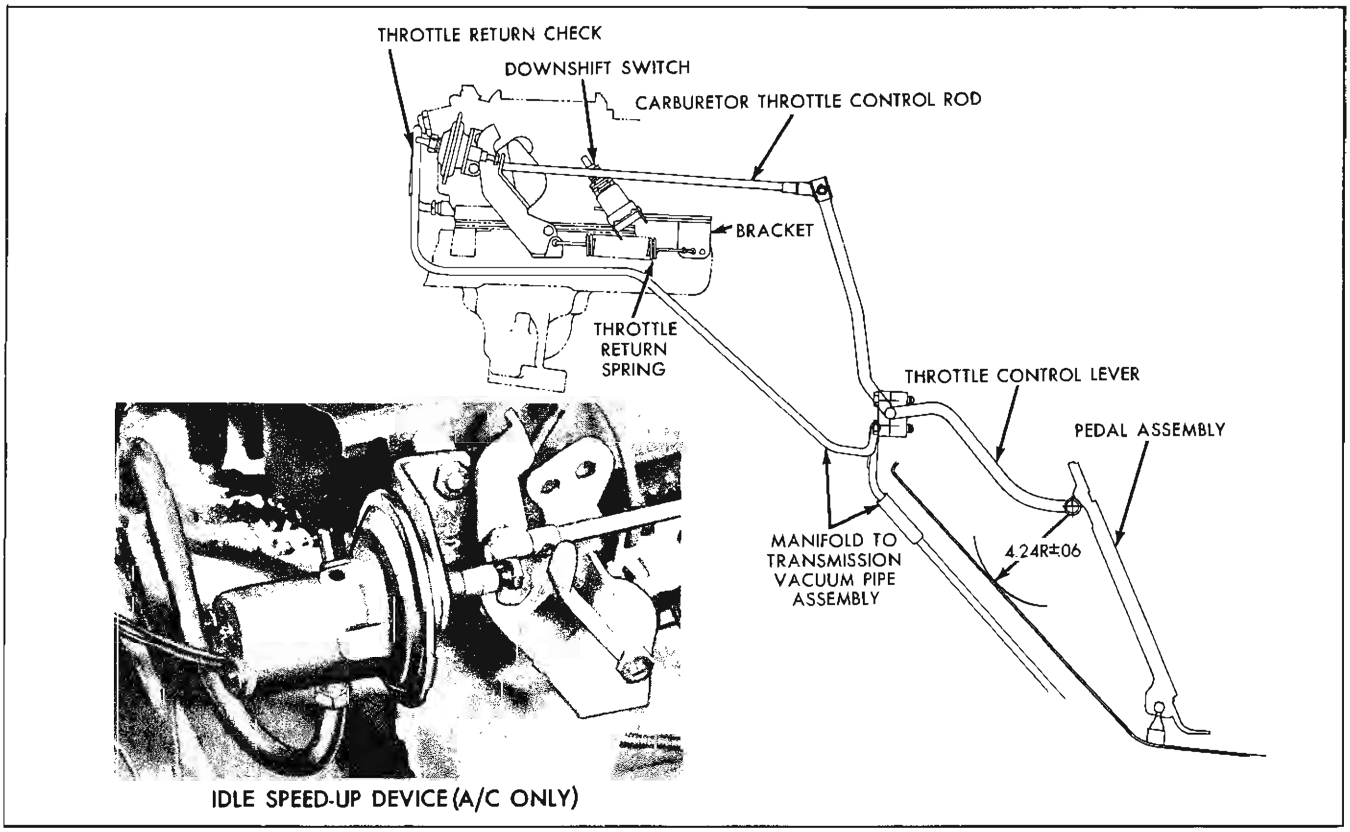



Fig. 6B-4 Four Cylinder—Four Barrel—Accelerator Linkage

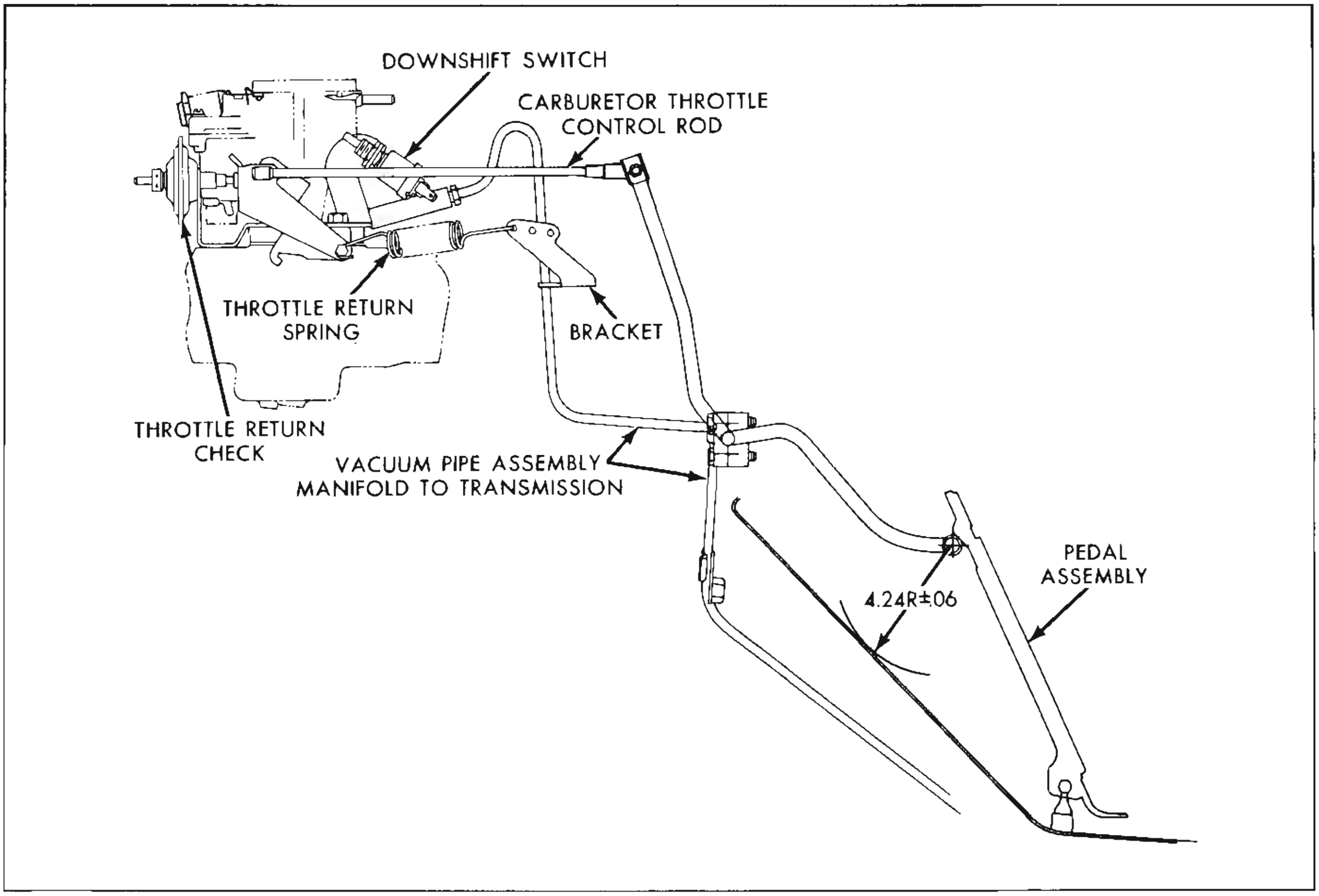



Fig. 6B-5 Eight Cylinder Accelerator Linkage

## ROCHESTER B AND BC CARBURETORS

The model B and BC carburetors are used on the four cylinder engine, model B on Synchro-Mesh transmission applications, and BC on automatic transmission applications. The model B is a manual choke carburetor.

Model BC incorporates a Rochester-GM automatic choke.

The two models are identical except for the choke system, distributor vacuum take off system and calibration

| CARBURETOR MODEL NO. | USED ON | THROTTLE BORE SIZE |
|---|---|---|
| 7020061 | Synchro-Mesh Transmission Four Cylinder Engine | $1\frac{9}{16}''$ |
| 7020066 | Automatic Transmission Four Cylinder Engine | $1\frac{9}{16}''$ |

### DESCRIPTION

Both B and BC model carburetors incorporate several distinct features. The carburetor features a concentric float bowl, which completely surrounds the main bore of the carburetor. The design of the float bowl in conjunction with the centrally located discharge nozzle prevents fuel loss on inclined roads. Regardless of the angle the car assumes, the fuel level is below the nozzle spill point at all times.

A second feature of this carburetor is the unique design of the main well assembly. This assembly contains the main metering jet and power valve. It is attached to the carburetor air horn and is suspended in the float bowl with the suspension of the main well in the bowl. Engine heat cannot be directly transmitted to the main passageway through the main metering jet.

On the model BC carburetor the choke housing is located on the air horn and is connected to the manifold vacuum by an external steel tube. Clean, hot air is supplied to the choke from the air horn located below the air cleaner, from here it is drawn through the heat stove in the manifold to the choke through steel tubing.

Both the model B and BC carburetor incorporates the six systems of carburetion: float, idle, part throttle, pump, power, and choke.

### FLOAT SYSTEM (Fig. 6B-6)

The model B and BC carburetors employ the conventional float needle and seat to control fuel level in the float bowl. With the concentric float bowl design, dual floats are used to maintain a constant fuel level throughout all operating ranges and engine angles. The float bowl is designed so that the fuel is centrally located around the main well, so the efficient carburetor metering may be maintained under all engine operating conditions.

Fuel entering the carburetor first passes through the inlet filter located behind the fuel inlet nut. The fuel inlet filter is cylindrical in shape and it is held in place against the fuel inlet nut by a small pressure release spring. The filter element can be easily removed for periodic cleaning by removing the fuel inlet line and nut. Should the filter become clogged, fuel flow will not be restricted because the filter element will be pushed off its seat, against the pressure release spring, allowing fuel to temporarily by-pass the filter element. A small fibre gasket seals the fuel filter element against the inside of the fuel inlet nut.

As the fuel level drops in the carburetor bowl, the twin floats also drop, thus moving the fuel inlet needle off its seat. The pressure from the fuel pump, forces fuel through the filter element into the fuel inlet passage, past the float needle seat, into the fuel bowl. As the fuel level rises, the floats rise and when the correct fuel level is reached the fuel is shut off at the float needle seat, thereby keeping the fuel level constant. The float tang prevents the float from moving too far downward into the float bowl. This tang also prevents the float needle from dropping out of the seat during disassembly and assembly operations.

Two external vents and one internal vent transmit outside air pressure to the fuel in the float bowl. The amount of fuel metered by the carburetor is dependent upon the pressure in the float bowl, causing fuel to flow. These vents allow the carburetor to automatically compensate for the air cleaner restriction. In addition the two external vents serve as hot idle compensators (i.e. release excessive hot vapors from float bowl during hot idle).

### IDLE SYSTEM (Fig. 6B-7)

The idle system consists of the idle tube, idle passages, idle air bleeds, idle mixture adjustment needle, idle discharge holes, and an idle speed adjustment screw.

A fixed air bleed in the throttle valve acts as a deterrent to stalling due to gum formation in the throttle valve. The fixed idle air bleed maintains a constant idle air flow for part of the idle air requirement, while the idle speed adjusting screw regulates the remainder of the idle air. The engine idle speed can be adjusted by the idle speed adjusting screw.

The idle mixture needle hole is in the high vacuum area below the throttle valve while the fuel bowl is vented to atmospheric pressure. Vacuum can be called lack of pressure, so a high vacuum area can be spoken of as an area of low pressure. There is considerable pressure difference between the normal atmospheric pressure on the fuel in the bowl and the low pressure (or high vacuum) at the idle mixture needle hole. The fuel/air mixture will be forced by atmospheric pressure to occupy any low pressure area. Due to the difference in pressure the fuel will flow from fuel bowl to the engine manifold.

The atmospheric pressure, acting on the fuel in the bowl, forces fuel through the main metering jet into the main well. The fuel travels first through the primary idle tube and vertical channel and then through the horizontal cross bar in the air horn. The secondary idle tube which controls idle quantity is in the cross bar and is located beyond the nozzle open-

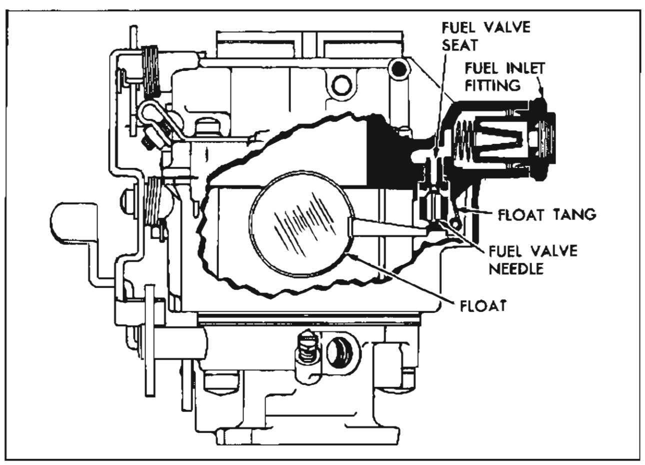



Fig. 6B-6—Float System

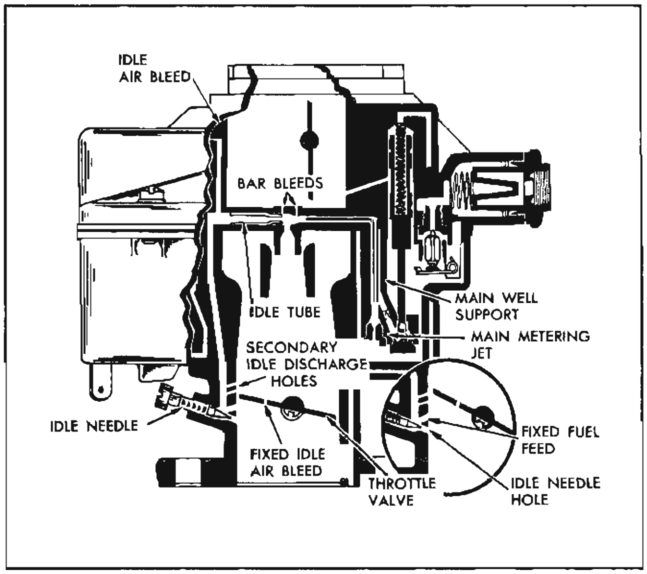



Fig. 6B-7 Idle System

ing. Air mixes with the fuel at the air bleeds in the center of the cross bar and the idle air bleed at the top of the vertical idle channel.

The fuel/air mixture then travels through the vertical passage in the fuel bowl to the throttle valve surface. The fuel/air mixture then travels part way around the throttle bore through a horizontal passage in the bowl and starts down the vertical passage in the throttle body. Here more air is added to the mixture from the idle discharge holes. The fuel/air mixture then passes around the idle adjustment needle which regulates the amount of fuel/air mixture admitted to the carburetor bore. The mixture then travels through the idle needle hole where more air

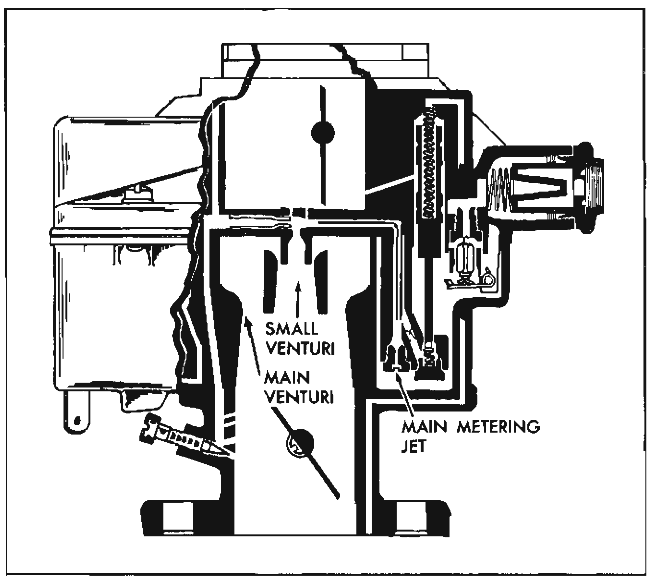



Fig. 6B-8 Part Throttle System

is added to the mixture. It then travels into the intake manifold.

Except for the variable of the idle mixture adjustment needle the idle system is specifically calibrated for low engine speeds.

The model BC carburetor will be equipped with vacuum operated throttle return check when used on an air conditioned Tempest with automatic transmission. The return check is designed to open the throttle valve to increase engine speed slightly and prevent stalling when engine vacuum drops slightly. It also acts as a retard to throttle closing when the driver suddenly takes his foot off the accelerator pedal.

### *PART THROTTLE SYSTEM (Fig. 6B-8)*

When the throttle valve is opened, there is a change in pressure differential points. Opening of the throttle valve progressively exposes the idle discharge holes to manifold vacuum and the air stream with the result that they deliver additional fuel/air mixture for fast idle engine requirements.

Further opening of the throttle valve increases the speed of the air stream passing through the venturi, lowering the pressure (or raising the vacuum) in the small venturi area of the carburetor bore. At the same time, the throttle valve is moved away from the wall of the bore, progressively reducing the vacuum and thus the mixture flow at the idle discharge holes.

Since the low pressure point is now in the small venturi area, fuel and fuel/air mixture will be forced from the fuel bowl through the main metering system into the venturi as follows:

The fuel passes through the main metering jet into the main well, where it rises in the main well tube. The fuel continues up the main well tube to the horizontal cross-bar in the air horn and across the cross-bar to the main nozzle. At this point air is bled into the fuel and the mixture is discharged through the main discharge nozzle into the small venturi. Here the air/fuel mixture mixes with additional air and moves on to the bore of the carburetor and into the intake manifold.

The calibration of the main metering jet and air bleeds in the cross-bar maintain economical fuel/air ratios through the part throttle or cruising range. Therefore, no adjustments are necessary on the part throttle system of the B and BC carburetors.

### *POWER SYSTEM (Fig. 6B-9)*

A vacuum operated power system is used on the carburetor to provide additional fuel for sustained high speed operation or increased road load power.

A direct manifold vacuum passage within the carburetor to the engine intake manifold operates this system. At any manifold vacuum below approximately 5" of mercury, it forces the power actuating piston down.

The end of the power piston unseats the spring loaded ball in the power valve. Fuel passes around the ball into the base of the main well support. The calibrated power restriction meters the fuel prior to joining the fuel from the main metering jet. Conversely as the manifold vacuum rises above 5" of mercury, the power piston is drawn up immediately to the up position and the spring loaded ball of the power valve closes returning the carburetor to the economical part throttle "mixture". There is no adjustment required for the power system.

The relief passage which is drilled from the bore of the air horn to the power piston passage serves to relieve any vacuum built up around the piston diameter. This vacuum, if unrelieved, will draw fuel past the piston and down the vacuum passage into the manifold, resulting in an overly rich condition.

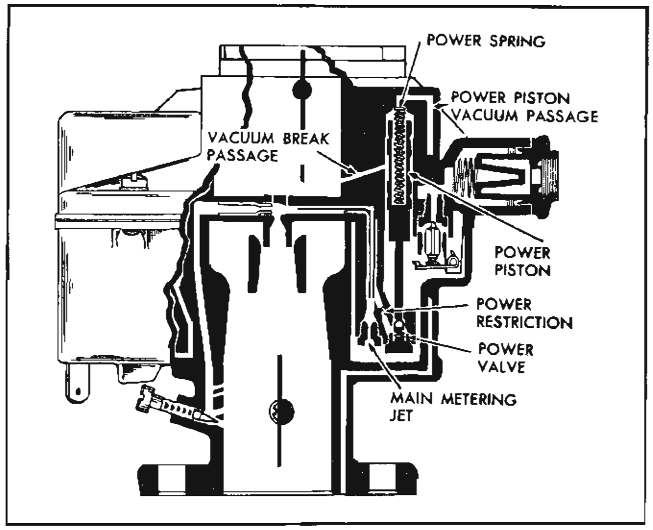



Fig. 6B-9 Power System

*PUMP SYSTEM (Fig. 6B-10)*

Extra fuel for smooth, quick acceleration is supplied by a double spring pump plunger. Rapid opening of the throttle valve, as in the case where accelerating from low speeds, causes an immediate increase in air velocity. Since fuel is heavier than air, it requires a short period of time to "catch up" with the air flow. To avoid a leanness during this momentary lag, the accelerator pump furnishes a quantity of liquid fuel sprayed into the air stream to mix with the incoming air and maintain the proper fuel/air mixture.

The pump is operated by the combined action of two springs which are calibrated to move the plunger in such a manner that a sustained charge of fuel is delivered for smooth acceleration. The pump is attached by linkage to the accelerator. When the throttle valves are closed, the pump plunger moves upward in its cylinder, creating a low pressure area (partial vacuum) in the cylinder below the plunger. Atmospheric pressure acting on the fuel in the bowl forces fuel into the cylinder through the anti-percolator ball in the pump plunger head. The discharge ball is seated at this time to prevent air being forced into the cylinder.

When the plunger is moved downward for acceleration, the force of the stroke seats the anti-percolator ball check to prevent fuel flow into the bowl. The fuel is forced up the pump discharge passage. The pressure of the fuel lifts the pump outlet ball check from its seat and the fuel passes on through the pump jets in the bowl where it is sprayed into the venturi and delivered to the engine.

At higher speeds pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a predetermined amount, the pump plunger bottoms in the cylinder eliminating pump discharge.

The "anti-percolator" check valve, contained inside the plunger provides relief for any vapors which might form during hot idle or when a hot engine is not operating. The ball check is designed so that it can move up and down in its passage. Throughout the above periods it is seated by gravity and vapors in the pump will rise and by-pass the ball check through small holes in the plunger head.

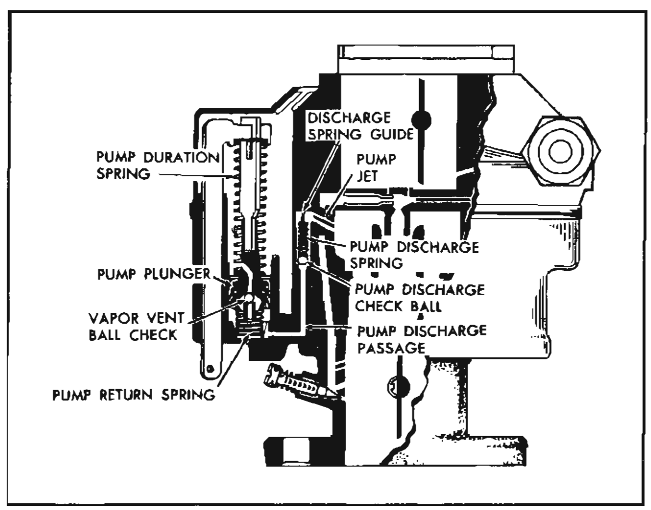



Fig. 6B-10 Pump System

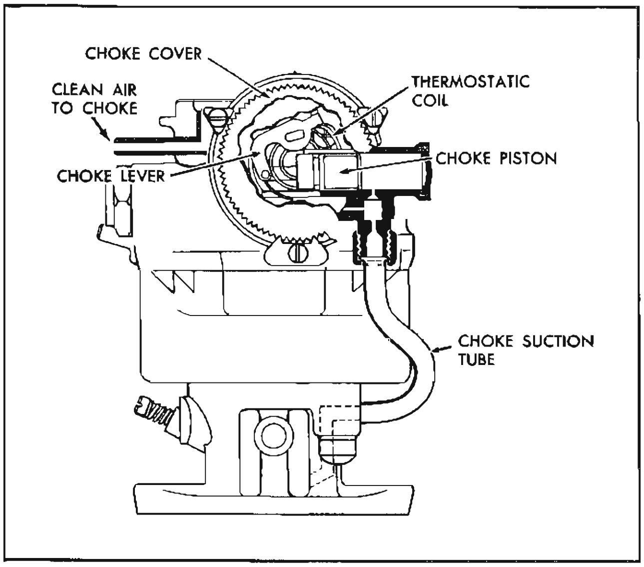



Fig. 6B-11 Choke System

### *CHOKE SYSTEM*

MODEL BC (FIG. 6B-11)

The purpose of the choke system is to provide a rich mixture for cold engine operation. It is necessary to have an extra rich mixture, because fuel vapor has a tendency to condense on cold engine parts, thus decreasing the amount of combustible mixture available at the combustion chamber.

The choke system includes a thermostatic coil, housing, choke piston, choke valve, and fast idle cam and linkage. It is controlled by a combination of manifold vacuum, air velocity against the offset choke valve, and tension of the thermostatic spring.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. Starting the engine causes air velocity to strike the offset choke valve. This tends to open it along with the action of the intake manifold vacuum on the choke piston. After a slight opening of the choke valve, the tension of the thermostatic coil spring balances the force of air on the valve and the pull of vacuum at the piston.

As the engine warms up, manifold vacuum exists in the choke housing. Hot air from the choke stove is forced into this low pressure area through a passage in the side of the choke housing to heat the thermostatic coil.

A secondary baffle plate serves to distribute heat from its entering point at the side of the coil evenly throughout the choke housing, to prevent a hot spot in the coil center, which would cause a rapid opening of the choke valve. The thermostatic coil relaxes gradually until the choke is fully open.

As the engine is accelerated during warm-up the corresponding drop in manifold vacuum on the piston allows the thermostatic coil to momentarily close the choke, providing a richer mixture.

During warm-up it is necessary to provide a fast idle to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke shaft. The idle screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to the idle position until the choke valve is fully opened.

If the engine becomes flooded during the starting period, the choke valve can be partially opened manually to allow increased air flow to carburetor. This is accomplished by depressing the accelerator pedal to the floor. The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke valve.

To insure trouble free operation of the choke system and minimize wear, Teflon bushings, on the choke shaft, choke collar, and air horn bushings are being used on the BC carburetor.

MODEL B

The model B carburetor is essentially identical to the BC carburetor with the exceptions being the choke system and the distributor vacuum take off system.

The model B has a manually controlled choke and has the necessary linkage to accept the manual control cable. Fast idle is controlled during cold and closed choke operations by means of a cam on the choke shaft driving a fast idle lever which holds the throttle valve partially open to allow higher engine R.P.M.

The throttle body on the model B carburetor is drilled and tapped to receive a fitting so that vacuum may be supplied to the distributor. The model BC carburetor has no vacuum take off hole in the throttle body. The vacuum for the distributor is obtained from the intake manifold.

The model B is not equipped with vacuum operated throttle return check.

## ADJUSTMENTS ON CAR—ROCHESTER B AND BC CARBURETOR

All Rochester B and BC adjustments can be performed on the car. With the exception of the idle speed and mixture adjustment and the unloader adjustment, all adjustments are included in the "Overhaul and Adjustments" procedure. Following are the idle speed and mixture adjustments and the unloader adjustment.

### IDLE SPEED AND MIXTURE ADJUSTMENT ROCHESTER B OR BC

With the engine at operating temperature, adjust idle speed to the following specifications:

Synchro-Mesh .............. 680-700 R.P.M.

Automatic (In Drive) .............. 580-600 R.P.M.

Air Conditioned:

(Automatic Drive Position—
Air Conditioning off) .......... 630-650 R.P.M.

(S/M Neutral—
Air Conditioning off) .......... 680-700 R.P.M.

1. As a preliminary setting, turn idle mixture screw out 1½ turns from lightly seated position and speed screw in ½ to one turn from throttle closed position.

2. Set hand brake securely, place transmission in neutral and connect tachometer to engine.

3. Start engine and warm up thoroughly. Be sure choke is fully open and carburetor is completely off fast idle.

4. Place automatic in "drive" and adjust idle speed screw to obtain specified idle speed.

5. Turn mixture screw to best quality (highest R.P.M.) idle.

6. Reset idle speed screw to specified idle speed if mixture adjustment changed setting.

7. Recheck mixture adjustment to insure smoothest possible idle.

NOTE: Always recheck idle mixture setting after making idle R.P.M. adjustment with idle speed screw.

### THROTTLE RETURN CHECK ADJUSTMENT
*(with air conditioning, automatic trans.)*

1. Set hot idle and mixture adjustment to specifications.

2. Place transmission in neutral.

3. With engine running, disconnect vacuum hose from throttle return check and plug open end of vacuum hose.

4. Adjust the contact screw of the throttle return check to obtain speed of 1175 r.p.m.

NOTE: Hold sleeve next to diaphragm from turning while adjusting contact screw.

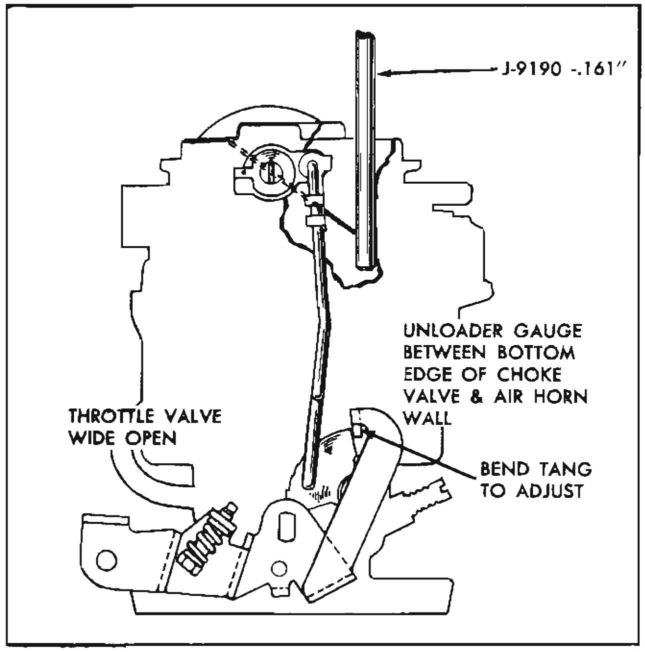



Fig. 6B-12 Unloader Adjustment

### UNLOADER ADJUSTMENT—(Fig. 6B-12) (AUTOMATIC CHOKE ONLY)

NOTE: Unloader adjustment cannot be made correctly unless linkage is properly adjusted.

1. Remove carburetor air cleaner assembly.

2. Depress accelerator pedal to pedal stop on floor. (This should be done by person sitting in driver's seat of car to simulate driving conditions.)

3. With accelerator pedal depressed as in above step, bend tang on throttle lever to give a clearance of .161" tool J-9190 between the choke valve and the inside of the air horn.

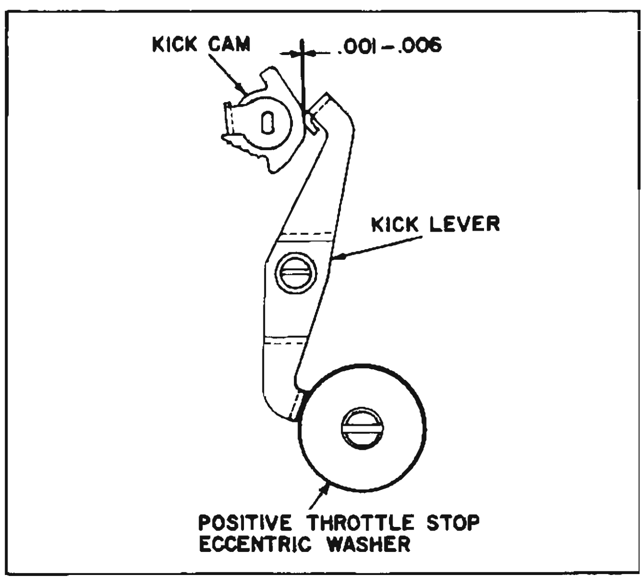



Fig. 6B-13 Throttle Stop Adjustment

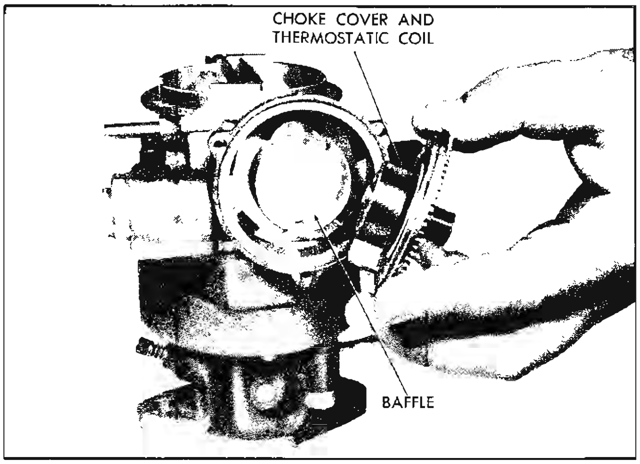



Fig. 6B-14 Removing Choke Cover

4. Replace air cleaner assembly.

The above procedure will eliminate variance in linkage, pedal location, etc., and should ensure correct unloader action.

### *THROTTLE STOP ADJUSTMENT (Fig. 6B-13) (MANUAL CHOKE ONLY)*

When servicing a Tempest model B carburetor it is not necessary to remove the positive idle stop eccentric washer. However, should this washer become loose or be removed, it may be adjusted as follows:

With the choke valve wide open, rotate the eccentric washer to a position where a clearance of .001"-.006" is maintained between the upper end of the kick lever and the kick cam as shown in Fig. 6B-13. Lock the eccentric washer in place with the screw.

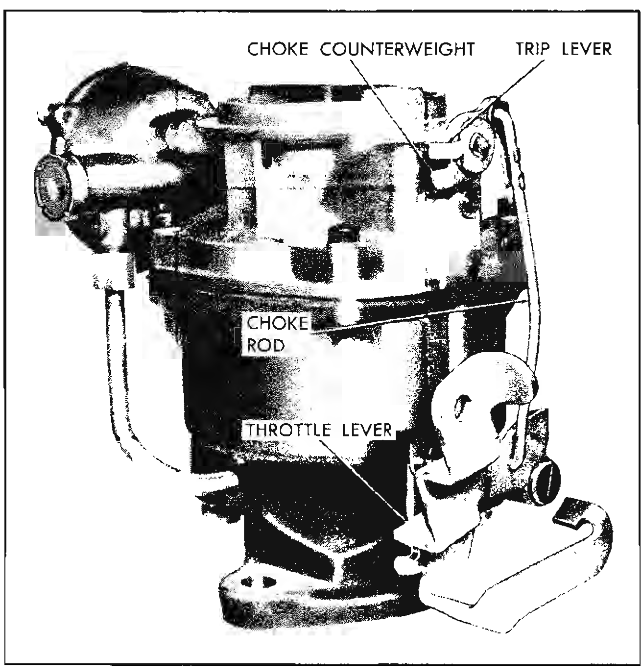



Fig. 6B-15 Rochester BC Carburetor

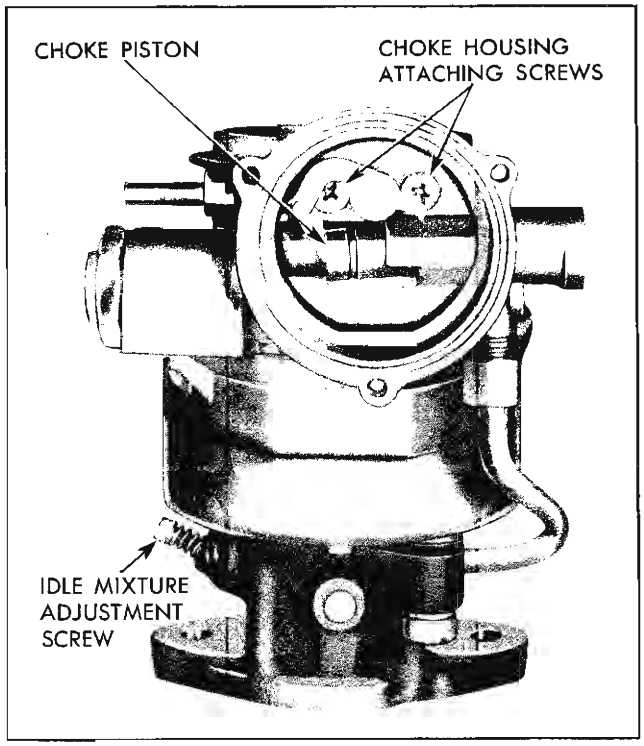



Fig. 6B-16 Location of Choke Piston

## OVERHAUL AND ADJUSTMENT

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the contents of the fuel bowl should be examined for contamination as the carburetor is disassembled.

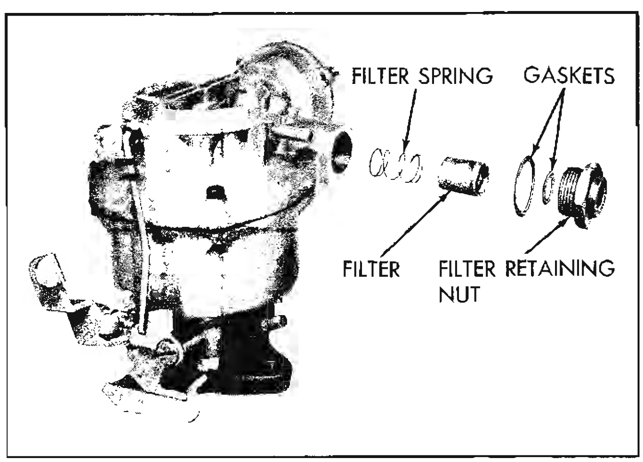



Fig. 6B-17 Removing Fuel Filter

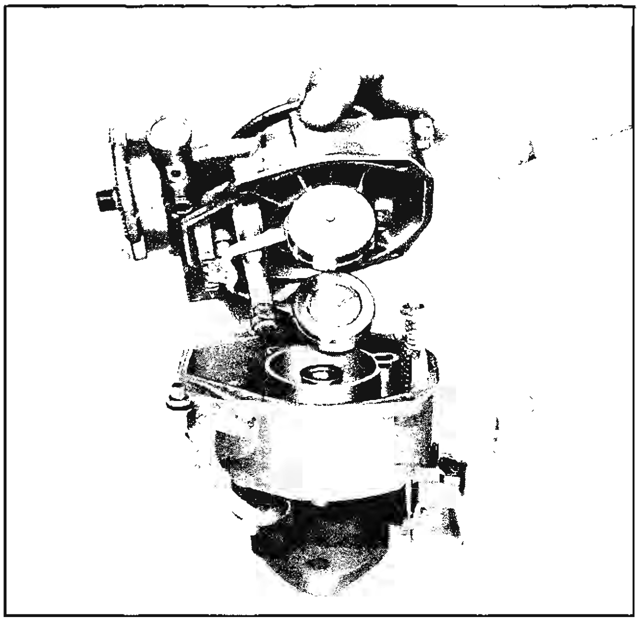


Fig. 6B-18 Removing Air Horn from Bowl

## DISASSEMBLY OF CHOKE

1. Loosen ½" fitting on choke vacuum tube.

2. Remove three choke cover attaching screws and retainers, remove choke cover, cover gasket, and thermostatic coil assembly from carburetor (Fig. 6B-14).

3. Remove baffle plate.

4. Remove pin spring and clip from respective ends of choke rod and remove rod (Fig. 6B-15).

5. Remove throttle return check valve and mounting bracket (automatic choke only).

6. Remove retaining screw at end of choke shaft and carefully pry off choke trip lever, spacing washer, and choke counterweight.

7. Remove two choke valve screws and remove choke valve.

8. Rotate choke shaft clockwise to remove choke piston from housing, then remove piston and choke shaft from carburetor (Fig. 6B-16).

9. Remove choke piston pin and piston from choke shaft.

10. Remove two choke housing attaching screws. Choke housing and gasket may now be removed from air horn.

## AIR HORN DISASSEMBLY

1. Remove filter retainer nut and gasket with 1" wrench. Remove filter, spring and gasket (Fig. 6B-17).

2. Remove four screws and throttle return check (automatic only). Lift air horn straight up from bowl so as not to damage floats (Fig. 6B-18). Place air horn float side up on flat surface.

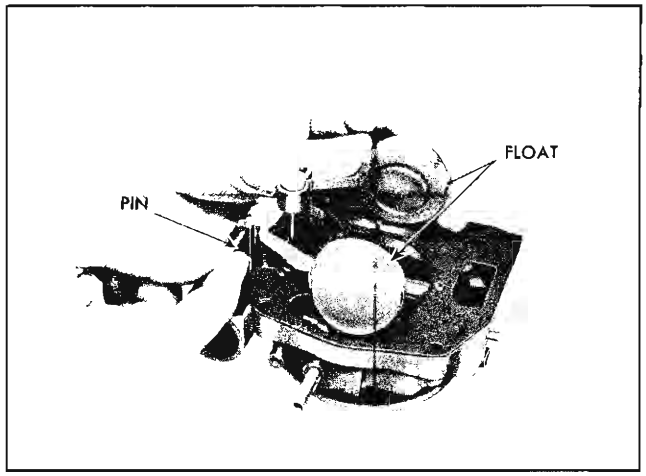



Fig. 6B-19 Removing Float Hinge Pin

3. Remove float hinge pin (Fig. 6B-19) and lift float assembly from air horn. Float needle may now be removed.

4. Remove float seat and gasket with ½" bit screwdriver (Fig. 6B-20).

5. Remove main metering jet from main well support (Fig. 6B-21).

6. Remove power check valve ball retainer, spring and ball (Fig. 6B-22).

7. Remove main well support.

8. Remove power piston and spring (Fig. 6B-23).

NOTE: Do not remove primary idle tube from air horn.

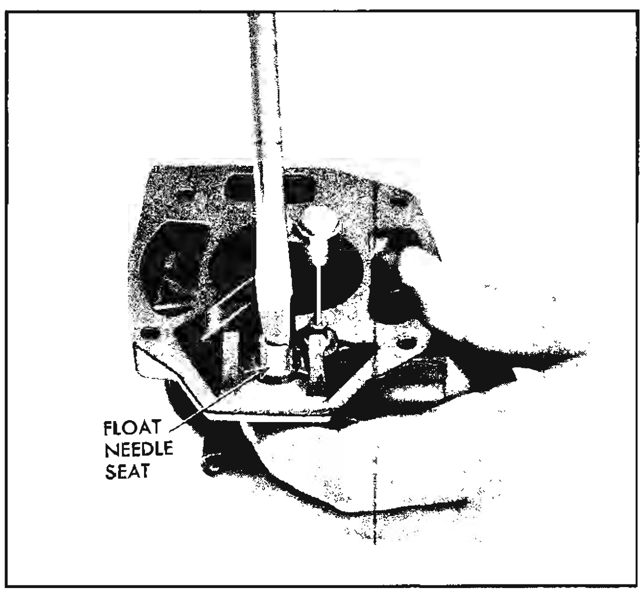



Fig. 6B-20 Removing Float Needle Seat

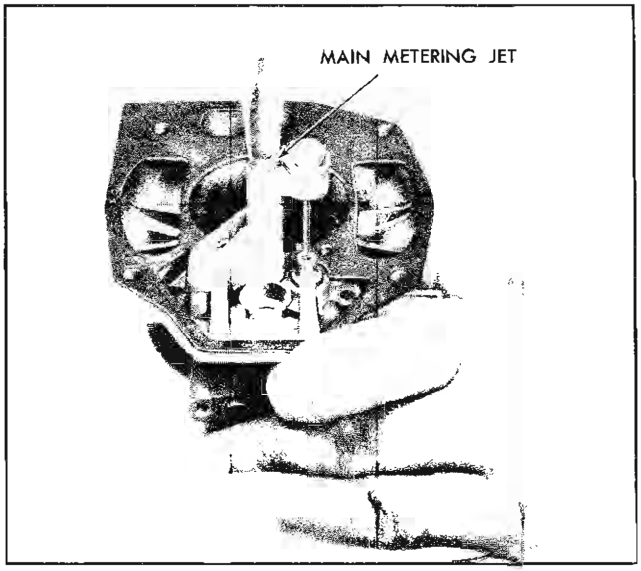



Fig. 6B-21 Removing Main Metering Jet

9. Air horn gasket may now be removed.

**BOWL DISASSEMBLY**

1. Using a pair of long nose pliers, remove pump discharge glide, spring and ball (Fig. 6B-24).

2. Remove two pin springs from pump link and remove pump link from throttle lever. Remove pump plunger arm.

3. Remove pump plunger from bowl (Fig. 6B-25).

4. Remove pump return spring (Fig. 6B-26).

NOTE: Do not remove choke suction tube from throttle body.

5. Place carburetor bowl with suction tube projected over edge of flat surface and remove two throttle body attaching screws. Throttle body and gasket may now be removed.

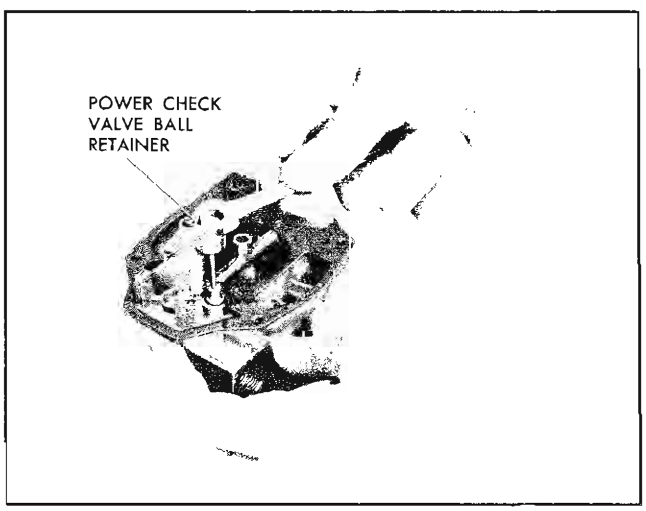



Fig. 6B-22 Removing Power Check Valve Ball Retainer

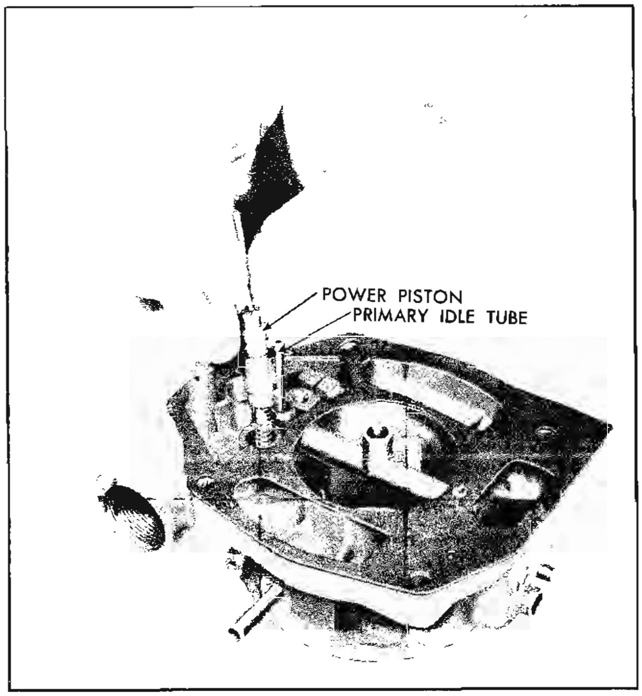



Fig. 6B-23 Removing Power Piston

**THROTTLE BODY DISASSEMBLY**

1. Remove idle adjusting needle and spring.

2. Remove idle screw from throttle lever.

3. Remove fast idle cam.

NOTE: Due to close tolerance fit of the throttle

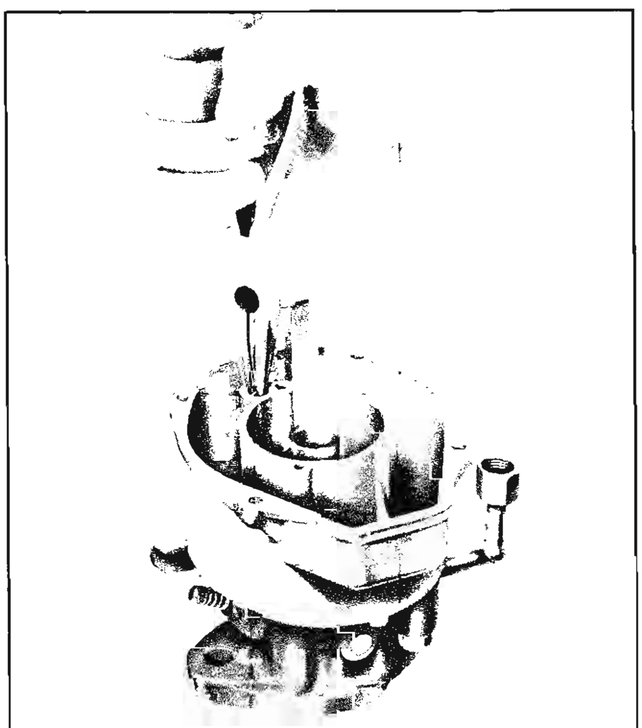


Fig. 6B-24 Removing Pump Discharge Guide valve in the bore of the throttle body do not remove the throttle valve or shaft from the throttle body.

4. Remove vacuum take off fitting. (Synchro-Mesh transmission application only.)

### *CLEANING AND INSPECTION*

1. Thoroughly clean carburetor castings and metal parts in carburetor cleaning solvent.

***CAUTION: Choke coil and pump plunger should not be immersed in solvent. Clean pump plunger in clean gasoline only.***

2. Blow all passages in castings dry with compressed air and blow off all parts until they are dry.

***CAUTION: Do not pass drills or wires through calibrated jets or passages as this may enlarge orifice and seriously affect carburetor calibration.***

3. Check all parts for wear. If wear is noted, defective part must be replaced.

NOTE: Especially the following:

a. Check float needle and seat for wear.

b. Check float button for wear and float for dents. Check floats for leaks by shaking.

c. Check throttle and choke shaft bores in throttle body and air horn castings for wear or out of round.

d. Inspect idle mixture adjusting needle for burrs or ridges.

e. If wear is noted on steps of fast idle cam it should be replaced as it may upset engine idle during the choke period.

f. Inspect pump plunger leather. Replace plunger if leather is damaged.

g. Inspect for burrs on the power piston or distorted or bent power piston nail or spring.

4. Always use new gaskets in reassembling.

5. Check to see that lower end of choke vacuum tube is tight in throttle body seal.

6. Inspect choke vacuum tube hex nut packing. If packing is unduly compressed or out of round, it should be replaced.

7. Clean all dirt or lint out of inlet filter. If filter remains plugged, replace it. Check spring for distortion, replace it if necessary.

## ASSEMBLY AND ADJUSTMENT

### *THROTTLE BODY*

1. Install idle stop screw in throttle lever.

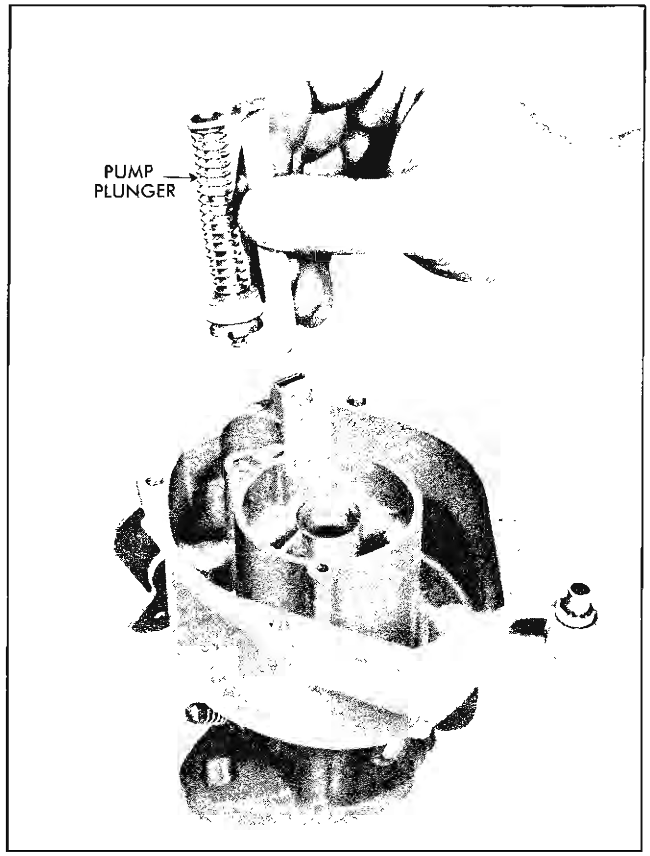



Fig. 6B-25 Removing Pump Plunger

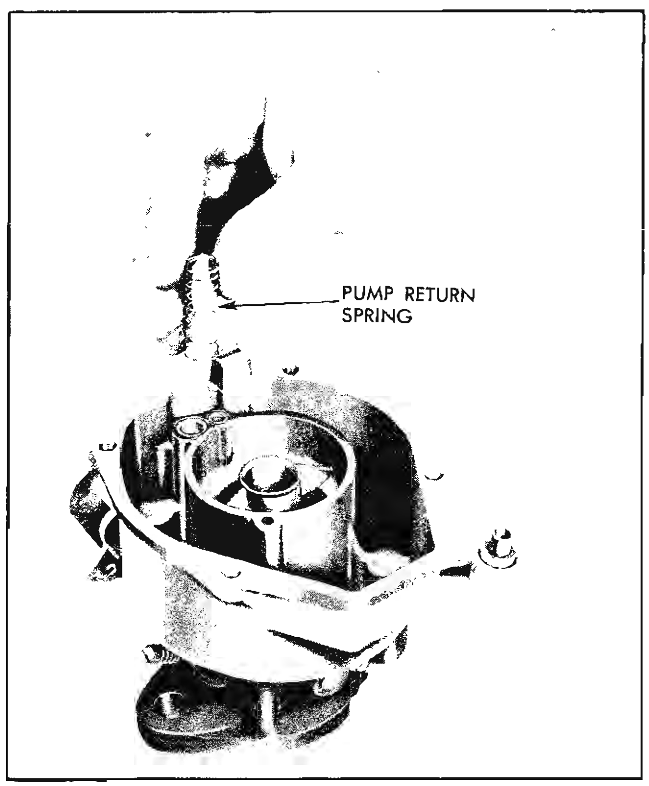



Fig. 6B-26 Removing Pump Return Spring

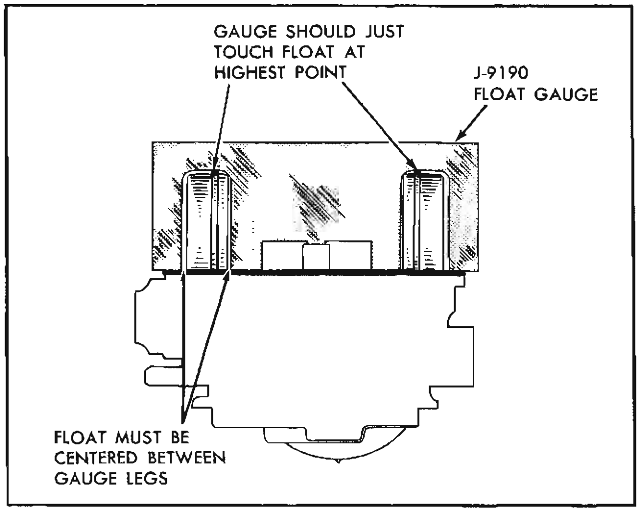



Fig. 6B-27 Float Level Adjustment

2. Screw idle mixture adjusting needle and spring into throttle body until it is finger tight. Back needle out 1½ turns as a temporary idle adjustment.

3. Install fast idle cam with letters R P facing outward.

4. Using new gasket, attach throttle body to bowl using two screws and lock washers. Tighten screws evenly and securely.

NOTE: If needed, a new vacuum seal will be installed after carburetor is completely assembled.

5. Install vacuum take off fitting (Synchro-Mesh application only).

### BOWL ASSEMBLY

1. Install large steel ball in pump discharge cavity. Insert spring and guide on top of ball. Tap spring guide lightly to seat in casting.

2. Place pump return spring in pump well.

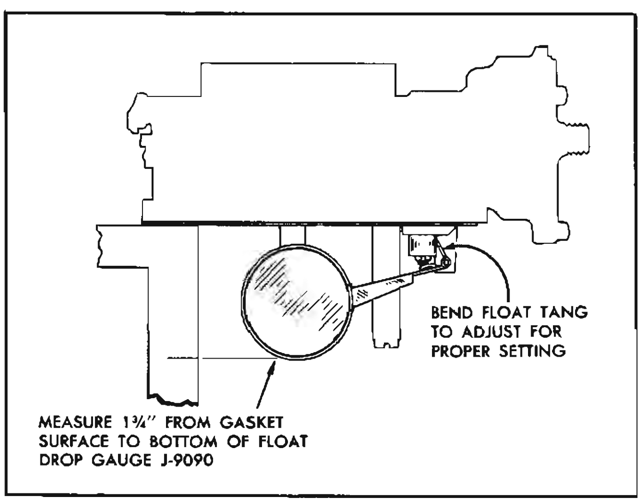



Fig. 6B-28 Float Drop Adjustment

3. Install pump plunger assembly in bowl.

4. Attach pump link to pump plunger arm and throttle lever.

NOTE: Dog leg in the pump link must face away from the throttle shaft.

### AIR HORN ASSEMBLY

1. Install float needle seat and gasket using screw driver with ½" bit.

2. Install power piston spring and power piston in vacuum cavity.

NOTE: Piston should ride free in cavity.

3. Place new gasket atop air horn, check to be sure that all air horn and gasket holes are in line.

4. Assemble power valve ball, spring, and retainer in main well support.

5. Attach main well support to air horn securely.

NOTE: Check for free motion of power piston.

6. Install main metering jet in main well support.

7. Place float needle in float needle seat.

8. Place float carefully in position and install float hinge pin.

### FLOAT LEVEL ADJUSTMENT (Fig. 6B-27)

With air horn inverted and gasket in place, position gauge J-9190 1⁹⁄₃₂" over the float with the gauge tang inserted in the discharge nozzle. Bend the float arms as necessary so that the top of each float just touches the gauge and the float is centered between the gauge legs.

### FLOAT DROP ADJUSTMENT (Fig. 6B-28)

Bend float as necessary to obtain a distance of 1¾" from the gasket surface to the bottom of float with the air horn held in the upright position and the float hanging free. Measure with scale or tool J-9190.

9. Attach air horn to bowl with attaching screw.

10. Install filter gasket, filter spring, and filter retainer nut and gasket.

### ASSEMBLY OF CHOKE

1. Place new gasket into position and attach choke housing to air horn with two screws. Tighten screws securely.

2. Place new hex fitting packing on choke suction tube. Tighten fitting on choke housing sufficiently to prevent loss of vacuum (Fig. 6B-31).

3. Assemble choke piston to shaft with pin and place choke shaft into choke housing. Rotate choke shaft counterclockwise so that the piston rides in housing cavity.

4. Install choke valve on choke shaft with letters R P facing upward. Center choke valve before tightening screws.

5. Place baffle and choke cover gasket into position, install choke coil and cover.

6. Rotate cover counterclockwise until index mark on housing is located one notch rich on model B carburetor and two notches rich on BC carburetor (Fig. 6B-29).

7. Attach three retainers and screws to choke housing and tighten securely. Recheck to see that adjustment previously made has not moved.

NOTE: Choke valve should be lightly closed at room temperature 75°F. when index mark on cover and housing are aligned.

8. Place choke counterweight on end of choke shaft with tang facing choke housing. Install spacing washer and trip lever so that tang of trip lever is atop counterweight tang, when choke is full open.

9. Install choke rod to counterweight and fast idle cam and secure with clip and spring. The dog leg of the rod must face idle mixture adjusting needle. Check valve for free movement.

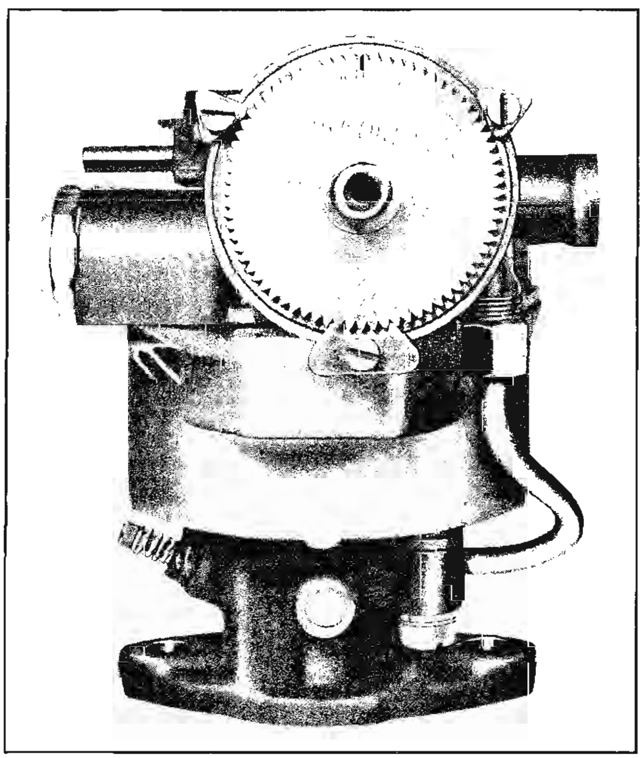


Fig. 6B-29 Locating of Index Mark on Choke Cover

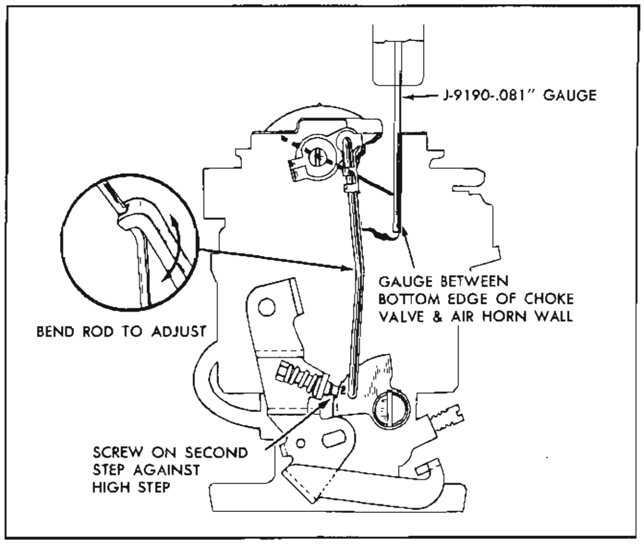



Fig. 6B-30 Choke Rod Adjustment

***CHOKE ROD SETTING (AUTOMATIC TRANSMISSION ONLY (Fig. 6B-30)***

With idle screw on the second step and against the high step of the cam, bend choke rod as necessary with tool J-9190-.081" to obtain specified clearance between the lower edge of the choke valve and air horn wall.

10. If the choke suction tube and seal assembly in the throttle body requires replacement, proceed as follows:

This operation must be performed after the carburetor is completely assembled.

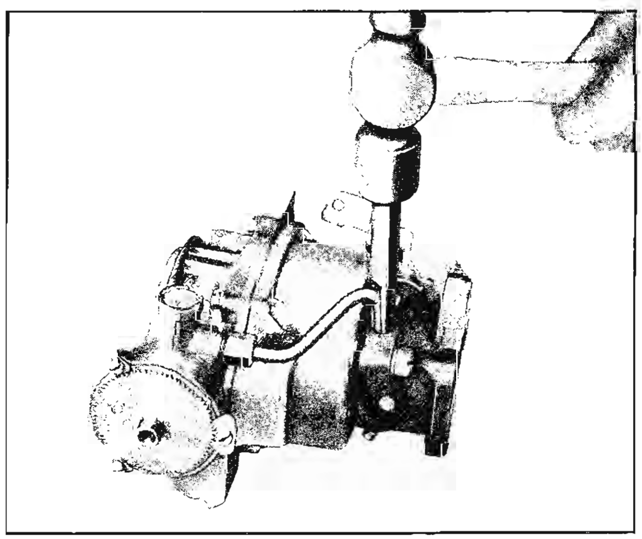


Fig. 6B-31 Installing Choke Tube Seal in Throttle Body

a. Loosen throttle body to bowl attaching screws.

b. Place flared end of tube with seal into throttle body. Using seal punch J-4551, tap lightly to hold seal in throttle body. Rotate tube while tapping seal so that it is started uniformly and evenly into the throttle body (Fig. 6B-31).

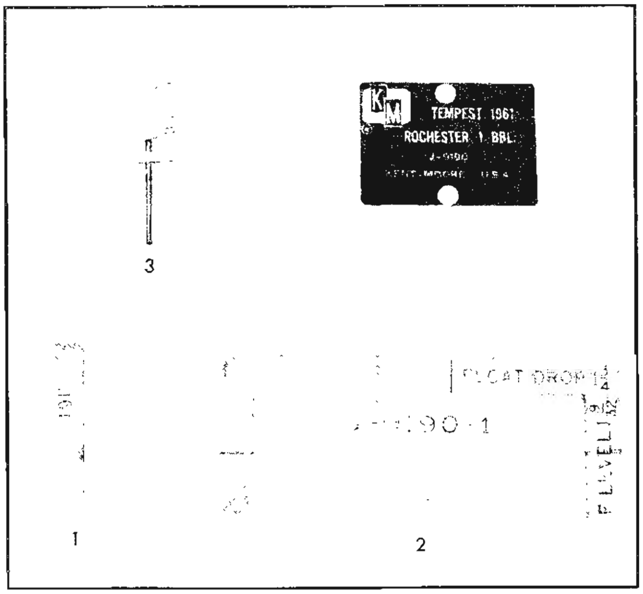
c. Install hex fitting and new packing on upper end of tube and fasten tube to choke housing by turning hex nut up "finger" tight.

d. Using seal punch tool J-4551 and hammer, spread seal into throttle body securely.

e. Completely loosen hex nut and check that tube is tight in throttle body. (Will not turn.) Then tighten hex nut to choke housing securely.

f. Tighten throttle body to bowl screws evenly and securely.

g. After installing carburetor on car, run idling to warm up engine, check packing joint with gasoline. If there is any leak, engine will stall or roll.




1. .161" unloader gauge
2. Float drop and level gauge
3. .081" choke rod gauge

Fig. 6B-32 Special Tools J-9190

# ROCHESTER 4GC CARBURETOR

| Carburetor Model Number | Used On |
|---|---|
| 7023069 | Four Cylinder Synchro-Mesh |
| 7023070 | Four Cylinder—Automatic |

## GENERAL DESCRIPTION

The Rochester 4GC carburetor is essentially two 2-jet carburetors in a single casting. The "primary side" contains all six carburetor systems—float, idle, part throttle, power, pump, and choke; the "secondary side" supplements the "primary side" with separate float and power systems.

This carburetor uses the Rochester calibrated cluster design, which places in a removable assembly the main well tubes, idle tubes, mixture passages, air bleeds, and pump jets.

When the cluster is removed for service purposes, all of these vital parts can be readily seen, cleaned and examined because the main well tubes and idle tubes are permanently installed in the cluster body by means of a precision pressed fit.

The cluster fits on a platform provided in the body casting of the carburetor so that the main well and idle tubes and main well inserts are suspended in the fuel. A gasket is used between the cluster casting and body platform.

This method of design and assembly serves to insulate the main well tubes and idle tubes from engine heat thus preventing heat expansion and percolation spill-over during hot idle periods of operation and during the time the hot engine is not operating.

Four vertical vent tubes are located in the air horn in addition to four pitot tubes. The vertical vent stacks provide space for the fuel to go during severe stop and start maneuvers, preventing fuel spillage from the pitot tubes.

### *FLOAT SYSTEM (Fig. 6B-33)*

The primary and secondary sections of the carburetor have separate bowls, floats, needles and seats.

All fuel enters the carburetor through a common inlet fitting. From this point the fuel flows through separate passages to the respective float bowls.

As the fuel level in the bowl drops, the twin floats also drop, allowing the needle to move off its seat. Pressure from the fuel pump forces fuel through the filter screen into the inlet passage, through the small filter screen under the needle seat and then into the float bowl. As the fuel level in the bowl rises, the floats rise and once again shut off the inlet needle.

The four cylinder engine carburetor has a torsion spring, located on the float hinge pin, which acts as an assist in closing the inlet needle on its seat by exerting pressure against the float hanger. A slight amount of pressure is exerted by the torsion spring when the needle valve is in its closed position. The spring pressure increases slightly as the torsion spring is wound up further.

A passage in the float bowls, slightly above the normal fuel level, connects the primary and secondary float bowls. With this design any abnormal rise in level on one side will be absorbed by the other, without disrupting engine operation.

Both sides of the carburetor are individually and internally vented. These vents transmit the air pressure from beneath the air cleaner to the fuel in the float bowl. The amount of fuel metered by the carburetor is dependent upon the pressure in the float bowl causing fuel to flow. By locating the vents below the air cleaner, or internally, the carburetor is automatically balanced with the air cleaner, since the same pressure causing air to flow will also be causing fuel to flow. The four vertical vent stacks, which are in addition to the standard pitot tubes, are pressed into the air horn casting and care should be used to avoid damage to them.

On the four cylinder engine to minimize difficult hot weather starting or rough idling due to fuel vapor formation in the float bowl, the carburetor incorporates an external idle vent valve which functions when the throttle valves are in the closed position.

This valve is located in the center of the carburetor air horn on the primary (pump side) of the carburetor. The valve consists of an actuating lever integral with the pump lever, which operates a rubber valve mounted over the vent hole. The rubber vent valve is attached to a spring arm which holds the valve closed.

When the throttle valves are closed, the actuating lever contacts the spring arm to which the rubber vent is attached, and holds the valve open. This permits vapors from the fuel bowl to vent themselves to the atmosphere. As the throttle valves are opened, the spring arm closes the vent valve, eliminating the atmospheric vent and returning the carburetor to an internal balance. A guard is installed over the vent valve to prevent damage during air cleaner removal.

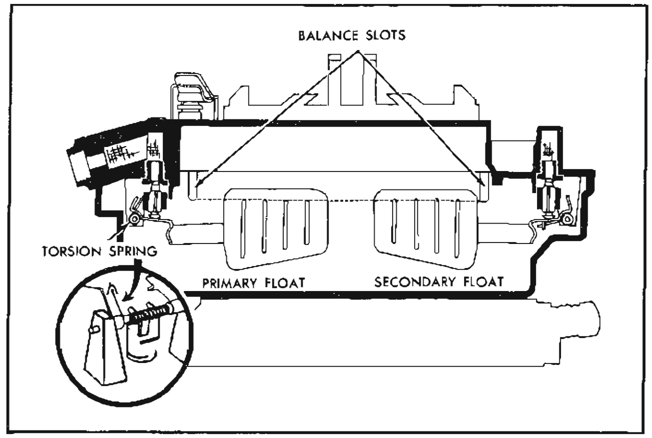



Fig. 6B-33 Float System

### *IDLE SYSTEM (FOUR CYLINDER) (Fig. 6B-34)*

An adjustable idle system is provided on the primary side of the carburetor only. An idle circuit is incorporated in the secondary side of the carburetor which supplies supplementary fuel discharged through lower idle air bleeds to the primary side for part throttle operation.

In the normal idle speed position, the throttle valves are completely closed. Idle air is taken from above the secondary valves, adjusted by an air-adjustment screw at the rear of the throttle body, and discharged into the primary bores below the throttle valve. Thus the idle air adjusting screw controls idle r.p.m.

The idle mixture needle hole is in the high vacuum area below the throttle valves, while the fuel bowl is vented to atmospheric pressure. Vacuum can be called a lack of pressure, so a high vacuum area can be spoken of as an area of low pressure. Thus it can be said that there is considerable pressure difference between the normal atmospheric pressure on the fuel in the bowl and the low pressure (or high vacuum) at the idle mixture needle hole.

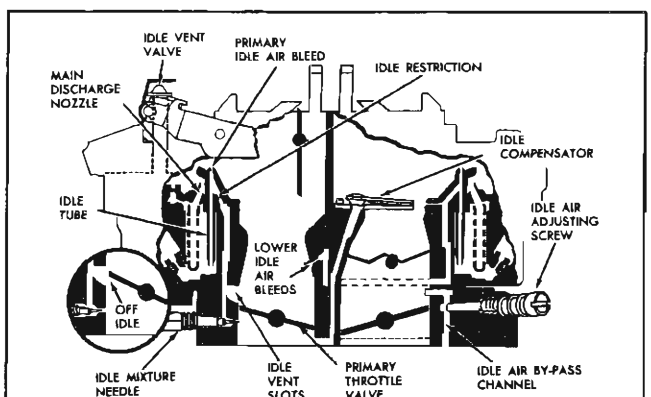



Fig. 6B-34 Idle System (Four Cylinder)

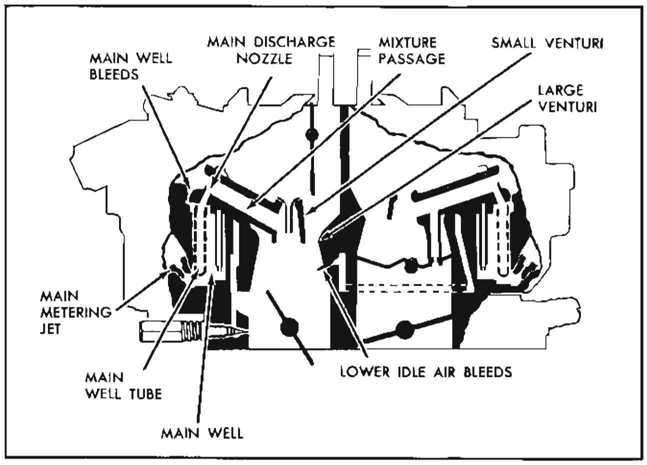



Fig. 6B-35—Part Throttle

Incorporated in the idle system are secondary lower idle air bleed tubes, located in the venturi wall of the primary side, and fed by the idle tubes in the secondary cluster. These lower idle air bleed tubes provide an additional source of fuel to maintain a constant mixture ratio at wide primary throttle openings. The tubes act as nozzles and supplement the fuel discharge of the main system to fill the gap between late part throttle and pre-power system operation.

No fuel is discharged until the primary throttles are open sufficiently to allow enough air flow to create a low pressure area at the tube. Fuel then flows and continues to do so as long as the low pressure is maintained throughout part throttle and wide open throttle operation.

The fuel and fuel/air mixture will be forced by atmospheric pressure to occupy the low pressure area. Atmospheric pressure acting on the fuel in the bowl forces fuel through the main metering jets into the main well area. The fuel travels up the idle tube after passing through the idle metering orifice at the lower tip of the tube. Air joins the fuel at the primary idle air bleeds. This mixture then passes through the idle

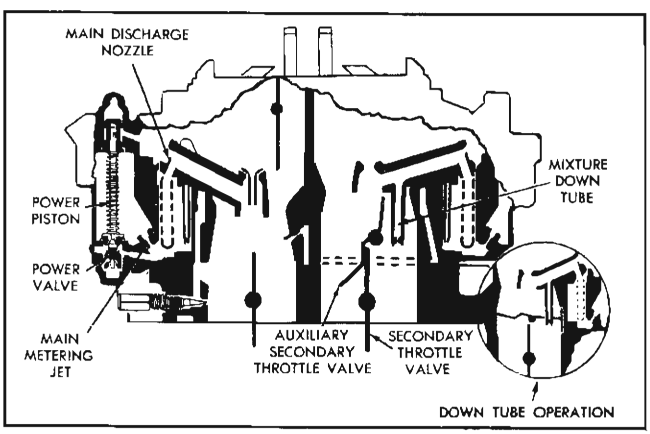



Fig. 6B-36 Power System

restrictions which tend to mix thoroughly the fuel and air. More air enters the mixture at the secondary idle air bleeds. This mixture then passes down the vertical idle channel. At the lower end of the channel, additional air is bled into the mixture through the idle slots. The resultant mixture is then discharged into the throttle bore from the idle needle holes.

In addition to this mixture of fuel and air, there is air entering the bore from the idle air by-pass channel; for smooth operation, the air from the by-pass channel, the fixed air bleeds and the fuel/air mixture from the idle needle hole must combine to form the correct final mixture for normal idle engine speed.

As the throttle valves are opened, the bleed effect of the idle discharge slots gradually diminishes. When these slots become exposed to manifold vacuum they become fuel discharge openings to meet the increased fuel demand.

The idle mixture adjusting screws govern the amount of fuel/air mixture admitted to the carburetor bore at idle.

Also included in the idle system is the idle compensator. This consists of a bi-metal strip, a valve, and a mounting bracket. It is mounted between the large venturi on the secondary side. The valve seats on a drilled channel which leads into the center throttle body attaching bolt hole.

From there the passage goes to the underside of the primary throttle valves. In operation, when idling hot for long periods, the bi-metal strip will become heated, bending up and forcing the valve off its seat. This allows additional idle air (under the influence of manifold vacuum) to be drawn in below the throttle valves, offsetting the enrichening effects of the high temperatures. When underhood temperatures are lowered, the valve closes and idle operation returns to normal.

### PART THROTTLE SYSTEM (Fig. 6B-35)

As the throttle valves are opened to a greater degree and more air is drawn through the carburetor, it is necessary to provide means, other than the idle systems, for supplying additional fuel to meet the engine requirements. The primary side of the carburetor meets the increased demand for fuel in the following manner.

The increased air flow through the venturi during part throttle operation lowers the pressure at the tip of the main discharge nozzles. This differential in pressure forces fuel from the float bowl, through the main metering jets and into the main well tubes. After passing through the main well tubes the mixture passes from the tip of the nozzle through the mixture passage to the venturi and on into the intake manifold.

As the throttle opening is progressively increased and more fuel is drawn through the main well tubes, the fuel level in the main well drops. Calibrated holes in the main well tubes are proportionately exposed to the air in the upper well area. When this occurs, they become air bleeds, mixing progressively more air with fuel passing through main well tubes. Thus, although the nozzle suction is increased by increasing the throttle opening, the fuel mixture to the engine remains constant throughout the part throttle range.

On the four cylinder engine, as throttle opening increases, the secondary lower idle air bleed tubes become part throttle feed nozzles in the main bore below the primary venturi.

### *POWER SYSTEM (Fig. 6B-36)*

As the primary throttle valves are opened to a point where more air and fuel are needed for increased power, mechanical linkage between the primary and secondary throttle valves starts to open the secondary valves. The ratio of motion is such that by the time the primary valves have reached wide open, the secondary valves are also wide open. With both the primary and secondary throttle valves open, the venturi systems in both sides feed fuel-air mixture through their respective main metering systems.

Spring loaded, auxiliary throttle valves are located in the secondary bores above the regular secondary throttle valves. When the throttle valves are moved to their wide open positions and engine speed is low, there is insufficient air flow through the secondary bores to force the spring loaded auxiliary valves open. This will concentrate all air flow through the primary throttle bores for improved metering of fuel and air. In this condition the carburetor is functioning as a 2-barrel carburetor. As the engine speed increases, the force of the air acting on the auxiliary valves increases to the point where the auxiliary valves are forced to open. The calibration of auxiliary valve spring tension is such that valve opening occurs when greatest metering efficiency is possible.

The mixture down tube supplies additional fuel air mixture while the auxiliary valves are opening. For maximum power under load, a richer mixture is required than that necessary for normal throttle opening. This additional fuel is provided by one power system connected to the main metering systems in the primary section of the carburetor.

The power piston cylinder in the air horn of the carburetor is connected by a channel to the face of the mounting flange so it is subject to intake manifold vacuum. At part throttle position the vacuum is sufficient to hold the power piston in its "up" position against the tension of the piston spring. When the throttle valves are opened to a point where manifold vacuum drops to approximately 9 to 5 inches of mercury and additional fuel is required for satisfactory operation, the piston spring moves the power piston down to open the power valve. This allows additional fuel to enter the main discharge nozzles in the primary section through calibrated restrictions located below the main metering jets.

### *PUMP SYSTEM (Fig. 6B-37)*

Extra fuel for smooth, quick acceleration is supplied by a double spring pump plunger. A rapid opening of the throttle valves, as is the case when accelerating from low speeds, causes an immediate increase in air velocity. Since fuel is heavier than air it requires a short period of time for it to "catch up" with the air flow. To avoid a leanness during this momentary lag, the accelerator pump furnishes a quantity of liquid fuel, sprayed into the air stream to mix with incoming air and maintain the proper fuel/air mixture.

Since the secondary throttle valves remain closed during part throttle operation, only the primary side needs the extra boost; hence the primary side only contains the pump system.

The pump is operated by the combined action of two springs which are calibrated to move the plunger in such a manner that a sustained charge of fuel is delivered for smooth acceleration.

The pump is attached by linkage to the accelerator so that when the throttle valves are closed the pump plunger moves upward in its cylinder, creating a low pressure area (partial vacuum) in the cylinder below the plunger. Atmospheric pressure acting on the fuel in the bowl forces fuel into the cylinder through the inlet ball check. The discharge ball check is seated at

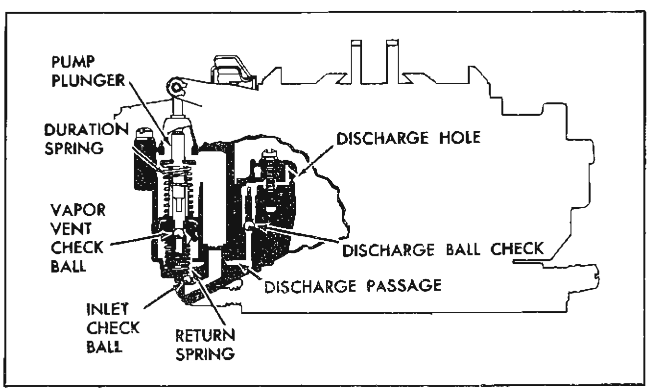



Fig. 6B-37—Pump System

this time to prevent air being forced into the cylinder.

When the plunger is moved downward for acceleration, the force of the stroke seats the inlet ball check to prevent flow to the fuel bowl, and the fuel is forced up the pump discharge passage. The pressure of the fuel lifts the pump discharge ball check from its seat and the fuel passes on through the pump jets in the cluster, where it is sprayed into the venturi and delivered to the engine.

At higher speeds, pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a predetermined amount, the pump plunger bottoms in the cylinder eliminating pump discharge.

The "anti-percolator" check ball, contained inside the plunger, provides relief for any vapors which might form during hot idle or when a hot engine is not operating. The ball check is designed so that it can move up and down in its passage. Throughout the above periods it is seated by gravity, and vapors in the pump well rise and by-pass the ball check through small holes in the plunger head. The "anti-perc" ball check also acts as an extra inlet during the upstroke of the pump plunger, but is seated by fuel pressure when the plunger moves down.

### CHOKE SYSTEM (Fig. 6B-38)

The purpose of the choke system is to provide a very rich mixture for cold engine operation. It is necessary to have an extra rich mixture because fuel vapor has a tendency to condense on the cold engine parts, thus decreasing the amount of combustible mixture available at the combustion chamber.

The choke system subjects all fuel outlets in the bore of the carburetor to manifold vacuum while restricting the intake of air.

The choke system includes a thermostatic coil, a choke housing, a choke piston, choke valve, and fast idle cam and linkage. It is controlled by a combination of manifold vacuum, air velocity against the offset choke valve, and tension of the thermostatic coil spring.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. Starting the engine causes air velocity to strike the offset choke valve. This tends to open it along with the action of the intake manifold vacuum on the choke piston. After a slight opening of the choke valve, the tension of the thermostatic coil spring balances the force of air on the valve and the pull of vacuum at the piston.

As the engine warms up, manifold vacuum exists in the choke housing. Filtered air from just beneath the air cleaner is taken through a tube in the air horn, down to the manifold, to the choke stove. The cleaned air is heated and then drawn up to the choke

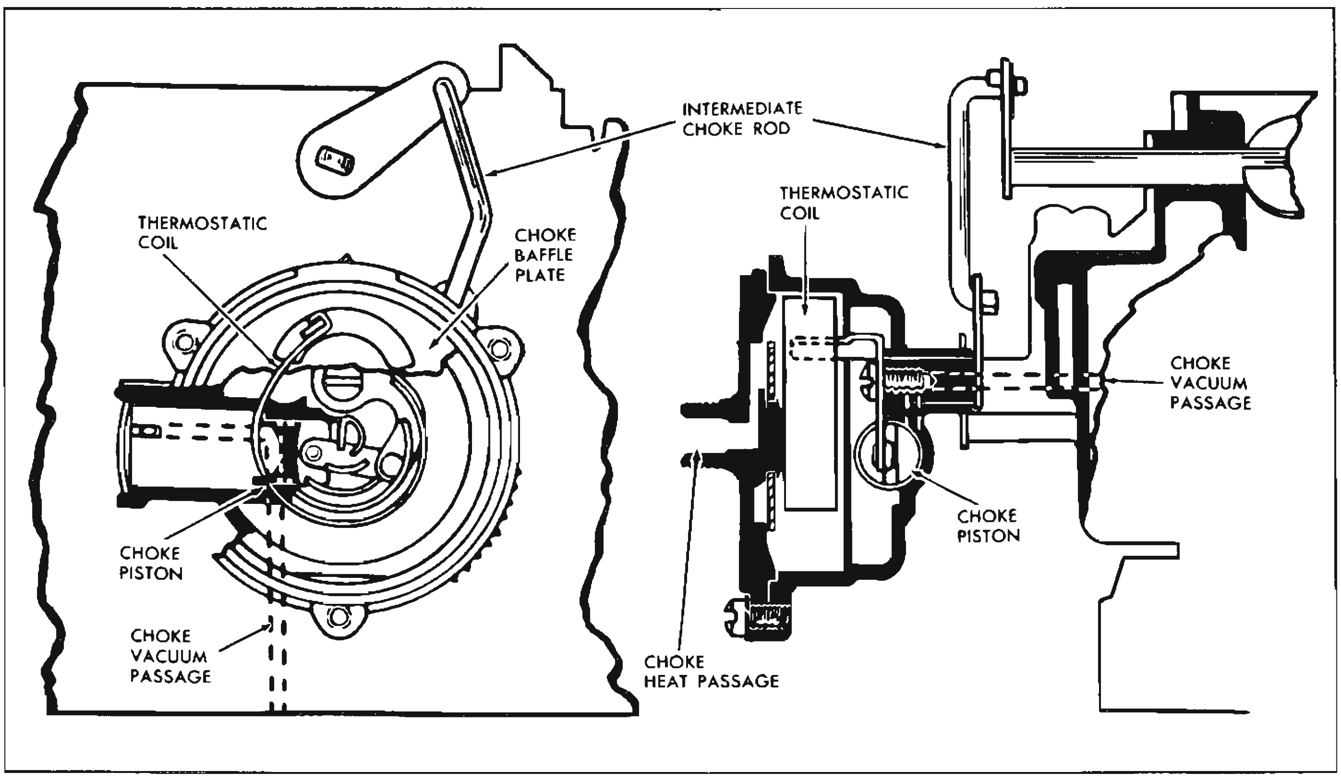



Fig. 6B-38 Choke System

housing to heat the thermostatic coil.

A baffle plate serves to evenly distribute the heat throughout the choke housing, to prevent a "hot spot" in the coil center, which would cause a rapid opening of the choke valve. The thermostatic coil relaxes gradually until the choke is fully open. The hot air, after having been drawn past the thermostatic coil, is drawn into the throttle body and deposited in a cavity on the primary half of the throttle body flange on the underside. This cavity is directly adjacent to the idle mixture adjusting needles and in this way heat is supplied to the throttle body for better warm up characteristics. A small slot from one end of the cavity into one primary bore deposits this heated air into the intake manifold.

If the engine is accelerated during warm-up, the corresponding drop in manifold vacuum allows the thermostatic coil to momentarily close the choke, providing a richer mixture.

During warm-up it is necessary to provide a fast idle to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke shaft. The idle screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to a normal warm engine idle position until the choke is open.

Since the secondary throttle valves remain closed, only the primary side requires a choke system. When the choke is closed, the fast idle cam is raised; the raised position of the fast idle cam "locks out" any opening of the secondary throttle valve by means of a lockout lever, which is free to move only when the cam is fully lowered.

If the engine becomes flooded during the starting period, the choke valve can be partially opened manually to allow increased air flow through the carburetor. This is accomplished by depressing the accelerator pedal to the floor and engaging the starter.

The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke valve.

## ADJUSTMENTS ON CAR FOUR CYLINDER ROCHESTER 4GC CARBURETOR

### *IDLE SPEED AND MIXTURE ADJUSTMENT*

With the engine at operating temperature adjust idle speed to the following specifications:

Synchro-Mesh .................. 680-700 R.P.M.
Automatic (In Drive) ........... 580-600 R.P.M.

Air Conditioned:
(Auto-Drive Range—
Air Conditioning off) ....... 630-650 R.P.M.

(S/M-Neutral—
Air Conditioning off) ....... 680-700 R.P.M.

***NOTE: Be sure hot idle compensator is closed while making adjustments.***

1. As a preliminary setting turn air screw out one turn from lightly seated position and mixture screws out 1½ turns.

2. Set hand brake securely. Place transmission in neutral and connect tachometer to engine.

3. Start engine and warm up thoroughly. Be sure choke is fully open and carburetor is completely off fast idle.

4. Place automatic transmission in "drive" and adjust air screw to obtain specified idle speed.

5. Adjust mixture screws to best quality (highest R.P.M.) idle.

6. Reset air screw to specified idle speed if mixture adjustment changed setting.

7. Recheck mixture adjustment to insure smoothest possible idle.

NOTE: Always recheck idle mixture setting after making idle R.P.M. adjustment with air screw.

8. Check idle speed after installation of air cleaner and reset idle if a difference in idle speed is noted.

### *FAST IDLE ADJUSTMENT*

1. Perform normal idle speed and mixture adjustment procedure as outlined above.

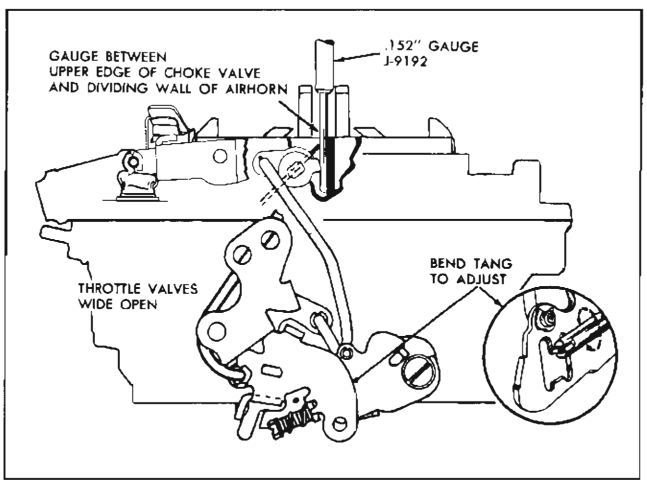



Fig. 6B-39 Unloader Adjustment (Shown off Car for Photographic Purposes)

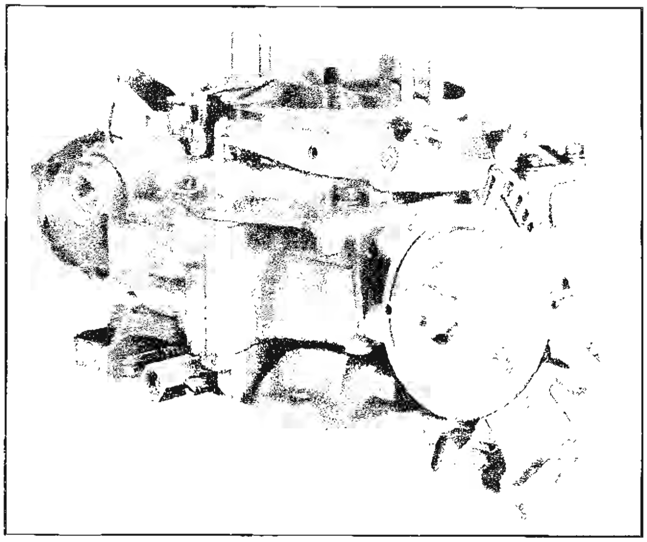


Fig. 6B-40 Secondary Throttle Lever Adjustment (Shown off Car for Photographic Purposes)

2. Place transmission in neutral, move fast idle cam so that fast idle screw is on top step of the cam.

3. Observing tachometer, adjust fast idle screw to give an engine speed of 3000 R.P.M. (auto), 2800 R.P.M. (s/m).

### THROTTLE RETURN CHECK ADJUSTMENT

1. Set hot idle and mixture adjustment to specifications.

2. Place transmission in neutral.

3. With engine running, disconnect vacuum hose from throttle return check and plug open end of vacuum hose.

4. Adjust the contact screw of the throttle return check to obtain speed of 1050 r.p.m.

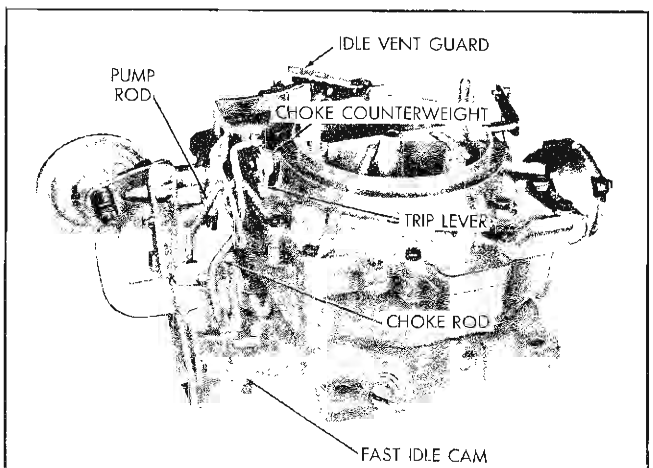



Fig. 6B-41—Rochester 4GC Carburetor

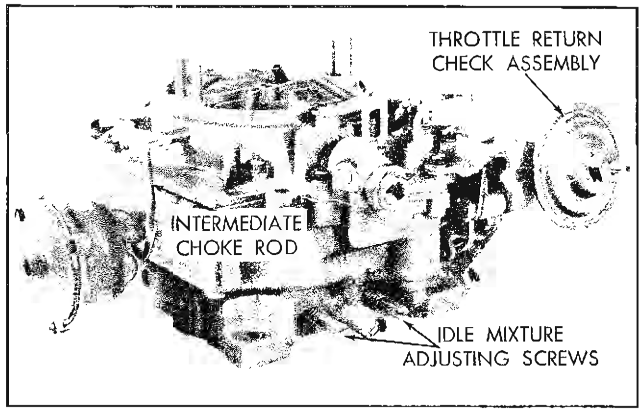



Fig. 6B-42 Rochester 4GC Carburetor

NOTE: Hold sleeve next to diaphragm from turning while adjusting contact screw.

### UNLOADER ADJUSTMENT (Fig. 6B-39)

1. Remove carburetor air cleaner assembly.

2. Depress accelerator pedal. (This should be done by person sitting in driver's seat of car to simulate actual driving conditions.)

3. With accelerator pedal depressed as in step 2, bend tang on fast idle cam to give a clearance of .152" (gauge J-9192) between top of choke valve and inside of the air horn.

4. Replace air cleaner assembly.

The above procedure will eliminate variance in linkage, floor mat, pedal location, etc. and should ensure correct unloader action.

### SECONDARY THROTTLE LEVER ADJUSTMENT (Fig. 6B-40)

1. Adjust carburetor idle speed and mixture. (Be sure secondary valves are closed during this adjustment.)

2. Shut off engine and manually close choke valve.

3. Position idle speed screw on the second step of the fast idle cam.

4. Measure clearance between the secondary lock spring and the secondary throttle operating lever (Fig. 6B-40). This clearance should be .038". Bend lock spring to adjust.

It is important that this adjustment be made accurately. .038" clearance ensures the proper amount of tension when car is on hot idle. Too much tension (less than .038" clearance) could interfere with the idle speed adjustment.

## OVERHAUL AND ADJUSTMENT

### *DISASSEMBLY OF AIR HORN*

1. Mount carburetor on legs J-8328.

2. Remove fuel inlet fitting and gasket; strainer on four cylinder only.

3. Remove idle vent valve guard and vent valve assembly (Fig. 6B-41).

4. Remove clip from upper end of pump rod and remove rod (Fig. 6B-41).

5. Remove trip lever retaining screw at end of choke shaft and remove trip lever (Fig. 6B-41).

6. Remove fast idle cam attaching screw and remove choke counterweight rod and fast idle cam as assembly (Fig. 6B-41).

7. Remove clip at upper end of intermediate choke rod (remove clip from lower end of rod, eight cylinder carburetor) and remove intermediate rod (Fig. 6B-42).

8. If choke valve or choke shaft is to be replaced, remove two choke valve retaining screws and slide choke valve from slot in choke shaft. Remove choke shaft.

9. Remove throttle return check assembly from air horn (four cylinder carburetor only).

10. Remove 13 air horn attaching screws (Fig 6B-43).

11. Carefully remove air horn by lifting straight up.

12. Place air horn on clean surface float side up.

13. Remove hinge pin, spring, and float assembly primary side (Fig. 6B-44).

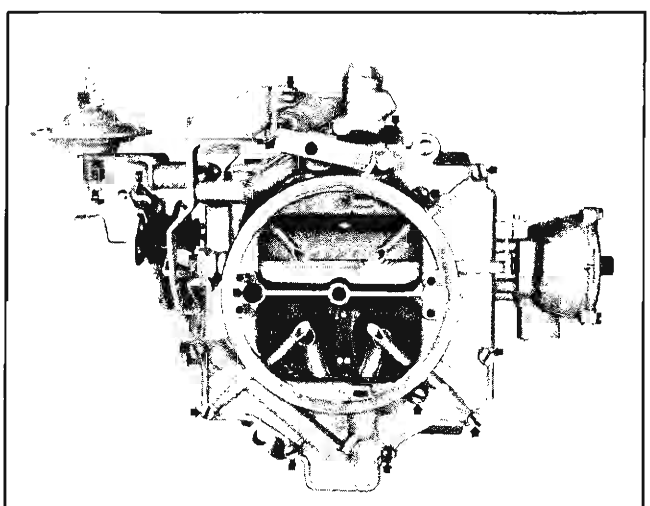


Fig. 6B-43 Location of Air Horn Attaching Screws

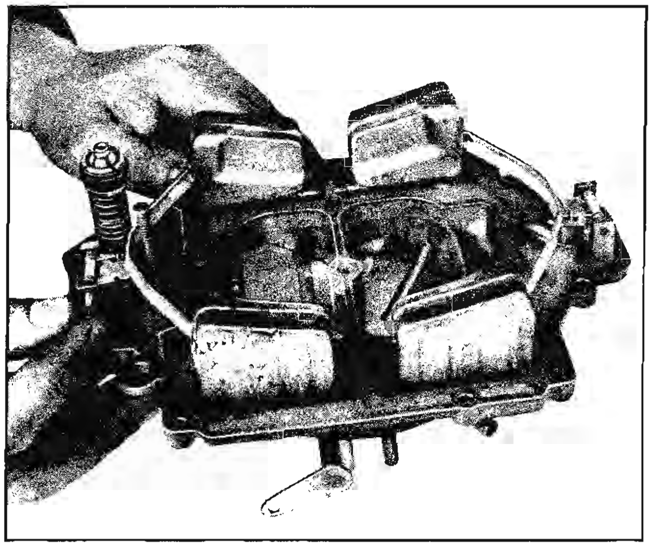


Fig. 6B-44 Removing Float Hinge Pin

NOTE: Method by which spring is installed (Fig. 6B-45).

14. Remove float needle, seat gasket and strainer from primary side.

***CAUTION: Group and keep together all parts of the primary side. Never mix primary and secondary parts.***

15. Remove and group hinge pin, spring, float, needle and seat, gasket and strainer screen from secondary side.

16. Remove air horn gasket.

17. Remove power piston.

18. Remove horseshoe retainer from pump plunger shaft.

19. Remove rubber seat and pump plunger assembly from air horn (Fig. 6B-46).

### *DISASSEMBLY OF BOWL*

1. Remove three attaching screws and lock wash-

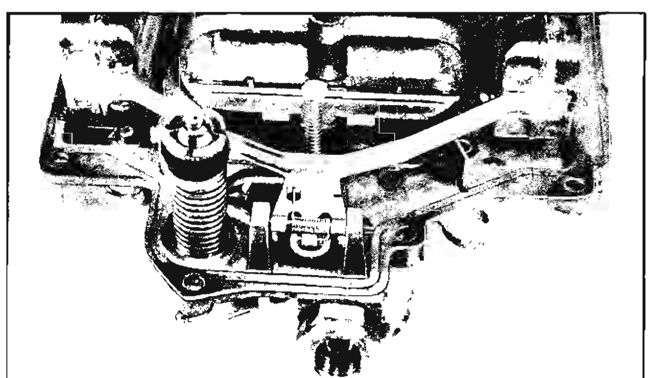


Fig. 6B-45 Float Spring Installation

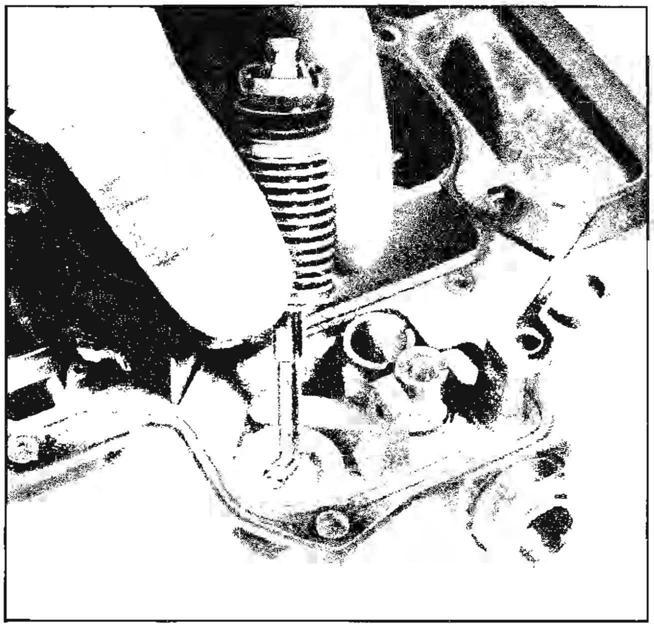


Fig. 6B-46 Removing Pump Plunger

ers from venturi cluster on primary side and carefully remove cluster and gasket (Fig. 6B-47).

NOTE: The primary venturi cluster contains the pump discharge nozzle and idle tubes in addition to main well tubes and must always be installed on the primary side. The venturi clusters are serviced as an assembly.

2. Remove main well inserts.

3. Remove main metering jets from primary side.

***CAUTION: Do not mix primary and secondary jets.***

4. Remove power valve.

5. Remove three screws and lock washers from secondary venturi cluster. Remove cluster and gasket.

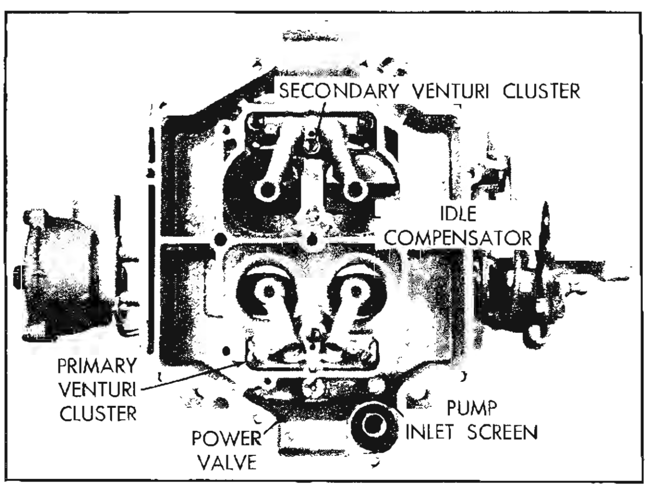



Fig. 6B-47 Fuel Bowl

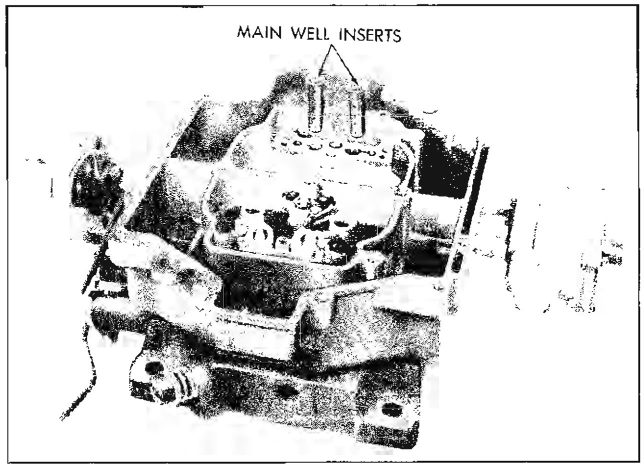



Fig. 6B-48 Main Well Inserts

6. Remove main metering jets from secondary side of bowl.

***CAUTION: Keep secondary jets separate from primary jets.***

7. Remove pump return spring from pump well.

8. Carefully invert bowl and remove aluminum pump inlet ball.

9. Using needle nose pliers, remove pump discharge spring guide, spring and steel ball (Fig. 6B-49).

10. If pump inlet screen is damaged or plugged, it should be replaced by prying up ring with pointed tool.

11. Remove three choke cover attaching screws.

12. Remove choke cover and gasket.

13. Remove choke baffle plate.

14. Detach piston and link assembly from intermediate choke shaft by removing screw (Fig. 6B-50).

15. Remove piston, link and lever from choke housing.

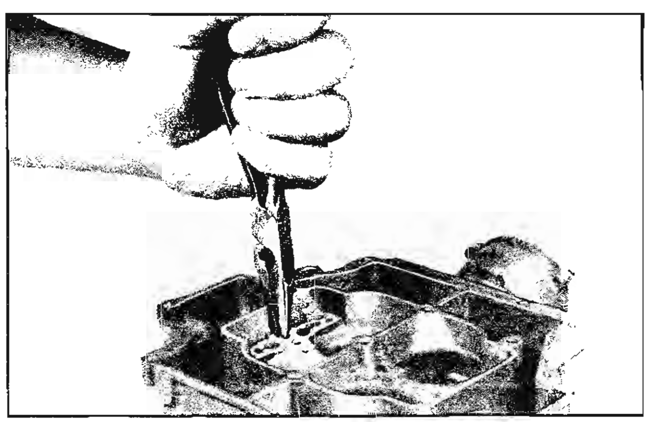


Fig. 6B-49 Removing Pump Discharge Spring

16. Detach choke housing by removing two attaching screws (Fig. 6B-50).

17. Remove intermediate choke shaft from choke housing.

18. Remove choke housing gasket.

19. Remove bowl and throttle body from legs.

### DISASSEMBLY OF THROTTLE BODY

1. Invert bowl on flat surface.

2. Remove four throttle body attaching screws and lock washers and remove throttle flange (Fig. 6B-51).

3. Remove throttle body gasket.

4. Remove idle mixture adjusting needles.

5. Remove idle by-pass air screw.

NOTE: The throttle body and throttle valves are serviced as a unit. No further disassembly of the throttle body should be attempted. It may be impossible to again reassemble throttle valves correctly in relation to vacuum and idle discharge orifices.

### DISASSEMBLY OF AUXILIARY THROTTLE BODY

As soon as the throttle body has been removed from the fuel bowl, the auxiliary throttle valve assembly (Fig. 6B-52) can be easily removed from its recess in the float bowl by simply lifting it out. If it should stick in the carburetor body, hold the bowl upright and tap the auxiliary throttle valve casting at both ends with a long punch from above.

NOTE: Do not attempt any further disassembly of the auxiliary throttle valve assembly. The spring tension is exactly calibrated and any change will completely upset the operation of the secondary side of the carburetor.

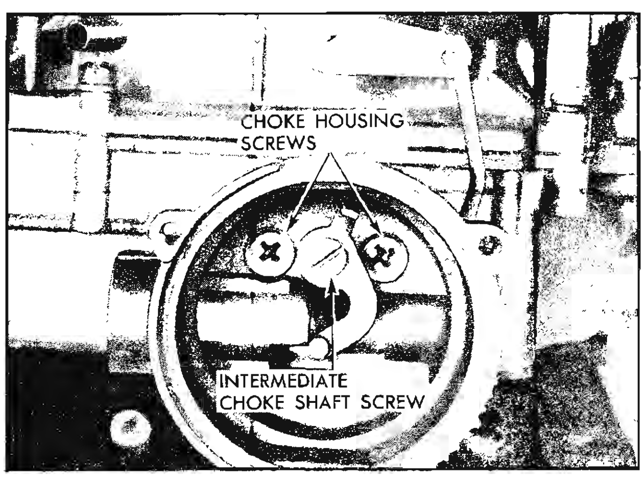



Fig. 6B-50—Location of Choke Housing Screws

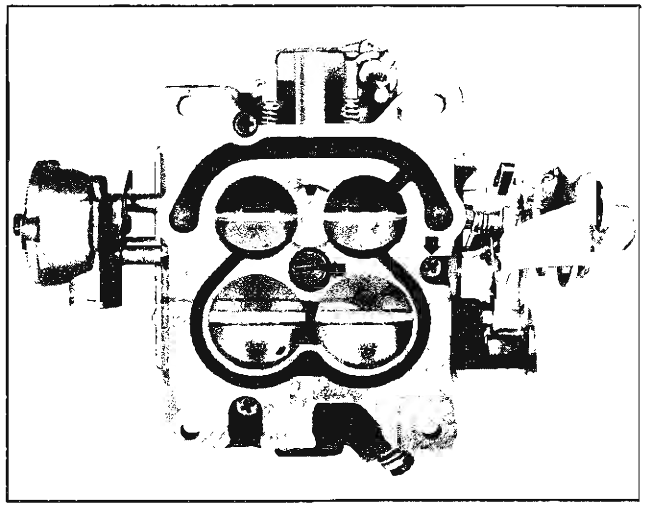


Fig. 6B-51 Location of Throttle Body Attaching Screws

### CLEANING AND INSPECTION OF PARTS

Dirt, gum, water or carbon contamination in the carburetor or on the exterior moving parts of the carburetor are often responsible for unsatisfactory performance. Efficient carburetion depends upon careful cleaning and inspection while servicing.

1. Thoroughly clean all metal parts of carburetor in clean carburetor cleaning solution.

***CAUTION: Composition and plastic parts such as pump plunger, rubber valve and gaskets should not be immersed in cleaner.***

2. Blow out all passages in castings with compressed air and blow off all parts so they are free of cleaner. Be sure to follow instructions furnished with cleaning solution.

***CAUTION: Do not use drills or wire to clean out jets,***

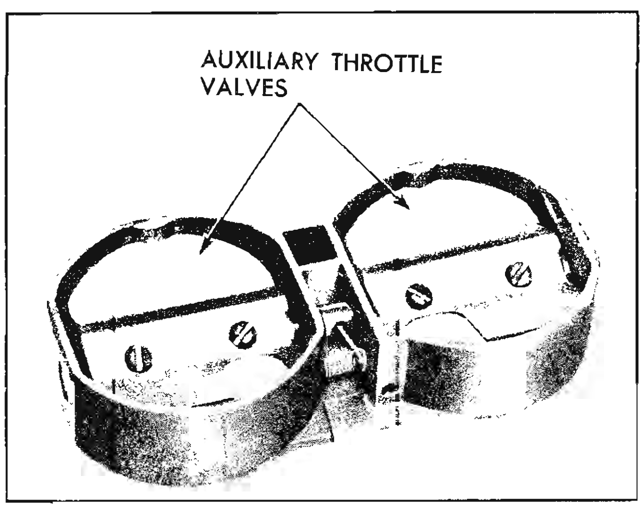



Fig. 6B-52 Auxiliary Throttle Body

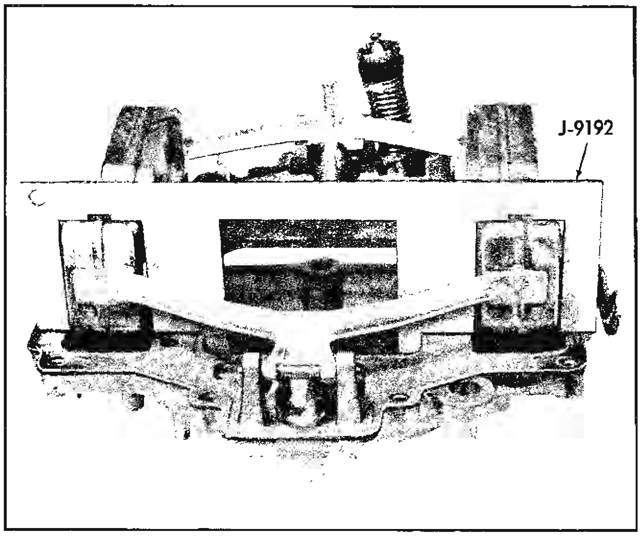



Fig. 6B-53 Float Level Adjustment

***ports or slots as this may enlarge the opening and affect carburetor operation.***

3. Carefully inspect parts for wear and replace those which are worn. Check the following specific points:

a. Inspect choke piston and choke piston housing for carbon. If necessary to clean choke piston housing, remove welch plug in the bottom of the housing. Plug can be removed by piercing center with a small pointed instrument and prying outward. Care should be used not to damage casting when removing plug. Before installing new plug, carbon present in piston and cylinder slots should be removed and welch plug seat should be carefully cleaned.

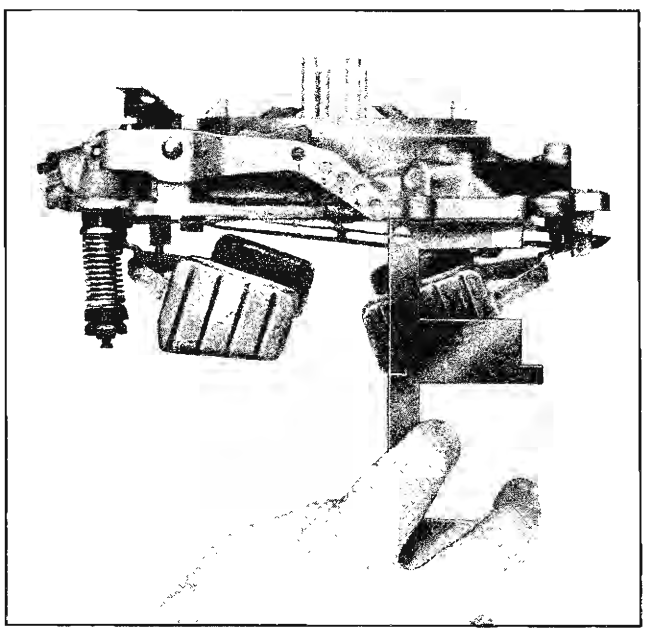


Fig. 6B-54 Float Drop Adjustment

b. Remove carbon from bores of throttle flange with sandpaper; never use emery cloth.

c. Inspect float needles and seats for wear; if worn, replace both needle and seat.

d. Inspect float hinge pins for excessive wear.

e. Inspect floats for dents and excessive wear on lip. Check for fluid inside floats by shaking. Replace float if any of above are present.

f. Inspect throttle shaft for excessive wear (looseness or rattle in body flange casting).

g. Inspect idle mixture adjusting air screws for burrs. Replace if burred.

h. Inspect pump plunger assembly. If leather is not in good condition, replace plunger.

i. Inspect gasket surfaces between fuel bowl assembly and air horn, and between bowl assembly and throttle body. Small nicks or burrs should be smoothed down to eliminate air or fuel leakage. Be especially careful when inspecting choke vacuum passages and the top surface of the inner wall of the fuel bowl.

j. Inspect holes in pump rocker arm, fast idle cam and throttle shaft lever. If holes are worn excessively or out of round to the extent of causing improper carburetor operation, the part should be replaced.

k. Inspect fast idle cam, if excessive wear is noted on cam, it should be replaced to ensure proper engine operation during warm up.

l. Check all filter screens for lint or dirt. Clean or replace as necessary.

m. Check venturi clusters for loose or damaged parts. If damage or looseness exists, replace cluster assembly.

## ASSEMBLY AND ADJUSTMENT

### *ASSEMBLY OF THROTTLE BODY*

1. Install auxiliary throttle valve assembly in float bowl.

2. Position new throttle body to bowl gasket on bowl making sure all holes are aligned.

3. Place throttle body on bowl and install four attaching screws and lock washers. Tighten screws evenly and securely.

4. Install idle mixture adjusting needles and springs. Tighten finger tight and back off $1\frac{1}{2}$ turns for approximate adjustment.

5. Install air screw on four cylinder carburetor only, back out one turn for approximate adjustment.

### *ASSEMBLY OF BOWL*

1. Place throttle body and bowl assembly on legs J-8328.

2. Install steel pump outlet ball, discharge spring and guide.

3. Install aluminum inlet ball and pump return spring.

4. Replace pump inlet screen and retainer if removed in disassembly.

5. Install primary and secondary main metering jets in their respective sides.

NOTE: Secondary jets have larger orifice.

6. Install power valve and gasket.

7. Install idle compensator and gasket using two small self-tapping screws.

8. Install secondary venturi cluster and gasket using three attaching screws and lock washers.

9. Install main well inserts four cylinder, baffles eight cylinder.

10. Install primary venturi cluster and gasket using three attaching screws and lock washers.

11. Place new choke housing gasket on choke housing.

12. Insert intermediate choke in choke housing.

13. Assemble choke housing to bowl four cylinder, to throttle body eight cylinder.

14. Assemble choke piston and lever with small pin.

15. Install choke piston in cylinder of choke housing and attach lever to intermediate choke shaft with attaching screw.

16. Choke baffle plate and cover should not be installed until carburetor is assembled and the intermediate choke rod is adjusted at a later point in the procedure.

### *ASSEMBLY OF AIR HORN*

1. Install rubber seal on pump plunger shaft.

2. Install pump plunger assembly in air horn making certain that the seal is properly located.

3. Assemble pump shaft into operating lever and install retainer.

4. Position new gasket on air horn.

5. Install power piston in place. Lightly stake retainer in place.

6. Install primary and secondary float needle seats, gaskets, and inlet screens in air horn.

***CAUTION: Primary and secondary needle seat orifices are of different size and must be installed in their respective sides.***

7. Install float, needle, hinge pin and spring on primary side.

NOTE: Be sure springs are properly installed.

8. Install float, needle pin and spring on secondary side.

## FLOAT ADJUSTMENT PROCEDURE

### FLOAT LEVEL ADJUSTMENT (FIG. 6B-53)

1. With air horn gasket in place, position float level gauge J-9192 over floats so that gauge is located at the highest point on float (Fig. 6B-53).

2. Bend float arms at center so floats just contact gauge as shown in Fig. 6B-53. The vertical height should be $1\frac{21}{64}$".

3. If necessary, bend float arm horizontally until each float pontoon is centered between gauge legs.

4. Repeat same adjustment on the opposite float assembly.

NOTE: With air horn inverted, lower tip of float should clear air horn casting. This ensures needle valve will fully close.

### FLOAT DROP ADJUSTMENT (FIG. 6B-54)

1. Check the distance between air horn and bottom of float with air horn held in upright position (Fig. 6B-54) with gauge J-9192. The distance between air horn, with gasket installed, and the bottom of the float at the lowest point is $1\frac{3}{4}$" minimum.

2. If adjustment is necessary, bend float tang toward float needle seat to lessen drop and away from seat to increase drop.

If necessary to adjust, bend the tang at the rear of the float hanger towards needle seat to decrease drop and away from needle seat to increase drop. Use care to avoid damage to torsion spring.

### PRIMARY AND SECONDARY FLOAT ALIGNMENT

Float alignment should be checked each time float level and drop adjustments are made to be sure pontoons do not rub on sides of bowl. Invert air horn and align screw holes in gasket with screw holes in air horn. Then make sure float pontoons are centered in the cut-out sections of gasket and the sides of pontoons are parallel with the adjacent edges of the gasket as viewed from directly above. Bend the float arms to align.

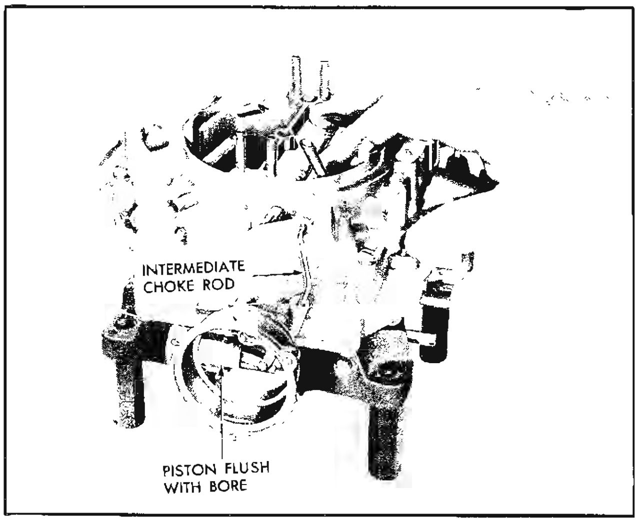



Fig. 6B-55 Intermediate Choke Rod Adjustment

Move float assembly from side to side at hinge pin to make sure pontoons do not extend over edges of cut-out sections of gasket.

### *ASSEMBLE AIR HORN TO BOWL*

1. Install air horn assembly on fuel bowl being careful to guide pump plunger into pump well. Check to see that floats are lined up correctly so they will not bend.

2. Align holes in air horn, gasket and fuel bowl.

3. Start, but do not tighten, 13 air horn attaching screws.

4. Tighten evenly and securely all inner attaching screws, then tighten outer screws.

5. Install choke shaft in air horn if removed.

6. Install choke valve through choke shaft with letters R/P facing up when choke valve is closed.

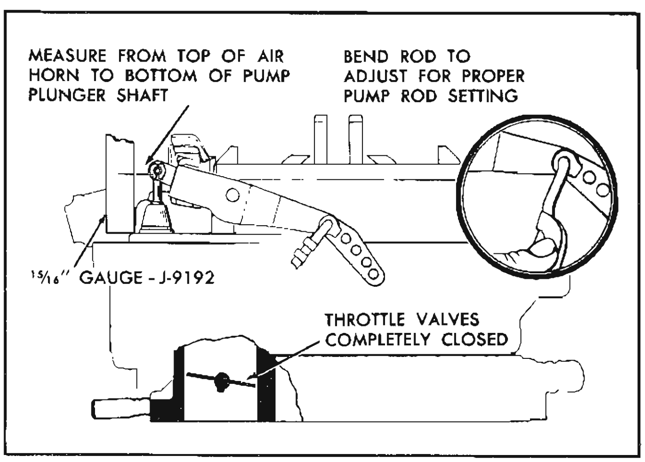



Fig. 6B-56 Pump Rod Adjustment

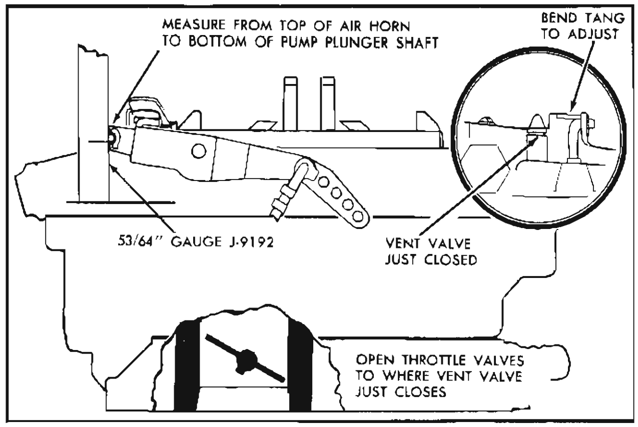



Fig. 6B-57 Atmospheric Idle Vent Adjustment

7. Start, but do not tighten, choke valve attaching screws.

8. Install choke counterweight, trip lever and fast idle cam.

9. To provide correct fit of choke valve in air horn, push lightly on choke shaft to obtain a minimum clearance of .020" between trip lever and counterweight lever. While holding in this position, tighten choke valve retaining screws and stake lightly.

10. Install intermediate choke rod and retaining clip.

### *INTERMEDIATE CHOKE ROD ADJUSTMENT (Fig. 6B-55)*

Holding choke valve completely closed, bend intermediate link, if necessary, so that the end of the choke piston is flush with the upper end of the choke piston bore.

### *COMPLETION OF CARBURETOR ASSEMBLY*

1. Place baffle plate in position in choke housing.

2. Install thermostatic coil and cover assembly, gasket, screws and retainers. Leave screws loose.

3. Rotate cover counterclockwise until the coil begins to close the choke valve. Set cover at index four cylinder synchro-mesh; four cylinder automatic one notch rich.

4. Install pump rod to pump lever and throttle lever with retainers.

NOTE: Pump rod is installed in No. 1 pump lever hole at factory. If a rich accelerator condition (stumble, etc.) is encountered particularly during warm weather, install pump rod in higher numbered hole in lever. The higher the hole number the leaner the pump discharge.

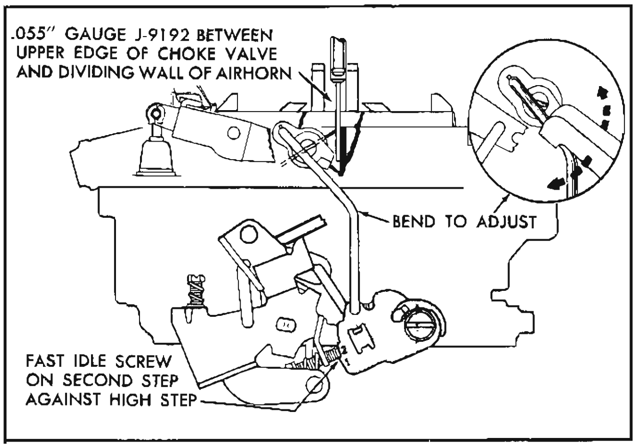



Fig. 6B-58—Choke Rod Adjustment

5. Install fuel inlet fitting and gasket in air horn. Install screen four cylinder only.

6. Install idle vent valve and guard using the self-tapping screw on four cylinder only.

### FINAL ADJUSTMENTS

The remaining adjustments should be made in the following sequence.

### PUMP ROD ADJUSTMENT (Fig. 6B-56)

1. Hold throttle valves closed and measure, using gauge J-9192-$1\frac{5}{16}$", from the top of air horn casting to the bottom of pump plunger rod. Bend pump rod to adjust.

2. Operate pump several times to be sure it is free.

### ATMOSPHERIC IDLE VENT ADJUSTMENT (Fig. 6B-57)

1. Open primary throttle valve to a point where the idle vent valve just closes.

2. With gauge J-9192-$\frac{53}{64}$" measure the distance between top of air horn casting and bottom of pump.

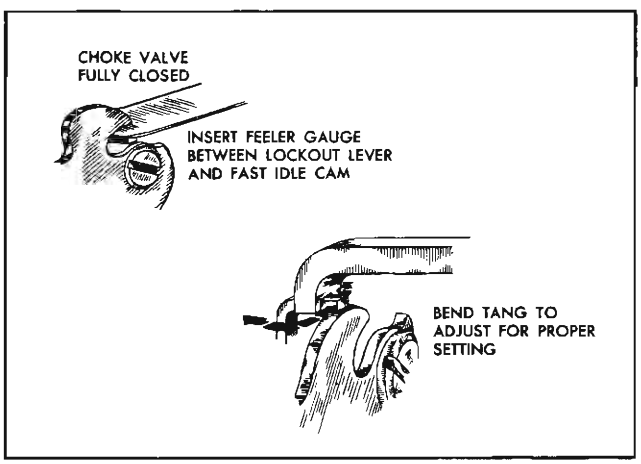



Fig. 6B-59 Secondary Throttle Lockout Adjustment

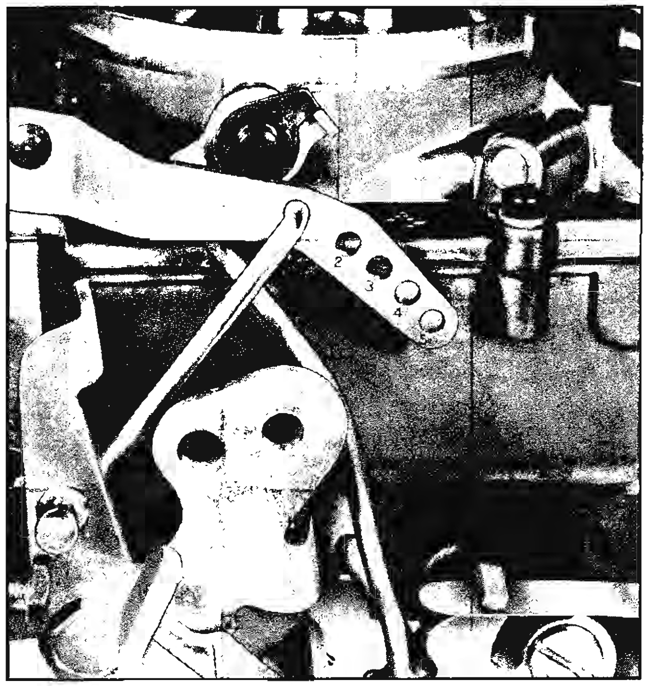



Fig. 6B-60 Secondary Throttle Contour Clearance Adjustment

### CHOKE ROD ADJUSTMENT (Fig. 6B-58)

1. Adjust fast idle screw so that it just contacts the second step (against shoulder of high step) of the fast idle cam.

2. Be sure that choke trip lever is contacting choke counterweight lever.

3. With gauge J-9192-.028" four cylinder, J-9384-01-.045" eight cylinder, measure clearance between the top edge of the choke valve and the dividing wall of the air horn. Bend choke rod at lower angle to adjust.

### SECONDARY THROTTLE LOCKOUT ADJUSTMENT (Fig. 6B-59)

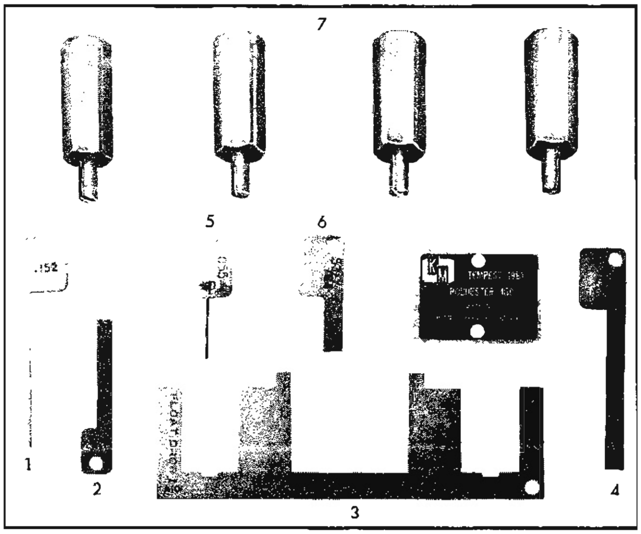
1. With the choke valve closed so that the secondary lockout tang is in the fast idle cam slot, using a .015" feeler gauge check the clearance between the cam and the tang.

2. Bend tang horizontally to adjust.

### SECONDARY THROTTLE CONTOUR CLEARANCE ADJUSTMENT

1. With the choke valve held wide open and the fast idle cam and secondary lockout tang positioned as shown (Fig. 6B-60), there should be a clearance of .015" between the cam and the tang four cylinder, .030" eight cylinder.

2. Bend the tang vertically to adjust.



1. .152" unloader guage
2. .038" secondary throttle lever gauge
3. Float drop and level gauge
4. 5/16" pump rod gauge
5. .028" choke rod gauge
6. Idle vent gauge
7. J-8328 legs

Fig. 6B-61 Special Tools J-9192

# ROCHESTER 2GC CARBURETOR

## V-8 ENGINE
## (1-11/16" Throttle Bore)

| Carburetor Model Number | Used On |
|---|---|
| 7023062 | V-8 Automatic |
| 7023071 | V-8 Synchromesh |

The Rochester 2GC carburetor used on Tempest V-8 engine incorporates 1 11/16" throttle bores and has the choke housing located on the throttle flange. This model is used as standard equipment on all automatic and synchromesh transmission Tempest V-8s. Rochester 2GC carburetor number 7023071 is used with the synchromesh transmission and number 7023062 is used with the automatic transmission.

## GENERAL DESCRIPTION

The cluster casting is the heart of the carburetor; it embodies the small or secondary venturi, the high speed passages, the main well tubes and nozzles, the idle tubes, and the calibrated air bleeds for both the low and high speed metering system, as well as the accelerating pump jets.

When the cluster is removed, all of these vital parts can be readily seen, cleaned and examined because the main well tubes and idle tubes are permanently installed in the custer body by means of a precision press fit.

The cluster fits on a platform provided in the body casting of the carburetor so that the main well and idle tubes are suspended in the fuel.

A gasket is used between the cluster casting and the body platform.

This method of design and assembly serves to insulate the main well tubes and idle tubes from engine heat thus preventing heat expansion and percolation spill-over during hot idle periods of operation and during the time the hot engine is not operating.

An external idle vent valve is located on the bowl cover which vents any fuel vapors which may form in the fuel bowl during periods of "hot" idle to the atmosphere. The fuel bowl is also internally vented to give a competely balanced carburetor.

The model 2GC carburetor is of side bowl construction. It is designed, however, with fuel supply jets and passages submerged below the liquid level to provide efficient engine operation under all driving conditions.

A carburetor choke housing is located on the throttle body assembly and is connected to the choke valve through an intermediate choke rod.

A center stud mounting provides for secure attachment of the carburetor air cleaner assembly.

Six "systems" are utilized in the Rochester 2GC carburetor. They are: Float System, Idle System, Part Throttle System, Power System, Pump System, and Choke System.

These systems are described and illustrated schematically in the following text.

### *FLOAT SYSTEM (Fig. 6B-62)*

The float system controls the level of fuel in the carburetor bowl.

Entering fuel first travels through the inlet strainer to remove particles which might block jets or passages. Then the fuel passes through the needle and seat into the carburetor bowl; flow continues until the rising liquid level raises the float to a position where the valve is closed. Thus the fuel level can be regulated by setting the float to close the valve when the proper level is reached.

A tang located at the rear of the float hanger prevents the float from traveling too far downward.

The carburtor is internally vented. The vent transmits the air pressure from beneath the air cleaner to the fuel in the float bowl. The amount of fuel metered by the carburetor is dependent upon the pressure in the float bowl causing fuel to flow. By locating the vents below the air cleaner, or internally, the carburetor automatically compensates for air cleaner restriction, since the same pressure causing air to flow will also be causing fuel to flow.

An external idle vent, located in the top of the float bowl, vents the bowl to atmosphere during idle operation. In this way any fuel vapors which may form in the bowl during hot idle or when parked will be vented to the outside. The idle vent automatically closes after the throttle valve has moved from the idle position into the part throttle range, returning the carburetor to internal balance.

### *IDLE SYSTEM (Fig. 6B-63)*

The idle system consists of the idle tubes, idle passages, idle air bleeds, idle mixture adjustment needles, idle discharge slot and an idle air adjustment screw.

In the curb idle speed position, the throttle valves are held open by the speed adjusting screw.

In order to obtain sufficient idle air for stable idle speed adjustment, a fixed air bleed is necessary; this is accomplished by a drilled hole in each throttle valve. The fixed idle air bleeds maintain a constant idle air flow for part of the idle air requirements, while the idle speed adjustment screw regulates the remainder of the idle air. Thus, the engine idle speed can be adjusted by the idle speed adjustment screw.

The idle mixture needle hole is in the high vacuum area below the throttle valve while the fuel bowl is vented to atmospheric pressure. Vacuum can be called a lack of pressure, so a high vacuum area can be spoken of as an area of low pressure. Thus it can

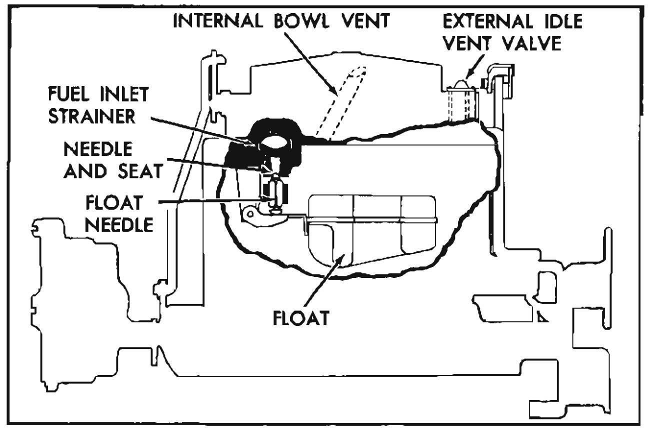



Fig. 6B-62 Float System

be said that there is considerable pressure difference between the normal atmospheric pressure on the fuel in the bowl and the low pressure (or high vacuum) at the idle mixture needle hole.

The fuel and fuel/air mixture will be forced by atmospheric pressure to occupy any low pressure area. It will flow from the fuel bowl to the manifold in the following manner:

The atmospheric pressure acting on the fuel in the bowl forces fuel through the main metering jets into the main well. It is metered by the idle fuel metering orifice at the lower tip of the idle tube and travels up the idle tube. When the fuel reaches the top of the idle tube, it mixes with air entering through the primary idle air bleed. The mixture moves through the horizontal idle passage where more air is added at a second idle air bleed and then down through a restriction in the vertical passage which serves to further break up the fuel. More air is picked up at a third idle air bleed just below the idle restriction.

The fuel/air mixture next moves down the vertical

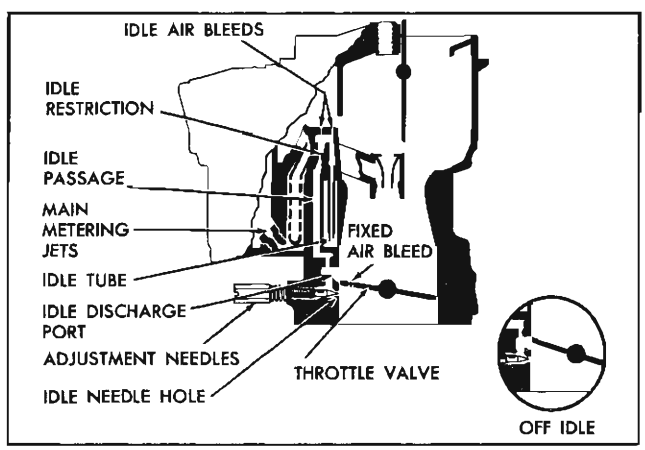



Fig. 6B-63 Idle System

idle passage to the idle discharge slot located just above the throttle valve. Through this slot further air is added to the mixture, which then passes through the idle mixture needle hole.

In addition to this mixture of fuel and air, there is air entering the carburetor bore through the fixed idle air bleeds. For smooth operation, the air from the idle needle hole must combine to form the correct final mixture for curb idle engine speed.

The position of the idle adjustment needle governs the amount of fuel/air mixture admitted to the carburetor bore.

Except for this variable at the idle adjustment needle, the idle system is specifically calibrated for low engine speeds.

A hot idle compensator is incorporated in all carburetors on cars equipped with factory installed air conditioning and all Hydra-Matic equipped tri-power engines. The function of the idle compensator is to prevent rough idle and stalling during prolonged hot idle conditions.

It consists of a bi-metal strip, a valve and mounting bracket. The idle compensator is mounted between the venturi on the large bore carburetors and on the back of the carburetor on the bowl casting on small bore carburetors. Below the compensator is a passage leading to manifold vacuum below the throttle blades.

As engine and underhood temperatures rise to a predetermined value, the bi-metal strip lifts the valve off its seat. This allows fresh air to enter the manifold below the throttle valves and off-set rich mixtures due to fuel vapors that are causing the rough idle and stalling.

When underhood temperatures return to normal, the bi-metal strip will lower and the compensator valve will close and normal idle operation will resume.

NOTE: No adjustments are necessary on the idle compensator. The compensator valve must be closed while adjusting engine idle.

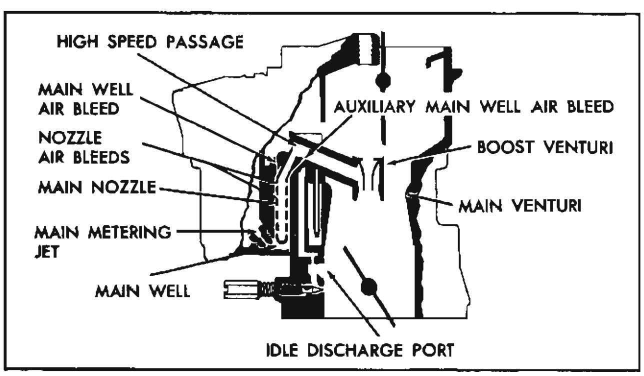



Fig. 6B-64 Part Throttle System

There is no distributor vacuum advance at idle with this carburetor installation on the Tempest V-8 with synchro-mesh transmission.

### *PART THROTTLE SYSTEM (Fig. 6B-64)*

As the throttle valve is opened, there is a change in pressure differential points.

Opening of the valve progressively exposes the idle discharge slot to manifold vacuum and the air stream with the result that they deliver additional fuel/air mixture for fast idle engine requirements.

Further opening of the throttle valve increases the speed of the air stream passing through the venturi, thus lowering the pressure (or raising the vacuum) in the small venturi area of the carburetor bore. At the same time, the edge of the throttle valve is moved away from the wall of the bore, progressively reducing the vacuum and thus the mixture flow at the idle discharge slot.

Since the low pressure point is now in the small venturi area, fuel and fuel/air mixture will be forced from the fuel bowl through the main metering system to the venturi as follows:

The fuel passes through the main metering jet into the main well, where it rises in the main well tube. Air entering through the main well air bleeds in the cluster is mixed with the fuel through the main well tube vents. The mixture continues up the main well tube through the nozzle, where more air is added. The mixture flows through the high speed passage to the small venturi, mixes with additional air and moves on to the bore of the carburetor, through the intake manifold, and into the cylinder as a final mixture for part throttle operation.

A second high speed bleed is incorporated in the cluster of large bore 2GC carburetors only. This bleed is drilled from the main well to the high speed passage and serves two purposes. It transmits low pressure from the secondary venturi and high speed passage to the main well, thereby, helping to raise fuel level. This raising of the level assists the initial feeding of fuel at low speed and also helps control the mixture during high speed operation.

As the throttle opening is increased and more fuel is drawn through the main well tubes the fuel level in the main well drops. More holes in the main well tubes are then exposed to the air in the upper well area and become air bleeds. This maintains the proper fuel/air mixture to the engine throughout the part throttle range.

Permanent jets and air bleeds calibrate the main metering system for efficient part throttle operation.

***POWER SYSTEM (Fig. 6B-65)***

As was pointed out under part throttle operation, the fuel level in the main well area drops as the throttle valves are opened. This is due to the fact that more fuel is drawn through the main well tubes, but the supply to the main well is held constant by the opening in the main metering jet. For high speed and/or heavy load conditions an additional source of fuel for the main well area is required. The power system accomplishes this purpose.

A spring loaded power piston, controlled by vacuum, regulates the power valve to supply the additional fuel.

The power piston vacuum channel is open to manifold vacuum in the carburetor bore beneath the throttle valves; thus the vacuum in the channel rises and falls with manifold vacuum.

During idle and part throttle operation, manifold vacuum in the channel is high. Therefore, air pressure in the passage beneath the power piston holds the piston in the fully raised position against the tension of the spring. As the load or speed is increased the throttle valves open wider and manifold vacuum drops. The calibrated spring forces the power piston down against the power valve to open it and allow fuel to flow through the power restrictions into the main wells. The amount of fuel is controlled by the main metering jet and the power restriction.

A two-step valve allows a gradual increase in fuel flow as the power valve is opened; at full throttle position, the power valve is fully opened to permit maximum calibrated fuel flow from the power system.

When the load is decreased the throttle valves close and manifold vacuum is increased. Therefore, air pressure below the power piston gradually overcomes the piston spring tension and forces the piston upward to its original position with the power valve fully closed.

***PUMP SYSTEM (Fig. 6B-66)***

Extra fuel for smooth, quick acceleration is supplied by a double spring pump plunger. A rapid opening of the throttle valves, as is the case when accelerating from low speeds, causes an immediate increase in air velocity. Since fuel is heavier than air it requires a short period of time for it to "catch" up with the air flow. To avoid a leanness during this momentary lag, the accelerator pump furnishes a quantity of liquid fuel sprayed into the air stream to mix with incoming air and maintain the proper fuel/air mixture.

The pump is operated by the combined action of two springs which are calibrated to move the plunger

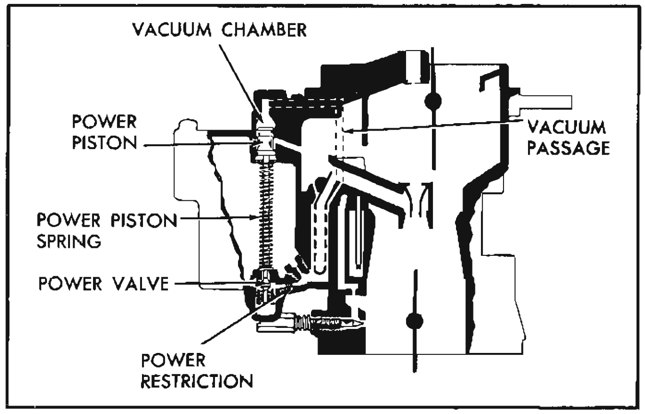



Fig. 6B-65 Power System

in such a manner that a sustained charge of fuel is delivered for smooth acceleration.

The pump is attached by linkage to the accelerator so that when the throttle valves are closed the pump plunger moves upward in its cylinder creating a low pressure area (partial vacuum) in the cylinder below the plunger. Atmospheric pressure acting on the fuel in the bowl forces fuel into the cylinder through the intake ball check. The discharge ball is seated at this time to prevent air being forced into the cylinder.

When the plunger is moved downward for acceleration, the force of the stroke seats the intake ball check to prevent flow to the fuel bowl, and the fuel is forced up the pump discharge passage. The pressure of the fuel lifts the pump outlet ball check from its seat and the fuel passes on through the pump jets in the cluster; where it is sprayed into the venturi and delivered to the engine.

At higher speeds pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a predetermined amount the pump

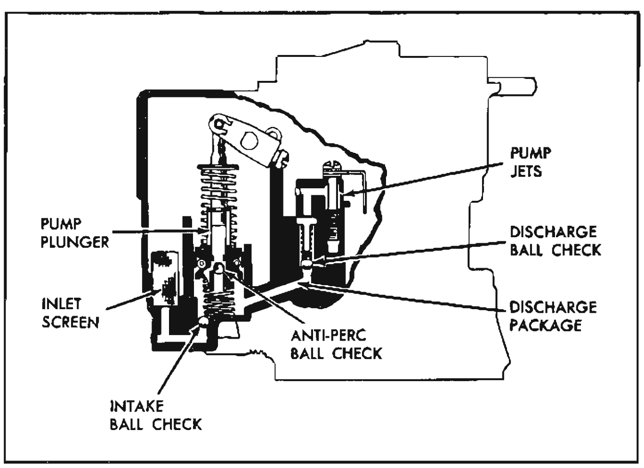



Fig. 6B-66 Pump System

plunger bottoms in the cylinder eliminating pump discharge.

An "anti-percolator" check valve, contained inside the plunger, provides relief for any vapors which might form during hot idle or when a hot engine is not operating. The ball check is designed so that it can move up and down in its passage. Throughout the above periods it is seated by gravity and vapors in the pump well rise and by-pass the ball check through small holes in the plunger head.

The "anti-perc" ball check also acts as an extra inlet during the upstroke of the pump plunger, but is seated by fuel when the plunger moves downward.

### CHOKE SYSTEM (Fig. 6B-67)

The purpose of the choke system is to provide a rich mixture for cold engine operation. It is necessary to have an extra rich mixture because fuel vapor has a tendency to condense on the cold engine parts; thus decreasing the amount of combustible mixture available at the combustion chamber.

The choke system subjects all fuel outlets in the bore of the carburetor to manifold vacuum while restricting the intake of air.

The choke system includes a thermostatic coil, housing, choke piston, choke valve, and fast idle cam and linkage. It is controlled by a combination of manifold vacuum, air velocity against the offset choke valve, and tension of the thermostatic spring.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. Starting the engine causes air velocity to strike the offset choke valve. This tends to open it along with the action of intake manifold vacuum on the choke piston. After a slight opening of the choke valve, the tension of the thermostatic coil spring balances the force of air on the valve and the pull of vacuum at the piston.

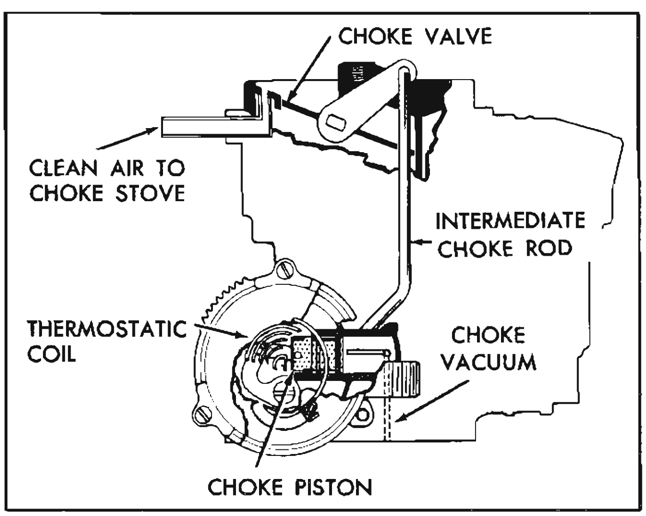



Fig. 6B-67 Choke System

As the engine warms up manifold vacuum exists in the choke housing. Clean hot air from the choke stove is forced into this low pressure area through a passage in the side of the choke housing to heat the thermostatic coil.

The clean air is supplied to the choke stove in the manifold from the air horn, above the choke valve (just below the air cleaner). Here filtered air from the air cleaner is picked up and carried to the stove by a metal pipe.

A secondary baffle plate serves to distribute the heat from its entering point at the side of the coil throughout the choke housing, to prevent a "hot spot" in the coil center, which would cause a rapid opening of the choke valve. The choke baffle is designed in some models with a hole or holes drilled in it. These holes are used to further control heat to the choke coil and, thereby, finely tailors the choke to the particular engine model. The thermostatic coil "relaxes" gradually until the choke is fully open.

If the engine is accelerated during warm-up, the corresponding drop in manifold vacuum on the choke piston allows the thermostatic coil to momentarily close the choke, providing a richer mixture.

During warm-up it is necessary to provide a fast idle to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke shaft. The idle speed screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to the idle position until the choke valve is fully open.

If the engine becomes flooded during the starting period, the choke valve can be partially opened manually to allow increased air flow through the carburetor. This is accomplished by depressing the accelerator pedal to the floor. The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke valve.

## ADJUSTMENTS ON CAR ROCHESTER 2GC CARBURETOR

All Rochester 2GC adjustments can be performed on the car. With the exception of the idle speed and mixture adjustment and the unloader adjustment, all adjustments are included in the OVERHAUL AND ADJUSTMENTS procedure. Following are the idle speed and mixture adjustments and the unloader adjustment.

Whenever idle speed screw is turned, the throttle should be opened slightly then closed to seat screw properly on cam.

### IDLE SPEED AND MIXTURE ADJUSTMENT

With the engine at operating temperature adjust idle speed to the following specifications.

Synchro-mesh, exc. Air Conditioning ... 480-500 rpm
Automatic, exc. Air Conditioning ...... 480-500 rpm
(in drive range)
Air Conditioning .................... 540-560 rpm
(Automatic drive range, air conditioning off)
(S/M neutral, air conditioning off)

The idle mixture should be adjusted to give a smooth idle at the specified idle speed. Missing is a sign of too lean an idle mixture while "rolling" or "loping" indicates too rich a mixture. Turning the idle mixture screw in, leans out the mixture; one and one-half turns out from the lightly seated position may be used as a preliminary setting of the mixture screws.

NOTE: All two barrel carburetors used on Tempest V-8 engines have a hot idle compensator. During idle adjustment make sure the hot idle compensator is closed by depressing the spring loaded button.

### UNLOADER ADJUSTMENT

NOTE: Unloader adjustment cannot be made correctly unless linkage is properly adjusted.

1. Remove carburetor air cleaner assembly.

2. Depress accelerator pedal forcibly to floor. (This should be done by person sitting in driver's seat of car to simulate driving conditions.) Check to see that accelerator pedal is not hitting "hump" over transmission.

3. With accelerator pedal depressed as in Step 2, bend tang on throttle lever to give a clearance of .143" to .183" (gauge set J-8556) between the top of the choke valve and the inside of the air horn.

4. Replace air cleaner assembly.

The above procedure will eliminate variance in linkage, floor mat, pedal location, etc., and should ensure correct unloader action.

## PERIODIC SERVICE ROCHESTER 2GC CARBURETOR

There are no periodic services required on the Rochester 2GC carburetor; however, choke linkage, choke valve and levers and pump linkage should be kept free of dirt and gum so that they will operate freely. DO NOT OIL LINKAGE.

## OVERHAUL AND ADJUSTMENT

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the carburetor should be carefully removed from the engine without draining the fuel from the bowl. The contents of the fuel bowl may then be examined for contamination as the carburetor is disassembled.

The following is a step-by-step sequence by which the Rochester 2GC carburetor may be completely disassembled and reassembled. Adjustments may be made and various parts of the carburetor may be serviced without completely disassembling the entire unit.

### DISASSEMBLY

#### DISASSEMBLY OF BOWL COVER

1. Remove fuel inlet filter retainer nut and gasket with ¾" wrench and remove the filter.

2. Disconnect the pump link (Fig. 6B-69) from the pump lever by removing spring clip. Remove lower end of pump rod from throttle lever by removing clip.

3. Detach choke intermediate rod (Fig. 6B-68) at lower end by removing clip, then detach choke intermediate rod from choke shaft by rotating until the tang on rod clears the slot in lever.

4. Remove retaining screw at the end of the choke shaft and remove choke trip lever and fast idle link and lever (Fig. 6B-69). Lever can be removed from link by turning until slot in lever will pass over tang on link. The link and fast idle cam are retained by a Truarc washer. Disassembly of these pieces will destroy the Truarc washer.

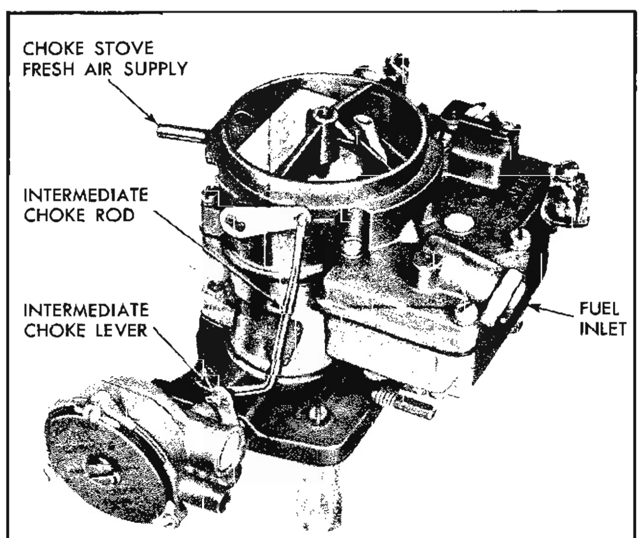



Fig. 6B-68 Rochester 2GC Carburetor

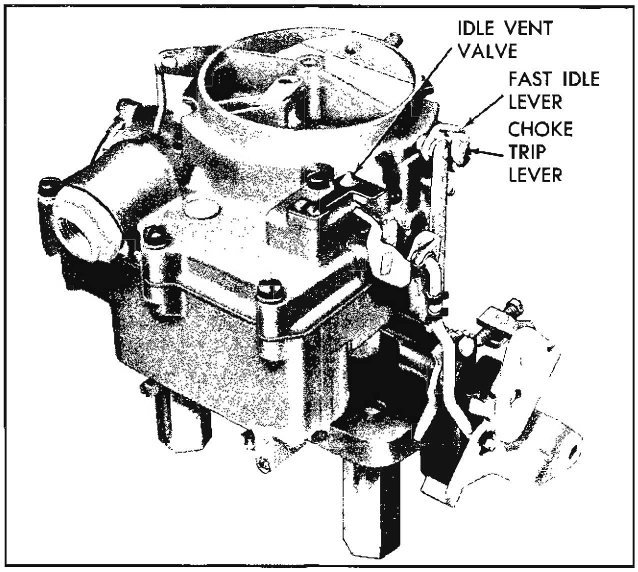



Fig. 6B-69 Rochester 2GC Carburetor

5. Remove eight cover screws (Fig. 6B-70) and lift cover from bowl (Fig. 6B-71).

6. Place upended cover on flat surface. Remove float hinge pin and lift float assembly from cover (Fig. 6B-71). Float needle may now be removed from seat.

7. Remove float needle seat, screen (Fig. 6B-72) and gasket with wide blade screwdriver.

8. Remove power piston (Fig. 6B-72) by depressing piston stem and allowing it to snap free or by holding stem and tapping lightly on air horn with a non-metallic object. Use care not to bend piston stem.

9. Remove retainer on pump plunger shaft, remove plunger assembly from pump arm (Fig. 6B-72). The pump lever and shaft may be removed by loosening set screw on inner arm and removing outer lever and shaft.

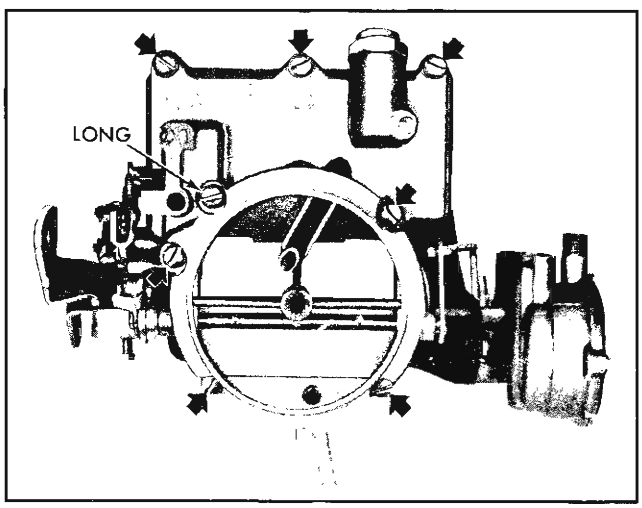



Fig. 6B-70 Location of Cover Attaching Screws

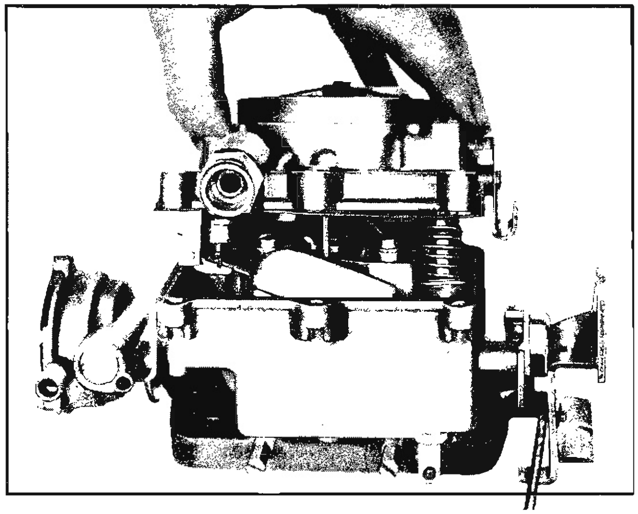


Fig. 6B-71 Removing Bowl Cover Assembly

10. The cover gasket may now be removed.

11. Remove idle vent valve.

12. Remove two choke valve attaching screws, then remove choke valve.

13. Remove choke valve shaft from bowl cover.

DISASSEMBLY OF BOWL

1. Remove pump inlet filter screen and pump plunger return spring, and remove aluminum check ball from bottom pump well (Fig. 6B-73).

2. Remove main metering jets and power valve (Fig. 6B-73).

3. Remove screw holding fuel deflector to cluster. Remove two remaining screws holding cluster to bowl and remove cluster and gasket.

4. Using a pair of long nose pliers, remove the pump discharge spring retainer (Fig. 6B-74). Then the spring and check ball may also be removed.

5. Invert carburetor and remove three large bowl to throttle body attaching screws. Throttle body and gasket may now be removed.

6. Remove fast idle cam and fast idle link as an assembly. DO NOT disassemble.

7. Remove idle compensator bracket and compensator if present.

DISASSEMBLY OF THROTTLE BODY

1. Remove idle adjusting needles and springs.

2. Remove fast idle screw from throttle lever if necessary to replace.

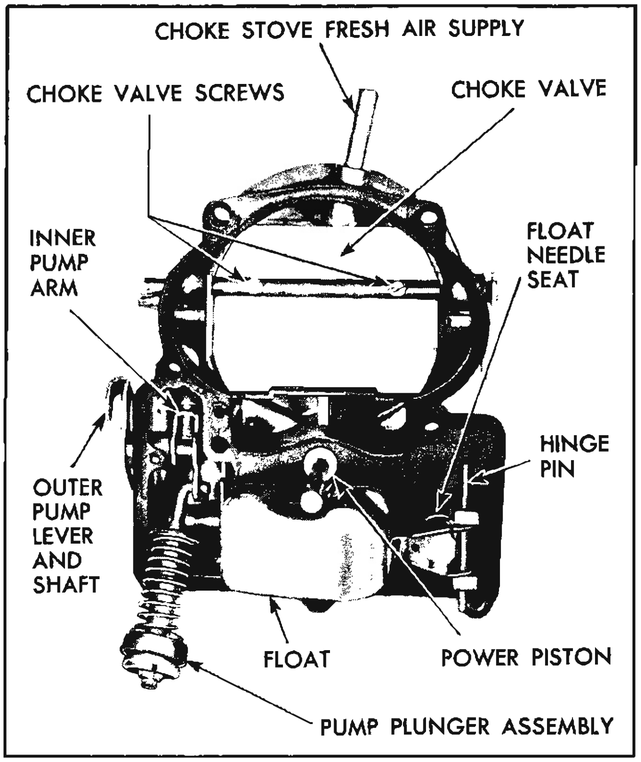



Fig. 6B-72 Bowl Cover Attaching Parts

3. Remove the three choke cover attaching screws and retainers, then remove choke cover and coil assembly from choke housing.

4. Remove choke cover gasket and baffle plate.

5. Remove choke piston lever attaching screw (Fig. 6B-75).

6. Remove piston link and lever assembly from carburetor.

NOTE: Piston can be removed from link by dropping out piston pin.

7. Remove the two choke housing attaching screws and detach choke housing from throttle body.

8. Remove intermediate choke shaft and lever from choke housing.

### CLEANING AND INSPECTION OF PARTS

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 clean cleaning solvent.

***CAUTION: Choke cover and coil, idle compensator, rubber vent valve, gaskets, and pump plunger should not be immersed in solvent. Clean pump plunger in clean gasoline only.***

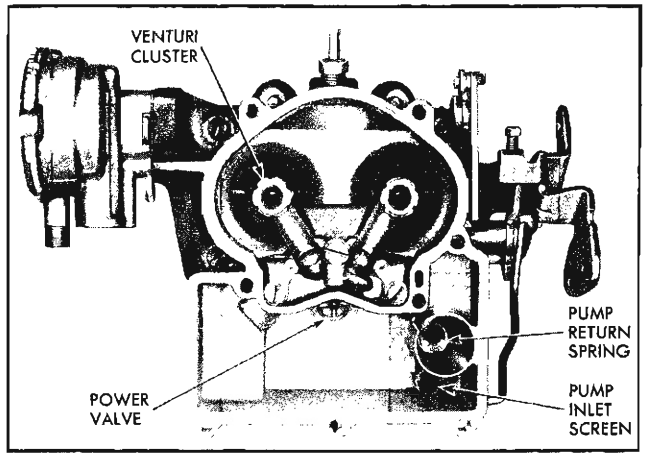



Fig. 6B-73 Carburetor Body Assembly Details

***To avoid damage to gasket between choke housing and throttle body do not soak the throttle body assembly in cleaner or solvent if choke piston housing has not been removed.***

2. Blow all passages in castings (Figs. 6B-76 through 6B-80) dry with compressed air and blow off all parts until they are dry.

***CAUTION: Do not pass drills or wires through calibrated jets or passages as they may enlarge orifices and seriously affect carburetor calibration.***

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.

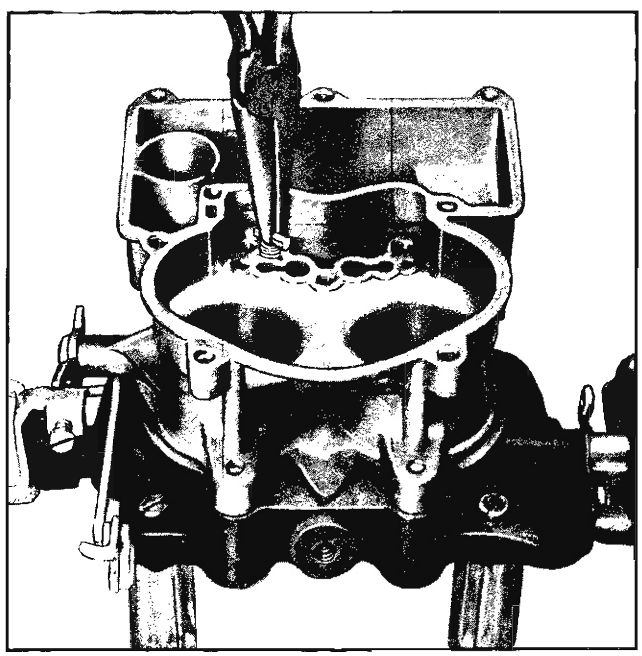


Fig. 6B-74 Removing Pump Discharge Spring Retainer

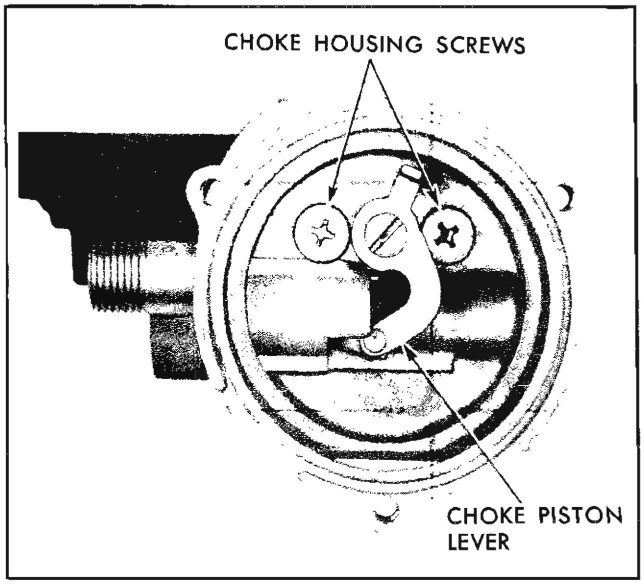



Fig. 6B-75 Choke Housing Screws

b. Check float lip for wear and float for dents. Check floats for gasoline leaks by shaking.

c. Check throttle and choke shaft bores in throttle body and cover castings for wear or out of round.

d. Inspect idle adjusting needle for burrs or ridges. Such a condition requires replacement.

e. Inspect fast idle cam—if wear is noted on steps of cam it should be replaced as it may upset engine idle speed during the warm-up period.

f. Inspect pump plunger leather. Replace plunger if cup is damaged.

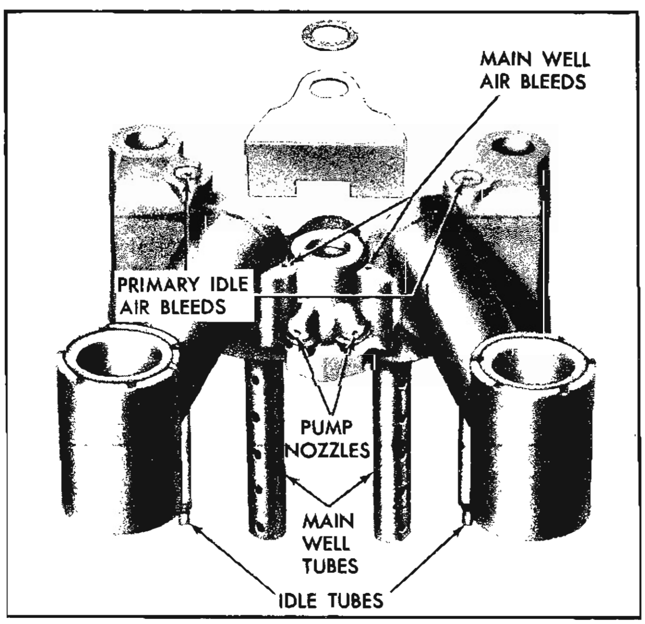



Fig. 6B-76 Passage Identification—Venturi Cluster

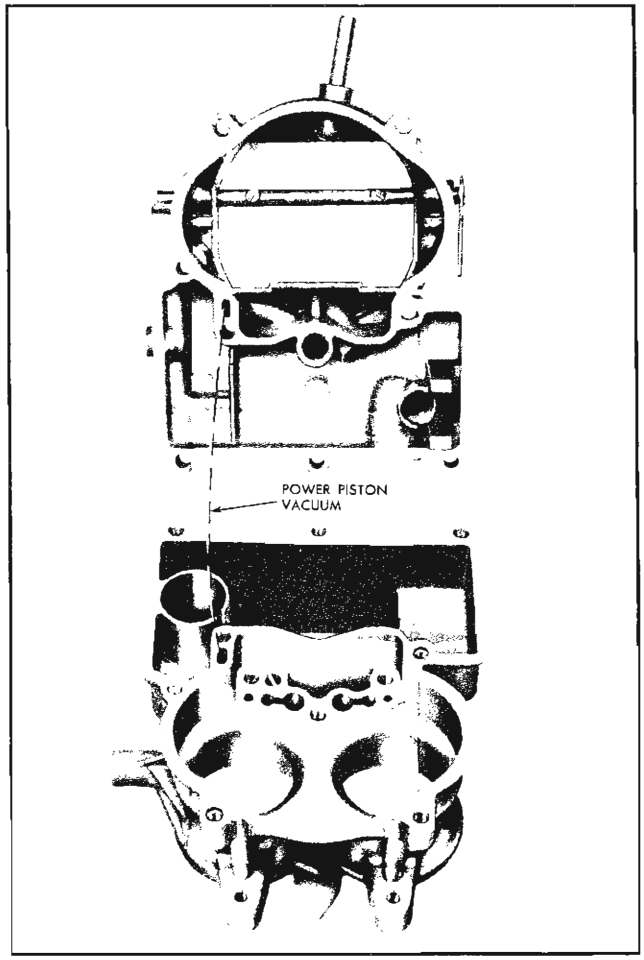



Fig. 6B-77 Passage Identification—Body to Bowl Cover

g. Inspect power piston and spring for burrs or distortion. Replace if necessary.

4. Check all filter screens for dirt or lint. Clean and if they are distorted or plugged, replace with new parts.

5. Inspect cluster casting. If any parts in castings are loose or damaged, cluster assembly must be replaced.

6. Use new gaskets in reassembly.

### *ASSEMBLY AND ADJUSTMENT*

### ASSEMBLY OF THROTTLE BODY

1. Install fast idle screw in throttle lever if removed.

2. Screw idle mixture and adjusting needles and springs into throttle body until finger tight. Back out screw 1½ turns as a preliminary idle adjustment.

3. Upend bowl, place new throttle body gasket in position and attach throttle body. Tighten screws evenly and securely.

NOTE: Choke housing should be reassembled to throttle body after installing air horn.

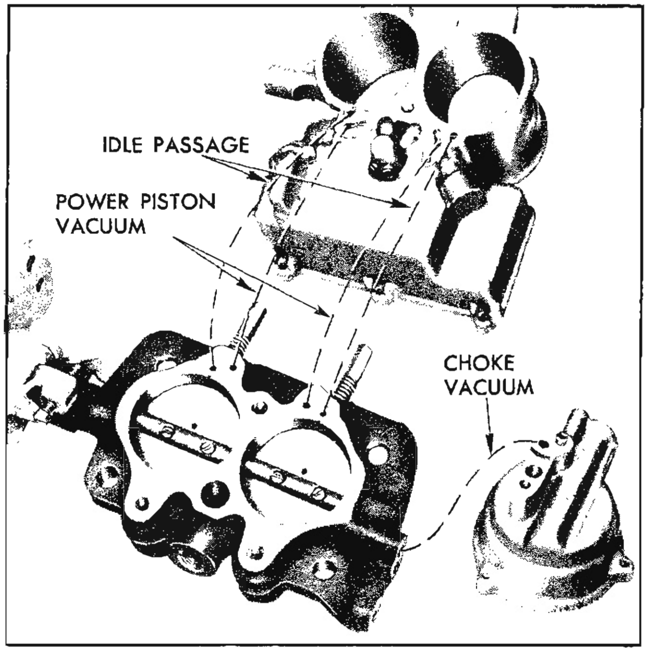



Fig. 6B-78 Passage Identification—Flange—Bowl—Choke Housing

ASSEMBLY OF BOWL

1. Install hot idle compensator on bowl section between venturi.

2. Drop steel pump discharge check ball into pump discharge hole. Ball is $\frac{3}{16}''$ diameter (do not confuse with aluminum intake ball). Install pump discharge spring and retainer.

3. Replace fuel deflector, cluster and gasket, tighten screws evenly and securely. Make certain center screw is fitted with gasket to prevent pump discharge leakage.

4. Replace main metering jets and power valve.

5. Drop aluminum pump intake ball check into hole in pump well. Install pump return spring, pressing with finger to center it in pump well.

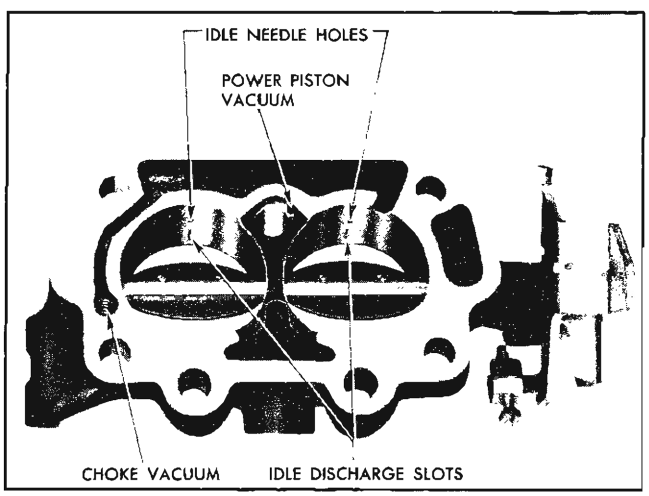



Fig. 6B-79 Passage Identification—Throttle Flange

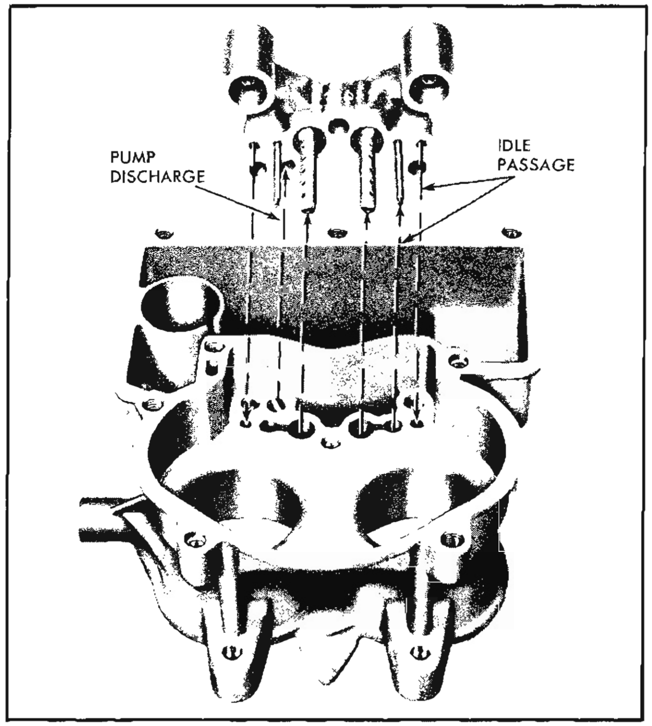



Fig. 6B-80 Passage Identification—Body to Cluster

6. Replace pump inlet strainer, pressing carefully into position.

ASSEMBLY OF BOWL COVER

1. Install choke shaft in air horn, then install choke valve on choke shaft using two attaching screws. Letters RP on choke valve should face towards top of air horn (Fig. 6B-81). Center choke valve before tightening screws, by installing the fast idle lever and choke trip lever. Maintain approximately .020" clearance between the fast idle lever and air horn casting. Then tighten choke valve screws and "stake" lightly. Then install choke trip lever and fast idle

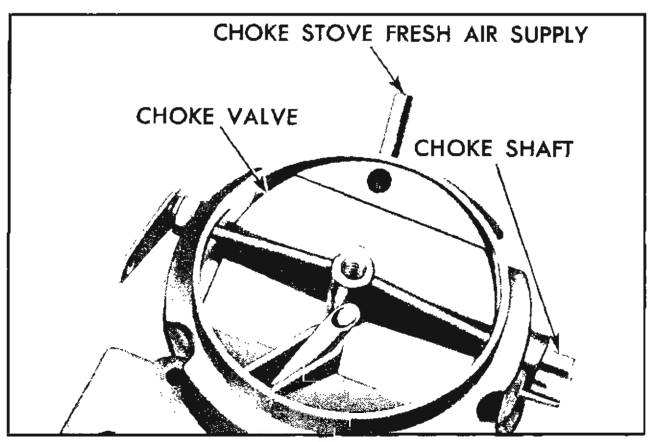



Fig. 6B-81 Choke Valve and Shaft Installed

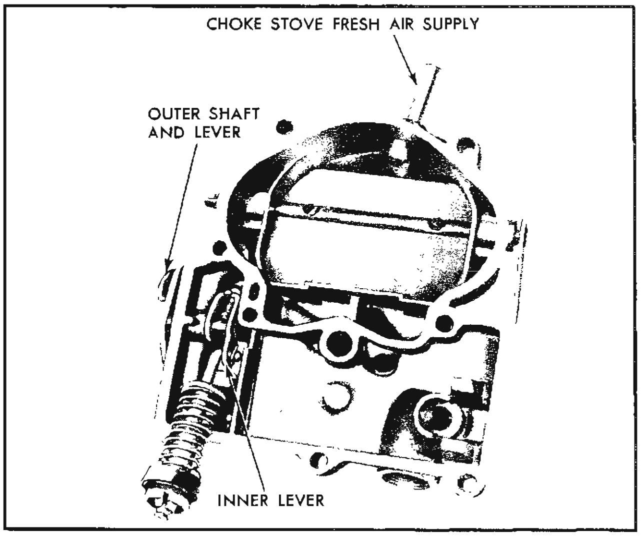



Fig. 6B-82 Pump Plunger Installed on Bowl Cover

lever. Choke valve should move freely in housing.

2. Replace pump outer lever and shaft assembly and inner lever, tighten retaining screw on inner lever (Fig. 6B-82.)

3. Install small fuel screen on needle seat.

4. Install float needle seat screen and gasket, using wide blade screwdriver.

5. Drop aluminum pump intake ball check into shaft end pointing inward towards center of air horn casting.

6. Install cover gasket.

7. Insert needle in seat, carefully position float and insert hinge pin.

8. Adjust float.

(a) Float Level Adjustment

With air horn inverted and gasket in place and needle seated, there should be 5/8"±1/16" clearance between the lower edge of float seam (sharp edge) at the toe end and air horn gasket (Fig. 6B-83). Use gauge set J-8556. To adjust, bend float arm at rear of float. Visually check float alignment after adjusting float.

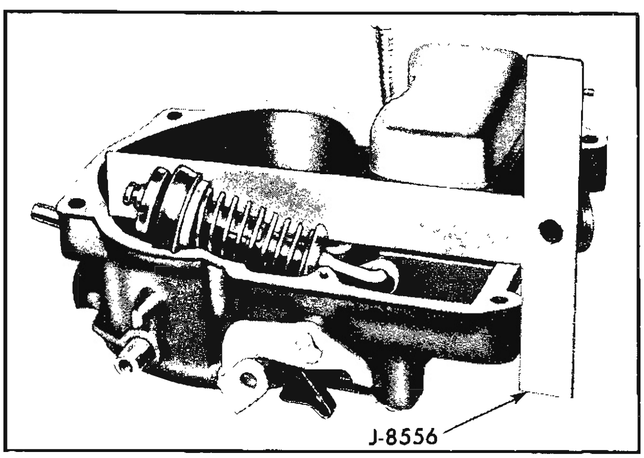



Fig. 6B-83 Checking Float Level

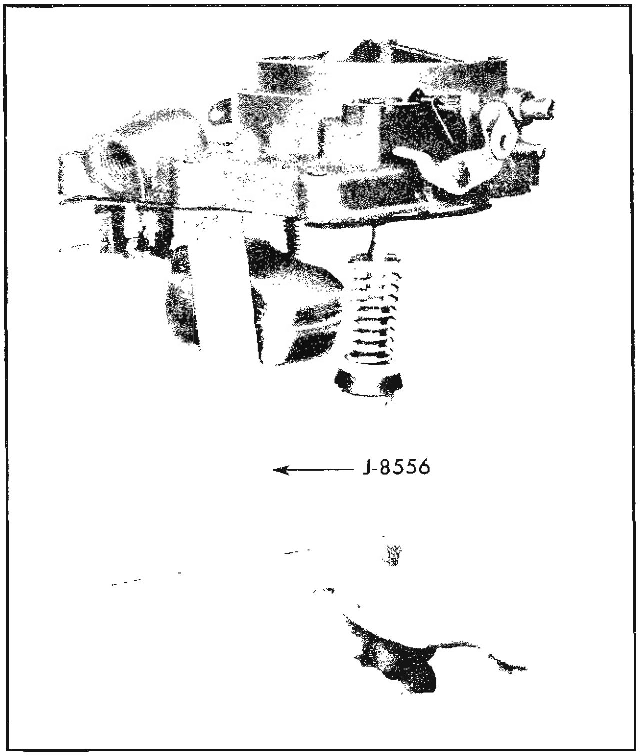



Fig. 6B-84 Checking Float Drop

(b) Float Drop Adjustment

With air horn right side up so that float can hang free, the distance from the gasket surface to the lowest point of the float should be a minimum of 1¾" and can be measured using the float gauge (Fig. 6B-84). Maximum drop can be any amount that will retain needle for installation. Needle must not wedge at maximum drop. To adjust, bend tang at rear of float towards needle seat to decrease float drop and away from needle seat to increase float drop.

9. Install power piston in vacuum cavity; piston should travel freely in cavity. Stake vacuum piston retainer washer.

10. Place cover on bowl, making certain that accelerator pump plunger is correctly positioned and will move freely.

11. Install and tighten eight cover screws evenly and securely.

12. Install filter with closed end toward air horn.

13. Install pump link and retainer.

14. Install idle vent valve.

15. To adjust pump link, place tool on top of

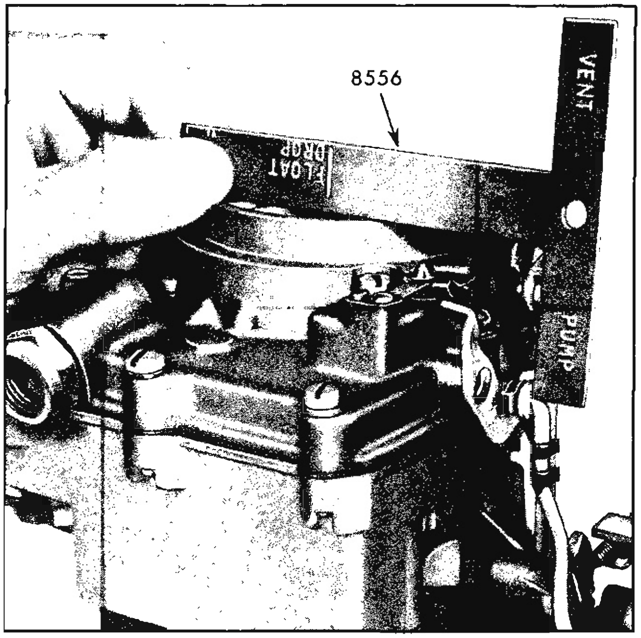



Fig. 6B-85 Pump Link Adjustment

cleaner mounting ring as shown in Fig. 6B-85. Then with throttle valves fully closed the top surface of the pump rod should just touch the end of the gauge. Measurement should be 1-21/64" ± 1/32". Bend pump link to adjust.

16. Install fast idle link and fast idle cam as an assembly and install fast idle lever on other end of fast idle link. Place fast idle lever on choke shaft with the tang facing outward and toward the pump lever. Install trip lever so that tang of trip lever is under tang of choke lever, and install retaining screw (Fig. 6B-86 and 6B-87).

17. Assemble intermediate choke shaft and lever and new gasket to choke housing. Attach to throttle body with two attaching screws.

18. Assemble choke piston and linkage to choke housing and attach to intermediate choke shaft. Insert intermediate choke rod into lever on air horn and attach to intermediate choke lever with horseshoe clip.

19. Hold choke valve completely closed and adjust intermediate choke rod as necessary so that choke piston is flush with end of choke housing bore.

20. Install choke baffle plate.

21. Install choke coil and cover and rotate cover counterclockwise until the index marks on cover and housing are aligned. Attach the three retainers and screws to choke housing, tighten securely.

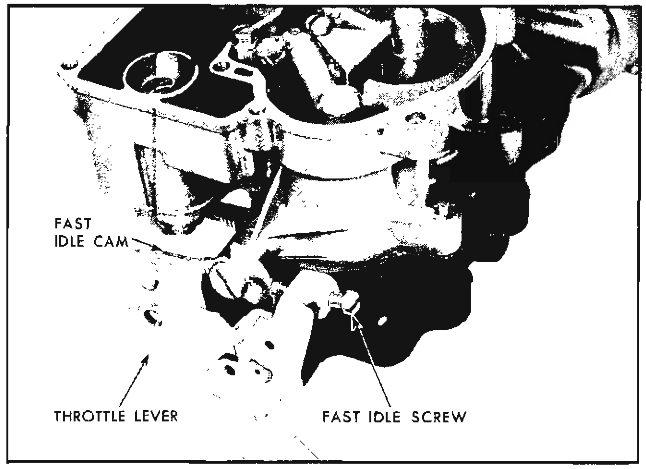



Fig. 6B-86 Fast Idle Cam Installed

NOTE: Choke valve should be lightly closed at room temperature (75°F.) when index marks on cover and housing are aligned.

***FINAL ADJUSTMENTS***

## CHOKE ROD ADJUSTMENT

1. With the thermostat cover set at index and the choke trip lever in contact with the fast idle lever, locate the fast idle screw on the second step of the fast idle cam, next to the shoulder of the high step.

2. Bend the tang on the fast idle lever so that the end of .080" wire gauge or drill just fits between the inner side of the air horn and the upper edge of the choke valve (Fig. 6B-88).

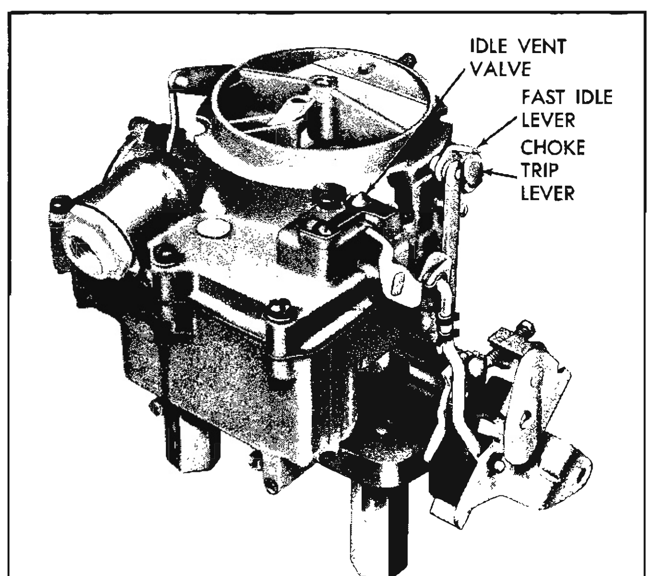



Fig. 6B-87 Carburetor Linkage Installed

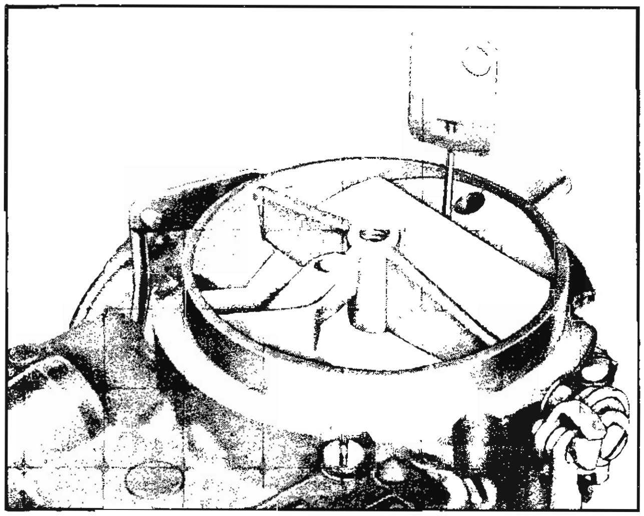


Fig. 6B-88 Choke Rod Adjustment

## IDLE VENT ADJUSTMENT

NOTE: Pump rod setting must always be made before making the idle vent adjustment.

With the idle vent valve just closed, bend the tang on the pump lever as necessary to obtain a dimension of $1\frac{17}{64}'' \pm \frac{1}{64}''$ between top of pump rod and top of air cleaner ring (Fig. 6B-89). Use tool J-8556 to check.

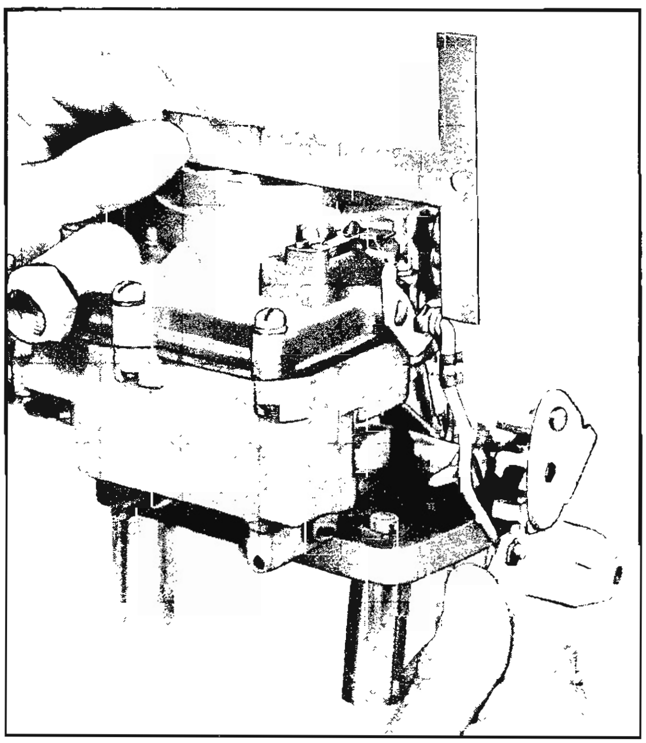
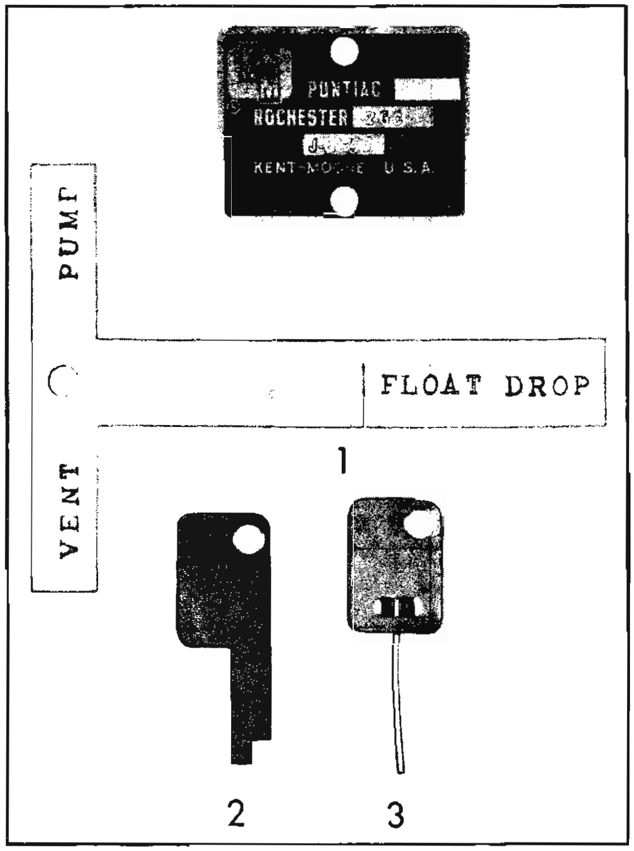


Fig. 6B-89 Idle Vent Valve Adjustment




1. "T" Gauge ............ Pump, Idle Vent, Float Level and Float Drop
2. .163" Gauge ........... Unloader
3. .080" Gauge ........... Choke Rod

Fig. 6B-90 Special Tools J-8556-01

# CARTER AFB FOUR BARREL CARBURETOR

| Carburetor Model No. | Used On |
|---|---|
| 3502S | Automatic Transmission V-326 H.O. Engine |
| 3477S | Synchro-Mesh Transmission V-326 H.O. Engine |

## DESCRIPTION

The Carter AFB (aluminum four barrel) carburetor used on V-326 H.O. engines is composed of two major assemblies, an air horn assembly and a combined throttle body and bowl called the body assembly. The air horn and body are made of cast aluminum.

The carburetor is basically two dual carburetors in one assembly. The half of the carburetor containing the step up rods, pump assembly and idle system is called the primary side of the carburetor. The other half is called the secondary side.

The carburetor contains the conventional carburetor circuits:

- Float Circuits
- Low Speed Circuits
- High Speed Circuits
- Pump Circuit
- Choke Circuit

### *FLOAT CIRCUIT (FIG. 6B-91)*

The purpose of the float circuit is to maintain the correct fuel level in the carburetor bowl at all times. The Carter AFB carburetor has two separate float circuits. Each float operates in its own float bowl and

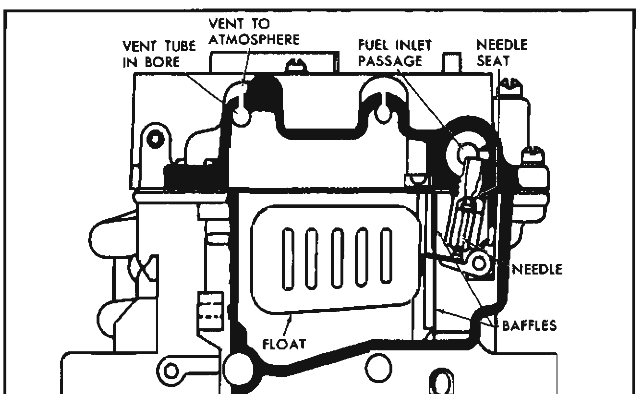



Fig. 6B-91 Float Circuit

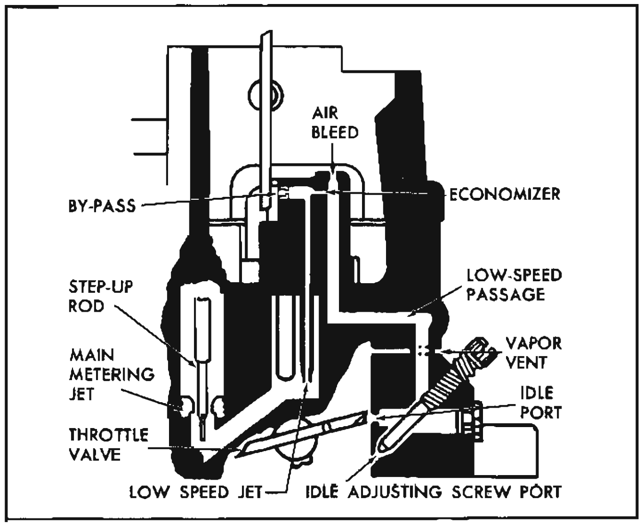



Fig. 6B-92 Low Speed Circuit

each bowl supplies fuel to a primary low speed circuit and to a primary and secondary high speed circuit. The two circuits operate identically.

When the fuel level in the bowl drops the float also drops allowing the needle to fall away from its seat.

Fuel at the fuel inlet under fuel pump pressure will then enter through the strainer screen past the needle and seat and into the float bowl. As the fuel level rises in the bowl the needle valve is seated cutting off the flow of fuel.

The intake needle seats are installed at an angle to give positive seating action of the intake needles. Intake needles and seats are carefully matched in manufacture and tested to ensure against fuel leakage. They should therefore always be used in pairs and not intermixed.

The bowl areas are vented to the inside of the air horn, to atmosphere and to each other to ensure equal pressure on the surface of the fuel at all times and to allow the escape of fuel vapors. Baffles are used in the bowl area to minimize fuel turbulence.

### *LOW SPEED CIRCUITS (FIG.6B-92)*

Fuel for idle and early part throttle operation is metered through the low speed circuits on the primary side of the carburetor. With the throttle valves closed, manifold vacuum exists at the idle needle port and idle discharge port. Atmospheric pressure will then force fuel throught the primary metering jet and up through the low speed jet. The fuel picks up air at the bypass and is metered and broken up in the

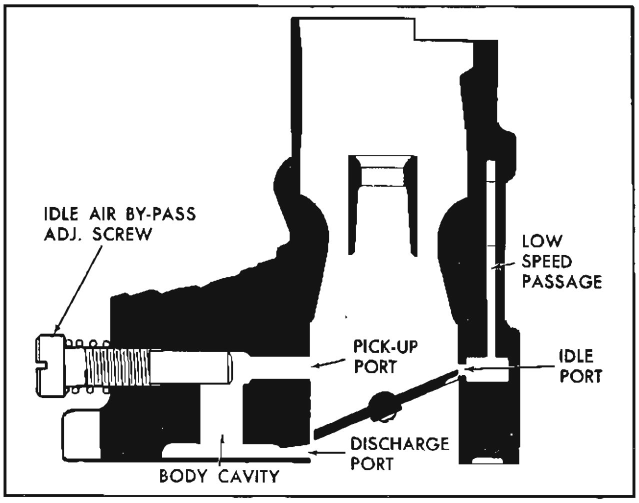



Fig. 6B-93 Idle Air By-Pass Circuit

economizer passage. The fuel mixture then passes by another air bleed, down the idle passage and is discharged at the idle discharge port and the idle needle port.

The idle ports are slot-shaped. As the throttle valves are opened, more of the idle ports are uncovered allowing a greater quantity of fuel mixture to enter the carburetor bores. The secondary throttle valves remain closed at idle.

To aid in hot starting, vapor vents are provided in the throttle bores.

During hot idle the throttle valves are completely closed with the by-passable type carburetor. Idle air is directed around the throttle valves through the passage shown in Fig. 6B-93. The amount of air going through the passage is controlled by the air adjusting screw, thereby also controlling idle speed.

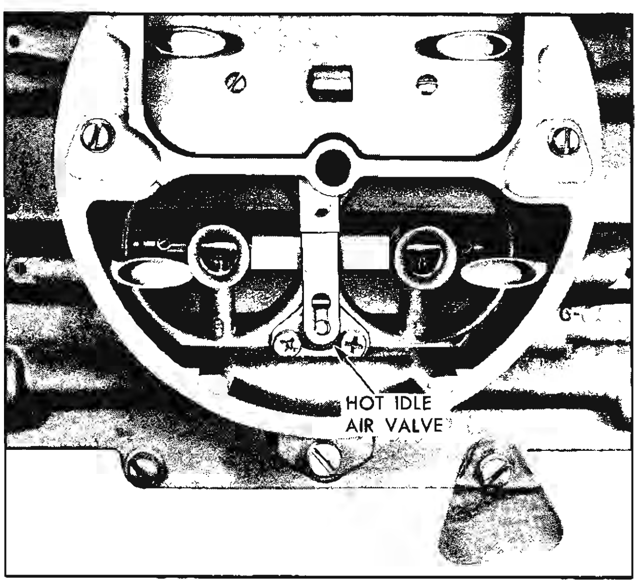



Fig. 6B-94 Hot Idle Air Valve

During long periods of idling with an extremely hot engine the fuel in the carburetor bowl becomes hot enough to form vapors. These vapors enter the carburetor bores by way of the inside bowl vents. The vapors mix with the idle air and are drawn into the engine causing an excessively rich mixture and a loss in rpm or enine stalling. Also, the decrease in the density of the air caused by extreme high under-hood temperatures reduces the idle speed.

The hot idle compensator (Fig. 6B-94) is calibrated to open under these temperature conditions, permitting additional air to enter the manifold below the secondary throttle valves (Fig. 6B-95) and mix with the fuel vapors providing a more combustible mixture. The engine rpm may still vary slightly, however, extreme rough idle operation and engine stalling are avoided.

The device is especially beneficial during traffic operation in very hot weather when the car is allowed to idle for a long period of time, particularly on air condition equipped automobiles. One of the other more common driving conditions that will bring the thermostatic valve into operation is when the car has been driven at highway speeds during a very hot day and then a line of traffic causes a delay where

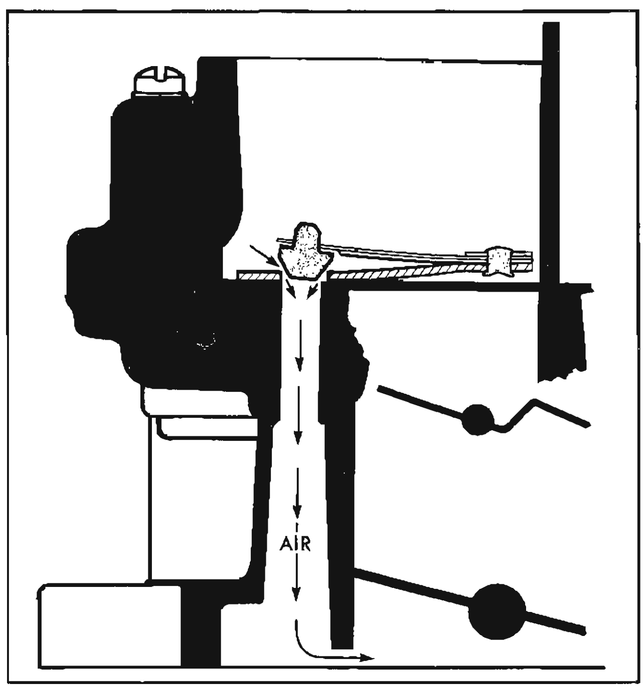



Fig. 6B-95 Hot Idle Air Valve Air Passage (Compensator) the engine must be run at idle speed, moving the car only a few feet at a time.

The valve is calibrated to open when the air temperature in the bore of the carburetor is between 125 and 135 degrees Fahrenheit with 15" vacuum applied to the valve seat. The operation of this valve cannot be checked accurately in field service, because of the difficulty of obtaining and measuring an accurate air temperature in the bore of the carburetor and the specified 15" of vacuum at the seat of the valve. In service, if any doubt exists concerning the operation of the valve, it should be replaced.

A small hole through each primary throttle valve supplies idle air to supplement the air supplied through the by-pass idle air circuit. These supplementary air supply holes provide better adjustability and increase the idle air volume to provide sufficient idle speed on new engines.

### *HIGH SPEED CIRCUIT—PRIMARY SIDE (FIG. 6B-96)*

Fuel for late part throttle and full throttle operation is supplied through the high speed circuit.

As the throttle valves are opened air flow through the carburetor increases to the point that fuel is picked up at the discharge nozzles located in the main venturi. The pressure differential caused by the rapid flow of air through the venturi forces fuel through the primary metering jet up through the main vent tube. After picking up air at the air bleed the mixture is forced out through the main discharge nozzle. The air bleed in the high speed circuit also serves as an anti-percolator passage.

The amount of fuel delivered through the primary high speed circuit is dependent upon aid flow or throttle valve opening and by the position of the step-up rods in the primary main metering jets. The step-up rods are controlled entirely by manifold vacuum. When manifold vacuum is high the step-up rod piston and step-up rod are held downward, restricting the flow of fuel through the primary main metering jet. Under any operating condition that reduces manifold vacuum such as acceleration or hill-climbing the step-up rod piston spring raises the step-up rod positioning the smaller diameter or power step in the jet. This allows additional fuel to be metered through the jet. The step-up rods are not adjustable.

### *HIGH SPEED CIRCUIT— SECONDARY SIDE (FIG. 6B-97)*

The throttle valves in the secondary side remain closed until the primary throttle valves open a pre-

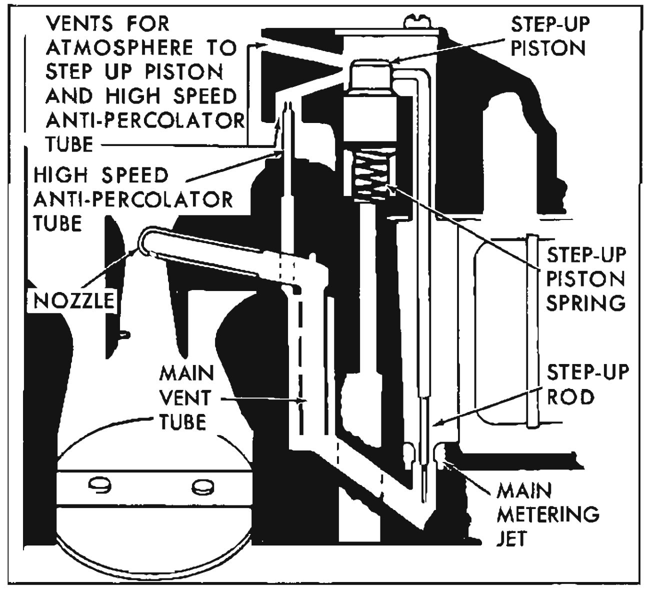



Fig. 6B-96 High Speed Circuit—Primary Side

determined amount (approximately 55° of throttle opening). They arrive at the wide open position at the same time as the primary throttle valves.

Mounted above the secondary throttle valves are the auxiliary throttle valves. These valves are opened by air flow and closed by counterweights. When the secondary throttle valves open, only the primary high speed circuit will function until there is sufficient air velocity to open the auxiliary throttle valves. When the auxiliary valves open, fuel will be supplied through the secondary high speed circuit.

Fuel for the secondary side is metered through the secondary main metering jets. No step-up rods are used.

To supplement the starting of the secondary high

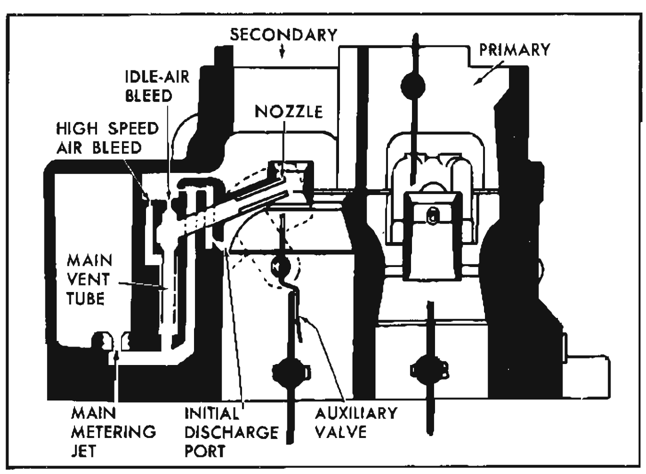



Fig. 6B-97 High Speed Circuit—Secondary Side

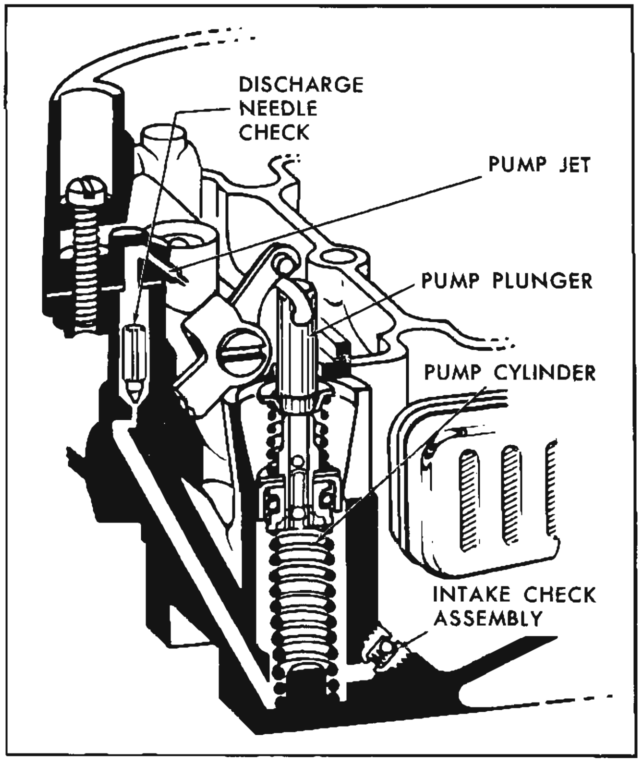



Fig. 6B-98 Pump Circuit

speed circuit an initial discharge system is used. Initial discharge ports are located next to the venturi struts. When the auxiliary valves start to open, a low pressure area results at these ports and atmospheric pressure forces fuel into the initial discharge passage. Air is picked up at the air bleed and the mixture enters the air stream at the initial discharge ports. As the auxiliary valves continue to open and the secondary nozzles begin to function, pressure increases at the discharge ports and their operation diminishes. An acceleration tube is used to smooth the transition from two to four barrel operation on acceleration.

### PUMP CIRCUIT (Fig. 6B-98)

The accelerating pump circuit located in the primary side provides for a measured amount of fuel to be discharged into the carburetor throat during acceleration from low car speeds. A rapid opening of the throttle valves, as is the case when accelerating from low speeds, causes an immediate increase in air velocity. Since fuel is heavier than air it requires a short period of time for it to "catch up" with the air flow. To avoid a leanness during this momentary lag, the accelerator pump furnishes a quantity of liquid fuel, sprayed into the air stream to mix incoming air and maintain the proper fuel-air mixture. The pump is operated by the combined action of two springs which are calibrated to move the plunger in such a manner that a sustained charge of fuel is delivered for smooth acceleration.

The pump is attached by linkage to the accelerator so that when the throttle valves are closed the pump plunger moves upward in its cylinder creating a low pressure area (partial vacuum) in the cylinder below the plunger. Atmospheric pressure acting on the fuel in the bowl forces fuel into this cylinder through the intake ball check. The discharge needle is seated at this time to prevent air being drawn into the cylinder.

When the throttle is opened, the friction of the plunger in the cylinder and the tension of the lower plunger spring resists the downward movement of the pump plunger causing the plunger shaft to telescope. This compresses the upper spring. The upper spring then overcomes the resistance and pushes the plunger down. However, the speed of the plunger is retarded by the lower spring so that a sustained charge of fuel is released into the system. The movement of the plunger exerts a pressure in the cylinder which seats the intake ball check preventing fuel from being forced back into the bowl. The same pressure also forces fuel up the discharge passage, unseating the pump discharge needle, and on through the pump jets in the cluster where it is sprayed into the carburetor throat.

At higher speeds, pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a predetermined amount, the pump plunger bottoms in the cylinder eliminating pump discharge.

During high speed operation, a vacuum exists at

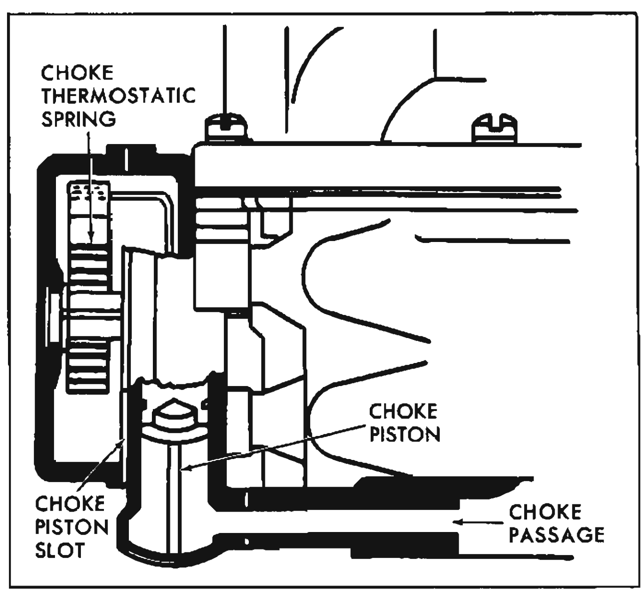



Fig. 6B-99 Choke Circuit

the pump discharge ports. To prevent atmospheric pressure from forcing fuel to these ports and into the system, the pump jets are vented. This allows air instead of fuel to be forced through the discharge ports.

An anti-percolator" check valve, contained inside the plunger, provides relief for any vapors which might form during hot idle or when a hot engine is not operating. The ball check is designed so that it can move up and down in its passage. Throughout the above periods it is unseated by gravity and vapors in the pump well rise and by-pass the ball check through small holes in the plunger head.

The "anti-perc" ball check also acts as an extra inlet during the upstroke of the plunger, but is seated by fuel when the plunger moves down.

### CHOKE CIRCUIT (FIG. 6B-99)

The purpose of the choke system is to provide a very rich mixture for cold engine operation.

The choke system subjects all fuel outlets in the bore of the carburetor to manifold vacuum while restricting the intake of air.

The choke system includes a thermostatic coil, housing, choke piston, choke valve, source of fresh air supply to the choke stove, and fast idle cam and linkage. It is controlled by a combination of intake manifold vacuum, air velocity against the offset choke valve, atmospheric temperature and hot air from the intake manifold.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. Starting the engine causes air velocity to strike the offset choke valve. This tends to open it along with the action of intake manifold vacuum on the choke piston. Thus, after a slight opening of the choke valve, the tension of the thermostatic coil spring balances the force of air on the valve and the pull of vacuum at the piston.

At the cold idle position, slots located in the sides of the choke piston cylinder are uncovered, exposing them to intake manifold vacuum. Air, heated in a tube running through the exhaust cross-over passage in the intake mainifold, then fills this low pressure area in the choke housing. The flow of warm air heats the thermostatic coil and causes it to lose its tension until full choke valve opening is accomplished. The clean air is supplied to the choke in the manifold from the air horn, just below the air cleaner. Here filtered air from the air cleaner is picked up and carried to the choke by a metal pipe.

A secondary baffle plate is located in the choke housing to distribute the warm air evenly over the thermostatic coil thereby insuring gradual relaxation of the coil. The baffle revolves with the choke valve and prevents the warm air from striking the thermostatic coil until the choke valve opens a predetermined amount. This delays choke opening.

If the engine is accelerated during the warm-up period, the corresponding drop in manifold vacuum allows the thermostatic coil to momentarily close the choke, providing a richer mixture.

To combat engine stalling during warm-up on cool, humid days, caused by "carburetor icing", heated air from the choke housing is circulated through a passage in the base of the carburetor flange.

During the warm-up period, it is necessary to provide a fast idle to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke shaft. The fast idle adjusting screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returing to a normal warm engine idle position until the choke is open.

If during the starting period, the engine becomes flooded the choke valve can be partially opened manually to allow increased air flow through the carburetor. This is accomplished by depressing the accelerator pedal forcibly to the floor and engaging the starter. The unloader projection on the throttle lever contacts the unloader lug on the fast idle cam and in turn partially opens the choke valve.

## ADJUSTMENTS ON CAR

All Carter adjustments can be performed on the car. All adjustments are included in the "Overhaul and Adjustments" procedure, with the exception of the idle speed and mixture adjustment, fast idle adjustment, and the unloader adjustment. Following are the idle speed, mixture, and the unloader adjustments.

### IDLE SPEED AND MIXTURE ADJUSTMENT

1. As a preliminary setting turn air screw out 1½ turns from lightly seated position and mixture screws out 1 turn.

2. Set hand brake securely, place transmission in neutral and connect tachometer to engine.

3. Start engine and warm up thoroughly. Make sure choke is fully open and carburetor is completely off fast idle.

***CAUTION: When adjusting idle make sure hot idle compensator is held manually closed during adjustment.***

4. Adjust the air screw to obtain correct idle rpm. (Use drive range on Hydra-Matic equipped cars.)

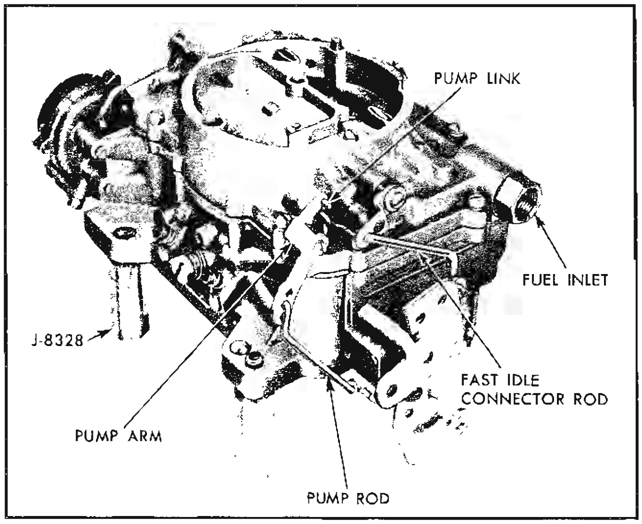



Fig. 6B-100 Carter AFB Carburetor

5. Turn mixture screws to best quality (highest rpm) idle.

6. Reset air screw to correct rpm if mixture adjustment changed setting.

7. Recheck mixture adjustment to insure smoothest possible idle.

NOTE: Always recheck idle mixture setting *after* making idle rpm adjustment with air screw.

## IDLE SPECIFICATIONS

Synchro-Mesh, exc. air conditioner . . 640-660 rpm
Automatic, exc. air conditioning . . . . . 540-560 rpm in drive range
Air conditioning Equipped
Automatic—Drive-range, A/C off
S/M—Neutral, A/C off

### FAST IDLE ADJUSTMENT

The fast idle setting must be made *after* the idle speed and mixture adjustment has been made. With the engine completely warmed up and the fast idle screw on highest step of fast idle cam, set fast idle screw to give an engine speed of 2200 rpm.

### UNLOADER ADJUSTMENT

1. Remove carburetor air cleaner assembly.

2. Depress accelerator pedal forcibly to floor. (This should be done by person sitting in driver's seat of car to simulate driving conditions.)

3. With accelerator pedal depressed as in step 2, bend tang on throttle lever to give a clearance of

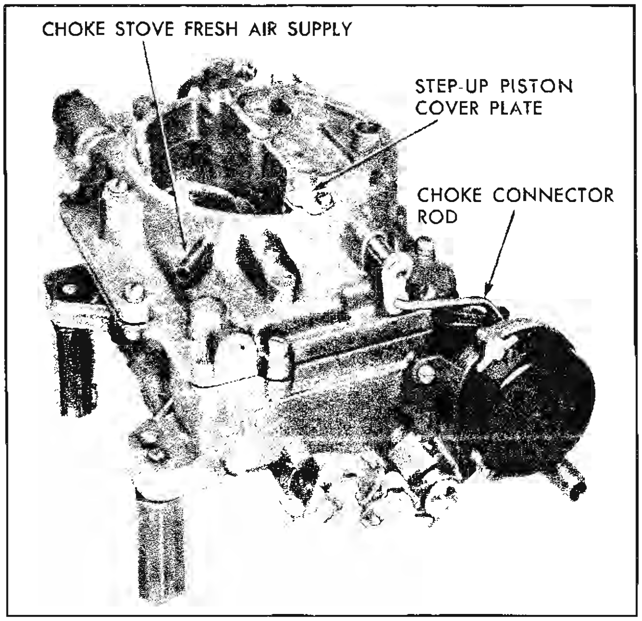



Fig. 6B-101 Carter AFB Carburetor

$5/32'' \pm 1/64''$ between the top of the choke valve and the inside of the air horn.

4. Replace air cleaner assembly.

The above procedure will eliminate variance in linkage, floor mat, pedal location, etc. and should ensure correct unloader action.

## OVERHAUL AND ADJUSTMENT

### DISASSEMBLY

## DISASSEMBLE AIR HORN

1. Place carburetor on stand J-5923 or J-8328 and remove gasoline inlet strainer nut, gasket and inlet screen (Fig. 6B-100).

2. Remove throttle connector rod and anti-rattle spring (Fig. 6B-100).

3. Remove fast idle connector rod at upper end.

4. Remove choke connector rod (Fig. 6B-101).

5. Remove two step-up piston cover plate attaching screws and cover plates (Fig. 6B-101).

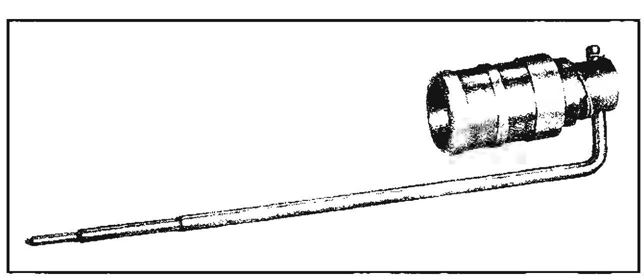


Fig. 6B-102 Step Up Rod and Piston Assembly

6. Remove two step-up rods and step-up pistons. If desired, step-up rod may be separated from piston by unhooking step-up rod retaining spring from end of rod (Fig. 6B-102). Remove two step-up rod piston springs.

7. Remove choke shaft lever retainer screw, choke shaft lever and washer from end of choke shaft.

8. Remove two choke valve attaching screws and choke valve.

9. Remove ten air horn attaching screws and lift off air horn assembly.

10. Slide choke shaft from air horn.

11. Remove pump arm and link and pump plunger assembly.

12. Remove float hinge pin, float and float needle assembly on inlet side of carburetor (Fig. 6B-103).

13. Remove float needle seat and gasket using wide blade screwdriver.

NOTE: Keep individual float parts grouped so the same needle and seat are used together.

14. Remove remaining float hinge pin, float, float needle, float needle seat and gasket.

15. Remove air horn gasket.

DISASSEMBLE BODY

1. Remove three choke coil housing attaching screws and choke coil housing and thermostatic coil.

2. Remove coil housing gasket and baffle plate.

3. Remove choke lever attaching screw. (Fig. 6B-104). Remove choke piston, lever and link assembly by rotating piston from bore.

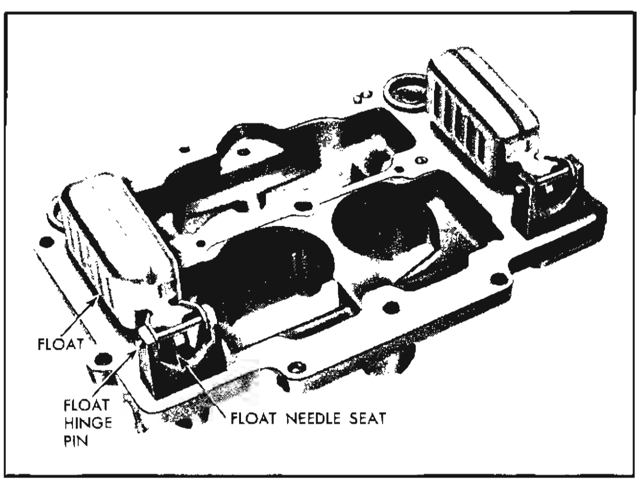



Fig. 6B-103 Air Horn Assembly

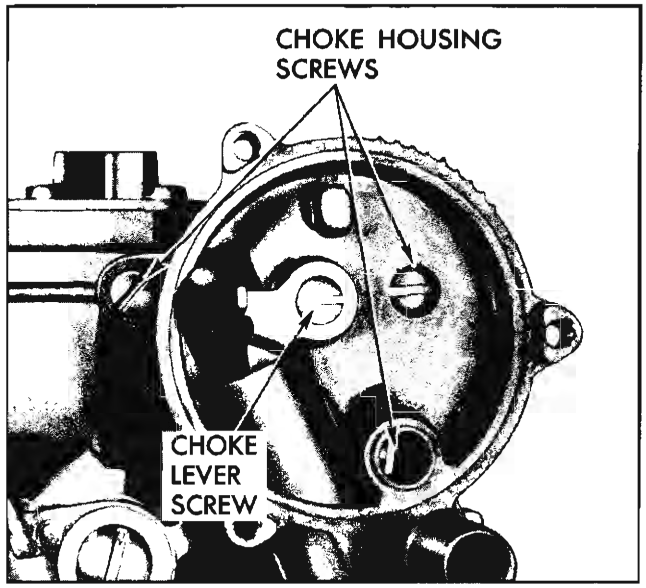



Fig. 6B-104 Location of Choke Housing Screws

4. Remove three choke housing to body attaching screws (Fig. 6B-104) and remove choke housing and gasket.

5. Remove lower choke lever and shaft from choke housing.

6. Remove pump jet cluster and gasket. (Fig. 6B-105).

7. Remove two screws and primary venturi and gasket on pump side (Fig. 6B-105).

8. Remove two screws and primary venturi and gasket on choke side.

NOTE: The venturi assemblies are not interchangeable.

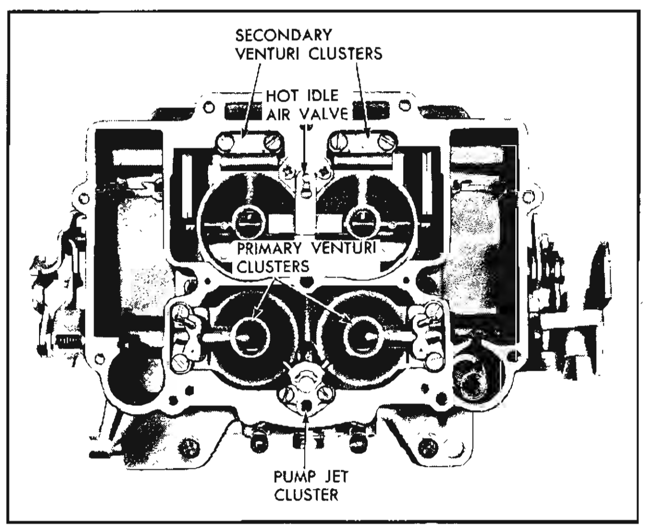



Fig. 6B-105 Top View of Carburetor Body Assembly

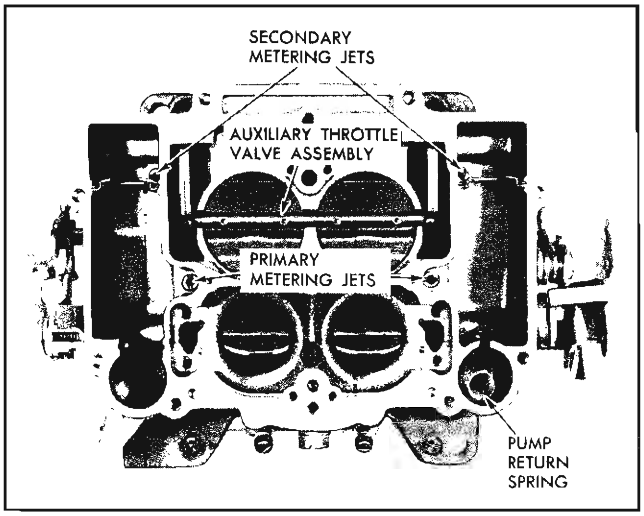



Fig. 6B-106 Body Assembly with Cluster Removed

9. Remove hot idle air valve and gasket.

10. Remove secondary venturi on pump and choke sides (Fig. 6B-105).

11. Lift out auxiliary throttle valve, shaft and weight assembly (Fig. 6B-106).

12. Remove two primary metering jets.

13. Remove two secondary metering jets.

14. Remove pump return spring.

15. Remove pump intake check.

16. Remove idle mixture screws.

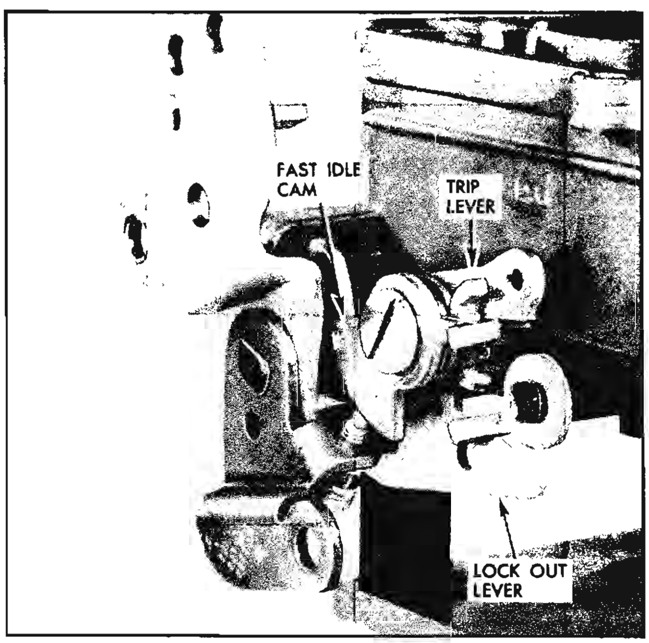



Fig. 6B-107 Location of Fast Idle Cam and Lockout Lever

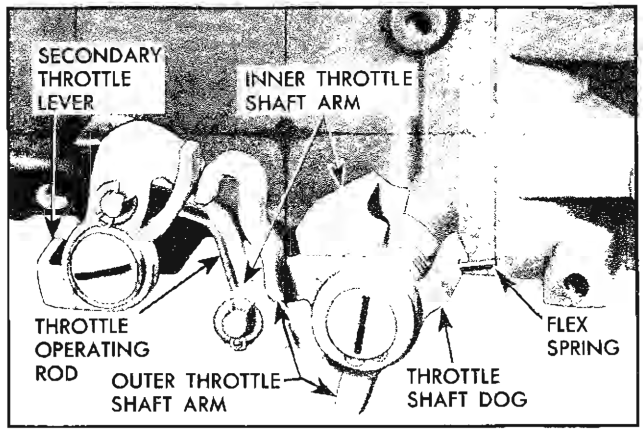



Fig. 6B-108 Primary and Secondary Throttle Linkage

17. Remove air screw.

18. Carefully invert carburetor body and remove pump discharge check needle.

19. Remove throttle lever adjusting screw and spring.

20. Remove fast idle cam attaching screw, fast idle cam, trip lever and lockout lever (Fig. 6B-107).

21. Remove primary to secondary throttle operating rod (Fig 6B-108).

22. Remove screw, secondary throttle shaft washer and secondary throttle operating lever and spring.

23. Unhook throttle flex spring from primary outer throttle shaft arm.

24. Remove primary throttle shaft lever attaching screw and washer from primary throttle shaft.

25. Remove outer throttle shaft arm and throttle shaft dog (Fig. 6B-108).

26. Remove inner throttle shaft arm and flex spring.

27. If necessary to remove throttle shafts remove throttle valve attaching screws, throttle valves and slide shaft from carburetor body.

28. Remove fast idle adjusting screw if necessary to replace.

### CLEANING AND INSPECTION

Dirt, gum, water or carbon contamination in the carburetor 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 all

metal parts in clean carburetor cleaning solution.

***CAUTION: Composition and plastic parts such as pump plunger and gaskets should not be immersed in cleaner.***

2. Blow out all passages (Figs. 6B-109, 110, 111, 112, and 87) in casting with compressed air and blow off all parts to ensure they are free of cleaner.

NOTE: Follow instruction furnished with cleaning solution container.

***CAUTION: Do not use drills or wire to clean out jets or ports as this may enlarge the opening and affect carburetor operation.***

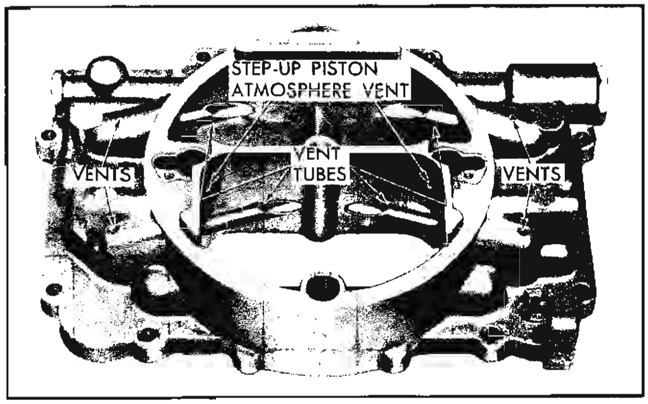



Fig. 6B-109 Passage Identification—Air Horn

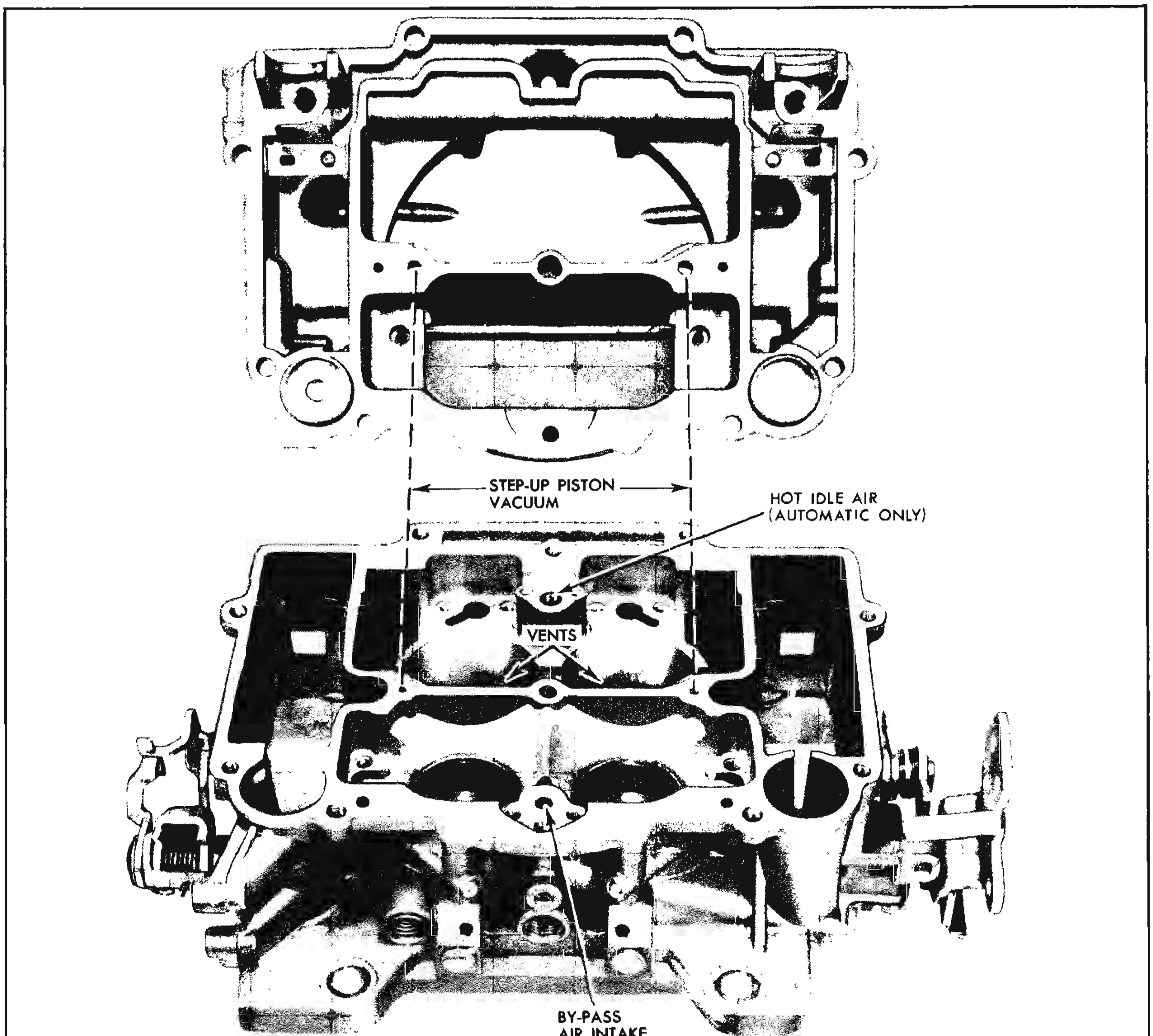



Fig. 6B-110 Passage Identification—Air Horn to Body

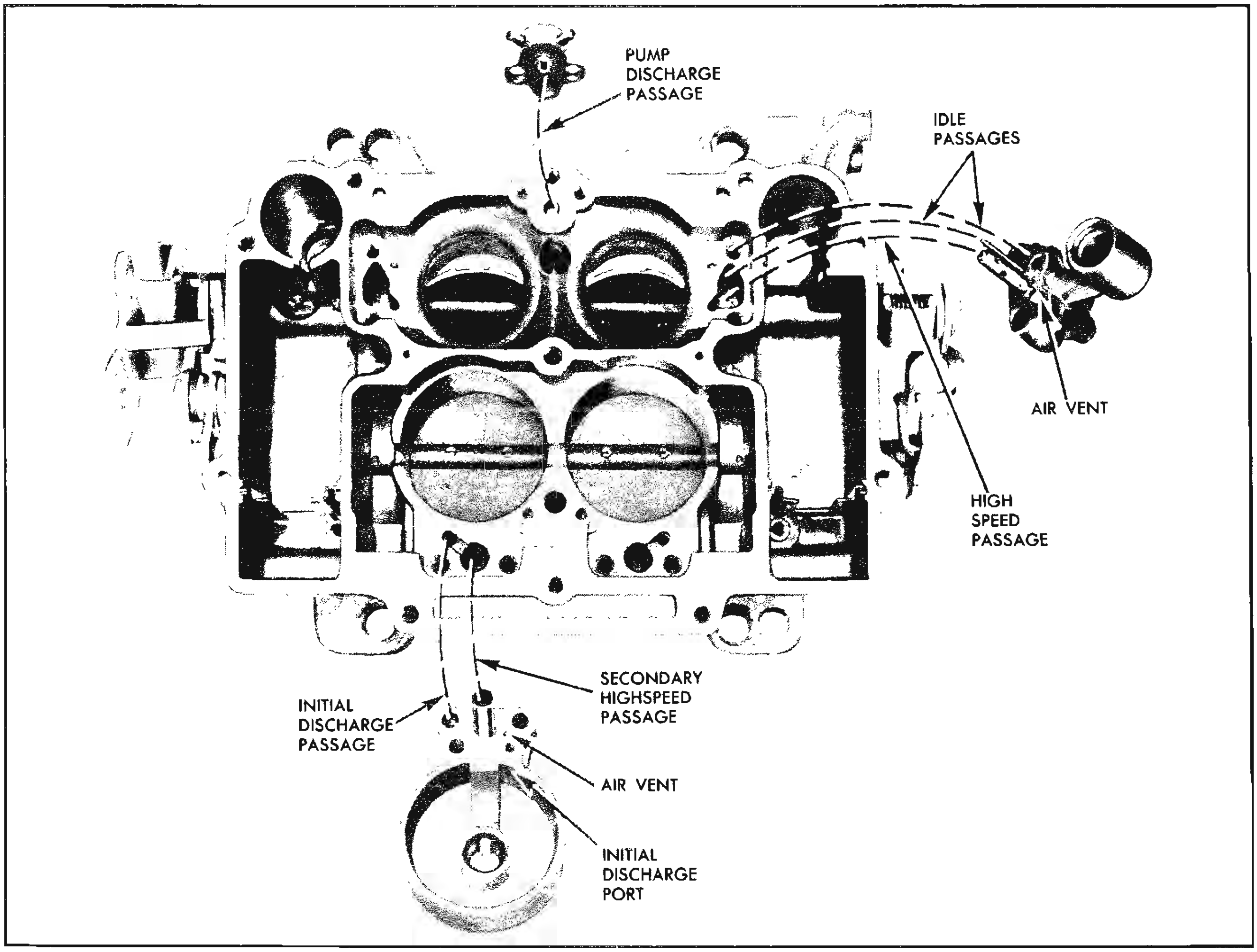



Fig. 6B-111 Passage Identification—Clusters to Body

3. Carefully inspect parts for wear and replace those which are worn, checking the following specific points:

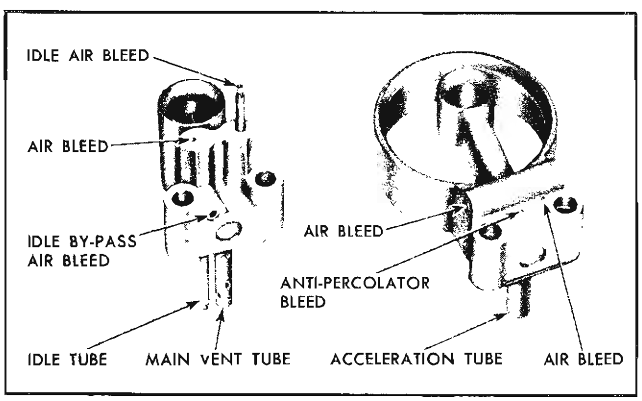



Fig. 6B-112 Passage Identification—Primary and Secondary Venturi Clusters

A. Inspect choke piston and choke piston housing for carbon and gum. If necessary to clean choke piston housing, remove Welch plug in the bottom of

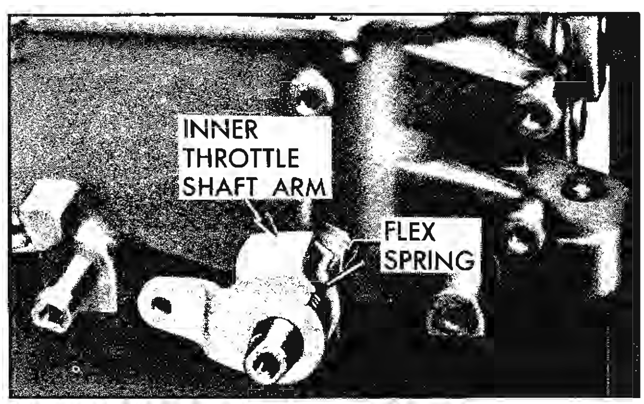



Fig. 6B-113 Inner Throttle Shaft Arm and Flex Spring Installed

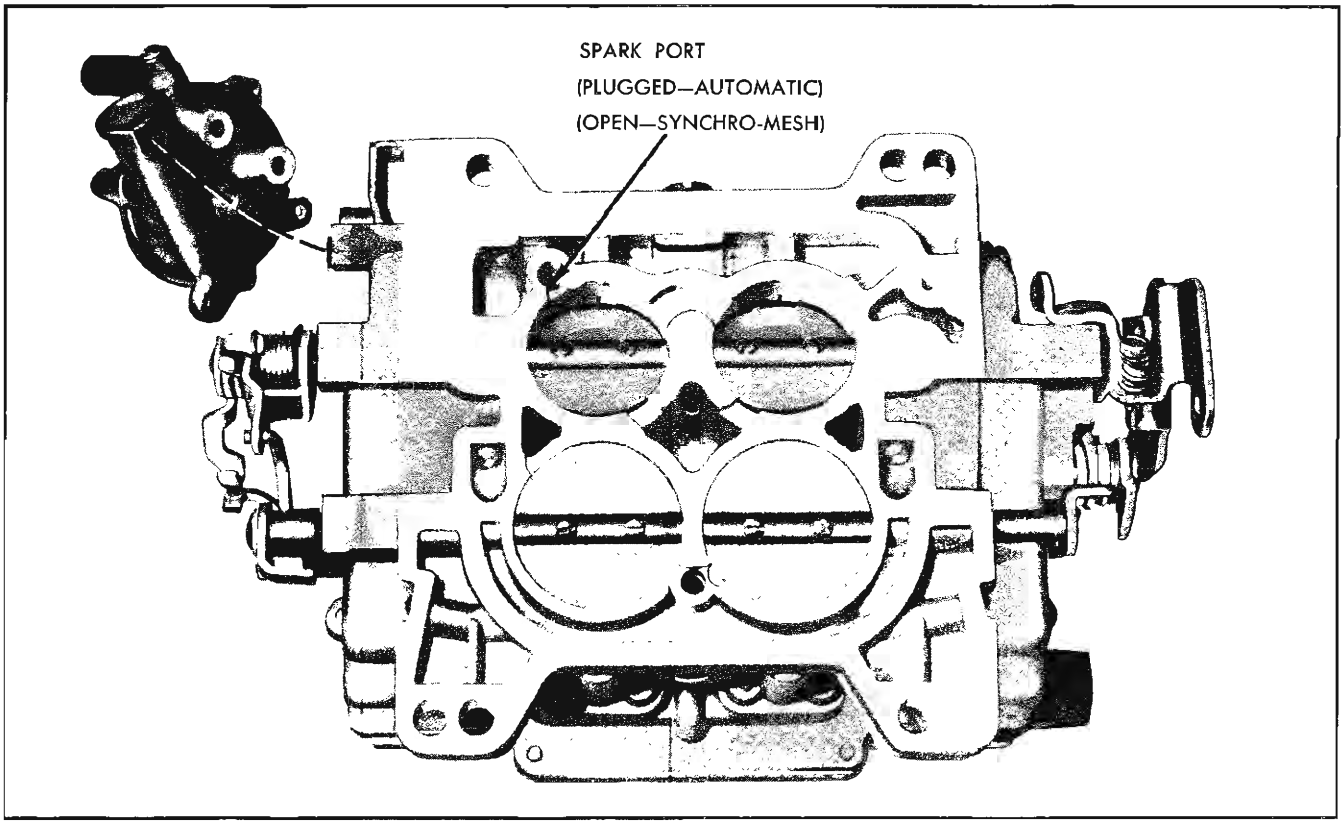



Fig. 6B-114 Passage Identification—Flange Area of Body

housing. Plug can be removed by piercing center with a small pointed instrument and prying outward. Care should be exercised so that damage will not result to the casting when removing this plug. Before installing new plug, carbon present in piston cylinder slots should be removed and the Welch plug seat should be carefully cleaned.

B. Remove carbon from bores of throttle flange.

C. Inspect float needles, and seats for wear; if leaking, both needle and seat must be replaced.

D. Inspect float pins for excessive wear.

E. Inspect floats for dents and excessive wear on lip. Check for fluid inside floats by shaking. Replace float if any of above are present.

F. Inspect throttle shafts for excessive wear (looseness or rattle in body flange casting).

G. Inspect idle mixture adjusting screws for burrs. Replace if burred or scored.

H. Inspect pump plunger assembly. If leather is not in good condition, replace plunger.

I. Inspect gasketed surfaces between body and air horn, and between body and flange. Small nicks or burrs should be smoothed down to eliminate air or fuel leakage. Be especially particular when inspecting choke vacuum passage and the top surface of the inner wall of the bowl.

J. Inspect holes in pump rocker arm, fast idle cam and throttle shaft lever. If holes are worn excessively or out of round to the extent of causing improper carburetor operation, the part should be replaced.

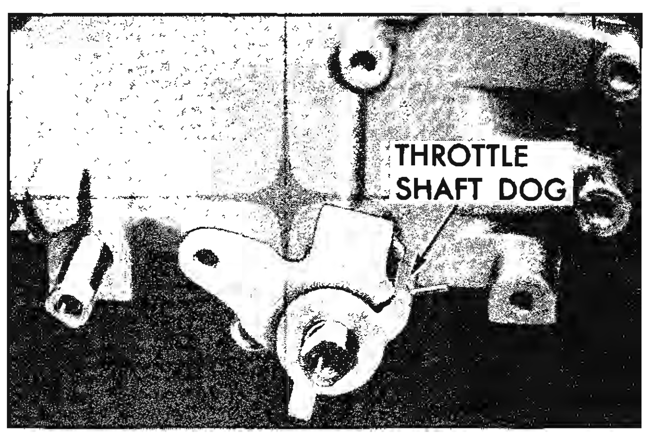



Fig. 6B-115 Throttle Shaft Dog Installed

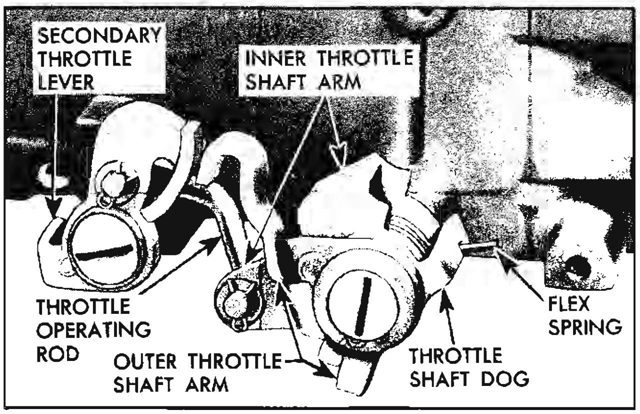



Fig. 6B-116 Primary and Secondary Throttle Linkage Installed

K. If excessive wear is noted on fast idle cam, it should be replaced to ensure proper engine operation during warm up.

L. Check all filter screens for lint or dirt. Clean or replace as necessary.

M. Check venturi clusters for loose or damaged parts. If damage or looseness exists, replace cluster assembly.

### *ASSEMBLY AND ADJUSTMENTS*

### ASSEMBLE THROTTLE BODY

1. If throttle shafts were removed during disassembly insert shafts through body with lever ends on pump side of body.

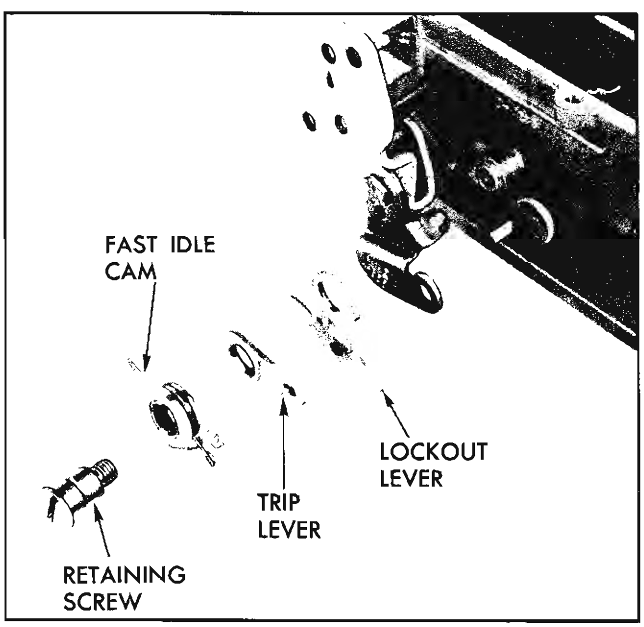



Fig. 6B-117 Lockout Lever and Fast Idle Cam

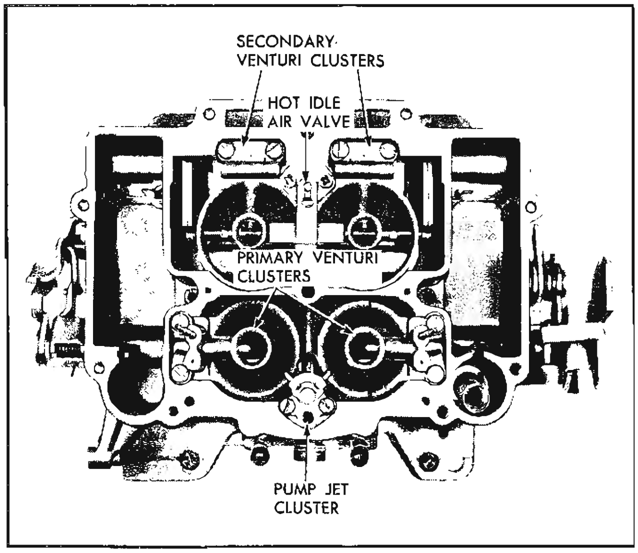



Fig. 6B-118 Venturi Clusters Installed

2. Using new screws install primary and secondary throttle valves so that trade mark (c in circle) is visible from the bottom of body with throttle valves closed.

3. Install fast idle adjusting screw.

4. Place carburetor body on stand.

5. Install pump intake check.

6. Install inner throttle shaft arm and flex spring on primary throttle shaft (Fig. 6B-113).

7. Install throttle shaft dog on primary throttle shaft (Fig. 6B-115).

8. Install outer throttle shaft arm, washer and retaining screw on primary throttle shaft (Fig. 6B-116).

9. Hook end of flex spring into notch on outer throttle shaft arm.

10. Install secondary throttle operating spring, lever, washer and screw (Fig. 6B-116). Wind spring two turns tight.

11. Install throttle operating rod, washers and spring clips.

12. Install lockout dog, trip lever, fast idle cam and screw (Fig. 6B-117).

13. Install throttle lever screw and spring.

14. Install idle mixture screws. Turn in finger tight and back out one turn for approximate adjustment.

15. Install air screw. Turn in finger tight and back out $1\frac{1}{2}$ turns for approximate adjustment.

16. Install primary metering jets and secondary metering jets in their respective bores.

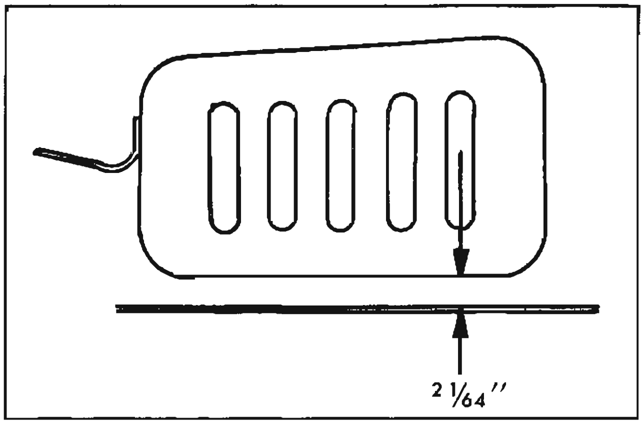



Fig. 6B-119 Float Level Check

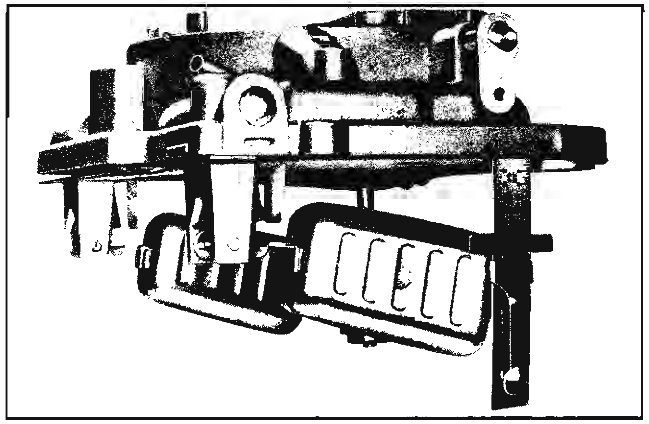


Fig. 6B-120 Checking Float Drop

17. Set auxiliary throttle valves in place.

18. Install secondary venturi and gaskets on choke and pump sides.

19. Install hot idle air valve and gasket.

20. Install primary venturi and gaskets on choke and pump side of carburetor (Fig. 6B-118).

21. Install pump discharge check needle, point down and pump jet cluster and gasket with two screws.

22. Install pump plunger return spring in pump bore.

23. Install lower choke shaft and lever in choke housing and attach choke housing and gasket to carburetor body and three self-tapping screws.

24. Install choke piston and link assembly in choke housing.

25. Attach choke piston linkage to lower choke shaft with screw and spacer washer.

NOTE: Before proceeding with next step perform choke piston lever adjustment.

26. Install choke baffle plate, cover gasket, and choke cover and spring assembly. Set choke at one notch rich.

## ASSEMBLE AIR HORN

1. Slide choke shaft into air horn.

2. Install air horn gasket.

3. Install float needle seat and gasket, float needle and float assembly on pump side of air horn.

4. Install float needle seat and gasket, float needle, and float assembly on choke side of air horn.

5. Adjust float:

A. Alignment—

a. Sight down the side of the float shell to determine if the side of the float is parallel to the outer edge of the air horn casting. Adjust by bending float lever by applying pressure to the end of the float shell with the fingers while supporting the float lever with the thumb.

***CAUTION: To avoid damaging the float, apply only enough pressure to bend float lever.***

b. After aligning float remove as much clearance as possible between arms of float lever and lugs on air horn by bending the float lever. Arms of float lever should be parallel to the inner surfaces of lugs on air horn as possible. Floats must operate freely without excess clearance on hinge pin.

B. Level (Fig. 6B-119)

With air horn inverted, gasket in place and needle seated, there should be $2\frac{1}{64}'' \pm \frac{1}{32}''$ clearance be-

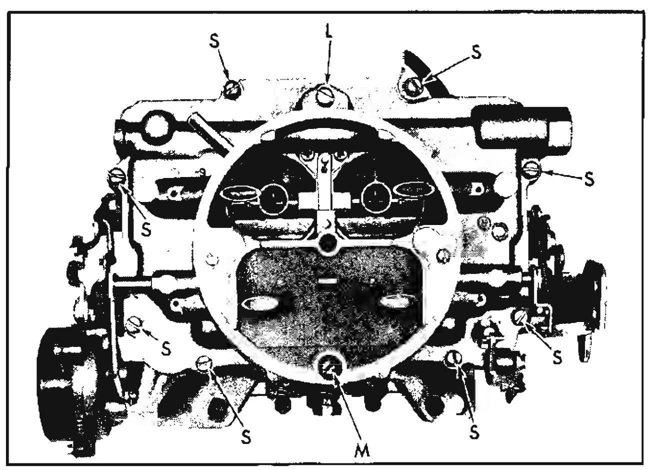



Fig. 6B-121 Location of Air Horn Attaching Screws
L=long, M=medium, S=short

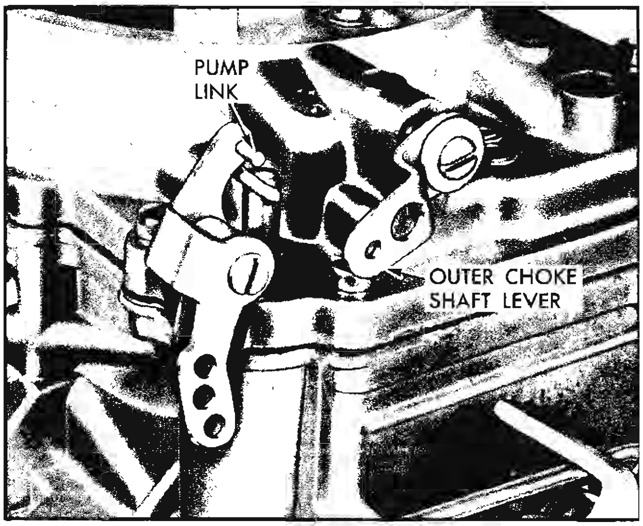



Fig. 6B-122 Pump Link Installed

tween float at point below first indention on side of float from toe end and air horn gasket. Fig. 6B-119 illustrates point where $^{21}/_{64}$″ dimension should be checked. Bend float arm to adjust. Adjust both floats and recheck float alignment.

C. Drop (Fig. 6B-120)

With bowl cover held in upright position and measuring from outer end of each float, the distance between top of floats and bowl cover gasket should be a minimum of $^{23}/_{32}$″ ± $^{1}/_{32}$″. To adjust, bend stop tabs on float brackets.

NOTE: Maximum float drop can be any amount which will retain needle for installation. Needle must not wedge at maximum drop.

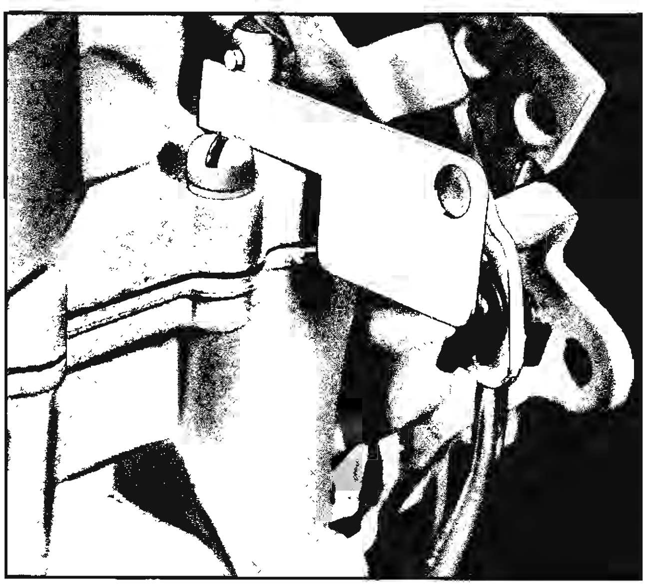


Fig. 6B-123 Checking Pump Adjustment

6. Insert pump plunger shaft through air horn and retain with pump link.

7. Install air horn attaching screws (Fig. 6B-121).

8. Install two step-up rod piston springs in their respective bores.

9. Install step-up rod and piston on pump side of carburetor.

10. Install step-up rod and piston on choke side of carburetor.

11. Install two step-up piston cover plates and screws.

12. Install pump arm lever to air horn casting and connect pump link. Link must be installed as shown in Fig. 6B-122.

13. Insert lower end of pump connector rod in hole in throttle lever. Install upper end of rod in center hole in pump arm lever, retaining with clip.

14. Install choke valve with circle c in trademark visible with the choke valve closed.

15. Install choke connector rod between upper and lower choke lever.

16. Install choke shaft lever, washer, and screw on end of choke shaft (Fig 6B- 122).

17. Install fast idle connector rod between fast idle cam and inner choke shaft lever.

18. Install throttle connector rod, and washers.

19. Install inlet screen plug and gasket.

### *ADJUSTMENTS*

#### ADJUST PUMP

1. Be sure choke is wide open so fast idle cam does not hold throttle valves open.

2. The distance from the top of the bowl cover to bottom of "S" pump link should be $^{5}/_{16}$″ ± $^{1}/_{32}$″ (Fig. 6B-123). Adjust pump linkage so that all play is removed at closed throttle position and full throttle lever travel is still obtainable.

NOTE: The three-speed Hydra-Matic carburetor is drilled for distributor vacuum spark advance but plugged with a pipe plug. In no case should the throttle return check diaphragm be connected to this passage. However, in the four-speed Hydra-Matic carburetor, this hole is drilled for the throttle return check and the throttle return check hose is connected at this point.

3. To adjust, bend throttle connector rod at lower angle.

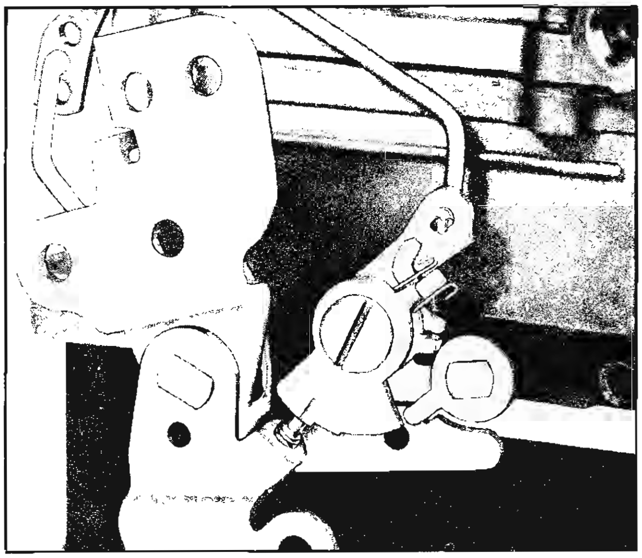


Fig. 6B-124 Checking Choke Shaft Lever

## ADJUST CHOKE PISTON LEVER

1. Remove three choke coil housing screws and choke coil housing and thermostatic coil.

2. Remove coil housing gasket and baffle plate.

3. Completely close choke valve.

4. Choke piston should be flush to $\frac{1}{64}''$ below outer lip of cylinder.

5. To adjust, bend choke connector rod.

## ADJUST CHOKE SHAFT LEVER

With choke valve fully closed and choke level and arm in contact, bend choke connector rod to align cam index mark on fast idle cam with fast idle screw (Fig. 6B-124).

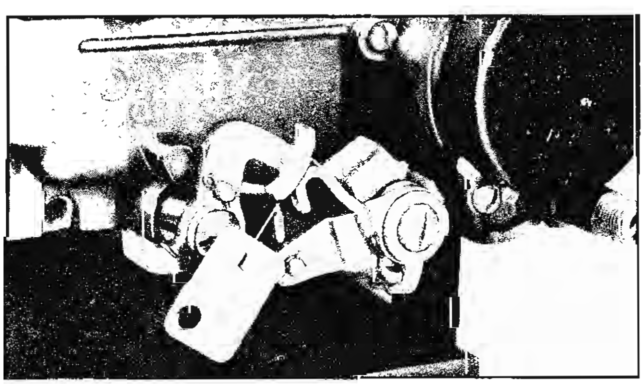


Fig. 6B-125 Checking Secondary Throttle Lever Adjustment

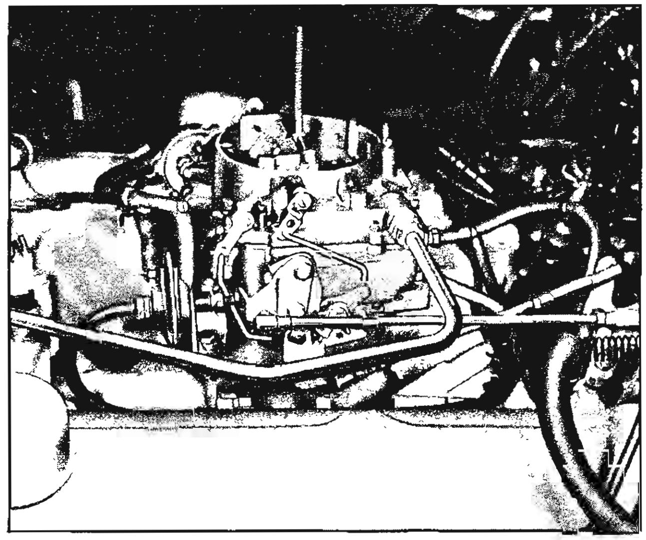


Fig. 6B-126 Throttle Return Check Hook-up with Automatic Transmission

## ADJUST SECONDARY THROTTLE LEVER

1. Open fully both sets of throttle valves. (In this position the stop lugs on primary and secondary throttle levers should contact the boss on the flange.)

2. To adjust, bend secondary throttle operation rod at angle.

NOTE: Primary throttle valves will be a few degrees past vertical and secondary throttle valve will be a few degrees from vertical at wide open throttle.

3. Now close primary and secondary throttle valves.

4. There should be .020" clearance between positive closing shoes on primary and secondary throttle levers (Fig. 6B-125) at their closest position.

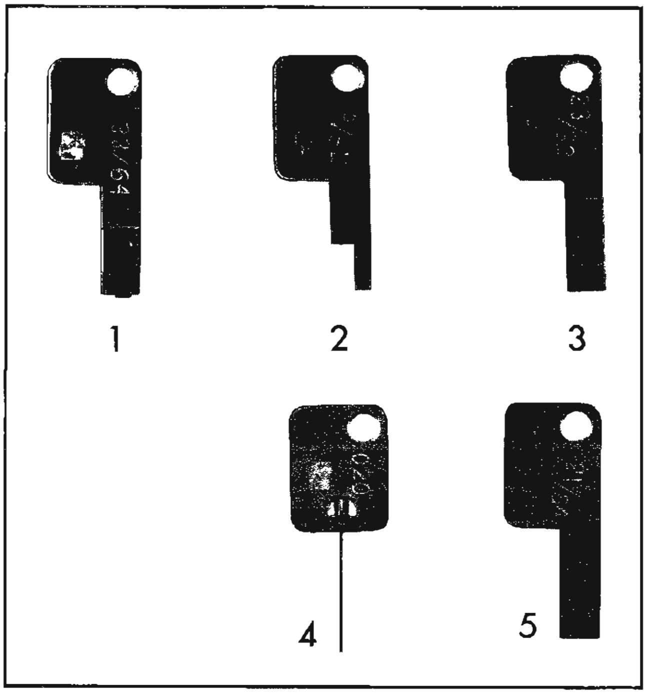
5. To adjust, bend shoe on primary lever.

## ADJUST SECONDARY THROTTLE LOCKNUT

1. Crack throttle valves and manually open and close the choke valve.

2. Tang on secondary throttle lever should freely engage in notch of lockout dog.

3. If necessary to adjust, bend tang on secondary throttle lever.




1. $\frac{5}{16}$" Gauge ........ Pump Rod
2. .125" Gauge ....... Unloader
3. $\frac{23}{32}$" Gauge ....... Float Drop
4. .020" Gauge ....... Secondary Throttle Lever
5. $\frac{21}{64}$" Gauge ....... Float Level

Fig. 6B-127 Carter AFB Special Tools J-7691-01

| CARBURETOR MODEL | USAGE | FEATURES |
|---|---|---|
| 3502S | Automatic | Distributor vacuum and throttle return check vacuum taken from back of carburetor.<br><br>Spark port at left of idle mixture screws plugged. |
| 3477S | Synchro-Mesh | Timed spark advance with spark port and no throttle return check. |

# CARBURETOR—GENERAL

## TROUBLE DIAGNOSIS AND TESTING

When carburetor troubles are encountered they can usually be corrected by making the adjustments outlined under ADJUSTMENTS ON CAR. The following list of common troubles and their causes will frequently save considerable time in locating the cause of the difficulty.

NOTE: Before any work is performed on the carburetor, make sure trouble is not due to poor compression, or in the ignition system due to improper timing, defective spark plugs, burned ignition points, etc. Always diagnose performance trouble by using the Pontiac Tune-N-Test Guide before adjusting or repairing the carburetor.

When the cause of trouble is not located by the Tune-N-Test, check for trouble in the carburetor system as follows:

### *POOR FUEL ECONOMY*

NOTE: Before any attempt is made to improve fuel economy the actual gasoline mileage should be determined using a tenth of a gallon tester. If the mileage obtained during this test compares favorably with that found on other normal cars, the poor mileage must be attributed to the driving conditions or driving habits of the owner. Also consider factors such as dragging brakes, soft tires, improper tire size, and improper speedometer driven gear.

1. Check automatic choke, if used, to see that it operates properly and that it is correctly indexed.
2. On four cylinder engine inspect manifold heat valve to see that it operates freely and thermostat is installed properly.
3. Check for leaks in fuel line fittings, at fuel tank, or at fuel pump bowl.
4. Check for dirty or restricted air cleaner.
5. Test for high fuel pump pressure.
6. Disassemble carburetor and check for evidence of vacuum leaks.
7. Check float level.

### *SURGING CONDITION WITH HOT ENGINE*

1. Lean carburetor adjustment. Check idle mixture setting.
2. Check fuel pump pressure and output.
3. Check needle and seat on leak down tester.
4. Check float adjustment.
5. Check for dirty or obstructed jets or fuel passages.
6. Check for loose cluster or jets.

### *FLAT SPOT OR POOR ACCELERATION*

1. Check manifold heat control valve on four-cylinder engine thermostat for correct operation.
2. Check accelerator pump output visually to see if operating.
3. Check accelerator pump adjustment.
4. Check accelerator pump inlet and outlet valves for leakage.
5. Check for seating of accelerator pump plunger vent ball.
6. Check accelerator pump passages for dirt or obstructions.

### *ROUGH IDLE*

1. Check speed and mixture adjustment.
2. Check mixture screws for wear or burrs.
3. Check for manifold gasket leaks.
4. Check vacuum and choke heat connection.
5. Check operation and setting of choke system.
6. Check idle passage and throttle bore for carbon and dirt.
7. Check float adjustment.
8. Check for secondary throttle sticking (4 barrel).
9. Check engine compression.
10. Check spark plug gaps.

### *IMPROPER HIGH SPEED PERFORMANCE*

1. Check spark plugs for correct gap and condition.
2. Check distributor points.
3. Check fuel pump output and pressure.
4. Check filter for restriction or plugging.
5. Check carburetor for evidence of internal vacuum leaks.
6. Check float level adjustment.
7. Check high speed passages for dirt or obstruction.

### *FLOODING OR LEAKING*

1. Check for foreign material in needle and seat area.
2. Check needle and seat on leak down tester.
3. Check float adjustment (make sure float is not binding or rubbing).
4. Check for leaking or collapsed float.
5. Check for cracked bowl or loose passage plugs.

## SERVICE SPECIFICATIONS

| Carburetor Model | Float Level | Float Drop | Choke Rod | Unloader | Stat Setting | Pump Rod | Idle Vent | Secondary Throttle Lever |
|---|---|---|---|---|---|---|---|---|
| Rochester B & BC 7023067 7023068 4-Cyl. | 1 9/32″ | 1 3/4″ min. | .081″ model BC only | .161″ model BC only | Index | — | — | — |
| Rochester 4GC 7023069 7023070 4-Cyl. | 1 21/64″ | 1 3/4″ min. | .028″ | .152″ | Index | 15/16″ | 53/64″ | .015″ |
| Rochester 2GC 7023071 7023062 V-8 | 5/8″ | 1 3/4″ | .080″ | .160″ | Index | 1 11/32″ | 1 9/32″ | — |
| Carter AFB 3202S 3477S V-8 | 21/64″ ± 1/32″ | 23/32″ min. | — | 5/32″ ± 1/32″ | One Notch Rich | In Center Hole 5/16″ ± 1/32″ | — | .020″ |

# FUEL PUMP

### DESCRIPTION (Figs. 6B-128 and 129)

The fuel pump transfers gasoline from the tank to the carburetor in sufficient quantity to meet engine requirements at any speed or load.

The rocker arm spring keeps the rocker arm in constant engagement with the eccentric on the engine camshaft so that the rocker arm moves downward and upward as the camshaft rotates. As the rocker arm is moved downward, it bears against a link which is also pivoted on the rocker arm pin. The link is hooked to the diaphragm pull rod so that the diaphragm is moved away from the fuel chamber and the diaphragm spring is compressed. The enlarging fuel chamber moves gasoline from the tank through the tubing inlet valve and into the space below the diaphragm.

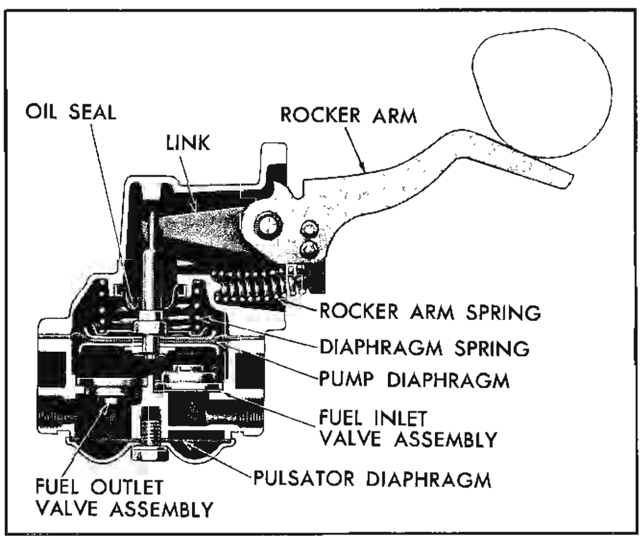



Fig. 6B-128 Schematic View Fuel Pump (4 Cyl.)

As the rotating eccentric permits the rocker arm to move away from contact with the link, the compressed diaphragm spring is free to move the diaphragm downward to expel the fuel through the outlet valve to the carburetor bowl.

Because the diaphragm is moved downward only by the diaphragm spring, the pump delivers fuel to the carburetor only when the pressure in the outlet line is less than the pressure maintained by the diaphragm spring. Fuel is delivered to the carburetor only when the needle valve is open. When the needle valve is closed by pressure of fuel on the float, the pump builds up pressure in the space below the diaphragm and in the outlet tube until the diaphragm spring is compressed. The diaphragm then remains stationary until more fuel is required.

## OVERHAUL AND ADJUSTMENT

### DISASSEMBLY

1. Scratch locating marks on fuel cover and pump body so that inlets and outlets will be properly located when pump is reassembled.

2. Place pump in soft jawed vice. (Fig. 6B-130).

3. Remove bolt and washer from pulsator cover plate. Remove pulsator cover and diaphragm from pump cover.

4. Remove pump cover screws except any two that are diametrically opposite.

5. Press down firmly on the cover to hold the diaphragm spring compressed and remove the remaining two screws. Release the cover slowly and remove cover assembly.

6. Drive out rocker arm pin with a tapered drift

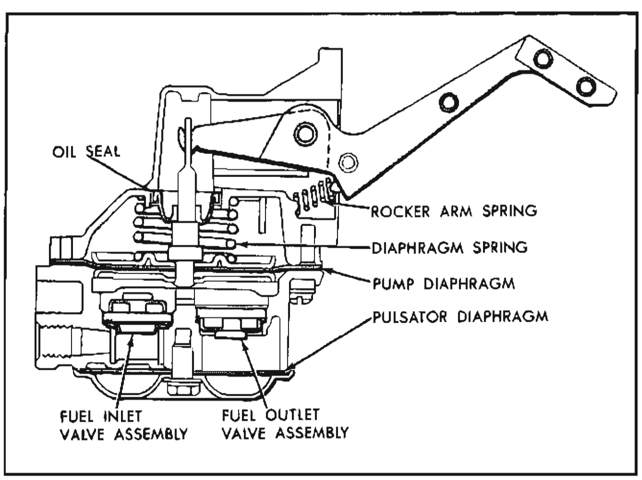



Fig. 6B-129 Schematic View of Fuel Pump (V-8)

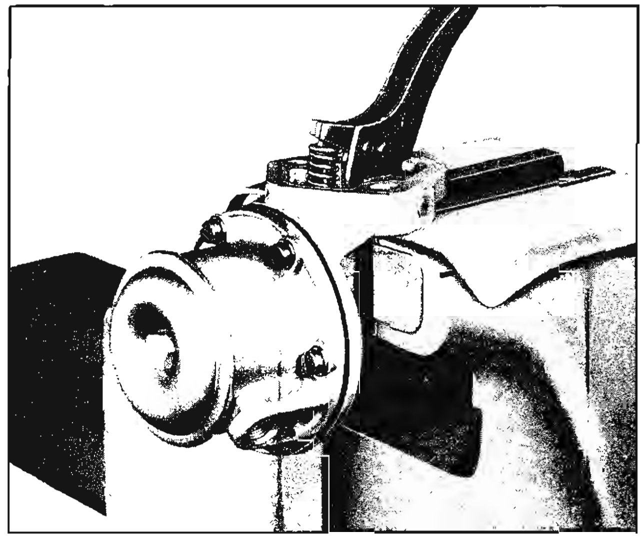


Fig. 6B-130 Fuel Pump Positioned in Vise (4 Cyl.)

after removing sufficient staked metal from the pin. Be sure to leave sufficient metal for restaking.

7. Remove rocker arm, rocker arm spring and link.

8. Remove diaphragm assembly and diaphragm spring.

9. Using a small chisel, round file or small grinding wheel, remove metal from around oil seal retainer which was displaced by staking during assembly. Pull out seal and seal retainer using a hooked shaped tool.

***CAUTION: Use care not to damage oil seal seats.***

10. Remove metal displaced by staking around inlet and outlet valves. Pry valves and cages out with screwdriver blade. Lift out gaskets.

### CLEANING AND INSPECTION

1. Clean and rinse all metal parts in solvent. Blow out all passages with compressed air.

2. Inspect pump body, cover and pulsator cover for cracks, breakage or distorted flanges. Examine all screw holes for stripped or crossed threads. If any of these three parts are damaged, the pump should be replaced.

3. Inspect rocker arm, link and pin for wear.

### ASSEMBLY

1. Install new oil seal and retainer in pump body and press firmly in place.

2. Stake die cast lip in four places to retain seals.

3. Position link and rocker arm in pump body with hook of link pointing toward top of pump.

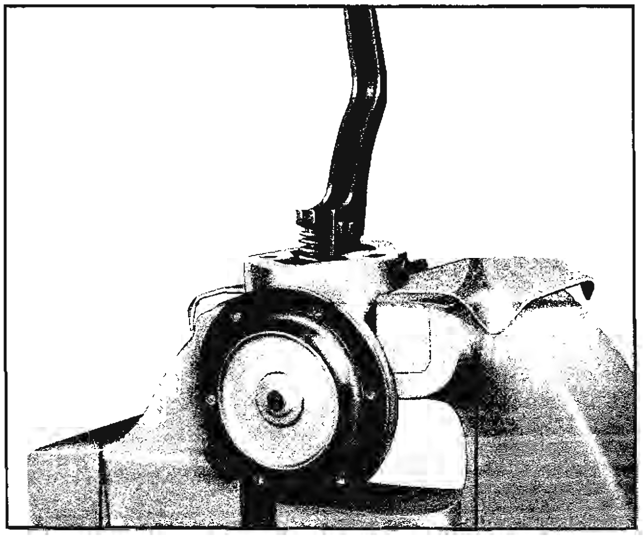


Fig. 6B-131 Diaphragm Assembly Installed (4 Cyl.)

4. Align holes and drive rocker arm pin through rocker arm.

5. Install small washer on rocker arm pin and re-stake pin securely.

6. Install inlet and outlet gaskets and valves in pump cover. Press valve and cage assembly against gasket and stake in position.

7. Soak pump diaphragm in clean kerosene. Fuel oil may be used, but do not use shellac or sealing compound.

8. Place pump body in soft jawed vise.

9. Place diaphragm on bench with pull rod pointing up. Position spring over pull rod.

10. Pick up diaphragm and spring as an assembly and push pull rod through oil seal into body. Be sure diaphragm spring is seated in body. Have flat of pull rod parallel to flat of link with the diaphragm flush with the body. With palm of hand, turn the diaphragm 90°, or until flat of pull rod is perpendicular to pump link. This motion should engage the pull rod "eye" with the link hook. If not, repeat this procedure until the connection is made (Fig. 6B-131).

***CAUTION: Extreme care should be used to avoid damaging oil seal.***

11. Position rocker arm spring between projection on rocker arm and conical projection on body.

12. Install pump cover on body making sure that scratch marks on cover and body line up. Push on rocker arm until diaphragm is flat across body flange. Install cover screws and lockwashers loosely until screws just engage lockwashers. Push rocker arm through its full stroke and hold in that position while tightening cover screws securely.

NOTE: Diaphragm must be flexed before tightening cover screw or pump will deliver too much pressure.

13. Place new pulsator diaphragm on pump body. Install pulsator cover with bolt and lockwasher.

## TROUBLE DIAGNOSIS AND TESTING

Always check fuel pump while it is mounted on the engine and be sure there is gasoline in the tank.

The line from the tank to the pump is the suction side of the system. The line from the pump to the carburetor is the pressure side of the system. A leak on the pressure side of system would be visible because of dripping fuel. A leak on the suction side would not be apparent except for its effect of reducing the volume of fuel on the pressure side.

1. Tighten any loose line connections and look for bends or kinks in lines which could reduce the flow of fuel.

2. Tighten diaphragm flange screws.

3. Disconnect fuel pipe at carburetor. Disconnect distributor to coil primary wire so that the engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If little or no gasoline flows from open end of pipe, then fuel pipe is clogged or pump is inoperative. Before removing pump, disconnect fuel pipe at inlet of pump and at gas tank outlet pipe and blow through them with an air hose to make sure they are clear. Reconnect pipes to pump and retest while cranking engine.

4. If fuel flows from pump in good volume from pipe at carburetor, check fuel delivery pressure to be certain that fuel pump is operating within specified limits as follows:

a. Attach a fuel pump pressure test gauge to disconnected end of pump to carburetor pipe.

b. Run engine at approximately 100 r.p.m. on gasoline in carburetor bowl and note reading on pressure gauge.

c. If pump is operating properly, the pressure will be between 4 p.s.i. to 5⅜ p.s.i. at 1000 r.p.ms on a 4 cylinder engine; 5¼ to 6¾ at 1000 r.p.m. on V-8. If pressure is too low or too high, or varies materially at different speeds, the pump should be removed for repair.

# ENGINE TUNE-UP

## CONTENTS OF THIS SECTION



## GENERAL DESCRIPTION

A minor tune and test consists of testing battery, cleaning, regapping or replacing, if required, spark plugs and distributor points; adjusting distributor dwell angle, ignition timing, carburetor idle mixture, hot idle speed and fast idle speed, checking manifold heat control valve and check automatic choke operation and setting.

The complete or major tune and test procedure consists of these basic items plus other ignition, compression, electrical and carburetor checks, and a final road test to ensure continued trouble free operation.

## BASIC PROCEDURE

### CONNECT TUNE-UP EQUIPMENT

Follow manufacturer recommendations for the use of testing equipment. Fig. 6C-1 shows a basic schematic for instrumentation which will apply to many types of test equipment and may be used as a rough guide if equipment manufacturers instructions are not available.

Connections shown in Fig. 6C-1 are made as follows:

1. Voltmeter
   a. Positive lead to resistor side of coil.
   b. Negative lead to ground.
2. Timing Light
   a. Positive lead to positive battery terminal.
   b. Negative lead to ground.
   c. Trigger lead to number 1 spark plug.
3. Tachometer
   a. Positive lead to distributor side of coil.
   b. Negative lead to ground.
4. Dwell Meter
   a. Positive lead to distributor side of coil.
   b. Negative lead to ground.

### TEST BATTERY VOLTAGE BEFORE AND WHILE CRANKING ENGINE

NOTE: Disconnect distributor to coil primary wire during this test to prevent engine from firing.

Terminal voltage while cranking must not be less than 9.0 volts. Engine cranking speed (approximately 180 RPM) should also be observed during this check to see that it is satisfactory. If cranking speed is low, check starting circuit to locate cause of low speed. If battery voltage is low while cranking, further tests of battery and/or starting motor circuit should be made to locate trouble.

To insure proper electrical operation, the battery should be in good condition and be adequately charged. Check cell to cell voltage as outlined in section 11 and recharge or replace as necessary.

### REMOVE AND RECONDITION SPARK PLUGS

See that correct spark plugs are used. Spark plug insulators should be thoroughly cleaned to prevent possible flash-over. Thoroughly clean lower insulator and cavity by sand blasting. File both electrodes flat (rounded surfaces increase voltage required to fire plugs) and set gap to .035". When plugs are reinstalled, use new gaskets and tighten plugs to 25 lb. ft. torque.

### CLEAN AND ADJUST DISTRIBUTOR POINTS

Remove distributor cap and inspect points for excessive burning or pitting. Replace points if necessary. Use a point file to clean contact area and remove scale from points. Filing is for cleaning purposes only. Do not attempt to remove all roughness. Apply a trace of bearing lubricant to the breaker cam. Adjust distributor dwell angle to 31-34 degrees on four cylinder models and 26-32 degrees on eight cylinder models.

### SET IGNITION TIMING

With distributor vacuum line disconnected and car operating at normal idle speed or below, set ignition timing. Follow procedure outlined in Section 11 of this manual. Correct settings are 6° BTDC for both engines.

### ADJUST HOT IDLE SPEED AND MIXTURE

Following adjustment procedure outlined in section 6B, adjust carburetor idle speed and mixture to the following specifications:

| | 4 CYL. | 8 CYL. |
|---|---|---|
| S. M. Transmission | 680-700 | 600 RPM |
| Auto. Transmission w/o Air Conditioning* | 580-600 | 500 RPM |
| Auto. Transmission with Air Conditioning* | 630-650 | 500 RPM |

*NOTE: Set idle speed with transmission in drive. Air Conditioning Off.

### ADJUST FAST IDLE SPEED

Following procedures outlined in Section 6-B, adjust fast idle speed to the following:

| | |
|---|---|
| 4 Cylinder, 4 bbl., Auto Trans. | 3000 RPM |
| 4 Cylinder, 4 bbl., S.M. Trans. | 2800 RPM |

NOTE: There is no fast idle adjustment on one barrel equipped units.

### ANTI-STALL DIAPHRAGM SETTING

Before attempting to set the anti-stall diaphragm, the hot idle speed must be adjusted on 1 and 2 Bbl. carburetors, and the hot idle speed and fast idle speed both must be set on the 4 Bbl. carburetor to specifications.

With the engine running, place transmission in neutral, disconnect the vacuum hose from throttle return check and plug end of vacuum hose. Adjust the contact screw of the throttle return check to obtain the specified speed below. After adjustment, unplug vacuum hose and reconnect to throttle return check.

***CAUTION: The anti-stall diaphragm plunger must be restrained from turning while adjusting plunger screw to prevent injury to the diaphragm.***

| SPEED SPECIFICATIONS | VACUUM DISCONNECTED |
|---|---|
| Tempest 4 Cyl. 1 Bbl. A/C | 1175 rpm |
| Tempest 4 Cyl. 4 Bbl. | 1050 rpm |
| Tempest V-8 Automatic Trans. | 1050 rpm |

### SEE THAT EXHAUST MANIFOLD HEAT VALVE OPERATES FREELY

Manifold heat valve must operate freely. If stuck open, it can cause sluggish operation of the engine, especially during warm-up. If stuck closed, engine performance when hot will be unsatisfactory.

### CHECK CARBURETOR CHOKE AND UNLOADER OPERATION AND ADJUSTMENT

The specified choke setting provides ideal choke operation in all climates. No seasonal changes are necessary.

Settings are center index on all automatic choke equipped units.

The choke should just close at 75°F. when set at index. In rare cases, it may be necessary to change slightly (never more than two notches) from the standard setting to properly calibrate the choke. Excess carbon in choke housing may indicate a leaking choke heat tube.

Choke linkage and fast idle cam must operate freely. Do not lubricate linkage since this will collect dust and cause sticking.

Check unloader action. Inoperative unloader can cause complaints of difficult hot starting. Adjust as outlined in Section 6B.

## ADDITIONAL PROCEDURES

For diagnosis purposes, it is sometimes necessary to proceed further than the basic tune-up procedure. The following steps plus a road test are included in a complete or major tune and test procedure.

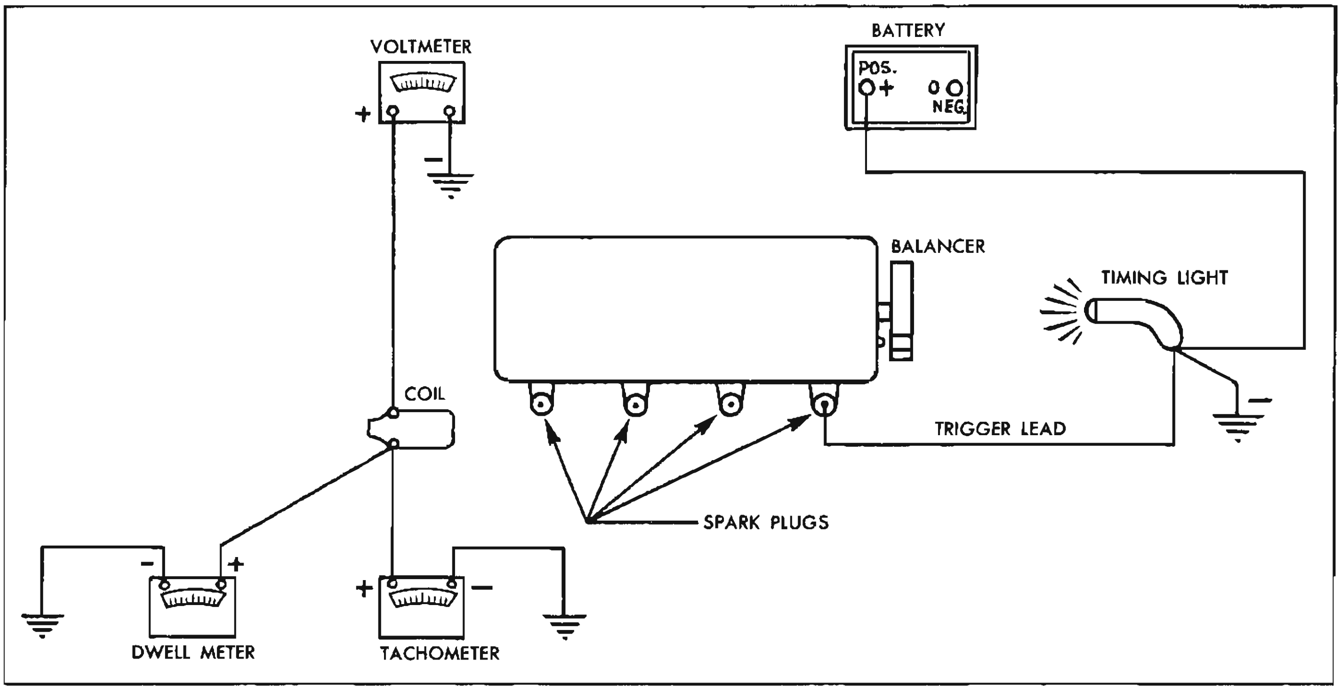



Fig. 6C-1 Basic Instrumentation for Tune-up

***TEST COMPRESSION PRESSURE OF EACH CYLINDER***

NOTE: If this test is to be performed, it should be done when plugs are removed for service during the basic tune-up procedure.

Unless checking for worn rings or for the cause of low speed miss, compression check should not be necessary.

Test compression with engine warm, all spark plugs removed and throttle and choke open. No cylinder should be less than 80% of the highest cylinder (see examples). Excessive variation between cylinders, accompanied by low speed missing of the cylinder or cylinders which are low, usually indicates a valve not properly seating or a broken piston ring. Low pressures, even though uniform, may indicate worn rings. This may be accompanied by excessive oil consumption.

TEMPEST (4 CYL.)

EXAMPLE 1

| Cyl. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Press. | 136 | 102 | 135 | 144 |

80% of 144 (highest) is 115. Thus cylinder No. 2 is less than 80% of No. 4. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

EXAMPLE 2

| Cyl. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Press. | 85 | 96 | 90 | 87 |

80% of 96 is 77. While all cylinders are well above 77, they are all excessively low. This indicates all poor valves or, if accompanied by oil consumption, worn rings or low crank speed.

If compression is subnormal, the tune-up will probably not be satisfactory.

TEMPEST (V-8)

**Example 1**

| Cyl. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Press. | 136 | 138 | 135 | 144 | 102 | 137 | 140 | 141 |

80% of 144 (highest) is 115. Thus cylinder No. 5 is less than 80% of No. 4. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

**Example 2**

| Cyl. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Press. | 85 | 91 | 90 | 87 | 96 | 93 | 87 | 89 |

80% of 96 is 77. While all cylinders are well above 77, they are all excessively low. This indicates all poor valves, or if accompanied by oil consumption, worn rings or low crank speed. If compression is subnormal, the tune-up will probably not be satisfactory.

### CLEAN TOP OF BATTERY, TIGHTEN TERMINALS AND HOLD DOWN CLAMP

***CAUTION: Never reverse battery leads, even for an instant, as reverse polarity current flow will damage diodes in the alternator.***

Clean top of battery and terminals with a solution of baking soda and water. Rinse off and dry with compressed air. The top of the battery must be clean to prevent current leakage between the terminals and from the positive terminal to the hold down clamp.

In addition to current leakage, prolonged accumulation of acid and dirt on top battery may cause blistering of the material covering the connector straps and corrosion of the straps. After tightening terminals, coat them with petrolatum to protect them from corrosion. Hold down clamp should be tightened to 22-27 lb. in. torque.

***CAUTION: Excessive tightening of the hold down clamp can crack the battery case.***

### CLEAN CARBURETOR AIR CLEANER AND CRANKCASE VENTILATOR AIR CLEANERS

The entire air cleaner should be removed from the car for cleaning. The metal cover and shell of the air cleaner should be cleaned on the inside surfaces.

Remove filter element from standard carburetor air cleaner. Wash dirt from filter element and from crankcase ventilator inlet by plunging up and down several times in suitable solvent. Drain dry and re-oil.

The heavy duty air cleaner element should be washed in kerosene, squeezed dry and dipped in SAE 10W-30 oil. Squeeze dry again to remove excess oil. DO NOT WRING DRY.

### CLEAN AND INSPECT HIGH TENSION WIRES, DISTRIBUTOR CAP AND ROTOR

NOTE: This operation is to be performed while checking distributor points during the basic tune-up procedure. Inspect distributor cap for cracks and flash over.

External surfaces of all parts of the secondary system must be cleaned to reduce the possibility of voltage loss. All wires should be removed from the distributor cap and coil so that terminals can be inspected and cleaned. Burned or corroded terminals indicate that wires were not fully seated, causing arcing between the end of the wire and the terminal. When replacing wires in terminal, be sure they are fully seated before pushing rubber nipple down over tower. Check distributor rotor for damage.

### TIGHTEN INTAKE MANIFOLD AND CARBURETOR ATTACHING NUTS

Intake manifold attaching screws and nuts on engines should be tightened to 40 lb. ft. torque. Carburetor attaching nuts should be tightened securely. Leaks at these areas can cause rough idle, surging, deceleration popping, or deceleration whistle.

### INSPECTION

Inspect for oil and/or coolant leaks. Check radiator hoses. Check and adjust engine fan and accessory drive belt tension. Clean steering wheel.

## ROAD TEST

### TEST PERFORMANCE OF CAR

Observe performance of engine at low speed, during acceleration, and at constant speed. Check for missing, stalling, surging, poor acceleration or flat spots on acceleration. If any irregularity is found, refer to the appropriate section of the manual for repair procedures.

### TEST OPERATION OF:

BRAKES—Pedal should not go closer than 2" from floor mat and car should not pull to either side.

PARKING BRAKE—Should hold the car without excessive movement of parking brake pedal.

AUTOMATIC TRANSMISSION – Observe shift at minimum, medium, and full throttle and test part throttle and forced downshift. Watch for slipping or unusual shift characteristics that may indicate need for adjustment.

STEERING GEAR – See that steering operates normally and that steering wheel does not have excessive play. Also observe for alignment of steering wheel, pull, wander, or other irregularity that might indicate need for front end alignment.

WINDSHIELD WIPER—Wiper operation should be tested with windshield wet in order to properly judge the action.

CLUTCH—See that clutch engages smoothly and that pedal has approximately 1" of free travel. "Hard" pedal or lack of pedal return may indicate need for linkage adjustment.

LIGHTS AND HORNS—Test operation and aim of headlights, operation of all lights and horn.

INSTRUMENTS—Observe operation of all instruments. Observe especially for possible abnormal readings which may indicate trouble.

ACCESSORIES—Test operation of radio, heater, defroster, cigar lighter, other accessories.

# ENGINE CLUTCH

## CONTENTS OF THIS SECTION

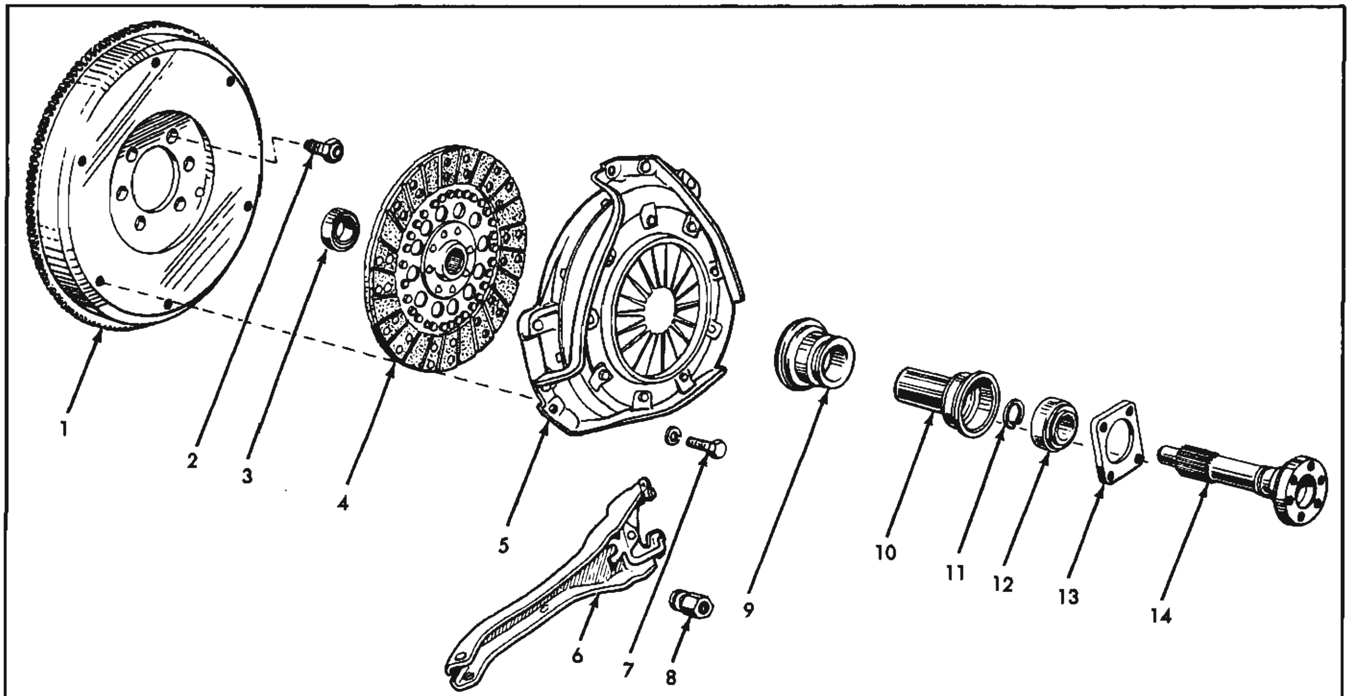


## DESCRIPTION

A single plate, dry disc type clutch is used on all Tempest cars with synchro-mesh transmissions. The clutch assembly consists of the clutch driven plate assembly, the clutch cover and pressure plate assembly, and the clutch release mechanism

The driven plate for all three Tempest clutches differs from each other in plate size and damper spring calibration. Grooves on both sides of the clutch plate lining prevent the sticking of the plate to the flywheel and pressure plate due to vacuum between the members.

The driven plate incorporates a damper assembly in the hub to prevent the transmitting of vibration from engine to transmission.




1. Flywheel
2. Flywheel Attaching Bolts
3. Clutch Pilot Bearing
4. Clutch Driven Plate
5. Clutch Cover & Pressure Plate
6. Clutch Release Fork
7. Clutch Cover Attaching Bolts
8. Clutch Release Fork Ball Nut
9. Clutch Release Bearing
10. Clutch Release Bearing Support
11. Clutch Drive Shaft Bearing Retainer
12. Clutch Drive Shaft Bearing
13. Retaining Plate
14. Clutch Drive Shaft

Fig. 6D-1 Engine Flywheel and Clutch (4 cyl. Std.)

The clutch pressure plate for the four cylinder standard clutch (Fig. 6D-1) is of the disc spring type. There is an overcenter effect inherent in the action of the disc spring itself. This eliminates the need for an overcenter assist spring.

The clutch pressure plate for the four cylinder heavy duty clutch (Fig. 6D-2) is a coil spring pressure plate without centrifigal rollers.

On the heavy duty clutch an overcenter spring is incorporated in the pedal linkage under the dash to assist the effort exerted by the driver is disengaging the clutch.

The clutch pressure plate for the Tempest V-8 clutch (Fig. 6D-3) is of the disc spring type. It differs from the four cylinder standard clutch in size.

Pressure plate spring pressure forces the driven plate against the flywheel, thereby coupling the engine to the transmission.

The clutch release mechanism consists of a ball thrust bearing, appropriate levers and linkage to manually control the action of the bearing. The ball thrust bearing is piloted on a tubular support. When pressure is applied to the clutch pedal to release the clutch, the clutch fork pivots on its ball socket. The inner end then pushes the release bearing forward so that it presses against the inner ends of the clutch release levers, releasing the clutch (Fig. 6D-1). Pedal effort is transmitted by the pedal to the lever assembly and thence through the clutch fork.

## PERIODIC SERVICE

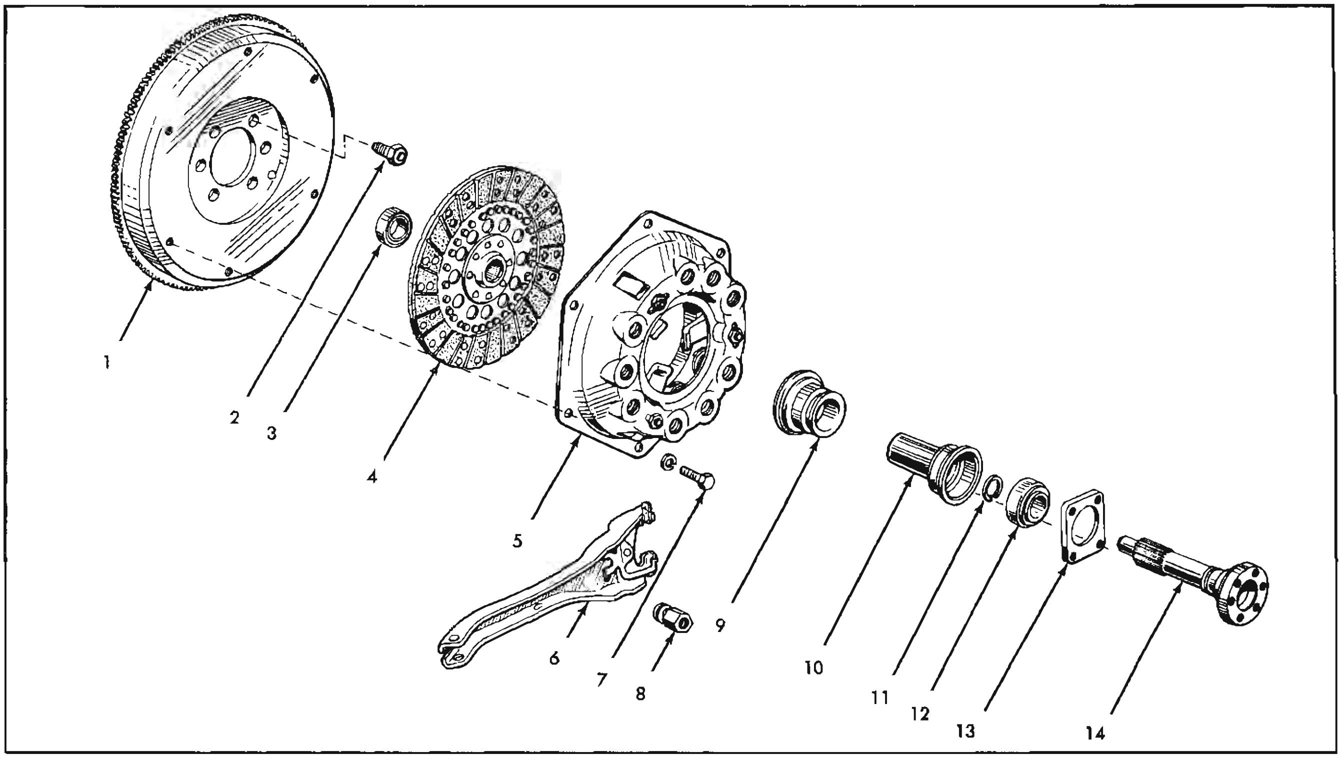
See "General Lubrication" Section.

## CLUTCH PEDAL ADJUSTMENT

***CAUTION: On the heavy duty clutch do not attempt to adjust pressure plate release levers as they are adjusted at the factory with a special fixture, and cannot be adjusted correctly unless a fixture is used.***

Wear on the clutch parts necessitates occasional lash adjustment. No other adjustment is made. Lash adjustment should be made as follows:

1. Unhook the linkage return spring.




1. Flywheel
2. Flywheel Attaching Bolts
3. Clutch Pilot Bearing
4. Clutch Driven Plate
5. Clutch Cover & Pressure Plate
6. Clutch Release Fork
7. Clutch Cover Attaching Bolts
8. Clutch Release Fork Ball Nut
9. Clutch Release Bearing
10. Clutch Release Bearing Support
11. Clutch Drive Shaft Bearing Retainer
12. Clutch Drive Shaft Bearing
13. Retaining Plate
14. Clutch Drive Shaft

Fig. 6D-2 Engine Flywheel and Clutch (4 cyl. H.D.)

2. Loosen the trunnion lock nuts sufficiently to allow the rod and fork to be moved rearward until release bearing contacts pressure plate fingers lightly.

3. Run the rear nut up to the trunnion (Fig. 6D-3).

4. Shorten the rod 7 turns and secure both nuts.

5. Reinstall spring. Approximately 1" of lash should be at the pedal.

## LOWER CLUTCH LINKAGE ASSEMBLY

### *REMOVE AND REPLACE*

1. Remove anti-rattle spring.

2. Remove clutch adjusting rod rear cotter pin and clevis pin.

3. Remove clutch adjusting rod front retaining clip from trunnion.

4. Remove clutch rod (Fig. 6D-3 and 6D-4).

5. Remove clutch pedal linkage rod retaining ring and washer and remove from lever assembly.

6. Remove retaining clip and remove idler lever to flywheel housing link.

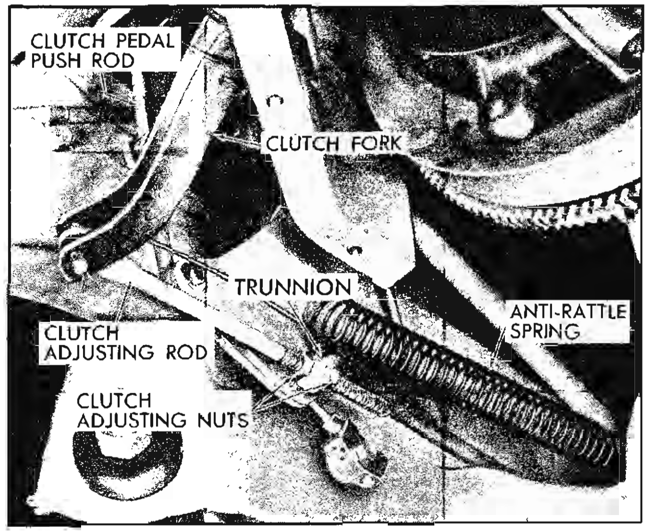
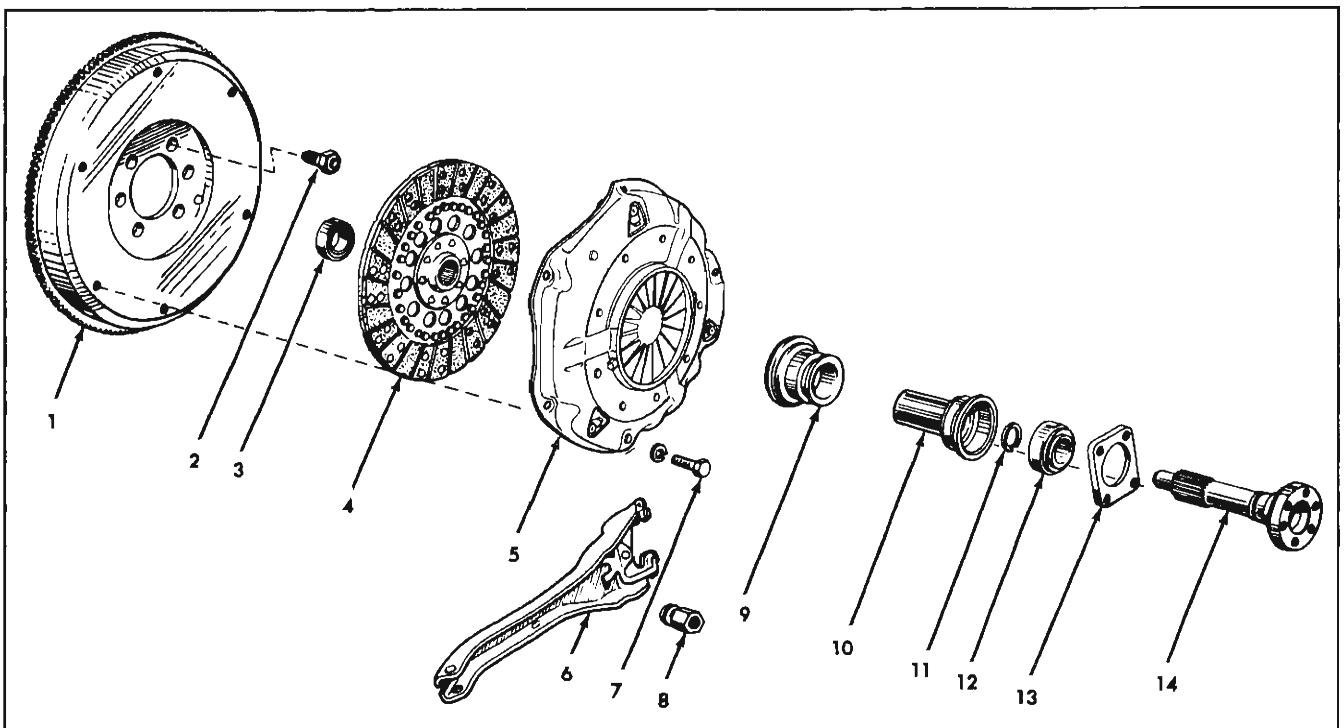



Fig. 6D-3 Clutch Adjusting Rod (4 cyl.)

7. Remove retaining clips on upper and lower idler lever pivot studs.

8. Remove upper and lower idler lever link assembly.

9. To install assembly, reverse above precedures.




1. Flywheel
2. Flywheel Attaching Bolts
3. Clutch Pilot Bearing
4. Clutch Driven Plate
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6. Clutch Release Fork
7. Clutch Cover Attaching Bolts
8. Clutch Release Fork Ball Nut
9. Clutch Release Bearing
10. Clutch Release Bearing Support
11. Clutch Drive Shaft Bearing Retainer
12. Clutch Drive Shaft Bearing
13. Retaining Plate
14. Clutch Drive Shaft

Fig. 6D-4 Engine Flywheel and Clutch (V-8 Engine)

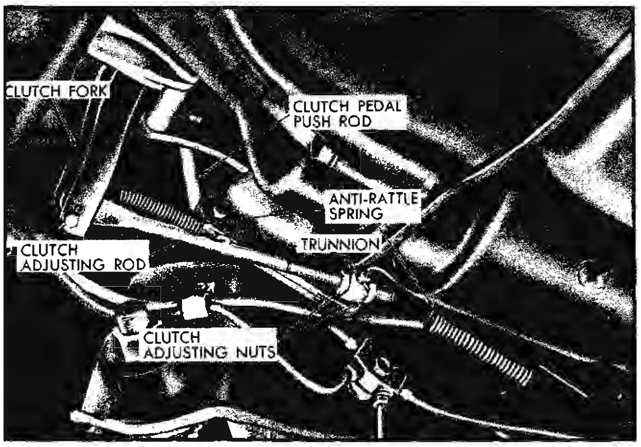



Fig. 6D-5 Clutch Adjusting Rod (V-8)

NOTE: Make certain lever assembly is installed as shown in Fig. 6D-9 or incorrect clutch operation will result.

10. Adjust clutch as described in Clutch Lash Adjustment.

## UPPER CLUTCH LINKAGE ASSEMBLY

### *4 CYLINDER (STANDARD) AND V-8— REMOVE AND REPLACE*

1. Remove two pedal arm to actuating lever attaching bolts (Fig. 6D-7).

2. Remove pedal arm.

3. Remove clutch push rod retaining clip and remove rod.

4. Remove pivot bolt from pedal to push rod actuating lever.

5. Remove actuating lever.

6. To replace reverse the above precedures.

## UPPER CLUTCH LINKAGE ASSEMBLY

### *4 CYLINDER (HEAVY DUTY)*

REMOVE

1. Remove overcenter spring (Fig. 6D-8).

2. Remove clutch pedal.

3. Remove pivot bolt.

4. Remove two bolts securing overcenter lever.

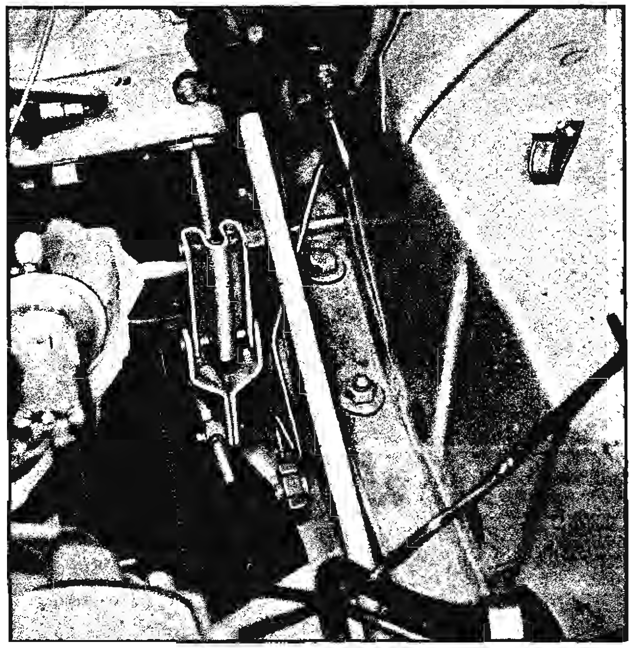


Fig. 6D-6 Clutch Linkage (Top View)

5. Remove retaining ring securing link to stop bracket and remove bumper assembly.

6. Remove overcenter lever and assembly.

7. Remove bolt to rear hole of stop bracket and remove stop bracket.

8. Disconnect pedal linkage rod from lever assembly.

9. Remove lever asembly.

REPLACE

1. Install lever assembly.

2. Install stop bracket, overcenter lever, and pivot bolt; install link to stop bracket.

3. Connect pedal linkage to rod lever assembly and secure with retaining ring.

4. Install nut and secure pivot bolt. Torque nut to 20-35 lb. ft.

***CAUTION: Over-tightening of nut will cause a bind in the linkage assembly.***

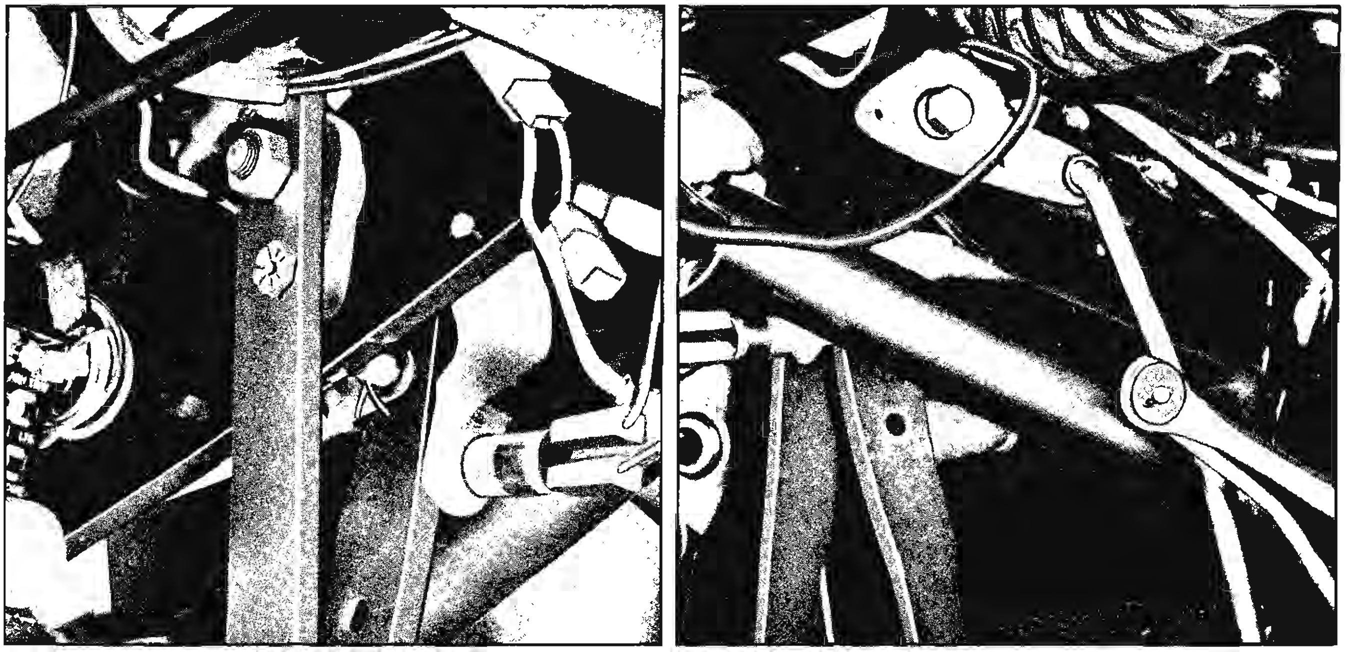
5. Install and secure clutch pedal with two bolts.

6. Install bolt securing stop bracket at rear hole.

7. Install two bolts securing overcenter lever.

8. Secure link to stop bracket with retaining ring.

9. Install overcenter spring.



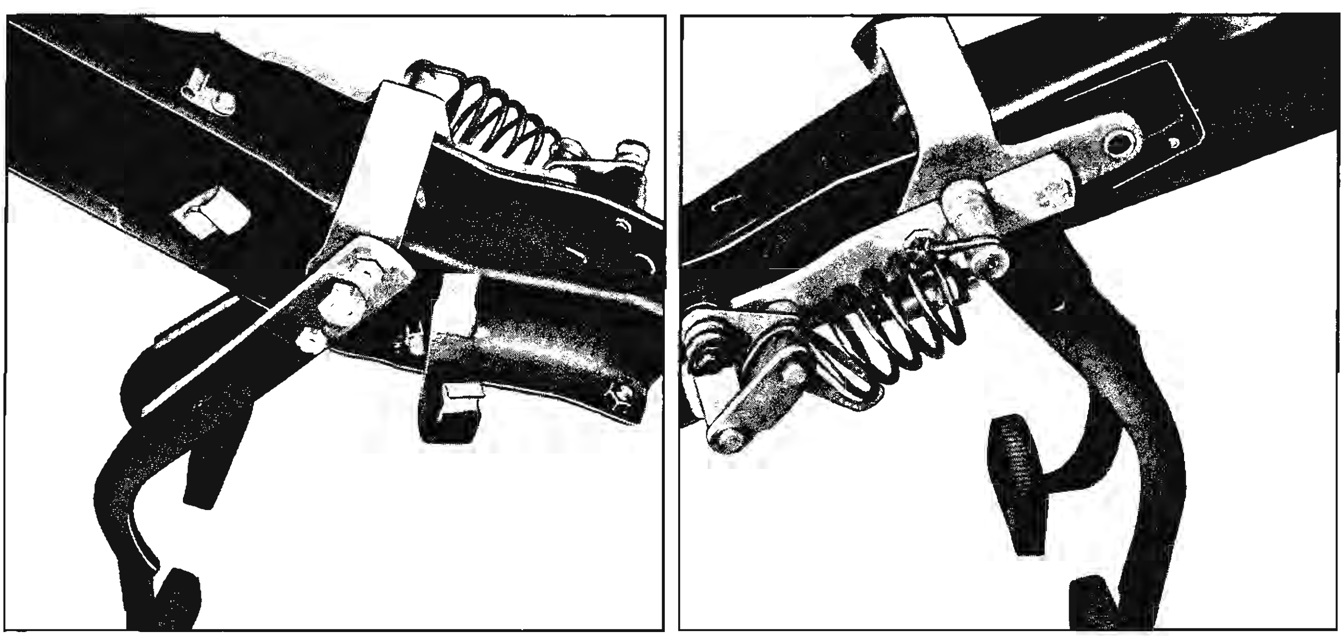
Left Side Right Side

Fig. 6D-7 4-cyl & V-8 Standard Upper Clutch Linkage

## CLUTCH ASSEMBLY

### *REMOVE*

1. Raise car.
2. Disconnect stabilizer bar at body frame rail.
3. Disconnect exhaust pipe.
4. Disconnect front of torque tube from clutch housing as outlined in Section 4. Support torque tube at front after dropping front of tube enough to permit sufficient access to the clutch assembly.
5. Disconnect clutch rod from fork.
6. Disconnect clutch linkage link from clutch housing stud.
7. Remove starter
8. Remove clutch housing assembly with components intact



Left Side Right Side

Fig. 6D-8 4 cyl. Heavy Duty Upper Clutch Linkage

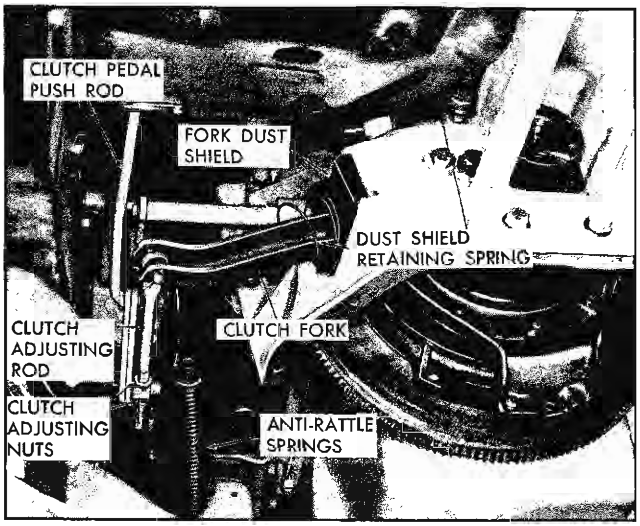



Fig. 6D-9 4 Cylinder Engine Lower Clutch Linkage

9. Remove clutch pressure plate and cover assembly and clutch driven plate.

***CAUTION: Index the pressure plate and cover to flywheel prior to disassembly.***

10. Remove fork spring.

11. Remove fork cover plates.

12. Remove fork ball nut support bolt, fork, and release bearing.

13. Remove retaining plate bolts (Fig. 6D-11).

14. Remove clutch drive shaft and retaining plate.

15. Remove clutch release bearing support.

### INSPECT

1. Inspect clutch driven plate for broken or distorted springs, worn or loose facings, oil on facings, and damaged spline which could cause binding. If any of the above defects are present, replace driven plate with new assembly.

NOTE: Servicing of clutch driven plate should be by replacement of plate assembly only.

2. Inspect pressure plate and cover assembly to see that it is free of oil and grease. Check pressure plate for scores or cracked surface.

NOTE: Servicing of clutch driven plate or pressure plate and cover assembly should be made by replacement of assemblies only.

3. Examine clutch release bearing support carefully to be certain there are no burrs on outer surface which pilots clutch release bearing. Make sure there is a light coat of molybdenum disulphide grease in inner groove of clutch release bearing assembly.

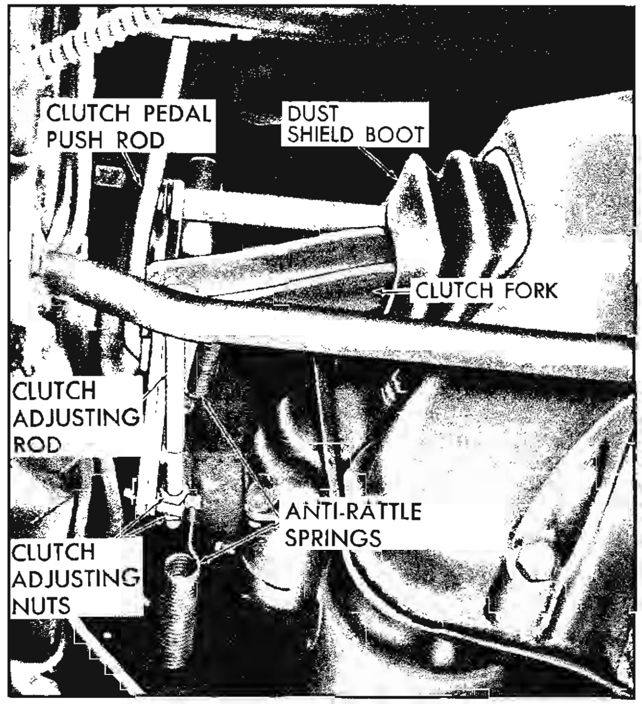



Fig. 6D-10 V-8 Lower Clutch Linkage

4. Try release bearing on support to make sure no binding exists.

5. Check release bearing by placing thrust load on bearing by hand and turning bearing race. Replace if bearing feels rough when turning.

6. Clean flywheel face with carbon tetrachloride, sandpaper or steel wool.

7. Check clutch pilot bearing for looseness in crankshaft counterbore.

8. If bearing is loose, remove from crankshaft and inspect bore for wear. If bearing has been run loose in crankshaft for some time, a noticeable ridge will be found in counterbore. If diameter of bore is more than .005" oversize (spec. 1.379"), the crankshaft must be replaced. Thoroughly clean all dirt and rust from crankshaft counterbore area.

9. If bearing is tight in counterbore, rotate with finger to check for roughness. If roughness is evident, replace bearing.

10. Inspect fingers on clutch cover and pressure plate for excess wear. If fingers are deeply grooved, replace cover and pressure plate assembly.

11. Install release bearing and clutch release fork ball in clutch release fork as shown, Fig. 6D-12.

12. Inspect fork assembly as follows:

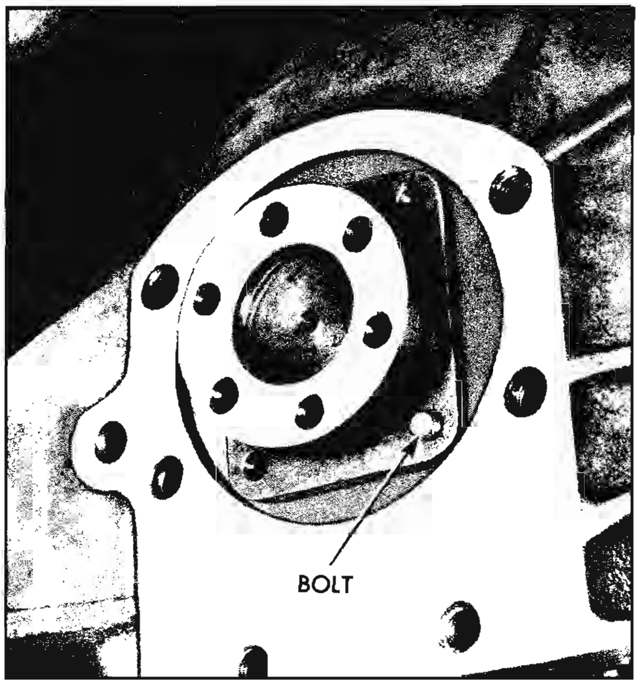



Fig. 6D-11 Retaining Plate Bolt

a. End of fork assembly and spring must completely fill groove in release bearing as shown. Spring should be under enough tension so that if fork is held with release bearing down, bearing will not fall out of fork.

b. With release bearing installed in fork, the end of spring retaining fork ball must have tension on ball so that there is no possible end play of ball.

NOTE: If fork assembly does not meet requirements outlined in (a.) above, it is permissible to attempt correction by bending ends of fork spring. However, after bending, the spring still must meet the requirements of step (b.). In many instances, bending of the spring ends will cause tension on the stud ball to be reduced. If fork assembly cannot be corrected by bending spring, discard and check new fork assembly.

13. Apply a light coating of special molybdenum disulphide grease to face surface of release bearing, fingers on pressure plate, and pilot end of clutch shaft.

### *CLUTCH DRIVE SHAFT BEARING*

#### REMOVE

1. Remove retaining ring (Fig. 6D-13).

2. Set shaft in press (Fig. 6D-14) and press bearing off.

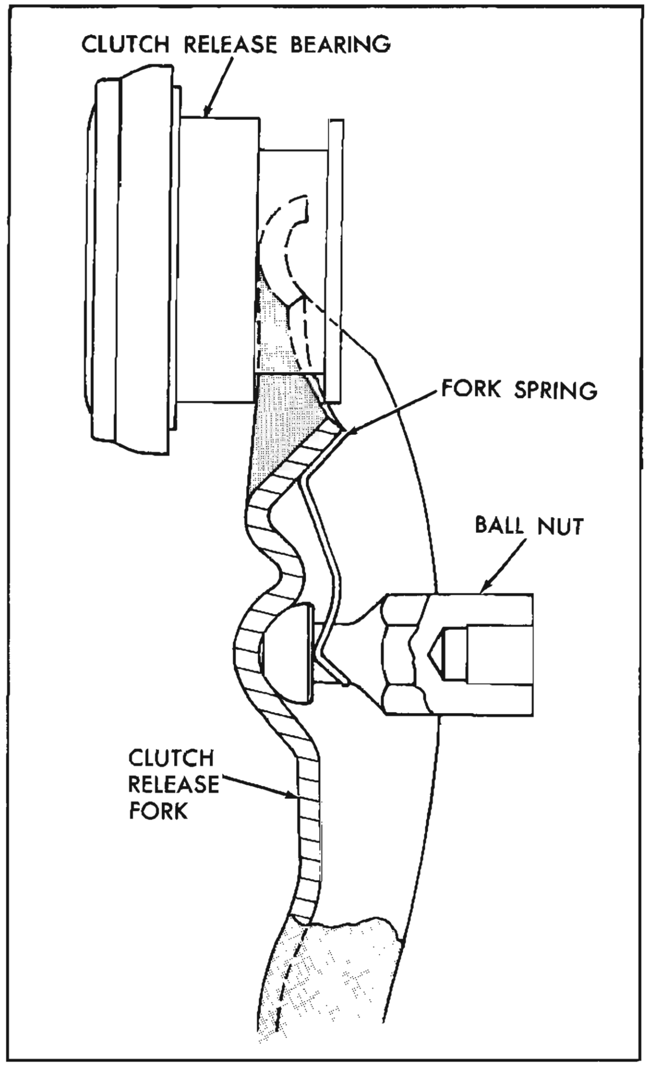



Fig. 6D-12 Fork Installed in Release Bearing

#### INSTALL

1. Set shaft in press as shown in (Fig. 6D-15) and press new bearing onto shaft.

2. Install retaining ring.

### *FLYWHEEL CLUTCH DRIVE SHAFT PILOT BEARING*

#### REMOVE

1. Remove retainer plate and oil seal.

2. Install tool J-4383 (Fig. 6D-16) and remove pilot bearing.

3. Remove oiling felt.

#### INSTALL

1. Fill bore in crankshaft $\frac{1}{3}$ full of molybdenum disulphide grease.

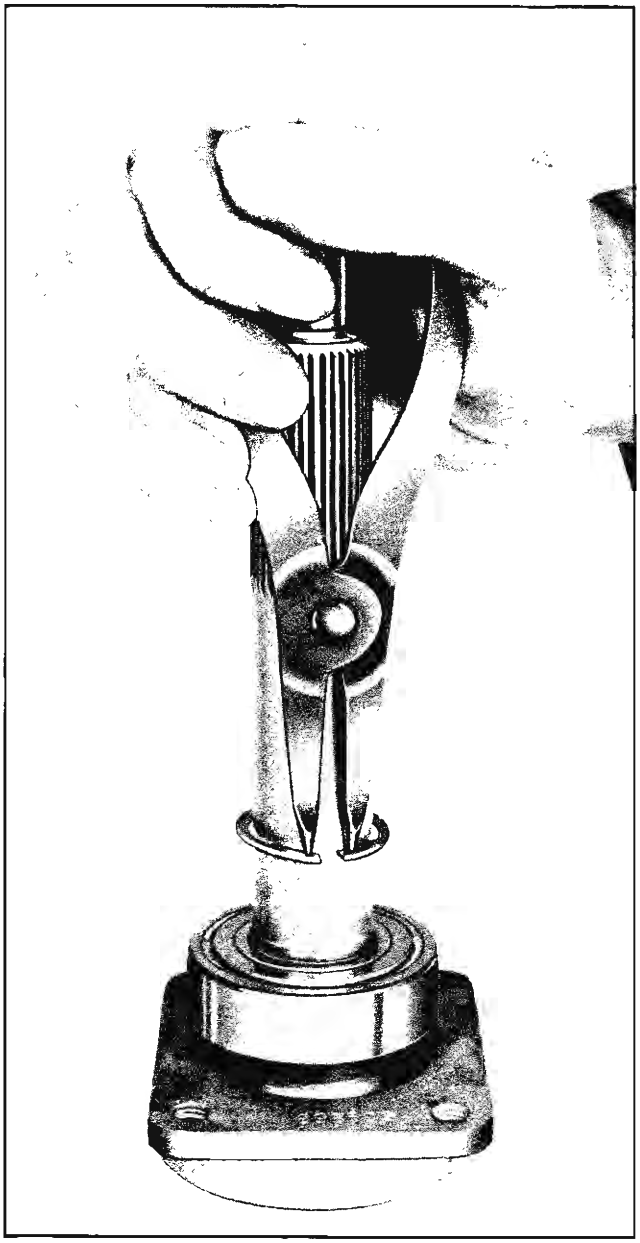


Fig. 6D-13 Removing Drive Shaft Bearing Retainer

2. Install oiling felt which has had molybdenum disulphide grease worked into it.

3. Install new bearing with tool J-5736 (Fig. 6D-17).

4. Install oil seal and retainer plate. Torque bolts to 35 lb. ft.

### INSTALL CLUTCH ASSEMBLY

1. Install driven plate (as shown in Fig. 6D-1) and pressure plate and cover assembly, making sure index mark lines up with one on flywheel.

NOTE: Use clutch drive shaft to align clutch driven plate. Remove shaft after all pressure plate bolts are tightened to 20-35 lb. ft. torque.

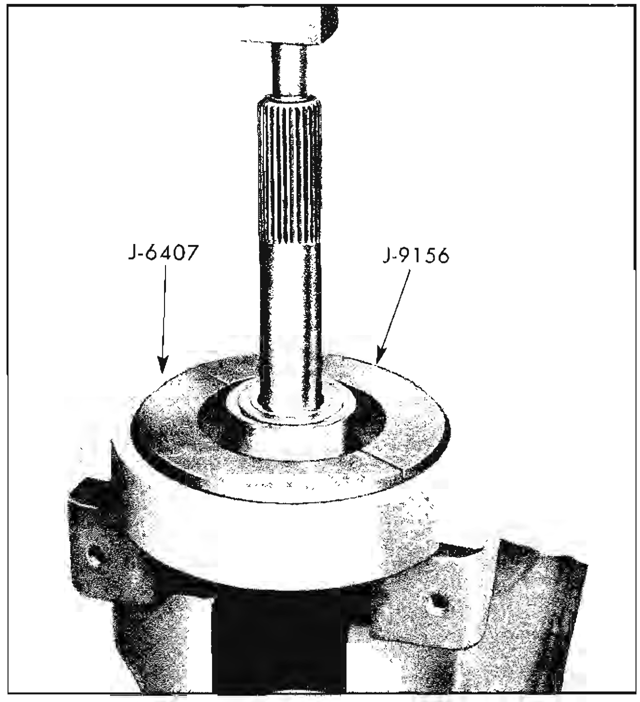



Fig. 6D-14 Removing Drive Shaft Bearing

2. Install clutch release bearing support on drive shaft.

3. Install drive shaft and retaining plate in housing and tighten bolts to 10-25 lb. ft. torque.

4. Install clutch release bearing on clutch release bearing support. Make sure surface of support and internal groove of release bearing has a light coat of molybdenum disulphide grease.

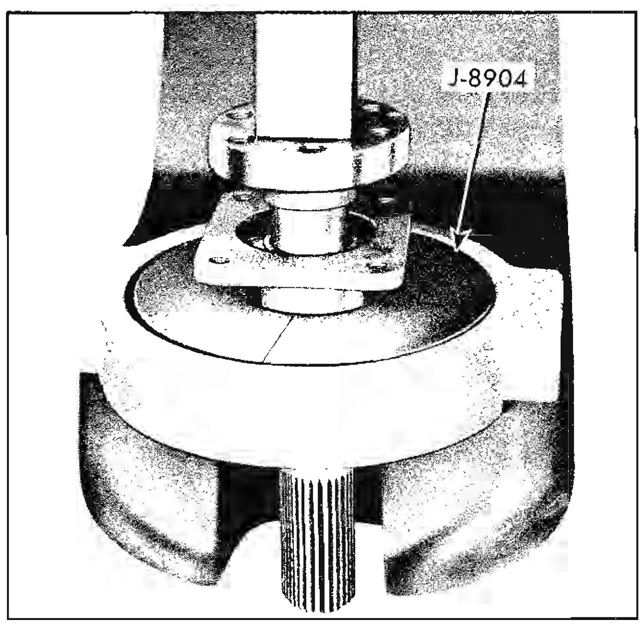



Fig. 6D-15 Installing Drive Shaft Bearing

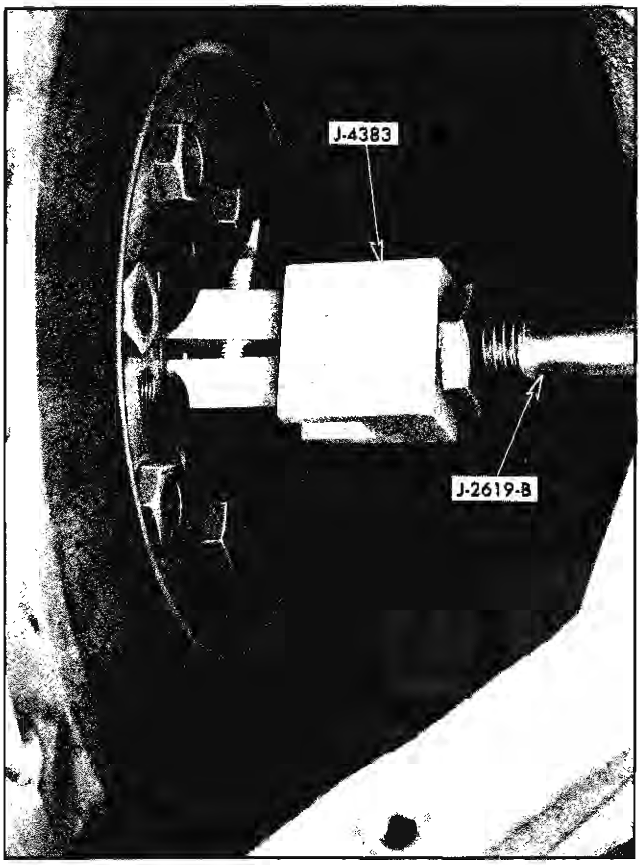



Fig. 6D-16 Removing Drive Shaft Pilot Bearing

5. Coat ball nut with molybdenum disulphide grease and install in fork.

6. Install fork with ball nut facing to rear of car, hook clutch fork in groove of release bearing (Fig. 6D-12), and install ball nut support bolt.

7. Install dust shields together (with a light coat of wheel bearing grease between them). (A boot is used for V-8.)

8. Install clutch fork spring on standard.

9. Tighten clutch ball nut support bolt to 30-45 lb. ft. torque.

10. Coat drive shaft splines lightly with molybdenum disulphide grease and install clutch housing assembly and components, installing clutch rod in fork

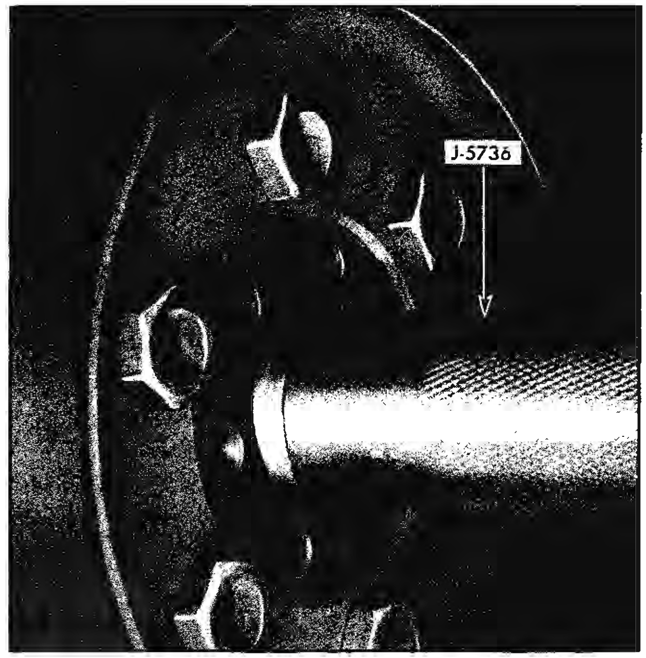



Fig. 6D-17 Installing Drive Shaft Pilot Bearing

at same time. Torque clutch housing to engine block bolts to 40-60 lb. ft. Be sure face of release bearing and release fingers are coated with molybdenum disulphide grease.

NOTE: Coat contact area of clutch rod at fork end with wheel bearing grease.

11. Connect clutch linkage link to clutch housing stud.

12. Install clutch rod clevis pin, anti-rattle spring, and cotter pin at fork end.

13 Install front of torque tube to clutch housing as outlined in Section 4.

14. Install starter.

15. Connect exhaust pipe.

16. Connect stabilizer bar at body frame rail. Torque bolts to 20-35 lb. ft.

17. Make clutch pedal adjustment as outlined on page 6D-2.

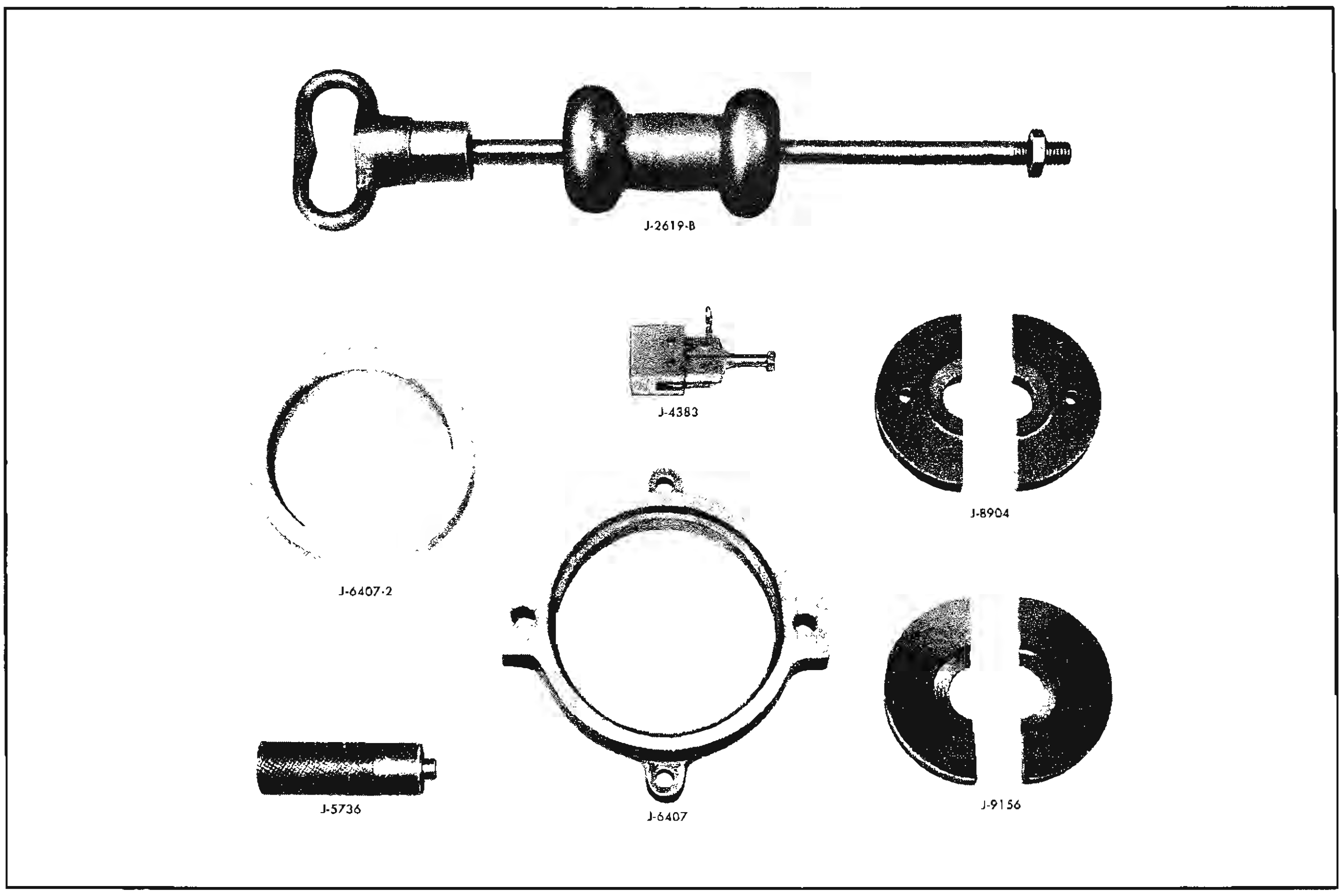
## SPECIFICATIONS

Pedal Lash—7 turns of adjustment nuts away from Zero Lash position.

| | |
|---|---|
| Disc Facings Type | Single Plate Dry |
| Diameter of Disc | Std.—9.4″ O.D.<br>HD—10″ O.D.<br>V-8—10.4″ O.D. |
| Release Brg. | Std.—Crown Face<br>HD—Flat Face<br>V-8—Crown Face |
| Number of Thrust Springs | Std.—Disc Spring<br>HD—12 Coil Spring<br>V8—Disc Springs |
| Number of Torsion Springs | Std. 6<br>HD 6<br>V8 6 |

## TORQUE SPECIFICATIONS

| | LB. FT. |
|---|---|
| Upper clutch linkage pivot bolt nut | 20-35 |
| Pressure plate and cover assembly to flywheel bolts | 20-35 |
| Drive shaft retaining plate bolts | 10-25 |
| Ball nut support bolt | 30-45 |
| Clutch housing to engine block bolts | 40-60 |
| Stabilizer bar to body frame rail bolts | 20-35 |




## SPECIAL TOOLS

J-2619-B Slide Hammer

J-4383 Clutch Pilot Bearing Remover

J-8904 Clutch Drive Shaft Bearing Installer

J-5736 Clutch Pilot Bearing Installer

J-6407 Press Plate Holder

J-9156 Clutch Drive Shaft Bearing Remover

# SYNCHRO-MESH TRANSMISSION

## CONTENTS OF THIS SECTION



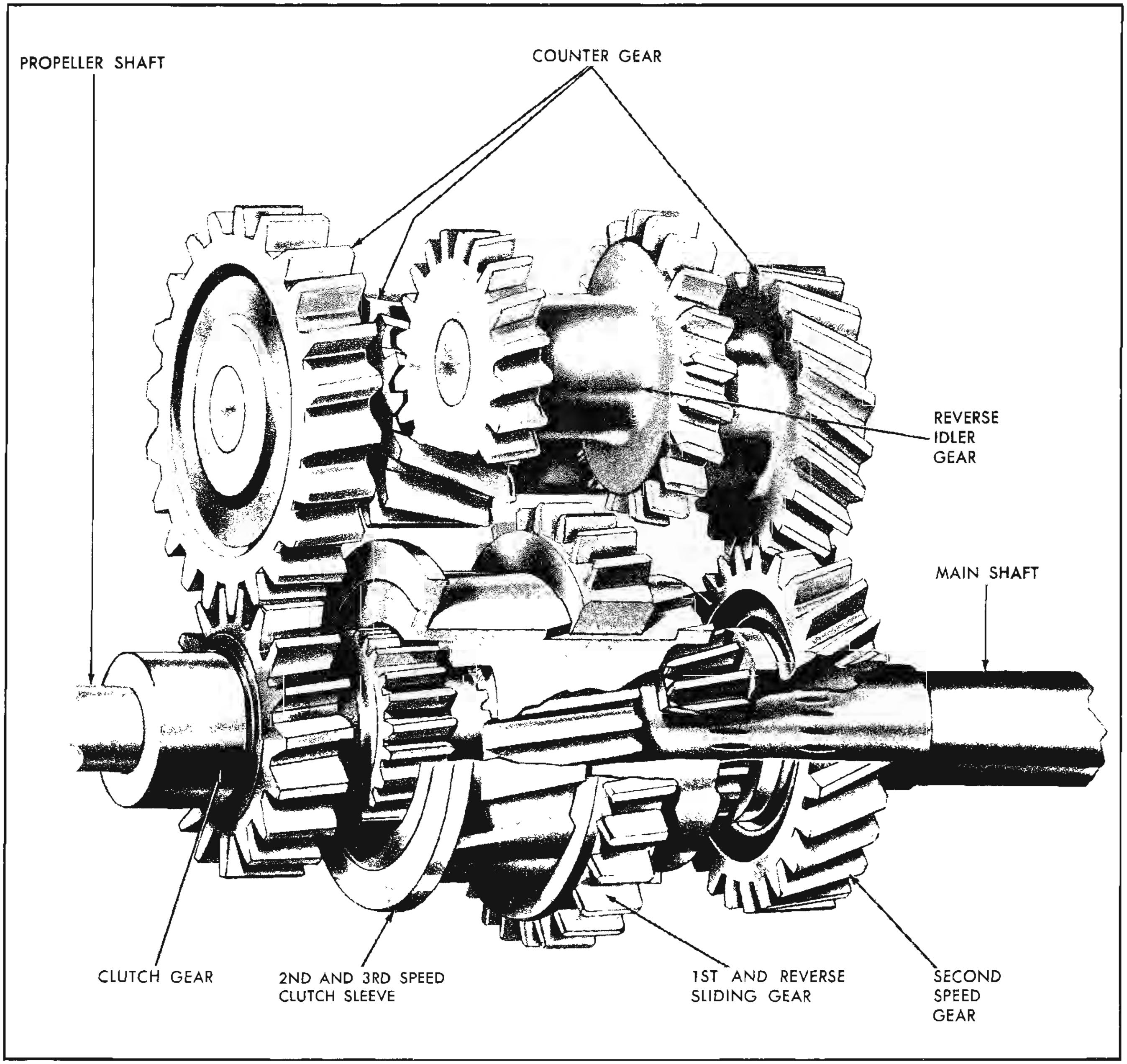



Fig. 7-1 Cut-away of Synchro-Mesh Transmission Gears (Viewed through top of case)

## DESCRIPTION

The Tempest manual three speed synchro-mesh transmission (Fig. 7-1) mounts on the differential carrier at the rear of the car. This light weight and compact transmission shares a common lubrication system with the differential. This is possible because of the inter-connecting holes between the two housings which permit the common lubricant to circulate through both units.

The gearshift lever and control are located at the center just forward of the front seat. A shift control rod connects the gearshift lever and control to the transmission manual shift shaft at the rear of the car.

In the transmission, the manual shift shaft carries a finger which extends upward to engage either the first and reverse fork or the second and third fork, depending on shift lever position. As the two forks are parallel to each other, a slight rotational motion of the shift shaft places the actuating finger in the proper fork and permits the desired shift. An interlock between the two fork shafts holds the fork not being actuated in the neutral crossover position.

The transmission gear ratios for the four cylinder engine are: 2.94:1 in first; 1.68:1 in second; 1.00:1 in third; and 3.32:1 in reverse. Gear ratios for the V-8 engine transmission are: 2.47:1 in first; 1.53:1 in second; 1.00:1 in third; and 2.47:1 in reverse.

The location of first and reverse sliding gear and clutch sleeve determine the different drive ratios in the transmission.

The clutch gear, counter gear, reverse idler gear, and the second speed gear are in constant mesh. No. power is transmitted to the mainshaft unless the first and reverse sliding gear or the clutch sleeve is engaged.

The synchronizer rings in the clutch sleeve bring the clutch sleeve up to the speed of the gear to be engaged. This feature permits smooth engagement when shifting into second and third speeds.

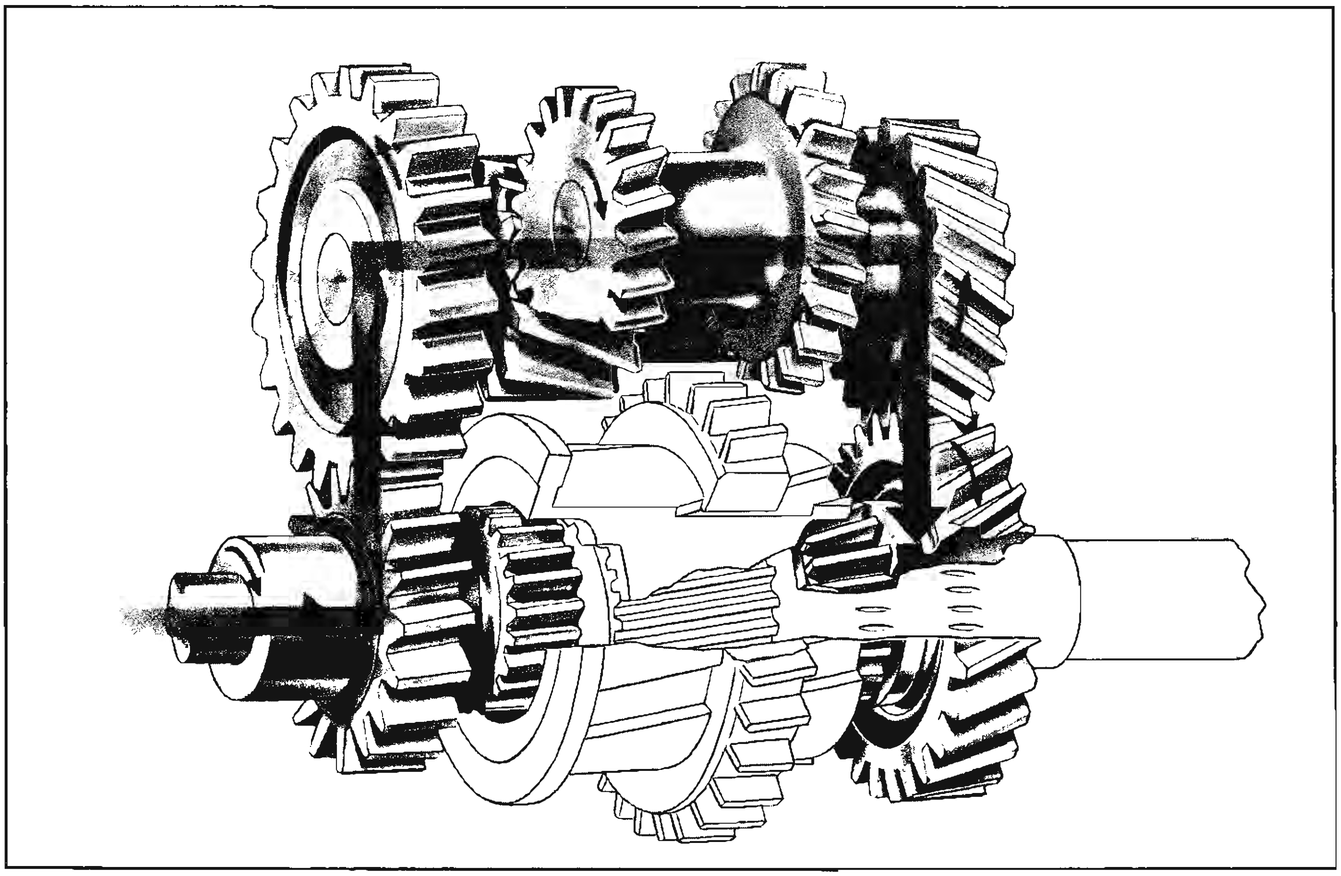


Fig. 7-2 Power Flow with Transmission Gears in Neutral Position

## NEUTRAL (FIG. 7-2)

The clutch sleeve and the first and reverse sliding gear are not engaged with the clutch gear, counter gear, reverse idler gear, or the second speed gear. Therefore, there is no transmission of power to the mainshaft.

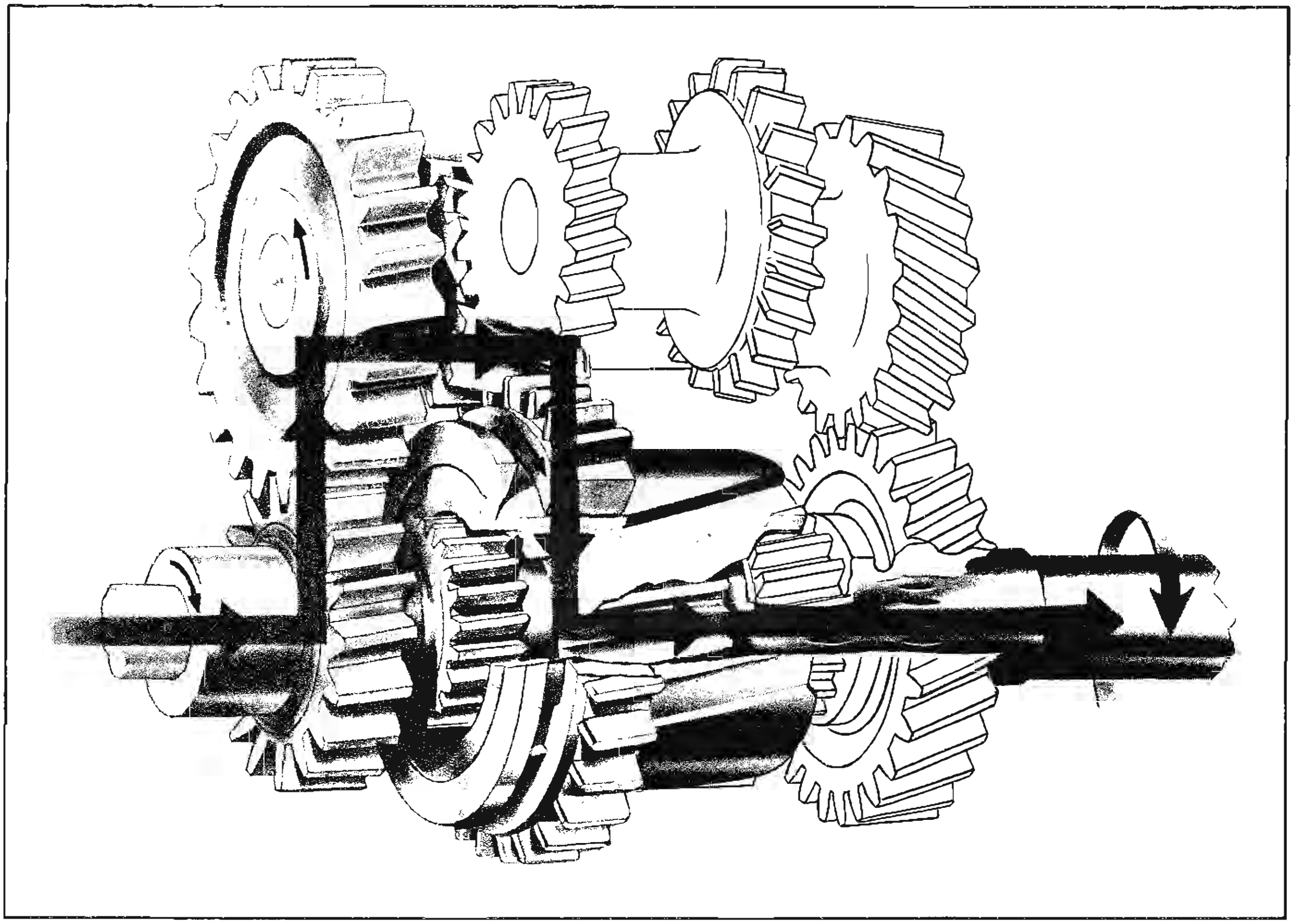


Fig. 7-3 Power Flow with Transmission Gears in First Gear Postion

## FIRST (FIG. 7-3)

The first and reverse sliding gear is positioned forward on the clutch sleeve to engage the counter gear. Power is transmitted to the mainshaft via the clutch gear, counter gear, first and reverse sliding gear, and clutch sleeve.

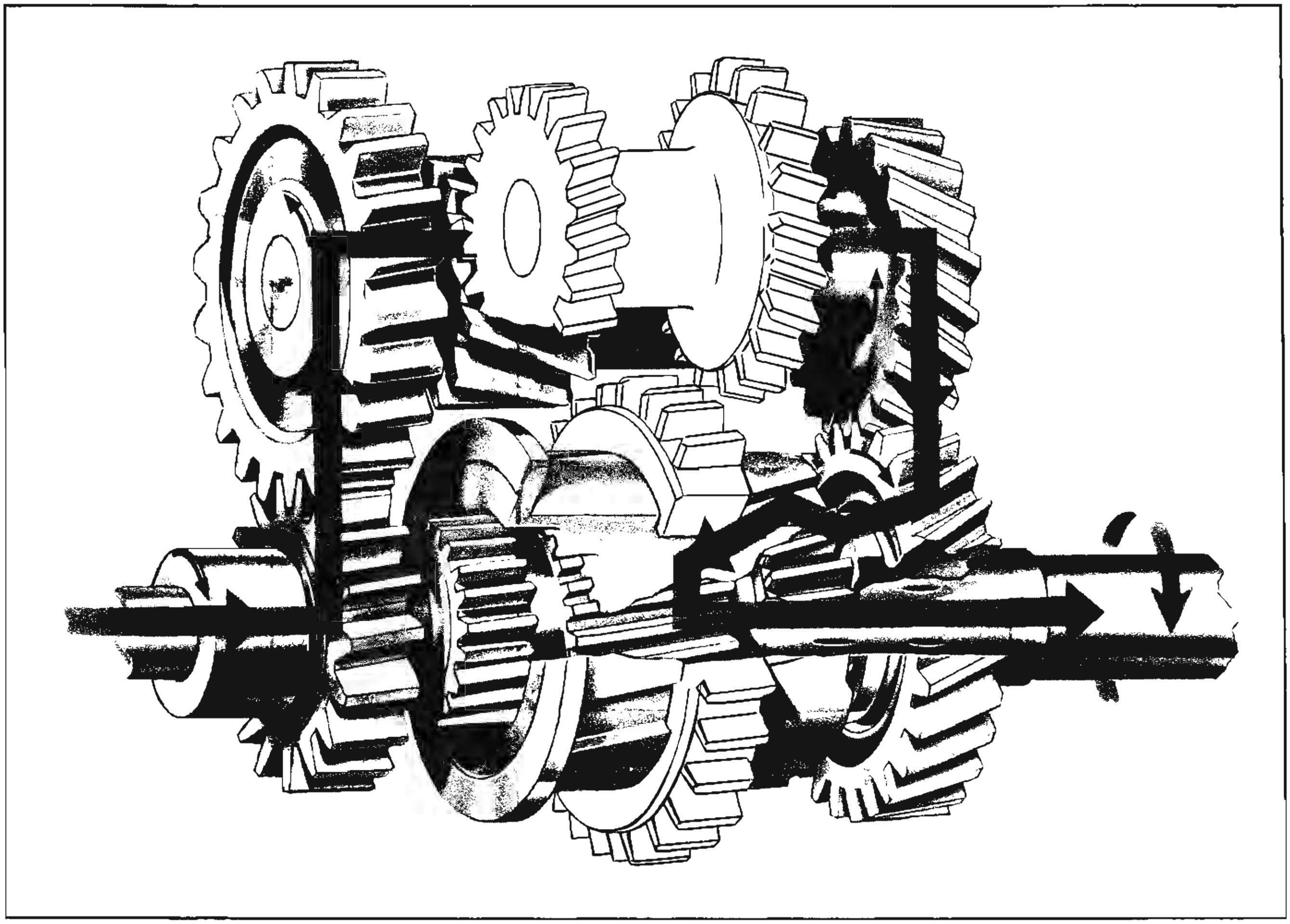


Fig. 7-4 Power Flow with Transmission Gears in Second Gear Position

## SECOND (FIG. 7-4)

The first and reverse sliding gear is disengaged from the counter gear and the clutch sleeve is positioned rearward to engage the second speed gear. Power is transmitted to the mainshaft via the clutch gear, counter gear, second speed gear and clutch sleeve.

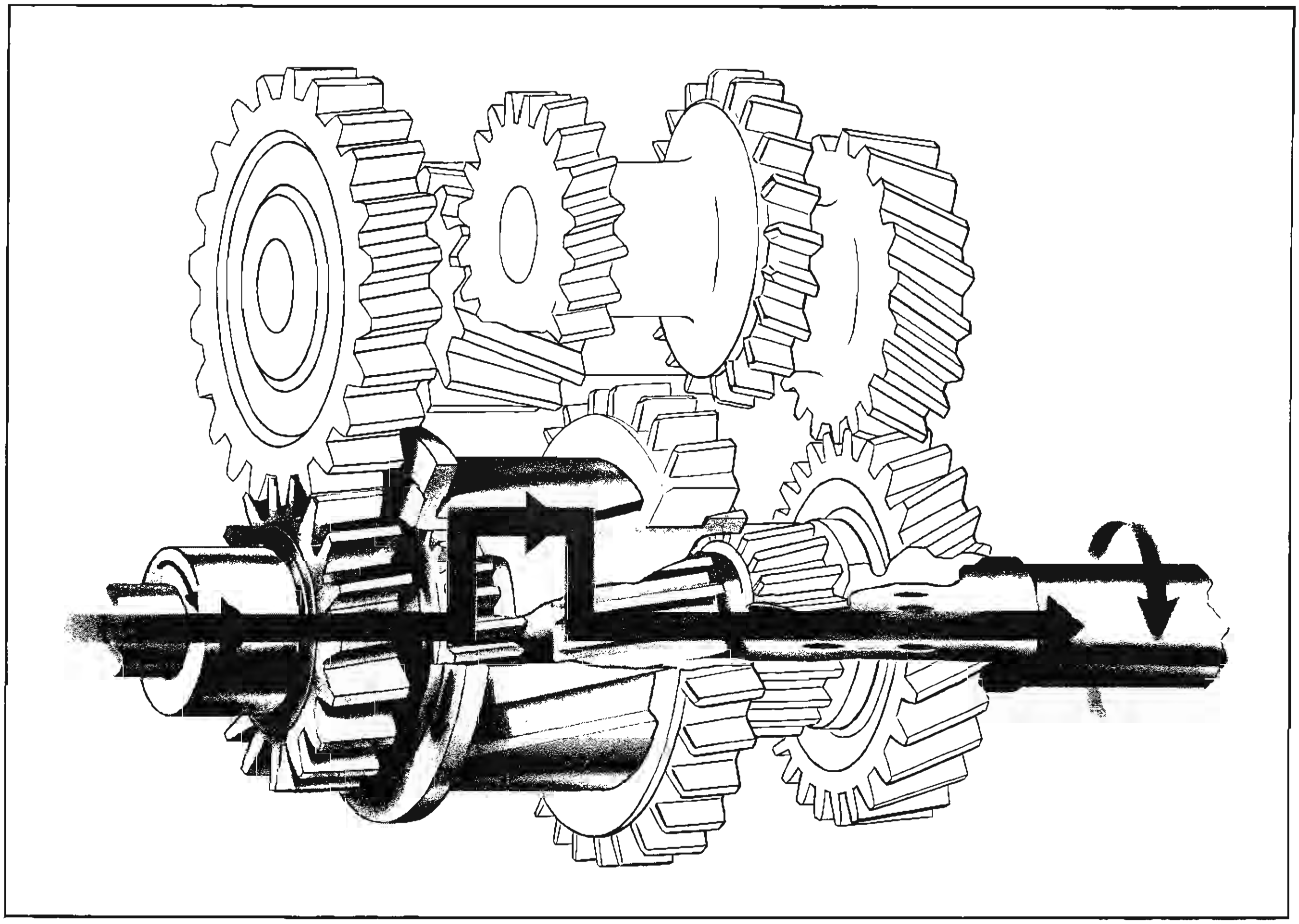


Fig. 7-5 Power Flow with Transmission Gears in Third Gear Position

## THIRD (FIG. 7-5)

The clutch sleeve is repositioned forward, disengaging the second speed gear and engaging the clutch gear. Power is transmitted to the mainshaft via the clutch gear and clutch sleeve.

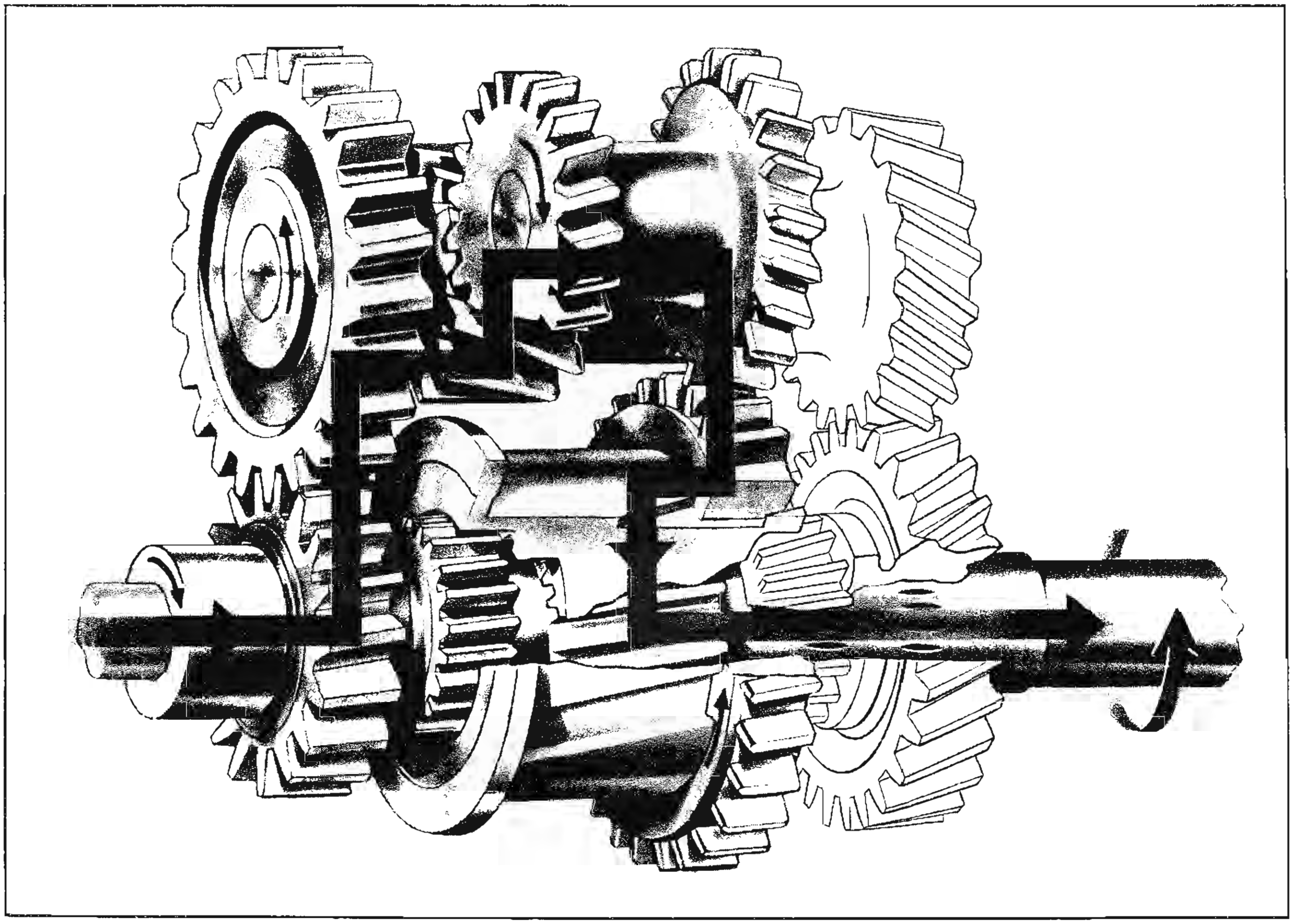


Fig. 7-6 Power Flow with Transmission Gears in Reverse Position

## REVERSE (FIG. 7-6)

The first and reverse sliding gear is positioned rearward to engage the reverse idler gear, with the clutch sleeve disengaged from the clutch gear and second speed gear. Power is transmitted to the main-shaft via the clutch gear, counter gear, reverse idler gear, first and reverse sliding gear, and clutch sleeve.

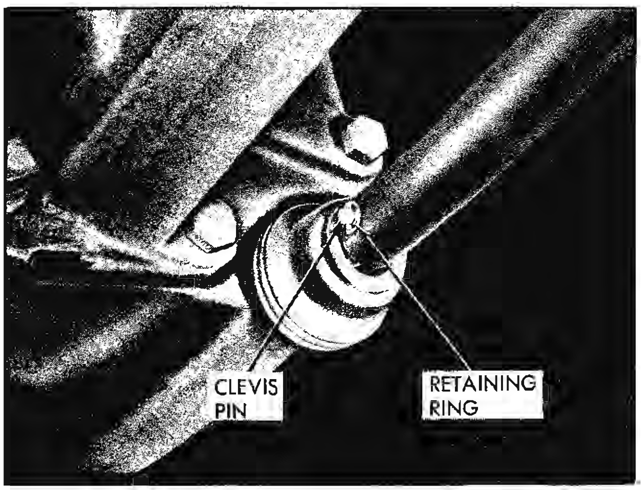



Fig. 7-7 Control Rod Clevis Pin

## GEARSHIFT CONTROL ASSEMBLY

### *REMOVE*

1. Slide boot toward transmission to expose clevis pin (Fig. 7-7). Remove clevis pin retaining ring and clevis pin.

2. Remove ball from control lever.

3. Remove bolts securing transmission gearshift lever and housing to torque tube (Fig. 7-8).

4. Move gearshift lever and housing assembly toward front of car, removing control rod from manual shift shaft.

5. Remove boot from transmission.

### *INSTALL*

1. Position transmission manual shift shaft in neutral gear position.

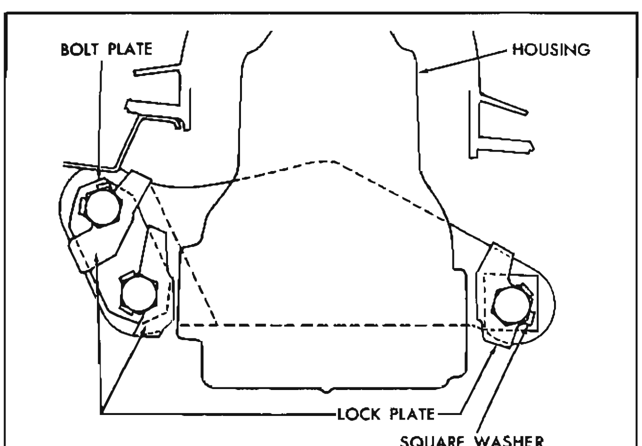



Fig. 7-8 Gearshift Lever and Housing Installation

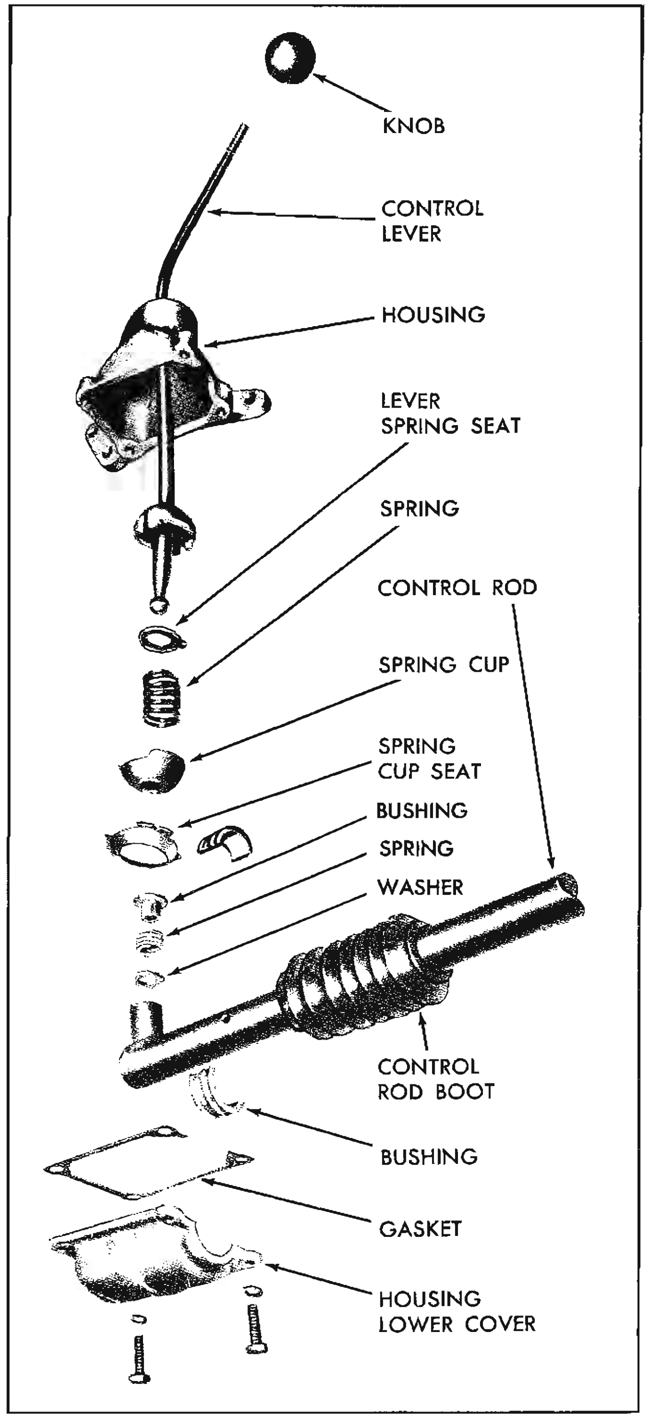



Fig. 7-9—Gearshift Lever and Housing

2. Install manual shift shaft and control rod boot.

3. Install control rod on manual shift shaft and secure with clevis pin and retaining ring (Fig. 7-7).

4. Secure transmission gear shift lever and housing to torque tube (Fig. 7-8). Torque bolts to 10-15 lb. ft.

5. Install ball on control lever.

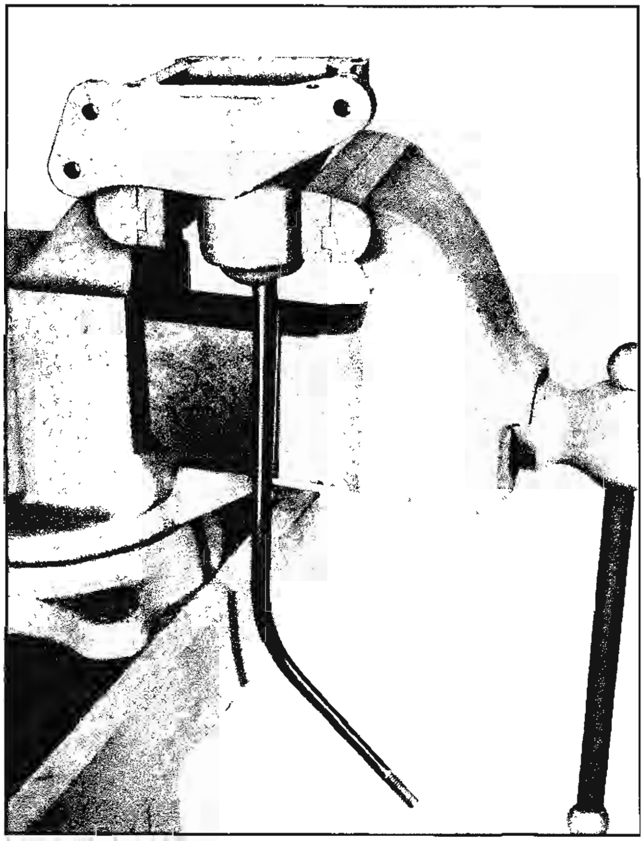


Fig. 7-10 Housing in Vise

## GEARSHIFT LEVER AND HOUSING

### DISASSEMBLE

1. Remove housing lower cover bolts and washers (Fig. 7-9) and remove cover.

2. Lower transmission control rod and remove bushing, spring, and washer from socket (Fig. 7-9). Use wire to support front end of control rod at a convenient height.

3. Remove control lever ball from lever and remove shift control assembly from torque tube.

4. Mount shift control in vise (Fig. 7-10).

5. Depressing spring cup, rotate spring cup seat to disengage it from housing.

6. Remove spring cup seat, spring cup, and spring.

7. Remove control lever and control lever spring seat.

### ASSEMBLE

1. Mount housing in vise.

2. Lightly coat all bearing surfaces with molybdenum disulphide grease.

3. Install control lever spring seat in control lever as shown in Fig. 7-11.

NOTE: It is important that the seat be installed with tab as shown so that spring tension will position lever towards second and high position.

4. Install control lever in housing as shown in Fig. 7-12.

5. Install spring and spring cup. Notches in spring cup must line up with control lever as shown in Fig. 7-13.

6. Install spring cup seat with seat detent aligned to engage housing notch (Fig. 7-14). Depress spring cup and rotate spring cup seat until three seat extensions fully engage three housing shoulders.

NOTE: It is important that the seat is fully engaged or an inoperative control lever may result.

7. Install shift control assembly on torque tube.

8. Install washer, spring, and bushing into control rod socket (Fig. 7-9).

9. Install transmission control rod, engaging boot-retaining groove.

NOTE: Place molybdenum disulphide grease into control rod socket prior to connecting control rod to control lever ball.

10. Install housing lower cover gasket and cover and torque bolts to 4-5 lb. ft.

11. Install control lever knob.

## TRANSMISSION EXTENSION ASSEMBLY

### DISASSEMBLE (FIG. 7-15)

1. Remove extension housing.

2. Remove transmission extension bearing seal using tool J-6292 and slide hammer.

3. Remove bearing retainer rings.

4. Drive out bearings and spacer using tool J-21033 and handle J-7079-2.

### ASSEMBLE (FIG. 7-15)

1. Install rear bearing using tool J-21033 and handle J-7079-2.

2. Install spacer and front bearing in same manner.

3. Install bearing retainer rings.

4. Install new bearing seal using tool J-21033 and handle J-7079-2.

5. Install extension housing.

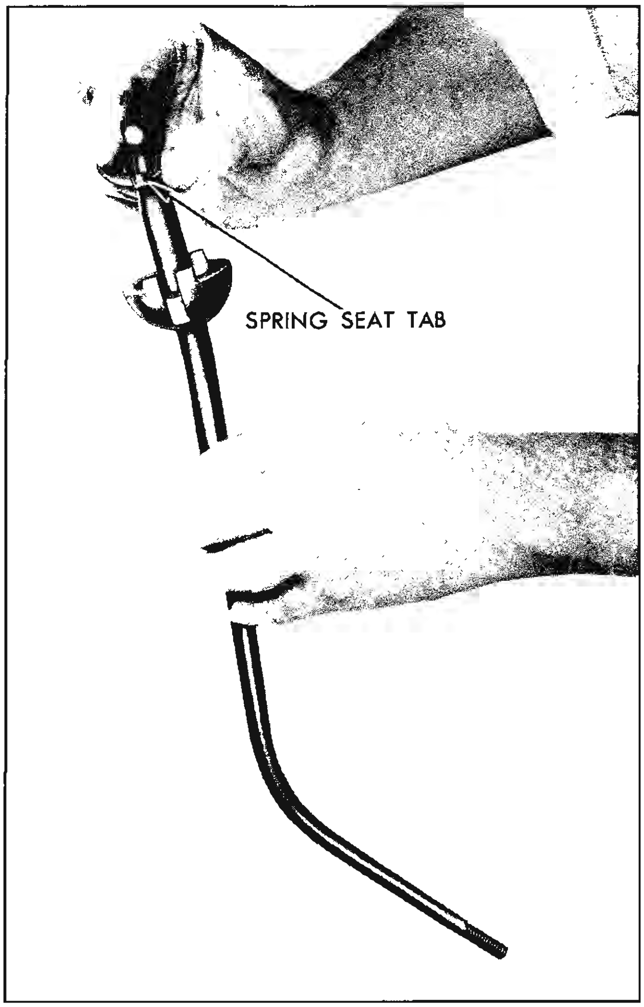



Fig. 7-11 Installing Spring Seat

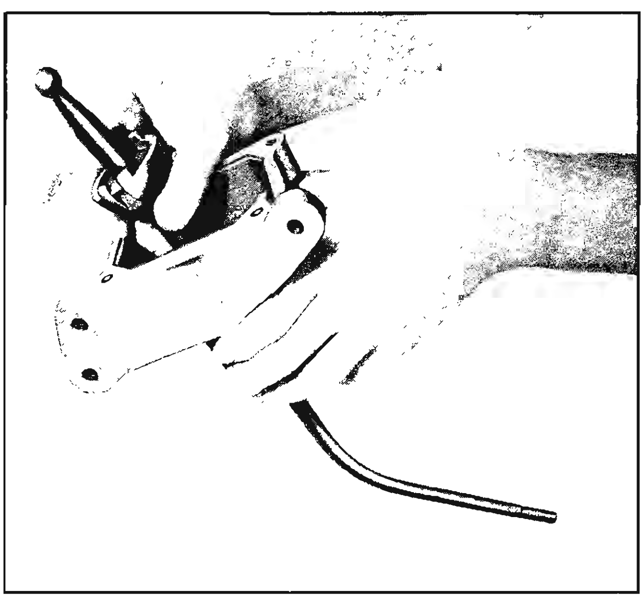


Fig. 7-12 Installing Shift Lever

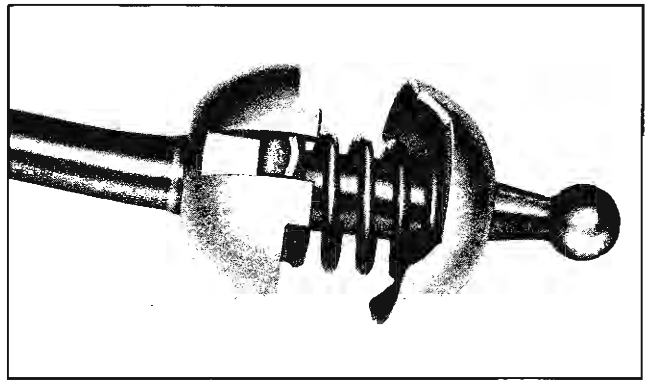


Fig. 7-13 Lining up Spring Cup

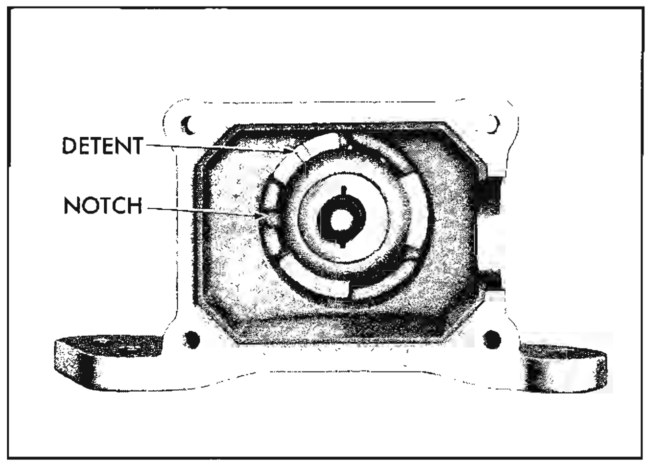
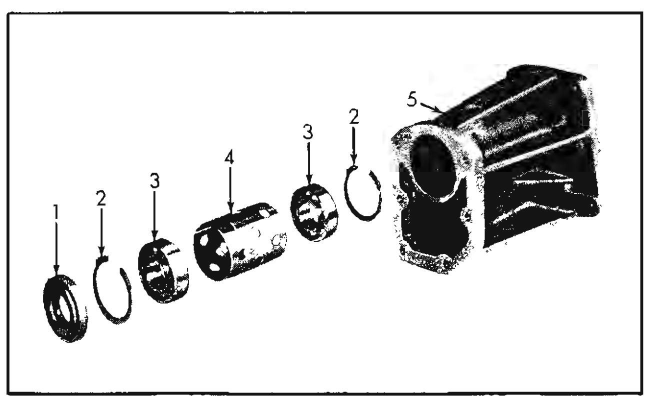



Fig. 7-14 Installing Spring Cup Seat




1. Seal
2. Retaining Ring
3. Bearing
4. Spacer
5. Bearing
6. Retaining Ring
7. Extension Housing

Fig. 7-15 Transmission Extension Assembly

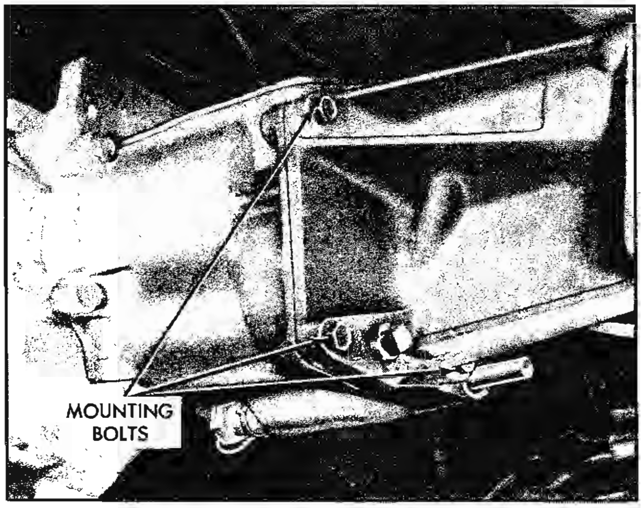



Fig. 7-16 Extension Mounting Bolts

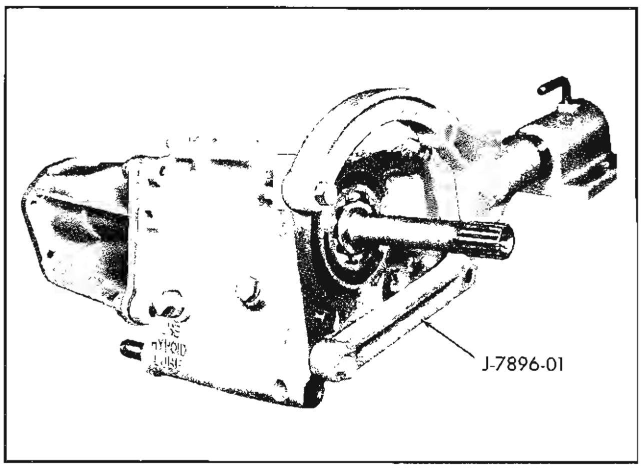



Fig. 7-17 Transmission on Holding Fixture

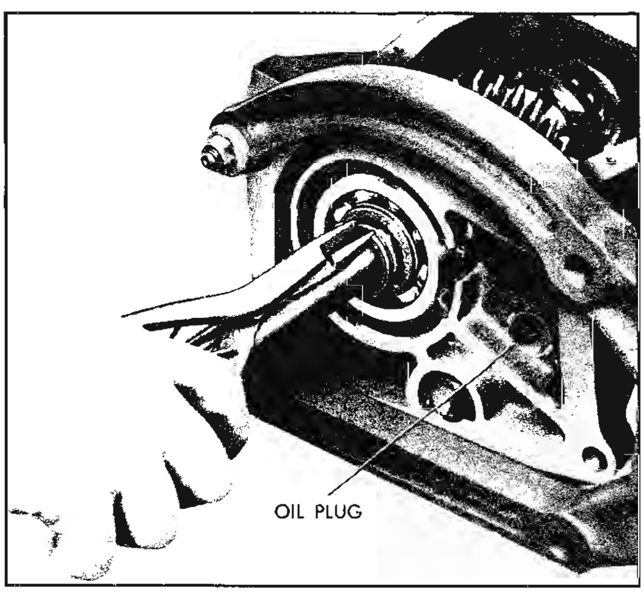



Fig. 7-18 Removing Main Shaft Snap Ring

## REPLACE TRANSMISSION ASSEMBLY

To remove and replace transmission, differential, propeller shaft, and torque tube from car, see Section 4.

## DISASSEMBLE TRANSMISSION

1. Mount transmission on holding fixture J-7896-01 (Fig. 7-17) and remove extension assembly. Do not scratch or dent mounting surface.

2. Remove filler plug.

3. Remove transmission case top cover and gasket.

4. Remove snap ring from mainshift groove at rear of case. Snap ring is immediately behind mainshaft bearing (Fig. 7-18).

5. Drive out clutch gear bearing and clutch gear by driving on mainshaft (Fig. 7-19). Remove clutch gear and bearing.

6. Continue to drive or press mainshaft out of transmission and remove thrust washer.

***CAUTION: Be sure synchronizer ring tangs are lined with the mainshaft splines (Fig. 7-20) prior to driving out shaft, otherwise damage to ring and shaft splines will occur.***

7. Remove second speed gear, first and reverse sliding gear, and second and third speed clutch sleeve from case by lifting out through top cover hole. Remove second speed gear from clutch sleeve.

8. To remove the mainshaft bearing from the case, fully expand retaining ring and start bearing out by tapping on outer race (Fig. 7-21). Then drive bearing out of case.

9. Remove detent cover plug and remove second and third gear detent spring and ball.

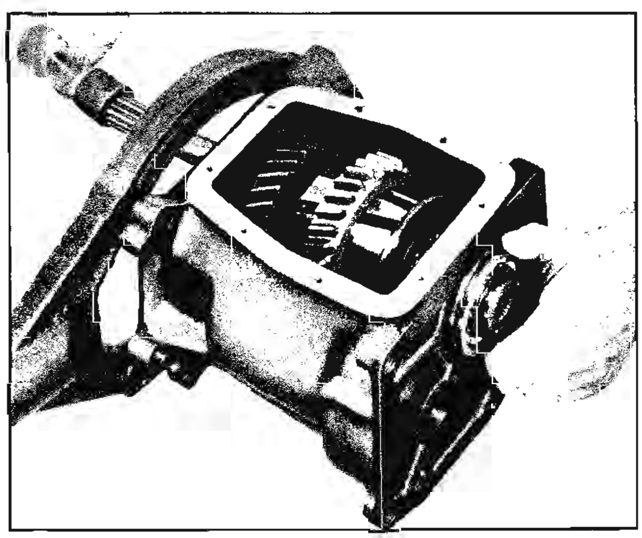


Fig. 7-19 Driving out Clutch Gear and Bearing

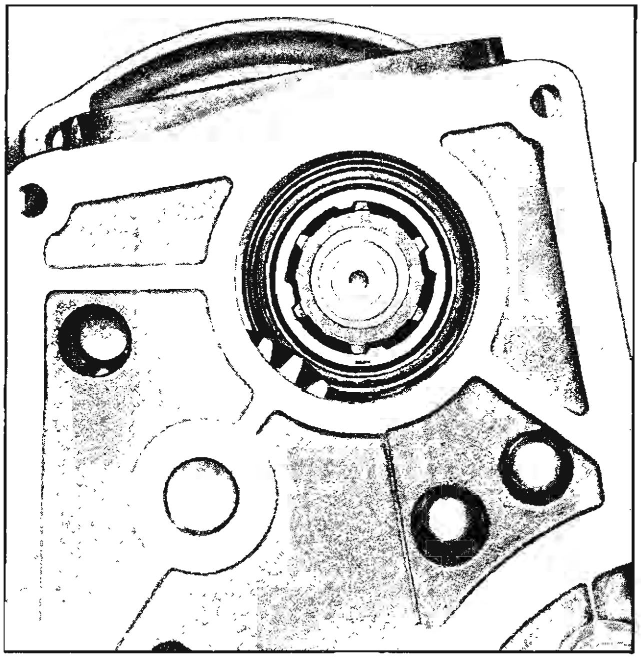


Fig. 7-20 Synchronizer Tangs Aligned with Mainshaft Splines

10. With suitable punch, drive out roll pin securing second and third shift fork (Fig. 7-22) to shaft. Then tap shaft toward front of case with a drift and remove fork, shaft, and roll pin.

11. Remove interlock from detent cavity.

12. Remove first and reverse shift fork and shaft in the same manner as the second and third fork.

13. Remove first and reverse gear detent ball and spring.

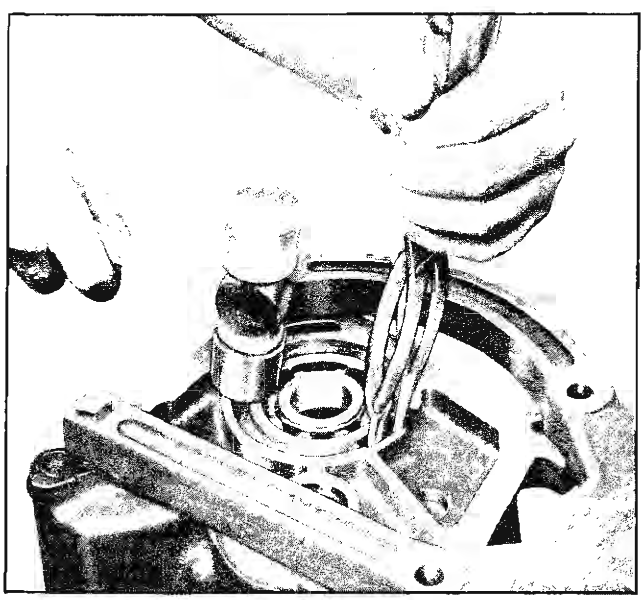


Fig. 7-21 Removing Mainshaft Bearing

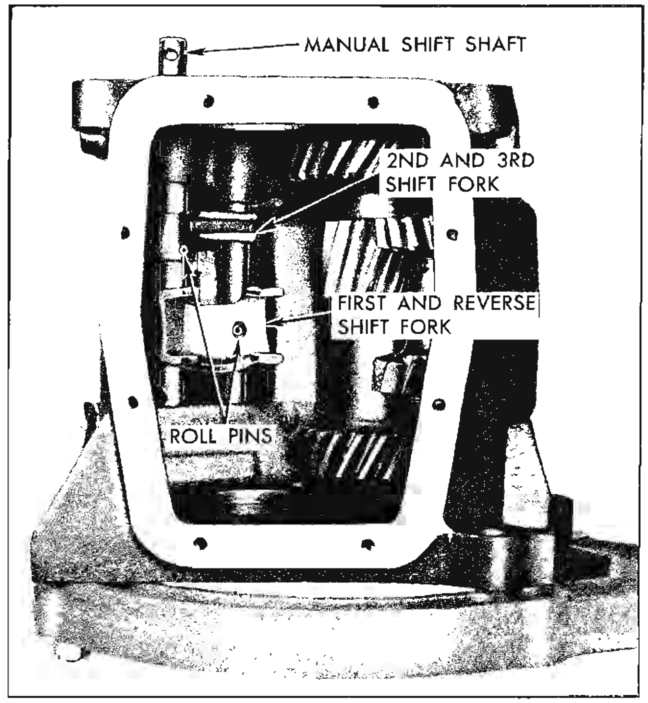



Fig. 7-22 Transmission Shift Forks

14. Remove two cap screws and lockwasher securing shift finger (Fig. 7-23) to manual shift shaft and pull shaft from case.

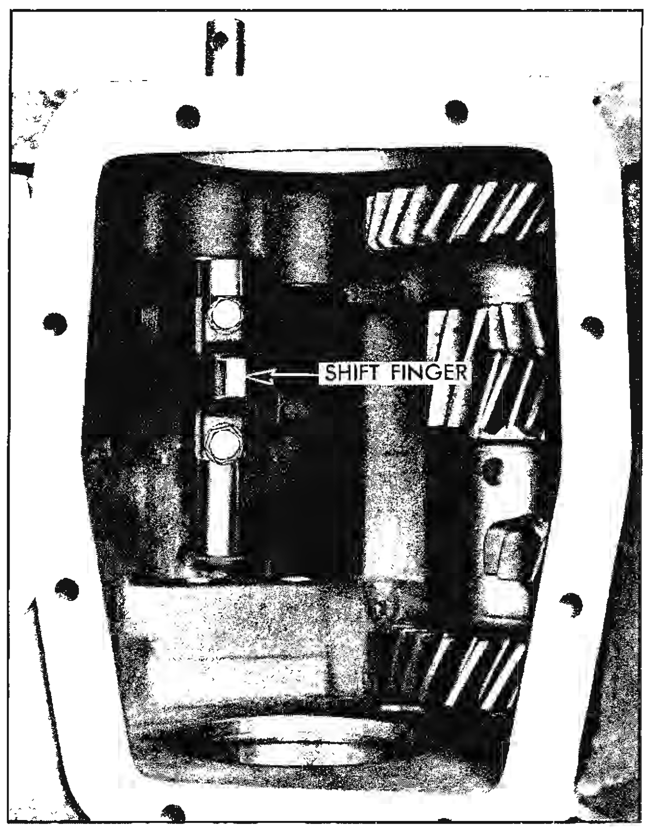



Fig. 7-23 Transmission Shift Finger

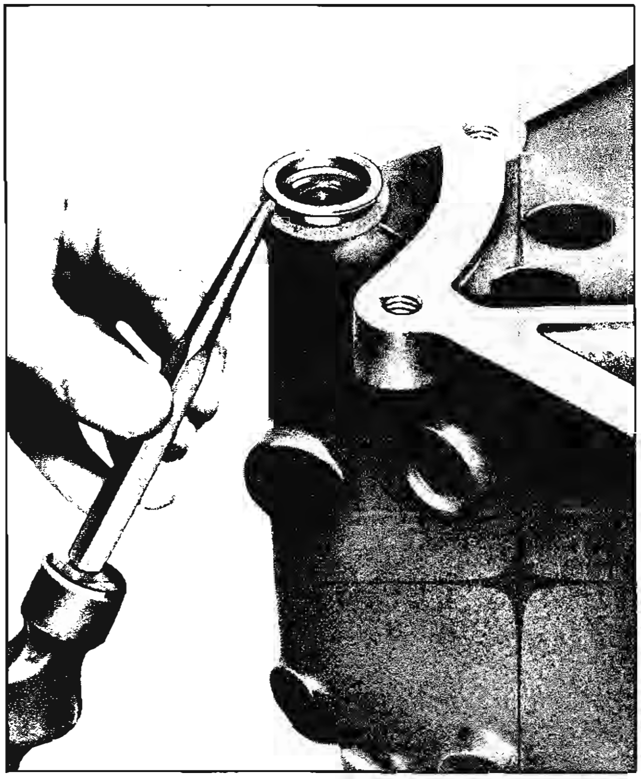


Fig. 7-24 Removing Seal

15. Remove manual shift shaft seal (Fig. 7-24).

16. Remove counter gear and thrust washers by driving counter gear shaft out from rear of case with tool J-5777 (Fig. 7-25).

***CAUTION: Hold counter gear shaft while driving out to insure it is flush with tool J-5777 at all times. This will prevent displacement of any rollers. Be sure tool is free from burrs.***

17. If replacement is anticipated, remove reverse idler gear. To remove, first drive the reverse idler shaft lock pin into the shaft, then drive the reverse idler shaft out of case with a drift from the through hole at the rear of the case. Remove the caged needle bearing and the thrust washer used at the rear of the reverse idler gear.

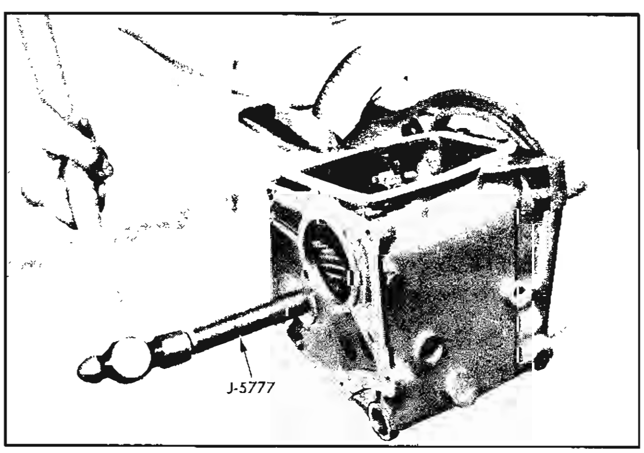



Fig. 7-25 Removing Counter Gear Shaft

18. Remove mainshaft bearing retaining ring from case.

All transmission on components are shown in Fig. 7-26.

## INSPECTION AND REPAIR

### *BEARINGS*

1. Wash bearings thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.

***CAUTION: Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the race and balls.***

3. After making sure bearings are clean, lubricate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

### *TRANSMISSION CASE*

Wash the transmission case inside and out with cleaning solvent and inspect for cracks. Inspect faces for burrs and, if any are present, dress them off with a fine cut mill file.

### GEARS

1. Inspect all gears and, if necessary, replace any that are worn or damaged.

2. Check first and reverse sliding gear to make sure it slides freely on clutch sleeve.

3. Check the clutch sleeve to see that it slides freely on mainshaft.

### *REVERSE IDLER GEAR BUSHINGS*

The bushings used in the idler gear are pressed into the gear then peened into holes in the bores to lock them into place, and are accurately bored with special diamond boring tools. This insures the positive alignment of the bushings and their shafts, as well as proper meshing of the gears. Because of the high degree of accuracy to which these parts are machined, the bushings are not serviced separately.

Check bushings for excessive wear by using a narrow feeler gauge between the shaft and the bushing. The proper clearance is from .002" to .004".

### COUNTER GEAR NEEDLE BEARINGS

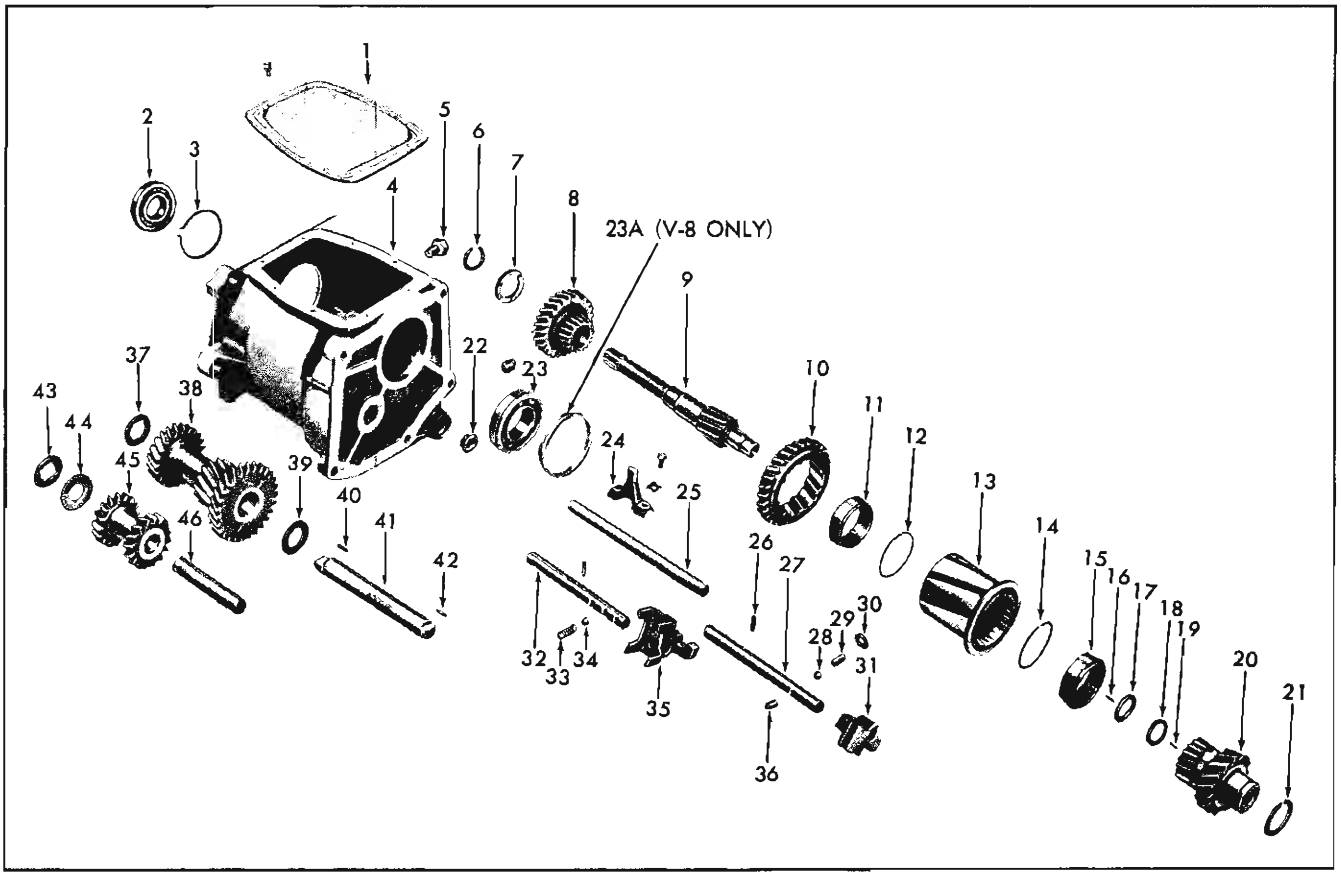
All counter gear bearing rollers should be inspected closely and if excessive wear shows, they should all be replaced as well as the shaft.

To replace the counter gear shaft bearing rollers:

1. Insert tool J-5777 in counter gear.

2. Place some cup grease in the bearing area at each end of the counter gear and install the 25 rollers in each end. The grease will hold the rollers in place while installing (Fig. 7-27).

3. Apply grease to counter gear thrust washers.




1. Top Cover
2. Mainshaft Bearing
3. Bearing Retainer
4. Transmission Case
5. Detent Cap
6. Snap Ring (Selective)
7. Thrust Washer
8. Second Speed Gear
9. Mainshaft
10. First and Reverse Sliding Gear
11. Synchronizer Ring
12. Synchronizer Ring Retainer
13. Second and Third Clutch Sleeve
14. Synchronizer Ring Retainer
15. Synchronizer Ring
16. Roller
17. Spacer
18. Spacer
19. Roller
20. Clutch Gear
21. Clutch Gear Bearing Snap Ring
22. Manual Shift Shaft Seal
23. Clutch Gear Bearing

23A. Brg. Adapter Ring (V-8)

24. Shift Finger
25. Manual Shift Shaft
26. Roll Pin
27. Second and Third Shift Fork Shaft
28. Detent Ball
29. Detent Spring
30. Detent Cap Gasket
31. Second and Third Shift Fork.
32. First and Reverse Shift Fork Shaft
33. Detent Spring
34. Detent Ball
35. First and Reverse Shift Fork
36. Interlock
37. Thrust Washer
38. Counter Gear
39. Thrust Washer
40. Roller
41. Counter Gear Shaft
42. Roller
43. Thrust Washer
44. Caged Needle Bearings
45. Reverse Idler Gear
46. Idler Gear Shaft

Fig. 7-26 Synchro-mesh Transmission Exploded View

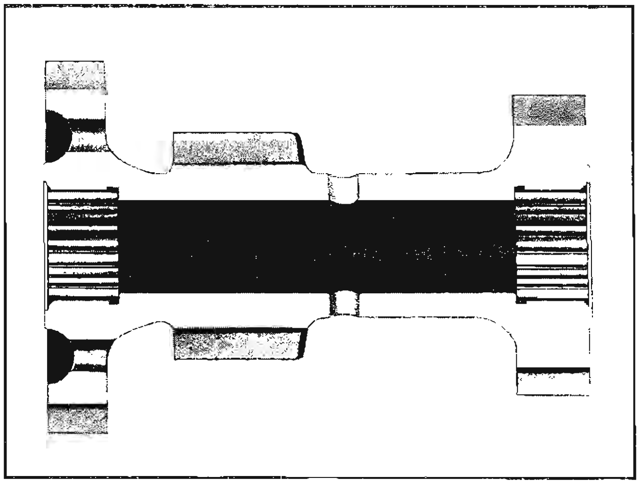


Fig. 7-27 Counter Gear Rollers Installed

***CLUTCH GEAR BEARING REPLACEMENT***

As the clutch gear and bearing are removed as a unit, it will be necessary to drive the clutch gear out of the bearing if replacement of either the gear or the bearing is required.

TO REMOVE:

1. Remove all rollers.

2. Remove snap ring.

3. Place outer race of bearing on top of vise, and tap out clutch gear with a soft hammer (Fig. 7-28).

Installation of new bearing can be accomplished by tapping or pressing new bearing onto clutch gear with a suitable tool (such as J-6133) used on the bearing inner race. Ring groove should be away from gear (Fig. 7-28).

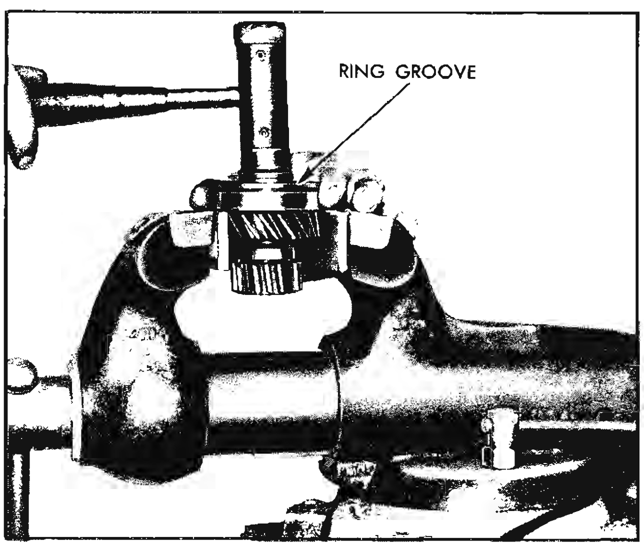



Fig. 7-28 Removing Clutch Gear Bearing

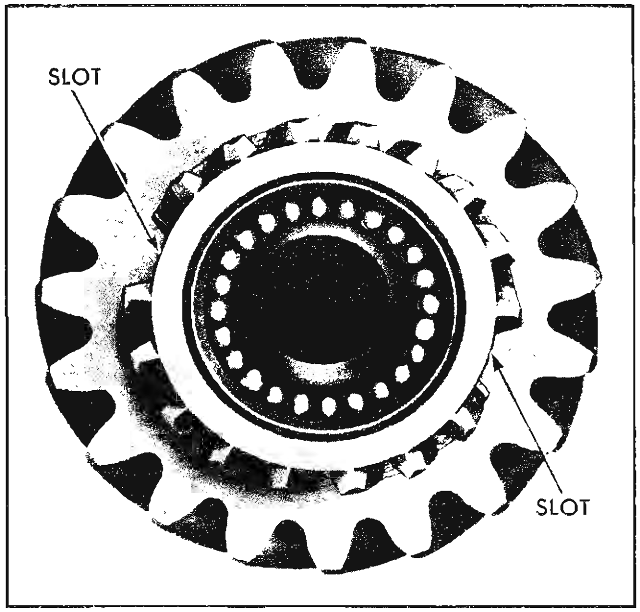



Fig. 7-29 Clutch Gear Needle Bearings

Place some cup grease in the mainshaft pilot hole of the clutch gear and install 26 rollers and small spacer. Then install the large spacer and 28 rollers (Fig. 7-29).

***CLUTCH SLEEVE AND SYNCHRONIZER RINGS***

1. Remove first and reverse sliding gear.

2. Turn synchronizer ring in clutch sleeve until ends of synchronizer ring retainer can be seen through slot in clutch sleeve.

3. Using Tool J-932, expand retainer into counterbore in clutch sleeve. This raises retainer from groove in ring so ring may be easily slipped out (Fig. 7-30).

4. Check synchronizing cones for wear or for being loose in clutch sleeve. If cones are damaged in any way, it will be necessary to replace the clutch sleeve

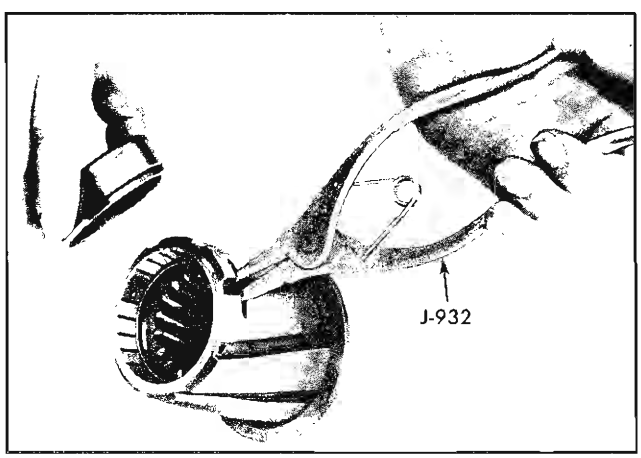



Fig. 7-30 Removing Synchronizer Ring

assembly and both synchronizer rings. Clutch sleeve should be replaced if there is more than .030" end play between cone and synchronizer ring.

5. Inspect synchronizer rings for smoothness.

6. Place synchronizer rings in the synchronizing cones and check with thumbs to see that rings do not rock. Excessive rocking indicates a poor fit between the rings and cone, which will not permit proper synchronizing of gears during shifting.

7. Install synchronizer ring retainers in the counterbores in ends of clutch sleeves.

8. Using Tool J-932 in slot in clutch sleeve, expand each retainer in the counterbore, lubricate each synchronizer ring with light oil and install in clutch sleeve.

NOTE: Look through slot and make sure retainers seat in groove all the way around the rings so they will turn freely.

9. Install first and reverse sliding gear on clutch sleeve.

### *SYNCHRONIZER ENERGIZING SPRINGS*

1. One of the ends of each spring is slightly offset. Each spring must be assembled in its groove in clutch gear and second speed gear with offset or locking end between the third and fourth teeth of either of the two banks of teeth on these gears, thus keeping the spring from turning in its groove (Fig. 7-31).

2. Under normal operation it should never be necessary to replace the energizing springs. However, should an energizing spring be removed for any reason, a new spring should be installed. The spring may be removed by slipping a thin blade under the spring and raising it sufficiently to slide it off over the clutch gear teeth.

***CAUTION: Spring must be carefully installed so as not to expand it greater than the diameter of the clutch gear teeth as the spring will set.***

## ASSEMBLE TRANSMISSION

1. Mount transmission case on J-7896-01.

2. Install manual shift shaft seal.

3. With tab facing out, place thrust washer on same end as larger counter gear and rest counter gear on bottom of case (larger gear toward front of case). Raise counter gear and engage tool J-5777 through thrust washer and into case front hole just enough to hold counter gear in place. Be sure thrust washer tab engages notch in case.

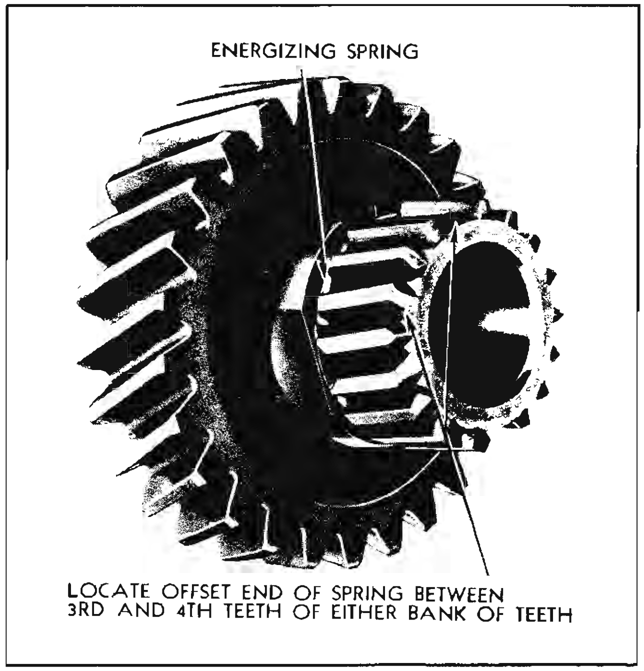



Fig. 7-31 Position of Energizing Spring

4. With tab facing out, insert rear thrust washer (tab engaging notch), insert counter gear shaft at rear of case, and drive out J-5777 with counter gear shaft (notched end facing rear of case). The shaft is a slight press fit at front of case.

***CAUTION: Hold tool J-5777 against counter gear shaft while driving out to insure it is flush with shaft at all times. This will prevent displacement of any rollers. Be sure shaft is free from burrs.***

5. If reverse idler gear was removed, coat needle thrust bearing and thrust washer with grease and position them on reverse idler gear in that order. The

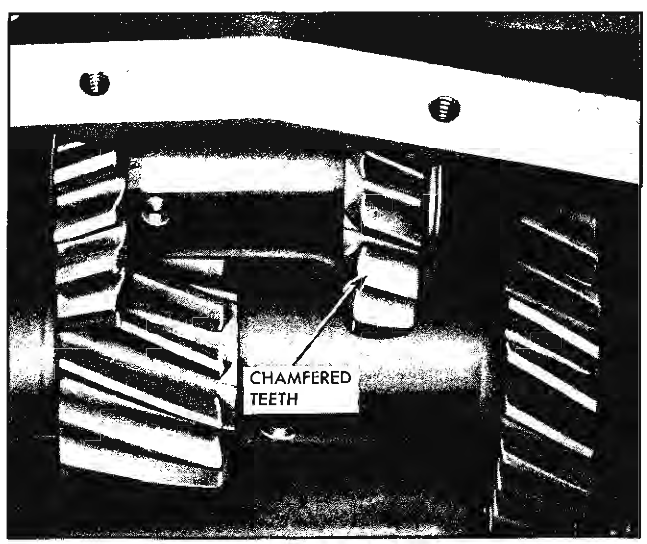



Fig. 7-32 Reverse Idler Gear Installed

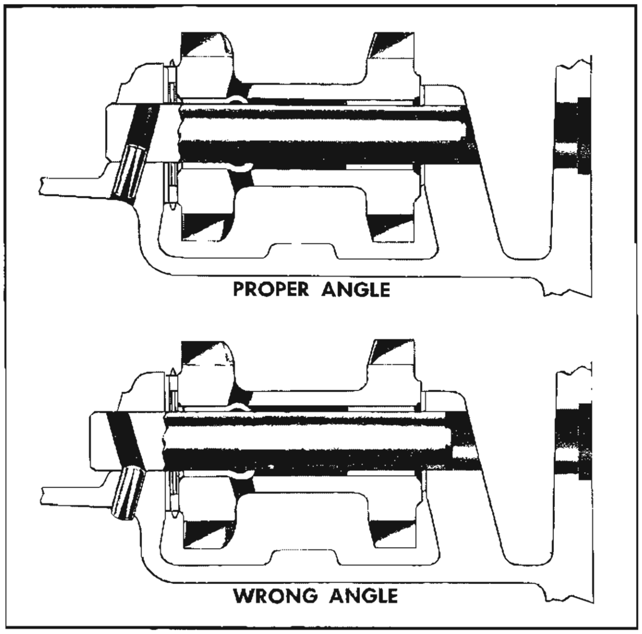



Fig. 7-33 Proper Lock Pin Installation

needle bearing must be against end with chamfered gear teeth (Fig. 7-32). Coat bushings with transmission lubricant.

6. Place reverse idler gear assembly in position in case so thrust bearing is toward rear of case.

7. Install reverse idler shaft from rear, making sure lock pin hole in shaft lines up with hole in the case at same angle (Fig. 7-33).

8. Use a new idler shaft lock pin and drive it in approximately $\frac{1}{16}''$ beyond flush with case. Use a suitable sealer to seal pin when installed.

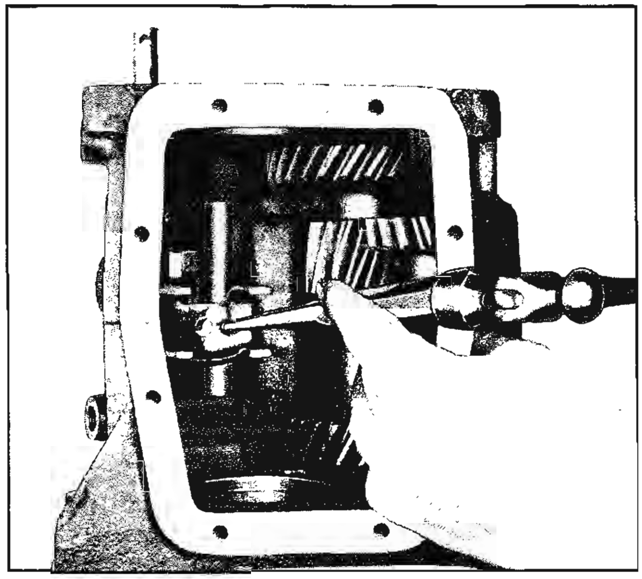


Fig. 7-35 Installing Roll Pin

9. Lubricate manual shift shaft with oil, then insert through seal into case. Position shift finger and secure to shaft with two lockwashers and cap screws. Tighten cap screws to 5-7 lb. ft. torque.

10. Install detent spring and ball (Fig. 7-34), in that order, in detent cavity. Tap ball and spring to insure spring is resting on bottom of cavity.

11. Start roll pin into first and reverse fork. Start first and reverse shift fork shaft (shorter than second and third fork shaft) through lower hole at front of case with three detents facing detent ball and slip fork on shaft. Depressing detent ball, press shaft over ball to center detent position. Secure fork to shaft with roll pin (Fig. 7-35).

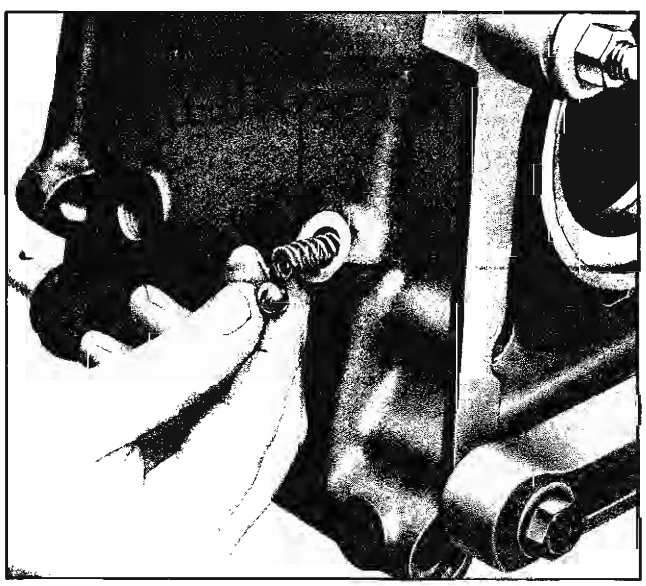


Fig. 7-34 Installing Detent Spring and Ball

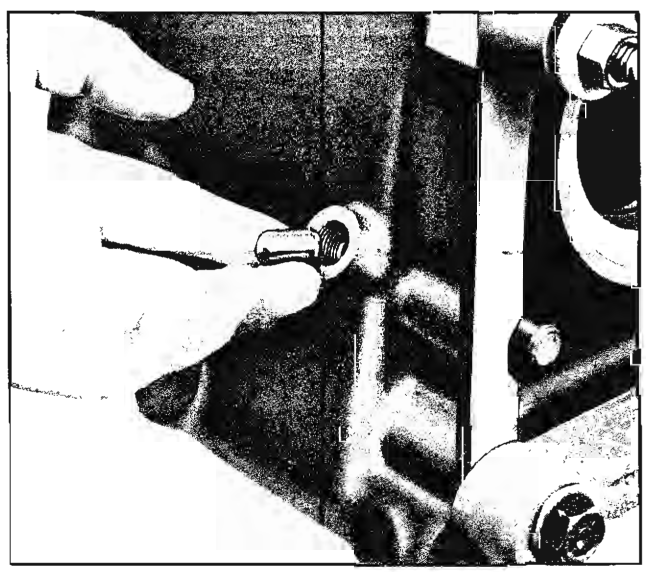


Fig. 7-36 Installing Interlock

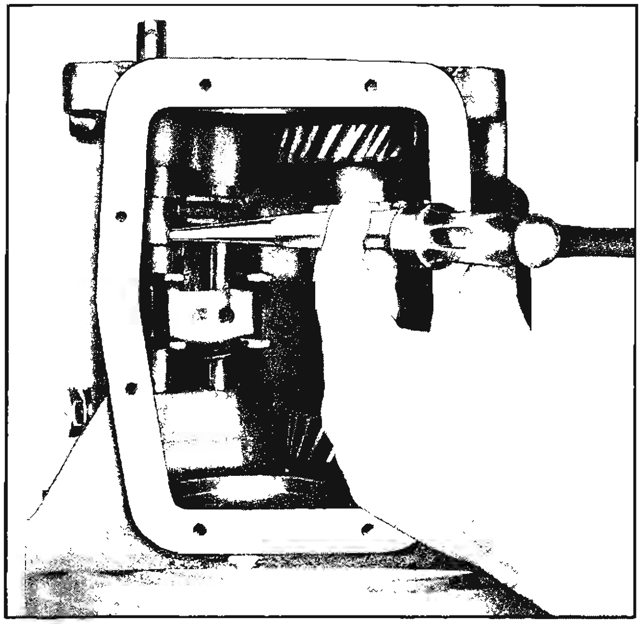


Fig. 7-37 Installing Roll Pin

12. Coat interlock lightly with oil and install in detent cavity (Fig. 7-36).

NOTE: Be sure manual shift lever shift finger is engaged with first and reverse shift fork prior to installing second and third shift fork.

13. Start roll pin into fork. Insert second and third shift fork shaft through front of case with three detents facing away from interlock, and slip fork onto shaft. Secure shift fork to shaft with roll pin (Fig. 7-37).

14. Move second and third shift fork shaft to center detent position and insert detent ball and spring (in that order). Install detent cavity cover and gasket and torque to 25-35 lb. ft.

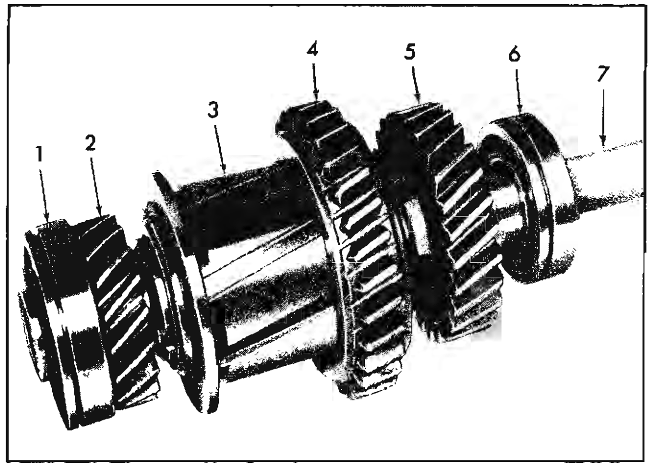
NOTE: Check for free movement of manual shift shaft in all gear positions after installing detent plug.

15. Check synchronizer rings to be sure they turn freely.

16. Indexing properly with synchronizer ring tangs, install second speed gear (5, Fig. 7-38) in clutch sleeve.

17. Place assembled clutch sleeve, first and reverse sliding gear, and second speed gear in case (with second speed gear at rear of case). Make sure first and reverse sliding gear and shoulder on clutch sleeve are in proper forks.

18. Place mainshaft in clutch gear and, from front of case, insert mainshaft through bores of clutch sleeve and second speed gear (Fig. 7-39).




1. Clutch Gear Bearing
2. Clutch Gear
3. Second and Third Clutch Sleeve
4. First and Reverse Sliding Gear
5. Second Speed Gear
6. Mainshaft Bearing
7. Mainshaft

Fig. 7-38 Stack-up of Components on Mainshaft

***CAUTION: Be sure that tangs of synchronizer ring are aligned wth mainshaft splines (Fig. 7-20) before installing mainshaft and that clutch gear slots (Fig. (7-29) are properly aligned with larger tangs on synchronizer ring.***

19. Drive clutch gear bearing into place (Fig. 7-40).

20. Place transmission and fixture on bench. Install thrust washer on mainshaft with its oil grooves toward second speed gear.

21. Install mainshaft bearing retainer ring.

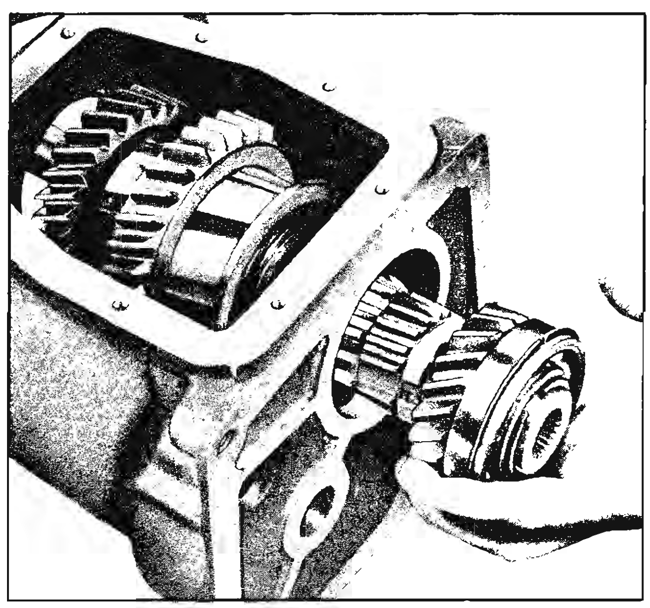


Fig. 7-39 Installing Mainshaft and Clutch Gear

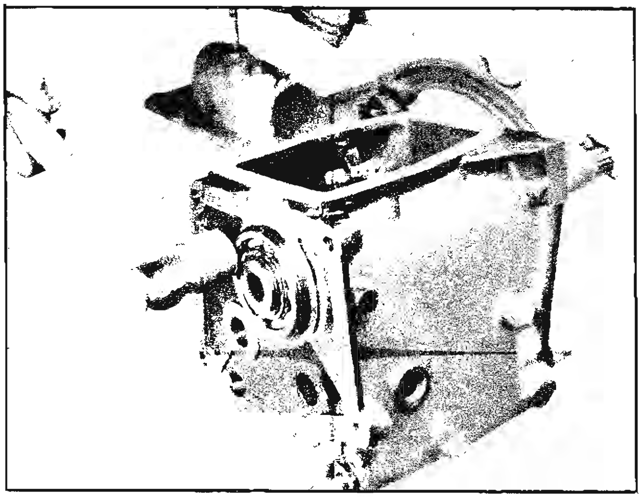


Fig. 7-40 Installing Clutch Gear Bearing

22. Install mainshaft bearing with ring groove toward case and, with retainer ring expanded, drive bearing onto mainshaft with tool J-6133 (Fig. 7-41).

23. Install ½" deep socket in clutch gear and continue to drive on mainshaft bearing until the snap ring groove on mainshaft is accessible (Fig. 7-42).

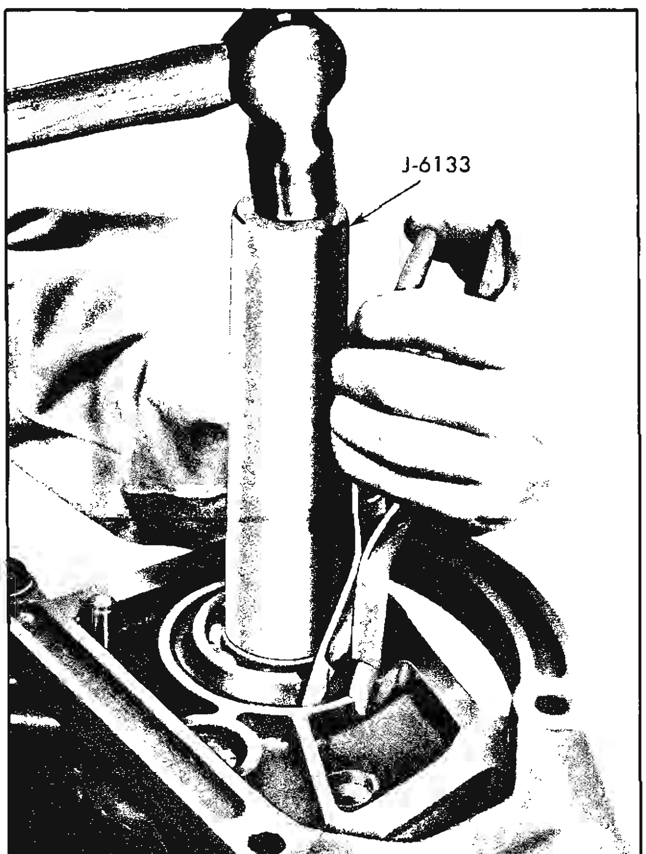



Fig. 7-41 Installing Mainshaft Bearing

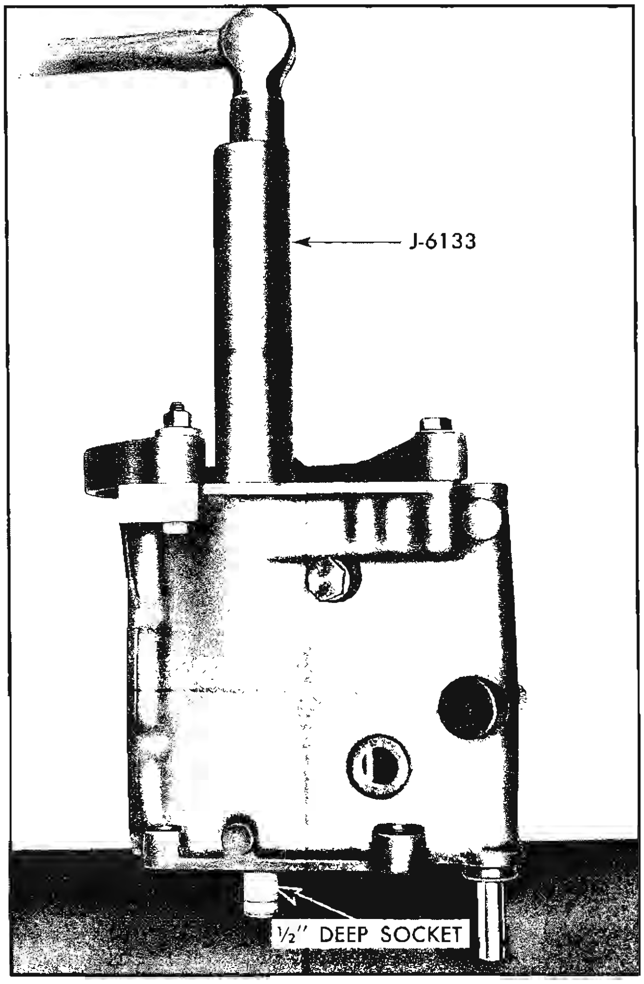



Fig. 7-42 Making Snap Ring Groove Accessible

Remove ½" deep socket.

24. Install snap ring. Check end play of mainshaft by inserting feeler gauge between snap ring and bearing inner race. Final end clearance must be .004" maximum. Change to applicable thickness snap ring if original does not meet this limit. Snap rings are available in four (4) thicknesses, ranging from .086" to .097".

NOTE: After making this check, drive mainshaft forward into case until snap ring contacts bearing inner race.

25. Check for free movement of manual shift shaft to be sure each gear position may be easily obtained.

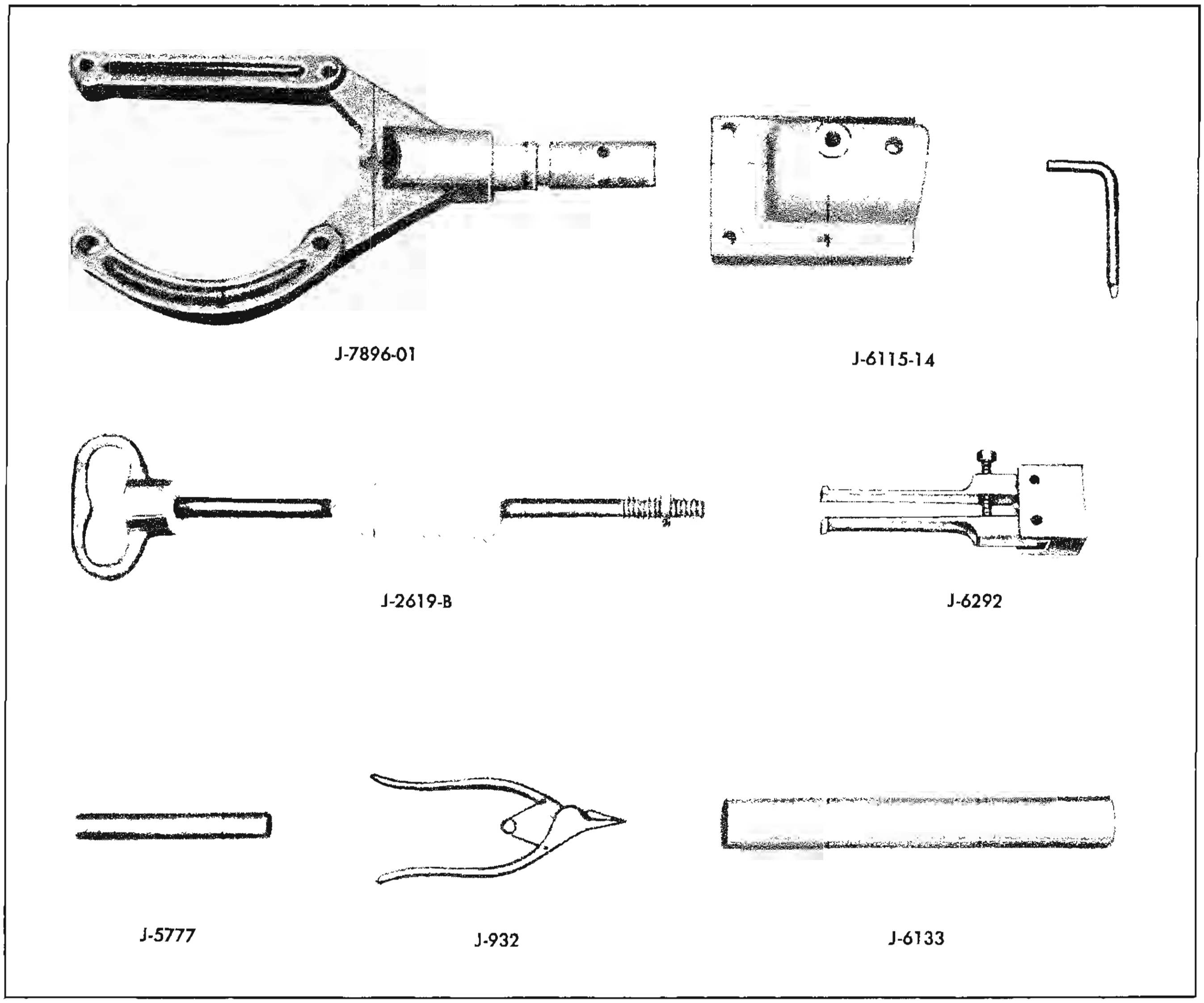
26. Install top cover and gasket. Tighten top cover bolts to 3-4 lb. ft.

27. Install extension assembly. Torque bolts to 35-40 lb. ft.

28. Make sure oil plug is properly installed (Fig. 7-18).

## TORQUE SPECIFICATIONS

| | Lb. Ft. | | Lb. Ft. |
|---|---|---|---|
| Gearshift Lever Housing to Torque Tube Bolts | 10-15 | Detent Cavity Cover | 25-35 |
| Shift Lever Housing Cover Bolts | 4-5 | Top Cover Bolts | 3-4 |
| Shift Finger to Shift Shaft Cap Screws | 5-7 | Extension to Transmission Bolts | 35-40 |




J-7896-01 Transmission Holding Fixture
J-6115-14 Holding Fixture Base
J-2619-B Slide Hammer
J-6292 Extension Housing Seal Remover
J-5777 Counter Shaft Roller Loader
J-932 Synchronizer Ring Retainer Pliers
J-6133 Mainshaft Bearing Installer
J-21033 Extension Housing Oil Seal Installer
J-7079-2 Handle

Fig. 7-43 Special Tools

# AUTOMATIC TRANSMISSION

CONTENTS OF THIS SECTION



## GENERAL DESCRIPTION

The automatic transmission used in the Pontiac Tempest consists of an air cooled, three element torque converter and a two speed planetary transmission.

The transmission is attached to the differential carrier assembly to form a transmission-axle assembly. As a result, the converter is mounted on the opposite side of the carrier from the transmission. Two shafts run axially through the differential pinion shaft, transmitting torque from the engine to the converter and back to the transmission assembly.

Torque multiplication is obtained both hydraulically through the converter and mechanically through a planetary gear set. The transmission provides neutral, low range, direct drive and reverse. Gear ratios are 1.76 in low and reverse and 1:1 in direct drive. The components of the transmission are shown schematically in Fig. 7A-1.

The transmission used with the 326 V-8 engine is of a different calibration than that used with the four cylinder engine. Under no circumstances should the 326 engine transmission or transmission-axle assembly be interchanged with the four cylinder.

The primary differences found in these two units are in the number of plates in the clutch packs, the downshift timing valve, modulator and governor. See the Master Parts Catalog for complete part number information.

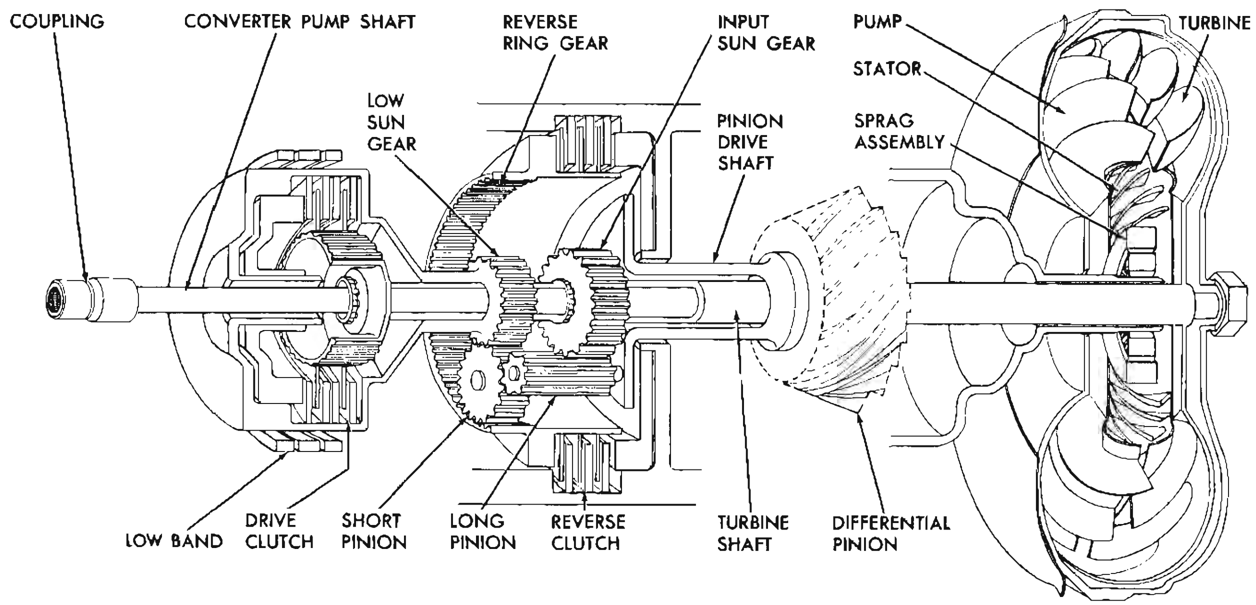



Fig. 7A-1 Transmission—Axle Schematic

## TORQUE CONVERTER OPERATION

The torque converter is a device which multiplies engine torque when required. The converter assembly has three members; a driving member called the converter pump, a driven member called the turbine, and a stator located between the pump and turbine. The three components are immersed in oil. The converter pump is mechanically connected, through the converter pump and propeller shafts, to the engine. When the engine is running, oil within the converter cavity is maintained under pressure by the oil pump. Oil is then picked up at the inner section of the converter pump and directed to its outer edges where it is thrown against the curved blades in the turbine. This causes the turbine to rotate, driving the turbine shaft. As the oil leaves the turbine blades it is traveling in a direction opposite to the pump rotation. The blades of the stator (curved in the opposite direction to those in the turbine) change the direction of oil flow so that the oil strikes the back side of the converter pump blades helping to drive the pump. Therefore, the total torque transmitted to the drive line is the combination of engine torque plus the additional torque supplied by the redirected oil striking the back side of the converter pump blades.

The stator is mounted on a sprag clutch, which holds the stator from moving in a reverse direction when the unit is acting to multiply torque. As the turbine speed approaches pump speed there is progressively less torque multiplication. The stator, which in the beginning was standing still, is picked up by the rapidly rotating oil and accelerates until the pump, turbine and stator are turning at almost the same speed. When the stator rotates, interference in the oil flow between the turbine and pump is minimized. When all three members are turning together there is no torque multiplication in the converter and it is acting as a fluid coupling.

Following is a description of the power flow in each of the transmission ranges.

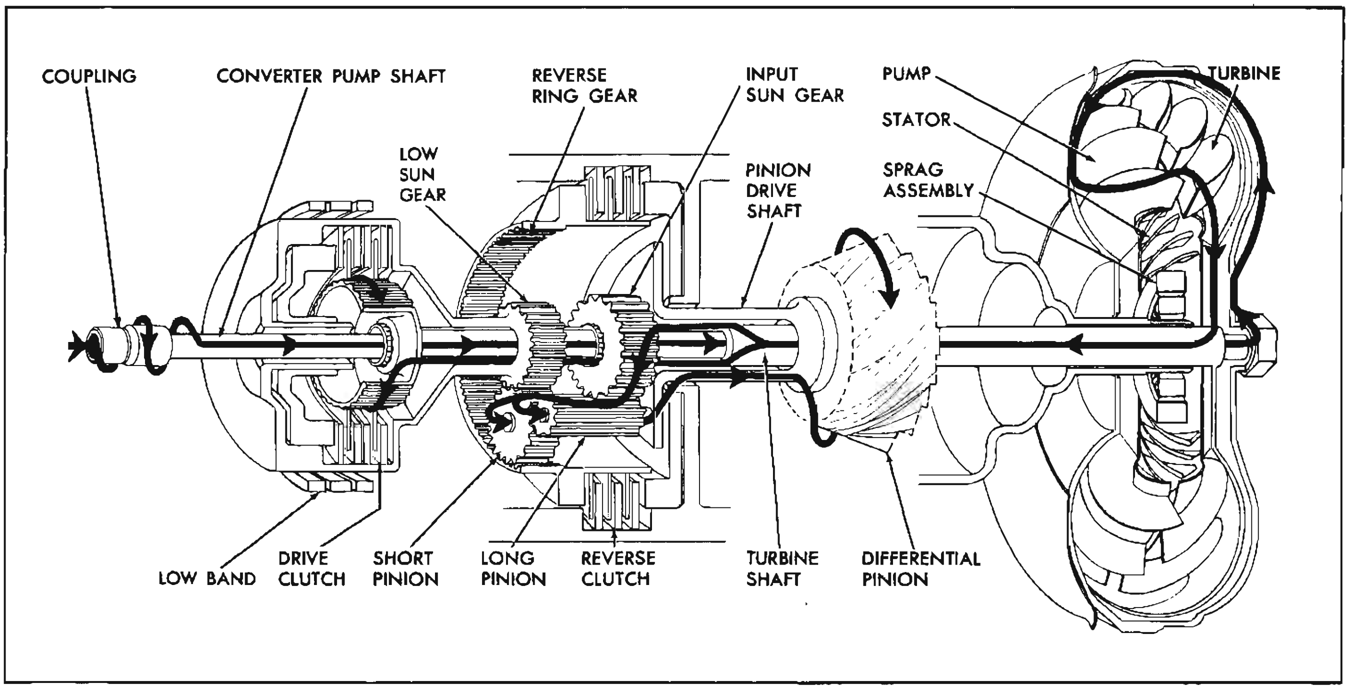



Fig. 7A-2 Power Flow—Neutral

## POWER FLOW

### *POWER FLOW NEUTRAL (FIG. 7A-2)*

Engine torque is transmitted by the propeller shaft through the coupling to the converter pump shaft. This shaft extends through the entire transmission and differential assembly to the torque converter where it drives the converter pump. The converter pump in turn drives the turbine which is connected to the turbine shaft. The input sun gear driven by the turbine shaft drives the long pinions which are engaged with the short pinions. The short pinions in turn drive the low sun gear. Since the reverse clutch, low band and drive clutch are in a released position no power can be further transmitted and the unit is in neutral.

SUMMARY—NEUTRAL

Low Band — Released

Drive Clutch — Released

Reverse Clutch — Released

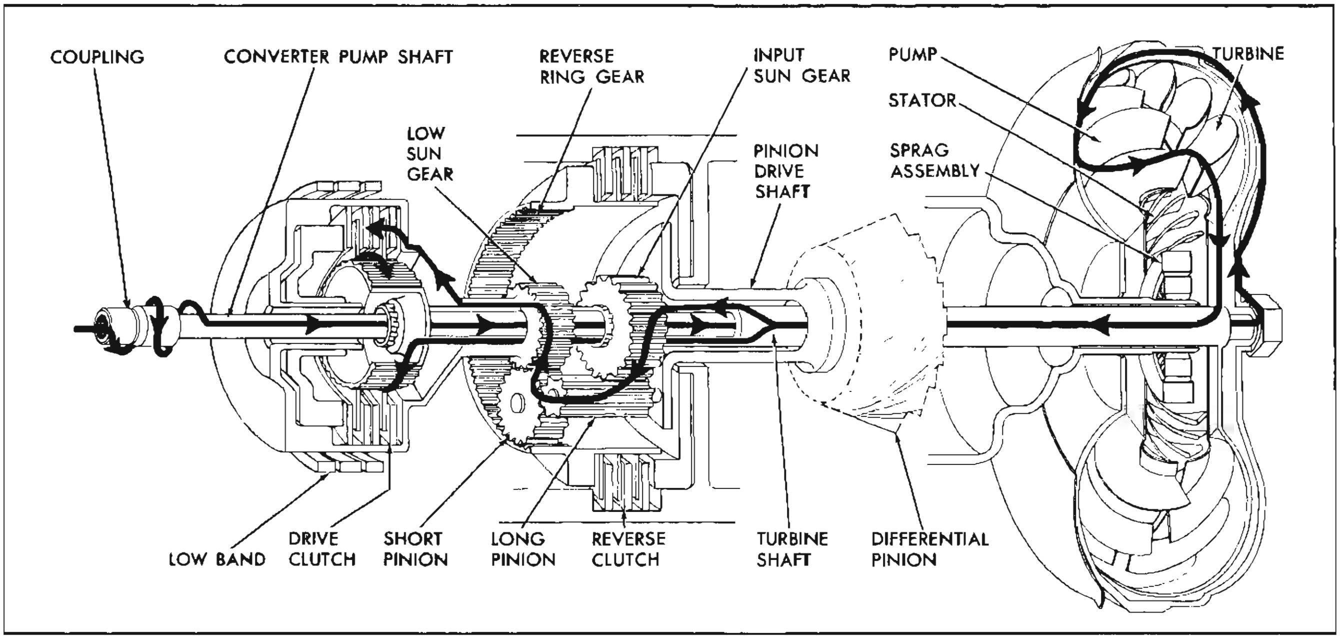



Fig. 7A-3 Power Flow—Low

***POWER FLOW—LOW (FIG. 7A-3)***

Engine torque is transmitted by the propeller shaft through the coupling to the converter pump shaft. This shaft extends through the entire transmission and differential assembly to the torque converter where it drives the converter pump. The converter pump in turn drives the turbine which is connected to the turbine shaft. The input sun gear, driven by the turbine shaft, drives the long pinions which are engaged with the short pinions.

With the low band applied the low sun gear is held stationary, this causes the planet carrier to rotate around the low sun gear in the same direction as engine rotation and in reduction.

The planet carrier in turn drives the differential pinion.

SUMMARY—LOW

Low Band — Applied

Drive Clutch — Released

Reverse Clutch — Released

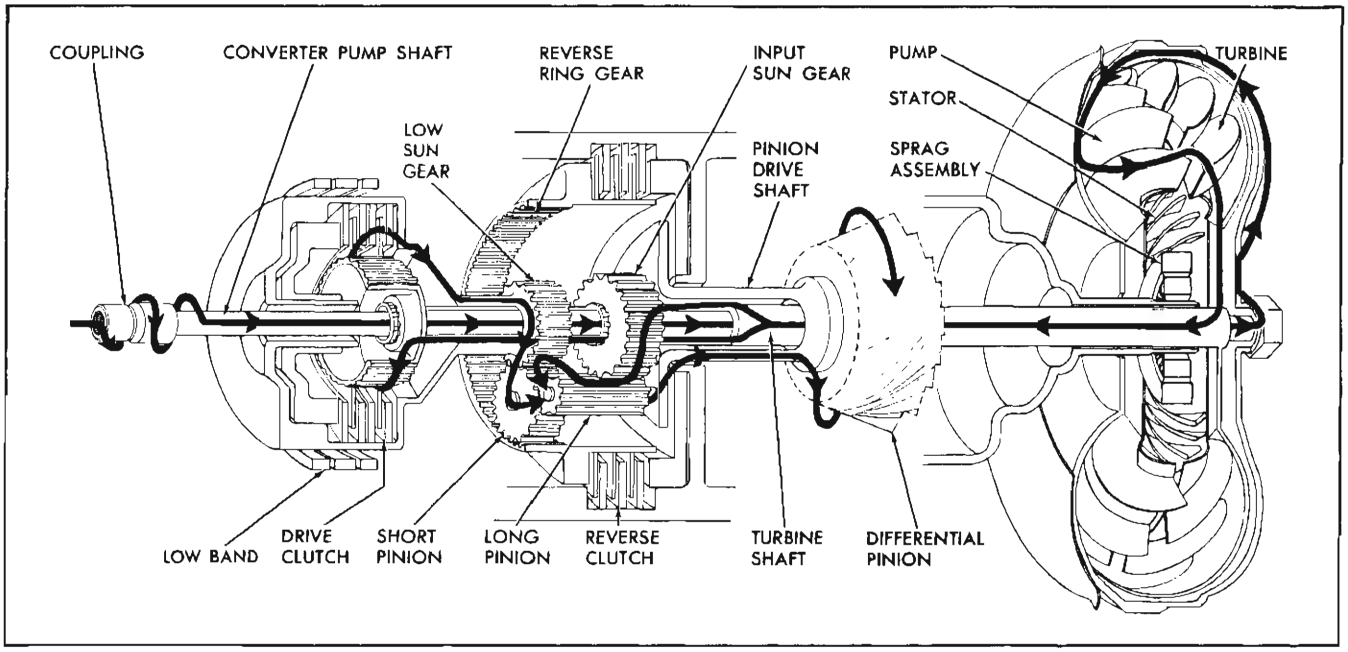



Fig. 7A-4 Power Flow—Direct Drive

### *POWER FLOW—DIRECT DRIVE (FIG. 7A-4)*

Engine torque is transmitted by the propeller shaft to the converter pump shaft. In direct drive the low band is released and the drive clutch is applied. Torque is transmitted by the turbine shaft directly to the low sun gear through the drive clutch.

The low sun gear drives the short pinions which are in mesh with the long pinions. The input sun gear, which is splined to the turbine shaft, also drives the long pinions. This causes the planet carrier to lock up in direct drive.

SUMMARY—DIRECT DRIVE

Low Band — Released

Drive Clutch — Applied

Reverse Clutch — Released

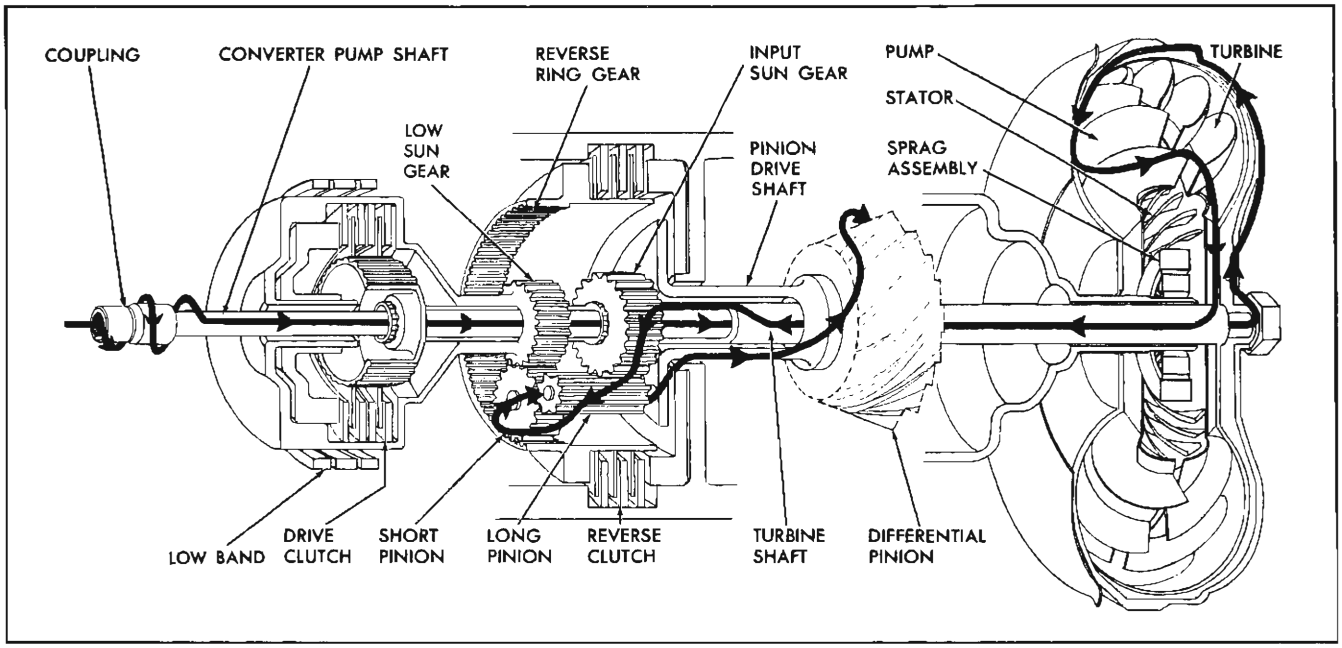



Fig. 7A-5 Power Flow—Reverse

### *POWER FLOW—REVERSE (FIG. 7A-5)*

Engine torque is transmitted by the propeller shaft through the coupling to the converter pump shaft. This shaft extends through the entire transmission and differential assembly to the torque converter where it drives the converter pump. The converter pump in turn drives the turbine which is connected to the turbine shaft. The input sun gear driven by the turbine shaft drives the long pinions which are engaged with the short pinions.

In reverse the reverse clutch is applied, holding the reverse ring gear stationary. Therefore the short pinions rotating clockwise drive the planet carrier in a counterclockwise direction and in reduction.

SUMMARY—REVERSE

Low Band —Released

Drive Clutch —Released

Reverse Clutch —Applied

Following is a summary of the hydraulic operation required for the foregoing power flows.

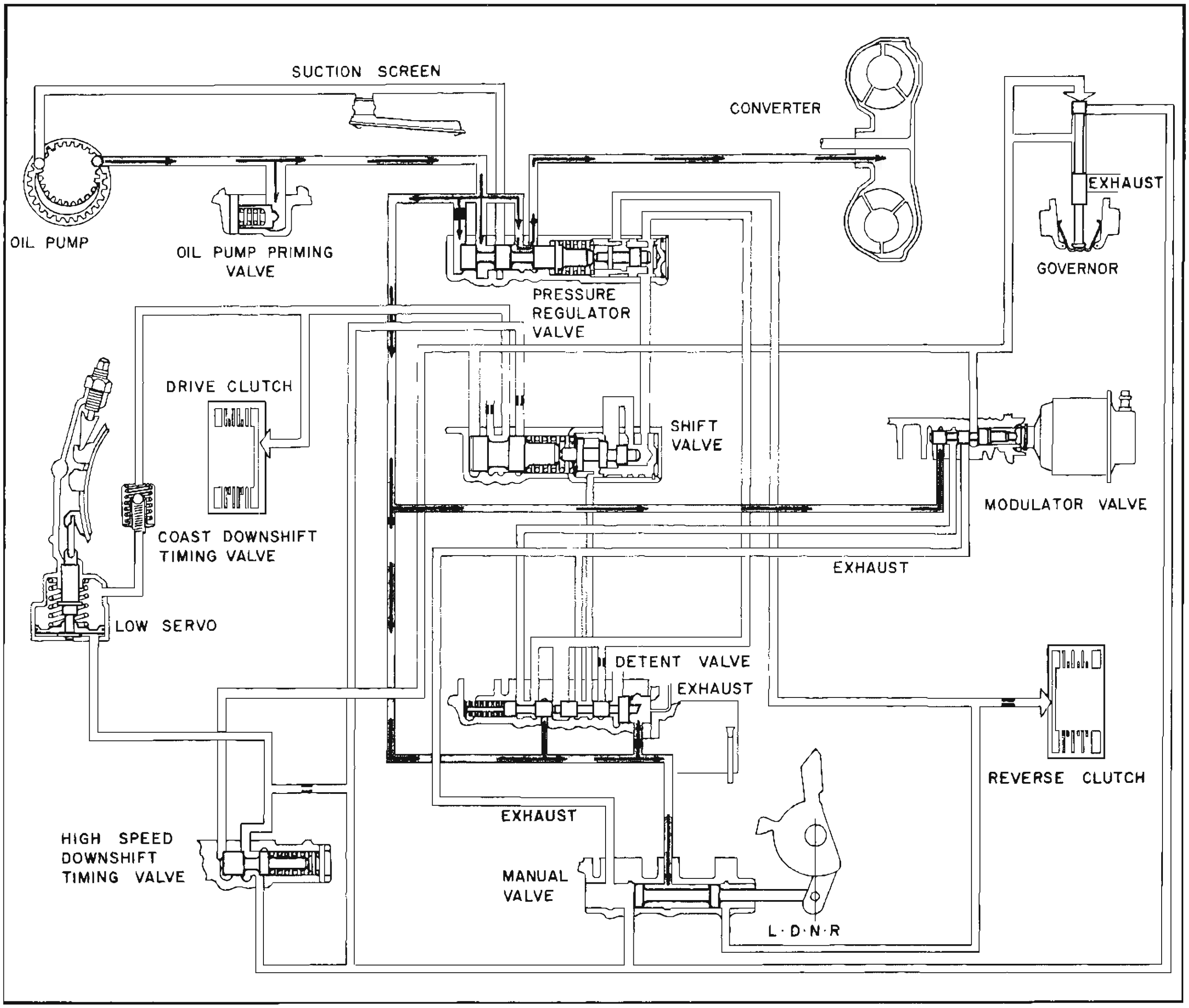



Fig. 7A-6 Oil Circuits—Neutral

## HYDRAULIC OPERATION

### *HYDRAULIC OPERATION—NEUTRAL (FIG. 7A-6)*

### PUMP

The engine drives the propellor shaft which is splined through the coupling to the convertor pump drive shaft. A drive plate mounted on the front end of the shaft drives the transmisison pump. As the engine is started, the pump picks up oil from the sump through the pump inlet screen. Any air in the pump passes out through the pump priming valve. As pressure begins to build up, it seats the priming valve to prevent oil leakage. Oil flows from pump to the pressure regulator valve in the areas between the first and second and the second and third lands.

Oil from the pump pressure cavity is also sent to the manual valve. In neutral, the manual control valve is positioned so that no oil is permitted to flow to the clutches or band.

### PRESSURE REGULATOR

Oil also flows through a small opening in the valve body gasket into a cavity at the left end of the pressure regulator valve. As pressure begins to build up against the valve, the valve starts moving against the spring and booster valve and opens the converter feed orifice. This occurs at approximately 60 psi.

When the converter circuit is under pressure, the valve continues to move against its spring and booster

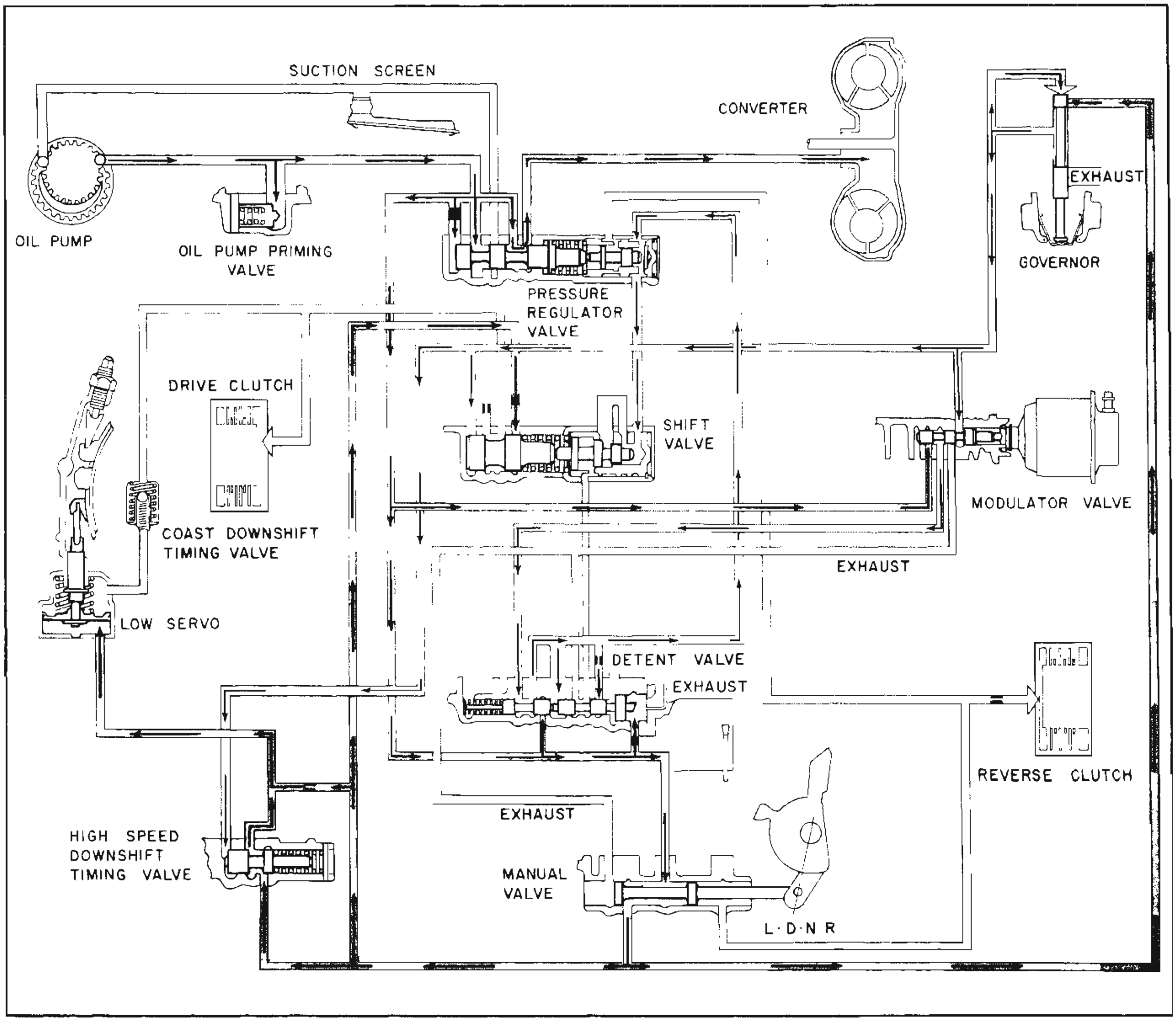



Fig. 7A-7 Oil Circuits—Automatic Low

valve until the area between the second and third lands is opened to pump inlet. When the exhaust port or channel is opened, pressure begins to fall, and the pressure regulator valve spring forces the valve to move back, shutting off the exhaust port. The valve balances at a point where the hydraulic and spring forces are equal, maintaining an even main line pressure.

Oil is also sent from the pressure regulator valve to the modulator valve. Oil at main line pressure enters the modulator bore at the area between first and second lands.

The modulator valve produces a modified pressure as explained under "Modulator Valve".

The modulator pressure is directed through the detent valve to the right hand, smaller diameter of the pressure booster valve. This valve is in contact with the right end of the pressure regulator valve. Any force to the left on the pressure regulator valve, due to the modulator pressure, is added to the force of the pressure regulator valve spring.

## MODULATOR VALVE

Engine vacuum is utilized to control main line pressure in accordance with engine power output in "N", "D" and "R" positions. Engine vacuum is applied to the modulator valve aneroid assembly. The diaphragm is spring-loaded, the spring force acting to push the diaphragm against the end of the modulator valve.

Oil from the pressure regulator valve is sent to the main line port of the modulator valve. The modulated pressure at which the valve balances in Drive Range is determined by the force due to the modulator diaphragm and spring, and the force due to governor pressure. Any oil pressure in excess of that called for by the modulator action is exhausted to sump at the manual valve. Low engine vacuum tends to increase the modulator pressure. This results in main line pressure varying in accordance with load.

In manual low range, main line pressure is applied to the modulator exhaust passage at the manual valve. Main line pressure is thus applied through the exhaust circuit and detent valve to the right side of the large diameter land of the shift regulator valve to prevent the shift valve from upshifting to high.

### CONVERTER CIRCUIT AND LUBRICATION

At the time that the pressure regulator valve described above began moving from the rest or bottomed position in its bore, it uncovered a port in the valve body called the converter feed port. When this port is uncovered, oil from the mainline pressure cavity is permitted to flow into the converter circuit. The oil is directed through a passage in the differential housing, and is delivered to the converter between the turbine shaft and the stator shaft.

Oil leaves the converter and flows back to the transmission between the turbine shaft and the converter pump shaft. This lubricates the shaft bushings.

## *HYDRAULIC OPERATION— AUTOMATIC LOW (FIG. 7A-7)*

### GOVERNOR

The governor supplies a pressure, variable with car speed, to the shift valve, modulator valve and high speed downshift timing valve. Oil from the pump is directed to a land on the governor valve. As car speed increases, centrifigal force causes the governor weights to move the governor valve in, directing pump pressure to the end of the governor valve, the modulator valve and high speed downshift timing valve. The pressure on the end of the governor valve balances the force of the centrifugal weights. The faster the governor spins, the greater is the oil pressure required to hold the governor weights in equilibrium. Therefore, as car speed varies, the centrifugal force varies, regulating the pressure accordingly. As car speed increases, the hydraulic pressure from the governor to the two valves will increase.

### LOW-DRIVE SHIFT CIRCUIT

The low-drive shift circuit contains the governor, modulator valve, detent valve and shift valve. Operation of the governor and the modulator valve is described in preceding paragraphs. Operation of the detent valve and shift valve is covered in following paragraphs.

### OPERATION—SHIFT VALVE

The shift valve controls the flow of oil to or from the drive clutch and release side of the low servo piston. The position of the shift valve is controlled by governor pressure opposing the shift valve spring plus modulator valve pressure, which is routed through the pressure regulator.

When the manual valve is shifted to "D" range, main line pressure is supplied to the low servo and the shift valve. The modulator valve pressure that is developed is applied through the detent valve and pressure regulator valve to the outer end of the shift regulator valve. This pressure moves the shift regulator valve against the shift valve, opening a passage that allows modulator valve pressure to be imposed on the large diameter area of the shift regulator valve. Modulator valve pressure on this surface plus the force of the shift valve spring keeps the valve in low range. A land of the shift valve blocks off main line pressure to the clutch and to the release side of the low servo piston. Main line pressure from the manual valve to the apply side of the low servo piston applies the low band and places the transmission in low range.

The shift valve spring helps keep the shift valve in low range position during light throttle operation to obtain desired acceleration or car performance. It also moves the shift valve from the high to the low position on a closed throttle downshift, so the transmission is in low range to provide good acceleration performance at any speed below 12 mph.

## *HYDRAULIC OPERATION— AUTOMATIC HIGH (Fig. 7A-8)*

As car speed increases, governor pressure, which is applied to the left side of the shift valve, increases. When the pressure is great enough, it moves the shift valve, closing the exhaust passage and opening the clutch apply and low band release circuit to main line pressure.

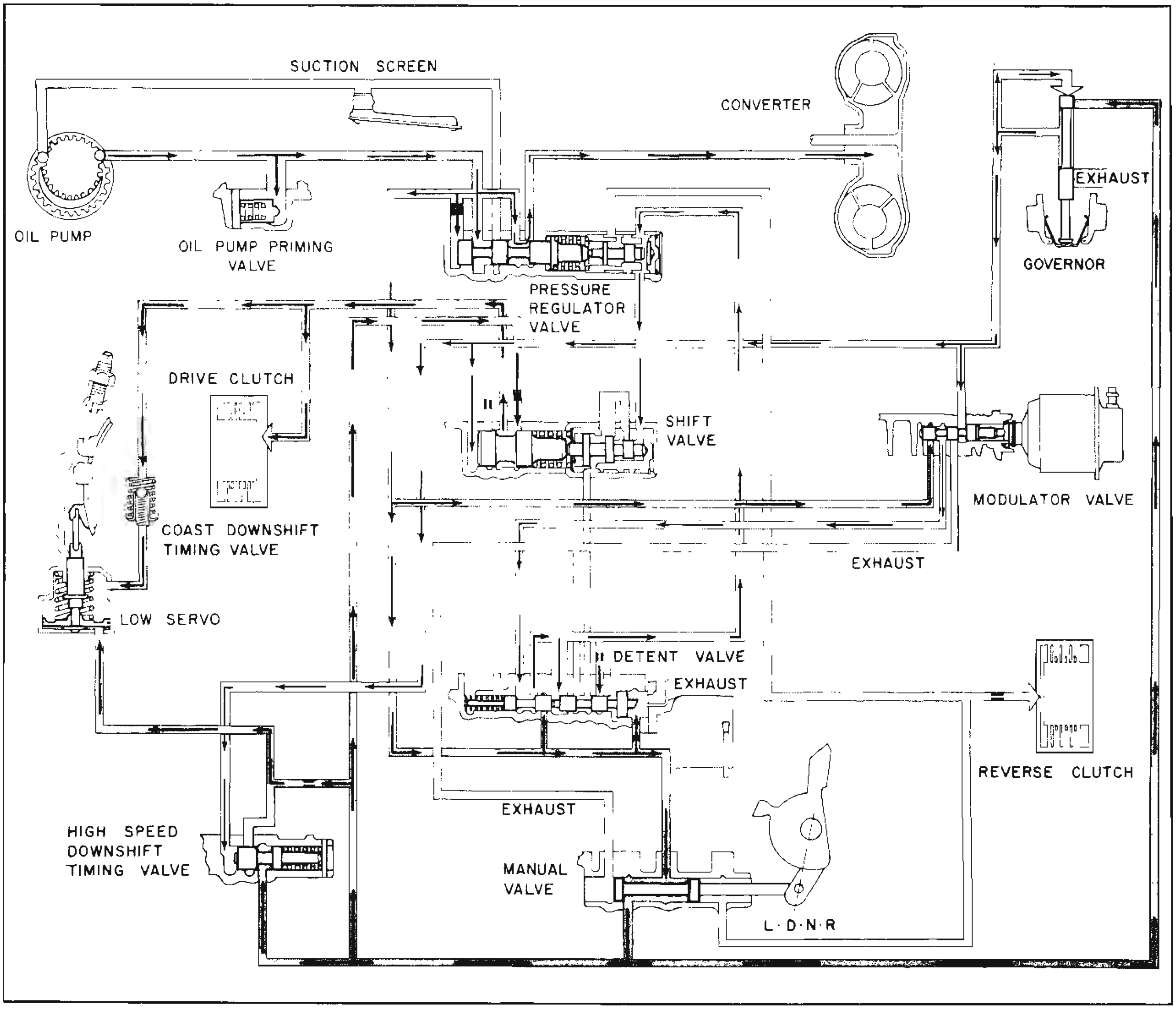



Fig. 7A-8 Oil Circuits—Automatic High

The clutch is applied, the low band is released and the transmission shifts into high range. The shift valve also moves the shift regulator valve against its stop cutting off modulator pressure against the large diameter of the shift regulator valve.

When a reduction in speed causes governor pressure to drop off sufficiently, modulator and spring forces opposing the governor pressure move the shift valve, closing off main line pressure to the high clutch and to the release side of the low servo piston and the high clutch line is open to an exhaust port. This disengages the high clutch and allows main line pressure from the manual valve to apply the low band, placing the transmission in low range. As soon as the valve moves, the clutch and the release side of the low servo line are opened to sump and the pressure between the two small lands is dissipated. This has the effect of a sudden increase of the net force tending to move the valve to its new (low) position. To aid in producing a smooth low band application on a coast downshift, a coast downshift timing valve is installed in the low servo release circuit. This spring loaded ball check valve has the effect of delaying the "bleed off" of servo release oil and thereby avoids a severe band application. Part throttle downshifts are possible up to about 33 mph.

## FORCED DOWNSHIFT

Prior to a forced downshift, main line pressure applied to the downshift solenoid end of the detent valve

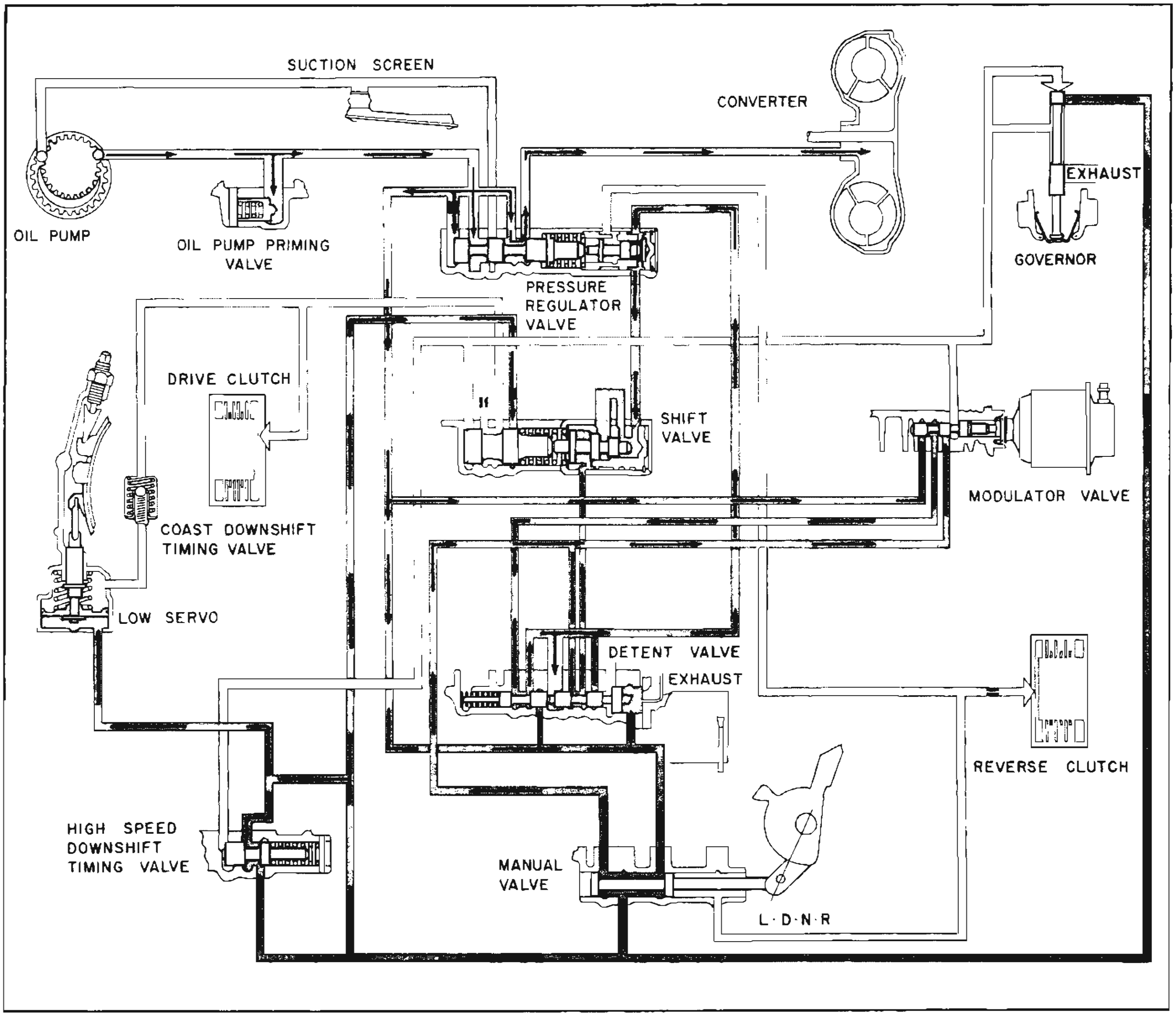



Fig. 7A-9 Oil Circuits—Manual Low

compresses the spring and holds the valve against the stop. In this position modulator valve pressure is aplied through the detent valve to the end of the pressure regulator valve and the shift valve. When the accelerator pedal is depressed to the floor, the throttle control downshift switch is actuated and the downshift solenoid is energized. When the downshift solenoid is energized, it opens an exhaust port that dumps to sump the main line pressure applied to the end of the detent valve. The detent valve spring then can move the valve to the right, picking up main line pressure and routing it to the shift regulator valve as detent pressure and to the end of the pressure regulator valve as boost pressure to increase main line pressure to maximum. Modulated main line pressure applied as detent pressure to the shift regulator valve, plus the force of the shift valve spring, overcomes governor pressure applied to the end of the shift valve and the valve shifts to low, thereby releasing the high clutch and applying the low band.

The coast downshift valve again functions as described in **OPERATION-SHIFT VALVE** to aid in producing a smooth low band application. Rate of low band application is also controlled by the action of the high speed downshift timing valve. This high speed downshift timing valve assumes a balanced position determined by the force of a spring on one end and governor pressure on the other. When gover-

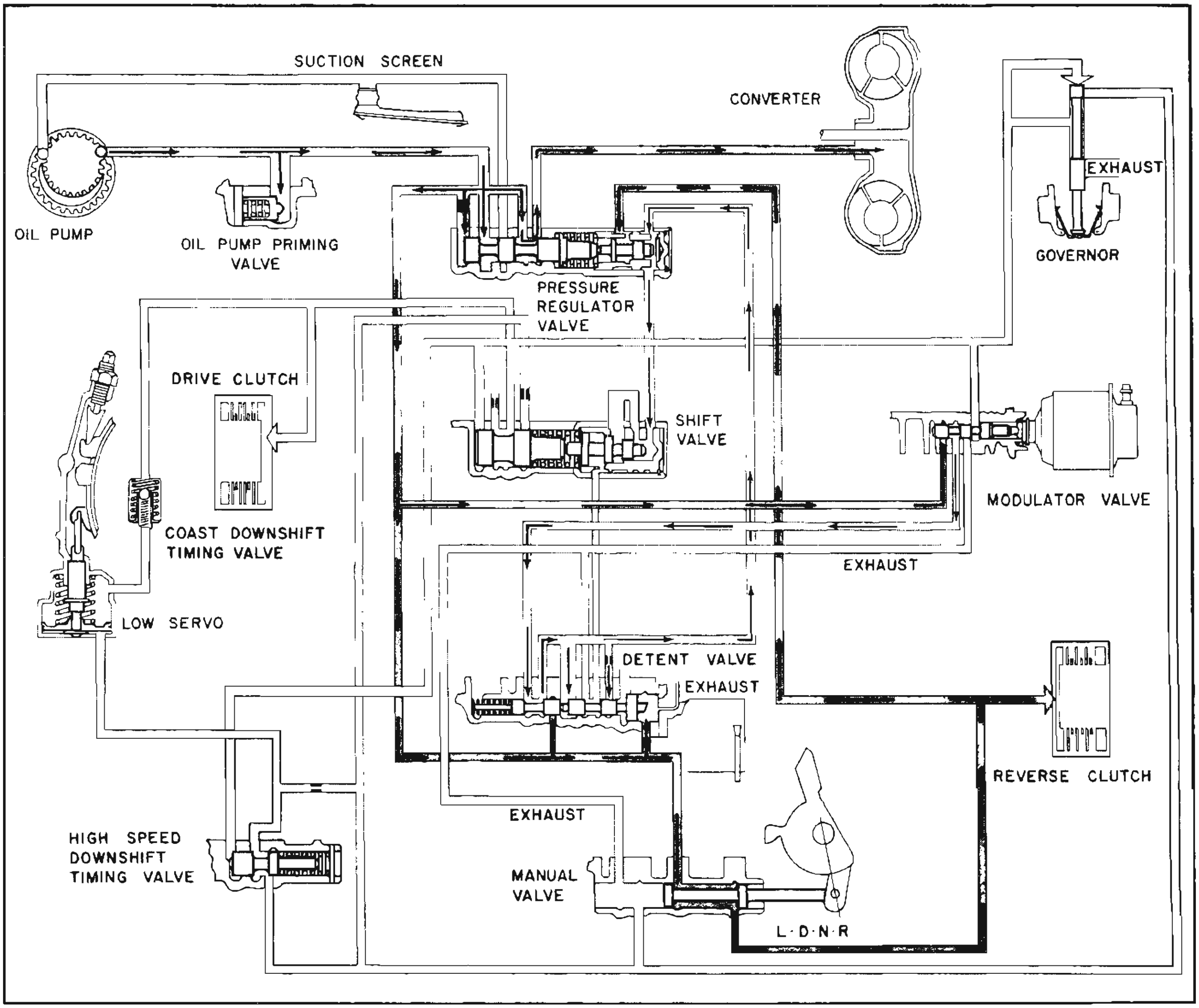



Fig. 7A-10 Oil Circuits—Reverse

nor pressure is high, the high speed downshift timing valve cuts off the larger passage of main line pressure to the low servo apply circuit and leaves open only the restricted passage. At lower governor pressures this downshift valve allows main line oil to be applied to the low servo circuit through the unrestricted passage. As a result, the rate of low band apply is a function of governor pressure. At higher speeds the band is not applied as quickly as at lower speeds. This gives the engine an instant to speed up after the clutch is released and before the low band is applied.

### *HYDRAULIC OPERATION— MANUAL LOW (FIG. 7A-9)*

In manual low, the manual valve is positioned to block off the modulator valve exhaust passage. This results in maintaining the boost pressure at the highest value determined by the modulator valve response to engine manifold vacuum. This boost pressure is applied through the detent valve and pressure regulator valve to the shift regulator valve to oppose governor pressure and prevent an upshift out of low range. At the same time, the force of the boost pressure on the pressure regulator valve raises main line pressure in proportion to the load on the engine. If the transmission is shifted to manual low position at any car speed, a downshift will occur.

### *HYDRAULIC OPERATION— REVERSE (FIG. 7A-10)*

In reverse, the manual valve is positioned to direct oil under main line pressure to the apply side of the reverse clutch and to the reverse apply sensitive area of the pressure regulator valve. With the reverse pressure-sensitive area of the pressure regulator valve supplied with full main line pressure, the pressure regulator valve will regulate at 106 to 222 psi to produce the required reverse clutch apply forces, depending upon engine manifold vacuum.

There is no reverse inhibitor; it is possible to shift to reverse at any car speed. However, reverse should not be engaged while car is in motion.

## MAINTENANCE AND ADJUSTMENTS

### *OIL RECOMMENDATIONS*

It is important to use only Automatic Transmission Fluid (Type A). This is an all-season fluid, ideal for year-round operation. No special additives to these fluids are required or recommended.

Instructions for checking fluid level and for draining and refilling transmission follow:

### *OIL LEVEL*

The transmission oil level should be checked every 6000 miles. Oil should be added only when the level is near the "ADD" mark on the indicator (Fig. 7A-11) with oil at normal operating temperature. The oil level indicator is located under a plate in the right front of the luggage compartment (Fig. 7A-12).

NOTE: The difference in oil level between Full and Add is one (1) pint.

In order to check oil level accurately, the engine should be idled with the transmission oil at normal temperature and the control lever in neutral (N) position.

It is important that the oil level be maintained no higher than the "FULL" mark on the transmission oil level indicator. DO NOT OVERFILL, for when the oil level is at the full mark on the dip stick, it is just slightly below the planetary gear unit. If oil is added which brings the oil level above the full mark, the planetary unit will run in the oil, foaming and aerating the oil. This will cause malfunction of the transmission assembly due to improper application of the band or clutches and excessive temperature.

If the transmission is found consistently low on oil, a thorough inspection should be made to find and correct all external oil leaks.

All mating surfaces, such as the pump, oil pan rail, filler tube, governor, and the attachment to the differential carrier should be carefully examined for signs of leakage. The modulator must also be checked to insure that the diaphragm has not ruptured as this would allow transmission oil to be drawn into the intake manifold. Usually, the exhaust will be excessively smoky if the diaphragm ruptures, due to the transmission oil drawn into the combustion

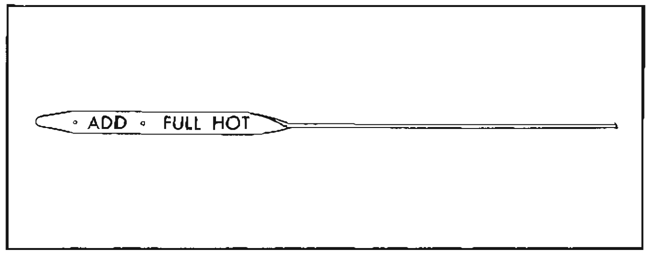



Fig. 7A-11 Oil Level Indicator

chamber. Also check level in differential to be certain oil is not leaking from transmission to carrier assembly.

### *DRAINING AND REFILLING*

No periodic draining of the transmission oil is recommended.

When the transmission requires repair, drain the oil by loosening the filler tube attaching nut in the oil pan and allow oil to drain; no drain plug is provided.

To refill the transmission, tighten the filler tube attaching nut and add four (4) pints transmission fluid using filler tube and funnel. Start engine and allow engine to idle in neutral 3-5 minutes to warm oil, then check oil and add as required to raise to the level of the "FULL" mark. Assuming that the converter was not drained (since it is welded) and allowing for a nominal spillage or draindown, approximately six (6) pints of oil will be required for refill.

***CAUTION: Do not over-fill!***

The dry capacity of the V-8 transmission, including converter, is 19.7 pints. Normal refills require 6 pints. Dry capacity of the four cylinder transmission, including converter, is 17 pints; normal refills require 6 pints.

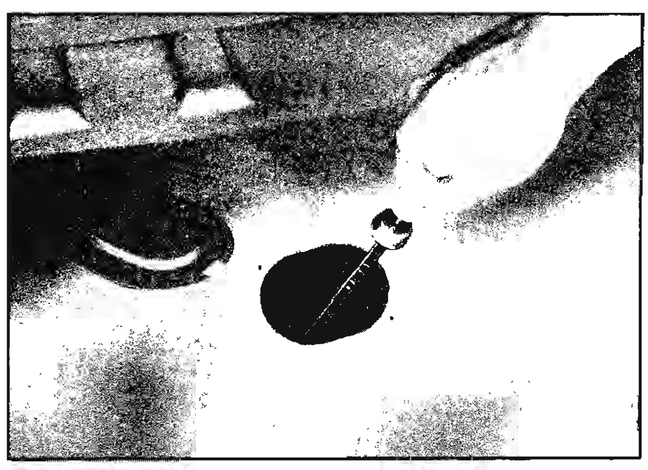


Fig. 7A-12 Location of Oil Level Indicator

### NEUTRALIZER AND BACK-UP LIGHT SWITCH ADJUSTMENT

The starter neutralizer and back-up light switch is located on the rear of the gearshift control and indicator assembly.

Properly adjusted, the switch should turn on the back-up lights in reverse and prevent engine cranking with the selector lever in any position other than "N" (neutral). If engine cranks in any other position, adjust the switch by loosening the two switch mounting screws and repositioning as required.

### SHIFT LINKAGE CHECK AND ADJUST

#### CHECK

If improper shift linkage adjustment is suspected, a check can be made quickly without any disassembly as described below:

1. Start engine. If cold, allow 2-3 minutes for transmission fluid to warm up.

2. With engine at normal idle speed, slowly move the range selector lever up from "N" toward "R" and note by feel the point at which reverse clutch applies. Properly adjusted, reverse clutch should apply within band from tooth peak to full reverse detent (Fig. 7A-13).

3. Make same check as in step 2 above while moving selector lever from "N" toward "D". Properly adjusted, the low band should apply as selector lever indicator is felt to be between tooth peak separating neutral from drive and full drive detent.

4. Unless shifts are obtained at points illustrated in Fig. 7A-13, the shift linkage should be adjusted with gauge J-8365.

#### ADJUSTMENT

Adjustment of the manual valve linkage should be checked after any transmission overhaul or control cable, or range selector control assembly replacement, as described below:

1. Drain oil from transmission by unscrewing filler tube nut, then remove oil pan.

2. Place range selector lever in driving compartment in "D" (drive).

3. Insert J-8365 into manual valve bore as shown (Fig. 7A-14) with tab of gauge upward so it engages to forward port of the valve body.

4. With J-8365 in place, push forward on manual valve levers. Properly adjusted J-8365 will be held in place horizontally without being supported.

5. If readjustment is required, loosen lock screw (Fig. 7A-15), push the manual valve levers forward so that J-8365 is held in position. Retighten lock screw.

6. When satisfactory adjustment is obtained, install oil pan and filler tube, then refill transmission with oil.

### LOW BAND ADJUSTMENT

No periodic adjustment of the low band is recommended. However, if necessary it may be performed as follows:

1. Lower transmission to allow access to adjusting screw.

2. To adjust, loosen lock nut and tighten adjusting screw to 40 ± 5 lb. in. torque, then back off four (4) full turns exactly. While holding adjusting screw stationary, tighten adjusting screw lock nut securely.

### DOWNSHIFT SWITCH ADJUSTMENT

1. Check and adjust carburetor throttle rod as covered in Section 6B.

2. With throttle valve in wide open position, use adjusting nuts to position downshift switch as shown in Fig. 7A-16. Clearance between switch body and lever should be .030" to .060". Tighten nuts securely.

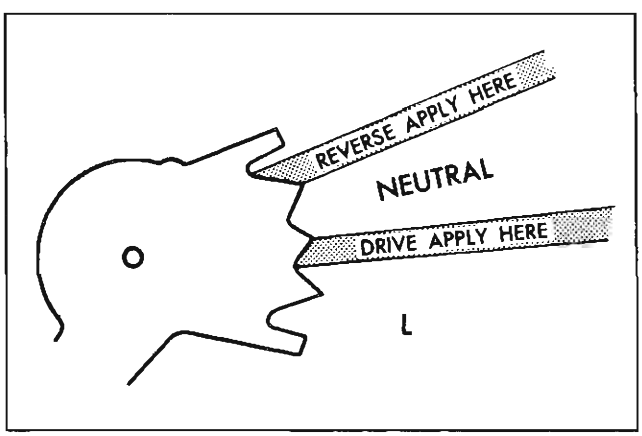



Fig. 7A-13 Shift Linkage Check Diagram

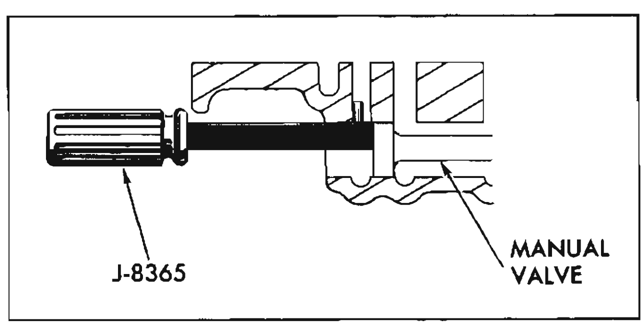



Fig. 7A-14 Gauging Manual Valve

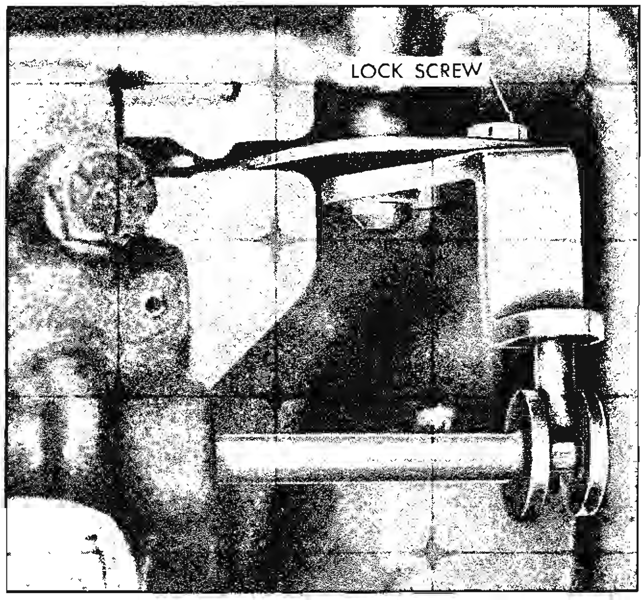



Fig. 7A-15 Manual Valve Lever Lock Screw

## SERVICE OPERATIONS— TRANSMISSION IN CAR

The Tempest automatic transmission service operations which can be performed on the car are covered in this section. It is important that further transmission disassembly not be performed in the vehicle as any work which changes the transmission end play requires compensation (see step 10, ASSEMBLY OF TRANSMISSION). Failure to observe this precaution could result in extensive damage.

### *TRANSMISSION CONTROL CABLE REPLACEMENT*

1. Remove bolt securing transmission control cable housing to transmission case (Fig. 7A-17).

2. Disconnect cable at range selector assembly.

3. Remove cable from body clips and body grommet.

4. Remove cable from car.

5. Install O-ring seal on new cable.

6. Locate cable in approximate position in car as shown in Fig. 7A-18 for dash mounting and 7A-19 for console mounting.

7. Seat O-ring and secure installation by installing bolt and lock washer.

8. Complete cable installation as shown in Figure 7A-18 or 7A-19, working from rear of car forward. Keep slack in cable at front of car.

9. Check linkage and cable adjustment as outlined on page 7A.

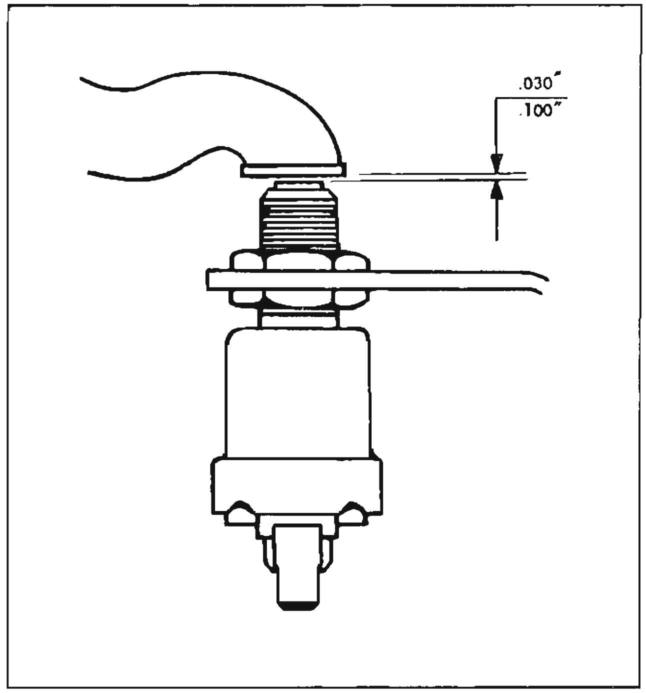



Fig. 7A-16 Downshift Switch Adjustment

### *PARKING LOCK CONTROL CABLE REPLACEMENT*

1. Remove screw and lock washer assembly securing parking lock control cable assembly to cover and pawl assembly (Fig. 7A-20). Remove cable assembly and O-ring seal.

2. Disconnect cable from transmission control lever assembly.

3. Remove cable from body clips and body grommet. Remove cable from car.

4. Install new O-ring seal on transmission end of new cable assembly.

5. Locate cable in approximate position as shown in figure 7A-18 for dash mounting and 7A-19 for console mounting.

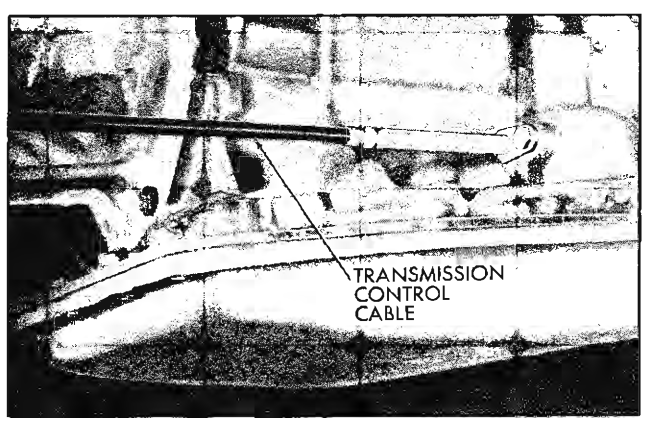



Fig. 7A-17 Transmission Control Cable

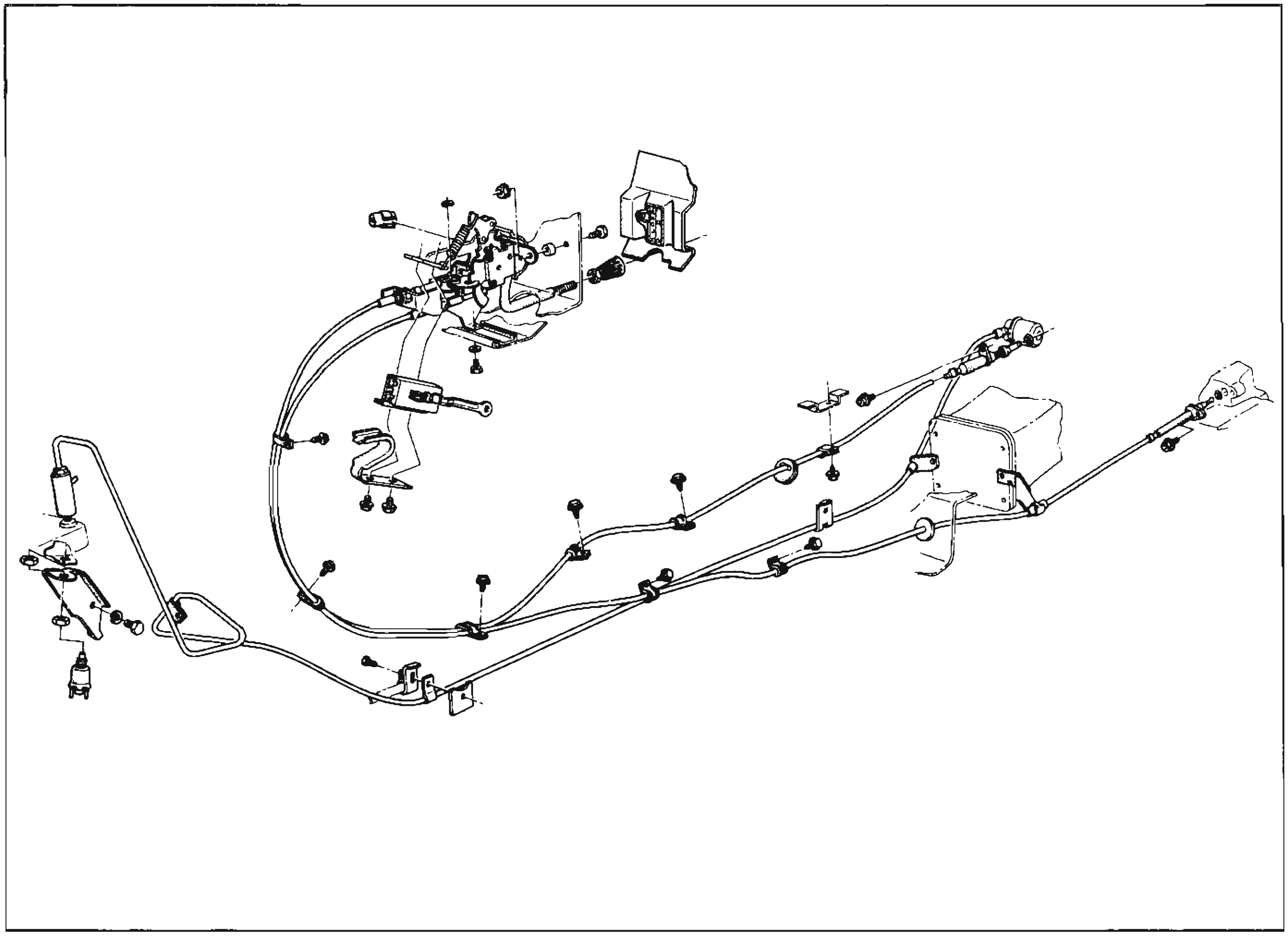


Fig. 7A-18 Transmission and Parking Lock Control Cables—Dash Mounted

6. Seat O-ring seal and secure installation with screw and lock washer assembly.

7. Complete cable installation as shown in Figure 7A-18 or 7A-19 working from rear of car forward. Keep slack in cable at front of car.

8. Connect cable to transmission control lever assembly. Secure cable with body clips.

### PARKING LOCK COVER AND PAWL ASSEMBLY

#### REMOVAL

1. Remove screw and lock washer assembly securing parking lock control cable assembly to cover and pawl assembly (Fig. 7A-20). Remove cable assembly and O-ring seal.

2. Remove cover and pawl assembly mounting screws and remove assembly and gasket.

#### INSPECTION AND REPAIRS

Inspect parking pawl for damage or wear. Check to see that the actuator rollers turn freely. Replace worn or damaged parts.

#### INSTALLATION

1. Using a new gasket, install cover and pawl assembly and secure with screws and washers.

2. Install new O-ring seal on end of cable assembly.

3. Seat O-ring seal and secure installation with screw and lock washer assembly.

### EXTENSION HOUSING OIL SEAL REPLACEMENT

1. Remove torque tube and propeller shaft as covered in Section 4.

2. Pry out old oil seal. Use tool J-6292 to remove seal from four cylinder engine transmission extension.

3. Tap new oil seal into position using installer J-21033 and handle J-7079-2.

4. Install torque tube and propeller shaft.

### EXTENSION HOUSING FRONT BEARING REPLACEMENT

1. Remove tórque tube and propeller shaft as covered in Section 4.

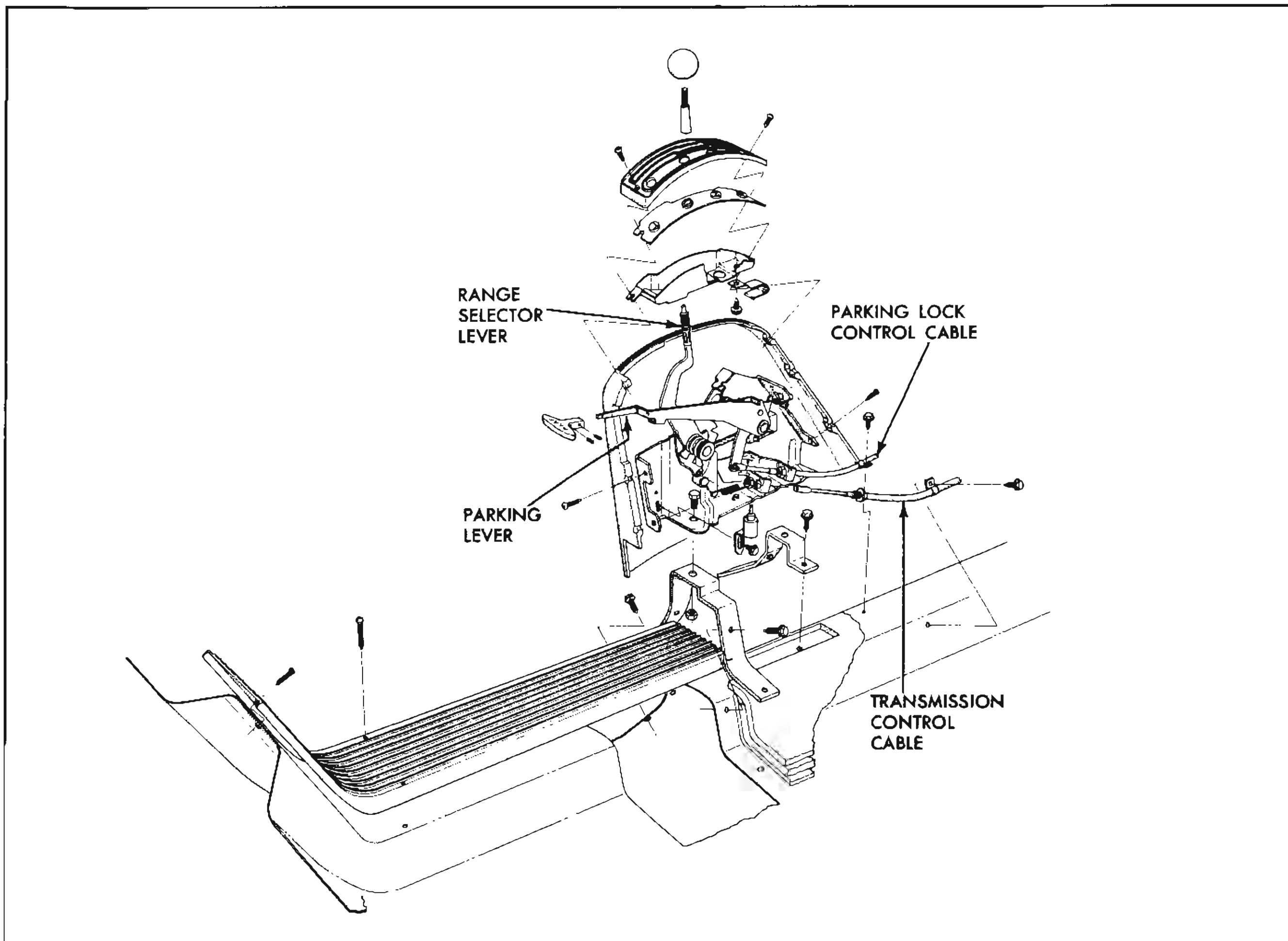



Fig. 7A-19 Transmission and Parking Lock Control Cables--Console Mounted

2. Remove oil seal (see above).

3. Remove bearing retaining ring and remove bearing.

4. Tap in new front bearing using installer J-21033 and handle J-7079-2.

5. Install bearing retaining ring.

6. Install new oil seal using installer J-21033 and handle J-7079-2.

7. Install torque tube and propeller shaft.

## *MODULATOR*

The modulator is mounted on the right side of the transmission (Fig. 7A-21) and can be serviced from beneath the vehicle after disconnecting the control arm bracket.

### REMOVAL

1. Remove vacuum hose at modulator.

2. Remove modulator retainer plate.

3. Remove modulator and valve from transmission case.

### INSPECTION AND REPAIRS

Check the modulator valve for nicks and burrs. If such cannot be repaired with a slip stone, replace the valve.

The modulator can be checked with a vacuum source for leakage. However, leakage normally results in transmission oil pull-over, oil smoky exhaust and continually low transmission oil. No modulator repairs are possible; replace as an assembly.

### INSTALLATION

1. Install modulator valve in bore in transmission.

2. Place new O-ring seal on modulator.

3. Install modulator, tighten retainer plate firmly, and install vacuum hose.

## *GOVERNOR*

The governor is accessible from beneath the vehicle and is mounted on the left side (Fig. 7A-22).

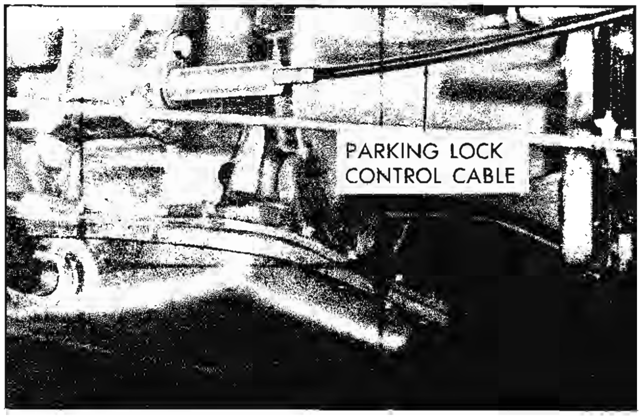



Fig. 7A-20 Parking Lock Control Cable

REMOVAL

Remove speedometer driven gear.

Unscrew the lock screw securing the governor tab to the case, then pull the governor from the transmission.

REPAIRS

The only part replaceable on the governor is the driven gear. To remove, drive out roll pin with a punch and pull out old gear. Drill a new hole in the governor 90 degrees from the original. Insert new gear and reinstall roll pin.

INSTALLATION

1. Install new O-ring seal on governor.

2. Insert governor into transmission with a slight twist to engage gear teeth.

3. Secure installation with lock bolt and install speedometer driver gear.

***DOWNSHIFT SOLENOID REPLACEMENT (FIG. 7A-23)***

1. Loosen oil filler nut to drain transmission oil. Remove filler pipe from oil pan.

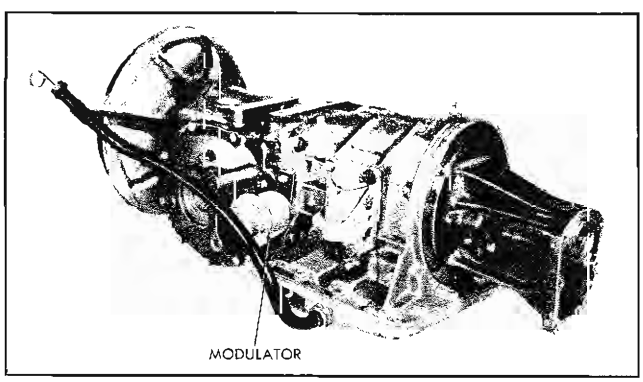



Fig. 7A-21 Location of Modulator

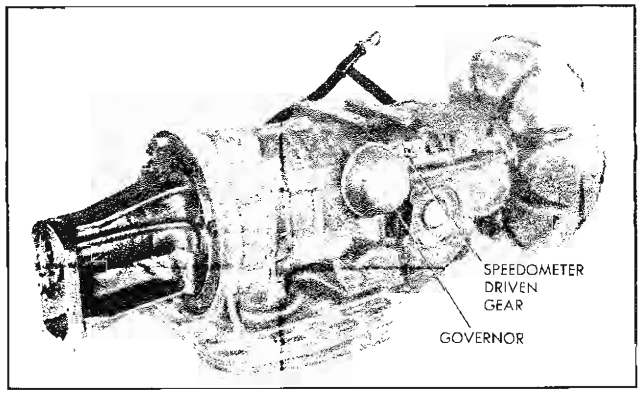



Fig. 7A-22 Transmission—Axle Assembly

2. Remove 16 screws and lock washers securing oil pan and remove oil pan and gasket.

3. Disconnect downshift solenoid lead from terminal.

4. Remove two screws attaching downshift solenoid and separate solenoid and gasket from valve body.

NOTE: It may be necessary to remove one reinforcement plate screw to remove screw nearer the plate.

5. Using a new gasket, assemble downshift solenoid to valve body and secure with two screws.

6. Connect downshift solenoid lead to terminal.

7. Using a new gasket, replace oil pan. Tighten screws to 35-45 lb. in.

8. Tighten filler tube attaching nut and refill transmission with oil.

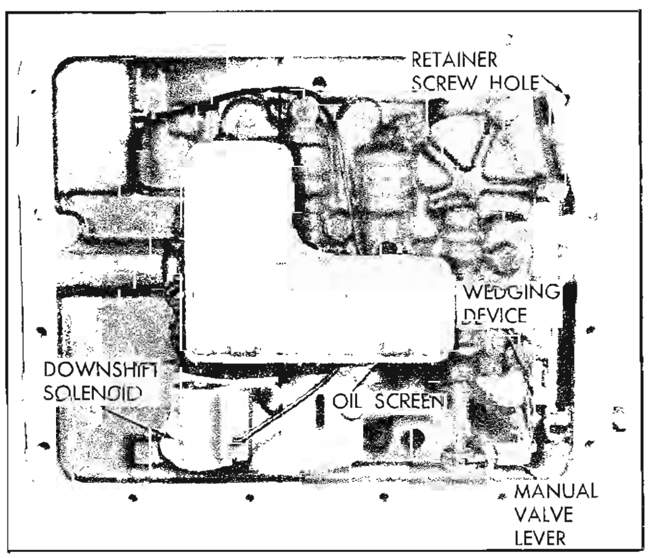



Fig. 7A-23 Transmission—Oil Pan Removed

***DOWNSHIFT SOLENOID CONNECTOR ASSEMBLY REPLACEMENT (FIG. 7A-23)***

1. Loosen oil filler nut to drain transmission oil. Remove filler pipe from oil pan.

2. Remove 16 screws and lock washers securing oil pan and remove oil pan and gasket.

3. Disconnect downshift solenoid lead from terminal and disconnect external lead from terminal.

4. Compress connector assembly retaining fingers and push out assembly and seal.

5. Install new connector assembly and seal into case. Retaining fingers must spread out inside of case to secure assembly.

6. Connect internal and external leads.

7. Using a new gasket, replace oil pan. Tighten screws to 35-45 lb. in.

8. Tighten filler tube attaching nut and refill transmission with oil.

***VALVE BODY AND LOW SERVO***

REMOVAL

1. Loosen oil filter nut to drain transmission oil. Remove filler pipe from oil pan.

2. Remove 16 screws and lock washers securing oil pan and remove oil pan and gasket.

3. Remove oil screen and O-ring seal (Fig. 7A-23).

4. Loosely install a retainer (Fig. 7A-24) in pan screw hole illustrated in Fig. 7A-23.

NOTE: Retainer can be made from piece of sheet metal or other suitable material. (The modulator clamp may be used for this purpose.)

5. Remove screws securing valve body to transmission, tap valve body lightly with a soft hammer to loosen from its dowels in transmission case, then carefully lower valve body about $\frac{1}{16}''$. Rotate retainer into place so it secures servo piston and tighten with pan screw. This eliminates possibility of servo piston slipping down out of its bore and loss of low band engagement with its apply components.

6. Disconnect downshift solenoid lead from terminal.

7. Remove valve body and gasket.

8. If necessary to remove low servo, tighten low band adjusting screw fully.

9. Remove transfer plate and reinforcement plate. Remove retainer and pull downward on low servo piston shaft with screwdriver.

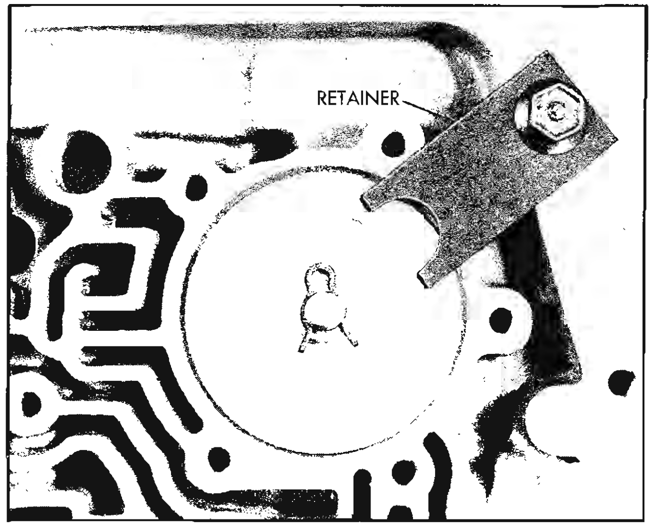



Fig. 7A-24 Servo Piston Retainer

DISASSEMBLY—VALVE BODY (FIG. 7A-25)

1. Remove manual valve.

2. Remove two screws attaching downshift solenoid and separate solenoid and gasket from valve body.

3. Remove detent valve, modulator pressure control valve, and valve spring.

4. Remove shift valve retaining ring, sleeve, shift control valve, spring seat, spring, and shift valve.

5. Remove pressure regulator valve retaining ring, sleeve, modulator valve, spring, and regulator valve.

6. Remove roll pin, spring, and high speed downshift valve.

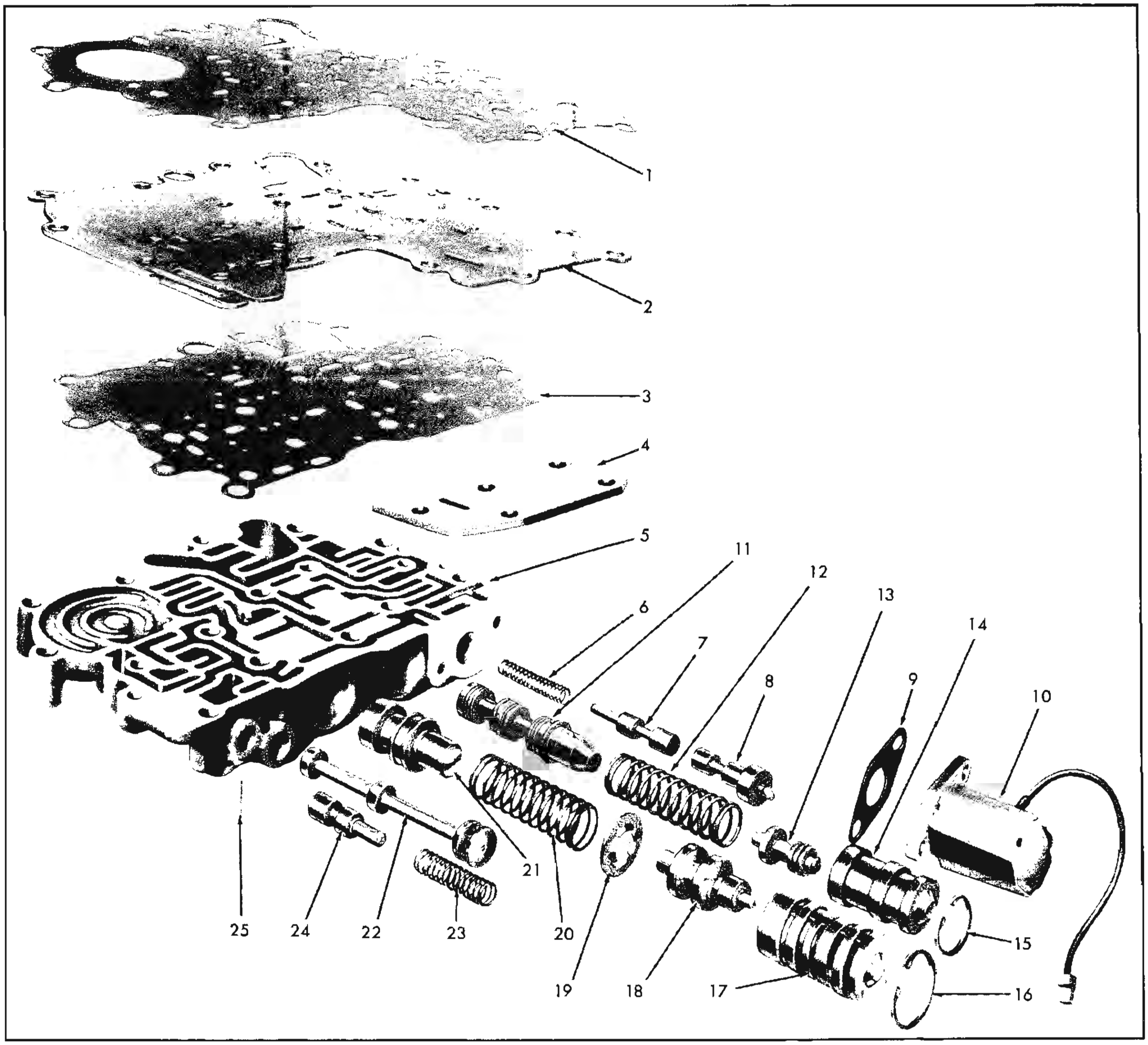
INSPECTION—VALVE BODY

As most valve body failures are initally caused by dirt or other foreign material preventing a valve from functioning properly, a thorough cleaning of all parts in *clean* solvent is mandatory. Check all valves and their operating bores for burrs or other deformities which could result in valve "hang-up".

INSPECTION AND REPAIRS—
LOW SERVO PISTON

To disassemble the low servo piston, remove the hairpin retainer securing the piston to the piston rod and separate all components. The cushion spring pressure on this piston is relatively slight; no press is required.

Remove piston ring from the piston and install it in the low servo bore and measure the ring gap. If within limits ring gap will be .002"-.012".




1. Transfer Plate to Case Gasket
2. Transfer Plate
3. Transfer Plate to Valve Body Gasket
4. Reinforcement Plate
5. Valve Body
6. Pressure Control Valve Spring
7. Pressure Control Valve
8. Detent Valve
9. Downshift Solenoid Gasket
10. Downshift Solenoid
11. Pressure Regulator Valve
12. Pressure Regulator Valve Spring
13. Pressure Regulator Boost Valve
14. Pressure Regulator Boost Valve Sleeve
15. Retaining Ring
16. Retaining Ring
17. Shift Regulator Valve Sleeve
18. Shift Regulator Valve
19. Spring Seat
20. Shift Valve Spring
21. Shift Valve
22. Manual Valve
23. High Speed Downshift Timing Valve Spring
24. High Speed Downshift Timing Valve
25. Retaining Pin

Fig. 7A-25 Valve Body—Exploded View

Assemble ring to piston. Measure clearance between ring and one wall of the piston groove. Clearance should be .0005"-.005".

To assemble low servo, place spring seat on piston shaft. Install cushion spring. Complete assembly by compressing cushion spring slightly with piston and secure piston to shaft with hairpin retainer.

### ASSEMBLY—VALVE BODY (FIG. 7A-25)

1. Install high speed downshift timing valve into its bore with stem out. Install spring and roll pin.

2. Install regulator valve into its bore with stem out and install spring. Assemble modulator valve and sleeve with stem out. Install assembly into bore and secure with retaining ring.

3. Install shift valve into its bore with stem out and install spring and spring seat with raised portion of seat toward spring. Assemble shift control valve and sleeve with large diameter stem out. Install assembly into bore and secure with retaining ring.

4. Assemble modulator pressure control valve spring on stem of valve and install into its bore spring first. Install detent valve with beveled stem out.

5. Using a new gasket, assemble the downshift solenoid to the valve body and secure with two screws.

6. Install manual valve.

### VALVE BODY AND LOW SERVO—INSTALLATION

1. Install low servo piston and return spring in bore in transmission (Fig. 7A-26) and engage notch in piston shaft with low band apply strut, loosening low band screw enough to permit piston ring to seat in case bore and allow installation of valve body.

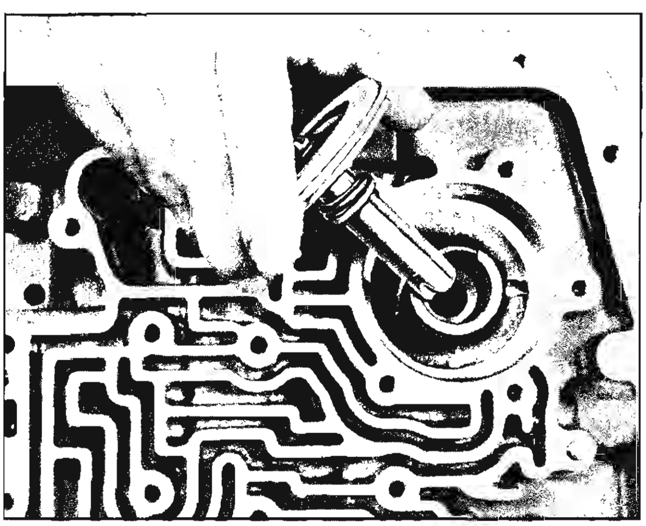


Fig. 7A-26 Low Servo Piston and Return Spring

2. Install retainer to hold servo piston in bore.

3. Position new gasket on transmission case and install transfer plate and reinforcement plate.

4. Position new gasket on valve body.

5. Position valve body in transmission indexing on dowels and remove retainer. Be sure manual valve indexes properly with pin on inner shaft lever.

6. Secure valve body with 15 screws. Torque screws to 100-140 lb. in.

7. Install oil pick-up screen and O-ring in valve body.

8. Position manual valve lever in full reverse position so it is held securely by wedging device (Fig. 7A-23) in transfer plate. Engage shift control cable and secure.

9. Using a new pan gasket, install transmission oil pan and torque pan attaching bolts to 35-45 lb. in. It is important that an even torque be applied to the pan bolts to prevent leakage between oil pan and transmission case pan rail.

10. Tighten filler tube attaching nut, then refill transmission with oil.

11. Readjust low band as covered on page 7A-17.

## TRANSMISSION REMOVAL

Removal of transmission is covered in Section 4.

## TRANSMISSION DISASSEMBLY

1. Remove converter cover nut assembly using J-9183 wrench to hold converter (Fig. 7A-27) and remove converter assembly using remover J-21199. An alternate method is to install converter holder tool J-21198 into front end of pump shaft to keep pump shaft from turning while the nut assembly is removed.

NOTE: Plug opening in converter to retain oil or drain into clean container.

2. Remove speedometer driven gear.

3. Remove governor assembly and O-ring (Fig. 7A-28).

4. Remove turbine shaft (Fig. 7A-29).

5. Remove remaining screws retaining transmission to differential carrier assembly.

6. Separate transmission and differential carrier.

7. Remove modulator, O-ring and modulator valve.

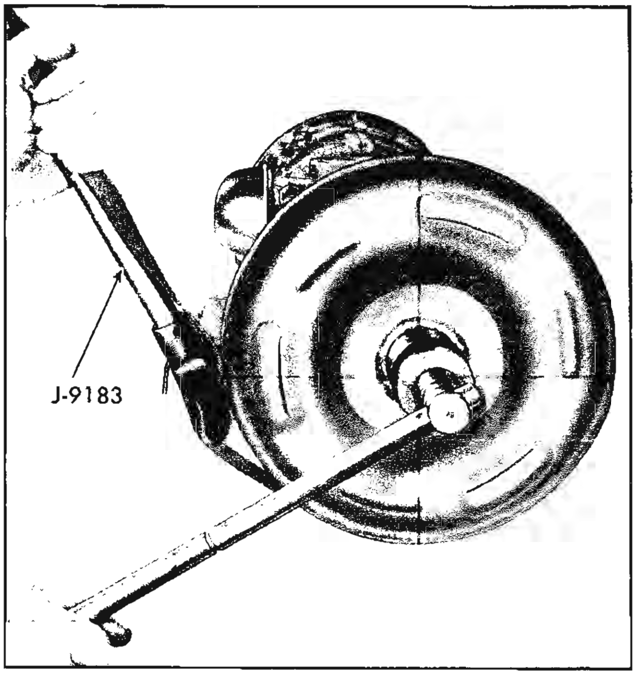



Fig. 7A-27 Removing Converter Nut

8. Mount transmission in holding fixture J-7896-01 (Fig. 7A-30).

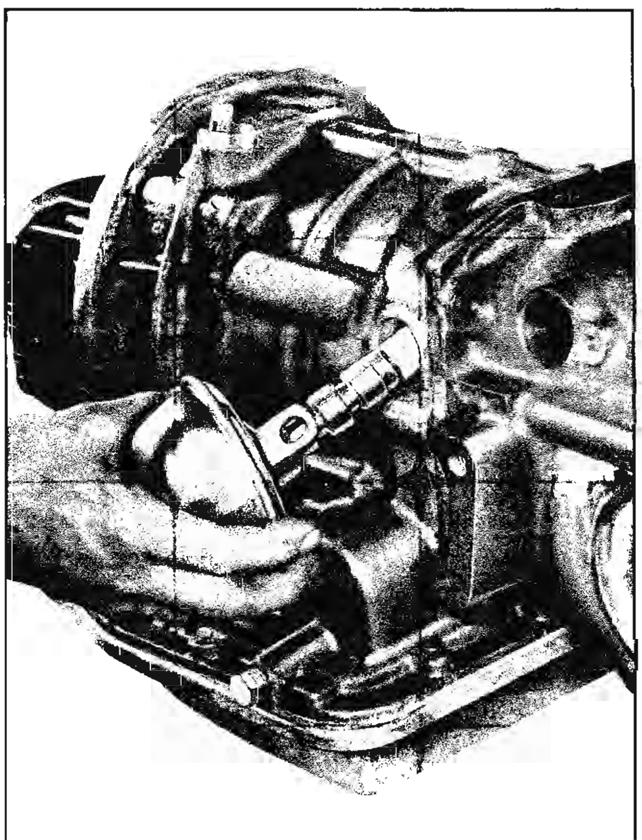


Fig. 7A-28 Removing Governor

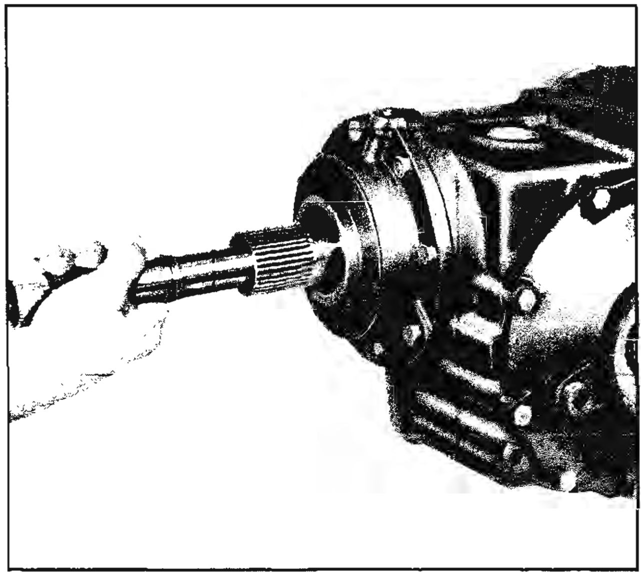


Fig. 7A-29 Removing Turbine Shaft

9. Loosen low band adjusting screw jam nut and fully tighten low band adjusting screw (Fig. 7A-30).

10. Remove seven housing attaching screws.

11. Using a soft hammer tap off extension housing and pump assy. Remove pump body to case gasket.

12. Rotate transmission to vertical position with front end up.

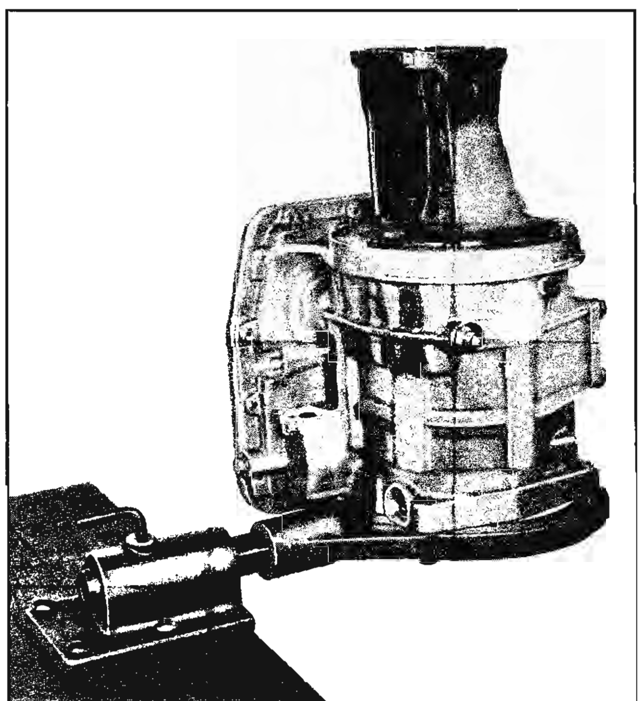


Fig. 7A-30 Transmission Mounted in Holding Fixture

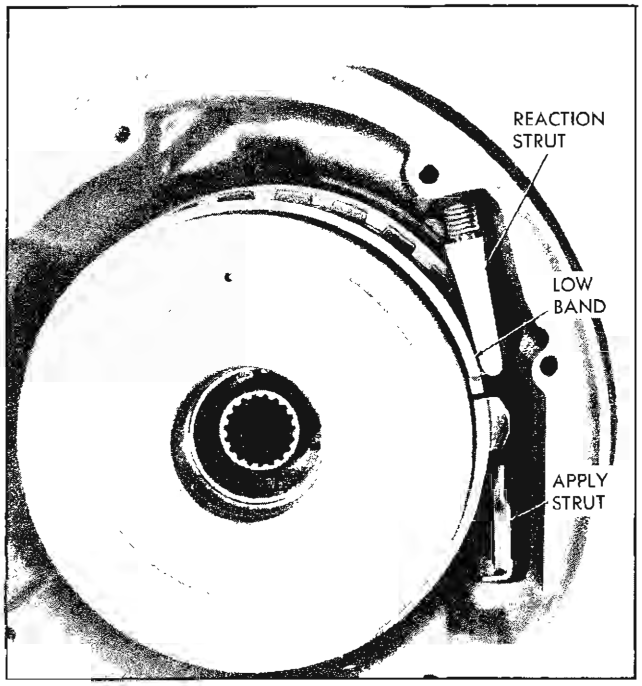



Fig. 7A-31 Location of Apply and Reaction Struts

13. Loosen low band adjusting screw and remove low band, apply strut and reaction strut (Fig. 7A-31).

14. Remove clutch drum assembly (Fig. 7A-32).

***CAUTION: Use care to avoid damaging the machined surfaces on the front face of the clutch drum.***

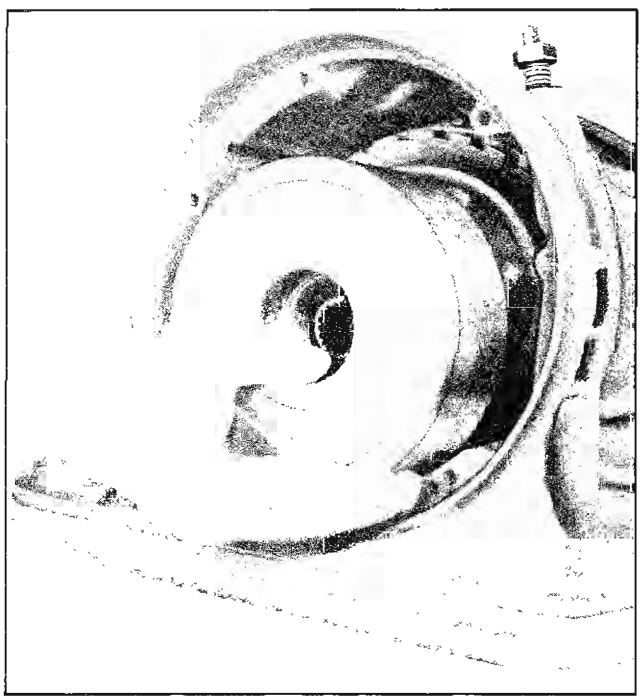


Fig. 7A-32 Removing Clutch Drum Assembly

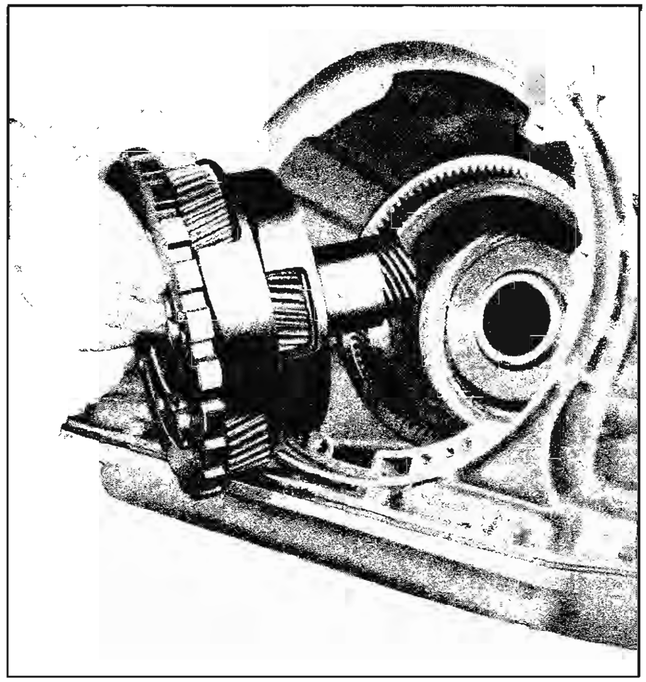


Fig. 7A-33 Removing Planet Carrier Assembly

15. Remove planet carrier assembly, fiber washer and cupped race from ring gear (Fig. 7A-33).

16. Remove ring gear from engagement with reverse clutch plates.

17. Remove reverse clutch snap ring (Fig. 7A-34).

18. Remove pressure plate, drive plates (faced) and reaction plates (steel). (Transmission for V-8

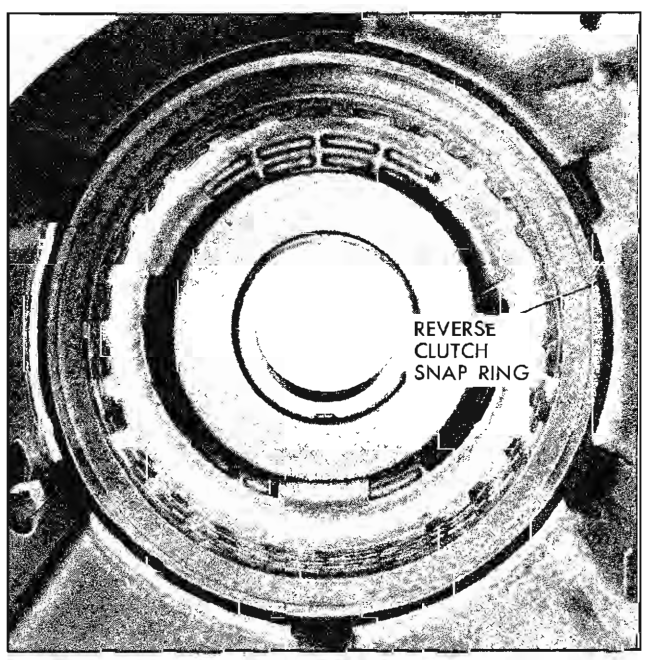



Fig. 7A-34 Reverse Clutch Snap Ring

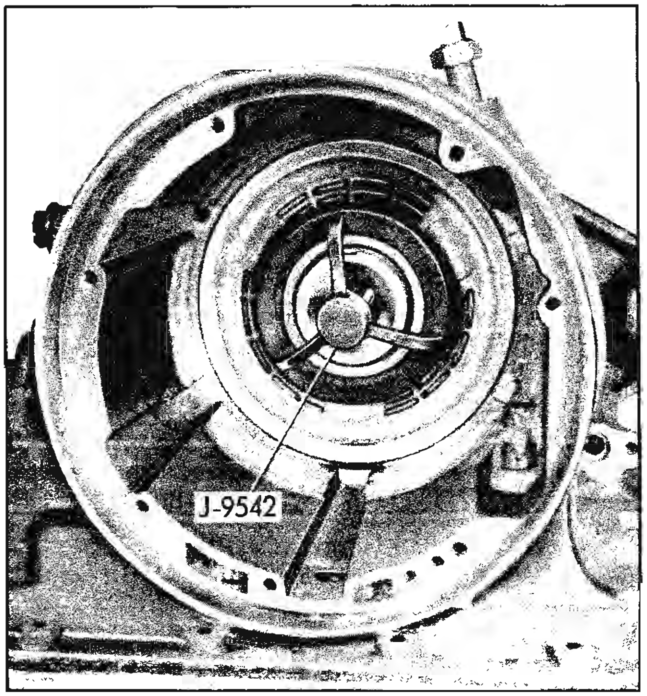



Fig. 7A-35 Compressing Reverse Piston Springs

engine has spring plate under last reaction plate.)

## INSPECTION AND OVERHAUL OF INDIVIDUAL TRANSMISSION COMPONENTS

### *REVERSE PISTON*

REMOVAL

1. Compress spring retainer with J-9542 spring compressor as illustrated in Fig. 7A-35.

2. With spring retainer compressed until springs bottom, remove snap ring. Carefully release pressure. Remove spring retainer and return springs.

3. To remove reverse piston, it is necessary to apply air pressure at the reverse piston apply pressure port.

4. Remove piston inner and outer seals. Seals should be discarded and new seals installed at reassembly.

INSPECTION (FIG. 7A-37)

1. Wash all parts in clean solvent and dry with compressed air.

***CAUTION: Do not use rags to dry parts.***

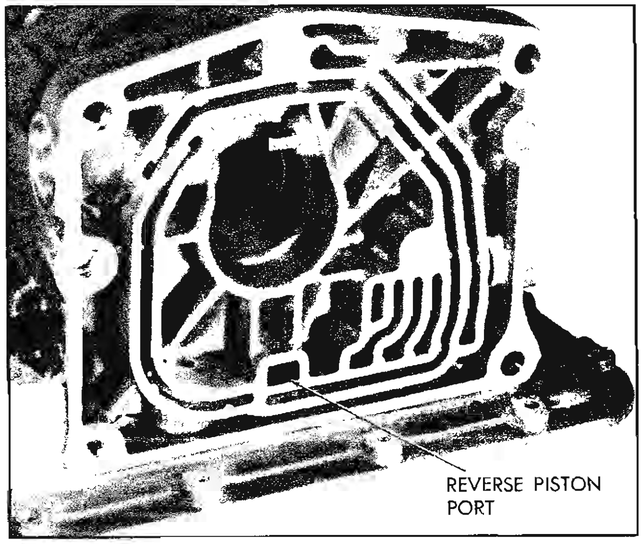



Fig. 7A-36 Reverse Piston Apply Pressure Port

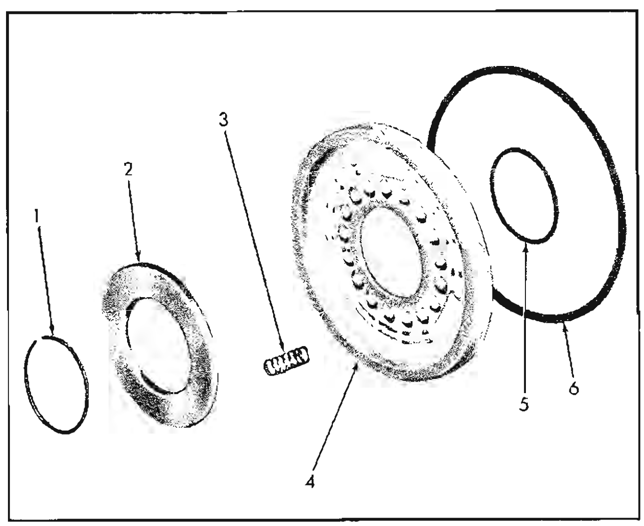
2. Check for broken piston return springs and make a comparative check of spring heights by standing all of the springs in a row. If appreciable difference in spring height is noticed, replace springs.

ASSEMBLY

1. Install piston inner seal in reverse piston.

2. Install piston outer seal in reverse piston.

3. Install reverse piston in case, tapping lightly if necessary.




1. Spring Retainer Snap Ring
2. Spring Retainer
3. Reverse Piston Return Springs (17 Used)
4. Reverse Piston
5. Reverse Piston Inner Seal
6. Reverse Piston Outer Seal

Fig. 7A-37 Reverse Piston—Exploded View

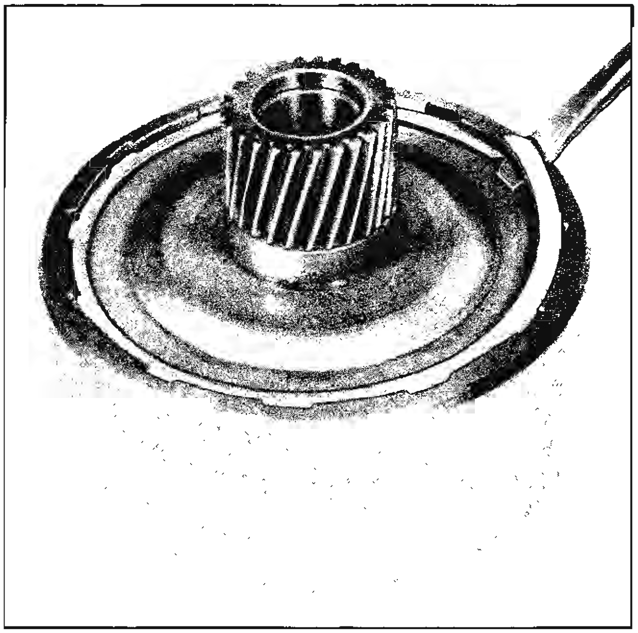


Fig. 7A-38 Removing Clutch Drum Snap Ring

4. Position 17 return springs in their seats on reverse piston, then place spring retainer on springs.

5. Compress springs using as illustrated in Fig. 7A-35.

6. With springs fully compressed, install snap ring in its groove.

7. Remove spring compressor.

### CLUTCH DRUM

DISASSEMBLY

1. Remove snap ring (securing low sun gear and clutch flange assembly to clutch drum) (Fig. 7A-38).

2. Remove low sun gear clutch flange and hub to flange thrust washer.

3. Lift out clutch hub (Fig. 7A-39), then remove nested drive and reaction plates and hub thrust washer.

4. To remove spring retainer, compress the springs using J-9542 spring compressor as shown (Fig. 7A-40). Remove snap ring.

5. Carefully release pressure, then remove spring retainer and return springs (Fig. 7A-41).

6. To remove clutch piston, pull upward with a twisting motion on center. Remove piston seal.

7. To complete disassembly, remove piston inner seal from hub of clutch drum.

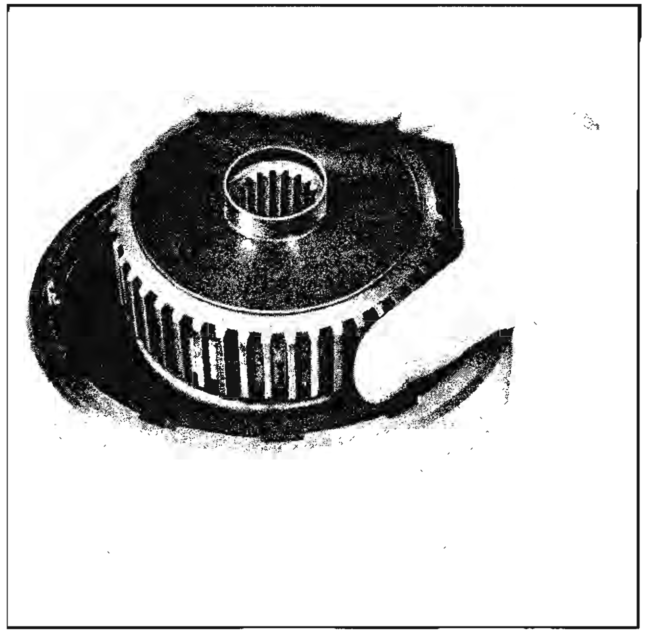


Fig. 7A-39 Removing Clutch Hub

INSPECTION (FIG. 7A-41)

1. Wash all parts in cleaning solvent (air dry).

***CAUTION: Do not use rags to dry parts.***

2. Inspect drum brake band surface for excessive scoring or burning. Also, check drum bushing for scoring or excessive wear.

3. Check steel ball in clutch drum that acts as a relief valve (Fig. 7A-42). Be sure that it is free to

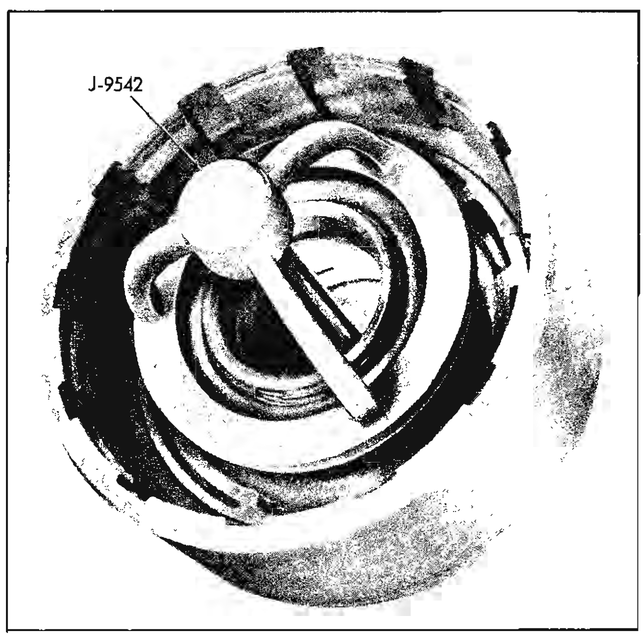
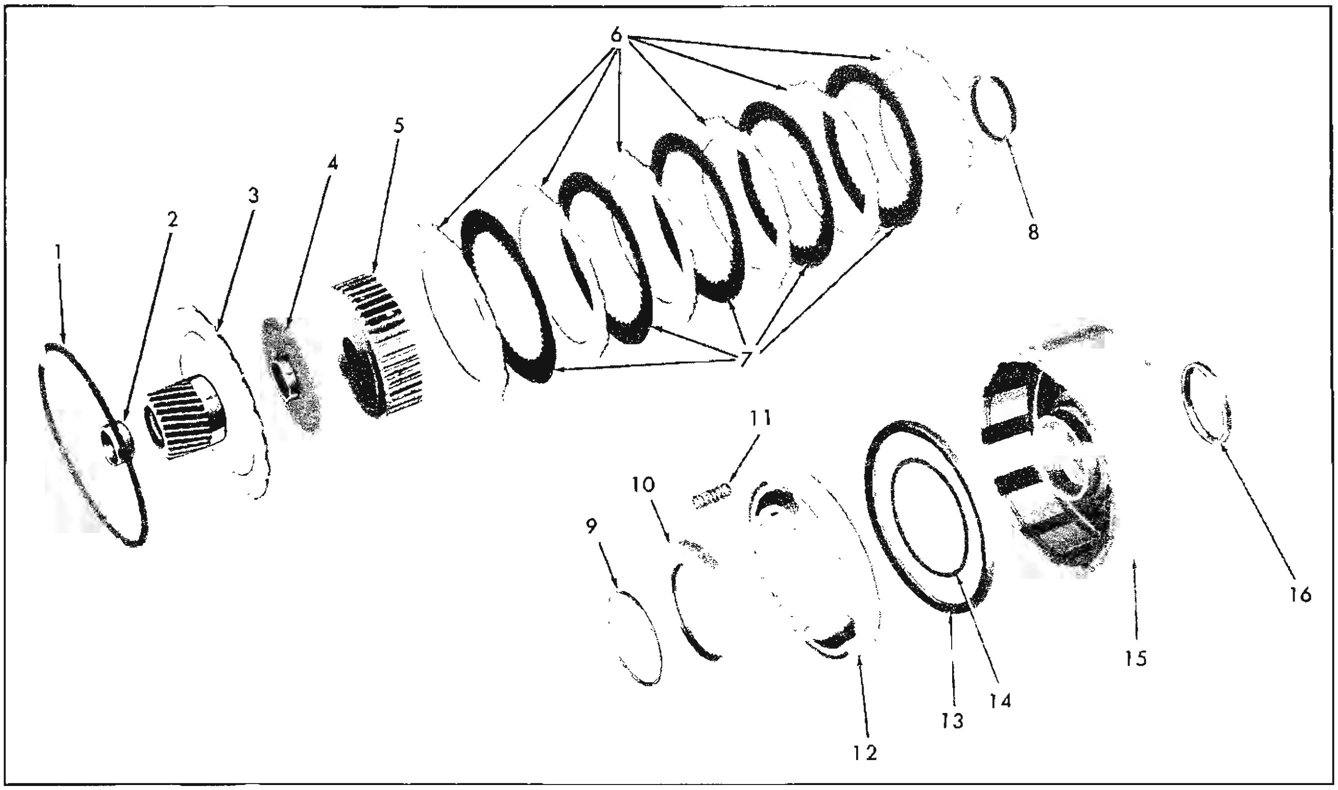



Fig. 7A-40 Compressing Clutch Springs




1. Clutch Flange Retaining Ring
2. Low Sun Gear Bushing
3. Clutch Flange and Low Sun Gear Assembly
4. Clutch Hub-to-Clutch Flange Thrust Washer
5. Clutch Hub
6. Reaction Plates (4 Used in L-4, 6 Used in V-8)
7. Faced Plates (3 Used in L-4, 5 Used in V-8)
8. Clutch Hub Thrust Washer
9. Return Spring Retainer Snap Ring
10. Return Spring Retainer
11. Clutch Piston Return Spring (24 Used)
12. Clutch Piston
13. Clutch Piston Seal
14. Clutch Drum Hub Seal
15. Clutch Drum
16. Clutch Drum Bushing

Fig. 7A-41 Clutch Drum—Exploded View

move in hole and that the orifice leading to front of drum is open. If clutch relief valve check ball in the clutch drum is loose enough to come out or not loose enough to rattle, replace clutch drum as an assembly. Replacement or restaking of ball should not be attempted.

4. Check fit of clutch flange in drum slots. There should be no appreciable radial play between these two parts. Also check low sun gear for nicks or burrs and bushing for wear.

5. Check clutch plates for burning, pitting or metal pick up. Also check to see that faced plates are a free fit over clutch hub and that steel plates are a free fit in clutch drum slots. Check for excessive wear on friction facing of drive plate teeth. Check condition of clutch hub splines and mating splines on faced plates.

## CLUTCH DRUM BUSHING REPLACEMENT

1. Remove old bushing with J-8400-1 chisel using care not to damage bushing bore.

2. Install new bushing with tool J-9546 (Fig. 7A-43).

## LOW SUN GEAR BUSHING REPLACEMENT

1. Remove old bushing with J-8400-1 or other suitable tool, using care not to damage bushing bore.

2. Install new bushing with tool J-21094 (Fig. 7A-44).

## ASSEMBLY (FIG. 7A-41)

1. Install piston inner seal in hub of clutch drum. Be sure seal lips are downward (toward the front of transmission).

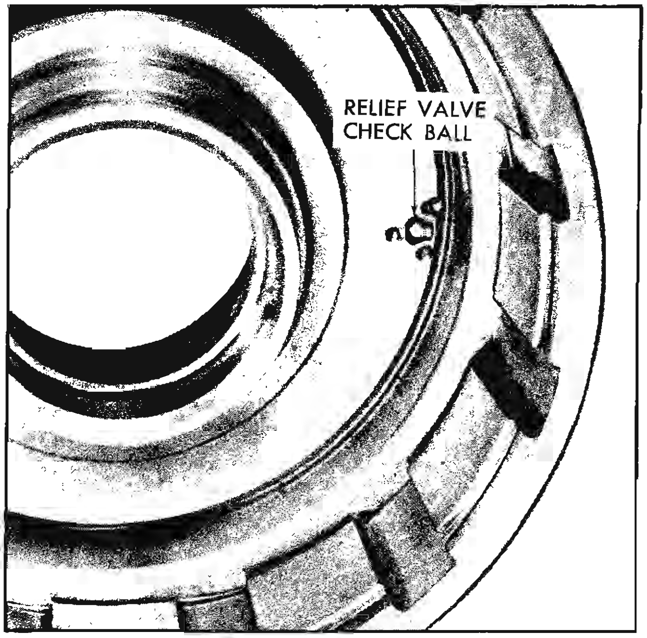



Fig. 7A-42 Relief Check Ball

2. Install a new piston seal in clutch piston. Be sure seal lips are toward front of transmission (clutch drum) when installed. Lubricate both piston inner seal and the piston seal, then install clutch piston in clutch drum with a twisting motion.

3. Place the 24 return springs in position on clutch piston. Place spring retainer on springs.

4. Compress springs, as illustrated in Fig. 7A-40. With springs fully compressed, install snap ring in groove on clutch drum hub and remove compressor.

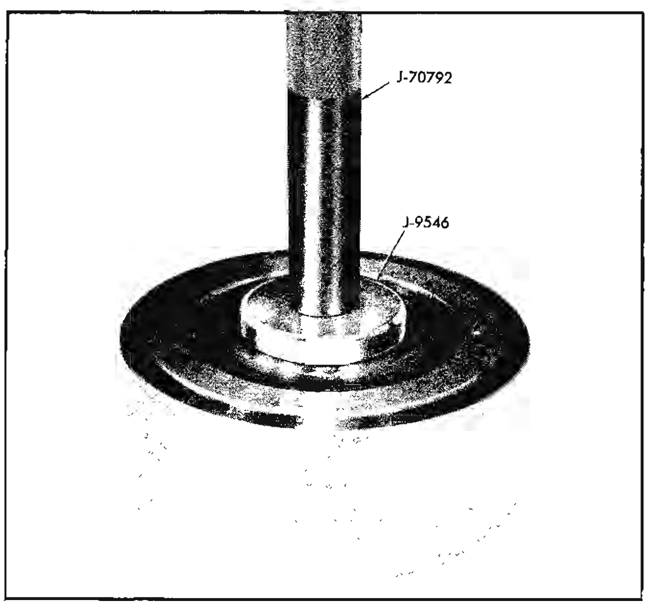



Fig. 7A-43 Installing Clutch Drum Bushing

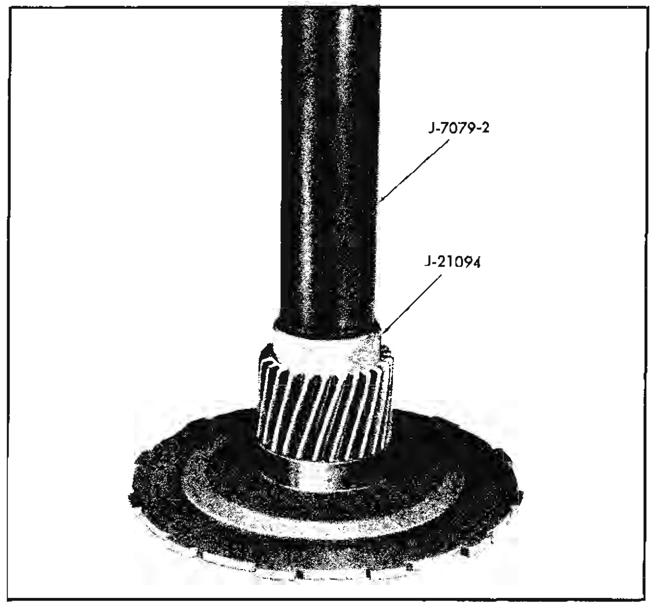



Fig. 7A-44 Installing Low Sun Gear Bushing

5. Install hub front thrust washer with its lip toward clutch drum. Align two dimples with notches in hub. Install clutch hub.

6. Install steel reaction plates and faced drive plates alternately, starting with a steel plate.

NOTE: The clutch assembly for V-8 engine transmission contains 6 steel plates and 5 faced plates. The clutch assembly for four cylinder engine transmission contains 4 steel plates and 3 faced plates.

7. Install hub rear thrust washer with its flange toward low sun gear, then install low sun gear and clutch flange assembly and secure with snap ring. Openings of retainer ring should be lined up with a clutch drum slot.

8. Check assembly by turning clutch hub to insure it is free to rotate.

### *PUMP AND EXTENSION HOUSING*

#### DISASSEMBLY (FIG. 7A-45)

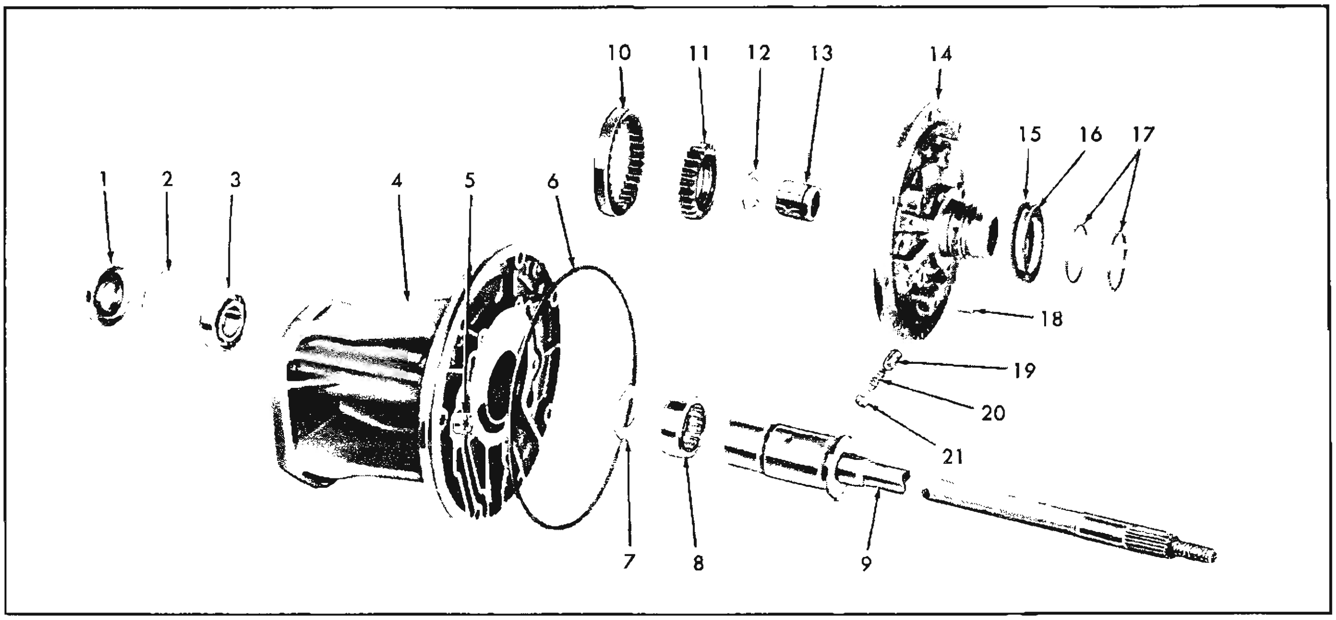
1. Remove two hook type oil sealing rings, thrust washer and shims (if present) from pump hub.

NOTE: V-8 transmission uses a thrust bearing assembly instead of a thrust washer.

2. Remove 5 screws securing extension housing to pump body and separate pump body and housing.

NOTE: Use care to avoid dropping gears from pump body.

3. Remove pump shaft.




1. Seal
2. Retainer Ring
3. Bearing Assembly
4. Extension Housing
5. Coast Downshift Timing Valve
6. Seal
7. Thrust Washer
8. Bearing Assembly
9. Pump Shaft
10. Pump Driven Gear
11. Pump Drive Gear
12. Thrust Washer
13. Bushing
14. Pump Body
15. Shim
16. Thrust Washer
17. Oil Seal Ring
18. Retainer Pin
19. Pump Priming Valve
20. Spring
21. Spring Seat

Fig. 7A-45 Exploded View of Pump and Extension Housing

4. Mark, but do not scar, pump gear faces to facilitate reassembly with same face up and remove gears.

5. Remove pump shaft thrust washer.

6. Drive out pump priming valve retaining pin and remove valve spring and valve from pump body.

7. Remove coast downshift timing valve from extension housing only if it is known to be defective.

8. Remove housing outer seal ring.

9. Pry out oil seal (Fig. 7A-46) or use Tool J-6292.

10. Remove front bearing retainer ring (Fig. 7A-47).

11. Remove front bearing using Tool J-6292.

12. Remove rear bearing and thrust washer by inserting needle bearing remover J-21263 through front of extension and driving out the back.

## INSPECTION (FIG. 7A-45)

1. Wash all parts in cleaning solvent and blow out oil passages.

2. Inspect pump gears for nicks or damage. Inspect drive gear bushing for wear or scoring.

3. Inspect extension housing face for nicks or scoring.

4. Inspect pump body for nicks or scoring.

5. Check oil control rings removed from pump body. Install rings in operating position in bore of clutch assembly to verify that they have end clearance.

6. Check condition of bushing in pump body, if damaged, replace as outlined below.

7. With parts clean and dry, install pump gears and check:

a. Clearance between OD of driven gear and body should be .0025"-.005" (Fig. 7A-48).

b. Clearance between driven gear and crescent should be .0025"-.005" (Fig. 7A-49).

c. With scale and feeler gauge check gear end clearance. This clearance should be .0005"-.0015" Fig. 7A-50).

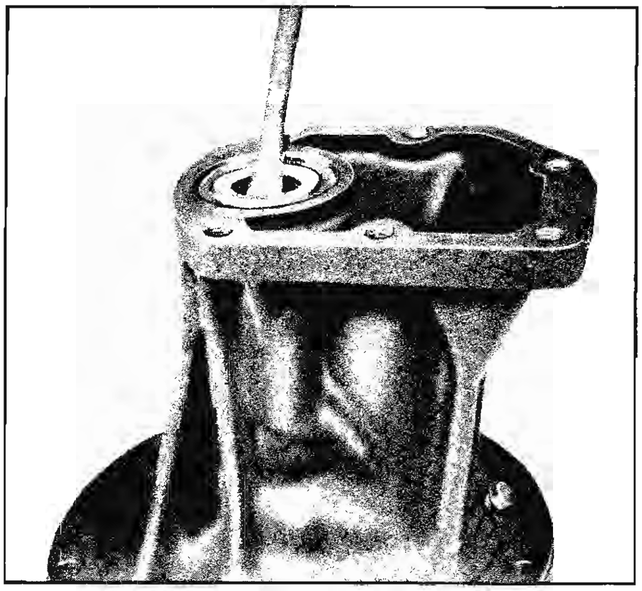


Fig. 7A-46 Removing Extension Housing Oil Seal (V-8)

8. Inspect front and rear bearings for damage, wear or roughness.

## PUMP BODY BUSHING REPLACEMENT

1. Remove old bushing using J-8400-1 tool.

2. Install new bushing using tool J-21098 and handle J-8092 (Fig. 7A-51).

## ASSEMBLY

1. Install pump shaft thrust washer in extension housing with grooves facing up.

2. Install caged needle bearing in extension housing with identification on outer race facing up, using installer J-21249.

3. Install front bearing using installer J-21033 and handle J-7079-2.

4. Install retaining ring.

5. Using soft hammer, or installer J-21033 and handle J-7079-2, tap in new drive line oil seal.

6. Using installer J-21237, install coast downshift timing valve (Fig. 7A-45) in extension housing with tip down. Installer J-21237 is designed to drive the valve into the extension housing so that distance from housing face to top edge of valve is 3/8".

***CAUTION: Do not install valve by tapping on spring retaining fingers or the calibration will be affected.***

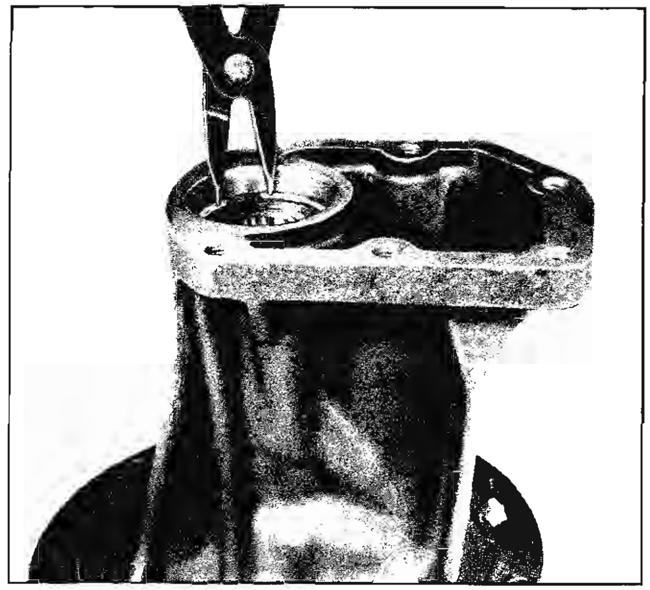


Fig. 7A-47 Removing Bearing Retainer Ring (V-8)

7. Install pump priming valve into pump body, stem first. Install valve spring and secure with retaining pin (Fig. 7A-45).

8. Install pump gears (with previously marked faces up), thrust washer and pump shaft assembly.

9. Assemble extension housing to pump body and install 7 outer screws for preliminary alignment.

10. Align extension housing and pump body using alignment band J-21034 (Fig. 7A-52). Secure assembly with 5 screws and remove alignment band. Rotate shaft to check for binding.

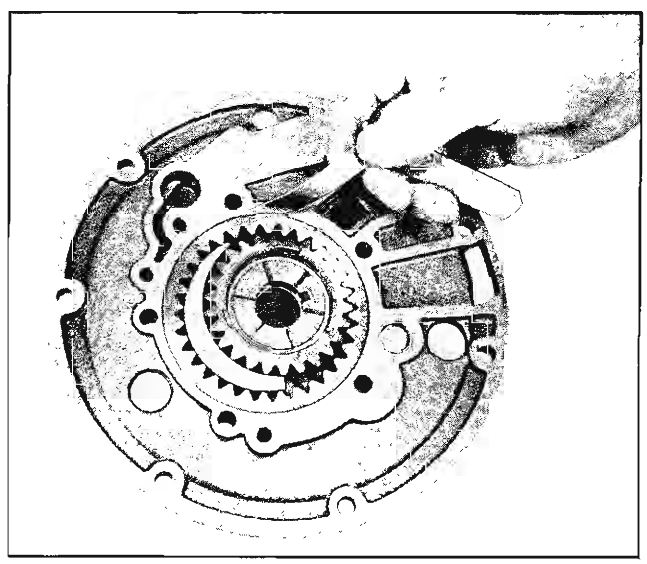


Fig. 7A-48 Checking Gear to Body Clearance

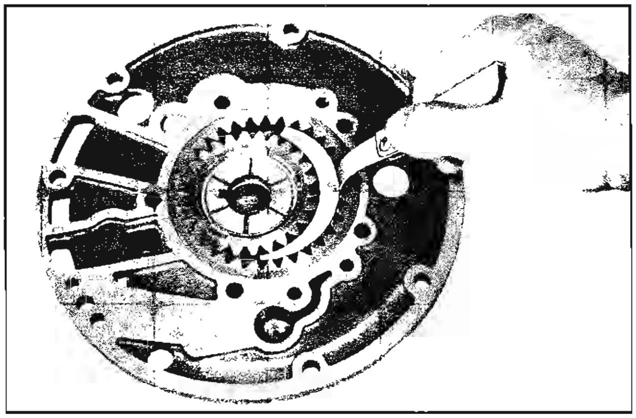


Fig. 7A-49 Checking Gear to Crescent Clearance

11. Install shims as required on pump body hub and then install thrust washer (bearing assembly for V-8), engaging tang of washer in notch in pump body. Install the two hook type oil seal rings.

NOTE: Number of shims to be used is determined in step 10, ASSEMBLY OF TRANSMISSION.

12. Install new outer seal ring in groove on OD of extension housing.

### *PLANET CARRIER*

#### PRELIMINARY INSPECTION

1. Wash planet carrier assembly in cleaning solvent; blow out all oil passages and air dry.

***CAUTION: Do not use rags to dry parts.***

2. Inspect planet pinions for nicks or other tooth damage.

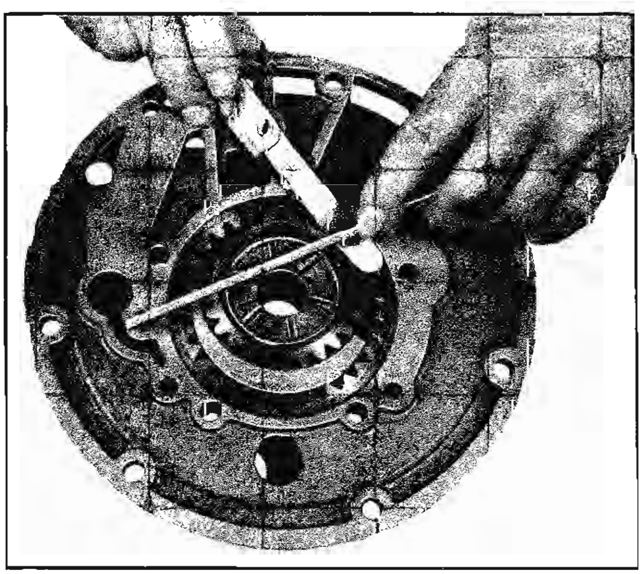


Fig. 7A-50 Checking Gear End Clearance

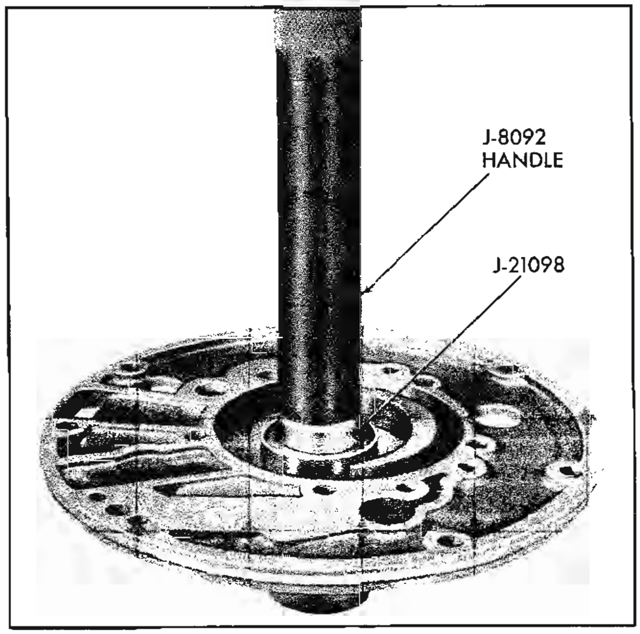



Fig. 7A-51 Installing Pump Body Bushing

3. Check end clearance of planet pinions. This clearance should be .006"-.030". (Fig. 7A-53).

4. Check input sun gear for tooth damage. Check input sun gear rear thrust washer for damage.

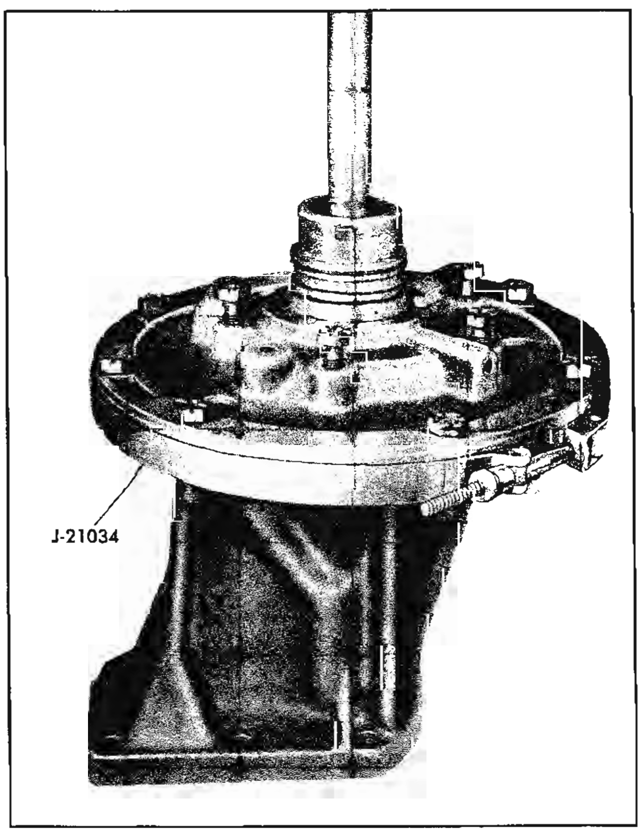



Fig. 7A-52 Aligning Pump Body and Extension Housing

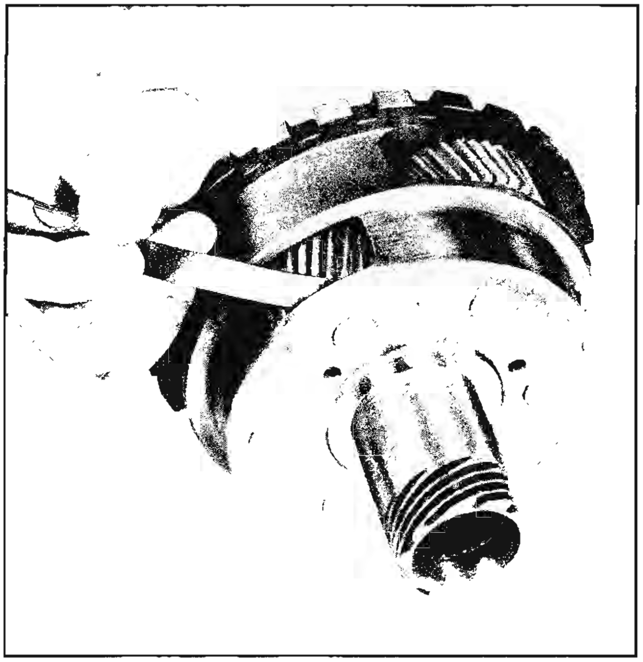


Fig. 7A-53 Checking Planet Pinion End Clearance

5. Inspect output shaft bearing surface for nicks or scoring.

6. Inspect output shaft splines for nicks or damage.

If the planet pinions, pinion needle bearings, pinion thrust washers, input sun gear, or input sun gear thrust washer show evidence of excessive wear or damage, they should be replaced using the following procedure:

## DISASSEMBLY (FIG. 7A-54)

1. Place planet carrier in fixture or vise so that front end faces up.

2. Using prick punch or other similar means, mark each pinion shaft and planet carrier assembly so that on reassembly pinions can be installed in same hole from which removed.

NOTE: Pinion shafts are not selectively fit, but it is good practice to reinstall them in the original locations.

3. Remove pinion shaft lock plate screws and rotate lock plate clockwise enough to remove it.

4. Starting with a short planet pinion, and using a soft steel drift, drive on front end of pinion shaft until shaft is beyond press fit area of front flange. Insert loader J-9538 into short planet pinion, pushing pinion shaft ahead of it until loader is centered in pinion and pinion shaft is removed.

NOTE: Loader J-9538 comes in two parts, one long for use with long pinions, and one short for use with short pinions.

5. Remove short pinion and pinion rear thrust washer.

6. Remove loader J-9538, needle bearings and needle bearing spacers (2) from pinion.

***CAUTION: Use care to avoid losing pinion needle bearings. Twenty needle bearings are used in each short pinion with a spacer at each end.***

By following the procedure in steps 4, 5 and 6 above, remove the remaining short pinions.

8. Remove input sun gear thrust bearing race, thrust bearing, input sun gear, and rear thrust washer.

9. By following the procedure in steps 4, 5 and 6 above, and using long part of loader J-9538, remove long planet pinions and 3 front (paired) thrust washers.

***CAUTION: Use care to avoid losing pinion needle bearings. Twenty needle bearings are used at each end of each long pinion, separated by a wide spacer and with a spacer at each end.***

## INSPECTION

1. Wash all parts in cleaning solvent and air dry.

2. Recheck pinion gears and input sun gear for nicks or other tooth damage. Check thrust bearing and washers for wear. Replace worn or damaged parts.

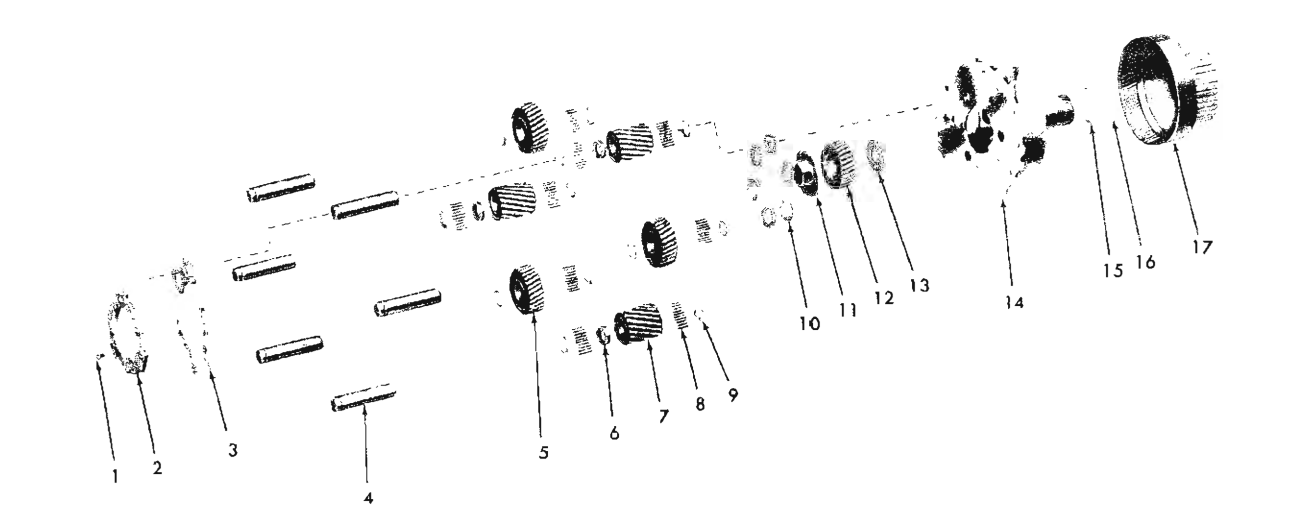
3. Inspect pinion needle bearings carefully. If excessive wear shows, all needle bearings must be replaced. Inspect pinion shafts and replace worn shafts.

## ASSEMBLY (FIG. 7A-54)

1. Using loader J-9538, assemble needle bearing spacers and needle bearings in one of the long pinions (20 bearings at each end with wide spacer in between and a thin one at each end). Use petrolatum to aid in assembling and holding needle bearings in position.

2. Position long planet pinion, with J-9538 centered in pinion and with thrust washers at each end, in planet carrier. Use a "paired" thrust washer at the front and a single washer at rear, with oil grooves in both washers facing the pinion.

3. Select the proper pinion shaft, as marked in step 2 of the disassembly procedure, lubricate the shaft, and install it from the front end, pushing loader ahead of it. As loader is pushed down, verify that it picks up rear thrust washer.




1. Screw
2. Lock Plate
3. Paired Thrust Washer
4. Pinion Shaft
5. Short Pinion
6. Wide Spacer
7. Long Pinion
8. Needle Bearings
9. Spacer
10. Rear Thrust Washer
11. Bearing Assembly
12. Input Sun Gear
13. Thrust Washer
14. Carrier
15. Fiber Thrust Washer
16. Steel Thrust Washer
17. Reverse Ring Gear

Fig. 7A-54 Planet Carrier—Exploded View

NOTE: Make certain that shaft lock plate slot is properly aligned toward center of assembly before installing shaft.

4. With brass or soft steel drift, drive pinion shaft in until lock plate slot is flush with assembly surface.

5. Following the general procedure described in steps 1 through 4 above, install the remaining two long pinions.

6. Install input sun gear rear thrust washer, input sun gear, front thrust bearing, and bearing race, with ID flange up.

7. Following the general procedure described in steps 1 through 4 above, install short pinions in carrier adjacent to previously installed long pinions.

NOTE: Front (paired) thrust washer already installed with long pinion is used with adjacent short pinion.

8. Check end clearance of pinions. This clearance should be .006"-.030".

9. Install pinion shaft lock plate so that tangs engage slots in shafts and the three screw holes are accessible.

10. Install pinion shaft lock plate attaching screws and tighten to 2½-3 lb. ft.

***TURBINE SHAFT***

### INSPECTION

Inspect splined areas for wear or damage. Check lubrication holes to be sure they are open. Inspect bushing for wear or damage. If bushing is damaged, replace as described below. Check the hook type oil seal ring to make sure it is free to rotate.

### BUSHING REPLACEMENT

1. To remove old bushing, cut out with chisel J-8400-1. Use care not to damage the bore.

2. Install new bushing as illustrated in Fig. 7A-55 using tool J-21095.

***CONVERTER***

NOTE: It is unecessary to drain converter as it is welded and no internal repairs can be made.

### INSPECTION

Check converter seams for stress or breaks and either replace converter or repair welds as required. If welds are repaired, keep added material to a minimum by chipping off scale and filing away excess weld to retain converter balance. Check converter hub bushing for wear or damage.

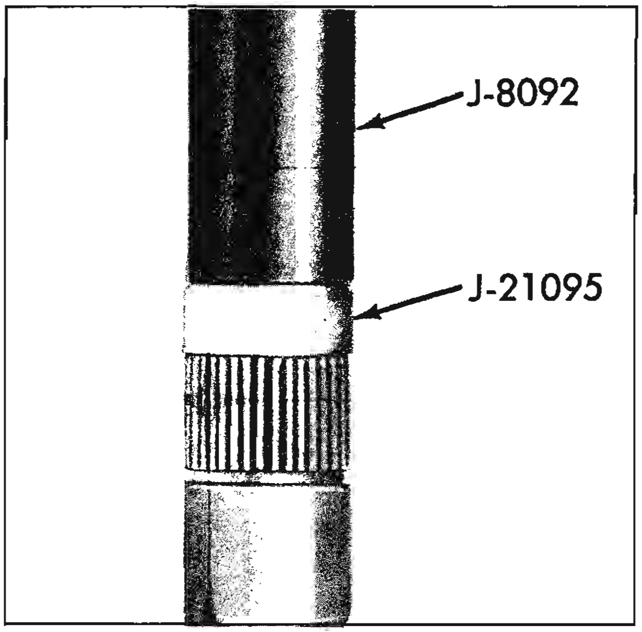



Fig. 7A-55 Installing Turbine Shaft Bushing

CONVERTER BUSHING REPLACEMENT

1. Remove old bushing with chisel J-8400-1, using care not to damage converter bore.

2. Install new bushing using tool J-21096 as shown in Fig. 7A-56.

## ASSEMBLY OF TRANSMISSION

1. Install transmission case in holding fixture J-7896-01, if removed, with rear of case down.

2. Install reverse clutch spring plate (V-8 transmission only), drive plates, and reaction plates as shown in Fig. 7A-57. Notched lug in each steel reaction plate is installed so that it is at top of groove at 4 o'clock position in case (Fig. 7A-58). Install pressure plate (Fig. 7A-58). The pressure plate has a rectangular "dimple" in the lug that engages the 4 o'clock case groove.

3. Install reverse clutch plate snap ring (Fig. 7A-59).

4. Check for correct selective reverse reaction spacer plate running clearance as follows:

a. Position transmission horizontally.

b. Using feeler gauges, measure clearance between pressure plate and first faced plate. If clearance is .025" to .060", running clearance is correct.

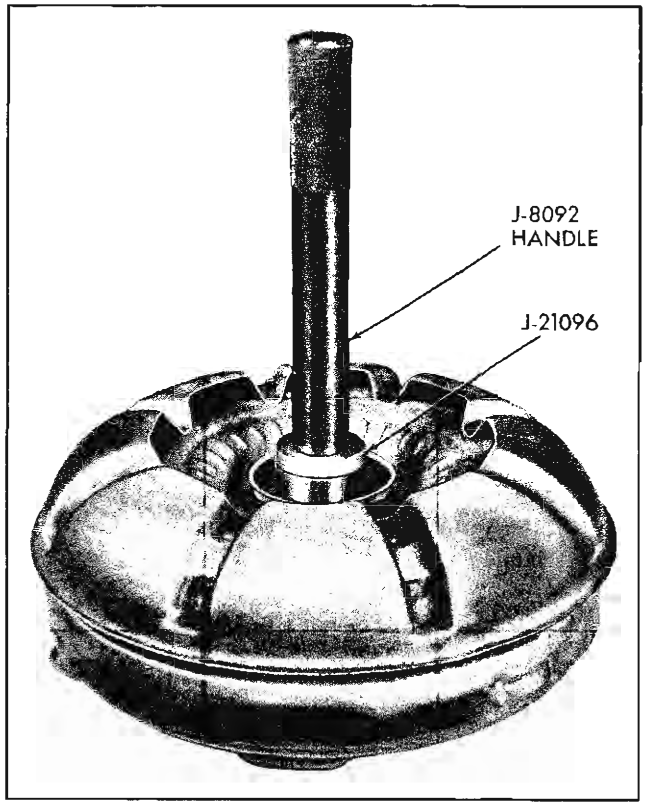



Fig. 7A-56 Installing Converter Bushing

c. If clearance is not within limits, remove reverse clutch pack and install a thicker or thinner selective plate (Fig. 7A-58) next to piston as required. Selective plates are available in three thicknesses: .070", .102" and .134".

NOTE: Install selective plate on top of spring plate in V-8 transmission.

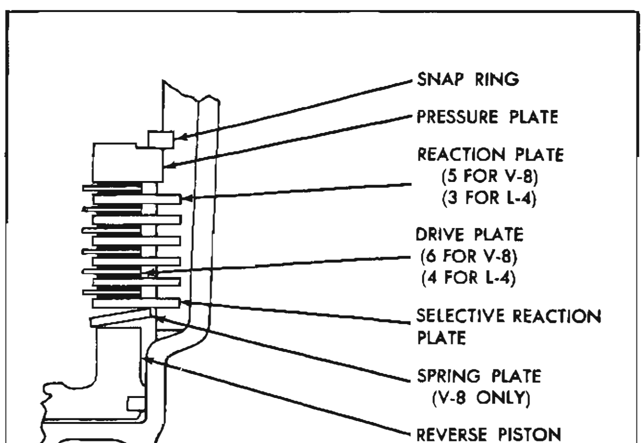



Fig. 7A-57 Reverse Clutch Plate Assembly Sequence

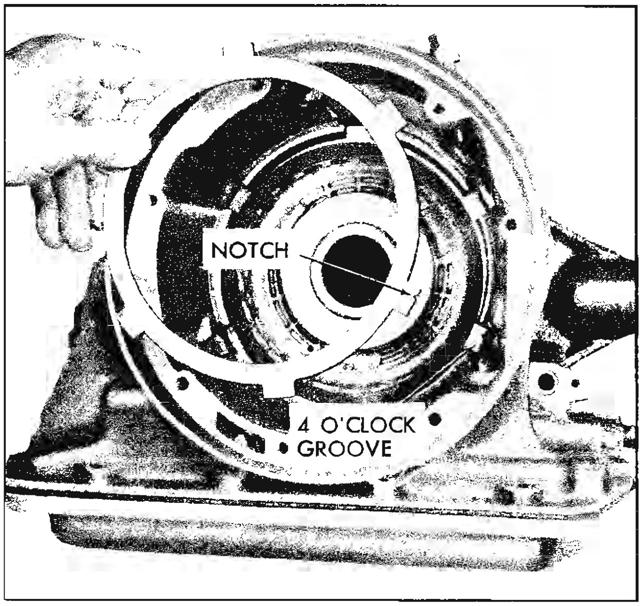



Fig. 7A-58 Installing Reverse Clutch Reaction Plates

5. Align internal lands of reverse clutch drive plates and center them in case.

6. Engage reverse ring gear with reverse drive plates. Engagement must be made by "feel" while moving drive plates laterally.

7. Install metal thrust washer on reverse piston hub, engaging washer "dimples" in hub notches, then install fiber washer on top of it.

8. Install planet carrier with a slight twist to engage planet pinions with reverse ring gear.

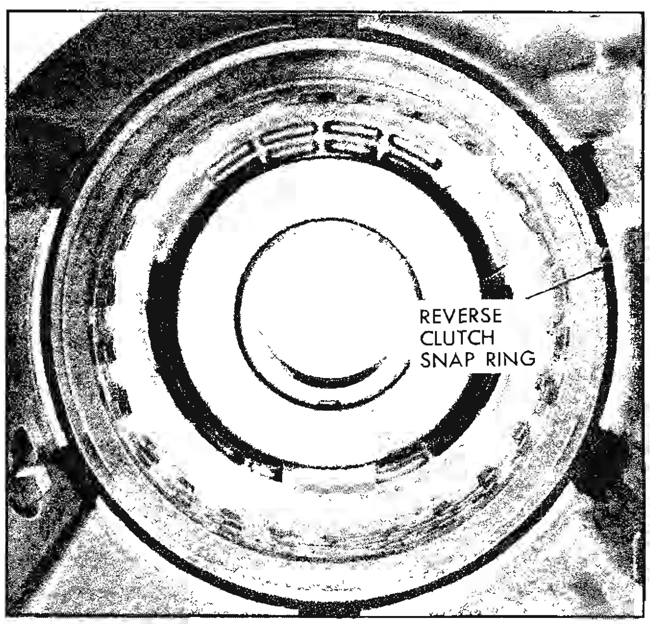



Fig. 7A-59 Reverse Clutch Snap Ring

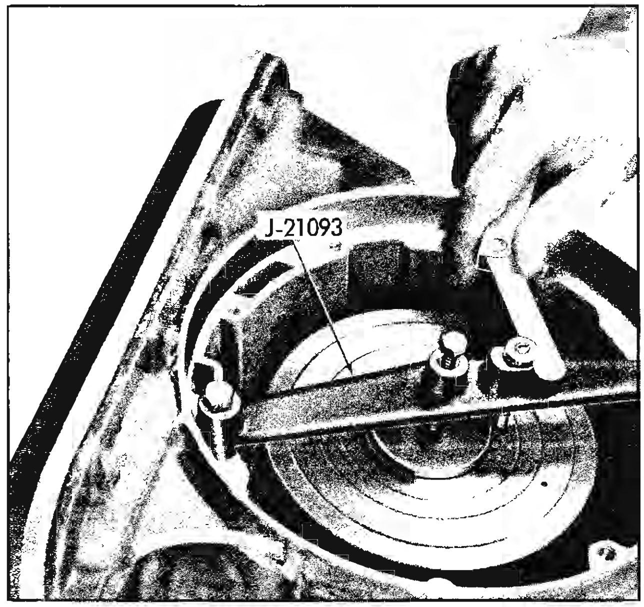



Fig. 7A-60 Measuring for Shim Determination

9. Install clutch drum assembly, using a slight twist to engage low sun gear with pinions in planet carrier.

10. Install shim selector gauge J-21093 and check end clearance (Fig. 7A-60). The measurement made with feeler gauge determines number of shims to be used. Refer to chart (Fig. 7A-61) for number of shims to be used in step 12. PUMP AND EXTENSION HOUSING ASSEMBLY–REMOVE TOOL.

NOTE: If the pin of gauge J-21093 does not rest on the face of the clutch drum, there is excessive end play, probably due to worn parts that should be replaced. If the feeler gauge thickness exceeds .0485″, incorrect assembly of parts is indicated and the assembly should be rechecked.

| Gauge Thickness | No. of Shims Required |
|---|---|
| Flush to .0015″ | 3 |
| .0015″ to .0175″ | 2 |
| .0175″ to .0335″ | 1 |
| .0335″ to .0485″ | 0 |

Fig. 7A-61 Shim Chart

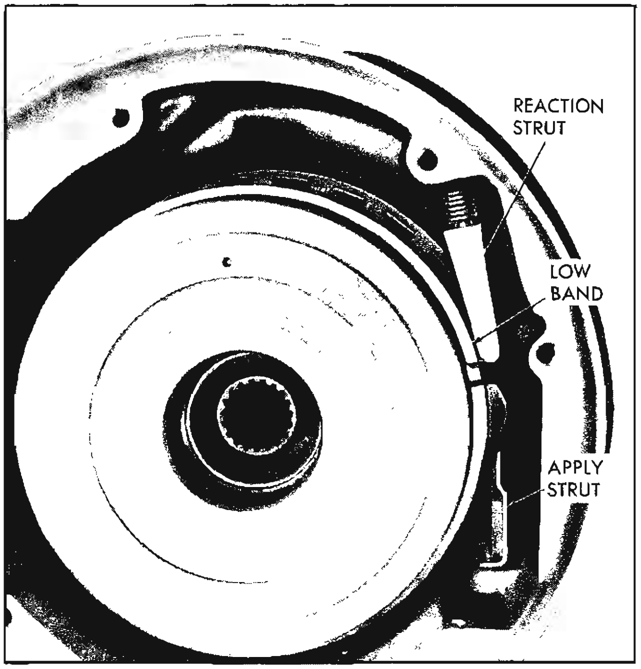



Fig. 7A-62 Location of Apply and Reaction Struts

11. Install low band, apply strut, and reaction strut (Fig. 7A-62). Tighten low band adjusting screw enough to prevent struts from falling out of place. Shake clutch drum slightly to center low band and linkage.

12. Install new pump gasket, then index and install pump and extension housing assembly. Use care to avoid breaking the cast iron oil rings on pump body hub as they enter the clutch drum bore.

13. Install 7 retaining screws (with O-rings under head) and tighten to 14-22 lb. ft.

14. Adjust low band by first tightening adjusting screw to 4 ± 5 inch-lbs., then back off four (4) full turns exactly. Hold adjusting screw and lock adjustment by fully tightening lock nut.

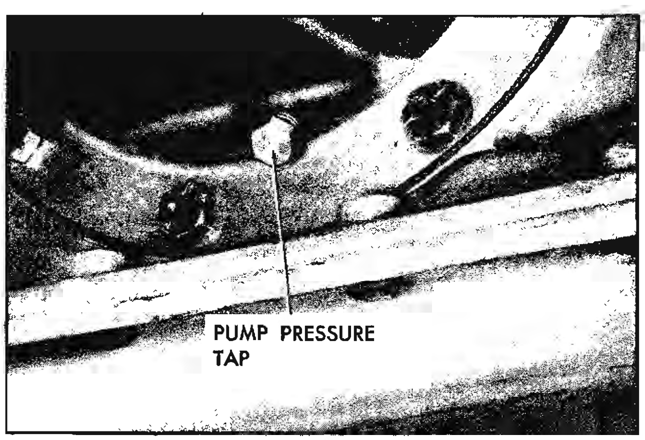



Fig. 7A-63 Pump Pressure Tap Location

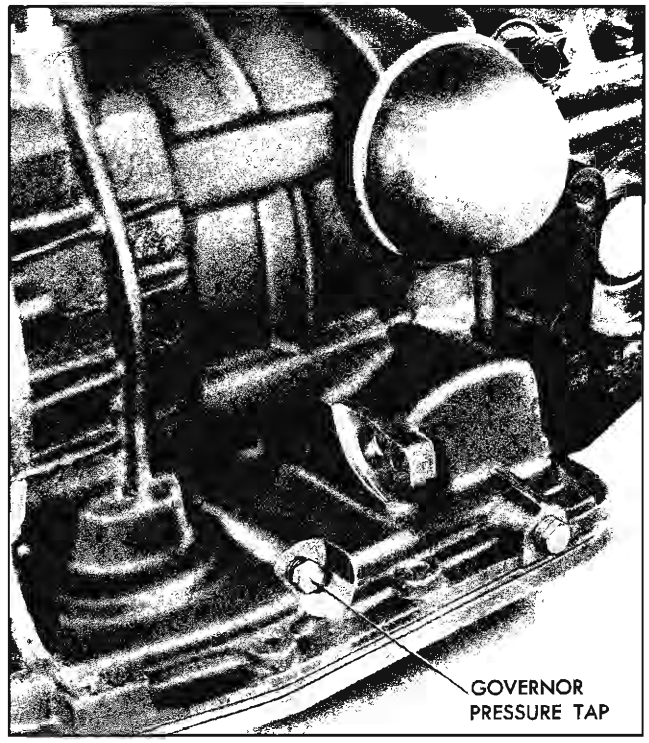



Fig. 7A-64 Governor Pressure Tap Location

## ASSEMBLE TRANSMISSION TO DIFFERENTIAL CARRIER ASSEMBLY

1. Apply a new gasket to either carrier or rear face of transmission case using petrolatum.

2. Remove transmission from holding fixture. Align carrier and transmission on a flat surface and carefully guide pump shaft through differential carrier.

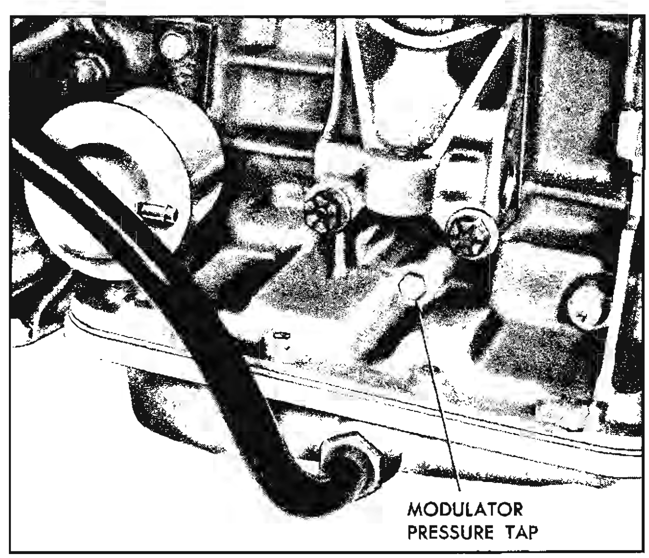



Fig. 7A-65 Modulator Pressure Tap Location

3. Install governor, using new O-ring seal, and secure transmission to carrier with four screws. Drive two screws from carrier side first to minimize chance of cocking mating surfaces. Tighten screws to 30-35 lb. ft.

4. Install turbine shaft, using care to avoid damaging bushings.

5. Install converter.

6. Install converter nut and seal assembly. Tighten nut until a sudden increase in resistance is felt. Complete tightening nut until torque is 10-20 lb. ft. above that required for tightening prior to sudden increase in resistance.

7. Install modulator valve and modulator assembly and secure with clamp.

8. Install speedometer driven gear.

9. Install parking pawl assembly.

10. Install transmission and axle assembly as covered in Section 4.

## TROUBLE DIAGNOSIS

### PRESSURE TAP LOCATIONS

Pressure taps are available for checking pump, governor, and modulator pressures. The pump pressure tap is located on the extension housing (Fig. 7A-63). The governor pressure tap is located in a recess near the bottom of the case on the same side as the governor (Fig. 7A-64). The modulator pressure tap is located in a recess near the bottom of the case on the same side as the modulator (Fig. 7A-65). To facilitate connecting pressure gauge lines to the governor or modulator pressure taps, it is suggested that a pipe extension be made up to bring the point of line connection out beyond the edge of the oil pan.

### TEST PREPARATION

All tests can be made without driving the vehicle by simply raising the wheels 3-5 inches from the floor by using jack stands. With pressure gauges installed, perform the following preliminary steps.

- Establish pressure gauges indicator needle rest positions at zero pressure.
- Thoroughly warm up transmission.
- Check transmission oil level.
- Check linkage adjustment.

Absence of pump pressures results in no drive in any range as this pressure is required to apply the applicable clutch or the low band. Common causes would be stuck pressure regulator valve or broken or disengaged pump drive lugs.

Failure of pressure to rise when disconnecting the vacuum hose (or high pressures with the hose connected) would indicate a stuck modulator valve, defective modulator, or collapsed hose.

### PRESSURE CHECKS

Refer to chart (Fig. 7A-66) normal operating pressures. The pressures listed in the chart are only approximate and are to be used only as a gauge in trouble diagnosis.

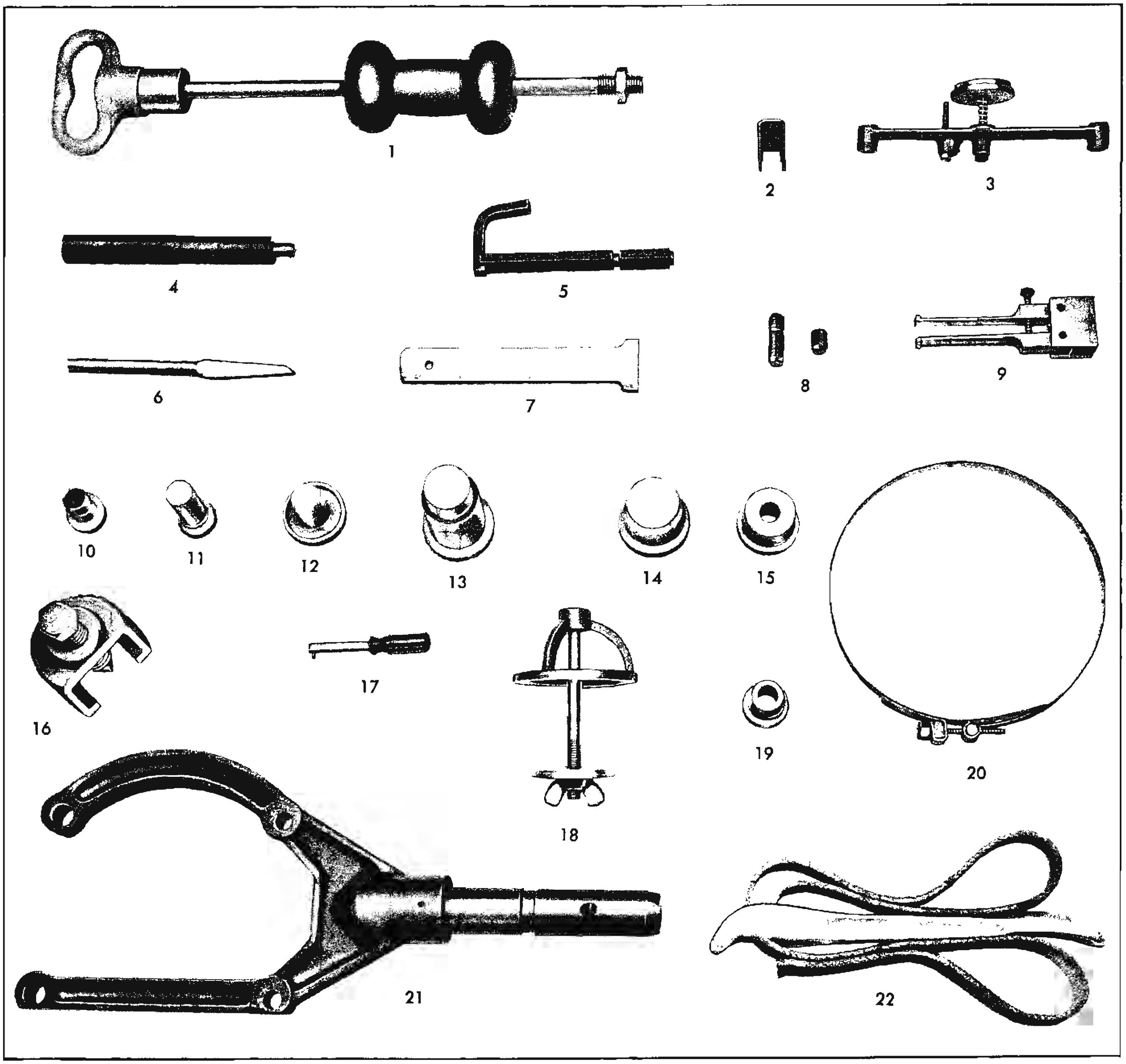
## TORQUE SPECIFICATIONS

| | |
|---|---|
| Case to carrier bolts | 55-75 lb. ft. |
| Valve body to case bolts | 100-140 lb. in. |
| Pump body to extension housing bolts | 14-22 lb. ft. |
| Extension housing to case bolts | 14-22 lb. ft. |
| Oil pan to case bolts | 35-45 lb. in. |
| Modulator clamp bolt | 100-132 lb. in. |
| Low band lock nut | 20-25 lb. ft. |
| Converter nut | 10-20 lb. ft. above torque required to tighten nut until sudden resistance is felt. |

| Pressure Tap | Pressure Reading (Approximate) |
|---|---|
| Governor | L-4:25-30 psi @ 20 mph to 50-70 psi @ 50 mph<br>V-8:35-40 psi @ 20 mph to 65-85 psi @50 mph |
| Modulator | 110 psi @ sea level (wide open throttle with parking brake on) to 70 psi @ 6000 feet |
| Pump | 50 psi while coasting in high; 110 psi @ sea level (wide open throttle with parking brake on) to 90 psi @ 6000 feet |

Fig. 7A-66 Pressure Check Chart

## SPECIAL TOOLS




1. J-2619-B Slide Hammer
2. J-21237 Coast Downshift Valve Installer
3. J-21093 Shim Selector Gauge
4. J-7079-2 Handle
5. J-21198 Converter Holding Tool
6. J-8400-1 Bushing Chisel
7. J-21263 Needle Bearing Remover
8. J-9538 Pinion Loader
9. J-6292 Seal Remover
10. J-21095 Turbine Shaft Bushing Installer
11. J-21098 Pump Body Bushing Installer
12. J-21033 Seal Installer
13. J-21249 Needle Bearing Installer
14. J-9546 Clutch Drum Bushing Installer
15. J-21096 Converter Bushing Installer
16. J-21199 Converter Remover
17. J-8365 Manual Valve Lever Gauge
18. J-9542 Piston Spring Compressor
19. J-21094 Low Sun Gear Bushing Installer
20. J-21034 Pump to Extension Housing Alignment Band
21. J-7896-01 Holding Fixture
22. J-9183 Strap Wrench

Fig. 7A-67 Special Tools

# FOUR-SPEED SYNCHROMESH TRANSMISSION

CONTENTS OF THIS SECTION



## DESCRIPTION

The Tempest four-speed transmission (Fig. 7B-25) is of the helical gear, constant mesh type to provide full synchronization in all forward gears. Spur gears on the mainshaft and countershaft are engaged by a small sliding spur gear to provide reverse. Reverse is not synchronized.

Like the Tempest three-speed, the mainshaft is supported at the front in a double row of needle bearings carried by the clutch gear and at the rear by a ball bearing race. In turn, the clutch gear is carried in the front of the case by an identical ball bearing race.

The countergear is of single piece construction and is carried on double rows of needle bearings at each end. Thrust washers are used both front and rear between the countergear and the transmission case. A slight press fit is used at the front of the countershaft to retain the shaft and to prevent lubrication loss at this point.

Vehicle shift components are comparable to those used with the Tempest three-speed transmission (See Section 7).

In the transmission, three shift fork shafts are mounted parallel above the transmission selector shaft which is attached to the tunnel shift tube. The transmission selector shaft carries a finger which extends upward to engage the shift forks. As the three forks are mounted on parallel shafts, a slight rotation of the selector shaft moves the shift finger from the 1-2 fork in the center to the 3-4 fork which is outboard. To engage the reverse shifter head, which is mounted on the inboard shaft, the shift finger must be moved laterally against a spring-loaded plunger at the neutral crossover point. The plunger is required to prevent accidental shifting into reverse while in motion, as the 1-2 fork has a gate to permit passage of the shift finger through it to reach reverse.

Gear ratios are 3.65:1 in first, 2.35:1 in second, 1.44:1 in third, and 1.00:1 in fourth. Reverse is 3.66:1.

## GEARSHIFT CONTROL ASSEMBLY

### REMOVE

1. Loosen clamp nut securing control rod to control rod coupling. (Fig. 7B-1).

2. Remove bolts securing transmission gearshift lever and housing to torque tube.

3. Move gearshift lever and housing assembly toward front of car, removing control rod from control rod coupling.

4. Remove cotter pin and clevis pin securing control rod coupling to manual shift shaft (Fig. 7B-2).

5. Remove coupling from shaft.

6. Remove boot.

### INSTALL

1. Position transmission manual shift shaft in first gear position on the three speed synchro-mesh transmission or in second gear position on the four speed synchro-mesh transmission.

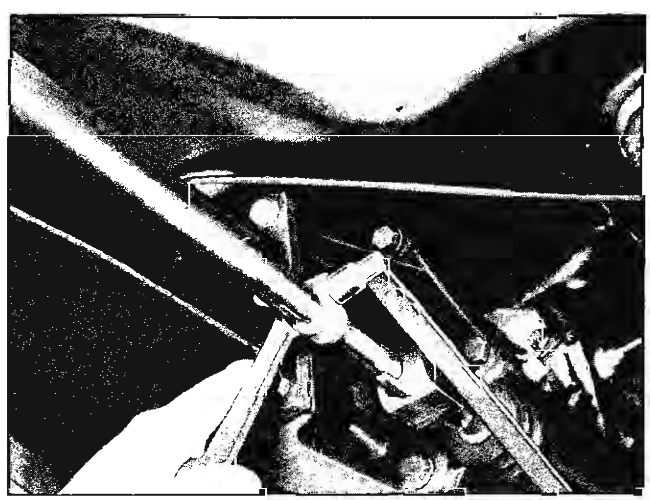


Fig. 7B-1 Control Rod Clamp Nut

2. Install manual shift shaft and control rod coupling boot (Fig. 7B-2).

3. Install control rod coupling on manual shift shaft and secure with clevis pin and cotter pin (Fig. 7B-2).

NOTE: Slot in control rod coupling should be in up position (Fig. 7B-3).

4. Slide control rod on control rod coupling, with control rod finger (Fig. 7B-4) in coupling slot (Fig. 7B-3).

5. Secure transmission gear shift lever and housing to torque tube (Fig. 7B-5). Torque bolts to 10-15 lb. ft.

6. Install pin in control rod alignment hole and push control rod forward into gearshift lever and housing, until pin hits flange of housing (Fig. 7B-6).

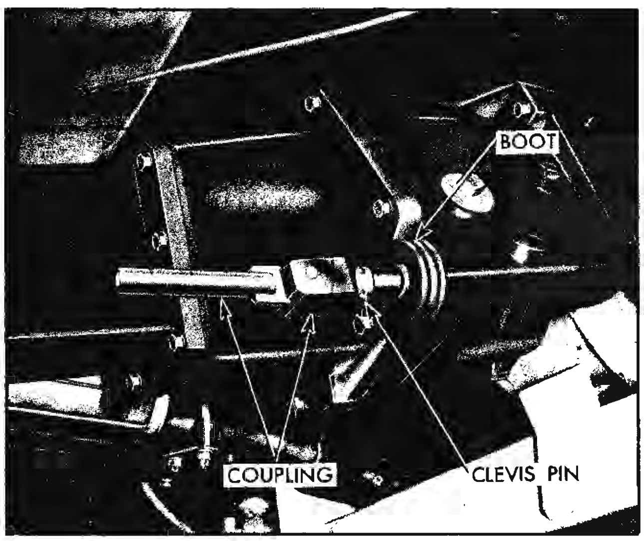



Fig. 7B-2 Control Rod Coupling Assembly

7. Secure control rod to coupling by tightening clamp nut to 10-20 lb. ft. torque (Fig. 7B-1).

8. Remove pin from control rod alignment hole and position control rod boot over housing shoulder.

## ADDITIONAL SERVICE PROCEDURES

For information concerning service procedures for the transmission extension assembly and transmission replacement, see pages 7-8 to 7-10 in Section 7.

## DISASSEMBLE TRANSMISSION

1. Remove side cover from case.

2. Remove plug, detent spring, and ball from 3-4 detent channel (Fig. 7B-7) at the left-rear of the case.

3. Drive roll pin from 3-4 shift fork with a pin

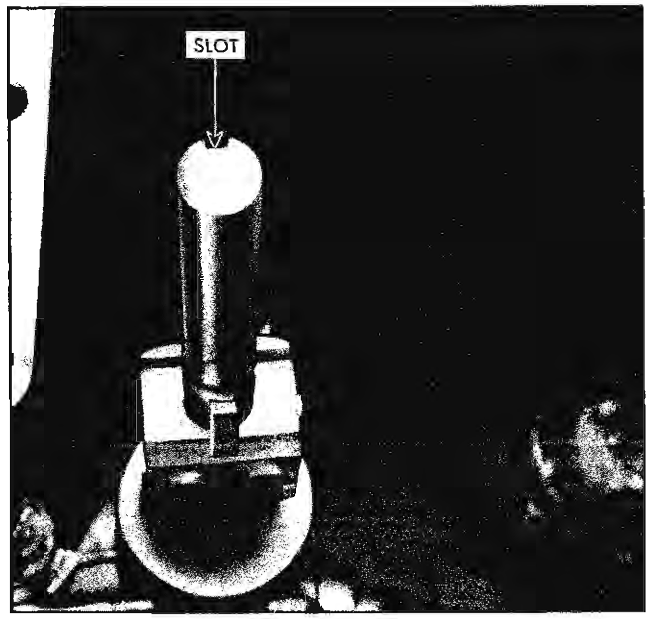



Fig. 7B-3 Control Rod Coupling Slot

punch (Fig. 7B-8). Remove 3-4 shift shaft with a drift and remove fork. Shaft can be driven from case in either direction.

4. Remove plug, spring, and detent ball from 1-2 detent channel at front of case adjacent to shifter shaft (Fig. 7B-9).

5. Move 1-2 shift fork (Fig. 7B-10) into second gear, then remove roll pin securing fork to shaft with a pin punch. Remove shift fork and shaft by tapping shaft out of case in either direction. Don't lose interlock pin from shaft or case.

6. Remove the snap rings located at the clutch gear, between the clutch gear and bearing, and between the clutch gear bearing and case (Fig. 7B-11).

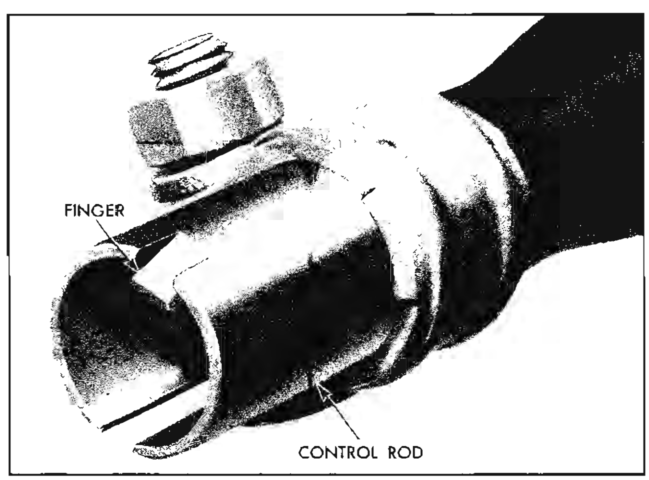



Fig. 7B-4 Control Rod Coupling Finger

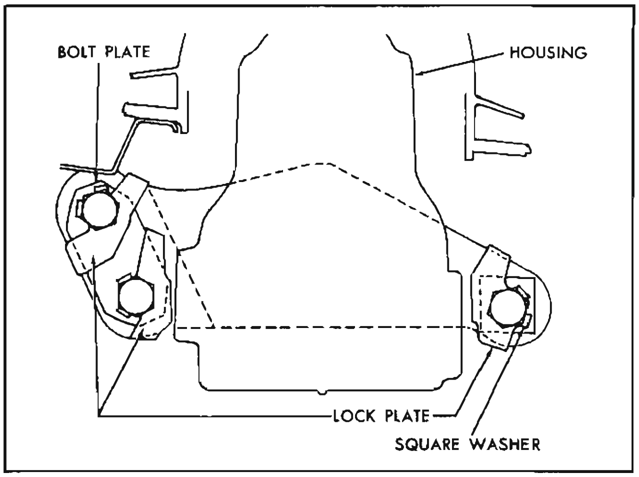



Fig. 7B-5 Gearshift Lever and Housing Location

7. Install clutch bearing puller J-8880 as follows:

a. Assemble pulled plates J-8880-1 (Fig. 7B-12) onto clutch gear bearing by inserting plates into the bearing groove, then secure puller plates together with two screws.

b. Insert adapter plug J-8880-2 into bore of clutch gear.

c. Attach body J-8111-23 to puller plates with two ½"-13 x 2½" screws and two ½" flat washers. Back out large puller screw in body as required to permit attachment of body to puller plates with these screws.

d. Remove the clutch gear bearing by turning

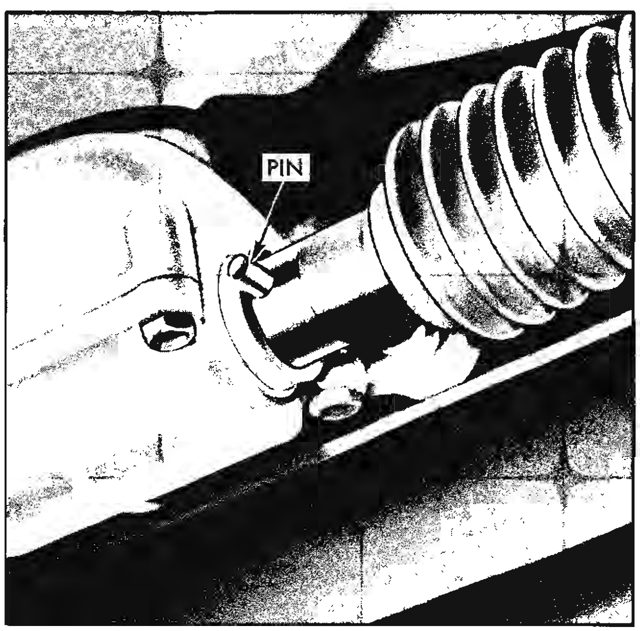



Fig. 7B-6 Control Rod Alignment Pin

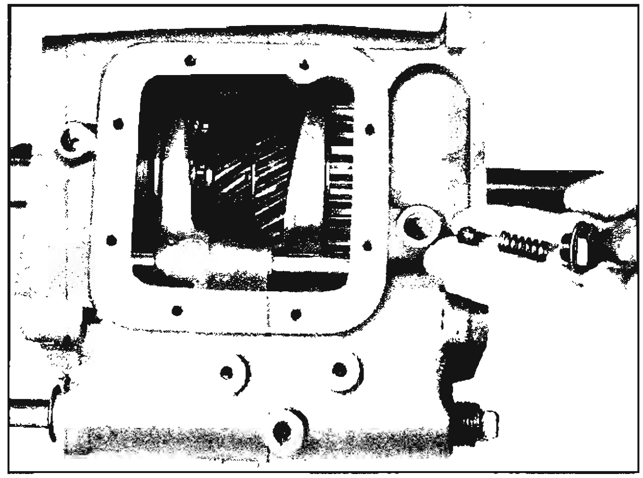


Fig. 7B-7 Detent Ball, Spring and Plug

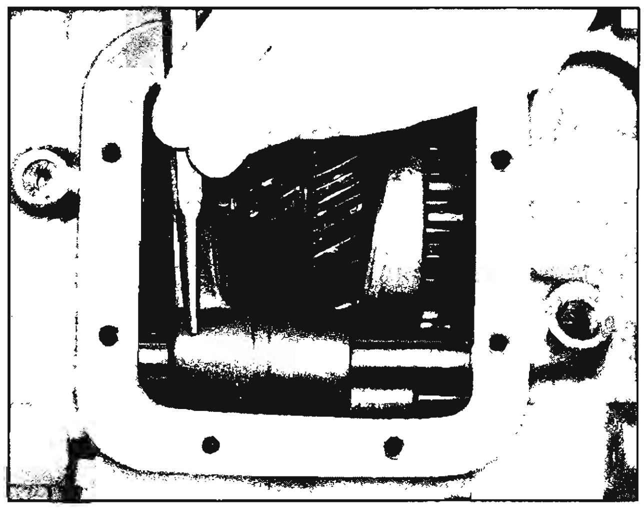


Fig. 7B-8 Removing Roll Pin

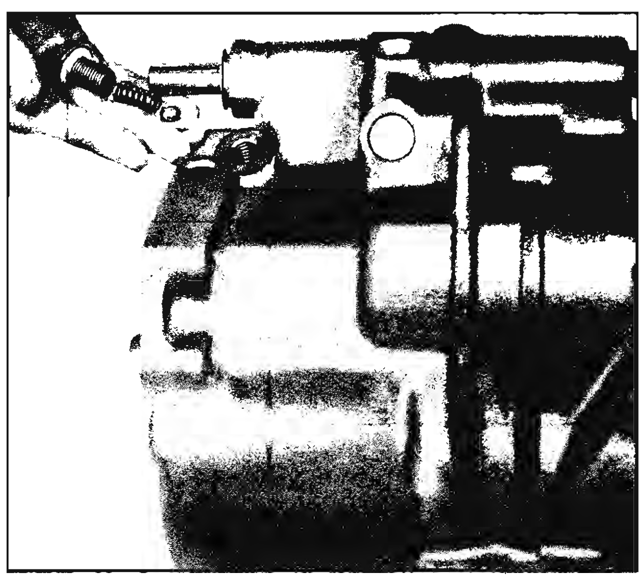


Fig. 7B-9 Detent Channel (1-2)

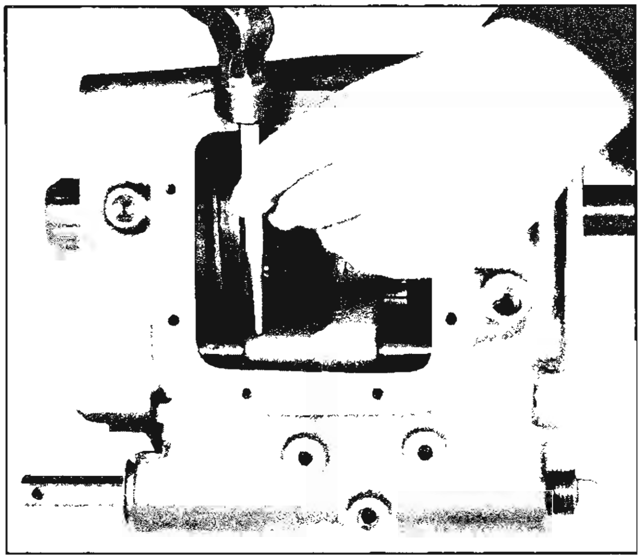


Fig: 7B-10 Removing Roll Pin

puller screw in J-8880 as shown (Fig. 7B-12). Separate puller plates from bearing.

8. Remove two snap rings securing rear main shaft bearing retainer in place (Fig. 7B-13).

9. Remove mainshaft with assembled gears and rear bearing retainer as shown in Fig. 7B-14, with sliding sleeve full forward. It may be necessary to jiggle the output shaft, making sure the clutch gear does not separate from mainshaft.

10. Using a pin punch, drive roll pin from reverse shifter head (Fig. 7B-15), then remove shifter head and shaft from case by tapping shaft out in either direction with a drift.

11. Drive out reverse idler gear and reverse shifter fork shafts from the case by driving rearward with a

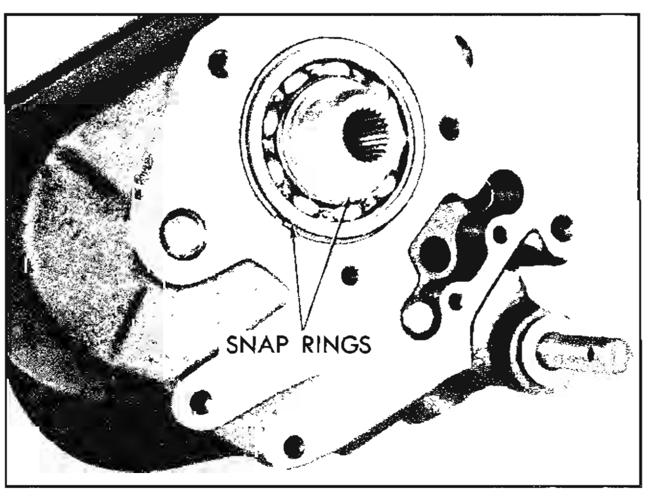



Fig. 7B-11 Clutch Gear Bearing Retained

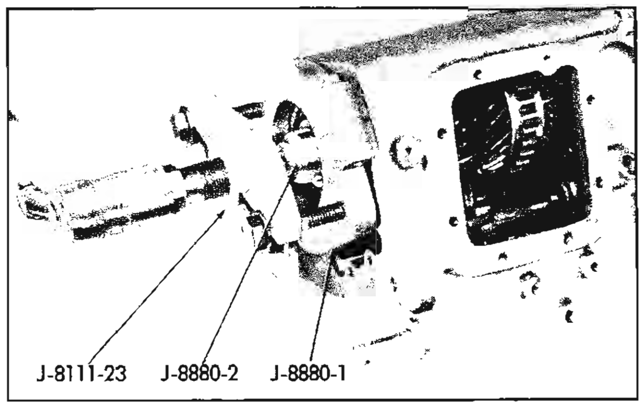



Fig. 7B-12 Removing Clutch Gear Bearing

drift. Use care not to lose Woodruff key used in reverse idler gear shaft. Remove idler gear and reverse shifter fork (Fig. 7B-16) from case.

12. Remove reverse shifter lever (Fig. 7B-16) by lifting off its pin in the case.

13. To remove the countergear, use tool J-9563. Drive countershaft rearward until the countershaft is fully disengaged from the case and J-9563 is fully within the countergear (Fig. 7B-17). Remove one thrust washer and carefully remove the countergear from the case, using care not to tip countergear to prevent needle bearings from falling out.

14. Remove two countergear thrust washers from case.

15. Using a magnet or by tipping the case, remove the two interlocks and the detent ball and spring remaining in the 3-4 detent channel.

16. Remove shift finger from selector shaft by first

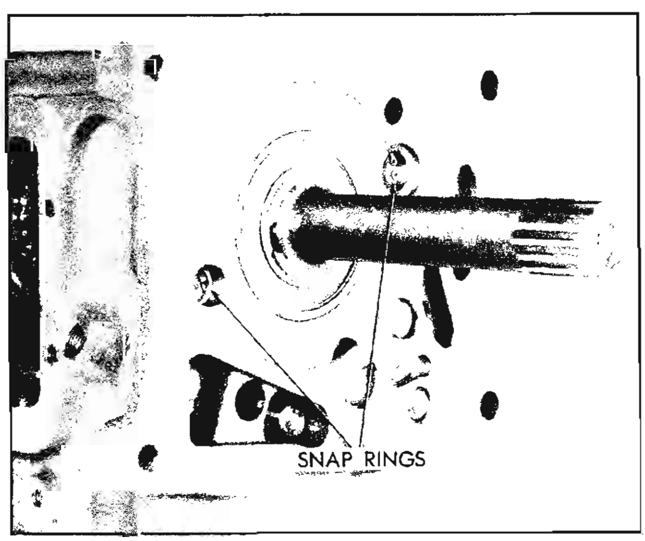



Fig. 7B-13 Bearing Retainer Snap Rings

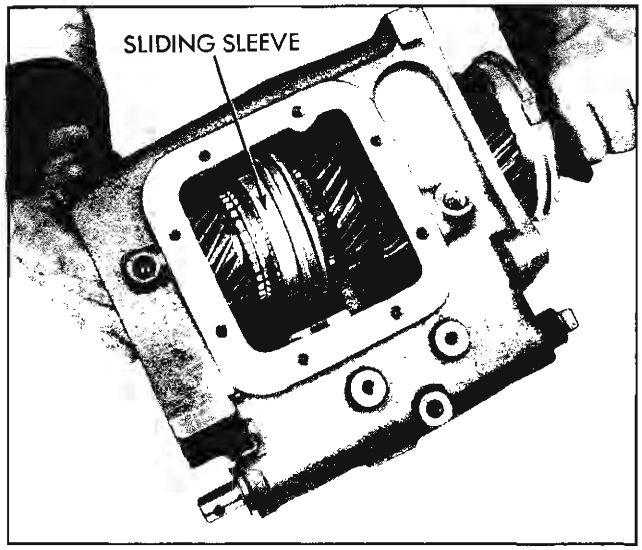



Fig. 7B-14 Removing Mainshaft Assembly

flattening lock tabs securing the two retaining screws, then remove shifter shaft plug in rear of case. Tap shaft rearward from case out through hole with a drift.

17. With suitable tool, remove reverse inhibitor plug, spring, ball seat and ball (Fig. 7B-18). Remove other plug, spring, and reverse inhibitor plunger (Fig. 7B-19).

## DISASSEMBLE MAINSHAFT

1. Place clutch gear downward against table top and carefully lift mainshaft out of clutch gear to prevent disturbing clutch gear roller bearings.

***CAUTION: Be sure to keep needle retainer washer with clutch gear.***

2. Remove special snap ring from front of mainshaft, then slide or press with J-8893 in J-6407 press

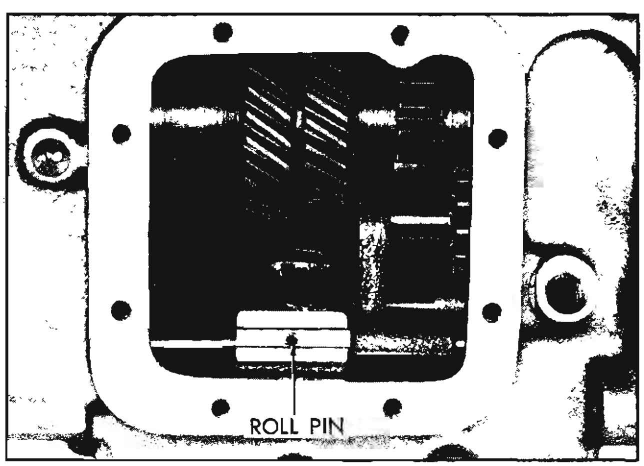



Fig. 7B-15 Reverse Shifter Head

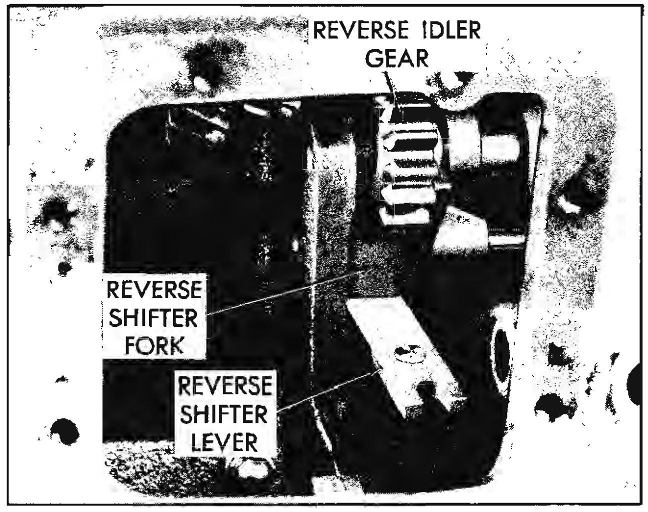



Fig. 7B-16 Reverse Shifter Assembly

plate holder (Fig. 7B-20) 3-4 synchronizer unit with blocker rings, third speed gear, radial needle bearing, and second speed gear from mainshaft. Remove 1-2 synchronizer from hub and do not lose keys.

3. Remove rear bearing selective snap ring, then remove rear bearing and retainer and first speed gear as an assembly, using press with J-8893 in J-6407 press plate holder (Fig. 7B-21). Be careful not to lose first speed gear thrust washer.

4. Remove 1-2 blocker rings.

5. Press mainshaft out of 1-2 synchronizer unit and first speed gear sleeve with J-6547 in J-6407 (Fig. 7B-22). This completes disassembly of mainshaft.

## INSPECTION AND REPAIR

### *TRANSMISSION CASE*

Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the

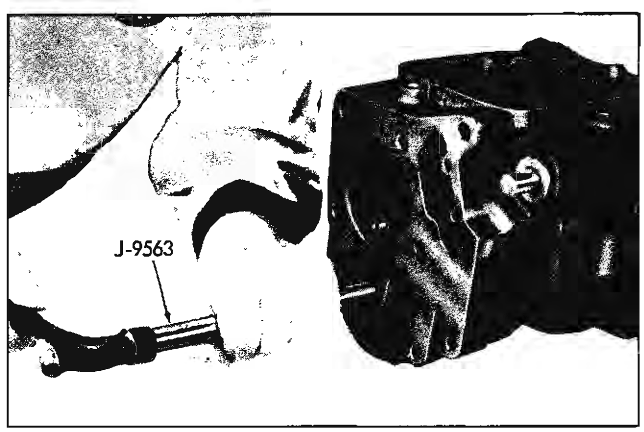



Fig. 7B-17 Removing Countergear

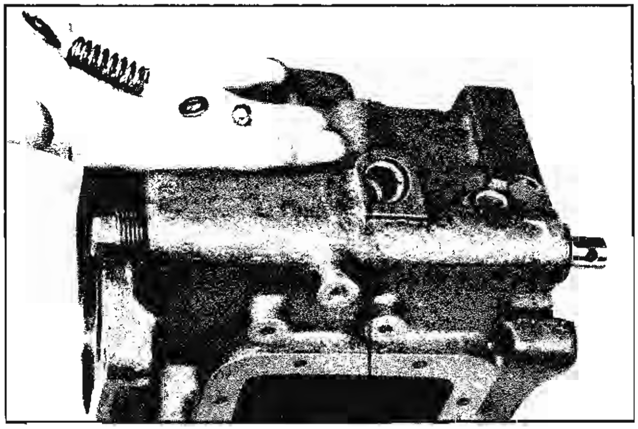


Fig. 7B-18 Reverse Inhibitor Detent

rear face which fits against differential carrier for burrs and if any are present, dress them off with a fine mill file.

Also check the condition of the shifter shaft seal and replace if necessary.

***FRONT AND REAR BEARINGS***

1. Wash the front and rear bearings thoroughly in a cleaning solvent.

2. Blow out bearings with compressed air.

***CAUTION: Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the race and balls.***

3. Make sure the bearings are clean, then lubricate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

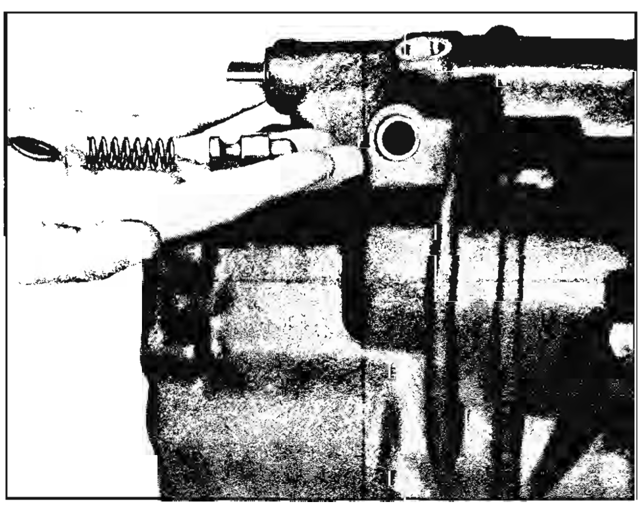


Fig. 7B-19 Reverse Inhibitor

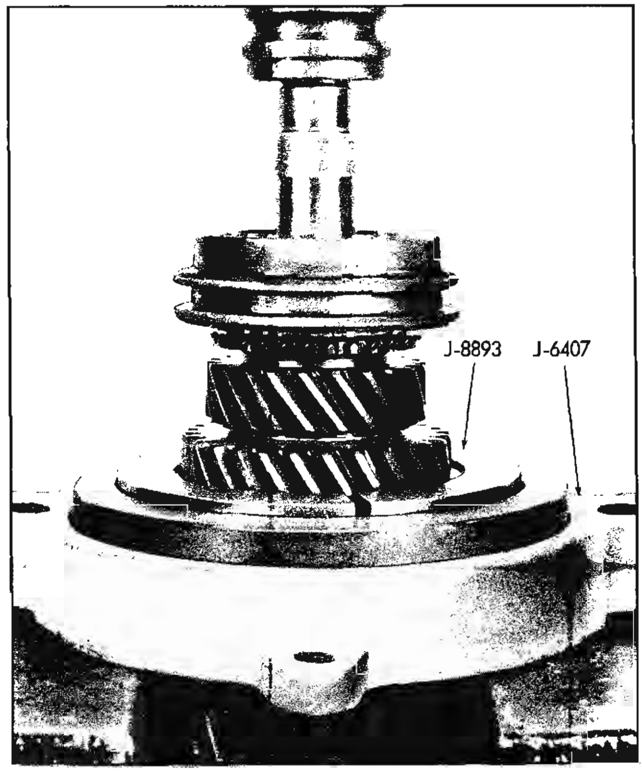



Fig. 7B-20 Disassembly of Mainshaft

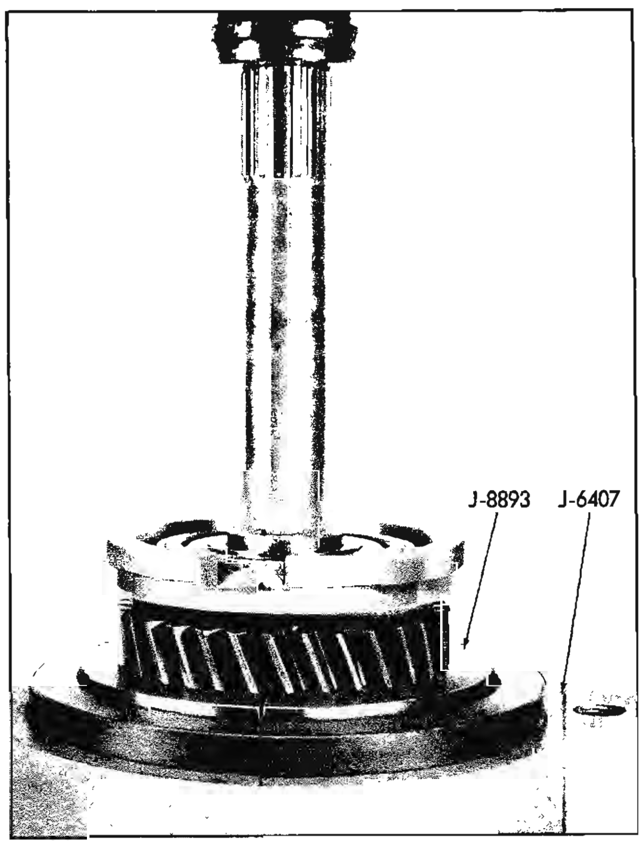



Fig. 7B-21 Disassembly of Mainshaft

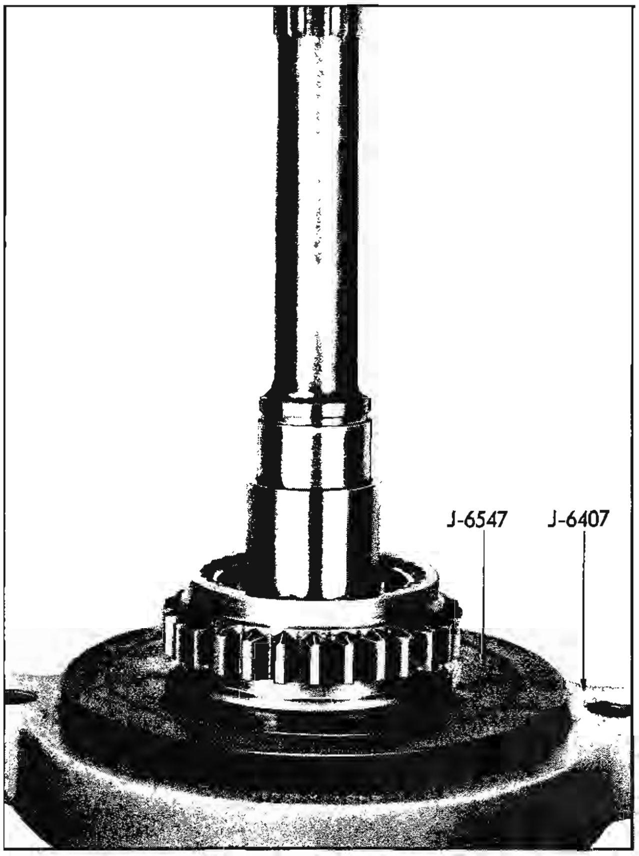



Fig. 7B-22 Disassembly of Mainshaft

### SHIFTER SHAFT SEAL

If shifter shaft seal needs replacing, it can be replaced in same manner as 3-speed transmission seal is replaced (Fig. 7-29) in Section 7.

### BEARING ROLLERS AND SPACERS

All clutch gear and countergear bearing rollers should be inspected closely and replaced if worn. Inspect countershaft at the same time and replace if necessary. Replace all worn spacers.

### GEARS AND THRUST WASHERS

Inspect all gears and thrust washers and, if necessary, replace all that are worn or damaged.

### CLUTCH KEYS AND SPRINGS

NOTE: The clutch hubs and sliding synchronizer sleeves are a matched assembly and should be kept together as originally assembled, but the three keys and two springs may be replaced if worn or broken.

REPLACEMENT

1. Push the hub from the sliding sleeve. The keys will fall free and the springs may be easily removed.

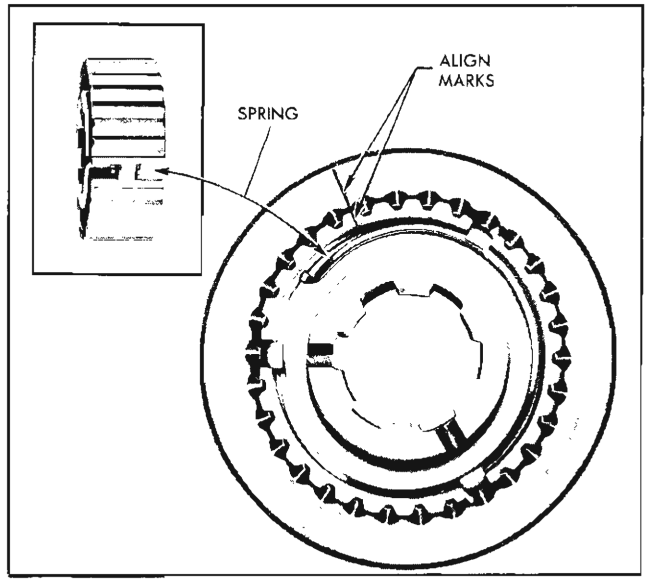



Fig. 7B-23 Synchronizer Spring and Hub Installed

2. Place the two springs in position (one on each side of the hub), so a tanged end of each spring falls into the same keyway in the hub (inset, Fig. 7B-23). Holding keys in position, align etched marks (Fig. 7B-23), in hub and sleeve, then slide hub into sleeve. *Be sure etched marks align after assembly.*

### COUNTERGEAR NEEDLE BEARING REPLACEMENT

1. Install J-9563 and then install spacer just deep enough at one end to serve as seat for needle bearings.

2. Install 23 needle bearings.

3. Install retainer and move spacer and needle bearings back enough to accommodate outside row of 23 needle bearings.

4. Install needle bearings and retainer.

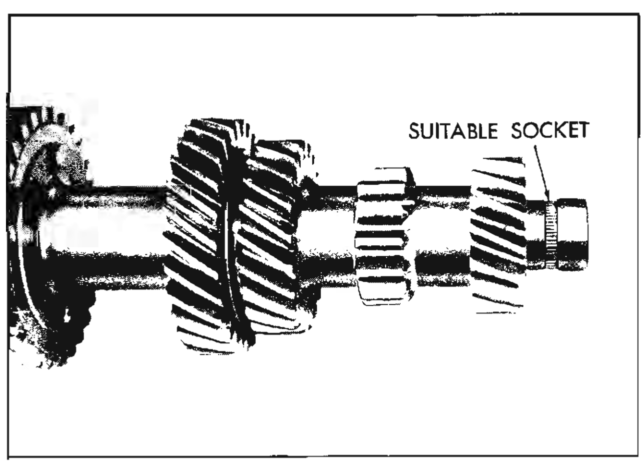



Fig. 7B-24 Suitable Socket Installed

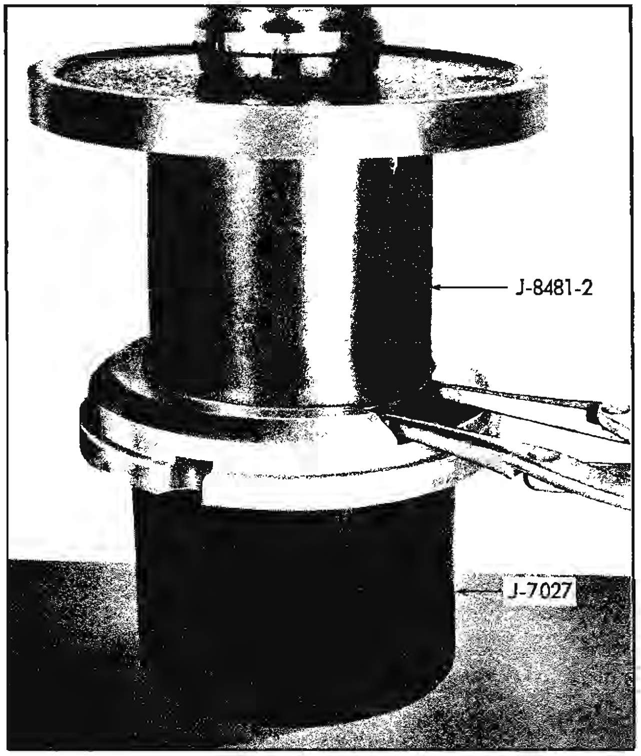



Fig. 7B-25 Removing Rear Bearing

5. With suitable socket, move needle bearings and spacer toward opposite end of countergear, just enough to serve as seat for needle bearings at opposite end (Fig. 7B-24).

6. Install 23 needle bearings and retainer.

7. Move needle bearing and retainer inward to accommodate outer row of needle bearings.

8. Install 23 needle bearings and retainer.

***REAR BEARING RACE REPLACEMENT***

If inspection reveals the necessity to replace the rear bearing, place the bearing and retainer in a press. Expand retainer ring and press out bearing using J-8481-2 and J-7027 (Fig. 7B-25). Install a new bearing by reversing this procedure (Fig. 7B-26).

## ASSEMBLE MAINSHAFT

1. Install 1-2 synchronizer hub onto mainshaft with shift fork groove of hub downward, then place first gear sleeve on mainshaft. Press both first gear sleeve and synchronizer hub onto mainshaft until they bottom, using J-6133 or other suitable tool (Fig. 7B-27).

2. Install blocker ring in rear of 1-2 synchronizer, being sure that notches in blocker ring engage keys in synchronizer unit. It should be noted that blocker

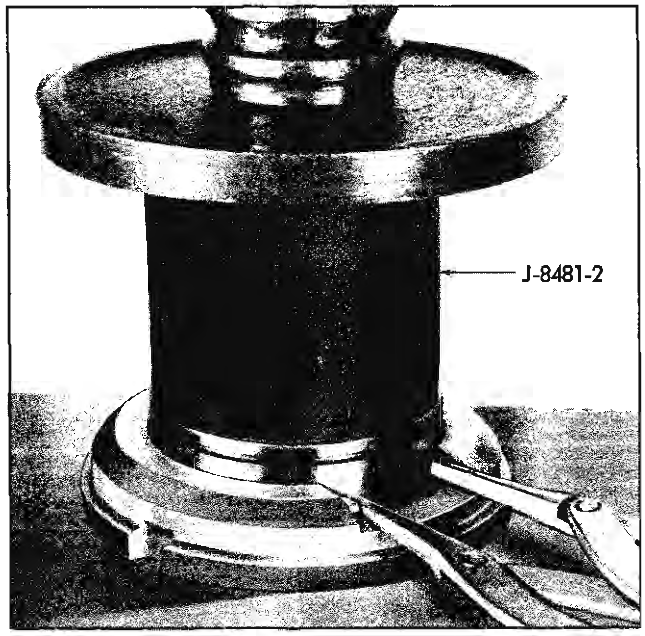



Fig. 7B-26 Installing Rear Bearing

rings used in the 1-2 synchronizer have slightly longer hub (Fig. 7B-28) than those used in the 3-4 synchronizer. Then slide first speed gear (Fig. 7B-32) and its thrust washer onto mainshaft.

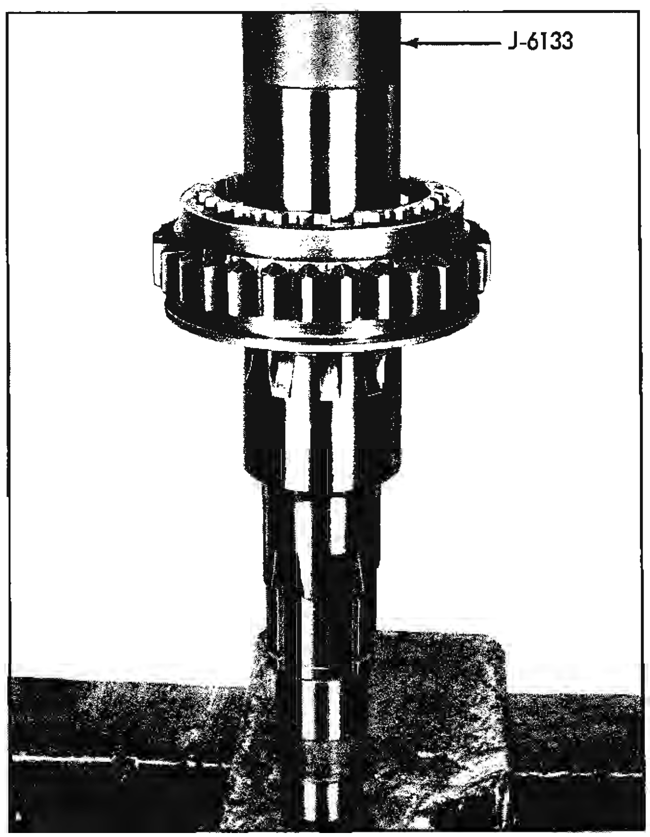



Fig. 7B-27 Installing 1-2 Synchronizer Hub


Fig. 7B-28 Blocker Rings

3. Press assembled rear bearing retainer and rear bearing onto mainshaft using J-6133 (Fig. 7B-29) and secure with selective fit snap ring. With the proper snap ring installed (three thicknesses available), maximum end play between rear face of rear bearing and snap ring will be .005".

4. Invert mainshaft, then install the second blocker ring (long hub) in front side of 1-2 synchronizer, again being sure to engage blocker ring notches with keys in synchronizer unit.

5. Install second speed gear (Fig. 7B-32) with clutching teeth toward 1-2 synchronizer, then place radial needle bearing on second speed gear.

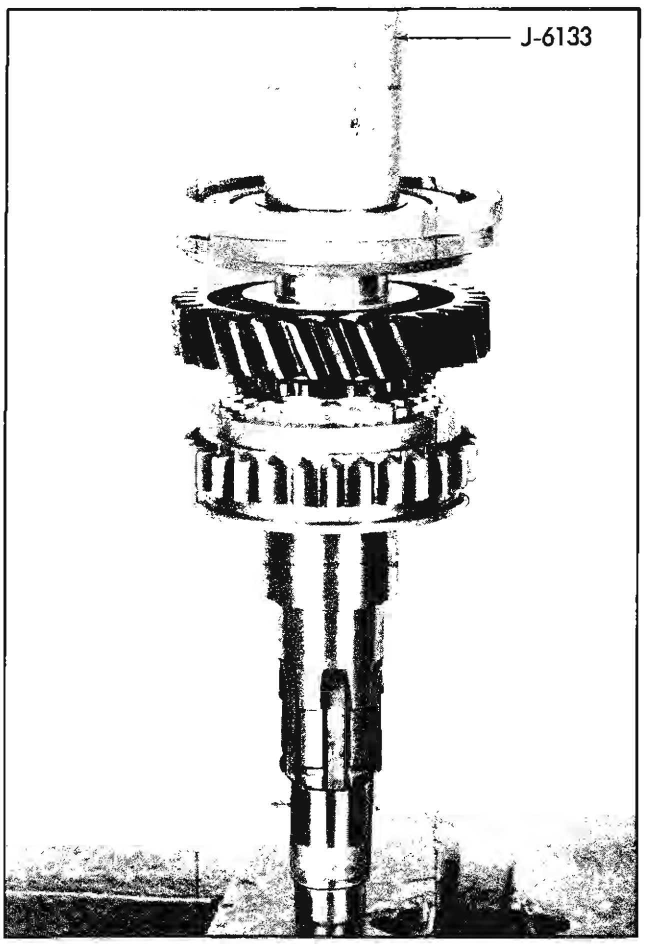



Fig. 7B-29 Installing Rear Bearing Retainer

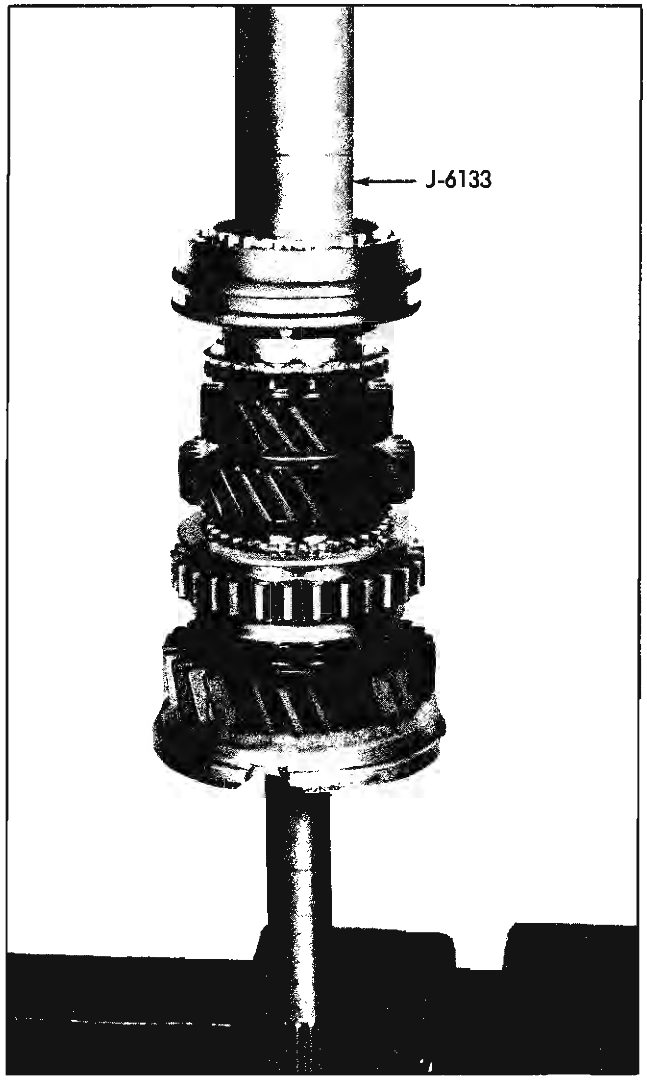



Fig. 7B-30 Installing 3-4 Synchronizer Unit

6. Install third speed gear, clutching teeth upward, onto mainshaft and seat it against the radial needle bearing (Fig. 7B-32).

7. Place 3-4 blocker ring on cone surface of third speed gear, then press 3-4 synchronizer unit onto blocker ring, with extended neck toward 3rd gear (Fig. 7B-30). Be sure notches in blocker ring engage clutch keys in synchronizer unit. Install second blocker ring onto 3-4 synchronizer unit. Install snap ring.

8. If clutch gear roller bearings have become displaced, load 33 needle bearings into innermost diameter and 37 needle bearings into outermost diameter, using a generous amount of petroleum jelly to prevent roller bearings from becoming displaced.

9. Carefully slide clutch gear onto mainshaft. It is good practice to place the clutch gear on a bench with

its pilot bore upward, needle bearing retainer in place, and insert the mainshaft into the clutch gear. This prevents accidentally dislodging the clutch gear roller bearings. Set assembled mainshaft (Fig. 7B-32) aside for later installation into transmission.

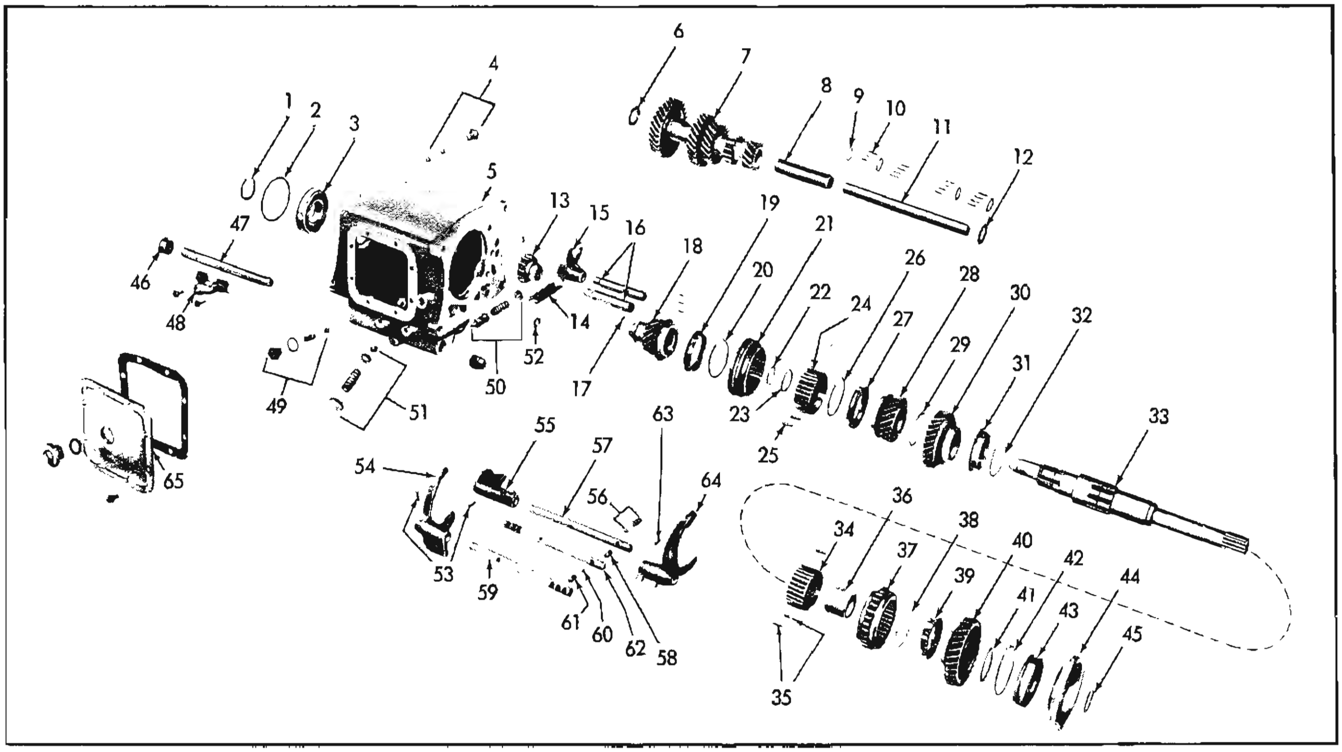
## ASSEMBLE TRANSMISSION

(See Fig. 7B-31 for transmission exploded view.)

1. Install reverse inhibitor plug, then spring and reverse inhibitor plunger (Fig. 7B-19).

2. Install reverse inhibitor detent ball, ball seat, spring, and plug (Fig. 7B-18).

3. Coat selector shaft with grease, then insert through seal from the inside of the case. Do not install shaft from front of case as notches in selector shaft will damage seal lips.



1. Snap Ring
2. Retainer Ring
3. Clutch Gear Bearing
4. 1-2 Detent Ball, Spring and Cap
5. Case
6. Thrust Washer
7. Countergear
8. Sleeve
9. Spacer
10. Needle Bearing
11. Shaft
12. Thrust Washer
13. Reverse Idler Gear
14. Shifter Lever
15. Shifter Fork
16. Shafts
17. Woodruff Key
18. Clutch Gear
19. Blocker Ring
20. Ring
21. 3-4 Sliding Sleeve
22. Washer
23. Snap Ring
24. 3-4 Clutch Hub
25. Key
26. Ring
27. Blocker Ring
28. Third Speed Gear
29. Radial Needle Bearings
30. Second Speed Gear
31. Blocker Ring
32. Ring
33. Main Shaft
34. 1-2 Clutch Hub
35. Keys
36. Sleeve
37. 1-2 Sliding Sleeve
38. Ring
39. Blocker Ring
40. First Speed Gear
41. Thrust Washer
42. Retaining Ring
43. Bearing
44. Bearing Retainer
45. Snap Ring
46. Seal
47. Selector Shaft
48. Selector Finger
49. 3-4 Detent Ball, Spring and Cap
50. Reverse Inhibitor Plunger, Spring, and Plug
51. Reverse Inhibitor Detent Ball, Ball Seat, Spring and Plug
52. Snap Rings
53. Roll Pins
54. 3-4 Shift Fork
55. Reverse Shifter Head
56. Detent Spring and Ball
57. Reverse Shifter Head Shaft
58. Interlock
59. 3-4 Shift Fork Shaft
60. Interlock Pin
61. Interlock
62. 1-2 Shift Fork Shaft
63. Roll Pin
64. 1-2 Shift Fork
65. Cover

Fig. 7B-31 Transmission—Exploded View

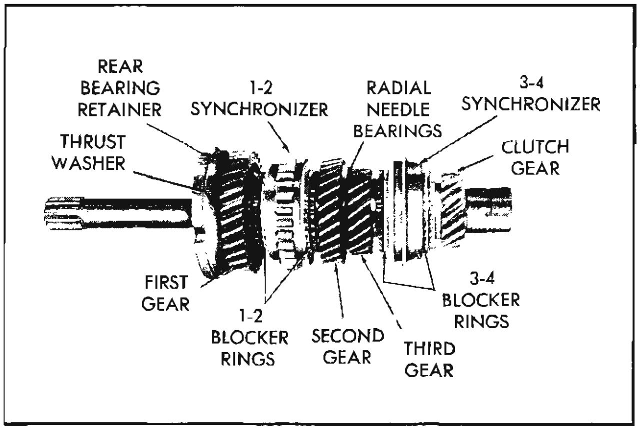



Fig. 7B-32 Assembled Mainshaft

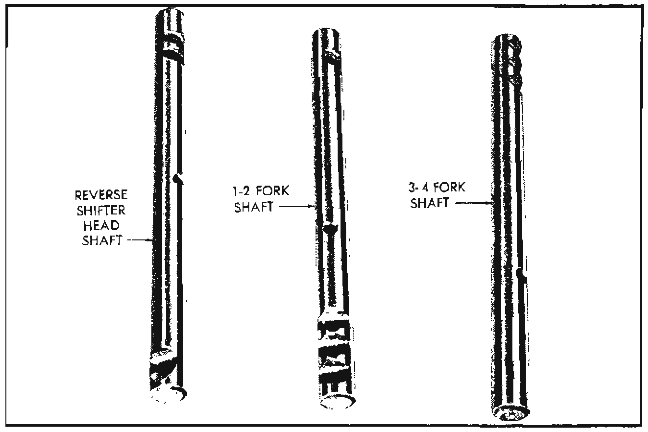



Fig. 7B-33 Shift Fork Shafts

4. Attach shift finger to selector shaft using two bolts and lock tabs. Bend tabs onto bolt heads after tightening bolts, then install drain plug in case at rear of selector shaft.

5. With tab facing out, place thrust washer on same end as larger countergear and rest countergear on bottom of case (larger gear toward front of case). Raise countergear and engage tool J-9563 through thrust washer and into case front hole just enough to hold countergear in place. Be sure thrust washer tab engages notch in case.

6. With tab facing out, insert rear thrust washer (tab engaging notch), insert countergear shaft at rear of case, and drive out J-9563 with countergear shaft. Tap countershaft until it is flush with the rear face of the case. The shaft is a slight press fit at front of case.

***CAUTION: Hold tool J-9563 against countergear shaft while driving out to insure it is flush with shaft at all times. This will prevent displacement of any needle bearings. Be sure shaft is free from burrs.***

7. Place reverse shifter lever (Fig. 7B-16) on pin in case with tapered end away from the reverse inhibitor.

8. Place the reverse idler gear shift fork in the case with its pin toward the front (Fig. 7B-16). Engage the fork pin with the reverse shifter lever, then insert the shift fork shaft.

9. With the reverse idler gear shift fork fully rearward, engage the reverse idler gear to the shift fork (Fig. 7B-16). Then align the Woodruff key groove in the idler gear shaft with the keyway in the rear face of the case and slide the shaft almost fully into the case, install Woodruff key in shaft, then fully bottom shaft.

10. Tap both reverse idler and shift fork shafts to insure full seating, then stake each shaft bore in two places below the rear face of the case adjacent to the shaft chamfer. Be sure stakes do not protrude above the rear face as this would disrupt the mating surface for the axle.

11. Insert a detent spring and ball in the 3-4 detent channel, checking that the spring goes fully to the bottom of the channel and that the detent ball does not roll out the reverse shifter head shaft hole in the detent channel.

12. Lay out the shift fork shafts (Fig. 7B-33) to prevent mixing the shafts during installation. With the interlock notches aligned, the reverse shifter head shaft can be identified as its pin hole is approximately centered on the shaft. The 1-2 fork shaft is most easily recognized as it has two interlock notches in the shaft and these notches are connected by a drilled hole which houses the interlock pin. Finally, the 3-4 fork shaft roll pin hole is closest to the end of the shaft opposite the detent notched end.

13. Depress the detent ball and spring in the 3-4

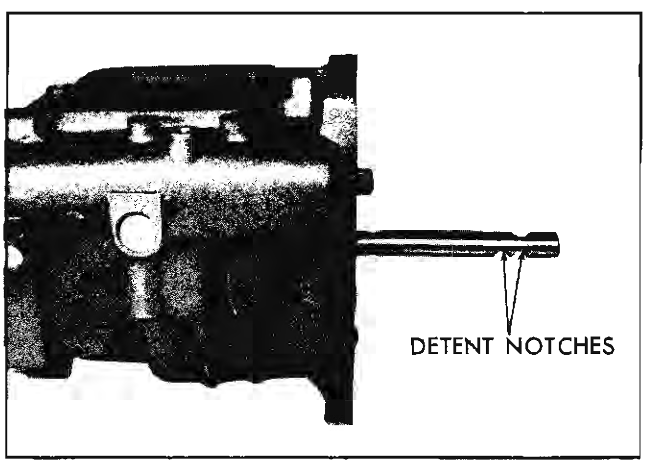



Fig. 7B-34 Reverse Shifter Head Shaft

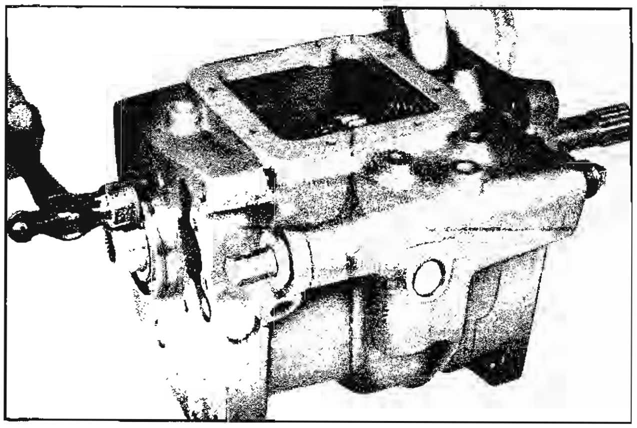


Fig. 7B-35 Installing Bearing

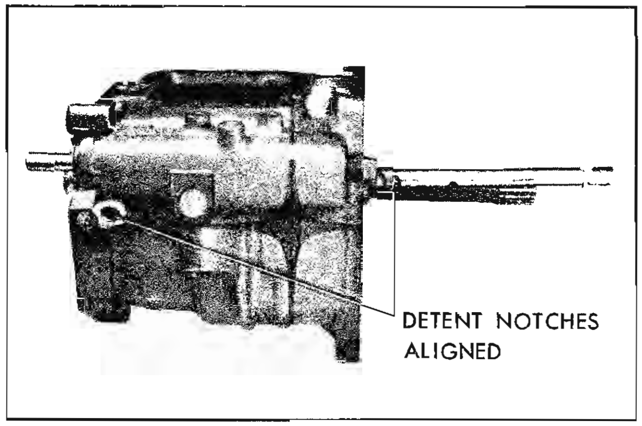



Fig. 7B-37 Fork Shaft Partially Installed

detent channel slightly with a small drift and insert the reverse shifter head shaft (Fig. 7B-34) paritally into the case to compress the detent. Then engage the pin of the reverse shifter head with the yoke of the reverse shift lever. Check that the shaft pin hole is aligned with the pin hole in the shifter head and push the shaft through until the pin holes in the head and shaft align. Secure shifter head to shaft with roll pin (Fig. 7B-15); place in neutral.

14. To install the assembled mainshaft in the case, shift the synchronizers into second and fourth simultaneously (both full forward) to provide clearance to pass the countergear. Insert the mainshaft through the rear bearing bore into the case. Align rear bearing retainer snap ring cut outs, with snap ring cut outs, in rear face of case, then tap rear bearing retainer into case until flush with the rear face.

***CAUTION: Make sure clutch gear stays securely in place.***

15. With large snap ring installed in outer diameter of front bearing, tap bearing into front of case and over clutch gear hub until large snap ring seats against front of case.

***CAUTION: Hold rear bearing retainer while tapping clutch gear bearing, to prevent retainer from working out of case (Fig. 7B-35).***

16. Retain clutch gear in bearing with selective snap ring (Fig. 7B-11). With proper snap ring installed, maximum end play between bearing and snap ring will be .005".

17. Install two rear bearing retainer rings (Fig. 7B-13).

18. Prior to installing the 1-2 shift fork, shift the 1-2 synchronizer and the 3-4 synchronizer to neutral.

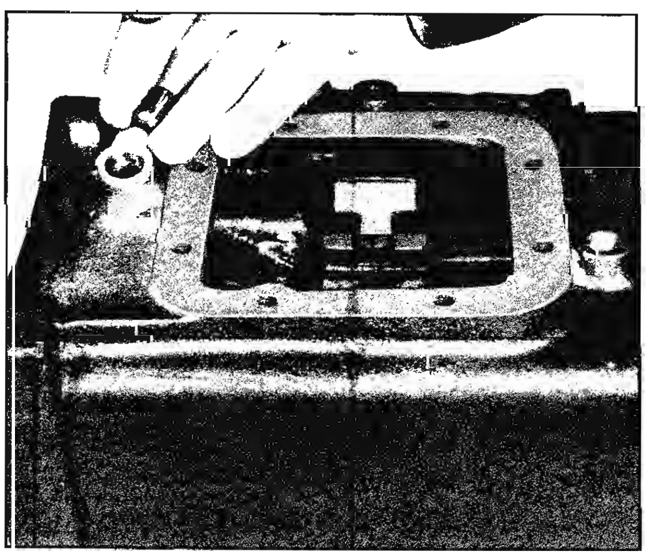


Fig. 7B-36 Installing Interlock

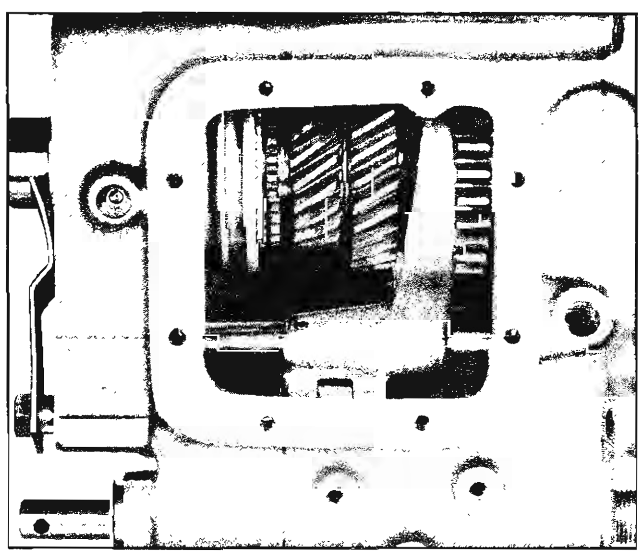


Fig. 7B-38 Fork (1-2) Installed

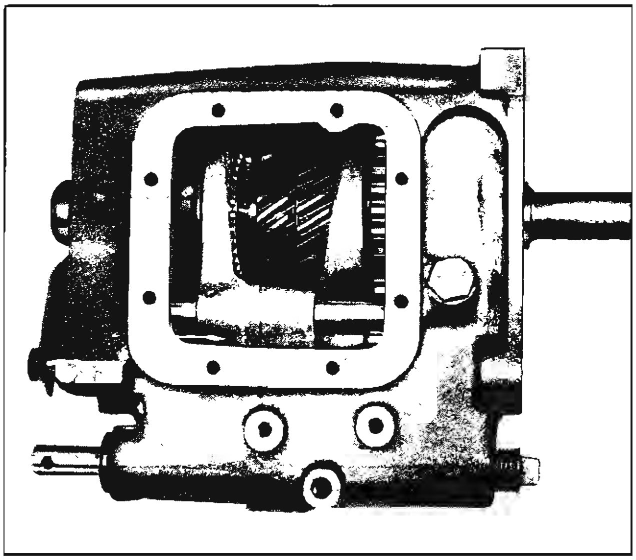


Fig. 7B-39 Fork (3-4) Installed

Then install one interlock in the 3-4 detent channel (Fig. 7B-36).

19. With the interlock pin in the hole in the interlock notch end, push the 1-2 shift fork shaft partially into the case (Fig. 7B-37). The interlock end (two opposite notches) of the shaft goes to the rear of the case. Engage 1-2 shift fork which is identified by the thru gate at the shift location, with the 1-2 synchronizer. Align the pin holes in the shaft and fork, and secure fork to shaft with roll pin (Fig. 7B-38).

20. Install detent ball, spring, gasket, and cap in 1-2 detent channel (Fig. 7B-9). Cap used at this location has the longer shank.

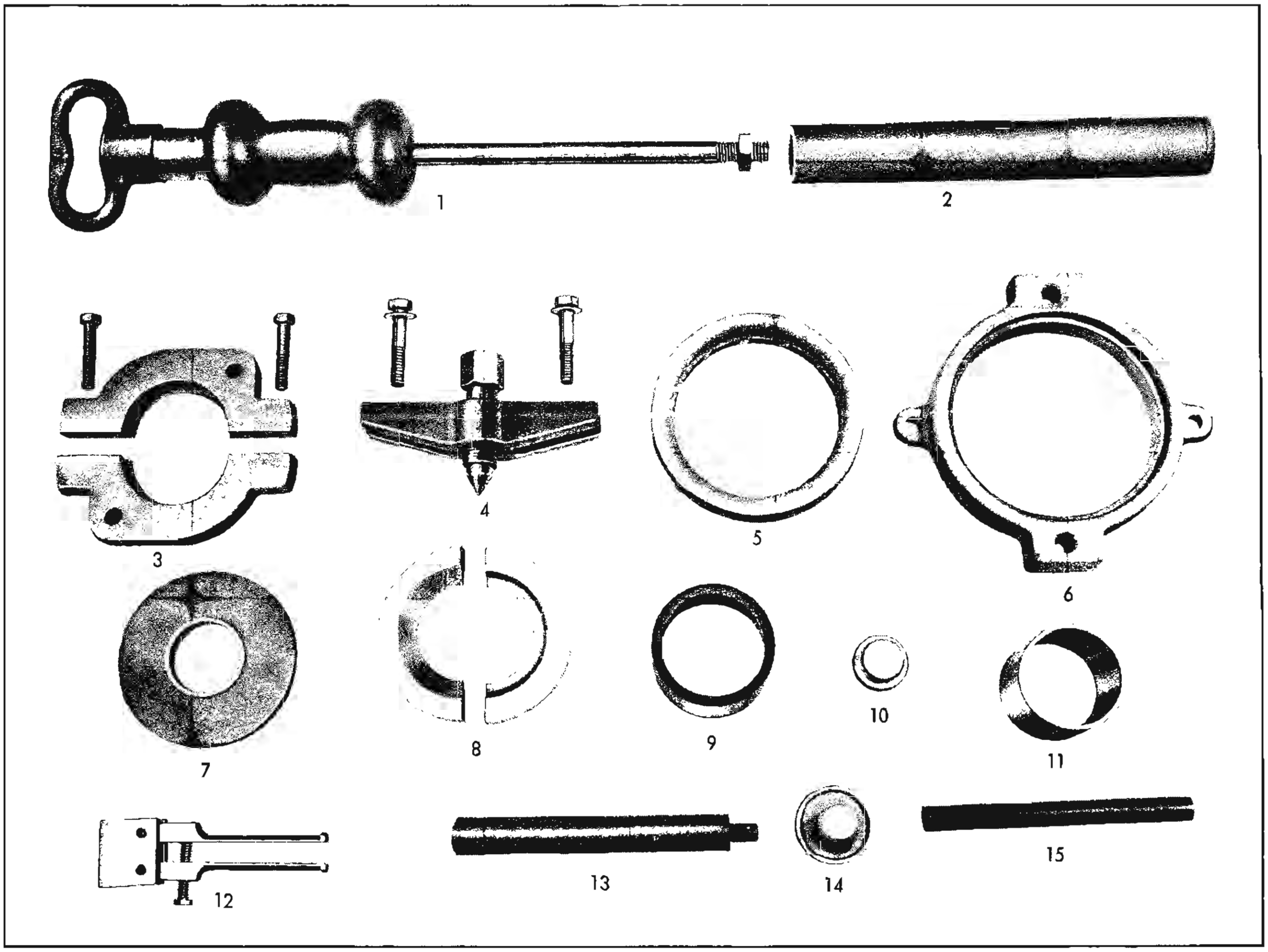
21. Drop remaining interlock into 3-4 detent channel, then push 3-4 shift fork shaft (with three detents away from interlock) partially through hole in front of case. Engage 3-4 shift fork in 3-4 synchronizer, align pin hole in shift fork and shaft. Secure shift fork shaft with roll pin (Fig. 7B-39).

22. Install remaining detent ball, spring, nylon washer, and cap in 3-4 detent channel at left rear of case.

23. Prior to installing side cover, test operation of shift forks by actuating the shift selector lever with a small pin punch inserted in the hole in the shifter shaft. If the transmission shifts satisfactorily, install side cover with new gasket and secure with eight bolts tightened 3-4 lb. ft.

## TORQUE SPECIFICATIONS

| | Lb. Ft. |
|---|---|
| Gearshift lever housing to torque tube bolts | 10-15 |
| Control rod to coupling clamp nut .......... | 10-20 |
| Shift lever housing cover bolts ............. | 4-5 |
| Shift finger to shift shaft cap screws ........ | 7-10 |
| Detent cavity covers .. . ................. | 10-20 |
| Top cover bolts .......................... | 3-4 |
| Extension to transmission bolts ............. | 35-40 |




| | | | |
|---|---|---|---|
| 1. J-2619-B | Slide Hammer | 9. J-7027 | Support |
| 2. J-6133 | Installer | 10. J-8880-2 | Adapter Plug |
| 3. J-8880-1 | Clutch Gear Bearing Puller Plates | 11. J-8481-2 | Rear Bearing Remover and Installer |
| 4. J-8111-23 | Clutch Gear Bearing Puller Body | 12. J-6292 | Seal Remover |
| 5. J-6407-2 | Press Plate Holder Adapter | 13. J-7079-2 | Handle |
| 6. J-6407 | Press Plate Holder | 14. J-2103-3 | Extension Housing Oil Seal Installer |
| 7. J-6547 | Support | 15. J-9563 | Countergear Needle Bearing Loader |
| 8. J-8893 | Support | | |

Fig. 7B-40 Special Tools

# FUEL TANK AND EXHAUST

CONTENTS OF THIS SECTION



## FUEL TANK

### DESCRIPTION

The fuel tank has a 20 gallon capacity and is constructed of two sheet metal sections welded together. The filler pipe is attached to the tank but is removable. The fuel tank is secured to the under side of the body by a metal strap held in place by a hook bolt on one end and a formed hook in strap on the other (Figs. 8-1—8-2).

The tank filler pipe is located on the left side of Station Wagons and the center rear on all other body styles. It is accessible through a spring hinge door.

Fuel tanks on all models use a vented filler cap (Fig. 8-5). On Station Wagons, the tank is also vented by a pipe from the front upper left corner of the tank to the upper filler neck.

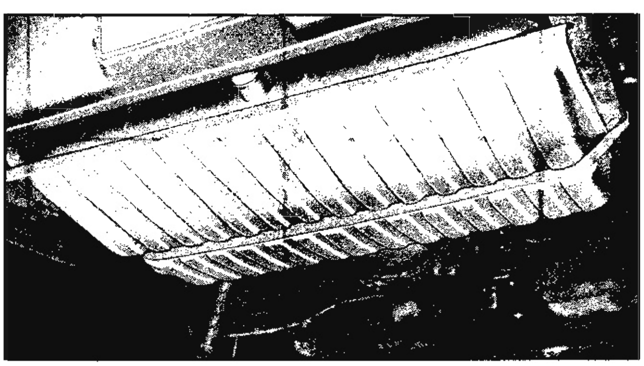


Fig. 8-1 Mounting Position of Fuel Tank

### SERVICE PROCEDURES

#### *TO DRAIN FUEL TANK*

1. Insert a length of hose (Fig. 8-6 for details) into the gas tank, pipe nipple end first, until weighted end of hose rests on bottom of tank.

2. With chuck of air hose inserted into hose slit, a short blast of air will cause the gas to flow.

NOTE: The tank can be drained rapidly by raising the car several feet off the floor when performing the above operation.

#### *REMOVE AND REPLACE FUEL TANK—SEDANS, COUPES AND CONVERTIBLES*

1. Disconnect wire from tank gauge unit at the unit or inside of trunk. If disconnected inside trunk, force wire through grommet.

Fig. 8-2 Fuel Tank Mounting Strap

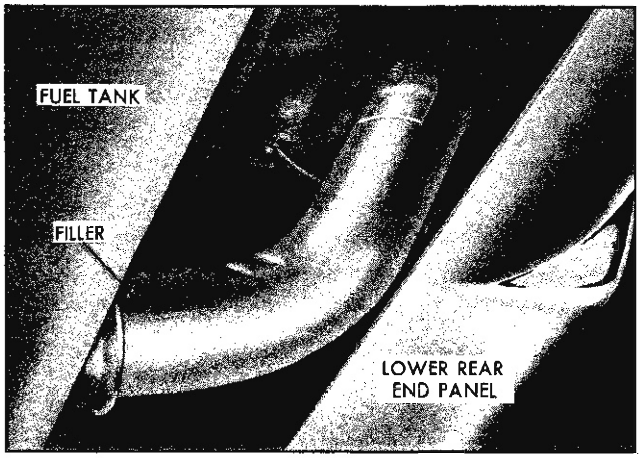



Fig. 8-3 Filler—Coupes, Sedans and Convertibles

2. Raise car and support fuel tank.
3. Drain fuel tank as described on page 8-1.
4. Remove clamp connecting fuel line to tank.
5. Remove screws holding filler pipe bracket and seal to body.
6. Remove filler pipe from fuel tank by pulling pipe from tank opening.
7. Remove nut securing support strap holding fuel tank to body.
8. Lower fuel tank from car.

To install, reverse above procedure.

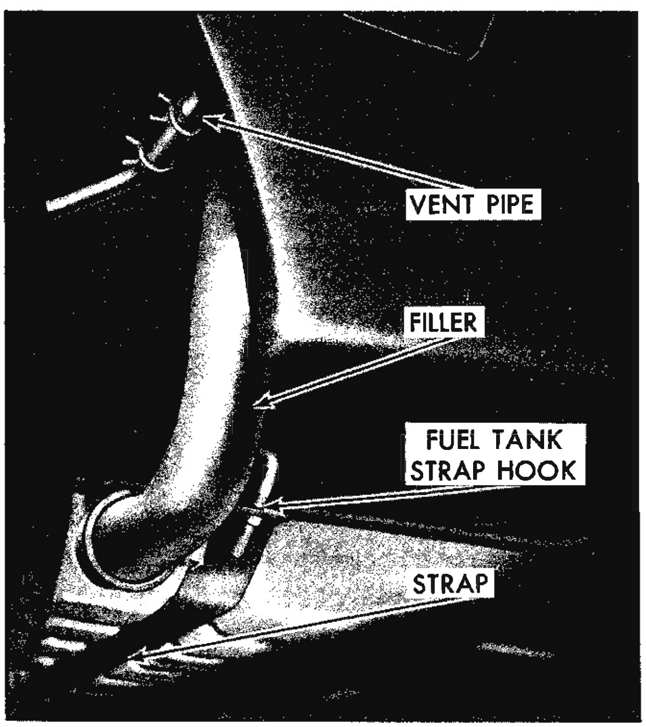



Fig. 8-4 Filler—Station Wagons

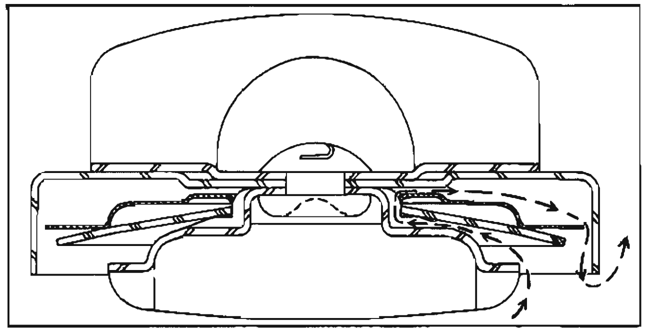


Fig. 8-5 Vent Cap

***REMOVE AND REPLACE FUEL TANK—STATION WAGON***

1. Disconnect wire from tank gauge unit at the unit or inside of trunk. If disconnected inside trunk, force wire through grommet.
2. Raise car and support fuel tank.
3. Drain fuel tank as described on page 8-1.
4. Remove clamp connecting fuel line to tank.
5. Remove screw holding vent pipe to side rail.
6. Disconnect vent hose from tank.
7. Remove screw from filler pipe bracket to tank adapter.
8. Remove upper body to filler pipe seal.
9. Remove filler pipe from tank by pulling pipe from tank opening.
10. Remove nut securing support strap holding fuel tank to body.
11. Lower fuel tank from car.

To install reverse above procedure.

## TROUBLE DIAGNOSIS

***LEAKS***

Before removing fuel tank to correct a leak, a careful inspection of the tank should be made to determine as accurately as possible the source of the leak. So called "seam leaks" very often turn out to be loose screws at the fuel gauge tank unit. In this case the gasoline runs down on the flange of the seam and drips off at points along the seam giving the false indication of leaking seams.

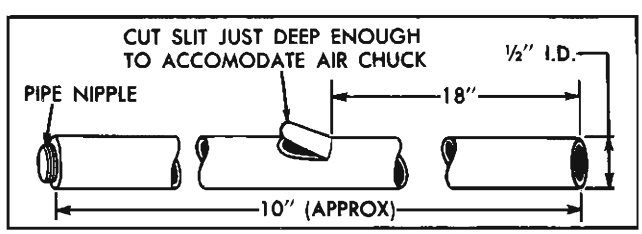



Fig. 8-6 Typical Drain Hose

### NOISES

Stones on top of the tank may be the cause and should be removed.

### TANK UNIT

Diagnosis for the fuel tank gauge unit appears in Section 11.

# EXHAUST SYSTEM

## DESCRIPTION

The major units of the exhaust system of the Four Cylinder Engine (Fig. 8-7) are the exhaust crossover pipe, exhaust pipe, muffler and tail pipe. The gases formed as fuel is burned in the combustion chamber of the engine pass into the exhaust manifold. Here if the engine is cold a thermostatically controlled valve in the outlet of the exhaust manifold blocks the passage of exhaust gases out of the manifold. Exhaust gases then pass through the crossover passage in the intake manifold heating the manifold stove. From the intake manifold the gases pass through the exhaust crossover pipe and into the connector. When the engine warms up the thermostatic valve opens and the exhaust gases pass directly into the connector. From here they are carried into the exhaust pipe through the muffler assembly and out the tail pipe.

The major units of the V-8 exhaust system (Fig. 8-8) are the exhaust crossover pipe, exhaust pipe, muffler and tail pipe. The fuel burned in the combustion chamber of the engine passes into the exhaust manifolds of the engine. A heat riser pipe in the right hand manifold supplies heated air to the carburetor choke assembly. The crossover pipe connects both exhaust manifolds to the exhaust pipe. From the exhaust pipe the gases pass through the muffler and out the tail pipe.

## SERVICE PROCEDURES

### REMOVE AND REPLACE EXHAUST SYSTEM—FOUR CYLINDER ENGINE

#### REMOVE

1. Remove two bolts and tabs connecting exhaust pipe to connector.

2. Remove nut on front muffler support strap to insulator.

3. Remove entire exhaust system by moving rearward to remove hook from tail pipe insulator.

#### REPLACE

1. Position exhaust system and slide hook through tail pipe insulators.

2. Connect front muffler support strap to insulator.

3. Secure exhaust pipe to connector.

### REMOVE AND REPLACE EXHAUST SYSTEM—8 CYLINDER ENGINE

#### REMOVE

1. Remove U-bolt connecting exhaust pipe to crossover pipe.

2. Remove nut on front muffler support strap to insulator.

3. Remove entire exhaust system by moving rearward to remove hook from tail pipe insulator.

4. Disconnect and remove exhaust crossover pipe from connector.

#### REPLACE

1. Position exhaust system and slide hook through insulator.

2. Secure front muffler support. Strap to insulator on torque tube.

3. Secure exhaust pipe to crossover pipe with U-bolt.

### REMOVE AND REPLACE EXHAUST CROSSOVER PIPE—4 CYLINDER ENGINE

1. Disconnect crossover pipe from intake manifold.

2. Remove two nuts from both U-bolts and remove U-bolt from support.

3. Disconnect and remove exhaust crossover pipe from connector.

4. Replace crossover pipe, using new gaskets, by reversing above steps. Tighten bolts at each end of crossover pipe to 15-25 lb. ft. torque.

### REMOVE AND REPLACE EXHAUST CROSSOVER PIPE—V-8 ENGINE

1. Remove four bolts connecting exhaust crossover pipe to exhaust manifold.

2. Remove clamp connecting exhaust crossover pipe to exhaust pipe.

3. Remove exhaust crossover pipe from car by dropping left side of pipe and pulling over right side of front crossmember downward (it may be necessary to loosen front muffler support and slide exhaust system rearward for more rocking clearance).

4. Replace exhaust crossover pipe by reversing above steps. Tighten bolts connecting crossover pipe to manifold 25-35 lb. ft. torque. Tighten nuts on clamp to 10-15 lb. ft. torque.

### REMOVE AND REPLACE CONNECTOR —4 CYLINDER ENGINE

NOTE: No gaskets are used between the manifold and connector or connector and exhaust pipe.

1. Remove two bolts attaching crossover pipe to connector.

2. Remove two bolts and tabs attaching exhaust pipe to connector.

3. Remove two bolts attaching connector to exhaust manifold.

4. Replace connector by reversing above steps. Tighten exhaust pipe to connector bolts and connector to manifold bolts 25-35 lb. ft. torque. Tighten crossover pipe to connector bolts 15-25 lb. ft. torque.

### REMOVE AND REPLACE EXHAUST PIPE —4 CYLINDER ENGINE

1. Remove two bolts connecting exhaust pipe to connector.

2. Remove clamp securing exhaust pipe to muffler.

3. Remove exhaust pipe from car.

4. Replace exhaust pipe by reversing above steps. Tighten exhaust pipe to connector bolts 15-25 lb. ft. torque and clamp U-bolt nuts 10-15 lb. ft. torque.

NOTE: No gaskets are used between the manifold and connector or connector and exhaust pipe.

### REMOVE AND REPLACE EXHAUST PIPE —V-8 ENGINE

1. Remove clamps at both ends of exhaust pipe.

2. Remove exhaust pipe from car.

3. Replace exhaust pipe by reversing above procedure. Tighten nuts to 10-15 lb. ft. torque.

### REMOVE AND REPLACE MUFFLER—V-8 ENGINE

1. Remove clamp from support assembly and from front of muffler.

2. Remove muffler from car.

3. Replace muffler by reversing above steps. Tighten nuts on clamp to 10-15 lb. ft. torque.

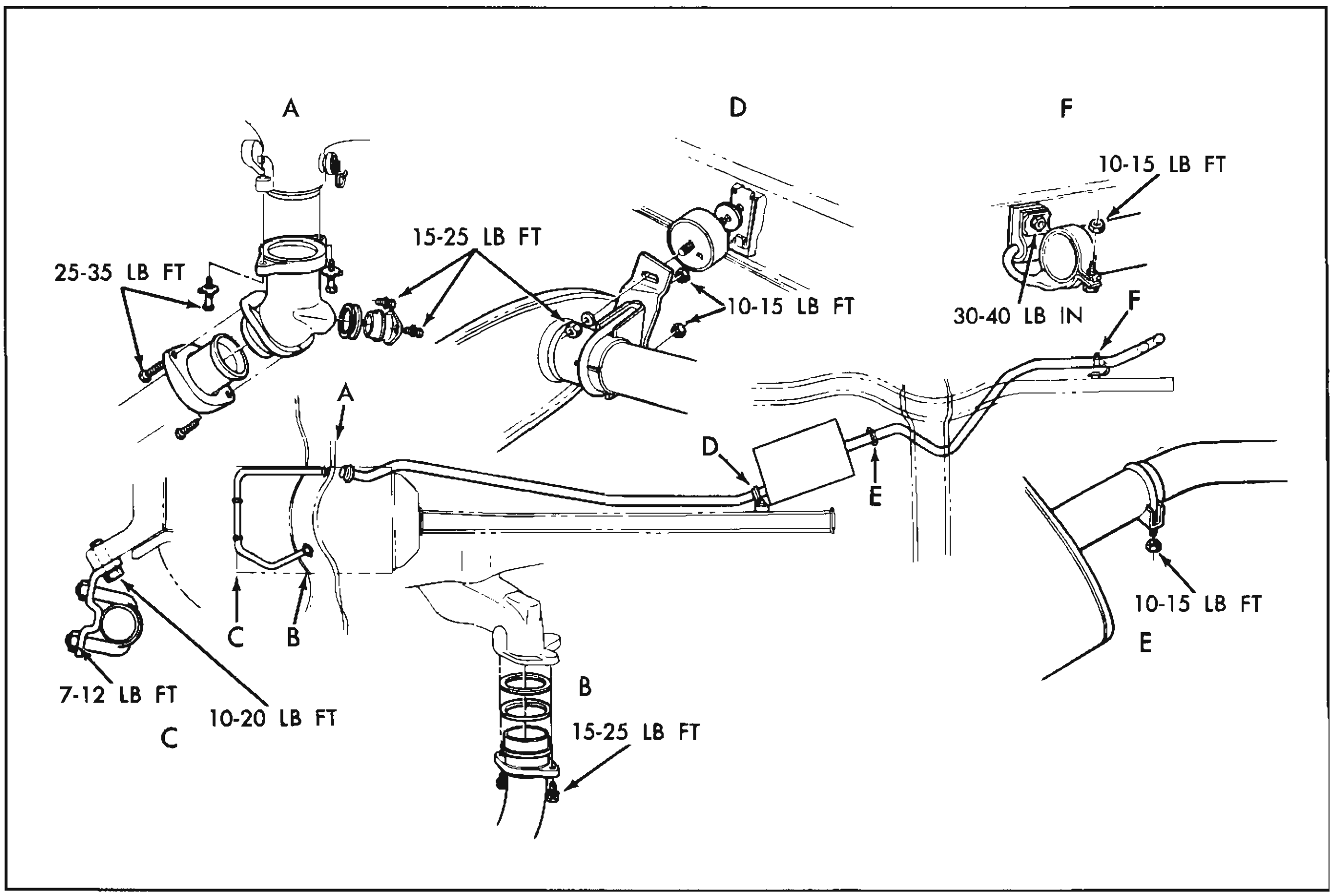



Fig. 8-7 Exhaust System—Four Cylinder Engine

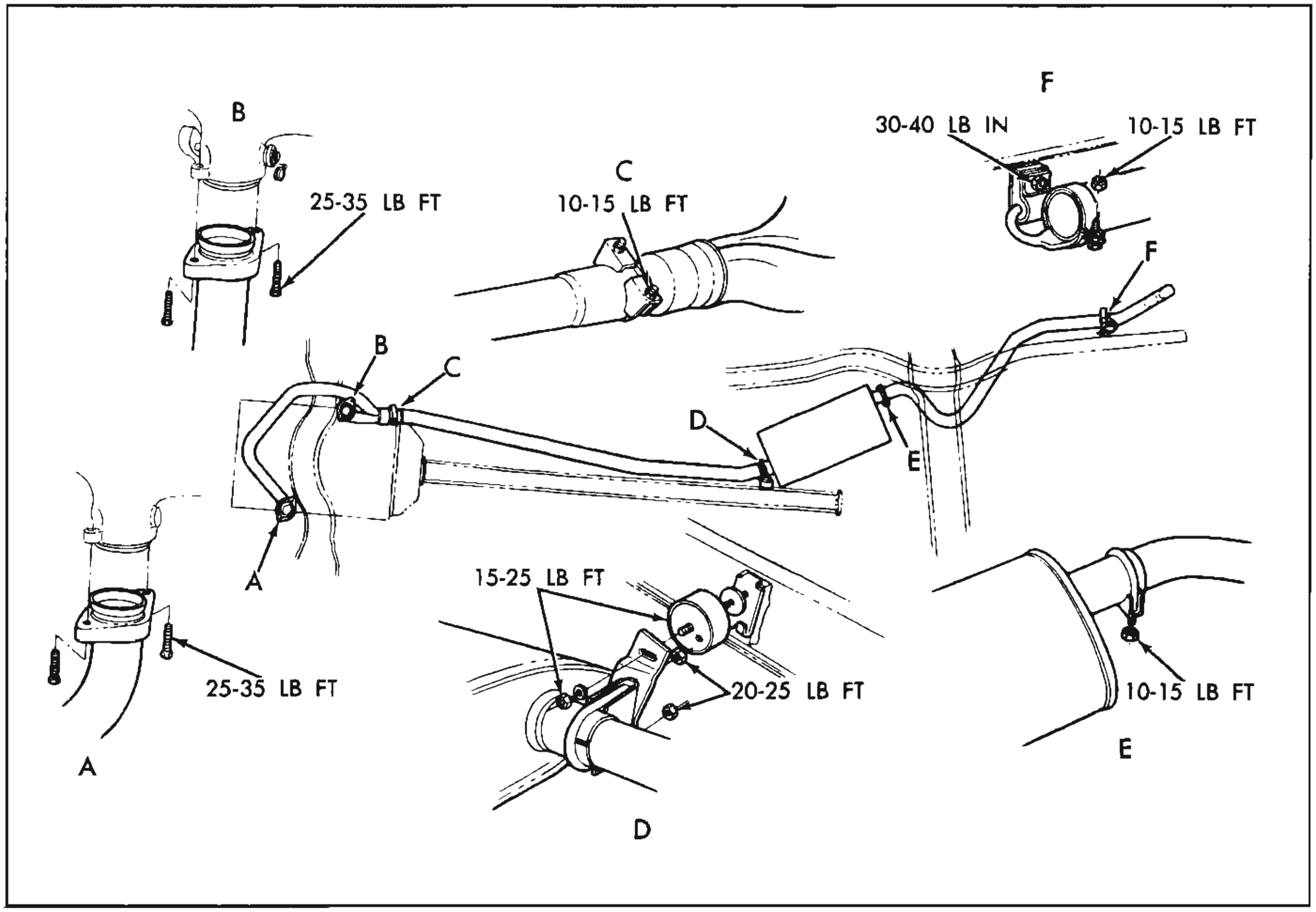



Fig. 8-8 Exhaust System—Eight Cylinder Engine

***REMOVE AND REPLACE TAIL PIPE***

1. Remove U-bolt connecting muffler and tail pipe to support assembly.

2. Remove clamp securing hook to tail pipe.

3. Remove tail pipe from car.

4. Replace by reversing above steps. Tighten U-bolt nuts to 10-15 lb. ft. torque. Tighten screw on clamp to 30-40 lb. in. torque.

***REMOVE AND REPLACE MUFFLER SUPPORT ASSEMBLY—V-8 ENGINE***

1. Remove two nuts from U-bolt and remove clamp.

2. Remove muffler support assembly from car.

3. Replace muffler support assembly by reversing above steps. Tighten U-bolt nuts to 10-15 lb. ft. torque.

***REMOVE AND REPLACE TAIL PIPE SUPPORT —V-8 ENGINE***

1. Remove screws from clamp on tail pipe.

2. Remove hook from support.

3. Remove screw from washer and insulator.

4. Replace tail pipe support by reversing above steps. Tighten screw securing insulator to 30-40 lb. in. torque. Tighten clamp screw to 15-45 lb. in. torque.

## SPECIFICATIONS

Fuel Tank Capacity ....................... 20 Gal.

Exhaust crossover pipe diameter (Four Cylinder) ....................... 1⅛"

Exhaust crossover pipe diameter (V-8) ......... 2"

Exhaust pipe diameter (Four Cylinder 1 bbl) .. 1¾"

Exhaust pipe diameter (4 cyl. 4 bbl.) & V-8 .. 2¼"

Tail pipe diameter (1 bbl., 4 cyl.) ........... 1½"

Tail pipe diameter (4 bbl., 4 cyl.) & 2 bbl. V-8 .. 2"

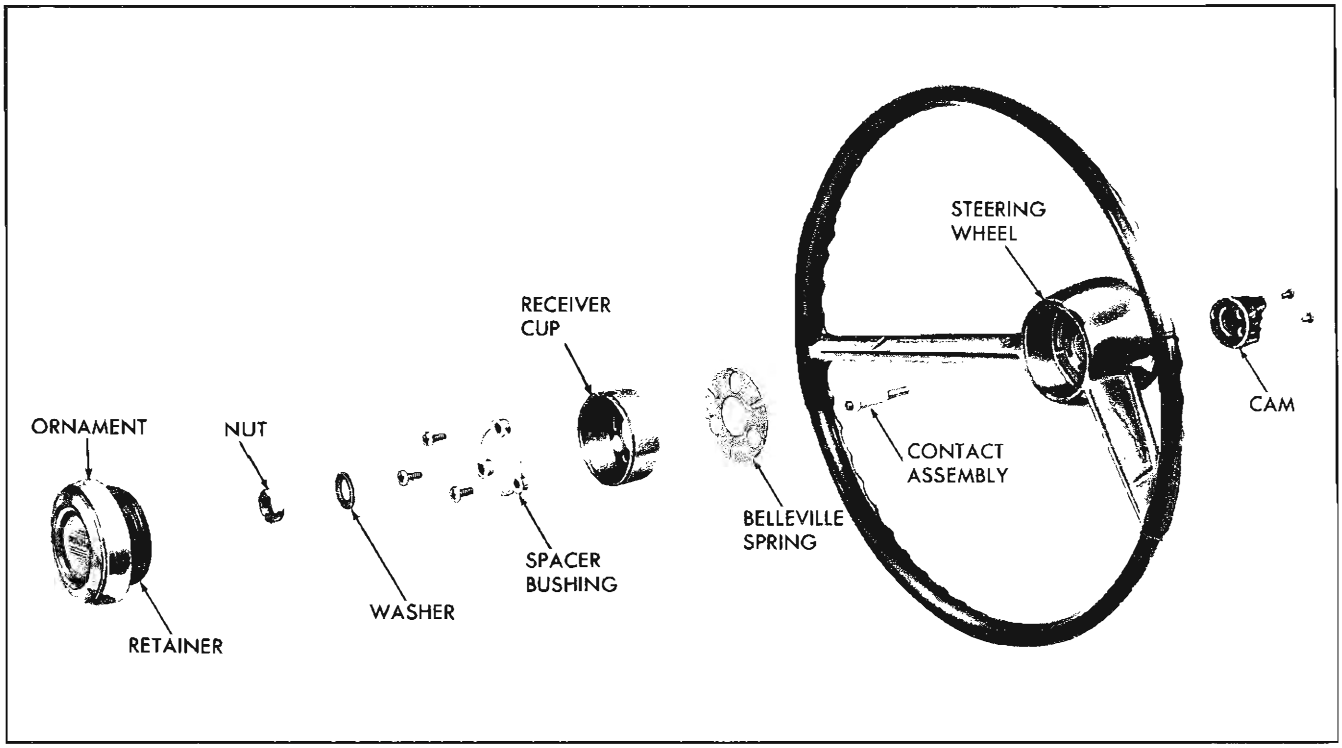



Fig. 9-1 Standard Steering Wheel Assembly

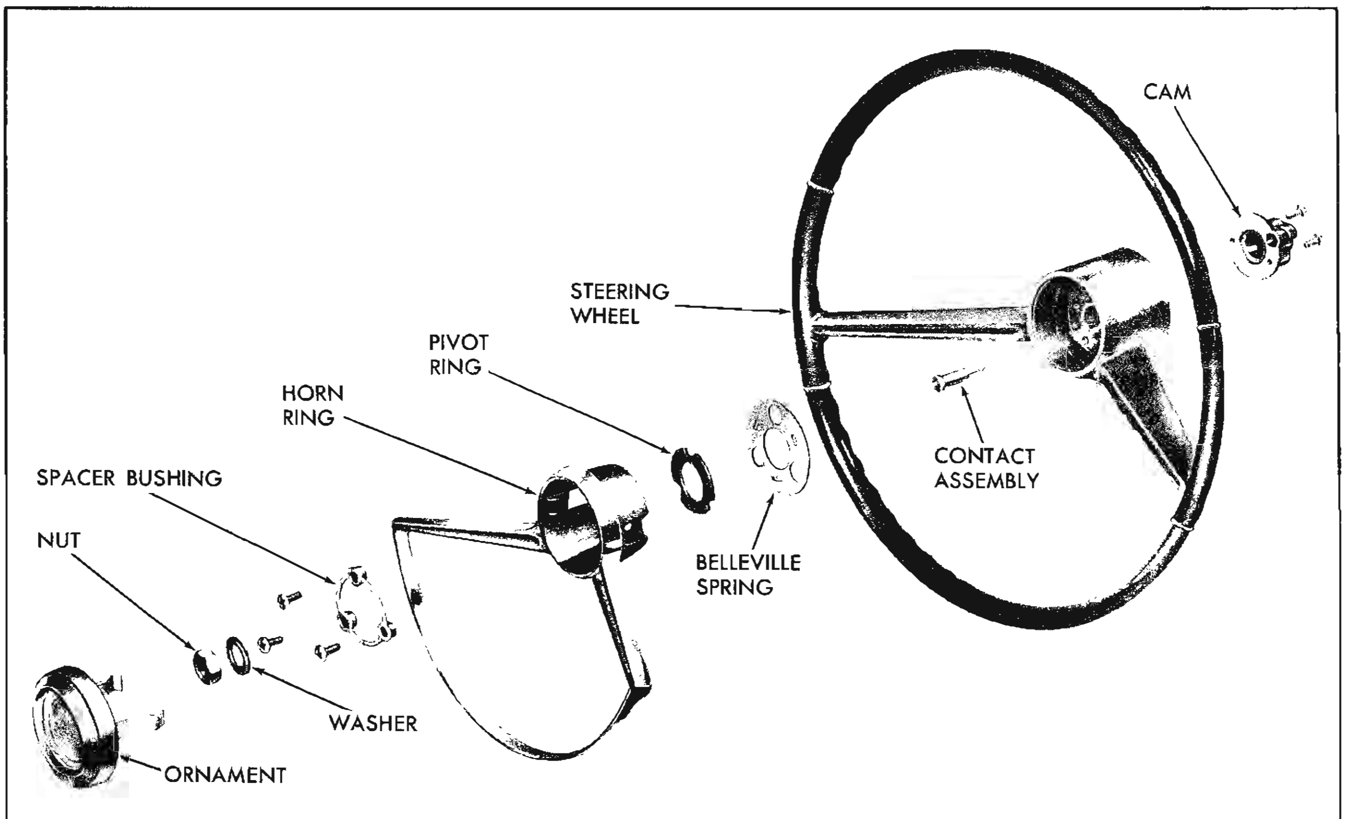



Fig. 9-2 Deluxe Steering Wheel Assembly

# STEERING

CONTENTS OF THIS SECTION



## STANDARD AND DELUXE STEERING WHEEL

### REMOVE AND REPLACE

1. Lift to remove ornament (Figs. 9-4 and 9-5).

2. Remove nut and washer from shaft.

3. Remove spacer bushing.

4. Remove horn ring (deluxe wheel) or receiver cup (standard wheel).

5. Remove pivot ring (deluxe wheel) and belleville spring.

6. Remove contact assembly.

7. Remove steering wheel using Puller J-3044-01 (Fig. 9-6).

8. To replace, reverse the above procedure, making sure steering wheel is in straight ahead position (Fig. 9-7). Tighten steering wheel nut to 2½ lb. ft. torque and stake.

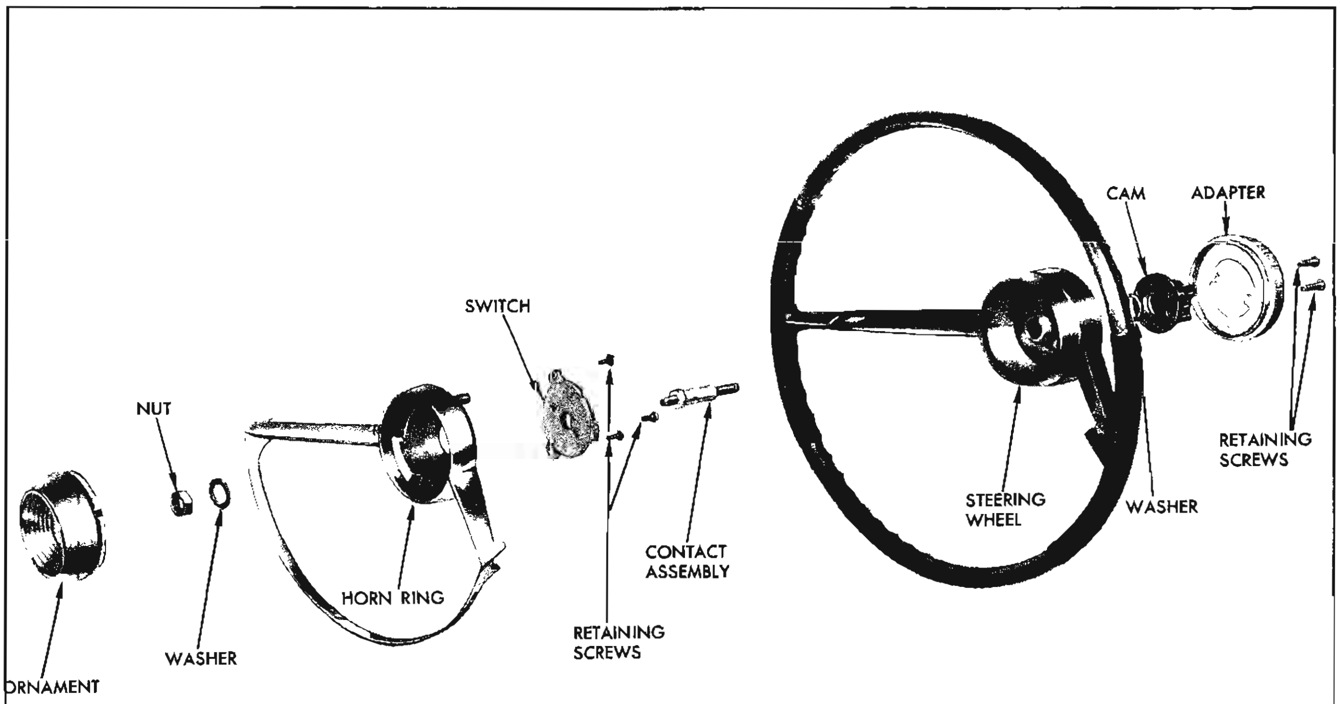



Fig. 9-3 Custom Steering Wheel Assembly

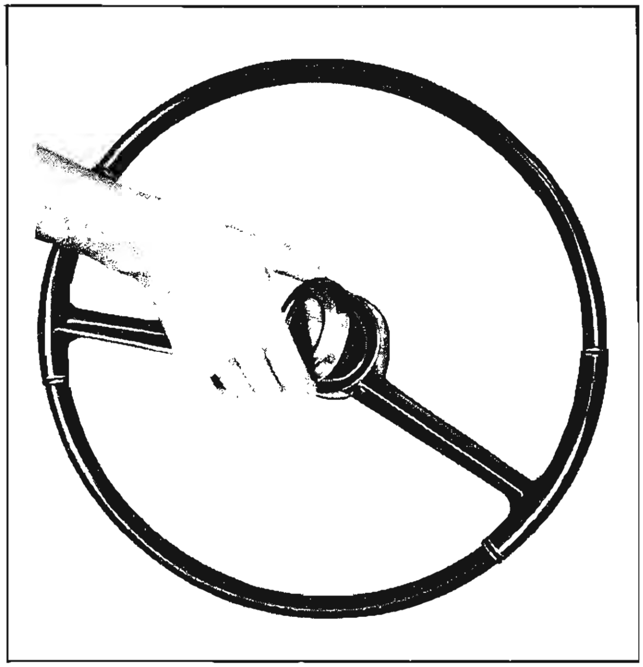


Fig. 9-4 Standard Horn Button

## CUSTOM STEERING WHEEL—REMOVE AND REPLACE

REMOVE

1. Twist steering wheel ornament and lift to remove.

2. Remove retaining nut and washer from steering gear shaft (Fig. 9-3).

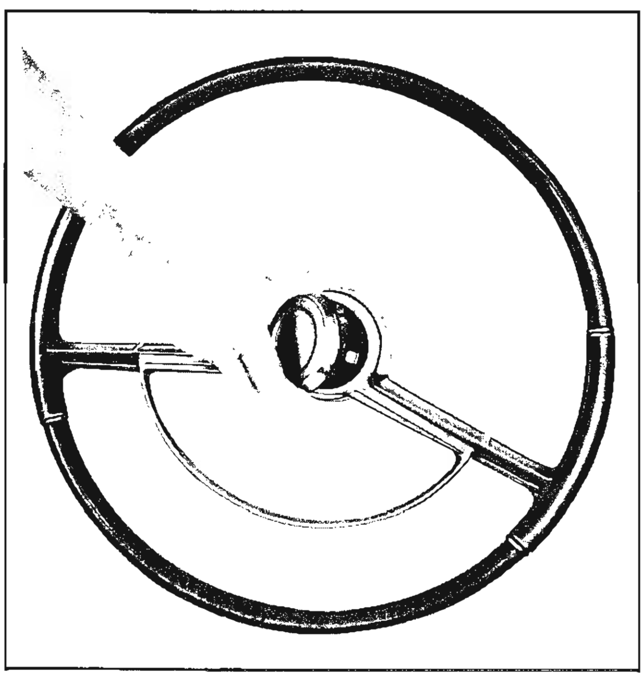


Fig. 9-5 Deluxe Horn Button

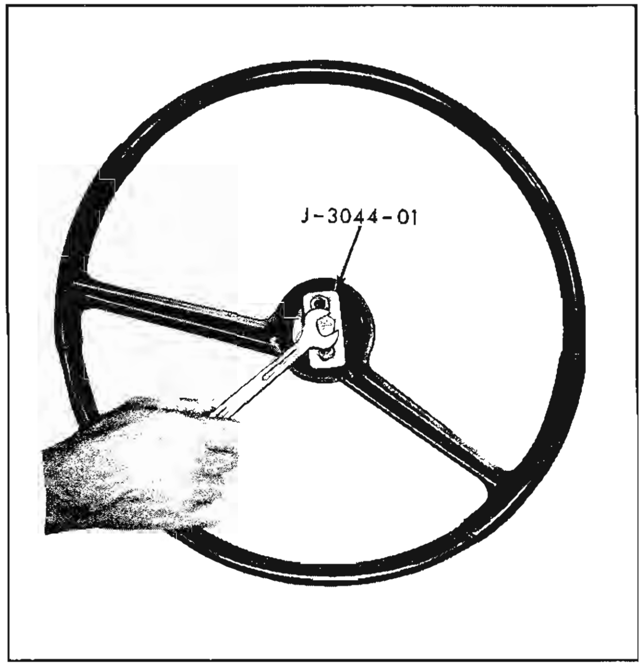



Fig. 9-6 Pulling Steering Wheel

3. Pull horn ring and contact assembly from steering column upper bearing.

4. Remove steering wheel from shaft using puller J-3044.

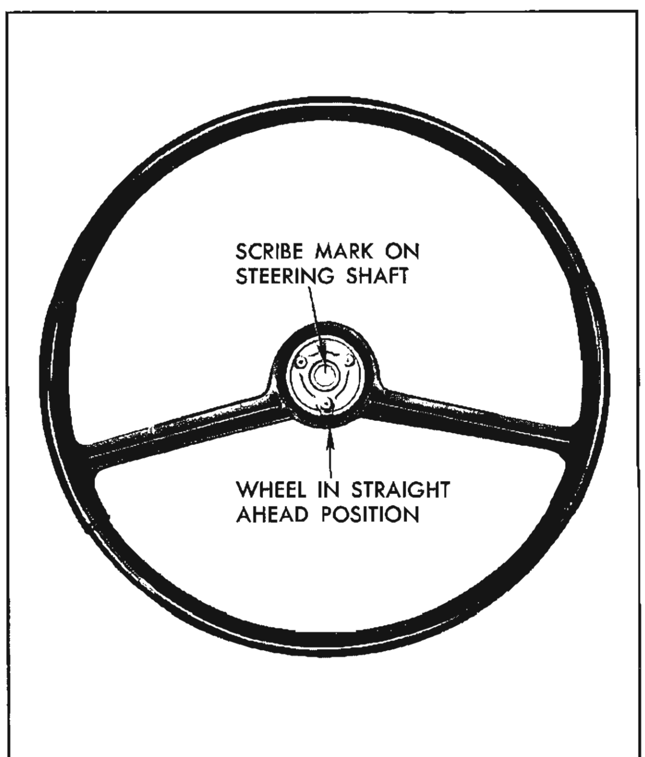



Fig. 9-7 Steering Wheel Installed

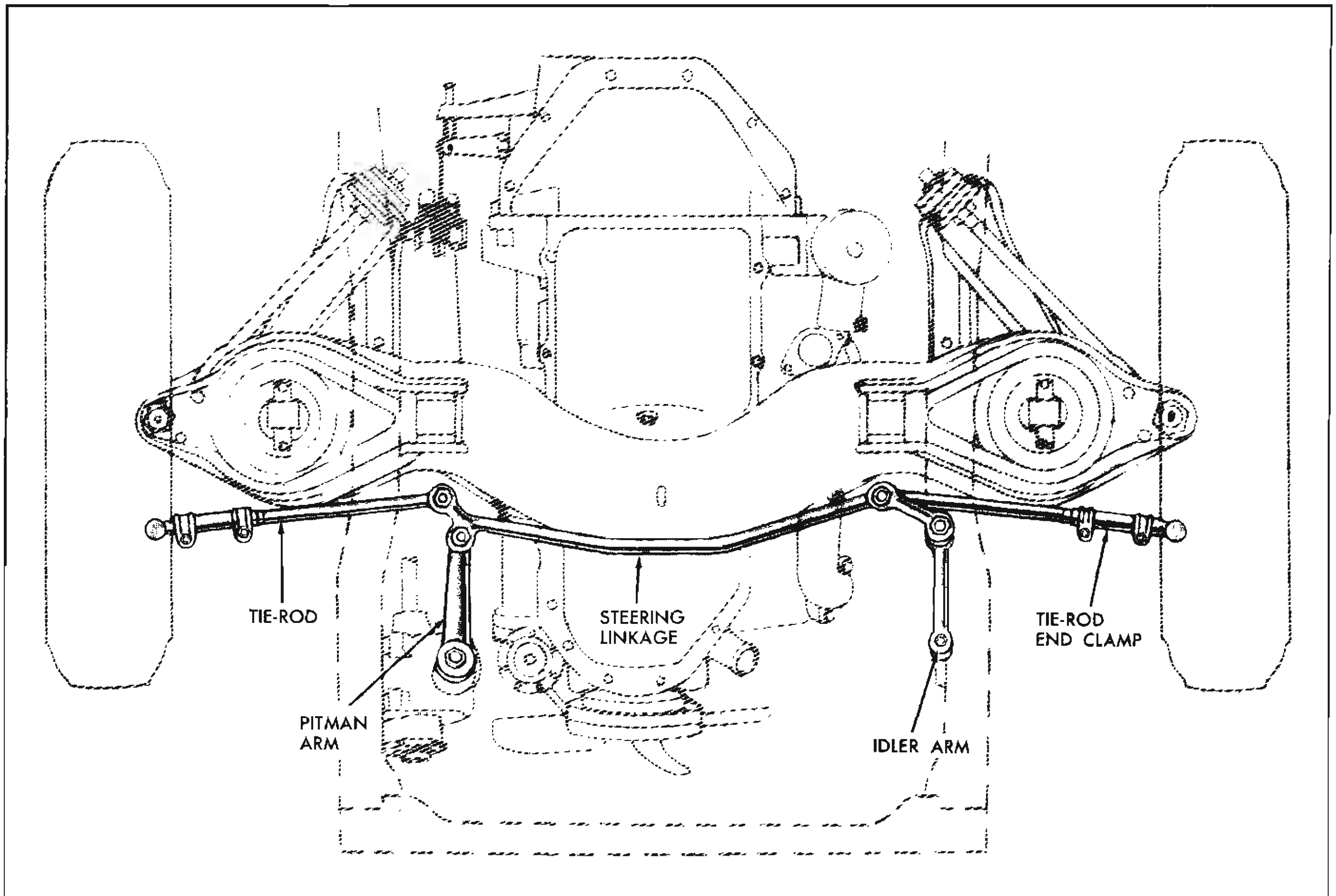



Fig. 9-8 Standard Steering Linkage

REPLACE

1. Install steering wheel over shaft making certain splines on inner bore of wheel and O.D. of shaft line up.

NOTE: Scribe mark on steering shaft must be positioned at top of shaft and steering wheel must not vary more than five degrees from horizontal when front wheels are straight ahead.

2. Install horn ring and contact assembly on steering gear shaft.

3. Install washer and steering wheel retaining nut and torque 20-35 lb. ft. and stake.

4. Install steering wheel ornament, twisting to seat.

## STEERING LINKAGE

### *REMOVE*

1. Raise car.

2. Remove cotter pin and nut and remove tie-rod end stud from steering arm at each front wheel with tool J-6627.

3. Remove nut and lock washer and remove pitman arm from pitman arm shaft with tool J-5504-B.

4. Remove idler arm nuts and remove idler arm and steering linkage from car.

### *INSTALL*

1. Install idler arm and steering linkage into car, securing idler arm with bolts, lock washers and nuts. Tighten to 48-62 lb. ft. torque.

2. Install pitman arm on pitman shaft. Make sure steering gear is at high point with wheels straight ahead before installing arm on shaft.

3. Install pitman arm lock washer and nut. Torque to 100-125 lb. ft.

4. Install tie-rod end into steering arm at each front wheel and torque nut to 60-95 lb. ft. Install cotter pin.

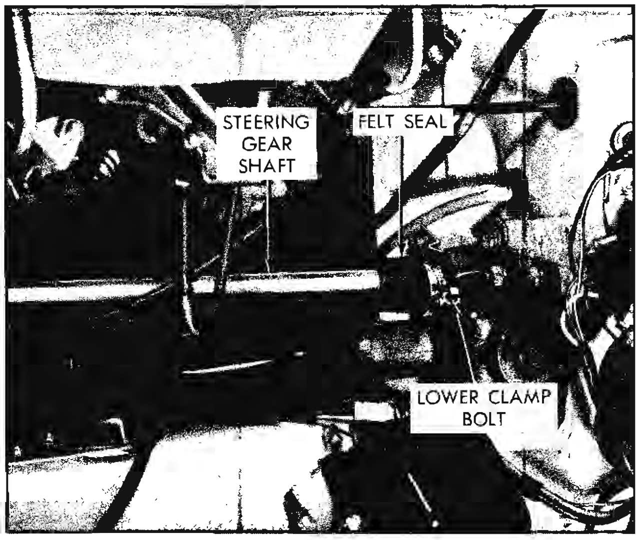



Fig. 9-9—Steering Shaft and Jacket

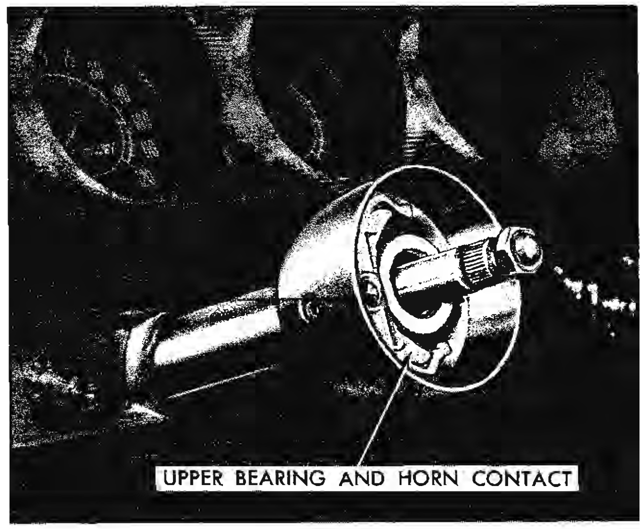



Fig. 9-10 Upper Steering Column Assembly

## STEERING LINKAGE

### *DISASSEMBLE*

1. Thread idler support from bushing, then idler arm from bushing.

2. Tie-rod ends and idler arm, may be disconnected from steering linkage by removing cotter pins and nuts and using Tool J-6627. Use Tool J-5504-B to disconnect pitman arm from pitman shaft.

### *ASSEMBLE*

1. Connect pitman arm, idler arm, and tie rod ends to steering linkage and torque nuts to 50 lb. ft. NOTE: Do not back off nuts to insert cotter pins.

2. Thread idler arm onto bushing, then idler support onto bushing. Torque bushing to 110-115 lb. ft.

NOTE: Distance between idler arm support lower mounting bolt hole and top of arm should be 2.27".

## STEERING COLUMN JACKET

### *REMOVE*

1. Remove steering wheel.

2. Loosen lower steering column jacket clamp (Fig. 9-9).

3. Disconnect directional signal switch wires from main harness.

4. Remove upper steering column jacket bezel screws (Fig. 9-10) and upper steering column jacket clamp, located just under front edge of instrument panel.

5. Pull steering column jacket out.

### *INSTALL*

1. Install steering column jacket into lower retainer (line up key-way).

2. Torque lower clamp nut to 4-5 lb. ft.

3. Install upper clamp and torque bolts to 4-5 lb. ft.

4. Install upper bearing and horn contact (Fig. 9-10).

5. Connect directional signal wires to main harness.

6. Install steering wheel (page 9-1).

7. Install bezel attaching screws.

# STEERING GEAR

## DESCRIPTION

The steering gear (Fig. 9-11) is the recirculating ball nut type having a gear and overall ratio of 24:1. The ball nut, mounted on the worm, is driven through steel balls which circulate in helical grooves in both the worm and nut. Ball return guides, attached to the nut, serve to recirculate the two sets of twenty-five balls each in the grooves.

As the steering wheel is turned to the right, the nut moves upward. When the wheel is turned to the left the nut moves downward.

The teeth on the sector (which are forged as part of the pitman.shaft) and the ball nut are so designed that a tighter fit exists between the two when the front wheels are straight ahead. Proper engagement between the sector and the ball nut is obtained by an

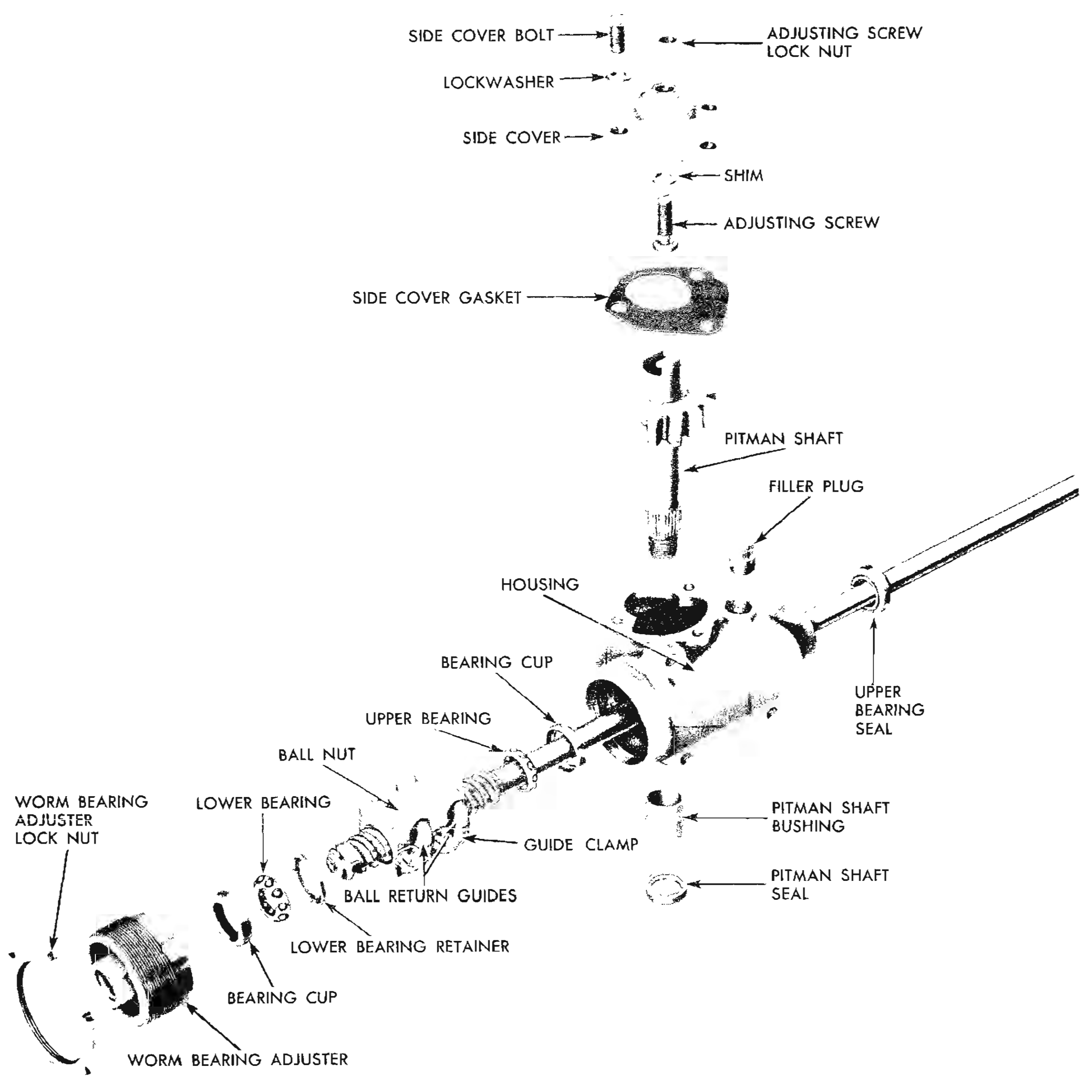



Fig. 9-11 Steering Gear Exploded View

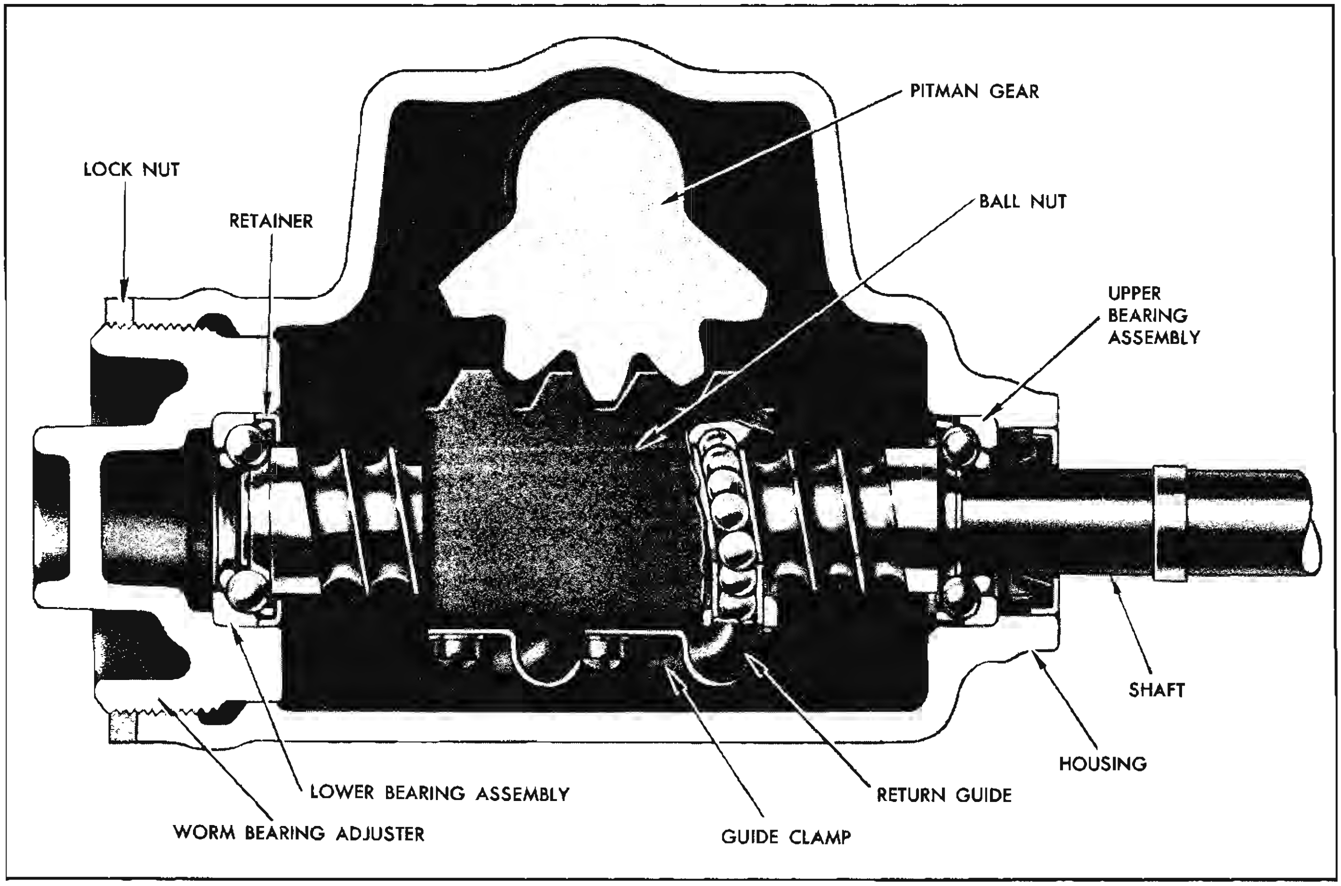



Fig. 9-12 Steering Gear Cut-away View

adjusting screw which moves the pitman shaft endwise, permitting desired engagement of the tapered teeth of the ball nut and sector gear. The worm bearing adjuster can be turned to provide proper pre-loading of the upper and lower bearings.

## PERIODIC SERVICE

Periodic service consists of periodical lubrication as outlined in General Lubrication section.

## ADJUSTMENTS ON CAR

Correct adjustment of the steering gear is extremely important and can only be obtained by following the correct procedure. Before any adjustments are made to the steering gear, in an attempt to correct such conditions as shimmy, hard or loose steering and road shocks, careful check should be made to determine that front suspension alignment, shock absorbers, wheel balance and tire pressure are correctly adjusted and/or are operating satisfactorily.

There are two adjustments on the recirculating ball type steering gear:

1. Worm bearing preload adjustment.
2. Sector and ball nut backlash adjustment.

***CAUTION: It is very important when adjusting the steering gear, that the adjustment be made in the above sequence. Failure to do so will result in damage to the steering gear.***

Service adjustment is not required until worm bearing load falls below 2 in. lbs. and/or total overcenter load falls below worm bearing load plus 2 in. lbs.

### *ADJUST WORM BEARING PRELOAD*

1. Disconnect steering linkage from pitman arm (Fig. 9-8) by removing cotter pin and nut and using Tool J-6627.

2. Tighten pitman arm nut to 100-125 lb. ft. torque.

3. Loosen steering column bracket to make certain column is not sprung due to misalignment. If misaligned, shim at steering gear housing to frame bolts and tighten bracket (Fig. 9-14).

4. Remove horn button.

5. Loosen pitman shaft adjusting screw lock nut and back off adjusting screw a few turns (Fig. 9-15).

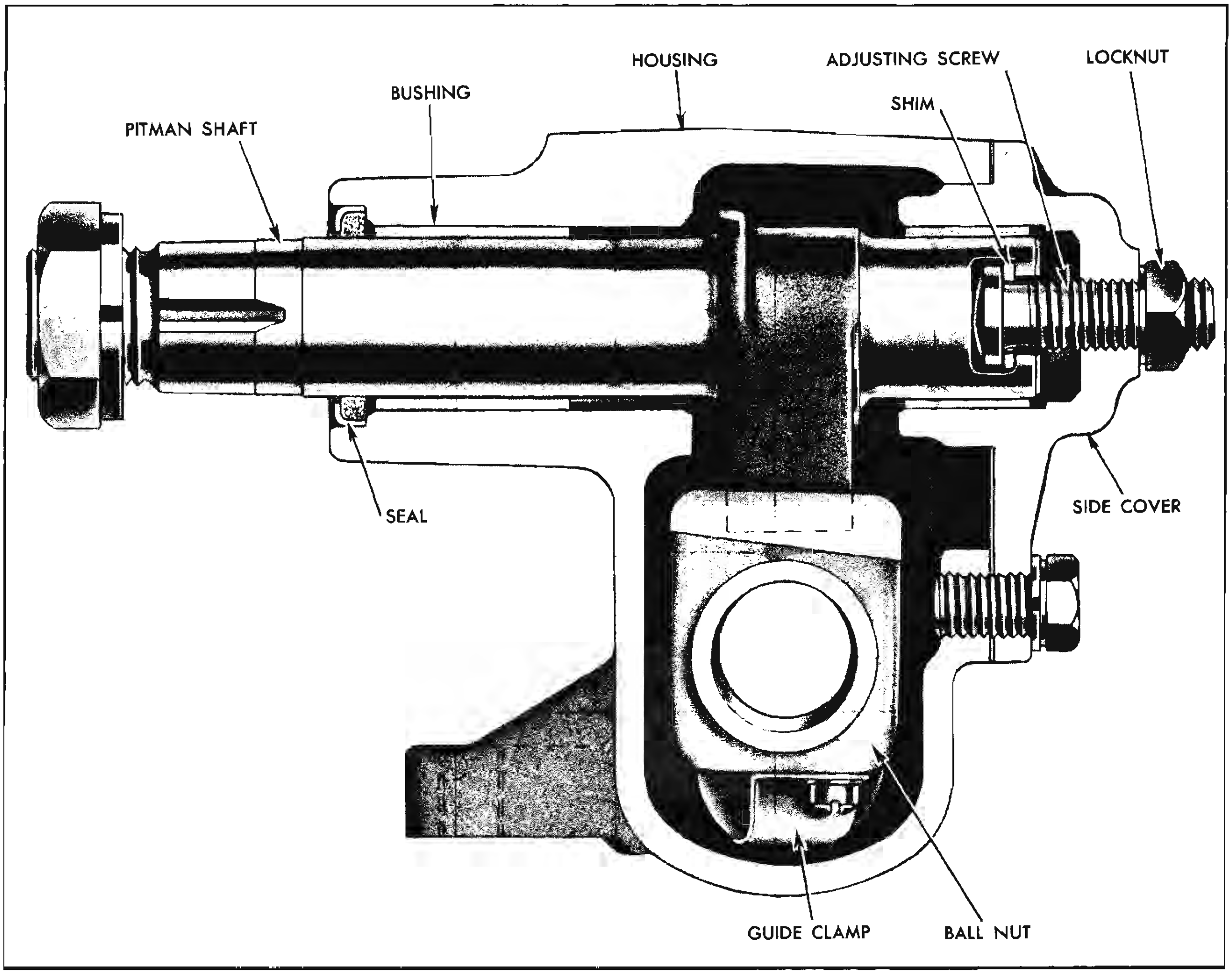



Fig. 9-13 Steering Gear Cut-away View

6. With a inch pound torque wrench at steering wheel, measure pull required to keep wheel in motion when off high point, at least 30° off center (Fig. 9-16).

Pull required should be 6-10 in. lbs. (Standard Steering) or (1½-5½) in. lbs. (Power Steering). To correct, loosen worm bearing adjuster lock nut (Fig. 9-11) with brass drift and turn adjuster to bring pull within limits.

7. Retighten worm bearing adjuster lock nut to 70-100 lb. ft. torque when adjustment is correct and recheck as in steps 5 and 6.

#### *ADJUST SECTOR AND BALL NUT BACKLASH*

1. When worm bearing preload has been adjusted correctly, pitman shaft adjusting screw should be turned clockwise until a pull of worm bearing load plus 2-6 in. lbs. (Standard Steering) or 3-7 in. lbs. (Power Steering) at the steering wheel is required to turn the wheel through high point. This load should not exceed 17 in. lbs. (Standard Steering) or 11 in. lbs. (Power Steering).

2. Tighten pitman shaft adjusting screw lock nut to 18-27 lb. ft. torque and recheck adjustment.

3. Reassemble steering connecting linkage to pitman arm. Set spokes of steering wheel in straight ahead position (mark on steering shaft up, Fig. 9-7). If road wheels are not straight ahead, adjust steering tie rods.

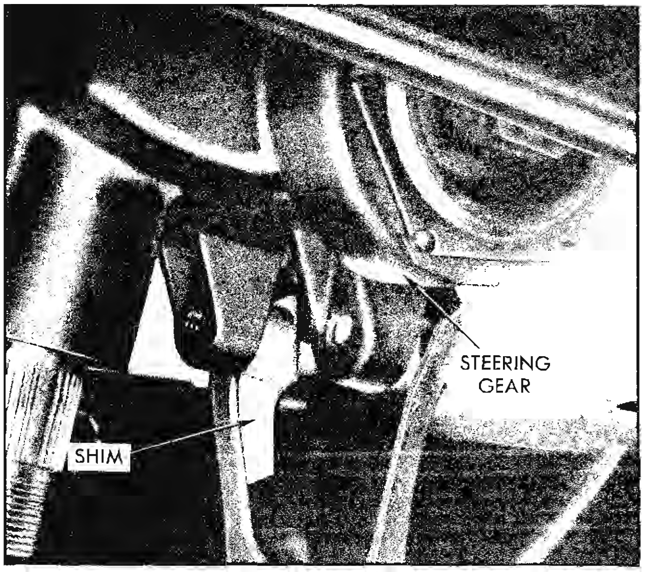



Fig. 9-14 Steering Gear Housing Shim

## STEERING GEAR

### *REMOVE*

1. Remove steering wheel as outlined on page 9-1.

2. Remove bolts retaining steering gear housing to side rail and remove gear and shaft from car.

3. Remove plastic collar and felt seal from steering column.

### *INSTALL*

1. Install shaft, with felt seal and plastic collar, (Fig. 9-9) into steering column and secure gear to side rail with three bolts and spacers. Torque bolts to 70-90 lb. ft. Use shims as necessary to align shaft with steering column jacket (Fig. 9-14).

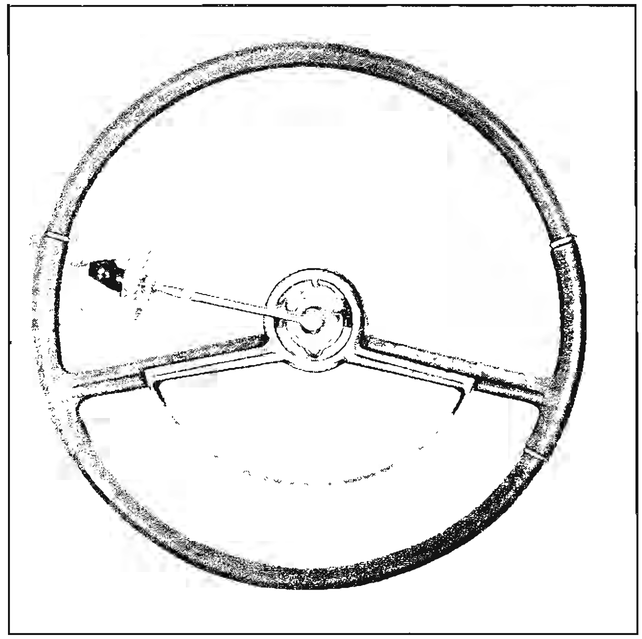


Fig. 9-16 Checking Pull at Wheel

NOTE: On power steering cars be sure to secure booster cylinder shaft bracket with two lower steering gear housing to side rail bolts. Install as shown in Fig. 9A-7.

2. Install felt seal and plastic collar into steering gear column jacket.

NOTE: Install steering column upper bearing prior to installing seal and collar (Fig. 9-10).

### *DISASSEMBLE*

1. Mount steering gear assembly on holding fixture J-5205.

2. Rotate wormshaft with steering wheel, until

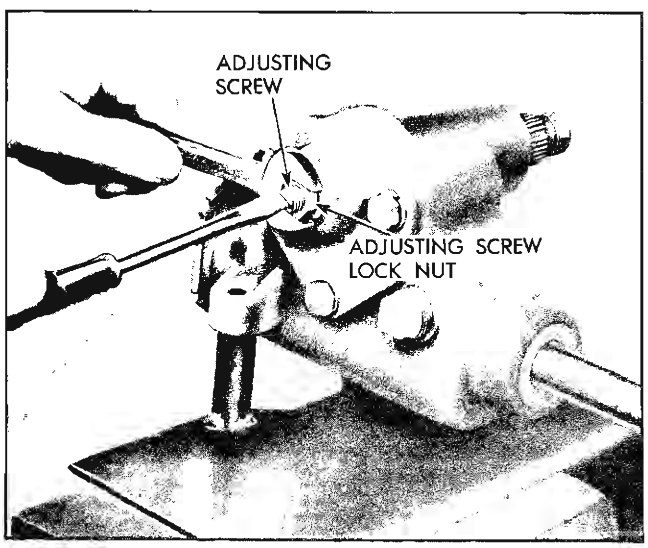



Fig. 9-15 Adjusting Pitman and Ball Nut Backlash

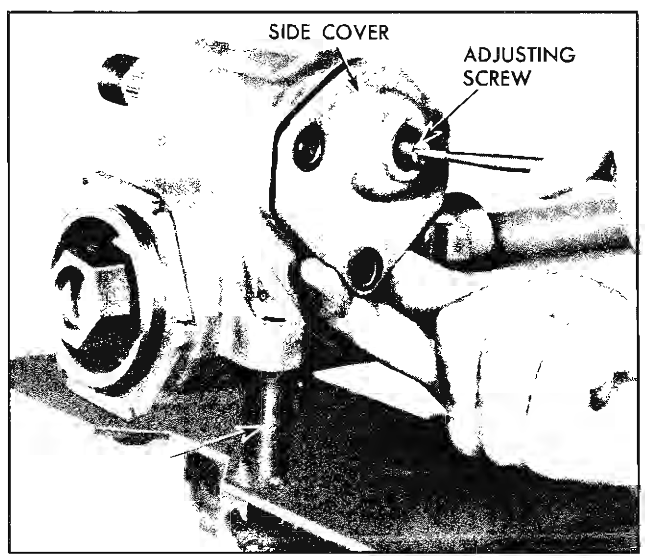



Fig. 9-17 Removing or Replacing Side Cover

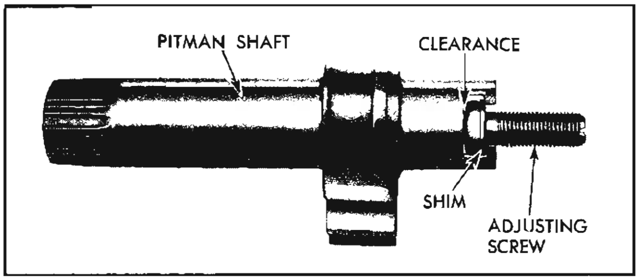



Fig. 9-18 Pitman Shaft and Adjusting Screw

wheel is in center of travel. Remove pitman adjusting screw lock nut.

3. Remove side cover and gasket by turning adjusting screw clockwise through cover (Fig. 9-17).

4. Remove adjusting screw from slot in end of pitman shaft. Make sure shim found on adjusting screw remains with screw (Fig. 9-18).

5. Remove pitman shaft from housing using care that threads do not damage seal in housing.

6. Loosen worm bearing adjuster lock nut with brass drift and remove adjuster and lower bearing.

7. Push worm and shaft assembly, with ball nut assembly, through bottom of housing and remove upper bearing.

8. Remove ball nut return guide clamp, remove guides, turn ball nut over and remove balls. Rotating shaft slowly from side to side will aid in removing balls.

9. Remove ball nut from worm. NOTE: Unless all balls are removed nut cannot be removed.

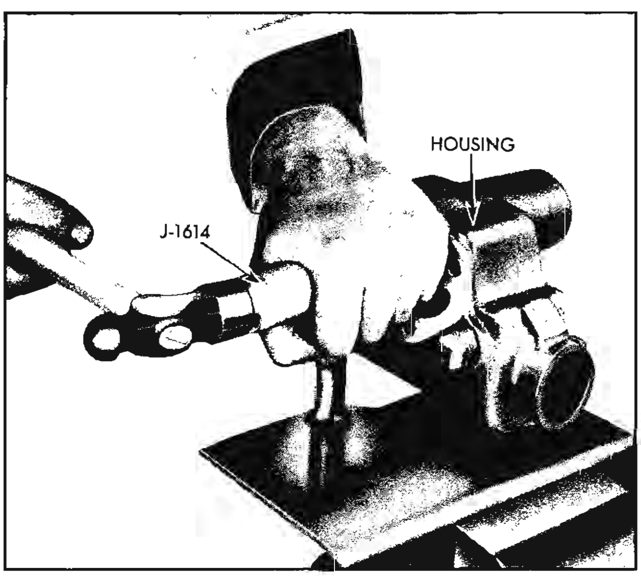



Fig. 9-19 Removing or Replacing Pitman Shaft Bushing

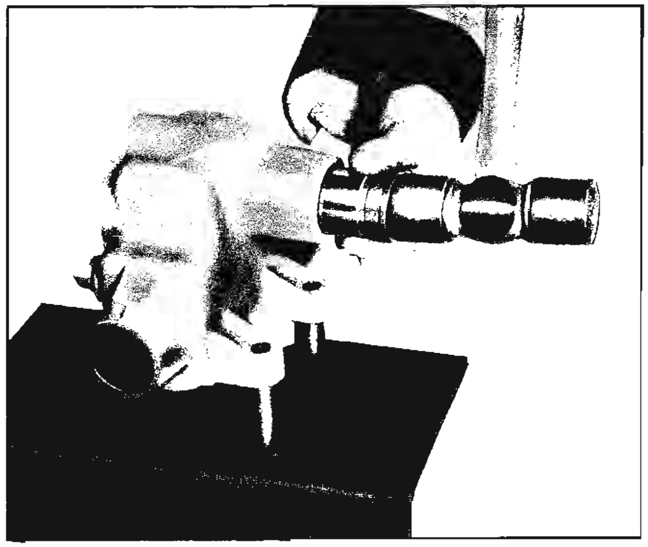


Fig. 9-20 Installing Pitman Shaft Seal

### CLEANING AND INSPECTION

1. Wash all parts in clean kerosene or other suitable solvent.

2. Inspect all bearings, bearing cups, worm groove, bushings, seals, teeth for scoring, wear, pitting, etc. which would necessitate replacement.

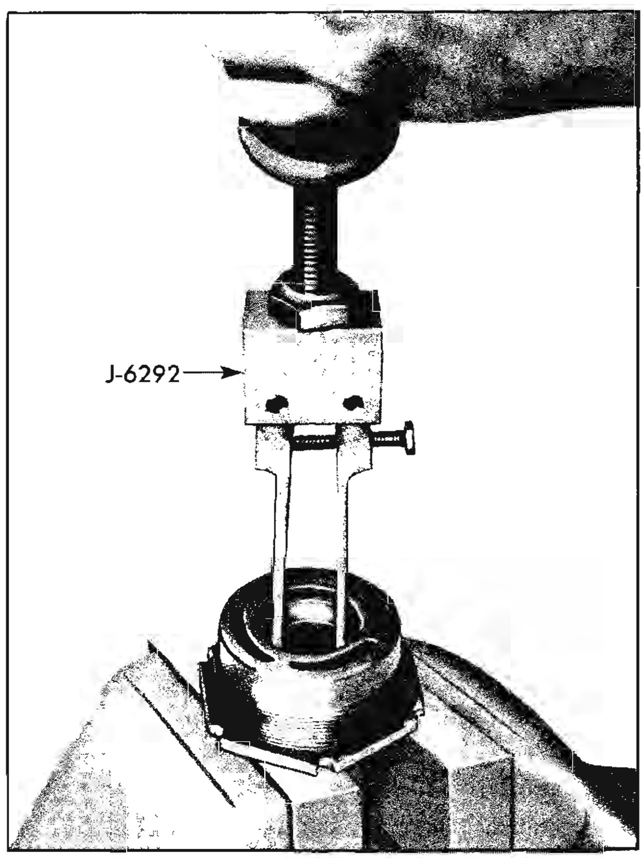



Fig. 9-21 Removing Lower Bearing Cup

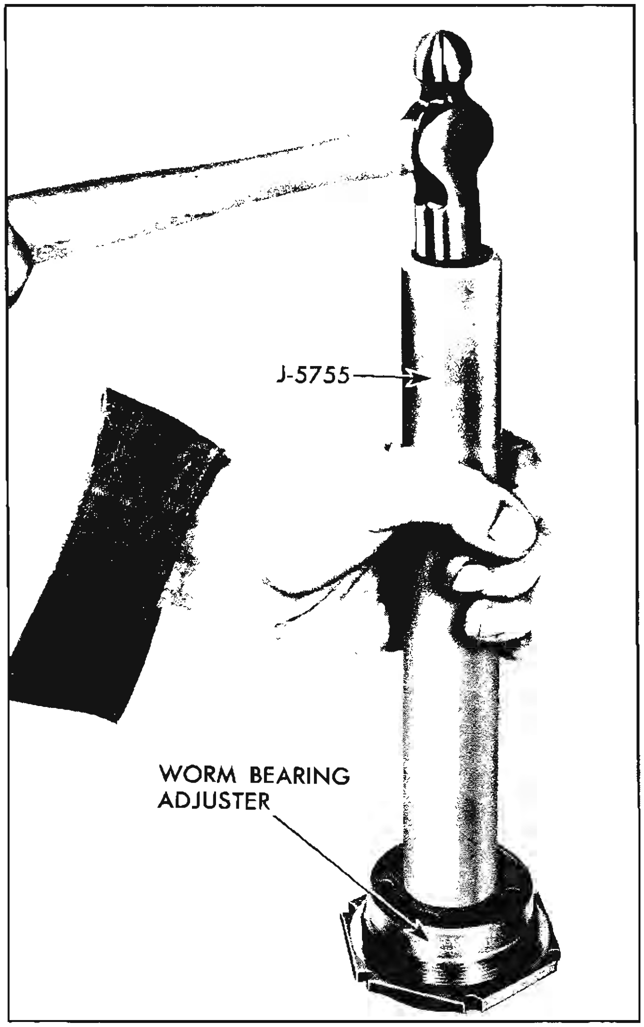



Fig. 9-22 Installing Lower Bearing Cup

3. Inspect housing and cover for sandholes or cracks.

If pitman shaft bushing, seal, upper and lower bearing cups, upper bearing seal, steering gear housing, or column jacket are worn excessively or damaged, replace parts.

#### *REMOVE AND REPLACE PITMAN SHAFT SEAL AND/OR BUSHING*

1. Pry bearing retainer off with suitable screwdriver.

2. Drive out bushing with Tool J-1614 (Fig. 9-19).

3. Install bushing with Tool J-1614, making sure bushing is flush with inner surface of housing (Fig. 9-13).

4. Install pitman shaft seal. A suitable socket which presses on outer diameter of seal may be used. (Fig. 9-20).

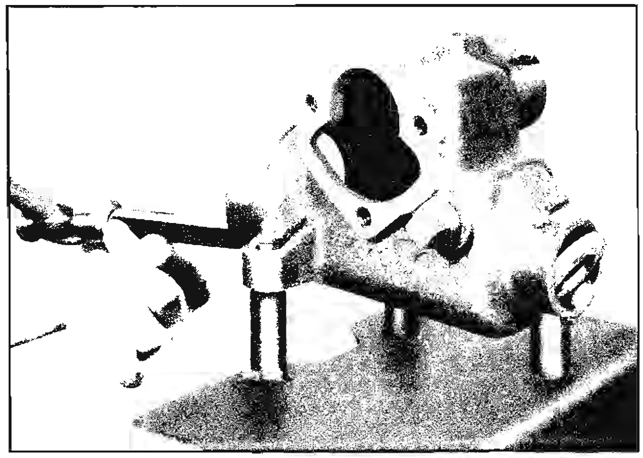


Fig. 9-23 Removing Upper Bearing Seal

#### *REPLACE LOWER BEARING CUP*

1. Pry pitman shaft seal out with suitable screwdriver.

2. Remove lower bearing.

3. Place worm bearing adjuster in vise and remove lower bearing cup with Tool J-6292 (Fig. 9-21).

4. Install lower bearing cup with Tool J-5755 (Fig. 9-22).

5. Install lower bearing.

6. Install lower bearing retainer.

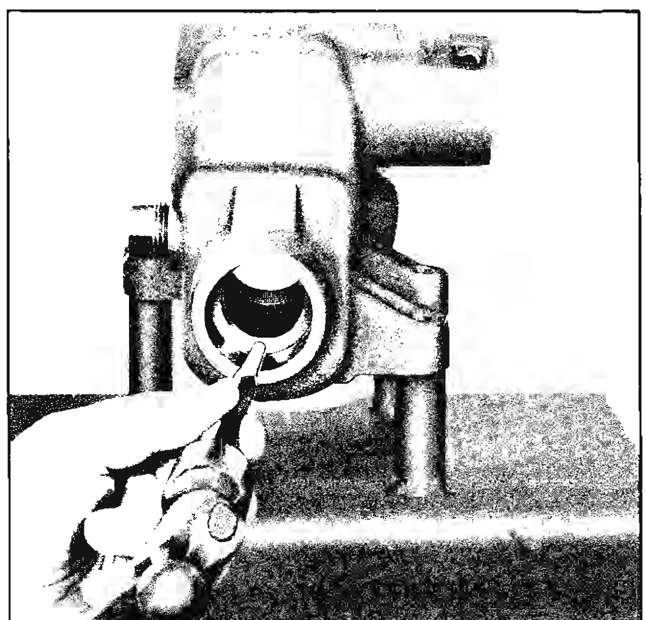


Fig. 9-24 Removing Upper Bearing Cup

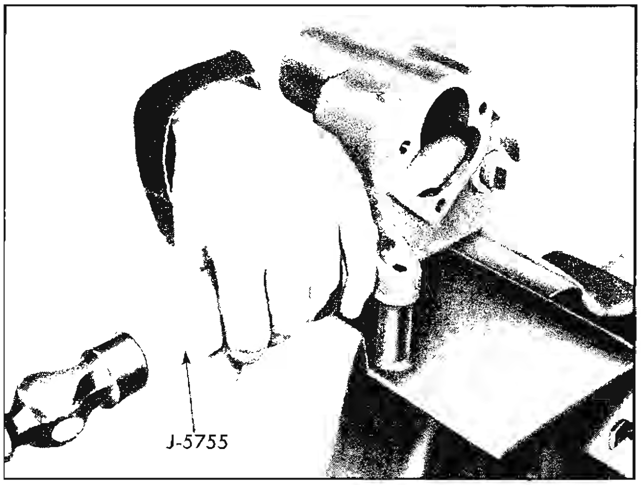



Fig. 9-25 Installing Upper Bearing Cup

### REPLACE UPPER BEARING CUP AND/OR SEAL

1. Remove upper bearing seal by driving out with suitable punch (Fig. 9-23).

2. Remove upper bearing cup with punch (Fig. 9-24).

3. Install upper bearing cup using tool J-5755 (Fig. 9-25).

4. Install new upper bearing seal (Fig. 9-26).

### ASSEMBLE

NOTE: All seals, bushings and bearings should be prelubricated before assembly.

1. Position ball nut on shaft so that deep side of teeth are located as shown in Fig. 9-27.

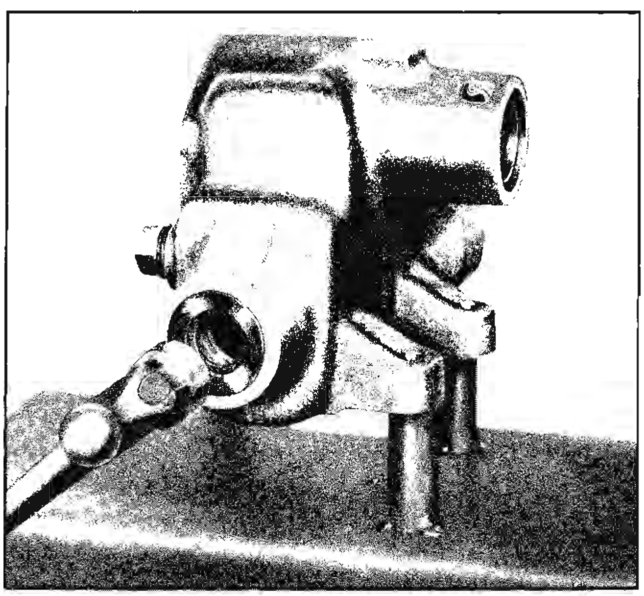


Fig. 9-26 Installing Upper Bearing Seal

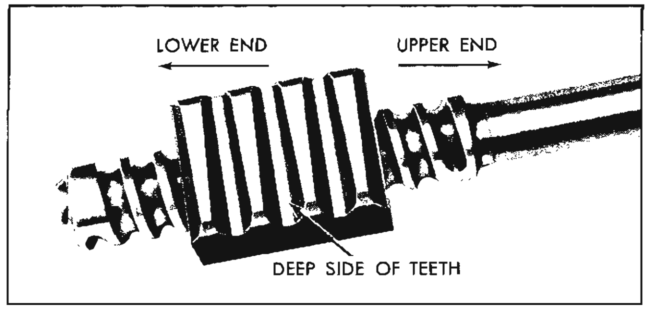



Fig. 9-27 Ball Nut Properly Installed on Shaft

2. Install 20 balls in each circuit (one circuit at a time) of ball nut (rotate steering shaft slightly to aid in installing balls) and insert 5 balls in each return guide using petrolatum to hold balls in place. Install return guide clamp and screw.

***CAUTION: Be careful that rotation of shaft does not cause balls to enter crossover passage between circuits. This will cause improper operation of ball nut.***

3. Place upper bearing on shaft. Center ball nut on worm, then slide steering shaft, bearing and nut into housing.

4. Install worm adjuster in housing. NOTE: Adjuster should be installed just tight enough to hold bearing races in place. Final adjustment will be made later.

5. Install pitman shaft adjusting screw and selective shim in pitman shaft (Fig. 9-18). NOTE: Screw must be free to turn, but have no more than .002" end play. If end play of screw in slot is too tight or too loose, select new shim to give proper clearance. Shims are furnished in four thicknesses: .063", .065", .067", and .069".

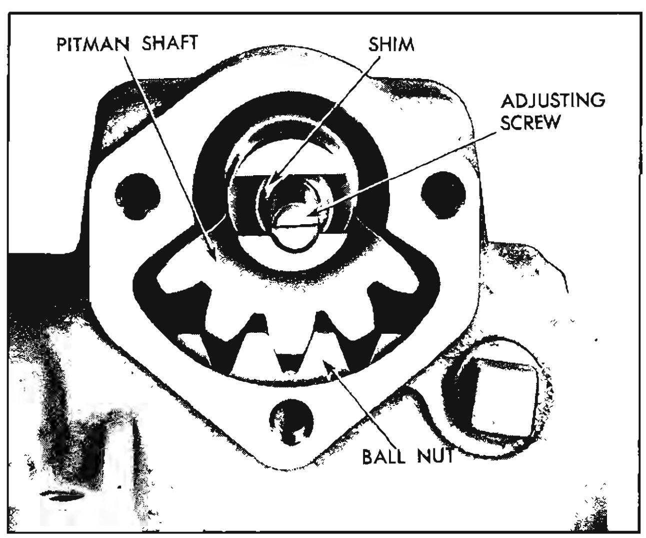



Fig. 9-28 Adjusting Worm Bearing Preload

6. Install pitman shaft and adjusting screw with sector and ball nut teeth positioned as shown in Fig. 9-28.

7. Install side cover and gasket on adjusting screw, turning screw counterclockwise until it projects through cover 5/8" to 3/4".

8. Install three side cover attaching bolts and torque to 25-35 lb. ft.

9. Tighten pitman shaft adjusting screw so that teeth on shaft and ball nut engage but do not bind. Final adjustment will be made later.

10. Fill steering gear with all-season steering gear lubricant.

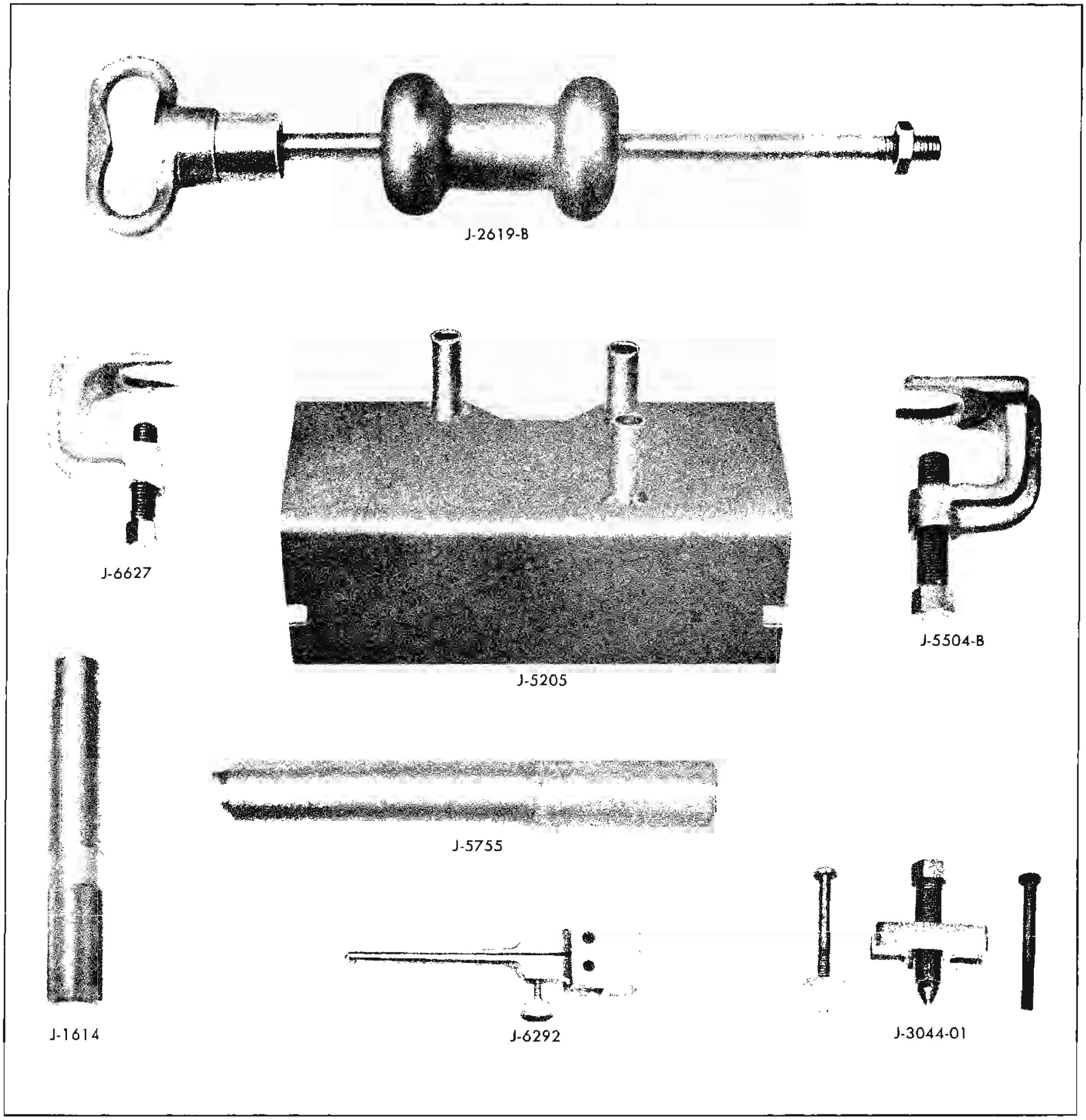
11. Place steering wheel on shaft and turn steering gear from one extreme to the opposite to make certain there are no unusual binds.

NOTE: Never allow ball nut to strike the ends of the ball races in worm, due to the possibility of damage to ball guides. Steering gear is now ready for final adjustment of worm bearing preload and sector and ball nut backlash.

12. Adjust steering gear according to procedure outlined on page 9-6.

## TORQUE SPECIFICATIONS

| | LB. FT. |
|---|---|
| Steering wheel nut | 2½ |
| Idler arm bolts and nuts | 48-62 |
| Pitman arm nut | 100-125 |
| Tie-rod end to steering arm nut | 60-95 |
| Pitman arm, and tie-rod ends to steering linkage retaining nuts | 50 |
| Idler arm bushing | 110-115 |
| Steering column jacket lower clamp nut | 4-5 |
| Steering column jacket upper clamp bolts | 4-5 |
| Worm bearing adjuster screw lock nut | 70-100 |
| Pitman shaft adjusting screw lock nut | 18-27 |
| Steering gear to side rail bolts | 70-90 |
| Side cover attaching bolts | 25-35 |




| | | | |
|---|---|---|---|
| J-2619-B | Slide Hammer | J-1614 | Pitman Shaft Bushing Remover and Replacer |
| J-6627 | Ball Stud Remover | J-5755 | Steering Shaft Worm Bearing Cup Installer |
| J-5205 | Steering Gear Holding Fixture | J-3044-01 | Steering Wheel Puller |
| J-5504-B | Pitman Arm Puller | J-6292 | Steering Shaft Worm Bearing Cup Remover |

Fig. 9-29 Special Tools

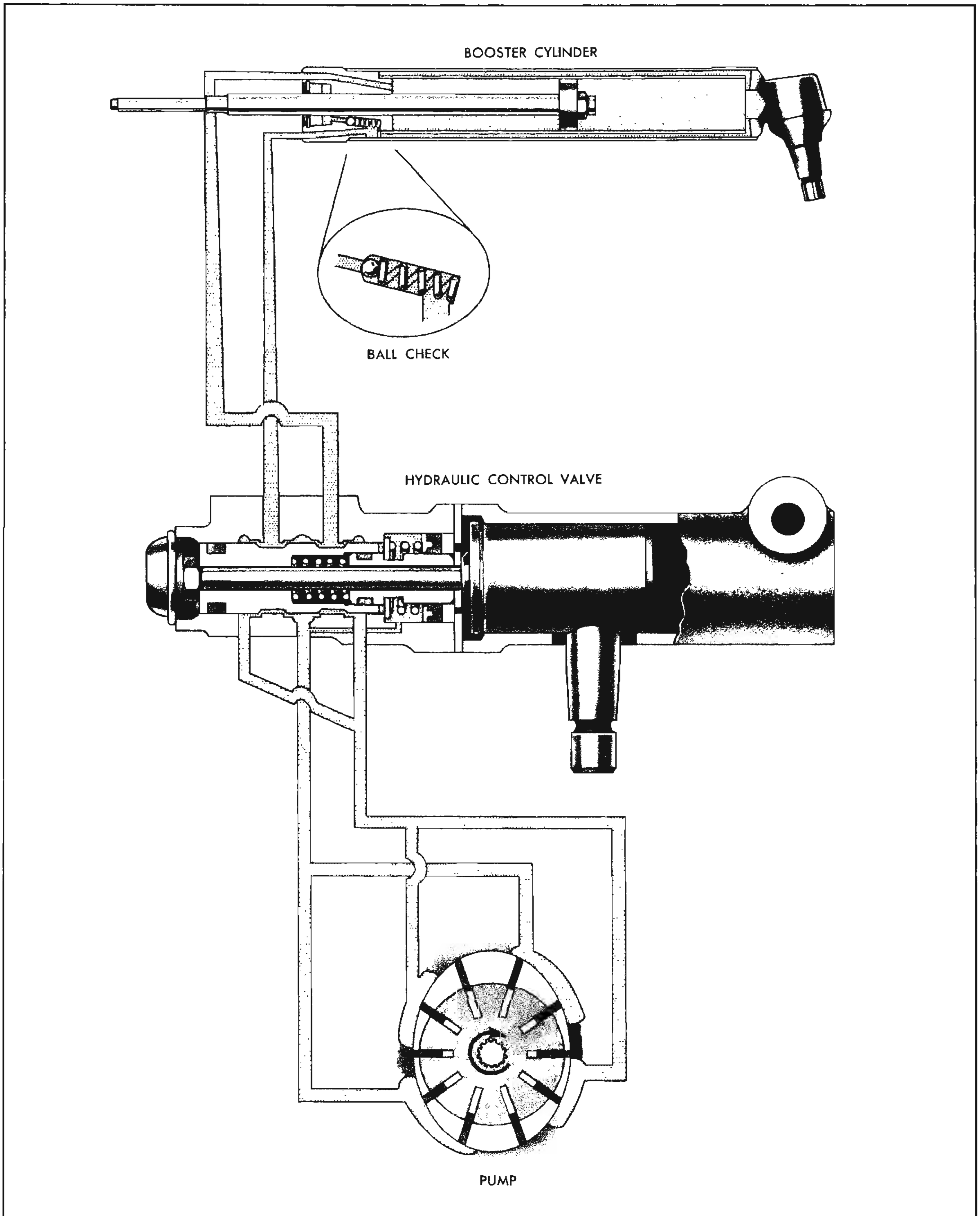



Fig. 9A-1 Power Steering System

# POWER STEERING

CONTENTS OF THIS SECTION



## POWER STEERING SYSTEM

### DESCRIPTION

The hydraulic power steering system consists of a pulley driven vane type pump, an oil reservoir which is part of the pump assembly, a double-acting hydraulic power booster cylinder, and a hydraulic control valve (Fig. 9A-1).

The power steering pump is the source of hydraulic power which assists the driver in steering the car. It is pulley driven by means of the crankshaft pulley.

The hydraulic power booster cylinder converts hydraulic power into mechanical output. The cylinder is double acting which permits it to drive the steering linkage in either direction as desired by the driver when he turns the steering wheel.

The hydraulic control valve ports oil to the power cylinder according to the direction the steering wheel is turned. It is an open center valve which permits oil to be routed back to the reservoir when the system is not assisting the driver in steering. When the steering wheel is turned and steering assistance is necessary, the valve ports pressure oil to the cylinder according to the assistance required.

## POWER STEERING VANE TYPE PUMP

### DESCRIPTION

The power steering pump has an outlet capacity of 1.25 gallons per minute at idle. It is mounted on the engine and driven by a belt from the crankshaft harmonic balancer.

The component parts of the power steering pump are encased in a reservoir (Fig. 9A-2) filled with oil, which is used for the control valve (valve and adapter assembly) and the booster cylinder. The reservoir has a filler neck with a cap and is fastened to the pump housing. Only the housing face and shaft hub are exposed.

A pump housing within the reservoir houses a babbitt bushing and a shaft seal, and has two openings from the rear side. The larger of these openings has two dowel pins in the pump inner face that hold the functional parts of the pump: the thrust plate, rotor ring (which contains the rotor and vanes) and the pressure plate. The smaller opening houses a flow control valve and spring.

#### *THRUST PLATE*

The thrust plate is located adjacent to the inner

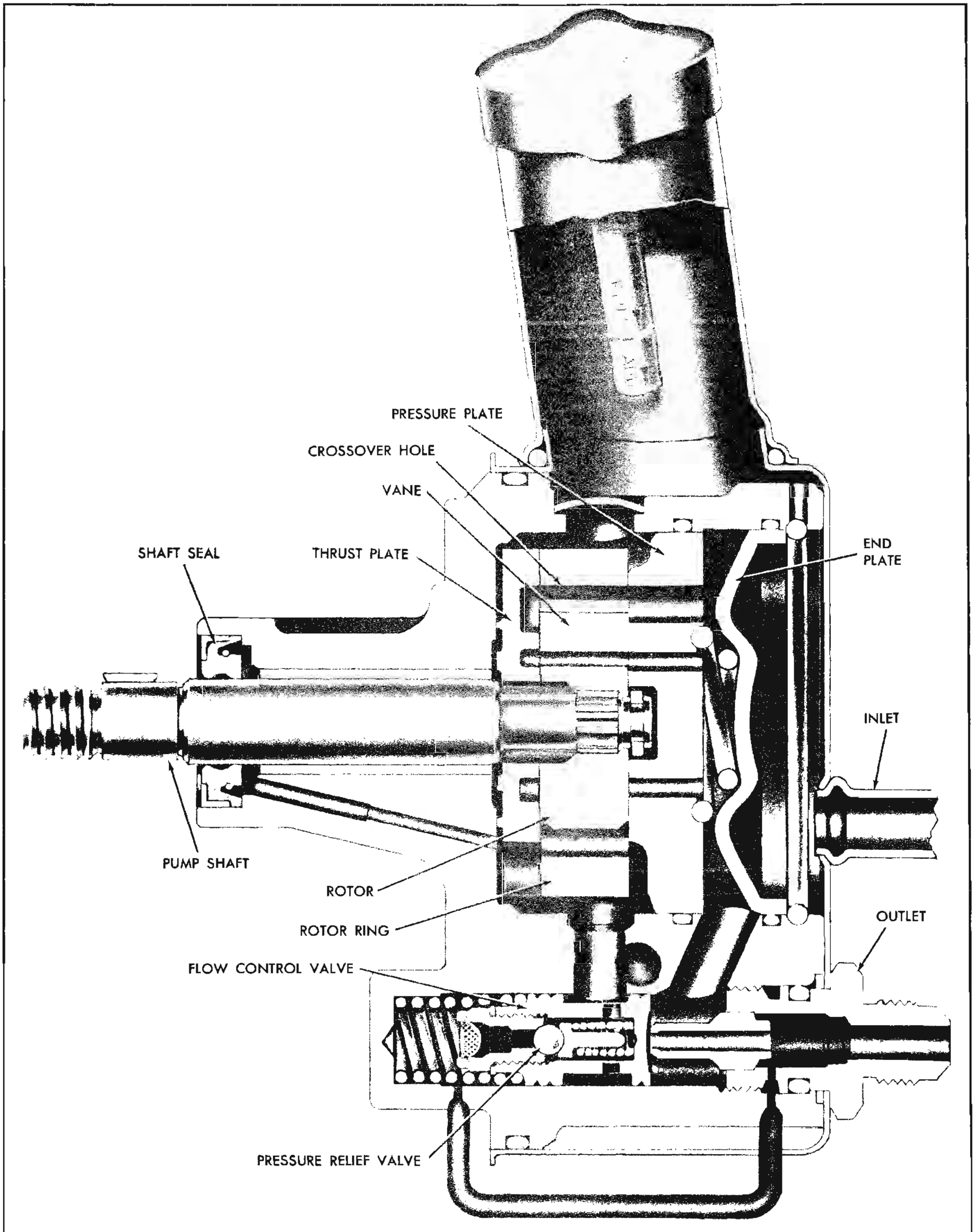



Fig. 9A-2 Power Steering Pump

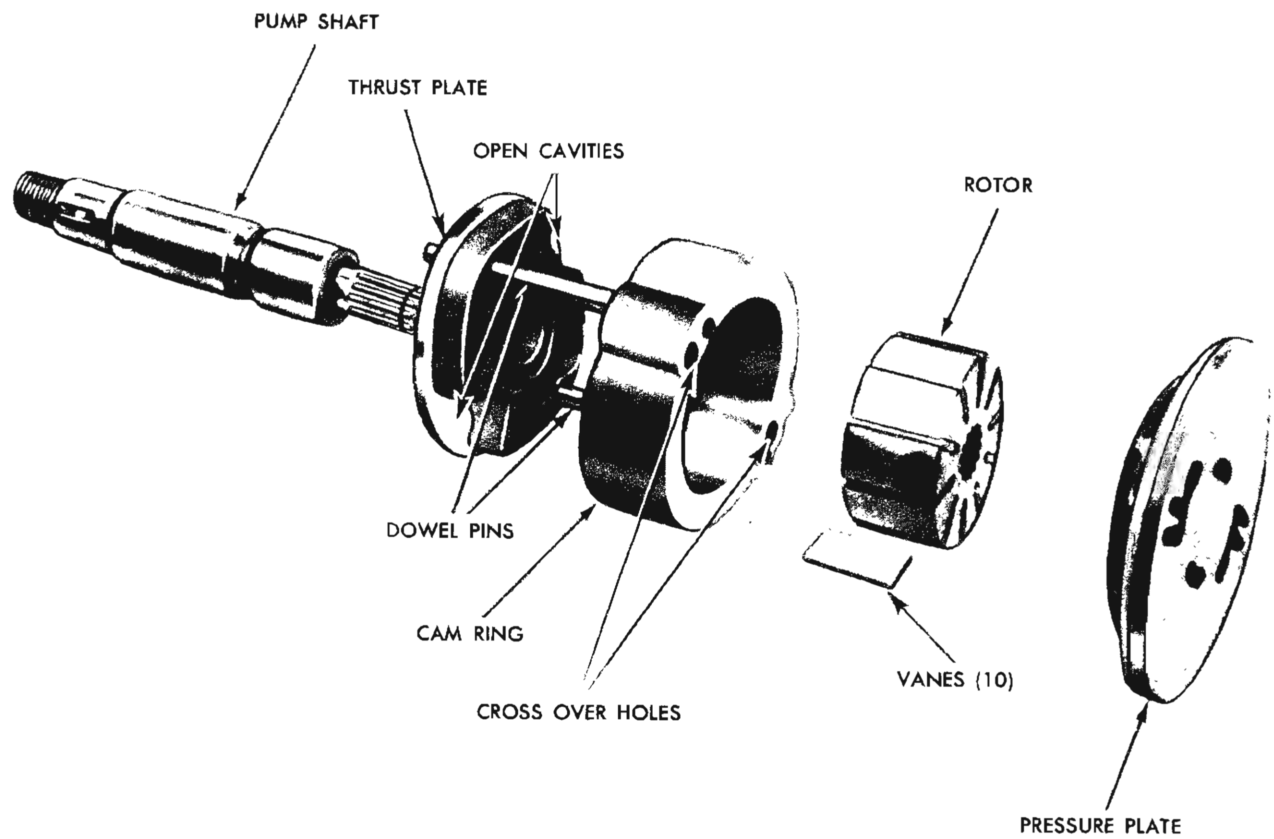



Fig. 9A-3 Power Steering Pump Components

face of the pump housing. One side of the thrust plate performs the function of taking the rearward shaft thrust. The other side consists of six crescent or kidney shaped cavities and two openings at the plate sides and opposite each other (Fig. 9A-3).

Four of the crescent shaped cavities are located around the drive shaft hole (but are not connected with each other) and are for undervane oil pressure. The other two cavities are for discharging the oil under pressure into a high pressure area that provides oil for the control valve and the booster cylinder. These two cavities are in line with the two crossover holes in the pump ring which feed high pressure (discharging) oil through the pressure plate into the high pressure area to provide oil requirements as called for by the control valve and booster cylinder.

The two openings diametrically opposite from each other, are for intake of oil from the suction part of the pump.

#### *PUMP RING*

The pump ring is a flat plate with a cam surface center opening. This ring encompasses the rotor and vanes and is located adjacent to the face of the thrust plate on the same two dowel pins that retain the thrust plate. The rotor is loosely splined to the pump drive shaft and turns with the shaft. Ten slots for vanes are evenly spaced around the rotor and extend from the rotor outer diameter inward to the center approximately $\frac{13}{32}$″ deep.

#### *PRESSURE PLATE*

The pressure plate contains six holes that extend through the plate and two cavities. Four of the holes around the drive shaft hole are connected to high pressure oil. This oil is used to supply oil pressure to the vanes to insure their following the cam surface in the pump ring. The other two holes are for discharging the oil under pressure to the high pressure area for control valve and booster cylinder use.

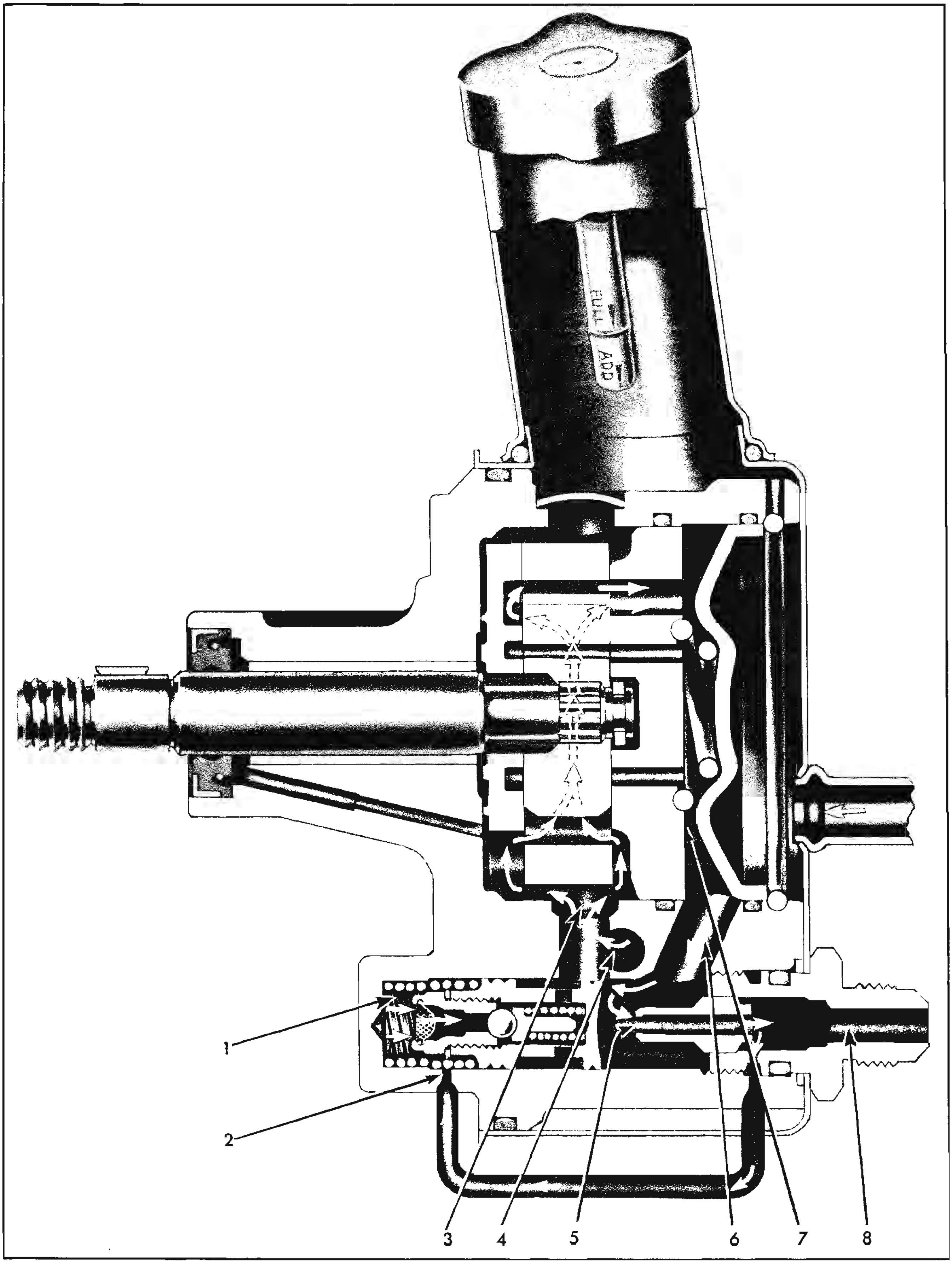



Fig. 9A-4 Oil Flow—Low Speed or Partial Turn

The two cavities are radially open to the suction part of the pump and intake oil flows through these openings.

### RESERVOIR

The reservoir is an oil storage space and provides a means of directing the return oil back to the pump.

### DRIVE SHAFT

The pump drive shaft is belt-driven by the crankshaft harmonic balancer and extends through all the major parts mentioned above except the pressure plate. The pump shaft rotates at a pump to engine ratio of 1.24.

## OPERATION

### FILLING THE PUMP AND SYSTEM (FIG. 9A-4)

When the pump, control valve, and booster cylinder are completely void of oil, adding oil to the reservoir will completely envelop the pump housing assembly which is inside the reservoir. The weight of the oil will cause it to flow through a drilled passage in the lower portion of the housing (4) and to another drilled hole leading to a groove around the rotor ring (3). This tends to fill this area and also the two "openings" on the surface of the thrust plate. Oil fills the lower openings in the thrust plate to feed the rising portion of the rotor ring. Some air is forced out of the pump through openings and clearances of parts in the pump housing.

Since the rotor is splined to the drive shaft, it turns with the shaft and the vanes follow the cam surface machined in the pump ring. The cam is designed with two vane rising and two falling areas and, therefore, causes a complete pumping cycle to occur every 180 degrees of pump drive shaft rotation. Centrifugal force throws the vanes against the ring to pick up a little oil to be forced into the high pressure area.

Some oil will leak along the pump drive shaft to the shaft seal and to the area behind the thrust plate (via drilled passages in the housing). As more and more oil is picked up by the vanes, more oil will be forced into the cavities of the thrust plate. From here it will flow through the two crossover holes in the rotor ring and the pressure plate, and empty into the high pressure area of the pump, between the pressure plate and the housing end plate (7).

As the high pressure area fills, some oil returns through two holes drilled through the crescent shaped slots in the pressure plate. It is directed behind the vanes to force them to follow the cam surface of the pump ring. Eventually most of the air will be bled from the pump and displaced by oil.

The control valve and booster cylinder may be filled by turning through full right and left turns a few times.

### OIL FLOW—LOW SPEED OR PARTIAL TURN (FIG. 9A-4)

From the high pressure chamber, the oil flows through a drilled passage (6) leading to a passage drilled through the outlet union (5). Oil is directed to the control valve through this outlet union (8). The outlet union passage also connects to the area that houses the flow control valve spring. The connecting passage is drilled in the housing and is directed to a pressure sensing orifice (2) which leads to the spring chamber behind the flow control valve (1).

Oil to the control valve is supplied until all air has been forced out of the control valve and booster cylinder via the pump return line.

When the quantity of oil displaced by the pump exceeds the predetermined steering system requirements a pressure drop occurs and oil flows through the outlet union passage. This pressure drop is communicated to the flow control valve spring chamber. With this pressure opposing the high pressure on the face of the flow control valve and outlet union, the valve opens slightly to provide oil pressure control or relief. The external surface still allows some oil to flow through the system.

### OIL FLOW—HIGH SPEED, NO TURN, STRAIGHT AHEAD (FIG. 9A-5)

When operating at moderate and high speeds it is desirable to keep oil flow to a minimum in order to limit temperature rise. Therefore, the flow control valve opens wider (due to increased oil pressure) to allow more oil to be by-passed within the pump.

The pressure unbalance between the valve spring chamber and the outlet union increases as the engine speed increases. The greater pressure on the outlet union side then pushes the flow control valve back further to open the by-pass hole wider, thereby diverting more oil into the intake chamber (3). Supercharging of the intake chamber occurs under these conditions. Oil at high velocity discharging past the valve into the intake chamber picks up make-up oil from the reservoir on the jet pump principle. Then by reduction of velocity, velocity energy is converted into supercharge pressure.

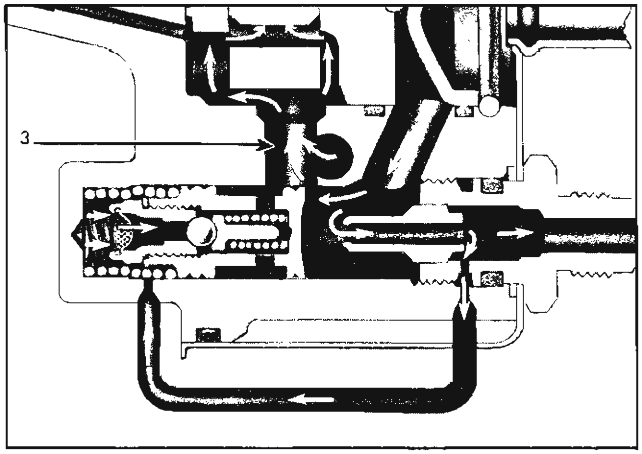



Fig. 9A-5 Oil Flow—High Speed, No Turn, Straight Ahead

#### *OIL FLOW—TURN AGAINST RESISTANCE (FIG. 9A-6)*

During a turn, resistance is offered to the pitman shaft and rack-piston nut, and extends to the pump high pressure chamber. It also extends through the pressure sensing orifice to the flow control valve spring chamber. Pressure in the chamber continues to build up until it overcomes the opposing spring pressure on the ball check in the flow control valve. If this pressure is slight, the ball check is sufficient to bleed off any excess pressure.

When the pressure is high, the flow control valve spring chamber pressure reduces below the opposing high pressure on the face of the outlet union and flow control valve plunger. The valve opens wide to provide oil pressure control for the control valve and booster cylinder. Oil flows through the passage leading to the suction or intake part of the pump.

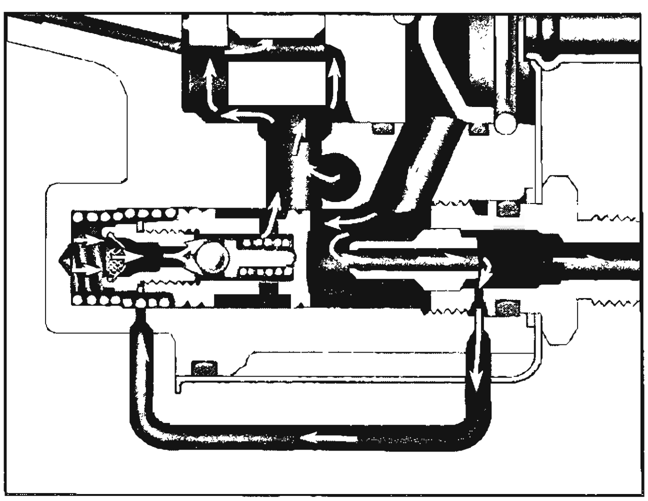


Fig. 9A-6 Oil Flow—Turn Against Resistance

Supercharging occurs when pressure oil in the area around the outlet union and flow control valve plunger discharges into the suction passage at high velocity.

## REPLACE POWER STEERING PUMP

#### *REMOVE*

1. Drain power steering by removing inlet hose.
2. Disconnect outlet hose and connector (Fig. 9A-7).
3. Remove pulley nut.
4. Loosen generator to bracket adjusting bolt (4 cylinder engine) or remove power steering pump to bracket adjusting bolt (V-8 engine).
5. Remove belt from pump pulley and remove pulley.
6. Remove rear pump to bracket nut (Fig. 9A-7).
7. Remove bolts (4 cylinder engine) securing pump to bracket or lower bracket retaining bolt (V-8 engine) and remove pump from car.

#### *INSTALL*

1. Install pump on bracket and torque nuts or bolts to 25-35 lb. ft.
2. Secure pump to rear bracket and torque nut to 20-35 lb. ft.
3. Install pulley on pump.
4. Install lower bracket retaining bolt (V-8 engine).
5. Install belt on pump pulley and adjust as outlined in table in Section 6A. Torque pump to bracket adjusting nut or alternator to bracket adjusting bolt to 20-35 lb. ft.
6. Torque lower bracket retaining bolt to 20-35 lb. ft. torque.
7. Torque pulley nut to 70-85 lb. ft.
8. Connect outlet and inlet hoses.
9. Fill pump with Hydra-Matic fluid, run pump at 1000 rpm for 30 seconds.
10. Refill pump before turning steering wheel.
11. Bleed system after filling pump reservoir by running pump and turning steering wheel through entire travel to expel air.
12. Check oil level.

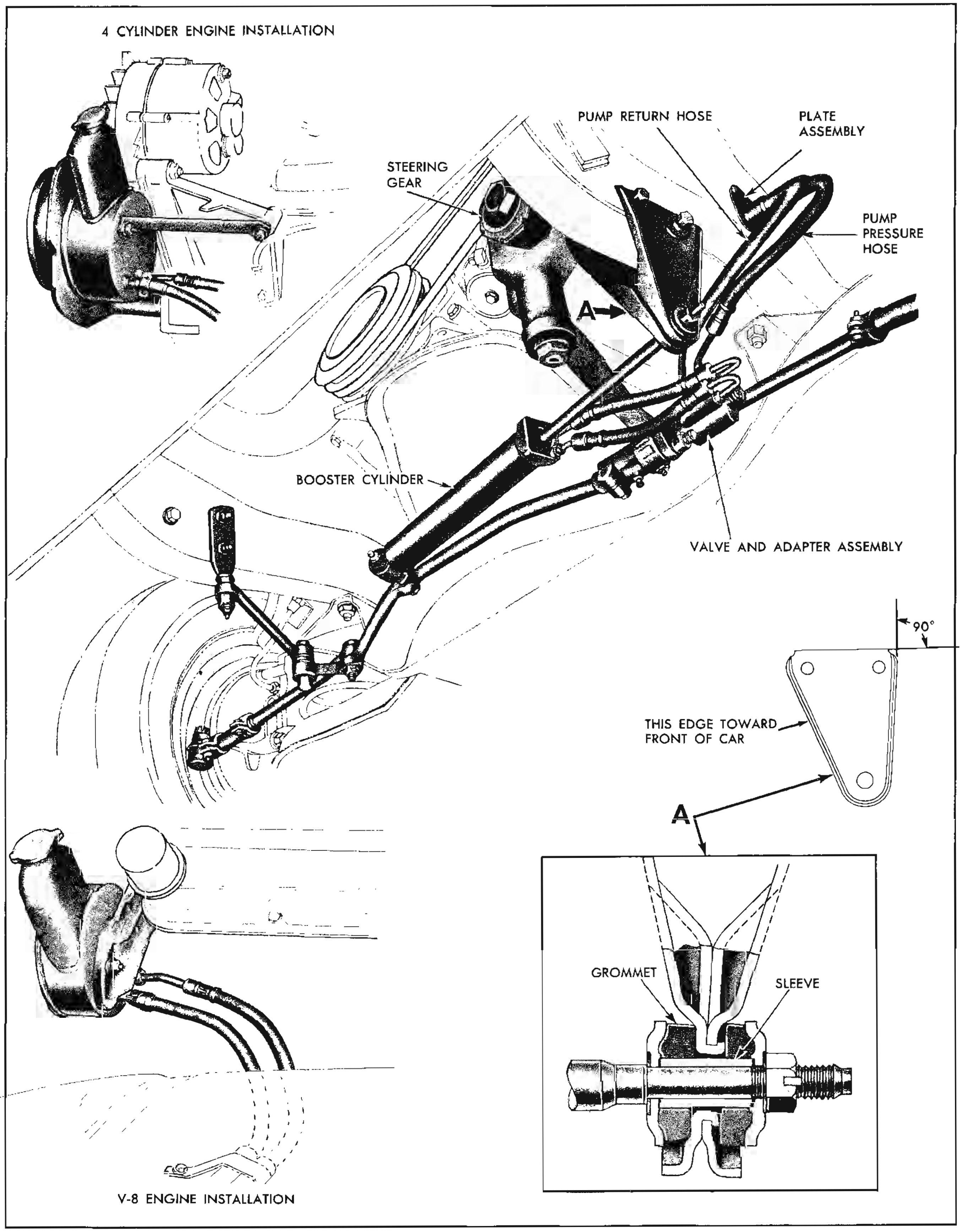



Fig. 9A-7 Power Steering Installation

13. Test for leaks in system with front wheels beside obstruction to prevent turning gear to limit. Apply 3 to 8 lb. load at rim of steering wheel, with engine running at 1000-1200 rpm to obtain maximum operating pressure.

14. Check hoses and fittings for leaks.

15. Fill reservoir to oil level full, as indicated on pump dip stick.

16. If oil is still foamy, allow vehicle to stand a few minutes with the engine off and repeat bleeding.

If bracket is removed, torque all bolts when re-installing to 20-35 lb. ft.

## PERIODIC SERVICE

See General Lubrication section.

## STEERING LINKAGE

### *REMOVE*

1. Raise car.

2. Disconnect valve and adapter assembly inlet and outlet lines.

3. Remove booster cylinder shaft nut, spacer, and grommet and remove shaft from support bracket by pushing shaft into cylinder.

4. Remove cotter pin and nut and remove tie-rod end stud from steering arm at each front wheel with tool J-6627.

5. Remove nut and lock washer and remove pitman arm from pitman arm shaft with tool J-5504-B.

6. Remove idler arm nuts and remove idler arm and steering linkage from car.

### *INSTALL*

1. Install idler arm and steering linkage into car, securing idler arm with bolts, lock washers and nuts. Tighten to 20-30 lb. ft. torque.

2. Install pitman arm on pitman shaft. Make sure steering gear is at high point with wheels straight ahead before installing arm on shaft.

3. Install pitman arm lock washer and nut. Torque to 100-125 lb. ft.

4. Install tie-rod end into steering arm at each front wheel and torque nut to 60-95 lb. ft. Install cotter pin.

5. With retainer grommet and spacer on shaft, install booster cylinder shaft into bracket. Install grommet retainer and nut. Torque nut to 18-30 lb. ft. and install cotter pin.

6. Connect valve and adapter assembly inlet and outlet hoses.

## STEERING LINKAGE

### *DISASSEMBLE*

1. Thread idler support from bushing, then idler arm from bushing.

2. Tie-rod ends, idler arm, and booster cylinder may be disconnected from steering linkage by removing cotter pins and nuts and using Tool J-6627. Use Tool J-5504-B to disconnect pitman arm from pitman shaft.

3. Unscrew valve and adapter assembly from steering linkage after loosening retaining bolt.

### *ASSEMBLE*

1. Thread valve and adapter assembly onto steering linkage and tighten retaining bolt to 12-15 lb. ft. torque.

2. Connect booster cylinder, pitman arm, idler arm, and tie rod ends to steering linkage and torque nuts to 50 lb. ft. NOTE: Do not back off nuts to insert cotter pins.

3. Thread idler arm onto bushing, then idler support onto bushing. Torque bushing to 110-115 lb. ft. NOTE: Distance between idler arm support lower mounting bolt hole center line and top of arm should be 2.27".

## DISASSEMBLE

***CAUTION: In clamping pump in vise, be careful not to exert excessive force on front hub of pump as this may distort the bushing.***

1. Remove union and seal.

2. Remove pump rear mounting bolts.

3. Lift reservoir from housing by tapping reservoir at flange, rocking back and forth.

4. Remove mounting bolt and union "O" rings.

5. Remove end plate retaining ring. Push end plate retaining ring out of groove using a punch through 1/8" diameter hole in pump housing (Fig. 9A-8), and remove with screwdriver. End of retaining ring should be next to hole to ease removal.

6. Remove end plate and spring. End plate is spring-loaded and will generally sit above the housing

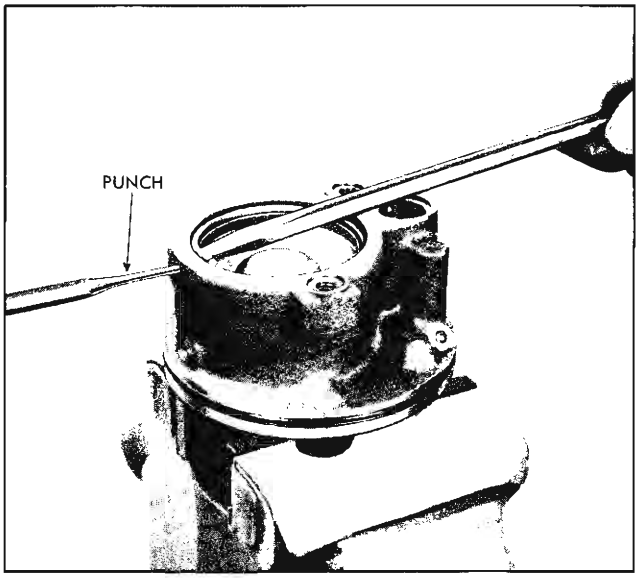



Fig. 9A-8 Removing Retaining Ring

level. If sticking should occur, a slight tapping action will free the plate (Fig. 9A-9).

7. Remove end plate "O" ring.

8. With pump housing turned over remove flow control valve and spring (Fig. 9A-10) and tap housing on wood block until pressure plate falls free (Fig. 9A-11).

9. Remove pressure plate, pump ring and vanes, being careful not to drop parts (Fig. 9A-12).

10. Remount housing in vise. Using a suitable tool, remove shaft retainer on end of drive shaft.

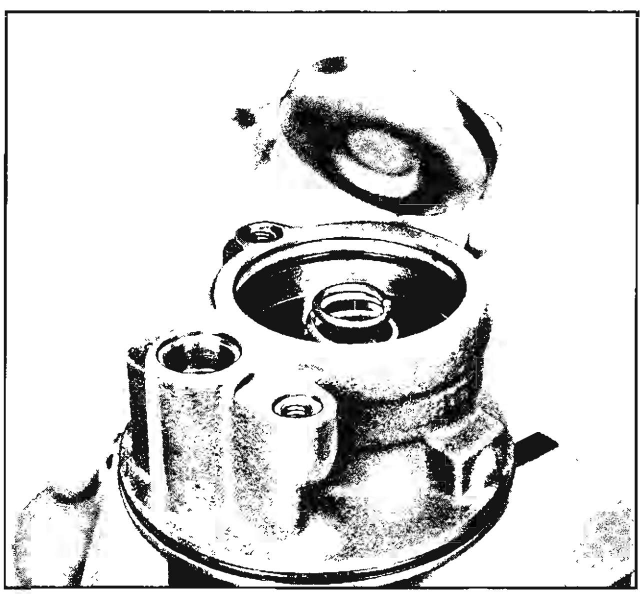


Fig. 9A-9 Removing End Plate

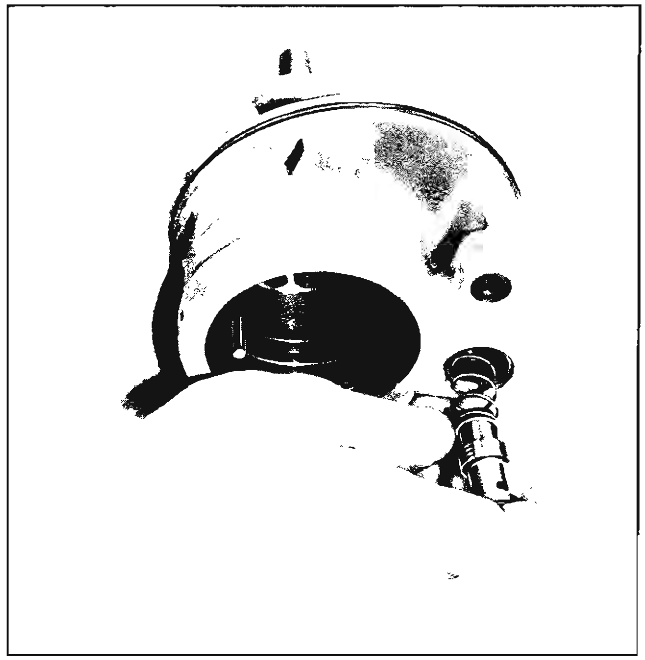


Fig. 9A-10 Removing Flow Control Valve

11. Remove rotor and thrust plate.

12. Remove shaft through front of housing (Fig. 9A-13).

## CLEAN PARTS

Carefully clean all parts, except "O" ring seals which are to be replaced and should not be immersed in cleaning solvent. Lubricate all "O" ring seals and the drive shaft seal with vaseline and install in proper location. Be sure not to immerse the drive shaft seal in the cleaning solvent as this could damage it. Fig. 9A-14 shows an exploded view of the pump.

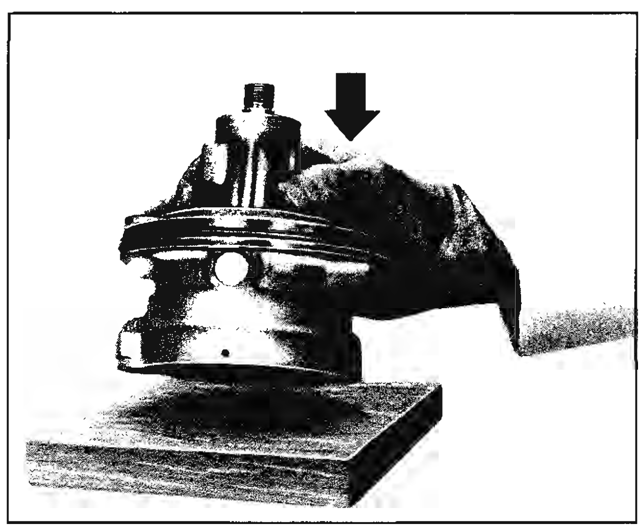


Fig. 9A-11 Removing Pressure Plate

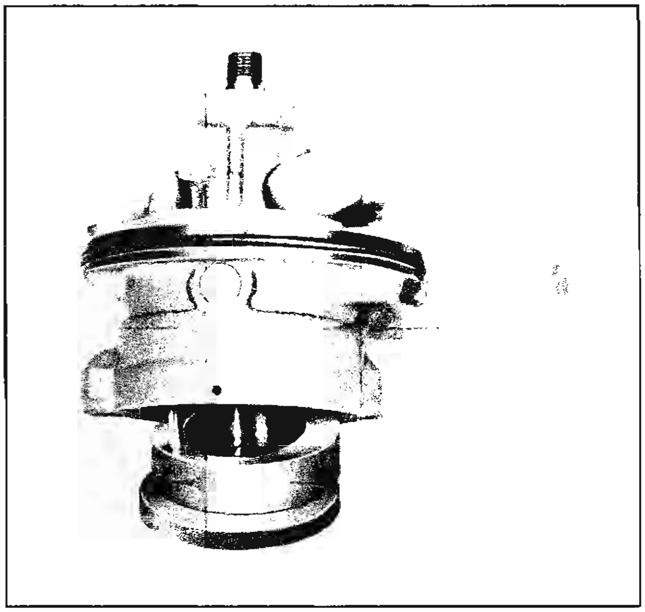


Fig. 9A-12 Pressure Plate and Rotor Ring Removed

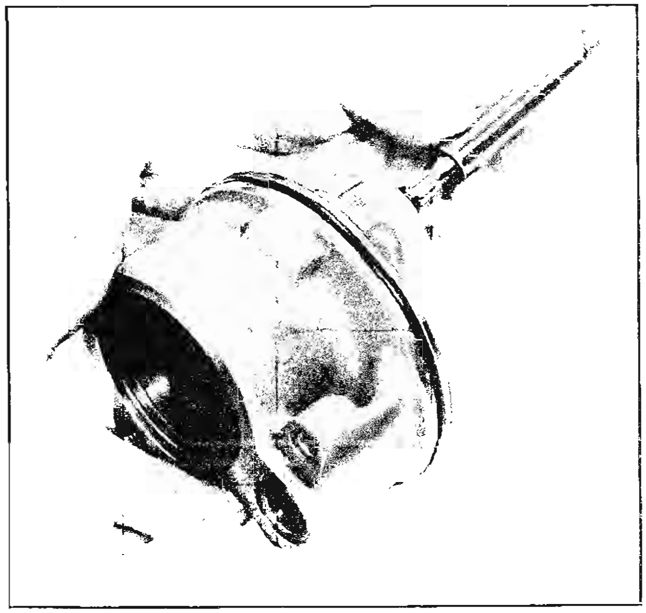


Fig. 9A-13 Removing Pump Shaft

## ASSEMBLE

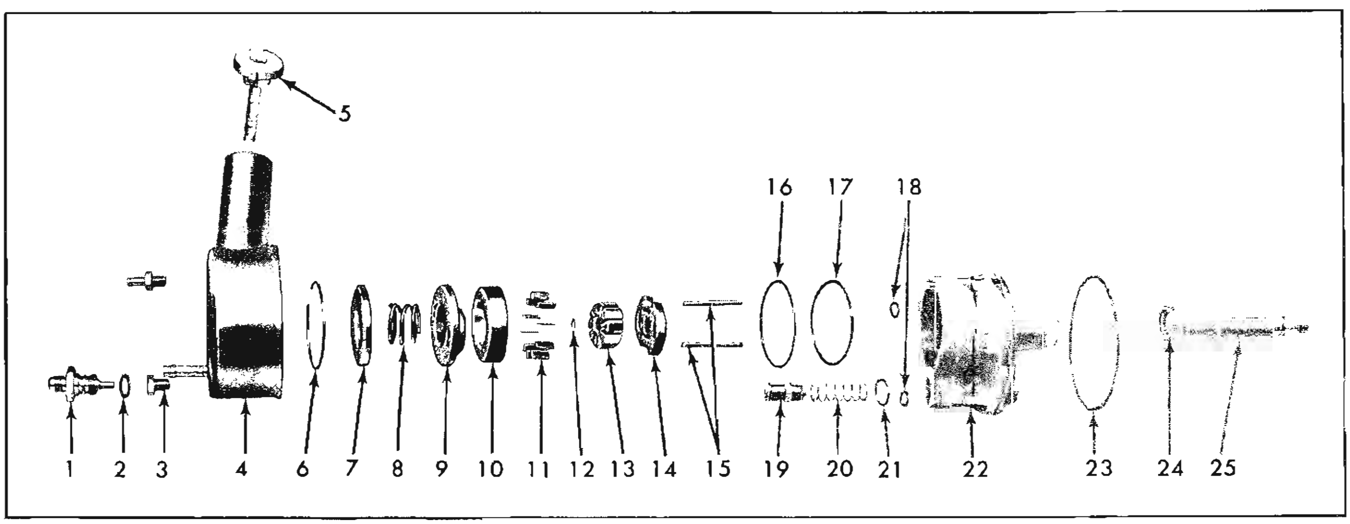
Be sure all parts are clean during reassembly.

1. Insert shaft at hub end of housing, spline end entering mounting face side (Fig 9A-15).

2. Install thrust plate on dowel pins with ported face to rear of pump housing (Fig. 9A-16).

3. Install rotor (must be free on splines) on pump shaft at splined end.

NOTE: Assemble rotor with flat side toward rear of pump (Fig. 9A-17).




1. Union
2. Seal
3. Mounting Bolts
4. Reservoir
5. Dip Stick and Cover
6. End Plate Retaining Ring
7. End Plate
8. Spring
9. Pressure Plate
10. Pump Ring
11. Vanes
12. C-Washer
13. Rotor
14. Thrust Plate
15. Dowel Pins
16. End Plate "O" Ring
17. Pressure Plate "O" Ring
18. Mounting Bolt "O" Ring Seals
19. Flow Control Valve
20. Flow Control Valve Spring
21. Flow Control Valve "O" Ring Seal
22. Pump Housing
23. Reservoir "O" Ring Seal
24. Shaft Seal
25. Drive Shaft

Fig. 9A-14 Power Steering Pump Exploded View

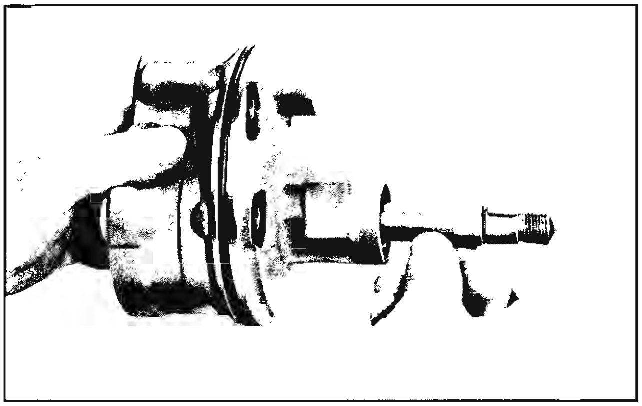


Fig. 9A-15 Installing Pump Shaft

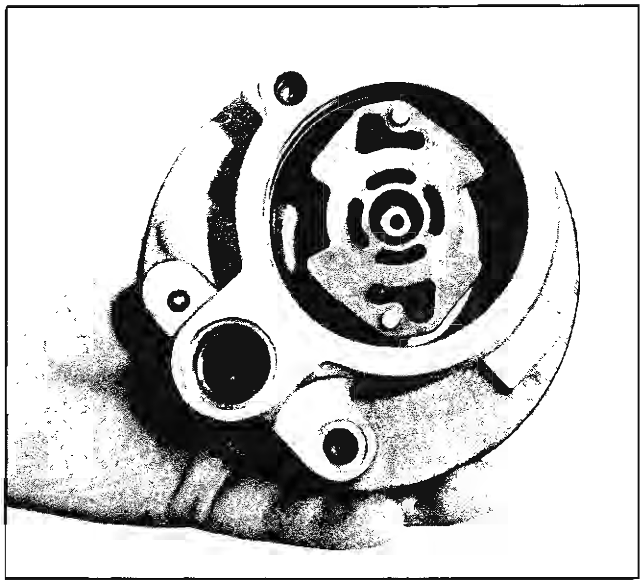


Fig. 9A-16 Thrust Plate Installed

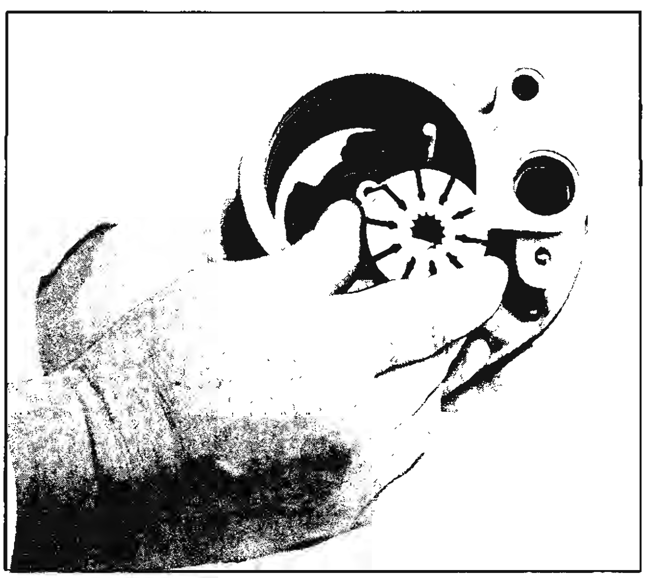


Fig. 9A-17 Installing Rotor

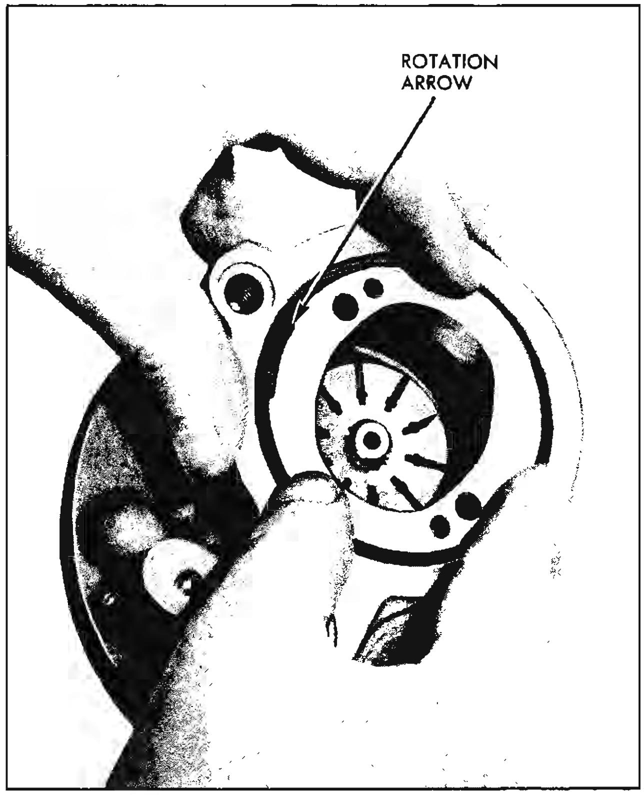



Fig. 9A-18 Installing Pump Ring

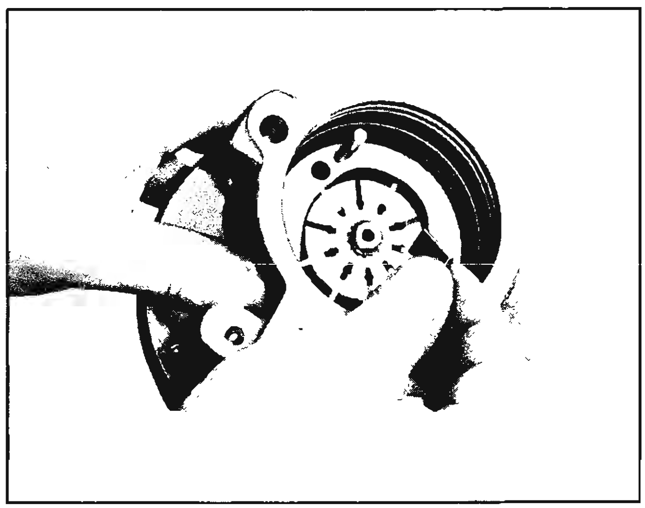


Fig. 9A-19 Installing Pump Vanes

4. Using suitable tool, install shaft retainer.

5. Install pump ring on dowel pins with rotation arrow facing to the rear of pump housing (Fig. 9A-18).

6. Install vanes in rotor slots with radius edge towards outside (Figs. 9A-19 and 9A-20).

7. Lubricate outside diameter and chamfer of pres-

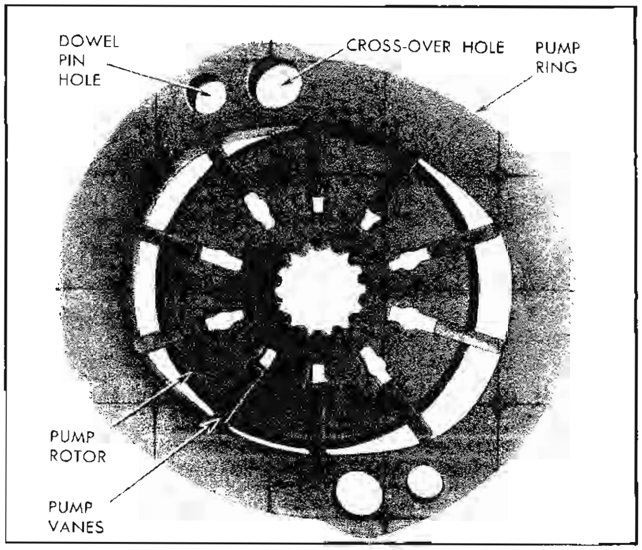



Fig. 9A-20 Pump Vanes Installed

sure plate with vaseline to insure against damaging O-ring and install on dowel pins with ported face toward the pump ring. Applying pressure to outer edge only, seat pressure plate. Never press or hammer on the center of the pressure plate as this will cause permanent distortion with resulting pump failure. (Pressure plate will travel about $\frac{1}{16}''$ to seat).

8. Install end plate "O" ring.

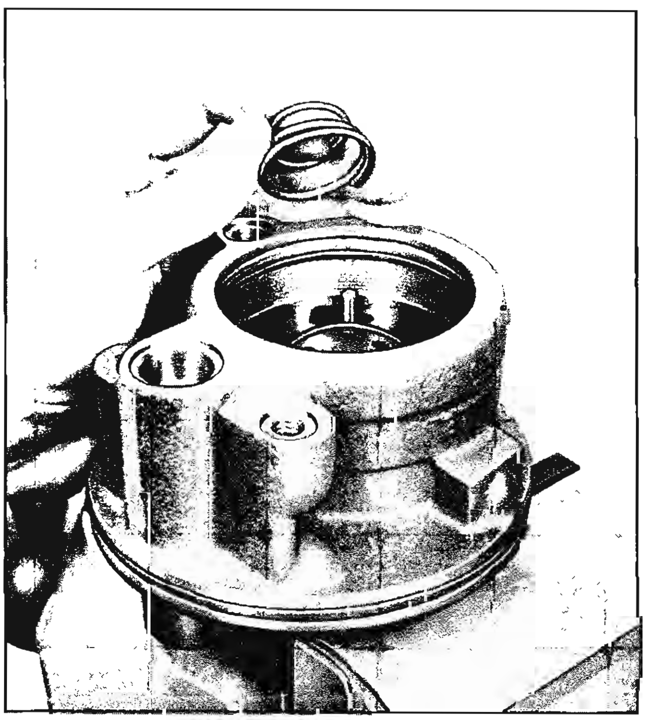


Fig. 9A-21 Installing Pressure Plate Spring

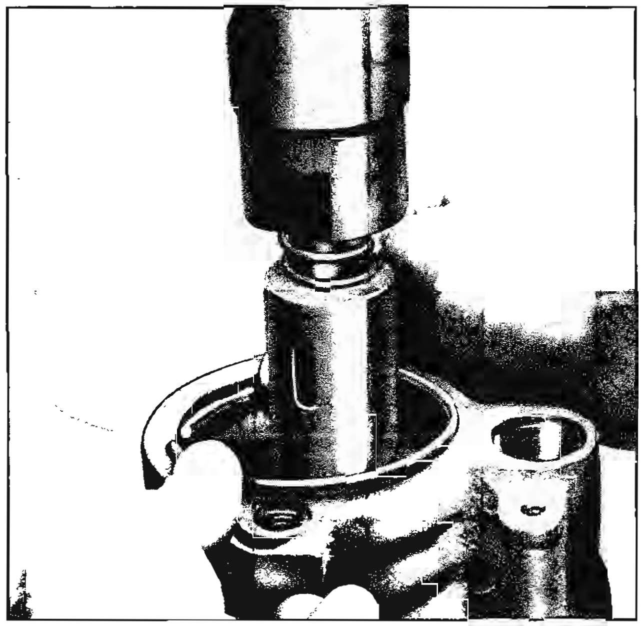


Fig. 9A-22 Installing End Plate

9. Install pressure plate spring in center groove of pressure plate (Fig. 9A-21).

10. Lubricate outside diameter of end plate with vaseline to insure against damaging "O" ring and install in housing using an arbor press.

11. Install end plate retaining ring while pump is in arbor press. Be sure it is completely seated in the groove of the housing (Fig. 9A-22).

12. Install flow control spring and flow control plunger. Be sure end with screen goes into bore first.

13. Install mounting bolt and union "O" rings.

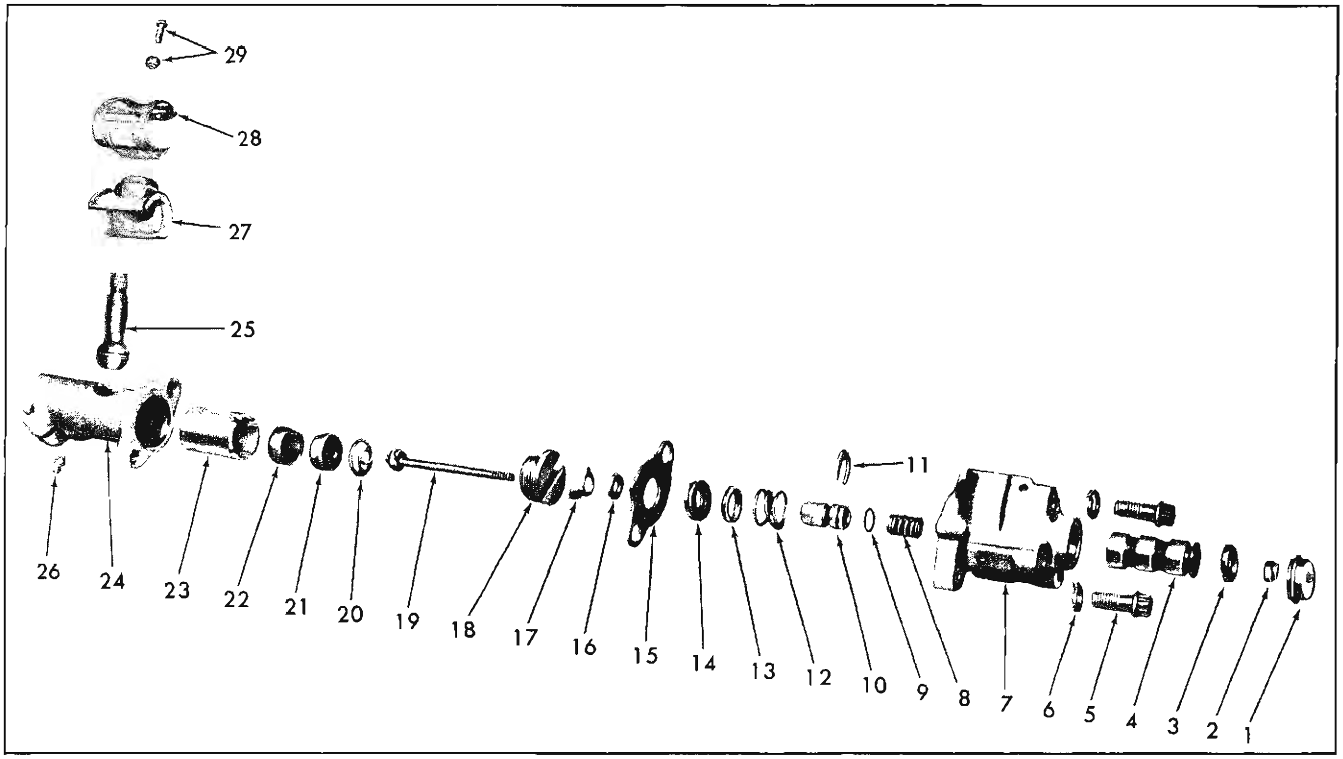
14. Drop reservoir into place and press down until reservoir seats on housing.

15. Install studs, torque to 25-35 lb. ft., and outlet union, and torque to 25-35 lb. ft. Install drive shaft key. Support the shaft on the opposite side of key when installing key.

## HYDRAULIC CONTROL VALVE

### DESCRIPTION

The hydraulic control valve consists of two major sub-assemblies, the adapter assembly and the valve assembly. The valve housing and the adapter housing are bolted together. The inner parts of the valve and the inner parts of the adapter are held together as a unit by a valve shaft (Fig. 9A-23).




1. Dust Cover
2. Adjusting Nut
3. Seal
4. Valve Spool
5. Valve Mounting Bolts
6. Lock Washer
7. Valve Housing
8. Valve Adjustment Spring
9. "O" Ring Seal
10. Valve Reaction Spool
11. Spring Thrust Washer
12. Reaction Chamber Spring
13. Spring Retainer
14. Annulus Seal
15. Annulus Spacer
16. Valve Shaft Washer
17. Plug to Sleeve Key
18. Ball Adjuster Plug
19. Valve Shaft
20. Ball Seat Spring
21. Ball Seat
22. Ball Seat
23. Sleeve Bearing
24. Adapter Housing
25. Ball Stud
26. Lube Fitting
27. Dust Shield
28. Clamp
29. Attaching Nut, Bolt

Fig. 9A-23 Hydraulic Control Valve Exploded View

The major parts of the adapter assembly are the adapter housing which is fixed to the steering linkage, the ball stud which is fixed to pitman arm, the bearing sleeve, ball seats, spring, and adjuster plug which all contribute to hold the ball stud in the adapter housing.

The major parts of the valve assembly are the valve housing which contains the four oil ports, the valve spool, reaction spool and valve adjustment spring (which act as a unit inside the adapter assembly), the reaction chamber spring which preloads the valve spool, and the three different seals which contain the oil in the valve housing.

Another part which is not part of either of the two major sub-assemblies is the adjusting nut (Fig. 9A-23). It is used to adjust the valve on the hydraulic center.

## OPERATION

The hydraulic control valve (or valve and adapter assembly) is attached to the left end of the steering linkage (Fig. 9A-7) and is actuated by the steering gear pitman arm in the following manner:

The ball stud is retained in the bearing sleeve which is an inner part of the adapter assembly. Protruding from the slot in the adjuster plug is the valve shaft. The adjuster plug is threaded into the bearing sleeve and is held from turning by a small key. The valve shaft is held in the adjuster plug and is prevented from turning by the flats on the head of the shaft (Fig. 9A-23).

The valve spool is attached to the other end of the valve shaft so that any movement of the ball stud with respect to the adapter housing is positively transmitted to the valve spool. The spool is restricted to a movement of .050" travel to the right and left from its centered position by the depth of a counterbore in the adapter housing (Fig. 9A-23) and the thickness of the flange on the adjuster plug.

The valve spool has two annular grooves which connect with three annular grooves inside of the valve housing (Fig. 9A-23). The middle annular groove in the housing connects with the pressure line from the pump. The two outside annular grooves in the housing connect with the return line to the pump.

When the spool is shifted off center, oil is restricted from passing into the outside grooves and is forced into one of the cylinder line passages in the housing. The more the spool is shifted in either direction the greater the restriction becomes and, therefore, the greater the assisting oil pressure becomes.

The valve spool is preloaded by means of the reaction chamber spring in the housing counterbore which restrains the spool from actuation. It is necessary to overcome the preload of this spring before the valve spool can be moved in either direction. When there is sufficient resistance to rotation of the pitman arm developed at the front wheels, continued turning of the hand wheel will result in movement of the valve shaft, which overcomes the preload of the spring.

### *NO TURN POSITION (FIG. 9A-24)*

In the no turn position, the valve spool is centered in the housing by the valve adjustment spring. Oil is pumped through the middle groove in the valve housing and flows through the two outside grooves which communicate with the return line to the pump.

Since the oil is not blocked at any point, there is low pressure in the system and no steering assist.

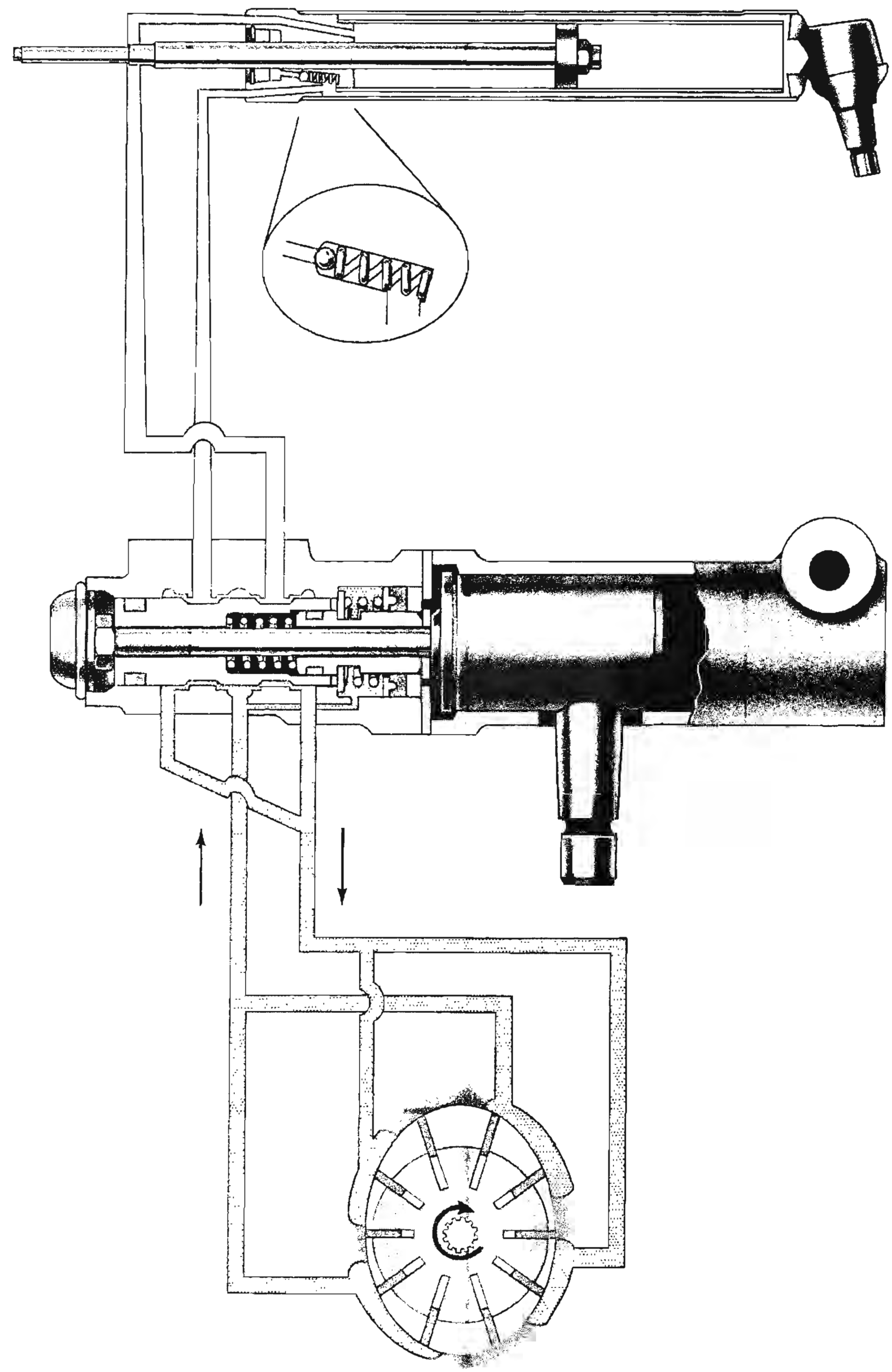


Fig. 9A-24 Operation in No Turn Position

***RIGHT TURN POSITION (FIG. 9A-25)***

When a right turn is started, movement from the steering gear pitman arm moves the ball stud, bearing sleeve, adjuster plug, valve shaft, valve spool, and valve reaction spool to the right.

Oil from the pump is cut off from the two outside grooves which communicate with the return line to the pump and the right groove to the booster cylinder.

Pressure, therefore, builds up and is communicated through the left groove which communicates with the line to the right booster cylinder chamber.

Since the pressure in the right chamber exceeds that in the left chamber, the cylinder is pushed to the right to supply the right turn assist.

Pressure in the line keeps the pressure relief valve closed. Oil forced out of the left chamber returns to the valve housing and back to the pump via the return line from the valve housing.

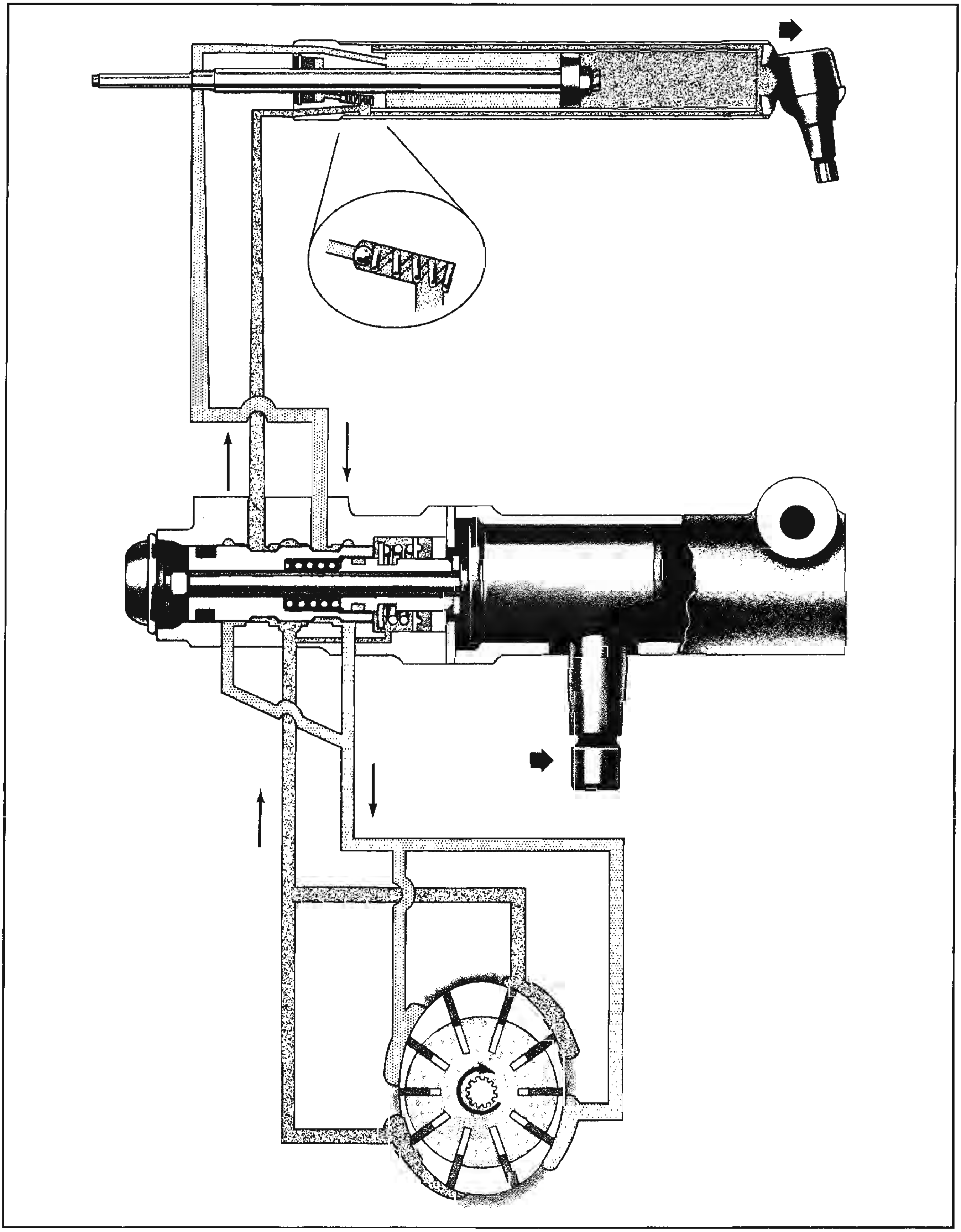


Fig. 9A-25 Operation in Right Turn Position

### LEFT TURN POSITION (FIG. 9A-26)

When a left turn is started, movement from the steering gear pitman arm moves the ball stud, bearing sleeve, adjuster plug, valve shaft, valve spool, and valve reaction spool to the left.

Oil from the pump is cut off from the two outside grooves which communicate with the return line to pump, and the left groove to the booster cylinder.

Pressure, therefore, builds up and is communicated through the right groove which communicates with the line to the left booster cylinder chamber.

Since pressure in the left chamber exceeds that in the right chamber, the cylinder is pushed to the left to supply the left turn assist.

Oil is forced out of the right chamber and returns to the valve housing and back to the pump via the return line from the valve housing.

The ball check provides an escape for oil trapped in area A, when excess pressure builds up from leak-by around shaft B.

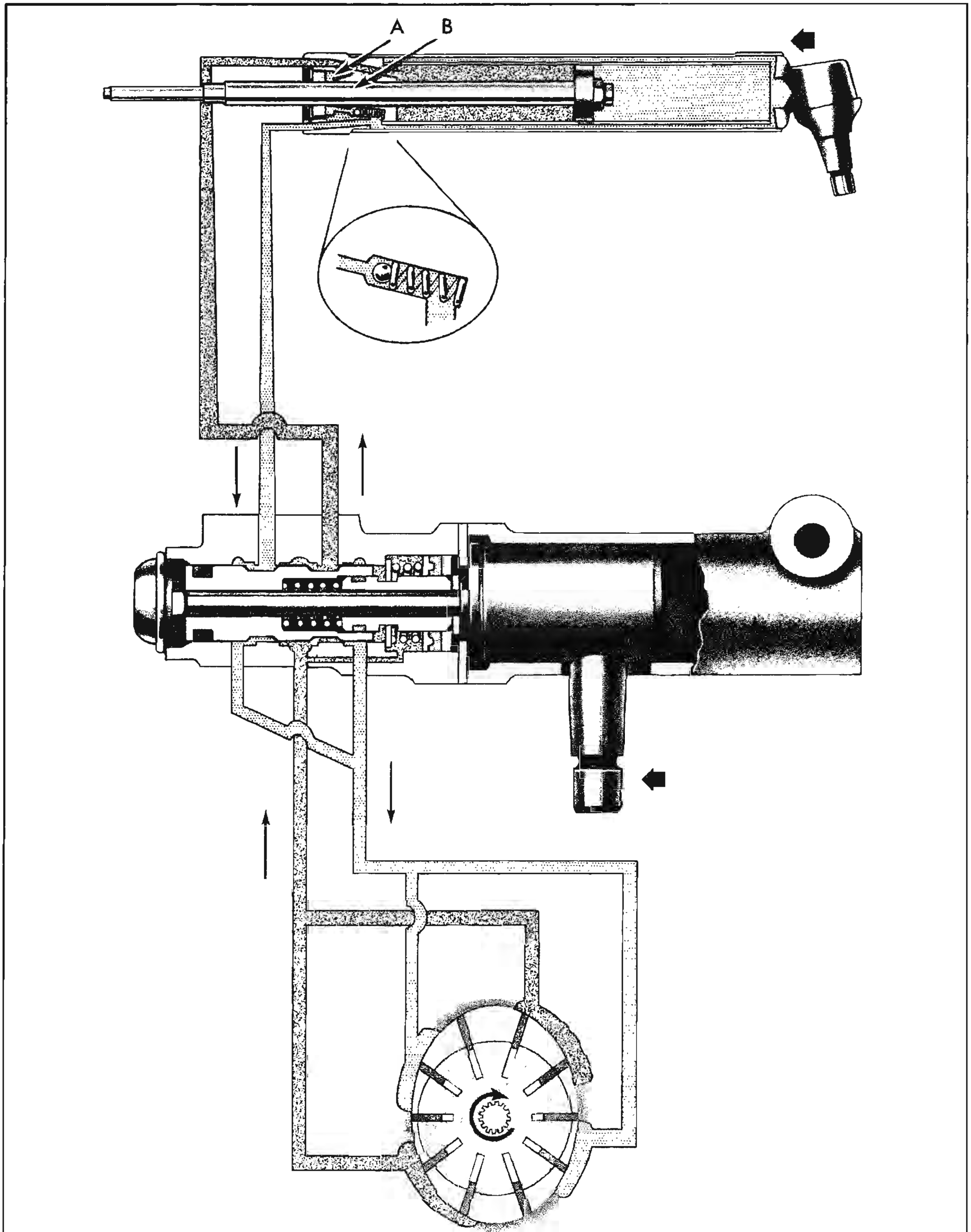



Fig. 9A-26 Operation in Left Turn Position

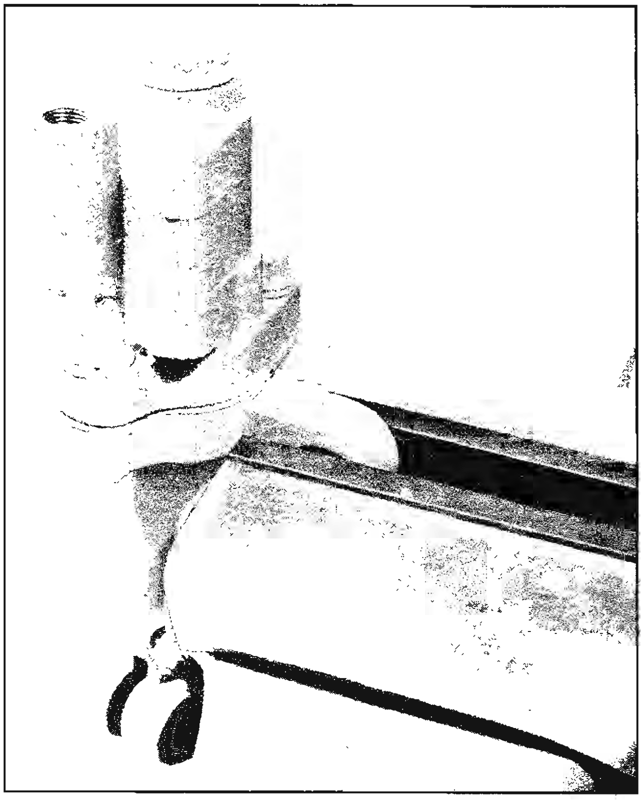


Fig. 9A-27 Holding Control Valve

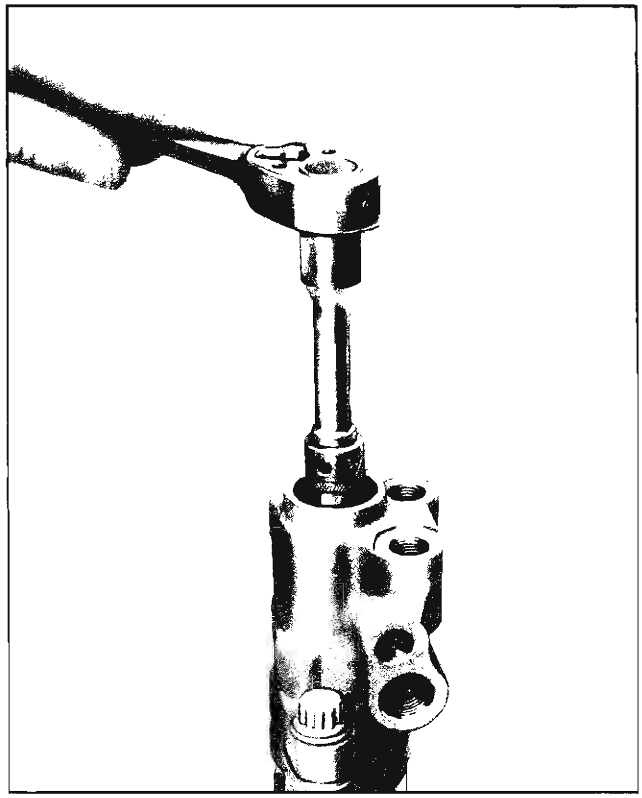


Fig. 9A-29 Removing Adjusting Nut

## DISASSEMBLE

1. Remove adapter clamp and seal and place valve in vise as shown (Fig. 9A-27) and remove dust cover (Fig. 9A-28).

2. Remove adjusting nut (Fig. 9A-29).

3. Remove valve to adapter bolts (Fig. 9A-30) and remove valve housing and spool from adapter (Fig. 9A-31).

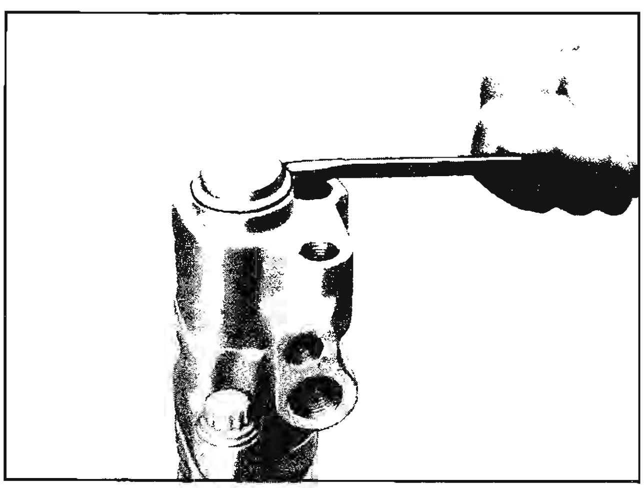


Fig. 9A-28 Removing Dust Cover

4. Remove spool from housing (Fig. 9A-32).

5. Remove spring, recation spool, washer, recation spring, spring retainer, and seal (Fig. 9A-33). "O" ring may now be removed from the reaction spool.

6. Remove the annulus spacer (Fig. 9A-34).

7. Remove valve shaft washer (Fig. 9A-35).

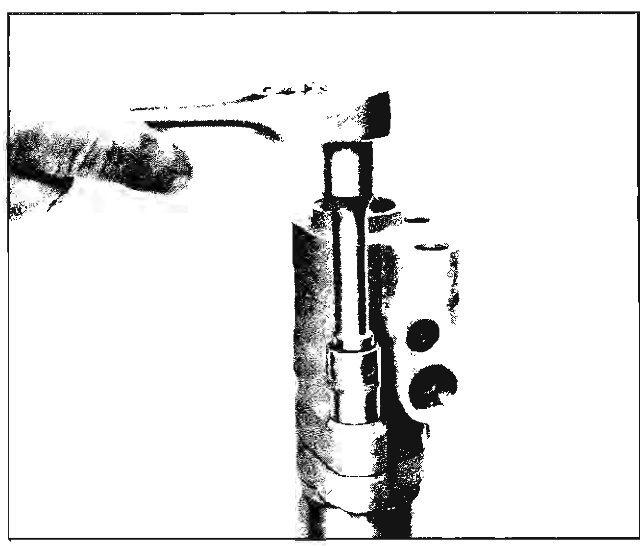


Fig. 9A-30 Removing Valve to Adapter Bolts

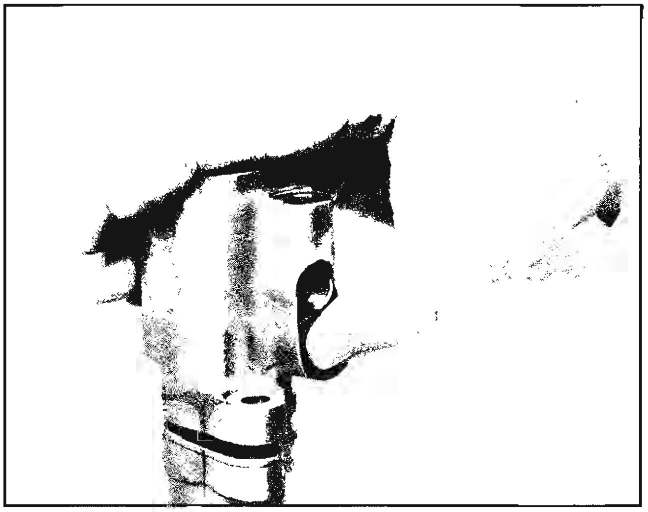


Fig. 9A-31 Removing Valve Housing and Spool

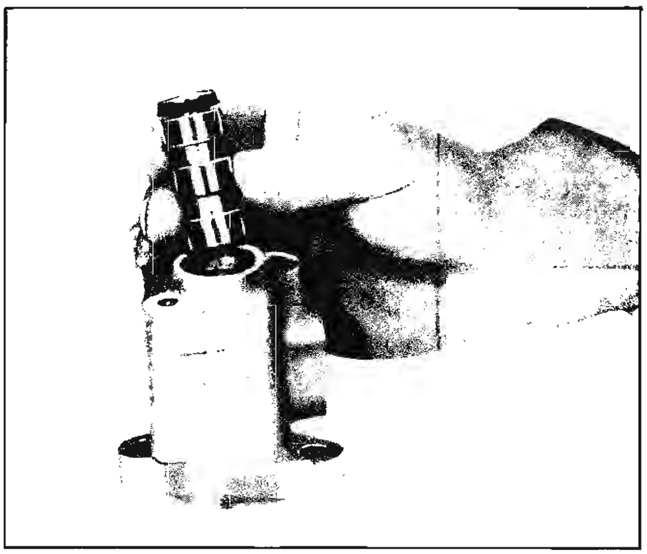


Fig. 9A-32 Removing Valve Spool

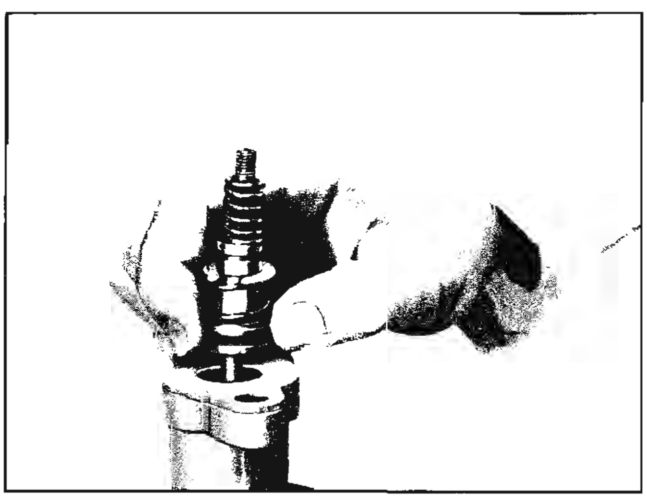


Fig. 9A-33 Removing Reaction Components

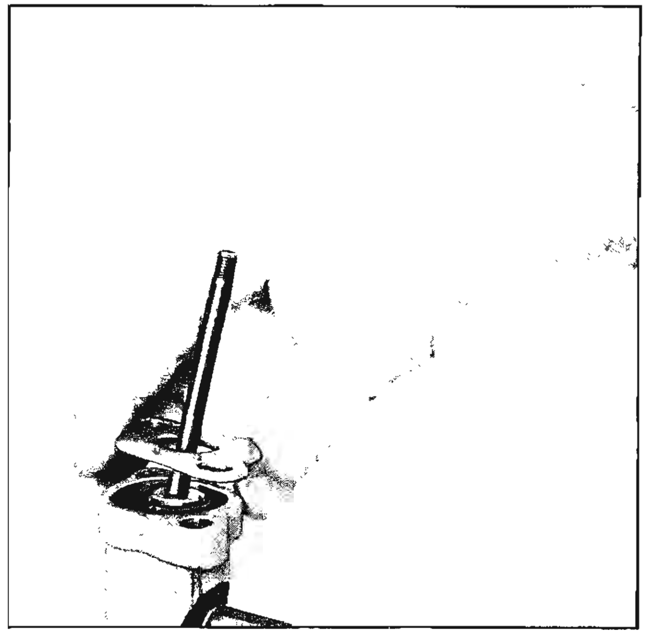


Fig. 9A-34 Removing Annulus Spacer

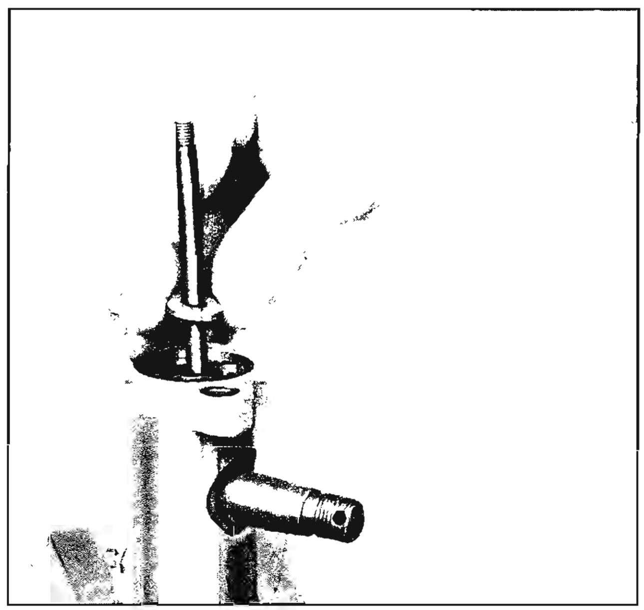


Fig. 9A-35 Removing Valve Shaft Washer

8. Remove plug to sleeve key (Fig 9A-36).

9. So as not to nick the top surface, turn adjuster plug out of sleeve carefully (Fig. 9A-37).

10. Remove the adapter from the vise and invert, permitting the spring and one of the two ball seats to fall free (Fig. 9A-38).

11. Remove the ball stud and the other ball seat and the sleeve will fall free (Fig. 9A-39).

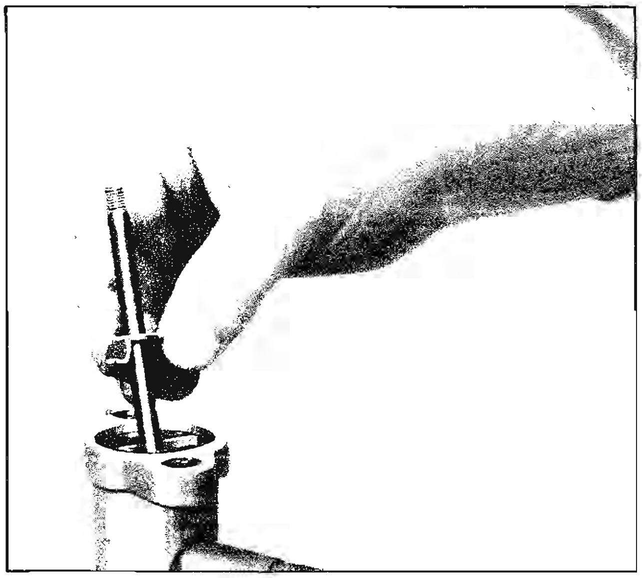


Fig. 9A-36 Removing Plug to Sleeve Key

## CLEANING AND INSPECTION

1. Wash all metal parts in solvent cleaner and dry them with a lint free cloth.

2. Inspect all parts for scratches, burrs, distortion, evidence of wear and replace all worn or damaged parts, including mating parts where necessary.

3. Replace all seals, gaskets, covers with approved service parts.

If valve ports are to be removed:

1. Tap threads in holes of valve ports (Fig. 9A-40).

2. Remove ports by using suitable size bolt into threaded hole, with washer and nut as extractor (Fig. 9A-41).

3. Install new ports with Tool J-6217 (Fig. 9A-42).

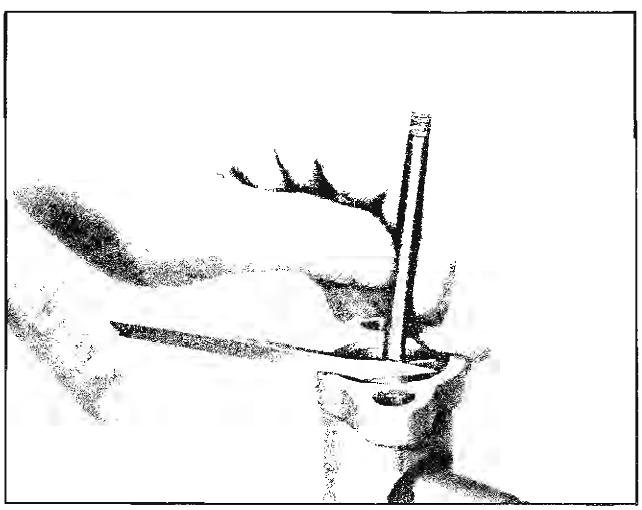


Fig. 9A-37 Removing Adjuster Plug

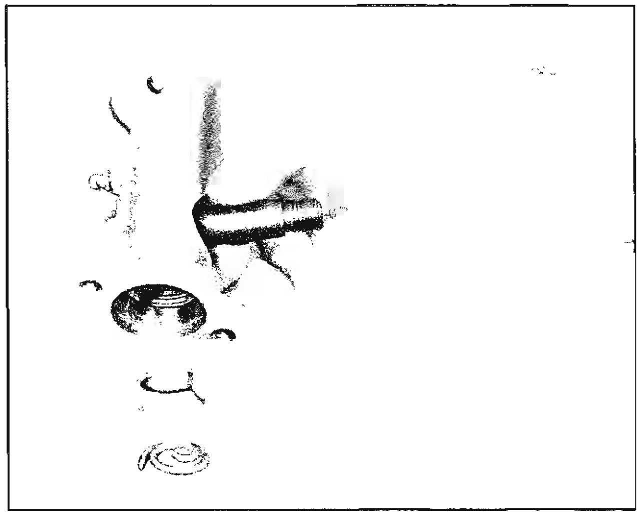


Fig. 9A-38 Removing Spring and Ball Seat

## ASSEMBLE

1. Replace the sleeve and ball seat in the adapter, then the ball stud.

2. Replace the other ball seat and the spring with the small coil down (Fig. 9A-43).

3. Clamp the adapter in vise, put the shaft through the seat in the adjuster plug and screw adjuster plug in sleeve (Fig. 9A-44).

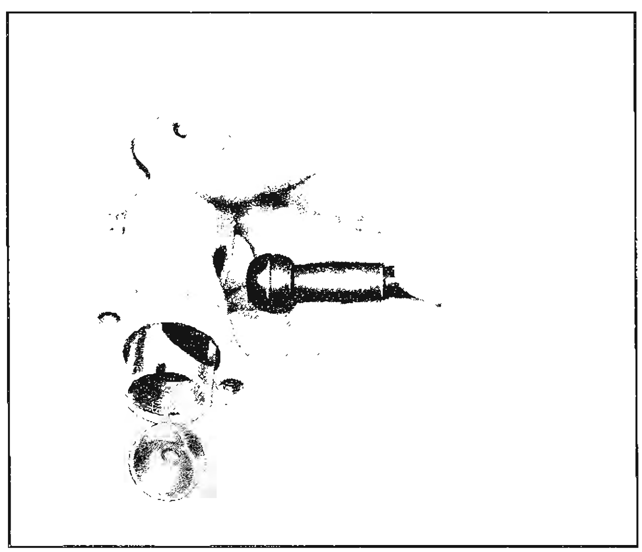


Fig. 9A-39 Removing Ball Seat, Sleeve, and Ball Stud

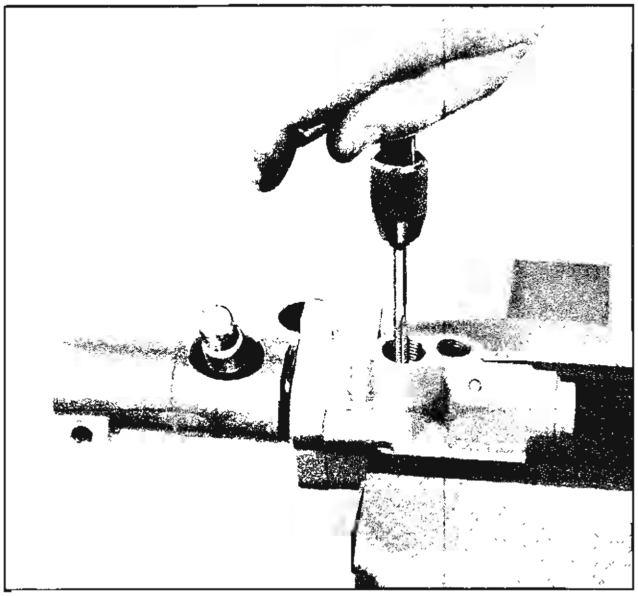


Fig. 9A-40 Tapping Valve Ports

4. Turn the plug in until it is tight, then back it off until the slot lines up with notches in the sleeve.

5. Insert the key, making sure that the small tangs on the ends of the key fit into the notches in the sleeve (Fig. 9A-45).

6. Install "O" ring seal on reaction spool.

7. Install the valve shaft washer, annulus spacer, reaction seal (lip up), spring retainer, reaction spring and spool, and washer and adjustment spring. Install the washer with the chamfer "up".

8. Install the seal on the valve spool (lip down), then install spool in housing (Fig. 9A-32) being careful not to jam spool in housing.

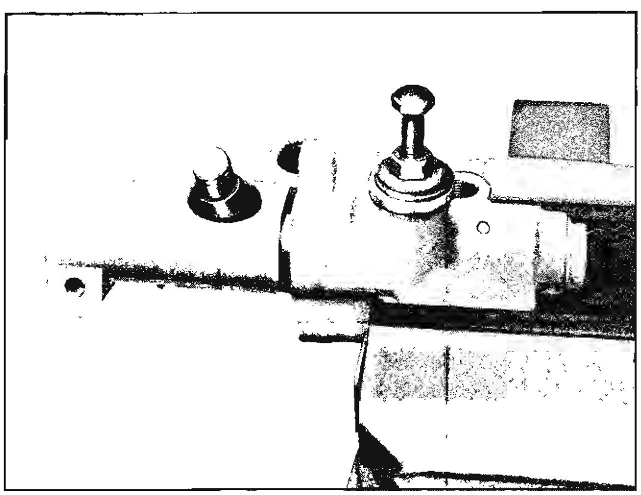


Fig. 9A-41 Installation to Remove Valve Port

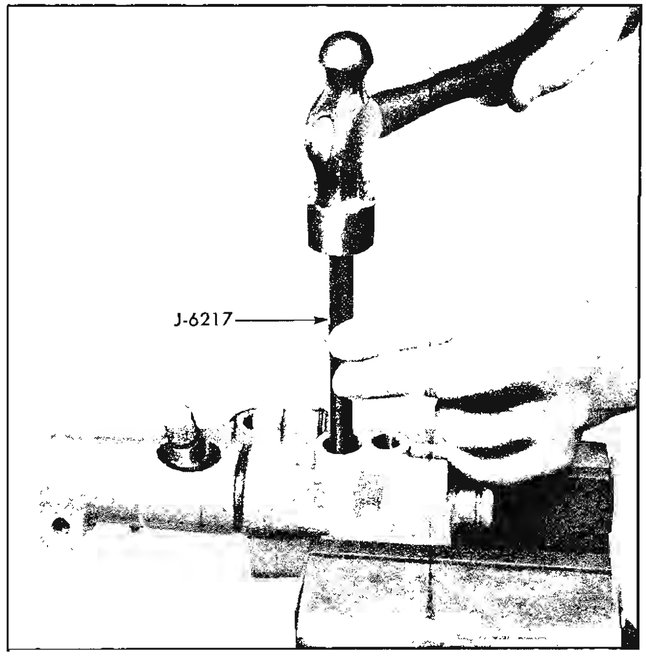



Fig. 9A-42 Installing New Valve Port

9. Install housing and spool onto adapter. The side ports should be on the same side as the ball stud. Bolt the housing to the adapter. Torque bolts to 25-30 lb. ft.

10. Depress the valve spool and turn the lock nut onto the shaft about four turns.

11. Install adapter seal and clamp.

NOTE: Always use a new nut.

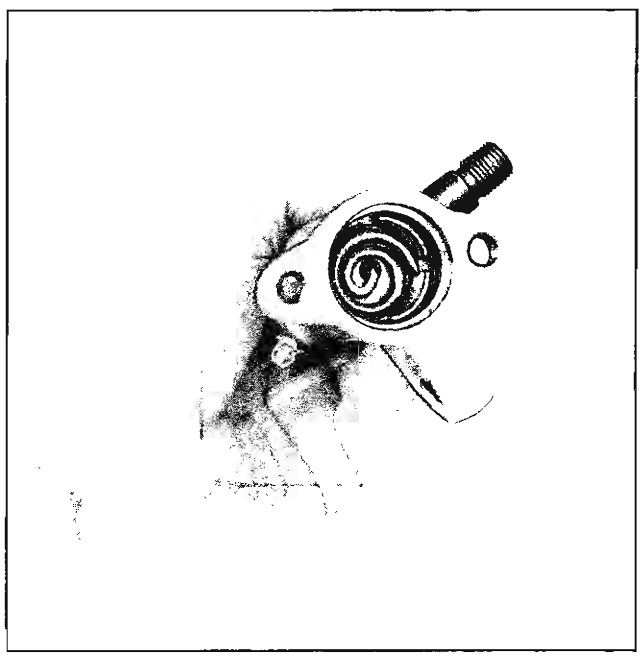


Fig. 9A-43 Ball Seat Spring Installed

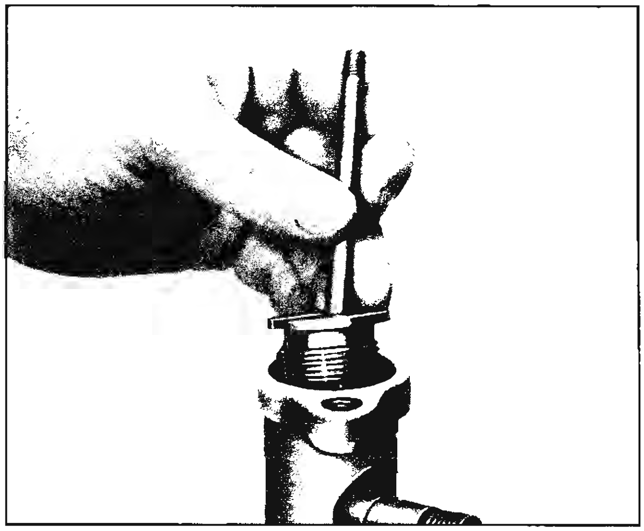


Fig. 9A-44 Installing Adjuster Plug

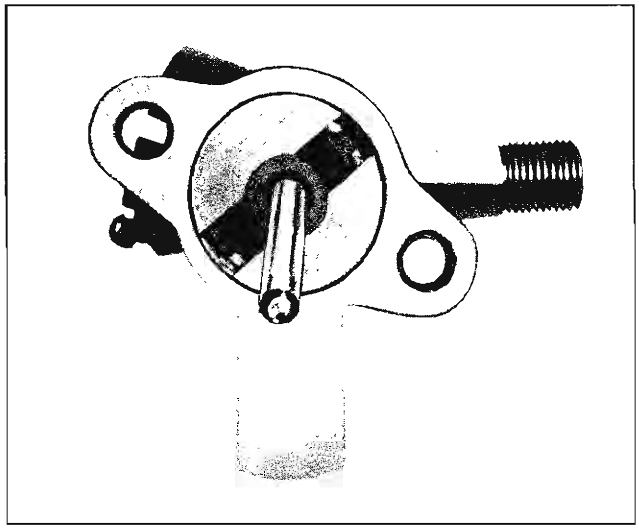


Fig. 9A-45 Installing Key in Sleeve Notches

# BOOSTER CYLINDER

## DISASSEMBLE

(See Fig. 9A-46).

1. To remove the piston rod seal, remove the snap ring and pull out the rod, being careful not to spray oil out of the ports.

2. Remove the piston rod scraper, scraper element, backup washer and piston rod seal from the rod.

3. To remove the ball stud, depress the end plug and remove the snap ring. Push on the end of the ball stud and remove the end plug, spring, spring seat, and ball stud. If the ball seat is to be removed it must be pressed out, using Tool J-8937 (Fig. 9A-47).

## ASSEMBLE

1. Reassemble the piston rod seal components by reversing the disassembly procedure. Apply a thin coating of lubriplate on the inner surfaces of the seal and scraper element before assembly.

2. Reverse the disassembly procedure when reassembling the ball stud. Fill the area beneath the end plug with chassis lubricant. NOTE: If the ball seat was removed, press new seat into place using Tool J-8937 (Fig. 9A-48).

3. In each case, be sure that the snap ring is securely seated in the ring groove.

# INSTALLATION BALANCING

Because this is an adjustable valve, it must be adjusted after being disassembled.

The following steps should be followed in balancing a control valve. The same procedure may be followed to correct a complaint of harder steering effort required in one direction than the other.

1. Install valve in vehicle. Connect all hoses and fill the pump reservoir with oil. Do not connect the cylinder rod to the frame bracket. If the vehicle is already in operation, it will be necessary to detach the cylinder rod from the frame bracket.

2. With all hoses attached and the proper amount of oil added to the system, the engine should be started with the car on the hoist. One of the two following conditions will exist:

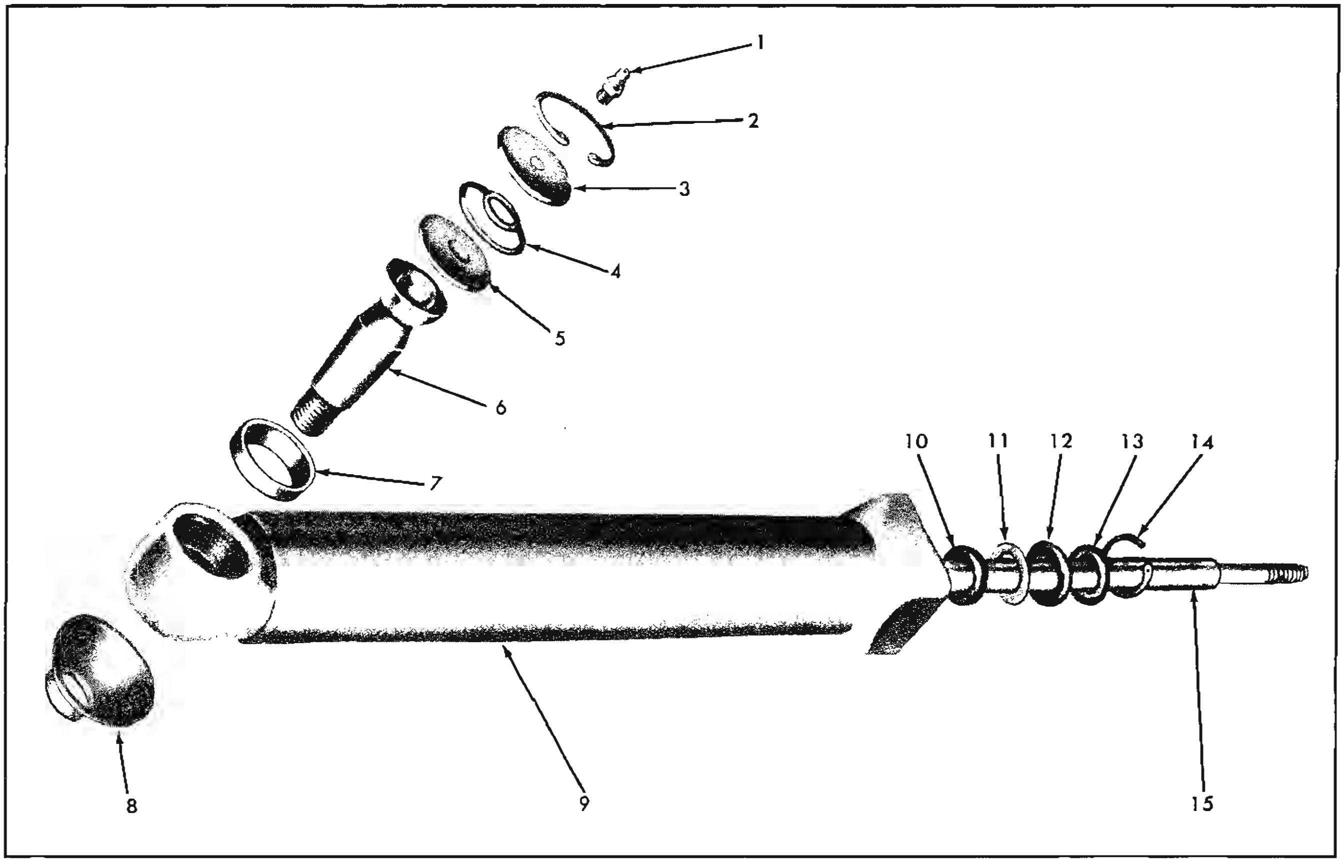
a. If the piston rod remains retracted, the lock nut should be advanced until the rod starts to move out. The nut should then be backed off until the rod starts to move in. Reposition the nut to exactly ½ the rotation required to change the direction of shaft movement.

b. If the piston rod extends upon starting the pump, the lock nut should be retarded until the rod starts to move in. The nut should then be advanced until the rod starts to move out. Reposition the nut to exactly ½ the rotation required to change the direction of shaft movement.

***CAUTION: Do not turn the nut back and forth more than is necessary to balance the valve.***

3. When the valve is balanced, the piston rod should be able to be moved in and out manually.

4. The engine should then be turned off and the




1. Lube Fitting
2. Snap Ring
3. End Plug
4. Spring
5. Spring Seat
6. Ball Stud
7. Ball Seat
8. Ball Stud Shield
9. Piston Body
10. Piston Rod Seal
11. Back-up Washer
12. Scraper Element
13. Piston Rod Scraper
14. Snap Ring
15. Piston Rod

Fig. 9A-46 Booster Cylinder Exploded View

cylinder rod connected to the frame bracket.

5. As a check, the engine should be started again with the car on the hoist. If the front wheels do not turn in either direction from center, the valve has been properly balanced.

6. Install the dust cap on the end of the valve.

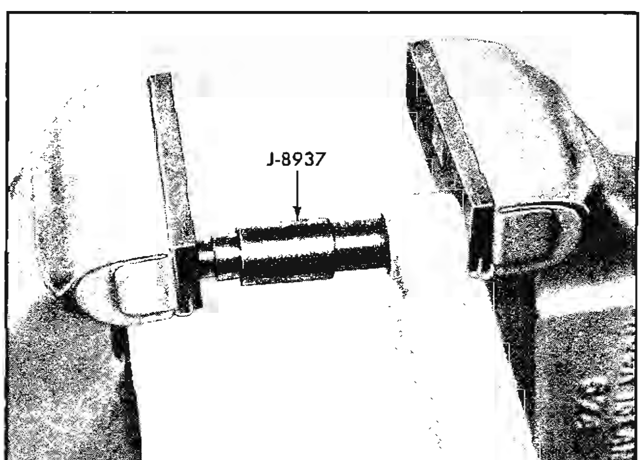



Fig. 9A-47 Removing Ball Seat

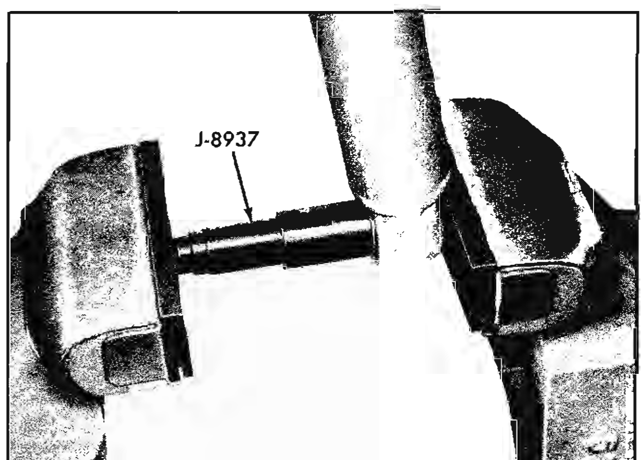



Fig. 9A-48 Installing Ball Seat

# TROUBLE DIAGNOSIS

## POWER STEERING SYSTEM

Cleanliness is a highly important factor in the service of the power steering system. If dirt enters the hydraulic system, it will cause noise, leaks, or faulty operation. When working on a power steering unit, be sure to completely clean the outside before disassembly. Careful thought to cleanliness while disassembling and reassembling the power unit is essential.

### *LEAKS*

If the complaint is oil loss in the power steering system, the following steps should be performed. First, wipe the complete system dry. This includes the pump, control valve, booster cylinder, and four hoses. Then fill the pump reservoir, start the engine, operate the steering system and observe where leakage is occurring. The position of the leak will then indicate the cause of the leak. If the leakage is at the hose connection, the fitting should be tightened and then rechecked to determine if that stopped the leakage. If the oil leak is from one of the units, it should be removed from the car. Improperly installed seals is a major cause of leaks. Damage to seal will cause leaks if the housings have sharp edges which will cut the seal. Sharp edges should be removed with a fine stone and new seals installed.

### *NOISE*

When the complaint is excessive noise, it is sometimes diffcult to isolate the sound. Following is a quick check to determine whether or not the steering system is at fault. Disconnect the pump drive belt and operate the car. If the noise is no longer present, then make the power steering system the next check.

Another good thing to remember is never diagnose a power steering complaint without first checking fluid level and drive belt tension. Either may cause noises and malfunctions which could conceivably be blamed on the steering unit. When checking fluid level, be sure bubbles are not present in the fluid. If bubbles are found, the system should be bled.

Obstructions in the hydraulic system will also cause noise. For instance, a slight burr on the edge of the valve spool lands or a hose restriction will cause noise on turns. Removal of the burr with a fine stone or replacement of the hose will be necessary for correction.

If belt noise (possibly accompanied by a knock or steering wheel oscillation) is present on extreme turns, improper pump belt tension may be the cause.

### *HARD STEERING*

Dirt in the system can cause hard steering, since greater effort is required to reposition the spool and bring the power steering into operation. The repair is to completely clean the hydraulic system. If dirt is not the cause, usually the pump or cylinder are responsible.

## POWER STEERING PUMP

### *NOISE*

The power steering pump is not completely noiseless. Some noise may be present whenever the wheels are against the wheel stops. This noise usually becomes greater as the engine speed is increased as in making a full cramped U-turn. The noise is caused by the system relief valve and is normal. Momentary aeration of the oil is sometimes noticeable under these conditions.

Some noise may also be present under standstill parking conditions.

Power steering pump noise can be confused with many other things such as transmission, rear axle, generator, etc.

If excessive noise is present, remove the pump drive belt, to be sure the pump is at fault.

If the pump is excessively noisy, the following steps should be taken:

1. Check belt tightness and check for bent pulley.

2. Check oil level and fill to level if necessary and follow good bleeding procedure.

3. Check to make sure hoses are not touching any other parts of the car, particularly the sheet metal.

4. Check for air in the oil. Air will show as bubbles or the oil will appear milky. Small amounts of air cause extremely noisy operation. If air is present:

a. Tighten all fittings and bolts.

b. Check the entire system for source of air leak.

Air can leak into the system at any place. Air leaks usually occur at joints in the system where oil passes through at high velocity, such as hose connections or at the drive shaft seal.

The pump should be operated for a few minutes at idle speed after each step in attempting to eliminate air. Occasionally turn the steering wheel between extreme turns to allow the air to bleed out of the oil.

5. Check the pressure plate, thrust plate, and rotor for scoring.

NOTE: A high polish is always present on the face as a result of normal wear. Do not confuse this with scoring. Light scoring can be cleaned up by carefully lapping on a flat surface. Be sure to thoroughly wash away all lapping compound.

6. Check the vanes to insure that the radius edge is toward the outside and that they operate freely in the rotor slots.

7. Check the contour surface of the pump ring for extreme wear. Normally there may be some scuff marks and uniform wear. This is not detrimental to pump noise or function. However, if the wear consists of chatter marks or gouges that can be felt with the finger, both the ring and vanes should be replaced. The vanes should be replaced because if the ring is worn sufficiently to be felt with the finger, the vanes usually are worn too.

8. Check the face of the thrust plate and rotor for scoring or metal pick up. Light scoring or pick up can be cleaned up by lapping (see 5 above).

9. Check bushing and shaft. If worn heavily or failed, noise may result.

10. Cases of pump noise caused by the flow control plunger have been known to exist. If other measures fail, try a new plunger and spring.

11. Check for burrs on valve hole and supercharge hole intersection and remove burrs.

### *LEAKS*

1. Tighten all fittings and bolts.

2. Try to determine source of leak by wiping off pump assembly.

3. Possible sources of pump leakage are:

| SOURCE OF LEAK | CAUSE | REMEDY |
|---|---|---|
| Top of reservoir | Reservoir too full. | Fill to proper level. |
| | Excessive air pressure in oil. | Proceed as in 4 above to determine cause of air. |
| | Welch plug missing from housing. | Install welch plug. |
| At reservoir | O-ring cut or improperly installed. | Replace O-ring or install properly. |
| | Reservoir damaged. | Replace reservoir. |
| At the pressure fitting or studs on control valve, cylinder or pump. | Not tightened sufficiently. | See page 9A-6. |
| | Cross threaded. Defective seal on fittings or hose. Damaged seals. | Correct as necessary. |
| At shaft seal of pump. | Defective seal or damaged shaft. | Replace seal without disassembling pump. Replace shaft if seal surface is scratched or nicked. |
| Leaks in metal parts. | Defective castings. | Replace. |
| At cylinder rod seal. | | Replace seal. |
| At control valve. | | Replace seals. |

***INOPERATIVE, POOR, OR NO ASSIST***

1. Check for loose drive belt.

2. Check and fill reservoir. Bleed system.

3. Air in the oil. Locate source of air leak and correct.

4. Defective hoses as determined by inspection. Correct.

5. Extreme wear of pump ring. Replace part.

6. Dirt in relief valve. Clean and replace.

7. Piston seal leak. Replace cylinder.

8. Self steering. Balance control valve (Page 9A-24).

9. If steering gear is at fault, see Section 9.

10. Determine the source of trouble; that is pump, control valve cylinder or hoses as outlined below.

TEST NO. 1–OIL CIRCUIT OPEN:

a. Install a pressure gauge in the pressure line between the pump and control valve. Be sure to check and identify the pressure lines.

b. Turn the steering wheel from one end to the other end and note the pressure on the gauge while holding the wheel momentarily against each end. This maximum pressure reading should not be less than 775 psi with the engine idling (see Section 6B), the oil temperature in the reservoir between 150 to 170 degrees Fahrenheit as measured with a thermometer.

NOTE: To obtain temperatures of 150 degrees to 170 degrees desired for testing, turn wheels through normal operating range several times.

***CAUTION: Do not hold the steering wheel against the stop for any extended period of time.***

If the maximum pressure is below 775 psi, it indicates there is some trouble in the hydraulic circuit. However, it does not indicate whether the pump or the control valve is at fault. To determine if the pump alone or the control valve alone, or if both are at fault, proceed with Test No. 2. It will not be necessary to proceed with Test No. 2 if the pressure as read for each end is more than 40 psi different, since the control valve is at fault.

TEST NO. 2–OIL CIRCUIT CLOSED:

a. Set engine idle (see Section 6B).

b. Turn the shut-off valve of gauge to the closed position.

NOTE: Shut-off valve must be located between the gauge and the control valve.

c. Observe and compare the maximum pump pressure at idle. It should not be less than 775 psi.

NOTE: By comparing this reading with Test No. 1 (testing complete circuit), it is possible to determine whether the fault is with the pump or the control valve or both.

DIAGNOSIS OF ABOVE TESTS

a. First test below 775 psi, second test more than 50 psi greater–control valve is at fault.

b. First test below 775 psi, second test not more than 50 psi greater–pump at fault.

If pump is determined to be at fault, proceed as follows:

a. Remove reservoir and flow control plunger. Be sure the flow control plunger operates freely in the pump housing bore. If stuck, dislodge. Check for burrs or dirt that may cause a sticky valve.

b. Check the small screw in the end of the flow control valve for looseness. If loose, tighten, being careful not to damage machined surfaces.

c. Insure that the pressure plate and thrust plate are flat against the pump ring.

d. Check the pressure plate, thrust plate, and rotor for scoring.

NOTE: A high polish is always present on the face as a result of normal wear. Do not confuse this with scoring.

e. Check the vanes to insure that the radius edge is toward the outside and that they operate freely in the rotor slots.

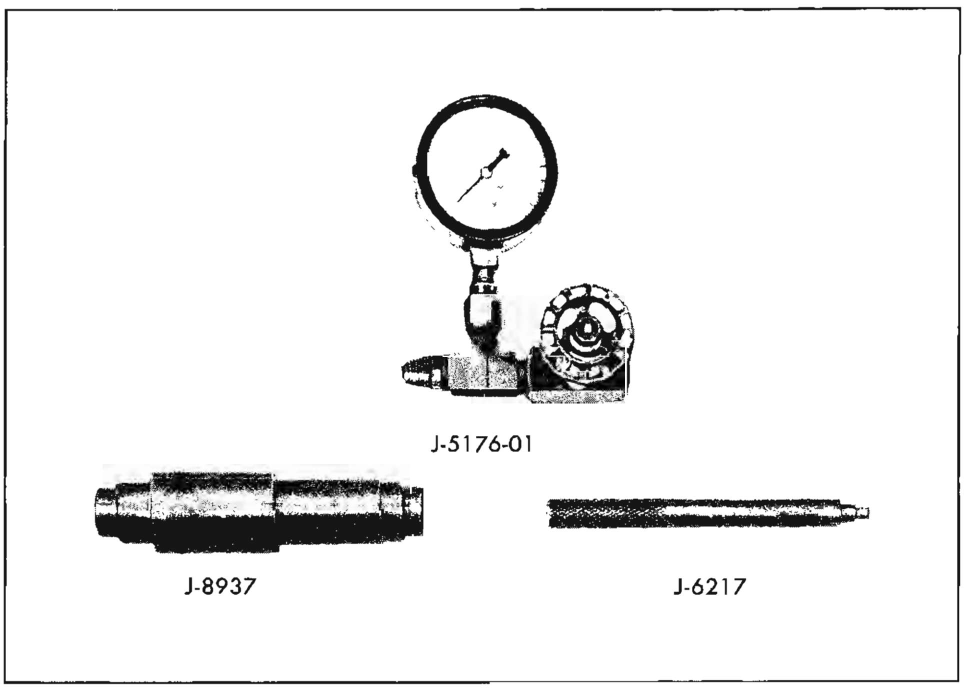
f. The internal parts of the flow control plunger may be at fault. Try a new assembly. Do not attempt to service parts, as this assembly is properly calibrated at the factory.

g. Check for broken drive shaft.

## TORQUE SPECIFICATIONS

| | LB. FT. |
|---|---|
| Pump to support retaining nuts or bolts | 25-35 |
| Pump to rear bracket support nut | 20-35 |
| Belt tension adjusting bolt or nut | 20-35 |
| Pulley nut | 70-85 |
| Cover retaining stud or bolt | 25-35 |
| Outlet union | 25-35 |
| Valve to adapter bolts | 25-30 |

## SPECIAL TOOLS




J-5176-01 Pressure Checking Gauge
J-8937 Booster Cylinder Ball Seat Remover and Installer
J-6217 Valve Port Installer

Fig. 9A-49 Special Tools

# CHASSIS SHEET METAL

CONTENTS OF THIS SECTION



## SHEET METAL ALIGNMENT

Proper alignment of the front end sheet metal will provide proper relationship of adjoining sheet metal parts, ease of hood operation and eliminate squeaks, rattles and vibration.

### FRONT FENDER ALIGNMENT

Vertical and fore and aft adjustment is provided at rear of fenders by enlarged holes in the fender bracket or body at the attaching points (Fig. 10-1, 10-2).

Fenders can be moved closer to or farther from the cowl by adding or removing shims between fender and body. Fenders can also be adjusted vertically by shifting the fender on the enlarged bolt holes (Fig. 10-1, 10-2).

1. Check the space between the front door to fender rear edge and adjust as necessary to obtain a parallel space.

2. Check to insure that all connections at the fender attaching bolts are tight.

### HOOD

The hood is of rigid sheet metal construction with the outer panel of single sheet metal with a rugged inner panel reinforcement frame. Further rigidity is given by reinforcement diagonal braces strategically located so as to give extra strength at stress points.

1. Slotted holes in the hinge bracket to hood are provided to align hood fore and aft (Fig. 10-3).

2. The parallel space between hood sides and fender is accomplished by the rubber wedges mounted to each fender.

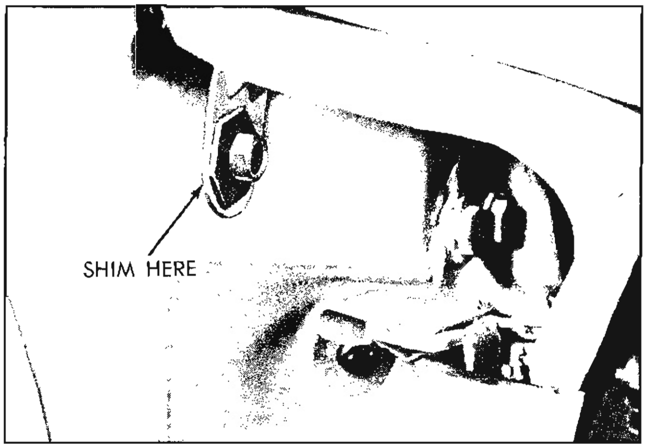



Fig. 10-1 Upper Fender Adjusting Bolt

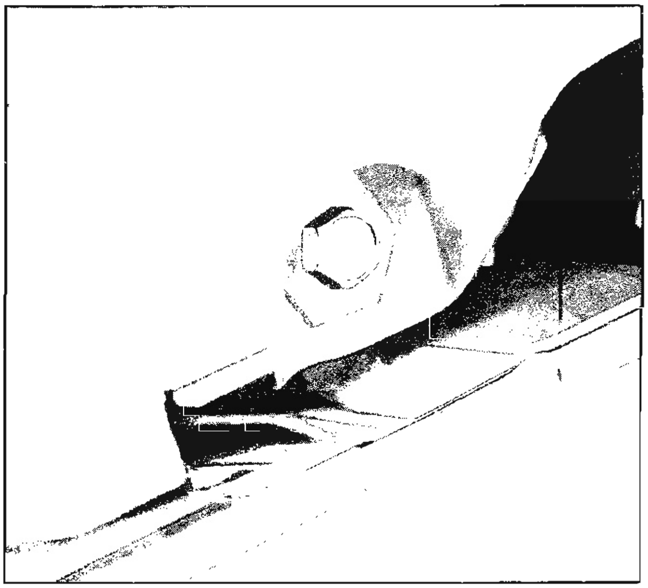


Fig. 10-2 Lower Fender Adjusting Bolt

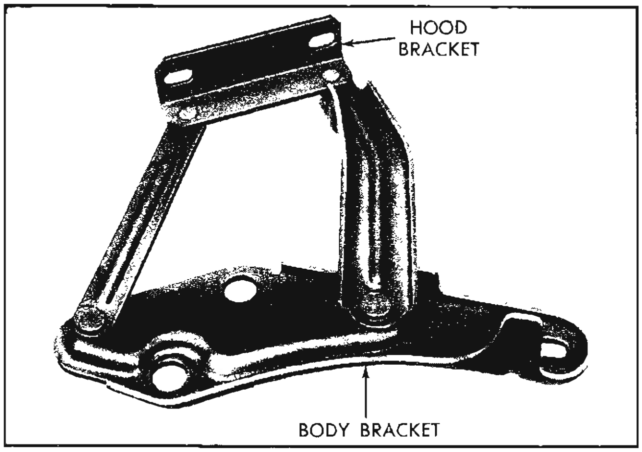



Fig. 10-3 Hood Hinge

3. The rear corners of the hood should be held down against the hood lacing to keep rear of hood from dancing or vibrating. The rear hood height is adjustable by moving hood hinge at body mount. The hinge bolt holes are enlarged giving room for adjustment.

### HOOD HINGES

The hood is mounted on hinges (Fig. 10-3) mounted to wheel house. Double assist over center springs are used, (one at each hood hinge) both ends of which are fastened to the arms of the hinge. This construction provides hold-open power.

A hood to hinge reinforcement bracket which has two points of attachment is used. Fore and aft adjustment of the hood is provided for by slotted holes in the bracket.

### HOOD LATCH

A positive locking hood latch is used and incorporates a safety hood latch and a pilot assembly (Fig. 10-4). The hood latch is fastened to the hood and both assemblies lock to the front fender cross brace when hood is closed. The hood is opened by reaching below the center of the front bumper and pushing release rod toward right front fender (Fig. 10-5). To release the safety latch, reach under partially opened hood and push release lever upward (Fig. 10-5).

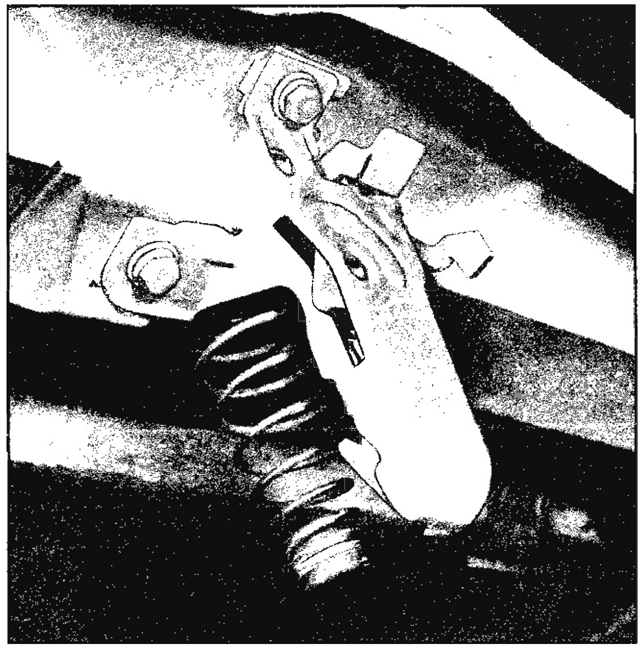


Fig. 10-4 Pilot Assembly and Hood Latch

### HOOD LATCH ADJUSTMENT

Should the hood be difficult or even fail to release or close, there are 2 adjustments that can be made.

1. To adjust the hood latch fore and aft, shim front screw position.

2. To adjust hood latch, sideways loosen three attaching screws and align latch left or right.

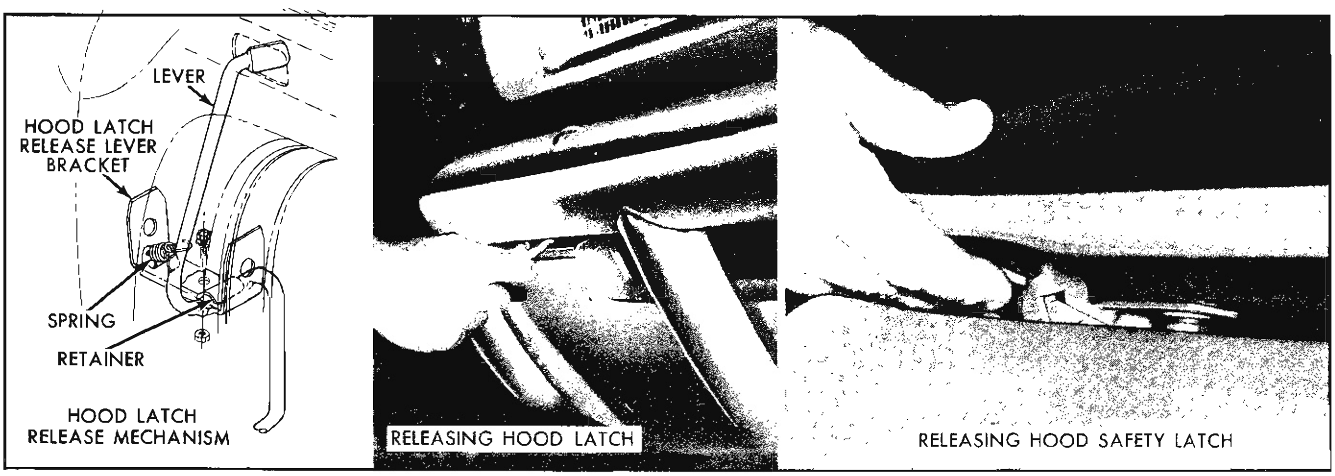



Fig. 10-5 Hood Release Mechanism and Procedure

Proper adjustment of hood latch to provide for easy hood closing is as follows:

1. Check tightness of hood latch bolts.

2. Raise or lower hood bumpers on front fender cross brace (Fig. 10-6).

3. Press down on nose of hood.

a. If some give or looseness is noticed, hood is not tight and will vibrate and raise up on corners at high speeds. In this case, shorten latch bolt and recheck.

b. If hood is tight with no give, the hood could be properly adjusted or could be too tight.

CHECK AS FOLLOWS:

1. Close hood.

2. Release latch and raise hood 10"-12".

3. Manually close hood with sufficient effort to insure hood tightness.

4. Adjust hood latch assembly and bumpers to permit hood to close flush with fenders and upper grille panel.

### *BUMPER ALIGNMENT*

FRONT AND REAR

The bumper mounting bracket is the only adjusting point for the front or rear bumper. This adjusting point is used for both fore and aft and vertical adjustments.

## SHEET METAL REPLACEMENT

### *FRONT FENDER—REMOVE AND REPLACE*

REMOVE

1. Remove front bumper.

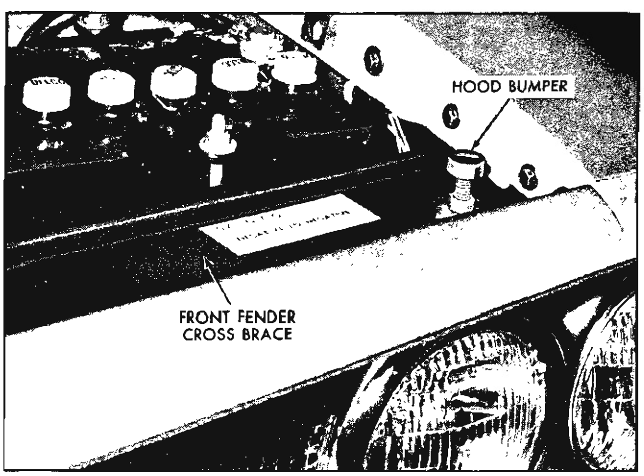



Fig. 10-6 Hood Bumper

2. Remove fender extension.

3. Remove head lamps and head lamp frame.

4. Remove three screws—fender to lower grille panel.

5. Remove two screws—front fender to front fender cross brace.

6. Remove nine screws—fender to body (upper).

7. Remove one screw—fender to rear upper shroud and one screw—fender to rear lower shroud.

8. Remove fender by lifting up and away.

NOTE: For right front fender removal, disconnect radiator and antenna mast, remove antenna nut, remove screw from fender rear brace to antenna and let assembly drop through fender.

REPLACE

To install fender, reverse the above procedure.

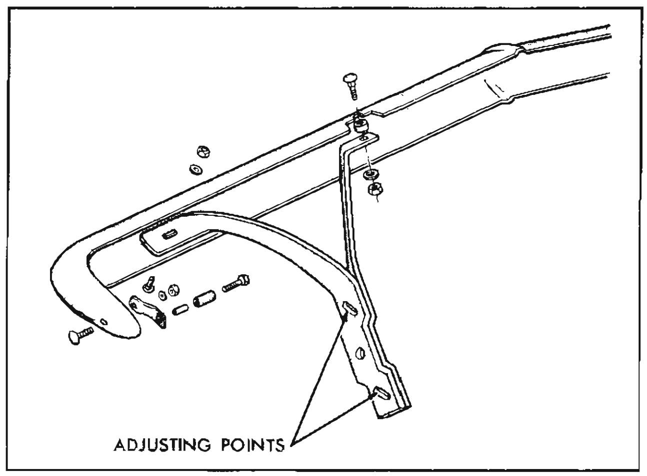



Fig. 10-7 Front Bumper

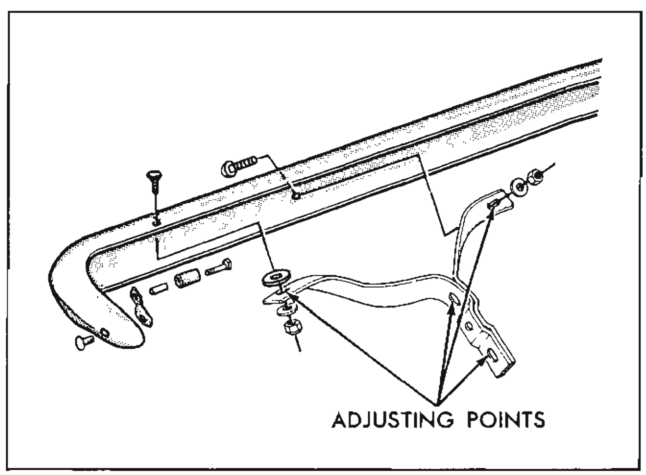



Fig. 10-8 Rear Bumper

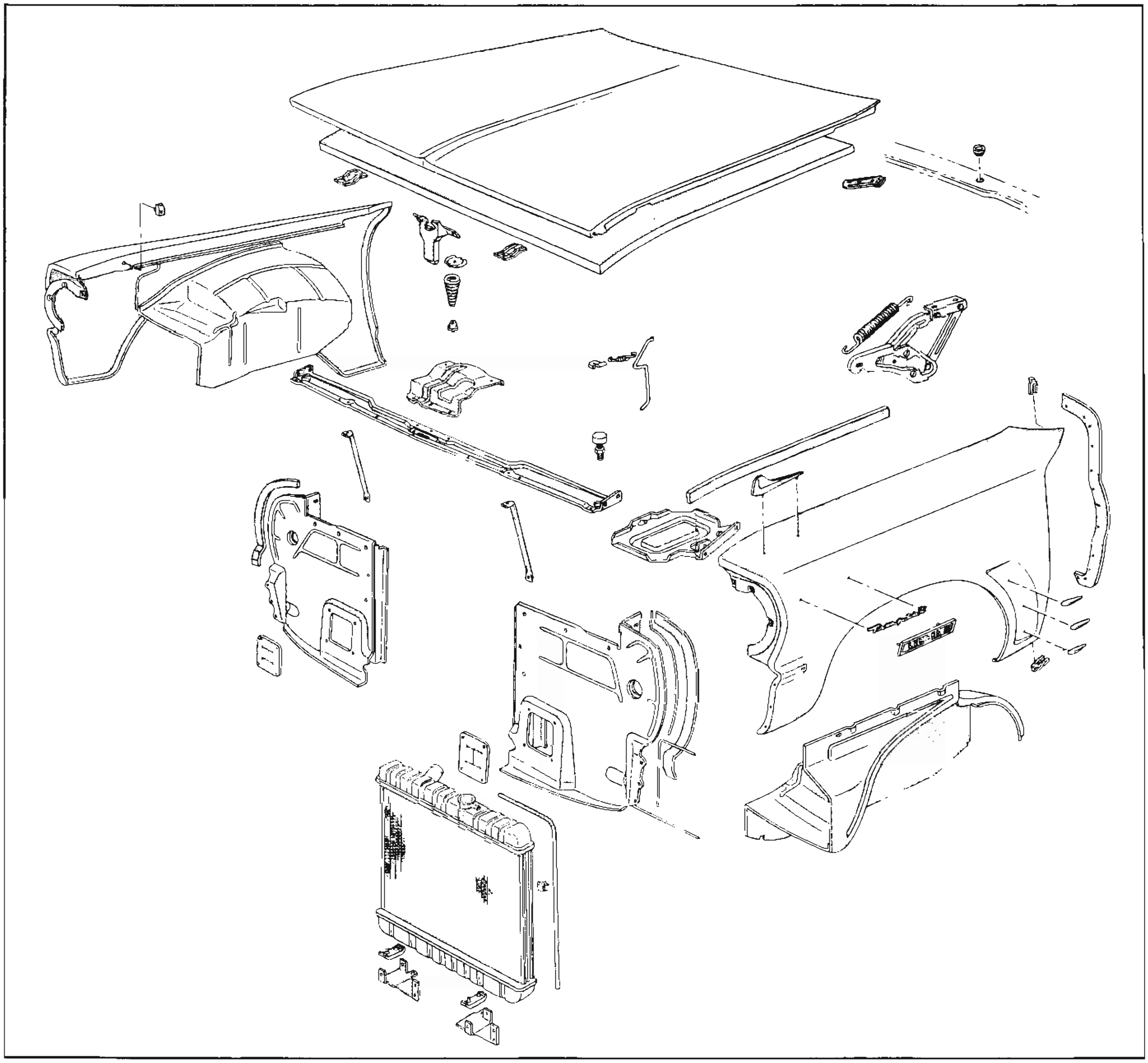


Fig. 10-9 Exploded View—Front End Sheet Metal

### GRILLE PANEL (UPPER)—REMOVE AND REPLACE

1. Remove head lamp doors, head lamp and fender extensions.

2. Remove seven upper screws—grille panel to front fender cross brace.

3. Remove ten lower screws—lower to upper grille panel.

4. Lift panel and pull forward.

5. To replace upper grille panel, reverse above procedure.

### GRILLE PANEL (LOWER)—REMOVE AND REPLACE

1. Remove bumper.

2. Remove three screws each side—front fender to lower grille panel.

3. Remove one screw each side—fender extension to lower panel.

4. Remove ten screws—lower panel to upper panel.

5. Remove 6 screws, lower panel to lower radiator right and left hand baffle assemblies.

6. Remove lower grille panel forward and down.

7. To replace lower grille panel, reverse the above procedure.

### GRILLE (RIGHT AND LEFT)—REMOVE AND REPLACE

1. Remove upper grille panel assembly.

2. Unscrew and remove grille from upper grille panel assembly.

3. To install right or left grille, reverse the above procedure.

### FRONT FENDER CROSS BRACE — REMOVE AND REPLACE

1. Remove upper grille panel.

2. Remove two supports.

3. Remove battery.

4. Remove three screws each side—baffle assembly to front fender cross brace and two screws each side cross brace to fender.

5. Slide cross brace forward and remove.

6. To install front fender cross brace, reverse the above procedure.

### HOOD SPRING—REMOVE AND REPLACE

REMOVE

1. Close hood a little to expand spring.

2. Insert tool J-8923 on spring (Fig. 10-11).

3. Open hood all the way so spring can be removed.

REPLACE

1. If new spring is to be installed, insert J-8923 in spring once it is expanded.

2. Open hood until spring can be put in place on hinge.

3. Close hood a little and remove J-8923.

### HOOD HINGE—REMOVE AND REPLACE

REMOVE

1. Open hood.

2. Remove hood spring. Page 10-6.

3. Remove screws holding hood to hinge.

4. Remove screws holding hinge to wheelhouse assembly.

REPLACE

1. Position hinge to wheelhouse assembly and tighten attaching screws.

2. Position hinge to hood and tighten attaching grille.

3. Replace hood hinge spring. Page 10-6.

4. Close hood and check hood alignment.

5. If hood is misaligned, measure amount of misalignment.

a. Open hood, mark position of hinge relative to hood.

b. Loosen hinge and move hinge the amount it was off.

c. Tighten securely and recheck alignment.

NOTE: The hood may be aligned vertically and fore and aft. Vertical adjustment is made between hinge and wheelhouse assembly. Fore and aft adjustment between hood and hinge (Fig. 10-3).

### HOOD REPLACEMENT

The hood can be removed by removing the attaching screws between hinges and hood. When replacing the hood, adjust the alignment of one hinge at a time, as outlined in steps 4 and 5 under Hood Hinge —Remove and Replace.

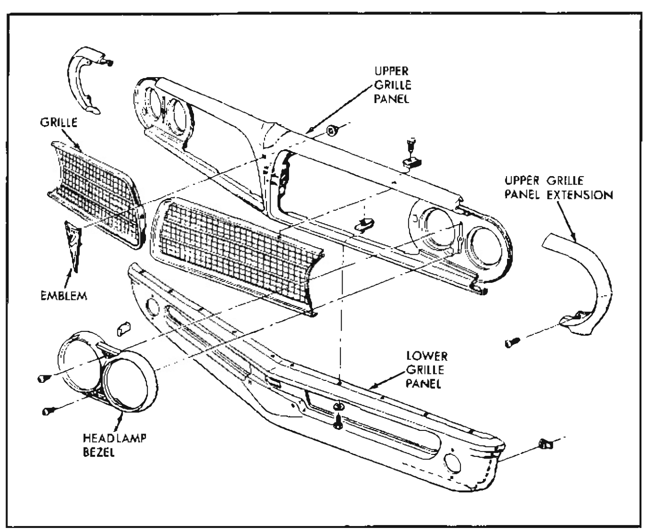



Fig. 10-10 Grille Assembly

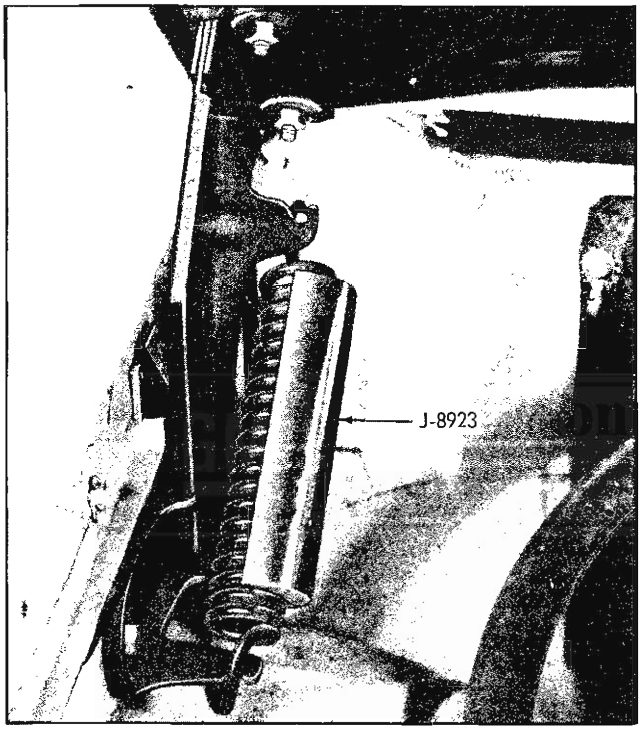


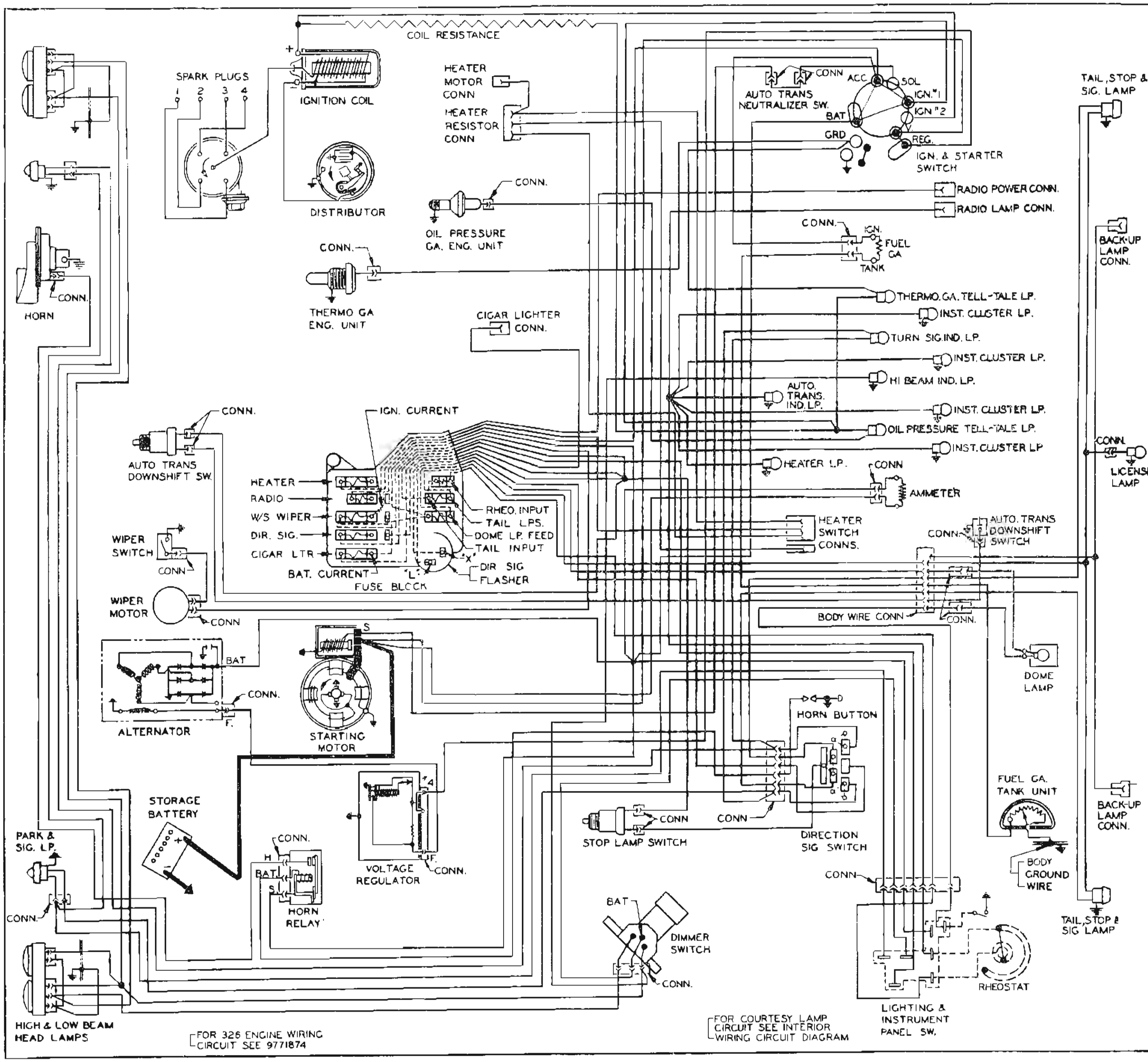

Fig. 10-11 Hood Spring Tool J-8923

### *RADIATOR—REMOVE AND REPLACE*

1. Drain radiator.
2. Disconnect overflow, upper and lower radiator hoses.
3. Remove radiator fan shield.
4. Remove radiator.
5. To install radiator, reverse above procedure.

# ELECTRICAL AND INSTRUMENTS

## CONTENTS OF THIS SECTION




LIGHTING SWITCH
- DOME LP. GRD - NAT WHITE
- PARK - PURPLE
- TAIL - DK. GREEN
- HEAD LAMP - ORANGE
- BAT - TAN
- RHEO INP. - PURPLE-WHITE STR.
- RHEO OUTPUT - GRAY

IGN. & STARTER SWITCH
- BAT - RED
- IGN#1 - PURPLE
- IGN#2 - BLACK
- ACC - YELLOW-BLACK STR
- ACC. TO FUSE BLOCK - YELLOW
- SOL - BROWN
- GRD TO TEMP. GA T.T. - DK GREEN
- GRD TO ENG UNIT - DK GREEN
- 'V' BROWN
- "REG".- BLACK

INST CLUSTER
- TELL TALE LPS. FEED - PURPLE
- TEMP T.T. TO IGN. SW - DK. GREEN
- OIL T.T. TO ENG UNIT - BROWN
- CLUSTER LAMPS - GRAY
- HI BEAM IND. - LT GREEN
- AMM. BAT. - YELLOW
- AMM. REG. - RED
- FUEL GA. TO:
  - IGN SW. - YELLOW-BLACK STR
  - BODY WIRE CONN - BROWN

VOLTAGE REGULATOR
- F DK BLUE
- #4 - BLACK

ALTERNATOR
- BAT. - BROWN
- F - DK BLUE

DIMMER SWITCH
- BAT. - ORANGE
- HI BEAM - LT GREEN
- HI BEAM IND. - LT. GREEN
- LOW BEAM - TAN

BODY WIRE CONN.
- R.H. STOP & SIG. - PURPLE
- L.H. STOP & SIG. - PINK
- TAIL & LICENSE - LT. BLUE
- DOME LAMP GRD. - NAT. WHITE
- DOME LAMP FEED - ORANGE
- FUEL TANK GA. - BROWN
- AUTO TRANS DOWN SHIFT - BLACK

HORN RELAY
- H (HORNS) - BLACK
- S (BUTTON) - BROWN
- BAT. - RED

FUSE BLOCK
- WIPER MOTOR - BROWN-WHITE STR.
- HEATER - TAN
- RADIO - BROWN
- IGN. CURRENT - YELLOW
- TAIL INPUT - DK. GREEN
- TAIL OUTPUT - LT BLUE
- RHEO INPUT - PURPLE-WHITE STR.
- DOME FEED - ORANGE
- FLASHER "X" - BLACK
- FLASHER "L" - YELLOW
- BAT. - RED
- DIR SIG. & STOP - GRAY BLACK STR
- CIGAR FEED - NAT. WHITE
- CIGAR LTR. - RED

W/S WIPER MOTOR
- BAT - BROWN-WHITE STR
- SWITCH - BLACK-WHITE STR

HEATER SWITCH
- HI - BLACK
- BAT - TAN
- LOW - YELLOW-BLACK STRIPE
- MED. - BROWN

HEATER LAMP - DK. BLUE-WHITE STR

DIR SIG SWITCH
- L H REAR - PINK
- R H REAR - PURPLE
- HORN BUTTON - BROWN
- L H FRONT - LT. BLUE
- L H IND LP. - LT BLUE
- L'ON FLASHER - YELLOW
- R.H FRONT DK BLUE
- R.H. IND. LP - DK. BLUE

HEAD LAMPS
- HI BEAM (INBOARD) - LT GREEN
- HI-BEAM (R H OUTBOARD) - WHITE
- HI-BEAM (L.H. OUTBOARD) - LT GREEN
- LOW BEAM - TAN
- GROUND (R H LPS.) - GRAY-BLK STR
- GROUND (L H LPS.) - BLACK

STARTER SOL.
- S - PURPLE
- BAT - YELLOW
- V - BROWN

AUTO. TRANS DOWNSHIFT SWITCH
- TO STOP LP FUSE - BLACK
- TO BODY CONN - BLACK

Fig. 11-1 Circuit Diagram

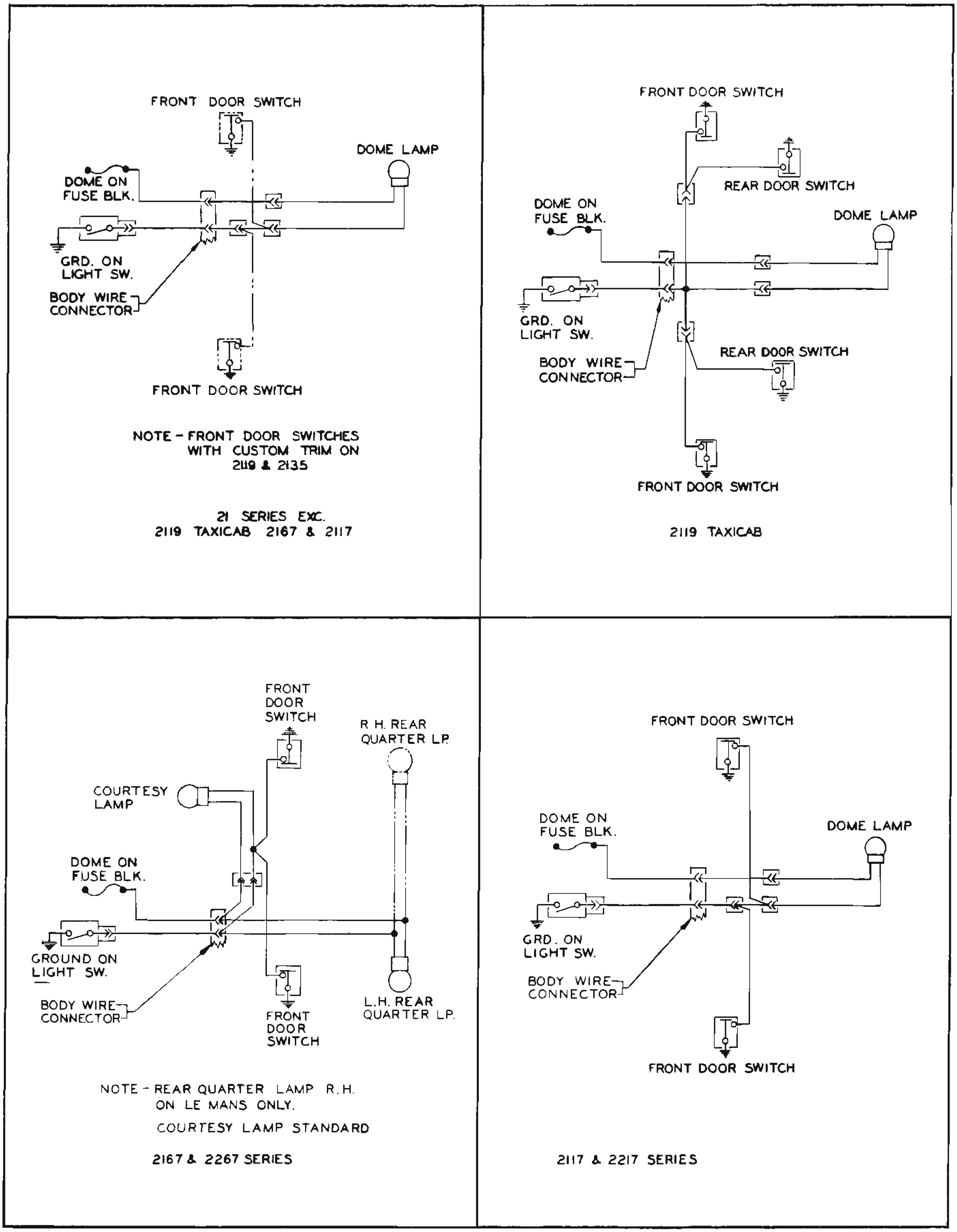



Fig. 11-2 Circuit Diagram—Interior

The electrical system operates on 12 volts. This section of the manual is subdivided into the following sections:

1. Starting Circuit
2. Charging Circuit
3. Ignition Circuit
4. Lighting Circuit
5. Instruments
6. Windshield Wiper

The complete wiring diagram (less accessories) for all models is shown schematically in Figs. 11-1, 11-2, and 11-3.

# STARTING CIRCUIT

The starting circuit includes the starting motor, solenoid, battery, and cables.

## BATTERY

### *DESCRIPTION*

The Delco Model 554, 9 plate battery (Fig. 11-4) is a 12 volt, 44 amp hour capacity unit and is used with the 37 amp alternator. The Model 558, 61 amp hour, 11 plate battery is used with the 42 amp alternator. The Model 458, 53 amp hour, 9 plate battery is used with the eight cylinder engine.

***CAUTION: Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.***

Battery liquid is highly acid. Avoid spilling on clothing or other fabric. This battery has a specific gravity of 1.260-1.280 at full charge at 80°F. The battery date code is located on the second cell cover from the positive post end. This date code should always be included on product information reports or battery correspondence.

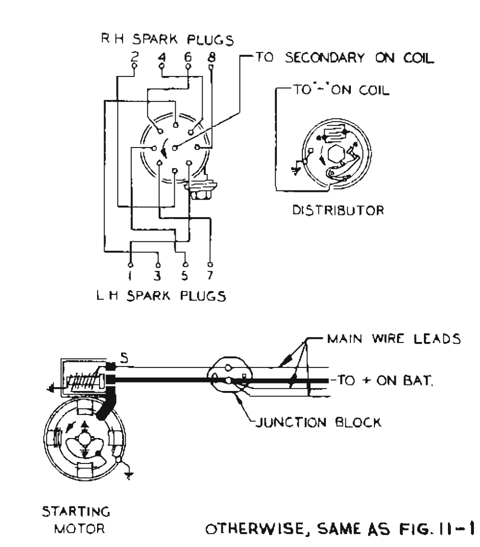



Fig. 11-3 Wiring Circuit Schematic—V-8 Engine

### *PERIODIC SERVICE*

Liquid level in the battery should be checked every 2,000 miles or once a month. In extremely hot weather, the checking should be more frequent. If the liquid level is found to be low, add water to each cell until the liquid level rises to the bottom of the vent well. Do not overfill! Distilled water, or water passed through a "demineralizer" should be used for this purpose in order to eliminate the possibility of harm-

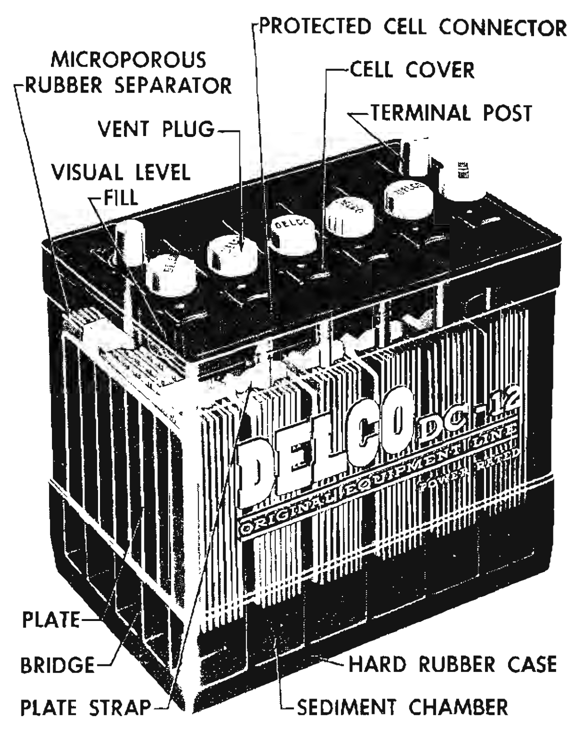



Fig. 11-4 Delco 12 Volt Battery

ful impurities being added to the electrolyte. Many common impurities will greatly shorten battery life.

The external condition of the battery and the battery cables should be checked periodically. The top of the battery should be kept clean and the battery holddown bolts should be kept properly tightened. Particular care should be taken to see that the top of battery is kept clean of acid film and dirt because of the high voltage between the battery terminals. For best results when cleaning batteries, wash with a dilute ammonia or soda solution to neutralize any acid present and flush off with clean water. Care must be taken to plug vent holes and keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down bolts should be kept tight enough to prevent the battery from shaking around in its support so as not to damage the battery case, but they should not be tightened to the point where the battery case will be placed under a severe strain. The torque specification is 2 lb. ft.

To insure good contact, the battery cables should be installed on the battery posts with 1/8" of the post showing above cable. If the battery posts or cable terminals are corroded, the cables should be disconnected and the terminals and clamps cleaned separately with a soda solution and a wire brush. After cleaning, apply a thin coating of petrolatum on the posts and cable clamps to help retard corrosion.

## *REPAIRS*

### CABLE REPLACEMENT

When replacing battery ground cable be sure the connections are secure.

### SUPPORT REPLACEMENT

When replacing the battery support, it is important that the outer edges of the battery bear firmly and evenly against the support. To provide even support, install shims as necessary between the corners of the support and the support bracket. Battery hold down clamp should be tightened to 2 lb. ft. torque.

## *TESTING, BOOSTING, AND CHARGING*

### QUICK IN-THE-CAR BATTERY TEST

#### Inspection

Check outside of battery for damage or signs of serious abuse such as broken case or broken covers. Check inside of battery by removing the vent caps and inspecting for signs of abuse such as electrolyte level too low, or unusual odors. If battery shows signs of serious damage or abuse, it should be replaced. If not, make Light Load Test.

#### Light Load Test

Check electrical condition of battery cells as follows:

a. Disconnect high tension lead from coil. Place load on battery by holding starter switch "on" for 3 seconds.

b. Turn on headlights (low beam). After 1 minute, with lights still "on", read individual cell voltages of battery with voltmeter (.01 volt division). Compare readings with the following:

Uniform Readings

If any cell reads 1.95 volts or more and the difference between the highest and lowest cell is less than .05 volts, battery is good. However, if any cell reads less than 1.95 volts, battery should be fully recharged for good performance (see Charging After Light Load Test).

Non-Uniform Readings

If any cell reads 1.95 volts or more and there is a difference of .05 volts or more between the highest and the lowest cell, the battery should be replaced.

Low Readings

If all cells read less than 1.95 volts, battery is too low to test properly. Failure of the meter to register on all cells does not indicate a defective battery. Boost charge battery and repeat Light Load Test (see Boost Charging for Light Load Test). If battery is found to be good after boosting, it should be fully recharged for good performance.

If none of the cells come up to 1.95 volts after the first boost charge, the battery should be given a second boost. Batteries which do not come up after second boost charge should be replaced.

NOTE: Any battery found to be good by the Light Load Test that does not perform satisfactorily, should be removed from the car and tested as outlined under "Out-of-the-Car Charging and Testing".

## IN-THE-CAR BOOSTING AND CHARGING

### Boost Charging for the Light Load Test

Boost 12-volt battery at 50 amperes for 20 minutes (50 x 20=1000 ampere minutes). If charger will not give these rates, charge for an equal number of ampere minutes at best rate available. For purposes of this test do not boost battery more than the amount indicated.

### Charging After the Light Load Test

For best performance, a good battery should be fully charged before being returned to service.

If batteries are to be fully charged by means of a quick charger, the charge rate must be reduced to a safe limit when the electrolyte temperature reaches 125°F or when gassing becomes excessive. Failure to do so may harm the battery.

## OUT-OF-THE-CAR CHARGING AND TESTING

The procedures outlined below under Slow Charging and The Full Charge Hydrometer Test should be used on any battery originally found to be "good" by the Light Load Test, but which does not perform satisfactorily.

### Slow Charging

Adjust electrolyte to proper level by adding water, then charge battery at 5 amperes until fully charged. Full charge of the battery is indicated when the specific gravity of each cell has not increased when checked at three hourly intervals and all cells are gassing freely.

Due to the low rate during slow charging, plenty of time must be allowed. Charge periods of 24 hours or more are often required.

### The Full Charge Hydrometer Test

The "Full Charge Hydrometer Test" is not valid unless battery has been tested and found to be good by the Light Load Test.

Make sure battery is fully charged as described above. Hydrometer readings taken on partially charged batteries are unreliable for the test outlined below.

Measure specific gravity of electrolyte in each cell and compare readings with the following:

#### Normal Reading

If cell readings range between 1.230 and 1.310, the battery is ready for use. Any variation in the specific gravity between cells within this range does not indicate a defective battery.

#### Low Reading

If any cell reads less than 1.230 and battery has been in service 3 months or less, battery is good, but it has been improperly filled with electrolyte or water and will give poor performance. To correct this condition, empty the electrolyte from any cell reading less than 1.230 and refill with 1.265 specific gravity battery grade electrolyte. The battery is now ready for use.

If any cell reads less than 1.230 and battery has been in service more than 3 months, it should be replaced.

#### High Reading

If any cell reads above 1.310, battery may be returned to service. However, specific gravities above 1.310 are harmful to the battery and will cause early failure. Such high readings are caused by the improper addition of electrolyte. Adjusting the specific gravity will not correct the damage that has been done by high acid condition.

### *TROUBLE DIAGNOSIS*

If the battery remains undercharged, check for loose alternator belt, defective alternator, high resistance in the charging circuit, oxidized regulator contact points, or a low voltage setting.

If the battery uses an abnormal amount of water, the voltage regulator setting may be too high.

Measure the terminal voltage of the battery during cranking. Disconnect distributor to coil primary wire during this check to prevent engine firing. If the terminal voltage is less than 9.0 volts, remove the battery from service for further checking.

## STARTING MOTOR

### *DESCRIPTION*

The enclosed shift lever starting motor (Fig. 11-5) is a 12-volt extruded frame type unit.

The starting motor has the solenoid shift lever mechanism and the solenoid plunger enclosed in the drive housing, thus protecting it from exposure to road dirt, icing conditions and splash. It has an overrunning clutch type of drive. The overrunning

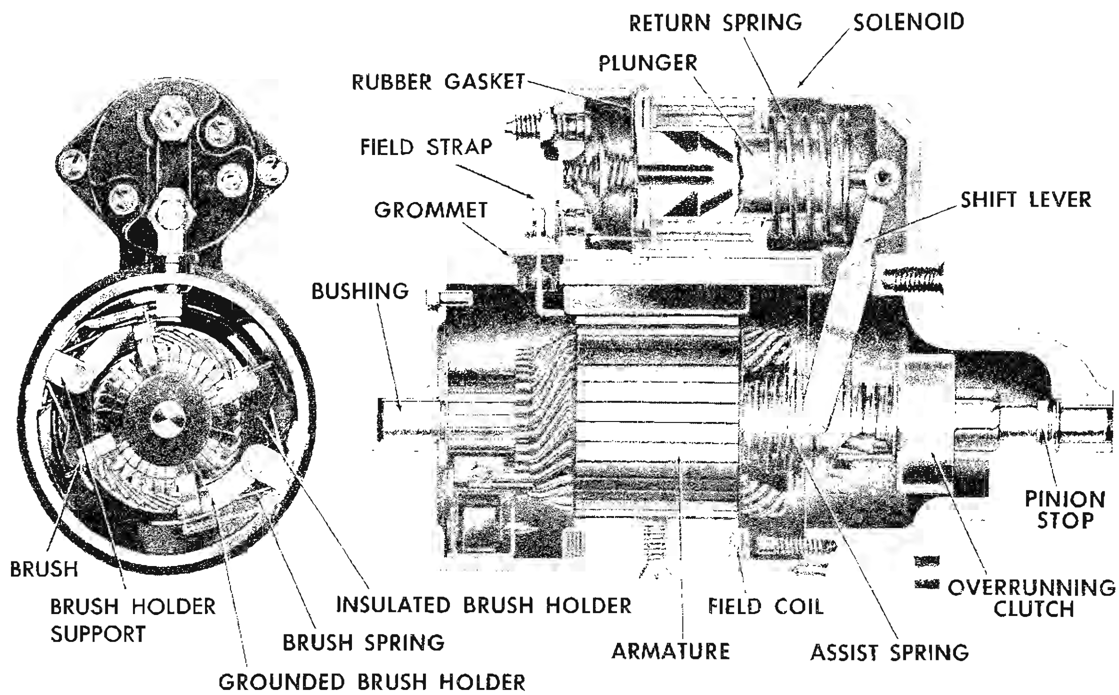



Fig. 11-5 Cross Section of Starting Motor

clutch is operated by a solenoid switch mounted to a flange on the starting motor drive housing. Instead of a nameplate, lettering and model numbers are rolled into the outside of the field frame, thereby providing a more permanent type of identification.

The 4-cylinder engine starting motor has four poles and four field coils. The field circuit used in this motor is a series field. The V-8 engine starting motor has three series windings and one shunt winding.

The motor has a series field in which all four field coils are connected in series from the motor terminal of the solenoid to the insulated brushes. The end of the field windings extends out through a rubber grommet assembled in an opening in the frame and is attached directly to the "motor" terminal of the solenoid. The rubber grommet insulates the extended end of the field windings from the frame (ground) and prevents dirt, water and oil from entering the motor.

The brush rigging has brush arm supports attached directly to the extruded section of the field frame. One ground brush and one insulated brush are both pivoted from the same brush holder support, thus only two brush holder supports are required. A single ribbon type spring applies tension to each pair of brushes.

An overrunning clutch type of drive is used to engage the cranking motor pinion with the flywheel. The flange mounted solenoid switch operates the overrunning clutch drive by means of a linkage to the shift lever. When the control switch is closed the solenoid is energized, shifting the cranking motor pinion into mesh with the flywheel. Battery current is delivered to the motor when the main contacts of the solenoid are then closed. The armature rotates and turns the flywheel. Overrunning action of the clutch protects the cranking motor armature from excessive speed when the engine fires. A compression type spring located inside the solenoid case returns the shift lever and clutch to their normal at-rest position.

The armature shaft and clutch have mating spiral splines which aid in meshing of the gears and thus prevents transmission of cranking power until the clutch pinion is fully engaged in the flywheel ring gear. A special assist spring is located around the armature shaft between the end fiber of the armature and the collar of the clutch drive. This spring aids the solenoid in overcoming the return spring force in the first movement of the clutch along the armature shaft. A pinion stop, consisting of a snap ring and retainer and a thrust collar assembled on the armature shaft, takes all the end thrust.

The solenoid is attached to the drive end housing with two screws. A molded push rod is assembled in the contact assembly. A shoulder molded on the push rod and a cup that can be easily assembled to the rod and locked into position over two molded bosses, holds the contact assembly in place.

### PERIODIC SERVICE

No periodic lubrication of the starting motor or solenoid is required. The motor and brushes cannot be inspected without disassembling the unit, so no service is required on the motor or solenoid between overhaul periods.

### CHECKS AND ADJUSTMENTS ON CAR

Although the starting motor cannot be checked against specifications on the car, a check can be made for excessive resistance in the cranking circuit. To check for excessive resistance in the cranking circuit, measure:

1. The voltage drop, during cranking, between the insulated battery post and the battery terminal of the solenoid.

2. The voltage drop, during cranking, between the battery terminal of the solenoid and the motor terminal of the solenoid.

3. The voltage drop, during cranking, between the grounded battery post and the starting motor frame.

***CAUTION: To prevent the engine from firing during the above checks, disconnect the primary lead to the distributor, either at the distributor or at the coil.***

If the voltage drop for any one of the above three checks exceeds 0.2 volt, excessive resistance is indicated in that portion of the cranking circuit being checked. Locate and eliminate the cause for any excessive voltage drop in these circuits in order to obtain maximum efficiency of the cranking system.

When the solenoid fails to pull in, the trouble may be due to excessive voltage drop in the solenoid control circuit. To check for this condition, close the starting switch and measure the voltage drop between the battery terminal of the solenoid and the switch terminal of the solenoid. Excessive resistance in the solenoid control circuit is indicated and should be corrected if this voltage drop exceeds 3.5 volts.

If the voltage drop does not exceed 3.5 volts and the solenoid does not pull in, measure the voltage available at the switch terminal of the solenoid. If the solenoid does not feel warm, it should pull in whenever the voltage available at the switch terminal is 7.7 volts or more (when the solenoid feels warm, it will require a somewhat higher voltage to pull in).

### REMOVE FROM CAR

1. Disconnect battery ground cable at battery terminal post.

2. Disconnect battery positive cable and wiring harness leads from starting motor solenoid.

3. Remove starting motor, using straight box end wrench through slot in four cylinder engine block casting for lower mounting bolt.

### DISASSEMBLE STARTER

1. Disconnect the field strap (Fig. 11-5) from terminal on solenoid.

2. Remove through bolts.

3. Remove commutator end frame, leather washer, field frame assembly, and armature assembly from drive housing.

4. Remove overrunning clutch from armature shaft as follows:

a. Slide thrust collar (Fig. 11-6) off end of armature shaft.

b. Slide a standard half inch pipe coupling or other metal cylinder of suitable size (an old pinion of

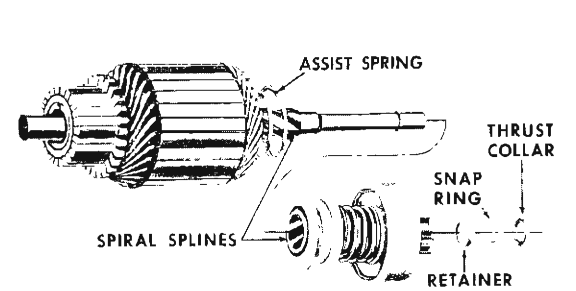



Fig. 11-6 Armature and Overrunning Clutch Assembly

suitable size can be used if available) onto shaft so end of coupling or cylinder butts against edge of retainer (Fig. 11-7). Tap end of coupling with hammer, driving retainer towards armature and off snap ring.

c. Remove snap ring from groove in shaft using pliers or other suitable tool. If snap ring is too badly distorted during removal it may be necessary to use a new one when reassembling clutch.

d. Slide retainer and clutch from armature shaft.

## REMOVE SOLENOID

1. Remove solenoid to drive housing attaching screws and remove solenoid.

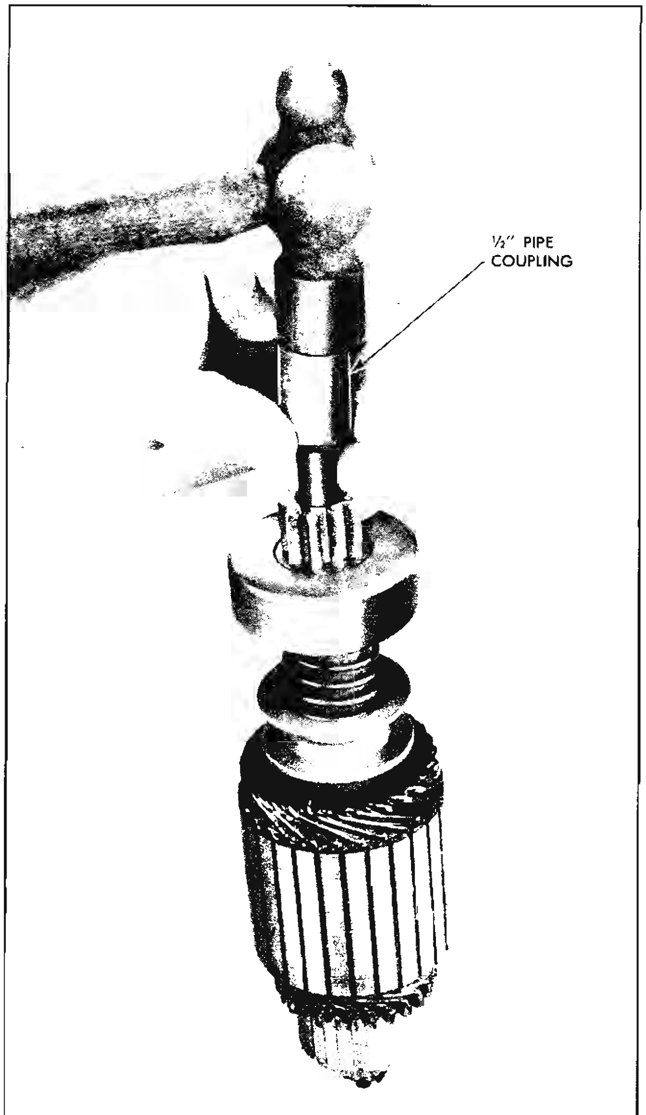



Fig. 11-7 Driving Retainer Off Snap Ring

2. Remove solenoid return spring.

3. Remove shift lever pivot pin.

4. Remove shift lever and plunger assembly.

### DISASSEMBLE SOLENOID

1. Remove nuts from the motor terminal and switch terminal and the two attaching screws.

2. Using care, remove cover.

***CAUTION: These terminal studs have welded lead connections. Do not twist during removal of nuts.***

### CLEAN AND INSPECT

1. If the solenoid contacts are slightly burned or dirty, the contacts should be cleaned. When the contacts are badly burned, the burned parts should be replaced.

2. Test overrunning clutch action. The pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Replace assembly if necessary. Badly chipped pinion teeth may indicate chipped teeth on the ring gear. This should be checked under such conditions and replaced if necessary.

3. Check brush holders to see that they are not deformed or bent, but will properly hold brushes against the commutator.

4. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.

5. The overrunning clutch, armature and fields should not be cleaned in any degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and would damage the insulation in the armature and field coils. It is suggested that all parts except the clutch, be cleaned with oleum spirits and a brush. The clutch can be wiped with a clean cloth.

If the commutator is dirty it may be cleaned with No. 00 sandpaper. *Never use emery cloth to clean commutator.*

## *SERVICE*

### ARMATURE

If the armature commutator is worn, dirty, out of round or has high insulation, the armature should be put in a lathe so the commutator can be turned down. The insulation should then be undercut 1/32 of an inch wide and 1/32 of an inch deep, and the slots cleaned out to remove any trace of dirt or copper dust. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any burrs left as a result of the undercutting procedure.

The armature should be checked for opens, short circuits and grounds as follows:

1. Open—The most likely place for an open to occur is at the commutator riser bars as a result of excessively long cranking periods. Inspect the points where the conductors are joined to the commutator bars for loose connections. The poor connections cause arcing and burning of the commutator bars as the starting motor is used. If the bars are not too badly burned, repair can often be effected by resoldering the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material. The insulation should then be undercut.

2. Short Circuit—Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.

3. Ground—Grounds in the armature can be detected by the use of 110-volt test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure which is often brought about by overheating of the starting motor produced by excessively long cranking periods or by accumulation of brush dust between the commutator bars and the steel commutator ring.

### FRAME AND FIELD

The field winding can be checked for an open or a ground by using a test lamp as follows:

1. Ground—Touch one lead of the 110-volt test

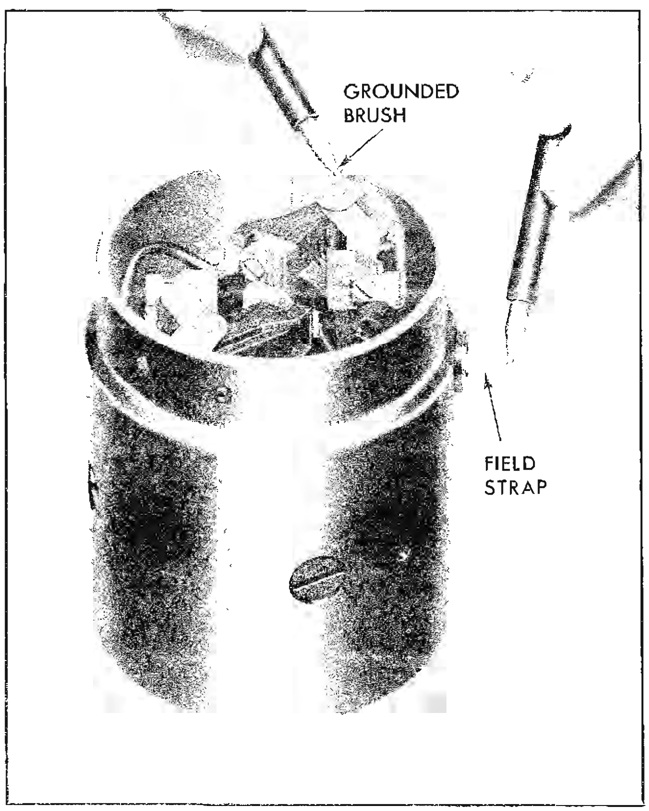



Fig. 11-8 Testing Field Coils for Ground

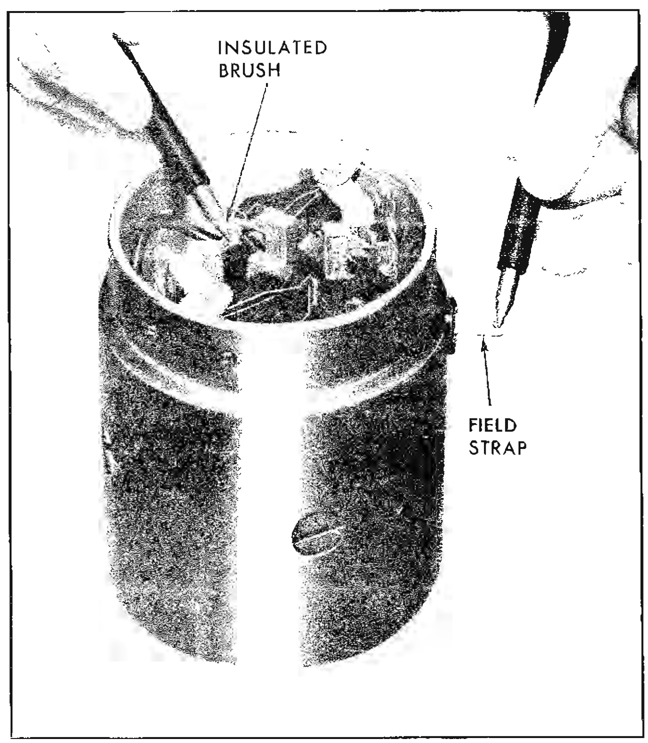



Fig. 11-9 Testing Field Coils for Open Circuit

lamp to the grounded brush and the other lead to the field connector strap (Fig. 11-8). If the lamp lights, at least one field coil is grounded and the defective coil will require repair or replacement.

2. Open—Touch one test lamp lead to insulated brush and one lead to field connector strap (Fig. 11-9). If lamp does not light, the series field coils are open.

3. On V-8 engine starting motors, place one lead on each end of the shunt coil. Disconnect the shunt coil grounds before this check is made. If the lamp does light, the shunt coil is open and will require replacement.

## FIELD COIL REMOVE

Field coils can be removed from the field frame assembly most easily by use of a pole shoe screwdriver. A pole shoe spreader should also be used since this prevents distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place. Formed insulators are used to protect the field leads from grounding to the frame. These must be replaced on assembly.

## REPLACE BRUSHES

1. Remove brush holder pivot pin which positions one insulated and one grounded brush.

2. Remove brush spring.

3. Replace brushes as necessary.

To assemble, reverse above procedure.

### *ASSEMBLE SOLENOID*

1. When reassembling the cover on the solenoid make sure the terminal studs are properly positioned in cover. The cover gasket must be centered under the cover to insure proper sealing.

2. Install cover attaching screws and install nuts on motor and switch terminals.

## INSTALL SOLENOID

1. Install plunger and lever assembly and pivot pin.

2. Install return spring.

3. Attach solenoid to starter drive housing and secure with two attaching screws.

### *ASSEMBLE STARTER*

1. Assemble overrunning clutch to armature shaft as follows:

a. Lubricate drive end of armature shaft with high melting point grease.

b. Slide clutch assembly onto armature shaft with pinion outward (Fig. 11-7).

c. Slide retainer onto shaft with cupped surface facing end of the shaft (Fig. 11-7).

d. Stand armature on end on wood surface with commutator down. Position snap ring on upper end of shaft and hold in place with a block of wood. Hit wood block a blow with hammer forcing snap ring over end of shaft. Slide snap ring down into groove (Fig. 11-10).

e. Assemble thrust collar on shaft with shoulder next to snap ring (Fig. 11-11).

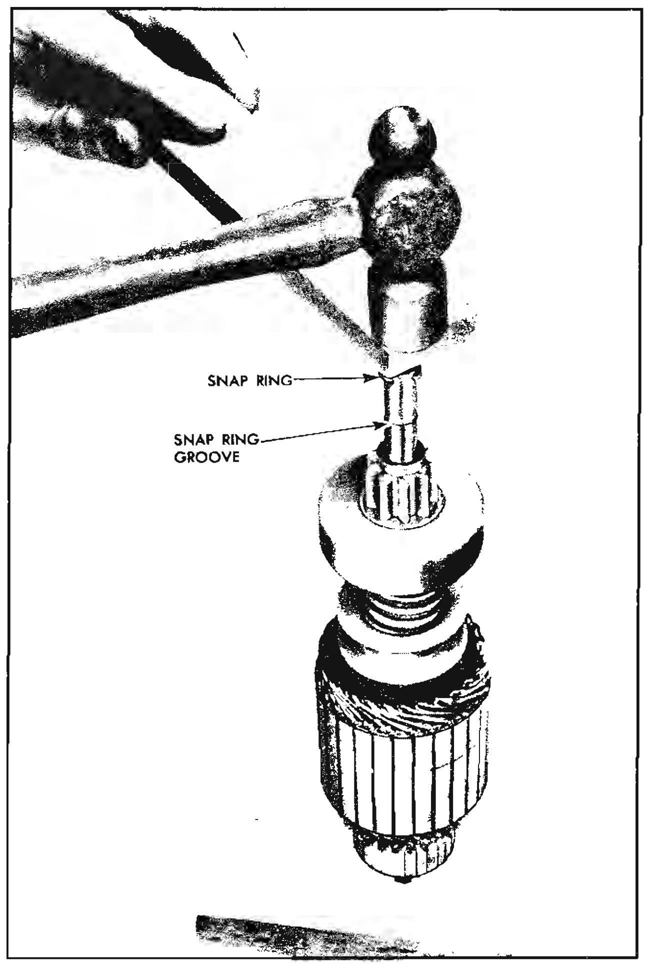



Fig. 11-10 Forcing Snap Ring onto Armature Shaft

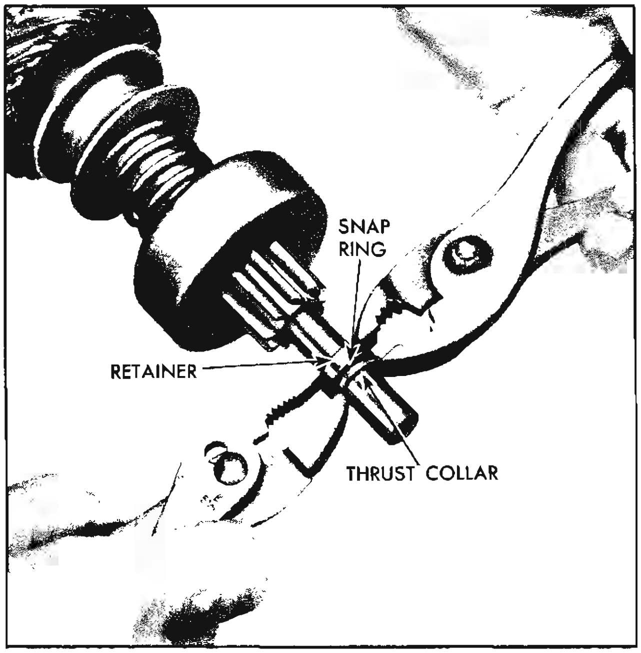



Fig. 11-11 Forcing Retainer Over Snap Ring

f. Place armature flat on work bench, and position retainer and thrust collar next to snap ring. Then, using two pairs of pliers at same time (one pair on either side of shaft), grip retainer and thrust collar and squeeze until retainer is forced over snap ring (Fig. 11-11).

2. Place 4 or 5 drops of light engine oil in drive housing bushing. Make sure thrust collar is in place against snap ring and retainer. Slide armature and clutch assembly into place in drive housing, engaging shift lever with clutch.

3. Position field frame over armature, and apply sealing compound between frame and solenoid case.

Position frame against drive housing, using care to prevent damage to brushes.

4. Place 4 or 5 drops of light engine oil in bushing in commutator end frame. Place leather thrust washer on armature shaft and slide commutator end frame onto shaft.

5. Install through bolts and tighten securely.

6. Reconnect the field coil lead to the motor solenoid terminal.

### *PINION CLEARANCE CHECK*

There are no provisions for adjusting pinion clearance on the enclosed shift lever cranking motor. When the shift lever mechanism is correctly assembled, the pinion clearance should fall within the specified limits (.010"-.140"). When the clearance is out of these limits it may indicate excessive wear of solenoid linkage or shift lever yoke buttons.

The pinion clearance should be checked after motor has been disassembled and then reassembled. To check, connect a voltage source of approximately 6 volts (three battery cells in series of 6-volt battery) between the solenoid switch terminal and ground.

NOTE: Do not connect the voltage source to the ignition coil terminal "R" of the solenoid. Do not use a 12-volt battery instead of the 6 volts specified as this will cause the motor to operate. As a further precaution to prevent motoring, connect a heavy jumper lead from the solenoid motor terminal to ground. After energizing the solenoid with the clutch shifted towards the pinion stop retainer, push the pinion back toward the commutator end as far as possible to take up any slack movement, then check the clearance with a feeler gauge (Fig. 11-12).

### *INSTALL IN CAR*

1. Install starting motor, using straight box end wrench through slot in four cylinder engine block casting for lower mounting bolt.

2. Connect battery positive cable and wiring harness leads to starting motor solenoid.

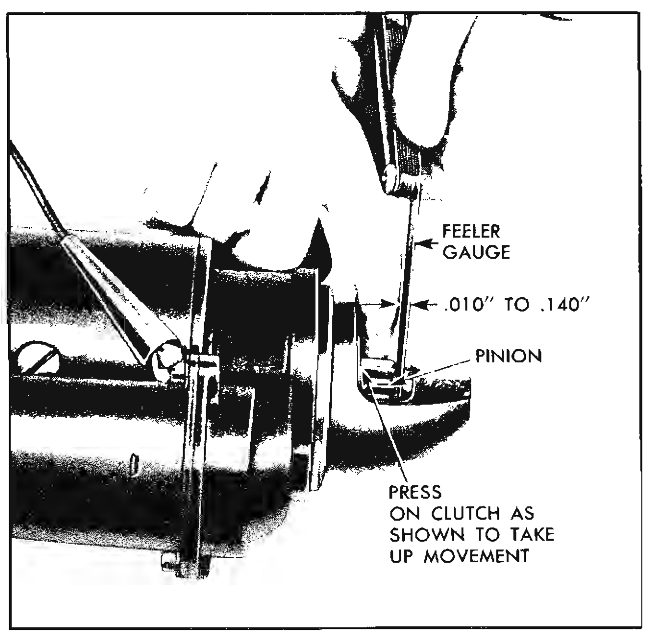



Fig. 11-12 Measuring Pinion Clearance

3. Connect battery ground cable at battery terminal post.

### TROUBLE DIAGNOSIS

***CAUTION: Specific gravity of battery must be 1.215 or higher before making the following tests:***

1. If the solenoid does not pull in, measure the voltage between the switch S terminal of the solenoid and ground with the starting switch closed.

***CAUTION: If the solenoid feels warm, allow to cool before checking. If the voltage is less than 7.7 volts, check for excessive resistance in the solenoid control circuit. If the voltage exceeds 7.7 volts, remove the starting motor and check (1) solenoid current draw, (2) starting motor pinion clearance, and (3) freedom of shift lever linkage.***

2. If the solenoid "chatters" but does not hold in, check the solenoid for an open "hold-in" winding.

3. If motor engages but does not crank or cranks slowly, check for excessive resistance in the external cranking circuit or within the starting motor.

# CHARGING CIRCUIT

The charging circuit consists of the alternator, voltage regulator, battery and ammeter (for a complete discussion on the battery see "Starting Circuit").

## ALTERNATOR

### DESCRIPTION

A 37 amp alternator is used as standard equipment on the 4 and 8 cylinder engine cars. A 42 amp alternator is used on cars equipped with air conditioning.

As the name implies an alternator is a generator that produces alternating current which is converted to direct current through the use of six silicon diodes mounted within the alternator.

It has the advantage of developing a continuous supply of current (up to 19 amps at idle), lighter weight, promoting longer battery and brush life, needing no periodic lubrication, and limiting its own current output (which eliminates the need for a current regulator). Brush life is increased due to low field current in rotor, nonsegmented slip rings, and no arcing. Also, no cut-out relay is needed in the regulator, since the one-way diodes in the alternator protect it from the battery.

In addition to the diodes, the main components of the alternator are the slip ring end frame, the drive end frame, the stator and the rotor (Fig. 11-13).

### END FRAMES

The slip ring end frame houses the diodes and the brush assembly. The drive end frame retains the rotor assembly, fan and pulley. The stator assembly is sandwiched between the two end frames

### STATOR

The stator assembly is made up of a laminated iron frame and a stator or output winding which is wound into slots of the frame. Each of the three windings is connected to the other two at one end and have two diodes connected to the other end.

### ROTOR

The rotor assembly consists of a doughnut shaped field coil mounted between two iron segments with 14 interlacing fingers which make up the north and south poles. It is held together on the shaft by a press fit and rotates inside the stator assembly.

The rotor shaft is supported by prelubricated ball bearings in the drive end frame and a prelubricated roller bearing in the slip ring end frame.

Two slip rings, upon which the brushes ride, are mounted on one end of the rotor shaft and are attached to the leads from the field coil.

### DIODES

The function of a diode is to permit current to flow in only one direction and to block it from flowing in the opposite direction. Therefore, the alternating current induced in the stator windings will appear as direct current at the output or "BAT" terminal of the alternator.

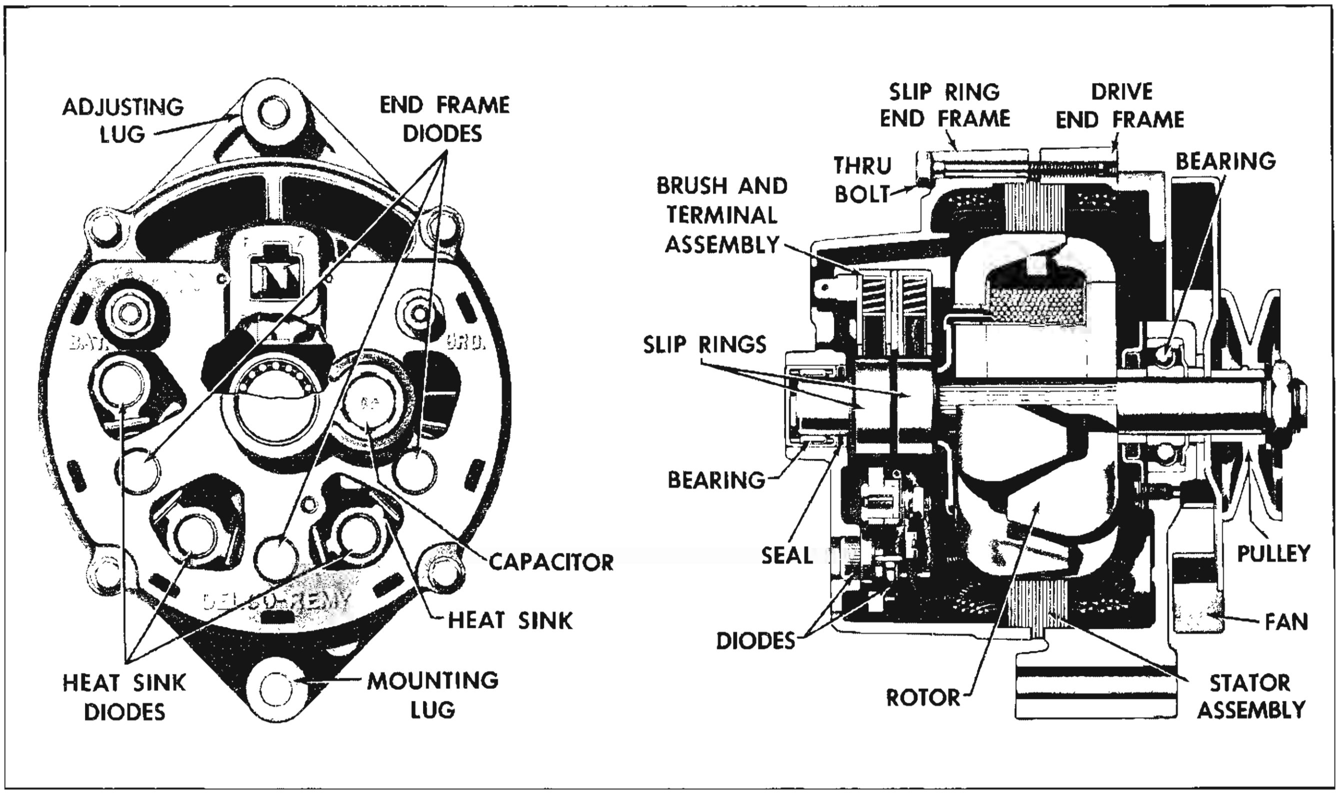



Fig. 11-13 Cross Section of Alternator

However, since the diodes permit current to flow in only one direction, no current will flow from the battery through the alternator to ground.

Three negative diodes are pressed into the slip ring end frame. Three positive diodes are pressed into a "heat sink" which is insulated from the slip ring end frame.

### *OPERATING PRINCIPLES*

When the ignition switch is turned "on", current flows from the battery through the ignition switch, through the lower contact points of the voltage regulator and to the field terminal of the alternator. Low field current then flows through one brush, through the slip ring upon which it rides and through the field coil in the rotor. After leaving the field coil, it flows through the other slip ring and brush to ground. Thus, this current energizes the field coil. With the engine running, the 14 pole rotor creates a spinning magnetic field whose lines of force cut through the stationary stator windings, inducing alternating current in the stator windings.

The diodes convert the alternating current into direct current at the battery terminal. The diodes also prevent the battery from discharging through the alternator.

NOTE: Since the rotor poles have practically no residual magnetism, the field windings must be energized before the alternator will produce any current. This current is supplied by the battery when the ignition switch is turned on. Since the alternator does not have a permanent magnet, it is not necessary to polarize it.

### *PERIODIC SERVICE*

The alternator *does not* require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end, and a roller bearing at the slip ring end, and each has a permanent grease supply which eliminates the need for periodic lubrication. At periodic intervals, check the mounting bolts for tightness and the belt for proper alignment, wear and tension.

***CAUTION: When applying belt tension, apply pressure at center of alternator, never against either end frame.***

### *SERVICE PRECAUTIONS*

Since the alternator 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. Do not attempt to polarize the alternaor. It isn't necessary since there are no permanent magnets.

2. Do not short across or ground any of the terminals on the alternator or regulator.

3. Never operate the alternator on an open circuit (with the field terminal connected and the output terminal disconnected). Make absolutely certain all connections in the circuit are secure. If the alternator is operating on an open circuit, extremely high voltages may result that are both dangerous and damaging to the alternator.

4. When installing a battery, always make absolutely sure the negative post of the battery is attached to the ground strap.

***CAUTION: Never reverse battery leads, even for an instant, as reverse polarity current flow will damage diodes in alternator.***

5. When connecting a booster battery, make certain to connect the negative battery terminals together and the positive battery terminals together.

6. 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.

### CHECK IN CAR

If the electrical system is not charging properly, follow the in-car checks outlined under "Standard Alternator Regulator", prior to removing the alternator. If electrical system trouble is found to be in the alternator, it need not be removed from the car unless the drive end frame needs servicing, because the slip ring end frame separates from the drive end frame by simply loosening drive belt and removing four through bolts. If the drive end frames must be serviced, remove alternator as follows.

### REMOVE FROM CAR

1. Disconnect positive battery terminal.

***CAUTION: Failure to observe this step may result in an injury from hot battery lead at alternator.***

2. Remove two leads at alternator.

3. Loosen adjusting bolts.

4. Remove alternator drive belt.

***CAUTION: To prevent damage to belt, it should be removed in the following sequence: 1—from water pump pulley; 2—from crankshaft pulley; 3—from alternator pulley.***

5. Remove the bolts which retain alternator.

6. Remove alternator from car.

### DISASSEMBLE ALTERNATOR

1. If rotor, drive end frame bearings, or pulley and fan need replacement, remove and replace the shaft nut using strap wrench J-9183 around the fan. assembly.

NOTE: If the nut should happen to be cross-threaded or rusted and unusually difficult to remove, an alternate procedure is to use the strap wrench J-9183 around the rotor. The torque on the nut is 50-60 lb. ft.

2. Scribe a mark between the two halves of the alternator to help locate the parts in the same position during assembly.

3. Remove four through bolts.

4. Separate the drive end frame and the rotor assembly from the stator assembly by prying apart with a screw driver at stator slot. The fit between the two is not tight and the two can be separated easily.

NOTE: The separation is to be made between the stator assembly and Drive End Frame.

***CAUTION: As the rotor and drive end frame assembly is separated from the slip ring frame assembly, the brushes will fall down onto the shaft and come in contact with the lubricant. Brushes which come in contact with shaft should be cleaned immediately to avoid contamination by oil, or they will have to be replaced.***

### ROTOR

The rotor may be checked electrically for grounded, open or short-circuited field coils as follows:

1. To check for grounds, connect a 110 volt test lamp or an ohmmeter from either slip ring to the rotor shaft, or to the rotor poles. If the lamp lights or the ohmmeter reading is low, the field winding is grounded (Fig. 11-14).

2. To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open (Fig. 11-14).

3. The 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 1.9-2.3 amperes. An ammeter reading above this value indicates shorted windings.

4. Rotor assemblies which fail above tests should be replaced.

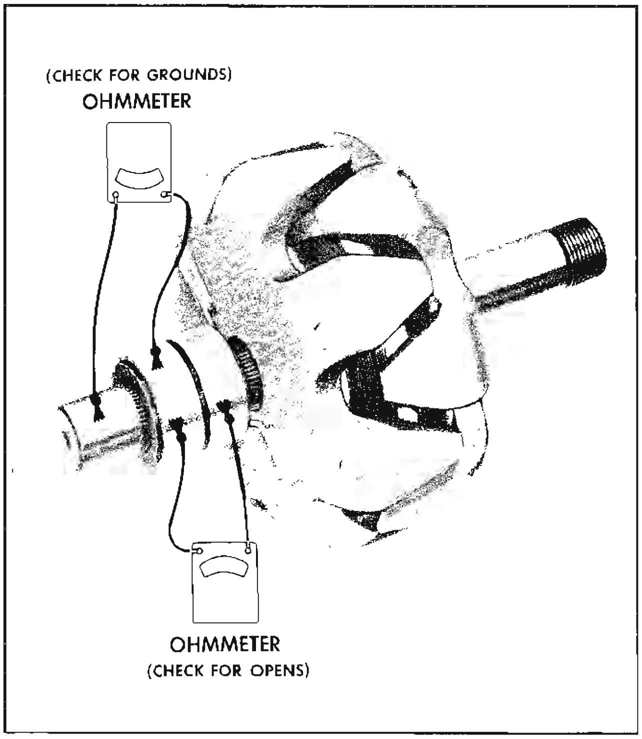



Fig. 11-14 Checking Rotor

The rotor may be cleaned and inspected as follows:

a. If the magnetic poles of the rotor need cleaning, they may be cleaned by brushing with oleum spirits.

***CAUTION: Do not clean with degreasing solvent.***

b. Inspect slip rings for dirt and roughness. These may be cleaned with a solvent, if necessary. They may also be cleaned and finished with 400 grain or finer polishing cloth. Do not use sand paper. 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" maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

### DRIVE END FRAME BEARING

1. Remove three screws from retainer plate and remove retainer plate inner collar and gasket.

2. Press out bearing and oil slinger.

3. The bearings in an alternator are permanently lubricated and require no lubrication during the life of the bearing. If a dry bearing is encountered, do not attempt to lubricate, as an improper lubricant, or an excessive amount of lubricant may burn bearing, or be thrown off and contaminate the inside of alternator. Replace dry, worn, or rough bearings with a new bearing which will be prepacked with proper amount and type of lubricant.

4. To install, press in bearing and grease slinger with a tube or collar that just fits over the outer race.

5. Install retainer plate gasket and inner collar with three screws. It is recommended that a new retainer plate be installed if the felt seal is hardened or excessively worn.

### STATOR

If the stator is to be checked and/or replaced:

1. Remove 3 stator lead attaching nuts and washers (Fig. 11-15).

2. 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.

3. The stator windings may be checked with a 110 volt test lamp or an ohmmeter as follows:

a. To check for grounded windings, connect lamp or ohmmeter from any stator lead to frame. If lamp lights or ohmmeter reading is low the stator is grounded (see Fig. 11-16).

b. To test for opens, successively connect 110 volt test lamp or an ohmmeter between stator leads. If

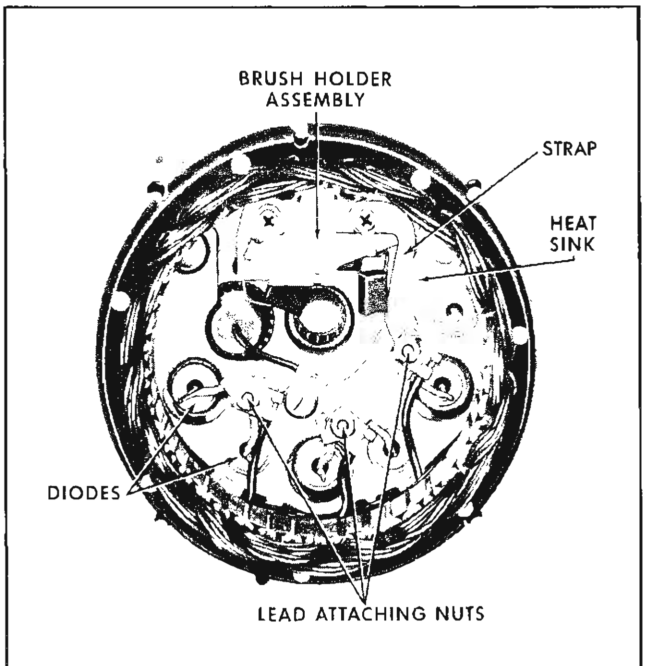



Fig. 11-15 Slip Ring End Frame

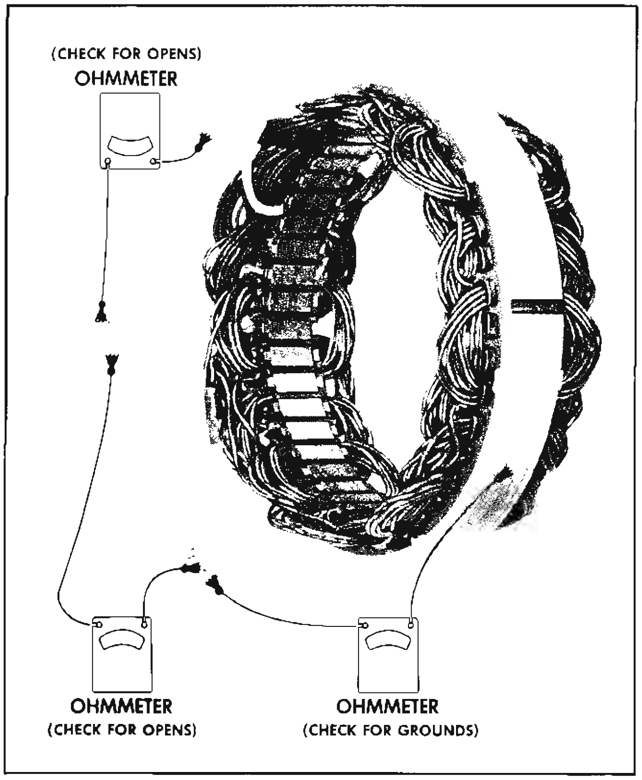



Fig. 11-16 Checking Stator

lamp fails to light and if ohmmeter reading is high, there is an open in the stator windings (see Fig. 11-16).

c. A short circuit in the stator windings is difficult to locate without laboratory test equipment, due to low resistance of the windings. However, if all other electrical checks are normal and the alternator fails to supply rated output, shorted stator windings are indicated.

d. Stator assemblies which fail above test should be replaced.

4. If necessary, stator assembly may be cleaned by brushing with oleum spirits.

***CAUTION: Do not clean in solvent.***

5. The stator can be installed by reversing steps 1 and 2.

### BRUSHES

1. Remove two brush holder screws and stator lead to strap attaching nut and washer (Fig 11-15).

2. Remove brush holder assembly and brushes. Carefully note stack-up of parts (Fig. 11-17) for reassembly.

3. Inspect brush spring for evidence of damage or corrosion.

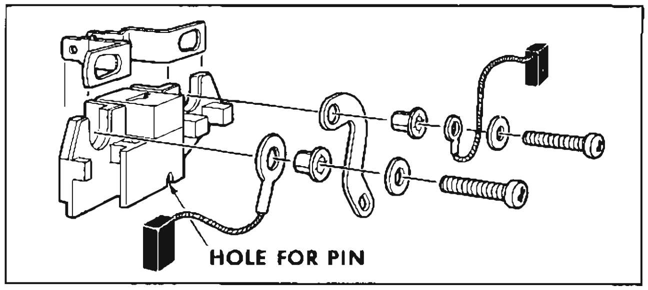



Fig. 11-17 Brush Holder Assembly

4. Inspect brushes for wear or contamination.

5. If old brushes are to be reused, they must be thoroughly cleaned with a soft dry cloth and must be completely free of oil.

6. If there is any doubt about condition of brush springs, they should be replaced.

7. Install the spring and brushes into the brush holder (they should slide in and out without binding). Insert a straight wood or plastic toothpick (to prevent scratching brush face) into the hole at the bottom of the holder to retain the brushes.

8. Attach the brush holder assembly into the end frame, noting carefully the stack-up of parts as shown in Fig. 11-17. Allow the wood or toothpick to protrude through the hole in the end frame and install stator lead to strap attaching nut and washer (Fig. 11-15).

### SLIP RING END FRAME BEARING AND SEAL

1. With stator removed, press out bearing and seal with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing toward the inside. Support inside of frame with hollow cylinder to allow seal and bearing to pass through.

2. The bearings in an alternator are permanently lubricated and require no lubrication during the life of the bearing. If a dry bearing is encountered, do not attempt to lubricate, as an improper lubricant, or an excessive amount of lubricant may burn bearing, or be thrown off and contaminate the inside of alternator. Replace dry, worn, or rough bearings with a new bearing which will be prepacked with proper amount and type of lubricant.

3. Place a flat plate over the bearing and press in from outside toward the inside of frame until the bearing is flush with the outside of the end frame. Support the inside of 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.

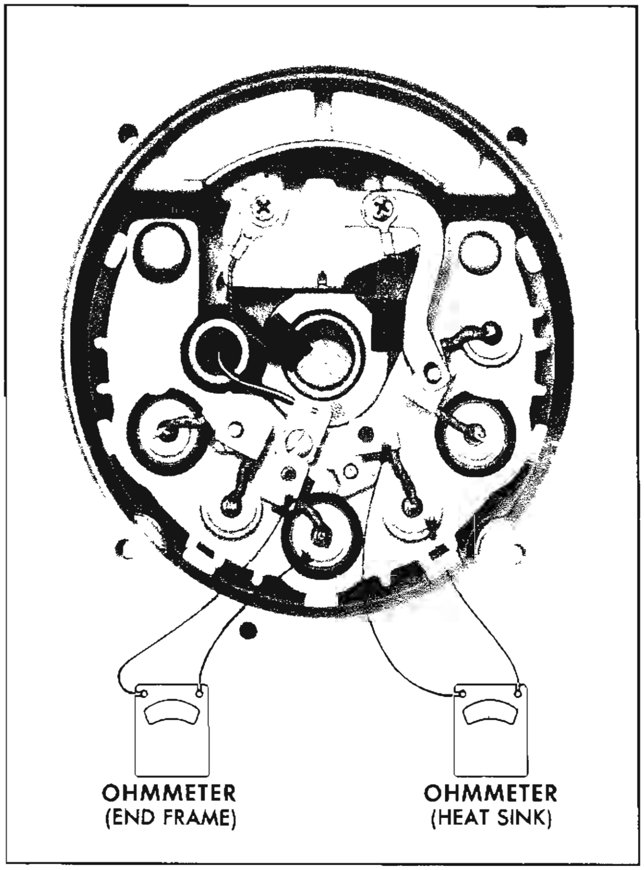



Fig. 11-18 Checking Diodes

4. From inside of frame, insert seal flush against bearing.

5. Install stator and connect leads.

### DIODES

Diodes are checked by making use of their principles of allowing electricity to pass through in only one direction. Two methods are available:

#### OHMMETER METHOD

The lowest range scale on the ohmmeter should be used, and it should have a 1½ volt cell. To determine the cell voltage, turn the selector to the lowest scale, and then connect the ohmmeter leads to a voltmeter. The voltmeter will indicate cell voltage.

Heat Sink Diodes:

1. With the stator disconnected, check a diode in the heat sink by connecting one of the ohmmeter leads to the heat sink, and the other ohmmeter lead to the diode lead and note reading, (see Fig. 11-18).

2. Reverse ohmmeter leads and note reading.

3. If both readings are very low or very high (read the same), the diode is defective. A good diode will give one low reading and one high reading.

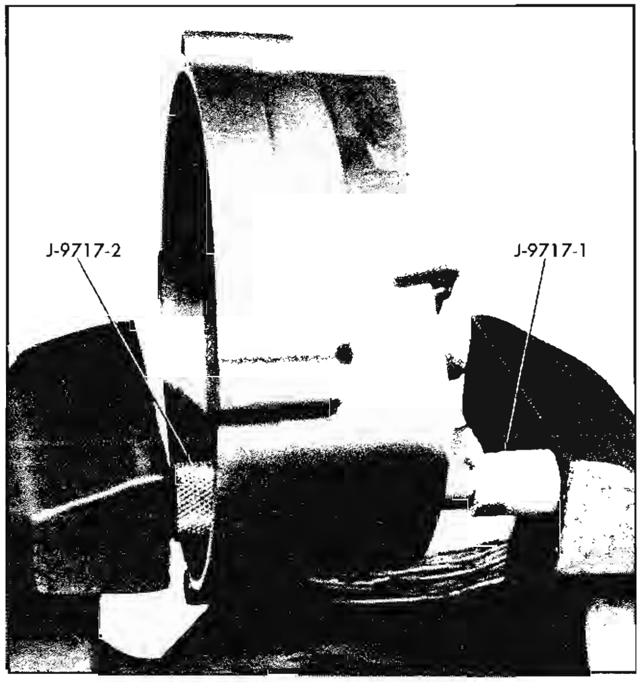



Fig. 11-19 Removing Diode

4. Check the other two diodes in the heat sink in the same manner.

End Frame Diodes:

1. To check a diode mounted in the end frame, connect one of the ohmmeter leads to the end frame and the other ohmmeter lead to the diode lead and note reading (see Fig. 11-18).

2. Reverse ohmmeter leads and note readings.

3. If both readings are very low or very high (read the same), the diode is defective. A good diode will give one low reading and one high reading.

4. Check the other two diodes in the end frame in the same manner.

#### TEST LAMP METHOD

An alternate method of checking diodes is to use a test lamp of not more than 12 volts in place of the ohmmeter.

***CAUTION: Do not use 110 volt test lamp to check diodes.***

With the stator disconnected, connect the test lamp across each diode as previously described, first in one direction and then the other.

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 checks.

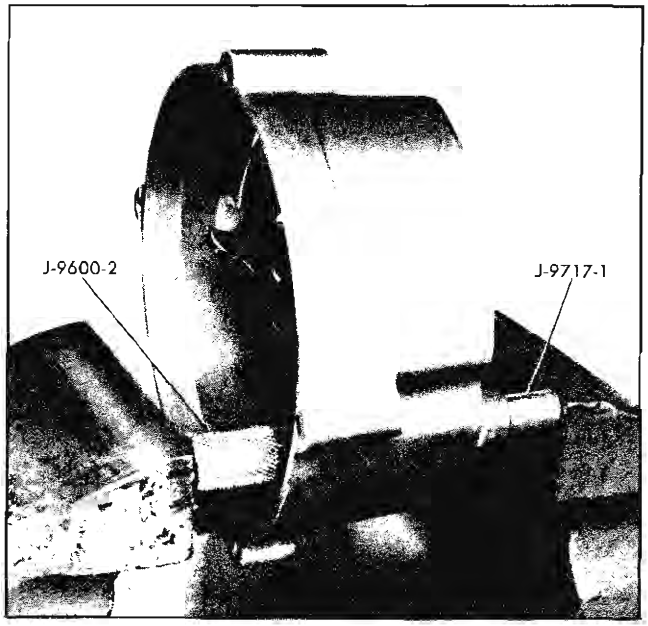



Fig. 11-20 Installing Diode

Diodes which fail the electrical tests should be replaced. If diode must be replaced:

1. With stator removed, support slip ring end frame in vise or arbor press with J-9717-2 against casting and position remover J-9717-1 against diode as shown in Fig. 11-19.

2. Tighten vise to remove diode.

***CAUTION: Never attempt to remove diode by striking it, as the shock may damage the other diodes.***

3. To install a diode, place a new diode in installer J-9600-2.

4. Place slip ring end farme in a vise so that new diode is in position and remover J-9717-1 supports casting (Fig. 11-20).

5. Tighten vise to install diode.

***CAUTION: Never attempt to install diode by striking it, as the shock may damage the other diodes.***

6. Install stator and connect leads.

### HEAT SINK ASSEMBLY

NOTE: Do not disassemble unless absolutely necessary. The heat sink must be completely insulated from end frame.

1. With stator removed, remove screw retaining condenser lock washer, flat washer, fiber insulator and condenser lead.

2. Remove "BAT" and "GRID" terminals and respective washers and insulators from end frame

3. Remove heat sink and washers.

4. Replace heat sink assembly, noting the stack-up of parts shown in Fig. 11-21.

5. Attach condenser lead to heat sink with washer and screws. Be sure insulating washer is between heat sink and end frame.

6. Install stator and connect leads.

### ASSEMBLE ALTERNATOR

1. Before assembling rotor and drive end frame to slip ring end frame, make sure the bearing surfaces of the shaft are perfectly clean.

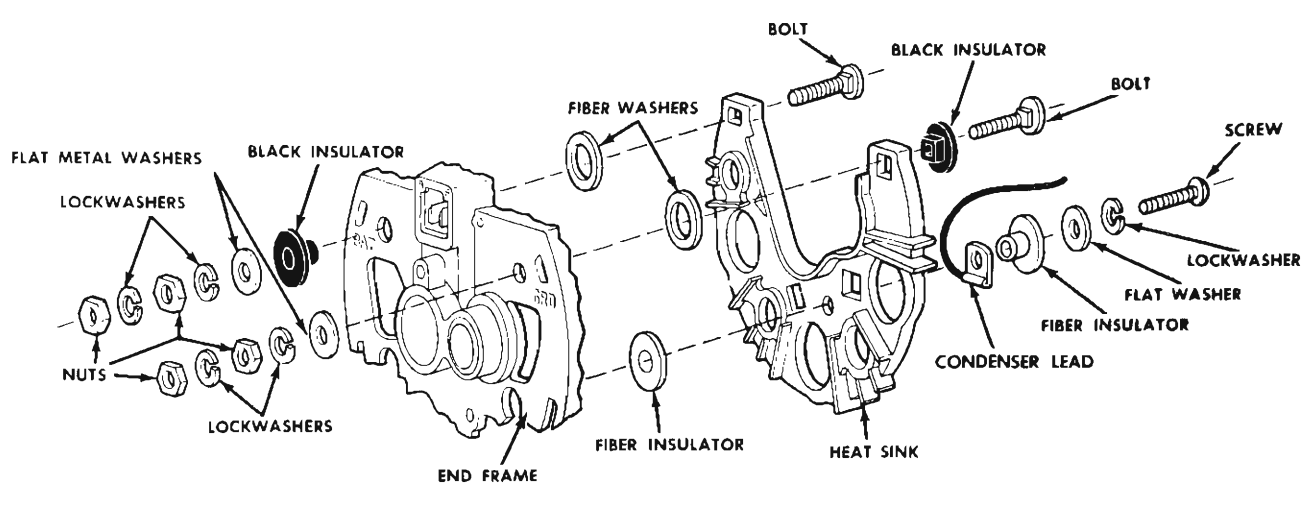



Fig. 11-21 Heat Sink Assembly

2. Join together two end frames, matching scribe marks.

3. Install four through bolts.

4. Remove wood or toothpick from brush holder assembly.

### *INSTALL IN CAR*

1. If removed from car, install alternator to mounting bracket with bolts, washers, and nuts. Do Not Tighten.

2. Install alternator drive belt.

***CAUTION: To prevent damage to belt it should be installed in the following sequence: 1—in alternator pulley groove; 2—in crankshaft pulley groove; 3—in water pump pulley groove.***

3. On all but air conditioned cars, exert a force on alternator using J-21268. On air conditioned cars use a lever between mounting bracket and timing chain cover. Adjust belt tension according to chart on page 6A-10.

4. Tighten bolts to 25-35 lb. ft., except bolt at sliding slot on bracket used for other than air conditioned cars, which is 10-25 lb. ft.

5. Install field and battery leads to alternator.

6. Connect positive battery terminal.

***CAUTION: Take care not to reverse polarity.***

### *NOISEY ALTERNATOR*

Noise from an alternator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, a defective diode, out-of-round or rough slip rings, hardened brushes, or a defective stator.

## ALTERNATOR REGULATOR

### *DESCRIPTION*

The only function of the alternator double contact regulator (Fig. 11-22) is to limit the voltage output of the alternator, since the alternator limits its own current ouput, the diodes prevent the battery from discharging through the alternator, and the alternator field windings are energized directly through the ignition switch.

### *OPERATING PRINCIPLES*

Following is a brief description of the operating principles of the unit. A typical wiring diagram showing the internal circuits of the regulator is shown in Fig. 11-23. NOTE: On cars equipped with a radio, a condenser is connected to the No. 4 regulator terminal. If a condenser is not used, neither is the No. 4 terminal.

***CAUTION: Do not connect anything to the No. 4 terminal other than a condenser.***

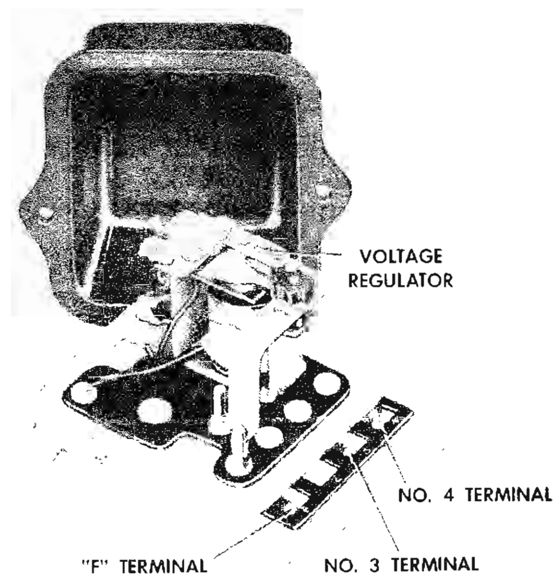



Fig. 11-22 Voltage Regulator

As the speed of the alternator increases , the voltage at the "BAT" terminal of the alternator also incresases. This causes a higher current flow through the voltage regulator shunt winding. The increased magnetism created by the higher current through the shunt winding causes the lower contacts to separate, and field current then flows through a resistor resulting in reduced field current. This reduced field current causes

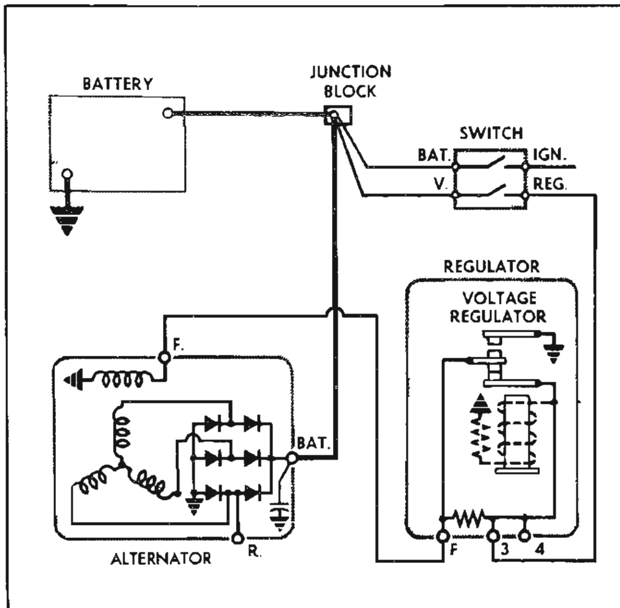



Fig. 11-23 Regulator in Charging Circuit

the alternator voltage to decrease, which decreases current flow and thereby the magnetic pull of the voltage regulator winding. The spring causes the contacts to reclose and the cycle then repeats many times per second to limit the alternator voltage to a pre-set value.

As the alternator speed increases even further, the resistor connected across the contacts is not of sufficiently high value to maintain voltage control of the lower contacts. The higher output further increases the magnetism, causing the upper or shorting contacts to close. When this happens, the alternator field winding is grounded and no current passes through winding. With no current in the field winding, the alternator voltage decreases, which also decreases the magnetism in the regulator shunt winding and the upper or shorting contact points open. With these points open, field current flows through the resistor and the field winding. As the voltage incresases, the contacts re-close. This cycle then repeats many times per second to limit the alternator voltage to a pre-set value at high alternator speeds. The voltage regulator unit operates to limit the value of alternator voltage throughout the alternator speed range. Consequently, the electrical accessories are protected from too high voltage which would damage them.

### *PERIODIC SERVICE*

Normally periodic service of the regulator is not required. However, it may occasionally be necessary to clean and adjust the regulator contact points, adjust air gap and tailor voltage setting according to type of driver and climatic conditions.

### *CHECK AND ADJUST ON CAR*

### CHARGING SYSTEM TESTS

Any malfunction of the charging system will eventually result in:

Overcharging battery, as evidenced by excessive use of water.

An undercharged battery as evidenced by slow cranking speed (hard start).

Overcharging Battery:

Overcharging of battery may be due to:

1. Shorted battery cell.

2. High voltage regulator setting.

Undercharged Battery:

An undercharged battery may be due to:

1. Battery malfunction

a. Intermittent open at terminal post.

b. Sulphated.

c. Intermittent open of cell connector.

2. Low alternator output

a. Slipping drive belt.

b. Alternator malfunction.

c. Low alternator field current

3. Improper alternator regulation

a. Malfunction and/or low setting of voltage regulator.

4. High resistance in wiring circuit (loose or corroded connections, broken wires, etc.).

Whenever malfunction of the charging system is suspected, the following test procedures should be followed until any problems are located and corrected.

NOTE: Before making any electrical checks, visually inspect all connections, including the slip-on connectors at the regulator and alternator to make sure they are clean and tight.

### ALTERNATOR OUTPUT

1. Check alternator drive belt tension and adjust according to specifications chart on page 6A-10.

***CAUTION: When adjusting belt tension, apply pressure at center of alternator, never against the ends of alternator.***

2. Connect an ammeter in series in charging circuit at the alternator output terminal (BAT) as shown in Fig. 11-24.

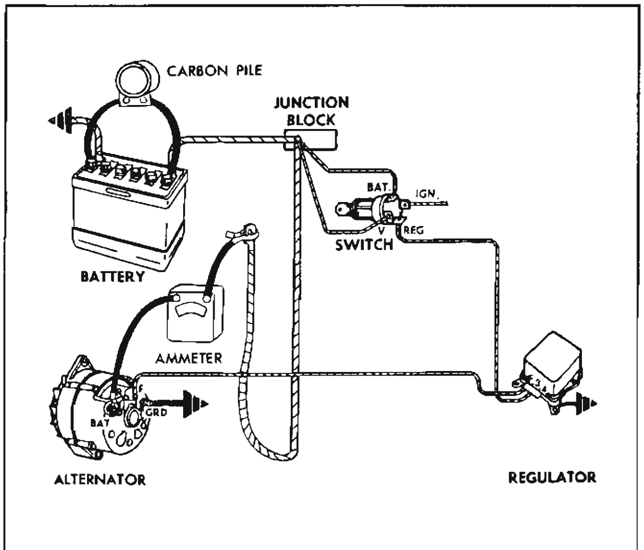



Fig. 11-24 Measuring Output

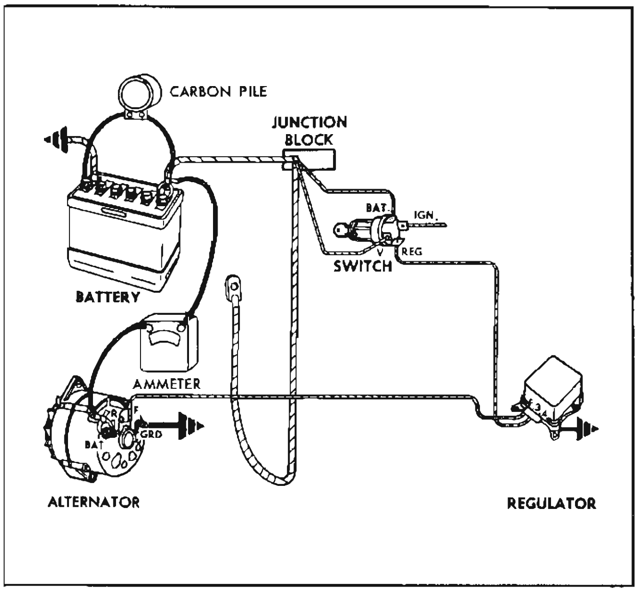



Fig. 11-25 Ammeter Measuring Output

***CAUTION: Disconnect battery positive cable while making ammeter connection between output lead and ammeter lead, in a position where it cannot touch ground.***

a. Reconnect battery.

b. Connect a tachometer from distributor terminal of coil to ground.

3. Start engine and load battery with carbon pile resistor. Adjust engine idle to 500 rpm. Alternator output should be 15 amperes or more. Increase engine speed to 2500 rpm and increase carbon pile load on battery until alternator reaches maximum output.

NOTE: The maximum obtainable output may be less than the rated output because of high temperatures at the alternator (up to 5 amperes at 160° F.).

a. If alternator output comes within 5 amps of rated output, proceed to "Voltage Setting."

b. If output fails to reach specified amount, shut off engine and proceed with the following tests until source of trouble is located and correct output is obtained. These tests will determine and locate excessive resistance, faulty connections, grounds, opens, shorts and/or defective regulator or alternator in charging circuit.

4. Disconnect ammeter lead from alternator output lead and connect ammeter lead to positive terminal of battery (Fig. 11-25).

***CAUTION: Disconnect battery positive cable (do not let it touch ground) while disconnecting ammeter lead from output lead. Do not let alternator output lead touch ground.***

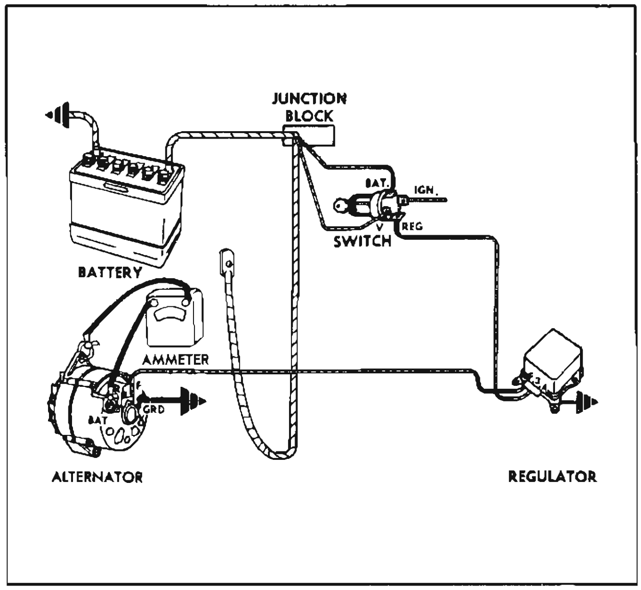



Fig. 11-26 Ammeter Measuring Output

a. Start engine and increase to 2500 rpm. Again increase carbon pile load on battery until alternator reaches maximum output.

b. If output is now correct, excessive resistance or an open or short is indicated between alternator and battery. Proceed to Insulated Charging Circuit Test under "Circuit Resistance Test."

c. If alternator output does not come up to specifications, proceed to next step.

5. Move ammeter lead from positive battery terminal to alternator frame (Fig 11-26). Start engine and increase to 2500 rpm.

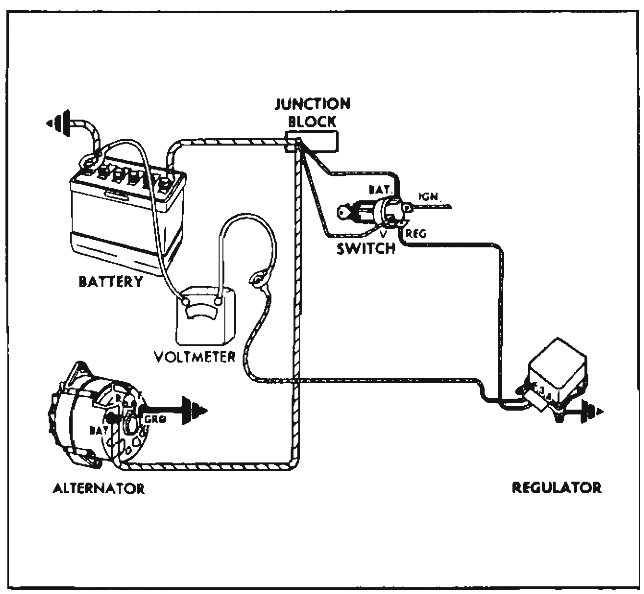



Fig. 11-27 Voltmeter in Circuit

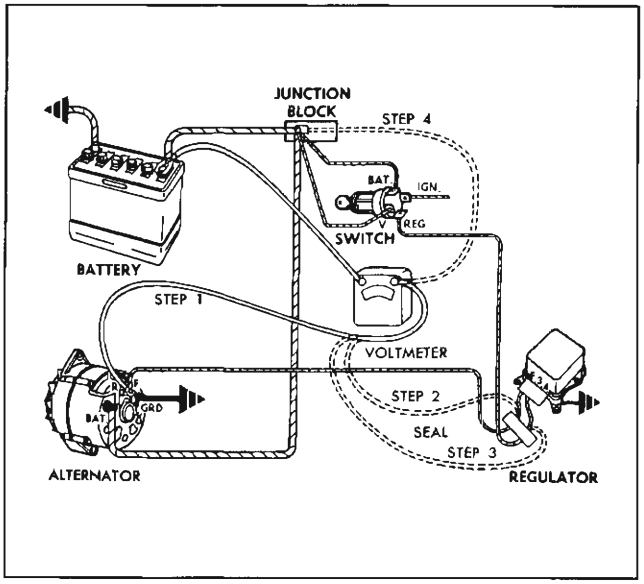



Fig. 11-28 Voltmeter Measuring Resistance

a. If alternator reaches approximate rated output, check for improper grounding of battery and alternator to engine block.

b. If alternator output still does not come up to specifications, malfunction in field circuit is possible. Proceed to next step.

6. Disconnect field lead at alternator and connect voltmeter between this lead and ground terminal of battery (Fig. 11-27). With ignition off, voltage should be zero. If not, faulty ignition switch or wiring connection at switch is indicated. With ignition on, reading should equal battery voltage. If not, faulty ignition switch and/or open at connections are indicated. If field circuit checks out properly, proceed to step 7.

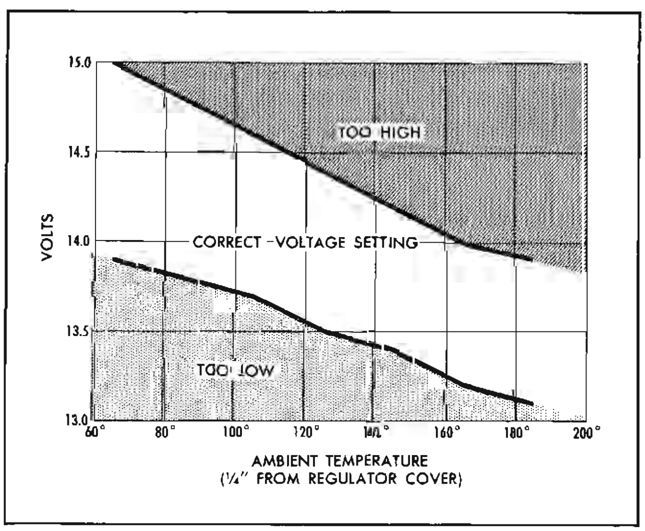



Fig. 11-29 Temperature Correction Chart

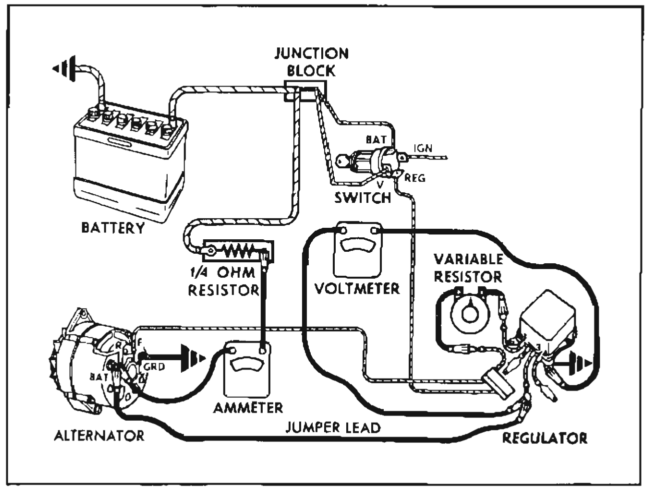



Fig. 11-30 Checking Voltage Setting

7. Reconnect field lead to alternator and connect voltmeter between field lead connection at alternator and positive battery terminal (Fig. 11-28). With ignition on, reading should be less than 0.3 volts. If not, move voltmeter lead from alternator field terminal to F terminal on regulator (using adapter J-9782-3) and then move from F terminal to the No. 3 terminal. As a final check, move the voltmeter lead from regulator No. 3 terminal to horn relay junction. These checks should locate point of excessive resistance. If contact points are oxidized, refer to "Clean Contact Points" for cleaning instructions.

NOTE: If the above tests have not located the cause for low alternator output, the alternator should be checked as outlined under the Section which describes the alternator, page 11-13.

## VOLTAGE SETTING

The voltage at which the regulator operates varies with changes in regulator ambient temperatures (Fig. 11-29). The ambient temperature is the temperature of the air measured ¼ of an inch from the regulator cover.

To check and adjust the voltage setting, proceed as follows:

1. Connect an ammeter and a ¼ ohm resistor with a rating of 25 watts or more in series in the circuit at the "BAT" terminal on the alternator (Fig. 11-30). In case the battery is discharged, the ¼ ohm resistor will limit the alternator output to 10 amperes or less which is required when checking and adjusting the voltage setting.

2. Make connections to the adapter as shown in Fig. 11-31. Use a 25 ohm 25 watt variable resistor in series with the field winding at the regulator "F"

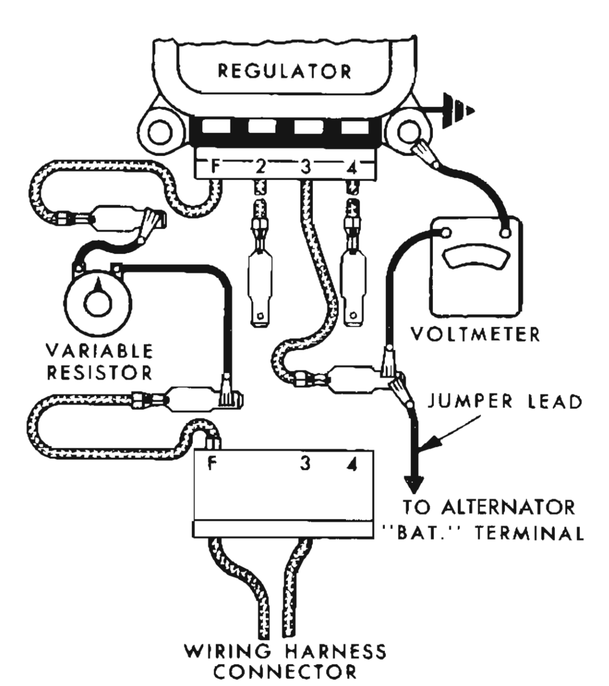



Fig. 11-31 Checking Voltage Setting

terminal, and connect a jumper lead from the adapter to the alternator output or "BAT" terminal as shown. Also, connect a voltmeter from the adapter to ground, as shown. Turn the variable resistor to the closed or "no resistance" position.

3. Operate the alternator for 15 minutes at approximately 1500 engine rpm (approximately 3500 alternator rpm). Leave cover on regulator to establish operating temperatures. Accessories and lights must be turned off.

4. After the 15 minute warm-up period, cycle the generator by the following procedure:

a. Turn the variable resistor in the field circuit to the "off" or full resistance position.

b. Disconnect then reconnect the jumper lead at the "BAT" terminal of the alternator.

c. Return the variable resistor to the closed or "no resistance" position.

d. Bring engine speed up to 2500 rpm (approximately 6000 alternator rpm) and note the voltage setting (refer to Fig. 11-29). The regulator should be operating on the upper or shorting contacts. If it will not operate on the upper contacts, the battery is in an extreme state of discharge, and must be at least partially re-charged before proceeding. The methods of identifying upper or lower contact operation is covered in Step 9.

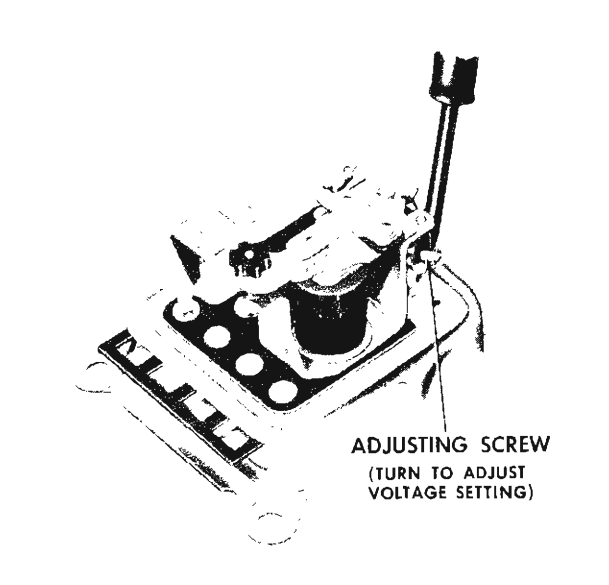



Fig. 11-32 Adjusting Voltage Setting

5. To adjust the voltage setting while operating on the upper or shorting contacts, turn the adjusting screw as shown in Fig. 11-32.

***CAUTION: Always make final setting by tightening the screw clockwise. This insures that the spring-holder will be against the head of the screw. If it is necessary to loosen the screw counterclockwise, turn it until the screw head is approximately 1/8" above the adjusting bracket, then pry holder up against screw head, then turn clockwise to make setting.***

6. After making the setting, cycle the alternator as covered in step 4 above.

7. Operate at 2500 engine rpm (approximately 6000 alternator rpm), and note setting. Re-adjust if necessary.

8. Always cycle the alternator as covered in step 4 before reading the final voltage setting on the voltmeter.

9. After making the voltage setting while operating on the upper set of contacts, check the voltage setting while operating on the lower set of contacts as follows: Slowly increase the resistance of the variable resistor with the engine operating at 2500 rpm (approximately 6000 alternator rpm) until the regulator begins to operate on the lower set of contacts. Then note the voltage reading, and refer to Fig. 11-29. NOTE: If turning the variable resistor does not cause the regulator to operate on the lower set of contacts, return variable resistor to the "no resistance" position, turn

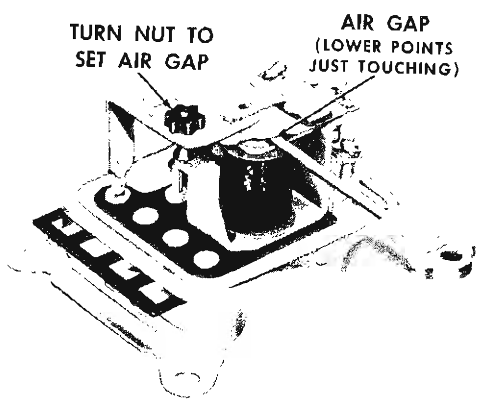



Fig. 11-33 Checking Air Gap

the carbon pile to slightly load the battery, and then adjust the variable resistor to cause the regulator to operate on the lower set of contacts. Usually, turning on the vehicle headlights can substitute for the carbon pile. The most desirable method for determining that the regulator is operating on the lower set of contacts is to use earphones connected from the regulator "F" terminal to ground. As the variable resistor is turned, and operation changes from the upper set of contacts to the lower set, the earphone sound will fade away and stop completely and then return when the lower set of contacts begins to operate. The alternate method is to observe the voltmeter change from one value to another, but this is less desirable since it is not as accurate.

10. The difference in voltage between the operation of the upper set of contacts and the lower set is increased by slightly increasing the air gap between the armature and center of core and decreased by slightly decreasing the air gap (see Fig. 11-33) for changing the voltage regulator air gap. If it is found necessary to make this air gap adjustment, it will be necessary to recheck the voltage setting of both sets of contacts.

## TAILORING VOLTAGE SETTING

It is important to remember that the voltage setting for one type of operating condition may not be satisfactory for a different type of operating condition. Vehicle underhood temperatures, operating speeds and nighttime service all are factors which help determine the proper voltage setting.

The desired voltage regulator setting is that which keeps the battery in a satisfactory state of charge without causing excessive water usage (as evidenced by water consumption exceeding one ounce per cell each 1000 miles). In order to obtain the desired setting, tailor the voltage regulator setting. To properly tailor voltage, refer to Fig. 11-29 and use a magnetic thermometer to measure regulator temperature. If magnetic thermometer is not available, a regular thermometer should be held with bulb 1/4" from regulator cover.

1. When the battery uses too much water, lower the setting .3 volt and check for an improved condition over a reasonable service period. Repeat until the battery remains charged with a minimum use of water.

2. When the battery is consistently undercharged, increase the setting to .3 volt and check for an improved condition over a reasonable service period. Repeat until the battery remains charged with a minimum use of water. NOTE: Avoid settings above 14.8 volts as these may cause damage to lights and other voltage sensitive equipment.

It rarely will be found necessary to use a voltage regulator setting outside the normal range in order to correct battery conditions. Batteries which do not respond to voltage regulator settings within the normal range usually will be found to be (1) batteries used in cars that are operated consistently at low speeds or in heavy traffic, or (2) batteries that have abnormal charging characteristics.

1. When a car is operated consistently at low speeds or in heavy traffic, the battery may remain undercharged even with a voltage regulator setting of 14.8 volts. Under these operating conditions, alternator output and charging time may be insufficient to offset electrical loads on the battery. Periodic recharging of the battery from an outside source or replacement of the original alternator with a higher output alternator will be required in these cases.

2. Batteries suspected of having abnormal charging characteristics should be removed for a complete check. If the checks indicate that the battery is still serviceable, voltage regulator setting outside the normal range may be adopted, provided it does not cause damage to lights or other voltage sensitive equipment or cause the battery to use water. NOTE: Bulb life will be shortened by setting the voltage regulator above the specified voltage.

On new cars or on other applications where no battery history is available, any corrected voltage regulator setting found within the normal range may be considered satisfactory unless local conditions or subsequent battery performance indicate the need for tailoring the voltage regulator setting.

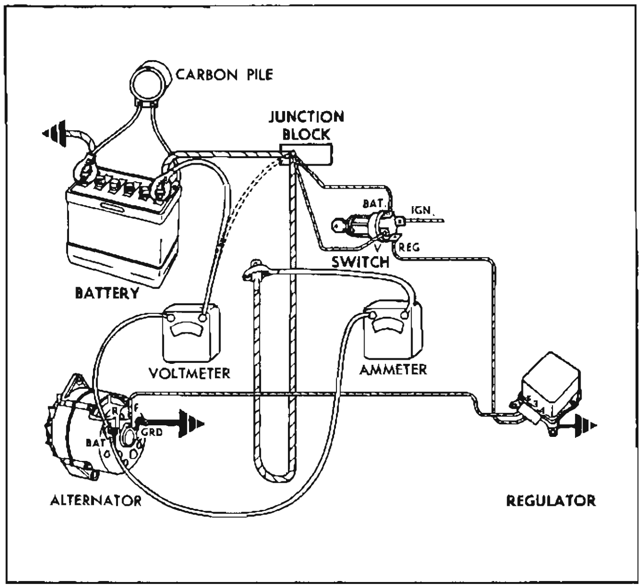



Fig. 11-34 Ammeter in Charging Circuit

When the need for changing the voltage regulator setting has been established, proceed as follows: Remove the regulator cover and turn adjusting screw clockwise to raise the setting, counterclockwise to lower the setting. Before taking the new reading after each adjustment, replace the regulator cover as quickly as possible and cycle the alternator.

***CAUTION: Final adjustment should always be made by increasing spring tension to assure contact between the screw head and spring support (Fig. 11-32).***

Sometimes the spring support does not follow the screw head as spring tension is decreased, and it will be necessary to bend the spring support to insure contact between the screw head and spring support. Failure of the voltage regulator unit to "hold" its setting usually results from (1) setting or checking the voltage regulator at other than operating temperature, and (2) the screw head not touching the spring support after final adjustment is completed.

## CIRCUIT RESISTANCE TEST

Insulated Charging Circuit Test:

With an ammeter in charging circuit (Fig. 11-34) connect positive lead of voltmeter to alternator output terminal (BAT). Adjust engine speed to approximately 1000 rpm and increase carbon pile load on battery until a current flow of 10 amperes is obtained. touch negative lead of voltmeter to positive terminal of battery and note reading. A reading in excess of .3 volt indicates excessive resistance between battery and alternator. Move negative voltmeter lead to each connection along the circuit toward the alternator. A sudden drop in the reading indicates a loose or corroded connection between that point and the last one tested. Move voltmeter lead to junction block. Noticeable reduction in voltage drop indicates high resistance in battery positive cable and/or connections. No noticeable reduction indicates high resistance in vehicle ammeter and/or leads, and/or connections.

### *REMOVE REGULATOR*

To remove the regulator, disconnect battery ground cable and leads from the regulator and remove regulator. NOTE: The three terminals are of the slip connection type, and a special connector body on the vehicle wiring harness is keyed to mating slots in the regulator base to insure proper connections. A plastic projection on the connector body serves to latch the assembly together. This prevents disconnections due to vibration. The assembly can be disconnected by *carefully* lifting the latch slightly.

***CAUTION: Excessive force will break the latch.***

### *CHECK AND ADJUST OUT OF CAR*

While electrical adjustments are made with the regulator on the car as outlined it is necessary to remove the regulator for cleaning contact points and adjusting air gaps.

## CLEAN CONTACT POINTS

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 alcohol to remove any residue. If the voltage control has not improved, repeat the cleaning and washing process.

Never use emery cloth or sandpaper to clean contact points.

### ADJUST POINT OPENING AND AIR GAPS

Point Opening: With the lower contacts touching, measure the point opening between the upper contacts as shown in Fig. 11-35. If necessary, adjust to .015" by bending the upper contact arm, being careful not to bend hinge.

Air Gap: Measure the air gap with a feeler gauge placed between the armature and core when the lower contacts are touching as shown in Fig. 11-33. If necessary adjust to .057" by turning the nylon nut located on the contact support.

#### *INSTALL REGULATOR*

1. Connect leads to regulator and connect battery ground cable.

2. Check and adjust electrical settings of the regulator on the car as outlined under "Check and Adjust on Car".

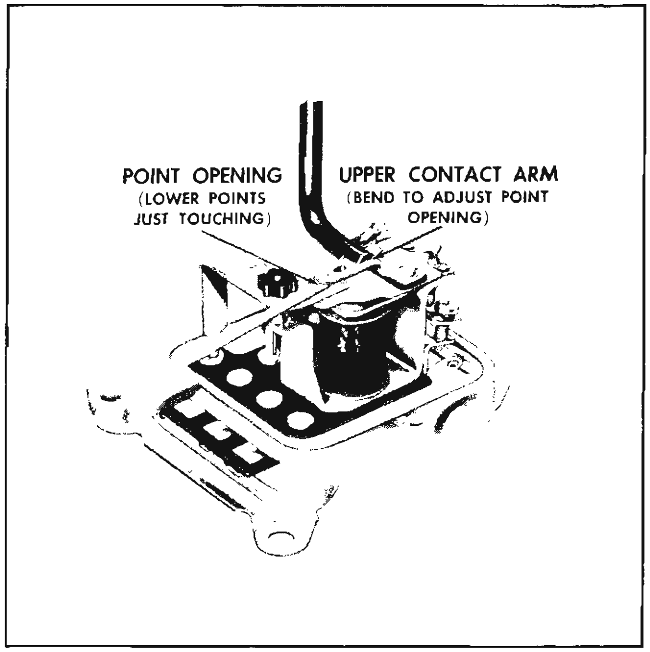



Fig. 11-35 Adjusting Point Opening

## IGNITION CIRCUIT

The ignition circuit (Fig. 11-36) includes the distributor, ignition coil, ignition resistance wire, ignition switch, spark plugs, battery, and the resistance type secondary cables.

For battery, see "Starting Circuit."

### PERIODIC SERVICE

The distributor and spark plugs are the only components of the ignition circuit that require periodic service. The remainder of the ignition circuit requires only periodic inspection to check the operation of the units, tightness of the electrical connections, and the condition of the wiring.

All leads located in either the coil tower or distributor cap should be checked to make sure they are pressed all the way down in their inserts. If rubber boots are used at these connections, they, too, should be tightly in place over the connection.

***CAUTION: Lead from distributor should be connected to coil negative terminal and lead from ignition switch to coil positive terminal.***

Two types of distributors are used: 1) A 12 volt, aluminum, internal adjustment distributor on 4 cylinder Tempests and 2) A 12 volt, cast iron, external adjustment distributor on 8 cylinder Tempests.

Both function in much the same manner to (1) cause a high voltage surge from the coil (2) time these surges with regard to engine requirements

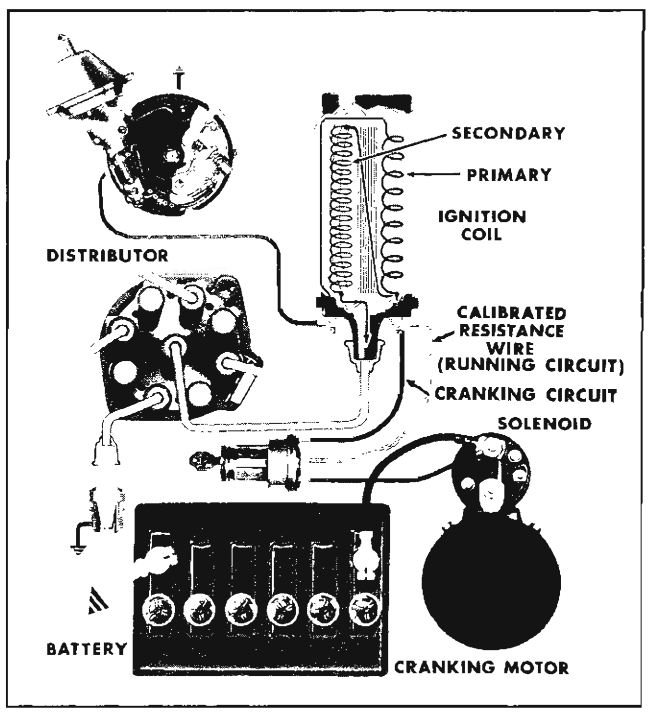



Fig. 11-36 Ignition Circuit

through the use of centrifugal and vacuum advance mechanisms (3) direct the high voltage surges through the distributor rotor, cap, and high tension wiring to the spark plugs.

They differ only in appearance and method of adjusting dwell angle.

## DISTRIBUTOR—4 CYLINDER ENGINE

### DESCRIPTION

The 4 cylinder engine distributor (Fig. 11-37) is a 12 volt, pivot plate type, in which the lower shaft bushing is lubricated by oil from the engine. A movable upper breaker plate rides on three nylon rubbing blocks and pivots on a stationary breaker plate which is attached to the housing. The contact set is attached to the movable breaker plate and is serviced as a complete assembly.

A vacuum control unit, attached to the distributor housing, is externally mounted to the movable breaker plate, and contains an enclosed spring-loaded diaphragm linked mechanically to the movable breaker plate inside the distributor. The enclosed air tight side of the diaphragm is connected to the intake manifold side of the carburetor. Under part throttle operation, the intake manifold vacuum actuates the diaphragm and the movable plate moves, thus advancing the spark and increasing fuel economy. During acceleration or when the engine is pulling heavy, the vacuum is not sufficient to actuate the diaphragm and the movable breaker plate is held in the retarded position by a calibrated return spring which bears against the vacuum diaphragm.

The centrifugal advance mechanism consists of an automatic cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, the weights are thrown outward against the pull of the springs. This movement advances the cam, causing the contact points to open earlier, thereby advancing the spark.

When replacing the contact set assembly, add a trace of Delco-Remy Cam and Ball Bearing Lubricant to the breaker cam. No other lubrication is required. In addition to lubrication, there should be periodic inspection of the distributor cap, rotor, and breaker points and of the wiring and timing.

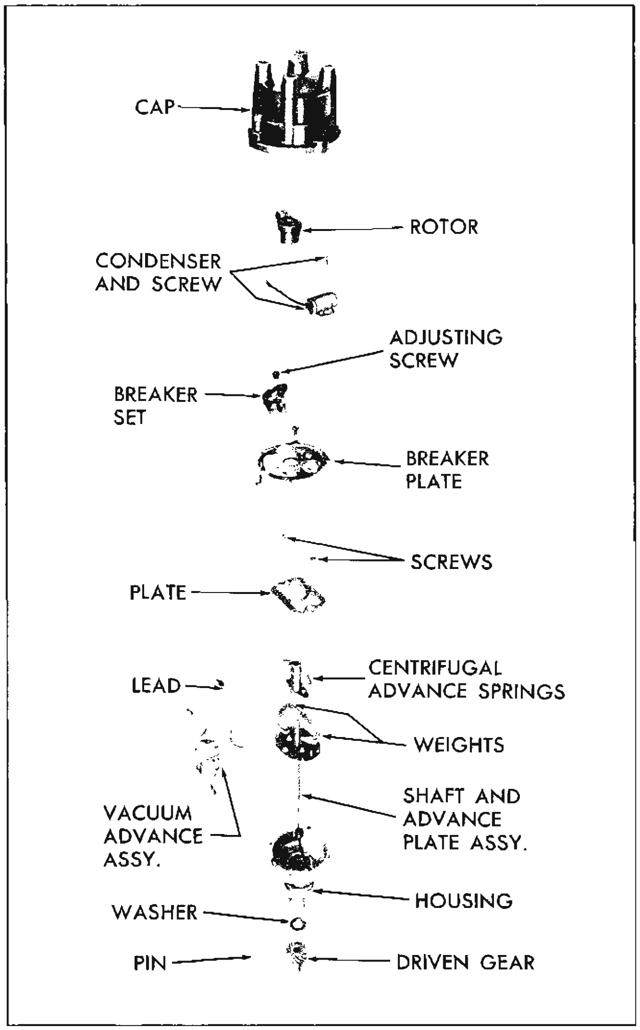



Fig. 11-37 4 Cylinder Engine Distributor

### ADJUSTMENT OF POINTS

NEW POINTS

*Feeler Gauge*

1. Remove distributor cap and rotor.

2. Crank engine until breaker points are fully opened (high point on breaker cam).

3. Loosen adjusting screw slightly (Fig. 11-38). With screwdriver in slot and feeler gauge between breaker points, slowly adjust to .019".

4. Tighten adjusting screw and recheck adjustment. Reinstall rotor and cap.

*Dial Indicator*

1. Remove distributor cap and rotor.

2. Attach dial indicator to breaker arm and crank

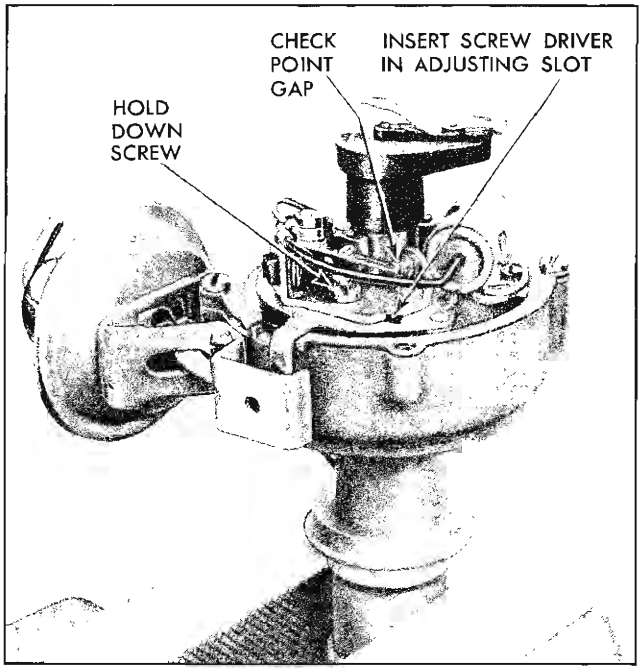



Fig. 11-38 Adjusting Points

engine intermittently. Adjust to .019". Tighten adjusting screw and recheck adjustment.

3. Remove dial indicator and reinstall rotor and cap.

*Dwell Angle*

The dwell angle method can be used to check for proper setting with the distributor in or removed from the car. NOTE: If distributor is removed, dwell should always be rechecked after the distributor is installed in the car. Dwell should be 31-34°.

With distributor removed from car, mount in distributor testing machine:

1. Connect the dwell meter to the distributor primary lead.

2. With the distributor operating, turn the adjusting screw until the proper dwell angle is obtained.

## OLD POINTS

The dial indicator and dwell angle methods can be used to adjust old points. Do not use the feeler gauge method, as pitted points can give a false gap setting. Old points should be adjusted to .016".

### TEST

While the distributor is mounted in tester, test the distributor for variation of spark, correct centrifugal and vacuum advance, and condition of contacts. This test will give valuable information on the distributor condition and indicate parts which need replacement.

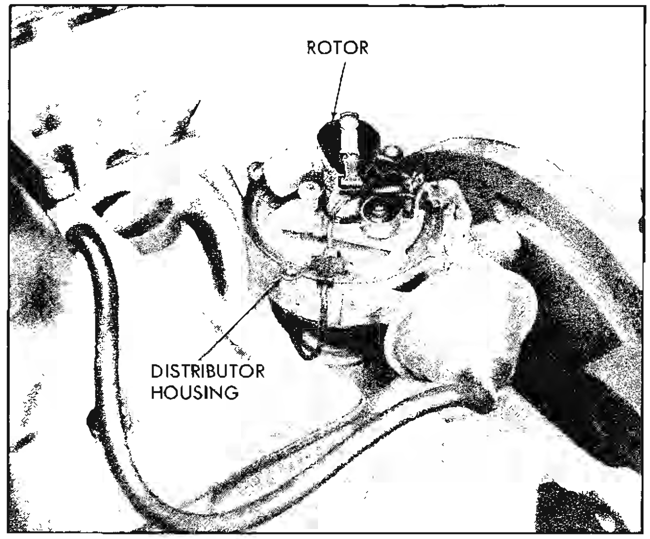



Fig. 11-39 Rotor in No. 1 Firing Position

When testing the distributor condenser it should be tested with a reliable condenser tester. The condenser should be tested for the following properties:

1. Insulation Resistance (or Leakage)
2. Series Resistance
3. Breakdown Test
4. Capacity (mfd.)

### REMOVE

1. Disconnect distributor-to-coil primary wire.

2. Remove distributor cap.

3. Crank engine so rotor is in position to fire No. 1 cylinder (Fig. 11-39) and timing mark on harmonic balancer is indexed with pointer.

4. Remove vacuum line from distributor.

5. Remove distributor clamping screw and hold-down clamp.

6. Remove distributor. It will be noted that the rotor will rotate as the distributor is pulled out of the block. Note the relationship of the rotor and the distributor housing after removal so that the rotor can be set in the same position when the distributor is being installed. NOTE: Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.

### DISASSEMBLE

1. Loosen screws retaining distributor cap and remove cap and rotor.

2. Disconnect primary and condenser leads from between plastic retainer and breaker set spring. Remove breaker points adjusting and hold down screw and remove breaker points assembly.

3. Remove primary lead and retainer.

4. Remove condenser and bracket.

5. Remove screws from vacuum advance diaphragm bracket. With slight downward pressure to disengage lever, remove vacuum advance assembly.

6. Remove screws securing breaker plate and remove breaker plate.

7. Remove roll pin from driven gear and remove driven gear and washer.

8. Pull centrifugal advance assembly out of distributor housing and remove screws and washers securing centrifugal advance upper plate.

9. Remove weight control springs, weights from base plate and pull breaker cam assembly from main shaft.

### ASSEMBLE

Assembly of the distributor is the reverse of the disassembly procedure outlined above. When installing the gear on the shaft, use a new roll pin. The pin must be tight in the hole to prevent any movement between the gear and the shaft.

### INSTALL

1. Check to see that engine is at firing position for No. 1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with pointer (Fig. 11-48).

2. Position new distributor to block gasket on block.

3. Before installing distributor, index rotor with housing as noted when distributor was removed. This will simplify indexing the distributor shaft and gear with the oil pump drive shaft and the drive gear on the camshaft. Distributor and rotor will be positioned as shown in Fig. 11-39 when properly installed with No. 1 piston in firing position.

4. Replace distributor clamp leaving screw loose enough to allow distributor to be turned for timing adjustment.

5. Install spark plug wires in distributor cap. Place wire for No. 1 cylinder in tower (marked on old cap during disassembly), then install remaining wires around the cap according to the firing order (1-3-4-2).

6. Attach distributor to coil primary wire.

7. Replace distributor cap.

8. Adjust timing and then tighten distributor clamp screw.

9. Attach vacuum line to distributor.

## DISTRIBUTOR—8 CYLINDER ENGINE

### DESCRIPTION

The external adjustment type distributor is shown in Fig. 11-40. The cap has a window for adjusting dwell angle with the cap in place. Adjustment of dwell can be made on the car while the engine is operating or while the distributor is being operated on a distributor tester. The centrifugal advance components are located above the breaker plate and cam. This arrangement allows the cam and the breaker lever to be located directly adjacent to the upper bearing for increased stability. The breaker plate is of one piece construction and rotates on the outer diameter of the upper bearing. The plate is held in position by

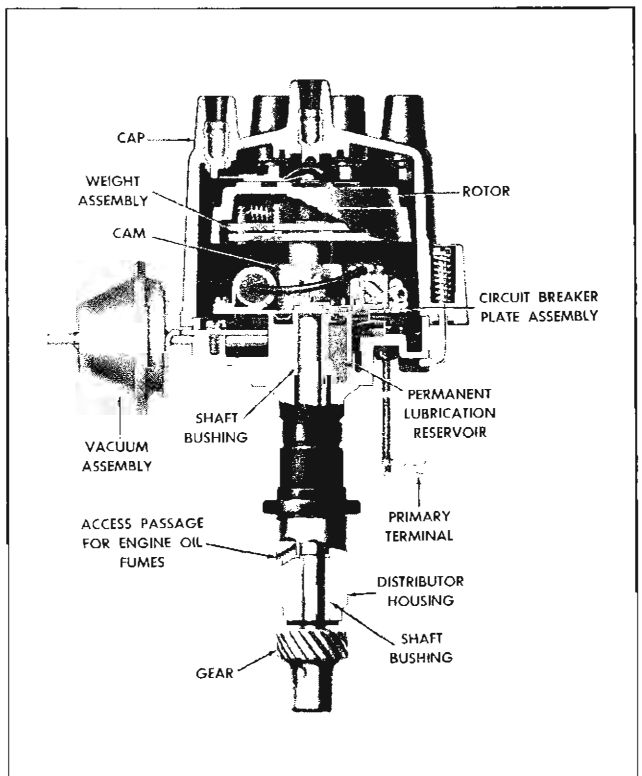



Fig. 11-40 V-8 Engine Distributor

a retainer clip in the upper shaft bushing. The molded rotor serves as a cover for the centrifugal advance mechanism. The vacuum control unit is mounted under the movable breaker plate to the distributor housing. The contact set is attached to the movable breaker plate. The service replacement contact set has the breaker lever spring tension and point alignment preadjusted at the factory and is serviced as one complete assembly. Only the point opening (dwell angle) requires adjustment after replacement.

The vacuum advance on automatic transmission cars is connected directly to manifold vacuum so there is full vacuum advance at idle. During acceleration or when the engine is pulling heavy, the vacuum is not sufficient to actuate the diaphragm. The movable plate is held in the retarded position by a calibrated return spring which bears against the vacuum diaphragm.

Cars equipped with synchro-mesh transmissions do not have distributor vacuum at idle but operate similarly above idle speed.

The centrifugal advance mechanism consists of a centrifugal advance cam actuated by two centrifugal weights controlled by springs. As the speed of the distributor shaft increases with engine speed, the weights are thrown outward against the pull of the springs. This advances the breaker arm causing the contact points to open earlier and thus advancing the spark.

#### *PERIODIC SERVICE*

A permanent lubricant reservoir is built into the distributor housing to lubricate the upper end of the shaft. No periodic lubrication is required.

When replacing the contact set assembly apply a trace of petrolatum to the breaker cam. No other lubrication is required. The movable breaker plate is lubricated by lubricant from the upper shaft bushing.

This distributor also requires periodic inspection of cap and rotor, wiring, and point condition, and a check for correct spark timing. This should be done at each tune-up and at least every spring and fall.

#### *ADJUSTMENT*

1. With the engine operating, raise the window provided in the cap.

2. Insert a "Hex" type wrench into the head of the adjusting screw as shown in Fig. 11-41.

3. Turn screw to adjust point opening by one of the following methods:

##### PREFERRED METHOD

Turn the adjusting screw until the 28°-32° dwell is obtained as measured by a dwell meter. (When using dwell meter be sure to test distributor resistance before testing dwell angle.)

NOTE: Providing the dwell meter is accurate and is used correctly, points can be set very accurately. Several design features such as the use of the upper shaft bushing as a bearing for the breaker plate, and the construction of the advance mechanism have made this possible.

##### ALTERNATE METHOD

Turn the adjusting screw (clockwise) until the engine begins to misfire. Then turn the screw one-half turn in the opposite direction (counterclockwise). This will give the proper dwell angle.

#### *REMOVE*

1. Disconnect distributor-to-coil primary wire.

2. Remove distributor cap.

3. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with pointer.

4. Remove vacuum line from distributor.

5. Remove distributor clamping screw and hold-down clamp.

6. Remove distributor and distributor to block gasket. It will be noted that the rotor will rotate as the distributor is pulled out of the block. Note the rela-

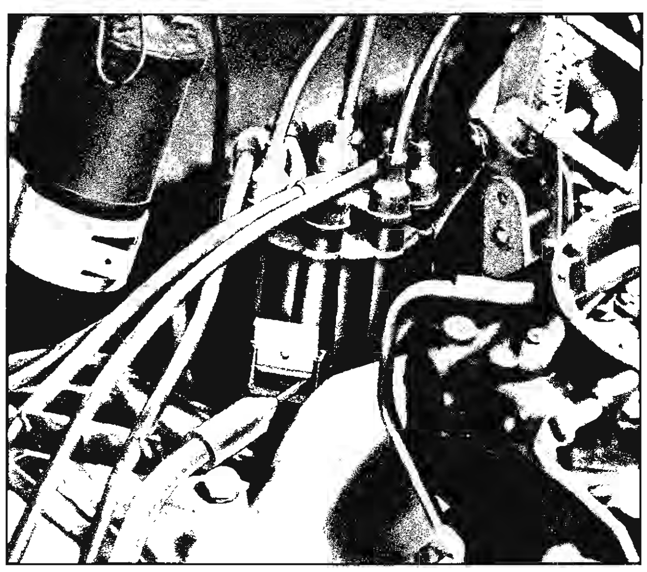


Fig. 11-41 Adjusting Dwell Angle

tionship of the rotor and the distributor housing after removal, so that the rotor can be set in the same position when the distributor is being installed.

NOTE: Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.

### INSPECT

With the distributor removed from the vehicle it is advisable to place the distributor in a distributor testing machine or synchroscope. When mounting distributor in tester, first secure the gear in the drive mechanism, then push distributor housing down toward the gear to take up end play between the gear and housing, and finally secure the housing in the tester. Test the distributor for variation of spark, correct centrifugal and vacuum advance, and condition of contacts. This test will give valuable information on the distributor condition and indicate parts replacement which may be necessary.

When checking the distributor condenser it should be checked with a reliable condenser tester. The condenser should be checked for the following properties: (1) insulation resistance (or leakage), (2) series resistance, (3) breakdown test, (4) capacity (mfd.).

### REPLACE CONTACT SET

The contact point set is replaced as one complete assembly. The breaker lever spring tension and point alignment of the service contact set have been preadjusted at the factory. Only the point opening requires adjusting after replacement.

Replace contact set as follows:

1. Remove two attaching screws (Fig. 11-42) which hold base of contact set assembly in place.

2. Remove condenser lead and primary lead from nylon insulated connection by turning screw (Fig. 11-42) in contact set.

3. Replacement is the reverse of removal.

***CAUTION: Make sure the condenser lead and primary lead are located as in Fig. 11-43. Leads must be properly located to eliminate interference between leads and cap, weight base, or breaker plate.***

4. Apply a trace of petrolatum to the breaker cam.

### ADJUST DWELL ANGLE

The following method can be used to adjust the dwell angle to the proper setting with the distributor removed from the car.

NOTE: Dwell should always be rechecked after the distributor is installed in the car.

1. With distributor mounted in distributor testing machine, connect the dwell meter to the distributor primary lead.

2. With the distributor operating, turn the adjusting screw (Fig. 11-41) until the proper dwell angle is obtained.

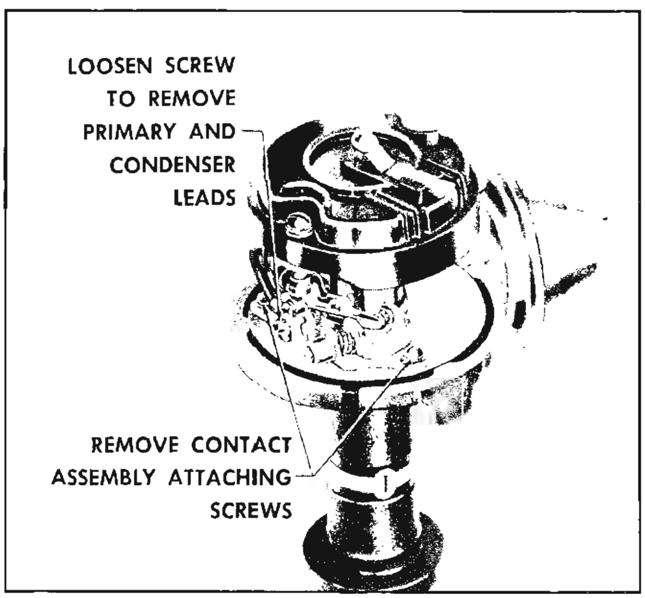



Fig. 11-42 Distributor Contact Details

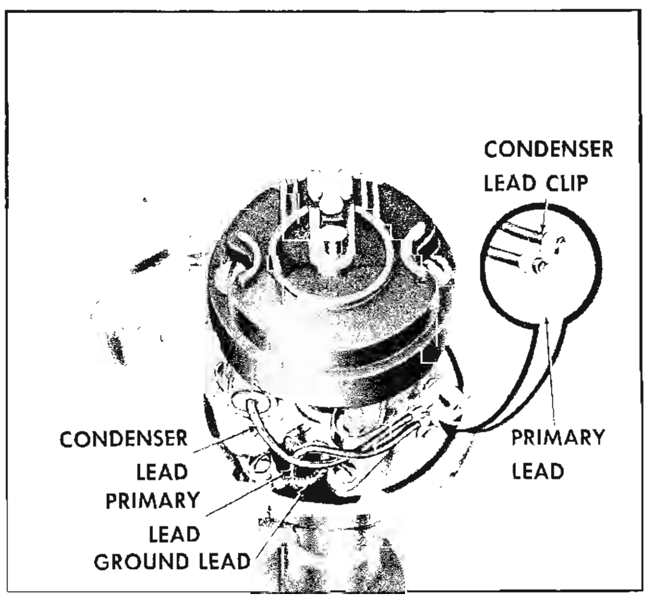



Fig. 11-43 Arrangement of Leads

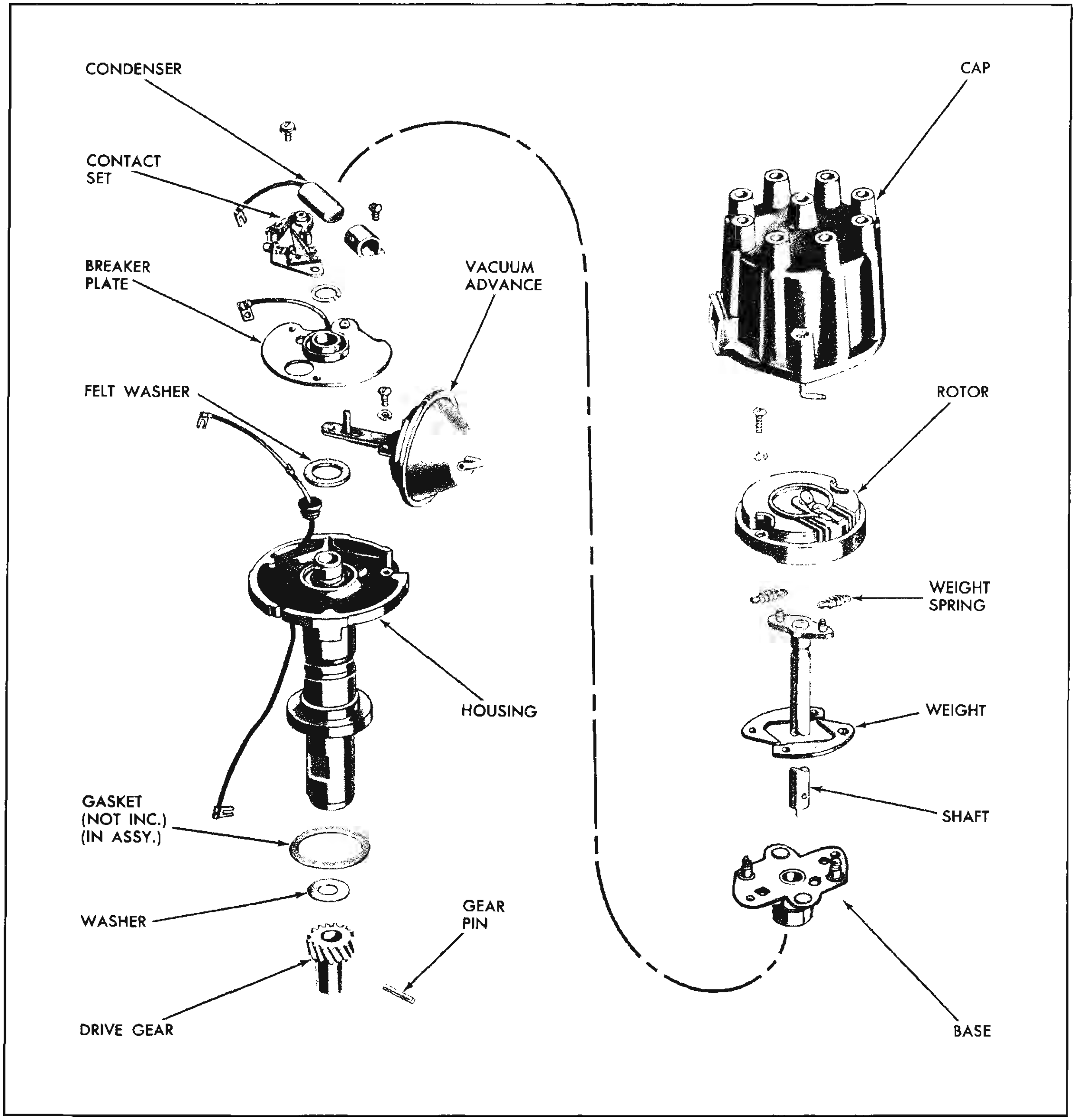



Fig. 11-44 V-8 Engine Distributor—Exploded View

***DISASSEMBLE***

1. Remove the rotor by removing the two attaching screws, lock washers, and flat washers (Fig. 11-44).

NOTE: It will be observed that the rotor is doweled to the weight base so that it can be installed in only one position.

2. Remove both the weight springs and both the advance weights.

3. Remove retaining pin from the gear by driving it out of the gear with a drift and hammer.

***CAUTION: Distributor should be supported in such a way that the distributor shaft will not be damaged when driving the pin out.***

4. Slide gear and washer off the shaft.

5. Pull shaft and cam-weight base assembly from the housing.

6. Remove contact set assembly.

7. Remove condenser hold-down screw, condenser and bracket from the breaker plate.

8. Remove spring retainer and raise plate from the housing.

9. Remove two attaching screws and lock washers and plate ground lead, and remove the vacuum advance unit.

10. Remove felt washer from around bushing in the housing.

**NOTE:** No attempt should be made to service the shaft bushings in the housing, as the housing and bushings are serviced as a complete assembly.

### ASSEMBLE

Assembly of the distributor is the reverse of the disassembly procedure outlined above. When installing the gear on the shaft use a new retaining pin. The pin must be tight in the hole to prevent any movement between the gear and the shaft.

Note that the rotor can be installed in only one position. It will be broken if an attempt is made to install it backwards.

### INSTALL

1. Check to see that engine is at firing position for No. 1 cylinder (No. 1 piston at top of compression stroke) and timing mark on harmonic balancer is indexed with pointer (Fig. 11-48).

2. Position new distributor to block gasket on block.

3. Install distributor in block so that vacuum diaphragm faces the left side of the engine and rotor points toward contact in cap for No. 1 cylinder. Before installing distributor, index rotor with housing as noted when distributor was removed. This will simplify indexing the distributor shaft and gear with the oil pump drive shaft and the drive gear on the camshaft. Distributor and rotor will be positioned as shown in Fig. 11-45 when properly installed with No. 1 piston in firing position.

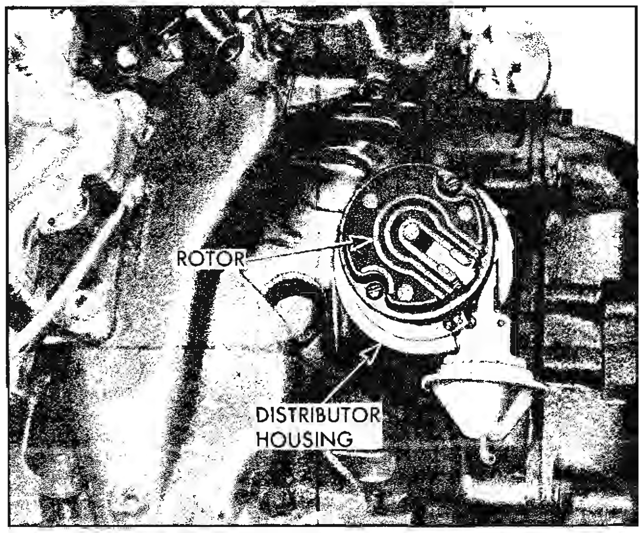



Fig. 11-45 Relationship of Distributor Housing in Firing Position For No. 1 Cylinder

4. Replace distributor clamp leaving screw loose enough to allow distributor to be turned for timing adjustment.

5. Install spark plug wires in distributor cap. Place wire for No. 1 cylinder in tower (marked on old cap during disassembly), then install remaining wires counterclockwise around the cap according to the firing order (1-8-4-3-6-5-7-2).

6. Attach distributor to coil primary wire.

7. Replace distributor cap.

8. Adjust dwell and timing and then tighten distributor clamp screw.

9. Attach vacuum line to distributor.

## SPARK PLUGS

### DESCRIPTION

AC type 45S spark plugs are used to provide optimum performance for all normal service.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling or continual stop-and-go or slow-speed driving.

Spark plugs in Pontiac Tempest engines are protected by an insulating nipple made of special heat resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent "flash-over", with resultant missing of the engine, even though a film is allowed to accumulate on the exposed portion of the plug porcelains. NOTE: Do not mistake "Corona" discharge for "flash-over" or a shorted insulator. Corona is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

All AC Spark Plugs have a type number on the insulator which designates the thread size as well as relative position of the plug in the "Heat Range". Type numbers starting with "4" are 14 mm. thread size.

The last digit of the type number indicates the "Heat Range" position of the plug in the AC Heat Range System. Read these numbers as you would a thermometer—the higher the last digit, the "hotter" the plug will operate in the engine; the lower the last digit, the "cooler" the plug.

### PERIODIC SERVICE

Periodically (the actual time depending on operating conditions) the plugs should be removed for cleaning, inspection and regapping.

### REMOVE

1. Remove spark plug wires.

2. Remove any foreign matter from around spark plugs by blowing out with compressed air.

3. Using a $^{13}/_{16}''$ spark plug socket, remove the spark plugs.

### INSPECT

Spark plug life is governed to a large extent by operating conditions and plug life varies accordingly. To insure peak performance, spark plugs should be checked, cleaned and regapped every 5000 miles.

Worn and dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear may be due to dirty or leaded plugs, excessive gap or broken insulator.

Dirty or leaded plugs may be evident by black carbon deposits, or red, brown, yellow or blistered oxide deposits on the plugs. The black deposits are usually the result of slow speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too "cold" will also result in carbon deposits. Red, brown, etc., oxide deposits, a consequence of the use of leaded fuel, usually result in spark plug failure under severe operating conditions. The oxides have no adverse effect on plug operation as long as they remain in a powdery state. But, under high speed or hard pull, the powder oxide deposits melt and form a heavy glaze coating on the insulating which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out the plug.

Excessive gap wear on plugs of low mileage, usually indicates the engine is operating at high speeds or loads that are consistently greater than normal or that a plug which is too "hot" is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking past the threads and gasket, due to insufficient compression of the spark plug gasket, dirt under the gasket seat, or the use of old gaskets. Too "lean" carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or moisture penetrates the fracture. The fracture is usually just below the crimped part of the shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of a break may result from the plug operating too "hot" such as encountered in sustained periods of high speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the

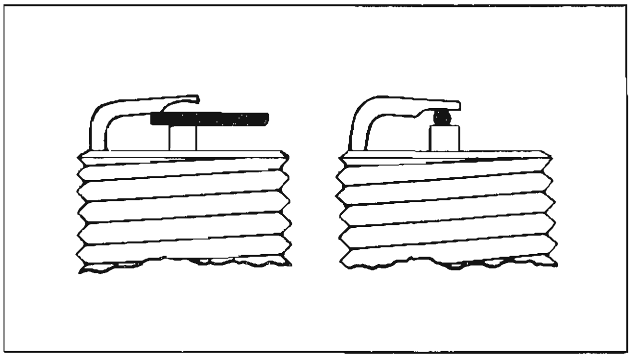


Fig. 11-46 Flat Feeler Versus Round Wire Gauge for Measuring Spark Plug Gap

ground (side) electrode. Never bend the center wire. Spark plugs with broken insulators should always be replaced.

### CLEAN AND REGAP

Clean the spark plugs thoroughly using an abrasive type cleaner. All spark plugs must be of the same make and number or heat range. Use a round feeler gauge to adjust the spark plug gaps to .035″ (Fig. 11-46). Test spark plugs following instructions furnished with Spark Plug Cleaner and Indicator (Fig. 11-47).

***CAUTION:** Before adjusting gap, file center electrode flat. In adjusting the spark plug gap, never bend the center electrode which extends through the porcelain center. Always make adjustments by bending the ground (side) electrode.*

### INSTALL

1. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm. x 1.25 SAE spark plug tap (available through local jobbers) or by using a small, soft wire brush in an electric drill. If a tap is used, coat it with plenty of grease to catch any chips.

***CAUTION:** Use extreme care when using tap to prevent cross threading. Also, crank engine several times to blow out any material dislodged during cleaning operation.*

2. Install spark plugs in engine, using new gaskets, and tighten to 20-25 lb. ft. torque.

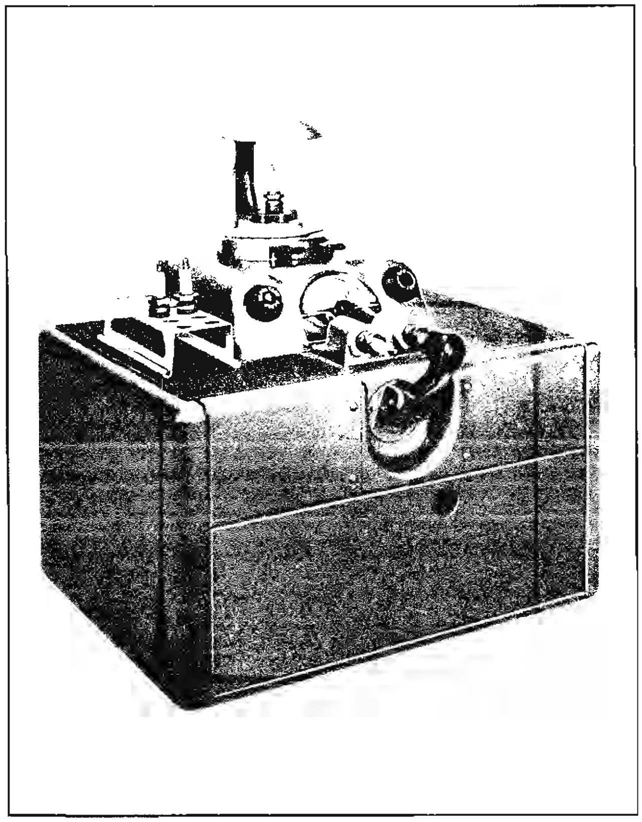


Fig. 11-47 Spark Plug Cleaner and Indicator

## SPARK PLUG TROUBLE DIAGNOSIS

| PLUG CONDITIONS | FACTORS CAUSING THIS CONDITION | CORRECTIVE ACTION |
|---|---|---|
| Plug "Flash Over" (Firing from upper terminal to base of plug). | Dirty insulator tops—oil, dirt and moisture on insulator will shunt current to base of plug. The above condition can be caused by failure of spark plug boot. | Keep plugs wiped clean with cloth moistened with cleaning solvent. Check spark plug boot and replace if necessary. |
| Oil or Carbon Fouling. | Wet, black deposits on firing end of plug indicate oil pumping condition. This is usually caused by worn piston rings, pistons, cylinders or sticky valves. | Correct engine condition. In most cases plugs in this condition will be serviceable after proper cleaning and regapping. |

| PLUG CONDITIONS | FACTORS CAUSING THIS CONDITION | CORRECTIVE ACTION |
|---|---|---|
| | Soft, fluffy, dry carbon deposits usually indicate a rich mixture operation, excessive idling, improper operation of automatic choke or faulty adjustment of carburetor. | If troubles are not eliminated, use "hotter" type plug. |
| | Hard baked-on, black carbon deposits result from use of too cold a plug. | Use "hotter" type plug. |
| Lead Fouling (Light and powdery or shiny glazed coating on firing end). | By-products of combustion and fuel additives, deposited as a powder which may later melt and glaze on insulator tip. | Remove deposits by blast cleaning. If this is not possible, plugs should be replaced. |
| Normal Electrode Wear. | Due to intense heat, pressure and corrosive gases together with spark discharge, the electrode wears and gap widens. | Plugs should be regapped every 5000 miles. |
| Rapid Electrode Wear. | Condition may be caused by (1) burned valves, (2) gas leakage past threads and seat gaskets, due to insufficient installation torque or damaged gasket (3) too lean a mixture or (4) plug too "hot" for operating speeds and loads. | Correct engine condition. Install plugs to specified torque. Use a new spark plug seat gasket each time a new or cleaned spark plug is installed. Use "colder" type plug if condition continues to exist. |
| Broken Upper Insulator (Firing around shell crimp under load conditions). | Careless removal or installation of spark plug. | Replace with a new spark plug. |
| Broken Upper Insulator (Firing Tip). | The cause is usually carelessness in regapping by either bending of center wire to adjust the gap, or permitting the gapping tool to exert pressure against the tip of the center electrode or insulator, when bending the side electrode to adjust the gap. | Replace with a new spark plug. |
| | Fracture or breakage of lower insulator may also occasionally occur if the engine has been operated under conditions causing severe and prolonged detonation or pre-ignition. | Use "colder" type plug for the particular type of operation. |
| Damaged Shell. | Very seldom occurs but cause is almost always due to mishandling by applying excessive torque during installation. This failure is usually in the form of a crack in the Vee of the thread next to the seat gasket or at the groove below the hex. | Replace with a new spark plug. |

## IGNITION COIL AND RESISTOR

The 12 volt coil is an oil filled, hermetically sealed unit designed specifically for use with an external resistance. The number of turns in the primary winding results in a higher inductance in this winding, which makes it possible for this coil to provide a higher secondary voltage output throughout the speed range.

In order to improve ignition performance during cranking an external resistance is used. This resistor is an integral part of the wiring and is calibrated to the proper value.

For optimum starting performance at low temperatures, the resistance is by-passed during cranking, thereby connecting the ignition coil directly to the battery. This provides full battery voltage available at the coil and thus keeps ignition voltage as high as possible during cranking. The resistance is by-passed automatically through the ignition and starting switch when the switch is in the "start" position.

## SECONDARY IGNITION CABLES

All ignition cables in the secondary or high tension system (coil to distributor and distributor to plugs) are neoprene jacketed. This cable is resistant to the action of oil, grease, battery acid and road salt, and offers resistance to corona breakdown. Ignition cables have a multiple, cloth thread core impregnated with a graphite solution to give the correct conductivity. These cables give proper resistance for suppression of radio and television interference.

No external suppressors should be used on the ignition system on car radio installation.

## IGNITION TIMING

Correct timing of the spark, with relation to engine piston position, is made in the shop by use of a power timing light and timing marks on the harmonic balancer (Fig. 11-48).

It is imperative, due to vacuum advance at idle, to disconnect the distributor vacuum advance line before setting ignition timing.

At the time the spark is adjusted, the general appearance of the breaker points should be observed.

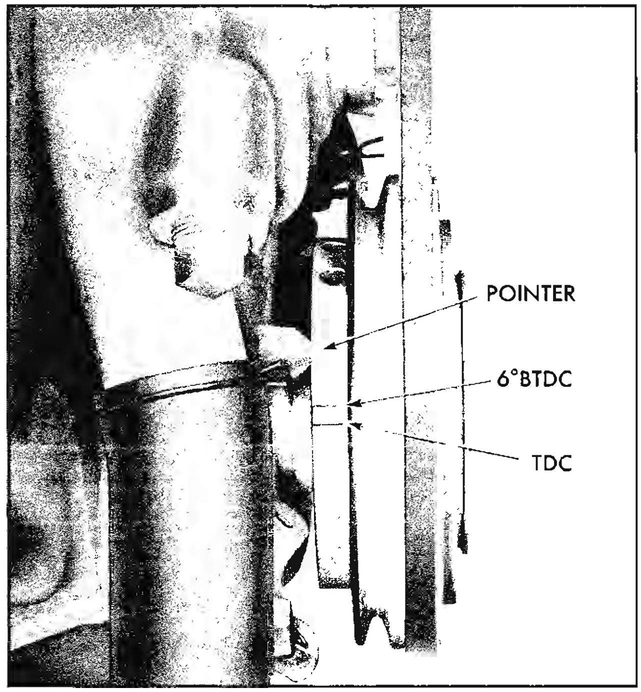



Fig. 11-48 Timing Marks and Pointer

If a smudge line appears on the point support and breaker plate just beneath the points, burned points (from oil or crankcase vapor between the points) are very probable. Points which have gone several thousand miles will have a rough surface, but this does not mean the points are worn out. The roughness between points matches so that a large contact area is maintained and the points will continue to provide satisfactory service. If dirt or scale are present the points should be cleaned with a few strokes of a clean, fine-cut, contact file. Do not attempt to remove all roughness or dress the point surfaces down smooth. Never use emery cloth or sandpaper to clean points. If points are burned or badly pitted they should be replaced and the cause of this condition found and corrected. If this is not done the new points will also burn and pit in a short time.

Adjust ignition timing as follows:

1. Adjust breaker point gap.

2. Connect power timing light.

3. Loosen distributor clamp screw and rotate distributor until power timing light shows that pointer is at 6° BTDC mark on harmonic balancer. Tighten distributor clamp screw to 15-20 lb. ft. torque.

## IGNITION AND STARTING SWITCH

The ignition and starting switch is key-operated to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch has four positions, "Off" when the key is straight up and down, "Accessory" when turned to the left, "On" when turned to the right until spring pressure is felt, and "Start" when turned fully to the right against spring pressure.

With the switch in either the "Accessory" or "On" positions the following electrical circuits are activated: stop lights, air conditioning, directional signals, parking brake warning light, radio, back-up lights, heater and defroster and electric windshield wiper. In the "On" position the ignition primary circuit is activated through the resistance and the alternator field current.

There are eight terminals on the back of the switch. The terminal marked "Bat" is connected to the battery and supplies the power to the switch. The accessory terminal supplies power to the accessories when the switch is in the "Acc" or running positions. The "Sol" terminal supplies power to the solenoid to activate the starter in the start position. The terminal marked "Ground" completes the test circuit for the temperature "Hot" indicator bulb when the switch is turned to the start position.

These circuits are all cut off when the ignition switch is in the "Off" or "Start" positions.

When the ignition switch is turned to the start position, the ignition primary circuit is activated directly, by-passing the resistance, and the starting motor circuit is activated to crank the engine.

Two ignition terminals, marked "Ign-1" and "Ign-2", will be found on the back of the switch. The "Ign-1" terminal is energized when the ignition switch is in the normal operating position. It directs current to the ignition coil through the resistance. The "Ign-2" position is energized when the ignition switch is turned to the starting position. It directs current to the coil around the resistance to provide full battery voltage to the coil when starting.

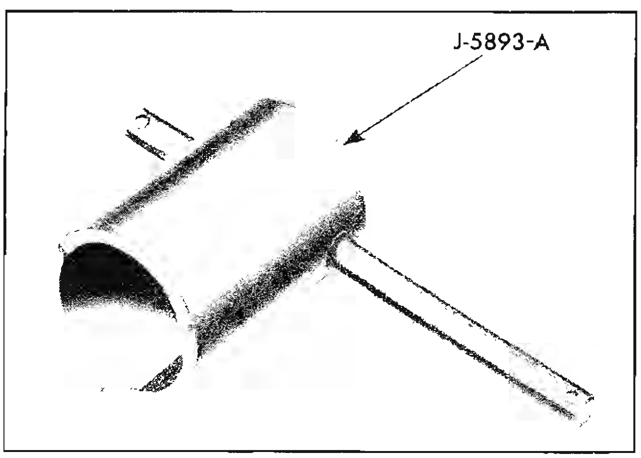



Fig. 11-49 Ignition Switch Ferrule Spanner

The two terminals "V" and "Reg" are connected to a special set of contacts inside the ignition switch. Externally the "V" terminal is connected directly to the battery and the "Reg" terminal is connected to the No. 3 terminal of the voltage regulator. When the ignition switch is in the "on" position the special set of contacts are closed and current flow can be traced from the battery, through the switch, through the voltage regulator to the field terminal of the alternator, and finally through the rotor field coil windings to ground.

### *REPLACE SWITCH*

1. Remove positive cable from battery to protect against short circuit.

2. Remove ignition switch ferrule by unscrewing with special spanner J-5893-A (Fig. 11-49).

3. Remove switch from back of instrument panel and disconnect wires.

4. Replace switch by reversing above steps.

### *REPLACE SWITCH LOCK CYLINDER*

1. Place ignition key in lock and depress lock plunger by inserting small pin through hole in lock cap.

2. While holding plunger in, turn key approximately 20° counterclockwise to release lock cylinder and remove cylinder from switch.

3. To install lock cylinder, insert key in cylinder. Then, with key and cylinder turned about 20° counterclockwise, insert cylinder in lock and rotate clockwise to lock in place.

### *FREE UP LOCK*

Occasionally an ignition lock may stick, making it difficult to insert key and turn lock. In such case, blow a very small quantity of powdered graphite into the lock key hole and operate lock several times to free up.

## IGNITION SYSTEM TROUBLE DIAGNOSIS

### *QUICK CHECKS*

If the engine does not run, the ignition system is at fault if:

1. There is no spark during cranking, when a spark plug wire is held 1/4 inch from the engine.

2. The engine starts but immediately stops when the ignition switch is released from the "Start" position.

### DIAGNOSIS PROCEDURE

If the ignition system is at fault, the following checks will help locate the difficulty. All checks are to be made with the lights and accessories off and in the sequence shown. Voltage readings referred to are indicated in Fig. 11-50.

If these checks fail to find cause of trouble—remove distributor, coil, and resistance wire from engine and check to specifications. Also check wiring harness.

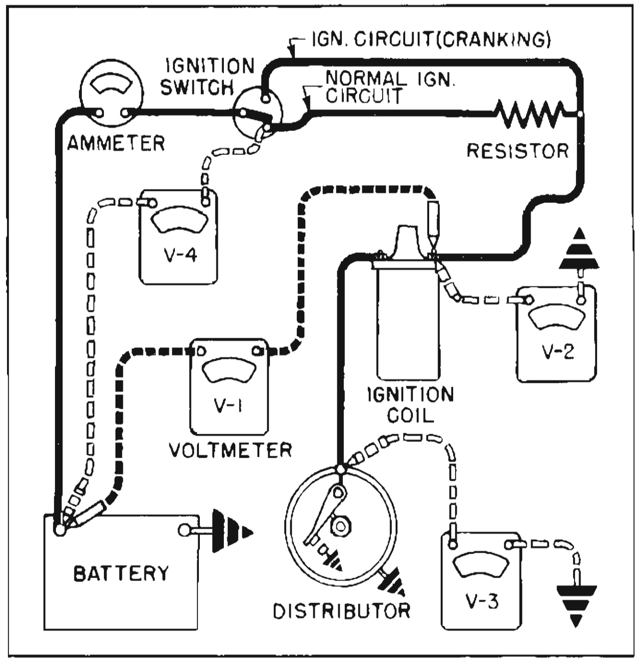



Fig. 11-50 Testing Diagram for Ignition Circuit

| OPERATION | SPECIFICATION | POSSIBLE TROUBLE |
|---|---|---|
| Check all connections in primary and secondary circuit. | | |
| Remove secondary coil lead from distributor cap. Hold ¼ inch from engine while cranking, and observe if spark occurs. | | If spark occurs:<br>Distributor cap.<br>Rotor.<br>Spark plug wiring. |
| Check Voltage $V_1$ while cranking. | 1 Volt Max. | Open circuit from battery side of coil to solenoid switch.<br>Solenoid switch not closing ignition circuit.<br>Ground in circuit from coil terminal to solenoid switch.<br>Ground in coil. |
| Check Voltage $V_2$ ignition switch "On", points open. | Normal Battery Voltage. | Low battery.<br>Points not open.<br>Ground in circuit from coil to distributor.<br>Ground in distributor.<br>Ground in coil.<br>Ground in circuit from coil to solenoid switch or to resistor. |

| OPERATION | SPECIFICATION | POSSIBLE TROUBLE |
|---|---|---|
| Check Voltage $V_2$ ignition switch "On", points closed. | 5 to 7 Volts. | If over 7 volts check following:<br>Contacts not closed.<br>Loose connection in distributor.<br>Distributor not grounded to engine.<br>Faulty contacts.<br>Loose connection between coil and distributor.<br>Resistance out of circuit due to shorted or incorrect wiring.<br>Solenoid switch contacts stay closed.<br>Wire resistor has too little resistance.<br>Coil primary is open.<br>If under 5 volts, check following:<br>Loose connections between battery and resistor.<br>Loose connections between resistor and coil.<br>Resistor open or has excessive resistance. |
| Check Voltage $V_3$ ignition switch "On", points closed. | 0.2 Volts Max. | Contacts not closed.<br>Loose connection in distributor.<br>Distributor not grounded to engine.<br>Faulty contacts—if faulty, recheck voltage $V_2$, ignition switch on, points closed. |
| Check Voltage $V_4$ ignition switch "On", points closed. | 0.7 Volts Max. | Loose connection from wire resistor through ignition switch circuit to battery. |

# LIGHTING AND HORN POWER CIRCUITS

## DESCRIPTION

### *FUSE BLOCK*

The fuse block (Fig. 11-51) has replaceable fuse clips which are serviced separately. An efficient tool for fuse clip removal can be made from a cotter pin approximately 2½ inches long. Cut off long leg even with short leg. File a bevel on the outside of both legs. Spread the pin wide enough to span the fuse clip.

To remove fuse clip, insert cotter pin over center of fuse clip (Fig. 11-52) and push in to disengage locking ears on both sides of clip. Continue pushing after ears disengage and fuse clip will come out through fuse block.

NOTE: Fuse and light applications can be found in the specification tables at the end of this section.

### *WIRING HARNESS*

The wiring harness routing has clip retainers to reduce the possibility of damage to the harness. Particular attention should be given toward making sure that the wiring is not pinched, stretched, or positioned

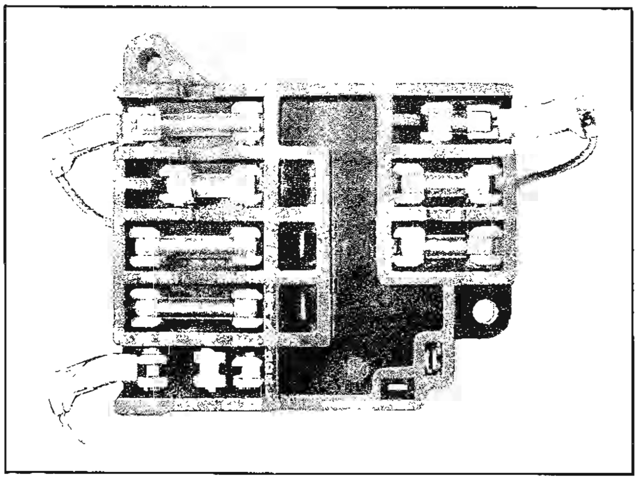


Fig. 11-51 Fuse Block

so as to contact any movable parts under the instrument panel. This includes the hand brake, foot brake, ash trays, accelerator linkage or the heater linkage. In the engine compartment the following routing should be checked: wires to generator, wires in clip retainer opposite carburetor choke heat tube, around regulator, horn relay, battery, starter solenoid, large dash clips, and the large dash grommet.

### WIRING CONNECTORS

Wiring connectors have a locking design to insure a tight fit and to prevent them from separating.

NOTE: When servicing the connector, insert a thin bladed screwdriver between the male and female section to unlock the assembly before pulling it apart.

### LIGHTING

The headlight system consists of two dual headlight units mounted in a horizontal arrangement on each side of the car. In this installation the outboard light is a dual filament seal beam unit. The inboard unit contains a single filament and is used as the primary source of light for the high beam.

When driving with low beam only the low beam filament of the outboard lights is used. On high beam all four lights are used.

Lighting is controlled by two switches. First, the instrument panel main lighting switch which has two "on" positions or notches, the first for parking, tail and license lights, and the extreme out position for the headlights, tail and license lights. Rotating the lighting switch knob operates a rheostat for dimming the instrument panel lights; with the rheostat in the extreme counterclockwise position the instrument

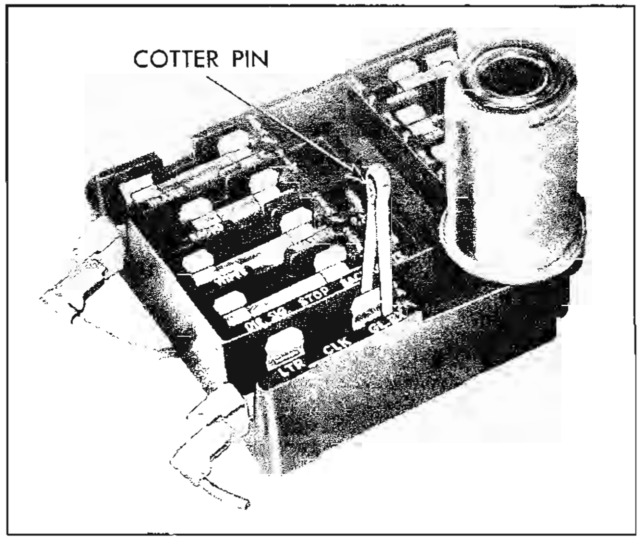



Fig. 11-52 Removing Fuse Clip

panel lights are completely off and the dome light is turned on. Second, the headlight beam switch (foot operated) determines if the headlight country (bright) beam or traffic (dim) beam is on when the main lighting switch is pulled out. A red indicator lamp on the speedometer shows when the headlight country beam is on.

Parking lights use a two filament bulb. One filament is for the directional signal and the other is for the parking light.

Headlights are of sealed beam construction so that the light source, reflector, lens, and lens gasket are all assembled in one sealed unit. When the filament burns out or the lens is cracked or broken, the entire unit is readily replaceable with a new unit.

The filaments used in the twelve volt headlights are very fragile. Therefore, these headlight units must be handled carefully.

### HEADLIGHT AIMING

Preparation of car for aiming operation includes:

1. Make sure car is in good horizontal and vertical alignment with aiming test equipment.

2. Jounce car to equalize suspension.

3. Make sure the aiming is performed with car at curb height (see Section 3).

4. Tires should be inflated uniformly to recommended pressure (see Section 3A).

Aiming screen data is contained in Fig. 11-53. When aiming upper beam the pattern of only the inboard upper beam units is to be used.

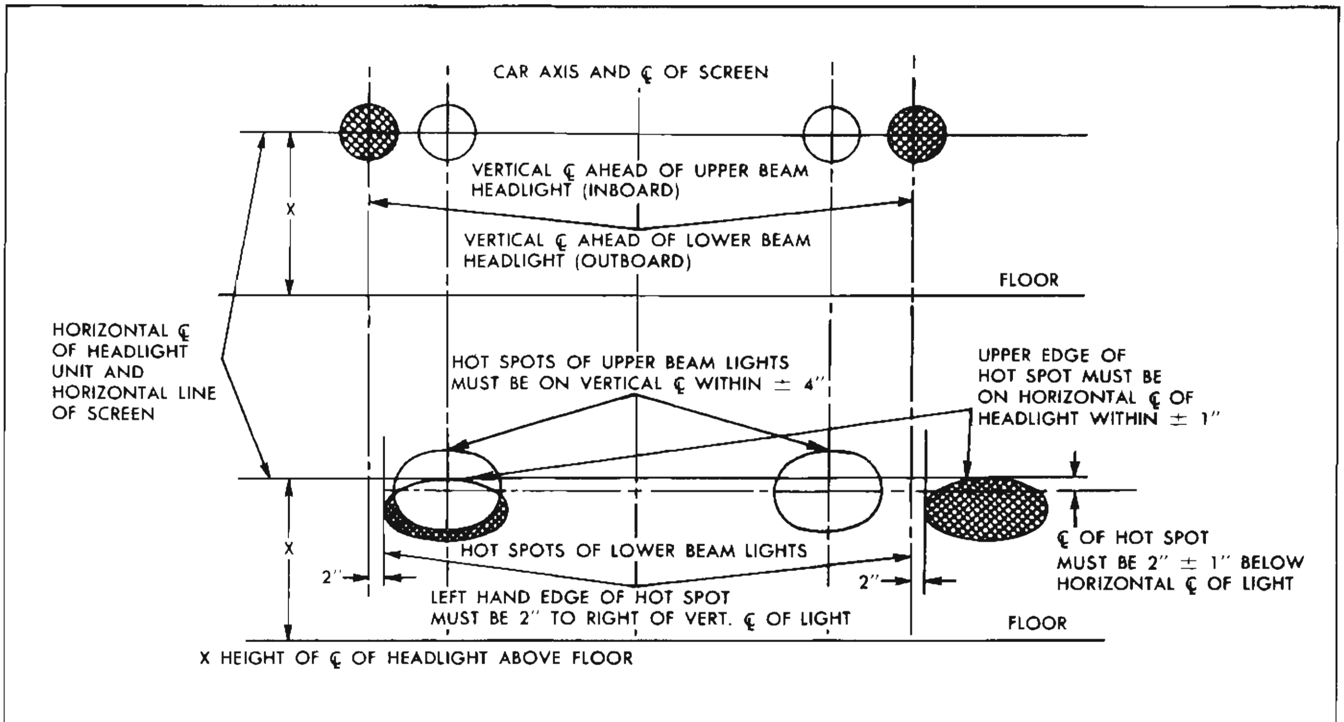



Fig. 11-53 Headlight Aiming Screen Chart

The hot spot of each light shall have relationship to the vertical and horizontal center line of the individual light unit within the limits and conditions shown in Fig. 11-53 at a distance of 25 feet.

### TAIL LIGHT

The tail light bulb is a double filament bulb which acts as a stop light, tail light and turn signal light. The bulb can be removed from the inside of the trunk.

### STOP LIGHT SWITCH

The stop light switch must be checked whenever the brake pedal height has been changed. Adjustment is made by positioning the switch and bracket in relation to the pedal arm.

NOTE: Make sure that the switch does not restrict pedal action.

### HORNS

The horn used on the car uses a solenoid actuated diaphragm to develop a resonating air column in the horn projector.

A relay is used in the horn circuit because of the high current required to operate the horn. The relay reduces the length of heavy gauge wire required and makes a more direct connection between the horn and the battery. Consequently, higher voltage is available at the horn and better performance is obtained by eliminating the voltage drop which otherwise would be in the horn button wiring circuit.

A second horn is available as optional equipment. It is designed to give a blended tone with other horn.

### CIGAR LIGHTER

The cigar lighter releases automatically (usual time for release is 10 to 14 seconds) which means that if the plug assembly for some reason is held in by the operator's hand a sufficient length of time (60 to 90 seconds), the fuse will blow or circuit breaker contact button will release. This may in some cases account for a blown fuse or released circuit breaker contact button where none of the other parts of the lighters are defective.

If temperature of the element shows indications of incorrect timing (too hot or too cold), the socket assembly containing the bi-metal hold-in fingers must be replaced.

The lighters have a safety feature in the form of two retaining fingers, which prevent the knob and element assembly from falling out or popping out of the socket onto the floor. If these fingers do not keep the knob and element assembly from falling out onto floor, the socket assembly should be replaced.

### DIRECTIONAL SIGNAL

The directional signal circuit consists of the switch, flasher, one light in the instrument cluster, the stop light filaments in the rear lights, and the turn signal filaments in the parking lights.

The electrical switch is mounted in the directional signal housing. It is actuated by a lever running to the inside of the directional signal housing.

The flasher, which is mounted on the fuse block, consists of two sets of points, a coil, and resistor. One set of points controls the flashing of the instrument panel light and the other set controls the flashing of the front and rear lights. The frequency of the turn signal is 80 to 100 flashes per minute.

## SERVICE OPERATIONS

### DIRECTIONAL SIGNAL

#### REMOVE

1. Remove steering wheel as outlined in Section 9.

2. Disconnect horn wire lead and directional signal connector.

3. Rotate directional signal housing on steering column jacket and remove housing from steering jacket (Fig. 11-54).

#### INSTALL

1. Install directional signal housing on steering column and position as shown in Fig. 11-55.

2. Install steering wheel as outlined in Section 9.

3. Connect horn wire lead and directional signal connector.

### DIRECTIONAL SIGNAL WIRING

Direction signal schematic wiring diagram is shown in Fig. 11-1.

### REPLACE SEALED BEAM UNIT

1. Remove headlight door.

2. Remove retaining ring and sealed beam unit from mounting.

3. Pull connector from rear of beam unit and separate sealed beam unit from retaining ring.

4. Assemble new sealed beam unit into retaining ring and plug sealed beam unit into connector.

5. Install beam unit and retaining ring.

6. Check headlight aiming and readjust if necessary.

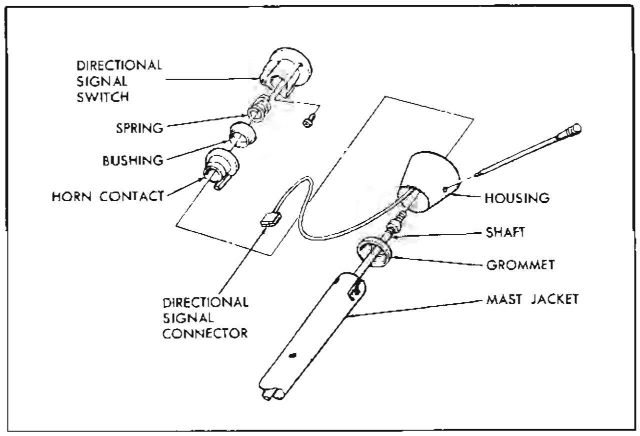



Fig. 11-54 Direction Signal Assembly

7. If headlight door rubber seal is defective, remove seal and cement new seal securely to door.

8. Replace headlight door.

### REPLACE LIGHT SWITCH

1. Remove one battery cable from battery post.

2. Pull switch knob to headlight "On" position, push latch button on bottom of switch assembly and pull out switch knob assembly.

3. Unscrew ferrule and remove switch assembly.

4. Remove "push-on" connectors from light switch and connect to new switch.

5. Position new switch in instrument panel, and start ferrule into switch assembly. Tighten securely.

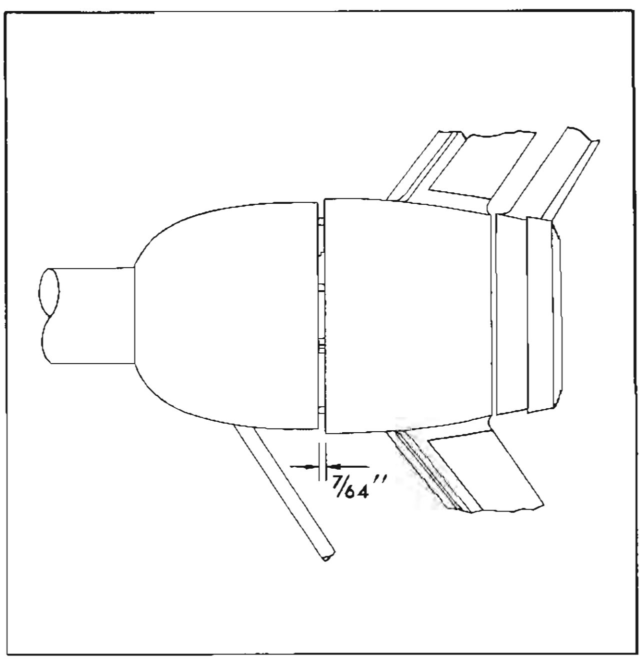



Fig. 11-55 Position For Housing

6. Insert knob assembly into switch assembly until end of rod engages catch.

7. Install cable on battery post.

### *CIGAR LIGHTER*

#### REPLACE ELEMENT

Unscrew element and shield assembly from knob and install new element.

#### REPLACE LIGHTER SOCKET

1. Remove wire connector from rear of lighter socket.

2. Use 1" deep socket to loosen clamping shell. Unscrew lighter socket and remove socket from instrument panel.

3. To install, reverse above procedure, seeing that clamping shell is turned up *finger tight only* on lighter socket.

## TROUBLE DIAGNOSIS

Troubles in the lighting and horn power circuits are caused by loose connections, open or shorted wiring, or blown fuses. In each case trouble diagnosis requires following through the circuit until the source of difficulty is found. To aid in making an orderly check, refer to Figs. 11-1 and 11-2.

| CAUSE | REMEDY |
|---|---|
| ***STOP LIGHT INOPERATIVE*** | |
| Improperly centered directional signal switch. | Center directional signal switch. |
| ***DIRECTIONAL SIGNAL FAILS TO OPERATE*** | |
| Blown Fuse. | Replace Fuse. |
| Defective flasher unit. | Replace flasher unit. |
| Loose connection circuit. | Check and tighten connections. |
| Failure of directional signal in left or right parking light or stop light. | Replace light. |

| CAUSE | REMEDY |
|---|---|
| ***INDICATOR LIGHT FLASHES EXTREMELY FAST*** | |
| Loose connections in circuit. | Check and tighten connections. |
| Failure of parking light. | Replace parking light. |
| Failure of stop light. | Replace stop light. |
| ***HORNS WILL NOT OPERATE*** | |

NOTE: To locate the trouble, connect a jumper lead to the first and last terminals of the relay (terminal numbers are stamped on the relay base). If the horn blows, the trouble is in the relay, horn button, or wiring. To determine whether the relay, horn button, or wiring is at fault, ground the No. 2 terminal of the relay. If the horn blows, the horn button or wiring is at fault. If the horn does not blow and the wiring between the battery and relay is not defective, con-

| CAUSE | REMEDY |
|---|---|
| nect a voltmeter between the horn terminal and the horn mounting nut. Again connect the jumper lead to the first and last terminals of the relay and note the voltmeter reading. If no voltmeter reading is obtained, the wiring between the relay and horn is open or the horn is not grounded. If the voltmeter reading is less than 7.0 volts, the trouble is due to high resistance connections in the wiring or a faulty horn. If the voltmeter reading is above 7.0 volts, the trouble is due to faulty horn. | |
| Loose connections in circuit. | Check and tighten connections. |
| Defective horn switch. | Replace defective parts. |
| Defective horn relay. | Replace relay. |
| Defects within horn. | Replace horn. |

***HORNS HAVE POOR TONE***

| CAUSE | REMEDY |
|---|---|
| Low available voltage at horn. | Check battery and charging circuit. |
| Defects within horn. | Although the horn should blow at any voltage above 7.0 volts, a weak or poor tone may occur at operating voltages below 11.00 volts. If the horn has a weak or poor tone at an operating voltage of 11.00 volts or higher, remove the horn and replace. |

***HORNS OPERATE INTERMITTENTLY***

| CAUSE | REMEDY |
|---|---|
| Loose or intermittent connections in horn relay or horn circuit. | Check and tighten connections. |
| Defective horn switch. | Remove button or ring and replace defective parts. |
| Defective relay. | Replace relay. |
| Defects within horn. | Replace horn. |

# INSTRUMENTS

## DESCRIPTION

Instruments consist of a fuel gauge, temperature indicator light (thermo-gauge), charge indicator light, oil pressure indicator light, and speedometer. Authorized service on the instruments can be obtained through branches of United Motors Service Division and AC Service Stations. However, knowledge of instrument circuit checks helps to determine if operating difficulties lie in the instrument itself or in its allied circuit.

### FUEL GAUGE

An electric fuel gauge is used on all models. The fuel gauge indicates the quantity of gasoline in the tank only when the ignition switch is turned on or to the accessory position. When the ignition is turned off or to start the pointer may come to rest at any position. The letters "E" and "F" on the fuel gauge are used to point our direction of indicator travel only. Gauge readings are made from five markings on the gauge face. The left hand line indicates empty, the center line half-full and the right hand line full. The dash unit of this instrument consists principally of two coils spaced 90° apart, with an armature and pointer assembly mounted at the intersection of the center lines of the two coil end pieces (Fig. 11-56). Silicone liquid in the armature bearing prevents vibration of the pointer on rough roads. One end of the left coil is connected to the left gauge terminal which is connected directly to the battery (through the ignition switch). The other end of the left coil and one end of the right coil are connected to the right gauge terminal which is connected directly to a rheostat which is the fuel gauge tank unit. The other end of the right coil and the tank unit are grounded. The resistance allows more current to flow through the right hand coil as the tank fills up, causing the right hand coil to balance the constant magnetism of the left hand coil, bringing the pointer and armature assembly to rest somewhere between the two coils, the exact position depending on the relative magnetic strength between the two coils. The fuel gauge tank unit consists of a float, with linkage connecting to a movable contact arm and a rheostat. As the float rises, due to filling the tank, the contact arm moves over the rheostat cutting in resistance and allowing more current to flow through the right-hand "full" coil of the panel unit.

### TEMPERATURE INDICATOR LIGHT

The engine temperature indicator light is con-

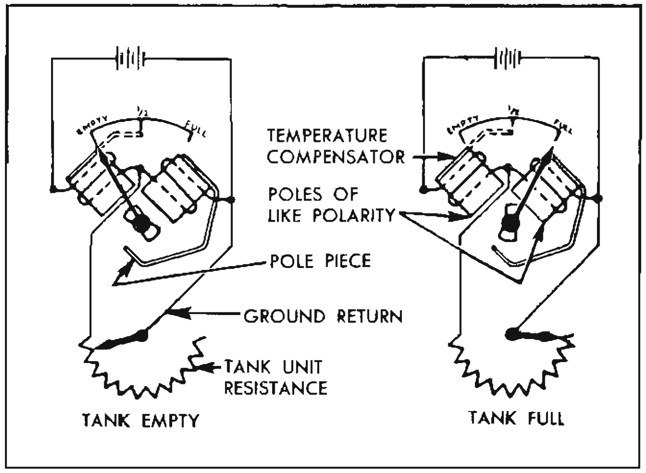



Fig. 11-56 Fuel Gauge Diagram

trolled by a thermal switch which senses coolant temperatures.

When the ignition switch is turned to the "Start" position a test circuit is closed to indicate whether the red light is functioning properly.

If the engine cooling system is not functioning properly, the thermal switch will close the circuit to the red light when the engine temperature reaches 248°F. The thermal switch does not require servicing. If it's defective, it should be replaced.

***CAUTION: Low boiling coolants will not operate light.***

### ALTERNATOR INDICATOR

The alternator indicator (sometimes referred to as ammeter) consists of a frame to which is attached a soft iron pole piece. The frame also supports a permanent magnet armature and pointer assembly.

When no current flows through the alternator indicator, the magnet holds the pointer armature and pointer so it indicates 0. When current passes in either direction through the indicator the resulting magnetic field attracts the armature opposing the effect of the permanent magnet and giving a reading proportional to the current flow.

NOTE: The charge indicator is marked "D" on one side and "C" on the other since it only indicates flow of current and does not show how much current is flowing. No attempt should be made to interpret the reading in amperes current flow.

### ENGINE OIL PRESSURE LIGHT

The engine oil pressure indicator light is controlled by a pressure operated switch located in the oil filter pad.

When the engine is running, the light operates only when the oil pressure is not satisfactory. This light should come on when the ignition is turned "on" and the engine is not running.

The oil pressure switch breaks contact at $5 \pm 1.5$ psi on increasing pressure and makes contact at $5 \pm 1.5$ psi on decreasing pressure.

### SPEEDOMETER

The speedometer incorporates a speed indicating mechanism and an odometer to record total mileage. A flexible cable, which enters the speedometer driven gear in the transmission on one end and the speedometer head at the other, rotates both mechanisms whenever the transmission main shaft, propeller shaft and wheels rotate. The speed indicating portion of the speedometer operates on the magnetic principle. In the speedometer head is a permanent magnet which rotates at the same speed as the cable. This magnet exerts a pull on a speed cup causing it to move in direct ratio to the revolving magnet speed. A pointer is attached to the speed cup spindle to indicate speed on the speedometer dial. A finely calibrated hair spring (also part of the speed cup assembly) opposes the magnetic pull on the speed cup so the pointer indicates true speed; it also pulls the cup and pointer to zero when the car stops.

The odometer is driven by a series of gears from a worm gear cut on the magnet shaft. The odometer discs are so geared that as any one disc finishes a complete revolution, the next disc to the left is turned one-tenth of a revolution.

## PERIODIC SERVICE

No periodic service or lubrication of instruments (except for the speedometer cable) is required. In fact lubrication of instruments must never be attempted since it will interfere with their satisfactory operation. Never attempt to lubricate the fuel gauge tank unit; adequate lubrication of this unit is provided by splash of the gasoline.

In some cases the speedometer cable becomes noisy or the speed indicator wavers or jerks. This may be due to a dry cable which should be lubricated as outlined in the General Lubrication Section.

## REPAIRS

### REMOVE INSTRUMENT CLUSTER

1. Disconnect battery and remove left A/C duct (Fig. 11-57).
2. Remove retaining nuts.
3. Remove speedometer cable.
4. Pull cluster and housing out from instrument panel opening to gain access to wiring.
5. Starting at the top, remove bulbs and wiring.
6. To replace, reverse above procedure.

### REMOVE AND REPLACE INDIVIDUAL INSTRUMENT

(Cluster removed from car)

#### SPEEDOMETER

1. Remove screws retaining speedometer head.
2. Remove screws securing speedometer to head assembly.
3. Replace—reverse steps.

#### FUEL AND ALTERNATOR GAUGES

1. Remove wire connector and bulb (in car operation).
2. Remove screws.
3. Remove gauge.
4. Replace—reverse steps 1-3.

#### IGNITION SWITCH

See Page 11-39.

#### HEATER CONTROL

See Section 12.

#### FUEL GAUGE TANK UNIT

1. Clean away any dirt that has collected around tank unit so it will not enter tank.
2. Loosen tank strap to permit easy access to tank unit.
3. Disconnect lead on tank terminal, fuel line and remove tank unit.
4. Install new tank unit and check for freedom of float arm movement.
5. Install attaching screws and tighten.
6. Secure terminals and fuel line.

#### SPEEDOMETER CABLE

1. Disconnect speedometer cable casing from speedometer head.
2. Slide old cable from upper end of casing, or if broken, from both ends of casing.
3. Take a short piece of speedometer cable with a tip to fit the speedometer and insert it in the speedometer socket. Spin the short cable between the fingers in the direction that higher speed is indicated

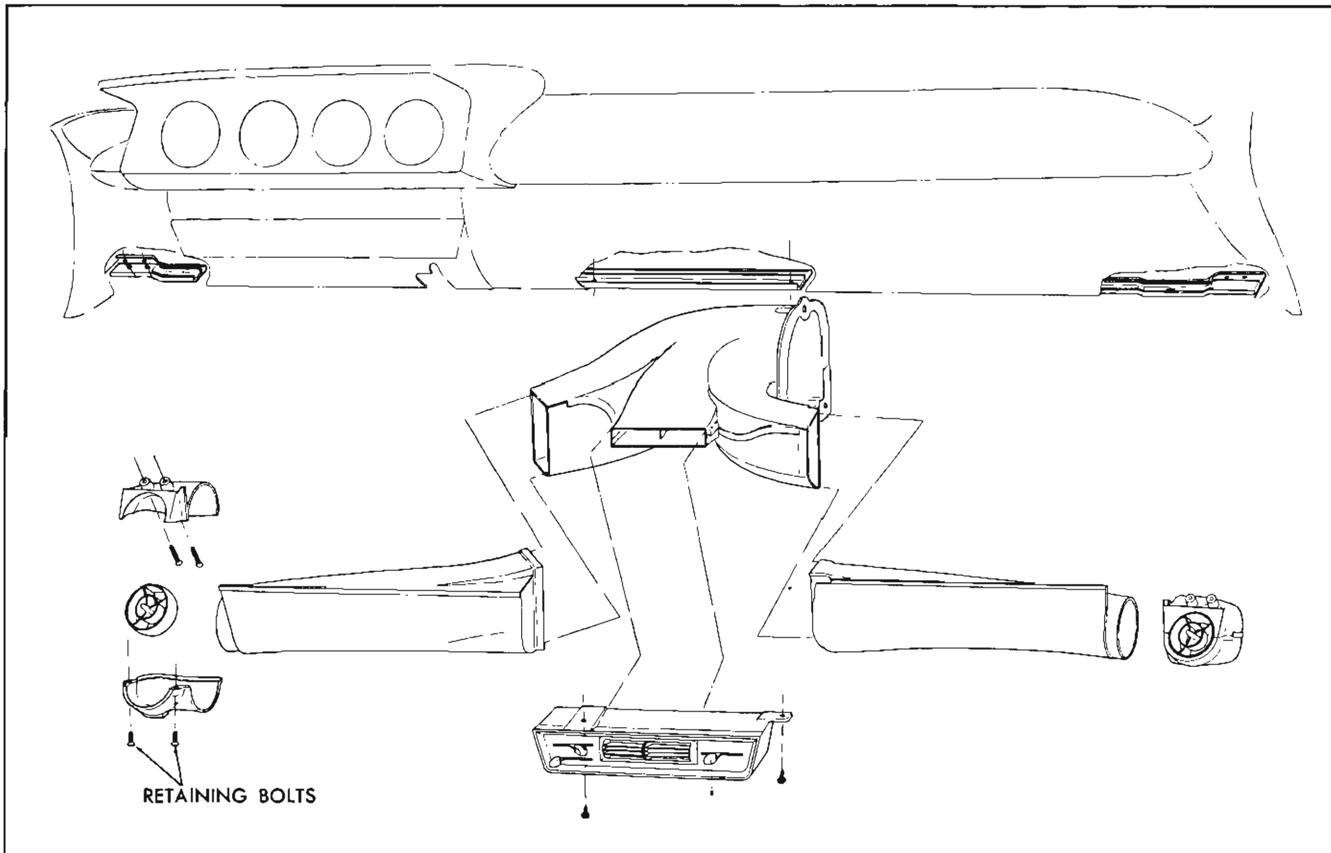



Fig. 11-57 Air Conditioning Ducts

on the speedometer dial and note if there is any tendency to bind. If binding is noted, there is trouble inside the head and the speedometer should be repaired.

4. Inspect cable casing, especially at transmission end, for sharp bends and breaks. If breaks are noted, replace casing.

5. Lubricate cable as outlined in General Lubrication Section.

6. Insert cable into upper end of casing, lower end first.

7. Seat upper cable tip in speedometer and tighten casing connector to speedometer case as tightly as possible with fingers.

NOTE: Insufficient tightening of connector will result in connector loosening, causing speedometer indicator to waver.

8. See that there are no sharp bends in casing.

## INSTRUMENT TROUBLE DIAGNOSIS

| CAUSE | REMEDY |
|---|---|
| ***GASOLINE GAUGE DOES NOT REGISTER WITH IGNITION ON*** | |
| Break in line between instrument panel unit and ignition switch. | Check line and connections to switch and panel unit. |
| Defective panel unit. | Check and replace. |

| CAUSE | REMEDY |
|---|---|
| ***GASOLINE GAUGE SHOWS FULL UNDER ALL CONDITIONS*** | |
| Break in line between tank and instrument panel unit. | Check and repair. |
| Defective tank unit. | Check and replace. |
| Tank unit improperly grounded. | Ground tank to chassis and check gauge operation. |
| ***GASOLINE GAUGE SHOWS EMPTY UNDER ALL CONDITIONS*** | |
| Lead to tank unit grounded. | Make necessary repair. |
| Defective tank unit. | Check and replace. |
| Defective panel unit. | Check and replace. |
| ***SPEEDOMETER*** | |
| Noisy Speedometer Cable. | Loosen over-tightened casing nuts and retighten finger tight at both ends. |
| | Remove kinks from cable. |
| Pointer and Odometer Inoperative. | Remove kinks from cable. |
| | Replace broken cable. |
| | Check for lubricant in speedometer head. |
| Inaccurate Reading. | Check tire size. |
| | Check for correct speedometer driven gear. |
| Cable dry. | Lubricate. |
| Kinked cable. | Replace cable. Reroute casing so that bends have no less than 6″ radius. |
| Defective speedometer head. | Replace or have repaired at authorized service station. |
| Casing connector loose on speedometer case. | Tighten connector. |

## INSTRUMENT TESTING

### *FUEL GAUGE TANK AND INSTRUMENT PANEL UNITS*

In order to isolate trouble in the fuel tank or instrument panel unit, use either an extra tank unit, which is known to be good, or commercial gas gauge tester.

***CAUTION: In process of testing fuel gauge panel unit never place full battery current on terminal to which wire to tank is normally attached. To do so will burn out resistance coil in tank unit even though the terminal is touched only momentarily.***

To test, remove lead to tank unit from instrument panel unit and then use one of the following methods:

### *TESTING WITH EXTRA TANK UNIT*

1. Attach a wire lead from the terminal on the extra tank unit to the tank unit terminal on the panel unit and connect a second wire from body of extra tank unit to car chassis.

2. Turn on ignition and move float on extra tank unit to full and empty positions. If panel unit indicates corresponding reading, it is satisfactory and trouble is in tank unit or wire lead from panel unit to tank unit.

3. Check wiring to tank unit by disconnecting lead from tank unit in car and connecting to test unit. With test unit grounded to chassis, move float to full and empty positions and see that instrument panel unit reads correctly. Incorrect reading indicates defect in wiring.

4. Check tank unit by removing from tank, reconnecting the lead and operating unit in same manner as the test unit (tank unit must be grounded while testing). If instrument panel shows correct reading, trouble was caused by poor connection of lead to tank unit or poor ground. If instrument panel does not give correct reading, install a new tank unit.

### TESTING WITH TESTER

The calibration limits of the fuel gauge dash unit are 30 ohms-full, 15 ohms-½ full and 1 ohm-empty.

1. Remove lead to tank unit from instrument panel unit. Attach wire of tester to the tank unit terminal on panel unit and ground the tester by connecting the black wire to a good ground.

2. Turn on ignition switch and move lever on tester through its full travel. If panel unit reads "empty" and "full", it is satisfactory and trouble is in tank unit or possibly wire lead from instrument panel unit to tank unit.

3. Check wiring to tank by disconnecting lead from tank unit in car and connecting to tester. Ground tester and move lever on tester through its full travel. If instrument panel unit shows "empty" and "full", tank unit is probably defective and should be checked as in step 4 above.

# ONE SPEED WIPER

## DESCRIPTION

The single speed wiper consists of a shunt wound motor. The gear train consists of helical gear at the end of the armature shaft. The helical gear drives an intermediate gear and pinion assembly, the pinion of which drives an output gear and shaft assembly. The crank arm is attached to the shaft of the output gear. (Fig. 11-58). An impulse type washer pump is used on the single speed wiper. See washer pump section for detailed explanation.

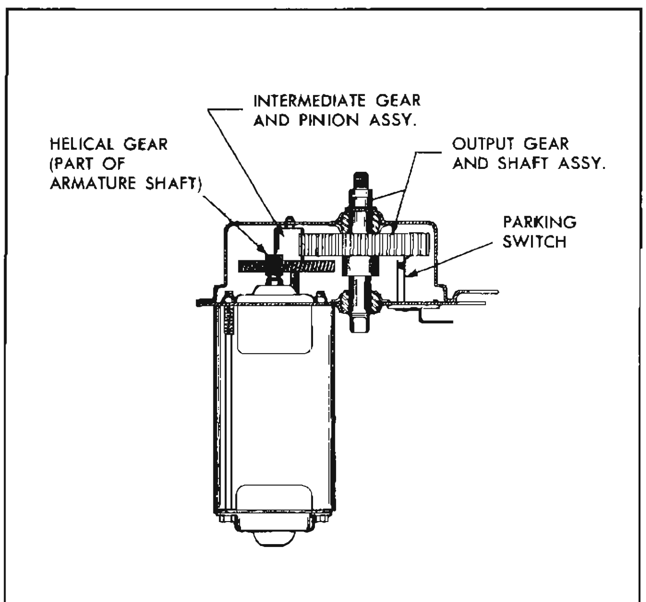



Fig. 11-58 Wiper Gear Train

## OPERATION

Two switches, dash and parking are connected in parallel and control the starting and stopping of the wiper. The park switch contacts, which are located in the wiper gear box (Fig. 11-58), are normally closed. The purpose of the parking switch is explained in the following paragraph. (Refer to wiring diagram in Fig. 11-60).

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

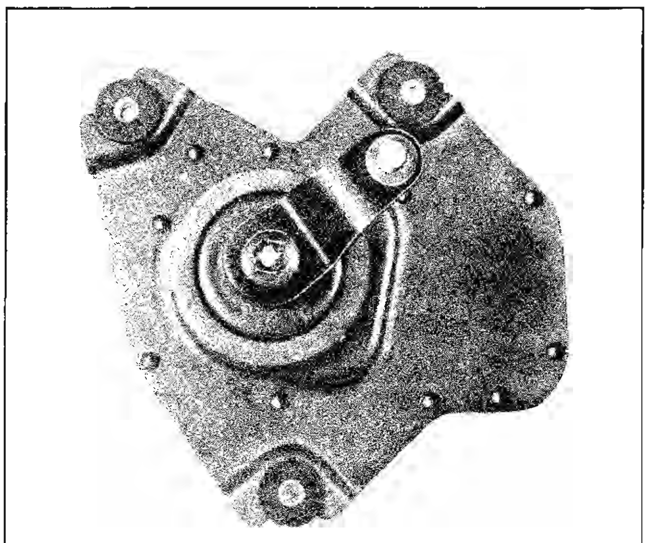


Fig. 11-59 Mounting for Wiper

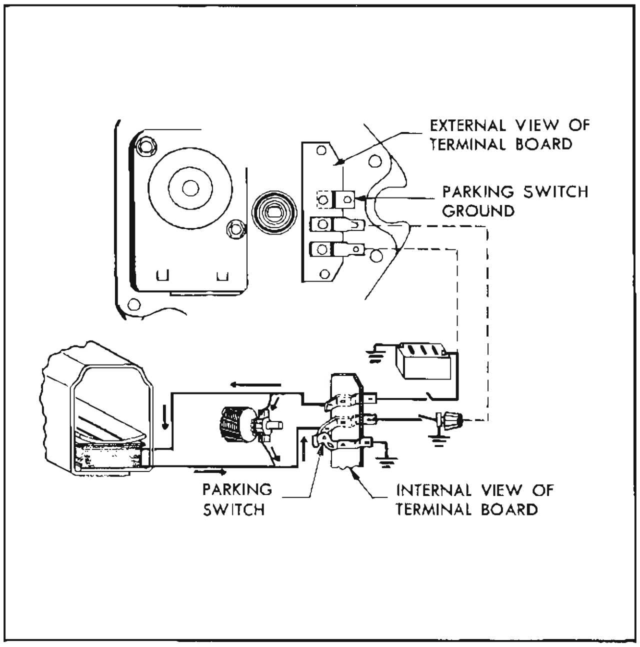



Fig. 11-60 Wiper Wiring Diagram

are normally closed, maintain the motor circuit to ground at the wiper. This allows the wiper to keep operating until the blades or wiper crank arm can reach the park position (Blades approx. 2" above windshield molding). At the same time the blades reach the park position, a cam on the output gear opens the park switch contacts. This opens the motor circuit to ground, stopping the motor. Thus, the parking switch actually controls wiper operation only during that short period of time, between the owner turning the wiper "off" at the dash switch and when the wiper has completely stopped.

Turning the wiper "on" at the dash switch overrides the open park switch contacts and closes the wiper motor circuit to ground starting the wiper. NOTE: Although the park switch contacts are opened once during each revolution of the output gear, the park switch has no control over the wiper until the dash switch is turned "off."

## CONNECTIONS TO OPERATE WIPER

Fig. 11-61 shows the proper method of connecting jumper leads to the wiper so that it can be operated independently of the dash switch or car wiring for test purposes. NOTE: Specification table at end of this section lists current draw data.

## WIPER SWITCH—REPLACE (FIG. 11-62)

1. Loosen Allen screw and remove knob.

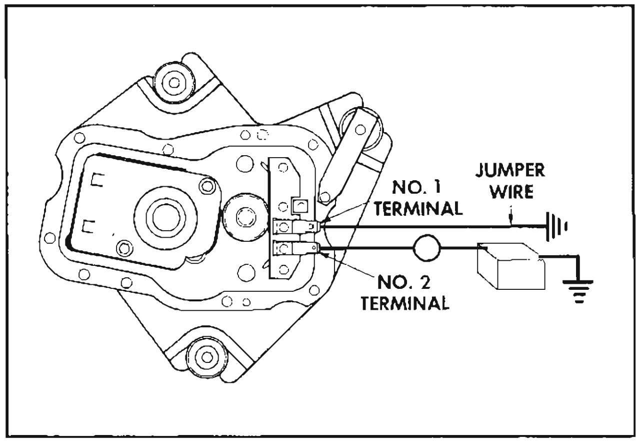



Fig. 11-61 Connection for Test Purposes

2. Remove retaining nut securing shaft and escutcheon.
3. Remove switch and disconnect terminals.
4. To install, reverse above procedure.

## WIPER TRANSMISSIONS AND LINKAGE—REPLACE (FIG. 11-63)

1. Remove arm and blade assemblies.
2. Remove fresh air intake grille.
3. Remove wiper transmission retaining screws.
4. Remove left A/C duct (Fig. 11-57).
5. Remove clip securing left wiper transmission crank to linkage which attaches to wiper motor crank.
6. Remove wiper transmissions and linkage.
7. To install, reverse above procedure. Make sure wiper blades are in park position after they are installed.

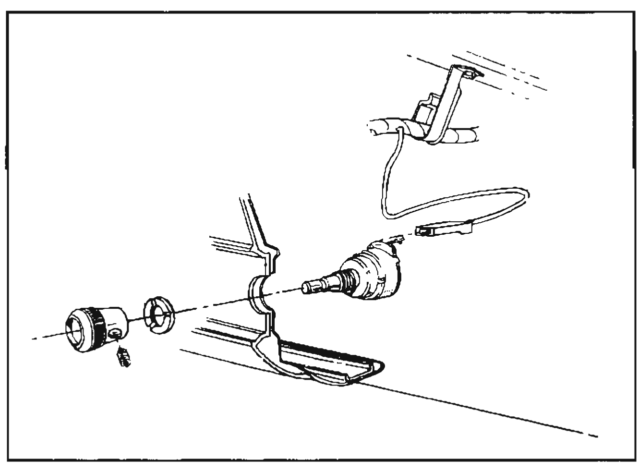


Fig. 11-62 Windshield Wiper Switch

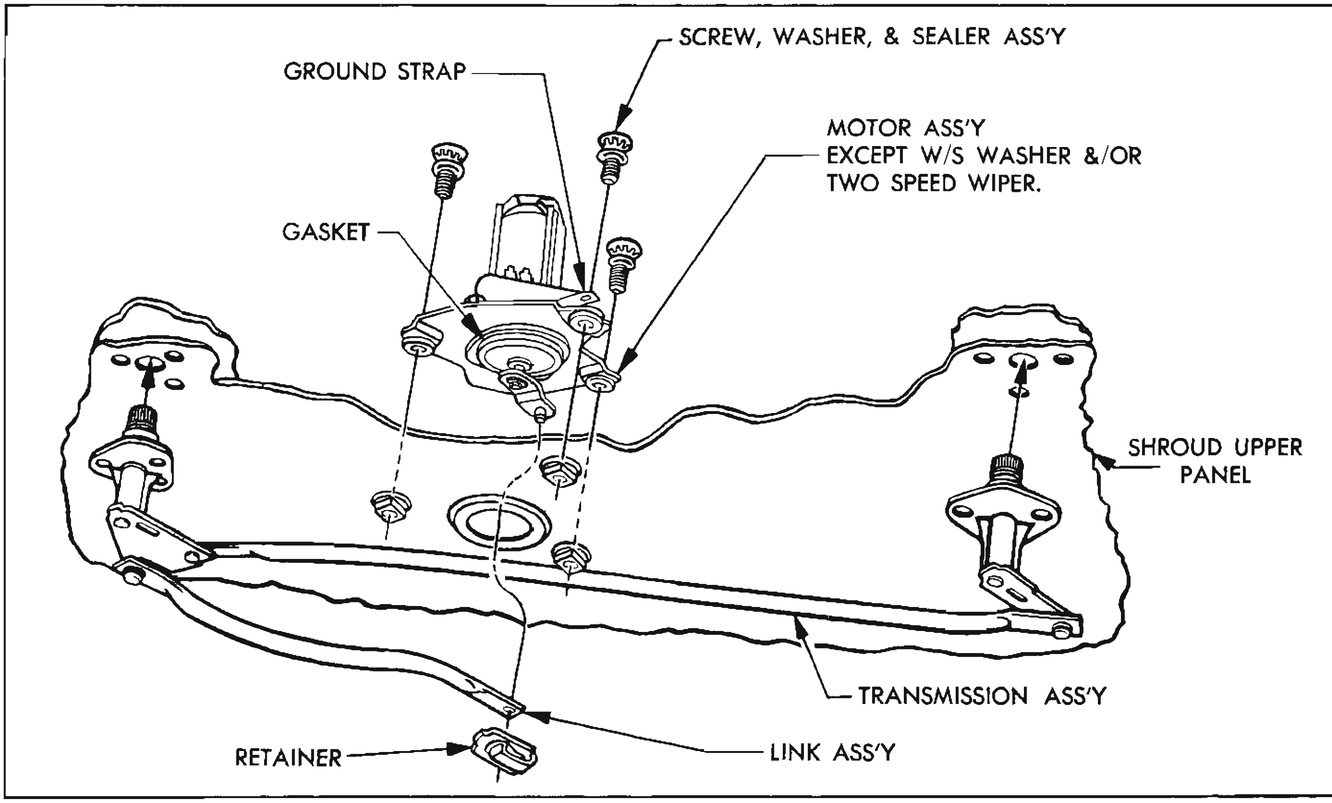



Fig. 11-63 Windshield Wiper Transmission

## REMOVE WIPER

1. Remove hoses and wire terminals connected to wiper unit.

2. Remove clip securing wiper crank to wiper transmission arm. This connects inside the car at fire wall, under instrument panel.

3. Remove screws securing wiper assembly to fire wall.

## INSTALL WIPER

1. Make sure gasket is on motor (Fig. 11-63).
2. Install wiper assembly on fire wall and secure.
3. Connect wire terminals and hoses.
4. Connect wiper crank to wiper transmission arm.

## TROUBLE DIAGNOSIS

Trouble diagnosis procedures are divided into two categories: (1) Wiper installed in car; (2) Wiper detached from car.

Typical Trouble Conditions

A. Inoperative

B. Will not shut off

C. Intermittent operation

D. Blades do not return to park position when wiper is turned off.

***WIPER INSTALLED IN CAR***

WIPER INOPERATIVE – Important: Ignition switch must be on to make electrical tests.

1. Check the following:
   (1) Car wiring harness is properly attached to wiper terminals and dash switch.
   (2) Wiper ground strap properly connected to wiper and car body.
   (3) Dash switch is mounted securely in dash.
   (4) Check fuse.

2. If everything checks out in Step 1 and wiper fails to operate, disconnect wiring harness from wiper and check for 12 volts at harness terminal that connects to wiper terminal No. 2, Fig. 11-61.

No voltage indicates defective car wiring.

***CAUTION: Do not connect hot line to No. 1 Terminal.***

3. Connect 12 volt supply to No. 2 wiper terminal and connect a jumper wire from terminal No. 1 to ground (Fig. 11-61). If wiper operates, the dash switch or wiring between dash switch and wiper is defective.

4. If wiper fails to operate in Step 3 remove body parts as required to disconnect wiper transmission from wiper crank arm. Recheck wiper operation as explained in Step 3. If wiper operates correctly, a defective transmission or binding condition exists. If wiper still fails to operate, remove wiper from car and follow instructions under "Wiper Detached From Car."

## WIPER WILL NOT SHUT OFF

1. Disconnect wiring from dash switch. If wiper shuts off, a defective dash switch is indicated.

2. If wiper still operates in Step 1, disconnect wiring from wiper and connect 12 volt supply direct to wiper terminal No. 2 (Fig. 11-61). Do not connect any jumper wire to terminal No. 1.

—Wiper shuts off correctly—check for grounded lead that extends between wiper terminal No. 1 and dash switch.

—Wiper fails to shut off—remove wiper from car and follow instructions under "Wiper Detached From Car."

## INTERMITTENT OPERATION

1. Check the following: Loose ground strap, loose dash switch mounting, loose connection.

## DO NOT RETURN TO PARK POSITION WHEN WIPER IS TURNED OFF

Remove wiper from car and check for a dirty or broken park switch (See Fig. 11-58 for park switch location).

## *WIPER DETACHED FROM CAR*

Connect 12 VDC Power source and ammeter to wiper as shown in Fig. 11-61 and observe current draw and wiper operation. NOTE: Identify wiper part number from wiper motor end cap and select proper current draw from specification table.

## WIPER INOPERATIVE

—Current Draw—0

1. Check solder connection at terminal board.

2. Disassemble motor section and check all splice connections (Fig. 11-64).

—Current Draw—2-3 amps

Dissassemble motor and check for the following items:

a. Open armature.

b. Brushes sticking.

c. Brush springs improperly positioned (See Fig. 11-65).

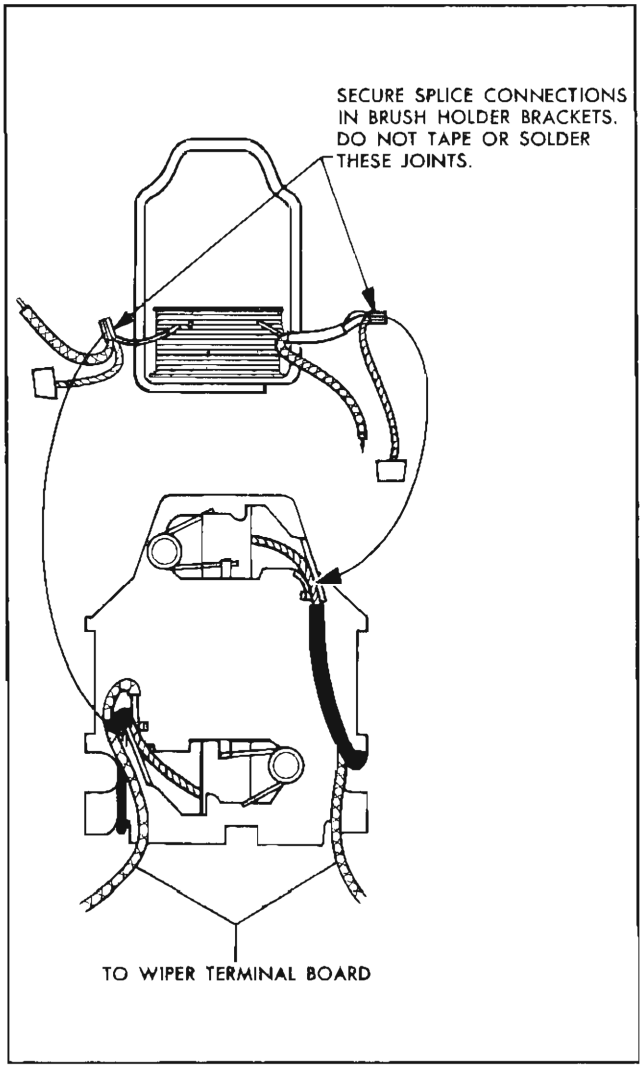



Fig. 11-64 Motor Splice Connections

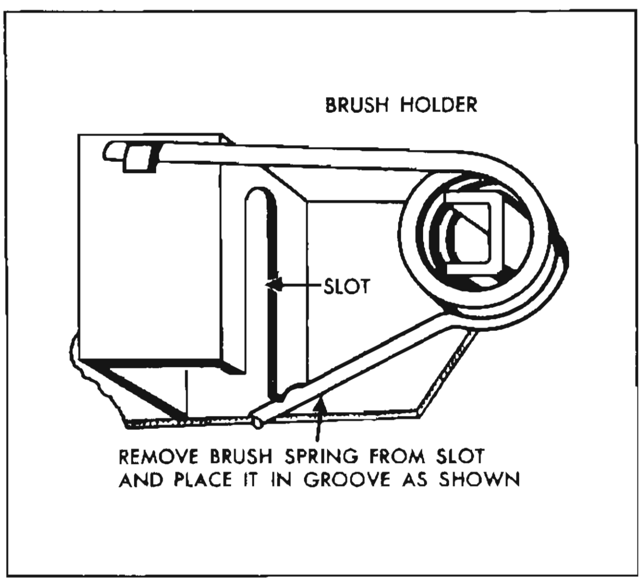



Fig. 11-65 Brush Spring

d. Brush pigtail connections at splice joints (Fig. 11-64).

—Current Draw—10-12 Amps.

1. Check for open shunt field circuit.

2. Check for broken gear.

WIPER RUNS SLOW, VIBRATES AND CURRENT DRAW APPROX. 7-9 AMPS.

1. Check for binds in gear train.

2. Check for shorted armature (armature may be checked on a growler).

WIPER SHUTS OFF BEFORE CRANK ARM REACHES PARK POSITION

Wiper crank arm stops rotating immediately when jumper wire is disconnected from wiper terminal No. 1 (Fig. 11-61). NOTE: When crank arm has reached park position the crank arm index grooves will line up approx. with the ridges on the gear box cover.

Check for dirty, broken or bent park switch contacts.

WIPER WILL NOT SHUT OFF

Wiper crank arm fails to stop in park position when jumper wire is removed from wiper Terminal No. 1. Fig. 11-61.

1. Check that park switch contacts are opening.

2. Check for grounded condition in the internal motor lead that connects to terminal No. 1, Fig. 11-61.

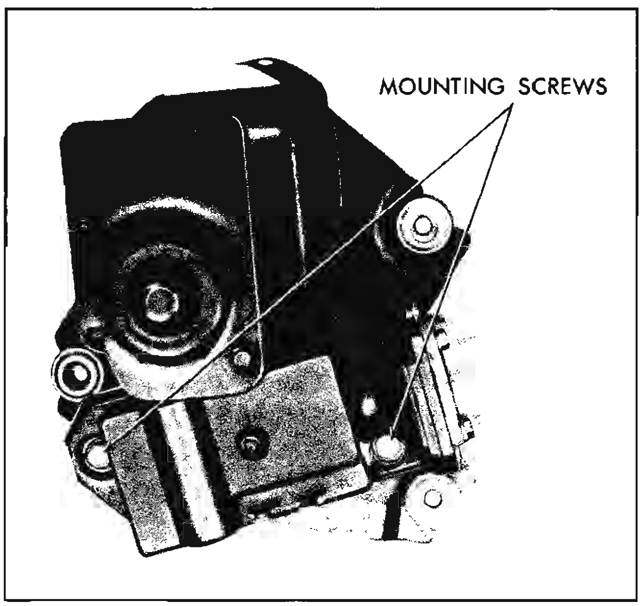



Fig. 11-66 Washer Pump Mounting Screws

## ADJUSTMENTS

Armature end play is automatically adjusted by the proper assembly of end play washers. See Fig. 11-69 for proper assembly of end play washers.

## GEAR BOX

***DISASSEMBLE***

(Gear Box disassembly is the same regardless of mounting type).

1. For wipers equipped with a washer pump remove the two washer pump mounting screws (Fig. 11-66) and lift washer pump off wiper.

2. Remove sintered iron washer pump drive cam as required (Fig. 11-67). The cam is pressed on the shaft but can be wedged off by using two screwdrivers between cam and plate.

3. Clamp crank arm in a vise and remove crank arm retaining nut, arm, retainer ring, and endplay washers.

4. Drill out the gear box cover retaining rivets and remove cover from gear train.

***CAUTION: Mark ground strap location for reassembly purposes.***

NOTE: Screws, nuts and lockwashers for reassembling cover to wiper are contained in a service repair pkg., Part No. 4910591.

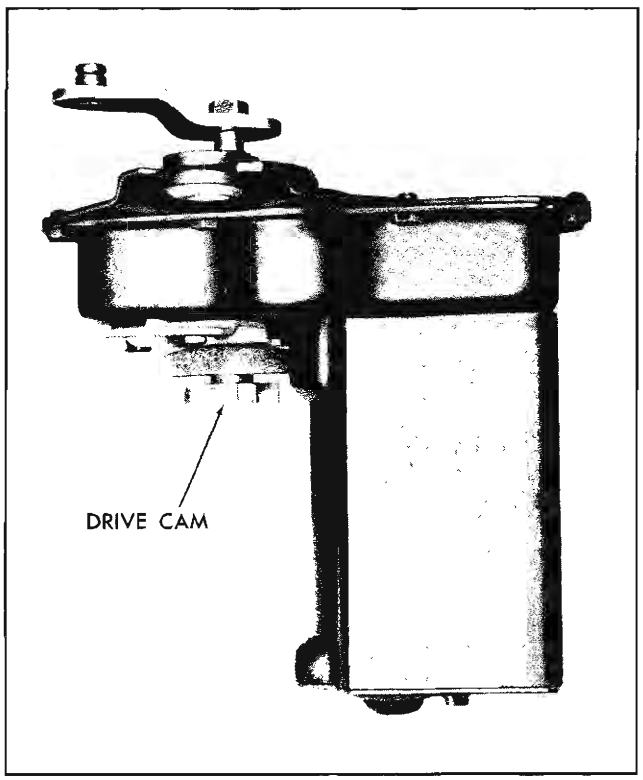



Fig. 11-67 Washer Pump Drive Cam

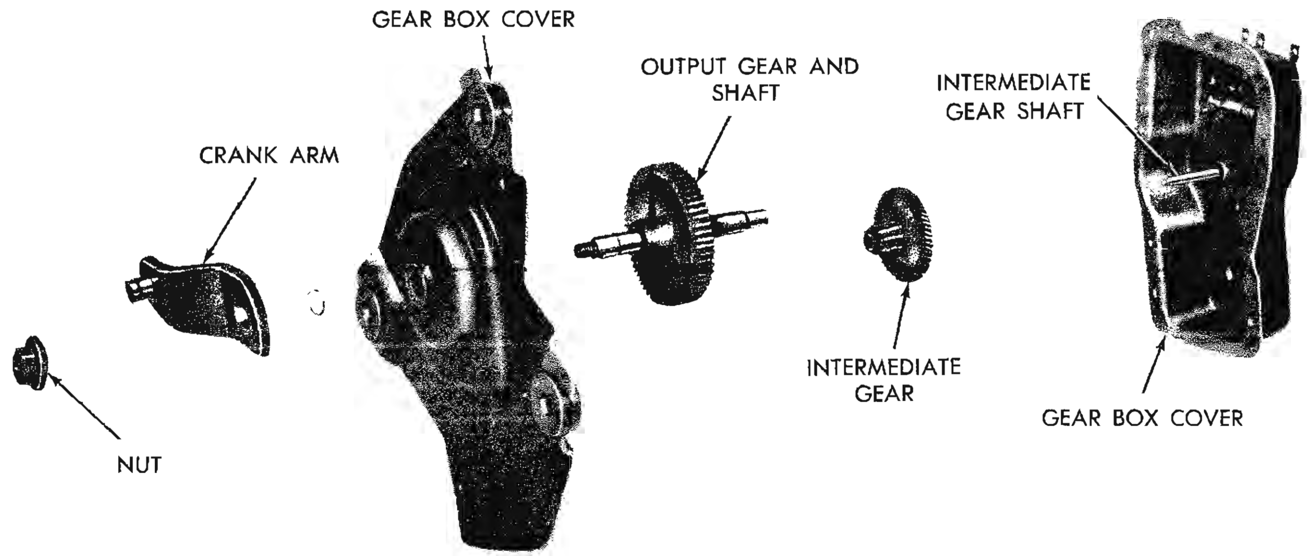



Fig. 11-68 Gear Box Exploded View

5. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft. (Fig. 11-68).

6. Remove terminal board and park switch assembly as follows:

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.

### *ASSEMBLY*

Reverse steps 1 thru 7 except as noted:

1. Reassembly of Gear Cover—Be sure cover is located properly over locating dowel pins and be sure to re-install ground strap and gasket.

2. Reassembly of Crank Arm—Operate wiper to park position (Fig. 11-61) and install crank arm on output shaft so that identification marks line up with those in the cover. Clamp crank in vise before securing the retaining nut.

## MOTOR SECTION

### *DISASSEMBLE AND ASSEMBLE*

Refer to Fig. 11-70.

1. Follow steps 1 thru 7(a) under gear box disassembly.

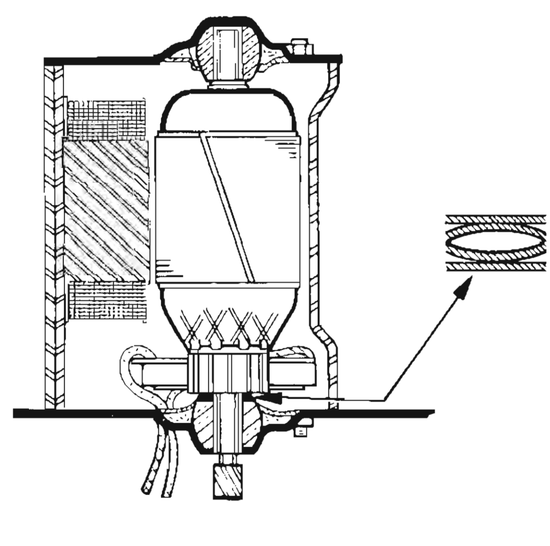


Fig. 11-69 End Play Washers

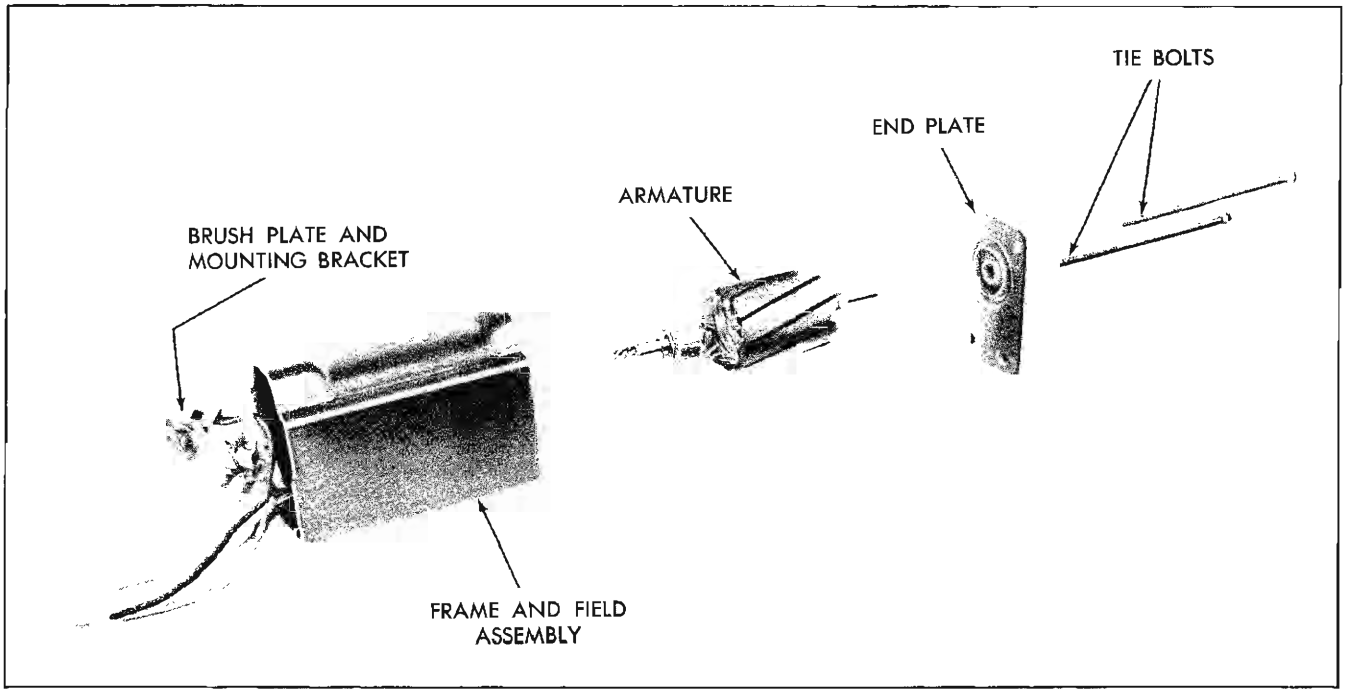



Fig. 11-70 Motor Exploded View

2. Remove tie bolts.

3. Release brush spring pressure against brushes as shown in Fig. 11-65.

4. Move brushes away from armature and slide armature out of frame and field assembly. Pull end cap assembly off armature.

5. Remove end play adjusting washers.

To reassemble motor, reverse steps 1 thru 4 as required.

## LUBRICATION

Armature shafts and Bearings:

Light Grade Machine Oil.

Gear Teeth (All):

Delco Cam and Ball Bearing Lubricant.

## WIPER SPECIFICATIONS

–Operating Test Voltage .................. 12 VDC

–Crank Arm Rotation (looking at arm) ...... CCW

–Crank Arm Speed .................. 43RPM

–Current Draw (Amps.)

No load .............................. 3 Max.

Dry windshield ...................... 3.5 Max.

Stall .............................. 11.0 Max.

# TWO SPEED WIPER

## GENERAL DESCRIPTION

The mounting used for the single speed wiper is used for the 2 speed wiper.

The washer pump used on the new type two-speed wiper is the same as that used on the new type single speed wiper.

## PRINCIPLE OF OPERATION

The principle of operation is very similar to that of the single speed wiper. A combination pictorial and schematic circuit is shown in Fig. 11-71. An explanation of "LO," "HI" and parking circuits follows:

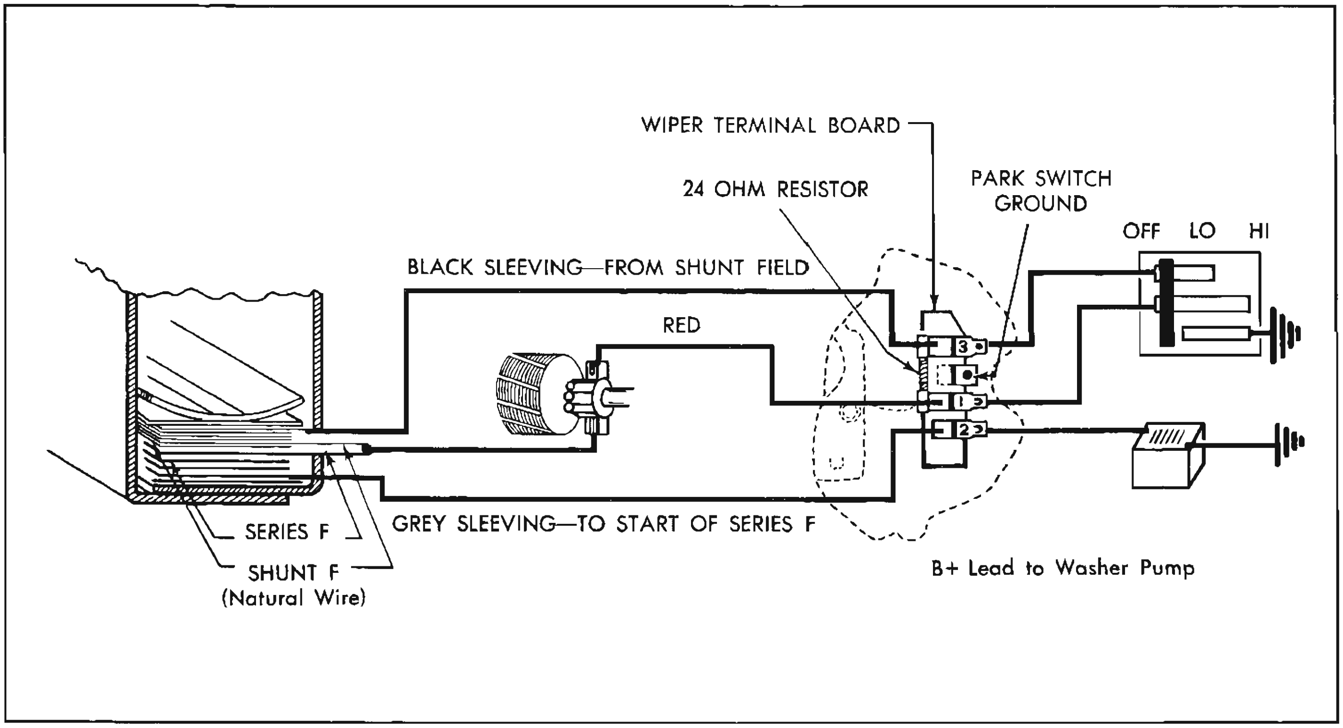



Fig. 11-71 Wiper Wire Schematic

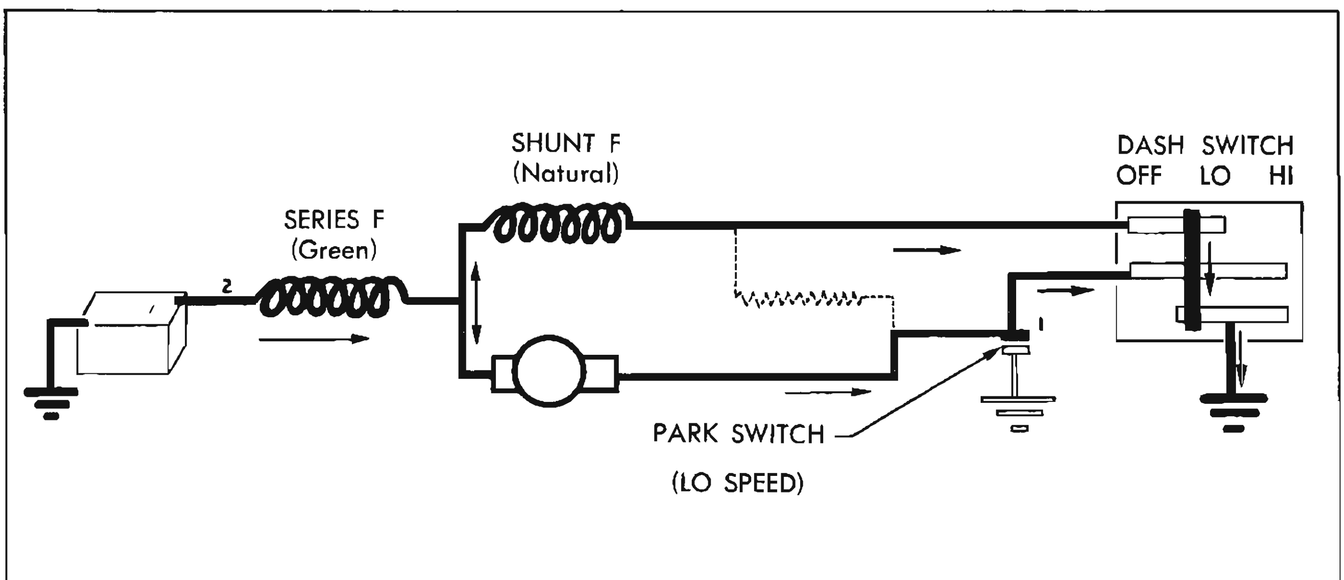



Fig. 11-72 Low Speed Circuit

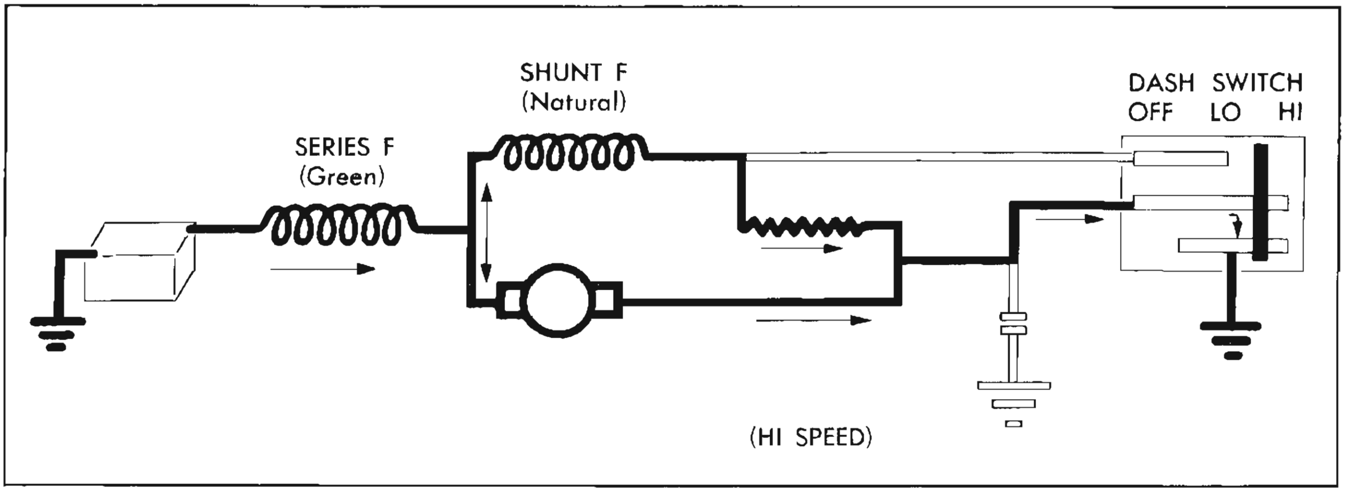



Fig. 11-73 Hi Speed Circuit

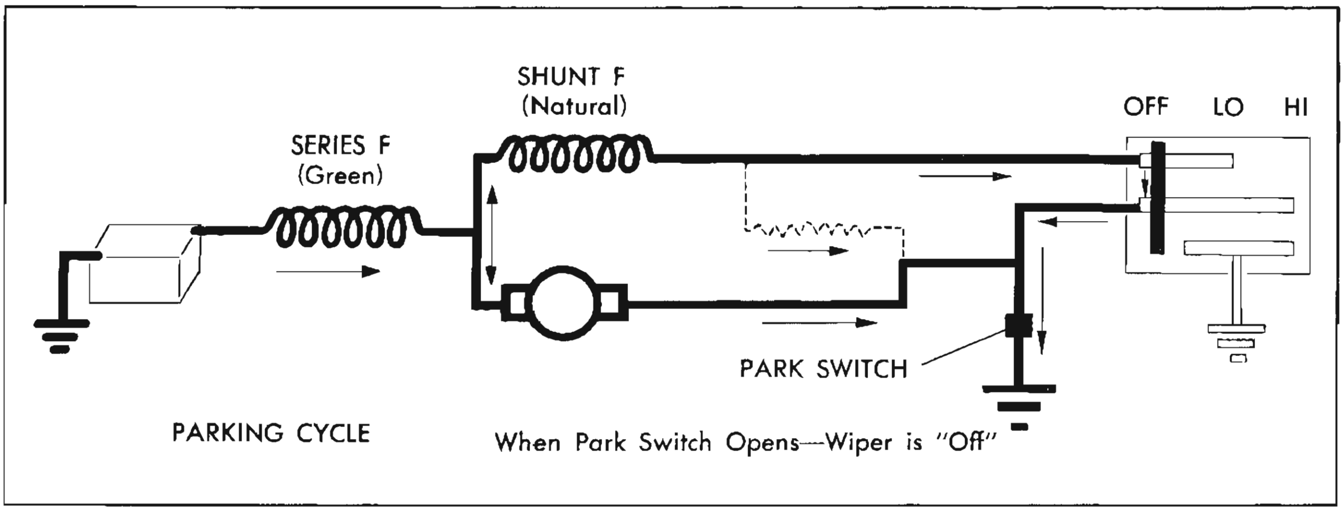



Fig. 11-74 Parking Cycle

***LO SPEED—Figure 11-72***

When the dash switch is moved to the "LO" speed position (Ign. Sw. On) current from the battery flows through the series field coil and divides; part passing through the shunt field coil to ground at the dash switch, the other part passing through the armature to ground at the dash switch.

***HI SPEED—Figure 11-73***

Moving the "Dash" switch to the "HI" speed position *opens* the shunt field circuit to ground at the dash switch and keeps the armature circuit closed to ground. The shunt field current must then pass through a 24 ohm resistor located on the back of the wiper terminal board, and then through the same lead that connects the armature circuit to ground through the dash switch.

***PARKING CIRCUIT—Figure 11-74***

Moving the dash switch to the "off" position opens both the armature and shunt field circuits to ground at the dash switch. However, both of these circuits are still closed to ground through the parking switch.

(NOTE: The shunt field circuit actually flows via the dash switch back to the wiper parking switch direct to ground which means that wiper is *actually operating in "LO" speed* during the parking cycle.)

When the cam on the wiper output gear opens the park switch contacts, the wiper is "off" and the blades and/or wiper crank arm should be in the park position.

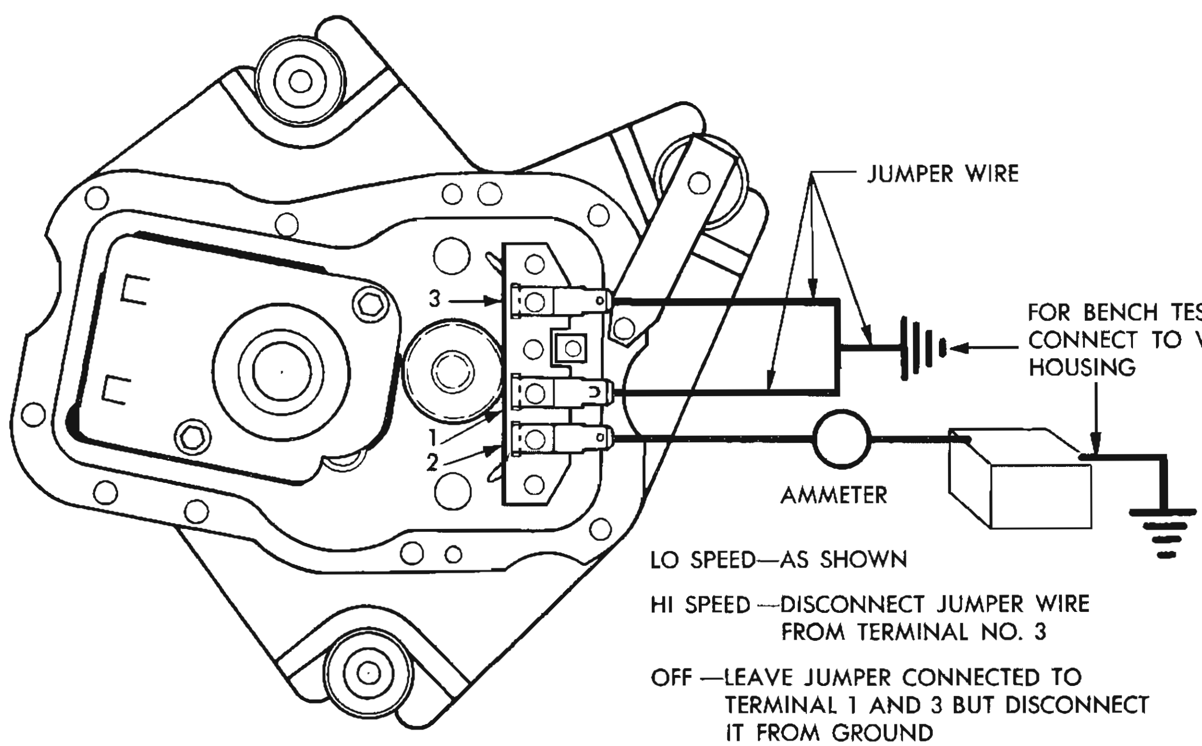



Fig. 11-75 Connections for Testing

## CONNECTIONS TO OPERATE WIPER

Fig. 11-75 illustrates the method of connecting leads to the wiper for either bench operation or to run wiper independently of dash switch and car wiring when installed in car.

## TROUBLE DIAGNOSIS

Typical Wiper Troubles:

A. Wiper inoperative.

B. Wiper will not shut off.

C. Wiper has one speed *fast*.

D. Wiper has one speed *slow* and shuts off with Dash Switch in "Hi" speed position.

E. Blades do not return to park position when wiper is turned "off."

F. Wiper speed normal in "Lo" but too fast in "Hi."

G. Intermittent operation.

Trouble diagnosis procedures are divided into two (2) main categories:

(1) Wiper Installed In Car.

(2) Wiper Detached From Car.

***WIPER INSTALLED IN CAR***

### WIPER INOPERATIVE

1. Check that wiring harness is properly connected to wiper and dash switch; wiper ground strap is connected securely to car body; and dash switch is securely mounted.

2. With ignition switch on, check for 12 volts at harness terminal that connects to number (2) terminal (Figure 11-75).

3. To determine if dash switch or car wiring are at fault, disconnect harness from wiper motor and try operating wiper as shown in Fig. 11-75. If wiper fails to operate, remove body parts as required, disconnect transmissions from wiper crank arm and recheck wiper operation. If wiper still fails to perform correctly, remove wiper from car and check wiper ac-

cording to procedure under "Wiper Detached From Car."

## WIPER WILL NOT SHUT OFF

1. Determine if wiper has both "Lo" and "Hi" speeds, "Lo" speed only, or "Hi" speed only. NOTE: wiper must operate in "Lo" speed during parking cycle)

2. Disconnect wiring harness from wiper motor and try operating wiper independently of dash switch as shown in Fig. 11-75.

—If wiper operates correctly independently of the dash switch, (i.e. shuts off correctly with crank arm in park position) refer to the table below for possible trouble location—

| Step I Diagnosis | Possible Trouble |
|---|---|
| Wiper had both speeds | (1) Lead between wiper terminal No. 1 and dash switch grounded.<br>(2) Defective dash switch. |
| Wiper had "Lo" speed only | (1) Lead between wiper terminal No. 3 and dash switch grounded.<br>(2) Defective dash switch. |
| Wiper had "Hi" speed only | (1) Lead between wiper terminal and dash switch open.<br>(2) Defective dash switch. |

—If wiper still fails to operate correctly in Step 2, remove it from car and check it per instructions under "Wiper Detached From Car."

## WIPER HAS ONE SPEED—FAST

Check for a defective dash switch or open lead between terminal Number 3 and dash switch.

## WIPER HAS ONE SPEED SLOW AND SHUTS "OFF" WITH DASH SWITCH IN "HI" SPEED POSITION

Reverse harness leads that connect to wiper terminals 1 and 3.

## BLADES DO NOT RETURN TO PARK POSITION WHEN WIPER IS TURNED "OFF"

1. Check wiper ground strap connection to car body.

2. Remove wiper from car and check for dirty, bent or broken park switch contacts.

## WIPER SPEED NORMAL IN "LO" BUT TOO FAST IN "HI"

Remove wiper from car and check for an open terminal board resistor.

## INTERMITTENT OPERATION

Check for loose wiper ground strap connections and/or loose dash switch mounting.

### *WIPER DETACHED FROM CAR*

It is assumed that in many cases there is no information available to the repairman about the original wiper complaint. It is necessary, therefore, that wiper operation be checked according to the instructions shown in Fig. 11-75. NOTE: Be sure and use an ammeter capable of reading at least 30 amperes in the feed wire circuit.

## WIPER INOPERATIVE

Connect up wiper to operate in "Lo" speed and observe current draw. Current draw ratings shown below will provide a hint as to the possible source of trouble.

| Ammeter Reading (Amps) | Possible Trouble |
|---|---|
| 0 | (1) Loose solder connection at wiper terminal No. 2.<br>(2) Loose splice joints (Fig. 11-76). |
| 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. |

## WIPER WILL NOT SHUT OFF AND,

| | Possible Trouble—Refer |
|---|---|
| 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. |

WIPER HAS "HI" SPEED ONLY—See Typical Trouble in table above.

WIPER HAS "LO" SPEED ONLY—See Typical Trouble in table above.

WIPER CRANK ARM DOES NOT RETURN TO PARK POSITION when wiper is turned off (i.e. crank arm stops rotating immediately).

Check for dirty, bent or broken park switch contacts.

WIPER SPEED NORMAL IN "LO" BUT TOO FAST IN "HI"

Check for open 24 ohm resistor on back of wiper terminal board.

INTERMITTENT OPERATION

Check for sticking brushes, loose splice joints, etc.

## DISASSEMBLY-ASSEMBLY PROCEDURES

Except for the internal wiring to the wiper terminal board, the disassembly-assembly procedures for the two speed wiper covered in this section are the same as those outlined for the single speed wiper. See Fig. 11-76 for internal wiring.

## WIPER SPECIFICATIONS

Operating Volts ........................ 12 VDC

Crank Arm Rotation (looking at Crank Arm).... Counterclockwise

Crank Arm Speed (RPM's) (No Load):

Lo ........................ 34 Min.

Hi ........................ 65 Min.

Current Draw—Amps.:

No Load (Lo Speed) ........................ 3.6 Max.

Installed in Car—(Dry Glass) ........ 4.5 Max.

Stall ........................ 12 Max.

Shunt Field Resistance ........................

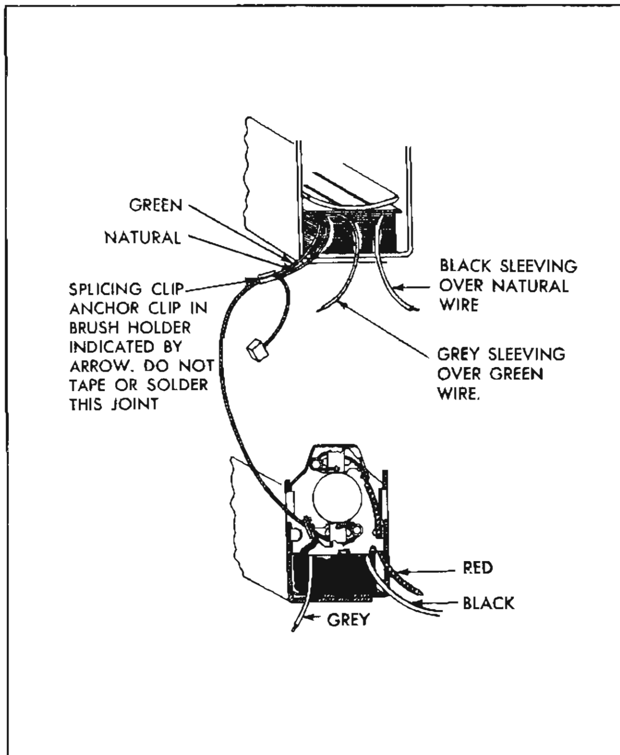



Fig. 11-76 Internal Wiring

# WINDSHIELD WASHER PUMP

## PRINCIPLE OF OPERATION

The pump is a positive displacement type, employing a small bellows, bellows spring and valve arrangement. The pumping mechanism is actuated by a pin driven by the wiper. The programming (starting and completion of a wash cycle) is accomplished electrically and mechanically by a relay assembly and ratchet wheel arrangement. (See Fig. 11-77).

Explanation of pump operation follows:

### *WIPER ON—WASHER OFF*

When the washer pump is mounted on the wiper correctly, a pin on the lower side of the pump engages with a 4 lobe cam. The pin is part of a spring loaded plate and ratchet pawl assembly and acts as a cam follower. Thus, with the wiper running, the pin actuates the plate and ratchet pawl assembly back and forth in a horizontal plane. Another pin, attached to the upper side of the plate and ratchet pawl assembly, extends through a slot in the bellows plunger arm. This pin moves freely back and forth in the slot while the pumping mechanism is in the "lock-out" position and no pumping action occurs.

The pump is in the "lock-out" position when the relay holding contacts are open and a tang on the plunger arm rests against the widest part of an eccentric ramp located on the lower surface of the ratchet wheel (Fig. 11-79). The tang holds the bellows plunger arm in a retracted position (bellows spring compressed) allowing the plunger arm actuator pin on the plate and ratchet pawl assembly (Fig. 11-77) 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.

### *TURNING THE WASHER ON*

Depressing the dash switch washer button closes the washer pump relay circuit to ground. (Refer to Fig. 11-80). (NOTE: If wiper was "off" the wiper switch is mechanically turned on to the "On" position by the washer button.)

With the washer relay coil energized, the ratchet pawl, which is normally held away from the ratchet wheel by a spring, is pulled toward the coil pole and engages the ratchet wheel teeth. The ratchet pawl and plate assembly, which moves back and forth continuously when the wiper is on, now starts to rotate the ratchet wheel (Fig. 11-81).

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

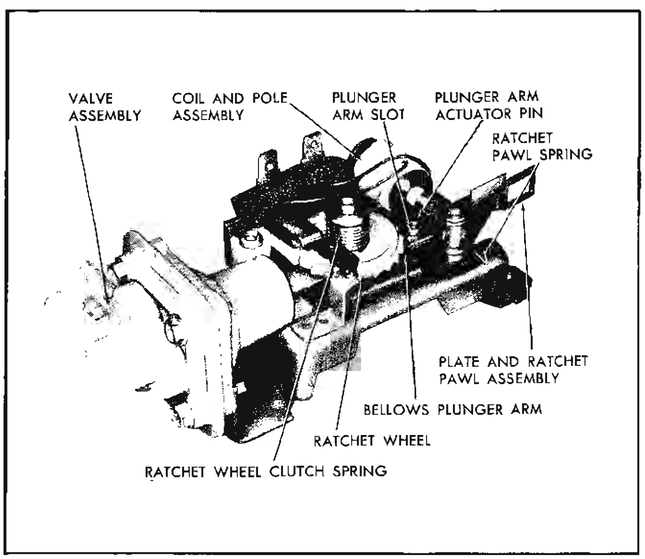



Fig. 11-77 Washer Pump Assembly

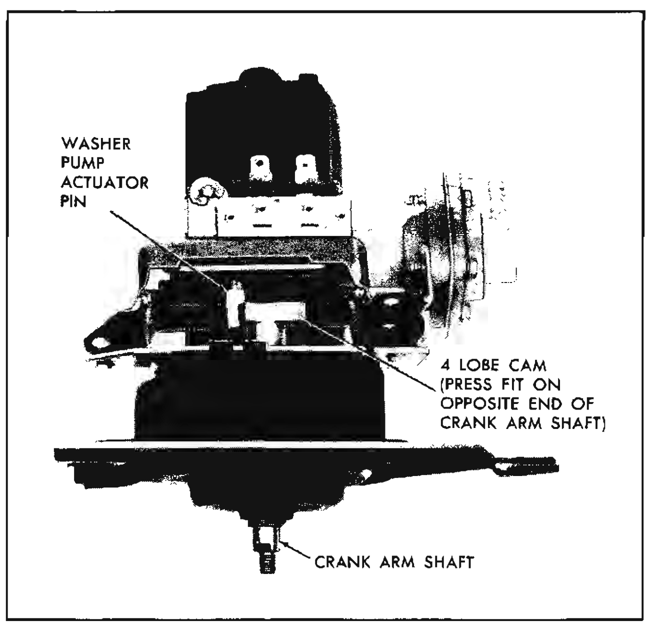



Fig. 11-78 Washer Pump Drive System

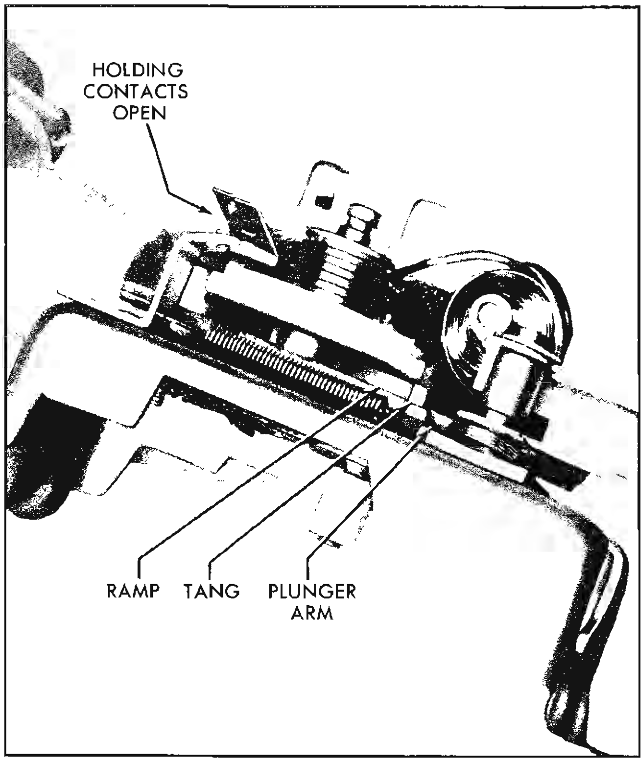



Fig. 11-79 Washer Pump Assembly

has been turned through 360° or 21 teeth, at which time the ratchet wheel will again open the contacts.

***PUMPING CYCLE***

(EXHAUST HALF OF PUMP STROKE):

With the pumping mechanism released from its "lock-out" position, the bellows spring expands and collapses the bellows forcing water out two outlet valves (Fig. 11-82). The plunger arm, which is attached to the bellows, is pulled forward with the bellows and the back edge of the plunger arm slot moves up tight against the plunger arm actuator pin. (Refer to Figure 11-77 to identify plunger arm slot and pin.) The actuator pin, which was previously moving back and forth freely in the plunger arm slot, will now pull the plunger arm back and compress the bellows spring each time the pin actuates the plate and ratchet pawl assembly.

(INTAKE HALF OF PUMP STROKE):

Pulling the plunger arm back compresses the bellows spring (Fig. 11-83) 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

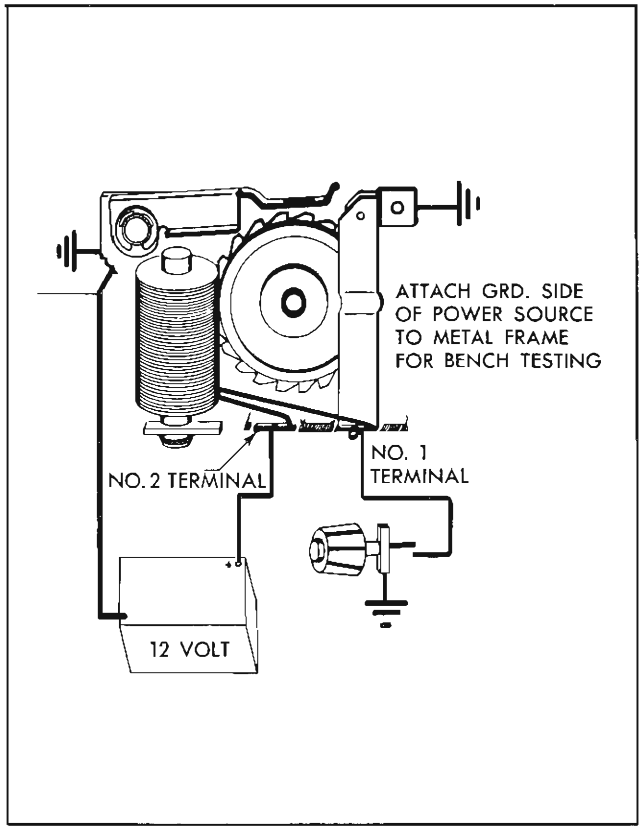



Fig. 11-80 Pump Wiring Circuit

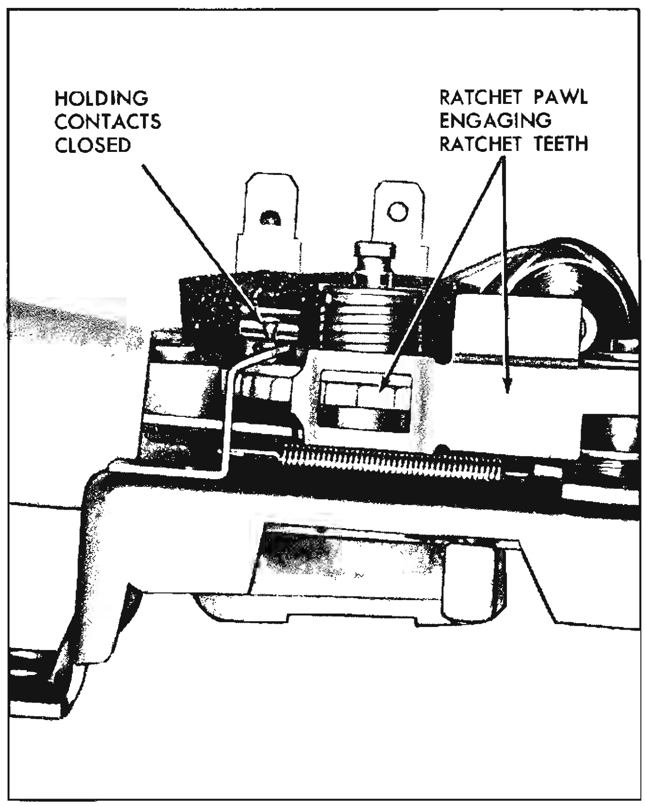



Fig. 11-81 Pump Contacts & Ratchet Pawl

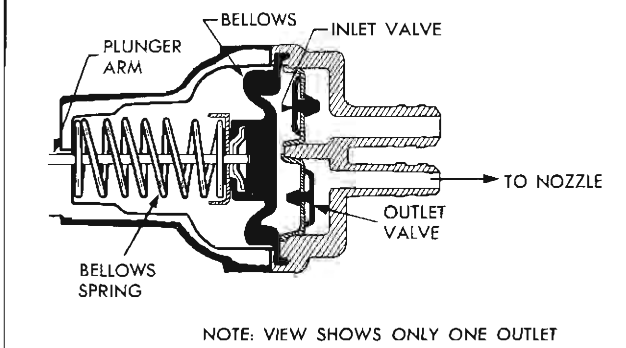



Fig. 11-82 Pumping Cycle (Exhaust)

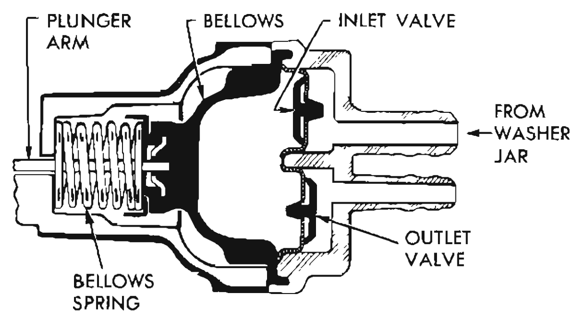



Fig. 11-83 Pumping Cycle (Intake)

pumping mechanism, the ratchet wheel is rotated one tooth.

### *COMPLETION OF WASH CYCLE*

The wash cycle is completed when the electrical circuit to the relay coil is opened and the pumping mechanism reaches its "lock-out" position. This is accomplished as follows:

When the ratchet wheel has been rotated through 360° or 21 teeth, the relay coil holding contacts are pushed open by a "hump" on the ratchet wheel. This opens the coil circuit and the spring loaded ratchet pawl moves away from the ratchet wheel preventing further rotation of the ratchet wheel.

As the ratchet wheel rotates the tang on the bellows plunger arm starts to ride up the eccentric ramp on the lower surface of the ratchet wheel. The full "lock-out" position of the pumping mechanism is reached when the tang is up on the widest part of the ramp (Fig. 11-79). The tang reaches the "lock-out" position at the same time the relay coil holding contacts open.

## TROUBLE DIAGNOSIS

Trouble shooting procedures are divided into two categories (1) Washer installed in car and (2) Washer detached.

### *WASHER PUMP ON CAR*

WASHER INOPERATIVE:

1. Check the following items:

(1) Jar has adequate quantity of water solution.

(2) Hoses are not damaged and hose connections are tight.

(3) Screen at end of jar cover hose is not plugged.

(4) Electrical connections to washer pump and dash switch.

(5) Nozzles are not plugged.

2. If all items in Step 1 check out, start wiper motor only, then push washer button and listen for "click" as washer relay pulls in. If no "click" is heard, check for 12 volts at terminal No. 2 (Fig. 11-84). No voltage indicates defective wiring. If "click" is heard, proceed to Step 4.

3. If correct voltage was found in step No. 2, connect a jumper wire from terminal No. 1 to ground (Fig. 11-84) 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.

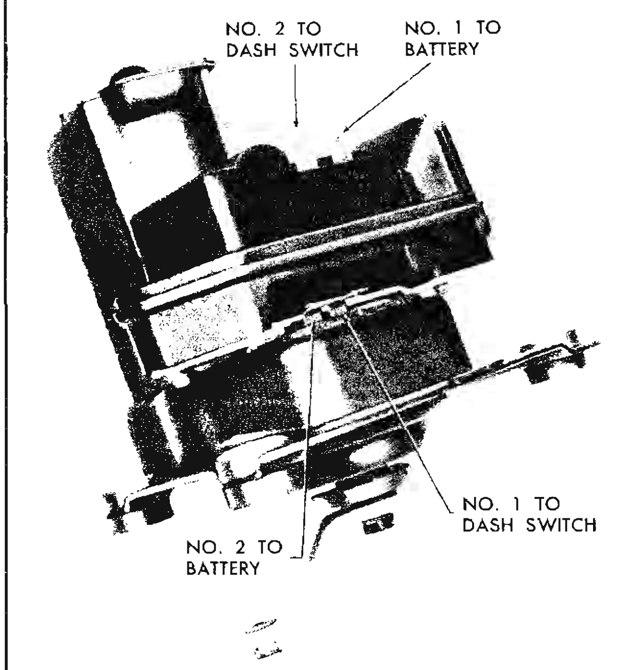



Fig. 11-84 Washer Pump Terminals

***WASHER PUMP DETACHED***

CHECK PUMP OPERATION AS FOLLOWS:

1. Remove washer pump cover and connect 12 volt power supply to washer pump as shown in Fig. 11-80. Connect jumper wire from terminal No. 1 to ground. Turn ratchet pawl to the position shown in Fig. 11-80. 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 actuate the plate and ratchet pawl assembly to turn the ratchet wheel one tooth. Observe if relay holding contacts close (Fig. 11-81) and the pump plunger arm is released from its "lock-out" position. (Fig. 11-79 shows plunger arm in "lock-out" position.)

3. Disconnect jumper wire from terminal No. 1. Relay coil should remain energized and hold ratchet pawl against ratchet wheel. Failure to do so indicates open or dirty holding contacts.

4. If pump performs correctly in Step 3, continue to manually actuate the plate and ratchet pawl assembly until the ratchet wheel has been turned through 360° or 21 teeth. After the ratchet wheel has been rotated 21 teeth, the holding contacts should be opened by a "hump" on the wheel and the pump plunger arm should be in the "lock-out" position (Fig. 11-79).

CHECK VALVE ASSEMBLY AS FOLLOWS:

1. Attach a hose to the large or intake pipe. You should be able to blow through it but *not* draw through it.

2. Attach a hose individually to each of the small or exhaust pipes. You should be able to draw through them but *not blow* through them.

If any of three valves allow air to pass in both directions, the valve assembly is defective.

## DISASSEMBLY PROCEDURES

***RELAY***

1. Remove washer pump cover.

2. Unsolder coil leads from terminals. (NOTE: No coil polarity is necessary when resoldering coil leads.)

3. Remove coil retainer clip and slip coil assembly out of mounting bracket.

***RATCHET PAWL***

1. Remove washer pump cover.

2. Disengage spring from ratchet pawl.

***CAUTION: Be sure spring is properly assembled before replacing washer pump cover.***

3. Remove "E" ring and slide ratchet pawl off shaft.

***VALVE ASSEMBLY***

Remove the four screws that secure the nozzle assembly to the bellows housing (Fig. 11-85).

***CAUTION: It is sometimes necessary to carefully pry the bellows lip out of the valve body groove.***

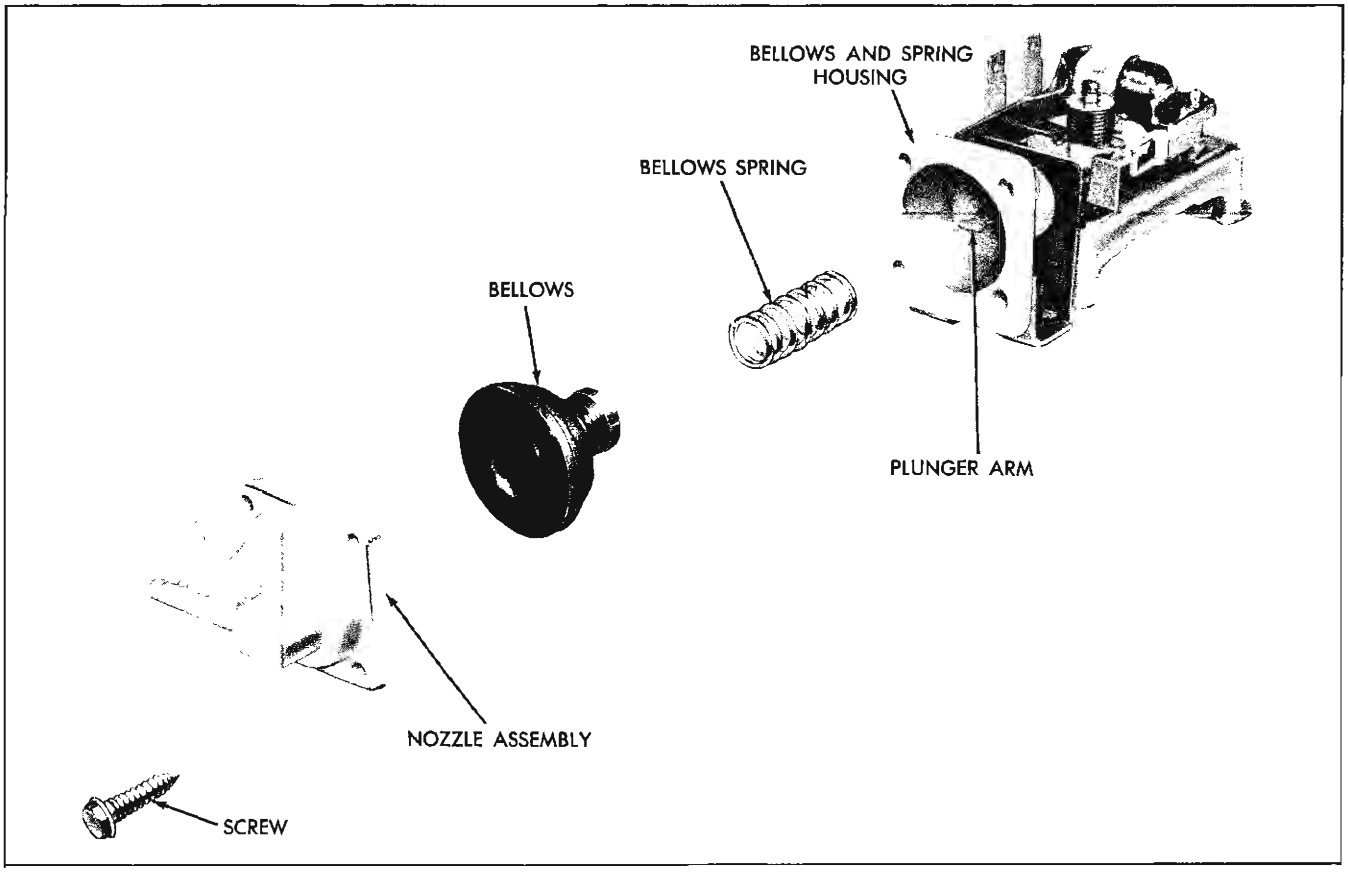



Fig. 11-85 Washer Pump Exploded View

### *BELLOWS*

1. Remove nozzle assembly.

2. Manually operate pump to release pump from "lock-out" position (See "Checking Washer Pump Detached").

3. Hold bellows plunger arm from moving, then push in against bottom of bellows with thumb and twist bellows 90°. This should release bellows and bellows spring.

## ASSEMBLY PROCEDURES

In each of above cases, reverse procedure to assemble.

## SPECIFICATIONS

| | |
|---|---|
| Number of "squirts" at full pressure | 12 |
| Pressure (PSI) | 11-15 |
| Coil Resistance (ohms) | 20 |

# SPECIFICATIONS

| | 37 Amp Alternator | 42 Amp Alternator | V-8 Engine |
|---|---|---|---|
| Battery Model | 554 | 558 | 458 |
| Capacity at 20 hr. rate, amp.-hr. | 44 | 61 | 53 |

| | 4 Cylinder Engine | | V-8 Engine | |
|---|---|---|---|---|
| | Standard | Air Condition | Standard | Air Condition |
| Alternator Model | 1100632 | 1100634 | 1100637 | 1100636 |
| Rated Output | 37 amps, 14 V | 42 amps, 14 V | 37 amps, 14 V | 42 amps, 14 V |
| Cold Output | | | | |
| Amps @ alternator rpm | 25 @ 2000 | 28 @ 2000 | 25 @ 2000 | 28 @ 2000 |
| Amps @ alternator rpm | 35 @ 5000 | 40 @ 5000 | 35 @ 5000 | 40 @ 5000 |
| Field Current Draw | 1.9-2.3 amps | 1.9-2.3 amps | 1.9-2.3 amps | 1.9-2.3 amps |
| Regulator Model | 1119511 | 1119511 | 1119511 | 1119511 |
| Voltage Regulator | | | | |
| Air Gap, inches | .057 | .057 | .057 | .057 |
| Point Opening, in. | .015 | .015 | .015 | .015 |
| Normal Range (125°F.), volts | 13.5-14.4 | 13.5-14.4 | 13.5-14.4 | 13.5-14.4 |

| | 4-Cylinder Engine | V-8 Engine |
|---|---|---|
| Starting Motor Model | 1107796 | 1107270 |
| Brush Spring Tension, Oz. | 35 | 35 |
| Resistance Test (Armature Locked) | | |
| Volts | 4.3 | 3.5 |
| Amperes | 270-320 | 300-360 |
| Solenoid Switch Model | 1114271 | 1119798 |
| Hold-in Winding | 10.5-12.5 Amps., 10 Volts | 10.5-12.5 Amps., 10 Volts |
| Both Windings | 42-49 Amps., 10 Volts | 42-49 Amps., 10 Volts |

| | | | |
|---|---|---|---|
| Distributor Model | 1110286 | 1110300 | 1111020 |
| Application | Lo-Comp. | Hi-Comp. | |
| Rotation Viewed From Cap End | CC | CC | CC |
| Point Opening, inches | .019" (new) .016" (used) | .019" (new) .016" (used) | |
| Breaker Lever Tension | 19-23 oz. | 19-23 oz. | 19-23 oz. |

| | 4-Cylinder Engine | | V-8 Engine |
|---|---|---|---|
| Cam Angle (Set To Range) | 31°-34° | 31°-34° | 28°-32° |
| Condenser Capacity Mfd. | .18-.23 | .18-23 | .18-23 |
| Centrifugal Advance (Distributor) | | | |
| Start | 0°-2° 625 rpm | ½°-2½° 450 rpm | ½°-2½° 450 rpm |
| Intermediate | 9°-11° 1300 rpm | 7°-9° 1000 rpm | 7°-9° 1000 rpm |
| Maximum | 12°-14° 2200 rpm | 10°-12° 2300 rpm | 10°-12° 2300 rpm |
| Vacuum Control Model | 1116195 | 1116195 | 1116173 |
| Application | For Dist. 1110284 | For Dist. 1110300 | For Dist. 1111020 |
| Inches of Mercury to start advance | 6-8 | 6-8 | 6-8 |
| Inches of Mercury for full advance | 13-15 | 13-15 | 13-15 |
| Maximum Advance (mean) | 10°±0.75° | 10°±0.75° | 10±0.75° |

| | 4 Cylinder Engine | V-8 Engine |
|---|---|---|
| Ignition Coil Model | 1115169 | 1115174 |
| Primary Resistance, Ohms (75°F.) | 1.46-1.63 | 1.77-2.05 |
| Secondary Resistance, Ohms (75°F.) | 5600-6900 | 6500-9500 |
| Spark Plugs | A.C. | A.C. |
| Size | 14 MM | 14 MM |
| Type | 45S | 45S |
| Gap | .035″ | .035″ |
| Torque | 15-25 lb. ft. | 15-25 lb. ft. (use thread lubricant) |
| Ignition Resistor Wire Resistance at 80°F. Ohms | 1.80 | 1.32 |
| Ignition timing (at hot idle speed with vacuum line disconnected and manifold opening covered) | 6°BTDC | 6° BTDC |

| Horns | Model | Type | Ampere Draw |
|---|---|---|---|
| | 9000439 | Standard | 8-11 Amps. 12.5V |
| | 9000440 | Optional | 8-11 Amps. 12.5V |

| Relays | Model | Application | Air Gap at Core —Points Closed (in.) | Point Opening (in.) | Closing Voltage (Range) |
|---|---|---|---|---|---|
| | 1116980 | Horn | .020 | .018 | 1.5-9.5 |

## FUSES AND CIRCUIT PROTECTION

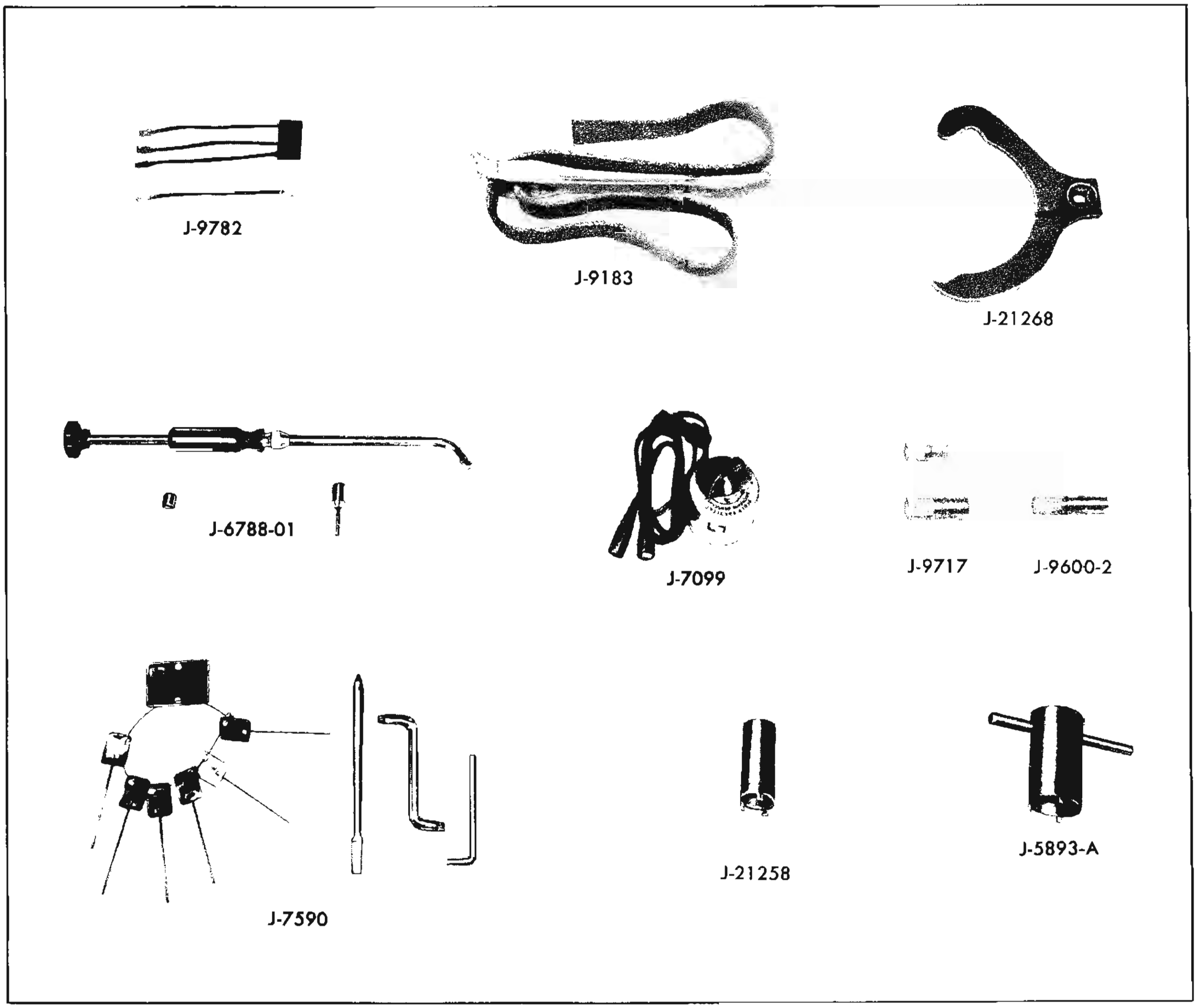
### REGULAR EQUIPMENT

| | | Fuse Capacity—Amps | Location on Fuse Block | "On" and "Off" with Lighting Switch | "On" and "Off" with Ignition Switch | Rheostat Control by Turning the Lighting Switch Knob | In Series with Circuit Breaker on Lighting Switch | Direct Connection to Battery |
|---|---|---|---|---|---|---|---|---|
| STANDARD EQUIPMENT | Headlights | | | * | | | * | |
| | Headlight Beam Indicator | | | * | | | * | |
| | Parking Lights | | | * | | | * | |
| | Tail Lights and Trunk Light | 9 | Tail Lts. | * | | | * | * |
| | License Light | 9 | Tail Lts. | * | | | * | |
| | Instrument, Clock and Ash Tray Lights | 4 | Panel Lights | * | | * | * | |
| | Dome Light and Courtesy Lights | 9 | Covr-Dome | * | | | | * |
| | Electric W/S Wiper Motor # | 25 | Wiper | | * | | | |
| | Stoplights | 20 | Stop | | * | | | |
| | Direction Signals & Indicator | 20 | Dir. Sig. | | * | | | |
| | Cigar Lighter, Clock and Glove Box Light | 20 | Ltr-Clk-Gl. Bx. | | | | | * |
| SPECIAL EQUIPMENT | Back-Up Lights | 20 | Back-up Lts. | | * | | | |
| | Parking Brake "On" Warning Light | 25 | P. Brake | | * | | | |
| | Heater Control Panel Light | 4 | Panel Lights | * | | * | * | |
| | Heater Blower Motor and Air Conditioning Power | 20 | Heater, Air C. | | * | | | |
| | Radio Dial Light | 4 | Panel Lights | * | | * | * | |
| | Radio Power | 2.5 | Radio | | * | | | |
| | Shift Lever Indicator Light Auto. Trans. | 4 | Panel Lights | * | | * | * | |
| | Windshield Washer | 25 | Washer | | * | | | |

(#) Electric W/S Wiper Motor has an internal Circuit Breaker.
Lighting Switch Circuit Breaker will carry a 22 amp. load continuously. Will open with 35 amps. within 30 to 60 seconds.
Fuse Block is located on Passenger side of dash, left side of car.

| LIGHT USAGE<br>LIGHT | TRADE NO. | 2-Door Sedans | 4-Door Sedans | Convert. | Station Wagon | LeMans |
|---|---|---|---|---|---|---|
| **STANDARD EQUIPMENT** | | | | | | |
| Head (37.5W) | 4001 | 2 | 2 | 2 | 2 | 2 |
| Head (37.5-50W) | Type 2 SB | 2 | 2 | 2 | 2 | 2 |
| Parking & Directional Signal | 1034 | 2 | 2 | 2 | 2 | 2 |
| Tail, Stop & Directional Signal | 1034 | 2 | 2 | 2 | 2 | 2 |
| Tail | 67 | 2 | 2 | 2 | 2 | 2 |
| Directional Signal Indicator | 57 | 1 | 1 | 1 | 1 | 1 |
| License | 67 | 1 | 1 | 1 | 1 | 1 |
| Fuel Gauge | 57 | 1 | 1 | 1 | 1 | 1 |
| Speedometer | 57 | 1 | 1 | 1 | 1 | 1 |
| Oil Pressure Indicator | 57 | 1 | 1 | 1 | 1 | 1 |
| Temperature Indicator | 57 | 1 | 1 | 1 | 1 | 1 |
| Beam Indicator, Head Light | 57 | 1 | 1 | 1 | 1 | 1 |
| Dome | 1004 | 1 | 1 | | 1 | |
| Ammeter | 57 | 1 | 1 | 1 | 1 | 1 |
| Courtesy | | | | 1 | | 1 |
| Heater Control | 57 | 1 | 1 | 1 | 1 | 1 |
| **SPECIAL ORDER EQUIPMENT** | | | | | | |
| Back-Up | 1073 | 2 | 2 | 2 | 2 | 2 |
| Auto. Trans. Indicator | 53 | 1 | 1 | 1 | 1 | 1 |
| Parking Brake, Warning | 57 | 1 | 1 | 1 | 1 | 1 |
| Radio Dial | 57 | 1 | 1 | 1 | 1 | 1 |
| Clock | 57 | 1 | 1 | 1 | 1 | 1 |
| Courtesy | 89 | 1 | 1 | | 1 | |
| Glove Box | 57 | 1 | 1 | 1 | 1 | 1 |
| Ash Tray | 53 | 1 | 1 | 1 | 1 | 1 |
| Trunk | 57 | 1 | 1 | 1 | | 1 |

# SPECIAL TOOLS




| | | | |
|---|---|---|---|
| J-9782 | Regulator Connector Adapter | J-9717 | Diode Remover Tools |
| J-9183 | Alternator Strap Wrench | J-9600-2 | Diode Installer |
| J-21268 | Alternator Belt Tensioner | J-7590 | Alternator Regulator Service Set |
| J-6788-01 | Distributor Adjusting Tool | J-21258 | Instrument Panel Nut Wrench |
| J-7099 | 25 Ohm Rheostat | J-5893-A | Ignition Switch Ferrule Spanner |

Fig. 11-86 Special Tools

# HEATING AND ACCESSORIES

## CONTENTS OF THIS SECTION



## TEMPEST HEATER

### GENERAL DESCRIPTION

Pontiac's Tempest Heating and Defroster System provides rapid warm-up sensation and even distribution of warmed air to all parts of the car. All air entering the system is taken through hood high cowl vents providing air with a minimum of dust, foreign material and undesirable fumes.

The use of outside air exclusively provides constant and rapidly changing air inside the car, eliminating a smoke-filled interior and keeps the occupants comfortable.

The driver has fingertip control of the temperature warmed air entering the car. When heated air is desired, the blower forces air taken from the hood high cowl air inlet duct through the heater core and then through an air distributing system to the air outlets.

The design of the heater and defroster system, its valves and controls permits a method of obtaining different amounts of forced air flow for ventilation.

#### *AIR OUTLETS AND CONTROLS (Fig. 12-1)*

#### AIR OUTLETS

Heated air enters the interior of the car and is distributed by a center outlet grille opening at the bottom of the heater duct, which disperses air over the front floor area and is so aimed that it also directs air to the rear passenger compartment.

Additional outlets are provided on the right and left sides of the heater outlet air duct for additional air distribution to the driver and front seat passenger floor area.

#### CONTROL PANEL

The heater control panel (Fig. 12-2) is located to the left of the steering column on the lower section of the instrument panel. The panel has three levers sliding in a vertical plane which control air flow and fan speed; one each for "FAN", "TEMP", and "AIR". When all levers are in the full up position, all valves and control units are closed and the fan blower motor is off.

#### FAN CONTROL

The fan control lever has four distinct positions—"OFF", "LO", "MED", and "HI"; "OFF" is in the full up position, "LO" and "MED" partially down, and "HI" in the full down position (Fig. 12-3).

#### TEMPERATURE CONTROL

When the temperature control lever is in the full up position the heater air valve is closed preventing

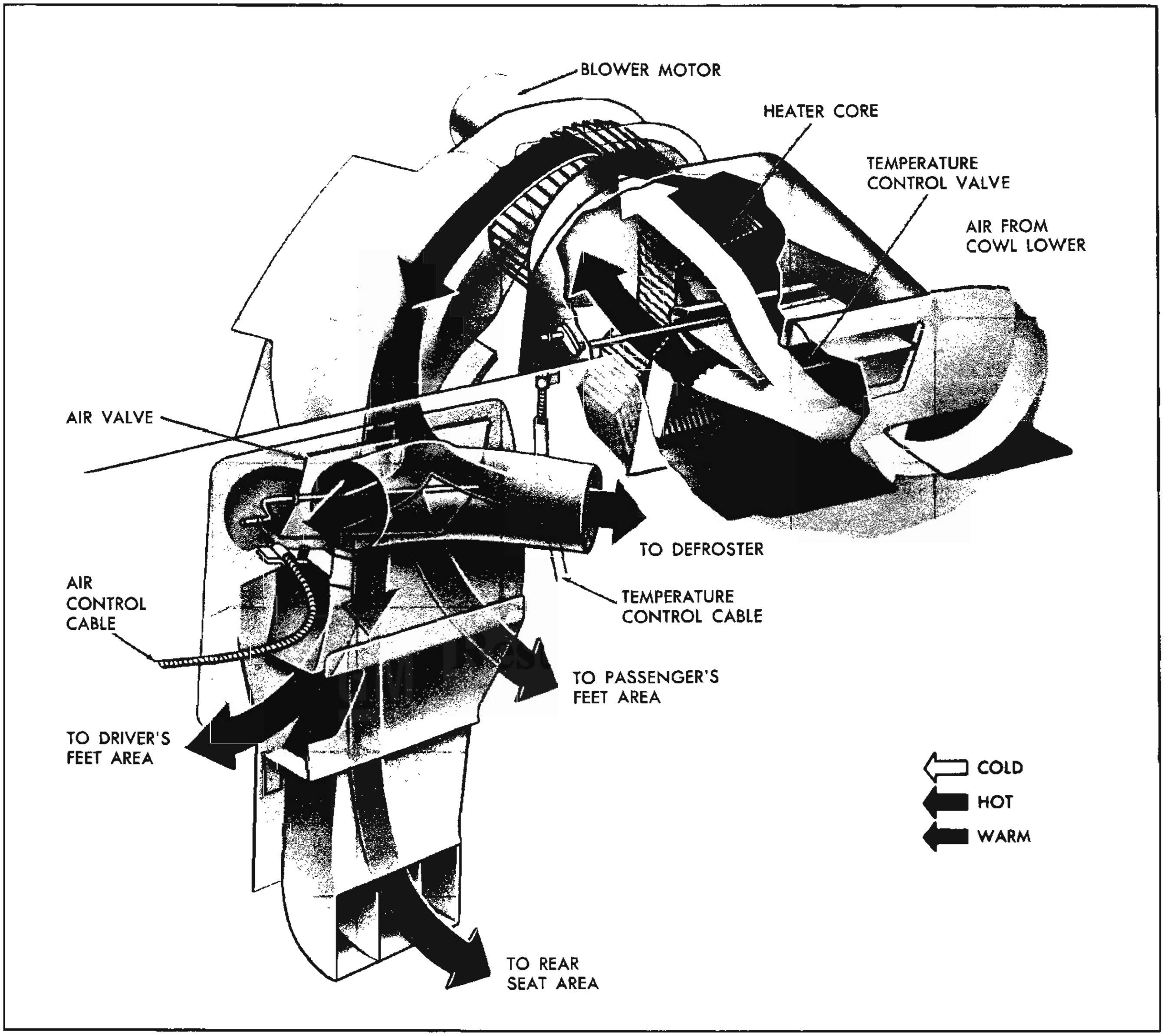



Fig. 12-1 Air Flow Through the Heater System

heat from entering the passenger compartment. As the lever is moved progressively downward, more and more air is introduced through the heater core. In the full down position, maximum heat is obtained only if the air control lever is positioned in "NORMAL" or "DEFROST" detent.

With the air control lever in the "NORMAL" detent, depress the temperature control to the full down position during engine warm up. After the inside of the car is at the desired temperature level, adjust the temperature lever to maintain this temperature.

## AIR CONTROL

With the air lever in the full up position no air will enter through the heater system. As the lever is depressed to "NORMAL" or "DEFROST" detent, outside air is introduced through the heater air system.

"NORMAL" detent position permits partial air flow out of the defroster nozzles while providing the majority of air flow through the heater air system.

Moving the air control lever downward from the "NORMAL" detent position to the "DEFROST" detent position permits air to be directed to the windshield, with only a limited amount of air coming out of the heater outlets (Fig. 12-3).

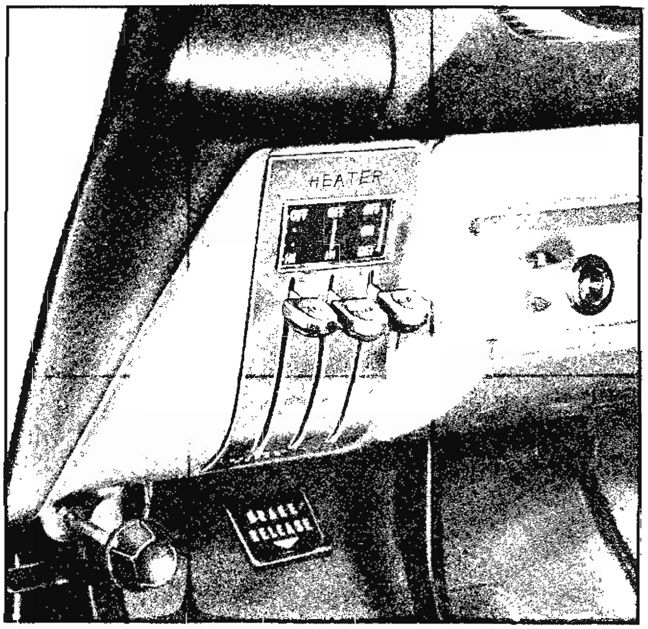



Fig. 12-2 Heater Control Panel In Car

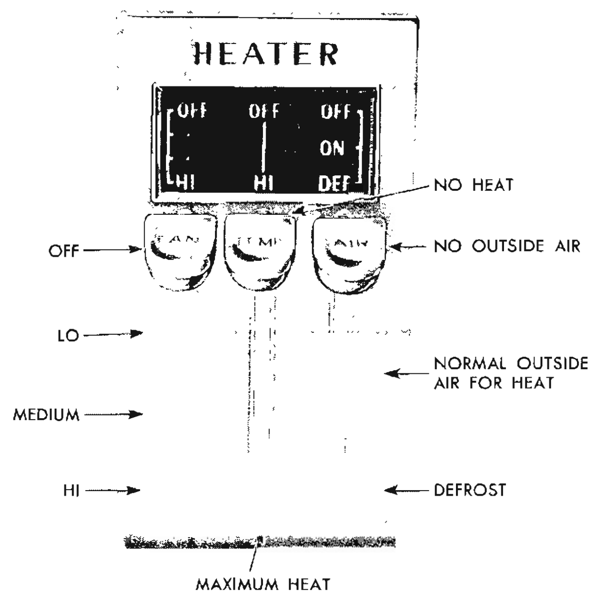



Fig. 12-3 Heater Control Lever Positions

## TIPS ON USE OF HEATER AND DEFROSTER SYSTEM

### *KEEPING COMFORTABLE IN EXTREMELY HUMID "MUGGY" WEATHER*

When the relative humidity is extremely high causing discomfort on a day when the temperature is 55°F.-70°F., depress the air control lever to the midway position (normal) and move the temperature control lever down slightly. This will permit outside air to enter the heater core and provide minimum heating. Move the fan control lever to the low speed position.

### *KEEPING COMFORTABLE IN MILD WEATHER*

When the weather is cool, but the sun is very bright, as in spring or fall or at high altitudes, use both the heater and the cowl ventilators at the same time, positioning the air control lever at "NORMAL" detent and setting the temperature control and fan speed for desired comfort.

### *CONTROLLING TEMPERATURE IN CAR*

The most satisfactory method of controlling the temperature in the car is to:

1. Set air control lever down for maximum air flow (normal detent).

2. Position temperature control lever down for maximum heating, then adjust to maintain the desired temperature in the car.

3. Set fan speed for your personal comfort.

### *USING THE HEATING SYSTEM FOR VENTILATION*

The heating system is designed so that it can also be used for ventilation when it is not necessary to warm the air. Ventilation may be obtained by placing the air control lever in the "NORMAL" detent position for maximum air flow and the temperature control lever in the extreme up (OFF) position to prevent the air from passing over the heater core. Select the amount of air flow desired by positioning the fan control lever at the speed desired.

## MINOR ADJUSTMENTS

### *TEMPERATURE CONTROL CABLE*

NOTE: This adjustment should be checked when insufficiently heated or slightly warmed air leaves the heated outlets while temperature control lever is in the "OFF" position.

1. Check to see that the temperature control valve cable housing extends no more than 1/16" beyond the cable housing clamp on the control panel assembly (Fig. 12-5).

2. Move temperature control valve lever (at the heater control panel) making sure lever moves up against its stop ("off" position).

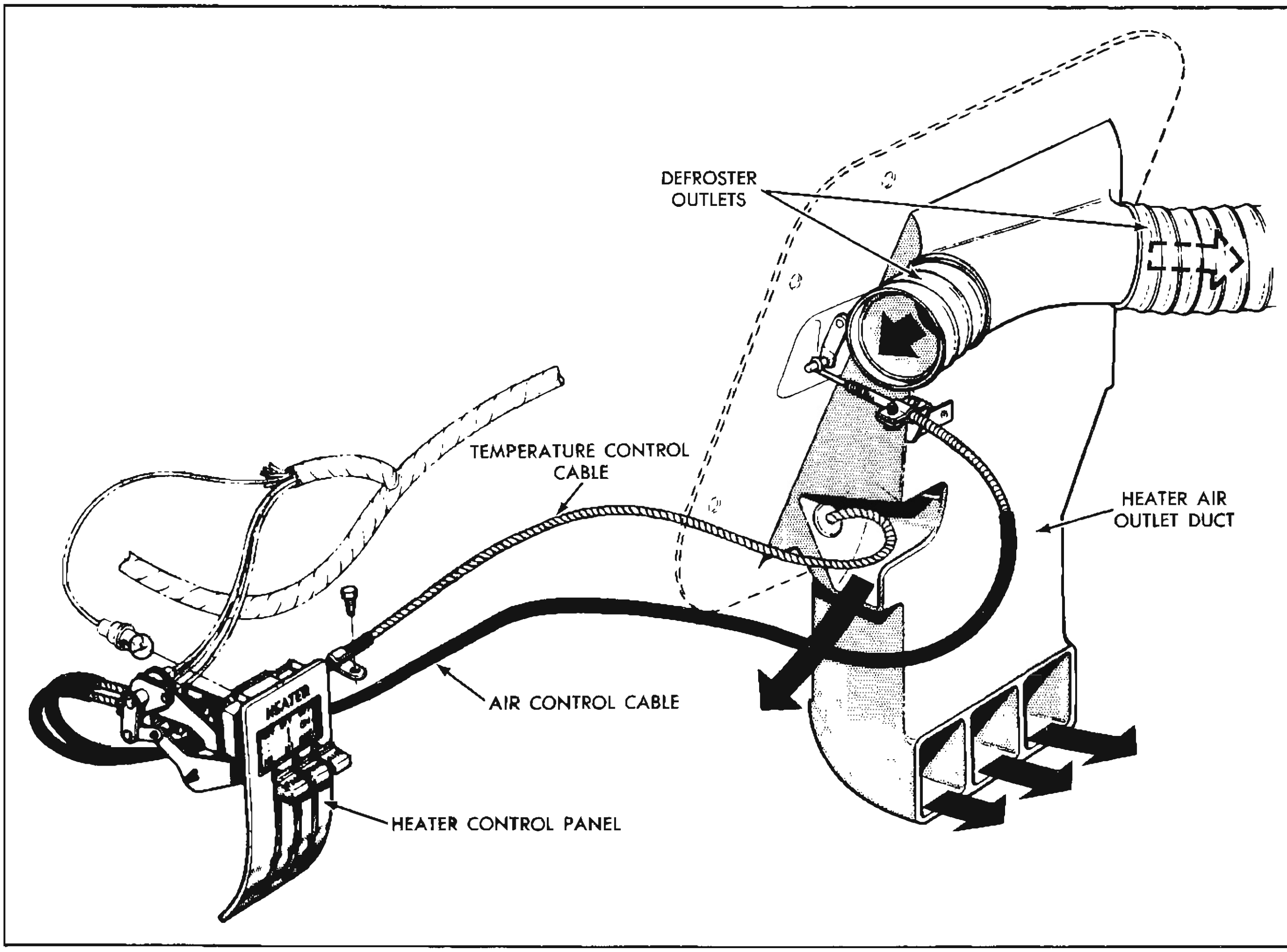



Fig. 12-4 Major Heater Units Inside Car

3. Loosen cable housing clamp screw at temperature control valve (Fig. 12-6).

4. Slide cable housing and temperature control valve arm apart (temperature control arm will move up) to remove cable slack and secure cable housing clamp.

5. Check operation of cable.

NOTE: After adjustment, the temperature lever must be in alignment with the air and fan levers while all three levers are positioned in the full up position.

#### *AIR CONTROL CABLE*

1. Check to see that the air cable housing does not extend any farther than $\frac{1}{16}''$ beyond the cable housing clamp on the control panel (Fig. 12-5).

2. Move air control lever (at the heater control panel) to "OFF" position (up against its stop).

3. Loosen the bowden cable clamp in the heater air outlet duct (Fig. 12-7).

4. Rotate the air selector cam in the heater air outlet duct full forward.

5. Attach cable looped end on air valve pin (with cable sheath passing through cable clamp).

6. Slide cable sheath away from air valve lever arm to remove cable slack and tighten cable clamp.

7. Check operation of air valve.

NOTE: After adjustment all levers on control panel must be in alignment when all are in the full up position.

## MAJOR REPAIRS

#### *HEATER CONTROL PANEL ASSEMBLY—REMOVE AND REPLACE*

1. Disconnect battery.

2. Disconnect headlamp switch assembly from instrument panel.

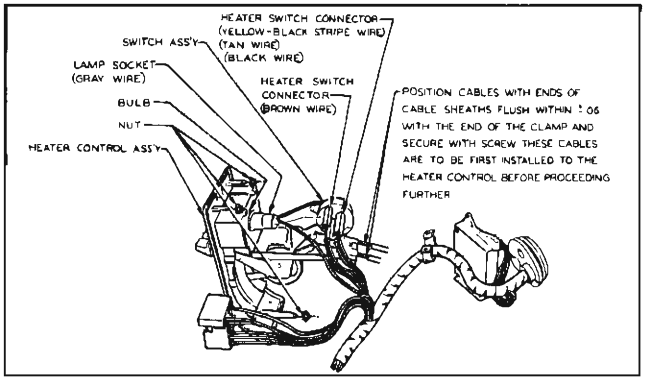



Fig. 12-5 Adjustment of Control Cables at Control Panel

3. Remove one stamped nut at bottom and two at top from back side of heater control assembly.

4. Move control assembly out from instrument panel and disconnect temperature and air control bowden cables from heater control assembly (Fig. 12-8).

5. Disconnect wires and remove control assembly.

6. Replace by reversing the above procedure.

7. Adjust air control bowden cable.

8. Adjust temperature control bowden cable.

9. Connect battery.

### HEATER FAN (BLOWER) SWITCH—REMOVE AND REPLACE

1. Disconnect battery.

2. Disconnect headlamp switch assembly from instrument panel.

3. Remove heater control assembly.

4. Remove heater blower switch from control assembly (Figs. 12-9 and 12-10).

NOTE: Remove plastic "hinge" by removing round pin from center of hinge, then remove hinge.

5. Replace blower switch, making sure control lever engages in all four positions without hitting top or bottom of lever slot, and the lever does not contact depressions in left side of slot.

6. Replace control assembly.

7. Connect headlamp switch assembly.

8. Adjust air control bowden cable.

9. Adjust temperature control bowden cable.

10. Connect battery.

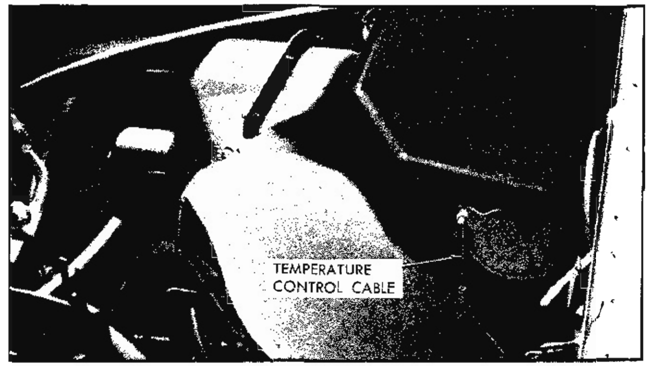



Fig. 12-6 Location of Temperature Control Valve Lever

### TEMPERATURE CONTROL CABLE—REMOVE AND REPLACE

1. Disconnect temperature control cable from heater air inlet duct (on engine side of dash shroud). See Fig. 12-6.

2. Disconnect temperature control bowden cable from heater control assembly.

3. Replace by reversing the above procedure, making sure insulated end of cable is toward control panel. (Insulation protects wires from chafing on cable housing.)

4. Adjust temperature control bowden cable.

### AIR CONTROL CABLE—REMOVE AND REPLACE

1. Disconnect air control bowden cable at heater control assembly.

2. Disconnect bowden cable from air distribution valve lever and clamp.

3. Remove air control bowden cable.

4. Replace by reversing the above procedure.

5. Adjust air control bowden cable.

### BLOWER MOTOR—REMOVE AND REPLACE (Fig. 12-11)

1. Disconnect hot wire to blower motor at motor.

2. Remove three blower motor housing to inlet air duct screws and remove blower motor assembly.

3. Replace by reversing the above procedure, making sure blower motor ground wire is attached at top screw.

4. Note that the blower impeller (and for the Pontiac Circ-L-Aire Air Conditioner) is of opposite rotation from the Pontiac heater. The proper Tempest impeller (and Circ-L-Aire Air Conditioner) is iden-

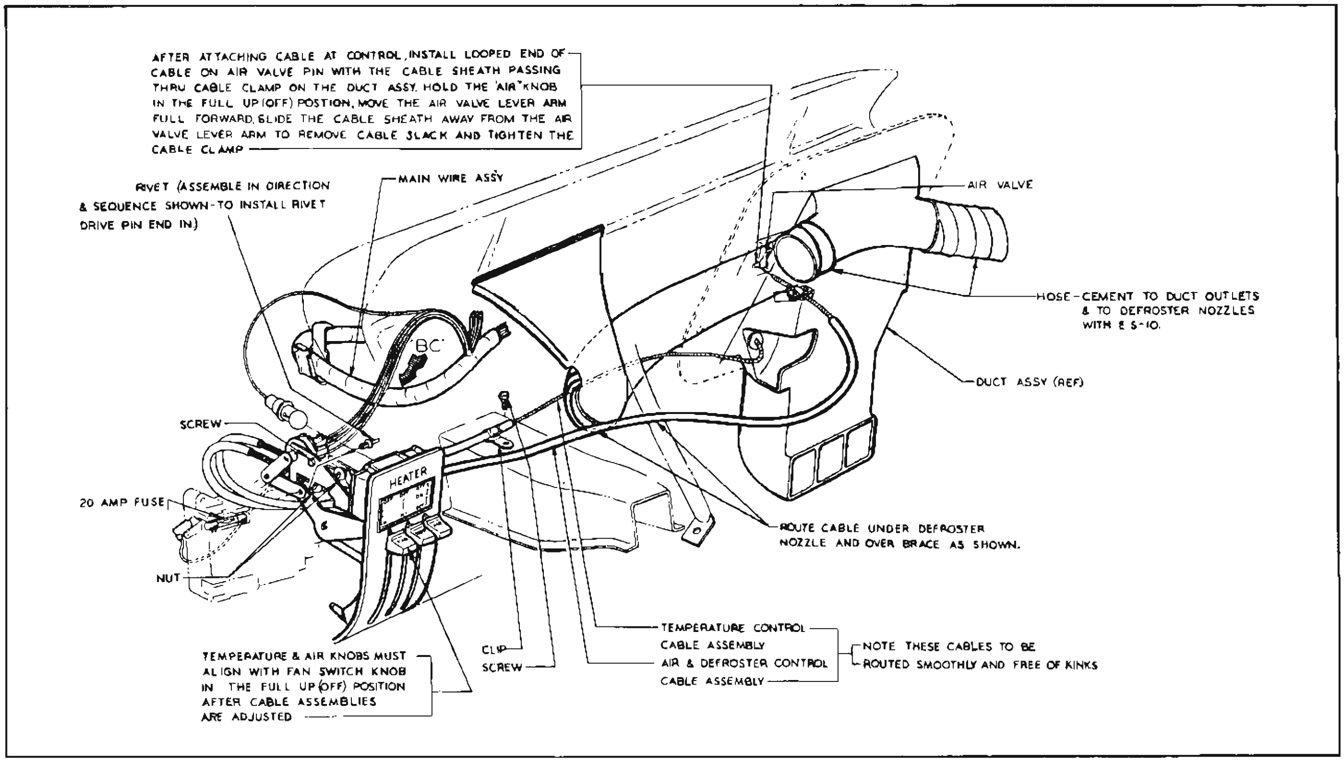



Fig. 12-7 Reference Illustration—Body Interior Details

tified by a gold colored inlet ring. Use of the wrong impeller will cause excessive blower noise and reduced air flow.

## *HEATER AIR OUTLET DUCT ASSEMBLY— REMOVE AND REPLACE*

1. Disconnect air valve control cable from air outlet duct.

2. Disconnect temperature control cable from air inlet duct and heater core assembly.

3. Pull temperature control cable inside car.

4. Disconnect battery.

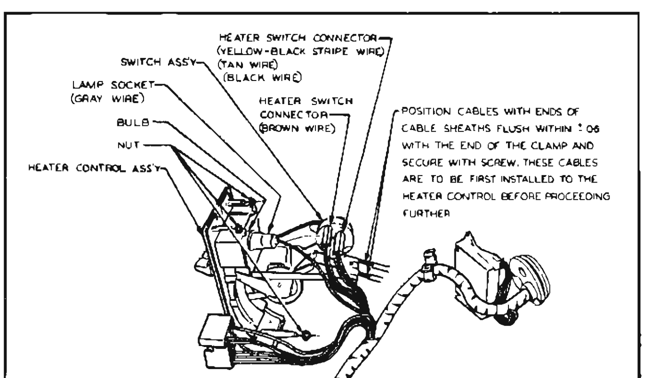



Fig. 12-8 Connections at Heater Control Panel

5. Disconnect coil and bracket from dash shroud.

6. Remove blower motor assembly.

7. Remove distributor cap.

8. Remove air outlet duct to dash shroud screws and remove duct assembly.

9. Replace by reversing the above procedure.

10. Adjust temperature control cable.

11. Adjust air control cable.

## *HEATER AIR INLET DUCT AND CORE ASSEMBLY— REMOVE AND REPLACE (Fig. 12-13)*

1. Drain radiator.

2. Remove heater blower motor.

3. Disconnect temperature control cable at heater assembly.

4. Disconnect heater water outlet hose (top hose) at core.

5. Disconnect heater water inlet hose (bottom hose) at core.

6. Remove heater core and inlet air duct assembly.

7. Replace by reversing the above procedure.

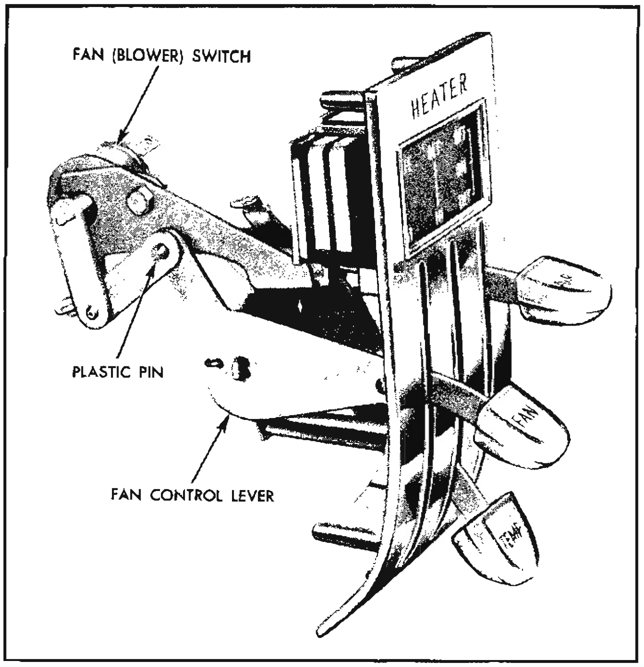



Fig. 12-9 Heater Control Fan (Blower) Linkage

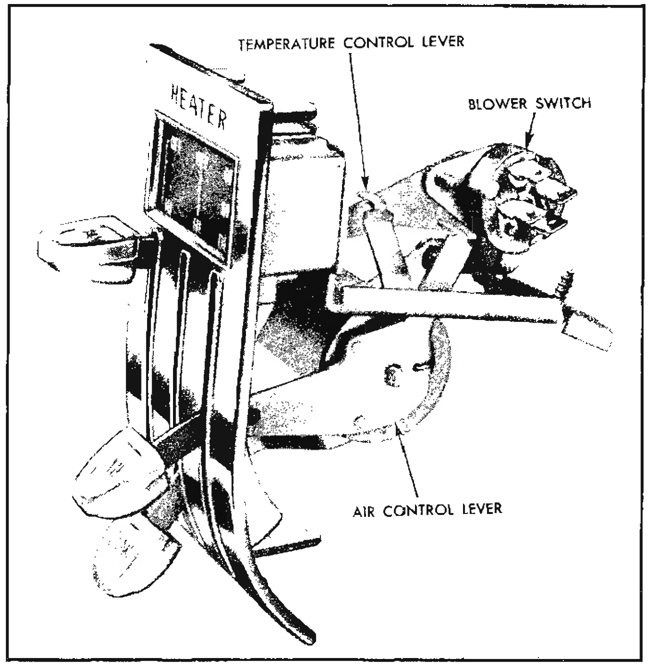



Fig. 12-10 Heater Control Cable Linkage

8. Adjust temperature control cable.
9. Fill radiator.

## OPERATING INSTRUCTIONS

To warm a car under various weather and driving conditions, use the following control settings after the green light indicating a "COLD" engine goes out:

***FAST WARM-UP (CAR WHICH HAS BEEN STANDING IN COLD)***

| CONTROL | SETTING |
|---|---|
| Fan control lever | full down for high speed |
| Temperature control lever | down, for maximum heating, then adjusted for occupant comfort |
| Air control lever | full down until windshield is "de-iced" or "defogged", then to midway position for maximum air flow at heater outlets and partial defrost |
| Car windows | front door vent and door window open slightly to assist in de-icing or defogging, then closed or positioned to provide comfort for all occupants |
| Side cowl ventilators | closed |

***SLOW CITY DRIVING IN COLD WEATHER***

| CONTROL | SETTING |
|---|---|
| Fan control lever | full down for high speed |
| Temperature control lever | down, for maximum heating, then adjusted for comfort |
| Air control lever | at midway position for maximum air flow and partial defrost |
| Car windows | closed |
| Side cowl ventilators | closed |

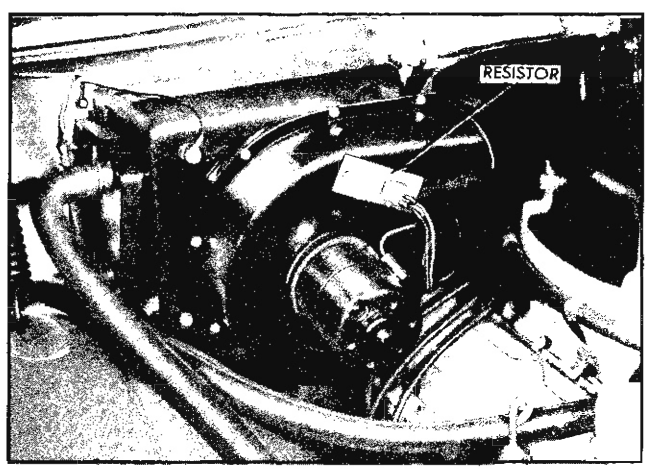



Fig. 12-11 Blower Motor and Resistor Assembly

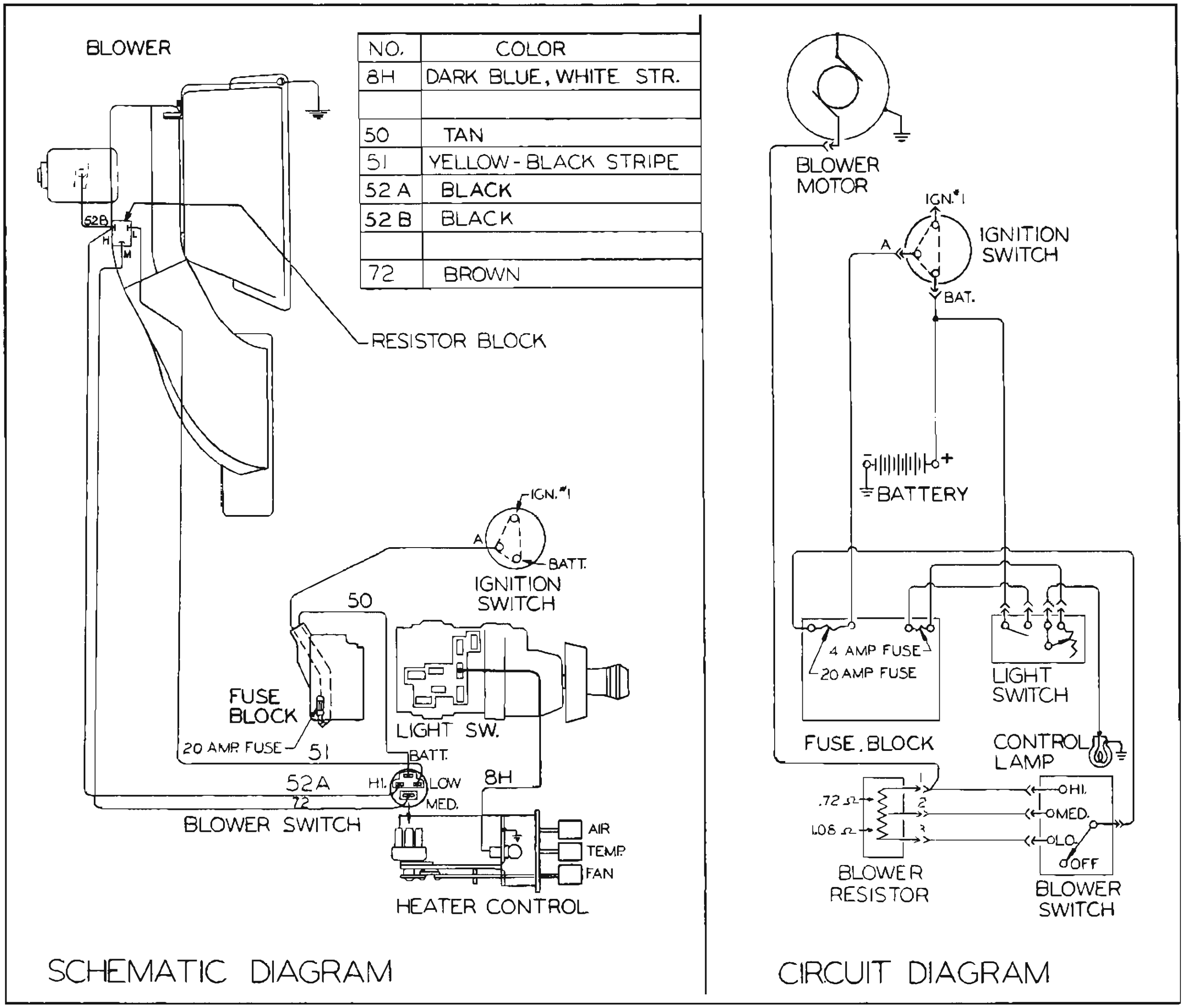



Fig. 12-12 Schematic and Circuit Diagram of Heater System

***NORMAL COOL WEATHER HIGHWAY CRUISING***

| CONTROL | SETTING |
| --- | --- |
| Fan control lever | full down for high speed |
| Temperature control lever | position to obtain desired temperature |
| Air control lever | at midway position for maximum air flow and partial defrost |
| Car windows | closed, door vent(s) may be opened to suit occupant comfort |
| Side cowl ventilators | closed |

***COLD WEATHER HIGHWAY CRUISING***

| CONTROL | SETTING |
| --- | --- |
| Fan control lever | full down for high speed |
| Temperature control lever | down, for maximum heating, then adjusted for occupant comfort |
| Air control lever | at midway position for maximum air flow and partial defrost |
| Car windows | closed |
| Side cowl ventilators | closed |

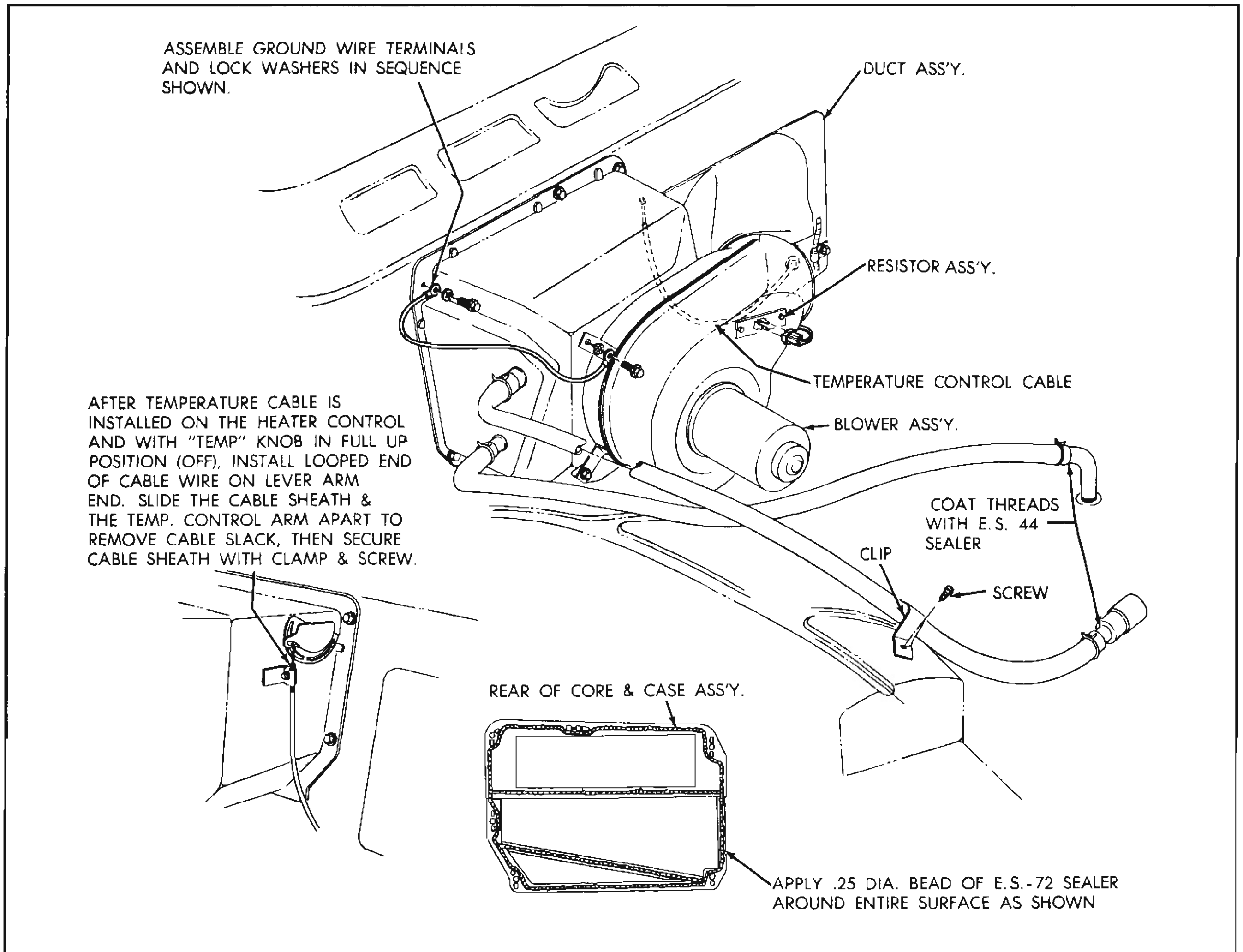



Fig. 12-13 Reference Illustration—Heater Units in Engine Compartment

## TESTING

### *OPERATIONAL TEST*

The purpose of performing a heater operational test is to prove the heater system is operating properly.

### PRELIMINARY CHECKS

#### Engine Compartment

1. Check radiator for proper engine coolant level.

2. Inspect radiator core and heater hoses for leaks, at the same time inspecting for kinked or collapsed heater hoses.

3. Inspect the blower to heater air distributor to see that it is properly installed (to prevent any air leaks from engine compartment, which may have objectionable fumes or odors).

#### Inside Car Body

1. Check to see that all control levers operate smoothly, and they are in alignment when all are in the full up position.

2. Start engine.

3. Place "FAN" control lever in "OFF" position; blower should not operate.

4. Move "FAN" lever to the "LO" and "MED" position; blower should operate. Continue by moving lever to the "HI" position; blower should operate at a speed faster than at "LO" and "MED" positions.

5. Move "AIR" lever down slowly until the mid-way down position is reached; more and more air should flow through outlet as lever is depressed.

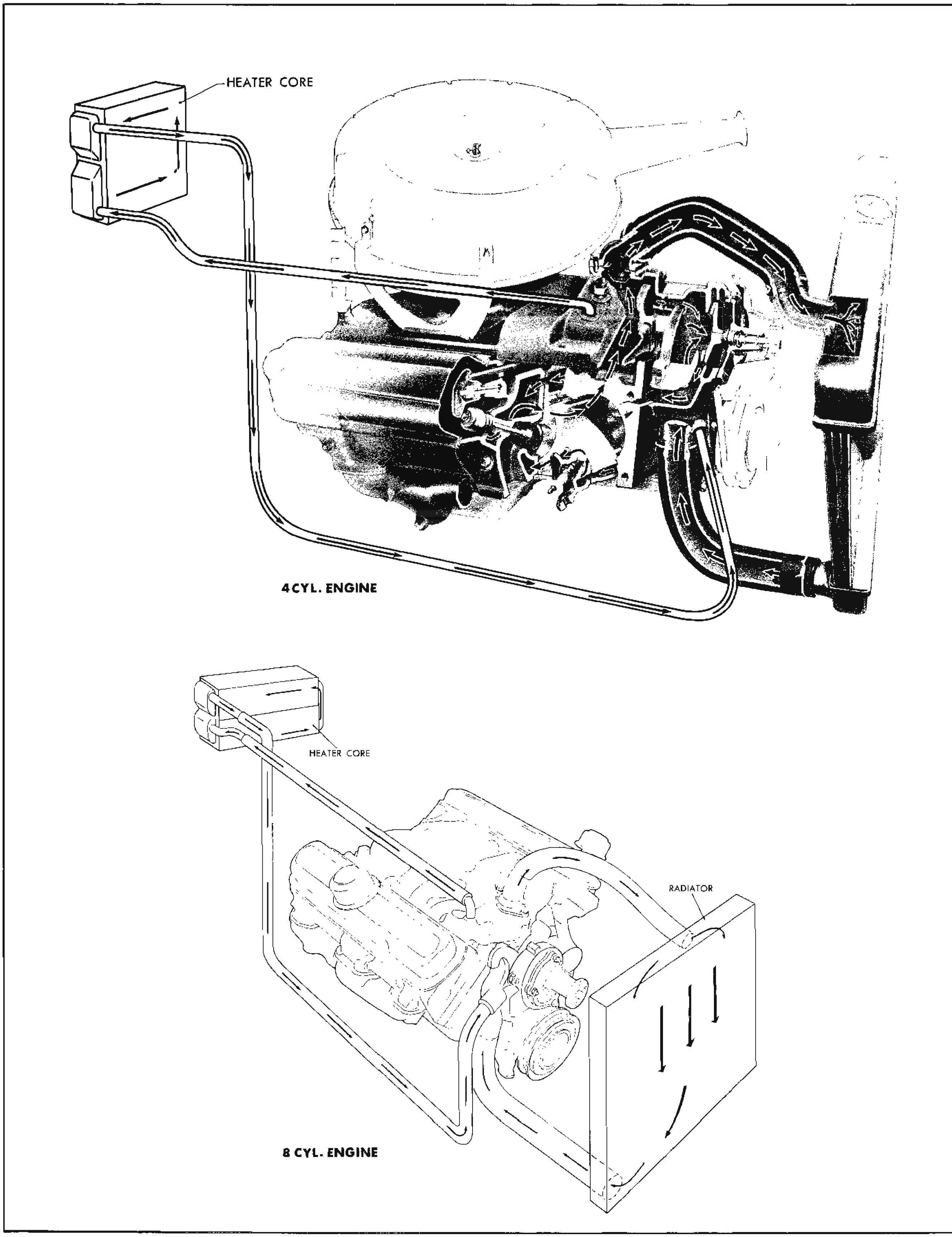



Fig. 12-14 Water Flow Through Heater System

6. Move "AIR" lever down slowly until the full down position is reached, at the same time sensing the amount of air flowing from the defroster outlets. More and more air should flow through these outlets as the lever is depressed.

7. After engine has warmed up, move "TEMP" control lever from full up to full down position. Air at outlet should get progressively warmer.

Should the heater control levers operate satisfactorily during the above checks, it would appear that heater controls operation is normal. If during the checks irregularities are noted or complaints on heater operation could not be noted or determined, then refer to TROUBLE DIAGNOSIS for the complaint or cause and the remedy.

## HEATER TROUBLE DIAGNOSIS

### *INSUFFICIENT HEATING*

| COMPLAINT OR CAUSE | REMEDY |
|---|---|
| Slow warming in car. | Incorrect operation of controls. Advise operator of proper operation of heater controls. |
| Objectionable engine or exhaust fumes in car. | Check for good seal between hood and cowl.<br>Check for good seal between vent grille and cowl.<br>Locate and seal any other air leaks. |
| Cold drafts on floor. | Check operation and adjustment of cowl vent cables.<br>Check adjustment of air valve cable.<br>Advise operator of proper operation of heater system. |
| Insufficient heat to rear seat. | Check for obstructions under front seat. Advise owners to operate blower. |
| Low engine coolant level. | Check radiator and fill to proper level, run engine to clear air lock. |
| Failure of engine cooling system to warm up. | Check radiator cap and engine thermostat and replace if required. See section on ENGINE COOLING AND LUBRICATION. |
| Kinked heater hoses. | Remove kink or replace hose. |
| Foreign material obstructing water flow in heater core. | Remove foreign material if possible, otherwise replace core. |
| Temperature control cable improperly adjusted. | Adjust cable. |
| Air valve does not open. | Check for proper installation and/or adjustment of air control cables. |

### *INADEQUATE REMOVAL OF FOG OR ICE*

| CAUSE | REMEDY |
|---|---|
| Air valve does not open. | Check for proper installation and/or adjustment of air control cable. |
| Temperature control valve does not open. | Check and adjust temperature control cable. |
| Defroster valve does not open fully. | Adjust air control cable. |

### INADEQUATE REMOVAL OF FOG OR ICE (Continued)

| CAUSE | REMEDY |
|---|---|
| Obstructions in defroster outlets at windshield. | Remove obstruction. On cars with instrument panel pads, look for and fix loose panel pad cover at defroster outlets. |
| Dinged defroster outlets. | Reshape outlet flange with pliers. The outlet should have a uniform opening, $\frac{5}{16}''$ wide. |
| Blower motor not connected. | Connect wire. |
| Inoperative blower motor. | Check heater fuse.<br>Replace motor. |
| Inoperative blower motor switch. | Replace switch. |

### TOO WARM IN CAR

| CAUSE | REMEDY |
|---|---|
| Inoperative temperature control valve. | Adjust temperature control cable. |
| Incorrect operation of controls. | Advise operator of proper operation of heater system. |

### BLOWER INOPERATIVE

| CAUSE | REMEDY |
|---|---|
| Blown fuse. | Replace fuse. |
| Inoperative motor. | Replace motor. |
| Open circuit. | Replace circuit between ignition switch, blower switch, and blower motor. |
| Inoperative blower motor switch. | Replace faulty switch. |

### MISCELLANEOUS

| PROBLEM | REMEDY |
|---|---|
| Control levers not aligned due to incorrect adjustment. | Adjust control cables. |
| Blown fuses. | Shorts in electrical system.<br>Locate and correct short.<br>Blower wheel rubbing on case.<br>Failed blower motor. |
| Heater "gurgle". | Check engine coolant level in radiator. |

## SPECIFICATIONS

**Cooling System Capacity (Engine with Heater)** .......... 12.6 qts.

**Fuse Sizes**

Heater Electrical System (on fuse block) .......... 20 amp.

Heater Control Panel Lamp (on fuse block) .......... 4 amp.

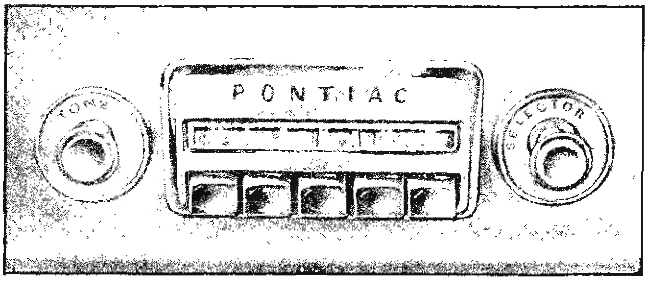



Fig. 12-15 Tempest Push Button Radio

## PUSH BUTTON RADIO

### *DESCRIPTION*

The all-transistorized Push Button Radio (Fig 12-15) gives instant response when radio is turned on. Station pick-up and power output are excellent and current drain is less than half that of manual types.

The radio is designed to allow manual or push button tuning and has additional advantages of automatic volume control and excellent tone control.

### *ON CAR TROUBLE DIAGNOSIS*

Most radio complaints usually fall into one of three categories; the radio is either dead, weak or noisy. Before removing a radio from the car, a few simple checks can be made in a very short time. In some cases the radio will not need to be removed at all. Refer to the RADIO TROUBLE DIAGNOSIS before removing radio.

If all the diagnosis checks fail to turn up the problem, the condition is in the radio itself. The radio should be removed from the car and sent to an authorized service station. Enclose all pertinent information, including date of purchase, mileage, customer's name and address and customer's complaint. This information is important to the radio technician and will aid him when making repairs.

### *RADIO—REMOVE AND REPLACE—(Fig. 12-16)*

1. Remove radio control knobs.
2. Remove retaining nuts and escutcheons.
3. Disconnect antenna and speaker leads.
4. Remove lamp wire assembly (top of receiver on push button models—bottom of receiver on manual radios).
5. Remove support to radio bracket bolt and washers and remove radio.

NOTE: On air conditioned cars the glove box and left hand evaporator support must be removed and the radio removed through this opening.

6. Install radio by reversing above procedures

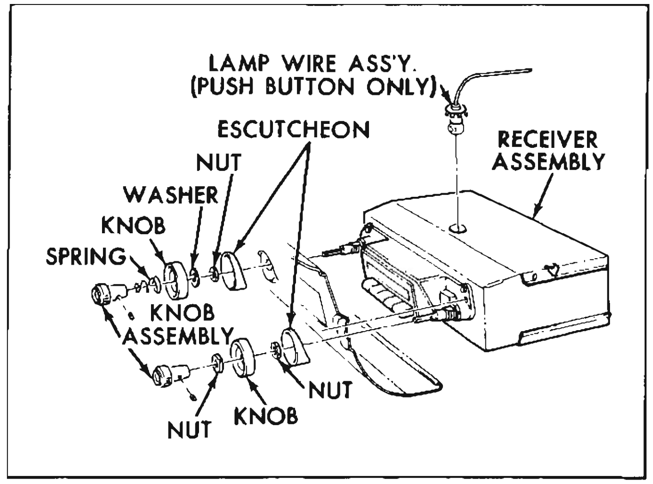



Fig. 12-16 Tempest Radio—Front View Reference Illustration

### *SPEAKER—REMOVE AND REPLACE—(Fig. 12-17)*

1. Remove radio as outlined above.
2. Remove nuts securing speaker to speaker support.
3. Disconnect output connector and remove speaker.
4. Reverse above procedure to install.

### *ADJUST ANTENNA TRIMMER*

In order to make the antenna trimmer adjustment, the car should be outdoors and as far removed from electrical disturbances as possible. Set the antenna to its minimum height. Tune in a weak station between 600 and 1000 kilocycles and turn the volume control on full. This is necessary in order to affect the action of the automatic volume control. Using a screwdriver, turn the trimmer adjusting screw located behind the dummy knob on the manual tuning shaft. Turn the screw until the station peaks in volume.

The antenna trimmer adjustment should be made after a set has been removed from the car and worked

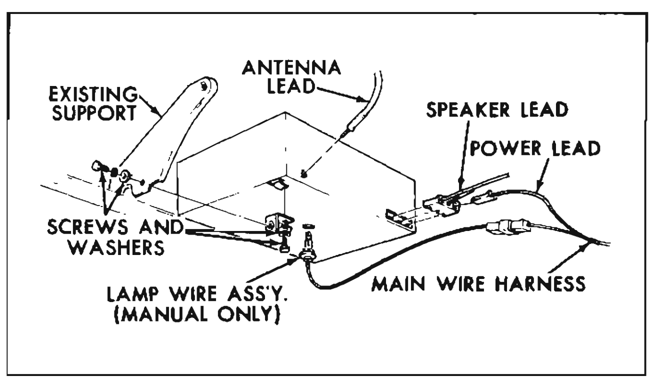



Fig. 12-17 Tempest Radio—Rear View Reference Illustration

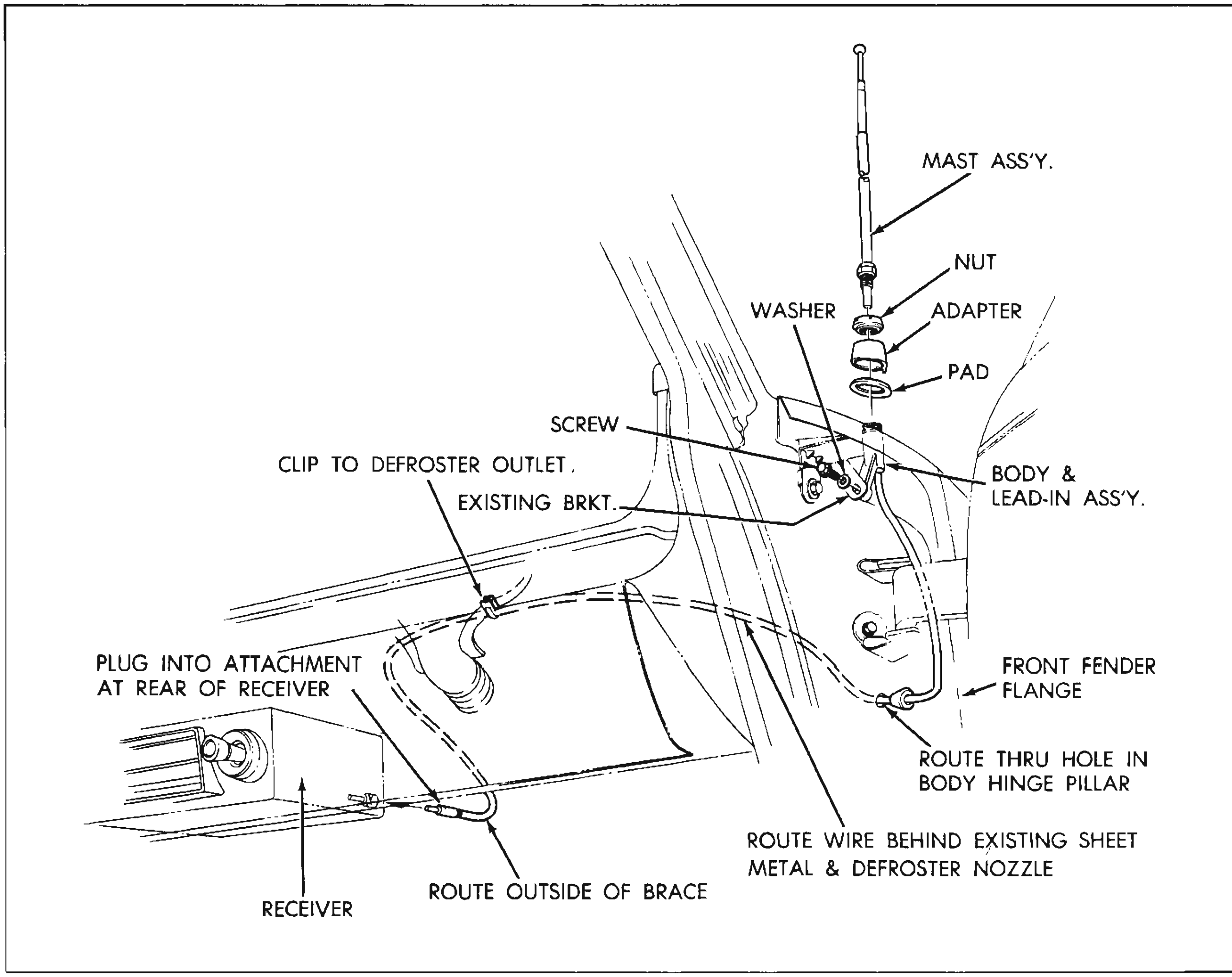



Fig. 12-18 Reference Illustration—Tempest Antenna

on by a radio repair man. The reason for trimming the antenna after service work has been performed is that the radio repair man will undoubtedly have adjusted the trimmer to match his antenna so that it no longer matches the antenna in the car from which it was removed.

Trimming the antenna is especially important with the all-transistor radios as this will directly offset sensitivity and selectivity. Complaints of station "mixing" on all-transistor radios can be reduced by this adjustment.

### *SET RADIO PUSH BUTTONS*

1. Turn radio on.
2. Select five desired stations (set buttons one at a time).
3. Pull selector button out as far as it will go.
4. Tune in the desired station, using the manual control knob.
5. Push the selector button in and release.

## MANUAL ANTENNA

The manual antenna is mounted on the right front fender, in approximately a vertical position (Fig. 12-18).

### *PERIODIC SERVICE*

Many antenna troubles can be prevented by cleaning the antenna mast at periodic intervals (at least once a month). This is easily performed by wiping the extended mast with a soft cloth when the car is being lubricated or washed.

During the winter months the mast should be lubricated also by wiping it with a cloth containing a light oil.

### *ANTENNA—REMOVE AND REPLACE*

1. Remove glove box.
2. Disconnect lead-in plug from radio receiver (Fig. 12-17).

3. Disconnect lead-in from clip on defroster nozzle.
4. Remove right hand kick pad.
5. Remove antenna mast assembly.
6. Remove upper nut, adapter and pad (Fig. 12-18).
7. Remove antenna body.
8. Reverse above procedure to install.

## RADIO TROUBLE DIAGNOSIS

***Alternator Noise***

Connect capacitor from the "BAT" terminal on the alternator to ground or frame of the car.

***Voltage Regulator Noise***

Place capacitor between the "V" terminal of the regulator and chassis.

***Ball On End of Antenna Rod***

Ball eliminates the sharp point and reduces the effect of static discharge. Curb feelers bent too close to ground will cause noise in the auto radio.

***Wheel Static***

Caused by voltage being developed as the wheel rotates on the axle. Noise is eliminated by placing wheel static collectors in the two front wheels; button end of spiral spring must ride snugly in hole on end of axle and be free from grease.

***Tire Static***

Caused by electrical charge being built up inside tire due to friction between tire and road. Noise is eliminated by inserting tire static powder into tires using a specal injection gun.

***CAUTION: Inject powder carefully or powder will backfire in face.***

***MOST AUTO RADIO COMPLAINTS FALL INTO ONE OF THREE CATEGORIES***

**A. Radio Is Dead**

1. Thump check radio—turn radio on and listen intently for a distinct "thump" from the speaker which should be heard as current builds up through the power transistor.
   a. If "thump" is heard, go to check (3).
   b. If no "thump", check fuse.
      (1) A 2.5 ampere fuse is used in all Pontiac radios. If radio plays, after replacing fuse, tap radio with rubber mallet or heel of hand and race the engine; if another fuse blows, remove radio for repair.
      (2) If fuse is OK, check all radio interconnecting cables for secure connections. If still no thump, remove radio for repair.
      (3) Check antenna by substitution; simply unplug regular antenna and plug in a spare. If radio is still dead, remove for repair.

**B. Radio Is Weak**

1. Check to see if antenna trimmer is peaked by tuning to a weak station and grasping antenna rod with hand. If volume drops considerably the trimmer is peaked properly; if the volume remains same or increases slightly, antenna trimmer needs adjusting. Use procedure outlined under ADJUST ANTENNA TRIMMER.
2. If radio is still weak, trimmer does not peak, check antenna by substitution.
3. Plug speaker in securely. Make sure speaker is plugged in securely at radio. If radio is still weak, remove the receiver for repair.

**C. Radio Is Noisy**

1. Constant noise complaint is almost always due to a defect inside the radio but could be caused by a bad antenna. Check with a substitute antenna.
2. Noisy when tapped or jarred, caused by loose antenna connection to the radio, a poor connection to car's power, poor speaker connection, or a loose part or connection inside the radio.
3. Noisy only when engine is running due to faulty noise suppression equipment.
   a. Check antenna lead-in shielding for proper grounding at both antenna base and radio. Poor connections at either of these points can result in engine noise interference.
4. If noise is present only while car is moving, problem is either wheel or tire static, or the result of missing ball at antenna tip.
   a. To check for wheel or tire static, drive car on a macadam road until noise is noticed then apply brakes; if noise disappears, it's wheel static; if noise persists, it's tire static.
5. Noisy when car equipment is operated such as directional lights, brake lights, power seat, or power windows.
   a. Check to see that lead-in wire is tight and properly seated in radio.
   b. Make certain antenna body is grounded to car body.

If all the above checks fail to turn up the problem, the condition is in the radio itself. The radio should be removed from the car and sent to an authorized

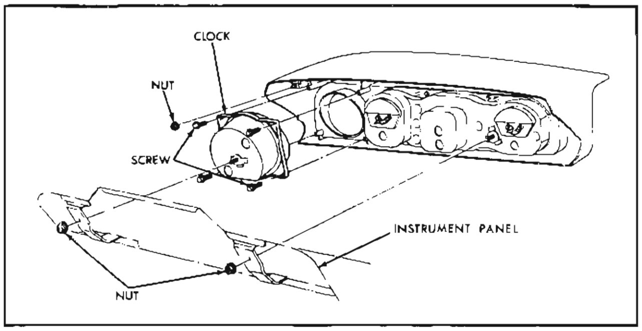



Fig. 12-19 Reference Illustration—Tempest Clock

service station. Include all pertinent information that might help the radio technician repair the radio as quickly as possible.

## ELECTRIC CLOCK

The electric clock operates on direct current from the car battery and must not be compared too closely for accuracy to the home electric clock operating on alternating current. The cycles per second of alternating current used in the home are controlled and periodically corrected at the power house, thereby eliminating accumulation of errors.

With the direct current system no such control is possible; therefore, automobile electric clocks will accumulate errors day by day the same as hand wound, spring operated clocks.

The electric clock provides automatic regulation of the rate when the position of the hands is changed manually. Moving the hands forward or backward adjusts the length of the hair spring to make the clock run faster or slower. The amount of change in rate depends upon the amount the hands are changed. Maximum rate change is approximately 20 seconds per day and is obtained when the hands are moved five minutes. If the clock is reset less than five minutes the change in rate is proportionally less than 20 seconds

### SETTING CLOCK

When setting clock to correct for errors in time, pull reset stem out, move hands counterclockwise to correct time if clock is running fast, or move hands clockwise to correct time if clock is running slow, then allow reset stem to return to its normal position. This will automatically adjust the rate of the clock.

Owners should be advised to set the clock to the correct time once a week at regular intervals to ensure maximum accuracy.

### CLOCK—REMOVE AND REPLACE (Fig. 12-19)

1. Remove instrument panel to cluster and bezel assembly retaining nuts from rear of instrument panel.
2. Remove two cluster assembly to instrument panel brackets retaining nuts.
3. Pull cluster and bezel assembly from instrument panel and disconnect power and lamp leads at rear of clock.
4. Remove screws retaining clock to cluster and bezel assembly and remove clock.
5. Install clock by reversing above procedure.

## BACK-UP LIGHT SWITCH

### SYNCHRO-MESH TRANSMISSION CARS

The back up light switch on synchro-mesh transmission equipped cars is located at the rear of the synchro-mesh transmission.

NOTE: the switch is located below the lubricant level in the transmission, therefore, be careful when removing or replacing the switch to avoid loss of lubricant.

### AUTOMATIC TRANSMISSION CARS

The location and adjustment of the back-up light and neutralizer switch on automatic transmission equipped cars is described in Section 7A of this manual.

## FRONT SEAT BELTS

Four eye bolt anchors are located in the floor at rear of front seat for quick installation of seat belts.

To install belts, spread hooks at end of each belt and insert through eye bolt as shown in Fig. 12-20. Close hooks and insert rivet through holes and drive in flush. Slip boot down over hooks.

## TACHOMETER

### DESCRIPTION

The tachometer (Fig. 12-21) is mounted in the right opening of the cluster and bezel assembly, utilizing the same opening usually reserved for electric clock.

This unit indicates the number of engine R.P.M. in hundreds and has an adjustable red pointer which can be moved to any desired position on the dial to indicate pre-determined shift points.

### TACHOMETER—REMOVE AND REPLACE

1. Remove instrument panel to cluster and bezel assembly retaining nuts from rear of instrument panel.
2. Remove two cluster assembly to instrument panel brackets retaining nuts.

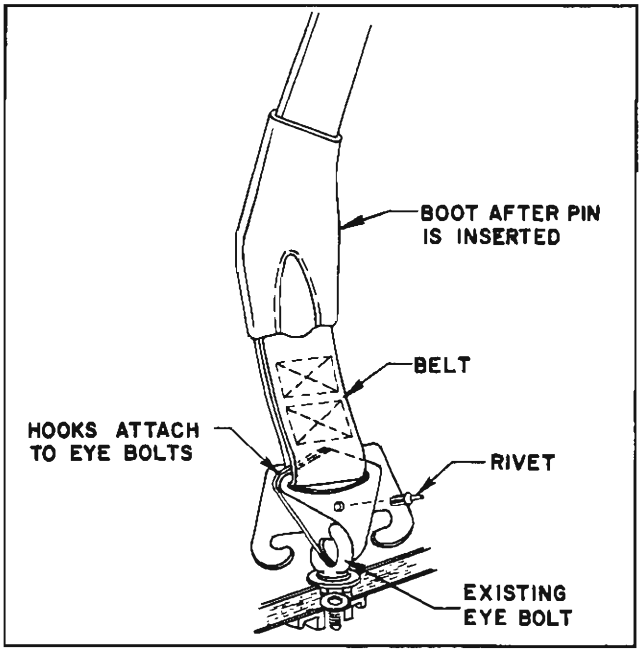



Fig. 12-20 Installing Front Seat Belts

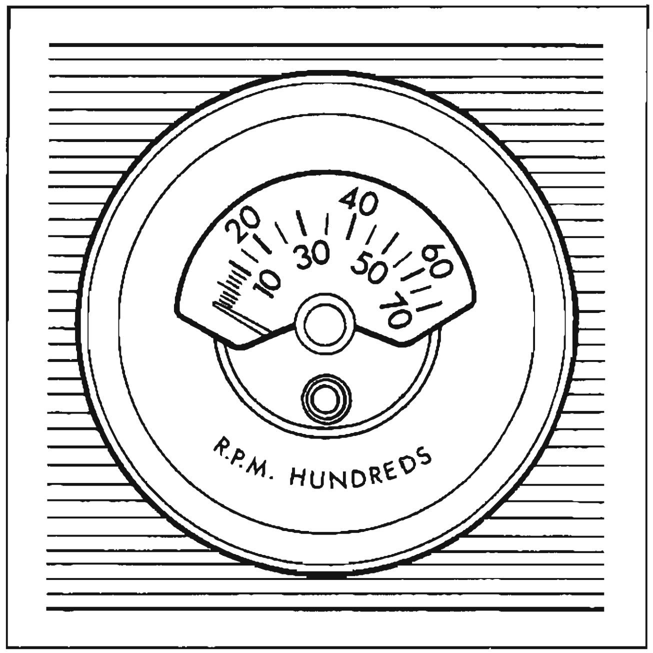



Fig. 12-21 Tempest Tachometer

3. Pull cluster and bezel assembly from instrument panel and disconnect power and lamp leads at rear of tachometer.

4. Remove screws retaining tachometer to cluster and bezel assembly and remove tachometer.

5. To replace, reverse above procedures.

### *RESET TACHOMETER NEEDLE*

If it becomes necessary to reset the tachometer, a precision tachometer must be hooked up to work in conjunction with assembly in car.

1. Remove cluster and bezel assembly as outlined above, but do not disconnect leads.

2. Connect precision tachometer to assembly in car.

3. Remove round metal plug from rear of tachometer housing.

4. Turn engine over at 3000 R.P.M. as indicated on precision tach (lower or higher readings may result in inaccurate needle setting).

5. Insert small screw driver through hole at rear of housing and turn rheostat clockwise to lower needle or counterclockwise to raise needle.

6. When proper needle setting has been obtained as indicated on precision instrument, turn engine off, remove precision tachometer and replace unit by reversing removal procedures.

# INDEX

## L



## M



## O



## P



## R



## S

## W